Hardware manual
ACS880-04XT drive module packages (500 to 1200 kW)
### List of related manuals

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<th>Code (English)</th>
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<td>Multilingual code: 3AXD50000037978 3AXD50000025169</td>
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<td>3AU00000085685 3AU00000113605</td>
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<tr>
<td>ACS-AP-x Assistant control panels user’s manual</td>
<td>3AU00000085685 3AU00000113605</td>
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<tr>
<td>BCU-02/12/22 control units hardware manual</td>
<td>3AU00000085685 3AU00000113605</td>
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<td>3AU00000085987</td>
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<tr>
<td>Quick start-up guide for ACS880 drives with primary control program</td>
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<td>3AU0000100140</td>
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<td>ACS880+C132 marine type-approved drive modules and module packages supplement</td>
<td>3AXD50000037752</td>
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<td>FSO-12 safety functions module user’s manual</td>
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<td>FSO-21 safety functions module user’s manual</td>
<td>3AXD50000015614</td>
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<td>FSE-31 pulse encoder interface module user’s manual</td>
<td>3AXD50000016597</td>
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<td>ACS880 ATEX-certified Safe disconnection function application guide</td>
<td>3AU00001323231</td>
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<tr>
<td>ACS880-01 drives and ACS880-04 drive modules common DC systems application guide</td>
<td>3AU0000127818</td>
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<tr>
<td>FPTC-01 thermistor protection module (option +L536) for ACS880 drives user’s manual</td>
<td>3AXD50000027750</td>
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<td>3AFE68577519</td>
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<td>Sine filters hardware manual</td>
<td>3AXD500000166814</td>
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<td></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.

Videos:
http://www.youtube.com/watch?v=IhKOSx3HmzQ
https://www.youtube.com/watch?v=naq86e2qc1tY
Update notice

The notice concerns the ACS880-04XT hardware manuals listed below.

Contents of the notice: Checking the compatibility of the drive with IT (ungrounded) and corner-grounded delta systems, identifying different types of electrical power systems, disconnecting EMC filter and ground-to-phase varistor. Notice code (EN): 3AXD50000205417 Rev A. Valid: From 2017-11-30 until revision E of the manual.

<table>
<thead>
<tr>
<th>Manual code</th>
<th>Revision</th>
<th>Language</th>
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<tr>
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<td>D</td>
<td>English</td>
</tr>
<tr>
<td>3AXD50000035653</td>
<td>D</td>
<td>Deutsch</td>
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</table>

Checking the compatibility with IT (ungrounded) and corner-grounded delta systems

- **EMC filter +E200 (690 V drives and drive modules)**

  Drive internal EMC filter +E200 is not suitable for use on an IT (ungrounded) system. See section *Disconnection table* (page 2). Disconnect the filter before you connect the drive to the supply network.

  ![WARNING!](image.png)

  Do not install any drive with EMC filter +E200 on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system). The system will be connected to ground potential through the EMC filter capacitors of the drive. This can cause danger, or damage the drive.

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

- **EMC filter ARFI-10 (ordering code 68241561) – 400 V and 500 V drives and drive modules**

  EMC filter ARFI-10 is not suitable for use on an IT (ungrounded) system. See section *Disconnection table* (page 2). Disconnect the filter before you connect the drive to the supply network.

  ![WARNING!](image.png)

  Do not install the drive with EMC filter ARFI-10 on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system). The varistor circuit can be damaged.

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

- **Ground-to-phase varistor**

  The ground-to-phase varistor of the drive is not suitable for use on an IT (ungrounded) system. Disconnect the ground-to-phase varistor before you connect the drive to the supply network. Check the table on page 2.

  ![WARNING!](image.png)

  Do not install the drive with the ground-to-phase varistor connected to an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system). The varistor circuit can be damaged.
### Corner-grounded and midpoint-grounded 690 V delta systems

**WARNING!** Do not install the drive on a 690 V corner-grounded or midpoint-grounded delta system. Disconnecting the EMC filter and ground-to-phase varistor does not prevent damage to the drive.

### Disconnection table

**EMC filter +E200**

Check from this table if you have to disconnect the EMC filter (EMC AC screw) with option +E200 or ground-to-phase varistor (VAR screw).

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Symmetrically grounded TN systems (TN-S systems)</th>
<th>Corner-grounded and midpoint-grounded delta systems (&lt; 600 V)</th>
<th>IT systems (ungrounded or high-resistance-grounded (&gt;30 ohms))</th>
</tr>
</thead>
<tbody>
<tr>
<td>R10, R11</td>
<td>Do not remove EMC AC or VAR.</td>
<td>Do not remove EMC AC or VAR.</td>
<td>Remove EMC AC, VAR.</td>
</tr>
</tbody>
</table>

**Note:** These are the EMC filter and varistor screws of different drive frame sizes.

<table>
<thead>
<tr>
<th>Frame size</th>
<th>EMC filter (+E200) screw</th>
<th>Ground-to-phase varistor screw</th>
</tr>
</thead>
<tbody>
<tr>
<td>R10, R11</td>
<td>EMC AC</td>
<td>VAR</td>
</tr>
</tbody>
</table>
EMC filter ARFI-10 (ordering code 68241561)

Check from this table if you have to remove EMC filter ARFI-10 or ground-to-phase varistor (VAR screw).

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Symmetrically grounded TN systems (TN-S systems)</th>
<th>Corner-grounded and midpoint-grounded delta systems (≤ 600 V)</th>
<th>IT systems (ungrounded or high-resistance-grounded (&gt;30 ohms))</th>
</tr>
</thead>
<tbody>
<tr>
<td>R10, R11</td>
<td>Do not remove ARFI-10 or VAR.</td>
<td>Do not remove ARFI-10 or VAR.</td>
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Note: These are the EMC filter and varistor screws of different drive frame sizes.

<table>
<thead>
<tr>
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<th>EMC filter screw</th>
<th>Ground-to-phase varistor screw</th>
</tr>
</thead>
<tbody>
<tr>
<td>R10, R11</td>
<td>-</td>
<td>VAR</td>
</tr>
</tbody>
</table>

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

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_{L-L})</th>
<th>(U_{L1-G})</th>
<th>(U_{L2-G})</th>
<th>(U_{L3-G})</th>
<th>Electrical power system type</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>0.58·X</td>
<td>0.58·X</td>
<td>0.58·X</td>
<td>Symmetrically grounded TN system (TN-S system)</td>
</tr>
<tr>
<td>X</td>
<td>1.0·X</td>
<td>1.0·X</td>
<td>0</td>
<td>Corner-grounded delta system (nonsymmetrical)</td>
</tr>
<tr>
<td>X</td>
<td>0.5·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>

### Disconnection instructions

#### Precautions before electrical work

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

**WARNING!** Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do electrical 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 at the power supply of the drive.
   - Make sure that reconnection is not possible. Lock the disconnector to open position and attach a warning notice to the disconnector.
   - 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 input power terminals (L1, L2, L3) and the grounding terminal (PE) is close to 0 V.
   - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding terminal (PE) 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.
- **Internal EMC option +E200**
  Disconnect the filter grounding wire (EMC AC) and ground-to-phase varistor grounding wire (VAR) before you connect the drive to the supply network. Insulate the end of the wire and attach it. The wires are located at the side of the drive module next to the circuit board compartment.

![EMC AC and VAR wires](image)

- **External EMC option ARFI-01**
  Grounding wire EMC AC (see the figure above) is not connected at the factory. Do not connect it. Remove the varistor grounding wire (VAR). Remove the ARFI-10 filter from the cabinet.
Hardware manual

ACS880-04XT drive module packages
(500 to 1200 kW)

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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 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.
Safety Instructions

- 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. 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 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.
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 electrician, do not do installation or maintenance work. Go through these steps before you begin any installation or maintenance work.

1. Clearly identify the work location.
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.
Safety instructions

Additional instructions and notes

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

• If you are not a qualified electrician, do not do installation or maintenance work.
• 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. If you do, the brake chopper starts to operate which causes the overheating of the brake resistor (if present). Overvoltage can also cause the motor to rush to its maximum speed.
• 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 and brake resistor terminals (UDC+, UDC-, R+ and R-) are at a dangerous voltage.
• External wiring can supply dangerous voltages to the terminals of relay outputs (XRO1, XRO2 and XRO3).
• 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 electrician, do not do grounding work.
• Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
• Make sure that the conductivity of the grounding conductors is sufficient. See section Selecting the power cables on page 75. 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.

---
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 modules and install the modules 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 you work 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.
Contents of the manual

This manual contains the instructions and information for the drive module configuration. The chapters of the manual are briefly described below.

Safety instructions gives safety instructions for the installation, commissioning, operation and maintenance of the drive module.

Introduction to the manual introduces the manual.

Operation principle and hardware description describes the drive module.

Guidelines for planning the cabinet installation 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.

Guidelines for planning the electrical installation gives instructions in the motor and cable selection, protections and cable routing.

Installation instructions gives the basic installation instructions that are common for the different installation procedures.

Installation example – standard, optional IP20 shrouds and power cable connection terminals describes the installation process of a drive module in a 600 mm wide Rittal TS 8 cabinet in a bookshelf way of mounting.

Installation example with option “Full power cabling panels to be attached to a cabinet (IP20)” describes the installation process of a drive module with full cabling panels in a Rittal 400 mm wide cabinet.

Installation checklist contains lists for checking the mechanical and electrical installation of the drive.

Start-up refers to the start-up instructions of the cabinet-installed drive.

Fault tracing describes the LED indications and refers to the fault tracing instructions of the drive.

Maintenance contains maintenance instructions.

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

Technical data contains the technical specifications of the drive module, e.g., the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings.

Dimension drawings contains dimension drawings of the drive module installed into a Rittal TS 8 cabinet.

Example circuit diagram shows an example circuit diagram for a cabinet-installed drive unit.

Safe torque off function describes the Safe torque off function of the drive and gives instructions on its implementing.

Resistor braking describes selection, protection and wiring of optional brake choppers and resistors. The chapter also contains technical data.

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

Step-by-step drawings for an installation example of drive module with optional IP20 shrouds and input and output terminals in Rittal TS 8 600 mm wide cabinet shows how to install the drive module in a Rittal TS 8 cabinet.
Step-by-step drawings for installing full cabling panels (option) in a Rittal TS 8 400 mm wide cabinet shows how to install a drive module with full cabling panels into a Rittal TS 8 cabinet.

Step-by-step drawings for a flat installation example in Rittal TS 8 600 mm wide cabinet shows how to install the drive module in flat position into a Rittal TS 8 cabinet.

Step-by-step drawings for option “Power cable connection terminals on the right-hand side of the drive module” installation example in Rittal TS 8 600 mm wide cabinet shows how to install drive module with option “Power cable connection terminals on the right-hand side of the drive module” into a Rittal TS 8 cabinet.

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, e.g., +E200. 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 45.

Quick installation, commissioning and operating flowchart

<table>
<thead>
<tr>
<th>Task</th>
<th>See</th>
</tr>
</thead>
<tbody>
<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 47) Guidelines for planning the electrical installation (page 69) Technical data (page 179) Resistor braking (page 229) 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 94) Checking the delivery (page 100) If the drive module has been non-operational for more than one year, the converter DC link capacitors need to be reformed. (Reforming the capacitors, page 166)</td>
</tr>
<tr>
<td>Check the installation site. Fasten the base of the cabinet to the floor.</td>
<td>Checking the installation site (page 93) Ambient conditions (page 190) Guidelines for planning the cabinet installation (page 47)</td>
</tr>
<tr>
<td>Route the cables.</td>
<td>Routing the cables (page 81)</td>
</tr>
</tbody>
</table>
26 Introduction to the manual

**Check the insulation of the supply cable, the motor and the motor cable and the resistor cable (if present).**

**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 and brake resistors (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.

**Install the drive module into a cabinet (page 123)**
- Connecting the power cables and installing the shrouds (page 123)
- 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 with option “Full power cabling panels to be attached to a cabinet (IP20)”**
- 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 DC connection cables and the brake resistor (if any) cables 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.

**Installing the drive module into a cabinet (page 123)**
- Connecting the power cables and installing the shrouds (page 123)
- Connecting the external control unit to the drive module (page 103)
- Mounting the external control unit (page 105)
- Manuals for any optional equipment

**Check the installation.**

**Connecting the control cables to the terminals of the control unit (page 115)**

**Commission the drive.**

**Start-up (page 153)**

**Commission the brake chopper (if used).**

**Resistor braking (page 229)**

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

**Appropriate firmware manual**
Terms and abbreviations

<table>
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<th>Explanation</th>
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<tr>
<td>AIBP</td>
<td>Input bridge protection board</td>
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<tr>
<td>BCU</td>
<td>Drive control unit</td>
</tr>
<tr>
<td>BPOW</td>
<td>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>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>
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<tr>
<td>FCAN-01</td>
<td>Optional CANopen adapter module</td>
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<td>FCNA-01</td>
<td>Optional ControlNet fieldbus adapter module</td>
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<tr>
<td>FDCO-0x</td>
<td>Optional optical DDCS communication module</td>
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<td>FDNA-01</td>
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<td>FEA-03</td>
<td>Optional I/O extension and encoder module adapter</td>
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<td>FECA-01</td>
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<td>FEN-01</td>
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<td>FEN-11</td>
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<td>FEN-31</td>
<td>Optional HTL encoder interface module</td>
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<td>Optional high performance Ethernet/IP™, Modbus/TCP and PROFINET IO adapter module, 2-port</td>
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<td>FPBA-01</td>
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<td>FPTC-01</td>
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<tr>
<td>Frame (size)</td>
<td>Size of the drive module. The drive modules described in this manual are of frame size R10 and R11.</td>
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<td>Optional Modbus RTU adapter module</td>
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<td>FSE-31</td>
<td>Pulse encoder interface module which can be used in safety applications</td>
</tr>
<tr>
<td>Term/Abbreviation</td>
<td>Explanation</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------</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>PLC</td>
<td>Programmable logic controller</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>SOIA</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>ZINT</td>
<td>Main circuit board</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 packages.
Product overview

The ACS880-04XT is a drive module package (drive) for controlling asynchronous AC induction motors, permanent magnet motors, AC induction servomotors. The drive consists of two drive modules (ACS880-04 +P943) and a separate control unit.

The main circuit of the drive module is shown below.

1. AC choke
2. Rectifier. Converts alternating current and voltage to direct current and voltage.
3. DC link. DC circuit between rectifier and inverter
4. Inverter. Converts direct current and voltage to alternating current and voltage.
5. Brake chopper (option +D150). Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
### Drive connection examples

<table>
<thead>
<tr>
<th>6-pulse connection</th>
<th>6-pulse connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>No additional protection for the input and motor cables against thermal overload is needed.</td>
<td>No additional protection for the input and motor cables against thermal overload is needed.</td>
</tr>
<tr>
<td>WARNING! Make sure that both contactors close at the same time. Otherwise, the charging current will flow through one module only and damage to the module can occur.</td>
<td></td>
</tr>
</tbody>
</table>

1. Drive module
2. Brake chopper (option +D150)
3. External brake resistors
### 12-pulse connection

Protection against thermal overload for the input cables with fuses is needed.

![Diagram](image)

**WARNING!** Make sure that both contactors close at the same time. Otherwise, the charging current will flow through one module only and damage to the module can occur.

### 6-pulse connection

Protection against thermal overload for the input cables with fuses is needed.

![Diagram](image)

**WARNING!** Make sure that both contactors close at the same time. Otherwise, the charging current will flow through one module only and damage to the module can occur.

<table>
<thead>
<tr>
<th></th>
<th>12-pulse connection</th>
<th>6-pulse connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drive module</td>
<td>Drive module</td>
</tr>
<tr>
<td>2</td>
<td>Brake chopper (option +D150)</td>
<td>Brake chopper (option +D150)</td>
</tr>
<tr>
<td>3</td>
<td>External brake resistors</td>
<td>External brake resistors</td>
</tr>
</tbody>
</table>
Layout

- **Standard drive module configuration**

![Diagram showing the layout of a drive module with labeled parts.]

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lifting lugs</td>
</tr>
<tr>
<td>2</td>
<td>Fastening bracket</td>
</tr>
<tr>
<td>3</td>
<td>Input cable connection busbars (L1/U1, L2/V1, L3/W1) and DC+ and DC- busbars</td>
</tr>
<tr>
<td>4</td>
<td>Circuit board compartment</td>
</tr>
<tr>
<td>5</td>
<td>Output cable connection busbars (T1/U2, T2/V2, T3/W2) and brake resistor connection busbars (R+ and R- with option +D150)</td>
</tr>
<tr>
<td>6</td>
<td>External control unit</td>
</tr>
<tr>
<td>7</td>
<td>Main cooling fans</td>
</tr>
<tr>
<td>8</td>
<td>Pedestal</td>
</tr>
<tr>
<td>9</td>
<td>Retractable support legs</td>
</tr>
<tr>
<td>10</td>
<td>Base fastening screws</td>
</tr>
<tr>
<td>11</td>
<td>Handle for pulling the drive module out of the cabinet</td>
</tr>
<tr>
<td>12</td>
<td>Common mode filter (+E208)</td>
</tr>
<tr>
<td>13</td>
<td>PE busbar</td>
</tr>
<tr>
<td>14</td>
<td>Pedestal guide plate</td>
</tr>
<tr>
<td>15</td>
<td>Telescopic extraction and insertion ramp</td>
</tr>
<tr>
<td>16</td>
<td>Cables for connecting the control unit to the drive modules</td>
</tr>
</tbody>
</table>

**Note:** The front covers are removed in this photo, see numbers 2 and 3 on the next page.
Drive module configuration with IP20 shrouds (option) and full-size output cable connection terminals (option)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drive module</td>
</tr>
<tr>
<td>2</td>
<td>Upper front cover</td>
</tr>
<tr>
<td>3</td>
<td>Lower front cover</td>
</tr>
<tr>
<td>4</td>
<td>Clear plastic shrouds attached</td>
</tr>
<tr>
<td>5</td>
<td>Common mode filter (+E208)</td>
</tr>
<tr>
<td>6</td>
<td>Pedestal</td>
</tr>
<tr>
<td>7</td>
<td>External control unit</td>
</tr>
</tbody>
</table>

See the next page for the part descriptions.
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clear plastic shroud to be attached onto the drive module input power cabling (a). Lead-through shroud for side cabling (b).</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Clear plastic shrouds to be attached onto the drive module output power cabling</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>Clear plastic shroud to be attached on top of the drive module (lead-through for top cabling)</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>Upper back clear plastic shroud</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>Lower back clear plastic shroud</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Front clear plastic shroud</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Full-size input power cable connection terminals (option)</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>Full-size output power cable connection terminals (option)</td>
<td>17</td>
</tr>
<tr>
<td>9</td>
<td>Grounding terminal for output power cable shields</td>
<td>18</td>
</tr>
</tbody>
</table>
**Drive module for flat mounting (option) with IP20 shrouds (option)**

Front view of an assembled drive module for flat mounting is shown below. This option adds flat mounting brackets to the standard drive module configuration. The pedestal has been removed in this assembly. You must cut the lower part of the output cabling clear plastic shroud off when no pedestal is in use.

<table>
<thead>
<tr>
<th>Flat mounting position (front view)</th>
<th>Side view</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Flat mounting bracket (two pcs). The brackets are installed to the mounting plate with 2×8 screws. Four combi screws for installing the drive module to the brackets are included in the delivery.</td>
<td>4 Bottom grille to be installed to the base of the drive module for IP20 degree of protection</td>
</tr>
<tr>
<td>2 External control unit</td>
<td>5 Grounding terminal for output cabling is better visible in this photo than on page 34.</td>
</tr>
<tr>
<td>3 Cables for connecting the control unit to the drive modules</td>
<td></td>
</tr>
</tbody>
</table>

See section *Drive module configuration with IP20 shrouds (option) and full-size output cable connection terminals (option)* on page 34 for the part descriptions.
### Drive module with full power cabling panels (option)

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Assembled drive module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Input power cabling panel</td>
<td>7 Rubber grommet</td>
</tr>
<tr>
<td>2 Side guides</td>
<td>8 Input power cabling panel to be attached to the drive cabinet</td>
</tr>
<tr>
<td>3 Output power cabling panel</td>
<td>9 Output power cabling panel to be attached to the drive cabinet</td>
</tr>
<tr>
<td>4 Top guide plate</td>
<td>10 Front cover</td>
</tr>
<tr>
<td>5 Pedestal guide plate</td>
<td>11 External control unit</td>
</tr>
<tr>
<td>6 Telescopic extraction and insertion ramp</td>
<td>12 Cables for connecting the control unit to the drive modules</td>
</tr>
</tbody>
</table>
## Drive module configuration with power cable connection terminals on the right-hand side of the drive module (option)

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lifting lugs</td>
</tr>
<tr>
<td>2</td>
<td>Fastening bracket</td>
</tr>
<tr>
<td>3</td>
<td>Input cable connection busbars (L1/U1, L2/V1, L3/W1) and DC+ and DC- busbars</td>
</tr>
<tr>
<td>4</td>
<td>Circuit board compartment cooling fans</td>
</tr>
<tr>
<td>5</td>
<td>Circuit board compartment</td>
</tr>
<tr>
<td>6</td>
<td>Output cable connection busbars (T1/U2, T2/V2, T3/W2) and brake resistor connection busbars (R+ and R- with option +D150)</td>
</tr>
<tr>
<td>7</td>
<td>Main cooling fans</td>
</tr>
<tr>
<td>8</td>
<td>Pedestal</td>
</tr>
<tr>
<td>9</td>
<td>Retractable support legs</td>
</tr>
<tr>
<td>10</td>
<td>Base fastening screws</td>
</tr>
<tr>
<td>11</td>
<td>Handle for pulling the drive module out of the cabinet</td>
</tr>
<tr>
<td>12</td>
<td>PE busbar</td>
</tr>
<tr>
<td>13</td>
<td>Pedestal guide plate</td>
</tr>
<tr>
<td>14</td>
<td>Telescopic extraction and insertion ramp</td>
</tr>
<tr>
<td>15</td>
<td>External control unit</td>
</tr>
<tr>
<td>16</td>
<td>Cables for connecting the control unit to the drive modules</td>
</tr>
</tbody>
</table>

**Note:** The front covers are removed in this photo, see numbers 2 and 3 on page 34.
- **Control unit**

  See section *Drive module configuration with IP20 shrouds (option) and full-size output cable connection terminals (option)* on page 34.

- **Control panel**

  The control panel is ordered separately and can be mounted on the cabinet door using optional DPMP-01 mounting platform.

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

**Overview of power and control connections**

The diagram below shows the power connections and control interfaces of the drive 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 45.
2. Slot 4 for RDCO-0x
3. Connector X12 for the FSO-xx safety functions module
4. Memory unit (see page 166)
5. I/O terminal blocks. See section Default I/O connection diagram on page 116.
6. Fiber optic links to the drive modules
7. Ethernet interface
8. Control panel
9. Brake resistor (optional, see page 229)
10. d/dt or sine filter (optional, see page 237)
11. XSTO OUT terminals are wired to BGDR connectors if Safe torque off function is taken into use. See chapter Safe torque off function (page 217).
12. The BCU control unit can be powered from one or both drive modules or from an external uninterruptible power source.
### External control unit connection cables

The cables for connecting the drive module and control panel to the control unit are shown below. The length of the cables is 3 meters (9.8 feet). See sections [Connecting the control unit to the drive module](#) (page 114) and [Connecting a control panel](#) (page 121) for the actual connections.

1) These cables are included in the delivery as standard.

2) This cable must be ordered separately, see page 170 for DPMP-01 door mounting kit.
Type designation labels

A type designation label is attached to the drive modules. The type designation label of the drive module package is delivered in an envelope.

Drive module package label

The type designation label includes a rating, markings, a type designation and a serial number, which allow individual recognition of each drive module package. An example label is shown below.

```
1 Type designation, see section Type designation key on page 45.
2 Manufacturer’s address
3 Frame size
4 Ratings. See section Ratings on page 179, section Electrical power network specification on page 188 and section Motor connection data on page 189.
5 Valid markings
6 Cooling method
7 Degree of protection
8 Short-circuit withstand strength. See section Electrical power network specification on page 188.
9 Maximum input voltage (UL/CSA). See section Electrical power network specification on page 188.
10 Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit’s manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.
```
Drive module label

The type designation label includes a rating, markings, a type designation and a serial number, which allow individual recognition of each drive module.

| 1 | Type designation, see section Type designation key on page 45. |
| 2 | Manufacturer’s address                                |
| 3 | Ratings. See section Ratings on page 179, section Modules used on page 185, section Electrical power network specification on page 188 and section Motor connection data on page 189. |
| 4 | Valid markings                                         |
| 5 | Frame size                                             |
| 6 | Cooling method                                         |
| 7 | Degree of protection                                   |
| 8 | Short-circuit withstand strength. See section Electrical power network specification on page 188. |
| 9 | Maximum input voltage (UL/CSA). See section Electrical power network specification on page 188. |
| 10| Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit’s manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number. |
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, e.g., +E200. 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>Drive module package code, e.g., ACS880-04XT-1610A-5. Drive module code, e.g., ACS8880-04-880A-5+P943</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>-04XT</td>
<td>When no options are selected; two drive modules to be installed in a cabinet, IP00 (UL open type), bookshelf mounting with pedestal, external control unit, cables for connecting the control unit to the drive module, build-in input choke, no EMC filter, terminals for input, motor and DC connection, common mode filter (+E208), ACS880 primary control program, Safe torque off function, coated boards, memory stick containing all manuals with all available languages.</td>
</tr>
<tr>
<td>Size</td>
<td>xxxxA Refer to the rating tables, page 175.</td>
</tr>
<tr>
<td>Voltage range</td>
<td></td>
</tr>
<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 V AC.</td>
</tr>
<tr>
<td>Option codes (plus codes). These codes are printed on the type designation label of the drive modules.</td>
<td></td>
</tr>
<tr>
<td>Construction, pedestal and cabling</td>
<td></td>
</tr>
<tr>
<td>C132</td>
<td>Marine type-approved drive module</td>
</tr>
<tr>
<td>P943</td>
<td>Drive module for parallel connection (standard).</td>
</tr>
<tr>
<td>Filters</td>
<td></td>
</tr>
<tr>
<td>E200</td>
<td>EMC filter for second environment YN (grounded) system, category C3. Available for ACS880-04XT-xxxx-7 types only.</td>
</tr>
<tr>
<td>E201</td>
<td>EMC filter for second environment IT (ungrounded) system, category C3. Available for ACS880-04XT-xxxx-7 types only.</td>
</tr>
<tr>
<td>E208</td>
<td>Common mode filter. Included as standard.</td>
</tr>
<tr>
<td>E210</td>
<td>EMC filter for second environment YN (grounded) and IT (ungrounded) systems, category C3. Available for ACS880-04XT-xxxx-3 and -5 types only.</td>
</tr>
<tr>
<td>Resistor braking</td>
<td></td>
</tr>
<tr>
<td>D150</td>
<td>Brake chopper</td>
</tr>
<tr>
<td>Safety</td>
<td></td>
</tr>
<tr>
<td>G971</td>
<td>ATEX-certified Safe motor disconnection function using the drive Safe torque off function. This option code is printed only on the type designation label of the drive module package.</td>
</tr>
<tr>
<td>Warranty</td>
<td></td>
</tr>
<tr>
<td>P904</td>
<td>Extended warranty 24/30</td>
</tr>
<tr>
<td>Paper manuals. Note: The delivered manual set can include manuals in English if the translation is not available.</td>
<td></td>
</tr>
<tr>
<td>R700</td>
<td>English</td>
</tr>
<tr>
<td>S701</td>
<td>German</td>
</tr>
</tbody>
</table>
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
You can put the drive module in the bookshelf or flat position or on its back 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.
Guidelines for planning the cabinet installation

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 with IP20 shrouds (option)
Layout example with IP20 shrouds (option) and one “drive module with power cable connection terminals on the right-hand side” (option)
Layout example, doors closed

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

1a) Air inlet for the drive module
1b) Air inlet for the other equipment
1c) Air inlet for circuit boards and DC and output busbars
2a) Air outlet with an extra exhaust fan for the drive module
2b) Air outlet for the other equipment
2c) Air outlet for the drive module and other equipment on the cabinet roof. An exhaust fan if needed. We recommend this alternative instead of 2a.
3 Drive control panel with DPMP-01 mounting platform (option). The control panel is connected to the drive module control unit inside the cabinet.
4 Contactor control switch and emergency stop switch (connected to the contactor control circuit inside the cabinet)
5 Operating handle of the disconnector
6 Rubber grommets for degree of protection
7 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 187.
Guidelines for planning the cabinet installation

- Layout example, doors open (standard configuration)

This diagram shows a layout example for standard drive modules.
Guidelines for planning the cabinet installation

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 66.
Guidelines for planning the cabinet installation

- Layout example, doors open with IP20 shrouds (option)

Layout example for one module is shown below.

1 Supporting frame of the cabinet
2a Vertical (2a) and horizontal (2b) air baffles that separate the cool and hot areas (leak-proof lead-throughs). See also page 60.
2c Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page on 51)
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 Motor cable including the protective ground conductor of the drive module
9 Drive module control unit
10 External control cables
11 Grounding screws
12 Alternative to grounding screws (11)
13 Air flow to the roof
14 Air flow through the drive module
15 Air flow to the brake option
16 Air flow to circuit boards and DC and output busbars
- **Layout example, doors open with IP20 shrouds (option) and “drive module with power cable connection terminals on the right-hand side” (option)**

Layout example for one drive module is shown below.

![Diagram of drive module installation](image)

1. Supporting frame of the cabinet
2a. Vertical (2a) and horizontal (2b) air baffles that separate the cool and hot areas (leak-proof lead-throughs). See also page 60.
2c. Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page 57)
3. Cabinet grounding busbar (PE)
4. Input power cable including the protective ground conductor (PE) of the drive
5. Disconnector and fuses
6. 2-Phase output power connection terminals
7. 3-Phase output power connection terminals
8. Motor cable including the protective ground conductor of the drive module
9. Drive module control unit
10. External control cables
11. Grounding screws
12. Alternative to grounding screws (11)
13. Air flow to the roof
14. Air flow through the drive module
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>5 N·m (3.6 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 lead-throughs 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 lead-throughs improves the EMC shielding of the cabinet.
58 Guidelines for planning the cabinet installation

• 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 1](image1.png)

1. Cable
2. Cable tie
3. Strain relief
4. Bare cable shield
5. Knitted wire mesh
6. Cabinet lead-through 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 2](image2.png)

1. Tightening screw
2. EMI conductive cushion
3. Strain relief
4. Grommet
5. Lead-through 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 187 and 190. 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 66.

• 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. Minimum air inlets are four Rittal air filters (SK 3243.200 for a 600 mm wide cabinet) or two ABB air inlet filters (see section *Cabinet ventilation* on page 171).

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

• The drawing below shows two typical cabinet cooling solutions. The air inlet is at the bottom of the cabinet, while the outlet is at the top, either on the upper part of the door or on the roof. We recommend that the air outlet is on the cabinet roof. Use an extra exhaust fan if the air outlet is on the cabinet door.

  ![Air inlets and outlets on the cabinet door](image)

  ![Air flow inside the drive module](image)

<table>
<thead>
<tr>
<th>Air inlets and outlets on the cabinet door</th>
<th>Air flow inside the drive module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Air inlet</td>
<td></td>
</tr>
<tr>
<td>2  Air outlet</td>
<td></td>
</tr>
</tbody>
</table>

• The internal cooling fans of the drive modules and reactors/chokes 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.

The following sections show how to place the air baffles for one drive module.
Bookshelf mounting with IP20 shrouds (option)

This diagram shows the air baffle position inside an example cabinet. For dimensions of the baffle, see page 213.

1a Air flow to the drive module, max. 40 °C (104 °F)
1b Air inlet to the drive circuit boards and DC and output busbars
2a Vertical air baffle that separates the cool and hot areas in the cabinet
2b Horizontal air baffle
2c Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page 51).
3 Drive module
4 Disconnector and fuses
5 Contactor
6 Drive module control unit
7 Air flow out
8 Note: The upper grating in the cabinet door must be located in the area marked with the horizontal shading lines for correctly directed cooling air flow to the circuit board compartment of the drive module.
9 Cabinet grounding busbar (PE)
Guidelines for planning the cabinet installation

- Bookshelf mounting (standard drive module configuration)

This diagram shows air baffle positions inside an example cabinet. For the descriptions, see the next page.
### Bookshelf mounting with option “Full power cabling panels to be attached to a cabinet (IP20)”

See chapter *Step-by-step drawings for installing full cabling panels (option) in a Rittal TS 8 400 mm wide cabinet* on page 245 and dimension drawing for frame R10 on page 204 or dimension drawing for frame R11 on page 210.

| 1a | Air flow to the drive module, max. 40 °C (104 °F) | 3 | Drive module |
| 1b | Air inlet to the drive circuit boards and DC and output busbars | 4 | Disconnector and fuses |
| 2a | Vertical air baffle that separates the cool and hot areas in the cabinet | 5 | Contactor |
| 2b | Vertical air baffle | 6 | Drive module control unit |
| 2c | Upper horizontal air baffle | 7 | Air flow out |
| 2d | Lower horizontal air baffle | 8 | Note: The upper grating in the cabinet door must be located in the area marked with the horizontal shading lines for correctly directed cooling air flow to the circuit board compartment of the drive module. |
| 2e | Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page 51). | 9 | Cabinet grounding busbar (PE) |
Flat mounting (option)

This diagram shows air baffle positions inside an example cabinet.

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Air flow to the drive module, max. 40 °C (104 °F)</td>
</tr>
<tr>
<td>1b</td>
<td>Air inlet to the drive circuit boards and DC and output busbars</td>
</tr>
<tr>
<td>2a</td>
<td>Horizontal air baffles that guide cooling air flow</td>
</tr>
<tr>
<td>2b</td>
<td>Horizontal air baffle</td>
</tr>
<tr>
<td>2c</td>
<td>Vertical air baffle</td>
</tr>
<tr>
<td>2d</td>
<td>Vertical air baffle that guides air flow to the inside the drive module</td>
</tr>
<tr>
<td>3</td>
<td>Drive module</td>
</tr>
<tr>
<td>4</td>
<td>Disconnecter and fuses</td>
</tr>
<tr>
<td>5</td>
<td>Contactor</td>
</tr>
<tr>
<td>6</td>
<td>Drive module control unit</td>
</tr>
<tr>
<td>7</td>
<td>Air flow out</td>
</tr>
<tr>
<td>8</td>
<td>Air gap between the drive module front and cabinet wall for cooling air flow</td>
</tr>
<tr>
<td>9</td>
<td>Cabinet grounding busbar (PE)</td>
</tr>
</tbody>
</table>
Flat mounting (option) with IP20 shrouds (option)

This diagram shows air baffle positions inside an example cabinet. For dimensions of the baffle, see page 215.

---

1a Air flow to the drive module, max. 40 °C (104 °F)
1b Air inlet to the drive circuit boards and DC and output busbars
2 Horizontal air baffle
3 Drive module
4 Disconnector and fuses
5 Contactor
6 Drive module control unit
7 Air flow out
8 Air gap between the drive module front and cabinet wall for cooling air flow
9 Cabinet grounding busbar (PE)
Guidelines for planning the cabinet installation

**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.

<table>
<thead>
<tr>
<th>Air outlet on the cabinet roof</th>
<th>Air outlet in the upper part of the cabinet door</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Air inlet</td>
<td>2 Air outlet</td>
</tr>
</tbody>
</table>

- **Free space around the drive module**

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

  The module can be installed in a cabinet with the following dimensions:
  - width 400 mm (15.75 in.)
  - depth 600 mm (23.62 in.)
  - height 2000 mm (78.74 in.).

**Other installation positions**

Contact your local ABB representative for more information.

- **Drive module on its back**

  If you install the drive module on its back, make sure that the hot cooling air that flows upwards from the module does not cause danger.
Planning the placement of the control panel

The control panel can be mounted onto the cabinet door using a control panel mounting platform (option). For the installation instructions, refer to DPMP-01 mounting platform for ACS-AP control panel (3AUA0000100140 [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 171.
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. One main
contactor for the drive, or contactors for both drive modules can be used if they are closed
simultaneously. See section Drive connection examples on page 31. Select the contactor
according to nominal voltage of the drive and the drive or drive module current.

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 71. 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 ... 2 · \( U_N \)
  • motor nominal current range 1/6 ... 2 · \( I_N \) of the drive in DTC control and 0 ... 2 · \( I_N \)
in scalar control. The control mode is selected by a drive parameter.
Guidelines for planning the electrical installation

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 Motor insulation system</th>
<th>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>
<td></td>
</tr>
<tr>
<td>Random-wound M2_, M3_ and M4_</td>
<td>$U_N \leq 500$ V</td>
<td>Standard</td>
<td>$+ N + CMF$</td>
</tr>
<tr>
<td></td>
<td>$500 \leq U_N \leq 600$ V</td>
<td>Standard</td>
<td>$+ N + du/dt + CMF$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reinforced</td>
<td>$+ N + CMF$</td>
</tr>
<tr>
<td></td>
<td>$600 \leq U_N \leq 690$ V</td>
<td>(cable length $\leq 150$ m)</td>
<td>$+ N + du/dt + CMF$</td>
</tr>
<tr>
<td></td>
<td>$600 \leq U_N \leq 690$ V</td>
<td>(cable length $&gt; 150$ m)</td>
<td>$+ N + CMF$</td>
</tr>
<tr>
<td>Form-wound HK_ and AM_</td>
<td>$380 \leq U_N \leq 690$ V</td>
<td>Standard</td>
<td>$+ N + CMF$</td>
</tr>
<tr>
<td></td>
<td>$P_N &lt; 500$ kW</td>
<td>$+ N + du/dt + CMF$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$P_N \geq 500$ kW</td>
<td>$+ N + du/dt + CMF$</td>
<td></td>
</tr>
<tr>
<td>Old* form-wound HK_ and modular</td>
<td>$380 \leq U_N \leq 690$ V</td>
<td>Check with the motor manufacturer.</td>
<td></td>
</tr>
<tr>
<td>Random-wound HK_ and AM_**</td>
<td>$0 \leq U_N \leq 500$ V</td>
<td>Enamelled wire with fiber glass taping</td>
<td>$+ N + CMF$</td>
</tr>
<tr>
<td></td>
<td>$500 \leq U_N \leq 690$ V</td>
<td>$+ N + du/dt + CMF$</td>
<td></td>
</tr>
</tbody>
</table>

* manufactured before 1.1.1998
** For motors manufactured before 1.1.1998, check for additional instructions with the motor manufacturer.
1) See also section When is a $du/dt$ filter needed? on page 237.
The abbreviations used in the table are defined below.

### 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.

---

### Guidelines for planning the electrical installation

The abbreviations used in the table are defined below.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_N$</td>
<td>Nominal AC line voltage</td>
</tr>
<tr>
<td>$U_{LL}$</td>
<td>Peak line-to-line voltage at motor terminals which the motor insulation must withstand</td>
</tr>
<tr>
<td>$P_N$</td>
<td>Motor nominal power</td>
</tr>
<tr>
<td>$du/dt$</td>
<td>$du/dt$ filter at the output of the drive</td>
</tr>
<tr>
<td>CMF</td>
<td>Common mode filter (option +E208)</td>
</tr>
<tr>
<td>N</td>
<td>N-end bearing (Insulated motor non-drive end bearing)</td>
</tr>
</tbody>
</table>

### 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.

---

### Table: Additional requirements for non-ABB motors

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Nominal AC supply voltage</th>
<th>Requirement for</th>
<th>ABB $du/dt$ and common mode filters, insulated N-end motor bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-ABB motors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random-wound and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>form-wound</td>
<td>$U_N \leq 420$ V</td>
<td>Standard: $U_{LL} = 1300$ V</td>
<td>$+ N + CMF$ 1)</td>
</tr>
<tr>
<td></td>
<td>$420$ V $&lt; U_N \leq 500$ V</td>
<td>Standard: $U_{LL} = 1300$ V</td>
<td>$+ N + du/dt + CMF$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reinforced: $U_{LL} = 1600$ V, 0.2 microsecond rise time</td>
<td>$+ N + CMF$ 1)</td>
</tr>
<tr>
<td></td>
<td>$500$ V $&lt; U_N \leq 600$ V</td>
<td>Reinforced: $U_{LL} = 1600$ V</td>
<td>$+ N + du/dt + CMF$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reinforced: $U_{LL} = 1800$ V</td>
<td>$+ N + CMF$ 1)</td>
</tr>
<tr>
<td></td>
<td>$600$ V $&lt; U_N \leq 690$ V</td>
<td>Reinforced: $U_{LL} = 1800$ V</td>
<td>$+ N + du/dt + CMF$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reinforced: $U_{LL} = 2000$ V, 0.3 microsecond rise time</td>
<td>$+ N + CMF$ 1)</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.***

1) See also section *When is a $du/dt$ filter needed?* on page 237.
Guidelines for planning the electrical installation  73

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 du/dt and common mode filters, insulated N-end motor bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_N &lt; 500$ V</td>
<td>Standard + N + CMF 1)</td>
<td></td>
</tr>
<tr>
<td>$500 &lt; U_N &lt; 600$ V</td>
<td>Standard + du/dt + N + CMF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td>$600 &lt; U_N &lt; 690$ V</td>
<td>Reinforced + N + CMF 1)</td>
<td></td>
</tr>
</tbody>
</table>

1) See also section When is a du/dt filter needed? on page 237.

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 du/dt filter, insulated N-end bearing and ABB common mode filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_N &lt; 420$ V</td>
<td>Standard $U_{IL} = 1300$ V + N + CMF 1)</td>
<td></td>
</tr>
<tr>
<td>$420 &lt; U_N &lt; 500$ V</td>
<td>Standard $U_{IL} = 1300$ V + N + du/dt + CMF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td>$500 &lt; U_N &lt; 600$ V</td>
<td>Reinforced $U_{IL} = 1600$ V, 0.2 microsecond rise time + N + CMF 1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or</td>
<td></td>
</tr>
<tr>
<td>$600 &lt; U_N &lt; 690$ V</td>
<td>Reinforced $U_{IL} = 1800$ V, 0.3 microsecond rise time + N + du/dt + CMF</td>
<td></td>
</tr>
</tbody>
</table>

1) 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.

1) See also section When is a du/dt filter needed? on page 237.
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 filter is included in the standard drive module delivery.
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 179) 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 80.
- 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 80). 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 $S$ (mm$^2$)</th>
<th>Minimum cross-sectional area of the corresponding protective conductor $S_p$ (mm$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S \leq 16$</td>
<td>$S$</td>
</tr>
<tr>
<td>$16 &lt; S \leq 35$</td>
<td>16</td>
</tr>
<tr>
<td>$35 &lt; S$</td>
<td>$S/2$</td>
</tr>
</tbody>
</table>
## Typical power cable sizes

The tables below give copper and aluminum cable types with concentric copper shield for the drive modules with nominal current. See also *Terminal and lead-through data for the power cables* on page 187.

<table>
<thead>
<tr>
<th>Drive type</th>
<th>IEC input and motor cabling</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cabling per drive module 1)</td>
<td>Common cabling for the drive modules 2)</td>
</tr>
<tr>
<td></td>
<td>Cu cable type</td>
<td>Al cable type</td>
</tr>
<tr>
<td></td>
<td>mm²</td>
<td>mm²</td>
</tr>
<tr>
<td><strong>U_N = 400 V</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1010A-3</td>
<td>3 × (3 × 120)</td>
<td>3 × (3 × 185)</td>
</tr>
<tr>
<td>1190A-3</td>
<td>3 × (3 × 150)</td>
<td>3 × (3 × 240)</td>
</tr>
<tr>
<td>1330A-3</td>
<td>3 × (3 × 185)</td>
<td>4 × (3 × 185)</td>
</tr>
<tr>
<td>1610A-3</td>
<td>3 × (3 × 240)</td>
<td>4 × (3 × 240)</td>
</tr>
<tr>
<td><strong>U_N = 500 V</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1010A-5</td>
<td>3 × (3 × 120)</td>
<td>3 × (3 × 185)</td>
</tr>
<tr>
<td>1160A-5</td>
<td>3 × (3 × 150)</td>
<td>3 × (3 × 240)</td>
</tr>
<tr>
<td>1310A-5</td>
<td>3 × (3 × 185)</td>
<td>4 × (3 × 185)</td>
</tr>
<tr>
<td>1610A-5</td>
<td>3 × (3 × 240)</td>
<td>4 × (3 × 240)</td>
</tr>
<tr>
<td><strong>U_N = 690 V</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0810A-7</td>
<td>3 × (3 × 95)</td>
<td>3 × (3 × 120)</td>
</tr>
<tr>
<td>0960A-7</td>
<td>3 × (3 × 120)</td>
<td>3 × (3 × 185)</td>
</tr>
<tr>
<td>1080A-7</td>
<td>3 × (3 × 150)</td>
<td>3 × (3 × 185)</td>
</tr>
<tr>
<td>1320A-7</td>
<td>3 × (3 × 185)</td>
<td>4 × (3 × 185)</td>
</tr>
</tbody>
</table>

### Drive type ACS880-04XT

<table>
<thead>
<tr>
<th>Drive type</th>
<th>IEC external 1) DC cabling between drive modules</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cu cable type</td>
<td>Al cable type</td>
</tr>
<tr>
<td></td>
<td>mm²</td>
<td>mm²</td>
</tr>
<tr>
<td><strong>U_N = 400 V</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1010A-3</td>
<td>2 × (3 × 120)</td>
<td>2 × (3 × 185)</td>
</tr>
<tr>
<td>1190A-3</td>
<td>2 × (3 × 150)</td>
<td>2 × (3 × 185)</td>
</tr>
<tr>
<td>1330A-3</td>
<td>2 × (3 × 185)</td>
<td>2 × (3 × 185)</td>
</tr>
<tr>
<td>1610A-3</td>
<td>2 × (3 × 240)</td>
<td>2 × (3 × 240)</td>
</tr>
<tr>
<td><strong>U_N = 500 V</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1010A-5</td>
<td>2 × (3 × 120)</td>
<td>2 × (3 × 185)</td>
</tr>
<tr>
<td>1160A-5</td>
<td>2 × (3 × 150)</td>
<td>2 × (3 × 185)</td>
</tr>
<tr>
<td>1310A-5</td>
<td>2 × (3 × 185)</td>
<td>2 × (3 × 185)</td>
</tr>
<tr>
<td>1610A-5</td>
<td>2 × (3 × 240)</td>
<td>2 × (3 × 240)</td>
</tr>
<tr>
<td><strong>U_N = 690 V</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0810A-7</td>
<td>2 × (3 × 95)</td>
<td>2 × (3 × 120)</td>
</tr>
<tr>
<td>0960A-7</td>
<td>2 × (3 × 120)</td>
<td>2 × (3 × 185)</td>
</tr>
<tr>
<td>1080A-7</td>
<td>2 × (3 × 150)</td>
<td>2 × (3 × 185)</td>
</tr>
<tr>
<td>1320A-7</td>
<td>2 × (3 × 185)</td>
<td>2 × (3 × 185)</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) See page 32.
3) The supply cables are connected to a common switch or breaker, see page 31. The whole input current flows through common cabling and you can use the recommended cables for that. The connection from the switch to the drive modules inside the cabinet can be made with busbars.

*) The table gives DC cable types when the cables are outside the cabinet. For DC cables inside the cabinet, select a cable capable of carrying 2/3 of the continuous output current of one drive module.

**) Connection (2 × (3 × xxx)): two phase conductors of one three-phase cable between the DC+ terminals of the drive modules and two phase conductors of the second three-phase cable between the DC- terminals of the drive modules. The third phase conductors unconnected.

### Drive type ACS880-04X:

#### Input and motor cabling

<table>
<thead>
<tr>
<th>Drive type</th>
<th>U_N</th>
<th>Cabling per drive module</th>
<th>Common cabling for the drive modules</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cu cable type</td>
<td>Al cable type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AWG/kcmil</td>
<td>AWG/kcmil</td>
</tr>
<tr>
<td>U_N = 400 V</td>
<td></td>
<td>2 × 600 or 3 × 300</td>
<td>3 × 400 or 4 × 250</td>
</tr>
<tr>
<td>1010A-3</td>
<td></td>
<td>2 × 700 or 3 × 350</td>
<td>3 × 400 or 4 × 250</td>
</tr>
<tr>
<td>1190A-3</td>
<td></td>
<td>3 × 500 or 4 × 300</td>
<td>3 × 500 or 4 × 300</td>
</tr>
<tr>
<td>1330A-3</td>
<td></td>
<td>3 × 600 or 4 × 400</td>
<td>4 × 500</td>
</tr>
<tr>
<td>U_N = 500 V</td>
<td></td>
<td>2 × 600 or 3 × 300</td>
<td>3 × 500 or 4 × 300</td>
</tr>
<tr>
<td>1010A-5</td>
<td></td>
<td>2 × 700 or 3 × 350</td>
<td>3 × 600 or 4 × 400</td>
</tr>
<tr>
<td>1190A-5</td>
<td></td>
<td>3 × 500 or 4 × 300</td>
<td>3 × 600 or 4 × 400</td>
</tr>
<tr>
<td>1330A-5</td>
<td></td>
<td>3 × 600 or 4 × 400</td>
<td>4 × 500</td>
</tr>
<tr>
<td>U_N = 690 V</td>
<td></td>
<td>2 × 350 or 3 × 4/0</td>
<td>2 × 500 or 3 × 250</td>
</tr>
<tr>
<td>0810A-7</td>
<td></td>
<td>2 × 500 or 3 × 250</td>
<td>2 × 700 or 3 × 350</td>
</tr>
<tr>
<td>0960A-7</td>
<td></td>
<td>2 × 600 or 3 × 350</td>
<td>3 × 500 or 4 × 300</td>
</tr>
<tr>
<td>1080A-7</td>
<td></td>
<td>3 × 500 or 4 × 300</td>
<td>3 × 600 or 4 × 400</td>
</tr>
</tbody>
</table>

### Drive type ACS880-06X:

#### External DC cabling between drive modules

<table>
<thead>
<tr>
<th>Drive type</th>
<th>U_N</th>
<th>Cu cable type</th>
<th>Al cable type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AWG/kcmil</td>
<td>AWG/kcmil</td>
</tr>
<tr>
<td>U_N = 400 V</td>
<td></td>
<td>2 × 400</td>
<td>2 × 400</td>
</tr>
<tr>
<td>1010A-3</td>
<td></td>
<td>2 × 400</td>
<td>2 × 400</td>
</tr>
<tr>
<td>1190A-3</td>
<td></td>
<td>2 × 400</td>
<td>2 × 400</td>
</tr>
<tr>
<td>1330A-3</td>
<td></td>
<td>2 × 400</td>
<td>2 × 400</td>
</tr>
<tr>
<td>U_N = 500 V</td>
<td></td>
<td>2 × 400</td>
<td>2 × 400</td>
</tr>
<tr>
<td>1010A-5</td>
<td></td>
<td>2 × 400</td>
<td>2 × 400</td>
</tr>
<tr>
<td>1190A-5</td>
<td></td>
<td>2 × 400</td>
<td>2 × 400</td>
</tr>
<tr>
<td>1330A-5</td>
<td></td>
<td>2 × 400</td>
<td>2 × 400</td>
</tr>
<tr>
<td>U_N = 690 V</td>
<td></td>
<td>2 × 400</td>
<td>2 × 400</td>
</tr>
<tr>
<td>0810A-7</td>
<td></td>
<td>1 × 350</td>
<td>1 × 500</td>
</tr>
<tr>
<td>0960A-7</td>
<td></td>
<td>2 × 300</td>
<td>2 × 300</td>
</tr>
<tr>
<td>1080A-7</td>
<td></td>
<td>2 × 600</td>
<td>2 × 300</td>
</tr>
<tr>
<td>1320A-7</td>
<td></td>
<td>2 × 300</td>
<td>2 × 400</td>
</tr>
</tbody>
</table>
Guidelines for planning the electrical installation

1) 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.

2) See page 32.

3) The supply cables are connected to a common switch or breaker, see page 31f. The whole input current flows through common cabling and you can use the recommended cables for that. The connection from the switch to the drive modules inside the cabinet can be made with busbars.

*) The table gives DC cable types when the cables are outside the cabinet. For DC cables inside the cabinet, select a cable capable of carrying 2/3 of the continuous output current of one drive module.

**) Connection (1× xxx): One phase conductor of the three-phase cable between the DC+ terminals of the drive modules and another phase conductor of the three-phase cable between the DC- terminals of the drive modules. The third phase conductor unconnected.

Connection (2 × xxx): Two phase conductors of one three-phase cable between the DC+ terminals of the drive modules and two phase conductors of the second three-phase cable between the DC- terminals of the drive modules. The third phase conductors unconnected.
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>Cable Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. The shield must agree with the requirements of IEC 61800-5-1, see page 75. Check with local / state / country electrical codes for allowance.</td>
</tr>
<tr>
<td>PE</td>
<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 IEC 61800-5-1, see page 75.</td>
</tr>
<tr>
<td>PE</td>
<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 IEC 61800-5-1, see page 75.</td>
</tr>
</tbody>
</table>

Power cable types for restricted use

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>A four-conductor system (three phase conductors and a protective conductor on a cable tray) is not allowed for motor cabling (allowed for input cabling).</td>
</tr>
</tbody>
</table>

Recommended DC cable type

Unshielded single-core DC cable can be used inside the cabinet. If the DC cables are run outside the cabinet, use shielded three-core cables. The shield is connected only at one end. Maximum length is four meters.

Not allowed power cable types

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>Symmetrical shielded cable with individual shields for each phase conductor is not allowed on any cable size for input and motor cabling.</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 on page 75, or IEC 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.

| 1 | Insulation jacket |
| 2 | Copper wire screen |
| 3 | Helix of copper tape or copper wire |
| 4 | Inner insulation |
| 5 | Cable core |

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.
Planning the braking system

See chapter Resistor braking.

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
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 and the input cable with fuses or a circuit breaker with current restriction. See section Drive connection examples on page 31.

Equip the fuses with blown fuse indicators for stopping the drive.

Size the fuses or the circuit breaker according to local regulations for the input cable protection. Select the fuses for the drive according to the instructions given in 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.

Circuit breakers

The protective characteristics of circuit breakers depend on the type, construction and settings of the breakers. There are also limitations pertaining to the short-circuit capacity of the supply network. Your local ABB representative can help you in selecting the breaker type when the supply network characteristics are known.

You can use the circuit breakers listed below. Other circuit breakers can be used with the drive if they provide the same electrical characteristics. ABB does not assume any liability whatsoever for the correct function and protection with circuit breakers not listed below. Furthermore, if the recommendations given by ABB are not obeyed, the drive can experience problems that the warranty does not cover.

*Note:* Fuses must be used with circuit breakers in the USA.

<table>
<thead>
<tr>
<th>Drive module type</th>
<th>Frame size</th>
<th>ABB molded case circuit breaker [T(max)]</th>
<th>Product ID (Type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-04-505A-3</td>
<td>R10</td>
<td>1SDA054412R1 T5H 630 PR221DS-L S/I In=630 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-585A-3</td>
<td>R10</td>
<td>1SDA069428R1 T6V 800 PR221DS-L S/I In=800 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-650A-3</td>
<td>R10</td>
<td>1SDA069428R1 T6V 800 PR221DS-L S/I In=800 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-725A-3</td>
<td>R11</td>
<td>1SDA062770R1 T7H 1000 PR231/P L S/I In=1000A 3p F F</td>
<td>50</td>
</tr>
<tr>
<td>ACS880-04-820A-3</td>
<td>R11</td>
<td>1SDA062770R1 T7H 1000 PR231/P L S/I In=1000A 3p F F</td>
<td>50</td>
</tr>
<tr>
<td>ACS880-04-880A-3</td>
<td>R11</td>
<td>1SDA062770R1 T7H 1000 PR231/P L S/I In=1000A 3p F F</td>
<td>50</td>
</tr>
<tr>
<td>ACS880-04-460A-5</td>
<td>R10</td>
<td>1SDA054412R1 T5H 630 PR221DS-L S/I In=630 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-503A-5</td>
<td>R10</td>
<td>1SDA054412R1 T5H 630 PR221DS-L S/I In=630 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-583A-5</td>
<td>R10</td>
<td>1SDA054412R1 T5H 630 PR221DS-L S/I In=630 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-635A-5</td>
<td>R10</td>
<td>1SDA069428R1 T6V 800 PR221DS-L S/I In=800 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-715A-5</td>
<td>R11</td>
<td>1SDA062770R1 T7H 1000 PR231/P L S/I In=1000A 3p F F</td>
<td>50</td>
</tr>
<tr>
<td>ACS880-04-820A-5</td>
<td>R11</td>
<td>1SDA062770R1 T7H 1000 PR231/P L S/I In=1000A 3p F F</td>
<td>50</td>
</tr>
</tbody>
</table>

*Note:* $U_N = 400$ V

<table>
<thead>
<tr>
<th>Drive module type</th>
<th>Frame size</th>
<th>ABB molded case circuit breaker [T(max)]</th>
<th>Product ID (Type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-04-460A-5</td>
<td>R10</td>
<td>1SDA054412R1 T5H 630 PR221DS-L S/I In=630 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-503A-5</td>
<td>R10</td>
<td>1SDA054412R1 T5H 630 PR221DS-L S/I In=630 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-583A-5</td>
<td>R10</td>
<td>1SDA054412R1 T5H 630 PR221DS-L S/I In=630 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-635A-5</td>
<td>R10</td>
<td>1SDA069428R1 T6V 800 PR221DS-L S/I In=800 3p F F</td>
<td>30</td>
</tr>
<tr>
<td>ACS880-04-715A-5</td>
<td>R11</td>
<td>1SDA062770R1 T7H 1000 PR231/P L S/I In=1000A 3p F F</td>
<td>50</td>
</tr>
<tr>
<td>ACS880-04-820A-5</td>
<td>R11</td>
<td>1SDA062770R1 T7H 1000 PR231/P L S/I In=1000A 3p F F</td>
<td>50</td>
</tr>
</tbody>
</table>

*Note:* $U_N = 500$ V
Guidelines for planning the electrical installation

1) Maximum allowed rated conditional short-circuit current (IEC 61800-5-1) of the electrical power network

2) Contact your local ABB representative

**WARNING!** Due to the inherent operating principle and construction of circuit breakers, independent of the manufacturer, hot ionized gases can escape from the breaker enclosure in case of a short-circuit. To ensure safe use, pay special attention to the installation and placement of the breakers. Obey the manufacturer's instructions.

## 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.

<table>
<thead>
<tr>
<th>Drive module type</th>
<th>Frame size</th>
<th>ABB molded case circuit breaker (I_max)</th>
<th>Product ID (Type)</th>
<th>kA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-04-880A-5</td>
<td>R11</td>
<td>TSKA02270R1 (T7H 1000 PR251P LS/1 In=1000A 3p F F)</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>ACS880-04-330A-7</td>
<td>R10</td>
<td>TSKA05412R1 (TSH 630 PR221DS-LS/1 In=630A 3p F F)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>ACS880-04-370A-7</td>
<td>R10</td>
<td>TSKA05412R1 (TSH 630 PR221DS-LS/1 In=630A 3p F F)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>ACS880-04-430A-7</td>
<td>R10</td>
<td>TSKA05412R1 (TSH 630 PR221DS-LS/1 In=630A 3p F F)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>ACS880-04-470A-7</td>
<td>R11</td>
<td>TSKA05412R1 (TSH 630 PR221DS-LS/1 In=630A 3p F F)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>ACS880-04-522A-7</td>
<td>R11</td>
<td>TSKA069428R1 (T6V 800 PR221DS-LS/1 In=800A 3p F F)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>ACS880-04-590A-7</td>
<td>R11</td>
<td>TSKA069428R1 (T6V 800 PR221DS-LS/1 In=800A 3p F F)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>ACS880-04-650A-7</td>
<td>R11</td>
<td>TSKA069428R1 (T6V 800 PR221DS-LS/1 In=800A 3p F F)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>ACS880-04-721A-7</td>
<td>R11</td>
<td>TSKA07210R1 (T6V 800 PR221DS-LS/1 In=800A 3p F F)</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

1) Maximum allowed rated conditional short-circuit current (IEC 61800-5-1) of the electrical power network
2) Contact your local ABB representative

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Guidelines for planning the electrical installation

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

See section Drive connection examples on page 31.

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

In 6-pulse connection with a common main circuit breaker, the drive protects the input cables against thermal overload when the cables are dimensioned according to the nominal current of the drive.

For 12-pulse connection and 6-pulse connection with individual circuit breakers, use gG fuses with blown fuse indicators for the thermal protection of the input cables. Wire the indicators to stop the drive in case of a blown fuse.

**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, e.g., 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.
Guidelines for planning the electrical installation

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
We do not recommend to connect the drive modules to a common DC system.

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 (3UA000013231 [English])
- FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537) user’s manual (3AXD50000027782 [English]).

Implementing safety functions provided by the FSO-xx safety functions module (option)
The drive can be equipped with an FSO-xx safety functions module (option) 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 (3AXD50000015812 [English]) or FSO-21 safety functions module user’s manual (3AXD50000015614 [English]).
Declaration of Conformity

See page 193.
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. See also section Implementing a bypass connection on page 89.

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.

Implementing a bypass connection

If bypassing is required, employ mechanically or electrically interlocked contactors between the motor and the drive and between the motor and the power line. Make sure with interlocking that the contactors cannot be closed simultaneously. The installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

**WARNING!** Never connect the drive output to the electrical power network. The connection may damage the drive.
Example bypass connection

An example bypass connection is shown below.

Switching the motor power supply from drive to direct-on-line

1. Stop the drive and the motor with the drive control panel (drive in the local control mode) or the external stop signal (drive in the remote control mode).
2. Open the main contactor of the drive with S11.
3. Switch the motor power supply from the drive to direct-on-line with S40.
4. Wait for 10 seconds to allow the motor magnetization to die away.
5. Start the motor with S41.
Switching the motor power supply from direct-on-line to drive

1. Stop the motor with S42.
2. Switch the motor power supply from direct-on-line to the drive with S40.
3. Close the main contactor of the drive with switch S11 (→ turn to position ST for two seconds and leave to position 1).
4. Start the drive and the motor with the drive control panel (drive in the local control mode) or the external start signal (drive in the remote control mode).

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.
Implementing a motor temperature sensor connection

**WARNING!** IEC 60664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-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 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 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 an extension module with basic insulation (e.g., FAIO-01) or with reinforced insulation, (e.g., FPTC-xx) between the sensor connector and the other connectors of the module. See the table below for the sensor connection to the extension module and the sensor insulation requirement.
4. You can connect a sensor to an external thermistor relay, the insulation of which is rated for the main circuit voltage of the drive.

**Example circuit diagram**

See page 215.

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

**Note:** The inaccuracy of the drive analog inputs for Pt100 sensors is 10 °C (18 °F). If a better accuracy is needed, use the FAIO-01 analog I/O extension module (option +L525).
Installation instructions

Contents of this chapter
This chapter contains the general installation instructions for the drive modules.

Safety

WARNING! If you are not a qualified electrician 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 190 for the allowed ambient conditions and section Losses, cooling data and noise on page 187 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.

The drive modules are packed into two similar transport packages tied together with bands. Move the transport packages by pallet truck to the installation site.

Unpack the package as follows (see the package drawing on page 95):

1. Cut the bands (A).
2. Unpack the additional boxes (B).
3. Remove the outer sheathing by lifting it (C).
4. Remove the sheathing by lifting it (D).
5. Remove the pedestal guide plate as shown below.

- Insert lifting hooks to the drive module lifting eyes and lift the module to the installation place.
- **Package drawings**

The package of one drive module is shown below.

![Package drawing](image)

<table>
<thead>
<tr>
<th>Transport package contents</th>
</tr>
</thead>
</table>
| 1. **With option “IP20 shrouds for covering the input and motor cabling area”**: Clear plastic shrouds.  
  *With option “Full power cabling panels to be attached to a cabinet (IP20)”*: Input cabling panel parts.  
  See below for the box contents. |
| 2. **With option “Full size output cable connection terminals”**: Output cable connection terminals.  
  *With option “Full size input cable connection terminals and PE busbar”*: Input cable connection terminals.  
  *With option “Full power cabling panels to be attached to a cabinet (IP20)”*: Output cabling panel parts.  
  See below for the box contents. |
| 3. Plywood support |
| 4. Drive module with factory installed options and multilingual residual voltage warning sticker, top guide plate, pedestal guide plate, telescopic ramp package, fastening screws in a plastic bag, external control unit and factory installed optional modules, control panel and cable or control panel with door mounting kit (option), delivery documents, printed multilingual start-up quick guide and memory stick containing all manuals. Other printed manuals if ordered. |
| 5. **With option “Flat mounting”**: Back fastening bars |
| 6. **With option “Power cable connection terminals on the right-hand side”**: Accessories for mounting. |
| 7. Pallet |
With option "Power cable connection terminals on the right-hand side": Top and bottom brackets and handle (item 6 in the package drawing on the previous page)

1. Top bracket
2. Bottom bracket
3. Handle
4. Screw package

Box B1 contents with option "IP20 shrouds for covering the input and motor cabling area"

1. Paper fill
2. Clear plastic shroud for output cabling
3. Cardboard box cover
4. Cardboard box bottom
5. Support
6. Bands
7. Back clear plastic shroud (lower)
8. Back clear plastic shroud (upper)
9. Front clear plastic shroud
10. Clear plastic shroud for input cabling
11. Top clear plastic shroud
12. Clear plastic shroud for input cable lead-through from side
13. Screws in a plastic bag
14. Metallic shroud without ground bar
15. Bottom grille and mounting bracket
Box B1 contents with option “Full power cabling panels to be attached to a cabinet (IP20)”: Input power cabling panel parts

1. Screw package
2. Paper fill
3. Input power cabling panel
4. Cardboard tray
5. Top cardboard cover
6. Support
7. Bands
8. Plastic bag
9. Rubber grommet
10. Grounding busbar to be connected to the input power cabling panel and the drive module

Box B2 contains this box with option “Full size output cable connection terminals”

1. Paper fill
2. Output cable connection terminal T3/W2
3. Output cable connection terminal T2/Y2
4. Output cable connection terminal T1/U2
5. Grounding terminal
6. Cardboard box
7. Screws and insulators a plastic bag
Box B2 contains additionally this box with option “Full size input cable connection terminals and PE busbar”:

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 contents:

1. Screw package
2. Telescopic extraction and insertion ramp
3. Cardboard box
**Accessories box contents**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></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 lead-through 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 to Rittal cabinet punched section. See page 106.</td>
</tr>
<tr>
<td>4</td>
<td>Support bracket for attaching the drive module from top to a mounting plate or wall. The bracket brings a gap for cooling air flow and prevents the drive module screws from chafing the plate. See page 105.</td>
</tr>
<tr>
<td>5</td>
<td>Cardboard box</td>
</tr>
</tbody>
</table>

**Flat installation box contents (“Flat mounting” option)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Screw package</td>
</tr>
<tr>
<td>2</td>
<td>Paper fill</td>
</tr>
<tr>
<td>3</td>
<td>Mounting bars for 600 mm wide Rittal TS 8 cabinet</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 on page 94 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 lead-through 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. Check that the motor cable is disconnected from the drive output terminals T1/U2, T2/V2 and T3/W2.

2. 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.

Brake resistor and resistor cable

Check the insulation of the brake resistor assembly (if present) as follows:

1. Check that the resistor cable is connected to the resistor, and disconnected from the drive output terminals R+ and R-.

2. At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.
Installing the bottom grille for IP20 degree of protection

- If IP20 degree of protection is needed from the bottom side, install the bottom grille as shown below.
Checking the compatibility with IT (ungrounded) systems

EMC filter +E200 is not suitable for use in an IT (ungrounded) system. If the drive is equipped with filter +E200, disconnect the filter grounding wire before connecting the drive to the supply network. Insulate the end of the wire and attach it. The wire is located behind the middle front cover.

**WARNING!** If a drive with EMC filter +E200 is installed on an IT system (an ungrounded power system or a high resistance-grounded [over 30 ohm] power system), the system will be connected to earth potential through the EMC filter capacitors of the drive. This can cause danger, or damage the drive.

Installation alternatives

You can install the drive module into a cabinet using different procedures depending on the drive configuration. Obey the general power and control cable installation instructions that we give in this chapter and see the installation example of your drive configuration in the following chapters.

- **Standard drive module configuration – Bookshelf mounting**
  
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. For an installation example, see *Installation example – standard, optional IP20 shrouds and power cable connection terminals* on page 125.

- **Flat mounting**
  
  You can attach the drive module with option “Flat mounting” to the cabinet mounting plate in flat position
  
  - with bolts through the mounting holes at the top and bottom of the module,
  
  or you can, first, attach the mounting brackets delivered with the option to the cabinet mounting plate and then attach the drive module to the mounting brackets with screws.

  See the dimension drawing for frame R10 on page 205 or for frame R11 on page 211.
For an installation example on how to install the drive module without pedestal in flat position in a Rittal TS 8 cabinet, see appendix Step-by-step drawings for a flat installation example in Rittal TS 8 600 mm wide cabinet on page 247.

Option “Full-size input power cable connection terminals and PE (ground) busbar”

Connect the input power cable connection terminals as shown in chapter Step-by-step drawings for an installation example of drive module with optional IP20 shrouds and input and output terminals in Rittal TS 8 600 mm wide cabinet on page 241.

Install the metallic shroud with ground bar as shown below.

Option “Full power cabling panels to be attached to a cabinet (IP20)”

For an installation example of the drive module with option “Full power cabling panels to be attached to a cabinet (IP20)” into a Rittal cabinet including power cable connection procedure, see chapter Step-by-step drawings for installing full cabling panels (option) in a Rittal TS 8 400 mm wide cabinet page 245.
- **Option “Power cable connection terminals on the right-hand side of the drive module”**

For an installation example of the drive module with option “Power cable connection terminals on the right-hand side of the drive module” into a Rittal cabinet, see chapter Step-by-step drawings for option “Power cable connection terminals on the right-hand side of the drive module” installation example in Rittal TS 8 600 mm wide cabinet on page 249. Otherwise, install the drive module as the standard drive module configuration.

- **Attaching the drive module to a mounting plate or wall**

Use the support bracket if you attach the drive module directly to a mounting plate or wall. The support bracket prevents the drive module screws from chafing against the plate.
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 fastening bracket.

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

Attaching the type designation label
Attach the drive module package type designation label delivered with the drive modules to the cabinet door.

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.
1. Use a separate grounding PE cable (1a) or a cable with a separate PE conductor (1b) if the conductivity of the shield does not meet the requirements for the PE conductor (see page 75).
2. 360-degree grounding is recommended if shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
3. 360-degree grounding is required.
4. Line contactor
5. Common mode filter
6. du/dt filter or sine filter (options)
7. Use a separate grounding cable if the shield does not meet the requirements of IEC 61439-1 (see page 75) and there is no symmetrically constructed grounding conductor in the cable (see page 80).
8. External brake resistor
9. Drive module
10. Switch-disconnector and separate fuses or switch fuse
**Note 1:** If there is a symmetrically constructed grounding conductor on 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.

**Note 2:** The minimum allowed motor cable length without optional output filters is 2 m.

**Note 3:** Maximum cable length of the DC cables is 4 m.

**Note 4:** In this connection, the drive protects the input cables against thermal overload.

**Note 5:** Motor cables must be installed symmetrically to the common motor.
Power cable connection diagram example (6-pulse and 12-pulse)

1 Use a separate grounding PE cable (1a) or a cable with a separate PE conductor (1b) if the conductivity of the shield does not meet the requirements for the PE conductor (see page 75).
### 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 lead-through 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 symmetrically to terminals T1/U2, T2/V2 and T3/W2 of the drive module. For the tightening torques, see page 187.
4. Drive modules with option +D150: Run the power cables from the brake resistor to the cabinet. Ground the cable shield (if present) 360° at the lead-through plate. Connect the conductors to the R+ and R- terminals. For the tightening torques, see page 187.
5. Connect the UDC+ terminals of the drive modules together. Connect the UDC- terminals of the drive modules together. For the tightening torques, see page 187.
If the DC cables are run outside the cabinet, ground the cable shield 360° at one end only.

6. Make sure that all power is disconnected and reconnection is not possible. Use proper safe disconnect procedures according to local codes.

7. Run the input cables from the supply source to the cabinet. Ground the cable shields 360° at the lead-through plate.

8. 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.

9. 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 187.
Mounting the external control unit

See BCU-02/12/22 control units hardware manual (3AUA0000113605 [English]).

Layout and connections of the control unit

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slot 1</td>
</tr>
<tr>
<td>Slot 2</td>
</tr>
<tr>
<td>Slot 3</td>
</tr>
<tr>
<td>Slot 4</td>
</tr>
<tr>
<td>X205</td>
</tr>
<tr>
<td>Battery</td>
</tr>
<tr>
<td>A1</td>
</tr>
<tr>
<td>A2</td>
</tr>
<tr>
<td>X2D TERM</td>
</tr>
<tr>
<td>DDCS</td>
</tr>
<tr>
<td>7-segment display</td>
</tr>
</tbody>
</table>

Multicharacter indications are displayed as repeated sequences of characters

- "U" is indicated briefly before "o.
- Control program startup in progress
- Firmware cannot be started.
- Memory unit missing or corrupted
- Firmware download from PC to control unit in progress
- At power-up, the display may show short indications of eg. "1", "2", "b" or "U".
- These are normal indications immediately after power-up. If the display ends up showing any other value than those described, it indicates a hardware failure.
### Description

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XAI</td>
<td>Analog inputs</td>
</tr>
<tr>
<td>XAO</td>
<td>Analog outputs</td>
</tr>
<tr>
<td>XDI</td>
<td>Digital inputs, digital input interlock (DIIL)</td>
</tr>
<tr>
<td>XAO</td>
<td>Digital input/outputs</td>
</tr>
<tr>
<td>XD2D</td>
<td>Drive-to-drive link</td>
</tr>
<tr>
<td>XD24</td>
<td>+24 V output (for digital inputs)</td>
</tr>
<tr>
<td>XETH</td>
<td>Ethernet port (e.g., for PC communication)</td>
</tr>
<tr>
<td>XPOW</td>
<td>External power input</td>
</tr>
<tr>
<td>XRO1</td>
<td>Relay output RO1</td>
</tr>
<tr>
<td>XRO2</td>
<td>Relay output RO2</td>
</tr>
<tr>
<td>XRO3</td>
<td>Relay output RO3</td>
</tr>
<tr>
<td>XSTO</td>
<td>Safe torque off connection (input signals)</td>
</tr>
<tr>
<td>XSTO OUT</td>
<td>Safe torque off connection (to drive modules)</td>
</tr>
<tr>
<td>X12</td>
<td>(On the opposite side) Connection for FSO-xx safety functions module (optional)</td>
</tr>
<tr>
<td>X13</td>
<td>Control panel connection</td>
</tr>
<tr>
<td>X485</td>
<td>Not in use</td>
</tr>
<tr>
<td>V1T/V1R</td>
<td>Fiber optic connection for drive modules 1 and 2 (VxT = transmitter, VxR = receiver)</td>
</tr>
<tr>
<td>V2T/V2R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V3T/V3R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V4T/V4R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V5T/V5R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V6T/V6R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V7T/V7R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V8T/V8R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V9T/V9R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V10T/V10R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V11T/V11R</td>
<td>Not in use</td>
</tr>
<tr>
<td>V12T/V12R</td>
<td>Not in use</td>
</tr>
<tr>
<td>SD CARD</td>
<td>Data logger memory card for drive module communication</td>
</tr>
<tr>
<td>BATT OK</td>
<td>Real-time clock battery voltage is higher than 2.8 V. If the LED is off when the control unit is powered, replace the battery.</td>
</tr>
<tr>
<td>FAULT</td>
<td>The control program has generated a fault. See the firmware manual of the drive modules.</td>
</tr>
<tr>
<td>PWR OK</td>
<td>Internal voltage supply is OK</td>
</tr>
<tr>
<td>WRITE</td>
<td>Writing to memory card in progress. Do not remove the memory card.</td>
</tr>
</tbody>
</table>
Connecting the control unit to the drive module

**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, page 99.

- **Connections to the drive module**
  - Connect power supply cable of the control unit to the BPOW connector and the ground wire of the cable to the ground terminal.
  - Connect the BGDR cable to the BGDR connector.
  - For drive modules with SOIA board, connect the fiber optic cables to the V20 and V10 connectors.

  Secure the cables at the clamps as shown below.
Connections to the control unit

Connect the fiber optic, power supply and BGDR cables to the control unit as follows:

<table>
<thead>
<tr>
<th>BPOW</th>
<th>BCU control unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>X3: 1</td>
<td>XPOW:1 (+24V)</td>
</tr>
<tr>
<td>X3: 2</td>
<td>XPOW:2 (GND)</td>
</tr>
<tr>
<td>X3: 3 (not used)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BGDR</th>
<th>BCU control unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive module 1</td>
<td>(connector XSTO OUT)</td>
</tr>
<tr>
<td>X7:1</td>
<td>5 (IN1)</td>
</tr>
<tr>
<td>X7:2</td>
<td>6 (SGND)</td>
</tr>
<tr>
<td>X8:1</td>
<td>7 (IN2)</td>
</tr>
<tr>
<td>X8:2</td>
<td>8 (SGND)</td>
</tr>
<tr>
<td>Drive module 2</td>
<td>(connector XSTO OUT)</td>
</tr>
<tr>
<td>X7:1</td>
<td>5 (IN1)</td>
</tr>
<tr>
<td>X7:2</td>
<td>6 (SGND)</td>
</tr>
<tr>
<td>X8:1</td>
<td>7 (IN2)</td>
</tr>
<tr>
<td>X8:2</td>
<td>8 (SGND)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ZINT/SOIA</th>
<th>BCU control unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZINT: V1; SOIA: V10</td>
<td>V1T</td>
</tr>
<tr>
<td>ZINT: V2; SOIA: V20</td>
<td>V2T</td>
</tr>
</tbody>
</table>

Connecting the control cables to the terminals of the control unit

Control cable connection procedure

1. Route the cables to the control unit.
2. Strip the cable ends and conductors. When connecting to the drive I/O, use electrical tape or shrink tubing to contain the strands. Elsewhere, twist the outer shield strands into a bundle, crimp a lug onto it and connect it to the nearest chassis grounding point.
3. Connect the conductors to the appropriate detachable terminals of the control unit, see page 116.

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. Keep the shields continuous as close to the terminals of the control unit as possible. Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor, eg. 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.
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- **Default I/O connection diagram**

  **Drive-to-drive link XD2D**
  - B 1
  - A 2
  - BGBD 3
  - SGND 4

  **RS485 connection X485**
  - Not in use
  - A 6
  - B 7
  - SGND 8

  **Relay outputs**
  - XRD1…XRD3
  - NC 10
  - COM 12
  - NO 13
  - NC 21
  - COM 22
  - NO 23
  - NC 31
  - COM 32

  **Safe torque off**
  - XSTO, XSTO OUT
  - IN1 5
  - SGND 6
  - IN2 7
  - SGND 8

  **Digital inputs XDI**
  - DI1 1
  - DI2 2
  - DI3 3
  - DI4 4
  - DI5 5
  - DI6 6
  - DI7 7
  - DI8 8

  **Digital inputs/outputs XDIO**
  - XDI1
  - XDI2
  - XDI3
  - XDI4
  - XDI5
  - XDI6
  - XDI7
  - XDI8

  **Auxiliary voltage output XDIO**
  - +24VDC DC 200 mA
  - Digital input ground
  - Digital input/output ground
  - Digital input/output ground
  - Digital input/output ground

  **Analog inputs, reference voltage output**
  - 10 V DC, R1 = 10 kohm
  - UVREF 1
  - 10 V DC, R1 = 10 kohm
  - XREF 2
  - Ground
  - AGND 3
  - Voltage reference
  - X1 4
  - X2 (–) 5
  - X1 (+) 6
  - 0(4)…20 mA, R1 = 200 ohm
  - X2 7

  **Analog outputs**
  - 0(4)…20 mA, R1 = 500 ohm
  - AO1 1
  - AO2 2

  **Motor speed rpm 0…20 mA, R1 = 500 ohm**
  - AO3 3
  - AO4 4

  **Motor current 0…20 mA, R1 = 500 ohm**
  - AO5 5
  - AO6 6

  **External power input**
  - XPOW 1
  - 24 V DC, 2.05 A
  - Two supplies can be connected for redundancy

  **Safety functions module connection**
  - X11

  **Control panel connection**
  - X205

  **Memory unit connection**
  - X205
Notes:

The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 ... 2.5 mm² (24...12 AWG). The torque is 0.5 N·m (5 lbf·in).

1) See section Drive-to-drive link (page 119).

2) See chapter Safe torque off (page 120).

3) 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.

4) Constant speed 1 is defined by parameter 22.26.

5) See section DIIL input (XD24:1) (page 118).

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

7) Determines whether DICOM is separated from DIOGND (i.e., common reference for digital inputs floats; in practice, selects whether the digital inputs are used in current sinking or sourcing mode). See also BCU-02/12/22 control units hardware manual (3AU/0000113605 [English]) DICOM = DIOGND ON: DICOM connected to DIOGND.
   OFF: DICOM and DIOGND separate.

8) Current [0(4)...20 mA, \( R_{in} = 100 \) ohm] or voltage [0(2)...10 V, \( R_{in} > 200 \) kohm] input selected by switch A11. Change of setting requires reboot of control unit.

9) Current [0(4)...20 mA, \( R_{in} = 100 \) ohm] or voltage [0(2)...10 V, \( R_{in} > 200 \) kohm] input selected by switch A12. Change of setting requires reboot of control unit.

External power supply for the control unit (XPOW)

The control unit must be powered from a 24 V DC, 2 A power supply. The power supply is connected to terminal block XPOW. A second supply can be connected to the same terminal block for redundancy.
DI6 (XDI:6) as PTC sensor input

A 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](image)

**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.

DIIL input (XD24:1)

The DIIL 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.
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.

**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.

**Drive-to-drive link**

The drive-to-drive link is a daisy-chained RS-485 transmission line that allows basic master/follower communication with one master drive and multiple followers.

Set termination activation switch D2D.TERM to the ON position on the drives at the ends of the drive-to-drive link. On intermediate drives, set the switch to the OFF position.

Use shielded twisted-pair cable (~100 ohm, for example, PROFIBUS-compatible cable) for the wiring. For best immunity, high quality cable is recommended. Keep the cable as short as possible; the maximum length of the link is 50 meters (164 ft). Avoid unnecessary loops and running the cable near power cables (such as motor cables). Ground the cable shields as described in section Connecting the control cables to the terminals of the control unit on page 115.
The following diagram shows the wiring of the drive-to-drive link.

**Safe torque off**
This input can be used to implement a safe torque off function. See chapter *Safe torque off* (page 120).

**Safety functions module connection (X12)**
See section *Implementing safety functions provided by the FSO-xx safety functions module (option)* on page 86, and FSO-12 safety functions module user’s manual (3AXD50000015612 [English]).

**SDHC memory card slot**
The control unit has an on-board data logger that collects real-time data from the inverter module power stages to help fault tracing and analysis. The data is stored onto the SDHC memory card inserted into the SD CARD slot and can be analyzed by ABB service personnel.

**Wiring the microswitches of the fuses**
Wire the microswitches of the drive input fuses to the DIIL input as shown below or to an external switch for stopping the drive in case of fuse burning.
Connecting a control panel

With DPMP-01 door mounting platform (option), 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 drive module packages by constructing a panel bus. Each drive module package must be equipped with a control panel mounting platform or an FDPI-02 module (available separately). For further information, see FDPI-02 diagnostics and panel interface user's manual (3AUA0000113618 [English]).

1. Connect the panel to one drive module package using an Ethernet (e.g., CAT5E) cable.
   - Use Menu – Settings – Edit texts – Drive to give a descriptive name to the unit
   - Use parameter 49.01 to assign the unit 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 unit.

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

3. In the last package, switch bus termination on. With a panel platform, move the terminating switch into the outer position. (With an FDPI-02 module, move termination switch S2 into the TERMINATED position.) Termination should be off on all other packages.

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

If a PC is connected to the control panel, the drive module 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 121.

**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.

**Installing optional modules**

See BCU-02/12/22 control units hardware manual (3AUA0000113605 [English]).

**Installing FSO safety functions module**

See BCU-02/12/22 control units hardware manual (3AUA0000113605 [English]).

**Connecting the memory unit**

See BCU-02/12/22 control units hardware manual (3AUA0000113605 [English]).
Installation instructions
Installation example – standard, optional IP20 shrouds and power cable connection terminals

Contents of this chapter
In this chapter, the drive module is installed in a 600 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 electrician 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

### Drive module standard parts
- Drive module
- Fastening bracket
- Pedestal guide plate
- Telescopic extraction and insertion ramp
- Fastening screws and insulators in a plastic bag
- External control unit

### Rittal parts / Alternative ABB parts

<table>
<thead>
<tr>
<th>Rittal part code</th>
<th>Qty (pcs)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS 8608.500</td>
<td>1</td>
<td>Enclosure without mounting plate, bottom plates and side panels.</td>
</tr>
</tbody>
</table>
| TS 7967.000      | 1         | Spacers for roof plates, / ABB roof  
**Note:** For alternative ABB outlet kits, see section [Air outlet kits](#) on page 173. |
| TS 6612.160      | 5         | Punched section with mounting flange, outer mounting level for 600 mm horizontal |
| TS 4396.500      | 4 / 2     | Support rails  
**ABB roof**  
**Note:** For alternative ABB air filters, see section [Air inlet kits](#) page 171. |

### Customer-made parts (not ABB or Rittal products)
- Air baffles 2  
**See section [Preventing the recirculation of hot air](#) on page 60.**

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 into a cabinet on page 127 and installation drawings on page 243.</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 <a href="#">Preventing the recirculation of hot air</a> on page 84.</td>
</tr>
</tbody>
</table>
Installation example – standard, optional IP20 shrouds and power cable connection terminals

Installing the drive module into a cabinet

See a video of the installation at YouTube: http://www.youtube.com/watch?v=IhKOSx3HmzQ

See appendix: Step-by-step drawings for an installation example of drive module with optional IP20 shrouds and input and output terminals in Rittal TS 8 600 mm wide cabinet on page 241. Connecting the power cables and installing the IP20 shrouds (if present) on page 128.

- Install the punched section to the back of the cabinet frame.
- Install the bottom grille to the drive module for IP20 degree of protection from bottom if there is no leak-proof bottom plate in the cabinet. See page 102.
- Install the support rails and pedestal guide plate to the cabinet bottom frame.
- Install the telescopic insertion ramp to the pedestal guide plate.
- Remove the sheeting from the clear plastic shrouds from both sides.
- Install the top metallic shroud to the drive module.
- Install the back shrouds to the drive module.
- To prevent the drive module from falling, attach its lifting lugs with chains to the cabinet frame.
- Push the drive module carefully into the cabinet along the telescopic insertion ramp.
- Remove the ramp.
- Fasten the drive module to the pedestal guide plate.
- Fasten the drive module from top to the punched section at the cabinet back. Note: The fastening bracket grounds the drive module to the cabinet frame.
- Install the air baffles.

<table>
<thead>
<tr>
<th>3</th>
<th>For the standard drive module configuration, connect the power cables to the drive module output and input busbars. For option “Full size output cable connection terminals and PE busbar”, connect the output power cable terminals and motor cables. For option “IP20 shrouds for covering the input and motor cabling area”, connect the shrouds onto the motor cabling area and while connecting the input cables onto the input cabling area. For option “Full size input cable connection terminals and PE busbar”, connect the input power cable terminals and input cables.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Mount the external control unit. BCU-02/12/22 control units hardware manual (JAU0000113605 [English])</td>
</tr>
<tr>
<td>6</td>
<td>Connect the control cables. Connecting the control cables to the terminals of the control unit, page 115.</td>
</tr>
<tr>
<td>7</td>
<td>Install the remaining parts, for example, cabinet doors, side plates, etc. The component manufacturer’s instructions. Installing the roof and door (Rittal parts) on page 130.</td>
</tr>
</tbody>
</table>

Installing the drive module into a cabinet
### Connecting the power cables and installing the IP20 shrouds (if present)

#### Task (motor cables, standard drive module configuration)

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Run the motor cables to the cabinet. Ground the cable shields 360 degrees at the cabinet lead-through.</td>
</tr>
<tr>
<td>5</td>
<td>Connect the twisted shields of the motor cables to the grounding terminal of the drive module.</td>
</tr>
<tr>
<td>6</td>
<td>Connect the phase T3/W2 conductors to the T3/W2 busbar.</td>
</tr>
<tr>
<td>7</td>
<td>Connect the phase T2/V2 conductors to the T2/V2 busbar.</td>
</tr>
<tr>
<td>8</td>
<td>Connect the phase T1/U2 conductors to the T1/U2 busbar.</td>
</tr>
</tbody>
</table>

#### Task (DC cables)

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connect the UDC+ terminals of the drive modules together. Connect the UDC- terminals of the drive modules together. If the DC cables are run outside the cabinet, ground the cable shield 360° at one end only.</td>
</tr>
</tbody>
</table>

#### Task (motor cables, options “Full size output cable connection terminals” and “IP20 shrouds for covering the motor cabling area” included)

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</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 lead-through.</td>
</tr>
<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, options “Full size input cable connection terminals and PE busbar” and IP20 shrouds for covering the input cabling area” included)

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground the input cable shields (if present) 360 degrees at the cabinet lead-through.</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>
</tbody>
</table>
### Installation example – standard, optional IP20 shrouds and power cable connection terminals

<table>
<thead>
<tr>
<th>Step</th>
<th>Task (input cables, options “Full size input cable connection terminals and PE busbar” and IP20 shrouds for covering the input cabling area” included)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Step drill carefully sufficiently big holes to the lead-through 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>
<tr>
<td>5</td>
<td>For drive modules without option “Full size input cable connection terminals and PE busbar”: Connect the input cable conductors to the drive module L1/U1, L2/V1 and L3/W1 connection busbars. Go to step 12. For option “Full size input cable connection terminals and PE busbar”: Do steps 6 to 11.</td>
</tr>
<tr>
<td>6</td>
<td>Screw in and tighten the insulators to the drive module by hand. Install the L1/U1 connection terminal to the insulators. <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>7</td>
<td>Connect the L1/U1 conductors to the L1/U1 connection terminal.</td>
</tr>
<tr>
<td>8</td>
<td>Install the L2/V1 connection terminal to the insulators. See the warning in step 5.</td>
</tr>
<tr>
<td>9</td>
<td>Connect the L2/V1 conductors to the L2/V1 connection terminal.</td>
</tr>
<tr>
<td>10</td>
<td>Install the L3/W1 connection terminal to the insulators. See the warning in step 5.</td>
</tr>
<tr>
<td>11</td>
<td>Connect the L3/W1 conductors to the L3/W1 connection terminal.</td>
</tr>
<tr>
<td>12</td>
<td>Install the lead-through clear plastic shroud. Install the front clear plastic shroud and upper front cover. Remove the cardboard protective covering from the drive module air outlet.</td>
</tr>
<tr>
<td>13</td>
<td>Install the side and top clear plastic shrouds to the drive module.</td>
</tr>
</tbody>
</table>
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.
Installing the roof and door (ABB air filters and roof)

This drawing shows a layout tested by ABB.
Removing the protective covering from the drive module air outlet

**WARNING!** Remove the protective covering from the top of the drive module after the installation. If the covering is not removed, the cooling air cannot flow freely through the module and the drive will run to overtemperature.

Miscellaneous

- **Input power cable lead-through from top**

  If you run the input cables from top to the drive module, drill the lead-through holes to the top clear plastic shroud.
Installation example with option “Full power cabling panels to be attached to a cabinet (IP20)”

Contents of this chapter
In this chapter, the drive module is installed in a 400 mm wide Ritual TS 8 cabinet in a bookshelf way. The module is placed in an upright position on the cabinet bottom with its 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 electrician 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 with option "Full power cabling panels to be attached to a cabinet (IP20)"**

**Required parts**

The parts are used in this installation example:

<table>
<thead>
<tr>
<th>Drive module standard parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Drive module</td>
</tr>
<tr>
<td>• Top guide plate</td>
</tr>
<tr>
<td>• Fastening bracket</td>
</tr>
<tr>
<td>• Grounding busbar</td>
</tr>
<tr>
<td>• Pedestal guide plate</td>
</tr>
<tr>
<td>• Telescopic extraction and insertion ramp</td>
</tr>
<tr>
<td>• Fastening screws in a plastic bag</td>
</tr>
<tr>
<td>• External control unit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive module options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option code</td>
</tr>
<tr>
<td>------------------------------</td>
</tr>
<tr>
<td>3AXD500000024520 for frame R10, 3AXD50000024561 for frame R11</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 8406.510</td>
</tr>
<tr>
<td>TS 8106.239</td>
</tr>
<tr>
<td>EZ01K 7965.009 (one set = four pieces) / ABB 3AUA0000112501 (IP20) ABB 3AUA0000114967 (IP42)</td>
</tr>
<tr>
<td>Note: For alternative ABB outlet kits, see section Air outlet kits on page 172.</td>
</tr>
<tr>
<td>TS 8612.160</td>
</tr>
<tr>
<td>TS 8612.140</td>
</tr>
<tr>
<td>SK 5243.200 / ABB 3AUA0000117002 (IP20) ABB 3AUA0000117007 (IP42)</td>
</tr>
<tr>
<td>Note: For alternative ABB air filters, see section Air inlet kits page 171.</td>
</tr>
<tr>
<td>TS 4396.500</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>Cabinet bottom plate (alternative to Rittal support rails)</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
Installation example with option “Full power cabling panels to be attached to a cabinet (IP20)”

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 135 and appendix Step-by-step drawings for installing full cabling panels (option) in a Rittal TS 8 400 mm wide cabinet on page 245.</td>
</tr>
<tr>
<td>3</td>
<td>Connect the power cables to the cabling panels.</td>
<td>Connecting the power cables, page 136.</td>
</tr>
<tr>
<td>4</td>
<td>Install the drive module into the cabinet.</td>
<td>Installing the drive module into the cabinet, page 140</td>
</tr>
<tr>
<td>5</td>
<td>Install the external control unit.</td>
<td>BCU-02/12/22 control units hardware manual (3AUA000113605 [English])</td>
</tr>
<tr>
<td>6</td>
<td>Connect the control cables.</td>
<td>Connecting the control cables to the terminals of the control unit on 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

Install the mechanical accessories into the cabinet as shown in appendix Step-by-step drawings for installing full cabling panels (option) in a Rittal TS 8 400 mm wide cabinet on page 245.

If you do not use Rittal support rails on the bottom of the cabinet but make an own bottom plate instead, see the dimension drawing on page 212 for the correct dimensions. **Note:** If the thickness of the bottom plate is not 2.5 mm (0.1 in.), adjust the dimensions accordingly.
Connecting the power cables

- Power cable connection diagram example (6-pulse and 12-pulse)
Installation example with option “Full power cabling panels to be attached to a cabinet (IP20)”

---

**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 lead-through 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 187.
4. **Drive modules with option +D150:** Run the power cables from the brake resistor to the cabinet. Ground the cable shield (if present) 360° at the lead-through plate. Connect the conductors to the R+ and R- terminals. For the tightening torques, see page 187.
5. Connect the UDC+ terminals of the drive modules together. Connect the UDC- terminals of the drive modules together. For the tightening torques, see page 187. If the DC cables are run outside the cabinet, ground the cable shield 360° at one end only.
6. Make sure that all power is disconnected and reconnection is not possible. Use proper safe disconnect procedures according to local codes.
7. Run the input cables from the supply source to the cabinet. Ground the cable shields 360° at the lead-through plate.

---

**Note:**

1. If there is a symmetrically constructed grounding conductor on 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.
2. The minimum allowed motor cable length without optional output filters is 10 m.
3. Maximum cable length of the DC cables is four meters.
4. Protect the input cables with additional fuses or circuit breaker against thermal overload.
5. Motor cables must be installed symmetrically to the common motor.
8. 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.

9. 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 187.
An example installation without DC cabling is shown below.

**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>View without cabinet side plate in place.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A) 360-degree grounding at the lead-through plate for the input power cables</td>
<td></td>
</tr>
<tr>
<td>B) Grounding busbar of the input power cabling panel</td>
<td></td>
</tr>
<tr>
<td>C) 360-degree grounding at the lead-through plate for the output power cables</td>
<td></td>
</tr>
<tr>
<td>D) Grounding busbar of the output power cabling panel</td>
<td></td>
</tr>
<tr>
<td>E) Allowed space for power cables. <strong>Note:</strong> 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.</td>
<td></td>
</tr>
</tbody>
</table>
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. Attach the mounting bracket to the drive module. **Note:** This bracket will ground the drive module to the cabinet frame.

2. Install the telescopic extraction and insertion ramp to the cabinet base with two screws.

3. Remove the upper and lower left-hand side front covers of the drive module (M4×8 combi screws, 2 N·m).
4. Attach the drive module lifting lugs to the cabinet frame with chains.
5. Push the drive module carefully into to the cabinet preferably with the help from another person.
6. Attach the grounding busbar that has been previously attached to the input cabling panel to the drive module. **Note:** The design of the grounding busbar can be different from what is shown in the figure.

7. Connect the busbars of the drive module to the busbars of the cabling panels (M12 combi screw, 70 N·m [52 lbf·ft]).
8. Attach the drive module to the cabinet from top and bottom, see page 143 (frame R10) or page 146 (frame R11). **Note:** The top fastening bracket grounds the drive module to the cabinet frame.
9. Attach the cabinet roof on the spacers and the side panels, see page 145.
10. Remove the filter mats from the air filters according to Rittal’s instructions. Install the filters to the cabinet door, see page 145.
11. Put back the removed front covers of the drive module on the power cable sections, and connect the control cables (see section Connecting the control cables to the terminals of the control unit on page 115).
Installation example with option “Full power cabling panels to be attached to a cabinet (IP20)”
Installation example with option “Full power cabling panels to be attached to a cabinet (IP20)”

Assembly drawing of installing the drive module to the cabinet (frame R10)
Installation example with option "Full power cabling panels to be attached to a cabinet (IP20)"

Assembly drawing of installing the drive module to the cabinet (frame R11)
Installation example with option “Full power cabling panels to be attached to a cabinet (IP20)”

Assembly drawing of installing the roof and door

This drawing shows a layout tested by ABB. If you use ABB air filters, place them vertically in the positions shown in the drawing on page 126.

1 Door
2 Install these gratings as close to each other as possible. Remove the filter mats.
Removing the protective covering from the drive module air outlet

WARNING! Remove the protective covering from the top of the drive module after the installation. If the covering is not removed, the cooling air cannot flow freely through the module and the drive will run to overtemperature.

Miscellaneous

- Installations with input and motor cables of size 4 × 240 mm² per phase

If resistor cables are to be connected, the lower side plate of the output cabling panel must be removed and the resistor cables lead from side to the terminals of the output cabling panel.
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 option “Full power cabling panels to be attached to a cabinet (IP20)” is optimized to the Rittal TS 8406.510 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 8406.510</td>
<td>1</td>
<td>Enclosure without mounting plate. Includes frame, door, side and back panels.</td>
</tr>
<tr>
<td>TS 8606.500</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><strong>Cabinet construction</strong></td>
<td></td>
</tr>
<tr>
<td>The drive module is fastened properly to the cabinet. (<a href="#">See chapters Guidelines for planning the cabinet installation</a> and <a href="#">Step-by-step drawings for installing full cabling panels (option) in a Rittal TS 8 400 mm wide cabinet</a>)</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. 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

<table>
<thead>
<tr>
<th>Check that …</th>
<th>☐</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drive option modules and other components</strong></td>
<td>☐</td>
</tr>
<tr>
<td>Type and number of option modules and other equipment is correct. Option modules and other equipment are not damaged.</td>
<td>☐</td>
</tr>
<tr>
<td>Optional modules and terminals are labelled correctly.</td>
<td>☐</td>
</tr>
<tr>
<td>The placement of optional modules and other equipment inside the cabinet and on the cabinet door is correct.</td>
<td>☐</td>
</tr>
<tr>
<td>The mounting of optional modules and other equipment is correct.</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Internal cabling of the cabinet assembly</strong></td>
<td>☐</td>
</tr>
<tr>
<td>Main circuit:</td>
<td>☐</td>
</tr>
<tr>
<td>• DC cabling is OK.</td>
<td>☐</td>
</tr>
<tr>
<td>• AC supply input cabling is ok.</td>
<td>☐</td>
</tr>
<tr>
<td>• AC output cabling is ok.</td>
<td>☐</td>
</tr>
<tr>
<td>• Supply for brake resistor (if used) is ok.</td>
<td>☐</td>
</tr>
<tr>
<td>Cable types, cross-sections, colours and optional markings are correct.</td>
<td>☐</td>
</tr>
<tr>
<td>Cabling is not susceptible to interference. Check the twisting of cables and cable routes.</td>
<td>☐</td>
</tr>
<tr>
<td>Connection of cables to devices, terminal blocks and drive module circuit boards:</td>
<td>☐</td>
</tr>
<tr>
<td>• Cables are connected to terminals tight enough by pulling the cable.</td>
<td>☐</td>
</tr>
<tr>
<td>• Cable termination on terminals chaining is done correctly.</td>
<td>☐</td>
</tr>
<tr>
<td>• Bare conductors are not too far outside the terminal causing an insufficient clearance or loss of shielding against contact.</td>
<td>☐</td>
</tr>
<tr>
<td>• The control unit is wired properly to the drive module.</td>
<td>☐</td>
</tr>
<tr>
<td>• The control panel cable is connected properly.</td>
<td>☐</td>
</tr>
<tr>
<td>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.).</td>
<td>☐</td>
</tr>
<tr>
<td>The type, markings, insulation plates and cross connections of terminal blocks are correct.</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Grounding and protection</strong></td>
<td>☐</td>
</tr>
<tr>
<td>The grounding colors, cross-section and grounding points of modules and other equipment match the circuit diagrams. No long routes for pigtailed.</td>
<td>☐</td>
</tr>
<tr>
<td>Connections of PE cables and busbars are tight enough. Pull the cable to test that it does not loosen. No long routes for pigtailed.</td>
<td>☐</td>
</tr>
<tr>
<td>Doors equipped with electrical equipment are grounded. No long grounding routes. From EMC standpoint best result is achieved with a flat copper braid.</td>
<td>☐</td>
</tr>
<tr>
<td>Fans that can be touched are shrouded.</td>
<td>☐</td>
</tr>
<tr>
<td>Live parts inside the doors are protected against direct contact to at least IP2x.</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Labels</strong></td>
<td>☐</td>
</tr>
<tr>
<td>The type designation labels and warning and instruction stickers are made according to the local regulations and placed correctly.</td>
<td>☐</td>
</tr>
<tr>
<td><strong>Switches and doors</strong></td>
<td>☐</td>
</tr>
<tr>
<td>Mechanical switches, main disconnecting switch and cabinet doors function properly.</td>
<td>☐</td>
</tr>
</tbody>
</table>
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 one year, the electrolytic DC capacitors in the DC link of the drive have been reformed. See page 166.
- 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 brake resistor (if present) has been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.)
- The motor cable (and brake resistor cable, if present) 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.
Contents of this chapter

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

Start-up procedure

1. Only qualified electricians are allowed to start-up the drive.
2. Make sure that the installation of the drive module has been checked according to the checklist in chapter Installation checklist, and that the motor and driven equipment are ready for start.
3. Perform the start-up tasks instructed by the cabinet-installer of the drive module.
4. Switch the power on, setup the drive control program, and perform the first start of the drive and motor. See the appropriate start-up guide or firmware manual. If you need more information on the use of the control panel, see ACS-AP-x Assistant control panels user’s manual (3AUA0000085685 [English]).
In addition to the parameter settings required by the application, make the following settings for the drive module package:

- Set 95.04 Control board supply according to how the drive control unit is powered.
- Set parameter 95.09 Fuse switch control to Disable.
- Select the drive module type in parameter 95.31 Parallel connection rating id.
- Reboot the control unit either by cycling the power, or by parameter 96.08 Control board boot.
- For drives with resistor braking (option), see also section Start-up on page 233.
- 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]).

5. For drives with ABB motors in explosive atmospheres, see also ACS880 drives with ABB motors in explosive atmospheres (3AXD50000019585 [English]).

6. For drive modules in which the Safe torque off function is in use: Test and validate the operation of the Safe torque off function. See section Start-up including acceptance test on page 223.

7. For drive modules with an FSO-xx safety functions module (options +Q972 and Q973): 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]) or FSO-21 safety functions module user’s manual (3AXD50000015614 [English]).
Fault tracing

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

LEDs with option DPMP-01

<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></td>
<td></td>
<td>Control unit is powered and +15 V is supplied to the control panel.</td>
</tr>
<tr>
<td>mounting platform</td>
<td></td>
<td></td>
<td>Control unit is powered and +15 V is supplied to the control panel.</td>
</tr>
<tr>
<td>POWER</td>
<td>Green</td>
<td></td>
<td>Drive in fault state.</td>
</tr>
<tr>
<td>FAULT</td>
<td>Red</td>
<td></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.
Fault tracing
Maintenance

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

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

The 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 environmental conditions may require shorter maintenance intervals for certain components.
158  Maintenance

- **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**

ABB recommends these annual inspections to ensure the highest reliability and optimum performance.

<table>
<thead>
<tr>
<th>Target</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>IP22 and IP42 air inlet and outlet meshes on the cabinet doors</td>
</tr>
<tr>
<td>H</td>
<td>IP54 air filters on the cabinet doors</td>
</tr>
<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>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>Cooling</td>
<td></td>
</tr>
<tr>
<td>Main cooling fan of drive module</td>
<td>R</td>
</tr>
<tr>
<td>Circuit board compartment cooling fans of drive module</td>
<td>R</td>
</tr>
<tr>
<td>NSIN filter cooling fan</td>
<td>R</td>
</tr>
<tr>
<td>Aging</td>
<td></td>
</tr>
<tr>
<td>BCU control unit battery (real-time clock)</td>
<td>R</td>
</tr>
<tr>
<td>Control panel battery (real-time clock)</td>
<td>R</td>
</tr>
</tbody>
</table>

| ![Image](https://via.placeholder.com/150) |

**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. 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. Undo the fastening screws of the handle plate of the drive module.
3. Remove the handle plate.
4. Vacuum the interior of the heatsink from the opening.
5. 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.
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 circuit board compartment cooling fan**

  ![Image](image1)

  **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. Remove the drive module out of the cabinet. See section *Replacing the standard drive module and drive module with option “IP20 shrouds for covering the input and motor cabling area”* on page 162, or for drive modules with option
3. Undo the fastening screw of the fan enclosure.
4. Unplug the power supply cable of the fan.
5. Install the new fan in reverse order to the above.
6. Reset the counter (if used) in group 5 in the primary control program.
Replacing the 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. Remove the drive module out of the cabinet. See section *Replacing the standard drive module and drive module with option “IP20 shrouds for covering the input and motor cabling area”* on page 162, or for drive modules with option
3. Open the support legs of the pedestal.
4. Undo the two screws that fasten the fan assembly plate.
5. Tilt the fan assembly plate down.
6. Disconnect the power supply wires of the fans.
7. Remove the fan assembly from the drive module.
8. Undo the fastening screws of the fan(s) and remove the fan(s) from the assembly plate.
9. Install the new fan(s) in reverse order to the above.
10. Reset the counter (if used) in group 5 in the primary control program.
Replacing the standard drive module and drive module with option “IP20 shrouds for covering the input and motor cabling area”

**Note:** The replacement module must be of the same type as the original module: same type code and same option codes.

---

**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. Disconnect the power supply, BGDR and fiber optic cables from the drive module.
5. 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.
6. Remove the screws that attach the drive module to the cabinet at the top and behind the front support legs.
7. Attach the extraction ramp to the cabinet base with two screws.
8. To prevent the drive module from falling, attach its top lifting lugs with chains 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 to the above.
Replacing the drive module with option “Full power cabling panels to be attached to a cabinet (IP20)”

Note: The replacement module must be of the same type as the original module: same type code and same option codes.

**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 left-hand side upper and lower front covers of the drive module by undoing the fastening screws. M4×10 combi screws, 2 N·m.
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. Undo the screws that fasten the drive module to the cabinet at the top (a) and behind the front support legs (b).
6. Remove the front air baffle.
7. Attach the extraction ramp to the cabinet base with two screws.
8. 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.

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

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

11. Install the new module in reverse order to the above.
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 a year or more, reform the capacitors. See page 43 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]).

Replacing the control panel battery

The battery is housed on the rear of the control panel. Replace it with a new CR 2032 battery. Dispose the old battery according to local disposal rules or applicable laws.

Replacing the real-time clock battery

See BCU-02/12/22 control units hardware manual (3AUA0000113605 [English]).

Replacing the memory unit

See BCU-02/12/22 control units hardware manual (3AUA0000113605 [English]).

Replacing the SD/SDHC memory card

See BCU-02/12/22 control units hardware manual (3AUA0000113605 [English]).

Replacing the control unit

See BCU-02/12/22 control units hardware manual (3AUA0000113605 [English]). The spare part control units are of type BCU-22. It can be used for replacing the BCU-02.
Reduced run

A “reduced run” function makes it possible to continue operation with one drive module if the other module is out of service, for example, because of maintenance work. In principle, reduced run is possible with only one module, but the physical requirements of operating the motor still apply; the remaining module in use must be able to provide the motor with enough magnetizing current.

- **Starting reduced run operation**

  **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. If the control unit is powered from the faulty module, connect the control unit to another 24 V DC power supply. We strongly recommend using an external power supply with parallel-connected drive modules.
  3. Disconnect all cables from the module to be serviced and remove it from its bay. See section Replacing the standard drive module and drive module with option “IP20 shrouds for covering the input and motor cabling area” on page 162 or section Replacing the drive module with option “Full power cabling panels to be attached to a cabinet (IP20)” on page 164.
  4. Switch on the power to the remaining drive module.
  5. Enter the number of drive modules present into parameter 95.13 Reduced run mode.
  6. Reset all faults and start the drive module. The maximum current is now automatically limited according to the new drive module configuration. A mismatch between the number of detected modules (95.14) and the value set in 95.13 will generate a fault.
  7. If the STO function is in use, validate it as described in chapter Safe torque off function (page 217).

- **Resuming normal operation**

  **WARNING!** Repeat the steps described in section Precautions before electrical work on page 18. If you ignore them, injury or death, or damage to the equipment can occur.

  1. Reinstall the module into its bay.
  2. Switch on the power to the drive module package.
  3. Enter “0” into parameter 95.13 Reduced run mode.
  4. If the STO function is in use, validate it as described in chapter Safe torque off function (page 217).
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/lvacdrivesengineeringsupport/content. For access, contact your local ABB representative.

• See the installation examples for Rittal cabinet tested by ABB in section Installing the roof and door (Rittal parts) on page 130 and in section Assembly drawing of installing the roof and door on page 145.

ACS-AP-W control panel

The control panel is not included with the drive module but must be ordered separately. One control panel is required for the commissioning of an ACS880 drive system, even if the Drive composer PC tool is used.

For more information on the control panel, see ACS-AP-x assistant control panels user’s manual (3AU00000085685 [English]). See also sections Control panel (page 39) and Controlling several drives from one control panel through panel bus (page 122).
The control panel can be mounted on the cabinet door with the help of a door mounting kit.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Ordering code</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS-AP-W</td>
<td>Control panel with Bluetooth</td>
<td>3AXD500000025965</td>
<td><img src="image" alt="ACS-AP-W Illustration" /></td>
</tr>
<tr>
<td>ACS-AP-I</td>
<td>Control panel with</td>
<td>3AUA0000088311</td>
<td><img src="image" alt="ACS-AP-I Illustration" /></td>
</tr>
<tr>
<td>DPMP-01</td>
<td>Door mounting kit for flush mounting. Includes a control panel mounting platform, an IP54 cover and a 3-meter panel connection cable.</td>
<td>3AUA0000108878</td>
<td><img src="image" alt="DPMP-01 Illustration" /></td>
</tr>
</tbody>
</table>

**Brake resistors**
See section *SAFUR resistors* on page 234.

**Output (du/dt) filters**
See section *du/dt filters* on page 237.

**Sine filters**
See section *Sine filters* on page 238.
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>
<th>Instruction code</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 mm / IP20</td>
<td>A-4-X-021</td>
<td>3AUA0000117002</td>
<td><img src="image1" alt="Air inlet kit 1" /></td>
<td>3AUA0000116879</td>
</tr>
<tr>
<td>400 mm / IP42</td>
<td>A-4-X-024</td>
<td>3AUA0000117007</td>
<td><img src="image2" alt="Air inlet kit 2" /></td>
<td>3AUA0000116873</td>
</tr>
<tr>
<td>400 mm / IP54</td>
<td>A-4-X-027</td>
<td>3AXD5000009184</td>
<td><img src="image3" alt="Air inlet kit 3" /></td>
<td>3AUX0000099889</td>
</tr>
<tr>
<td>Enclosure width / Degree of protection</td>
<td>Kit code</td>
<td>Ordering code</td>
<td>Illustration</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------</td>
<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><img src="image1" alt="Illustration" /></td>
<td></td>
</tr>
<tr>
<td>600 mm / IP42</td>
<td>A-6-X-025</td>
<td>3AUA0000117008</td>
<td><img src="image2" alt="Illustration" /></td>
<td></td>
</tr>
<tr>
<td>600 mm / IP54</td>
<td>A-6-X-028</td>
<td>3AXD50000009185</td>
<td><img src="image3" alt="Illustration" /></td>
<td></td>
</tr>
<tr>
<td>800 mm / IP20</td>
<td>A-8-X-023</td>
<td>3AUA0000117005</td>
<td><img src="image4" alt="Illustration" /></td>
<td></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>
<td>400 mm / IP20</td>
<td>1</td>
<td>A-4-X-062</td>
<td>3AUA0000125203</td>
<td><img src="image1.png" alt="Air outlet kit 1" /></td>
</tr>
<tr>
<td>800 mm / IP20</td>
<td>2</td>
<td></td>
<td></td>
<td><img src="image2.png" alt="Air outlet kit 2" /></td>
</tr>
<tr>
<td>600 mm / IP20</td>
<td>1</td>
<td>A-6-X-063</td>
<td>3AUA0000125204</td>
<td><img src="image3.png" alt="Air outlet kit 3" /></td>
</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>
<td>--------------</td>
</tr>
<tr>
<td>400 mm / IP42</td>
<td>1</td>
<td>A-4-X-060</td>
<td>3AUA0000114968</td>
<td><img src="image1" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Note: Fan to be ordered separately</td>
</tr>
<tr>
<td>800 mm / IP42</td>
<td>2</td>
<td></td>
<td></td>
<td><img src="image2" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Note: Fan to be ordered separately</td>
</tr>
<tr>
<td>600 mm / IP42</td>
<td>1</td>
<td>A-6-X-061</td>
<td>3AUA00001149789</td>
<td><img src="image3" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Note: Fan to be ordered separately</td>
</tr>
<tr>
<td>400 mm / IP54 (IEC)</td>
<td>1</td>
<td>A-4-X-064</td>
<td>3AXD50000009187</td>
<td><img src="image4" alt="Illustration" /></td>
</tr>
<tr>
<td>800 mm / IP54 (IEC)</td>
<td>2</td>
<td></td>
<td></td>
<td><img src="image5" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Note: Fan to be ordered separately</td>
</tr>
<tr>
<td>400 mm / IP54 (UL)</td>
<td>1</td>
<td>A-4-X-067</td>
<td>3AXD50000010362</td>
<td><img src="image6" alt="Illustration" /></td>
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<tr>
<td>800 mm / IP54 (UL)</td>
<td>2</td>
<td></td>
<td></td>
<td><img src="image7" alt="Illustration" /></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Note: Fan to be ordered separately</td>
</tr>
</tbody>
</table>
Cooling fans

One or two cooling fans are to be installed inside the air outlet compartment to ensure sufficient cooling of the cabinet.

### 600 mm / IP54

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Data</th>
<th>Qty</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan</td>
<td>RB4C-355/170</td>
<td>1</td>
<td>3AXD50000006934</td>
</tr>
<tr>
<td>Capacitor</td>
<td>MSB MKP 6/603/E1679</td>
<td>1</td>
<td>3AXD50000006959</td>
</tr>
<tr>
<td>Connector</td>
<td>SPB2,5/7 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD50000000723</td>
</tr>
<tr>
<td>Connector</td>
<td>SC 2.5-R27 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD50000000724</td>
</tr>
</tbody>
</table>

### 600 mm / IP54

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Data</th>
<th>Qty</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan</td>
<td>CRBB/4-400/188</td>
<td>1</td>
<td>3AXD50000006111</td>
</tr>
<tr>
<td>Capacitor</td>
<td>MSB MKP 12603/E1679</td>
<td>1</td>
<td>3AXD50000006885</td>
</tr>
<tr>
<td>Connector</td>
<td>SPB2,5/7 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD50000000723</td>
</tr>
<tr>
<td>Connector</td>
<td>SC 2.5-R27 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD50000000724</td>
</tr>
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### Ordering information

<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><strong>800 mm / IP54</strong></td>
<td>Fan: RB4C-355/170</td>
<td>2</td>
<td>3AXD50000006934</td>
</tr>
<tr>
<td></td>
<td>Capacitor: MSB MKP 6/603/E1679</td>
<td>2</td>
<td>3AXD50000006959</td>
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<tr>
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<td>Connector: SB2,5/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000723</td>
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<tr>
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<td>Connector: SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000724</td>
</tr>
<tr>
<td><strong>400 mm, 600 mm / IP20, IP42</strong></td>
<td>Fan: R2E225-RA92-17 (230 V)</td>
<td>1</td>
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<tr>
<td></td>
<td>Capacitor: MSB MKP 3,5/603/E1679</td>
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<tr>
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<td>Connector: SPB2,5/7 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD50000000723</td>
</tr>
<tr>
<td></td>
<td>Connector: SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD50000000724</td>
</tr>
<tr>
<td><strong>400 mm / IP54</strong></td>
<td>Fan: RB4C-355/170</td>
<td>1</td>
<td>3AXD50000006934</td>
</tr>
<tr>
<td></td>
<td>Capacitor: MSB MKP 6/603/E1679</td>
<td>1</td>
<td>3AXD50000000889</td>
</tr>
<tr>
<td></td>
<td>Connector: SPB2,5/7 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD50000000723</td>
</tr>
<tr>
<td></td>
<td>Connector: SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD50000000724</td>
</tr>
<tr>
<td><strong>600 mm / IP54</strong></td>
<td>Fan: CRBB/4-400/188</td>
<td>1</td>
<td>3AXD500000006111</td>
</tr>
<tr>
<td></td>
<td>Capacitor: MSB MKP 12/603/E1679</td>
<td>1</td>
<td>3AXD50000000888</td>
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<td>Connector: SPB2,5/7 (2.5 mm², 12AWG)</td>
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<td>3AXD50000000723</td>
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<tr>
<td></td>
<td>Connector: SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
<td>1</td>
<td>3AXD50000000724</td>
</tr>
<tr>
<td><strong>800 mm / IP20, IP42</strong></td>
<td>Fan: R2E225-RA92-17 (230 V)</td>
<td>2</td>
<td>3AXD50000000514</td>
</tr>
<tr>
<td></td>
<td>Capacitor: MSB MKP 3,5/603/E1679</td>
<td>2</td>
<td>3AXD50000000882</td>
</tr>
<tr>
<td></td>
<td>Connector: SPB2,5/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000723</td>
</tr>
<tr>
<td></td>
<td>Connector: SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000724</td>
</tr>
<tr>
<td><strong>800 mm / IP54</strong></td>
<td>Fan: RB4C-355/170</td>
<td>2</td>
<td>3AXD50000006934</td>
</tr>
<tr>
<td></td>
<td>Capacitor: MSB MKP 6/603/E1679</td>
<td>2</td>
<td>3AXD50000000889</td>
</tr>
<tr>
<td></td>
<td>Connector: SPB2,5/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000723</td>
</tr>
<tr>
<td></td>
<td>Connector: SC 2,5-RZ/7 (2.5 mm², 12AWG)</td>
<td>2</td>
<td>3AXD50000000724</td>
</tr>
</tbody>
</table>

**EMC filter ARFI-10**

Order code: 68241561

**FSO accessories kit**

<table>
<thead>
<tr>
<th>Kit code</th>
<th>Ordering code</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-X-X-279</td>
<td>3AXD50000025495</td>
<td><img src="image-url" alt="Illustration" /></td>
</tr>
</tbody>
</table>
## Accessory kits

<table>
<thead>
<tr>
<th>Kit</th>
<th>Ordering code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full size input cable connection terminals and PE busbar. Not to be used with full power cabling panels which are to be attached to a cabinet.</td>
<td>3AXD50000024518</td>
<td></td>
</tr>
<tr>
<td>Full size output cable connection terminals. Not to be used with full power cabling panels which are to be attached to a cabinet.</td>
<td>3AXD50000024519</td>
<td></td>
</tr>
<tr>
<td>For frame R10: Full power cabling panels to be attached to a cabinet (IP20)</td>
<td>3AXD50000024520</td>
<td></td>
</tr>
<tr>
<td>For frame R11: Full power cabling panels to be attached to a cabinet (IP20)</td>
<td>3AXD50000024561</td>
<td></td>
</tr>
<tr>
<td>Power cable connection terminals on the right-hand side of the drive module. Not to be used with full power cabling panels which are to be attached to a cabinet. Not to be used with flat mounting.</td>
<td>3AXD50000024562</td>
<td></td>
</tr>
<tr>
<td>Flat mounting. Not to be used with full power cabling panels which are to be attached to a cabinet. Not to be used with power cable connection terminals on the right-hand side of the drive module.</td>
<td>3AXD50000024563</td>
<td></td>
</tr>
<tr>
<td>For frame R10: IP20 shrouds for covering the input and motor cabling area. Not to be used with full power cabling panels which are to be attached to a cabinet.</td>
<td>3AXD50000024564</td>
<td></td>
</tr>
<tr>
<td>For frame R11: IP20 shrouds for covering the input and motor cabling area. Not to be used with full power cabling panels which are to be attached to a cabinet.</td>
<td>3AXD50000024564</td>
<td></td>
</tr>
</tbody>
</table>
Technical data

Contents of this chapter

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

Ratings

The ratings of the drive module packages with 50 Hz and 60 Hz supply are given below.

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Input current</th>
<th>Output ratings</th>
<th>Nominal use</th>
<th>Light-duty use</th>
<th>Heavy-duty use</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-04XT</td>
<td>1010A-3</td>
<td>2×R10</td>
<td>1010</td>
<td>1270</td>
<td>1441</td>
<td>1010</td>
</tr>
<tr>
<td></td>
<td>1160A-3</td>
<td>2×R10</td>
<td>1160</td>
<td>1343</td>
<td>1755</td>
<td>1190</td>
</tr>
<tr>
<td></td>
<td>1330A-3</td>
<td>2×R11</td>
<td>1330</td>
<td>1886</td>
<td>2024</td>
<td>1330</td>
</tr>
<tr>
<td></td>
<td>1610A-3</td>
<td>2×R11</td>
<td>1610</td>
<td>2024</td>
<td>2024</td>
<td>1610</td>
</tr>
<tr>
<td>U_N = 400 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1010A-5</td>
<td>2×R10</td>
<td>1010</td>
<td>1270</td>
<td>1441</td>
<td>1010</td>
</tr>
<tr>
<td></td>
<td>1160A-5</td>
<td>2×R10</td>
<td>1160</td>
<td>1343</td>
<td>1755</td>
<td>1160</td>
</tr>
<tr>
<td></td>
<td>1330A-5</td>
<td>2×R11</td>
<td>1330</td>
<td>1564</td>
<td>2024</td>
<td>1330</td>
</tr>
<tr>
<td></td>
<td>1610A-5</td>
<td>2×R11</td>
<td>1610</td>
<td>2024</td>
<td>2024</td>
<td>1610</td>
</tr>
</tbody>
</table>

The table above shows the technical specifications for different drive module packages with 50 Hz and 60 Hz supply. The ratings include input current, output ratings, nominal use, light-duty use, and heavy-duty use. The specifications are given for different frame sizes with corresponding input and output power ratings.
### IEC RATINGS

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Input current</th>
<th>Max. current</th>
<th>Output ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-04XT-</td>
<td>AAA A k W A k V A</td>
<td>I&lt;sub&gt;1&lt;/sub&gt;</td>
<td>I&lt;sub&gt;max&lt;/sub&gt;</td>
<td>I&lt;sub&gt;max_start&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>S&lt;sub&gt;n&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P&lt;sub&gt;Ld&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P&lt;sub&gt;ld&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P&lt;sub&gt;Hd&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P&lt;sub&gt;hd&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

#### NEMA RATINGS

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Input current</th>
<th>Max. current</th>
<th>Output ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-04XT-</td>
<td>AAA A k W A</td>
<td>I&lt;sub&gt;1&lt;/sub&gt;</td>
<td>I&lt;sub&gt;max&lt;/sub&gt;</td>
<td>I&lt;sub&gt;max_start&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
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<td>S&lt;sub&gt;n&lt;/sub&gt;</td>
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<td>P&lt;sub&gt;Ld&lt;/sub&gt;</td>
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<td>P&lt;sub&gt;ld&lt;/sub&gt;</td>
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<td></td>
<td></td>
<td></td>
<td>P&lt;sub&gt;Hd&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P&lt;sub&gt;hd&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

**Note:** To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. The power ratings apply to most IEC 34 motors at the nominal voltage of the drive. 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
- the minimum requirements of motor cable length are not met (see $du/dt$ filters (page 237) and Sine filters (page 238)).

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 for 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 238 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 recommended sine filters (see section Sine filters on page 238) and non-ABB Ex motors, contact ABB.

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Output ratings for special settings</th>
<th>Ex motor (ABB Ex motor)</th>
<th>ABB sine filter</th>
<th>Low noise mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nominal use</td>
<td>Light-duty use</td>
<td>Heavy-duty use</td>
<td>Nominal use</td>
</tr>
<tr>
<td></td>
<td>$I_N$</td>
<td>$P_N$</td>
<td>$I_{Nd}$</td>
<td>$I_H$</td>
</tr>
<tr>
<td>$U_N = 400$ V</td>
<td>A</td>
<td>kW</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>1010A-3</td>
<td>958</td>
<td>435</td>
<td>677</td>
<td>499</td>
</tr>
<tr>
<td>1190A-3</td>
<td>1126</td>
<td>580</td>
<td>795</td>
<td>587</td>
</tr>
<tr>
<td>1330A-3</td>
<td>1127</td>
<td>653</td>
<td>867</td>
<td>646</td>
</tr>
<tr>
<td>1610A-3</td>
<td>1489</td>
<td>828</td>
<td>1049</td>
<td>828</td>
</tr>
<tr>
<td>$U_N = 500$ V</td>
<td>1010A-5</td>
<td>924</td>
<td>618</td>
<td>886</td>
</tr>
<tr>
<td>1160A-5</td>
<td>1065</td>
<td>736</td>
<td>1018</td>
<td>771</td>
</tr>
<tr>
<td>1310A-5</td>
<td>1209</td>
<td>828</td>
<td>1179</td>
<td>760</td>
</tr>
<tr>
<td>1610A-5</td>
<td>1413</td>
<td>920</td>
<td>1374</td>
<td>1093</td>
</tr>
<tr>
<td>$U_N = 690$ V</td>
<td>0810A-7</td>
<td>712</td>
<td>669</td>
<td>693</td>
</tr>
<tr>
<td>0960A-7</td>
<td>793</td>
<td>736</td>
<td>767</td>
<td>681</td>
</tr>
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<td>1080A-7</td>
<td>892</td>
<td>828</td>
<td>865</td>
<td>826</td>
</tr>
<tr>
<td>1320A-7</td>
<td>1091</td>
<td>920</td>
<td>1056</td>
<td>883</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.
- $I_{Nd}$: Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
- $P_{Nd}$: Typical motor power for light-overload use.
- $I_{H}$: Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
- $P_{H}$: Continuous rms output current allowing 40% overload for 1 minute every 5 minutes
- $I_{Hd}$: Continuous rms output current allowing 45% overload for 1 minute every 5 minutes
- $P_{Hd}$: Continuous rms output current allowing 44% overload for 1 minute every 5 minutes
- *** Continuous rms output current allowing 44% 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. We recommend 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 the 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 type</th>
<th>ACS880-04XT-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deratings with selection High speed mode of parameter 95.15 Special HW settings</td>
<td></td>
</tr>
<tr>
<td>120 Hz output frequency</td>
<td>Maximum output frequency</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>1010A-3</td>
<td>120</td>
</tr>
<tr>
<td>1190A-3</td>
<td>120</td>
</tr>
<tr>
<td>1330A-3</td>
<td>120</td>
</tr>
<tr>
<td>1610A-3</td>
<td>120</td>
</tr>
<tr>
<td>$U_N=500$ V</td>
<td></td>
</tr>
<tr>
<td>1010A-5</td>
<td>120</td>
</tr>
<tr>
<td>1160A-5</td>
<td>120</td>
</tr>
<tr>
<td>1310A-5</td>
<td>120</td>
</tr>
<tr>
<td>1610A-5</td>
<td>120</td>
</tr>
<tr>
<td>$U_N=690$ V</td>
<td></td>
</tr>
<tr>
<td>0810A-7</td>
<td>120</td>
</tr>
<tr>
<td>0960A-7</td>
<td>120</td>
</tr>
<tr>
<td>1080A-7</td>
<td>120</td>
</tr>
<tr>
<td>1320A-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 45 °C (110 °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
- $I_{Hd}$: Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
- $^*$: Continuous rms output current allowing 40% overload for 1 minute every 5 minutes
Modules used

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Drive module</th>
<th>Qty</th>
<th>size</th>
</tr>
</thead>
<tbody>
<tr>
<td>U_N = 400 V</td>
<td>ACS880-04XT-1010A-3</td>
<td>ACS880-04-585A-3+P943</td>
<td>2×R10</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1190A-3</td>
<td>ACS880-04-650A-3+P943</td>
<td>2×R10</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1330A-3</td>
<td>ACS880-04-725A-3+P943</td>
<td>2×R11</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1610A-3</td>
<td>ACS880-04-880A-3+P943</td>
<td>2×R11</td>
</tr>
<tr>
<td>U_N = 500 V</td>
<td>ACS880-04XT-1010A-5</td>
<td>ACS880-04-583A-5+P943</td>
<td>2×R10</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1160A-5</td>
<td>ACS880-04-635A-5+P943</td>
<td>2×R10</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1310A-5</td>
<td>ACS880-04-715A-5+P943</td>
<td>2×R11</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1610A-5</td>
<td>ACS880-04-880A-5+P943</td>
<td>2×R11</td>
</tr>
<tr>
<td>U_N = 690 V</td>
<td>ACS880-04XT-0810A-7</td>
<td>ACS880-04-430A-7+P943</td>
<td>2×R10</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-0960A-7</td>
<td>ACS880-04-522A-7+P943</td>
<td>2×R11</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1080A-7</td>
<td>ACS880-04-590A-7+P943</td>
<td>2×R11</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1320A-7</td>
<td>ACS880-04-721A-7+P943</td>
<td>2×R11</td>
</tr>
</tbody>
</table>

Fuses (IEC)

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

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Input current (A)</th>
<th>A</th>
<th>A^s</th>
<th>V</th>
<th>Type DIN 43620</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>U_N = 400 V</td>
<td>ACS880-04XT-1010A-3</td>
<td>1010</td>
<td>1250</td>
<td>2 150 000</td>
<td>690</td>
<td>170M8554D</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1190A-3</td>
<td>1190</td>
<td>1250</td>
<td>2 150 000</td>
<td>690</td>
<td>170M8554D</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1330A-3</td>
<td>1330</td>
<td>1600</td>
<td>4 150 000</td>
<td>690</td>
<td>170M8557D</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1610A-3</td>
<td>1610</td>
<td>1600</td>
<td>4 150 000</td>
<td>690</td>
<td>170M8557D</td>
</tr>
<tr>
<td>U_N = 500 V</td>
<td>ACS880-04XT-1010A-5</td>
<td>1010</td>
<td>1250</td>
<td>2 150 000</td>
<td>690</td>
<td>170M8554D</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1160A-5</td>
<td>1160</td>
<td>1250</td>
<td>2 150 000</td>
<td>690</td>
<td>170M8554D</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1310A-5</td>
<td>1310</td>
<td>1600</td>
<td>4 150 000</td>
<td>690</td>
<td>170M8557D</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1610A-5</td>
<td>1610</td>
<td>1600</td>
<td>4 150 000</td>
<td>690</td>
<td>170M8557D</td>
</tr>
<tr>
<td>U_N = 690 V</td>
<td>ACS880-04XT-0810A-7</td>
<td>810</td>
<td>1000</td>
<td>985 000</td>
<td>690</td>
<td>170M8614D</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-0960A-7</td>
<td>960</td>
<td>1250</td>
<td>2 150 000</td>
<td>690</td>
<td>170M8555D</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1080A-7</td>
<td>1080</td>
<td>1400</td>
<td>2 700 000</td>
<td>690</td>
<td>170M8555D</td>
</tr>
<tr>
<td></td>
<td>ACS880-04XT-1320A-7</td>
<td>1320</td>
<td>1500</td>
<td>3 300 000</td>
<td>690</td>
<td>170M8556D</td>
</tr>
</tbody>
</table>

Note 1: See also Implementing thermal overload and short-circuit protection on page 83.

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.
Fuses (UL)

UL fuses for branch circuit protection per NEC per drive module 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 per drive module</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-04XT-</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Uₜₑₙ = 400 V</td>
<td>1010</td>
<td>800</td>
</tr>
<tr>
<td>1160A-3</td>
<td>1160</td>
<td>800</td>
</tr>
<tr>
<td>1520A-3</td>
<td>1520</td>
<td>800</td>
</tr>
<tr>
<td>1610A-3</td>
<td>1610</td>
<td>1000</td>
</tr>
<tr>
<td>Uₜₑₙ = 500 V</td>
<td>1010</td>
<td>800</td>
</tr>
<tr>
<td>1160A-5</td>
<td>1160</td>
<td>800</td>
</tr>
<tr>
<td>1520A-5</td>
<td>1520</td>
<td>800</td>
</tr>
<tr>
<td>1610A-5</td>
<td>1610</td>
<td>1000</td>
</tr>
<tr>
<td>Uₜₑₙ = 690 V</td>
<td>0810</td>
<td>810</td>
</tr>
<tr>
<td>0960A-7</td>
<td>890</td>
<td>600</td>
</tr>
<tr>
<td>1080A-7</td>
<td>1080</td>
<td>600</td>
</tr>
<tr>
<td>1320A-7</td>
<td>1320</td>
<td>800</td>
</tr>
</tbody>
</table>

Note 1: See also Implementing thermal overload and short-circuit protection on page 83.
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.

Dimensions, weights and free space requirements

### Drive module with option "IP20 shrouds for covering the input and motor cabling area"

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
<th>Weight*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>in</td>
<td>mm</td>
<td>kg</td>
</tr>
<tr>
<td>R10</td>
<td>1941</td>
<td>76.5</td>
<td>14.5</td>
<td>2.19</td>
</tr>
<tr>
<td>R11</td>
<td>1741</td>
<td>68.5</td>
<td>14.5</td>
<td>1.99</td>
</tr>
</tbody>
</table>

### Standard drive module configuration

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
<th>Weight*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>in</td>
<td>mm</td>
<td>kg</td>
</tr>
<tr>
<td>R10</td>
<td>1462</td>
<td>57.5</td>
<td>12.01</td>
<td>0.22</td>
</tr>
<tr>
<td>R11</td>
<td>1662</td>
<td>65.43</td>
<td>12.01</td>
<td>0.22</td>
</tr>
</tbody>
</table>

### Option "Full power cabling panels to be attached to a cabinet (IP20)"

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
<th>Weight*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>in</td>
<td>mm</td>
<td>kg</td>
</tr>
<tr>
<td>R10</td>
<td>1590</td>
<td>62.62</td>
<td>12.96</td>
<td>0.23</td>
</tr>
<tr>
<td>R11</td>
<td>1740</td>
<td>68.52</td>
<td>12.96</td>
<td>0.23</td>
</tr>
</tbody>
</table>

* approximate (depends on the selected options)
The weight of the cabling panels of option “Full power cabling panels to be attached to a cabinet (IP20)” is 30 kg (66 lb).

Additional depth with option “Flat mounting” when the mounting brackets are used: 18.5 mm (0.73 in.)

For requirements of free space around the drive module, see page 60.

**Losses, cooling data and noise**

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Frame size</th>
<th>Air flow per drive module</th>
<th>Heat dissipation per drive module</th>
<th>Noise Drive module</th>
<th>Noise Drive (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>m³/h</td>
<td>ft³/min</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td><strong>U_N = 400 V</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACS880-04XT-1010A-3</td>
<td>2×R10</td>
<td>1200</td>
<td>707</td>
<td>6409</td>
<td>72</td>
</tr>
<tr>
<td>ACS880-04XT-1100A-3</td>
<td>2×R10</td>
<td>1200</td>
<td>707</td>
<td>8122</td>
<td>72</td>
</tr>
<tr>
<td>ACS880-04XT-1330A-3</td>
<td>2×R11</td>
<td>1200</td>
<td>707</td>
<td>8764</td>
<td>72</td>
</tr>
<tr>
<td>ACS880-04XT-1630A-3</td>
<td>2×R11</td>
<td>1420</td>
<td>848</td>
<td>10578</td>
<td>71</td>
</tr>
<tr>
<td><strong>U_N = 500 V</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACS880-04XT-1010A-5</td>
<td>2×R10</td>
<td>1200</td>
<td>707</td>
<td>6409</td>
<td>72</td>
</tr>
<tr>
<td>ACS880-04XT-1100A-5</td>
<td>2×R10</td>
<td>1200</td>
<td>707</td>
<td>8122</td>
<td>72</td>
</tr>
<tr>
<td>ACS880-04XT-1310A-5</td>
<td>2×R11</td>
<td>1200</td>
<td>707</td>
<td>8764</td>
<td>72</td>
</tr>
<tr>
<td>ACS880-04XT-1610A-5</td>
<td>2×R11</td>
<td>1420</td>
<td>848</td>
<td>10578</td>
<td>71</td>
</tr>
<tr>
<td><strong>U_N = 690 V</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACS880-04XT-0810A-7</td>
<td>2×R10</td>
<td>1200</td>
<td>707</td>
<td>6409</td>
<td>72</td>
</tr>
<tr>
<td>ACS880-04XT-0960A-7</td>
<td>2×R11</td>
<td>1200</td>
<td>707</td>
<td>8764</td>
<td>72</td>
</tr>
<tr>
<td>ACS880-04XT-1080A-7</td>
<td>2×R11</td>
<td>1200</td>
<td>848</td>
<td>9862</td>
<td>72</td>
</tr>
<tr>
<td>ACS880-04XT-1320A-7</td>
<td>2×R11</td>
<td>1420</td>
<td>848</td>
<td>10578</td>
<td>71</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 lead-through data for the power cables**

- **Standard drive module configuration**
  
  It is possible to use the maximum cable size (4 × (3 × 240) mm² or 4 × [(3 × 500 AWG)]) only with special cable lugs and additional insulation. For more information, contact your local ABB representative.

- **Drive modules with full-size cable connection terminals (options)**
  
  The maximum accepted cable size is 4 × (3 × 240) mm² or 4 × (3 × 500 AWG). Screw size for connecting busbars to the drive module input and output busbars: M12, tightening torque 50...75 N·m.

- **Drive modules with option “Full power cabling panels to be attached to a cabinet (IP20)”**
  
  The maximum accepted cable size is 4 × (3 × 240) mm² or 4 × (3 × 500 AWG). The cabling panels are connected to the drive module busbars with M12 serrpress nuts, tightening torque 30 N·m (20 lbf·ft).
Input, motor and brake resistor cable terminal sizes and tightening torques are given below.

<table>
<thead>
<tr>
<th>Screw</th>
<th>Tightening torque</th>
<th>Screw</th>
<th>Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12</td>
<td>50...75</td>
<td>M10</td>
<td>30...44</td>
</tr>
<tr>
<td>1/2</td>
<td>37...55</td>
<td>3/8</td>
<td>22...32</td>
</tr>
</tbody>
</table>

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

Terminal data for the control cables

See page 108.

Electrical power network specification

Voltage \( (U_1) \)

ACS880-04XT-xxxx-3 drives: 380...415 V AC 3-phase +10%/-15%. This is indicated in the type designation label as typical input voltage level 3...400 V AC.

ACS880-04XT-xxxx-5 drives: 380...500 V AC 3-phase +10%/-15%. This is indicated in the type designation label as typical input voltage levels 3...400/480/500 V AC.

ACS880-04XT-xxxx-7 drives: 525...690 V AC 3-phase +10%/-15%. This is indicated in the type designation label as typical input voltage levels 3...525/600/690 V AC.

Network type

TN (grounded) and IT (ungrounded) systems

Short-circuit withstand strength \( I_{cc} \) (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 83.

Short-circuit current protection (UL 508A)

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 by the 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 100 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 the nominal frequency.

Imbalance

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

0.98 (at nominal load)

Transformer for 12-pulse supply

According to IEC60076-1:2011

Connection: Dy 11 d0 or Dyn 11 d0

Phase shift between secondaries: 30° electrical

Voltage difference between secondaries: < 0.5%

Short-circuit impedance of secondaries: > 5%

Short-circuit impedance difference between secondaries: <10% of the percentage impedance

No grounding of the secondaries allowed. Static shield recommended
Technical data   189

Motor connection data

Motor types
Asynchronous AC induction motors, permanent magnet motors and AC induction servomotors.

Voltage ($U_2$)
0...$U_1$, 3-phase symmetrical, $U_{\text{max}}$ at the field weakening point

Frequency resolution
0.01 Hz

Current
See section Ratings.

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

For drives with du/dt filter: 200 Hz
For drives with sine filter: 120 Hz

Switching frequency
3 kHz (typically)

Maximum recommended motor cable length

<table>
<thead>
<tr>
<th></th>
<th>DTC control</th>
<th>Scalar control</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 m (984 ft)</td>
<td>300 m (984 ft)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Motor cable longer than 100 m (328 ft) is allowed but then the EMC Directive requirements of Category C3 may not be fulfilled.

Minimum allowed motor cable length
For drive modules without du/dt filter: 2 m (7 ft) from each drive module to the motor or 4 m (13 ft) between the drive modules. The motor cabling must be symmetrical. See also section When is a du/dt filter needed? on page 237.

Brake resistor connection data
See page 229.

Control unit connection data (BCU-02)

BCU-02/12/22 control units hardware manual (3AUAG0000113605 [English])

Control panel type
ACS-AP-I assistant control panel

Efficiency
Approximately 98% at nominal power level

Protection classes

Degree of protection (IEC/EN 60529)
IP20.

With option "IP20 shrouds for covering the input and motor cabling area":
IP20, requires installation of bottom grille.

With option "Full power cabling panels to be attached to a cabinet (IP20)":
IP20.

Enclosure type (UL 508C)
UL Open Type

Overvoltage category (IEC 60664-1)
III
## Ambient conditions

Environmental limits for the drive are given below. The drive is to be used in a heated, indoor, controlled environment.

<table>
<thead>
<tr>
<th>Operation installed for stationary use</th>
<th>Storage in the protective package</th>
<th>Transportation in the protective package</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Installation site altitude</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>For TN and TT neutral-grounded network systems and IT non-corner grounded network systems: 0 to 4000 m (13123 ft) above sea level</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>For TN, TT and IT corner-grounded network systems: 0 to 2000 m (6561 ft) above sea level</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Output derated above 1000 m (3281 ft), see page 181</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

| **Surrounding air temperature**          | -                                 | -                                        |
| -15 to +55 °C (5 to 131 °F) No condensation allowed. | -                                 | -                                        |
| Output derated in the range +40 ... +55 °C (+104 ... +131 °F). See page 181. | -                                 | -                                        |
| -40 to +70 °C (-40 to +158 °F) | -                                 | -                                        |

| **Relative humidity**                   | 5 to 95%                           | Max. 95%                                 |
| No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases. | Max. 95%                           | Max. 95%                                 |

| **Contamination levels**                | 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 | IEC 60721-3-1:1997 | IEC 60721-3-2:1997 |
| Chemical gases                          | Class 3C2                          | Class 1C2                                | Class 2C2                                      |
| Solid particles                         | Class 3S2. No conductive dust allowed. | Class 1S3. (packing must support this, otherwise 1S2) | Class 2S2                                      |

| **Pollution degree**                    | 2                                 |                                          |

| **Atmospheric pressure**                | 70 to 106 kPa 0.7 to 1.05 atmospheres | 70 to 106 kPa 0.7 to 1.05 atmospheres | 60 to 106 kPa 0.6 to 1.05 atmospheres |

| **Vibration**                           | IEC 60068-2-6:2007, EN 60068-2-6:2008 Environmental testing Part 2: Tests – Test Fc: Vibration (sinusoidal) | Max. 0.1 mm (0.004 in.) (10 to 57 Hz), max. 10 m/s² (33 ft/s²) (57 to 150 Hz) sinusoidal | Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s² (23 ft/s²) (13.2 to 100 Hz) sinusoidal |
|                                         |                                   | Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s² (49 ft/s²), (9 to 200 Hz) sinusoidal | Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s² (49 ft/s²), (9 to 200 Hz) sinusoidal |
Technical data

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

Package
Plywood and cardboard, bands PP. The package of one drive module is shown below.

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.

- EN 61800-5-1:2007 Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy
- - emergency-stop device
- - supply disconnecting device
- - IP00 drive module into a cabinet.
- CSA-C22.2 No. 9-10 General Requirements - Canadian Electrical Code, Part II
- CSA C22.2 No. 14-13 Industrial Control Equipment
- CSA C22.2 No. 274-13 Adjustable speed drives
CE marking

A CE mark is attached to the drive to verify that the unit follows the provisions of the European Low Voltage and EMC. The CE marking also verifies that the drive, in regard to its safety functions (such as Safe torque off), conforms with the Machinery Directive as a safety component.

- **Compliance with the European Low Voltage Directive**
  The compliance with the European Low Voltage Directive has been verified according to standards EN 60204-1 and EN 61800-5-1.

- **Compliance with the European EMC Directive**
  The cabinet builder is in charge for the compliance of the drive with the European EMC Directive. For information on items to consider, see section *Compliance with EN 61800-3:2004* on page 195.

**Compliance with the European Machinery Directive**

The drive is an electronic product which is covered by the European Low Voltage Directive. However, the drive includes the Safe torque off function and can be equipped with other safety functions for machinery which, as safety components, are in the scope of the Machinery Directive. These functions of the drive comply with European harmonized standards such as EN 61800-5-2. The declaration of conformity is shown below.
Declaration of Conformity

EU Declaration of Conformity
Machinery Directive 2006/42/EC

We, ABB Oy, Homovie 13, 00380 Helsinki, Finland, declare under our sole responsibility that the following products:

Frequency converters and frequency converter components
- ACS880-04, -14, -34 (frames nxR8i)
- ACS880-041T (frames 2xR10 and 2xR11)
- ACS880-07
- ACS880-17, -37 (frames nxR8i: 380V – 690V; frame R11: 380V – 525V)
- ACS880-104, -107
- ACS880 multidrives

are identified with serial numbers beginning with 1 or 8

with regard to the safety functions:
- Safe torque off
- Safe motor temperature with FPTEC-01 module (option code +L536)
- Safe stop 1, Safe stop emergency, Safety-limited speed, Safe maximum speed, Safe brake control, Prevention of unexpected start-up, with FSO-12 module (option code +2G73)
- Safe stop 1, Safe stop emergency, Safety-limited speed, Safe maximum speed, Safe brake control, Safe Speed monitor, Safe direction, Prevention of unexpected start-up, with FSO-21 and F39E-01 modules (option codes +Q972 and +L5321)

ACS880-07, -17, -37 and ACS880 multidrives: Prevention of unexpected start-up (option codes +Q955, +Q957), Emergency stop (option codes +Q951, +Q952, +Q956, +Q964, +Q978, +Q979), Safety-limited speed (option codes +Q965, Q966)

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

3AXD10000105027 1.2
The following harmonized standards have been applied:

<table>
<thead>
<tr>
<th>Standard/Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 61800-5-2:2007</td>
<td>Adjustable speed electrical power drive systems – Part 5-2: Safety</td>
</tr>
<tr>
<td></td>
<td>requirements – Functional</td>
</tr>
<tr>
<td>EN ISO 13849-1:2006</td>
<td>Safety of machinery – Functional safety of safety-related electrical</td>
</tr>
<tr>
<td></td>
<td>electronic and programmable electronic control systems</td>
</tr>
<tr>
<td>EN ISO 13849-2:2012</td>
<td>Safety of machinery – Safety-related parts of control systems. Part 2:</td>
</tr>
<tr>
<td></td>
<td>General principles for design</td>
</tr>
<tr>
<td>EN ISO 13849-2:2012</td>
<td>Validation</td>
</tr>
<tr>
<td></td>
<td>requirements</td>
</tr>
<tr>
<td></td>
<td>safety-related systems</td>
</tr>
</tbody>
</table>

The products referred in this Declaration of conformity fulfill the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AXD100000497365.

Person authorized to compile the technical file:

Name and address: Vesa Tihonen, Hiomiotie 13, 00380 Helsinki, Finland.

Helsinki, 25 Apr 2017

[Signature]

Manufacturer representative: Peter Lindgren
Vice President, ABB Oy
Compliance with 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 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 ARFI-10 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 +E200, +E201 or +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 marking

Drive modules are cULus Listed.

UL checklist

- 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 the enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.
- The maximum surrounding 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 by the UL fuses given in the table on page 196. The ampere rating is based on tests done according to the appropriate UL standard.
• The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
• Integral solid state short circuit protection does not provide branch circuit protection. The input cable must be protected with fuses. Suitable IEC fuses are listed on page 185 and UL classified fuses on page 186. These fuses provide branch circuit protection in accordance with the National Electrical Code (NEC) and Canadian Electrical Code. For installation in the United States, also obey any other applicable local codes. For installation in Canada, also obey any applicable provincial codes.

  Note: Circuit breakers must not be used without fuses in the USA. See page 83 for suitable circuit breakers.

• The drive provides motor overload protection. For the adjustments, see the firmware manual.
• For drive overvoltage category, see page 189. For pollution degree, see page 190.

**CSA marking**

Drive modules are CSA marked.

**China RoHS marking**

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. The green mark is attached to the drive to verify that it 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.

**RCM marking**

RCM marking is required in Australia and New Zealand. An RCM mark is attached to the drive modules to verify compliance with the relevant standard (IEC 61800-3:2004), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

For fulfilling the requirements of the standard, see section *Compliance with EN 61800-3:2004* on page 195.

**WEEE marking**

The drive is marked with the wheelie bin symbol. It indicates that at the end of life the drive should enter the recycling system at an appropriate collection point and not placed in the normal waste stream. See section *Disposal* on page 191.

**EAC (Eurasian Conformity) marking**

The drive has EAC certification. EAC marking is required in Russia, Belarus and Kazakhstan.
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.
R10 with option +D150
R10 with options “Full size input and output cable connection terminals and PE busbar” and “IP20 shrouds for covering the input and motor cabling area”
R10 with options “Full size input and output cable connection terminals and PE busbar” and “Power cable connection terminals on the right-hand side of the drive module”
R10 with option “Full power cabling panels”
R10 with option “Full power cabling panels to be attached to a cabinet (IP20)” installed into a Rittal TS 8 cabinet
R10 with option “Flat mounting”
R11 with option +D150
R11 with options “Full size input and output cable connection terminals and PE busbar” and “IP20 shrouds for covering the input and motor cabling area”
R11 with options “Full size input and output cable connection terminals and PE busbar” and “Power cable connection terminals on the right-hand side of the drive module”
R11 with option “Full power cabling panels”
Frame R11 with option “Full power cabling panels to be attached to a cabinet (IP20) installed into a Rittal TS 8 cabinet”
R11 with option “Flat mounting”
Bottom plate for option “Full power cabling panels to be attached to a cabinet (IP20)” in Rittal TS 8 400 mm wide cabinet installation

Note: The bottom plate is not an ABB part.
Air baffles for the drive module with options “IP20 shrouds for covering the input and motor cabling area” and “Flat mounting”

This drawing shows the dimensions of the hole in the air baffle around the drive module. The drawing also shows the correct vertical location area of the air baffle as measured from the top grill.
Air baffles for option “Full power cabling panels to be attached to a cabinet (IP20)” in Rittal TS 8 400 mm wide cabinet installation

Note: These air baffles are not ABB parts.

External control unit

See BCU-02/12/22 control units hardware manual (3UA0000113605 [English]).
Example circuit diagram

Contents of this chapter
This chapter shows an example circuit diagram for a cabinet-installed drive module package.
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 (* option, ** to be acquired by the customer).

For BCU input and output signals, see page 116.

24 V DC supply

Common mode filter

*du/dt filter or sine filter

Common mode filter

Drive module

*Brake resistor

Motor

Cabinet

ACS-CP-I control panel

Switch fuse disconnector

Main contactor

Supply

Alarm

360 degree grounding recommended

For BCU input and output signals, see page 116.
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, 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>IEC 60204-1:2016</td>
<td></td>
</tr>
<tr>
<td>IEC 61326-3-1:2008</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>IEC 61800-5-2:2016</td>
<td>Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional</td>
</tr>
<tr>
<td>EN 61800-5-2:2007</td>
<td></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>


- **Compliance with the European Machinery Directive**

  See section Compliance with the European Machinery Directive on page 192. See Electrical planning instructions for ACS880 multidrive cabinets and modules (3AUA0000102324 [English]).
Wiring

The following diagrams present examples of Safe torque off wiring for
- Drive unit (two drive modules, internal power supply) on page 220
- Drive unit, single channel STO connection on page 221
- Drive unit (two drive modules, external power supply) on page 222.

See also section Overview of power and control connections (page 39).

For information on the specifications of the STO input, see BCU-02/12/22 control units hardware manual (3AU0000119605 [English]).

- 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 module documentation.

- Cable types and lengths
  We recommend double-shielded twisted-pair cable (see page 81).

Maximum cable lengths:
- 300 m (984 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.
Safe torque off function

Drive unit (two drive modules, internal power supply)
**Drive unit, single channel STO connection**

- Both STO inputs (IN1, IN2) must be connected to the activation switch. Otherwise, no SIL/PL classification is given.
- Pay special attention to avoiding any potential failure modes for the wiring. For example, use shielded cable. For measures for fault exclusion of wiring, see e.g. EN ISO 13849-2:2012, table D.4.
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 drive 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 a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a new start command is required to start the drive.
Safe torque off function

**Note:** If the Safe torque off function is not used, close the circuit as shown below. The drive will not start, if the circuit is not closed.

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 an FSO-xx safety functions module or an FPTC-0x module is installed, refer to its documentation.

<table>
<thead>
<tr>
<th>Action</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>WARNING!</td>
<td>Follow the safety instructions given in Safety instructions for ACS880 multistage cabinets and modules (3AU40000102301 [English]). Ignoring the instructions can cause physical injury or death, or damage to the equipment.</td>
</tr>
</tbody>
</table>

Ensure that the drive can be run and stopped freely during start-up.

Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.

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 drive’s operation. The motor should not start.
  - Close the STO circuit.
  - Reset any active faults. Restart the drive and check that the motor runs normally.

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

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

1. Open the activation switch, or activate the safety functionality that is wired to the STO connection.
2. STO inputs on the drive control unit de-energize, and the drive control unit cuts off the control voltage from the drive 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 a stop (if running). The drive will not restart while the activation switch or safety relay contacts are open.
5. Deactivate the STO by closing the activation switch, or resetting the safety functionality that is wired to the STO connection.
6. Reset any faults before restarting.

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

**WARNING!** (With permanent magnet 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 $180/p$ (with permanent magnet motors) or $180/2p$ (with synchronous reluctance [SynRM] motors) degrees regardless of the activation of the Safe torque off function. $p$ denotes the number of pole pairs.

Notes:

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

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 5 or 2 years; see section Safety data (page 227). 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 224).

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 224.

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, will trigger 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

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

### 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>HFT</td>
<td>IEC 61508</td>
<td>Hardware fault tolerance</td>
</tr>
<tr>
<td>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>PFH</td>
<td>IEC 61508</td>
<td>Average frequency of dangerous failures per hour</td>
</tr>
<tr>
<td>PFDavg</td>
<td>IEC 61508</td>
<td>Average probability of dangerous failures on demand</td>
</tr>
<tr>
<td>SIL CL</td>
<td>IEC 61508</td>
<td>Safety integrity level CL</td>
</tr>
<tr>
<td>SIL</td>
<td>IEC 61508</td>
<td>Safety integrity level</td>
</tr>
<tr>
<td>SFF</td>
<td>IEC 61508</td>
<td>Safety function failure probability (SFF)</td>
</tr>
<tr>
<td>PFD</td>
<td>IEC 61508</td>
<td>Probability of dangerous failure (PFD)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frame size</th>
<th>SIL/ SIL CL</th>
<th>SC</th>
<th>PL</th>
<th>SFF (%)</th>
<th>PFDavg (T1 = 2 years)</th>
<th>PFDavg (T1 = 5 years)</th>
<th>PFDavg (T1 = 20 years)</th>
<th>MTTFd (years)</th>
<th>DC (%)</th>
<th>Cat.</th>
<th>HFT (%)</th>
<th>CCF (%)</th>
<th>Lifetime (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2×R11, 2×R11</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>99</td>
<td>1.03E-06</td>
<td>2.56E-06</td>
<td>1.17E-10</td>
<td>16210</td>
<td>2&lt;6</td>
<td>1</td>
<td>85</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

- The following temperature profile is used in safety value calculations:
228  Safe torque off function

<table>
<thead>
<tr>
<th>Abbr.</th>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL</td>
<td>EN ISO 13849-1</td>
<td>Performance level. Levels a…e correspond to SIL</td>
</tr>
<tr>
<td>SC</td>
<td>IEC 61508</td>
<td>Systematic capability</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>
<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. Note that any T1 values given cannot be regarded as a guarantee or warranty. See also section Maintenance on page 226.</td>
</tr>
</tbody>
</table>
Resistor braking

Contents of this chapter
This chapter describes how to select, protect and wire brake choppers and resistors. The chapter also contains the technical data.

Operation principle and hardware description
The dive can be equipped with optional built-in brake chopper (+D150). Brake resistors are available as add-on kits.

The brake chopper handles the energy generated by a decelerating motor. The chopper connects the brake resistor to the intermediate DC circuit whenever the voltage in the circuit exceeds the limit defined by the control program. Energy consumption by the resistor lowers the voltage until the resistor can be disconnected.

Planning the braking system

- **Selecting the default brake circuit components**
  1. Calculate the maximum power generated by the motor during braking ($P_{\text{max}}$).
  2. Select a suitable drive, brake chopper and brake resistor combination for the application from the *Ratings* table on page 234. The braking power of the chopper must be greater or equal than the maximum power generated by the motor during the braking.
  3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the resistor heat dissipation capacity $E_R$.

  **Note:** If the $E_R$ value is not sufficient, it is possible to use a four-resistor assembly in...
Resistor braking

which two standard resistors are connected in parallel, two in series. The $E_R$ value of
the four-resistor assembly is four times the value specified for the standard resistor.
Note: Both drive modules must have own brake resistors. A common brake resistor is
not allowed.

Selecting a custom resistor

If you use a resistor other than the default resistor, make sure that:

1. The resistance of the custom resistor is greater or equal than the resistance of the
default resistor in the Ratings table on page 234:

$$ R \geq R_{\text{min}} $$

where

- $R$: Resistance of the custom resistor.
- $R_{\text{min}}$: Resistance of the default resistor

### WARNING!

Never use a brake resistor with a resistance smaller than $R_{\text{min}}$.
The drive and the chopper are not able to handle the overcurrent caused by
the low resistance.

2. The load capacity of the custom resistor is higher than the instantaneous maximum
power consumption of the resistor when it is connected to the drive DC link voltage by
the chopper:

$$ P_i > \frac{U_{\text{DC}}^2}{R} $$

where

- $P_i$: Load capacity of the custom resistor
- $U_{\text{DC}}$: Drive DC link voltage.
  - 1.35 · 1.25 · 415 V DC (when supply voltage is 380 to 415 V AC)
  - 1.35 · 1.25 · 500 V DC (when supply voltage is 440 to 500 V AC) or
  - 1.35 · 1.25 · 690 V DC (when supply voltage is 525 to 690 AC)
- $R$: Resistance of the custom resistor
Resistor braking

Selecting and routing the external brake resistor cables
Use the same cable type for the resistor cabling as for the drive input cabling to ensure that the input fuses also protect the resistor cable. Alternatively, a two conductor shielded cable with the same cross-sectional area can be used.

Minimizing electromagnetic interference
Obey these rules in order to minimize electromagnetic interference caused by the rapid current changes in the resistor cables:
• Shield the braking power line completely, either by using shielded cable or a metallic enclosure. Unshielded single-core cable can only be used if it is routed inside a cabinet that efficiently suppresses the radiated emissions.
• Install the cables away from other cable routes.
• Avoid long parallel runs with other cables. The minimum parallel cabling separation distance should be 0.3 meters.
• Cross the other cables at right angles.
• Keep the cable as short as possible in order to minimize the radiated emissions and stress on chopper IGBTs. The longer the cable the higher the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

Maximum cable length
The maximum length of the resistor cable(s) is 10 m (33 ft).

EMC compliance of the complete installation
Note: ABB has not verified that the EMC requirements are fulfilled with external user-defined brake resistors and cabling. The EMC compliance of the complete installation must be considered by the customer.

Placing the brake resistors
Install the resistors outside the drive module in a place where they will cool.
Arrange the cooling of the resistor in a way that:
• no danger of overheating is caused to the resistor or nearby materials
• the temperature of the room the resistor is located in does not exceed the allowed maximum.
Supply the resistor with cooling air/water according to the resistor manufacturer’s instructions.

WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, ensure that the material withstands high temperatures. Protect the resistor against contact.
Protecting the system against thermal overload

The brake chopper protects itself and the resistor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. The drive control program includes a resistor and resistor cable thermal protection function which can be tuned by the user. See the firmware manual.

A main contactor is not required for protecting against resistor overheating when the resistor is dimensioned according to the instructions and the internal brake chopper is in use. The drive will disable power flow through the input bridge if the chopper remains conductive in a fault situation but the charging resistor may fail.

Note: If an external brake chopper (outside the drive module) is used, a main contactor is always required.

A thermal switch (standard in ABB resistors) is required for safety reasons. The thermal switch cable must be shielded and may not be longer than the resistor cable. Wire the switch to a digital input on the drive control unit as shown in the figure below.

Protecting the resistor cable against short-circuits

The input fuses will also protect the resistor cable when it is identical with the input cable.

Mechanical installation of external brake resistors

All brake resistors must be installed outside the drive. Obey the resistor manufacturer’s instructions.

Electrical installation

Checking the insulation of the assembly

Obey the instructions given in section Brake resistor and resistor cable on page 101.

Connection diagram

See section Power cable connection diagram example (6-pulse) on page 107.

Connection procedure

- Connect the resistor cables to the R+ and R- terminals in the same way as the other power cables. If a shielded three-conductor cable is used, cut the third conductor and ground the twisted shield of the cable (protective earth conductor of the resistor assembly) at both ends.
- Connect resistor cables to the R+ and R- terminals of both drive modules in the same way as the other power cables. If a shielded three-conductor cable is used, cut the third conductor and ground the twisted shield of the cable (protective earth conductor of the resistor assembly) at both ends.
Note: It is not possible to use only one brake chopper in the drive module package, brake resistors must be connected to both drive modules.

- Connect the thermal switch of the brake resistor as described in section Protecting the system against thermal overload on page 232.

Start-up

Set the following parameters (ACS880 primary control program):

- Disable the overvoltage control of the drive by parameter 30.30 Overvoltage control.
- Set parameter 31.01 External event 1 source to point to the digital input where the thermal switch of the brake resistor is wired.
- Set parameter 31.02 External event 1 type to Fault.
- Enable the brake chopper by parameter 43.06 Brake chopper enable. If Enabled with thermal model is selected, set also the brake resistor overload protection parameters 43.08 and 43.09 according to the application.
- Check the resistance value of parameter 43.10 Brake resistance.

With these parameter settings, the drive stops by coasting at brake resistor overtemperature. For settings of other control programs, see the appropriate firmware manual.

⚠️ WARNING! If the drive is equipped with a brake chopper but the chopper is not enabled by the parameter setting, the internal thermal protection of the drive against resistor overheating is not in use. In this case, the brake resistor must be disconnected.

Note: Some brake resistors are coated with oil film for protection. At the start-up, the coating burns off and produces a little bit of smoke. Ensure proper ventilation at the start-up.
Resistor braking

Technical data

- Ratings

<table>
<thead>
<tr>
<th>Drive type AC8880-04XT-</th>
<th>Drive module type AC8880-04-</th>
<th>Internal brake chopper per drive module</th>
<th>Example brake resistor(s) per drive module</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>kW</td>
<td>ohm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U_n = 400 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1010A-3</td>
<td>585A-3+P943</td>
<td>315</td>
<td>1.3</td>
</tr>
<tr>
<td>1190A-3</td>
<td>650A-3+P943</td>
<td>315</td>
<td>1.3</td>
</tr>
<tr>
<td>1330A-3</td>
<td>725A-3+P943</td>
<td>400</td>
<td>0.7</td>
</tr>
<tr>
<td>1610A-3</td>
<td>880A-3+P943</td>
<td>400</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U_n = 500 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1010A-5</td>
<td>583A-5+P943</td>
<td>315</td>
<td>1.3</td>
</tr>
<tr>
<td>1160A-5</td>
<td>635A-5+P943</td>
<td>315</td>
<td>1.3</td>
</tr>
<tr>
<td>1310A-5</td>
<td>715A-5+P943</td>
<td>400</td>
<td>0.7</td>
</tr>
<tr>
<td>1610A-5</td>
<td>880A-5+P943</td>
<td>400</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U_n = 690 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0810A-7</td>
<td>430A-7+P943</td>
<td>285</td>
<td>2.2</td>
</tr>
<tr>
<td>0960A-7</td>
<td>522A-7+P943</td>
<td>350</td>
<td>2.0</td>
</tr>
<tr>
<td>1080A-7</td>
<td>590A-7+P943</td>
<td>400</td>
<td>1.8</td>
</tr>
<tr>
<td>1320A-7</td>
<td>721A-7+P943</td>
<td>400</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Pbrcont: Maximum continuous braking power. The braking is considered continuous if the braking time exceeds 30 seconds.

Rmin: The minimum allowed resistance value of the brake resistor.

R: Resistance value for the listed resistor assembly.

ER: Short energy pulse that the resistor assembly withstands every 400 seconds.

Pcont: Continuous power (heat) dissipation of the resistor when placed correctly.

The ratings apply at an ambient temperature of 40 °C (104 °F).

SAFUR resistors

The degree of protection of SAFUR resistors is IP00. The resistors are not UL listed. The thermal time constant of the resistors is 555 seconds.
Dimensions and weights

<table>
<thead>
<tr>
<th>Brake resistor type</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAFUR125F500</td>
<td>25 kg</td>
</tr>
<tr>
<td>SAFUR200F500</td>
<td>30 kg</td>
</tr>
</tbody>
</table>

Ordering codes

<table>
<thead>
<tr>
<th>Brake resistor type</th>
<th>ABB ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAFUR125F500</td>
<td>68759285</td>
</tr>
<tr>
<td>SAFUR200F500</td>
<td>68759340</td>
</tr>
</tbody>
</table>

- Terminals and cable lead-through data

See section *Terminal and lead-through data for the power cables* on page 188.
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 70.

Note for drive modules with motor cable length less than 20 m (65 ft) from each drive module before connecting them together: In addition to the requirements given in section Requirements table on page 71, du/dt filters or sine filters are required at the outputs of the drive modules for equalization of drive module currents. See also section Motor connection data on page 189 for the minimum motor cable length. If there is no du/dt filter and the motor cable length from each drive module is less than 20 m (65 ft), the nominal values of the drive must be de-rated by 15%.
du/dt and sine filters

Selection table

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

<table>
<thead>
<tr>
<th>Drive module type</th>
<th>u_N = 400 V</th>
<th>u_N = 500 V</th>
<th>u_N = 690 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS880-04-585A-3</td>
<td>FOCH0610-70</td>
<td>583A-5</td>
<td>FOCH0610-70</td>
</tr>
<tr>
<td></td>
<td>FOCH0610-70</td>
<td>635A-5</td>
<td>FOCH0610-70</td>
</tr>
<tr>
<td></td>
<td>FOCH0875-70</td>
<td>715A-5</td>
<td>FOCH0875-70</td>
</tr>
<tr>
<td></td>
<td>FOCH0875-70</td>
<td>880A-5</td>
<td>FOCH0875-70</td>
</tr>
</tbody>
</table>

Ordering codes

<table>
<thead>
<tr>
<th>Filter type</th>
<th>ABB ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOCH-0610-70</td>
<td>68550483</td>
</tr>
<tr>
<td>FOCH-0875-70</td>
<td>3AUA0000125245</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 70.

Selection table

Sine filter types for the drive modules are given below.

<table>
<thead>
<tr>
<th>Basic drive module type ACS880-04-</th>
<th>Sine filter type</th>
<th>Basic drive module type ACS880-04-</th>
<th>Sine filter type</th>
<th>Basic drive module type ACS880-04-</th>
<th>Sine filter type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FOCH0610-70</td>
<td></td>
<td>FOCH0610-70</td>
<td></td>
<td>FOCH0875-70</td>
</tr>
<tr>
<td></td>
<td>580A-3</td>
<td></td>
<td>630A-3</td>
<td></td>
<td>710A-3</td>
</tr>
<tr>
<td></td>
<td>650A-3</td>
<td></td>
<td>725A-3</td>
<td></td>
<td>880A-3</td>
</tr>
<tr>
<td></td>
<td>725A-3</td>
<td></td>
<td>880A-3</td>
<td></td>
<td>ISO900-6</td>
</tr>
<tr>
<td></td>
<td>880A-3</td>
<td></td>
<td>ISO900-6</td>
<td></td>
<td>ISO900-6</td>
</tr>
</tbody>
</table>

Ordering codes

<table>
<thead>
<tr>
<th>Filter type</th>
<th>ABB ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSIN900-6</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 182.
Description, installation and technical data of the sine filters

See Sine filters hardware manual (3AXD50000016814 [English]). For more information, contact ABB.
du/dt and sine filters
Step-by-step drawings for an installation example of drive module with optional IP20 shrouds and input and output terminals in Rittal TS 8 600 mm wide cabinet.
Step-by-step drawings for an installation example of drive module with optional IP20 shrouds and input and output terminals in Rittal TS 8 600 mm wide cabinet.
Step-by-step drawings for an installation example of drive module with optional IP20 shrouds and input and output terminals in Rittal TS 8 600 mm wide cabinet

Combi screw M6×20
Torx T25 2 N·m

Combi screw M6×20
Torx T25 2 N·m

Combi screw M4×10
Torx T20 2 N·m

Hex screw M12×35 full thread
70 N·m
Washer M12 or equal

Hex nut M12 70 N·m
Washer M12 or equal

Combi screw M6×20
Torx T20 2 N·m

Combi screw M4×8 Torx T20 2 N·m

Washer M12 or equal
Step-by-step drawings for an installation example of drive module with optional IP20 shrouds and input and output terminals in Rittal TS 8 600 mm wide cabinet.
Installation procedure

See the dimension drawing on page 205 (frame R10) or page 212 (frame R11) for the positions of the parts to be installed. See page 216 for the dimensions of the air baffles.

1. Install three Rittal support rails (TS 4396.500) on the bottom of the cabinet.
2. Install the pedestal guide onto the support rails.
3. Install the Rittal punched sections TS 8612.160 (5 pcs).
4. Install the Rittal punched sections TS8612.140 (3 pcs).
5. Install the air baffles.
6. Install the top guide plate.

Go to step 7 on the next page.
7. Install the output cabling panel. **Note:** After you have installed the output cabling panel, you can remove the support rail that lies under the panel if there is not enough space for cables.

8. Install the side guides to the output cabling panel (2 screws for each side guide).

9. Attach the grounding busbar to the input cabling panel. Back view is shown below.

10. Install the side guides to the input cabling panel (2 screws for each side guide).

11. Attach the input cabling panel to the punched section.

12. Install the Telescopic extraction and insertion ramp.
Step-by-step drawings for a flat installation example in Rittal TS 8 600 mm wide cabinet

**ABB parts**

1. Mounting bracket of option “Flat mounting”
2. No pedestal

Rittal 8606.500

Rittal 8612.160

Tapping screw M6×12 Torx T30 (Hex) 9 N·m

Combi screw M10×25 Hex 40 N·m

R10: 1367.5 [53.84]

R11: 1567.5 [61.71]
Step-by-step drawings for a flat installation example in Rittal TS 8 600 mm wide cabinet
Step-by-step drawings for option "Power cable connection terminals on the right-hand side of the drive module" installation example in Rittal TS 8 600 mm wide cabinet

**ABB parts for option "Power cable connection terminals on the right-hand side of the drive module"**

1. Support for back top mounting bracket
2. Handle
3. Bottom mounting bracket

**ABB standard parts**

4. Lowest back cover plate
5. Back top mounting bracket

For cabling, see layout example on page 55.
Step-by-step drawings for option “Power cable connection terminals on the right-hand side of the drive module” installation example in Rittal TS 8 600 mm wide cabinet
Further information

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

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

Providing feedback on ABB Drives manuals
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