ABB INDUSTRIAL DRIVES

# ACS880-17 drives (45...400 kW, 60...450 hp)

Hardware manual



# ACS880-17 drives (45…400 kW, 60…450 hp)

Hardware manual


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### *Further information*



1

# 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 and do maintenance work on it.

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

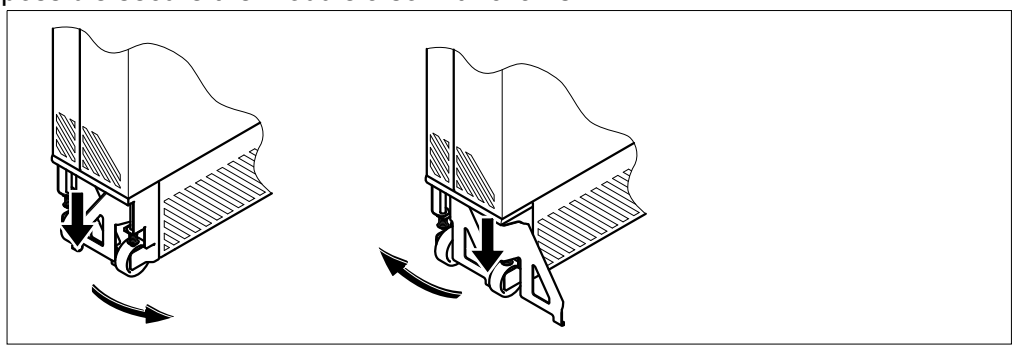
- Secure the cabinet to the floor to prevent it from toppling over when you pull out drive and LCL filter modules. The modules are heavy and have a high center of gravity.



- Wear protective gloves and long sleeves. Some parts have sharp edges.
- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Beware of hot air exiting from the air outlets.
- Keep the drive in its package or protect it otherwise from dust and metal shavings from drilling and grinding until you install it. Protect also the installed drive against dust and metal shavings. Electrically conductive debris inside the drive can cause damage or malfunction.
- Vacuum clean the area below the drive before the start-up to prevent the drive cooling fan from drawing the dust inside the drive.
- Do not cover the air inlet and outlet when the drive is running.
- Make sure that there is sufficient cooling. See section *Examining the installation site* (page *63*).
- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists. If you cannot avoid working on a powered drive, obey the local laws and regulations on live working (including – but not limited to – electric shock and arc protection).
- Before you connect voltage to the drive, make sure that the cabinet doors are closed. Keep the doors closed during operation.
- 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

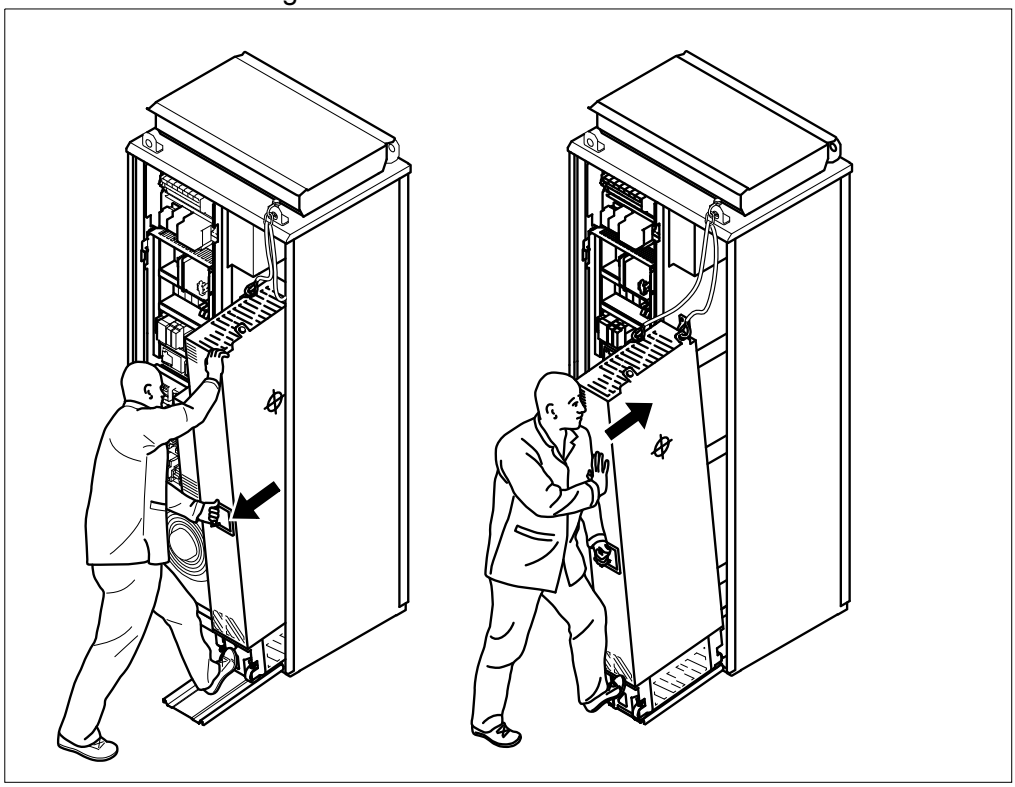
IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

- 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 at start-up. See chapter *The Safe torque off function* (page *259*). For other safety functions, see their separate instructions.
- Handle the drive and LCL filter modules carefully:
  - Use safety shoes with a metal toe cap to avoid foot injury.
  - Lift the module with a lifting device only. Use the designated lifting points.
  - Frame R11:
    - Do not tilt the module. It is **heavy** and its **center of gravity is high.**
    - Make sure that the module does not topple over when you move it on the floor: Do not leave the module unattended on a sloping floor. Extend the support legs: Press each leg a little down and turn it aside. Whenever possible secure the module also with chains.



    - 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.)
    - Secure the module installation ramp carefully.

- To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet frame before you push the module into the cabinet and pull it from the cabinet. Work carefully preferably with help from another person. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.



**Note:**

- If you select an external source for the start command and it is on, the drive will start immediately after fault reset unless you configure the drive for pulse start. See the firmware manual.
- When the control location is not set to Local, the stop key on the control panel will not stop the drive.
- Only authorized persons are allowed to repair a malfunctioning drive.

# Electrical safety in installation, start-up and maintenance

## Electrical safety precautions

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

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**WARNING!** Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation or maintenance work. Go through these steps before you begin any installation or maintenance work.

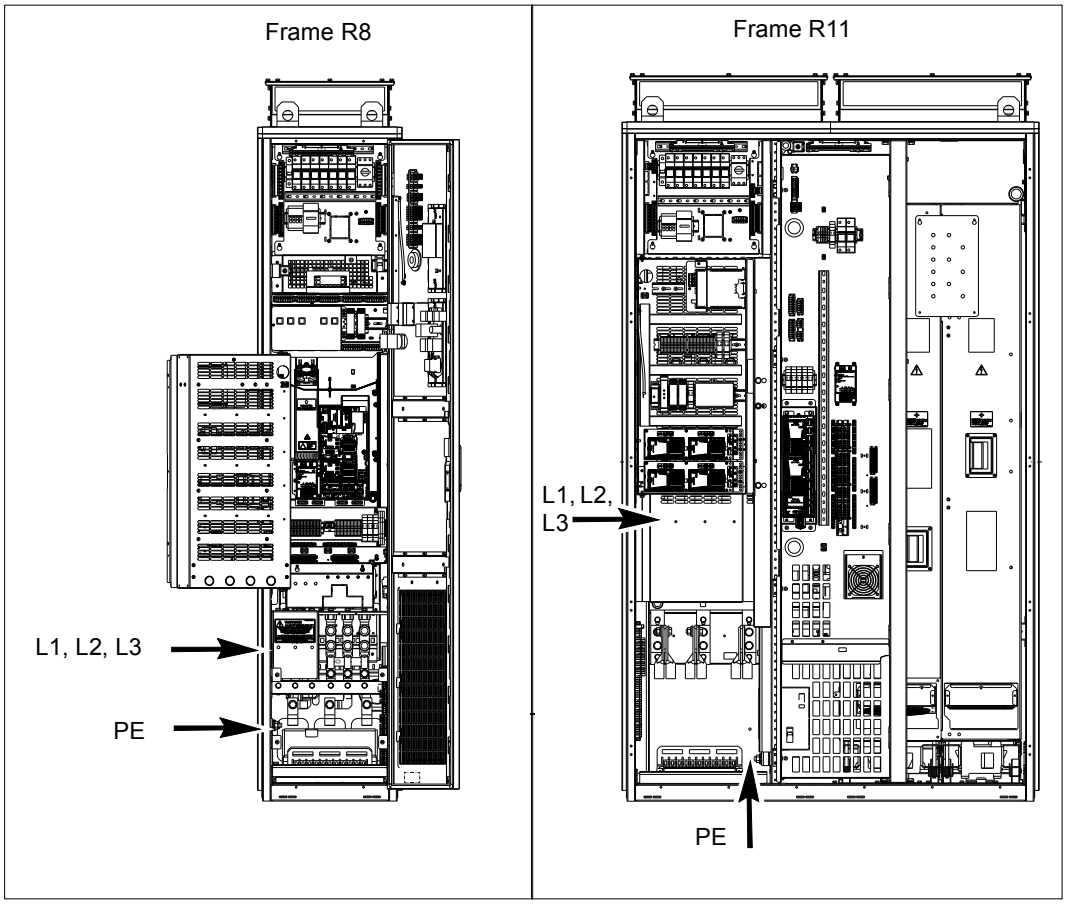
1. Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of electric shock and/or arcing exists.
2. Clearly identify the work location.
3. Disconnect all possible voltage sources.
   - Open the main disconnecting device (Q1) of the drive. Open the disconnector of the supply transformer as the main disconnecting device of the drive does not remove the voltage from the input busbars or V-meter (option +G334) 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.
4. Protect any other energized parts in the work location against contact.
5. Take special precautions when close to bare conductors.



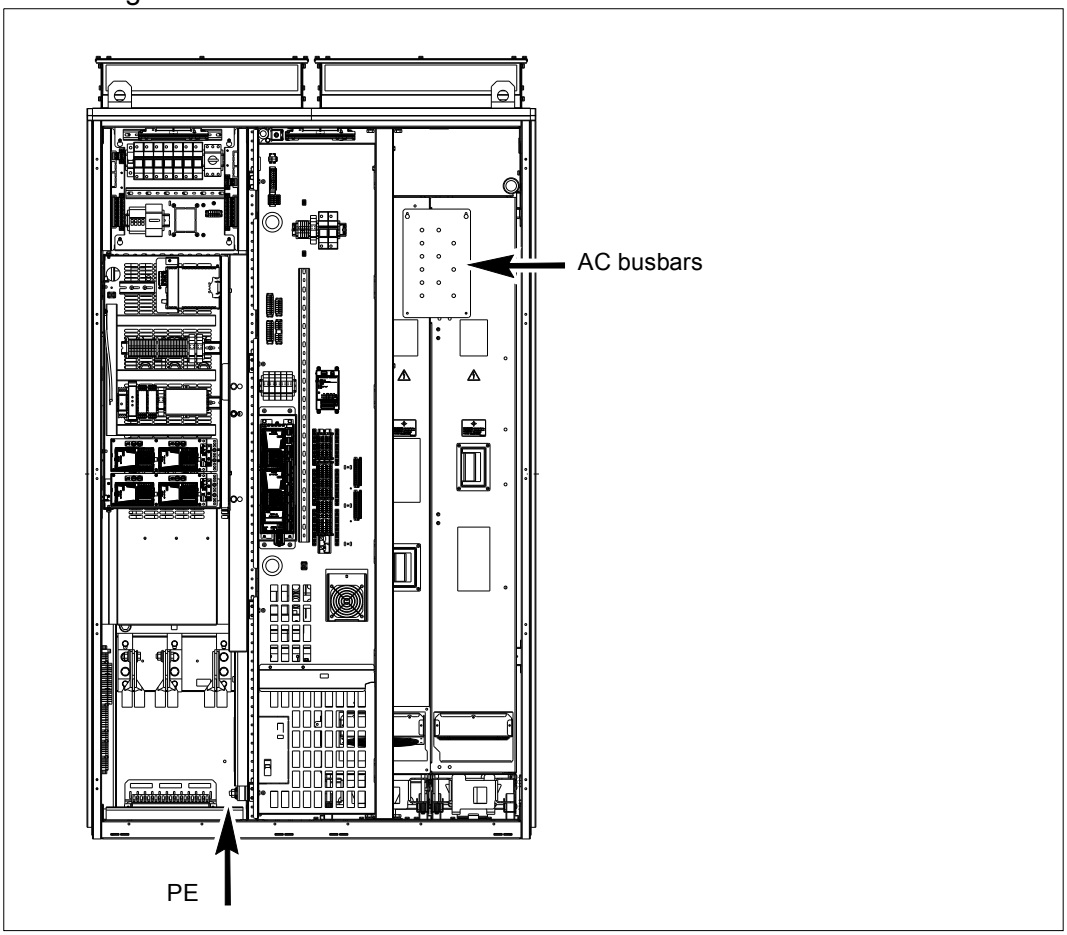
6. Measure that the installation is de-energized.

**WARNING!** If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).

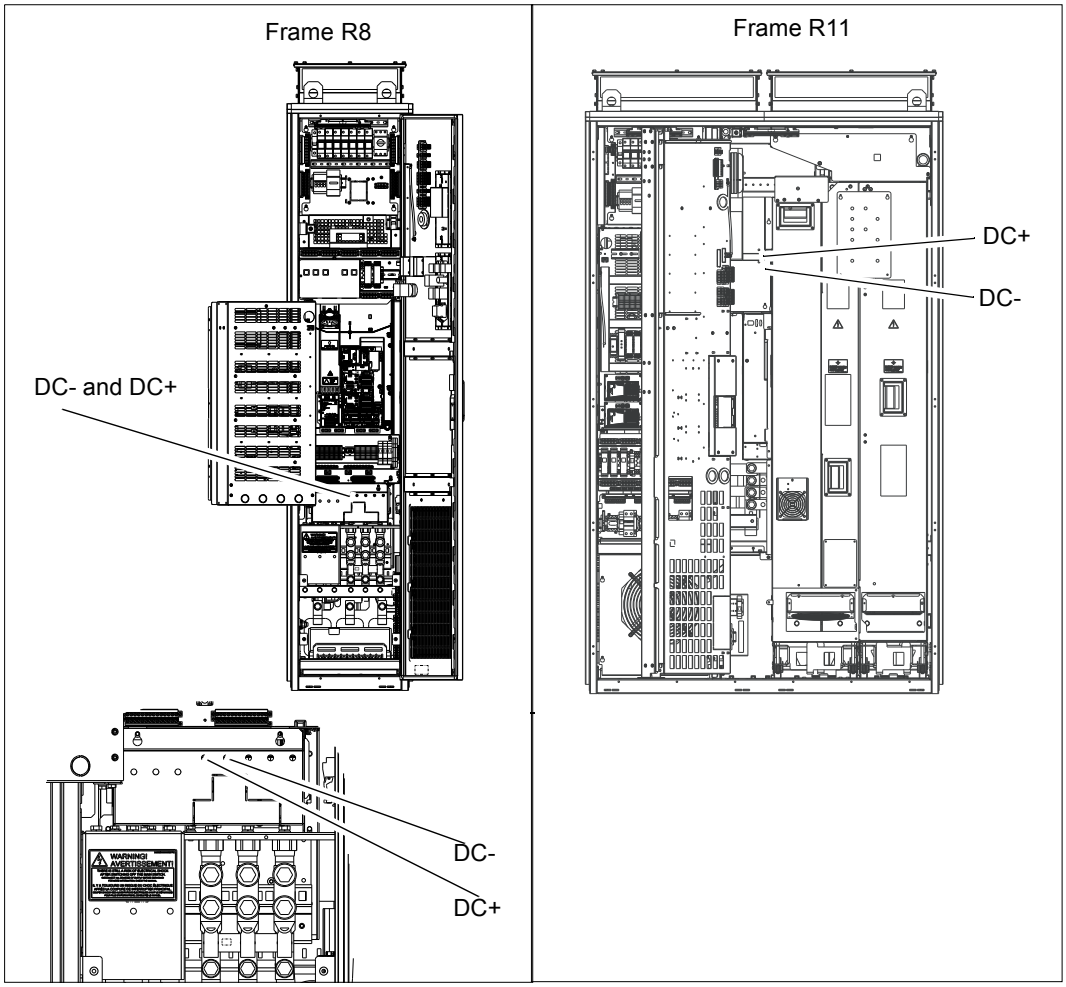
- Use a multimeter with an impedance of at least 1 Mohm.
- Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V. The measuring holes in the shroud of the standard drive are shown below.



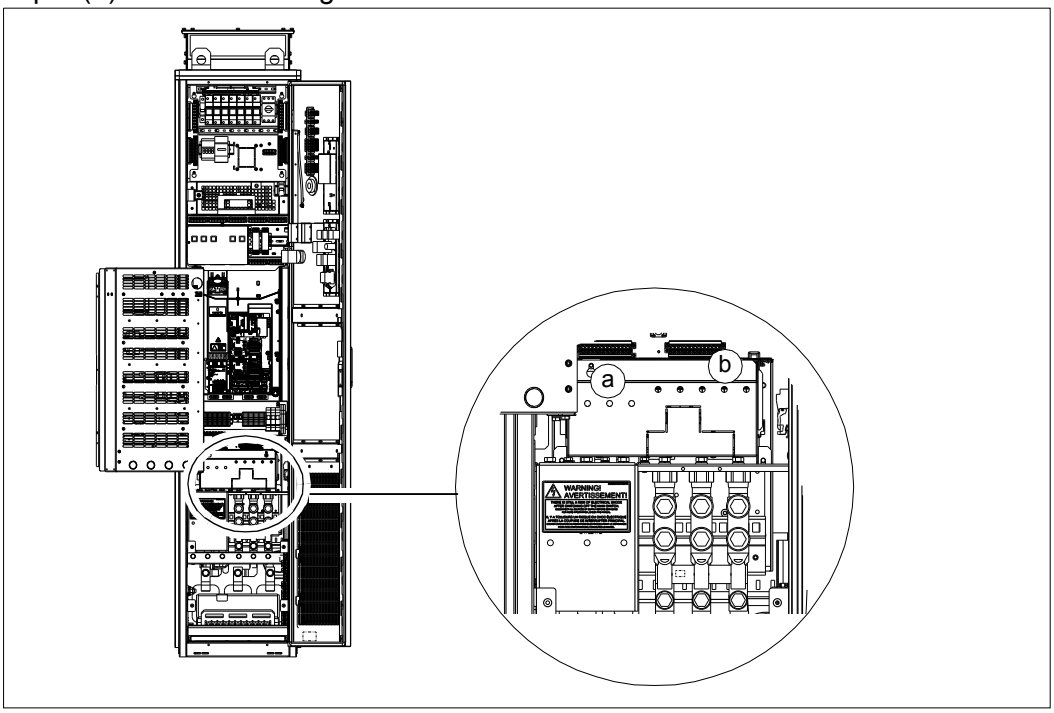
- Frame R11: Make sure that the voltage of the drive AC busbars between the drive module and the LCL filter and the grounding (PE) busbar are close to 0 V. The measuring holes in the shroud of the standard drive are shown below.



- Make sure that the voltage between the DC busbars is close to 0 V. You can measure the voltage through the holes in the shroud.



- For frame R8, you can measure the voltage at the drive module input (a) and output (b) terminals through the holes in the shroud.




7. Install temporary grounding as required by the local regulations. Connect the AC and DC busbars to PE with a temporary grounding tool.
8. Ask the person in control of the electrical installation work for a permit to work.

## Additional instructions and notes

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

- If you are not a qualified electrical professional, do not do electrical installation or maintenance work.
- Do not install a drive with an EMC filter (option +E202) on an IT (ungrounded) power system or a high resistance-grounded (over 30 ohms) power system without disconnecting the filter and/or the varistor screws.
- Do not connect the drive to a voltage higher than what is specified on the type designation label.
- We do not recommend that you secure the cabinet by arc welding. If you have to, obey the instructions on page *76*.
- Do not do insulation or voltage withstand tests on the drive or its 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 is at a dangerous voltage.
- External wiring can supply dangerous voltages to the relay outputs of the control units of the drive.

- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.



**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 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”).



## Additional instruction for DC connection



**WARNING!** Do not connect the drive DC link to a common DC system. The drive will get damaged.

## Grounding

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



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

- If you are not a qualified electrical professional, do not do grounding work.
- Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- Make sure that the conductivity of the grounding conductors is sufficient. See section *Selecting the power cables* (page *86*). 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 (PE) 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 damage to the equipment 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 (U2, V2, W2) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the plus and minus busbars of the drive DC link and the grounding (PE) busbar is close to 0 V.
- Install temporary grounding to the drive output terminals (U2, V2, W2). Connect the output terminals together as well as to the PE.
- Make sure that the operator cannot run the motor over the rated speed. Motor overspeed causes overvoltage which can damage the capacitors in the intermediate circuit of the drive.

2

# Introduction to the manual

## Contents of this chapter

This chapter describes the manual. It contains a flowchart of steps in checking the delivery, installing and starting up the drive. The flowchart refers to chapters/sections in this manual and to other manuals.

## Target audience

This manual is intended for people who plan the installation, install, start up, use and service the drive. Read the manual before working on the drive. You are expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

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

## Contents of the manual

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

*Safety instructions* gives safety instructions for the installation, start-up, operation and maintenance of the drive.

*Introduction to the manual* gives and introduction to this manual.

*Operation principle and hardware description* describes the operation principle and construction of the drive.

*Mechanical installation* describes how to install the drive mechanically.

*Guidelines for planning the electrical installation* contains instructions for the motor and cable selection, protections and cable routing.

*Electrical installation* gives instructions on wiring the drive.

*Control unit of frame R11* contains the default I/O connection diagrams, descriptions of the terminals and technical data for the control unit of the drive.

*Installation checklist* contains a list for checking the mechanical and electrical installation of the drive.

*Start-up* describes the start-up procedure of the drive.

*Fault tracing* describes the fault tracing possibilities of the drive.

*Maintenance* contains preventive maintenance instructions.

*Technical data* 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.

*Dimensions* contains example dimension drawings of the drive.

*The Safe torque off function* describes the Safe torque off function of the drive and gives instructions on its implementation.

# Related documents

| **Drive hardware manuals and guides** | **Code (English)** |
|---|---|
| *Drive/converter/inverter safety instructions* | Multilingual code: 3AXD50000037978 |
| *ACS880-17 drives (45…400 kW) hardware manual* | 3AXD50000035158 |
| *ACx-AP-x assistant control panels user's manual* | 3AUA0000085685 |
| *ACS880 frames R1 to R11 EMC filter and ground-to-phase varistor disconnecting instructions* | 3AUA0000125152 |
| | |
| **Drive firmware manuals and guides** | |
| *ACS880 primary control program firmware manual* | 3AUA0000085967 |
| *Quick start-up guide for ACS880 drives with primary control program* | 3AUA0000098062 |
| *ACS880 IGBT supply control program firmware manual* | 3AUA0000131562 |
| | |
| **Option manuals and guides** | |
| *Drive composer start-up and maintenance PC tool user's manual* | 3AUA0000094606 |
| *Bypass connection for ACS880-07, -17, -37 (40...1200 A) option description* | 3AXD50000048959 |
| *FSO-12 safety functions module user's manual* | 3AXD50000015612 |
| *FSO-21 safety functions module user's manual* | 3AXD50000015614 |
| *User's manual for Prevention of unexpected start-up (+Q950) for ACS880-07/17/37 drives* | 3AUA0000145922 |
| *User's manual for Emergency stop, stop category 0 (+Q951) for ACS880-07/17/37 drives* | 3AUA0000119895 |
| *User's manual for Emergency stop, stop category 1 (+Q952) for ACS880-07/17/37 drives* | 3AUA0000119896 |
| *User's manual for Prevention of unexpected start-up (+Q957) for ACS880-07/17/37 drives* | 3AUA0000119910 |
| *User's manual for Emergency stop, stop category 0 (+Q963) for ACS880-07/17/37 drives* | 3AUA0000119908 |
| *User's manual for Emergency stop, stop category 1 (+Q964) for ACS880-07/17/37 drives* | 3AUA0000119909 |
| *User's manual for Emergency stop, configurable stop category 0 or 1 (+Q978) for ACS880-07/17/37 drives* | 3AUA0000145920 |
| Manuals and quick guides for I/O extension modules, fieldbus adapter, etc. | |

You can find manuals and other product documents in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.
The code below opens an online listing of the manuals applicable to the product:

ACS880-17 (45…400 kW, 60…450 hp) manuals

## Categorization by frame size and option code

Some instructions, technical data and dimension drawings which concern only certain frame sizes are marked with the symbol of the frame size, for example R11. The frame size is marked on the type designation label (see page *58*).

The instructions, technical data and dimension drawings which only concern certain optional selections are marked with option codes (such as +E205). The options included in the drive can be identified from the option codes visible on the type designation label (see page *58*). The option selections are listed in section *Type designation key* (page *59*).

# Quick installation, commissioning and operation flowchart

| Task | See |
|---|---|
| Plan the electrical installation and acquire the accessories needed (cables, fuses, etc.).<br>Check the ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data. | *Guidelines for planning the electrical installation* (page *79*)<br>*Technical data* (page *211*) |
| ↓ | |
| Check the installation site. | *Ambient conditions* (page *226*) |
| ↓ | |
| Unpack and check the drive (only intact units may be started up).<br>Make sure that all necessary optional modules and equipment are present and correct.<br>Mount the drive. | *Mechanical installation* (page *63*)<br>If the drive has been non-operational for more than one year, the DC link capacitors need to be reformed (page *201*) |
| ↓ | |
| Route the cables. | *Routing the cables* (page *92*) |
| ↓ | |
| Check the insulation of the supply cable, the motor and the motor cable. | *Checking the insulation of the assembly* (page *101*) |
| ↓ | |
| If the drive is about to be connected to an IT (ungrounded) system, check that the drive is not equipped with EMC filter (option +E202). | *Checking the compatibility with IT (ungrounded), corner-grounded delta, midpoint-grounded delta and TT systems* (page *102*) |
| ↓ | |
| Connect the power cables.<br>Connect the control cables. | *Electrical installation* (page *101*) |
| ↓ | |
| Check the installation. | *Installation checklist* (page *155*) |
| ↓ | |
| Start the drive up. | *Start-up* (page *157*) |
| ↓ | |
| Operate the drive: start, stop, speed control etc. | Quick start-up guide, firmware manual |

# Terms and abbreviations

| Term/ Abbreviation | Description |
|---|---|
| ACx-AP-x | Assistant control panel, advanced operator keypad for communication with the drive. |
| Control unit, control board | The drive with frame R11 contains two ZCU control units. One controls the line-side converter, the other the motor-side converter.<br>The drive with frame R8 has only one motor-side ZCU control unit. Control board QCON-21 controls the line-side converter.<br>As standard, the external I/O control signals are connected to the control unit, or optional I/O extensions mounted on it. |
| Drive | Frequency converter for controlling AC motors. The drive consists of the *line-side converter* and *motor-side converter* connected together by the DC link.<br>In this manual, the term refers to the ACS880-17 as a whole. |
| Drive control unit | The control unit which controls the drive through the motor-side converter. The user control interface to the drive.<br>In this manual, the term refers to the motor-side converter control unit of the drive |
| EMC | Electromagnetic compatibility |
| EMI | Electromagnetic interference |
| EMT | Electrical metallic tubing |
| FAIO-01 | Optional analog I/O extension module |
| FCAN-01 | Optional FCAN-01 CANopen adapter module |
| FCNA-01 | Optional ControlNet™ adapter module |
| FDCO-01 | Optional DDCS communication module with two pairs of 10 Mbit/s DDCS channels |
| FDNA-01 | Optional DeviceNet™ adapter module |
| FECA-01 | Optional EtherCAT adapter module |
| FEN-01 | Optional TTL incremental encoder interface module |
| FEN-11 | Optional TTL absolute encoder interface module |
| FEN-21 | Optional resolver interface module |
| FEN-31 | Optional HTL incremental encoder interface module |
| FENA-11 | Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols |
| FENA-21 | Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port |
| FEPL-01 | Optional Ethernet POWERLINK adapter module |
| FIO-01 | Optional digital I/O extension module |
| FIO-11 | Optional analog I/O extension module |
| FPBA-01 | Optional PROFIBUS DP adapter module |
| Frame (size) | Relates to the construction type of the component in question. For example, several drive types with different power ratings may have the same basic construction, and a frame size is used in reference to all those drive types.<br>To determine the frame size of a drive type, see the rating tables in chapter *Technical data*. |
| FSO-12, FSO-21 | Optional functional safety module |
| IGBT | Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in drives due to their easy controllability and high switching frequency. |
| Line-side converter | The part of the *drive* that converts AC to DC for the motor. Includes an LCL filter.<br>The line-side converter of the ACS880-17 is also capable of feeding regenerative energy back into the electrical power network. |
| Motor-side converter | The part of the *drive* that converts DC to AC for the motor. The motor-side converter is also capable of feeding energy from a decelerating motor into the DC link. |

| Term/ Abbreviation | Description |
|---|---|
| I/O | Input/Output |
| QCON-21 | Control board that controls the line-side converter of frame R8. |
| RFI | Radio-frequency interference |
| STO | Safe torque off. See chapter *The Safe torque off function* (page *259*). |
| ZCU | Control unit type. The drive with frame R11 contains two ZCU control units. One controls the line-side converter, the other the motor-side converter.<br>The drive with frame R8 has only one motor-side ZCU control unit.<br>See also descriptions *Control unit, control board* and *Drive control unit* above. |
| ZMU | The memory unit attached to the control unit of the drive |

3

# Operation principle and hardware description

## Contents of this chapter

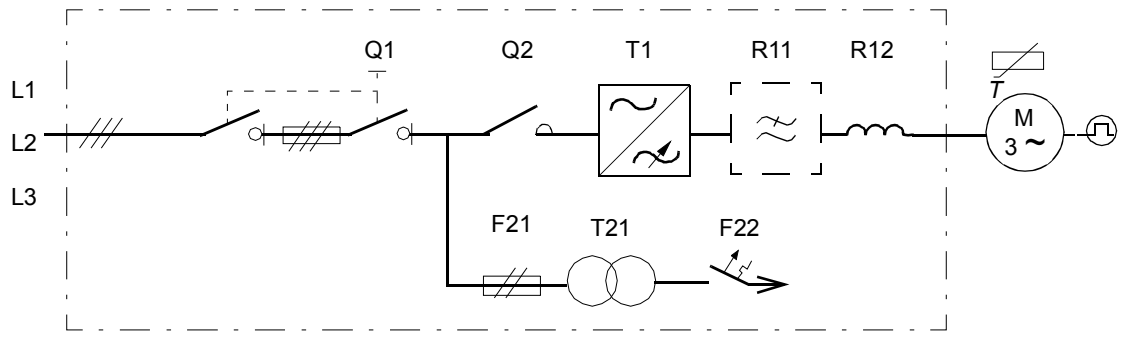
This chapter briefly describes the operation principle and construction of the drive.

## Operation principle

The ACS880-17 is a four-quadrant, air-cooled, cabinet-installed drive for controlling asynchronous AC induction motors, permanent magnet synchronous motors, AC induction servomotors and ABB synchronous reluctance (SynRM) motors.

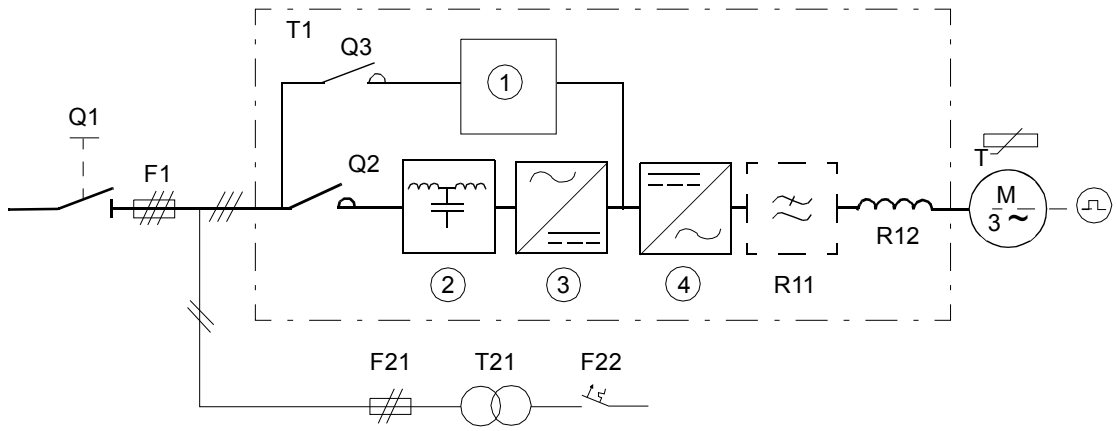
## Single-line circuit diagram of the drive

### Single-line diagram of R8




| | |
|---|---|
| F21 | Auxiliary voltage supply fuses |
| F22 | Auxiliary circuit protection switch |
| Q1 | Switch fuse |
| Q2 | Line contactor with options +Q951, +Q952, +Q978 |
| R11 | Common mode filter (option +E208) |
| R12 | du/dt filter (option +E205) or sine filter (option +E206) |
| T21 | Auxiliary voltage transformer supplying 24 V and 230/115 V control voltage for, for example, cabinet fan(s), control devices and I/O extension adapter module. |
| T1 | Drive module |
| | HTL pulse encoder for optional FEN-31 HTL incremental encoder interface module (option +L205) |
| T | PTC sensors for optional thermistor relay(s) (options +L205, +2L205) or Pt100 sensors for optional Pt100 relays (option +xL206) |

## Single-line diagram of R11

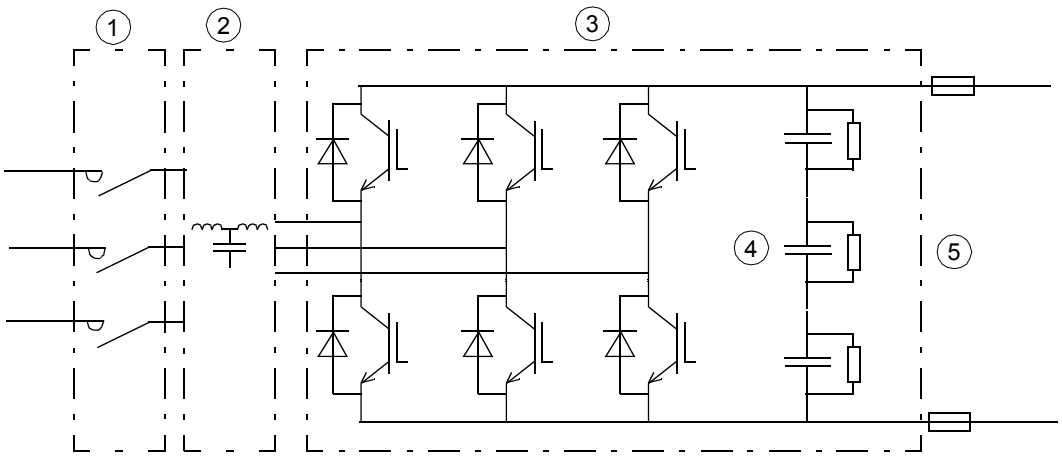



| | |
|---|---|
| Q1 | Main switch-disconnector (switch-disconnector and separate fuses) |
| F1 | AC fuses |
| F21 | Auxiliary voltage supply fuses |
| F22 | Auxiliary circuit protection switch |
| Q2 | Line contactor inside the drive module. Q2 is controlled by the line-side converter control unit. If Start (Running) command is given to the drive, Q2 is closed and the line-side converter starts to modulate. |
| Q3 | Charging circuit contactor (with options +Q951, +Q952, +Q978) or switch (as standard) |
| R11 | Optional common mode filter (option +E208) |
| R12 | Optional du/dt filter (option +E205) or sine filter (option +E206) |
| T1 | Drive module. Contains drive module (line-side converter + motor-side converter), LCL filter and line contactor. |
| T21 | Auxiliary voltage transformer supplying 24 V and 230/115 V control voltage for, for example, cabinet fan(s), control devices and I/O extension adapter module. |
| 1 | Charging circuit |
| 2 | LCL filter |
| 3 | Line-side converter |
| 4 | Motor-side converter |
| | Pulse encoder for FEN-31 HTL incremental encoder interface module (option +L502) |
| *T* | Motor temperature sensor |

## Line-side converter

The line-side converter rectifies three-phase AC current to direct current for the intermediate DC link of the drive. The line-side converter is also capable of regenerating, that is, feeding braking energy back into the electrical power network.

The following diagram shows the simplified main circuit of the line-side converter. In R11, a ZCU control unit controls the line-side converter. See *Overview of power and control connections*. In R8, a QCON-21 control board controls the line-side converter.




| | |
|---|---|
| 1 | Line contactor |
| 2 | LCL filter |
| 3 | Line-side converter |
| 4 | DC capacitors |
| 5 | DC link |

### AC voltage and current waveforms

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

### Charging

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

## Motor-side converter

The motor-side converter converts the DC back to AC that rotates the motor. It is also able to feed the braking energy from a rotating motor back into the DC link. A ZCU control unit controls the motor-side converter.

The control unit also controls the drive through the motor-side converter. In this manual, the term drive control unit refers to the motor-side converter control unit. For the location of the drive control unit, see *Cabinet layout* figures and *Overview of power and control connections*.

# Cabinet layout

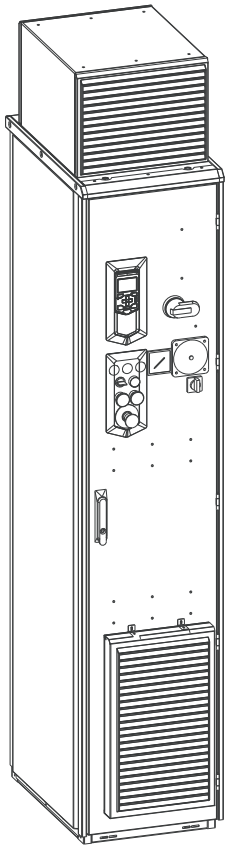
The layout drawings give an example of the R8 and R11 cabinets. The contents of the cabinet depend on the ordered options. For example:

- In the lower power R8 and R11 cabinets with only a few options the “door fan” is replaced with a shroud (basic cabinet without 24 V auxiliary voltage supply, option +E205 du/dt filter and +E208 common mode filter).
- In R8 cabinets, the swing-out frame and mounting plate above the “door fan” can be replaced with shrouds.
- In R11 cabinets, the swing-out frame and two mounting plates above the “door fan” can be replaced with shrouds.

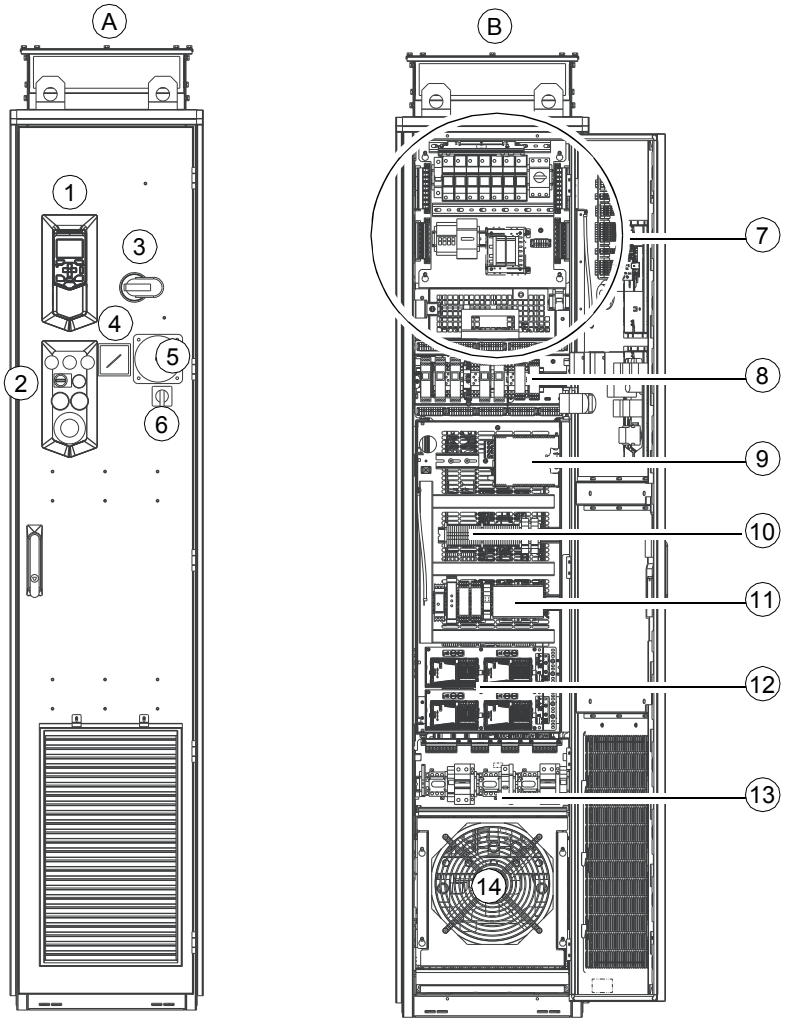
**Cabinet layout of R8**



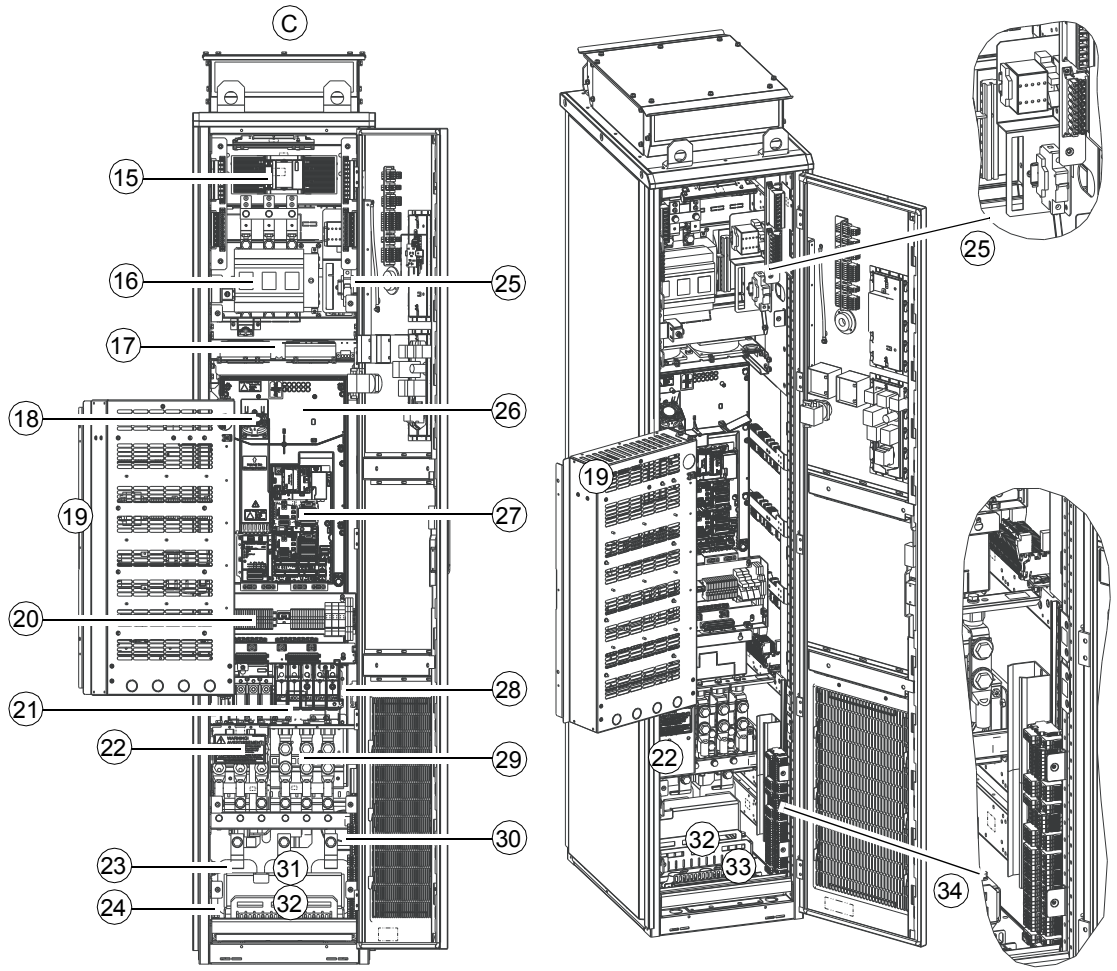
IP22 (UL Type 1)
IP42 (UL Type 1 Filtered) option +B054



IP54 (UL Type 12) option +B055




| | |
|---|---|
| A | Drive module cubicle, door closed |
| B | Drive module cubicle, door open |
| 1 | Drive control panel (see page *49*) |
| 2 | Operating buttons and door lights (see page *48*) |
| 3 | Main switch handle |
| 4 | Indicators, for example, V-meter and A-meter |
| 5 | UL Type V-meter |
| 6 | V-meter switch |
| 7 | Main fuses for control devices, IP54 fan with option +B055, transformer with option +B055, V-meter (option +G334), starter for auxiliary motor fan (option +M600) |
| 8 | Thermistor and PT100 relays (options +L505, +L506) |
| 9 | Buffering module and power supply unit |
| 10 | Terminal blocks X18 and X19 |
| 11 | Ground fault monitoring and safety circuit component |
| 12 | Optional extension adapters and modules |
| 13 | Components and connection terminals for options +G300, +G301, +G307, +G313 |
| 14 | “Door fan” |

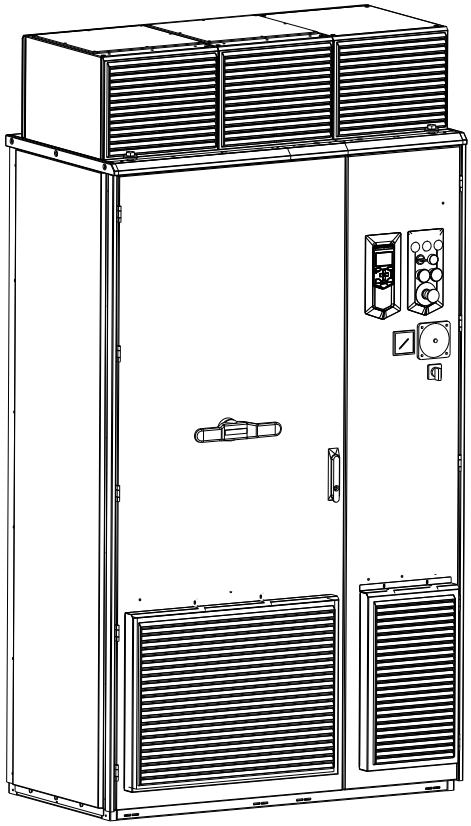



| | |
|---|---|
| C | Swing-out frame open |
| 15 | Main contactor |
| 16 | Switch fuse (Q1) |
| 17 | Internal cabinet fans |
| 18 | Auxiliary cooling fan |
| 19 | Swing-out frame |
| 20 | Terminal block (X504, option +L504) for external control cable connections to the control unit |
| 21 | Module cooling fan |
| 22 | Input cable connection terminals behind the shroud (bottom entry) |
| 23 | PE busbar |
| 24 | Cabinet heater (option +G300) |
| 25 | Auxiliary voltage transformer (T21) and distribution components |
| 26 | Drive module |
| 27 | Control unit (see page *145*) |
| 28 | X8X9 terminal block |
| 29 | Motor cable connection terminals (bottom entry) |
| 30 | Common mode filter (option +E208) |
| 31 | d*u*/d*t* filter (option +E205) |
| 32 | Power cable entry |
| 33 | Control cable entry |
| 34 | X250 terminal block |

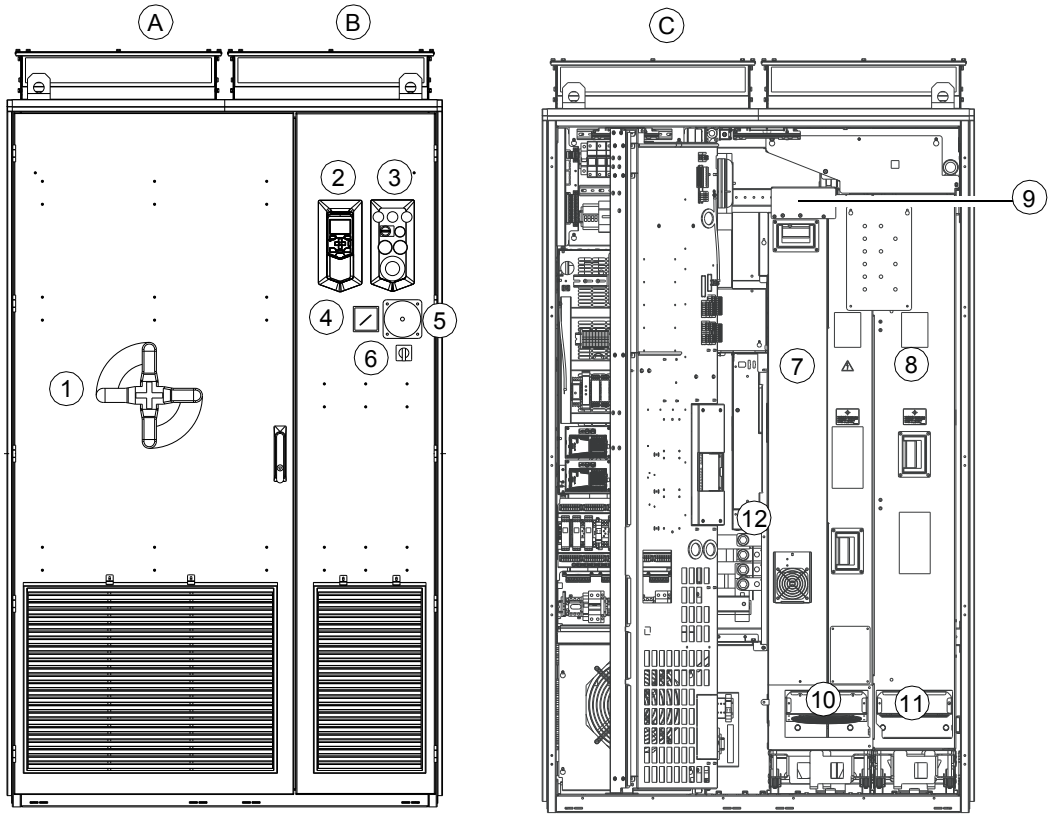
## Cabinet layout of R11



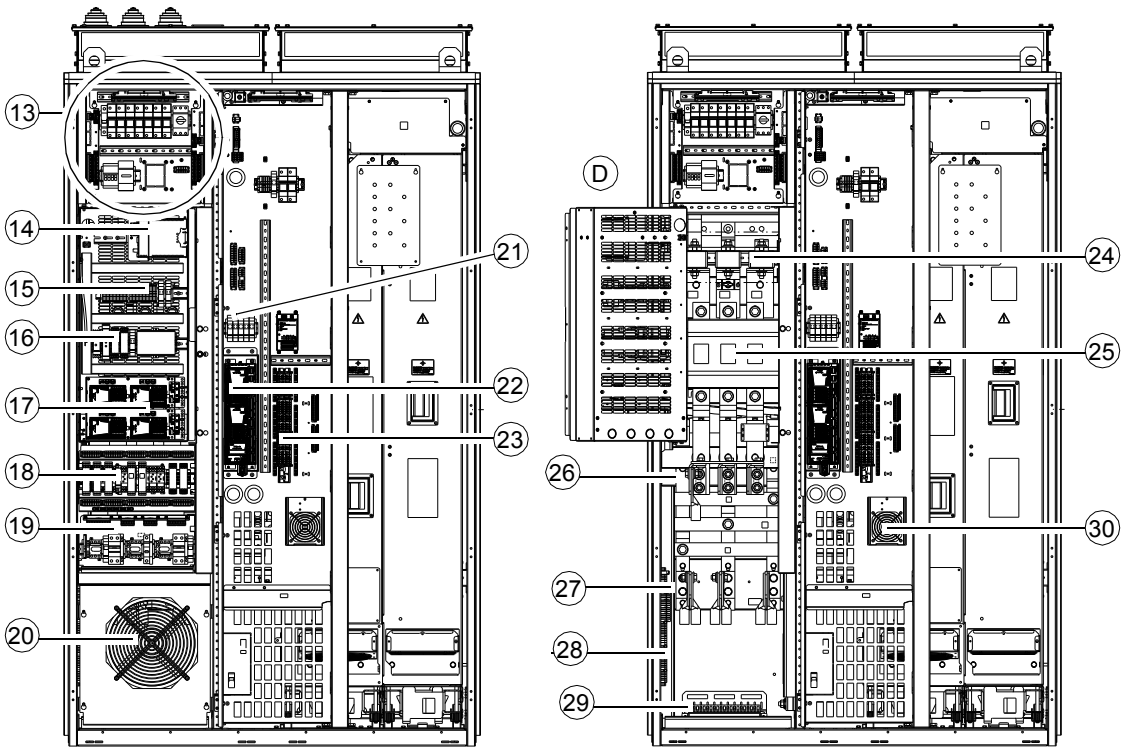
IP22 (UL Type 1)
IP42 (UL Type 1 Filtered) option +B054



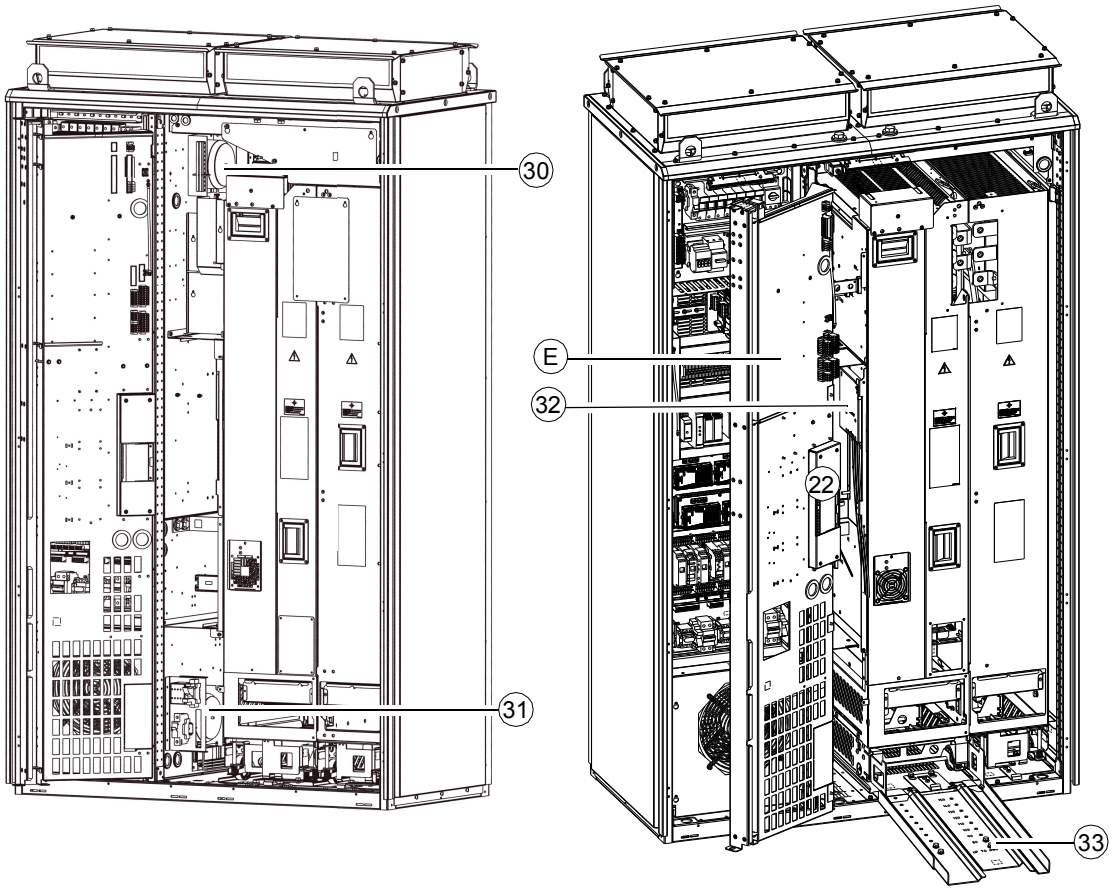
IP54 (UL Type 12) option +B055



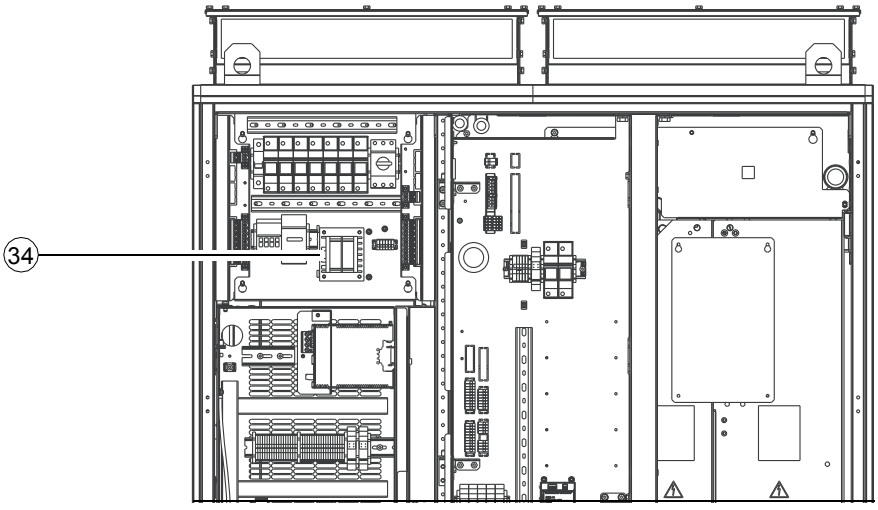

| | |
|---|---|
| A | Main breaker and power cabling cubicle |
| B | Drive module cubicle |
| C | Swing-out frame on the drive module side open |
| 1 | Main switch-disconnector (Q1) handle |
| 2 | Drive control panel (see page *49*) |
| 3 | Operating buttons and door lights (see page *48*) |
| 4 | Indicators, for example, V-meter and A-meter |
| 5 | UL Type V-meter |
| 6 | V-meter switch |
| 7 | Drive module |
| 8 | LCL filter module |
| 9 | Charging switch/contactor (Q3) |
| 10 | Drive module main cooling fans (1…2 pcs, 690 V R11 module has only one fan) |
| 11 | LCL filter module cooling fan |
| 12 | Circuit board fan |




| | |
|---|---|
| D | Swing-out frame |
| 13 | Main fuses for control devices, IP54 fan with option +B055, transformer with option +B055, V-meter (option +G334), starter for auxiliary motor fan (option +M600) |
| 14 | Buffering module and power supply unit |
| 15 | Terminal blocks X18 and X19 |
| 16 | Ground fault monitoring and safety circuit component |
| 17 | Optional extension adapters and modules |
| 18 | Thermistor and PT100 relays (options +L505, +L506) |
| 19 | Components and connection terminals for options +G300, +G301, +G307, +G313 |
| 20 | “Door fan” |
| 21 | Door light relays |
| 22 | Drive control unit |
| 23 | Terminal block (X504, option +L504) for external control cable connections to the control unit |
| 24 | Main AC fuses |
| 25 | Main switch-disconnector (Q1) |
| 26 | Input cable connection terminals behind the shroud (bottom entry) |
| 27 | Motor cable connection terminals (bottom entry) |
| 28 | X250 terminal block |
| 29 | Input and motor cable and control cable entry (bottom entry and exit) |
| 30 | Drive module auxiliary cooling fan |




| | |
|---|---|
| E | Swing-out frame |
| 30 | Auxiliary voltage transformer (T102) with option +B055 and distribution components (see page *103*) |
| 31 | Auxiliary voltage transformer (T21) and distribution components (see page *103*) |
| 32 | Line-side control unit |
| 33 | Extraction ramp |

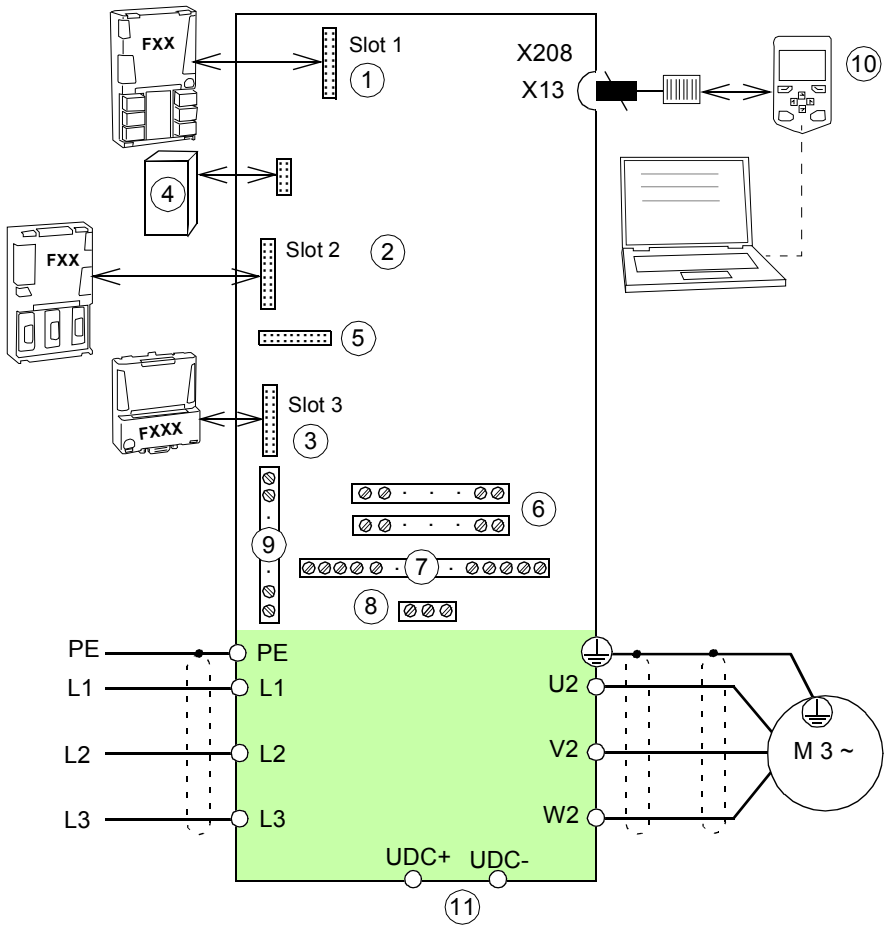



| | |
|---|---|
| 34 | Auxiliary voltage transformer (T101) with options +B055 and +C128 and distribution components (see page *103*) |

# Overview of power and control connections

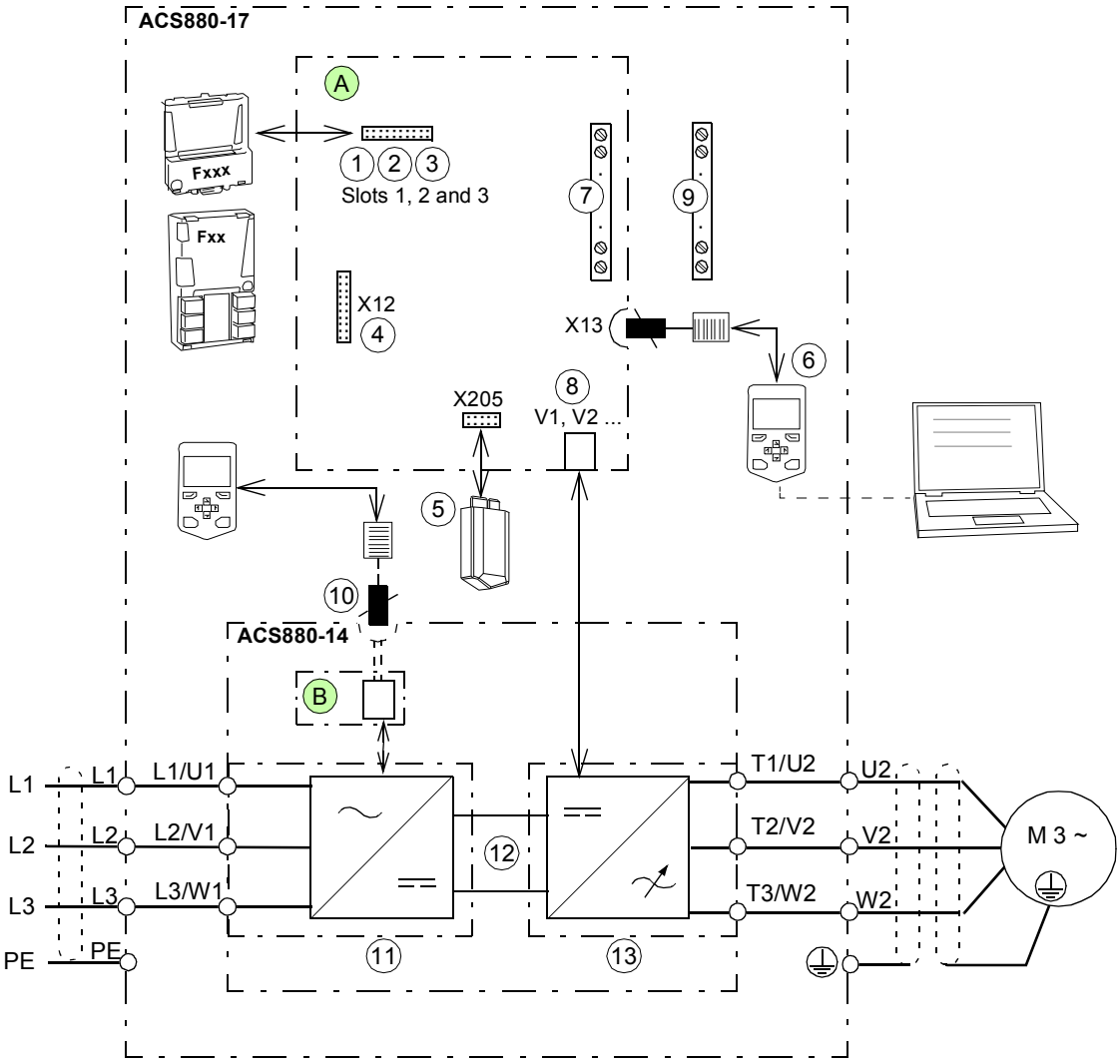
The diagram shows the power connections and control interfaces of the drive.

## Connection overview of R8




| | |
|---|---|
| 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 *59*. |
| 2 | |
| 3 | |
| 4 | Memory unit, see page *207*. |
| 5 | Connector for safety functions module |
| 6 | See *Control unit of frame R8* (page *135*). |
| 7 | Additional terminal block X504 for control cable connections to the control unit (option +L504) |
| 8 | Connection terminals for options +G300, +G307, +G313, see pages *52* and *53*. |
| 9 | Connection terminals for options, see page *46*. |
| 10 | See section *Control panel*, page *49*. |

## Connection overview of R11

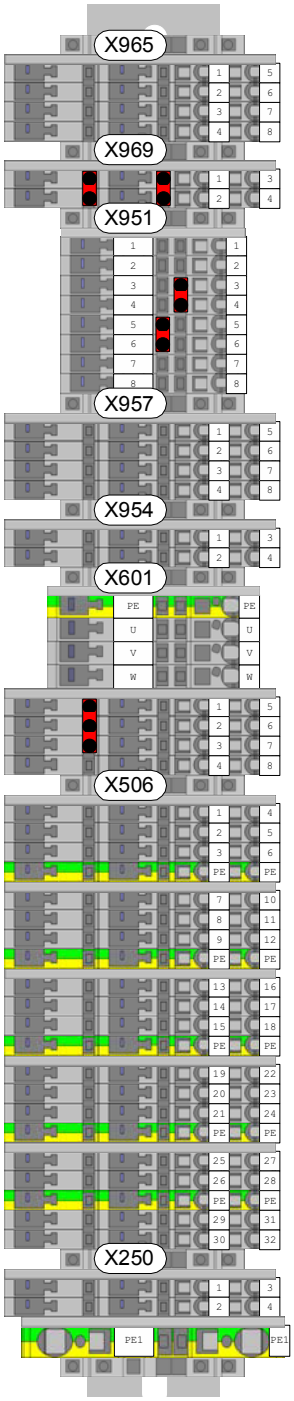



| | |
|---|---|
| A | Motor-side converter control unit (drive control unit) |
| B | Line-side converter control unit<br>For the control unit connections, see also *Replacing the drive and LCL filter modules (frame R11)*. |
| 1<br>2<br>3 | Analog and digital I/O extension modules, feedback interface modules and fieldbus communication modules can be inserted into slots 1, 2 and 3. See section *Type designation key* page *59*. |
| 4 | Connection for FSO-xx safety functions module |
| 5 | Memory unit (see page *207*) |
| 6 | See section *Control panel* (page *49*) |
| 7 | Terminal blocks on the drive control unit. See chapter *Control unit of frame R11* (page *145*). These terminals are optionally wired to terminal block X504 in the drive cabinet. |
| 8 | Fiber optic link to the motor-side converter. Similarly, the line-side converter is connected to the line-side converter control unit with fiber optic cables. |
| 9 | Terminal blocks for customer connections installed in the drive cabinet. Wiring details are given starting on page *113*. |
| 10 | Socket for external line-side converter control |
| 11 | Line-side converter |
| 12 | DC link |
| 13 | Motor-side converter |

## External control cable connection terminals

### Connection terminals of R8

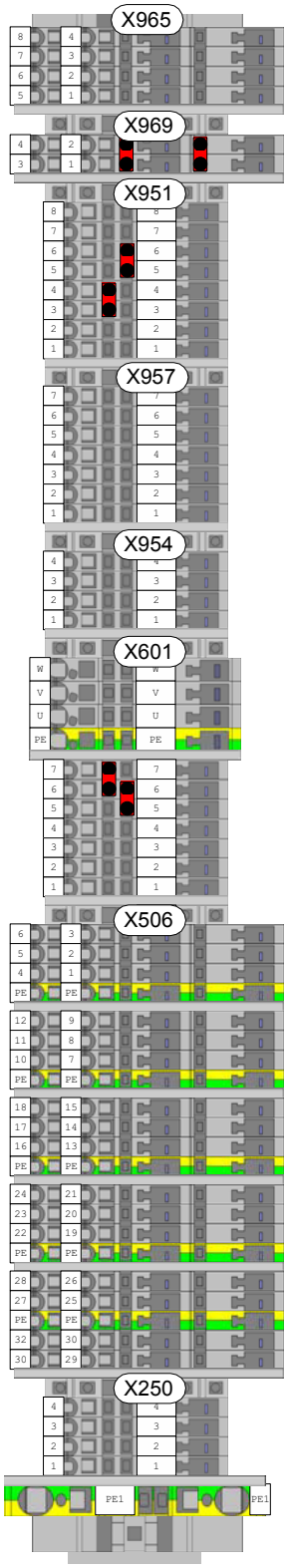
The layout of external control cable connection terminals at the right-hand side of the drive cabinet is shown below. The composition depends on the options selected.




| | Terminals for |
|---|---|
| X250 | Main switch feedback for customer and line contactor feedback with options +Q951, +Q952 or +Q978 |
| X506 | Thermistor relay or Pt100 relays (option +L505 or +L506) |
| X601 | Starter for auxiliary motor fan (options +M600…M605) |
| X951 | Push buttons for emergency stop options +Q951, +Q952, +Q963 and +Q964 |
| X954 | Ground fault monitoring for IT (ungrounded) systems (option +Q954) |
| X957 | Prevention of unexpected start-up with safety relays (option +Q957) |
| X965 | Safely limited speed with encoder (option +Q965) |
| X969 | External STO customer connection for safety options +Q951, +Q952, +Q963, +Q964, +Q957 and +Q971 |

## Connection terminals of R11

The layout of external control cable connection terminals at the left-hand side of the drive cabinet is shown below. The composition depends on the options selected.




| | Terminals for |
|---|---|
| X250 | Line contactor and main switch feedback for customer |
| X506 | Thermistor relay or Pt100 relays (option +L505 or +L506) |
| X601 | Starter for auxiliary motor fan (options +M600…M605) |
| X951 | Push buttons for emergency stop options +Q951, +Q952, +Q963 and +Q964 |
| X954 | Ground fault monitoring for IT (ungrounded) systems (option +Q954) |
| X957 | Prevention of unexpected start-up with safety relays (option +Q957) |
| X965 | Safely limited speed with encoder (option +Q965) |
| X969 | External STO customer connection for safety options +Q951, +Q952, +Q963, +Q964, +Q957 and +Q971 |

# Door switches and lights




| | Label in English | Label in local language | Description |
|---|---|---|---|
| 1 | READY | - | Ready light (option +G327) |
| 2 | RUN | - | Run light (option +G328) |
| 3 | FAULT | - | Fault light (option +G329) |
| 4 | RUN/ENBL<br>OFF ON<br>  | - | Run enable signal switch for the line-side converter with options +Q951, +Q952 and +Q978<br>OFF: Run enable signal off (starting the line-side converter not allowed). Opens the charging contactor.<br>ON: Run enable signal on (starting the line-side converter allowed). Closes the charging contactor Q3. |
| 5 | E-STOP RESET | - | Emergency stop reset push button (with emergency stop options only) |
| 6 | EARTH FAULT | - | Ground (earth) fault light with option +Q954 |
| 7 | - | - | Reserved for application-engineered equipment |
| 8 | EMERGENCY STOP | - | Emergency stop push button (with emergency stop options only) |

The layout depends on the options selected.

## Main disconnecting device (Q1)

The main disconnecting device switches the main supply to the drive on and off. To disconnect the main supply, turn the switch-disconnector (frame R11) or switch fuse (frame R8) to the 0/OFF position.

**WARNING!** The main disconnecting device does not isolate the input power terminals or V-meter (option +G334) from the power line. To isolate the input power terminals and V-meter, open the main breaker of the supply transformer.

**Note:** The drive is not fitted with an auxiliary voltage switch. The auxiliary voltage is switched on and off by the main disconnecting device (Q1), and protected by fuses F21.1-2.

## Other devices on the door

- Voltmeter (option +G334); comes with a phase selector switch. **Note:** The voltage is measured on the supply side of the main disconnecting device.
- AC current meter (option +G335) on one phase.

## Control panel

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

The control panel can be removed by pulling it forward from the top edge and reinstalled in reverse order. For the use of the control panel, see *ACS-AP assistant control panel user's manual* (3AUA0000085685 [English]) and the firmware manual.









## Control by PC tools

There is a USB connector on the front of the panel that can be used to connect a PC to the drive. When a PC is connected to the control panel, the control panel keypad is disabled.

# Descriptions of cabinet options

**Note:** All options are not available for all drive types, do not coexist with certain other options, or may require additional engineering. Check actual availability with ABB.

## Degree of protection

### Definitions

According to IEC/EN 60529, the degree of protection is indicated by an IP code where the first numeral means protection against ingress of solid foreign objects, and the second numeral protection against ingress of water. The IP codes of the standard cabinet and options covered in this manual are defined below.

| IP code | The equipment is protected … | |
|---|---|---|
| | First numeral | Second numeral |
| IP22 | against ingress of solid foreign objects ≥ 12.5 mm diameter * | against dripping (15° tilting) water |
| IP42 | against ingress of solid foreign objects ≥ 1 mm | against dripping (15° tilting) water |
| IP54 | dust-protected | against splashing water |

* meaning for protection of persons: against access to hazardous parts with finger

### IP22 (standard)

The degree of protection of the standard drive cabinet is IP22 (UL Type 1). The air outlets at the top of the cabinet and the air inlet gratings are covered with metallic gratings. With doors open, the degree of protection of the standard cabinet and all cabinet options is IP20. The live parts inside the cabinet are protected against contact with clear plastic shrouds or metallic gratings.

### IP42 (option +B054)

This option provides the degree of protection of IP42 (UL Type 1 Filtered). The air inlet gratings are covered with a metallic mesh between the inner and outer metallic gratings.

### IP54 (option +B055)

This option provides the degree of protection of IP54 (UL Type 12). It provides the cabinet air inlets with filter housings containing folded board air filter mats between the inner and outer metallic gratings. An additional fan and filtered outlets on the cabinet roof are also included.

## Channeled air inlet through bottom (option +C128)

This option provides air intake to the drive through the cabinet bottom when the drive is installed on an air duct in the floor.

See also *Air inlet through the bottom (option +C128)* on page *75*.

Required options: IP54 degree of protection (+B055)

## Channeled air outlet (option +C130)

This option provides a collar for fitting an air outlet duct. The collar is located on the cabinet roof. Depending on the equipment installed in each cubicle, the channeled air outlet either replaces, or adds to, the standard roof arrangement.

See also *Air outlet duct on the cabinet roof (option +C130)* on page *76*.

## Marine construction (option +C121)

The option includes the following accessories and features:

- reinforced mechanics
- grab railings
- door flush bolt which allows the door to open 90 degrees and prevents it from slamming close
- self-extinctive materials
- flat bars at base of the cabinet for attaching
- attaching braces at the top of the cabinet.

Required options: Appropriate additional wire marking option (see page *54*) according to the requirements of the classification society

Related options: halogen-free materials and wiring (+G330)

## UL listed (option +C129)

The option includes factory inspection of the cabinet according to UL 508C and the following accessories and features:

- US type main switch and fuses
- top entry and exit of cables
- US cable conduit entry (plain plate without ready-made holes)
- all components UL Listed/Recognized
- maximum supply voltage 600 V.

Related options: +H350 (bottom entry of cables), +H352 (bottom exit of cables) and +H358 (cable conduit entry)

The option is not available with +C121 (marine construction) or +E206 (sine output filter).

## Plinth height (options +C164 and +C179)

The standard height of the cabinet plinth is 50 mm. These options specify a plinth height of 100 mm (+C164) or 200 mm (+C179).

## Seismic design (option +C180)

This option involves seismic capability according to International building code 2012, test procedure ICC-ES AC-156. The installation level must not exceed 25% of the height of the building, and SDS (installation site specific spectral acceleration response) must not exceed 2.0 g.

The option includes the following accessories and features:

- reinforced plinth
- flat bars at base of the cabinet for attaching.

## Empty cubicles (options +C196, +C197, +C198, +C199, +C200, +C201)

The option adds an empty 400, 600 or 800 mm wide cubicle to the left or right end of the cabinet. The cubicle is equipped with blank power cable exits both at the top and the bottom.

## EMC filters (option + E202)

See section *Type designation key* on page *59* and sections *Compliance with the European EMC Directive* on page *229* and *Compliance with EN 61800-3:2004 + A1:2012* on page *232*.

More information: *Technical Guide No. 3 – EMC Compliant Installation and Configuration for a Power Drive System* (3AFE61348280 [English])

## du/dt filter (option +E205)

The du/dt filter protects the motor insulating system by reducing the voltage rise speed at the motor terminals. The filter also protects the motor bearings by reducing the bearing currents.

More information on when the option is required: See section *Examining the compatibility of the motor and drive* on page *79*.

## Sine filter (option +E206)

A sine filter provides true sinusoidal voltage waveform at the drive output by suppressing the high-frequency voltage components of the output. These high-frequency components cause stress to motor insulation as well as output transformer saturation (if present).

The sine filter option consists of three single-phase reactors and delta-connected capacitors at the output of the drive. The filter is fitted in a separate cubicle. A du/dt filter can be replaced with a sine filter.

More information: see page *85*.

## Common mode filter (option +E208)

The common mode filter contains ferrite rings mounted around the AC output busbars in the drive module. The filter protects the motor bearings by reducing the bearing currents.

More information on when the option is required: See section *Examining the compatibility of the motor and drive* on page *79*.

## Cabinet heater with external supply (option +G300)

The option contains:

- 50 W or 100 W heating elements in the cabinet
- load switch for providing electrical isolation during service
- miniature circuit breaker for overcurrent protection
- terminal block for external power supply.

The heater prevents humidity condensation inside the cabinet when the drive is not running. The power output of the semiconductor-type heating elements depends on the environmental temperature. The customer must switch the heating off when it is not needed by cutting the supply voltage off.

The customer must supply the heater from an external 110…240 V AC power source.

See also
- *Powering the heating and lighting equipment (options +G300, +G301 and +G313)* on page *117*
- *Auxiliary circuit power consumption* on page *227*
- circuit diagrams delivered with drive for the actual wiring.

### Cabinet lighting (option +G301)

This option contains LED lighting fixtures in each cubicle and a 24 V DC power supply. The lighting is powered from the same external 110…240 V AC power source as the cabinet heater (option +G300).

### Terminals for external interruptible control voltage (option +G307)

The option provides terminals for connecting external interruptible control voltage to the control unit and control devices when the drive is not running.

See also
- *Supplying power for the auxiliary circuits* on page *96*
- *Connecting an auxiliary voltage supply (UPS, option +G307)* on page *113*
- circuit diagrams delivered with drive for the actual wiring.

### Output for motor space heater (option +G313)

The option contains:
- load switch for providing electrical isolation during service
- miniature circuit breaker for overcurrent protection
- terminal block for external supply and heating element(s) connection.

The heater is off when the drive is operating. The customer controls the heating elements in the motor windings on and off with the external supply. The power and voltage of the motor heater depend on the motor.

See also
- *Supplying power for the auxiliary circuits* on page *96*
- *Powering the heating and lighting equipment (options +G300, +G301 and +G313)* on page *117*
- circuit diagrams delivered with drive for the actual wiring.

### Ready/Run/Fault lights (options +G327…G329)

These options provide “ready” (+G327, white), “run” (+G328, green) and “fault” (+G329, red) lights installed on the cabinet door.

### Halogen-free materials and wiring (option G330)

The option provides halogen-free cable ducts, control wires and wire sleeves, thus reducing toxic fire gases.

### V-meter with selector switch (option +G334)

The option contains a voltmeter and a selector switch on the cabinet door. The switch selects the two input phases across which the voltage is measured.

## A-meter in one phase (option +G335)

The option contains an ammeter that reads the current flowing through one (L1) input phase.

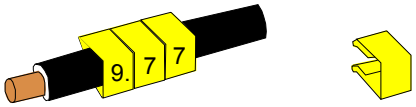
## Additional wire markings (options +G340 and +G342)

### Standard wire markings

As standard, wires and terminals are marked as follows:

- Plug-in connectors of wire sets: Connector labeled with designation (for example, “X1”). Both the connector and the individual wires are marked with pin numbers.
- Wires without a connector: Connector designation and pin number printed on wire (for example, “X1:7”).
- Fiber optic pairs: Component and connector designation printed on marker tape.
- Main input, output and PE terminals: Connector identifier (for example, “U1”, “PE”) printed on sticker on terminal, or on insulating material close to the terminal. PE cables marked with yellow/green tape.

The wire marking options are described below.

| | **Additional markings** |
|---|---|
| +G340 | Equipment pin numbers are marked with snap-on markers on wires between modules and on wires connected to equipment, terminal blocks and detachable screw terminals. Plug-in connector identifications are marked on labels near the connectors. The label holders are attached around conductor bundles. Main circuit conductors are marked with white tape or printing.<br>  |
| +G342 | Equipment identifications and terminal block pin numbers and remote addresses are marked with hoses or rings on wires between modules, and on wires connected to equipment, terminal blocks and detachable screw terminals. Plug-in connector identifications are marked on labels attached around the conductor bundles near the connectors. Main circuit conductors are marked with white tape or printing.<br>**Note:** Even wires with equipment and pin identifiers ready printed on the wire insulation are marked with rings or hoses. Remote end addresses **are not** marked on wire ends that are connected to plug-in connectors. Short and obvious connections are marked with printing only.<br>  |

## Bottom cable entry/exit (options +H350 and +H352)

For UL Listed (+C129) units, the default input and output cabling direction is through the roof of the cabinet. The bottom entry (+H350) and bottom exit (+H352) options provide power and control cable entries at the floor of the cabinet.

For non-UL Listed units, bottom entry/exit is the default cabling arrangement.

## Top cable entry/exit (options +H351 and +H353)

For non-UL Listed units, the default input and output cabling direction is through the bottom of the cabinet. The top entry (+H351) and top exit (+H353) options provide power and control cable entries at the roof of the cabinet. The entries are equipped with grommets and 360° grounding hardware.

For UL Listed (+C129) units, top entry/exit is the default cabling arrangement.

## Cable conduit entry (option +H358)

The option provides US/UK conduit plates (plain 3 m steel plates without any ready-made holes). US/UK conduit plates are provided as standard with options +C129 and +C134 instead of the normal cable entries.

## Additional terminal block X504 (option +L504)

The standard terminal blocks of the drive control unit are wired to the additional terminal block at the factory for customer control wiring. The terminals are spring loaded.

Cables accepted by the terminals:

- solid wire 0.08 to 4 $mm^2$ (28 to 12 AWG)
- stranded wire with ferrule 0.14 to 2.5 $mm^2$ (24 to 14 AWG)
- stranded wire without ferrule 0.08 to 2.5 $mm^2$ (28 to 12 AWG).

Stripping length: 10 mm (0.4 in)

**Note**: The optional modules inserted in the slots of the control unit (or optional FEA-03 extension adapter) are not wired to the additional terminal block. The customer must connect the optional module control wires directly to the modules.

## Thermal protection with PTC relays (options +L505, +2L505. +L513, +2L513)

PTC thermistor relay options are used for the overtemperature supervision of motors equipped with PTC sensors. When the motor temperature rises to the thermistor wake-up level, the thermistor resistance increases sharply. The relay detects the change and indicates motor overtemperature through its contacts.

**+L505, +2L505, +L513, +2L513**

Option +L505 provides a thermistor relay and a terminal block. The terminal block has connections for the measuring circuit (one to three PTC sensors in series), the output indication of the relay, and an optional external reset button. The relay can be reset either locally or externally, or the reset circuit can be jumpered for automatic reset.

The output indication of the relay can be wired by the customer for example to

- the main contactor or breaker control circuit of the drive, to open it in case of motor overtemperature,
- the appropriate digital input of the drive, to trip the drive and generate a fault message in case of motor overtemperature, or
- an external monitoring circuit.

Option +L513 is an ATEX-certified thermal protection function that has the same external connectivity as +L505. In addition, +L513 comes with +Q971 (ATEX-certified safe disconnection function) and is wired at the factory to activate the Safe torque off function of the drive in an overtemperature situation. A manual reset for the protection function is required by Ex/ATEX regulations. For more information, see *ATEX-certified motor thermal*

*protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).

Options +2L505 and +2L513 duplicate options +L505 and +L513 respectively, containing the relays and connections for two separate measurement circuits.

**+L536, +L537**

An alternative to a thermistor relay option is the FPTC-01 (option +L536) or FPTC-02 (option +L537, also requires option +Q971) thermistor protection module. The module mounts onto the drive control unit, and has reinforced insulation to keep the control unit PELV-compatible. The connectivity of the FPTC-01 and the FPTC-02 is the same. FPTC-02 is an ATEX-certified thermistor protection module, Type Examined as a protective device within the scope of the European ATEX Product Directive.

For protection purposes, the FPTC has a "fault" input for the PTC sensor. An overtemperature situation executes the SIL/PL-capable SMT (Safe motor temperature) safety function by activating the Safe torque off function of the drive.

The FPTC also has a "warning" input for the sensor. When the module detects overtemperature through this input, it sends a warning indication to the drive.

For more information and wiring examples, see the module manuals and the circuit diagrams delivered with the drive.

**More information**

See

- firmware manual for parameter settings
- *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English])
- *FPTC-01 thermistor protection module (option +L536) for ACS880 drives user's manual* (3AXD50000027750 [English])
- *FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537 +Q971) for ACS880 drives user's manual* (3AXD50000027782 [English])
- *Wiring the PTC thermistor relay(s) (options +L505, +2L505, +L513, +2L513)* on page *114*
- circuit diagrams delivered with the drive for the actual wiring.

## Pt100 relays (options +2L506, +3L506, +5L506, +8L506, +L514)

Pt100 temperature monitoring relays are used for overtemperature supervision of motors equipped with Pt100 sensors. For example, there can be three sensors to measure the temperature of the motor windings and two sensors for the bearings.

The standard Pt100 relay options include two (+2L506), three (+3L506), five (+5L506) or eight (+8L506) relays. The monitoring relays are connected to one to three auxiliary relays whose outputs are wired at the factory to a terminal block. The sensors are to be connected by the customer to the same terminal block.

As the temperature rises, the sensor resistance increases linearly. At an adjustable wake-up level, the monitoring relay de-energizes its output which then trips one of the auxiliary relays.

The output indication of the auxiliary relays can be wired by the customer for example to

- the main contactor or breaker control circuit of the drive, to open it in case of motor overtemperature,
- the appropriate digital input of the drive, to trip the drive and generate a fault message in case of motor overtemperature, or
- an external monitoring circuit.

Options +3L514 (3 relays), +5L514 (5 relays) are ATEX-certified thermal protection functions that have the same external connectivity as +nL506. In addition, each monitoring relay has a 0/4…20 mA output that is available on the terminal block. Option +nL514 comes with option +Q971 (ATEX-certified safe disconnection function) as standard and is wired at the factory to activate the Safe torque off function of the drive in an overtemperature situation. As the monitoring relay does not have a reset functionality, the manual reset required by Ex/ATEX regulations must be implemented using drive parameters. For more information, see *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).

See also

- firmware manual for parameter settings
- *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English])
- *Wiring the Pt100 relays (option +nL506)* on page *115* or *Wiring the Pt100 relays (option +nL514)* on page *116*
- Pt100 relay alarm and trip limit setting instructions on page *158*
- circuit diagrams delivered with the drive for the actual wiring.

## Starter for auxiliary motor fan (options +M600…+M605)

### What the option contains

The option provides switched and protected connections for one 3-phase auxiliary motor fan. Each fan connection is equipped with

- fuses
- a manual motor starter switch with an adjustable current limit
- a contactor controlled by the drive, and
- terminal block X601 for customer connections.

### Description

The output for the auxiliary fan is wired from the 3-phase supply voltage to terminal block X601 through a motor starter switch and a contactor. The contactor is operated by the drive. The 230 V AC control circuit is wired through a jumper on the terminal block; the jumper can be replaced by an external control circuit.

The starter switch has an adjustable trip current limit, and can be opened to permanently switch the fan off.

The statuses of both the starter switch and the fan contactor are wired to the terminal block.

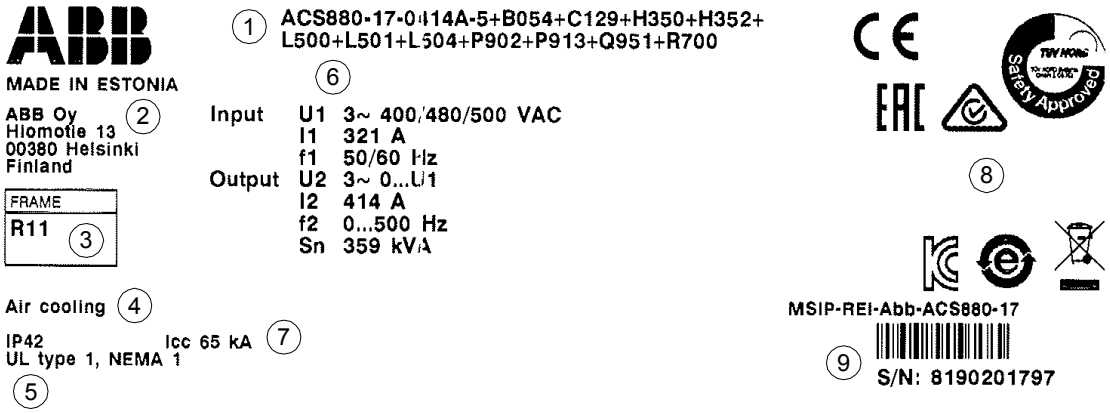
See the circuit diagrams delivered with the drive for the actual wiring.

# Type designation label

The type designation label includes an IEC and UL (NEC) rating, appropriate markings, a type designation and a serial number, which allow identification of each unit.

Quote the complete type designation and serial number when contacting technical support.

A sample label is shown below.




| | |
|---|---|
| 1 | Type designation, see section *Type designation key* below. |
| 2 | Manufacturing address |
| 3 | Frame size |
| 4 | Cooling method |
| 5 | Degree of protection |
| 6 | Ratings, see section *Ratings* on page *211* and *Electrical power network specification* on page *225*. |
| 7 | Short-circuit withstand strength, see section *Electrical power network specification* on page *225*. |
| 8 | Valid markings |
| 9 | 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. The first digits from left express the basic configuration (for example, ACS880-17-0650A-3). The optional selections are given thereafter, separated by plus signs, for example, +E202. The main selections are described below. Not all selections are available for all types. For more information, refer to *ACS880 Ordering Information* (3AXD10000052815, available on request).

| CODE | DESCRIPTION |
|---|---|
| **Basic codes** | |
| ACS880 | Product series |
| 17 | When no options are selected: cabinet-installed drive, IP22 (UL Type 1), switch fuse (R8), main switch-disconnector (R11), aR fuses, line contactor in frame R11, ACS-AP-W Assistant control panel, EMC filter of category C3 for second environment TN (grounded) and IT (ungrounded) systems in R11, no EMC filter in R8, ACS880 primary control program, Safe torque off function, coated circuit boards, bottom entry and exit of cables, USB memory stick containing circuit diagrams, dimension drawings and manuals. |
| **Size** | |
| xxxx | Refer to the rating tables (page *211*) |
| **Voltage range** | |
| 3 | 380…415 V. This is indicated in the type designation label as typical input voltage level 3 ~ 400 V AC. |
| 5 | 380…500 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 400/480/500 V AC. |
| 7 | 525…690 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 525/600/690 V AC. |
| **Option codes (plus codes)** | |
| **Degree of protection** | |
| B054 | IP42 (UL Type 1 Filtered) |
| B055 | IP54 (UL Type 12) |
| **Construction** | |
| C121 | Marine construction (reinforced mechanics and attaching, handrails, self-extinctive materials). Not with +C129, +C134, +C164, +C179, +C180 and +E206) |
| C128 | Air inlet through bottom of cabinet (+B055 required) |
| C129 | UL Listed (US type main switch fuse, top entry and exit of cables, cable conduit entries, all components UL Listed or Recognized, max. supply voltage 600 V) Not with +C121 and +E206. |
| C130 | Channeled air outlet (not with +H351, +H353, +C129 and +D151) |
| C132 | Marine type approval (+C121 marine construction required) |
| C134 | CSA Approved (US/CSA type main switch fuse, bottom entry and exit of cables, cable conduit entries, all components UL/CSA Listed or Recognized, max. supply voltage 600 V). Not with +C121 and +E206. |
| C164 | Plinth height 100 mm (not with +C121 or +C180) |
| C179 | Plinth height 200 mm (not with +C121 or +C180) |
| C180 | Seismic design (not with +C121, +C164, +C179 and +E206) |
| C196 | Empty cubicle 400 mm on right side |
| C197 | Empty cubicle 600 mm on right side |
| C198 | Empty cubicle 800 mm on right side |
| C199 | Empty cubicle 400 mm on left side |
| C200 | Empty cubicle 600 mm on left side |
| C201 | Empty cubicle 800 mm on left side |

| CODE | DESCRIPTION |
|---|---|
| **Filters** | |
| E200 | EMC filter for 2nd environment, TN (grounded) system, category C3 (for R8) |
| E201 | EMC filter for 2nd environment, IT (ungrounded) system, category C3 (for R8) |
| E202 | EMC filter for first environment, TN (grounded) system, category C2 (not for 690 V; +E208 required for R11) |
| E205 | du/dt filter |
| E206 | Sine output filter (not with +C121, +C129, +C134 and +C180) |
| E208 | Common mode filter |
| **Cabinet equipment** | |
| G300 | Cabinet and module heating elements (external supply) |
| G301 | Cabinet lighting |
| G307 | Terminals for connecting external control voltage (230 V AC or 115 V AC, for example, UPS) |
| G313 | Output for motor heater (external supply) |
| G327 | Ready light, white |
| G328 | Run light, green |
| G329 | Fault light, red |
| G330 | Halogen-free wiring and materials (not with +C129 or +C134) |
| G334 | V-meter with selector switch |
| G335 | A-meter in one phase |
| G340 | See section *Additional wire markings (options +G340 and +G342)* on page *54*. |
| G342 | |
| **Cabling** | |
| H350 | Bottom entry |
| H351 | Top entry |
| H352 | Bottom exit |
| H353 | Top exit |
| H358 | Cable conduit entry (US/UK) |
| **Control panel** | |
| J425 | ACS-AP-I Assistant control panel (Non-Bluetooth control panel) |
| **Fieldbus adapters** | |
| K451 | FDNA-01 DeviceNet™ adapter module |
| K454 | FPBA-01 PROFIBUS DP adapter module |
| K457 | FCAN-01 CANopen adapter module |
| K458 | FSCA-01 RS-485 adapter module |
| K462 | FCNA-01 ControlNet™ adapter module |
| K469 | FECA EtherCat adapter module |
| K470 | FEPL EtherPOWERLINK adapter module |
| K473 | FENA-11 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols |
| K475 | FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port |
| **I/O extensions and feedback interfaces** | |
| L500 | FIO-11 analog I/O extension module |
| L501 | FIO-01 digital I/O extension module |
| L502 | FEN-31 HTL incremental encoder interface module |
| L503 | FDCO-01 optical DDCS communication adapter module |
| L504 | Additional I/O terminal block |

| CODE | DESCRIPTION |
|---|---|
| L505 | Thermistor relay (1 or 2 pcs) |
| L506 | Pt100 relay (2, 3, 5 or 8 pcs) |
| L508 | FDCO-02 optical DDCS communication adapter module |
| L513 | ATEX-certified thermal protection with PTC sensors (1 or 2 pcs, +Q971 required) |
| L514 | ATEX-certified thermal protection with Pt100 relays (3 or 5 pcs, +Q971 required) |
| L515 | FEA-03 I/O extension adapter module (+L503 or +L508 required) |
| L516 | FEN-21 resolver interface module |
| L517 | FEN-01 TTL incremental encoder interface module |
| L518 | FEN-11 TTL absolute encoder interface module |
| L521 | FSE-31 pulse encoder interface (+Q972 required) |
| L525 | FAIO-01 analog I/O extension module |
| L526 | FDIO-01 digital I/O extension module |
| L536 | FPTC-01 thermistor protection module (not with +L505, +L506, +L513, +L514, +L537, +Q957, +Q951, +Q952, +Q963 and +Q964) |
| L537 | FPTC-02 ATEX-certified thermistor protection module (+Q971 required; not with +L505, +L506, +L513, +L521, +L536, +Q957, +Q951, +Q952, Q963, +Q964) |
| **Starter for auxiliary motor fan** | |
| M600 | Trip limit setting range: 1 … 1.6 A |
| M601 | Trip limit setting range: 1.6 … 2.5 A |
| M602 | Trip limit setting range: 2.5 … 4 A |
| M603 | Trip limit setting range: 4 … 6.3 A |
| M604 | Trip limit setting range: 6.3 … 10 A |
| M605 | Trip limit setting range: 10…16 A |
| **Control program** | |
| N5000 | Winder control program |
| N5050 | Crane control program (not with +Q952, +Q963, +Q964 and +Q979) |
| N5100 | Winch control program (not with +Q952, +Q963, +Q964 and +Q979) |
| N5200 | PCP control program |
| N5300 | Test bench control program |
| N5450 | Override control program (not with +Q972 and +Q973) |
| N5600 | ESP control program |
| N7502 | Control program for synchronous reluctance motors (SynRM) |
| N8010 | Application programming (not with +N5000, +N5050, +N5100, +N5200 or +N5450) |
| **Specialties** | |
| P902 | Customized |
| P904 | Extended warranty |
| P912 | Seaworthy packaging |
| P913 | Special color |
| P929 | Container packaging |
| **Safety functions** | |
| Q950 | Prevention of unexpected start-up with FSO-xx safety functions module, by activating the Safe torque off function |
| Q951 | Emergency stop (category 0) with safety relays, by opening the main breaker/contactor |
| Q952 | Emergency stop (category 1) with safety relays, by opening the main breaker/contactor (+L501 required; not with +N5000 and +N5050) |
| Q954 | Ground fault monitoring for IT (ungrounded networks) |

| CODE | DESCRIPTION |
|---|---|
| Q957 | Prevention of unexpected start-up with safety relays, by activating the Safe torque off function |
| Q963 | Emergency stop (category 0) with safety relays, by activating the Safe torque off function (not with +N5000 and +N5050) |
| Q964 | Emergency stop (category 1) with safety relays, by activating the Safe torque off function (+L501 required; not with +N5000 and +N5050) |
| Q965 | Safely limited speed with encoder (+Q972 and +L521 required) |
| Q971 | ATEX-certified safe disconnection function (+L513, +L514 or +L537 required; not with +Q957, +Q951, +Q952, +Q963 and +Q964) |
| Q972 | FSO-21 safety functions module (not with +Q957, +Q951, +Q952, +Q963, +Q964 and +Q972) |
| Q973 | FSO-12 safety functions module (not with +Q957, +Q951, +Q952, +Q963, +Q964 and +Q972) |
| Q978 | Emergency stop (configurable for category 0 or 1) with FSO-xx safety functions module, by opening the main breaker/contactor |
| Q979 | Emergency stop (configurable for category 0 or 1) with FSO-xx safety functions module, by activating the Safe torque off function (not with +N5000 and +N5050) |
| Q982 | PROFIsafe with FSO-xx safety functions module and FENA-21 Ethernet adapter module |
| **Full set of printed manuals in the selected language**<br>**Note:** The delivery may include manuals in English if the requested language is not available. | |
| R700 | English |
| R701 | German |
| R702 | Italian |
| R703 | Dutch |
| R704 | Danish |
| R705 | Swedish |
| R706 | Finnish |
| R707 | French |
| R708 | Spanish |
| R709 | Portuguese |
| R711 | Russian |
| R713 | Polish |

4

# Mechanical installation

## Contents of this chapter

This chapter describes the mechanical installation procedure of the drive.

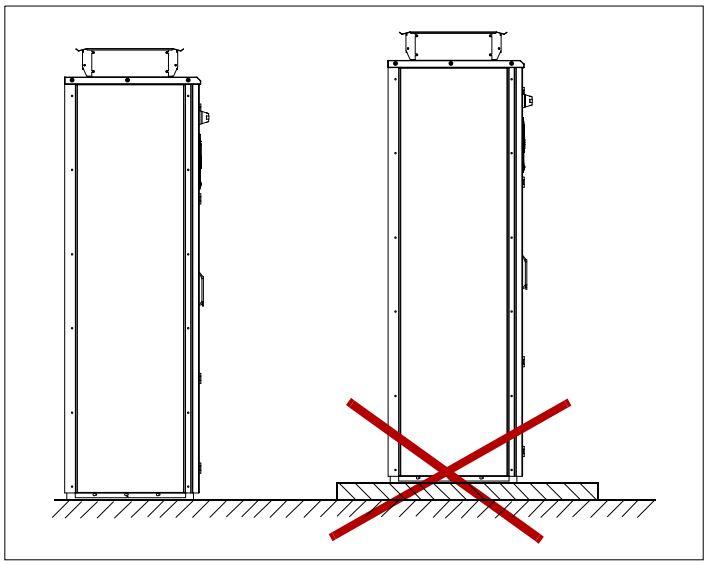
## Examining the installation site

Examine the installation site:

- The installation site is sufficiently ventilated or cooled to remove heat from the drive. [1)]
- The ambient conditions of the drive meet the specifications. [1)]
- The wall behind the unit is of non-flammable material.
- There is enough free space above the drive to enable cooling air flow, service and maintenance.
- The floor that the unit is installed on is of non-flammable material, as smooth as possible, and strong enough to support the weight of the unit. Check the floor flatness with a spirit level. The maximum allowed deviation from the surface level is 5 mm in every 3 meters. Level the installation site, if necessary, as the cabinet is not equipped with adjustable feet.

[1)] The heat losses and ambient conditions are specified in chapter *Technical data*.

**Note:** Try to avoid installing the drive on an elevated platform or a recess. The module extraction/installation ramp supplied with the drive can only be used on a level floor.



## Necessary tools

The tools required for moving the unit to its final position, attaching it to the floor and wall and tightening the connections are listed below:

- crane, fork-lift or pallet truck (check load capacity!), slate/spud bar, jack and rollers
- Pozidriv and Torx screwdrivers
- torque wrench
- set of wrenches or sockets.

## Checking the delivery

The drive delivery contains:

- drive cabinet or cabinet line-up (if option cabinets are ordered)
- optional modules (if ordered) installed onto the control unit at the factory
- appropriate drive and optional module manuals
- delivery documents.

Check that there are no signs of damage. Before attempting installation and operation, check the information on the type designation labels of the drive to verify that the delivery is of the correct type. See section *Type designation key* on page *59*.

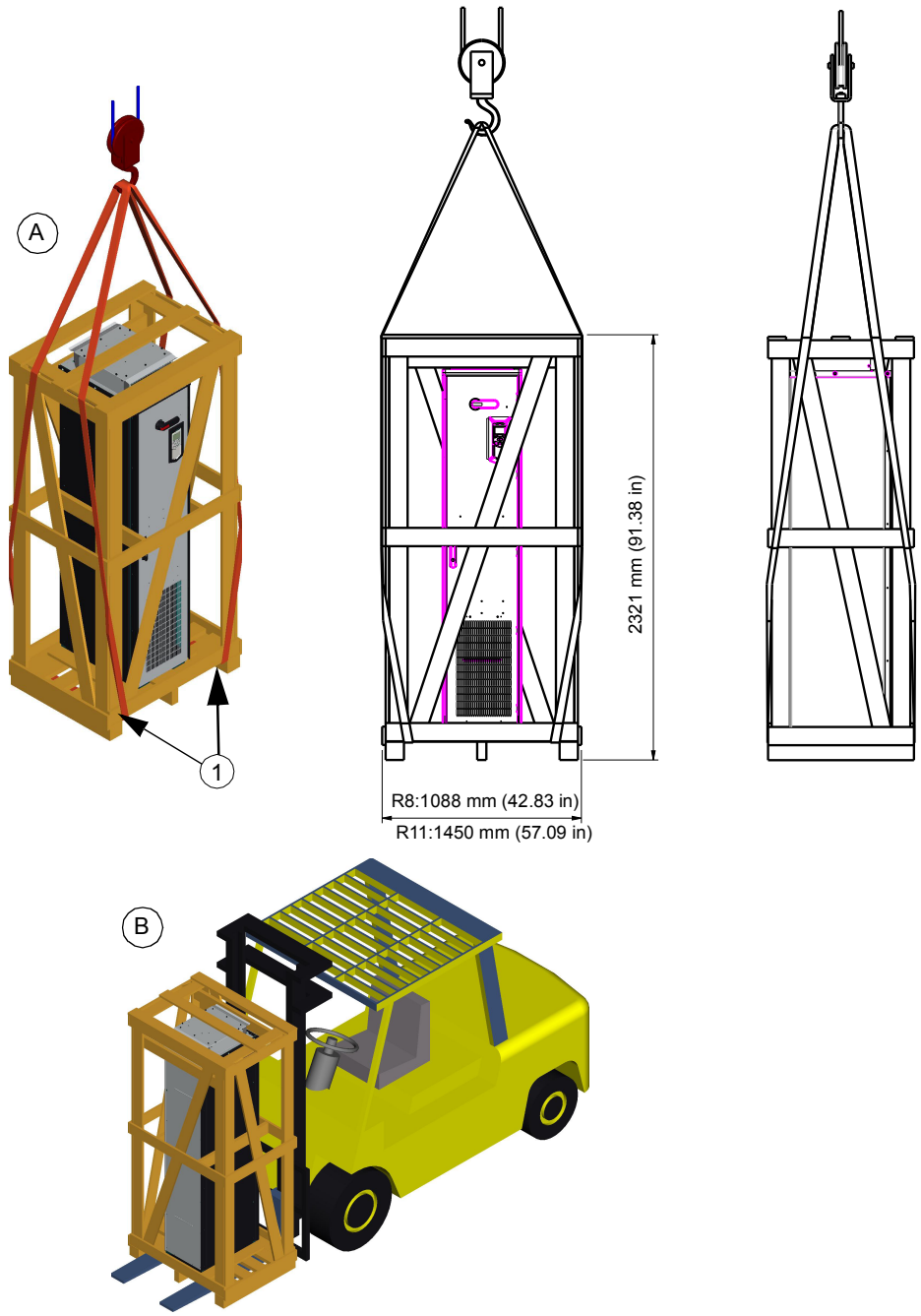
# Moving and unpacking the drive

Move the drive in its original packaging to the installation site as shown below to avoid damaging the cabinet surfaces and door devices. When you are using a pallet truck, check its load capacity before you move the drive.

The drive cabinet is to be moved in the upright position.

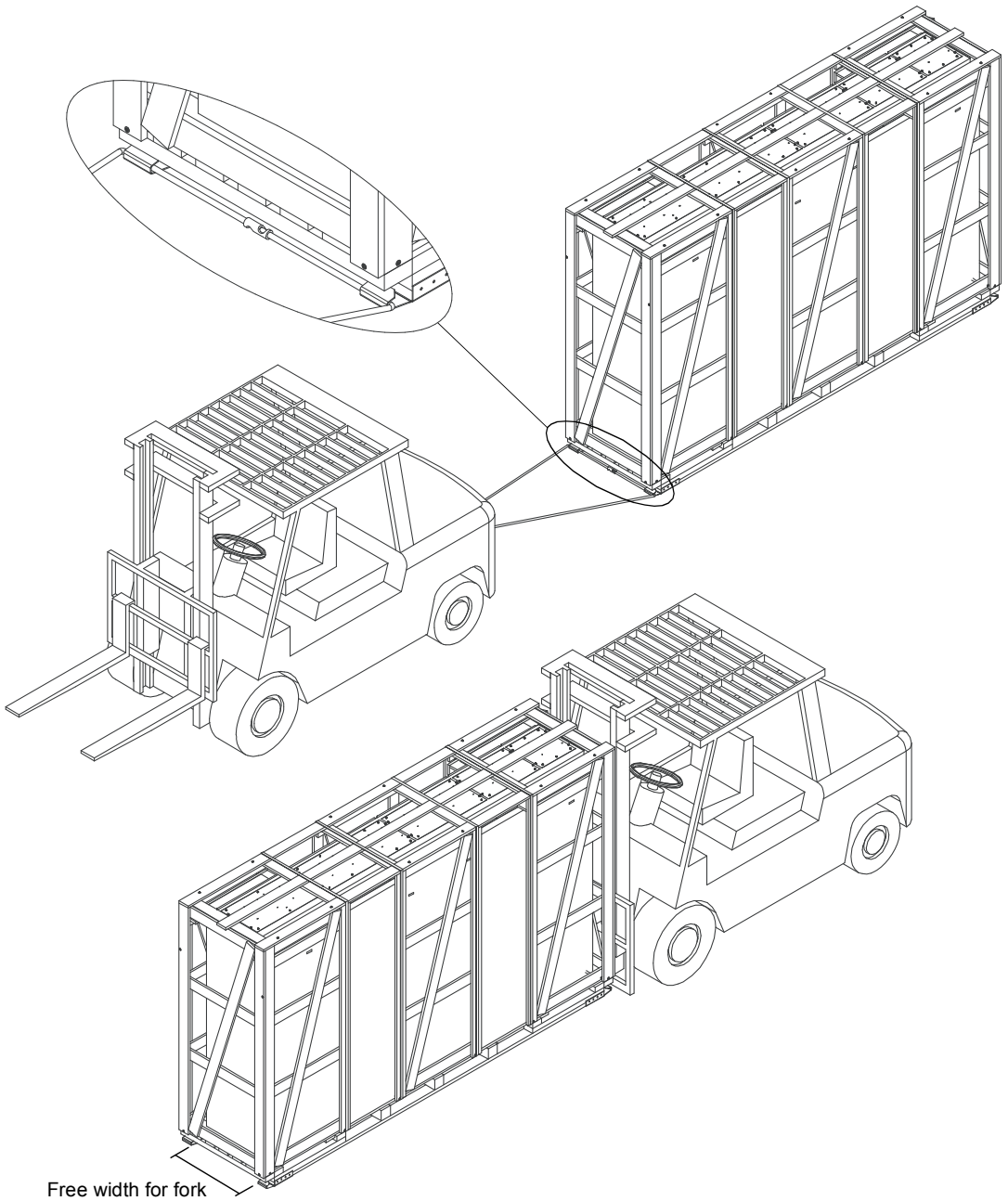
The center of gravity of the cabinet is high. Be therefore careful when moving the unit. Avoid tilting.

## Moving the drive in its packaging




| | |
|---|---|
| A | Lifting the transport package with slings. |
| 1 | Lifting points |
| B | Lifting the transport package with forklift |

## Moving the crate with a forklift



## Removing the transport package

Remove the transport package as follows:

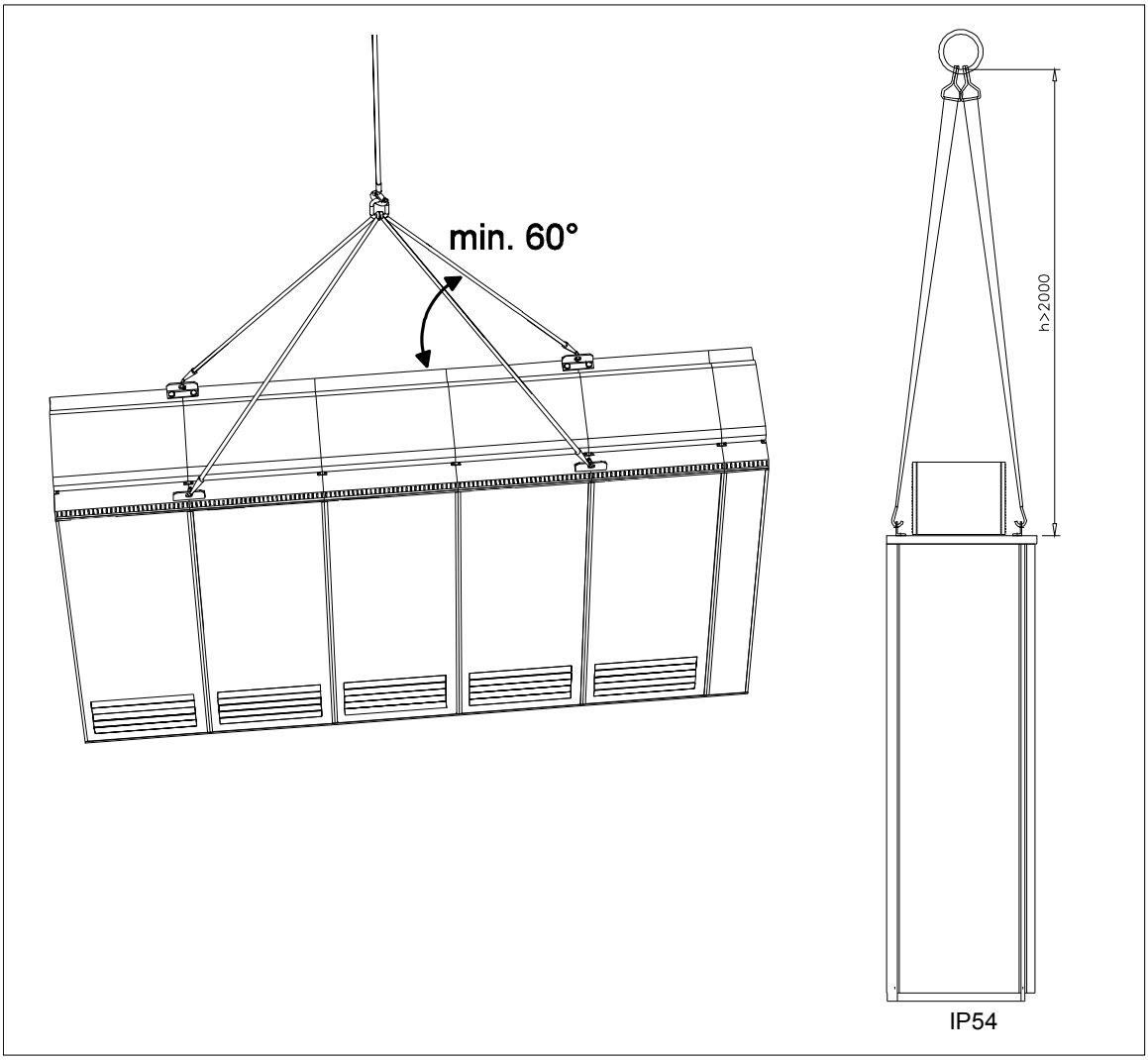
1. Undo the screws that attach the wooden parts of the transport crate together.
2. Remove the wooden parts.
3. Remove the clamps with which the drive cabinet is mounted onto the transport pallet by undoing the attaching screws.
4. Remove the plastic wrapping.

## Moving the unpacked drive cabinet

### Lifting the cabinet with a crane

Lift the drive cabinet using its lifting eyes. The lifting eyes can be removed after the cabinet is in its final position, but their mounting holes must be blocked to retain the degree of protection.

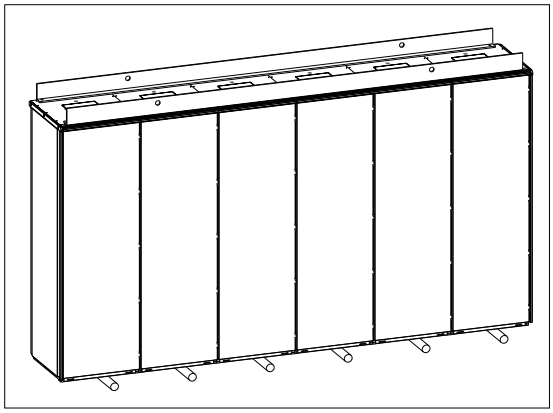
**Note:** The minimum allowed height of the lifting slings with IP54 units is 2 meters (6’7”).



### Moving the cabinet on rollers

**WARNING:** Do not move marine versions (option +C121) on rollers.

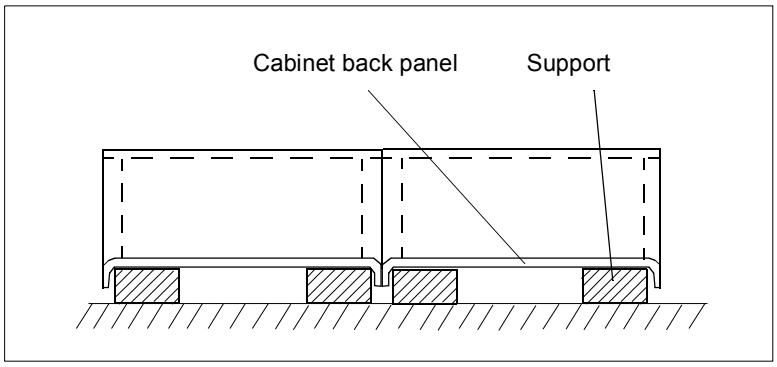
Lay the cabinet on the rollers and move it carefully until close to its final location. Remove the rollers by lifting the unit with a crane, forklift, pallet truck or jack.



### Moving the cabinet on its back

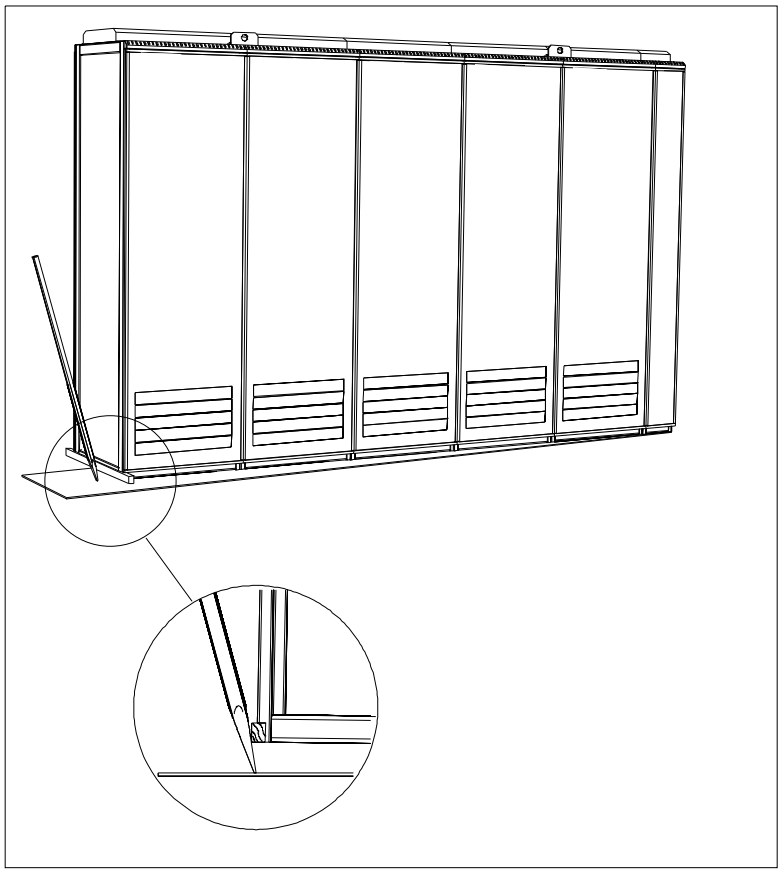
**WARNING:** Transportation of the cabinet on its back is only allowed if it is packed for such transportation at the factory. Transportation of the cabinet on its back is only allowed with the sine filters (option +E206) removed from the cabinet. Transportation of the R11 cabinet on its back is only allowed with the drive and LCL filter modules also removed from the cabinet.

If the cabinet needs to be laid on its back, support the cabinet from below alongside the cubicle seams.



### Final placement of the cabinet

Move the cabinet into its final position with a slate bar (spud bar). Place a piece of wood between the edge of the cabinet and the bar to protect the cabinet frame.

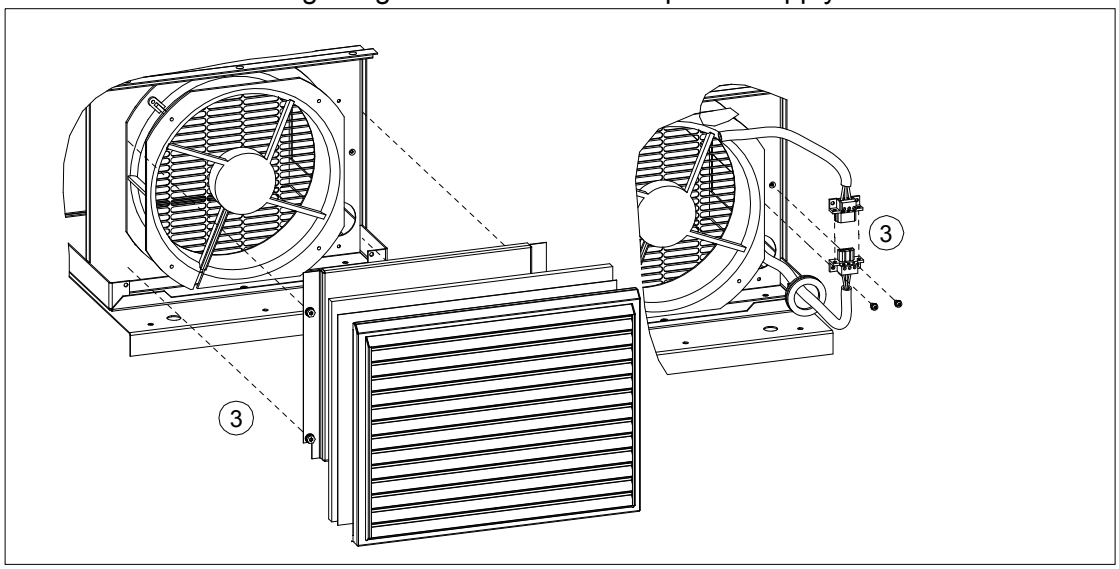


# Installing the IP54 roof (option +B055)

If the roof of an IP54 cabinet is delivered in a separate package, install the roof as follows.

## Frame R8

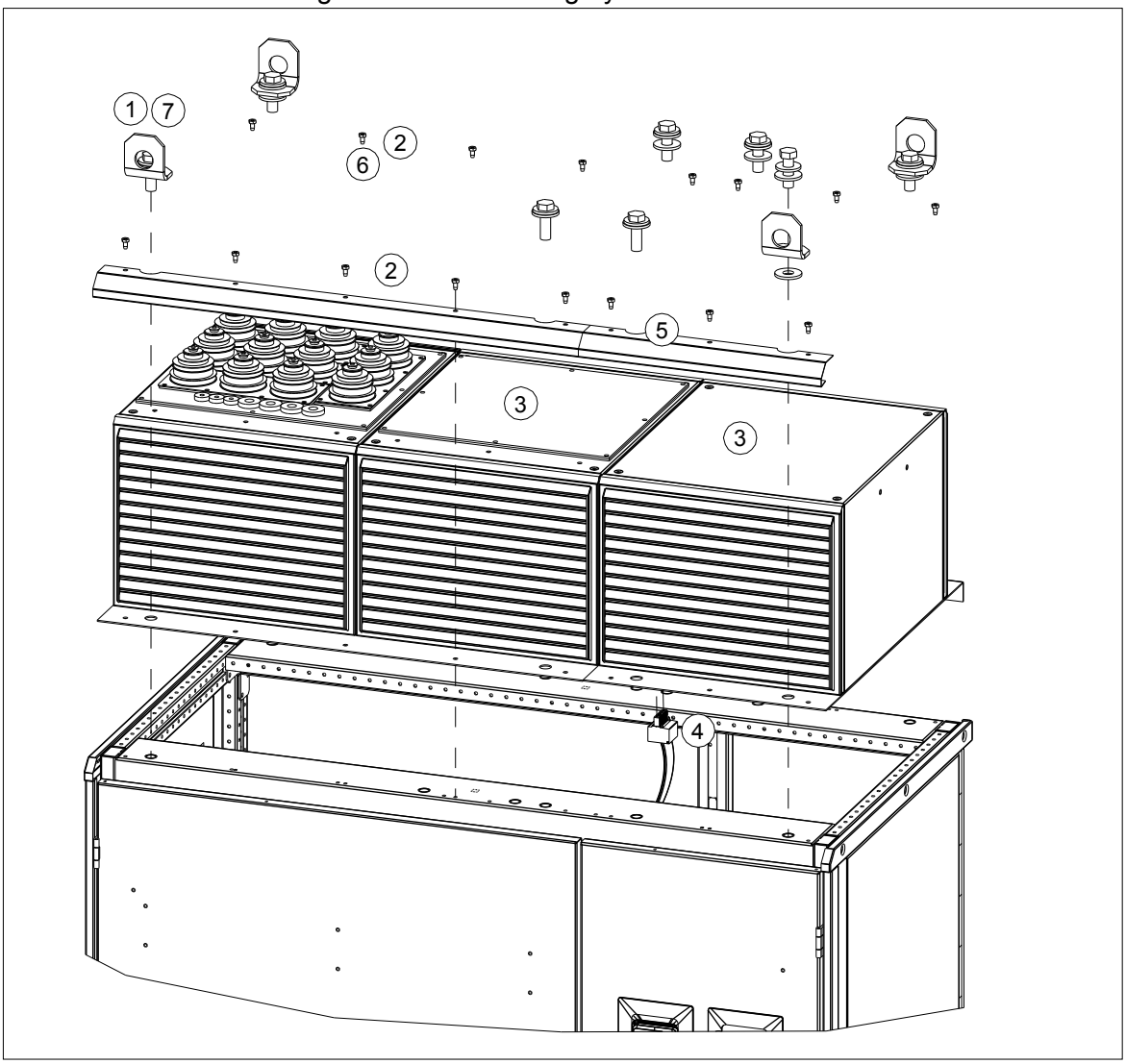
1. Undo the lifting eye screws and remove the lifting eyes. See step 1 in section *Frame R11* on page *71*.
2. To remove the top front profile of the cabinet, undo the mounting screws. Undo the back mounting screws. See step 2 in section *Frame R11* on page *71*.
3. Remove the IP54 filter grating and connect the fan power supply wires.




4. Install the front top profile of the cabinet in reverse order to step 2.
5. Attach the back mounting screws of the roof.
6. Install the IP54 filter grating.
7. Reinstall the mounting screws of the lifting eyes.

## Frame R11

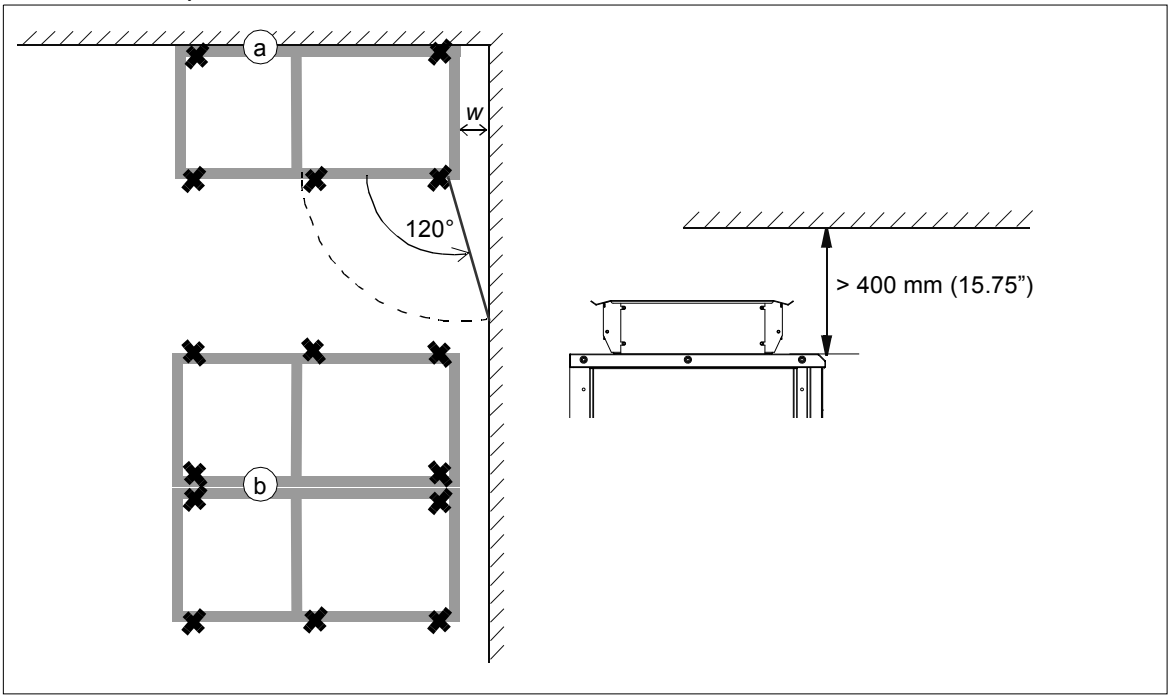
1. Undo the lifting eye screws and remove the lifting eyes.
2. To remove the top front profile of the cabinet, undo the mounting screws. Undo the back mounting screws.
3. Install the roof.
4. Connect the power supply wires to the fan.
5. Reinstall the front top profile of the cabinet in reverse order to step 2.
6. Install the back mounting screws of the roof.
7. Reinstall the mounting screws of the lifting eyes.



# Attaching the cabinet to the floor and wall or roof

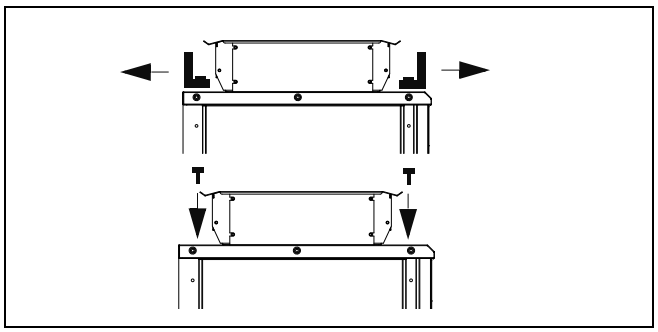
## General rules

- The drive must be installed in an upright vertical position.
- The cabinet can be installed with its back against a wall (a), or back-to-back with another unit (b).
- Leave 400 mm (15.75”) of free space above the basic roof level of the cabinet for cooling.
- Leave some space (w) at the side where the cabinet outmost hinges are to allow the doors to open sufficiently. The doors must open 120° to allow drive and LCL filter module replacement.




**Note 1:** Any height adjustment must be done before attaching the units or shipping splits together. Height adjustment can be done by using metal shims between the cabinet bottom and floor.

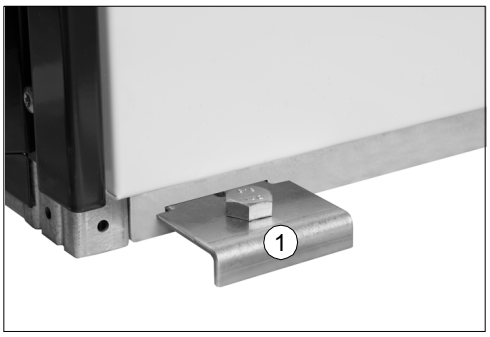
**Note 2:** If the lifting eyes are removed, reattach the bolts with the sealing rings delivered with the drive to retain the degree of protection of the cabinet. Drive cabinets with lifting bars: Remove the lifting bars. Reattach the bolts with the sealing rings delivered with the drive to retain the degree of protection of the cabinet. Tighten the bolt to a torque of 70 N·m (52 lb·ft).

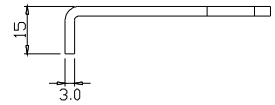


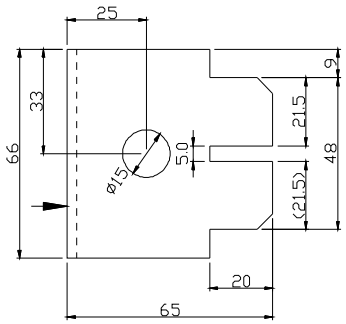
## Attaching methods

Attach the cabinet to the floor by using clamps along the edge of the cabinet bottom, or by bolting the cabinet to the floor through the holes inside (if they are accessible).

### Alternative 1 – Clamping

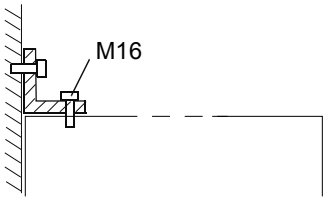


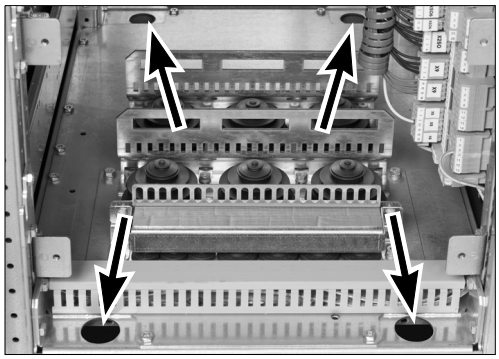




*Clamp dimensions*

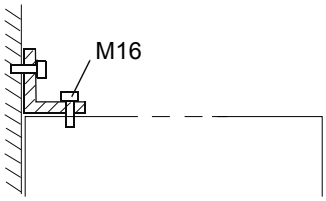
1. Insert the clamps into the twin slots along the front and rear edges of the cabinet frame body and attach them to the floor with a bolt. The recommended maximum distance between the clamps in the front edge is 800 mm (31.5”).
2. If floor mounting at the back is not possible, attach the top of the cabinet to the wall with L-brackets (not included in the delivery) bolted to the lifting eye holes.




### Alternative 2 – Using the holes inside the cabinet



1. Attach the cabinet to the floor through the bottom attaching holes with M10 to M12 (3/8” to 1/2”) bolts. The recommended maximum distance between the front edge attaching points is 800 mm (31.5”).
2. If the back attaching holes are not accessible, attach the cabinet at the top to wall with L-brackets (not included in the delivery) using the lifting eye holes.



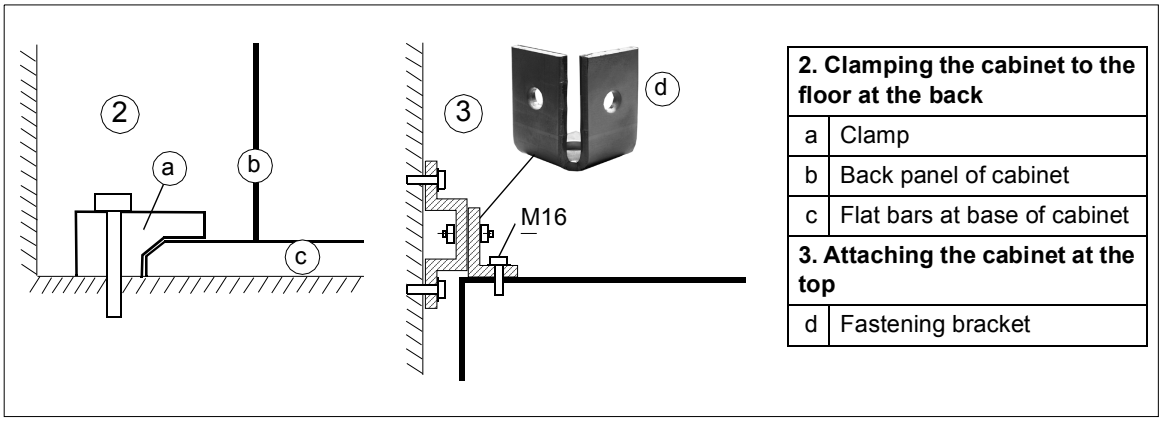
# Attaching the cabinet to the floor and wall or roof (marine units)

Obey the general rules given in section *General rules* on page *72*.

See the dimension drawing delivered with the drive for the locations of the attaching holes in the flat bars below the cabinet and for attaching points at the top of the cabinet. Top attaching brackets are included in the delivery.

Attach the cabinet to the floor and roof (wall) as follows:

1. Bolt the unit to the floor through the holes in each flat bar at the base of the cabinet using M10 or M12 screws.
2. If there is not enough room behind the cabinet for installation, clamp the rear ends of the flat bars to the floor.
3. Remove the lifting eyes and bolt the attaching brackets into the lifting eye holes. Attach the top of the cabinet to the rear wall and/or roof with brackets.



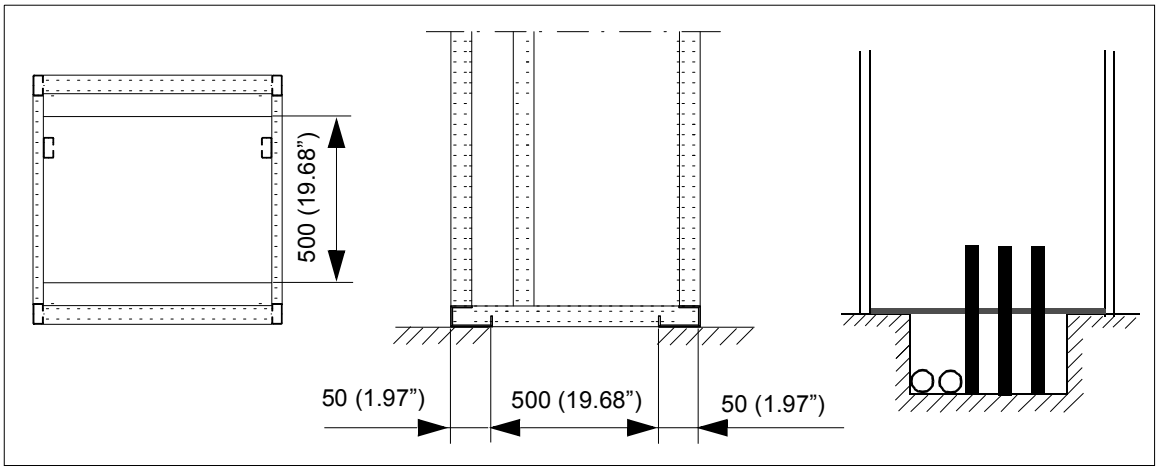

| **2. Clamping the cabinet to the floor at the back** | |
|---|---|
| a | Clamp |
| b | Back panel of cabinet |
| c | Flat bars at base of cabinet |
| **3. Attaching the cabinet at the top** | |
| d | Fastening bracket |

# Miscellaneous

## Cable duct in the floor below the cabinet

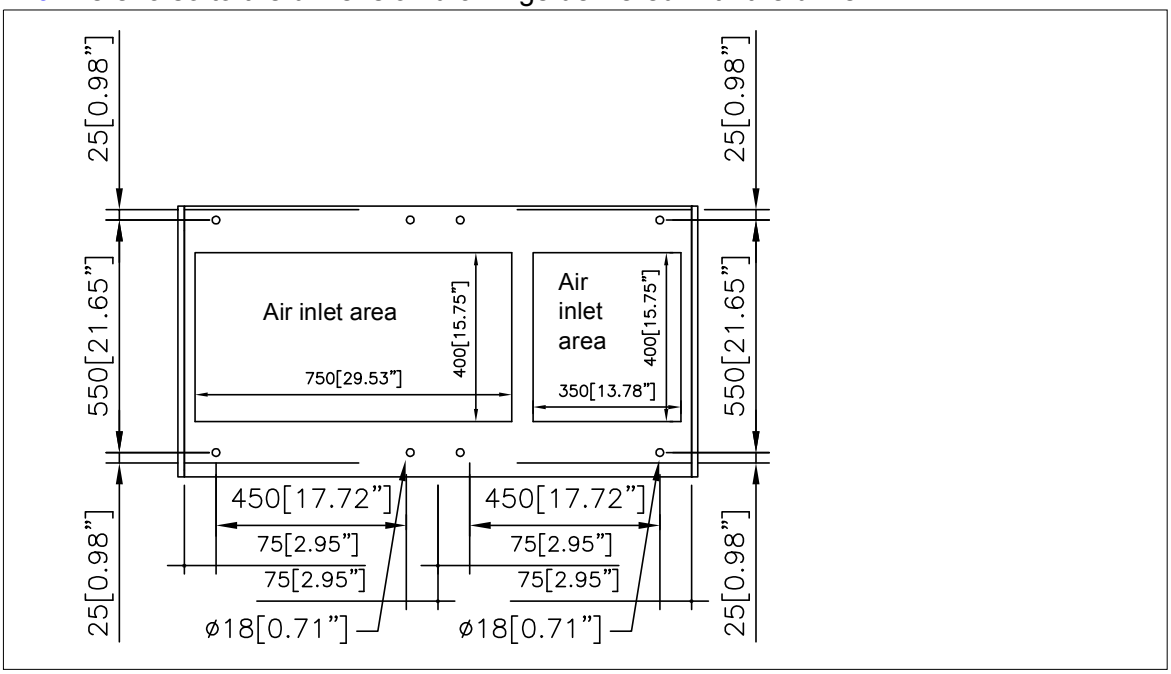
A cable duct can be constructed below the 500 mm wide middle part of the cabinet. The cabinet weight lies on the two 50 mm wide transverse sections which the floor must carry.

Prevent the cooling air flow from the cable duct to the cabinet by bottom plates. To ensure the degree of protection for the cabinet, use the original bottom plates delivered with the unit. With user-defined cable entries, take care of the degree of protection, fire protection and EMC compliance.




## Air inlet through the bottom (option +C128)

Drives with air intake through the bottom of the cabinet (option +C128) are intended for installation on an air duct in the floor. Option +C128 requires also option +B055. An example of the required air inlets in the floor is shown in the dimension drawing on page *245*. Refer also to the dimension drawings delivered with the drive.




Support the plinth of the cabinet all round.

The air duct must be able to supply a sufficient volume of cooling air. The minimum air flow values are given in section *Cooling data, noise* on page *222*.

**WARNING!** Make sure that the incoming air is sufficiently clean. If not, dust goes into the cabinet. The outlet filter on the cabinet roof prevents dust from going out. The collected dust can cause drive malfunction and danger of fire.

## Air outlet duct on the cabinet roof (option +C130)

The ventilation system must keep the static pressure in the air outlet duct sufficiently below the pressure of the room where the drive is located in order that the cabinet fans can produce the required air flow through the cabinet. Make sure that no dirty or moist air is able to flow backward to the drive in any case, even during off-time or while servicing the drive or the ventilation system.

### Calculating the required static pressure difference

The required static pressure difference between the exit air duct and the drive installation room can be calculated as follows:

$$\Delta p_s = (1.5\ldots2) \bullet p_d$$

where

$$p_d = 0.5 \bullet \rho \bullet v_m^2$$

$$v_m = q / A_c$$

$p_d$ ≙ Dynamic pressure

$\rho$ ≙ Air density (kg/m$^3$), normally 1.1 kg/m$^3$

$v_m$ ≙ Average air velocity in the exit duct(s) (m/s)

$q$ ≙ Rated air flow of the drive (m$^3$/s)

$A_c$ ≙ Cross-sectional area of the exit duct(s) (m$^2$)

Example

The cabinet has 3 exit openings of 315 mm diameter. The rated air flow of the cabinet is 4650 m$^3$/h =1.3 m$^3$/s.

$A_c = 3 \bullet 0.315^2 \bullet \pi / 4 = 0.234$ m$^2$

$v_m = q / A_c = 1.3 / 0.234 = 5.5$ m/s

$p_d = 0.5 \bullet \rho \bullet v_m^2 = 0.5 \bullet 1.1 \bullet 5.5^2 = 17$ Pa

The required pressure in the exit air duct is then, 1.5…2 • 17 Pa = 26…34 Pa, below the pressure in the room.

For more information, contact ABB.

## Arc welding

Attaching the cabinet by arc welding is not recommended. However, if arc welding is the only mounting option, connect the return conductor of the welding equipment to the cabinet frame at the bottom within 0.5 meters (1’6”) of the welding point.

**Note**: The thickness of the zinc coating of the cabinet frame is 100…200 micrometers (3.94…7.87 mil).

**WARNING!** Make sure that the return wire is connected correctly. Welding current must not return via any component or cabling of the drive. If the welding return wire is connected improperly, the welding circuit can damage electronic circuits in the cabinet.

**WARNING!** Do not inhale the welding fumes.



5

# Guidelines for planning the electrical installation

## Contents of this chapter

This chapter contains instructions for planning the electrical installation of the drive. Some instructions are mandatory to follow in every installation, others provide useful information that only concerns certain applications.

## Limitation of liability

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

## Selecting the supply disconnecting device

The drive is equipped with a main disconnecting device. The disconnecting device can be locked to the open position for installation and maintenance work.

## Examining the compatibility of the motor and drive

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

Select the motor size and drive type from to 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 *81*. 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 using a motor whose 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.

## Protecting the motor insulation and bearings

The drive employs modern IGBT inverter technology. Regardless of frequency, the drive output comprises pulses of approximately the drive DC bus voltage with a very short rise time. The pulse voltage can almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This 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 an optional drive du/dt and common mode filters and insulated N-end (non-drive end) motor bearings are required. Ignoring the requirements or improper installation may shorten motor life or damage the motor bearings and voids the warranty.

| **Motor type** | **Nominal AC supply voltage** | **Requirement for** | | |
|---|---|---|---|---|
| | | **Motor insulation system** | **ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings** | |
| | | | **100 kW ≤ $P_N$ < 350 kW or IEC 315 ≤ frame size < IEC 400** | **$P_N$ ≥ 350 kW or frame size ≥ IEC 400** |
| | | | **134 hp ≤ $P_N$ < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580** | **$P_N$ ≥ 469 hp or frame size > NEMA 580** |
| **ABB motors** | | | | |
| Random-wound M2_, M3_ and M4_ | $U_N$ ≤ 500 V | Standard | + N | + N + CMF |
| | 500 V < $U_N$ ≤ 600 V | Standard | + N + d*u*/d*t* | + N + d*u*/d*t* + CMF |
| | | or | | |
| | | Reinforced | + N | + N + CMF |
| | 600 V < $U_N$ ≤ 690 V (cable length ≤ 150 m) | Reinforced | + N + d*u*/d*t* | + N + d*u*/d*t* + CMF |
| | 600 V < $U_N$ ≤ 690 V (cable length > 150 m) | Reinforced | + N | + N + CMF |
| Form-wound HX_ and AM_ | 380 V < $U_N$ ≤ 690 V | Standard | + N + CMF | $P_N$ < 500 kW: +N + CMF |
| | | | | $P_N$ ≥ 500 kW +N + d*u*/d*t* + CMF |
| Old* form-wound HX_ and modular | 380 V < $U_N$ ≤ 690 V | Check with the motor manufacturer. | + N + d*u*/d*t* with voltages over 500 V + CMF | |
| Random-wound HX_ and AM_ ** | 0 V < $U_N$ ≤ 500 V | Enamelled wire with fiber glass taping | + N + CMF | |
| | 500 V < $U_N$ ≤ 690 V | | + N + d*u*/d*t* + CMF | |
| HDP | Consult the motor manufacturer. | | | |

* manufactured before 1.1.1998

** For motors manufactured before 1.1.1998, check for additional instructions with the motor manufacturer.

| Motor type | Nominal AC supply voltage | Requirement for | | |
|---|---|---|---|---|
| | | Motor insulation system | ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings | |
| | | | **100 kW ≤ $P_N$ < 350 kW or IEC 315 ≤ frame size < IEC 400** | **$P_N$ ≥ 350 kW or frame size ≥ IEC 400** |
| | | | **134 hp ≤ $P_N$ < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580** | **$P_N$ ≥ 469 hp or frame size > NEMA 580** |
| **Non-ABB motors** | | | | |
| Random-wound and form-wound | $U_N$ ≤ 420 V | Standard: $\hat{U}_{LL}$ = 1300 V | + N or CMF | + N + CMF |
| | 420 V < $U_N$ ≤ 500 V | Standard: $\hat{U}_{LL}$ = 1300 V | + d*u*/d*t* + (N or CMF) | + N + d*u*/d*t* + CMF |
| | | or | | |
| | | Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time | + N or CMF | + N + CMF |
| | 500 V < $U_N$ ≤ 600 V | Reinforced: $\hat{U}_{LL}$ = 1600 V | + d*u*/d*t* + (N or CMF) | + N + d*u*/d*t* + CMF |
| | | or | | |
| | | Reinforced: $\hat{U}_{LL}$ = 1800 V | + N or CMF | + N + CMF |
| | 600 V < $U_N$ ≤ 690 V | Reinforced: $\hat{U}_{LL}$ = 1800 V | + d*u*/d*t* + N | + N + d*u*/d*t* + CMF |
| | | Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 microsecond rise time *** | N + CMF | + N + CMF |

*** If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking or by the IGBT supply unit control program (parameter selectable function), check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

The abbreviations used in the table are defined below.

| Abbr. | Definition |
|---|---|
| $U_N$ | Nominal AC line voltage |
| $\hat{U}_{LL}$ | Peak line-to-line voltage at motor terminals which the motor insulation must withstand |
| $P_N$ | Motor nominal power |
| du/dt | du/dt filter at the output of the drive (standard equipment) |
| CMF | Common mode filter (standard equipment) |
| N | N-end bearing: insulated motor non-drive end bearing |
| n.a. | Motors of this power range are not available as standard units. Consult the motor manufacturer. |

### Additional requirements for explosion-safe (EX) motors

If you will use an explosion-safe (EX) motor, follow 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 regenerative and low harmonic drives

It is possible to increase the intermediate circuit DC voltage from the nominal standard level with a parameter in the control program. If you choose to do this, select the motor insulation system to withstand to the increased DC voltage level.

### 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).

| **Nominal AC supply voltage** | **Requirement for** | | |
|---|---|---|---|
| | **Motor insulation system** | **ABB du/dt and common mode filters, insulated N-end motor bearings** | |
| | | **100 kW ≤ $P_N$ < 200 kW** | **$P_N$ ≥ 200 kW** |
| | | **140 hp ≤ $P_N$ < 268 hp** | **$P_N$ ≥ 268 hp** |
| $U_N$ ≤ 500 V | Standard | + N | + N + CMF |
| 500 V < $U_N$ ≤ 600 V | Standard | + N + d*u*/d*t* | + N + d*u*/d*t* + CMF |
| | or | | |
| | Reinforced | + N | + N + CMF |
| 600 V < $U_N$ ≤ 690 V | Reinforced | + N + d*u*/d*t* | + N + d*u*/d*t* + CMF |

### 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.

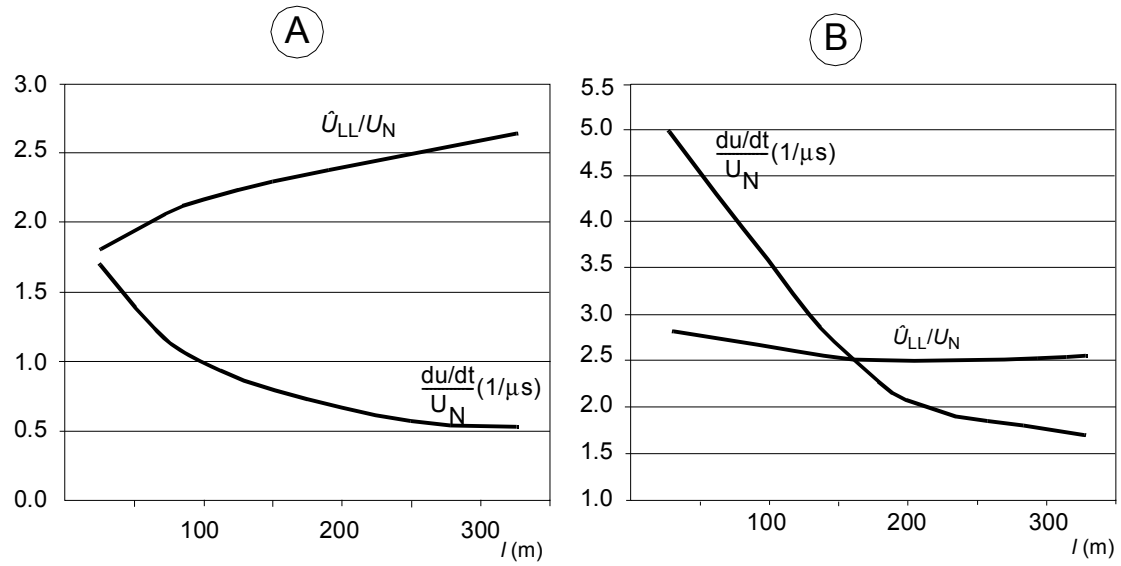
| **Nominal AC line voltage** | **Requirement for** | |
|---|---|---|
| | **Motor insulation system** | **ABB d*u*/d*t* filter, insulated N-end bearing and ABB common mode filter** |
| | | **100 kW ≤ $P_N$ < 350 kW or IEC 315 ≤ frame size < IEC 400** |
| | | **134 hp ≤ $P_N$ < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580** |
| $U_N$ ≤ 420 V | Standard: $\hat{U}_{LL}$ = 1300 V | + N + CMF |
| 420 V < $U_N$ ≤ 500 V | Standard: $\hat{U}_{LL}$ = 1300 V | + N + d*u*/d*t* + CMF |
| | or | |
| | Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time | + N + CMF |
| 500 V < $U_N$ ≤ 600 V | Reinforced: $\hat{U}_{LL}$ = 1600 V | + N + d*u*/d*t* + CMF |
| | or | |
| | Reinforced: $\hat{U}_{LL}$ = 1800 V | + N + CMF |

| **Nominal AC line voltage** | **Requirement for** | |
|---|---|---|
| | **Motor insulation system** | **ABB d*u*/d*t* filter, insulated N-end bearing and ABB common mode filter** |
| | | **100 kW ≤ $P_N$ < 350 kW or IEC 315 ≤ frame size < IEC 400** |
| | | **134 hp ≤ $P_N$ < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580** |
| 600 V < $U_N$ ≤ 690 V | Reinforced: $\hat{U}_{LL}$ = 1800 V | + N + d*u*/d*t* + CMF |
| | Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 microsecond rise time | + N + CMF |

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

If you need to calculate the actual peak voltage and voltage rise time considering the actual cable length, proceed as follows:

- Peak line-to line voltage: Read the relative $\hat{U}_{LL}/U_N$ value from the diagram below and multiply it by the nominal supply voltage ($U_N$).
- Voltage rise time: Read the relative values $\hat{U}_{LL}/U_N$ and (du/dt)/$U_N$ from the diagram below. Multiply the values by the nominal supply voltage ($U_N$) and substitute into equation $t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.




| | |
|---|---|
| A | Drive with du/dt filter |
| B | Drive without du/dt filter |
| *l* | Motor cable length |
| $\hat{U}_{LL}/U_N$ | Relative peak line-to-line voltage |
| (du/dt)/$U_N$ | Relative du/dt value |

### Additional note for sine filters (option +E206)

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

# 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 *211*) for the rated currents, and section *Typical cable sizes* (page *87*) for typical cable sizes.
- Select a cable rated for at least 70 °C maximum permissible temperature of conductor in continuous use. For US, see *Additional US requirements*, page *89*.
- 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 cable (see page *88*). 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 with restrictions, 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.

| Cross-sectional area of the phase conductors S ($mm^2$) | Minimum cross-sectional area of the corresponding protective conductor $S_p$ ($mm^2$) |
|---|---|
| $S \leq 16$ | S |
| $16 < S \leq 35$ | 16 |
| $35 < S$ | S/2 |

## Typical cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for nominal current. For drawings of the terminals, see chapter *Dimensions* (page *237*).

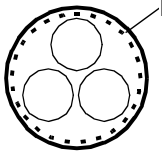
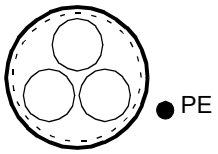
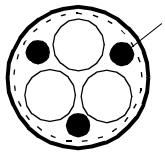
| Drive type ACS880-17- | Frame size | IEC [1] | | UL [2] |
|---|---|---|---|---|
| | | Cu cable size | Al cable size | Cu cable size |
| | | $mm^2$ | $mm^2$ | AWG/kcmil |
| **$U_N$ = 400 V** | | | | |
| 0105A-3 | R8 | 3×50 | 3×70 | 1 |
| 0145A-3 | R8 | 3×95 | 3×120 | 2/0 |
| 0169A-3 | R8 | 3×120 | 3×150 | 3/0 |
| 0206A-3 | R8 | 3×150 | 3×240 | 250 MCM |
| 0293A-3 | R11 | 2 × (3×95) | 2 × (3×120) | 2 × 3/0 |
| 0363A-3 | R11 | 2 × (3×120) | 2 × (3×185) | 2 × 4/0 |
| 0442A-3 | R11 | 2 × (3×150) | 3 × (3×120) | 2 × 250 |
| 0505A-3 | R11 | 3 × (3×95) | 3 × (3×150) | 2×500 MCM or 3×250 MCM |
| 0585A-3 | R11 | 3 × (3×120) | 3 × (3×185) | 2×600 MCM or 3×300 MCM |
| 0650A-3 | R11 | 3 × (3×150) | 3 × (3×240) | 2×700 MCM or 3×350 MCM |
| **$U_N$ = 500 V** | | | | |
| 0101A-5 | R8 | 3×50 | 3×70 | 1 |
| 0124A-5 | R8 | 3×95 | 3×95 | 2/0 |
| 0156A-5 | R8 | 3×120 | 3×150 | 3/0 |
| 0180A-5 | R8 | 3×150 | 3×185 | 250 MCM |
| 0260A-5 | R11 | 2 × (3×70) | 2 × (3×95) | 2 × 2/0 |
| 0361A-5 | R11 | 2 × (3×120) | 2 × (3×185) | 2 × 250 MCM |
| 0414A-5 | R11 | 2 × (3×150) | 2 × (3×240) | 2 × 250 MCM |
| 0460A-5 | R11 | 2 × (3×185) | 3 × (3×120) | 2×400 MCM or 3×4/0 |
| 0503A-5 | R11 | 3 × (3×95) | 3 × (3×150) | 2×500 MCM or 3×250 MCM |
| **$U_N$ = 690 V** | | | | |
| 0174A-7 | R11 | 3×120 | 2 × (3×70) | 4/0 |
| 0210A-7 | R11 | 3×185 | 2 × (3×95) | 300 MCM |
| 0271A-7 | R11 | 3×240 | 2 × (3×120) | 400 MCM |
| 0330A-7 | R11 | 2 × (3×95) | 2 × (3×150) | 2 × 250 MCM or 3×2/0 |
| 0370A-7 | R11 | 2 × (3×120) | 2 × (3×150) | 2 × 300 MCM or 3×3/0 |
| 0430A-7 | R11 | 2 × (3×185) | 3 × (3×120) | 2 × 350 MCM or 3×4/0 |

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, PVC insulation, surface temperature 70 °C (EN 60204-1 and IEC 60364-5-52/2001). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive.
2. The cable sizing is based on NEC Table 310-16 for copper wires, 75 °C (167 °F) wire insulation at 40 °C (104 °F) ambient temperature. Not more than three current-carrying conductors in raceway or cable or earth (directly buried). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

## Alternative power cable types

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

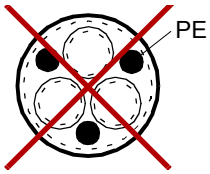
### Recommended power cable types

| | |
|---|---|
|  | Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. The shield must meet the requirements of IEC 61800-5-1, see page *86*. Check with local / state / country electrical codes for allowance. |
|  | 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 meet the requirements of IEC 61800-5-1, see page *86*. |
|  | Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must meet the requirements of IEC 61800-5-1. |

### Power cable types for limited use

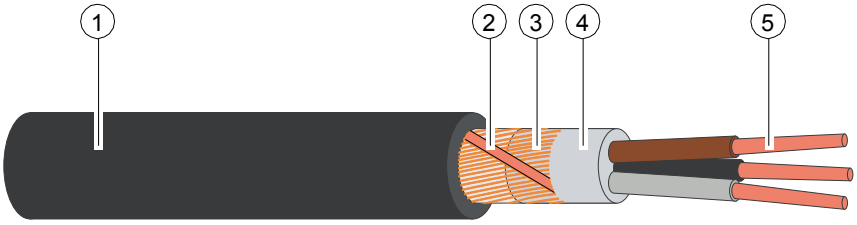
| | |
|---|---|
|  | A four-conductor system consisting of unshielded single-core phase conductors and a protective conductor on a cable tray) is **not allowed for input cabling on IT (ungrounded) networks.**<br>**WARNING!** Do not use unshielded single-core cables with drives on IT (ungrounded) networks. A dangerous voltage can become present on the non-conductive outer sheath of the cable. This can cause injury or death. |
| | A four-conductor system consisting of separate phase conductors (regardless of the presence of shielding) and a protective conductor on a cable tray is **not allowed for motor cabling**. |

### Not allowed power cable types

| | |
|---|---|
|  | Symmetrical shielded cable with individual shields for each phase conductor is **not allowed on any cable size for input and motor cabling**. |

## 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 section *General rules* on page *86*, 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 | Helix of copper tape or copper wire |
| 3 | Copper wire screen |
| 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 us not required. A dedicated ground cable is always required.

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

### Armored cable / shielded power cable

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

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

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

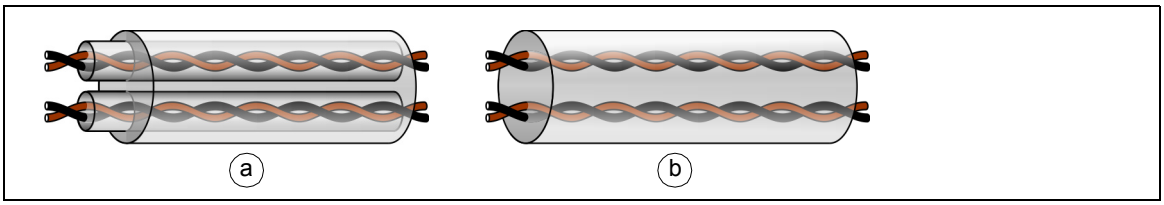
# Selecting the control cables

## Shielding

All control cables must be shielded.

Use a double-shielded twisted pair cable for analog signals. This type of cable is recommended 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 be longer than three meters (10 ft). Cable type: shielded CAT 5e or better Ethernet patch cable with RJ-45 ends.

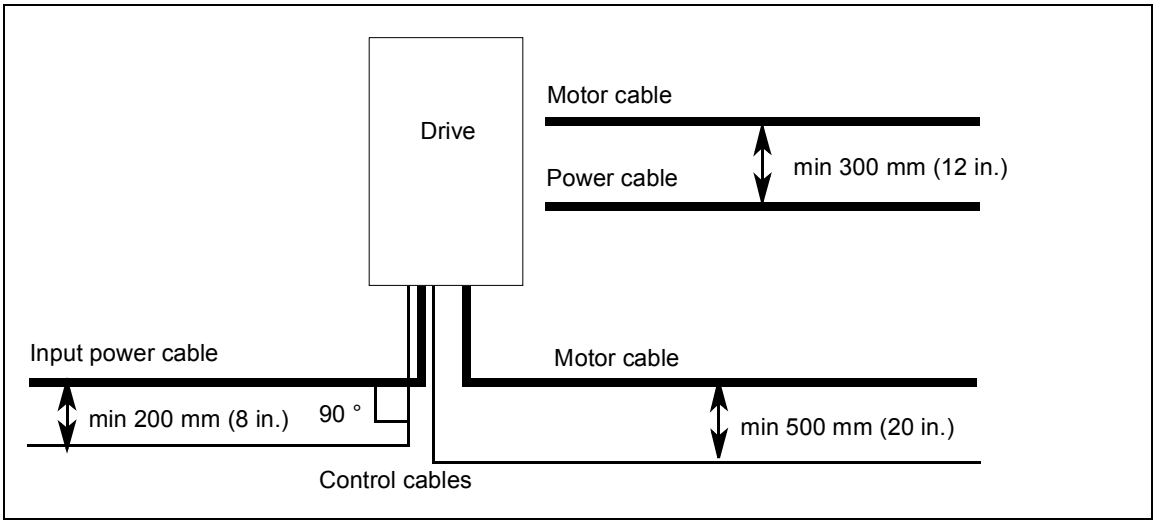
# Routing the cables

Route the motor cable away from other cable routes. Motor cables of several drives can be run in parallel 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 run extra cables through the drive.

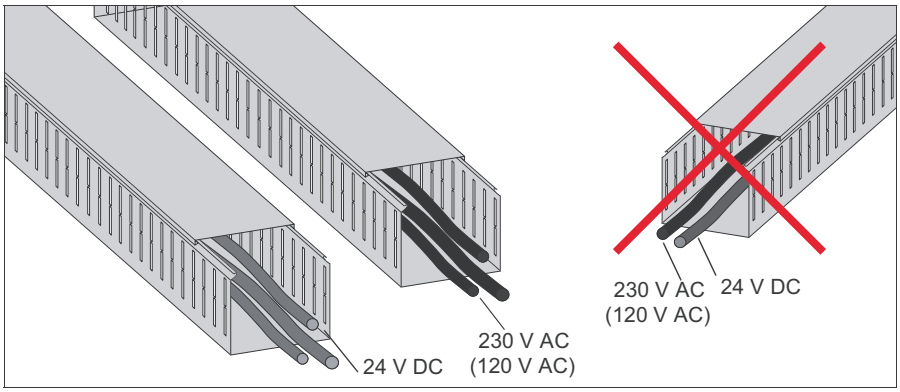
The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

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 on 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.
- North America: 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.

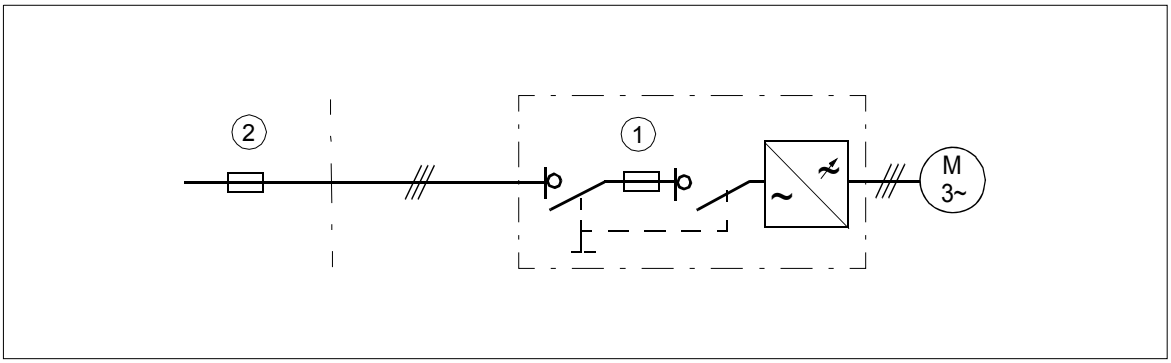
## Implementing thermal overload and short-circuit protection

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

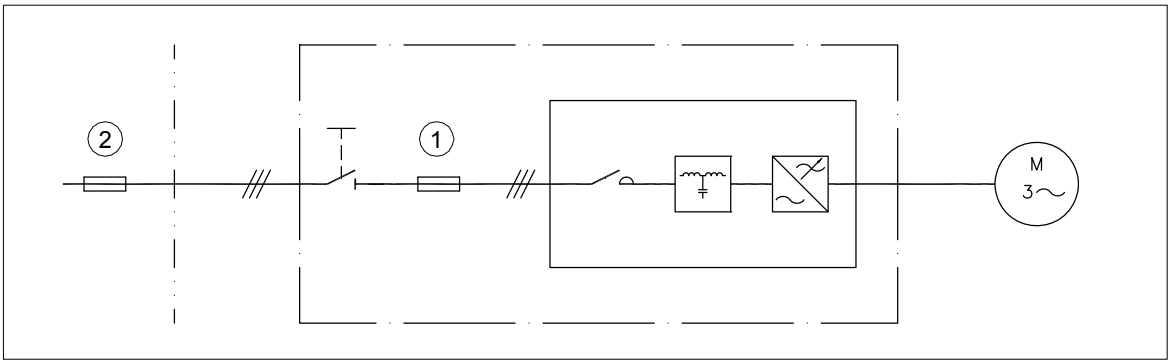
The drive is equipped with internal AC fuses (1) as standard. The fuses restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Protect the input cable with fuses or circuit breaker (2) according to local safety regulations, appropriate input voltage and the rated current of the drive (see chapter *Technical data*).

**R8**




**R11**




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

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

### Protecting the drive and the power cables against thermal overload

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

---



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

---

### Protecting the motor against thermal overload

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

The most common temperature sensors are:

- motor sizes IEC180…225: thermal switch, eg. Klixon
- motor sizes IEC200…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.

## Implementing a ground fault detection function

The drive has a function that detects ground faults in the motor and motor cable. The user can select how the drive reacts to a ground fault (parameter setting). Note that this function is not a personnel safety or a fire protection feature. See the firmware manual for more information.

An optional ground fault monitoring device (option +Q954) is available for IT (ungrounded) systems. The option includes a ground fault indicator on the drive cabinet door.

### Residual current device compatibility

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

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

## Implementing the emergency stop function

The drive can be equipped with a category 0 and 1 emergency stop function (option +Q951, +Q952, +Q963, +Q964, +Q978 or +Q979). For safety reasons, install the emergency stop devices at each operator control station and at other operating stations where emergency stop may be needed.

**Note**: Pressing the stop key ⛛ on the control panel of the drive, or turning the operating switch of the drive from position “1” to “0” does not generate an emergency stop of the motor or separate the drive from dangerous potential.

---

See the appropriate user's manual for the wiring, start-up and operation instructions.

| Option code | User's manual | Manual code (English) |
|---|---|---|
| +Q951 | Emergency stop, stop category 0 (using main contactor/breaker) | 3AUA0000119895 |
| +Q952 | Emergency stop, stop category 1 (using main contactor/breaker) | 3AUA0000119896 |
| +Q963 | Emergency stop, stop category 0 (using Safe torque off) | 3AUA0000119908 |
| +Q964 | Emergency stop, stop category 1 (using Safe torque off) | 3AUA0000119909 |
| +Q978 | Emergency stop, stop category 0 or 1 (using main contactor/breaker and Safe torque off) | 3AUA0000145920 |
| +Q979 | Emergency stop, stop category 0 or 1 (using Safe torque off) | 3AUA0000145921 |

## Implementing the Safe torque off function

See chapter *The Safe torque off function* (page 259).

## 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. Option +Q971 is available with options +L537, +L513 or +L514.

For more information, see

- *FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual* (3AXD50000027782 [English])
- *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).

## Implementing the Prevention of unexpected start-up function

The drive can be equipped with a Prevention of unexpected start-up (POUS) function either with an FSO-xx safety functions module (option +Q950) or with a safety relay (option +Q957). The POUS function enables short-time maintenance work (like cleaning) on the non-electrical parts of the machinery without switching off and disconnecting the drive.

See the appropriate user's manual for the wiring, start-up and operation instructions.

| Option code | User's manual | Manual code (English) |
|---|---|---|
| +Q950 | Prevention of unexpected start-up, with FSO-xx safety functions module | 3AUA0000145922 |
| +Q957 | Prevention of unexpected start-up, with safety relay | 3AUA0000119910 |

## Implementing the functions provided by the FSO-xx safety functions module (option +Q972 or +Q973)

The drive can be equipped with an FSO-xx safety functions module (option +Q972 or +Q973) which enables the implementation of functions such as Safe brake control (SBC),

Safe stop 1 (SS1), Safe stop emergency (SSE), Safely limited speed (SLS) and Safe maximum speed (SMS).

The settings of the FSO-xx are at default when delivered from the factory. The connectors of the module are pre-wired to terminal block X68. The wiring of the external safety circuit and configuration of the FSO-xx module are the responsibility of the machine builder.

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

For wiring instructions, safety data and more information on the functions provided by the FSO-xx, refer to its manual.

### Declaration of Conformity

See page *230*.

## Implementing the Power-loss ride-through function

Implement the power-loss ride-through function as follows:

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



**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.

The main contactor of the drive opens in a power-loss situation. When the power returns, the contactor closes. However, if the power-loss situation lasts so long that the drive trips on undervoltage, it must be reset and started again to continue operation. If the power-loss situation lasts so long that the buffer module (see page *44*) runs out, the main contactor remains open and the drive operates only after reset and a new start.

With external uninterruptible control voltage (option +G307), the main contactor remains closed in power-loss situations. If the power-loss situation lasts so long that the drive trips on undervoltage, it must be reset and started again to continue operation.

## Supplying power for the auxiliary circuits

The drive is equipped with an auxiliary control voltage transformer which supplies control voltage, for example, for the control devices and cabinet fan(s).

The following options are to be supplied from external power sources:

- +G300/+G301: Cabinet heaters and/or lighting (230 or 115 V AC; external fuse: 16 A)
- +G307: Connection for an external uninterruptible power supply (230 or 115 V AC; external fuse: 16 A) to the control unit and control devices when the drive is not powered
- +G313: Power supply connection (230 V AC; external fuse 16 A) for a motor space heater output.

# 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, make sure 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 recommend to install a safety switch between the permanent magnet synchronous 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 *98*.

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

An application-engineered bypass connection is available from ABB. For more information, see *Bypass connection for ACS880-07, -17, -37 (40...1200 A) option description* (3AXD50000048959 [English]).

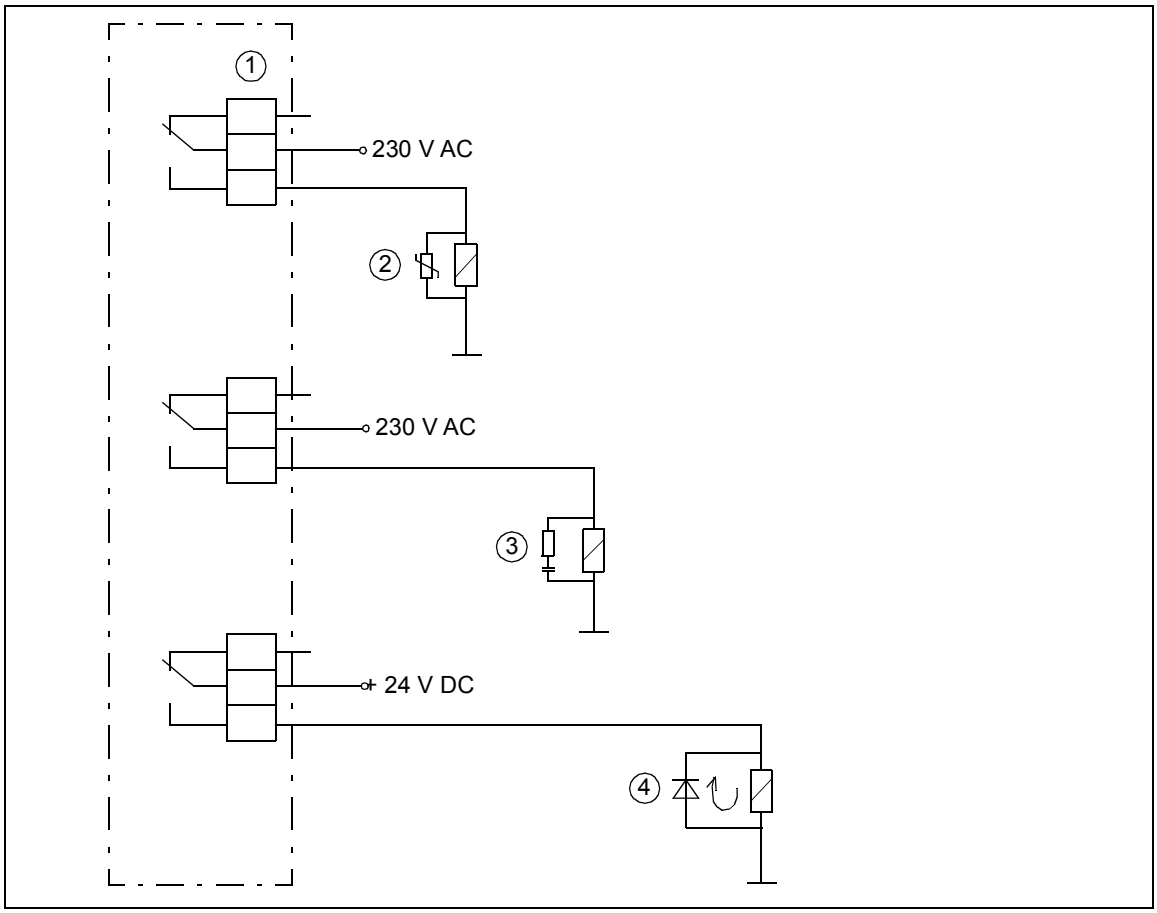
**WARNING!** Never connect the drive output to the electrical power network. The connection may damage the drive.

## Protecting the contacts of relay outputs

Inductive loads (relays, contactors, motors) cause voltage transients when switched off.

The relay contacts on the drive control unit are protected with varistors (250 V) against overvoltage peaks. In spite of this, it is highly recommended that inductive loads are equipped with noise attenuating circuits (varistors, RC filters [AC] or diodes [DC]) in order to minimize the EMC emission at switch-off. If not suppressed, the disturbances may connect capacitively or inductively to other conductors in the control cable and form a risk of malfunction in other parts of the system.

Install the protective component as close to the inductive load as possible. Do not install protective components at the relay outputs.




1) Relay outputs; 2) Varistor; 3) RC filter; 4) diode

# Implementing a motor temperature sensor connection

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

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

1. If there is double or reinforced insulation between the sensor and the live parts of the motor, you can connect the sensor directly to the analog/digital inputs of the drive.
2. If there is basic insulation between the sensor and the live parts of the motor, you can connect the sensor to the analog/digital inputs of the drive if all circuits connected to the drive's digital and analog inputs (typically extra-low voltage circuits) are protected against contact and insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit. Note that extra-low voltage circuits (such as 24 V DC) typically do not meet these requirements.
3. You can connect the sensor to the drive via an option module.The sensor and the module must form a double or reinforced insulation between the motor live parts and the drive control unit. See section *Connection of motor temperature sensor to the drive via an option module* (page *99*).
4. You can connect the sensor to a digital input of the drive via a relay (internal option or customer's external relay). The sensor and the relay must form a double or reinforced insulation between the motor live parts and the drive control unit. See section *Connection of motor temperature sensor to the drive via a relay* (page *100*).

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

This table shows:

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

| Option module | | Temperature sensor type | | | Temperature sensor insulation requirement |
|---|---|---|---|---|---|
| **Type** | **Insulation/Isolation** | **PTC** | **KTY** | **Pt100, Pt1000** | |
| FIO-11 | Galvanic isolation between sensor connector and other connectors (including drive control unit connector) | - | X | X | Reinforced insulation |
| FEN-xx | Galvanic isolation between sensor connector and other connectors (including drive control unit connector) | X | X | - | Reinforced insulation |

| Option module | | Temperature sensor type | | | Temperature sensor insulation requirement |
|---|---|---|---|---|---|
| **Type** | **Insulation/Isolation** | **PTC** | **KTY** | **Pt100, Pt1000** | |
| FAIO-01 | Basic insulation between sensor connector and drive control unit connector. No insulation between sensor connector and other IO connectors. | X | X | X | Basic insulation. Connectors of option module other than sensor connector must be left unconnected. |
| FPTC-xx [1)] | Reinforced insulation between sensor connector and other connectors (including drive control unit connector). | X | - | - | No special requirement |

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

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

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

| PTC relay | | Temperature sensor insulation requirement |
|---|---|---|
| **Type** | **Insulation** | |
| Drive options +L505 and +L513 | Basic insulation 6 kV | Basic insulation |
| External relay | Basic insulation 6 kV | Basic insulation |

PTC alternative B. Decisive voltage class B of IEC 60800-5-1 (basic insulation) is provided with a 6 kV relay. Circuits connected to all motor protection relay inputs and outputs must be protected against direct contact.

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

| Pt100 relay | | Temperature sensor insulation requirement between sensor and live parts of motor |
|---|---|---|
| **Type** | **Insulation** | |
| Drive options +L506 and +L514 | Basic insulation < 6 kV | Double or reinforced insulation |
| External relay | Basic insulation 6 kV | Basic insulation |

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

6

# Electrical installation

## Contents of this chapter

This chapter gives instructions on the wiring the drive.

## Warnings



**WARNING!** Only qualified electrical professionals are allowed to carry out the work described in this chapter. Follow the *Safety instructions* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

## 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

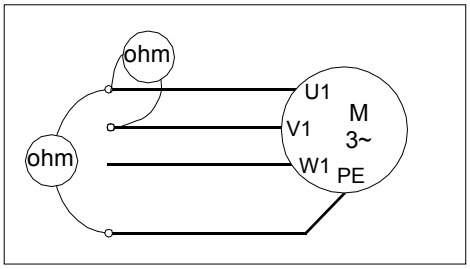
Check the insulation of the input cable according to local regulations before connecting it to the drive.

### Motor and motor cable

**WARNING!** Obey the 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 *Electrical safety precautions* (page *19*) before you start the work.
2. Check that the motor cable is disconnected from the drive output terminals U2, V2 and W2.
3. Measure the insulation resistance 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 moisture is suspected, dry the motor and repeat the measurement.




## Checking the compatibility with IT (ungrounded), corner-grounded delta, midpoint-grounded delta and TT systems

The standard drive with ground-to-phase varistors connected can be installed to a symmetrically grounded TN-S system. If you install the drive to another systems, you may need to disconnect the EMC filter and ground-to-phase varistors. For instructions, see *ACS880 frames R1 to R11 EMC filter and ground-to-phase varistor disconnecting instructions* (3AUA0000125152 [English]).

### EMC filter (options +E200 or +E202)

A drive with EMC filter options +E200 and +E202 connected can be installed to a symmetrically grounded TN-S system.

**WARNING!** Do not install the drive with the EMC filter options +E200 and +E202 connected to a system that the filter is not suitable for. This can cause danger, or damage the drive.

**Note**: When EMC filter +E200 and +E202 is disconnected, the drive EMC compatibility is considerably reduced.

### Ground-to-phase varistor

A drive with the ground-to-phase varistor connected can be installed to a symmetrically grounded TN-S system.

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

### Corner-grounded and midpoint-grounded 690 V delta systems

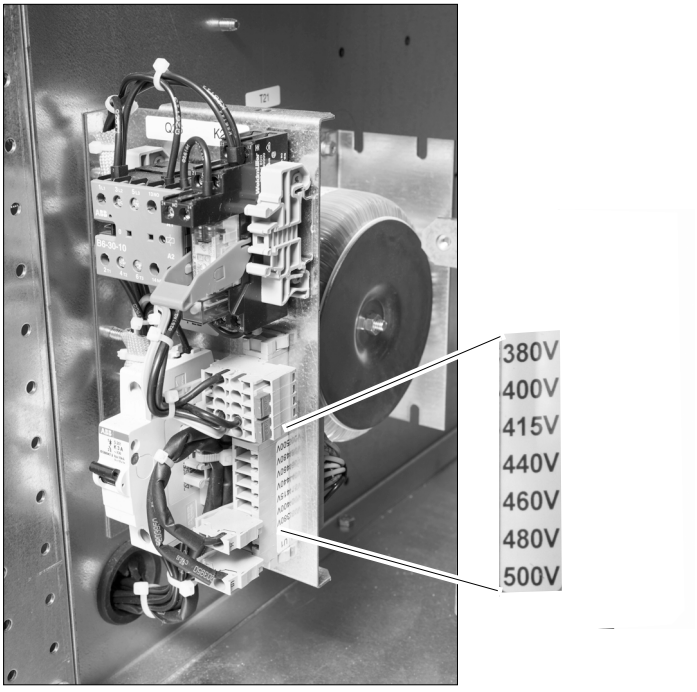
**WARNING!** Do not install the drive on a 690 V corner-grounded or midpoint-grounded delta system. Disconnecting the EMC filter and ground-to-phase varistor does not prevent damage to the drive.

## Attaching the device stickers to the cabinet door

A multilingual device label sticker is delivered with the drive. Attach the stickers in the local language on the English texts; see section *Door switches and lights* (page *48*).

## Checking the settings of auxiliary voltage transformers

Check the tap settings of all auxiliary voltage transformers. Set the voltage according to the power network voltage. This figure shows an example connection.




Transformer T21 is included as standard.

In frame R8, additional transformer T101 comes with options +B055 and +C128.

In frame R11, additional transformer T102 comes with options +B055 and +C128.

The locations of the transformers are shown on page *39* and page *43*.

# Connecting the control cables

See chapter *Control unit of frame R8* (page *135*) or *Control unit of frame R11* (page *145*) for the default I/O connections of the inverter unit (with the ACS880 primary control program). The default I/O connections can be different with some hardware options, see the circuit diagrams delivered with the drive for the actual wiring. For other control programs, see their firmware manuals.

## Control cable connection procedure



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

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Run the control cables into the drive module cubicle as described in section *Grounding the outer shields of the control cables at the cabinet entry* (page *105*).
3. Route the control cables as described in section *Routing the control cables inside the cabinet* (page *107*).
4. Connect the control cables as described starting on page *112*.

### Grounding the outer shields of the control cables at the cabinet entry

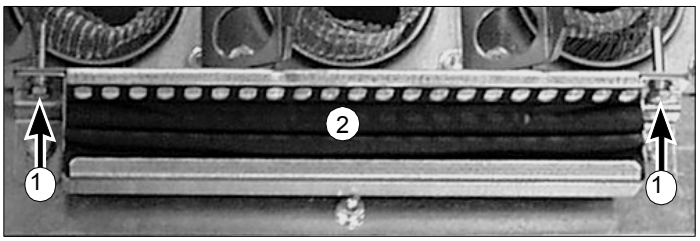
Applicability

This section applies to drives without solid cable conduit plate (no options +C129, +C134, +H358).

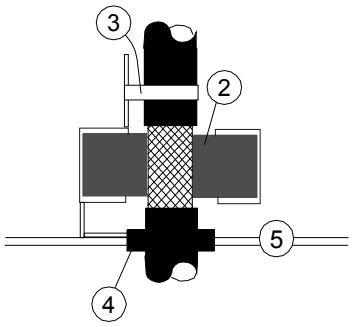
Procedure

Ground the outer shields of all control cables 360 degrees at the EMI conductive cushions as follows:

1. Loosen the tightening screws of the EMI conductive cushions and pull the cushions apart.
2. Cut adequate holes to the rubber grommets in the entry plate and lead the cables through the grommets and the cushions into the cabinet.
3. Strip off the cable plastic sheath above the entry plate just enough to ensure proper connection of the bare shield and the EMI conductive cushions.
4. Tighten the two tightening screws so that the EMI conductive cushions press tightly round the bare shield.




*View from above*



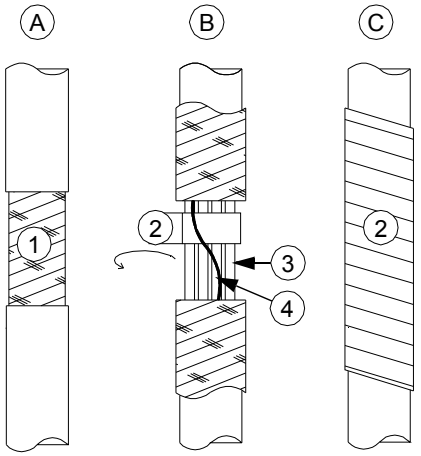

| | |
|---|---|
| 1 | Tightening screw |
| 2 | EMI conductive cushion |
| 3 | Strain relief |
| 4 | Grommet |
| 5 | Entry plate |

**Note 1**: Keep the shields continuous as close to the connection terminals as possible. Secure the cables mechanically at the entry strain relief.

**Note 2:** If the outer surface of the shield is non-conductive:

- Cut the shield at the midpoint of the bare part. Be careful not to cut the conductors or the grounding wire (if present).
- Turn the shield inside out to expose its conductive surface.

- Cover the turned shield and the stripped cable with copper foil to keep the shielding continuous.



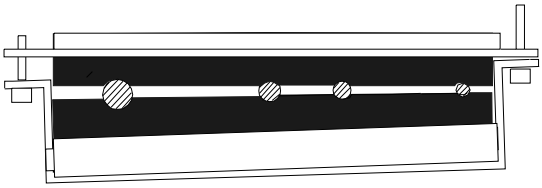

| | |
|---|---|
| A | Stripped cable |
| B | Conductive surface of the shield exposed |
| C | Stripped part covered with copper foil |
| 1 | Cable shield |
| 2 | Copper foil |
| 3 | Shielded twisted pair |
| 4 | Grounding wire |

**Note for top entry of cables:** When each cable has its own rubber grommet, sufficient IP and EMC protection can be achieved. However, if very many control cables come to one cabinet, plan the installation beforehand as follows:

1. Make a list of the cables coming to the cabinet.
2. Sort the cables going to the left into one group and the cables going to the right into another group to avoid unnecessary crossing of cables inside the cabinet.
3. Sort the cables in each group according to size.
4. Group the cables for each grommet as follows ensuring that each cable has a proper contact to the cushions on both sides.

| Cable diameter in mm | Max. number of cables per grommet |
|---|---|
| ≤ 13 | 4 |
| ≤ 17 | 3 |
| < 25 | 2 |
| ≥ 25 | 1 |

5. Arrange the bunches according to size from thickest to the thinnest between the EMI conductive cushions.



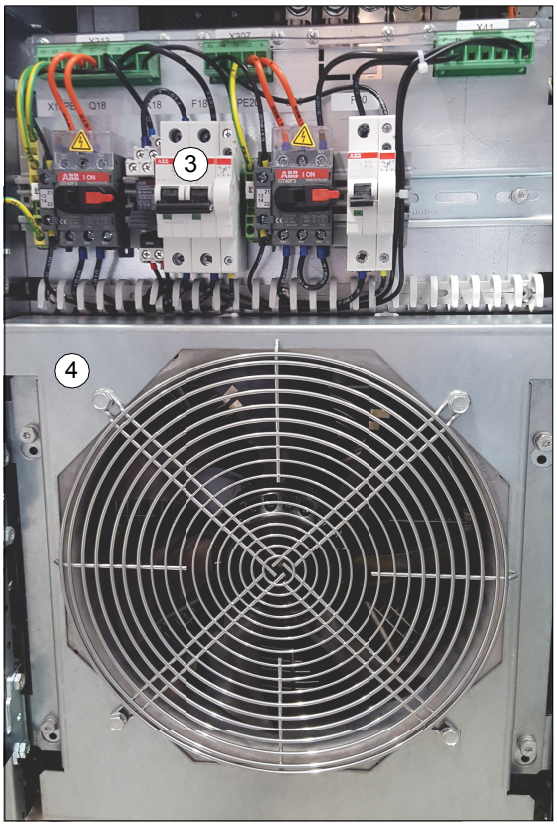
If more than one cable go through a grommet, seal the grommet by applying Loctite 5221 (catalogue number 25551) inside the grommet.

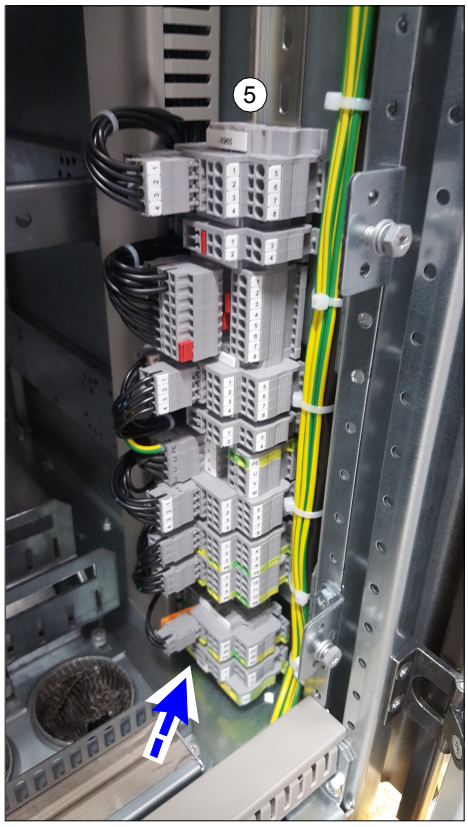
### Routing the control cables inside the cabinet

Use the existing trunking in the cabinet wherever possible. Use sleeving if cables are laid against sharp edges. When running cables to or from the swing-out frame, leave enough slack at the hinge to allow the frame to open fully.

Frame R8

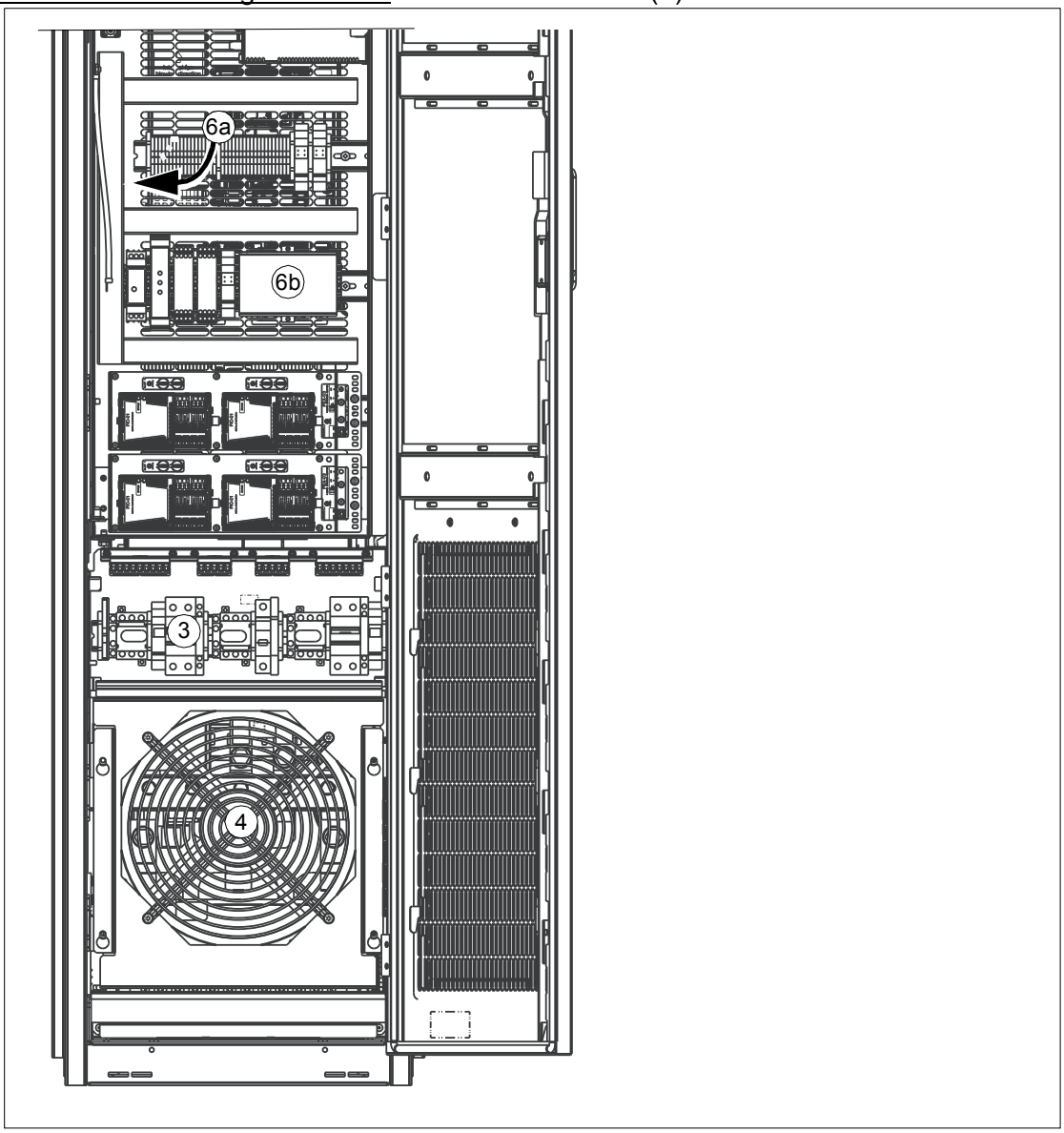
1. Stop the drive and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Open the cabinet door.
3. If there is a mounting plate above the fan, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   If there is no mounting plate, but instead a shroud above the fan, undo the four screws and remove the shroud.
4. Remove the “door fan” (see section *Replacing the cabinet “door fan”* on page *168*).
5. See page *46*. Bottom entry: Route the cables of these options to the connection terminals at the right-hand side of the cabinet as shown below. Top entry, see page *109*.



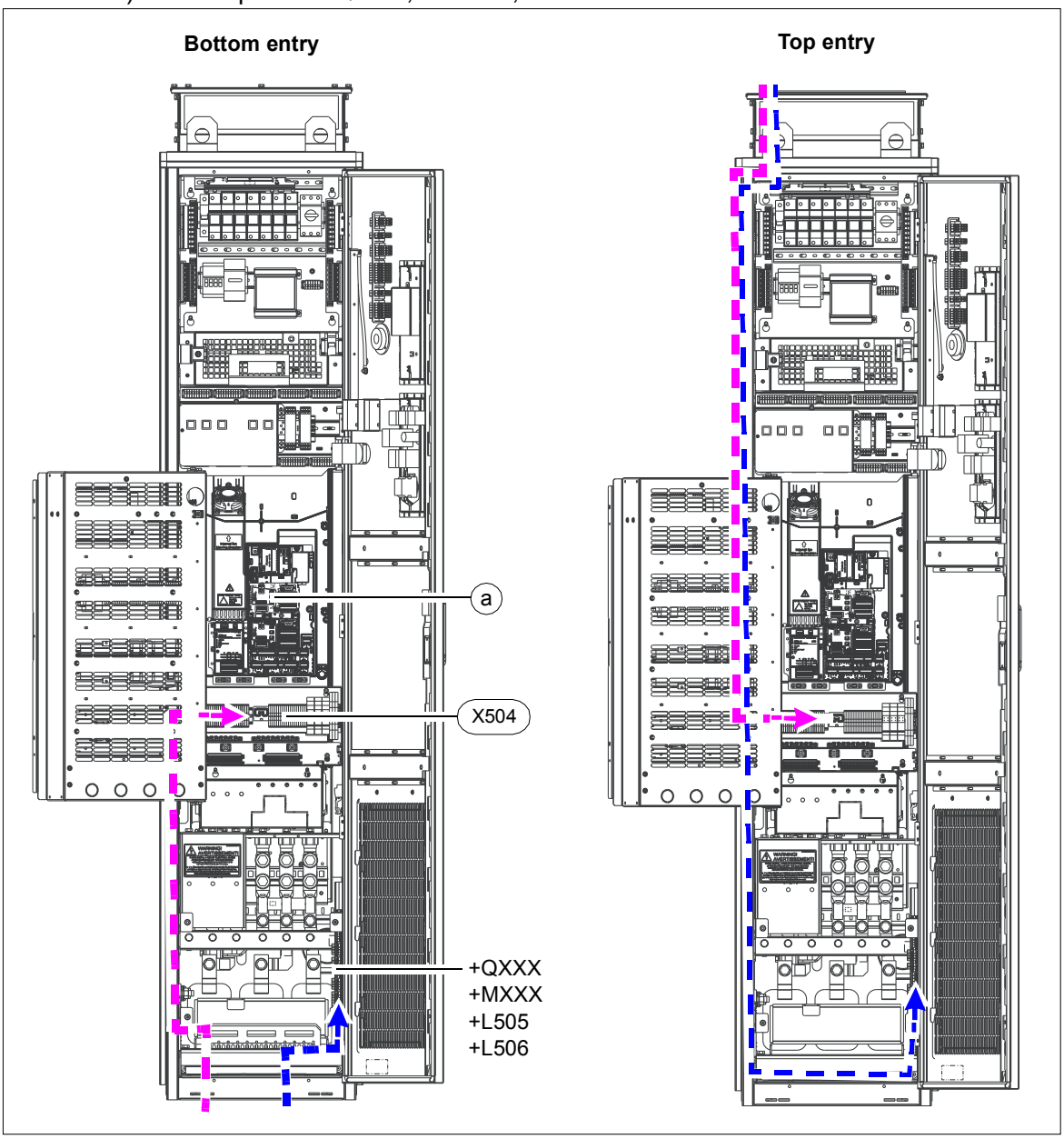




| |
|---|
| Line contactor and main switch feedback for customer |
| Prevention of unexpected start-up with safety relays (option +Q957) |
| Push buttons for emergency stop options +Q951, +Q952, +Q963 and +Q964 |
| Ground fault monitoring for IT (ungrounded) systems (option +Q954) |
| External STO customer connection for safety options +Q951, +Q952, +Q963, +Q964, +Q957 and +Q971 |
| Starter for auxiliary motor fan (options +M600…+M605) |
| Thermistor relay or Pt100 relays (option +L505 or +L506) |

6. Drives with swing-out frame: Open the swing-out frame (a).
   Marine drives (option +C121): To open the swing-out frame, undo the three M6 screws on the left side of the swing-out frame.
   Drives without swing-out frame: Remove the shroud (b).



7. Route the cables to the control unit (a) and additional terminal block X504 (option +L504) and to options +QXXX, +MXXX, +L505 and +L506 as shown below.



Frame R11

1. Stop the drive and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.

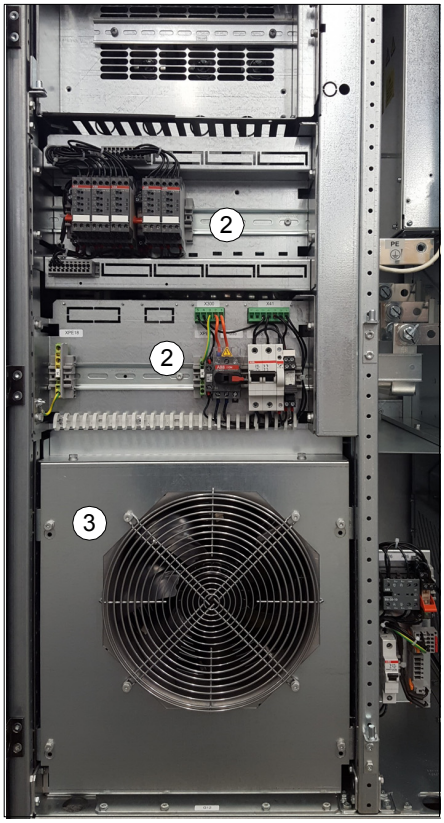
1. Open the cabinet door.

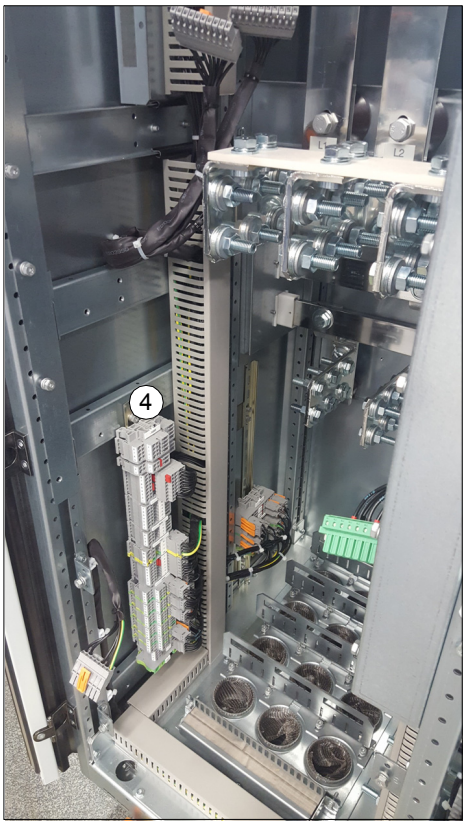
2. If there is a mounting plate/two plates above the fan, loosen the four screws of the plate and pull out the plate/s. Unplug the connectors and remove the plate/s.

   If there is no mounting plate/s, but instead a shroud/s above the fan, undo the four screws and remove the shroud/s.

3. Remove the “door fan” (see section *Replacing the cabinet “door fan”* on page *168*).

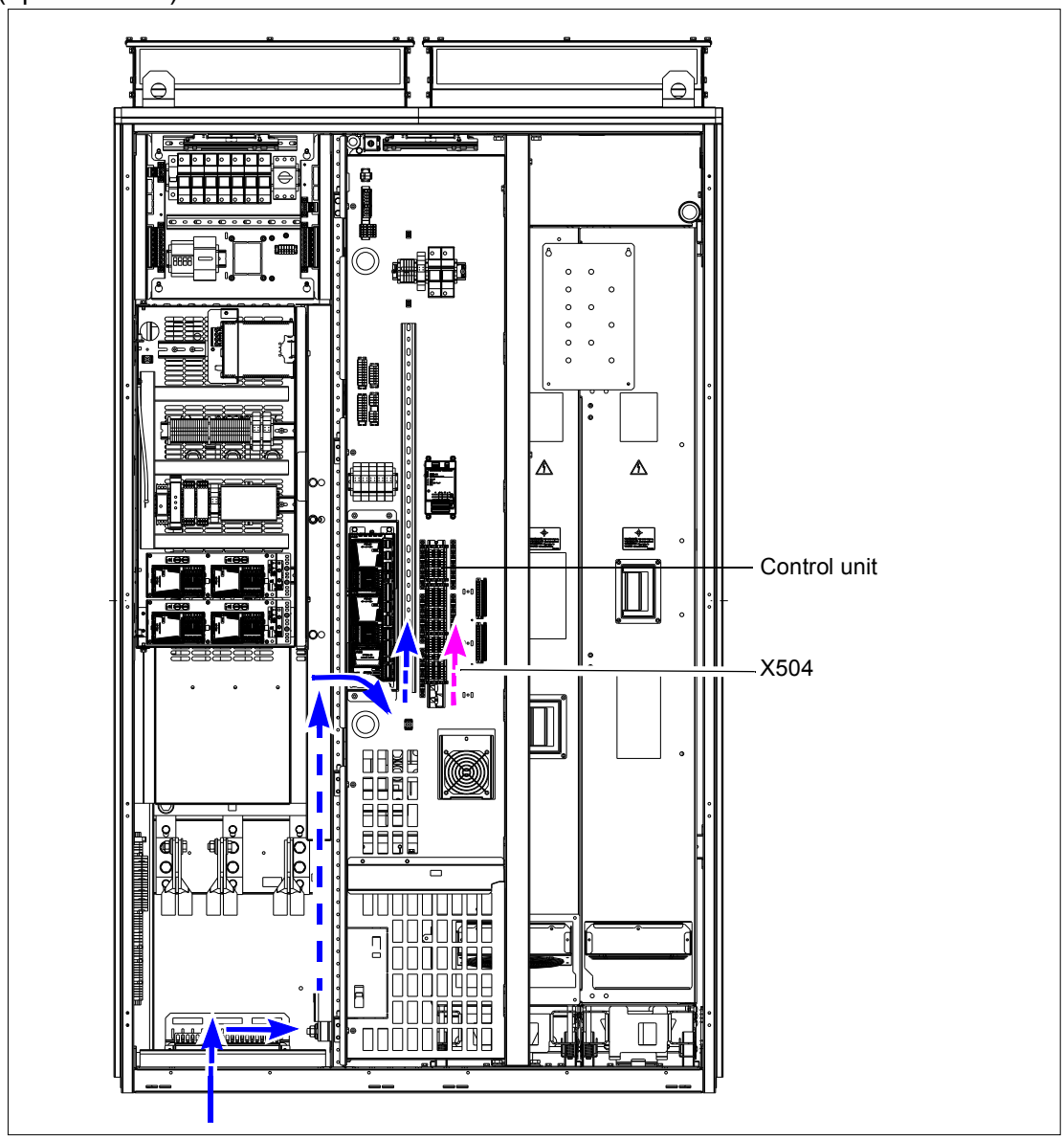
4. See page *47*. Bottom entry: Route the cables of these options to the connection terminals at the left-hand side of the cabinet as shown below.



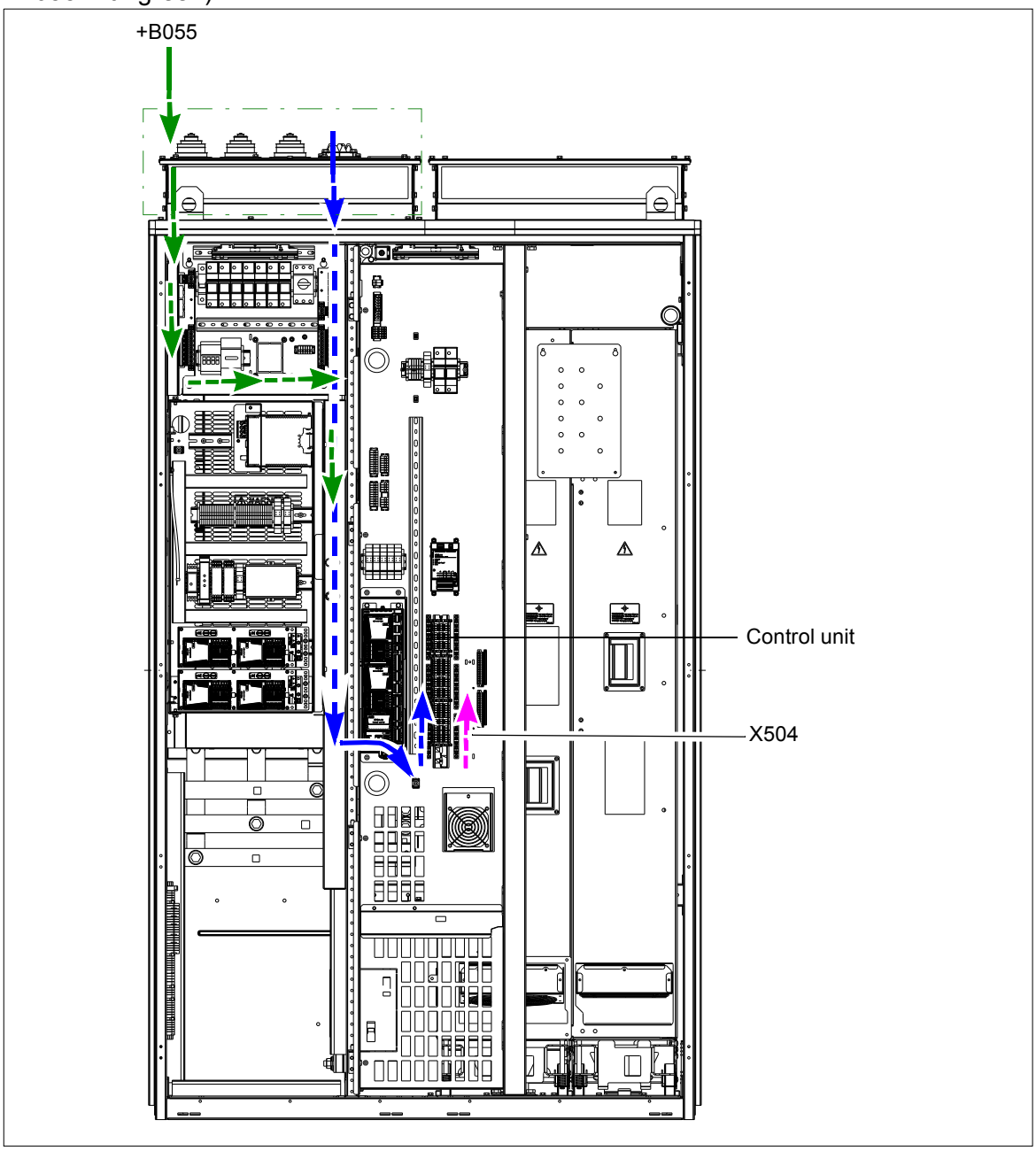




| |
|---|
| Line contactor and main switch feedback for customer |
| Prevention of unexpected start-up with safety relays (option +Q957) |
| Push buttons for emergency stop options +Q951, +Q952, +Q963 and +Q964 |
| Ground fault monitoring for IT (ungrounded) systems (option +Q954) |
| External STO customer connection for safety options +Q951, +Q952, +Q963, +Q964, +Q957 and +Q971 |
| Starter for auxiliary motor fan (options +M600…+M605) |
| Thermistor relay or Pt100 relays (option +L505 or +L506) |

5. Bottom entry: Route the cables to the control unit, additional terminal block X504 (option +L504) as shown below.



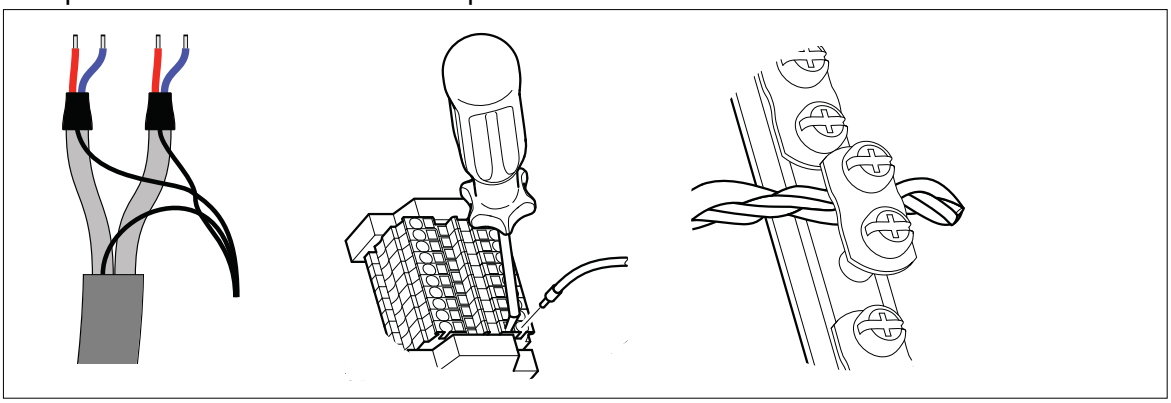
Top entry: Route the control cables to the control unit and additional terminal block X504 (option +L504) as shown below (standard cabinet and option +B054 with blue color; option +B055 with green).




### Connecting to the drive control unit

To connect the conductors to the terminals of the drive control unit or terminal block X504 (option +L504), see section *Default I/O connection diagram of frame R8* on page *137* or *Default I/O connection diagram of frame R11* on page *147*.

Connect the inner twisted pair shields and all separate grounding wires to the grounding clamps next the control unit or the optical terminal block.



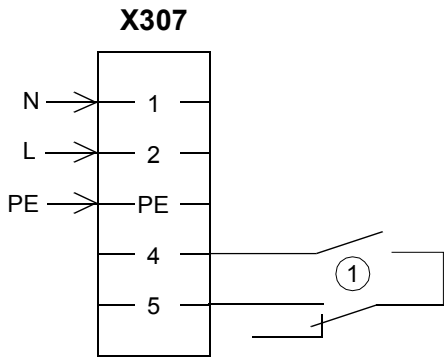
**Notes:**

- Do not ground the outer shield of the cable here since it is grounded at the entry.
- 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.

At the other end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, 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.

### Connecting an auxiliary voltage supply (UPS, option +G307)

Wire the external control voltage to terminal block X307 at the back side of the mounting plate as shown below.




1 Internal wiring of UPS supervision: load break switch or circuit breaker off/fault = contact open.

### Connecting emergency stop push buttons (options +Q951, +Q952, +Q963, +Q964, +Q978, +Q979)

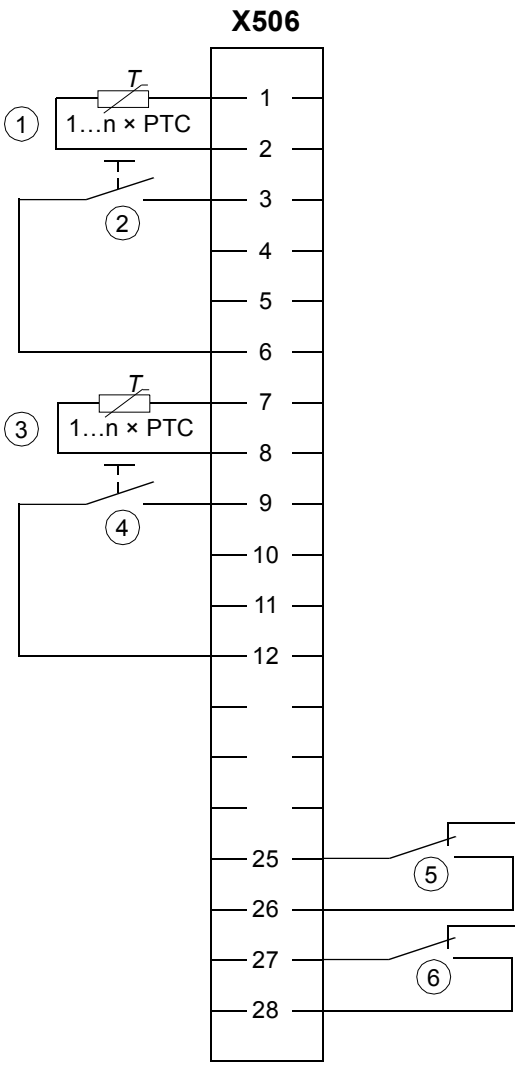
Connect external emergency stop push buttons according to the circuit diagrams delivered with the drive.

### Wiring the starter for auxiliary motor fan (options +M600…+M605)

Connect the power supply wires for the auxiliary motor fan to terminal block X601 according to the circuit diagrams delivered with the drive.

### Wiring the PTC thermistor relay(s) (options +L505, +2L505, +L513, +2L513)

The external wiring of option +2L505 and +2L513 (two thermistor relays) is shown below. For example, one relay can be used to monitor the motor windings, the other to monitor the bearings. The maximum contact load capacity is 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive. For instructions on commissioning options +L513 and +2L513, see *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).




1 PTC sensors monitored by relay K74.
$R_G = R_1 + R_2 + R_N \leq 1.5$ kohm.

2 External reset for relay K74 (to be bridged for autoreset functionality)
**Note:** With +L505 and +2L505, the terminals can be bridged for automatic reset. However, this is not allowed by ATEX regulations.

3 PTC sensors monitored by relay K75.
$R_G = R_1 + R_2 + R_N \leq 1.5$ kohm.

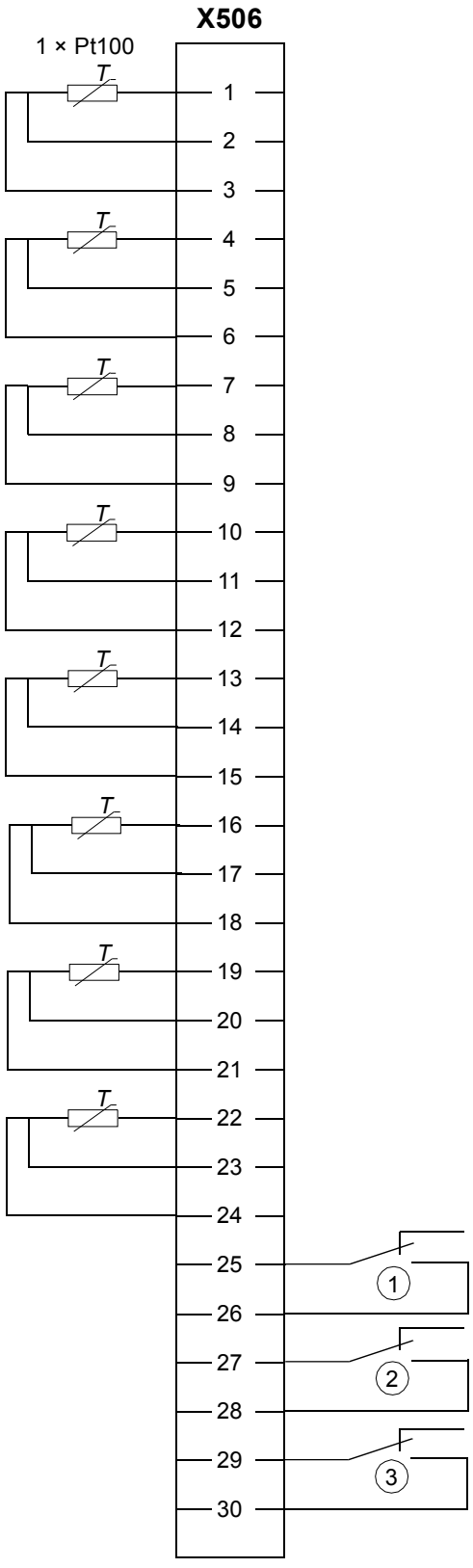
4 External reset for relay K75 (to be bridged for autoreset functionality)
**Note:** With +L505 and +2L505, the terminals can be bridged for automatic reset. However, this is not allowed by ATEX regulations.

5 Overheat indication from relay K74: overtemperature = contact open.

6 Overheat indication from relay K75: overtemperature = contact open.

### Wiring the Pt100 relays (option +nL506)

External wiring of eight Pt100 sensor modules is shown below. Contact load capacity 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive.



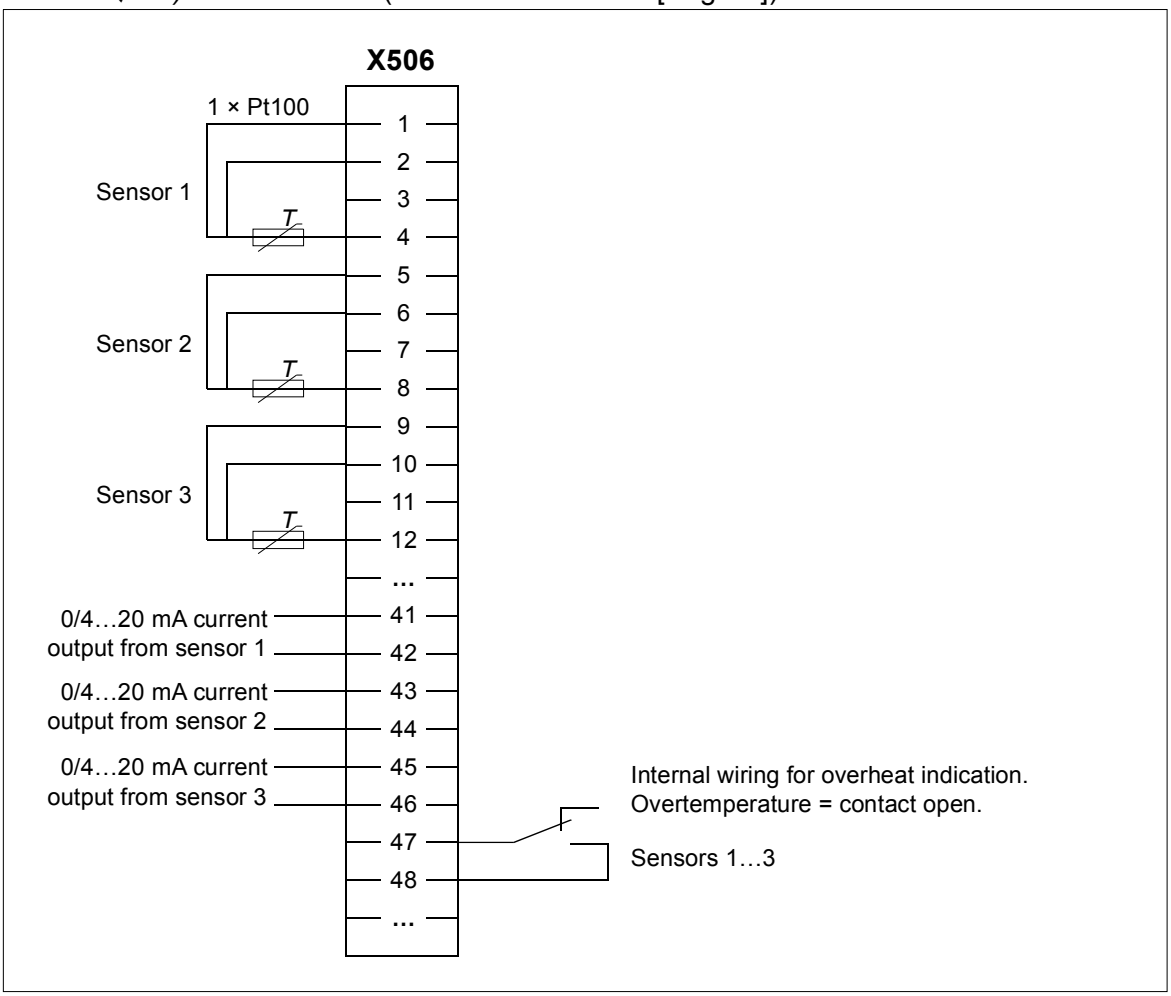

1 Internal wiring of the windings overheat (modules 1…3): overtemperature = contact open.

2 Internal wiring of the bearings overheat (module 4 and 5): overtemperature = contact open.

3 Internal wiring of the windings overheat (modules 6…8): overtemperature = contact open.

### Wiring the Pt100 relays (option +nL514)

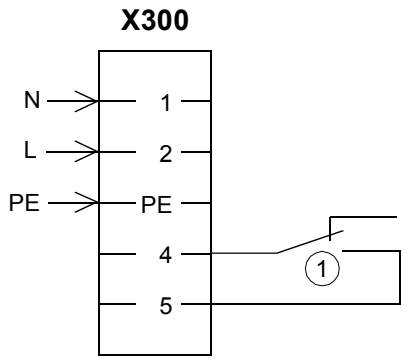
External wiring of three Pt100 sensors is shown below. The maximum contact load capacity is 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive. For instructions on commissioning option +nL514, see *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).



**Powering the heating and lighting equipment (options +G300, +G301 and +G313)**

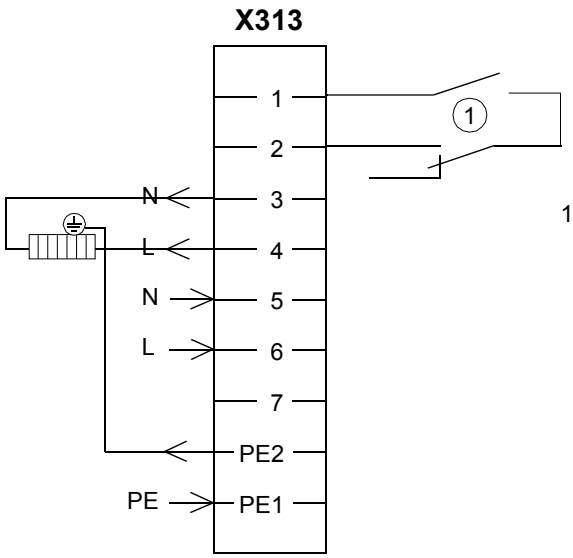
See the circuit diagrams delivered with drive.

Connect the external power supply wires for the cabinet heater and lighting to terminal block X300 at the back of the mounting plate. For the actual wiring, see the circuit diagram delivered with the drive.




1 Internal wiring of the cabinet heater: heater off/fault = contact open.

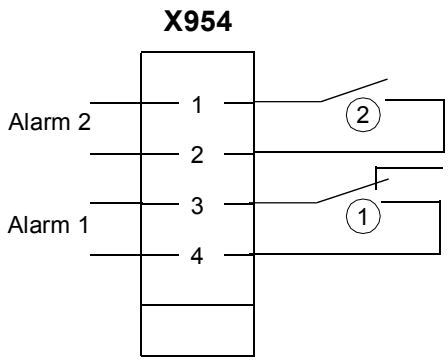
Connect the motor heater wiring to terminal block X313 as shown below. Maximum external power supply 16 A. For the actual wiring, see the circuit diagram delivered with the drive.




1 Internal wiring of the motor space heater supervision: load break switch or protection switch off/fault = contact open.

### Wiring ground fault monitoring for IT ungrounded systems (option +Q954)

We recommend to connect Alarm 1 for drive tripping and Alarm 2 for alarm signals in order to avoid unnecessary trippings due to the ground fault monitor self testing with Alarm 2. For the actual wiring, see the circuit diagram delivered with the drive.



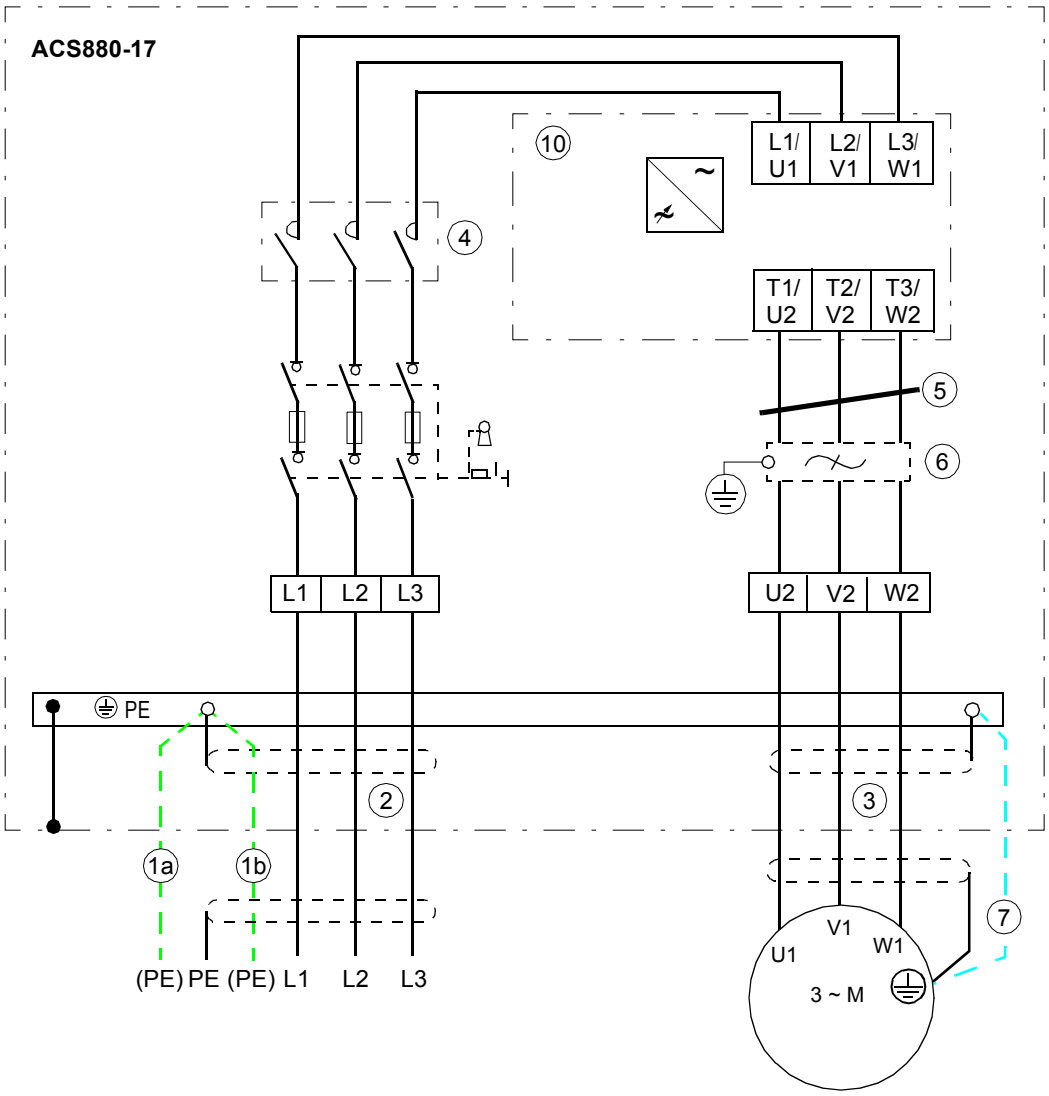

2 Internal wiring: Ground fault alarm 1. No ground fault = contact closed. Contact load capacity 250 V AC 2 A.

1 Internal wiring: Ground fault alarm 2: No ground fault = contact closed. Contact load capacity 250 V AC 8 A.

# Connecting the power cables

## Connection diagram

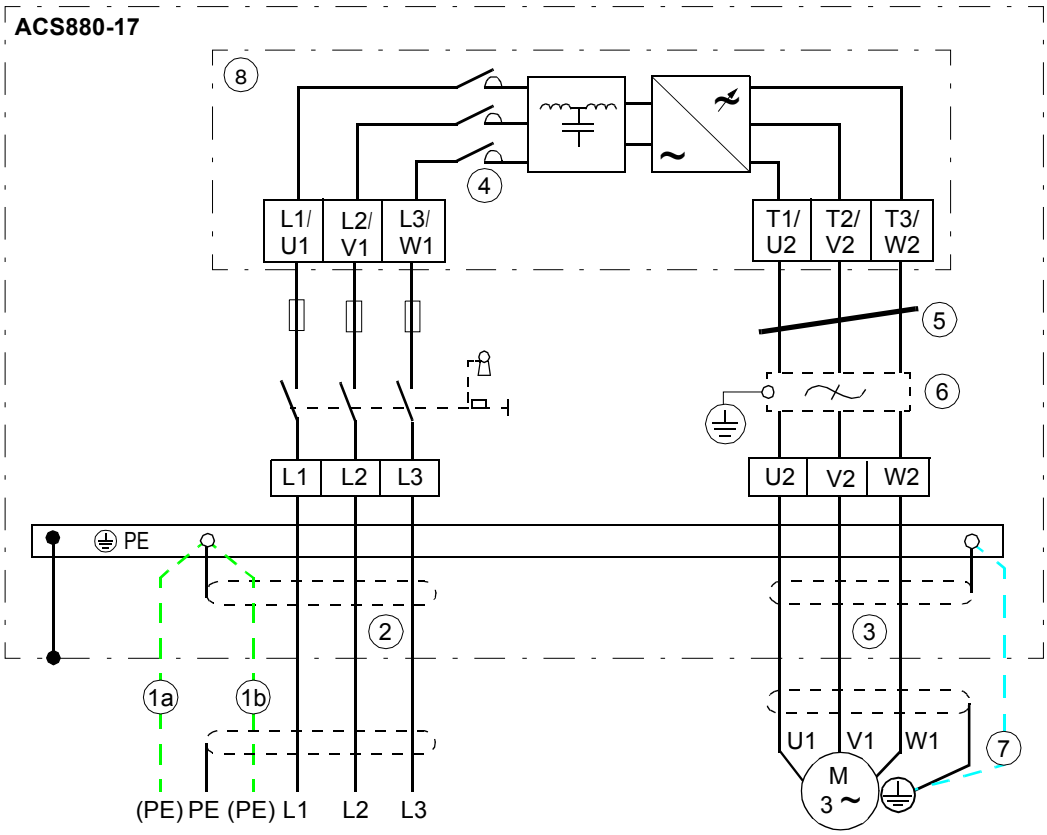
### Connection diagram of frame R8




| | |
|---|---|
| 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 *86*). |
| 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 (option for +Q951, +Q952, +Q978) |
| 5 | Common mode filter (option +E208) |
| 6 | du/dt filter or sine filter (options +E205 and +E206) |
| 7 | Use a separate grounding cable if the shield does not meet the requirements of IEC 61439-1 (see page *86*) and there is no symmetrically constructed grounding conductor in the cable (see page *88*). |
| 8 | Drive module |

**Note:**
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.

## Connection diagram of frame R11




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 86).

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 (option +E208)

6 du/dt filter (option +E205) or sine filter (option +E206)

7 Use a separate grounding cable if the shield does not meet the requirements of IEC 61439-1 (see page 86) and there is no symmetrically constructed grounding conductor in the cable (see page 88).

8 Drive module

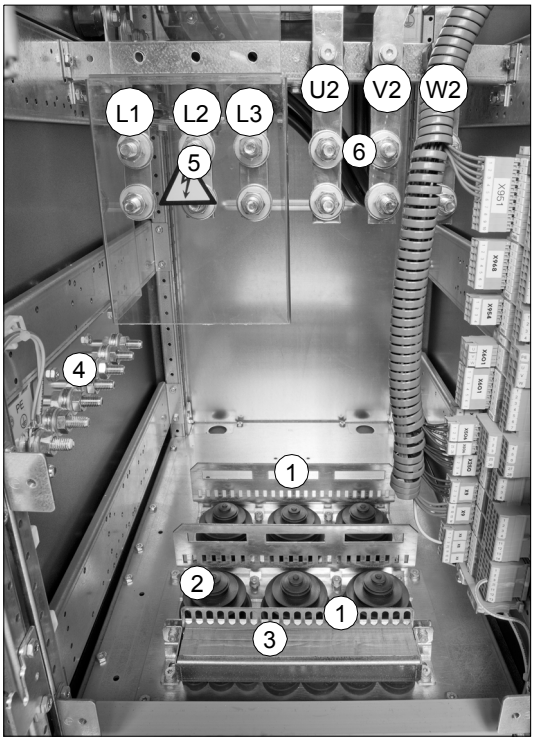
**Note:**
If there is a symmetrically constructed grounding conductor on the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.
Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at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

## Layout of power cable connection terminals and cable entries

The layout of power cable connection terminals and cable entries of the standard drive are shown below.

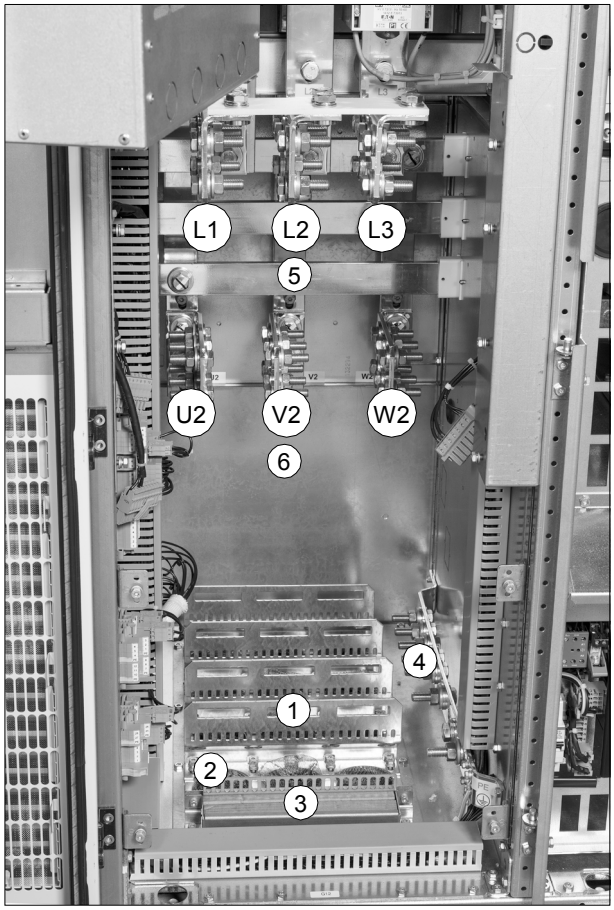
**Note:** You have to remove the “door fan” to gain access to the cable terminals and entries (see page *168*).

### Frame R8




| | |
|---|---|
| 1 | Strain relief |
| 2 | Power cable entries. Conductive sleeve under the grommet. |
| 3 | Control cable entry with EMI conductive cushions. |
| 4 | PE terminal |
| 5 | Input power cable terminals L1, L2 and L3 |
| 6 | Motor cable terminals U2, V2, W2 |

## Frame R11

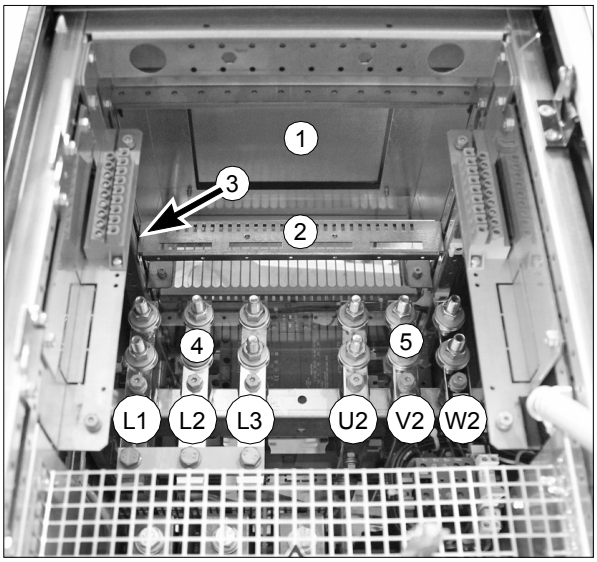



| | |
|---|---|
| 1 | Strain relief |
| 2 | Power cable entries. Conductive sleeve under the grommet. |
| 3 | Control cable entry with EMI conductive cushions. |
| 4 | PE terminal |
| 5 | Input power cable terminals L1, L2 and L3 |
| 6 | Motor cable terminals U2, V2, W2 |

### Layout of power cable connection terminals (option +C129)

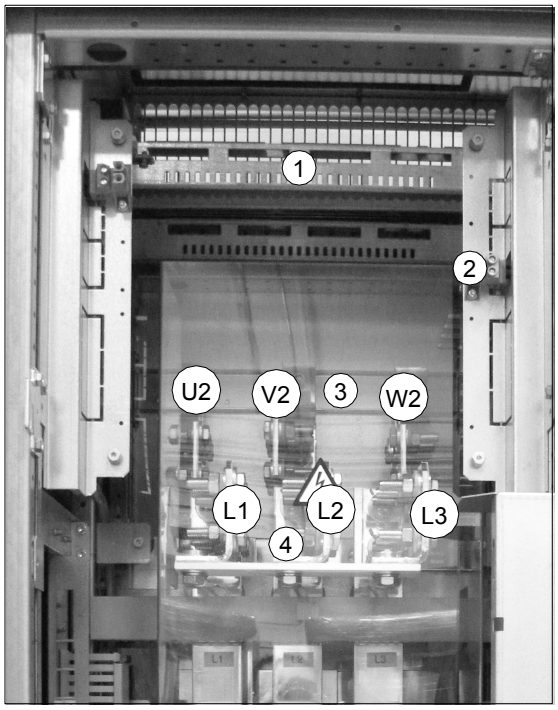
This figure shows the layout of the power cable connection terminals of frame R8.






| | |
|---|---|
| 1 | Power cable entries |
| 2 | Strain relief |
| 3 | Ground bar |
| 4 | Input cable power connection terminals L1, L2 and L3 |
| 5 | Motor cable connection terminals U2, V2, W2 |

This figure shows the layout of the power cable connection terminals of frame R11.




| | |
|---|---|
| 1 | Strain relief |
| 2 | PE terminal |
| 3 | Motor cable connection terminals U2, V2, W2 |
| 4 | Input cable power connection terminals L1, L2 and L3 |

## Connection procedure (IEC)

1. Do the steps in section *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet door.
3. For R8 bottom entry of cables:
   - If there is a mounting plate above the fan, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   - If there is no mounting plate, but a shroud above the fan, undo the four screws and remove the shroud.
   - Remove the “door fan” (see section *Replacing the cabinet “door fan”* on page *168*).
   - Remove the plastic shroud in front of input terminals.

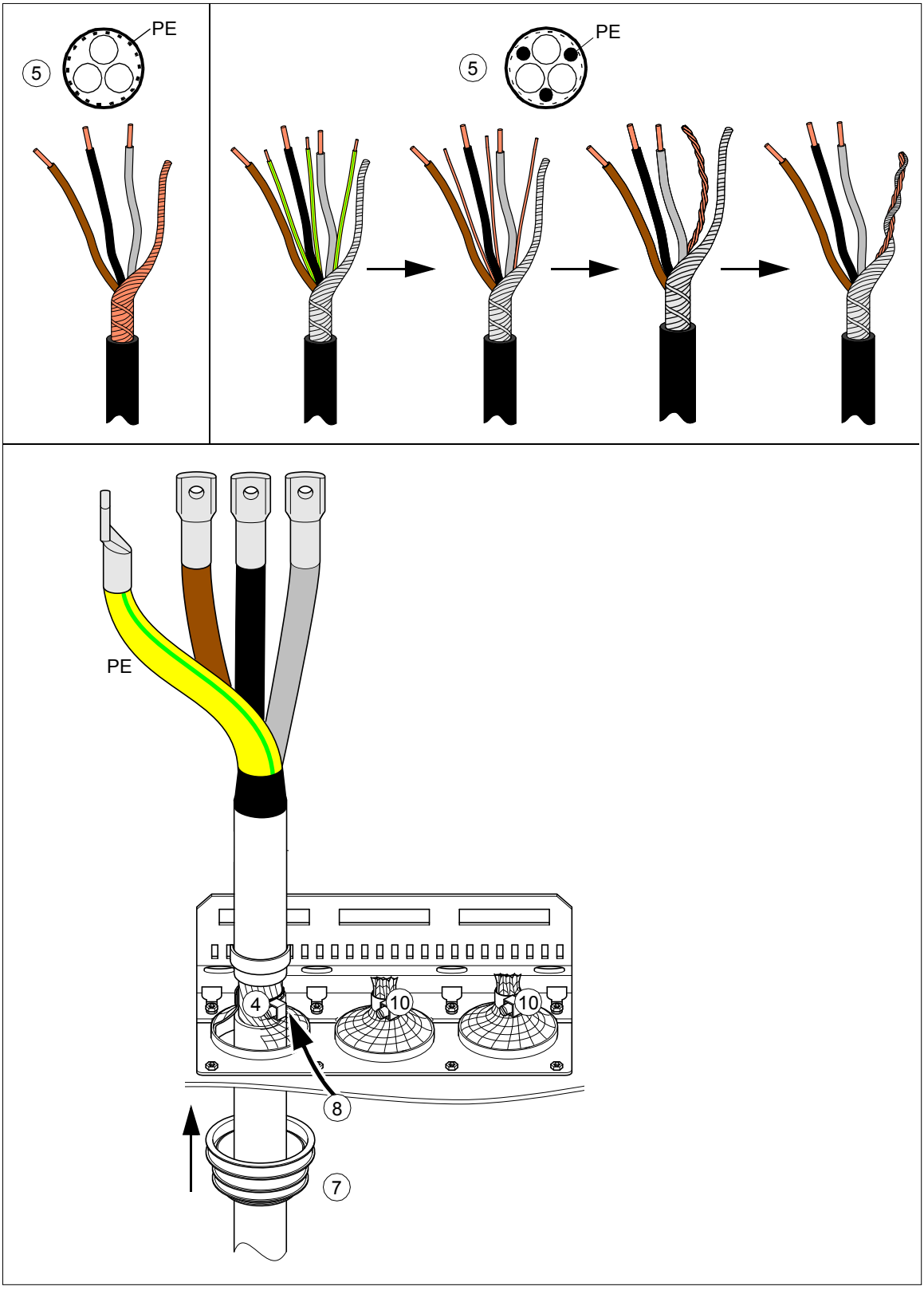
   For R8 top entry of cables:
   - Unplug the connectors at the top mounting plate, loosen the four screws and lift off the top mounting plate.
   - Remove the plastic shroud in front of input terminals.

   For R11 bottom entry of cables:
   - If there is a mounting plate/two plates above the fan, loosen the four screws of the plate and pull out the plate/s. Unplug the connectors and remove the plate/s.
   - If there is no mounting plate/s, but a shroud/s above the fan, undo the four screws and remove the shroud/s.
   - Remove the “door fan” (see section *Replacing the cabinet “door fan”* on page *168*).
   - Marine drives (option +C121): Undo the three M6 screws on the left side of the swing-out frame.
   - Undo the two screws and open the swing-out frame or remove the shroud if there is no swing-out frame.
   - Remove the plastic shroud in front of input terminals.

   For R11 top entry of cables:
   - Marine drives (option +C121): Undo the three M6 screws on the left side of the swing-out frame.
   - Undo the two screws and open the swing-out frame or remove the shroud if there is no swing-out frame.
   - Marine drives (option +C121): Undo the four M6 screws and remove the support in front of top fuse plate.
   - Unplug the connectors, loosen the four M6 screws and remove the top fuse plate.
4. Peel off 3 to 5 cm of the outer insulation of the cables above the entry plate for the 360° high-frequency grounding.
5. Prepare the ends of the cables.

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

6. If fire insulation is used, make an opening in the mineral wool sheet according to the diameter of the cable.
7. Remove rubber grommets from the entry plate for the cables to be connected. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Slide the cables through the entry with the conductive sleeves and attach the grommets to the holes.
8. Attach the conductive sleeves to the cable shields with cable ties.
9. Seal the slot between the cable and mineral wool sheet (if used) with sealing compound (eg, CSD-F, ABB brand name DXXT-11, code 35080082).
10. Tie up the unused conductive sleeves with cable ties.
11. Connect the twisted shields of the motor cables to the ground bar and the phase conductors to the U2, V2 and W2 terminals.
12. Tighten the power cable screws to the torque given in *Terminal and exit data for the power cables* on page *224*.
13. Reinstall the shrouds and mounting plates.


5
PE
5
PE
PE
4
10
10
8
7

## Connection procedure (US)

**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. Do the steps in section *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet door.
3. For R8 bottom entry of cables:
   - If there is a mounting plate above the fan, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   - If there is no mounting plate, but instead a shroud above the fan, undo the four screws and remove the shroud.
   - Remove the "door" fan (see section *Replacing the cabinet "door fan"* on page *168*).
   - Remove the plastic cover in front of input terminals.

   For R8 top entry of cables:
   - Unplug the connectors, loosen the four screws and lift off the top mounting plate.
   - Remove the plastic cover in front of input terminals.

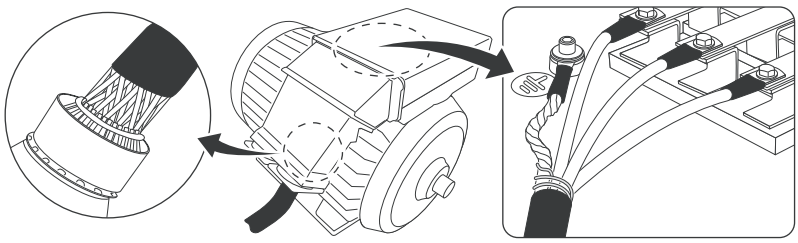
   For R11 bottom entry of cables:
   - If there is a mounting plate/two plates above the fan, loosen the four screws of the plate and pull out the plate/s. Unplug the connectors and remove the plate/s.
   - If there is no mounting plate/s, but instead a shroud/s above the fan, undo the four screws and remove the shroud/s.
   - Remove the "door" fan (see section *Replacing the cabinet "door fan"* on page *168*).
   - (In marine versions, option +C121, undo the three M6 screws on the left side of the swing-out frame.)
   - Undo the two screws and open the swing-out frame or remove the shroud if there is no swing-out frame.
   - Remove the plastic cover in front of input terminals.

   For R11 top entry of cables:
   - (In marine versions, option +C121, undo the three M6 screws on the left side of the swing-out frame.)
   - Undo the two screws and open the swing-out frame or remove the shroud if there is no swing-out frame. (In marine versions, option +C121, undo the four M6 screws and remove the support in front of top fuse plate.) Unplug the connectors, loosen the four M6 screws and remove the top fuse plate.

4. Plan cable access and mark the conduit plate accordingly for the input and output power and control cables.
5. Remove the conduit plate from the drive cabinet and cut holes as needed for the conduit connections. **Note:** Never cut metal in or around an equipment cabinet. Metal debris can cause damage to electrical equipment and hazardous conditions.
6. Reinstall the conduit plate to cabinet and connect all electrical conduits as needed to conduit plate. Do not leave any open holes at the top of the cabinet.
7. Run the motor power cables and separate ground cable (if present) from the motor to cabinet.
8. Connect the motor power cable shields and separate ground cable (if present) to the ground bar at the top of the cabinet for top entry and at the bottom of the cabinet if bottom entry (option +H350).
9. Connect the motor phase conductors to the output power terminals U2, V2 and W2.
10. For drives with external brake resistors (option +D150 and no +D151):
    - Run the power cables from the brake resistor to the brake copper cubicle including the grounding cable.
    - Connect the ground cable to the ground bar at the bottom of the cabinet.
    - Connect the brake resistor power cables to the R- and R+ terminals.
11. Make sure that all power is disconnected and reconnection is not possible. Use proper safe disconnect procedures according to local codes.
12. Run the AC power supply cables and separate ground cables (if present) from the supply source to the cabinet.
13. Connect AC power supply cable shields and separate ground cables (if present) to the ground bar at the top of the cabinet for top entry and at the bottom of the cabinet if bottom entry (option +H350).
14. Connect AC supply phase conductors to terminals L1, L2 and L3.
15. Reinstall the shrouds and mounting plates.

## Grounding the motor cable shield at the motor end

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



See also *Continuous motor cable shield or enclosure for equipment on the motor cable* on page *93*.

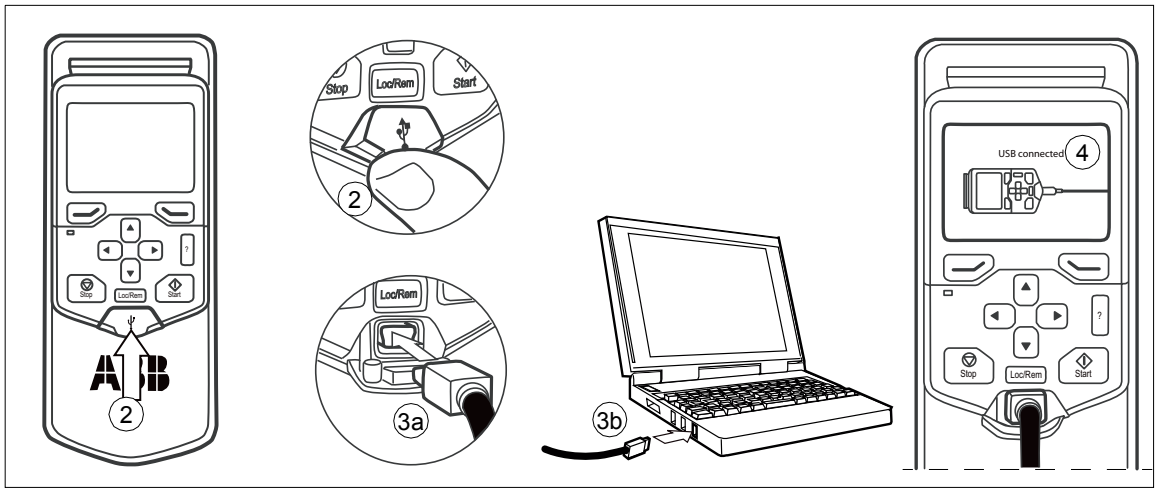
# Connecting a PC

A PC (with eg. the Drive composer PC tool) can be connected to the drive control unit as follows:

1. Connect the control panel to the drive control unit either by using an Ethernet (eg. CAT5E) networking cable, or by inserting the panel into the panel holder (if present).

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

2. Remove the USB connector cover on the front of the control panel.
3. Connect an USB cable (Type A to Type Mini-B) between the USB connector on the control panel (3a) and a free USB port on the PC (3b).
4. The panel will display an indication whenever the connection is active.




5. See the documentation of the PC tool for setup instructions.

**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.

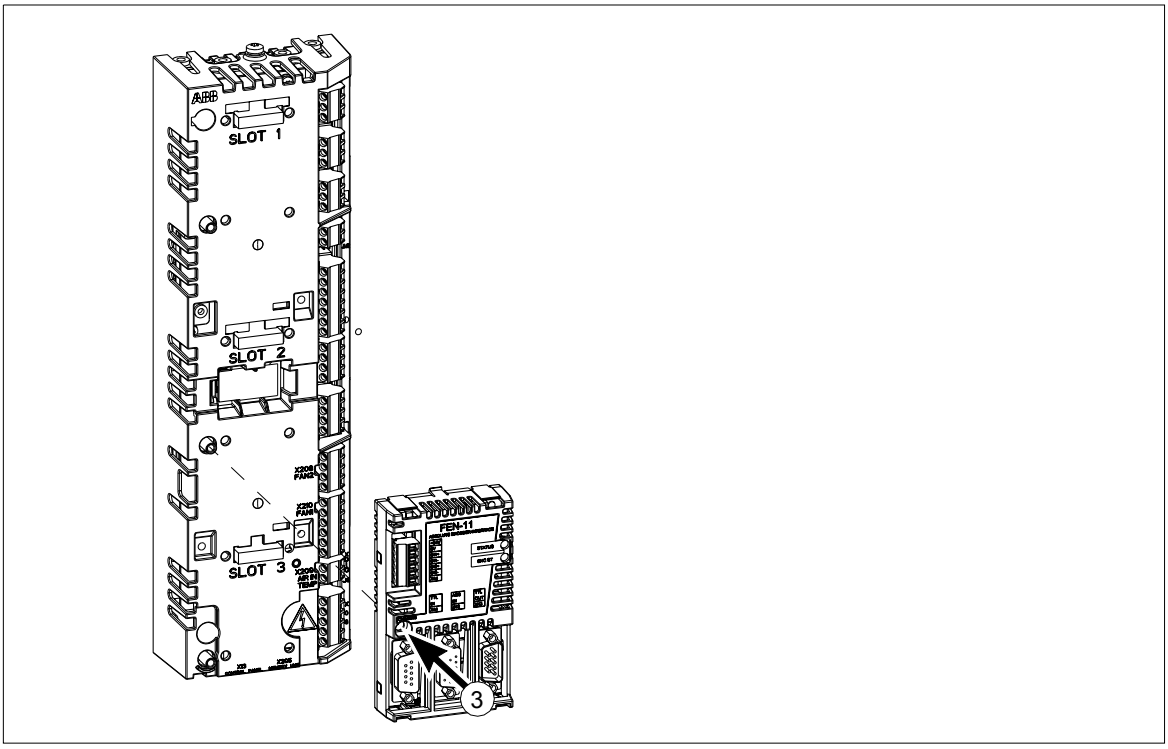
# Installing option modules

## Mechanical installation of I/O extension, fieldbus adapter and pulse encoder interface modules

See page *44* for the available slots for each module. Install the option modules as follows:

**WARNING!** Obey the 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 *Electrical safety precautions* (page *19*) before you start the work.
2. For R8: Open the swing-out frame or remove the shroud if there is no swing-out frame.
   For R11: Open the cabinet door.
3. Insert the module carefully into its position on the control unit (see section *Cabinet layout* on page *37* for the control unit location).
4. Attach the mounting screw. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.

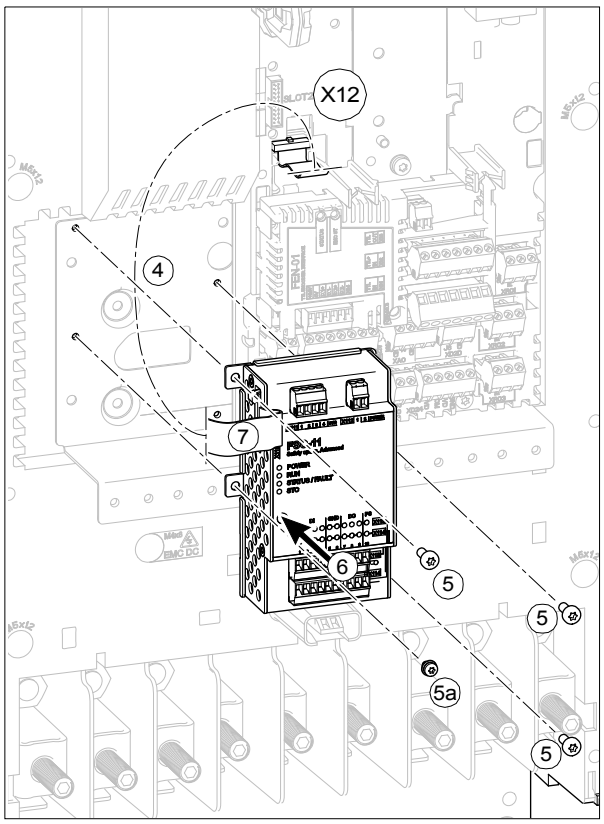


## Installation of safety functions modules (frame R8)

Install the safety functions module next to the ZCU-12 control unit as described below.

**WARNING!** Obey the 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 *Electrical safety precautions* (page *19*) before you start the work.
2. Open the door.
3. Open the swing-out frame.
4. Insert the module carefully into its position.
5. Attach the module with four screws. **Note:** Correct installation of the module enclosure grounding screw (a) is essential for fulfilling the EMC requirements and for proper operation of the module.
6. Tighten the grounding screw of the electronics to tightening torque 0.8 N·m.
7. Connect the data communication cable to connector X110 on the module and to connector X12 on the drive control unit.
8. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.
9. Connect the external +24 V power supply cable to connector X112.
10. Connect the other wires as shown in *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).



## Installation of safety functions modules (frame R11)

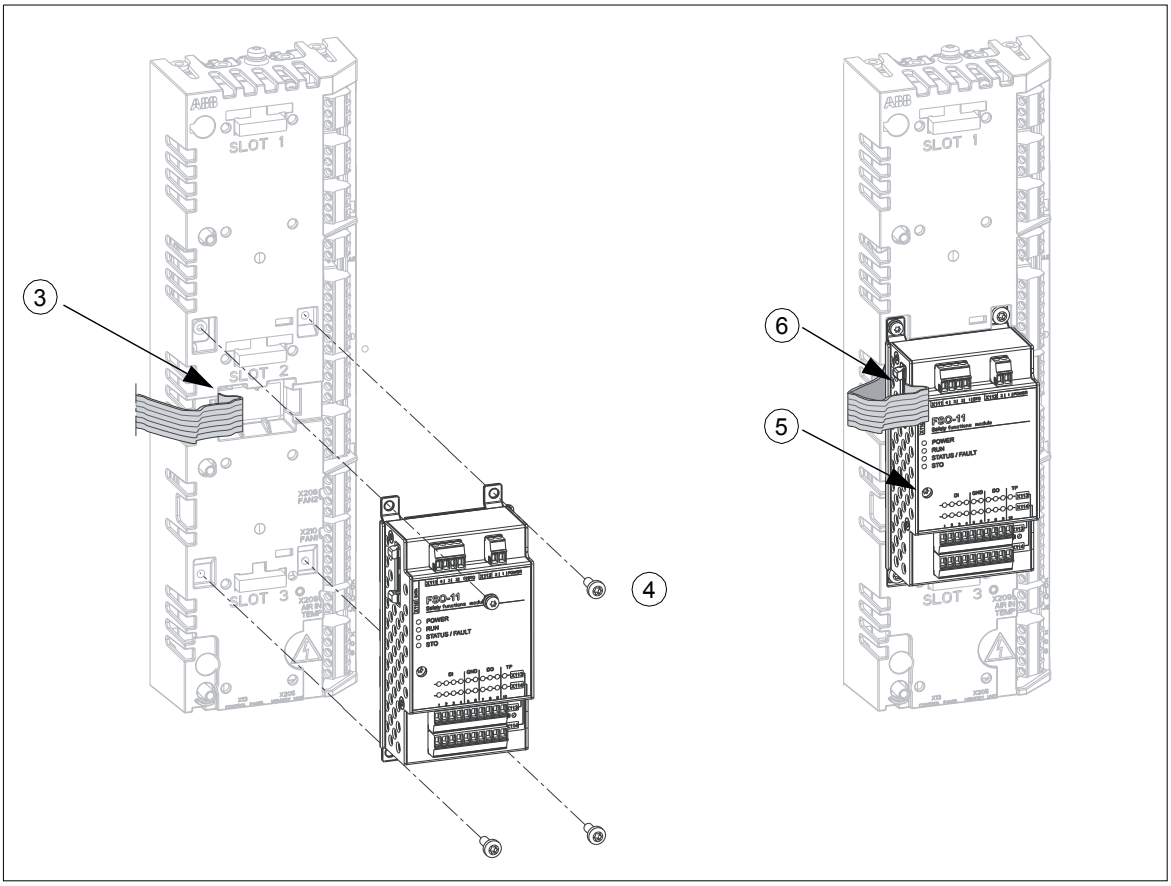
Install the safety functions module next to the ZCU-14 control unit as described below. Change the mounting plate of the module as shown in *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]).



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

**Case 1: FSO-xx safety functions module on Slot 2**

1. Stop the drive and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Open the doors.
3. Connect the FSO-xx data cable to connector X12 on the control unit.
4. Attach the FSO-xx safety functions module to Slot 2 with four screws.
5. Tighten the FSO-xx electronics grounding screw to 0.8 N·m. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.
6. Connect the FSO-xx data cable to FSO-xx connector X110.
7. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.
8. Connect the external +24 V power supply cable to connector X112.
9. Connect the other wires as shown in *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

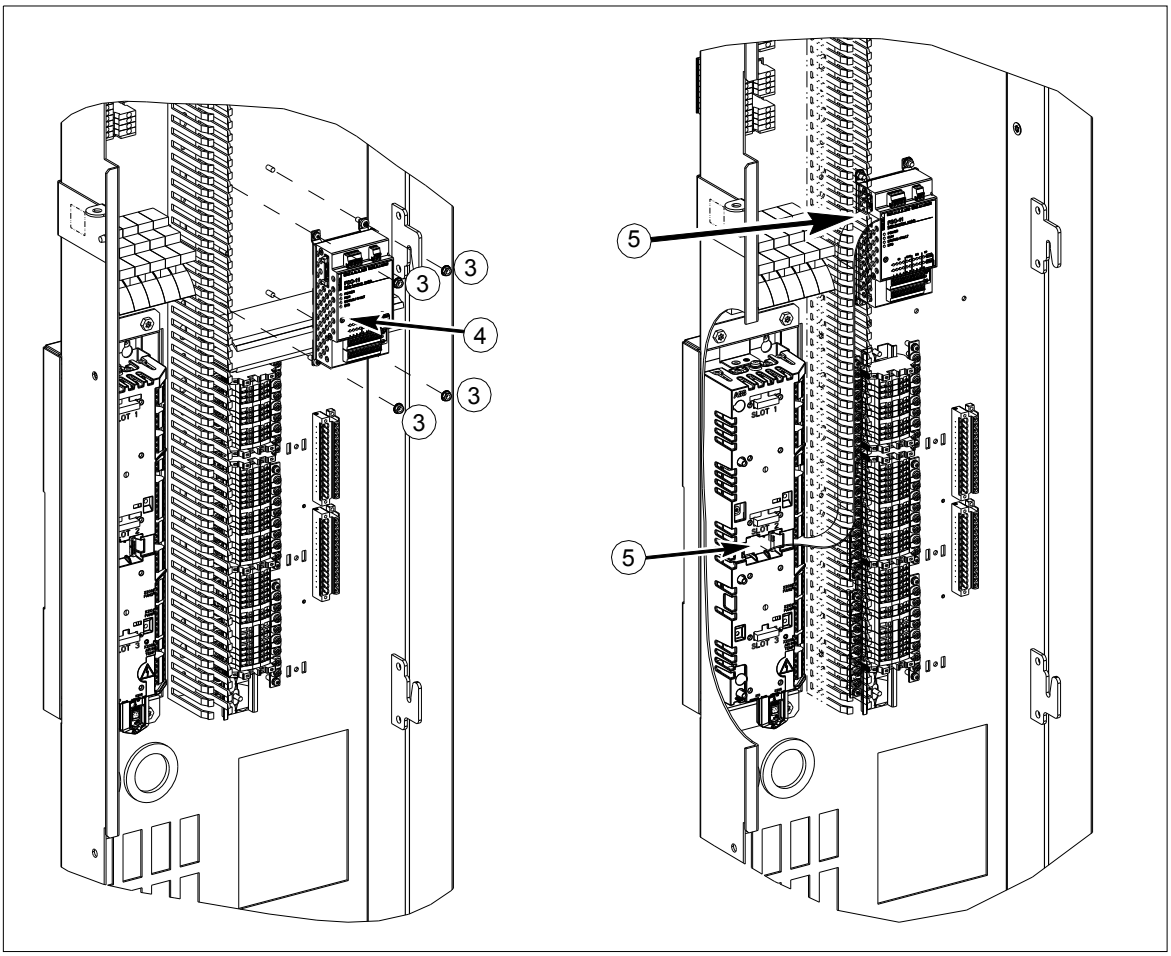

3
4
5
6
SLOT 1
SLOT 2
SLOT 3
FSO-11
POWER
RUN
STATUS / FAULT
STO

### Case 2: FSO-xx safety functions module next to the control unit

Install the safety functions module next to the control unit as described below. Change the original mounting plate of the module to the alternative plate included in the module package.

**WARNING!** Obey the 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 *Electrical safety precautions* (page *19*) before you start the work.
2. Open the doors.
3. Attach the FSO-xx safety functions module to the mounting plate with four screws.
4. Tighten the FSO-xx electronics grounding screw o 0.8 N·m. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.
5. Connect the FSO-xx data cable to FSO-xx connector X110 and to connector X12 on the control unit.



7

# Control unit of frame R8

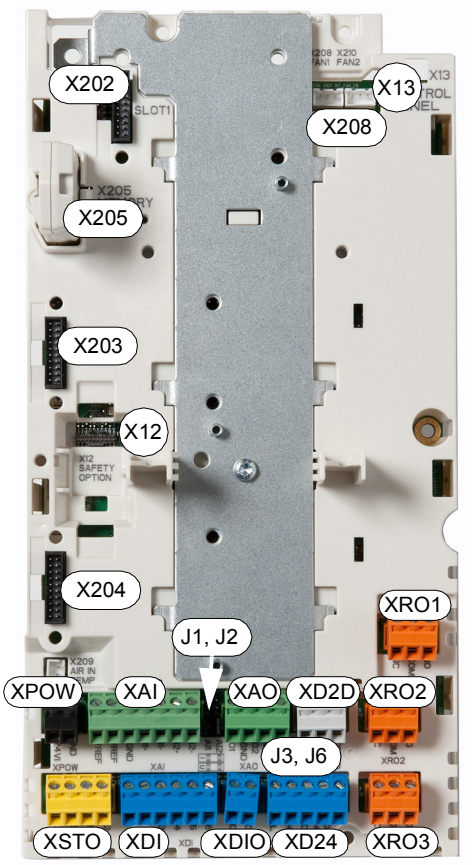
## Contents of this chapter

This chapter contains the default I/O connection diagram, descriptions of the terminals and technical data for the control unit (ZCU-12) of drive frame R8.

The ZCU control unit of frame R8 controls the motor-side converter. Control board QCON-21 controls the line-side converter.

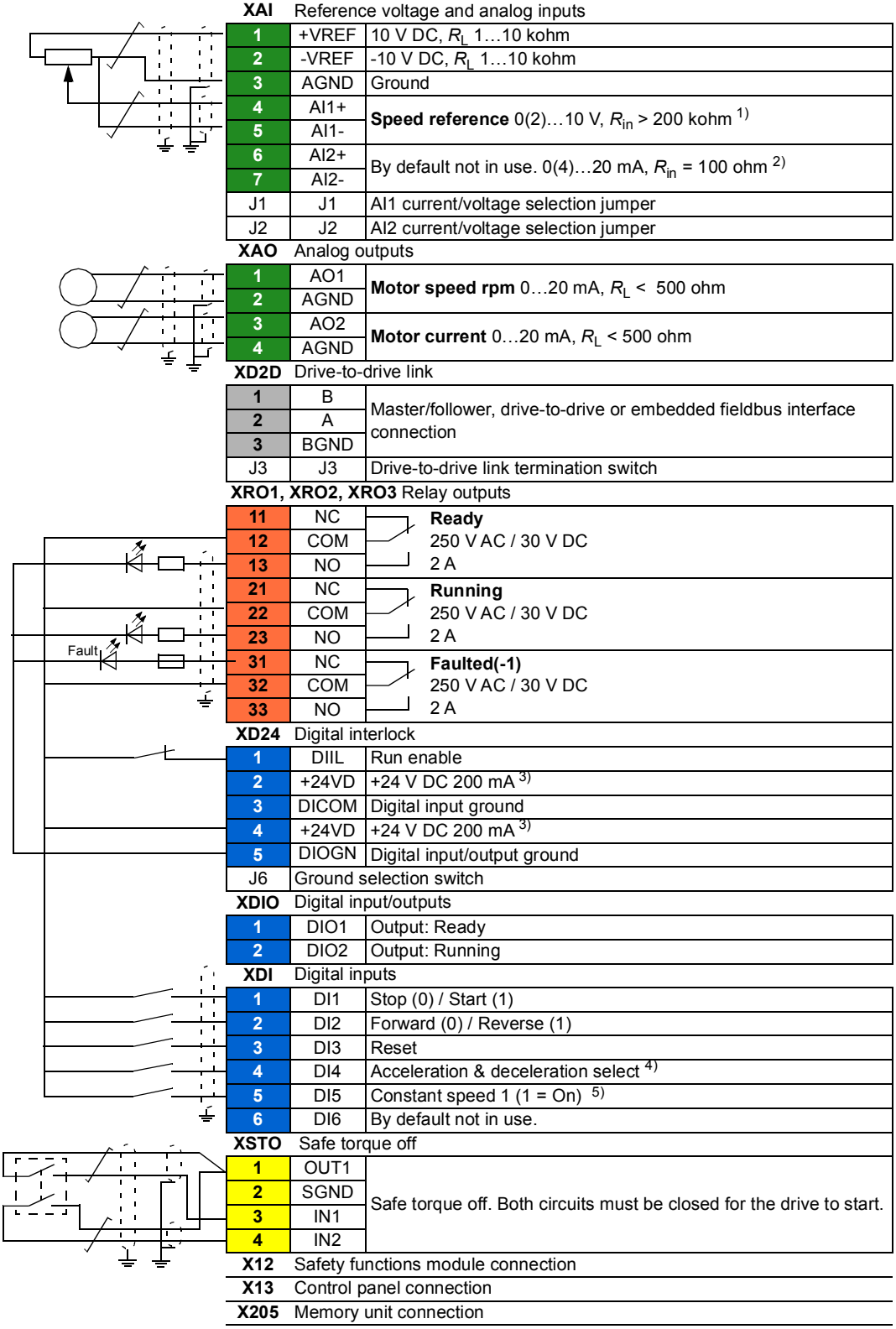
# Layout

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




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

# Default I/O connection diagram of frame R8




**XPOW** External power input

| | | |
|---|---|---|
| 1 | +24VI | 24 V DC, 2 A |
| 2 | GND | |

**XAI** Reference voltage and analog inputs

| | | |
|---|---|---|
| 1 | +VREF | 10 V DC, $R_L$ 1…10 kohm |
| 2 | -VREF | -10 V DC, $R_L$ 1…10 kohm |
| 3 | AGND | Ground |
| 4 | AI1+ | **Speed reference** 0(2)…10 V, $R_{in}$ > 200 kohm [1] |
| 5 | AI1- | |
| 6 | AI2+ | By default not in use. 0(4)…20 mA, $R_{in}$ = 100 ohm [2] |
| 7 | AI2- | |
| J1 | J1 | AI1 current/voltage selection jumper |
| J2 | J2 | AI2 current/voltage selection jumper |

**XAO** Analog outputs

| | | |
|---|---|---|
| 1 | AO1 | **Motor speed rpm** 0…20 mA, $R_L$ < 500 ohm |
| 2 | AGND | |
| 3 | AO2 | **Motor current** 0…20 mA, $R_L$ < 500 ohm |
| 4 | AGND | |

**XD2D** Drive-to-drive link

| | | |
|---|---|---|
| 1 | B | Master/follower, drive-to-drive or embedded fieldbus interface connection |
| 2 | A | |
| 3 | BGND | |
| J3 | J3 | Drive-to-drive link termination switch |

**XRO1, XRO2, XRO3** Relay outputs

| | | |
|---|---|---|
| 11 | NC | **Ready** 250 V AC / 30 V DC 2 A |
| 12 | COM | |
| 13 | NO | |
| 21 | NC | **Running** 250 V AC / 30 V DC 2 A |
| 22 | COM | |
| 23 | NO | |
| 31 | NC | **Faulted(-1)** 250 V AC / 30 V DC 2 A |
| 32 | COM | |
| 33 | NO | |

**XD24** Digital interlock

| | | |
|---|---|---|
| 1 | DIIL | Run enable |
| 2 | +24VD | +24 V DC 200 mA [3] |
| 3 | DICOM | Digital input ground |
| 4 | +24VD | +24 V DC 200 mA [3] |
| 5 | DIOGN | Digital input/output ground |
| J6 | | Ground selection switch |

**XDIO** Digital input/outputs

| | | |
|---|---|---|
| 1 | DIO1 | Output: Ready |
| 2 | DIO2 | Output: Running |

**XDI** Digital inputs

| | | |
|---|---|---|
| 1 | DI1 | Stop (0) / Start (1) |
| 2 | DI2 | Forward (0) / Reverse (1) |
| 3 | DI3 | Reset |
| 4 | DI4 | Acceleration & deceleration select [4] |
| 5 | DI5 | Constant speed 1 (1 = On) [5] |
| 6 | DI6 | By default not in use. |

**XSTO** Safe torque off

| | | |
|---|---|---|
| 1 | OUT1 | Safe torque off. Both circuits must be closed for the drive to start. |
| 2 | SGND | |
| 3 | IN1 | |
| 4 | IN2 | |

**X12** Safety functions module connection

**X13** Control panel connection

**X205** Memory unit connection

Accepted control unit terminal wire sizes: 0.5 … 2.5 mm$^2$ (24…14 AWG). Tightening torques: 0.5 N·m (5 lbf·in) for both stranded and solid wiring. For terminal X504 (option +L504), see page *55*. See the page *138* for the notes.

**Notes:**

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

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

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

[4] 0 = open, 1 = closed

| DI4 | Ramp times according to |
|---|---|
| 0 | Parameters *23.12* and *23.13* |
| 1 | Parameters *23.14* and *23.15* |

[5] Constant speed 1 is defined by parameter *22.26*.

Further information on the usage of the connectors and jumpers is given in the sections below. For the technical data of the connectors, see section *Technical data* on page *141*.

## Jumpers and switches

| Jumper/ Switch | Description | Positions |
|---|---|---|
| **J1 (AI1)** | Determines whether analog input AI1 is used as a current or voltage input. |  Current (I) |
| | |  Voltage (V) |
| **J2 (AI2)** | Determines whether analog input AI2 is used as a current or voltage input. |  Current (I) |
| | |  Voltage (U) |
| **J3** | Drive-to-drive link termination. Must be set to terminated position when the drive is the last unit on the link. |  Bus is terminated. |
| | |  Bus is not terminated. |
| **J6** | Common digital input ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). See the *Ground isolation diagram* on page *144*. |  DICOM and DIOGND connected (default).<br>  DICOM and DIOGND separated. |

## External power supply for the control unit (XPOW)

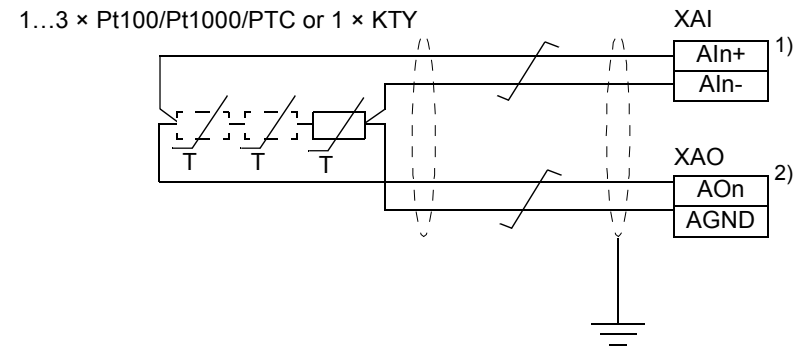
External +24 V (2 A) power supply for the control unit can be connected to terminal block XPOW. Using an external supply is recommended if

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

See also the firmware manual, parameter *95.04*.

## AI1 and AI2 as Pt100, Pt1000, PTC and KTY84 sensor inputs (XAI, XAO)

Three Pt100/Pt1000 or PTC sensors or one KTY84 sensor for motor temperature measurement can be connected between an analog input and output as shown below. (Alternatively, you can connect the KTY to FIO-11 or FAIO-01 analog I/O extension module or FEN-xx encoder interface module.) At the sensor end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, 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.



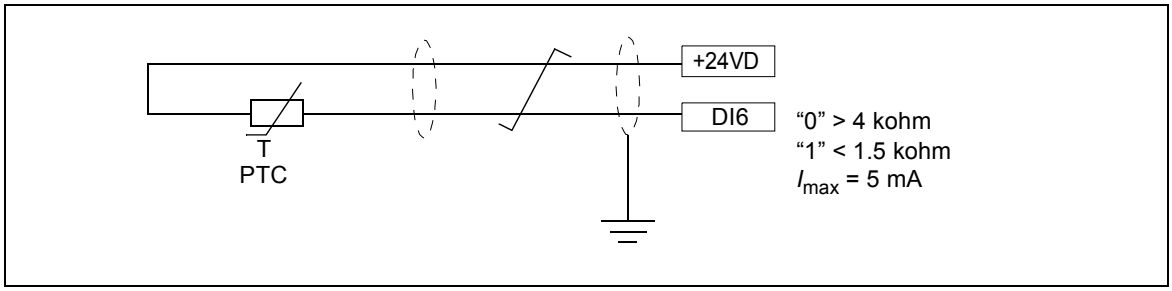

1. Set the input type to voltage with switch J1 for analog input AI1or with J2 for analog input AI2. Set the appropriate analog input unit to V (volt) in parameter group *12 Standard AI*.
2. Select the excitation mode in parameter group *13 Standard AO*.

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

## DI6 (XDI:6) as PTC sensor input

A PTC sensor can be connected to this input for motor temperature measurement as follows. The sensor resistance 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. Leave the other end of the shield unconnected or ground it directly via a few nanofarads high-frequency capacitor, for example, 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points. See the firmware manual for parameter settings.

**Note:** PTC sensors can alternatively be connected to FEN-xx encoder interface module.




**WARNING!** As the inputs pictured above are not insulated according to IEC/EN 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 selected as the source of, for example, an emergency stop command or an external event. For more information, see the firmware manual.

## The XD2D connector

The XD2D connector provides an RS-485 connection that can be used for

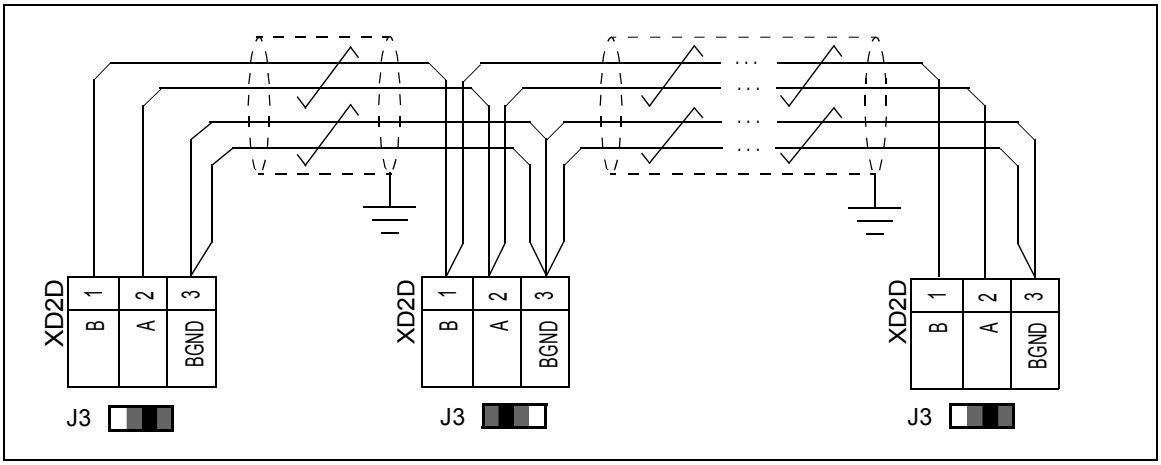
- basic master/follower communication with one master drive and multiple followers,
- fieldbus control through the embedded fieldbus interface (EFB), or
- drive-to-drive (D2D) communication implemented by application programming.

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

Enable bus termination on the units at the ends of the drive-to-drive link. Disable bus termination on the intermediate units.

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

The following diagram shows the wiring between control units for frame R8.




### Safe torque off (XSTO)

For the drive to start, both connections (OUT1 to IN1 and IN2) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting an external Safe torque off circuit to the drive. For information on the implementation of a Safe torque off function, see chapter *The Safe torque off function* on page *259*.

### FSO-xx safety functions module connection (X12)

See section *Implementing the functions provided by the FSO-xx safety functions module (option +Q972 or +Q973)* on page *95*, chapter *The Safe torque off function* and *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

## Technical data

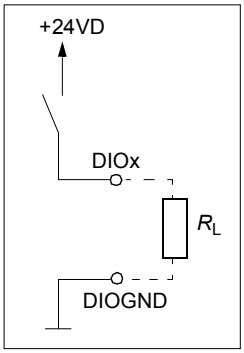
| | |
|---|---|
| **Power supply (XPOW)** | Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)<br>24 V (±10%) DC, 2 A<br>Supplied from the power unit of the drive, or from an external power supply through connector XPOW. Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG). |
| **Relay outputs RO1…RO3 (XRO1 … XRO3)** | Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)<br>250 V AC / 30 V DC, 2 A<br>Protected by varistors |
| **+24 V output (XD24:2 and XD24:4)** | Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)<br>Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2. |
| **Digital inputs DI1…DI6 (XDI:1 … XDI:6)** | Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)<br>24 V logic levels: "0" < 5 V, "1" > 15 V<br>$R_{in}$: 2.0 kohm<br>Input type: NPN/PNP (DI1…DI5), NPN (DI6)<br>Hardware filtering: 0.04 ms, digital filtering up to 8 ms<br>DI6 (XDI:6) can alternatively be used as an input for PTC sensors.<br>"0" > 4 kohm, "1" < 1.5 kohm<br>$I_{max}$: 15 mA (for DI6 5 mA) |
| **Start interlock input DIIL (XD24:1)** | Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)<br>24 V logic levels: "0" < 5 V, "1" > 15 V<br>$R_{in}$: 2.0 kohm<br>Input type: NPN/PNP<br>Hardware filtering: 0.04 ms, digital filtering up to 8 ms |

**Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2)**

Input/output mode selection by parameters.

DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual, parameter group *11*.

Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)
As inputs:
24 V logic levels: “0” < 5 V, “1” > 15 V
$R_{in}$: 2.0 kohm
Filtering: 0.25 ms
As outputs:
Total output current from +24VD is limited to 200 mA.




**Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)**

Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)
10 V ±1% and –10 V ±1%, $R_{load}$ 1…10 kohm

**Analog inputs AI1 and AI2 (XAI:4 … XAI:7).**

Current/voltage input mode selection by jumpers. See page *138*.

Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)
Current input: –20…20 mA, $R_{in}$: 100 ohm
Voltage input: –10…10 V, $R_{in}$: > 200 kohm
Differential inputs, common mode range ±30 V
Sampling interval per channel: 0.25 ms
Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms
Resolution: 11 bit + sign bit
Inaccuracy: 1% of full scale range
Inaccuracy for Pt100 sensors: 10 °C (50 °F)

**Analog outputs AO1 and AO2 (XAO)**

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

**Drive to drive link (XD2D)**

Connector pitch 5 mm, wire size 2.5 $mm^2$
Physical layer: RS-485
Maximum cable length of the link: 50 m
Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842
Transmission rate: 8 Mbit/s
Termination by switch

**Embedded Modbus RTU (XD2D)**

Connector pitch 5 mm, wire size 2.5 $mm^2$
Physical layer: RS-485
Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842
Transmission rate: 9.6…115.2 kbit/s
Termination by switch

**Safe torque off connection (XSTO)**

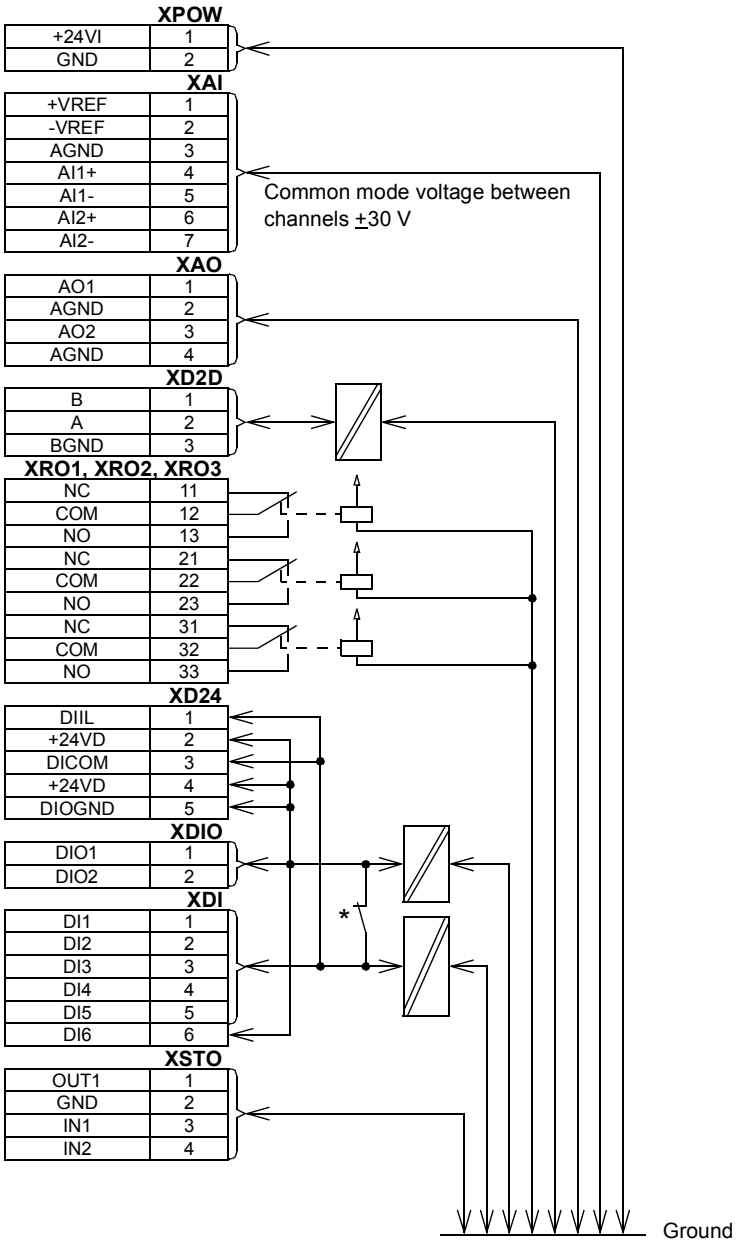
Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)
Input voltage range: -3…30 V DC
Logic levels: “0” < 5 V, “1” > 17 V
For the drive to start, both connections must be closed (OUT1 to IN1 and IN2).
Current consumption of frame R8: 12 mA (+24 V DC, continuous) per STO channel
Maximum output current from OUT1 (24 V DC continuous): 100 mA
EMC (immunity) according to IEC 61326-3-1

| | |
|---|---|
| **Control panel / PC connection** | Connector: RJ-45<br>Cable length < 3 m (10 ft) |

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



**Ground isolation diagram**




***Ground selector (J6) settings**

| |
|---|
| (ZCU-12)<br>All digital inputs share a common ground (DICOM connected to DIOGND). This is the default setting. |
| (ZCU-12)<br>Ground of digital inputs DI1…DI5 and DIIL (DICOM) is isolated from DIO signal ground (DIOGND). Isolation voltage 50 V. |

8

# Control unit of frame R11

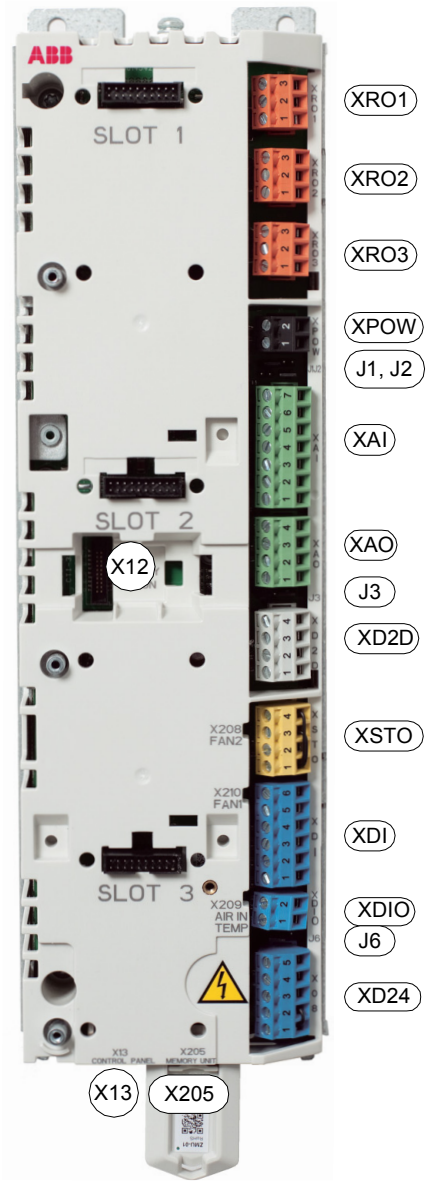
## Contents of this chapter

This chapter contains the default I/O connection diagram, descriptions of the terminals and technical data for the control unit (ZCU-14).

Frame R11 contains two ZCU control units. One controls the line-side converter, the other the motor-side converter.

# Layout

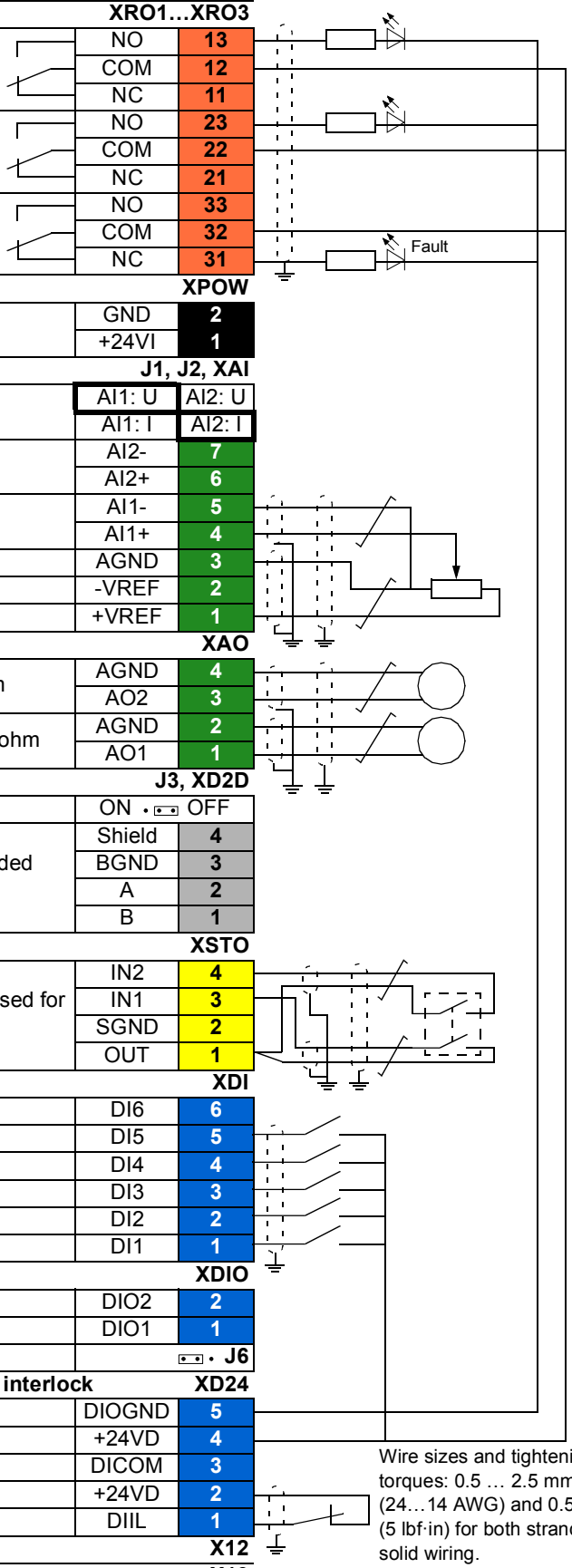
The layout of the external control connection terminals of the control unit is shown below.




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

# Default I/O connection diagram of frame R11

| | | |
|---|---|---|
| **Relay outputs** | | **XRO1…XRO3** |
| **Ready**<br>250 V AC / 30 V DC<br>2 A | NO | 13 |
| | COM | 12 |
| | NC | 11 |
| **Running**<br>250 V AC / 30 V DC<br>2 A | NO | 23 |
| | COM | 22 |
| | NC | 21 |
| **Faulted(-1)**<br>250 V AC / 30 V DC<br>2 A | NO | 33 |
| | COM | 32 |
| | NC | 31 |
| **External power input** | | **XPOW** |
| 24 V DC, 2 A | GND | 2 |
| | +24VI | 1 |
| **Reference voltage and analog inputs** | | **J1, J2, XAI** |
| AI1/AI2 current/voltage selection | AI1: U | AI2: U |
| | AI1: I | AI2: I |
| By default not in use.<br>0(4)…20 mA, $R_{in}$ = 100 ohm [2] | AI2- | 7 |
| | AI2+ | 6 |
| **Speed reference**<br>0(2)…10 V, $R_{in}$ > 200 kohm [1] | AI1- | 5 |
| | AI1+ | 4 |
| Ground | AGND | 3 |
| -10 V DC, $R_L$ 1…10 kohm | -VREF | 2 |
| 10 V DC, $R_L$ 1…10 kohm | +VREF | 1 |
| **Analog outputs** | | **XAO** |
| **Motor current** 0…20 mA, $R_L$ < 500 ohm | AGND | 4 |
| | AO2 | 3 |
| **Motor speed rpm** 0…20 mA, $R_L$ < 500 ohm | AGND | 2 |
| | AO1 | 1 |
| **Drive-to-drive link** | | **J3, XD2D** |
| Drive-to-drive link termination [6] | ON • ▭ | OFF |
| Master/follower, drive-to-drive or embedded fieldbus interface connection | Shield | 4 |
| | BGND | 3 |
| | A | 2 |
| | B | 1 |
| **Safe torque off** | | **XSTO** |
| Safe torque off. Both circuits must be closed for the drive to start. | IN2 | 4 |
| | IN1 | 3 |
| | SGND | 2 |
| | OUT | 1 |
| **Digital inputs** | | **XDI** |
| By default not in use. | DI6 | 6 |
| Constant speed 1 select (1 = on) [5] | DI5 | 5 |
| Acceleration & deceleration select [4] | DI4 | 4 |
| Reset | DI3 | 3 |
| Forward (0) / Reverse (1) | DI2 | 2 |
| Stop (0) / Start (1) | DI1 | 1 |
| **Digital input/outputs** | | **XDIO** |
| Output: Running | DIO2 | 2 |
| Output: Ready | DIO1 | 1 |
| **Ground selection** [7] | ▭ • | **J6** |
| **Auxiliary voltage output, digital input interlock** | | **XD24** |
| Digital input/output ground | DIOGND | 5 |
| +24 V DC 200 mA [3] | +24VD | 4 |
| Digital input ground | DICOM | 3 |
| +24 V DC 200 mA [3] | +24VD | 2 |
| Run Enable | DIIL | 1 |
| **Safety functions module connection** | | **X12** |
| **Control panel connection** | | **X13** |
| **Memory unit connection** | | **X205** |




Wire sizes and tightening torques: 0.5 … 2.5 mm$^2$ (24…14 AWG) and 0.5 N·m (5 lbf·in) for both stranded and solid wiring.
See page *148* for notes.

**Notes:**

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

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

[3] Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by tDIO1 and DIO2.

[4] 0 = open, 1 = closed

| DI4 | Ramp times according to |
|---|---|
| 0 | Parameters *23.12* and *23.13* |
| 1 | Parameters *23.14* and *23.15* |

[5] Constant speed 1 is defined by parameter *22.26*.

6) Must be set to ON when the drive is the last unit on the drive-to-drive (D2D) link.

7) Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats).
• DICOM connected to DIOGND. • DICOM and DIOGND separate

Further information on the usage of the connectors and jumpers is given in the sections below.

## Jumpers and switches

| Jumper/ Switch | Description | Positions |
|---|---|---|
| **J1 (AI1)** | Determines whether analog input AI1 is used as a current or voltage input. |  Current (I) |
| | |  Voltage (V) |
| **J2 (AI2)** | Determines whether analog input AI2 is used as a current or voltage input. |  Current (I) |
| | |  Voltage (U) |
| **J3** | Drive-to-drive link termination. Must be set to terminated position when the drive is the last unit on the link. |  Bus is terminated. |
| | |  Bus is not terminated. |
| **J6** | Common digital input ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). See the *Ground isolation diagram* on page *153*. |  DICOM and DIOGND connected (default).  DICOM and DIOGND separated. |

## External power supply for the control unit (XPOW)

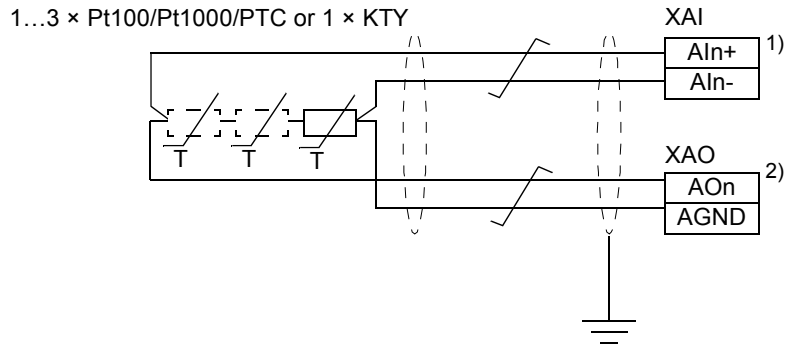
External +24 V (2 A) power supply for the control unit can be connected to terminal block XPOW. Using an external supply is recommended if

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

See also the firmware manual, parameter *95.04*.

## AI1 and AI2 as Pt100, Pt1000, PTC and KTY84 sensor inputs (XAI, XAO)

Three Pt100, Pt1000 or PTC sensors or one KTY84 sensor for motor temperature measurement can be connected between an analog input and output as shown below. (Alternatively, you can connect the KTY to FIO-11 analog /I/O extension module or FEN-xx encoder interface module.) Do not connect both ends of the cable shields directly to ground. If a high-frequency capacitor of a few nanofarads, eg. 3.3.nF / 630 V, cannot be used at one end, leave that end of the shield unconnected.



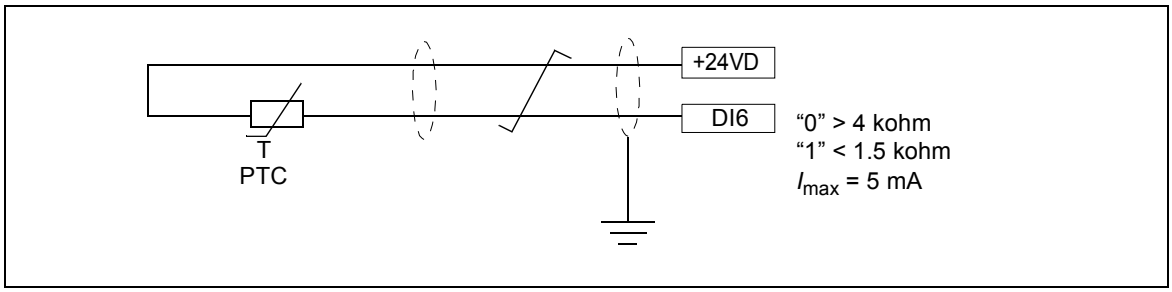

1. Set the input type to voltage with switch J1 for analog input AI1or with J2 for analog input AI2. Set the appropriate analog input unit to V (volt) in parameter group *12 Standard AI*.
2. Select the excitation mode in parameter group *13 Standard AO*.

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

## DI6 (XDI:6) as PTC sensor input

A PTC sensor can be connected to this input for motor temperature measurement as follows. The sensor resistance 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 high-frequency capacitor of a few nanofarads, eg. 3.3.nF / 630 V, cannot be used at one end, leave that end of the shield unconnected. See the firmware manual for parameter settings.

**Note:** PTC sensors can alternatively be connected to FEN-xx encoder interface module.




**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 selected as the source of, for example, an emergency stop command or an external event. For more information, see the firmware manual.

## The XD2D connector

The XD2D connector provides an RS-485 connection that can be used for

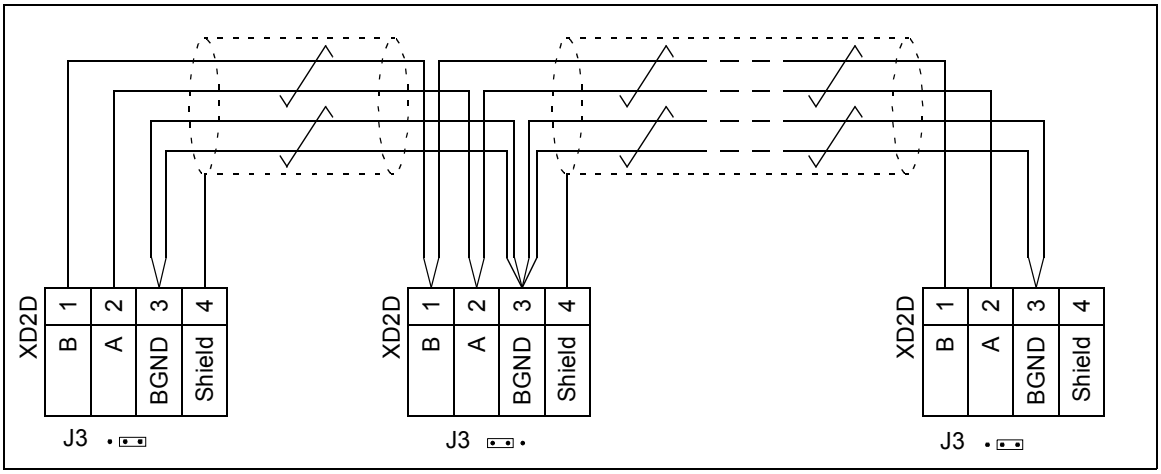
- basic master/follower communication with one master drive and multiple followers,
- fieldbus control through the embedded fieldbus interface (EFB), or
- drive-to-drive (D2D) communication implemented by application programming.

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

Enable bus termination on the units at the ends of the drive-to-drive link. Disable bus termination on the intermediate units.

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

The following diagram shows the wiring between control units for frame R11.




### Safe torque off (XSTO)

For the drive to start, both connections (OUT1 to IN1 and IN2) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting an external Safe torque off circuitry to the drive. See chapter *The Safe torque off function* on page *259*.

### FSO-xx safety functions module connection (X12)

See section *Implementing the functions provided by the FSO-xx safety functions module (option +Q972 or +Q973)* on page *95*, chapter *The Safe torque off function* and *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

## Technical data

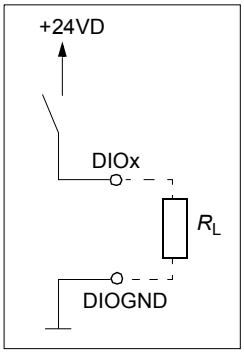
| | |
|---|---|
| **Power supply (XPOW)** | 24 V (±10%) DC, 2 A<br>Supplied from the power unit of the drive, or from an external power supply through connector XPOW. Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG). |
| **Relay outputs RO1…RO3 (XRO1 … XRO3)** | Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)<br>250 V AC / 30 V DC, 2 A<br>Protected by varistors |
| **+24 V output (XD24:2 and XD24:4)** | Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)<br>Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2. |
| **Digital inputs DI1…DI6 (XDI:1 … XDI:6)** | Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)<br>24 V logic levels: "0" < 5 V, "1" > 15 V<br>$R_{in}$: 2.0 kohm<br>Input type: NPN/PNP (DI1…DI5), NPN (DI6)<br>Hardware filtering: 0.04 ms, digital filtering up to 8 ms<br>DI6 (XDI:6) can alternatively be used as an input for PTC sensors.<br>"0" > 4 kohm, "1" < 1.5 kohm<br>$I_{max}$: 15 mA (for DI6 5 mA) |
| **Start interlock input DIIL (XD24:1)** | Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)<br>24 V logic levels: "0" < 5 V, "1" > 15 V<br>$R_{in}$: 2.0 kohm<br>Input type: NPN/PNP<br>Hardware filtering: 0.04 ms, digital filtering up to 8 ms |

**Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2)**

Input/output mode selection by parameters.

DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual, parameter group *11*.

Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)
As inputs:
24 V logic levels: “0” < 5 V, “1” > 15 V
$R_{in}$: 2.0 kohm
Filtering: 0.25 ms
As outputs:
Total output current from +24VD is limited to 200 mA.




**Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)**

Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)
10 V ±1% and –10 V ±1%, $R_{load}$ 1…10 kohm

**Analog inputs AI1 and AI2 (XAI:4 … XAI:7).**

Current/voltage input mode selection by jumpers. See page *148*.

Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)
Current input: –20…20 mA, $R_{in}$: 100 ohm
Voltage input: –10…10 V, $R_{in}$: > 200 kohm
Differential inputs, common mode range ±30 V
Sampling interval per channel: 0.25 ms
Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms
Resolution: 11 bit + sign bit
Inaccuracy: 1% of full scale range
Inaccuracy for Pt100 sensors: 10 °C (50 °F)

**Analog outputs AO1 and AO2 (XAO)**

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

**Drive to drive link (XD2D)**

Connector pitch 5 mm, wire size 2.5 $mm^2$
Physical layer: RS-485
Maximum cable length of the link: 50 m
Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842
Transmission rate: 8 Mbit/s
Termination by switch

**Embedded Modbus RTU XD2D**

Connector pitch 5 mm, wire size 2.5 $mm^2$
Physical layer: RS-485
Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842
Transmission rate: 9.6…115.2 kbit/s
Termination by switch

**Safe torque off connection (XSTO)**

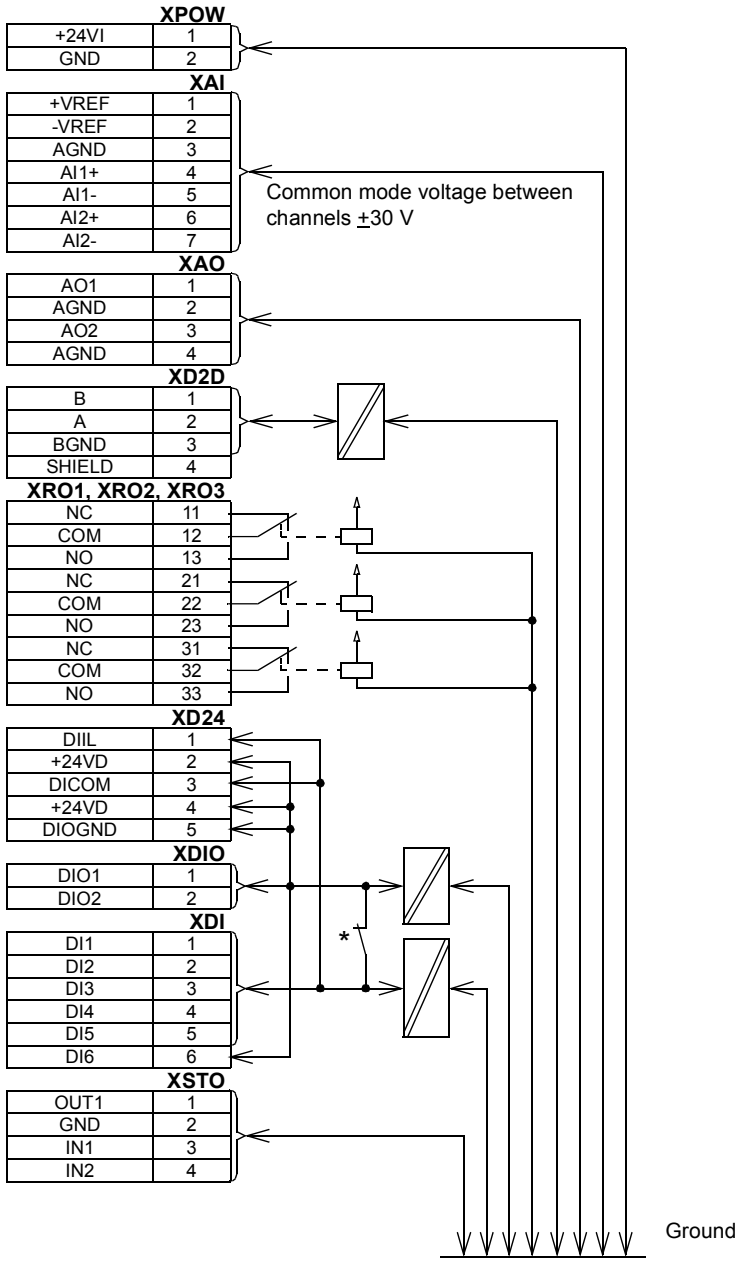
Connector pitch 5 mm (0.2 in), wire size 2.5 $mm^2$ (14 AWG)
Input voltage range: -3…30 V DC
Logic levels: “0” < 5 V, “1” > 19 V
For the drive to start, both connections must be closed (OUT1 to IN1 and IN2).
Current consumption: 50 mA (+24 V DC, continuous) per STO channel.
EMC (immunity) according to IEC 61326-3-1

**Control panel / PC connection**

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

The terminals on the board fulfill the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if the relay is used with a voltage higher than 48 V.

**Ground isolation diagram**




***Ground selector (J6) settings**

| |
|---|
| (ZCU-14)<br>All digital inputs share a common ground (DICOM connected to DIOGND). This is the default setting. |
| (ZCU-14)<br>Ground of digital inputs DI1…DI5 and DIIL (DICOM) is isolated from DIO signal ground (DIOGND). Isolation voltage 50 V. |



9

# Installation checklist

## Contents of this chapter

This chapter contains an installation checklist which you must complete before you start up the drive.

## Warnings



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

## Checklist

Do the steps in section *Electrical safety precautions* (page *19*) before you start the work. Go through the checklist together with another person.

| **Check that …** | ☑ |
|---|---|
| The ambient operating conditions meet the specifications given in chapter *Technical data*. | ☐ |
| The drive cabinet has been fixed to floor, and if necessary due to vibration etc, also from top to the wall or roof. | ☐ |
| The cooling air will flow freely in and out of the drive cabinet. | ☐ |
| If the drive will be connected to an IT (ungrounded) or a corner grounded TN network: The optional EMC filter (+E202) of the drive (if any) has been disconnected. See page *102*. | ☐ |
| If the drive has been stored over one year: The electrolytic DC capacitors in the DC link of the drive have been reformed. See *Converter module capacitor reforming instructions* (3BFE64059629 [English]). | ☐ |

| **Check that …** | ☑ |
|---|---|
| There is an adequately sized protective ground conductor between the drive and the switchboard, and the conductor has been connected to appropriate terminal. Proper grounding has also been measured according to the regulations. | ☐ |
| There is an adequately sized protective ground conductor between the motor and the drive, and the conductor has been connected to appropriate terminal. Proper grounding has also been measured according to the regulations. | ☐ |
| The supply voltage matches the nominal input voltage of the drive. Check the type designation label. | ☐ |
| The voltage setting of the auxiliary voltage transformers. See page *103*. | ☐ |
| The input power cable has been connected to the appropriate terminals, the phase order is correct, and the terminals have been tightened. (Pull on the conductors to check.) | ☐ |
| The motor cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.) | ☐ |
| The motor cable has been routed away from other cables. | ☐ |
| No power factor compensation capacitors have been connected to the motor cable. | ☐ |
| If a drive bypass connection will be 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. | ☐ |
| The control cables have been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.) | ☐ |
| There are no tools, foreign objects or dust from drilling inside the drive. | ☐ |
| 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. | ☐ |

10

# Start-up

## Contents of this chapter

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

## Start-up procedure

The tasks which are needed in certain cases only are marked with underlining, and option codes are given in brackets. Default device designations (if any) are given in brackets after the name, for example “main switch-disconnector (Q1)”. The same device designations are typically also used in the circuit diagrams.

These instructions cannot and do not cover all possible start-up tasks of a customized drive. Always refer to the delivery-specific circuit diagrams when proceeding with the start-up.



**WARNING!** Only qualified electrical professionals are allowed to do the work described in this chapter.

**Note:** For certain options (such as functional safety options +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q978, +Q979), additional start-up instructions are given in their separate manuals. See the listing of manuals inside the front cover.

| Action | ☑ |
|---|---|
| **Safety** | |
| **WARNING!** Obey the safety instructions during the start-up procedure. See chapter *Safety instructions* on page *15*. | ☐ |
| **Checks/Settings with no voltage connected** | |
| Ensure that the disconnector of the supply transformer is locked to the off (0) position, ie. no voltage is, and cannot be connected to the drive inadvertently. | ☐ |
| Check that the switch fuse (frame R8) (Q1) or main switch-disconnector (frame R11) (Q1) is switched off. | ☐ |
| Check the mechanical and electrical installation of the drive. See *Installation checklist* (page *155*). | ☐ |
| Check the settings of breakers/switches in the auxiliary circuits. See the circuit diagrams delivered with the drive. | ☐ |
| Check the tap settings of transformers T21 (standard) and T101, T102 (if present). See page *103*. | ☐ |
| Disconnect any unfinished or uninspected auxiliary voltage (115/230 V AC) cables that lead from the terminal blocks to the outside of the equipment. | ☐ |
| Check that both channels of the Safe torque off circuit connected to the STO inputs of drive control unit are closed. Refer to the wiring diagrams delivered with the drive. | ☐ |
| If the Safe torque off functionality is used, check that the STO OUT output on the drive control unit is chained to the STO inputs of all drives.<br>If the Safe torque off functionality is not used, check that the STO input on all drives is correctly wired to +24 V and ground. | ☐ |
| For drives with ground fault monitoring for IT (ungrounded) systems (option +Q954): Adjust the settings of the ground fault monitor to suit the installation. See the circuit diagrams of the delivery and *IRDH275B Ground Fault Monitor Operating Manual* by Bender (code: TGH1386en). | ☐ |
| For drives with Pt100 relays (option +(n)L506):<br>• Check the connections against the circuit diagrams of the delivery.<br>• Set the alarm and trip levels of the Pt100 relays.<br>Set the alarm and trip levels of the Pt100 relay as low as possible based on the operating temperature and test results of the machine. The trip level can be set, for example, 10 °C higher than what the temperature of the machine is at maximal load in the maximum environmental temperature.<br>We recommend to set the operating temperatures of the relay, typically for example, as follows:<br>• 120…140 °C when only tripping is in use<br>• alarm 120…140 °C and trip 130…150 °C when both alarm and tripping are used. | ☐ |
| **Powering up the auxiliary circuit of the drive** | |
| Make sure that it is safe to connect voltage. Ensure that<br>• nobody is working on the drive or circuits that have been wired from outside into the drive cabinet<br>• the cover of the motor terminal box is in place. | ☐ |
| For drives with a voltmeter (option +G334): Make sure that the circuit breaker of the measuring circuit (F5) is closed. | ☐ |
| Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits. | ☐ |
| Close the cabinet doors. | ☐ |
| Close the main breaker of the supply transformer. | ☐ |

| Action | ☑ |
|---|---|
| Close the switch fuse (frame R8) (Q1) or main switch-disconnector (frame R11) (Q1). This will power up the main circuit of the drive as well as the auxiliary voltage circuit.<br>**Note:** Do not use excessive force. The switch fuse (frame R8) or main switch-disconnector (frame R11) can only be closed when the main input terminals (L1, L2, L3) are powered. | ☐ |
| **Setting up the line-side converter parameters** | |
| The line-side converter control program parameters are set at the factory. Normally, there is no need to change them at the start-up.<br>For more information on the line-side converter control parameters, see *ACS880 primary control program firmware manual (3AUA0000085967* [English]) or *ACS880 IGBT supply control program firmware manual (3AUA0000131562 [English])*. | ☐ |
| **Setting up the motor-side converter parameters, and performing the first start** | |
| Set up the motor control program. See the appropriate start-up guide and/or firmware manual. There is a separate start-up guide only for some control programs.<br>If you need more information on the use of the control panel, see *ACX-AP-X Assistant control panels user's manual* (3AUA0000085685 [English]). | ☐ |
| For drives with a sine output filter (option +E206): Check that parameter *95.15*, bit 1 has been activated. | ☐ |
| For drives with a fieldbus adapter module (optional): Set the fieldbus parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the fieldbus adapter module, and the drive firmware manual.<br>Check that the communication works between the drive and the PLC. | ☐ |
| For drives with an encoder interface module (optional): Set the encoder parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the encoder interface module, and the drive firmware manual. | ☐ |
| **Activating the Run enable signal of the line-side converter (with options +Q951, +Q952 and +Q978)** | |
| Turn the operating switch (S21) to the ON (1) position to activate the run enable signal for the line-side converter. | ☐ |
| **On-load checks** | |
| Start the motor to perform the ID run. | ☐ |
| Check that the cooling fans rotate freely in the right direction, and the air flows upwards. A paper sheet set on the intake (door) gratings stays. The fans run noiselessly. | ☐ |
| Check that the motor starts. stops and follows the speed reference in the correct direction when controlled with the control panel. | ☐ |
| Check that the motor starts. stops and follows the speed reference in the correct direction when controlled through the customer-specific I/O or fieldbus. | ☐ |
| Drives in which the Safe torque off control circuit is connected in use: Test and validate the operation of the Safe torque off function. See *Start-up including acceptance test* (page *265*). | ☐ |
| Drives with functional safety options +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q978, +Q979: Refer to the respective manuals of the safety option for option-specific start-up instructions. | ☐ |



11

# Fault tracing

## Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

## LEDs

| Where | LED | Color | Indication |
|---|---|---|---|
| Control panel mounting platform | POWER | Green | Control unit is powered and +15 V is supplied to the control panel. |
| | FAULT | Red | Drive in fault state. |

## Warning and fault messages

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

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# Maintenance

## Contents of this chapter

This chapter contains preventive maintenance instructions.

## Maintenance intervals

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

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

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

## Descriptions of symbols

| Action | Description |
|---|---|
| I | Visual inspection and maintenance action if needed |
| P | Performance of on/off-site work (commissioning, tests, measurements or other work) |
| R | Replacement |

## Recommended annual maintenance actions by the user

| Action | Target |
|---|---|
| I | IP22 and IP42 air inlet and outlet meshes on the cabinet doors |
| R | IP54 air filters on the cabinet doors |
| P | Quality of supply voltage |
| I | Spare parts |
| P | DC circuit capacitor reforming, spare modules and spare capacitors |
| I | Tightness of terminals |
| I | Dustiness, corrosion or temperature |
| I | Heat sink cleaning |
| I | ABB-SACE air circuit breaker maintenance |

## Recommended maintenance intervals after start-up

| Component | Years from start-up | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3 | 6 | 9 | 12 | 15 | 18 | 21 |
| **Cooling** | | | | | | | |
| **Main cooling fan** | | | | | | | |
| Main cooling fan (R8) speed-controlled | | | R | | | R | |
| Main cooling fan (R11) speed-controlled | | | R | | | R | |
| Main cooling fan (R11 LCL) speed-controlled | | | R | | | R | |
| **Auxiliary cooling fan** | | | | | | | |
| Circuit board compartment cooling fans | | | R | | | R | |
| **Cabinet cooling fan** | | | | | | | |
| Internal cooling fan (R8 50 Hz) | | | R | | | R | |
| Internal cooling fan (R8 60 Hz) | | R | | R | | R | |
| Cabinet cooling fan, door (50 Hz) | | | R | | | R | |
| Cabinet cooling fan, door (60 Hz) | | | R | | | R | |
| Cabinet cooling fan IP54 (50 Hz) | | | R | | | R | |
| Cabinet cooling fan IP54 (60 Hz) | | R | | R | | R | |
| **NSIN filter cooling fan** | | | | | | | |
| NSIN filter cooling fan | | | R | | | R | |
| **Aging** | | | | | | | |
| ZCU control unit battery (real-time clock) | | R | | R | | R | |
| Control panel battery (real-time clock) | | | R | | | R | |

4FPS10000239703

# Cabinet

## Cleaning the interior of the cabinet

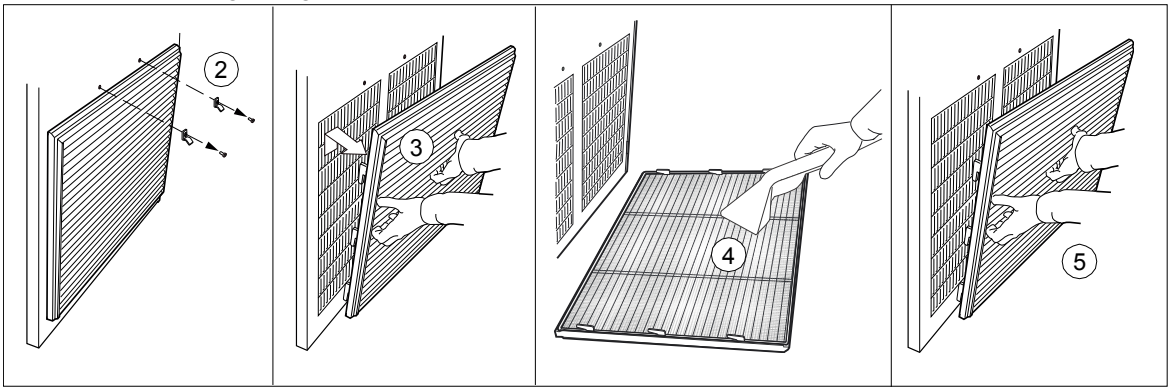
**WARNING!** Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

**WARNING!** Use a vacuum cleaner with an antistatic hose and nozzle, and wear a grounding wristband. Otherwise an electrostatic charge might build up and damage the circuit boards.

1. Stop the drive and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Open the cabinet doors.
3. Clean the interior of the cabinet. Use a vacuum cleaner and a soft brush.
4. Clean the air inlets of the fans and air outlets of the module (top).
5. Clean the air inlet gratings on the doors (see section *Cleaning the door air inlets (IP22 and IP42)* on page *165)*.
6. Close the doors.

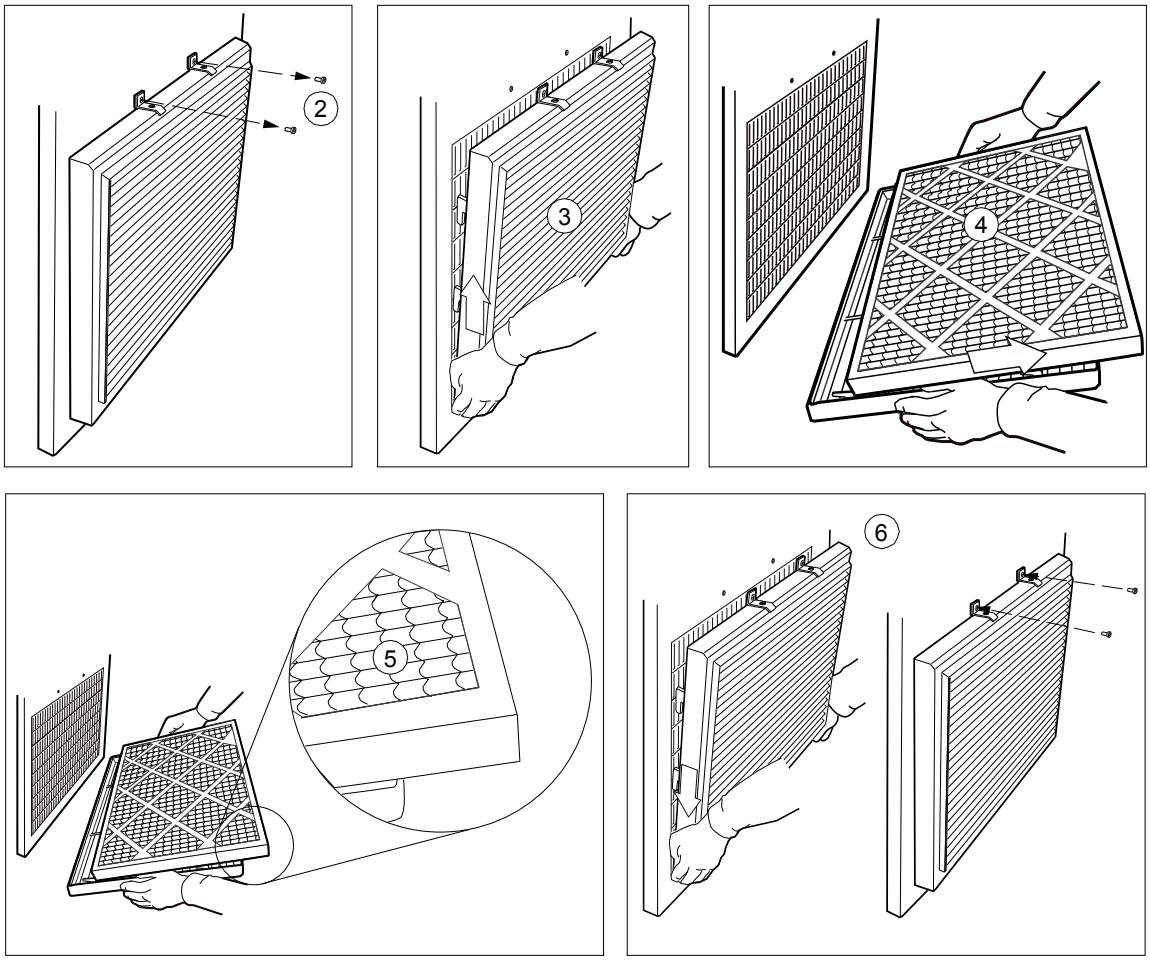
## Cleaning the door air inlets (IP22 and IP42)

1. Stop the drive and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Remove the fasteners at the top of the grating.
3. Lift the grating and pull it away from the door.
4. Vacuum clean or wash the grating on both sides.
5. Reinstall the grating in reverse order.



## Cleaning the door air inlets (IP54)

1. Stop the drive and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Remove the fasteners at the top of the grating.
3. Lift the grating and pull it away from the door.
4. Remove the air filter mat.
5. Place the new filter mat in the grating the metal wire side facing the door.
6. Reinstall the grating in reverse order.




## Cleaning the outlet (roof) filters (IP54)

The outlet (roof) filters in IP54 drives can be accessed by pulling the gratings upwards.

## Replacing the outlet (roof) filters (IP54)

1. Stop the drive and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Remove the front and back gratings of the fan by lifting them upwards.
3. Remove the air filter mat.
4. Place the new filter mat in the grating.
5. Reinstall the grating in reverse order.

# Heatsink

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



**WARNING!** Obey the 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 *Electrical safety precautions* (page *19*) before you start the work.
2. Remove the drive module from the cabinet. See section *Replacing the drive module (frame R8)* (page *181*) and *Replacing the drive and LCL filter modules (frame R11)* (page *190*).
3. Remove the module cooling fans. See section *Fans* below.
4. Blow dry clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust. **Note**: If there is a risk of dust entering adjoining equipment, perform the cleaning in another room.
5. Reinstall the cooling fans.

# Power connections

## Retightening the power connections



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

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Check the tightness of the cable connections. Use the tightening torques given in chapter *Technical data*.

# Fans

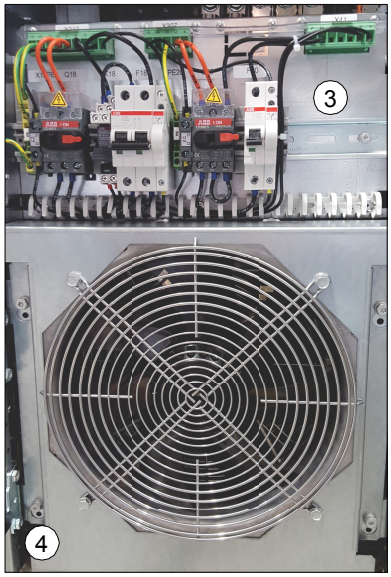
The lifespan of the cooling fans of the drive depends on the running time, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. Reset the running time signal after a fan replacement.

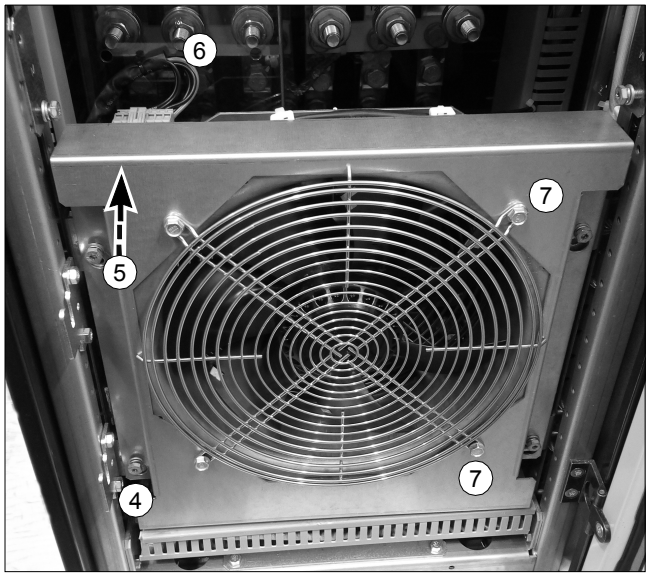
Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

## Replacing the cabinet “door fan”

**WARNING!** Obey the 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 *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet door.
3. If there is a mounting plate/s above the fan, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   If there is no mounting plate/s, but instead a shroud/s above the fan, undo the four screws and remove the shroud/s.
   For frame R11 with option +C121: Undo the screws and remove the marine supports. See *Replacing the drive and LCL filter modules (frame R11)* on page *190*.
4. Loosen the four mounting screws of the fan mounting plate.
5. Lift the mounting plate upwards.
6. Unplug the fan supply wires.
7. Lift the fan mounting plate off.
8. Undo the four mounting screws of the fan and remove the fan from the mounting plate. The finger guard of the fan is attached by the same screws on its front side. Keep the finger guard for reuse.
9. Install the new fan in reverse order.

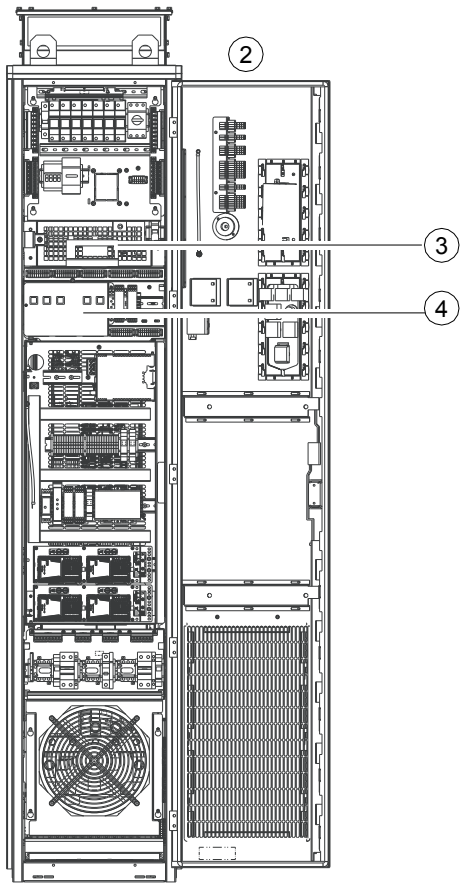


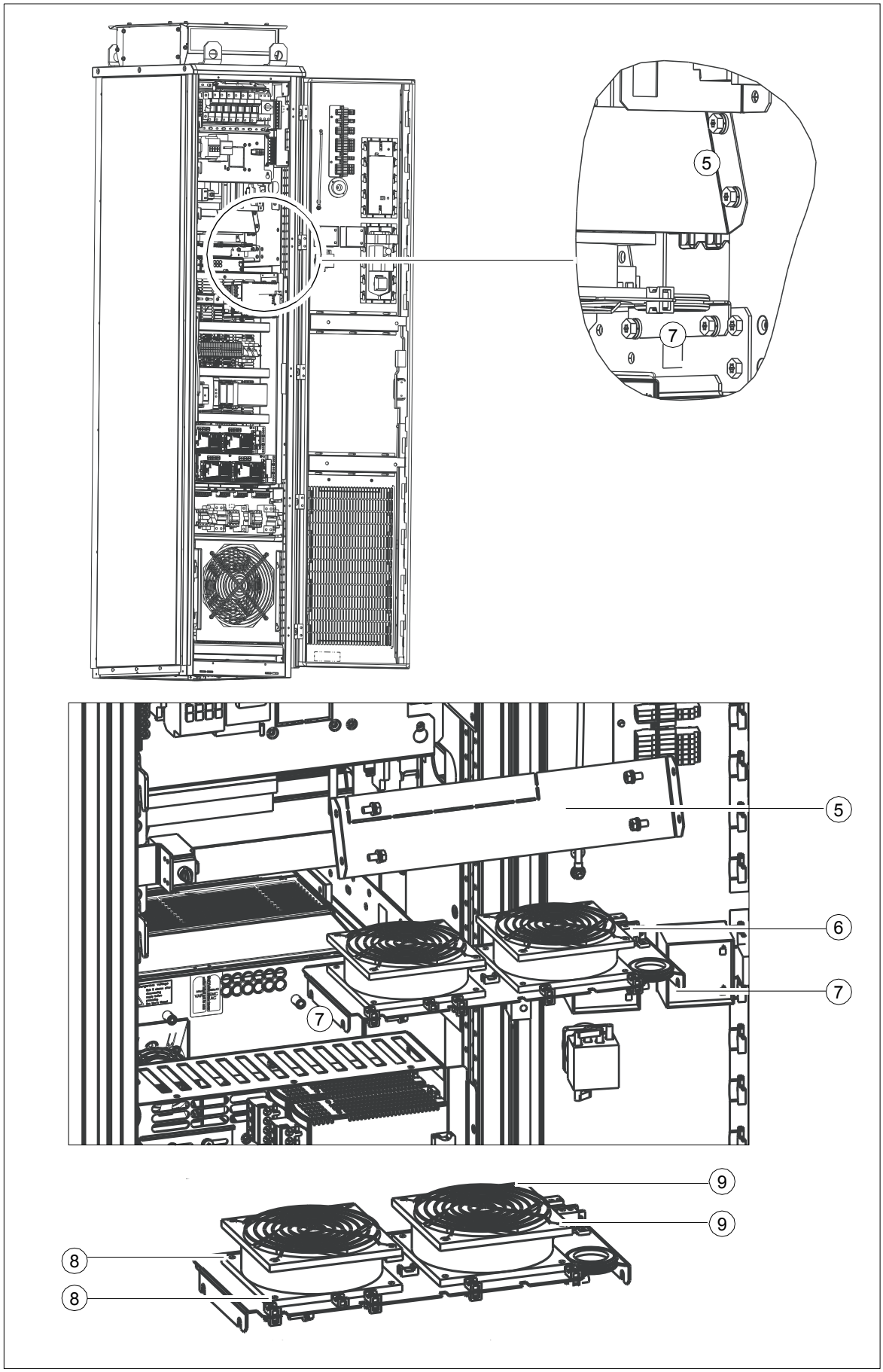



## Replacing the internal cabinet cooling fans (frame R8)

**WARNING!** Obey the 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 *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet door.
3. Remove the fuse replacement handle and shroud.
4. Remove the mounting plate.
5. Undo the four M6 combi screws and remove the air guide.
6. Unplug the fan plate connector.
7. Loosen the four combi screws, lift the fan up a bit and remove the fan plate.
8. Undo the four mounting screws of each fan (8 screws in total) and remove the fans from the mounting plate. The lower finger guards of the fans are attached with the same screws and removed at the same time.
9. Undo the four mounting screws of the top finger guards of the fans (8 screws in total). Keep all finger guards for reuse.
10. Install the new fans in reverse order to the above.

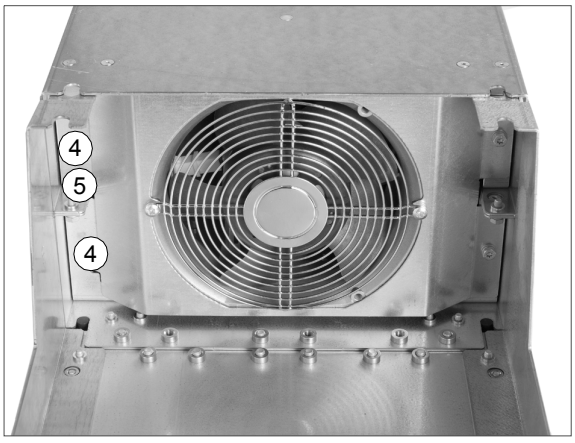


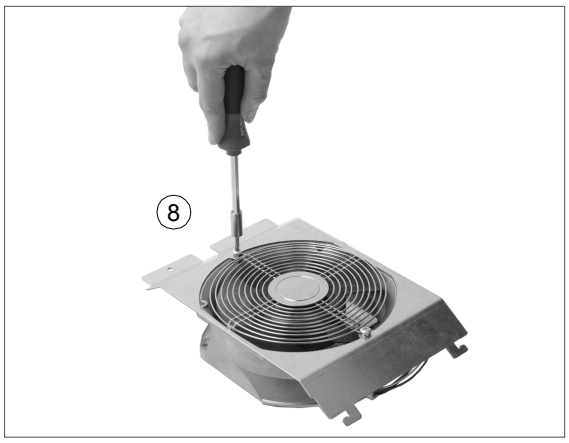

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## Replacing the drive module main fan (frame R8)

**WARNING!** Obey the 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 *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet door.
3. Slide the drive module forward as described under *Replacing the drive module (frame R8)* on page *181*.
4. Undo the mounting screws of the fan mounting plate (view from bottom below).
5. Pull the fan mounting plate down from the side edge.
6. Unplug the power supply wires.
7. Lift the fan mounting plate off.
8. Remove the fan from the mounting plate. The finger guard of the fan is attached by the same screws and is removed at the same time. Keep the finger guard for reuse.
9. Install the new fan in reverse order.
10. Close the cabinet door.
11. Reset the counter (if used) in group 5 in the primary control program.



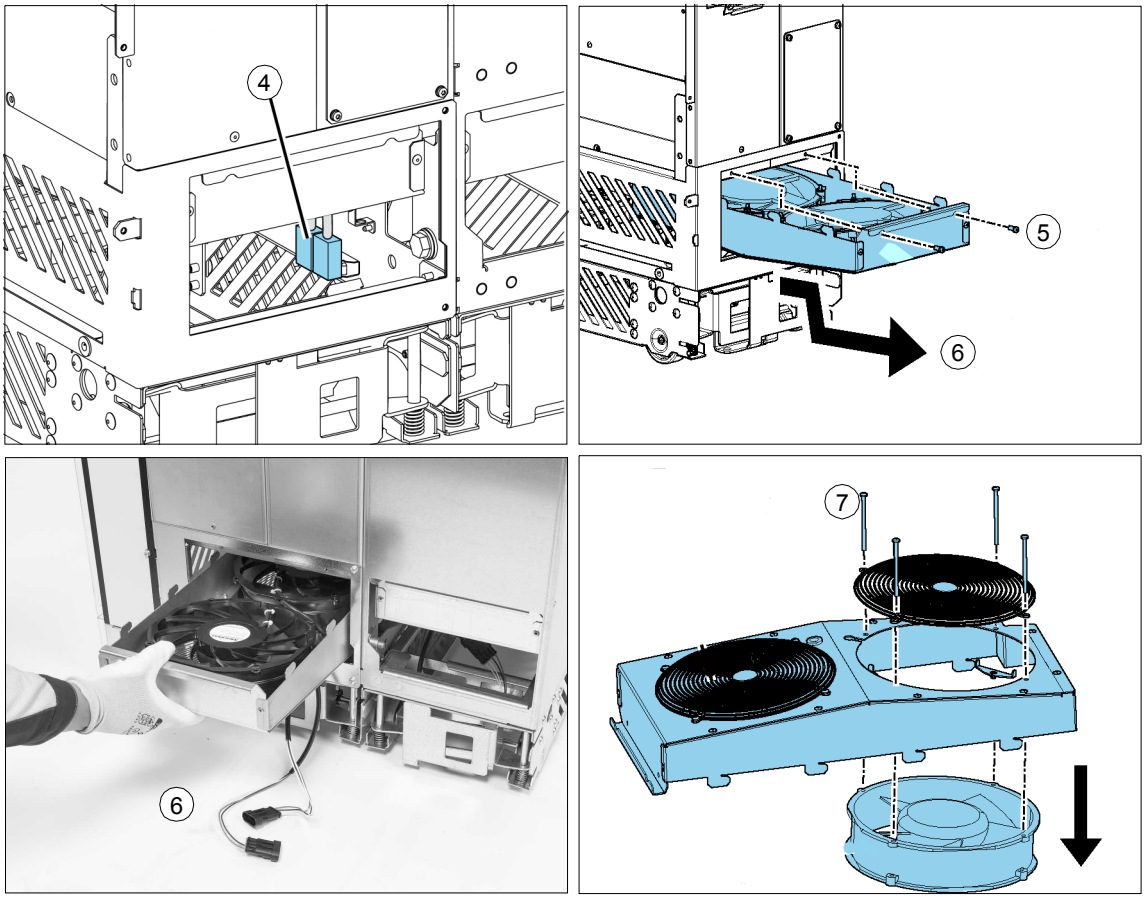



## Replacing the drive module main fans (frame R11)

**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 *Electrical safety precautions* on page *19* before you start the work.
2. To remove the marine supports in drives with option +C121, see *Replacing the drive and LCL filter modules (frame R11)* on page *190*.
3. To open the module section swing-out frame, undo the M10 bolts from top and bottom (4 pcs). See *Replacing the drive and LCL filter modules (frame R11)* on page *190*.
4. Disconnect the power supply wires of the fans from the connectors FAN1:PWR1 and FAN2:PWR2.

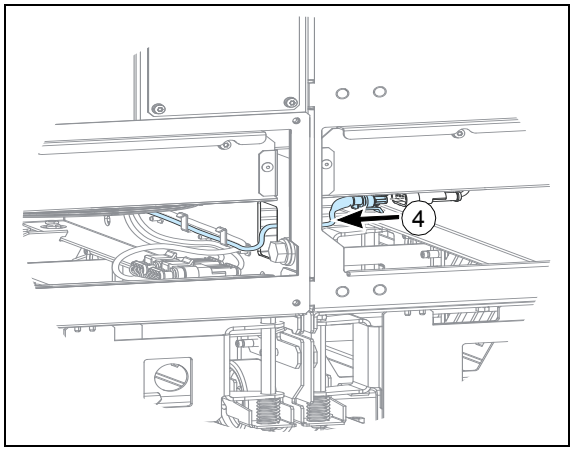
   **Note:** 690 V R11 drive modules have only one fan in the cassette.
5. Undo the mounting screws of the fan cassette.
6. Pull the fan cassette out.
7. Undo the mounting screws of the fan(s). The finger guard of the fan is attached by the same screws and is removed at the same time. Keep the finger guard for reuse.
8. Install the new fans in reverse order to the above. For 690 V drive modules, connect the fan power supply wires to connector FAN1:PWR1. For the other drive modules, connect the power supply wires to both FAN1:PWR1 and FAN2:PWR2.
9. Close the swing-out frame, reinstall the 4 screws and marine supports (option +C121) and close the cabinet doors.
10. Reset the counter (if used) in group 5 in the primary control program.

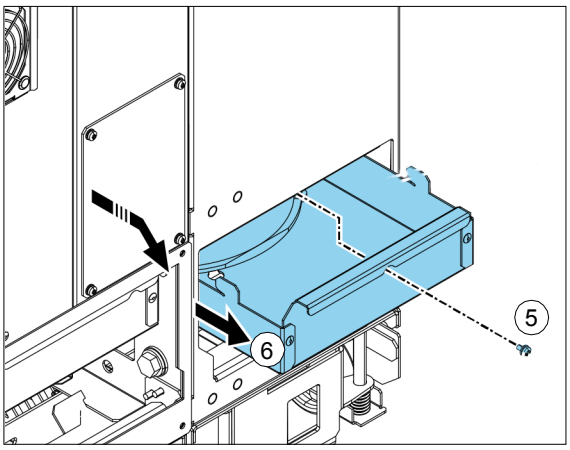

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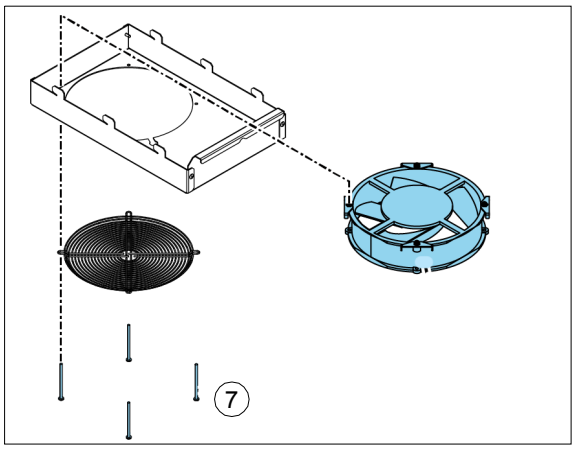
## Replacing the LCL filter module fan (frame R11)

**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 *Electrical safety precautions* on page *19* before you start the work.
2. To remove the marine supports in drives with option +C121, see *Replacing the drive and LCL filter modules (frame R11)* on page *190*.
3. To open the module section swing-out frame, undo the M10 bolts from top and bottom (4 pcs). See *Replacing the drive and LCL filter modules (frame R11)* on page *190*.
4. Disconnect the power supply wire of the fan from connector FAN3:LCL.
5. Undo the mounting screw of the fan cassette.
6. Pull the fan cassette out.
7. Undo the mounting screws of the fan. The finger guard of the fan is attached by the same screws and is removed at the same time. Keep the finger guard for reuse.
8. Install the new fan in reverse order to the above. Make sure that the arrow in the fan points up.
9. Close the swing-out frame, reinstall the 4 screws and marine supports (option +C121) and close the cabinet doors.



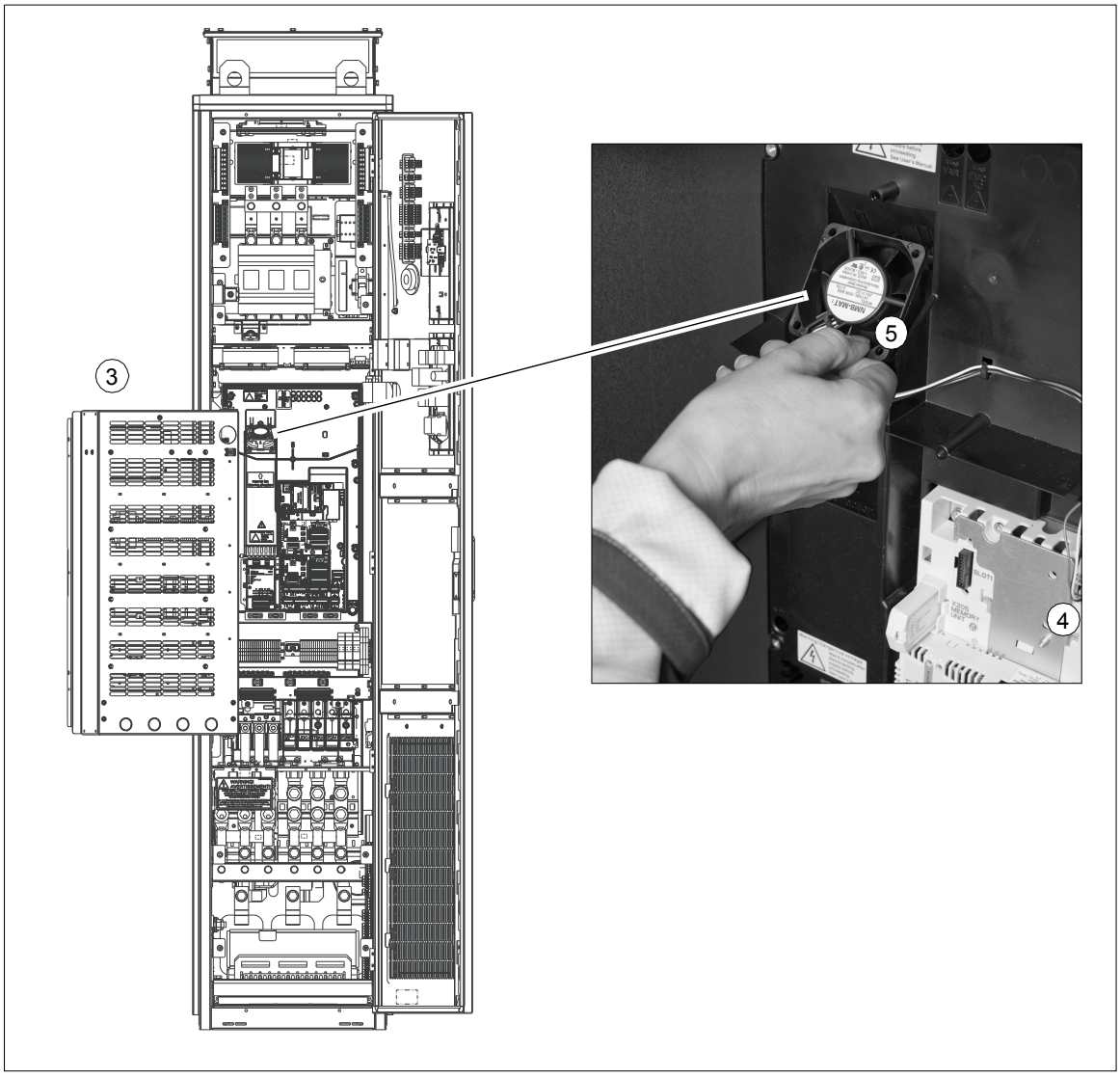



## Replacing the auxiliary cooling fan of the drive module (frame R8)

**WARNING!** Obey the 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 *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet door.
3. Open the swing-out frame or remove the shroud if there is no swing-out frame.
4. Unplug the power supply wires from the control unit terminal X208:FAN2.
5. Lift the fan up.
6. Install the new fan in reverse order. Make sure that the arrow on the fan points up.
7. Close the swing-out frame and cabinet door.
8. Reset the counter (if used) in group 5 in the primary control program.

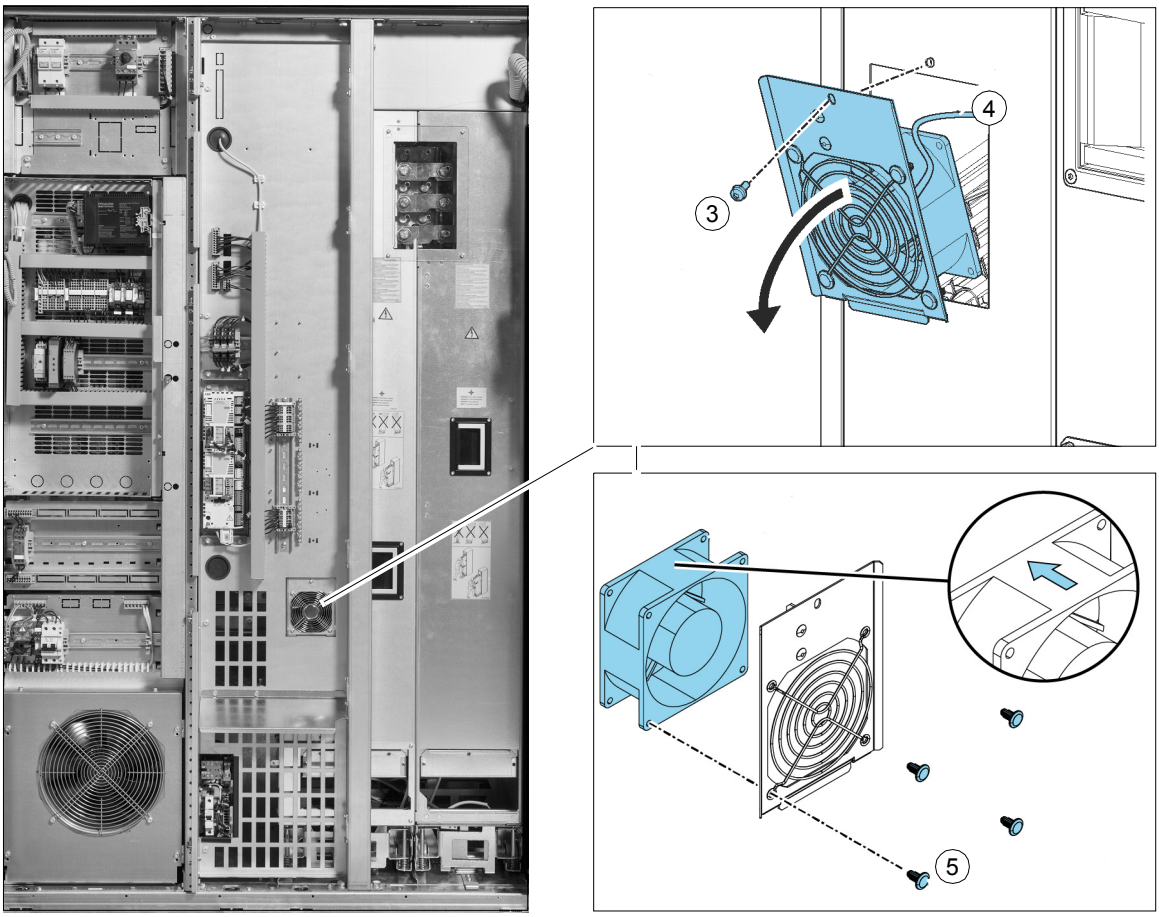


## Replacing the auxiliary cooling fans of the drive module (frame R11)

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

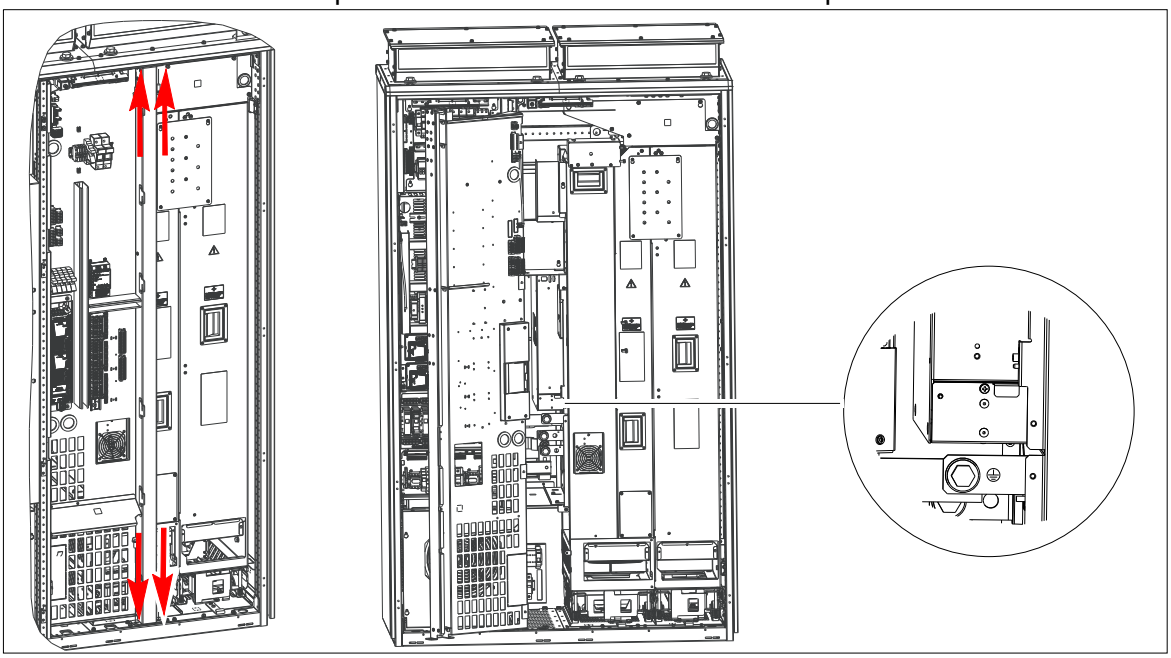
Fan in the front panel:

1. Stop the drive and do the steps in section *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet doors.
3. Undo the mounting screw of the fan cassette.
4. Unplug the power supply cable of the fan.
5. Undo the mounting screws of the fan.
6. Install the new fan in reverse order to the above. Make sure that the arrow in the fan points to the drive module.
7. Close the cabinet door.
8. Reset the counter in group 5 in the primary control program.

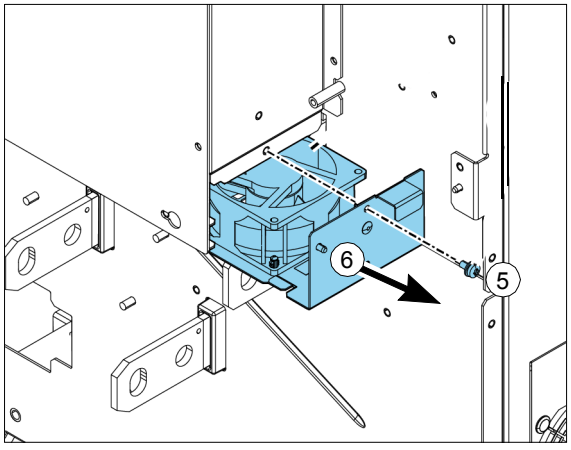


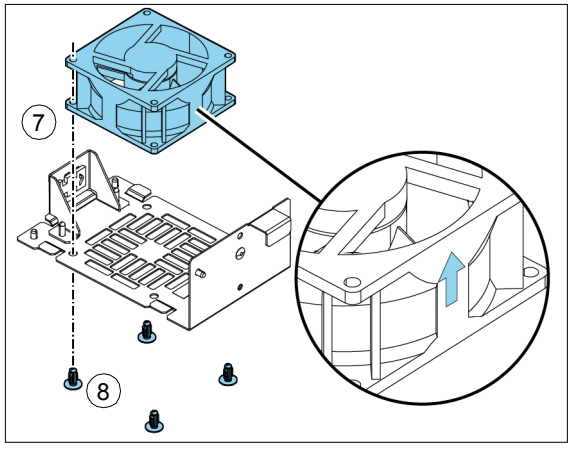
Fan at the bottom of the circuit board compartment:

1. Stop the drive and do the steps in section *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet door.
3. To remove the marine supports in drives with option +C121, see *Replacing the drive and LCL filter modules (frame R11)* on page *190*.
4. To open the swing-out frame, undo the M10 bolts from top and bottom (4 pcs). The fan locates in the bottom part of drive module circuit board compartment.



5. Undo the mounting screw of the fan cassette.
6. Pull the fan cassette out.
7. Unplug the power supply cable of the fan.
8. Undo the mounting screws of the fan.
9. Install the new fan in reverse order to the above. Make sure that the arrow in the fan points up.
10. Close the swing-out frame, reinstall the 4 screws and marine supports (option +C121) and close the cabinet doors.
11. Reset the counter (if used) in group 5 in the primary control program.

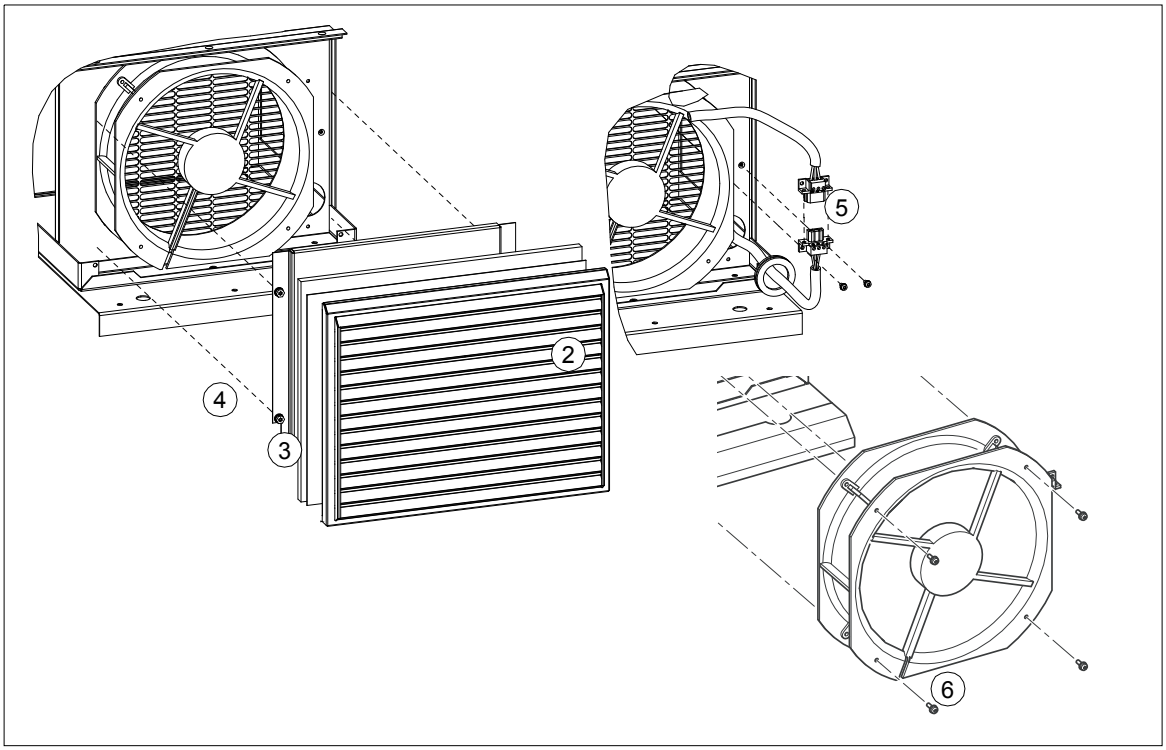


## Frame R8: Replacing the IP54 (UL Type 12) roof fan

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

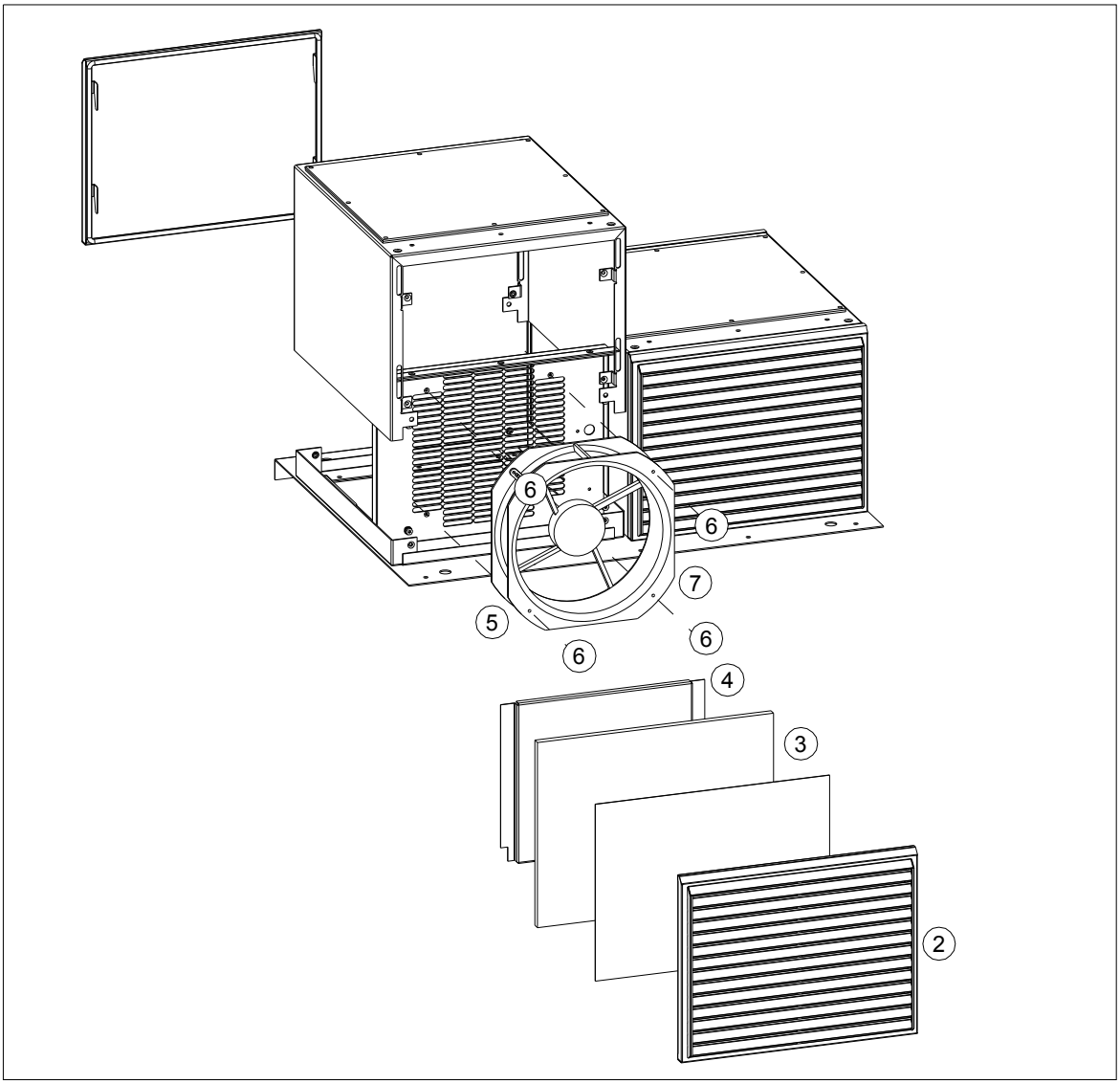
1. Stop the drive and do the steps in section *Electrical safety precautions* on page *19* before you start the work.
2. Slide the front grating upwards and remove it.
3. Remove the air filter.
4. Loosen the mounting screws of the front mesh. Remove the mesh.
5. Disconnect the fan supply wires.
6. Undo the mounting screws of the fan.
7. Pull the fan out.
8. Install the new fan in reverse order.



## Frame R11 with options +B055 and +C128: Replacing the roof fan

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

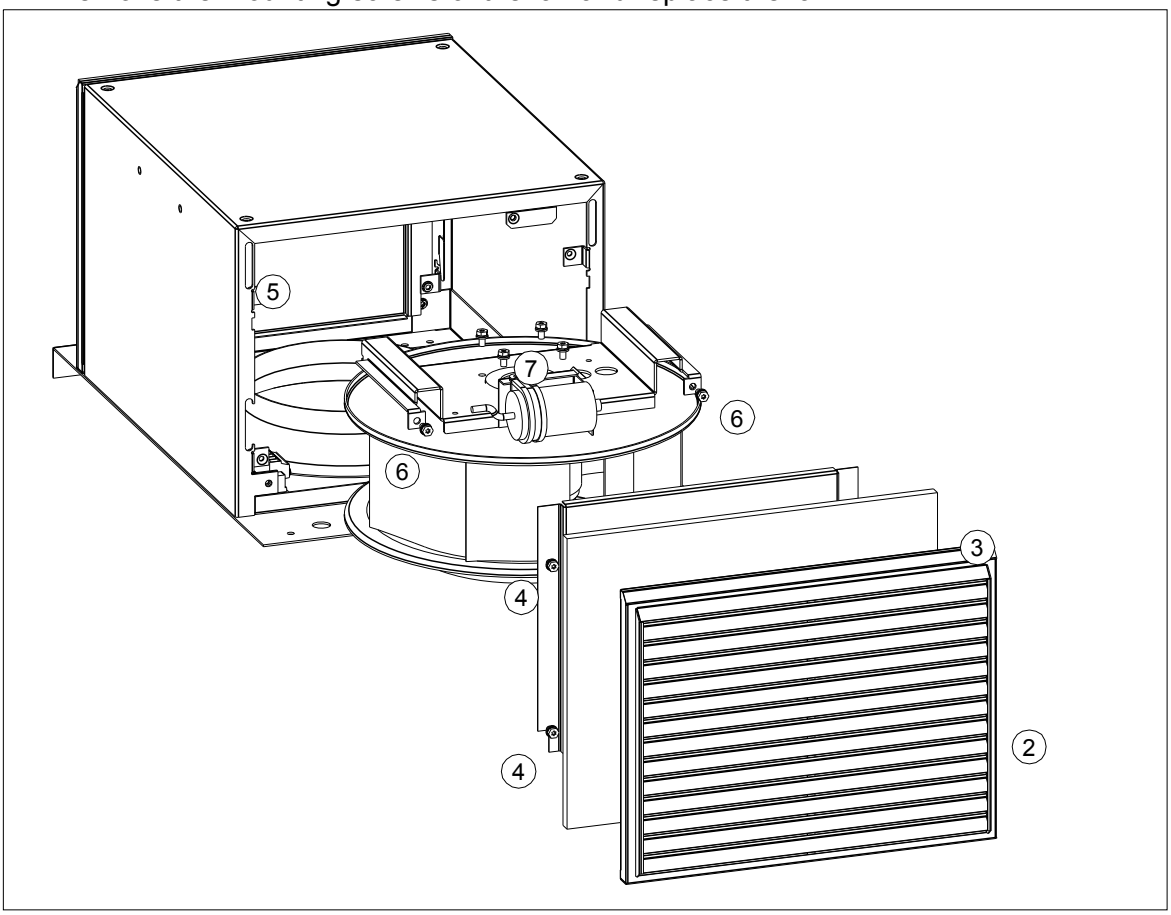
1. Stop the drive and do the steps in section *Electrical safety precautions* on page *19* before you start the work.
2. Slide the front gratings upwards and remove them.
3. Remove air filters.
4. To remove the wire mesh, undo the mounting screws.
5. Disconnect the fan power supply wires.
6. Remove the mounting screws of the fan.
7. Remove the fan.
8. Install the new fan in reverse order.



## Frame R11 with option +B055: Replacing the roof fan

**WARNING!** Obey the 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 *Electrical safety precautions* on page *19* before you start the work.
2. Slide the front grating upwards and remove it.
3. Remove the air filter.
4. Undo the four M6 combi screws and remove the mesh.
5. Disconnect the fan power supply wires.
6. Undo the two M6 combi screws, lift the fan assembly upwards and slide it out.
7. Remove the mounting screws of the fan and replace the fan.




## Replacing the sine filter cooling fan

For replacing the cooling fans of NSINxxx-x sine filters, see *Sine filters hardware manual* (3AXD50000016814 [English]).

# Replacing the drive module (frame R8)

## Required tools

- lifting device
- set of screw drivers
- torque wrench with an extension bar
- lifting chains.

A lifting device is available from ABB with order code 3AXD50000047447.

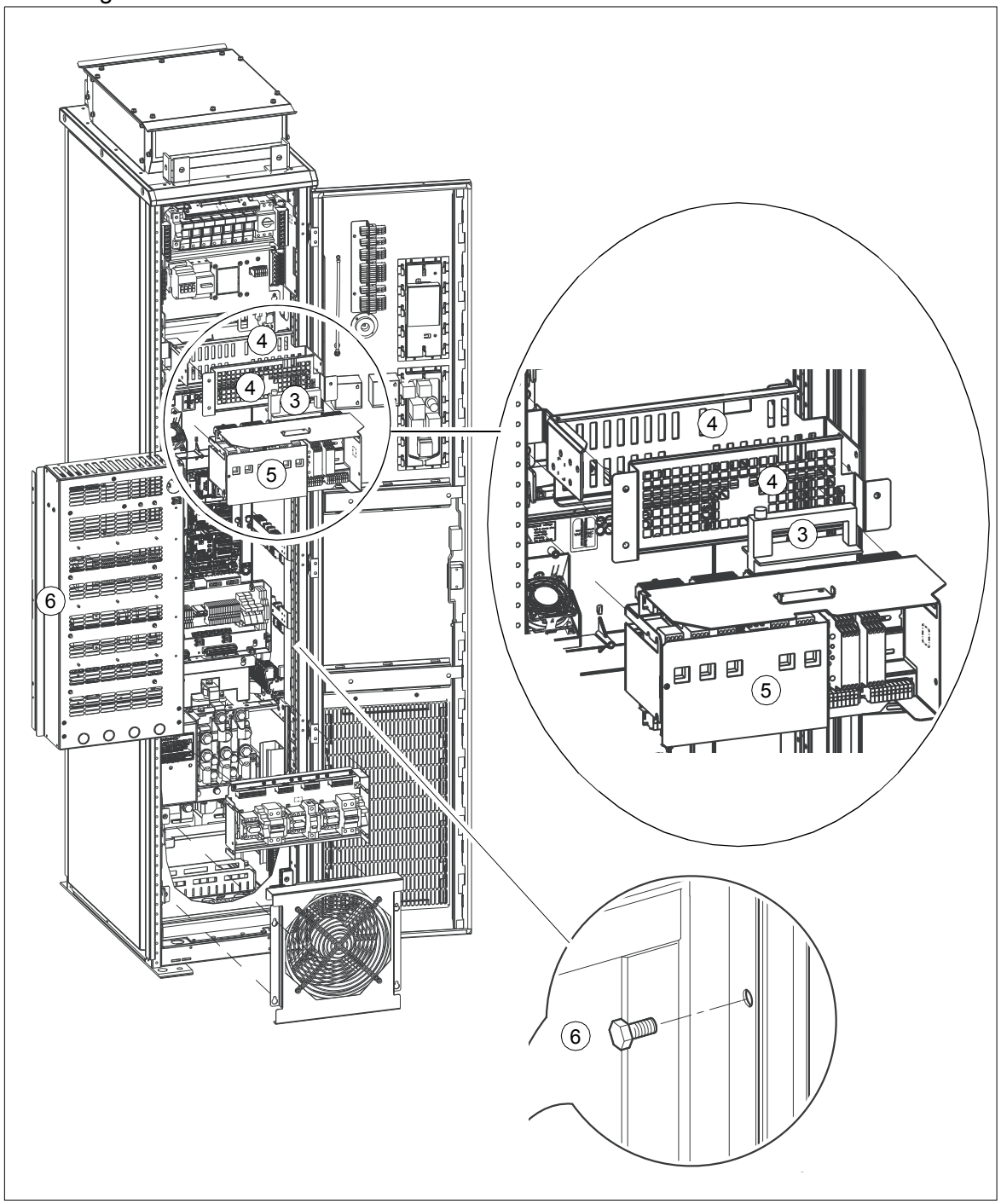
## Safety



**WARNING!** Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur. Secure the cabinet to the floor to prevent it from toppling over when you slide out the heavy drive module.

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Open the cabinet door.
3. Remove the fuse replacement handle.
4. Remove the shroud. For drives with option +C121: Remove the marine shroud.
5. Unplug the connectors and remove the mounting plate.

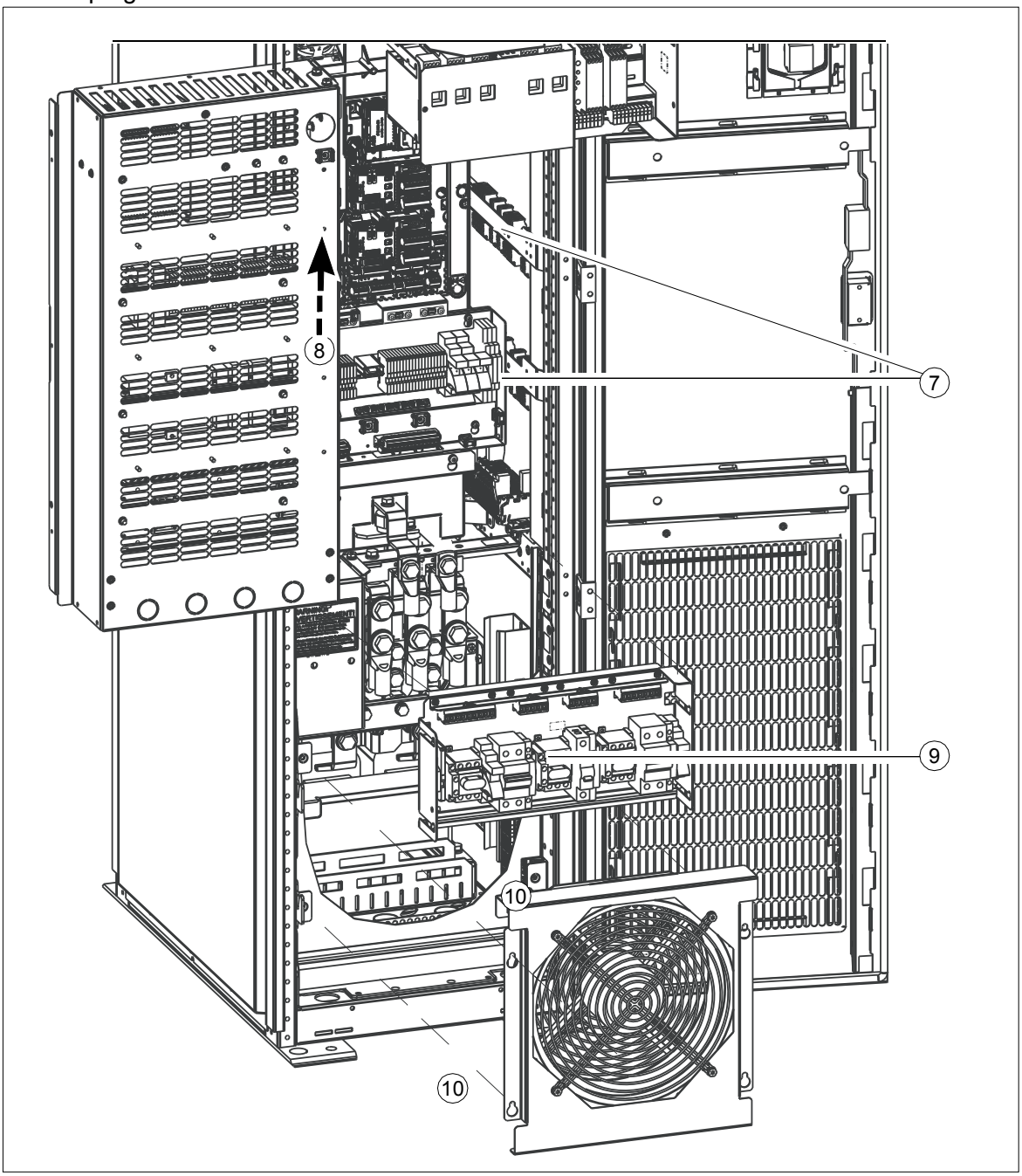
6. <u>For drives with option +C121:</u> Undo the three M6 screws on the left side of the swing-out frame.
   <u>All drives:</u> Undo the two M6 screws on the right side of the swing-out frame and open the swing-out frame or remove the shroud and four shroud fixing brackets if there is no swing-out frame.



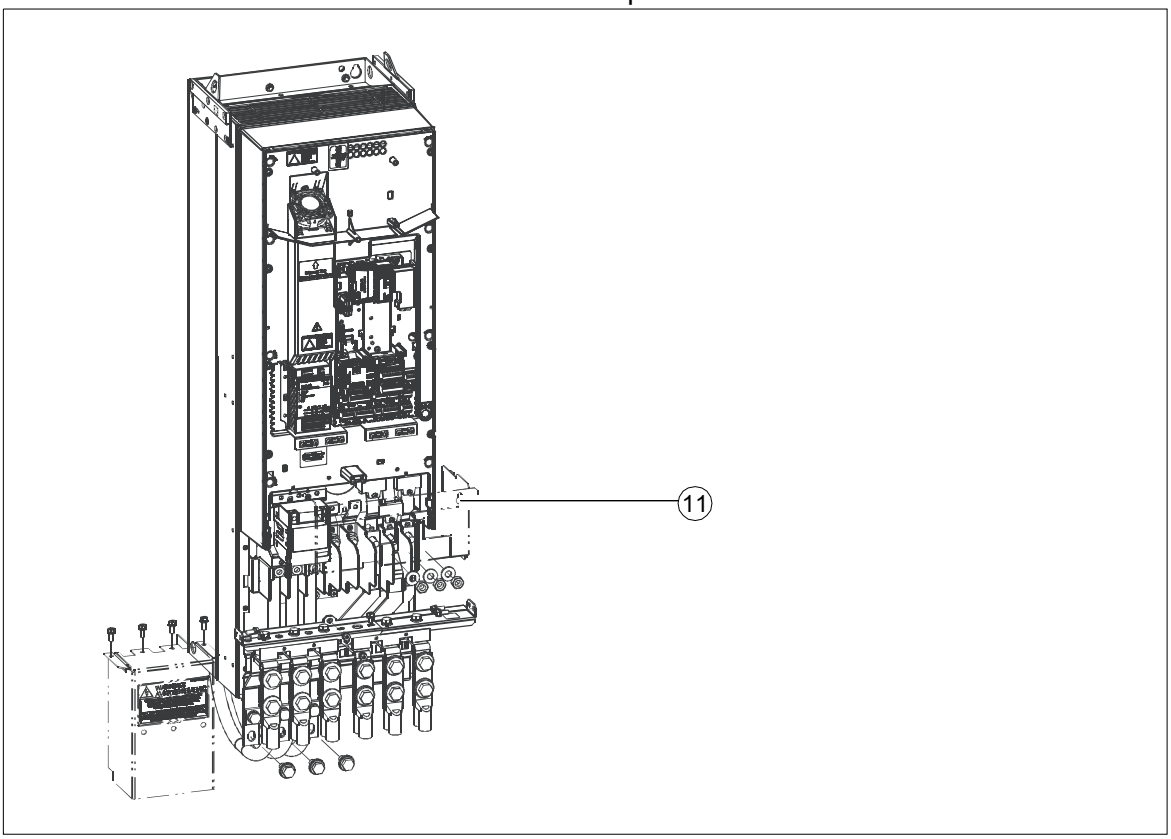

7. Disconnect the control panel cable from the module and the control wire terminals on the right side of the cabinet.
8. If the swing-out frame does not open enough to allow module replacement, undo the swing-out frame grounding wire and lift the swing-out frame off its hinges.
9. To remove the mounting plate above the “door fan”, loosen the mounting screws and lift the plate up or remove the shroud and four fixing brackets if there is no mounting plate.

For drives with options +G300, +G301, +G307 and +G313: Disconnect the control cable terminals at the back side of the mounting plate.

10. Unplug the connector and remove the fan or remove the shroud if there is no fan.



11. Loosen the four M5 screws and remove the plastic shroud.



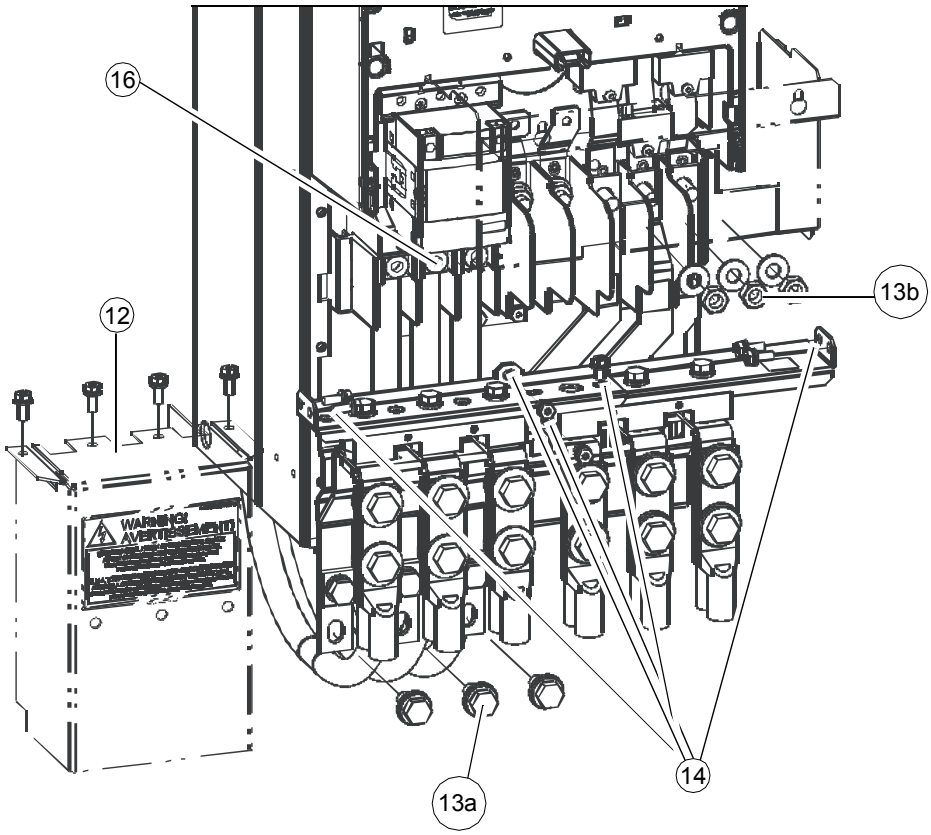

12. For drives with bottom entry: Undo the four M6 combi screws and remove the plastic shroud.
13. For drives with bottom entry or exit: Remove the connection terminal subassembly:

    Undo the screws or nuts:
    - Bottom entry (a): three M10 screws

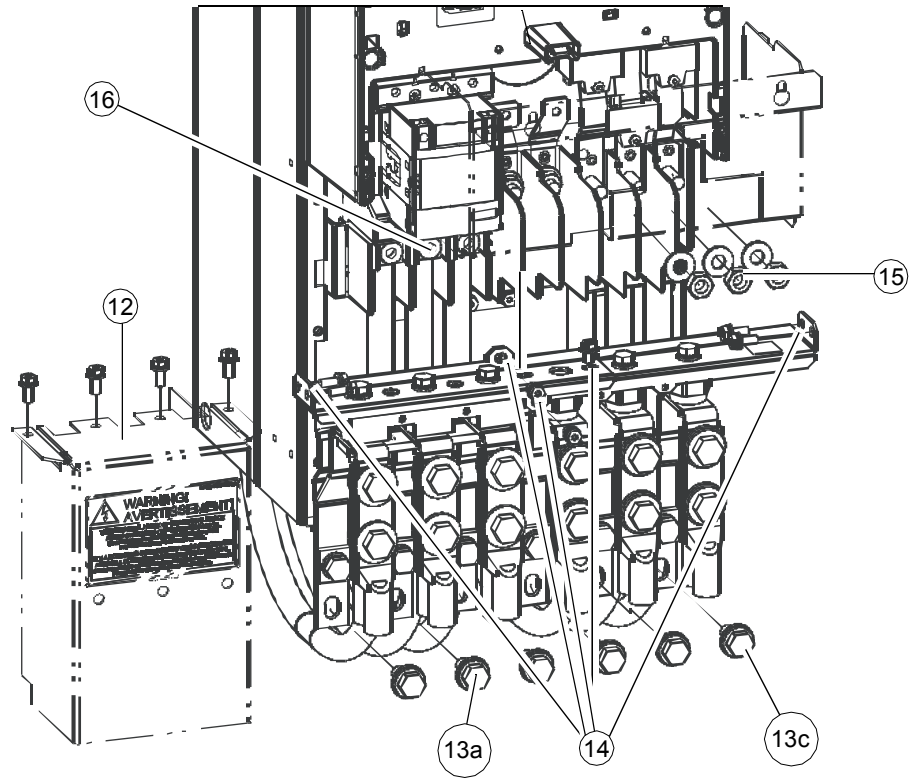
    **Note:** If you find it difficult to access the screws of steps 13a or 13c, you can disconnect the power cables of step 14 and remove the terminal subassembly.
    - Bottom exit from module (b): three M10 nuts
    - Bottom exit and common mode filter (option +E208) or du/dt filter (option +E205) (c): three M10 nuts
14. For drives with bottom entry or exit: Undo the 7 M6 screws and bend down the left half of the connection terminal subassembly. Then bend down the right half of the subassembly so that the power cables do not disturb the module replacement.

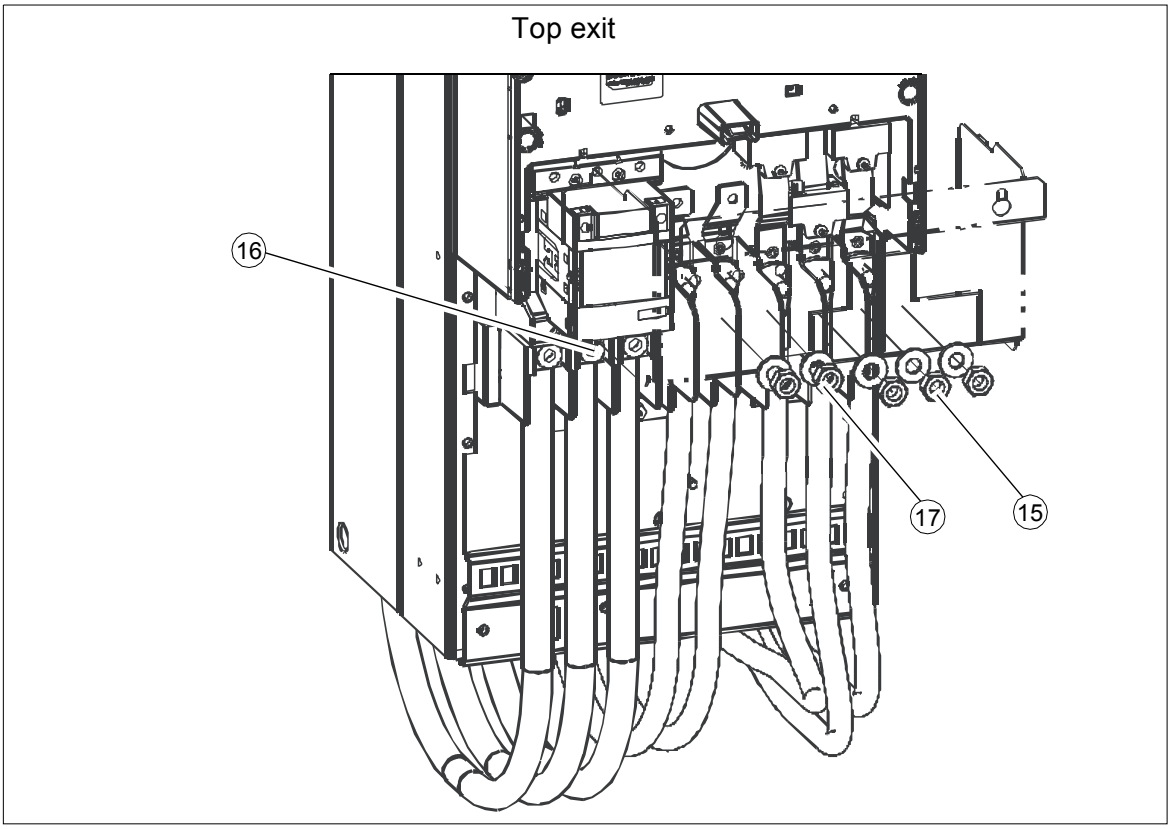
    **Note:** If you find it difficult to access the screws of steps 13a or 13c, you can disconnect the power cables of step 14 and remove the terminal subassembly.
15. Top exit or bottom exit and option +E208 or E205: Undo the three M10 nuts. Bend the three motor cables down so that they do not disturb the module replacement.
16. Loosen the three hex head screws, pull out three power cables and bend them down so that they do not disturb the module replacement.
17. For drives with brake chopper (option +D150) : Undo the two M10 nuts and bend the two power cables down so that they do not disturb the module replacement.

Bottom exit from module



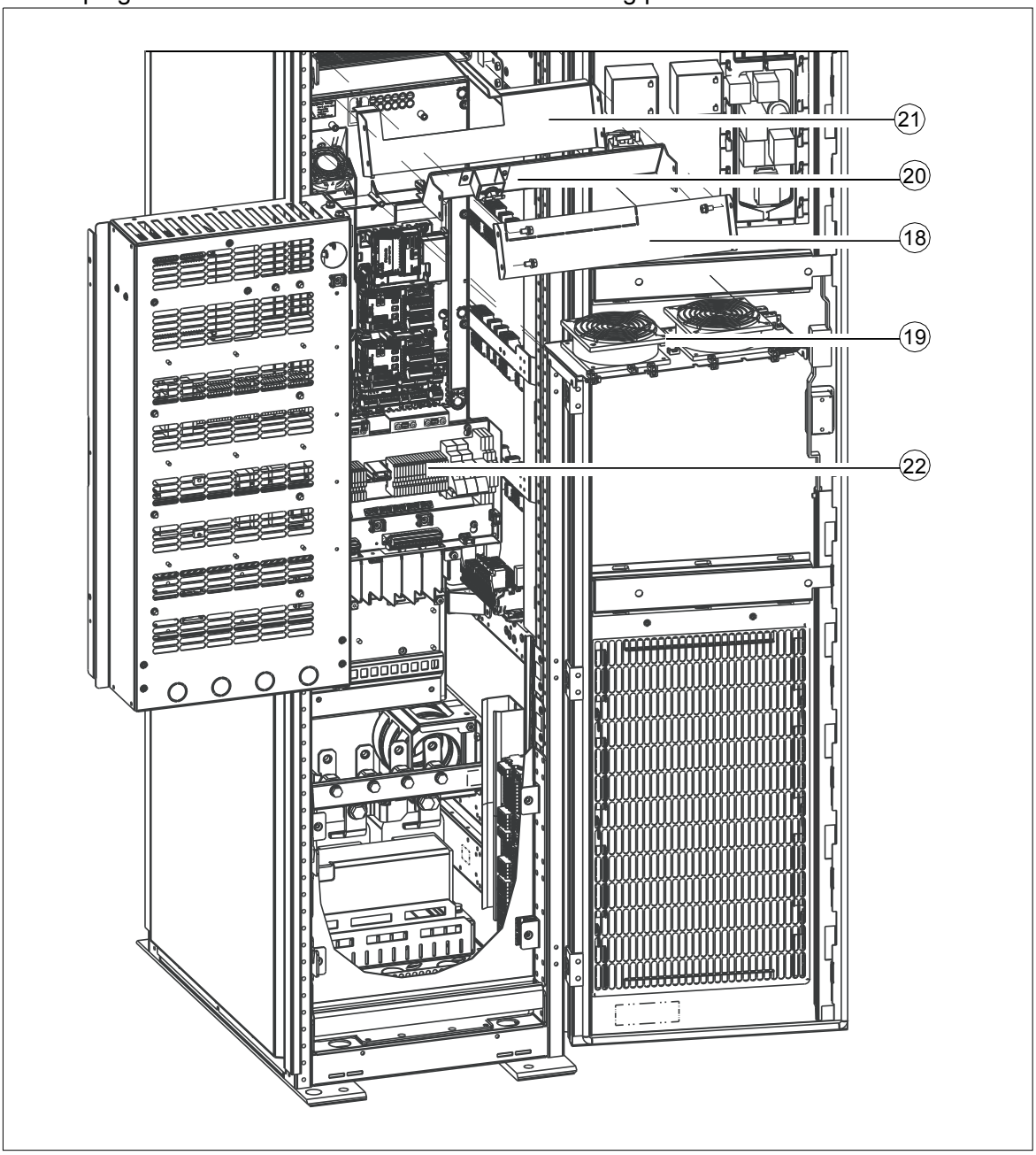

Bottom exit with +E208 or +E205





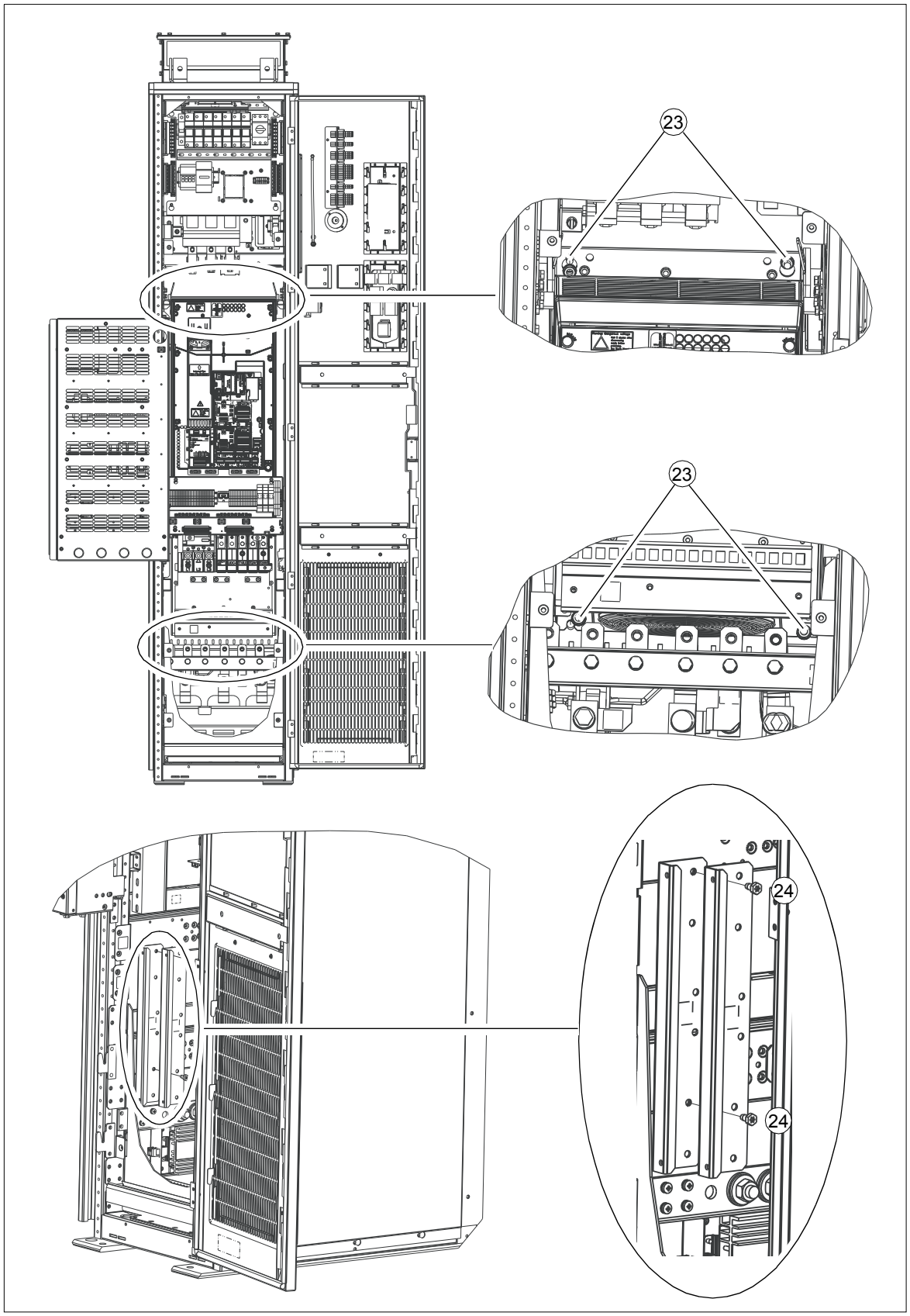

18. Undo the four M6 combi screws and remove the plastic air guide.
19. Loosen the four M6 combi screws, unplug the connector, lift the fan up a bit and remove the fan plate.
20. For easier removal of the module, undo the four M6 combi screws, disconnect the wires of the thermal switch and remove the plastic air guide.
21. For easier removal of the module, undo the four M6 combi screws and remove the plastic air guide.

22. Unplug the wires and connectors of X504 mounting plate.



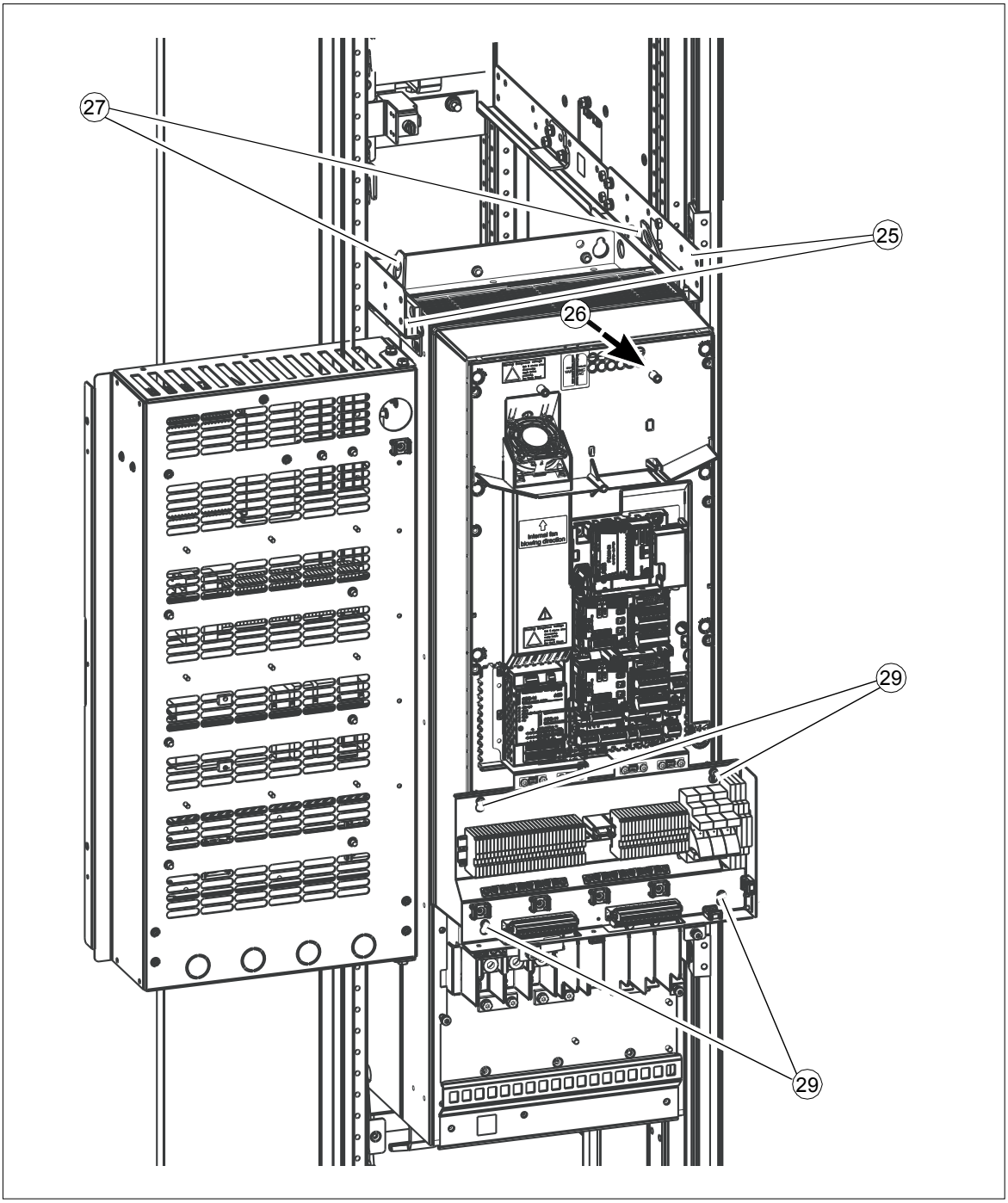

23. Undo the four M8 Serpress® nuts.

24. Undo the two M6 self-tapping screws in the bottom left side of the cabinet and remove the module slide extension rails.




25. Install the extension rails at the end of the sliding bars.
26. Slide the drive module towards the end of the sliding bars.

27. Secure the drive module with chains from the lifting eyes.
28. Lift the module out of the cabinet with a lifting device.
29. Loosen the four M5 combi screws and remove X504 mounting plate.
30. Remove the four M4 standoffs and place them to a new module.
31. Place X504 mounting plate to the new module and attach the M5 combi screws.
32. Install the new module in reverse order.



# Replacing the drive and LCL filter modules (frame R11)

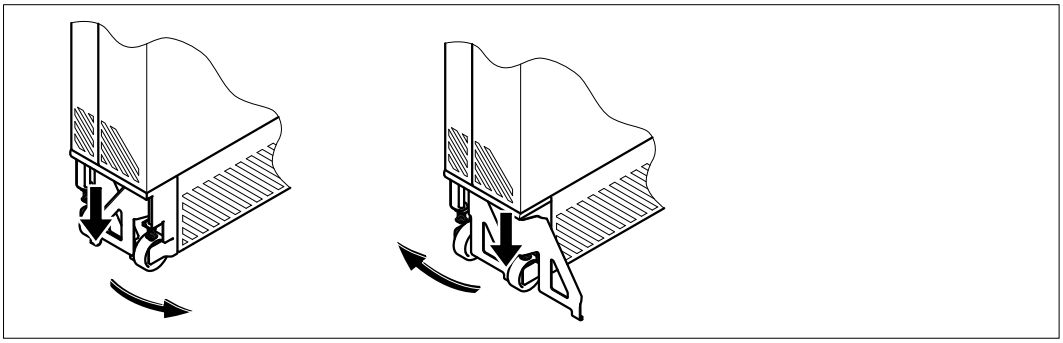
## Required tools

- installation ramp
- set of screw drivers
- torque wrench with an extension bar
- lifting chains.

## Safety

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

- Handle the drive and LCL filter modules carefully:
  - Use safety shoes with a metal toe cap to avoid foot injury.
  - Lift the module only by the lifting lugs.
  - Make sure that the module does not topple over when you move it on the floor: Extend the support legs: Press each leg a little down and turn it aside. Whenever possible secure the module also with chains.

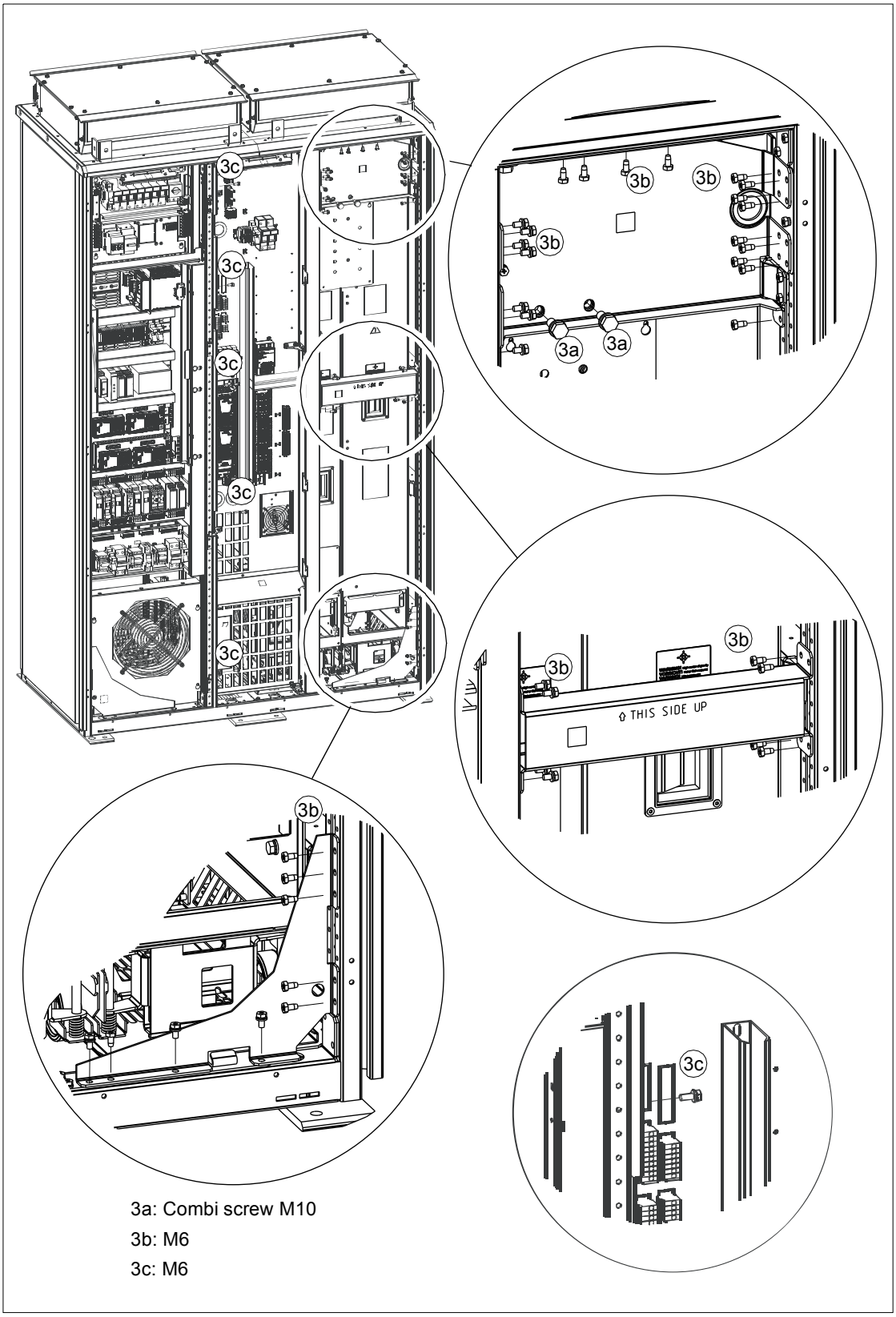


  - Do not tilt the drive module. It is **heavy** and its **center of gravity is high.** Do not leave the module unattended on a sloping floor.

## Replacing the drive module (frame R11)

Replacing the drive module requires preferably two persons.

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Open the cabinet doors.
3. For drives with option +C121:
   Undo the two module attaching screws (3a).
   Undo the M6 screws and remove the three supports (3b).
   Undo the five M6 screws on the left side of the swing-out frame (3c).

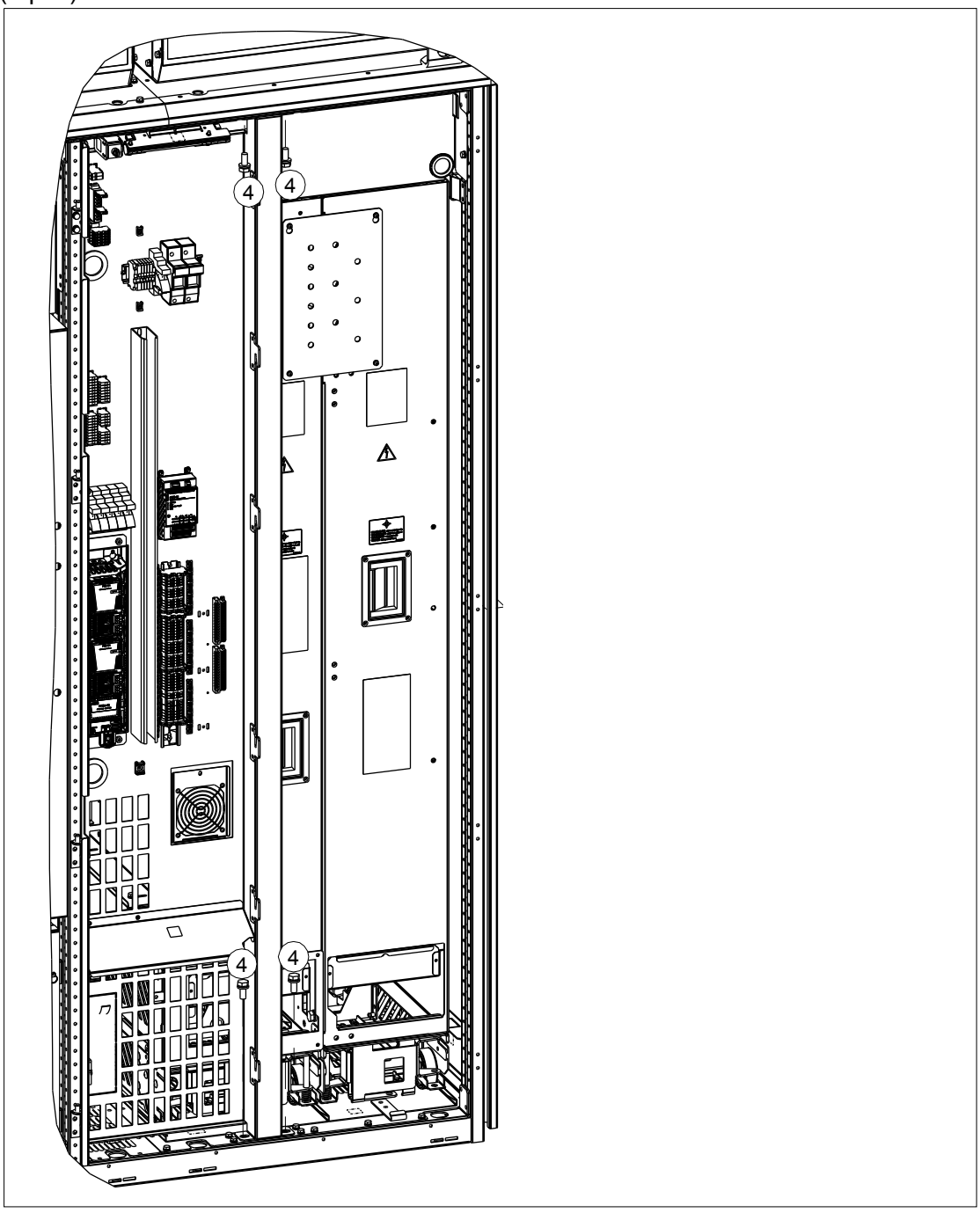



3a: Combi screw M10

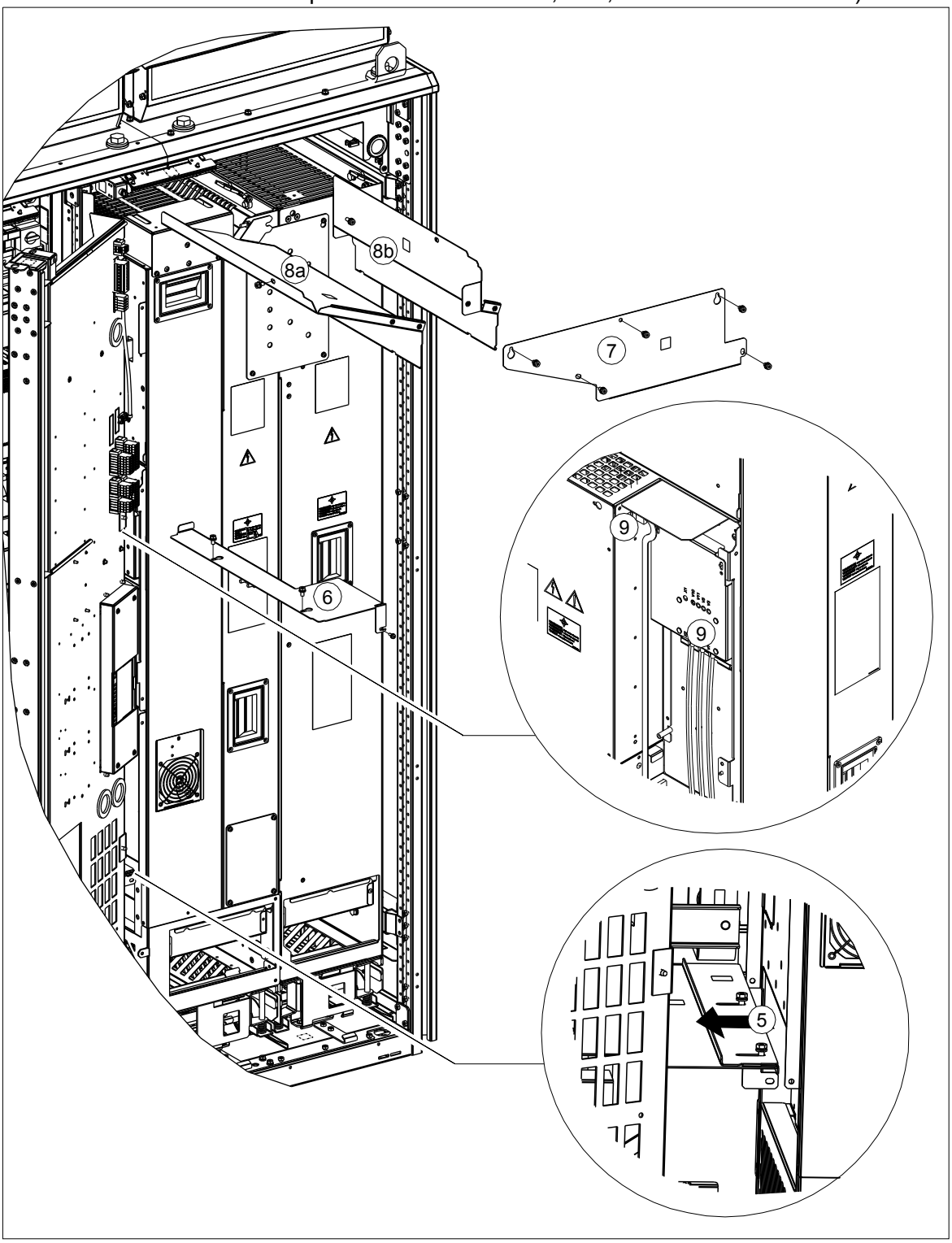
3b: M6

3c: M6

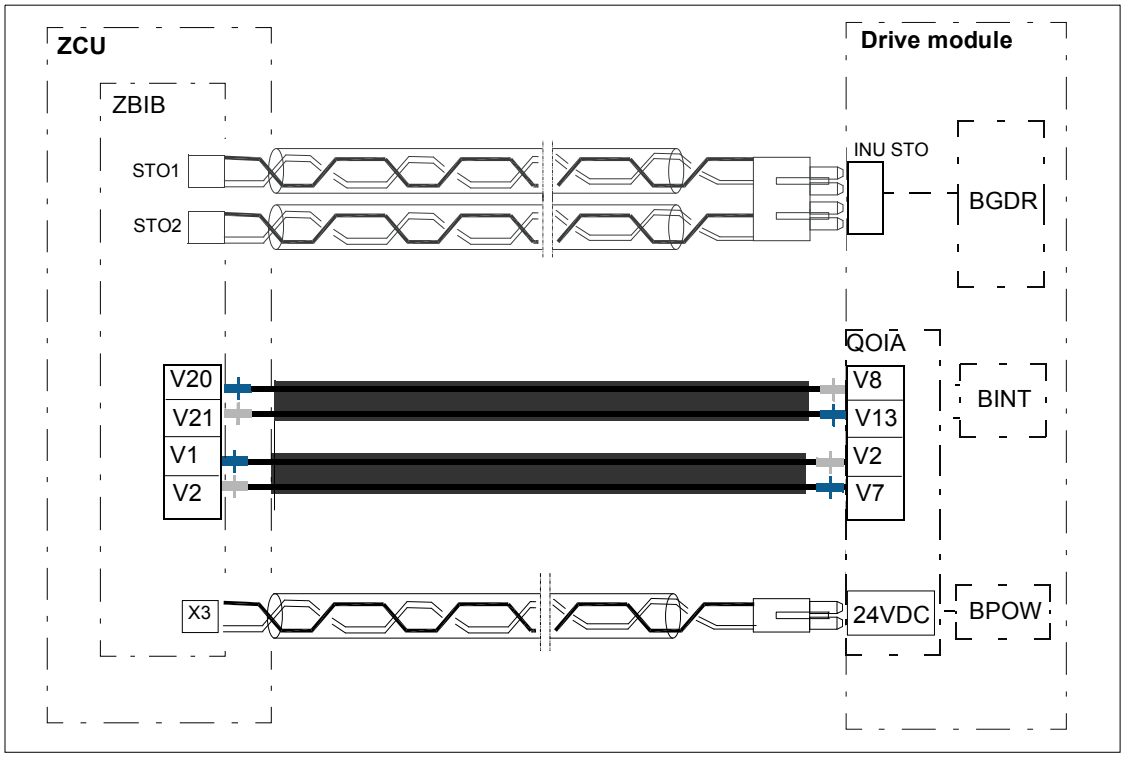
4. To open the module section swing-out frame, undo the M10 bolts from top and bottom (4 pcs).



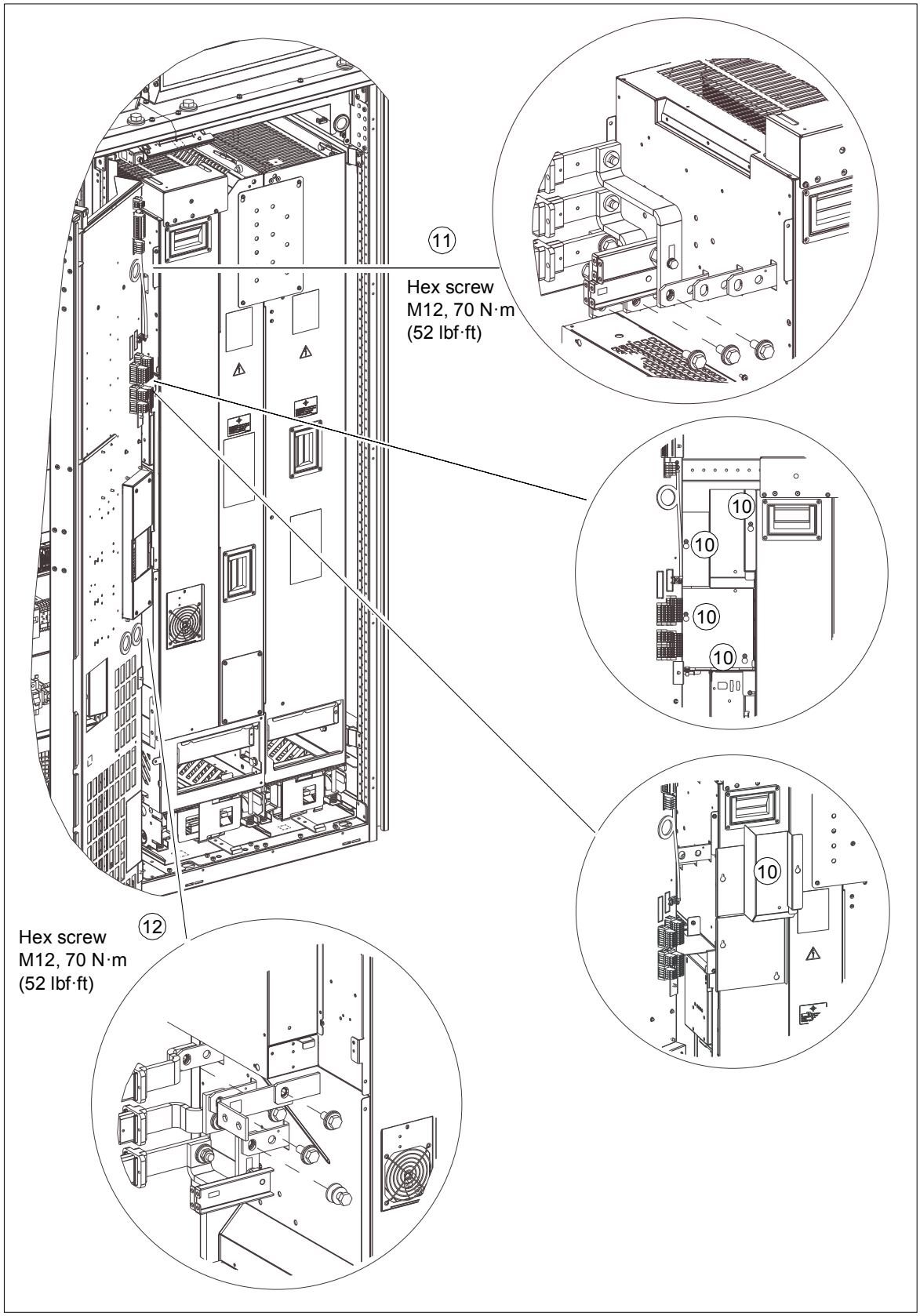
5. Loosen the two M6 screws of the air baffle and push it to the left. (Not for drives with option +C128.)
6. Remove the air baffle.
7. Remove the air baffle. (Not for drives with option +C121.)
8. Remove the air baffle: (8a) in IP22/IP42 drives, (8b) in IP54 drives.
9. Disconnect all cables from line-side converter control unit (from terminal X2, INU STO connector and the fiber optic cables from the V8, V13, V2 and V7 connectors).



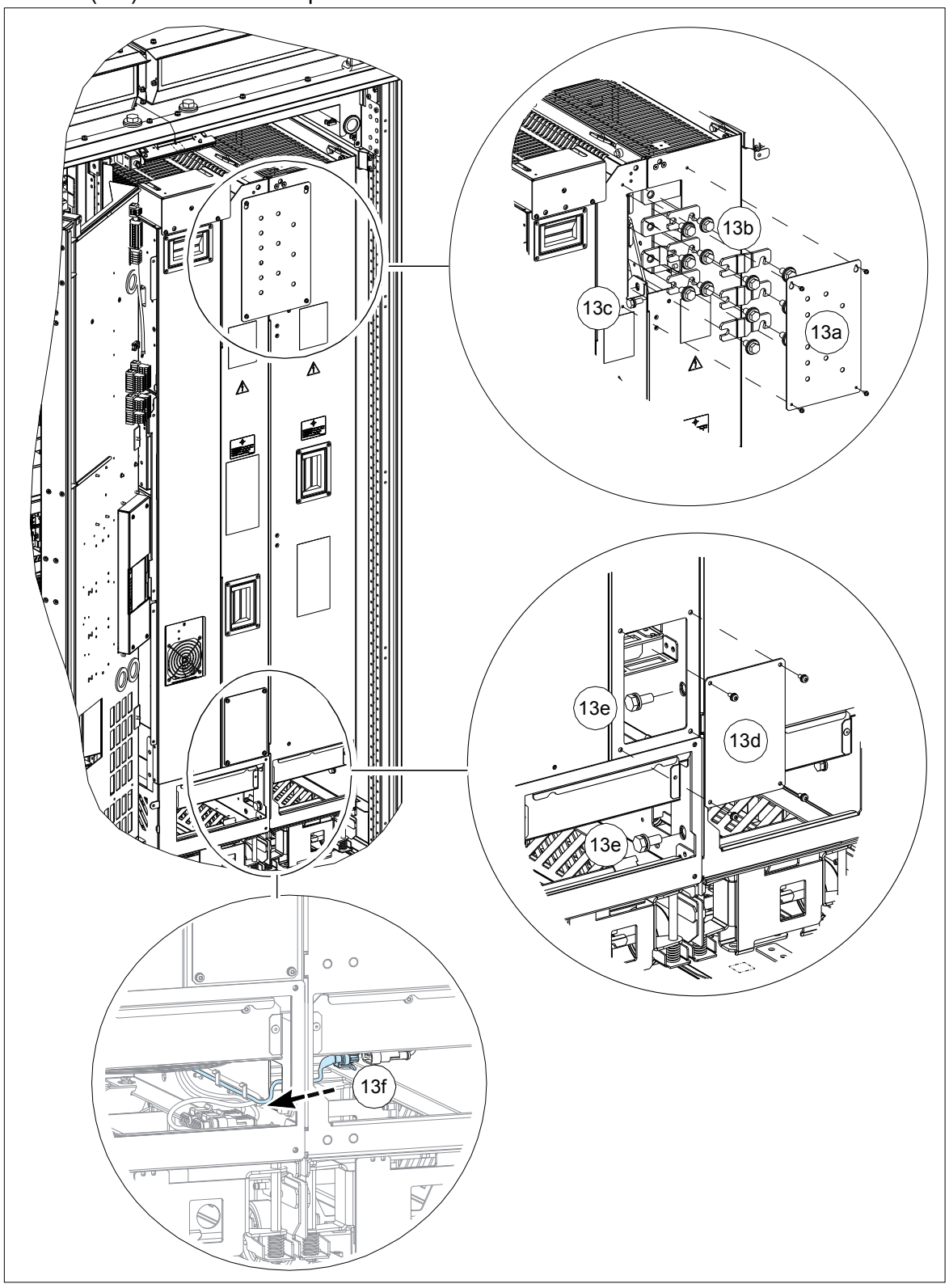
The connections between the line-side converter control unit and drive control unit are shown below. The drive control unit remains in its place when you remove the drive module.



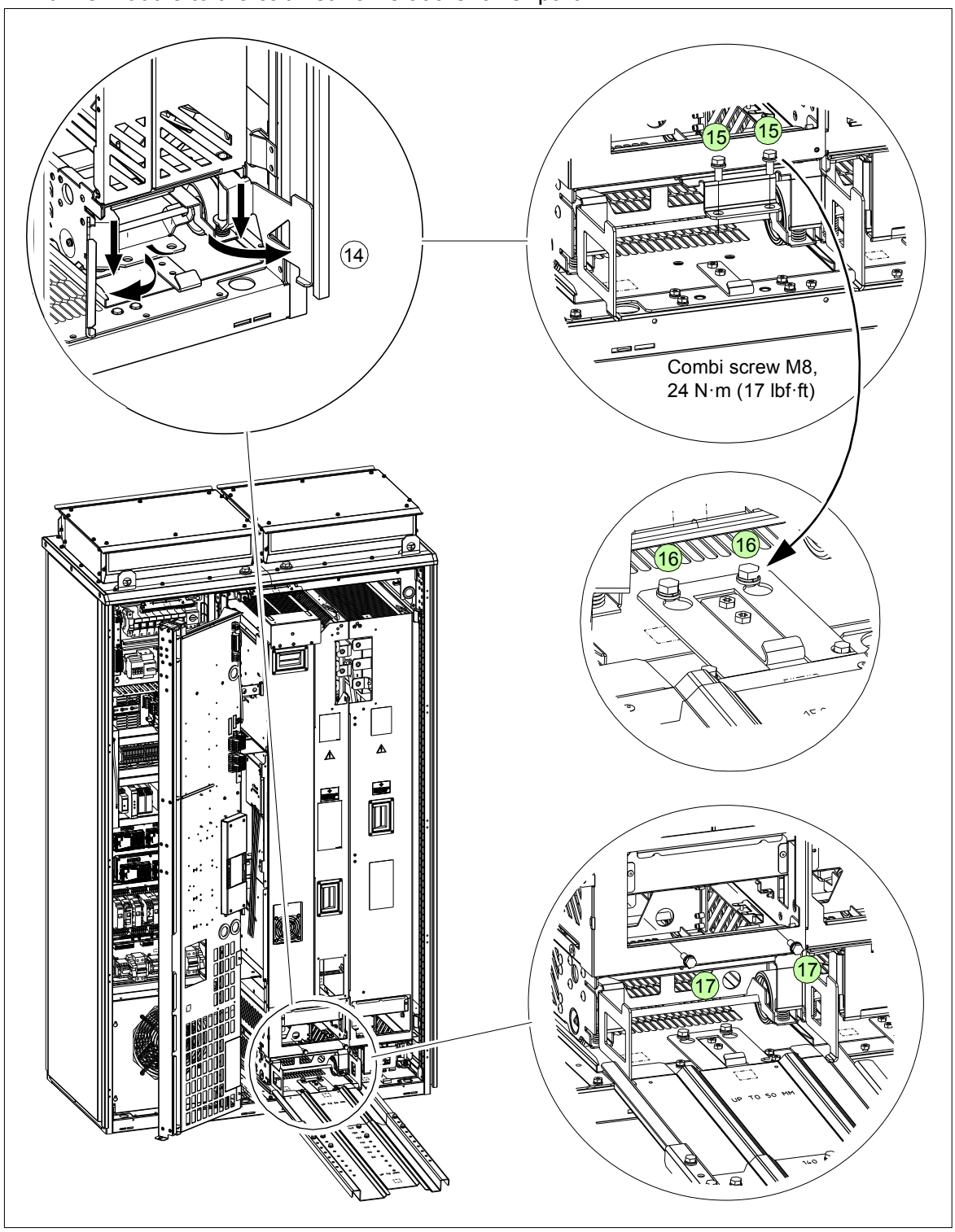
10. Loosen the M4 screws, lift the plastic shroud of the DC busbars up and remove it.
11. Disconnect the input power cabling busbars from the drive module busbar terminals. For drives with option +D150, disconnect the DC busbars also.
12. Disconnect the output power cabling and PE busbars from the drive module busbar terminals.



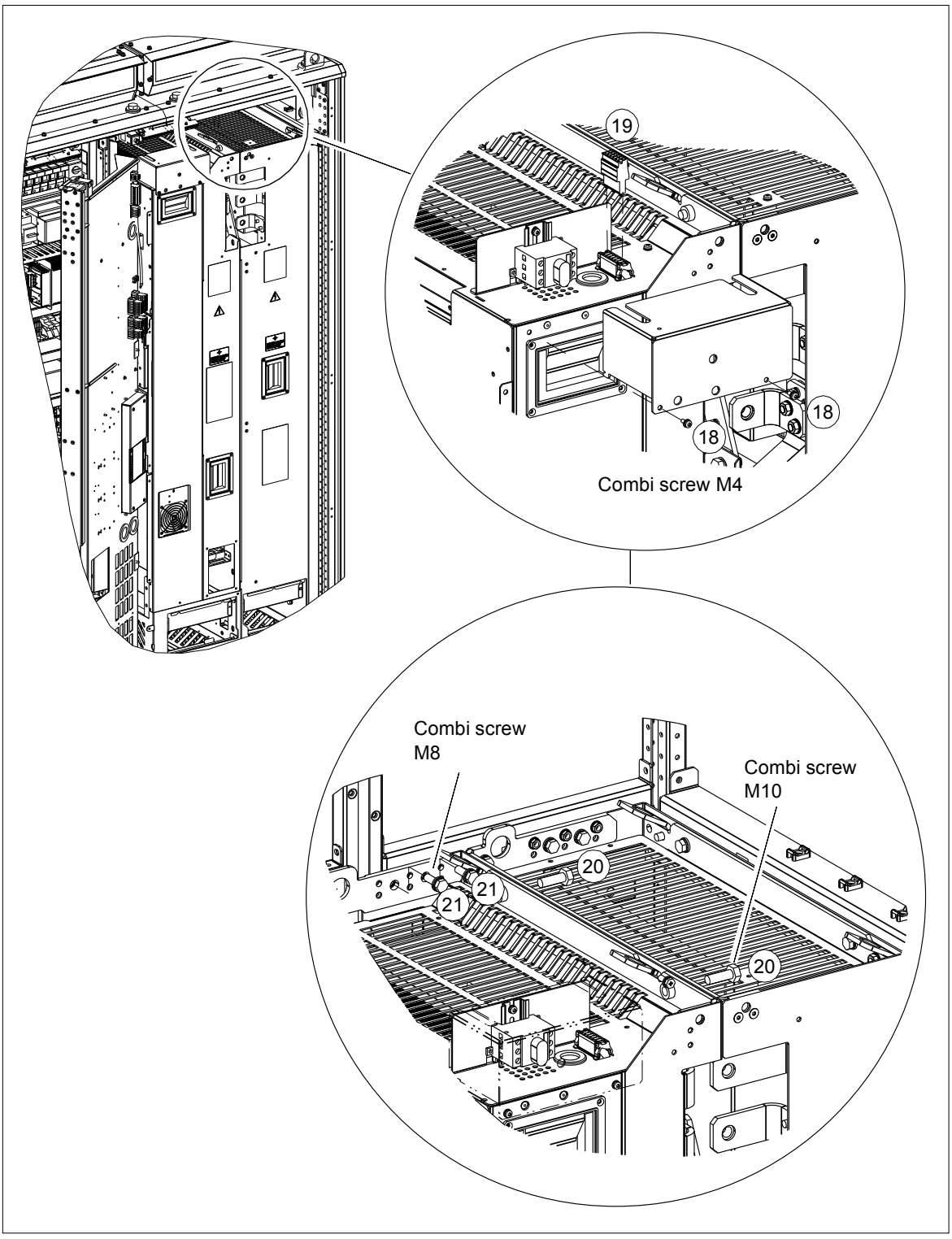
13. To disconnect the drive module from the LCL filter module:
    - (13a) Remove the shroud.
    - (13b) Remove the bolts that connect the power busbars.
    - (13c) Remove the attaching bolt.
    - (13d) Remove the shroud.
    - (13e) Remove the bolts.
    - (13f) Disconnect the power wire of the LCL filter fan from connector FAN3:LCL.



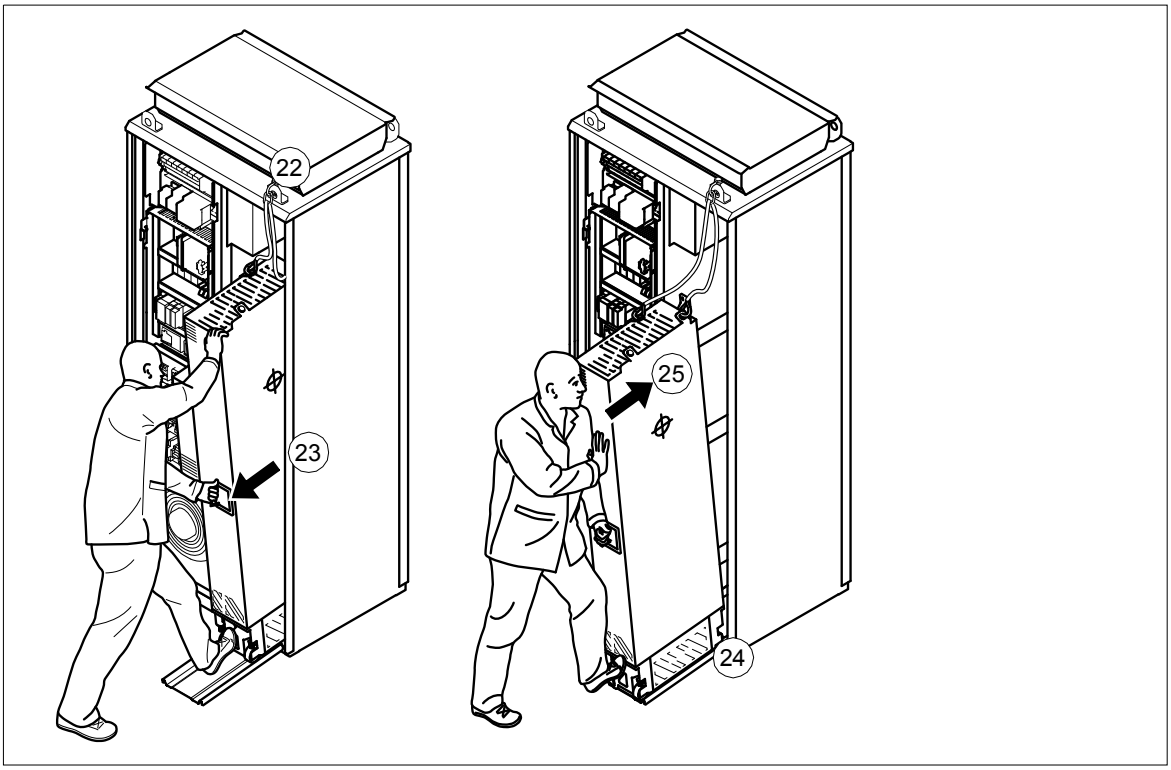
14. To open the support legs 90 degrees, press each leg a little down and turn it aside.
15. To remove the lower support bracket of the drive module, undo the two screws.
16. Adjust the extraction ramp to the correct height and attach it to the cabinet base with the two mounting screws of the support bracket that was removed.
17. <u>For drives with marine construction (option +C121):</u> Remove the bolts that attach the drive module to the cabinet frame at the lower part.



18. To remove the shroud on the charging circuit switch/contactor, undo the two mounting screws.
19. Unplug the connector and auxiliary contact wires of the charging circuit switch/contactor.
20. Undo the two bolts that attach drive module to the LCL filter module.
21. Undo the bolts that attach drive module from back to the cabinet frame.



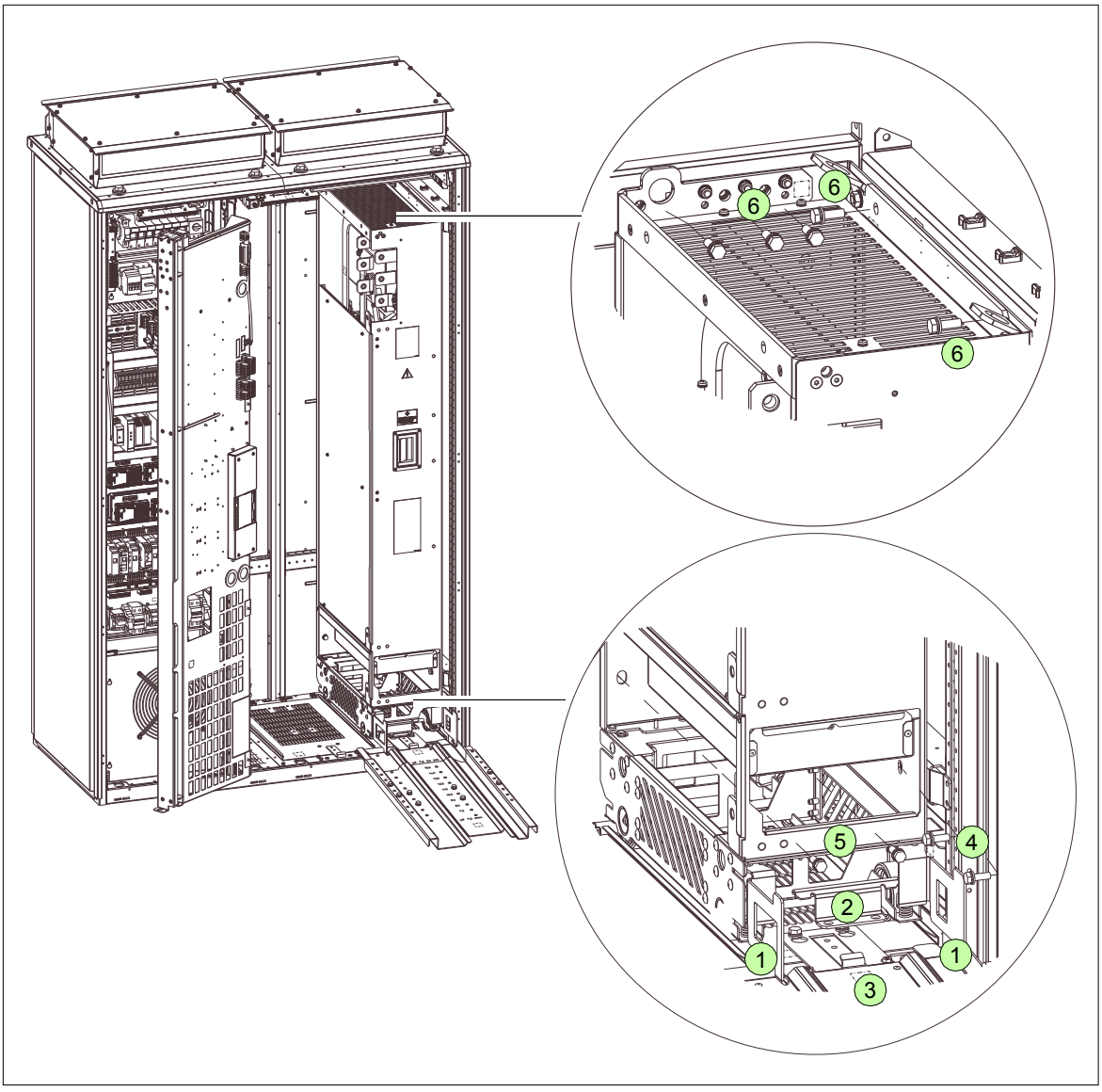
22. Attach the lifting lugs of the module to be removed to the cabinet lifting lug with chains.
23. Pull the module carefully out of the cabinet preferably with help from another person.
24. Before the module back wheels reach the attaching hook on the floor, open also the back support legs of the drive module by pressing each leg a little downwards and turning it aside. Close the legs when the module back wheels have passed the attaching hook.
25. Install the new module in reverse order.



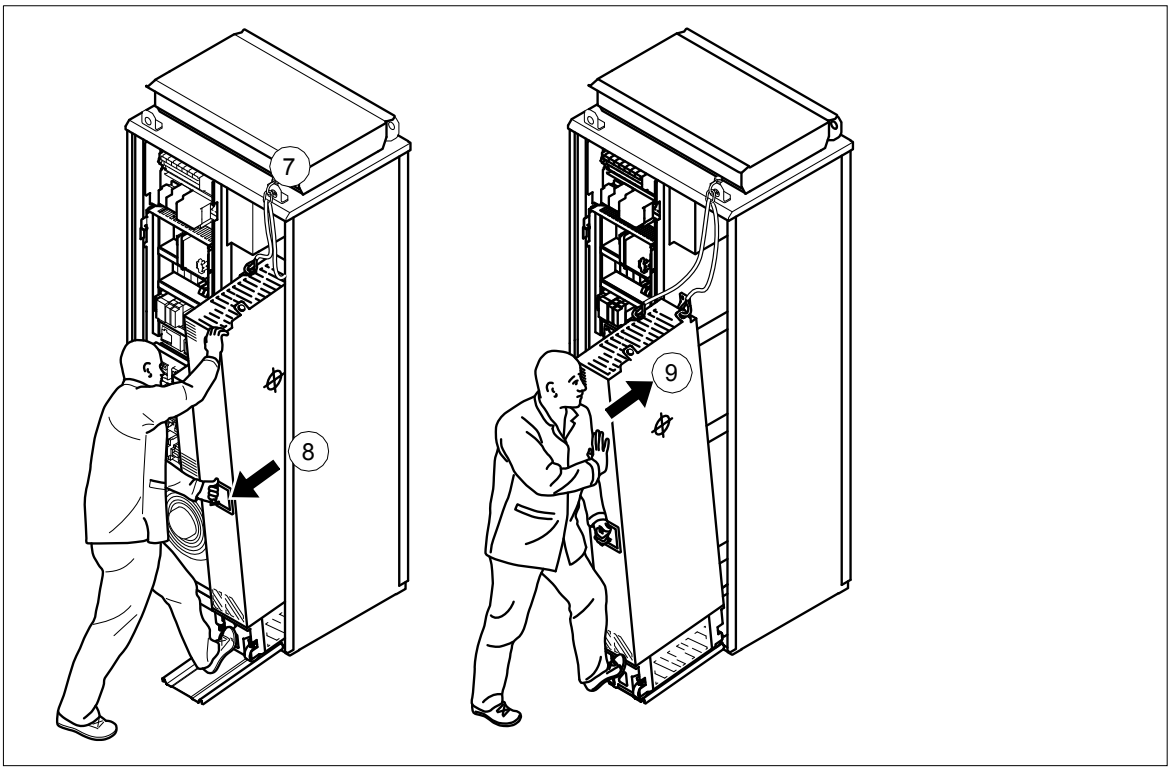
## Replacing the LCL filter module

If LCL filter module is also to be replaced:

1. To open the support legs 90 degrees, press each leg a little down and turning it aside.
2. To remove the lower support bracket of the LCL filter module, undo the two screws.
3. Adjust the extraction ramp to the correct height and attach it to the cabinet base with the two mounting screws of the lower support bracket that was removed.
4. Undo the two lower screws that attach the LCL filter module to the cabinet from the right.
5. For drives with marine construction (option +C121): Undo the two lower screws that attach the LCL filter module to the cabinet frame from back.
6. Undo the 5 bolts that attach LCL filter module from back and from the right to the cabinet frame.



7. Attach the lifting lugs of the module to be removed to the cabinet lifting lug with chains.
8. Pull the LCL filter module carefully out of the cabinet preferably with help from another person.
9. Install new module in reverse order.




# Capacitors

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

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

## Reforming the capacitors

The capacitors must be reformed if the drive has not been powered (either in storage or unused) for a year or more. See section *Type designation label* on page *58* for how to find out the manufacturing date from the serial number.

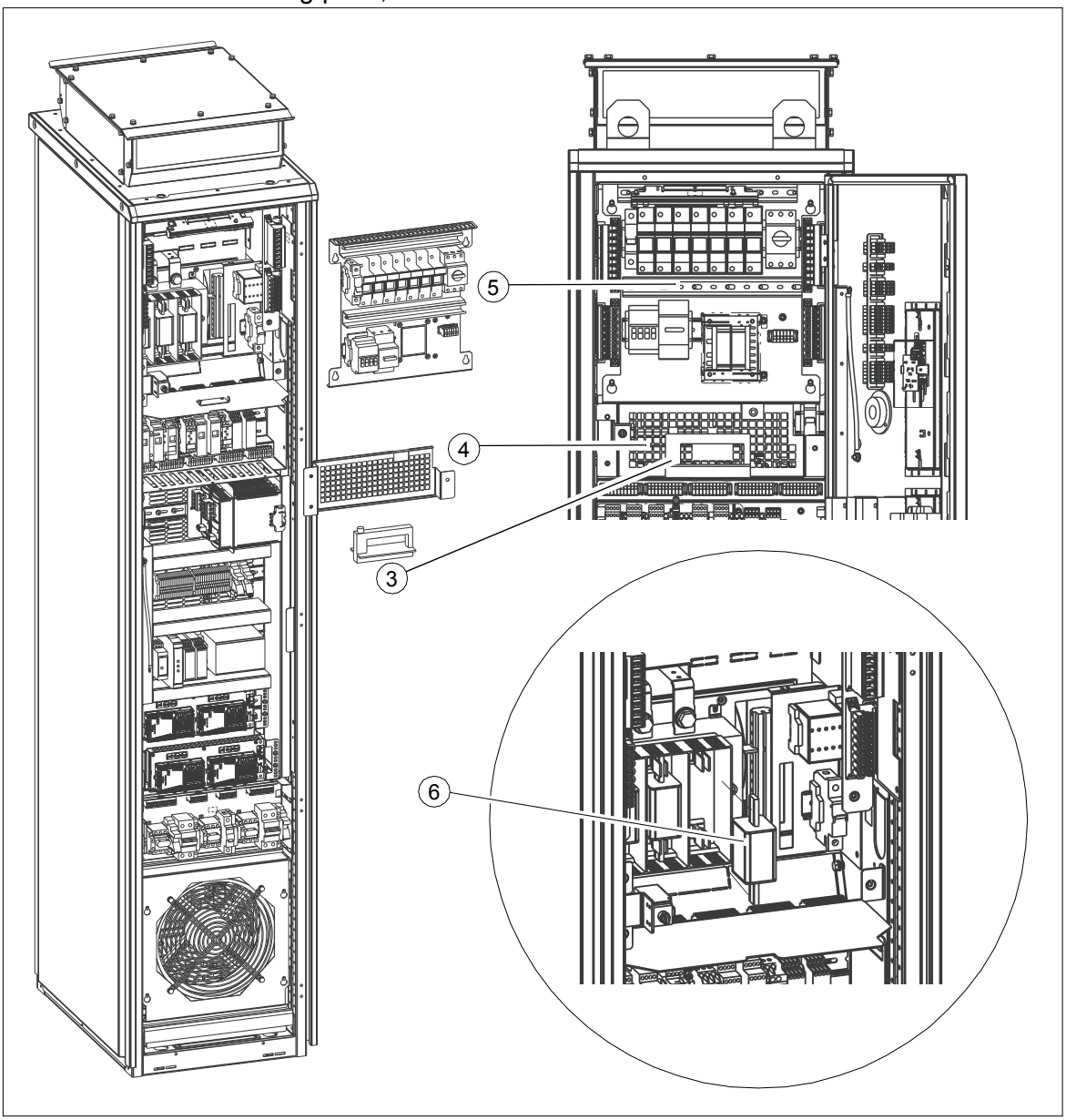
For information on reforming the capacitors, see *Converter module capacitor reforming instructions* (3BFE64059629 [English]), available on the Internet (go to http://www.abb.com and enter the document code in the Search field).

# Fuses

## Replacing fuses (frame R8)

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

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Open the cabinet door.
3. Remove the fuse replacement handle.
4. Remove the shroud.
5. Remove the top mounting plate.
6. Pull out the fuses with the fuse handle and replace them with the new fuses.
7. Reinstall the mounting plate, shroud and fuse handle.



## Replacing fuses (frame R11)

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

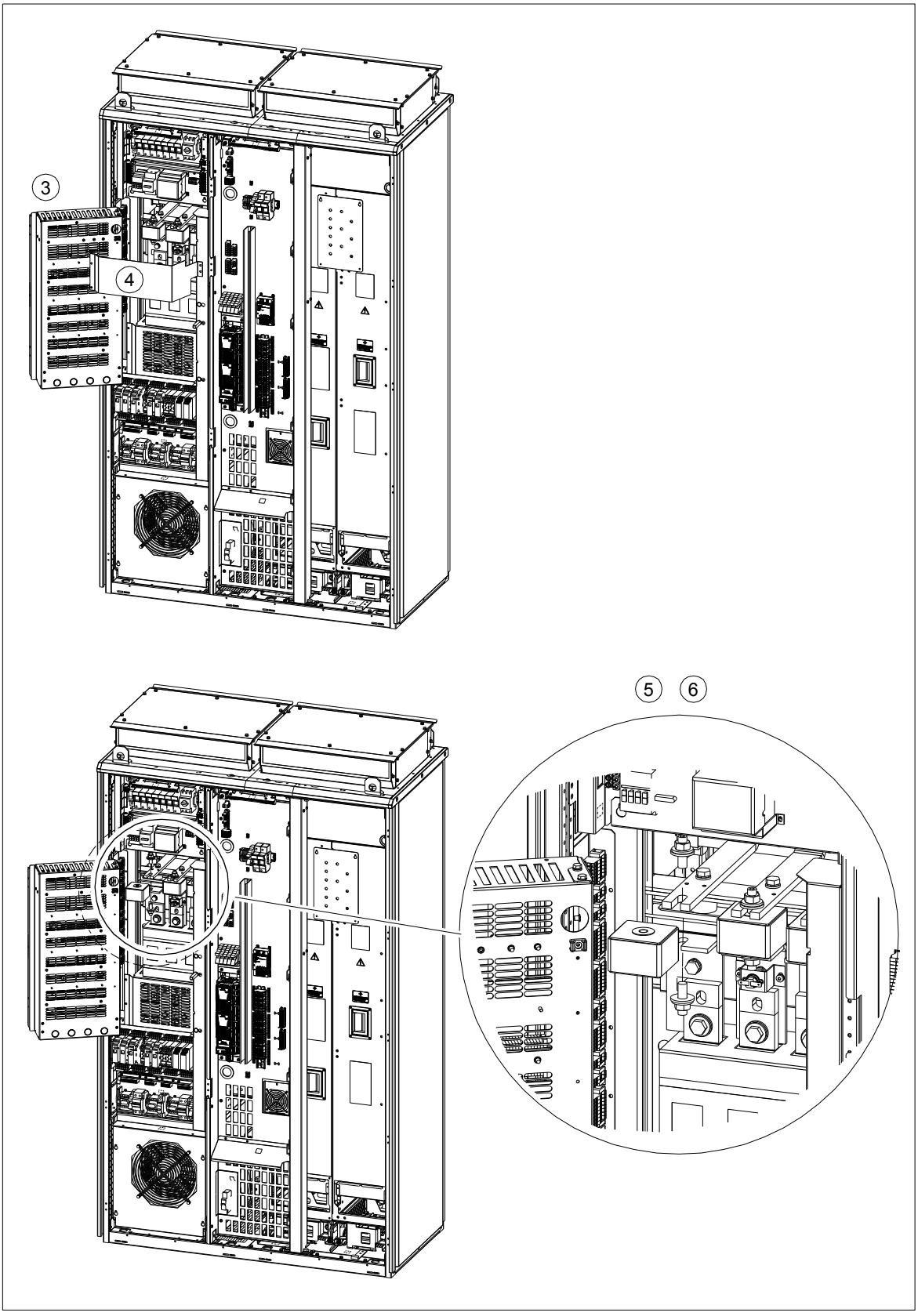
1. Stop the drive (if running) and do the steps in section *Electrical safety precautions* (page *19*) before you start the work.
2. Open the cabinet door.
3. Open the swing-out frame or remove the shroud – Bottom entry of cables:
   Marine drives (option +C121): Undo the three M6 screws on the left side of the swing-out frame. All drives: Undo the two M6 screws on the right side of the swing-out frame and open the swing-out frame, or remove the shroud if there is no swing-out frame.

   Open the swing-out frame or remove the shroud – Top entry of cables:
   Marine drives (option +C121): Undo the three M6 screws on the left side of the swing-out frame. All drives: Undo the two M6 screws on the right side of the swing-out frame and open the swing-out frame, or remove the shroud if there is no swing-out frame. Remove the plate under the swing-out frame (if present) or remove the shroud.
4. Remove the plastic shroud in front of the fuses.



**Note:** You can access the screws on the left side of the fuse shroud easier if you open the swing-out frame slightly and use the gap between the swing-out frame and cabinet frame to access the screws.

5. Slacken the nuts of the headless screws of the fuses so that you can slide out the fuse blocks. Make a note of the order of the washers on the screws.
6. Remove the screws, nuts and washers from the old fuses and attach them to the new fuses. Make sure to keep the washers in the original order.
7. Insert the new fuses into their slots in the cubicle.
8. Tighten the nuts to torque as follows:
   - Cooper-Bussmann fuses: 50 N·m (37 lbf·ft) if size 3; 40 N·m (30 lbf·ft) if size 2
   - Mersen (Ferraz-Shawmut): 46 N·m (34 lbf·ft) if size 33; 26 N·m (19 lbf·ft) if size 32
   - Other fuses: Refer to the fuse manufacturer's instructions.
9. Reinstall the shrouds and mounting plate if removed earlier. Close the swing-out frame. Close the cabinet door.


3
4
5
6

# Control panel

## Replacing the battery

1. Turn the lid on the back of the panel counter-clockwise until the lid opens.
2. Replace the battery with a new CR2032 battery.
3. Put the lid back and tighten it by turning it clockwise.
4. Dispose of the old battery according to local disposal rules or applicable laws.



## Cleaning

See *ACx-AP-x assistant control panels user's manual* [3AUA0000085685 (English)].

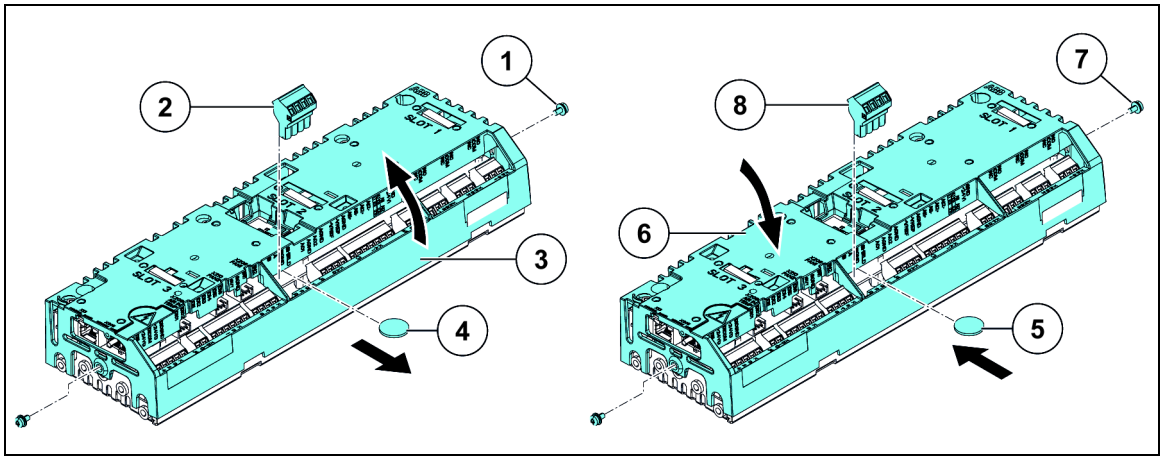
# Replacing the control unit battery

**WARNING!** Obey the 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 *Electrical safety precautions* on page *19* before you start the work.

To replace the control unit battery:

1. Remove the M4x8 (T20) screws at the ends of the control unit.
2. To see the battery, remove the XD2D terminal block.
3. Carefully lift the edge of the control unit cover on the side with the I/O terminal blocks.
4. Carefully pull the battery out of the battery holder.
5. Carefully put a new CR2032 battery into the battery holder.
6. Close the control unit cover.
7. Tighten the M4×8 (T20) screws.
8. Install the XD2D terminal block.



# Memory unit

When a drive is replaced, the parameter settings can be retained by transferring the memory unit from the defective drive to the new drive. One memory unit is located on the drive control unit (motor-side converter control unit), see page *146*, another on the line-side converter control unit.

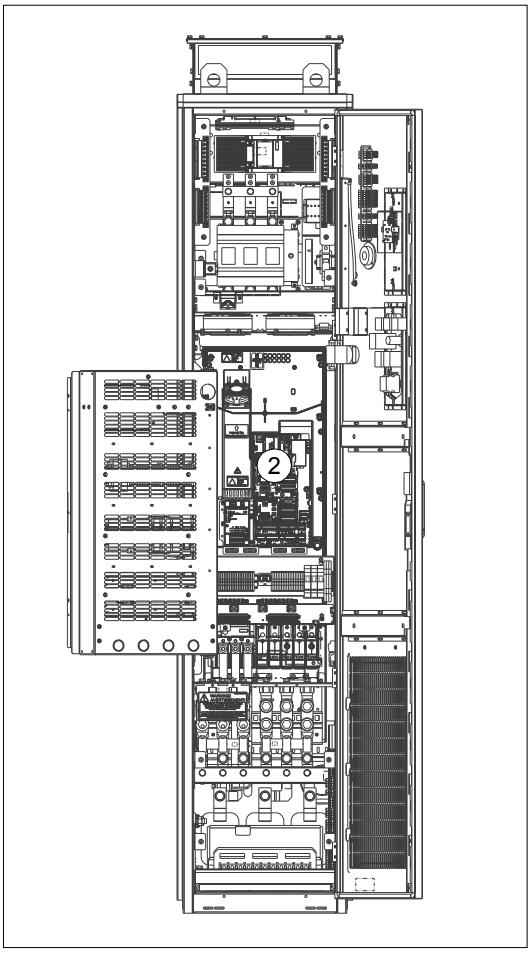
**WARNING!** Do not remove or insert the memory unit when the drive module is powered.

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

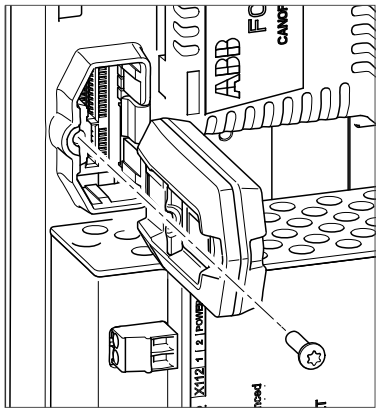
## Replacing the memory unit of the motor-side converter control unit (frame R8)

**WARNING!** Obey the 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 *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet door and swing-out frame or remove the shroud if there is no swing-out frame. The control unit is located behind swing-out frame or shroud.



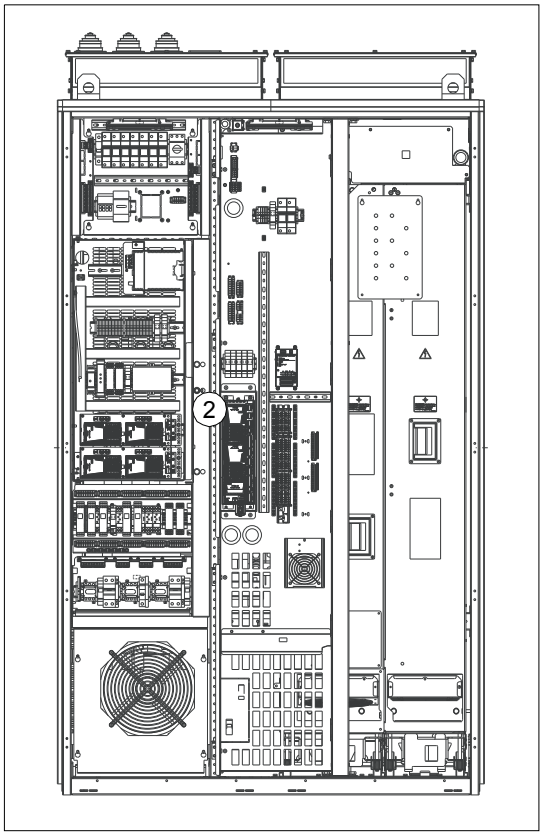
3. Undo the memory unit mounting screw and take the memory unit out. Replace the unit in reverse order. **Note**: There is a spare screw next to the memory unit slot.



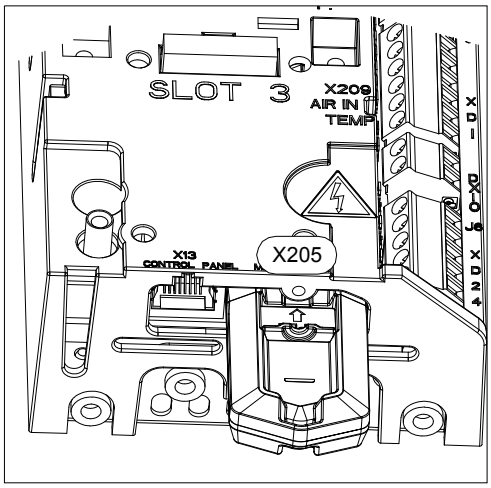
## Replacing the memory unit of the motor-side converter control unit (frame R11)

**WARNING!** Obey the 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 *Electrical safety precautions* on page *19* before you start the work.
2. Open the cabinet doors. The control unit is located on the module-side swing-out frame. For the location, see also *Cabinet layout*.



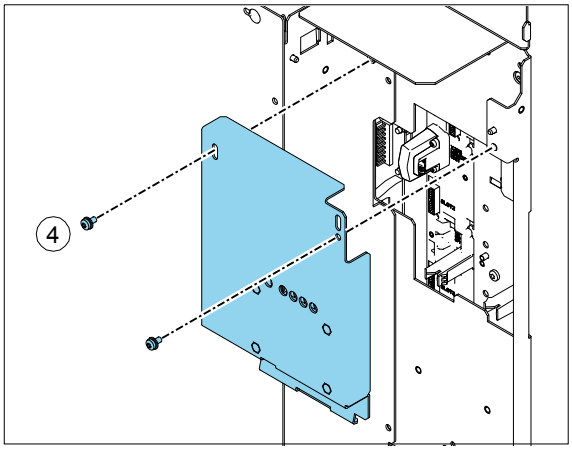
3. Remove the mounting screw.
4. Pull the memory unit out.
5. Install the new memory unit in reverse order. **Note**: There is a spare screw next to the memory unit slot.

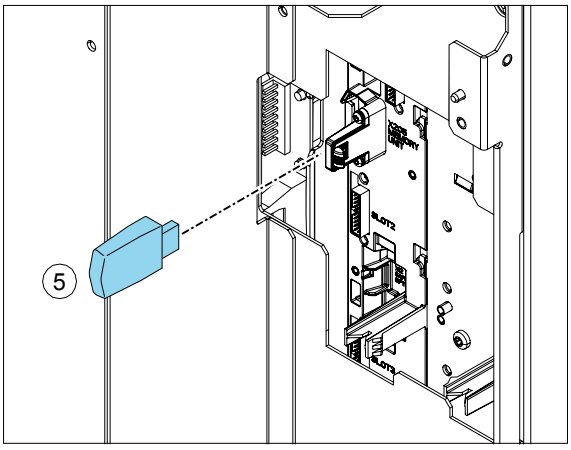



## Replacing the memory unit of the line-side converter control unit (frame R11)

**WARNING!** Obey the 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 *Electrical safety precautions* on page *19* before you start the work.
2. To remove the marine supports in drives with option +C121, see *Replacing the drive and LCL filter modules (frame R11)*.
3. To open the module section swing-out frame, undo the M10 bolts from top and bottom (4 pcs). See *Replacing the drive and LCL filter modules (frame R11)*.
4. Remove the cover on the memory unit.
5. Pull the memory unit out.
6. Insert the new memory unit in reverse order.



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# Technical data

## Contents of this chapter

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

## Marine type-approved drives (option +C132)

See *ACS880 +C132 marine type-approved cabinet-built drives supplement* (3AXD50000039629 [English]) for the ratings, marine-specific data and reference to valid marine type approvals.

## Ratings

The nominal ratings for the drives with 50 Hz and 60 Hz supply are given below. The symbols are described in section *Definitions* on page *213*.

### IEC ratings

| Drive type ACS880-17- | Frame size | Input current | Nominal ratings | | | | | Output ratings | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Light-overload use | | Heavy-duty use | |
| | | $I_1$ | $I_2$ | $I_{max}$ | $P_N$ | $S_N$ | | $I_{Ld}$ | $P_{Ld}$ | $I_{Hd}$ | $P_{Hd}$ |
| | | A | A | A | kW | kVA | | A | kW | A | kW |
| $U_N$ = 400 V | | | | | | | | | | | |
| 0105A-3 | R8 | 88 | 105 | 148 | 55 | 73 | | 100 | 55 | 87 | 45 |
| 0145A-3 | R8 | 120 | 145 | 178 | 75 | 100 | | 138 | 75 | 105 | 55 |
| 0169A-3 | R8 | 144 | 169 | 247 | 90 | 117 | | 161 | 90 | 145 | 75 |
| 0206A-3 | R8 | 176 | 206 | 287 | 110 | 143 | | 196 | 110 | 169 | 90 |

| Drive type ACS880-17- | Frame size | Input current | Nominal ratings | | | | Output ratings | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Light-overload use | | Heavy-duty use | |
| | | $I_1$ | $I_2$ | $I_{max}$ | $P_N$ | $S_N$ | $I_{Ld}$ | $P_{Ld}$ | $I_{Hd}$ | $P_{Hd}$ |
| | | A | A | A | kW | kVA | A | kW | A | kW |
| 0293A-3 | R11 | 257 | 293 | 418 | 160 | 203 | 278 | 160 | 246 | 132 |
| 0363A-3 | R11 | 321 | 363 | 498 | 200 | 251 | 345 | 200 | 293 | 160 |
| 0442A-3 | R11 | 401 | 442 | 545 | 250 | 306 | 420 | 250 | 363 | 200 |
| 0505A-3 | R11 | 401 | 505 | 560 | 250 | 350 | 480 | 250 | 363 | 200 |
| 0585A-3 | R11 | 505 | 585 | 730 | 315 | 405 | 556 | 315 | 442 | 250 |
| 0650A-3 | R11 | 569 | 650 | 730 | 355 | 450 | 618 | 355 | 505 | 250 |
| $U_N$ = 500 V | | | | | | | | | | |
| 0101A-5 | R8 | 71 | 101 | 148 | 55 | 87 | 91 | 55 | 77 | 45 |
| 0124A-5 | R8 | 96 | 124 | 178 | 75 | 107 | 118 | 75 | 96 | 55 |
| 0156A-5 | R8 | 115 | 156 | 247 | 90 | 135 | 148 | 90 | 124 | 75 |
| 0180A-5 | R8 | 141 | 180 | 287 | 110 | 156 | 171 | 110 | 156 | 90 |
| 0260A-5 | R11 | 205 | 260 | 418 | 160 | 225 | 247 | 160 | 240 | 132 |
| 0361A-5 | R11 | 257 | 361 | 542 | 200 | 313 | 343 | 200 | 260 | 160 |
| 0414A-5 | R11 | 321 | 414 | 542 | 250 | 359 | 393 | 250 | 361 | 200 |
| 0460A-5 | R11 | 404 | 460 | 560 | 315 | 398 | 450 | 315 | 414 | 250 |
| 0503A-5 | R11 | 455 | 503 | 560 | 355 | 436 | 492 | 355 | 460 | 315 |
| $U_N$ = 690 V | | | | | | | | | | |
| 0174A-7 | R11 | 149 | 174 | 274 | 160 | 208 | 165 | 160 | 142 | 132 |
| 0210A-7 | R11 | 186 | 210 | 384 | 200 | 251 | 200 | 200 | 174 | 160 |
| 0271A-7 | R11 | 232 | 271 | 411 | 250 | 324 | 257 | 250 | 210 | 200 |
| 0330A-7 | R11 | 293 | 330 | 480 | 315 | 394 | 320 | 315 | 271 | 250 |
| 0370A-7 | R11 | 330 | 370 | 520 | 355 | 442 | 360 | 355 | 330 | 315 |
| 0430A-7 | R11 | 375 | 430 | 520 | 400 | 514 | 420 | 400 | 370 | 355 |

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## UL (NEC) ratings

| Drive type ACS880-17- | Frame size | Input current | Max. current | App. power | Output ratings | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Light-overload use | | Heavy-duty use | |
| | | $I_1$ | $I_{max}$ | $S_N$ | $I_{Ld}$ | $P_{Ld}$ | $I_{Hd}$ | $P_{Hd}$ |
| | | A | A | kVA | A | hp | A | hp |
| $U_N$ = 480 V | | | | | | | | |
| 0101A-5 | R8 | 74 | 148 | 87 | 96 | 75 | 77 | 60 |
| 0124A-5 | R8 | 100 | 178 | 107 | 124 | 100 | 96 | 75 |
| 0156A-5 | R8 | 120 | 247 | 135 | 156 | 125 | 124 | 100 |
| 0180A-5 | R8 | 147 | 287 | 156 | 180 | 150 | 156 | 125 |
| 0260A-5 | R11 | 205 | 418 | 225 | 260 | 200 | 240 | 200 |
| 0302A-5 | R11 | 239 | 498 | 262 | 302 | 250 | 260 | 200 |
| 0361A-5 | R11 | 257 | 542 | 313 | 361 | 300 | 302 | 250 |
| 0414A-5 | R11 | 321 | 542 | 359 | 414 | 350 | 361 | 300 |
| 0460A-5 | R11 | 404 | 560 | 398 | 430 | 350 | 414 | 350 |
| 0503A-5 | R11 | 455 | 560 | 436 | 483 | 400 | 483 | 400 |

| Drive type ACS880-17- | Frame size | Input current | Max. current | App. power | Output ratings | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Light-overload use | | Heavy-duty use | |
| | | $I_1$ | $I_{max}$ | $S_N$ | $I_{Ld}$ | $P_{Ld}$ | $I_{Hd}$ | $P_{Hd}$ |
| | | A | A | kVA | A | hp | A | hp |
| $U_N$ = 600 V | | | | | | | | |
| 0174A-7 | R11 | 146 | 274 | 208 | 168 | 175 | 144 | 150 |
| 0210A-7 | R11 | 166 | 384 | 251 | 192 | 200 | 168 | 175 |
| 0271A-7 | R11 | 208 | 411 | 324 | 242 | 250 | 192 | 200 |
| 0330A-7 | R11 | 250 | 480 | 394 | 289 | 300 | 242 | 250 |
| 0370A-7 | R11 | 291 | 520 | 442 | 336 | 350 | 289 | 300 |
| 0430A-7 | R11 | 375 | 520 | 514 | 412 | 450 | 336 | 350 |

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## Definitions

$I_1$ Nominal rms input current at 40 °C (104 °F)

$I_2$ Continuous rms output current. No overload capability at 40 °C (104 °F)

$I_{max}$ Maximum output current. Available for 10 seconds at start, then as long as allowed by drive temperature.

$P_N$ Typical motor power in no-overload use

$S_N$ Apparent power in no-overload use

$I_{Ld}$ Continuous rms output current allowing 10% overload for 1 minute every 5 minutes.
[1] No overload

$P_{Ld}$ Typical motor power in light-overload use

$I_{Hd}$ Continuous rms output current allowing 50% overload for 1 minute every 5 minutes.

$P_{Hd}$ Typical motor power in heavy-duty use

**Note 1:** The ratings apply at an ambient temperature of 40 °C (104 °F).

**Note 2:** 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.

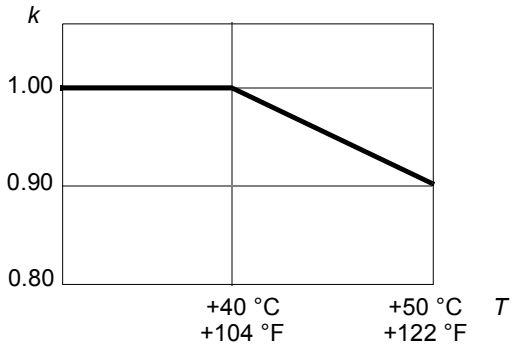
The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.

## Derating

### Ambient temperature derating

In the temperature range +40…50 °C (+104…122 °F), the rated output current is derated by 1% for every added 1 °C (1.8 °F).

To calculate the output current, multiply the current in the ratings table by the derating factor *(k)*:



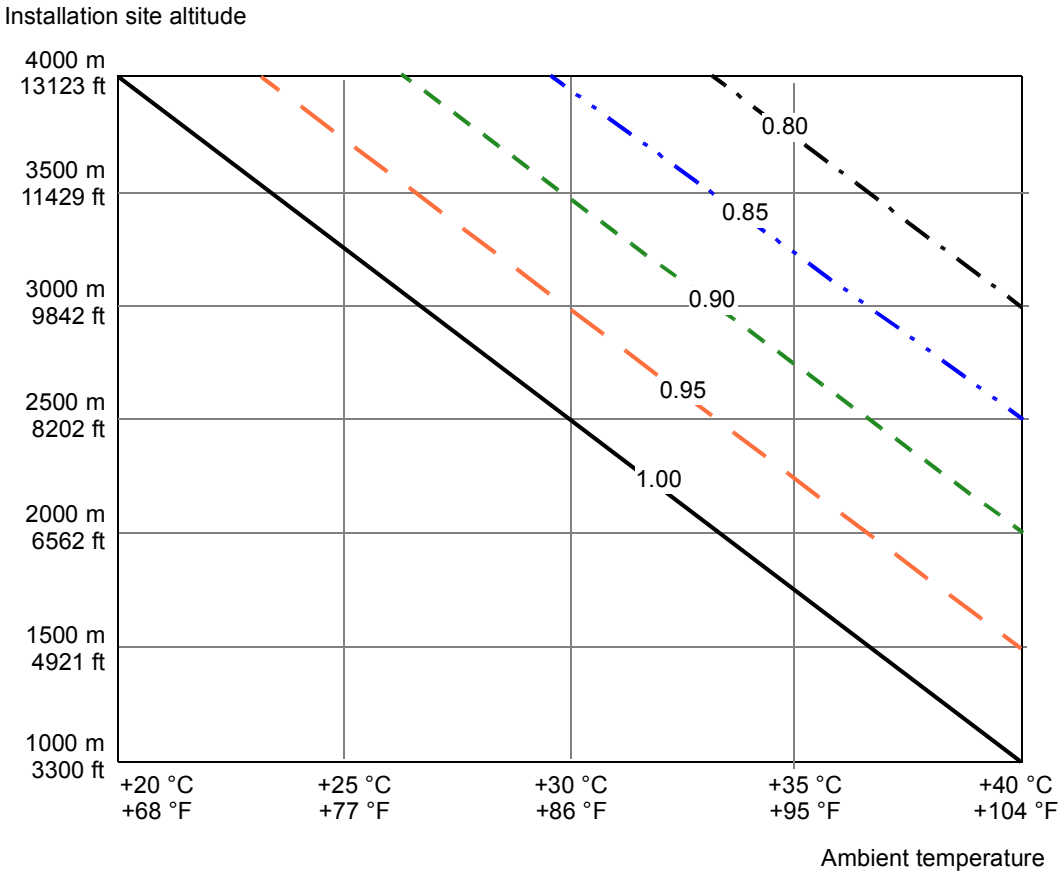

For example:

| Temperature | Derated current | | |
|---|---|---|---|
| 40 ºC (104 ºF) | $I_2$ | $I_{Ld}$ | $I_{Hd}$ |
| 45 ºC (113 ºF) | 0.95 · $I_2$ | 0.95 · $I_{Ld}$ | 0.95 · $I_d$ |
| 50 ºC (122 ºF) | 0.90 · $I_2$ | 0.90 · $I_{Ld}$ | 0.90 · $I_{Hd}$ |

### Altitude derating

At altitudes from 1000 to 4000 m (3281 to 13123 ft) above sea level, the output current 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.




| | |
|---|---|
| | Derating factor 1.00 |
| | Derating factor 0.95 |
| | Derating factor 0.9 |
| | Derating factor 0.85 |
| | Derating factor 0.80 |

### Deratings for special settings in the drive control program

Enabling special settings in the motor-side converter control program can require output current derating.

#### Ex motor, sine filter, low noise

- 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 option +E206 is selected 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**.

For non-ABB Ex motors, contact ABB.

**Note**: If Ex motors are used together with sine filters, EX motor in Parameter **95.15 Special HW settings** is disabled and ABB Sine filter in Parameter **95.15 Special HW settings** is enabled. Obey the instructions of the motor manufacturer.

| Drive type ACS880-17- | Output ratings for special settings | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ex motor (ABB Ex motor) | | | | ABB sine filter | | | | Low noise mode | | | |
| | Nominal use | | Light-duty use | Heavy-duty use | Nominal use | | Light-duty use | Heavy-duty use | Nominal use | | Light-duty use | Heavy-duty use |
| | $I_N$ | $P_N$ | $I_{Ld}$ | $I_{Hd}$ | $I_N$ | $P_N$ | $I_{Ld}$ | $I_{Hd}$ | $I_N$ | $P_N$ | $I_{Ld}$ | $I_{Hd}$ |
| | A | kW | A | A | A | kW | A | A | A | kW | A | A |
| $U_N$ = 400 V | | | | | | | | | | | | |
| 0105A-3 | 105 | 55 | 100 | 105 | 105 | 55 | 100 | 87 | 105 | | 100 | 87 |
| 0145A-3 | 145 | 75 | 138 | 145 | 145 | 75 | 138 | 105 | 145 | | 138 | 105 |
| 0169A-3 | 169 | 90 | 161 | 169 | 169 | 90 | 161 | 145 | 169 | | 161 | 145 |
| 0206A-3 | 206 | 110 | 196 | 196 | 206 | 110 | 196 | 169 | 206 | | 196 | 169 |
| 0293A-3 | 234 | 132 | 222 | 234 | 264 | 160 | 251 | 221 | 217 | 132 | 204 | 180 |
| 0363A-3 | 278 | 160 | 264 | 278 | 327 | 200 | 310 | 264 | 258 | 160 | 243 | 215 |
| 0442A-3 | 345 | 200 | 328 | 345 | 398 | 250 | 378 | 327 | 320 | 200 | 301 | 256 |
| 0505A-3 | 420 | 250 | 399 | 345 | 455 | 250 | 432 | 327 | 390 | 250 | 367 | 317 |
| 0585A-3 | 480 | 315 | 456 | 420 | 527 | 315 | 500 | 398 | 445 | 250 | 419 | 317 |
| 0650A-3 | 556 | 315 | 528 | 480 | 585 | 355 | 556 | 455 | 516 | 315 | 485 | 386 |
| $U_N$= 500 V | | | | | | | | | | | | |
| 0101A-5 | 101 | 45 | 91 | 45 | 101 | 45 | 91 | 45 | 101 | | 91 | 77 |
| 0124A-5 | 124 | 55 | 118 | 55 | 124 | 55 | 118 | 55 | 124 | | 118 | 96 |
| 0156A-5 | 156 | 75 | 148 | 75 | 156 | 75 | 148 | 75 | 156 | | 148 | 124 |
| 0180A-5 | 180 | 90 | 171 | 90 | 180 | 90 | 171 | 90 | 180 | | 171 | 156 |
| 0260A-5 | 228 | 132 | 217 | 171 | 216 | 132 | 205 | 162 | 212 | 132 | 199 | 157 |
| 0302A-5 | 247 | 160 | 235 | 228 | 234 | 160 | 222 | 216 | 229 | 160 | 216 | 210 |
| 0361A-5 | 287 | 250 (hp) | 287 | 247 | 272 | 250 (hp) | 272 | 234 | 266 | 250 (hp) | 264 | 227 |
| 0414A-5 | 343 | 200 | 326 | 247 | 325 | 200 | 309 | 234 | 318 | 200 | 300 | 227 |
| 0460A-5 | 393 | 250 | 373 | 343 | 373 | 250 | 354 | 325 | 365 | 250 | 343 | 315 |
| 0503A-5 | 437 | 315 | 428 | 393 | 414 | 315 | 405 | 373 | 406 | 250 | 393 | 362 |
| $U_N$= 690 V | | | | | | | | | | | | |
| 0174A-7 | 125 | 132 | 119 | 105 | 128 | 132 | 122 | 107 | 66 | 75 | 63 | 55 |
| 0210A-7 | 153 | 160 | 145 | 125 | 157 | 160 | 149 | 128 | 81 | 90 | 77 | 66 |
| 0271A-7 | 185 | 200 | 176 | 153 | 189 | 200 | 180 | 157 | 98 | 110 | 93 | 81 |
| 0330A-7 | 238 | 250 | 226 | 185 | 244 | 250 | 231 | 189 | 126 | 132 | 119 | 98 |
| 0370A-7 | 290 | 315 | 282 | 238 | 297 | 315 | 288 | 244 | 154 | 160 | 149 | 126 |
| 0430A-7 | 326 | 355 | 317 | 290 | 333 | 355 | 324 | 297 | 172 | 200 | 167 | 153 |

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| | |
|---|---|
| $U_N$ | Nominal voltage of the drive |
| $I_N$ | Continuous rms output current. No overload capability at 40 °C (104 °F) |
| $P_N$ | Typical motor power in no-overload use. |
| $I_{Ld}$ | Continuous rms output current allowing 10% overload for 1 minute every 5 minutes |
| $I_{Hd}$ | Continuous rms output current allowing 50% overload for 1 minute every 5 minutes |
| The ratings apply at an ambient temperature of 40 °C (104 °F). | |

### High speed mode

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

This table gives the drive module ratings for 120 Hz output frequency and the maximum output frequency for 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.

| Drive type ACS880-17- | Deratings with selection High speed mode of parameter 95.15 Special HW settings | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 120 Hz output frequency (no derating) | | | | Maximum output frequency 500 Hz | | | |
| | Nominal use | | Light-duty use | Heavy-duty use | Nominal use | | Light-duty use | Heavy-duty use |
| | $I_N$ | $P_N$ | $I_{Ld}$ | $I_{Hd}$ | $I_N$ | $P_N$ | $I_{Ld}$ | $I_{Hd}$ |
| | A | kW | A | A | A | kW | A | A |
| $U_N$ = 400 V | | | | | | | | |
| 0105A-3 | 105 | 55 | 100 | 87 | 105 | | 100 | 87 |
| 0145A-3 | 145 | 75 | 138 | 105 | 145 | | 138 | 105 |
| 0169A-3 | 169 | 90 | 161 | 145 | 156 | | 148 | 122 |
| 0206A-3 | 206 | 110 | 196 | 169 | 192 | | 180 | 155 |
| 0293A-3 | 246 | 132 | 234 | 206 | 201 | 110 | 193 | 170 |
| 0363A-3 | 293 | 160 | 278 | 246 | 240 | 132 | 229 | 203 |
| 0442A-3 | 363 | 200 | 345 | 293 | 297 | 200 | 284 | 241 |
| 0505A-3 | 442 | 250 | 420 | 363 | 362 | 250 | 346 | 299 |
| 0585A-3 | 505 | 250 | 480 | 363 | 413 | 250 | 395 | 299 |
| 0650A-3 | 585 | 315 | 556 | 442 | 479 | 315 | 458 | 364 |
| $U_N$= 500 V | | | | | | | | |
| 0101A-5 | 101 | 55 | 91 | 77 | 101 | | 91 | 77 |
| 0124A-5 | 124 | 75 | 118 | 96 | 124 | | 118 | 96 |
| 0156A-5 | 156 | 90 | 148 | 124 | 144 | | 136 | 87 |
| 0180A-5 | 180 | 110 | 171 | 156 | 169 | | 160 | 147 |
| 0260A-5 | 240 | 132 | 228 | 180 | 196 | 132 | 188 | 148 |
| 0302A-5 | 260 | 160 | 247 | 240 | 213 | 160 | 203 | 198 |
| 0361A-5 | 302 | 250 (hp) | 302 | 260 | 247 | 200 (hp) | 249 | 214 |
| 0414A-5 | 361 | 200 | 343 | 260 | 295 | 250 | 283 | 214 |
| 0460A-5 | 414 | 250 | 393 | 361 | 339 | 250 | 324 | 297 |
| 0503A-5 | 460 | 315 | 450 | 414 | 376 | 315 | 371 | 341 |
| $U_N$= 690 V | | | | | | | | |
| 0174A-7 | 142 | 132 | 135 | 119 | 82 | 75 | 78 | 68 |
| 0210A-7 | 174 | 160 | 165 | 142 | 100 | 110 | 95 | 82 |
| 0271A-7 | 210 | 200 | 200 | 174 | 121 | 132 | 115 | 100 |
| 0330A-7 | 271 | 250 | 257 | 210 | 156 | 160 | 148 | 121 |
| 0370A-7 | 330 | 315 | 320 | 271 | 190 | 200 | 184 | 156 |

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| | |
|---|---|
| *f* | Output frequency |

| | |
|---|---|
| $f_{max}$ | Maximum output frequency with High speed mode |
| $U_N$ | Nominal voltage of the drive |
| $I_N$ | Continuous rms output current. No overload capability at 40 °C (104 °F) |
| $P_N$ | Typical motor power in no-overload use. |
| $I_{Ld}$ | Continuous rms output current allowing 10% overload for 1 minute every 5 minutes |
| $P_{Ld}$ | Typical motor power for light-overload use. |
| $I_{Hd}$ | Continuous rms output current allowing 50% overload for 1 minute every 5 minutes |
| The ratings apply at an ambient temperature of 40 °C (104 °F). | |

# Fuses (IEC)

The drive is equipped with aR fuses listed below as standard.

| Drive type ACS880-17- | Input current (A) | Ultrarapid (aR) fuses (one fuse per phase) | | | | | |
|---|---|---|---|---|---|---|---|
| | | A | $A^2s$ | V | Manufacturer | Type | Size |
| **$U_N$ = 400 V** | | | | | | | |
| 0105A-3 | 88 | 160 | 8250 | 690 | Bussmann | 170M3814D | 1 |
| 0145A-3 | 120 | 250 | 31000 | 690 | Bussmann | 170M3816D | 1 |
| 0169A-3 | 144 | 250 | 31000 | 690 | Bussmann | 170M3816D | 1 |
| 0206A-3 | 176 | 315 | 52000 | 690 | Bussmann | 170M3817D | 1 |
| 0293A-3 | 257 | 500 | 145000 | 690 | Bussmann | 170M5410 | 2 |
| 0363A-3 | 321 | 630 | 210000 | 690 | Bussmann | 170M6410 | 3 |
| 0442A-3 | 401 | 700 | 300000 | 690 | Bussmann | 170M6411 | 3 |
| 0505A-3 | 401 | 800 | 465000 | 690 | Bussmann | 170M6412 | 3 |
| 0585A-3 | 505 | 900 | 670000 | 690 | Bussmann | 170M6413 | 3 |
| 0650A-3 | 569 | 1000 | 945000 | 690 | Bussmann | 170M6414 | 3 |
| **$U_N$ = 500 V** | | | | | | | |
| 0101A-5 | 71 | 160 | 8250 | 690 | Bussmann | 170M3814D | 1 |
| 0124A-5 | 96 | 250 | 31000 | 690 | Bussmann | 170M3816D | 1 |
| 0156A-5 | 115 | 250 | 31000 | 690 | Bussmann | 170M3816D | 1 |
| 0180A-5 | 141 | 315 | 52000 | 690 | Bussmann | 170M3817D | 1 |
| 0260A-5 | 205 | 400 | 74000 | 690 | Bussmann | 170M5408 | 2 |
| 0361A-5 | 257 | 630 | 210000 | 690 | Bussmann | 170M6410 | 3 |
| 0414A-5 | 321 | 700 | 300000 | 690 | Bussmann | 170M6411 | 3 |
| 0460A-5 | 404 | 700 | 300000 | 690 | Bussmann | 170M6411 | 3 |
| 0503A-5 | 455 | 800 | 465000 | 690 | Bussmann | 170M6412 | 3 |
| **$U_N$ = 690 V** | | | | | | | |
| 0174A-7 | 149 | 400 | 74000 | 690 | Bussmann | 170M5408 | 2 |
| 0210A-7 | 186 | 400 | 74000 | 690 | Bussmann | 170M5408 | 2 |
| 0271A-7 | 232 | 500 | 105000 | 690 | Bussmann | 170M5410 | 2 |
| 0330A-7 | 293 | 630 | 210000 | 690 | Bussmann | 170M6410 | 3 |
| 0370A-7 | 330 | 630 | 210000 | 690 | Bussmann | 170M6410 | 3 |
| 0430A-7 | 375 | 700 | 300000 | 690 | Bussmann | 170M6411 | 3 |

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**Note 1:** See also *Implementing thermal overload and short-circuit protection* on page *93*.

**Note 2:** Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.

**Note 3:** Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

# Fuses (UL)

The drive with options +C129 and +C134 is equipped for branch circuit protection per NEC with standard fuses listed below. The fuses restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive. **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.

| Drive type ACS880-17- | Input current A | Fuse (one fuse per phase) | | | | |
|---|---|---|---|---|---|---|
| | | A | V | Manufacturer | Type | UL class / Size |
| $U_N$ = 400 V | | | | | | |
| 0105A-3 | 88 | 250 | 600 | Bussmann | DFJ-250 | Class J |
| 0145A-3 | 120 | 250 | 600 | Bussmann | DFJ-250 | Class J |
| 0169A-3 | 144 | 250 | 600 | Bussmann | DFJ-250 | Class J |
| 0206A-3 | 176 | 300 | 600 | Bussmann | DFJ-300 | Class J |
| 0293A-3 | 257 | 500 | 690 | Bussmann | 170M5410 | 2 |
| 0363A-3 | 321 | 630 | 690 | Bussmann | 170M6410 | 3 |
| 0442A-3 | 401 | 700 | 690 | Bussmann | 170M6411 | 3 |
| 0505A-3 | 401 | 800 | 690 | Bussmann | 170M6412 | 3 |
| 0585A-3 | 505 | 900 | 690 | Bussmann | 170M6413 | 3 |
| 0650A-3 | 569 | 1000 | 690 | Bussmann | 170M6414 | 3 |
| $U_N$ = 480 V | | | | | | |
| 0101A-5 | 74 | 250 | 600 | Bussmann | DFJ-250 | Class J |
| 0124A-5 | 100 | 250 | 600 | Bussmann | DFJ-250 | Class J |
| 0156A-5 | 120 | 250 | 600 | Bussmann | DFJ-250 | Class J |
| 0180A-5 | 147 | 300 | 600 | Bussmann | DFJ-300 | Class J |
| 0260A-5 | 205 | 400 | 600 | Bussmann | 170M5408 | 2 |
| 0302A-5 | 239 | 500 | 690 | Bussmann | 170M5410 | 2 |
| 0361A-5 | 257 | 630 | 690 | Bussmann | 170M6410 | 3 |
| 0414A-5 | 321 | 700 | 690 | Bussmann | 170M6411 | 3 |
| 0460A-5 | 404 | 700 | 690 | Bussmann | 170M6411 | 3 |
| 0503A-5 | 455 | 800 | 690 | Bussmann | 170M6412 | 3 |
| $U_N$ = 600 V | | | | | | |
| 0174A-7* | 146 | 315 | 600 | Bussmann | 170M4410 | 1 |
| 0210A-7 | 166 | 400 | 690 | Bussmann | 170M5408 | 2 |
| 0271A-7 | 208 | 500 | 690 | Bussmann | 170M5410 | 2 |
| 0330A-7 | 250 | 630 | 690 | Bussmann | 170M6410 | 3 |
| 0370A-7* | 291 | 700 | 690 | Bussmann | 170M6411 | 3 |
| 0430A-7 | 375 | 700 | 690 | Bussmann | 170M6411 | 3 |

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**Note 1:** See also *Implementing thermal overload and short-circuit protection* on page *93*.
**Note 2:** Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.

**Note 3:** Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

# Dimensions and weights

| Frame size | Height [1] | | | | Width [2] | | Depth [3] | | | | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IP22/42 | | IP54 | | | | IP22/42 | | IP54 | | | |
| | mm | in. | mm | in. | mm | in. | mm | in. | mm | in. | kg | lb |
| Standard cabinet | | | | | | | | | | | | |
| R8 | 2145 | 84.45 | 2315 | 91.14 | 430 | 16.93 | 685 | 26.97 | 702 | 27.64 | 320 | 705 |
| R11 | 2145 | 84.45 | 2315 | 91.14 | 1230 | 48.43 | 710 | 27.95 | 710 | 27.95 | 750 | 1653 |

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1. For marine construction (option +C121) extra height is 10 mm (0.39 in.) due to the attaching bars at the bottom of the cabinet.
2. Extra width with EMC filter (option +E202): 200 mm (7.87 in.) for frame R8 and 400 mm (15.75 in.) for frame R11.
3. For drives with marine attaching bars (option +C121): Depth is 757 mm (29.80 in).

## Dimensions and weights of sine filter cabinet (option +E206)

| Frame size | Height | | | | Width | | Depth | | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|
| | IP22/42 | | IP54 | | | | | | | |
| | mm | in. | mm | in. | mm | in. | mm | in. | kg | lb |
| $U_N$ = 400 V | | | | | | | | | | |
| 0105A-3 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 330 | 728 |
| 0145A-3 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 330 | 728 |
| 0169A-3 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 330 | 728 |
| 0206A-3 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 330 | 728 |
| 0293A-3 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 430 | 948 |
| 0363A-3 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 430 | 948 |
| 0442A-3 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 430 | 948 |
| 0505A-3 | 2145 | 84.45 | 2315 | 91.14 | 1000 | 39.37 | 646 | 25.43 | 840 | 1852 |
| 0585A-3 | 2145 | 84.45 | 2315 | 91.14 | 1000 | 39.37 | 646 | 25.43 | 840 | 1852 |
| 0650A-3 | 2145 | 84.45 | 2315 | 91.14 | 1000 | 39.37 | 646 | 25.43 | 840 | 1852 |
| $U_N$ = 500 V | | | | | | | | | | |
| 0101A-5 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 330 | 728 |
| 0124A-5 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 330 | 728 |
| 0156A-5 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 330 | 728 |
| 0180A-5 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 330 | 728 |
| 0260A-5 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 340 | 750 |
| 0302A-5 [1] | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 340 | 750 |
| 0361A-5 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 430 | 948 |
| 0414A-5 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 430 | 948 |
| 0460A-5 | 2145 | 84.45 | 2315 | 91.14 | 1000 | 39.37 | 646 | 25.43 | 840 | 1852 |
| 0503A-5 | 2145 | 84.45 | 2315 | 91.14 | 1000 | 39.37 | 646 | 25.43 | 840 | 1852 |
| $U_N$ = 690 V | | | | | | | | | | |
| 0174A-7 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 410 | 904 |
| 0210A-7 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 410 | 904 |
| 0271A-7 | 2145 | 84.45 | 2315 | 91.14 | 600 | 23.62 | 646 | 25.43 | 410 | 904 |
| 0330A-7 | 2145 | 84.45 | 2315 | 91.14 | 400 | 15.75 | 646 | 25.43 | 340 | 750 |
| 0370A-7 | 2145 | 84.45 | 2315 | 91.14 | 400 | 15.75 | 646 | 25.43 | 340 | 750 |

| Frame size | Height | | | | Width | | Depth | | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|
| | IP22/42 | | IP54 | | | | | | | |
| | mm | in. | mm | in. | mm | in. | mm | in. | kg | lb |
| 0430A-7 | 2145 | 84.45 | 2315 | 91.14 | 400 | 15.75 | 646 | 25.43 | 340 | 750 |

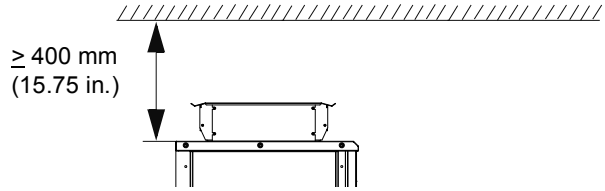
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**1) US type**

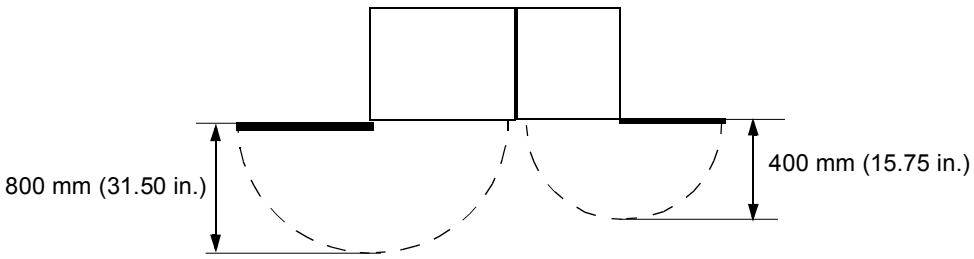
# Free space requirements

| Front | | Side | | Above* | |
|---|---|---|---|---|---|
| mm | in. | mm | in. | mm | in. |
| 150 | 5.91 | - | - | 400 | 15.75 |

* Measured from the base plate of the cabinet top.




**Door opening:**



# Cooling data, noise

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

| Drive type ACS880-17- | Air flow | | | | Heat dissipation | | Noise | |
|---|---|---|---|---|---|---|---|---|
| | - | | +E206 | | - | +E206 [1] | - | +E206 [2] |
| | $m^3/h$ | $ft^3/min$ | $m^3/h$ | $ft^3/min$ | kW | kW | dB(A) | dB(A) |
| $U_N$ = 400 V | | | | | | | | |
| 0105A-3 | 700 | 412 | * | * | 2.22 | 0.6 | 70 | 70 |
| 0145A-3 | 700 | 412 | * | * | 3.33 | 0.55 | 70 | 70 |
| 0169A-3 | 700 | 412 | * | * | 3.57 | 0.55 | 70 | 70 |
| 0206A-3 | 805 | 474 | * | * | 4.44 | 0.9 | 70 | 70 |
| 0293A-3 | 2100 | 1279 | * | * | 6.88 | 1.57 | 77 | 77 |
| 0363A-3 | 2100 | 1279 | * | * | 8.52 | 1.57 | 77 | 77 |
| 0442A-3 | 2100 | 1279 | * | * | 10.52 | 1.7 | 77 | 77 |
| 0505A-3 | 2100 | 1279 | 2000 | 1177 | 10.54 | 3.0 | 77 | 80 |
| 0585A-3 | 2100 | 1279 | 2000 | 1177 | 13.16 | 3.4 | 77 | 80 |
| 0650A-3 | 2100 | 1279 | 2000 | 1177 | 14.78 | 3.8 | 77 | 80 |
| $U_N$ = 500 V | | | | | | | | |
| 0101A-5 | 700 | 412 | * | * | 2.32 | 0.63 | 70 | 70 |
| 0124A-5 | 700 | 412 | * | * | 3.14 | 0.63 | 70 | 70 |
| 0156A-5 | 700 | 412 | * | * | 3.54 | 0.55 | 70 | 70 |
| 0180A-5 | 805 | 474 | * | * | 4.27 | 0.55 | 70 | 70 |
| 0260A-5 | 2100 | 1279 | * | * | 6.86 | 0.9 | 77 | 77 |
| 0302A-5 | 2100 | 1279 | - | - | - | - | 77 | 77 |
| 0361A-5 | 2100 | 1279 | * | * | 8.50 | 1.57 | 77 | 77 |
| 0414A-5 | 2100 | 1279 | * | * | 10.51 | 1.57 | 77 | 77 |
| 0460A-5 | 2100 | 1279 | 2000 | 1177 | 13.15 | 3.3 | 77 | 80 |
| 0503A-5 | 2100 | 1279 | 2000 | 1177 | 14.76 | 3.6 | 77 | 80 |
| $U_N$ = 690 V | | | | | | | | |
| 0174A-7 | 2100 | 1279 | * | * | 6.86 | 0.93 | 77 | 77 |
| 0210A-7 | 2100 | 1279 | * | * | 8.46 | 0.93 | 77 | 77 |
| 0271A-7 | 2100 | 1279 | * | * | 10.49 | 0.93 | 77 | 77 |
| 0330A-7 | 2100 | 1279 | 700 | 412 | 13.09 | 2.2 | 77 | 80 |
| 0370A-7 | 2100 | 1279 | 700 | 412 | 14.71 | 2.3 | 77 | 80 |
| 0430A-7 | 2100 | 1279 | 700 | 412 | 16.53 | 2.4 | 77 | 80 |

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[1] Additional heat dissipation of sine filter (option +E206)

[2] Noise of the drive + sine filter (option +E206)

* Natural convection

# Sine output filter data

Sine output filters are available as option +E206. The table below shows the types and technical data of the filters and filter cubicles used in the drive.

| Drive type ACS880-17- | Sine filter(s) used | | $I_N$ | Cooling data | |
|---|---|---|---|---|---|
| | Qty | Type | | Heat dissipation | Air flow |
| | | | A | kW | $m^3/h$ ($ft^3/min$) |
| $U_N$ = 400 V | | | | | |
| 0105A-3 | 1 | B84143V0130R230 | 91 | 0.63 | * |
| 0145A-3 | 1 | B84143V0162R229 | 126 | 0.55 | * |
| 0169A-3 | 1 | B84143V0162R229 | 153 | 0.55 | * |
| 0206A-3 | 1 | B84143V0230R229 | 187 | 0.90 | * |
| 0293A-3 | 1 | B84143V0390R229 | 264 | 1.57 | * |
| 0363A-3 | 1 | B84143V0390R229 | 327 | 1.57 | * |
| 0442A-3 | 1 | B84143V0390R229 | 398 | 1.57 | * |
| 0505A-3 | 1 | NSIN0900-6 | 455 | 2.89 | 2000 (1177) |
| 0585A-3 | 1 | NSIN0900-6 | 527 | 3.35 | 2000 (1177) |
| 0650A-3 | 1 | NSIN0900-6 | 585 | 3.73 | 2000 (1177) |
| $U_N$ = 500 V | | | | | |
| 0101A-5 | 1 | B84143V0130R230 | 80 | 0.63 | * |
| 0124A-5 | 1 | B84143V0130R230 | 104 | 0.63 | * |
| 0156A-5 | 1 | B84143V0162R229 | 140 | 0.55 | * |
| 0180A-5 | 1 | B84143V0162R229 | 162 | 0.55 | * |
| 0260A-5 | 1 | B84143V0230R229 | 234 | 0.90 | * |
| 0302A-5 [1)] | 1 | B84143V0390R229 | 272 | 1.57 | * |
| 0361A-5 | 1 | B84143V0390R229 | 325 | 1.57 | * |
| 0414A-5 | 1 | B84143V0390R229 | 373 | 1.57 | * |
| 0460A-5 | 1 | NSIN0900-6 | 414 | 3.16 | 2000 (1177) |
| 0503A-5 | 1 | NSIN0900-6 | 453 | 3.46 | 2000 (1177) |
| $U_N$ = 690 V | | | | | |
| 0174A-7 | 1 | B84143V0207R230 | 157 | 0.93 | * |
| 0210A-7 | 1 | B84143V0207R230 | 189 | 0.93 | * |
| 0271A-7 | 1 | B84143V0207R230 | 244 | 0.93 | * |
| 0330A-7 | 1 | NSIN0485-6 | 297 | 2.0 | 700 (412) |
| 0370A-7 | 1 | NSIN0485-6 | 333 | 2.2 | 700 (412) |
| 0430A-7 | 1 | NSIN0485-6 | 387 | 2.6 | 700 (412) |

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| | |
|---|---|
| 1) | USA only |
| * | Natural convection |
| $I_N$ | Continuous rms output current. No overload capability at 40 °C (104 °F) |

# Terminal and exit data for the power cables

The locations and sizes of exits are shown in the dimension drawings delivered with the drive, and in the dimension drawing examples starting on page *237*.

The location and size of power cable terminals are shown in the drawings starting on page *251*.

## IEC

| Frame size | Number of holes in the entry plate for the power cables. Hole diameter 60 mm. | Terminals L1, L2, L3, U2, V2, W2, UDC+/R+, UDC- and R- | | | Grounding terminals | |
|---|---|---|---|---|---|---|
| | | Max. phase conductor size<br>$mm^2$ | Bolt size | Tightening torque | Bolt size | Tightening torque<br>N·m |
| R8 | 6...12 | 185 | M10 | 20...40 N·m | M12 | 50...75 N·m |
| R11 | 12 | 3×240 or 4×185 | M12 | 50...75 N·m | M12 | 50...75 N·m |

## US

| Frame size | Terminals L1, L2, L3, U2, V2, W2, UDC+/R+, UDC- and R- | | | Grounding terminals | |
|---|---|---|---|---|---|
| | Max. phase conductor size<br>AWG/kcmil | Busbar bolt size – Hole spacing | Tightening torque<br>bf·ft | Bolt size | Tightening torque<br>bf·ft |
| R8 | 350 MCM...1×500 MCM or 4×350 MCM | M12 7/16") × 1 – 1.75” | 15…30 | M10 (3/8”) | 37…55 |
| R11 | 1×500 MCM or 4×350 MCM | M12 (7/16") × 3 – 1.75” | 37…55 | M10 (3/8”) | 37…55 |

# Terminal data for the drive control unit

See chapter *Control unit of frame R11* (page *145*).

# Electrical power network specification

**Voltage ($U_1$)**

ACS880-17-xxxxx-3 drives: 380…415 VAC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage level.
3 ~ 400 V AC.

ACS880-17-xxxxx-5 drives: 380…500 VAC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage levels.
3 ~ 400/480/500 V AC.

ACS880-17-xxxxx-7 drives: 525…690 VAC 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

**Frequency ($f_1$)**

50/60 Hz, Variation ± 5% of nominal frequency

**Imbalance**

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

**Short-circuit withstand strength (IEC 61439-1)**

Maximum allowable prospective short-circuit current is 65 kA when the input cable is protected with gG type fuses (IEC 60269) having maximum operating time of 0.1 seconds and maximum current rating as follows:

- 400 A for frame R8
- 1250 A for frame R11.

**Short-circuit current protection (UL 508C)**

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 the input cable is protected with class T fuses.

**Short-circuit current protection (CSA C22.2 No. 14-13)**

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 the input cable is protected with T class fuses.

**Power factor**

cos $phi_1$ = 1, cos phi (total) = 0.99

**Harmonic distortion**

THD (Total harmonic distortion) current < 0.05 · $I_{1cont.max}$ if supply network voltage is not distorted by other loads and when the drive operates at the nominal load.

$I_{1cont.max}$ is continuous maximum input current of the line-side converter.

The table below shows typical results on indicated networks. The values are measured at the drive's input terminals.

| $R_{sc}$ | THD Voltage [%] | THD Current [%] |
|---|---|---|
| 20 | 3 | 2.5* |
| 100 | 1.9 | 2.5* |

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

$$\sqrt{\sum_{2}^{50}\left(\frac{I_n}{I_N}\right)^2}$$

$I_n$ $n^{th}$ harmonic component

$I_N$ nominal current

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

$R_{sc}$ $I_{sc}/I_N$

$I_{sc}$ short-circuit current at point of common coupling (PCC)

$I_N$ drive nominal current

* Other loads can influence the THD value.

# Motor connection data

| | |
|---|---|
| **Motor types** | Asynchronous AC induction motors, permanent magnet synchronous motors, AC induction servomotors, ABB synchronous reluctance (SynRM) motors |
| **Voltage ($U_2$)** | 0 to $U_1$, 3-phase symmetrical, This is indicated in the type designation label as typical output voltage level as 3 ~ 0…$U_1$, $U_{max}$ at the field weakening point. |
| **Frequency ($f_2$)** | 0…±500 Hz. Operation above 120 Hz can require type-specific derating, see section *High speed mode* (page *217*).<br>For drives with sine filter (option +E206): 120 Hz.<br>For drives with du/dt filter (option +E205): 120 Hz. |
| **Current** | See section *Ratings.* |
| **Switching frequency** | 3 kHz (typically) |
| **Maximum recommended motor cable length** | 500 m (1640 ft).<br>**Note:** Longer cables cause a motor voltage decrease which limits the available motor power. The decrease depends on the motor cable length and characteristics. Contact ABB for more information. Note that a sine filter (optional) at the drive output also causes a voltage decrease.<br>**Note:** With motor cables longer than 100 m (328 ft) the EMC Directive requirements may not be fulfilled. |

# Control unit connection data

See chapter *Control unit of frame R11* (page *145*).

# Efficiency

97% at nominal power level

# Protection classes

| | |
|---|---|
| **Degrees of protection (IEC/EN 60529)** | IP22 (standard), IP42 (option +B054), IP54 (option +B055) |
| **Enclosure types (UL 61800-5-1)** | UL Type 1 (standard), UL Type 1 Filtered (option +B054), UL Type 12 (option +B055). For indoor use only |
| **Overvoltage category (IEC 60664-1)** | III |
| **Protective class (IEC/EN 61800-5-1)** | I |

# Ambient conditions

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

| | **Operation**<br>installed for stationary use | **Storage**<br>in the protective package | **Transportation**<br>in the protective package |
|---|---|---|---|
| **Installation site altitude** | 0 to 2000 m (6561 ft) above sea level. For altitudes over 2000 m, contact ABB.<br>Output derated above 1000 m (3281 ft). See section *Derating*. | - | - |

| | | | |
|---|---|---|---|
| **Air temperature** | 0 … +40 °C (+32 … +104 °F). No condensation allowed.<br>Output derated in the range +40 … +50 °C (+104 … +122 °F). See section *Derating*. | -40 to +70 °C (-40 to +158 °F) | -40 to +70 °C (-40 to +158 °F) |
| **Relative humidity** | Max. 95% | Max. 95% | Max. 95% |
| | No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases. | | |
| **Contamination** | 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 | IEC 60721-3-2 |
| Chemical gases | Class 3C2 | Class 1C2 | Class 2C2 |
| Solid particles | Class 3S2 (3S1 with IP20). No conductive dust allowed. | Class 1S3 (packing must support this, otherwise 1S2) | Class 2S2 |
| **Pollution degree**<br>(IEC/EN 61800-5-1) | Pollution degree 2 | - | - |
| **Vibration** | IEC 61800-5-1<br>IEC 60068-2-6:2007, EN 60068-2-6:2008 Environmental testing Part 2: Tests –Test Fc: Vibration (sinusoidal)<br>10…57 Hz: max. 0.075 mm amplitude<br>57…150 Hz: 1 g | IEC 60721-3-1:2018 Part 3-1:<br>Class 1M12 | IEC 60721-3-2:2018 Part 3-2:<br>Class 2M4 |
| **Shock**<br>IEC 60068-2-27:2008, EN 60068-2-27:2009<br>Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock | Not allowed | With packing max.<br>100 m/s$^2$ (330 ft./s$^2$)<br>11 ms | With packing max.<br>100 m/s$^2$ (330 ft./s$^2$)<br>11 ms |

# Auxiliary circuit power consumption

| | |
|---|---|
| **Cabinet heater and lighting (options +G300 and +G301)** | 150 W |
| **External uninterruptible power supply (option +G307)** | 150 W |
| **Motor heater (option +G313)** | According to heater type |

# Materials

**Cabinet**

Hot-dip zinc coated 1.5 mm thick steel sheet (thickness of coating approximately 100…200 micrometers). Polyester thermosetting powder coating (thickness approximately 80 micrometers) on visible surfaces, color RAL 7035 and RAL 9017.

Plastic parts are made of UV resistant f1 classified plastics.

**Busbars**

Tin-plated copper

**Air filters of IP54 units**

| Inlet (door) | Outlet (roof) |
|---|---|
| Camfil/airComp 300-50<br>288 mm x 521 mm<br>688 mm x 521 mm | Camfil/airTex G150<br>2 pcs: 398 mm x 312 mm |

**Fire safety of materials**

(IEC 60332-1)

Insulating materials and non-metallic items mostly self-extinctive

**Package**

Standard package:

- timber, polyethylene sheet (thickness 0.15 mm), stretch film (thickness 0.023 mm), PP tape, PET strap, sheet metal (steel)
- for land and air transport when planned storage time is less than 2 months or when storage can be arranged in clean and dry conditions less than 6 months
- can be used when products will not be exposed to corrosive atmosphere during transport or storage

Container package:

- timber, VCI sheet film (PE, thickness 0.10 mm), VCI stretch film (PE, thickness 0.04 mm), VCI emitter bags, PP tape, PET strap, sheet metal (steel)
- for sea transport in containers
- recommended for land and air transport when storage time prior to installation exceeds 6 months or storage is arranged in partially weather-protected conditions

Seaworthy package:

- timber, plywood, VCI sheet film (PE, thickness 0.15 mm), VCI stretch film (PE, thickness 0.04 mm), VCI emitter bags, PP tape, PET strap, sheet metal (steel)
- for sea transport with or without containerization
- for long storage periods in environments where roofed and humidity-controlled storage cannot be arranged

Cabinets are attached to the pallet with screws and braced from the top end to the package walls to prevents swaying inside the package. Package elements are attached together with screws. For handling the packages, see section *Moving and unpacking the drive* on page *65*.

**Disposal**

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

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

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

# Applicable standards

| | |
|---|---|
| | The drive complies with the standards below. The compliance with the European Low Voltage Directive is verified according to standard EN 61800-5-1. |
| **European electrical safety requirements product standards** | |
| **EN 61800-5-1:2007** | *Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy* |
| **IEC 60146-1-1:2009**<br>**EN 60146-1-1:2010** | *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements* |
| **IEC 60204-1:2005 +A1:2008** | *Safety of machinery. Electrical equipment of machines. Part 1: General requirements.* |
| **EN 60204-1:2006 +AC:2010** | Provisions for compliance: The final assembler of the machine is responsible for installing emergency-stop device. |
| **IEC 60529:1989**<br>**EN 60529:1991** | *Degrees of protection provided by enclosures (IP code)* |
| **IEC/EN 60664-1:2007** | *Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests* |
| **IEC/EN 61439-1:2011** | *Low-voltage switchgear and control gear assemblies -- Part 1: General rules* |
| **UL 50:2015** | *Enclosures for Electrical Equipment, Non-Environmental Considerations, 13th edition* |
| **UL 508A: 2016** | *UL Standard for Safety, Power Conversion* |
| **UL 508A: 2013** | *UL Standard for Industrial Control Panels, second edition* |
| **EMC performance** | |
| **IEC 61800-3:2004/A1:2011**<br>**EN 61800-3/A1:2012** | *Adjustible speed electrical power drive systems. Part 3: EMC requirements and specific test methods* |

# CE marking

A CE mark is attached to the drive to verify that the drive complies with the provisions of the European Low Voltage and EMC Directives. 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 standard EN 61800-5-1.

## Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004) covers requirements stated for drives. See section *Compliance with EN 61800-3:2004 + A1:2012* below.

## 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.

## EU Declaration of Conformity

# EU Declaration of Conformity

Machinery Directive 2006/42/EC

We
Manufacturer: ABB Oy
Address: Hiomotie 13, 00380 Helsinki, Finland.
Phone: +358 10 22 11
declare under our sole responsibility that the following products:

**Frequency converters** and **frequency converter components**

**ACS880-04, -14, -34** (frames nxR8i)

**ACS880-04XT**

**ACS880-07, -17, -37**

**ACS880-104**

**ACS880 multidrives**

**ACS880-104LC** (frames nxR8i)

**ACS880-07CLC**

identified with serial numbers beginning with 1 or 8

with regard to the safety functions

**Safe torque off**

**Safe motor temperature** with FPTC-01 module (option code +L536)

**Safe stop 1, Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Prevention of unexpected start-up**, with FSO-12 module (option code +Q973)

**Safe stop 1, Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Safe Speed monitor, Safe direction, Prevention of unexpected start-up**, with FSO-21 and FSE-31 modules (option codes +Q972 and +L521)

**ACS880-07, -17, -37, -07CLC and ACS880 multidrives: Prevention of unexpected start-up** (option codes +Q950; +Q957), **Emergency stop** (option codes +Q951; +Q952; +Q963; +Q964; +Q978; +Q979), **Safely-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.



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IMS template code: 3AFE011906, Rev: A

The following harmonized standards have been applied:

| | |
|---|---|
| EN 61800-5-2:2007 | Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional |
| EN 62061:2005 + AC:2010 + A1:2013 + A2:2015 | Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems |
| EN ISO 13849-1:2015 | Safety of machinery – Safety-related parts of control systems. Part 1: General principles for design |
| EN ISO 13849-2:2012 | Safety of machinery – Safety-related parts of the control systems. Part 2: Validation |
| EN 60204-1:2006 + A1:2009 + AC:2010 | Safety of machinery – Electrical equipment of machines – Part 1: General requirements |

The following other standard has been applied:

| | |
|---|---|
| IEC 61508:2010, parts 1-2 | Functional safety of electrical / electronic / programmable electronic safety-related systems |
| IEC 61800-5-2:2016 | Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional |

The products referred in this Declaration of conformity fulfil the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AXD10000497305.

Person authorized to compile the technical file:
Name and address: Vesa Tiihonen, Hiomotie 13, 00380 Helsinki, Finland

Helsinki, 09 May 2018

Manufacturer representative:

Peter Lindgren
Vice President, ABB Oy



3AXD10000105027 Rev. S
IMS template code: 3AFE011906, Rev: A

# Compliance with EN 61800-3:2004 + A1:2012

## Definitions

EMC stands for **E**lectro**m**agnetic **C**ompatibility. 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 option +E202.
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 (328 ft).

---

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

---

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

## Category C3

The drive complies with the standard with the following provisions:

1. Frame R8: The drive is equipped with EMC filter option +E200 or +E201.
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 (328 ft).

---

**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

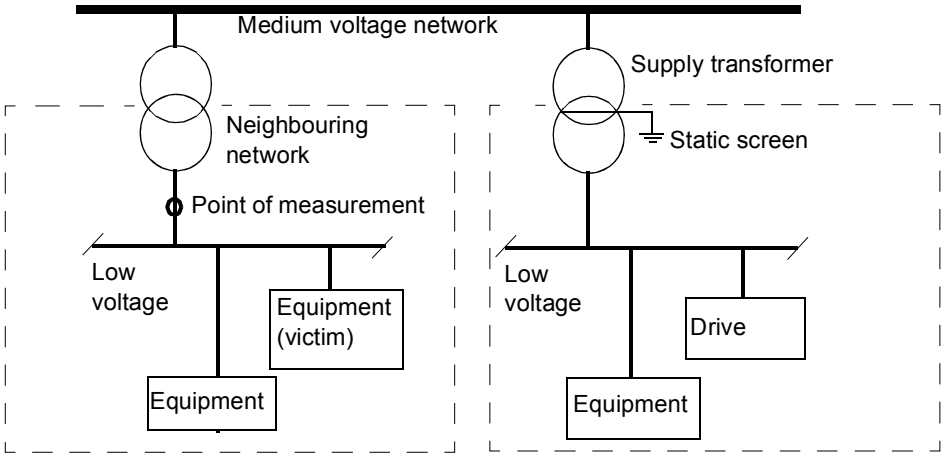
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the drive is used on such a network.

### 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 natural 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

The drive is UL approved. The approval is valid with rated voltages.

### UL checklist

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

- Make sure that the drive type designation label includes the cULus Listed marking.
- **CAUTION - Risk of electric shock**. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.
- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.
- The maximum surrounding air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 50 °C (104 to 122 °F).
- The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 V maximum when the input cable is protected with fuses given on page *225*. The ampere rating is based on tests done according to the appropriate UL standard.

  If the short-circuit tests are done with other fuses than the ones given in the UL fuse table of the manual, give those fuses. See sections *Electrical power network specification / Short-circuit current protection (ANSI/UL 61800-5-1:2015)* and *Short-circuit current protection (CSA C22.2 No 14-13)*.
- The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
- The input cable must be protected with fuses. 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. For suitable circuit breakers, contact your local ABB representative.

  **WARNING!** The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electric shock, current-carrying parts and other components of the controller should be examined and replaced if damaged.
- The drive is equipped with UL classified fuses which provide branch circuit protection in accordance with the National Electrical Code (NEC) and Canadian Electrical Code. The fuses are listed on page *219*.
- The drive provides motor overload protection. For adjustments, see the firmware manual.
- For drive overvoltage category, see page *226*. For pollution degree, see page *226*.

## CSA marking

The drives are CSA marked. The approval is valid with rated voltages.

## 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 + A1:2012*.

## The KC (Korea Certification) marking

Product complies with Korea's product safety requirements for electrical and electronic equipment and components that utilize power from 50…1000 V AC.

## 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 *228*.

## EAC (Eurasian Conformity) marking

The drive has EAC certification. EAC marking is required in Russia, Belarus and Kazakhstan.

## EIP (Electronic Information Products) marking

An EIP mark is attached to the drive to verify that the drive complies with the regulations of the Chinese Administrative Measure on the Control of Pollution Caused by Electronic Information Products.

## Tightening torques

Unless a tightening torque is specified in the text, the following torques can be used.

### Electrical connections

| Size | Torque (N·m) | Note |
|---|---|---|
| M3 | 0.5 | Strength class 4.6...8.8 |
| M4 | 1 | Strength class 4.6...8.8 |
| M5 | 4 | Strength class 8.8 |
| M6 | 9 | Strength class 8.8 |
| M8 | 22 | Strength class 8.8 |
| M10 | 42 | Strength class 8.8 |
| M12 | 70 | Strength class 8.8 |
| M16 | 120 | Strength class 8.8 |

### Mechanical connections

| Size | Max. torque (N·m) | Note |
|---|---|---|
| M5 | 6 | Strength class 8.8 |
| M6 | 10 | Strength class 8.8 |
| M8 | 24 | Strength class 8.8 |

### Insulation supports

| Size | Max. torque (N·m) | Note |
|---|---|---|
| M6 | 5 | Strength class 8.8 |
| M8 | 9 | Strength class 8.8 |
| M10 | 18 | Strength class 8.8 |
| M12 | 31 | Strength class 8.8 |

## Cable lugs

| Size | Max. torque (N·m) | Note |
|---|---|---|
| M8 | 15 | Strength class 8.8 |
| M10 | 32 | Strength class 8.8 |
| M12 | 50 | Strength class 8.8 |

# 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.

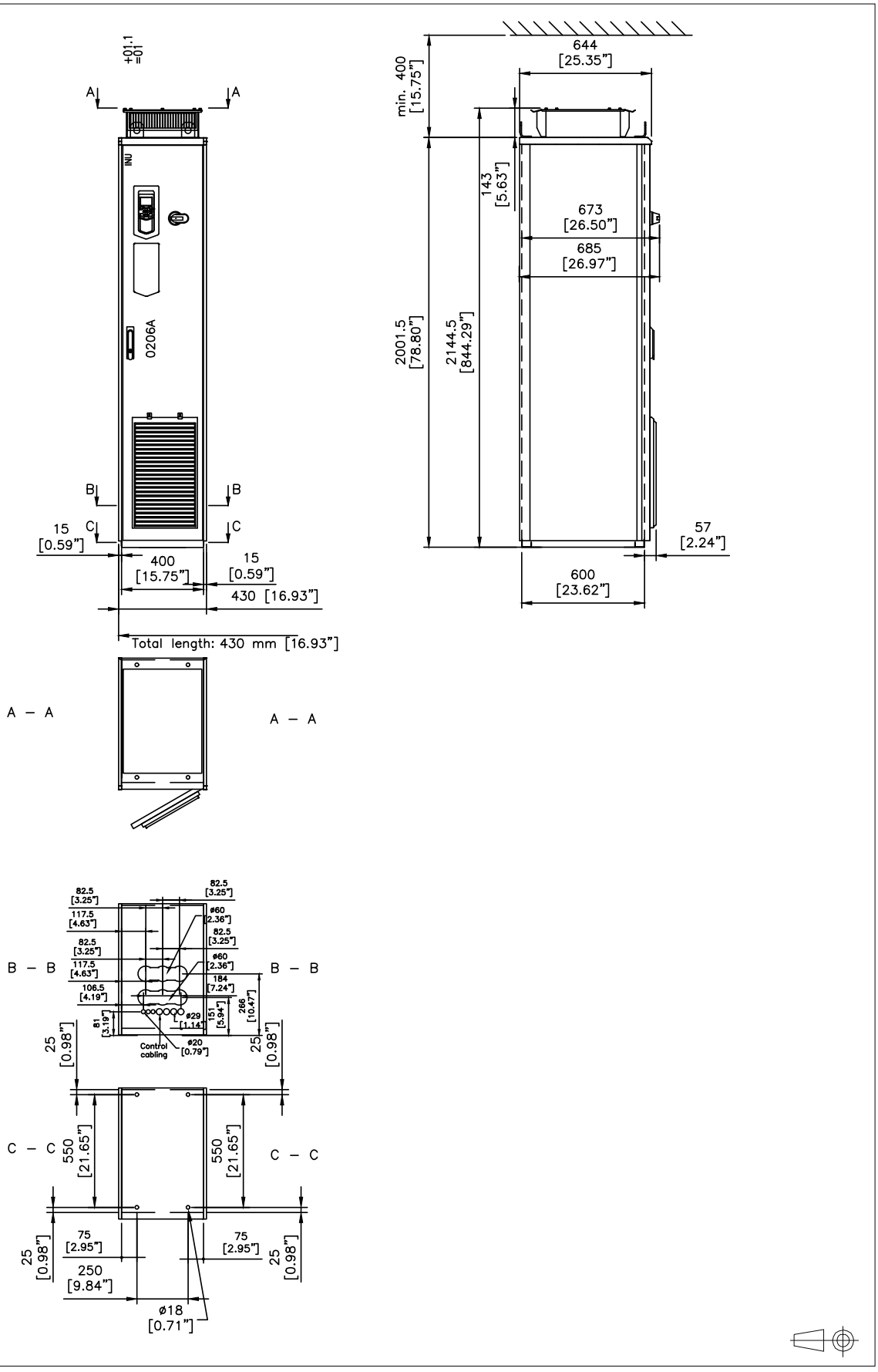
14

# Dimensions

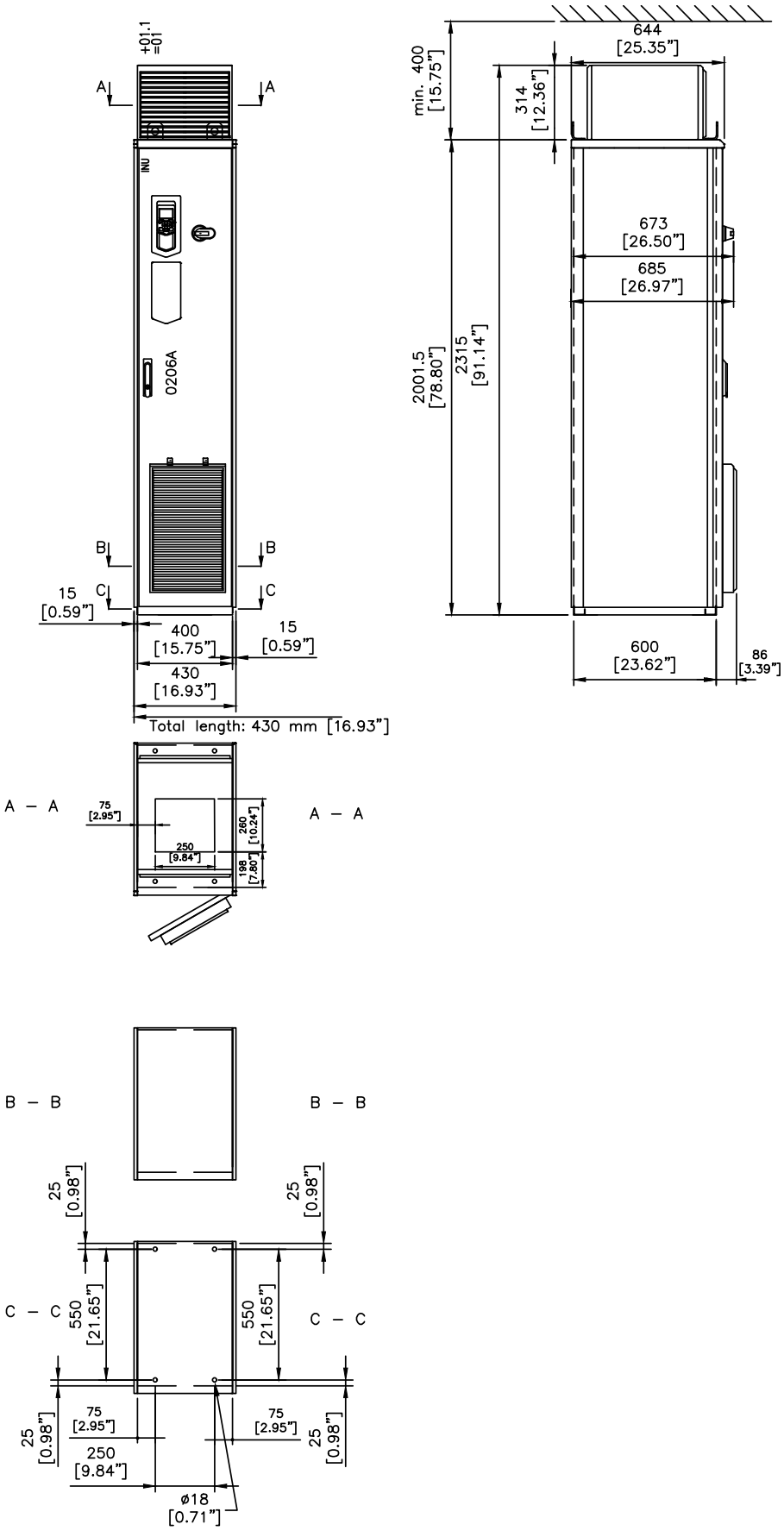
## Contents of this chapter

This chapter contains example dimension drawings.

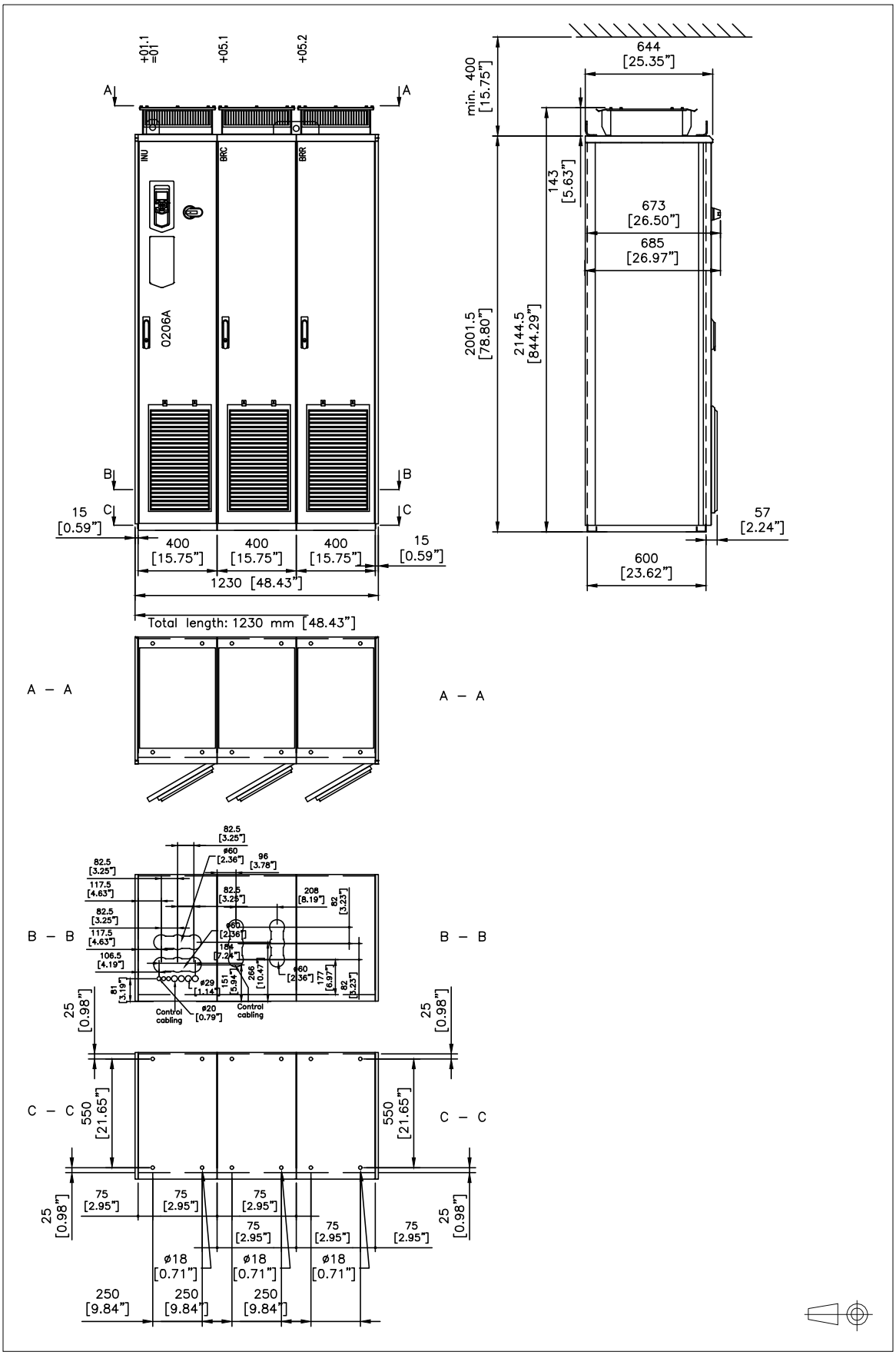
# R8: IP22 (UL Type 1), option +B054 (IP42 [UL Type 1 Filtered])



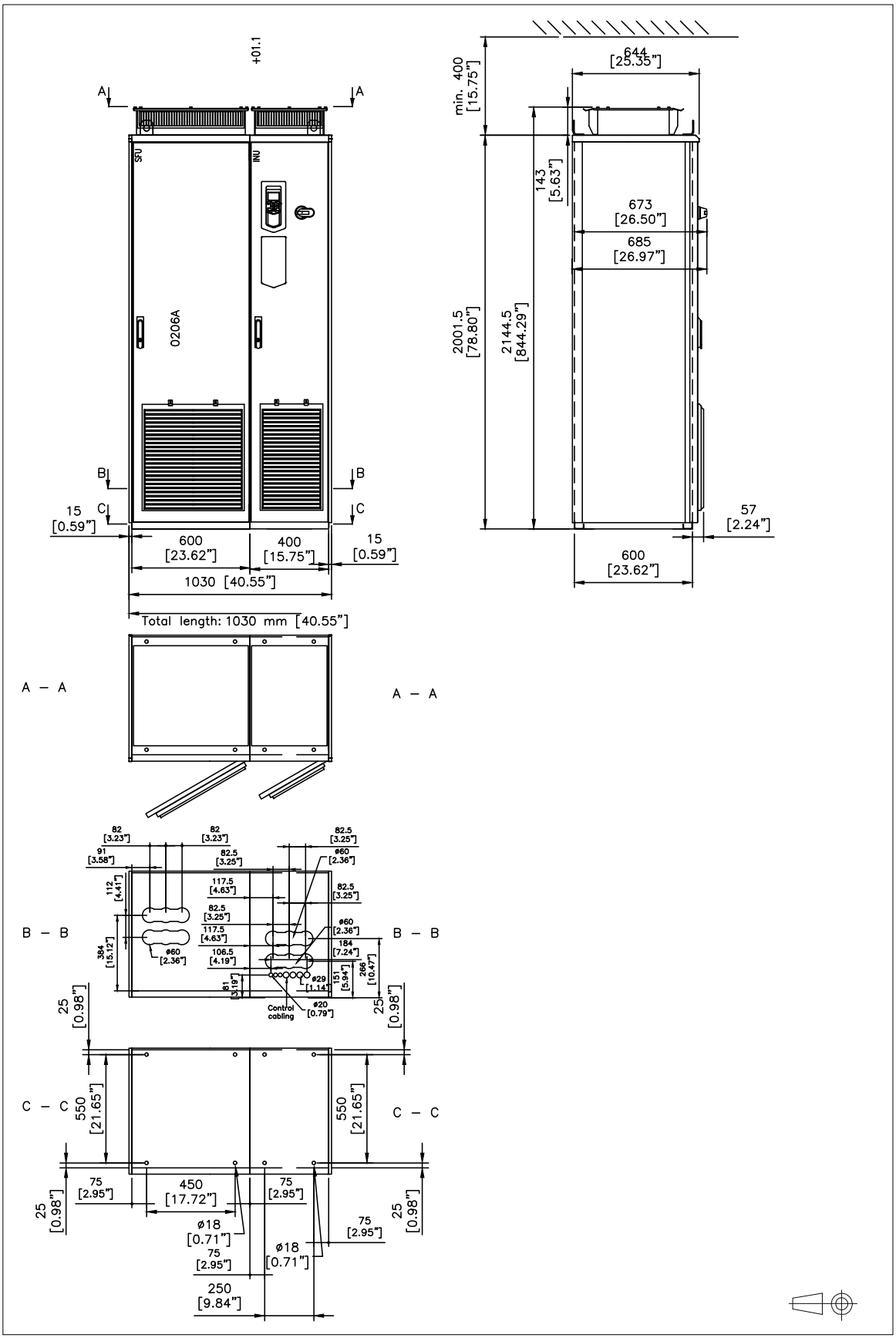
# R8 (IP54, UL Type 12, option +B055): option +C129



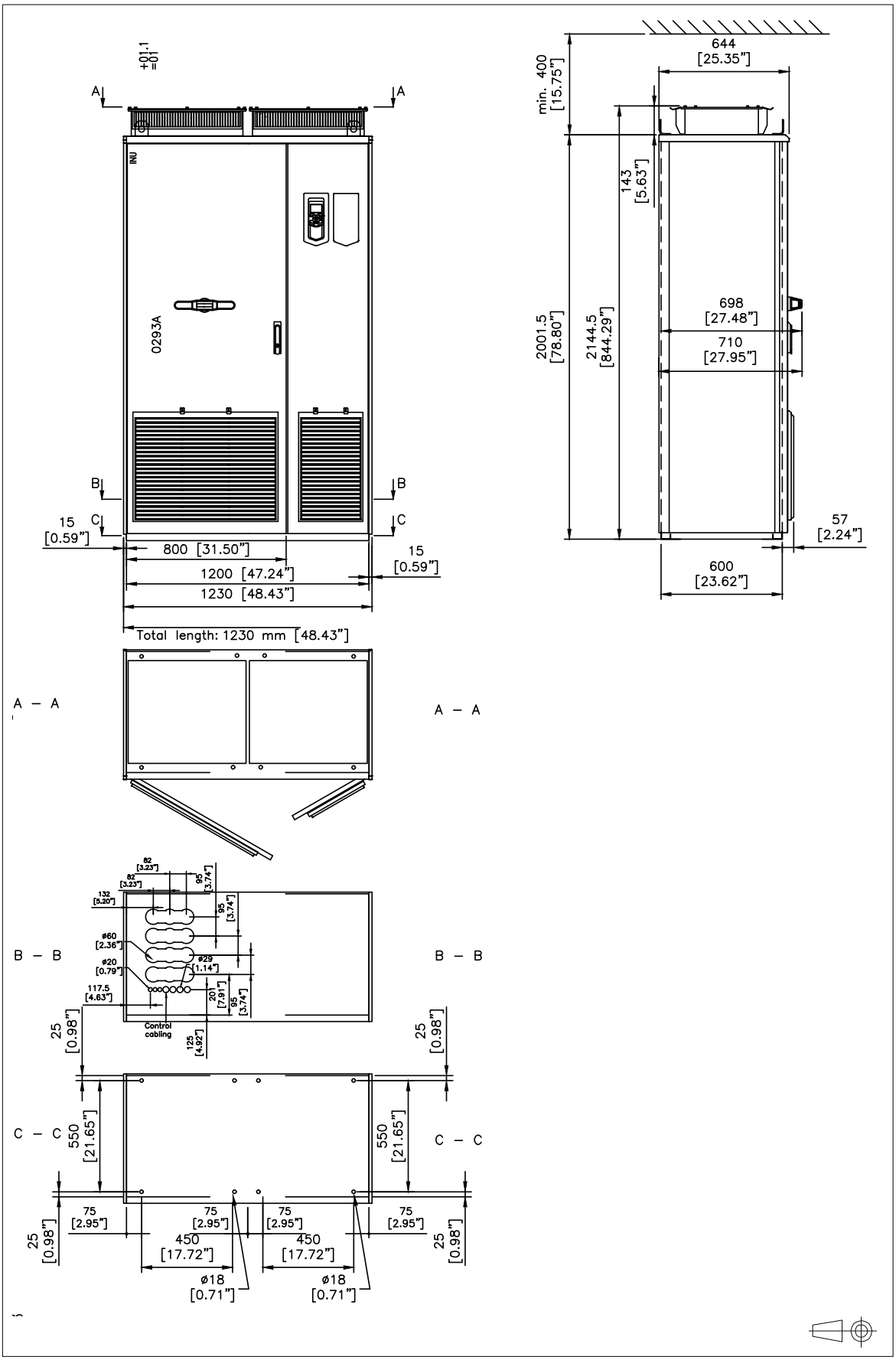
# R8 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +D150, +D151



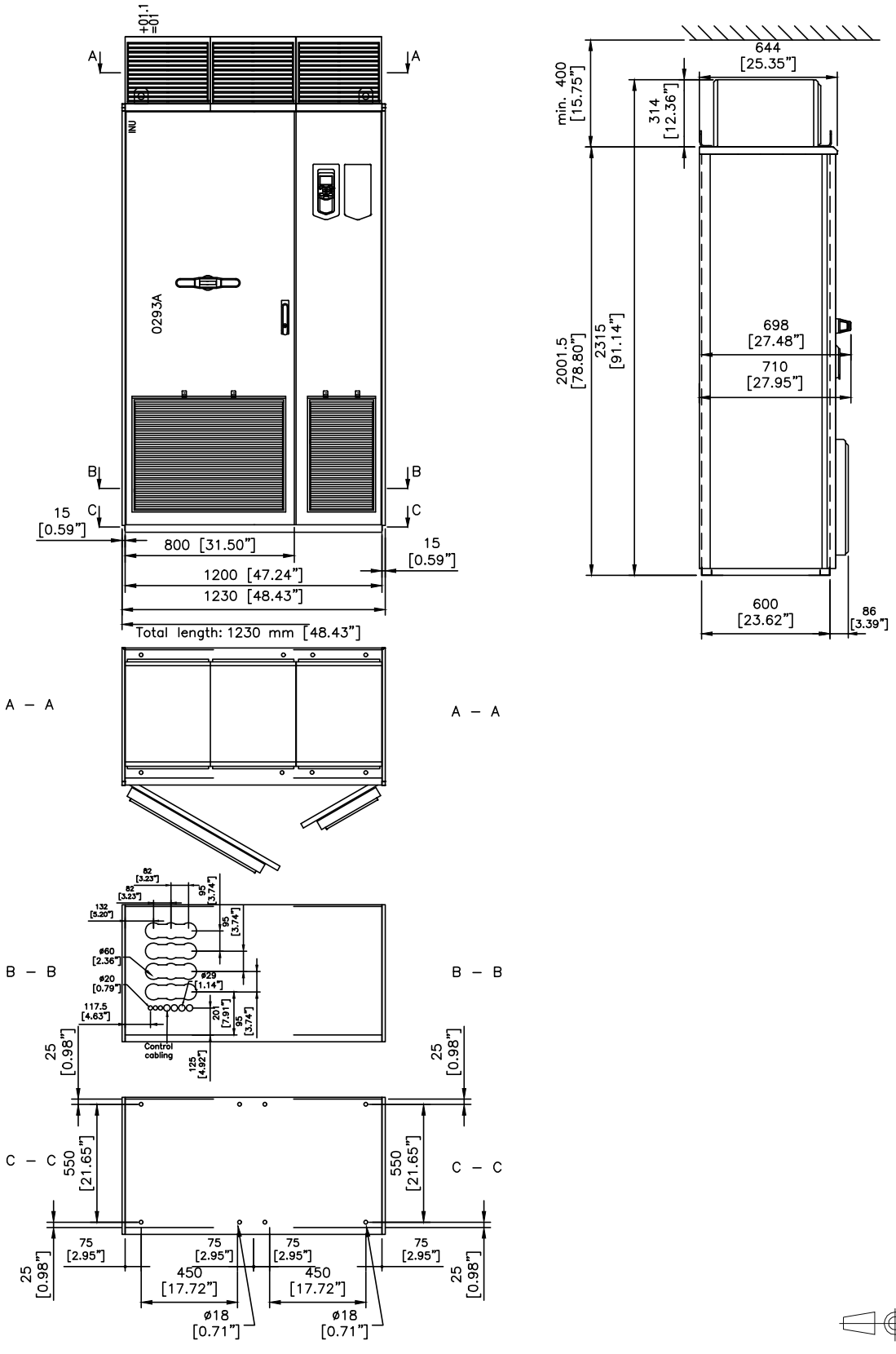
# R8 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option+E206



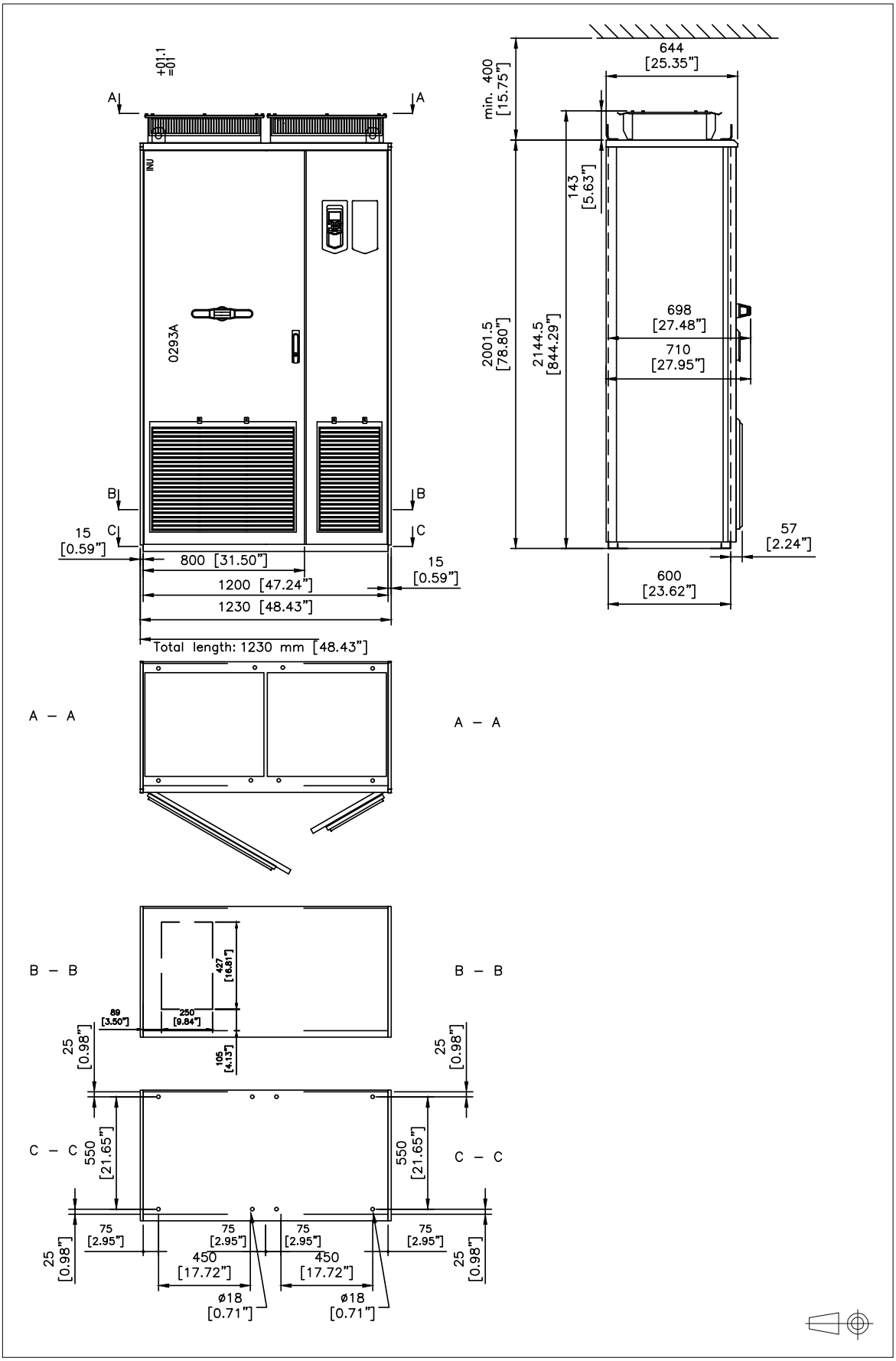
# R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054)



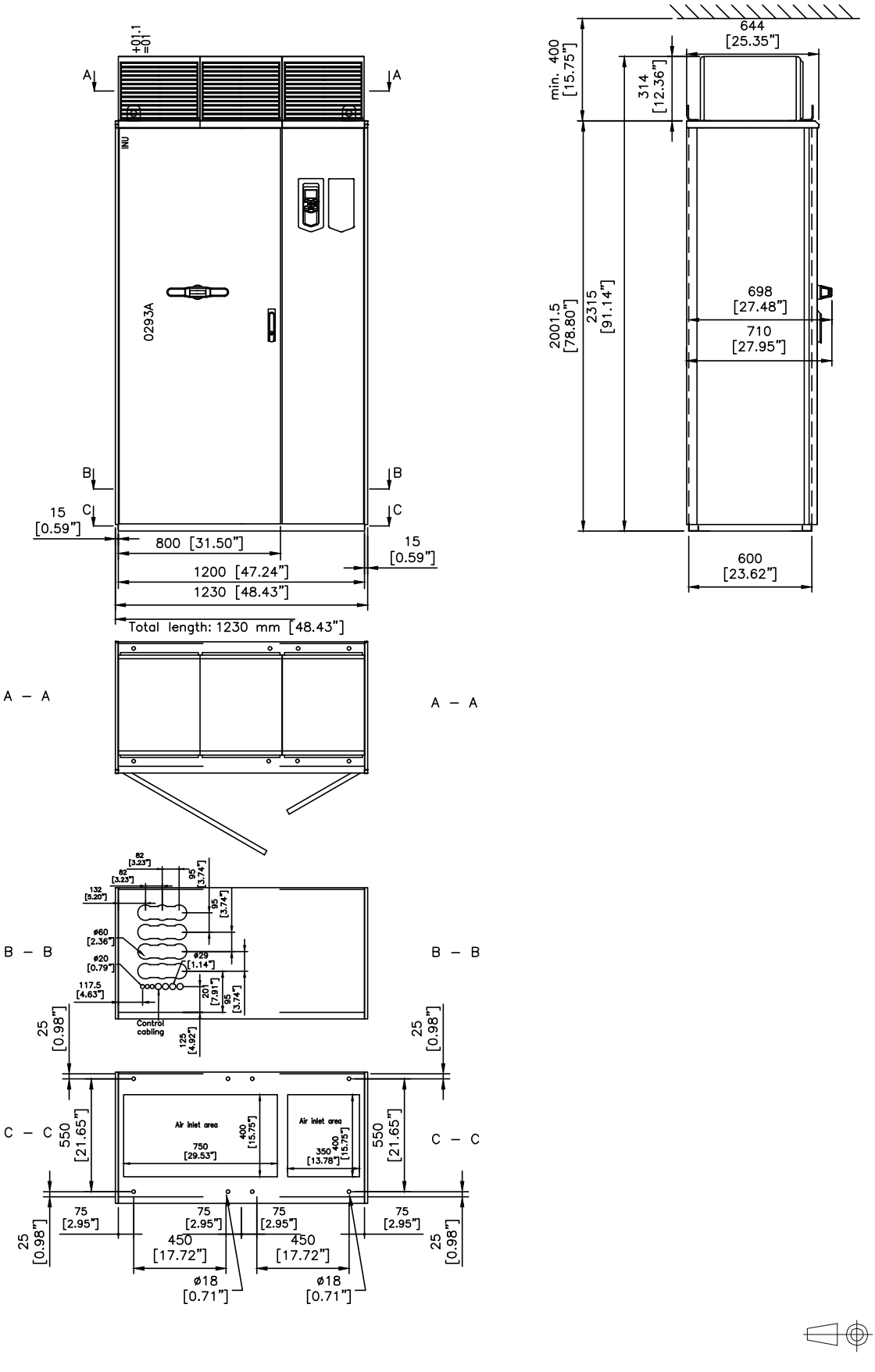
# R11: option+B055 (IP54 [UL Type 12])



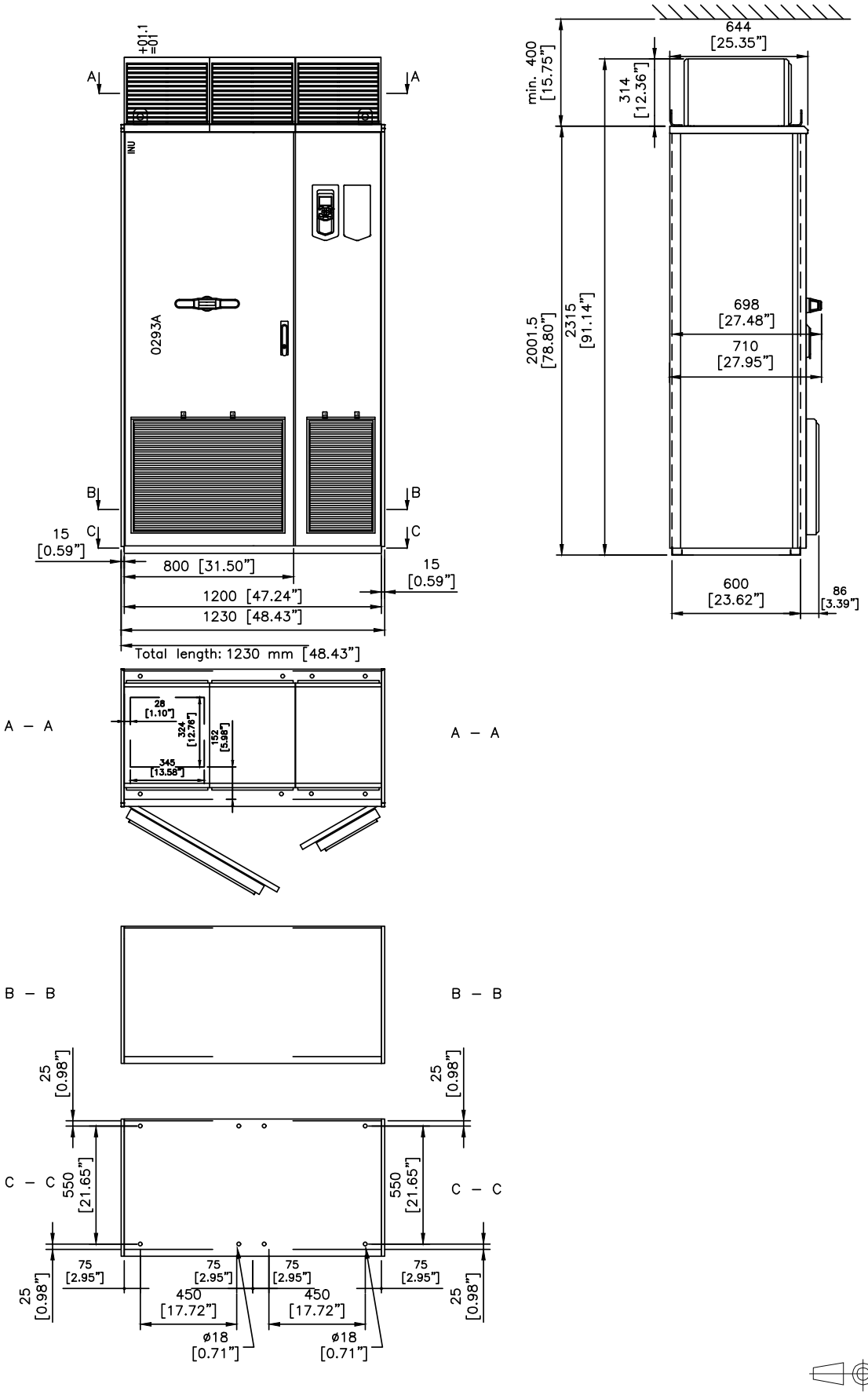
# R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +C129, +H350, +H352



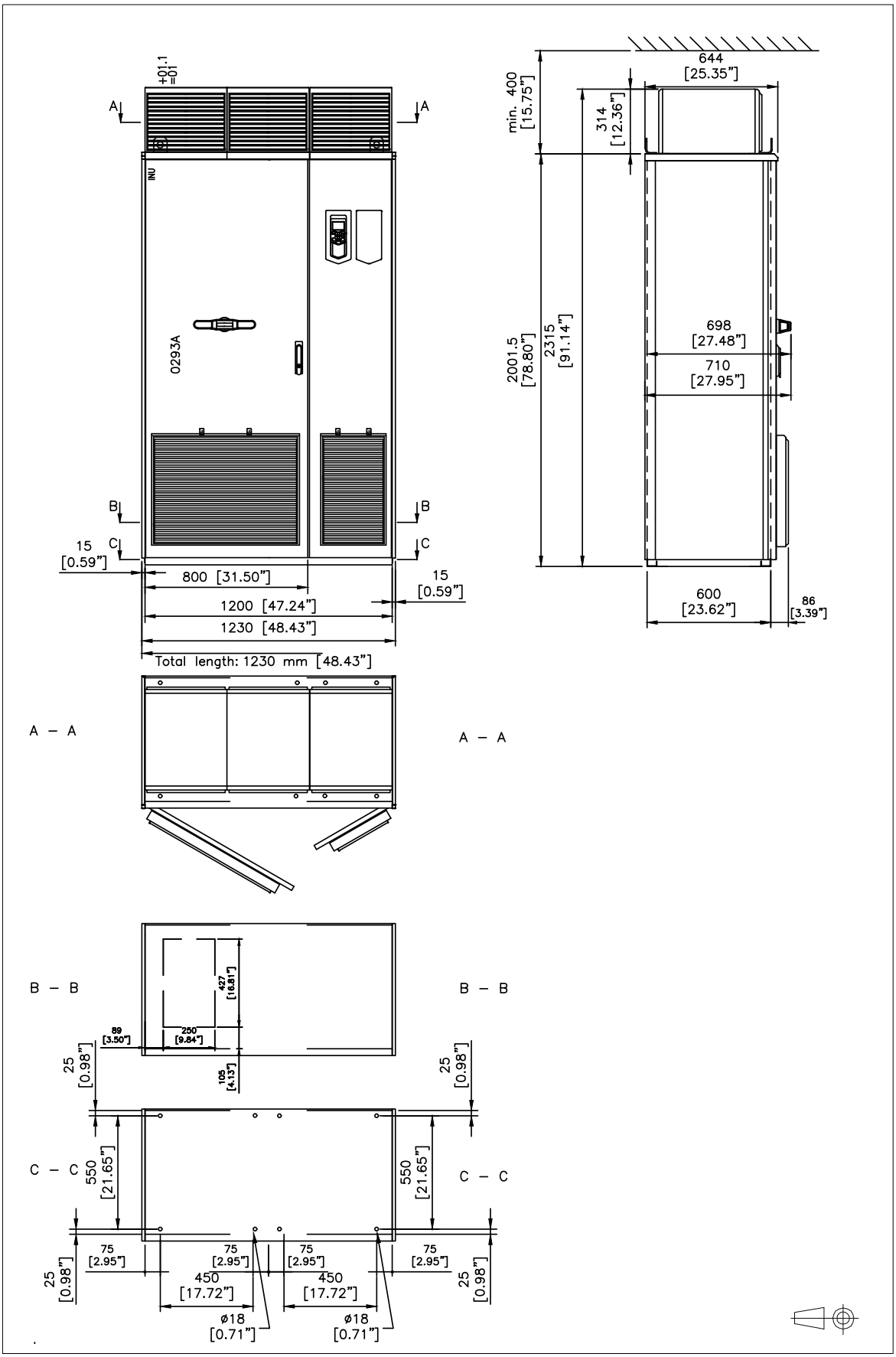
# R11 option +B055 (IP54 [UL Type 12]): option +C128



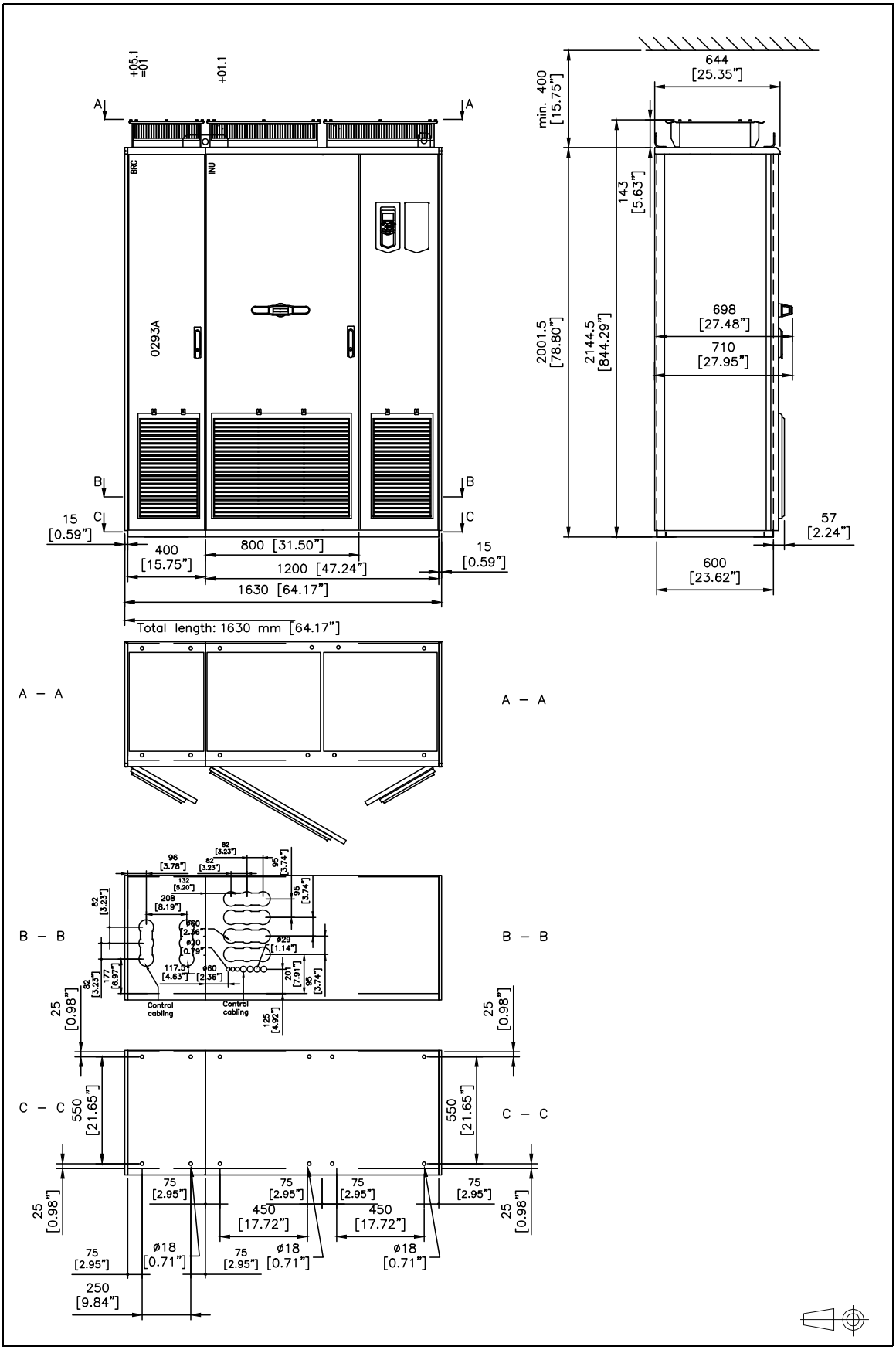
# R11 option +B055 (IP54 [UL Type 12]): option +C129



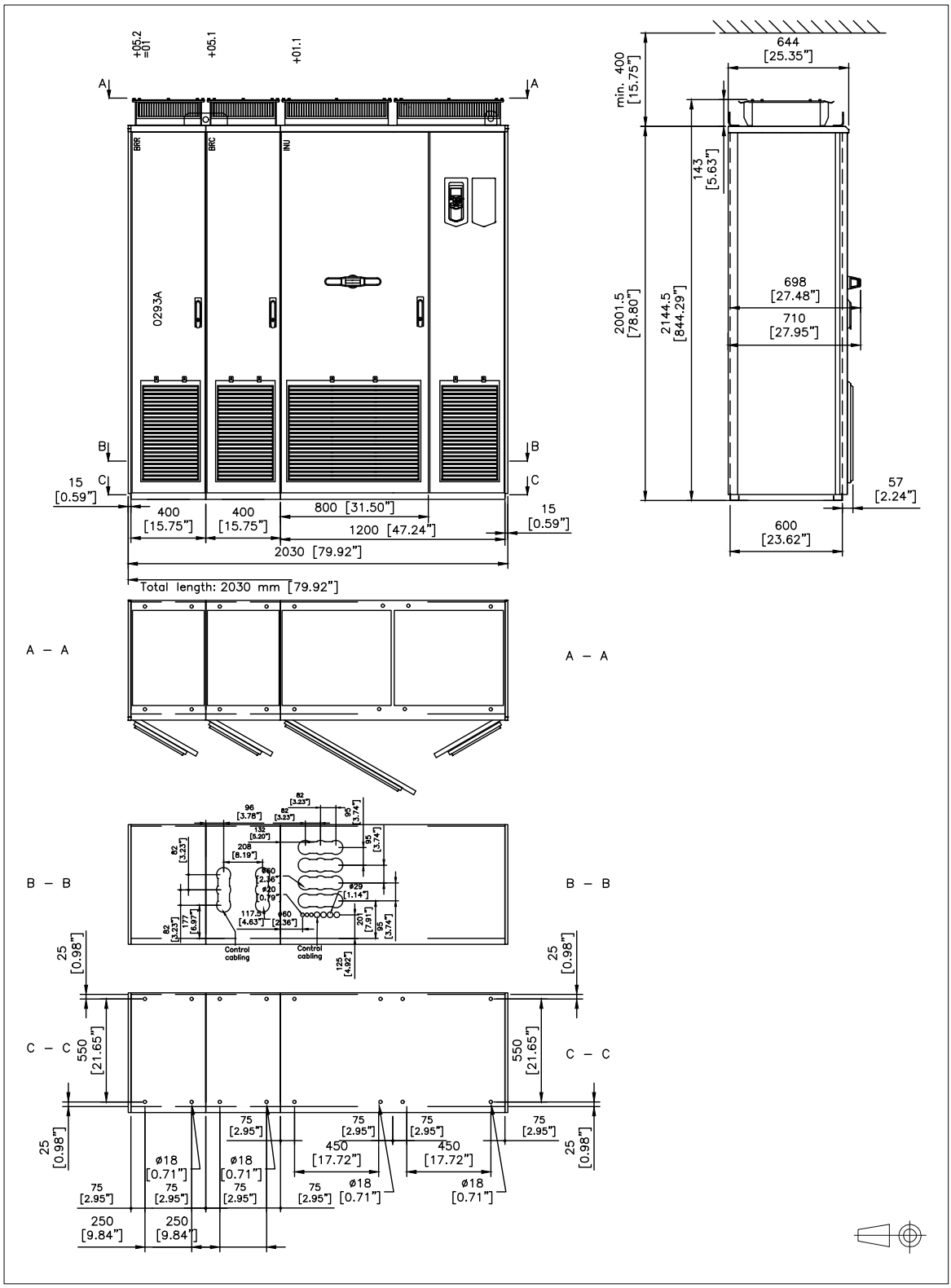
# R11 option +B055 (IP54 [UL Type 12]): options +C129, +H350, +H352



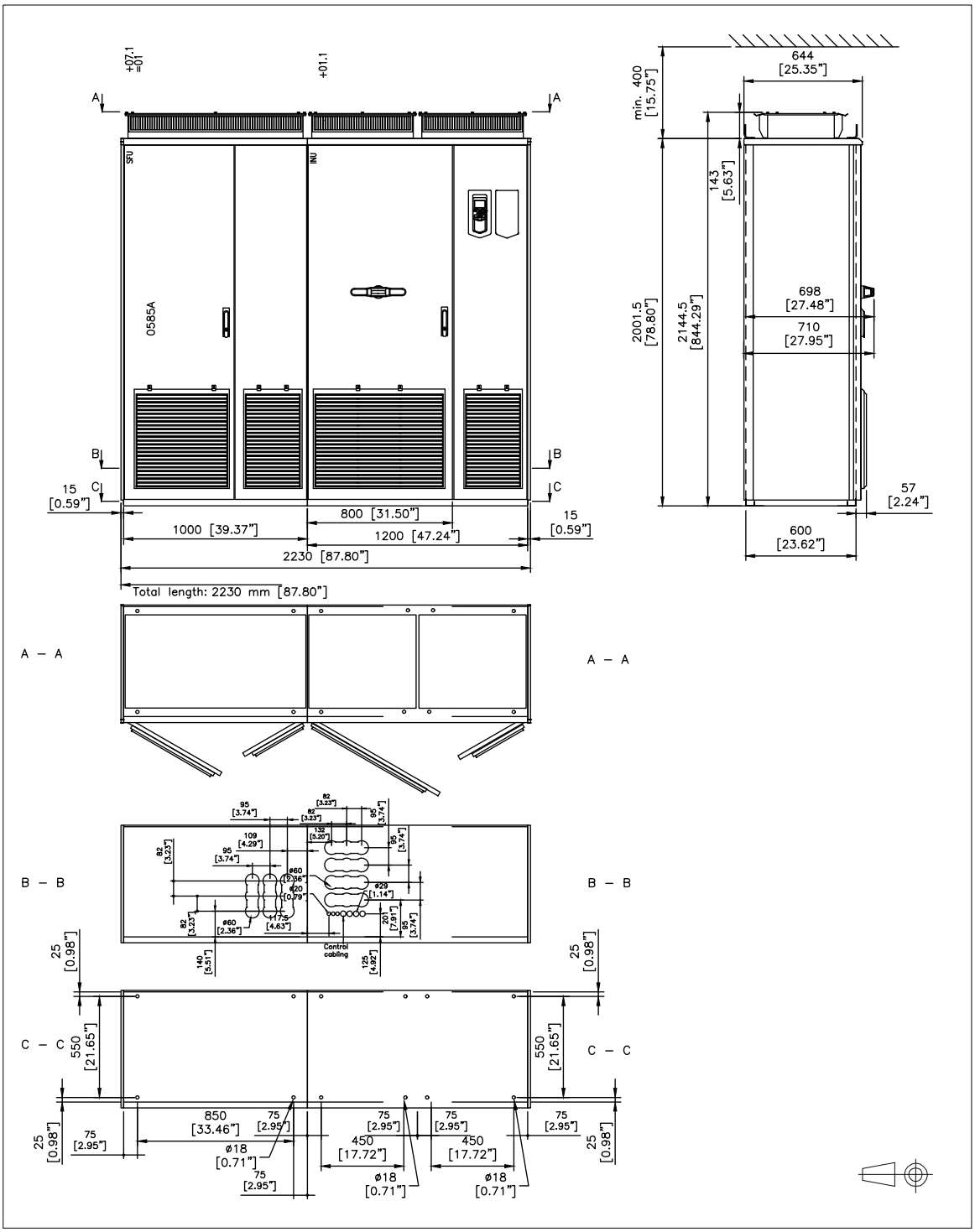
# R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +D150



# R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +D150, +D151

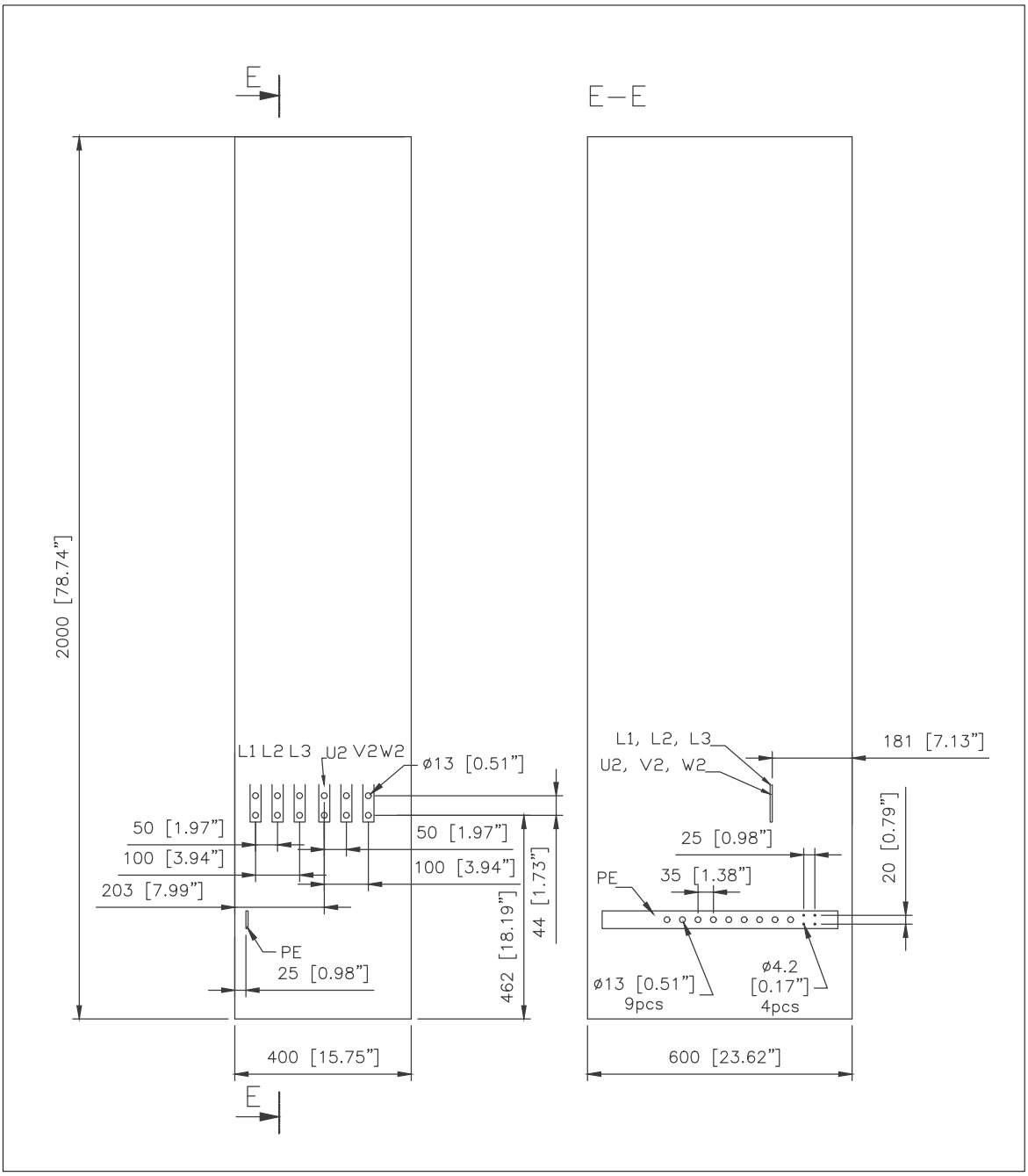


# R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +E206)

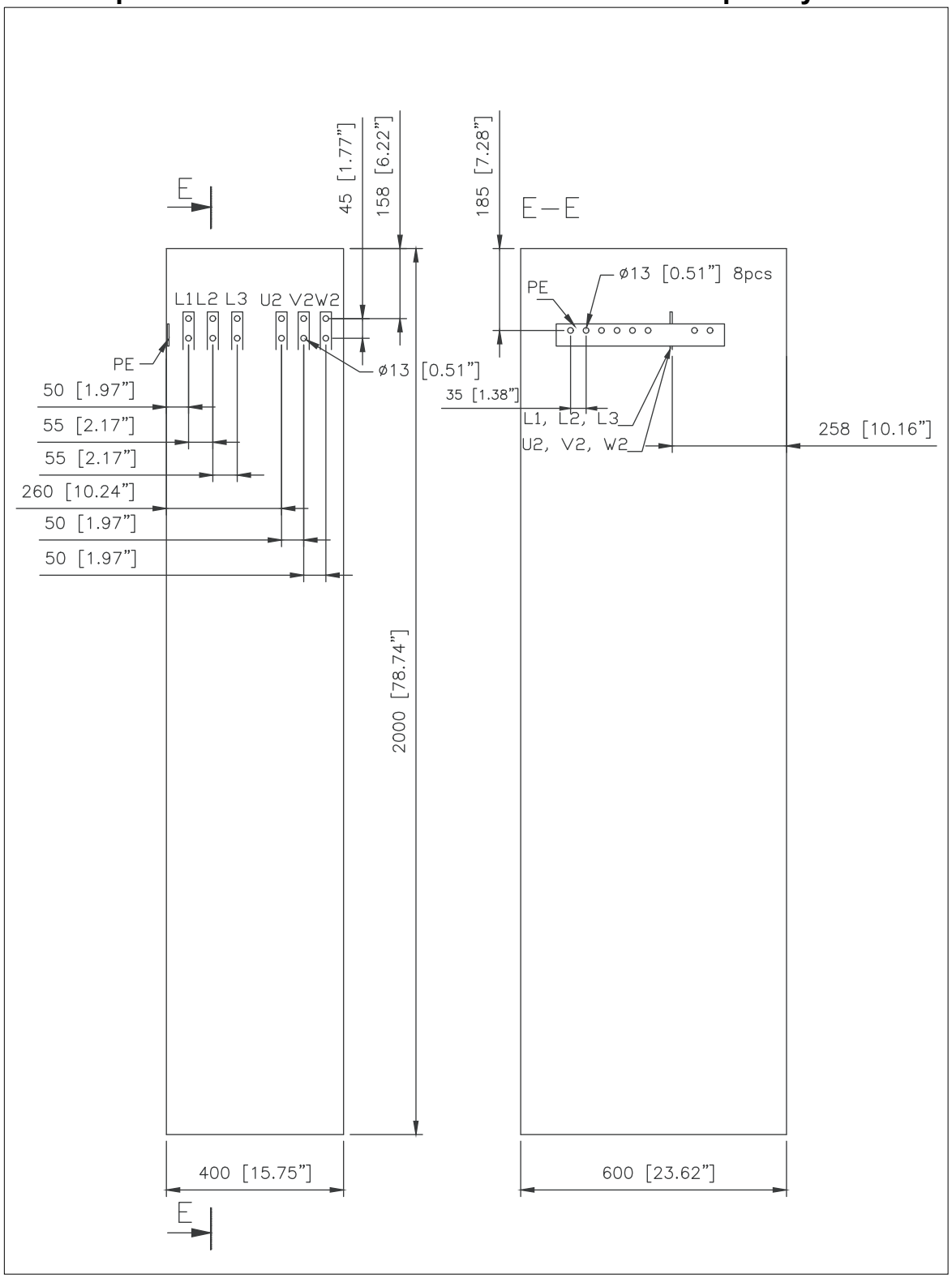


# Location and size of power cable connection terminals

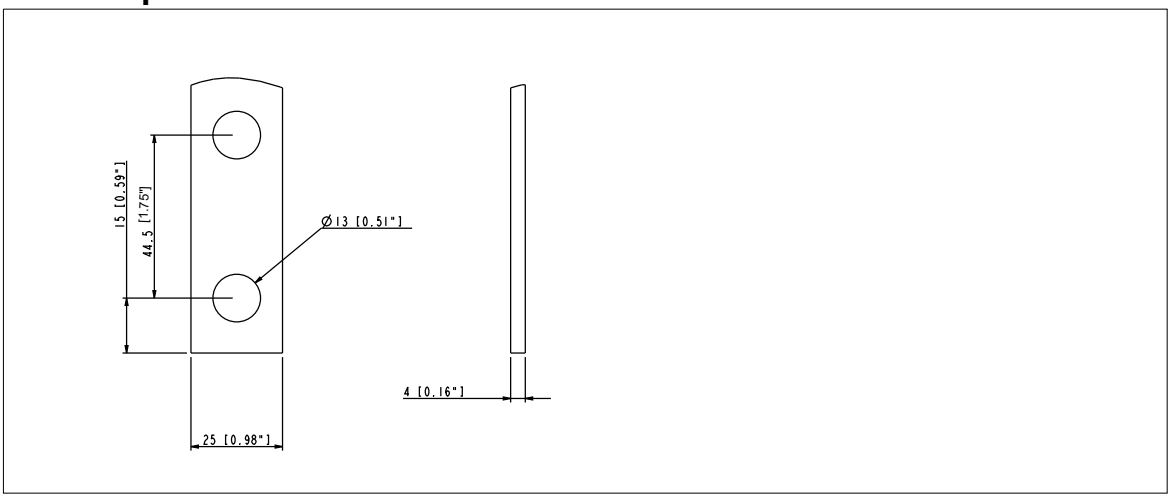
## R8 input and motor cable terminal dimensions – bottom entry and exit



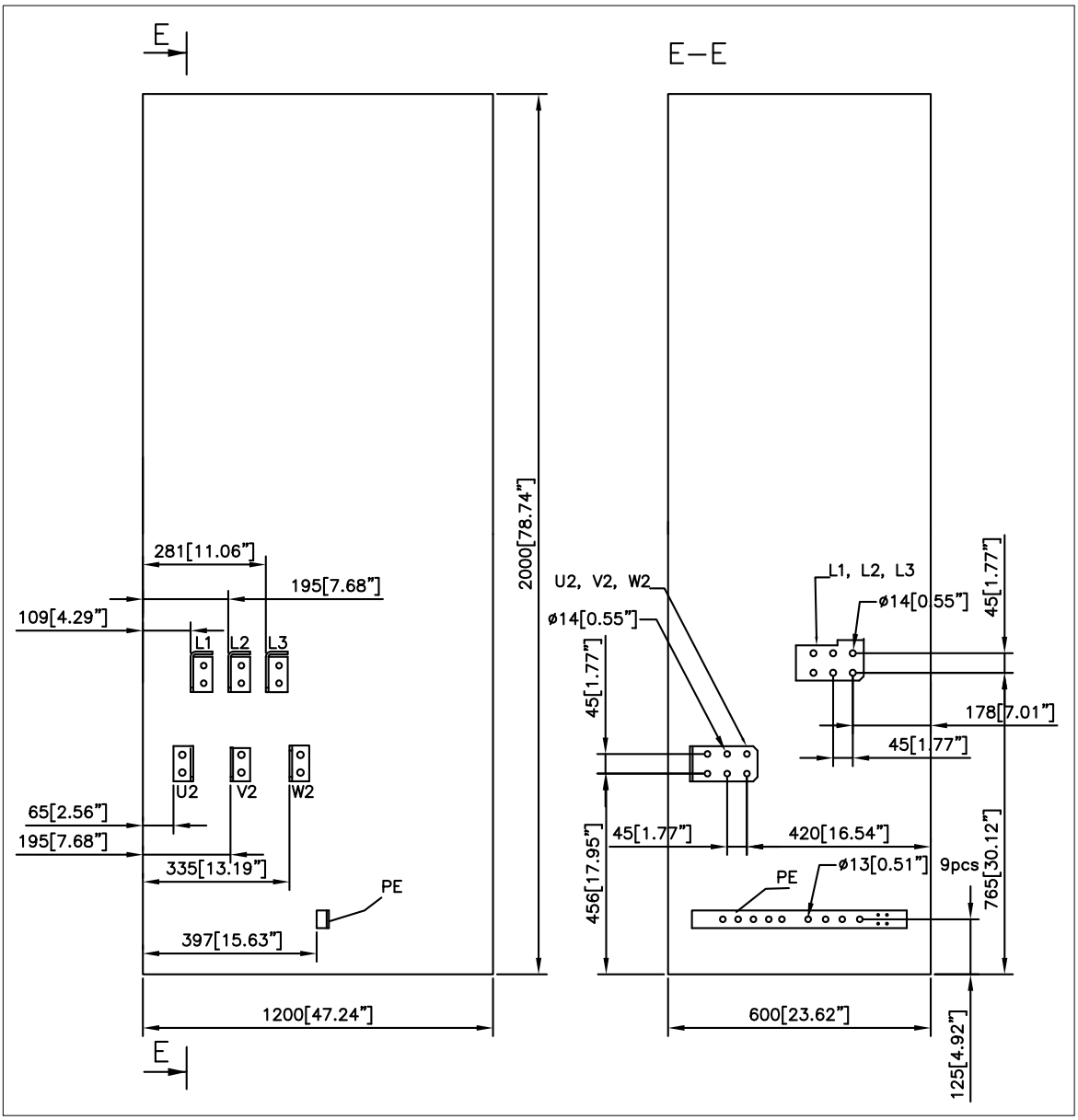
## R8 input and motor cable terminal dimensions – top entry and exit



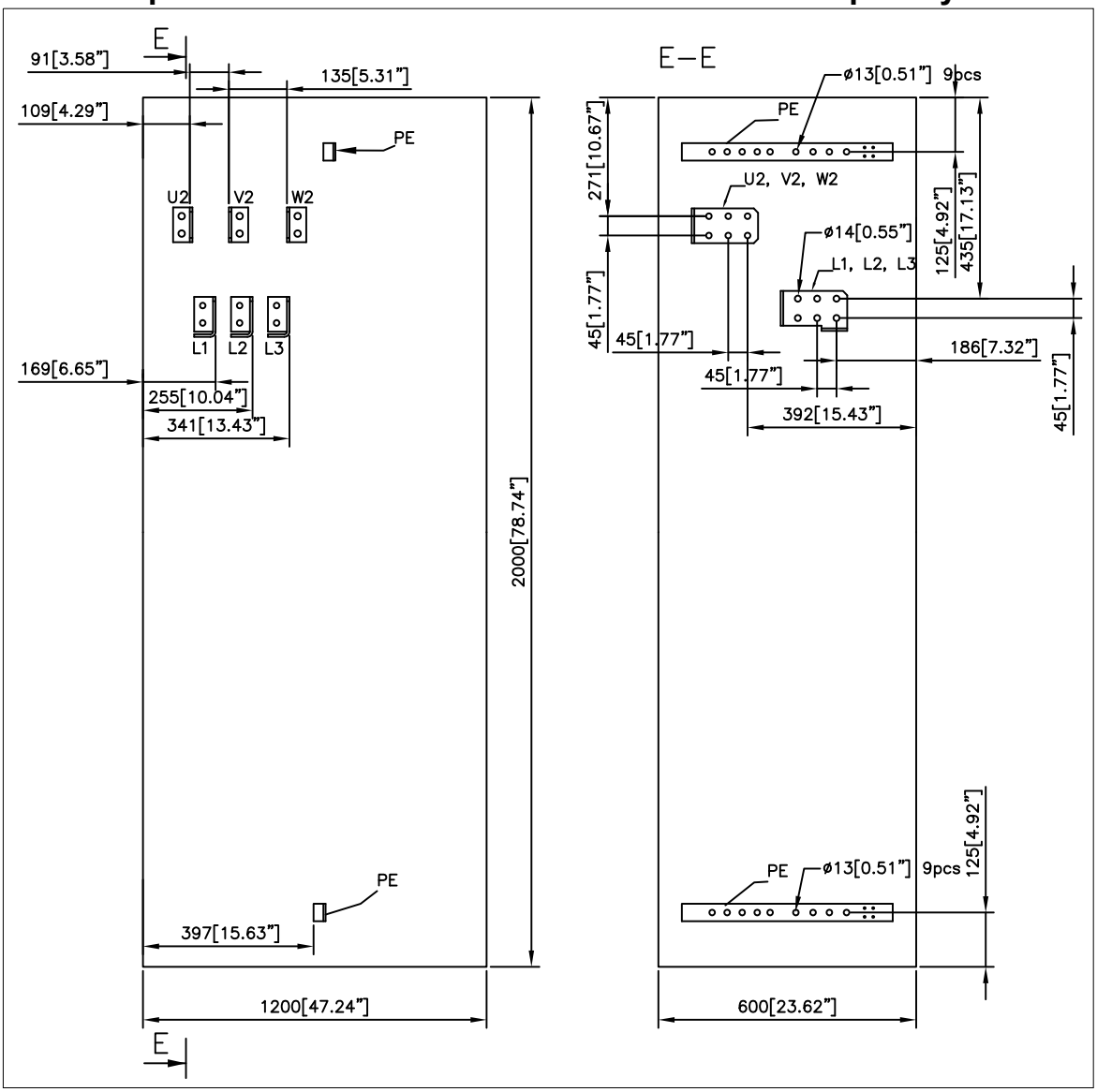
## R8 input and motor cable terminals



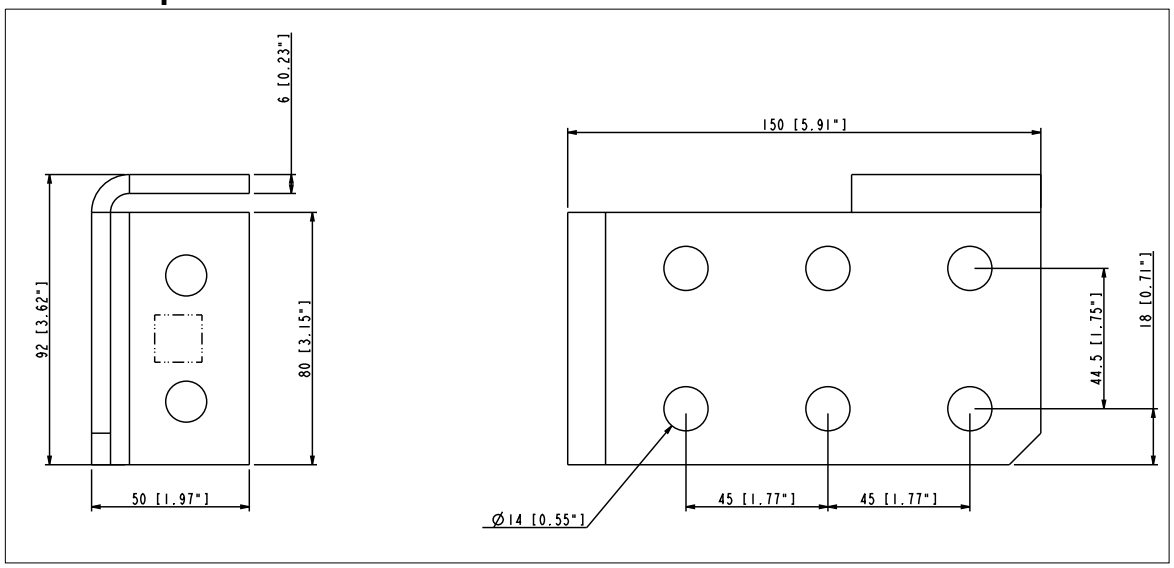
## R11 input and motor cable terminal dimensions – bottom entry and exit



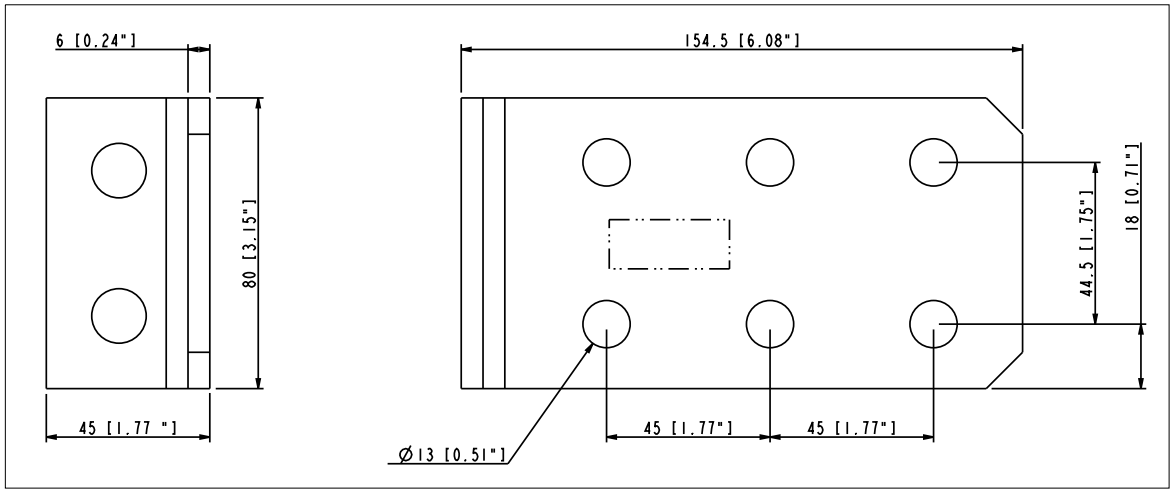
## R11 input and motor cable terminal dimensions – top entry and exit



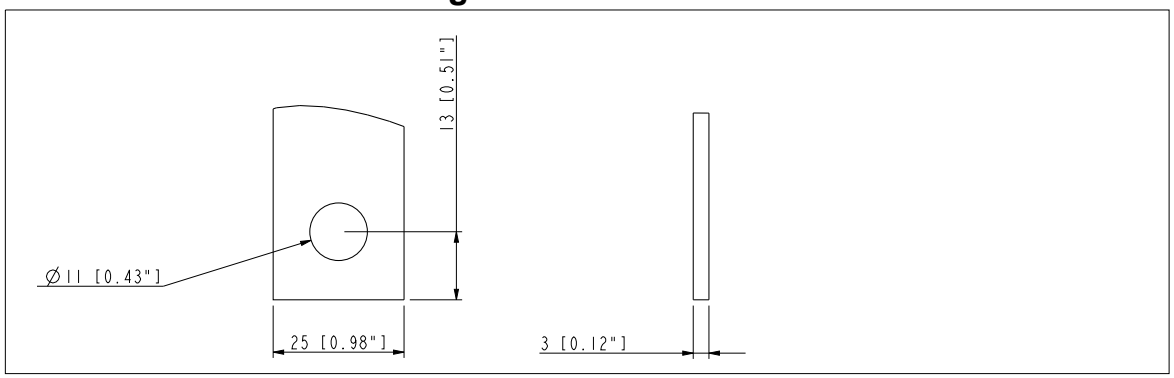
## R11 input cable terminals



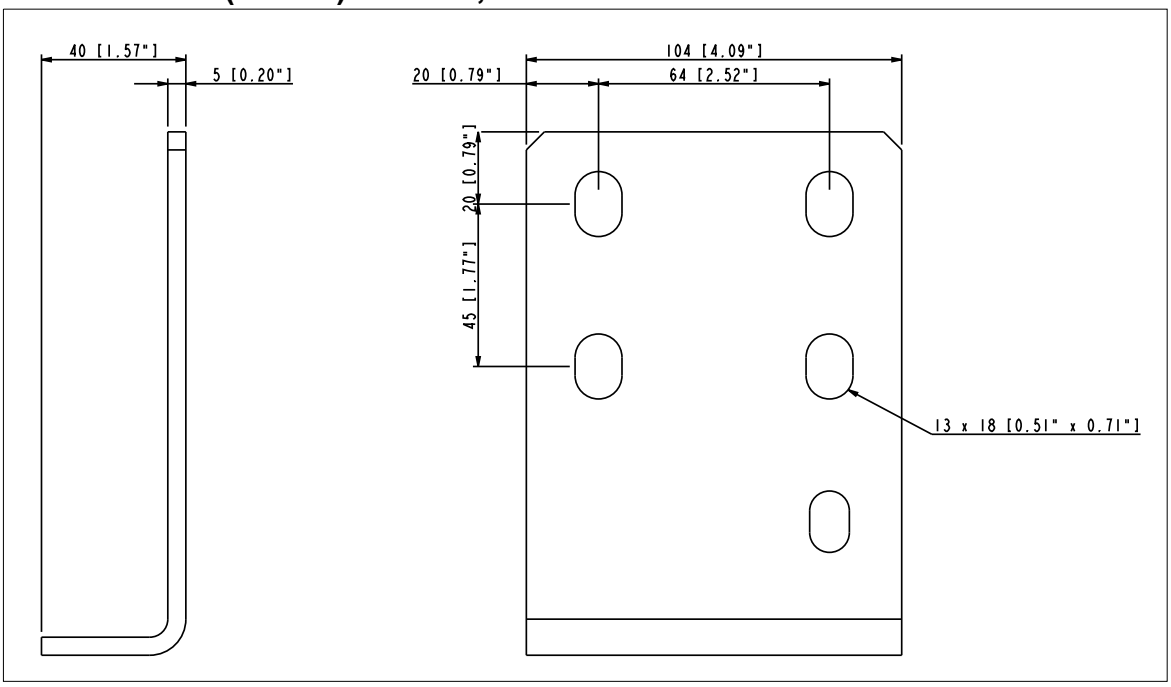

## R11 motor cable terminals



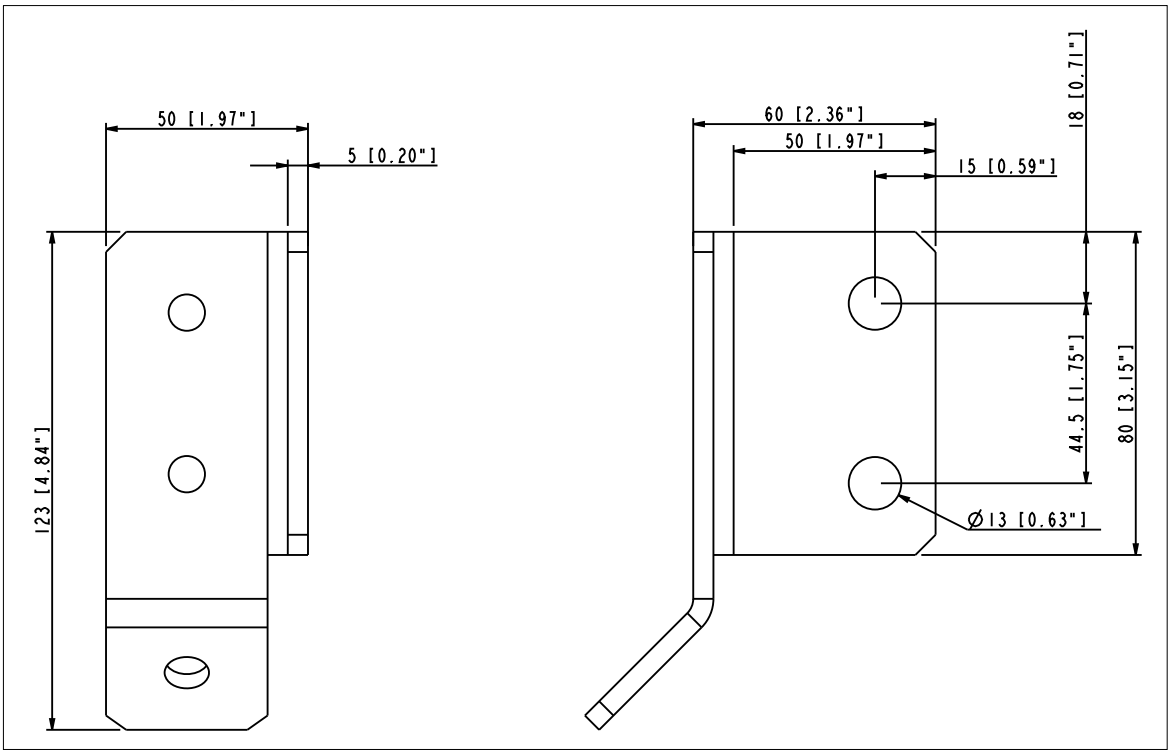

## Terminals for connecting external resistors



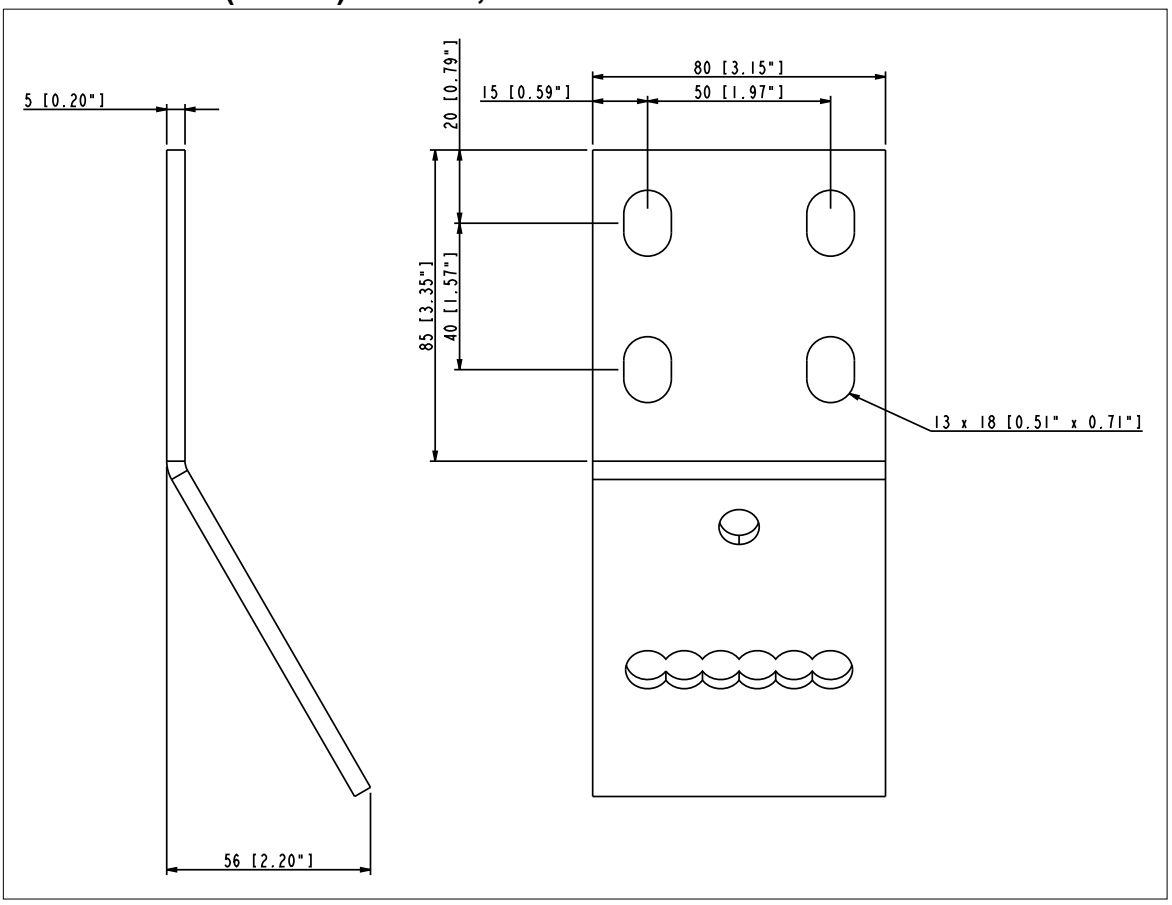
## Sine filter (+E206) cubicle, 400 mm: motor cable terminals




## Sine filter (+E206) cubicle, 600 mm: motor cable terminals



## Sine filter (+E206) cubicle, 1000 mm: motor cable terminals



15

# The Safe torque off function

## Contents of this chapter

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

## Description

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

**Note:** The Safe torque off function does not disconnect the voltage from the drive, see the warning on page 267.

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

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

The Safe torque off function complies with these standards:

| Standard | Name |
|---|---|
| IEC 60204-1:2016<br>EN 60204-1:2006 + A1:2009 + AC:2010 | *Safety of machinery – Electrical equipment of machines – Part 1: General requirements* |

| Standard | Name |
|---|---|
| IEC 61000-6-7:2014 | *Electromagnetic compatibility (EMC) - Part 6-7: Generic standards - Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations* |
| IEC 61326-3-1:2017 | *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* |
| IEC 61508-1:2010 | *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements* |
| IEC 61508-2:2010 | *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems* |
| IEC 61511-1:2016 | *Functional safety – Safety instrumented systems for the process industry sector* |
| EN 61800-5-2:2007<br>IEC 61800-5-2:2016 | *Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional* |
| IEC 62061:2005 + A1:2012 + A2:2015<br>EN 62061:2005 +AC:2010+A1:2013+A2:2015 | *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems* |
| EN ISO 13849-1:2015 | *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design* |
| EN ISO 13849-2:2012 | *Safety of machinery – Safety-related parts of control systems – Part 2: Validation* |

The function also corresponds to Prevention of unexpected start-up as specified by EN 1037:1995 + A1:2008 and Uncontrolled stop (stop category 0) as specified in EN 60204-1.

### Compliance with the European Machinery Directive

See section *Compliance with the European Machinery Directive* on page *229*.

## Wiring

The following diagrams present examples of Safe torque off wiring for

- a single drive (page *262*)
- multiple drives (page *263*)
- multiple drives when an external 24 V DC power supply is used (page *264*).

For information on the specifications of the STO input, see chapter *Control unit of frame R8* (page *135*) and *Control unit of frame R11* (page *145*).

## 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.

- If 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

- Double-shielded twisted-pair cable is recommended.
- 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.

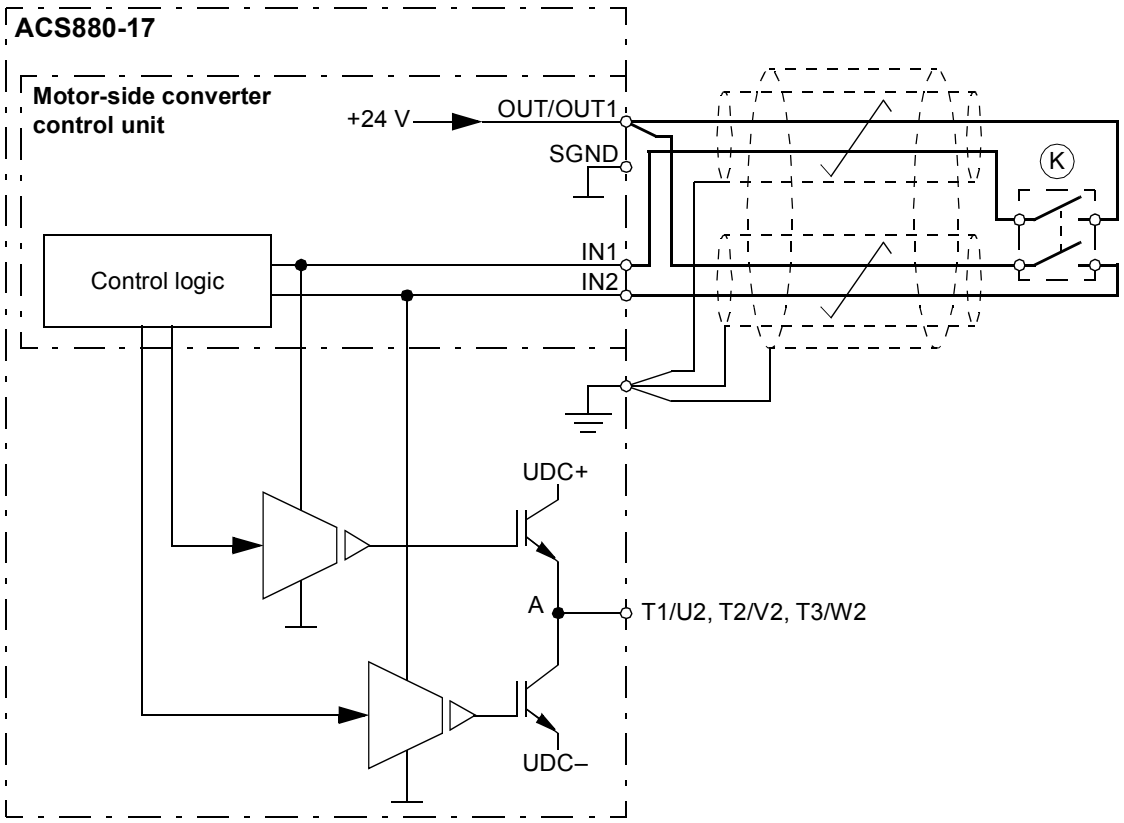
**Note:** The voltage at the STO input terminals of each drive control unit must be at least 17 V DC to be interpreted as “1”.

## Grounding of protective shields

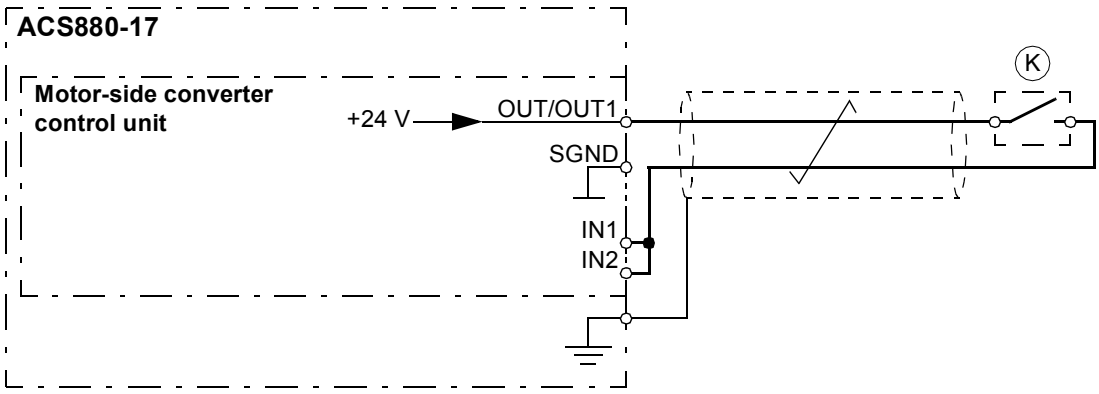
- Ground the shield in the cabling between the activation switch and the control unit at the control unit.
- Ground the shield in the cabling between two control units at one control unit only.

## Single drive (internal power supply)

### Dual-channel connection



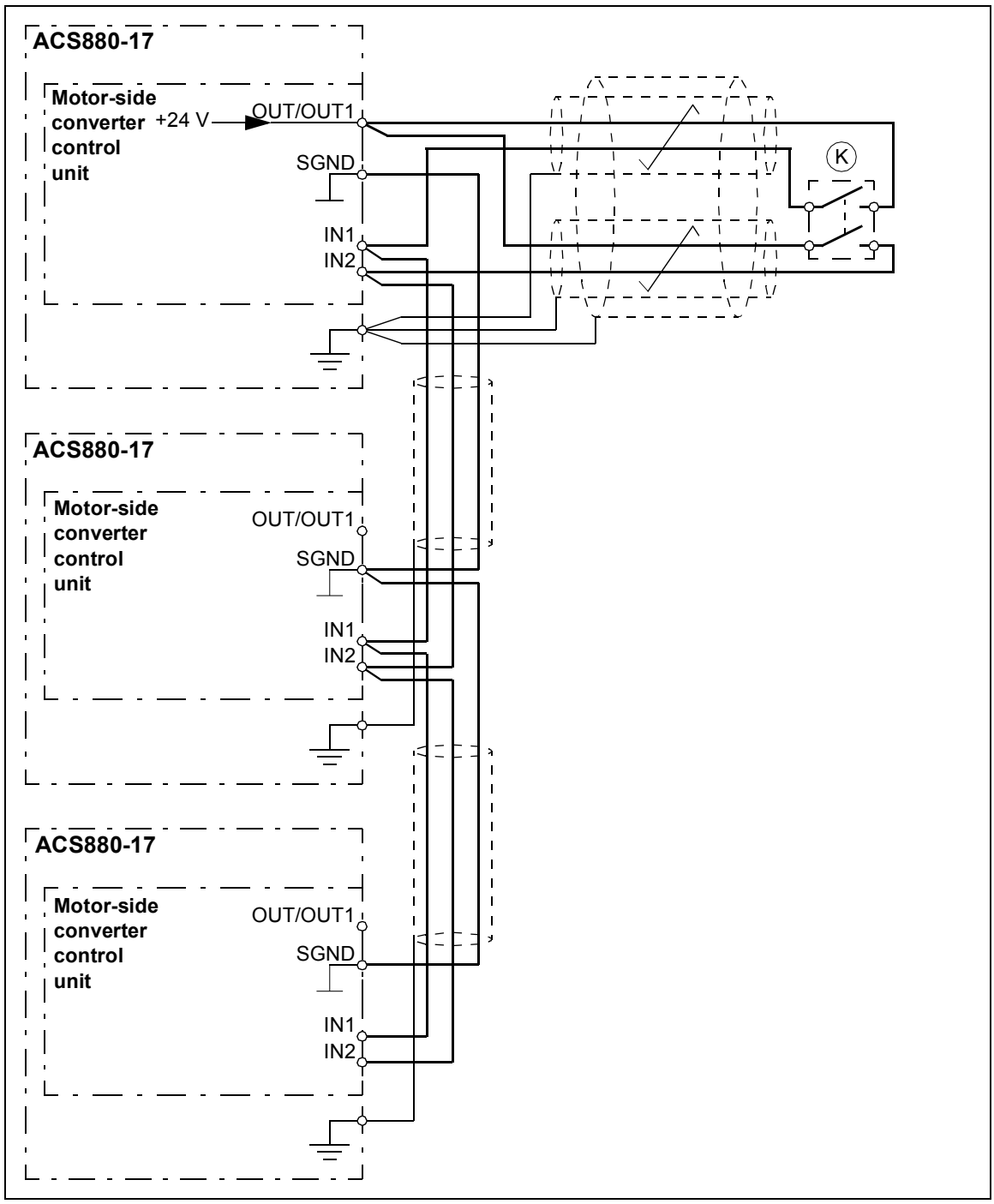

### Single-channel connection



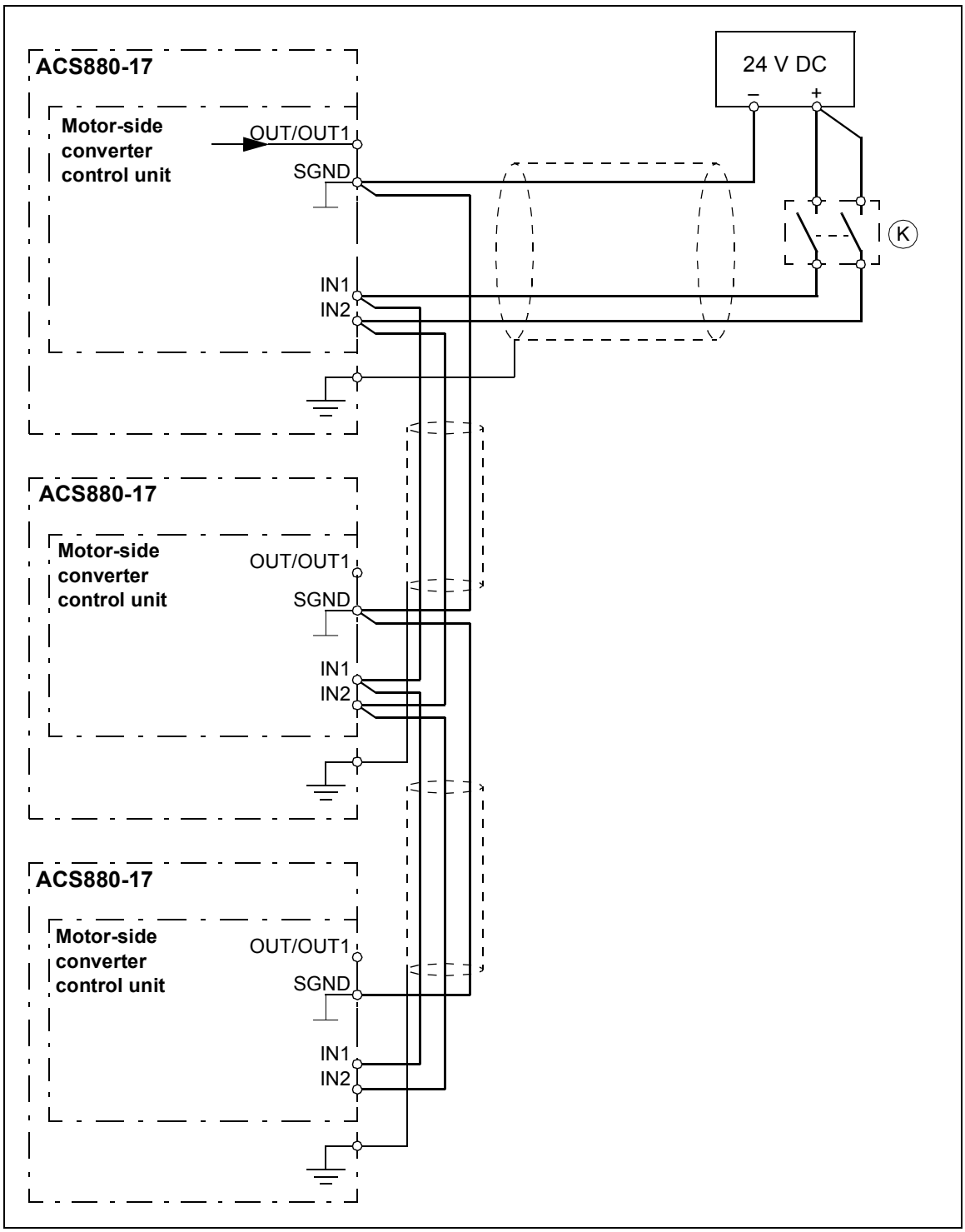

**Notes**:

- 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 eg. EN ISO 13849-2:2012, table D.4.

## Multiple drives (internal power supply)



### Multiple drives (external power supply)




## Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. The STO inputs on the motor-side converter control unit de-energize.
3. The control unit cuts off the control voltage from the output IGBTs.

4. The control program generates an indication as defined by parameter *31.22* (refer to the firmware manual of the motor-side converter).
5. The motor coasts to a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a reset may be needed (depending on the setting of parameter *31.22*). A new start command is required to start the drive.

# Start-up including acceptance test

To ensure the safe operation of a safety function, validation is required. The final assembler of the machine must validate the function by performing an acceptance test. The acceptance test must be performed

- at initial start-up of the safety function
- after any changes related to the safety function (circuit boards, wiring, components, settings, etc.)
- after any maintenance work related to the safety function.

## Competence

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

## Acceptance test reports

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

## Acceptance test procedure

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

**Note:** If the drive is equipped with safety option +L536, +L537, +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q978 or +Q979, do the procedure shown in the documentation of the option. If the drive is equipped with safety functions module FSO-12, FSO-21, safety option +Q972, +Q973, +Q982 or thermistor protection module FPTC-01/-02 (option +L536 or + L537), do the procedure shown in the FSO/FPTC module documentation.

| **Action** | ☑ |
|---|---|
| **WARNING!** Follow the safety instructions given in chapter *Safety instructions* (page *15*). If you ignore them, injury or death, or damage to the equipment can occur. | ☐ |
| 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. | ☐ |

| Action | ☑ |
|---|---|
| Test the operation of the STO function when the motor is stopped.<br>• Give a stop command to the drive (if running) and wait until the motor shaft is at a standstill.<br>Ensure that the drive operates as follows:<br>• Open the STO circuit. The drive generates an indication if one is defined for ‘stopped’ state in parameter *31.22* (see the firmware manual).<br>• Give a start command to verify that the STO function blocks the drive’s operation. The motor should not start.<br>• Close the STO circuit.<br>• 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.<br>• Start the drive and ensure the motor is running.<br>• 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).<br>• Reset any active faults and try to start the drive.<br>• Ensure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped.<br>• Close the STO circuit.<br>• 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.<br>• 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).<br>• Give a start command to verify that the STO function blocks the drive’s operation. The motor should not start.<br>• Close the STO circuit.<br>• Reset any active faults. Restart the drive and check that the motor runs normally.<br>• 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).<br>• Give a start command to verify that the STO function blocks the drive’s operation. The motor should not start.<br>• Close the STO circuit.<br>• Reset any active faults. Restart the drive and check that the motor runs normally. | |
| Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation. | ☐ |

# Use

1. Open the activation switch, or activate the safety functionality that is wired to the STO connection.
2. The STO inputs of the motor-side converter 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. The motor coasts to a stop (if running). The drive will not restart while the activation switch or safety relay contacts are open.
5. Deactivate the STO by closing the activation switch, or reseting 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 all possible voltage sources.

**WARNING!** The Safe torque off functionality is only achieved through the XSTO connector of the motor-side converter control unit. True Safe torque off functionality is not achieved through the XSTO connectors of the line-side converter control unit.

The Safe torque off function is supported by any ACS880 motor-side converter firmware. It is not supported by line-side converter firmware.

**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 180/2*p* (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 *268*). 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 *265*).

**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* (page *265*).

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 motor-side converter control program parameter *31.22*.

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

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

Any failures of the Safe torque off function must be reported to ABB.

## 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.

| Frame | SIL/ SILCL | PL | SFF (%) | PFH (1/h) | $PFD_{avg}$ ($T_1$ = 2 a) | $PFD_{avg}$ ($T_1$ = 5 a) | $MTTF_D$ (a) | DC* (%) | SC | Cat. | HFT | CCF (%) | Mission time ($T_M$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R8 | 3 | e | 99.1 | 3.20E-09 | 2.66E-05 | 6.65E-05 | 10333 | ≥ 90 | 3 | 3 | 1 | 80 | 20 |
| R11 | 3 | e | 99.66 | 3.65E-09 | 3.20E-05 | 8.00E-05 | 20219 | ≥ 90 | 3 | 3 | 1 | 80 | 20 |

3AXD10000006217 H, 3AXD10000481168 A

The following temperature profile is used in safety value calculations:

- 670 on/off cycles per year with $\triangle T$ = 71.66 °C
- 1340 on/off cycles per year with $\triangle T$ = 61.66 °C
- 30 on/off cycles per year with $\triangle T$ = 10.0 °C
- 32 °C board temperature at 2.0% of time
- 60 °C board temperature at 1.5% of time
- 85 °C board temperature at 2.3% of time.

- With frame size R8, the STO is a type A safety component as defined in IEC 61508-2. With frame size R11, the STO is type B.
- 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: R8: 2 ms (typical), 15 ms (maximum), R11: 2 ms (typical), 30 ms (maximum)
- Fault detection time: Channels in different states for longer than 200 ms
- Fault reaction time: Fault detection time + 10 ms
- STO fault indication (parameter *31.22*) delay: < 500 ms
- STO warning indication (parameter *31.22*) delay: < 1000 ms

## Abbreviations

| Abbr. | Reference | Description |
|---|---|---|
| Cat. | EN ISO 13849-1 | 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. |
| CCF | EN ISO 13849-1 | Common cause failure (%) |
| DC | EN ISO 13849-1 | Diagnostic coverage |
| HFT | IEC 61508 | Hardware fault tolerance |
| $MTTF_D$ | EN ISO 13849-1 | 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 |
| $PFD_{avg}$ | IEC 61508 | Average probability of dangerous failure on demand |
| PFH | IEC 61508 | Average frequency of dangerous failures per hour |
| PL | EN ISO 13849-1 | Performance level. Levels a…e correspond to SIL |
| SC | IEC 61508 | Systematic capability |
| SFF | IEC 61508 | Safe failure fraction (%) |
| SIL | IEC 61508 | Safety integrity level (1…3) |
| SILCL | IEC/EN 62061 | Maximum SIL (level 1…3) that can be claimed for a safety function or subsystem |
| STO | IEC/EN 61800-5-2 | Safe torque off |
| $T_1$ | IEC 61508-6 | Proof test interval. $T_1$ is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of $T_1$ is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid.<br>See also section *Maintenance* (page *267*). |
| $T_M$ | EN ISO 13849-1 | Period of time covering the intended use of a safety function/device. After the mission time, the safety device(s) must be replaced. Note that any $T_M$ values given cannot be regarded as a guarantee or warranty. |

# 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 abb.com/searchchannels.

## Product training

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

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

## Document library on the Internet

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

**abb.com/drives**

ACS880-17 drives (45…400 kW, 60…450 hp) hardware manual

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