ABB INDUSTRIAL DRIVES

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

Hardware manual



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

Hardware manual

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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

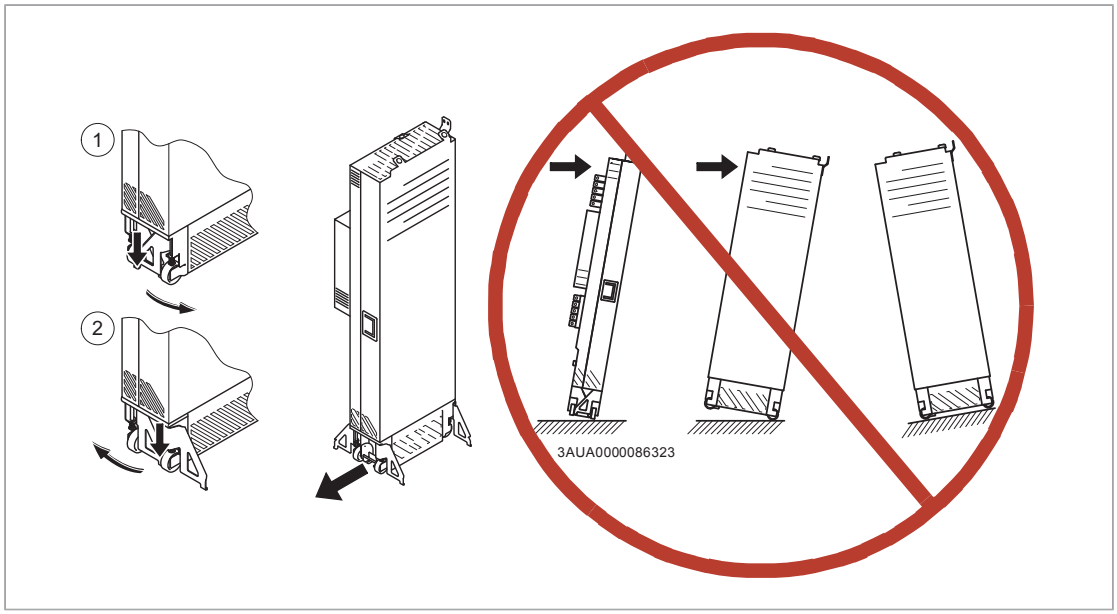
These instructions are for all personnel who do work on the drive.

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

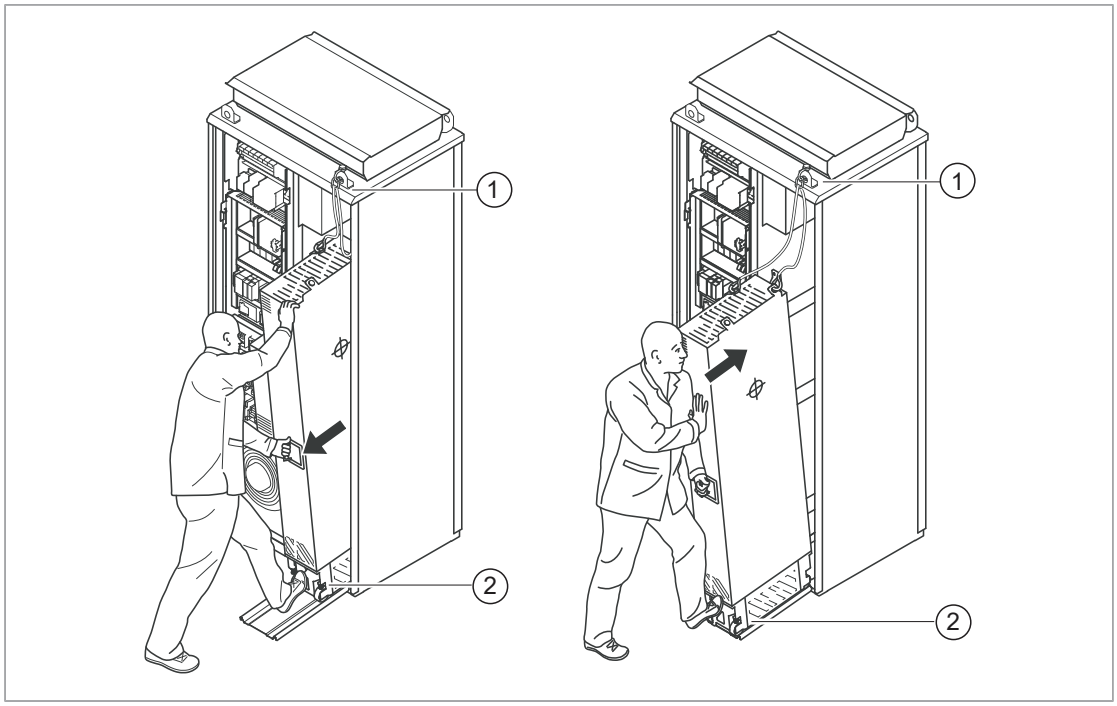
- Keep the drive in its package until you install it. After unpacking, protect the drive from dust, debris and moisture.
- Use the required personal protective equipment: safety shoes with metal toe cap, safety glasses, protective gloves and long sleeves, etc. Some parts have sharp edges.
- Lift a heavy 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.
- 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 use the module extraction/installation ramp with plinth heights that exceed the maximum allowed height.
- Attach the module extraction/installation ramp carefully.
- Make sure that the module does not fall over when you move it on the floor: To open the support legs, press each leg a little down and turn it aside (1, 2). Whenever possible attach the module also with chains. Do not tilt the drive module. It is heavy and its center of gravity is high. The module overturns when tilted more than 5 degrees. Do not leave the module unattended on a sloping floor.



- To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet (1) before you push the module into the cabinet and pull it from the cabinet. Push the module into the cabinet and pull it from the cabinet carefully preferably with help from another person. Keep a constant pressure with one foot on the base of the module (2) to prevent the module from falling on its back.



- 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 disconnector of the supply transformer. (The main disconnecting device in the drive cabinet does not disconnect the voltage from the AC input power busbars of the drive cabinet.)
   - Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
   - If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
   - Disconnect 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.

6. Install temporary grounding as required by the local regulations.
7. Ask for a permit to work from the person in control of the electrical installation work.

Additional instructions and notes



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

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

- 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.
- Remove the code labels attached to mechanical parts such as busbars, shrouds and sheet metal parts before installation. They may cause bad electrical connections, or, after peeling off and collecting dust in time, cause arcing or block the cooling air flow.

Note:

- When the drive is connected to the input power, the motor cable terminals and the DC bus are 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.

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 19).
- 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.



2

Introduction to the manual

Contents of this chapter

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

Applicability

This manual applies to ACS880-14 drive modules intended for user-defined cabinet installations.

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

The frame size identifies information which concerns only a certain frame size of the drive. The frame size is shown on the type designation label. All frame sizes are listed in the technical data.

The option code (A123) identifies information which concerns only a certain optional selection. The options included in the drive are listed on the type designation label.

Quick installation, commissioning and operating flowchart

Task	See chapter/section
Plan the mechanical and electrical installation and acquire the accessories needed (cables, fuses, etc.). Examine the ambient conditions, ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.	Guidelines for planning the mechanical installation (Page 47) Guidelines for planning the electrical installation (Page 67) Technical data (Page 177) Option manual (if optional equipment is included)
⬇	
Unpack and examine the units. Make sure that all necessary optional modules and equipment are present and correct. Only intact units can be started up.	Moving and unpacking (Page 57) Examining the delivery (Page 64) If the drive module has been non-operational for a year or more, the converter DC link capacitors need to be reformed. (Reforming the capacitors (Page 167))
⬇	
Examine the installation site. Attach the base of the cabinet to the floor.	Examining the installation site (Page 57) Ambient conditions (Page 197)
⬇	
Route the cables.	Routing the cables (Page 81)
⬇	
Measure the insulation of the supply cable, the motor and the motor cable and the resistor cable (if present).	Measuring the insulation (Page 94)
⬇	
Standard drive modules • Install the additional components into the enclosure: for example, main disconnector, main contactor, main AC fuses, etc.. • Install the drive module into the enclosure. • Connect the motor cables to the drive module terminals. • Connect the brake resistor and DC connection cables (if any) to the drive module terminals. • If the main disconnector is installed into the enclosure, connect it to the drive module terminals and the input power cabling to the disconnector. • Connect the cables from the drive module to the external control unit and install the control unit into the enclosure	Installing the drive module and LCL filter module into an enclosure (Page 128) Connecting the motor cables and installing the shrouds (Page 129) Connecting the input cables and installing the shrouds (Page 130) Connecting the external control unit to the drive module (Page 100) Attaching the external control unit (Page 102) Manuals for any optional equipment
⬇	

Task	See chapter/section
Drive modules with optional cabling panels (+H381) • Install the cabling panels into the enclosure. • Install the additional components into the enclosure: for example, main disconnector, main contactor, main AC, fuses, etc. • If the main disconnector is installed into the enclosure, connect the input power cabling to it • Connect the input power cables and motor cables to the cabling panel terminals. • Connect the brake resistor and DC connection cables (if any) to the cabling panel terminals. • Install the drive module into the enclosure • Attach the cabling panel busbars to the drive module busbars. • Connect the cables from the drive module to the control unit and install the control unit into the enclosure	Installing the mechanical accessories into a enclosure (Page 137) Connecting the power cables (Page 139) Installing the drive module into the enclosure (Page 142) Connecting the external control unit to the drive module (Page 100) Attaching the external control unit (Page 102) Manuals for any optional equipment
⬇	
Drive modules without full-size output cable connection terminals (option +0H371) and IP20 shrouds (option +0B051) • Install the additional components into the cabinet: for example, main PE busbar, main disconnector, main contactor, main AC, fuses, etc. • Install the drive module into the cabinet. • Connect the power cabling between the drive module and the rest of the main circuit components in the cabinet (if any) • Connect the input power cables and motor cables to the drive cabinet. • Connect the brake resistor and DC connection cables (if any) to the drive cabinet. • Connect the cables from the drive module to the control unit and install the control unit into the cabinet.	Mechanical installation (Page 57) Electrical installation (Page 93) Manuals for any optional equipment
⬇	
Connect the control cables to the drive control unit.	Connecting the external control unit to the drive module (Page 100)
⬇	
Examine the installation.	Installation checklist (Page 147)
⬇	
Commission the drive.	Start-up (Page 149)
⬇	
Operate the drive: start, stop, speed control etc.	Appropriate firmware manual

Terms and abbreviations

Term	Description
BGDR	Gate driver board
CMF	Common mode filtering
DDCS	Distributed drives communication system protocol
Drive	Frequency converter for controlling AC motors
DTC	Direct torque control, a motor control method
EMC	Electromagnetic compatibility
FAIO-01	Analog I/O extension module

Term	Description
FCAN	Optional CANopen® adapter module
FCNA-01	Optional ControlNet™ adapter module
FDCO-01	DDCS communication module with two pairs of 10 Mbit/s DDCS channels
FDCO-02	DDCS communication module with one pair of 10 Mbit/s and one pair of 5 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
FSPS-21	Optional functional safety module
HTL	High-threshold logic
IGBT	Insulated gate bipolar transistor
IT system	Type of supply network that has no (low-impedance) connection to ground. See IEC 60364-5.
Line-side converter	Converts alternating current and voltage to direct current and voltage for the intermediate DC link of the drive. The line-side converter can transfer energy from the electrical power system to the DC link and vice versa.
Motor-side converter	Converts intermediate DC link current to AC current for the motor
PLC	Programmable logic controller
QOIA	Optical interface adapter board
RFI	Radio-frequency interference
STO	Safe torque off (IEC/EN 61800-5-2)
TN system	Type of supply network that provides a direct connection to ground
TTL	Transistor-transistor logic
ZBIB	Adapter board connected to the control board in the control unit (ZCU)
ZCU	Type of control unit

Related documents

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



ACS880-14 manuals

3

Operation principle and hardware description

Contents of this chapter

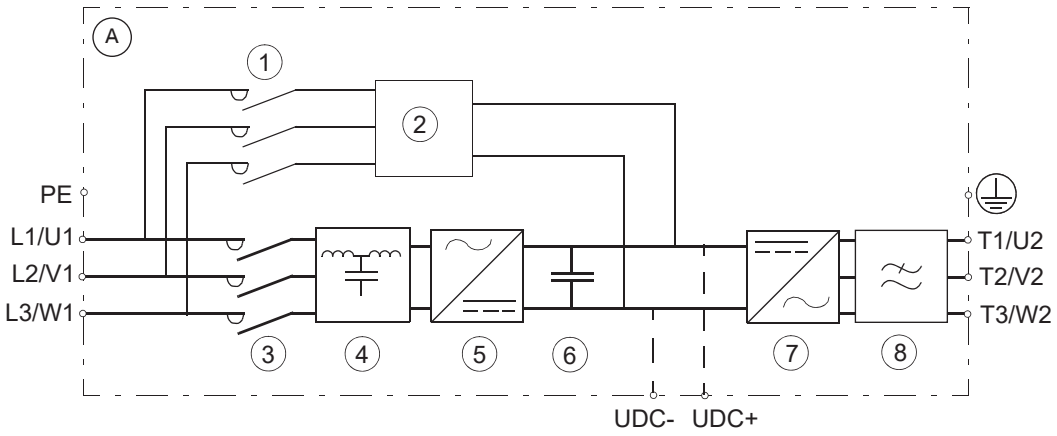
This chapter describes the operating principle and construction of the drive module.

Operation principle

The ACS880-14 is a regenerative drive module for controlling asynchronous AC induction motors, permanent magnet motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors).

The drive includes a line-side converter and a motor-side converter. The parameters and signals for both of them are combined into one primary user program.

Block diagram of the main circuit of the drive module

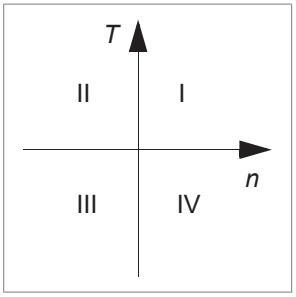


A	ACS880-14 drive module
1	Charging circuit contactor
2	Charging circuit
3	Line contactor
4	LCL filter
5	Line-side converter
6	DC link. DC circuit between the line-side converter and motor-side converter.
7	Motor-side converter
8	Common mode filter (+E208)

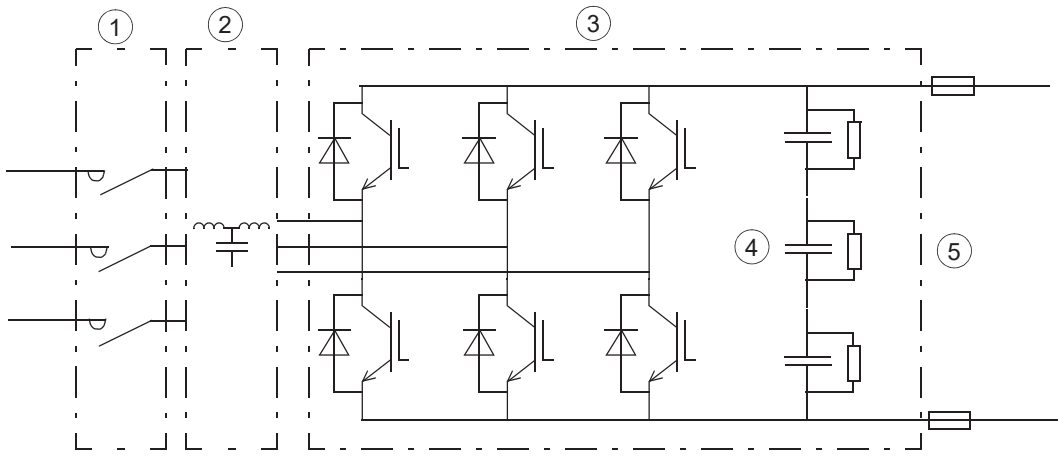
Line-side converter

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

The line-side converter can transfer energy from the electrical power system to the drive DC link and vice versa.Thus the drive can operate the motor in all four quadrants (speed, torque). The figure below visualizes the operation of the four-quadrant drive. In quadrants I and III, the drive operates in the motoring mode and takes energy from the power system. In quadrants II and IV, the drive operates in generating mode, and regenerates energy back to the power system.



The following figure shows the simplified main circuit diagram of the line-side converter.



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

AC voltage and current waveforms

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

Charging

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

Motor-side converter

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

DC voltage boost function

The drive can boost its DC link voltage. In other words, it can increase the operating voltage of the DC link from its default value.

To take the DC voltage boost function in use:

1. adjust the user DC voltage reference value (94.22) and
2. select the user-defined reference (94.22) as the source for the drive DC voltage reference (94.21).

Benefits of the DC voltage boost

- possibility to supply nominal voltage to the motor even when the supply voltage of the drive is below the motor nominal voltage level
- compensation of voltage drop due to output filter, motor cable or input supply cables
- increased motor torque in the field weakening area (ie, when the drive operates the motor in the speed range above the motor nominal speed)
- possibility to use a motor with higher nominal voltage than the actual supply voltage of the drive. Example: A drive that is connected to 415 V can supply 460 V to a 460 V motor.

Impact of DC voltage boost on input current

When the DC voltage is boosted, the drive can be drawing more input current than what is rated in the type designation label. Derating is needed:

- when the motor is running at the field weakening area or close to it and the drive is running at nominal load or close to it
- when the situation lasts long
- when the boost is more than 10%.

The rise of the input current can heat the fuses. If there are brief low line situations when the drive boosts voltage significantly, there is a risk for nuisance fuse blowing of smaller AC line fuses.

For more information, refer to ACS880-11, ACS880-31, ACS880-14, ACS880-34, ACS880-17, ACS880-37 drives product note on DC voltage boost (3AXD50000691838 [English]).

Layout

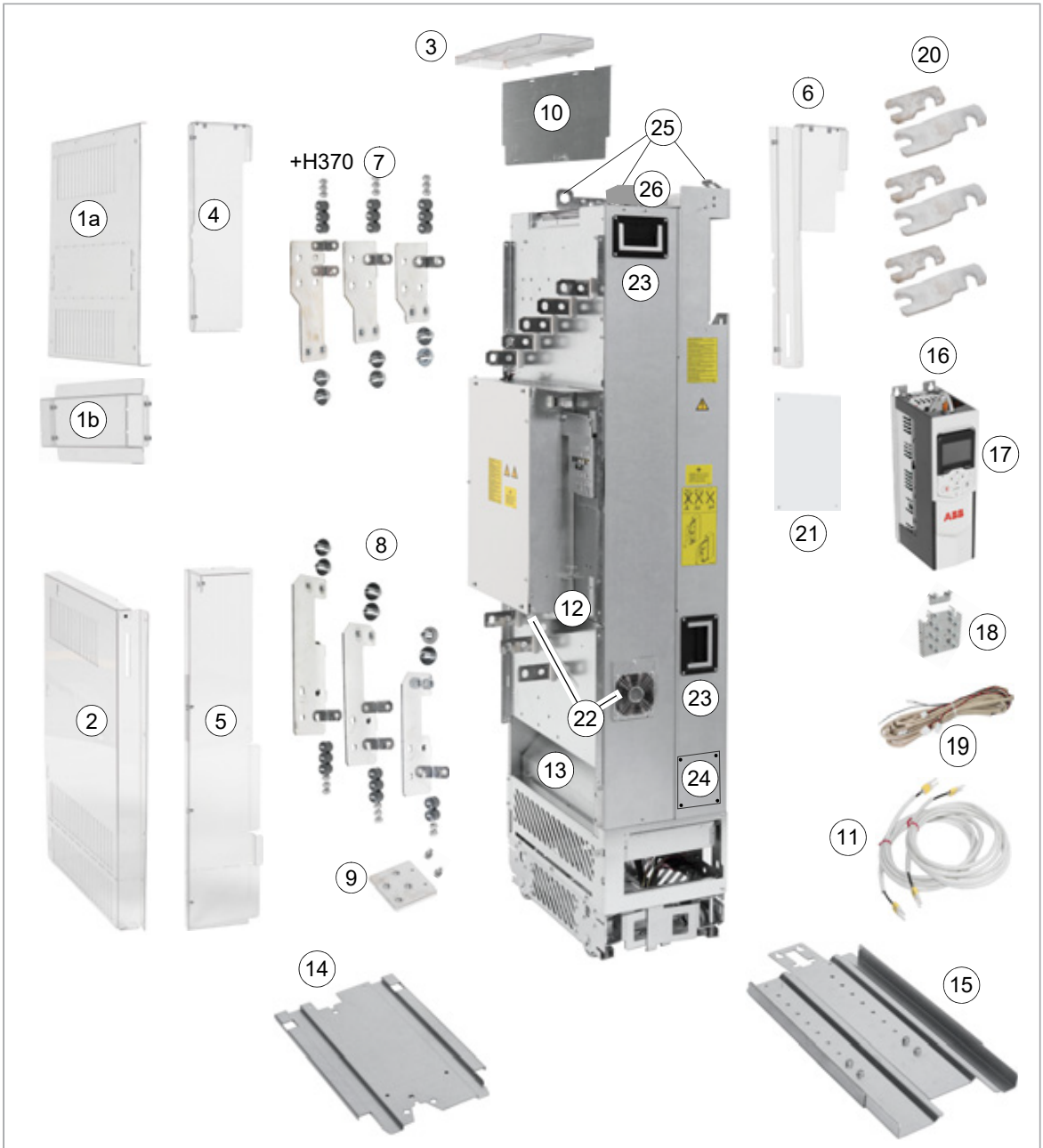
Standard drive module configuration



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

See the next page for descriptions and photos of the external control unit and drive module. For LCL filter module, see section LCL filter module (Page 37).

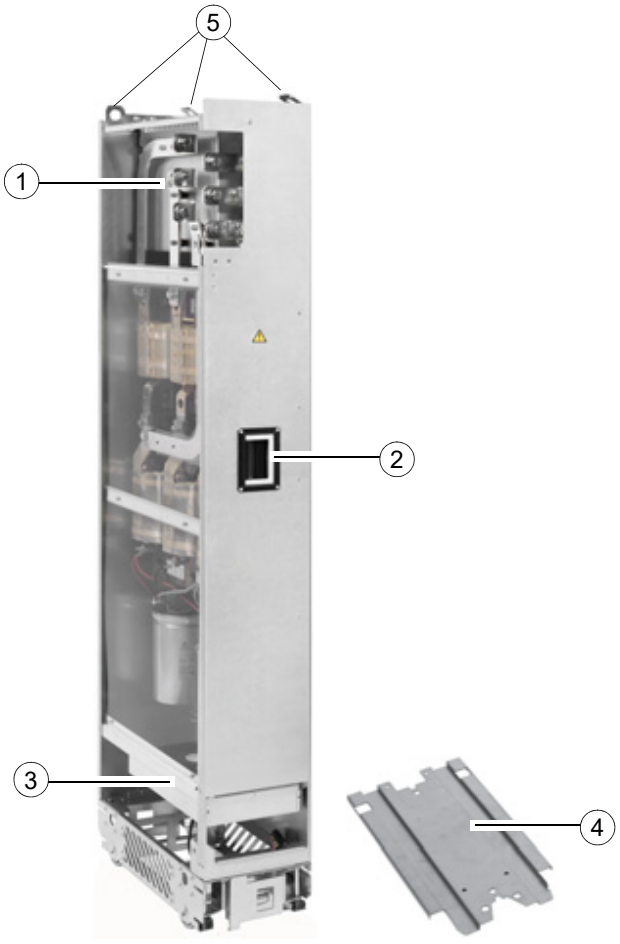
Drive module



1	Clear plastic shroud to be attached onto the drive module input power cabling (1a). Entry shroud for side cabling (1b).	14	Pedestal guide plate for the drive module
2	Clear plastic shrouds to be attached onto the drive module output power cabling	15	Telescopic extraction/installation ramp
3	Clear plastic shroud to be attached on top of the drive module (entry for top cabling)	16	External control unit
4	Upper back clear plastic shroud	17	Control panel
5	Lower back clear plastic shroud	18	Control cable clamp plate
6	Front clear plastic shroud	19	Cables for connecting the control unit to the drive module (ZBIB - INU STO and 24VDC power)
7	Input power cable connection terminals (option +H370)	20	Busbars for connecting the drive module to the LCL filter electrically

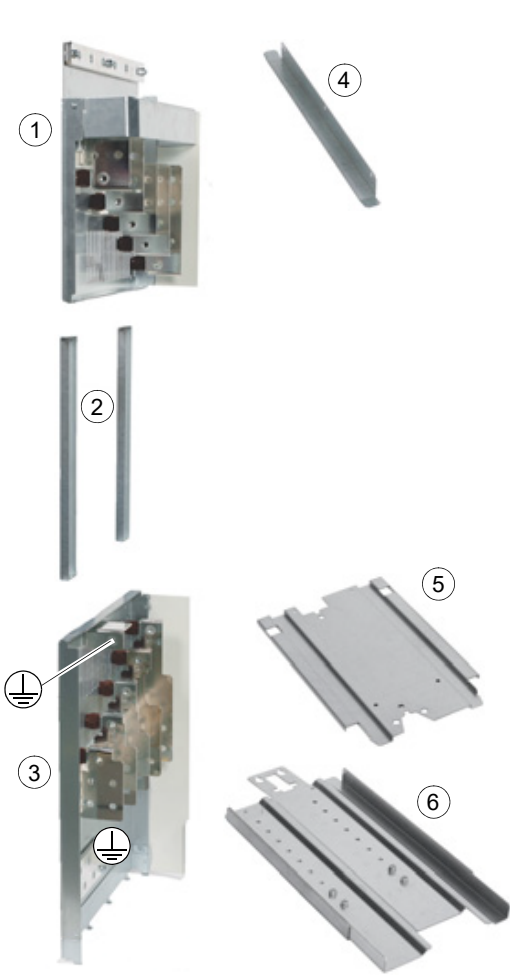
8	Output power cable connection terminals	21	Cover for the busbar connection
9	Grounding terminal for output power cable shields	22	Auxiliary cooling fan
10	Metallic shroud. With option +H370, the shroud includes a ground bar.	23	Handle
11	Fiber optic cables for connecting the control unit to the drive module (INU ZBIB - QOIA)	24	Cover. When removed, you can attach the drive module to the LCL filter module.
12	PE (ground) terminal	25	Lifting lugs
13	Main cooling fans	26	Connector for charging circuit switch or contactor

LCL filter module



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

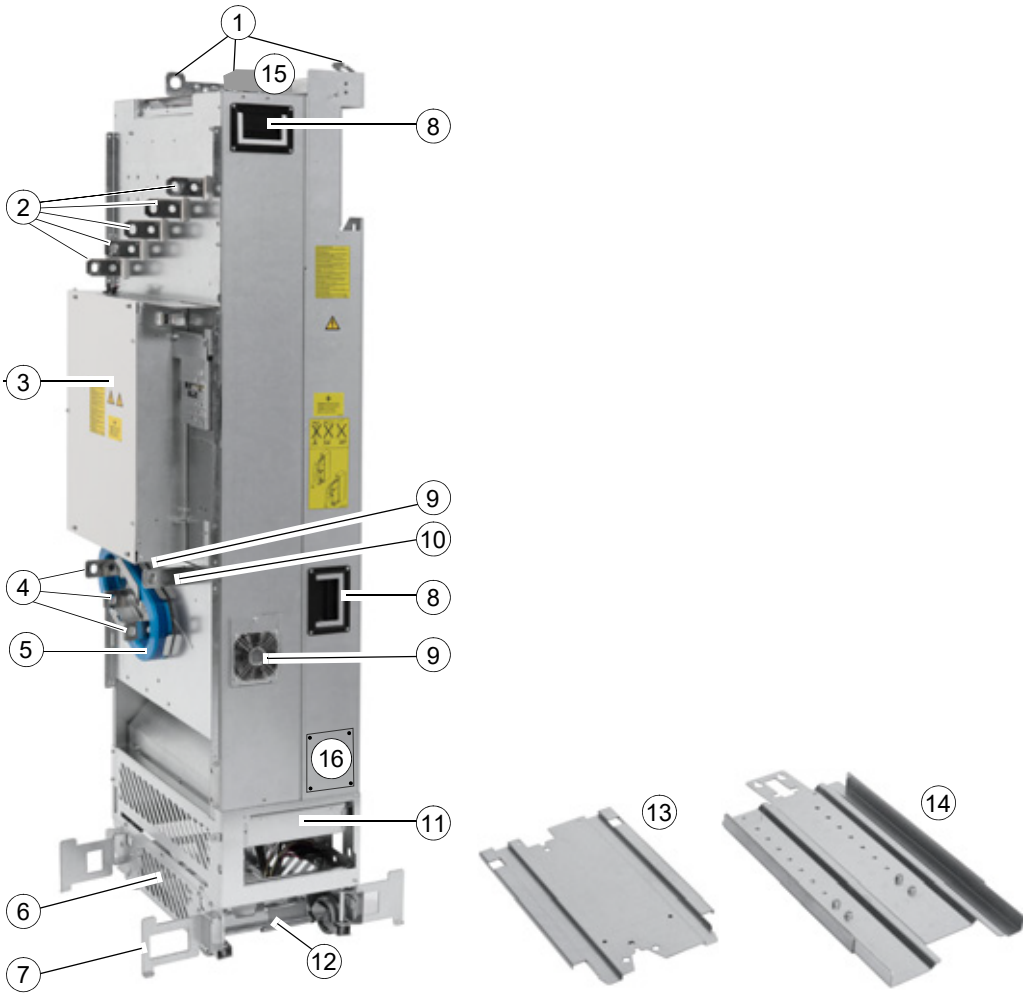
Drive module with full power cabling panels (option +H381)





Accessories		Assembled drive module	
1	Input power cabling panel	8	Input power cabling panel to be attached to the drive cabinet
2	Side guides	9	Output power cabling panel to be attached to the drive cabinet
3	Output power cabling panel	10	Front cover
4	Top guide plate	11	Handle
5	Pedestal guide plate	12	Lifting lugs
6	Telescopic extraction and insertion ramp	13	Auxiliary cooling fan, another auxiliary cooling fan is located below the circuit board compartment
7	Rubber grommet	-	-

Drive module without full-size output cable connection terminals (option +0H371) and IP20 shrouds (option +0B051) and with common mode filter (+E208)



1	Lifting lugs	9	Auxiliary cooling fan
2	Input cable connection busbars (L1/U1, L2/V1, L3/W1) and DC+ and DC- busbars (UDC+, UDC-)	10	PE busbar
3	Circuit board compartment	11	Main cooling fans
4	Output cable connection busbars (T1/U2, T2/V2, T3/W2)	12	Base attaching screws
5	Common mode filter (option +E208)	13	Pedestal guide plate
6	Pedestal	14	Telescopic extraction and insertion ramp
7	Retractable support legs	15	Connector for charging circuit switch or contactor
8	Handle for pulling the drive module	16	Cover. When removed, you can attach the drive module to the LCL filter module.

Note: The front covers are removed in this photo, see numbers 3 and 4 in Standard drive module configuration.

Control panel

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

One control panel can also be used to control several drives through a panel link; see section Panel bus (Control of several units from one control panel) (Page 106).

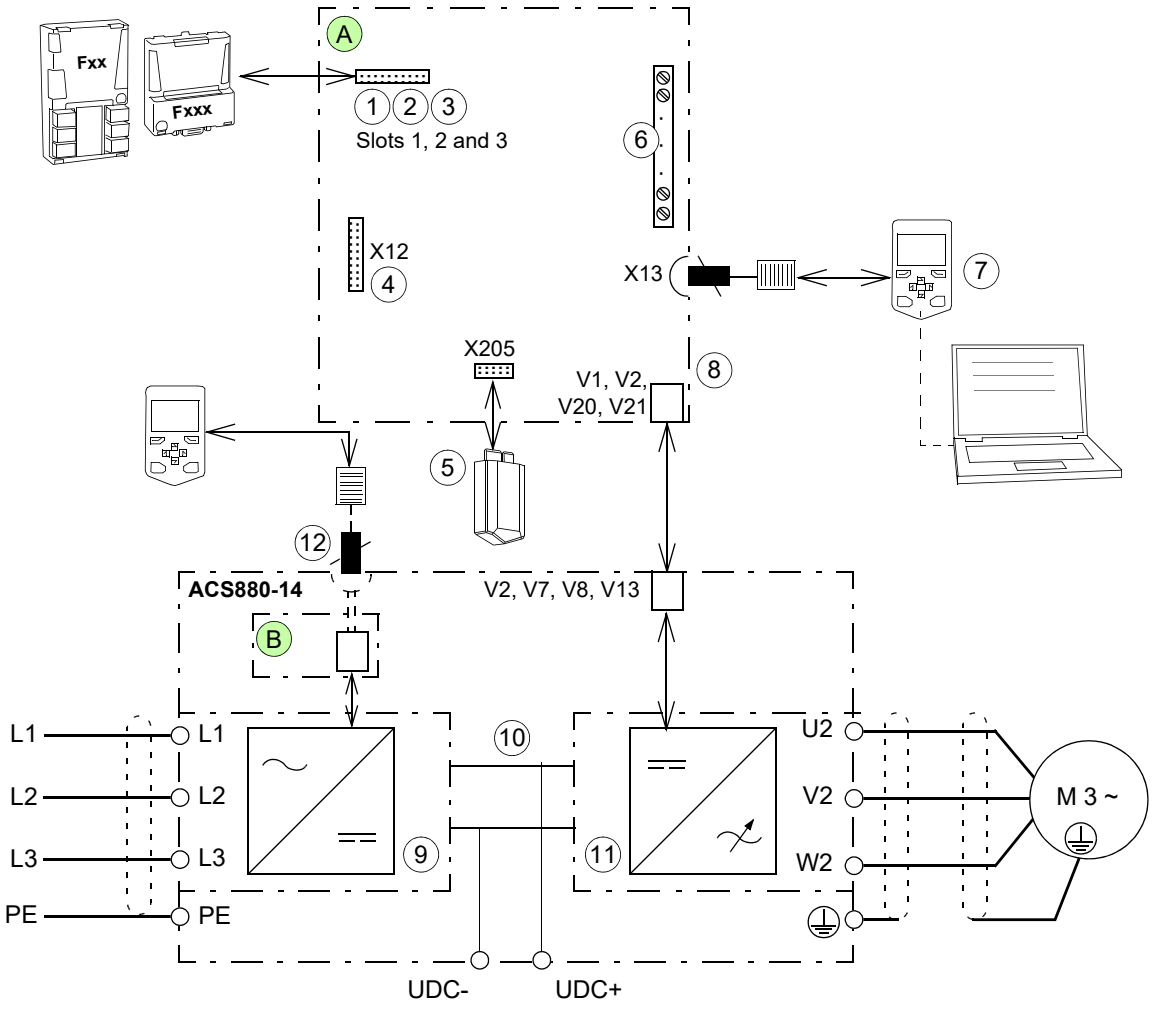
For the use of the control panel, see the firmware manual or ACS-AP-I, -S, -W and ACH-AP-H, -W assistant control panels user's manual (3AUA0000085685 [English]).



1	ACS-AP-I Assistant control panel (option +J425)
2	ACS-AP-W Assistant control panel with bluetooth

Overview of power and control connections

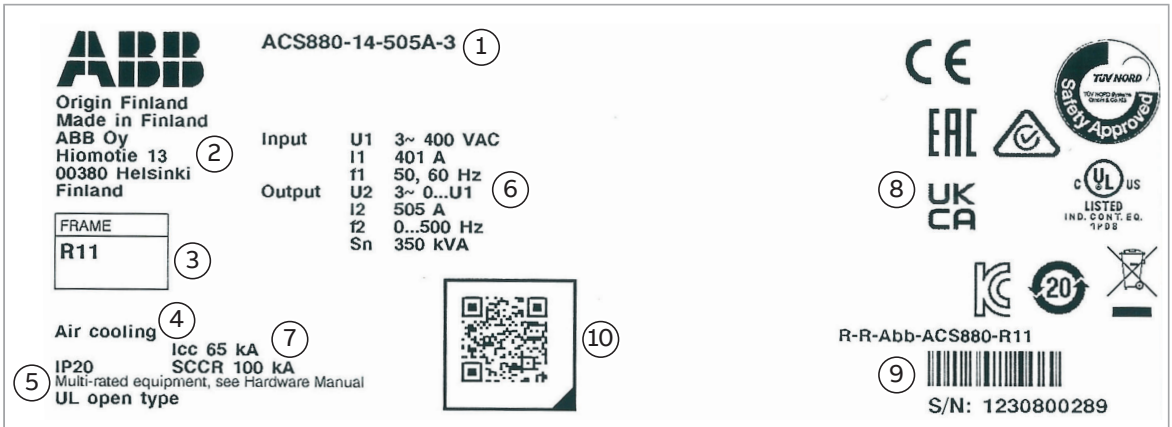
The diagram shows the power connections and control interfaces of the drive module.



A	External control unit (motor-side converter control unit)
B	Line-side converter control unit
1 2 3	Analog and digital I/O extension modules, feedback interface modules and fieldbus communication modules can be inserted into slots 1, 2 and 3. See Type designation key (Page 42).
4	Connector for the FSO-xx safety functions module (X12). The module can be installed on or above the control unit, see Installing the FSO-xx safety functions module (Page 112).
5	Memory unit (see section Memory unit*)*
6	I/O terminal blocks. See chapter External control unit (Page 115).
7	Control panel (see section Control panel)
8	Fiber optic link to the motor-side converter. Similarly, the line-side converter is connected to the line-side converter control unit with fiber optic cables.
9	Line-side converter
10	DC link
11	Motor-side converter
12	Socket for external line-side control unit control (not required for normal operation of the drive)

Type designation label

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



1	Type designation, see section Type designation key.
2	Name and address of the manufacturer
3	Frame size
4	Cooling method
5	Degree of protection
6	Ratings, see section Electrical ratings (Page 177).
7	Prospective short-circuit current rating, see section Electrical power network specification (Page 194).
8	Valid markings
9	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.
10	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. 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.

Basic code

Code	Description
ACS880	Product series
Type	

Code	Description
-14	The standard delivery includes: regenerative single drive module to be installed in an enclosure, IP20 (UL Type Open), bookshelf mounting with pedestal, external control unit with ACS-AP-W Assistant control panel with Bluetooth interface and panel holder, build-in LCL filter, full-size output cable connection terminals, no EMC filter, DC connection busbars, clear plastic shrouds for covering the input power and motor cable connections, ACS880 primary control program, Safe torque off function, coated boards, printed multilingual quick installation and start-up guide, extraction/installation ramp. Refer to section Option codes (Page 43) for options.
Size	
-xxxxA	See the ratings table.
Voltage range	
-3	380…415 V AC
-5	380…500 V AC
-7	525…690 V AC

Option codes

Code	Description
0B051	No IP20 shrouds for cabling area (Not to be used with option +H381)
C132	Marine type approval
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)
C208	Marine product certification issued by Registro Italiano Navale (RINA)
C209	Marine product certification issued by Bureau Veritas
E200	EMC filter for 2nd environment TN (grounded) system, category C3
E201	EMC filter for 2nd environment IT (ungrounded) system, category C3
E202	EMC filter for 1st environment TN (grounded) system, category C2. Requires option +E208. Available for ACS880-14-xxxx-3 and -5 types only.
E208	Common mode filter ACS880-14-xxxx-3 and -5 drive modules: Option +E202 and option +E208 to be ordered to get common mode filter installed. ACS880-14-xxxx-7 drive modules: Included as standard. +E208 not shown in the type designation label.
0H371	No full size cable connection terminals for output power cables
H370	Full-size input terminals
H381	Full power cabling panels to be attached to a cabinet. The drive module can be pulled out from the cabinet without disconnecting the power cables. IP20 degree of protection. Not to be used with options +0B051 and +H370.
0J400	No control panel
J410	DPMP-01 door mounting kit
J413	DPMP-02 door mounting kit (surface mounting) for the panel
J425	ACS-AP-I control panel
K451	FDNA-01 DeviceNet™ adapter module
K454	FPBA-01 PROFIBUS DP adapter module

Code	Description
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 EtherPOWERLINK adapter module
K475	FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
K490	FEIP-21 EtherNet/IP adapter module
K491	FMBT-21 Modbus/TCP adapter module
K492	FPNO-21 PROFINET IO adapter module
L500	FIO-11 analog I/O extension module (1, 2 or 3 pcs)
L501	FIO-01 digital I/O extension module
L502	FEN-31 HTL incremental encoder interface module
L503	FDCO-01 optical DDCS communication adapter module
L508	FDCO-02 optical DDCS communication adapter module
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	CAIO-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
N5000	Winder control program
N5050	Crane control program
N5100	Winch control program
N5150	Centrifuge control program
N5200	PCP (Progressive Cavity Pump) control program
N5250	Rod pump control program
N5350	Cooling tower control program
N5450	Override control program
N5500	Spinning and traverse control program
N5600	ESP (Electrical Submersible Pump) control program
N5650	Tower crane control program
N8010	Drive application programming
0P919	No extraction/installation ramp
P904	Extended warranty (24 months from commissioning or 30 months from delivery)
P909	Extended warranty (36 months from commissioning or 42 months from delivery)
P911	Extended warranty (60 months from commissioning or 66 months from delivery)
Q971	ATEX-certified safe disconnection function
Q972	FSO-21 safety functions module

Code	Description
Q973	FSO-12 safety functions module
Q982	PROFIsafe with FSO-xx safety functions module and FENA-21 Ethernet adapter module
Q986	PROFIsafe safety functions module, FSPS-21
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)]

1) Manuals in English may be included if a translation in the specified language is not available.

4

Guidelines for planning the mechanical installation

Contents of this chapter

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

Generic cabinet planning instructions

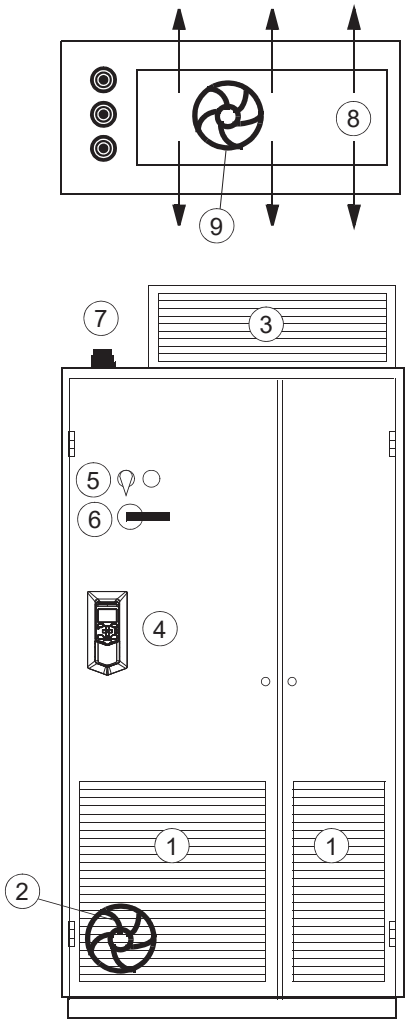
Refer to Drive modules cabinet design and construction instructions (3AUA0000107668 [English]).

Installation positions of the drive module

The drive module must be installed in an upright bookshelf position in a cabinet.

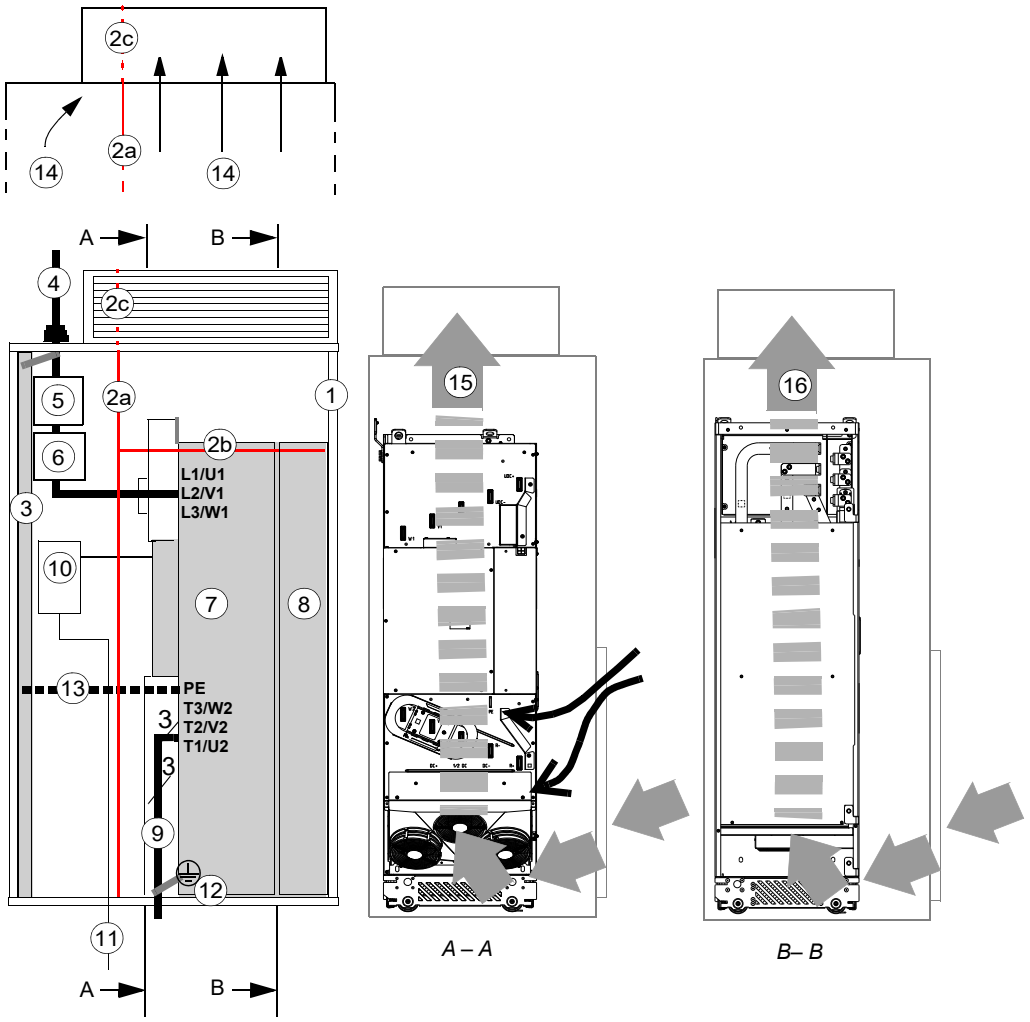
Layout example, door closed

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



1	Air inlet for the drive module	6	Operating handle of the disconnector
2	An extra fan is not necessary if an extra air baffle is used on the cabinet roof (see the following layout examples)	7	Rubber grommets for degree of protection
3	Air outlet for the drive module and LCL filter module and other equipment on the cabinet roof. An exhaust fan if needed.	8	Roof air flow viewed from top
4	Drive control panel with DPMP-01 mounting platform (option +J410). The control panel is connected to the drive module control unit inside the cabinet.	9	Fan required for IP20, IP42 or IP54 air outlet kit, has to be ordered separately. See Cooling fans (Page 175).
5	Contactor control switch and emergency stop switch (connected to the contactor control circuit inside the cabinet)	-	
Note: The sizes of the air inlet and outlet gratings are critical for proper cooling of the drive module. For losses and cooling data requirements, see the technical data.			

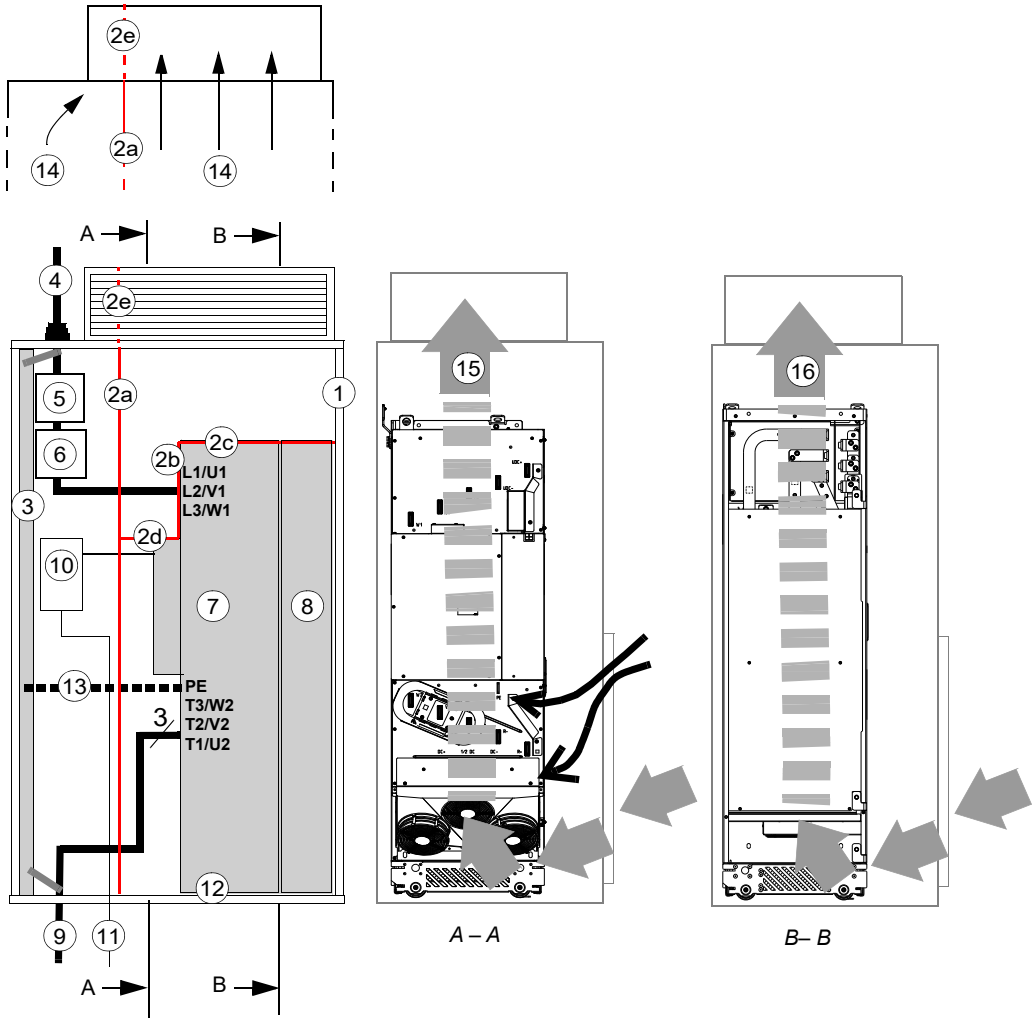
Layout example, door open (standard drive module configuration)



1	Supporting frame of the cabinet	8	LCL filter module
2a	Vertical (2a) and horizontal (2b) air baffles that separate the cool and hot areas (leakproof entries). See section Preventing the recirculation of hot air (Page 52).	9	Motor cable including the protective ground conductor of the drive module
2b		10	Drive module control unit
2c	Optional air baffle that is needed when there is no fan on the lower part of the cabinet door. See section Preventing the recirculation of hot air (Page 52).	11	External control cables
3	Cabinet grounding busbar (PE)	12	Grounding screws
4	Input power cable including the protective ground conductor (PE) of the drive	13	Alternative to grounding screws (12)
5	Disconnector and fuses	14	Air flow to the roof
6	Contactor	15	Air flow through the drive module
7	Drive module	16	Air flow through the LCL filter

Layout example, door open (option +0B051)

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

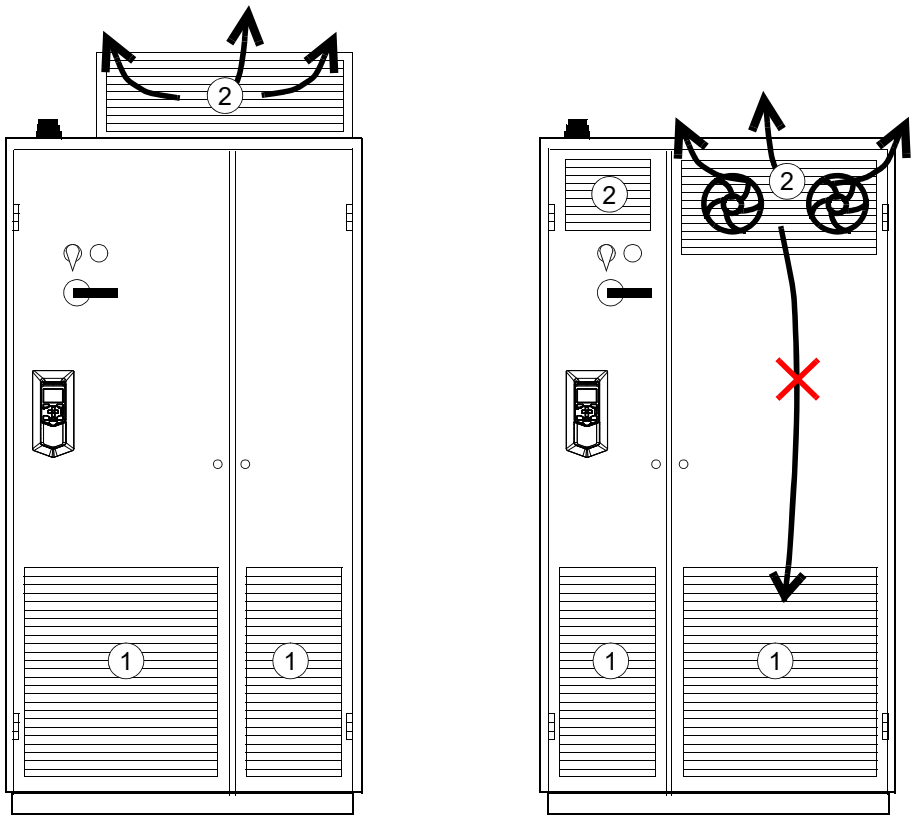


1	Supporting frame of the cabinet	9	Motor cable including the protective ground conductor of the drive module
2	Vertical (2a, 2b) and horizontal (2c, 2d) air baffles that separate the cool and hot areas (leak-proof lead-throughs). See section Preventing the recirculation of hot air (Page 52).	10	Drive module control unit
2e	Optional air baffle that is needed when there is no fan on the lower part of the cabinet door. See section Preventing the recirculation of hot air (Page 52).	11	External control cables
3	Cabinet grounding busbar (PE)	12	Grounding screws
4	Input power cable including the protective ground conductor (PE) of the drive	13	Alternative to grounding screws (12)
5	Disconnector and fuses	14	Air flow to the roof
6	Contactor	15	Air flow through the drive module
7	Drive module	16	Air flow through the LCL filter
8	LCL filter module	-	-

Note: The power cable shields can also be grounded to the drive module grounding terminals.
Note: See also section Required free space (Page 54).

Cooling solutions

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

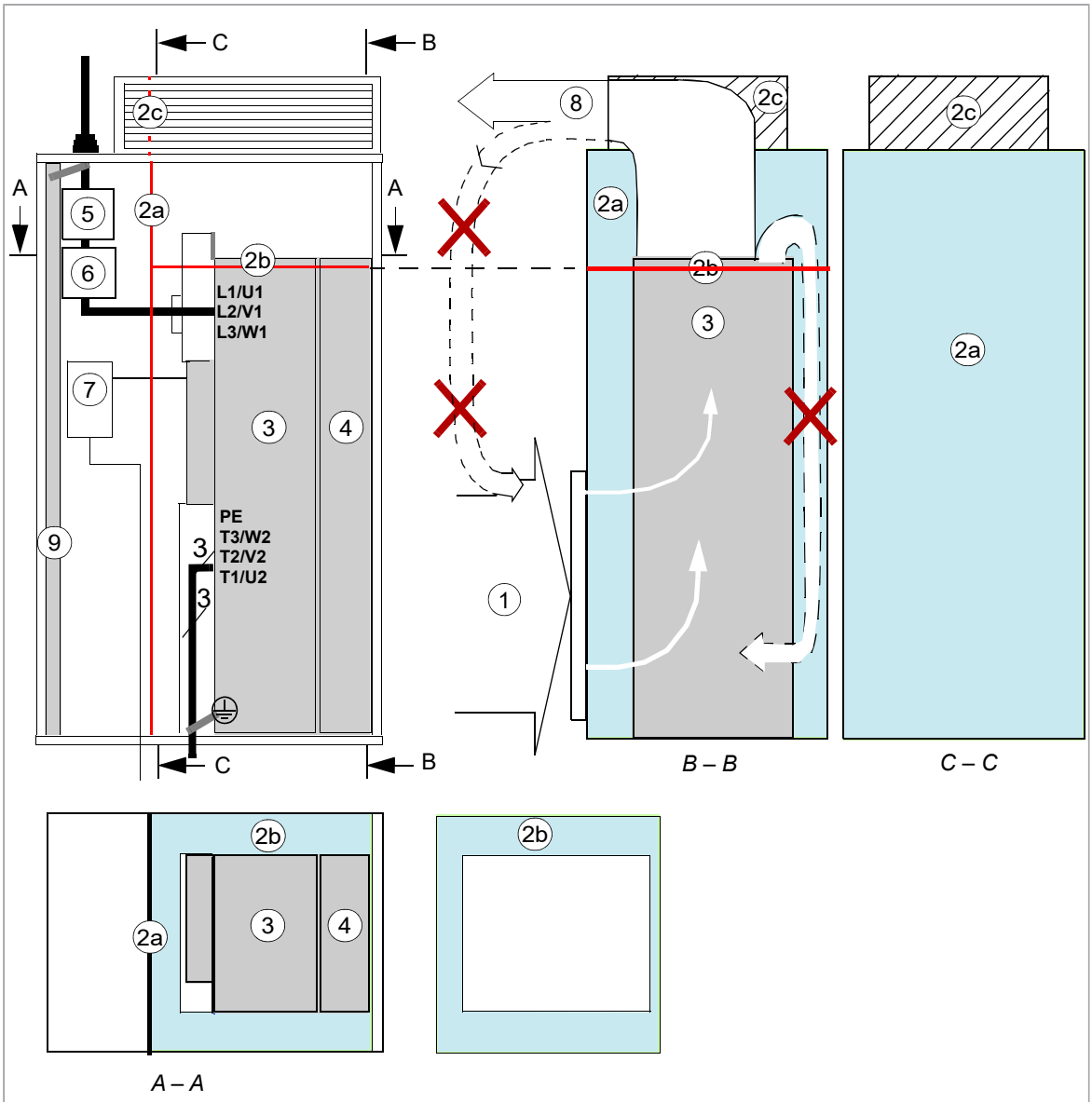


1	Air inlet
2	Air outlet

Preventing the recirculation of hot air

Bookshelf mounting (standard drive module configuration)

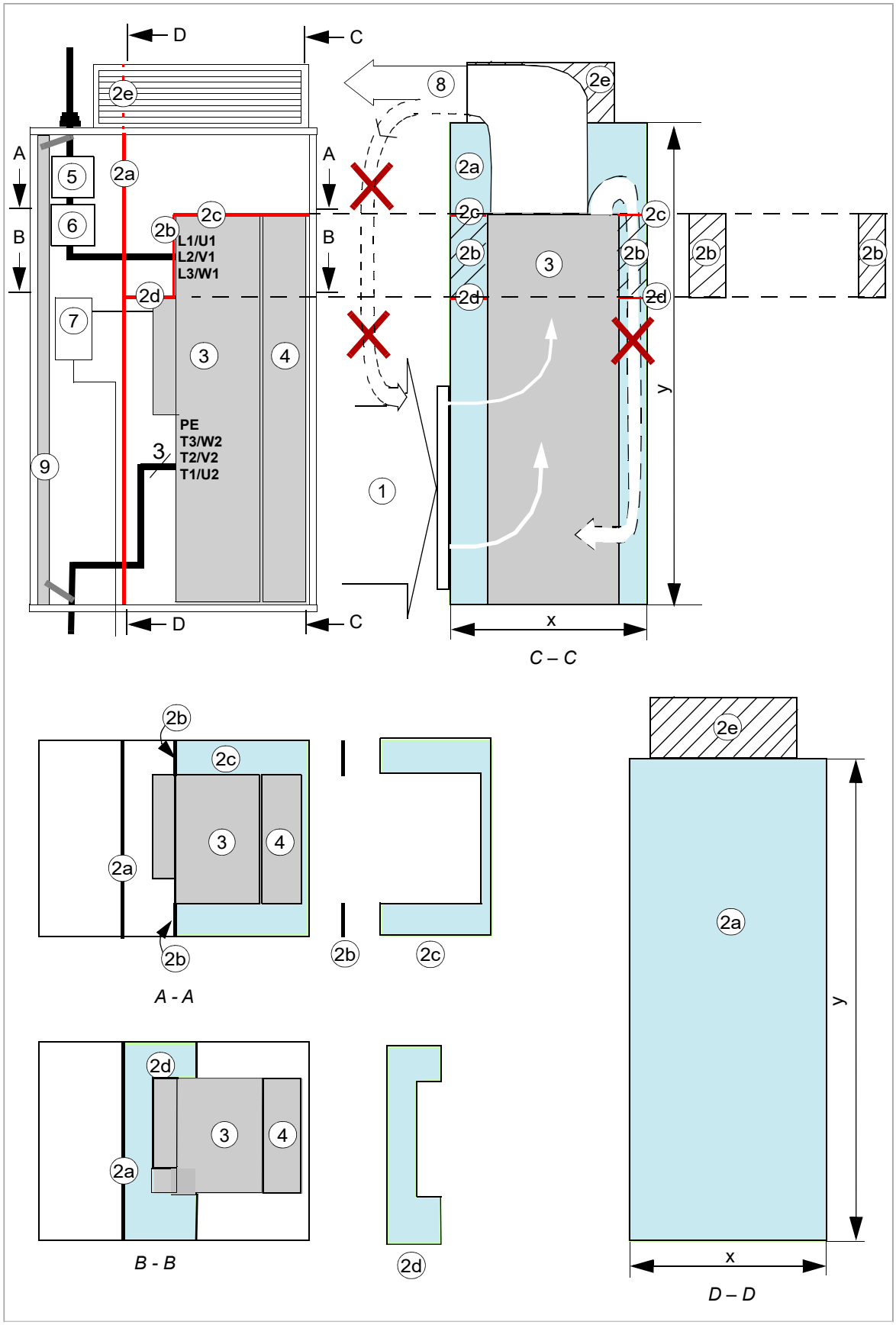
This diagram shows the air baffle position inside an example cabinet. For dimensions of the baffle, see the dimension drawings.



1	Air flow to the drive modules, max. 40 °C (104 °F)	5	Disconnector and fuses
2a	Vertical air baffle that separates the cool and hot areas in the cabinet	6	Contactor
2b	Horizontal air baffle	7	Drive control unit
2c	Optional air baffle that is needed when there is no fan on the lower part of the cabinet door	8	Air flow out
3	Drive module	9	Cabinet grounding busbar (PE)
4	LCL filter module	-	-

Bookshelf mounting (option +0B051)

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



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

Bookshelf mounting (option +H381)

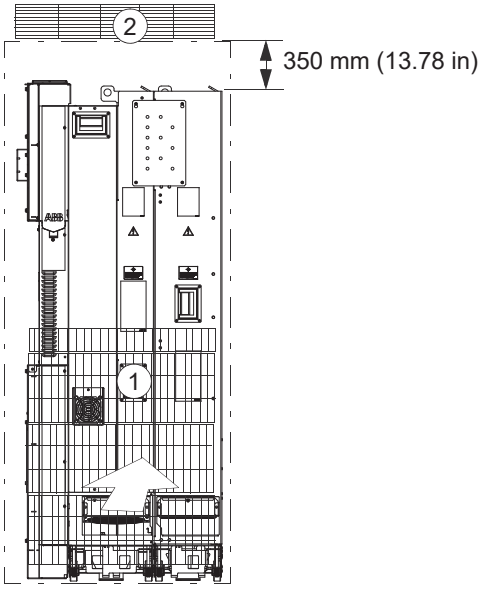
See Installation example with full cabling panels (option +H381) (Page 135).

Required free space

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

Free space at the top of the drive module

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



1	Air inlet
2	Air outlet

Free space around the drive module

A free space of 10 mm (0.39 in) around the drive module is required from the cabinet back panel and front door. No free space for cooling is required on the left- and right-hand sides of the module.

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

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

ABB air inlet and outlet kits

See chapter Ordering information (Page 171).

5

Mechanical installation

Contents of this chapter

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

Examining the installation site

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

See section Ambient conditions (Page 197) for the allowed ambient conditions and section Losses, cooling data and noise (Page 192) for the required cooling air.

Moving and unpacking



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

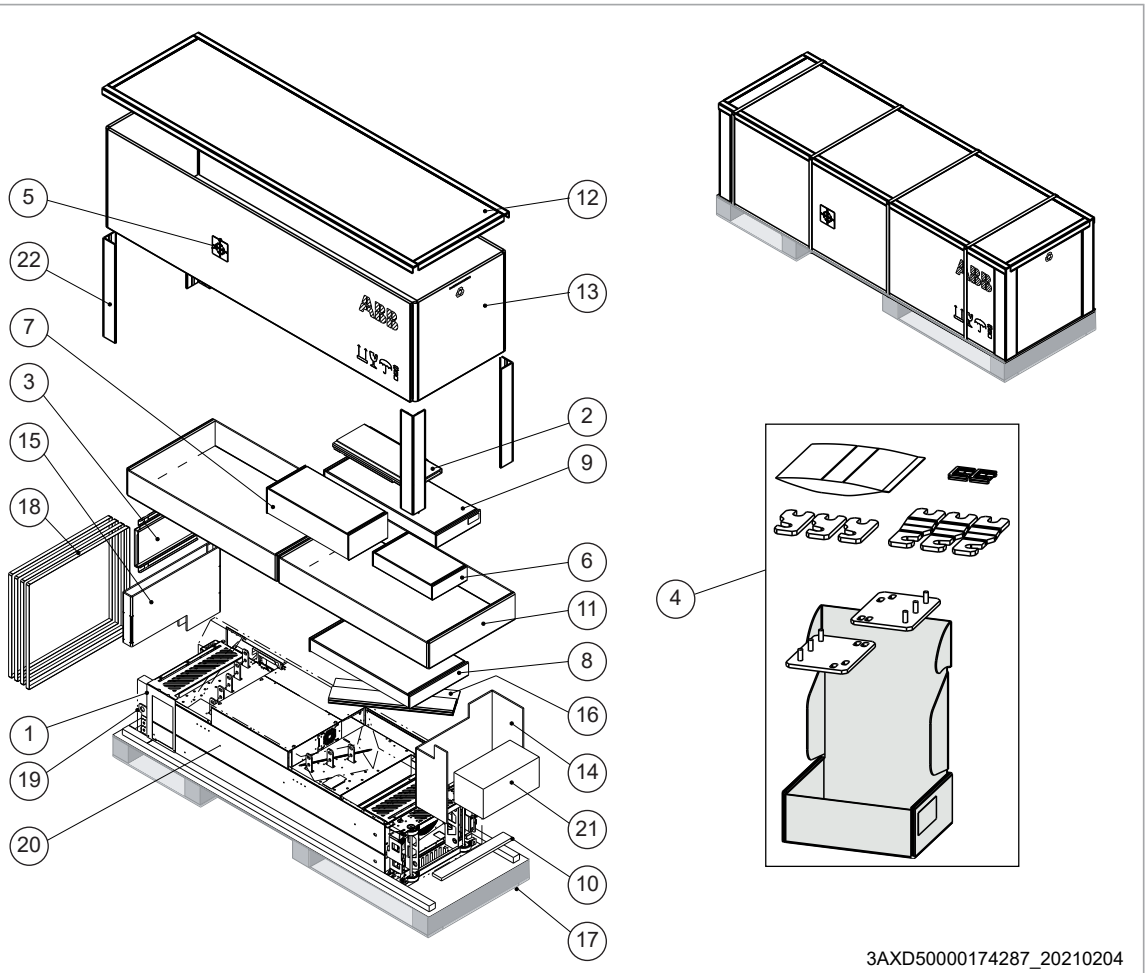
Move the transport package by pallet truck to the installation site.

To unpack the package:

- Cut the straps.
- Lift the lid.
- Lift the sleeve.
- Unpack the top boxes (drive module package).
- Insert lifting hooks to the drive and LCL filter module lifting lugs and lift the modules to the installation place.

Package drawings

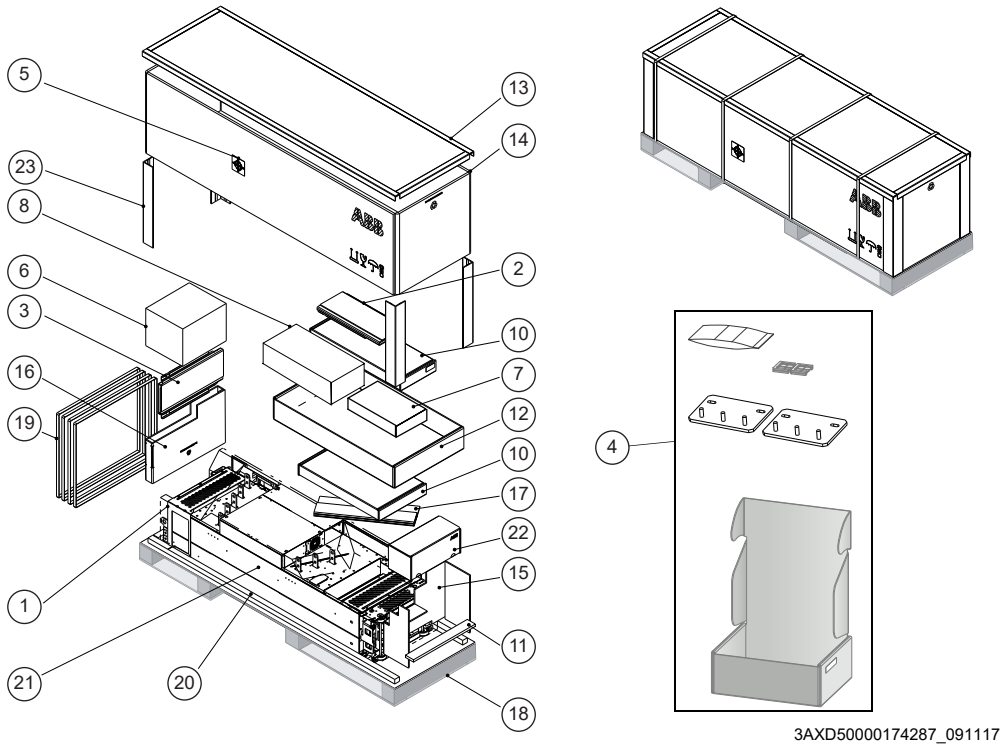
Drive module package without option +E202



Transport package contents	
1	Finger guard
2	Pedestal guide plate for the LCL filter module
3	Pedestal guide plate for the drive module
4	Accessories box See the box contents on the following pages.
5	Center of gravity symbol
6	Package for LCL filter fan
7	Package for LCL filter pedestal
8	Telescopic extraction/installation ramp
9	Package for option +H370: Full-size input power cable connection terminals and PE busbar.
10	Plywood support
11	With standard drive module configuration: Clear plastic shrouds box and output cable connection terminals box. With option +H370: Also input cable connection terminals box.
12	Lid for sleeve
13	Cardboard sleeve
14–16	Cardboard support

17	Pallet
18	Strap
19	VCI film or bag
20	Drive module with factory installed options and multilingual residual voltage warning sticker, fastening screws in a plastic bag, control panel and cable or control panel with door mounting kit (option +J410), delivery documents, printed multilingual quick installation and start-up guide.
21	External control unit
22	Edgeboard supports

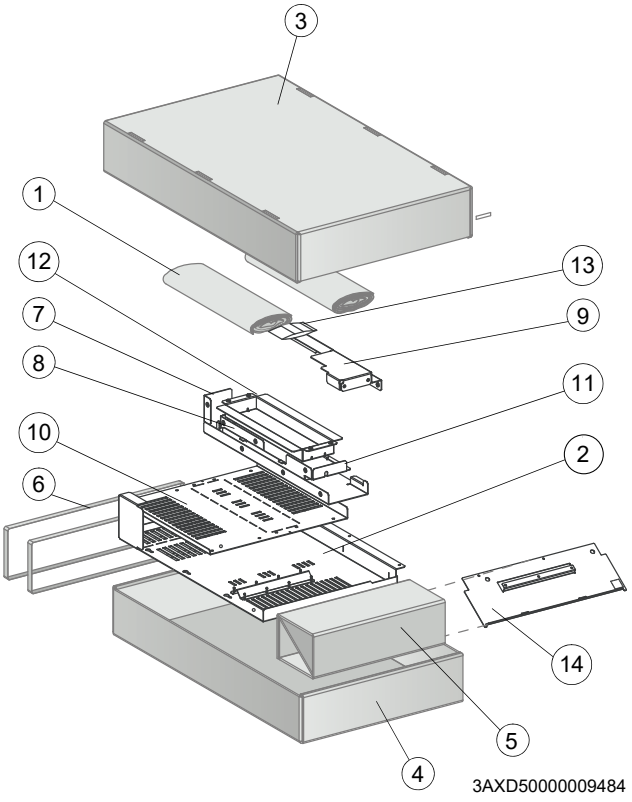
Package with option +E202



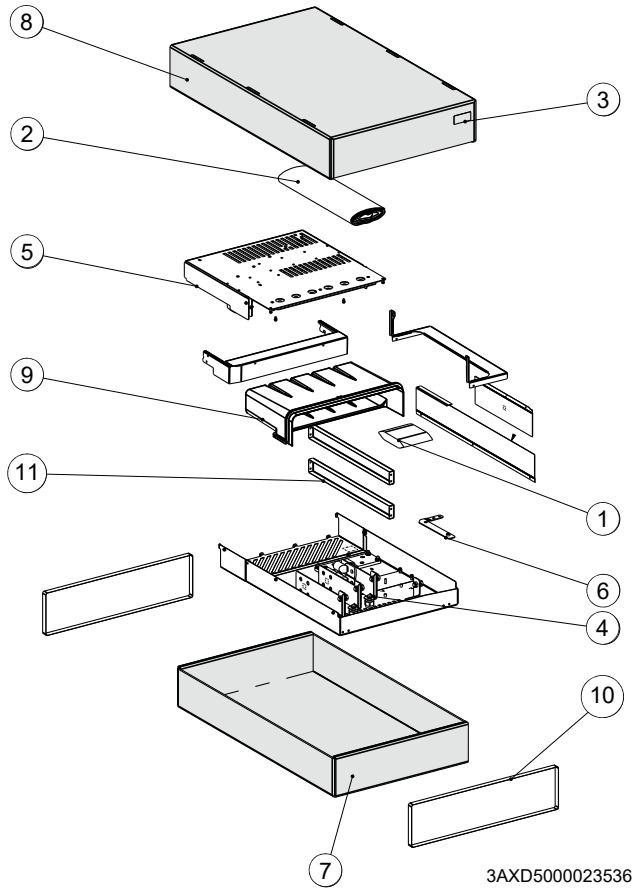
Transport package contents	
1	With standard drive module configuration: Clear plastic shrouds. With option +H381: Input cabling panel parts. See below for the box contents.
2	Pedestal guide plate for the LCL filter module
3	Pedestal guide plate for the drive module
4	Accessories box See below for the box contents
5	Center of gravity symbol
6	Package for EMC filter ARFI-10 (option +E202)
7	Package for LCL filter fan
8	Package for LCL filter pedestal

9	Telescopic extraction and insertion ramp
10	Package for option H370: Full-size input power cable connection terminals and PE busbar.
11	Plywood support
12	With standard drive module configuration: Clear plastic shrouds box and output cable connection terminals box. With option +H370: Also Input cable connection terminals box.
13	Lid for sleeve
14	Cardboard sleeve
15–17	Cardboard support
18	Pallet
19	Strap
20	VCI film or bag
21	Drive module with factory installed options and multilingual residual voltage warning sticker, fastening screws in a plastic bag, control panel and cable or control panel with door mounting kit (option +J410), delivery documents, printed multilingual installation and start-up quick guides. Other printed manuals with option +R700.
22	External control unit
23	Edgeboard supports

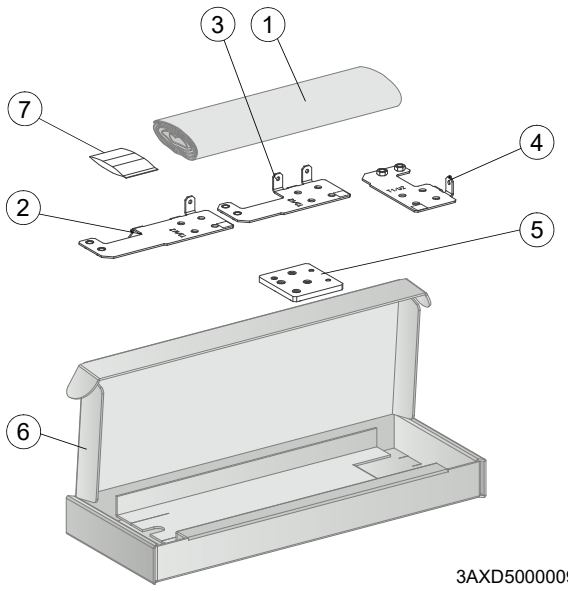
Boxes



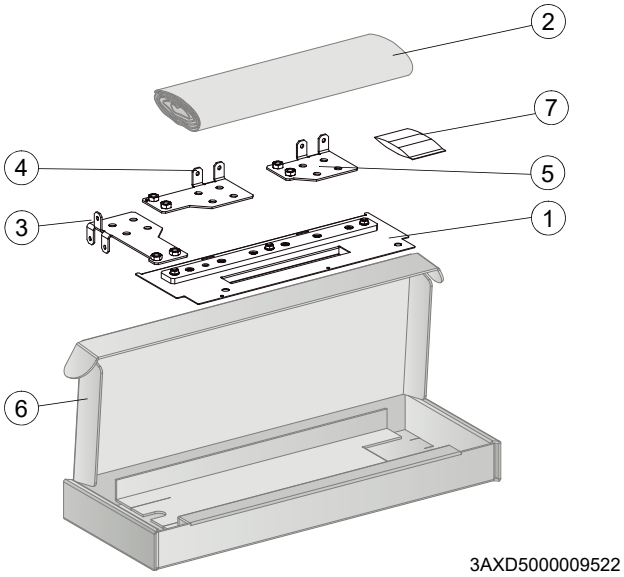
Shroud box with standard drive module configuration	
1	Paper fill
2	Clear plastic shroud for output cabling
3	Cardboard box cover
4	Cardboard box bottom
5	Support
6	Bands
7	Back clear plastic shroud (lower)
8	Back clear plastic shroud (upper)
9	Front clear plastic shroud
10	Clear plastic shroud for input cabling
11	Top clear plastic shroud
12	Clear plastic shroud for input cable entry from side
13	Screws in a plastic bag
14	Metallic shroud without ground bar



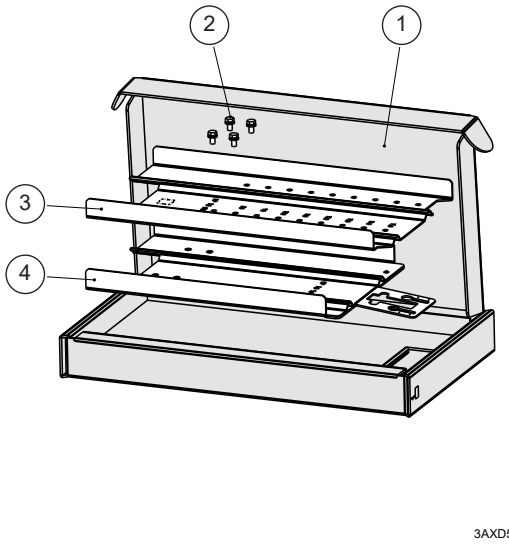
Option +H381 box: Input power cabling panel parts	
1	Screw package
2	Paper fill
3	Code label
4	Output power cabling panel
5	Input power cabling panel
6	Grounding busbar to be connected to the input power cabling panel and the drive module
7	Cardboard box bottom
8	Cardboard box cover
9	Rubber grommet
10	Strap
11	Support bracket



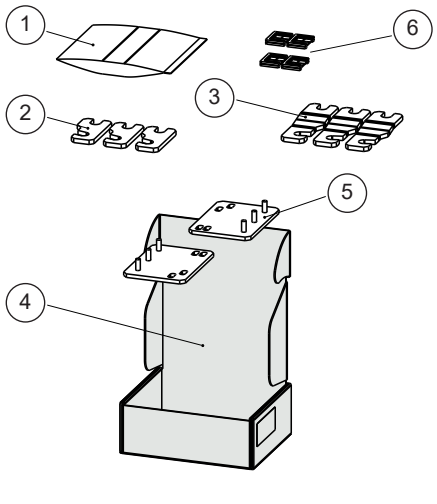
Output connection terminals box with standard drive module configuration	
1	Paper fill
2	Output cable connection terminal T3/W2
3	Output cable connection terminal T2/V2
4	Output cable connection terminal T1/U2
5	Grounding terminal
6	Cardboard box
7	Screws and insulators in a plastic bag



Option +H370: input cable connection terminals box	
1	Metallic shroud with ground bar
2	Paper fill
3	Input cable connection terminal L3/W1
4	Input cable connection terminal L2/V1
5	Input cable connection terminal L1/U1
6	Cardboard box
7	Screws and insulators in a plastic bag

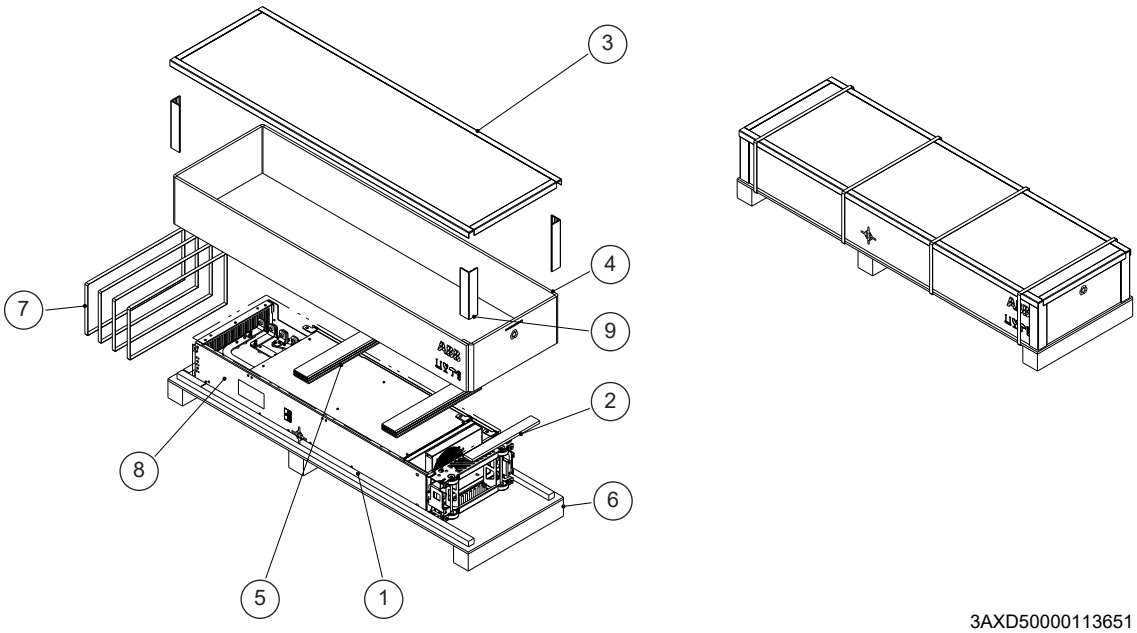


Ramp box	
1	Cardboard box
2	Combi screws (4 pcs)
3	Ramp extension (50 to 150 mm)
4	Ramp up to 50 mm



Accessories box	
1	Screw package
2	Busbar for main contactor - LCL connection (3 pcs)
3	Busbar for IGBT - LCL connection (3 pcs)
4	Cardboard box
5	Installation bracket (2 pcs)
6	Feed-through (4 pcs)

LCL filter module package



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

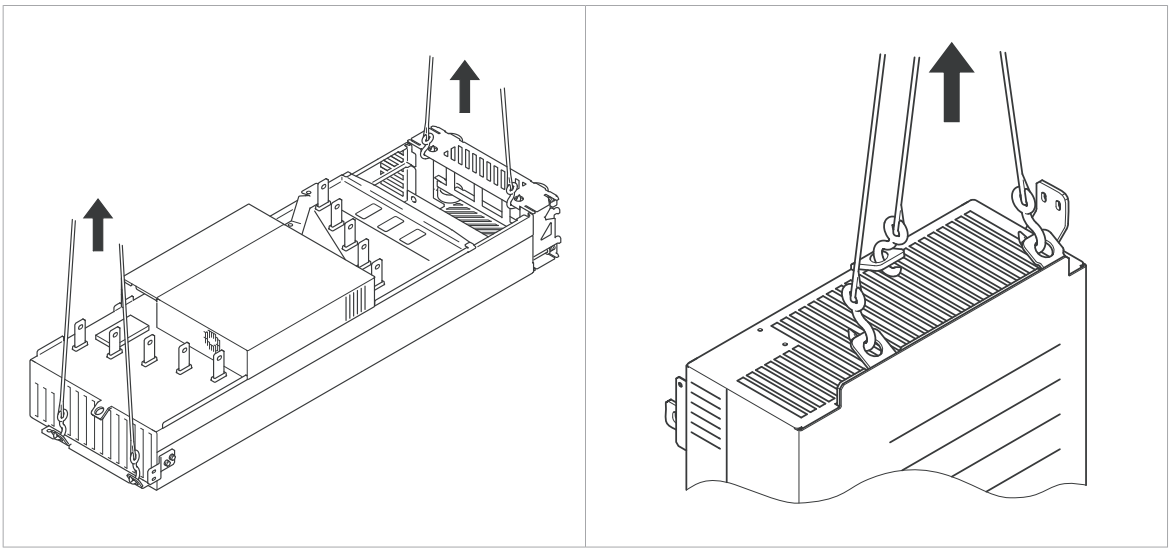
Examining the delivery

Make sure that all items listed in Moving and unpacking (Page 57) are present.

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

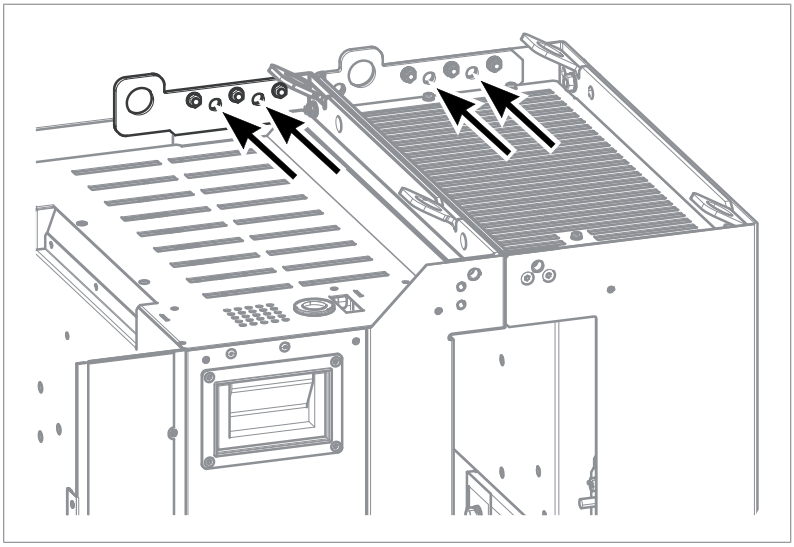
Lifting

Lift the drive module only by the lifting lugs.



Attaching the drive module and LCL filter module to a mounting plate or wall

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



You can attach the modules to Rittal VX25 enclosure with the mounting brackets delivered with the drive, see Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243).

Attaching the drive module to the LCL filter module

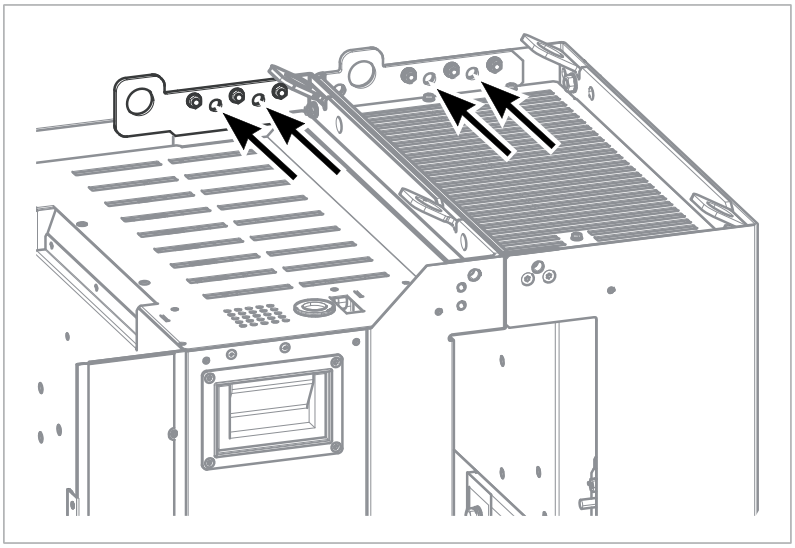
See Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243).

Attaching the drive module and the LCL filter module to the enclosure base

See Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243).

Grounding the drive module and the LCL filter module

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

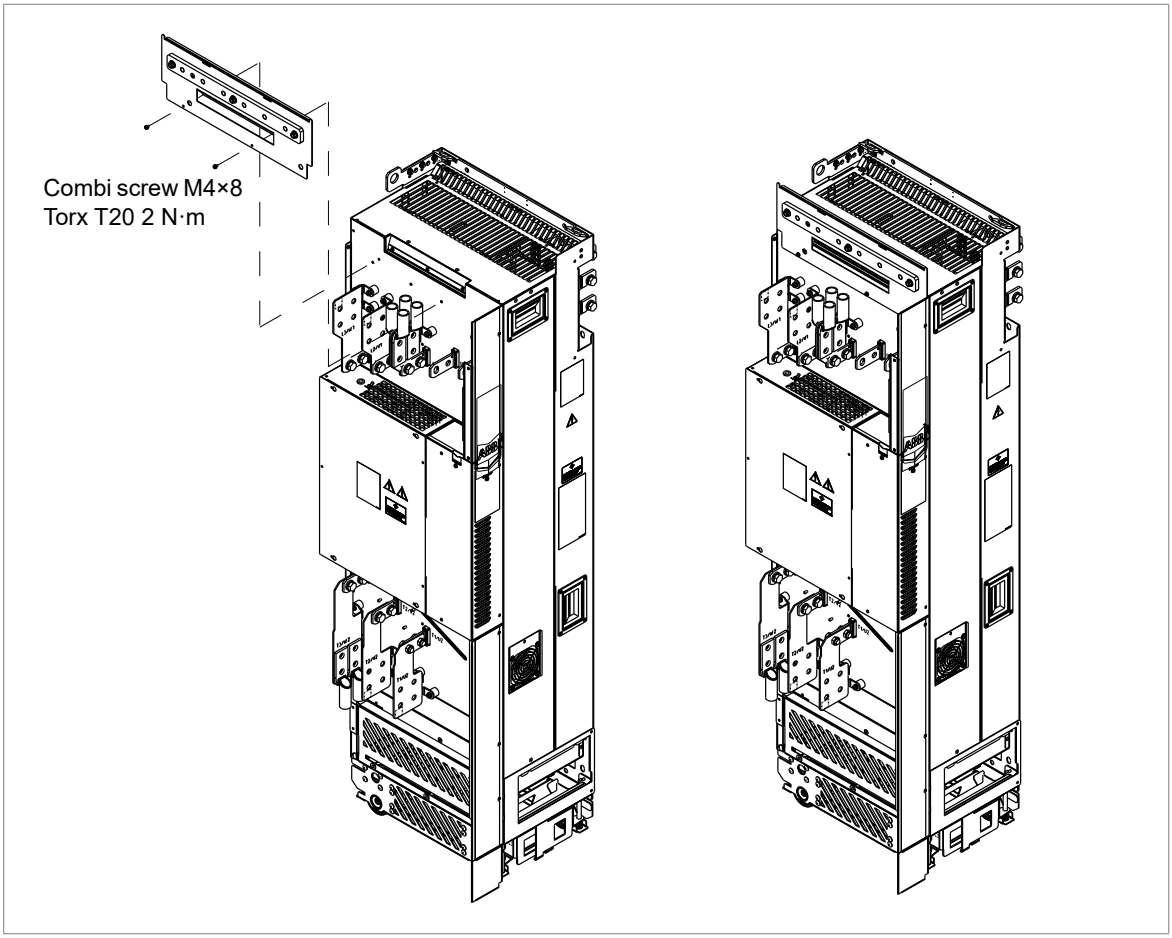


Installing the drive in Rittal VX25 enclosure

For an installation example on how to install the drive module into a Rittal VX25 enclosure, see Installation into a Rittal VX25 enclosure (Page 125) and Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243).

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

Install the metallic shroud with ground bar as shown below.



Connect the input power cable connection terminals as shown in Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243).

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

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

6

Guidelines for planning the electrical installation

Contents of this chapter

This chapter contains guidelines for planning the electrical installation of the drive.

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 main supply disconnecting device

You must equip the drive with a main supply disconnecting device which meets the local safety regulations. You must be able to lock the disconnecting device to the open position for installation and maintenance work.

To comply with European Union directives and United Kingdom regulations related to standard EN 60204-1, the disconnecting device must be one of these types:

- switch-disconnector of utilization category AC-23B (IEC 60947-3)
- disconnector that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector (EN 60947-3)
- circuit-breaker suitable for isolation in accordance with IEC 60947-2.

Selecting the main contactor

You can equip the drive with a main contactor.

Follow these guidelines when you select a customer-defined main contactor:

- Dimension the contactor according to the nominal voltage and current of the drive. Also consider the environmental conditions such as surrounding air temperature.
- IEC installations: Select contactor with utilization category AC-1 (number of operations under load) according to IEC 60947-4.
- Consider the application life time requirements.

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 69). For basics of protecting the motor insulation and bearings in drive systems, see Protecting the motor insulation and bearings (Page 68).

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.

d*u*/d*t* 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 d*u*/d*t* 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 72).

Motor type	Nominal AC line voltage	Requirement for	
		Motor insulation system	ABB d*u*/d*t* 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	+ d*u*/d*t*
		Reinforced	-
	600 V < $U_n \leq$ 690 V (cable length ≤ 150 m)	Reinforced	+ d*u*/d*t*
	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 + d*u*/d*t* 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 + d*u*/d*t* + 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 72).

Motor type	Nominal AC line voltage	Requirement for		
		Motor insulation system	ABB du/dt and common mode filters, insulated N-end motor bearings	
			100 kW ≤ P_n < 350 kW or IEC 315 ≤ frame size < IEC 400	P_n ≥ 350 kW or frame size ≥ IEC 400
			134 hp ≤ P_n < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580	P_n ≥ 469 hp or frame size > NEMA 580
Random-wound M2_, M3_ and M4_	U_n ≤ 500 V	Standard	+ N	+ N + CMF
	500 V < U_n ≤ 600 V	Standard	+ N + du/dt	+ N + du/dt + CMF
		Reinforced	+ N	+ N + CMF
	600 V < U_n ≤ 690 V (cable length ≤ 150 m)	Reinforced	+ N + du/dt	+ N + du/dt + CMF
	600 V < U_n ≤ 690 V (cable length > 150 m)	Reinforced	+ N	+ N + CMF
Form-wound HX_ and AM_	380 V < U_n ≤ 690 V	Standard	+ N + CMF	P_n < 500 kW: +N + CMF
				P_n ≥ 500 kW: +N + du/dt + CMF
Old[1] form-wound HX_ and modular	380 V < U_n ≤ 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 ≤ 500 V	Enamelled wire with fiber glass taping	+ N + CMF	
	500 V < U_n ≤ 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 non-ABB motors, P_n < 100 kW (134 hp)

See also Abbreviations (Page 72).

Motor type	Nominal AC line voltage	Requirement for	
		Motor insulation system	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 ≤ 420 V	Standard: $\hat{U}_{LL}$ = 1300 V	-
	420 V < U_n ≤ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ du/dt
		Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 µs rise time	-
	500 V < U_n ≤ 600 V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ du/dt
		Reinforced: $\hat{U}_{LL}$ = 1800 V	-
	600 V < U_n ≤ 690 V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ du/dt
		Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 µs 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 72).

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

Product type	Availability of du/dt filter	Availability of common mode filter (CMF)
ACS880-14	Ordered separately, see chapter Filters (Page 241)	Option +E208

Additional requirements for explosion-safe (EX) motors

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

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

Use the selection criteria given for non-ABB motors.

Additional requirements for the 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 d*u*/d*t* and common mode filters, insulated N-end motor bearings		
		P_n < 100 kW	100 kW ≤ P_n < 200 kW	P_n ≥ 200 kW
		P_n < 140 hp	140 hp ≤ P_n < 268 hp	P_n ≥ 268 hp
U_n ≤ 500 V	Standard	-	+ N	+ N + CMF
500 V < U_n ≤ 600 V	Standard	+ d*u*/d*t*	+ d*u*/d*t* + N	+ d*u*/d*t* + N + CMF
	Reinforced	-	+ N	+ N + CMF
600 V < U_n ≤ 690 V	Reinforced	+ d*u*/d*t*	+ d*u*/d*t* + N	+ d*u*/d*t* + 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.

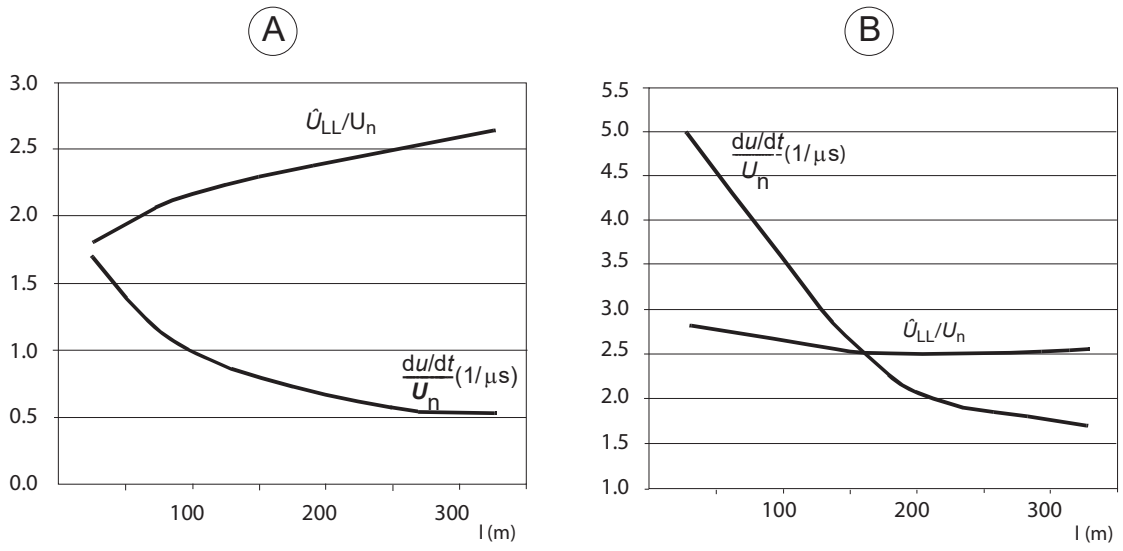
Nominal AC supply voltage	Requirement for		
	Motor insulation system	ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings	
		P_n < 100 kW or frame size < IEC 315	100 kW < P_n < 350 kW or IEC 315 < frame size < IEC 400
		P_n < 134 hp or frame size < NEMA 500	134 hp < P_n < 469 hp or NEMA 500 < frame size < NEMA 580
$U_n \leq 420$ V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N or CMF	+ N or CMF
420 V < U_n < 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
	Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	+ N or CMF	+ N or CMF
500 V < $U_n \leq 600$ V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ N or CMF	+ N + CMF
600 V < $U_n \leq 690$ V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ N + d*u*/d*t*	+ N + d*u*/d*t* + CMF
	Reinforced: $\hat{U}_{LL}$ = 2000 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 (d*u*/d*t*)/U_n from the diagram below. Multiply the values by the nominal supply voltage (U_n) and substitute into equation $t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.



A	Drive with d*u*/d*t* filter
B	Drive without d*u*/d*t* filter
l	Motor cable length
$\hat{U}_{LL}/U_n$	Relative peak line-to-line voltage
(d*u*/d*t*)/U_n	Relative d*u*/d*t* value
Note: $\hat{U}_{LL}$ and d*u*/d*t* values are approximately 20% higher with resistor braking.	

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 · 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 76).

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.

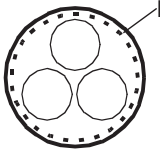
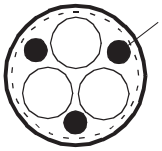
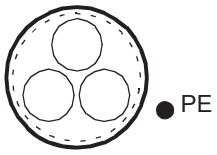
Typical power cable sizes

See the technical data.

Power cable types

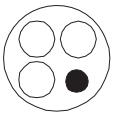
Preferred power cable types

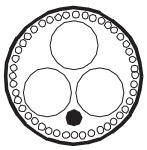
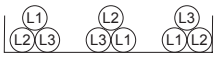
This section presents the preferred cable types. Make sure that the selected cable type also complies with local/state/country electrical codes.

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
 Symmetrical shielded (or armored) cable with three phase conductors and concentric PE conductor as shield (or armor)	Yes	Yes
 Symmetrical shielded (or armored) cable with three phase conductors and symmetrically constructed PE conductor and a shield (or armor)	Yes	Yes
 Symmetrical shielded (or armored) cable with three phase conductors and a shield (or armor), and separate PE conductor/cable [1)]	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
 Four-conductor cabling in PVC conduit or jacket (three phase conductors and PE)	Yes with phase conductor smaller than 10 mm^2 (8 AWG) Cu.	Yes with phase conductor smaller than 10 mm^2 (8 AWG) Cu, or motors up to 30 kW (40 hp). **Note:** Shielded or armored cable, or cabling in metal conduit is always recommended to minimize radio frequency interference.

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
 Four-conductor cabling in metal conduit (three phase conductors and PE). For example, EMT, or four-conductor armored cable	Yes	Yes with phase conductor smaller than 10 mm² (8 AWG) Cu, or motors up to 30 kW (40 hp)
 Shielded (Al/Cu shield or armor) [1] four-conductor cable (three phase conductors and a PE)	Yes	Yes with motors up to 100 kW (135 hp). A potential equalization between the frames of motor and driven equipment is required.
 A single-core cable system: three phase conductors and PE conductor on cable tray  Preferable cable arrangement to avoid voltage or current unbalance between the phases	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
 Symmetrical shielded cable with individual shields for each phase conductor	No	No

Additional guidelines – North America

ABB recommends the use of metallic conduit for power wiring. ABB also recommends the use of symmetrical shielded VFD cable between drive and motor(s).

This table shows examples of methods for wiring the drive. Refer to NFPA 70 (NEC) along with state and local codes for the appropriate methods for your application.

Wiring method	Notes
Conduit - Metallic [1) 2)]	
Electrical metallic tubing: Type EMT	Prefer symmetrical shielded VFD cable. Use separate conduit run for each motor. Do not run input power wiring and motor wiring in the same conduit.
Rigid metal conduit: Type RMC	
Liquid-tight flexible metal electrical conduit: Type LFMC	
Conduit - Non-metallic [2) 3)]	
Liquid-tight flexible non-metallic conduit: Type LFNC	Prefer symmetrical shielded VFD cable. Use separate conduit run for each motor. Do not run input power wiring and motor wiring in the same conduit.
Wireways [2)]	
Metallic	Prefer symmetrical shielded VFD cable. Separate motor wiring from input power wiring and other low voltage wiring. Do not run outputs of multiple drives parallel. Bundle each cable (wiring) together and use separators where possible.
Free air [2)]	
Enclosures, air handlers, etc.	Prefer symmetrical shielded VFD cable. Allowed internally in enclosures when in accordance with UL.

1) Metallic conduit may be used as an additional ground path, provided this path is a solid path capable of handling ground currents.
2) See NFPA NFPA 70 (NEC), UL, and local codes for your application.
3) Non-metallic conduit use underground is allowed; however, these installations inherently have an increased chance for nuisance problems due to the potential for water/moisture in the conduit. Water/moisture in the conduit increases the likelihood of VFD faults or warnings. Proper installation is required to make sure there is no intrusion of water/moisture.

Metal conduit

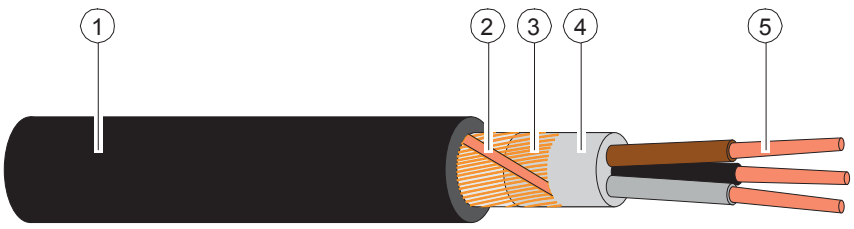
Couple separate parts of a metal conduit together: bridge the joints with a ground conductor bonded to the conduit on each side of the joint. Also bond the conduits to the drive enclosure and motor frame. Use separate conduits for input power, motor, brake resistor, and control wiring. Do not run motor wiring from more than one drive in the same conduit.

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.



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

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 mm^2 if the conductor is mechanically protected,

or

- 4 mm^2 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 mm^2 Cu or 16 mm^2 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 mm^2 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.

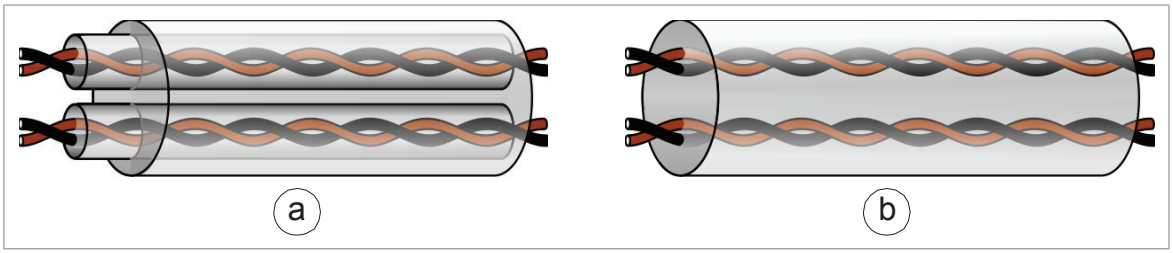
Selecting the control cables

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

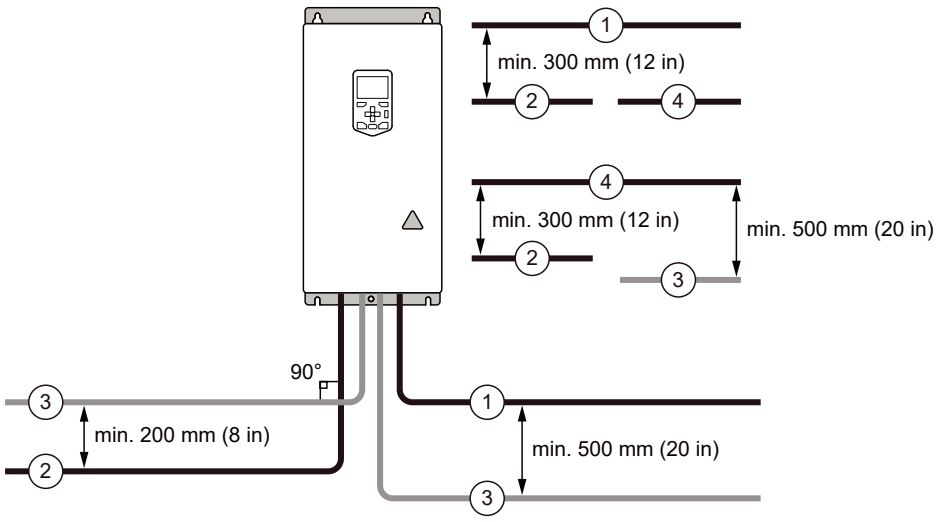
Connect the Drive Composer PC tool to the drive through the USB port of the control panel. Use a USB Type A (PC) - Type Mini-B (control panel) cable. The maximum length of the cable is 3 m (9.8 ft).

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.



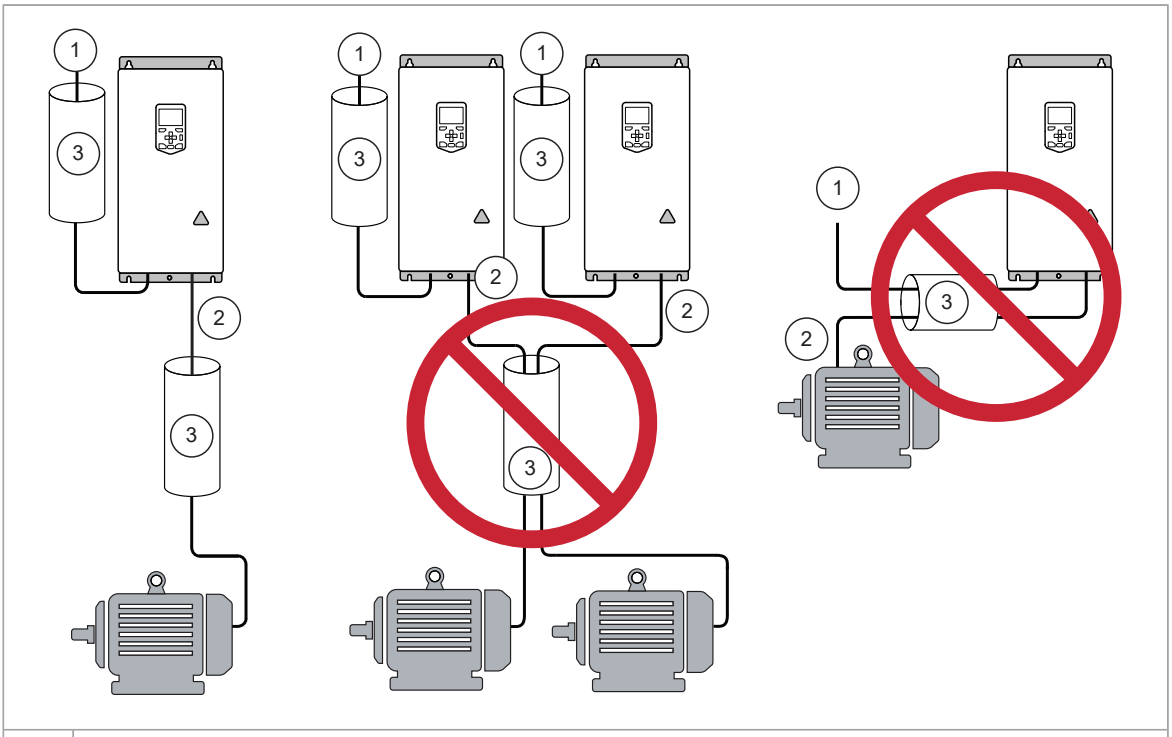
1	Motor cable
2	Input power cable
3	Control cable
4	Brake resistor or chopper cable (if any)

General guidelines – North America

Make sure that the installation is in accordance with national and local codes. Obey these general guidelines:

- Use separate conduits for the input power, motor, brake resistor (optional), and control cabling.
- Use separate conduit for each motor cabling.

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



1	Input power cabling
2	Motor cabling
3	Conduit

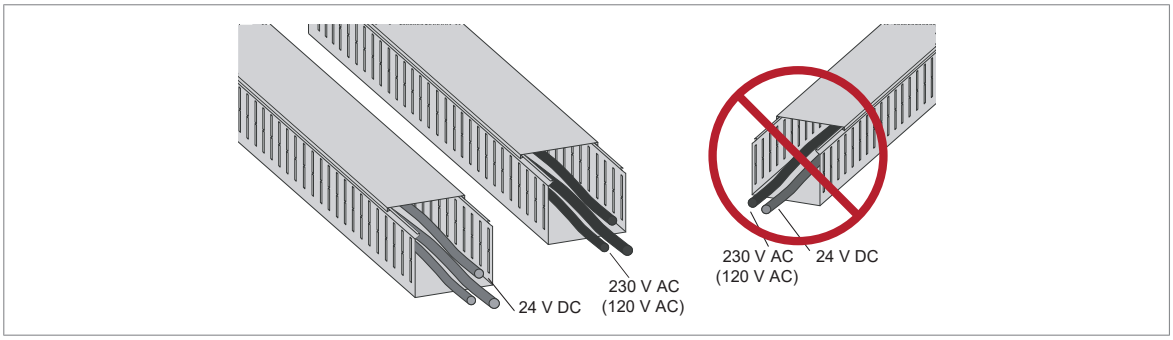
Continuous motor cable shield/conduit or enclosure for equipment on the motor cable

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

- 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).



Implementing motor and motor cable short-circuit and thermal overload protection

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 motor cables against thermal overload

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

WARNING!
If the drive is connected to multiple motors, use a separate overload protection for each motor cable and motor. The drive overload protection is tuned for the total motor load. It may not detect an overload in one motor circuit only.

North America: The local code (NEC) requires an overload protection and a short-circuit protection for each motor circuit. Use, for example:

- manual motor protector
- circuit breaker, contactor and overload relay or
- fuses, contactor and overload relay.

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.

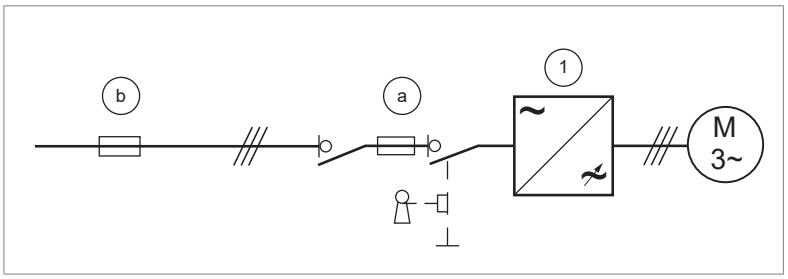
The protection feature of the drive allows the user to specify the class of operation in the same manner as the overload relays are specified in standards UL/IEC 60947-4-1 and NEMA ICS 2.

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

For more information, see drive firmware manual.

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

Protect the drive (1) with fuses (a) and the input cable with fuses (b) or a circuit breaker.



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

Note: Circuit breakers must not be used without fuses.

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

Protecting the drive against thermal overload

The drive has overload protection as standard.

Protecting the input power cable against thermal overload

The drive has overload protection as standard. If the sizing of the input power cable is correct, the drive overload protection protects also the cable against overload. In case of parallel input power cables, it may be necessary to protect each cable separately. Obey the local regulations.

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 86). 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 rated).

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

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

For safety reasons, install the emergency stop devices at each operator control station and at other operating stations where the emergency stop may be needed. Implement the emergency stop according to relevant standards.

Note: You can use the Safe torque off function of the drive to implement the Emergency stop function.

Implementing the Safe torque off function

See The Safe torque off function (Page 221).

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 you equip the drive with a main contactor or breaker, make sure that it restores the drive input power after a short break. The contactor must either re-connect after the break automatically, or remain closed over the break. Depending on the contactor control circuit design, this can require an additional hold circuit, uninterruptible auxiliary power supply or auxiliary power supply buffering.

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. If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.
3. 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 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.

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

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 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 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

Controlling a contactor between drive and motor

The control of the output contactor depends on how you use the drive, that is, which motor control mode and which motor stop mode you select.

If you have the DTC motor control mode and the motor ramp stop mode selected, 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.

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

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



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

Implementing a bypass connection

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

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

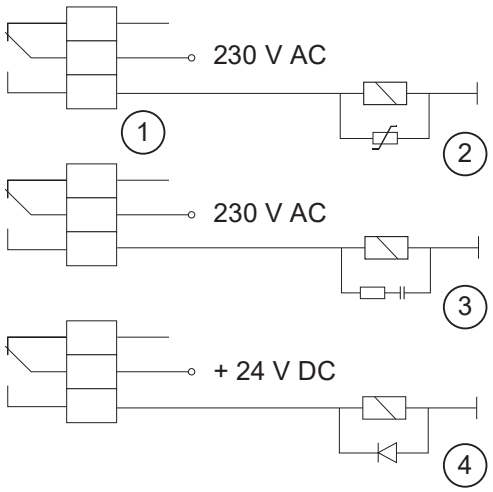
WARNING!
Never connect the drive output to the electrical power network. The connection may damage the drive.

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.



1	Relay output
2	Varistor
3	RC filter
4	Diode

7

Electrical installation

Contents of this chapter

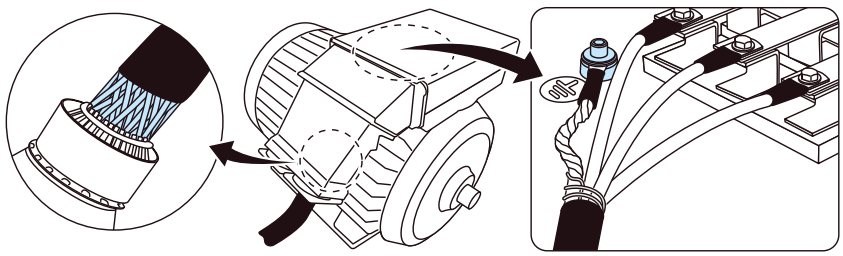
This chapter gives instructions on the wiring of the drive.

Safety

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

Grounding the motor cable shield at the motor end

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



Measuring the insulation

Measuring the insulation 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 input power cable

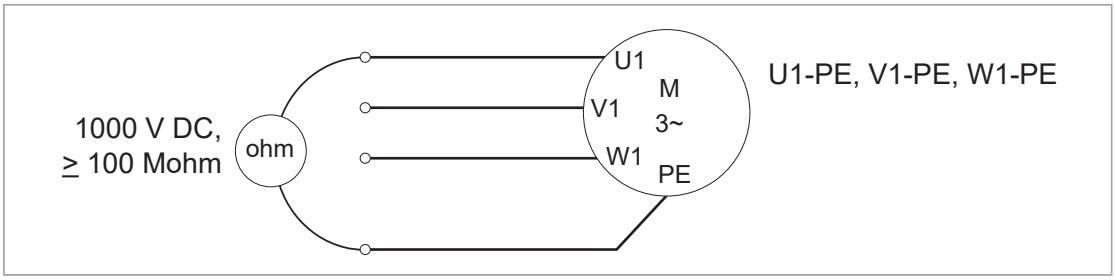
Before you connect the input power cable to the drive, measure its insulation resistance according to local regulations.

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 19) 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.



Grounding system compatibility check

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

EMC filter options +E200 and +E202

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

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

Ground-to-phase varistor

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

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

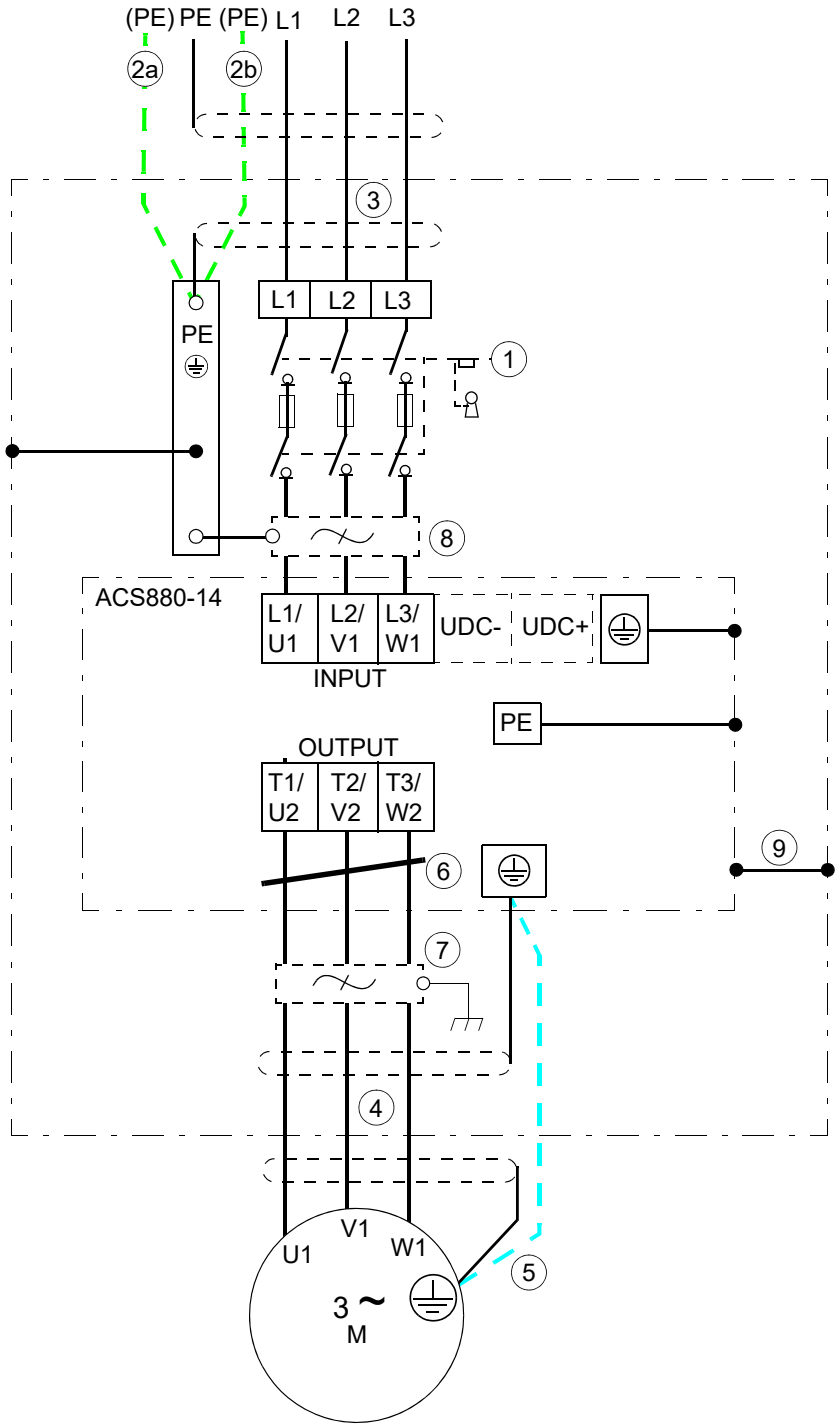
Installing the EMC filter (option +E202)

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

Connecting the power cables

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

Power cable connection diagram

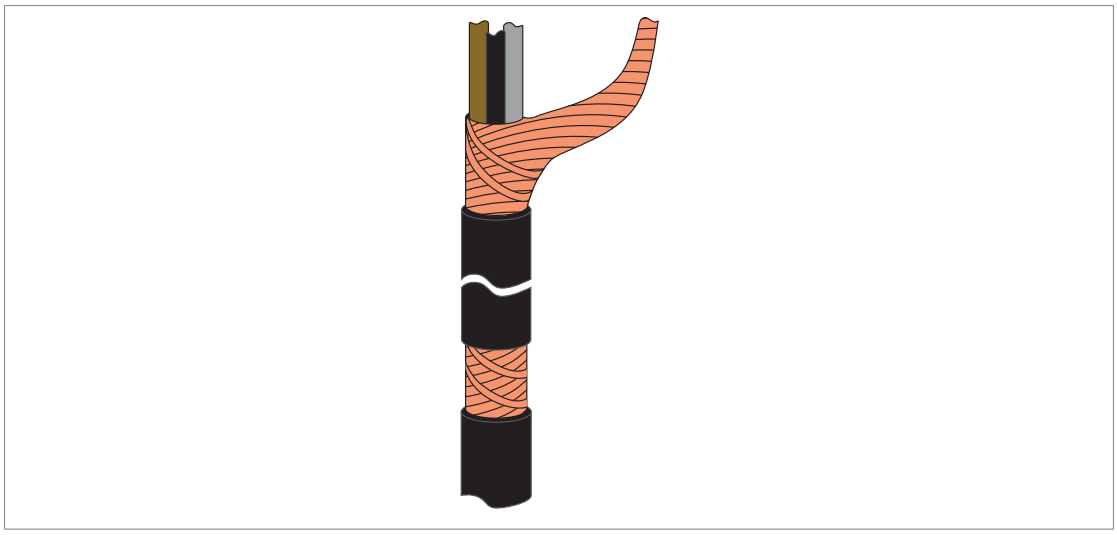


1	For alternatives, see Guidelines for planning the electrical installation (Page 67). In the installing example of this chapter, the disconnecting device is not in the same cubicle with the drive module.
2	If a shielded cable is used (not required but recommended) and the conductivity of the shield is < 50% of the conductivity of the phase conductor, use a separate PE cable (2a) or a cable with a grounding conductor (2b)
3	ABB recommends 360° grounding at the cabinet entry if a shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
4	ABB recommends 360° grounding at the cabinet entry

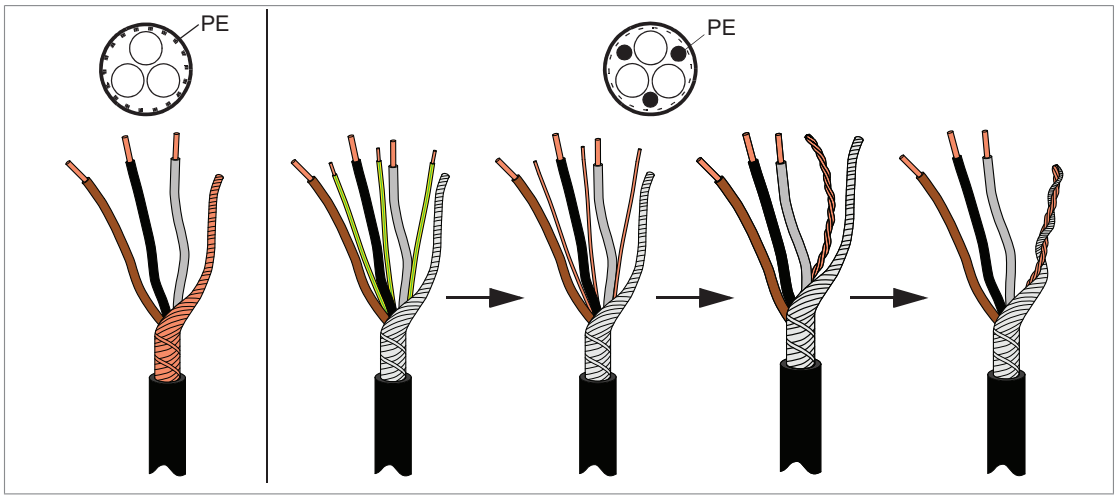
5	Use a separate grounding cable if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor and there is no symmetrically constructed grounding conductor in the cable (see Guidelines for planning the electrical installation (Page 67))
6	Common mode filter (option)
7	d*u*/d*t* filter (option)
8	EMC filter (option +E202)
9	The drive module frame must be connected to the cabinet frame. See Drive modules cabinet design and construction instructions (3AUA0000107668 [English]) and section Grounding the drive module and the LCL filter module (Page 65).
Note: If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends. Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.	

Preparing the cable ends and making 360° grounding at the cable entry

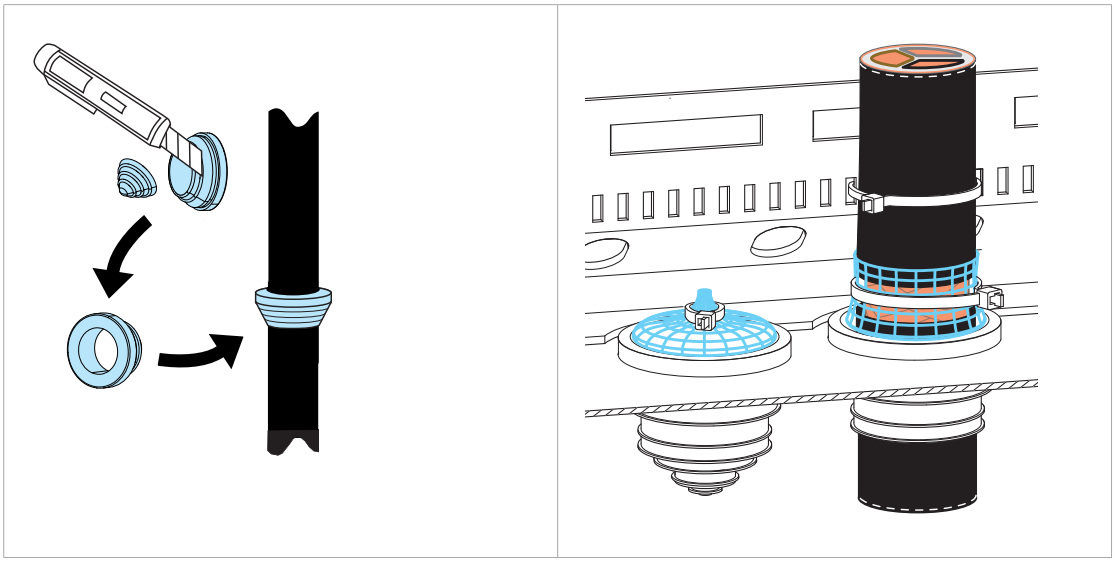
1. Peel off 3…5 cm (1 1/4 … 2 in) of the outer insulation of the cables at the cable entries with the conductive sleeves for the 360° high-frequency grounding.



2. Prepare the ends of the cables.



3. Put the cables through the entry plate. If the entry holes have rubber grommets, use one grommet for each cable. Cut adequate hole into the grommet and put the cable through the grommet inside the cabinet.
4. Attach the conductive sleeves to the cable shields with cable ties. Tie up the unused conductive sleeves with cable ties. An example of bottom entry is shown below. For top entry, put the grommet upwards.



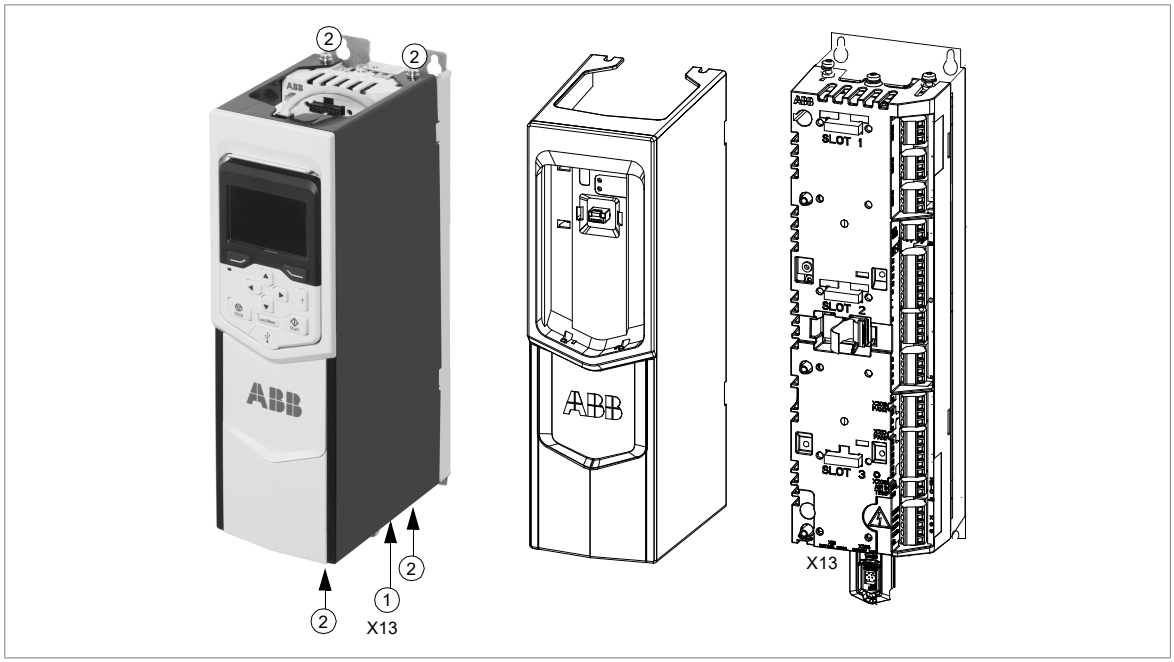
Power cable connection procedure

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

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

Removing the control panel holder from the external control unit

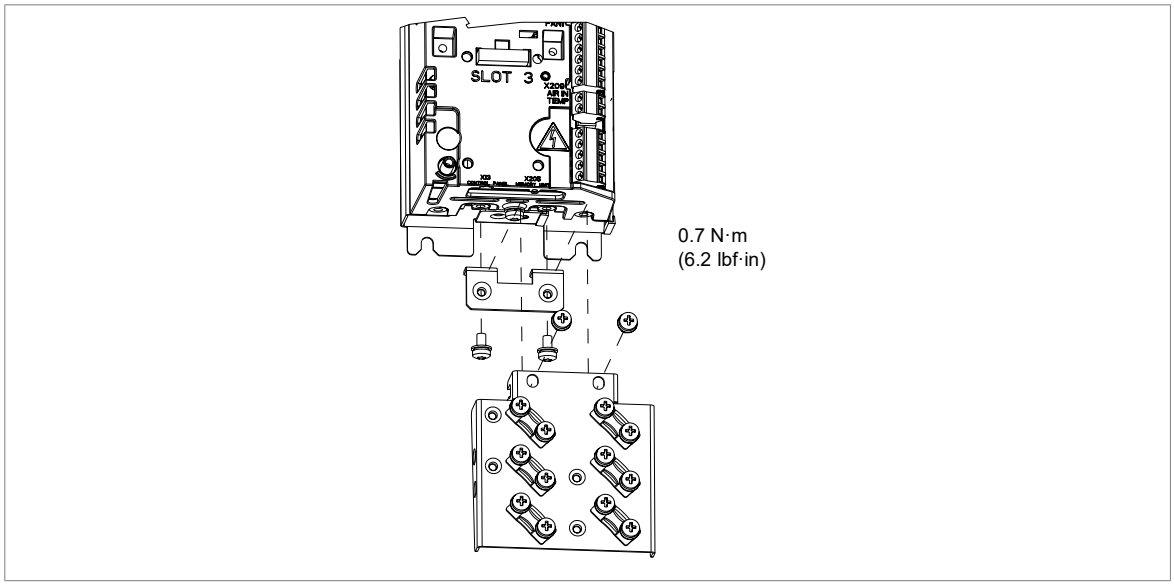
1. Disconnect the control panel cable from connector X13 on the control unit.
2. Loosen the mounting screws of the control panel holder and take the holder off.



Attaching the control cable clamp plate

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

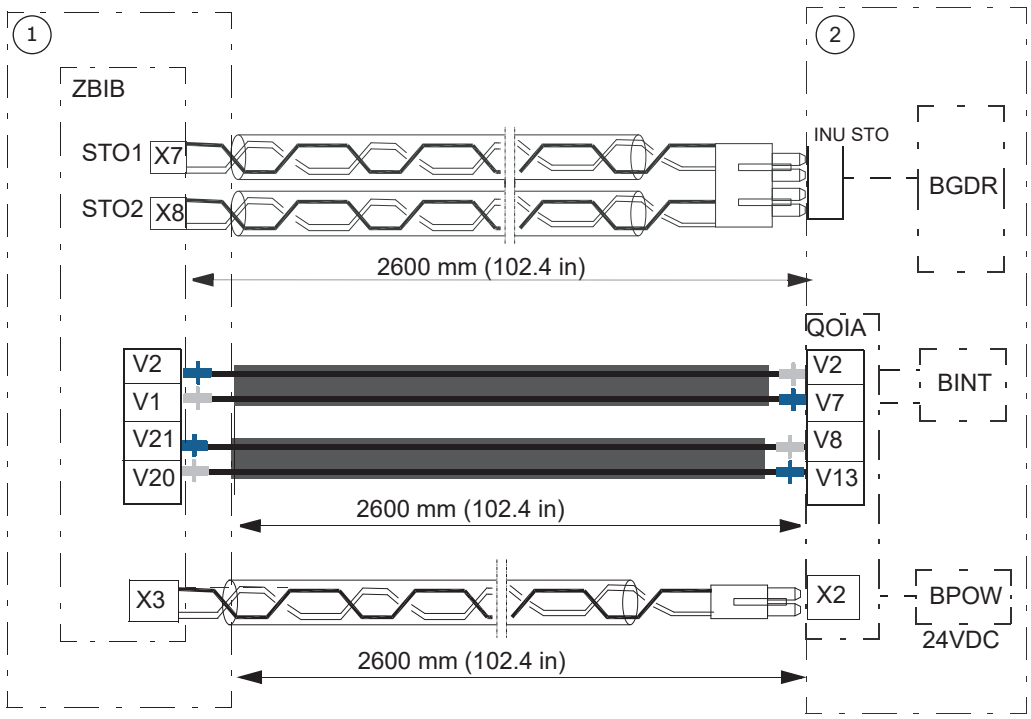
Note: If you install the FSO-xx safety functions module above the control unit, attach the control cable clamp plate on the base of the control unit.



Connecting the external control unit to the drive module

External control unit connection cables

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



1	ZCU control unit
2	Drive module

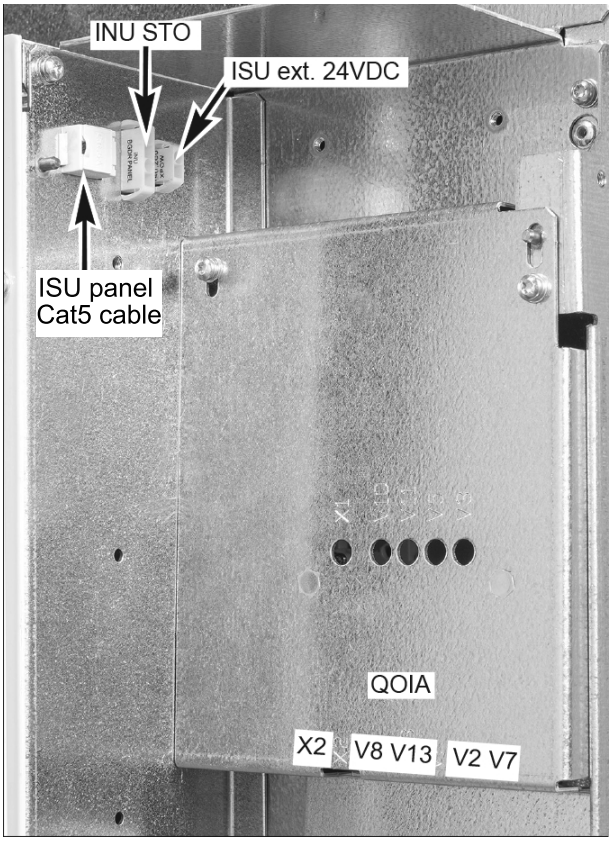
WARNING!
Handle the fiber optic cables with care. When you unplug the cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the ends are extremely sensitive to dirt.

Routing the external control unit cables into the drive module

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

Connecting control cables to the drive module

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

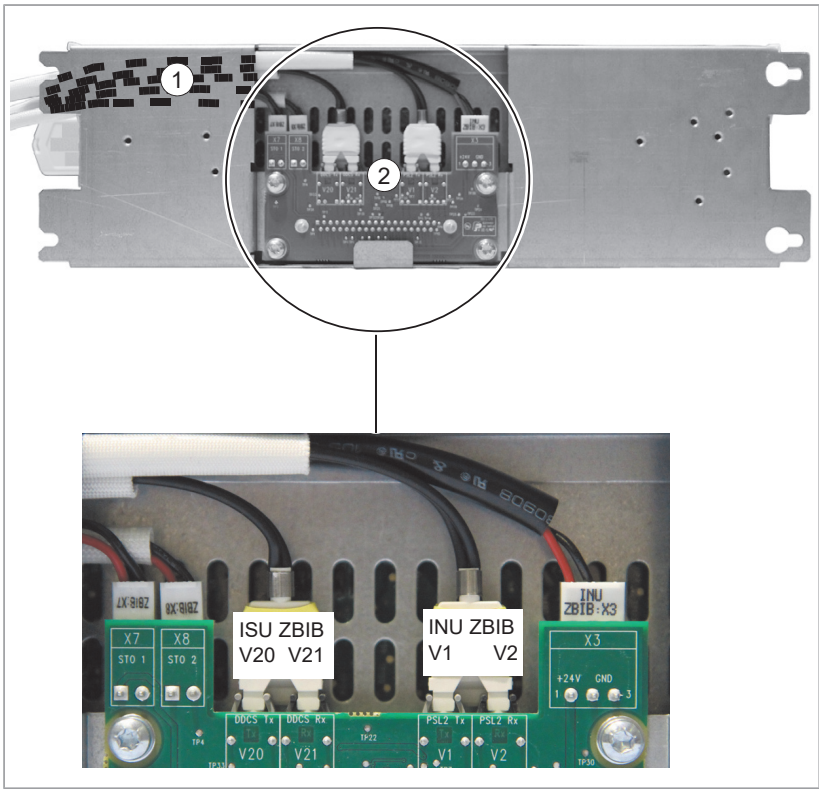


QOIA	ZBIB
INU STO	X7 (STO1)
	X8 (STO2)
X2	X3
V2	V2
V7	V1
V8	V21
V13	V22

Note: ISU ext. 24VDC connector is for supplying external 24 V DC to the line-side converter control unit if needed. ISU panel connector is for connecting the control panel to the line-side converter control unit if needed.

Connecting control cables to the control unit

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



QOIA	ZBIB
INU STO	X7 (STO1)
	X8 (STO2)
X2	X3
V2	V2
V7	V1
V8	V21
V13	V22

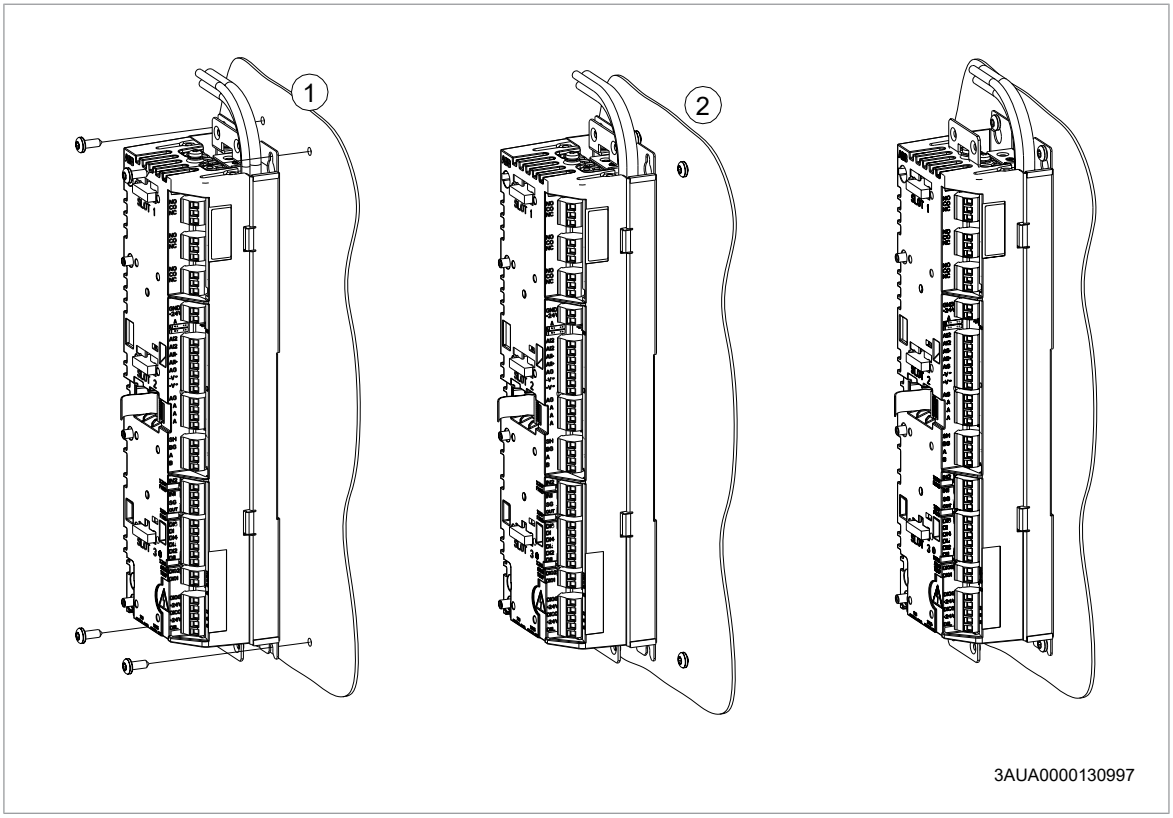
Attaching the external control unit

The drive control unit can be attached on a mounting plate or onto a DIN rail.

Attaching the external control unit to a mounting plate or wall

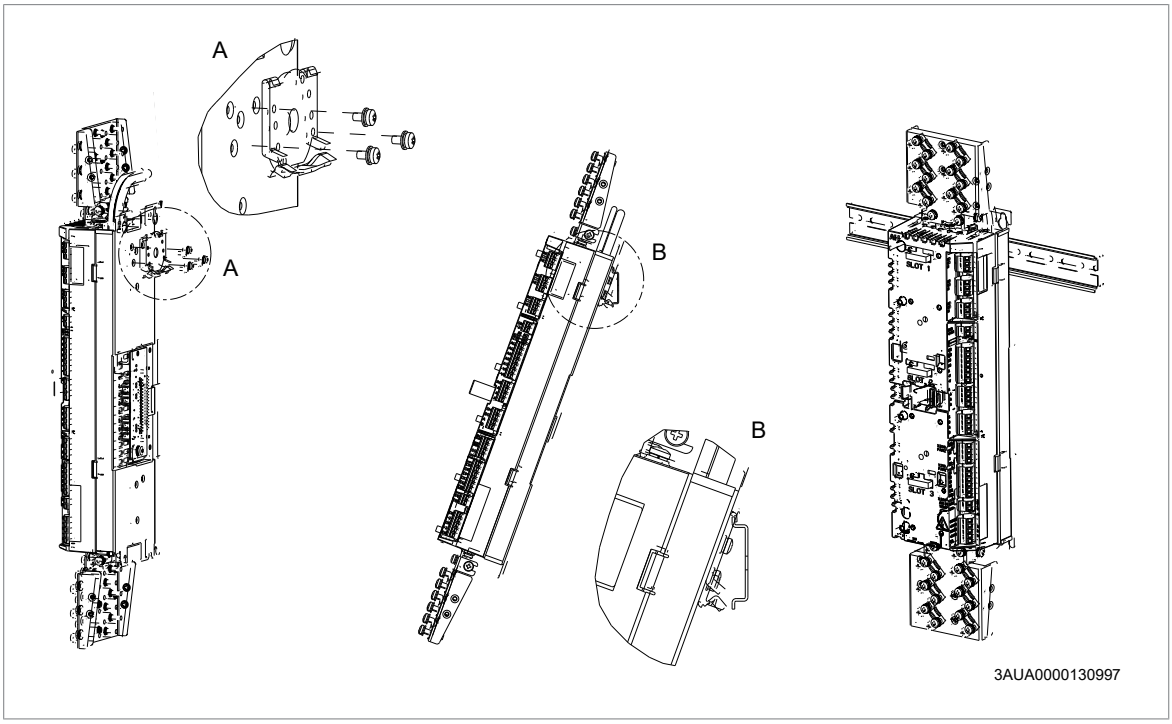
The external control unit and its mounting template are delivered in a cardboard box inside the drive module package. The mounting template contains a mounting pattern for two different control units, one on each side. Make sure to use the ZCU-14 control unit mounting pattern.

1. Mark the positions of the fastening screws to the wall through the mounting template.
2. Attach the screws.
3. Lift the control unit onto the screws and tighten the screws.



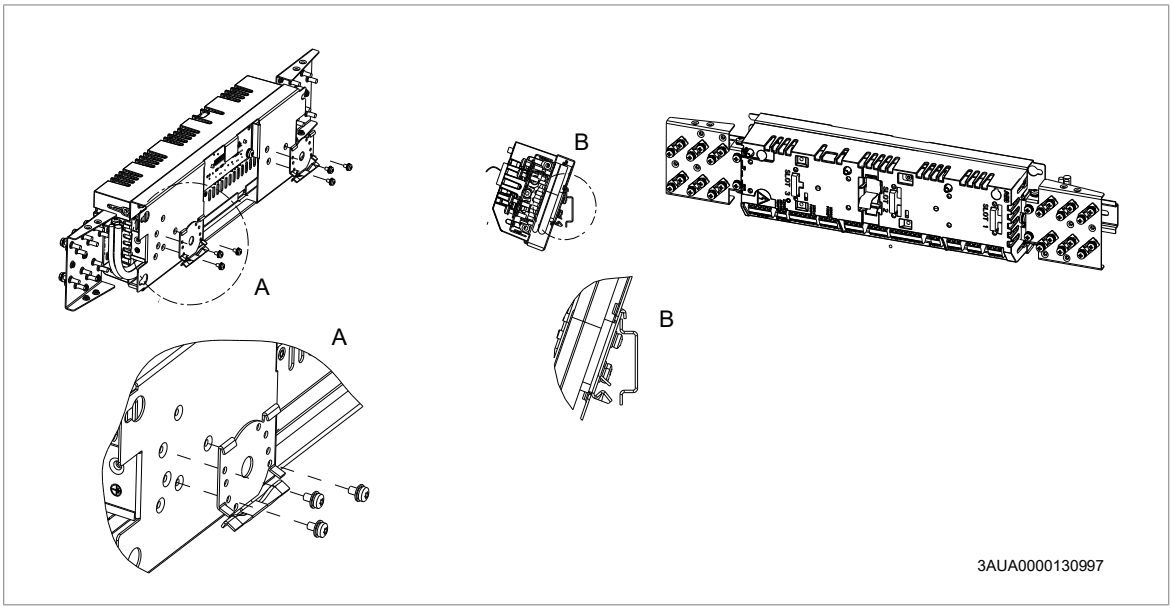
Attaching the external control unit vertically on a DIN rail

1. Attach the latch (A) to the back of the control unit with three screws.
2. Click the control unit to the rail as shown below (B).



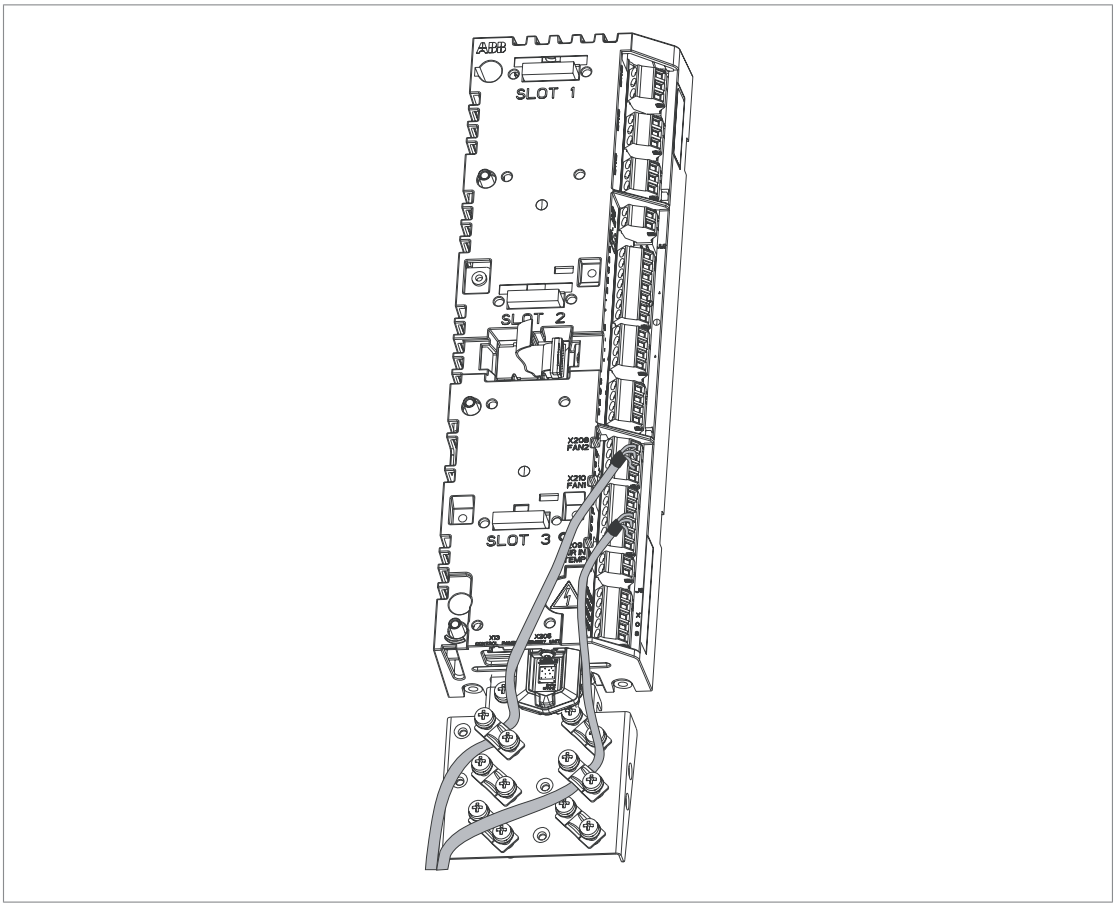
Attaching the external control unit horizontally on a DIN rail

1. Attach the latches (A) to the back of the control unit with three screws.
2. Click the control unit to the rail as shown below (B).



Connecting the control cables to the terminals of the external control unit

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



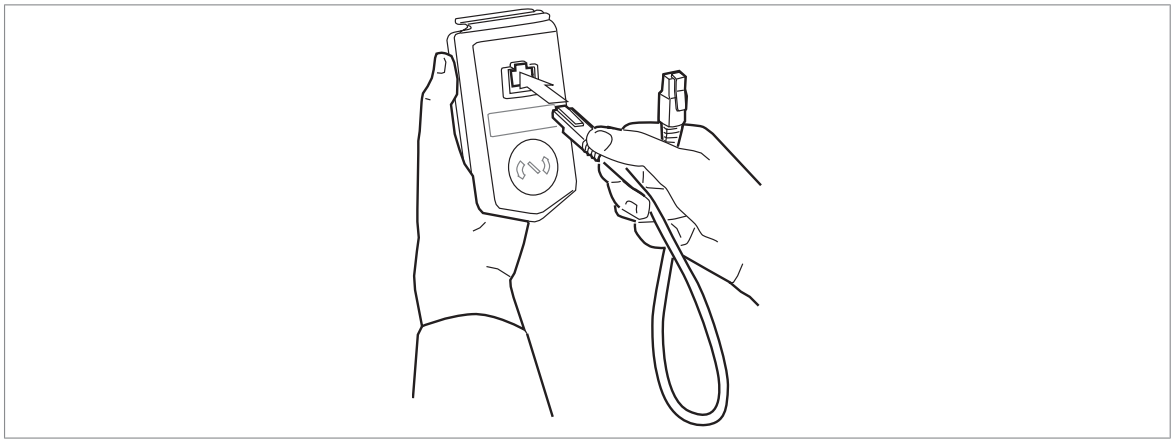
2. Ground the shields of the control cables at the clamp plate. Use torque 1.5 N·m (13 lbf·in). The shields should be continuous as close to the terminals of the control unit as possible. Only remove the outer jacket of the cable at the cable clamp so that the clamp presses on the bare shield. The shield (especially in case of multiple shields) can also be terminated with a lug and fastened with a screw at the clamp plate. Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor eg, 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points. Tighten the screws to secure the connection.
3. Connect the conductors to the appropriate detachable terminals of the control unit. See the Default I/O diagram of the drive control unit (ZCU-1x) (Page 117). Use shrink tubing or insulating tape to contain any strain strands.

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

Connecting a control panel

With control panel door mounting platform, connect the control panel as follows:

1. Connect an Ethernet cable to the RJ-45 connector of the control panel.
2. Connect the other end of the cable to the X13 connector of the control unit.



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

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.

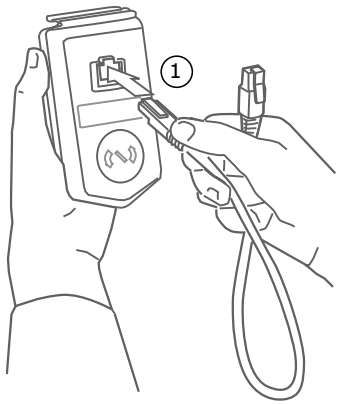
   *The parameter group is 149 with supply (line-side), brake or DC/DC converter units.

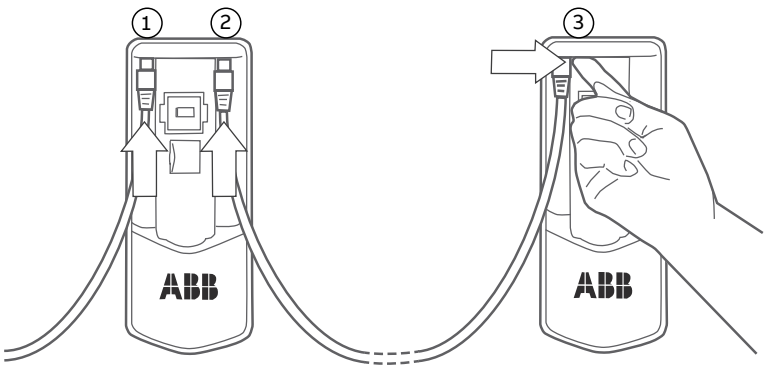
   Repeat the above for each drive.
2. With the panel connected to one unit, link the units using Ethernet cables.
3. Switch on the bus termination on the drive that is farthest from the control panel in the chain.
   - With drives that have the panel mounted on the front cover, move the terminating switch into the outer position.
   - With an FDPI-02 module, move termination switch S2 into the TERMINATED 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.

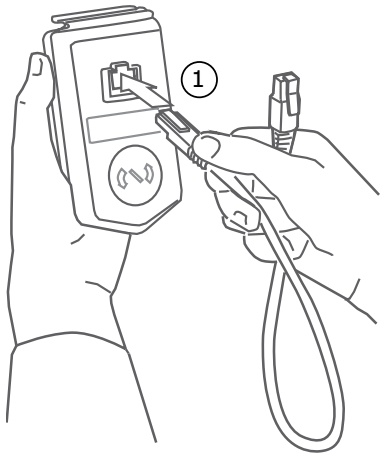
If a PC is connected to the control panel, the drives on the panel bus are automatically displayed in the Drive Composer PC tool.

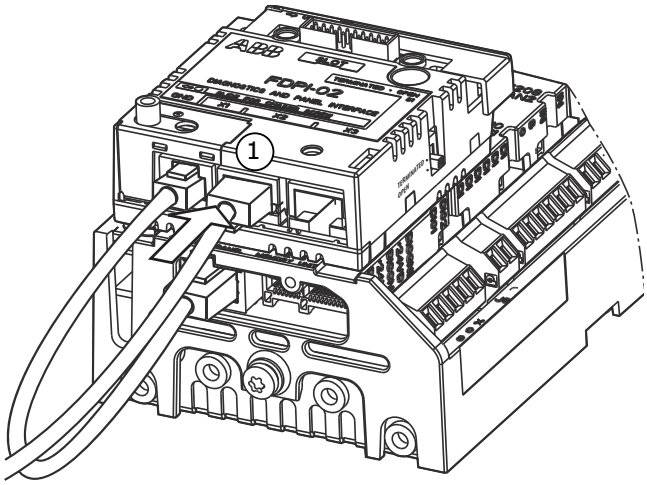
With twin connectors in the control panel holder:

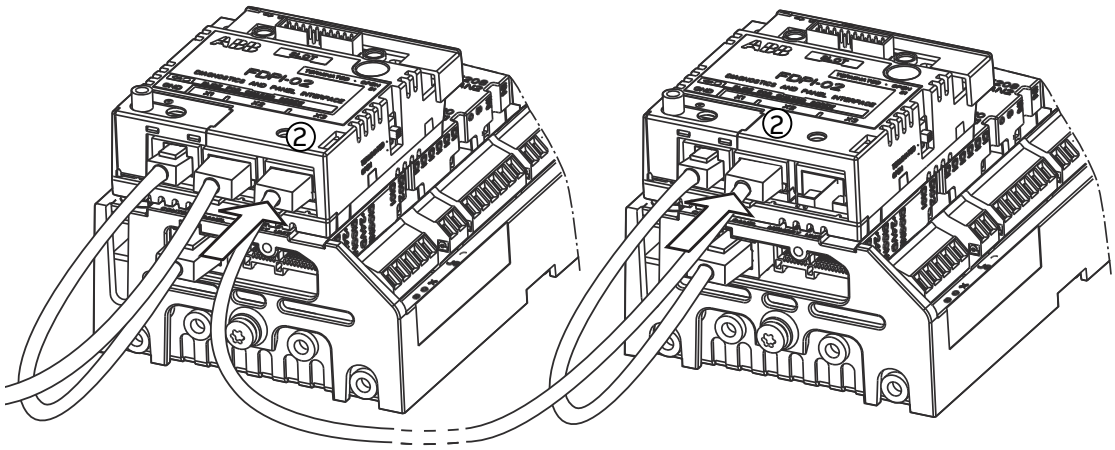


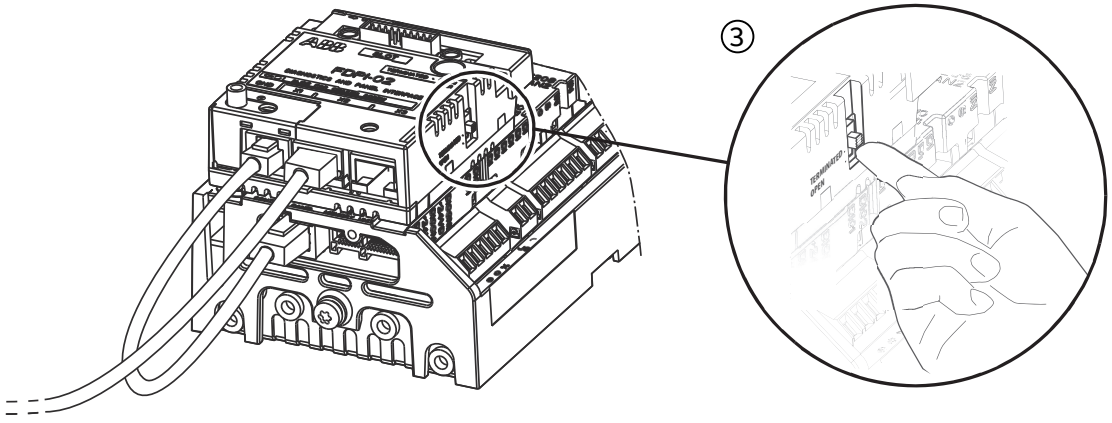


With FDPI-02 modules:

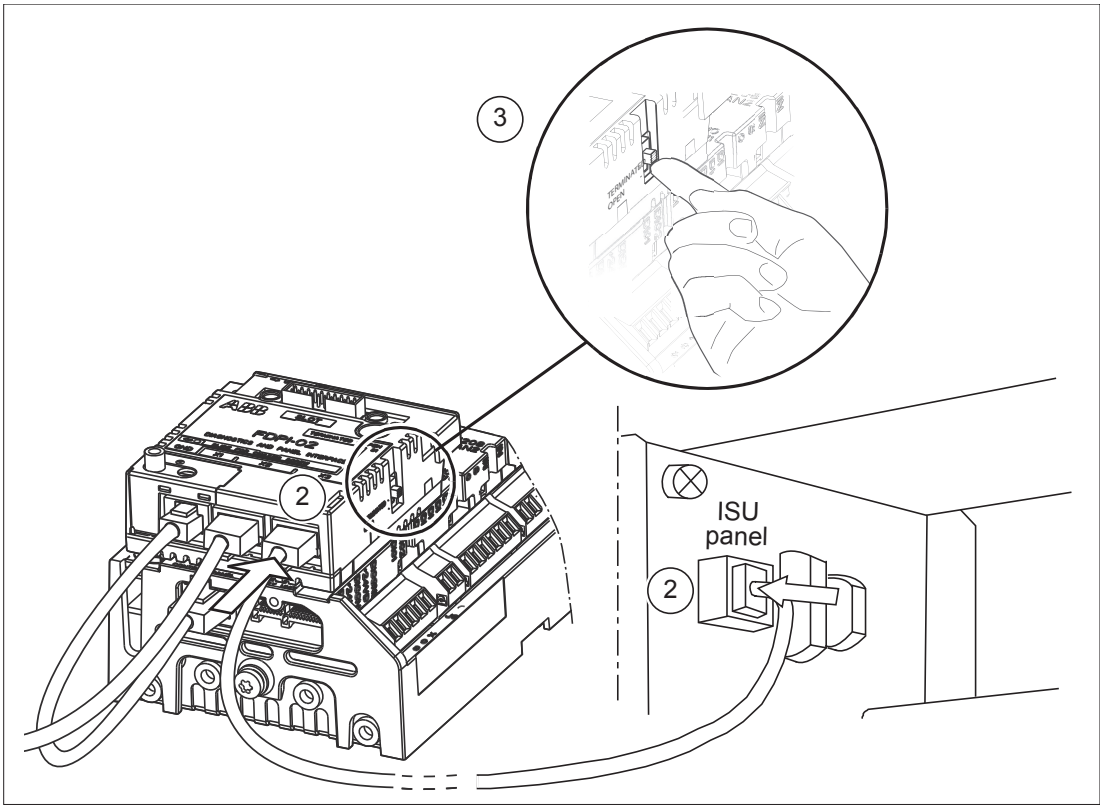




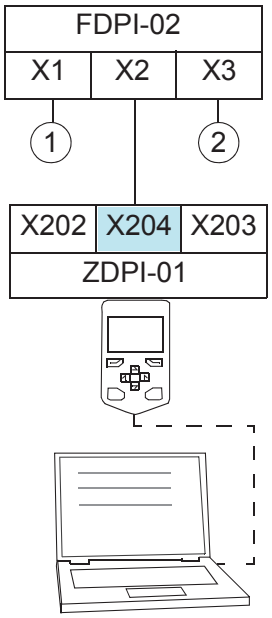




With FDPI-02 module ACS880-14 and ACS880-34:



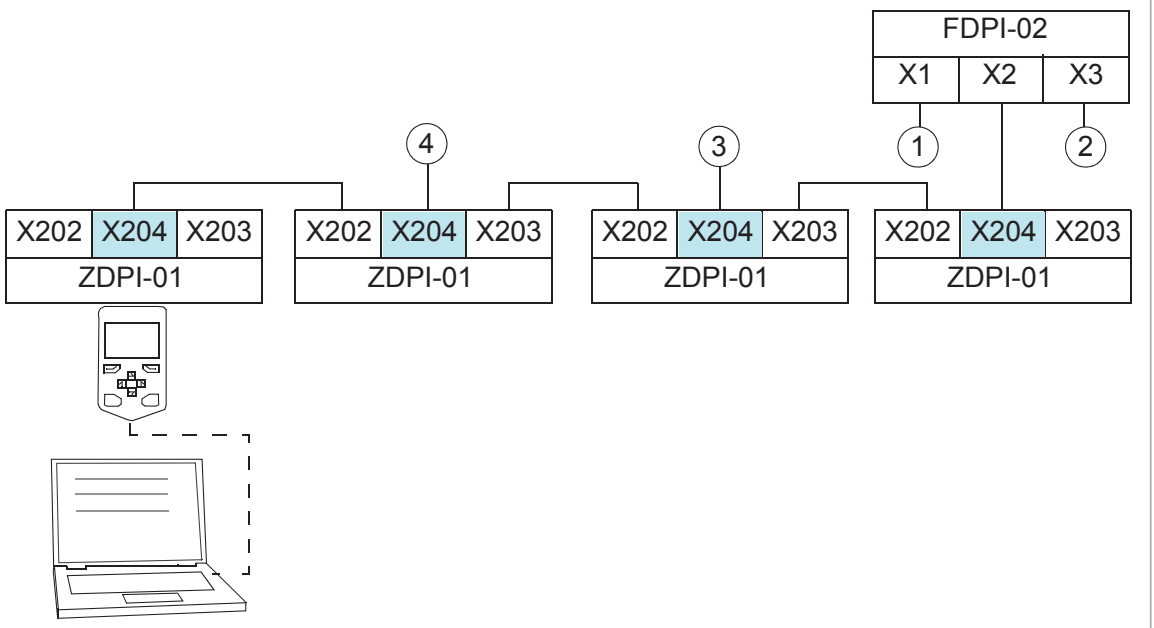
Panel bus wiring with FDPI-02 – single drive



X1-1	FDPI-02 diagnostics and panel interface installed onto the motor-side converter control unit
X2-X204	X2: Daisy chain bus terminal 1, RJ-45 shielded female connector for connecting a control panel

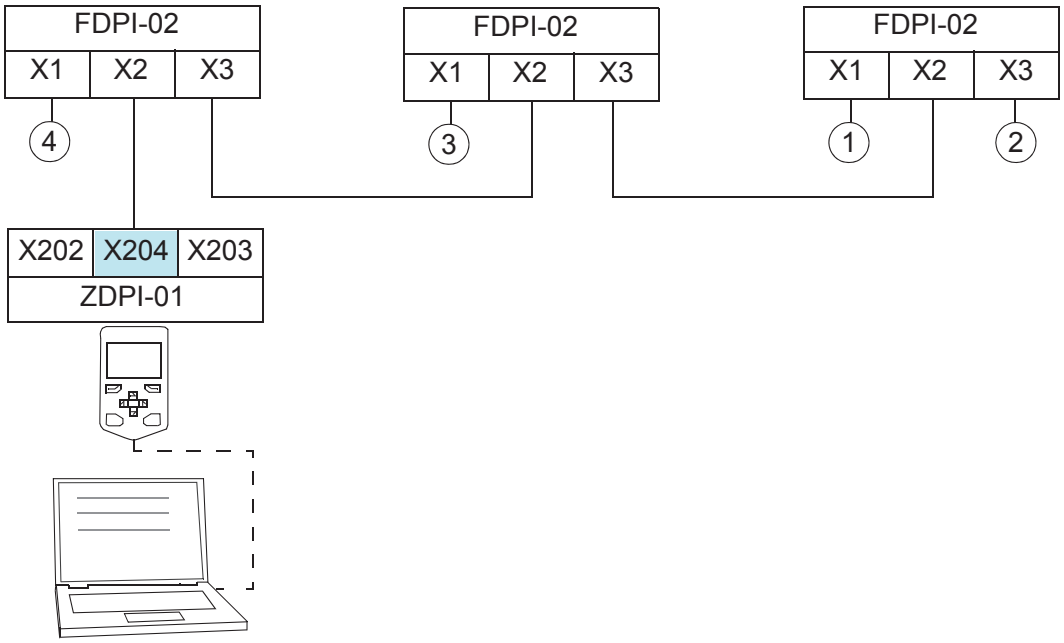
X3-2	X3: Daisy chain bus terminal 2, RJ-45 shielded female connector for connecting to the line-side converter control unit RJ-45 connector (X13, CONTROL PANEL)

Panel bus wiring with FDPI-02 and ZDPI-01 – several drives



X1-1	FDPI-02 diagnostics and panel interface installed onto the motor-side converter control unit
X2-X204	X2: Daisy chain bus terminal 1, RJ-45 shielded female connector for connecting a control panel
X3-2	X3: Daisy chain bus terminal 2, RJ-45 shielded female connector for connecting to the line-side converter control unit RJ-45 connector (X13, CONTROL PANEL)
3	Drive 2
4	Drive 3

Panel bus wiring with FDPI-02 – several drives



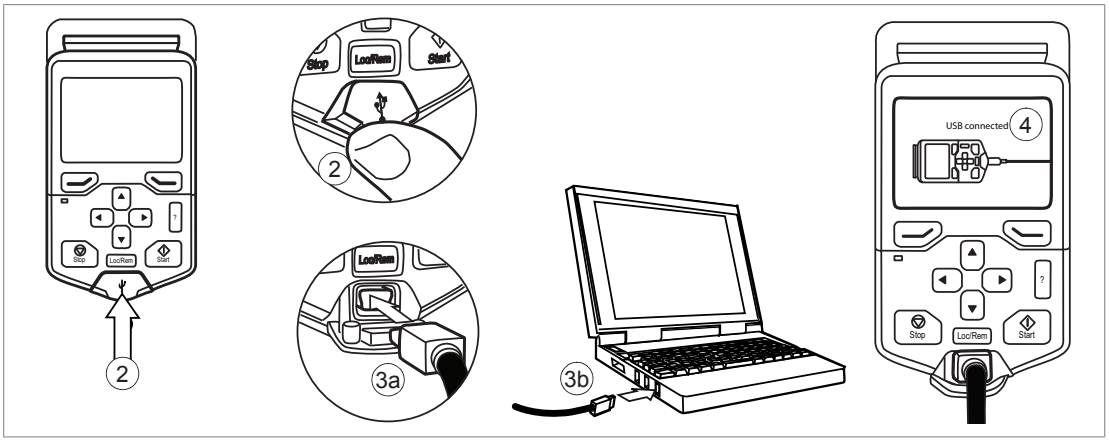
X1-1	FDPI-02 diagnostics and panel interface installed onto the motor-side converter control unit
X2-X204	X2: Daisy chain bus terminal 1, RJ-45 shielded female connector for connecting a control panel
X3-2	X3: Daisy chain bus terminal 2, RJ-45 shielded female connector for connecting to the line-side converter control unit RJ-45 connector (X13, CONTROL PANEL)
3	Drive 2
4	Drive 3

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.



Installing option modules

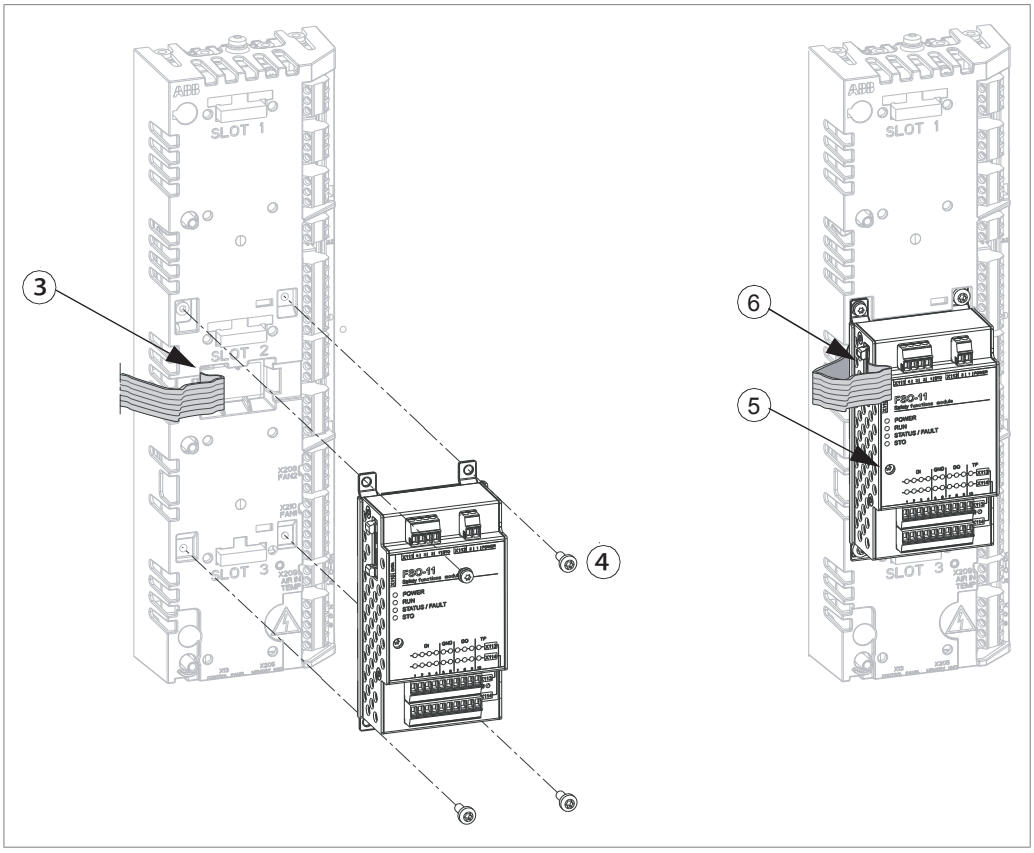
Installing the FSO-xx safety functions module

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

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 19) before you start the work.
2. If the bottom plate of the FSO-xx module looks different from that in the drawing below, remove the bottom plate and attach the alternative bottom plate from the FSO package to module.
3. Connect the FSO-xx data cable to connector X12 on the control unit.
4. Attach the FSO-xx module to Slot 2 with four screws.
5. Tighten the FSO module electronics grounding screw to 0.8 N·m. Note: The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.
6. Connect the FSO-xx data cable to FSO-xx connector X110.
7. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.

8. Connect the external +24 V power supply cable to connector X112.
9. Connect the other wires as shown in FSO-12 safety functions module user's manual (3AXD50000015612 [English]) or FSO-21 safety functions module user's manual (3AXD50000015614 [English]).



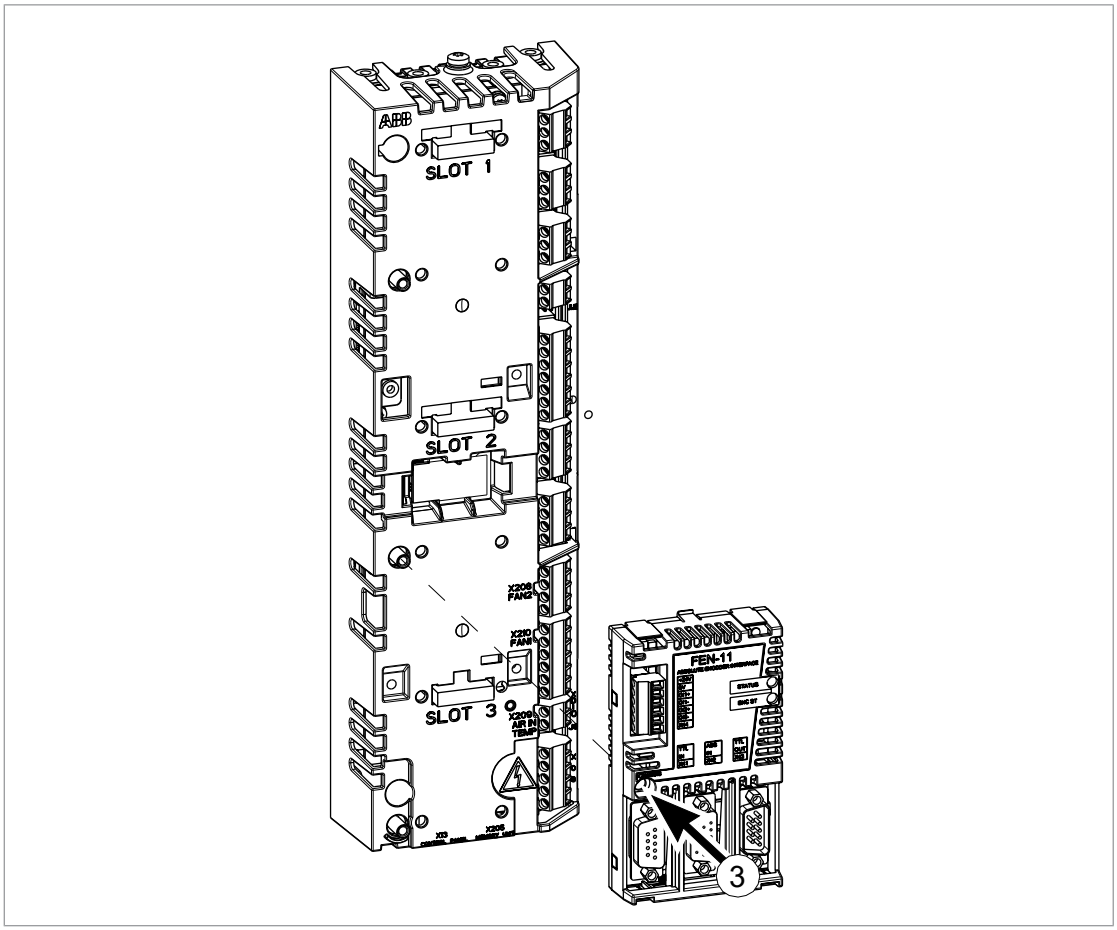
Installing I/O extension, fieldbus adapter and pulse encoder interface modules

See Overview of power and control connections for the available slots for each module.

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 19) before you start the work.
2. Insert the module carefully into its position on the control unit.
3. Tighten the grounding screw torque of 0.8 N·m.

   Note: The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for correct operation of the module.



Wiring the option modules

See the appropriate option module manual for specific installation and wiring instructions.

8

External control unit

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).

Unpacking the delivery

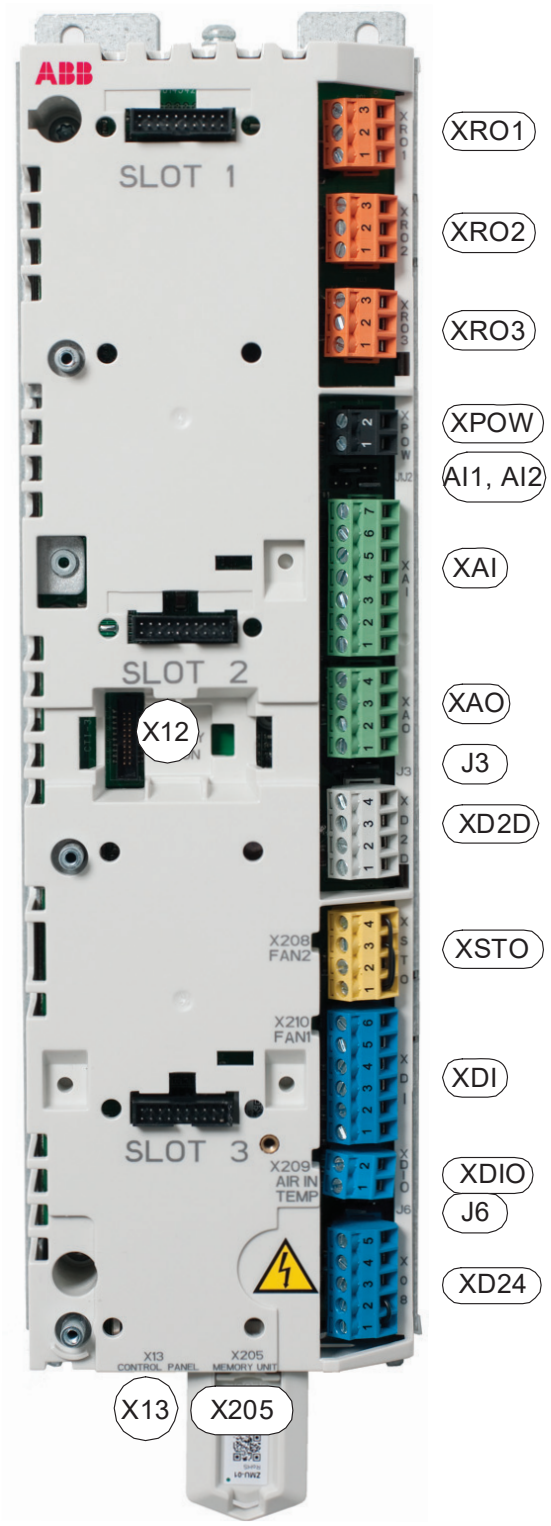
The external control unit is delivered in a cardboard box inside the main drive module package.

Unpack the external control unit package. Make sure that it contains these items:

- ZCU-14 control unit
- mounting template.

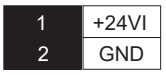
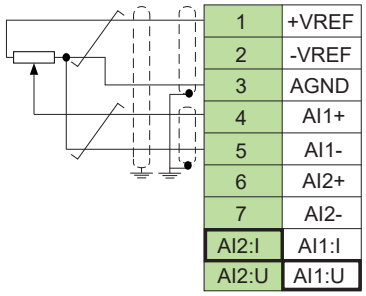
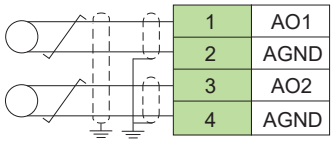
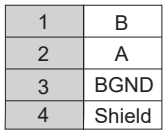
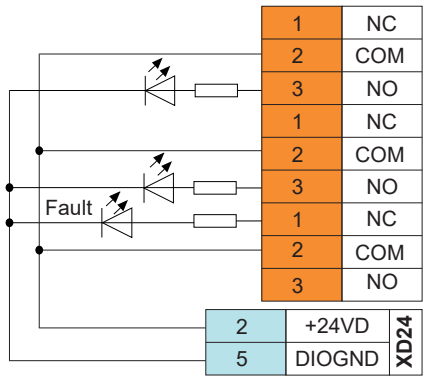
The mounting template contains a mounting pattern for a ZCU-14 control unit on one side and a mounting pattern for a CCU-24 control unit on the other side.

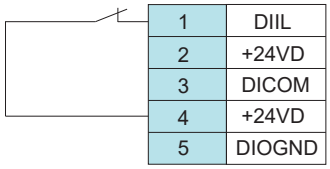
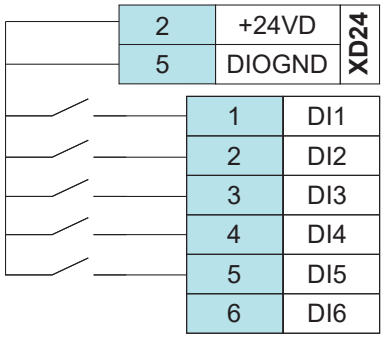
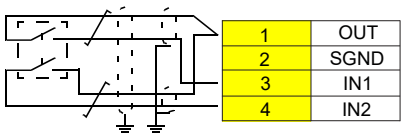
ZCU-14 layout



	Description
XPOW	External power input
XAI	Analog inputs
XAO	Analog outputs
XD2D	Drive-to-drive link
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XD24	Digital input interlock (DIIL) and +24 V output
XDIO	Digital input/outputs
XDI	Digital inputs
XSTO	Safe torque off connection (inverter unit only). **Note:** This connection only acts as a true Safe torque off input when the ZCU is controlling an inverter unit. When the ZCU is controlling a supply unit, de-energizing the inputs will stop the unit but will not constitute a true safety function.
X12	Connection for FSO-xx safety functions module (inverter unit only).
X13	Control panel connection
X202	Option slot 1
X203	Option slot 2
X204	Option slot 3
X205	Memory unit connection (memory unit inserted in the drawing)
AI1, AI2	Voltage/Current selection jumpers (AI1, AI2) for analog inputs
J3	Drive-to-drive link termination switch (J3)
J6	Common digital input ground selection jumper (J6).

Default I/O diagram of the drive control unit (ZCU-1x)

Connection	Term	Description
XPOW External power input		
	+24VI GND	24 V DC, 2 A min. (without optional modules)
XAI Reference voltage and analog inputs		
	+VREF -VREF AGND AI1+ AI1- AI2+ AI2- J1 J2	10 V DC, R_L 1…10 kohm -10 V DC, R_L 1…10 kohm Ground **Speed reference** 0(2)…10 V, R_{in} > 200 kohm [1)] By default not in use. 0(4)…20 mA, R_{in} = 100 ohm [1)] Current (I) / voltage (U) selection jumper for AI1 Current (I) / voltage (U) selection jumper for AI2
XAO Analog outputs		
	AO1 AGND AO2 AGND	**Motor speed rpm** 0…20 mA, R_L < 500 ohm **Motor current** 0…20 mA, R_L < 500 ohm
XD2D Drive-to-drive link		
	B A BGND Shield **J3**	Master/follower, drive-to-drive or embedded fieldbus connection [2)] Drive-to-drive link termination [2)]
XRO1, XRO2, XRO3 Relay outputs		
	NC COM NO NC COM NO NC COM NO	**Ready run** 250 V AC / 30 V DC 2 A **Running** 250 V AC / 30 V DC 2 A **Fault (-1)** 250 V AC / 30 V DC 2 A

Connection	Term	Description
XD24 Auxiliary voltage output, digital interlock [3]		
	DIIL	Run enable [3]
	+24VD	+24 V DC 200 mA [4]
	DICOM	Digital input ground
	+24VD	+24 V DC 200 mA [4]
	DIOGND	Digital input/output ground
XDIO Digital input/outputs		
	DIO1	Output: Ready run
	DIO2	Output: Running
	J6	Ground selection [5]
XDI Digital inputs		
	DI1	Stop (0) / Start (1)
	DI2	Forward (0) / Reverse (1)
	DI3	Reset
	DI4	Acc/Dec time select [6]
	DI5	Constant speed 1 (1 = On) [7]
	DI6	By default, not in use.
	OUT	Safe torque off circuits must be closed for the drive to start. [8]
	SGND	
	IN1	
	IN2	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

1) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected by jumper. Change of setting requires reboot of control unit.
2) See section The XD2D connector (Page 119)
3) See section DIIL input (Page 119).
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) Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats; in practice, selects whether the digital inputs are used in current sinking or sourcing mode). See also ZCU-1x ground isolation diagram (Page 123). DICOM=DIOGND ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.
6) 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.
7) Constant speed 1 is defined by parameter *22.26*.
8) See chapter The Safe torque off function (Page 221).

The wire size accepted by all screw connectors (for both stranded and solid wire) is 0.5 … 2.5 mm^2 (24…12 AWG). The torque is 0.5 N·m (5 lbf·in).

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 86) and the module manuals.

External power supply for the control unit (XPOW)

The control unit is powered from a 24 V DC, 2 A supply through terminal block XPOW.

Using an external 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 certified.

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.

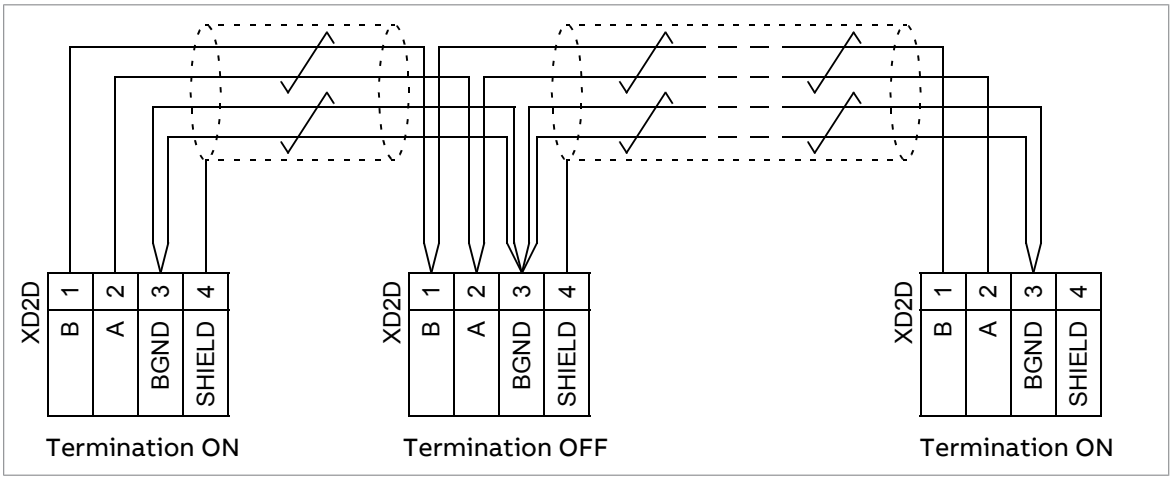
See the firmware manual of the drive for the related parameter settings.

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, fro exmple, 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.

ZCU-14



Safe torque off (XSTO)

See chapter The Safe torque off function (Page 221).

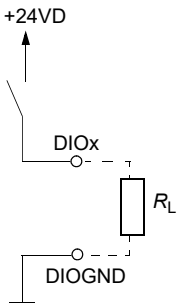
Note: The XSTO input only acts as a true Safe torque off input on the inverter control unit. De-energizing the IN1 and/or IN2 terminals of other units (supply, DC/DC converter, or brake unit) will stop the unit but not constitute a true safety function.

FSO safety functions module connection (X12)

Refer to the applicable FSO module user's manual.

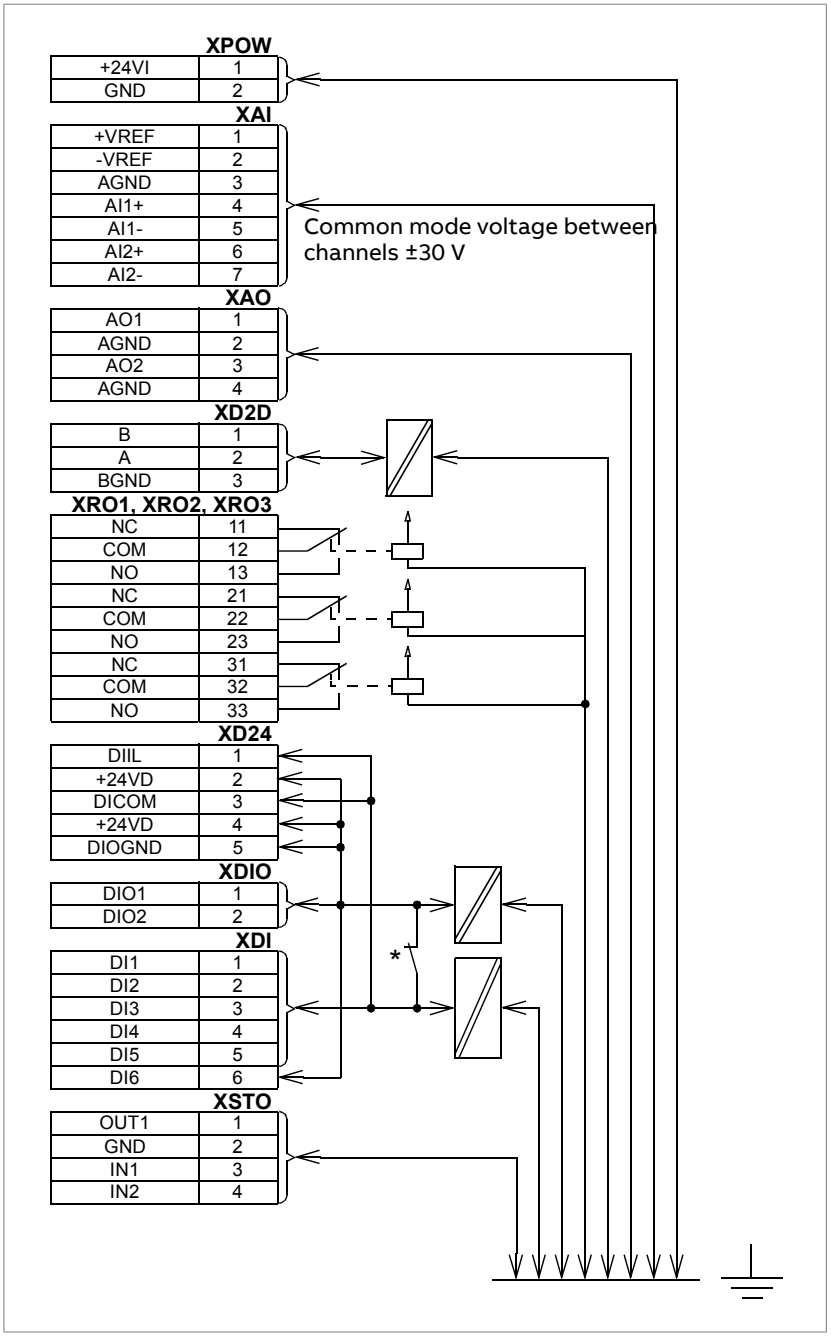
Connector data

Power supply (XPOW)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) 24 V (±10%) DC, 2 A External power input.
Relay outputs RO1…RO3 (XRO1…XRO3)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) 250 V AC / 30 V DC, 2 A Protected by varistors
+24 V output (XD24:2 and XD24:4)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
Digital inputs DI1…DI6 (XDI:1…XDI:6)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) 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)
Start interlock input DIIL (XD24:1)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) 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

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.	Connector pitch 5 mm, wire size 0.5 … 2.5 mm² (22…12 AWG) As inputs: 24 V logic levels: "0" < 5 V, "1" > 15 V. R_{in}: 2.0 kohm. Filtering: 1 ms. As outputs: Total output current from +24VD is limited to 200 mA 
Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm² (22…12 AWG) 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 jumpers	Connector pitch 5 mm, wire size 0.5 … 2.5 mm² (22…12 AWG) Current input: -20…20 mA, R_{in} = 100 ohm Voltage input: -10…10 V, R_{in} > 200 kohm Differential inputs, common mode range ±30 V Sampling interval per channel: 0.25 ms Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range
Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm² (22…12 AWG) 0…20 mA, R_{load} < 500 ohm Frequency range: 0…300 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
XD2D connector	Connector pitch 5 mm, wire size 0.5 … 2.5 mm² (22…12 AWG) 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 jumper
RS-485 connection (X485)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm² (22…12 AWG) 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)

Safe torque off connection (XSTO)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Input voltage range: -3…30 V DC Logic levels: "0" < 5 V, "1" > 17 V. **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 true Safe torque off functionality is only achieved through the XSTO connector of the drive/inverter control unit. Current consumption: 66 mA (continuous) per STO channel EMC (immunity) according to IEC 61326-3-1 and IEC 61800-5-2
Safe torque off output (XSTO OUT)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) To STO connector of inverter module.
Control panel connection (X13)	Connector: RJ-45 Cable length < 100 m (328 ft)
The terminals of the control unit fulfill the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if a voltage higher than 48 V is connected to the relay output.	

ZCU-1x ground isolation diagram



* Ground selector (J6) settings

• ⊡

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

• ⊡

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

9

Installation into a Rittal VX25 enclosure

Contents of this chapter

This chapter gives an installation example of the standard drive module configuration in a 800 mm wide Rittal VX25 enclosure with Rittal parts, alternative ABB parts and needed customer-made parts. For control cable installation, see chapter Electrical installation (Page 93).

For instructions on how to install the drive module in a 800 mm wide Rittal TS 8 enclosure, see revision B of this manual.

This chapter also includes references on how to install the drive module with ready-made ABB installation kits into a Rittal VX25 enclosure.

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).

Installation into a Rittal VX25 enclosure with ready-made ABB installation kits

A supplement to this manual, ACH580-34, ACQ580-34, ACS880-14 and ACS880-34 drive modules installation in Rittal VX25 enclosure supplement (3AXD50000815838 [English]), gives instructions on how to install the drive module and additional equipment into a Rittal VX25 400 mm + 800 mm wide enclosure. The installation uses ready-made ABB installation kits. The supplement contains dimension drawings, ordering codes and an example set of circuit diagrams. The kits include their installation drawings.

ACH580-34, ACQ580-34, ACS880-14 and ACS880-34 drive modules installation in Rittal VX25 enclosure animation (3AXD50000883707 [English]) shows an example installation in detail.

Safety



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.

Necessary parts

Drive module standard parts		
• Drive module and LCL filter module • Fastening brackets (2 pcs) • Pedestal guide plates (2 pcs) • Telescopic extraction/installation ramp • Fastening screws and insulators in a plastic bag • External control unit		
Rittal parts / Alternative ABB parts		
Rittal part code	**Qty (pcs)**	**Description**
8806.000	1	Enclosure without bottom plates and side panels. Includes supports for installing air baffles.
7967.000 (one set = four pieces)	1	Spacers for roof plates / ABB roof
8100.743	1	Punched section with mounting flange, inner mounting level for 800 mm horizontal
Contact ABB for the suitable filter	4	Air filter. Remove the filter mats.
Alternative ABB parts for Rittal parts		
ABB air inlet kit 800 mm 3AUA0000117005 (IP20) 3AUA0000117009 (IP42)	2	See section Air inlet kits (Page 172)
ABB air outlet kit 800 mm 3AUA0000125203 (IP20) 3AUA0000114968 (IP42)	2	See section Air outlet kits (Page 174)
Customer-made parts (not ABB or Rittal products)		
Air baffles	4	See section Air baffles (Page 215)
Bottom plate	1	See section Bottom plate (Page 214)

Necessary tools

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

Overall flowchart of the installation process

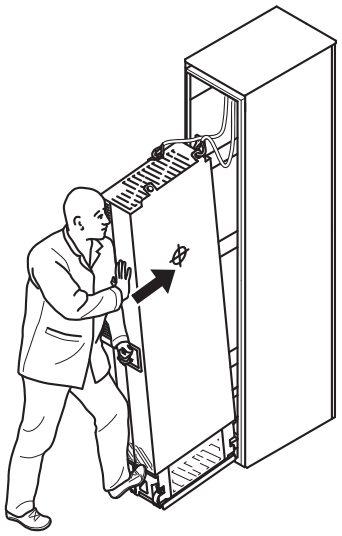
Step	Task	For instructions, see
1	Install the Rittal parts, drive bottom guide plate and loose drive options in the drive module cubicle	Installing the drive module and LCL filter module into an enclosure (Page 128)
2	Install the auxiliary components (such as mounting plates, switches, busbars etc.)	The component manufacturer's instructions Preventing the recirculation of hot air (Page 52)

Step	Task	For instructions, see
3	Attach the drive module and LCL filter module into the enclosure	Installing the drive module and LCL filter module into an enclosure (Page 128)
4	Connect the power cables and clear plastic shrouds to the drive module. Connect the power supply cable to the LCL filter cooling fan.	Connecting the motor cables and installing the shrouds (Page 129) Connecting the input cables and installing the shrouds (Page 130) Connecting the power cables (Page 95)
5	Install the air baffles	Installing the air baffles (Page 132)
6	Install the external control unit	Attaching the external control unit (Page 102)
7	Connect the control cables	Connecting the control cables to the terminals of the external control unit (Page 104)
8	Install the remaining parts, for example, air baffles, cabinet doors, side plates, etc.	The component manufacturer's instructions

Installing the drive module and LCL filter module into an enclosure

See Installing the drive module and LCL filter module into a Rittal VX25 enclosure (Page 244).

Step	Tasks
Mechanical accessories	
1	Attach the plinth to the floor.
2	Attach the enclosure frame to the plinth.
3	Make the bottom plate with 360-degree grounding entries for power cables. Attach the bottom plate to the enclosure frame.
4	Attach the punched section to the back of enclosure frame.
5	Attach the mounting brackets to the punched section.
LCL filter module	
6	Install the pedestal to the LCL filter module.
7	Install the cooling fan to the LCL filter module.
8	Attach the LCL filter module pedestal guide plate to the enclosure bottom plate.
9	Attach the drive module pedestal guide plate to the enclosure bottom plate.
10	Attach the extraction/installation ramp to the LCL filter module pedestal guide plate.
11	To prevent the LCL filter module from falling, attach its lifting lugs with chains to the enclosure frame.

12	Push the LCL filter module carefully into the enclosure along the extraction/installation ramp. Work preferably with help from another person as shown below. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back. 
13	Unfasten the extraction/installation ramp and attach the LCL filter module to bottom plate.
Drive module	
14	Attach the extraction/installation ramp to the drive module pedestal guide plate.
15	Remove the sheeting from the clear plastic shrouds of the drive module from both sides.
16	Install the top metallic shroud to the drive module.
17	Install the back shrouds to the drive module.
18	To prevent the drive module from falling, attach its lifting lugs with chains to the enclosure frame.
19	Push the drive module carefully into the enclosure along the extraction/installation ramp. Work preferably with help from another person as shown above. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
20	Unfasten the extraction/installation ramp and attach the drive module to the bottom plate.
LCL filter module and drive module attachments and intermediate electrical connections	
21	Attach the LCL filter module and drive module to the punched section.
22	Attach the LCL filter module to the side of drive module from top. Reinstall the cover.
23	Attach the drive module and LCL filter module to the bottom plate.
24	Connect the LCL filter busbars to the drive module busbars with the connecting busbars.
25	Attach the LCL filter module to the drive module side from bottom.
26	Connect the LCL filter fan power supply cable to connector FAN3:LCL.
Air baffles	
-	After the electrical installation has been done, install the air baffles. For instructions, see section Installing the air baffles (Page 132).

Connecting the motor cables and installing the shrouds

See Connecting the motor cables and installing the shrouds (Page 249).

Step	Tasks (motor cables)
1	Install the grounding terminal to the drive module base.
2	Run the motor cables to the enclosure. Ground the cable shields 360° at the enclosure entry.

3	Connect the twisted shields of the motor cables to the grounding terminal.
4	Screw in and tighten the insulators to the drive module by hand. Install the T3/W2 connection terminal to the insulators.  **WARNING!** Do not use longer screws or bigger tightening torque than given in the installation drawing. They can damage the insulator and cause dangerous voltage to be present at the module frame.
5	Connect the phase T3/W2 conductors to the T3/W2 terminal.
6	Install the T2/V2 connection terminal to the insulators. See the warning in step 4.
7	Connect the phase T2/V2 conductors to the T2/V2 connection terminal.
8	Install the T1/U2 connection terminal to the insulators. See the warning in step 4.
9	Connect the phase T1/U2 conductors to the T1/U2 terminal.
10	Remove the plastic sheeting from the motor cable clear plastic shroud from both sides.
11	Install the shroud on the motor cable connections.
12	Install the lower front cover to the drive module.
13	Drill holes for the power cables to the bottom clear plastic shrouds.
14	Remove the plastic sheeting from the bottom clear plastic shrouds.
15	Install the bottom first shroud on the motor cable entry.
16	Install the second shroud on the motor cable entry.

Connecting the input cables and installing the shrouds

See Connecting the input power cables and installing the shrouds (Page 252).

Step	Tasks (input cables)
1	Ground the input cable shields (if present) 360° at the enclosure entry.
2	Connect the twisted shields of the input cables and separate ground cable (if present) to the enclosure grounding busbar.
3	Step drill carefully sufficiently big holes to the entry clear plastic shroud for the cables to be connected. Align the holes in the vertical direction according to the alignment holes in the shroud. Smooth the hole edges. Remove the plastic sheeting from both sides of the shroud. Attach the cables firmly to the enclosure frame to prevent chafing against the hole edges.
4	Put the conductors of the input cables through the drilled holes in the clear plastic shroud.
5	For drive modules without option +H370: Connect the input cable conductors to the drive module L1/U1, L2/V1 and L3/W1 connection busbars. Go to step 12.
6	**Tasks with option +H370: Do steps 6 to 11**.
7	Screw in and tighten the insulators to the drive module by hand. Install the L1/U1 connection terminal to the insulators.  **WARNING!** Do not use longer screws or bigger tightening torque than given in the installation drawing. They can damage the insulator and cause dangerous voltage to be present at the module frame.
8	Connect the L1/U1 conductors to the L1/U1 connection terminal.
9	Install the L2/V1 connection terminal to the insulators. See the warning in step 5.
10	Connect the L2/V1 conductors to the L2/V1 connection terminal.
11	Install the L3/W1 connection terminal to the insulators. See the warning in step 5.

12	Connect the L3/W1 conductors to the L3/W1 connection terminal.
13	Install the side clear plastic shroud and the upper front cover of the drive module.
14	Install the entry clear plastic shroud and motor cable shroud.
15	Install the top clear plastic shroud to the drive module.

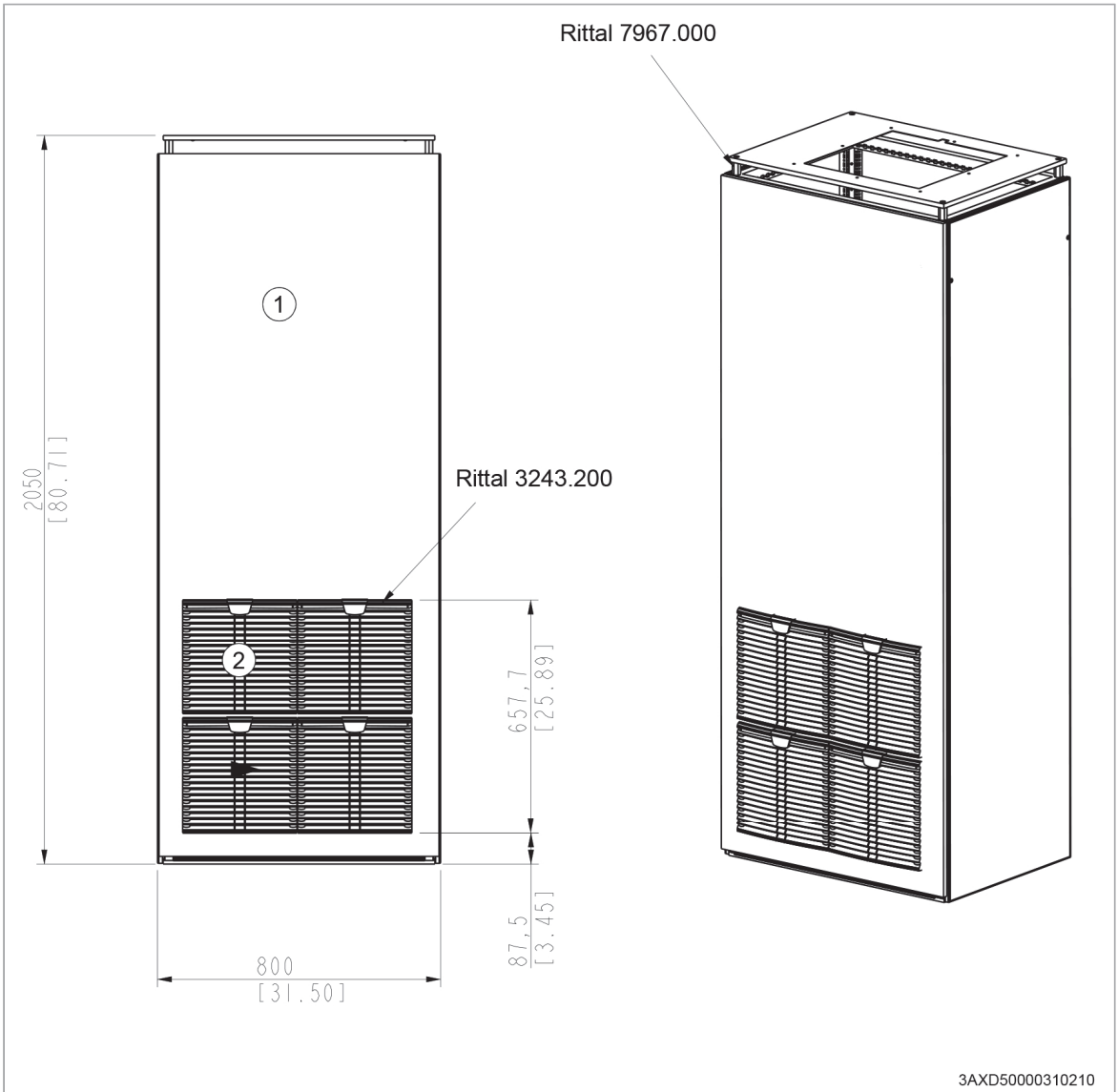
Installing the air baffles

See:

- Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243)
- Air baffles (Page 215)
- Air baffles for option +H381 in 800 mm wide Rittal VX25 enclosure (Page 216).

Installing the roof and door (Rittal parts)

This drawing shows a layout tested by ABB.

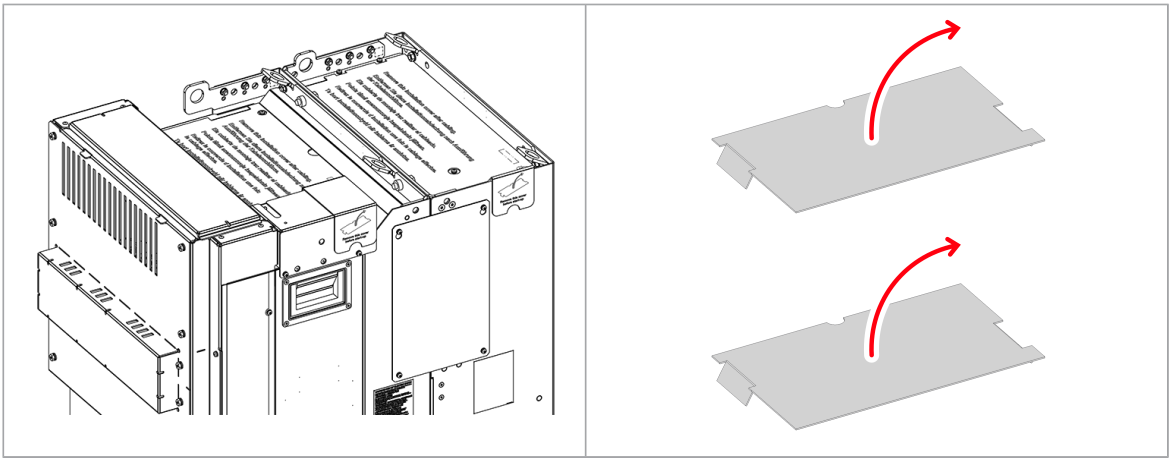


1	Door
2	Install these gratings as close to each other as possible. Remove the filter mats.

Removing the protective covering from the drive module and LCL filter module air outlet

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

WARNING!
Remove the protective covering from the top of the LCL filter module after the installation. If the covering is not removed, the cooling air cannot flow freely through the module and the module will overheat.



10

Installation example with full cabling panels (option +H381)

Contents of this chapter

In this chapter, the drive module and LCL filter module are installed in a 800 mm wide Rittal VX25 enclosure in a bookshelf way. The modules are placed in an upright position on the enclosure bottom with the front facing the enclosure door. Space for the additional components can be made by connecting two or more VX25 enclosures together. Available alternative ABB parts are also given.

Limitation of liability

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

- **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).

Safety



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.

Necessary parts

Drive module standard parts		
• Drive module and LCL filter module • Top guide plate • Fastening brackets (2 pcs) • Grounding busbar • Pedestal guide plates (2 pcs) • Telescopic extraction and insertion ramp • Fastening screws in a plastic bag • External control unit		
Drive module options		
Option code	**Qty (pcs)**	**Description**
+H381	1	Full power cabling panels
Rittal parts and alternative ABB parts		
Rittal part code	**Qty (pcs)**	**Description**
VX 8806.000	1	Enclosure frame: Frame, rear door, roof plate, plinth.
VX 8106.245	1	Side panels for the enclosure
SZ/DK 7967.000 (one set = four pieces) + additional spacers	1	Spacers for roof plate. Alternative ABB roof (3AUA0000125203 [IP20], AUA0000114968 [IP42]), see Air outlet kits (Page 174).
VX 8617.140 (one set = four pieces)	1	Punched section without mounting flange, for 800 mm horizontal
SK 3243.200 / ABB 3AUA0000117002 (IP20) ABB 3AUA0000117007 (IP42)	4 / 2	Air filter 323 mm × 323 mm. Remove the filter mat according to the manufacturer's instructions. Alternative ABB air filters (3AUA0000117002 [IP20], 3AUA0000117007 [IP42]), see Air inlet kits (Page 172).
Customer-made parts (not ABB or Rittal products)		
Air baffles	4	See Air baffles for option +H381 in 800 mm wide Rittal VX25 enclosure (Page 216)
Enclosure bottom plate	1	See Bottom plate (Page 214)

Necessary tools

- Set of screw drivers (Torx and Pozidriv)
- Set of metric magnetic-end hexagon sockets
- Torque wrench with a 500 mm (20 in) or 2 × 250 mm (2 × 10 in) long extension bar

Overall flowchart of the installation process

Step	Task	For instructions, see
1	Install the Rittal parts and drive module mechanical accessories into the enclosure	Installing the mechanical accessories into a enclosure (Page 137)
2	Connect the power cables to the cabling panels	Connecting the power cables (Page 139)
3	Install the drive module into the enclosure	Installing the drive module into the enclosure (Page 142)
4	Install the external control unit	Attaching the external control unit (Page 102)
5	Connect the control cables	Connecting the external control unit to the drive module (Page 100)
6	Install the remaining parts, for example, enclosure doors, side plates, etc.	The component manufacturer's instructions

Installing the mechanical accessories into a enclosure

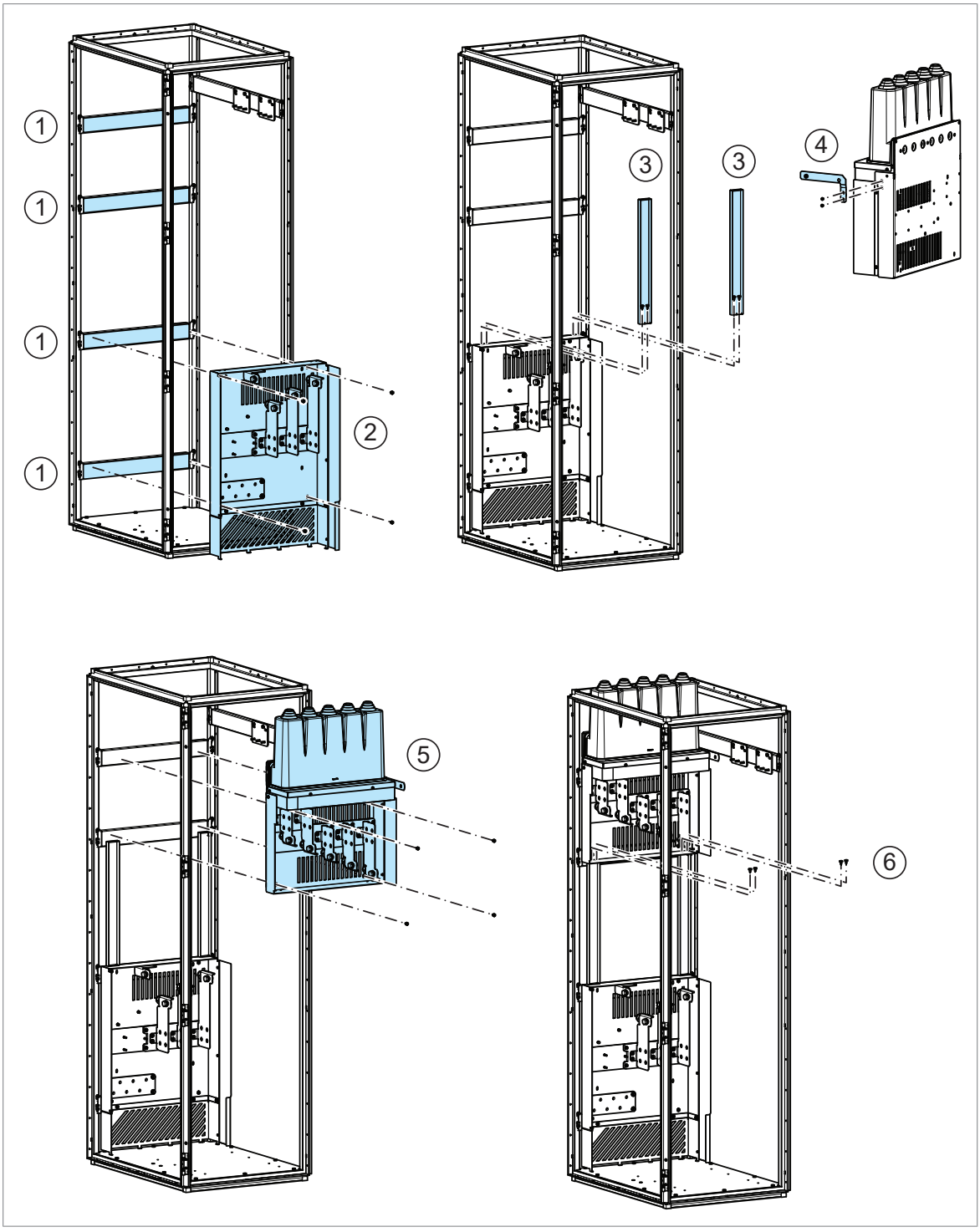
See Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243) for these steps:

1. Attach the plinth to the floor.
2. Attach the enclosure frame to the plinth.
3. Make the bottom plate with 360-degree grounding entries for power cables. Attach the bottom plate to the enclosure frame.
4. Attach the punched section to the back of enclosure frame.
5. Attach the mounting brackets to the punched section.

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

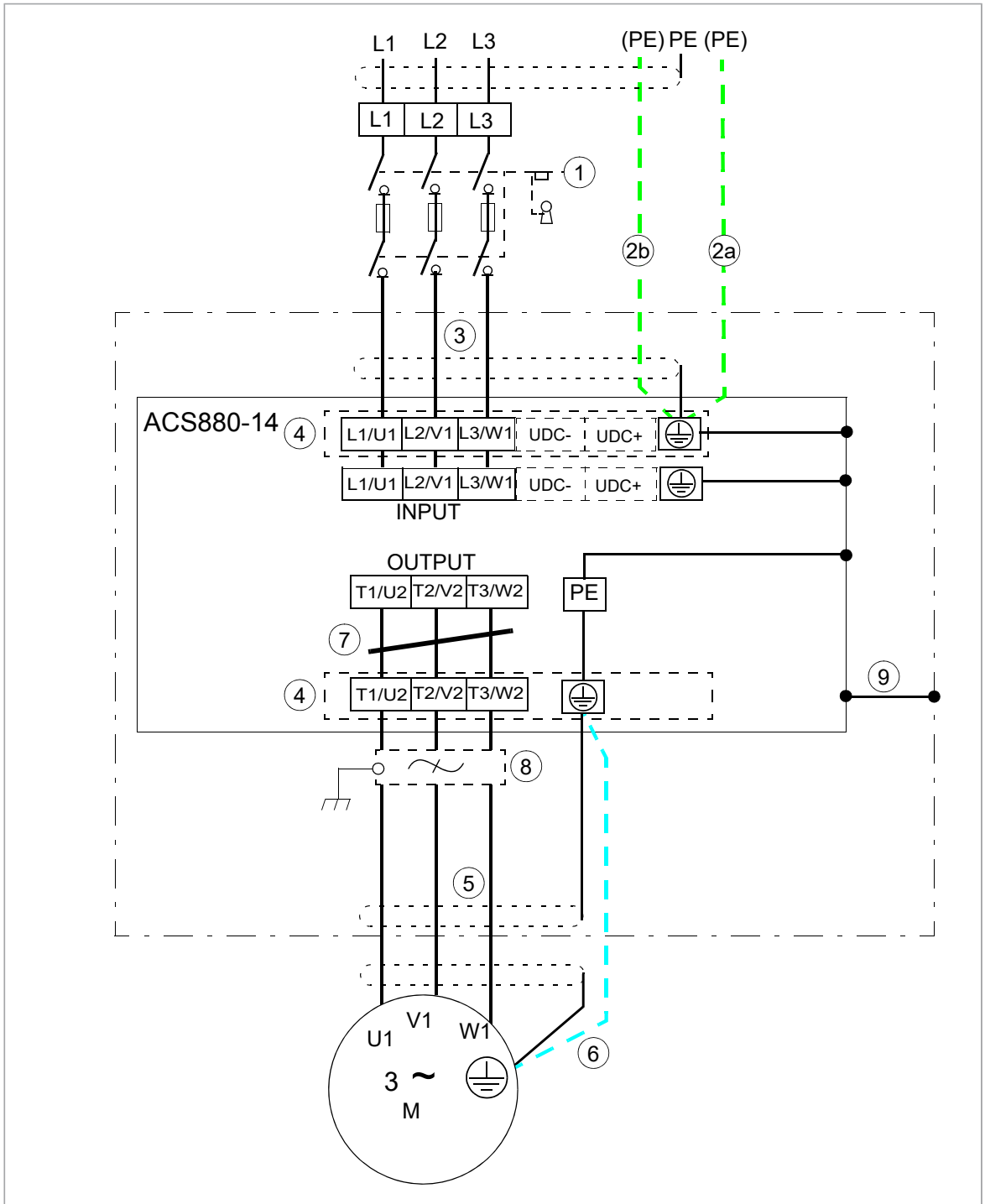
1. Install the Rittal punched sections VX 8100.742 to which the output cabling panel and the input cabling panel will be attached.
2. Attach the output cabling panel to the punched sections.
3. Install the side guides to the output cabling panel (2 screws for each guide).
4. Attach the grounding busbar to the input cabling panel.
5. Attach the input cabling panel to the punched sections.
6. Attach the input cabling panel to the side guides (2 screws for each side guide).
7. Install the telescopic extraction and insertion ramp as shown in chapter Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243).

138 Installation example with full cabling panels (option +H381)



Connecting the power cables

Connection diagram



1	For alternatives, see section Selecting the main supply disconnecting device (Page 67). In the installing example of this chapter, the disconnecting device is not in the same cubicle with the drive module.
2	If a shielded cable is used (not required but recommended) and the conductivity of the shield is < 50% of the conductivity of the phase conductor, use a separate PE cable (2a) or a cable with a grounding conductor (2b).
3	ABB recommends 360° grounding at the enclosure entry if a shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.

4	Input and output power cabling panels (option +H381)
5	ABB recommends 360° grounding at the enclosure entry
6	Use a separate grounding cable if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor and there is no symmetrically constructed grounding conductor in the cable (see section Recommended power cable types)
7	Common mode filter (option)
8	d*u*/d*t* filter (option)
9	The drive module frame must be connected to the enclosure frame. See Drive modules cabinet design and construction instructions (3AUA0000107668 [English]) and section Grounding the drive module and the LCL filter module (Page 65).
Note: If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends. Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.	

Power cable connection procedure

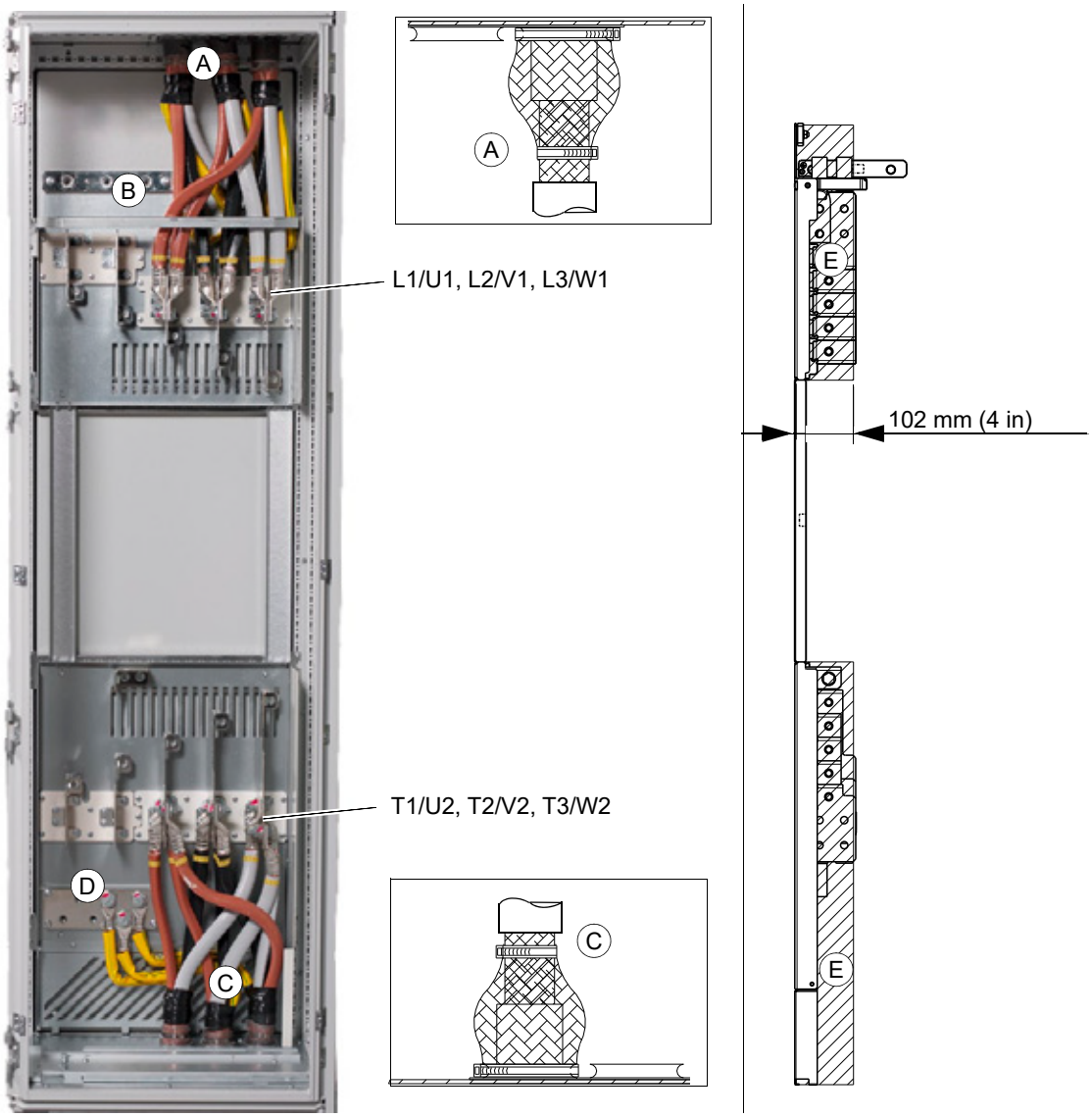


WARNING!
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

Refer to Units with optional cabling panels (+H381) (Page 194) for the tightening torques of the power cables.

1. Run the motor cables from the motor to the enclosure. Ground the cable shields 360° at the entry plate.
2. Twist the cable shields of the motor cables into bundles and connect them and any separate ground conductors or cables to the ground busbar of the output power cabling panel.
3. Connect the phase conductors of the motor cables to terminals T1/U2, T2/V2 and T3/W2 of the output cabling panel.
4. Make sure that all power is disconnected and reconnection is not possible. Use proper safe disconnect procedures according to local codes.
5. Run the input cables to the enclosure. If IP20 degree of protection for the drive module is needed, install the input power cables through the rubber grommet. For instructions, refer to Installing the rubber grommet (Page 145).
6. Twist the cable shields of the input cables into bundles and connect them and any separate ground conductors or cables to grounding busbar of the input cabling panel.
7. Connect the phase conductors of the input cables to terminals L1/U1, L2/V1 and L3/W1 of the input cabling panel.

An example installation is shown below.



View without enclosure side plate in place.

A	360-degree grounding at the entry plate for the input power cables
B	Grounding busbar of the input power cabling panel
C	360-degree grounding at the entry plate for the output power cables
D	Grounding busbar of the output power cabling panel
E	Allowed space for power cables.

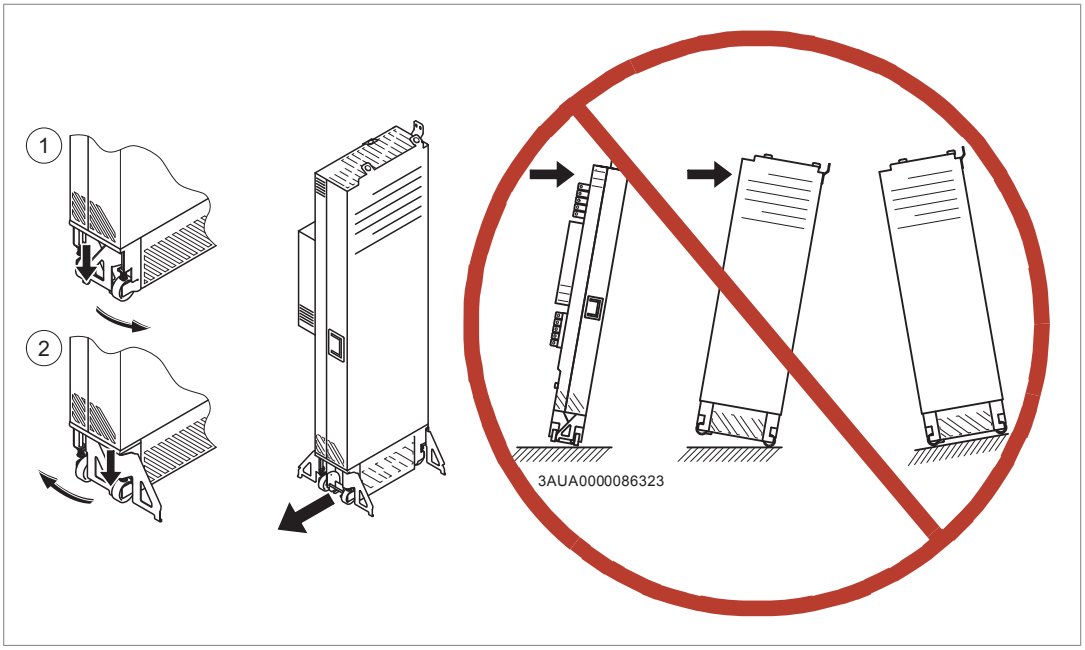
Note: The input and output power cables must fit inside the area marked with diagonal lines to prevent chafing of the cables when the drive module is inserted into the enclosure.

Installing the drive module into the enclosure

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

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

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



Installation procedure

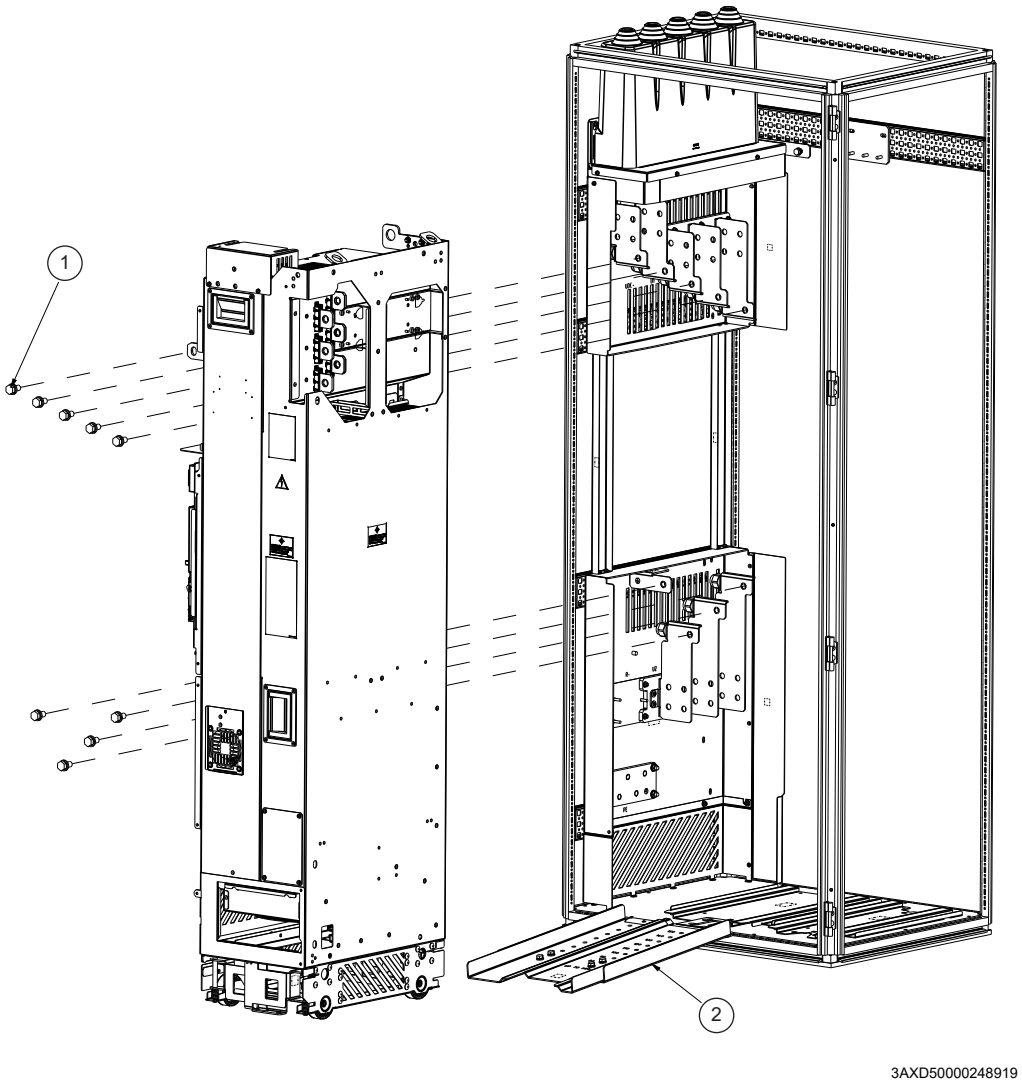
1. Install the drive module and the LCL filter module into the Rittal enclosure as shown in Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243).
2. Attach the grounding busbar that has been previously attached to the input cabling panel to the drive module.
3. Remove the upper and lower left-hand side front covers of the drive module (M4×8 combi screws, 2 N·m [1.48 lbf·ft]).
4. Connect the busbars of the drive module to the busbars of the cabling panels (M12 combi screw, 70 N·m [52 lbf·ft]).





5. Attach the enclosure roof on the spacers.
6. Attach the side panels.
7. Remove the filter mats from the air filters according to Rittal's instructions. Install the filters to the enclosure door.
8. Install the removed front covers of the drive module.
9. Connect the control cables (see section Connecting the control cables to the terminals of the external control unit (Page 104)).

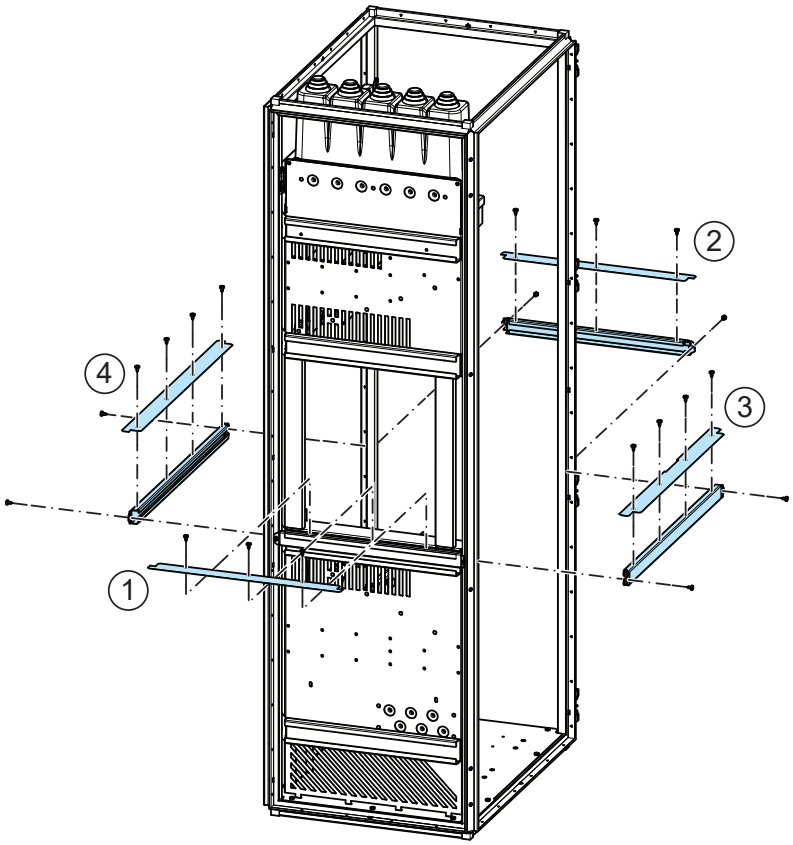
Assembly drawing of connecting the drive module to the cabling panels



1	Combi screw M12×25 hex (delta) or equal (9 pcs)
2	Extraction/insertion ramp (3AXD50000476374)

Installing air baffles (non-ABB parts)

See Air baffles for option +H381 in 800 mm wide Rittal VX25 enclosure (Page 216) for the air baffle measurements.



1	Left	3	Front
2	Right	4	Rear

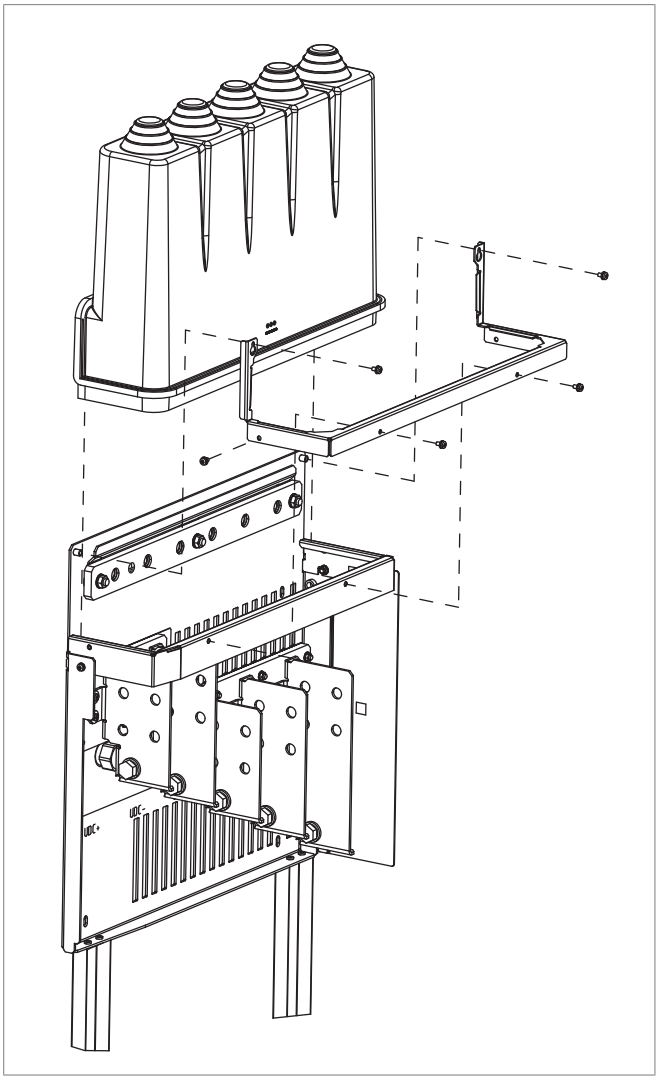
Miscellaneous

Installing the rubber grommet

To get IP20 degree of protection for the drive module, install the input power cables through the rubber grommet. Install the grommet as follows:

1. Cut adequate holes into the grommet for the input power cables.
2. Put the cables through the grommet.
3. Attach the grommet to the input cabling panel with five M4×8 Torx T20 screws as shown below.

146 Installation example with full cabling panels (option +H381)



11

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 19) before you start the work.

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

Make sure that ...	☑
The drive module is fastened properly to the enclosure.	☐
The cooling air can flow freely in and out of the drive. Air recirculation inside the cabinet is not possible (air baffle plates are installed, or there is another air guiding solution).	☐
If the drive is connected to a network other than a symmetrically grounded TN-S system: You have done all the required modifications (for example, you may need to disconnect the EMC filter or ground-to-phase varistor). See the electrical installation instructions.	☐
The enclosures of the equipment in the cabinet have proper galvanic connection to the cabinet protective earth (ground) busbar; The connection surfaces at the fastening points are bare (un-painted) and the connections are tight, or separate grounding conductors have been installed.	☐
The main circuit connections inside the drive cabinet correspond to the circuit diagrams.	☐
The control unit has been connected. See the circuit diagrams.	☐
Appropriate AC fuses and main disconnecting device are installed.	☐
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.	☐
The input power cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.	☐
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.	☐
The motor cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.	☐
The motor cable is routed away from other cables.	☐
No power factor compensation capacitors are connected to the motor cable.	☐
The control cables are connected to the correct terminals, and the terminals are tightened to the correct torque.	☐
If a drive bypass connection will be used: 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.	☐
There are no tools, foreign objects or dust from drilling inside the drive.	☐
The area in front of the drive is clean: the drive cooling fan cannot draw any dust or dirt inside.	☐
The terminal box cover of the motor is in place. Cabinet shrouds are in place and doors are closed.	☐
The motor and the driven equipment are ready for power-up.	☐

12

Start-up

Contents of this chapter

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

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]).

Start-up procedure

1. Only qualified electrical professionals are allowed to start-up the drive.
2. Make sure that the installation of the drive module has been checked according to the checklist in chapter Installation checklist, and that the motor and driven equipment are ready for start.
3. Perform the start-up tasks instructed by the cabinet-installer of the drive module.
4. Switch the power on, setup the drive control program, and perform the first start of the drive and motor. See ACS880-14 drive modules quick installation and start-up guide (3AXD50000212446 [English]) or ACS880 primary control program firmware manual (3AUA0000085967 [English]). If you need more information on 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]).
   - For drives with ABB d*u*/d*t* filter: Make sure that bit 13 of parameter 95.20 HW options word 1 is switched on.
   - For drives with ABB sine filter: Make sure that parameter 95.15 Special HW settings is set to ABB sine filter. For other sine filters: See Sine filter hardware manual (3AXD50000016814 [English]).

5. For drives with ABB motors in explosive atmospheres: See also ACS880 drives with ABB motors in explosive atmospheres (3AXD50000019585 [English]).
6. For drive modules in which the Safe torque off function is in use: Test and validate the operation of the Safe torque off function. See Validation test procedure (Page 229).
7. For drive modules with an FSO-xx safety functions module (options +Q972 and Q973): Test and validate the operation of the safety functions. See the delivery-specific circuit diagrams and FSO-12 safety functions module user's manual (3AXD50000015612 [English]) or FSO-21 safety functions module user's manual (3AXD50000015614 [English]).

13

Fault tracing

Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

LEDs

The table below describes the LEDs of the drive module with option +J410.

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

Warning and fault messages

See the quick installation and start-up guide or the firmware manual for the descriptions, causes and remedies of the control program warning and fault messages.

14

Maintenance

Contents of this chapter

This chapter contains maintenance instructions of the drive modules.

Maintenance intervals

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

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

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

Descriptions of symbols

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

Recommended annual maintenance actions by the user

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

Recommended annual actions by the user	Annually
Connections and environment	
Quality of supply voltage	P
Spare parts	
Spare parts	I
DC circuit capacitors reforming, spare modules and spare capacitors	P
Inspections by the user	
Tightness of terminals	I
Dustiness, corrosion and temperature	I
Heat sink cleaning	I

Recommended maintenance intervals after start-up

Component	Years from start-up						
	3	6	9	12	15	18	21
Cooling							
Main cooling fan							
Main cooling fan			R			R	
Auxiliary cooling fan							
Circuit board compartment cooling fans LONG-LIFE			R			R	
IP55 cooling fans			R			R	
Aging							
ZCU control unit battery (real-time clock)		R		R		R	
Control panel battery (real-time clock)			R			R	

4FPS10000239703

Recommended functional safety actions

Functional safety actions	
Safety function test interval	I
Safety component expiry (Mission time T_M) 20 years	R

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 19) before you start the work.
2. Open the cabinet door.
3. Clean the interior of the cabinet. Use a vacuum cleaner and a soft brush.
4. Clean the air inlets of the fans and air outlets of the modules (top).
5. Clean the air inlet gratings (if any) on the door.
6. Close the door.

Cleaning the interior of the heatsink

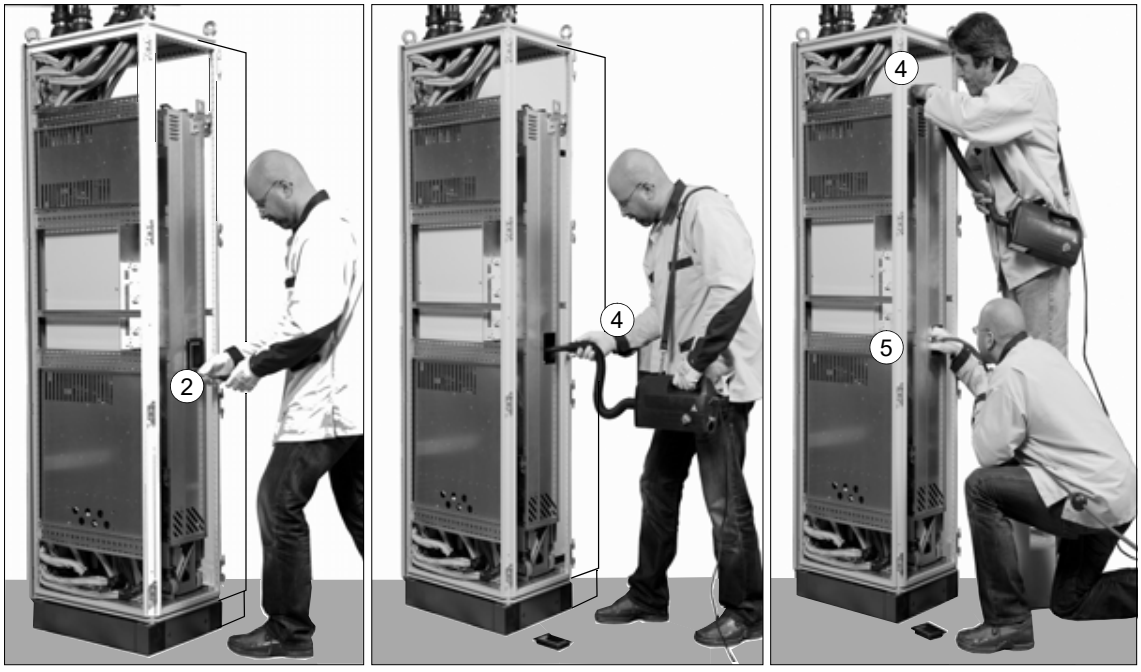
The module heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean.

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

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

1. Stop the drive and do the steps in section Electrical safety precautions (Page 19) before you start the work.
2. Make sure that the drive is disconnected from the power line and all other precautions described under Grounding (Page 21) have been taken into consideration.
3. Undo the attaching screws of the handle plate of the drive module.
4. Remove the handle plate.
5. Vacuum the interior of the heatsink from the opening.
6. Blow clean compressed air (not humid or oily) upwards from the opening and, at the same time, vacuum from the top of the drive module.

   Note: If there is a risk of dust entering adjoining equipment, perform the cleaning in another room.
7. Reinstall the handle plate.



Cleaning the interior of the LCL filter

Clean the interior of the LCL filter in the same way as the heatsink in section Cleaning the interior of the heatsink (Page 156).

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.

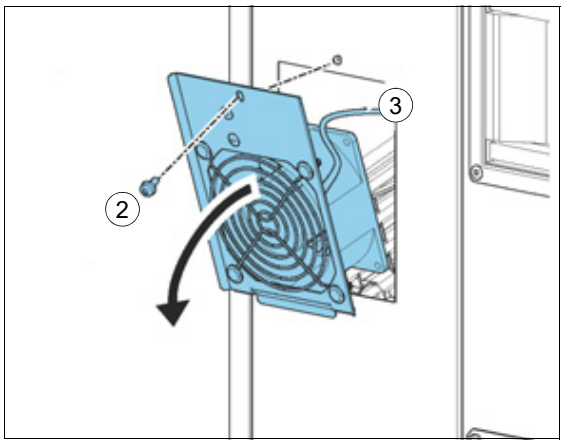
Replacement fans are available from ABB. Do not use other than ABB-specified spare parts.

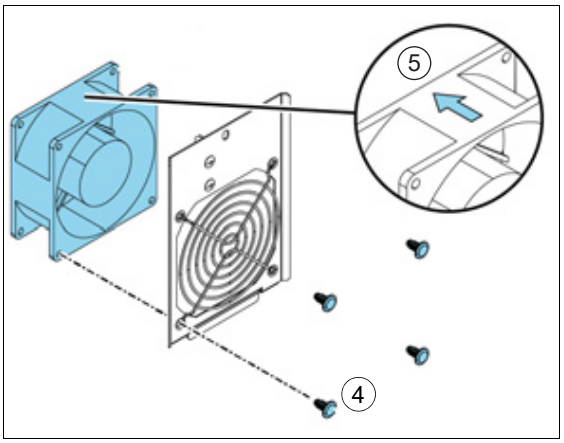
Replacing the auxiliary cooling fans of the drive module

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

Fan in the front panel:

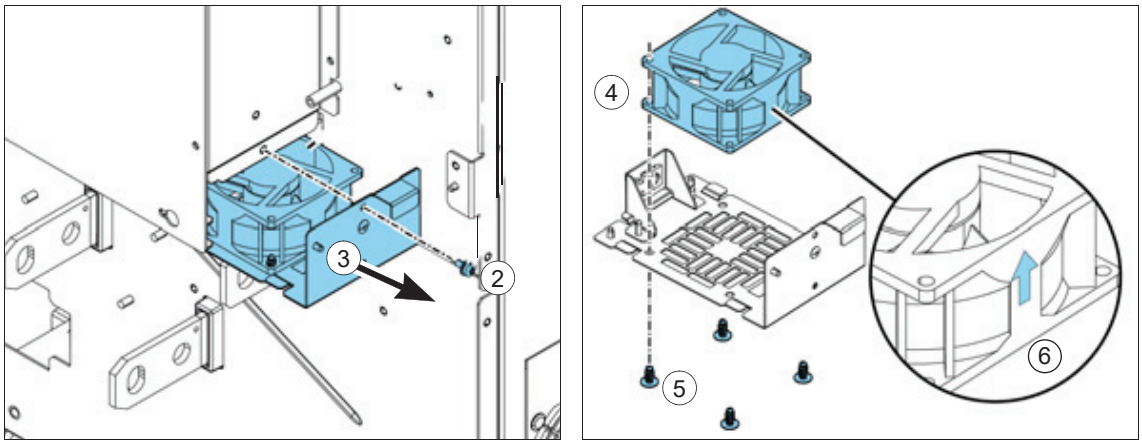
1. Stop the drive and do the steps in section Electrical safety precautions (Page 19) before you start the work.
2. Loosen the mounting screw of the fan cassette.
3. Disconnect the power supply cable of the fan.
4. Undo the mounting screws of the fan.
5. Install the new fan in reverse order. Make sure that the arrow in the fan points to the drive module.
6. Reset the counter (if used) in group 5 in the drive control program.





Fan at the bottom of the circuit board compartment:

1. Stop the drive and do the steps in section Electrical safety precautions (Page 19) before you start the work.
2. Loosen the mounting screw of the fan cassette.
3. Pull the fan cassette out.
4. Disconnect the power supply cable of the fan.
5. Undo the mounting screws of the fan.
6. Install the new fan in reverse order. Make sure that the arrow in the fan points up.
7. Reset the counter (if used) in group 5 in the drive control program.

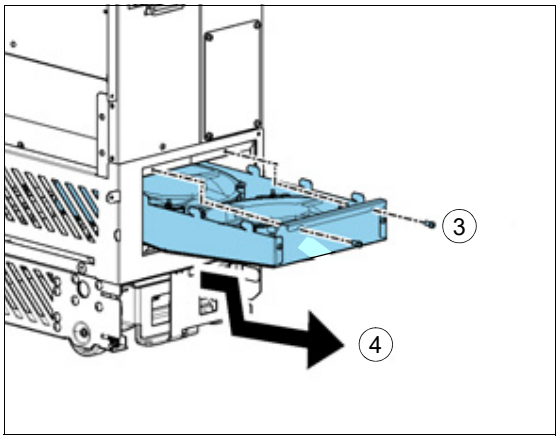


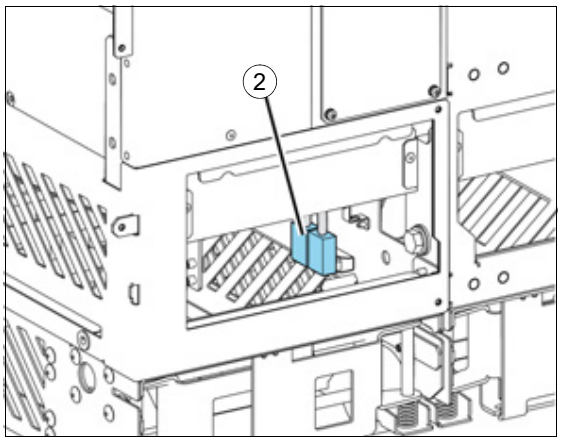
Replacing the drive module main cooling fans

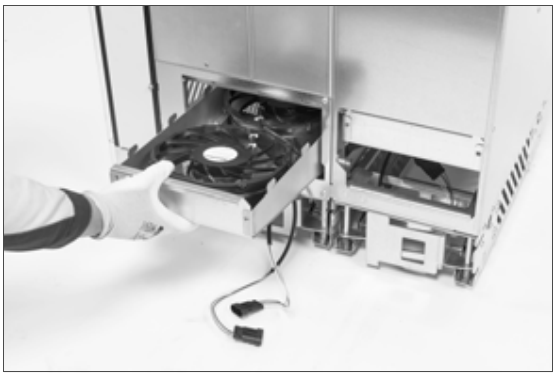
WARNING!
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

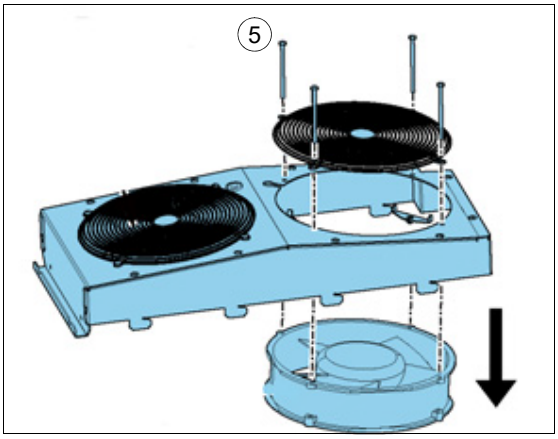
1. Stop the drive and do the steps in section Electrical safety precautions (Page 19) before you start the work.
2. Disconnect the power supply wires of the fans from the connector. FAN1:PWR1 and FAN2:PWR2.
3. Loosen the mounting screws of the fan cassette.
4. Pull the fan cassette out.
5. Loosen the mounting screws of the fan(s).

   Note: 690 V drive modules have only one fan in the cassette.
6. Install the new fans in reverse order. For 690 V drive modules, connect the fan power supply to connector FAN1:PWR1. For other drive modules, connect the power supply wires to both FAN1:PWR1 and FAN2:PWR2.
7. Reset the counter (if used) in group 5 in the drive control program.





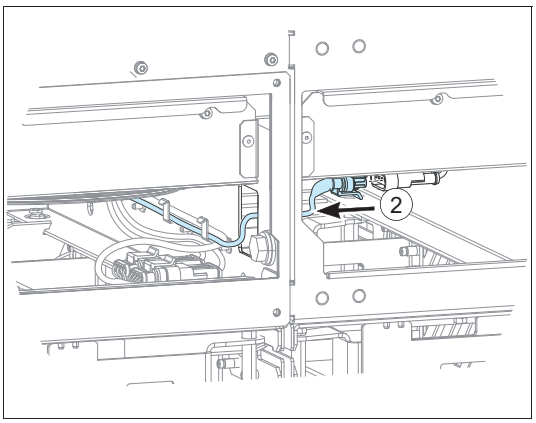


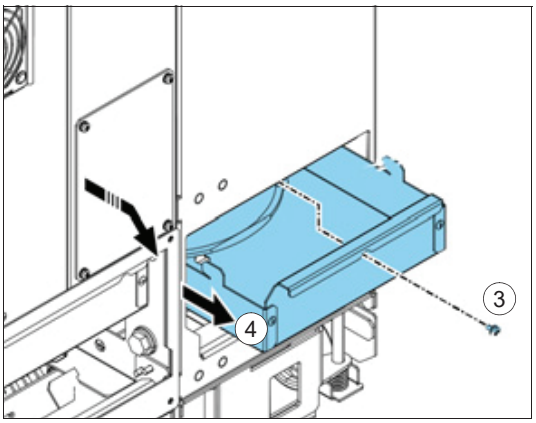


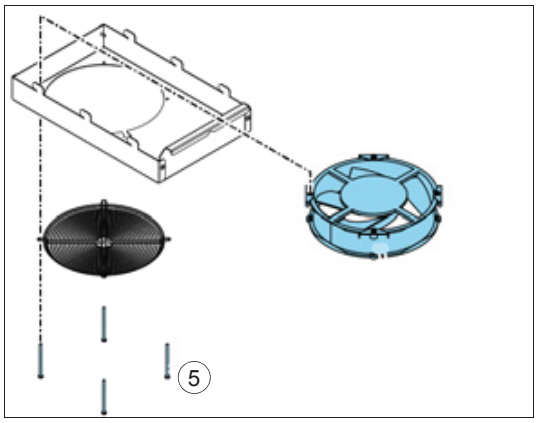
Replacing the LCL filter module cooling fan

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

1. Stop the drive and do the steps in section Electrical safety precautions (Page 19) before you start the work.
2. Disconnect the power supply wire of the fan from connector FAN3:LCL.
3. Loosen the attaching screw of the fan cassette.
4. Pull the fan cassette out.
5. Loosen the mounting screws of the fan. The finger guard of the fan is attached by the same screws and is removed at the same time. Keep the finger guard for reuse.
6. Install the new fan in reverse order. Make sure that the arrow in the fan points up.





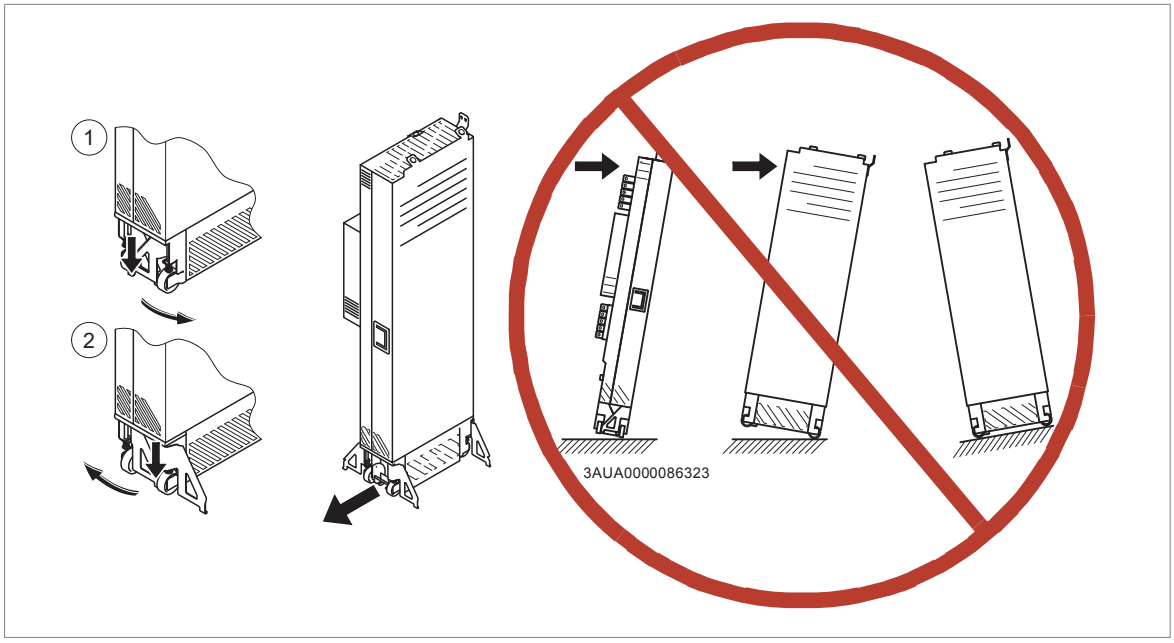


Replacing the standard drive module

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

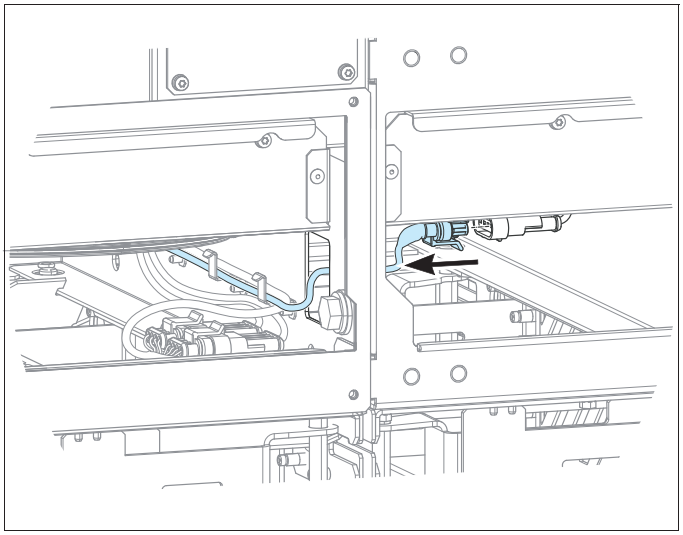
Handle the drive module carefully:

- Use safety shoes with a metal toe cap to prevent foot injury.
- Lift the drive module only by the lifting lugs.
- Make sure that the module does not fall over when you move it on the floor. To open the support legs, press each leg a little down and turn it aside (1, 2). Whenever possible secure the module also with chains.
- Do not tilt the drive module. It is heavy and its center of gravity is high. The module overturns from a sideways tilt of 5°. Do not leave the module unattended on a sloping floor.

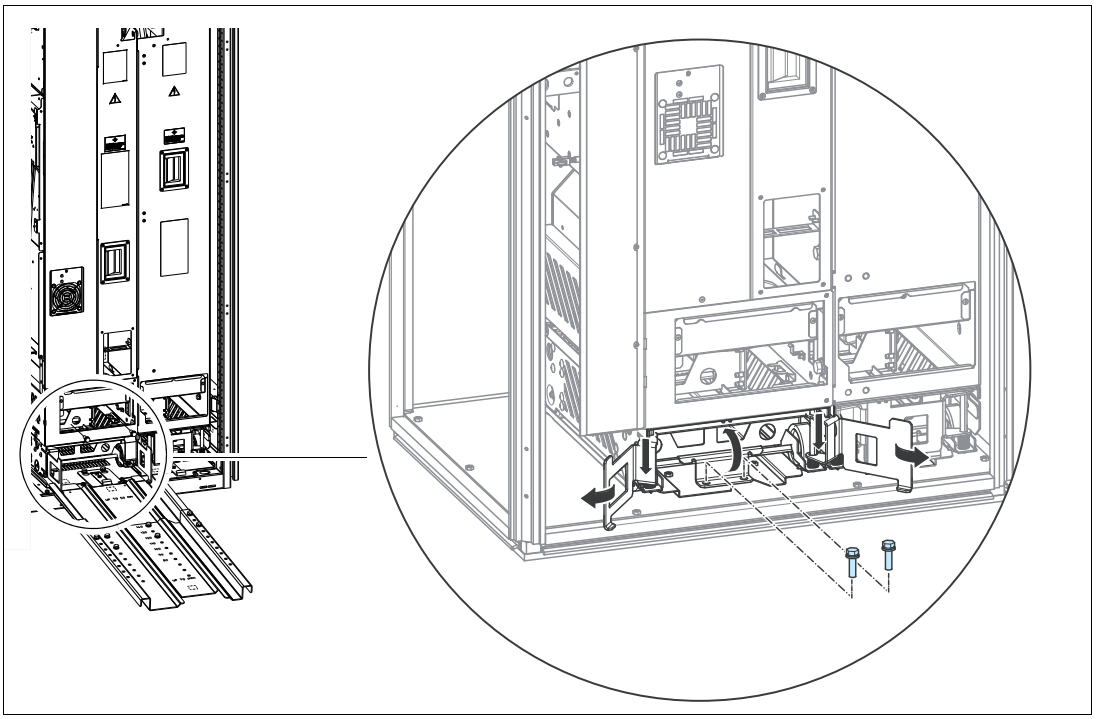


1. Stop the drive and do the steps in section Electrical safety precautions (Page 19) before you start the work.
2. Remove the clear plastic shrouds on the power cables and parts in front of the drive module (if present).
3. Disconnect the power cables.
4. Disconnect the cables between the drive module and the control unit. See section Connecting the external control unit to the drive module (Page 100).

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



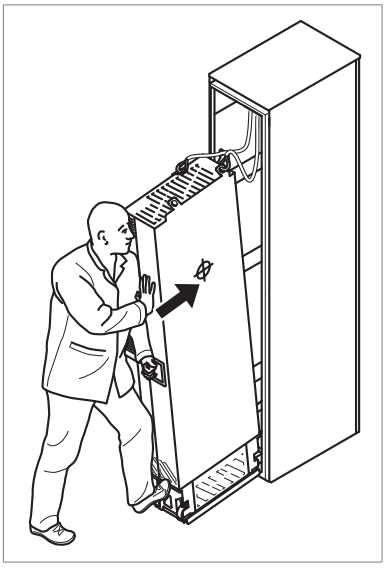
6. Remove the screws that attach the drive module to the cabinet at the top and behind the front support legs.
7. Remove the screws that connect the drive module to the LCL filter module from top and at the side.
8. To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet frame.
9. To open the support legs 90°, press each leg a little down and turn it aside.
10. Adjust the extraction/installation ramp to the correct height and attach it to the cabinet base with the two mounting screws.



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



12. Install the new module in reverse order.



Replacing the LCL filter module

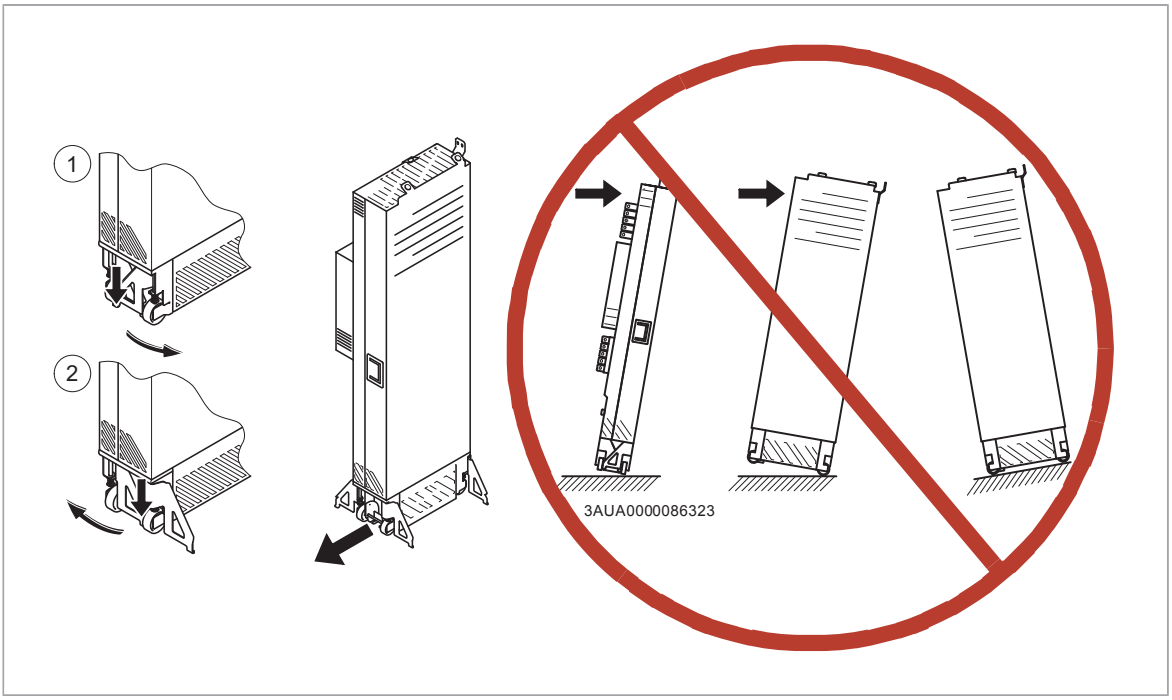
Replace the LCL filter module in the same way as the drive module.

Replacing the drive module with option +H381

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

Handle the drive module carefully:

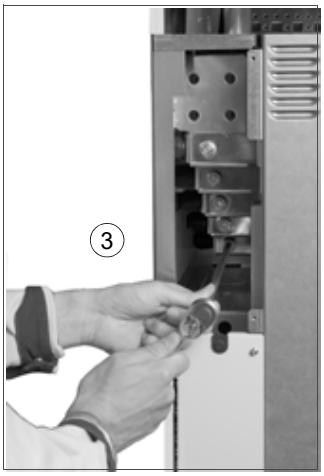
- Use safety shoes with a metal toe cap to prevent foot injury.
- Lift the drive module only by the lifting lugs.
- Make sure that the module does not topple over when you move it on the floor: To open the support legs, press each leg a little down and turn it aside (1, 2). Whenever possible secure the module also with chains.
- Do not tilt the drive module. It is heavy and its center of gravity is high. The module overturns from a sideways tilt of 5°. Do not leave the module unattended on a sloping floor

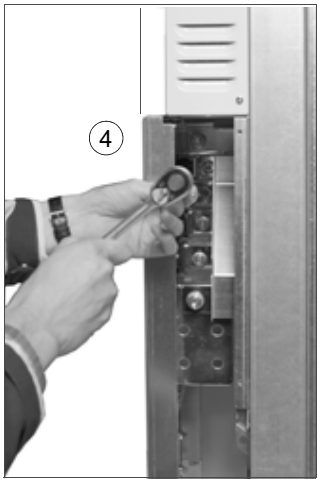


1. Stop the drive and do the steps in section Electrical safety precautions (Page 19) before you start the work.
2. To remove the left-hand side upper and lower front covers of the drive module, undo the fastening screws. M4×10 combi screws, 2 N·m (18 lbf·in).
3. Disconnect the drive module busbars from the input cabling panel. Combi screw M12, 70 N·m (52 lbf·ft).
4. Disconnect the drive module busbars from the output cabling panel. Combi screw M12, 70 N·m (52 lbf·ft).
5. Remove the front air baffle.
6. See Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243):

- Disconnect the drive module from the LCL filter module.
- Loosen the screws that attach the drive module to the enclosure frame.
- Attach the extraction ramp to the enclosure base with two screws.

7. Disconnect the power supply cable and the fiber optic cables from the external control unit and coil them on the top of the drive module.
8. To prevent the drive module from falling, attach its top lifting lugs with chains to the enclosure frame.
9. Pull the drive module carefully out of the enclosure preferably with help from another person.
10. Install the new module in reverse order.







Replacing the LCL filter module with option +H381

See Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure (Page 243):

1. Disconnect the LCL filter module from the drive module.
2. Undo the screws that attach the LCL filter module to the enclosure frame.
3. Attach the extraction ramp to the enclosure base with two screws.
4. To prevent the LCL filter module from falling, attach its top lifting lugs with chains to the enclosure frame.

5. Pull the LCL filter module carefully out of the enclosure preferably with help from another person.
6. Install the new module in reverse order.

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]).

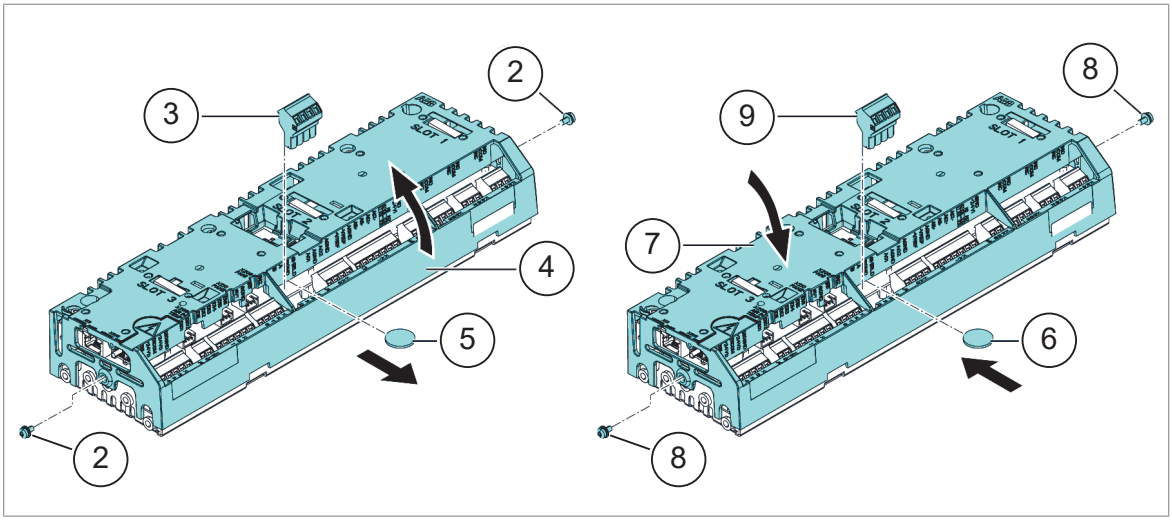
Control panel

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

Replacing the ZCU-14 control unit battery

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



Memory unit

One memory unit is located in the external control unit, see Overview of power and control connections (Page 41), another on the line-side converter control unit.

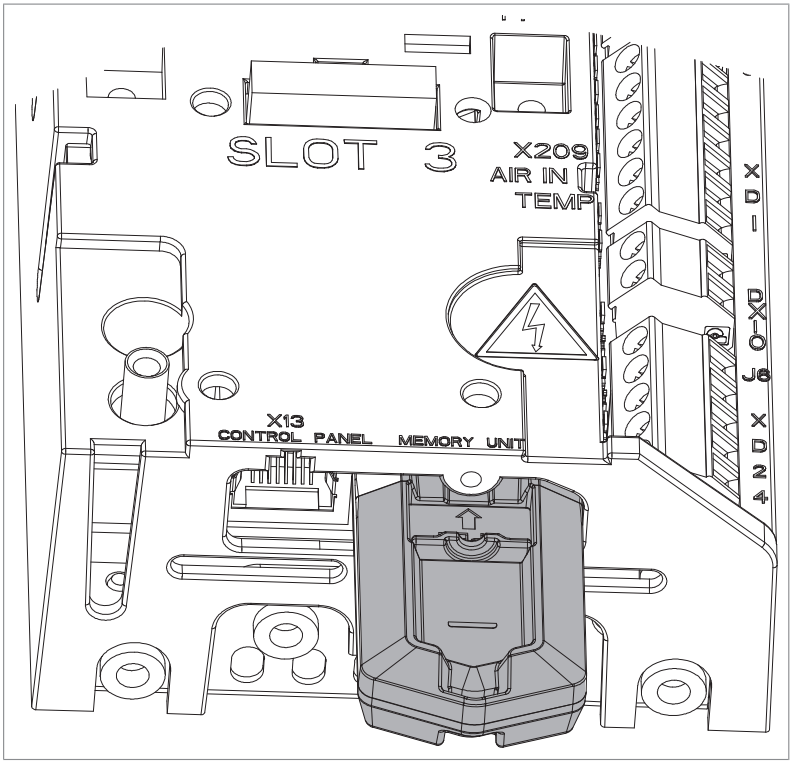
Replacing the memory unit of ZCU-14

After replacing a control unit, you can retain the existing parameter settings by transferring the memory unit from the defective control unit to the new control unit. After power-up, the drive will scan the memory unit. This can take several minutes.

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

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

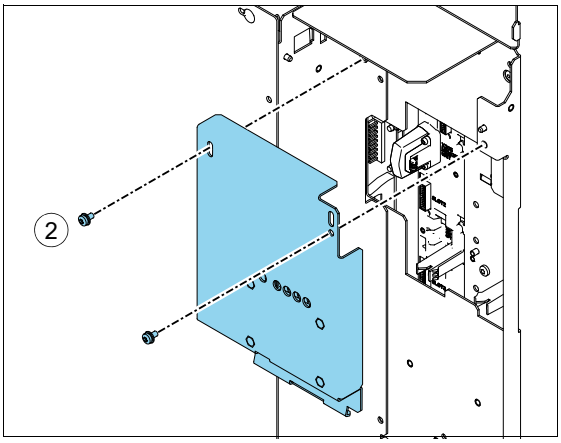
1. Stop the drive and do the steps in section Electrical safety precautions (Page 19) before you start the work.
2. Pull the clip of the memory unit forward.

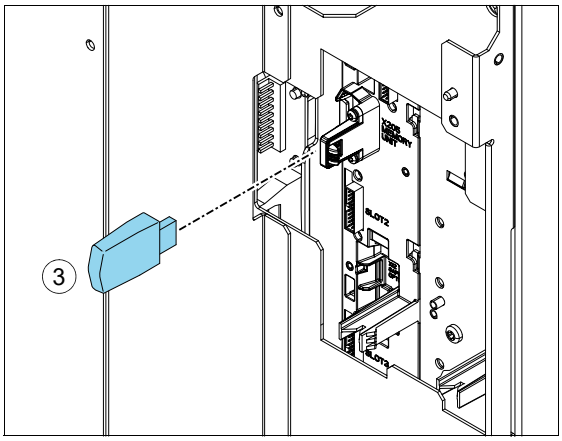


3. Take the unit off.
4. Replace the unit in reverse order.

Replacing the memory unit of the line-side converter control unit (ZCU-12)

1. Stop the drive and do the steps in section Electrical safety precautions (Page 19) before you start the work.
2. Remove the cover on the memory unit.
3. Pull the memory unit out.
4. Install the new memory unit in reverse order.





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.

15

Ordering information

Contents of this chapter

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

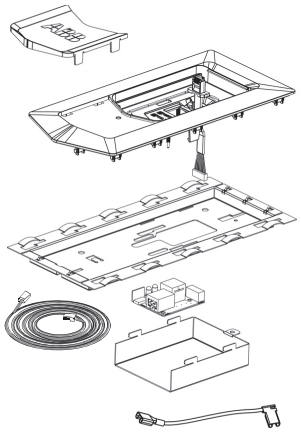
Note: This chapter only lists the installation accessories available from ABB. All other parts must be sourced from a third party by the system integrator.

ACS-AP-W and ACS-AP-I control panel

Type	Description	Ordering code	Illustration
ACS-AP-W	Control panel with Bluetooth	3AXD50000025965	
ACS-AP-I	Control panel	3AUA0000088311	

Control panel mounting platforms

The control panel can be mounted on the cabinet door with the help of a door mounting kit.

Type	Description	Ordering code	Illustration
DPMP-01	Door mounting kit for flush mounting. Includes a control panel mounting platform, an IP54 cover and a 3- meter panel connection cable.	3AUA0000108878	
DPMP-04	Control panel mounting platform	3AXD50000217717	

Output (d*u*/d*t*) filters

See section d*u*/d*t* filters (Page 241).

Sine filters

See section Sine filters (Page 242).

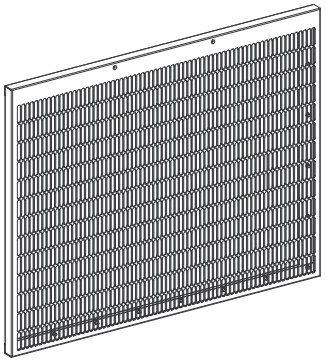
EMC filter ARFI-10

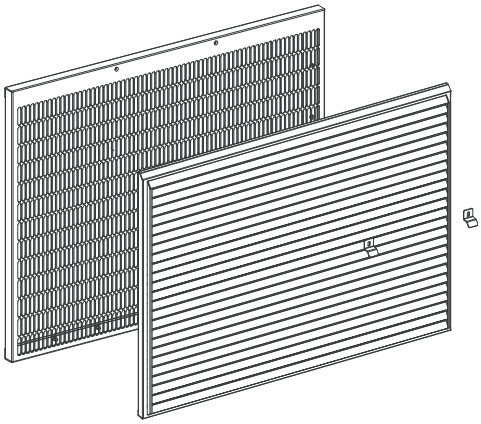
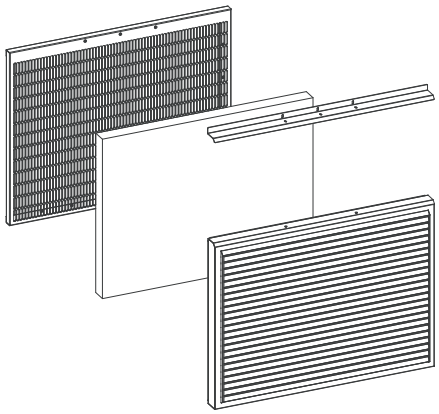
Ordering code: 68241561

Cabinet ventilation

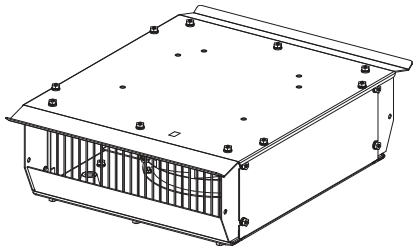
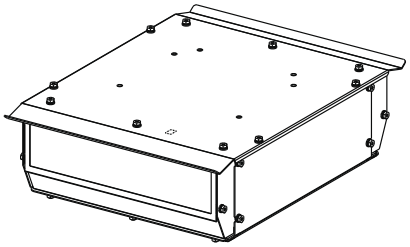
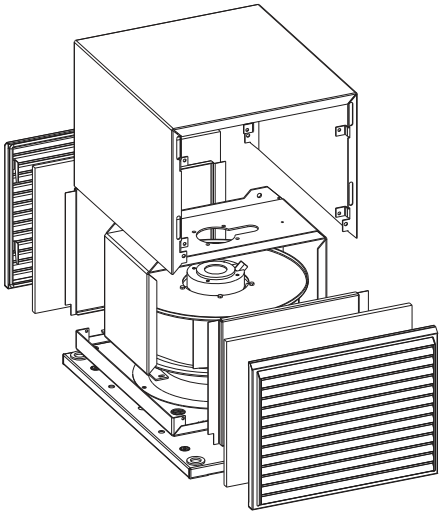
Air inlet kits

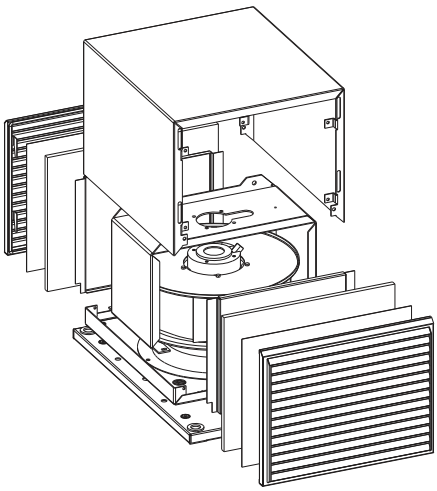
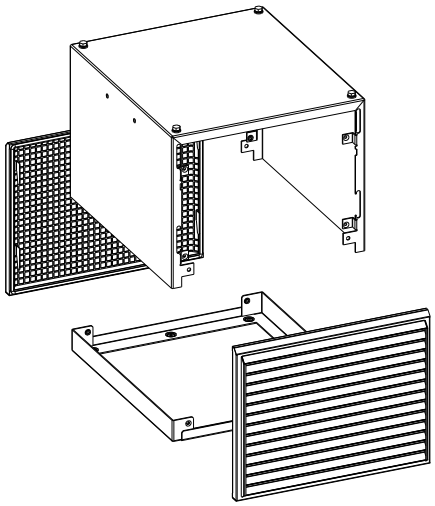
Mounting screws are included.

Enclosure width / Degree of protection	Kit code	Ordering code	Illustration
800 mm / IP20	A-8-X-023	3AUA0000117005	 Instruction code: 3AUA0000116887

Enclosure width / Degree of protection	Kit code	Ordering code	Illustration
800 mm / IP42	A-8-X-026	3AUA0000117009	 Instruction code: 3AUA0000116875
800 mm / IP54	A-8-X-029	3AXD50000009186	 Instruction code: 3AXD50000010001

Air outlet kits

Enclosure width / Degree of protection	Qty	Kit code	Ordering code	Illustration
800 mm / IP20	2	A-4-X-062	3AUA0000125201	 Instruction code: 3AXD50000001982 **Note:** Fan to be ordered separately
800 mm / IP42	2	A-4-X-060	3AUA0000114967	 Instruction code: 3AUA0000115290 **Note:** Fan to be ordered separately
800 mm / IP54 (IEC)	2	A-4-X-064	3AXD50000009187	 Instruction code: 3AXD50000010284 **Note:** Fan to be ordered separately

Enclosure width / Degree of protection	Qty	Kit code	Ordering code	Illustration
800 mm / IP54 (UL)	2	A-4-X-067	3AXD50000010362	 Instruction code: 3AXD50000010284 **Note:** Fan to be ordered separately
800 mm / IP31	2	A-4-X-068	3AXD50000944088	 Instruction code: 3AXD50000944712 **Note:** No fan available for this kit

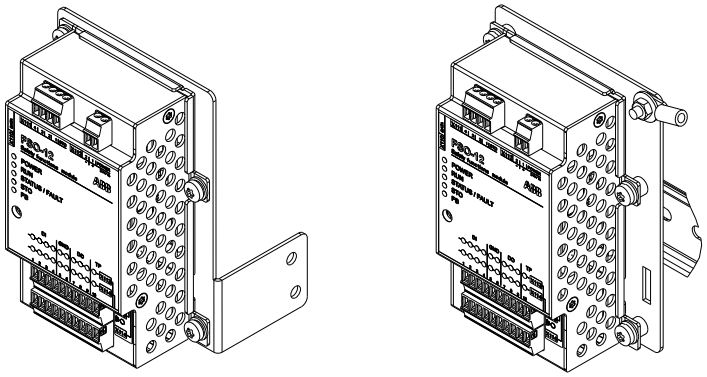
Cooling fans

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

Enclosure width / Degree of protection	Component		Qty	Ordering code
	Name	Data		
800 mm / IP20, IP42	Fan	R2E225-RA92-17 (230 V)	2	3AXD50000000514
	Capacitor	MSB MKP 3,5/603/E1679	2	3AXD50000000882
	Connector	SPB2,5/7 (2.5 mm^2, 12AWG)	2	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm^2, 12AWG)	2	3AXD50000000724

Enclosure width / Degree of protection	Component		Qty	Ordering code
	Name	Data		
800 mm / IP54	Fan	RB4C-355/170	2	3AXD50000006934
	Capacitor	MSB MKP 6/603/E1679	2	3AXD50000006959
	Connector	SPB2,5/7 (2.5 mm^2, 12AWG)	2	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm^2, 12AWG)	2	3AXD50000000724

FSO accessories kit

Kit code	Ordering code	Illustration
A-X-X-279	3AXD50000025495	 Instruction code: 3AXD50000025583

Retrofit accessory kits

Kit	Option code	Ordering code
Common mode filter kit	+E208	3AXD50000026145
Full size cable connection terminals for input power cables	+H370	3AXD50000019542
Full size cable connection terminals for output power cables	1)	3AXD50000019544
For frame R11: IP20 shrouds for covering the input and motor cabling area	2)	3AXD50000019538

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

2) The drive module is delivered with IP20 shrouds for covering the input and motor cabling area as standard. The shrouds can be excluded with option +0B051.

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Technical data

Contents of this chapter

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

Electrical ratings

This section gives ratings for the standard drive. For ratings of marine-type approved drives (option +C132), refer to ACS880-01…, ACS880-04…, ACS880-11…, ACS880-31…, ACS880-14… and ACS880-34… +C132 marine type-approved drives supplement (3AXD50000010521 [English]).

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

IEC RATINGS										
ACS880-14-...	**Frame size**	**Input current[1)]**	**Output ratings**							
			Nominal use				**Light-duty use**		**Heavy-duty use**	
		I_1	I_{max}	I_2	P_n	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	**A**	**A**	**kW**	**kVA**	**A**	**kW**	**A**	**kW**
U_n = 400 V										
246A-3	R11	212	350	246	132	170	234	132	206	110
293A-3	R11	257	418	293	160	203	278	160	246	132
363A-3	R11	321	498	363	200	251	345	200	293	160
442A-3	R11	401	621	442	250	306	420	250	363	200
505A-3	R11	401	631	505	250	350	480	250	363	200
585A-3	R11	505	751	585	315	405	556	315	442	250
650A-3	R11	569	859	650	355	450	618	355	505	250

IEC RATINGS										
ACS880-14-...	Frame size	Input current[1)]	Output ratings							
			Nominal use				Light-duty use		Heavy-duty use	
		I_1	I_{max}	I_2	P_n	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	A	kW	kVA	A	kW	A	kW
U_n = 500 V										
240A-5	R11	169	350	240	132	208	228	132	180	110
260A-5	R11	205	418	260	160	225	247	160	240	132
361A-5	R11	257	542	361	200	313	343	200	260	160
414A-5	R11	321	614	414	250	359	393	250	361	200
460A-5	R11	404	660	460	315	398	450	315	414	250
503A-5	R11	455	725	503	355	436	492	355	460	315
U_n = 690 V										
142A-7	R11	123	250	142	132	170	135	132	119	110
174A-7	R11	149	274	174	160	208	165	160	142	132
210A-7	R11	186	384	210	200	251	200	200	174	160
271A-7	R11	232	411	271	250	324	257	250	210	200
330A-7	R11	293	480	330	315	394	320	315	271	250
370A-7	R11	330	520	370	355	442	360	355	330	315
430A-7	R11	375	555	430	400	514	420	400	370	355

UL (NEC) RATINGS								
ACS880-14-...	Frame size	Input current[1)]	Output ratings					
			Max. current	App. power	Light-duty use		Heavy-duty use	
		I_1	I_{max}	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	kVA	A	hp	A	hp
U_n = 480 V								
240A-5	R11	169	350	208	240	200	228	150
260A-5	R11	205	418	225	260	200	240	200
302A-5	R11	239	498	262	302	250	260	200
361A-5	R11	257	542	313	361	300	302	250
414A-5	R11	321	614	359	414	350	361	300
460A-5	R11	404	660	398	450	350	414	350
503A-5	R11	455	725	436	492	400	483	400
U_n = 575 V								
142A-7	R11	123	250	170	144	150	125	125
174A-7	R11	149	274	208	168	175	144	150
210A-7	R11	186	384	251	192	200	168	175
271A-7	R11	232	411	324	242	250	192	200
330A-7	R11	293	480	394	289	300	242	250
370A-7	R11	330	520	442	336	350	289	300
430A-7	R11	375	555	514	412	450	336	350

[1] When the DC voltage is boosted, the drive can draw more input current than shown on the type designation label. This is the case when the motor is running continuously at or near the field weakening area and when the drive is running at or near nominal load. It can be a result of certain combinations of DC voltage boost levels and drive-type-specific derating curves.

The rise in input current can heat the input cable and fuses. To avoid heating, select an input cable and fuses according to the increased input current caused by the DC voltage boost. For more information, refer to ACS880-11, ACS880-31, ACS880-14, ACS880-34, ACS880-17, ACS880-37 drives product note on voltage boost (3AXD50000691838 [English]).

U_n	Nominal voltage of the drive
I_1	Nominal input current (rms) at 40 °C (104 °F)
S_n	Apparent power (no overload)
I_{max}	Maximum output current. Available for 10 seconds at start, otherwise as long as allowed by drive temperature. 140% … 200% of I_{Hd}, depending on power rating.
I_2	Continuous rms output current. No overload capability at 40 °C (104 °F). This is indicated in the type designation label as output current I_2.
P_n	Typical motor power in no-overload use
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-duty use
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
P_{Hd}	Typical motor power for heavy-duty use
Note: To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. The power ratings apply to most IEC 34 motors at the nominal voltage of the drive. ABB recommends to select the drive, motor and gear combination for the required motion profile with the DriveSize dimensioning tool available from ABB.	

Deratings

When is derating necessary

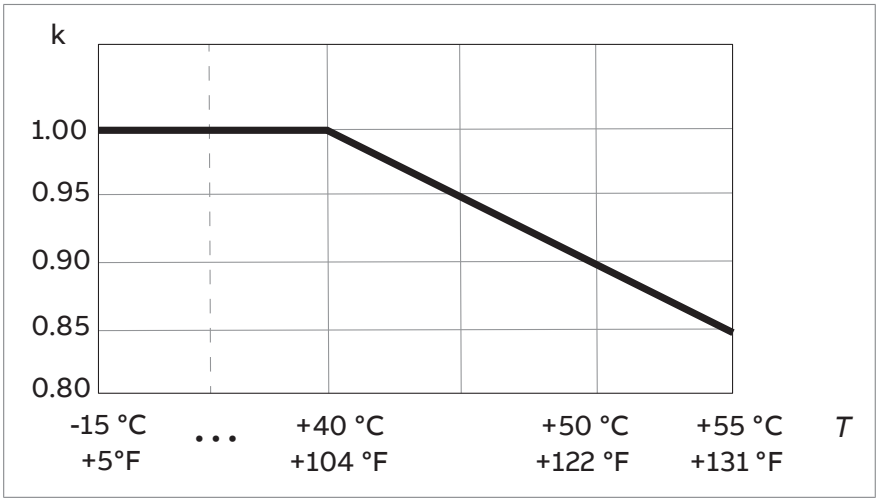
Derate the continuous output current of the drive if

- ambient temperature exceeds +40 °C (+104 °F) or
- drive is installed higher than 1000 m (3280 ft) above sea level
- switching frequency is other than default
- the minimum requirements of motor cable length are not met (see chapter d*u*/d*t* filters and sine filters)
- DC voltage boost feature is used.

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

Surrounding air temperature derating

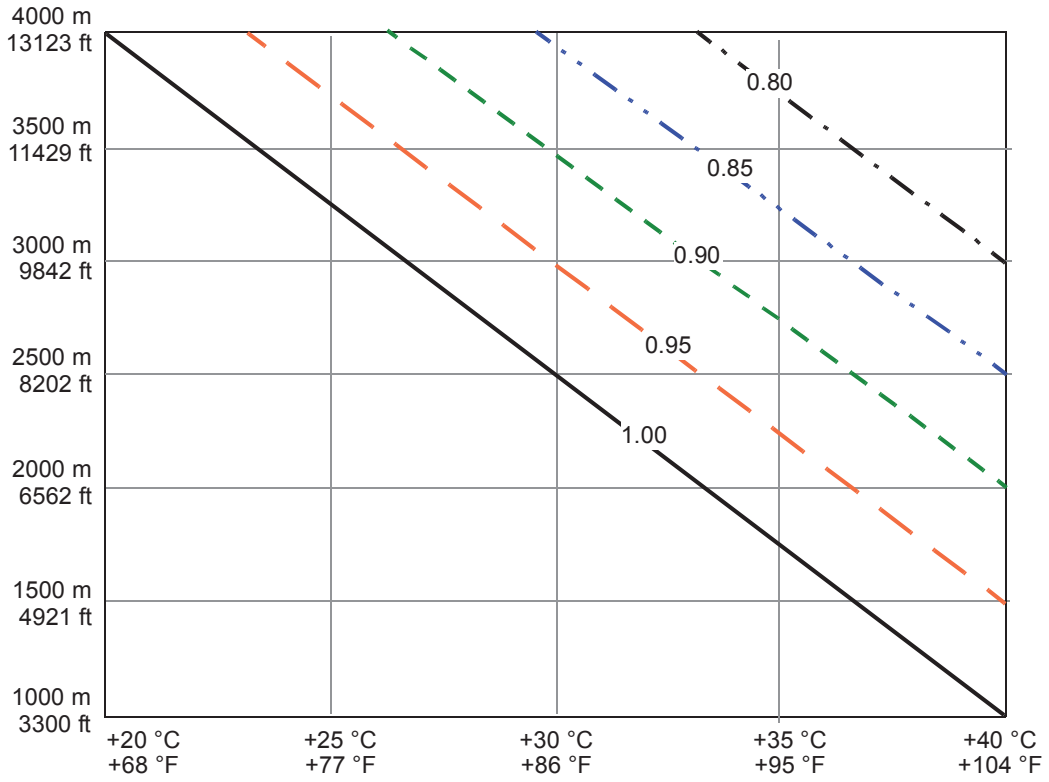
In the temperature range +40…55 °C (+104…131 °F), the rated output current is derated by 1% for every added 1 °C (1.8 °F) as follows. Calculate the output current by multiplying the current given in the rating table by the derating factor.



Altitude derating

At altitudes 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.



	Derating factor 1.00
	Derating factor 0.95
	Derating factor 0.90
	Derating factor 0.85
	Derating factor 0.80

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

Deratings for special settings in the drive control program

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

Ex motor, sine filter, low noise

Table below gives the deratings for these cases:

- drive is used with an ABB motor for explosive atmospheres (Ex) and **EX motor** in parameter 95.15 Special HW settings is enabled
- sine filter given in the selection table (see section Sine filters) is used and **ABB sine filter** in parameter 95.15 Special HW settings is enabled
- **Low noise optimization** is selected in parameter 97.09 Switching freq mode.

With other than recommended sine filters (see section Sine filters (Page 242)) and non-ABB Ex motors, contact ABB.

ACS880-14-...	Output ratings for special settings											
	Ex motor (ABB Ex motor)				ABB sine filter				Low noise mode			
	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use
	I_n	P_n	I_{Ld}	I_{Hd}	I_n	P_n	I_{Ld}	I_{Hd}	I_n	P_n	I_{Ld}	I_{Hd}
	A	kW	A	A	A	kW	A	A	A	kW	A	A
U_n = 400 V												
246A-3	234	132	222	196	221	132	210	185	217	132	204	180
293A-3	278	160	264	234	264	160	251	221	258	160	243	215
363A-3	345	200	328	278	327	200	310	264	320	200	301	256
442A-3	420	250	399	345	398	250	378	327	390	250	367	317
505A-3	480	315	456	345	455	250	432	327	445	250	419	317
585A-3	556	315	528	420	527	315	500	398	516	315	485	386
650A-3	618	355	587	480	585	355	556	455	573	315	539	441
U_n = 480 V												
302A-5	287	250 hp	287	247	272	250 hp	272	234	266	250 hp	264	277
U_n = 500 V												
240A-5	228	132	217	171	216	132	205	162	212	132	199	157
260A-5	247	160	235	228	234	160	222	216	229	160	216	210
361A-5	343	200	326	247	325	200	309	234	318	200	300	227
414A-5	393	250	373	343	373	250	354	325	365	250	343	315
460A-5	437	315	428	393	414	315	405	373	406	250	393	362
503A-5	478	355	467	437	453	315	443	414	443	315	430	402
U_n = 690 V												
142A-7	125	132	119	105	128	132	122	107	66	75	63	55
174A-7	153	160	145	125	157	160	149	128	81	90	77	66
210A-7	185	200	176	153	189	200	180	157	98	110	93	81
271A-7	238	250	226	185	244	250	231	189	126	132	119	98
330A-7	290	315	282	238	297	315	288	244	154	160	149	126

ACS880-14-...	Output ratings for special settings											
	Ex motor (ABB Ex motor)				ABB sine filter				Low noise mode			
	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use
	I_n	P_n	I_{Ld}	I_{Hd}	I_n	P_n	I_{Ld}	I_{Hd}	I_n	P_n	I_{Ld}	I_{Hd}
	A	kW	A	A	A	kW	A	A	A	kW	A	A
370A-7	326	355	317	290	333	355	324	297	172	200	167	153
430A-7	378	400	370	326	387	400	378	333	200	200	195	172

U_n	Nominal voltage of the drive
I_n	Continuous rms output current. No overload capability at 40 °C (104 °F)
P_n	Typical motor power in no-overload use
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-duty use
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes

High speed mode

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

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

ACS880-14-	Deratings with selection High speed mode of parameter 95.15 Special HW settings									
	120 Hz output frequency					Maximum output frequency				
	Frequency	Nominal use		Light-duty use	Heavy-duty use	Maximum frequency	Nominal use		Light-duty use	Heavy-duty use
	f	I_n	P_n	I_{Ld}	I_{Hd}	f_{max}	I_n	P_n	I_{Ld}	I_{Hd}
	Hz	A	kW	A	A	Hz	A	kW	A	A
U_n = 400 V										
246A-3	120	246	132	234	206	500	201	110	193	170
293A-3	120	293	160	278	246	500	240	132	229	203
363A-3	120	363	200	345	293	500	297	200	284	241
442A-3	120	442	250	420	363	500	362	250	346	299
505A-3	120	505	250	480	363	500	413	250	395	299
582A-3	120	585	315	556	442	500	479	315	458	364
650A-3	120	650	355	618	505	500	532	315	509	416
U_n = 480 V										
302A-5	120	302	250 (hp)	302	260	500	247	200 (hp)	249	214

ACS880-14-	Deratings with selection High speed mode of parameter 95.15 Special HW settings									
	120 Hz output frequency					Maximum output frequency				
	Frequency	Nominal use		Light-duty use	Heavy-duty use	Maximum frequency	Nominal use		Light-duty use	Heavy-duty use
	f	I_n	P_n	I_{Ld}	I_{Hd}	f_{max}	I_n	P_n	I_{Ld}	I_{Hd}
	Hz	A	kW	A	A	Hz	A	kW	A	A
U_n = 500 V										
240A-5	120	240	132	228	180	500	196	132	188	148
260A-5	120	260	160	247	240	500	213	160	203	198
361A-5	120	361	200	343	260	500	295	250	283	214
414A-5	120	414	250	393	361	500	339	250	324	297
460A-5	120	460	315	450	414	500	376	315	371	341
503A-5	120	503	355	492	460	500	412	315	405	379
U_n = 690 V										
142A-7	120	142	132	135	119	500	82	75	78	68
174A-7	120	174	160	165	142	500	100	110	95	82
210A-7	120	210	200	200	174	500	121	132	115	100
271A-7	120	271	250	257	210	500	156	160	148	121
330A-7	120	330	315	320	271	500	190	200	184	156
370A-7	120	370	355	360	330	500	213	250	207	190
430A-7	120	430	400	420	370	500	247	250	241	213
										3AXD00000588487

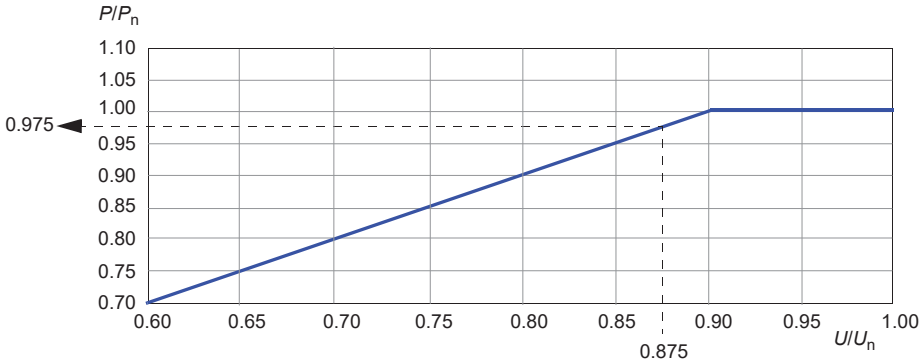
f	Output frequency
f_{max}	Maximum output frequency with High speed mode
U_n	Nominal voltage of the drive
I_n	Continuous rms output current. No overload capability at 40 °C (104 °F).
P_n	Typical motor power in no-overload use
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes

Derating for output voltage boost

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.

400 V and 500 V drives

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



Example 1: P_n for ACS880-14-650A-3 is 355 kW. The input voltage (U) is 350 V. -> U/U_n = 350 V / 400 V = 0.875. -> P/P_n = 0.975 -> The derated power P = 0.975 × 355 kW = 346 kW.

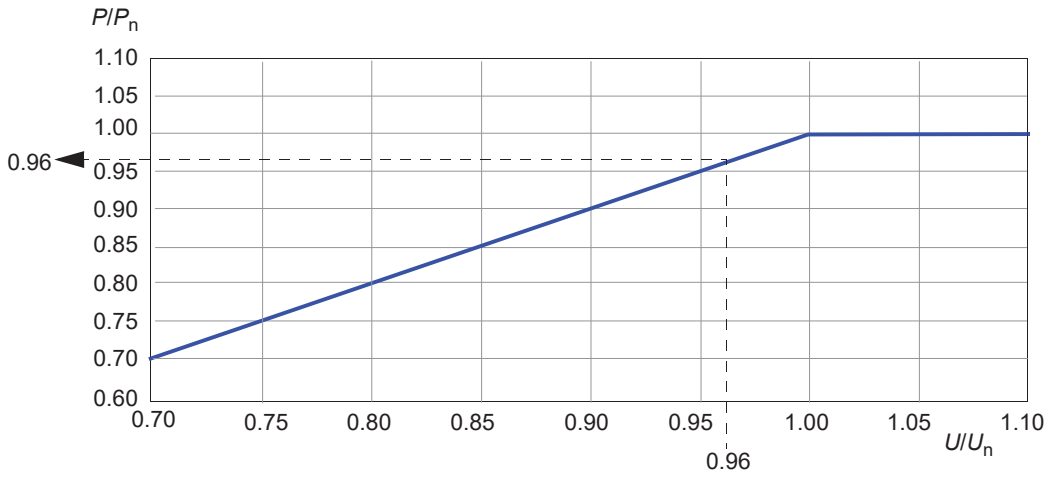
To boost the output voltage to correspond the nominal supply voltage 400 V, increase the DC voltage to 400 V × √2 = 567 V.

Example 2: P_n for ACS880-14-503A-5 is 355 kW. The input voltage (U) is 450 V. -> U/U_n = 450 V / 500 V = 0.9. -> P/P_n = 1.00 -> The derated power P = 1.00 × 355 kW = 355 kW.

To boost the output voltage to correspond the nominal supply voltage 500 V, increase the DC voltage to 500 V × √2 = 707 V.

575 V and 690 V drives

This drawing shows the required derating for -7 (575 V and 690 V) drive types.



Example 1: P_n for ACS880-14-430A-7 is 400 kW. The input voltage (U) is 660 V. -> U/U_n = 660 V / 690 V = 0.96 -> P/P_n = 0.96 -> The derated power P = 0.96 × 400 kW = 384 kW.

To boost the output voltage to correspond the nominal supply voltage 690 V, increase the DC voltage to 690 V × √2 = 977 V.

U	Input voltage of the drive
U_n	Nominal supply voltage of the drive. For -3 types U_n = 400 V, for -5 types U_n = 500 V. For -7 types U_n = 690 V but 575 V when P_n refers to nominal power ratings in the UL (NEC) 575 V rating table.
P	Derated output power of the drive
P_n	Nominal power rating of the drive

For more information, see ACS880-11, ACS880-31, ACS880-14, ACS880-34, ACS880-17, ACS880-37 drives product note on voltage boost (3AXD50000691838 [English]).

Fuses (IEC)

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

Ultrarapid (aR) fuses per drive module							
ACS880-14-...	Min. short-circuit current [1]	Input current	Fuse				
	A	A	A	A^2s	V	Bussmann type	Size
U_n = 400 V							
246A-3	1500	212	400	74000	690	170M5408	2
293A-3	2200	257	500	145000	690	170M5410	2
363A-3	2600	321	630	210000	690	170M6410	3
442A-3	3100	401	700	300000	690	170M6411	3
505A-3	4000	401	800	465000	690	170M6412	3
585A-3	5400	505	1000	945000	690	170M6414	3
650A-3	5400	569	1000	945000	690	170M6414	3
U_n = 500 V							
240A-5	1100	169	315	42000	690	170M4410	1
260A-5	1500	205	400	74000	690	170M5408	2
361A-5	2600	257	630	210000	690	170M6410	3
414A-5	3100	321	700	300000	690	170M6411	3
460A-5	3100	404	700	300000	690	170M6411	3
503A-5	4000	455	800	465000	690	170M6412	3
U_n = 690 V							
142A-7	900	123	250	21000	690	170M4409	1
174A-7	1100	149	315	42000	690	170M4410	1
210A-7	1500	186	400	74000	690	170M5408	2
271A-7	2200	232	500	145000	690	170M5410	2
330A-7	2600	293	630	210000	690	170M6410	3
370A-7	3100	330	700	300000	690	170M6411	3
430A-7	3100	375	700	300000	690	170M6411	3

[1] Minimum short-circuit current of the electrical power system

Note:

- See also sections:
  - Protecting the drive and the input power cable in short-circuits (Page 85)
  - Protecting the drive against thermal overload (Page 85)
  - Protecting the input power cable against thermal overload (Page 86).
- In multicable installations, install only one fuse per phase (not one fuse per conductor).
- Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.

- Fuses from other manufacturers can be used if they agree with the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

Calculating the short-circuit current of the installation

Make sure that the short-circuit current of the installation is at least the value given in the fuse table.

The short-circuit current of the installation can be calculated as follows:

$$I_{k2\text{-}ph} = \frac{U}{2 \cdot \sqrt{R_c^2 + (Z_k + X_c)^2}}$$

where

$I_{k2\text{-}ph}$	Short-circuit current in symmetrical two-phase short-circuit
U	Network line-to-line voltage (V)
R_c	Cable resistance (ohm)
Z_k	$Z_k = z_k \cdot U_n^2 / S_n$ = transformer impedance (ohm)
z_k	Transformer impedance (%)
U_n	Transformer rated voltage (V)
S_n	Nominal apparent power of the transformer (kVA)
X_c	Cable reactance (ohm)

Fuses (UL)

UL fuses by Cooper Bussman for branch circuit protection per NEC per drive module are listed below. Obey local regulations.

ACS880-14-...	Input current (A)	Fuse					
		A	V	Type DIN 43653	Type US Style	Type French Style	Size
U_n = 500 V							
240A-5	169	315	690	170M4010	170M4610	170M4310	1
260A-5	205	400	690	170M5008	170M5608	170M5308	2
302A-5	249	500	690	170M5010	170M5610	170M5310	2
361A-5	257	630	690	170M6010	170M6610	170M6310	3
414A-5	321	700	690	170M6011	170M6611	170M6311	3
460A-5	404	700	690	170M6011	170M6611	170M6311	3
503A-5	455	800	690	170M6012	170M6612	170M6212	3
U_n = 690 V							
142A-7	123	250	690	170M4009	170M4609	170M4309	1
174A-7	149	315	690	170M4010	170M4610	170M4310	1
210A-7	186	400	690	170M5008	170M5608	170M5308	2
271A-7	232	500	690	170M5010	170M5610	170M5310	2
330A-7	293	630	690	170M6010	170M6610	170M6310	3
370A-7	330	700	690	170M6011	170M6611	170M6311	3
430A-7	375	700	690	170M6011	170M6611	170M6311	3

Note:

- See also sections:
  - Protecting the drive and the input power cable in short-circuits (Page 85)
  - Protecting the drive against thermal overload (Page 85)
  - Protecting the input power cable against thermal overload (Page 86).
- In multicable installations, install only one fuse per phase (not one fuse per conductor).
- Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.
- Alternative fuses can be used if they meet certain characteristics. For acceptable fuses, see the manual supplement (3AXD50000645015).

Circuit breakers (UL)

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

Dimensions, weights and free space requirements

Standard drive module configuration (drive module + LCL filter module) – IP20 (UL Open Type)								
Frame size	Height		Width		Depth		Weight	
	mm	in	mm	in	mm	in	kg	lb
R11	1741	68.54	713	28.07	512	20.16	373	822

Optional selection +0B051+0H371 (without shrouds and full-size output power cable connection terminals) with LCL filter module – IP00 (UL Open Type)								
Frame size	Height		Width		Depth		Weight	
	mm	in	mm	in	mm	in	kg	lb
R11	1726	67.93	642	25.27	508	20.00	365	804

Drive module								
Frame size	Height		Width		Depth		Weight	
	mm	in	mm	in	mm	in	kg	lb
R11	1726	67.93	404	15.92	508	20.00	185	408

LCL filter module								
Frame size	Height		Width		Depth		Weight	
	mm	in	mm	in	mm	in	kg	lb
R11	1722	67.80	239	9.40	505	19.86	180	396

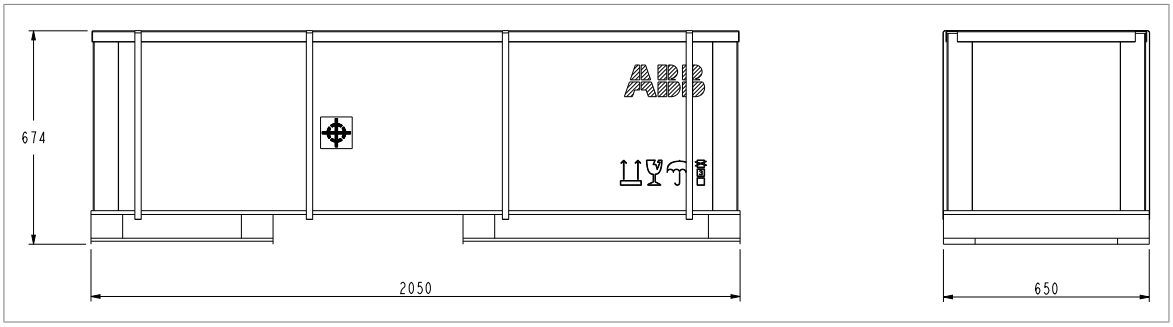
Optional selection +H381 (full power cabling panels) with LCL filter module								
Frame size	Height		Width		Depth		Weight	
	mm	in	mm	in	mm	in	kg	lb
R11	1780	70.08	709	27.91	517	20.35	401	884

Weight of optional selections								
Frame size	+E208		+0H371		+H370		+0B051	
	kg	lb	kg	lb	kg	lb	kg	lb
R11	3	7	-2.9	-6	2.9	6	-1.5	-3

For requirements of free space around the drive module, see Required free space (Page 54).

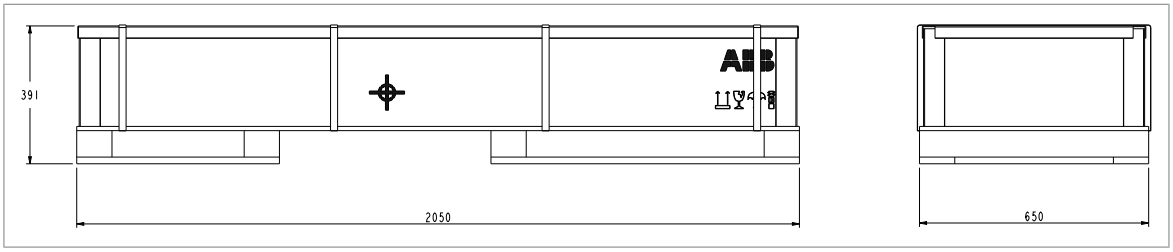
Package

Drive package



Weight: 36 kg (79 lb).

LCL filter module package



Weight: 32 kg (71 lb).

Losses, cooling data and noise

The air flow direction is from bottom to top.

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

ACS880-14-	Frame size	Air flow		Heat dissipation	Noise
		m³/h	ft³/min	W	dB(A)
U_n = 400 V					
246A-3	R11	2100	1236	5280	75
293A-3	R11	2100	1236	6400	75
363A-3	R11	2100	1236	8000	75
442A-3	R11	2100	1236	10000	75
505A-3	R11	2100	1236	10000	75
585A-3	R11	2100	1236	12600	75
650A-3	R11	2100	1236	14200	75
U_n = 500 V					
240A-5	R11	2100	1236	5280	75
260A-5	R11	2100	1236	6400	75
302A-5	R11	2100	1236	8000	75
361A-5	R11	2100	1236	8000	75
414A-5	R11	2100	1236	10000	75
460A-5	R11	2100	1236	12600	75
503A-5	R11	2100	1236	14200	75
U_n = 690 V					
142A-7	R11	2100	1236	5280	75
174A-7	R11	2100	1236	6400	75
210A-7	R11	2100	1236	8000	75
271A-7	R11	2100	1236	10000	75
330A-7	R11	2100	1236	12600	75
370A-7	R11	2100	1236	14200	75
430A-7	R11	2100	1236	16000	75

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

The cooling air temperature rises 30 °C when it goes through the drive module if the temperature of the input cooling air is 40 °C.

Typical power cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for the drives with nominal current. See also section Terminal and entry data for the power cables (Page 194).

IEC[1]			US[2]	
ACS880-14-...	Cu cable type	Al cable type	Cu cable type	Al cable type
	mm²	mm²	AWG/kcmil	AWG/kcmil
U_n = 400 V				
246A-3	2 × (3 × 50)	2 × (3 × 95)	250 MCM or 2 × 1	350 MCM or 2 × 2/0
293A-3	2 × (3 × 70)	2 × (3 × 120)	350 MCM or 2 × 2/0	500 MCM or 2 × 3/0
363A-3	3 × (3 × 50)	3 × (3 × 95)	500 MCM or 2 × 3/0	700 MCM or 2 × 4/0 or 3 × 2/0
442A-3	3 × (3 × 70)	3 × (3 × 120)	700 MCM or 2 × 4/0 or 3 × 2/0	2 × 300 MCM or 3 × 3/0
505A-3	3 × (3 × 70)	3 × (3 × 120)	700 MCM or 2 × 4/0 or 3 × 2/0	2 × 300 MCM or 3 × 3/0
585A-3	3 × (3 × 120)	3 × (3 × 150)	2 × 350 MCM or 3 × 4/0	2 × 500 MCM or 3 × 250 MCM
650A-3	3 × (3 × 120)	3 × (3 × 185)	2 × 400 MCM or 3 × 4/0	2 × 600 MCM or 3 × 300 MCM
U_n = 500 V				
240A-5	1 × (3 × 120)	2 × (3 × 70)	3/0	250 MCM or 2 × 1
260A-5	2 × (3 × 50)	3 × (3 × 70)	250 MCM or 2 × 1	350 MCM or 2 × 2/0
302A-5	2 × (3 × 70)	3 × (3 × 70)	300 MCM or 2 × 1/0	500 MCM or 2 × 3/0
361A-5	2 × (3 × 120)	3 × (3 × 70)	350 MCM or 2 × 2/0	500 MCM or 2 × 3/0
414A-5	3 × (3 × 50)	2 × (3 × 150)	500 MCM or 2 × 3/0	700 MCM or 2 × 4/0 or 3 × 2/0
460A-5	3 × (3 × 70)	3 × (3 × 120)	700 MCM or 2 × 4/0 or 3 × 2/0	2 × 300 MCM or 3 × 3/0
503A-5	3 × (3 × 95)	3 × (3 × 120)	2 × 250 MCM or 3 × 2/0	2 × 400 MCM or 3 × 4/0
U_n = 690 V				
142A-7	1 × (3 × 70)	2 × (3 × 50)	1/0	3/0
174A-7	2 × (3 × 50)	2 × (3 × 50)	2/0	4/0
210A-7	2 × (3 × 50)	2 × (3 × 70)	4/0	300 MCM or 2 × 1/0
271A-7	2 × (3 × 70)	3 × (3 × 50)	300 MCM or 2 × 1/0	400 MCM or 2 × 2/0
330A-7	2 × (3 × 50)	2 × (3 × 120)	400 MCM or 2 × 2/0	600 MCM or 2 × 4/0 or 3 × 1/0
370A-7	3 × (3 × 70)	2 × (3 × 150)	500 MCM or 2 × 3/0	700 MCM or 2 × 4/0 or 3 × 2/0
430A-7	3 × (3 × 70)	2 × (3 × 185)	700 MCM or 2 × 4/0 or 3 × 2/0	2 × 300 MCM or 3 × 3/0

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

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

Temperature: For IEC, select a cable rated for at least 70 °C maximum permissible temperature of conductor in continuous use. For North America, power cables must be rated for 75 °C (167 °F) or higher.
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.

Terminal and entry data for the power cables

Maximum accepted cable size	4 × (3 × 240) mm² or 4 × (3 × 500 MCM)
Screw size for connecting busbars to the drive module input and output busbars	M12
Tightening torque	50…75 N·m (37…55 lbf·ft)

Units with optional cabling panels (+H381)

The maximum accepted cable size is 4 × (3 × 240) mm² or 4 × (3 × 500 AWG). The cabling panels are connected to the drive module busbars with M12 serpress nuts, tightening torque 30 N·m (20 lbf·ft).

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

L1/U1, L2/V1, L3/W1, T1/U2, T2/V2, T3/W2, UDC+, UDC-				Grounding busbar			
Screw		Tightening torque		Screw		Tightening torque	
		N·m	lbf·ft			N·m	lbf·ft
M12	1/2	50…75	37…55	M10	3/8	30…44	22…32

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

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

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

Terminal data for the control cables

See Connector data (Page 120).

Electrical power network specification

Voltage (U_1)	ACS880-14-xxxx-3 drive modules: 380…415 VAC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage level 3~400 V AC. ACS880-14-xxxx-5 drive modules: 380…500 V AC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage levels 3~400/480/500 V AC. ACS880-14-xxxx-7 drive modules: 525…690 V AC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage levels 3~525/600/690 V AC (600 V AC UL, CSA).
Network type	TN (grounded) and IT (ungrounded) systemsS
Rated conditional short-circuit current I_{cc} (IEC 61800-5-1)	Maximum allowable prospective short-circuit current is 100 kA when protected by the fuses given in the fuse table.

<table>
<tr><td>Maximum prospective short-circuit current rating (SCCR) (UL 61800-5-1, CSA C22.2 No. 274-17)</td><td>The drive is suitable for use on a circuit capable of delivering not more than 100 kA rms symmetrical amperes at 600 V maximum when protected by the fuses given in the fuse table.</td></tr>
<tr><td>Frequency (f_1)</td><td>50/60 Hz. Variation ±5% of nominal frequency.</td></tr>
<tr><td>Imbalance</td><td>Max. ± 3% of nominal phase to phase input voltage</td></tr>
<tr><td>Fundamental power factor (cos phi$_1$)</td><td>1 (at nominal load)</td></tr>
<tr><td>Harmonic distortion</td><td>Harmonics are below the limits defined in IEEE 519-2014, and G5/4. The drive complies with IEC 61000-3-2, IEC 61000-3-4 and IEC 61000-3-12.

The table below shows typical values of the drive for short-circuit ratio (I_{sc}/I_1) of 20 to 100. The values will be met if the supply network voltage is not distorted by other loads and when the drive operates at nominal load.
<table>
<tr><th>Nominal bus voltage V at PCC</th><th>THDi (%)</th><th>THDv (%)</th></tr>
<tr><td>V ≤ 690 V</td><td>3*</td><td>< 3**</td></tr>
</table>
PCC Point on a public power supply system, electrically nearest to a particular load, at which other loads are, or could be, connected. The PCC is a point located upstream of the considered installation.

THDi Indicates the total harmonic current distortion of the wave form. This value is defined as the ratio (in %) of the harmonic current to the fundamental (non-harmonic) current measured at a load point at the particular moment when the measurement is taken:

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

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

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

I_{sc}/I_1 Short-circuit ratio
I_{sc} Maximum short-circuit current at PCC
I_1 Continuous rms input current of the drive
I_n Amplitude of the current harmonic n
U_1 Supply voltage
U_n Amplitude of the voltage harmonic n
* The short-circuit ratio can influence the THDi value
** Other loads can influence the THDv value</td></tr>
</table>

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors)
Voltage (U_2)	0 to U_1, 3-phase symmetrical. This is indicated in the type designation label as typical output voltage level as 3 0…U_1, U_{max} at the field weakening point.
Frequency (f_2)	0…500 Hz **Note:** Operation above 150 Hz can require type-specific derating. For more information, contact your local ABB representative. For drives with du/dt filter: 120 Hz For drives with sine filter: 120 Hz
Frequency resolution	0.01 Hz
Current	See section Electrical ratings (Page 177).
Switching frequency	3 kHz (typically)
Maximum recommended motor cable length	DTC control: 500 m (1640 ft) Scalar control: 500 m (1640 ft) **Note:** For restrictions due to EMC compatibility, see section EMC compliance (IEC/EN 61800-3:2004) (Page 201). Longer motor cables cause a motor voltage decrease which limits the available motor power. The decrease depends on the motor cable length and characteristics. Contact ABB for more information. Note that a sine filter (optional) at the drive output also causes a voltage decrease.

DC connection data

ACS880-14-…	Capacitance (mF)
U_n = 400 V	
246A-3	10.5
293A-3	10.5
363A-3	10.5
442A-3	10.5
505A-3	10.5
585A-3	14.0
650A-3	14.0
U_n = 500 V	
240A-5	10.5
260A-5	10.5
302A-5	10.5
361A-5	10.5
414A-5	10.5
460A-5	14.0
503A-5	14.0
U_n = 690 V	
142A-7	5.3
174A-7	5.3
210A-7	5.3

271A-7	5.3
330A-7	5.3
370A-7	5.3
430A-7	5.3

Control panel type

ACS-AP-W assistant control panel

Efficiency

Approximately 96.5% at nominal power level.

Ecodesign data (EU ecodesign)

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

Protection classes for module

Degrees of protection (IEC/EN 60529)	IP20 (standard) IP00 (option +0B051)
Enclosure types (UL 50/50E)	UL Open Type
Overvoltage category (IEC/EN 60664-1)	III
Protective class (IEC/EN 61800-5-1)	I

Ambient conditions

The table shows environmental limits for the drive. The drive must be used in a heated, indoor, controlled environment.

	Operation installed for stationary use	**Storage** in the package	**Transportation** in the package
Installation site altitude	For TN and TT neutral-grounded network systems and IT ungrounded network systems: 0 to 4000 m (13123 ft) above sea level Derating is needed above 1000 m [3281 ft]): refer to Altitude derating (Page 181)	-	-

Surrounding air temperature	-15…+55 °C (5…131 °F). No frost allowed. Refer to Surrounding air temperature derating (Page 180)	-40…+70 °C (-40…+158 °F)	-40…+70 °C (-40…+158 °F)
Relative humidity	5…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	IEC 60721-3-1:1997	IEC 60721-3-2:1997
Chemical gases	Class 3C2	Class 1C2	Class 2C2
Solid particles	Class 3S2. No conductive dust allowed.	Class 1S3. (packing must support this, otherwise 1S2)	Class 2S2
Pollution degree	2		
Atmospheric pressure	70…106 kPa 0.7 … 1.05 atmospheres	70…106 kPa 0.7 … 1.05 atmospheres	60…106 kPa 0.6 … 1.05 atmospheres
Vibration IEC 60068-2-6:2007, EN 60068-2-6:2008	Max. 0.1 mm (0.004 in) (10…57 Hz), max. 10 m/s^2 (33 ft/s^2) (57…150 Hz) sinusoidal	Max. 1 mm (0.04 in) (5 … 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 … 100 Hz) sinusoidal	Max. 3.5 mm (0.14 in) (2…9 Hz), max. 15 m/s^2 (49 ft/s^2) (9…200 Hz) sinusoidal
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009	Not allowed	With packing max. 100 m/s^2 (330 ft/s^2), 11 ms	With packing max. 100 m/s^2 (330 ft/s^2), 11 ms
Free fall	Not allowed	100 mm (4 in) for weight over 100 kg (220 lb)	100 mm (4 in) for weight over 100 kg (220 lb)

Storage conditions

Store the drive in humidity controlled enclosed environments. Keep the drive in its package.

Colors

Drive enclosure: NCS 1502-Y (RAL 9002 / PMS 420 C).

Materials

Drive

Refer to ACS880-04, ACS880-14, ACS880-34, ACS580-04, ACH580-04, ACH580-34, ACQ580-04 and ACQ580-34 drives Recycling instructions and environmental information (3AXD50000137688 [English]).

Package materials for module products

This is a complete list of the package materials. The materials vary depending on the frame size (packages do not contain all materials listed below).

- Cardboard (heavy duty quality with wet strength glue in large modules)
- Molded pulp
- Plywood
- Wood
- PP (strapping)
- EPP (foam)
- PE (plastic bag and/or VCI film)
- Metal (fixing clamps, screws).

Package materials for options, accessories and spare parts

- 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.

Materials of 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.

Applicable standards

The drive complies with these standards.

IEC 61800-5-1:2007 + AMD1:2016 EN 61800-5-1:2007 + +A1:2017+A11:2021	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy

IEC 60204-1:2016 EN 60204-1:2018	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. Provisions for compliance: The final assembler of the machine is responsible for installing: • emergency-stop device • supply disconnecting device • IP00 drive module into a cabinet.
IEC 60529:1989 EN 60529:1991 + A2:2013	Degrees of protection provided by enclosures (IP code)
IEC/EN 61800-3:2004 + A1:2012	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
UL 61800-5-1 First edition	UL Standard for Safety, Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy
CSA C22.2 No. 0-10	General Requirements - Canadian Electrical Code, Part II
CSA C22.2 No. 274-17	Adjustable Speed Drives

Markings

These markings are attached to the drive:

CE	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).
TÜV NORD Safety Approved	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.
UKCA	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).
c UL us LISTED	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.
EAC	EAC (Eurasian Conformity) mark Product complies with the technical regulations of the Eurasian Customs Union. EAC mark is required in Russia, Belarus and Kazakhstan.
20	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.

	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).

	KC mark Product complies with Korean Registration of Broadcasting and Communications Equipment Clause 3, Article 58-2 of Radio Waves Act.

	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.

EMC compliance (IEC/EN 61800-3:2004)

Definitions

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

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

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

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

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

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

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

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

Category C2

The drive complies with the standard with the following provisions:

1. The drive is equipped with EMC filter +E202 / ARFI-10 and common mode filter (+E208).
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 150 meters.

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

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

Category C3

The drive complies with the standard with the following provisions:

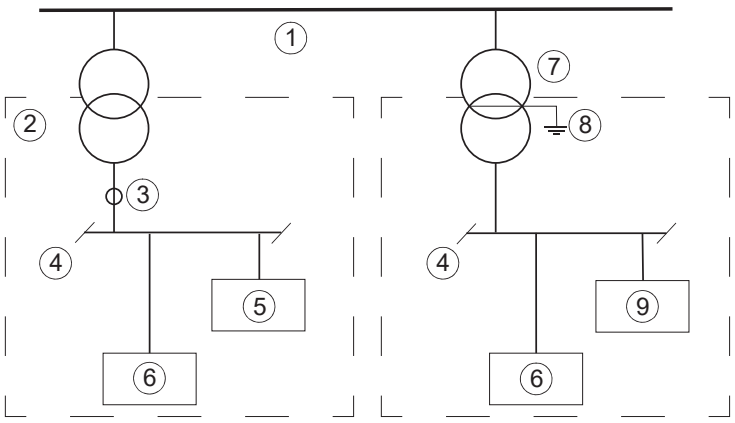
1. The drive is equipped with EMC filter +E200 or +E201.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 150 meters.

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

Category C4

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.



1	Medium voltage network	6	Equipment
2	Neighboring network	7	Supply transformer
3	Point of measurement	8	Static screen
4	Low voltage	9	Drive
5	Equipment (victim)	-	-

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 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…55 °C.
- 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 integral solid state short circuit protection of the drive does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.
- 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.

Marine approval

Refer to ACS880-01…, ACS880-04…, ACS880-11…, ACS880-31…, ACS880-14… and ACS880-34… +C132 marine type-approved drives supplement (3AXD50000010521 [English]).

Declarations of conformity

See the chapter The Safe torque off function (Page 221).

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.

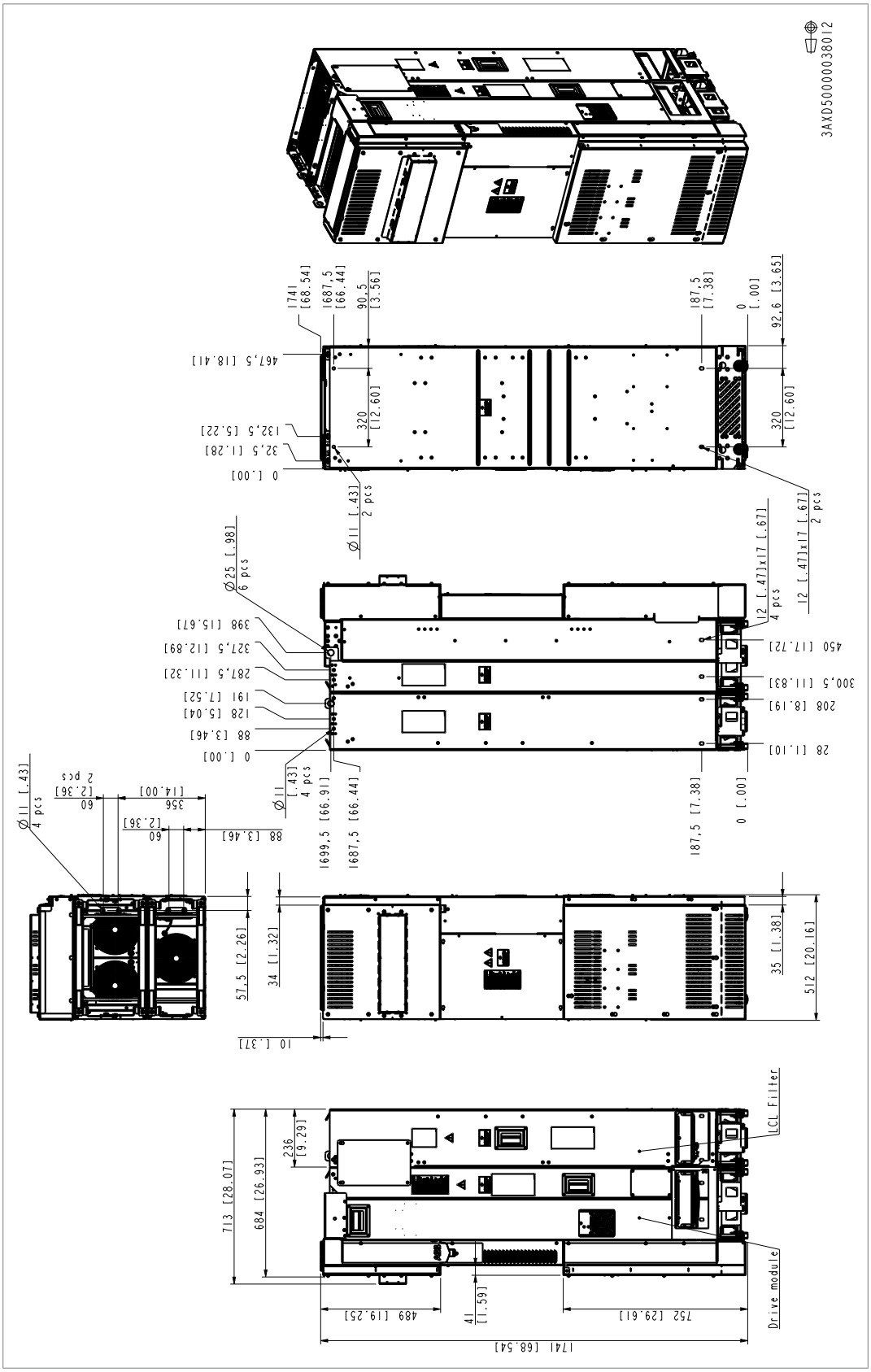
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Dimension drawings

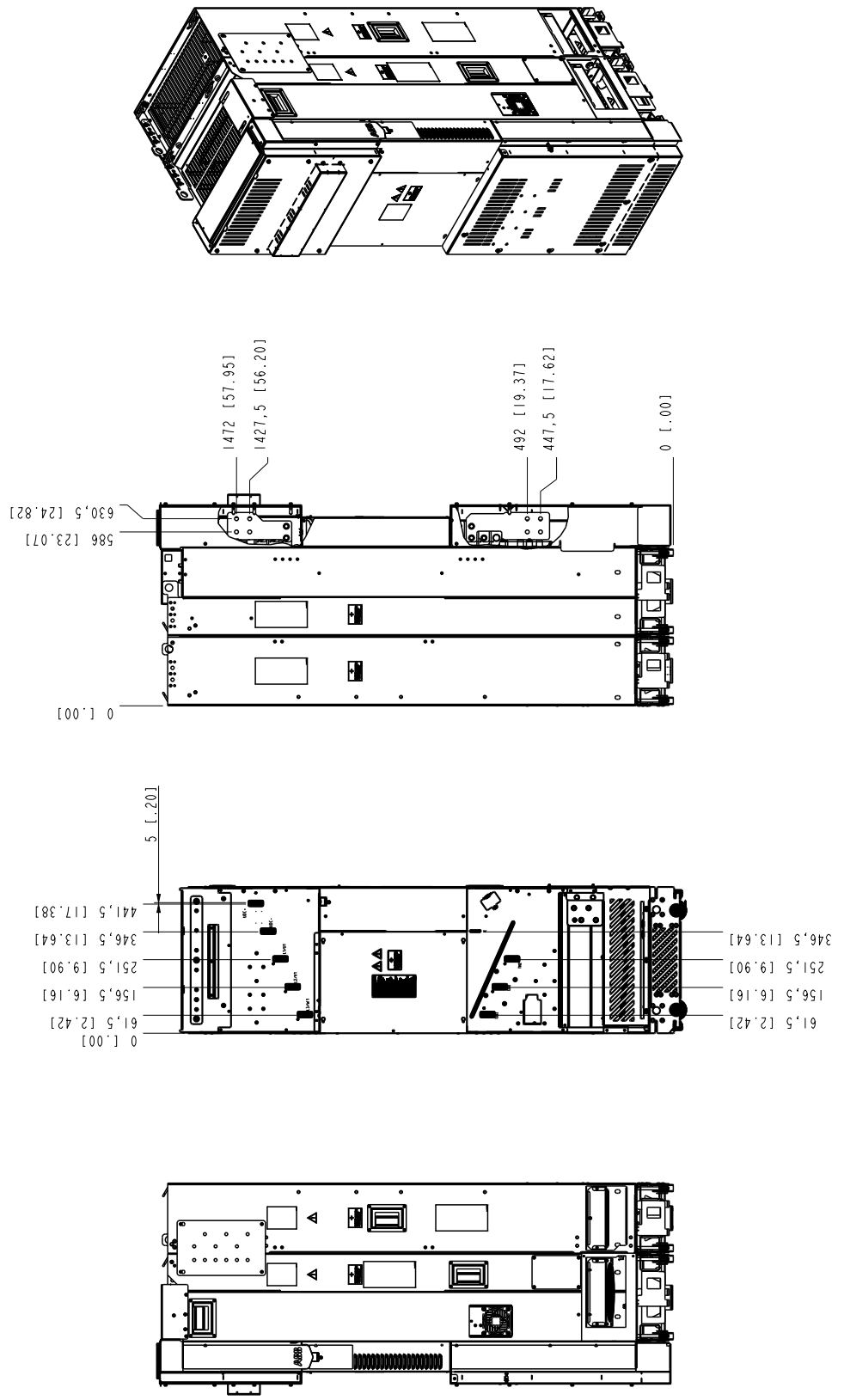
Contents of this chapter

This chapter contains dimension drawings of the drive modules with optional parts for Rittal VX25 enclosure.

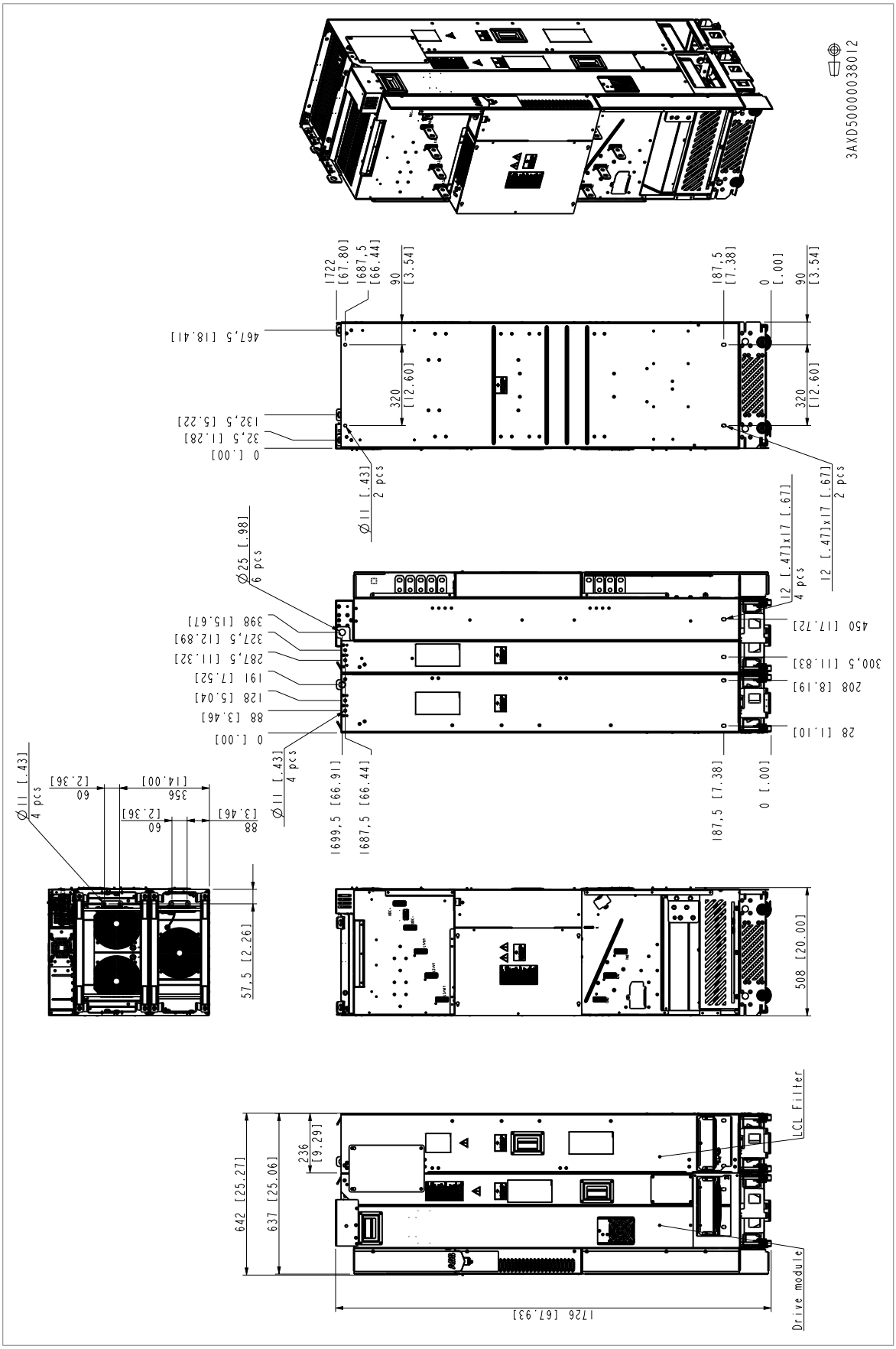
Standard configuration



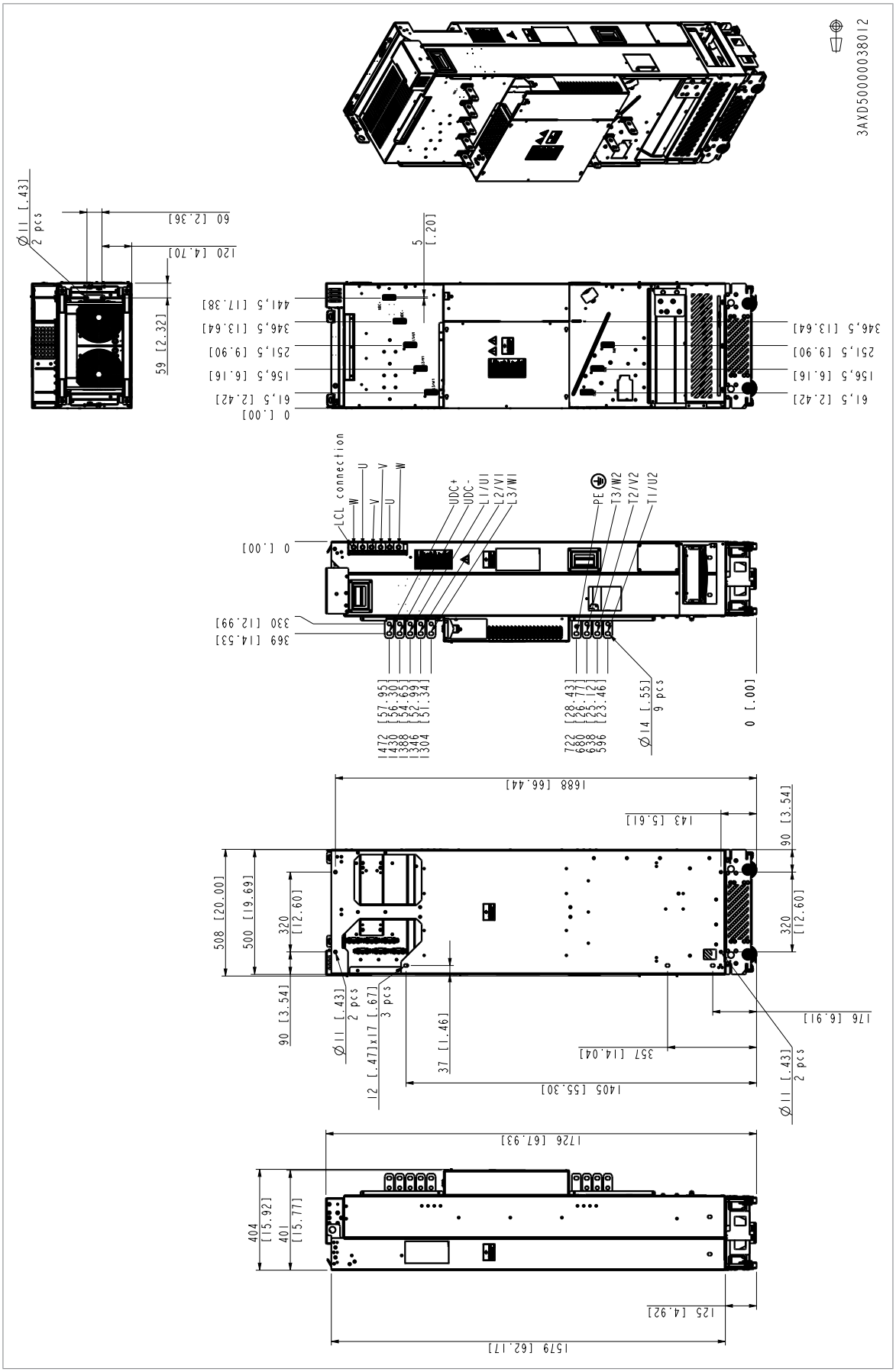
Location of power cable connection terminals with option +H370



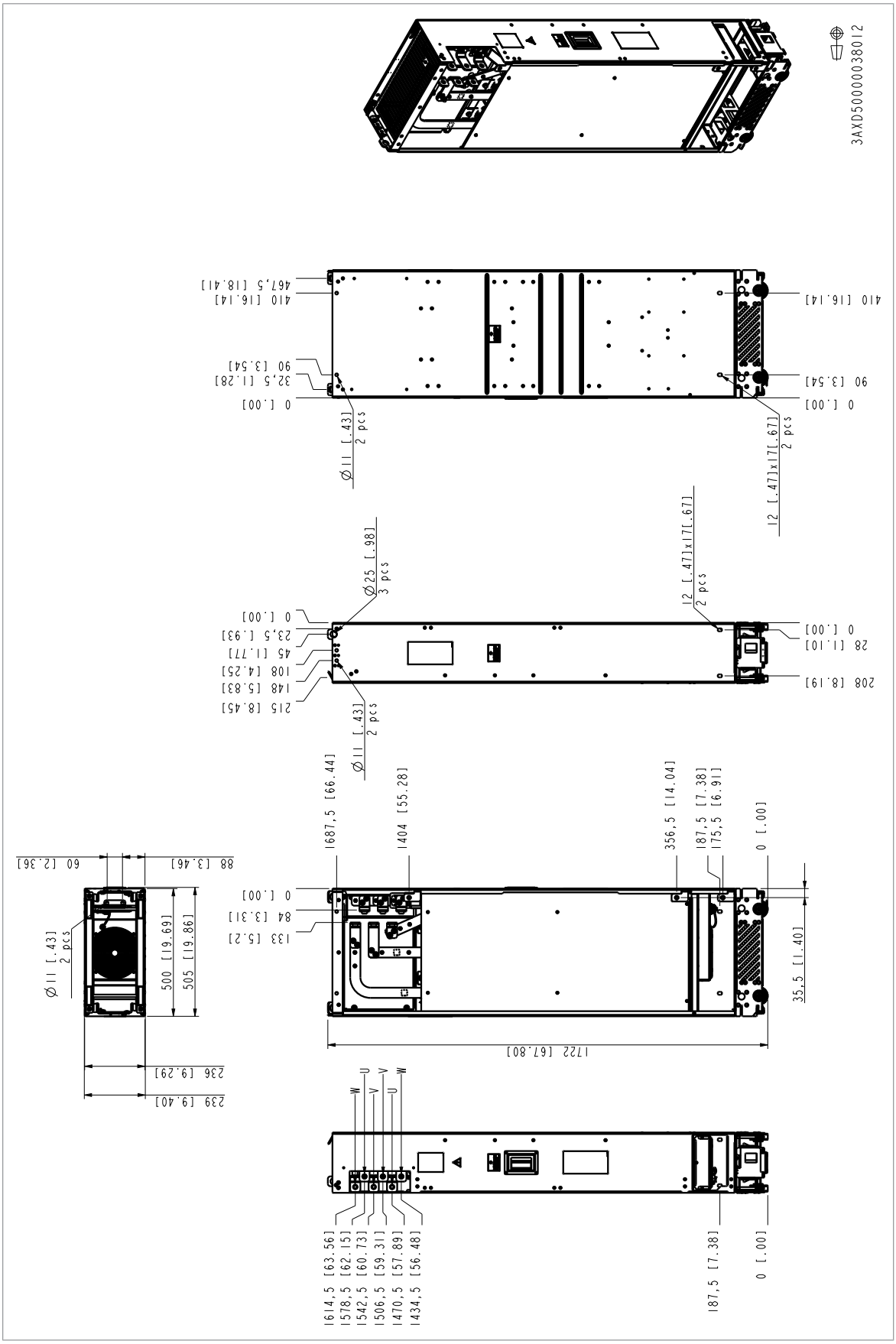
Configuration with options +0B051+0H371



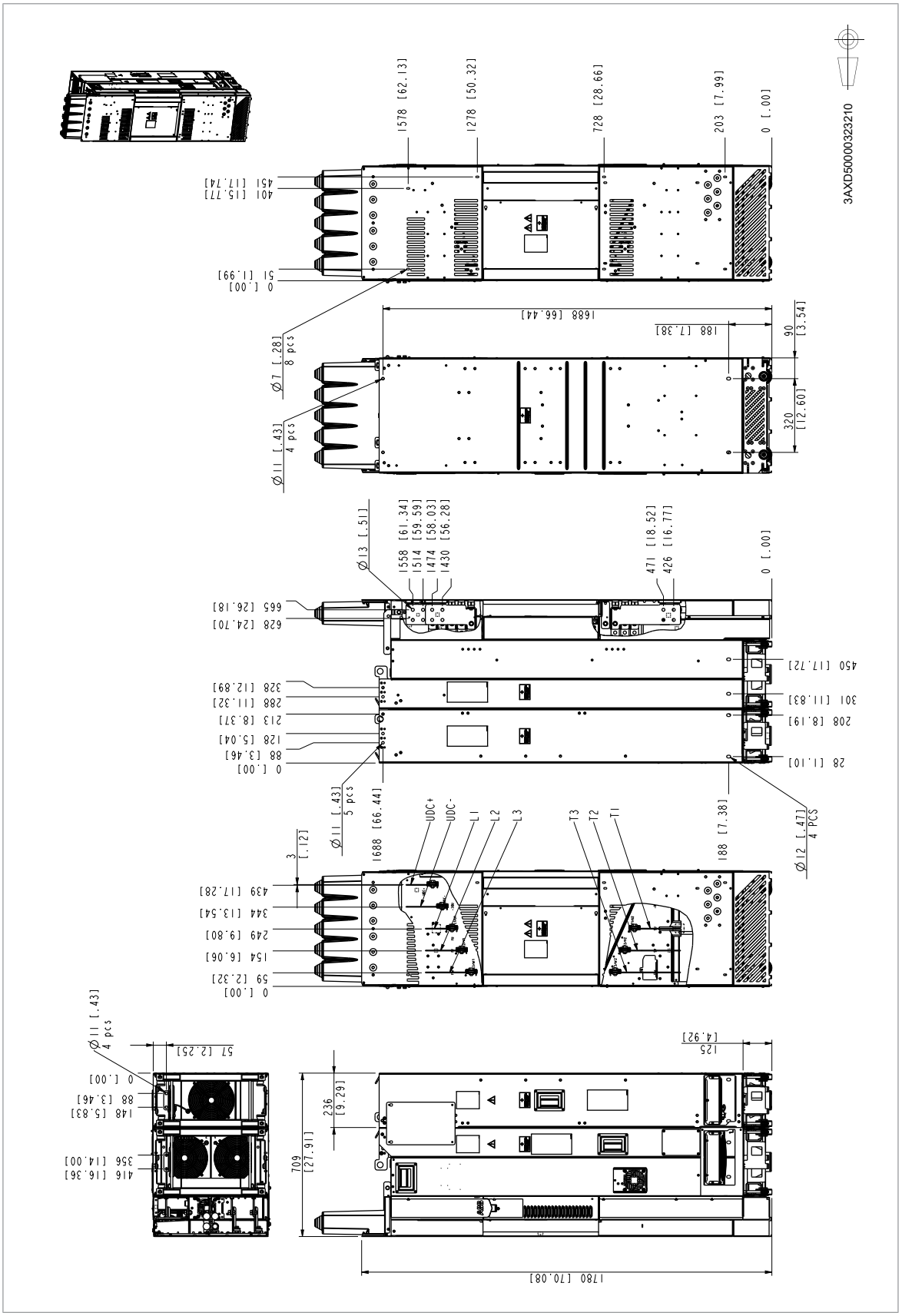
Drive module with options +0B051+0H371



LCL filter module

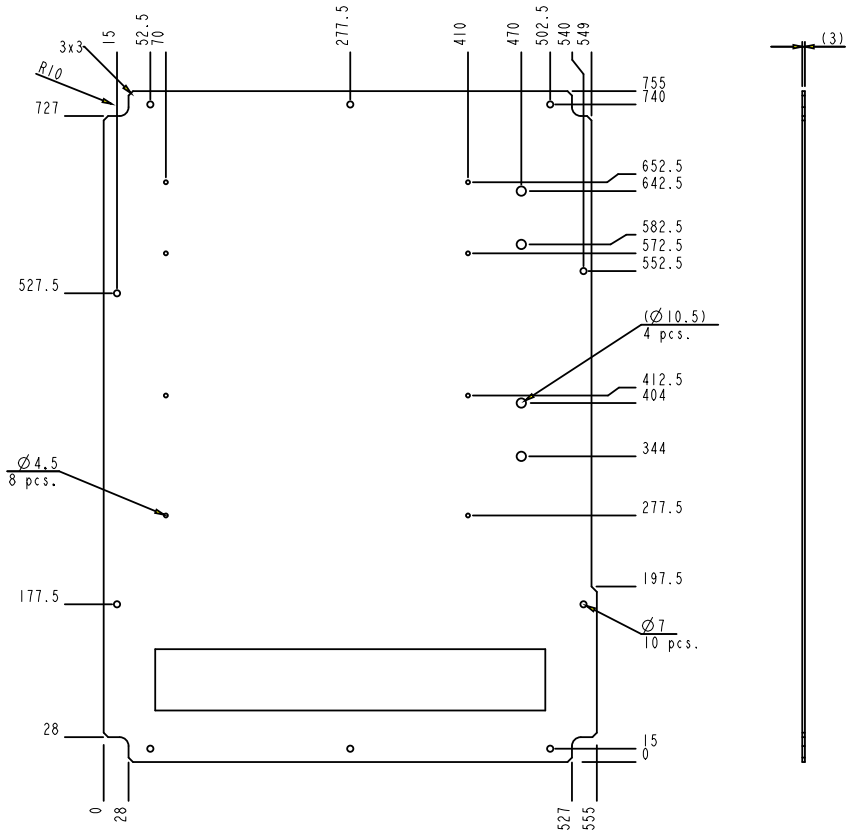


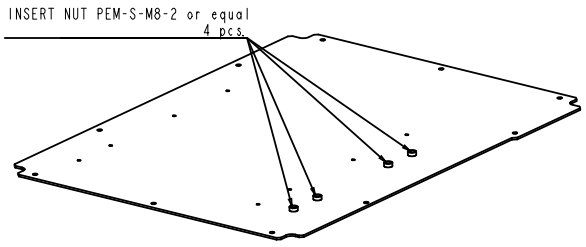
Configuration with option +H381



Bottom plate

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



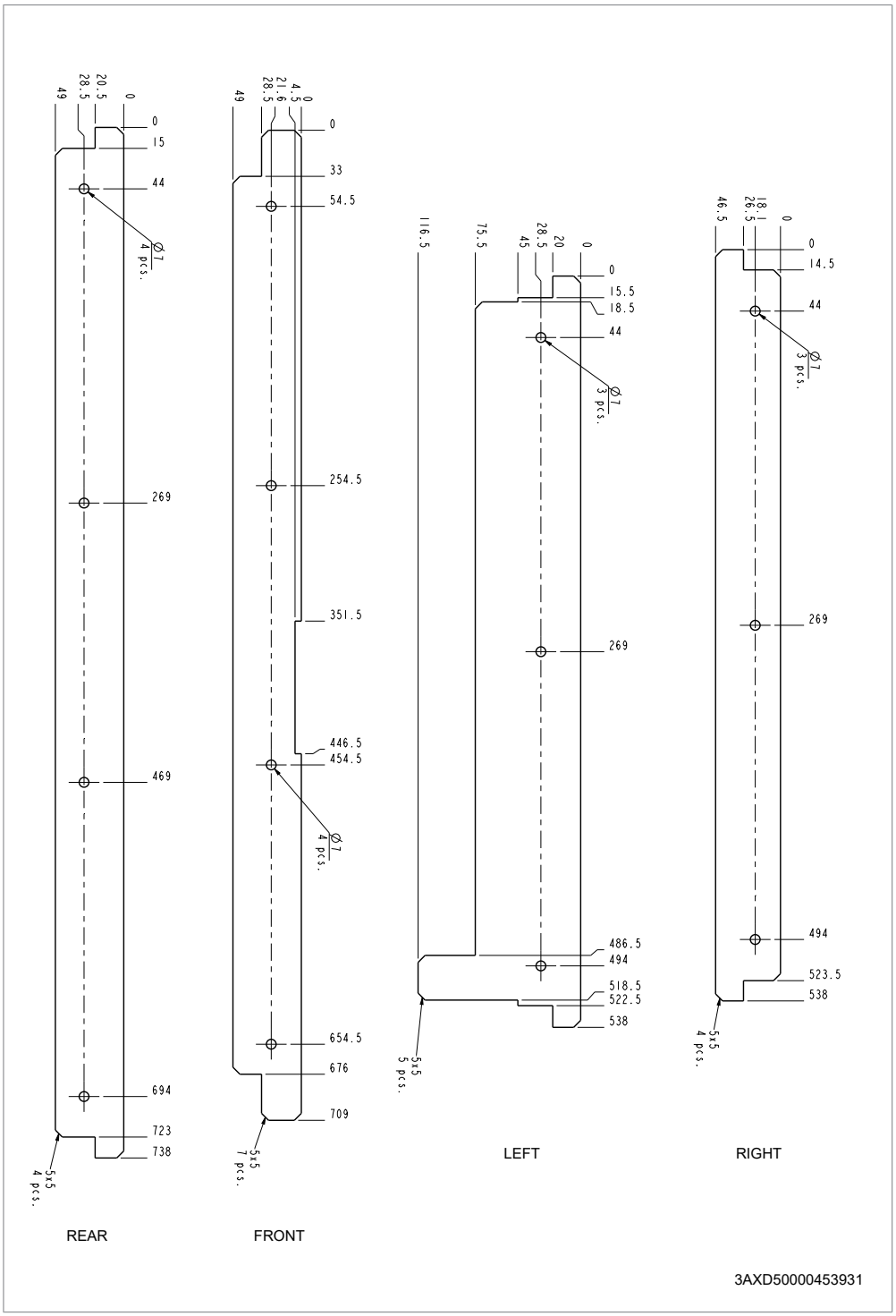


3AXD50000451944

Air baffles

This drawing shows the dimensions of the air baffles around the standard drive module for 800 mm Rittal VX25 enclosure.

These are not ABB products.

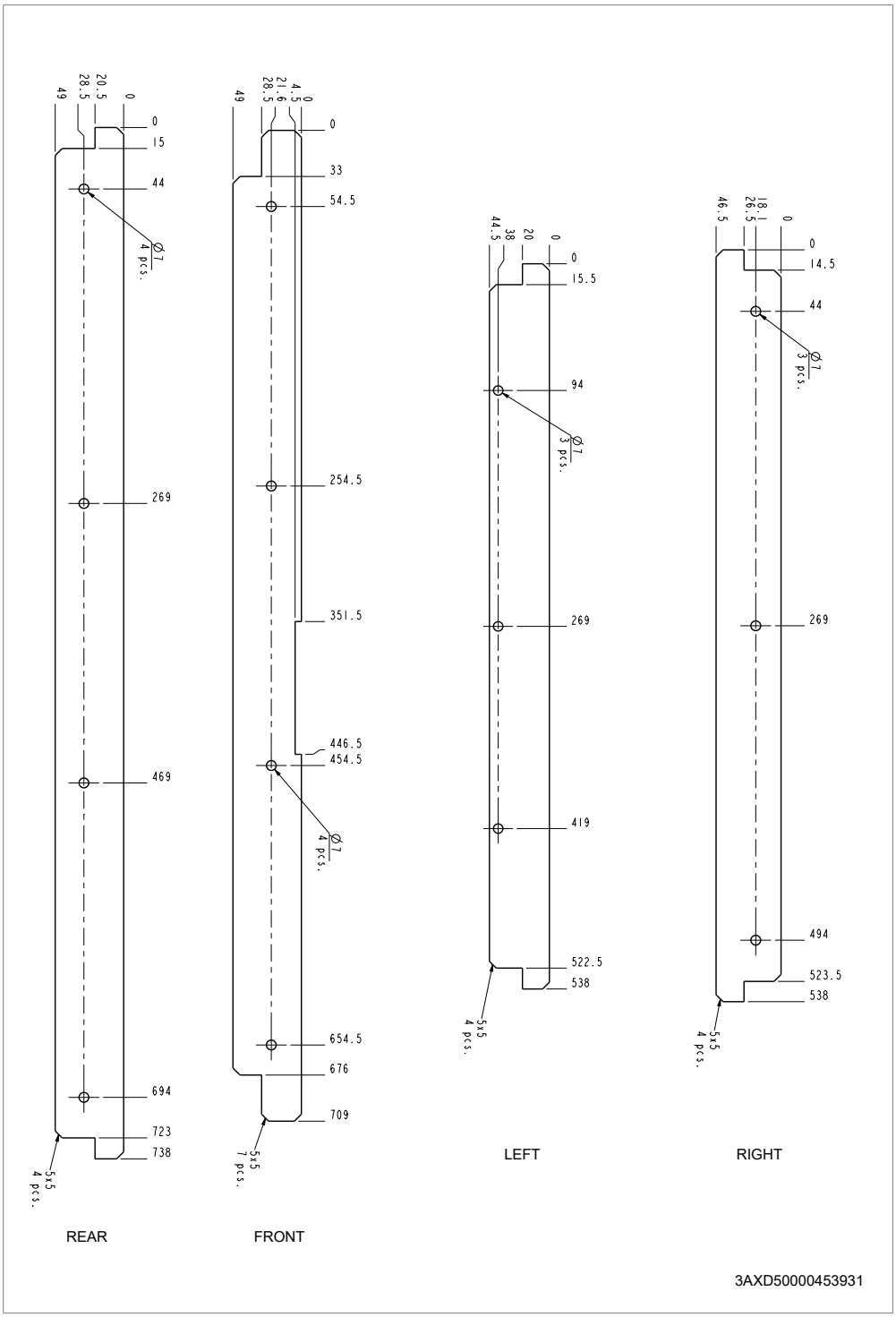


Material of the air baffles

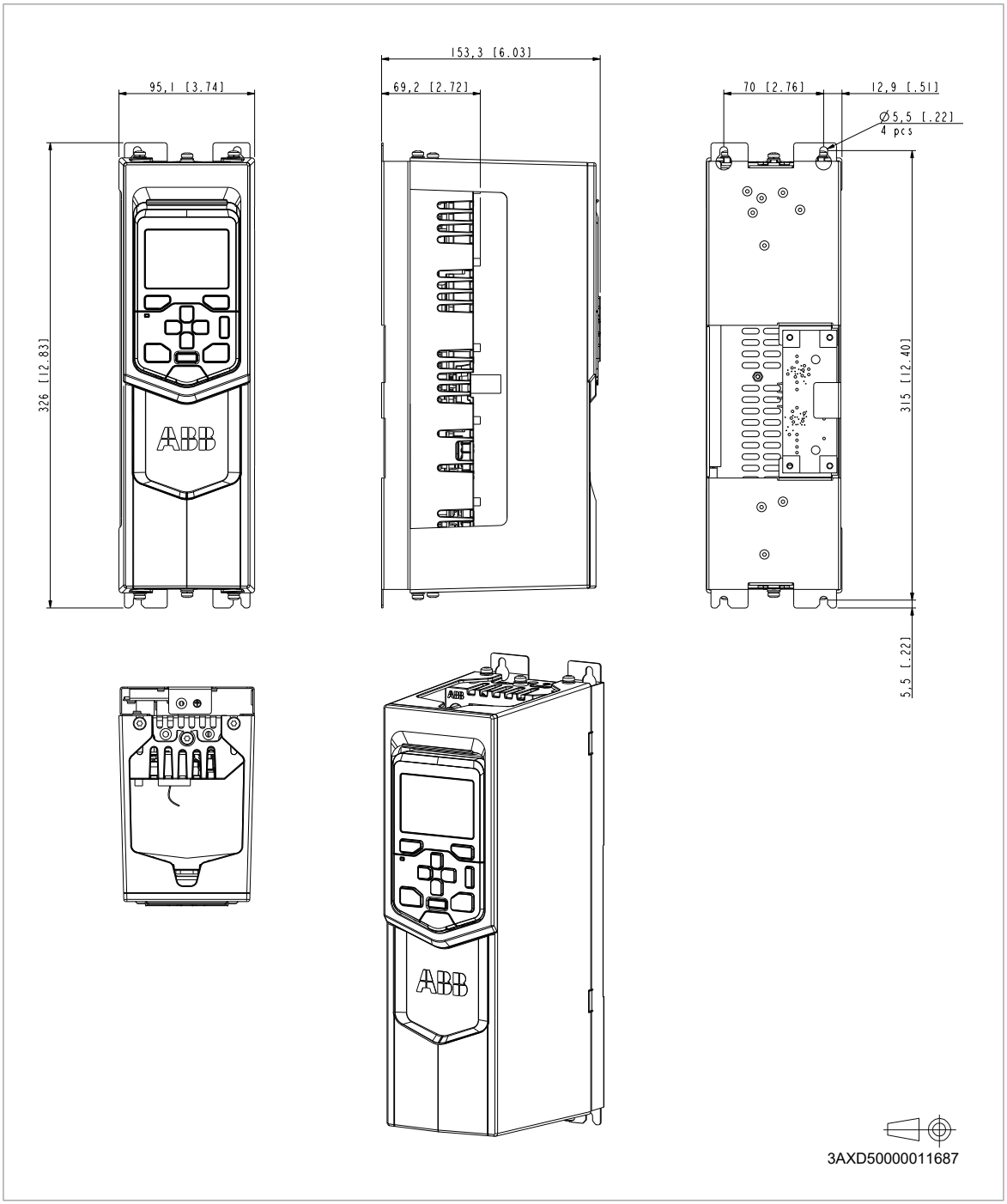
0.75 mm polycabonate (PC) film LEXAN® FR60 (GE) with UL94 V–0 listing, UV stability. (LEXAN® FR700 or Valox FR1 only with special permission). Unmarked bend radii 0.6 mm.

Air baffles for option +H381 in 800 mm wide Rittal VX25 enclosure

This drawing shows the dimensions of the air baffles for the full cabling panels option (+H381) in 800 mm Rittal VX25 enclosure. These are not ABB products.



External control unit



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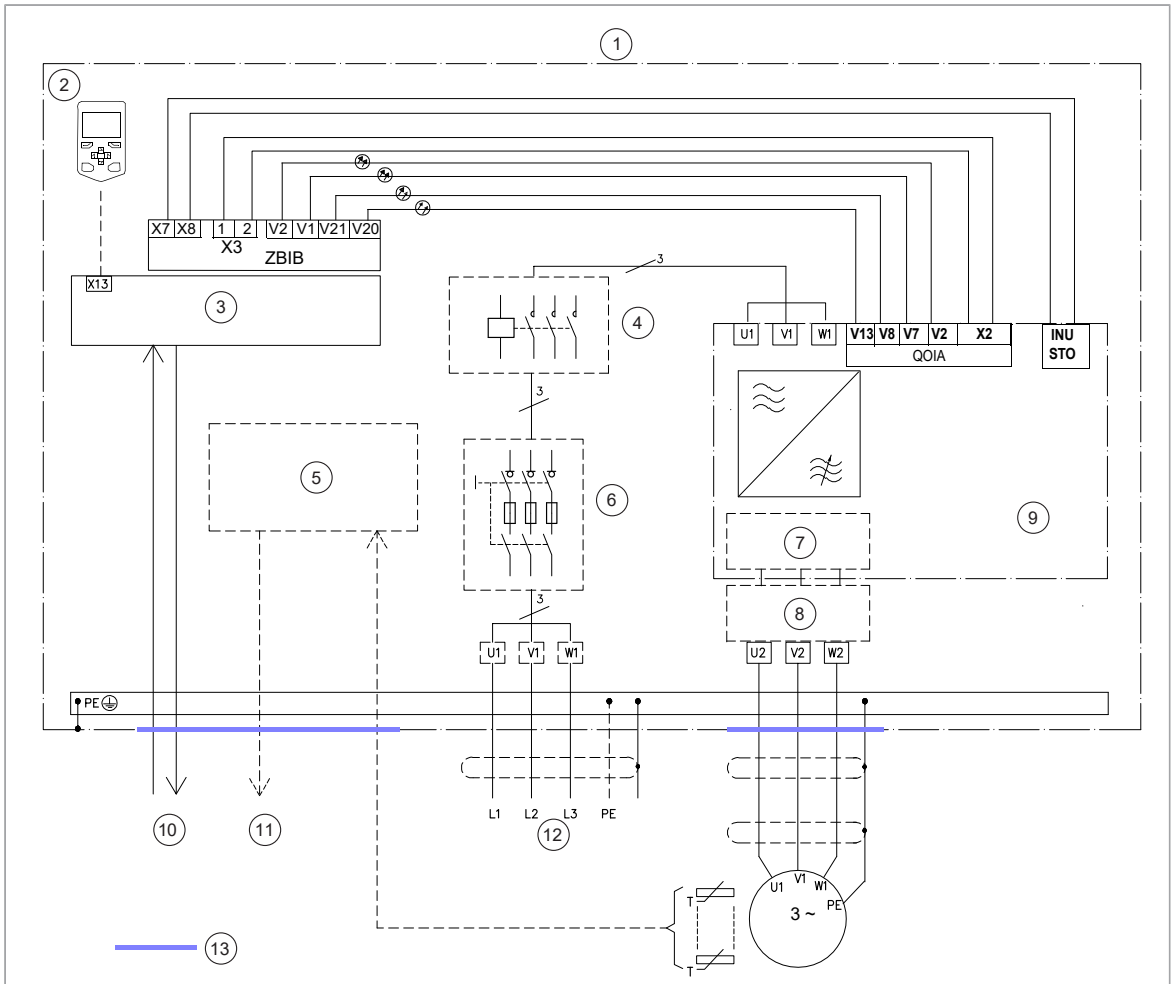
Example circuit diagrams

Contents of this chapter

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

Example circuit diagram

This diagram is an example for the main wiring of a drive cabinet. Note that the diagram includes components which are not included in a basic delivery (* plus code options, ** other options, *** to be acquired by the customer).



1	Cabinet
2	*ACS-AP-W control panel
3	ZCU control unit
4	***Main contactor
5	**Motor temperature supervision
6	***Switch fuse disconnector
7	*Common mode filter
8	**d*u*/d*t* filter or sine filter
9	Drive module
10	Input and output signals
11	Alarm
12	Supply
13	360° grounding recommended

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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

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 must be at least 17 V DC to be interpreted as “1”.

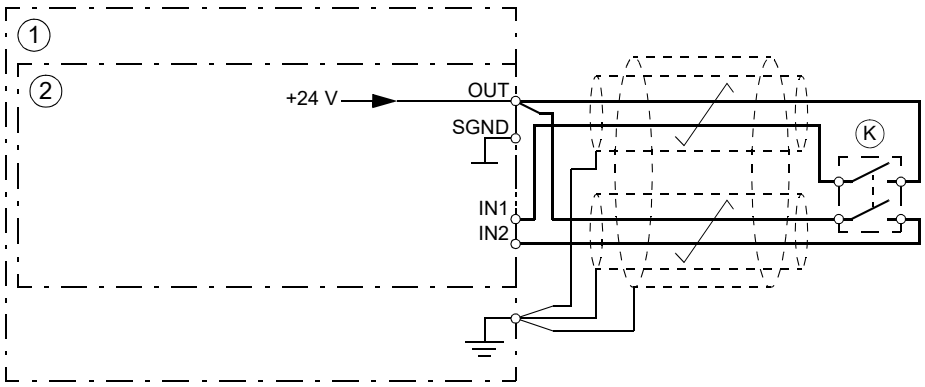
The pulse tolerance of the input channels is 1 ms.

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.

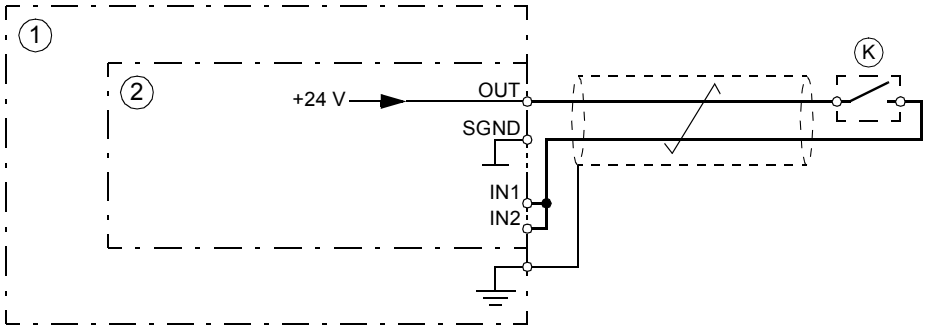
Single drive (internal power supply)

Dual-channel connection



1	Drive
2	Control unit
K	Activation switch

Single-channel connection



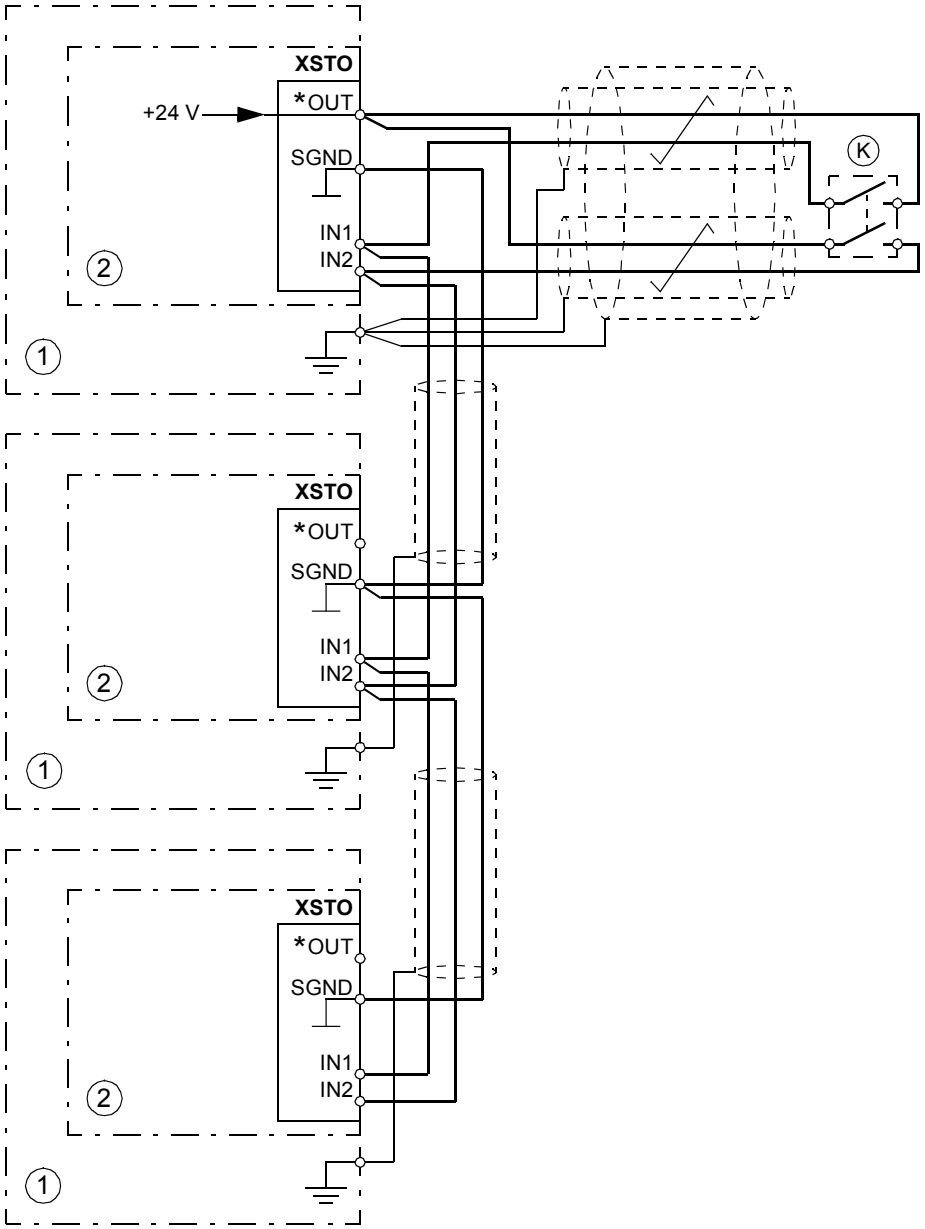
Note:

- 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.

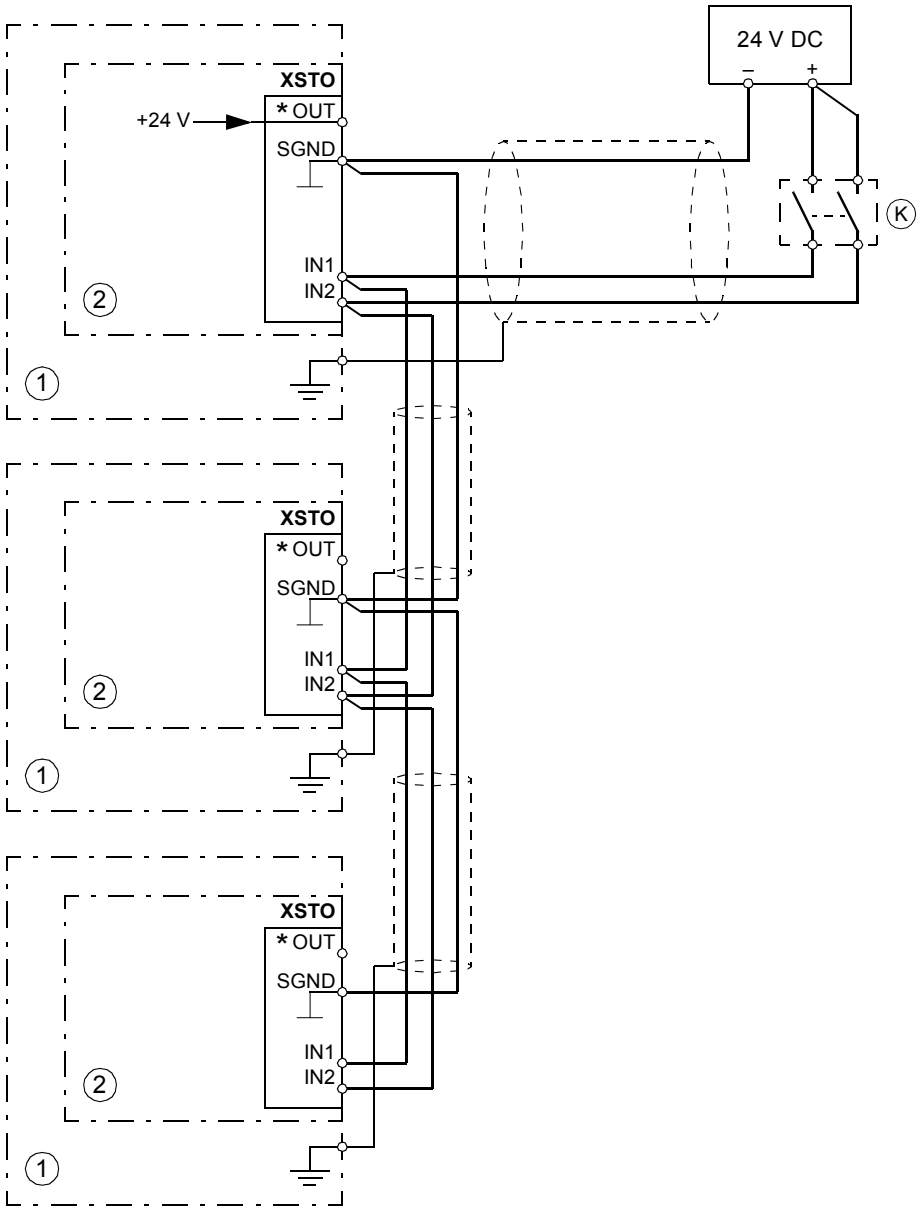
Multiple drives

Internal power supply



1	Drive
2	Control unit
K	Activation switch
* Terminal designation may vary depending on drive type	

External power supply



1	Drive
2	Control unit
K	Activation switch

* Terminal designation may vary depending on drive type

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 +Q972, +Q973 or +Q982, also do the procedure shown in the FSO module documentation.

If an FSPS-21 module is installed, refer to its documentation.

Action	☑
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Make sure that the motor can be run and stopped freely during start-up.	☐
Stop the drive (if running), switch the input power off and isolate the drive from the power line using a disconnector.	☐
Check the STO circuit connections against the wiring diagram.	☐
Close the disconnector and switch the power on.	☐

Action	☑
Test the operation of the STO function when the motor is stopped. • 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: • 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.	☐
Test the operation of the STO function when the motor is running. • Start the drive and make sure the motor is running. • Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for the 'running' state in parameter 31.22 (see the firmware manual). • Reset any active faults and try to start the drive. • Make sure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the failure detection of the drive. The motor can be stopped or running. • Open the 1st 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.	☐
Document and sign the validation test report which verifies that the safety function is safe and accepted for operation.	☐

Use

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



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



WARNING!
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 180/2*p* 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 235).

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 229).

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	☑
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Test the operation of the STO function. If the motor is running, it will stop during the test. • 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: • 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.	☐
Test the operation of the failure detection of the drive. The motor can be stopped or running. • 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.	☐
Document and sign the test report to verify that the safety function has been tested according to the procedure.	☐

Simplified proof test procedure

Action	☑
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Test the operation of the STO function. If the motor is running, it will stop during the test. • 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: • 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.	☐
Document and sign the test report to verify that the safety function has been tested according to the procedure.	☐

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)	λ_{Diag_s} (1/h)	λ_{Diag_d} (1/h)
					Perfect proof test		Simplified proof test										
					T_1 = 5 a	T_1 = 10 a	T_1 = 5 or 10 a										
R11	3	3	e	3.65E-09	8.00E-05	1.60E-04	3.20E-04	18327	≥90	99.65	3	1	80	20	7.50E-11	7.70E-07	7.50E-09
																	3AXD10001609379 A

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with ΔT = 71.66 °C
  - 1340 on/off cycles per year with ΔT = 61.66 °C
  - 30 on/off cycles per year with ΔT = 10.0 °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time.
- The STO is a type 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), 30 ms (maximum)
  - Fault detection time: Channels in different states for longer than 200 ms
  - Fault reaction time: Fault detection time + 10 ms.
- Indication delays:
  - STO fault indication (parameter 31.22) delay: < 500 ms
  - STO warning indication (parameter 31.22) delay: < 1000 ms.

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

Term or abbreviation	Reference	Description
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
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

ACS880-01/-11/-31
ACS880-04/-04F/-M04/-14/-34

with regard to the safety functions

- **Safe Torque Off**
- **Safe stop 1, Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Prevention of unexpected start-up (with FSO-12 option module, +Q973, encoderless)**
- **Safe stop 1, Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Safe speed monitor, Safe direction, Prevention of unexpected start-up (with FSO-21 and FSE-31 option modules, +Q972 and +L521, encoder supported)**
- **Safe motor temperature (with FPTC-01 thermistor protection module, +L536)**
- **Safe stop 1 (SS1-t, with FSPS-21 PROFIsafe module, +Q986)**

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 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 requirements
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:

IEC 61508:2010, parts 1-2	Functional safety of electrical / electronic / programmable electronic safety-related systems
IEC 61800-5-2:2016	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional

The product(s) referred in this Declaration of conformity fulfil(s) the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AXD10000497831.

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

Helsinki, August 31, 2022
Signed for and on behalf of:

Mika Vartiainen
Local Division
Manager
ABB Oy

Aaron D. Wade
Product Unit Manager
ABB Oy

Document number 3AXD10000099646

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

ACS880-01/-11/-31
ACS880-04/-04F/-M04/-14/-34

with regard to the safety functions

- Safe Torque Off

- Safe stop 1, Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Prevention of unexpected start-up (with FSO-12 option module, +Q973, encoderless)

- Safe stop 1, Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Safe speed monitor, Safe direction, Prevention of unexpected start-up (with FSO-21 and FSE-31 option modules, +Q972 and +L521, encoder supported)

- Safe motor temperature (with FPTC-01 thermistor protection module, +L536)

- Safe stop 1 (SS1-t, with FSPS-21 PROFIsafe module, +Q986)

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 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 requirements
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 1-2	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 product(s) referred in this declaration of conformity fulfil(s) the relevant provisions of other UK statutory requirements, which are notified in a single declaration of conformity 3AXD10001326405.

Authorized to compile the technical file: ABB Limited, Daresbury Park, Cheshire, United Kingdom, WA4 4BT.

Helsinki, August 31, 2022
Signed for and on behalf of:

Mika Vartiainen
Local Division
Manager
ABB Oy

Aaron D. Wade
Product Unit Manager
ABB Oy

Document number 3AXD10001329538

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Filters

Contents of this chapter

This chapter describes how to select d*u*/d*t* and sine filters for the drive.

d*u*/d*t* filters

When is a d*u*/d*t* filter necessary?

See section Examining the compatibility of the motor and drive (Page 68).

Selection table

d*u*/d*t* filter types for the drive modules are given below.

ACS880-14-...	d*u*/d*t* filter type	ACS880-14-...	d*u*/d*t* filter type	ACS880-14-...	d*u*/d*t* filter type
U_n = 400 V		U_n = 500 V		U_n = 690 V	
246A-3	FOCH0260-7x	240A-5	FOCH0260-7x	142A-7	FOCH0260-7x
293A-3	FOCH0260-7x	260A-5	FOCH0260-7x	174A-7	FOCH0260-7x
363A-3	FOCH0320-5x	302A-5	FOCH0320-5x	210A-7	FOCH0260-7x
442A-3	FOCH0320-5x	361A-5	FOCH0320-5x	271A-7	FOCH0260-7x
505A-3	FOCH0610-7x	414A-5	FOCH0320-5x	330A-7	FOCH0610-7x
585A-3	FOCH0610-7x	460A-5	FOCH0320-5x	370A-7	FOCH0610-7x
650A-3	FOCH0610-7x	503A-5	FOCH0610-7x	430A-7	FOCH0610-7x

Ordering codes

Filter type	Degree of protection	ABB ordering code
FOCH0320-50	IP00	68612209
FOCH0320-52	IP22	3AXD50000030047

Filter type	Degree of protection	ABB ordering code
FOCH0260-70	IP00	68490308
FOCH0260-72	IP22	3AXD50000030048
FOCH0610-70	IP00	68550505

Description, installation and technical data of the FOCH filters

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

Sine filters

When is a sine filter necessary?

See section Examining the compatibility of the motor and drive (Page 68).

Selection table

Sine filter types for the drive modules are given below.

ACS880-14-...	Sine filter type	ACS880-14-...	Sine filter type	ACS880-14-...	Sine filter type
U_n = 400 V		U_n = 500 V		U_n = 690 V	
246A-3	B84143V0230S229	240A-5	B84143V0230S229	142A-7	B84143V0130S230
293A-3	B84143V0390S229	260A-5	B84143V0230S229	174A-7	B84143V0207S230
363A-3	B84143V0390S229	302A-5	B84143V0390S229	210A-7	B84143V0207S230
442A-3	B84143V0390S229	361A-5	B84143V0390S229	271A-7	B84143V0207S230
505A-3	NSIN0900-6	414A-5	B84143V0390S229	330A-7	NSIN0485-6
585A-3	NSIN0900-6	460A-5	NSIN0485-6	370A-7	NSIN0485-6
650A-3	NSIN0900-6	503A-5	NSIN0900-6	430A-7	NSIN0485-6
					3AXD00000588487

ABB ordering codes

Filter type	ABB ordering code
NSIN0485-6	64254936
NSIN0900-6	64254961

Derating

See section Deratings for special settings in the drive control program.

Description, installation and technical data of the sine filters

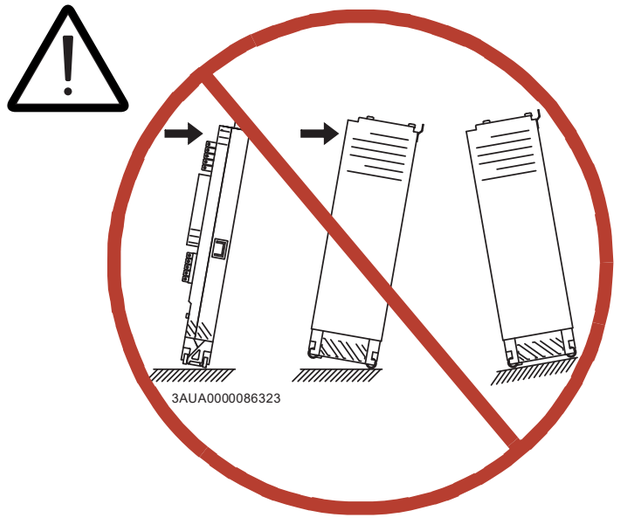
See Sine filters hardware manual (3AXD50000016814 [English]) and manufacturer's site on the Internet:
https://en.tdk.eu/tdk-en/1029890/products/product-catalog/emccomponents/output-filters--epcos-.

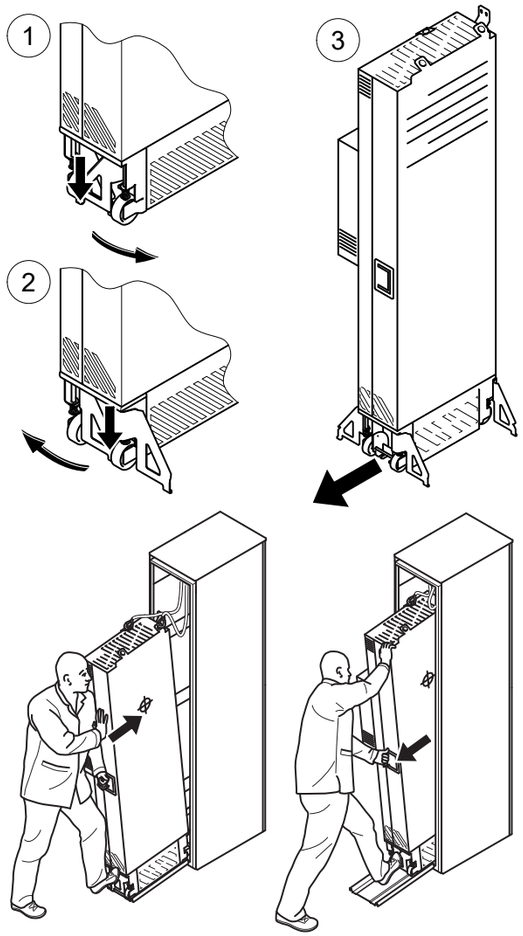
Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure

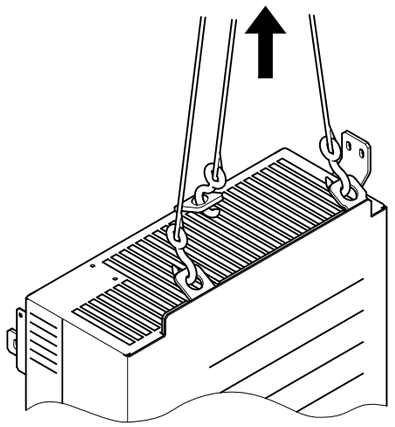
See:

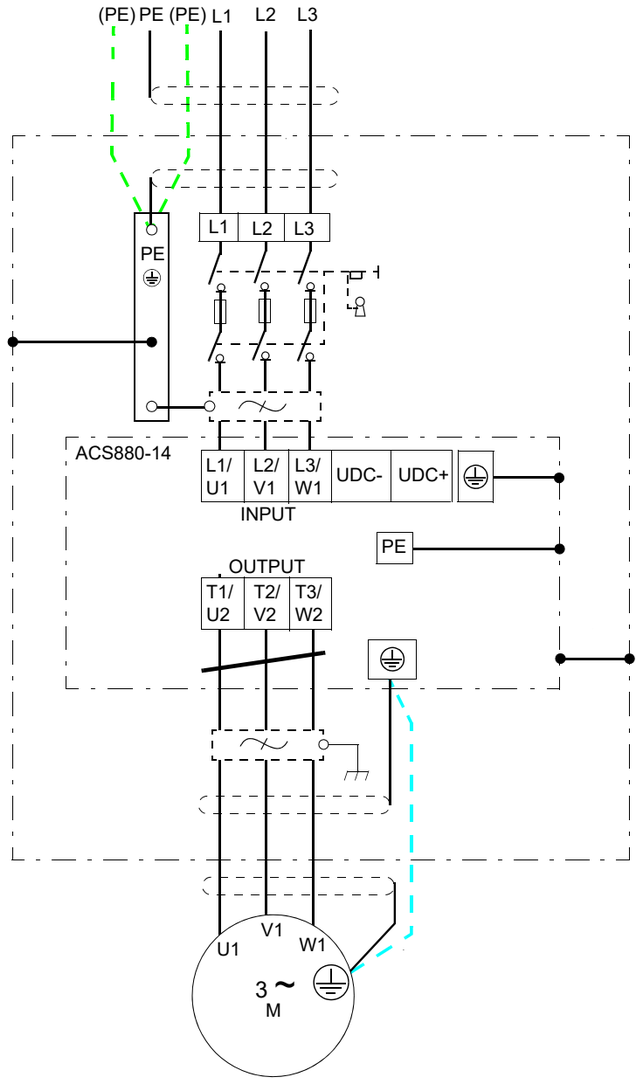
- Handling the drive module, power cable connection diagram (Page 243)
- Installing the drive module and LCL filter module into a Rittal VX25 enclosure (Page 244)
- Connecting the motor cables and installing the shrouds (Page 249)
- Connecting the input power cables and installing the shrouds (Page 252)
- Connecting the external control cables to the control unit (Page 254)
- Installing the air baffles and removing the cardboard covers (Page 255)

Handling the drive module, power cable connection diagram





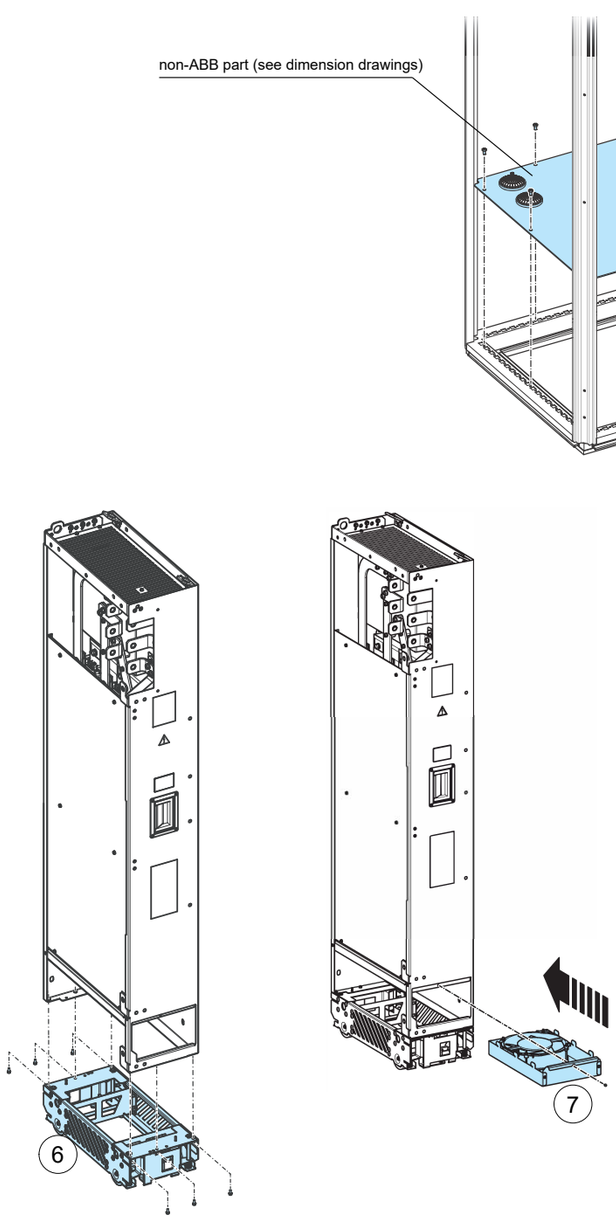


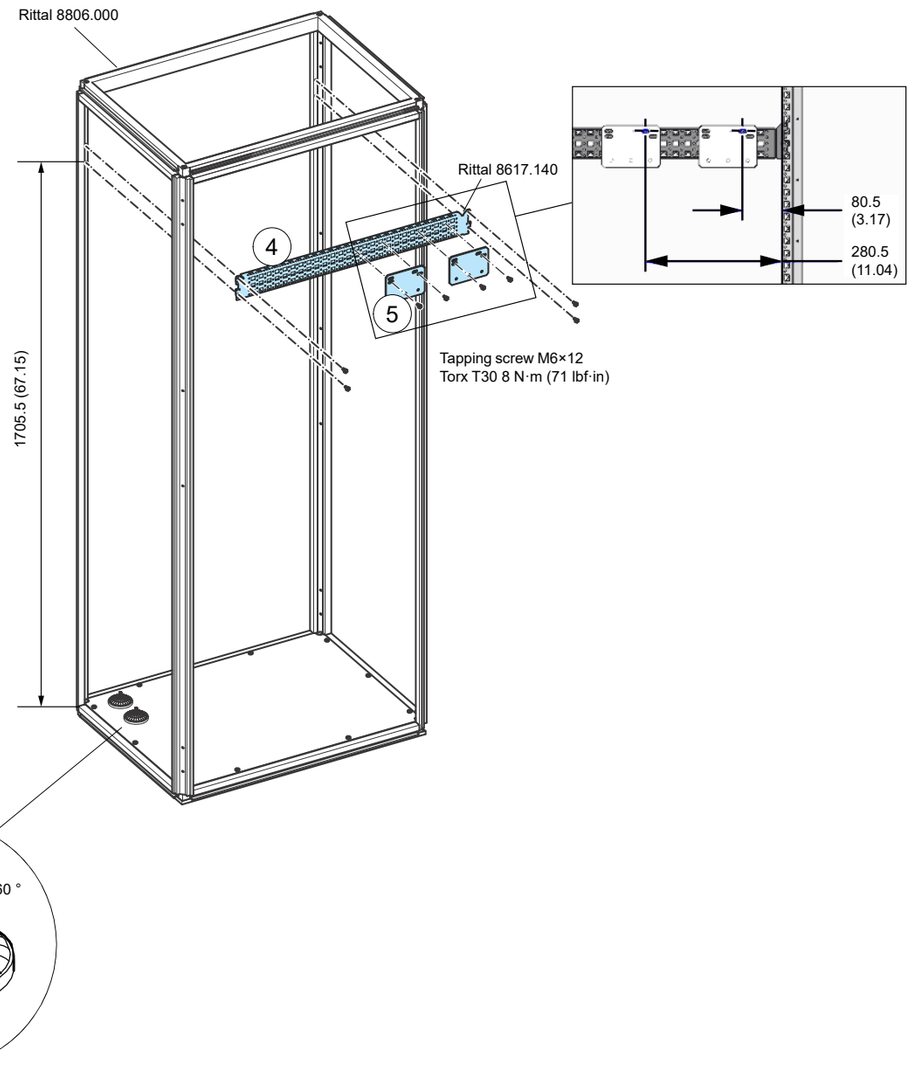


WARNING! The UDC+ and UDC- terminals of the drive module must not be used for any other than optional external brake chopper connection.

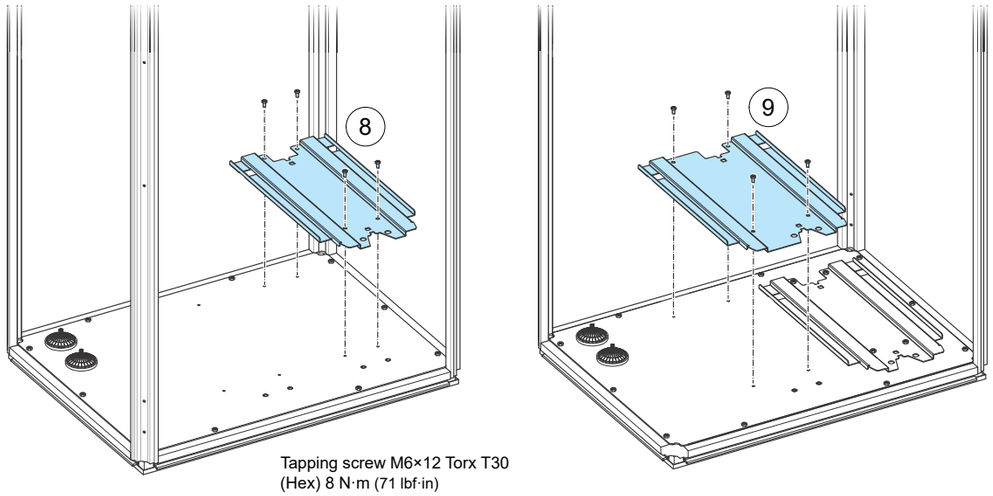
Installing the drive module and LCL filter module into a Rittal VX25 enclosure

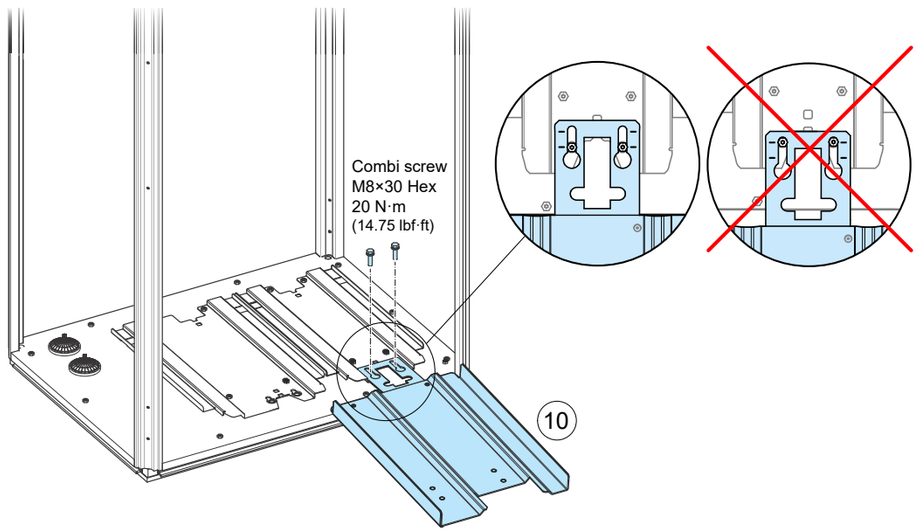
See instructions in section Installing the drive module and LCL filter module into an enclosure (Page 128).

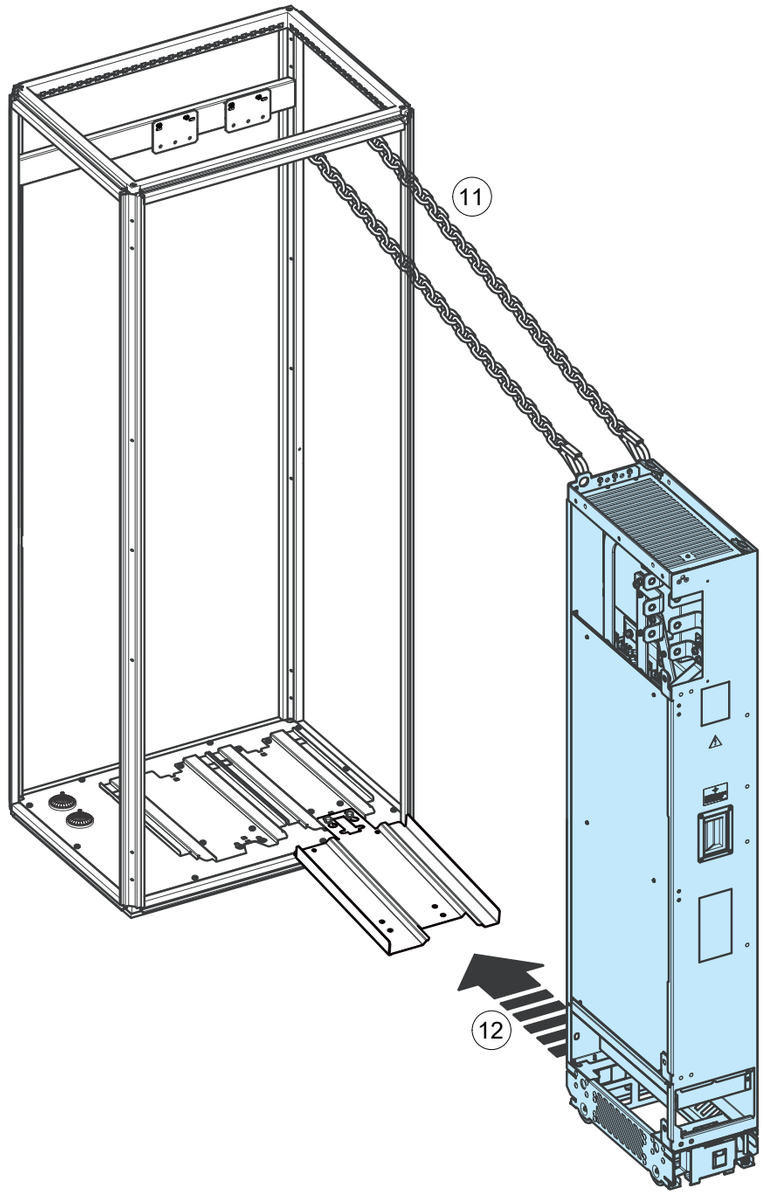


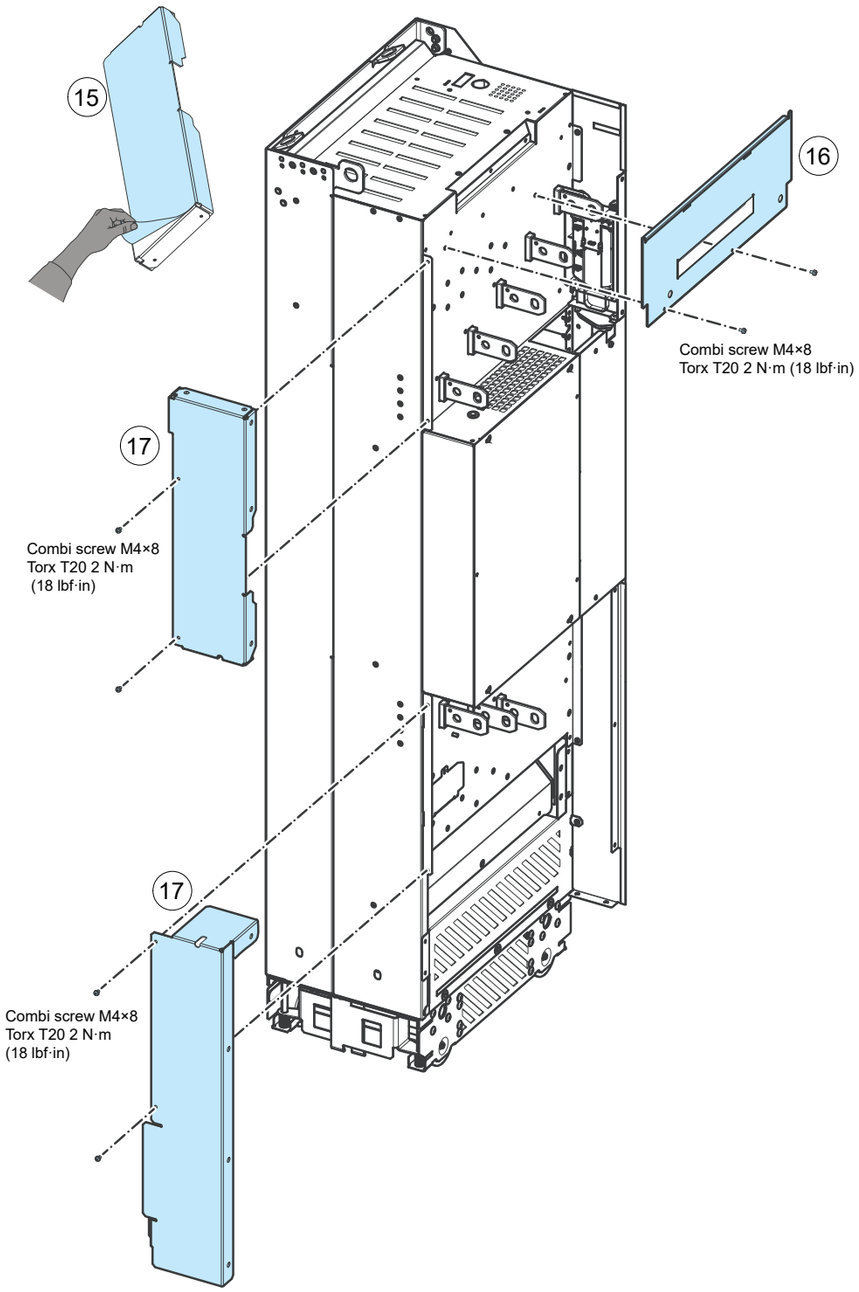


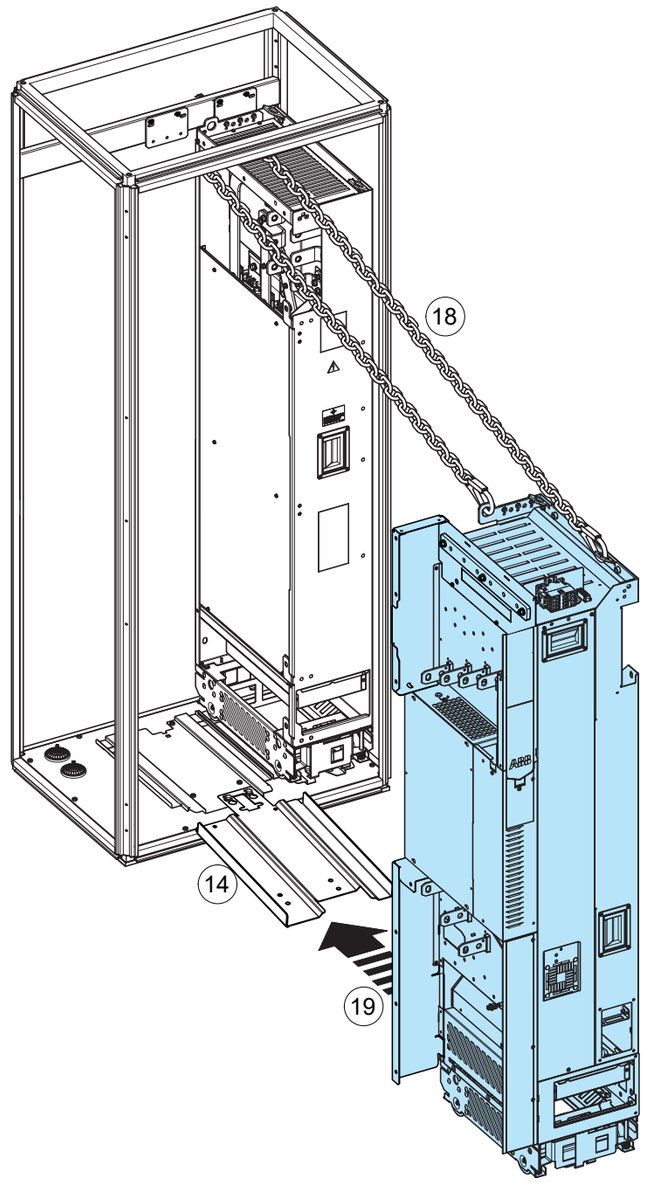
246 Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure



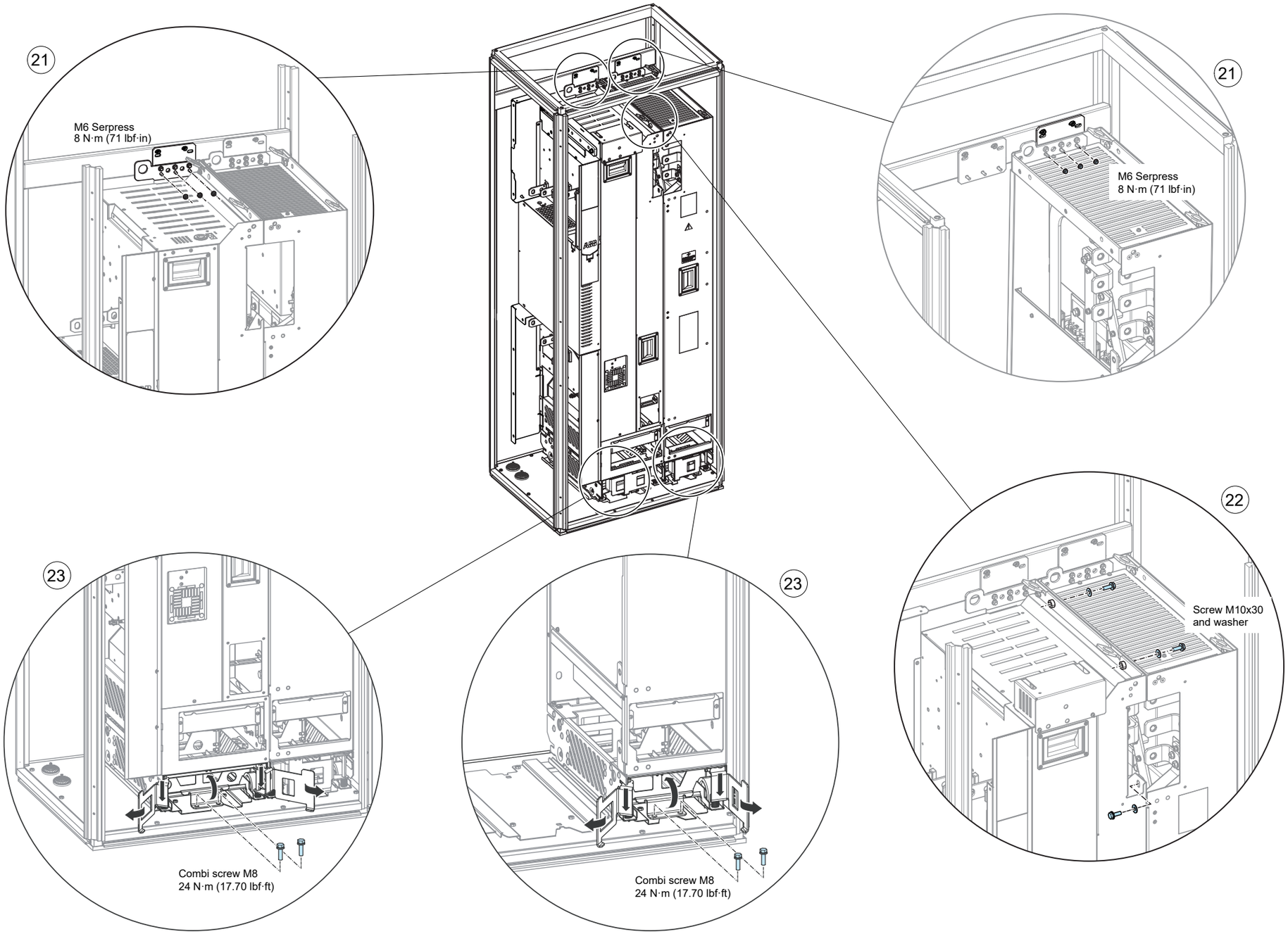


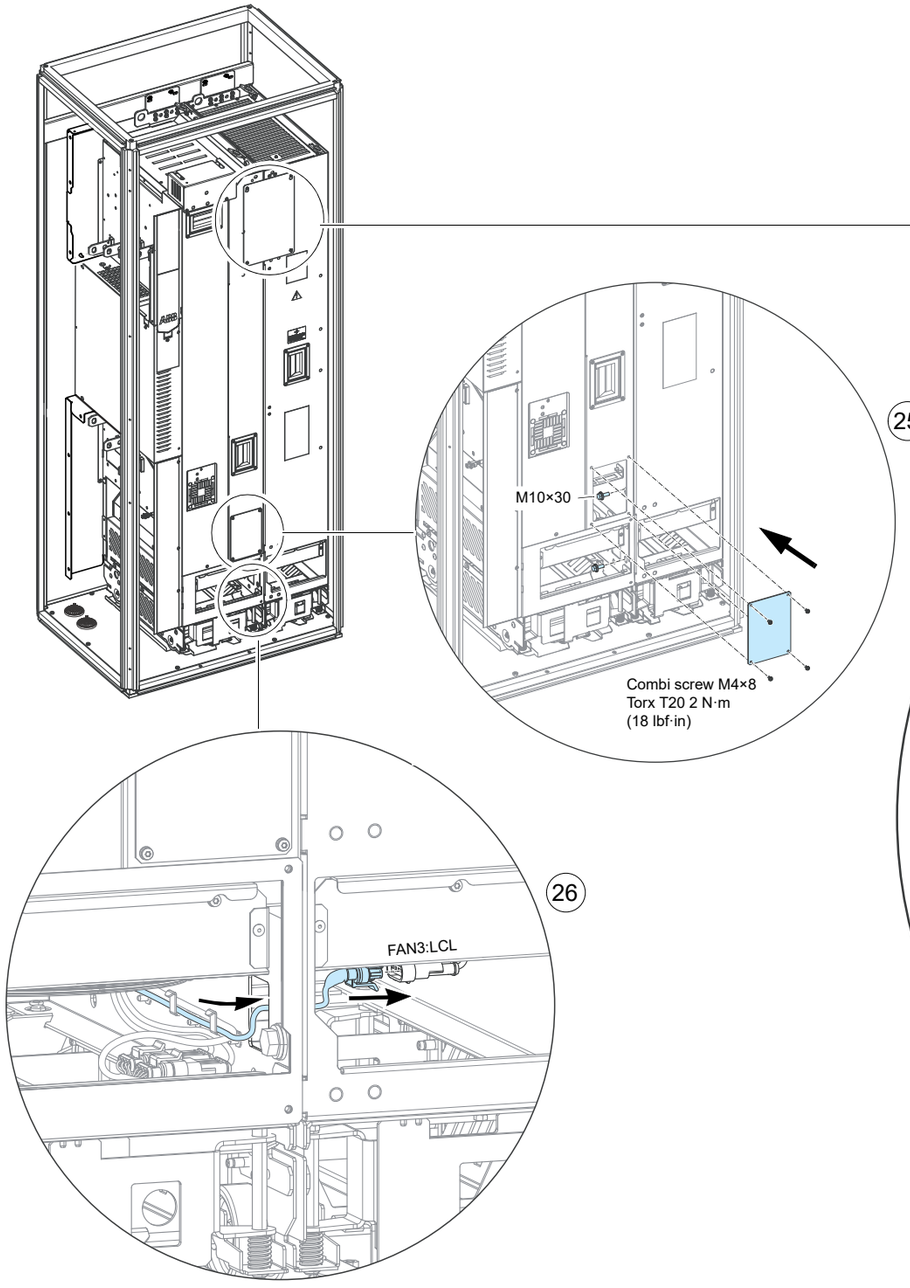



15
16
Combi screw M4×8
Torx T20 2 N·m (18 lbf·in)
17
Combi screw M4×8
Torx T20 2 N·m
(18 lbf·in)
17
Combi screw M4×8
Torx T20 2 N·m
(18 lbf·in)


18
14
19

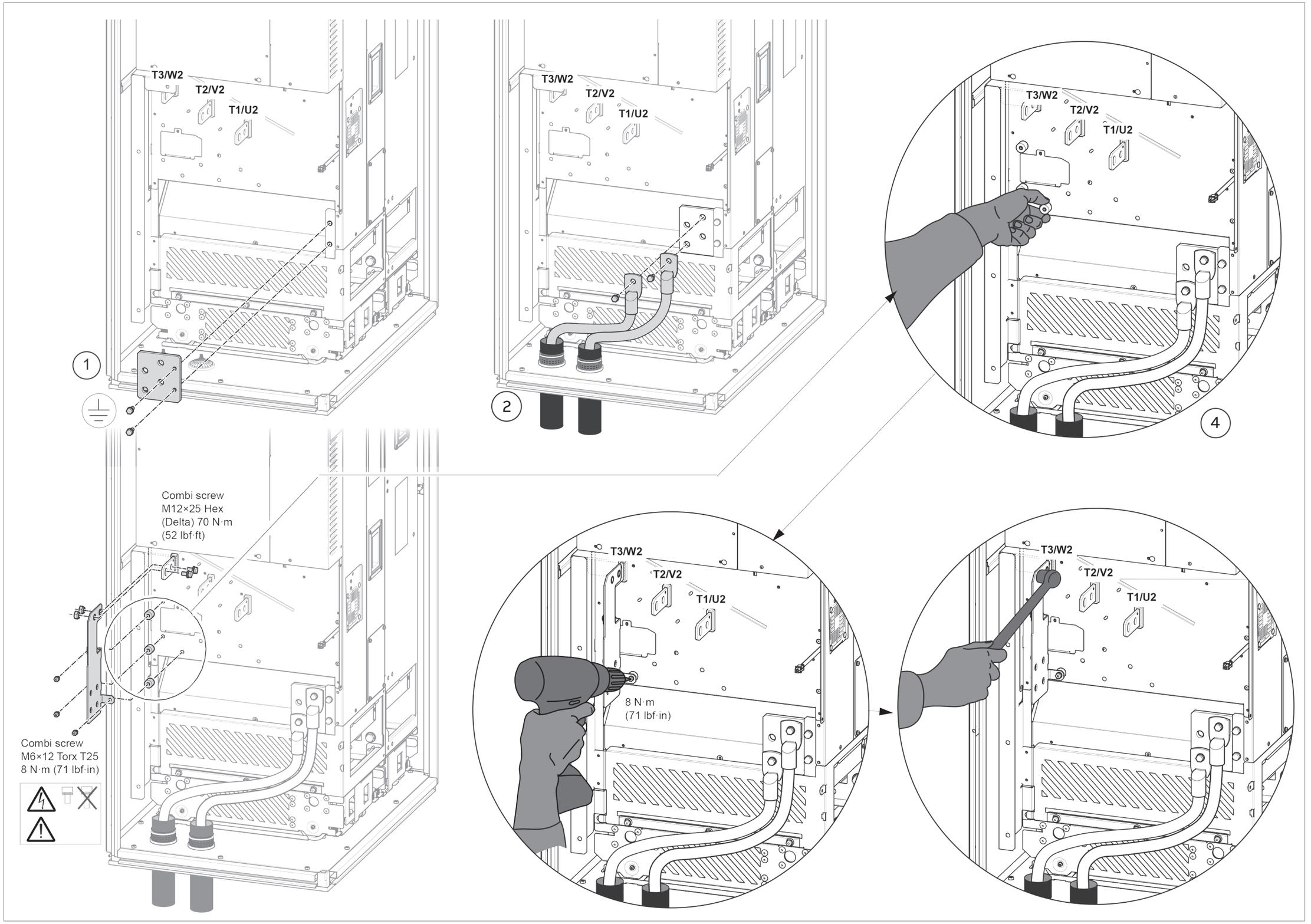
248 Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure



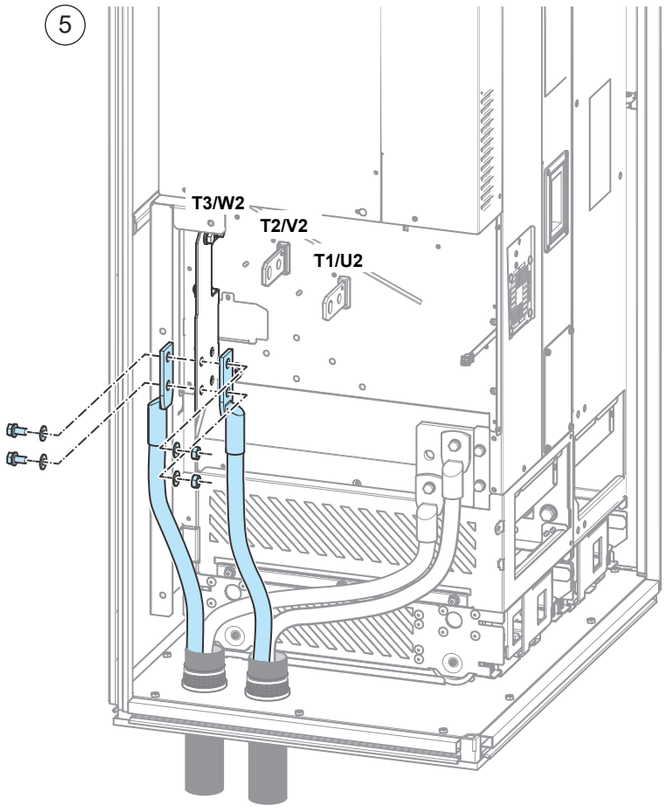

25
M10×30
Combi screw M4×8
Torx T20 2 N·m
(18 lbf·in)
26
FAN3:LCL
24
Combi screw
M12×25 70 N·m (52 lbf·ft)
Combi screw
M4×8 Torx T20
2 N·m (18 lbf·in)

Connecting the motor cables and installing the shrouds

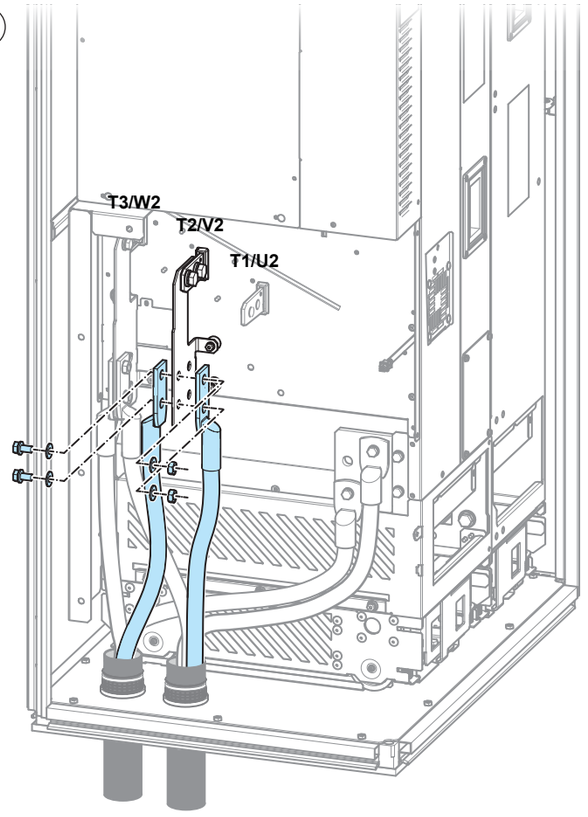
See instructions in section Connecting the motor cables and installing the shrouds (Page 129).



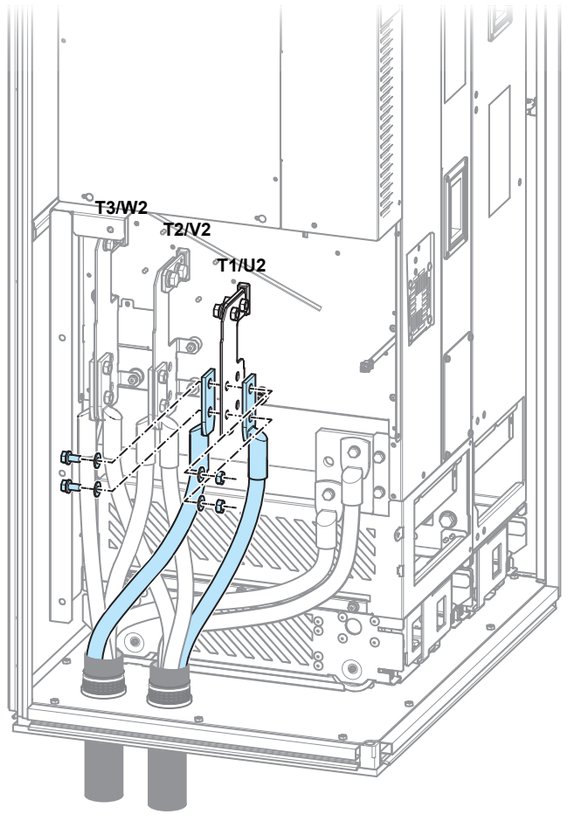
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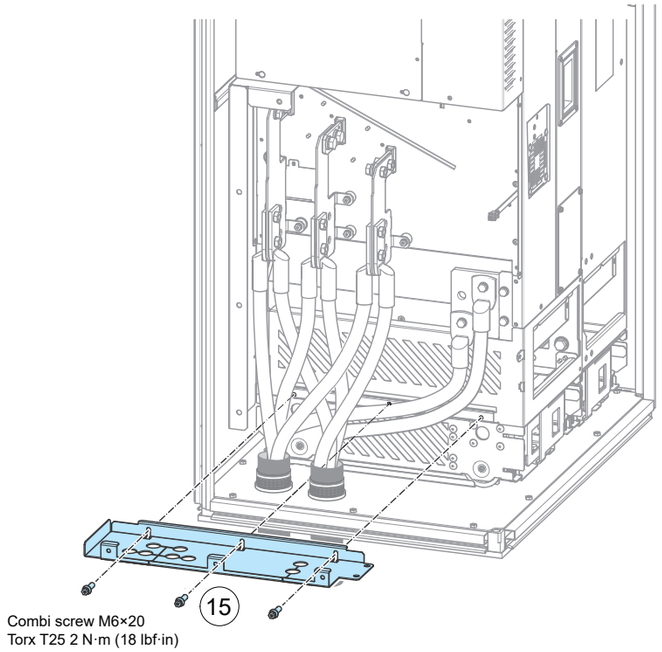
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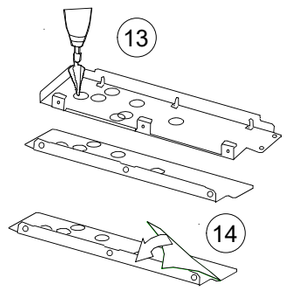


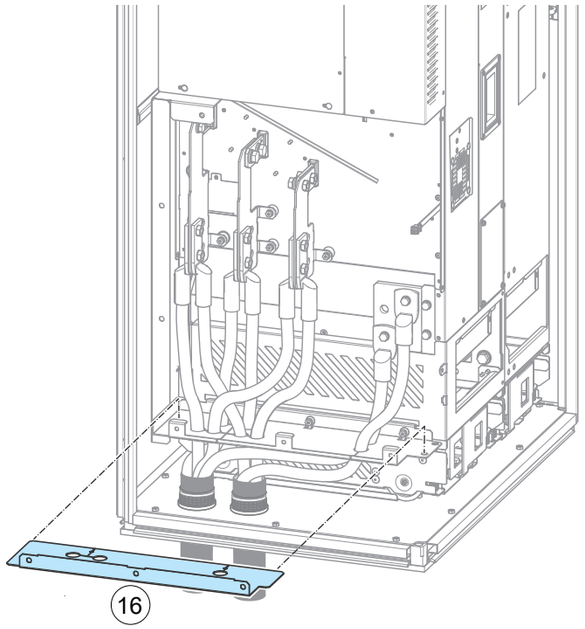
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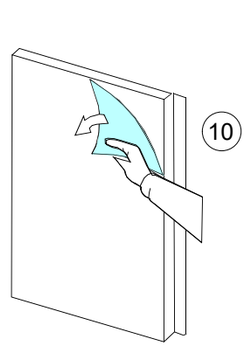


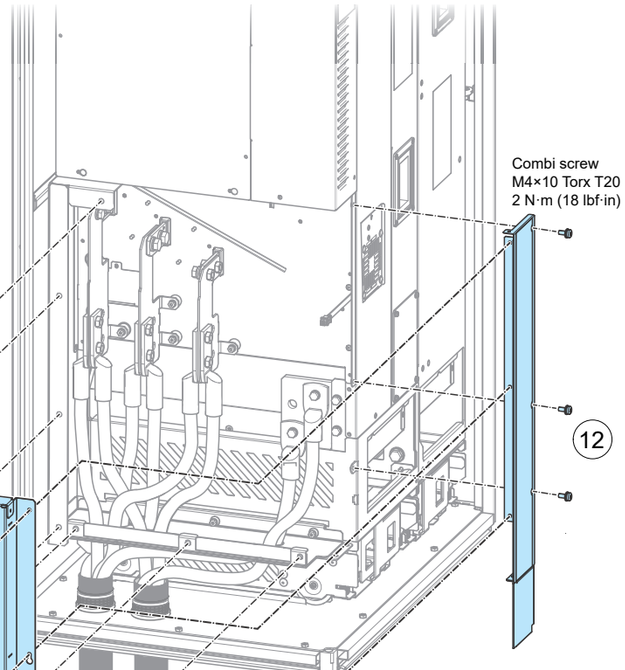
252 Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure

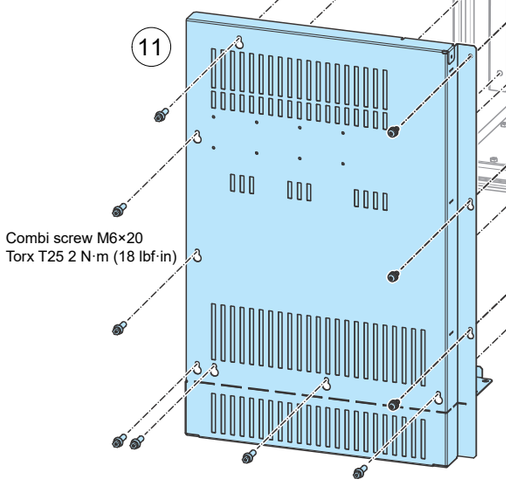






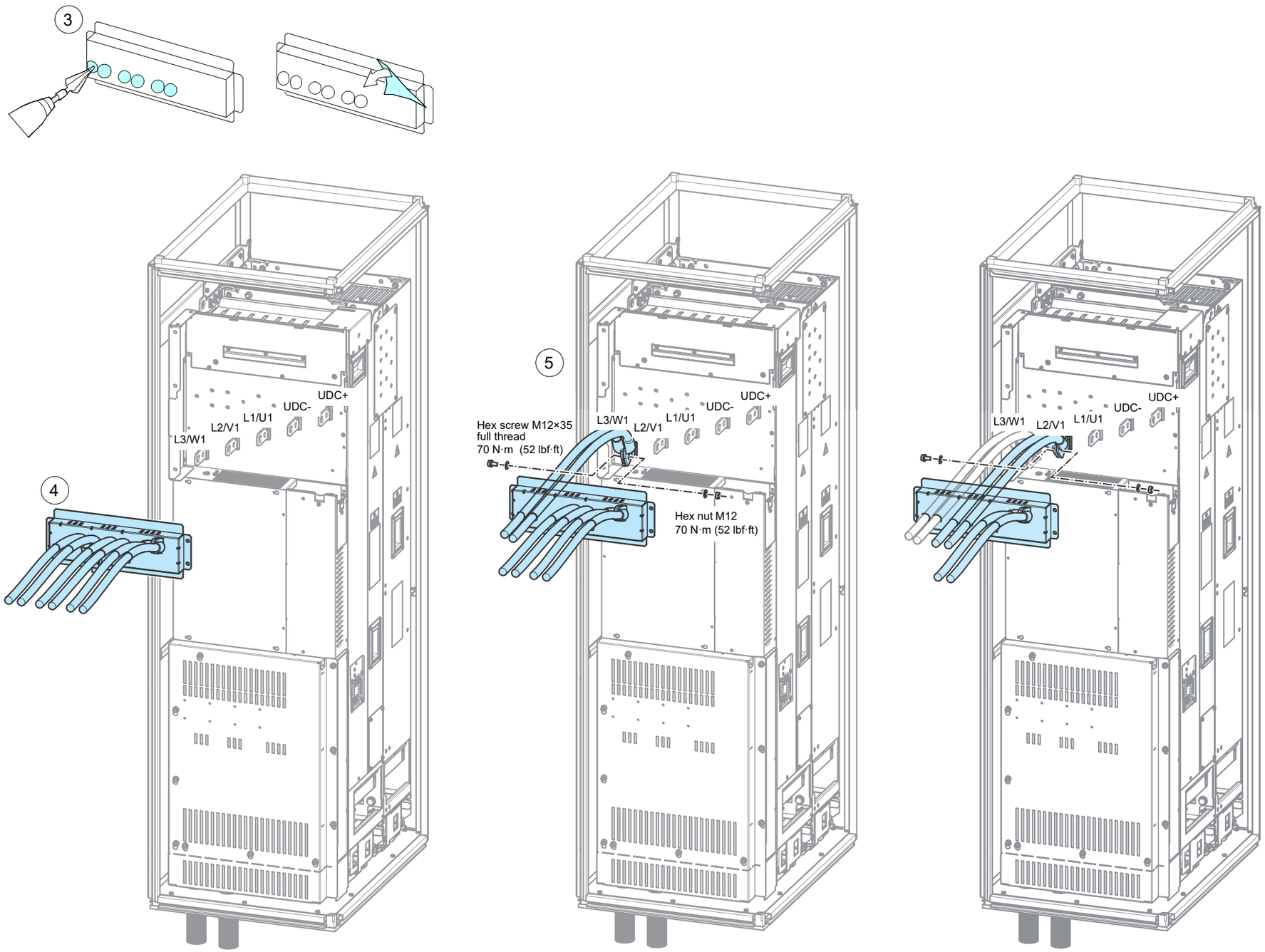




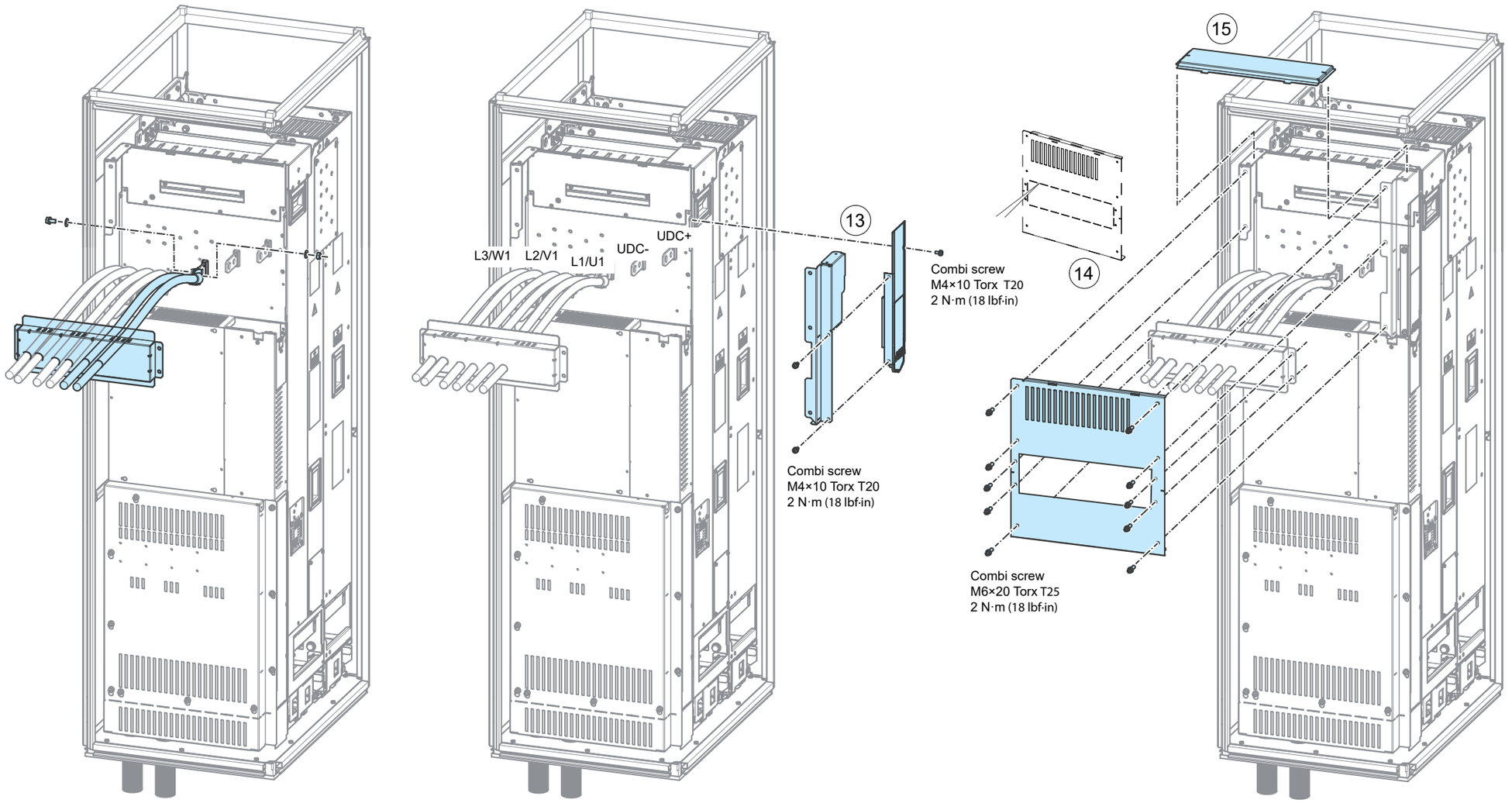


Connecting the input power cables and installing the shrouds

See instructions in section Connecting the input cables and installing the shrouds (Page 130)

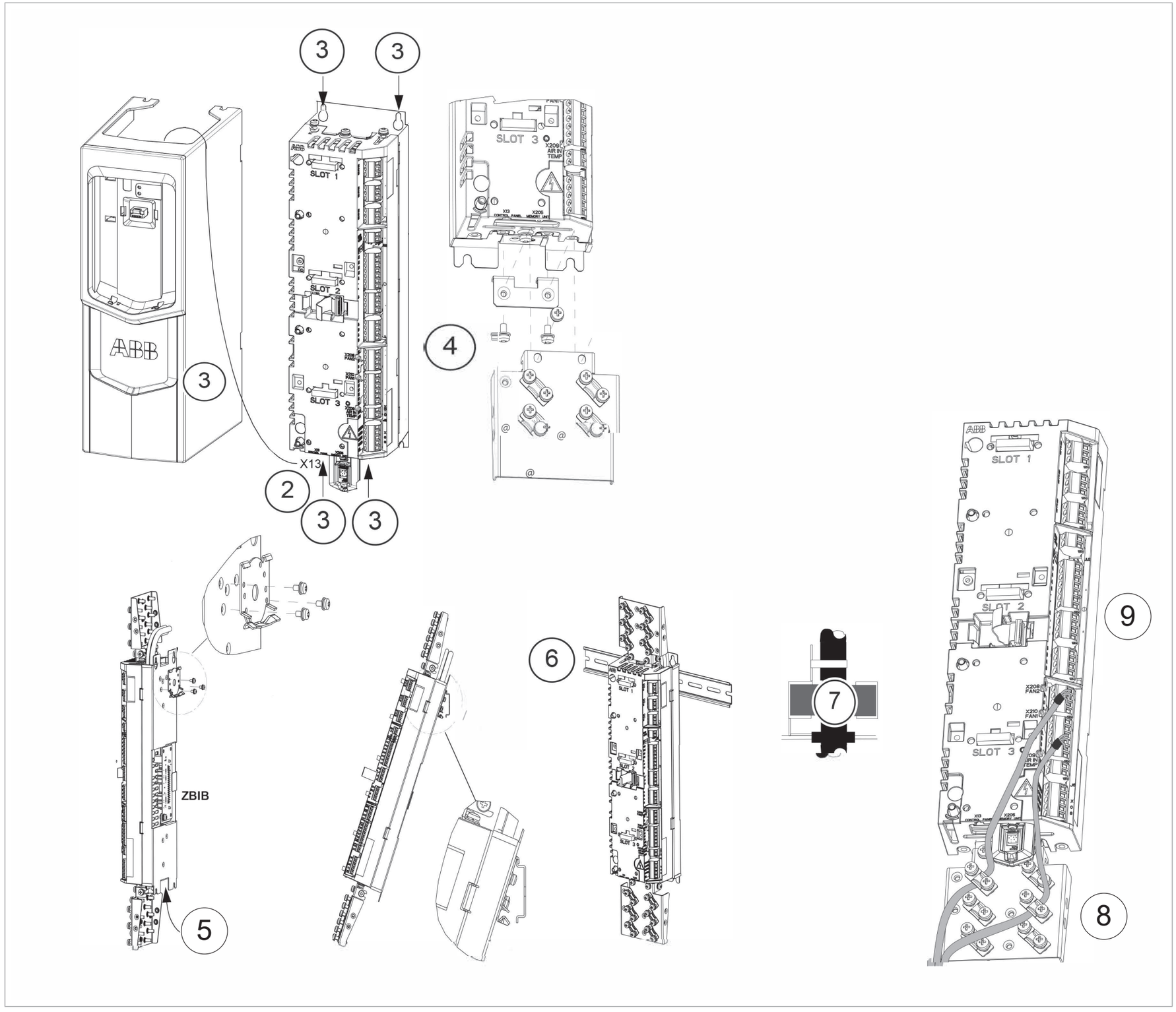


254 Step-by-step drawings for an installation example of standard drive configuration in Rittal VX25 800 mm wide enclosure



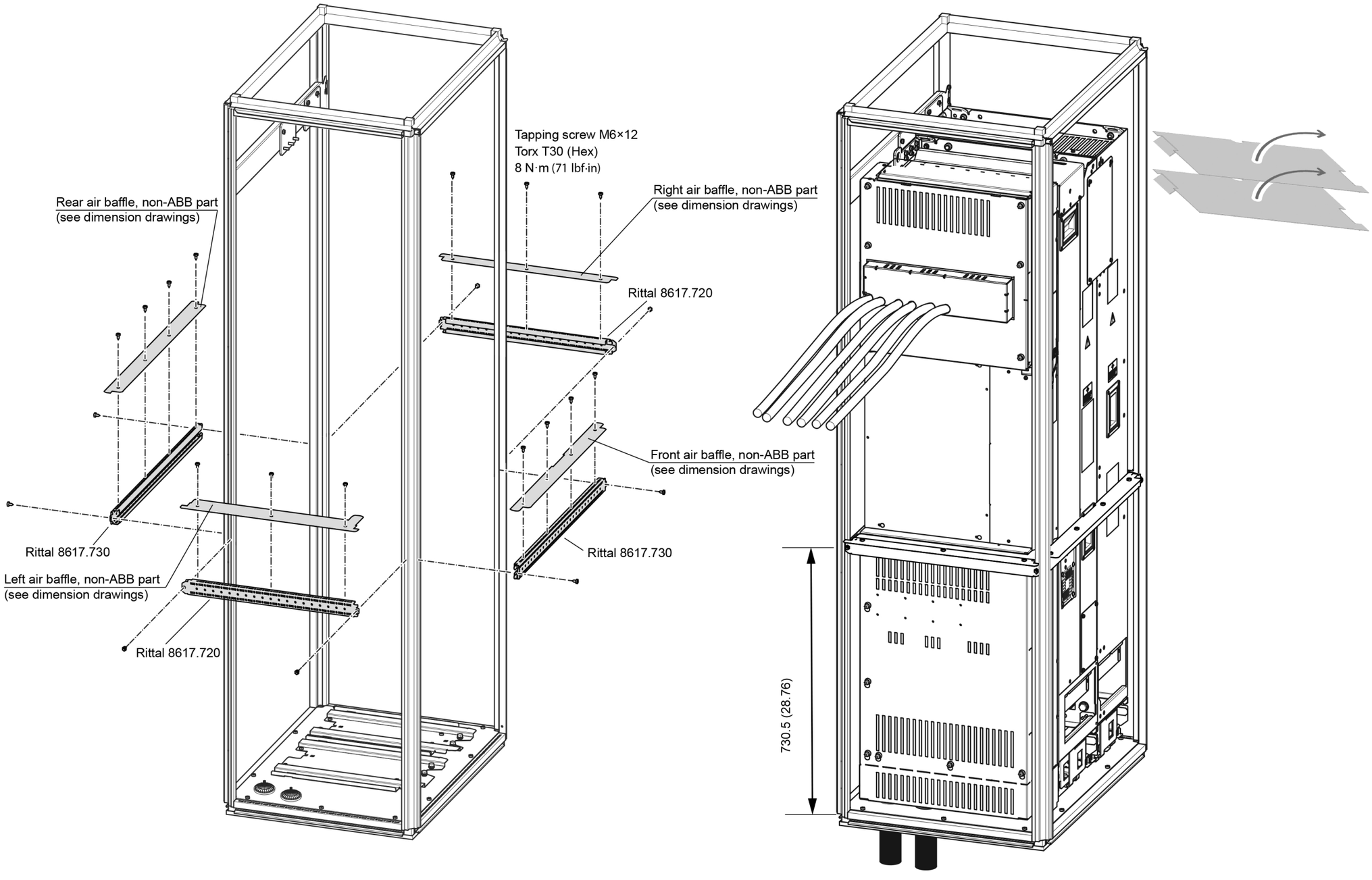
Connecting the external control cables to the control unit

See instructions in section Connecting the control cables to the terminals of the external control unit (Page 104).



Installing the air baffles and removing the cardboard covers

See instructions in section Air baffles (Page 215)



Further information

Product and service inquiries

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

Product training

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

Providing feedback on ABB manuals

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

Document library on the Internet

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

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