

ABB INDUSTRIAL DRIVES

ACS880-37 drives (160 to 3200 kW)

Hardware manual



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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, start-up, operate and do maintenance work on the drive. If you ignore the safety instructions, injury, death or damage can occur.

Use of warnings and notes

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

The manual uses these warning symbols:

**WARNING!**

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

**WARNING!**

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

**WARNING!**

Electrostatic sensitive devices warning tells you about the risk of electrostatic discharge which can cause damage to the equipment.

General safety in installation, start-up and maintenance

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



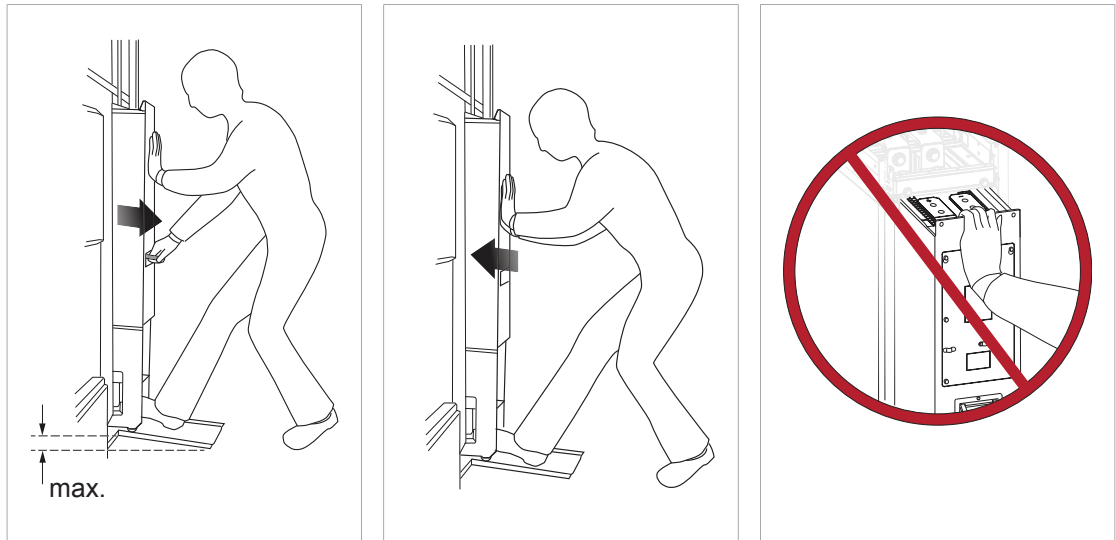
WARNING!

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

- Keep the drive in its package until you install it. After unpacking, protect the drive from dust, debris and moisture.
- Use the required personal protective equipment: safety shoes with metal toe cap, safety glasses, protective gloves and long sleeves, etc. Some parts have sharp edges.
- Lift a heavy drive with a lifting device. Use the designated lifting points. See the dimension drawings.
- Obey the local laws and regulations applicable to lifting, such as requirements for planning the lifting, for capacity and condition of lifting equipment, and for training of personnel.
- The lifting bars attached to large drive cabinets are heavy. Be careful when removing or reinstalling the bars. Whenever possible, use a lifting device attached to the designated lifting points.
- Attach the drive cabinet to the floor to prevent it from falling over. The cabinet has a high center of gravity. When you pull out heavy components or power modules, there is a risk of overturning. Attach the cabinet also to the wall when necessary.



- Do not stand or walk on the cabinet roof. Make sure that nothing presses against the roof, side or back plates or door. Do not store anything on the roof while the drive is in operation.
- Do not use the module extraction/installation ramp with plinth heights which exceeds the maximum allowed height.
- Secure the module extraction/installation ramp carefully.
- Push the module into the cabinet and pull it from the cabinet carefully preferably with help from another person. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back. Keep your fingers away from the edges of the front flange of the module.



- Do not roll the module on its wheels for a longer distance than what is required for inserting or extracting the module. To move the module to or from the vicinity of the cabinet, lay the module on its side on a pallet or equivalent, and use a forklift or pallet truck.
- Be careful when handling a tall module. The module overturns easily because it is heavy and has a high center of gravity. Whenever possible, secure the module with chains. Do not leave an unsupported module unattended especially on a sloping floor.



- Wear protective gloves and long sleeves! Some parts have sharp edges.
- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, and brake resistors, remain hot for a while after disconnection of the electrical supply.
- Vacuum clean the area around the drive before the start-up to prevent the drive cooling fan from drawing dust inside the drive.
- Make sure that debris from drilling, cutting and grinding does not go into the drive during installation. Electrically conductive debris inside the drive can cause damage or malfunction.
- Make sure that there is sufficient cooling. See the technical data.
- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.

If you cannot avoid working on a powered drive, obey the local laws and regulations on live working (including – but not limited to – electric shock and arc protection).

- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN/UL 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.
- If you have connected safety circuits to the drive (for example, Safe torque off or emergency stop), validate them at start-up. See separate instructions for the safety circuits.
- Beware of hot air exiting from the air outlets.
- Do not cover the air inlet or outlet when the drive is running.

Note:

- If you select an external source for the start command and it is on, the drive will start immediately after fault reset unless you configure the drive for pulse start. See the firmware manual.
- If the drive is in remote control mode, you cannot stop or start the drive with the control panel.
- Only authorized persons are allowed to repair a malfunctioning drive.



Electrical safety in installation, start-up and maintenance

■ Electrical safety precautions

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



WARNING!

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

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

Do these steps before you begin any installation or maintenance work.

1. Clearly identify the work location and equipment.
2. Disconnect all possible voltage sources. Make sure that re-connection is not possible. Lock out and tag out.
 - Open the main disconnecting device of the drive.
 - Open the charging switch if present.
 - Open the disconnecter of the supply transformer. (The main disconnecting device in the drive cabinet does not disconnect the voltage from the AC input power busbars of the drive cabinet.)
 - Close the grounding switch or switches ([Q9], option +F259) if present. Do not use excessive force as the switch has electromagnetic interlocking.
 - Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
 - If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
 - Disconnect all dangerous external voltages from the control circuits.
 - After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized. Use a quality voltage tester. 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).
 - Before and after you measure the installation, verify the operation of the voltage tester on a known voltage source.
 - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is zero.
 - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is zero.

Important! Repeat the measurement also with the DC voltage setting of the tester. Measure between each phase and ground. There is a risk of dangerous DC voltage charging due to leakage capacitances of the motor circuit. This



- voltage can remain charged for a long time after the drive power-off. The measurement discharges the voltage.
 - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding (PE) terminal is zero. In cabinet-built drives, measure between the drive DC busbars (+ and -) and the grounding (PE) busbar.
6. If the drive is not equipped with a grounding switch, install temporary grounding as required by the local regulations.
 7. Ask for a permit to work from the person in control of the electrical installation work.

■ Additional instructions and notes



WARNING!

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

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

- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.
- Make sure that the electrical power network, motor/generator, and environmental conditions agree with the drive data.
- Do not do insulation or voltage withstand tests on the drive.
- If you have a cardiac pacemaker or other electronic medical device, keep away from the area near motor, drive, and the drive power cabling when the drive is in operation. There are electromagnetic fields present which can interfere with the function of such devices. This can cause a health hazard.
- ABB does not recommend attaching the cabinet by arc welding. If you have to, obey the welding instructions in the drive manuals.

Note:

- When the drive is connected to the input power, the motor cable terminals and the DC bus are at a dangerous voltage.
The brake circuit, including the brake chopper (option +D150) and brake resistor (option +D151) are also at a dangerous voltage.
After disconnecting the drive from the input power, these remain at a dangerous voltage until the intermediate circuit capacitors have discharged.
 - External wiring can supply dangerous voltages to the relay outputs of the control units of the drive.
 - The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.
-



Optical components



WARNING!

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

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

Printed circuit boards



WARNING!

Use a grounding wristband when you handle printed circuit boards. Do not touch the boards unnecessarily. The boards contain components sensitive to electrostatic discharge.

■ Grounding

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



WARNING!

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

If you are not a qualified electrical professional, do not do grounding work.

- Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety.
 - Make sure that the conductivity of the protective earth (PE) conductors is sufficient and that other requirements are met. See the electrical planning instructions of the drive. Obey the applicable national and local regulations.
 - When using shielded cables, make a 360° grounding of the cable shields at the cable entries to reduce electromagnetic emission and interference.
 - In a multiple-drive installation, connect each drive separately to the protective earth (PE) busbar of the power supply.
-



General safety in operation

These instructions are for all personnel that operate the drive.



WARNING!

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

- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.
- If you have a cardiac pacemaker or other electronic medical device, keep away from the area near motor, drive, and the drive power cabling when the drive is in operation. There are electromagnetic fields present which can interfere with the function of such devices. This can cause a health hazard.
- Give a stop command to the drive before you reset a fault. If you have an external source for the start command and the start is on, the drive will start immediately after the fault reset, unless you configure the drive for pulse start. See the firmware manual.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN/UL 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

Note:

- 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. If you need to start or stop the drive, use the control panel keys or commands through the I/O terminals of the drive.
- If the drive is in remote control mode, you cannot stop or start the drive with the control panel.

Additional instructions for permanent magnet motor drives

■ Safety in installation, start-up, maintenance

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



WARNING!

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

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

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

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

- Stop the drive.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like belt, nip, rope, etc.
- Do the steps in section [Electrical safety precautions](#) (page 21).
- Install temporary grounding to the drive output terminals (T1/U, T2/V, T3/W). Connect the output terminals together as well as to the PE.

During the start-up:

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

■ Safety in operation



WARNING!

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





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, commission and do maintenance work on the drive, or create instructions for the end user of the drive concerning the installation and maintenance of the drive.

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

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. The frame size indicates the number of power modules that form the supply and inverter units respectively.

For example, the marking “2×R8i + 2×R8i” refers to a drive that has a supply unit consisting of two frame R8i supply modules and an inverter unit consisting of two frame R8i inverter modules. The frame size is marked on the type designation label, and can also be determined from the type code.

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. The option selections are listed in section [Type designation key](#) (page 58).

Use of component designations

Some device names in the manual include the component designation in brackets (for example, [Q20]). This will help you to identify the components in the circuit diagrams of the drive.

Quick installation, commissioning and operation flowchart

Task	See
<p>Plan the electrical installation and acquire the accessories needed (cables, fuses, etc.).</p> <p>Check the ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.</p>	<p>Guidelines for planning the electrical installation (page 89)</p> <p>Technical data (page 213)</p>
↓	
<p>Check the installation site.</p>	Ambient conditions (page 233)
↓	
<p>Unpack and check the drive (only intact units may be started up).</p> <p>Make sure that all necessary optional modules and equipment are present and correct.</p> <p>Install the drive mechanically.</p>	Mechanical installation (page 65)
↓	
<p>Route the cables.</p>	Routing the cables (page 104)
↓	
<p>If the drive is about to be connected to an IT (ungrounded) system, check that the drive is <u>not</u> equipped with EMC filter +E202.</p>	Compatibility check - IT (ungrounded) earthing system (page 116)
↓	
<p>Connect the power cables.</p> <p>Connect the control cables.</p>	Electrical installation (page 115)
↓	
<p>Check the installation.</p>	<p>Installation checklist (page 173)</p> <p>If the drive has been non-operational for more than one year, reform the DC link capacitors. See Converter module capacitor reforming instructions (3BFE64059629 [English]).</p>
↓	
<p>Start the drive up.</p>	Start-up (page 175)
↓	
<p>Operate the drive: start, stop, speed control etc.</p>	ACS880 quick start-up guide, firmware manual

Terms and abbreviations

Term/ Abbreviation	Description
ACS-AP-I	Industrial assistant non-Bluetooth control panel
ATEX	Directives 2014/34/EU and 1999/92/EC are commonly referred to as the ATEX directives (from "Atmosphères Explosibles")
BAMU	Auxiliary measurement unit
BCU	Type of control unit
Brake chopper	Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
Brake resistor	Dissipates the drive surplus braking energy conducted by the brake chopper to heat
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EMT	Electrical metallic tubing, type of cable conduit
FAIO-01	Analog I/O extension module
FCAN-01	Optional CANopen® adapter module
FCNA-01	Optional ControlNet™ adapter module
FDCO-01	DDCS communication module with two pairs of 10 Mbit/s DDCS channels
FDIO-01	Optional digital I/O extension module
FDNA-01	Optional DeviceNet™ adapter module
FEA-03	Optional I/O extension adapter
FECA-01	Optional EtherCAT® adapter module
FEIP-21	Optional Ethernet adapter module for EtherNet/IP™
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-21	Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
FEPL-02	Optional Ethernet POWERLINK adapter module
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FMBT-21	Optional Ethernet adapter module for Modbus TCP protocol
FPBA-01	Optional PROFIBUS DP® adapter module
FPNO-21	Optional PROFINET IO adapter module
FPTC-01	Optional thermistor protection module
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres
Frame, frame size	Physical size of the drive or power module
FSCA-01	Optional RS-485 (Modbus/RTU) adapter
FSE-31	Optional pulse encoder interface module for safety encoder
FSO-12, FSO-21	Optional functional safety modules
IGBT	Insulated gate bipolar transistor
Inverter unit	Inverter module(s) under control of one control unit, and related components. One inverter unit typically controls one motor.
Power module	Common term for drive module, inverter module, supply module, brake chopper module etc.
RFI	Radio-frequency interference
SAR	Safe acceleration range

Term/ Abbreviation	Description
SBC	Safe brake control
SLS	Safely-limited speed
SS1	Safe stop 1 (IEC/EN 61800-5-2)
SSE	Safe stop emergency
SSM	Safe speed monitor
STO	Safe torque off (IEC/EN 61800-5-2)
Supply unit	Supply module(s) under control of one control unit, and related components.
UCU	Type of control unit

Related manuals

You can find manuals on the Internet. See below for the relevant code/link. For more documentation, go to www.abb.com/drives/documents.



ACS880-37 (160 to 3200 kW) manuals

3

Operation principle and hardware description

Contents of this chapter

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

The ACS880-37 is a low-harmonic, air-cooled, cabinet-installed drive for controlling asynchronous AC induction motors, permanent magnet synchronous motors, AC induction servomotors and ABB synchronous reluctance (SynRM) motors.

The drive consists of several cubicles that contain

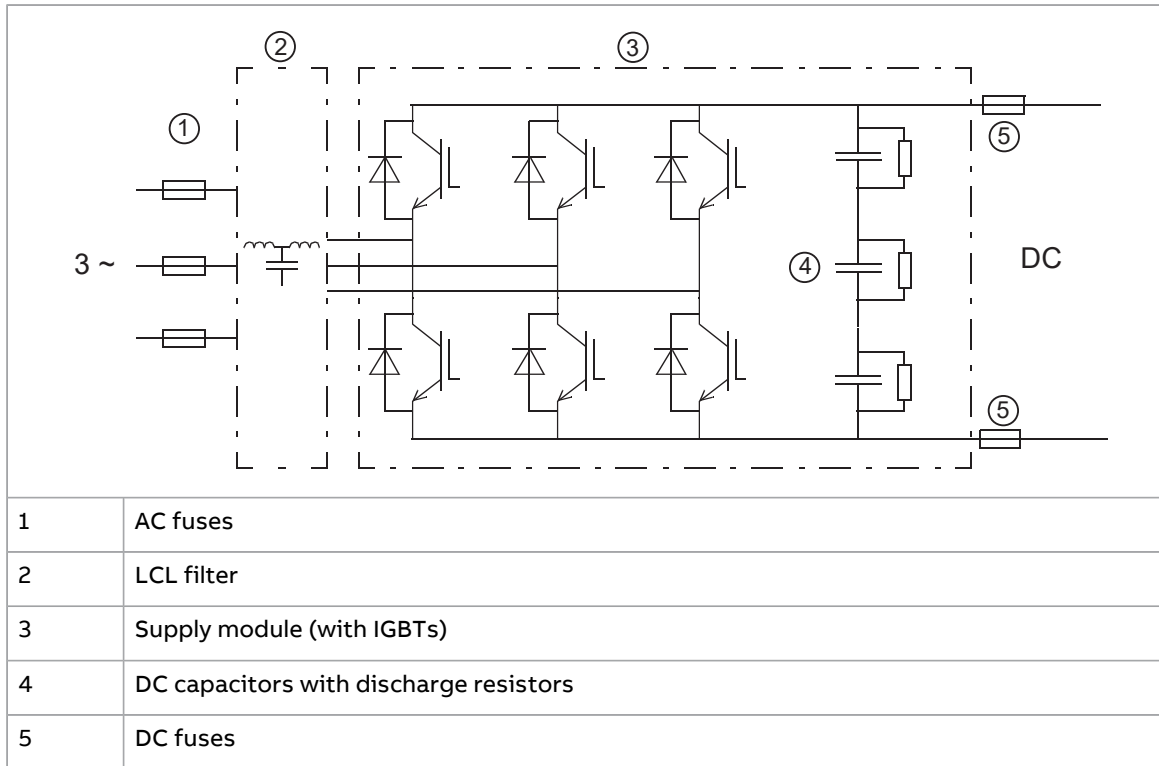
- the supply and motor terminals
- 1 to 6 IGBT supply module(s) forming the supply unit (line-side converter)
- 1 to 6 inverter modules forming the inverter unit (motor-side converter)
- optional equipment.

The actual arrangement of the cubicles varies from type to type and the selected options. Some optional equipment require additional cubicles. See chapter *Dimensions* for examples of cabinet line-ups.

Supply unit

The supply unit rectifies three-phase AC current to direct current for the intermediate DC link of the drive.

The following figure shows the simplified main circuit diagram of the supply unit. Larger drives have supply units that consist of multiple supply modules connected in parallel.



■ **AC voltage and current waveforms**

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

■ **Charging**

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

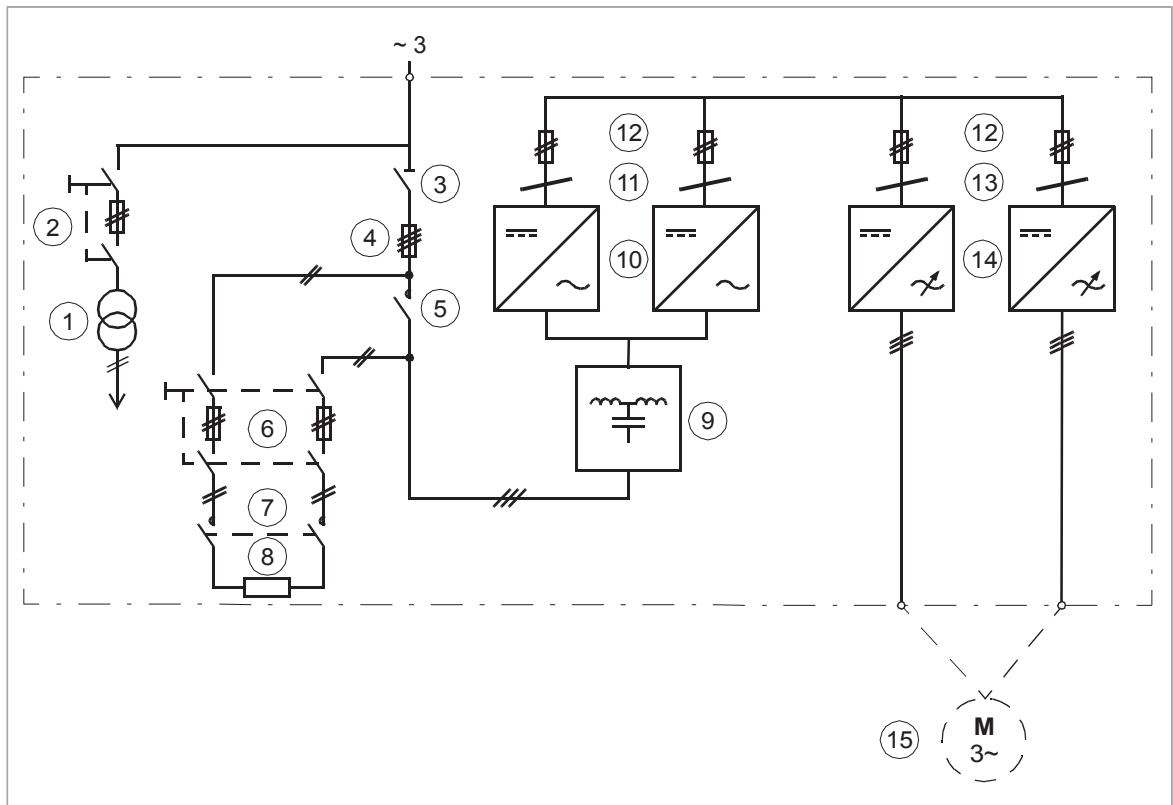
■ **Licensing**

Each supply module has a hardware license (+N8201) which allows the module to be used as an ACS880-37 supply module only. For example, a module with +N8201 cannot be used as an inverter module. On the other hand, it is possible to use a module without +N8201 as a spare part for an ACS880-37 supply module as long as the types of the modules are otherwise the same.

Inverter unit

The inverter unit 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.

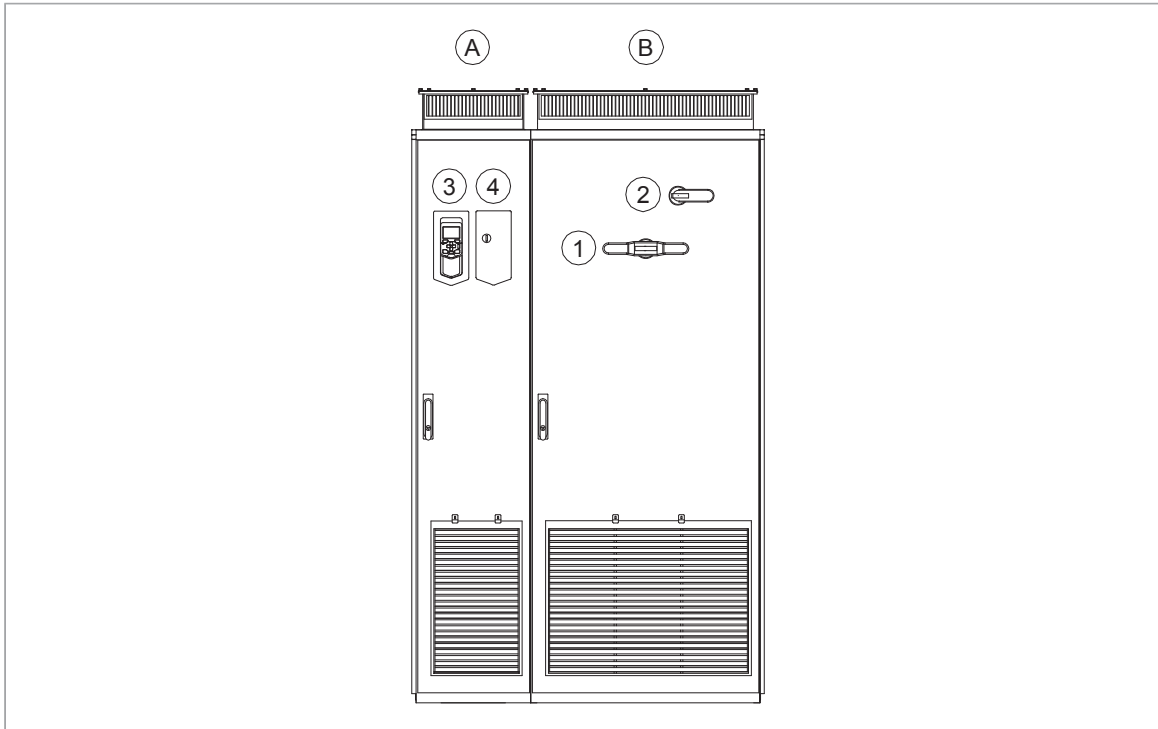
Overview circuit diagram of the drive



1	Auxiliary voltage transformer(s)
2	Auxiliary voltage switch [Q21]. Frame 1×R8i+1×R8i has fuse disconnectors [F20.x] in place of an auxiliary voltage switch. The auxiliary voltage is switched by the main switch/disconnector.
3	*Main switch/disconnector [Q1.1]
4	*AC fuses [F1.x]. If the drive has multiple LCL filters, there are additional AC fuses at the input of each filter.
5	*Main contactor [Q2]
*Some drive types can be ordered with a main circuit breaker (or are equipped with a main circuit breaker as standard) [Q1]. In that case, the AC fuses are located at the input of each LCL filter.	
6	Charging switch [Q3] and fuses
7	Charging contactor [Q4]
8	Charging resistors [R4.x]
9	LCL filter [R3.x]
10	Supply module(s) [T1.x]. The diagram shows two modules connected in parallel.
11	Common mode filters [R1.x] at the output of each supply module
12	DC fuses at the output of each supply module [F2.x], and at the input of each inverter module [F11.x]. Frame 1×R8i+1×R8i drives do not have DC fuses.
13	Common mode filters [R11.x] at the input of each inverter module (except frame 1×R8i+1×R8i)
14	Inverter unit consisting of one or several inverter modules [T11.x]
15	Motor

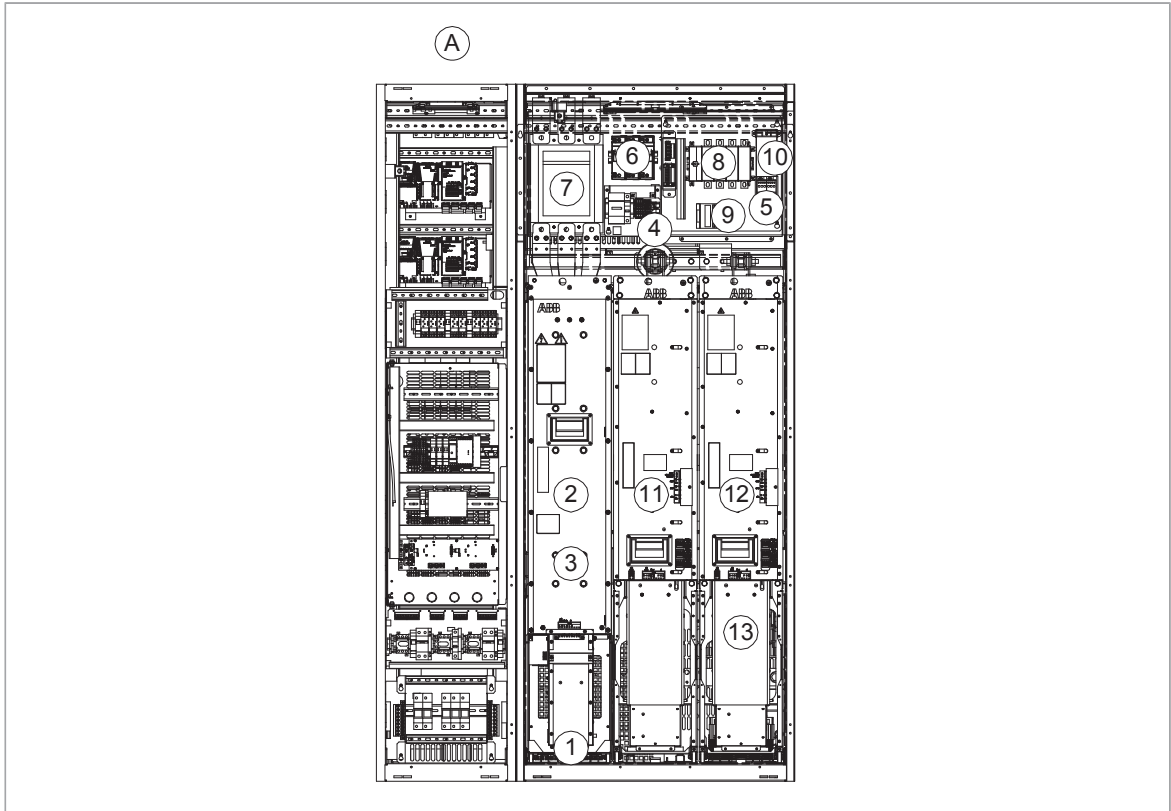
Cabinet line-up and layout examples

■ Frame 1×R8i+1×R8i



Cabinet line-up example

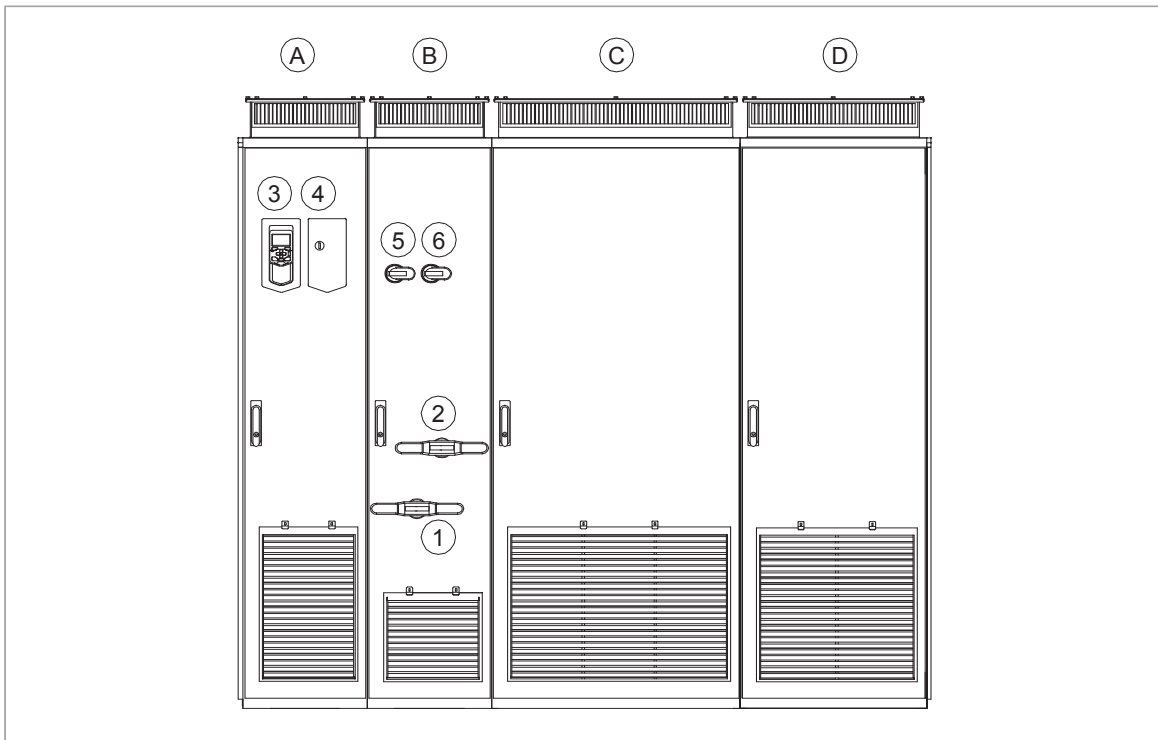
A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section Auxiliary control cubicle (ACU) layout (page 40) .
B	Supply and inverter module cubicle. Contains the supply module, LCL filter, inverter module and switchgear, as well as the power cable terminals.
1	Main switch-disconnector (Q1.1)
2	Charging switch [Q3]
3	Drive control panel. See section Control panel (page 47) .
4	Door switches and lights. See section Door switches and lights (page 45) .



Cabinet layout example

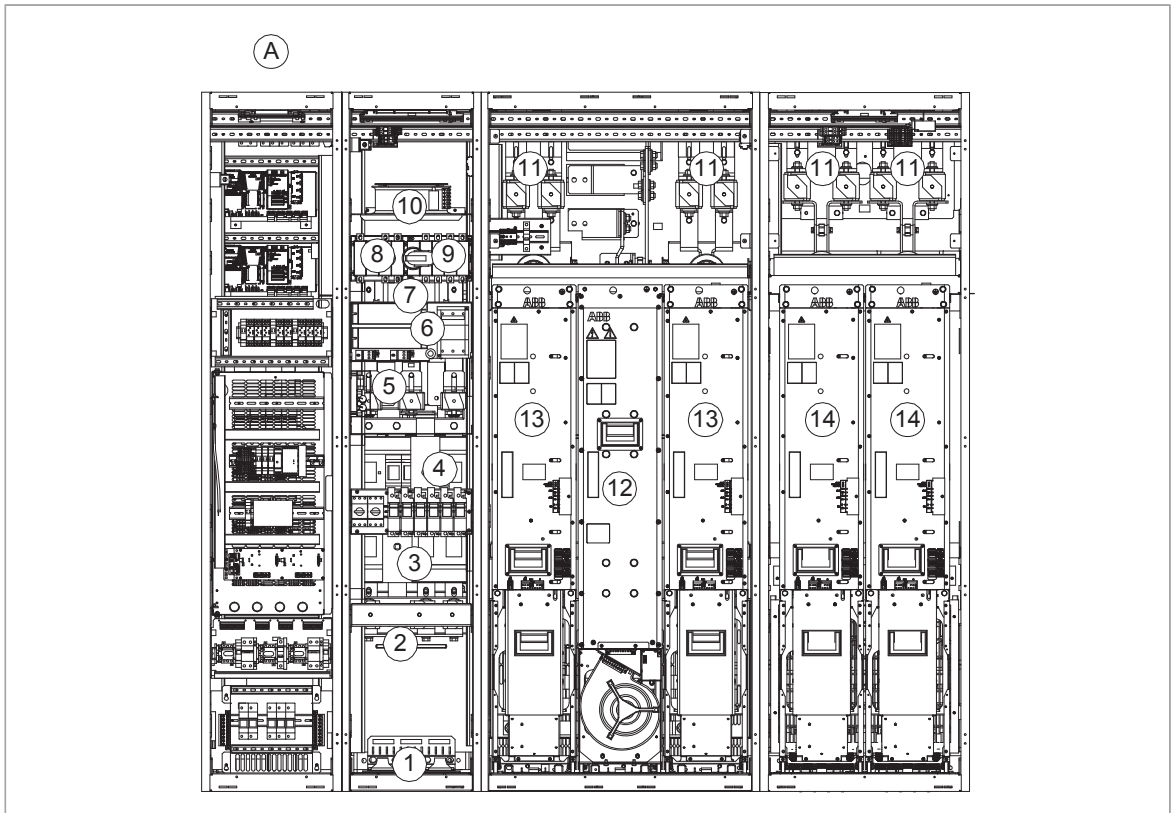
A	Auxiliary control cubicle (ACU). See section <i>Auxiliary control cubicle (ACU) layout</i> (page 40).
1	Input cable lead-throughs, PE busbar
2	LCL filter module
3	Input terminals (behind LCL filter module)
4	Main switch/disconnector [Q1.1] (behind mounting plate)
5	AC fuses (behind mounting plate)
6	Fuse disconnectors for auxiliary voltage [F20.x]
7	Main contactor [Q2.1]
8	Charging fuse switch [Q3]
9	Charging contactor
10	Charging resistors
11	Supply module
12	Inverter module
13	Output terminals (behind inverter module)

■ **Frame 2×R8i+2×R8i**



Cabinet line-up example

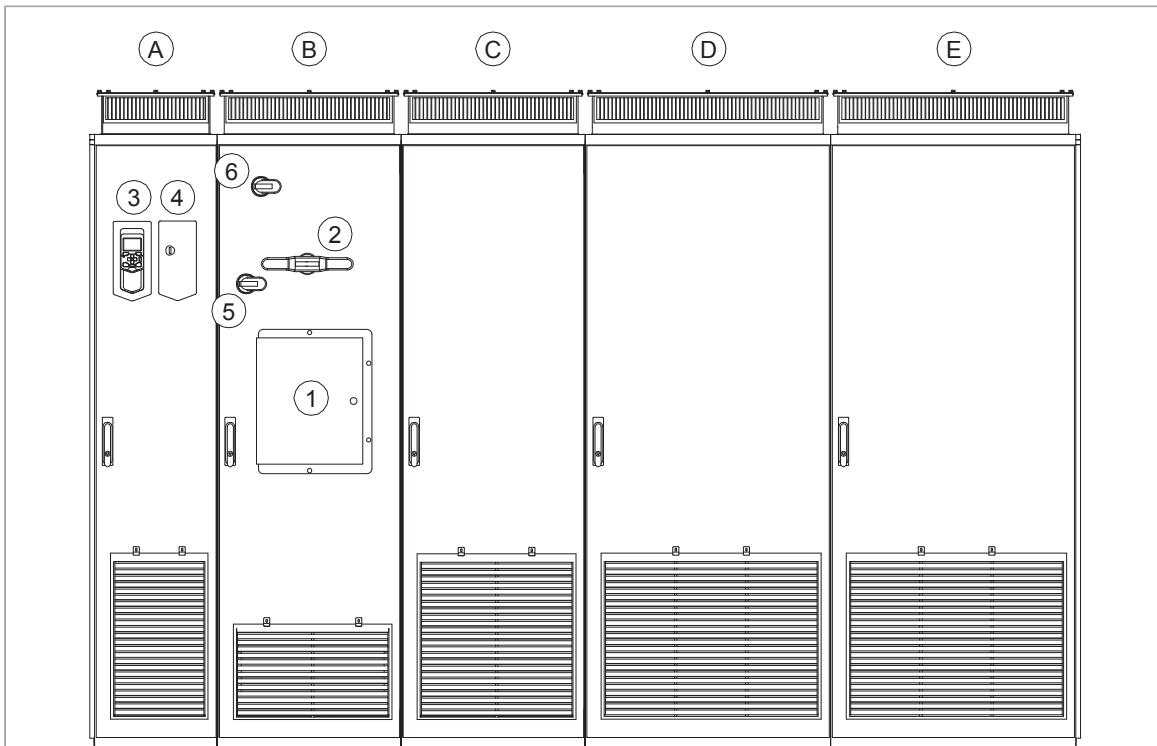
A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section <i>Auxiliary control cubicle (ACU) layout</i> (page 40).
B	Incoming cubicle. Contains the input terminals, switchgear and charging equipment.
C	Supply module cubicle. Contains two R8i supply modules together with an LCL filter module.
D	Inverter module cubicle. Contains two R8i inverter modules. As standard, the motor cables are run from each inverter module to the motor unless the drive is equipped with option +H359 (common motor terminal cubicle), +H366 (common output terminals) or +E206 (sine filters).
1	Main switch-disconnector (Q1.1)
2	Grounding/earthing switch [Q9.1] (option +F259)
3	Drive control panel. See section <i>Control panel</i> (page 47).
4	Door switches and lights. See section <i>Door switches and lights</i> (page 45).
5	Auxiliary voltage switch [Q21]
6	Charging switch [Q3]



Cabinet layout example

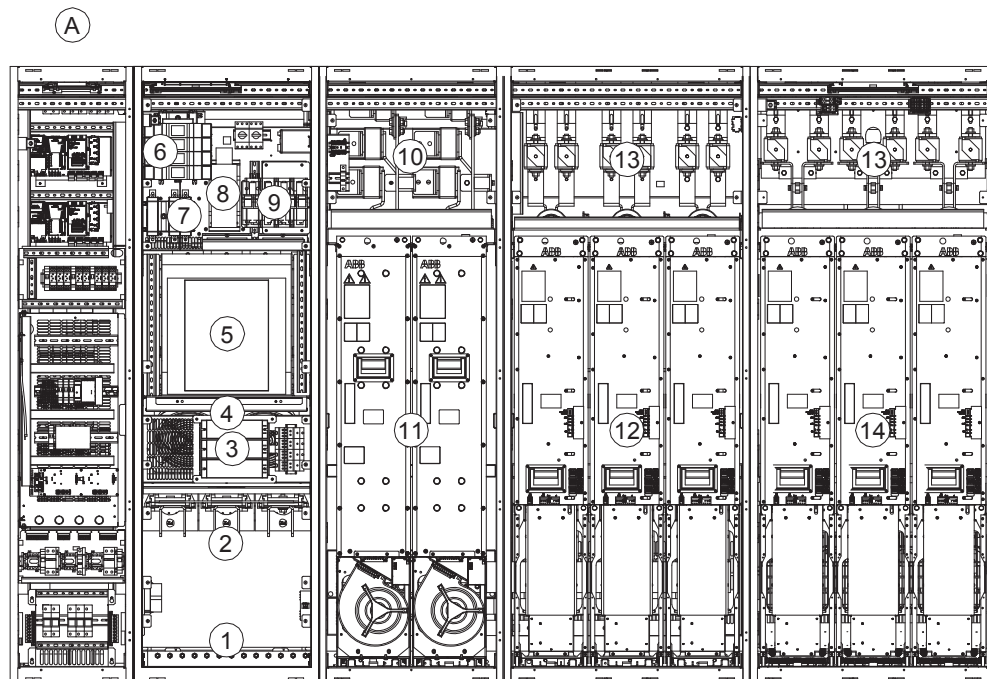
A	Auxiliary control cubicle (ACU). See section Auxiliary control cubicle (ACU) layout (page 40) .
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Main switch-disconnector (Q1.1)
4	Grounding/earthing switch [Q9.1] (option +F259)
5	AC fuses
6	Charging resistors and contactor
7	Main contactor (behind charging equipment)
8	Auxiliary voltage switch [Q21]
9	Charging switch [Q3]
10	Incoming cubicle cooling fan
11	DC fuses (at the output of each supply module and at the input of each inverter module)
12	LCL filter module
13	Supply modules
14	Inverter modules. The output terminals are located behind each module. Each module must be individually connected to the motor using separate cables unless the drive is equipped with option +H359 (common motor terminal cubicle), +H366 (common output terminals) or +E206 (sine filters).

■ **Frame 3×R8i+3×R8i (with main breaker, option +F255)**



Cabinet line-up example

A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section <i>Auxiliary control cubicle (ACU) layout</i> (page 40).
B	Incoming cubicle. Contains the input terminals, switchgear and charging equipment.
C	Supply module cubicle (1). Contains two LCL filter modules.
D	Supply module cubicle (2). Contains three R8i supply modules.
E	Inverter module cubicle. Contains three R8i inverter modules. As standard, the motor cables are run from each inverter module to the motor unless the drive is equipped with option +H359 (common motor terminal cubicle), +H366 (common output terminals) or +E206 (sine filters).
1	Main switch-disconnector (Q1.1)
2	Grounding/earthing switch [Q9.1] (option +F259)
3	Drive control panel. See section <i>Control panel</i> (page 47).
4	Door switches and lights. See section <i>Door switches and lights</i> (page 45).
5	Auxiliary voltage switch [Q21]
6	Charging switch [Q3]

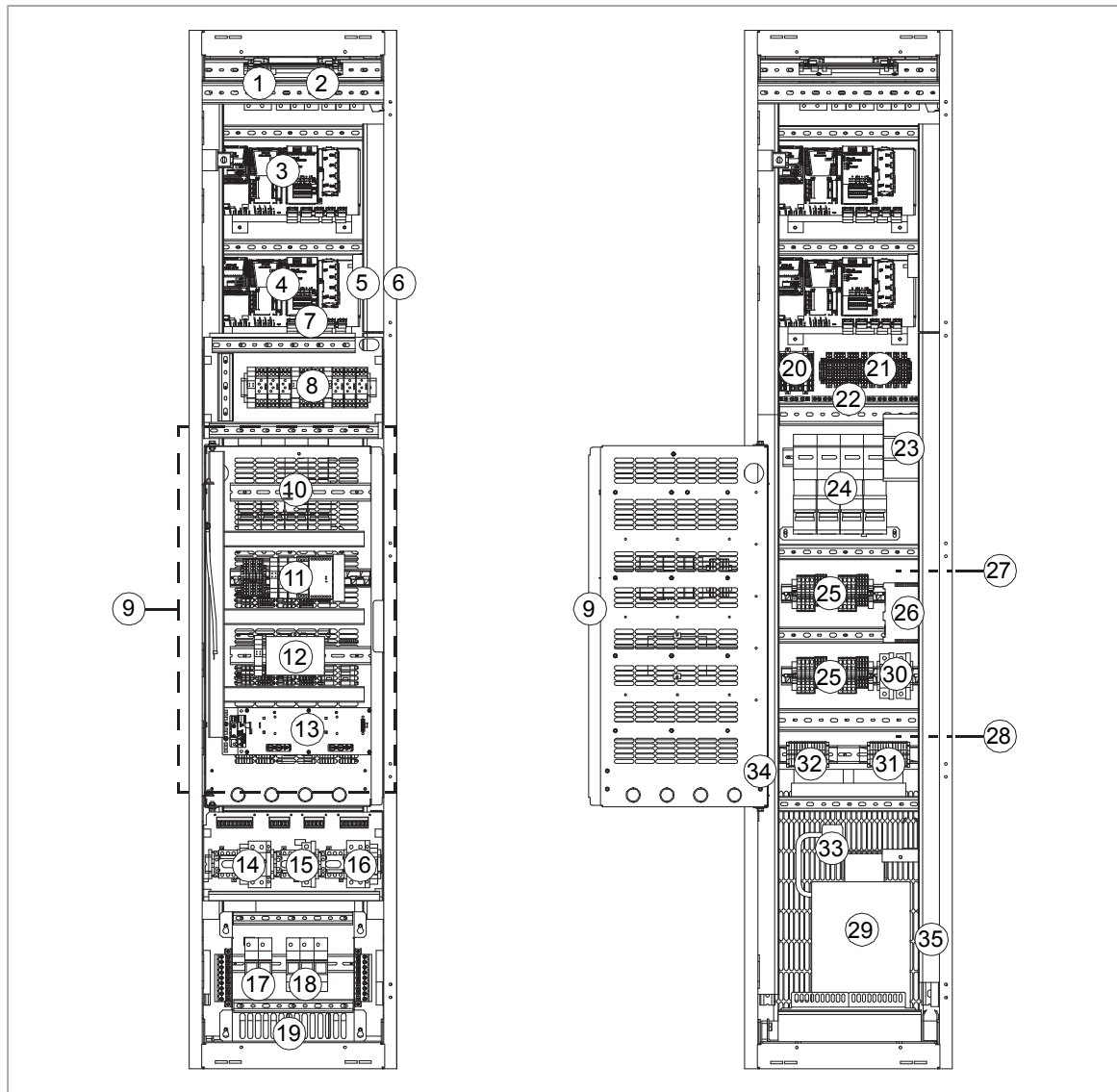


Cabinet layout example

A	Auxiliary control cubicle (ACU). See section <i>Auxiliary control cubicle (ACU) layout</i> (page 40).
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Charging resistors
4	Incoming cubicle cooling fans (behind the charging resistor mounting plate)
5	Main breaker [Q1]
6	Charging switch [Q3]
7	Auxiliary voltage switch [Q21]
8	Grounding/earthing switch [Q9.1] (option +F259)
9	Charging contactor (behind auxiliary equipment)
10	AC fuses
11	LCL filter modules
12	Supply modules
13	DC fuses (at the output of each supply module and at the input of each inverter module)
14	Inverter modules. The output terminals are located behind each module. Each module must be individually connected to the motor using separate cables unless the drive is equipped with option +H359 (common motor terminal cubicle), +H366 (common output terminals) or +E206 (sine filters).

■ **Auxiliary control cubicle (ACU) layout**

A layout example of the auxiliary control cubicle (ACU) is shown below. On the left: Swing-out frame closed, detachable mounting plates in place. On the right: Swing-out frame open, without detachable mounting plates.

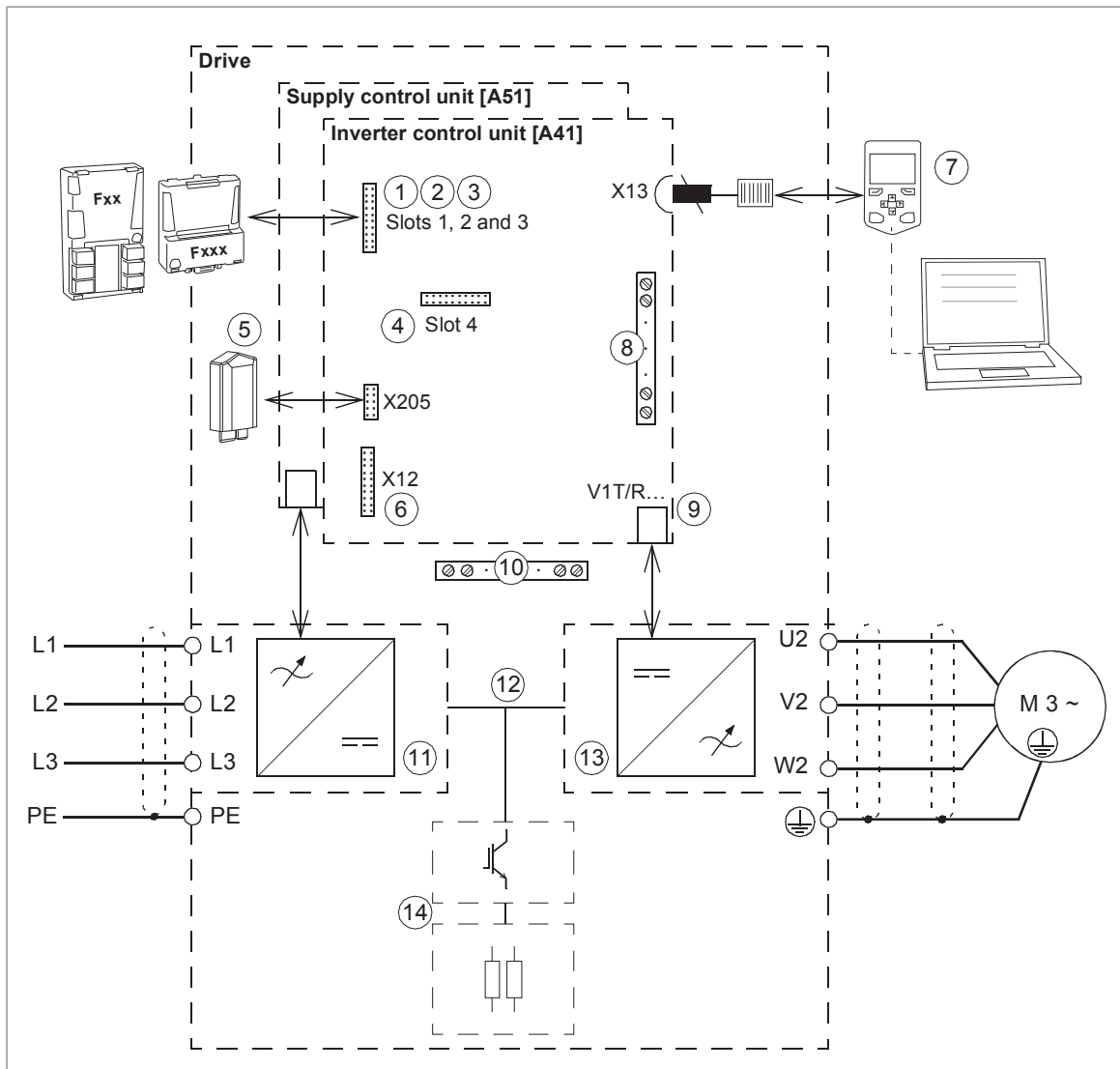


1	Fuse-disconnectors F101. On the primary of transformer T101 (item 27).	19	Lead-through for control cables
2	Fuse-disconnectors (F27) for motor cooling fan outputs (options +M602...610)	20	Terminal block (X68) for FSO-xx safety functions module (option +Q972 or +Q973)
3	Supply control unit (A51). See chapter <i>Control units of the drive</i> (page 147).	21	I/O terminal block (option +L504). The I/O of the inverter control unit is wired to this block.
4	Inverter control unit (A41). Three optional I/O extension, encoder interface, or fieldbus adapter modules can be installed on the unit. Additional modules are installed on item 13. See chapter <i>Control units of the drive</i> (page 147).	22	Grounding/clamping point for control cables
5	Auxiliary voltage circuit breaker F112. On the secondary of transformer T111 (item 29). Mounted on the right-hand inside wall.	23	24 V DC power supply and buffer module

6	Switch (F90) for ground fault monitoring (item 12)	24	Motor fan starters and contactors (options +M602...610)
7	FSO-xx safety functions module (option +Q972 or +Q973 and other options requiring FSO-xx)	25	Terminal blocks (X601) for motor fan connections (options +M602...610)
8	Temperature monitoring relays (options +L505 and +L506). The terminals (X506) are located on the back of the detachable mounting plate.	26	24 V DC power supply for cabinet lighting (option +G301)
9	Swing-out frame	27	Auxiliary voltage transformer T101 (at the back of the cubicle, not visible). Supplies IP54, brake chopper and brake resistor cabinet cooling fans (options +B055, +D150 and +D151).
10	Mounting rail for additional equipment	28	Auxiliary voltage transformer T21 (at the back of the cubicle, not visible). Supplies the control circuitry and the cooling fans in both the incoming unit (ICU) and the auxiliary control unit (ACU).
11	Safety relays for safety options (emergency stop, safe torque off)	29	Auxiliary voltage transformer T111. (Customized equipment only.)
12	Ground fault monitoring equipment for ungrounded systems (option +Q954)	30	Auxiliary voltage circuit breakers F22 and F102. On the secondary of transformers T21 (item 28) and T101 (item 27) respectively.
13	FEA-03 extension adapter (option +L515).	31	Input voltage setting for auxiliary voltage transformer T101 (item 27)
14	Switch and circuit breaker for externally-supplied motor space heater (option +G313). The terminals (X313) are located on the back of the detachable mounting plate.	32	Input voltage setting for auxiliary voltage transformer T21 (item 28)
15	Switch and circuit breaker for externally-supplied control voltage (option +G307), eg. UPS. The terminals (X307) are located on the back of the detachable mounting plate.	33	Input voltage setting for auxiliary voltage transformer T111 (item 29)
16	Switch and circuit breaker for externally-supplied cabinet lighting and heating (options +G300 and +G301). The terminals (X300) are located on the back of the detachable mounting plate.	34	Terminal blocks X250: indication of main switch-disconnector and contactor status X951: connection of external emergency stop button X954: ground fault alarm indication X957: for connection of Prevention of unexpected start-up switch. Mounted on the left-hand side wall.
17	Fuse-disconnectors F21. On the primary of transformer T21 (item 28). Mounted on a detachable plate.	35	Cubicle heater element (option +G300). Mounted on the right-hand side wall.
18	Fuse-disconnectors F111. On the primary of transformer T111 (item 29). Mounted on a detachable plate.		

Overview of power and control connections (BCU-x2)

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

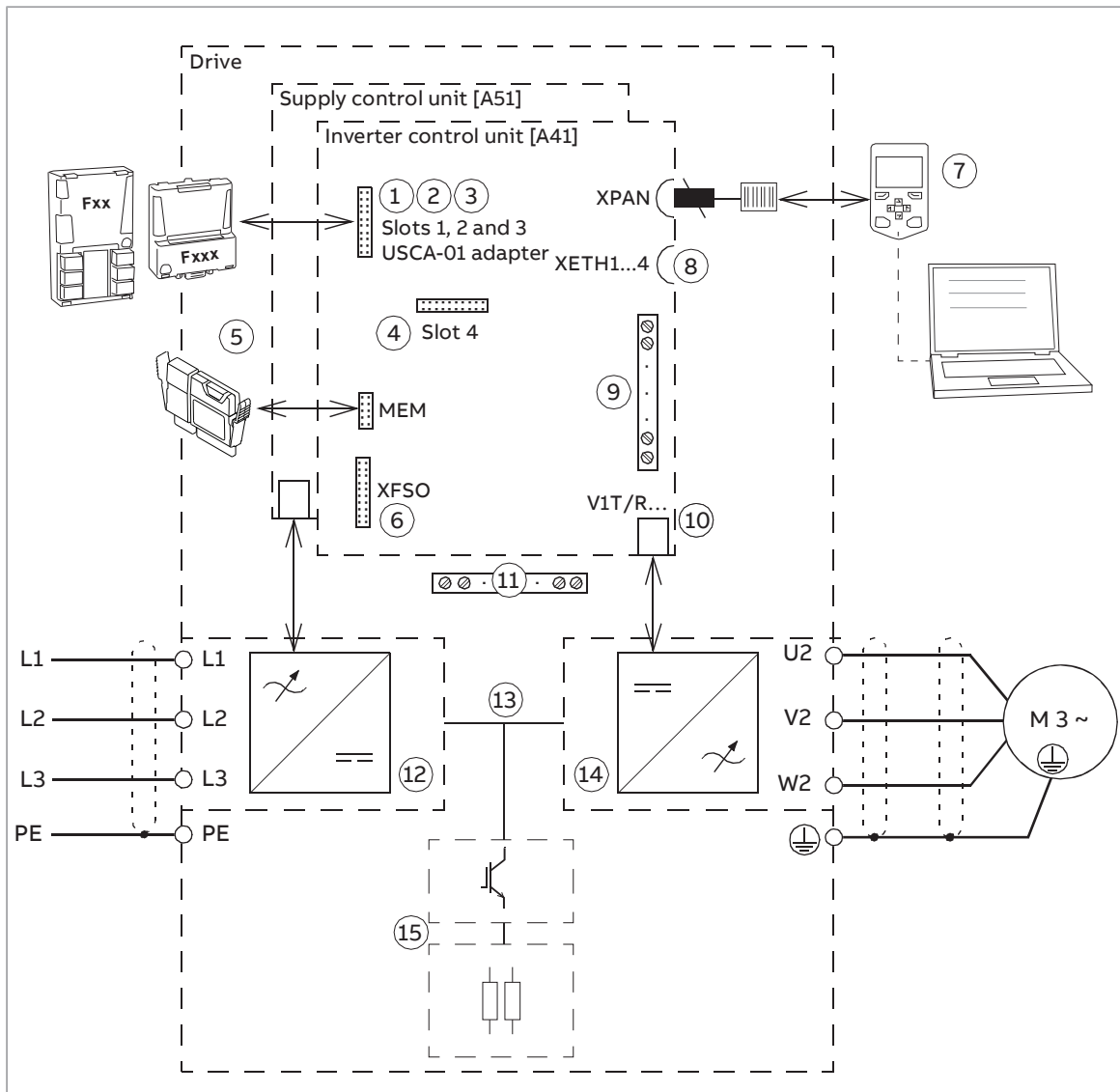


1	Option modules can be inserted into slots 1, 2, 3 and 4 as follows:	
2	Module type	Slots
3		
4	Analog and digital I/O extension modules	1, 2, 3
	Feedback interface modules	1, 2, 3
	Fieldbus communication modules	1, 2, 3
	RDCO-04 DDCS communication option module (standard equipment). As standard, a fiber optic link connects the supply and inverter control units.	4
	Additional modules can be installed on an optional FEA-03 extension adapter connected to an RDCO module on slot 4.	
5	Memory unit	
6	Connection for FSO safety functions module	
7	Control panel and PC connection	
8	Terminal blocks on the inverter control unit. These terminals are optionally wired to terminal block X504 in the auxiliary control cabinet of the drive.	

9	Fiber optic link to each inverter module. Similarly, each supply module is connected to the supply control unit by fiber optic cables.
10	Terminal blocks for customer connections installed in the drive cabinet. For the locations, see section <i>Auxiliary control cubicle (ACU) layout</i> (page 40).
11	Supply unit (consisting of one or more supply modules)
12	DC intermediate link
13	Inverter unit (consisting of one or more inverter modules)
14	Optional brake chopper (+D150) and resistors (+D151)

Overview of power and control connections (UCU-22...26)

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




1	Option modules can be inserted into slots 1, 2, 3 and 4 as follows:	
2	Module type	Slots
3	Analog and digital I/O extension modules	1, 2, 3
4	Encoder interface modules	1, 2, 3
	Fieldbus communication modules	1, 2, 3
	RDCO-04 DDCS communication option module (standard equipment). As standard, a fiber optic link connects the supply and inverter control units.	4
	Additional modules can be installed on an optional FEA-03 extension adapter connected to an RDCO module on slot 4.	
5	Memory unit	
6	Not in use	
7	Control panel and PC connection	

8	Ethernet ports for fieldbus communication (XETH 1...2) and tool communication (XETH 3...4). Not in use.
9	Terminal blocks on the inverter control unit. These terminals are optionally wired to terminal block X504 in the auxiliary control cabinet of the drive.
10	Fiber optic link to each inverter module. Similarly, each supply module is connected to the supply control unit by fiber optic cables.
11	Terminal blocks for customer connections installed in the drive cabinet. For the locations, see section <i>Auxiliary control cubicle (ACU) layout</i> (page 40).
12	Supply unit (consisting of one or more supply modules)
13	DC intermediate link
14	Inverter unit (consisting of one or more inverter modules)
15	Optional brake chopper (+D150) and resistors (+D151)

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	ENABLE / RUN 0-1 	-	Run enable signal switch for the supply unit	
			0	Run enable signal off (starting the supply unit not allowed)
			1	Run enable signal on (starting the supply unit allowed). Close the main disconnecting device (if present).
5	E-STOP RESET	-	Emergency stop reset push button (with emergency stop options only)	
6	EARTH FAULT	-	Ground (earth) fault light and reset push button (option +Q954)	
7	-	-	Reserved for order-based engineered equipment	
8	EMERGENCY STOP	-	Emergency stop push button (with emergency stop options only)	

The layout depends on the options selected.

■ Main disconnecting device (Q1.1)

Depending on the configuration of the drive, the main disconnecting device of the drive is either a switch-disconnector or a main circuit breaker. Units with a switch-disconnector also have a main contactor.

The main disconnecting device switches the main supply to the drive on and off. To disconnect the main supply, turn the switch-disconnector to the 0 (OFF) position, or rack out the main breaker (whichever device is installed).



WARNING!

The main disconnecting device does not isolate the input power terminals, AC voltage meters, or the auxiliary voltage circuit from the power line. To isolate the auxiliary voltage circuit, open the auxiliary voltage switch (Q21). To isolate the input power terminals and AC voltage meters, open the main breaker of the supply transformer.

To close the main disconnecting device, auxiliary voltage must be switched on, and the grounding switch (if present) must be open.

■ Auxiliary voltage switch [Q21]

The auxiliary voltage switch controls the supply to the internal auxiliary voltage transformers. The transformer feeds the control circuits inside the drive such as cooling fans, relays and measuring equipment.

Note: Frame 1×R8i+1×R8i units are not fitted with an auxiliary voltage switch. The auxiliary voltage is switched on and off by the main disconnecting device [Q1], and protected by fuse disconnectors F20.1...F20.3.

■ Grounding (earthing) switch [Q9], optional

The grounding switch [Q9] (option +F259) connects the main AC power bus to the PE busbar.

To close the grounding switch, auxiliary voltage must be switched on, and the main disconnecting device must be open.

**WARNING!**

The grounding switch does not ground the input power terminals of the drive or the auxiliary (control) voltage circuits.

■ 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 switch or breaker.

- AC current meter (option +G335) on one phase.

■ Control panel

The ACS-AP-W 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 inverter control program.

The control panel can be removed by pulling it forward by the top edge and reinstalled in reverse order. For the use of the control panel, see ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels 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 options

Note: All options are not available for all drive types, are not compatible with some other options, or require additional engineering.

■ 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 (UL Type 1)

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 (UL Type 1 Filtered) (option +B054)

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

IP54 (UL Type 12) (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.

■ Marine construction (option +C121)

The option includes the following accessories and features by default:

- 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 fastening
 - fastening brackets at the top of the cabinet.
-

Marine product certifications may require additional wire markings. Refer to section [Wire markings \(page 51\)](#).

■ **Cooling air inlet through bottom of cabinet (option +C128)**

See section [Air inlet through the bottom of the cabinet \(option +C128\) \(page 81\)](#).

■ **UL Listed (option +C129)**

The cabinet contains the following accessories and features:

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

■ **Channeled air outlet (option +C130)**

This option provides a collar for connection to 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.

With option +B055, this option also provides the cabinet air inlets with filter housings containing folded board air filter mats between the inner and outer metallic gratings.

See also section [Air outlet duct on the cabinet roof \(option +C130\) \(page 82\)](#).

■ **CSA Approved (option +C134)**

The option includes the following accessories and features:

- bottom entry and exit of cables with US cable conduit entry (plain plate without ready-made holes)
- all components UL/CSA listed/recognized
- maximum supply voltage 600 V
- main (air circuit) breaker when available for the particular drive type.

■ **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)**

The 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 S_{DS} (installation site specific spectral acceleration response) must not exceed 2.0 *g*.

The option adds the following accessories and features:

- reinforced mechanics
 - flat bars at base of the cabinet for fastening.
-

■ **Empty cubicles on left (options +C199...C201)**

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

The cubicle is equipped with blank panel entries (full panel or two-half panels) on the back.

■ **EMC filter (option +E202)**

EMC filter for 1st Environment (category C2) for TN (grounded) system.

■ **du/dt filter**

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 \(page 92\)](#).

■ **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 and has a dedicated cooling fan.

■ **Cabinet heater with external supply (option +G300)**

The option contains:

- heating elements in the cubicles or supply/inverter modules
- load switch for providing electrical isolation during service
- miniature circuit breaker for overcurrent protection
- terminal block for external power supply.

The heater prevents condensation inside the cabinet when the drive is not in operation. The power output of the heating elements increases when the surrounding air temperature is low and decreases when the surrounding air temperature is high. The customer must stop the heating when it is not needed by disconnecting the heater supply voltage.

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

For the actual wiring, see the circuit diagrams delivered with drive.

■ **Cabinet lighting (option +G301)**

This option contains LED lighting fixtures in each cubicle (except joining and brake resistor cubicles) 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 control voltage (option +G307)**

The option provides terminals for connecting an external uninterruptible control voltage to the control unit and control devices when the drive is not powered.

See also:

- [Supplying power for the auxiliary circuits \(page 110\)](#)
- 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 heater and external heater supply connection.

When the drive is powered (and not faulted), the heater is switched off. Otherwise, the heater is controlled by the external supply voltage.

The power and voltage of the heater depend on the motor.

See also:

- [Supplying power for the auxiliary circuits \(page 110\)](#)
- circuit diagrams delivered with drive for the actual wiring.

■ **Supply connection by busbars (option +G317)**

This option provides input (supply) terminals and a busbar entry that enable direct connection to busbar trunking systems.

■ **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 wiring and materials (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.

■ **Wire markings**

Standard wiring

Color

The standard color of the wiring is black, with the following exceptions:

- PE wiring: Yellow/Green, or yellow/green sleeving
 - UPS input wiring (option +G307): Orange
 - Pt100 sensor wiring with ATEX-certified thermal protection (option +nL514): Light blue.
-

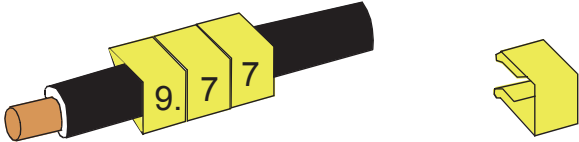

Markings

As standard, wires and terminals are marked as follows:

- Main circuit terminals: Connector identifier (eg. "U1") marked on terminal, or on insulating material close to the terminal. Input and output main circuit cables are not marked.
- Plug-in connectors of wire sets (except those that require special tools to disconnect) are labeled with connector designation (eg. "X1"). The marking is either directly on the connector, or near the connector on printed sleeving or tape.
- Grounding busbars are marked with stickers.
- Fiber optic cable pairs and data cables have component designation and connector designations (eg. "A1:V1", "A1:X1") marked with rings or tape.
- Data cables are marked with tape.
- Ribbon cables are marked with either labels or tape.
- Customer-specific (engineered) wiring (option +P902) is not marked.

Additional wire markings

The following additional wire markings are available.

Option	Additional markings
+G340 (class A3)	Single wires not attached to plug-in connectors are marked with component pin numbers on snap-on or ring markers. Plug-in connectors are marked with an identification label placed on the wires near the connector (individual wires are not marked). Short, obvious connections are not marked. PE wires are not marked unless connected directly to components. 
+G342 (class C1)	Single wires connected to components, between modules, or to terminal blocks are marked with component identification and pin numbers for both ends. The marking is printed on sleeving or, if necessary, snap-on markers. Plug-in connectors are marked with an identification label (or snap-on markers) placed on the wires near the connector (individual wires are not marked). Short, obvious connections are not marked. PE wires are not marked unless connected directly to components. 

■ **Voltage measurement with BAMU auxiliary measurement unit (option +G442)**

In weaker supply networks with a short-circuit ratio less than 8, it is highly recommended to install a BAMU auxiliary measurement unit to the drive. In such networks, there is a risk of nuisance DC overvoltage tripping due to disturbances caused by probable high-voltage THD in the supply voltage.

Short-circuit ratio is defined as the supply network's apparent short-circuit power $S_{k,net}$ V divided by the drive's nominal apparent power S_n .

■ **Common mode filter temperature monitoring (option +G453)**

This option contains thermal switches installed within the common mode filter assemblies of the drive. An overtemperature warning is generated when overheating is detected.

This is primarily intended for drive systems prone to high common mode currents, such as drive systems with long motor cabling connected to an ungrounded supply network.

■ **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. The entries are equipped with grommets and 360° grounding hardware.

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

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

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.

■ **Cable conduit entry (option +H358)**

The option provides US/UK conduit plates (plain 3 mm thick steel plates without any ready-made holes).

■ **Common motor terminal cubicle (option +H359)**

As standard, each inverter module must be individually cabled to the motor. This option provides an additional cubicle containing a single set of terminals for the motor cables.

The width of the cubicle and the size of the terminals within depend on the power rating of the drive.

Note that this option is not available with option +E206 (sine filters), In this case, the motor cables are connected to the sine filter cubicle.

■ **Common output terminals (option +H366)**

As standard, each inverter module must be individually cabled to the motor. This option adds bridging that connects the outputs of multiple (in practice, two or three) inverter modules mounted in the same cubicle. The bridging balances the motor current between the modules, which allows more cabling options. For example, it is possible to use a number of cables that could not otherwise be evenly distributed between the inverter modules.



WARNING!

The bridging can carry the nominal output of one inverter module. In case of three parallel modules, ensure that the load capacity of the bridging is not exceeded. For example, if the cabling connects to the output busbars at one module only, use the module in the middle.

Note: The +H366 option only interconnects the outputs of inverter modules within the same cubicle, not modules installed in different cubicles. Therefore, when the drive has more than three inverter modules, make sure that the load is distributed evenly between the modules:

- In case of two inverter cubicles of two modules, connect the same number of cables to each cubicle.
- In case of one inverter cubicle with three modules and another with two, each cubicle requires a number of cables proportional to the number of modules within. For example, connect three out of five (or six out of ten, etc.) cables to the cubicle with three modules, the remaining two out of five (four out of ten) cables to the cubicle with two modules.

■ Connectivity for wired remote monitoring (option +K496)

This option provides a gateway to connect the drive to ABB Ability™ via a local Ethernet network. Includes NETA-21 remote monitoring tool and FMBT-21 Modbus/TCP adapter module.

See the appropriate manual for more information.

Manual	Code (English)
NETA-21 remote monitoring tool user's manual	3AUA0000096939
NETA-21 remote monitoring tool installation and start-up guide	3AUA0000096881
FMBT-21 Modbus/TCP adapter module user's manual	3AXD50000158607
FMBT-21 Modbus/TCP adapter module quick installation and start-up guide	3AXD50000158560

■ Connectivity for wireless remote monitoring (option +K497)

This option provides a gateway to connect the drive to ABB Ability™ via a wireless 4G network. Includes NETA-21 remote monitoring tool, FMBT-21 Modbus/TCP adapter module and modem.

See the appropriate manual for more information.

Manual	Code (English)
NETA-21 remote monitoring tool user's manual	3AUA0000096939
NETA-21 remote monitoring tool installation and start-up guide	3AUA0000096881
FMBT-21 Modbus/TCP adapter module user's manual	3AXD50000158607
FMBT-21 Modbus/TCP adapter module quick installation and start-up guide	3AXD50000158560
InRouter 615-S commissioning guide	3AXD50000837939

■ 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.

Note: The optional modules inserted in the slots of the control unit are not wired to the additional terminal block. The customer must connect the optional module control wires directly to the modules.

Cables accepted by the terminals of the additional I/O terminal block:

- solid wire 0.2 ... 2.5 mm² (24...12 AWG)
- stranded wire with ferrule 0.25 ... 2.5 mm² (24...12 AWG)
- stranded wire without ferrule 0.2 ... 2.5 mm² (24...12 AWG).

■ **Thermal protection with PTC relays (options +L505, +2L505, +L513, +2L513, +L536, +L537)**

PTC thermistor relay options are used for overtemperature supervision of motors equipped with PTC sensors. When the motor temperature rises to the thermistor wake-up level, the resistance of the sensor 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), an 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.

By default, the thermistor relay is wired internally to digital input DI6 of the drive control unit. The loss of the input is set to trigger an external fault.

The output indication on the terminal block can be wired by the customer, for example, to an external monitoring circuit. See the circuit diagrams delivered with the drive.

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) as standard 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 inverter 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, but the FPTC-02 is Type Examined as a protective device within the scope of the European ATEX (and UKEX) 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.

See also

- firmware manual for parameter settings
- 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])
- circuit diagrams delivered with the drive for the actual wiring.

■ **Thermal protection with Pt100 relays (options +nL506, +nL514)**

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. As the temperature rises, the sensor resistance increases linearly. At an adjustable wake-up level, the monitoring relay de-energizes its output.

The standard Pt100 relay options include two (+2L506), three (+3L506), five (+5L506) or eight (+8L506) relays.

By default, the relays are wired internally to digital input DI6 of the drive control unit. The loss of the input is set to trigger an external fault. The options include a terminal block for sensor connection. The output indication on the terminal block can be wired by the customer, for example, to an external monitoring circuit. See the circuit diagrams delivered with the drive.

Options +3L514 (3 relays), +5L514 (5 relays) and +8L514 (8 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 +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])
- Pt100 relay alarm and trip limit setting instructions in the start-up instructions
- circuit diagrams delivered with the drive for the actual wiring.

■ **Starter for auxiliary motor fan (options +M600...M610)**

What the option contains

The option provides switched and protected connections for 3-phase auxiliary motor fans. 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.

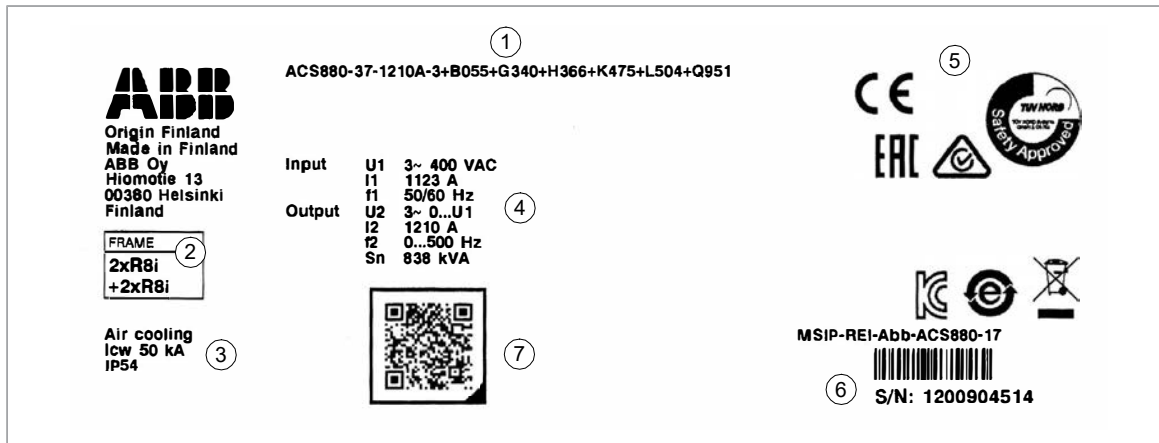
The statuses of both the starter switch and the fan contactor are wired to the terminal block.

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

Type designation label

The type designation label includes ratings, appropriate markings, a type designation and a serial number, which allow the identification of each unit. A sample label is shown below.

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



1	Type designation (see section Type designation key)
2	Frame size
3	Short-time withstand current rating (see chapter Technical data (page 213)); degree of protection; UL/CSA specifications
4	Ratings. See also chapter Technical data (page 213).
5	Valid markings
6	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.
7	Link to product information

Type designation key

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

Code	Description
Basic code	
ACS880	Product series
ACS880-37	Default configuration: air-cooled cabinet-installed drive, low harmonic, IP22 (UL type 1), main switch-disconnector (and contactor) or breaker, aR fuses, ACS-AP-W assistant control panel (with Bluetooth), EMC filter (category 3, 2nd Environment), du/dt filters, common mode filtering, standard wire markings, ACS880 primary control program, Safe torque off function, coated circuit boards, bottom entry and exit of cables with lead-through-type entries, multi-lingual door device label sticker, USB memory stick containing circuit diagrams, dimension drawings and manuals.
Size	

Code	Description
xxxxx	Refer to the rating tables
Voltage range	
3	380...415 V AC. This is indicated in the type designation label as typical input voltage level (3~ 400 V AC)
5	380...500 V AC. This is indicated in the type designation label as typical input voltage levels (3~ 400/480/500 V AC)
7	525...690 V AC. This is indicated in the type designation label as typical input voltage levels (3~ 525/600/690 V AC)

■ Option codes

Code	Description
B054	IP42 (UL Type 1 Filtered)
B055	IP54 (UL Type 12)
C121	Marine construction. See section Marine construction (option +C121) (page 48).
C128	Air inlet through bottom of cabinet. See section Air inlet through the bottom of the cabinet (option +C128) (page 81).
C129	UL Listed (evaluated to both U.S. and Canadian safety requirements). See section UL Listed (option +C129) (page 49).
C130	Channeled air outlet. See section Channeled air outlet (option +C130) (page 49).
C132	Marine type approval. Refer to ACS880...+C132 marine type-approved cabinet-built drives supplement (3AXD50000039629 [English]).
C134	CSA approved. See section CSA Approved (option +C134) (page 49).
C164	Plinth height 100 mm. See section Plinth height (options +C164 and +C179) (page 49).
C179	Plinth height 200 mm. See section Plinth height (options +C164 and +C179) (page 49).
C180	Seismic design. See section Seismic design (option +C180) (page 49).
C199	Empty 400 mm wide cubicle on left. See section Empty cubicles on left (options +C199...C201) (page 50).
C200	Empty 600 mm wide cubicle on left. See section Empty cubicles on left (options +C199...C201) (page 50).
C201	Empty 800 mm wide cubicle on left. See section Empty cubicles on left (options +C199...C201) (page 50).
C205	Marine product certification issued by DNV GL
C206	Marine product certification issued by the American Bureau of Shipping (ABS)
C207	Marine product certification issued by Lloyd's Register (LR)
C209	Marine product certification issued by Bureau Veritas
C228	Marine product certification issued by China Classification Society (CCS)
C229	Marine product certification issued by Russian Maritime Register of Shipping (RS)
D150	Brake choppers
D151	Brake resistors
E202	EMC/RFI filter for 1st environment TN (grounded) system, category C2
E205	du/dt filtering
E206	Sine output filter
F255	Main circuit breaker
F259	Grounding (earthing) switch

60 Operation principle and hardware description

Code	Description
G300	Cabinet and module heating elements (external supply). See section Cabinet heater with external supply (option +G300) (page 50).
G301	Cabinet lighting. See section Cabinet lighting (option +G301) (page 50).
G307	Terminals for connecting external control voltage (230 V AC or 115 V AC, eg. UPS). See section Terminals for external control voltage (option +G307) (page 51).
G313	Output for motor space heater (external supply)
G317	Supply connection by busbars
G327	Ready light on door, white
G328	Run light on door, green
G329	Fault light on door, red
G330	Halogen-free wiring and materials
G334	V-meter with selector switch
G335	A-meter in one phase
G340	Wire marking class A3. See section Wire markings (page 51).
G342	Wire marking class C1. See section Wire markings (page 51).
G442	BAMU auxiliary measurement unit. See section Voltage measurement with BAMU auxiliary measurement unit (option +G442) (page 52).
G453	Common mode filter temperature monitoring. See section Common mode filter temperature monitoring (option +G453) (page 53).
H350	Power cabling entry from bottom. See section Bottom cable entry/exit (options +H350 and +H352) (page 53).
H351	Power cabling entry from top. See section Top cable entry/exit (options +H351 and +H353) (page 53).
H352	Power cabling exit from bottom. See section Bottom cable entry/exit (options +H350 and +H352) (page 53).
H353	Power cabling exit from top. See section Top cable entry/exit (options +H351 and +H353) (page 53).
H358	Cable gland plates (3 mm steel, undrilled)
H359	Common motor terminal cubicle. See section Common motor terminal cubicle (option +H359) (page 53).
H366	Common output terminals (for inverter modules mounted in the same cubicle). See section Descriptions of options (page 48).
J425	ACS-AP-I control panel (without Bluetooth)
K451	FDNA-01 DeviceNet™ adapter module
K454	FPBA-01 PROFIBUS DP adapter module
K457	FCAN-01 CANopen adapter module
K458	FSCA-01 RS-485 (Modbus/RTU) adapter module
K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCAT adapter module
K470	FEPL-02 Ethernet POWERLINK adapter module
K475	FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
K490	FEIP-21 Ethernet adapter module for EtherNet/IP™
K491	FMBT-21 Ethernet adapter module for Modbus TCP
K492	FPNO-21 Ethernet adapter module for PROFINET IO

Code	Description
K496	Connectivity for wired remote monitoring. Includes NETA-21 remote monitoring tool with Ethernet connection, FMBT-21 Modbus/TCP adapter module (+K491). See section Connectivity for wired remote monitoring (option +K496) (page 54) .
K497	Connectivity for wireless remote monitoring. Includes NETA-21 remote monitoring tool, FMBT-21 Modbus/TCP adapter module (+K491) and 4G modem. See section Connectivity for wireless remote monitoring (option +K497) (page 54) .
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. See section Additional terminal block X504 (option +L504) (page 54) .
L505	Thermal protection with PTC relays (1 or 2 pcs). See section Thermal protection with PTC relays (options +L505, +2L505, +L513, +2L513, +L536, +L537) (page 55) .
L506	Thermal protection with Pt100 relays (2, 3, 5 or 8 pcs). See section Thermal protection with Pt100 relays (options +nL506, +nL514) (page 56) .
L508	FDCO-02 optical DDCS communication adapter module
L513	ATEX-certified thermal protection with PTC relays (1 or 2 pcs)
L514	ATEX-certified thermal protection with Pt100 relays (3, 5 or 8 pcs)
L515	FEA-03 I/O extension adapter
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 module
L525	FAIO-01 analog I/O extension module
L526	FDIO-01 digital I/O extension module
L536	FPTC-01 thermistor protection module
L537	FPTC-02 ATEX-certified thermistor protection module
M602	Starter for auxiliary motor fan, trip limit 2.5 ... 4 A
M603	Starter for auxiliary motor fan, trip limit 4 ... 6.3 A
M604	Starter for auxiliary motor fan, trip limit 6.3 ... 10 A
M605	Starter for auxiliary motor fan, trip limit 10...16 A
M606	Starter for auxiliary motor fan, trip limit 16...20 A
M610	Starter for auxiliary motor fan, trip limit 20...25 A
N5000	Winder control program
N5050	Crane control program
N5100	Winch control program
N5200	PCP (Progressive Cavity Pump) control program
N5300	Test bench control program
N5350	Cooling tower control program
N5450	Override control program
N5600	ESP (Electrical Submersible Pump) control program
N5700	Position control program
N5800	Offshore winch control program

62 Operation principle and hardware description

Code	Description
N8010	IEC 61131-3 application programmability
N8200	High speed (> 598 Hz) license
P902	Customized
P904	Extended warranty (30 months from delivery or 24 months from commissioning)
P909	Extended warranty (42 months from delivery or 36 months from commissioning)
P911	Extended warranty (66 months from delivery or 60 months from commissioning)
P912	Seaworthy packaging
P913	Special color (RAL Classic)
P947	Safety data calculation and validation for tailored safety functions
P948	Customized extended warranty
P966	Special color (other than RAL Classic)
Q950	Prevention of unexpected start-up with FSO 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
Q954	Earth fault monitoring for IT (ungrounded) systems
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
Q964	Emergency stop (category 1) with safety relays, by activating the Safe torque off function
Q965	Safely-limited speed with FSO-21 and encoder
Q971	ATEX-certified safe disconnection function
Q972	FSO-21 safety functions module
Q973	FSO-12 safety functions module
Q978	Emergency stop (configurable for category 0 or 1) with FSO safety functions module, by opening the main breaker/contactor
Q979	Emergency stop (configurable for category 0 or 1) with FSO safety functions module, by activating the Safe torque off function
Q982	PROFIsafe with FSO safety functions module and FPNO-21 Ethernet adapter module
Q986	FSPS-21 PROFIsafe safety functions module
R700	Printed manuals in English
R701	Printed manuals in German ¹⁾
R702	Printed manuals in Italian ¹⁾
R703	Printed manuals in Dutch ¹⁾
R704	Printed manuals in Danish ¹⁾
R705	Printed manuals in Swedish ¹⁾
R706	Printed manuals in Finnish ¹⁾
R707	Printed manuals in French ¹⁾
R708	Printed manuals in Spanish ¹⁾
R709	Printed manuals in Portuguese ¹⁾
R711	Printed manuals in Russian ¹⁾
R712	Printed manuals in Chinese ¹⁾
R713	Printed manuals in Polish ¹⁾
R714	Printed manuals in Turkish ¹⁾

Code	Description
V112	Module auxiliary and fan power supply connector change
V998	UCU-22...26 control unit

1) The delivery can include manuals in English if the requested language is not available.

4

Mechanical installation

Contents of this chapter

This chapter tells how to examine the installation site, unpack and examine the delivery and install the drive mechanically.

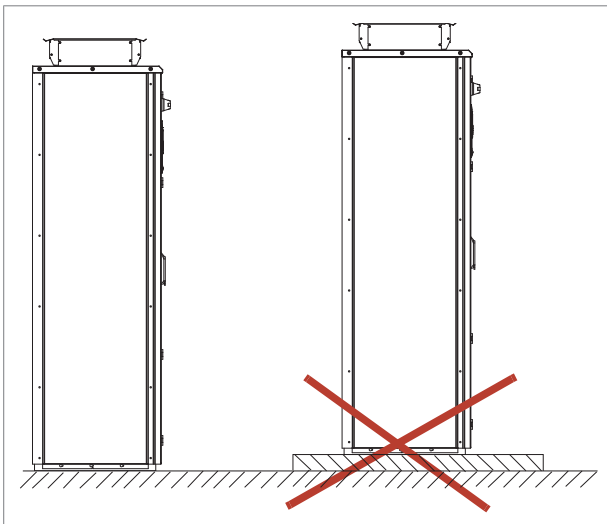


Examining the installation site

Examine the installation site. Make sure that:

- The installation site is sufficiently ventilated or cooled to remove heat from the drive. See the technical data.
- The ambient conditions of the drive meet the specifications. See the technical data.
- The material behind, above and below the drive is non-flammable.
- There is sufficient free space above the drive for cooling, maintenance, and operation of the pressure relief (if present).
- The floor that the drive cabinet 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 (0.2 in) in every 3 meters (10 ft). Level the installation site, if necessary, as the cabinet is not equipped with adjustable feet.

Do not install the drive on an elevated platform or a recess. The module extraction/installation ramp included with the drive is only suitable for a height difference of 50 mm (2 in) maximum (ie. the standard plinth height of the drive).



Necessary tools

The tools required for moving the unit to its final position, fastening 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.

Examining the delivery

The drive delivery contains:

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

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

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.

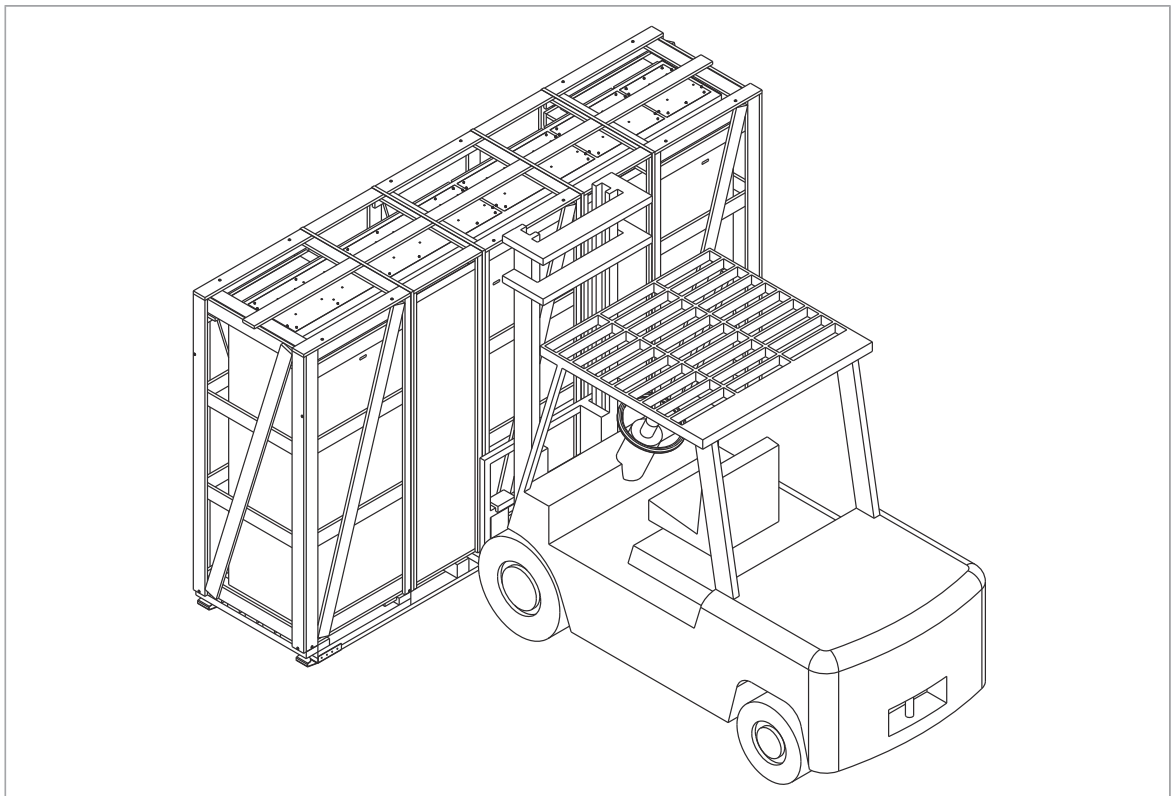
The center of gravity of the cabinet is high. Be therefore careful when moving the unit. Avoid tilting.

■ Moving the drive in its packaging

Lifting the crate with a forklift

**WARNING!**

Obey the local laws and regulations applicable to lifting, such as requirements for planning the lifting, for capacity and condition of lifting equipment, and for training of personnel.

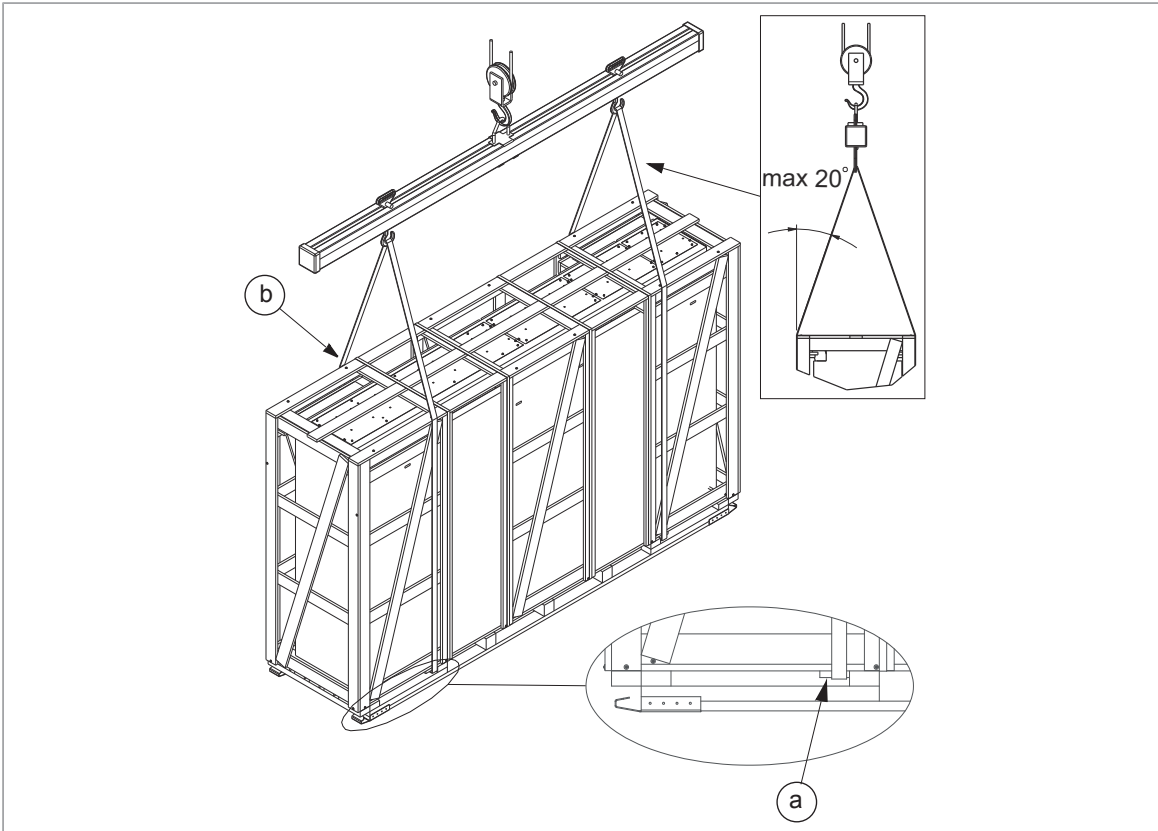


Lifting the crate with a crane



WARNING!

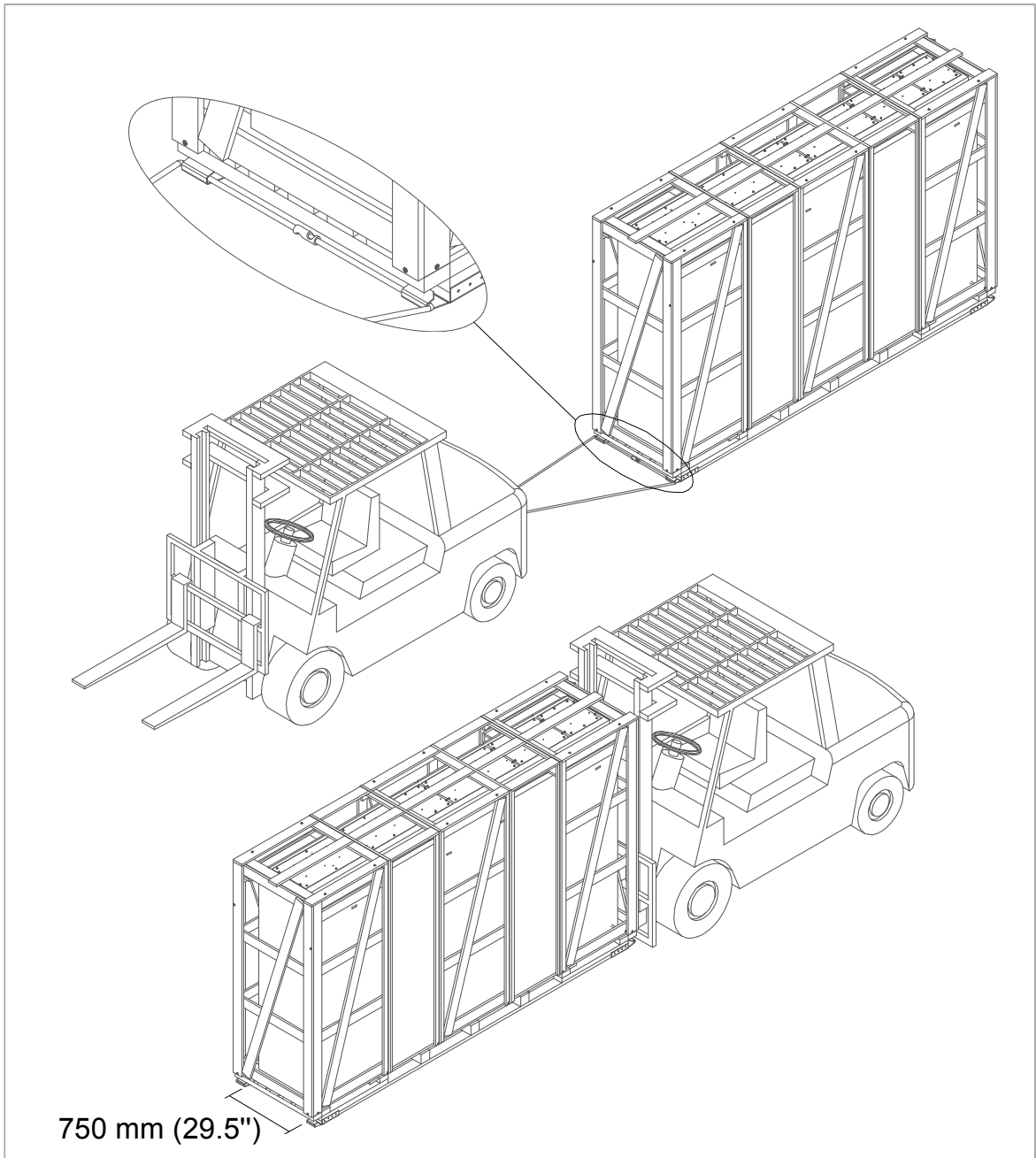
Obey the local laws and regulations applicable to lifting, such as requirements for planning the lifting, for capacity and condition of lifting equipment, and for training of personnel.



a	Lifting point
b	Optimal position for the lifting sling: as close to the traverse board as possible



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 to each other.
2. Remove the wooden parts.
3. Remove the clamps with which the drive cabinet is mounted onto the transport pallet by undoing the fastening screws.
4. Remove the plastic wrapping.

■ Moving the unpacked drive cabinet

Lifting the cabinet with a crane

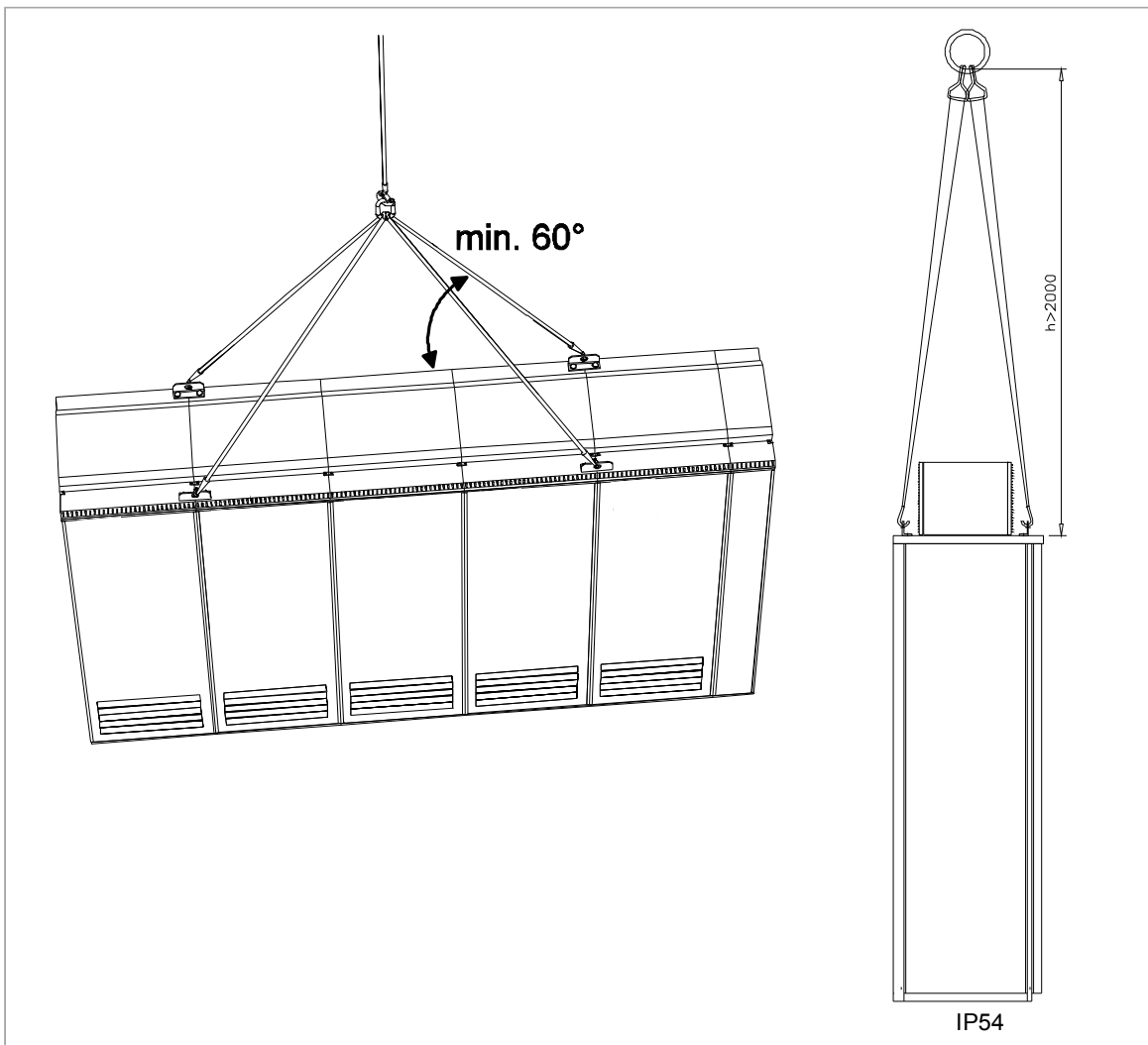


WARNING!

Obey the local laws and regulations applicable to lifting, such as requirements for planning the lifting, for capacity and condition of lifting equipment, and for training of personnel.

Lift the drive cabinet by its designated lifting points. Depending on the size of the cabinet, it has either bolt-on lifting lugs, or lifting bars with lifting holes.

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

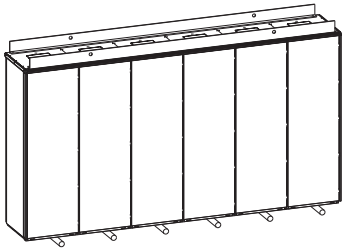


Moving the cabinet on rollers



WARNING!

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

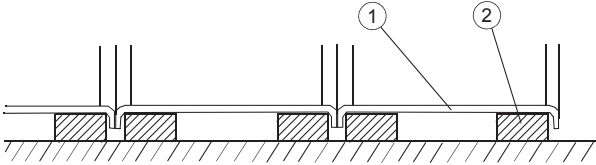
	<p>Lay the cabinet on the rollers and move it carefully until close to its final location. Remove the rollers by lifting the unit with a crane, forklift, pallet truck or jack.</p>
---	---

Moving the cabinet on its back

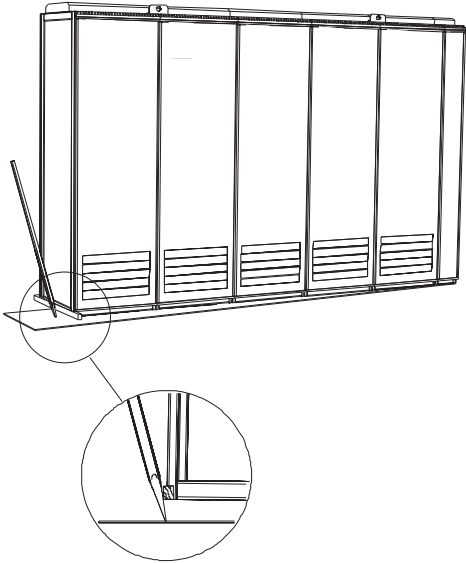
WARNING! Do not transport a drive with an LCL or L filter on its back. It will damage the filter.

Do not transport a drive with a sine filter (option +E206) on its back. It will damage the filter.

Support the cabinet from below alongside the cubicle seams.

	
1	Cabinet back panel
2	Support

Moving the cabinet to its final position

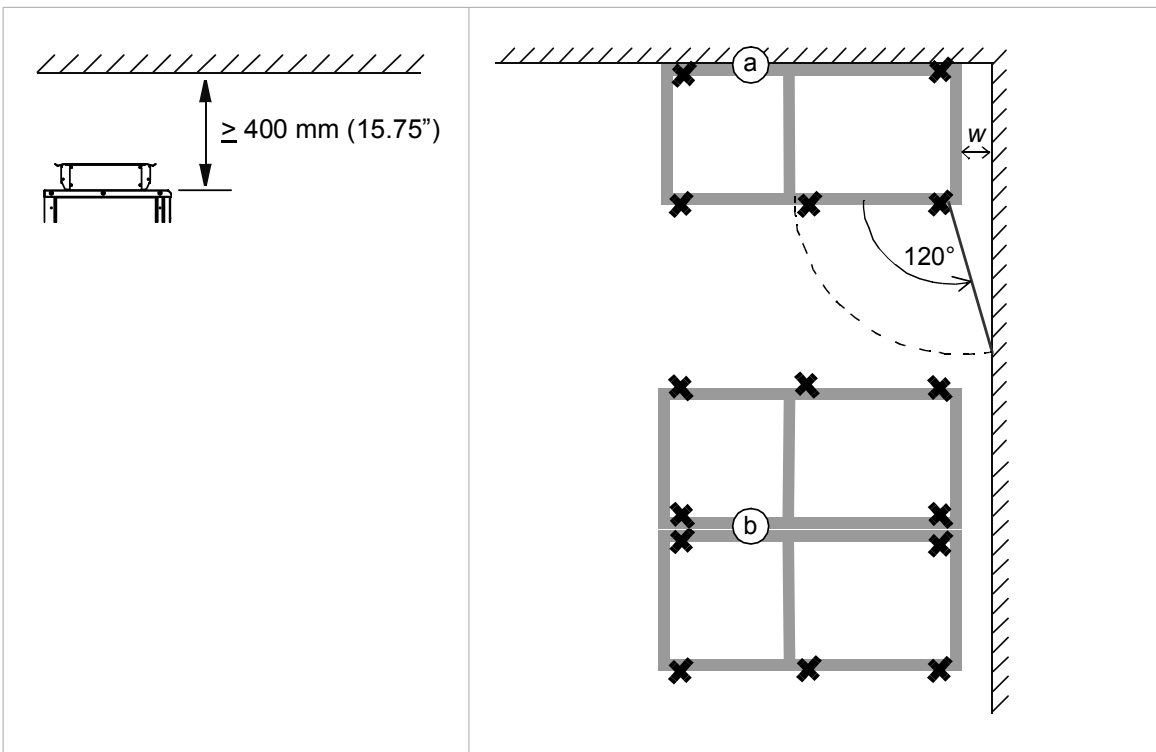
	<p>Move the cabinet into its final position with a slate bar (spud bar). Place a piece of wood between the edge of the cabinet and the bar to protect the cabinet frame.</p>
---	--



Attaching the cabinet to the floor and wall or roof

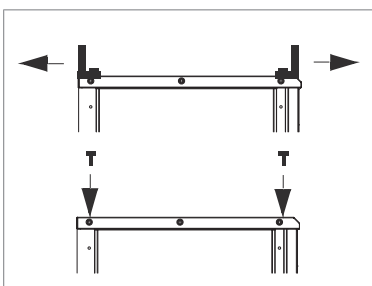
■ General rules

- The drive must be installed in an upright vertical position.
- Leave 400 mm (15.75") of free space above the basic roof level of the cabinet for cooling.
- The cabinet can be installed with its back against a wall (a), or back-to-back with another unit (b).
- 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 module replacement.



Note 1: Any height adjustment must be done before attaching the cabinet sections to the floor or to each other. Height adjustment can be done by using metal shims between the cabinet bottom and floor.

Note 2: Depending on the size of the cabinet, it has either bolt-on lifting eyes, or lifting bars with lifting holes. Bolt-on lifting eyes need not be removed unless the holes are used for attaching the cabinet. If the cabinet is delivered with lifting bars, remove them and store them for decommissioning. Plug any unused holes using the existing bolts and sealing rings included. Tighten to 70 N·m (52 lbf·ft).



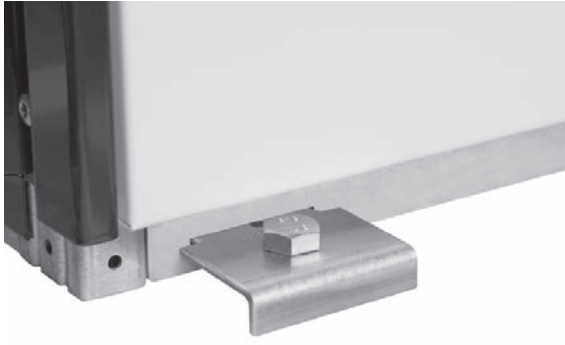
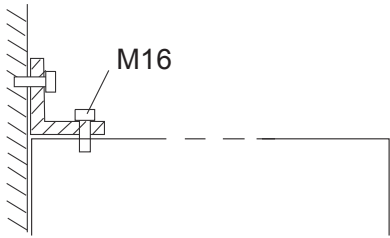
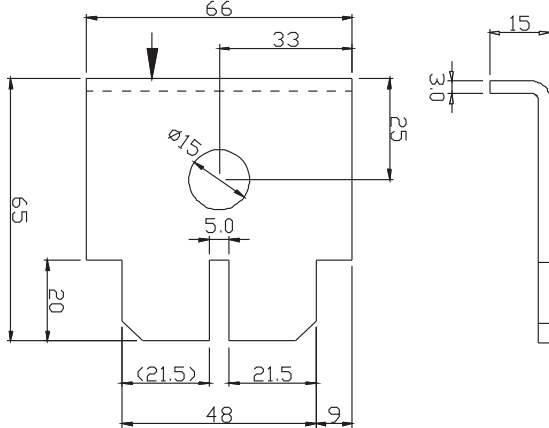
**WARNING!**

Do not stand or walk on the cabinet roof. Make sure that nothing presses against the roof, side or back plates or door. Do not store anything on the roof while the drive is in operation.

■ Attaching the cabinet (non-marine units)

Alternative 1 – Clamping

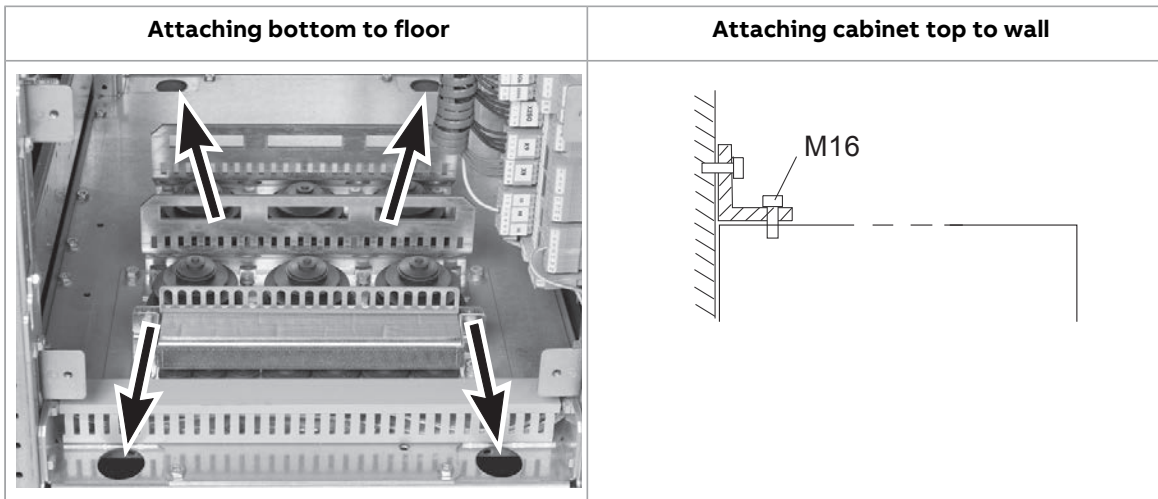
1. Insert the clamps (included) into the twin slots along the front and rear edges of the cabinet frame body and fasten them to the floor with a bolt. The recommended maximum distance between the clamps in the front edge is 800 mm (31.5”).
2. If floor mounting at the back is not possible, attach the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

Clamping bottom to floor	Attaching top to wall
	
	



Alternative 2 – Using the holes inside the cabinet

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



Alternative 3 – Cabinets with plinth options +C164 and +C179

Attach the plinth to the floor with the L-brackets with which the cabinet is attached to the transportation pallet.



■ **Attaching the cabinet (marine units)**

See the dimension drawing delivered with the drive for details of the fastening points.

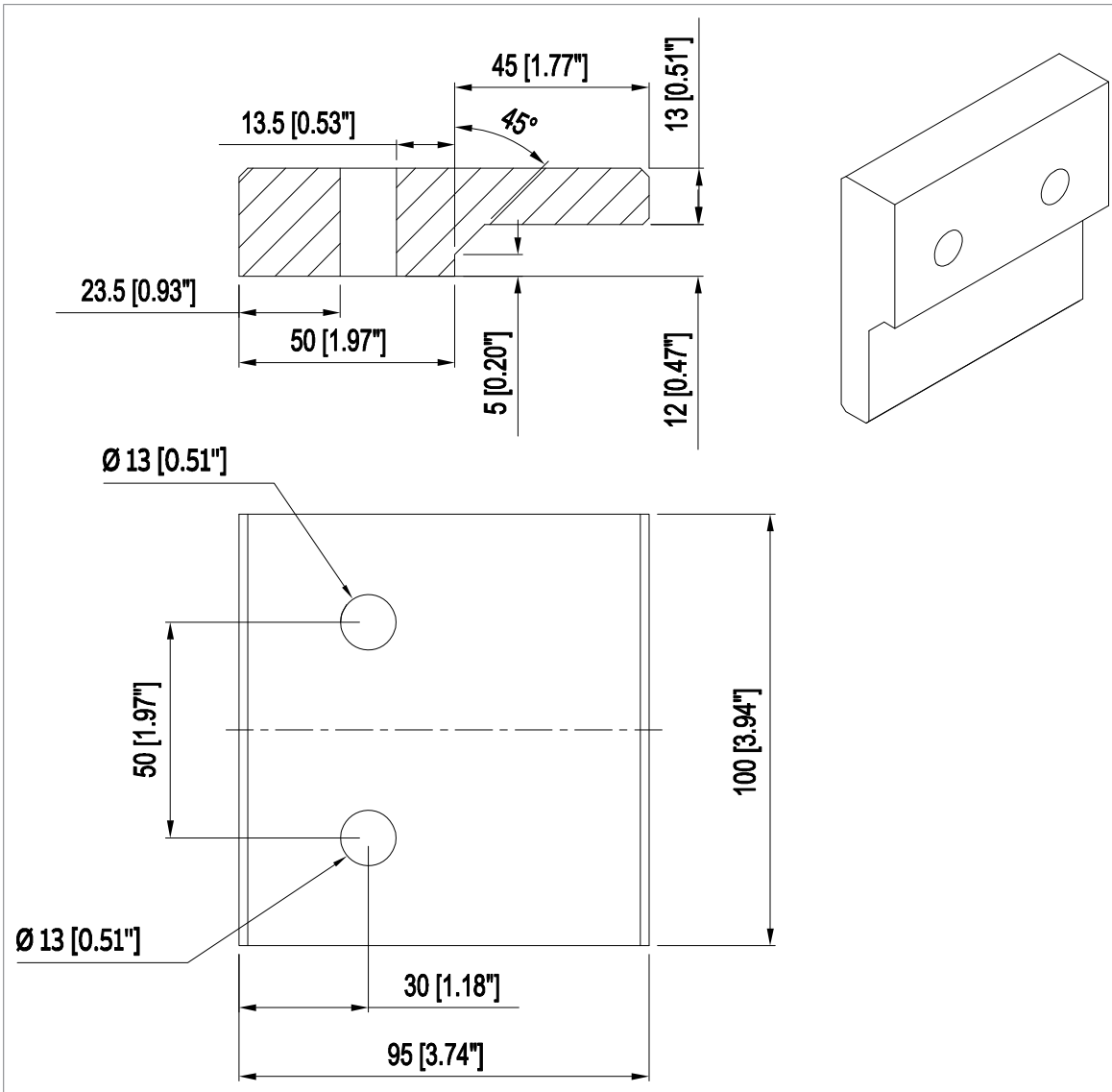
Fasten the cabinet to the floor and roof (wall) as follows:

1. Bolt the unit to the floor through the flat bars at the base of the cabinet using M10 or M12 screws.
2. If there is not enough room behind the cabinet for installation, clamp (a) the rear edges of the flat bars (c) to the floor. See the figure below.
3. Attach corner brackets (d) to the lifting eye holes. Fasten the corner brackets to the rear wall and/or roof with suitable hardware such as U-brackets (e).

a	Clamp (not included – refer to dimension drawing)	d	Corner bracket (included)
b	Back panel of cabinet	e	U-bracket (not included)
c	Flat bars at base of cabinet	-	-



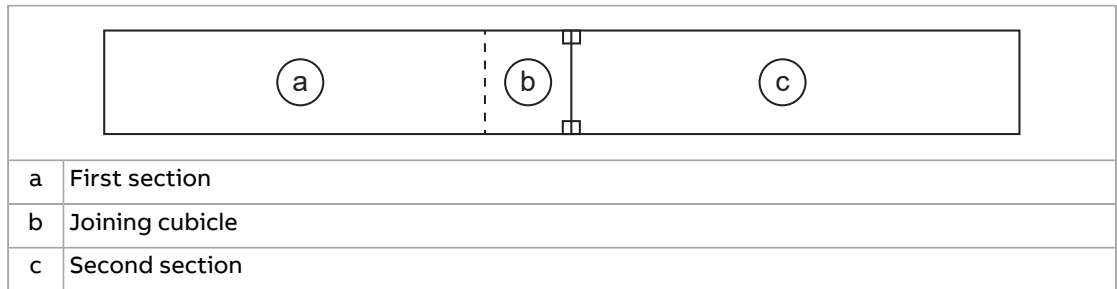
76 Mechanical installation



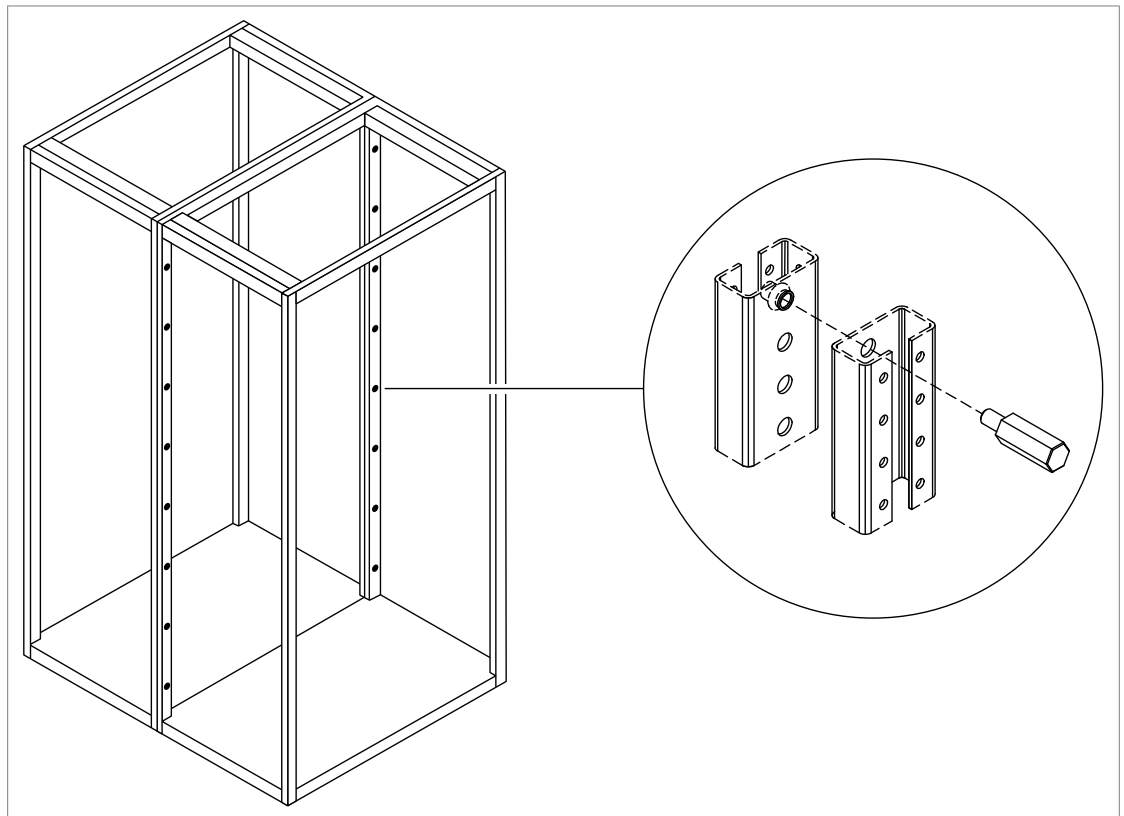
Joining cabinet sections together

Wide cabinet line-ups are delivered in multiple sections. The sections must be joined together at the installation site. There is a joining cubicle at the end of a section for this purpose. The screws for joining the sections are in a plastic bag inside the cabinet.

1. Attach the first section to the floor.
2. Remove any plates covering the rear post of the joining cubicle.
3. Align the two sections. The illustration below shows the placement of the sections.



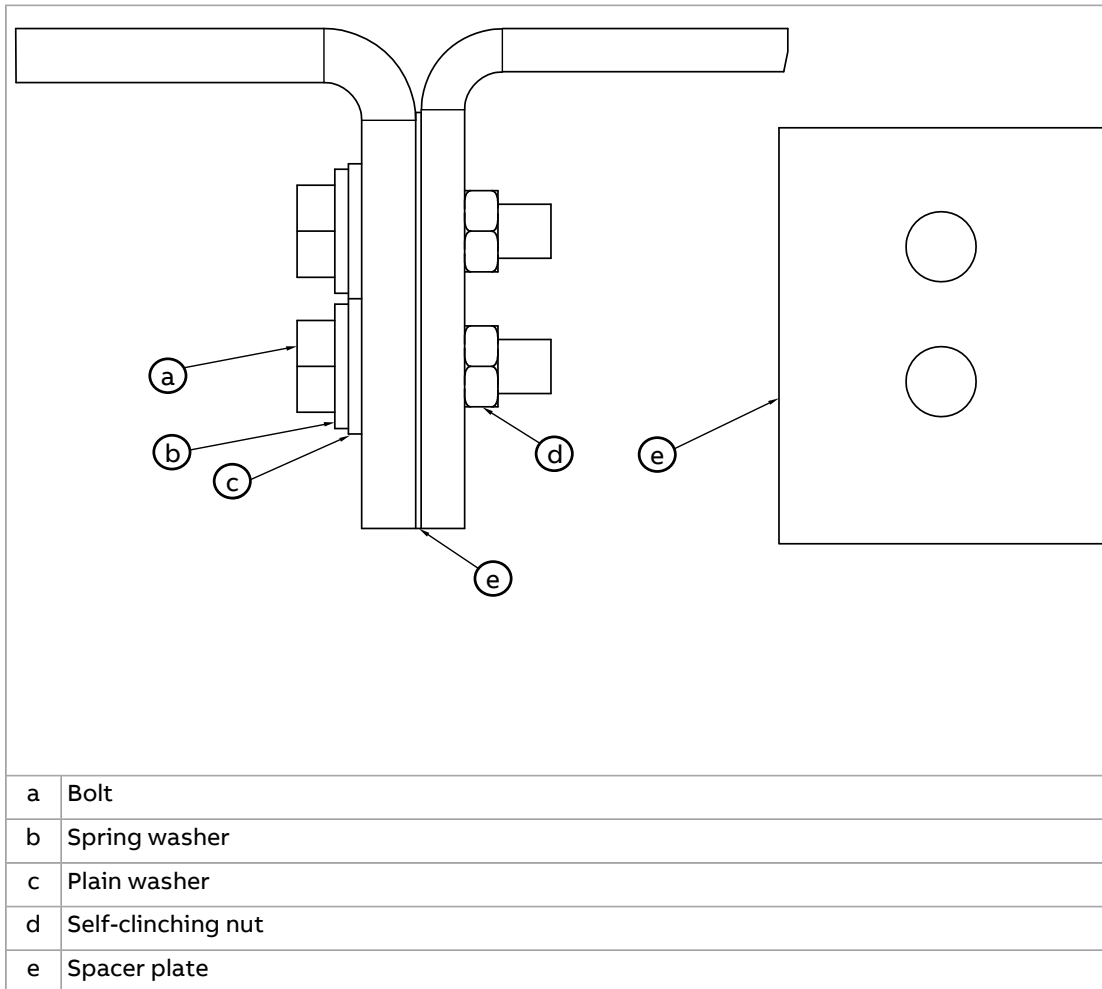
4. Attach the front and rear posts of the joining cubicle to the posts of the other section with 16 screws (8 per post). Tighten the screws to 5 N·m (3.7 lbf·ft).



5. Attach the second section to the floor.

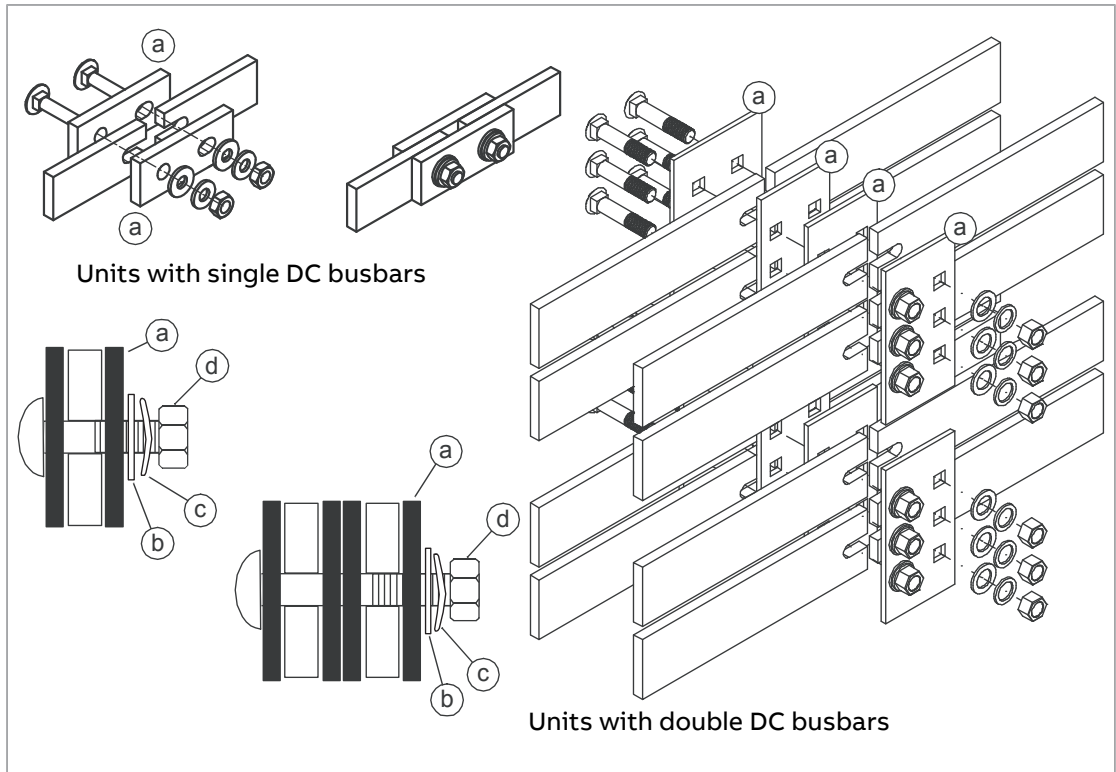
78 Mechanical installation

6. Connect the PE (ground) busbars using the M10 bolts included. Tighten to 35...40 N·m (25...30 lbf·ft). If necessary, adjust the connection between two PE busbars with the spacer plates (included in the delivery).



7. Remove the shroud covering the DC busbars in the joining cubicle.

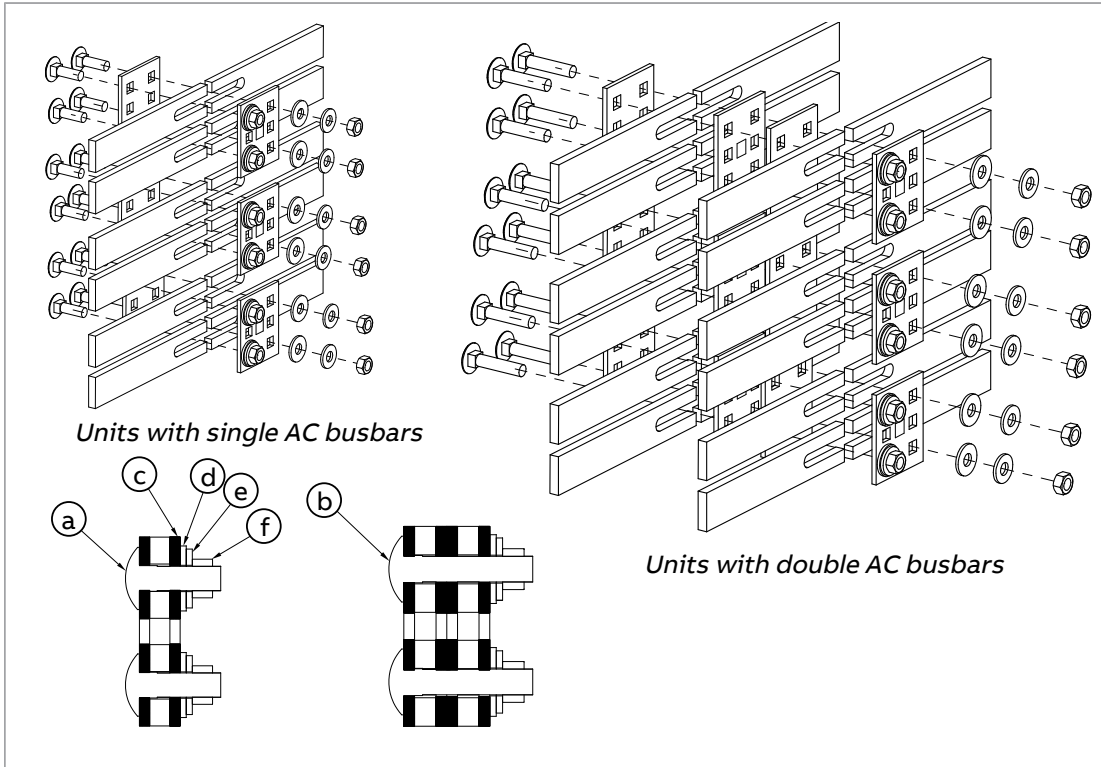
8. Connect the DC and AC busbars. Tighten the bolts to 55...70 N·m (40...50 lbf·ft).



Accessories kit identification:
 Single DC busbars: 3AXD50000125876
 Double DC busbars: 3AXD50000126361
 Triple DC busbars (not shown): 3AXD50000126378

a	Joint piece
b	Plain washer with electroplated zinc coating and blue chromate passivation
c	Spring washer with mechanically sprayed zinc coating
d	Nut (M12)





Accessories kit identification:

Single AC busbars: 3AXD50000126392

Double AC busbars: 3AXD50000126408

Triple AC busbars (not shown): 3AXD50000126514

a	Bolt (M12)
b	Bolt (M12)
c	Joint piece
d	Plain washer with electroplated zinc coating and blue chromate passivation
e	Spring washer with mechanically sprayed zinc coating
f	Nut (M12)



WARNING!

Make sure that you install the washers in the correct order, as shown in the illustration. For example, placing an unpassivated zinc-coated spring washer directly against the joint piece will cause corrosion.



WARNING!

Do not use any joining parts other than those delivered with the unit. The parts are carefully selected to match the material of the busbars. Other parts or materials can form a galvanic couple and cause corrosion.

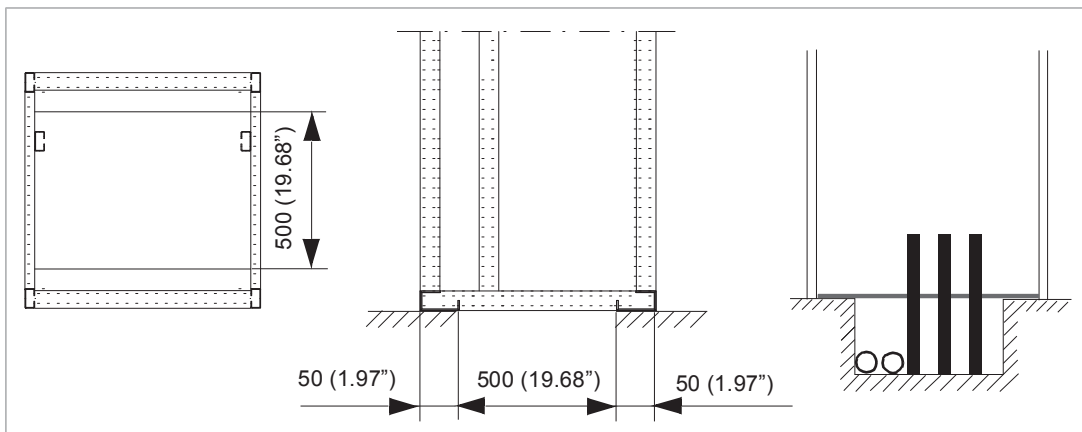
9. Reinstall any shrouding removed earlier.
10. Repeat procedure for any further sections.

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.



■ Arc welding

ABB does not recommend attaching the cabinet by arc welding. However, if arc welding is the only 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 cabinet frame is zinc-plated.



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!

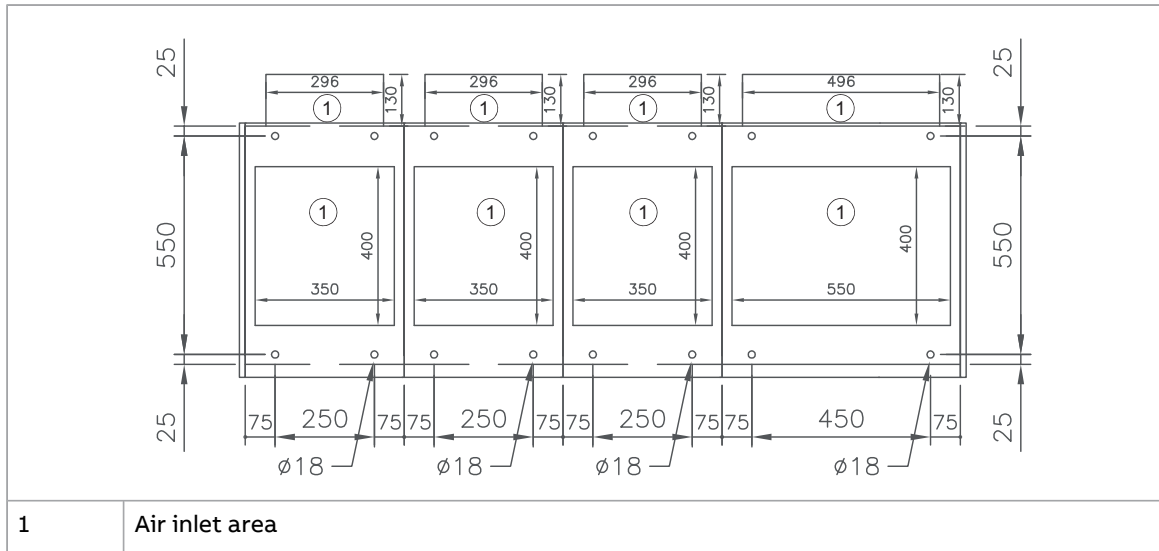
Do not inhale the welding fumes.

■ Air inlet through the bottom of the cabinet (option +C128)

Drives with air inlet through the bottom of the cabinet (option +C128) are intended for installation on an air duct in the floor. Each cubicle (except top entry adapter and joining cubicles) have an inlet through the bottom plate. The option also adds a 130 mm deep inlet area at the back of the cubicle.

An example of the air inlets in the cabinet bottom plate is shown below. Refer also to the dimension drawings delivered with the drive.

82 Mechanical installation



Support the plinth of the cabinet all round.

The air duct must be able to supply a sufficient volume of cooling air. See technical data for the minimum air flow values.

Top cable entry adapter and joining cubicles have no air inlet.



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 option adds air outlet ducts to each cubicle of the cabinet line-up. The outlet diameter (and quantity) of the ducts depend on the cubicle width. The ducts used are from the Veloduct series by FläktGroup.

Cubicle width (mm)	Outlet duct				Channel
	Veloduct type	Outer diameter (mm)	Inner diameter (mm)	Cross-sectional area (m ²)	Recommended inner diameter (mm)
300	BDEA-6-020	200	194	0.030	200.0 ... 200.7
400	BDEA-6-031	310	304	0.073	315.0 ... 315.9
500	BDEA-6-031	310	304	0.073	315.0 ... 315.9
600	BDEA-6-040	400	394	0.122	400.0 ... 401.0
700	BDEA-6-040	400	394	0.122	400.0 ... 401.0
800	2 × BDEA-6-031	310	304	0.145	315.0 ... 315.9
1000	2 × BDEA-6-031	310	304	0.145	315.0 ... 315.9

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:

$$\Delta p_s = (1.5 \dots 2) \cdot p_d$$

where

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

$$v_m = q / A_c$$

p_d	Dynamic pressure
ρ	Air density (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 m³/h = 1.3 m³/s.

$$A_c = 3 \cdot 0.315^2 \cdot \pi / 4 = 0.234 \text{ m}^2$$

$$v_m = 1.3 / 0.234 = 5.5 \text{ m/s}$$

$$p_d = 0.5 \cdot \rho \cdot v_m^2 = 0.5 \cdot 1.1 \cdot 5.5^2 = 17 \text{ Pa}$$

The required pressure in the exit air duct is then $1.5 \dots 2 \cdot 17 \text{ Pa} = 26 \dots 34 \text{ Pa}$ below the pressure in the room.



Lifting lugs and bars

■ Certificate of conformity

The certificate is available in ABB Library at www.abb.com/drives/documents (document number 3AXD10001061361).

■ Declarations 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:

Lifting bars, identified with material codes

64300971	64301284	64301411	64485342
64301047	64301306	64456695	64485351
64301063	64301314	64456725	64485369
64301080	64301322	64456822	64485377
64301101	64301331	64456881	64485458
64301136	64301349	64456890	68775558
64301152	64301357	64456920	68775540
64301187	64301365	64485296	3AUA5000013498
64301209	64301373	64485300	3AUA5000013504
64301250	64301381	64485318	3AUA0000055356
64301268	64301390	64485326	3AXD50000435524
64301276	64301403	64485334	3AXD50000435548

Lifting lugs, identified with material codes

64302621 64327151

used for lifting the following **frequency converters** and **frequency converter components**

ACS800LC types -x7LC, LC multidrives, -x07LC

ACS580, ACH580, ACQ580 types -07

ACS880 types -x7, multidrives, -x07, -xx07

ACS880LC types -x7LC, LC multidrives, -x07LC, -xx07

identified with serial numbers beginning with 1 or 8





are in conformity with all the relevant lifting accessory requirements of EU Machinery Directive 2006/42/EC.

Person authorized to compile the technical file:
Name and address: Vesa Tiihonen, Hiomotie 13, 00380 Helsinki, Finland

Helsinki, 16 Dec 2019

Signed for and on behalf of:

A blue ink signature of Peter Lindgren, consisting of stylized initials and a horizontal line.

Peter Lindgren
Vice President, ABB Oy

A blue ink signature of Vesa Tiihonen, consisting of a stylized 'V' and 'T' followed by a horizontal line.

Vesa Tiihonen
Manager, Product Engineering and Quality





Declaration of Conformity

Supply of Machinery (Safety) Regulations 2008

We

Manufacturer: ABB Oy

Address: Hiomotie 13, 00380 Helsinki, Finland.

Phone: +358 10 22 11

declare under our sole responsibility that the following products:

Lifting bars, identified with material codes

64300971	64301284	64301411	64485342
64301047	64301306	64456695	64485351
64301063	64301314	64456725	64485369
64301080	64301322	64456822	64485377
64301101	64301331	64456881	64485458
64301136	64301349	64456890	68775558
64301152	64301357	64456920	68775540
64301187	64301365	64485296	3AUA5000013498
64301209	64301373	64485300	3AUA5000013504
64301250	64301381	64485318	3AUA0000055356
64301268	64301390	64485326	3AXD50000435524
64301276	64301403	64485334	3AXD50000435548

Lifting lugs, identified with material codes

64302621	64327151
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used for lifting the following **frequency converters** and **frequency converter components**

ACS800LC types -x7LC, LC multidrives, -x07LC

ACS580, ACH580, ACQ580 types -07

ACS880 types -x7, multidrives, -x07, -xx07

ACS880LC types -x7LC, LC multidrives, -x07LC, -xx07

identified with serial numbers beginning with 1 or 8





are in conformity with all the relevant lifting accessory requirements of the Supply of Machinery (Safety) Regulations 2008.

Authorized to compile the technical file: ABB Oy, Hiomotie 13, 00380 Helsinki, Finland

Helsinki, 28 May 2021

Signed for and on behalf of:

Peter Lindgren

Peter Lindgren
Vice President, ABB Oy

Vesa Tiihonen

Vesa Tiihonen
Manager, Reliability and Quality, ABB Oy



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.

■ North America

Installations must be compliant with NFPA 70 (NEC)¹⁾ and/or Canadian Electrical Code (CE) along with state and local codes for your location and application.

¹⁾ National Fire Protection Association 70 (National Electric Code).

Selecting the supply transformer

■ Basic guidelines

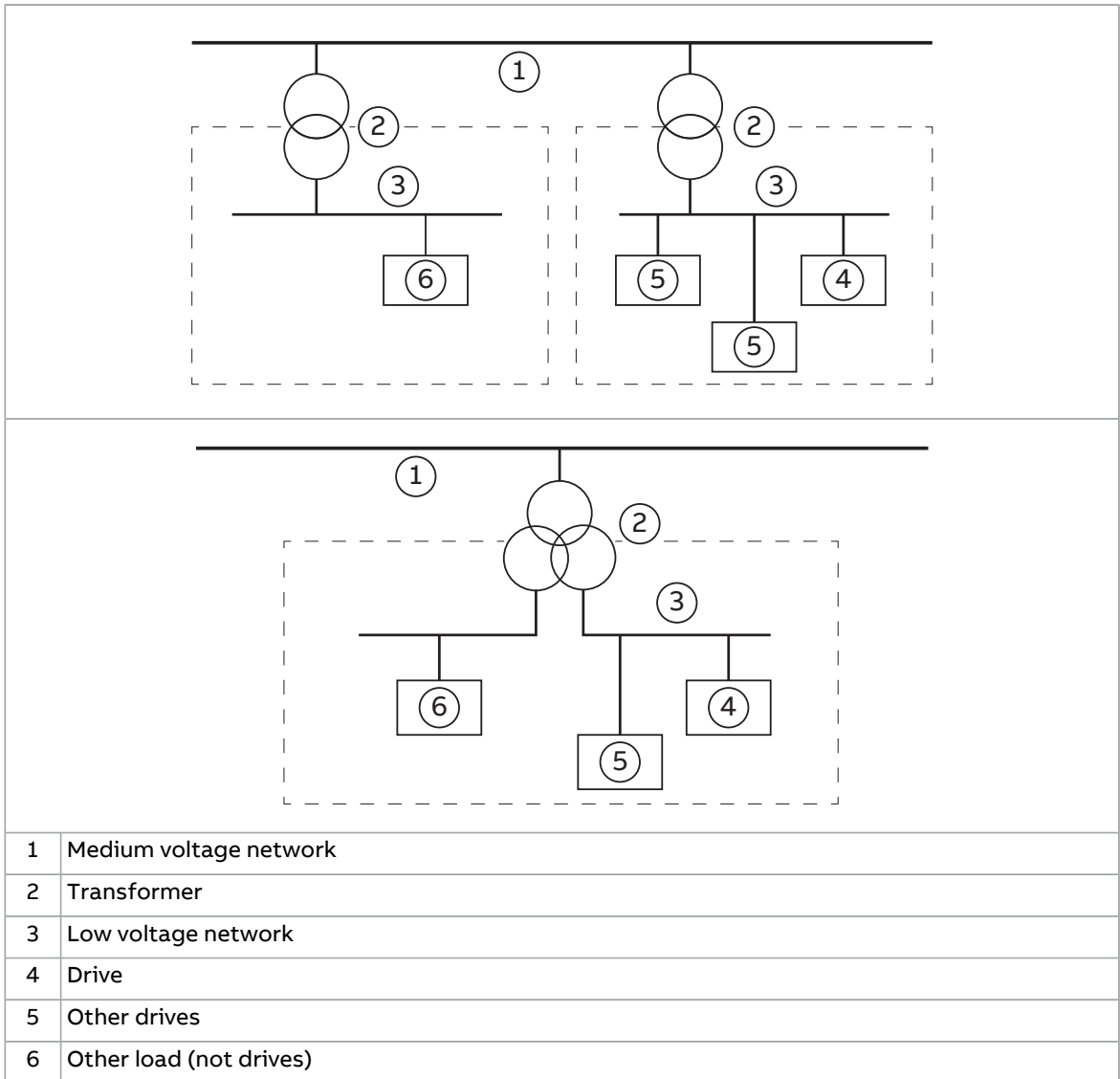
1. Define the apparent power of the transformer. You can use this rule of thumb:
 $S_N \text{ (kVA)} = 1.16 \times \text{sum of the motor shaft power (kW)}$
2. Define the nominal voltage for the transformer secondary winding according to the nominal input voltage of the drive. See the supply unit hardware manual.
3. Make sure that the transformer complies with the electrical power network specification of the drive. See the appropriate drive or supply unit hardware manual for:
 - nominal input voltage, allowed voltage variation and imbalance
 - nominal frequency and allowed variation
 - short-circuit withstand strength and short-circuit current protection requirements
 - etc.
4. Consider the additional notes below.
5. Contact the transformer manufacturer for more information on the transformer selection.

■ Additional notes

A drive larger than 500 kVA with an IGBT supply unit

Use a two-winding transformer dedicated to drives. Alternatively, use a three-winding transformer, and connect only drives to the same secondary winding. If it is necessary to connect other equipment to the same transformer winding, obey these instructions to prevent damage:

- Do not connect a direct online motor to the same transformer winding as the drive unless the motor is designed for use with variable frequency drives.
 - Do not connect capacitive loads (for example, lighting, PCs, PLCs, power factor compensation capacitors) to the same transformer winding as the drive.
-



Selecting the supply disconnecting device

The drive is equipped with a main disconnecting device as standard. Depending on the size of the drive, and the selected options, the type of disconnecting device may vary. Examples: switch-disconnector, withdrawable air circuit breaker, etc.

Selecting the main contactor or breaker

Depending on the drive type and size, it is fitted with a main contactor or a main breaker by default. With certain drive types, you can select either of the two.

Examining the compatibility of the motor and drive

Use asynchronous AC induction motors, permanent magnet synchronous motors, AC induction servomotors or ABB synchronous reluctance motors (SynRM motors) with the drive.

Select the motor size and drive type from the rating table on basis of the AC line voltage and motor load. You can find the rating table in the appropriate hardware manual. You can also use the DriveSize PC tool.

Make sure that the motor can be used with an AC drive. See [Requirements tables \(page 92\)](#). For basics of protecting the motor insulation and bearings in drive systems, see [Protecting the motor insulation and bearings \(page 92\)](#).

Note:

- Consult the motor manufacturer before using a motor with nominal voltage that 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 to the drive output voltage.

■ 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.

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

■ Requirements tables

These tables show how to select the motor insulation system and when a 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.

Requirements for ABB motors, $P_n < 100$ kW (134 hp)

See also Abbreviations (page 96).

Motor type	Nominal AC line voltage	Motor insulation system	Requirement for
			ABB du/dt and common mode filters, insulated N-end motor bearings
			$P_n < 100$ kW and frame size < IEC 315
			$P_n < 134$ hp and frame size < NEMA 500
Random-wound M2_, M3_ and M4_	$U_n \leq 500$ V	Standard	-
	500 V < $U_n \leq 600$ V	Standard	+ du/dt
		Reinforced	-
	600 V < $U_n \leq 690$ V (cable length ≤ 150 m)	Reinforced	+ du/dt
600 V < $U_n \leq 690$ V (cable length > 150 m)	Reinforced	-	
Form-wound HX_ and AM_	380 V < $U_n \leq 690$ V	Standard	N/A
Old ¹⁾ form-wound HX_ and modular	380 V < $U_n \leq 690$ V	Check with the motor manufacturer.	+ N + du/dt with voltages over 500 V + CMF
Random-wound HX_ and AM_ ²⁾	0 V < $U_n \leq 500$ V	Enamelled wire with fiber glass taping	+ N + CMF
	500 V < $U_n \leq 690$ V		+ N + du/dt + CMF
HDP	Consult the motor manufacturer.		

1) manufactured before 1.1.1998

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

Requirements for ABB motors, $P_n \geq 100$ kW (134 hp)

See also Abbreviations (page 96).

Motor type	Nominal AC line voltage	Motor insulation system	Requirement for	
			ABB du/dt and common mode filters, insulated N-end motor bearings	
			$100 \text{ kW} \leq P_n < 350 \text{ kW}$ or $\text{IEC } 315 \leq \text{frame size} < \text{IEC } 400$	$P_n \geq 350 \text{ kW}$ or $\text{frame size} \geq \text{IEC } 400$
			$134 \text{ hp} \leq P_n < 469 \text{ hp}$ or $\text{NEMA } 500 \leq \text{frame size} \leq \text{NEMA } 580$	$P_n \geq 469 \text{ hp}$ or $\text{frame size} > \text{NEMA } 580$
Random-wound M2_, M3_ and M4_	$U_n \leq 500 \text{ V}$	Standard	+ N	+ N + CMF
	$500 \text{ V} < U_n \leq 600 \text{ V}$	Standard	+ N + du/dt	+ N + du/dt + CMF
		Reinforced	+ N	+ N + CMF
	$600 \text{ V} < U_n \leq 690 \text{ V}$ (cable length $\leq 150 \text{ m}$)	Reinforced	+ N + du/dt	+ N + du/dt + CMF
$600 \text{ V} < U_n \leq 690 \text{ V}$ (cable length $> 150 \text{ m}$)	Reinforced	+ N	+ N + CMF	
Form-wound HX_ and AM_	$380 \text{ V} < U_n \leq 690 \text{ V}$	Standard	+ N + CMF	$P_n < 500 \text{ kW}$: +N + CMF
				$P_n \geq 500 \text{ kW}$: +N + du/dt + CMF
Old ¹⁾ form-wound HX_ and modular	$380 \text{ V} < U_n \leq 690 \text{ V}$	Check with the motor manufacturer.	+ N + du/dt with voltages over 500 V + CMF	
Random-wound HX_ and AM_ ²⁾	$0 \text{ V} < U_n \leq 500 \text{ V}$	Enamelled wire with fiber glass taping	+ N + CMF	
	$500 \text{ V} < U_n \leq 690 \text{ V}$		+ N + du/dt + CMF	
HDP	Consult the motor manufacturer.			

¹⁾ manufactured before 1.1.1998

²⁾ For motors manufactured before 1.1.1998, check for additional instructions with the motor manufacturer.

Requirements for non-ABB motors, $P_n < 100$ kW (134 hp)

See also Abbreviations (page 96).

Motor type	Nominal AC line voltage	Motor insulation system	Requirement for
			ABB du/dt and common mode filters, insulated N-end motor bearings
			$P_n < 100$ kW and frame size < IEC 315
			$P_n < 134$ hp and frame size < NEMA 500
Random-wound and form-wound	$U_n \leq 420$ V	Standard: $\hat{U}_{LL} = 1300$ V	-
	420 V < $U_n \leq 500$ V	Standard: $\hat{U}_{LL} = 1300$ V	+ du/dt
		Reinforced: $\hat{U}_{LL} = 1600$ V, 0.2 μ s rise time	-
	500 V < $U_n \leq 600$ V	Reinforced: $\hat{U}_{LL} = 1600$ V	+ du/dt
		Reinforced: $\hat{U}_{LL} = 1800$ V	-
	600 V < $U_n \leq 690$ V	Reinforced: $\hat{U}_{LL} = 1800$ V	+ du/dt
		Reinforced: $\hat{U}_{LL} = 2000$ V, 0.3 μ s rise time ¹⁾	-

¹⁾ If the intermediate DC circuit voltage of the drive is increased from the nominal level due to long term resistor braking cycles, check with the motor manufacturer if additional output filters are needed.

Requirements for non-ABB motors, $P_n \geq 100$ kW (134 hp)

See also Abbreviations (page 96).

Motor type	Nominal AC line voltage	Motor insulation system	Requirement for	
			ABB du/dt and common mode filters, insulated N-end motor bearings	
			$100 \text{ kW} \leq P_n < 350 \text{ kW}$ or $IEC 315 \leq \text{frame size} < IEC 400$	$P_n \geq 350 \text{ kW}$ or $\text{frame size} \geq IEC 400$
			$134 \text{ hp} \leq P_n < 469 \text{ hp}$ or $NEMA 500 \leq \text{frame size} \leq NEMA 580$	$P_n \geq 469 \text{ hp}$ or $\text{frame size} > NEMA 580$
Random-wound and form-wound	$U_n \leq 420 \text{ V}$	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	+ N or CMF	+ N + CMF
	$420 \text{ V} < U_n \leq 500 \text{ V}$	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	+ du/dt + (N or CMF)	+ N + du/dt + CMF
		Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$, 0.2 μs rise time	+ N or CMF	+ N + CMF
	$500 \text{ V} < U_n \leq 600 \text{ V}$	Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$	+ du/dt + (N or CMF)	+ N + du/dt + CMF
		Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$	+ N or CMF	+ N + CMF
	$600 \text{ V} < U_n \leq 690 \text{ V}$	Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$	+ du/dt + N	+ N + du/dt + CMF
		Reinforced: $\hat{U}_{LL} = 2000 \text{ V}$, 0.3 μs rise time ¹⁾	+ N + CMF	+ N + CMF

¹⁾ If the intermediate DC circuit voltage of the drive is increased from the nominal level due to long term resistor braking cycles, check with the motor manufacturer if additional output filters are needed.

Abbreviations

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
CMF	Common mode filter of the drive
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.

Availability of du/dt filter and common mode filter by drive type

Product type	Availability of du/dt filter	Availability of common mode filter (CMF)
ACS880-37	Standard	Standard

Additional requirements for explosion-safe (EX) motors

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

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

Use the selection criteria given for non-ABB motors.

Additional requirements for braking applications

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

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

Additional requirements for the regenerative and low harmonics 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 which withstands 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 protecting the motor insulation and bearings in drive systems 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		
		$P_n < 100 \text{ kW}$	$100 \text{ kW} \leq P_n < 200 \text{ kW}$	$P_n \geq 200 \text{ kW}$
		$P_n < 140 \text{ hp}$	$140 \text{ hp} \leq P_n < 268 \text{ hp}$	$P_n \geq 268 \text{ hp}$
$U_n \leq 500 \text{ V}$	Standard	-	+ N	+ N + CMF
$500 \text{ V} < U_n \leq 600 \text{ V}$	Standard	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
	Reinforced	-	+ N	+ N + CMF
$600 \text{ V} < U_n \leq 690 \text{ V}$	Reinforced	+ du/dt	+ du/dt + N	+ du/dt + N + 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).

If you plan to use a non-ABB high-output motor or an IP23 motor, consider these additional requirements for protecting the motor insulation and bearings in drive systems:

- If motor power is below 350 kW: Equip the drive and/or motor with the filters and/or bearings according to the table below.
- If motor power is above 350 kW: Consult the motor manufacturer.

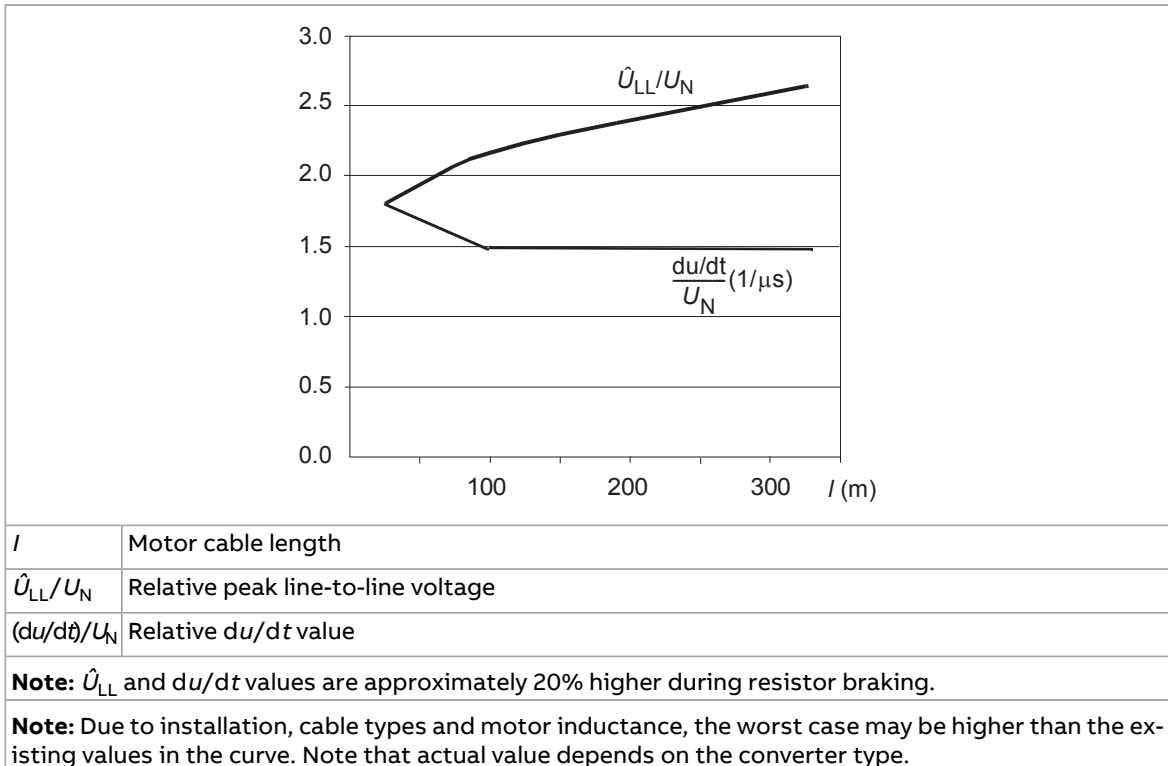
Nominal AC supply voltage	Requirement for		
	Motor insulation system	ABB du/dt and common mode filters, insulated N-end motor bearings	
		$P_n < 100 \text{ kW}$ or frame size < IEC 315	$100 \text{ kW} < P_n < 350 \text{ kW}$ or IEC 315 < frame size < IEC 400
	$P_n < 134 \text{ hp}$ or frame size < NEMA 500	$134 \text{ hp} < P_n < 469 \text{ hp}$ or NEMA 500 < frame size < NEMA 580	
$U_n \leq 420 \text{ V}$	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	+ N or CMF	+ N or CMF
$420 \text{ V} < U_n < 500 \text{ V}$	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	+ du/dt + (N or CMF)	+ N + du/dt + CMF
	Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$, 0.2 microsecond rise time	+ N or CMF	+ N or CMF
$500 \text{ V} < U_n \leq 600 \text{ V}$	Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$	+ du/dt + (N or CMF)	+ N + du/dt + CMF
	Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$	+ N or CMF	+ N + CMF
$600 \text{ V} < U_n \leq 690 \text{ V}$	Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$	+ N + du/dt	+ N + du/dt + CMF
	Reinforced: $\hat{U}_{LL} = 2000 \text{ V}$, 0.3 microsecond rise time ¹⁾	+ N + CMF	+ N + CMF

¹⁾ If the intermediate DC circuit voltage of the drive is increased from the nominal level due to long term resistor braking cycles, check with the motor manufacturer if additional output filters are needed.

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

The diagrams below show the relative peak line-to-line voltage and rate of change of voltage as a function of the motor cable length. 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 $t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.



Additional note for sine filters

A sine filter also protects the motor insulation system. The peak phase-to-phase voltage with a sine filter is approximately $1.5 \cdot U_n$.

Selecting the power cables

■ General guidelines

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

- **Current:** Select a cable capable of carrying the maximum load current and suitable for the prospective short-circuit current provided by the supply network. The method of installation and ambient temperature affect the cable current carrying capacity. Obey local regulations and laws.
- **Temperature:** For an IEC installation, select a cable rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use. For North America, select a cable rated for at least 75 °C (167 °F).
Important: For certain product types or option configurations higher temperature rating may be required. See the technical data for details.
- **Voltage:** 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. 1000 V AC cable is accepted for up to 690 V AC.

To comply with the EMC requirements of the CE mark, use one of the preferred cable types. See [Preferred power cable types \(page 100\)](#).

Symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as the stress on motor insulation, bearing currents and wear.

Metal conduit reduces electromagnetic emission of the whole drive system.

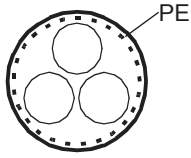
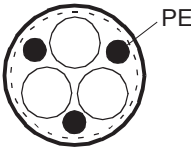
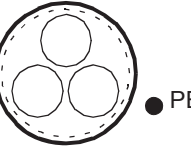
■ **Typical power cable sizes**

See the technical data.

■ **Power cable types**


Preferred power cable types

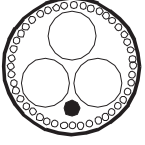

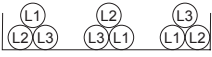

This section presents the preferred cable types. Make sure that the selected cable type also complies with local/state/country electrical codes.

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
 <p>Symmetrical shielded (or armored) cable with three phase conductors and concentric PE conductor as shield (or armor)</p>	Yes	Yes
 <p>Symmetrical shielded (or armored) cable with three phase conductors and symmetrically constructed PE conductor and a shield (or armor)</p>	Yes	Yes
 <p>Symmetrical shielded (or armored) cable with three phase conductors and a shield (or armor), and separate PE conductor/cable¹⁾</p>	Yes	Yes

¹⁾ A separate PE conductor is required if the conductivity of the shield (or armor) is not sufficient for the PE use.

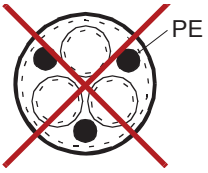
Alternate power cable types

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
 <p>Four-conductor armored cable (three phase conductors and PE)</p>	Yes	Yes with phase conductor smaller than 10 mm ² (8 AWG) Cu, or motors up to 30 kW (40 hp)

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
 <p>Shielded (Al/Cu shield or armor)¹⁾ four-conductor cable (three phase conductors and a PE)</p>	Yes	Yes with motors up to 100 kW (135 hp). A potential equalization between the frames of motor and driven equipment is required.
 <p>A single-core cable system: three phase conductors and PE conductor on cable tray</p>  <p>Preferable cable arrangement to avoid voltage or current imbalance between the phases</p>	Yes  WARNING! If you use unshielded single-core cables in an IT network, make sure that the non-conductive outer sheath (jacket) of the cables have good contact with a properly grounded conductive surface. For example, install the cables on a properly grounded cable tray. Otherwise voltage may become present on the non-conductive outer sheath of the cables, and there is even a risk of an electric shock.	No

¹⁾ Armor may act as an EMC shield, as long as it provides the same performance as a concentric EMC shield of a shielded cable. To be effective at high frequencies, the shield conductivity must be at least 1/10 of the phase conductor conductivity. The effectiveness of the shield can be evaluated based on the shield inductance, which must be low and only slightly dependent on frequency. The requirements are easily met with a copper or aluminum shield/armor. The cross-section of a steel shield must be ample and the shield helix must have a low gradient. A galvanized steel shield has a better high-frequency conductivity than a non-galvanized steel shield.

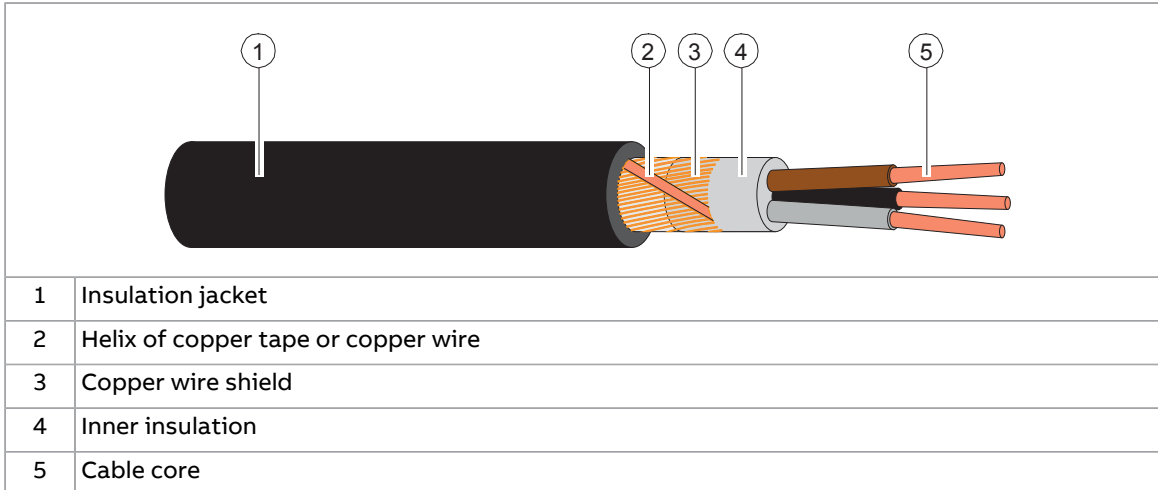
Not allowed power cable types

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
 <p>Symmetrical shielded cable with individual shields for each phase conductor</p>	No	No

■ **Power cable shield**

If the cable shield is used as the sole protective earth (PE) conductor, make sure that its conductivity agrees with the PE conductor requirements.

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.



Grounding requirements

This section gives general requirements for grounding the drive. When you plan the grounding of the drive, obey all the applicable national and local regulations.

The conductivity of the protective earth conductor(s) must be sufficient.

Unless local wiring regulations state otherwise, the cross-sectional area of the protective earth 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 earth conductor must 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 of the protective earth conductor related to the phase conductor size according to IEC/UL 61800-5-1 when the phase conductor(s) and the protective earth conductor are made of the same metal. If this is not so, the cross-sectional area of the protective earth conductor must 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 earth conductor S_p (mm ²)
$S \leq 16$	S ¹⁾
$16 < S \leq 35$	16
$35 < S$	$S/2$

¹⁾ For the minimum conductor size in IEC installations, refer to *Additional grounding requirements – IEC*.

If the protective earth conductor is not part of the input power cable or input power cable enclosure, the minimum permitted cross-sectional area is:

- 2.5 mm² if the conductor is mechanically protected,
or
- 4 mm² if the conductor is not mechanically protected. If the equipment is cord-connected, the protective earth conductor must be the last conductor to be interrupted if there is a failure in the strain relief mechanism.

■ Additional grounding requirements – IEC

This section gives grounding requirements according to standard IEC/EN 61800-5-1.

Because the normal touch current of the drive is more than 3.5 mA AC or 10 mA DC:

- the minimum size of the protective earth conductor must comply with the local safety regulations for high protective earth conductor current equipment, and
- you must use one of these connection methods:
 1. a fixed connection and:
 - a protective earth conductor with a minimum cross-sectional area of 10 mm² Cu or 16 mm² Al (as an alternative when aluminum cables are permitted),
 - or
 - a second protective earth conductor of the same cross-sectional area as the original protective earth conductor,
 - or
 - a device that automatically disconnects the supply if the protective earth conductor is damaged.
 2. a connection with an industrial connector according to IEC 60309 and a minimum protective earth conductor cross-section of 2.5 mm² as part of a multi-conductor power cable. Sufficient strain relief must be provided.

If the protective earth conductor is routed through a plug and socket, or similar means of disconnection, it must not be possible to disconnect it unless power is simultaneously removed.

Note: You can use power cable shields as grounding conductors only when their conductivity is sufficient.

■ Additional grounding requirements – UL (NEC)

This section gives grounding requirements according to standard UL 61800-5-1.

The protective earth conductor must be sized as specified in Article 250.122 and table 250.122 of the National Electric Code, ANSI/NFPA 70.

For cord-connected equipment, it must not be possible to disconnect the protective earth conductor before power is removed.

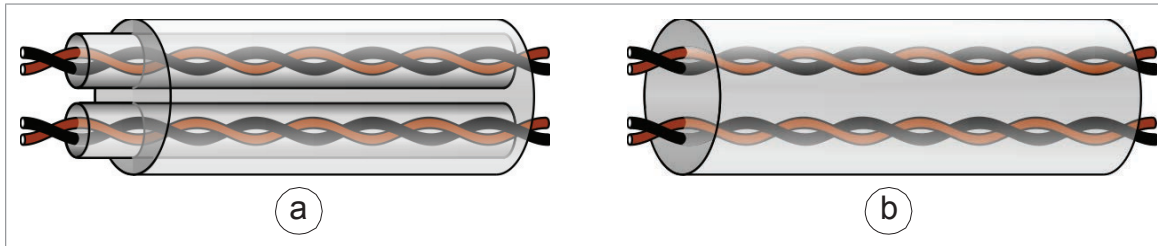
Selecting the control cables

■ Shielding

Only use shielded control cables.

Use a double-shielded twisted pair cable for analog signals. ABB recommends this type of cable also for the pulse encoder signals. Use one individually shielded pair for each signal. Do not use common return for different analog signals.

A double-shielded cable (a) 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. Do not mix 24 V DC and 115/230 V AC signals in the same cable.

■ Signals that can be run in the same cable

If their voltage does not exceed 48 V, relay-controlled signals can be run in the same cables as digital input signals. The relay-controlled signals should be run as twisted pairs.

■ Relay cable

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

■ Control panel to drive cable

Use EIA-485, Cat 5e (or better) cable with male RJ-45 connectors. The maximum length of the cable is 100 m (328 ft).

■ PC tool cable

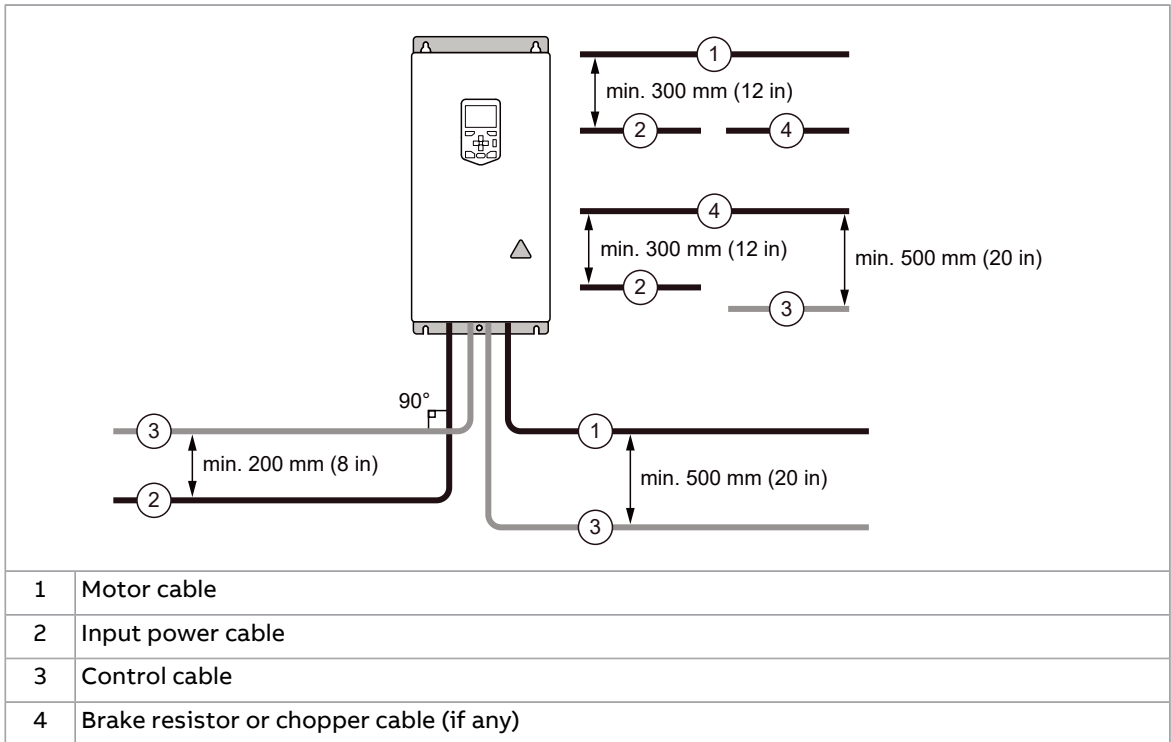
Connect the Drive Composer PC tool to the drive through the USB port of the control panel. Use a USB Type A (PC) - Type Mini-B (control panel) cable. The maximum length of the cable is 3 m (9.8 ft).

Routing the cables

■ General guidelines – IEC

- Route the motor cable away from other cables. Motor cables of several drives can be run in parallel installed next to each other.
- Install the motor cable, input power cable and control cables on separate trays.
- Avoid long parallel runs of motor cables with other cables.
- Where control cables must cross power cables, make sure that they are arranged at an angle as near to 90 degrees as possible.
- Do not run extra cables through the drive.
- Make sure that the cable trays have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

The following figure illustrates the cable routing guidelines with an example drive.



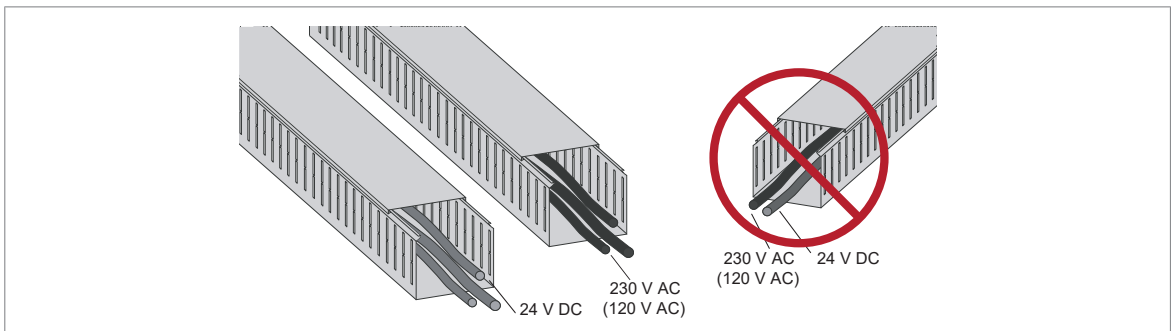
■ **Continuous motor cable shield/conduit and metal enclosure for equipment on the motor cable**

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:

- Install the equipment in a metal enclosure.
- Use either a symmetrical shielded cable, or install the cabling in a metal conduit.
- Make sure that there is a good and continuous galvanic connection in the shield/conduit between drive and motor.
- Connect the shield/conduit to the protective ground terminal of the drive and the motor.

■ **Separate control cable ducts**

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



Protecting the drive, input power cable, motor and motor cable in short circuit situations and against thermal overload

■ Protecting the input cabling and the drive upon a short-circuit

To protect the input cable in short-circuit situations, install fuses or a suitable circuit breaker at the supply side of the cabling.

The drive is equipped with fuses as standard. In case of a short-circuit inside the drive, the fuses protect the drive, restrict drive damage, and prevent damage to adjoining equipment.

■ 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 correctly
- the motor cable type complies with the motor cable selection guidelines by ABB
- the cable length does not exceed the allowed maximum length specified for the drive
- the setting of parameter 99.10 Motor nominal power in the drive is equal with the value given on the motor rating plate.

The electronic power output short-circuit protection circuitry meets the requirements of IEC 60364-4-41 2005/AMD1.

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

The most common temperature sensor types are PTC or Pt100.

For more information, see the firmware manual.

■ Protecting the motor against overload without thermal model or temperature sensors

Motor overload protection protects the motor against overload without using motor thermal model or temperature sensors.

Motor overload protection is required and specified by multiple standards including the US National Electric Code (NEC) and the common UL/IEC 61800-5-1 standard in conjunction with UL/IEC 60947-4-1. The standards allow for motor overload protection without external temperature sensors.

The protection feature of the drive allows the user to specify the class of operation in the same manner as the overload relays are specified in standards UL/IEC 60947-4-1 and NEMA ICS 2.

The motor overload protection supports thermal memory retention and speed sensitivity.

For more information, see drive firmware manual.

Protecting the drive against ground faults

The drive is equipped with an internal ground fault protective function to protect the unit against ground faults in the motor and motor cable. 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 (+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 for use with residual current devices of Type B.

Note: As standard, the drive contains capacitors connected between the main circuit and the frame. These capacitors and long motor cables increase the ground leakage current and may cause nuisance faults in residual current devices.

Implementing the emergency stop function

You can order the drive with an emergency stop function (option).

See the appropriate option manual for more information.

Note: The UCU control unit does not support options +Q978 and +Q979.

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 283).

Implementing the Prevention of unexpected start-up function

You can order the drive with a Prevention of unexpected start-up (POUS) function. The POUS function disables the control voltage of the power semiconductors of the drive (inverter) output stage. This prevents the drive from generating the torque required to rotate the motor. POUS enables a short-time maintenance work (like cleaning) on the non-electrical parts of the machinery without switching off and disconnecting the drive.

See the appropriate option manual for more information.

Note: The UCU control unit does not support option +Q950.

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 an ATEX-certified motor thermal protection

With option +Q971, the drive provides ATEX-certified safe motor disconnection without contactor using the drive Safe torque off function. To implement the thermal protection of a motor in explosive atmosphere (Ex motor), you must also:

- use an ATEX-certified Ex motor
- order an ATEX-certified thermistor protection module for the drive (option +L537), or acquire and install an ATEX-compliant protection relay
- do the necessary connections.

For cabinet-built drives, an ATEX-certified motor thermal protection function is also available (option +L513+Q971, or +L514+Q971). The drive is equipped with an ATEX-certified Safe motor disconnection function and with ATEX-compliant protection relays for PTC or Pt100 temperature sensors.

For more information, see:

User's manual	Manual code (English)
ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (+Q971) application guide	3AUA0000132231
FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual	3AXD50000027782
ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual	3AXD50000014979

Implementing the functions provided by the FSO safety functions module

You can order the drive with an FSO-12 safety functions module (option +Q973) or FSO-21 safety functions module (option +Q972). An FSO module enables the implementation of functions such as Safe brake control (SBC), Safe stop 1 (SS1), Safe stop emergency (SSE), Safely limited speed (SLS) and Safe maximum speed (SMS).

The settings of the FSO module have default values when delivered from the factory. The wiring of the external safety circuit and configuration of the FSO module are the responsibility of the user.

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

See the appropriate manual for more information.

Note: The UCU control unit does not support options +Q973 and +Q972.

Name	Code
FSO-12 safety functions module user's manual	3AXD50000015612
FSO-21 safety functions module user's manual	3AXD50000015614

Implementing the power loss ride-through function

If the incoming supply voltage is cut off, the drive will continue to operate by utilizing the kinetic energy of the rotating motor. The drive will be fully operational as long as the motor rotates and generates energy to the drive.

If the drive is equipped with a main contactor or breaker, it restores the drive input power after a short break. The contactor re-connects after the break automatically. If the drive is equipped an external uninterruptible auxiliary power supply (option +G307), it keeps the main contactor closed in power-loss situations

Note: If the power loss lasts so long that the drive trips on undervoltage, a fault reset and a fresh start command is required to continue operation.

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

1. Enable the power-loss ride-through function of the drive (parameter 30.31).
2. Enable the automatic restart of the motor after a short power supply break:
 - Set the start mode to automatic (parameter 21.01 or 21.19, depending on the motor control mode being used).
 - Define the automatic restart time (parameter 21.18).



WARNING!

Make sure that a flying restart of the motor will not cause any danger. If you are in doubt, do not implement the power loss ride-through function.

Implementing a bypass connection

If bypassing is required, employ mechanically or electrically interlocked contactors between the motor and the drive and between the motor and the power line. Make sure with interlocking that the contactors cannot be closed simultaneously. The

installation must be clearly marked as defined in IEC/EN/UL 61800-5-1, subclause 6.5.3, for example, “THIS MACHINE STARTS AUTOMATICALLY”.

Bypass connection is available as a factory-installed option for some cabinet-installed drive types. Consult ABB for more information.



WARNING!

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

Supplying power for the auxiliary circuits

The user must supply these options from external power sources:

- +G300/+G301: Cabinet heaters and/or lighting
- +G307: Connection for an external uninterruptible power supply
- +G313: Power supply connection for a motor space heater output

For the voltages and fuse sizes, refer to the circuit diagrams delivered with the drive.

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 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. Make sure 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.

Using a safety switch between the drive and the motor

ABB recommends to install a safety switch between the permanent magnet motor and the drive output. The switch is needed to isolate the motor from the drive during maintenance work on the drive.

Implementing the control of a contactor between drive and motor

Implementing the control of the output contactor depends on the motor control mode and stopping method selected.

When you select the DTC motor control mode and the motor ramp stop mode, use this operation sequence to open the contactor:

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



WARNING!

If DTC motor control mode is in use, do not open the output contactor while the drive controls the motor. The motor control operates faster than the contactor, and tries to maintain the load current. This can cause damage to the contactor.

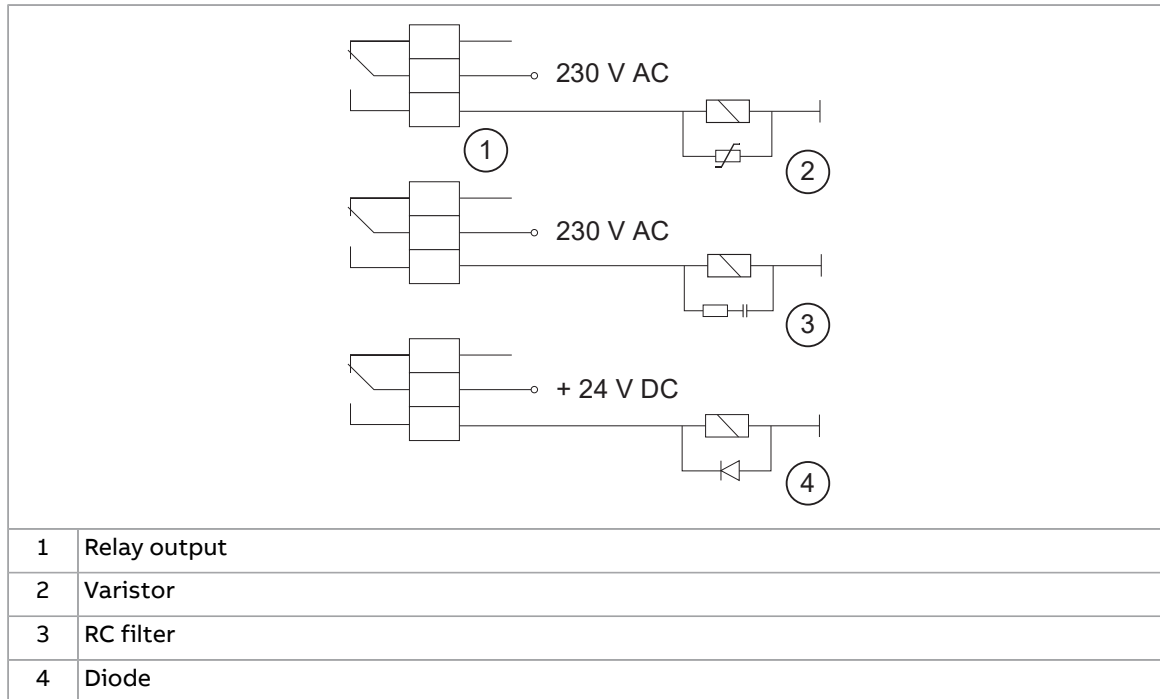
When you select the DTC motor control mode and the motor coast stop mode, you can open the contactor immediately after the drive has received the stop command. This is the case also if you use the scalar motor control mode.

Protecting the contacts of relay outputs

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

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

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



Implementing a motor temperature sensor connection



WARNING!

IEC 61800-5-1 requires double or reinforced insulation between live parts and accessible parts when:

- the accessible parts are not conductive, or
- the accessible parts are conductive, but not connected to the protective earth.

Obey this requirement when you plan the connection of the motor temperature sensor to the drive.

You have these implementation 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 input(s) of the drive. See the control cable connection instructions. Make sure that the voltage is not more than the maximum allowed voltage over the sensor.
2. If there is basic insulation between the sensor and the live parts of the motor, or if the insulation type is not known: 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 [Connecting a motor temperature sensor to the drive through an option module \(page 113\)](#). Make sure that the voltage does not exceed the maximum allowed voltage over the sensor.
3. If there is basic insulation between the sensor and the live parts of the motor, or if the insulation type is not known: You can connect a sensor to a digital input of the drive via an external relay. The sensor and the relay must form a double or reinforced insulation between the motor's live parts and the digital input of the drive. Make sure that the voltage does not exceed the maximum allowed voltage over the sensor.

■ Connecting a motor temperature sensor to the drive through 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 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 drive control unit connector. No isolation between sensor connector and other I/O connectors.	x	x	x	Reinforced insulation
FEN-01	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and TTL encoder emulation output.	x	-	-	Reinforced insulation
FEN-11	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and TTL encoder emulation output.	x	x	-	Reinforced insulation
FEN-21	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and TTL encoder emulation output.	x	x	-	Reinforced insulation
FEN-31	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and other connectors.	x	x	-	Reinforced insulation
FAIO-01	Basic insulation between sensor connector and drive control unit connector. No insulation between sensor connector and other I/O connectors.	x	x	x	Reinforced or basic insulation. With basic insulation, the other I/O connectors of the option module must be kept disconnected.
FPTC-01/02 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 classified).

114 Guidelines for planning the electrical installation

For more information, refer to the applicable option module user's manual.



6

Electrical installation

Contents of this chapter

This chapter gives instructions on the wiring of the drive.

Warnings

**WARNING!**

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

Measuring the insulation

■ Measuring the insulation resistance of the drive

**WARNING!**

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

■ Measuring the insulation resistance of the motor and motor cable

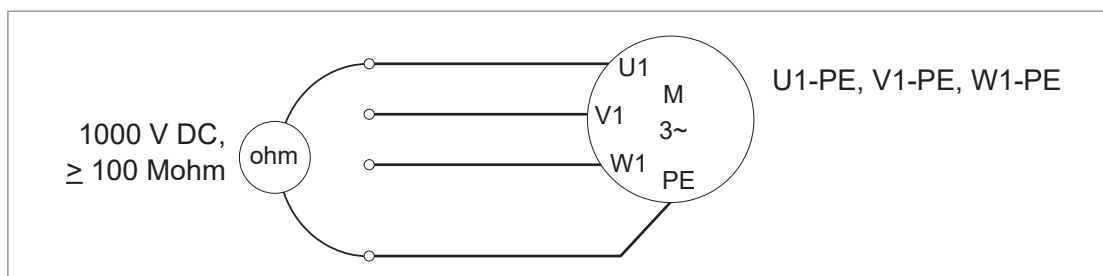


WARNING!

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

1. Do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Make sure that the motor cable is disconnected from the drive output terminals.
3. Measure the insulation resistance between each phase conductor and the protective earth conductor. Use a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must be more than 100 Mohm (reference value at 25 °C [77 °F]). For the insulation resistance of other motors, refer to the manufacturer's instructions.

Note: Moisture inside the motor reduces the insulation resistance. If you think that there is moisture in the motor, dry the motor and do the measurement again.



■ Measuring the insulation resistance of the input power cable

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

Compatibility check - IT (ungrounded) earthing system

Drives with a category 2, 1st environment EMC filter (option +E202) are not suitable for use in an IT (ungrounded) supply network system. If the drive is equipped with option +E202, disconnect the filter before connecting the drive to the IT supply network. Contact ABB for instructions.



WARNING!

Do not install a drive equipped with EMC filter +E202 on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system). The system will be connected to ground potential through the EMC filter capacitors of the drive. This can cause danger, or damage the drive.

Attaching the device stickers to the cabinet door

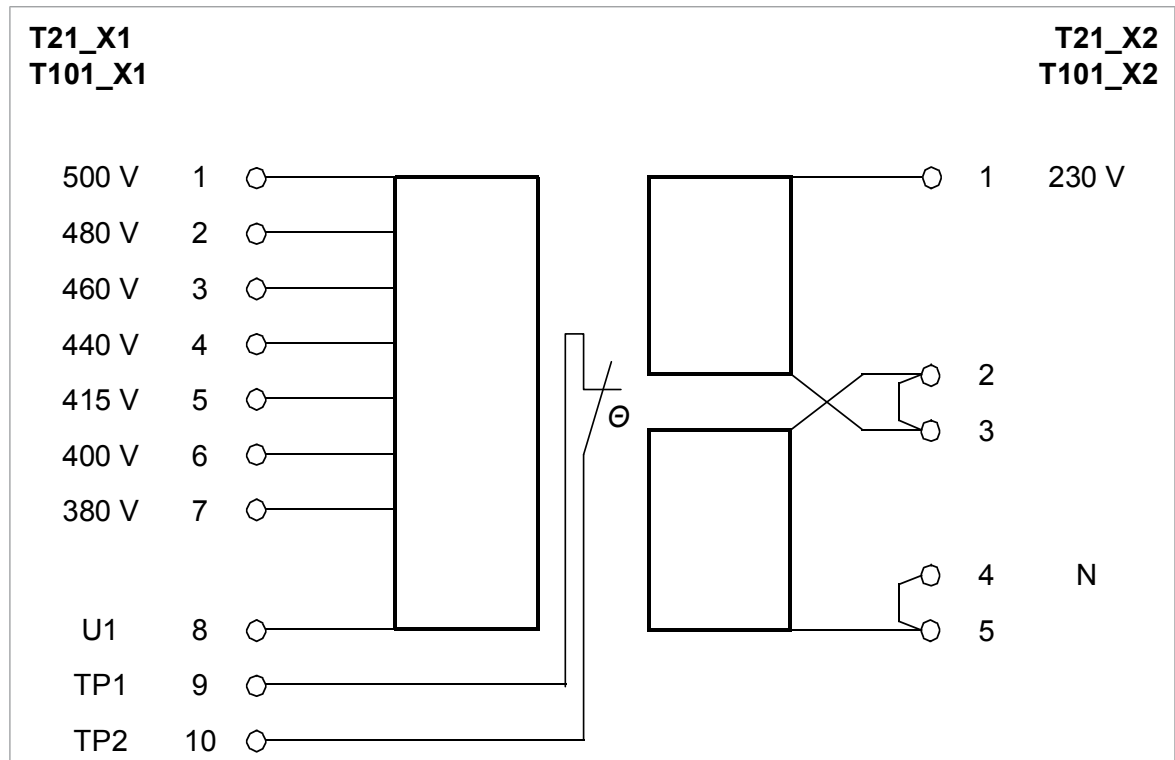
A multilingual device label sticker is delivered with the drive. Attach the stickers in the appropriate language on the English texts; see section [Door switches and lights](#) (page 45).

Checking the settings of transformers T21, T101 and T111

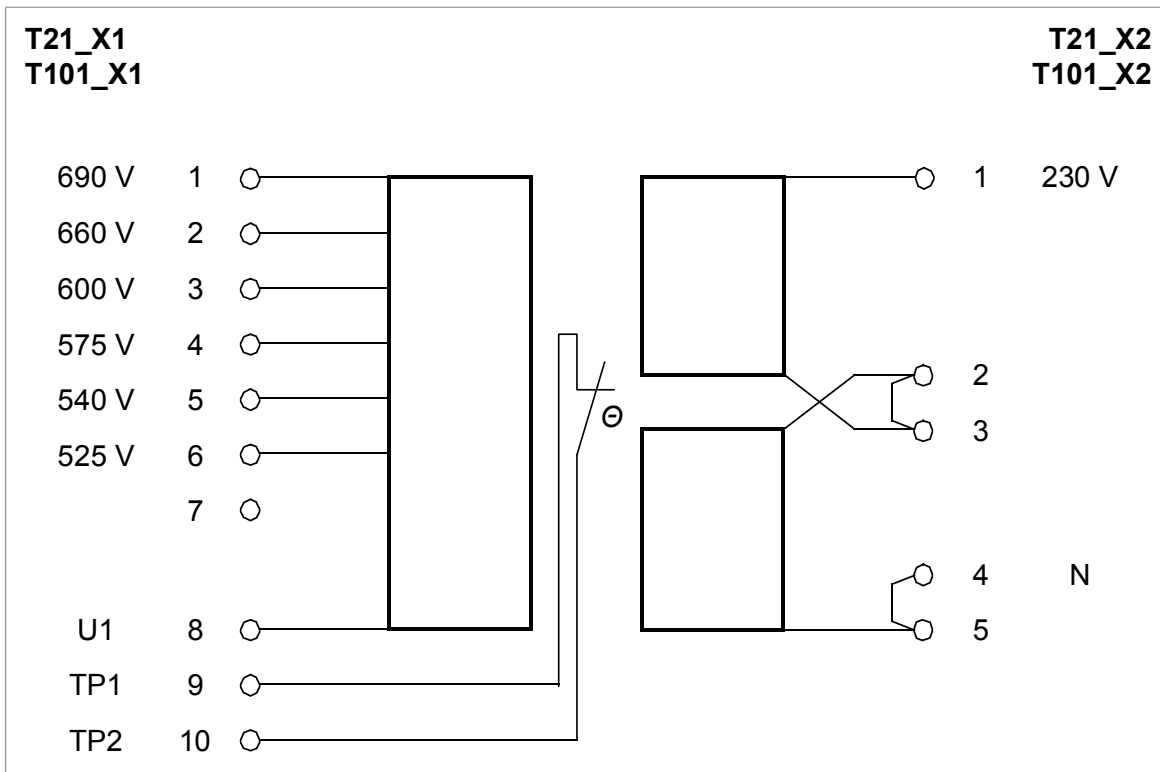
Check the tap settings of all auxiliary voltage transformers. Transformer T21 is standard equipment; T101 and T111 are present depending on drive configuration.

The voltage settings of transformers T21 and T101 are made at terminal blocks T21_X1/X2 and T101_X1/X2 respectively. The settings of transformer T111 are made on the transformer itself. The locations of the transformers and the terminal blocks are shown in section [Operation principle and hardware description](#) (page 31).

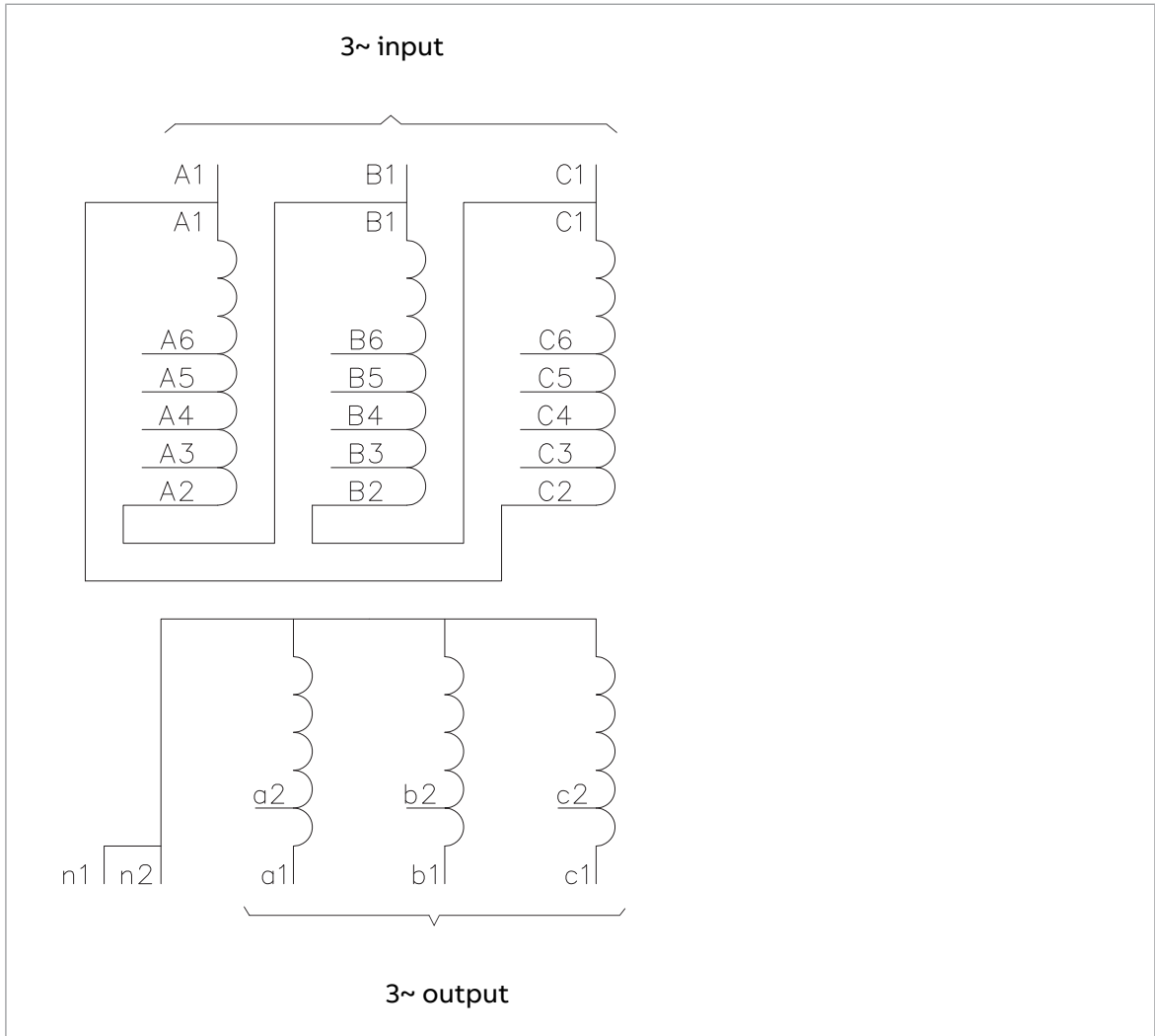
■ T21 and T101 tap settings (400...500 V units)



■ T21 and T101 tap settings (690 V units)



■ **T111 tap settings**



Supply voltage	Terminals	3~ input			3~ output	
		Tap settings			Terminals	
		A1-	B1-	C1-	400 V (50 Hz)	320/340 V (60 Hz)
690 V	A1, B1, C1	C2	A2	B2	a1, b1, c1	a2, b2, c2
660 V	A1, B1, C1	C2	A2	B2	a1, b1, c1	a2, b2, c2
600 V	A1, B1, C1	C3	A3	B3	a1, b1, c1	a2, b2, c2
575 V	A1, B1, C1	C3	A3	B3	a1, b1, c1	a2, b2, c2
540 V	A1, B1, C1	C4	A4	B4	a1, b1, c1	a2, b2, c2
525 V	A1, B1, C1	C4	A4	B4	a1, b1, c1	a2, b2, c2
500 V	A1, B1, C1	C4	A4	B4	a1, b1, c1	a2, b2, c2
480 V	A1, B1, C1	C5	A5	B5	a1, b1, c1	a2, b2, c2
460 V	A1, B1, C1	C5	A5	B5	a1, b1, c1	a2, b2, c2
440 V	A1, B1, C1	C5	A5	B5	a1, b1, c1	a2, b2, c2
415 V	A1, B1, C1	C6	A6	B6	a1, b1, c1	a2, b2, c2
400 V	A1, B1, C1	C6	A6	B6	a1, b1, c1	a2, b2, c2
380 V	A1, B1, C1	C6	A6	B6	a1, b1, c1	a2, b2, c2

Connecting the control cables

See chapter [Control units of the drive](#) 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 safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

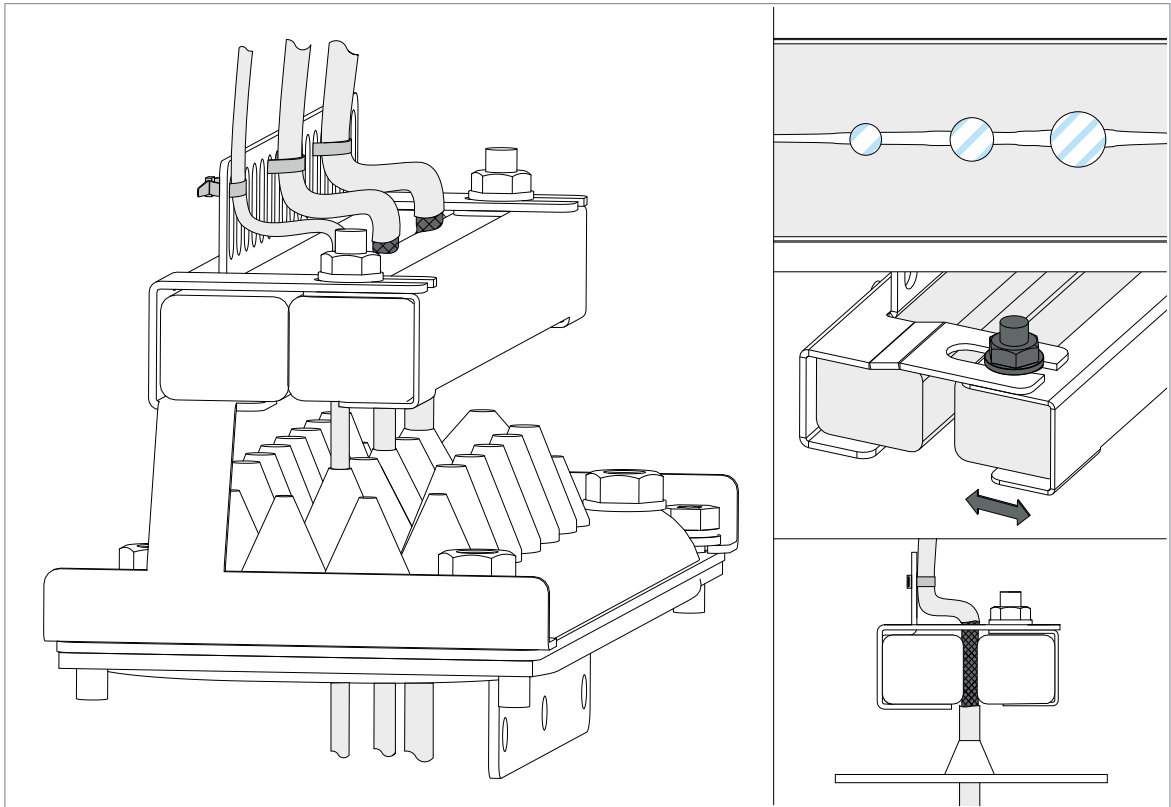
1. Do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Run the control cables into the cabinet as described in section [Grounding the outer shields of the control cables 360° at the cabinet entry](#).
3. Route the control cables as described in section [Routing the control cables inside the cabinet](#) (page 121).
4. Connect the control cables as described in section [Connecting control cabling](#) (page 122).

Grounding the outer shields of the control cables 360° at the cabinet entry

Ground the outer shields of all control cables 360° with the EMI conductive cushions at the cabinet entry. The grounding principle is the same for top and bottom entry cables. The illustrations show the bottom entry. The actual design details can vary.

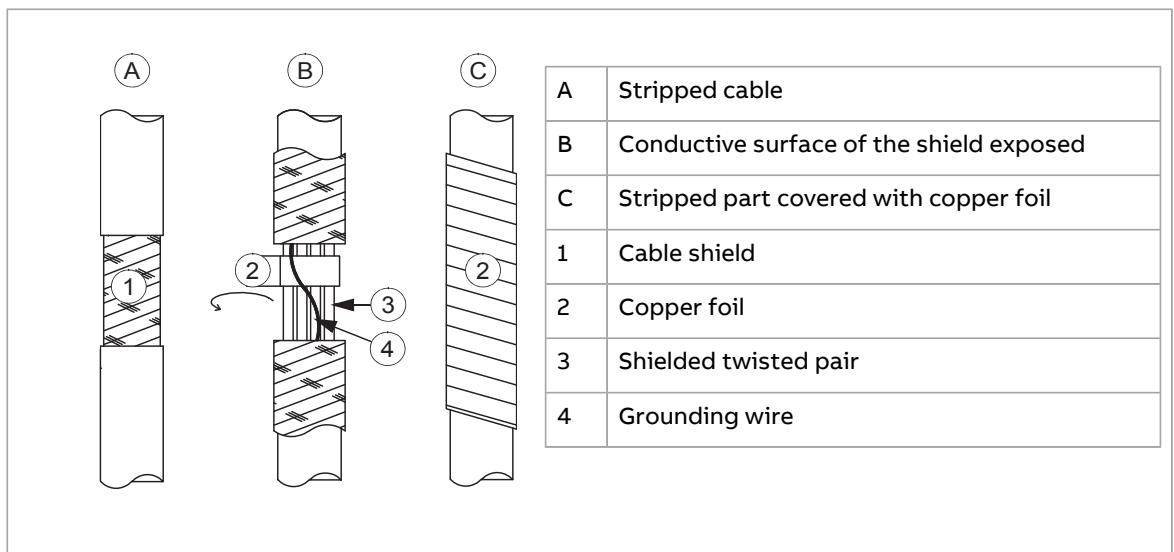
1. If necessary, remove the shrouding in front of the cable entry.
2. Put the cables in sequence from the smallest to the largest. This will help to achieve a good contact with the cushions.
3. Loosen the tightening bolts of the EMI conductive cushions and pull them apart.
4. Cut holes in the grommets and put the cables through the grommets.
5. Peel the insulation from the part of the cable that will be in contact with the EMI conductive cushion.
6. Put the cables between the cushions and attach them with cable ties for strain relief.
7. Move the cushions back together.
8. Tighten the bolts to make sure that the EMI conductive cushions press tightly around the peeled part of the cables.





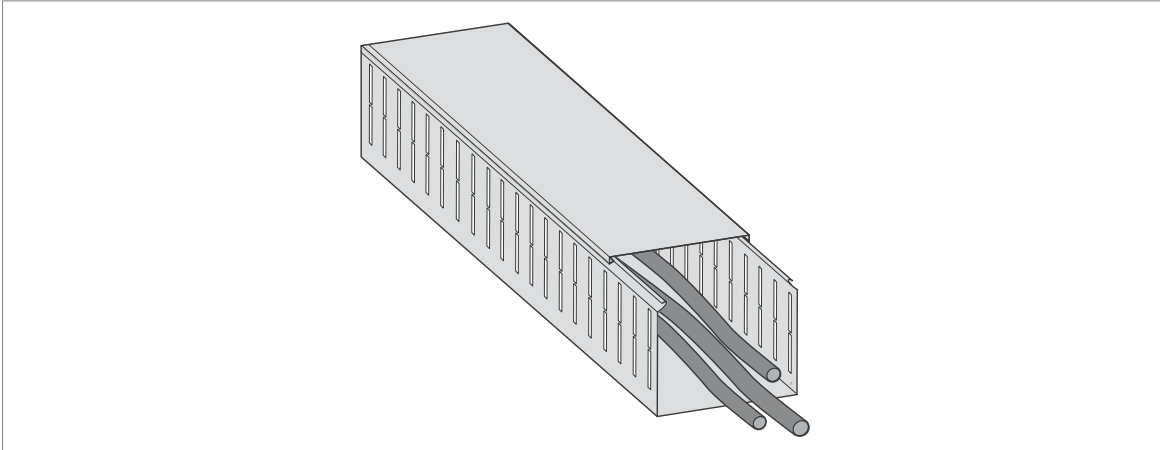
If the outer surface of the shield is non-conductive:

- Cut the shield at the midpoint of the peeled part. Be careful not to cut the conductors or the grounding wire.
- Turn the conductive side of the shield inside out over the insulation.
- Cover the exposed shield and the peeled cable with copper foil to keep the shielding continuous.



Routing the control cables inside the cabinet

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



Connecting control cabling

Connect the conductors to the appropriate terminals. Refer to the wiring diagrams delivered with the drive.

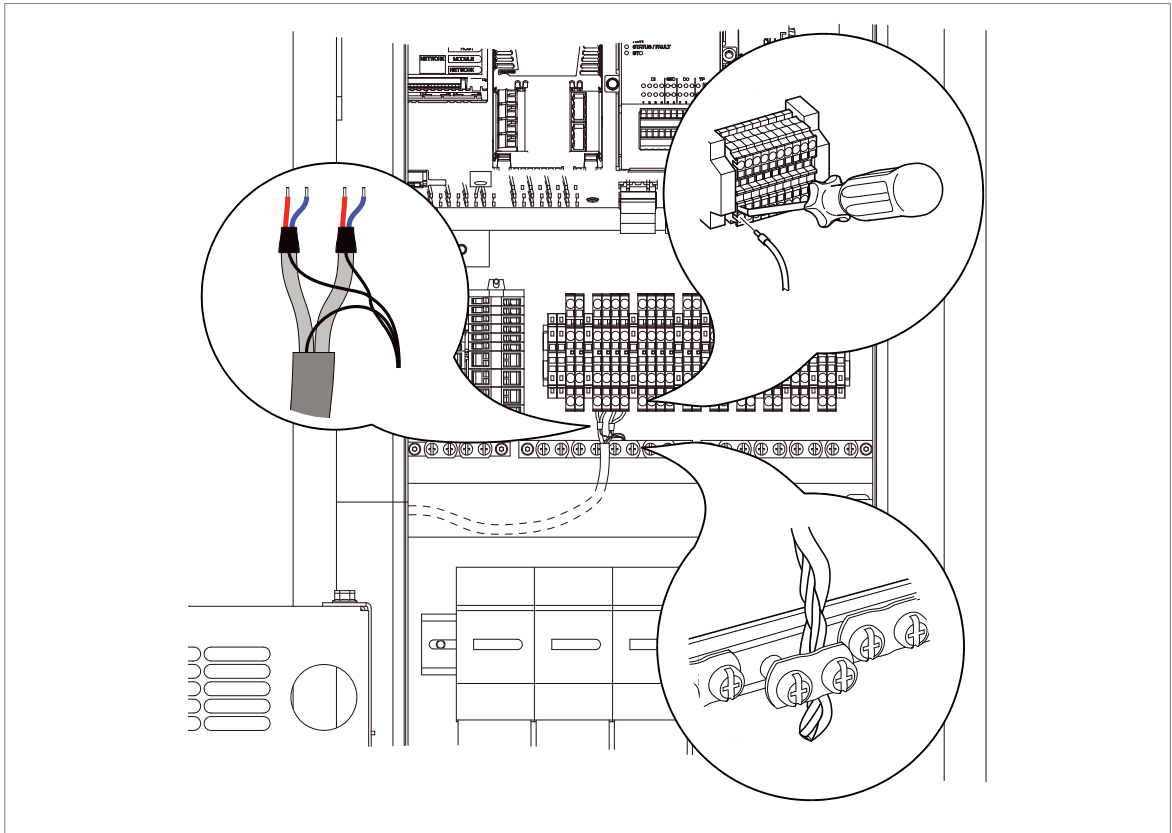
With option +L504, the terminals of the inverter control unit are available on terminal block X504.

Obey these instructions:

- Connect the inner twisted pair shields and all separate grounding wires to the grounding clamps near the terminals.
- Ground the outer shield of the cable at the cable entry, not at the grounding clamps near the terminals.
- 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.



The drawing below represents the grounding of the control cabling when connecting to a terminal block inside the cabinet. The grounding is done in the same way when connecting directly to a component such as the control unit.



Connecting the motor cables (units without common motor terminal cubicle or sine output filter)

On units without a common motor terminal cubicle or a sine output filter, the motor cables connect to busbars located behind the inverter module(s). The location and dimensions of the busbars are visible in the dimension drawings delivered with the drive, as well as the example drawings presented in this manual in chapter *Dimensions*.

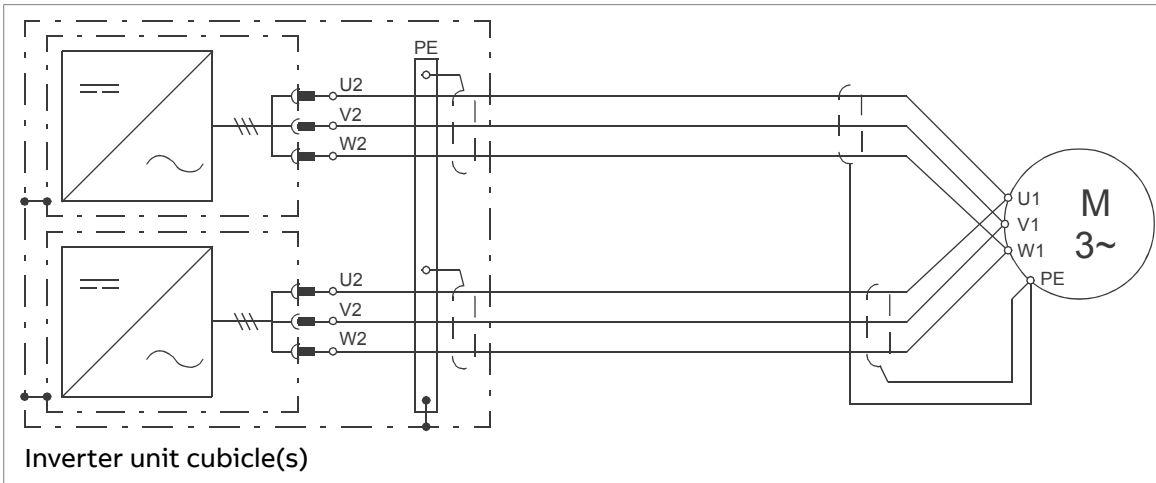
To allow the most room for the work, the modules can be removed completely from the cabinet. For instructions, see section *Removing the inverter module(s)* (page 125).

Especially in the case of multiple inverter modules in the same cubicle, you can consider only removing the fan carriage of each module. This is faster than removing the entire module, but allows less room for the connecting work. For instructions, see section *Removing the fan carriage of an inverter module* (page 129).

■ Motor connection diagram (without option +H366)

All parallel-connected inverter modules are to be cabled separately to the motor.

360° earthing is to be used at the cable entries.

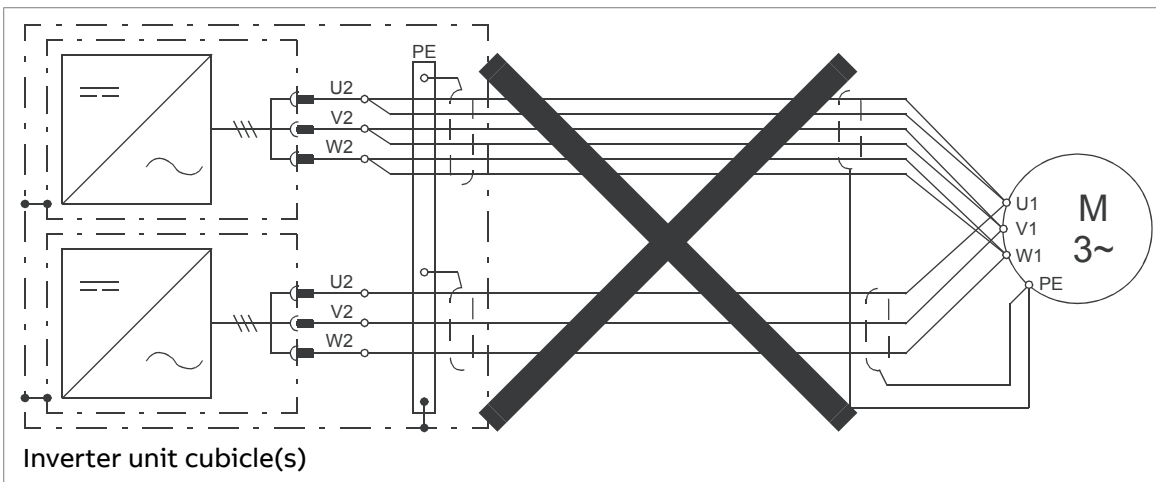


The recommended cable types are given in the technical data.



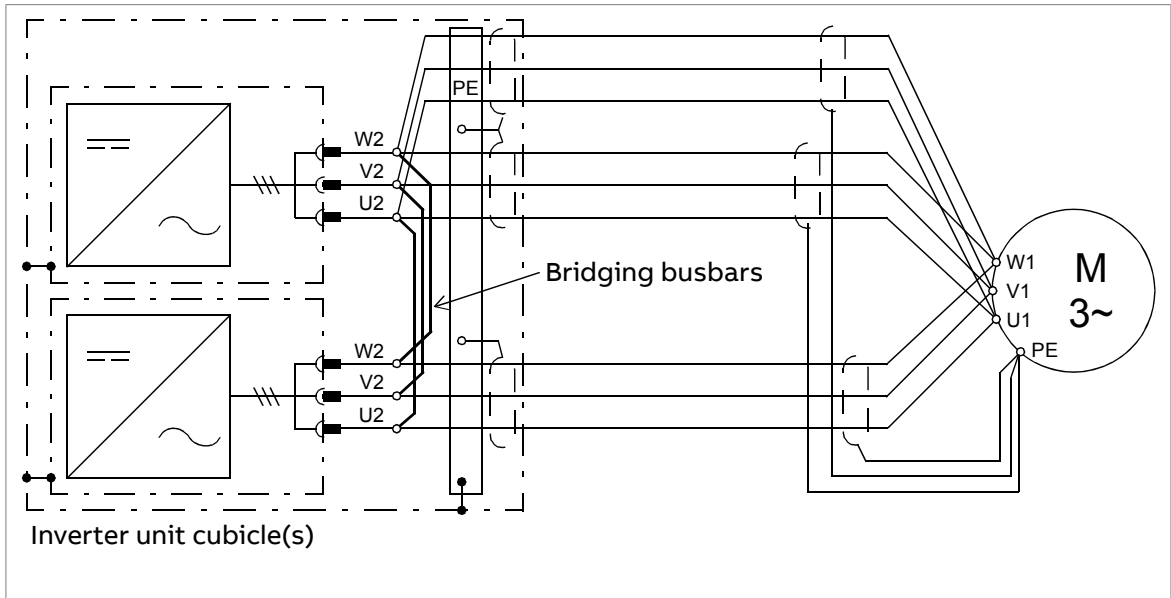
WARNING!

The cabling from all inverter modules to the motor must be physically identical considering cable type, cross-sectional area, and length.



■ **Motor connection diagram (with option +H366)**

With option +H366, the output busbars of the inverter modules within the same cubicle are connected by bridging busbars. The bridging balances the motor current between the modules, which allows more cabling options. For example, it is possible to use a number of cables that could not otherwise be evenly distributed between the inverter modules.



The recommended cable types are given in the technical data.



WARNING!

The bridging can carry the nominal output of one inverter module. In case of three parallel modules, ensure that the load capacity of the bridging is not exceeded. For example, if the cabling connects to the output busbars at one module only, use the module in the middle.

Note: The +H366 option only interconnects the outputs of inverter modules within the same cubicle, not modules installed in different cubicles. Therefore, when the drive has multiple inverter cubicles (ie. two cubicles of two modules each), make sure that the motor cabling is identical for both cubicles.

■ Procedure

Removing the inverter module(s)

To allow more room for cabling work, the inverter modules can be removed completely instead of only the fan carriages.

Refer to the drawings below.

Note: As an alternative to using the extraction/installation ramp, a lifter is available from ABB Service. See *Lifter for air-cooled drive modules user's guide* (3AXD50000332588 [English]).



WARNING!

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

1. Do the steps in section *Electrical safety precautions* (page 21) before you start the work.
2. Open the inverter module cubicle door.
3. Remove the shroud at the top of the cubicle.
4. Detach the terminal block [X50] at the top of the module.

5. Detach the DC busbars from the module. Make note of the order and position of the screws and washers.
6. Detach the wiring connected to the terminals on the front of the module (including fiber optic cabling). Move the disconnected wiring aside.
7. Drives with option +C121 (Marine construction) or +C180 (Seismic design):
 - a. Loosen the bolts holding the transverse retaining bracket both on the left and the right. (During reassembly, tighten these screws to 9 N·m [6.6 lbf·ft].)
 - b. Remove the bolts holding the retaining bracket to the module.
 - c. Remove the retaining bracket.
 - d. Reinstall the bolts to the module. Tighten to 22 N·m (16 lbf·ft).



WARNING! Do not proceed before the bolts are securely in place. Otherwise, the parts of the module can become separated and cause injury or damage.

8. Attach the module extraction/installation ramp (included) to the base of the cabinet so that the tabs on the mounting bracket enter the slots on the ramp.



WARNING! Check the markings on the ramp to make sure that it is suitable for the plinth height.

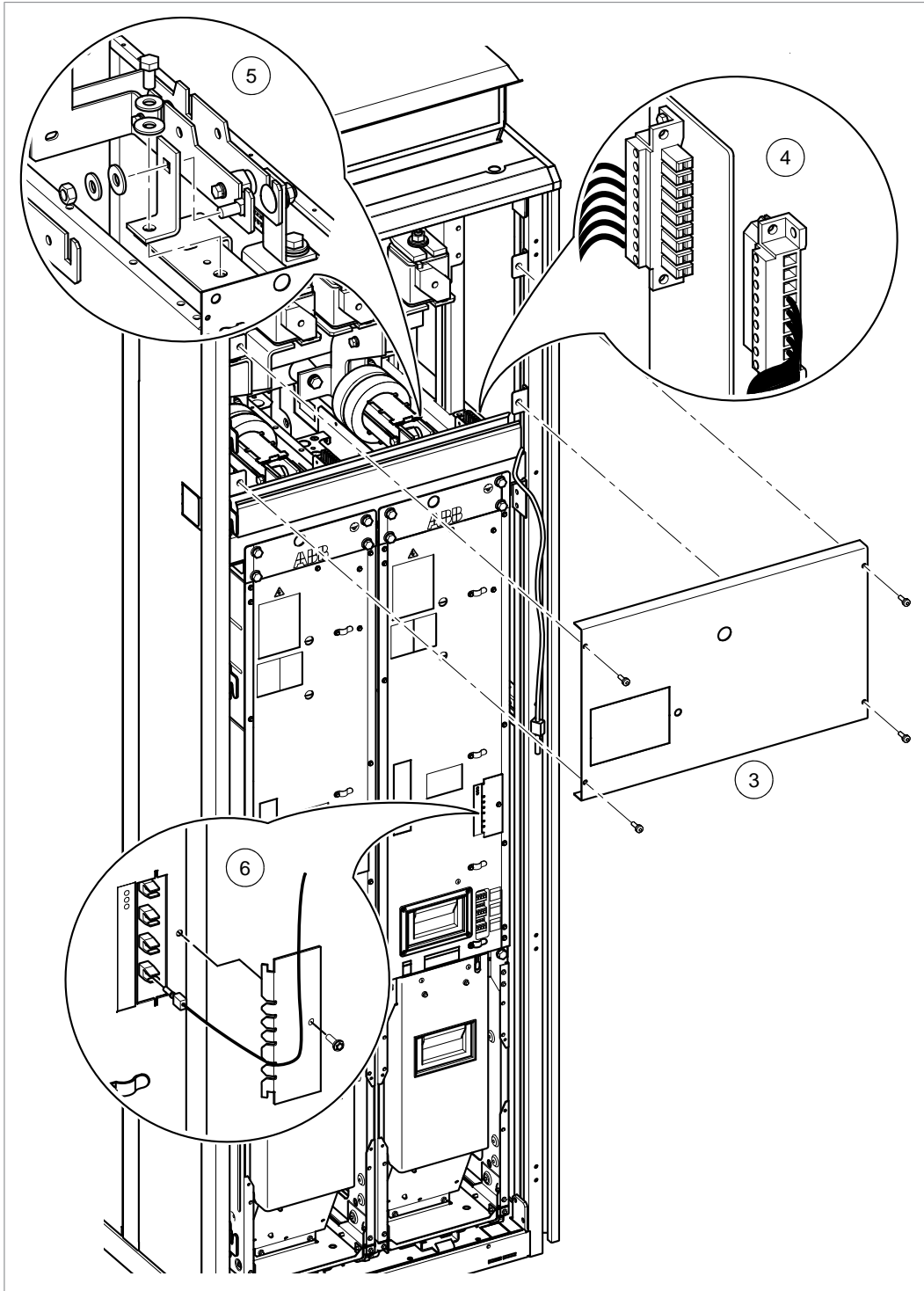
9. Remove the two retaining screws at the bottom front of the module.



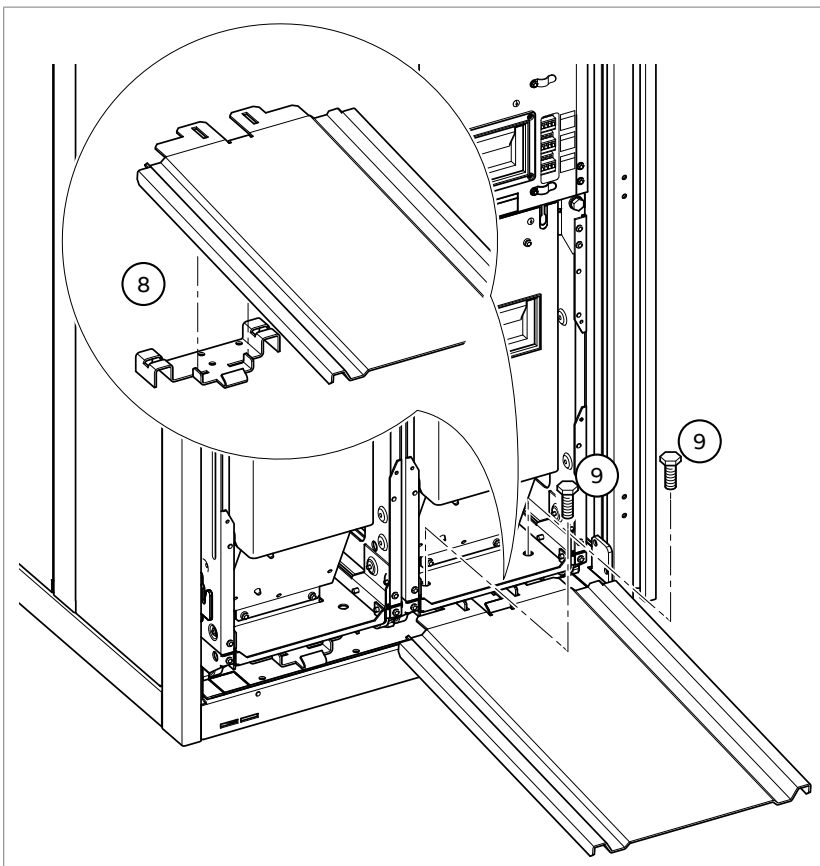
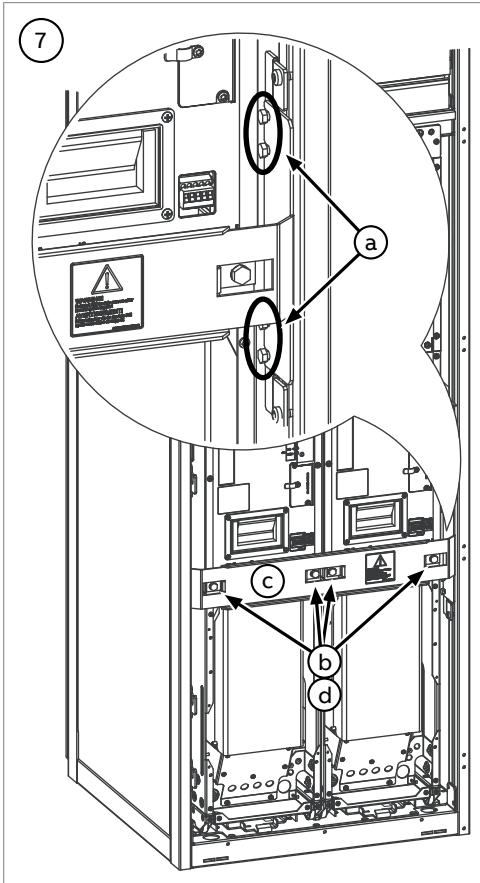
WARNING! Before you proceed, make sure the cabinet is level, or chock the wheels of the module.

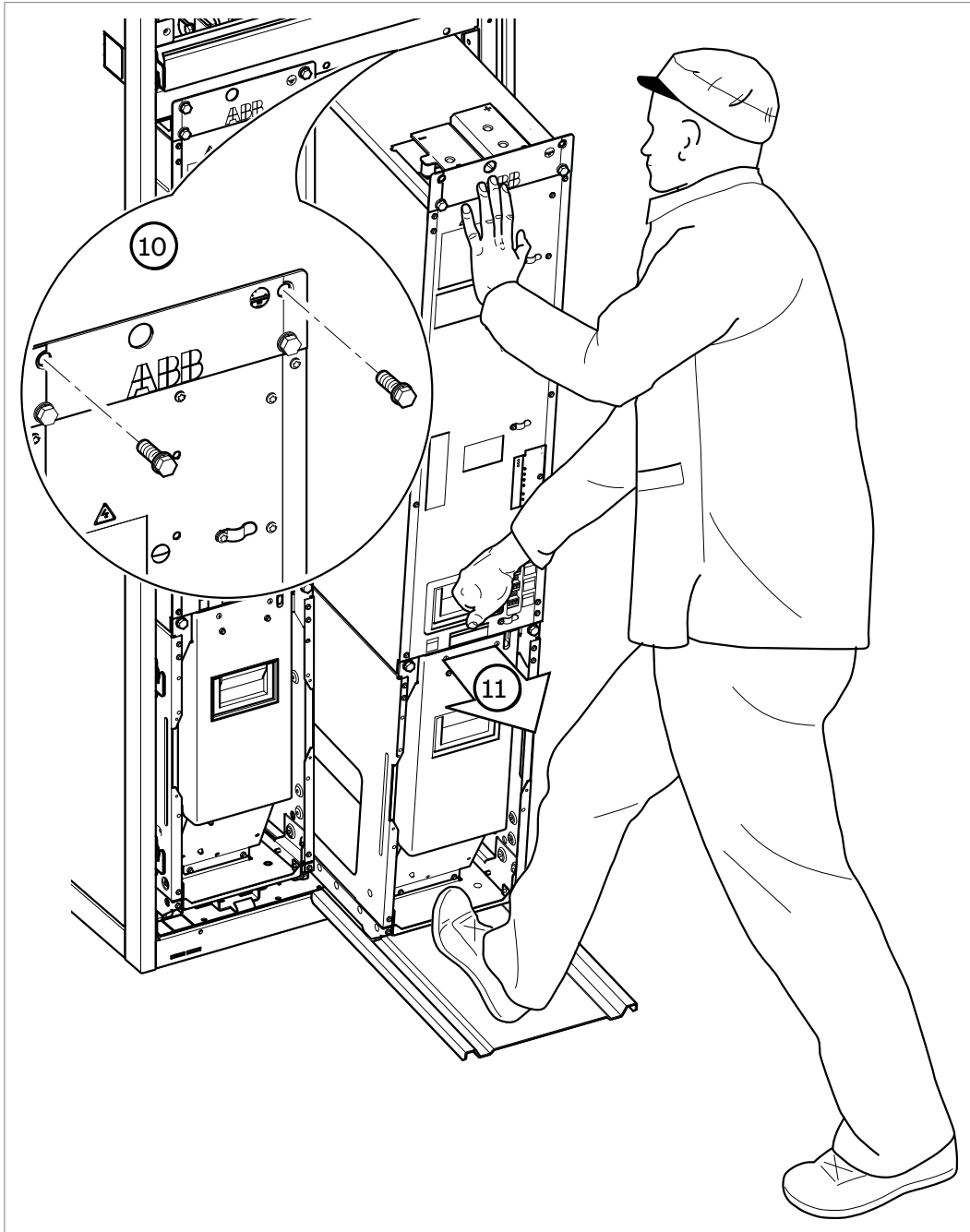
10. Remove the two retaining screws at the top front of the module.
11. Pull the module carefully out along the ramp. While pulling on the handle with your right hand, keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
12. Move the module into a safe location outside the immediate work area and make sure it cannot topple over. Chock the wheels of the module if the floor is not completely level.
13. Repeat the procedure for the other inverter modules.





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Removing the fan carriage of an inverter module

Refer to the drawings below.



WARNING!

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

1. Do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Open the inverter module cubicle door.
3. Remove the screws holding the front cover plate. Lift the cover plate somewhat to release it.
4. Disconnect the wiring at the top of the fan carriage.

5. Remove the two screws at the bottom of the fan carriage.



WARNING!

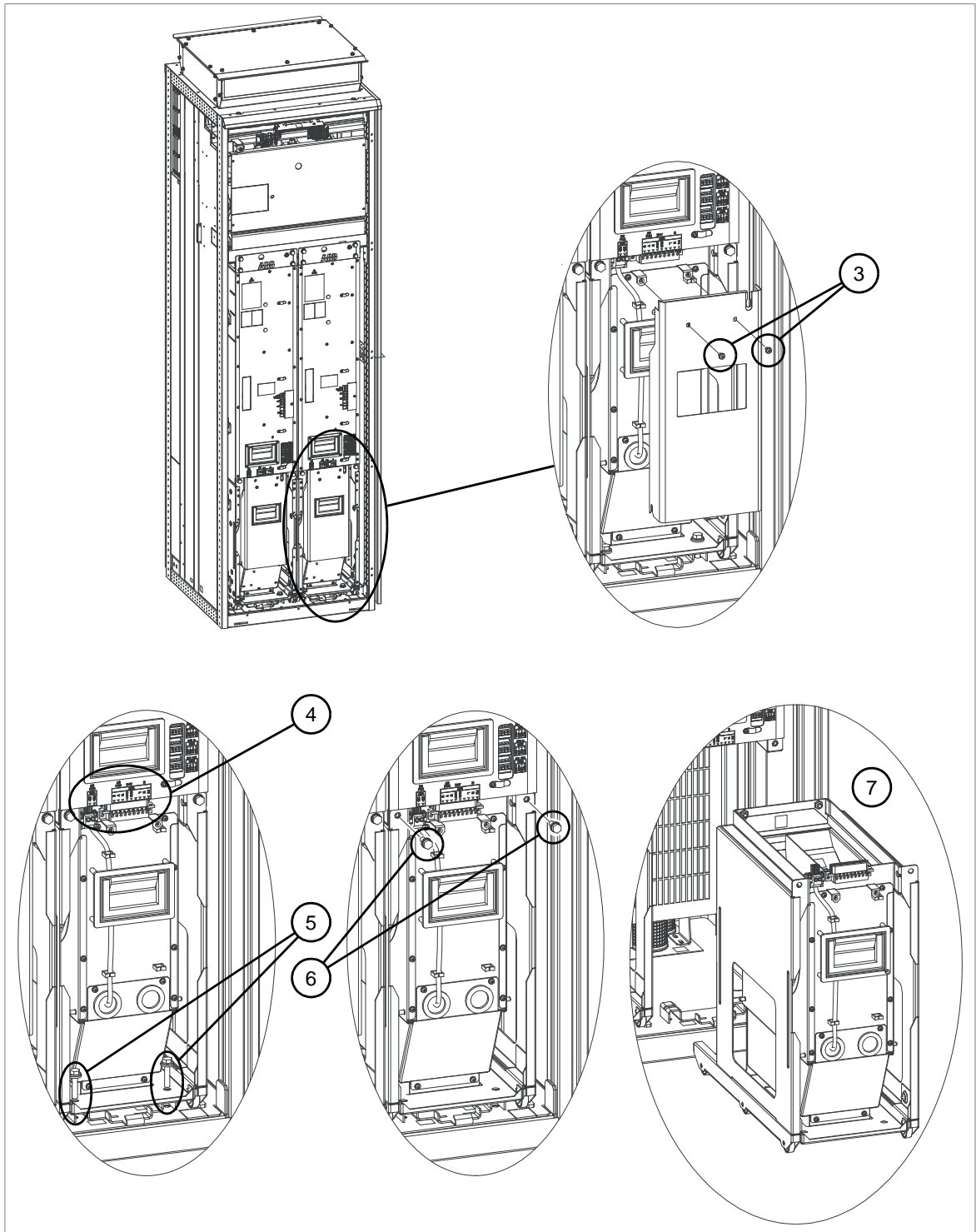
Before you proceed, make sure the two screws holding the top of the inverter module are in place.

6. Remove the two screws at the top of the fan carriage. (During reassembly, tighten these screws to 22 N·m [16 lbf·ft].)

Note: Units with marine or seismic design have an additional transverse bracket that is attached to the module with these screws. At this point, loosen the retaining screws of the bracket at the left and the right ends and remove it. (During reassembly, tighten the bracket retaining screws to 9 N·m [6.6 lbf·ft].)

7. Pull the fan carriage out.
8. Repeat the procedure for other fan carriages in the same cubicle.





Connecting the motor cables

Refer to the drawings below.



WARNING!

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

1. Do the steps in section Electrical safety precautions (page 21) before you start the work.
2. Remove the shroud in front of the output busbars.

3. For 360° grounding of the shield at the cable entry, remove the outer jacket of each cable where they pass through the cable entry (a).
4. Cut the cable to suitable length and strip the ends of the individual conductors. Twist the shield strands together to form a separate conductor and wrap it with tape.
5. Crimp suitable lug terminals onto the phase conductors and the ground conductor. The dimensions of the output busbars are shown in chapter Technical data.
6. Connect the phase conductors of the motor cable to the U2, V2 and W2 terminals. You can temporarily remove the plastic insulators (b) between the busbars to make the connecting work easier. See [Use of fasteners in cable lug connections \(page 140\)](#).

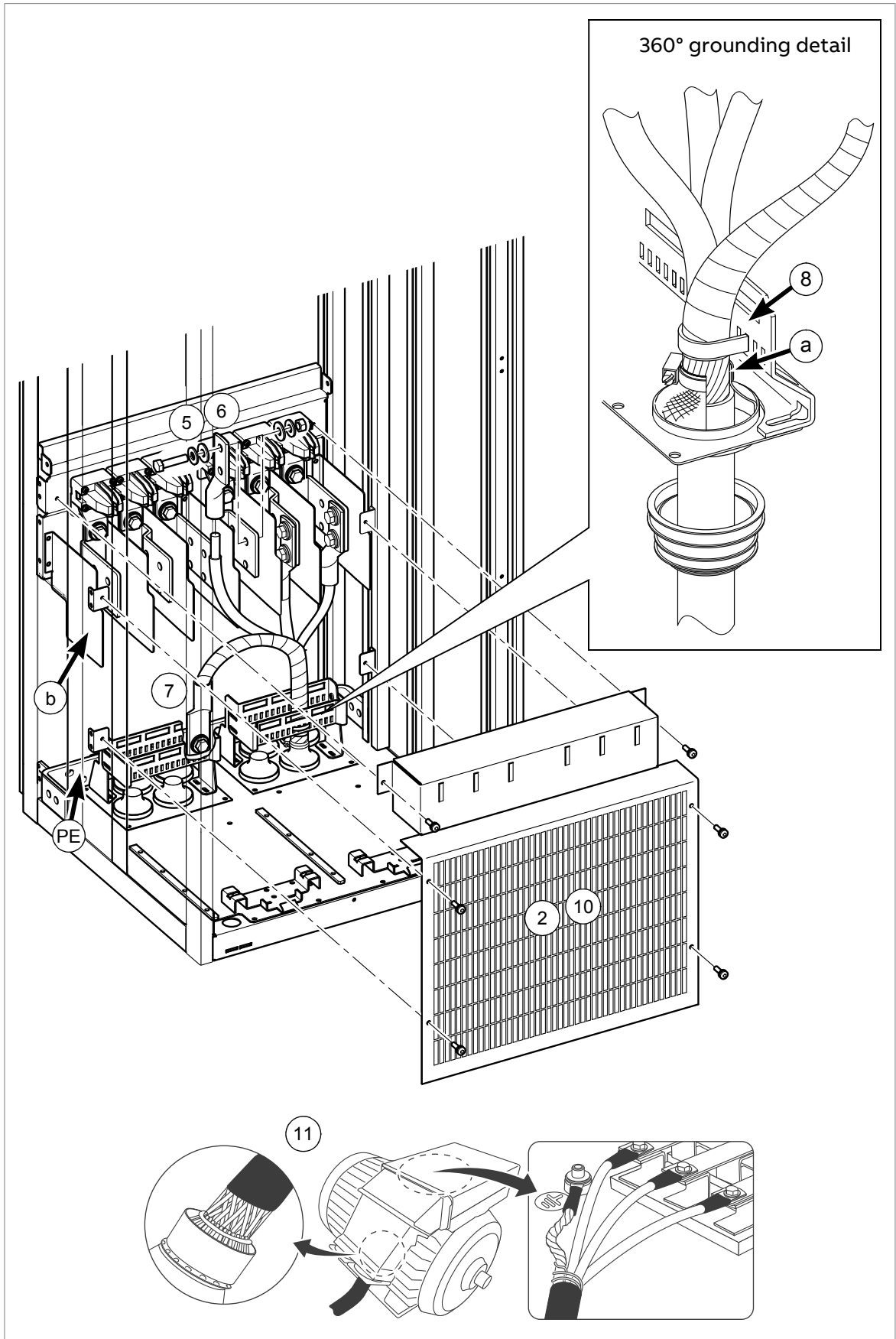


WARNING!

The plastic insulators (b) between the busbars must be in place when the inverter is powered.

7. Connect the shield (and any grounding conductors) of the cable to the PE busbar close to the cable entries.
8. Secure the cable mechanically.
9. Repeat the procedure for other modules (if any).
10. Refit the shroud removed earlier.
11. At the motor, connect the cables according to instructions from the motor manufacturer. Pay special attention to the phase order. For minimum radio-frequency interference, ground the cable shield 360 degrees at the cable entry of the motor terminal box, or ground the cable by twisting the shield so that the flattened shield is wider than 1/5 of its length.





Re-installing the fan carriage of an inverter module

(If the inverter module was removed completely instead of only the fan carriage, proceed to section [Re-inserting the inverter modules into the cubicle](#) (page 134)).

The re-installation of the fan carriage is the removal procedure in reverse. See section [Removing the fan carriage of an inverter module](#) (page 129).

Re-inserting the inverter modules into the cubicle



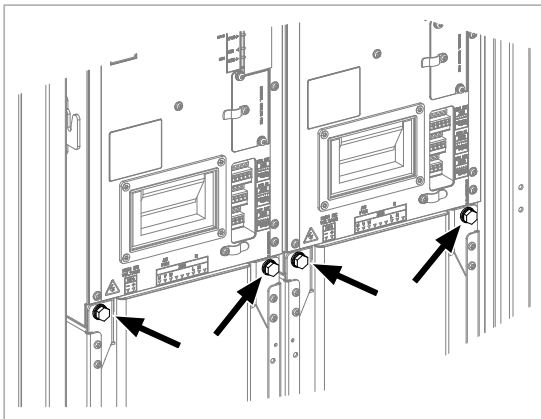
WARNING!

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

1. Make sure there are no tools, debris or any other foreign objects in the cubicle.
2. If not already in place, attach the module extraction/installation ramp (included) to the base of the cabinet so that the tabs on the mounting bracket enter the slots on the ramp.
3. Push the module up the ramp and back into the cubicle.
 - **Keep your fingers away from the edge of the module front plate to avoid pinching.**
 - **Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.**
4. Secure the top front of the module with two screws. Tighten to 22 N·m (16 lbf·ft).
5. Secure the bottom front of the module with two screws. Tighten to 22 N·m (16 lbf·ft).
6. Remove the ramp.
7. Drives with option +C121 (Marine construction) or +C180 (Seismic design):
 - a. Remove the bolts holding the fan carriage (two bolts per module).



WARNING! The module retaining screws (two at top, two at bottom per module) must be in place before removing these screws. Otherwise, the parts of the module can become separated and cause injury or damage.



- b. Reinstall the transverse retaining bracket. At the ends of the bracket, tighten the screws to 9 N·m [6.6 lbf·ft]. Reinstall the fan carriage bolts removed at previous step, and tighten to 22 N·m (16 lbf·ft).

8. Attach the DC busbars to the module. Tighten to 70 N·m (52 lbf·ft). See *Use of fasteners in cable lug connections* (page 140).
9. Reconnect terminal block [X50] at the top of the module.
10. Reconnect the wiring and fiber optic cables to the terminals on the front of the module.
11. Repeat the procedure for the other inverter modules.
12. Reinstall the shroud near the top of the cubicle.

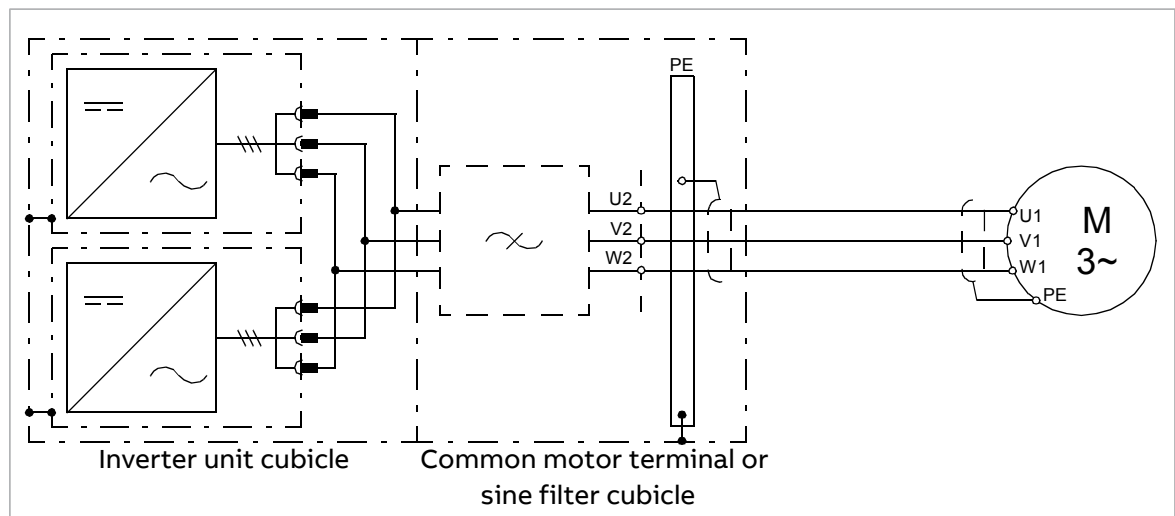
Connecting the motor cables (units with common motor terminal cubicle or sine output filter)

■ Output busbars

If the drive is equipped with option +H359, the motor cables connect to a common motor terminal cubicle. Similarly, if the drive is equipped with option +E206 (sine output filter), the motor cables connect to the output busbars in the sine filter cubicle.

The location and dimensions of the busbars are visible in the dimensional drawings delivered with the drive.

■ Connection diagram



The recommended cable types are given in the technical data.

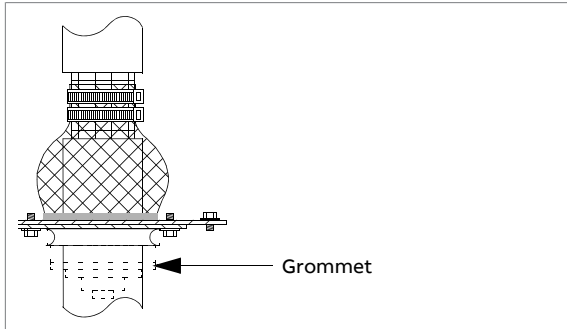
■ Procedure



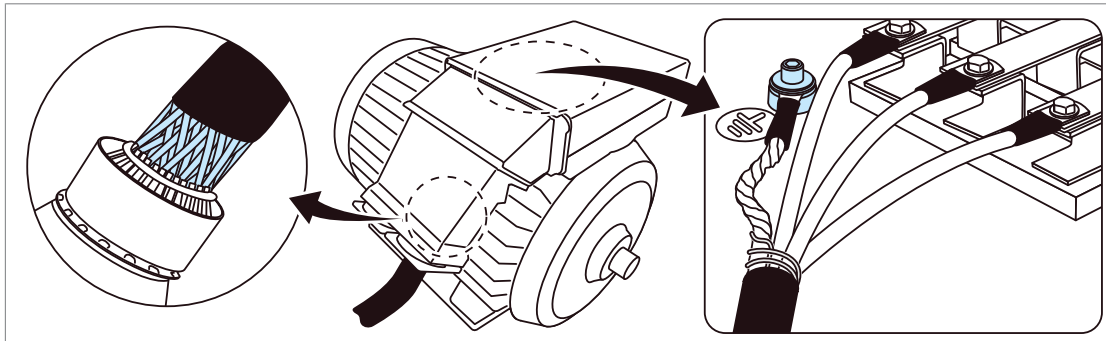
WARNING!

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

1. Do the steps in section *Electrical safety precautions* (page 21) before you start the work.
2. Open the door of the cubicle and remove the shrouding.
3. Lead the cables into the cubicle. Make the 360° earthing arrangement at the cable entry as shown.



4. Cut the cables to suitable length. Strip the cables and conductors.
5. Twist the cable screens into bundles and connect the bundles to the PE busbar in the cubicle.
6. Connect any separate ground conductors/cables to the PE busbar in the cubicle. Refer to section *Use of fasteners in cable lug connections* (page 140).
7. Connect the phase conductors to the output terminals. Use the tightening torques specified in section *Tightening torques* (page 241).
8. Refit any shrouding removed earlier and close the cubicle doors.
9. At the motor, connect the cables according to instructions from the motor manufacturer. Pay special attention to the phase order. For minimum radio-frequency interference, ground the cable shield 360 degrees at the cable entry of the motor terminal box, or ground the cable by twisting the shield so that the flattened shield is wider than $1/5$ of its length.



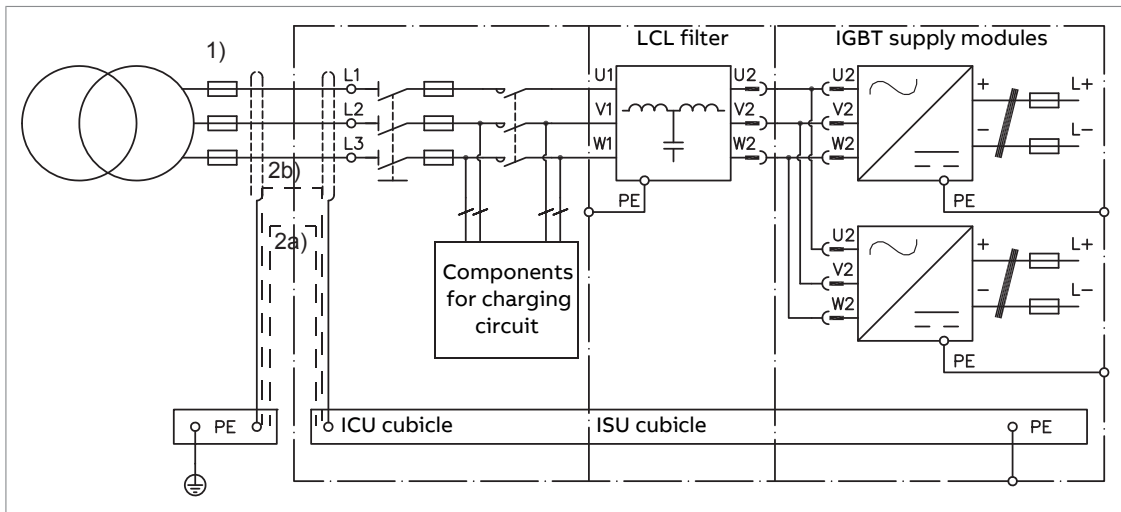
Connecting an external brake resistor assembly

See chapter *Resistor braking* (page 309).

For the location of the terminals, refer to the dimension drawings delivered with the unit or the dimension drawing examples in this manual.

Connecting the input power cables

■ Connection diagram



Notes:

1) Fuses or other protection means.

Use a separate grounding (PE) cable (2a) or a cable with separate PE conductor (2b) if the conductivity of the shield does not meet the requirement for the PE conductor. See section [Selecting the power cables](#) (page 99).

■ Layout of the input cable connection terminals and cable entries

The location and dimensions of the busbars are visible in the dimensional drawings delivered with the drive. Alternatively, see the example dimension drawings in the manual.

■ Connection procedure



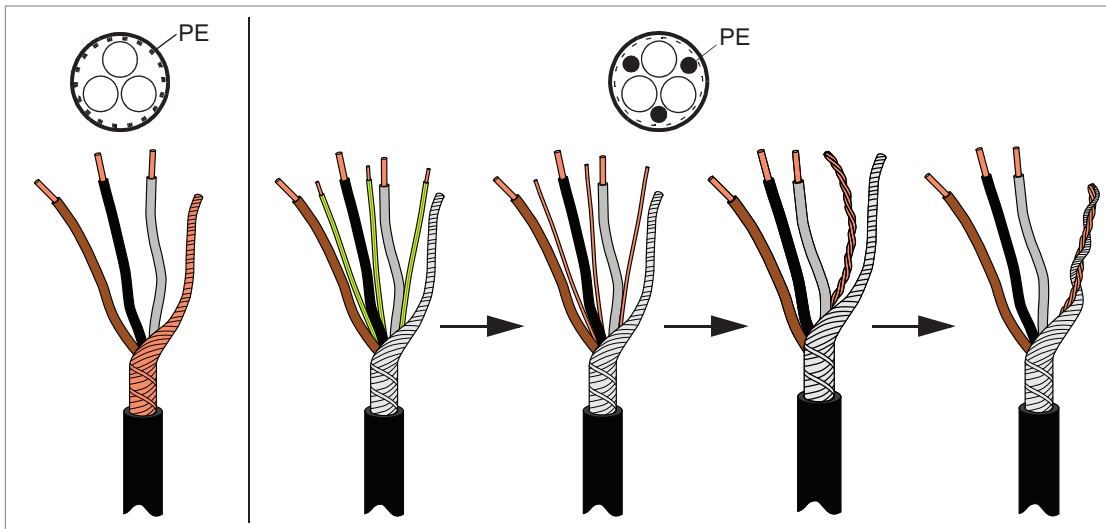
WARNING!

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

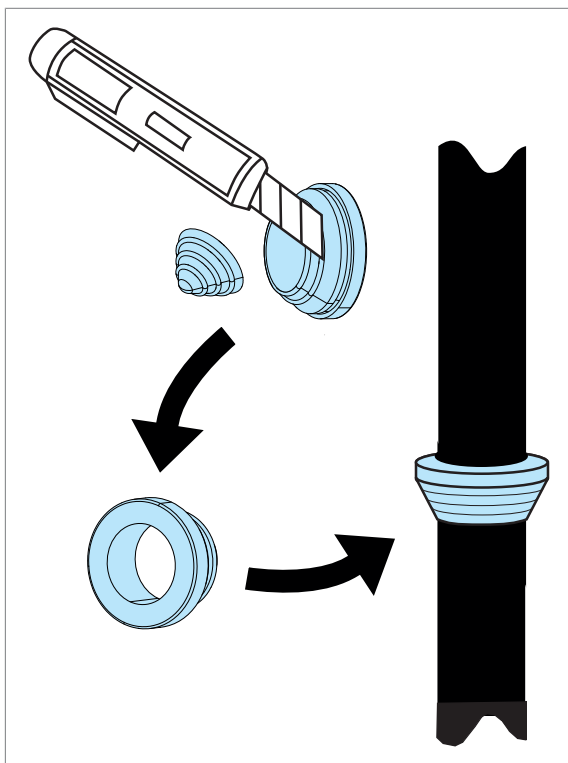
1. Do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Open the door of the incoming cubicle. In case of frame 1×R8i + 1×R8i, open the door of the supply and inverter module cubicle.
3. Frame 1×R8i + 1×R8i only: Remove the LCL filter module as described under [Replacing the LCL filter](#) (page 201).
4. Remove the shrouding covering the input terminals.
5. Peel off 3...5 cm (1.2 ... 2 inches) of the outer insulation of the cables above the cable entry plate for 360° high-frequency grounding.
6. Prepare the ends of the cables.

**WARNING!**

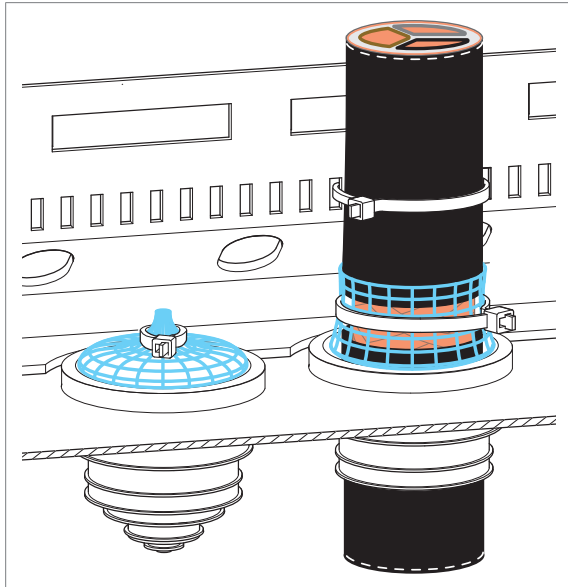
Apply grease to stripped aluminum conductors before attaching them to non-coated aluminum cable lugs. Obey the grease manufacturer's instructions. Aluminum-aluminum contact can cause oxidation in the contact surfaces.



- Remove rubber grommets from the cable entries for the cables to be connected. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Slide the cables into the cubicle through the conductive sleeves and attach the grommets to the holes.



- Attach the conductive sleeves to the cable shields with cable ties. Tie up the unused conductive sleeves with cable ties.



9. Connect the twisted shields of the cables to the PE busbar of the cabinet.
10. Connect the phase conductors of the input cable to the L1, L2 and L3 terminals. See [Use of fasteners in cable lug connections \(page 140\)](#). Tighten the screws to the torque given under [Tightening torques \(page 241\)](#).
11. Reinstall the shrouding removed earlier.
12. **Frame 1×R8i + 1×R8i only:** Reinstall the LCL filter module as described under [Replacing the LCL filter \(page 201\)](#).
13. Close the cubicle door.



Use of fasteners in cable lug connections

Use the bolts, nuts and washers delivered with the drive. Install all the fasteners in the correct order. See the figure below. Tighten the cable lug to the torque specified for the connection.

Cable lug on one side of the busbar

Cable lugs on both sides of the busbar

1	Bolt	4	Cable lug
2	Plain washer	5	Spring washer
3	Busbar	6	Nut



Connecting a PC

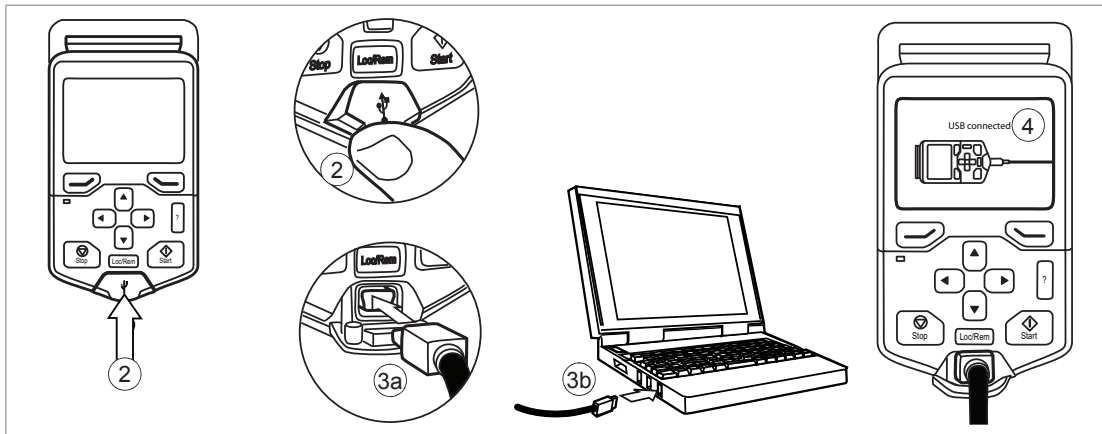


WARNING!

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

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

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



Panel bus (Control of several units from one control panel)

One control panel (or PC) can be used to control several drives (or inverter units, supply units etc.) by constructing a panel bus. This is done by daisy-chaining the panel connections of the drives. Some drives have the necessary (twin) panel connectors in the control panel holder; those that do not require the installation of an FDPI-02 module (available separately). For further information, see the hardware description and FDPI-02 diagnostics and panel interface user's manual (3AUA0000113618 [English]).

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

1. Connect the panel to one drive using an Ethernet (for example Cat 5e) cable.
 - Use Menu - Settings - Edit texts - Drive to give a descriptive name to the drive
 - Use parameter 49.01* to assign the drive with a unique node ID number
 - Set other parameters in group 49* if necessary
 - Use parameter 49.06* to validate any changes.

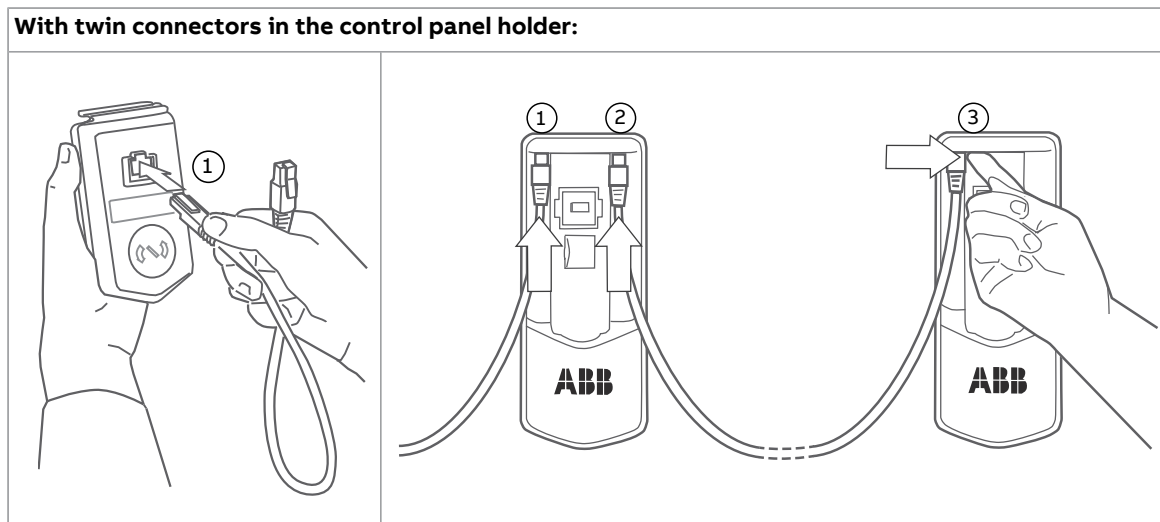
*The parameter group is 149 with supply (line-side), brake or DC/DC converter units.

Repeat the above for each drive.

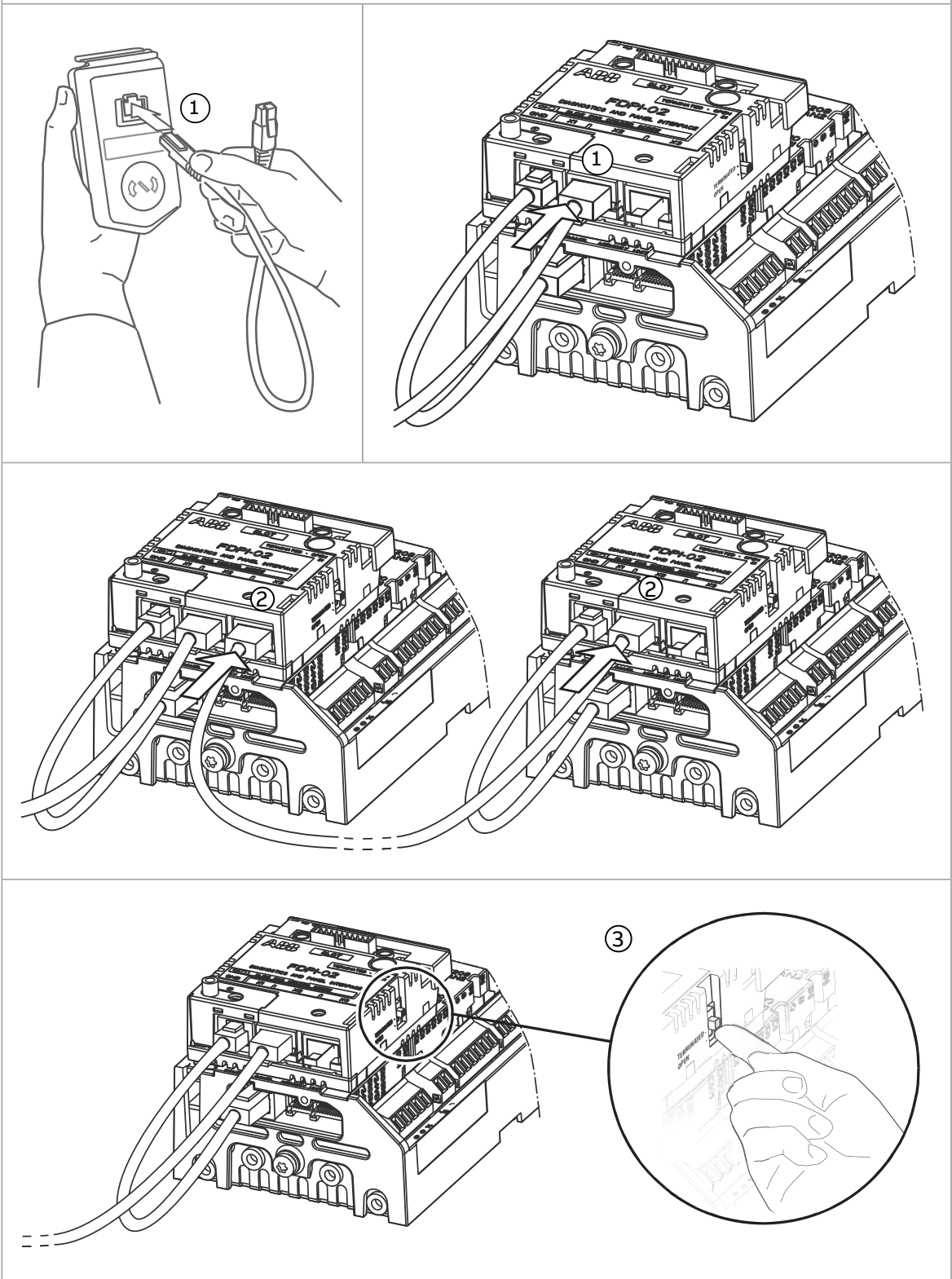
2. With the panel connected to one unit, link the units using Ethernet cables.

3. Switch on the bus termination on the drive that is farthest from the control panel in the chain.
 - With drives that have the panel mounted on the front cover, move the terminating switch into the outer position.
 - With the FDPI-02 module and BCU-02 control unit: move termination switch S1 on the FDPI-02 module into the TERMINATED position.
 - With the FDPI-02 module and UCU-22...26 control unit: move termination switch S1 on the FDPI-02 module into the OPEN position. Move control panel connection termination switch XPAN TERM on the UCU-22...26 control unit to ON position.Make sure that bus termination is off on all other drives.
4. On the control panel, switch on the panel bus functionality (Options - Select drive - Panel bus). The drive to be controlled can now be selected from the list under Options - Select drive.

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



With FDPI-02 modules and BCU-x2 control unit:



Installing option modules

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

See hardware description for the available slots for each module. Install the option modules as follows:



WARNING!

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

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Open the door of the auxiliary control cubicle (ACU).
3. Remove the shrouding at the top of the cubicle.
4. Locate the inverter control unit (A41).
5. Insert the module carefully into its position on the control unit.
6. Fasten the mounting screw.

Note: The screw secures and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.

■ Installation of an FSO safety functions module onto BCU



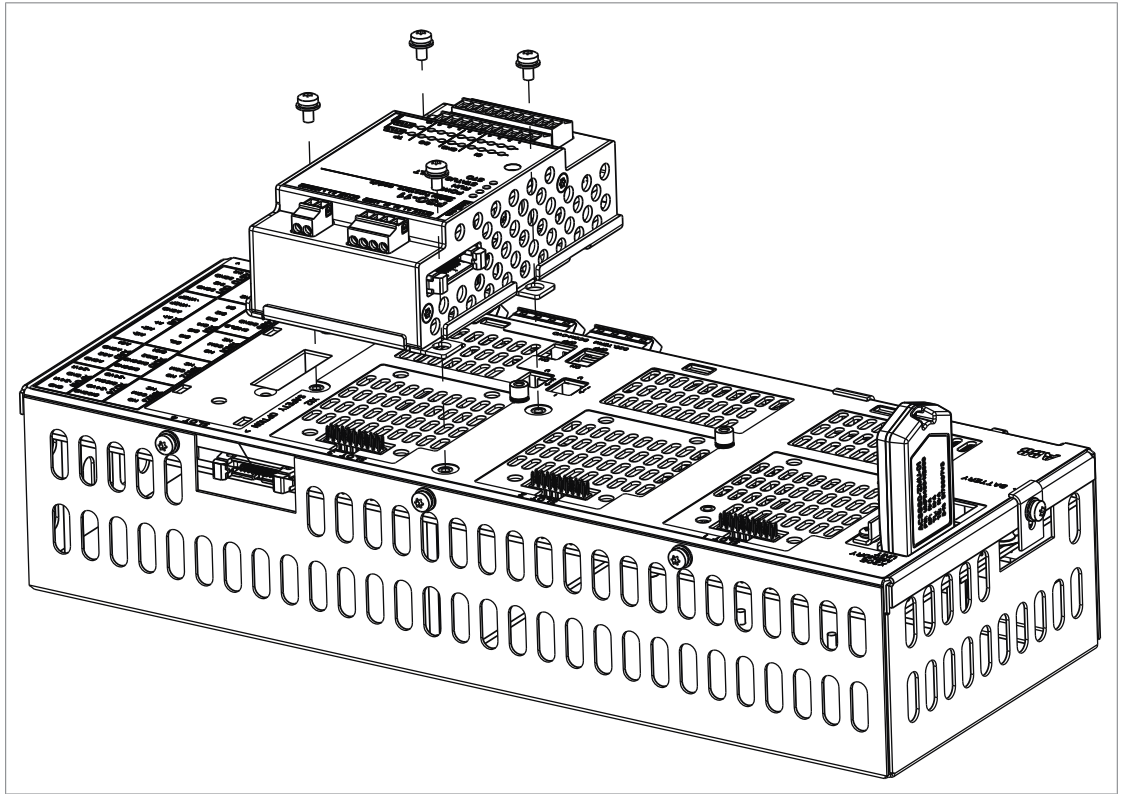
WARNING!

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

This procedure describes the installation of an FSO safety functions module onto the BCU control unit. As an alternative, the FSO module can be installed adjacent to the control unit, which is the standard method for factory-installed FSO modules. For instructions, refer to the applicable FSO module user's manual.

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
 2. The FSO module comes with alternative bottom plates for installation onto different control units. For installation onto a BCU control unit, the mounting points should be located at the long edges of the module as shown in the illustration below. If necessary, replace the bottom plate of the FSO module.
-

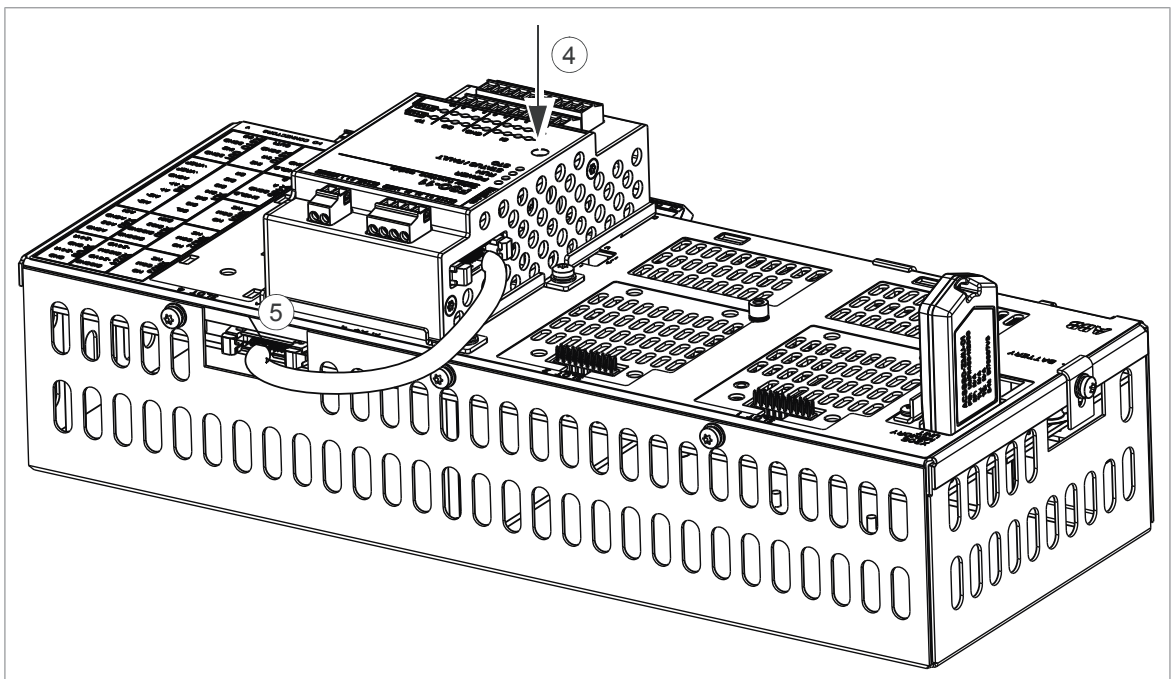
3. Attach the FSO module onto slot 3 of the BCU control unit [A41] with four screws.



4. Tighten the FSO module electronics grounding 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.

5. Connect the FSO module data cable between FSO connector X110 and BCU connector X12.
6. To complete the installation, refer to the instructions in the applicable FSO module user's manual.



■ **Wiring of option modules**

See the applicable optional module manual for specific installation and wiring instructions.





Control units of the drive

Contents of this chapter

This chapter

- describes the connections of the control unit(s) used in the drive,
- contains the specifications of the inputs and outputs of the control unit(s).

General

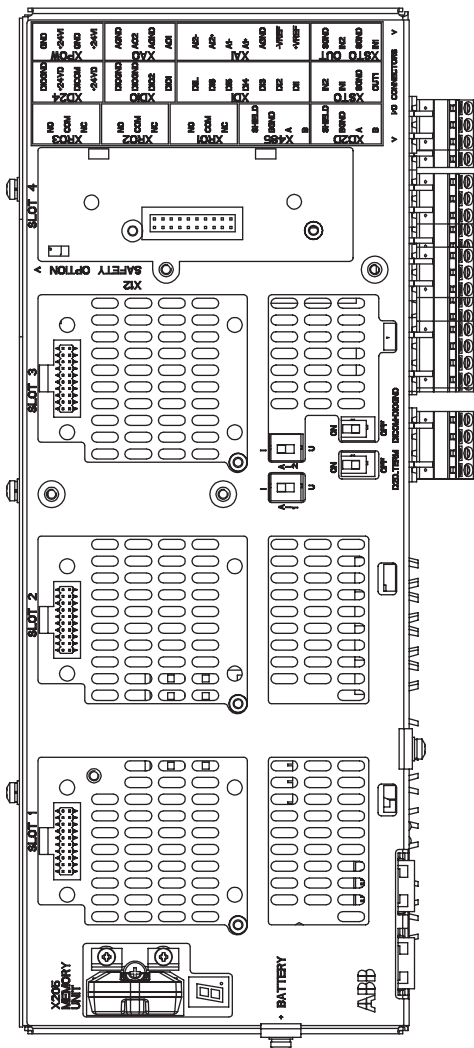
The drive utilizes either BCU-x2 control units or UCU-22...26 control units.

The supply and inverter units of the drive are each controlled by a dedicated control unit. The designation of the supply control unit is A51; the inverter control unit is A41. Both are connected to the power modules (ie. supply and inverter modules respectively) by fiber optic cables.

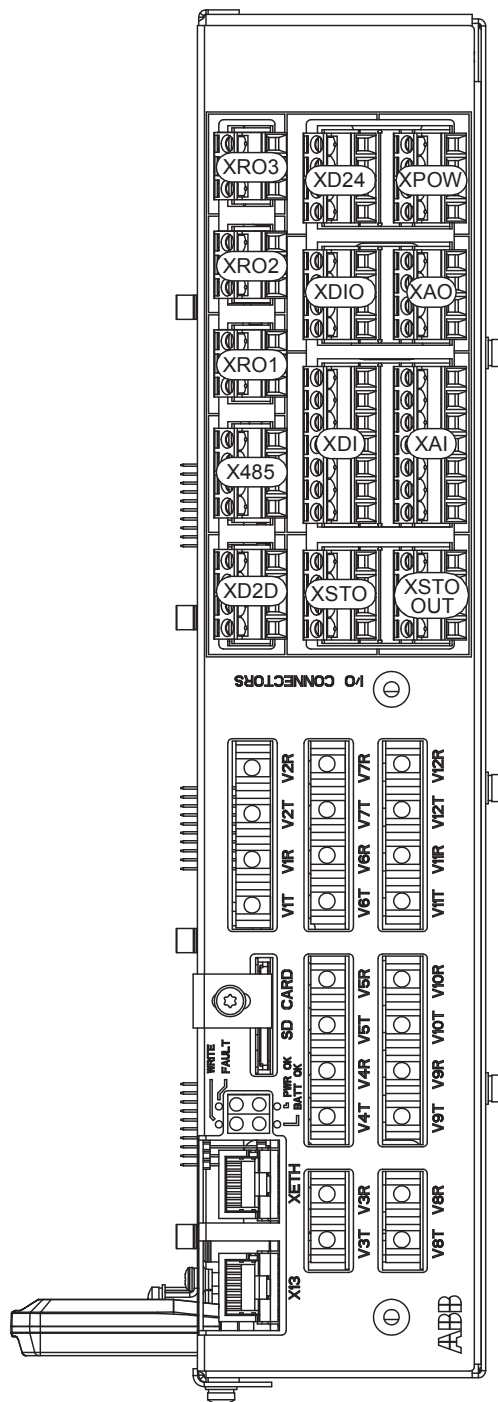
In this manual:

- the name "BCU-x2" represents the control unit types BCU-02 and BCU-12. These have a different number of power module connections (2 and 7 respectively) but are otherwise similar.
 - the name "UCU-22...26" represents the control unit types UCU-22 and UCU-23. These have a different number of power module connections (2 and 8 respectively) but are otherwise similar.
-

BCU-x2 layout



	Description
I/O	I/O terminals (see following diagram)
SLOT 1	I/O extension, encoder interface or fieldbus adapter module connection. (This is the sole location for an FDPI-02 diagnostics and panel interface.)
SLOT 2	I/O extension, encoder interface or fieldbus adapter module connection
SLOT 3	I/O extension, encoder interface, fieldbus adapter or FSO safety functions module connection
SLOT 4	RDCO-0x DDCS communication option module connection
X205	Memory unit connection
BATTERY	Holder for real-time clock battery (BR2032)
AI1	Mode selector for analog input AI1 (I = current, U = voltage)
AI2	Mode selector for analog input AI2 (I = current, U = voltage)
D2D TERM	Termination switch for drive-to-drive link (D2D)
DICOM=DIOGND	Ground selection. Determines whether DICOM is separated from DIOGND (ie. the common reference for the digital inputs floats). See the ground isolation diagram.
7-segment display	
Multicharacter indications are displayed as repeated sequences of characters	
	("U" is indicated briefly before "o".) Control program running
	Control program startup in progress
	(Flashing) Firmware cannot be started. Memory unit missing or corrupted
	Firmware download from PC to control unit in progress
	At power-up, the display may show short indications of eg. "1", "2", "b" or "U". These are normal indications immediately after power-up. If the display ends up showing any other value than those described, it indicates a hardware failure.







	Description
XAI	Analog inputs
XAO	Analog outputs
XDI	Digital inputs, Digital input interlock (DIIL)
XDIO	Digital input/outputs
XD2D	Drive-to-drive link
XD24	+24 V output (for digital inputs)
XETH	Ethernet port – Not in use
XPOW	External power input
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XSTO	Safe torque off connection (input signals)
XSTO OUT	Safe torque off connection (to inverter modules)
X12	(On the opposite side) Connection for FSO safety functions module (optional)
X13	Control panel / PC connection
X485	Not in use
V1T/V1R, V2T/V2R	Fiber optic connection to modules 1 and 2 (VxT = transmitter, VxR = receiver)
V3T/V3R ... V7T/V7R	Fiber optic connection to modules 3...7 (BCU-12/22 only) (VxT = transmitter, VxR = receiver)
V8T/V8R ... V12T/V12R	Fiber optic connection to modules 8...12 (BCU-22 only) (VxT = transmitter, VxR = receiver)
SD CARD	Data logger memory card for inverter module communication
BATT OK	Real-time clock battery voltage is higher than 2.8 V. If the LED is off when the control unit is powered, replace the battery.
FAULT	The control program has generated a fault. See the firmware manual of the supply/inverter unit.
PWR OK	Internal voltage supply is OK
WRITE	Writing to memory card in progress. Do not remove the memory card.

Default I/O diagram of the supply control unit (BCU-x2)

The diagram below shows the default I/O connections on the supply control unit (A51), and describes the use of the connections in the supply unit. Under normal circumstances, the factory-made wiring should not be changed.

The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 ... 2.5 mm² (22 ... 12 AWG). The tightening torque is 0.45 N·m (4 lbf-in).

Terminal			Description	
XD2D			Drive-to-drive link	
1	1	B	Not in use by default	
2	2	A		
3	3	BGND		
4	4	Shield		
	D2D.TERM		Drive-to-drive link termination switch ¹⁾	
X485			RS485 connection	
5	5	B	Not in use by default	
6	6	A		
7	7	BGND		
8	8	Shield		
XRO1, XRO2, XRO3			Relay outputs	
11	11	NC	Norm. closed	XRO1: Charging ²⁾ (Energized = Closes charging contactor.) 250 V AC / 30 V DC, 2 A
12	12	COM	Common	
13	13	NO	Norm. open	
21	21	NC	Norm. closed	XRO2: Fault (-1) ³⁾ (Energized = Indicates no fault.) 250 V AC / 30 V DC, 2 A
22	22	COM	Common	
23	23	NO	Norm. open	
31	31	NC	Norm. closed	XRO3: MCB ctrl ²⁾ (Energized = Closes main contactor/breaker.) 250 V AC / 30 V DC, 2 A
32	32	COM	Common	
33	33	NO	Norm. open	
XSTO, XSTO OUT			Safe torque off ⁴⁾	
1	1	OUT	XSTO: Factory connection. Both circuits (power module, control unit) must be closed for the supply unit to start (IN1 and IN2 must be connected to OUT).	
2	2	SGND		
3	3	IN1		
4	4	IN2		
5	5	IN1	XSTO OUT: Not in use.	
6	6	SGND		
7	7	IN2		
8	8	SGND		
XDI			Digital inputs	

Terminal		Description	
1 2 3 4 5 6 7	1	DI1	Temp fault ³⁾ (0 = overtemperature)
	2	DI2	Run / enable ³⁾ (1 = run / enable)
	3	DI3	MCB feedback ²⁾ (0 = main contactor/breaker open)
	4	DI4	Not in use by default. Can be used for eg, auxiliary circuit breaker fault.
	5	DI5	Not in use by default. Can be used for eg, earth fault monitoring.
	6	DI6	Reset ³⁾ (0 -> 1 = fault reset)
	7	DIIL	Not in use by default. Can be used for eg, emergency stop.
XDIO		Digital input/outputs	
1 2 3 4	1	DIO1	Not in use by default
	2	DIO2	Not in use by default
	3	DIOGND	Digital input/output ground
	4	DIOGND	Digital input/output ground
XD24		Auxiliary voltage output	
5 6 7 8	1	+24VD	+24 V DC 200 mA ⁵⁾
	2	DICOM	Digital input ground
	3	+24VD	+24 V DC 200 mA ⁵⁾
	4	DIOGND	Digital input/output ground
	DICOM=DIOGND		Ground selection switch ⁶⁾
XAI		Analog inputs, reference voltage output	
1 2 3 4 5 6 7	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+	Not in use by default. 0(2)...10 V, $R_{in} > 200$ kohm ⁷⁾
	5	AI1-	
	6	AI2+	Not in use by default. 0(4)...20 mA, $R_{in} = 100$ ohm ⁸⁾
	7	AI2-	
	AI1		AI1 current/voltage selection switch
	AI2		AI2 current/voltage selection switch
XAO		Analog outputs	
1 2 3 4	1	AO1	Zero (no signal indicated) ³⁾ 0...20 mA, $R_L < 500$ ohm
	2	AGND	
	3	AO2	Zero (not signal indicated) ³⁾ 0...20 mA, $R_L < 500$ ohm
	4	AGND	
XPOW		External power input	
1 2 3 4	1	+24VI	24 V DC, 2.05 A
	2	GND	
	3	+24VI	
	4	GND	
X12		Safety functions module connection (not in use in supply units)	
X13		Control panel connection	

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
Terminal	Description
X205	Memory unit connection




- 1) Must be set to ON when the supply unit is the first or last unit on the drive-to-drive (D2D) link. On intermediate units, set termination to OFF.
- 2) Use of the signal in the control program. When parameter 120.30 External charge enable has value Yes (default setting), the control program reserves this I/O terminal for external charging circuit control and monitoring, and parameters 110.24 RO1 source and 110.30 RO3 source are write-protected. If the value is No, you can use the I/O terminal for other purposes.
- 3) Use of the signal in the control program (fixed). See also the delivery-specific circuit diagrams.
- 4) This input only acts as a true Safe torque off input in inverter units. In other applications (such as a supply or brake unit), de-energizing the IN1 and/or IN2 terminal will stop the unit but not constitute a SIL/PL classified safety function.
- 5) Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.
- 6) Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.
- 7) Current [0(4)...20 mA, $R_{in} = 100 \text{ ohm}$] or voltage [0(2)...10 V, $R_{in} > 200 \text{ kohm}$] input selected by switch AI1. Change of setting requires reboot of control unit.
- 8) Current [0(4)...20 mA, $R_{in} = 100 \text{ ohm}$] or voltage [0(2)...10 V, $R_{in} > 200 \text{ kohm}$] input selected by switch AI2. Change of setting requires reboot of control unit.

Default I/O diagram of the inverter control unit (BCU-x2)

The table below describes the use of the connections in the inverter unit. Under normal circumstances, the factory-made wiring should not be changed.

The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 ... 2.5 mm² (22...12 AWG). The tightening torque is 0.45 N·m (4 lbf·in).

Terminal			Description	
XD2D			Drive-to-drive link	
1	1	B	Drive-to-drive link. Refer to section The XD2D connector (page 165) .	
2	2	A		
3	3	BGND		
4	4	Shield		
	D2D.TERM		Drive-to-drive link termination switch. Must be set to ON when the inverter unit is the first or last unit in the drive-to-drive (D2D) link. On intermediate units, set termination to OFF.	
X485			RS485 connection	
5	5	B	Not in use by default	
6	6	A		
7	7	BGND		
8	8	Shield		
XRO1, XRO2, XRO3			Relay outputs	
11	11	NC	Norm. closed	XRO1: Ready (Energized = Ready) 250 V AC / 30 V DC, 2 A
	12	COM	Common	
	13	NO	Norm. open	
21	21	NC	Norm. closed	XRO2: Running (Energized = Running) 250 V AC / 30 V DC, 2 A
	22	COM	Common	
	23	NO	Norm. open	
31	31	NC	Norm. closed	XRO3: Fault (-1) (Energized = No fault) 250 V AC / 30 V DC, 2 A
	32	COM	Common	
	33	NO	Norm. open	

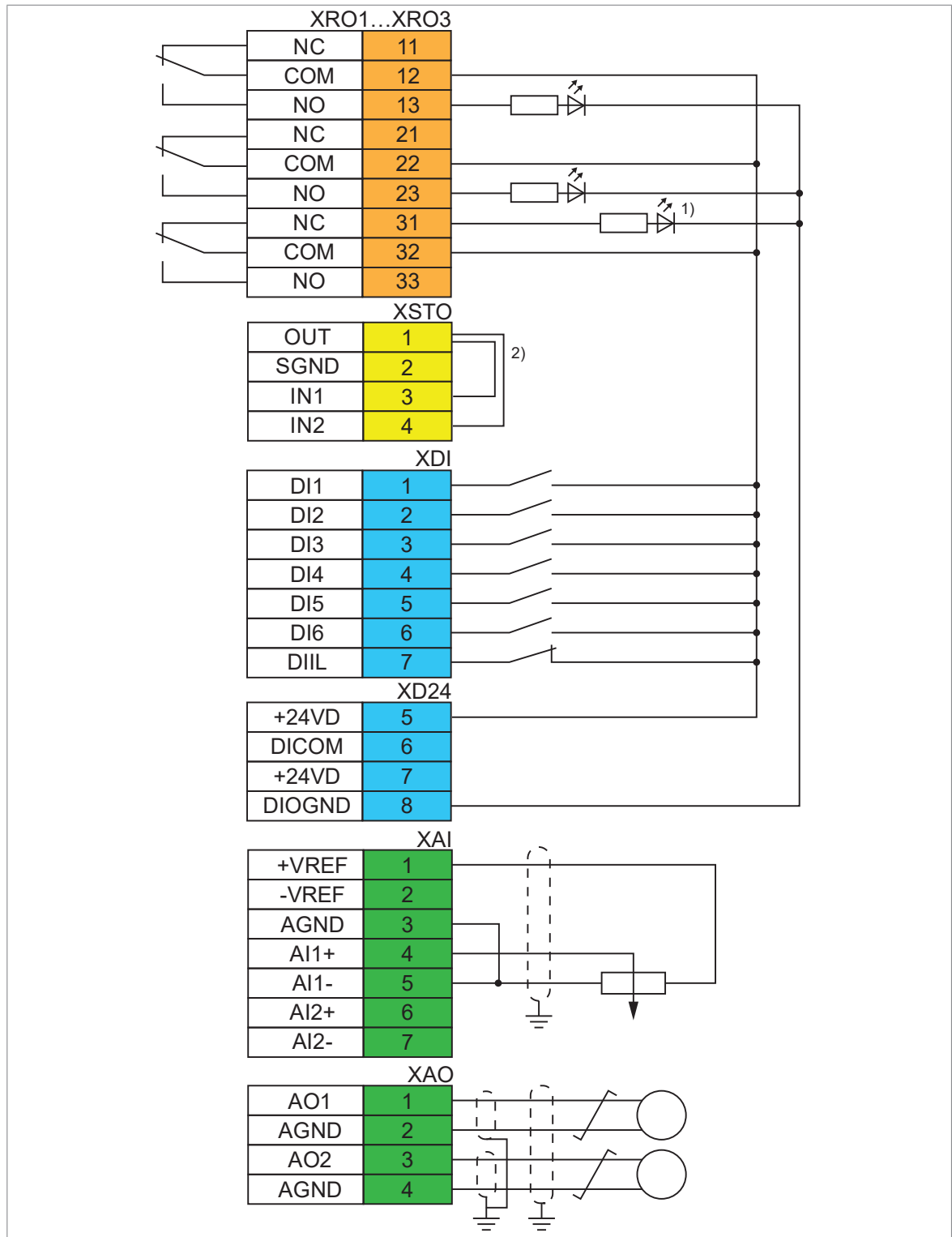
Terminal			Description								
XSTO, XSTO OUT			Safe torque off								
<table border="1"> <tr><td>1</td></tr> <tr><td>2</td></tr> <tr><td>3</td></tr> <tr><td>4</td></tr> <tr><td>5</td></tr> <tr><td>6</td></tr> <tr><td>7</td></tr> <tr><td>8</td></tr> </table>	1	2	3	4	5	6	7	8	1	OUT	XSTO: Factory connection. Both circuits must be closed for the drive to start (IN1 and IN2 must be connected to OUT). Refer to chapter The Safe torque off function.
	1										
	2										
	3										
	4										
	5										
	6										
	7										
8											
2	SGND										
3	IN1										
4	IN2										
5	IN1	XSTO OUT: Safe torque off output to inverter modules.									
6	SGND										
7	IN2										
8	SGND										
XDI			Digital inputs								
<table border="1"> <tr><td>1</td></tr> <tr><td>2</td></tr> <tr><td>3</td></tr> <tr><td>4</td></tr> <tr><td>5</td></tr> <tr><td>6</td></tr> <tr><td>7</td></tr> </table>	1	2	3	4	5	6	7	1	DI1	Stop (0) / Start (1)	
	1										
	2										
	3										
	4										
	5										
	6										
7											
2	DI2	Forward (0) / Reverse (1)									
3	DI3	Reset									
4	DI4	Acceleration & deceleration select ¹⁾									
5	DI5	Constant speed 1 select (1 = on) ²⁾									
6	DI6	Not in use by default.									
7	DIIL	Run enable ³⁾									
XDIO			Digital input/outputs								
<table border="1"> <tr><td>1</td></tr> <tr><td>2</td></tr> <tr><td>3</td></tr> <tr><td>4</td></tr> </table>	1	2	3	4	1	DIO1	Output: Ready				
	1										
	2										
	3										
4											
2	DIO2	Output: Running									
3	DIOGND	Digital input/output ground									
4	DIOGND	Digital input/output ground									
XD24			Auxiliary voltage output								
<table border="1"> <tr><td>5</td></tr> <tr><td>6</td></tr> <tr><td>7</td></tr> <tr><td>8</td></tr> </table>	5	6	7	8	5	+24VD	+24 V DC 200 mA ⁴⁾				
	5										
	6										
	7										
8											
6	DICOM	Digital input ground									
7	+24VD	+24 V DC 200 mA ⁴⁾									
8	DIOGND	Digital input/output ground									
	DICOM=DIOGND		Ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.								
XAI			Analog inputs, reference voltage output								
<table border="1"> <tr><td>1</td></tr> <tr><td>2</td></tr> <tr><td>3</td></tr> <tr><td>4</td></tr> <tr><td>5</td></tr> <tr><td>6</td></tr> <tr><td>7</td></tr> </table>	1	2	3	4	5	6	7	1	+VREF	10 V DC, R_L 1 ... 10 kohm	
	1										
	2										
	3										
	4										
	5										
	6										
7											
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 ⁵⁾									
5	AI1-										
6	AI2+	Not in use by default. 0(4)...20 mA, $R_{in} = 100$ ohm ⁶⁾									
7	AI2-										
	AI1	AI1 current/voltage selection switch									
	AI2	AI2 current/voltage selection switch									
XAO			Analog outputs								

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Terminal			Description
1 2 3 4	1	AO1	Motor speed rpm 0 ... 20 mA, $R_L < 500 \text{ ohm}$
	2	AGND	
	3	AO2	Motor current 0 ... 20 mA, $R_L < 500 \text{ ohm}$
	4	AGND	
XPOW			External power input
1 2 3 4	1	+24VI	24 V DC, 2.05 A Two supplies can be connected for redundancy.
	2	GND	
	3	+24VI	
	4	GND	
X12			Safety functions module connection
X13			Control panel connection
X205			Memory unit connection

- 1) 0 = Acceleration/deceleration ramps defined by parameters 23.12/23.13 in use.
1 = Acceleration/deceleration ramps defined by parameters 23.14/23.15 in use.
- 2) Constant speed 1 is defined by parameter 22.26.
- 3) The DIIL input is configured to stop the unit when the input signal is removed. This input does not have a SIL or PL classification.
- 4) Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.
- 5) Current [0(4)...20 mA, $R_{in} = 100 \text{ ohm}$] or voltage [0(2)...10 V, $R_{in} > 200 \text{ kohm}$] input selected by switch AI1. Change of setting requires reboot of control unit.
- 6) Current [0(4)...20 mA, $R_{in} = 100 \text{ ohm}$] or voltage [0(2)...10 V, $R_{in} > 200 \text{ kohm}$] input selected by switch AI2. Change of setting requires reboot of control unit.

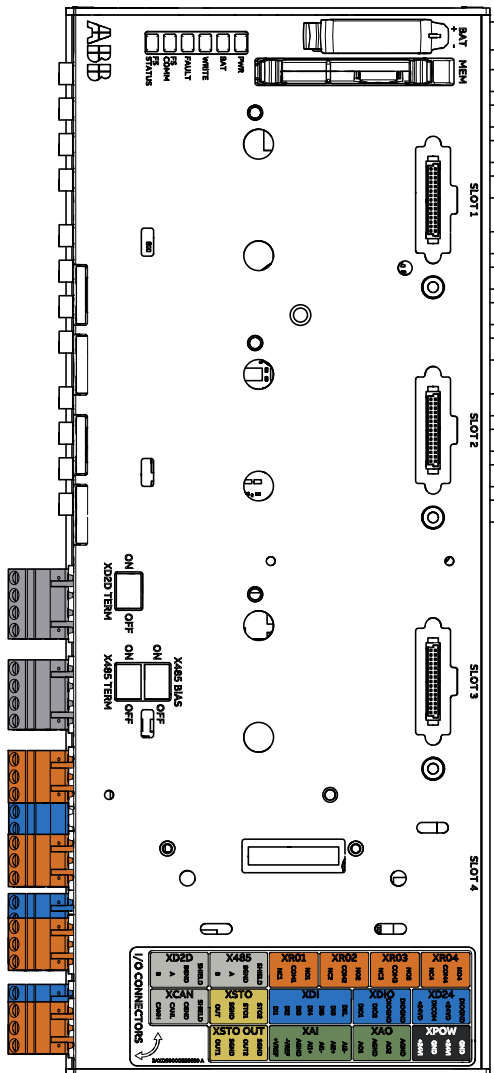
The diagram below shows the default I/O connections on the inverter control unit (A41).



1) Fault

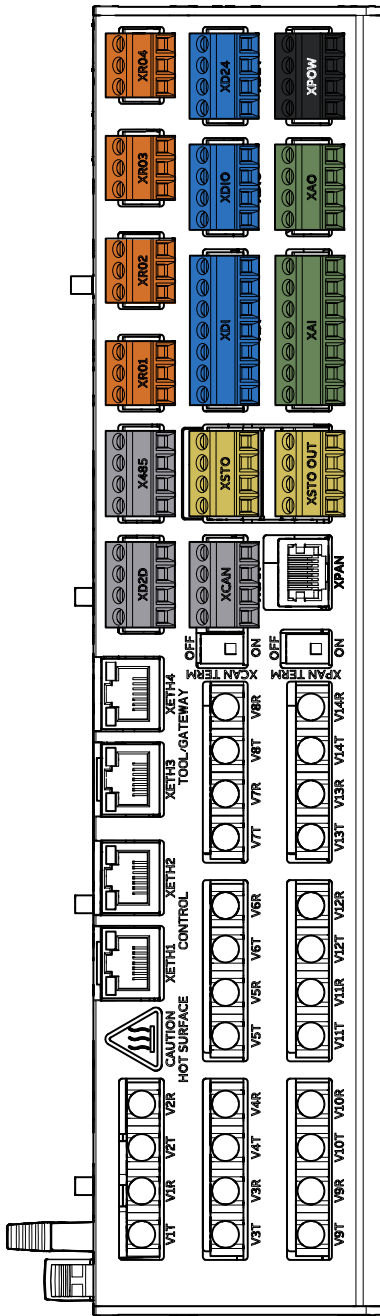
2) If necessary, you can connect an emergency stop button to the XSTO terminal. Refer to chapter The Safe torque off function.

UCU-22...26 layout



	Description
I/O	I/O terminals (see following diagram)
SLOT 1	I/O extension, encoder interface or fieldbus adapter module connection. For F-type modules with USCA-01 adapter.
SLOT 2	I/O extension, encoder interface or fieldbus adapter module connection. For F-type modules with USCA-01 adapter.
SLOT 3	I/O extension, encoder interface or fieldbus adapter module connection. For F-type modules with USCA-01 adapter.
SLOT 4	RDCO-0x DDCS communication option module connection
MEM	UMU-01 memory unit connection. Data logger microSDHC memory card for inverter module communication is inside the memory unit.
BAT	Holder for real-time clock battery (BR2032)
XD2D TERM	Termination switches for drive-to-drive link (XD2D)
X485 TERM	RS-485 link termination switch
X485 BIAS	RS-485 link bias switch
DICOM= DIOGND	Ground selection. Determines whether DICOM is separated from DIOGND (ie. the common reference for the digital inputs floats). See the ground isolation diagram.

LED	Description
PWR	When the PWR LED is on, the voltage supply is sufficient.
BAT	When the BAT LED is on, the real-time clock battery voltage is higher than 2.5 V. If the LED is off, replace the battery.
WRITE	When the WRITE LED is on, writing to microSDHC memory card is in progress. Do not remove the microSDHC memory card.
FAULT	The control program has generated a fault. See the firmware manual.
FS COMM	Reserved.
FS STATUS	Reserved.


























	Description
XAI	Analog input
XAO	Analog output
XCAN	Not in use
XCAN TERM	CAN bus termination switch
XDI	Digital input
XDIO	Digital input/output
XD2D	Drive-to-drive link
XD24	+24 V output (for digital input)
XETH1	Ethernet ports for fieldbus, internal switch
XETH2	
XETH3	Ethernet ports for tool communication, internal switch
XETH4	
XFSO	Not in use
XPAN	Control panel connection
XPAN TERM	Control panel connection termination switch
XPOW	External power input
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XRO4	Relay output RO4, reserved.
XSTO	Safe torque off connection (input signals)
XSTO OUT	Safe torque off connection (to inverter modules)
X485	RS-485 link
V1T/V1R ... V26T/V26R	Fiber optic connections to converter modules (VxT = transmitter, VxR = receiver)

Default I/O diagram of the supply control unit (UCU-22...26)





The diagram below shows the default I/O connections on the supply control unit (A51), and describes the use of the connections in the supply unit. Under normal circumstances, the factory-made wiring should not be changed.

The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 ... 2.5 mm² (22...12 AWG). The tightening torque is 0.45 N·m (4 lbf·in).

Terminal		Description	
XD2D		Drive-to-drive link	
 1	D2D_B	Not in use by default	
 2	D2D_A		
 3	BGND		
 4	SHIELD		
	XD2D TERM	Drive-to-drive link termination switch.	
X485		RS485 connection	
 5	B	Not in use by default	
 6	A		
 7	BGND		
 8	SHIELD		
	X485 BIAS	X485 bias selection switch	
	X485 TERM	X485 termination switch	
XCAN		CAN bus	
 9	CAN_H	Not supported	
 10	CAN_L		
 11	CAN_CGND		
 12	CAN_SHLD	Control cable shield	
	XCAN TERM	CANopen termination switch	
XRO1		Relay output 1	
 11	NC1	Norm. closed	XRO1: Charging ¹⁾ (Energized = Closes charging contactor.) 250 V AC / 30 V DC, 2 A
 12	COM1	Common	
 13	NO1	Norm. open	
XRO2		Relay output 2	
 21	NC2	Norm. closed	XRO2: Fault (-1) ²⁾ 250 V AC / 30 V DC, 2 A
 22	COM2	Common	
 23	NO2	Norm. open	
XRO3		Relay output 3	

Terminal			Description	
31	31	NC3	Norm. closed	XRO3: MCB ctrl ¹⁾ (Energized = Closes main contactor/breaker.) 250 V AC / 30 V DC, 2 A
32	32	COM3	Common	
33	33	NO3	Norm. open	
XRO4			Relay output 4	
41	41	NC4	Norm. closed	XRO4: Not supported 250 V AC / 30 V DC, 2 A
42	42	COM4	Common	
43	43	NO4	Norm. open	
XSTO			Safe torque off ³⁾	
1	1	OUT	XSTO: Factory connection. Both circuits must be closed for the supply to start (STO1 and STO2 must be connected to OUT).	
2	2	SGND		
3	3	STO1		
4	4	STO2		
XSTO OUT			Safe torque off connection (to inverter modules)	
5	5	OUT1	XSTO OUT: Not in use by default.	
6	6	SGND		
7	7	OUT2		
8	8	SGND		
XDI			Digital inputs	
	1	DI1	Temp fault ⁴⁾ (0 = overtemperature)	
1	2	DI2	Run / enable ⁴⁾ (1 = run / enable)	
2	3	DI3	MCB feedback ¹⁾ (0 = main contactor/breaker open)	
3	4	DI4	Not in use by default. Can be used for eg, auxiliary circuit breaker fault.	
4	5	DI5	Not in use by default. Can be used for eg, earth fault monitoring.	
5	6	DI6	Reset ⁴⁾ (0 -> = fault reset)	
6	7	DIIL	Not in use by default. Can be used for eg, emergency stop.	
7				
XDIO			Digital input/outputs	
1	1	DIO1	Not in use by default	
2	2	DIO2	Not in use by default	
3	3	DIOGND	Digital input/output ground	
4	4	DIOGND	Digital input/output ground	
XD24			Auxiliary voltage output	
5	5	+24VD	+24 V DC 200 mA ⁵⁾	
6	6	DICOM	Digital input ground	
7	7	+24VD	+24 V DC 200 mA ⁵⁾	
8	8	DIGND	Digital input/output ground	
	DICOM=DIOGND		Ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.	

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Terminal		Description
XAI		Analog inputs, reference voltage output
	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+ Not in use by default. 0(2)...10 V, $R_{in} > 200$ kohm ⁶⁾
	5	AI1- Not in use by default. 0(4)...20 mA, $R_{in} = 100$ ohm ⁷⁾
	6	AI2+ Not in use by default. 0(4)...20 mA, $R_{in} = 100$ ohm ⁷⁾
	7	AI2- Not in use by default. 0(4)...20 mA, $R_{in} = 100$ ohm ⁷⁾
XAO		Analog outputs
	1	AO1 Zero (no signal indicated) ⁴⁾ 0...20 mA, $R_L < 500$ ohm
	2	AGND
	3	AO2 Zero (not signal indicated) ⁴⁾ 0...20 mA, $R_L < 500$ ohm
	4	AGND
XPOW		External power input
	1	+24V
	2	GND
	3	+24V
	4	GND
		24 V DC, 2.05 A
XFSO		Safety functions module connection. Not in use by default.
XETH1		Ethernet ports for fieldbus. Not in use by default.
XETH2		
XETH3		Ethernet ports for tool communication. Not in use by default.
XETH4		
XPAN		Control panel connection
	XPAN TERM	Control panel connection termination switch
MEM		Memory unit connection

¹⁾ Use of the signal in the control program. When parameter 120.30 External charge enable has value Yes (default setting), the control program reserves this I/O terminal for external charging circuit control and monitoring, and parameters 110.24 RO1 source and 110.30 RO3 source are write-protected. If the value is No, you can use the I/O terminal for other purposes.

²⁾ Use of the signal in the control program (fixed). See also the delivery-specific circuit diagrams.

³⁾ This input only acts as a true Safe torque off input in inverter units. In other applications (such as a supply or brake unit), de-energizing the STO1 and/or STO2 terminal will stop the unit but not constitute a SIL/PL classified safety function.

⁴⁾ Use of the signal in the control program (fixed). See also the delivery-specific circuit diagrams.

⁵⁾ Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.





⁶⁾ Current [0(4)...20 mA, $R_{in} = 100$ ohm] or voltage [0(2)...10 V, $R_{in} > 200$ kohm]. Change of setting requires reboot of control unit.

⁷⁾ Current [0(4)...20 mA, $R_{in} = 100$ ohm] or voltage [0(2)...10 V, $R_{in} > 200$ kohm]. Change of setting requires reboot of control unit.


Default I/O diagram of the inverter control unit (UCU-22...26)

















The table below describes the use of the connections in the inverter unit. Under normal circumstances, the factory-made wiring should not be changed.

The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 ... 2.5 mm² (22...12 AWG). The tightening torque is 0.45 N·m (4 lbf·in).

Terminal		Description	
XD2D		Drive-to-drive link	
1	1	D2D_B	Drive-to-drive link. Refer to section The XD2D connector (page 165).
2	2	D2D_A	
3	3	BGND	
4	4	SHIELD	
	XD2D.TERM		Drive-to-drive link termination switch.
X485		RS485 connection	
5	5	B	Not in use by default
6	6	A	
7	7	BGND	
8	8	SHIELD	
	X485 BIAS		X485 bias selection switch
	X485 TERM		X485 termination switch
XCAN		CAN bus	
9	9	CAN_H	Not supported
10	10	CAN_L	
11	11	CAN_CGND	
12	12	CAN_SHLD	Control cable shield
	XCAN TERM		CANopen termination switch
XRO1		Relay output 1	
11	11	NC1	XRO1: Ready (Energized = Ready) 250 V AC / 30 V DC, 2 A
12	12	COM1	
13	13	NO1	
XRO2		Relay output 2	
21	21	NC2	XRO2: Running (Energized = Running) 250 V AC / 30 V DC, 2 A
22	22	COM2	
23	23	NO2	
XRO3		Relay output 3	

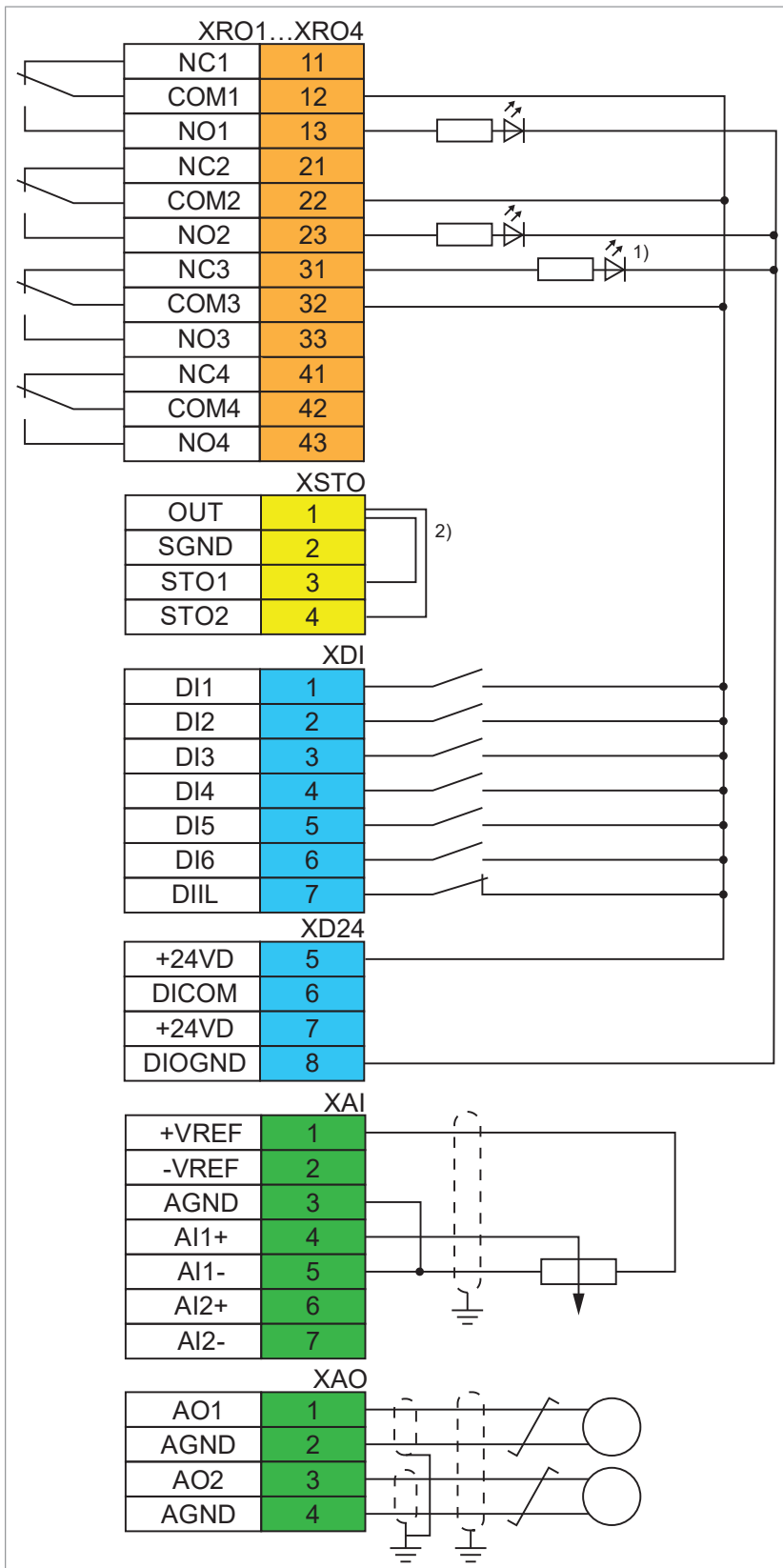
162 Control units of the drive

Terminal			Description
31	31	NC3	Norm. closed
32	32	COM3	Common
33	33	NO3	Norm. open
XRO3			XRO3: Fault (-1) (Energized = No fault) 250 V AC / 30 V DC, 2 A
XRO4			Relay output 4
41	41	NC4	Norm. closed
42	42	COM4	Common
43	43	NO4	Norm. open
XSTO			Safe torque off
1	1	OUT	XSTO: Factory connection. Both circuits (power module, control unit) must be closed for the drive to start (STO1 and STO2 must be connected to OUT). Refer to chapter The Safe torque off function (page 283) .
2	2	SGND	
3	3	STO1	
4	4	STO2	
XSTO OUT			Safe torque off connection (to inverter modules)
5	5	OUT1	XSTO OUT: Safe torque off output to inverter modules
6	6	SGND	
7	7	OUT2	
8	8	SGND	
XDI			Digital inputs
1	1	DI1	Stop (0) / Start (1)
2	2	DI2	Forward (0) / Reverse (1)
3	3	DI3	Reset
4	4	DI4	Acceleration & deceleration select ¹⁾
5	5	DI5	Constant speed 1 select (1 = on) ²⁾
6	6	DI6	Not in use by default.
7	7	DIIL	Run enable ³⁾
XDIO			Digital input/outputs
1	1	DIO1	Output: Ready
2	2	DIO2	Output: Running
3	3	DIOGND	Digital input/output ground
4	4	DIOGND	Digital input/output ground
XD24			Auxiliary voltage output
5	5	+24VD	+24 V DC 200 mA ⁴⁾
6	6	DICOM	Digital input ground
7	7	+24VD	+24 V DC 200 mA ⁴⁾
8	8	DIGND	Digital input/output ground
	DICOM=DIOGND		Ground selection switch. Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats). ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.

Terminal			Description
XAI			Analog inputs, reference voltage output
	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 ⁵⁾
	5	AI1-	
	6	AI2+	Not in use by default. 0(4)...20 mA, $R_{in} = 100$ ohm ⁶⁾
	7	AI2-	
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	
XPOW			External power input
	1	+24V	24 V DC, 2.05 A Two supplies can be connected for redundancy.
	2	GND	
	3	+24V	
	4	GND	
XFSO			Safety functions module connection. Not in use by default.
XETH1			Ethernet ports for fieldbus. Not in use by default.
XETH2			
XETH3			Ethernet ports for tool communication. Not in use by default.
XETH4			
XPAN			Control panel connection
	XPAN TERM		Control panel connection termination switch
MEM			Memory unit connection

- 1) 0 = Acceleration/deceleration ramps defined by parameters 23.12/23.13 in use.
1 = Acceleration/deceleration ramps defined by parameters 23.14/23.15 in use.
- 2) Constant speed 1 is defined by parameter 22.26.
- 3) The DIIL input is configured to stop the unit when the input signal is removed. This input does not have a SIL or PL classification.
- 4) Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.
- 5) Current [0(4)...20 mA, $R_{in} = 100$ ohm] or voltage [0(2)...10 V, $R_{in} > 200$ kohm]. Change of setting requires reboot of control unit.
- 6) Current [0(4)...20 mA, $R_{in} = 100$ ohm] or voltage [0(2)...10 V, $R_{in} > 200$ kohm]. Change of setting requires reboot of control unit.

The diagram below shows the default I/O connections on the inverter control unit (A41).



1) Fault

2) If necessary, you can connect a safety device (eg, a safety relay) to the XSTO terminal. Refer to chapter The Safe torque off function.

Additional information on the connections

■ Connecting motor temperature sensors to the drive

IEC/EN 60664 requires double or reinforced insulation between the control unit and the live parts of the motor. To achieve this, use an FPTC-01 or FPTC-02 protection module or an FAIO-01 extension module. See [Implementing a motor temperature sensor connection \(page 112\)](#) and the module manuals.

■ Power supply for the control unit (XPOW)

The control unit is powered from a 24 V DC, 2 A supply through terminal block XPOW. With a type BCU/UCU control unit, a second supply can be connected to the same terminal block for redundancy.

Using a second supply is recommended, if:

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

■ DIIL input

The DIIL input is used for the connection of safety circuits. The input is parametrized to stop the unit when the input signal is lost.

Note: This input is **not** SIL or PL classified.

■ The XD2D connector

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

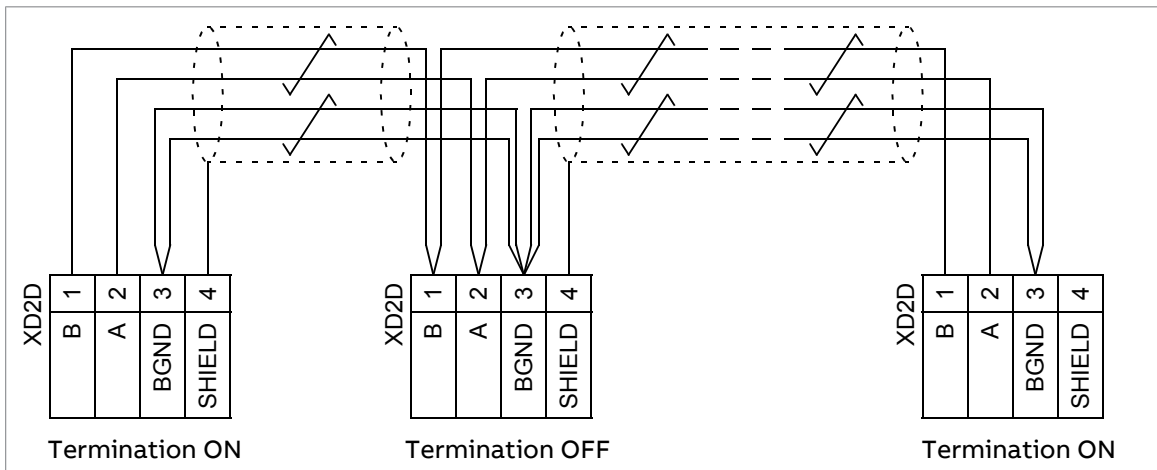
- basic master/follower communication with one master drive and multiple followers,
- fieldbus control through the embedded fieldbus interface (EFB), or
- drive-to-drive (D2D) communication implemented by application programming.

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 a high-quality shielded twisted-pair cable for the wiring, for example, Belden 9842. The nominal impedance of the cable should be 100...165 ohm. You can use one pair for the data wiring and another pair or a wire for the grounding. Avoid unnecessary loops and parallel runs near power cables.

The following diagram shows the wiring between control units.

BCU-x2, UCU-2x

- **Safe torque off (XSTO, XSTO OUT)**

See chapter [The Safe torque off function](#) (page 283).

Note: The XSTO input only acts as a true Safe torque off input on the inverter control unit. De-energizing the STO input terminals of other units (supply, DC/DC converter, or brake unit) will stop the unit but not constitute a SIL/PL classified safety function.

- **FSO safety functions module connection (X12, with BCU-x2 only)**

Refer to the applicable FSO module user's manual.

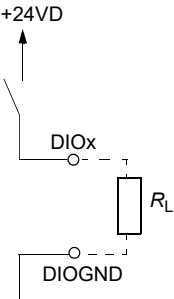
- **SDHC memory card slot**

The BCU-x2 has an on-board data logger that collects real-time data from the power modules to help fault tracing and analysis. The data is stored onto the SDHC memory card inserted into the SD CARD slot and can be analyzed by ABB service personnel.

- **MicroSDHC memory card slot**

The UCU-22...26 has an on-board data logger that collects real-time data from the power modules to help fault tracing and analysis. The data is stored onto the microSDHC memory card inserted into the UMU memory unit and can be analyzed by ABB service personnel.

Connector data

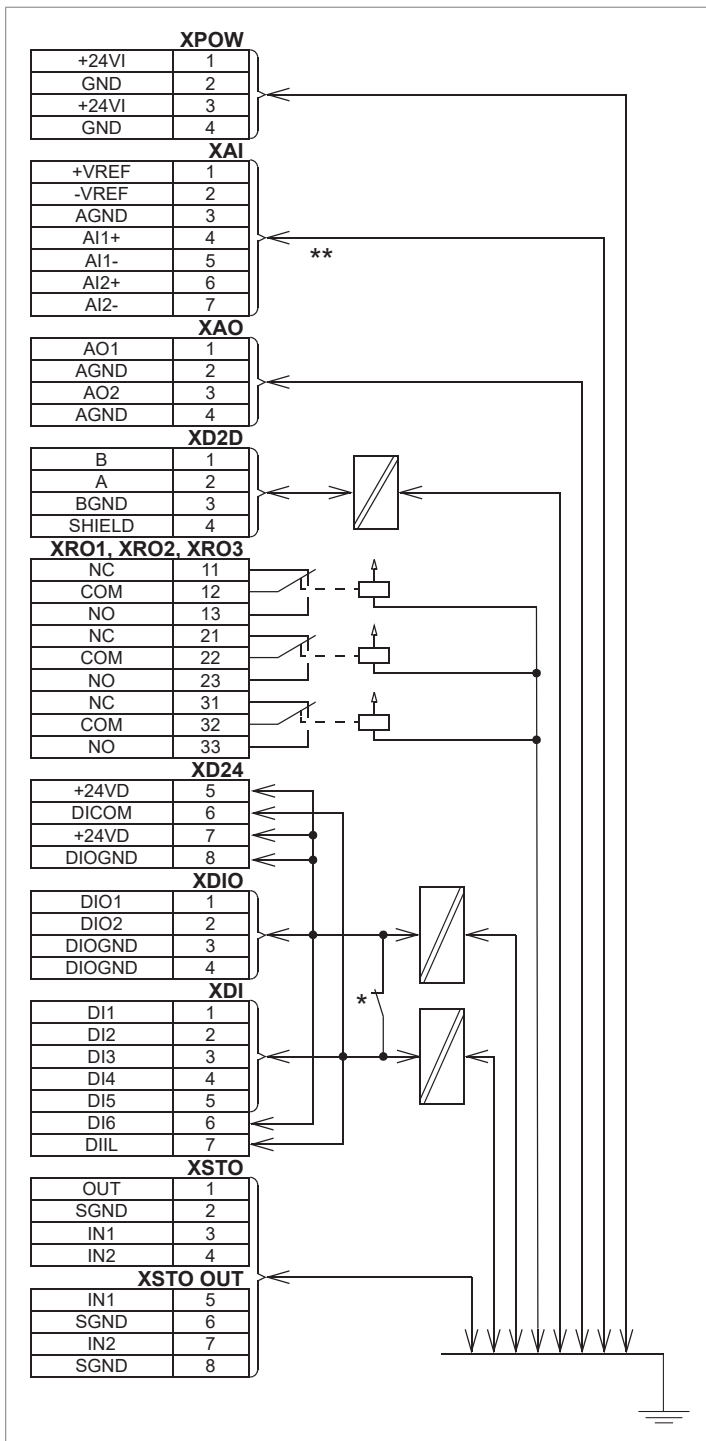
<p>Power supply (XPOW)</p>	<p>Connector pitch 5 mm, wire size 0.5 ... 2.5 mm² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 24 V (±10%) DC, 2 A (BCU-x2) 19...32 V DC, 2.9 A (UCU-22...26) External power input. Two supplies can be connected to the BCU-x2 and UCU-22...26 for redundancy.</p>
<p>Relay outputs RO1...RO3 (XRO1...XRO3 [BCU-x2]) Relay outputs RO1...RO4 (XRO1...XRO4 [UCU-22...26])</p>	<p>Connector pitch 5 mm, wire size 0.5 ... 2.5 mm² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 250 V AC / 30 V DC, 2 A Protected by varistors</p>
<p>+24 V output (XD24:2 and XD24:4)</p>	<p>Connector pitch 5 mm, wire size 0.5 ... 2.5 mm² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.</p>
<p>Digital inputs DI1...DI6 (XDI:1...XDI:6 [BCU-x2]) Digital inputs DI1...DIIL (XDI:1...XDI:7 [UCU-22...26])</p>	<p>Connector pitch 5 mm, wire size 0.5 ... 2.5 mm² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP (DI1...DI5), PNP (DI6) Hardware filtering: 0.04 ms, digital filtering up to 8 ms DI6 (XDI:6) can alternatively be used as an input for a PTC sensor. "0" > 4 kohm, "1" < 1.5 kohm. I_{max}: 15 mA (DI1...DI5), 5 mA (DI6)</p>
<p>Start interlock input DIIL (XDI:7)</p>	<p>Connector pitch 5 mm, wire size 0.5 ... 2.5 mm² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP Hardware filtering: 0.04 ms, digital filtering up to 8 ms</p>
<p>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 111/11. (BCU-x2) DIO1 can be configured as a frequency input (0...100 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 111/11. (UCU-22...26)</p>	<p>Connector pitch 5 mm, wire size 0.5 ... 2.5 mm² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) <u>As inputs</u>: 24 V logic levels: "0" < 5 V, "1" > 15 V. R_{in}: 2.0 kohm. Filtering: 1 ms. <u>As outputs</u>: Total output current from +24VD is limited to 200 mA</p> 

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Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm ² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 10 V ±1% and -10 V ±1%, R_{load} 1...10 kohm Maximum output current: 10 mA
Analog inputs AI1 and AI2 (XAI:4 ... XAI:7). Current/voltage input mode selection by switches (BCU-x2)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm ² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 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
Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm ² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 0...20 mA, $R_{load} < 500$ ohm Frequency range: 0...500 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
XD2D connector	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm ² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Physical layer: RS-485 Transmission rate: 8 Mbit/s Cable type: Shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 ... 165 ohm, for example Belden 9842) Maximum length of link: 50 m (164 ft) Termination by switch (BCU-x2) Termination and bias by switch (UCU-22...26)
RS-485 connection (X485)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm ² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Physical layer: RS-485 Cable type: Shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 ... 165 ohm, for example Belden 9842) Maximum length of link: 50 m (164 ft) Termination and bias by switch (UCU-22...26)
CAN connection (XCAN [UCU-22...26])	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm ² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Termination by switch This connection is not supported by the firmware.

Safe torque off connection (XSTO)	<p>Connector pitch 5 mm, wire size 0.5 ... 2.5 mm² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Input voltage range: -3...30 V DC Logic levels: "0" < 5 V, "1" > 17 V.</p> <p>Note: For the unit to start, both connections must be "1". This applies to all control units (including drive, inverter, supply, brake, DC/DC converter etc. control units), but SIL/PL classified Safe torque off functionality is only achieved through the XSTO connector of the drive/inverter control unit. Current consumption: 10 mA (continuous) per STO channel (UCU-22...26) Current consumption: 66 mA (continuous) per STO channel per inverter module (BCU-x2) EMC (immunity) according to IEC 61326-3-1 and IEC 61800-5-2 See also chapter The Safe torque off function (page 283).</p>
Safe torque off output (XSTO OUT)	<p>Connector pitch 5 mm, wire size 0.5 ... 2.5 mm² (22...12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) To STO connector of inverter module.</p>
Control panel connection (X13 [BCU-x2]) Control panel connection (XPAN [UCU-22...26])	<p>Connector: RJ-45 Cable length < 100 m (328 ft) (BCU-x2) Cable length < 50 m (164 ft) (UCU-22...26) Termination by switch (UCU-22...26)</p>
Ethernet connection (XETH [BCU-x2]) Fieldbus Ethernet connection with internal switch (XETH1 and XETH2 [UCU-22...26]) Tool Ethernet connection with internal switch (XETH3 and XETH4 [UCU-22...26])	<p>Connector: RJ-45 This connection is not supported by the firmware (BCU-x2) Cable type: minimum requirement CAT5e (UCU-22...26)</p>
SDHC memory card slot (SD CARD [BCU-x2])	<p>Memory card type: SDHC Maximum memory size: 4 GB</p>
microSDHC memory card slot (microSDHC CARD [UCU-22...26])	<p>Memory card type: microSDHC (minimum of class 4 speed grade) Supported memory size: 4 GB...32 GB</p>
Battery	Real-time clock battery type: BR2032
<p>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.</p>	

■ **BCU-x2 ground isolation diagram**

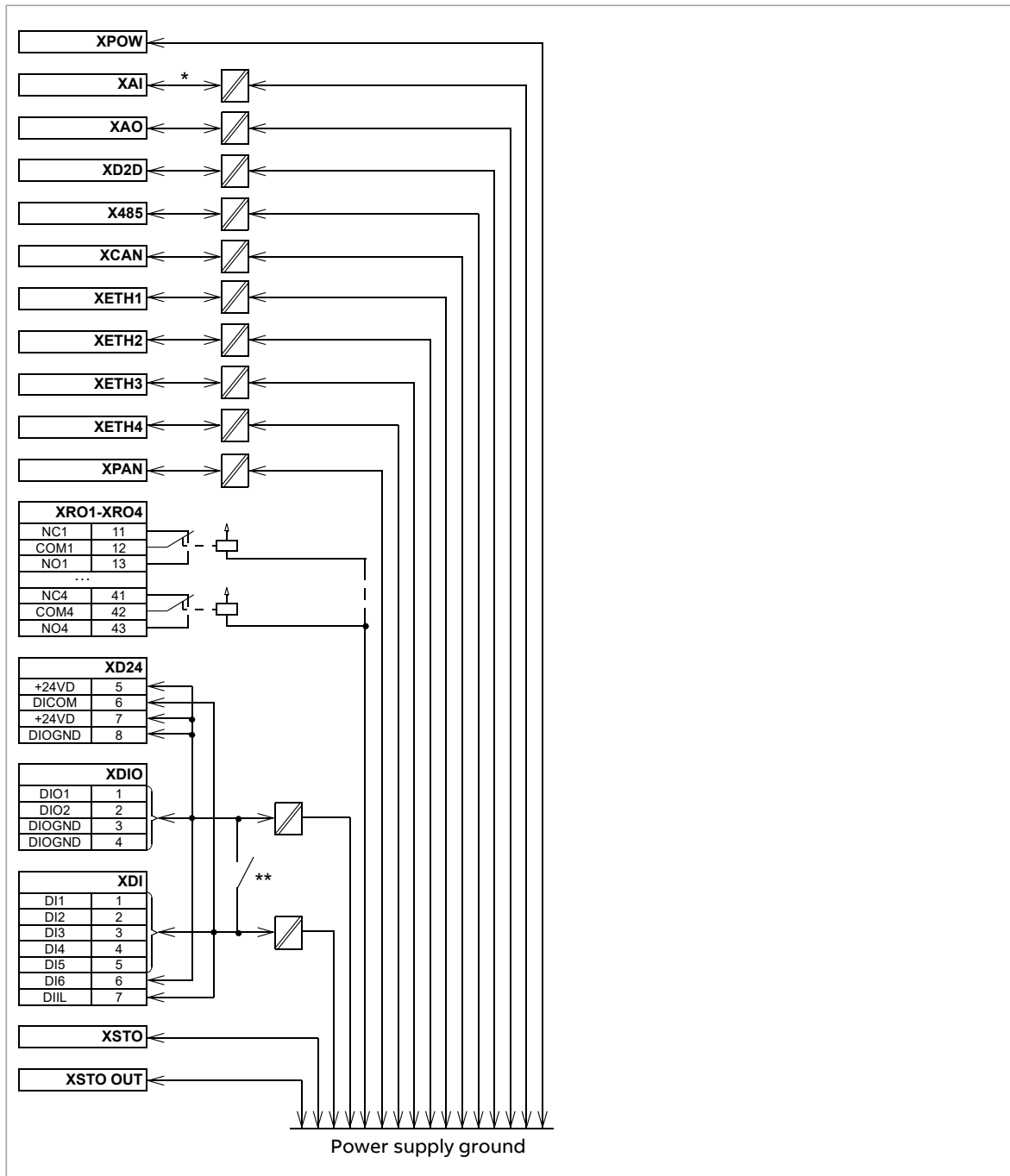


***Ground selector (DICOM=DIOGND) settings**

<p>DICOM=DIOGND: ON All digital inputs share a common ground (DICOM connected to DIOGND). This is the default setting.</p>
<p>DICOM=DIOGND: OFF Ground of digital inputs DI1...DI5 and DIIL (DICOM) is isolated from DIO signal ground (DIOGND). Isolation voltage 50 V.</p>

**The maximum common mode voltage between each AI input and AGND is +30 V

■ UCU-22...26 ground isolation diagram



*The maximum common mode voltage between each AI input and AGND is ± 30 V

**Ground selector (DICOM=DIOGND) settings

DICOM=DIOGND: ON

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

DICOM=DIOGND: OFF

Ground of digital inputs DI1...DI5 and DIIL (DICOM) is isolated from DIO signal ground (DIOGND). Isolation voltage 50 V.

8

Installation checklist

Contents of this chapter

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

Checklist

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



WARNING!

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



WARNING!

Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.

Make sure that ...	<input checked="" type="checkbox"/>
The ambient operating conditions meet the drive ambient conditions specification and enclosure rating (IP code).	<input type="checkbox"/>
The supply voltage matches the nominal input voltage of the drive. See the type designation label.	<input type="checkbox"/>
The insulation resistance of the input power cable, motor cable and motor is measured according to local regulations and the manuals of the drive.	<input type="checkbox"/>
The drive cabinet is attached to the floor, and if necessary due to vibration etc, also by its top to the wall or roof.	<input type="checkbox"/>

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Make sure that ...	<input checked="" type="checkbox"/>
The cooling air can flow freely in and out of the drive.	<input type="checkbox"/>
<u>If the drive is connected to a network other than a symmetrically grounded TN-S system:</u> You have done all the required modifications (for example, you may need to disconnect the EMC filter or ground-to-phase varistor). See the electrical installation instructions.	<input type="checkbox"/>
There is an adequately sized protective earth (ground) conductor(s) between the drive and the switchboard, the conductor is connected to correct terminal, and the terminal is tightened to the correct torque. Grounding has also been measured according to the regulations.	<input type="checkbox"/>
The input power cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.	<input type="checkbox"/>
There is an adequately sized protective earth (ground) conductor between the motor and the drive. The conductor is connected to the correct terminal, and the terminal is tightened to the correct torque. Grounding has also been measured according to the regulations.	<input type="checkbox"/>
The motor cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.	<input type="checkbox"/>
The motor cable is routed away from other cables.	<input type="checkbox"/>
No power factor compensation capacitors are connected to the motor cable.	<input type="checkbox"/>
<u>If an external brake resistor is connected to the drive:</u> There is an adequately sized protective earth (ground) conductor between the brake resistor and the drive, and the conductor is connected to the correct terminal, and the terminals are tightened to the correct torque. Grounding has also been measured according to the regulations.	<input type="checkbox"/>
<u>If an external brake resistor is connected to the drive:</u> The brake resistor cable is connected to the correct terminals, and the terminals are tightened to the correct torque.	<input type="checkbox"/>
<u>If an external brake resistor is connected to the drive:</u> The brake resistor cable is routed away from other cables.	<input type="checkbox"/>
The control cables are connected to the correct terminals, and the terminals are tightened to the correct torque.	<input type="checkbox"/>
The voltage setting of the auxiliary voltage transformers (if any) is correct. See the electrical installation instructions.	<input type="checkbox"/>
<u>If a drive bypass connection will be used:</u> The direct-on-line contactor of the motor and the drive output contactor are either mechanically and/or electrically interlocked, that is, they cannot be closed at the same time. A thermal overload device must be used for protection when bypassing the drive. Refer to local codes and regulations.	<input type="checkbox"/>
There are no tools, foreign objects or dust from drilling inside the drive.	<input type="checkbox"/>
The area in front of the drive is clean: the drive cooling fan cannot draw any dust or dirt inside.	<input type="checkbox"/>
The terminal box cover of the motor is in place. Cabinet shrouds are in place and doors are closed.	<input type="checkbox"/>
The motor and the driven equipment are ready for power-up.	<input type="checkbox"/>

9

Start-up

Contents of this chapter

This chapter contains the start-up and switch-off procedures 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 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 permitted 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.

Action	<input checked="" type="checkbox"/>
Safety	
WARNING! Obey the safety instructions during the start-up procedure. See chapter Safety instructions (page 17).	<input type="checkbox"/>
Checks/Settings with no voltage connected	



Action	<input checked="" type="checkbox"/>
Make sure that the disconnecter of the supply transformer is locked to the open position (i.e., voltage is not connected to the drive, and cannot be connected to the drive accidentally).	<input type="checkbox"/>
Make sure that the main switch-disconnector [Q1.1] is open, or the main breaker [Q1] is racked out.	<input type="checkbox"/>
Close the grounding switch [Q9.1] (option +F259). Do not use too much force. Electrical interlocking can prevent closing of the grounding switch.	<input type="checkbox"/>
Check the mechanical and electrical installation of the drive. See <i>Installation checklist</i> (page 173).	<input type="checkbox"/>
Check the settings of breakers/switches in the auxiliary circuits. See the circuit diagrams delivered with the drive.	<input type="checkbox"/>
Check the tap settings of transformers T21, T101 (if present) and T111 (if present). See section <i>Checking the settings of transformers T21, T101 and T111</i> (page 117).	<input type="checkbox"/>
Disconnect any unfinished or uninspected auxiliary voltage (115/230 V AC) cables that lead from the terminal blocks to the outside of the equipment.	<input type="checkbox"/>
Check that both channels of the Safe torque off circuit connected to the STO inputs of both the supply control unit [A51] and the inverter control unit [A41] are closed. Refer to the wiring diagrams delivered with the drive.	<input type="checkbox"/>
<u>Drives with ground fault monitoring for IT (ungrounded) systems (option +Q954):</u> If necessary, adjust the settings of the device. See the circuit diagrams of the delivery and the manual of the device.	<input type="checkbox"/>
<u>Drives with Pt100 relays (option +(n)L506):</u> <ul style="list-style-type: none"> • Check the connections against the circuit diagrams of the delivery. • Set the alarm and trip levels of the Pt100 relays. 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. ABB recommends to set the operating temperatures of the relay, typically for example, as follows: <ul style="list-style-type: none"> • 120...140 °C when only tripping is in use • alarm 120...140 °C and trip 130...150 °C when both alarm and tripping are used. 	<input type="checkbox"/>
Powering up the auxiliary circuit of the drive	
Make sure that it is safe to connect voltage. Make sure that: <ul style="list-style-type: none"> • nobody is working on the drive or circuits that have been wired from outside into the drive cabinet • the cover of the motor terminal box is in place. 	<input type="checkbox"/>
<u>Drives with a voltmeter (option +G334):</u> Make sure that the circuit breaker of the measuring circuit (F5.1) is closed.	<input type="checkbox"/>
Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits.	<input type="checkbox"/>
Close the cabinet doors.	<input type="checkbox"/>
Close the main breaker of the supply transformer.	<input type="checkbox"/>
Switch on the auxiliary voltage [Q21].	<input type="checkbox"/>
<u>Drives of frame size 1×R8i + 1×R8i:</u> Close the main switch-disconnector [Q1.1]. This will power up the main circuit of the drive as well as the auxiliary voltage circuit.	<input type="checkbox"/>
Setting up the supply unit parameters	
Check the voltage range setting in parameter 195.01 Supply voltage. For more information on setting up the supply control program, refer to <i>ACS880 IGBT supply control program firmware manual</i> (3AUA0000131562 [English]). If you need more information on the use of the control panel, refer to <i>ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual</i> (3AUA0000085685 [English]).	<input type="checkbox"/>
Setting up the inverter unit parameters, and performing the first start	
Set up the inverter control program. See the appropriate start-up guide and/or firmware manual. There is a separate start-up guide only for some control programs.	<input type="checkbox"/>



Action	<input checked="" type="checkbox"/>
Make sure that parameter 95.09 Switch fuse controller is set to Disabled.	<input type="checkbox"/>
<u>Drives with a brake chopper (option +D150):</u> See chapter Resistor braking (page 309).	<input type="checkbox"/>
<u>Drives with a sine output filter (option +E206):</u> Check that bit 1 of parameter 95.15 Special HW settings is activated.	<input type="checkbox"/>
<u>Drives with an fieldbus adapter module (optional):</u> 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. Check that the communication works between the drive and the PLC.	<input type="checkbox"/>
<u>Drives with an encoder interface module (optional):</u> 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.	<input type="checkbox"/>
Powering up the main circuit of the drive	
<u>Switch off the grounding switch [Q9.1] (option +F259).</u>	<input type="checkbox"/>
Close the main switch-disconnector [Q1.1] or main breaker [Q1]. Note: Do not use excessive force. The main switch-disconnector (or main breaker) can only be closed when: <ul style="list-style-type: none"> • the main input terminals [L1, L2, L3] are powered, and • auxiliary voltage is switched on [Q21], and • <u>the grounding switch [Q9.1, Q9.2] (option +F259) is open.</u> 	<input type="checkbox"/>
Turn the operating switch (S21) to the ON (1) position to activate the run enable signal. Depending on control source settings, this may also close the main contactor (if present). If a main contactor is present and does not close, refer to the circuit diagrams delivered by the drive as well as the appropriate firmware manuals.	<input type="checkbox"/>
On-load checks	
Start the motor to perform the ID run.	<input type="checkbox"/>
Check that the cooling fans rotate freely in the right direction, and the air flows upwards.	<input type="checkbox"/>
Check that the motor starts. stops and follows the speed reference in the correct direction when controlled with the control panel.	<input type="checkbox"/>
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.	<input type="checkbox"/>
<u>Drives in which the Safe torque off control circuit is in use:</u> Test and validate the operation of the Safe torque off function. See section Start-up including validation test (page 294).	<input type="checkbox"/>
<u>Drives with an emergency stop circuit (options +Q951, +Q952, +Q963, +Q964, +Q978, +Q979):</u> Test and validate the operation of the emergency-stop circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.	<input type="checkbox"/>
<u>Drives with the Prevention of unexpected start-up with safety relay (option +Q957):</u> Test and validate the operation of the Prevention of unexpected start-up circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.	<input type="checkbox"/>
<u>Drives with the Prevention of unexpected start with FSO safety functions module (option +Q950):</u> Test and validate the operation of the Prevention of unexpected start-up circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.	<input type="checkbox"/>
<u>Drives with the Safely-limited speed with the encoder interface (option +Q965):</u> Test and validate the operation of the Safely-limited speed circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.	<input type="checkbox"/>
<u>Drives with a motor thermal protection function (options +L513, +L514, +L536, +L537):</u> Test and validate the operation of the motor thermal protection function. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.	<input type="checkbox"/>



Switching off the drive

1. Stop the motor.
2. Turn the Run enable switch (S21) to the off (0) position to deactivate the Run enable signal and to switch the main contactor/breaker off.



10

Fault tracing

Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

Control unit LEDs (BCU-x2)

LED	Color	Indication
BATT OK	Green	Battery voltage of the real-time clock is OK (higher than 2.8 V). When the LED is not lit, <ul style="list-style-type: none">• battery voltage is below 2.8 V,• the battery is missing, or• the control unit is not powered.
PWR OK	Green	Internal voltage is sufficient.
FAULT	Red	The control program indicates that the equipment is faulty. See the appropriate firmware manual.
WRITE	Yellow	Writing to SD card in progress.

Control unit LEDs (UCU-22...26)

LED		Indication
BAT	Green	Battery voltage of the real-time clock is sufficient (higher than 2.5 V).
	Off	Battery voltage is below 2.5 V, the battery is missing or the control unit is not powered.
PWR	Green	Internal voltage is sufficient.
FAULT	Red	Control program indicates that the equipment is faulty. See the appropriate firmware manual.
WRITE	Yellow	Writing to microSDHC card in progress.
FS COMM	Green	Reserved
FS STATUS	Continuous green	Reserved

Control panel and panel platform/holder LEDs

The ACS-AP-... control panel has a status LED. The control panel mounting platform or holder has two status LEDs. For their indications, see the following table.

Location	LED	Indication
Control panel	Continuous green	The unit is functioning normally.
	Flickering green	Data is transferred between the PC and the unit through the USB connection of the control panel.
	Blinking green	There is an active warning in the unit.
	Continuous red	There is an active fault in the unit.
	Blinking red	There is a fault that requires the stopping and restarting of the drive/converter/inverter.
	Blinking blue (ACS-AP-W only)	The Bluetooth interface is enabled, in discoverable mode, and ready for pairing.
	Flickering blue (ACS-AP-W only)	Data is being transferred through the Bluetooth interface of the control panel.
Control panel mounting platform or holder (with the control panel removed)	Red	There is an active fault in the unit.
	Green	Power supply for the control unit is OK.

Warning and fault messages

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

11

Maintenance

Contents of this chapter

This chapter contains maintenance instructions.

Maintenance intervals

The tables below show the maintenance tasks which can be done by the end user. The complete maintenance schedule is available on the Internet (<https://new.abb.com/drives/services/maintenance/preventive-maintenance>). For more information, consult your local ABB Service representative (www.abb.com/searchchannels).

■ Description of symbols

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

■ Recommended maintenance intervals after start-up

Maintenance task/object	Years from start-up													
	0	1	2	3	4	5	6	7	8	9	10	11	12	...
Cooling														
Supply/Inverter module main cooling fan										R				
Supply/Inverter module circuit board compartment fan										R				
LCL filter cooling fan (50 Hz)										R				
LCL filter cooling fan (60 Hz)							R						R	
Sine filter cooling fan										R				
Door fan										R				
Other cabinet cooling fans (50 Hz)										R				
Other cabinet cooling fans (60 Hz)							R						R	
Batteries														
Control unit battery							R						R	
Control panel battery										R				
Connections and environment														
Air inlet and outlet cleaning (IP22/IP42)		I	I	I	I	I	I	I	I	I	I	I	I	I
Cabinet door filter change (IP54)		R	R	R	R	R	R	R	R	R	R	R	R	R
Checking tightness of cable and busbar terminals. Tightening if needed.		I	I	I	I	I	I	I	I	I	I	I	I	I
Checking ambient conditions (dustiness, corrosion, temperature)		I	I	I	I	I	I	I	I	I	I	I	I	I
Cleaning of heatsinks		I	I	I	I	I	I	I	I	I	I	I	I	I
Quality of supply voltage		P	P	P	P	P	P	P	P	P	P	P	P	P
Air circuit breaker maintenance (if present)		I	I	I	I	I	I	I	I	I	I	I	I	I
Spare parts														
Spare parts		I	I	I	I	I	I	I	I	I	I	I	I	I
DC circuit capacitor reforming (spare modules and spare capacitors)		P	P	P	P	P	P	P	P	P	P	P	P	P
Functional safety														
Safety function test	I See the maintenance information of the safety function.													
Safety component expiry (Mission time, T_M)	20 years													

Note:

- 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.
- 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.

Cabinet

■ Cleaning the interior of the cabinet



WARNING!

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



WARNING!

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

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Open the cabinet door.
3. Clean the interior of the cabinet. Use a vacuum cleaner and a soft brush.
4. Clean the air inlets of the fans and air outlets of the modules (top).
5. Clean the air inlet gratings (if any) on the door.
6. Close the door.

■ Cleaning the exterior of the drive



WARNING!

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

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Clean the exterior of the drive. Use:
 - vacuum cleaner with an antistatic hose and nozzle
 - soft brush
 - dry or damp (not wet) cleaning cloth. Moisten with clean water, or mild detergent (pH 5...9 for metal, pH 5...7 for plastic).



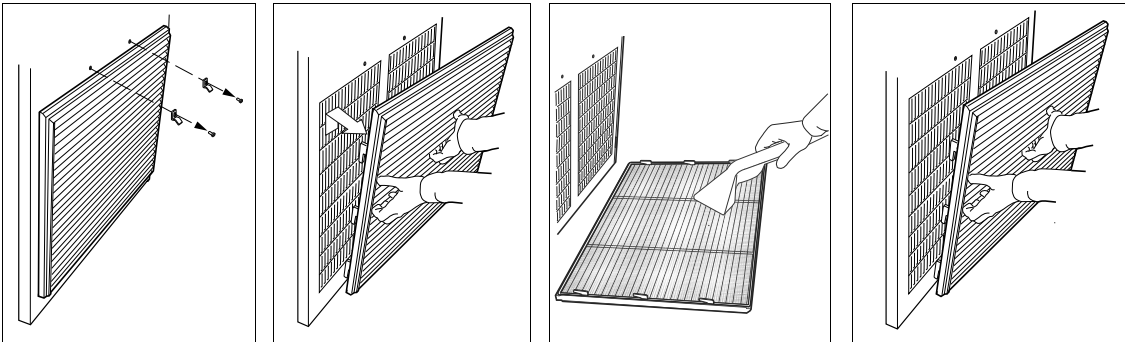
WARNING!

Prevent water from entering the drive. Never use excessive amount of water, a hose, steam, etc.

■ **Cleaning the door air inlets (IP22 and IP42)**

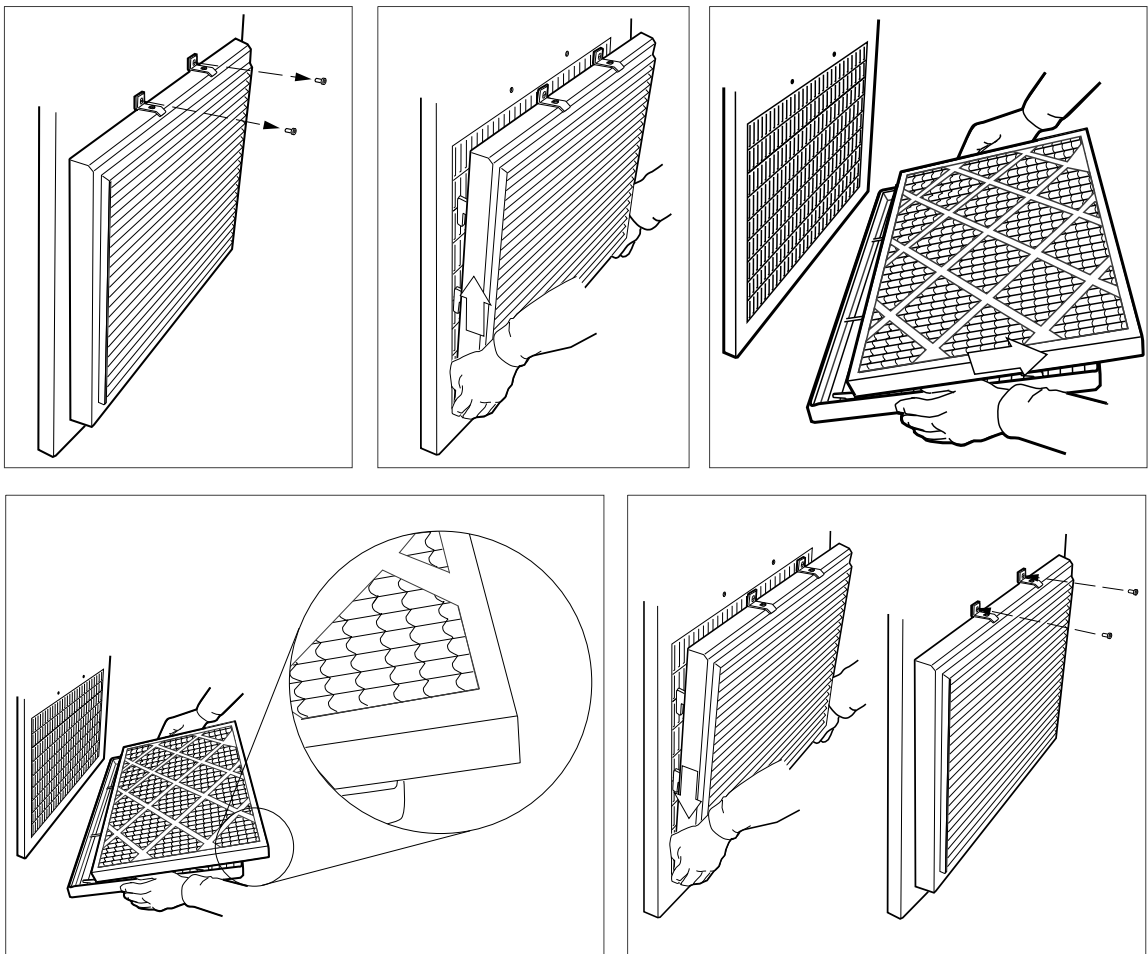
Check the dustiness of the air inlet meshes. If the dust cannot be removed by vacuum cleaning from outside through the grating holes with a small nozzle, proceed as follows:

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) 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.



■ Replacing the inlet door filters (IP54)

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) 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 roof outlet filters (IP54)

The outlet filters on the roof of IP54 units can be accessed by pulling the gratings upwards.

■ Replacing the outlet (roof) filters (IP54)

1. Remove the front and back gratings of the fan cubicle by lifting them upwards.
2. Remove the air filter mat.
3. Place the new filter mat in the grating.
4. Reinstall the gratings in reverse order.

Fans

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

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

■ Replacing R8i module cooling fan (speed-controlled version)

The module is equipped with a fan unit that contains two cooling fans.



WARNING!

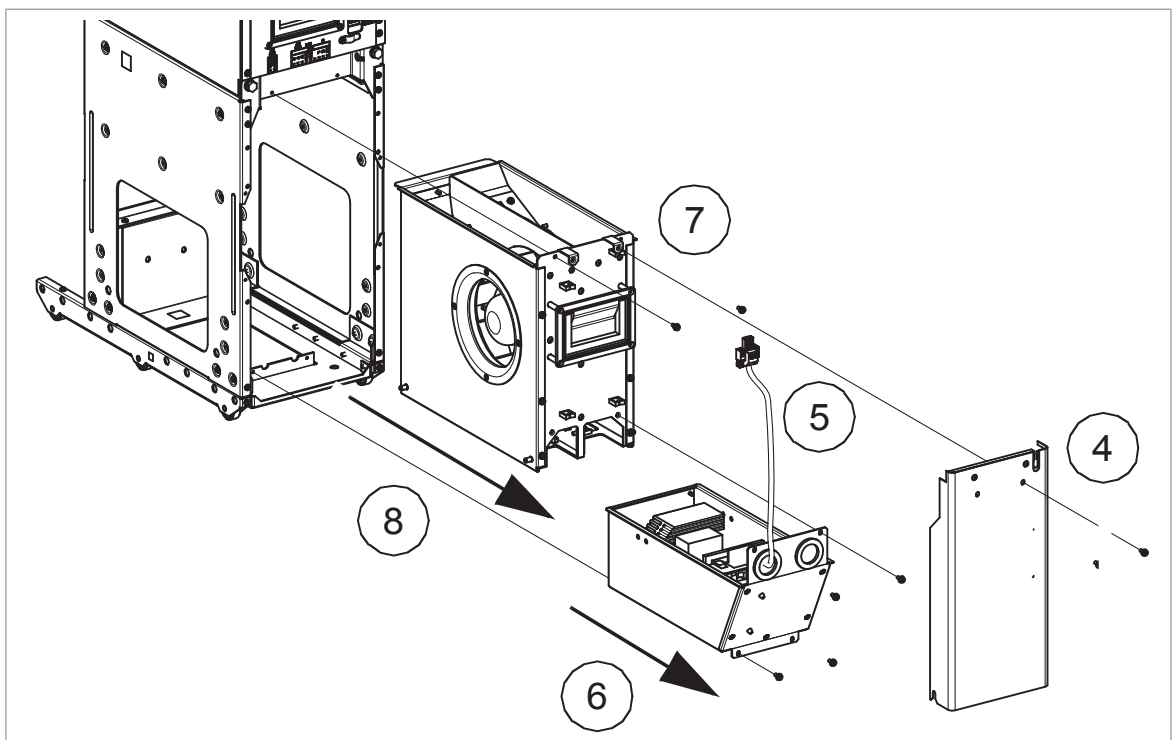
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.



WARNING!

Use the required personal protective equipment. Wear protective gloves and long sleeves. Some parts have sharp edges.

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Open the cubicle door.
3. Remove the shroud in front of the fan (if any).
4. Remove the screws holding the front cover plate. Lift the cover plate somewhat to release it.
5. Disconnect the fan wiring.
6. Remove the unit below the fan.
7. Remove the screws of the fan unit.
8. Pull out the fan unit.
9. Install a new fan in reverse order.



■ Replacing R8i module cooling fan (direct-on-line version)



WARNING!

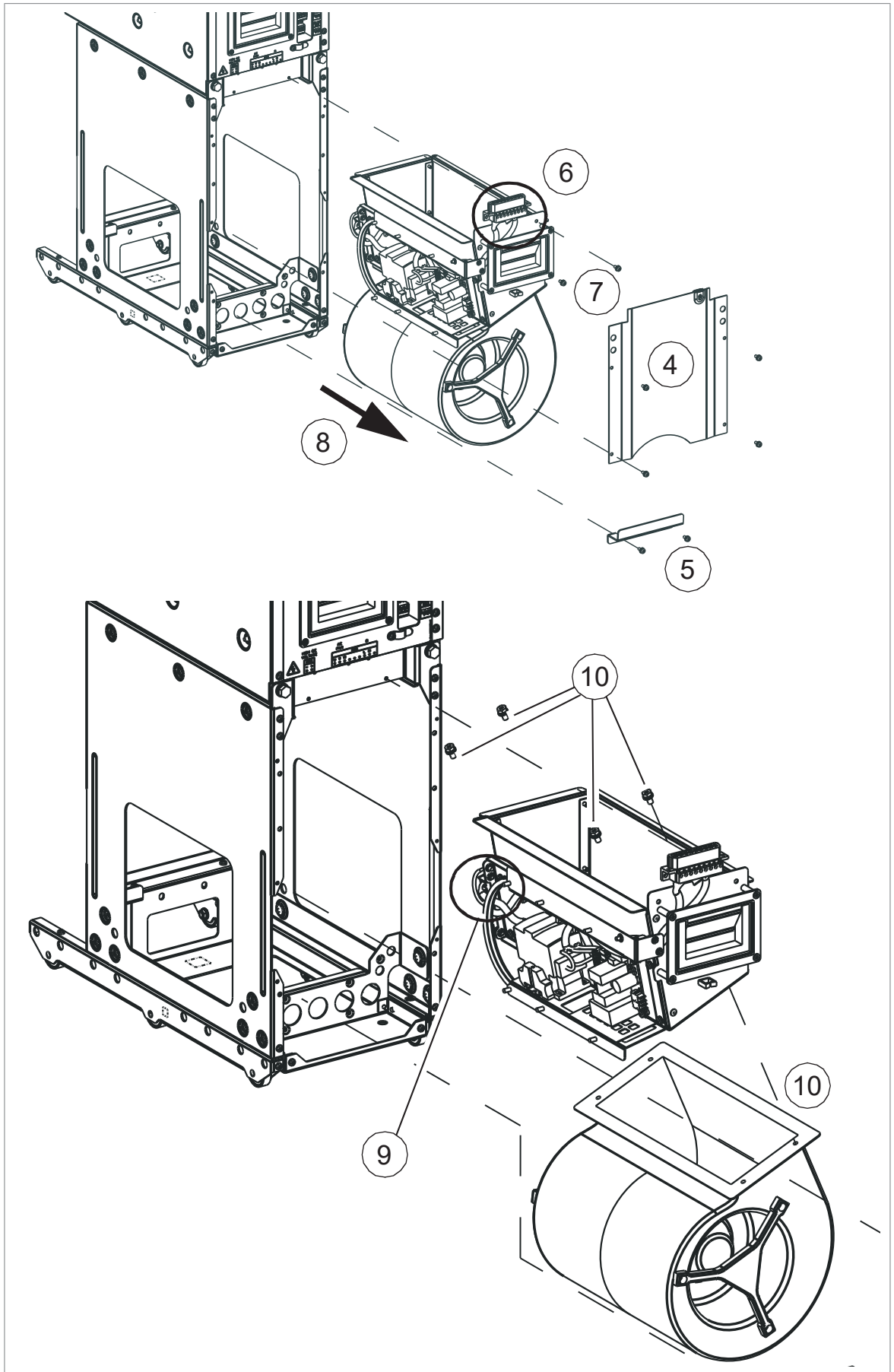
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.



WARNING!

Use the required personal protective equipment. Wear protective gloves and long sleeves. Some parts have sharp edges.

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
 2. Open the door.
 3. Remove the shroud in front of the fan (if any).
 4. Remove the screws holding the front cover plate. Lift the cover plate somewhat to release it.
 5. Remove the bracket.
 6. Disconnect the wiring of the fan unit.
 7. Remove the screws of the fan unit.
 8. Pull out the fan unit.
 9. Disconnect the fan wire from the fan unit.
 10. Remove the screws of the fan.
 11. Install a new fan in reverse order.
-



■ Replacing the fan of the LCL filter (BLCL-1x-x)

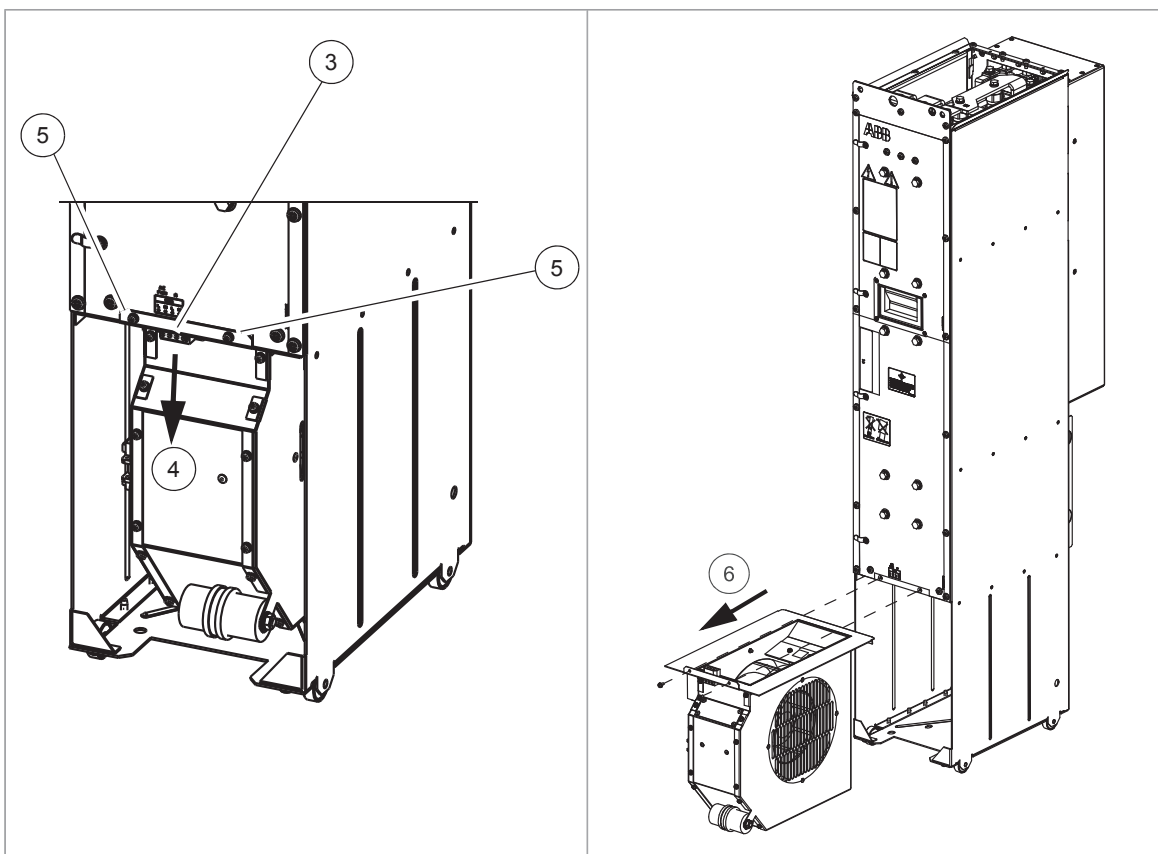


WARNING!

Obey the safety instructions given in ACS880 multidrive cabinets and modules safety instructions (3AUA0000102301 [English]). If you ignore the safety instructions, 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.

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Open the door.
3. Remove the two locking screws of fan supply plug connector.
4. Pull the plug connector downwards to unplug the fan wiring.
5. Remove two screws in front of the fan unit.
6. Pull the fan unit out.
7. Install a new fan in reverse order.



■ Replacing the fan of the LCL filter (BLCL-2x-x)

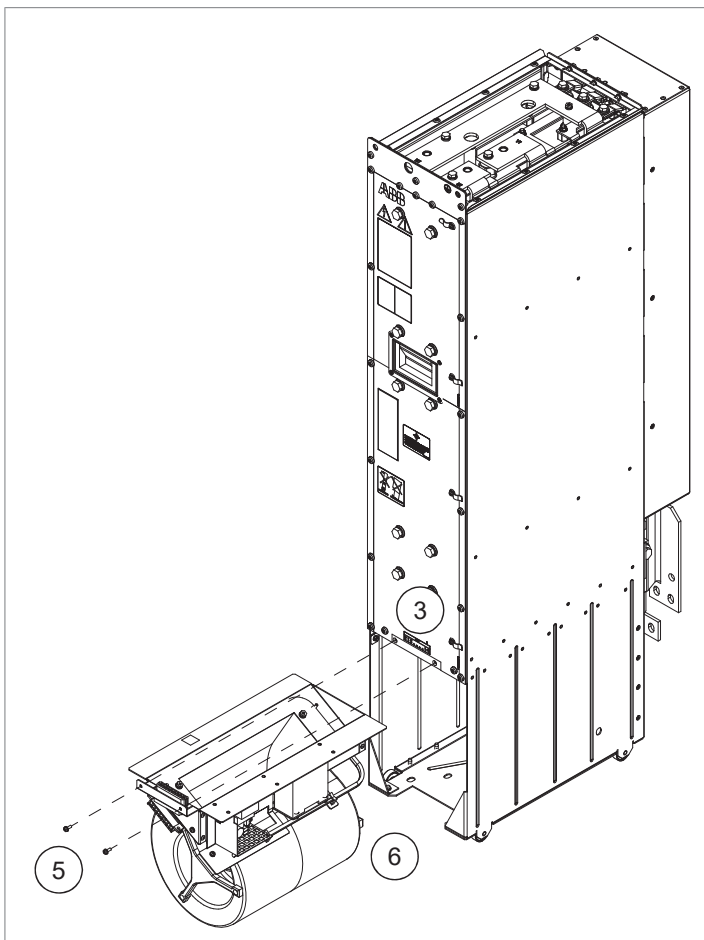


WARNING!

Obey the safety instructions given in ACS880 multidrive cabinets and modules safety instructions (3AUA0000102301 [English]). If you ignore the safety instructions, 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.

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Open the door.
3. Remove the two locking screws of fan supply plug connector.
4. Pull the plug connector downwards to unplug the fan wiring.
5. Remove the screws in front of the fan unit.
6. Pull the fan unit out.
7. Replace the fan of the fan unit. Install the fan unit in reverse order.



■ Replacing the circuit board compartment fan

Frame R8i modules are equipped with a fan blowing air through the circuit board compartment.

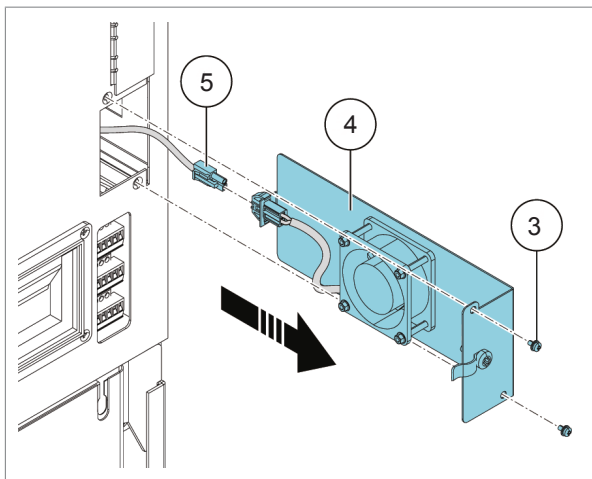
The fan is accessible from the front of the module.



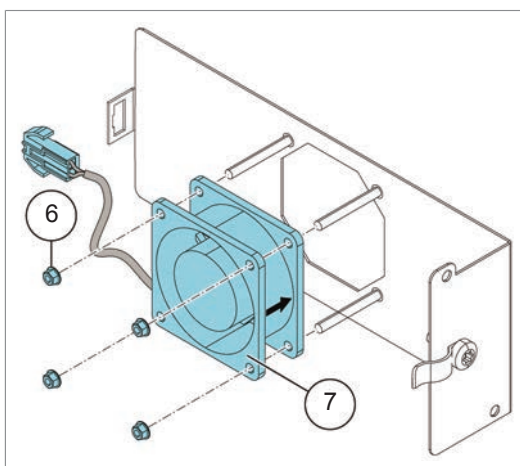
WARNING!

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

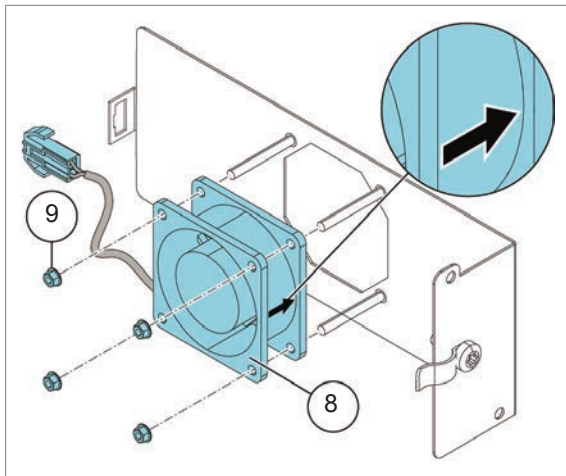
1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Open the door of the module cubicle.
3. Remove the two M4×12 (T20) screws which lock the fan holder.
4. Pull the fan holder out of the module.
5. Disconnect the fan cable.



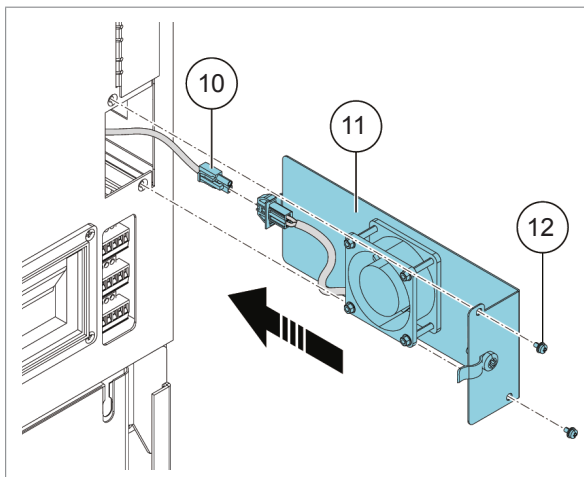
6. Remove the four M3 (5.5 mm) nuts which hold the fan.
7. Remove the fan from the fan holder.



8. Put the fan onto the threaded studs on the fan holder with the airflow direction arrow pointing towards the fan holder.
9. Install and tighten the four nuts removed earlier.



10. Connect the fan cable.
11. Align and push the fan holder into the module.
12. Install and tighten the two M4×12 (T20) screws.



■ Replacing the cooling fan in the auxiliary control cubicle



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 21) before you start the work.
2. Remove the shrouding from in front of the fan.
3. Unplug the power supply cable of the fan.
4. Remove the fastening screws of the fan.
5. Install the new fan in reverse order.

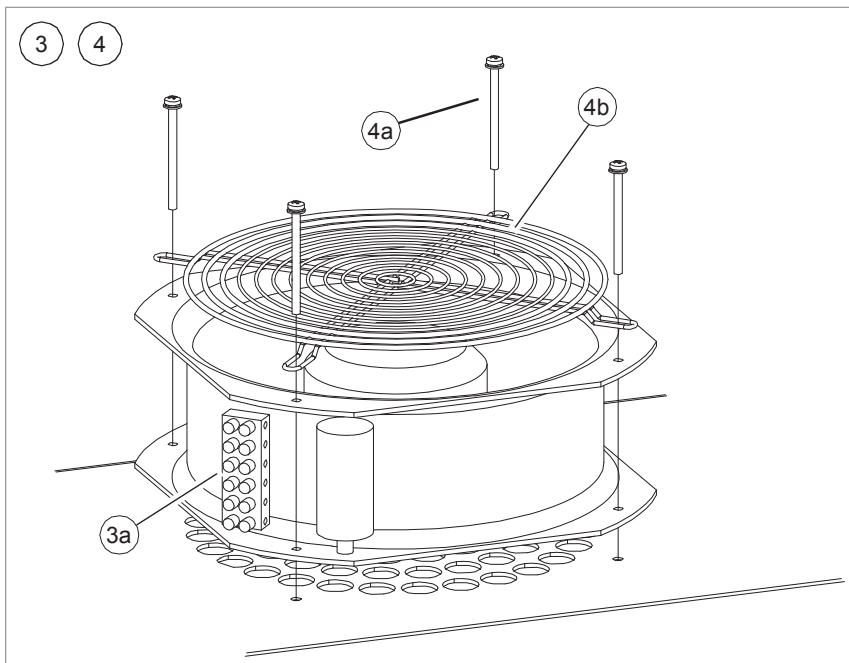
■ Replacing the cooling fan in the incoming cubicle



WARNING!

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

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Remove the shrouding (if any) in front of the fan.
3. Disconnect the fan wiring (a).
4. Remove the fastening screws (a) and finger guard (b) of the fan.
5. Install the new fan in reverse order. Make sure that the arrow indicating the air flow direction points up.



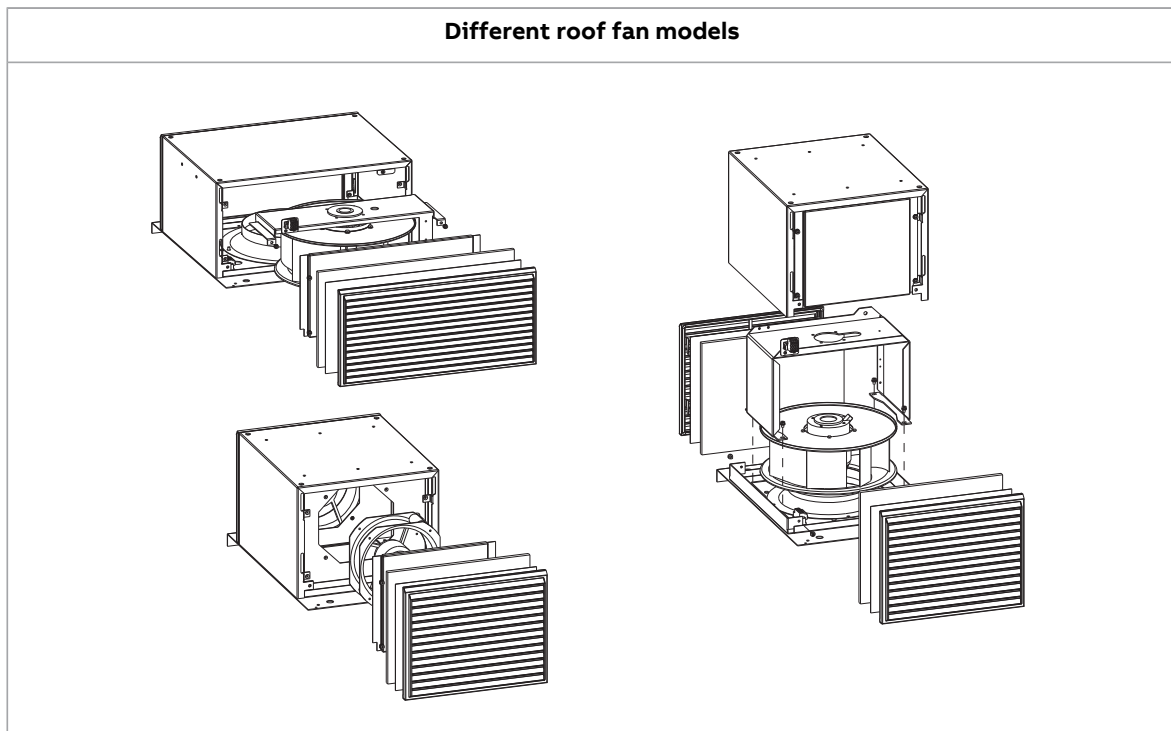
■ Replacing a roof fan (IP54/UL type 12)



WARNING!

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

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Remove all ventilation covers (lift and pull) and filters.
3. Remove the roof plate on top of the outlet (if any).
4. Disconnect the fan supply wires.
5. Loosen the mounting screws of the fan.
6. Remove the fan.
7. Install the new fan in reverse order.



■ Replacing the common motor terminal cubicle fan



WARNING!

Use the required personal protective equipment. Wear protective gloves and long sleeves. Some parts have sharp edges.

Fan attached to the cabinet door

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Open the cabinet door.
3. Disconnect the fan wiring.
4. Remove the connectors.
5. Remove the fastening screws.
6. Remove the fan.
7. Install the new fan in reverse order.

Roof fan (with options +C128 and +H353)

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Open the cabinet door.
3. Remove the finger guard.
4. Disconnect the fan wiring.
5. Remove the fastening screws.
6. Remove the fan.
7. Install a new fan in reverse order.

Floor fan (with options +C128 and +H353)

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Open the cabinet door.
3. Remove the finger guard.
4. Disconnect the fan wiring.
5. Remove the fastening screws.
6. Remove the fan.
7. Install a new fan in reverse order.

■ **Replacing the brake chopper and resistor cubicle fans (options +D150 and +D151)**

See chapter [Resistor braking](#) (page 309).

Supply and inverter modules

■ Replacing a supply or inverter module



WARNING!

Make sure the replacement module has exactly the same type code as the old module.

Follow the module extraction and insertion procedures in chapter *Electrical installation*.

■ Cleaning the 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!

Use the required personal protective equipment. Wear protective gloves and long sleeves. Some parts have sharp edges.



WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions* (page 21) before you start the work.
2. Remove the drive module from the cabinet.
3. Remove the module cooling fan(s). See the separate instructions.
4. Blow dry, clean and oil-free compressed air from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust. If there is a risk of dust entering adjoining equipment, do the cleaning in another room.
5. Reinstall the cooling fan.

■ Activating the reduced run of the inverter unit

A “reduced run” function is available for inverter units consisting of parallel-connected inverter modules. The function makes it possible to continue operation with limited current even if one (or more) module is out of service, for example, because of maintenance work. In principle, reduced run is possible with only one module, but the physical requirements of operating the motor still apply; for example, the modules remaining in use must be able to provide the motor with enough magnetizing current.

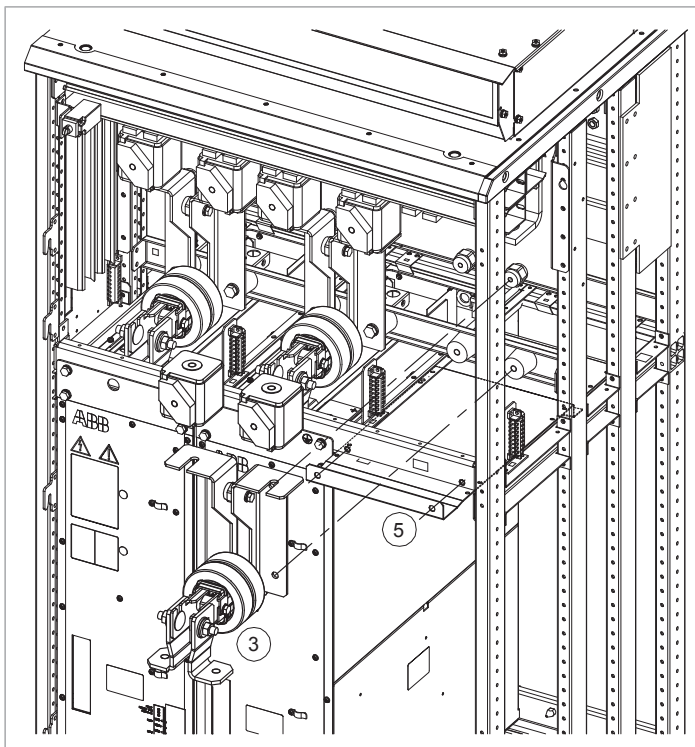


WARNING!

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

Refer to the drawing below.

1. Stop the drive and do the steps in section *Electrical safety precautions* (page 21) before you start the work.
2. Remove the shrouding above the module bay (in front of the DC fuses).
3. Remove the DC fuses and the busbar assembly connecting the fuses to the inverter module. Store these parts – they are to be reinstalled only with the inverter module. Make note of the order of washers.
4. Remove the faulty module from its bay. See the module replacement instructions.
5. Install the air baffle (included) to the underside of the top module guide:
 - Fasten the front edge of the baffle to the module mounting holes using the module mounting screws (2 × M8). Tighten to 9 N·m (6.6 lbf·ft).
 - Fasten the left/right sides of the baffle using M4 screws wherever possible. (This depends on the location of the module in the cubicle.) Tighten to 1...2 N·m (0.7 ... 1.5 lbf·ft).



6. If the inverter control unit (A41) is powered from the faulty module, connect the power supply wiring to another module using the extension wire set included.
7. If the Safe torque off (STO) function is in use, install the jumper wire set included in the STO wiring in place of the missing module. (This is not needed if the module was the last on the STO wire chain.)
8. Reinstall all shrouding removed earlier.

Note: Do not reinstall the DC fuses or busbars but store them elsewhere until the module can be reinstalled.

9. Switch on the power to the drive.
10. Enter the number of inverter modules present into parameter *95.13 Reduced run mode*.

11. Reset all faults and start the drive.
12. If the Safe torque off (STO) function is in use, perform a validation test. See the STO instructions.

The maximum current is now automatically limited according to the new inverter configuration. A mismatch between the number of detected modules and the value set in *95.13* will generate a fault.

Returning the module

1. Install the module in reverse order. Use the following tightening torques:
 - DC busbar assembly to upper insulators (2 × M8): 9 N·m (6.6 lbf·ft)
 - DC busbar assembly to lower insulators (2 × M10): 18 N·m (13.3 lbf·ft)
 - Fuses to DC busbars: 50 N·m (37 lbf·ft) (Bussmann), 46 N·m (34 lbf·ft) (Mersen/Ferraz-Shawmut)
 - Module to cabinet frame (4 × M8): 22 N·m (16 lbf·ft)
 - DC busbar assembly to module DC input (2 × M12): 70 N·m (52 lbf·ft)
2. Restore the original wiring (STO and control unit power supply whenever needed).
3. Set parameter *95.13* to 0 to disable the reduced run function.
4. If the Safe torque off (STO) function is in use, perform a validation test. See the STO instructions.

■ Activating the reduced run of the supply unit

A “reduced run” function is available for supply/rectifier units consisting of parallel-connected modules. The function makes it possible to continue operation with limited current even if one (or more) module is out of service, for example, because of maintenance work.

In principle, reduced run is possible with only one module, but the physical requirements of operating the motor still apply; for example, the modules remaining in use must be able to provide enough current. For allowed configurations when using reduced run function, see [ACS880 IGBT supply control program firmware manual \(3AUA0000131562 \[English\]\)](#).

Starting reduced run operation



WARNING!

Obey the safety instructions given in [ACS880 multidrive cabinets and modules safety instructions \(3AUA0000102301 \[English\]\)](#). If you ignore the safety instructions, 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.



WARNING!

Use the required personal protective equipment. Wear protective gloves and long sleeves. Some parts have sharp edges.

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. If the control unit is powered from the faulty module, connect the control unit to another 24 V DC power supply. ABB strongly recommends using an external power supply with supply/rectifier units consisting of parallel-connected modules.
3. Remove the module to be serviced from its bay.
4. Install an air baffle (for example, plexiglass) to the top module guide to block the airflow through the empty module bay.
5. Switch on the power to the supply/rectifier unit.
6. Enter the number of supply/rectifier modules present into parameter 195.13 Reduced run mode.
7. Reset all faults and start the supply/rectifier unit. The maximum current limit is now automatically set according to the new configuration. A mismatch between the number of detected modules (parameter 195.14) and the value set in 195.13 will generate a fault.

Resuming normal operation



WARNING!

Obey the safety instructions given in [AC5880 multidrive cabinets and modules safety instructions](#) (3AUA0000102301 [English]). If you ignore the safety instructions, 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.

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
 2. Remove the air baffle from the module bay.
 3. Reinstall the module into its bay.
 4. Switch on the power to the supply/rectifier unit.
 5. Enter "0" into parameter 195.13 Reduced run mode.
-

LCL filter

■ Replacing the LCL filter

Refer to the drawings below.



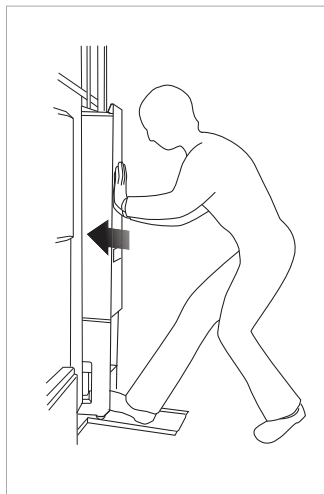
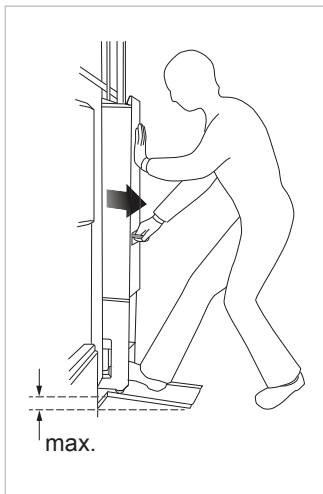
WARNING!

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



WARNING!

- Do not use the module extraction/installation ramp with plinth heights which exceeds the maximum allowed height.
- Secure the module extraction/installation ramp carefully.
- Push the module into the cabinet and pull it from the cabinet carefully preferably with help from another person. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back. Keep your fingers away from the edges of the front flange of the module.



- Do not roll the module on its wheels for a longer distance than what is required for inserting or extracting the module. To move the module to or from the vicinity of the cabinet, lay the module on its side on a pallet or equivalent, and use a forklift or pallet truck.
- Be careful when handling a tall module. The module overturns easily because it is heavy and has a high center of gravity. Whenever possible, secure the module with chains. Do not leave an unsupported module unattended especially on a sloping floor.

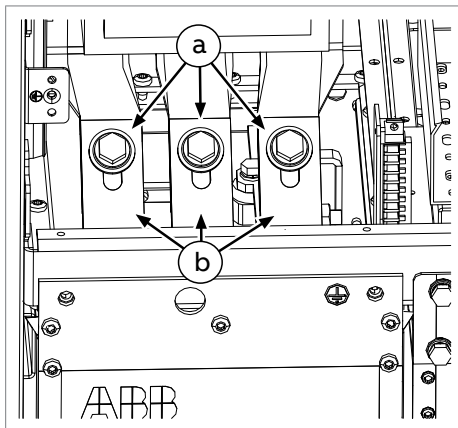


- Wear protective gloves and long sleeves! Some parts have sharp edges.

Note: As an alternative to using the extraction/installation ramp, a lifter is available from ABB Service. For more information, contact ABB Service, or see [Lifter for air-cooled drive modules user's guide \(3AXD50000332588 \[English\]\)](#).

1. Stop the drive (if running) and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Open the cubicle door.
3. Undo the four screws of the shroud in the upper part of the cubicle. Remove the shroud.
4. Unplug the signal connector cable on top of the module.
5. Remove the screws that connect the busbars to the top of the filter module. Be careful not to drop the screws into the module.

Frame 1×R8i+1×R8i only: Loosen the screws (a) and slide the busbars (b) upwards as far as they go. Tighten the screws (a) enough to hold the busbars in the up position.

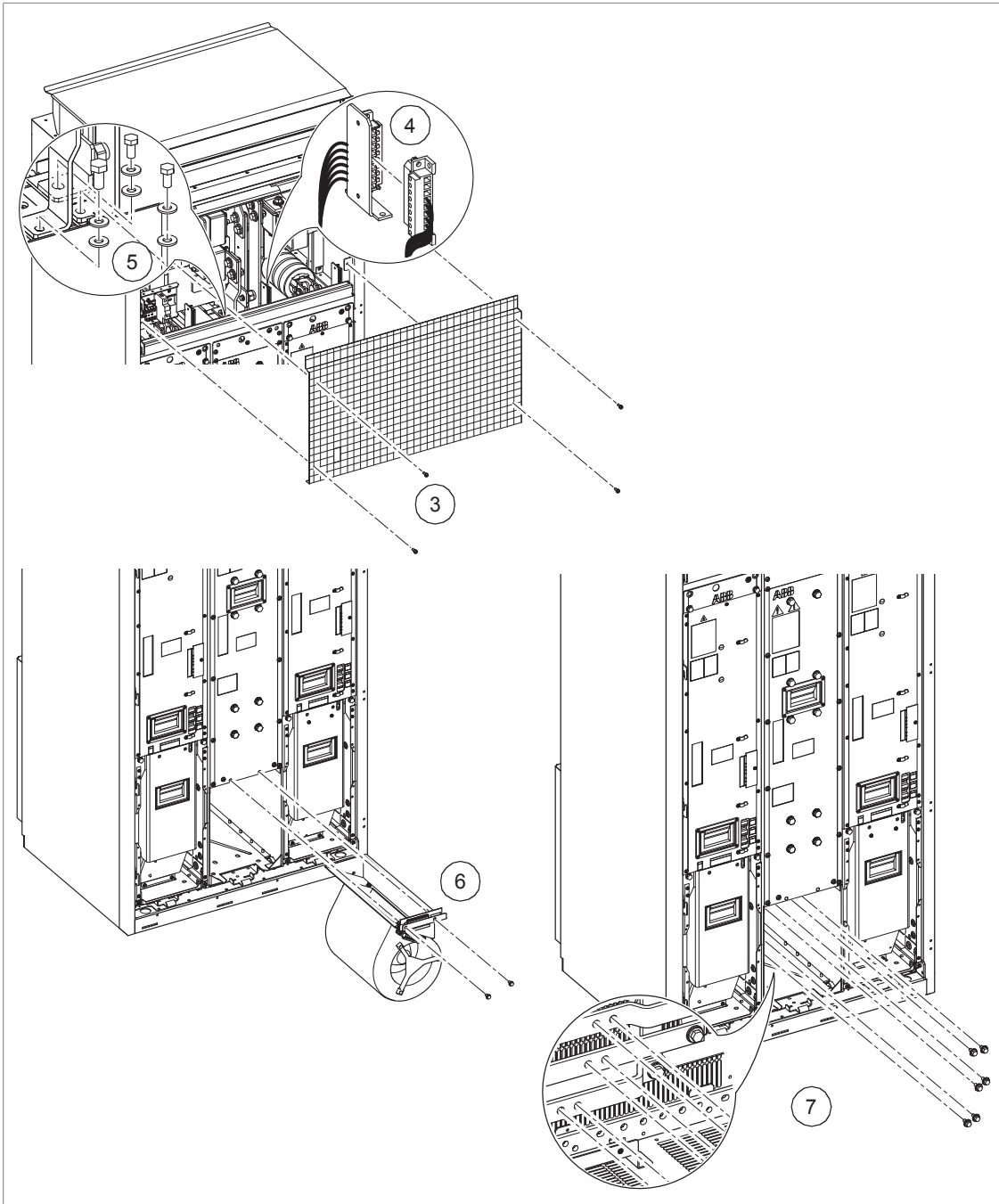


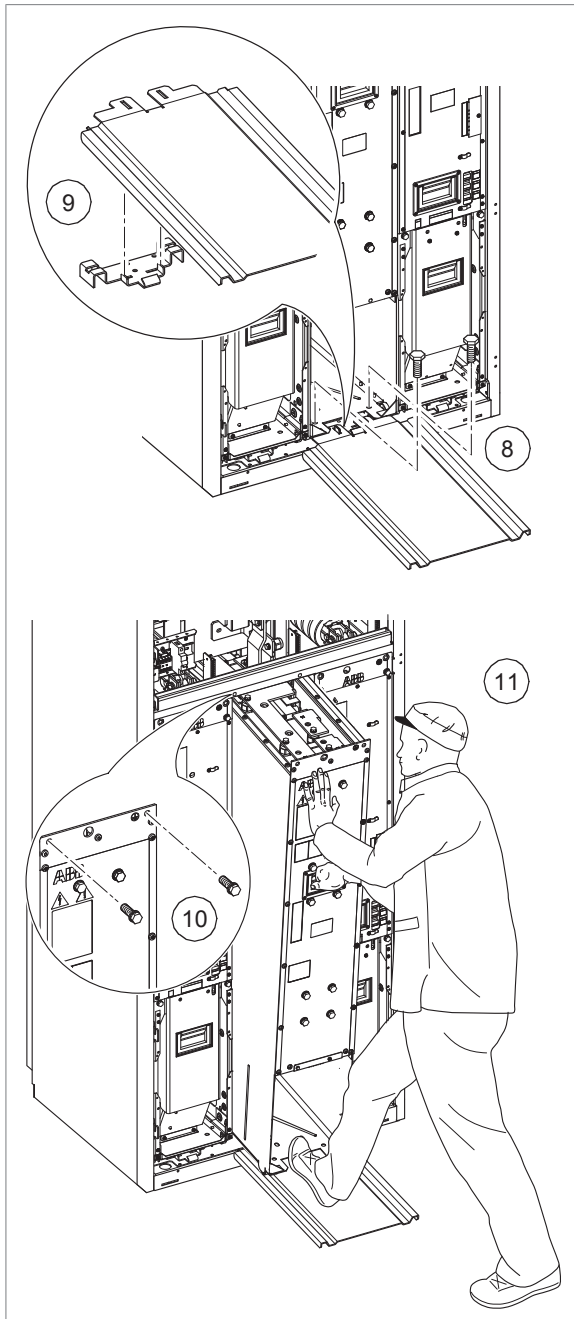
6. Remove the fan of the filter module. Unplug the signal connector cable and remove the screws in front of the fan.
7. Remove the fastening screws in the busbar behind the module.
8. Remove the two screws that fasten the bottom of the module to the base of the cabinet.
9. Install the module extraction/installation ramp: lift the ramp against the cabinet base so that the hooks of the base go into the ramp's holes.
10. Remove the two fastening screws that fasten the top of the module to the cabinet frame.
11. Pull the module carefully out of the cabinet along the ramp. While pulling on the handle, keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
12. Replace the module: install the module in reverse order. Mind you fingers. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.

Note: Be careful not to break the fastening screws: tighten the fastening screws of the module to 22 N·m (16.2 lbf·ft) and fastening bolts of the DC output busbars to 70 N·m (51.6 lbf·ft).

- Plug the module signal wire set to the module signal connector.
- Fasten the shrouds.

13. Remove the module extraction/installation ramp and close the cabinet doors.





Capacitors

The intermediate DC circuit of the drive contains several electrolytic capacitors. Operating time, load, and surrounding air temperature have an effect on the life of the capacitors. Capacitor life can be extended by decreasing the surrounding air temperature.

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

■ **Reforming the capacitors**

The capacitors must be reformed if the drive has not been powered (either in storage or unused) for a year or more. The manufacturing date is on the type designation label. For information on reforming the capacitors, refer to [Capacitor reforming instructions \(3BFE64059629 \[English\]\)](#).

Fuses

■ Replacing the AC and DC fuses in cabinet

This procedure instructs how to replace the drive AC and DC fuses inside the cabinet. The location of the fuses vary depending on the drive type and options. Locate the fuses to be replaced using the delivery-specific layout drawings and circuit diagrams.

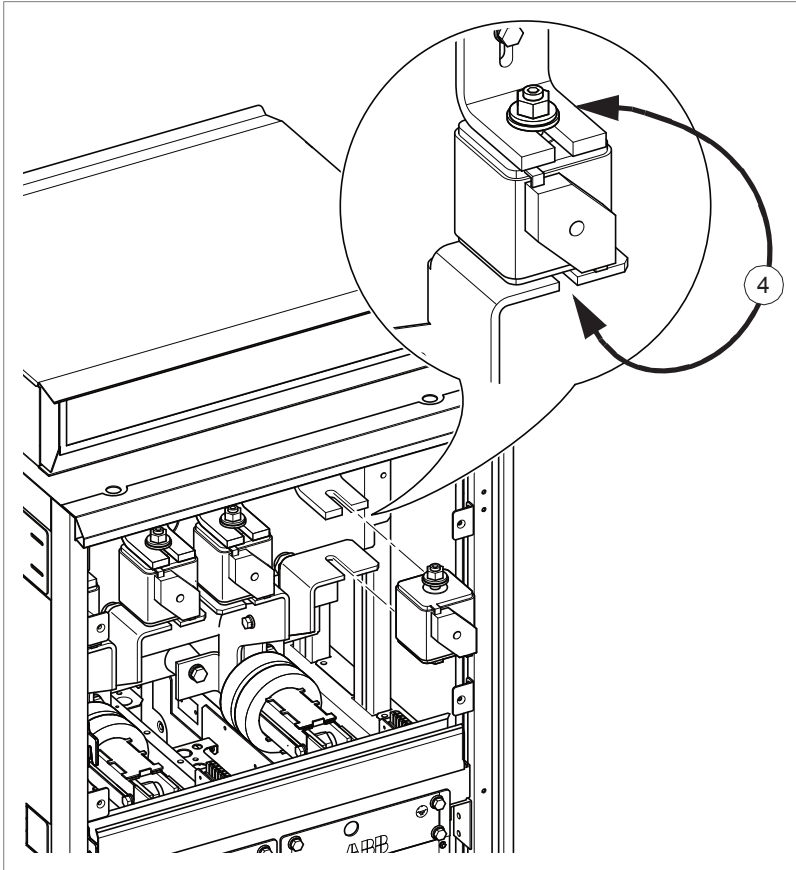
**WARNING!**

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 \(page 21\)](#) before you start the work.
 2. Open the door of the cubicle in which the fuses are.
 3. Remove the shrouding from in front of the fuses.
 4. Slacken the nuts of the headless screws of the fuses so that you can slide out the fuse blocks. Make note of the order of the washers on the screws.
 5. 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.
 6. Insert the new fuses into their slots in the cubicle. Pre-tighten the nuts first by hand or by applying a torque of no more than 5 N·m (3.7 lbf·ft).
 7. Tighten the nuts to torque as follows:
-

- Busmann fuses: 50 N·m (37 lbf·ft)
- Mersen (Ferraz-Shawmut): 46 N·m (34 lbf·ft)
- Other: Refer to the fuse manufacturer's instructions.

8. Reinstall the shroud and close the door.



Control panel

Refer to ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual (3AUA0000085685 [English]).

Control units

■ BCU control unit types

There are three variants of the BCU control unit used in ACS880 drives: BCU-02, BCU-12 and BCU-22. These have a different number of converter module connections (2, 7 and 12 respectively) but are otherwise identical. The three BCU types are interchangeable as long as the number of connections is sufficient. For example, the BCU-22 can be used as a direct replacement for both BCU-02 and BCU-12.

■ Replacing the memory unit (BCU-x2)

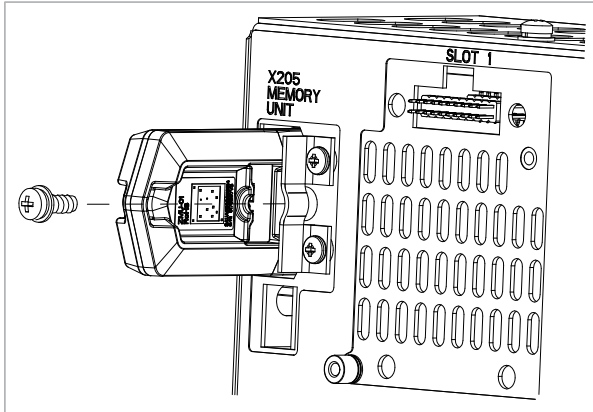
After replacing a control unit, you can keep the existing parameter settings by transferring the memory unit from the defective control unit to the new control unit.



WARNING!

Do not remove or insert the memory unit when the control unit is powered.

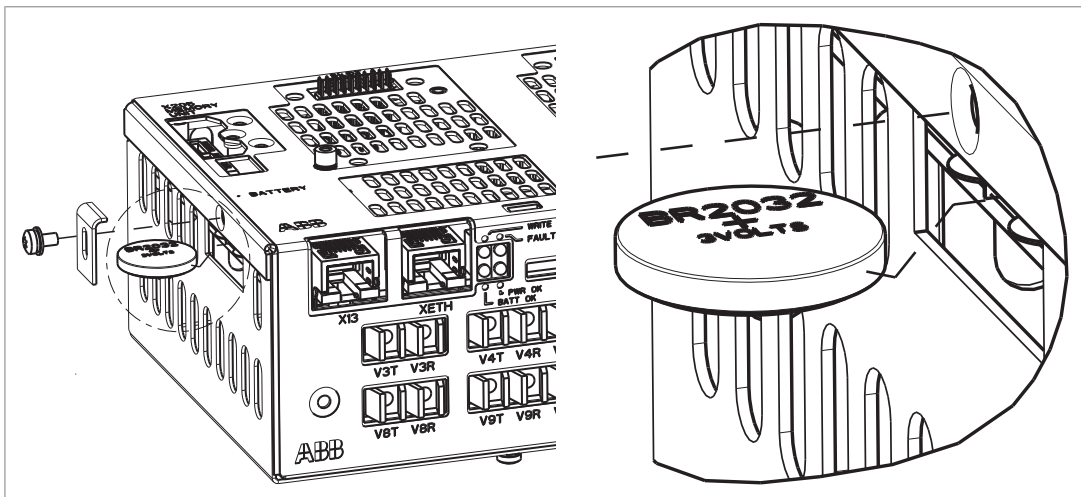
1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Make sure that the control unit is not powered.
3. Remove the fastening screw and pull the memory unit out.
4. Install a memory unit in reverse order.



■ Replacing the BCU control unit battery

Replace the real-time clock battery if the BATT OK LED is not illuminated when the control unit is powered.

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Undo the fastening screw and remove the battery.
3. Replace the battery with a new BR2032 battery.
4. Dispose of the old battery according to local disposal rules or applicable laws.
5. Set the real-time clock.



■ UCU control unit types

Different variants of the UCU control units are used in ACS880 drives: UCU-22...26. These have a different number of converter module connections but are otherwise identical. The UCU types are interchangeable as long as the number of connections is sufficient. For example, the UCU-24 can be used as a direct replacement for both UCU-22 and UCU-23.

■ Replacing the memory unit (UCU-22...26)

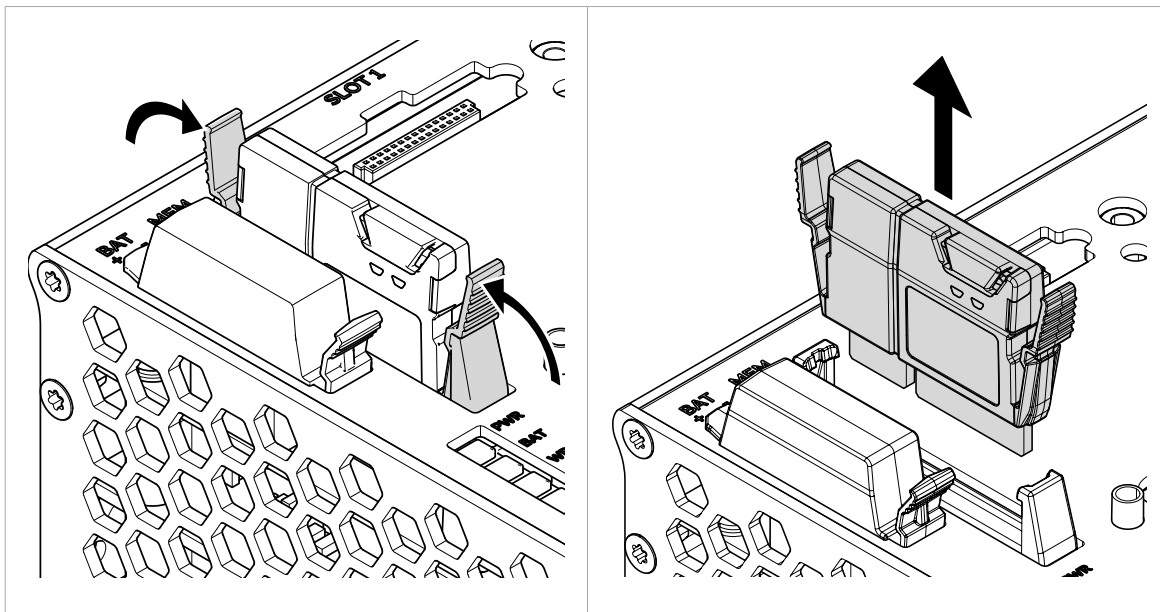
After replacing a control unit, you can keep the existing parameter settings by transferring the memory unit from the defective control unit to the new control unit.



WARNING!

Do not remove or insert the memory unit when the control unit is powered.

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Make sure that the control unit is not powered.
3. Push and hold in the clips on the memory unit. Pull the memory unit out.
4. Push the new memory unit in.



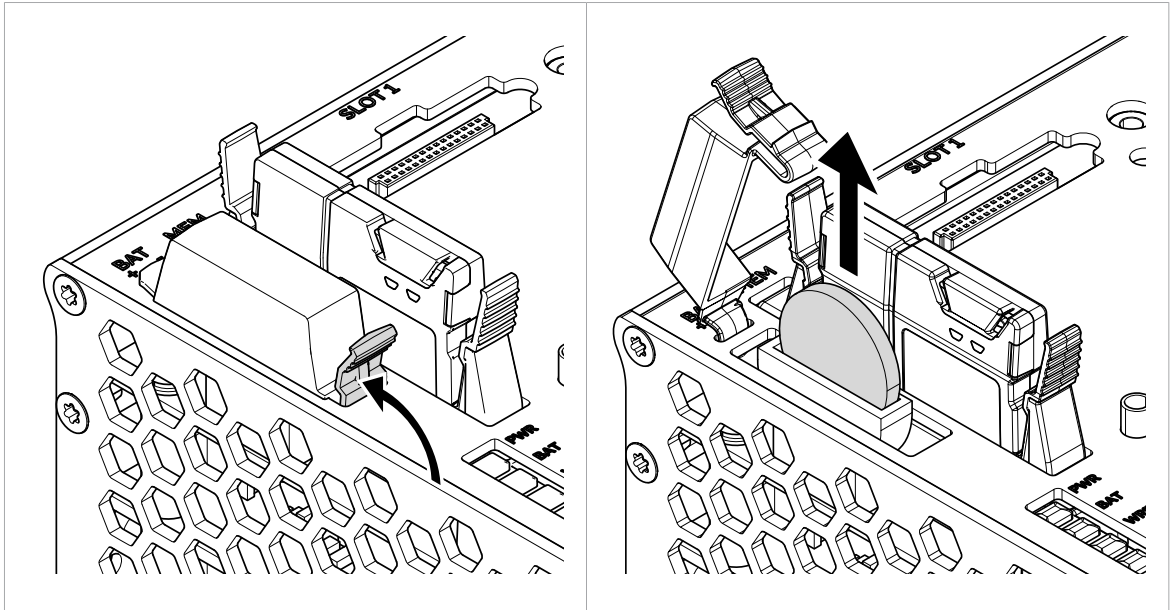
■ Replacing the UCU control unit battery

Replace the real-time clock battery if the BAT LED is off when the control unit is powered.

1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 21) before you start the work.
2. Open the battery cover.
3. Replace the battery with a new BR2032 battery.

Note: The real-time clock stays set for 2 minutes without battery.

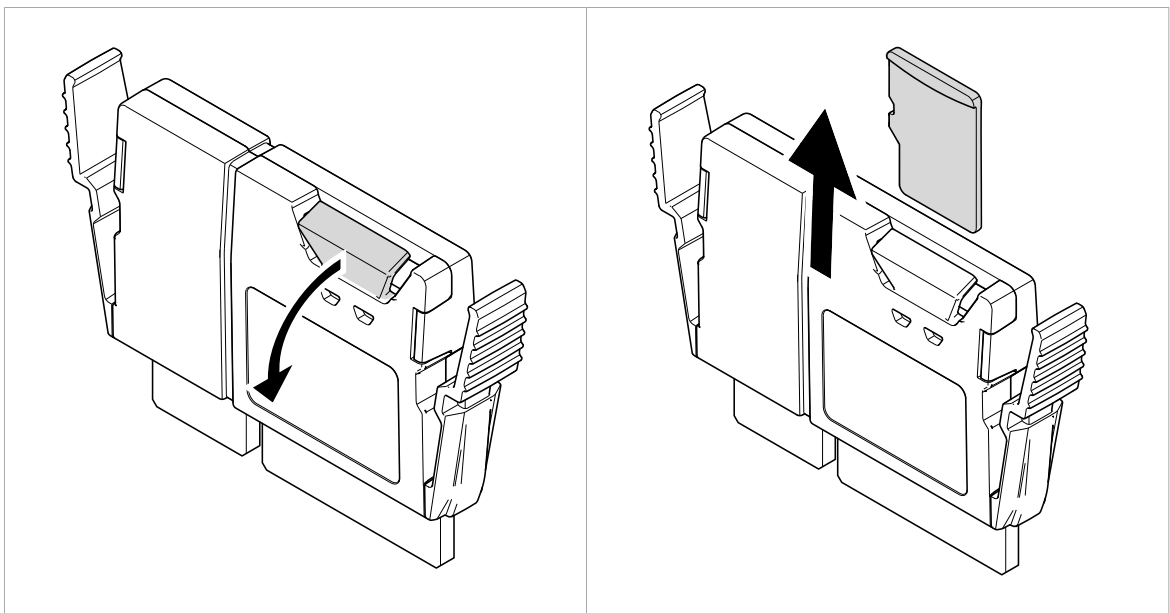
4. Close the battery cover.
5. Set the real-time clock if necessary.
6. Dispose of the old battery according to local disposal rules or applicable laws.



■ Replacing the microSDHC memory card (UCU-22...26)

Do not remove the microSDHC card while the yellow WRITE LED is on. Writing to the microSDHC card is in progress. For the replacement card type, see the technical data.

1. Remove the UMU memory unit from the control unit.
2. Move away from the cabinet before you remove the microSDHC card from the memory unit. The card is small and can fall into the cabinet.
3. Open the memory card cover in the memory unit.
4. Push the card to remove it.
5. Install the new card in reverse order.



Functional safety components

The mission time of functional safety components is 20 years which equals the time during which failure rates of electronic components remain constant. This applies to

the components of the standard Safe torque off circuit as well as any modules, relays and, typically, any other components that are part of functional safety circuits.

The expiry of mission time terminates the certification and SIL/PL classification of the safety function. The following options exist:

- Renewal of the whole drive and all optional functional safety module(s) and components.
- Renewal of the components in the safety function circuit. In practice, this is economical only with larger drives that have replaceable circuit boards and other components such as relays.

Note that some of the components may already have been renewed earlier, restarting their mission time. The remaining mission time of the whole circuit is however determined by its oldest component.

Contact your local ABB service representative for more information.

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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.

Ratings

The nominal ratings for the drives with 50 Hz and 60 Hz supply are given below. The symbols are described below the table.

ACS880-37-...	Input rating	Output ratings										
		No-overload use					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	hp	kVA	A	kW	hp	A	kW	hp
$U_N = 400\text{ V}$												
0450A-3	418	450	590	250	–	312	432	200	–	337	160	–
0620A-3	575	620	810	355	–	430	595	315	–	464	250	–
0730A-3	677	730	950	400	–	506	701	355	–	546	250	–
0800A-3	742	800	1040	450	–	554	768	400	–	598	315	–
0870A-3	807	870	1050	500	–	603	835	450	–	651	355	–
1110A-3	1030	1110	1450	630	–	769	1066	560	–	830	450	–
1210A-3	1123	1210	1580	710	–	838	1162	630	–	905	500	–
1430A-3	1327	1430	1860	800	–	991	1373	710	–	1070	560	–
1700A-3	1577	1700	2040	1000	–	1178	1632	900	–	1272	710	–
2060A-3	1911	2060	2680	1200	–	1427	1978	1100	–	1541	800	–
2530A-3	2347	2530	3040	1400	–	1753	2429	1200	–	1892	1000	–

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ACS880-37-...	Input rating	Output ratings										
		No-overload use					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	hp	kVA	A	kW	hp	A	kW	hp
$U_N = 500 V$												
0420A-5	390	420	550	250	350	364	403	250	300	314	200	250
0570A-5	529	570	750	400	500	494	547	355	450	426	250	350
0640A-5	594	640	840	450	500	554	614	400	500	479	315	400
0710A-5	659	710	930	500	600	615	682	450	500	531	355	450
0780A-5	724	780	1020	560	700	675.5	749	500	600	583	400	500
1010A-5	937	1010	1320	710	900	875	970	630	800	755	500	600
1110A-5	1030	1110	1450	800	1000	961	1066	710	900	830	560	700
1530A-5	1420	1530	1990	1100	1400	1325	1469	1000	1250	1144	800	1000
1980A-5	1837	1980	2580	1400	1750	1715	1901	1300	1500	1481	1000	1250
2270A-5	2106	2270	2960	1600	2000	1966	2179	1500	1900	1698	1200	1500
$U_N = 690 V$												
0320A-7	297	320	480	315	350	382	307	250	300	239	200	250
0390A-7	362	390	590	355	400	466	374	355	350	292	250	300
0460A-7	427	460	690	450	500	550	442	400	450	344	315	350
0510A-7	473	510	770	500	500	610	490	450	500	381	355	400
0580A-7	538	580	870	560	600	693	557	500	600	434	400	450
0660A-7	612	660	990	630	700	789	634	560	600	494	450	500
0770A-7	714	770	1160	710	800	920	739	710	700	576	560	600
0950A-7	881	950	1430	900	1000	1135	912	800	1000	711	710	700
1130A-7	1048	1130	1700	1100	1250	1350	1085	1000	1100	845	800	1000
1450A-7	1345	1450	2180	1400	1500	1733	1392	1300	1500	1085	1000	1100
1680A-7	1559	1680	2520	1600	1750	2008	1613	1500	1750	1257	1200	1250
1950A-7	1809	1950	2930	1900	2000	2330	1872	1800	2000	1459	1400	1500
2230A-7	2069	2230	3350	2200	2500	2665	2141	2000	2250	1668	1600	1750
2770A-7	2570	2770	4160	2700	3100	3310	2659	2600	2900	2072	2000	2250
3310A-7	3071	3310	4970	3200	-	3956	3178	3000	-	2476	2400	2700

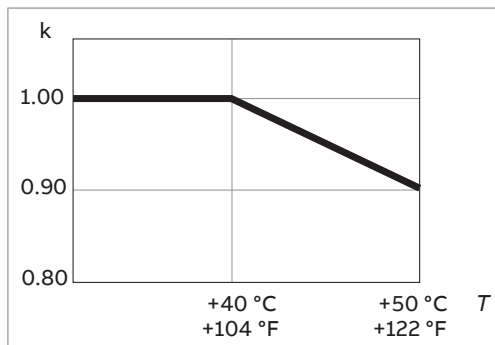
■ Definitions

U_N	Supply voltage range.
I_1	Nominal rms input current
I_2	Nominal output current (available continuously with no over-loading)
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. The horsepower ratings are typical NEMA motor sizes at 460 V (ACS880-37-xxxxA-5) and 575 V (ACS880-37-xxxxA-7) respectively.
S_N	Apparent 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 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
<p>Note 1: The ratings apply at an ambient temperature of 40 °C (104 °F).</p> <p>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.</p> <p>The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.</p>	

■ Derating

Ambient temperature derating

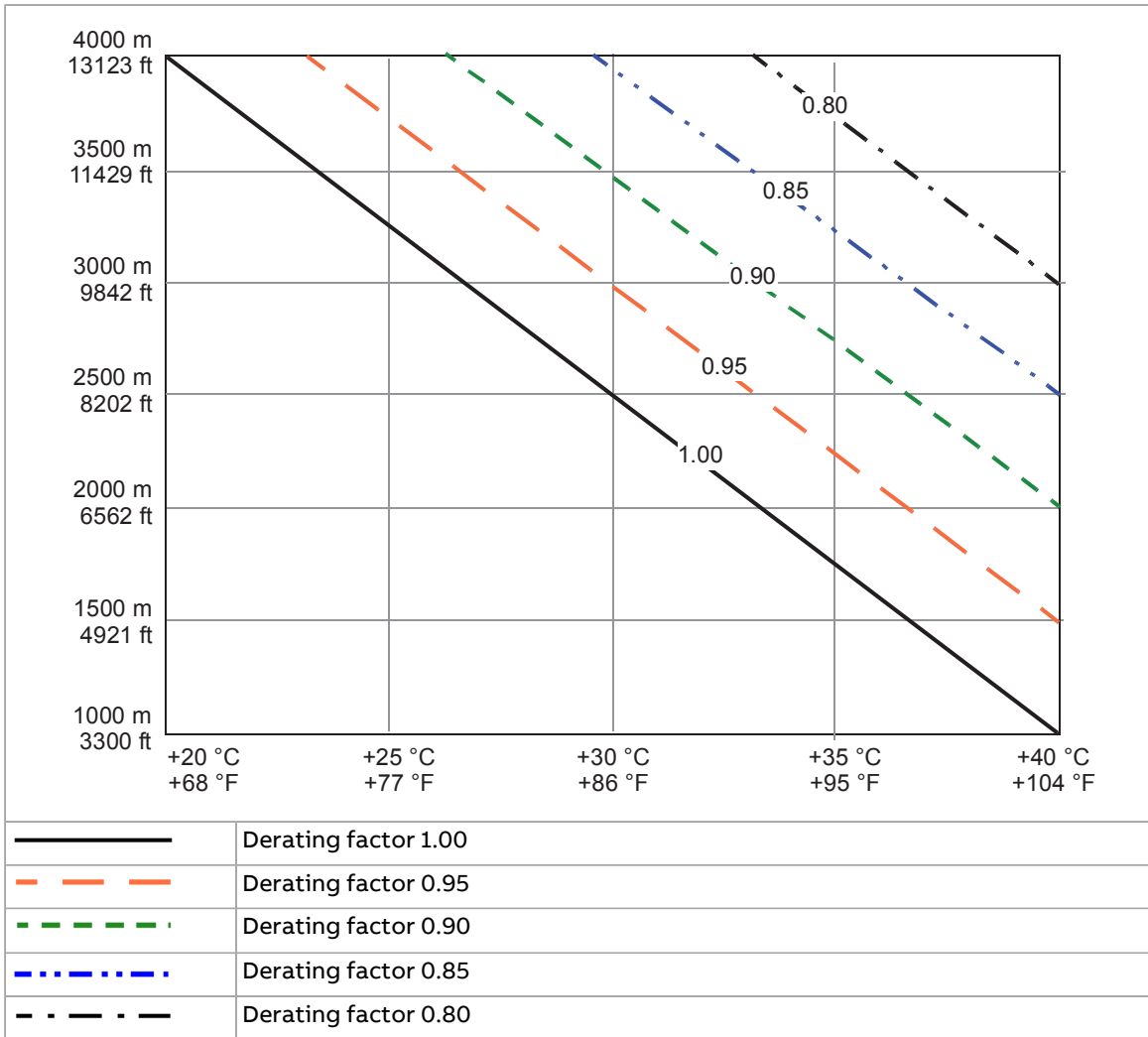
In the temperature range +40...50 °C (+104...122 °F), the rated output current is derated by 1% for every added 1 °C (1.8 °F). The output current can be calculated by multiplying the current given in the rating table by the derating factor (k):



Altitude derating

At altitudes more than 1000 m (3281 ft) above sea level, the output current derating is 1 percentage point for every added 100 m (328 ft). For example, the derating factor for 1500 m (4921 ft) is 0.95. The maximum permitted installation altitude is given in the technical data.

If the surrounding air temperature is less than +40 °C (104 °F), the derating can be reduced by 1.5 percentage points for every 1 °C (1.8 °F) reduction in temperature. A few altitude derating curves are shown below.



For a more accurate derating, use the DriveSize PC tool.

Switching frequency derating

Switching frequencies other than default can require output current derating. Contact ABB for more information.

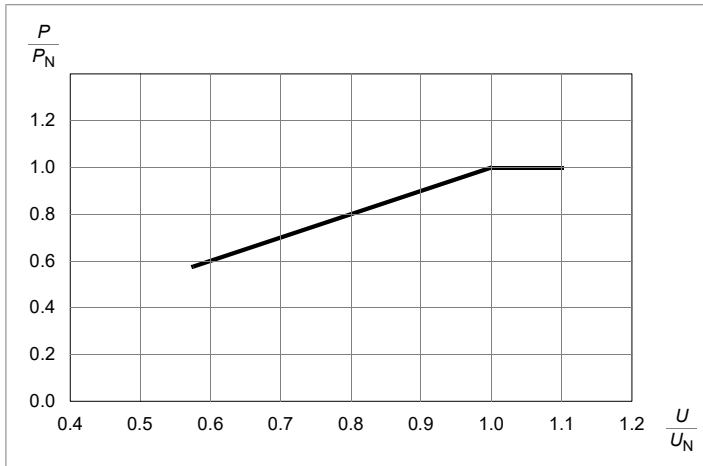
Output frequency derating

Motor operation above 150 Hz can require type-specific output current derating. Contact ABB for more information.

Derating for output voltage boosting

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

This drawing shows the required derating. It is valid for all supply voltage ranges.



Example: P_N for ACS880-37-1010A-5 is 710 kW. The supply voltage (U) is 450 V. $\rightarrow U / U_N = 450 \text{ V} / 500 \text{ V} = 0.9$. $\rightarrow P / P_N = 0.9$ \rightarrow The derated power P equals $0.9 \times 710 \text{ kW} = 639 \text{ kW}$.

To boost the output voltage to correspond to the nominal supply voltage 500 V, increase the DC voltage to $500 \text{ V} \times \sqrt{2} \times 1.03 = 726 \text{ V}$.

Note: The drive voltage rating must always be selected according to the boosted voltage value.

Note: Auxiliary voltage transformer must be set according to supply voltage levels. If drive selection based on boosted voltage level causes an unsuitable tap setting of the auxiliary voltage transformer, consult your local ABB representative.

Frame sizes and power module types

ACS880-37-...	Frame size	Supply module(s) used		LCL filter(s) used		Inverter modules used	
		Qty	Type ACS880-104-...	Qty	Type	Qty	Type ACS880-104-...
$U_N = 400\text{ V}$							
0450A-3	1×R8i+1×R8i	1	0470A-3+E205	1	BLCL-13-5+V991	1	0470A-3+E205
0620A-3	1×R8i+1×R8i	1	0640A-3+E205	1	BLCL-13-5+V991	1	0640A-3+E205
0730A-3	1×R8i+1×R8i	1	0900A-3+E205	1	BLCL-15-5+V991	1	0760A-3+E205
0800A-3	1×R8i+1×R8i	1	0900A-3+E205	1	BLCL-15-5+V991	1	0830A-3+E205
0870A-3	1×R8i+1×R8i	1	0900A-3+E205	1	BLCL-15-5+V991	1	0900A-3+E205
1110A-3	2×R8i+2×R8i	2	0640A-3+E205	1	BLCL-24-5+V991	2	0640A-3+E205
1210A-3	2×R8i+2×R8i	2	0640A-3+E205	1	BLCL-24-5+V991	2	0640A-3+E205
1430A-3	2×R8i+2×R8i	2	0760A-3+E205	1	BLCL-24-5+V991	2	0760A-3+E205
1700A-3	2×R8i+2×R8i	2	0900A-3+E205	1	BLCL-25-5+V991	2	0900A-3+E205
2060A-3	3×R8i+3×R8i	3	0900A-3+E205	2	BLCL-24-5+V991	3	0760A-3+E205
2530A-3	3×R8i+3×R8i	3	0900A-3+E205	2	BLCL-24-5+V991	3	0900A-3+E205
$U_N = 500\text{ V}$							
0420A-5	1×R8i+1×R8i	1	0440A-5+E205	1	BLCL-13-5+V991	1	0440A-5+E205
0570A-5	1×R8i+1×R8i	1	0590A-5+E205	1	BLCL-13-5+V991	1	0590A-5+E205
0640A-5	1×R8i+1×R8i	1	0810A-5+E205	1	BLCL-15-5+V991	1	0670A-5+E205
0710A-5	1×R8i+1×R8i	1	0810A-5+E205	1	BLCL-15-5+V991	1	0740A-5+E205
0780A-5	1×R8i+1×R8i	1	0810A-5+E205	1	BLCL-15-5+V991	1	0810A-5+E205
1010A-5	2×R8i+2×R8i	2	0590A-5+E205	1	BLCL-24-5+V991	2	0590A-5+E205
1110A-5	2×R8i+2×R8i	2	0590A-5+E205	1	BLCL-24-5+V991	2	0590A-5+E205
1530A-5	2×R8i+2×R8i	2	0810A-5+E205	1	BLCL-25-5+V991	2	0810A-5+E205
1980A-5	3×R8i+3×R8i	3	0810A-5+E205	2	BLCL-24-5+V991	3	0740A-5+E205
2270A-5	3×R8i+3×R8i	3	0810A-5+E205	2	BLCL-24-5+V991	3	0810A-5+E205
$U_N = 690\text{ V}$							
0320A-7	1×R8i+1×R8i	1	0340A-7+E205	1	BLCL-13-7+V991	1	0340A-7+E205
0390A-7	1×R8i+1×R8i	1	0410A-7+E205	1	BLCL-13-7+V991	1	0410A-7+E205
0460A-7	1×R8i+1×R8i	1	0600A-7+E205	1	BLCL-15-7+V991	1	0480A-7+E205
0510A-7	1×R8i+1×R8i	1	0600A-7+E205	1	BLCL-15-7+V991	1	0530A-7+E205
0580A-7	1×R8i+1×R8i	1	0600A-7+E205	1	BLCL-15-7+V991	1	0600A-7+E205
0660A-7	2×R8i+2×R8i	2	0410A-7+E205	1	BLCL-24-7+V991	2	0410A-7+E205
0770A-7	2×R8i+2×R8i	2	0410A-7+E205	1	BLCL-24-7+V991	2	0410A-7+E205
0950A-7	2×R8i+2×R8i	2	0600A-7+E205	1	BLCL-25-7+V991	2	0530A-7+E205
1130A-7	2×R8i+2×R8i	2	0600A-7+E205	1	BLCL-25-7+V991	2	0600A-7+E205
1450A-7	3×R8i+3×R8i	3	0600A-7+E205	2	BLCL-24-7+V991	3	0530A-7+E205
1680A-7	3×R8i+3×R8i	3	0600A-7+E205	2	BLCL-24-7+V991	3	0600A-7+E205
1950A-7	4×R8i+4×R8i	4	0600A-7+E205	2	BLCL-25-7+V991	4	0600A-7+E205
2230A-7	4×R8i+4×R8i	4	0600A-7+E205	2	BLCL-25-7+V991	4	0600A-7+E205
2770A-7	6×R8i+5×R8i	6	0600A-7+E205	3	BLCL-25-7+V991	5	0600A-7+E205

ACS880-37-...	Frame size	Supply module(s) used		LCL filter(s) used		Inverter modules used	
		Qty	Type ACS880-104-...	Qty	Type	Qty	Type ACS880-104-...
3310A-7	6×R8i+6×R8i	6	0600A-7+E205	3	BLCL-25-7+V991	6	0600A-7+E205

Fuses

■ AC fuses

Notes:

- Fuses with higher current rating than the recommended ones must not be used.
- 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.

ACS880-37-...	Input current (A)	Ultrarapid (aR) AC fuses							
		Qty	Rated current (A)	Bussmann (IEC/UL)			Mersen/Ferraz Shawmut (IEC only)		
				Type	Rated voltage (V)	Clearing βt at 660 V (A ² s)	Type	Rated voltage (V)	Clearing βt at rated voltage (A ² s)
$U_N = 400 V$									
0450A-3	450	3	700	170M6411	690	300000	SC32AR69V700TF	690	442000
0620A-3	620	3	900	170M6413	690	670000	SC33AR69V900TF	690	805000
0730A-3	730	3	1100	170M6415	690	1300000	SC33AR69V11CTF	690	1570000
0800A-3	800	3	1250	170M6416	690	1950000	SC33AR69V13CTF	690	2210000
0870A-3	870	3	1250	170M6416	690	1950000	SC33AR69V13CTF	690	2210000
1110A-3	1110	3	1600	170M6419	690	3900000	SC33AR60V16CTF	600	3000000
1210A-3	1210	3	2000	170M7062	690	3950000	–	–	–
1430A-3	1430	3	2500	170M7063	690	7800000	–	–	–
1700A-3	1700	3	2500	170M7063	690	7800000	–	–	–
2060A-3	2060	6	2000	170M7062	690	3950000	–	–	–
2530A-3	2530	6	2000	170M7062	690	3950000	–	–	–
$U_N = 500 V$									
0420A-5	420	3	700	170M6411	690	300000	SC32AR69V700TF	690	442000
0570A-5	570	3	900	170M6413	690	670000	SC33AR69V900TF	690	805000
0640A-5	640	3	1000	170M6414	690	945000	SC33AR69V10CTF	690	1070000
0710A-5	710	3	1100	170M6415	690	1300000	SC33AR69V11CTF	690	1570000
0780A-5	780	3	1250	170M6416	690	1950000	SC33AR69V13CTF	690	2210000
1010A-5	1010	3	1600	170M6419	690	3900000	SC33AR60V16CTF	600	3000000
1110A-5	1110	3	1600	170M6419	690	3900000	SC33AR60V16CTF	600	3000000
1530A-5	1530	3	2500	170M7063	690	7800000	–	–	–
1980A-5	1980	6	2000	170M7062	690	3950000	–	–	–
2270A-5	2270	6	2000	170M7062	690	3950000	–	–	–
$U_N = 690 V$									
0320A-7	320	3	500	170M6408	690	95000	SC32AR69V500TF	690	160000
0390A-7	390	3	630	170M6410	690	210000	SC32AR69V630TF	690	315000
0460A-7	460	3	700	170M6411	690	300000	SC32AR69V700TF	690	442000
0510A-7	510	3	800	170M6412	690	465000	SC32AR69V800TF	690	660000
0580A-7	580	3	900	170M6413	690	670000	SC33AR69V900TF	690	805000

ACS880-37-...	Input current (A)	Ultrarapid (aR) AC fuses							
		Qty	Rated current (A)	Bussmann (IEC/UL)			Mersen/Ferraz Shawmut (IEC only)		
				Type	Rated voltage (V)	Clearing βt at 660 V (A ² s)	Type	Rated voltage (V)	Clearing βt at rated voltage (A ² s)
0660A-7	660	3	1000	170M6414	690	945000	SC33AR69V10CTF	690	1070000
0770A-7	770	3	1250	170M6416	690	1950000	SC33AR69V13CTF	690	2210000
0950A-7	950	3	1400	170M6417	690	2450000	SC33AR69V14CTF	690	3030000
1130A-7	1130	3	1600	170M6419	690	3900000	SC33AR60V16CTF	600	3000000
1450A-7	1450	3 ¹⁾	2500	170M7063	690	7800000	-	-	-
		6 ²⁾	1250	170M7059	690	965000	-	-	-
1680A-7	1680	3 ¹⁾	2500	170M7063	690	7800000	-	-	-
		6 ²⁾	1250	170M7059	690	965000	-	-	-
1950A-7	1950	6	2000	170M7062	690	3950000	-	-	-
2230A-7	2230	6	2000	170M7062	690	3950000	-	-	-
2770A-7	2770	9	2000	170M7062	690	3950000	-	-	-
3310A-7	3310	9	2000	170M7062	690	3950000	-	-	-

1) Units with line contactor only.

2) All units.

■ DC fuses

Drives with parallel-connected supply and inverter modules (ie. frames 2×R8i+2×R8i and above) have DC fuses at the output of each supply module and at the input of each inverter module.

Notes:

- Fuses with higher current rating than the recommended ones must not be used.
- 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.

ACS880-37-...	DC fuses				
	Qty	Rated current (A)	Bussmann type	Rated voltage (V)	Clearing βt at 660 V (A ² s)
$U_N = 400 V$					
1110A-3	8	1250	170M6416	690	1950000
1210A-3	8	1250	170M6416	690	1950000
1430A-3	8	1400	170M6417	690	2450000
1700A-3	8	1600	170M6419	690	3900000
2060A-3	6 ¹⁾	1400	170M6417	690	2450000
	6 ²⁾	1600	170M6419	690	3900000
2530A-3	12	1600	170M6419	690	3900000
$U_N = 500 V$					

ACS880-37-...	DC fuses				
	Qty	Rated current (A)	Bussmann type	Rated voltage (V)	Clearing I^2t at 660 V (A ² s)
1010A-5 1110A-5	8	1100	170M6415	690	1300000
1530A-5	8	1400	170M6417	690	2450000
1980A-5 2270A-5	12	1400	170M6417	690	2450000
$U_N = 690$ V					
0660A-7 0770A-7	8	800	170M6546	1250	995000 ³⁾
0950A-7	8	1000	170M6548	1100	2150000 ³⁾
1130A-7	8	1100	170M6549	1000	2800000 ³⁾
1450A-7	12	1000	170M6548	1100	2150000 ³⁾
1680A-7	12	1100	170M6549	1000	2800000 ³⁾
1950A-7 2230A-7	16	1100	170M6549	1000	2800000 ³⁾
2770A-7	22	1100	170M6549	1000	2800000 ³⁾
3310A-7	24	1100	170M6549	1000	2800000 ³⁾

1) At outputs of supply modules.

2) At inputs of inverter modules.

3) Clearing at 1000 V.

■ Brake chopper DC fuses

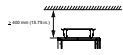
Optional (+D150) brake choppers have two DC fuses each. The fuse type is Bussmann 170M5146 (630 A 1250 V).

Dimensions and weights

See chapter Dimensions (page 243)

Free space requirements

The values are as required by cooling, maintenance and/or operation of the pressure relief (if present). Also obey the general mechanical installation instructions.

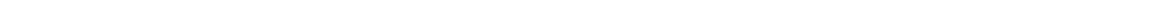
Front		Sides		Above	
mm	in.	mm	in.	mm	in.
1500	59	0	0	400 Measured from the base plate of the cabinet top. 	15.75

Cooling data, noise

ACS880-37-...	Air flow		Heat dissipation	Noise
	m ³ /h	ft ³ /min	kW	dB(A)
U_N = 400 V				
0450A-3	3760	2210	11	75
0620A-3	3760	2210	15	75
0730A-3	3760	2210	18	75
0800A-3	3760	2210	20	75
0870A-3	3760	2210	23	75
1110A-3	7220	4250	27	77
1210A-3	7220	4250	29	77
1430A-3	7220	4250	34	77
1700A-3	7220	4250	45	77
2060A-3	11580	6820	56	78
2530A-3	11580	6820	68	78
U_N = 500 V				
0420A-5	3760	2210	11	75
0570A-5	3760	2210	15	75
0640A-5	3760	2210	15	75
0710A-5	3760	2210	18	75
0780A-5	3760	2210	21	75
1010A-5	7220	4250	27	77
1110A-5	7220	4250	28	77
1530A-5	7220	4250	41	77
1980A-5	11580	6820	51	78
2270A-5	11580	6820	60	78
U_N = 690 V				
0320A-7	3760	2210	13	75
0390A-7	3760	2210	15	75
0460A-7	3760	2210	17	75
0510A-7	3760	2210	19	75
0580A-7	3760	2210	23	75
0660A-7	7220	4250	26	77
0770A-7	7220	4250	29	77
0950A-7	7220	4250	38	77
1130A-7	7220	4250	44	77
1450A-7	11580	6820	54	78
1680A-7	11580	6820	63	78
1950A-7	14440	8500	80	79
2230A-7	14440	8500	87	79
2770A-7	18800	11070	111	79
3310A-7	21660	12750	131	79

224 Technical data

These losses are not calculated according to the ecodesign standard IEC 61800-9-2.



Sine output filter data

Sine output filters are available as option +E206 for the drive types shown in the table below. The table shows the types and technical data of the filters and filter cubicles used. The standard filters listed require no current derating.

For availability of sine output filters for other drive types, contact your local ABB representative.

ACS880-37-...	Sine filter(s) used		Nominal current	Cooling data		Dimensions	
	Qty	Type		Heat dissipation	Air flow	Width	Weight
			A	kW	m ³ /h (ft ³ /min)	mm	kg (lbs)
$U_N = 400 \text{ V}$							
0450A-3	1	NSIN-0485-6	447	2	700 (410)	400	350 (770)
0620A-3	1	NSIN-0900-6	783	5	2000 (1180)	1000	550 (1210)
0730A-3	1	NSIN-0900-6	783	5	2000 (1180)	1000	550 (1210)
0800A-3	1	NSIN-1380-6	1201	7	2000 (1180)	1000	750 (1650)
0870A-3	1	NSIN-1380-6	1201	7	2000 (1180)	1000	750 (1650)
1110A-3	1	NSIN-1380-6	1201	7	2000 (1180)	1000	750 (1650)
1210A-3	1	NSIN-1380-6	1201	7	2000 (1180)	1000	750 (1650)
$U_N = 500 \text{ V}$							
0420A-5	1	NSIN-0485-6	447	2.5	700 (410)	400	350 (770)
0570A-5	1	NSIN-0900-6	783	6	2000 (1180)	1000	550 (1210)
0640A-5	1	NSIN-0900-6	783	6	2000 (1180)	1000	550 (1210)
0710A-5	1	NSIN-0900-6	783	6	2000 (1180)	1000	550 (1210)
0780A-5	1	NSIN-0900-6	783	6	2000 (1180)	1000	550 (1210)
1010A-5	1	NSIN-1380-6	1201	8	2000 (1180)	1000	750 (1650)
1110A-5	1	NSIN-1380-6	1201	8	2000 (1180)	1000	750 (1650)
$U_N = 690 \text{ V}$							
0320A-7	1	NSIN-0485-6	447	3	700 (410)	400	350 (770)
0390A-7	1	NSIN-0485-6	447	3	700 (410)	400	350 (770)
0460A-7	1	NSIN-0900-6	783	6	2000 (1180)	1000	550 (1210)
0510A-7	1	NSIN-0900-6	783	6	2000 (1180)	1000	550 (1210)
0580A-7	1	NSIN-0900-6	783	7	2000 (1180)	1000	550 (1210)
0660A-7	1	NSIN-0900-6	783	7	2000 (1180)	1000	550 (1210)
0770A-7	1	NSIN-0900-6	783	7	2000 (1180)	1000	550 (1210)
0950A-7	1	NSIN-1380-6	1201	9	2000 (1180)	1000	750 (1650)
1130A-7	1	NSIN-1380-6	1201	9	2000 (1180)	1000	750 (1650)

Input cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for nominal current.

ACS880-37-...	IEC ¹⁾		US ²⁾
	Al cable size	Cu cable size	Cu cable size
	mm ²	mm ²	AWG/kcmil
U_N = 400 V			
0450A-3	2 × (3 × 240 + 72 Cu)	2 × (3 × 150 + 70)	2 × (3 × 300 kcmil)
0620A-3	3 × (3 × 185 + 57 Cu)	2 × (3 × 240 + 120)	3 × (3 × 250 kcmil)
0730A-3	4 × (3 × 240 + 72 Cu)	2 × (3 × 240 + 120)	3 × (3 × 500 kcmil)
0800A-3	4 × (3 × 240 + 72 Cu)	2 × (3 × 240 + 120)	3 × (3 × 500 kcmil)
0870A-3	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	3 × (3 × 500 kcmil)
1110A-3	4 × (3 × 300 + 88 Cu)	3 × (3 × 300 + 150)	4 × (3 × 400 kcmil)
1210A-3	5 × (3 × 240 + 72 Cu)	4 × (3 × 240 + 120)	4 × (3 × 500 kcmil)
1430A-3	6 × (3 × 240 + 72 Cu)	4 × (3 × 300 + 150)	5 × (3 × 400 kcmil)
1700A-3	7 × (3 × 240 + 72 Cu)	6 × (3 × 240 + 120)	6 × (3 × 400 kcmil)
2060A-3	9 × (3 × 240 + 72 Cu)	7 × (3 × 240 + 120)	7 × (3 × 500 kcmil)
2530A-3	9 × (3 × 300 + 88 Cu)	8 × (3 × 240 + 120)	8 × (3 × 500 kcmil)
U_N = 500 V			
0420A-5	2 × (3 × 185 + 57 Cu)	2 × (3 × 150 + 70)	2 × (3 × 300 kcmil)
0570A-5	3 × (3 × 185 + 57 Cu)	3 × (3 × 120 + 70)	3 × (3 × 300 kcmil)
0640A-5	4 × (3 × 185 + 57 Cu)	3 × (3 × 185 + 95)	3 × (3 × 350 kcmil)
0710A-5	4 × (3 × 185 + 57 Cu)	3 × (3 × 185 + 95)	3 × (3 × 350 kcmil)
0780A-5	4 × (3 × 185 + 57 Cu)	3 × (3 × 185 + 95)	3 × (3 × 350 kcmil)
1010A-5	5 × (3 × 185 + 57 Cu)	4 × (3 × 185 + 95)	4 × (3 × 400 kcmil)
1110A-5	4 × (3 × 300 + 88 Cu)	3 × (3 × 300 + 150)	4 × (3 × 400 kcmil)
1530A-5	7 × (3 × 240 + 72 Cu)	5 × (3 × 240 + 120)	6 × (3 × 400 kcmil)
1980A-5	8 × (3 × 240 + 72 Cu)	6 × (3 × 300 + 150)	6 × (3 × 500 kcmil)
2270A-5	8 × (3 × 300 + 88 Cu)	7 × (3 × 240 + 120)	7 × (3 × 500 kcmil)
U_N = 690 V			
0320A-7	2 × (3 × 150 + 41 Cu)	2 × (3 × 95 + 50)	2 × (3 × 4/0 AWG)
0390A-7	2 × (3 × 185 + 57 Cu)	2 × (3 × 120 + 70)	2 × (3 × 250 kcmil)
0460A-7	3 × (3 × 185 + 57 Cu)	3 × (3 × 120 + 70)	3 × (3 × 300 kcmil)
0510A-7	3 × (3 × 185 + 57 Cu)	3 × (3 × 120 + 70)	3 × (3 × 300 kcmil)
0580A-7	3 × (3 × 185 + 57 Cu)	3 × (3 × 120 + 70)	3 × (3 × 300 kcmil)
0660A-7	3 × (3 × 240 + 72 Cu)	3 × (3 × 150 + 70)	3 × (3 × 300 kcmil)
0770A-7	4 × (3 × 185 + 57 Cu)	3 × (3 × 185 + 95)	3 × (3 × 350 kcmil)
0950A-7	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	3 × (3 × 500 kcmil)
1130A-7	4 × (3 × 300 + 88 Cu)	5 × (3 × 150 + 70)	4 × (3 × 400 kcmil)
1450A-7	6 × (3 × 240 + 72 Cu)	5 × (3 × 240 + 120)	5 × (3 × 400 kcmil)
1680A-7	7 × (3 × 240 + 72 Cu)	6 × (3 × 240 + 120)	6 × (3 × 500 kcmil)
1950A-7	8 × (3 × 240 + 72 Cu)	8 × (3 × 185 + 95)	6 × (3 × 500 kcmil)

ACS880-37-...	IEC ¹⁾		US ²⁾
	Al cable size	Cu cable size	Cu cable size
	mm ²	mm ²	AWG/kcmil
2230A-7	9 × (3 × 240 + 72 Cu)	7 × (3 × 240 + 120)	7 × (3 × 500 kcmil)
2770A-7	10 × (3 × 300 + 88 Cu)	9 × (3 × 240 + 120)	7 × (3 × 500 kcmil)
3310A-7	12 × (3 × 300 + 88 Cu)	9 × (3 × 300 + 150)	9 × (3 × 500 kcmil)

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 (IEC/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 310-15(B)(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.

Output cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for nominal current.

Note: If the drive is not equipped with a common motor terminal cubicle (option +H359), common output terminals (option +H366) or sine filter (option +E206), each inverter module of the drive is to be individually cabled to the motor.

ACS880-37-...	IEC ¹⁾		US ²⁾
	Al cable size	Cu cable size	Cu cable size
	mm ²	mm ²	AWG/kcmil
U_N = 400 V			
0450A-3	2 × (3 × 240 + 72 Cu)	2 × (3 × 185 + 95)	2 × (3 × 300 kcmil)
0620A-3	4 × (3 × 150 + 41 Cu)	3 × (3 × 150 + 70)	3 × (3 × 300 kcmil)
0730A-3	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	3 × (3 × 500 kcmil)
0800A-3	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	3 × (3 × 500 kcmil)
0870A-3	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	3 × (3 × 500 kcmil)
1110A-3	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 + 120)	4 × (3 × 500 kcmil)
1210A-3	6 × (3 × 240 + 72 Cu)	6 × (3 × 150 + 70)	6 × (3 × 300 kcmil)
1430A-3	8 × (3 × 185 + 57 Cu)	6 × (3 × 185 + 95)	6 × (3 × 350 kcmil)
1700A-3	8 × (3 × 240 + 72 Cu)	6 × (3 × 240 + 120)	6 × (3 × 500 kcmil)
2060A-3	9 × (3 × 240 + 72 Cu)	6 × (3 × 300 + 150)	9 × (3 × 350 kcmil)
2530A-3	12 × (3 × 240 + 72 Cu)	9 × (3 × 240 + 120)	9 × (3 × 500 kcmil)
U_N = 500 V			
0420A-5	2 × (3 × 240 + 72 Cu)	2 × (3 × 150 + 70)	2 × (3 × 300 kcmil)
0570A-5	3 × (3 × 185 + 57 Cu)	2 × (3 × 240 + 120)	2 × (3 × 500 kcmil)
0640A-5	4 × (3 × 185 + 57 Cu)	4 × (3 × 150 + 70)	4 × (3 × 350 kcmil)
0710A-5	4 × (3 × 185 + 57 Cu)	4 × (3 × 150 + 70)	4 × (3 × 350 kcmil)
0780A-5	4 × (3 × 185 + 57 Cu)	4 × (3 × 150 + 70)	4 × (3 × 350 kcmil)
1010A-5	6 × (3 × 150 + 41 Cu)	4 × (3 × 185 + 95)	4 × (3 × 400 kcmil)
1110A-5	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 + 120)	4 × (3 × 500 kcmil)
1530A-5	8 × (3 × 185 + 57 Cu)	6 × (3 × 185 + 95)	6 × (3 × 400 kcmil)
1980A-5	9 × (3 × 240 + 72 Cu)	6 × (3 × 300 + 150)	9 × (3 × 350 kcmil)
2270A-5	12 × (3 × 185 + 57 Cu)	9 × (3 × 185 + 95)	9 × (3 × 400 kcmil)
U_N = 690 V			
0320A-7	2 × (3 × 150 + 41 Cu)	2 × (3 × 95 + 50)	2 × (3 × 4/0 AWG)
0390A-7	2 × (3 × 185 + 57 Cu)	2 × (3 × 150 + 70)	2 × (3 × 250 kcmil)
0460A-7	3 × (3 × 185 + 57 Cu)	2 × (3 × 240 + 120)	2 × (3 × 500 kcmil)
0510A-7	3 × (3 × 185 + 57 Cu)	2 × (3 × 240 + 120)	2 × (3 × 500 kcmil)
0580A-7	3 × (3 × 185 + 57 Cu)	2 × (3 × 240 + 120)	2 × (3 × 500 kcmil)
0660A-7	4 × (3 × 150 + 41 Cu)	4 × (3 × 120 + 70)	3 × (3 × 300 kcmil)
0770A-7	4 × (3 × 185 + 57 Cu)	4 × (3 × 120 + 70)	4 × (3 × 300 kcmil)
0950A-7	6 × (3 × 150 + 41 Cu)	4 × (3 × 185 + 95)	4 × (3 × 350 kcmil)
1130A-7	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 + 120)	4 × (3 × 500 kcmil)

ACS880-37-...	IEC ¹⁾		US ²⁾
	Al cable size	Cu cable size	Cu cable size
	mm ²	mm ²	AWG/kcmil
1450A-7	9 × (3 × 150 + 41 Cu)	6 × (3 × 185 + 95)	6 × (3 × 350 kcmil)
1680A-7	9 × (3 × 185 + 57 Cu)	6 × (3 × 240 + 120)	6 × (3 × 500 kcmil)
1950A-7	9 × (3 × 240 + 72 Cu)	6 × (3 × 300 + 150)	8 × (3 × 350 kcmil)
2230A-7	12 × (3 × 185 + 57 Cu)	9 × (3 × 185 + 95)	8 × (3 × 500 kcmil)
2770A-7	12 × (3 × 240 + 72 Cu)	12 × (3 × 185 + 95)	10 × (3 × 500 kcmil)
3310A-7	12 × (3 × 300 + 88 Cu) XLPE-insulated only	12 × (3 × 240 + 120)	12 × (3 × 500 kcmil)

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 (IEC/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 310-15(B)(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.

Terminal and cable entry data for the power cables

The locations and sizes of the cable entries are shown in the dimension drawings delivered with the drive, and the dimension drawing examples in this manual.

Busbar terminal material: Tin-plated copper.

Terminal data for the supply and inverter control units

See chapter [Control units of the drive \(page 147\)](#).

Terminal data for block X504

Cables accepted by the terminals:

- solid wire 0.08 ... 4 mm² (28...12 AWG)
- stranded wire with ferrule 0.14 ... 2.5 mm² (24...12 AWG)
- stranded wire without ferrule 0.08 ... 2.5 mm² (28...12 AWG).

Stripping length: 10 mm (0.4 in).

Electrical power network specification

Voltage (U_1)	<p>400 V units: 380...415 V AC 3-phase $\pm 10\%$. This is indicated in the type designation label as typical input voltage level (3~ 400 V AC).</p> <p>500 V units: 380...500 V AC 3-phase $\pm 10\%$. This is indicated in the type designation label as typical input voltage levels (3~ 400/480/500 V AC).</p> <p>690 V units: IEC: 525...690 V AC 3-phase $\pm 10\%$ In corner-grounded TN systems: 525...600 V AC UL/CSA: 525...600 V AC This is indicated in the type designation label as typical input voltage levels (3~ 525/600/690 V AC).</p>									
Network type	TN (grounded) and IT (ungrounded) systems									
Frequency	50/60 Hz, variation $\pm 5\%$ of nominal frequency									
Imbalance	Max. $\pm 3\%$ of nominal phase-to-phase input voltage									
Short-circuit withstand strength (IEC/EN 61439-1)	<p>IEC/EN 61439-1:2009</p> <p>Frame 1×R8i + 1×R8i: Maximum allowable prospective short-circuit current (I_{cc}): 65 kA. The input cable must be equipped with fuses as follows: maximum 1250 A gG Maximum allowed operating time is <0.1 s for fuses mentioned above.</p> <p>Frame 2×R8i + 2×R8i and above: Rated peak withstand current (I_{pk}): 105 kA (143 kA for units with air circuit breaker and no grounding/earthing switch) Rated short-time withstand current (I_{cw}): 50 kA/1 s (65 kA/1 s for units with air circuit breaker and no grounding/earthing switch)</p>									
Short-circuit current protection (UL 508A, 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 class T fuses.									
Fundamental power factor ($\cos \phi_1$)	0.99									
Harmonic distortion	<p>Harmonics are below the limits defined in IEEE519.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>R_{sc}</th> <th>THD Voltage [%]</th> <th>THD Current [%]</th> </tr> </thead> <tbody> <tr> <td>20</td> <td>3</td> <td>2.5¹⁾</td> </tr> <tr> <td>100</td> <td>0.8</td> <td>2.5¹⁾</td> </tr> </tbody> </table> $THD = \sqrt{\sum_2^{50} \left(\frac{I_n}{I_N} \right)^2}$ <p>1) Other loads may influence the THD value. 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 = supply unit nominal current I_n = nth harmonic current component</p>	R_{sc}	THD Voltage [%]	THD Current [%]	20	3	2.5 ¹⁾	100	0.8	2.5 ¹⁾
R_{sc}	THD Voltage [%]	THD Current [%]								
20	3	2.5 ¹⁾								
100	0.8	2.5 ¹⁾								

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet synchronous motors and AC induction servomotors, ABB synchronous reluctance (SynRM) motors
Voltage (U_2)	0 ... U_1 , 3-phase symmetrical, U_{\max} at the field weakening point
Frequency (f_2)	0...500 Hz (0...120 Hz with sine output filters (option +E206)) <ul style="list-style-type: none"> • For higher operational output frequencies, please contact your local ABB representative. • Operation above 150 Hz may require type-specific derating. For more information, contact your local ABB representative.
Current	See the rating tables.
Switching frequency	3 kHz (typical). The switching frequency can vary per frame and voltage. For exact values, contact your local ABB representative.
Maximum recommended motor cable length	500 m (1640 ft). <p>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. Also note that a sine filter (optional) at the drive output also causes a voltage decrease.</p> <p>Note: With motor cables longer than 150 m (492 ft) the EMC Directive requirements may not be fulfilled.</p>

Efficiency

Approximately 97% at nominal power level

The efficiency is not calculated according to the ecodesign standard IEC 61800-9-2.

Energy efficiency data (ecodesign)

Energy efficiency data is not provided for the drive. The low-harmonic drives are exempt from the EU ecodesign requirements (Regulation EU/2019/1781, §2.3.d) and the UK ecodesign requirements (Regulation SI 2021 No. 745).

Optical components

The specifications of the optic cable are as follows:

- Storage temperature: -55 ... +85 °C (-67 ... +185 °F)
- Installation temperature: -20 ... +70 °C (-4 ... +158 °F)
- Maximum short-term tensile force: 50 N (11.2 lbf)
- Minimum short-term bend radius: 25 mm (1.0 in)
- Minimum long-term bend radius: 35 mm (1.4 in)
- Maximum long-term tensile load: 1 N (3.6 ozf)
- Flexing: Max. 1000 cycles

ABB drive products in general utilize 5 and 10 MBd (megabaud) optical components from Avago Technologies' Versatile Link range. Note that the optical component type is not directly related to the actual communication speed.

Note: The optical components (transmitter and receiver) on a fiber optic link must be of the same type.

Plastic optical fiber (POF) cables can be used with both 5 MBd and 10 MBd optical components. 10 MBd components also enable the use of Hard Clad Silica (HCS®) cables, which allow longer connection distances thanks to their lower attenuation. HCS® cables cannot be used with 5 MBd optical components.

The maximum lengths of fiber optic links for POF and HCS® cables are 20 and 200 meters (65.6 ft and 656 ft) respectively.

Protection classes

Degrees of protection (IEC/EN 60529)	IP22 (standard), IP42 (option +B054), IP54 (option +B055)
Enclosure types (UL50)	UL Type 1 (standard), UL Type 1 (option +B054), UL Type 12 (option +B055). For indoor use only.
Arcing class (IEC TR 61641)	B – ASSEMBLY providing personnel and ASSEMBLY protection under arcing conditions. Tested at the following voltage with an arcing current of 65 kA for 300 milliseconds: <ul style="list-style-type: none"> • 400 V units (indicated by "-3" in drive type): 420 V • 500 V units (indicated by "-5" in drive type): 550 V • 690 V units (indicated by "-7" in drive type): 760 V
Overvoltage category (IEC/EN 60664-1)	III, except for auxiliary power connections (fan, control, heating, lighting etc) which are category II.
Protective class (IEC/EN 61800-5-1)	I

Ambient conditions

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

	Operation installed for stationary use	Storage in the protective pack- age	Transportation in the protective pack- age
Installation site altitude	0...2000 m (0...6562 ft) above sea level. For altitudes over 2000 m, contact ABB. Output derated above 1000 m (3281 ft).	-	-
Air temperature	0 ... +40 °C (+32 ... +104 °F). No condensation allowed. Output derated in the range +40 ... +50 °C (+104 ... +122 °F). For UL and CSA compliant installations, the maximum surrounding air temperature is 40 °C (104 °F).	-40 ... +70 °C (-40 ... +158 °F)	-40 ... +70 °C (-40 ... +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 Chemical gases: Class 3C2 Solid particles: Class 3S2 (3S1 with IP20). No conductive dust allowed.	IEC 60721-3-1:1997 Chemical gases: Class 1C2 Solid particles: Class 1S3 (packing must support this, otherwise 1S2)	IEC 60721-3-2:1997 Chemical gases: Class 2C2 Solid particles: Class 2S2
Pollution degree IEC/EN 60664-1	2		
Vibration IEC/EN 61800-5-1 IEC 60068-2-6:2007, EN 60068-2-6:2008	IEC/EN 60721-3-3:2002 10...57 Hz: max. 0.075 mm amplitude 57...150 Hz: 1 g Units with marine construction (option +C121): Max. 1 mm (0.04 in) (5 ... 13.2 Hz), max. 0.7 g (13.2 ... 100 Hz) sinusoidal	IEC/EN 60721-3-1:1997 10...57 Hz: max. 0.075 mm amplitude 57...150 Hz: 1 g	IEC/EN 60721-3-2:1997 2...9 Hz: max. 3.5 mm amplitude 9...200 Hz: 10 m/s ² (32.8 ft/s ²)
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009	Not allowed	With packing max. 100 m/s ² (328 ft/s ²) 11 ms	With packing max. 100 m/s ² (328 ft/s ²) 11 ms

Transportation

The table below specifies the transportation methods and conditions for the drive. The transportation conditions must also comply with the environmental limits specified

in Ambient conditions (page 233). Seaworthy package (option +P912) is required for non-weather protected transportation conditions.

Package type	Method	Weather-protected conditions (IEC 60721-3-2)	Non-weather protected conditions (IEC 60721-3-2)
Standard package Wooden crate Vertical	Road, air, sea (in container). Special vehicle requirements: High-cube container. ABB recommends the use of container desiccant bags in sea transportation.	2K12: Transportation without temperature and humidity control allowed.	Not allowed.
Seaworthy package (option +P912) Wooden crate covered with plywood sheets Vertical	Road, air, sea (in container). Special vehicle requirements: High-cube container. ABB recommends the use of container desiccant bags in sea transportation.	2K12: Transportation without temperature and humidity control allowed.	2K14: Non-weather-protected transportation worldwide.

Storage conditions

The table below specifies the storage conditions for the drive. Store the drive in its package. ABB recommends seaworthy package (option +P912) if the drive is in long-term storage. The storage conditions must also comply with the environmental limits specified in Ambient conditions (page 233).

Package type	Storage conditions (IEC 60721-3-1)
Standard package Wooden crate Vertical	1K20: Up to 24 months in enclosed conditions (full temperature and humidity control). 1K22: Up to 6 months in enclosed conditions (no temperature or humidity control). 1K23, 1K24: Up to 3 months in sheltered conditions (roof providing protection from direct rain and sun). 1K25...1K27: Up to 48 hours between loading operations in open-air conditions (no protection).
Seaworthy package (option +P912) Wooden crate covered with plywood sheets Vertical	1K20: Up to 24 months in enclosed conditions (full temperature and humidity control). 1K22: Up to 12 months in enclosed conditions (no temperature or humidity control). 1K23, 1K24: Up to 12 months in sheltered conditions (roof providing protection from direct rain and sun). 1K25...1K27: Up to 1 month in open-air conditions (no protection). Not recommended, but can be temporarily allowed.

Colors

RAL Classic 7035, RAL Classic 9017.

Materials

■ Drive

Refer to [Recycling instructions and environmental information for ACS880 cabinet-installed drives and multidrive modules \(3AXD50000153909 \[English\]\)](#).

■ Packaging of drive

- Plywood¹⁾
- Wood
- PET (strapping)
- PE (VCI film)
- Metal (fixing clamps, screws)
- VCI emitter capsules
- Clay desiccant.

¹⁾ Seaworthy package only

■ Packaging of options

- Cardboard
- Kraft paper
- PP (straps)
- PE (film, bubble wrap)
- Plywood, wood (only for heavy components).

Materials vary according to the item type, size and shape. Typical package consists of a cardboard box with paper filling or bubble wrap. ESD-safe packing materials are used for printed circuit boards and similar items.

■ Manuals

Printed product manuals are made of recyclable paper. Product manuals are available on the Internet.

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. See [ACS880 cabinet-installed drives and multidrive modules recycling instructions and environmental information \(3AXD50000153909 \[English\]\)](#).

Applicable standards




Standard	Information
European electrical safety	
EN 61800-5-1:2007 + A1:2017 + A11:2021 IEC 61800-5-1:2007 + Amd1:2016	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements – Electrical, thermal and energy
EMC performance	
EN 61800-3:2004 + A1:2012 *IEC 61800-3 ed. 2.1 (2007 + Amd1:2011)	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods *For compliance with IEC 61800-3 ed. 3.0 (2017), please contact ABB.
IEC 60533:2015	Electrical and electronic installations in ships - Electromagnetic compatibility (EMC) - Ships with a metallic hull
IEC 62742:2021	Electrical and electronic installations in ships - Electromagnetic compatibility (EMC) - Ships with a non-metallic hull ¹⁾
Product requirements in North America	
UL 508A: 2nd edition	Industrial Control Panels ²⁾
CSA C22.2 No. 14-18, 13th edition	Industrial Control Equipment ²⁾
Enclosure and environmental protection	
EN 60529:1991 + A2:2013 + AC:2019 IEC 60529:1989 + Amd1:1999 + Amd2:2013 + Cor1:2019	Degrees of protection provided by enclosures (IP code)
UL 50: 12th edition	Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 50E: 1st edition	Enclosures for Electrical Equipment, Environmental Considerations
CSA C22.2 No. 94.1-15	Enclosures for Electrical Equipment, Non-Environmental Considerations
CSA C22.2 No. 94.2-15	Enclosures for Electrical Equipment, Environmental Considerations








¹⁾ Compliance requires special arrangements for filtering, damping, and compartmentalization.

²⁾ Applicable to drives with option +C129 or +C134.

Markings

These markings are attached to the drive:

	CE mark Product complies with the applicable European Union legislation. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).
	UKCA (UK Conformity Assessed) mark Product complies with the applicable United Kingdom's legislation (Statutory Instruments). Marking is required for products being placed on the market in Great Britain (England, Wales and Scotland).
	UL Listed mark for USA and Canada Product has been tested and evaluated against the relevant North American standards by the Underwriters Laboratories. Valid with rated voltages up to 600 V.

	<p>TÜV Safety Approved mark (functional safety) Product contains Safe torque off and possibly other (optional) safety functions which are certified by TÜV according to the relevant functional safety standards. Applicable to drives and inverters; not applicable to supply, brake or DC/DC converter units or modules.</p>
	<p>CSA certification mark for USA and Canada Product has been tested and evaluated against the relevant North American standards by the CSA Group. Valid with rated voltages up to 600 V.</p>
	<p>EAC (Eurasian Conformity) mark Product complies with the technical regulations of the Eurasian Customs Union. EAC mark is required in Russia, Belarus and Kazakhstan.</p>
	<p>Electronic Information Products (EIP) symbol including an Environment Friendly Use Period (EFUP). Product is compliant with the People's Republic of China Electronic Industry Standard (SJ/T 11364-2014) about hazardous substances. The EFUP is 20 years. China RoHS II Declaration of Conformity is available from https://library.abb.com.</p>
	<p>RCM mark Product complies with Australian and New Zealand requirements specific to EMC, telecommunications and electrical safety. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).</p>
	<p>KC mark Product complies with Korean Registration of Broadcasting and Communications Equipment Clause 3, Article 58-2 of Radio Waves Act.</p>
	<p>WEEE mark At the end of life the product should enter the recycling system at an appropriate collection point and not placed in the normal waste stream.</p>

EMC compliance (IEC/EN 61800-3)

■ Definitions

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

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

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

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

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and started up only by a professional when used in the first environment.

Note: A professional is a person or organization having necessary skills in installing and/or starting up power drive systems, including their EMC aspects.

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

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

■ **Category C2**

The drive complies with the standard with the following provisions:

1. The drive is equipped with a diode supply unit or an IGBT supply unit.
2. The drive is equipped with the the EMC filter for category C2 (option +E202).
3. The input power, motor cables, and control cables are selected as specified in the drive hardware manual.
4. The drive is installed according to the instructions given in the hardware manual.
5. 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 installer is required to take measures to prevent interference, in addition to the requirements for CE compliance listed above, if necessary.



WARNING!

Do not install a drive equipped with the C2 EMC filter 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. The drive is installed according to the instructions given in the appropriate drive hardware manual.
2. Maximum motor cable length is 100 meters (328 ft).



WARNING!

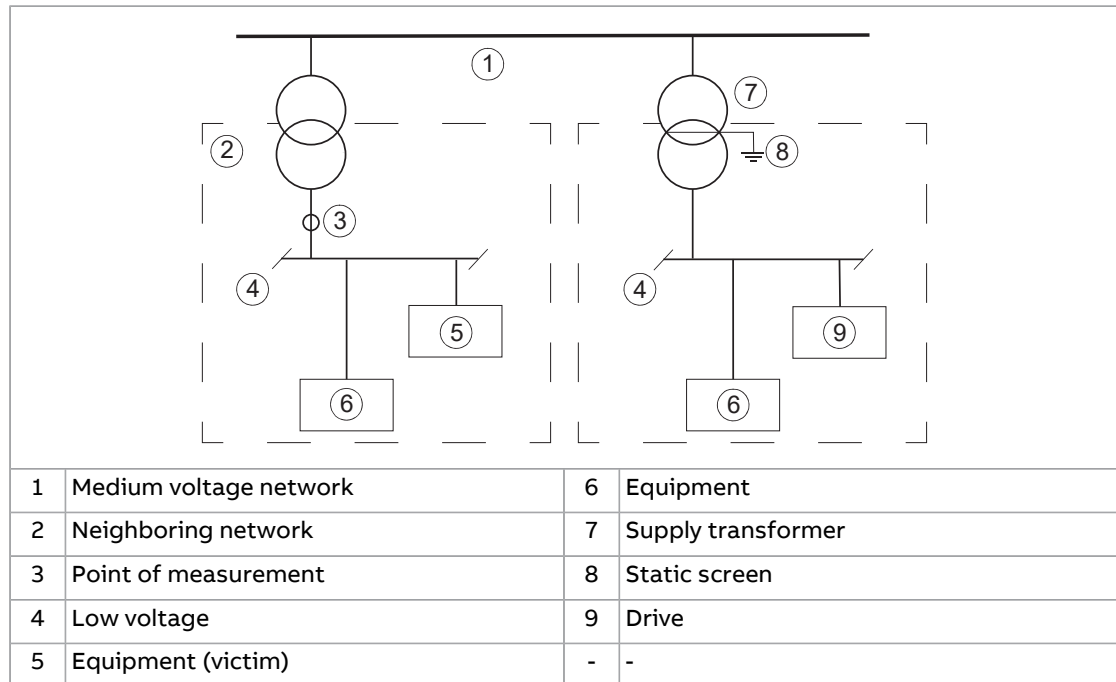
A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

■ **Category C4**

The drive complies with the C4 category with these provisions:

1. It is made sure 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, a supply transformer with static screening between the primary and secondary windings can be used.



2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available in [Technical guide No. 3 EMC compliant installation and configuration for a power drive system \(3AFE61348280 \[English\]\)](#).
3. The motor and control cables are selected, and routed according to the electrical planning guidelines of the drive. The EMC recommendations are obeyed.
4. The drive is installed according to its installation instructions. The EMC recommendations are obeyed.



WARNING!

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

UL and CSA checklist



WARNING!

Operation of this drive requires detailed installation and operation instructions provided in the hardware and software manuals. The manuals are provided in electronic format in the drive package or on the Internet. Keep 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 applicable marking.
- **DANGER - Risk of electric shock.** After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.

- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to the enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.
- The maximum surrounding air temperature is 40 °C at rated output current. The output current is derated for 40...50 °C.

Note: For cabinet-built drives, the maximum surrounding air temperature is 40 °C (104 °F).

- The drive is suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 600 V maximum when protected by the UL fuses given elsewhere in this chapter.
- The cables located within the motor circuit must be rated for at least 75 °C in UL-compliant installations.
- The input cable must be protected with fuses or circuit breakers. These protective devices provide branch circuit protection in accordance with the national regulations (National Electrical Code (NEC) or Canadian Electrical Code). Obey also any other applicable local or provincial codes.



WARNING!

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

-
- The drive is equipped with UL listed fuses which provide branch circuit protection in accordance with the National Electrical Code (NEC) and Canadian Electrical Code.
The fuses are listed elsewhere in this chapter.
 - The drive provides motor overload protection. The protection is not enabled when the drive leaves the ABB factory. For enabling the protection, see the firmware manual.
 - The drive overvoltage category according to IEC 60664-1 is III, except for auxiliary power connections (fan, control, heating, lighting, cooling unit pump etc) which are of category II.
-

Tightening torques

Unless a tightening torque is specified in the text, the following torques can be used.

■ Electrical connections

Size	Torque	Strength class
M3	0.5 N·m (4.4 lbf·in)	4.6...8.8
M4	1 N·m (9 lbf·in)	4.6...8.8
M5	4 N·m (35 lbf·in)	8.8
M6	9 N·m (6.6 lbf·ft)	8.8
M8	22 N·m (16 lbf·ft)	8.8
M10	42 N·m (31 lbf·ft)	8.8
M12	70 N·m (52 lbf·ft)	8.8
M16	120 N·m (90 lbf·ft)	8.8

■ Mechanical connections

Size	Max. torque	Strength class
M5	6 N·m (53 lbf·in)	8.8
M6	10 N·m (7.4 lbf·ft)	8.8
M8	24 N·m (17.7 lbf·ft)	8.8

■ Insulation supports

Size	Max. torque	Strength class
M6	5 N·m (44 lbf·in)	8.8
M8	9 N·m (6.6 lbf·ft)	8.8
M10	18 N·m (13.3 lbf·ft)	8.8
M12	31 N·m (23 lbf·ft)	8.8

■ Cable lugs

Size	Max. torque	Strength class
M8	15 N·m (11 lbf·ft)	8.8 (A2-70 or A4-70)
M10	32 N·m (23.5 lbf·ft)	8.8
M12	50 N·m (37 lbf·ft)	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 can be connected to and communicate information and data via a network interface. The HTTP protocol, which is used between the commissioning tool (Drive Composer) and the product, is an unsecured protocol. For independent and continuous operation of product such connection via network to commissioning tool is not necessary. However 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, prevention of physical access, 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.

Notwithstanding any other provision to the contrary and regardless of whether the contract is terminated or not, ABB and its affiliates are under no circumstances liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

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Dimensions

Cabinet line-up dimensions

The drive consists of cubicles built into a cabinet line-up. The tables below show the composition of cabinet line-ups for each frame size and the standard combinations of options. The dimensions are in millimeters.

Notes:

- The side panels at the left and right ends of the line-up increase the total line-up width by 30 millimeters (1.2”).
- The standard depth of the cabinet line-up is 644 mm (25.35”) excluding equipment such as handles and air inlet gratings. This is increased by 200 mm (7.87”) with top cable exit units, or by 130 mm with option +C128 (cooling air intake through bottom of cabinet).
- UL Listed (+C129) units are top cable entry/exit by default.
- Not all possible configurations are presented. For information on unlisted configurations, contact ABB.
- The data given is preliminary. ABB reserves the right to modify the design at any time without notice. Consult ABB for up-to-date, drive-specific information.

The tables are followed by selected dimension drawing examples.

■ Dimension tables

1×R8i+1×R8i										
Auxiliary control cubicle (ACU)	Supply and inverter module cubicle	Common motor terminal cubicle	Sine filter cubicle ¹⁾	Joining cubicle	Brake chopper 1 ²⁾	Brake resistor 1 ²⁾	Brake chopper 2 ²⁾	Brake resistor 2 ²⁾	Section widths	Line-up width
400	800								1200	1200
400	800	300							1500	1500
400	800		400						1600	1600
400	800		1000						2200	2200
400	800				400				1600	1600
400	800	300			400				1900	1900
400	800		400		400				2000	2000
400	800		1000		400				2600	2600
400	800				400	800			2400	2400
400	800	300			400	800			2700	2700
400	800		400		400	800			2800	2800
400	800		1000		400	800			3400	3400
400	800				400		400		2000	2000
400	800	300			400		400		2300	2300
400	800		1000		400		400		3000	3000
400	800				400	800	400	800	3600	3600
400	800	300			400	800	400	800	3900	3900
400	800		1000	200	400	800	400	800	2400 + 2400	4800

¹⁾ 400 mm with ACS880-37-0450A-3, -0420-5, -0320A-7 and -0390A-7, 1000 mm with other types.

²⁾ The number of brake choppers depends on required braking power. See chapter Resistor braking.

ACS880-37-1110A-3, -1010A-5, -1110A-5, -0660A-7, -0770A-7, -0950A-7, -1130A-7															
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Supply module cubicle	Inverter module cubicle	Joining cubicle	Common motor terminal cubicle	Sine filter cubicle	Joining cubicle	Brake chopper 1 ¹⁾	Brake resistor 1 ¹⁾	Brake chopper 2 ¹⁾	Brake resistor 2 ¹⁾	Brake chopper 3 ¹⁾	Brake resistor 3 ¹⁾	Section widths	Line-up width
400	400	800	600											2200	2200
400	400	800	600		300									2500	2500
400	400	800	600			1000								3200	3200
400	400	800	600					400		400				3000	3000
400	400	800	600		300			400		400				3300	3300
400	400	800	600			1000		400		400				4000	4000
400	400	800	600	200				400	800	400	800			2400 + 2400	4800

ACS880-37-1110A-3, -1010A-5, -1110A-5, -0660A-7, -0770A-7, -0950A-7, -1130A-7															
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Supply module cubicle	Inverter module cubicle	Joining cubicle	Common motor terminal cubicle	Sine filter cubicle	Joining cubicle	Brake chopper 1 ¹⁾	Brake resistor 1 ¹⁾	Brake chopper 2 ¹⁾	Brake resistor 2 ¹⁾	Brake chopper 3 ¹⁾	Brake resistor 3 ¹⁾	Section widths	Line-up width
400	400	800	600		300			400	800	400	800			2500 + 2400	4900
400	400	800	600			1000	200	400	800	400	800			3400 + 2400	5800
400	400	800	600					400		400		400		3400	3400
400	400	800	600		300			400		400		400		3700	3700
400	400	800	600			1000	200	400		400		400		3400 + 1200	4600
400	400	800	600	200				400	800	400	800	400	800	2400 + 3600	6000
400	400	800	600		300			400	800	400	800	400	800	2500 + 3600	6100
400	400	800	600			1000	200	400	800	400	800	400	800	3400 + 3600	7000

1) The number of brake choppers depends on required braking power. See chapter Resistor braking.

ACS880-37-1210A-3, -1430A-3, -1700A-3, -1530A-5																
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top entry	Supply module cubicle	Inverter module cubicle	Joining cubicle	Common motor terminal cubicle ¹⁾	Sine filter cubicle ²⁾	Joining cubicle	Brake chopper 1 ³⁾	Brake resistor 1 ³⁾	Brake chopper 2 ³⁾	Brake resistor 2 ³⁾	Brake chopper 3 ³⁾	Brake resistor 3 ³⁾	Section widths	Line-up width
400	600		800	600											2400	2400
400	600	200	800	600											2600	2600
400	600		800	600		300									2700	2700
400	600	200	800	600		300									2900	2900
400	600		800	600			1000								3400	3400
400	600	200	800	600			1000								3600	3600
400	600		800	600					400		400				3200	3200
400	600	200	800	600					400		400				3400	3400
400	600		800	600		300			400		400				3500	3500
400	600	200	800	600		300			400		400				3700	3700
400	600		800	600			1000		400		400				4200	4200
400	600	200	800	600			1000	200	400		400				3800 + 800	4600

ACS880-37-1210A-3, -1430A-3, -1700A-3, -1530A-5																
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top entry	Supply module cubicle	Inverter module cubicle	Joining cubicle	Common motor terminal cubicle ¹⁾	Sine filter cubicle ²⁾	Joining cubicle	Brake chopper 1 ³⁾	Brake resistor 1 ³⁾	Brake chopper 2 ³⁾	Brake resistor 2 ³⁾	Brake chopper 3 ³⁾	Brake resistor 3 ³⁾	Section widths	Line-up width
400	600		800	600	200				400	800	400	800			2600 + 2400	5000
400	600	200	800	600	200				400	800	400	800			2800 + 2400	5200
400	600		800	600		300			400	800	400	800			2700 + 2400	5100
400	600	200	800	600		300			400	800	400	800			2900 + 2400	5300
400	600		800	600			1000	200	400	800	400	800			3600 + 2400	6000
400	600	200	800	600			1000	200	400	800	400	800			3800 + 2400	6200
400	600		800	600					400		400		400		3600	3600
400	600	200	800	600					400		400		400		3800	3800
400	600		800	600		300			400		400		400		3900	3900
400	600	200	800	600		300			400		400		400		4100	4100
400	600		800	600	200				400	800	400	800	400	800	2600 + 3600	6200
400	600	200	800	600	200				400	800	400	800	400	800	2800 + 3600	6400
400	600		800	600		300			400	800	400	800	400	800	2700 + 3600	6300
400	600	200	800	600		300			400	800	400	800	400	800	2900 + 3600	6500

¹⁾ Double-busbar version with ACS880-37-1430A-3, -1700A-3, -1530A-5

²⁾ ACS880-37-1210A-3 only

³⁾ The number of brake choppers depends on required braking power. See chapter [Resistor braking](#).

3×R8i+3×R8i								
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top entry	Supply (LCL filter) cubicle	Supply module cubicle	Inverter module cubicle	Common motor terminal cubicle ¹⁾	Section widths	Line-up width
400	600		600	800	800		3200	3200
400	600		600	800	800	300	3500	3500

3×R8i+3×R8i								
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top entry	Supply (LCL filter) cubicle	Supply module cubicle	Inverter module cubicle	Common motor terminal cubicle 1)	Section widths	Line-up width
400	600		600	800	800	400	3600	3600
400	600		600	800	800	600	3800	3800
400	600	200	600	800	800		3400	3400
400	600	200	600	800	800	300	3700	3700
400	600	200	600	800	800	400	3800	3800
400	600	200	600	800	800	600	4000	4000

1) 300 mm double-busbar version with ACS880-37-1450A-7 and -1680A-7. 600 mm with ACS880-37-2530A-3+H353 (top exit). 400 mm with other types.

4×R8i+4×R8i									
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top entry	Supply module cubicle 1	Supply module cubicle 2	Inverter module cubicle 1	Common motor terminal cubicle	Inverter module cubicle 2	Section widths	Line-up width
400	600		800	800	600		600	3800	3800
400	600		800	800	600	400	600	4200	4200
400	600	200	800	800	600		600	4000	4000
400	600	200	800	800	600	400	600	3800 + 600	4400

6×R8i+5×R8i											
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU) 1)	Adapter for top entry	Supply module cubicle 1	Supply module cubicle 2	Supply module cubicle 3	Joining cubicle	Inverter module cubicle 1	Common motor terminal cubicle 2)	Inverter module cubicle 2	Section widths	Line-up width
400	600		800	800	800	200	800		600	3600 + 1400	5000
400	600		800	800	800	200	800	400	600	3600 + 1800	5400
400	600	200	800	800	800	200	800		600	3800 + 1400	5200
400	600	200	800	800	800	200	800	600	600	3800 + 2000	5800
400	1000		800	800	800	200	800		600	4000 + 1400	5400
400	1000		800	800	800	200	800	400	600	4000 + 1800	5800
400	1000	200	800	800	800	200	800		600	4200 + 1400	5600
400	1000	200	800	800	800	200	800	600	600	4200 + 2000	6200

1) 1000 mm with UL Listed (+C129) and CSA Approved (+C134) units, otherwise 600 mm.

2) 400 mm with bottom exit, 600 mm with top exit.

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6×R8i+6×R8i											
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU) 1)	Adapter for top entry	Supply module cubicle 1	Supply module cubicle 2	Supply module cubicle 3	Joining cubicle	Inverter module cubicle 1	Common motor terminal cubicle	Inverter module cubicle 2	Section widths	Line-up width
400	600		800	800	800	200	800		800	3600 + 1600	5200
400	600		800	800	800	200	800	600	800	3600 + 2200	5800
400	600	200	800	800	800	200	800		800	3800 + 1600	5400
400	600	200	800	800	800	200	800	600	800	3800 + 2200	6000
400	1000		800	800	800	200	800		800	4000 + 1600	5600
400	1000		800	800	800	200	800	600	800	4000 + 2200	6200
400	1000	200	800	800	800	200	800		800	4200 + 1600	5800
400	1000	200	800	800	800	200	800	600	800	4200 + 2200	6400

1) 1000 mm with UL Listed (+C129) and CSA Approved (+C134) units, otherwise 600 mm.

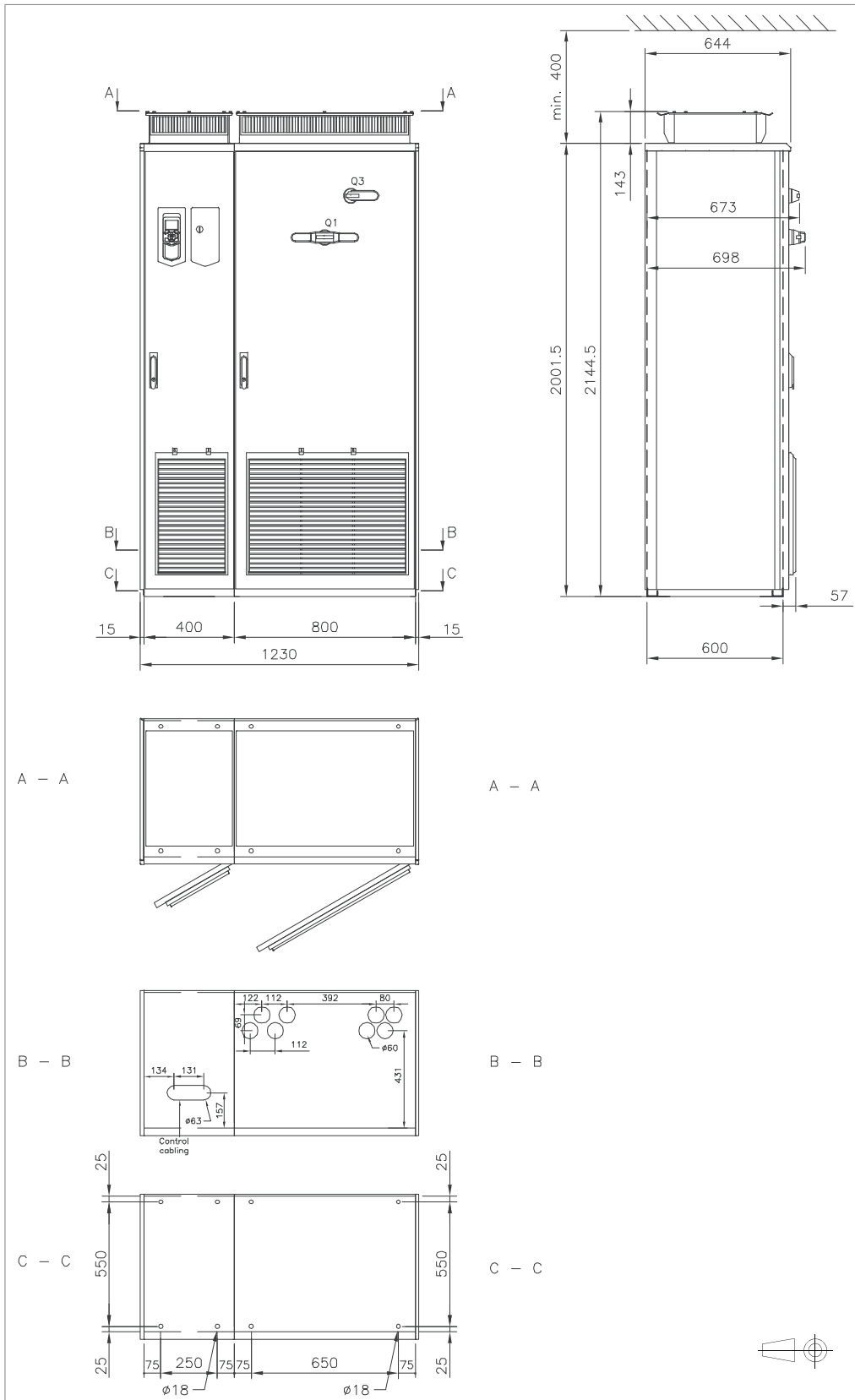
■ **Weights**

The table below lists the approximate basic weights.

ACS880-37...			Weight	
			kg	lbs
0450A-3 0620A-3 0730A-3 0800A-3 0870A-3	0420A-5 0570A-5 0640A-5 0710A-5 0780A-5	0320A-7 0390A-7 0460A-7 0510A-7 0580A-7	1180	2600
1110A-3	1010A-5 1110A-5	0660A-7 0770A-7 0950A-7 1130A-7	1970	4340
1210A-3 1430A-3 1700A-3	1530A-5		2090	4610
2060A-3 2530A-3			2290	5050
		1450A-7 2230A-7	2730	6020
	1980A-5 2270A-5		2930	6460
		1950A-7 2230A-7	3700	8160
		2770A-7	4830	10650
		3310A-7	4980	10980

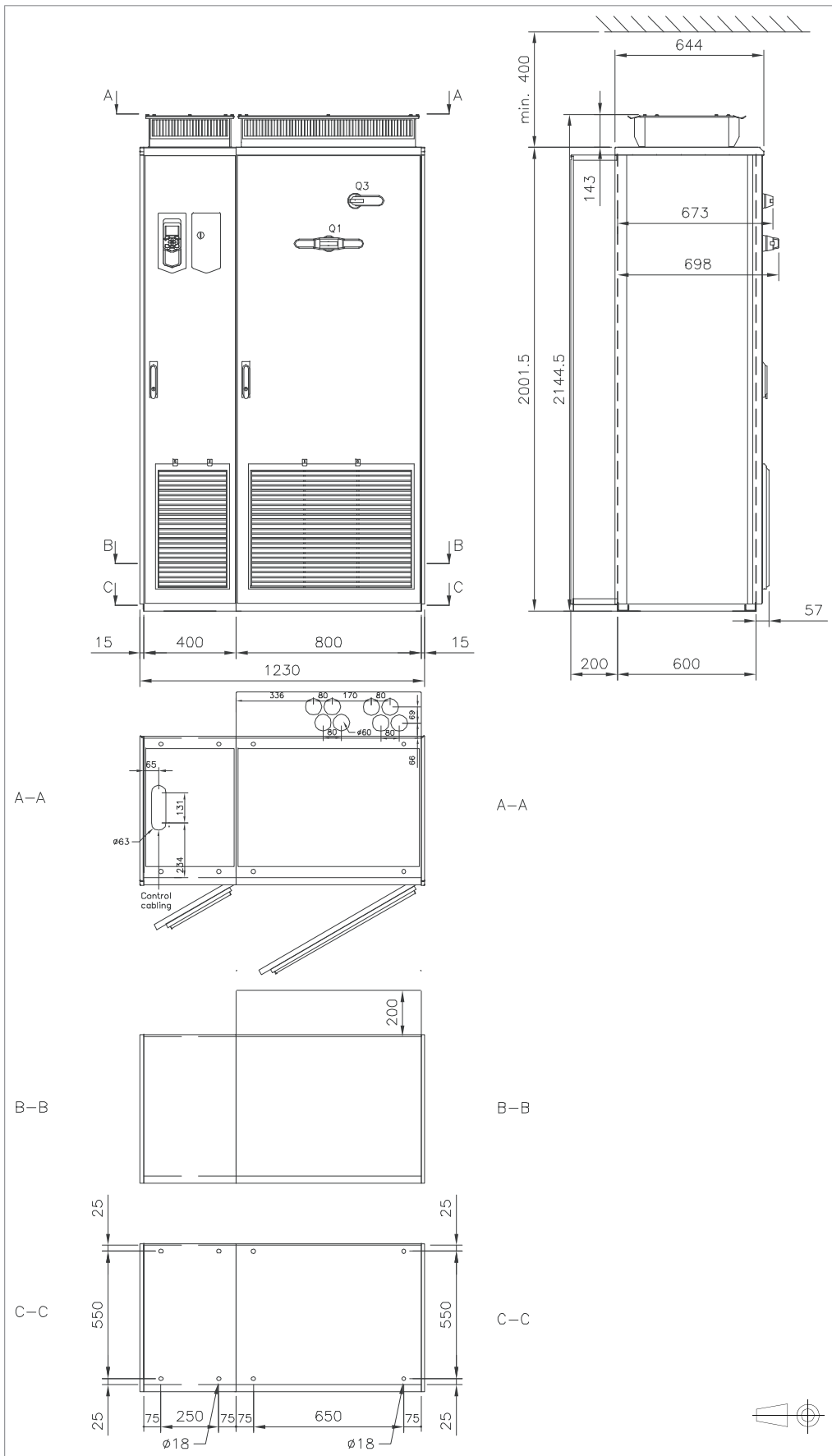
■ Dimension drawing examples

Frame 1×R8i+1×R8i

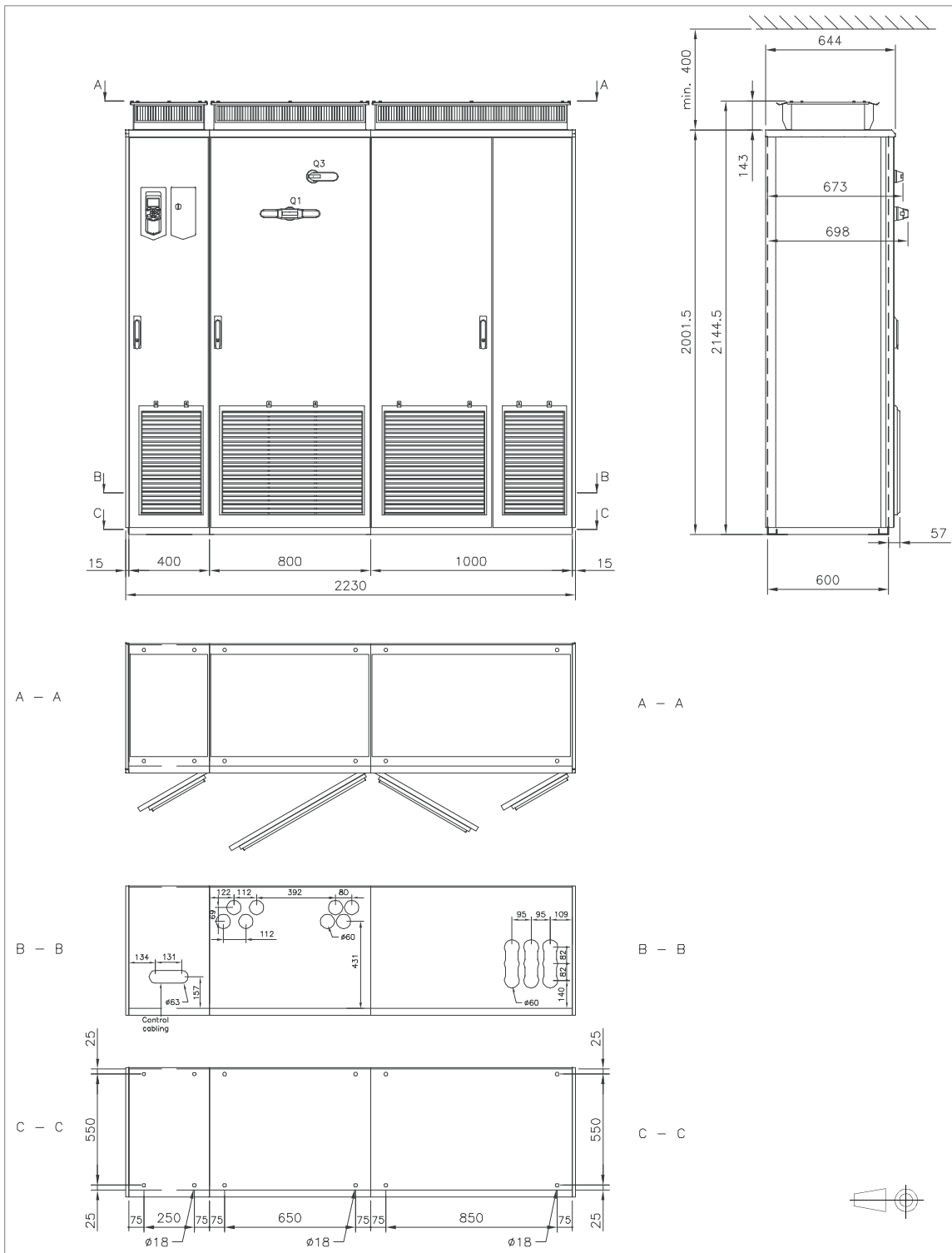


250 Dimensions

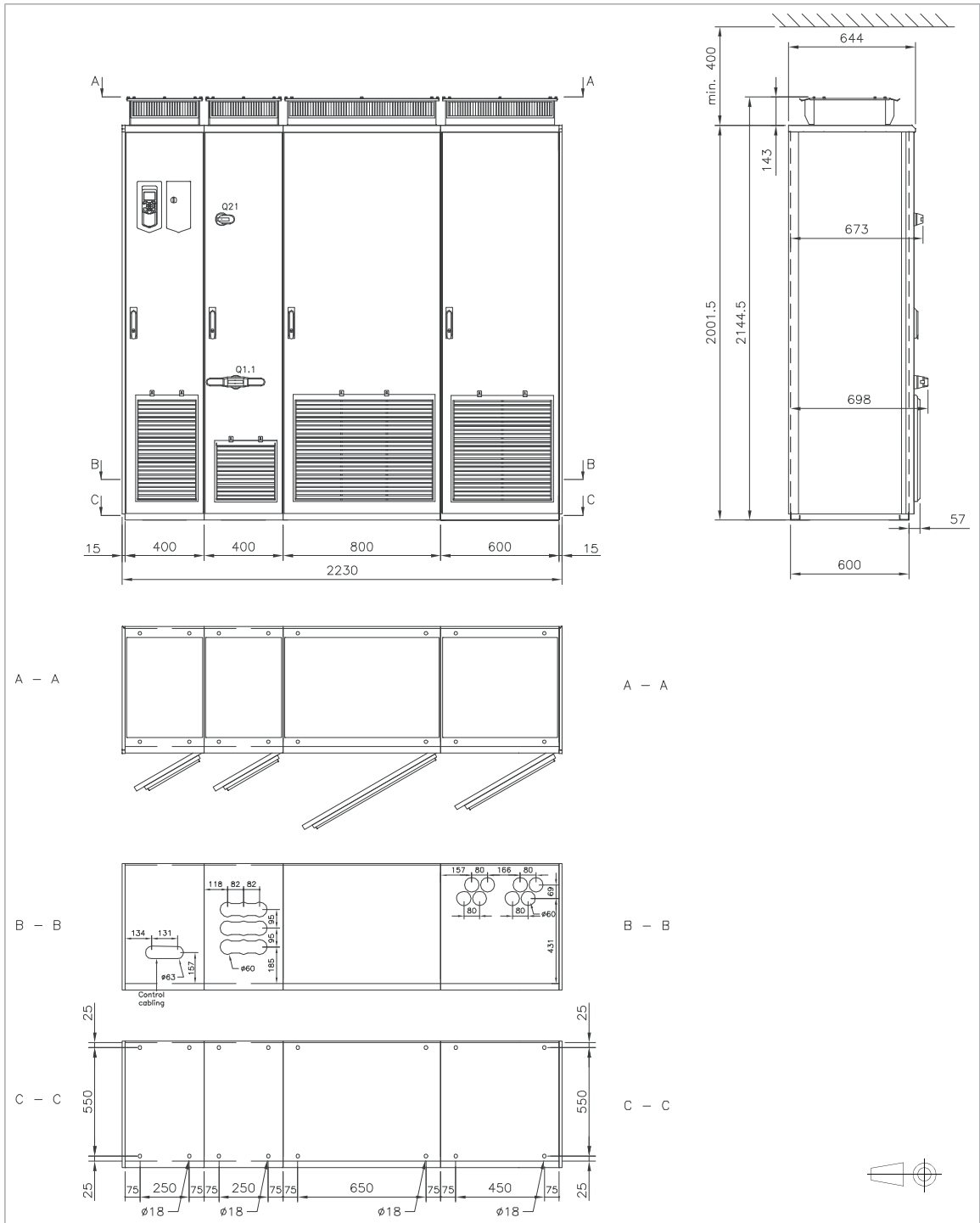
Frame 1xR8i+1xR8i, top cable entry/exit (+H351+H353)



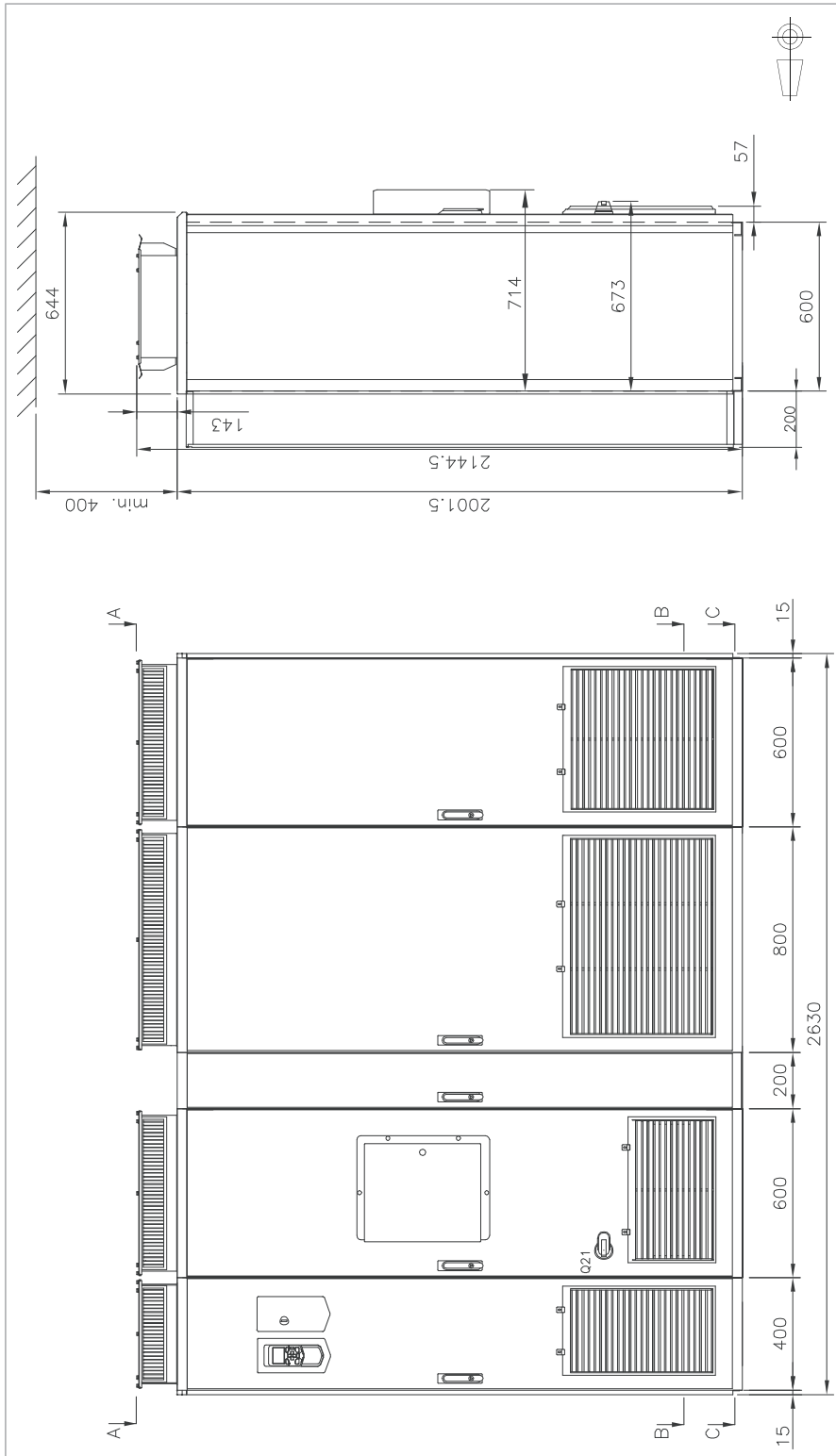
Frame 1×R8i+1×R8i with sine output filter (+E206)



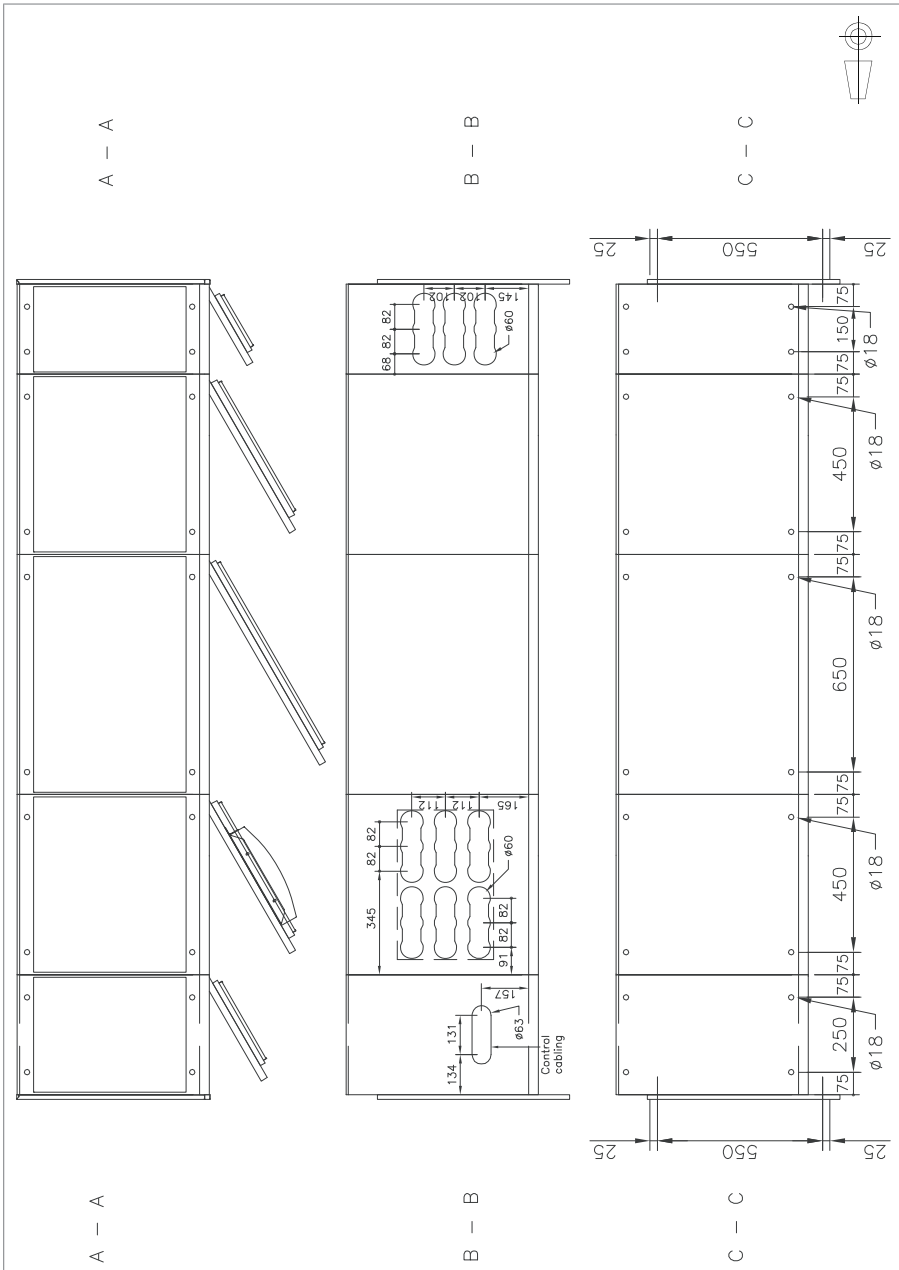
Frame 2×R8i+2×R8i (eg. ACS880-37-1110A-3), IP22



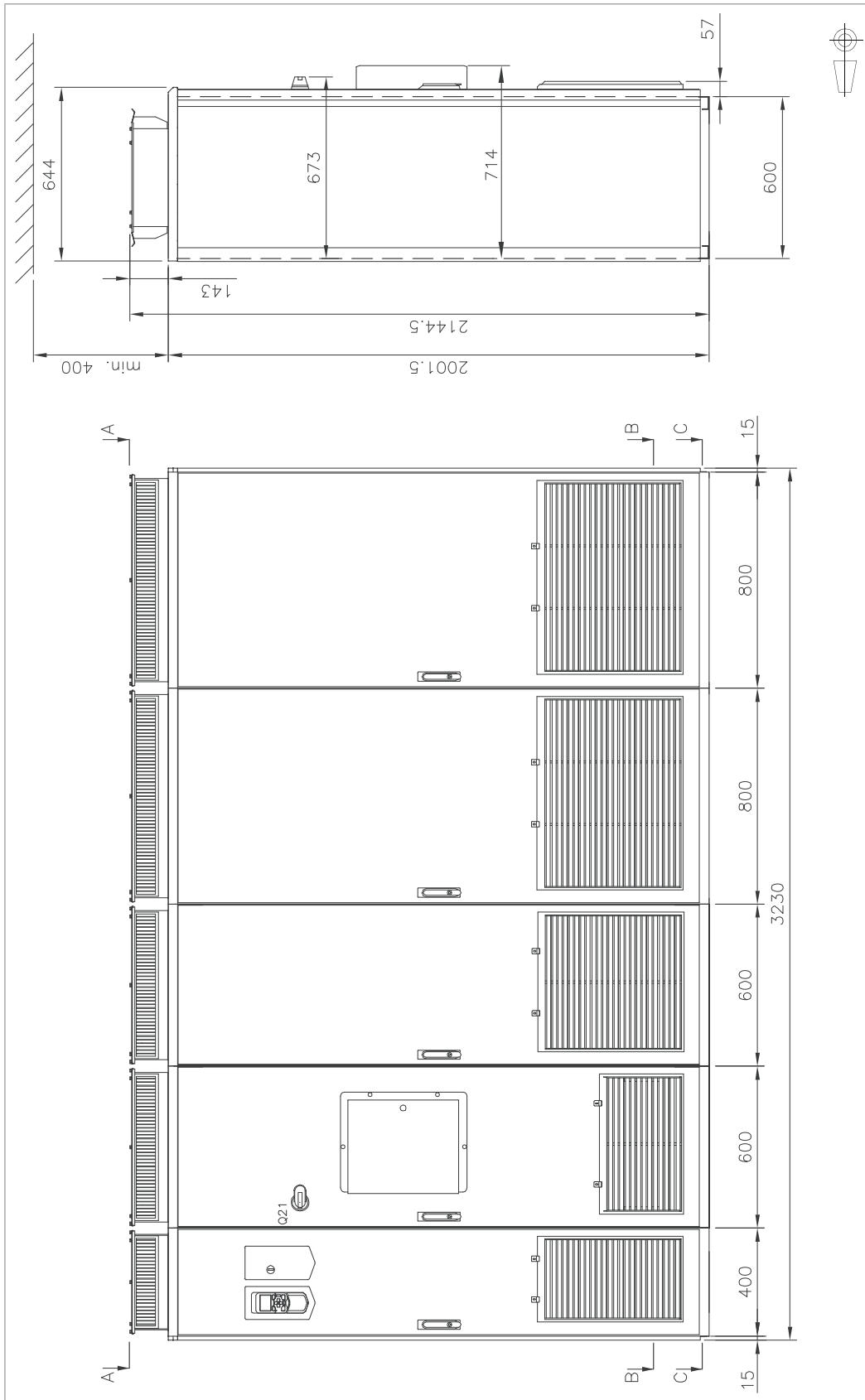
Frame 2×R8i+2×R8i with main breaker (+F255) and common motor terminal cubicle (+H359), 1/2



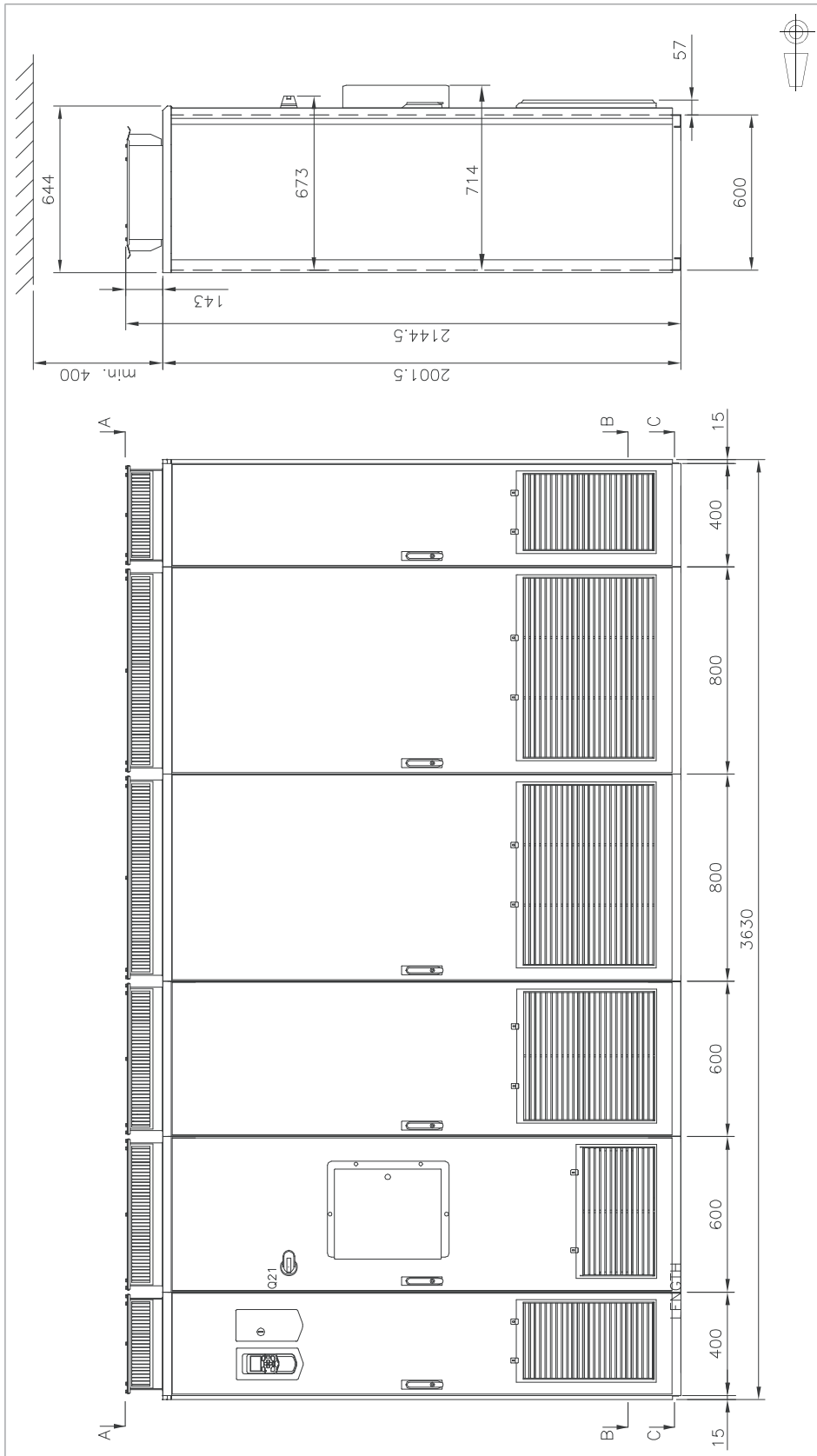
Frame 2×R8i+2×R8i with main breaker (+F255) and common motor terminal cubicle (+H359), 2/2



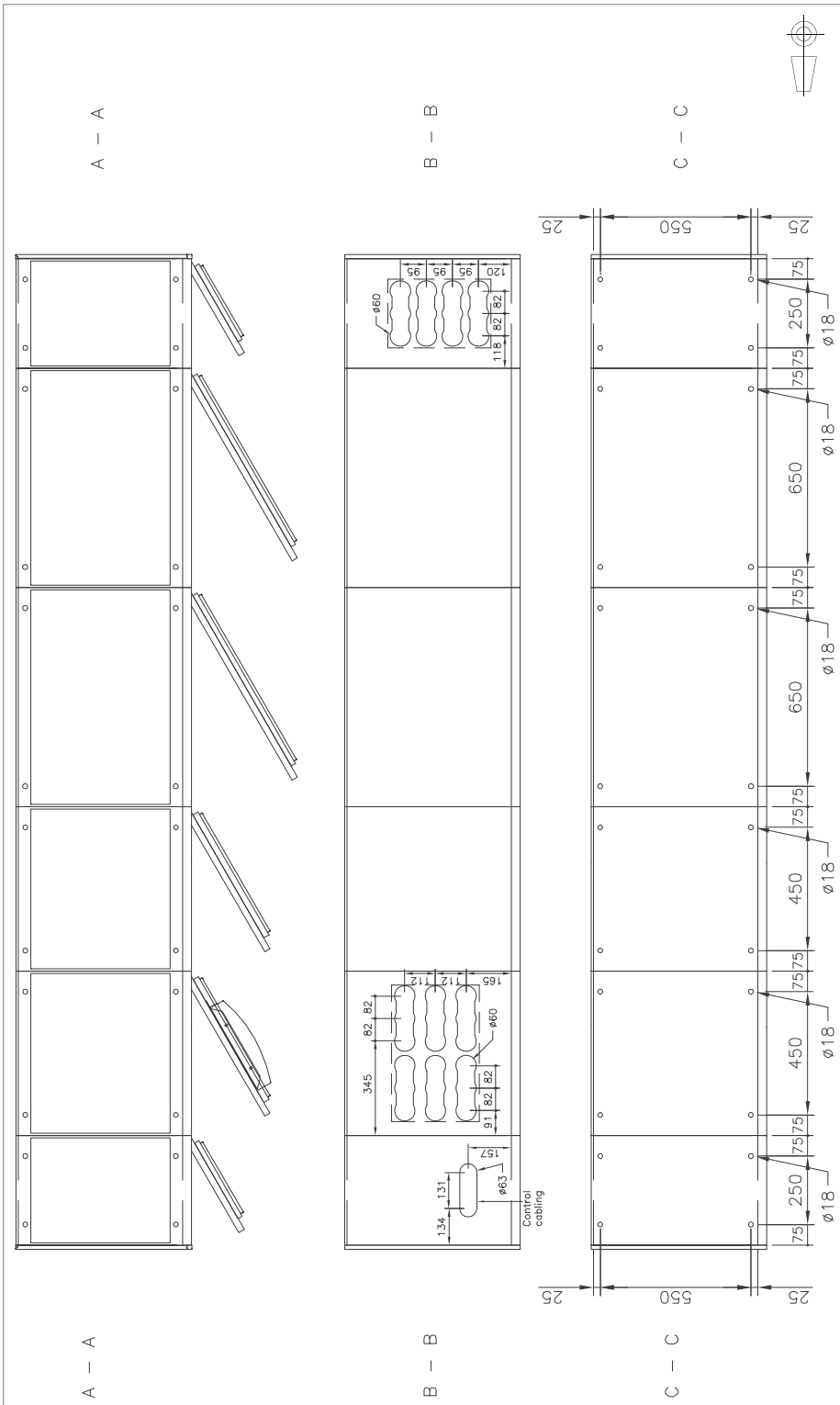
Frame 3×R8i+3×R8i, 1/2



Frame 3×R8i+3×R8i with common motor terminal cubicle (+H359), 1/2

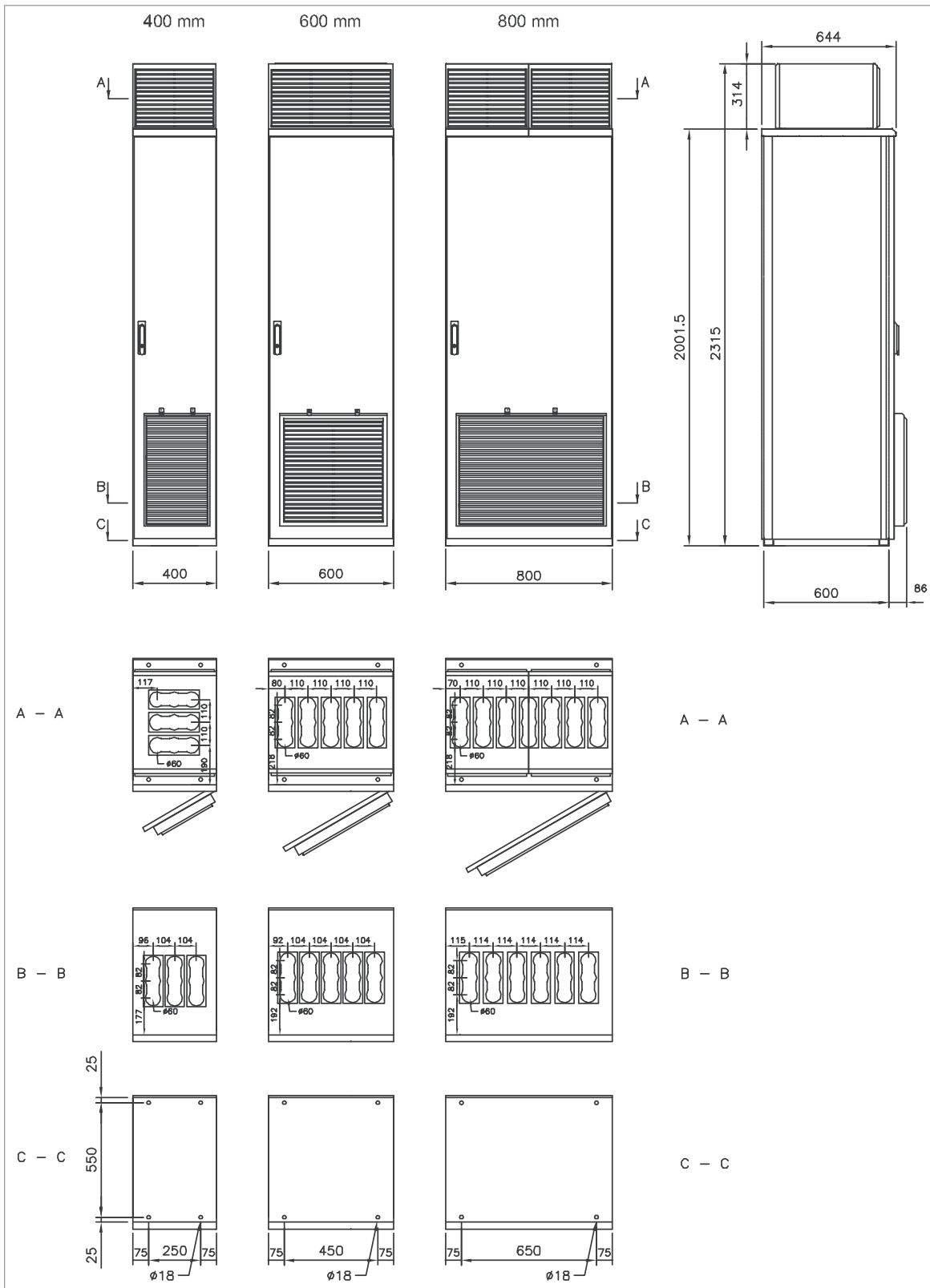


Frame 3×R8i+3×R8i with common motor terminal cubicle (+H359), 2/2



264 Dimensions

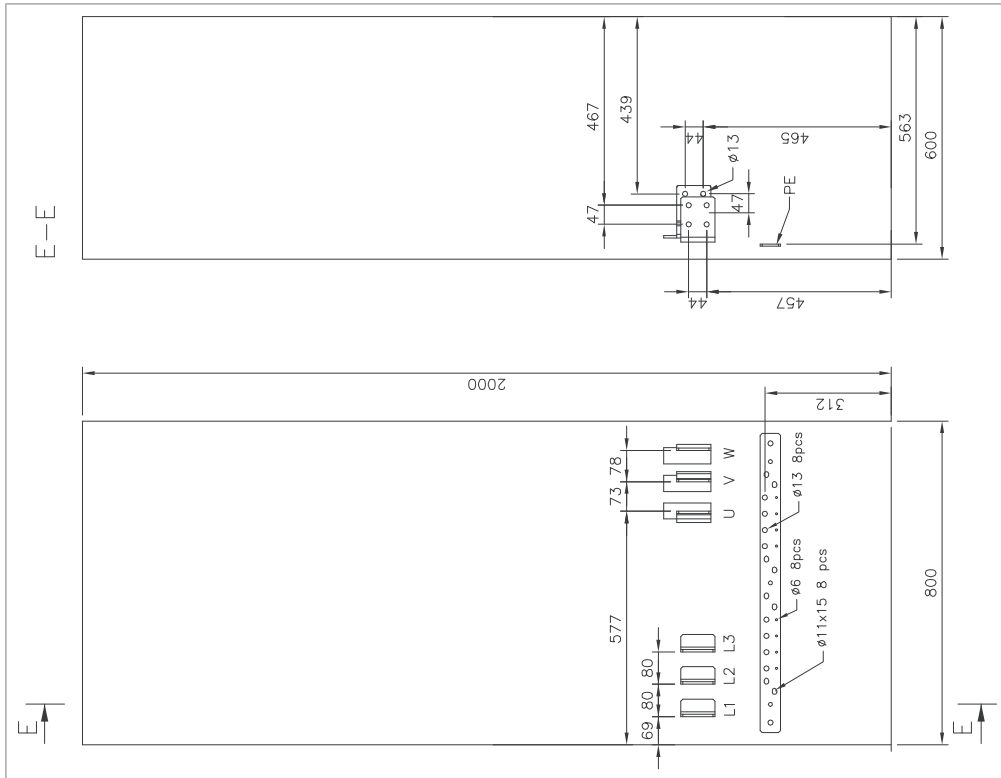
IP54



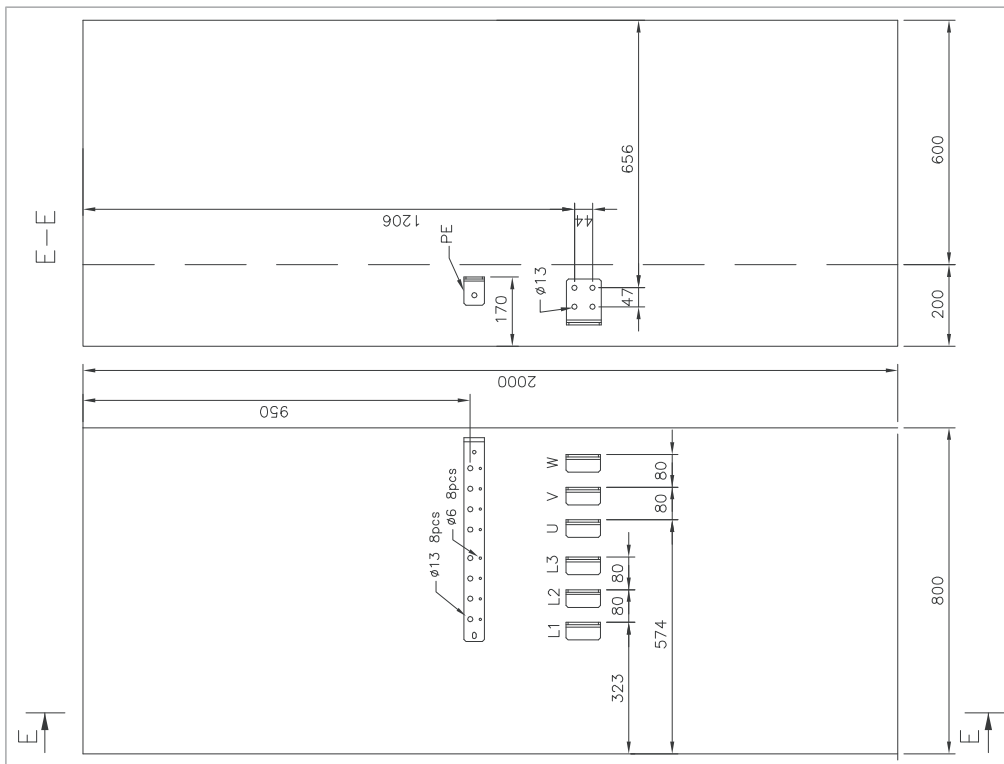
Location and size of input terminals

Note: See the dimension tables as to which incoming cubicles are used with which drive type and options.

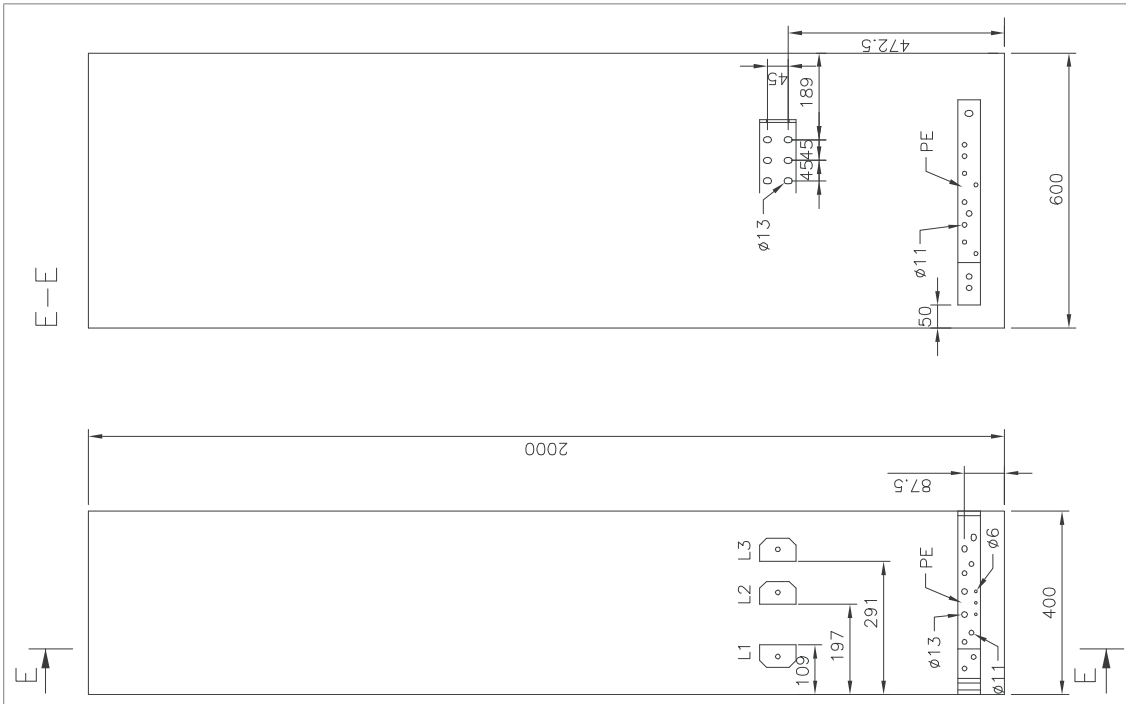
■ Frame 1×R8i+1×R8i, bottom cable entry



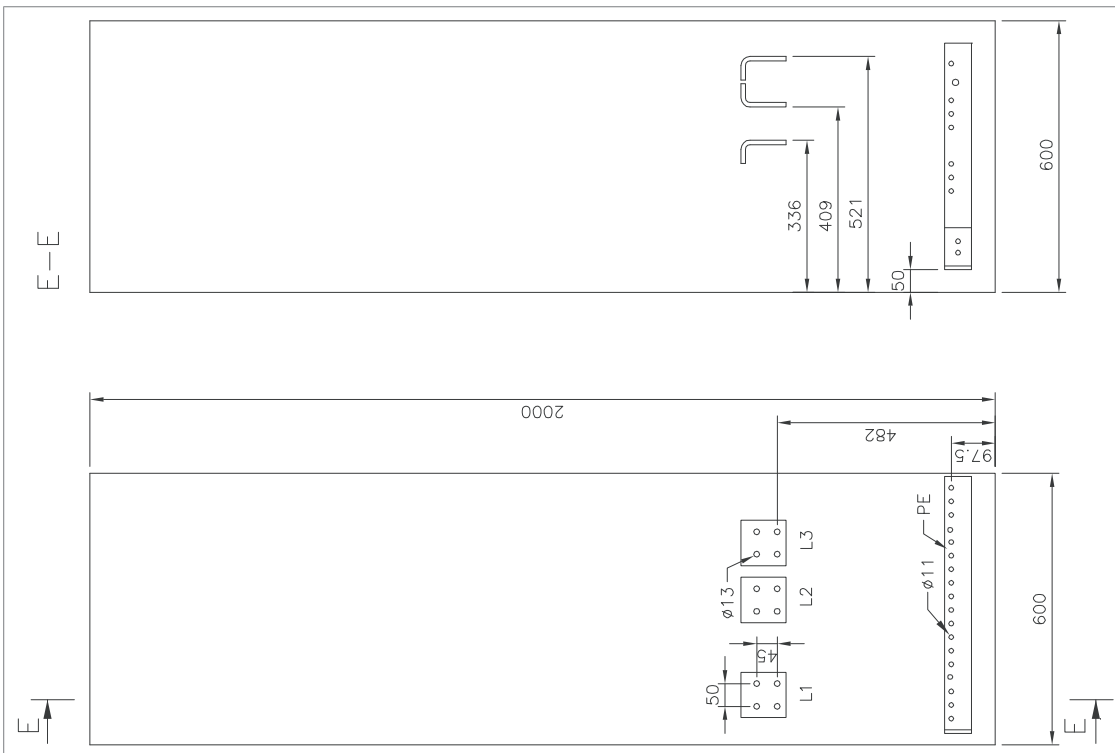
■ Frame 1×R8i+1×R8i, top cable entry (+H351)



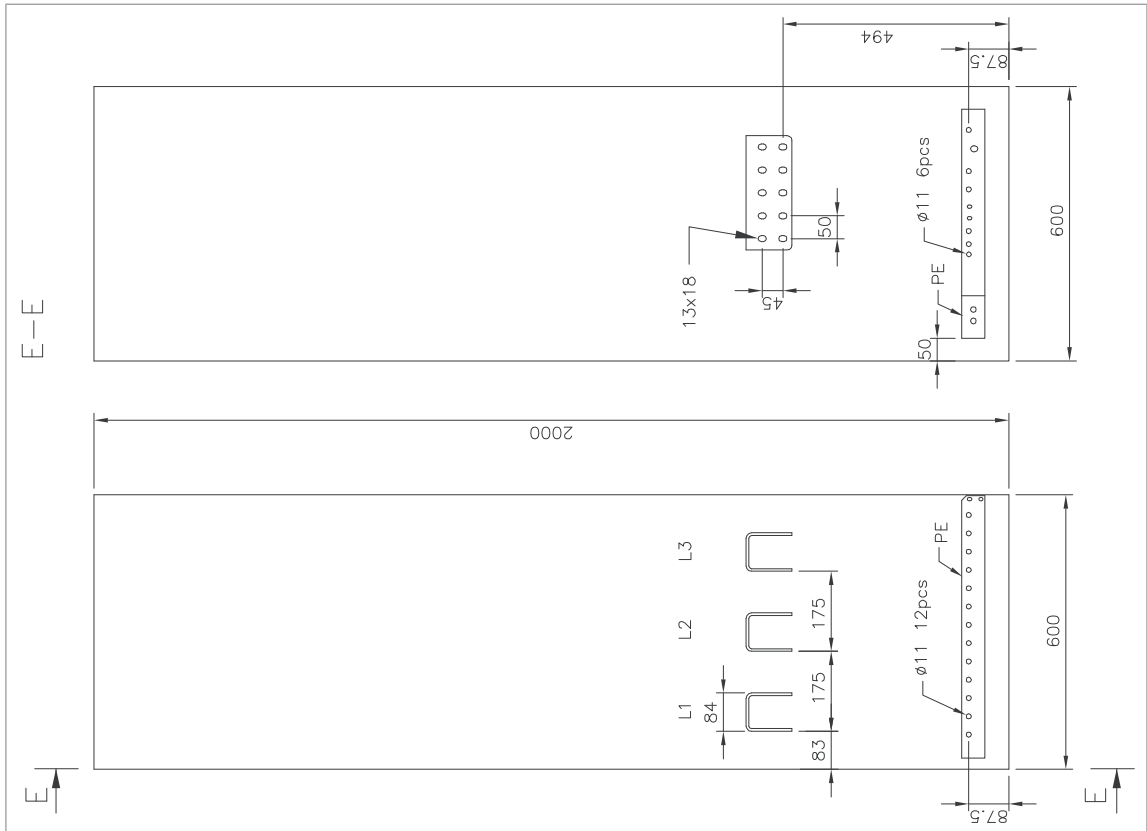
■ **Frame 2×R8i+2×R8i with main switch/disconnector (400 mm), bottom cable entry (+H353)**



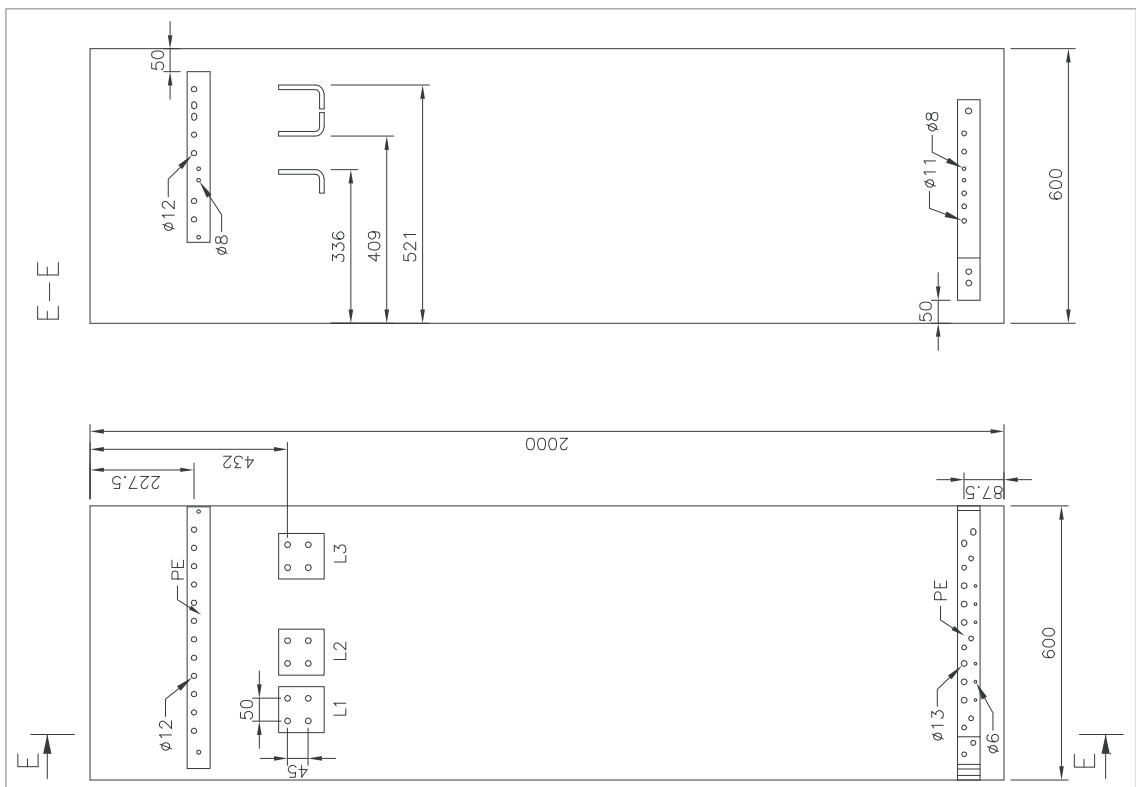
■ **Frame 2×R8i+2×R8i with main switch/disconnector (600 mm), bottom cable entry**



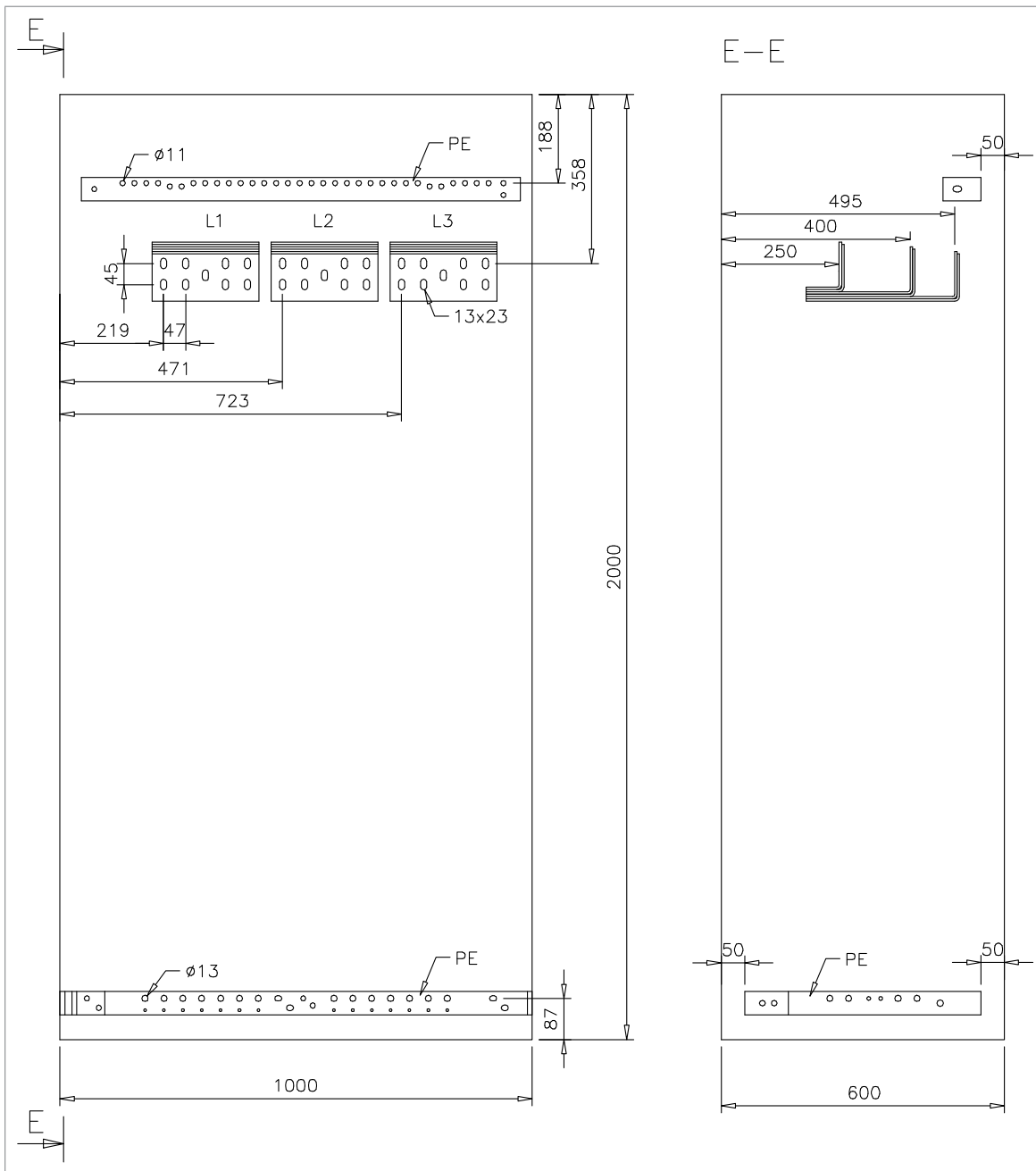
■ Units with main breaker (600 mm, +F255), bottom cable entry



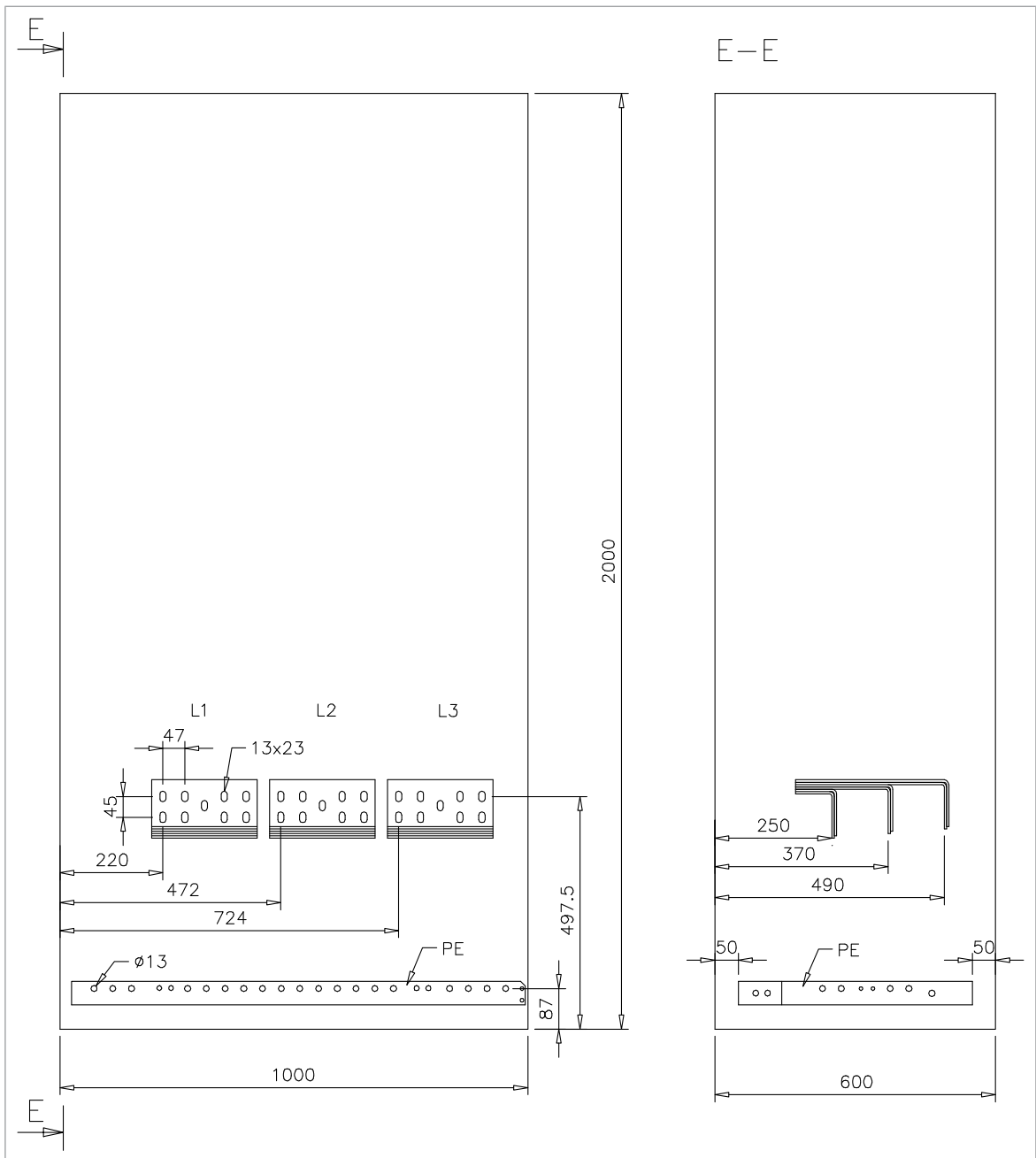
■ Units with main breaker (600 mm, +F255), top cable entry (+H351)



■ Units with main breaker (1000 mm), top cable entry



■ **Units with main breaker (1000 mm), bottom cable entry (+H350)**



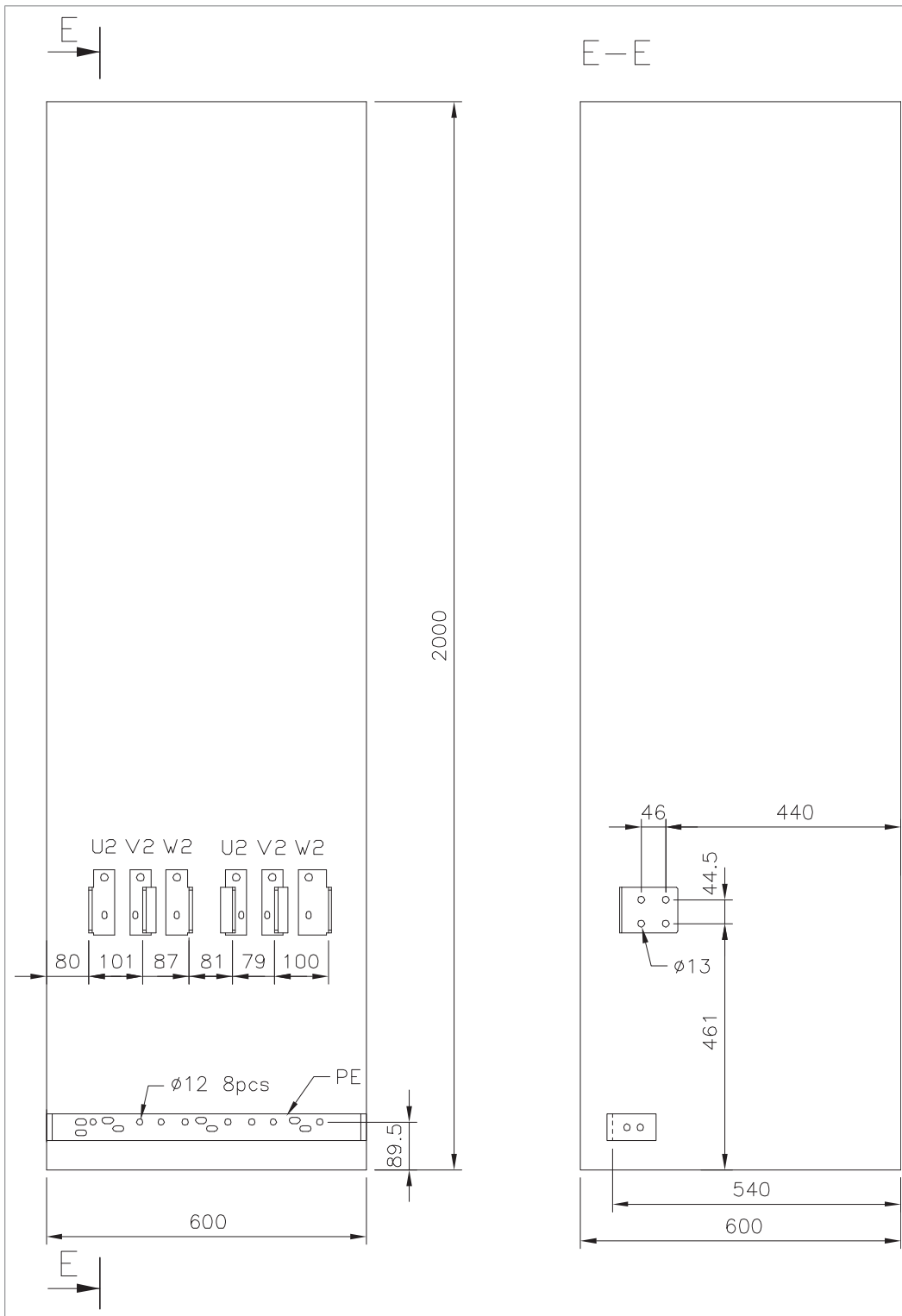
Location and size of output terminals

■ **Units without common motor terminal cubicle**

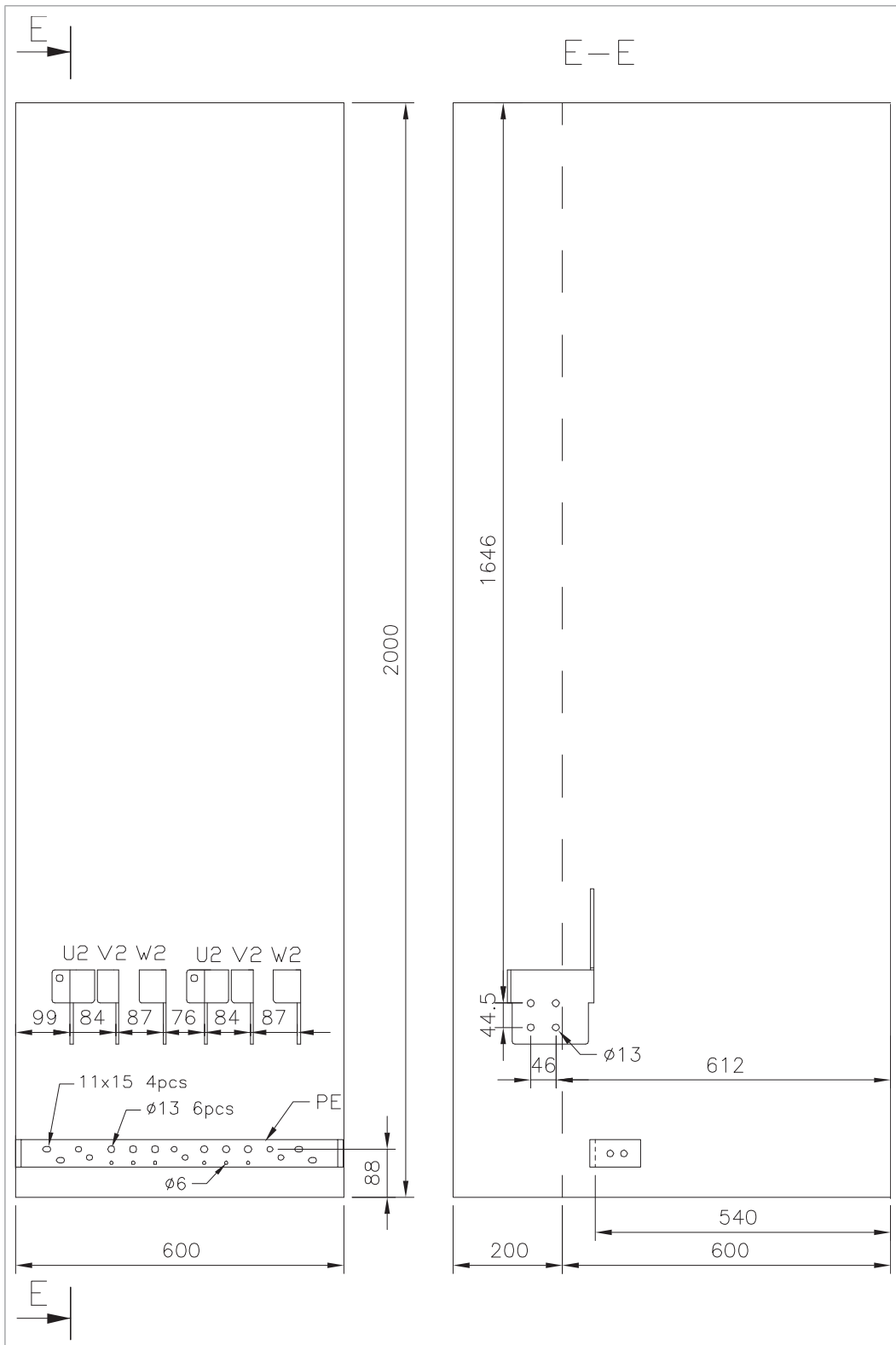
Frame 1×R8i+1×R8i (without sine output filter)

See sections Frame 1×R8i+1×R8i, bottom cable entry (page 265) and Frame 1×R8i+1×R8i, top cable entry (+H351) (page 265)

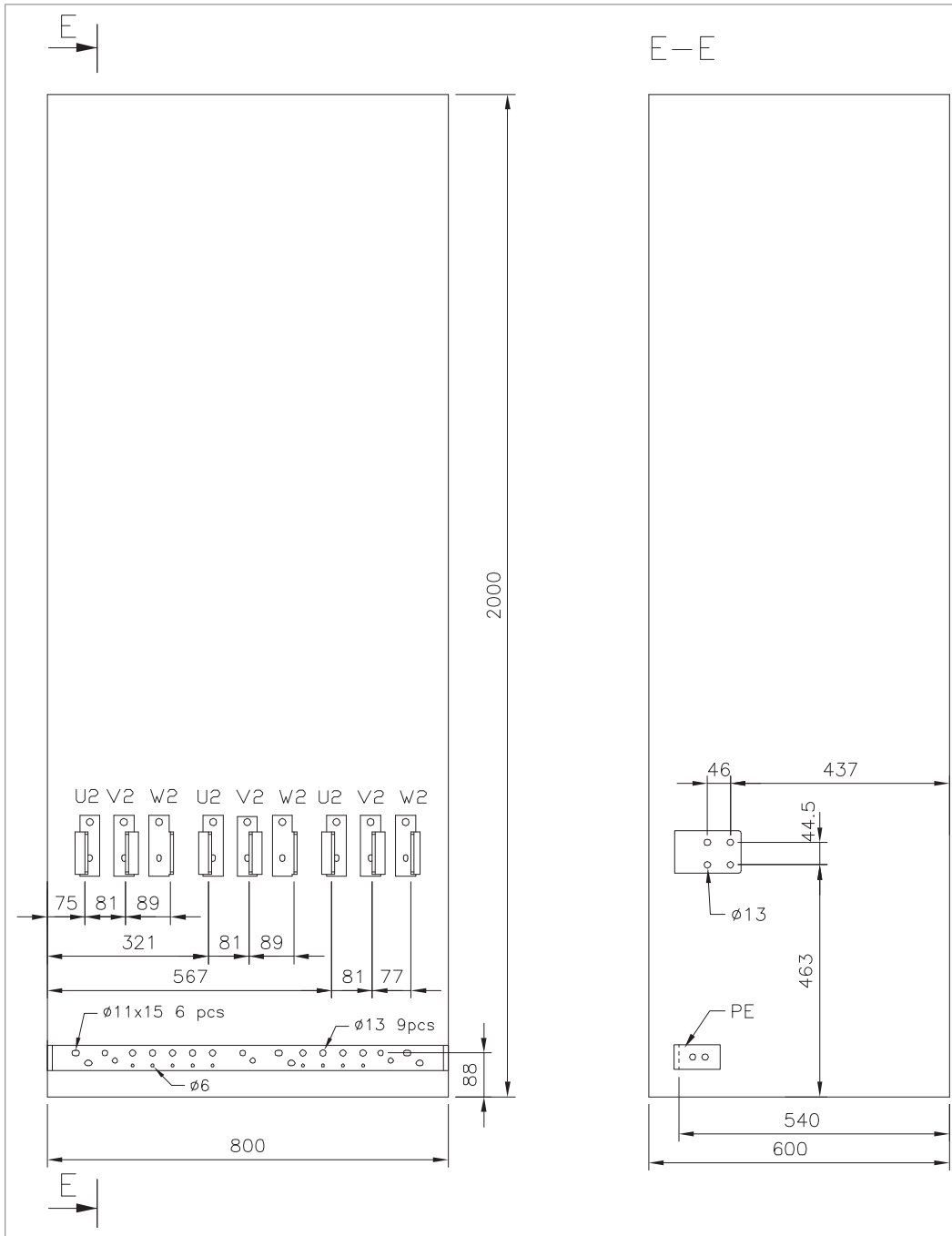
Inverter module cubicle with two R8i modules, bottom cable exit



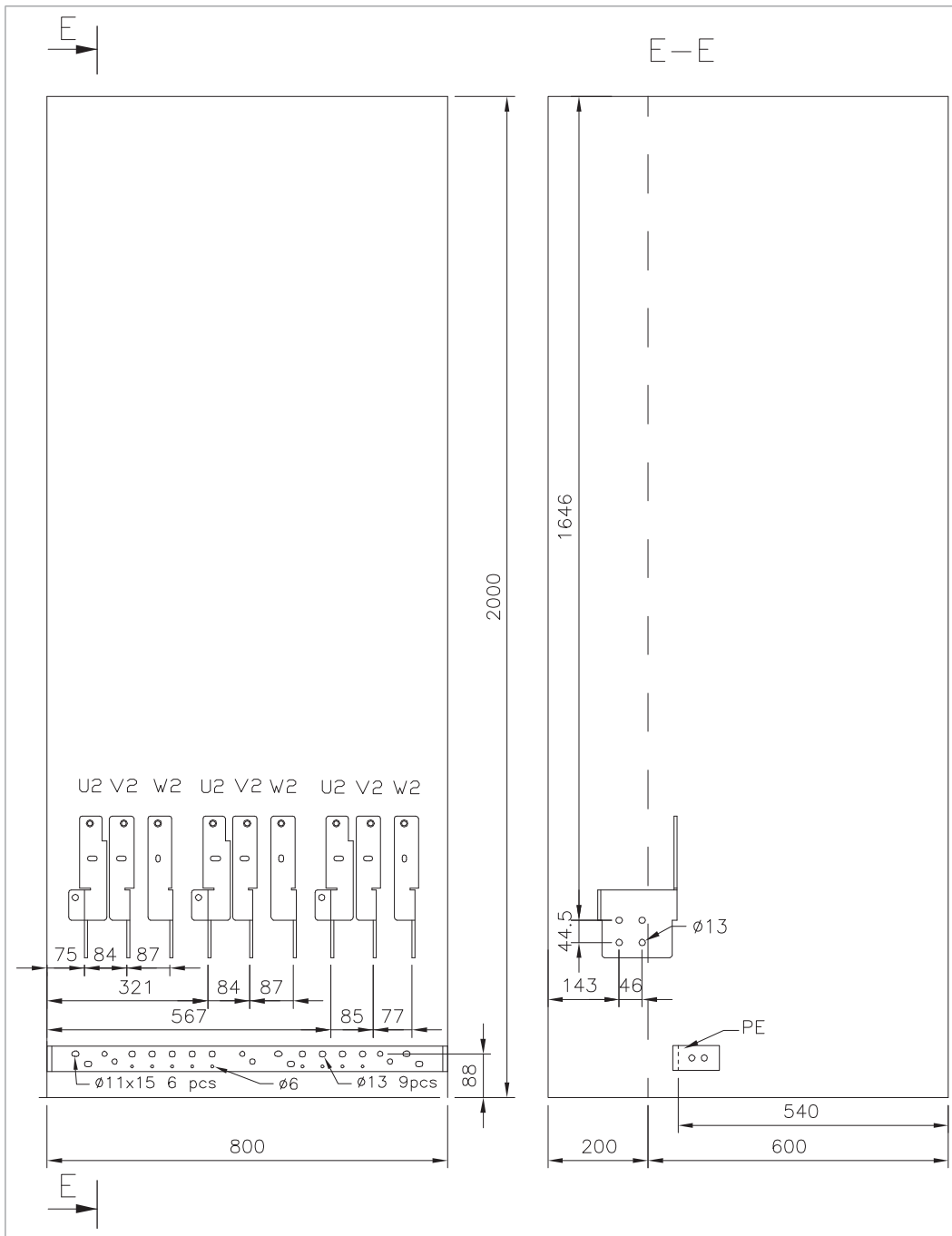
Inverter module cubicle with two R8i modules, top cable exit



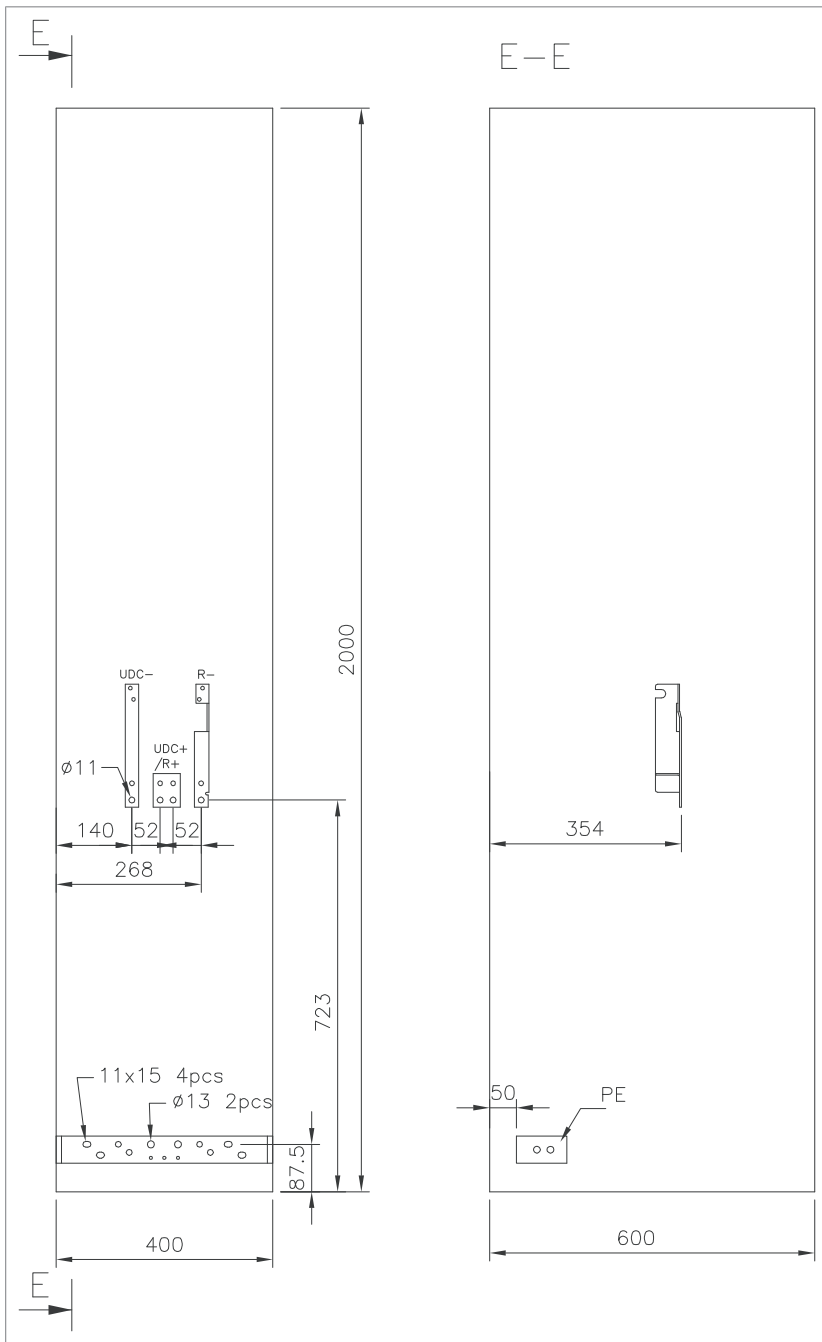
Inverter module cubicle with three R8i modules, bottom cable exit



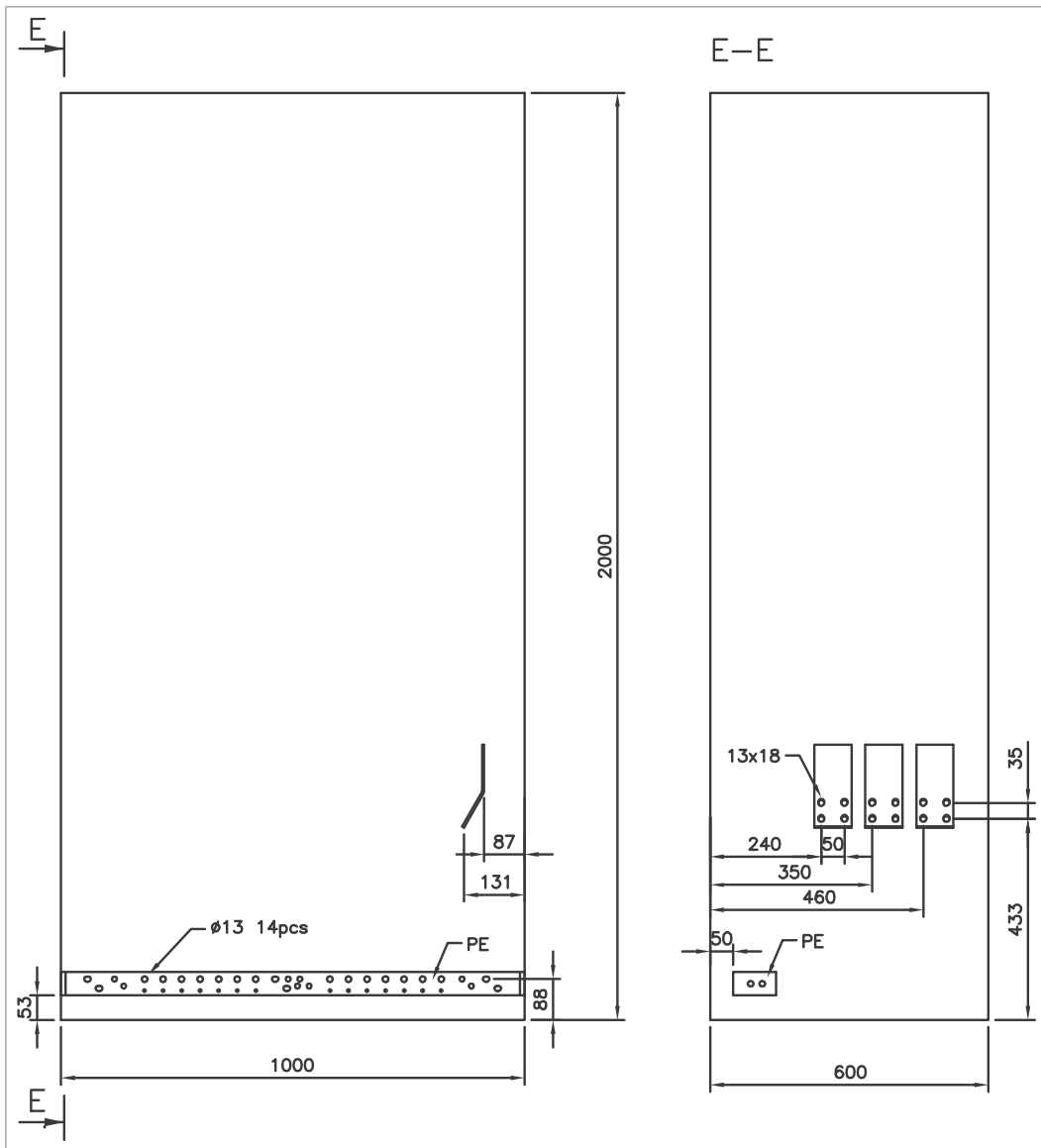
Inverter module cubicle with three R8i modules, top cable exit



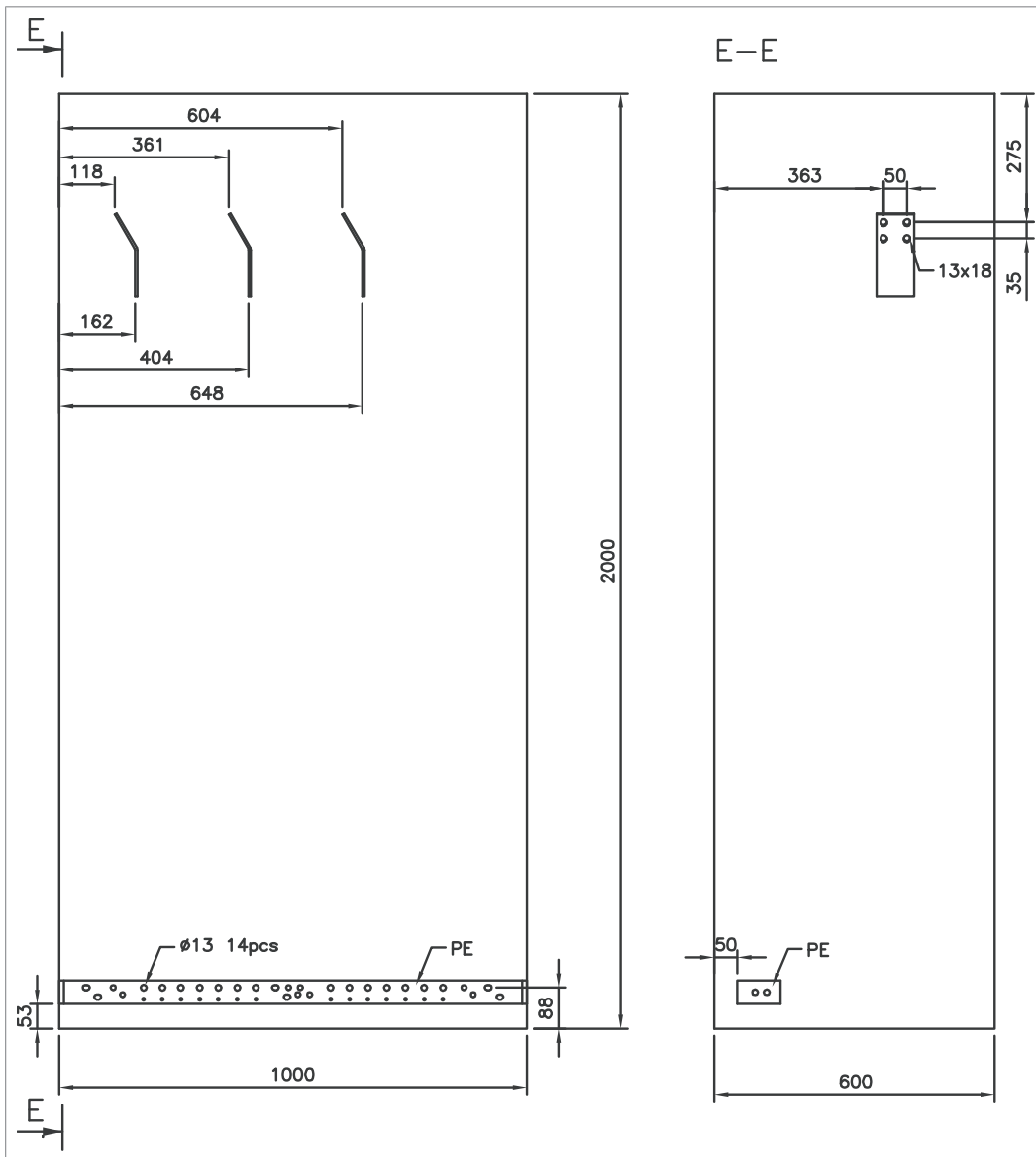
Brake chopper cubicle



Sine filter cubicle, 1000 mm, bottom cable exit

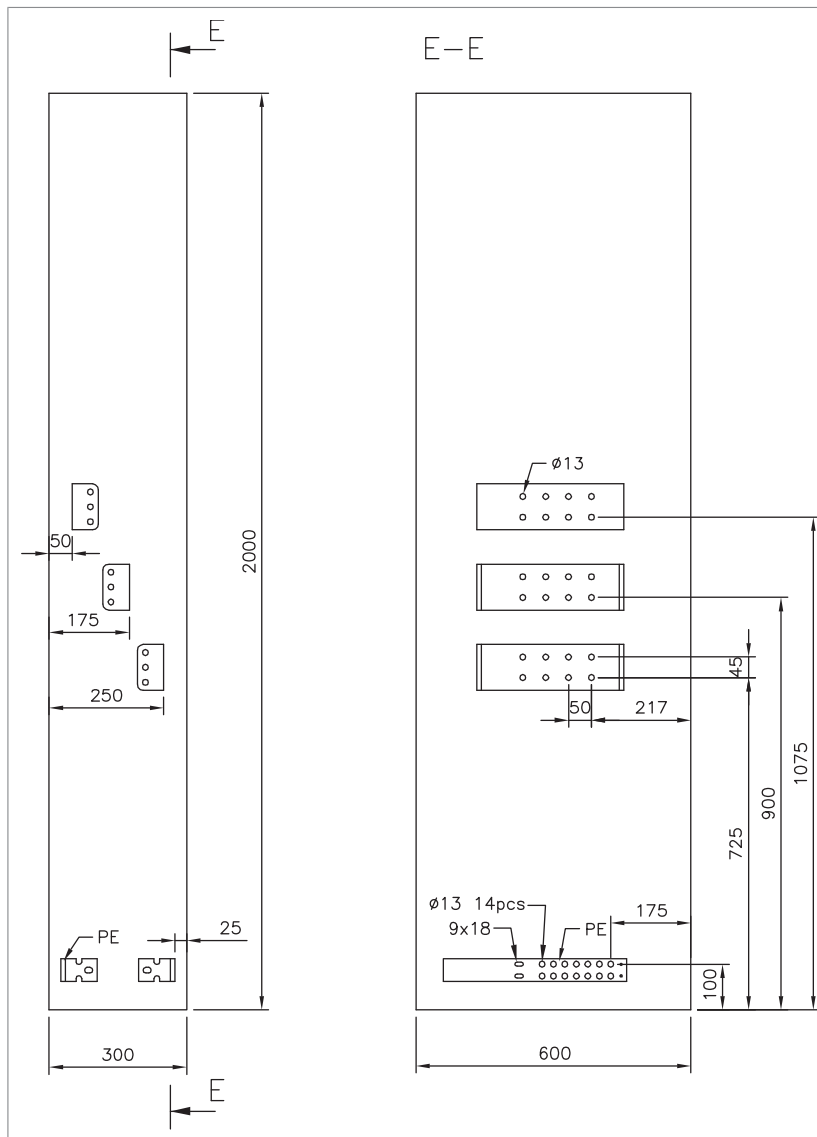


Sine filter cubicle, 1000 mm, top cable exit



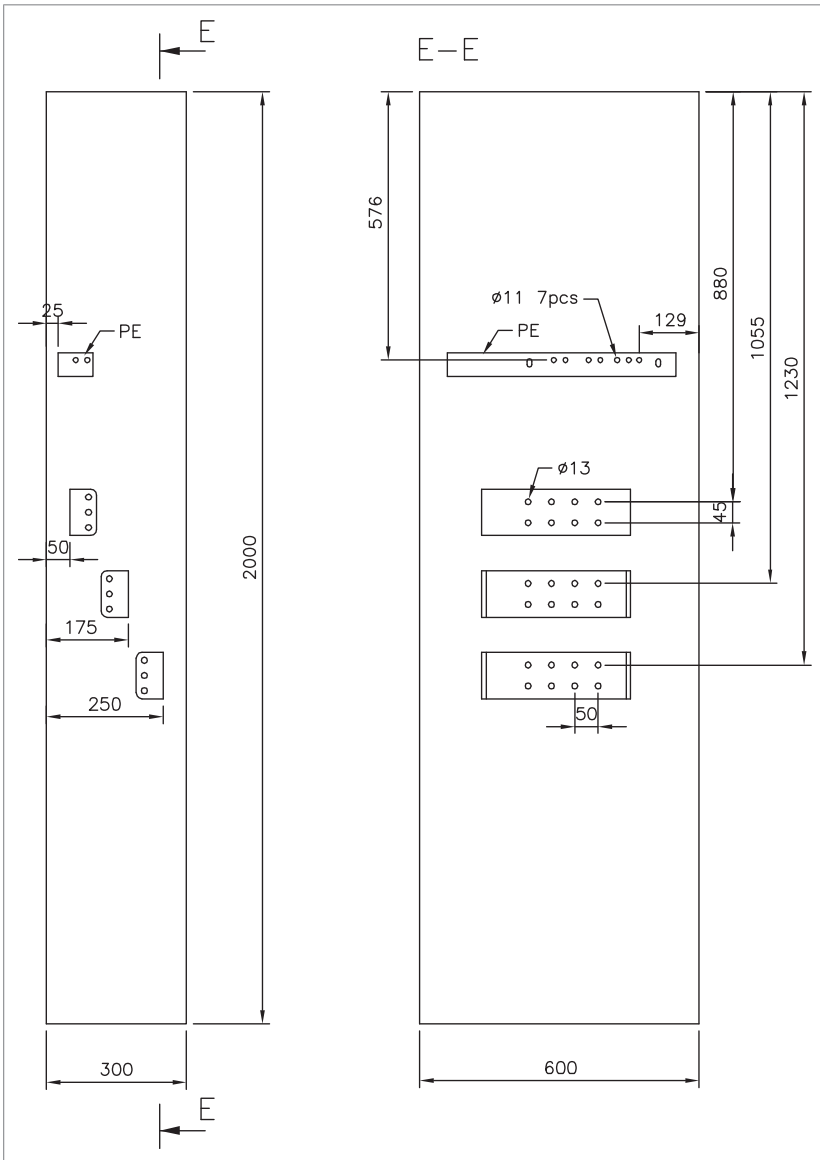
■ Units with common motor terminal cubicle (+H359)

Cubicle width 300 mm, bottom cable exit

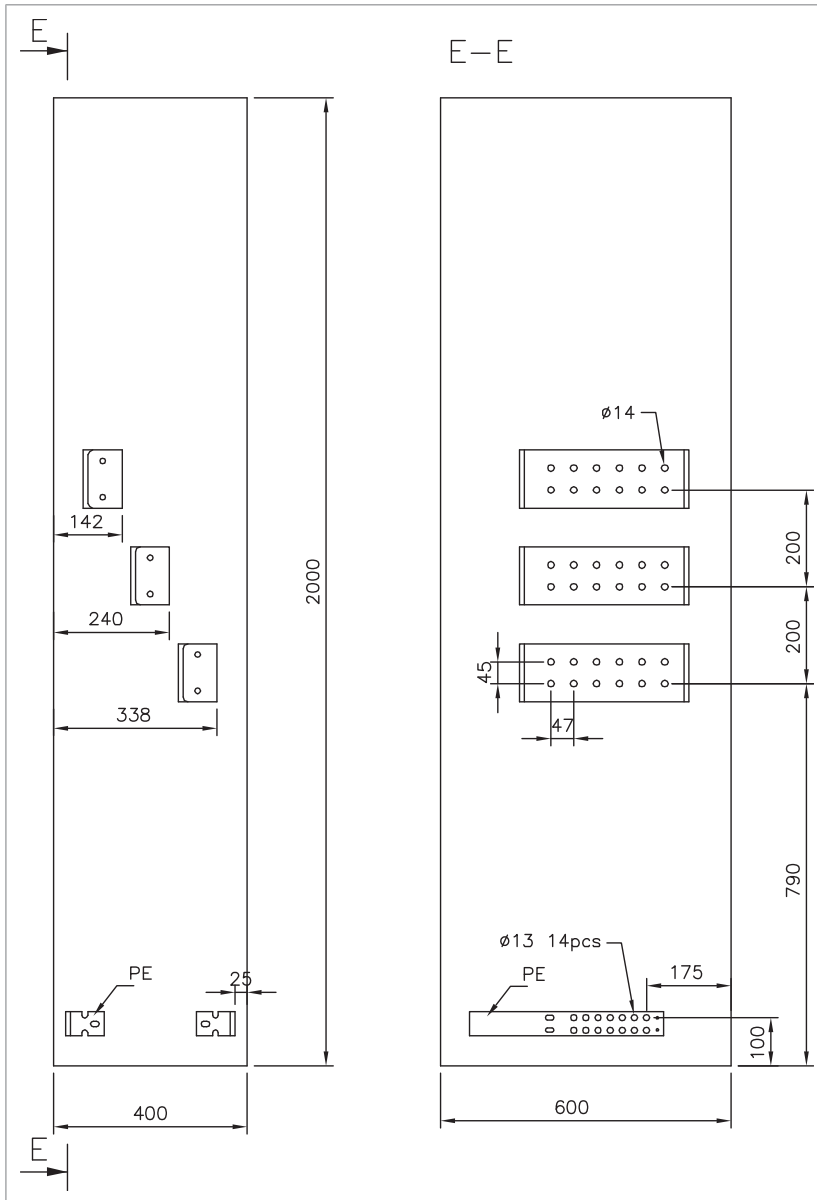


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Cubicle width 300 mm, top cable exit

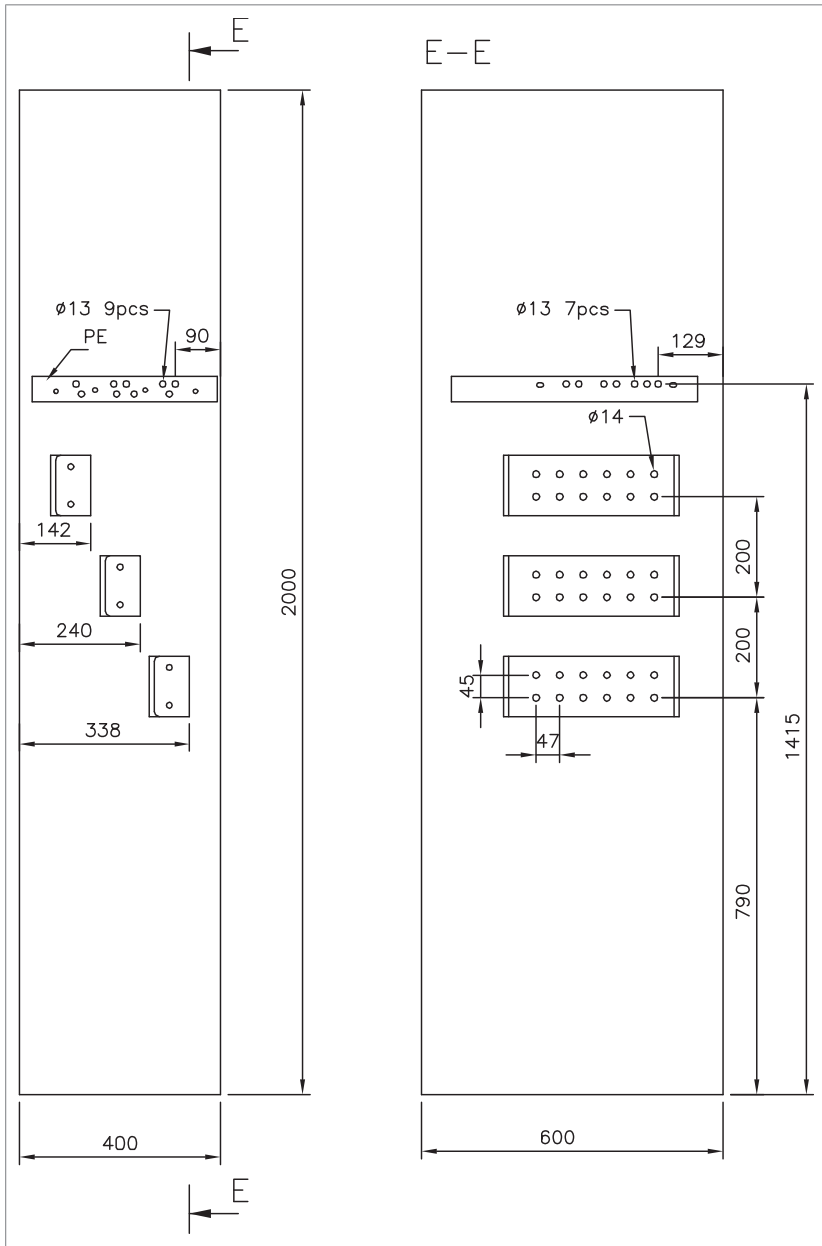


Cubicle width 400 mm, bottom cable exit

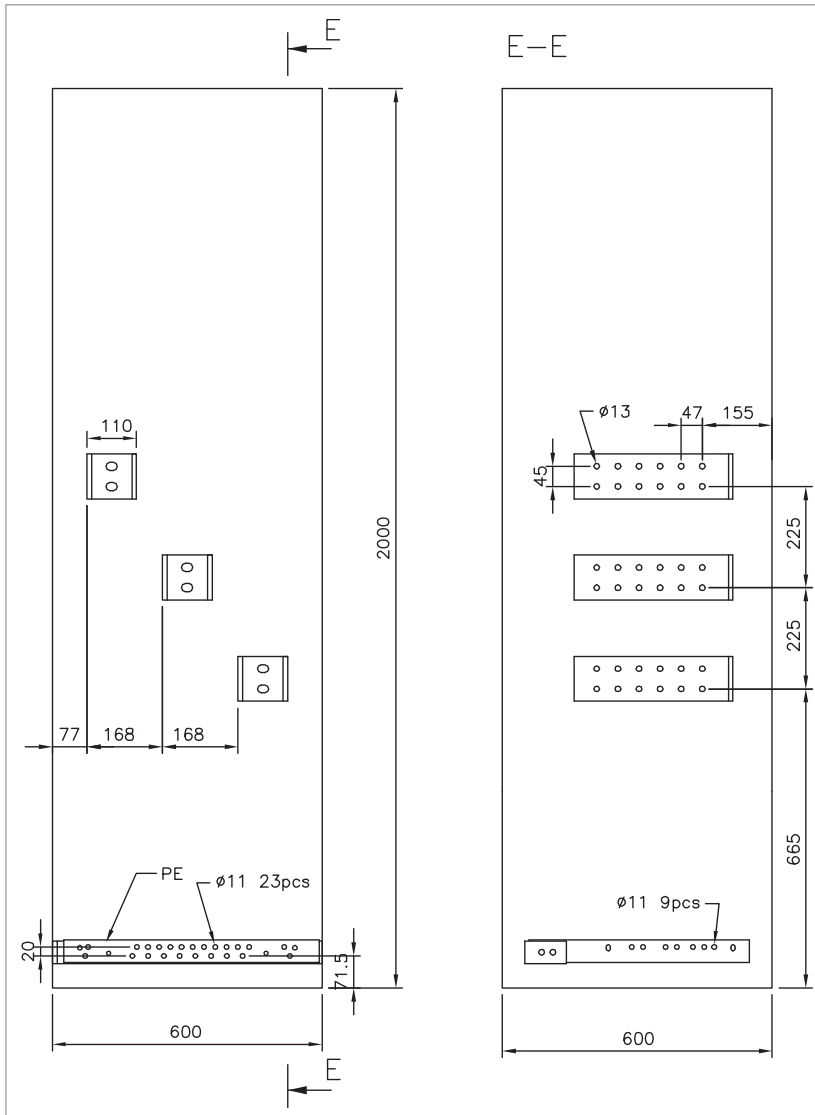


280 Dimensions

Cubicle width 400 mm, top cable exit

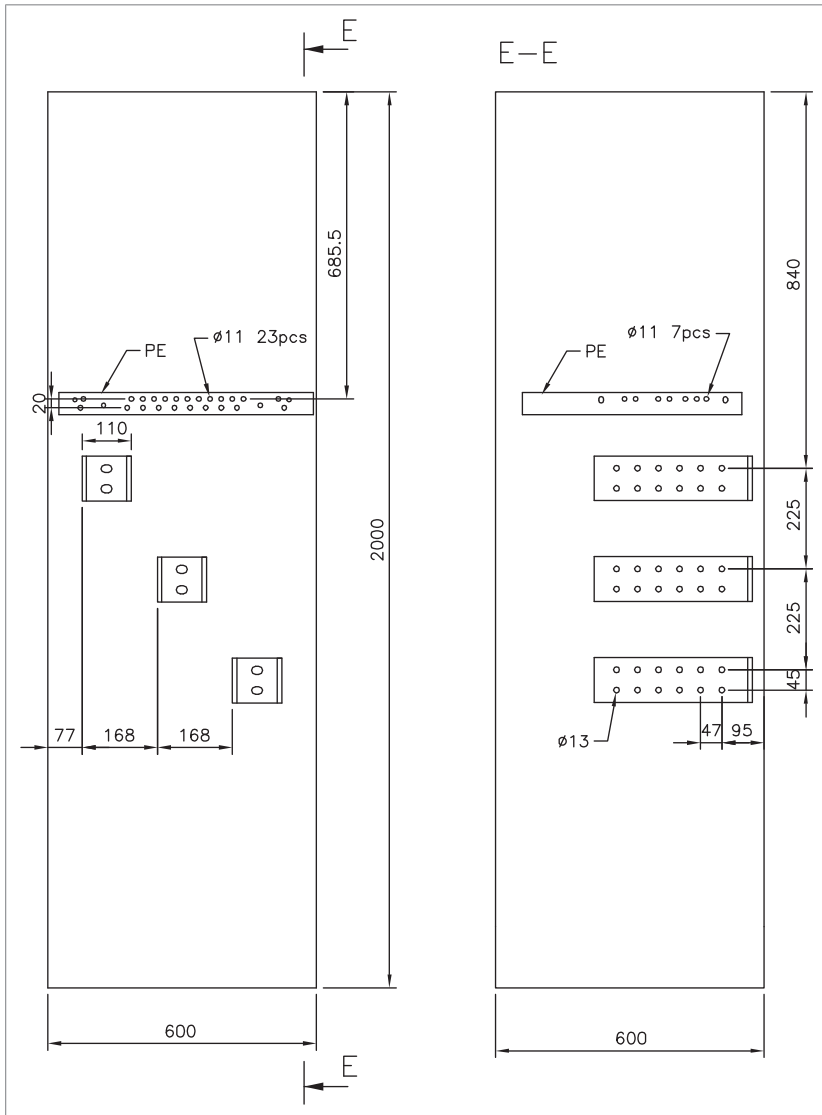


Cubicle width 600 mm, bottom cable exit



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Cubicle width 600 mm, top cable exit



16

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



WARNING!

In case of parallel-connected drives or dual-winding motors, the STO must be activated on each drive to remove the torque from the motor.

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

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

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

The Safe torque off function complies with these standards:

Standard	Name
IEC 60204-1:2021 EN 60204-1:2018	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 61511-1:2017	Functional safety – Safety instrumented systems for the process industry sector
IEC 61800-5-2:2016 EN 61800-5-2:2007	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional
EN IEC 62061:2021	Safety of machinery – Functional safety of safety-related 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 ISO 14118:2018 (ISO 14118:2017), and Uncontrolled stop (stop category 0) as specified in EN/IEC 60204-1.

■ Compliance with the European Machinery Directive and the UK Supply of Machinery (Safety) Regulations

The Declarations of conformity are shown at the end of this chapter.

Wiring

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

■ Activation switch

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

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

■ Cable types and lengths

- ABB recommends double-shielded twisted-pair cable.
- Maximum cable lengths:
 - 300 m (1000 ft) between activation switch [K] and drive control unit
 - 60 m (200 ft) between multiple drives
 - 60 m (200 ft) between external power supply and first control unit
 - 30 m (100 ft) between control unit and last inverter module in the chain.

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

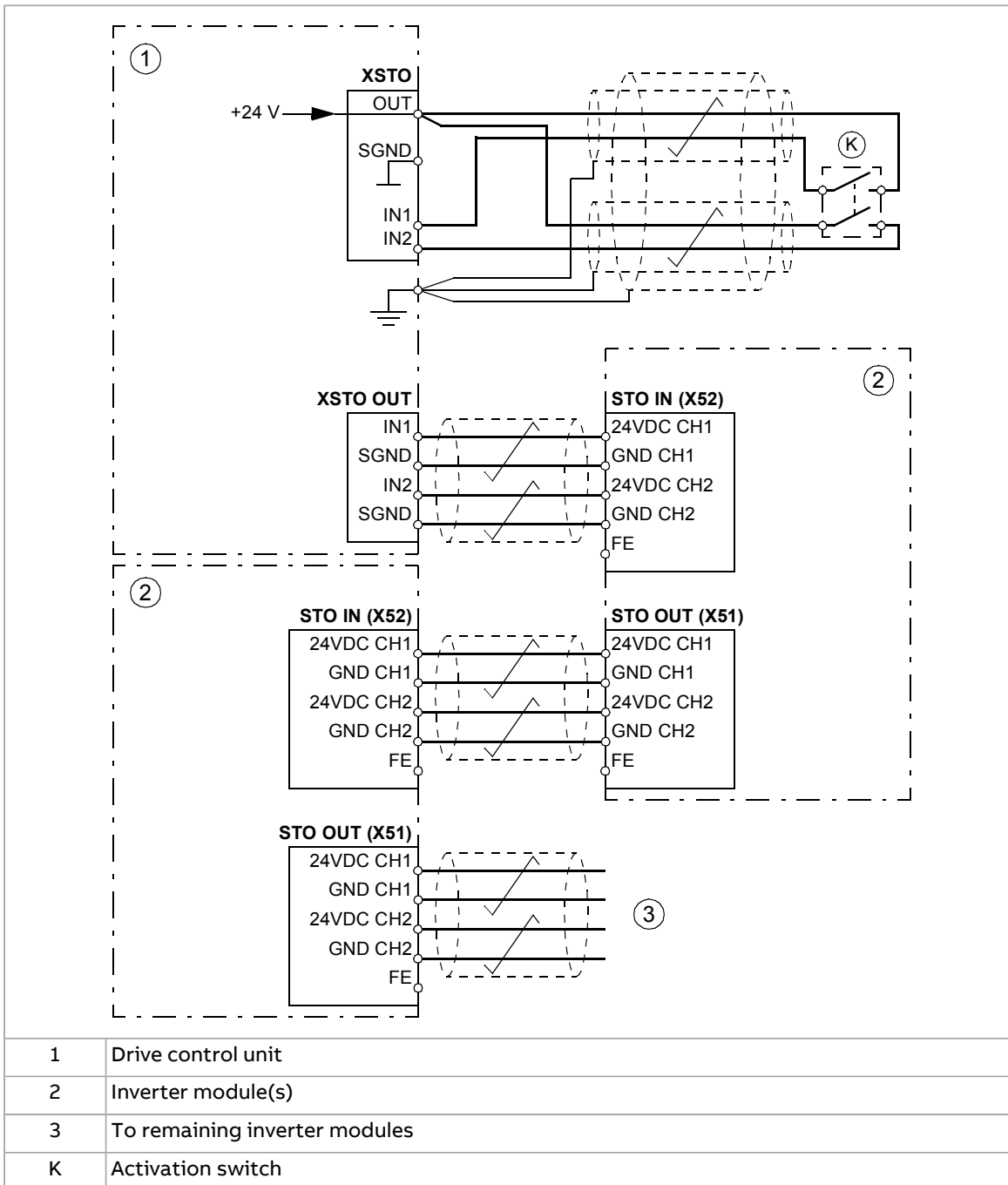
Note: The voltage at the STO input terminals of the control unit (or frame R8i inverter module) must be at least 17 V DC to be interpreted as “1”.

The pulse tolerance of the input channels is 1 ms.

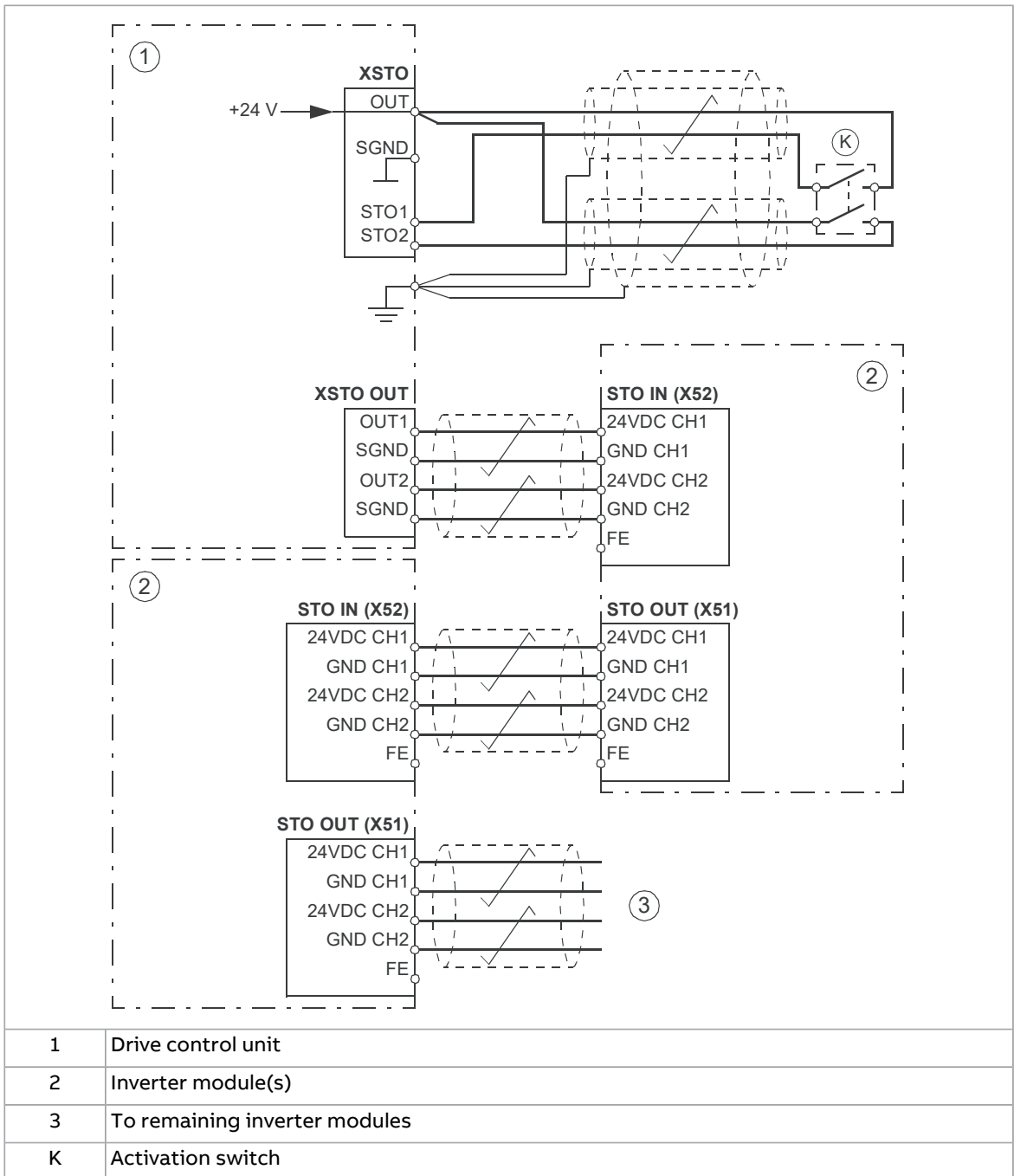
■ Grounding of protective shields

- Ground the shield in the cabling between the activation switch and the control unit at the control unit only.
 - Ground the shield in the cabling between two control units at one control unit only.
 - Do not ground the shield in the cabling between control unit and inverter module, or between inverter modules.
-

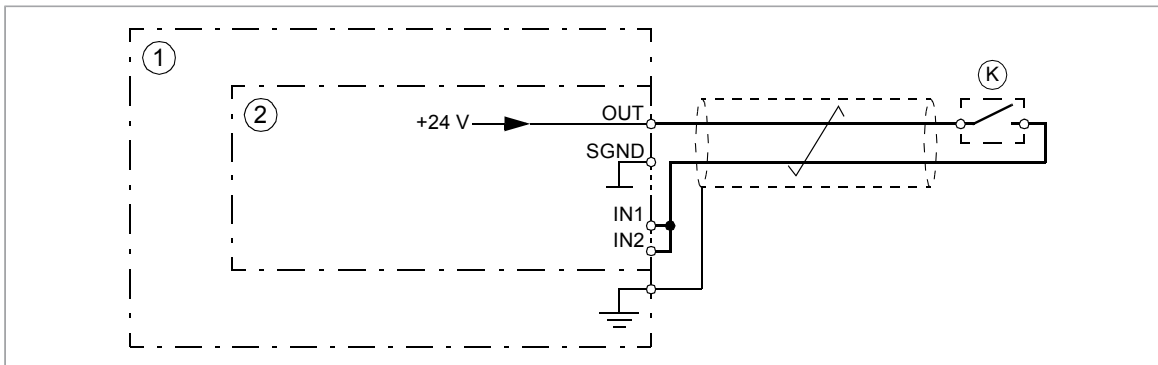
■ Dual-channel connection with internal power supply (BCU-x2)



■ Dual-channel connection with internal power supply (UCU-2x)



■ **Single-channel connection of activation switch (BCU-x2)**



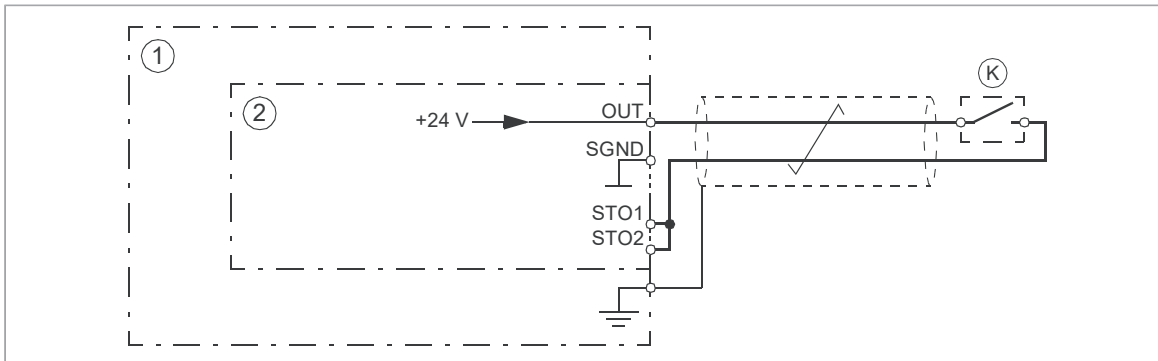
Note:

- 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.

1	Drive
2	Control unit
K	Activation switch

Note: A single-channel activation switch can limit the SIL/PL capability of the safety function to a lower level than the SIL/PL capability of the STO function of the drive.

■ **Single-channel connection of activation switch (UCU-2x)**



Note:

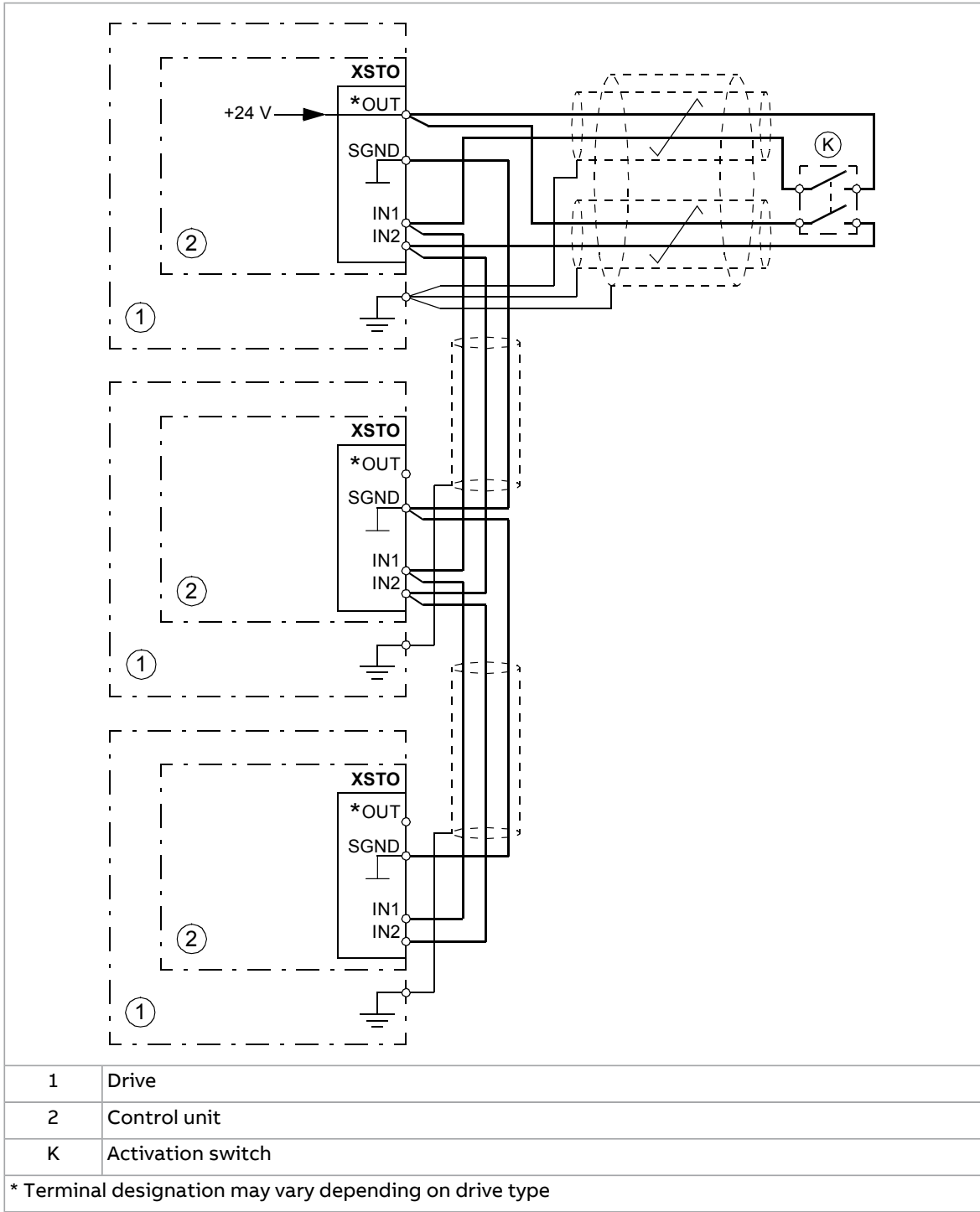
- Both STO inputs (STO1, STO2) must be connected to the activation switch. Otherwise, no SIL/PL classification is given.
- Pay special attention to avoiding any potential failure modes for the wiring. For example, use shielded cable. For measures for fault exclusion of wiring, see eg. EN ISO 13849-2:2012, table D.4.

1	Drive
2	Control unit
K	Activation switch

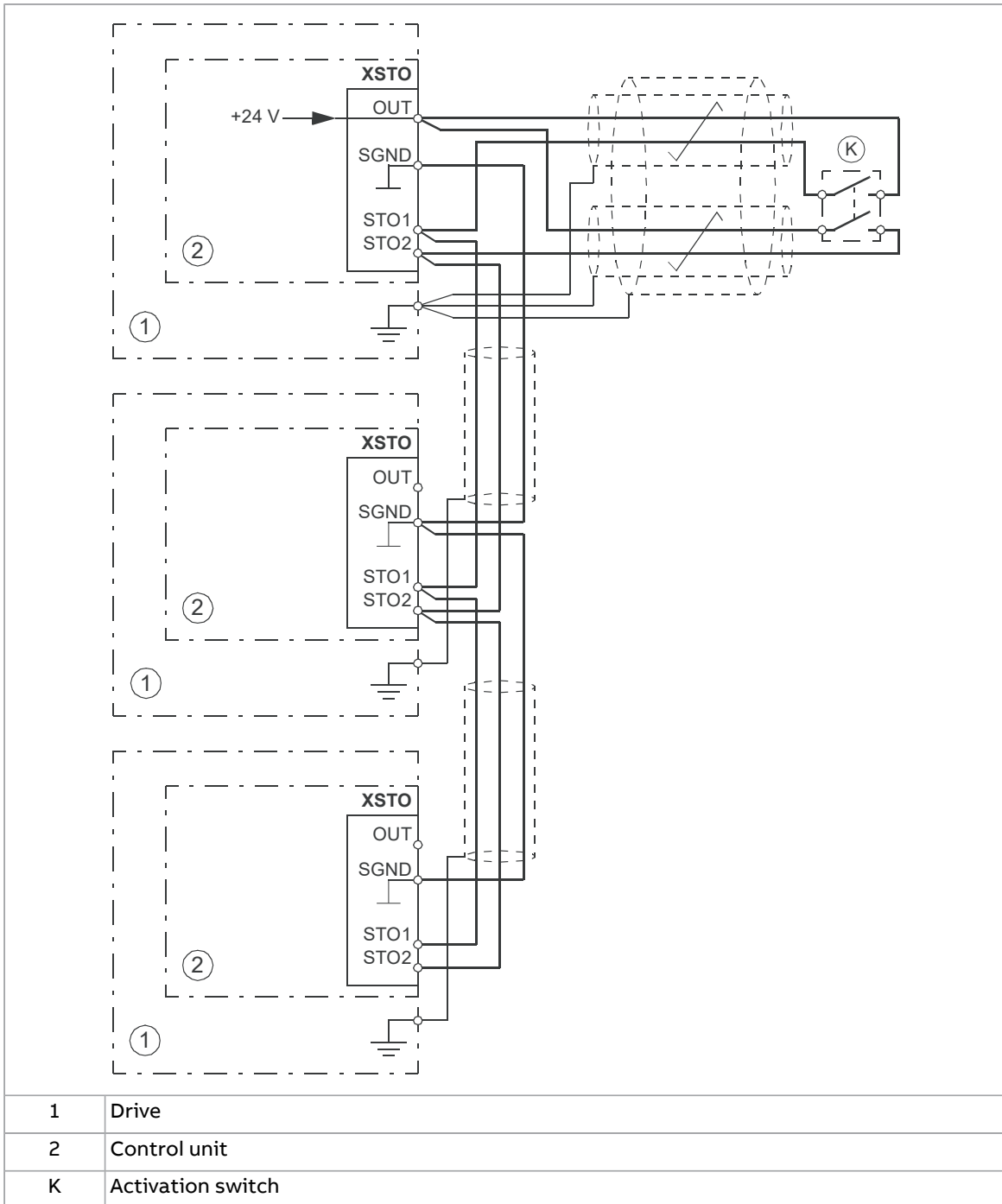
Note: A single-channel activation switch can limit the SIL/PL capability of the safety function to a lower level than the SIL/PL capability of the STO function of the drive.

■ Multiple drives

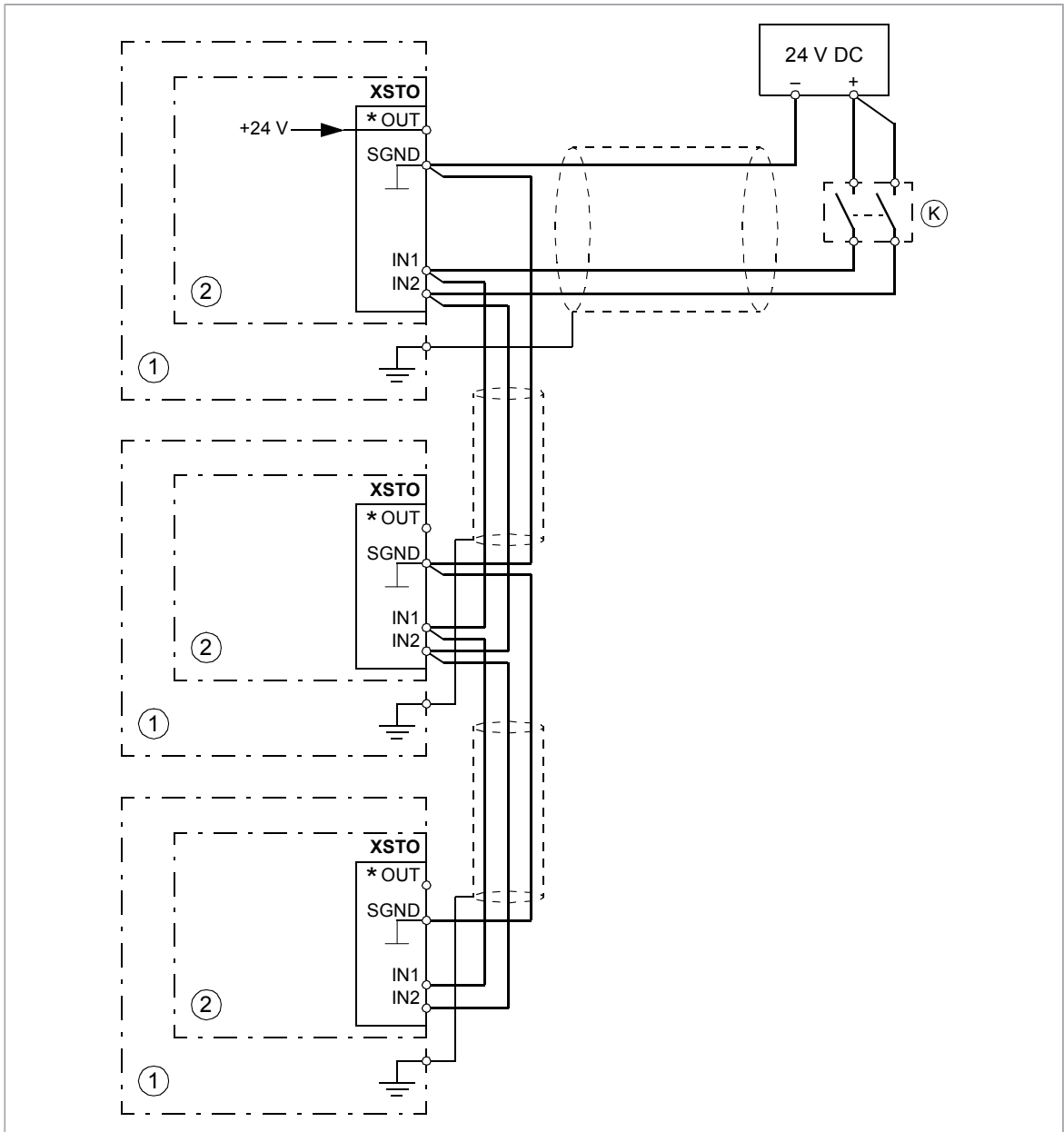
Internal power supply (example, drives with ZCU-xx and BCU-x2)



Internal power supply (example, drives with UCU-2x)

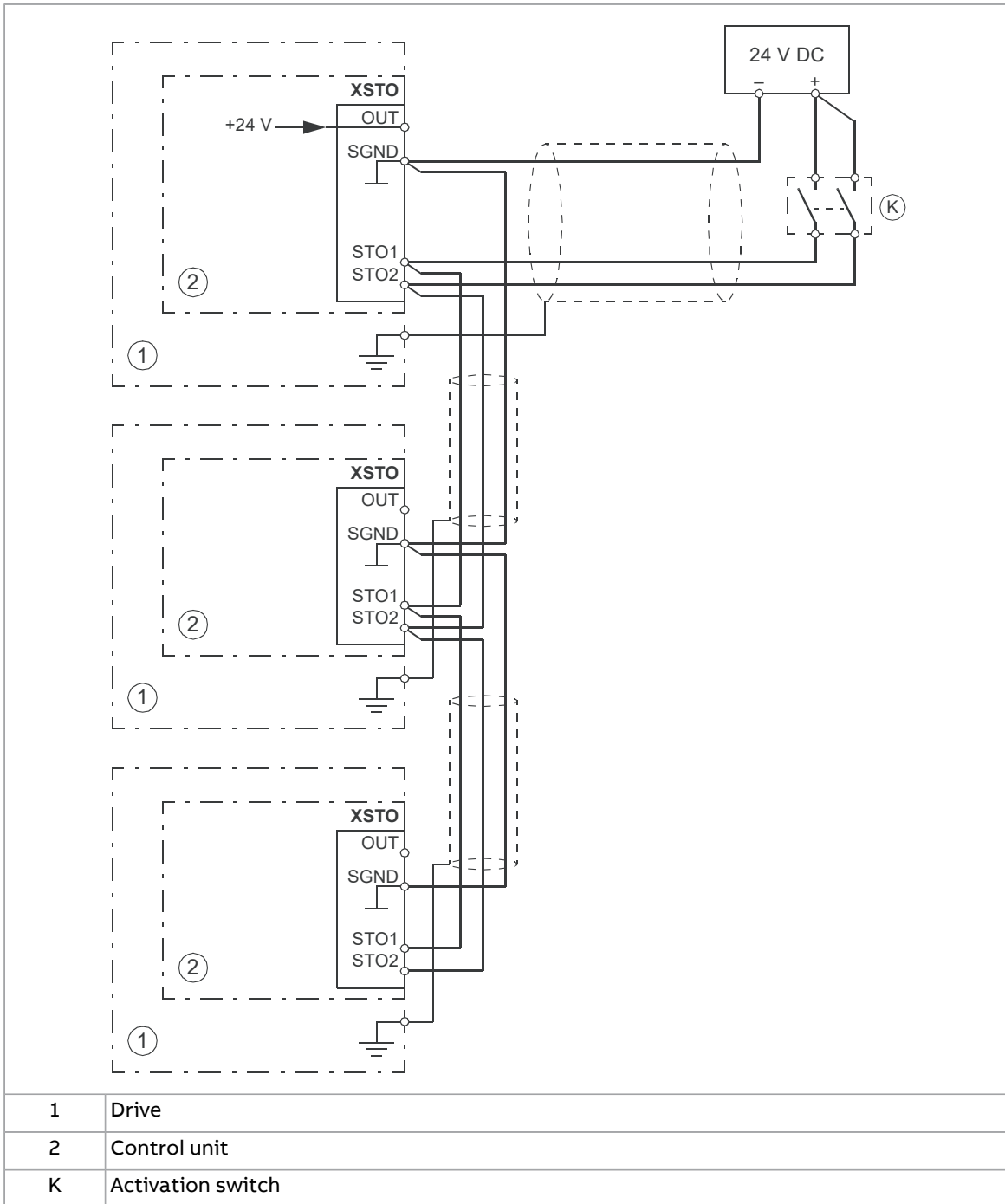


External power supply (example, drives with ZCU-xx and BCU-x2)



1	Drive
2	Control unit
K	Activation switch
* Terminal designation may vary depending on drive type	

External power supply (example, drives with UCU-2x)



Operation principle

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

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

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

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

Start-up including validation 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 a validation test. The test must be performed

1. at initial start-up of the safety function
2. after any changes related to the safety function (circuit boards, wiring, components, settings, replacement of inverter module, etc.)
3. after any maintenance work related to the safety function
4. after a drive firmware update
5. at the proof test of the safety function.

■ Competence

The validation 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.

■ Validation test reports

Signed validation 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 validation tests performed due to changes or maintenance shall be logged into the logbook.


■ Validation test procedure

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

Note: If the drive is equipped with safety option +L513, +L514, +L536, +L537, +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q965, +Q978 or +Q979, also do the procedure shown in the documentation of the option.

If an FSO or FSPS module is installed, refer to its documentation.

Note: All inverter modules of the drive must be powered and connected to the STO circuit during the validation test.

Action	<input checked="" type="checkbox"/>
 WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	<input type="checkbox"/>
Make sure that the motor can be run and stopped freely during start-up.	<input type="checkbox"/>
Stop the drive (if running), switch the input power off and isolate the drive from the power line using a disconnecter.	<input type="checkbox"/>
Check the STO circuit connections against the wiring diagram.	<input type="checkbox"/>
Close the disconnecter and switch the power on.	<input type="checkbox"/>
In case the drive consists of parallel-connected modules, check that the number of modules detected (parameter 95.14) matches the actual number of modules, and that the drive type is correctly set in parameter 95.31.	<input type="checkbox"/>

Action	<input checked="" type="checkbox"/>
<p>Test the operation of the STO function when the motor is stopped.</p> <ul style="list-style-type: none"> • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. <p>Make sure that the drive operates as follows:</p> <ul style="list-style-type: none"> • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). • Give a start command to verify that the STO function blocks the drive's operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
<p>Test the operation of the STO function when the motor is running.</p> <ul style="list-style-type: none"> • Start the drive and make sure the motor is running. • Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for the 'running' state in parameter 31.22 (see the firmware manual). • Reset any active faults and try to start the drive. • Make sure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
<p>Test the operation of the failure detection of the drive. The motor can be stopped or running.</p> <ul style="list-style-type: none"> • Open the 1st input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA81 fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the drive's operation. The motor should not start. • Open the STO circuit (both channels). • Give a reset command. • Close the STO circuit (both channels). • Reset any active faults. Restart the drive and check that the motor runs normally. • Open the 2nd input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA82 fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the drive's operation. The motor should not start. • Open the STO circuit (both channels). • Give a reset command. • Close the STO circuit (both channels). • Reset any active faults. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
<p>Document and sign the validation test report which verifies that the safety function is safe and accepted for operation.</p>	<input type="checkbox"/>

Use

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



WARNING!

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



WARNING!

The Safe torque off functionality is only achieved through the XSTO connector of the inverter control unit (A41). True Safe torque off functionality is not achieved through the XSTO connectors of other control units (such as the supply control unit or the brake control unit).

The Safe torque off function is supported by any ACS880 inverter or drive control program. It is not supported by supply, DC/DC converter or brake firmware.



WARNING!

The drive cannot detect or memorize any changes in the STO circuitry when the drive control unit is not powered or when the main power to the drive is off. If both STO circuits are closed and a level-type start signal is active when the power is restored, it is possible that the drive starts without a fresh start command. Take this into account in the risk assessment of the system.



WARNING!

Permanent magnet or synchronous reluctance [SynRM] motors only:

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

Notes:

- If a running drive is stopped by using the Safe torque off function, the drive will cut off the motor supply voltage and the motor will coast to a stop. If this causes
-

danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.

- The Safe torque off function overrides all other functions of the drive.
 - The Safe torque off function is ineffective against deliberate sabotage or misuse.
 - The Safe torque off function has been designed to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. The assembler of the machine must inform the final user about the residual risks.
-

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 10 years; see section [Safety data \(page 301\)](#).

There are two alternative procedures for proof testing:

1. Perfect proof testing. It is assumed that all dangerous failures of the STO circuit are detected during the test. PFD_{avg} values for STO with the perfect proof testing procedure are given in the safety data section.
2. Simplified proof testing. This procedure is faster and simpler than perfect proof testing. Not all dangerous failures of the STO circuit are detected during the test. The PFD_{avg} value for STO with the simplified proof testing procedure is given in the safety data section.

Note: The proof testing procedures are only valid for proof testing (periodic test, item 5 under section [Start-up including validation test](#)) but not for re-validation after changes made in the circuit. Re-validation (items 1..4 under [Start-up including validation test](#)) must be done according to the initial validation procedure.

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

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

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

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

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

If any wiring or component change is needed after start-up, or the parameters are restored, do the test given in section [Validation test procedure \(page 294\)](#).


Use only spare parts approved by ABB.

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


■ Competence

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

■ **Perfect proof test procedure**

Action	<input checked="" type="checkbox"/>
 WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	<input type="checkbox"/>
Test the operation of the STO function. If the motor is running, it will stop during the test. <ul style="list-style-type: none"> • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: <ul style="list-style-type: none"> • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
Test the operation of the failure detection of the drive. The motor can be stopped or running. <ul style="list-style-type: none"> • Open the 1st input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA81 fault indication (see the firmware manual). • Open the STO circuit (both channels). • Give a reset command. • Close the STO circuit (both channels). • Reset any active faults. • Open the 2nd input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA82 fault indication (see the firmware manual). • Open the STO circuit (both channels). • Give a reset command. • Close the STO circuit (both channels). • Reset any active faults. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
Document and sign the test report to verify that the safety function has been tested according to the procedure.	<input type="checkbox"/>

■ **Simplified proof test procedure**

Action	<input checked="" type="checkbox"/>
 WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	<input type="checkbox"/>
Test the operation of the STO function. If the motor is running, it will stop during the test. <ul style="list-style-type: none"> • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: <ul style="list-style-type: none"> • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
Document and sign the test report to verify that the safety function has been tested according to the procedure.	<input type="checkbox"/>

Fault tracing

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

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an FA81 or FA82 fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, will trigger the same reaction.

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

Any failures of the Safe torque off function must be reported to ABB.

Safety data

The safety data for the Safe torque off function is given below.

Note: The safety data is calculated for redundant use, and applies only if both STO channels are used.

Frame size	SIL	SC	PL	PFH ($T_1 = 20$ a) (1/h)	PFD _{avg}		MTTF _D (a)	DC (%)	SFF (%)	Cat.	HFT	CCF	T _M (a)	PFH _{diag} (1/h)	$\lambda_{Diag,s}$ (1/h)	$\lambda_{Diag,d}$ (1/h)
					Perfect proof test $T_1 = 5$ a	Simplified proof test $T_1 = 5$ or 10 a										
R8i	3	3	e	1.21E-10	2.66E-06	5.31E-06	1.06E-05	≥90	>99	3	1	80	20	4.85E-09	3.36E-07	2.86E-07
2×R8i	3	3	e	1.21E-10	2.66E-06	5.31E-06	1.06E-05	≥90	>99	3	1	80	20	5.64E-09	4.54E-07	3.65E-07
3×R8i	3	3	e	1.21E-10	2.66E-06	5.31E-06	1.06E-05	≥90	>99	3	1	80	20	6.43E-09	5.71E-07	4.44E-07
4×R8i	3	3	e	1.21E-10	2.66E-06	5.31E-06	1.06E-05	≥90	>99	3	1	80	20	7.22E-09	6.88E-07	5.23E-07
5×R8i	3	3	e	1.21E-10	2.66E-06	5.31E-06	1.06E-05	≥90	>99	3	1	80	20	8.00E-09	8.06E-07	6.01E-07
6×R8i	3	3	e	1.21E-10	2.66E-06	5.31E-06	1.06E-05	≥90	>99	3	1	80	20	8.79E-09	9.23E-07	6.80E-07

3AXDI0000078136 J, 3AXDI00001716945 C

- The STO is a type B safety component as defined in IEC 61508-2.
- Relevant failure modes:
 - The STO trips spuriously (safe failure)
 - The STO does not activate when requested
 - A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- STO response times:
 - STO reaction time (shortest detectable break): 1 ms
 - STO response time: 2 ms (typical), 25 ms (maximum)
 - Fault detection time: Channels in different states for longer than 200 ms
 - Fault reaction time: Fault detection time + 10 ms.
- Indication delays:
 - STO fault indication (parameter 31.22) delay: < 500 ms
 - STO warning indication (parameter 31.22) delay: < 1000 ms.

■ Terms and abbreviations

Term or abbreviation	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: (Total number of life units) / (Number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD _{avg}	IEC 61508	Average probability of dangerous failure on demand, that is, mean unavailability of a safety-related system to perform the specified safety function when a demand occurs
PFH	IEC 61508	Average frequency of dangerous failures per hour, that is, average frequency of a dangerous failure of a safety related system to perform the specified safety function over a given period of time
PFH _{diag}	IEC/EN 62061	Average frequency of dangerous failures per hour for the diagnostic function of STO
PL	EN ISO 13849-1	Performance level. Levels a...e correspond to SIL
Proof test	IEC 61508, IEC 62061	Periodic test performed to detect failures in a safety-related system so that, if necessary, a repair can restore the system to an "as new" condition or as close as practical to this condition
SC	IEC 61508	Systematic capability (1...3)
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1...3)
STO	IEC/EN 61800-5-2	Safe torque off

304 The Safe torque off function

Term or abbreviation	Reference	Description
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. See also section Maintenance.
T_M	EN ISO 13849-1	Mission time: the period of time covering the intended use of the safety function/device. After the mission time elapses, the safety device must be replaced. Note that any T_M values given cannot be regarded as a guarantee or warranty.
λ_{Diag_d}	IEC 61508-6	Dangerous failure rate (per hour) of the diagnostics function of STO
λ_{Diag_s}	IEC 61508-6	Safe failure rate (per hour) of the diagnostics function of STO

■ TÜV certificate

The TÜV certificate is available on the Internet at www.abb.com/drives/documents.

■ Declarations 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, -04FXT

ACS880-07, -17, -37, -107

ACS880-104

ACS880 multidrives

ACS880-104LC (690V, frames nxR7i and nxR8i)

ACS880-07CLC, -07LC, -17LC, -37LC, -107LC (690V, frames nxR7i and nxR8i)

ACS880 liquid-cooled multidrives

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 (SS1-t) with FSPS-21 module (+Q986)

Safe stop 1 (SS1-t and SS1-r), 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 (SS1-t and SS1-r), 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, -07LC, -17LC, -37LC, ACS880 multidrives and ACS880 liquid-cooled 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.

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 62061:2021	Safety of machinery – Functional safety of safety-related 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 60204-1:2018	Safety of machinery – Electrical equipment of machines – Part 1: General requirements

The following other standard has been applied:

IEC 61508:2010, parts 1-3	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.

Authorized to compile the technical file: ABB Oy, Hiomotie 13, 00380 Helsinki, Finland

Helsinki, 23 Jun 2022

Signed for and on behalf of:

Peter Lindgren
Peter Lindgren
Vice President, ABB Oy

Vesa Tiihonen
Vesa Tiihonen
Manager, Reliability and Quality, ABB Oy



Declaration of Conformity

Supply of Machinery (Safety) Regulations 2008

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, -04FXT

ACS880-07, -17, -37, -107

ACS880-104

ACS880 multidrives

ACS880-104LC (690V, frames nxR7i and nxR8i)

ACS880-07CLC, -07LC, -17LC, -37LC, -107LC (690V, frames nxR7i and nxR8i)

ACS880 liquid-cooled multidrives

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 (SS1-t) with FSPS-21 module (+Q986)

Safe stop 1 (SS1-t and SS1-r), 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 (SS1-t and SS1-r), 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, -07LC, -17LC, -37LC, ACS880 multidrives and ACS880 liquid-cooled 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 the Supply of Machinery (Safety) Regulations 2008, when the listed safety functions are used for safety component functionality.

The following designated 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 60204-1:2018	Safety of machinery – Electrical equipment of machines – Part 1: General requirements

The following other standards have been applied:

EN 61508:2010, parts 1-3	Functional safety of electrical / electronic / programmable electronic safety-related systems
EN 61800-5-2:2017	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 UK statutory requirements, which are notified in a single declaration of conformity 3AXD10001346556.

Authorized to compile the technical file:
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Helsinki, 23 Jun 2022

Signed for and on behalf of:

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Vesa Tiihonen
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Resistor braking

Contents of this chapter

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

Operation principle

The brake chopper handles the extra energy generated by motor during a quick deceleration. The extra energy increases the drive DC link voltage. The chopper connects the brake resistor to the DC link whenever the voltage is greater than the limit defined by the control program. Energy consumption by the resistor losses lowers the voltage until the resistor can be disconnected.

Factory-installed brake choppers and resistors

The following brake choppers (option +D150) and resistors (+D151) are available for the drive as factory-installed. It is also possible to use option +D150 with a custom resistor assembly.

U_N	ACS880-37 type	Brake chopper type (+D150)	Brake resistor type (+D151)	
400 V	ACS880-37-0450A-3	NBRA-659	2 × SAFUR180F460	
	ACS880-37-0620A-3			
	ACS880-37-0870A-3	2 × NBRA-659	2 × (2 × SAFUR180F460)	
	ACS880-37-1110A-3			
	ACS880-37-1210A-3			
	400 V	ACS880-37-1430A-3	3 × NBRA-659	3 × (2 × SAFUR180F460)
ACS880-37-1700A-3				
500 V	ACS880-37-0420A-5	NBRA-659	2 × SAFUR200F500)	
	ACS880-37-0570A-5			
	ACS880-37-0780A-5	2 × NBRA-659	2 × (2 × SAFUR200F500)	
	ACS880-37-1010A-5			
	ACS880-37-1110A-5			
	500 V	ACS880-37-1530A-5	3 × NBRA-659	3 × (2 × SAFUR200F500)
690 V	ACS880-37-0320A-7	NBRA-669	2 × SAFUR200F500)	
	ACS880-37-0390A-7			
	ACS880-37-0580A-7	2 × NBRA-669	2 × (2 × SAFUR200F500)	
	ACS880-37-0660A-7			
	ACS880-37-0770A-7			
	690 V	ACS880-37-0770A-7	3 × NBRA-669	3 × (2 × SAFUR200F500)
		ACS880-37-0770A-7		
ACS880-37-1130A-7				

Technical data

■ Ratings of chopper/resistor combinations

U_N	Chopper(s)	Resistors	R (ohm)	P_{brmax} (kW)	P_{brcont} (kW)	I_{max} (A)	Duty Cycle (10/60 s)		Duty Cycle (1/5 min)	
							P_{br} (kW)	I_{rms} (A)	P_{br} (kW)	I_{rms} (A)
400 V	NBRA-659	2 × SAFUR180F460	1.2	353	54	545	287	444	167	444
400 V	2 × NBRA-659	2 × (2 × SAFUR180F460)	1.2	706	108	1090	575	888	333	514
400 V	3 × NBRA-659	3 × (2 × SAFUR180F460)	1.2	1058	162	1635	862	1332	500	771
500 V	NBRA-659	2 × SAFUR200F500	1.35	403	54	605	287	355	167	206
500 V	2 × NBRA-659	2 × (2 × SAFUR200F500)	1.35	806	108	1210	575	710	333	412
500 V	3 × NBRA-659	3 × (2 × SAFUR200F500)	1.35	1208	162	1815	862	1065	500	618
690 V	NBRA-669	2 × SAFUR200F500	1.35	404	54	835	287	257	167	149
690 V	2 × NBRA-669	2 × (2 × SAFUR200F500)	1.35	807	108	1670	575	514	333	298
690 V	3 × NBRA-669	3 × (2 × SAFUR200F500)	1.35	1211	162	2505	862	771	500	447

■ Definitions

U_N Nominal voltage

R_n Nominal (recommended) resistance of the resistor assembly of one chopper module

R_{min} Resistance of specified resistors (per chopper module). This is also the minimum allowed resistance for the resistor assembly.

P_{brmax} Maximum short-term (1 min in every 10 min) braking power

P_{brcont} Maximum continuous power rating

I_{max} Maximum peak current

P_{br} Maximum braking power for the specified duty cycle

I_{rms} Rms current for the specified duty cycle

■ SAFUR resistor data

The following SAFUR resistors are available separately.

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Type	U_N	R	E_R	P_{Rcont}	IPxx
	V	ohm	kJ	kW	
SAFUR125F500	500	4.0	3600	9.0	IP00
SAFUR210F575	575	3.4	4200	10.5	IP00
SAFUR200F500	500	2.7	5400	13.5	IP00
SAFUR180F460	460	2.4	6000	15.0	IP00

U_N Nominal voltage

R Resistance

E_R Short energy pulse that the resistor assembly will withstand each 400 seconds

P_{Rcont} Continuous power (heat) dissipation of the resistor when placed correctly. Energy E_R dissipates in 400 seconds.

IPxx Degree of protection

■ Terminals and cable lead-through data of factory-installed chopper/resistor cubicles

See the dimension drawings delivered with the unit.

Planning the braking system

■ Verifying the load capacity of the braking equipment

1. Calculate the maximum power generated by the motor during braking (P_{\max}).
2. Ensure that the maximum power rating of the braking equipment is equal to or greater than P_{\max} .
The P_{brmax} values specified in the ratings table are for the reference braking cycle (1 minute of braking, 9 minutes of rest). If the actual duty cycle does not correspond to the reference cycle, either use the power rating given for the other two reference cycles (P_{br}), or calculate the maximum braking power for a custom braking cycle. See below for instructions on calculating P_{br} for other braking cycles.
3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the heat dissipation capacity of the resistor (E_R). If you use custom resistor(s), see also the separate instructions below.
If the E_R value of the resistor is not sufficient, it is possible to use a four-resistor assembly in which two resistors are connected in parallel, two in series. The E_R value of the four-resistor assembly is four times that of a single resistor.

Custom resistor

Resistors other than those available as option +D151 can be used provided that

- the resistance is not lower than the value given in the ratings table



WARNING!

Never use a brake resistor with a resistance below the value specified for the particular drive / brake chopper / resistor combination. The drive and the chopper would not be able to handle the overcurrent caused by the low resistance.

- the resistance of the custom resistor does not restrict the braking capacity needed, ie.

$$P_{\max} < U_{\text{DC}}^2 / R$$

where

P_{\max}	Maximum power generated by the motor during braking
U_{DC}	Voltage over the resistor during braking. UDC equals 1.35 · 1.25 · 415 V DC (when supply voltage is 380 to 415 V AC) 1.35 · 1.25 · 500 V DC (when supply voltage is 440 to 500 V AC) or 1.35 · 1.25 · 690 V DC (when supply voltage is 525 to 690 V AC)
R	Resistor resistance (ohm)

- the heat dissipation capacity E_R of the resistor is sufficient for the application (see step 3 above).

Calculating the maximum braking power for a custom duty cycle

These rules must be met during any braking cycle:

1. Braking energy transferred during any ten minute period must be less than or equal to the energy transferred during the reference braking cycle (1/9 min).
2. The maximum braking power for a custom braking cycle (P_{br}) must not exceed the rated maximum value P_{brmax} .

The rules as equations:

1. $n \times P_{br} \times t_{br} \leq P_{brmax} \times 60 \text{ s} \Rightarrow P_{br} \leq (P_{brmax} \times 60 \text{ s}) / (n \times t_{br})$
2. $P_{br} \leq P_{brmax}$

n Number of braking pulses during a 10-minute period

P_{br} Maximum braking power (kW) for a custom braking cycle

t_{br} Braking time (s)

P_{brmax} Maximum braking power for a reference braking cycle (1 minute of braking, 9 minutes of rest)

Example 1

The duration of a braking cycle is 30 minutes. The braking time is 15 minutes.

Result: If the braking time exceeds 10 minutes, the braking is considered continuous. The allowed continuous braking power is 10% of maximum braking power (P_{brmax}).

Example 2

The duration of a braking cycle (T) is three minutes. The braking time (t_{br}) is 40 seconds.

1. $n \times P_{br} \times t_{br} \leq P_{brmax} \times 60 \text{ s} \Rightarrow P_{br} \leq (P_{brmax} \times 60 \text{ s}) / (4 \times 40 \text{ s}) = 0.375 \times P_{brmax}$
2. $P_{br} \leq P_{brmax} \Leftrightarrow 0.375 \times P_{brmax} \leq P_{brmax}$ **OK**

Result: The maximum braking power for the custom braking cycle is 37% of the rated value given for the reference cycle.

■ Selecting and routing the cables of a custom resistor

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

Minimizing electromagnetic interference

Make sure that the installation is compliant with the EMC requirements. Obey these rules in order to minimize electromagnetic interference caused by the rapid voltage and current changes in the resistor cables:

- Shield the brake resistor cable. Use shielded cable or a metallic enclosure. If you use unshielded single-core cables, route them inside a cabinet that efficiently suppresses the radiated emissions.
 - Install the cables away from other cable routes.
 - Avoid long parallel runs with other cables. The minimum parallel cabling separation distance is 0.3 meters (1 ft).
 - Cross the other cables at 90° angles.
 - Keep the cable as short as possible in order to minimize the radiated emissions and stress on the brake chopper. The longer the cable the greater the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.
-

Maximum cable length

The maximum length of the resistor cable(s) is 50 m (164 ft).

■ Selecting the installation location for the brake resistors

Protect the open (IP00) brake resistors against contact. Install the brake resistor in a place where it cools effectively. Arrange the cooling of the resistor so that:

- no danger of overheating is caused to the resistor or nearby materials, and
- the temperature of the space that the resistor is in does not go above the allowed maximum value.



WARNING!

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

■ Protecting the brake system against thermal overload

The brake chopper protects itself and the resistor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. By default, a brake chopper fault is wired to stop the supply unit of the drive.

Thermal protection of the resistors

The standard resistors available as option +D151 are equipped with a thermal switch. The switches of the resistors are wired in series and connected to the Enable input of the brake chopper. The relay output of the chopper is wired to the supply control unit so that a chopper fault condition stops the supply unit.

With custom resistors, user must implement a similar protection. Use cable rated as follows:

- twisted pair, shielding recommended
- rated operating voltage between a conductor and ground (U_0) > 750 V
- insulation test voltage > 2.5 kV.

Keep the cable as short as possible.

■ Protecting the resistor cable against short-circuits

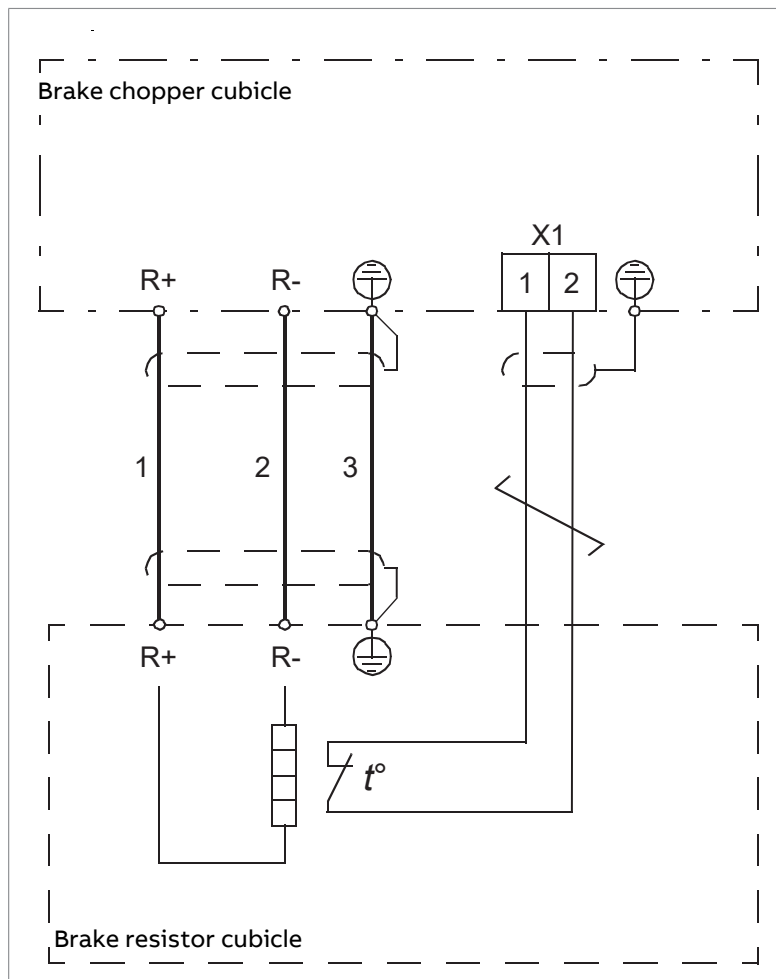
The input fuses of the drive will also protect the resistor cable provided that the resistor cable is of the same type as the input cable.

Mechanical installation of custom brake resistors

Obey the resistor manufacturer's instructions.

Electrical installation of custom brake resistors

■ Connection diagram



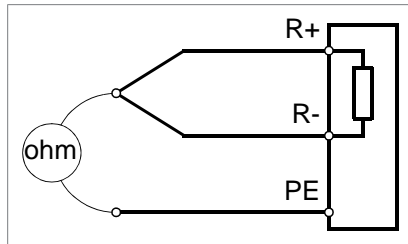
■ Connection procedure



WARNING!

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

- Do the steps in section Electrical safety precautions in chapter Safety instructions before you start the work.
- Connect the resistor cable at the resistor end only. If a shielded three-conductor cable is used, cut off the third conductor. Ground the twisted shield of the cable as well as any separate PE conductor (if present).
- At the chopper end of the cable, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



- Connect the resistor cable to the R+ and R- terminals of the chopper. If a shielded three-conductor cable is used, cut off the third conductor. Ground the twisted shield of the cable as well as any separate PE conductor (if present).
- Connect the thermal switch of the brake resistor to the enable input (X1) on the brake chopper control board. Use cable specified under [Thermal protection of the resistors](#) (page 315). If there are multiple thermal switches, connect them in series.

**WARNING!**

The ENABLE input terminal block of the brake chopper is at intermediate circuit potential when the supply unit of the drive is running. This voltage is extremely dangerous and can cause serious damage or injury if the isolation level and protection conditions for the thermal switches are not sufficient. The thermal switches must always be properly insulated (over 2.5 kV) and shrouded against contact.

Brake system start-up

Check the settings of the following inverter control program parameters (ACS880 primary control program):

- *30.30 Overvoltage control*: Overvoltage control disabled.

For settings of other control programs, see the appropriate firmware manual.

Note: New brake resistors may be coated with storage grease. As the brake chopper operates for the first time, the grease burns off and may produce some smoke. Make sure there is proper ventilation.

Maintenance

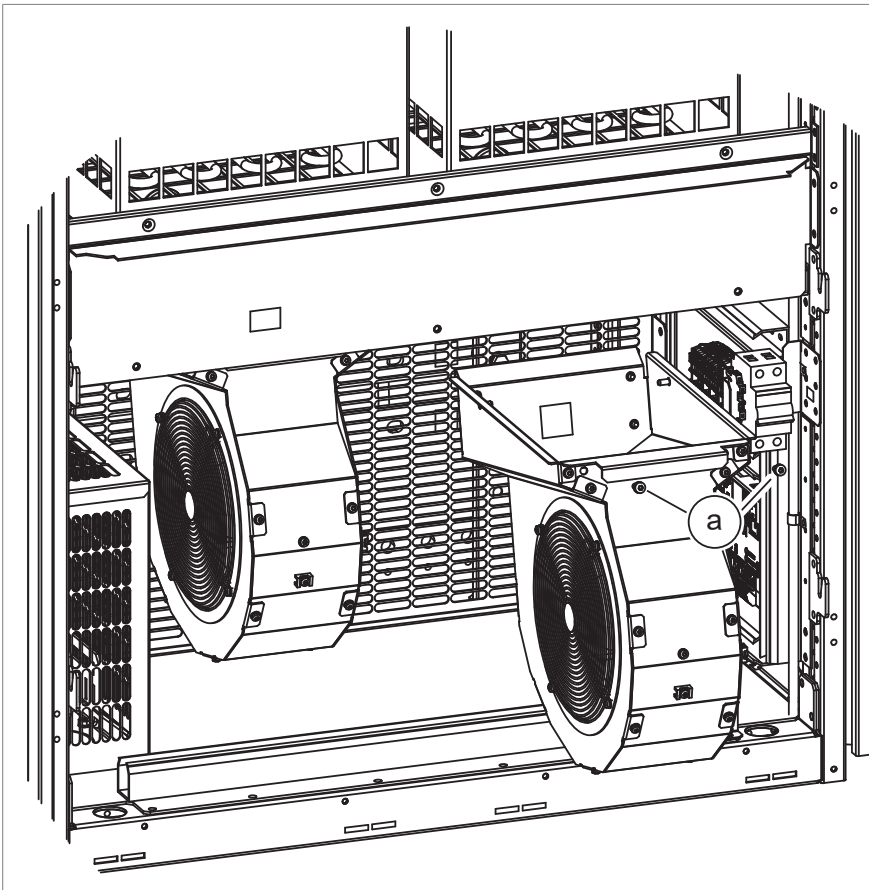
■ Replacing the brake resistor cabinet fan



WARNING!

Wear protective gloves and long sleeves. Some parts have sharp edges.

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 21\)](#) before you start the work.
2. Remove any shrouding in front of the cooling fans.
3. Disconnect the fan wiring.
4. Undo the two fastening screws (a).
5. Pull the fan housing outwards.
6. Install a new fan in reverse order.



Further information

Product and service inquiries

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

Product training

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

Providing feedback on ABB manuals

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

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