ABB INDUSTRIAL DRIVES

ACS880-34 drive modules (132 to 400 kW, 200 to 450 hp)

Hardware manual

List of related manuals

Drive hardware manuals and guides	Code (English)
Drive/converter/inverter safety instructions	Multilingual code: *3AXD50000037978*
ACS880-34 drive modules (132 to 400 kW, 200 to 450 hp) hardware manual	*3AXD50000035191*
ACS880-34 drive modules (132 to 400 kW, 200 to 450 hp) quick installation guide	*3AXD50000212453*
ACX-AP-x Assistant control panels user's manual	*3AUA0000085685*

Drive firmware manuals and guides	
ACS880 primary control program firmware manual	*3AUA0000085967*
Quick start-up guide for ACS880 drives with primary control program	*3AUA0000098062*
ACS880 IGBT supply control program firmware manual	*3AUA0000131562*

Option manuals and guides	
DPMP-01 mounting platform for ACS-AP control panel installation guide	*3AUA0000100140*
DPMP-02/03 mounting platform for ACS-AP-X control panels installation guide	*3AUA0000136205*
FSO-12 safety functions module user's manual	*3AXD50000015612*
ACS880 ATEX-certified Safe disconnection function application guide	*3AUA0000132231*
FOCH du/dt filters hardware manual	*3AFE68577519*
Sine filters hardware manual	*3AXD50000016814*
Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.	

You can find manuals and other product documents in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

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

ACS880-34 manuals

Hardware manual

ACS880-34 drive modules
(132 to 400 kW, 200 to 450 hp)

3AXD50000035191 Rev B
EN
EFFECTIVE: 2018-09-28

Table of contents

5. Guidelines for planning the electrical installation

6. Installation instructions

7. External control unit

8. Internal control unit (option +P905)

9. Installation example of the standard drive module configuration

10. Installation example with full cabling panels (option +H381)

11. Installation checklist

12. Start-up

13. Fault tracing

14. Maintenance

15. Ordering information

16. Technical data

17. Dimension drawings

18. Example circuit diagram

19. Safe torque off function

20. Resistor braking

1

Safety instructions

Contents of this chapter

This chapter contains the safety instructions which you must obey when you install and operate the drive and do maintenance on the drive. If you ignore the safety instructions, injury, death or damage can occur.

Use of warnings and notes

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

The manual uses these warning symbols:

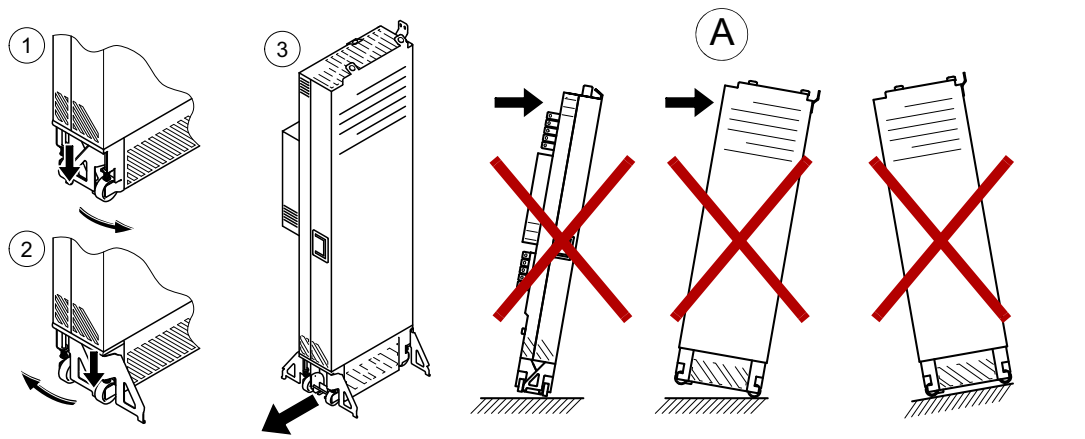
	**Electricity warning** tells about hazards from electricity which can cause injury or death, or damage to the equipment.
	**General warning** tells about conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.
	**Electrostatic sensitive devices warning** tells you about the risk of electrostatic discharge which can cause damage to the equipment.

General safety in installation, start-up and maintenance

These instructions are for all personnel that install the drive module and do maintenance work on it.

WARNING! Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.
•Use protective gloves when working on the drive module.

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



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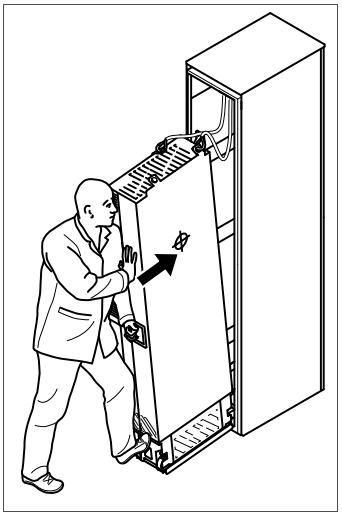
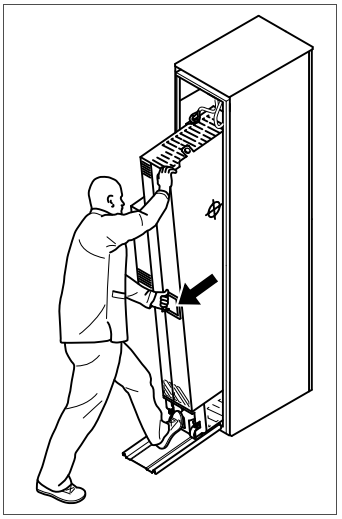
- Do not use the module installation ramp with plinth heights which exceed the maximum height marked on the ramp. (The maximum plinth height is 50 mm [1.97 in] when the telescopic ramp is fully retracted and 150 mm [5.91 in] when the ramp is fully extended.)
- Attach the module installation ramp carefully.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

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





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- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Make sure that debris from borings and grindings does not enter the drive during the installation. Electrically conductive debris inside the drive may cause damage or malfunction.
- Make sure that there is sufficient cooling.
- Before you connect voltage to the drive, make sure that the cabinet doors are closed. Keep the doors closed during the operation. Obey the panel builder's instructions.
- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY"
- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.
- Make sure that any safety circuits (for example, emergency stop and Safe torque off) are validated in start-up. See chapter *Start-up* (page *153*) for reference of the validation instructions.

Note:

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

Electrical safety in installation, start-up and maintenance

Precautions before electrical work

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

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

1. Clearly identify the work location.
2. Disconnect all possible voltage sources.
   - Open the main disconnector of the drive.
   - Open the disconnector of the supply transformer as the main disconnector of the drive does not remove the voltage from the input busbars of the drive.
   - Make sure that reconnection is not possible. Lock the disconnectors to open position and attach a warning notice to them.
   - Disconnect any external power sources from the control circuits before you do work on the control cables.
   - After you disconnect the drive, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized.
   - Use a multimeter with an impedance of at least 1 Mohm.
   - Make sure that the voltage between the drive module input power terminals (L1/U1, L2/V1, L3/W1) and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive module UDC+ and UDC- terminals and the grounding (PE) busbar is close to 0 V.
6. Install temporary grounding as required by the local regulations.
7. Ask for a permit to work from the person in control of the electrical installation work.

Additional instructions and notes

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

- If you are not a qualified electrical professional, do not do installation or maintenance work.
- Do not install a drive with EMC filter option +E200 or +E202 on an ungrounded power system or a high resistance-grounded (over 30 ohms) power system.
- Do not connect the drive to a voltage higher than what is on the type designation label. If you do, the brake chopper starts to operate which causes the overheating of the brake resistor (if present). Overvoltage can also cause the motor to rush to its maximum speed.
- We do not recommend that you secure the cabinet by arc welding.
- Do not do insulation or voltage withstand tests on the drive or drive modules.

Note:

- The motor cable terminals of the drive are at a dangerous voltage when the input power is on, regardless of whether the motor is running or not.
- The DC bus terminals (UDC+, UDC-) are at a dangerous voltage.
- External wiring can supply dangerous voltages to the terminals of relay outputs (XRO1, XRO2 and XRO3) of the drive control units.
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.

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

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

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

Grounding

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

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

- If you are not a qualified electrical professional, do not do grounding work.
- Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- Make sure that the conductivity of the grounding conductors is sufficient. See section *Selecting the power cables* on page *63*. Obey the local regulations.
- Connect the power cable shields to protective earth (PE) of the drive to make sure of personnel safety.
- Make a 360° grounding of the power and control cable shields at the cable entries to suppress electromagnetic disturbances.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) busbar of the switch board or the transformer.

Note:

- You can use power cable shields as grounding conductors only when their conductivity is sufficient.
- As the normal touch current of the drive is higher than 3.5 mA AC or 10 mA DC, you must use a fixed protective earth connection. See standard EN 61800-5-1, 4.3.5.5.2.

Additional instructions for permanent magnet motor drives

Safety in installation, start-up and maintenance

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

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

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

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

- Stop the motor.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
- Measure that the installation is de-energized.
  - Use a multimeter with an impedance of at least 1 Mohm.
  - Make sure that the voltage between the drive output terminals (T1/U2, T2/V2, T3/W2) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive input power terminals (L1/U1, L2/V1, L3/W1) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive module UDC+ and UDC- terminals and the grounding (PE) busbar is close to 0 V.
- Install temporary grounding to the drive output terminals (T1/U2, T2/V2, T3/W2). Connect the output terminals together as well as to the PE.
- Make sure that the operator cannot run the motor over the rated speed. Motor overspeed causes overvoltage can damage or explode the capacitors in the intermediate circuit of the drive.

Additional instruction for DC connection

WARNING! The UDC+ and UDC- terminals of the drive module must not be used for any other than optional external brake chopper connection. Drives connected to a common DC system will get damaged.

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

Target audience

This manual is intended for persons who

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

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

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

Categorization by frame size and option code

The instructions, technical data and dimension drawings which concern only certain drive frame sizes are marked with the symbol of the frame size (R10 or R11). The frame size is marked on the type designation label.

The instructions and technical data which concern only certain optional selections are marked with option codes, eg, +J410. The options included in the drive can be identified

from the option codes visible on the type designation label. The option selections are listed in section *Type designation key* on page *39*.

Quick installation, commissioning and operating flowchart

Task	See
Plan the mechanical and electrical installation and acquire the accessories needed (cables, fuses, etc.). Check the ambient conditions, ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.	*Guidelines for planning the cabinet installation* (page *43*) *Guidelines for planning the electrical installation* (page *57*) *Technical data* (page *183*) *Resistor braking* (page *229*) Option manual (if optional equipment is included)
↓	
Unpack and check the units. Check that all necessary optional modules and equipment are present and correct. Only intact units can be started up.	*Moving and unpacking the unit* (page *78*) *Checking the delivery* (page *85*) If the drive module has been non-operational for more than three years, the converter DC link capacitors need to be reformed. (*Reforming the capacitors*, page *171*)
↓	
Check the installation site. Fasten the base of the cabinet to the floor.	*Checking the installation site* (page *77*) *Ambient conditions* (page *196*) *Guidelines for planning the cabinet installation* (page *43*)
↓	
Route the cables.	*Routing the cables* (page *67*)
↓	
Check the insulation of the supply cable, the motor and the motor cable and the resistor cable (if present).	*Checking the insulation of the assembly* (page *85*)
↓	
Standard drive modules • Install the additional components into the cabinet: for example, main disconnector, main contactor, main AC fuses, etc.. • Install the drive module into the cabinet. • Connect the motor cables to the drive module terminals. • Connect the DC connection cables (if any) to the drive module terminals. • If the main disconnector is installed into the cabinet, connect it to the drive module terminals and the input power cabling to the disconnector. • Connect the cables from the drive module to the external control unit and install the control unit into the cabinet.	*Installing the drive module and LCL filter module into a cabinet* (page *133)* *Connecting the power cables and installing the shrouds* (page *134)* *Connecting the external control unit to the drive module* (page *103*) *Mounting the external control unit* (page *105*) Manuals for any optional equipment
↓	

Task	See
Drive modules with optional cabling panels (+H381) • Install the cabling panels into the cabinet. • Install the additional components into the cabinet: for example, main disconnector, main contactor, main AC fuses, etc.. • If the main disconnector is installed into the cabinet, connect the input power cabling to it. • Connect the input power cables and motor cables to the cabling panel terminals. • Connect the DC connection cables (if any) to the cabling panel terminals. • Install the drive module into the cabinet. • Fasten the cabling panel busbars to the drive module busbars. • Connect the cables from the drive module to the control unit and install the control unit into the cabinet.	*Installing the mechanical accessories into the cabinet* (page *139*) *Modular design of Rittal TS8 cabinets (page 148)* *Connecting the power cables* (page *93*) *Installing the drive module into the cabinet* (page *144*) *Connecting the external control unit to the drive module* (page *103*) *Mounting the external control unit* (page *105*) Manuals for any optional equipment
Drive modules without full-size output cable connection terminals (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 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.	*Installing the mechanical accessories into the cabinet* (page *139*) *Connecting the power cables* (page *93*) *Installing the drive module into the cabinet* (page *144*) *Connecting the external control unit to the drive module* (page *103*) *Mounting the external control unit* (page *105*) Manuals for any optional equipment
Connect the external control cables to the drive control unit.	External control unit: *Connecting the control cables to the terminals of the control unit* (page *107*) Internal control unit (option +P905): *Connecting the control cables to the internal control unit (option +P905)* (page *121*) Internal control unit (options +P905 and +0B051): *Connecting the control cables to the internal control unit (options +P905 and +0B051)* (page *122*)
Check the installation.	*Installation checklist* (page *149*)
Commission the drive.	*Start-up* (page *153*)

Task	See
Commission the brake chopper (if used).	*Resistor braking* (page *229*)
↓	
Operate the drive: start, stop, speed control etc.	Appropriate firmware manual

Terms and abbreviations

Term/Abbreviation	Explanation
ZPOW	Power supply board
BFPS	Fan power supply board
BGDR	Gate driver board
CMF	Common mode filtering
DDCS	Distributed drives communication system; a protocol used in optical fiber communication
Drive	Frequency converter for controlling AC motors. The drive consists of the <Cross-reference_lc>Line-side converter and <Cross-reference_lc>Motor-side converter connected together by the DC link. In this manual, the term refers to the ACS880-34 as a whole.
Drive control unit	The drive contains two control units. The drive control unit controls the drive through the motor-side converter. It is the user control interface to the drive. The line-side converter control unit controls the line-side converter.
DTC	Direct torque control
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
FAIO-01	Optional analog I/O extension module
FCAN-01	Optional CANopen adapter module
FCNA-01	Optional ControlNet fieldbus adapter module
FDCO-0x	Optional optical DDCS communication module
FDIO-01	Optional digital I/O extension module
FDNA-01	Optional DeviceNet™ fieldbus adapter module
FEA-03	Optional I/O extension and encoder module adapter
FECA-01	Optional EtherCAT adapter module
FEN-01	Optional TTL encoder interface module
FEN-11	Optional absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL encoder interface module
FENA-11	Optional high performance Ethernet/IP™, Modbus/TCP and PROFINET IO adapter module
FENA-21	Optional high performance Ethernet/IP™, Modbus/TCP and PROFINET IO adapter module, 2-port
FEPL-01	Optional Ethernet POWERLINK fieldbus adapter module

Term/Abbreviation	Explanation
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FLON-01	Optional LonWorks® adapter module
FPBA-01	Optional PROFIBUS DP adapter module
Frame (size)	Size of the drive module. The drive modules described in this manual are of frame size R11.
FSCA-01	Optional Modbus RTU adapter module
FSO	Optional safety functions module
HTL	High-threshold logic
IGBT	Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in converters due to their easy controllability and high switching frequency.
I/O	Input/Output
IT system	Type of supply network that has no (low-impedance) connection to ground/earth.
Line-side converter	The part of the <Cross-reference_lc>Drive that converts AC to DC for the motor. Includes an LCL filter. The line-side converter is also capable of feeding regenerative energy back into the electrical power network.
Motor-side converter	The part of the <Cross-reference_lc>Drive that converts DC to AC for the motor. The motor-side converter is also capable of feeding energy from a decelerating motor into the DC link.
PLC	Programmable logic controller
QOIA	Optical interface adapter board
RFI	Radio-frequency interference
SAFUR	Series of optional brake resistors
STO	Safe torque off
QOIA	Optical interface adapter board
TN system	Type of supply network that provides a direct connection to ground (earth).
TTL	Transistor-transistor logic
ZBIB	Adapter board connected to the control board in the control unit (ZCU)
ZCON	Control board. The external I/O control signals are connected to the control board, or optional I/O extensions installed on it.
ZCU	Control unit which contains the ZCON control board. The drive contains two ZCU control units. One controls the line-side converter, the other the motor-side converter. As standard, the external I/O control signals are connected to the control unit, or optional I/O extensions mounted on it.
ZINT	Main circuit board
ZMU	The memory unit attached to the control unit of the drive

3

Operation principle and hardware description

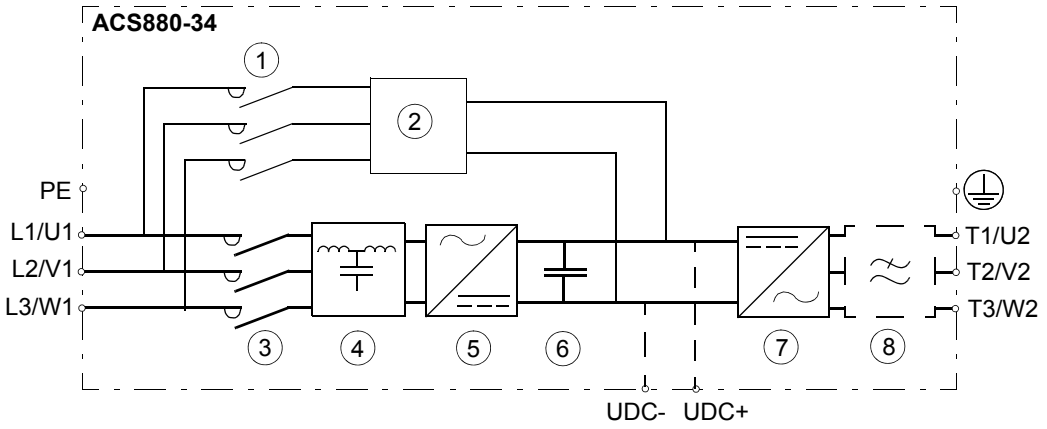
Contents of this chapter

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

Operation principle

The ACS880-34 is a low-harmonic drive module for controlling asynchronous AC induction motors, permanent magnet motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors).

Block diagram of the main circuit of the drive module

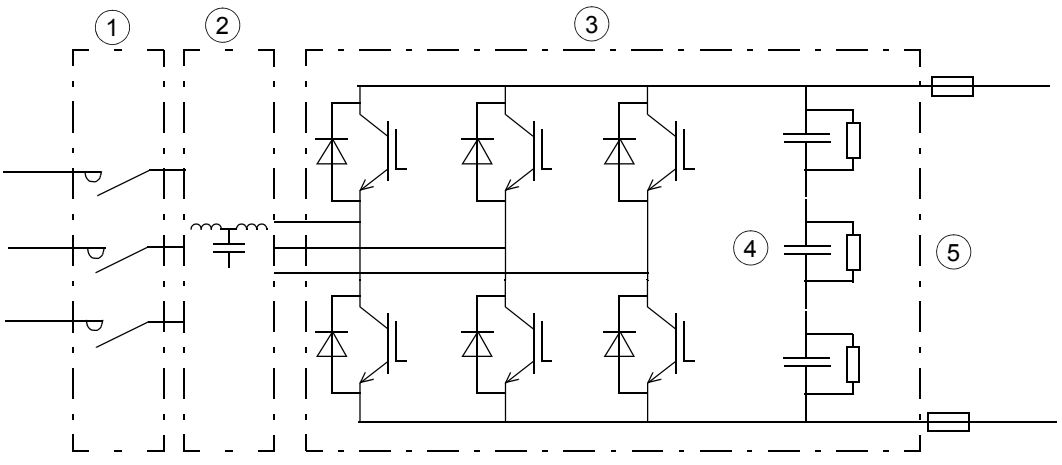


1	Charging circuit contactor
2	Charging circuit
3	Line contactor
4	LCL filter
5	Line-side converter.
6	DC link. DC circuit between the line-side converter and motor-side converter
7	Motor-side converter.
8	Common mode filter (option +E208)

Line-side converter

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

The following figure shows the simplified main circuit diagram of the line-side converter part. The line-side converter is controlled by a type ZCU control unit located inside the drive module.



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).

DC connection

You can connect an external brake chopper to the drive via the DC terminals. See chapter *Resistor braking* on page *229*.

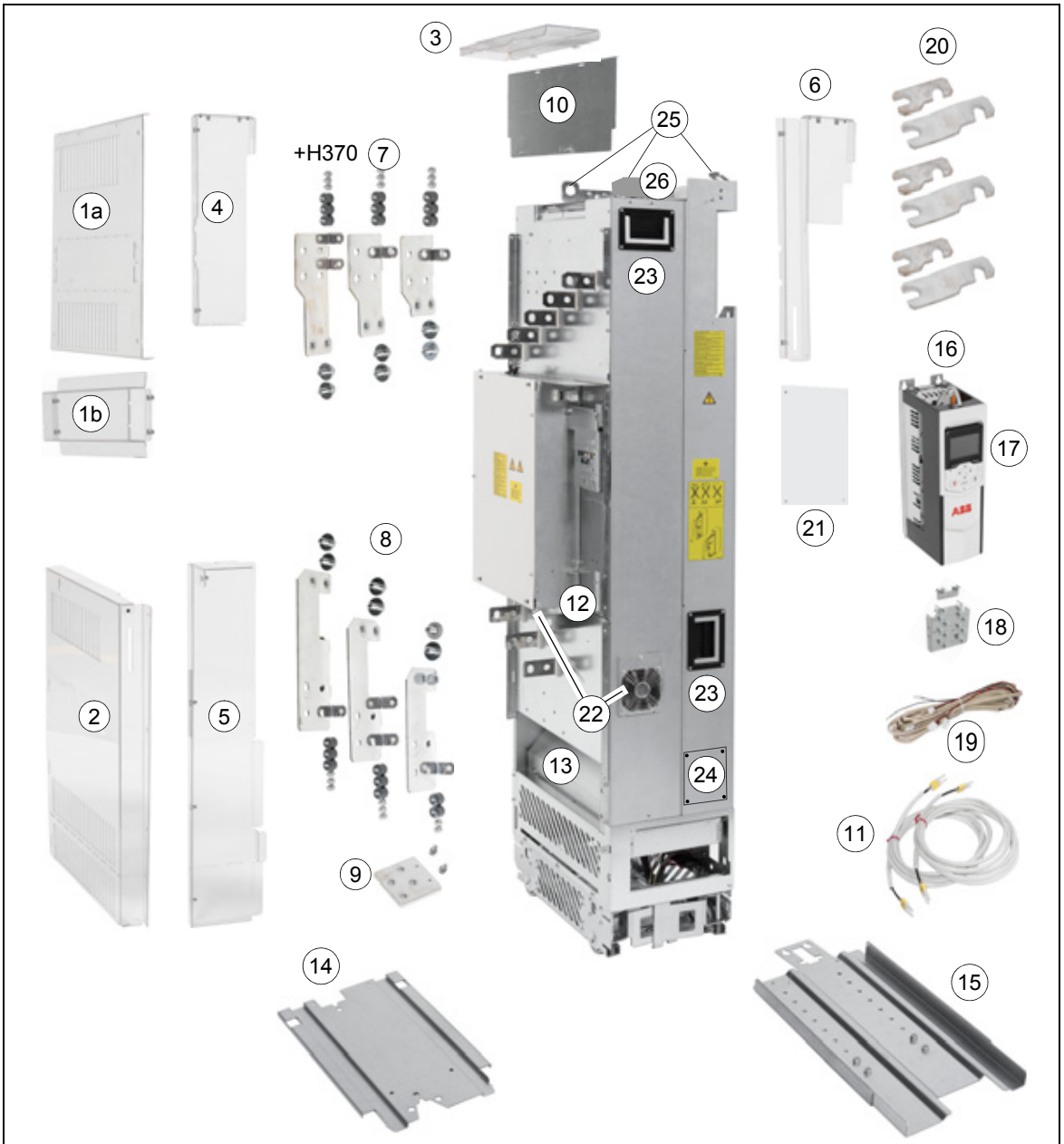
Layout

Standard drive module configuration

A	Converter module. Contains line-side converter and motor side converter. This can also be called drive module.	4	Lower front cover
B	LCL filter module	5	Cooling fan cassette
C	LCL filter module connected to the converter 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 converter module
3	Upper front cover	9	Cover on busbar connections

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

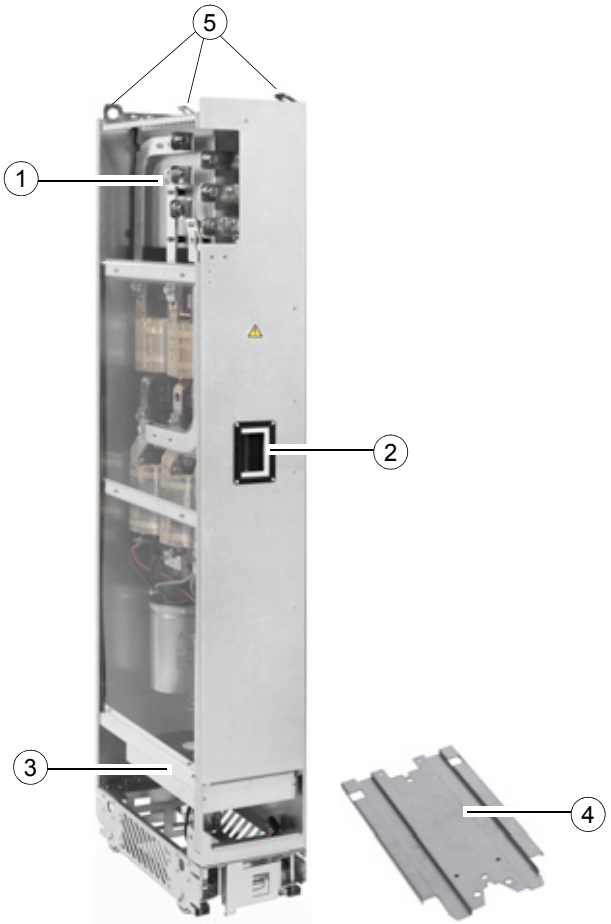
Converter module



1	Clear plastic shroud to be attached onto the drive module input power cabling (a). entry shroud for side cabling (b).	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 and insertion ramp
3	Clear plastic shroud to be attached on top of the drive module (entry for top cabling)	16	External control unit. The control unit can also be inside the drive module (option +P905)
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

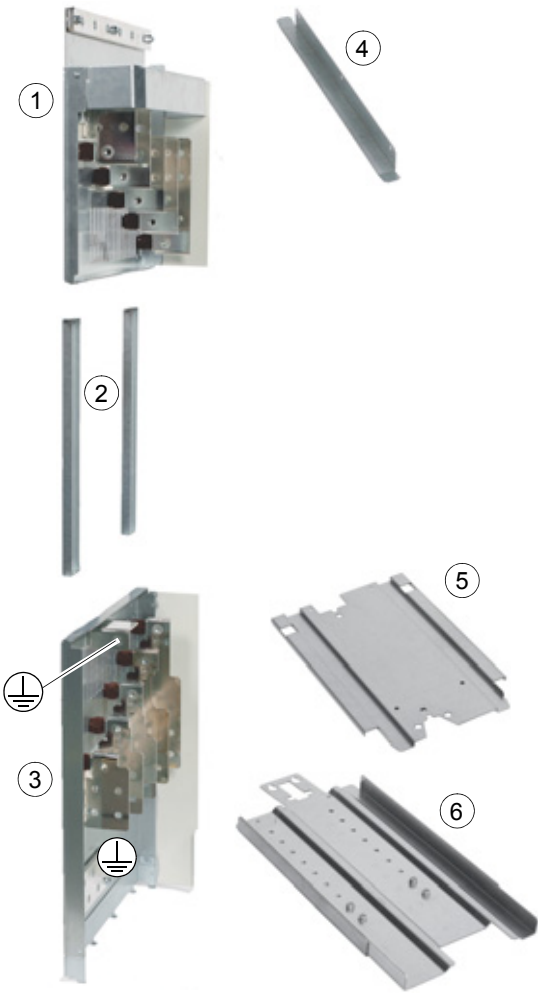
9	Grounding terminal for output power cable shields	22	Auxiliary cooling fan
10	Metallic shroud. With option +H370, the shroud includes a ground bar.	23	Handle
11	Fiber optic cables for connecting the control unit to the drive module (INU ZBIB - QOIA)	24	Cover. When removed, you can attach the drive 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

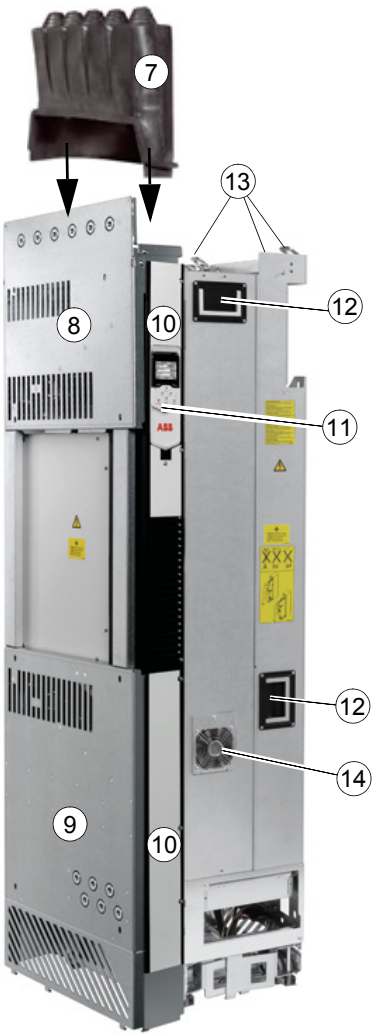
LCL filter module



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	-	-

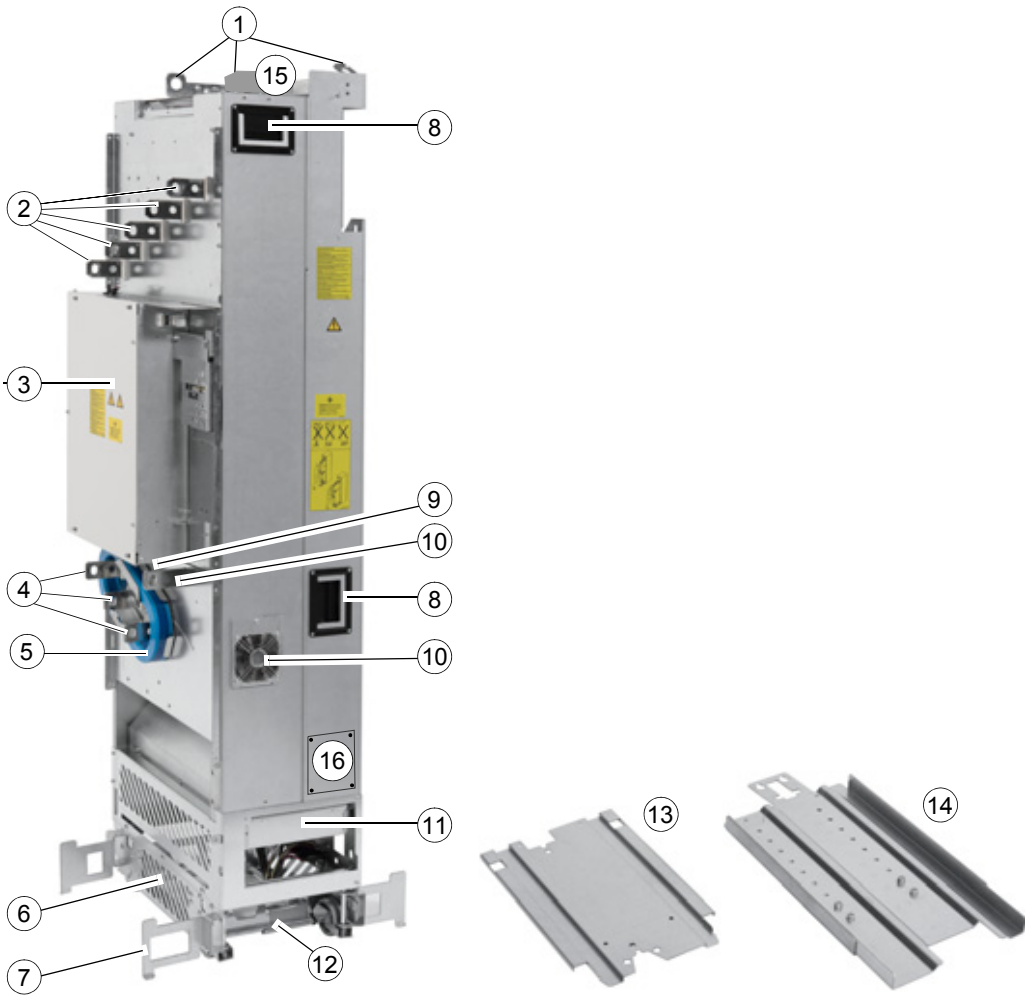
Power module with full power cabling panels (option +H381)





Accessories		Assembled power 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	Internal control unit (option +P905) and control panel holder mounted on the drive module (option +J414)
5	Pedestal guide plate	12	Handle
6	Telescopic extraction and insertion ramp	13	Lifting lugs
7	Rubber grommet	14	Auxiliary cooling fan, another auxiliary cooling fan is located below the circuit board compartment, see page *162*.

Converter module without full-size output cable connection terminals (option +0H371) and IP20 shrouds (option +0B051) and with common mode filter (option +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+, UCD-)	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 number 3 on page 32.

Control panel

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

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

For the use of the control panel, see the firmware manual or *ACX-AP-x Assistant control panels user's manual* (3AUA0000085685 [English]).

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

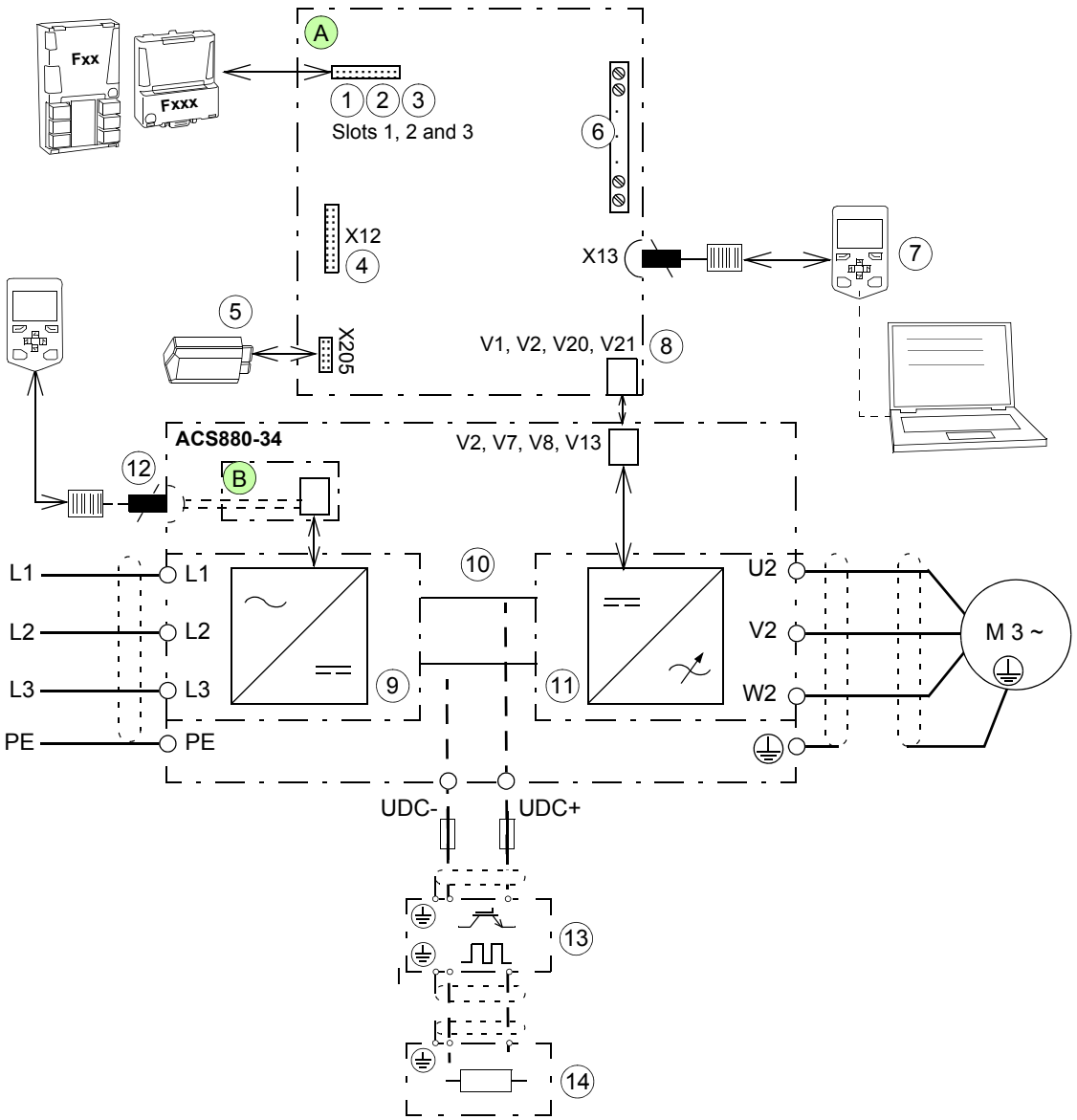
The control panel can be mounted on the cabinet door using a DPMP-01 mounting platform (option +J410) or a DPMP-02 mounting platform (option +J413).

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

1	ACS-AP-W Assistant control panel with Bluetooth interface
2	DPMP-01 door mounting kit (option +J410)
3	DPMP-02 door mounting kit for surface mounting (option +J413)

Overview of power and control connections

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

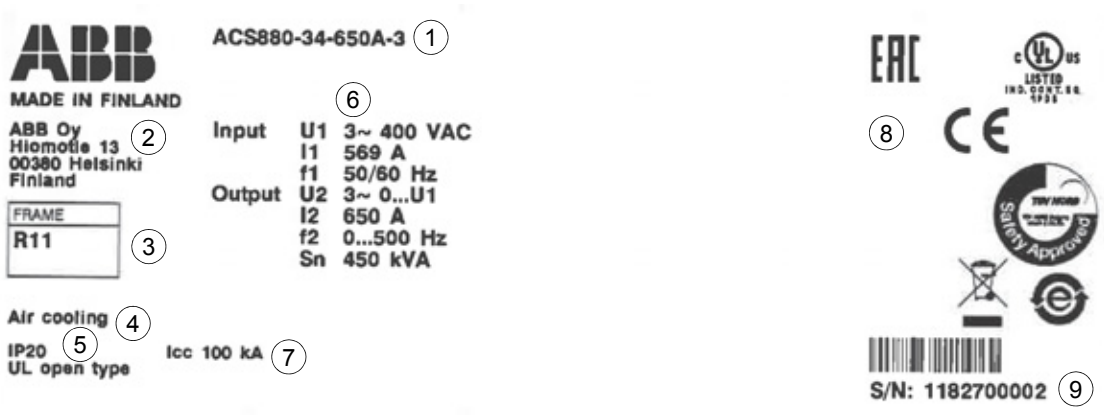


A	External control unit (motor-side converter control unit)
B	Line-side converter control unit
1 2 3	Analog and digital I/O extension modules, feedback interface modules and fieldbus communication modules can be inserted into slots 1, 2 and 3. See section *Type designation key* on page *39*.
4	Connector for the FSO-xx safety functions module (X12). The module can be installed on or above the control unit (see page *112* or *125*).
5	Memory unit (see page *172*)
6	I/O terminal blocks. See the layout on page *100* or *120* and default I/O connection diagram on page *108* or *123*.
7	Control panel (see page *96*)
8	Fiber optic link to the motor-side converter. Similarly, the line-side converter is connected to the line-side converter control unit with fiber optic cables.
9	Line-side converter
10	DC link

11	Motor-side converter
12	Socket for external ISU control (not required for normal operation of the drive)
13	Brake chopper (optional, see page *229*
14	Brake resistors (optional, see page *229*

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* on page *39*.
2	Manufacturing address
3	Frame size
4	Cooling method
5	Degree of protection
6	Ratings, see section
7	Short-circuit withstand strength, see section
8	Valid markings
9	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.

Type designation key

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

Code	Description
Basic code, eg, ACS880-04-880A-3	
Product series	
ACS880	ACS880 product series
Type	

Code	Description
-34	When no options are selected: low-harmonic single drive module to be installed in an enclosure, IP20 (UL open type), bookshelf mounting with pedestal, external control unit with ACS-AP-W Assistant control panel with Bluetooth interface and panel holder, build-in LCL filter, full-size output cable connection terminals, EMC filter (category C3 for second environment TN [grounded] and IT [ungrounded] systems), DC connection busbars, clear plastic shrouds for covering the input power and motor cable connections, ACS880 primary control program, Safe torque off function, coated boards, printed multilingual quick installation and start-up guides, CD containing all manuals with all available languages.
Size	
xxxA	Refer to the rating tables, page *183*.
Voltage range	
-3	380…415 V. This is indicated in the type designation label as typical input voltage level 3 ~ 400 V AC.
-5	380…500 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 400/480/500 V AC.
-7	525…690 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 525/600/690 (600 UL, CSA) V AC.
Option codes (plus codes)	
Construction, pedestal and cabling	
0B051	No IP20 shrouds for cabling area (not to be used with option +H381)
H370	Full-size input power cable connection terminals and PE busbar. Not to be used with option +H381.
0H371	No full-size output power cable connection terminals (not to be used with option +H381).
H381	Full power cabling panels to be attached to a cabinet. The drive module can be pulled from the cabinet for maintenance without disconnecting the power cables. Degree of protection IP20. (Not to be used with options +0B051 and 0H371.)
0P919	No installation ramp
Control panel and control unit	
P905	Internal drive control unit (attached to the power module).
0J400	No control panel and no control panel holder. **Note**: You need at least one loose control panel to be able to commission the drive.
J410	DPMP-01 door mounting kit (flush mounting) for the control panel. Includes a control panel mounting platform, an IP54 cover and a 3-meter panel connection cable.
J413	DPMP-02 door mounting kit (surface mounting) for the control panel. Includes a control panel mounting platform, an IP65 cover and a 3-meter panel connection cable.
J414	Control panel holder mounted on the drive module (requires option +P905).
J425	ACS-AP-I Assistant control panel
Filters	
E202	External EMC filter (ARFI-10) for first environment TN (grounded) system, category C2. Requires option +E208. Available for ACS880-04-xxxx-3 and -5 types only.
E208	Common mode filter
E210	EMC filter, for second environment TN (grounded) and IT (ungrounded) systems, category C3.
Fieldbus adapter modules	
K451	FDNA-01 DeviceNet™ fieldbus adapter module
K454	FPBA-01 PROFIBUS DP fieldbus adapter module
K457	FCAN-01 CANopen fieldbus adapter module
K458	FSCA-01 Modbus adapter module
K462	FCNA-01 ControlNet fieldbus adapter module
K469	FECA-01 EtherCAT® fieldbus adapter module
K470	FEPL-02 Ethernet POWERLINK fieldbus adapter module
K473	FENA-11 EtherNet/IP™, Modbus/TCP and PROFINET IO fieldbus adapter module
K475	FENA-21 EtherNet/IP™, Modbus/TCP and PROFINET IO fieldbus adapter module, 2-port
I/O extension and feedback interface modules	

Code	Description
L500	FIO-11 analog I/O extension module
L501	FIO-01 digital I/O extension module
L502	FEN-31 HTL encoder interface module
L503	FDCO-01 optical DDCS communication module
L508	FDCO-02 optical DDCS communication module
L515	FEA-03 F-series extension adapter
L516	FEN-21 resolver interface module
L517	FEN-01 TTL encoder interface module
L518	FEN-11 absolute encoder interface module
L521	FSE-31 pulse encoder interface. Requires option +Q972.
L525	FAIO-01 analog I/O extension module
L526	FDIO-01 digital I/O extension module
L536	FPTC-01 thermistor protection module
L537	FPTC-02 ATEX-certified thermistor protection module. Requires option +Q971.
Control program	
N7502	Enables setting of synchronous reluctance motor parameters in the drive control program.
Programmability	
N8010	Drive application programming (CODESYS)
Safety	
Q971	ATEX-certified Safe motor disconnection function using the drive Safe torque off function
Q972	FSO-21 safety functions module
Q973	FSO-12 safety functions module
Q982	PROFIsafe with FSO-xx safety functions module and FENA-21 Ethernet adapter module Requires option +Q972 or +Q973 and option +K475.
Warranty	
P904	Extended warranty 24/30
Paper manuals. Note: The delivered manual set can include manuals in English if the translation is not available.	
R700	English
R701	German
R702	Italian
R703	Dutch
R704	Danish
R705	Swedish
R706	Finnish
R707	French
R708	Spanish
R709	Portuguese (spoken in Portugal)
R711	Russian
R713	Polish
R714	Turkish

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4

Guidelines for planning the cabinet installation

Contents of this chapter

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

Limitation of liability

You must always plan and make the installation according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations.

Installation positions of the drive module

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

Basic requirements for the cabinet

Use a cabinet which

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

Planning the layout of the cabinet

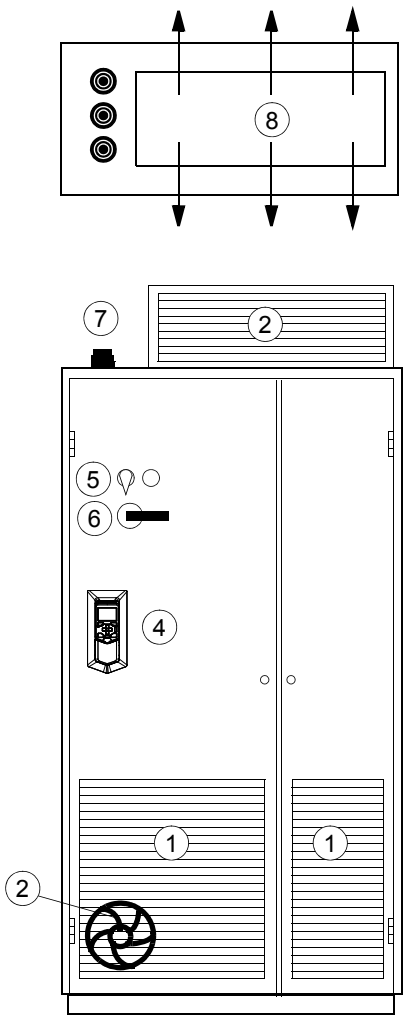
Plan a spacious layout to ensure easy installation and maintenance. Sufficient cooling air flow, obligatory clearances, cables and cable support structures all require space.

Place the control board(s) away from:

- main circuit components such as contactors, switches and power cables
- hot parts (heat sink, air outlet of the drive module).

Layout example, door closed

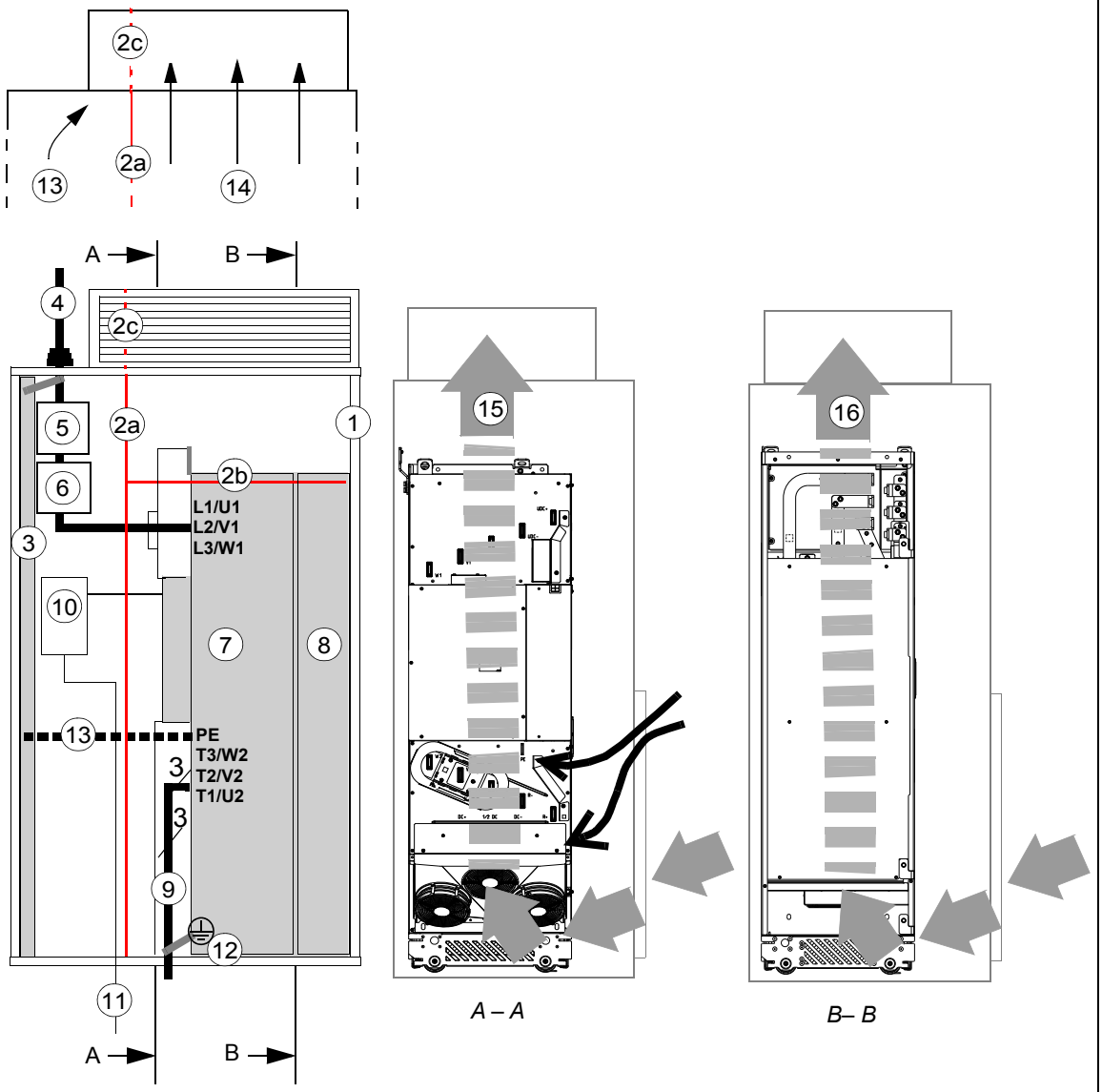
This diagram shows a cabinet layout example with the input power cable entry from top and the motor cable entry from bottom.



1	Air inlet for the drive module	5	Contactor control switch and emergency stop switch (connected to the contactor control circuit inside the cabinet)
2	An extra fan is not necessary if an extra air baffle is used on the cabinet roof (see page *47*).	6	Operating handle of the disconnector
3	Air outlet for the drive module and LCL filter module and other equipment on the cabinet roof. An exhaust fan if needed.	7	Rubber grommets for degree of protection
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.	8	Roof air flow viewed from top

Note: The sizes of the air inlet and outlet gratings are critical for proper cooling of the drive module. For losses and cooling data requirements, see page *192*.

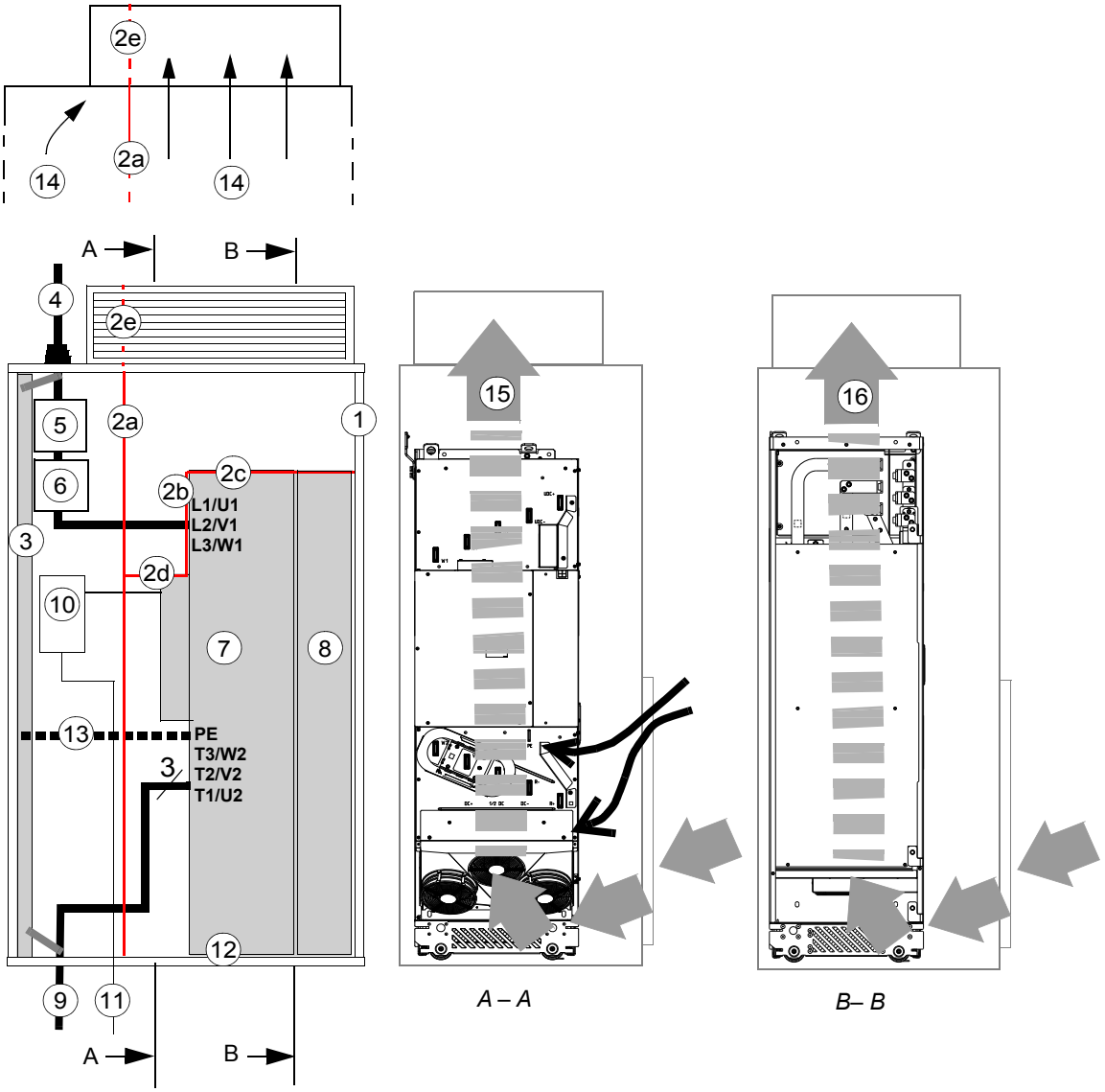
Layout example, door open (standard drive module configuration)



1	Supporting frame of the cabinet	8	LCL filter module
2a 2b	Vertical (2a) and horizontal (2b) air baffles that separate the cool and hot areas (leak-proof entries). See also page 52.	9	Motor cable including the protective ground conductor of the drive module
2c	Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page on 44)	10	Drive module control unit. **Note**: With an internal control unit (option +P905), the upper door air inlet is critical for proper cooling of the control board.
3	Cabinet grounding busbar (PE)	11	External control cables
4	Input power cable including the protective ground conductor (PE) of the drive	12	Grounding screws
		13	Alternative to grounding screws (11)
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 also page *52*.	10	Drive module control unit. **Note**: With an internal control unit (option +P905), the upper door air inlet is critical for proper cooling of the control board.
2e	Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page on *44*)	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 (11)
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 to the LCL filter module
8	LCL filter module	-	-

Note 1: The power cable shields can also be grounded to the drive module grounding terminals.

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

Arranging the grounding inside the cabinet

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

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

Selecting the busbar material and preparation of the joints

Note the following when you use busbars:

- Tin-plated copper is recommended but aluminum can also be used.
- The oxide layer from aluminum busbar joints must be removed and suitable anti-oxidant joint compound applied.

Tightening torques

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

Screw size	Torque
M5	3.5 N·m (2.6 lbf·ft)
M6	9 N·m (6.6 lbf·ft)
M8	20 N·m (14.8 lbf·ft)
M10	40 N·m (29.5 lbf·ft)
M12	70 N·m (52 lbf·ft)
M16	180 N·m (133 lbf·ft)

Planning the fastening of the cabinet

Note the following when you plan the fastening of the cabinet:

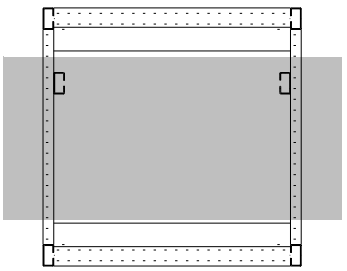
- Fasten the cabinet to the floor from the front and to the floor or wall from the back.
- Always fasten the drive module from its fastening points to the cabinet. For details, see the module installation instructions.

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

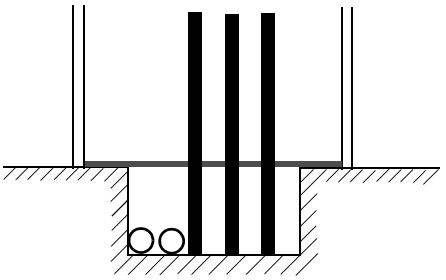
Planning the cabinet placement on a cable channel

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

- The cabinet structure must be sturdy enough. If the whole cabinet base is not supported from below, the cabinet weight will lie on the sections that the floor carries.
- Equip the cabinet with a sealed bottom plate and cable entries to ensure the degree of protection and to prevent the cooling air flow from the cable channel into the cabinet. **Note**: When the bottom grille and clear plastic shrouds around the motor cables are installed, the degree of protection of the drive module from bottom side is IP20.



The carrying structure on a cable channel



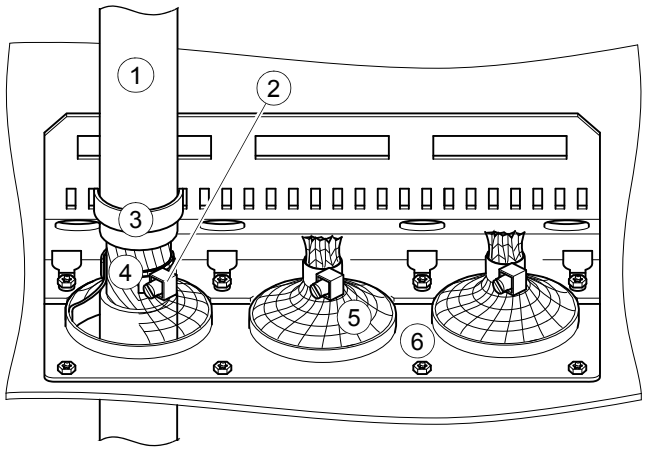
Cabinet side view with a bottom plate

Planning the electromagnetic compatibility (EMC) of the cabinet

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

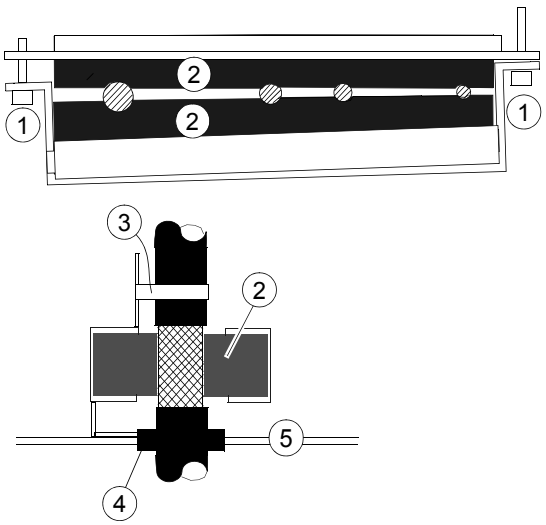
- Generally, the fewer and smaller the holes in the cabinet, the better the interference attenuation. The maximum recommended diameter of a hole in galvanic metal contact in the covering cabinet structure is 100 mm (3.94 in). Pay special attention to the cooling air inlet and outlet gratings.
- The best galvanic connection between the steel panels is achieved by welding them together as no holes are necessary. If welding is not possible, we recommend to leave the seams between the panels **unpainted** and equipped with special conductive EMC strips to provide adequate galvanic connection. Usually, reliable strips are made of flexible silicon mass covered with a metal mesh. The non-tightened touch-contact of the metal surfaces is not sufficient, so a conductive gasket between the surfaces is required. The maximum recommended distance between assembly screws is 100 mm (3.94 in).
- Construct sufficient high-frequency grounding network in the cabinet to avoid voltage differences and forming of high-impedance radiator structures. A good high-frequency grounding is made with short flat copper braids for low inductance. One-point high-frequency grounding cannot be used due to the long distances inside the cabinet.
- 360° high frequency grounding of the cable shields at the cable entries improves the EMC shielding of the cabinet.

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



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

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



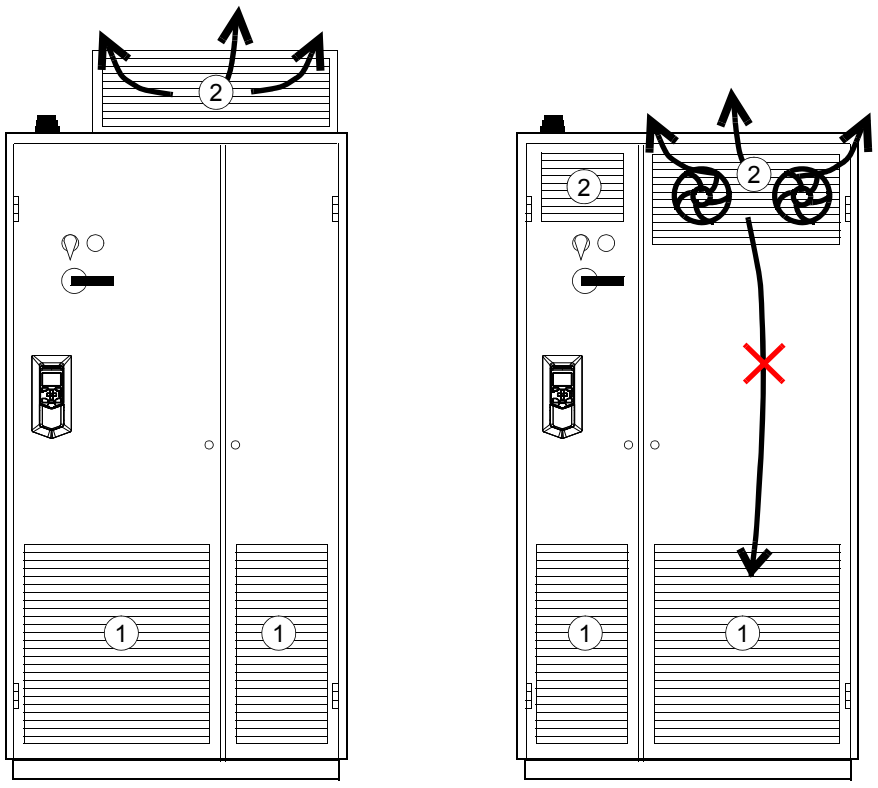
1 Tightening screw
2 EMI conductive cushion
3 Strain relief
4 Grommet
5 Cable entry plate

Planning the cooling

Note the following guidelines when you plan the cooling of the cabinet:

- Ventilate the installation site sufficiently so that the cooling air flow and ambient temperature requirements of the drive module are met, see pages *192* and *196*. The internal cooling fan of the drive module rotates at a constant speed thus blowing constant air flow through the module. Whether the same amount of air must be replaced all the time in the facility depends on how much heat must be removed.
- Leave enough free space around the components to ensure sufficient cooling. Observe the minimum clearances given for each component. For the required free space around the drive module, see page *55*.
- Also ventilate the heat dissipated by cables and other additional equipment.

- **Make sure that the air inlets and outlets are large enough to allow sufficient air flow in and out of the cabinet.** This is critical for proper cooling of the drive module.
- Equip the air inlets and outlets with gratings that
  - guide the air flow
  - protect against contact
  - prevent water splashes from entering the cabinet.
- The drawings below shows two typical cabinet cooling solutions. The air inlet is at the bottom of the cabinet, while the outlet is on the roof on the upper part of the door. Use extra exhaust fans if the air outlet is on the cabinet door, see page *192* for the required cooling air flow.



1 Air inlet
2 Air outlet

- The internal cooling fans of the power and LCL filter modules are usually sufficient to keep the component temperatures low enough in IP22 cabinets.
- In IP54 cabinets, thick filter mats are used to prevent water splashes from entering the cabinet. This requires the installation of additional cooling equipment, such as a hot air exhaust fan.

Preventing the recirculation of hot air

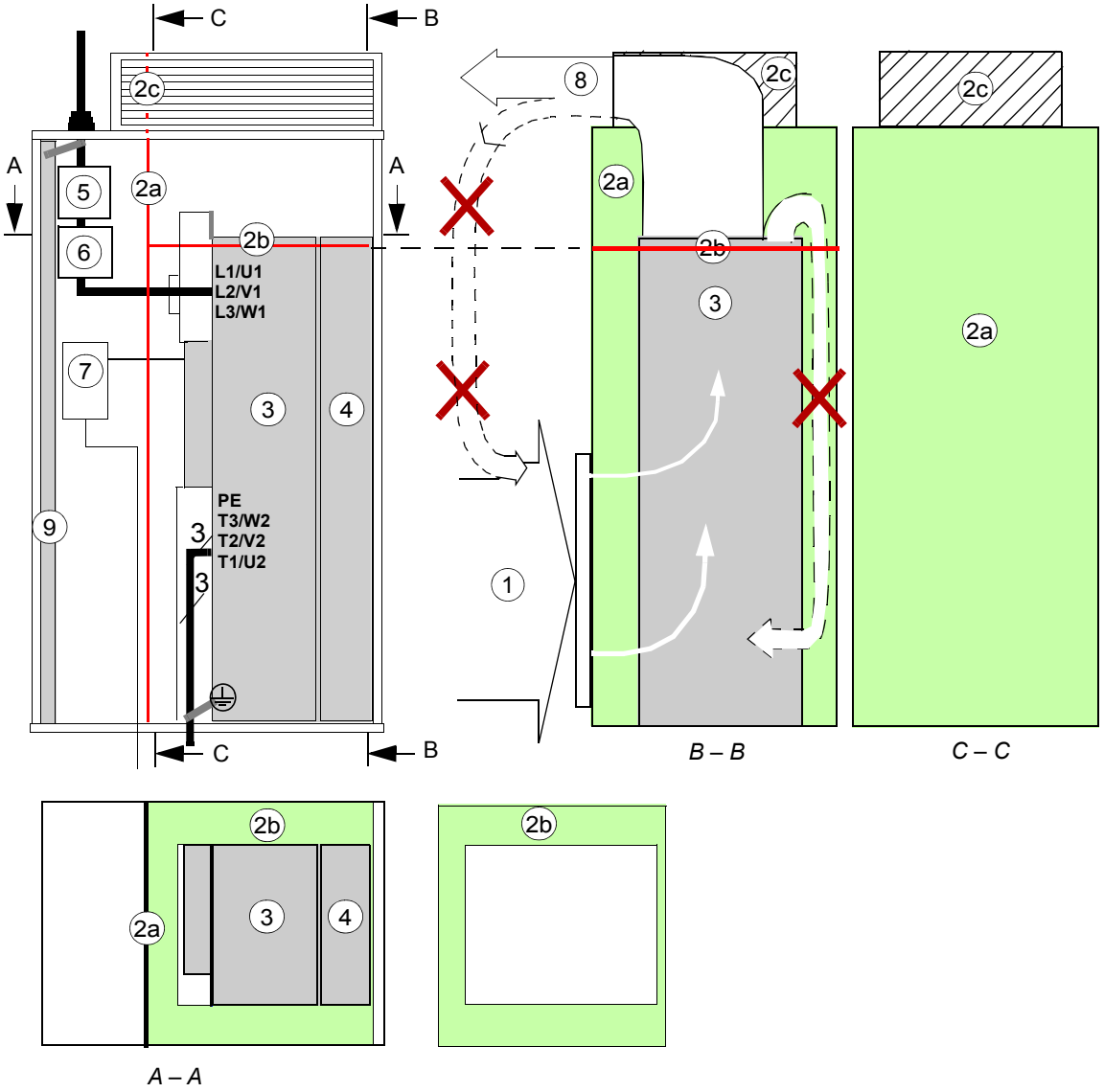
Prevent hot air circulation outside the cabinet by leading the outcoming hot air away from the area where the inlet air to the cabinet is taken. Possible solutions are listed below:

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

Prevent hot air circulation inside the cabinet with, for example, leak-proof air baffles. No gaskets are usually required.

Bookshelf mounting (standard drive module configuration)

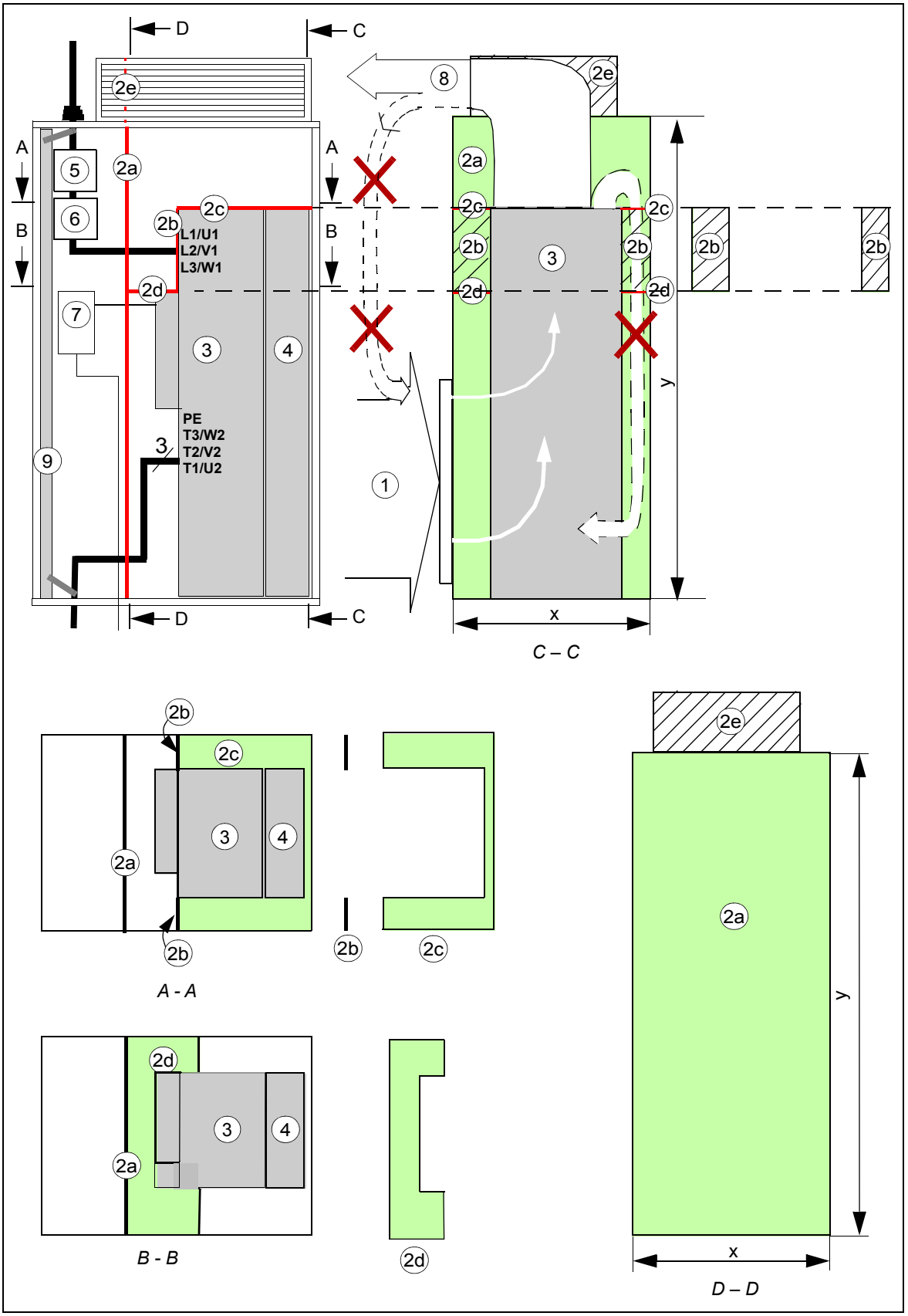
This diagram shows the air baffle position inside an example cabinet. For dimensions of the baffle, see page *212*.



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 (see 2 on page *44*).	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 module, 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 (see 1b on page *44*).	9	Cabinet grounding busbar (PE)
3	Drive module		

Bookshelf mounting (option +H381)

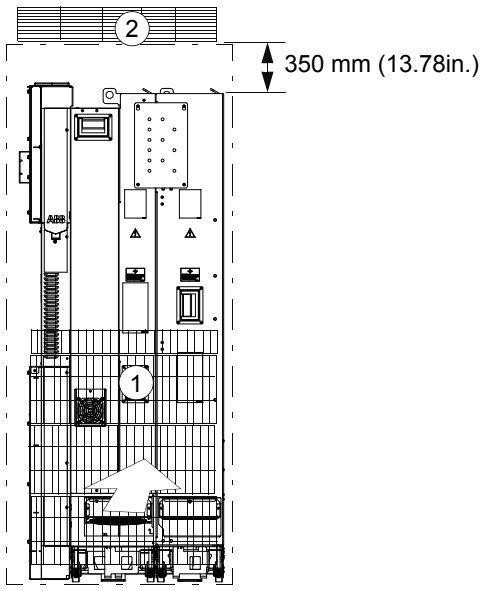
See chapter *Installation example with full cabling panels (option +H381)* on page *137*.

Required free space

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

Free space at the top of the drive module

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



Air outlet on the cabinet roof

1	Air inlet
2	Air outlet

Free space around the drive module

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

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

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

Planning the placement of the control panel

Note the following alternatives when you plan the placement of the control panel:

- When the control unit is inside the drive module (option +P905), the control panel can be integrated in the drive module (option +J414).
- The control panel can be mounted onto the cabinet door using a control panel mounting platform (options +J410 and +J413). For the installation instructions, refer to *DPMP-01 mounting platform for ACS-AP control panel* (3AUA0000100140 [English]) or *DPMP-02 mounting platform for ACS-AP-X control panel* (3AUA0000136205 [English]).

Planning the use of cubicle heaters

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

ABB air inlet and outlet kits

See section *Cabinet ventilation* on page *176*.

5

Guidelines for planning the electrical installation

Contents of this chapter

This chapter contains the instructions that you must obey when you select the motor, cables, protections, cable routing and way of operation for the drive system.

Limitation of liability

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

Selecting the supply disconnecting device

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

European Union

To agree with the European Union Directives, according to standard EN 60204-1, *Safety of Machinery*, the disconnecting device must be one of the following types:

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

Other regions

The disconnecting device must conform to the applicable safety regulations.

Selecting the main contactor

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

Examining the compatibility of the motor and drive

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

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

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

Note:

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

Protecting the motor insulation and bearings

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

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

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

Requirements table

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

<table>
<tr><th rowspan="3">Motor type</th><th rowspan="3">Nominal AC supply voltage</th><th colspan="3">Requirement for</th></tr>
<tr><th rowspan="2">Motor insulation system</th><th colspan="2">ABB du/dt and common mode filters, insulated N-end motor bearings</th></tr>
<tr><th>100 kW ≤ P_N < 350 kW
or
IEC 315 ≤ frame size < IEC 400</th><th>P_N ≥ 350 kW
or
frame size ≥ IEC 400</th></tr>
<tr><th></th><th></th><th>134 hp ≤ P_N < 469 hp
or
NEMA 500 ≤ frame size ≤ NEMA 580</th><th>P_N ≥ 469 hp
or
frame size > NEMA 580</th></tr>
<tr><td colspan="5">ABB motors</td></tr>
<tr><td rowspan="5">Random-wound M2_, M3_ and M4_</td><td>U_N ≤ 500 V</td><td>Standard</td><td>+ N</td><td>+ N + CMF</td></tr>
<tr><td rowspan="3">500 V < U_N ≤ 600 V</td><td>Standard</td><td>+ N + du/dt</td><td>+ N + du/dt + CMF</td></tr>
<tr><td colspan="3">or</td></tr>
<tr><td>Reinforced</td><td>+ N</td><td>+ N + CMF</td></tr>
<tr><td>600 V < U_N ≤ 690 V (cable length ≤ 150 m)</td><td>Reinforced</td><td>+ N + du/dt</td><td>+ N + du/dt + CMF</td></tr>
<tr><td>600 V < U_N ≤ 690 V (cable length > 150 m)</td><td>Reinforced</td><td>+ N</td><td>+ N + CMF</td></tr>
<tr><td rowspan="2">Form-wound HX_ and AM_</td><td rowspan="2">380 V < U_N ≤ 690 V</td><td rowspan="2">Standard</td><td rowspan="2">+ N + CMF</td><td>P_N < 500 kW:
+N + CMF</td></tr>
<tr><td>P_N ≥ 500 kW
+N + du/dt + CMF</td></tr>
<tr><td>Old* form-wound HX_ and modular</td><td>380 V < U_N ≤ 690 V</td><td>Check with the motor manufacturer.</td><td colspan="2">+ N + du/dt with voltages over 500 V + CMF</td></tr>
</table>

Motor type	Nominal AC supply voltage	Requirement for		
		Motor insulation system	ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings	
			100 kW ≤ P_N < 350 kW or IEC 315 ≤ frame size < IEC 400	**P_N ≥ 350 kW or frame size ≥ IEC 400**
			134 hp ≤ P_N < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580	**P_N ≥ 469 hp or frame size > NEMA 580**
Random-wound HX_ and AM_ **	0 V < U_N ≤ 500 V	Enamelled wire with fiber glass taping	+ N + CMF	
	500 V < U_N ≤ 690 V		+ N + d*u*/d*t* + CMF	
HDP	Consult the motor manufacturer.			

* manufactured before 1.1.1998

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

Non-ABB motors				
Random-wound and form-wound	U_N ≤ 420 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N or CMF	+ N + CMF
	420 V < U_N ≤ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
		or		
		Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	+ N or CMF	+ N + CMF
	500 V < U_N ≤ 600 V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
		or		
		Reinforced: $\hat{U}_{LL}$ = 1800 V	+ N or CMF	+ N + CMF
	600 V < U_N ≤ 690 V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ d*u*/d*t* + N	+ N + d*u*/d*t* + CMF
		Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 microsecond rise time ***	N + CMF	+ N + CMF

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

The abbreviations used in the table are defined below.

Abbreviation	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
d*u*/d*t*	d*u*/d*t* filter at the output of the drive
CMF	Common mode filter (option +E208)
N	N-end bearing (Insulated motor non-drive end bearing)

Additional requirements for explosion-safe (EX) motors

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

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

Use the selection criteria given for non-ABB motors.

Additional requirements for the braking applications

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

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

Additional requirements for ABB high-output and IP23 motors

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

Nominal AC supply voltage	**Requirement for**		
	Motor insulation system	**ABB du/dt and common mode filters, insulated N-end motor bearings**	
		100 kW ≤ P_N < 200 kW	**P_N ≥ 200 kW**
		140 hp ≤ P_N < 268 hp	**P_N ≥ 268 hp**
U_N ≤ 500 V	Standard	+ N	+ N + CMF
500 V < U_N ≤ 600 V	Standard	+ d*u*/d*t* + N	+ d*u*/d*t* + N + CMF
	or		
	Reinforced	+ N	+ N + CMF
600 V < U_N ≤ 690 V	Reinforced	+ 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. The table below shows the requirements for random-wound and form-wound non-ABB motors with nominal power smaller than 350 kW. For bigger motors, consult the motor manufacturer.

Nominal AC supply voltage	**Requirement for**	
	Motor insulation system	**ABB d*u*/d*t* filter, insulated N-end bearing and ABB common mode filter**
U_N ≤ 420 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N + CMF
420 V < U_N ≤ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N + d*u*/d*t* + CMF
	or	
	Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	+ N + CMF
500 V < U_N ≤ 600 V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ d*u*/d*t* + N + CMF
	or	
	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ N + CMF

Nominal AC supply voltage	Requirement for	
	Motor insulation system	**ABB d*u*/d*t* filter, insulated N-end bearing and ABB common mode filter**
600 V < $U_N \leq$ 690 V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ N + d*u*/d*t* + CMF
	Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 microsecond rise time ***	N + CMF

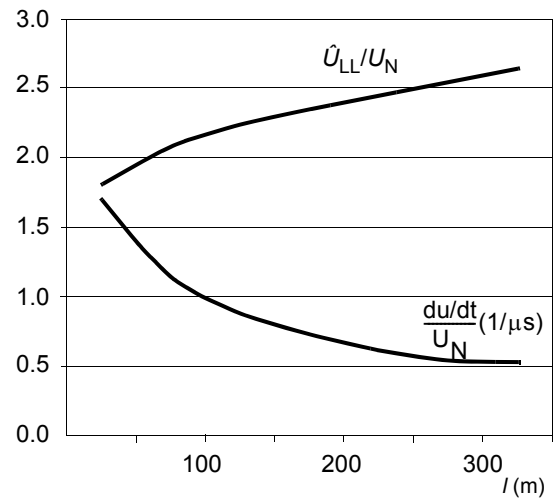
*** If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

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

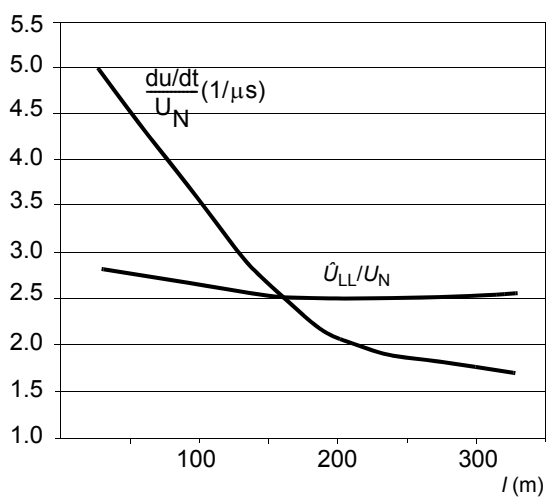
The diagrams below show the relative peak line-to-line voltage and rate of change of voltage as a function of the motor cable length with and without a d*u*/d*t* filter in use.

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

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



Drive with d*u*/d*t* filter



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: ÛLL and du/dt values are approximately 20% higher with resistor braking.

Additional note for sine filters

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

Additional note for common mode filters

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

Selecting the power cables

General rules

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

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

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

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

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

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

The protective conductor must always have an adequate conductivity.

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

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

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

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

Typical power cable sizes

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

Drive type ACS880-1434-	IEC [1]		US [2]	
	Cu cable type	Al cable type	Cu cable type	Al cable type
	mm²	mm²	AWG/kcmil	AWG/kcmil
U_N = 400 V				
246A-3	3 × (3×95)	3 × (3×150)	2××500 MCM or 3×250 MCM	2×700 MCM or 3×350 MCM
293A-3	3 × (3×95)	3 × (3×150)	2×500 MCM or 3×250 MCM	2×700 MCM or 3×350 MCM
363A-3	3 × (3×95)	3 × (3×150)	2×500 MCM or 3×250 MCM	2×700 MCM or 3×350 MCM
505A-3	3 × (3×95)	3 × (3×150)	2×500 MCM or 3×250 MCM	2×700 MCM or 3×350 MCM
585A-3	3 × (3×95)	3 × (3×150)	2×500 MCM or 3×250 MCM	2×700 MCM or 3×350 MCM
650A-3	3 × (3×120)	3 × (3×185)	2×600 MCM or 3×300 MCM	3×400 MCM or 4×250 MCM
725A-3	3 × (3×150)	3 × (3×240)	2×700 MCM or 3×350 MCM	3×400 MCM or 4×250 MCM
U_N = 500 V				
240A-5	3 × (3×95)	3 × (3×150)	2×400 MCM or 3×4/0	2×600 MCM or 3×300 MCM
260A-5	3 × (3×95)	3 × (3×150)	2×400 MCM or 3×4/0	2×600 MCM or 3×300 MCM
302A-5	3 × (3×95)	3 × (3×150)	2×400 MCM or 3×4/0	2×600 MCM or 3×300 MCM
361A-5	3 × (3×95)	3 × (3×150)	2×400 MCM or 3×4/0	2×600 MCM or 3×300 MCM
414A-5	3 × (3×95)	3 × (3×150)	2×400 MCM or 3×4/0	2×600 MCM or 3×300 MCM
460A-5	3 × (3×95)	3 × (3×150)	2×400 MCM or 3×4/0	2×600 MCM or 3×300 MCM
503A-5	3 × (3×95)	3 × (3×150)	2×500 MCM or 3×250 MCM	2×700 MCM or 3×350 MCM
583A-5	3 × (3×120)	3 × (3×185)	2×600 MCM or 3×300 MCM	3×500 MCM or 4×300 MCM
U_N = 690 V				
142A-7	2 × (3×120)	3 × (3×120)	2×250 MCM or 3×2/0	2×350 MCM or 3×4/0
174A-7	2 × (3×120)	3 × (3×120)	2×250 MCM or 3×2/0	2×350 MCM or 3×4/0
210A-7	2 × (3×120)	3 × (3×120)	2×250 MCM or 3×2/0	2×350 MCM or 3×4/0
271A-7	2 × (3×120)	3 × (3×120)	2×250 MCM or 3×2/0	2×350 MCM or 3×4/0
330A-7	2 × (3×120)	3 × (3×120)	2×250 MCM or 3×2/0	2×350 MCM or 3×4/0
370A-7	2 × (3×120)	3 × (3×120)	2×300 MCM or 3×3/0	2×400 MCM or 3×4/0
430A-7	3 × (3×95)	3 × (3×120)	2×350 MCM or 3×4/0	2×500 MCM or 3×250 MCM

3AXD00000588487

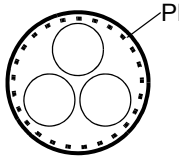
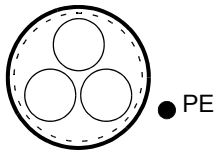
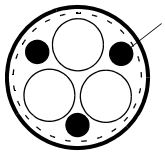
1) The cable sizing is based on max. 9 cables laid on a cable ladder side by side, three ladder type trays one on top of the other, ambient temperature 30 °C (86 °F) PVC insulation, surface temperature 70 °C (158 °F) (EN 60204-1 and IEC 60364-5-52). For other conditions, dimension the cables according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

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

Alternative power cable types

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

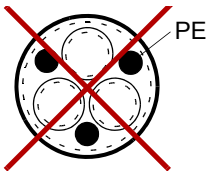
Recommended power cable types

	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. The shield must agree with the requirements of EC 61800-5-1, see page *63*. Check with local / state / country electrical codes for allowance.
	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. A separate PE conductor is required if the shield does not agree with the requirements of EC 61800-5-1, see page *63*.
	Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must agree with the requirements of EC 61800-5-1, see page *63*.

Power cable types for restricted use

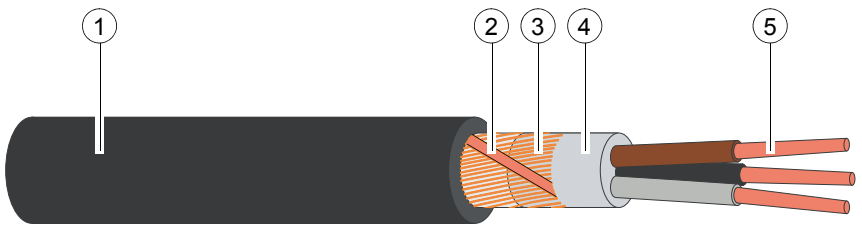
	A four-conductor system (three phase conductors and a protective conductor on a cable tray) is **not allowed for motor cabling** (allowed for input cabling).

Not allowed power cable types

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

Motor cable shield

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



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

Additional US requirements

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

Conduit

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

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

Armored cable / shielded power cable

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

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

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

Planning the braking system

See chapter *Resistor braking*.

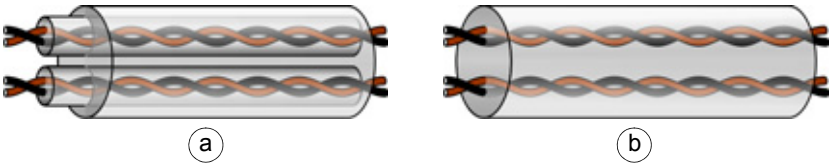
Selecting the control cables

Shielding

All control cables must be shielded.

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

A double-shielded cable (figure a below) is the best alternative for low-voltage digital signals but single-shielded (b) twisted pair cable is also acceptable.



Signals in separate cables

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

Signals allowed to be run in the same cable

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

Relay cable type

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

Control panel cable length and type

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

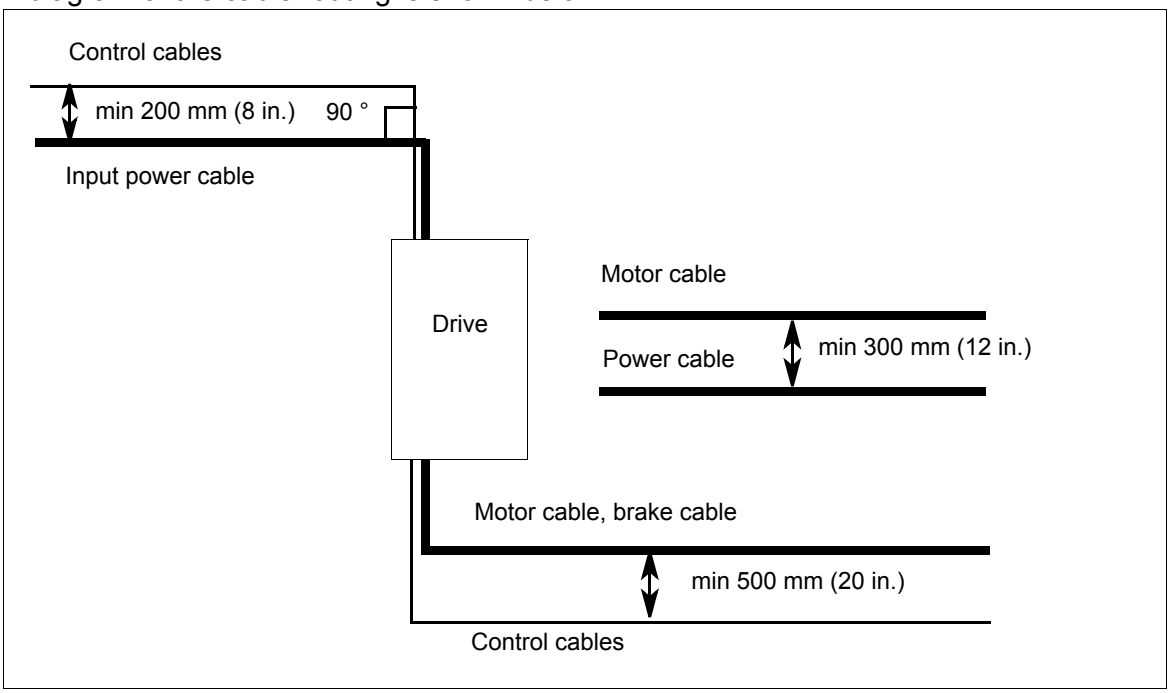
Routing the cables

Route the motor cable away from other cable routes. Motor cables of several drives can be run in parallel when installed next to each other. The motor cable, input power cable and control cables should be installed on separate trays. Avoid long parallel runs of motor cables with other cables in order to decrease electromagnetic interference caused by the rapid changes in the drive output voltage.

Where control cables must cross power cables, make sure they are arranged at an angle as near to 90 degrees as possible. Do not install extra cables through the drive.

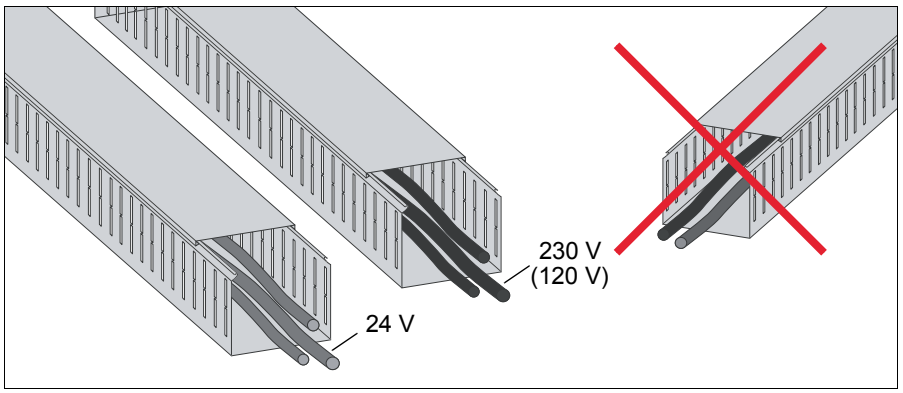
The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential

A diagram of the cable routing is shown below.



Separate control cable ducts

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



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

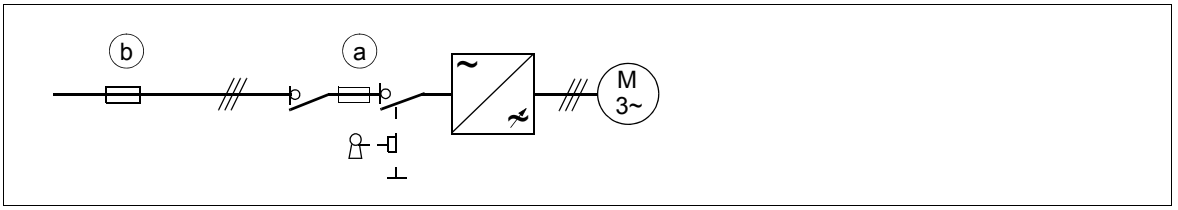
To minimize the emission level when safety switches, contactors, connection boxes or similar equipment are installed on the motor cable between the drive and the motor:

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

Implementing thermal overload and short-circuit protection

Protecting the drive and input power cable in short-circuits

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



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

Note: If the fuses for the drive protection are placed at the distribution board and the input cable is dimensioned according to the nominal input current of the drive given in the rating table on page *183*, the fuses will protect also the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive. No separate fuses for the input cable protection are needed.

Circuit breakers

aR fuses must be used with circuit breakers.

Protecting the motor and motor cable in short-circuits

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

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

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

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

Protecting the motor against thermal overload

According to regulations, the motor must be protected against thermal overload and the current must be switched off when overload is detected. The drive includes a motor thermal protection function that protects the motor and switches off the current when necessary. Depending on a drive parameter value, the function either monitors a calculated temperature value (based on a motor thermal model) or an actual temperature

indication given by motor temperature sensors. The user can tune the thermal model further by feeding in additional motor and load data.

The most common temperature sensors are:

- motor sizes IEC 180…225: thermal switch, eg, Klixon
- motor sizes IEC 200…250 and larger: PTC or Pt100.

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

Protecting the drive against ground faults

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

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

Residual current device compatibility

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

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

Connecting drive modules to a common DC system

Do not connect the drive module to a common DC system.

WARNING! The UDC+ and UDC- terminals of the drive module must not be used for any other than optional external brake chopper connection. Drives connected to a common DC system will get damaged.

Implementing the Emergency stop function

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

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

Implementing the Safe torque off function

See chapter *Safe torque off function* on page *217*.

Implementing the ATEX-certified Safe motor disconnection function (option +Q971)

With option +Q971, the drive provides ATEX-certified safe motor disconnection without contactor using the drive Safe torque off function. For more information, see *ACS880 ATEX-certified Safe disconnection function application guide* (3AUA0000132231 [English]) or *FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual* (3AXD50000027782 [English]).

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

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

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

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

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

Declaration of Conformity

See section *EU Declaration of Conformity (Machinery Directive)* page *202*.

Implementing the Power loss ride-through function

Implement the power loss ride-through function as follows:

1. Check that the power-loss ride-through function of the drive is enabled with parameter **30.31 Undervoltage control** in the ACS880 primary control program.
2. If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.

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

Using power factor compensation capacitors with the drive

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

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

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

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

Implementing a safety switch between the drive and the motor

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

Using a contactor between the drive and the motor

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

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

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

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

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

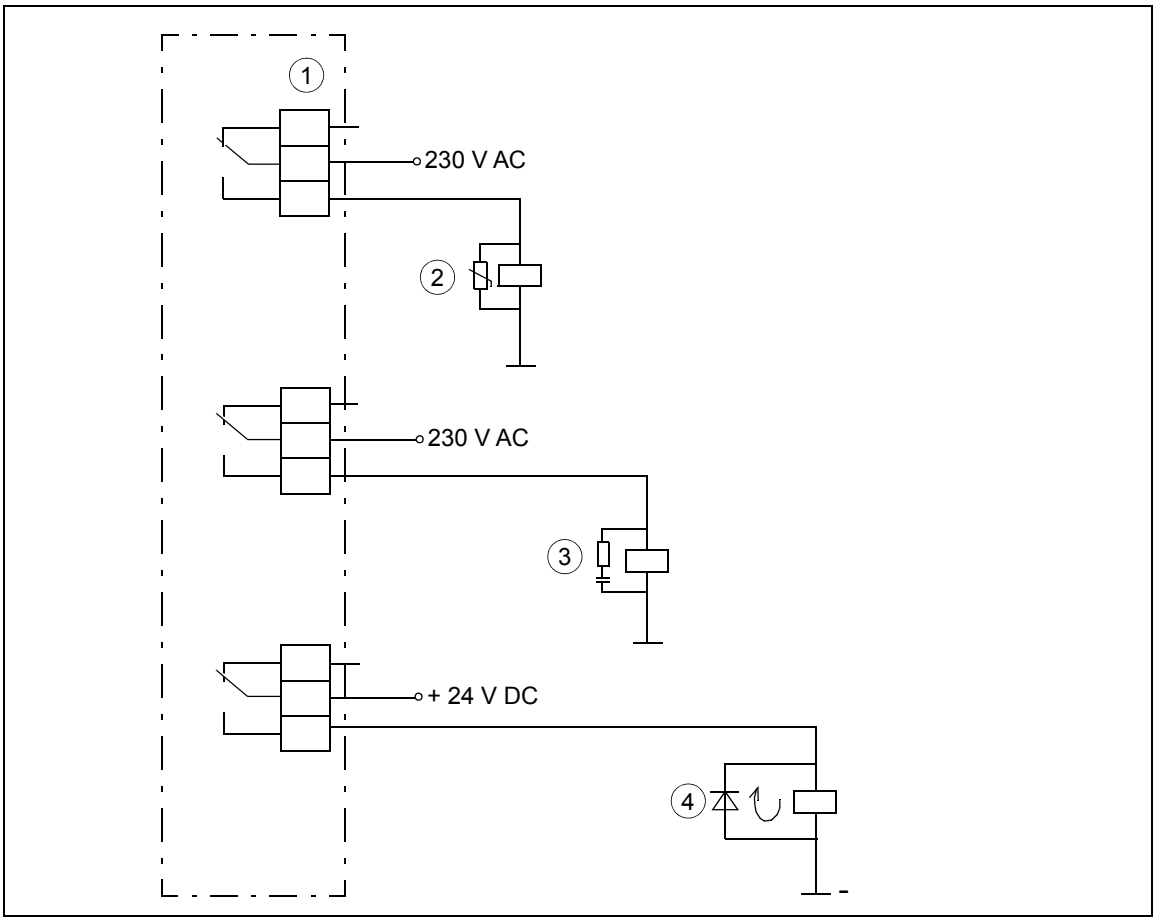
WARNING! When the DTC motor control mode is in use, never open the output contactor while the drive controls the motor. The DTC motor control operates extremely fast, much faster than it takes for the contactor to open its contacts. When the contactor starts opening while the drive controls the motor,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

Protecting the contacts of relay outputs

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

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

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



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

Connecting a motor temperature sensor to the drive I/O

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

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

1. If there is double or reinforced insulation between the sensor and the live parts of the motor, you can connect the sensor directly to the analog/digital inputs of the drive.
2. If there is basic insulation between the sensor and the live parts of the motor, you can connect the sensor to the analog/digital inputs of the drive if all circuits connected to the drive's digital and analog inputs (typically extra-low voltage circuits) are protected against contact and insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit. Note that extra-low voltage circuits (such as 24 V DC) typically do not meet these requirements.
3. You can connect the sensor to the drive via an option module.The sensor and the module must form a double or reinforced insulation between the motor live parts and the drive control unit. See section *Connection of motor temperature sensor to the drive via an option module* (page *75*).
4. You can connect the sensor to a digital input of the drive via a relay (internal option or customer's external relay). The sensor and the relay must form a double or reinforced insulation between the motor live parts and the drive control unit. See section *Connection of motor temperature sensor to the drive via a relay* (page *76*).

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

This table shows:

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

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

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

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

Connection of motor temperature sensor to the drive via a relay

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

PTC relay		Temperature sensor insulation requirement
Type	**Insulation**	
External relay	Basic insulation 6 kV	Basic insulation

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

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

Pt100 relay		Temperature sensor insulation requirement between sensor and live parts of motor
Type	**Insulation**	
External relay	Basic insulation 6 kV	Basic insulation

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

Example circuit diagram

See page *215*.

6

Installation instructions

Contents of this chapter

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

Safety

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

Checking the installation site

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

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

Moving and unpacking the unit

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

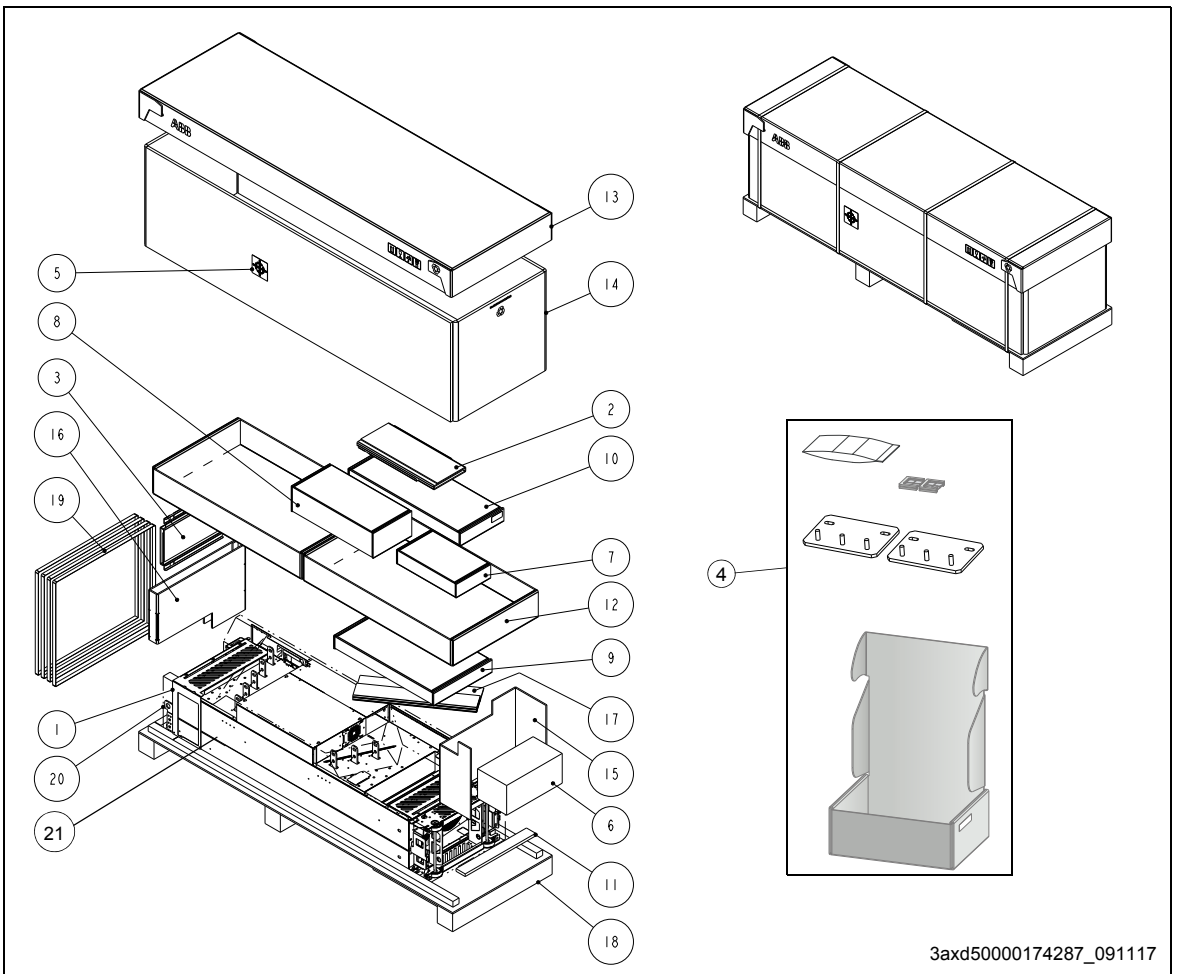
Move the transport package by pallet truck to the installation site.

Unpack the package as follows (see the package drawing on page *78*):

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

Package drawings

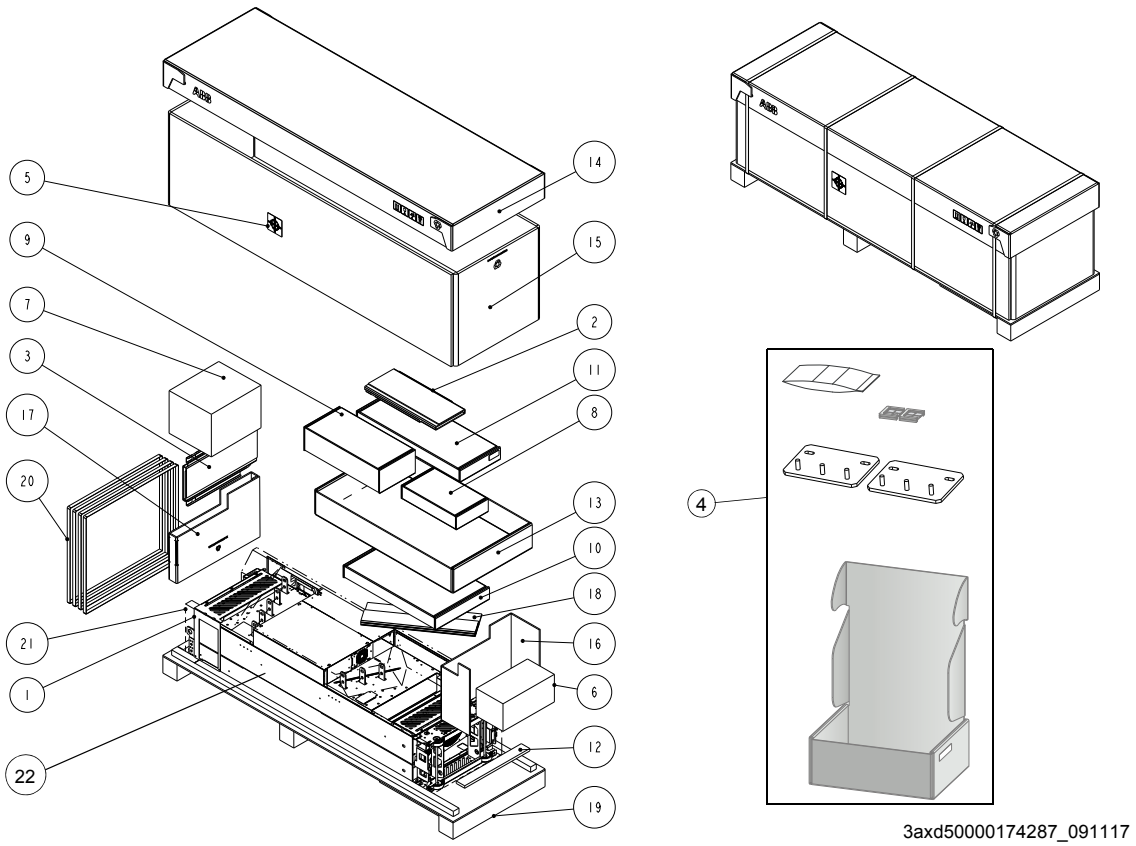
Drive module package without option +E202



Transport package contents	
1	Finger guard
2	Pedestal guide plate for the LCL filter module
3	Pedestal guide plate for the drive module
4	Accessories box, see page *84*.

5	Center of gravity symbol
6	External control unit
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. See below for the box contents.
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, internal control unit with control cable clamp plate and factory installed optional modules (option P905), control panel and cable or control panel with door mounting kit (option +J410), delivery documents, printed multilingual installation and start-up quick guides and manuals CD. Other printed manuals with option +R700.

Package with option +E202



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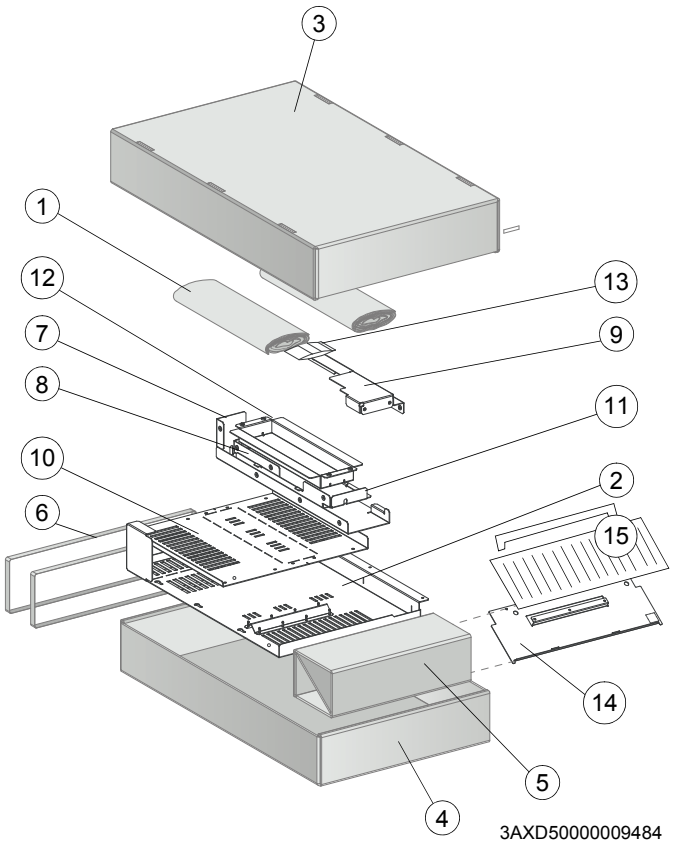
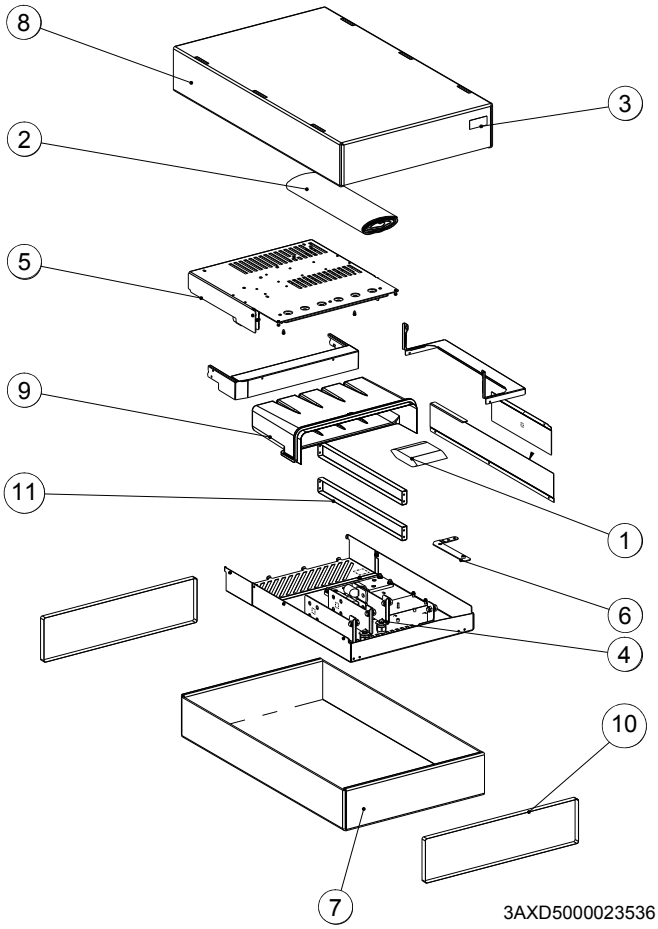
Transport package contents	
1	With standard drive module configuration: Clear plastic shrouds. With option +H381: Input cabling panel parts. See below for the box contents.
1	Finger guard
2	Pedestal guide plate for the LCL filter module
3	Pedestal guide plate for the drive module
4	Accessories box, see page 84.
5	Center of gravity symbol
6	External control unit
7	Package EMC filter ARFI-10 (option +E202)
8	Package for LCL filter fan
9	Package for LCL filter pedestal
10	Telescopic extraction and insertion ramp
11	Package for option H370: Full-size input power cable connection terminals and PE busbar.
12	Plywood support
13	With standard drive module configuration: Clear plastic shrouds box and output cable connection terminals box.With option +H370 also Input cable connection terminals box. See below for the box contents.
14	Lid for sleeve
15	Cardboard sleeve
16–18	Cardboard support
19	Pallet
20	Strap
21	VCI film or bag

22	Drive module with factory installed options and multilingual residual voltage warning sticker, fastening screws in a plastic bag, internal control unit with control cable clamp plate and factory installed optional modules (option P905), control panel and cable or control panel with door mounting kit (option +J410), delivery documents, printed multilingual installation and start-up quick guides and manuals CD. Other printed manuals with option +R700.

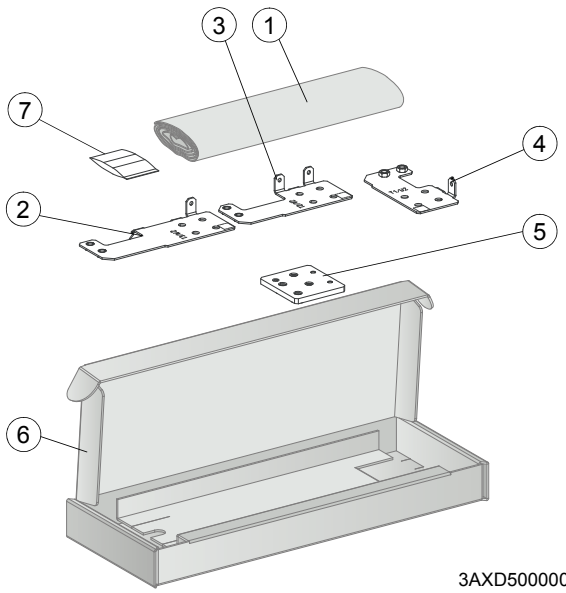
Boxes



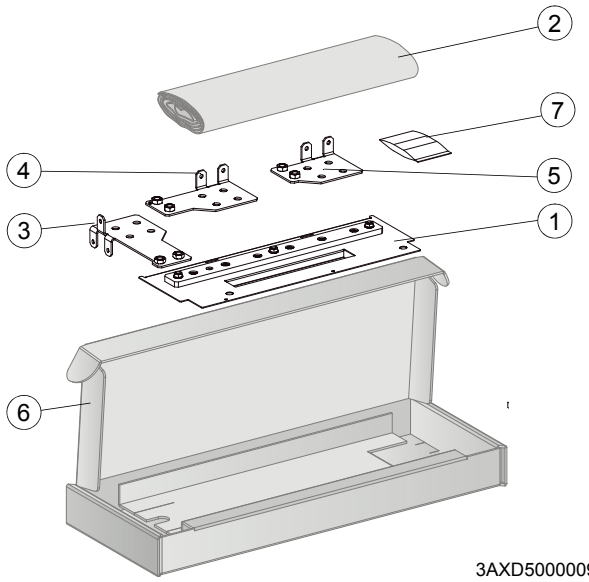
Shroud box with standard drive module configuration	
1	Paper fill
2	Clear plastic shroud for output cabling
3	Cardboard box cover
4	Cardboard box bottom
5	Support
6	Bands
7	Back clear plastic shroud (lower)
8	Back clear plastic shroud (upper)
9	Front clear plastic shroud
10	Clear plastic shroud for input 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
15	Bottom grille and mounting bracket. Not used.



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



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



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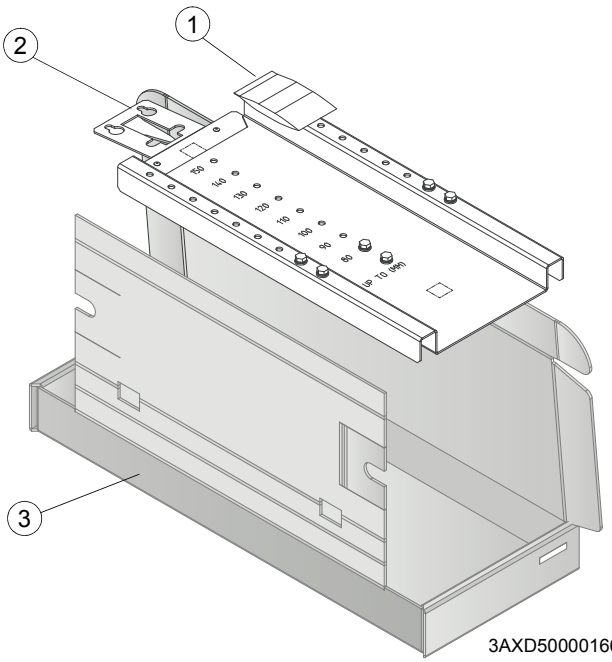
Option +H370: input cable connection terminals box	
1	Metallic shroud with ground bar
2	Paper fill
3	Input cable connection terminal L3/W1
4	Input cable connection terminal L2/V1
5	Input cable connection terminal L1/U1
6	Cardboard box
7	Screws and insulators in a plastic bag



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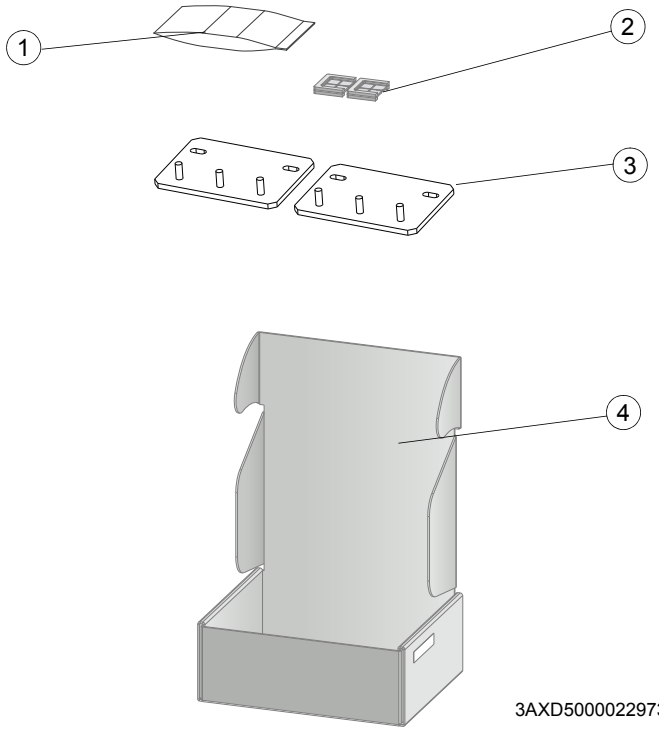
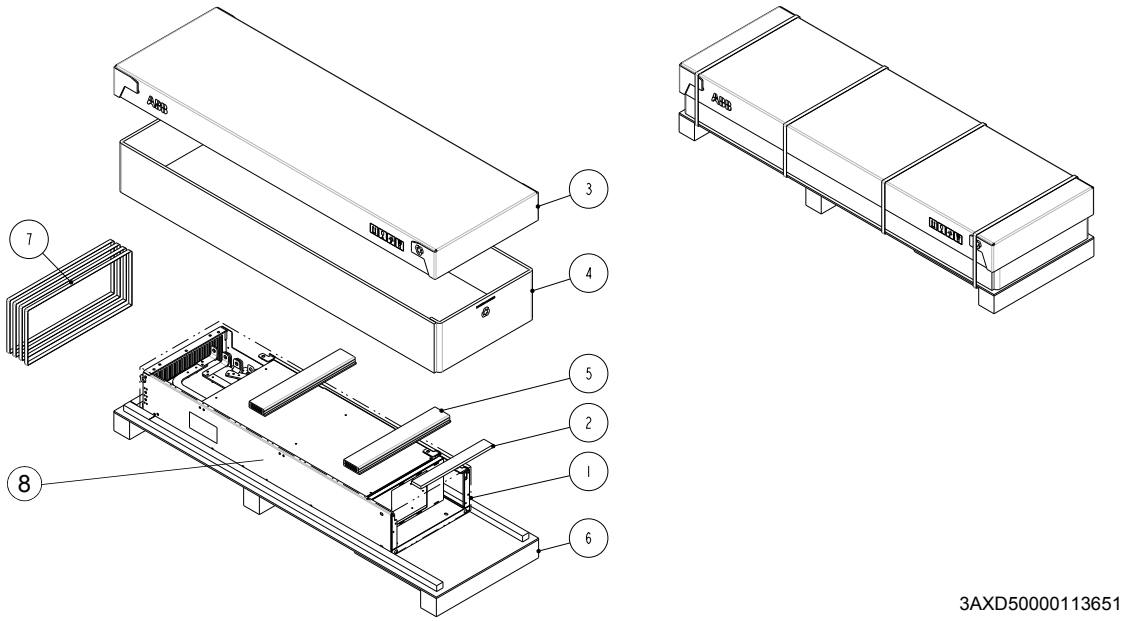
Ramp box	
1	Screw package
2	Telescopic extraction and insertion ramp
3	Cardboard box



Accessories box	
1	Screw package, includes also spacers for FSO module installation
2	Rubber grommets for control unit cable entry holes in the middle front cover of the drive module
3	Bracket for attaching the drive module from top.
4	Cardboard box

LCL filter module package



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

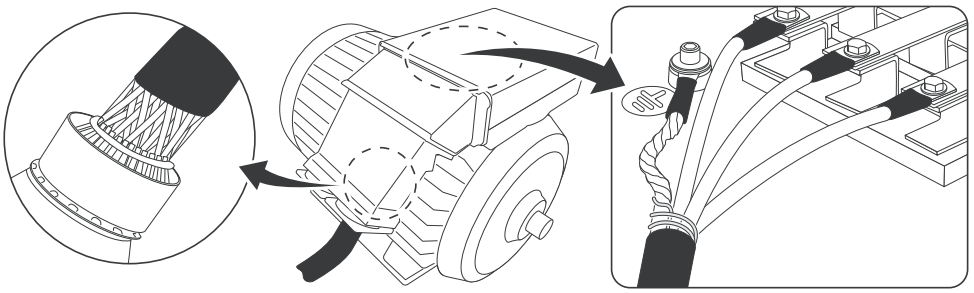
Checking the delivery

Check that all items listed in section *Moving and unpacking the unit* are present.

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

Installing the motor cable at the motor end

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



Checking the insulation of the assembly

Drive

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

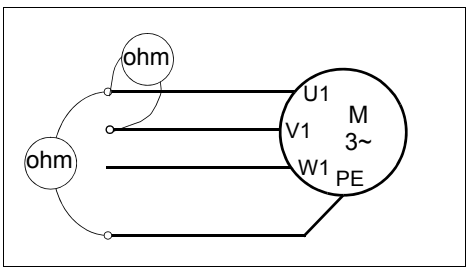
Input cable

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

Motor and motor cable

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

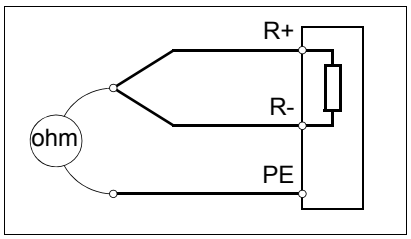
1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Check that the motor cable is disconnected from the drive output terminals T1/U2, T2/V2 and T3/W2.
3. Measure the insulation resistance between each phase conductor and then between each phase conductor and the Protective Earth conductor using a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, consult the manufacturer's instructions. **Note:** Moisture inside the motor casing will reduce the insulation resistance. If you suspect moisture, dry the motor and repeat the measurement.



Brake resistor and resistor cable

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Check that the resistor cable is connected to the resistor, and disconnected from the brake chopper output terminals.
3. At the brake chopper end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



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

EMC filter (option +E202)

A drive with EMC filter +E202 (ARFI-10) connected can be installed to a symmetrically grounded TN-S system. If you install the drive to another system, you may need to disconnect the EMC filter. See sections:

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

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

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

Ground-to-phase varistor

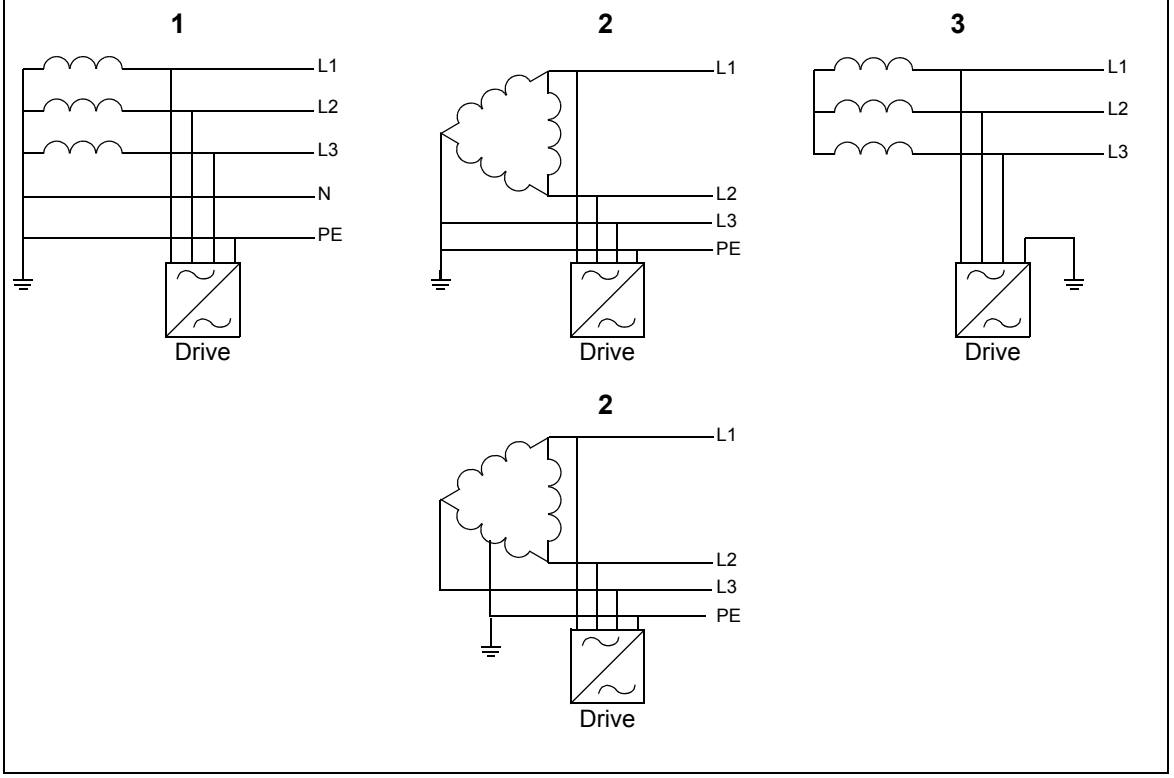
A drive with the ground-to-phase varistor connected can be installed to a symmetrically grounded TN-S system. If you install the drive to another system, you may need to disconnect the varistor. See sections

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

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

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

Frame size	Symmetrically grounded TN systems (TN-S systems) [1]	Corner-grounded and midpoint-grounded delta systems [2]	IT systems (ungrounded or high-resistance-grounded [>30 ohms]) [3]
R11	Do not disconnect EMC AC or VAR screws. Do not disconnect .ARFI-10.	Do not install the drive on a corner-grounded or mid-point grounded system.	Disconnect EMC AC and VAR screws. Disconnect ARFI-10



Note: These are the EMC filter and varistor screws.

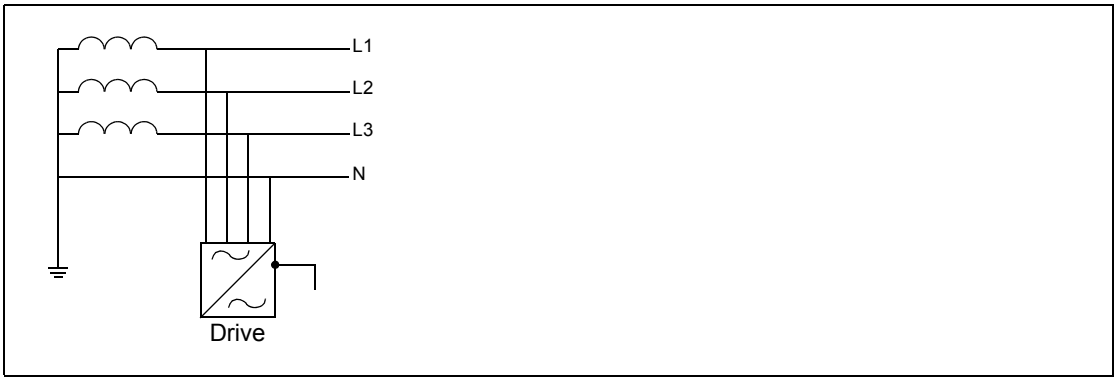
Frame size	EMC filter (+E202)	Ground-to-phase varistor screws
R11	EMC AC	VAR

Guidelines for installing the drive to a TT system

The drive can be connected on a TT system under these conditions:

1. Residual current device has been installed in the supply system.
2. These screws and ARFI-10 have been disconnected. Otherwise EMC filter and ground-to-phase varistor capacitor leakage current will cause the residual current device to trip.

Frame size	EMC filter +E202	Ground-to-phase varistor screws
R11	EMC AC, ARFI-10	VAR



3AXD10000681917

Note:

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

Identifying different types of electrical power systems

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

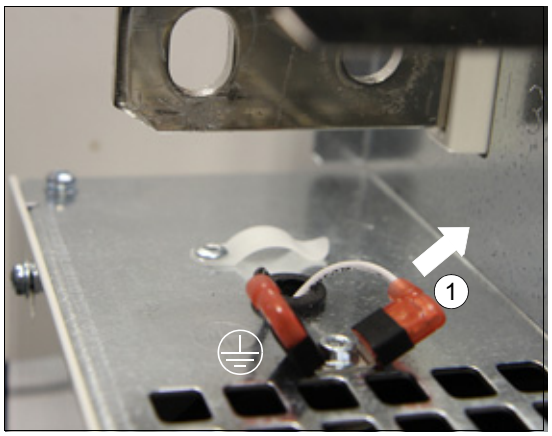
1. input voltage line to line (U_{L-L})
2. input voltage line 1 to ground (U_{L1-G})
3. input voltage line 2 to ground (U_{L2-G})
4. input voltage line 3 to ground (U_{L3-G}).

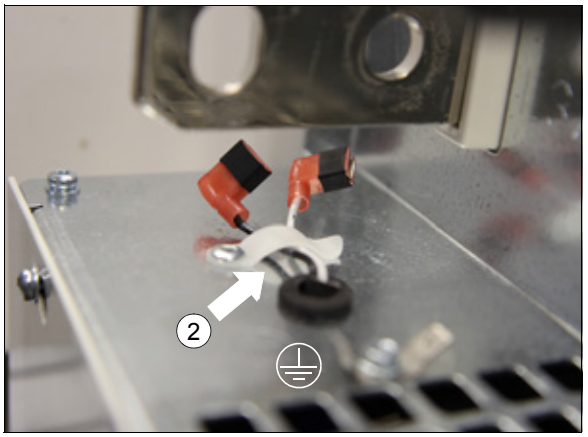
The line-to-ground voltages in relation to the line-to-line voltage of the electrical power system types are shown below.

U_{L-L}	U_{L1-G}	U_{L2-G}	U_{L3-G}	Electrical power system type
X	0.58·X	0.58·X	0.58·X	Symmetrically grounded TN system (TN-S system)
X	1.0·X	1.0·X	0	Corner-grounded delta system (nonsymmetrical)
X	0.5·X	0.5·X	0.57·X	Midpoint-grounded delta system (nonsymmetrical)
X	Varying level versus time	Varying level versus time	Varying level versus time	IT systems (ungrounded or high-resistance-grounded [>30 ohms]) nonsymmetrical

Disconnecting EMC filter and ground-to-phase varistor

EMC AC and varistor (VAR) grounding wires are located at the top of the circuit board compartment. Disconnect them (1) and attach them with the nearby plastic clamp (2). Remove the ARFI-10 filter from the cabinet,



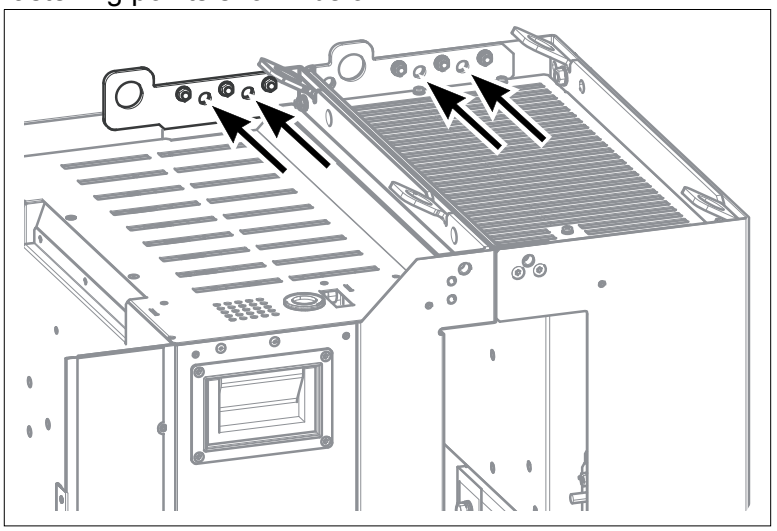


Installation alternatives

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

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

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



You can attach the modules to Rittal TS 8 cabinet with the mounting brackets delivered with the drive, see *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page *243*.

Attaching the drive module to the LCL filter module

See chapter *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page *243*.

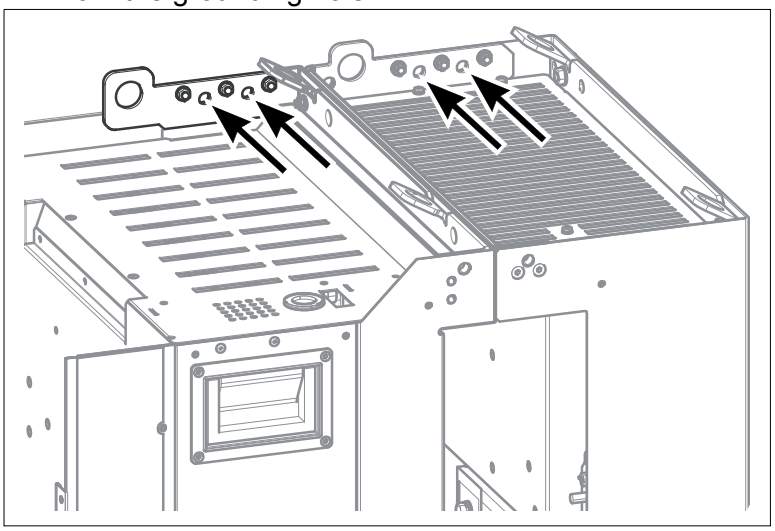
Attaching the drive module and the LCL filter module to the cabinet base

See chapter *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page *243*.

Alternatives for grounding the drive module

You can ground the drive module from its top back to the cabinet frame with these alternatives:

1. from the grounding hole



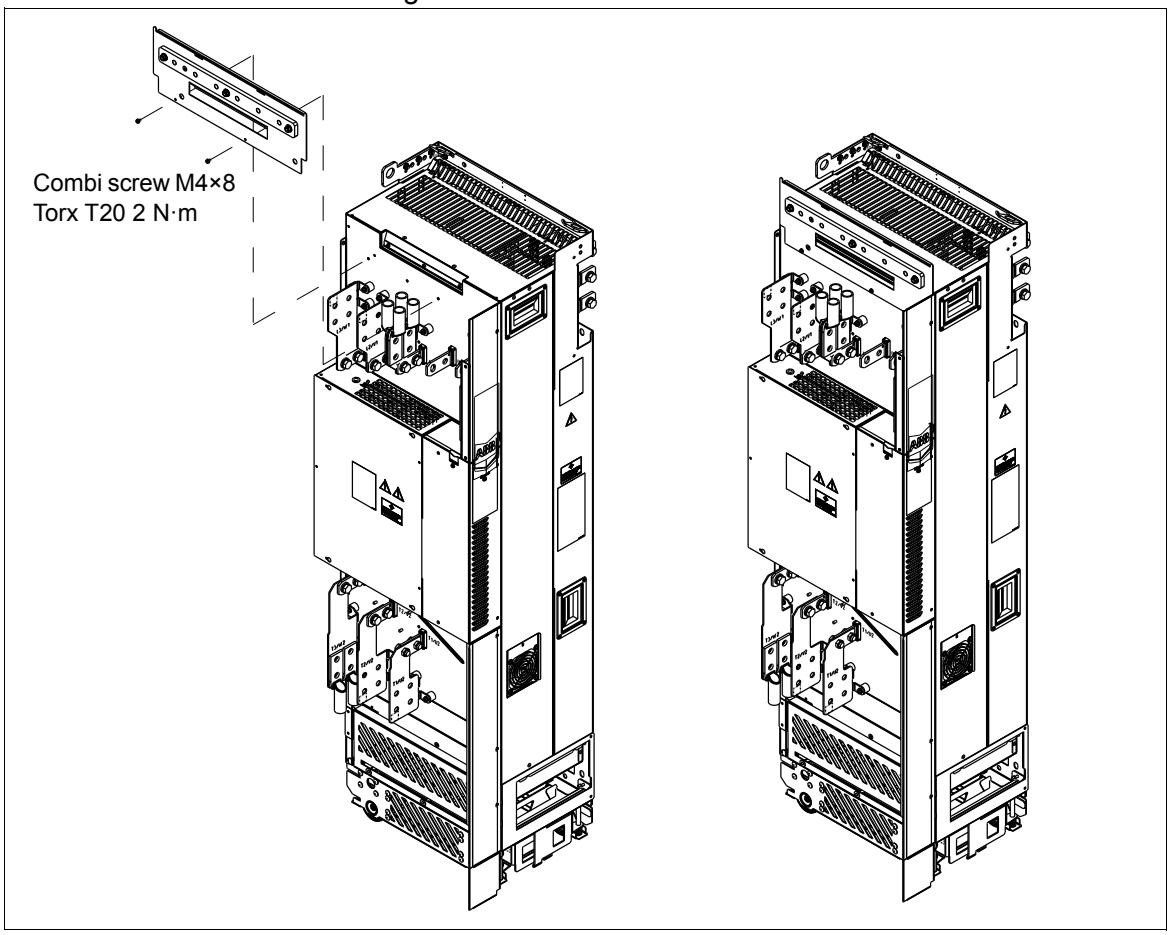
2. to a Rittal punched section with the mounting bracket.

Installing standard configuration in Rittal TS cabinet

For an installation example on how to install the drive module with clear plastic shrouds into a Rittal TS 8 cabinet, see chapter *Installation example of the standard drive module configuration* on page *131* and *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page *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 section *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on 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 properly.

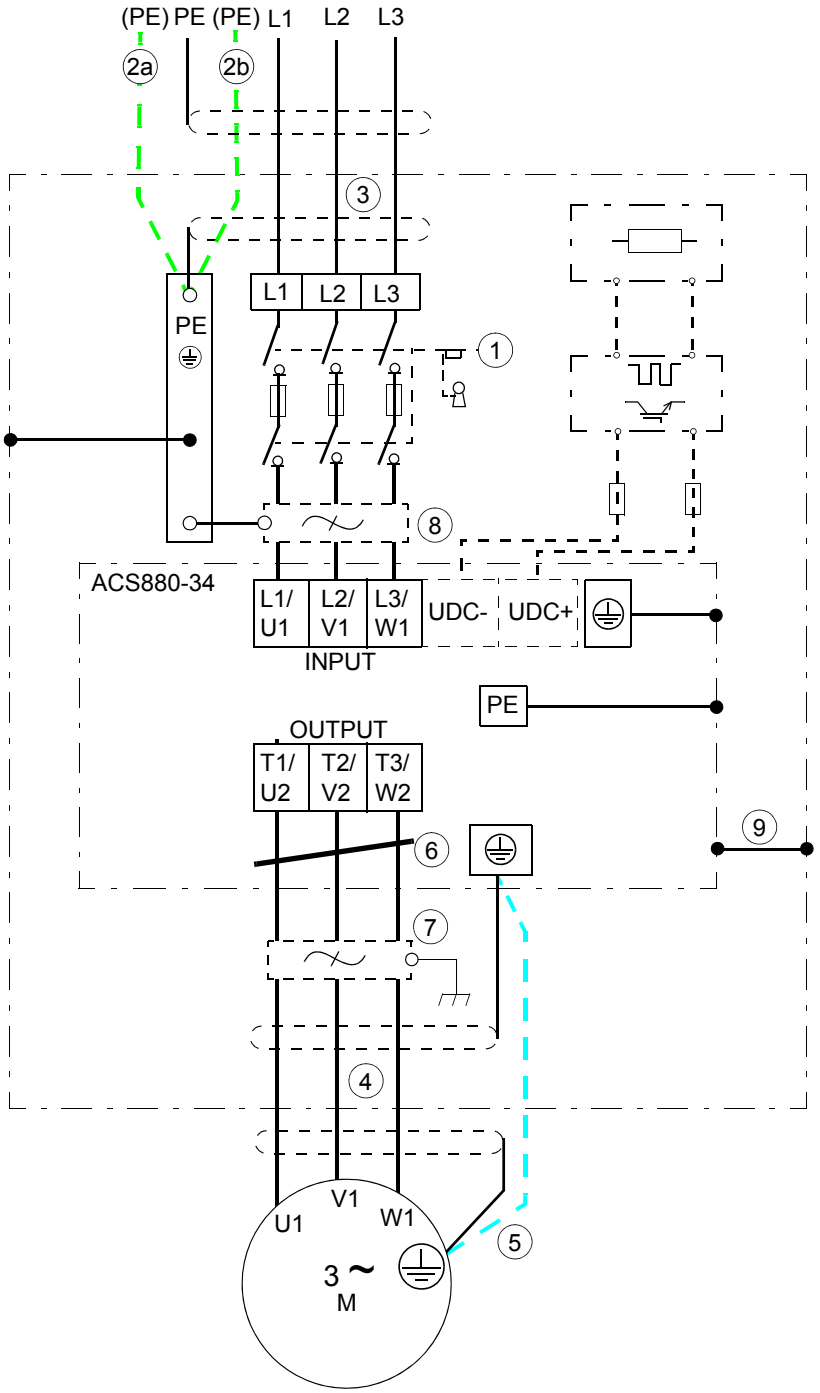
Installing the EMC filter (option +E202)

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

Connecting the power cables

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

Power cable connection diagram



1 For alternatives, see section *Selecting the supply disconnecting device* on page *58*. In the installing example of this chapter, the disconnecting device is not in the same cubicle with the drive module.

2 If a shielded cable is used (not required but recommended) and the conductivity of the shield is < 50% of the conductivity of the phase conductor, use a separate PE cable (2a) or a cable with a grounding conductor (2b).

3 We recommend 360-degree grounding at the cabinet entry if a shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.

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

5 Use a separate grounding cable if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor and there is no symmetrically constructed grounding conductor in the cable (see page *65*).

6	Common mode filter (optional, see page *59*)
7	d*u*/d*t* filter (optional, see page *239*)
8	EMC filter (option +E202, see page *93*)
9	The drive module frame must be connected to the cabinet frame. See section *Arranging the grounding inside the cabinet* on page *48* and *Alternatives for grounding the drive module* on page *91*.
10	Brake chopper
11	Brake resistors

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

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

1. Run the motor cables from the motor to the cabinet. Ground the cable shields 360° at the entry plate.
2. Twist the cable shields of the motor cables into bundles and connect them and any separate ground conductors or cables to the ground terminal of the drive module or to the cabinet ground bar.
3. Connect the phase conductors of the motor cables to terminals T1/U2, T2/V2 and T3/W2 of the drive module. For the tightening torques, see page *193*.
4. Make sure that all power is disconnected and reconnection is not possible. Use proper safe disconnect procedures according to local codes.
5. Run the input cables from the supply source to the cabinet. Ground the cable shields 360° at the entry plate.
6. Twist the cable shields of the input cables into bundles and connect them and any separate ground conductors or cables to the drive module ground terminal or to the cabinet PE busbar.
7. Connect the phase conductors of the input cables to terminals L1/U1, L2/V1 and L3/W1 of the drive module. For the tightening torques, see page *193*.
8. Brake chopper option: Run the power cables from the brake chopper to the cabinet. Ground the cable shield (if present) 360° at the entry plate. Connect the conductors to the UDC+ and UDC- terminals. For the tightening torques, see page *193*.

Connecting the control cables and installing option

modules

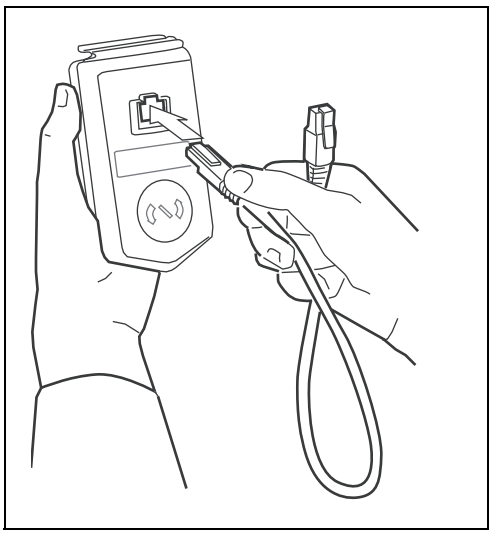
See chapter *External control unit* on page *99* or *Internal control unit (option +P905)* on page *119*.

Connecting a control panel

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

With door mounting kit (option +J410)), connect the control panel to the control unit as follows:

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



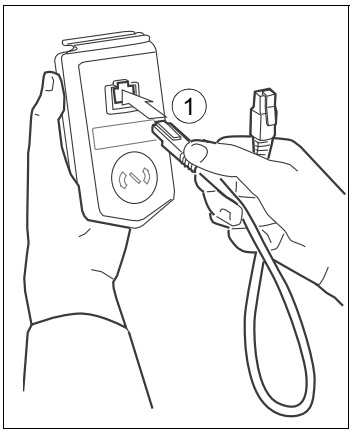
Controlling several drives from one control panel through panel bus

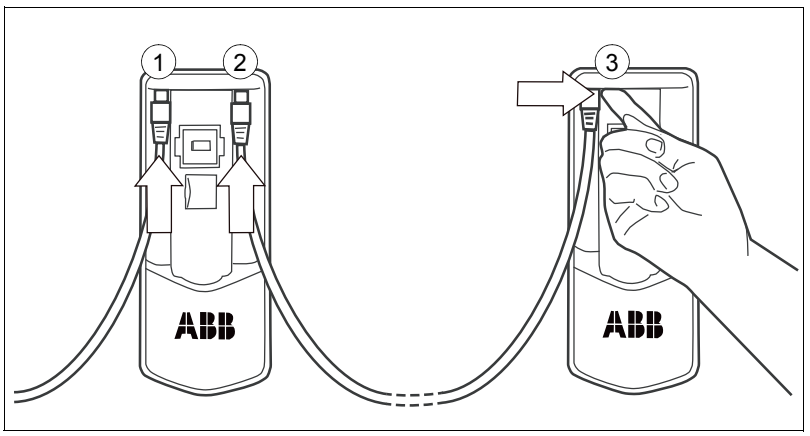
One control panel (or PC) can be used to control several drives by constructing a panel bus. An FDPI-02 module is required. For further information, see *FDPI-02 diagnostics and panel interface user's manual* (3AUA0000113618 [English]).

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

   Repeat the above for each drive.
2. With the panel connected to one drive, link the drives together using Ethernet cables. (Each panel platform has two connectors.)
3. In the last drive, switch bus termination on by moving the terminating switch into the outer position.Termination should be off on all other drives.
4. On the control panel, switch on the panel bus functionality (**Options** – **Select drive** – **Panel bus**). The drive to be controlled can now be selected from the list under **Options** – **Select drive**.

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





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

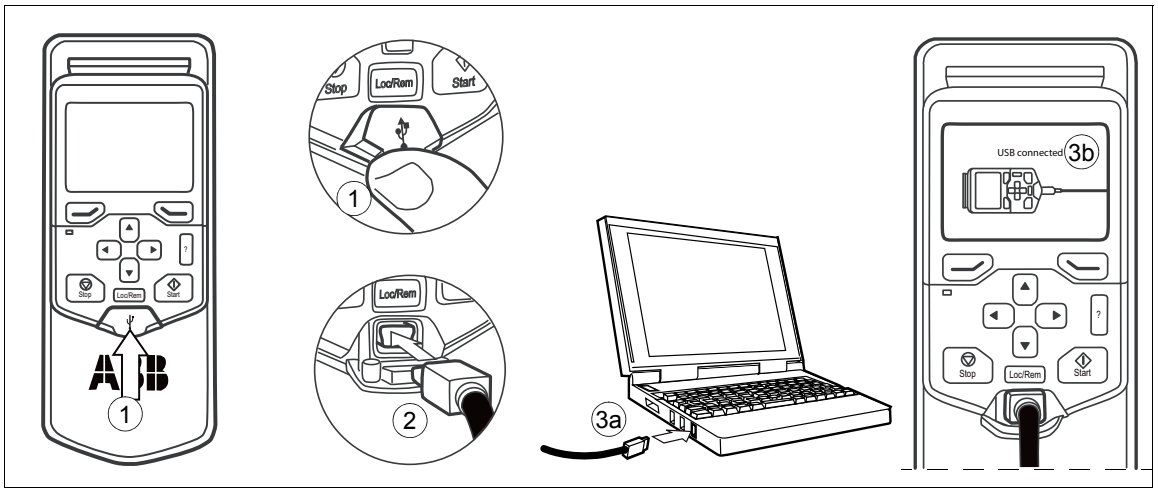
Connecting a PC

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

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

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

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



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

7

External control unit

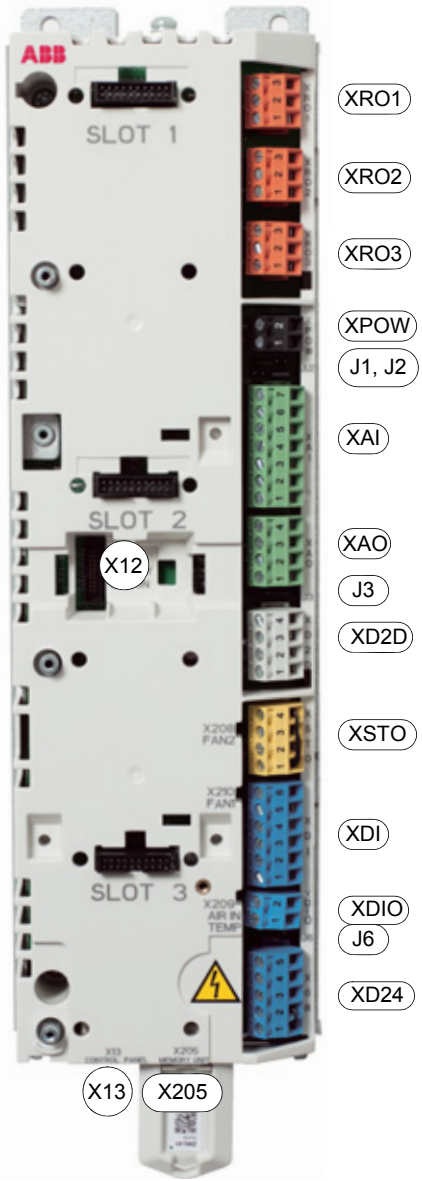
Contents of this chapter

This chapter contains:

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

Layout

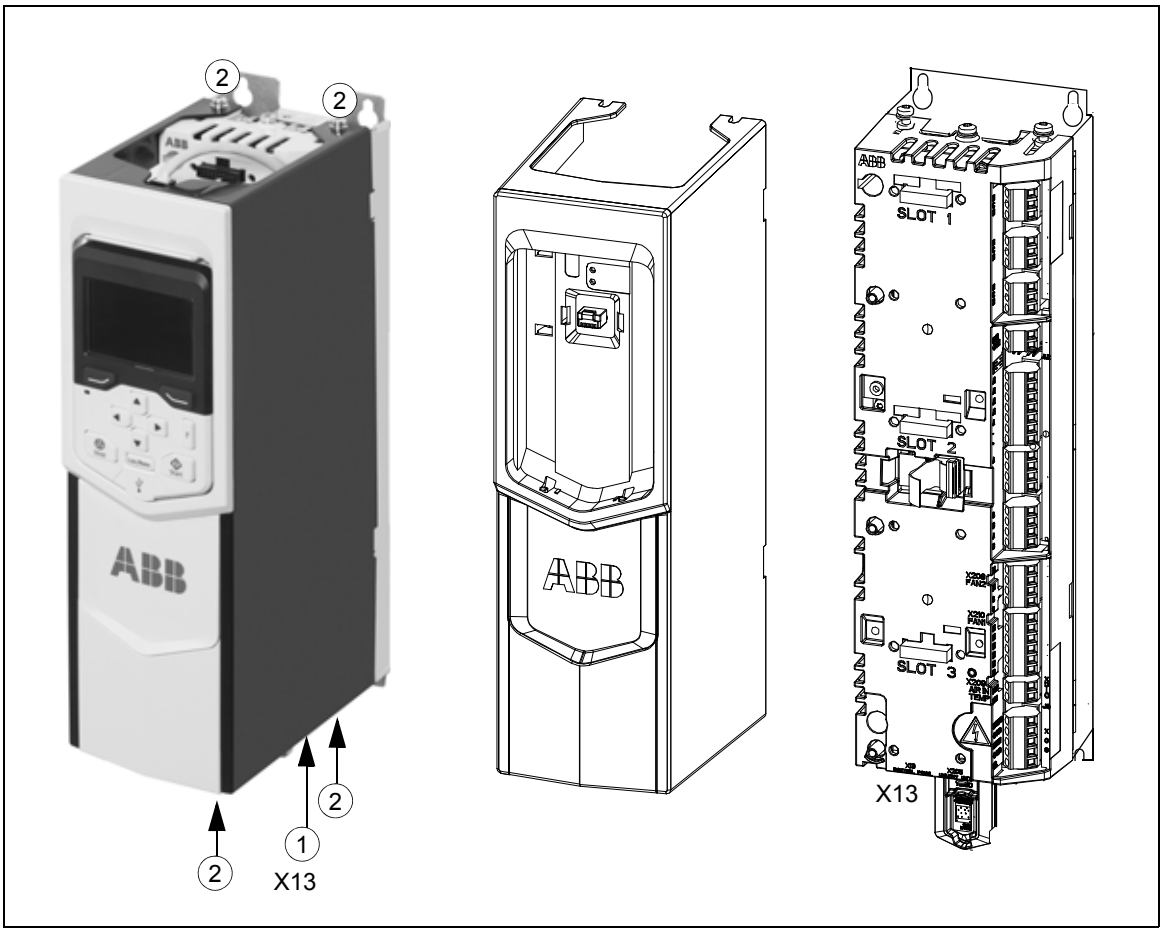
The layout of external control connection terminals of the control unit is shown below.



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

Removing the control panel holder from the external control unit

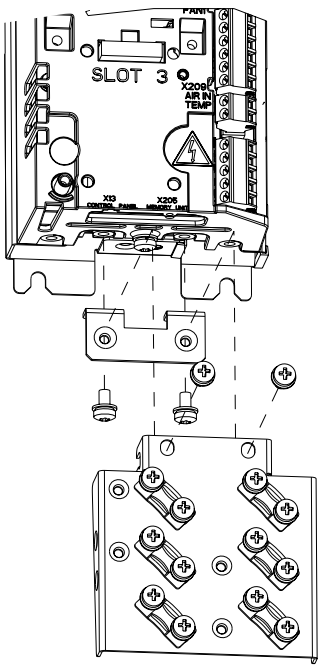
1. Disconnect the control panel cable from connector X13 on the control unit.
2. Loosen the mounting screws of the control panel holder and take the holder off.



Attaching the control cable clamp plate

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

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

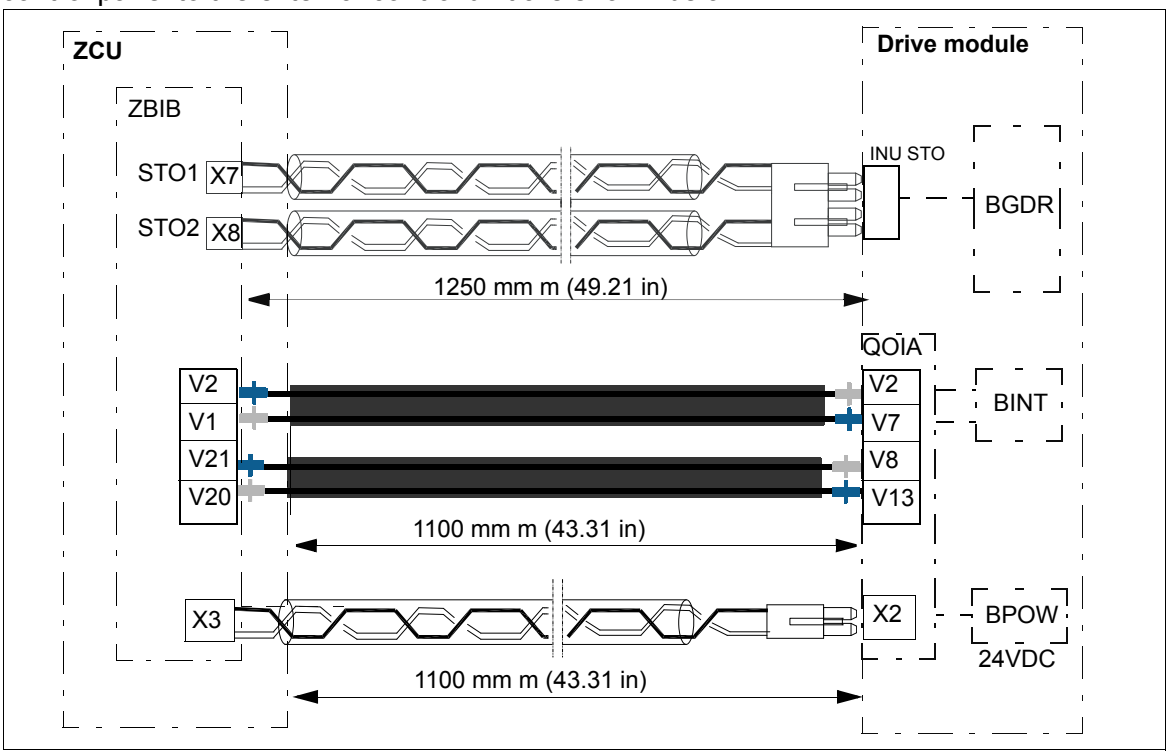


0.7 N·m
(6.2 lbf·in)

Connecting the external control unit to the drive module

External control unit connection cables

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



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

Routing the control unit cables into the drive module

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

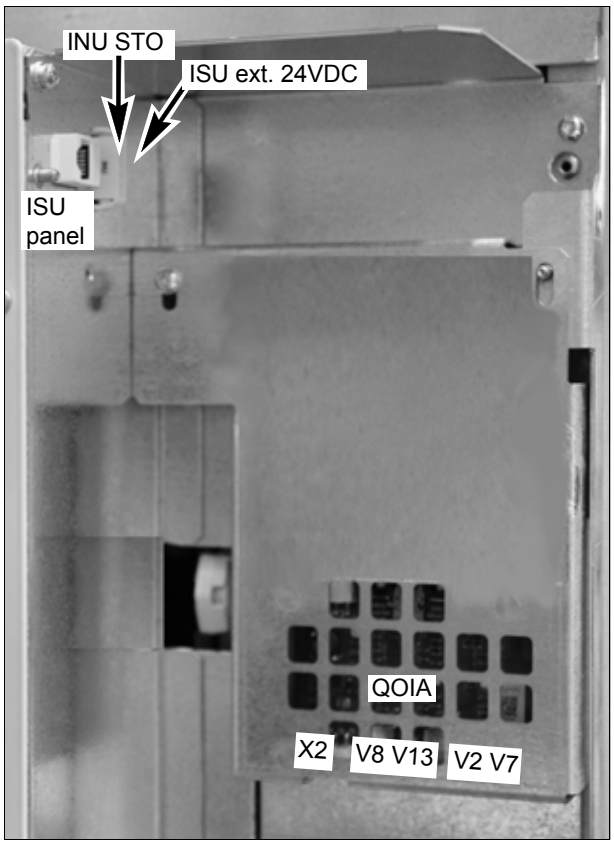
Connecting cables between the drive module and the control unit

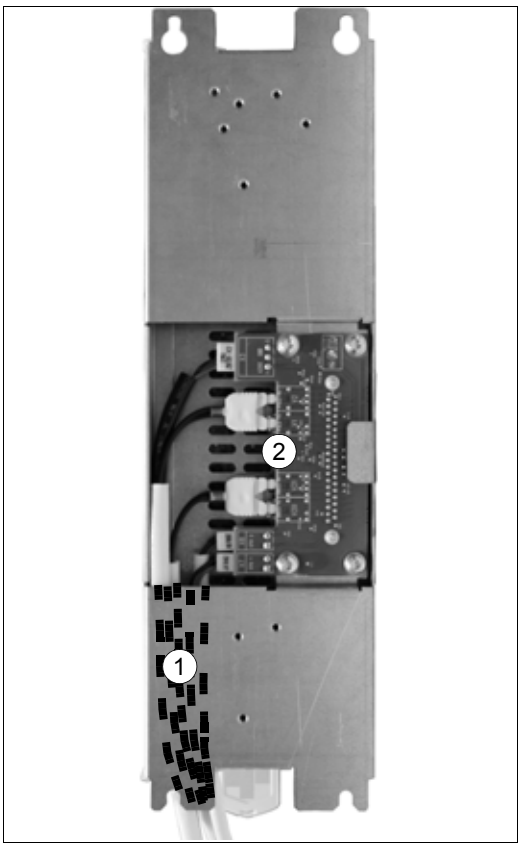
In the drive module:

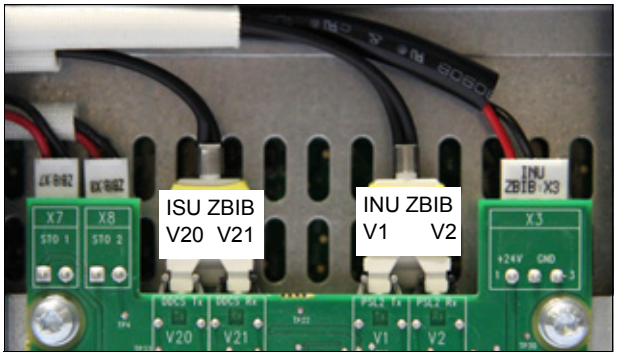
1. Connect power supply cable to terminal X2.
2. Connect the STO cable to the INU STO connector.
3. Connect the fiber optic cables to the QOIA V8, V13, V2 and V7 connectors.

In the control unit:

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







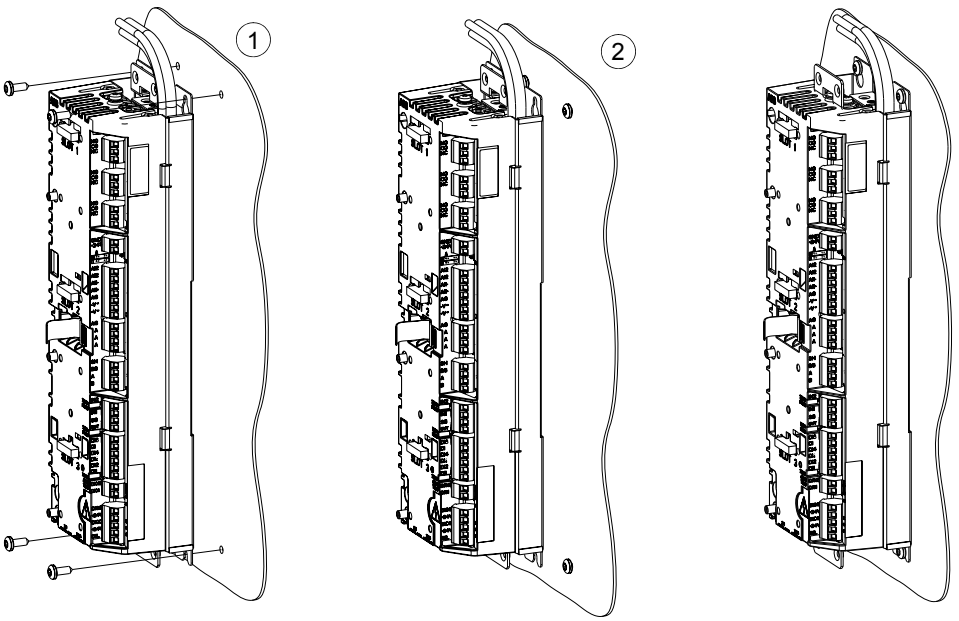
QOIA	ZBIB
X7 (STO1)	X7 (STO1)
X8 STO2)	X8 (STO2)
X2	X3
V2	V2
V7	V1
V8	V21
V13	V22

Mounting the external control unit

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

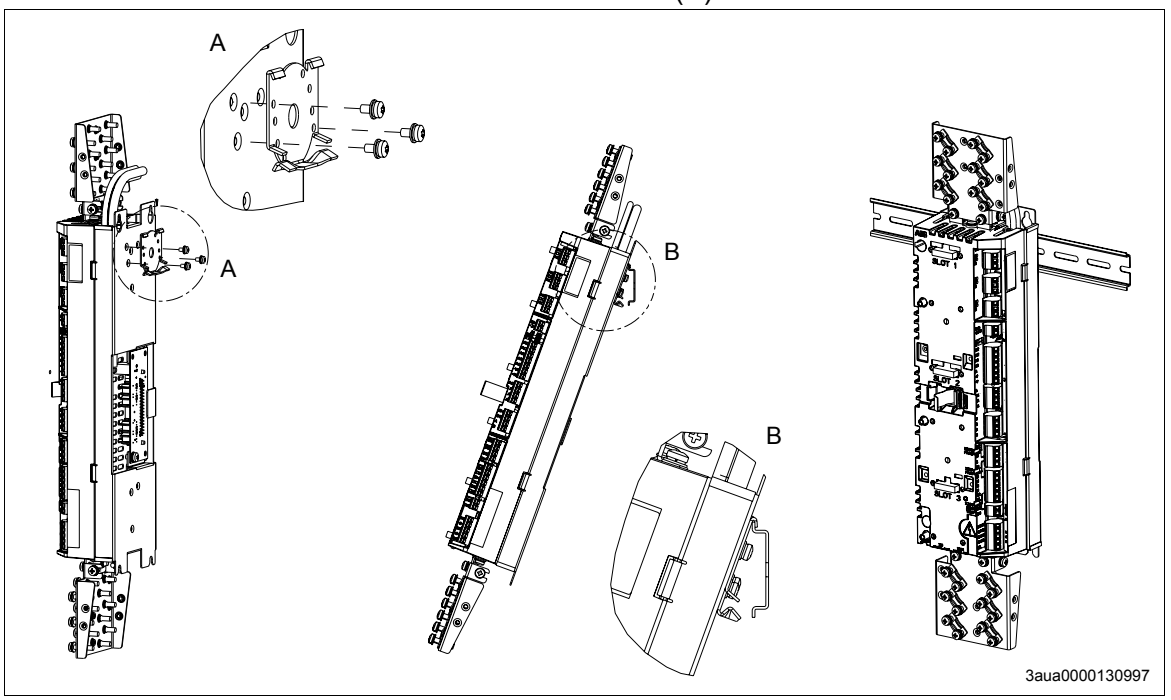
Mounting the external control unit to wall

1. Fasten the fastening screws in the wall.
2. Lift the unit onto the screws and tighten the screws.



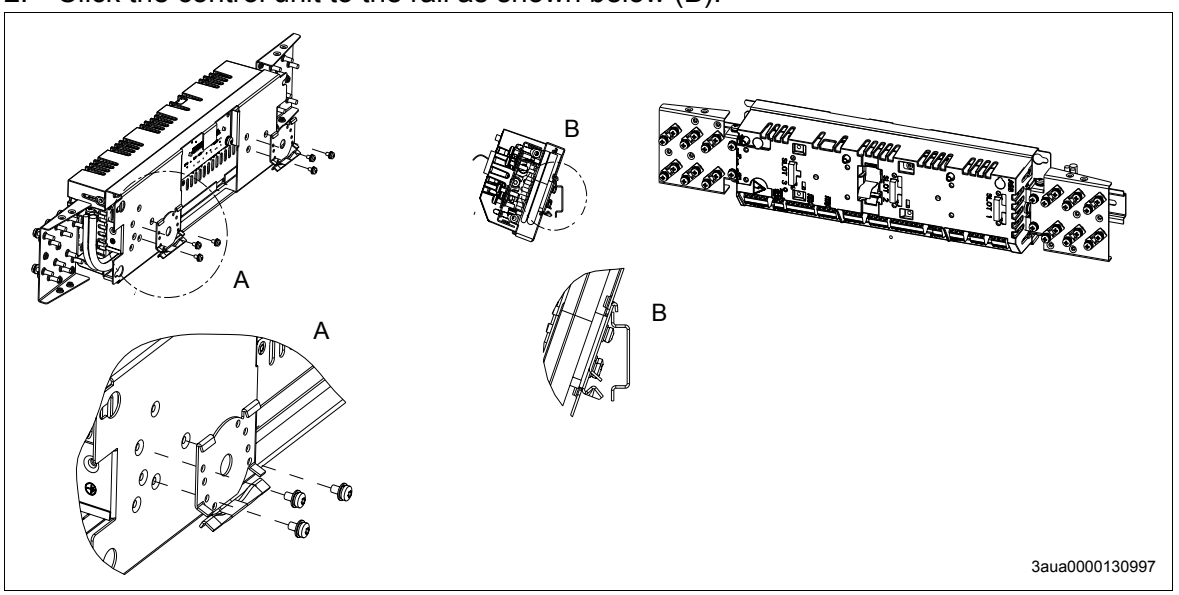
Mounting the external control unit vertically on a DIN rail

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



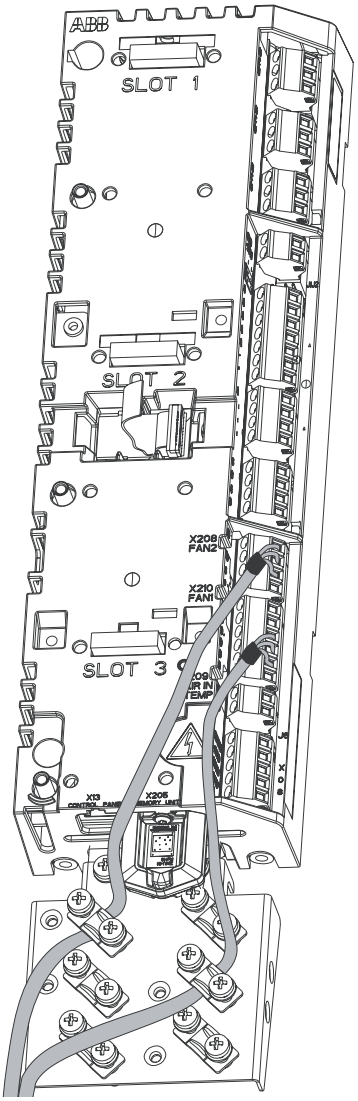
Mounting the control unit horizontally on a DIN rail

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



Connecting the control cables to the terminals of the control unit

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

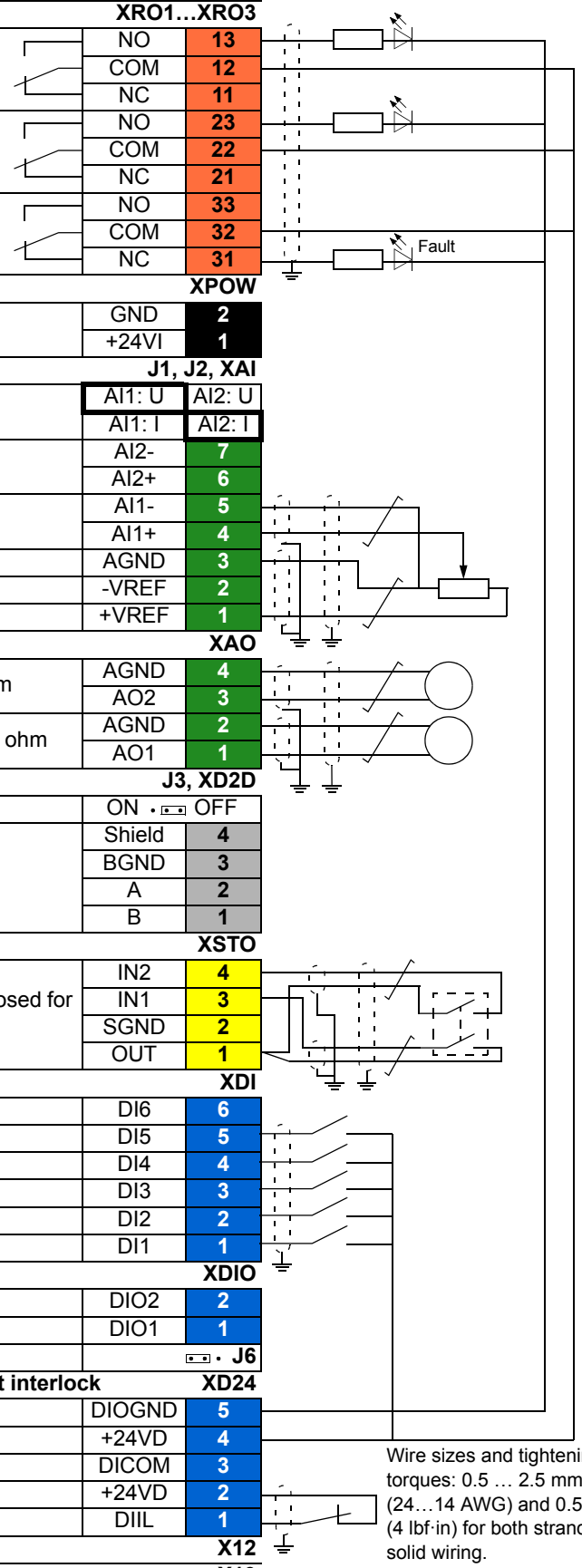


2. Ground the shields of the control cables at the clamp plate. The shields should be continuous as close to the terminals of the control unit as possible. Only remove the outer jacket of the cable at the cable clamp so that the clamp presses on the bare shield. The shield (especially in case of multiple shields) can also be terminated with a lug and fastened with a screw at the clamp plate. Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor, 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 page *108.* Use shrink tubing or insulating tape to contain any stray strands.

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

Default I/O connection diagram

Relay outputs		**XRO1…XRO3**
Ready 250 V AC / 30 V DC 2 A	NO	13
	COM	12
	NC	11
Running 250 V AC / 30 V DC 2 A	NO	23
	COM	22
	NC	21
Faulted(-1) 250 V AC / 30 V DC 2 A	NO	33
	COM	32
	NC	31
External power input		**XPOW**
24 V DC, 2 A	GND	2
	+24VI	1
Reference voltage and analog inputs		**J1, J2, XAI**
AI1/AI2 current/voltage selection	AI1: U	AI2: U
	AI1: I	AI2: I
By default not in use. 0(4)…20 mA, R_{in} = 100 ohm [2]	AI2-	7
	AI2+	6
Speed reference 0(2)…10 V, R_{in} > 200 kohm [1]	AI1-	5
	AI1+	4
Ground	AGND	3
-10 V DC, R_L 1…10 kohm	-VREF	2
10 V DC, R_L 1…10 kohm	+VREF	1
Analog outputs		**XAO**
Motor current 0…20 mA, R_L < 500 ohm	AGND	4
	AO2	3
Motor speed rpm 0…20 mA, R_L < 500 ohm	AGND	2
	AO1	1
Drive-to-drive link		**J3, XD2D**
Drive-to-drive link termination [6]	ON • ▭	OFF
Drive-to-drive link	Shield	4
	BGND	3
	A	2
	B	1
Safe torque off		**XSTO**
Safe torque off. Both circuits must be closed for the drive to start.	IN2	4
	IN1	3
	SGND	2
	OUT	1
Digital inputs		**XDI**
By default not in use.	DI6	6
Constant speed 1 select (1 = on) [5]	DI5	5
Acceleration & deceleration select [4]	DI4	4
Reset	DI3	3
Forward (0) / Reverse (1)	DI2	2
Stop (0) / Start (1)	DI1	1
Digital input/outputs		**XDIO**
Output: Running	DIO2	2
Output: Ready	DIO1	1
Ground selection [7]	▭ •	**J6**
Auxiliary voltage output, digital input interlock		**XD24**
Digital input/output ground	DIOGND	5
+24 V DC 200 mA [3]	+24VD	4
Digital input ground	DICOM	3
+24 V DC 200 mA [3]	+24VD	2
Run enable [8]	DIIL	1
Safety functions module connection		**X12**
Control panel connection		**X13**
Memory unit connection		**X205**



Wire sizes and tightening torques: 0.5 … 2.5 mm^2 (24…14 AWG) and 0.5 N·m (4 lbf·in) for both stranded and solid wiring.

See page 109 for notes.

Notes:

1) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected by jumper J1. Change of setting requires reboot of control unit.
2) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected by jumper J2. Change of setting requires reboot of control unit.
3) Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
4) 0 = Acceleration/deceleration ramps defined by parameters 23.12/23.13 in use.
   1 = Acceleration/deceleration ramps defined by parameters 23.14/23.15 in use.
5) Constant speed 1 is defined by parameter 22.26.
6) Must be set to ON when the drive is the last unit on the drive-to-drive (XD2D) link.
7) Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats). See also *Ground isolation diagram* on page *117*.
   • DICOM connected to DIOGND. • DICOM and DIOGND separate.
8) See section *DIIL input (XD24:1)* on page *111*.

External power supply for the control unit

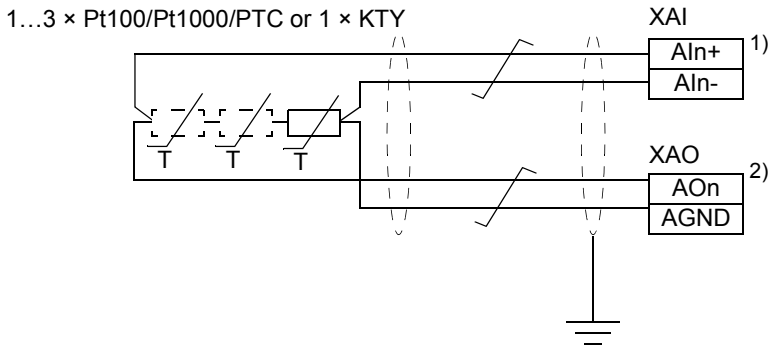
External +24 V (2 A) power supply for the control unit can be connected to terminal block XPOW. Using an external supply is recommended if

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

See also the firmware manual, parameter **95.04**.

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

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

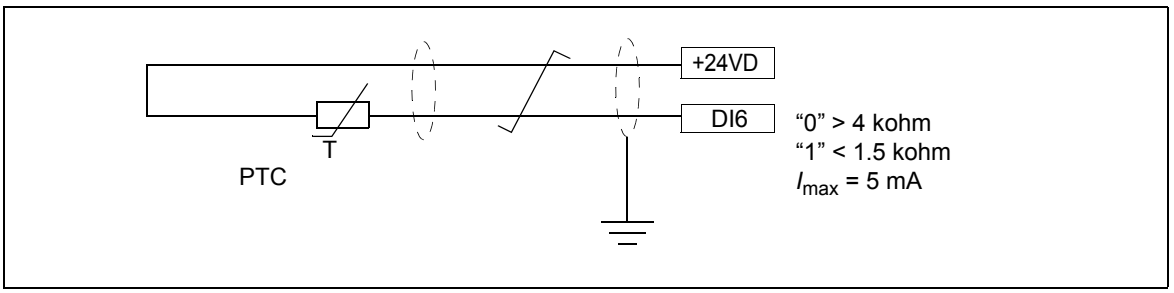


1. Set the input type to voltage with switch J1 for analog input AI1or with J2 for analog input AI2. Set the appropriate analog input unit to V (volt) in parameter group **12 Standard AI**.
2. Select the excitation mode in parameter group **13 Standard AO**.

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

DI6 (XDI:6) as PTC sensor input

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



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

DIIL input (XD24:1)

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

Drive-to-drive link (XD2D)

The drive-to-drive link is a daisy-chained RS-485 transmission line that can be used for

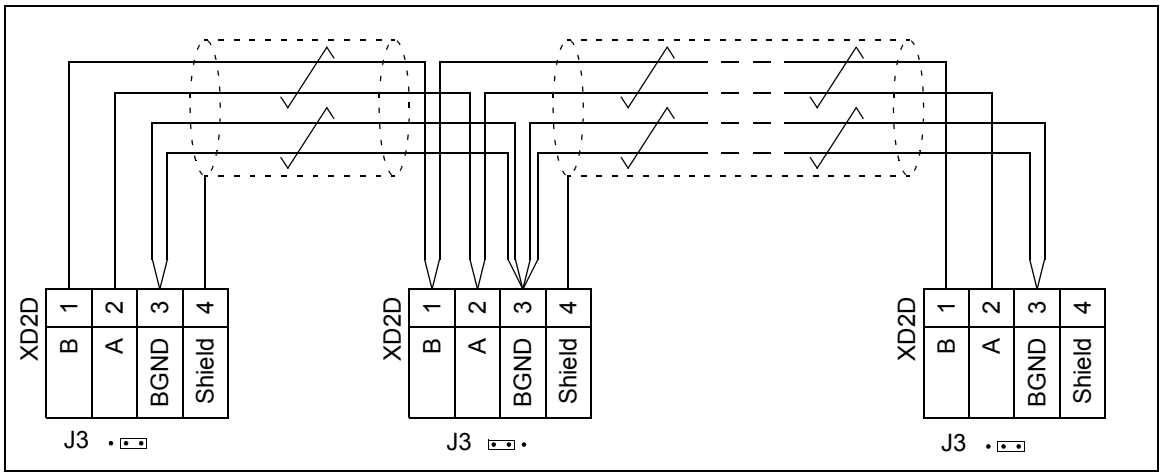
- basic master/follower communication with one master drive and multiple followers
- fieldbus control through the embedded fieldbus interface (EFB), and
- drive-to-drive (D2D) communication implemented by application programming.

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

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

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

The following diagram shows the wiring of the drive-to-drive link.



Safe torque off (XSTO)

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

See also chapter *Safe torque off function* on page *217*.

Safety functions module connection (X12)

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

Installing the control panel holder back onto the external control unit

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

Installing optional modules

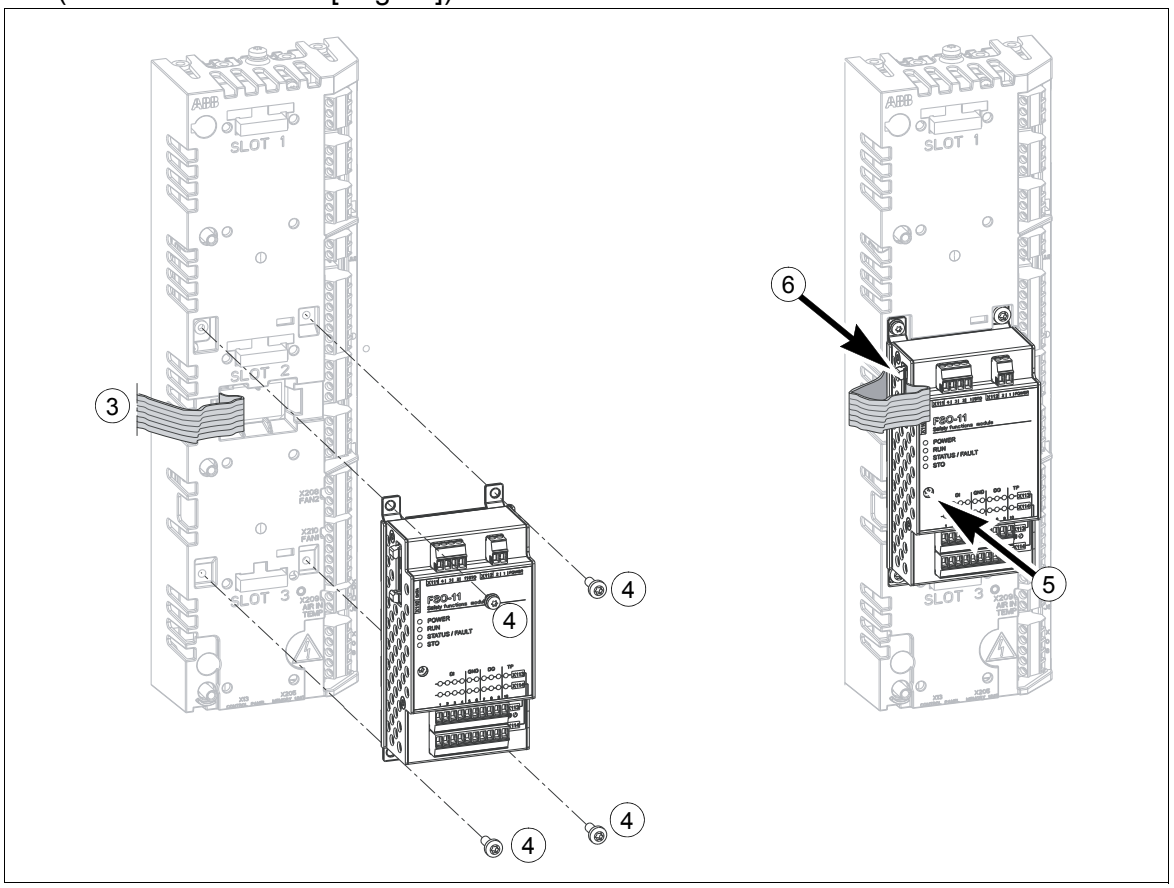
Installing the FSO safety functions module (option +Q973)

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

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start work.
2. If the bottom plate of the FSO-xx module looks different from that in the drawing below, remove the bottom plate and attach the alternative bottom plate from the FSO package to module.
3. Connect the FSO-xx data cable to connector X12 on the control unit.
4. Attach the FSO-xx module to Slot 2 with four screws.

5. Tighten the FSO module electronics grounding screw to 0.8 N·m. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.
6. Connect the FSO-xx data cable to FSO-xx connector X110.
7. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.
8. Connect the external +24 V power supply cable to connector X112.
9. Connect the other wires as shown in *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

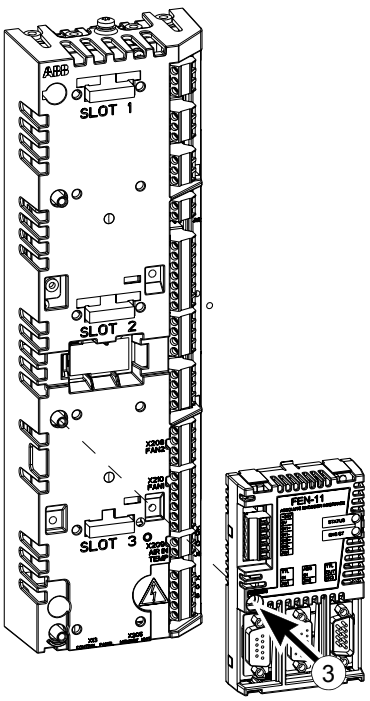


Installing I/O extension, fieldbus adapter and pulse encoder interface modules – external control unit

See page 38 for the available slots for each module.

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

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



Wiring the optional modules

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

Technical data (ZCU-14)

Power supply (XPOW)

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

Relay outputs RO1…RO3 (XRO1 … XRO3)

Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG)
250 V AC / 30 V DC, 2 A
Protected by varistors

+24 V output (XD24:2 and XD24:4)

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

Digital inputs DI1…DI6 (XDI:1 … XDI:6)

Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG)
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Input type: NPN/PNP (DI1…DI5), NPN (DI6)
Hardware filtering: 0.04 ms, digital filtering up to 8 ms
DI6 (XDI:6) can alternatively be used as an input for PTC sensors.
“0” > 4 kohm, “1” < 1.5 kohm
I_{max}: 15 mA (for DI6 5 mA)

Start interlock input DIIL (XD24:1)

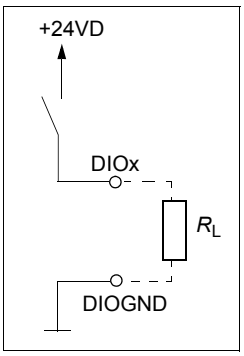
Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG)
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Input type: NPN/PNP
Hardware filtering: 0.04 ms, digital filtering up to 8 ms

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 **11**.

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



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

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

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

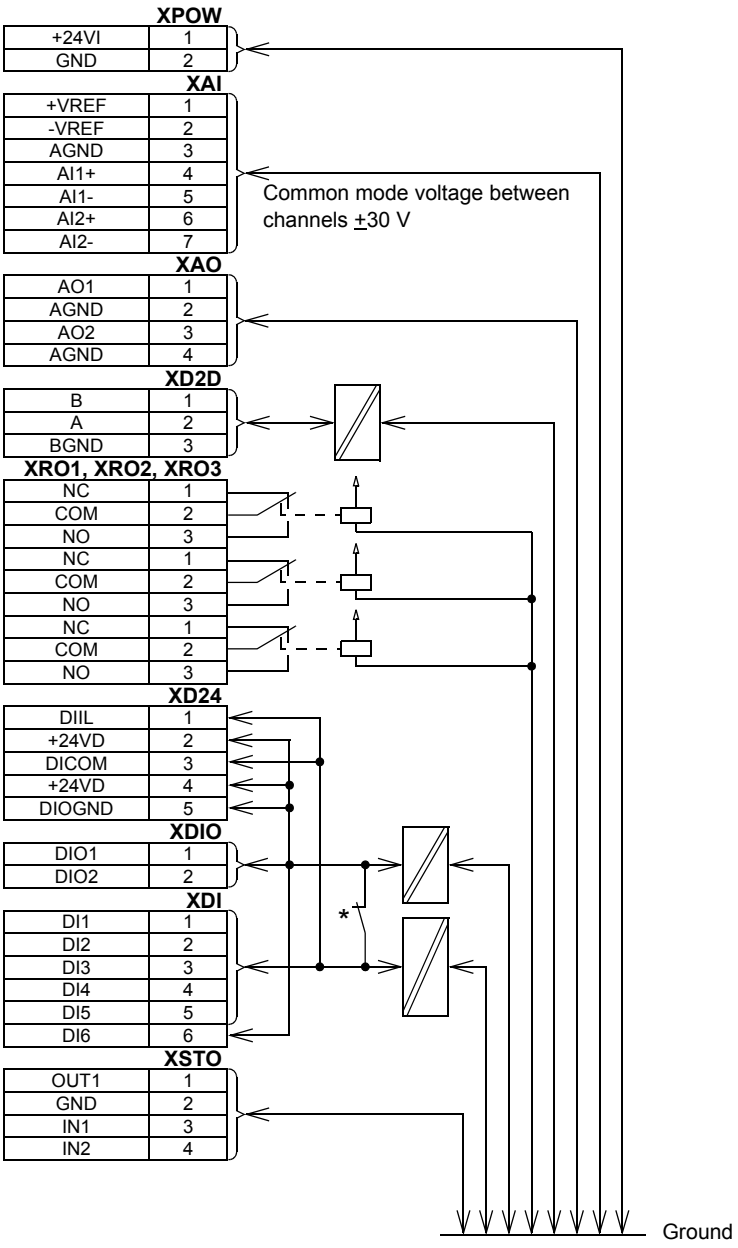
Current/voltage input mode selection by jumpers. See page *100*.

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

Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG) 0…20 mA, R_{load} < 500 ohm Frequency range: 0…300 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
Drive-to-drive link (XD2D)	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485 Maximum cable length of the link: 50 m Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842 Transmission rate: 8 Mbit/s Termination by jumper
Embedded Modbus RTU XD2D	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485 Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842 Transmission rate: 9.6…115.2 kbit/s Termination by switch
Safe torque off connection (XSTO)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG) Input voltage range: -3…30 V DC Logic levels: “0” < 5 V, “1” > 19 V For the drive to start, both connections must be closed (OUT1 to IN1 and IN2). Current consumption: 50 mA (+24 V DC, continuous) per STO channel. Maximum output current from OUT1 (24 V DC continuous): 100 mA EMC (immunity) according to IEC 61326-3-1
Control panel / PC connection	Connector: RJ-45 Cable length < 3 m (10 ft)

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

Ground isolation diagram



*** Ground selector (J6) settings**

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

7

Internal control unit (option +P905)

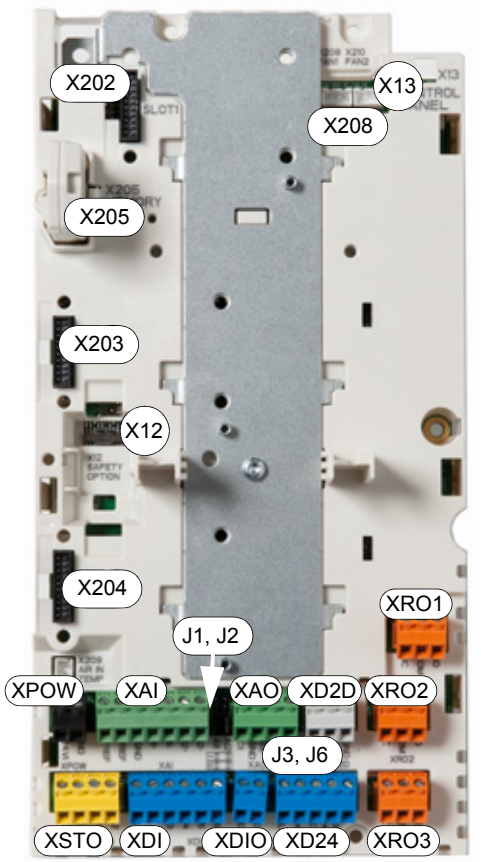
Contents of this chapter

This chapter contains:

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

Layout

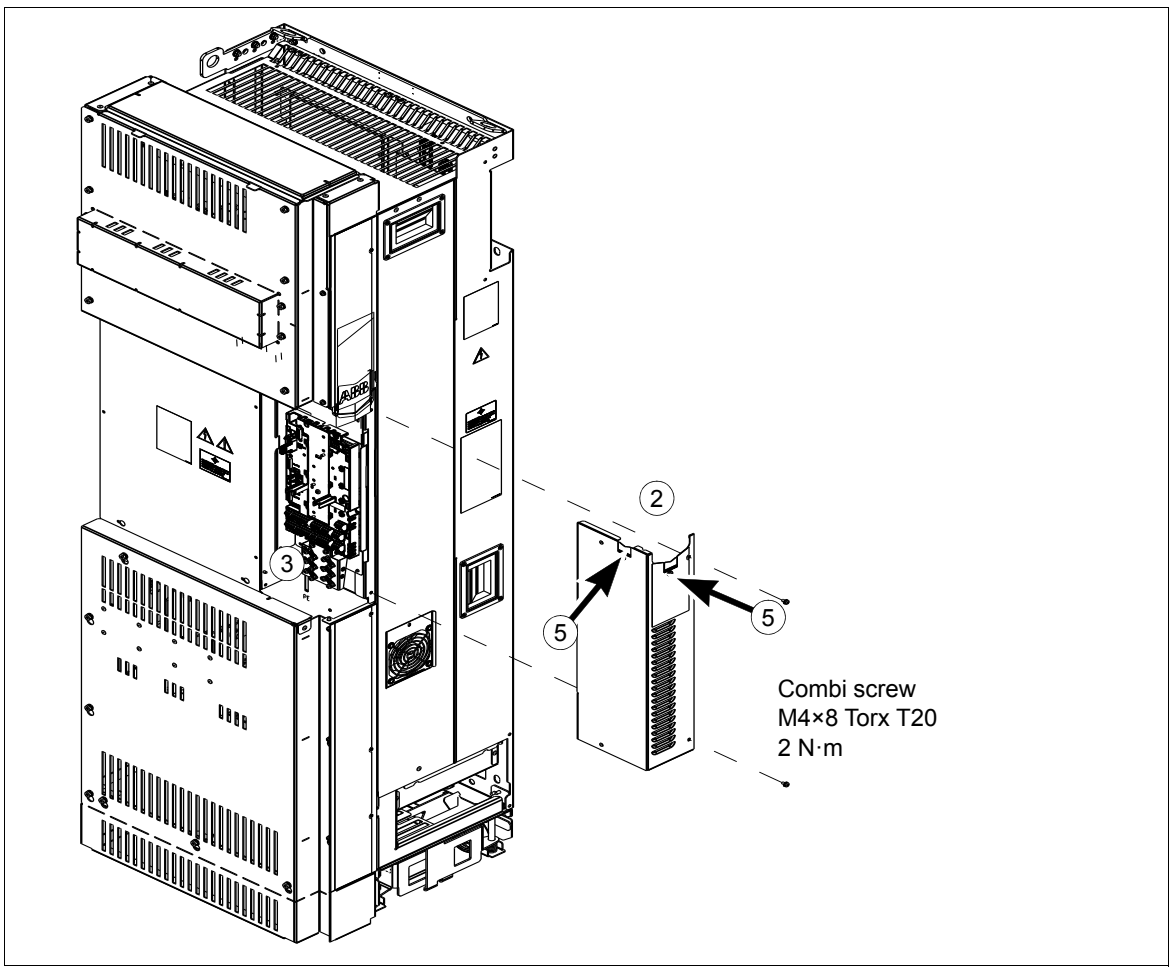
The layout of external control connection terminals of the control unit is shown below.



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

Connecting the control cables to the internal control unit (option +P905)

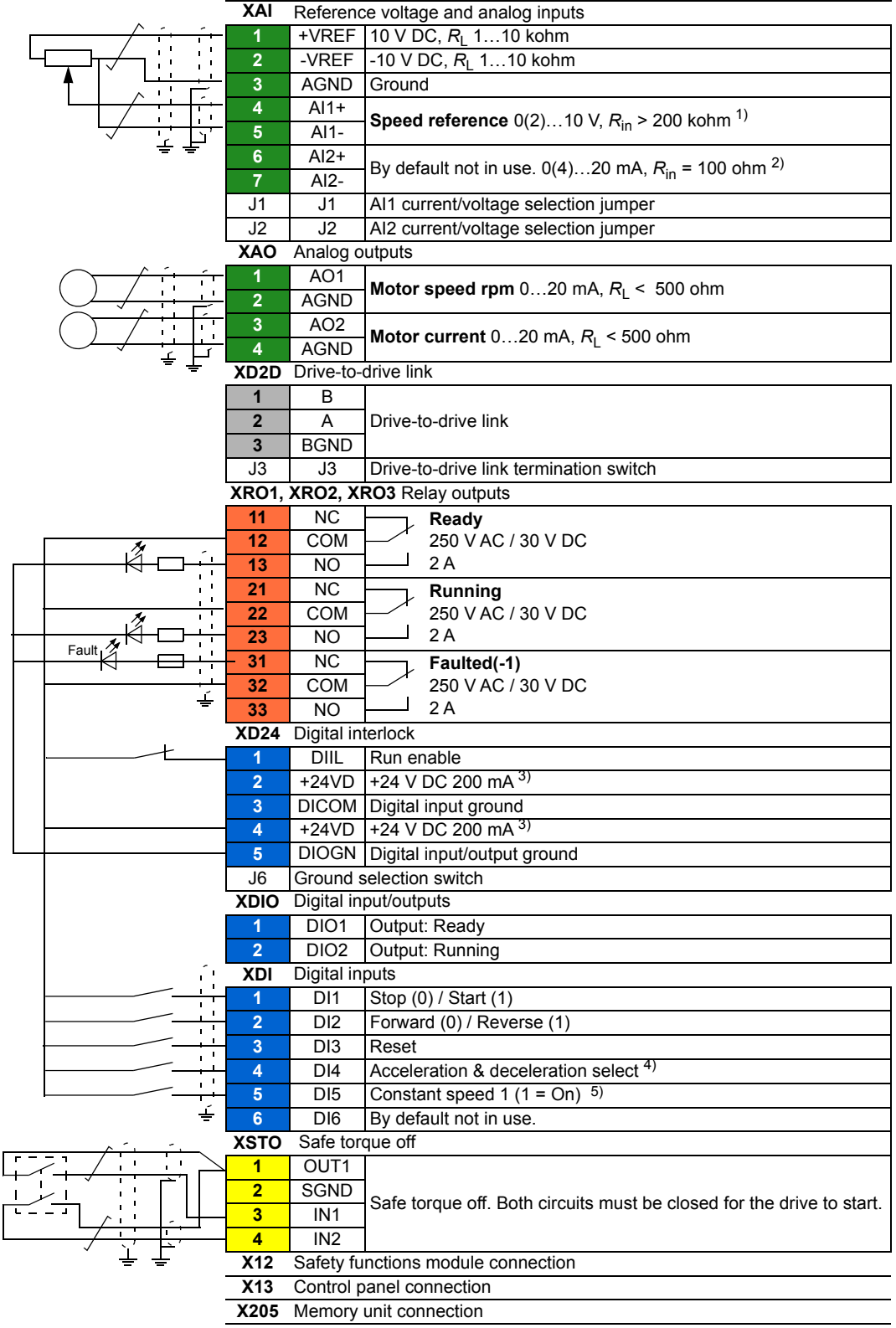
1. Ground the outer control cable shields 360 degrees at the cabinet entry plate (recommendation).
2. Remove the middle front cover of the drive module (view of standard drive module configuration below).
3. Fasten the clamp plate to the bottom of the control unit with two screws from front, see *Attaching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



Connecting the control cables to the internal control unit (options +P905 and +0B051)

1. Remove the middle front cover of the drive module.
2. Fasten the clamp plate to the control unit with two screws from front, see *Attaching the control cable clamp plate* on page *102*.
3. Fasten the optional modules if not fastened already.
4. Lead the control cables inside the drive cabinet.
5. Route the control cables along the control cable duct from bottom or top to the control unit. A view of a drive module with full cabling panels option +H381 is shown below.
6. Ground the outer control cable shields 360 degrees at the cabinet entry plate (recommendation).
7. Ground the control cables at the clamp plate as described in Step 2 in section *Connecting the control cables to the terminals of the control unit* on page *107*.
8. Connect the conductors to the appropriate detachable terminals of the control unit (see page *123*). Use shrink tubing or insulating tape to contain any stray strands. Tighten the screws to secure the connection.
   Note: Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

Default I/O connection diagram



XPOW External power input

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

XAI Reference voltage and analog inputs

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

XAO Analog outputs

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

XD2D Drive-to-drive link

1	B	Drive-to-drive link
2	A	
3	BGND	
J3	J3	Drive-to-drive link termination switch

XRO1, XRO2, XRO3 Relay outputs

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

XD24 Digital interlock

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

XDIO Digital input/outputs

1	DIO1	Output: Ready
2	DIO2	Output: Running

XDI Digital inputs

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

XSTO Safe torque off

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

X12 Safety functions module connection

X13 Control panel connection

X205 Memory unit connection

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

Notes:

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

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

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

[4] 0 = open, 1 = closed

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

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

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

Jumpers and switches

Jumper/ Switch	Description	Positions
J1 (AI1)	Determines whether analog input AI1 is used as a current or voltage input.	 Current (I)
		 Voltage (V)
J2 (AI2)	Determines whether analog input AI2 is used as a current or voltage input.	 Current (I)
		 Voltage (U)
J3	Drive-to-drive link termination. Must be set to terminated position when the drive is the last unit on the link.	 Bus is terminated.
		 Bus is not terminated.
J6	Common digital input ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). See the *Ground isolation diagram* on page *130*.	 DICOM and DIOGND connected (default).  DICOM and DIOGND separated.

See

- page *109* for description of external power supply
- page *110* for description of AI1 and AI2 as Pt100 and KTY84 sensor inputs (XAI, XAO)
- page *111* for DI6 (XDI:6) as PTC sensor input
- page *111* for DIIL input (XD24:1)
- page *112* for Safe torque off (XSTO)
- page *112* for Safety functions module connection (X12)
- Technical data of the connectors.

Drive-to-drive link (XD2D)

The drive-to-drive link is a daisy-chained RS-485 transmission line that can be used for

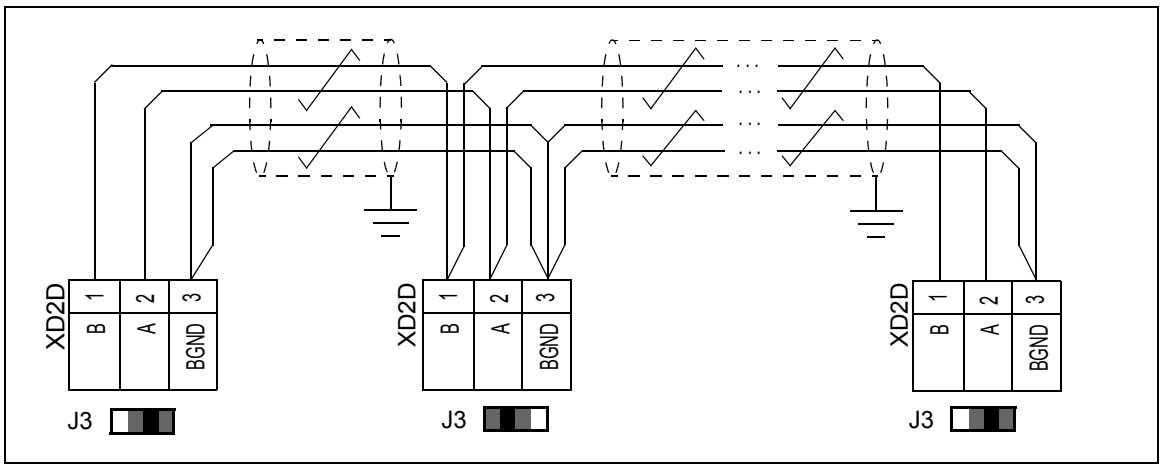
- basic master/follower communication with one master drive and multiple followers
- fieldbus control through the embedded fieldbus interface (EFB), and
- drive-to-drive (D2D) communication implemented by application programming.

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

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

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

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



Installing optional modules

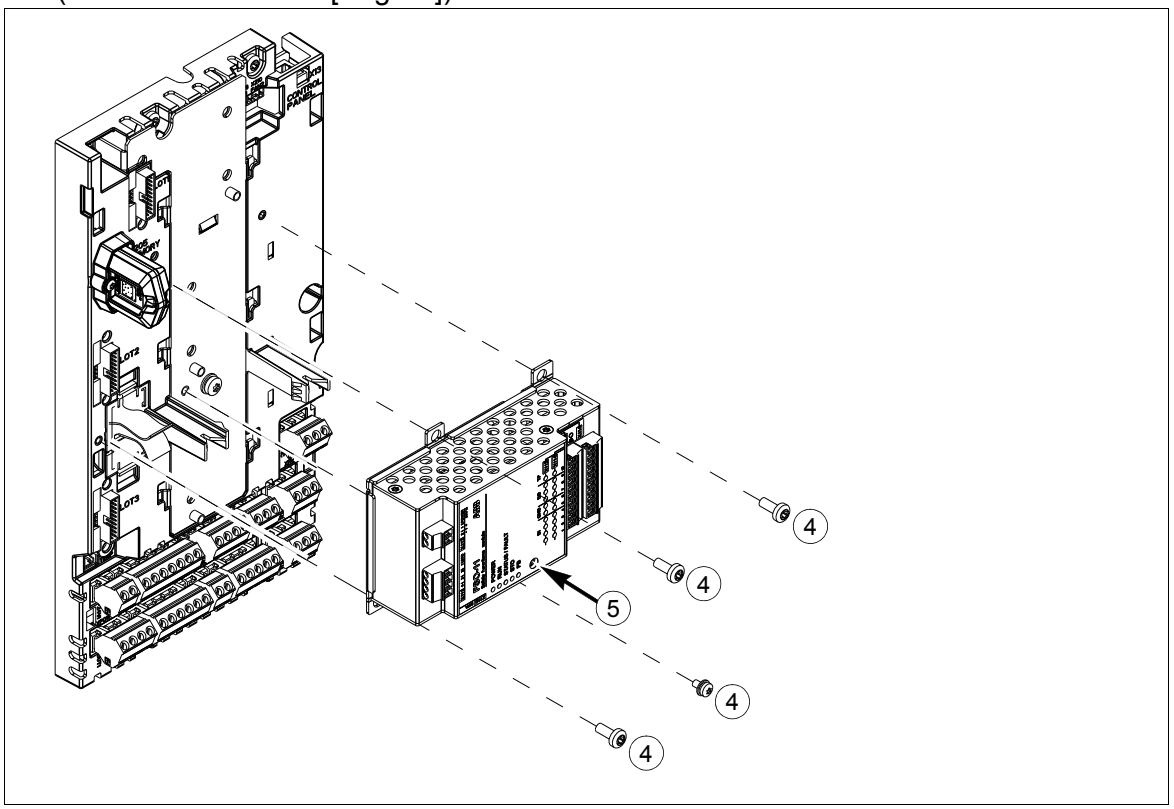
Installing the FSO safety functions module (option +Q973)

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

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

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

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

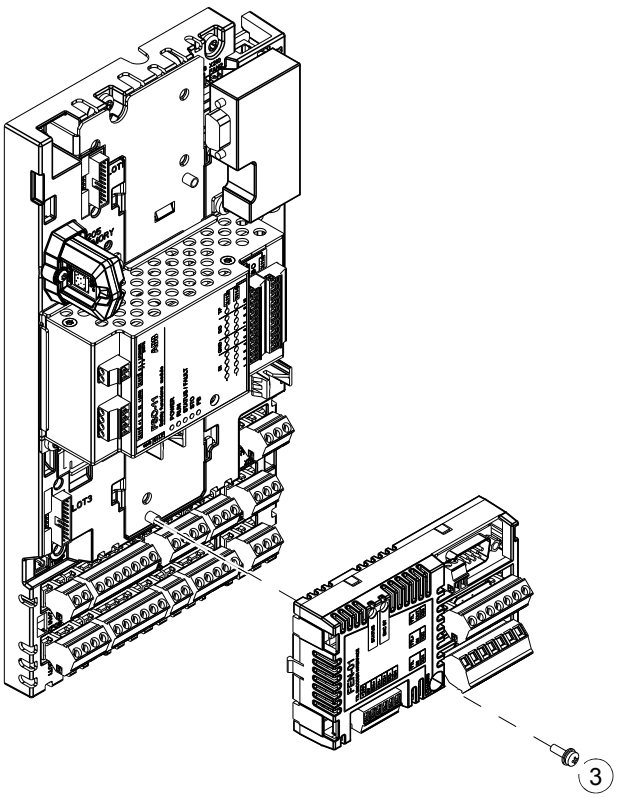


Installing I/O extension, fieldbus adapter and pulse encoder interface modules

See page *38* for the available slots for each module.

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

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



Wiring the optional modules

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

Technical data (ZCU-12)

Power supply (XPOW)

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

Relay outputs RO1…RO3 (XRO1 … XRO3)

Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG)
250 V AC / 30 V DC, 2 A
Protected by varistors

+24 V output (XD24:2 and XD24:4)

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

Digital inputs DI1…DI6 (XDI:1 … XDI:6)

Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG)
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Input type: NPN/PNP (DI1…DI5), NPN (DI6)
Hardware filtering: 0.04 ms, digital filtering up to 8 ms
DI6 (XDI:6) can alternatively be used as an input for PTC sensors.
“0” > 4 kohm, “1” < 1.5 kohm
I_{max}: 15 mA (for DI6 5 mA)

Start interlock input DIIL (XD24:1)

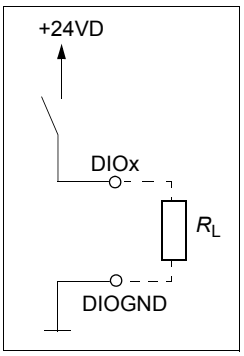
Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG)
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Input type: NPN/PNP
Hardware filtering: 0.04 ms, digital filtering up to 8 ms

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 **11**.

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



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

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

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

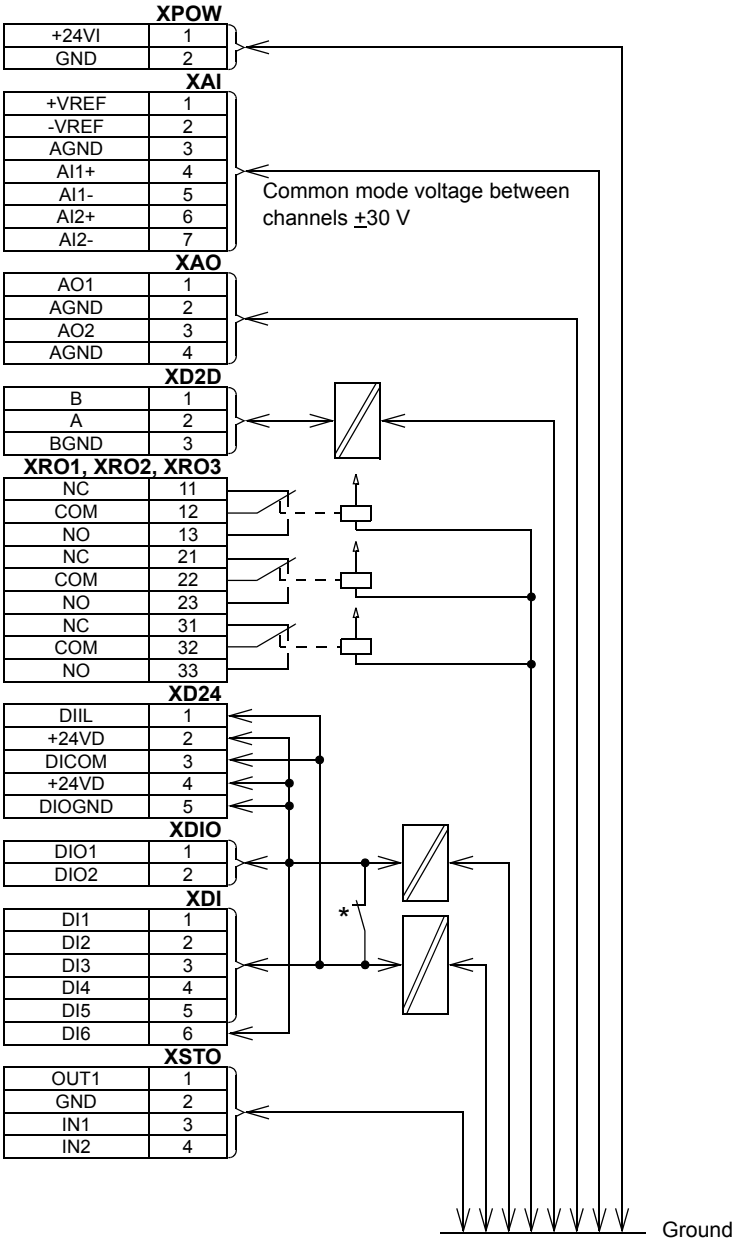
Current/voltage input mode selection by jumpers. See page *124*.

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

Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG) 0…20 mA, R_{load} < 500 ohm Frequency range: 0…300 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
Drive-to-drive link (XD2D)	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485 Maximum cable length of the link: 50 m Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842 Transmission rate: 8 Mbit/s Termination by jumper
Embedded Modbus RTU XD2D	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485 Cable type: Shielded twisted pair cable with twisted pair for data and a wire or pair for signal ground, nominal impedance 100…165 ohm, for example Belden 9842 Transmission rate: 9.6…115.2 kbit/s Termination by switch
Safe torque off connection (XSTO)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG) Input voltage range: -3…30 V DC Logic levels: “0” < 5 V, “1” > 17 V For the drive to start, both connections must be closed (OUT1 to IN1 and IN2). Current consumption 50 mA (+24 V DC, continuous) per STO channel Maximum output current from OUT1 (24 V DC continuous): 100 mA EMC (immunity) according to IEC 61326-3-1
Control panel / PC connection	Connector: RJ-45 Cable length < 3 m (10 ft)

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

Ground isolation diagram



***Ground selector (J6) settings**

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

9

Installation example of the standard drive module configuration

Contents of this chapter

In this chapter, the drive module is installed in a 800 mm wide Rittal TS 8 cabinet in a bookshelf way of mounting. The module is placed in an upright position on the cabinet bottom with its front facing the cabinet door. Available alternative ABB parts are also given.

Limitation of liability

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

Safety

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

Required parts

Drive module standard parts		
• Drive module • Fastening brackets (2 pcs) • Pedestal guide plates (2 pcs) • Telescopic extraction and insertion ramp • Fastening screws and insulators in a plastic bag • External control unit		
Rittal parts / Alternative ABB parts		
Rittal part code	**Qty (pcs)**	**Description**
TS 131 800	1	Enclosure without mounting plate, bottom plates and side panels. Includes supports for installing air baffles.
TS 7967.000 (one set = four pieces)	1	Spacers for roof plates. / ABB roof
TS 8612.580	1	Punched section with mounting flange, outer 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* on page *176*.
ABB air outlet kit 800 mm 3AUA0000125203 (IP20) 3AUA0000114968 (IP42)	2	See section *Air outlet kits* on page *178*.
Customer-made parts (not ABB or Rittal products)		
Air baffles	4	See section *Air baffles for the standard drive module* on page *212*.
Bottom plate	1	See section *Bottom plate* on page *211*.

Required tools

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

Overall flowchart of the installation process

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 a cabinet on page 133.*
2	Install the auxiliary components (such as mounting plates, air baffles, switches, busbars etc.).	The component manufacturer’s instructions *Preventing the recirculation of hot air* on page *52*.

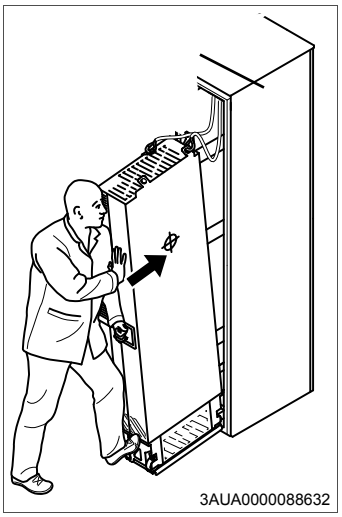
3	Attach the drive module and LCL filter module to the cabinet	*Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page *243*. *Connecting the power cables and installing the shrouds on page 134* *Connecting the power cables* on page *93*.
4	Connect the power cables and clear plastic shrouds to the drive module. Connect the power supply cable to the LCL filter cooling fan.	
5	Mount the external control unit.	*Mounting the external control unit,* page *105*
6	Connect the control cables.	*Connecting the control cables to the terminals of the control unit,* page *107*
7	Install the remaining parts, for example, cabinet doors, side plates, etc.	The component manufacturer's instructions.

Installing the drive module and LCL filter module into a cabinet

See appendix *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page *243* and *ACS880-34 quick installation guide* (3AXD500000212453 [English]).

- Attach the plinth to the floor.
- Attach the cabinet frame to the plinth.
- Make the bottom plate with 360-degree grounding entries for power cables.
- Attach the bottom plate to the cabinet.
- Attach the punched section to the back of the cabinet frame.
- Attach the mounting brackets to the punched section.
- Install the pedestal to the LCL filter module.
- Install the cooling fan to the LCL filter module.
- Attach the LCL filter module pedestal guide plate to the cabinet bottom plate.
- Attach the telescopic insertion ramp to the pedestal guide plate.
- To prevent the LCL filter module from falling, attach its lifting lugs with chains to the cabinet frame.
- Push the LCL filter module carefully into the cabinet along the telescopic insertion 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



- Unfasten the insertion ramp and attach the LCL filter module to bottom plate.
- Attach the drive module pedestal guide plate to the cabinet bottom plate.
- Attach the telescopic insertion ramp to the pedestal guide plate.
- Remove the sheeting from the clear plastic shrouds of the drive module from both sides.
- Install the top metallic shroud to the drive module.
- Install the back shrouds to the drive module.
- To prevent the drive module from falling, attach its lifting lugs with chains to the cabinet frame.
- Push the driver module carefully into the cabinet along the telescopic insertion ramp. Work preferably with help from another person as shown above. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
- Unfasten the insertion ramp and attach the drive module to the bottom plate.
- Attach the LCL filter module and drive module to the punched section.
- Attach LCL filter module to the side of drive module from top and bottom. Reinstall the cover.
- Connect the LCL filter busbars to the drive module busbars with the connecting busbars.
- Connect the LCL filter fan power supply cable to connector FAN3:LCL.
- Connect the power cables and install the shrouds as described in section *Connecting the power cables and installing the shrouds* on page *134*.
- Install the external control unit and connect the control cables as described in chapter *Installation instructions* on page *77*.
- Install the air baffles.

Connecting the power cables and installing the shrouds

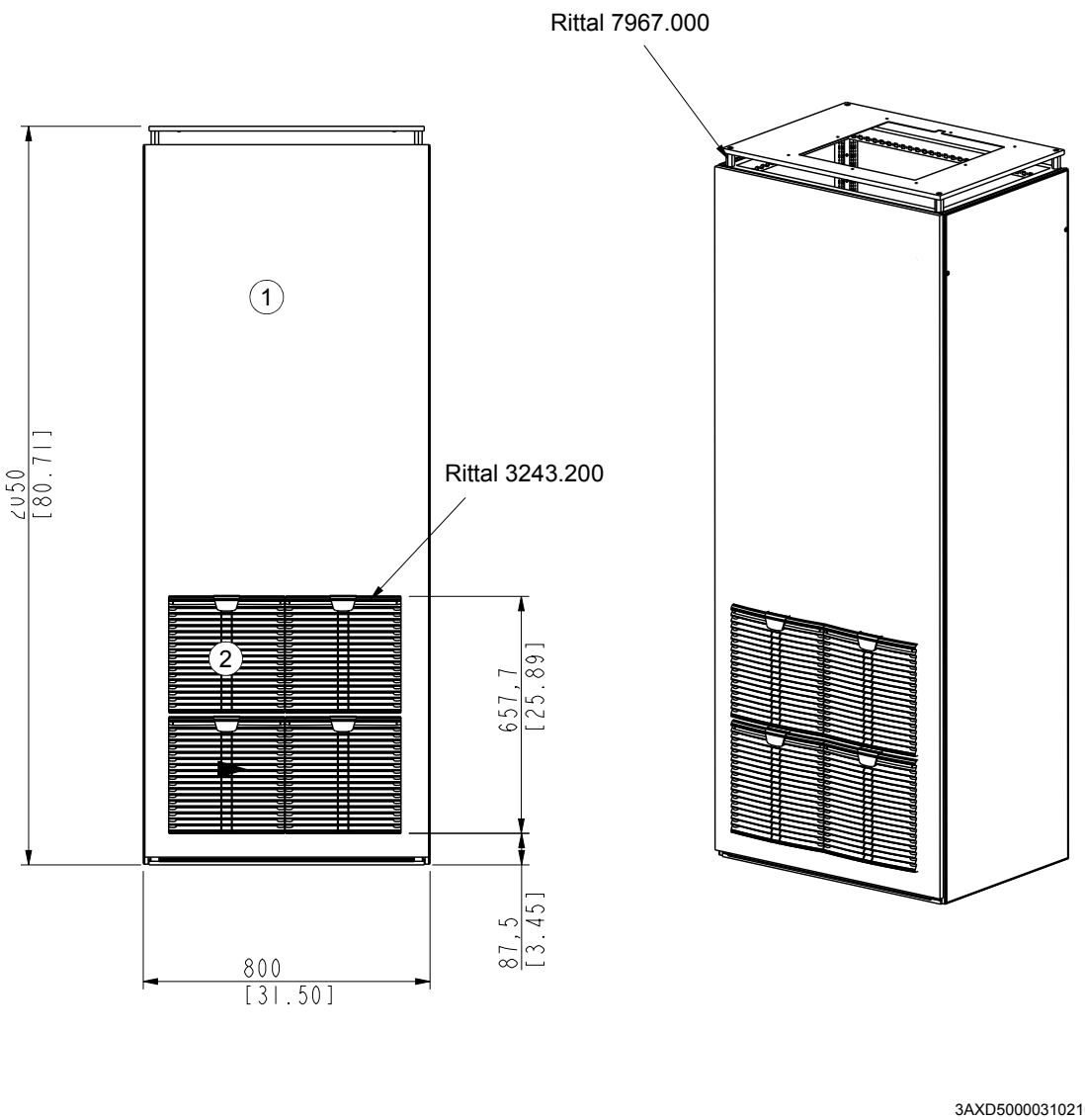
Step	Task (motor cables)
1	Install the grounding terminal to the drive module base.
2	Run the motor cables to the cabinet. Ground the cable shields 360 degrees at the cabinet entry

Step	Task (motor cables)
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 output clear plastic shrouds from both sides.
11	Install the shrouds to the drive module.
12	Install the lower front cover to the drive module.

Step	Task (input cables)
1	Ground the input cable shields (if present) 360 degrees at the cabinet entry.
2	Connect the twisted shields of the input cables and separate ground cable (if present) to the cabinet grounding busbar.
3	Step drill carefully sufficiently big holes to the entry clear plastic shroud for the cables to the connected. Align the holes in the vertical direction according to the alignment holes in the shroud. Smooth the hole edges. Remove the plastic sheeting from both sides of the shroud. Attach the cables firmly to the cabinet frame to prevent chafing against the hole edges.
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.
For option +H370: Do steps 6 to 11.	
6	Screw in and tighten the insulators to the drive module by hand. Install the L1/U1 connection terminal to the insulators.  **WARNING!** Do not use longer screws or bigger tightening torque than given in the installation drawing. They can damage the insulator and cause dangerous voltage to be present at the module frame. 
7	Connect the L1/U1 conductors to the L1/U1 connection terminal.
8	Install the L2/V1 connection terminal to the insulators. See the warning in step 5.
9	Connect the L2/V1 conductors to the L2/V1 connection terminal.
10	Install the L3/W1 connection terminal to the insulators. See the warning in step 5.
11	Connect the L3/W1 conductors to the L3/W1 connection terminal.
12	Install the entry clear plastic shroud. Install the front clear plastic shroud and upper front cover. Remove the cardboard protective covering from the drive module air outlet.
13	Install the side and top clear plastic shrouds to the drive module.

Installing the roof and door (Rittal parts)

This drawing shows a layout tested by ABB.



3AXD50000310210

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

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 TS 8 cabinet in a bookshelf way. The modules are placed in an upright position on the cabinet bottom with the front facing the cabinet door. Cabinet space for the additional components can be made by connecting two or more TS8 cabinets together. Available alternative ABB parts are also given.

Limitation of liability

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

Safety

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

Required parts

The parts are used in this installation example:

Drive module standard parts		
• Drive module and LCL filter module • Top guide plate • Fastening brackets (2pcs) • 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**
TS 8438.510	1	Enclosure without mounting plate, bottom plates and side panels.
TS 8108.235	1	Side panels for the cabinet
SZ/DK 7967.000 (one set = four pieces) + additional spacers	1	Spacers for roof plate. Alternative ABB roof (3AUA0000125203 [IP20], AUA0000114968 [IP42]), see section *Air outlet kits* on page *178*.
TS 8612.560 (one set = four pieces)	1	Punched section with mounting flange, outer mounting level for 600 mm horizontal
TS 8612.580 (one set = four pieces)	1	Punched section with mounting flange, outer mounting level 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 section *Air inlet kits* page *176*.
Customer-made parts (not ABB or Rittal products)		
Air baffles	4	See section *Air baffles for the standard drive module* on page *212* for the dimension drawings of the air baffles required in the cabinet.
Cabinet bottom plate	1	See section *Bottom plate* on page *211* for the dimension drawing of a customer-made bottom plate.

Required tools

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

Overall flowchart of the installation process

Step	Task	For instructions, see
1	Install the Rittal parts and drive module mechanical accessories into the cabinet.	*Installing the mechanical accessories into the cabinet* on page *139.*
3	Connect the power cables to the cabling panels.	*Connecting the power cables,* page *141.*
4	Install the drive module into the cabinet.	*Installing the drive module into the cabinet,* page *144*
5	Install the external control unit.	*Mounting the external control unit,* page *105*
6	Connect the control cables.	*Connecting the external control unit to the drive module,* page *107*
7	Install the remaining parts, for example, cabinet doors, side plates, etc.	The component manufacturer's instructions

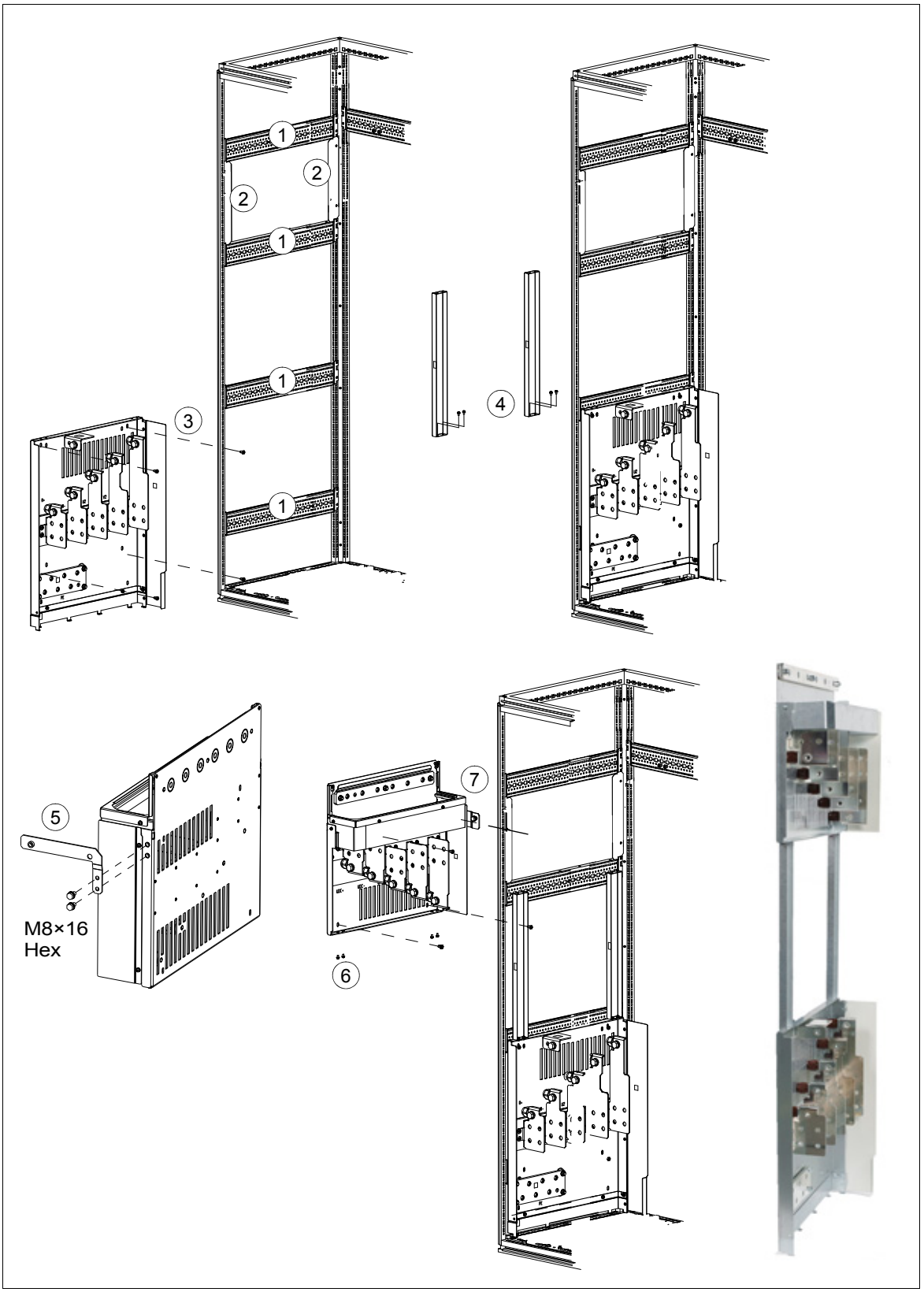
Installing the mechanical accessories into the cabinet

See appendix *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page *243* for these steps:

- Attach the plinth to the floor.
- Attach the cabinet frame to the plinth.
- Make the bottom plate with 360-degree grounding entries for power cables.
- Attach the bottom plate to the cabinet.
- Attach the punched section to the back of the cabinet frame.
- Attach the mounting brackets to the punched section.

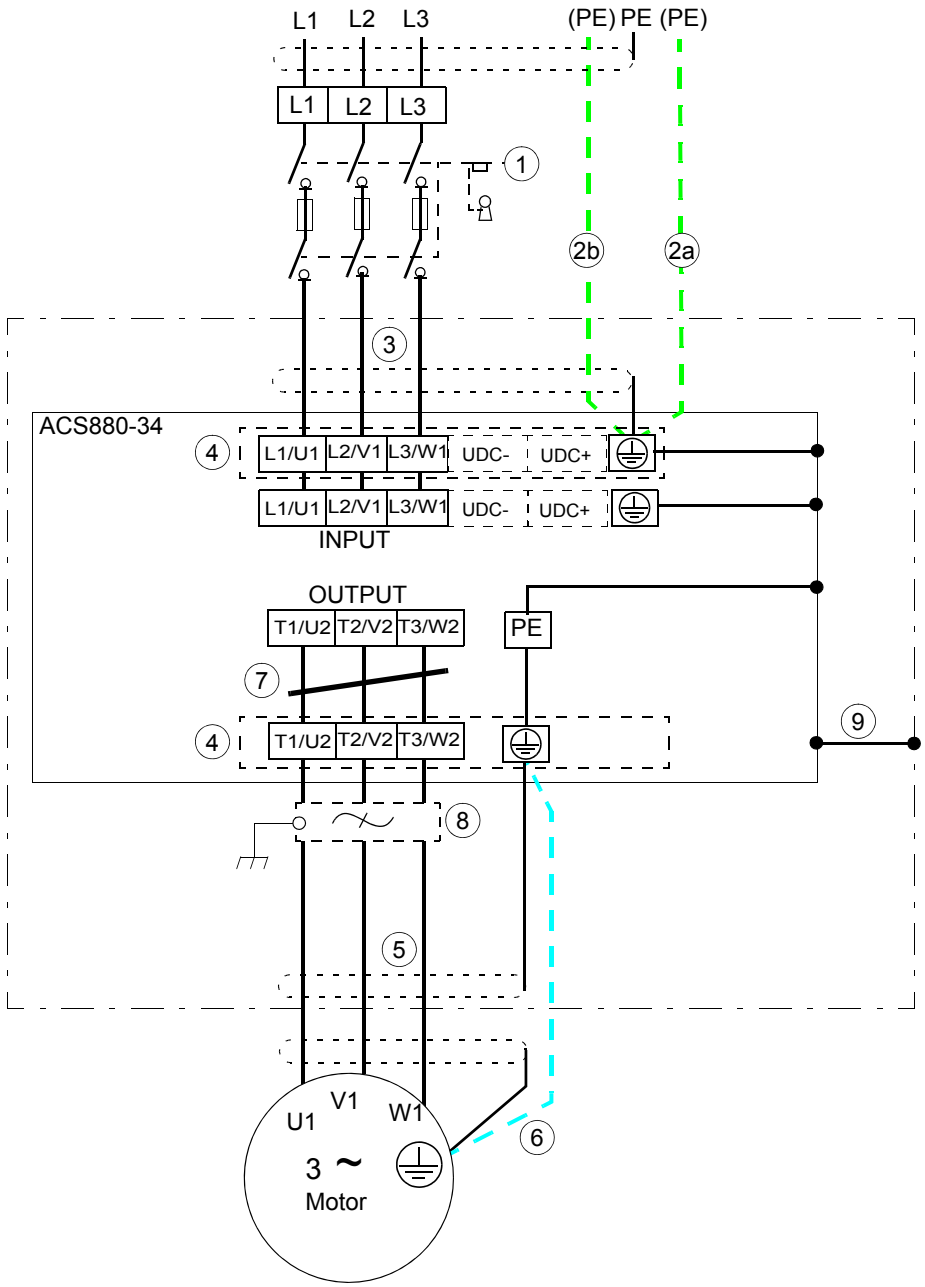
To install the full cabling panels to the cabinet frame (see the drawings on the next page):

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


1
2
2
1
1
1
3
4
5
M8×16
Hex
6
7

Connecting the power cables

Connection diagram



1	For alternatives, see section *Selecting the supply disconnecting device* on page *58.* In the installing example of this chapter, the disconnecting device is not in the same cubicle with the drive module.
2	If a shielded cable is used (not required but recommended) and the conductivity of the shield is < 50% of the conductivity of the phase conductor, use a separate PE cable (2a) or a cable with a grounding conductor (2b).
3	We recommend 360-degree grounding at the cabinet entry if a shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
4	Input and output power cabling panels (option +H381)
5	We recommend 360-degree grounding at the cabinet entry, see page *49.*
6	Use a separate grounding cable if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor and there is no symmetrically constructed grounding conductor in the cable (see page *65*).

7 Common mode filter (optional, see page 59).

8 d*u*/d*t* filter (optional, see page 239).

9 The drive module frame must be connected to the cabinet frame. See section *Arranging the grounding inside the cabinet* on page 48 and *Alternatives for grounding the drive module* on page 91.

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.

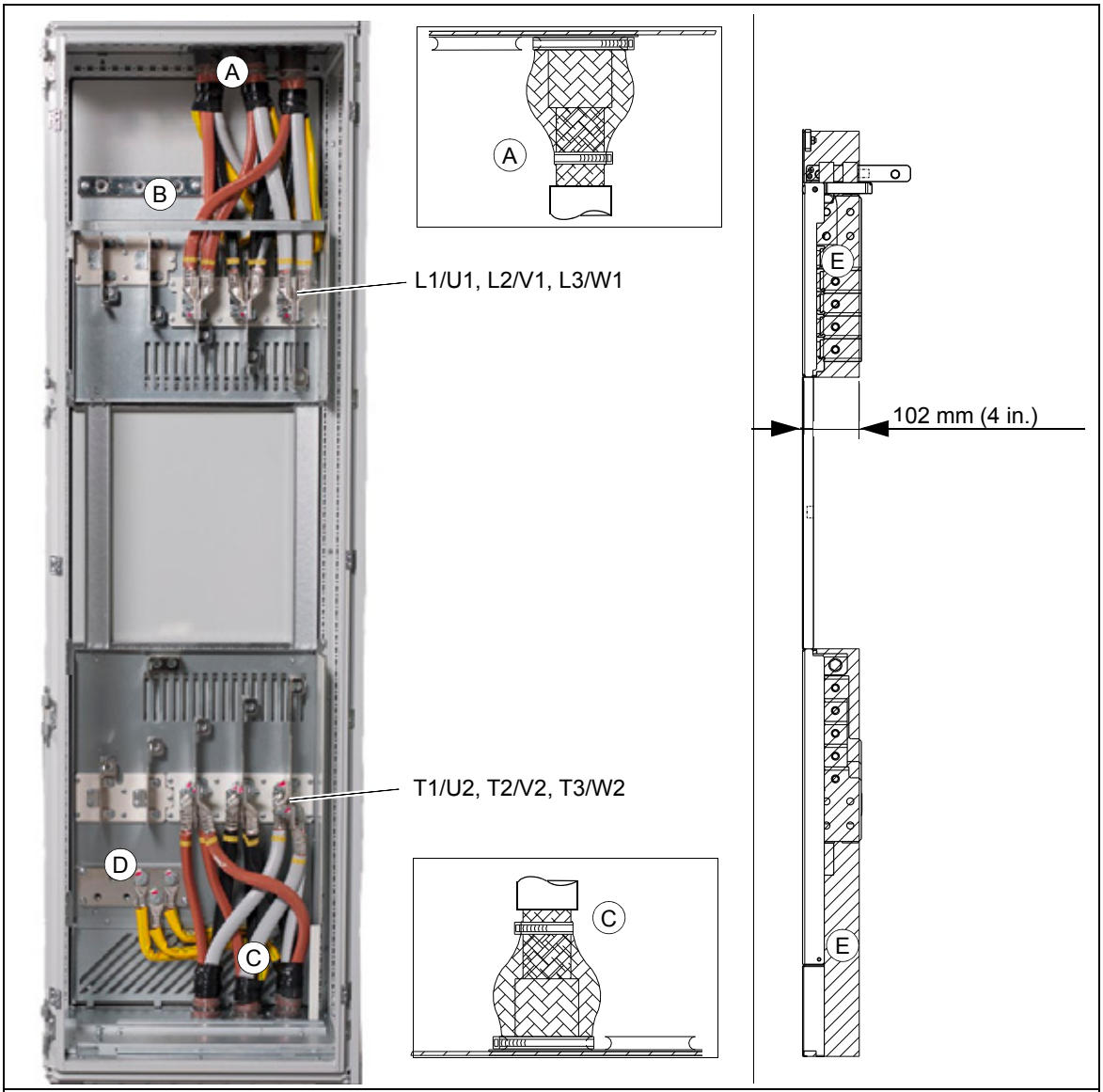
Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.

Power cable connection procedure

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

1. Run the motor cables from the motor to the cabinet. Ground the cable shields 360° at the entry plate.
2. Twist the cable shields of the motor cables into bundles and connect them and any separate ground conductors or cables to the ground busbar of the output power cabling panel.
3. Connect the phase conductors of the motor cables to terminals T1/U2, T2/V2 and T3/W2 of the output cabling panel. For the tightening torques, see page 193.
4. Make sure that all power is disconnected and reconnection is not possible. Use proper safe disconnect procedures according to local codes.
5. Run the input cables from the supply source to the cabinet. Ground the cable shields 360° at the entry plate.
6. Twist the cable shields of the input cables into bundles and connect them and any separate ground conductors or cables to grounding busbar of the input cabling panel.
7. Connect the phase conductors of the input cables to terminals L1/U1, L2/V1 and L3/W1 of the input cabling panel. For the tightening torques, see page 193.
8. Brake chopper option: Connect the conductors to the UDC+ and UDC- terminals. For the tightening torques, see page 193.

An example installation is shown below.



View without cabinet side plate in place.

A) 360-degree grounding at the entry plate for the input power cables

B) Grounding busbar of the input power cabling panel

C) 360-degree grounding at the entry plate for the output power cables

D) Grounding busbar of the output power cabling panel

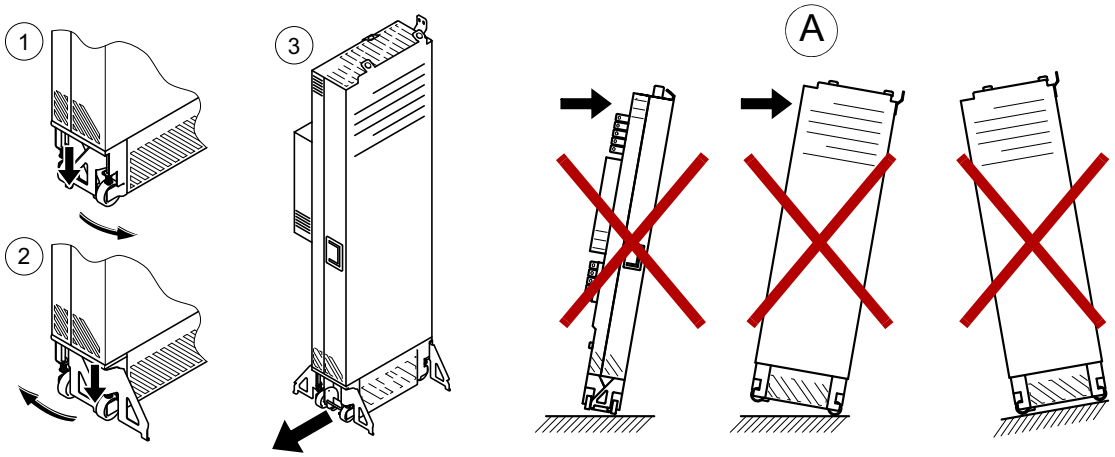
E) Allowed space for power cables. **Note:** The input and output power cables must fit inside the area marked with diagonal lines to prevent chafing of the cables when the drive module is inserted into the cabinet.

Installing the drive module into the cabinet

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

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

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

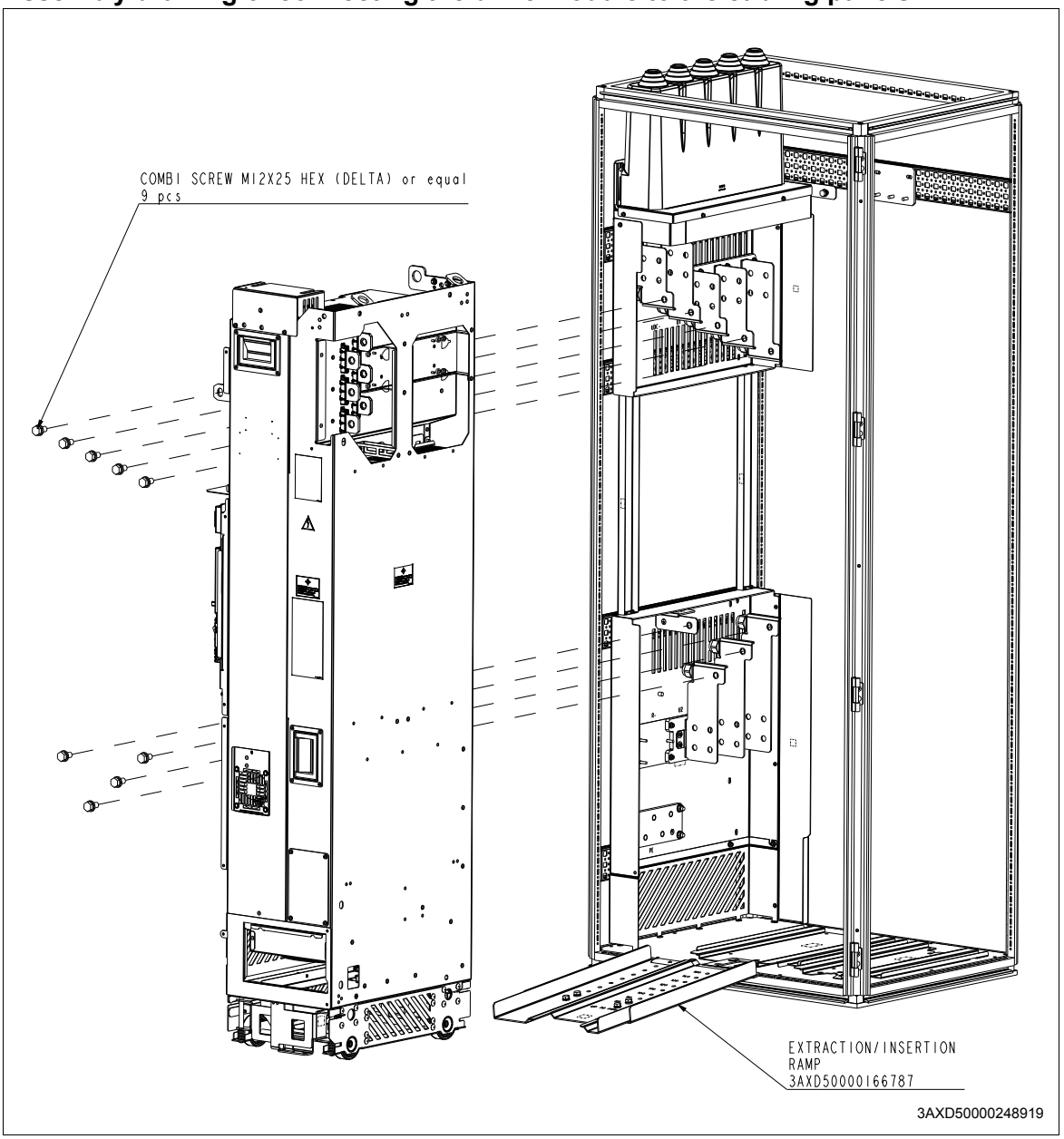


Installation procedure

1. Install the drive module and the LCL filter module into the Rittal cabinet as shown in appendix *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on page *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).
4. Connect the busbars of the drive module to the busbars of the cabling panels (M12 combi screw, 70 N·m [52 lbf·ft]).

5. Attach the cabinet roof on the spacers.
6. Attach the side panels,
7. Remove the filter mats from the air filters according to Rittal's instructions. Install the filters to the cabinet door.
8. Put back the removed front covers of the drive module.
9. Connect the control cables (see section *Connecting the control cables to the terminals of the control unit* on page *107*).

Assembly drawing of connecting the drive module to the cabling panels

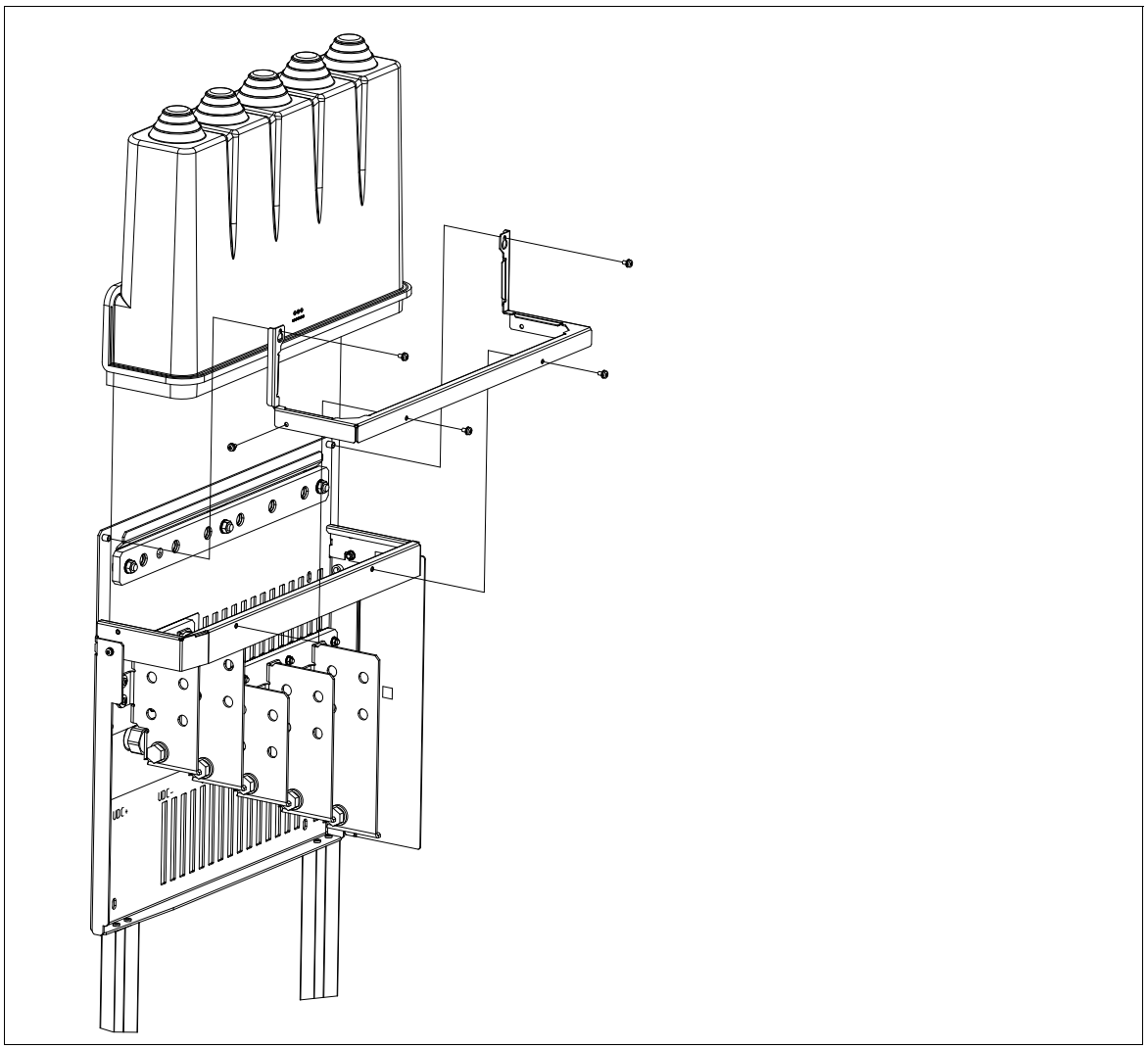


Miscellaneous

Installing the rubber grommet

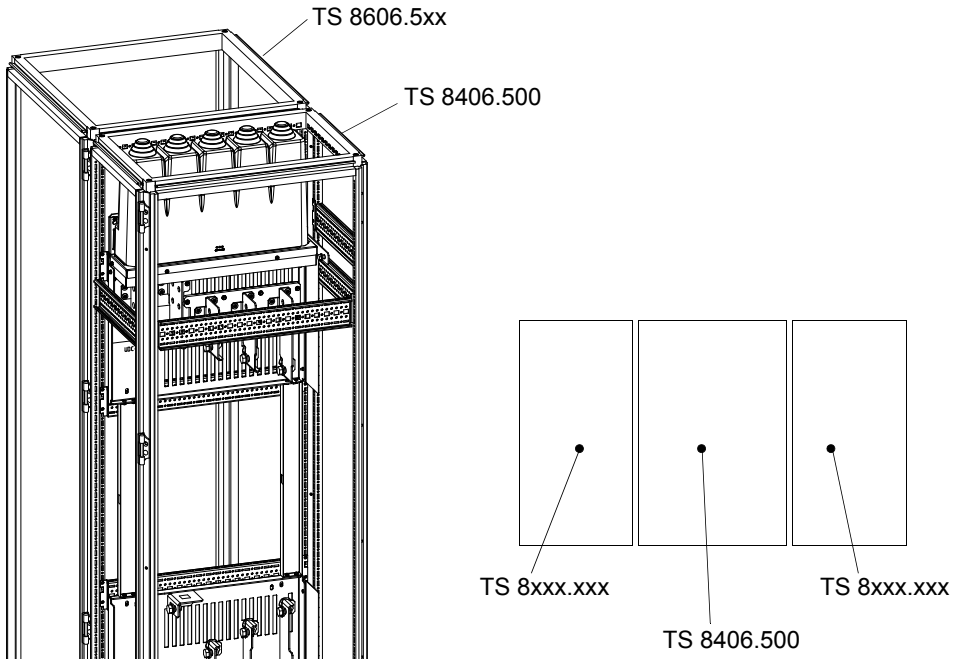
To get IP20 degree of protection for the drive module, install the input power cables through the rubber grommet. Install the grommet as follows:

1. Cut adequate holes into the grommet for the input power cables.
2. Put the cables through the grommet.
3. Attach the grommet to the input cabling panel with five M4x8 Torx T20 screws as shown below.



Modular design of Rittal TS8 cabinets

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



Rittal code	Qty (pcs)	Description
TS 8406.500	1	Enclosure without mounting plate. Includes frame, door, side and back panels.
TS 8606.5xx	1	Enclosure without mounting plate. Includes frame, door, side and back panels.
8800.410 – One set	6	Baying clamp for connecting the cabinet frames
8800.430 – One set	4	Angular baying bracket for connecting the cabinet frames
8800.860 – One set	1	Baying cover top if two cabinet roofs are connected

11

Installation checklist

Contents of this chapter

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

Installation checklist

Go through the checklist below together with another person.

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

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

Check that …	☑
Drive option modules and other components	
Type and number of option modules and other equipment is correct. Option modules and other equipment are not damaged.	☐
Optional modules and terminals are labelled correctly.	☐
The placement of optional modules and other equipment inside the cabinet and on the cabinet door is correct.	☐
The mounting of optional modules and other equipment is correct.	☐
Internal cabling of the cabinet assembly	
Main circuit: • AC supply input cabling is ok. • AC output cabling is ok. • Brake chopper and resistor cabling (if used) is ok.	☐
Cable types, cross-sections, colours and optional markings are correct.	☐
Cabling is not susceptible to interference. Check the twisting of cables and cable routes.	☐
Connection of cables to devices, terminal blocks and drive module circuit boards: • Cables are connected to terminals tight enough by pulling the cable. • Cable termination on terminals chaining is done correctly. • Bare conductors are not too far outside the terminal causing an insufficient clearance or loss of shielding against contact. • The control unit is wired properly to the drive module. • The control panel cable is connected properly.	☐
Cables are not lying against sharp edges or bare live parts. Bending radius of fiber optic cables is at least 3.5 cm (1.38 in.).	☐
The type, markings, insulation plates and cross connections of terminal blocks are correct.	☐
Grounding and protection	
The grounding colors, cross-section and grounding points of modules and other equipment match the circuit diagrams. No long routes for pigtails.	☐
Connections of PE cables and busbars are tight enough. Pull the cable to test that it does not loosen. No long routes for pigtails.	☐
Doors equipped with electrical equipment are grounded. No long grounding routes. From EMC standpoint best result is achieved with a flat copper braid.	☐
Fans that can be touched are shrouded.	☐
Live parts inside the doors are protected against direct contact to at least IP2x.	☐
Labels	
The type designation labels and warning and instruction stickers are made according to the local regulations and placed correctly.	☐
Switches and doors	
Mechanical switches, main disconnecting switch and cabinet doors function properly.	☐

Check that …	☑
Installation of the cabinet	
The drive cabinet has been attached to floor and also from top to the wall or roof.	☐
The ambient operating conditions agree with the specifications given in chapter *Technical data*.	☐
The cooling air will flow freely in and out of the drive cabinet, and air recirculation inside the cabinet will not be possible (air baffle plates are on place).	☐
If the drive module has been stored over three years: The electrolytic DC capacitors in the DC link of the drive have been reformed. See page *171*.	☐
There is an adequately sized protective ground conductor between the drive and the switchboard.	☐
There is an adequately sized protective ground conductor between the motor and the drive.	☐
All protective ground conductors have been connected to the appropriate terminals and the terminals have been tightened. (Pull the conductors to check.)	☐
The enclosures of the equipment in the cabinet have proper galvanic connection to the cabinet protective earth (ground) busbar; The connection surfaces at the fastening points are bare (unpainted) and the connections are tight, or separate grounding conductors have been installed.	☐
The supply voltage matches the nominal input voltage of the drive. Check the type designation label.	☐
The input power cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.)	☐
Appropriate AC fuses and a main disconnector have been installed.	☐
The motor cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.)	☐
The brake resistor (if present) has been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.)	☐
The motor cable (and brake resistor cable, if present) has been routed away from other cables.	☐
No power factor compensation capacitors have been connected to the motor cable.	☐
The control cables (if any) have been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.)	☐
If a drive bypass connection is used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked, ie, cannot be closed simultaneously.	☐
There are no tools, foreign objects or dust from drilling inside the drive module.	☐
All shrouds and cover of the motor connection box are in place. Cabinet doors have been closed.	☐
The motor and the driven equipment are ready for start.	☐

12

Start-up

Contents of this chapter

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

Start-up procedure

The table below lists the actions in the start-up procedure of the drive module. The tasks which are needed in certain cases only are marked with underlining, and option codes are given in brackets. These instructions cannot and do not cover all possible start-up tasks of a customized drive. Perform the start-up tasks instructed by the cabinet-installer of the drive module.

Action	☑
Safety	
WARNING! Obey the safety instructions during the start-up procedure. See chapter *Safety instructions* on page *15*. Only qualified electrical professionals are allowed to start-up the drive.	☐
Checks/Settings with no voltage connected	
Ensure that the disconnector of the supply transformer is locked to the off (0) position, ie. no voltage is, and cannot be connected to the drive inadvertently.	☐
Check the mechanical and electrical installation of the drive. See *Installation checklist* on page *149*.	☐
Check that both channels of the Safe torque off circuit connected to the STO inputs of drive control unit are closed. Refer to the wiring diagrams delivered with the drive.	☐

Action	☑
If the Safe torque off functionality is used, check that the STO OUT output on the drive control unit is chained to the STO inputs of all drives. If the Safe torque off functionality is not used, check that the STO input on all drives is correctly wired to +24 V and ground.	☐
Powering up the auxiliary circuit of the drive	
Make sure that it is safe to connect voltage. Ensure that • nobody is working on the drive or circuits that have been wired from outside into the drive cabinet • the cover of the motor terminal box is in place.	☐
Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits.	☐
Close the cabinet doors.	☐
Close the main breaker of the supply transformer.	☐
Setting up the line-side converter parameters	
The line-side converter control program parameters are set at the factory. Normally, there is no need to change them at the start-up. For more information on the line-side converter control parameters, see *ACS880 primary control program firmware manual (3AUA0000085967* [English]) or *ACS880 IGBT supply control program firmware manual (3AUA0000131562 [English]).*	☐
Setting up the motor-side converter parameters, and performing the first start	
Set up the motor control program. See the appropriate start-up guide and/or firmware manual. There is a separate start-up guide only for some control programs. If you need more information on the use of the control panel, see *ACS-AP-X Assistant control panels user's manual* (3AUA0000085685 [English]).	☐
For drives with ABB du/dt filter, check that bit 13 of parameter **95.20 HW options word 1** is switched on.	
For drives with ABB sine filter, check that parameter **95.15 Special HW settings** is set to **ABB sine filter**. For other sine filters, see *Sine filter hardware manual* (3AXD50000016814 [English]).	☐
For drives with a fieldbus adapter module (optional): Set the fieldbus parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the fieldbus adapter module, and the drive firmware manual. Check that the communication works between the drive and the PLC.	☐
For drives with an encoder interface module (optional): Set the encoder parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the encoder interface module, and the drive firmware manual.	☐
For drives with optional brake chopper, see section *Start-up* on page *229*.	
On-load checks	
Start the motor to perform the ID run.	☐
Check that the cooling fans rotate freely in the right direction, and the air flows upwards. A paper sheet set on the intake (door) gratings stays. The fans run noiselessly.	☐
Check that the motor starts. stops and follows the speed reference in the correct direction when controlled with the control panel.	☐
Check that the motor starts. stops and follows the speed reference in the correct direction when controlled through the customer-specific I/O or fieldbus.	☐
Drives in which the Safe torque off control circuit is in use: Test and validate the operation of the Safe torque off function. See *Start-up including acceptance test* on page *223*.	☐

Action	☑
For drives with ATEX-certified Safe motor disconnection function using the drive Safe torque off function (option +Q971), see *ACS880 ATEX-certified Safe disconnection function application guide* (3AUA0000132231 [English]). For drives with ABB motors in explosive atmospheres, see also *ACS880 drives with ABB motors in explosive atmospheres* (3AXD50000019585 [English]).	☐
For drive modules with an FSO-12 safety functions module (option): Test and validate the operation of the safety functions. See the delivery-specific circuit diagrams and *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]).	☐

13

Fault tracing

Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

LEDs with options +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 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

If installed in an appropriate environment, the drive requires very little maintenance. Maintenance and component replacement intervals are based on the assumption that the equipment is operated within the specified ratings and ambient conditions. ABB recommends annual drive inspections to ensure the highest reliability and optimum performance.

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

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

Descriptions of symbols

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

Recommended annual maintenance actions by the user

Action	Target
P	Quality of supply voltage
I	Spare parts
P	DC circuit capacitors reforming, spare modules and spare capacitors
I	Tightness of terminals
I	Dustiness, corrosion and temperature
I	Heat sink cleaning

Recommended maintenance intervals after start-up

Component	Years from start-up							
	3	6	9	12	15	18	20	21
Cooling								
Main cooling fan								
Main cooling fan (speed controlled)			R			R		
LCL filter module cooling fan			R			R		
Auxiliary cooling fan								
Fan for circuit board compartment (speed-monitored)			R			R		
Aging								
ZCU control unit battery (real-time clock)		R		R		R		
Control panel battery (real-time clock)			R			R		

4FPS10000239703

Cabinet

Cleaning the interior of the cabinet

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

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

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

Heatsink

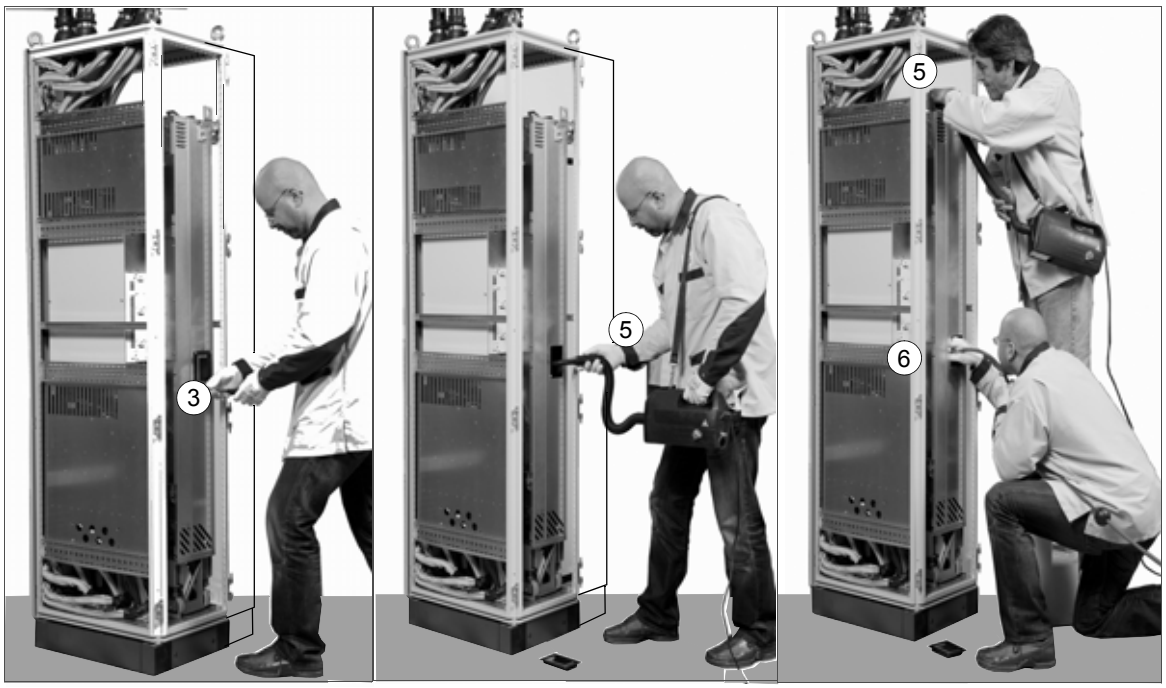
The module heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean.

Cleaning the interior of the heatsink

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

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Make sure that the drive is disconnected from the power line and all other precautions described under *Grounding* on page *20* have been taken into consideration.
3. Undo the fastening screws of the handle plate of the drive module.
4. Remove the handle plate.
5. Vacuum the interior of the heatsink from the opening.
6. Blow clean compressed air (not humid or oily) upwards from the opening and, at the same time, vacuum from the top of the drive module.



Cleaning the interior of the LCL filter

Clean the interior of the LCL filter in the same way as the heatsink in section *Cleaning the interior of the heatsink* on page *161*.

Fans

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

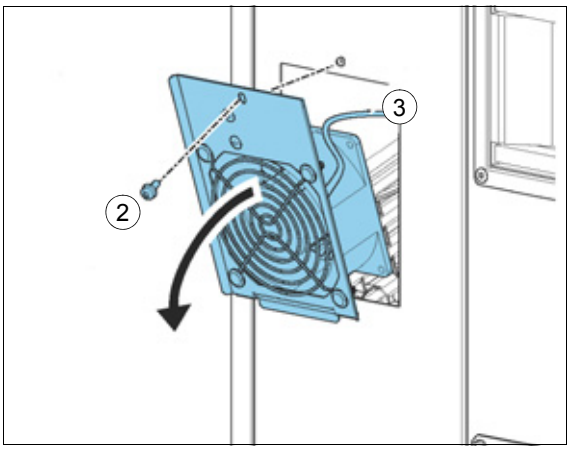
Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

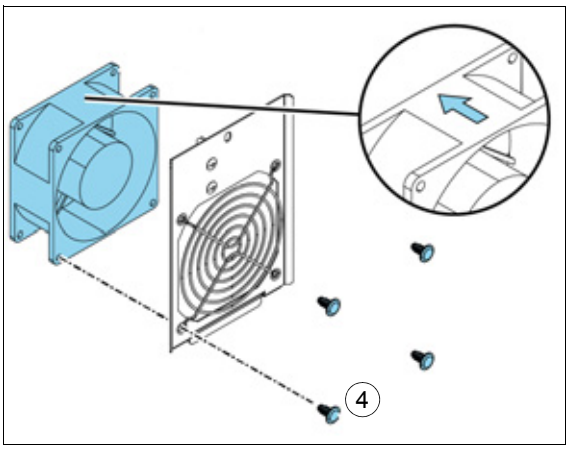
Replacing the auxiliary cooling fans of the drive module

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

Fan in the front panel:

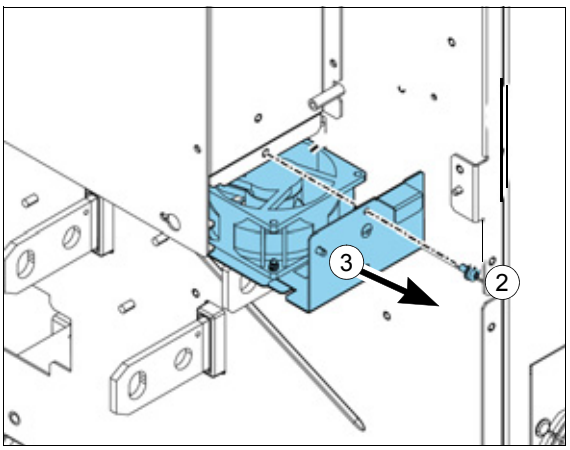
1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Undo the mounting screw of the fan cassette.
3. Unplug the power supply cable of the fan.
4. Undo the mounting screws of the fan.
5. Install the new fan in reverse order. Make sure that the arrow in the fan points to the drive module.
6. Reset the counter (if used) in group 5 in the primary control program.

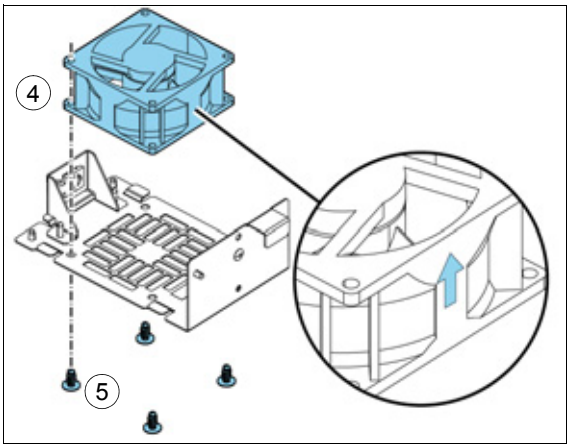




Fan at the bottom of the circuit board compartment:

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Undo the mounting screw of the fan cassette.
3. Pull the fan cassette out:
4. Unplug the power supply cable of the fan.
5. Undo the mounting screws of the fan.
6. Install the new fan in reverse order. Make sure that the arrow in the fan points up.
7. Reset the counter (if used) in group 5 in the primary control program.

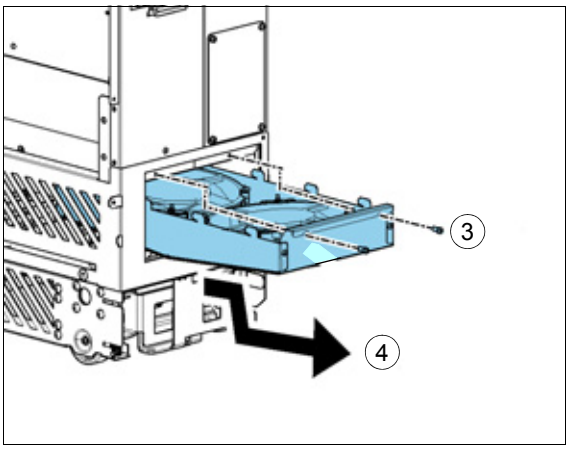


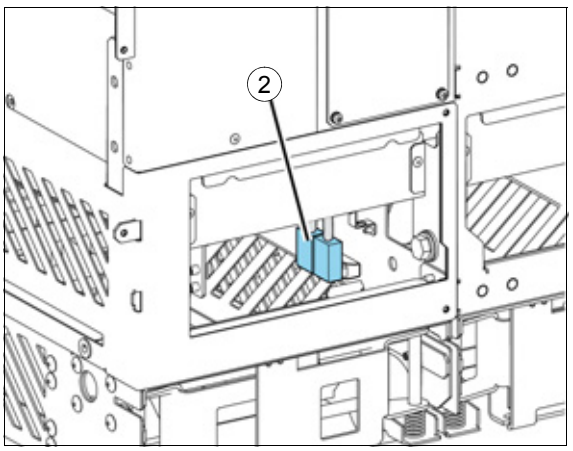


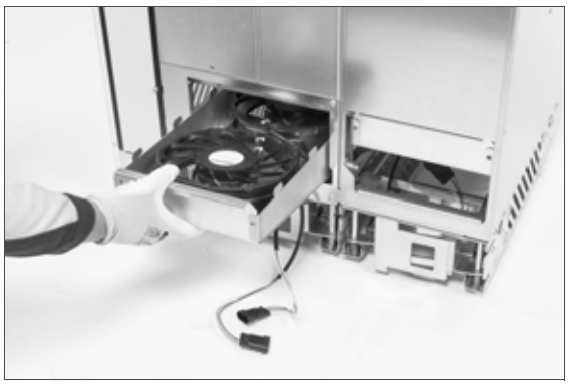
Replacing the drive module main cooling fans

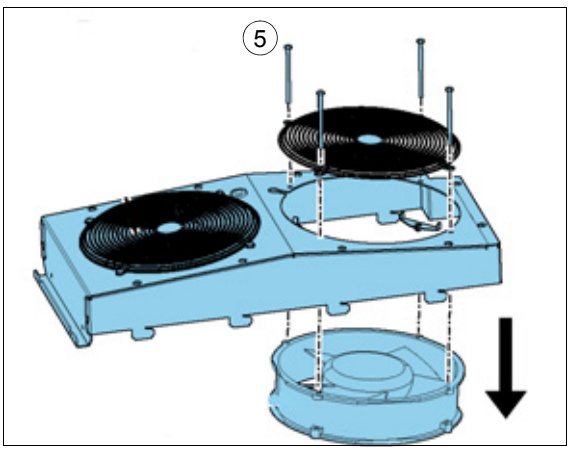
WARNING! Obey the safety instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Disconnect the power supply wires of the fans from the connector. FAN1:PWR1 and FAN2:PWR2.
3. Undo the mounting screws of the fan cassette.
4. Pull the fan cassette out.
5. Undo the mounting screws of the fan(s).
   Note: 690 V drive modules have only one fan in the cassette.
6. Install the new fans in reverse order. For 690 V drive modules, connect the fan power supply to connector FAN1:PWR1. For other drive modules, connect the power supply wires to both FAN1:PWR1 and FAN2:PWR2.
7. Reset the counter (if used) in group 5 in the primary control program.





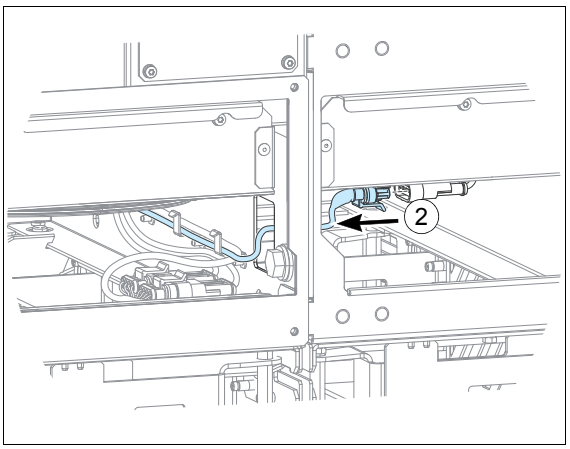


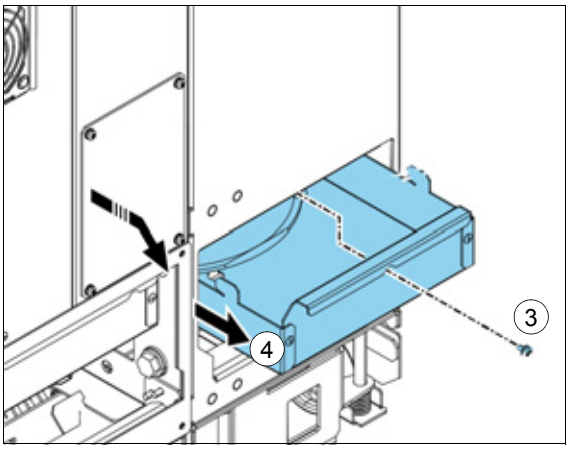


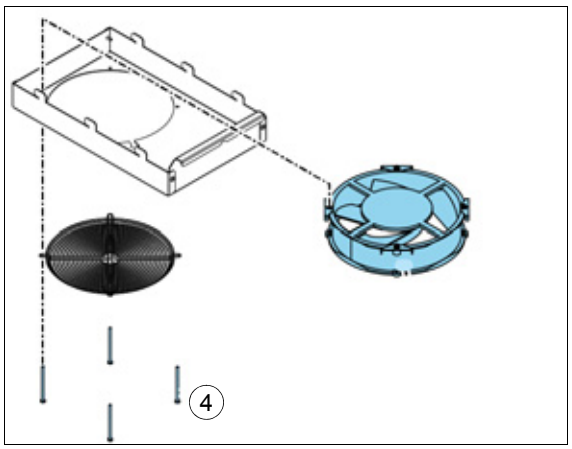
Replacing the LCL filter module cooling fan

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Disconnect the power supply wire of the fan from connector FAN3:LCL.
3. Undo the attaching screw of the fan cassette.
4. Pull the fan cassette out.
5. Undo the mounting screws of the fan. The finger guard of the fan is attached by the same screws and is removed at the same time. Keep the finger guard for reuse
6. Install the new fan in reverse order. Make sure that the arrow in the fan points up.



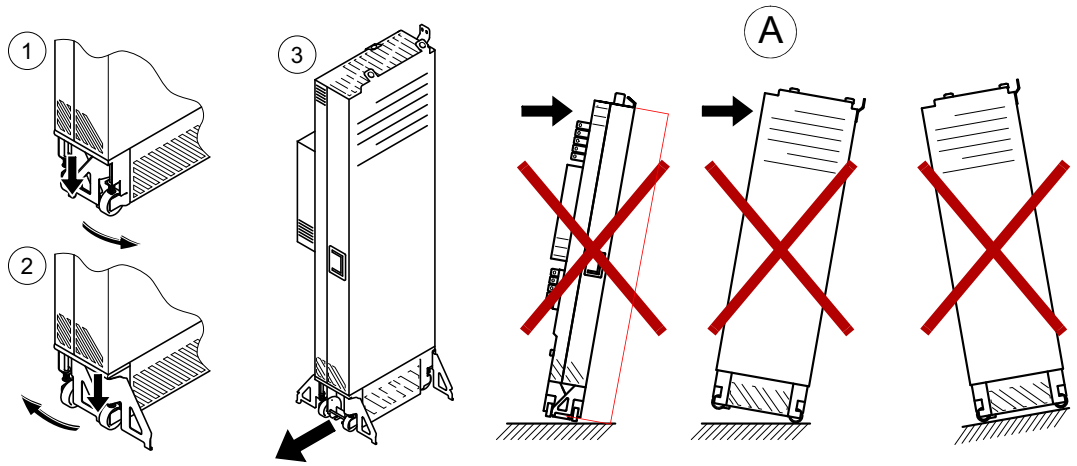




Replacing the standard drive module

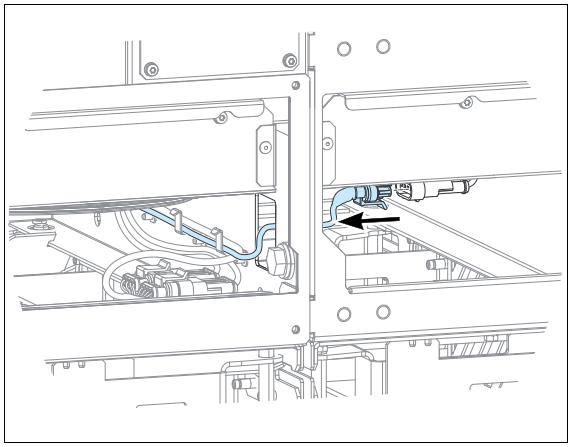
WARNING! Obey the safety instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

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

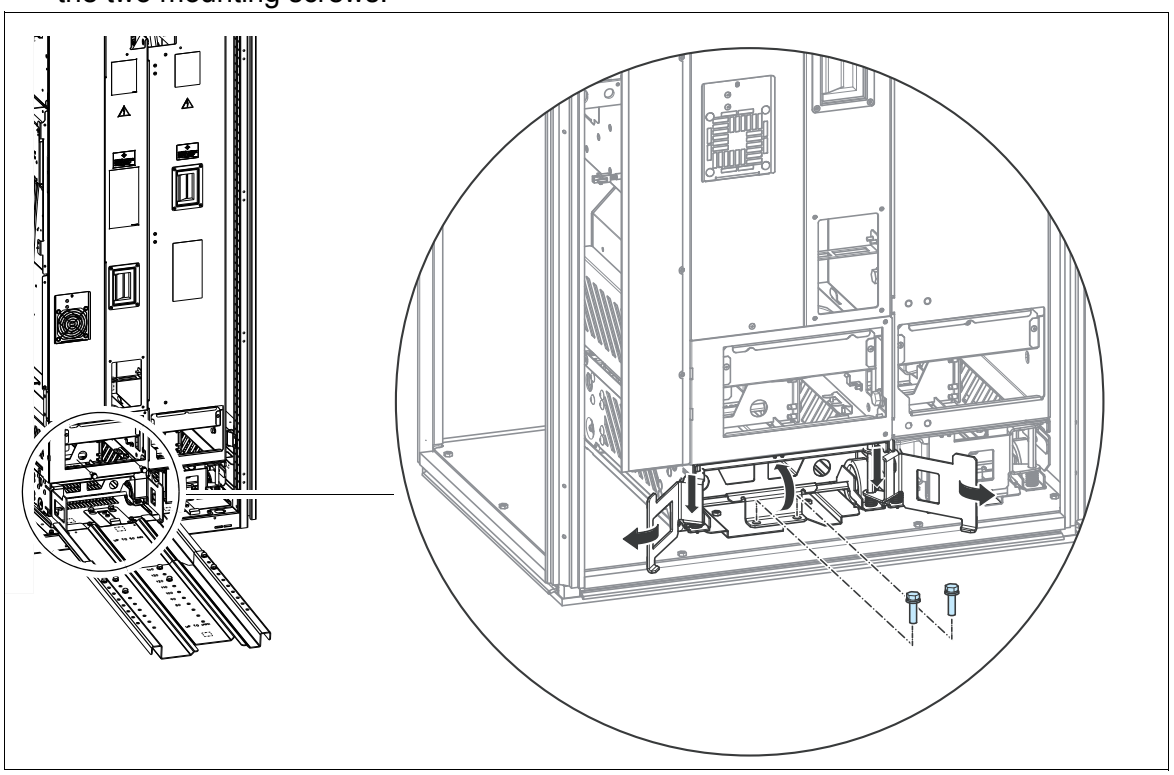


1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Remove the clear plastic shrouds on the power cables and parts in front of the drive module (if present).
3. Disconnect the power cables.
4. Drives with external control unit: Disconnect the cables between the drive module and the control unit. See section *Connecting the external control unit to the drive module* on *103*.
5. Drives with internal control unit (option +P905): Disconnect the external control cables connected to the control unit. See section *Internal control unit (option +P905)* on page *119*.

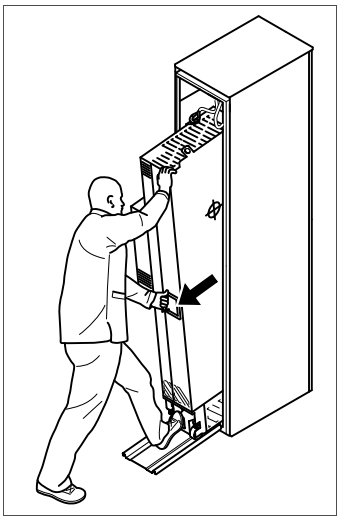
6. Disconnect the cooling fan power supply cable from the LCL filter module. Pull the cable inside the drive module.



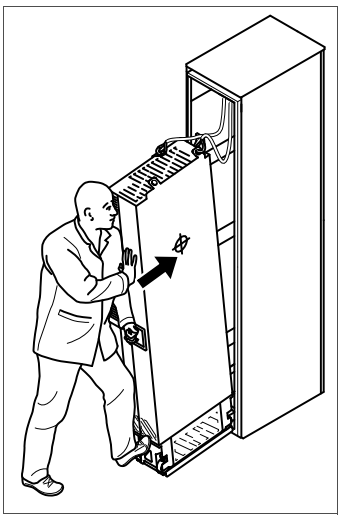
7. Remove the screws that attach the drive module to the cabinet at the top and behind the front support legs.
8. Remove the screws that connect the drive module to the LCL filter module from top and at the side.
9. To prevent the drive module from falling, attach its top lifting lugs with chains with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



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



13. Install the new module in reverse order.



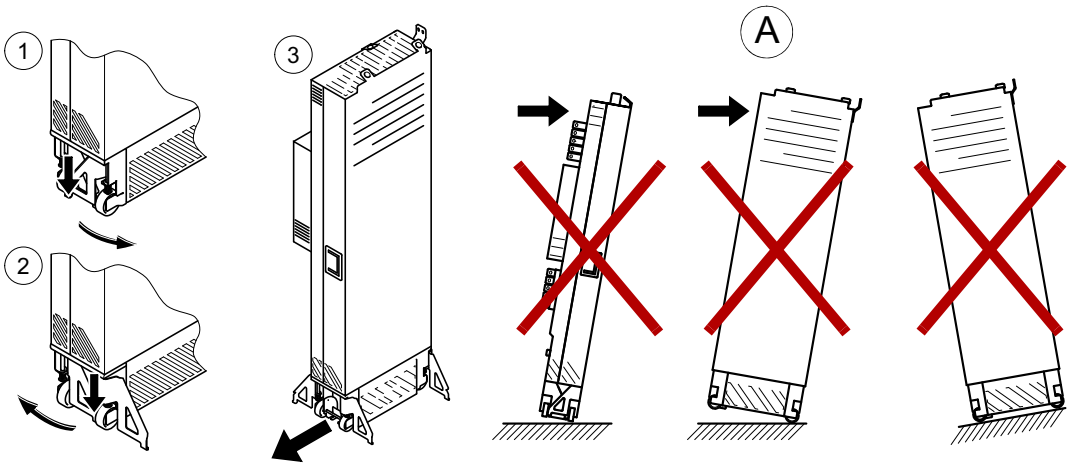
Replacing the LCL filter module

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

Replacing the drive module with option +H381

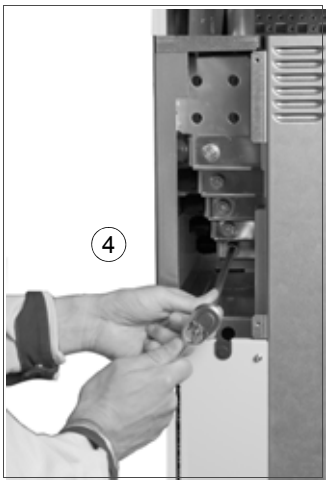
WARNING! Obey the safety instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

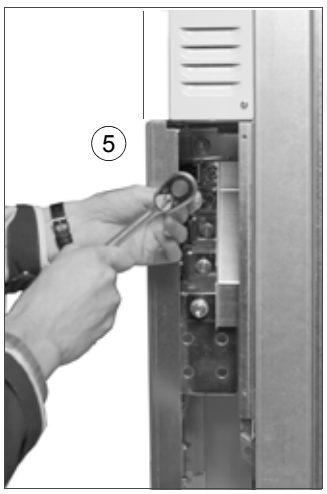
- Handle the drive module carefully:
  - Use safety shoes with a metal toe cap to prevent foot injury.
  - Lift the drive module only by the lifting lugs.
  - Make sure that the module does not topple over when you move it on the floor: Open the support legs by pressing each leg a little down (1, 2)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



1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. To remove the left-hand side upper and lower front covers of the drive module, undoi the fastening screws. M4×10 combi screws, 2 N·m.
   For drive modules with an internal control unit (option +P905) and control panel (option +J414): Remove the control panel and the control panel cable from the internal control unit.
3. Disconnect the drive module busbars from the input cabling panel. Combi screw M12, 70 N·m (52 lbf·ft).
4. Disconnect the drive module busbars from the output cabling panel. Combi screw M12, 70 N·m (52 lbf·ft).
5. Remove the front air baffle.
6. See *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on *243*:
   - Disconnect the drive module from the LCL filter module.
   - Undo the screws that attach the drive module to the cabinet frame,
   - Attach the extraction ramp to the cabinet base with two screws.

7. Disconnect the power supply cable and the fiber optic cables from the external control unit and coil them on the top of the drive module.
   For drive modules with an internal control unit (option +P905): Detach the control unit from the drive module by undoing the fastening screws below the optional modules and turn the control unit and the cables aside. (Alternatively remove the clamp plate, and disconnect the cables from the control unit.)
8. To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet frame.
9. Pull the drive module carefully out of the cabinet preferably with help from another person.
10. Install the new module in reverse order.





Replacing the LCL filter module with option +H381

1. See *Step-by-step drawings for an installation example of standard drive configuration in Rittal TS 8 800 mm wide cabinet* on *243*:
   - Disconnect the LCL filter module from the drive module.
   - Undo the screws that attach the LCL filter module to the cabinet frame.
   - Attach the extraction ramp to the cabinet base with two screws.
2. To prevent the LCL filter module from falling, attach its top lifting lugs with chains to the cabinet frame.
3. Pull the LCL filter module carefully out of the cabinet preferably with help from another person.
4. Install the new module in reverse order.

Capacitors

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

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

Reforming the capacitors

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

Control panel

Replacing the control panel battery

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

Cleaning

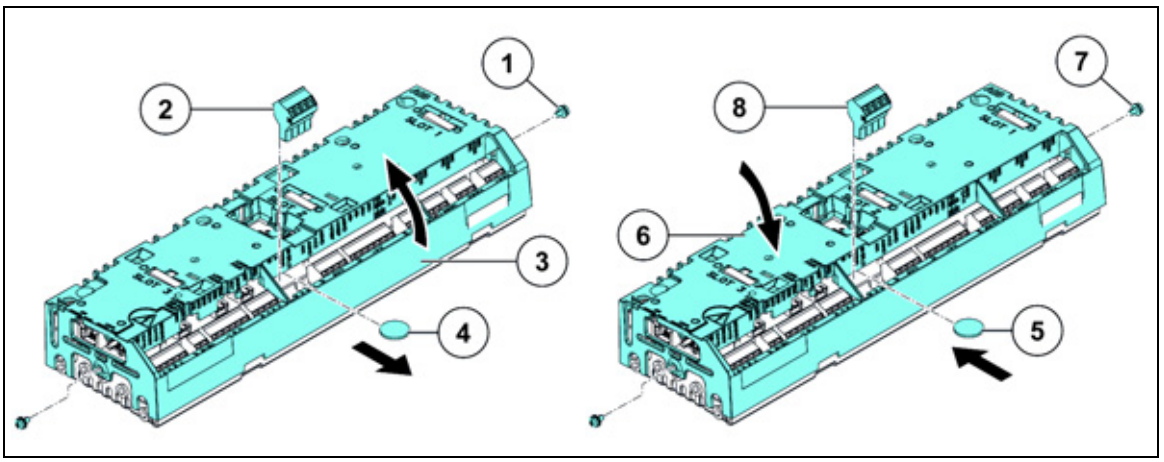
See *ACX-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).

Replacing the control unit battery – external control unit

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

To replace the control unit battery:

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



Memory unit

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

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

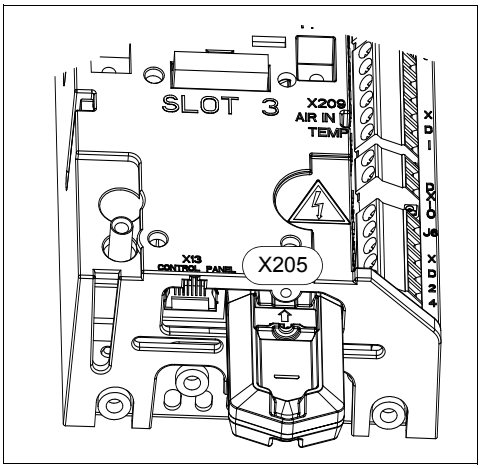
After power-up, the drive scans the memory unit. If a different control program or different parameter settings are detected, they are copied to the drive. This can take several minutes.

Replacing the drive control unit memory unit

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

1. Remove the fastening screw.
2. Pull the memory unit out.
3. Install the new memory unit in reverse order.

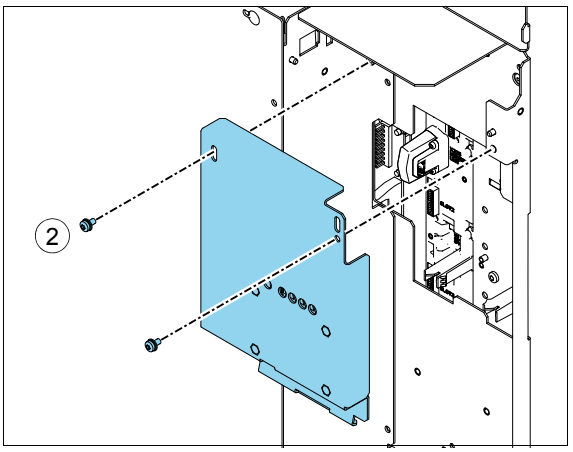
Note: There is a spare screw next to the memory unit slot.

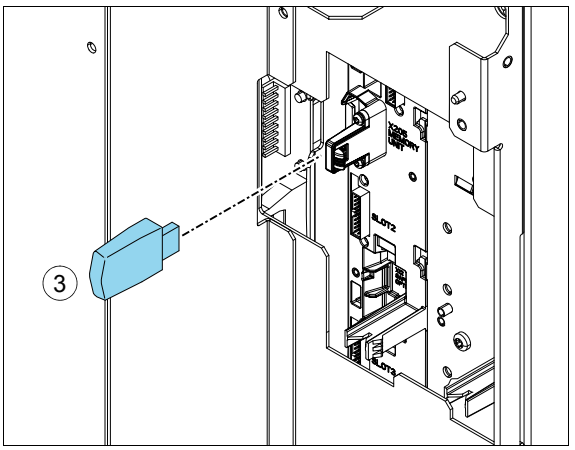


To remove the memory unit from the line-side converter control unit:

Replacing the line-side converter control unit memory unit

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





15

Ordering information

Contents of this chapter

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

Notes:

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

Brake choppers and resistors

See section *Resistor braking* on page *229*.

Output (du/dt) filters

See section *du/dt filters* on page *239*.

Sine filters

See section *Sine filters* on page *240*.

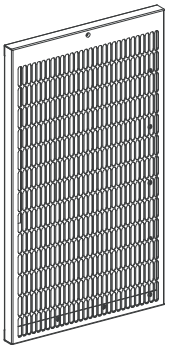
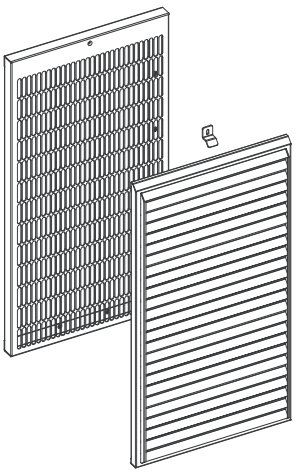
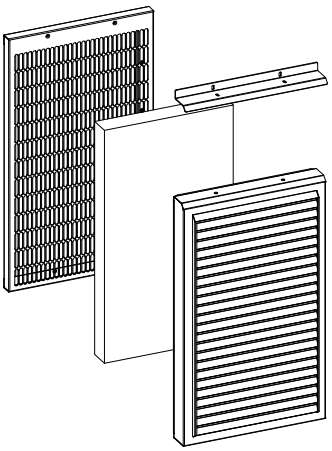
EMC filter ARFI-10

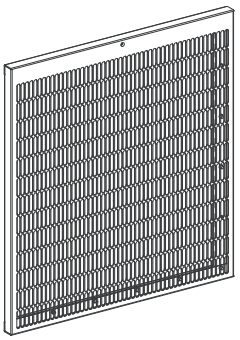
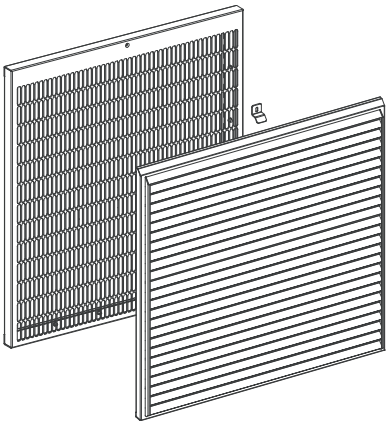
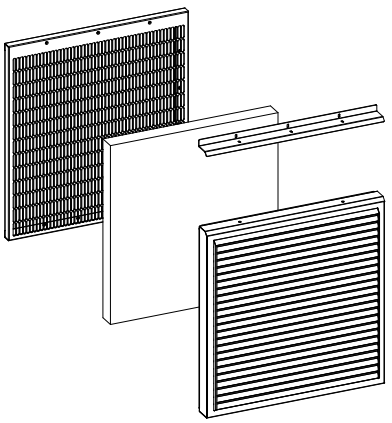
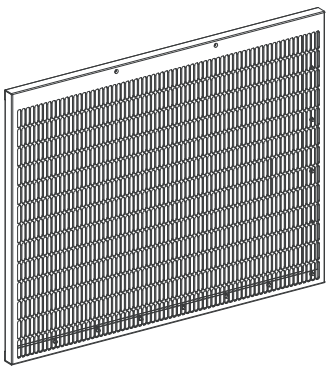
Order code: 68241561

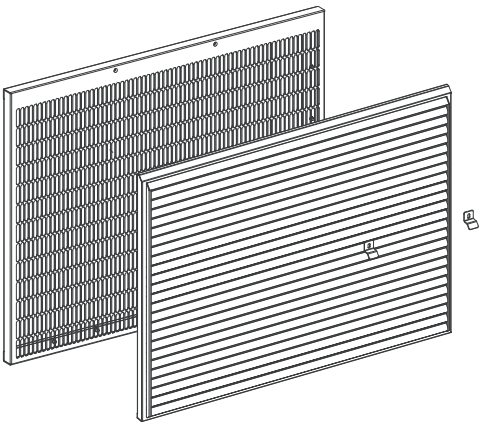
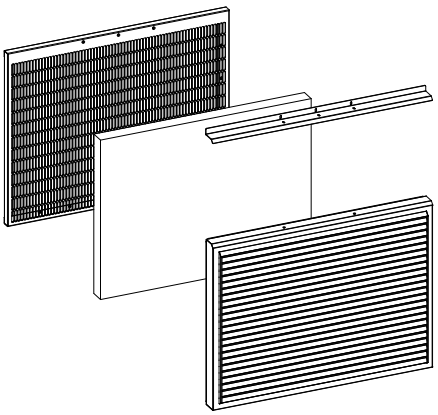
Cabinet ventilation

Air inlet kits

Mounting screws are included.

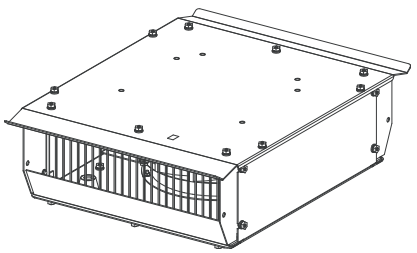
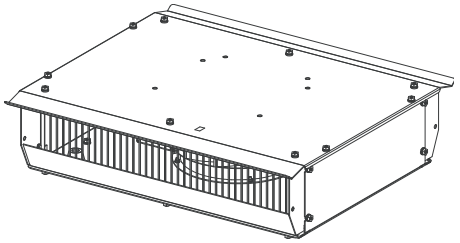
Enclosure width / Degree of protection	Kit code	Ordering code	Illustration
400 mm / IP20	A-4-X-021	3AUA0000117002	 Instruction code: 3AUA0000116879
400 mm / IP42	A-4-X-024	3AUA0000117007	 Instruction code: 3AUA0000116873
400 mm / IP54	A-4-X-027	3AXD50000009184	 Instruction code: 3AXD50000009989

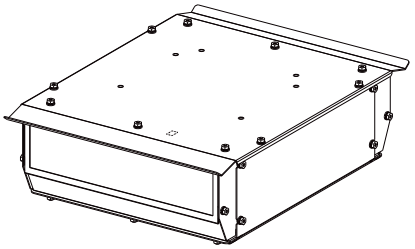
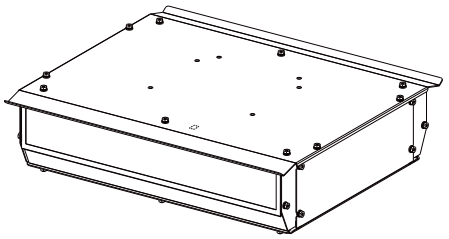
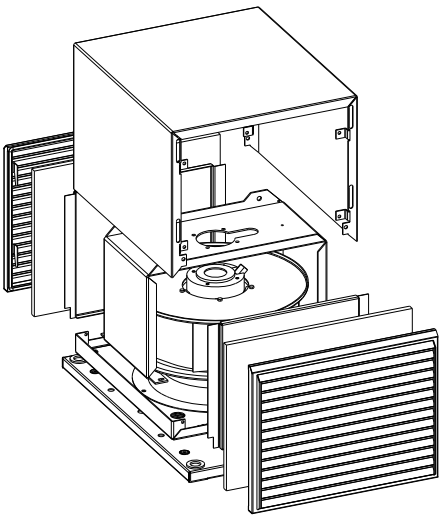
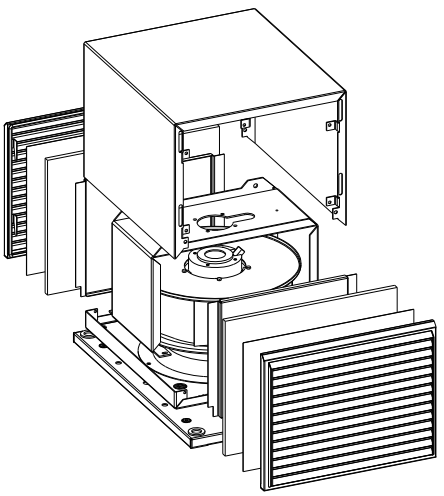
Enclosure width / Degree of protection	Kit code	Ordering code	Illustration
600 mm / IP20	A-6-X-022	3AUA0000117003	 Instruction code: 3AUA0000116880
600 mm / IP42	A-6-X-025	3AUA0000117008	 Instruction code: 3AUA0000116874
600 mm / IP54	A-6-X-028	3AXD50000009185	 Instruction code: 3AXD50000009990
800 mm / IP20	A-8-X-023	3AUA0000117005	 Instruction code: 3AUA0000116887

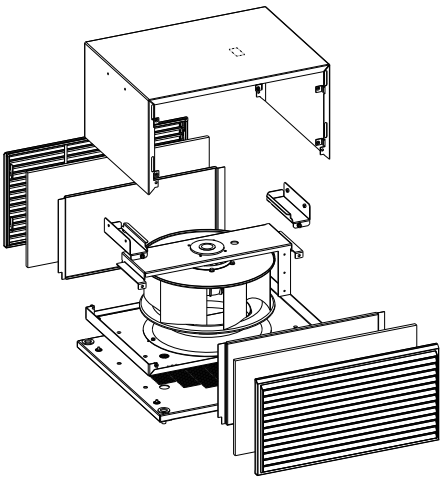
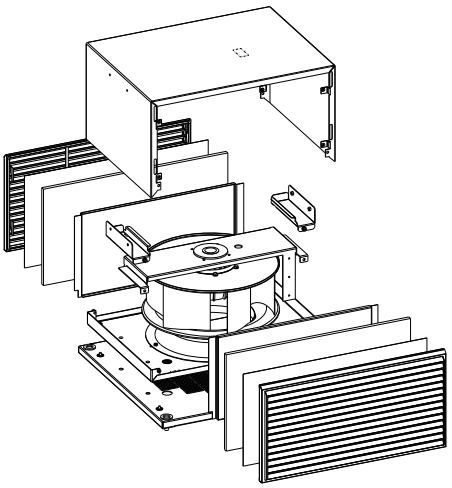
Enclosure width / Degree of protection	Kit code	Ordering code	Illustration
800 mm / IP42	A-8-X-026	3AUA0000117009	 Instruction code: 3AUA0000116875
800 mm / IP54	A-8-X-029	3AXD50000009186	 Instruction code: 3AXD50000010001

Air outlet kits

Note: The fan is to be ordered separately.

Enclosure width / Degree of protection	Qty	Kit code	Ordering code	Illustration
400 mm / IP20	1	A-4-X-062	3AUA0000125203	 Instruction code: 3AXD50000001982 **Note:** Fan to be ordered separately
800 mm / IP20	2			
600 mm / IP20	1	A-6-X-063	3AUA0000125204	 Instruction code: 3AXD50000001980 **Note:** Fan to be ordered separately

Enclosure width / Degree of protection	Qty	Kit code	Ordering code	Illustration
400 mm / IP42	1	A-4-X-060	3AUA0000114968	 Instruction code: 3AUA0000115290 **Note:** Fan to be ordered separately
800 mm / IP42	2			
600 mm / IP42	1	A-6-X-061	3AUA00001149789	 Instruction code: 3AUA0000115152 **Note:** Fan to be ordered separately
400 mm / IP54 (IEC)	1	A-4-X-064	3AXD50000009187	 Instruction code: 3AXD50000010284 **Note:** Fan to be ordered separately
800 mm / IP54 (IEC)	2			
400 mm / IP54 (UL)	1	A-4-X-067	3AXD50000010362	 Instruction code: 3AXD50000010284 **Note:** Fan to be ordered separately
800 mm / IP54 (UL)	2			

Enclosure width / Degree of protection	Qty	Kit code	Ordering code	Illustration
600 mm / IP54 (IEC)	1	A-6-X-065	3AXD50000009189	 Instruction code: 3AXD50000010004 **Note:** Fan to be ordered separately
600 mm / IP54 (UL)	1	A-6-X-066	3AXD50000010327	 Instruction code: 3AXD50000010004 **Note:** Fan to be ordered separately

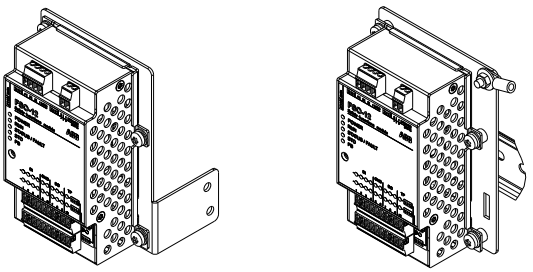
Cooling fans

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

Enclosure width / Degree of protection	Component		Qty	Ordering code
	Name	Data		
IEC				
400 mm / IP54	Fan	RB4C-355/170	1	3AXD50000006934
	Capacitor	MSB MKP 6/603/E1679	1	3AXD50000006959
	Connector	SPB2,5/7 (2.5 mm2, 12AWG)	1	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm2, 12AWG)	1	3AXD50000000724
600 mm / IP54	Fan	CRBB/4-400/188	1	3AXD50000006111
	Capacitor	MSB MKP 12/603/E1679	1	3AXD50000006885
	Connector	SPB2,5/7 (2.5 mm2, 12AWG)	1	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm2, 12AWG)	1	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 mm2, 12AWG)	2	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm2, 12AWG)	2	3AXD50000000724
UL				
400 mm, 600 mm / IP20, IP42	Fan	R2E225-RA92-17 (230 V)	1	3AXD50000000514
	Capacitor	MSB MKP 3,5/603/E1679	1	3AXD50000000882
	Connector	SPB2,5/7 (2.5 mm2, 12AWG)	1	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm2, 12AWG)	1	3AXD50000000724
400 mm / IP54	Fan	RB4C-355/170	1	3AXD50000006934
	Capacitor	MSB MKP 6/603/E1679	1	3AXD50000006959
	Connector	SPB2,5/7 (2.5 mm2, 12AWG)	1	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm2, 12AWG)	1	3AXD50000000724
600 mm / IP54	Fan	CRBB/4-400/188	1	3AXD50000006111
	Capacitor	MSB MKP 12/603/E1679	1	3AXD50000006885
	Connector	SPB2,5/7 (2.5 mm2, 12AWG)	1	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm2, 12AWG)	1	3AXD50000000724
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 mm2, 12AWG)	2	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm2, 12AWG)	2	3AXD50000000724
800 mm / IP54	Fan	RB4C-355/170	2	3AXD50000006934
	Capacitor	MSB MKP 6/603/E1679	2	3AXD50000006959
	Connector	SPB2,5/7 (2.5 mm2, 12AWG)	2	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm2, 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	*	3AXD50000019544
For frame R11: IP20 shrouds for covering the input and motor cabling area	**	3AXD50000019538

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

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

16

Technical data

Contents of this chapter

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

Ratings

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

IEC RATINGS										
Drive type ACS880-34-	**Frame size**	**Input current**	**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	412	246	132	170	234	132	206	110
293A-3	R11	257	492	293	160	203	278	160	246	132
363A-3	R11	321	586	363	200	251	345	200	293	160
442A-3	R11	401	726	442	250	306	420	250	363	200
505A-3	R11	401	726	505	250	350	480	250	363	200
585A-3	R11	505	884	585	315	405	556	315	442	250
650A-3	R11	569	1010	650	355	450	618	355	505	250
U_N = 500 V										
240A-5	R11	169	360	240	132	208	228	132	180	110
260A-5	R11	205	480	260	160	225	247	160	240	132
361A-5	R11	257	520	361	200	313	343	200	260	160
414A-5	R11	321	722	414	250	359	393	250	361	200
460A-5	R11	404	828	460	315	398	450	315	414	250
503A-5	R11	455	920	503	355	436	492	355	460	315

IEC RATINGS										
Drive type ACS880-34-	**Frame size**	**Input current**	**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 = 690 V										
142A-7	R11	123	238	142	132	170	135	132	119	110
174A-7	R11	149	284	174	160	208	165	160	142	132
210A-7	R11	186	348	210	200	251	200	200	174	160
271A-7	R11	232	420	271	250	324	257	250	210	200
330A-7	R11	293	542	330	315	394	320	315	271	250
370A-7	R11	330	660	370	355	442	360	355	330	315
430A-7	R11	375	740	430	400	514	420	400	370	355

3AXD00000588487

UL (NEC) RATINGS								
Drive type ACS880-34-	**Frame size**	**Input current**	**Max. current**	**Output ratings**				
				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	360	208	240	200	180	150
260A-5	R11	205	480	225	260	200	240	200
302A-5	R11	239	520	262	302	250	260	200
361A-5	R11	257	520	313	361	300	302	250
414A-5	R11	321	722	359	414	350	361	300
460A-5	R11	404	828	398	430	350	414	350
503A-5	R11	455	920	436	483	400	483	400
U_N = 575 V								
142A-7	R11	125	238	170	144	150	125	125
174A-7	R11	146	284	208	168	175	144	150
210A-7	R11	166	348	251	192	200	168	175
271A-7	R11	208	420	324	242	250	192	200
330A-7	R11	250	542	394	289	300	242	250
370A-7	R11	291	660	442	336	350	289	300
430A-7	R11	375	740	514	412	450	336	350

3AXD00000588487

U_N	Nominal voltage of the drive
I_{1N}	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_{max_start}	Maximum output current at start. Available for two seconds only at start every seven seconds if start current limit is activated by parameter **30.15 Maximum start current.**
I_N	Continuous rms output current. No overload capability at 40 °C (104 °F)
P_N	Typical motor power in no-overload use.
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-overload use.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
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.

We recommend to select the drive, motor and gear combination for the required motion profile with the DriveSize dimensioning tool available from ABB.

When is derating needed

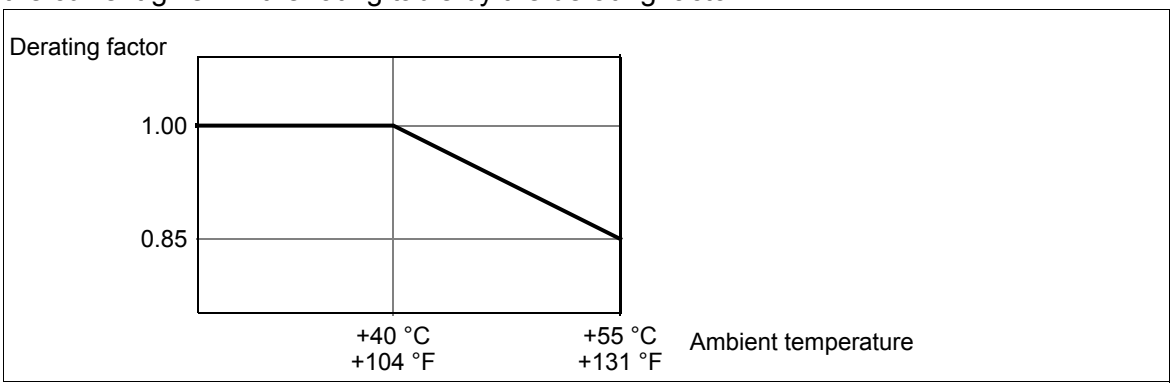
Derate the continuous output current of the drive if

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

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

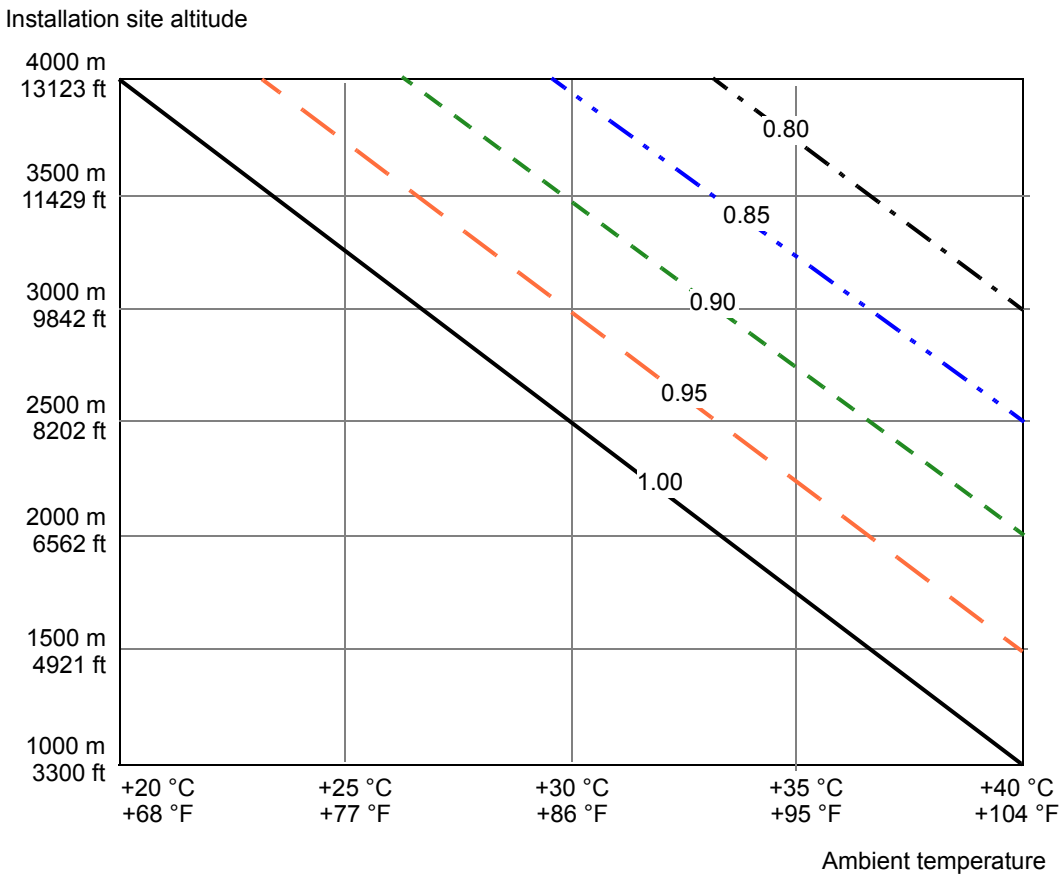
Ambient temperature derating

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



Altitude derating

At altitudes from 1000 to 4000 m (3300 to 13123 ft) above sea level, the derating is 1% for every 100 m (328 ft). If ambient temperature is below +40 °C (+104 .°F), the derating can be reduced by 1.5% for every 1 °C reduction in temperature. For a more accurate derating, use the DriveSize PC tool. A few altitude derating curves are shown below.



	Derating factor 1.00
	Derating factor 0.95
	Derating factor 0.9
	Derating factor 0.85
	Derating factor 0.80

Deratings for special settings in the drive control program

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

Ex motor, sine filter, low noise

Table below gives the deratings in these cases:

- drive is used with an ABB motor for explosive atmospheres (Ex) and **EX motor** in Parameter **95.15 Special HW settings** is enabled
- sine filter given in the selection table on page *240* is used and **ABB sine filter** in **Parameter 95.15 Special HW settings** is enabled
- **Low noise optimization** is selected in **Parameter 97.09 Switching freq mode**.

With other than listed sine filters (see section *Sine filters* on page *240*) and non-ABB Ex motors, contact ABB.

Drive module type ACS880-34-	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 = 460 V												
302A-5	287	250 hp	287	247	272	250 hp	272	232	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	119	132	119	105	122	132	122	107	66	75	63	55
174A-7	145	160	145	125	149	160	149	128	81	90	77	66
210A-7	176	200	176	153	180	200	180	157	98	110	93	81
271A-7	226	250	226	185	231	250	231	189	126	132	119	98
330A-7	282	315	282	238	288	315	288	244	154	160	149	126
370A-7	317	355	317	290	324	355	324	297	172	200	167	153
430A-7	370	400	370	326	378	400	378	333	200	200	195	172

3AXD00000588487

U_N	Nominal voltage of the drive
I_N	Continuous rms output current. No overload capability at 40 °C (104 °F)
P_N	Typical motor power in no-overload use.
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-overload use.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
*	Continuous rms output current allowing 44% overload for 1 minute every 5 minutes

High speed mode

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

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

Drive module type ACS880-34**-**	**Deratings with selection High speed mode of parameter 95.15 Special HW settings**									
	120 Hz output frequency					**Maximum output frequency**				
		Nominal use		**Light-duty use**	**Heavy-duty use**		**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
585A-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 = 460 V										
302A-5	120	302	250 hp	302	260	500	247	200 hp	249	214
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	400	500	247	250	241	213

3AXD00000588487

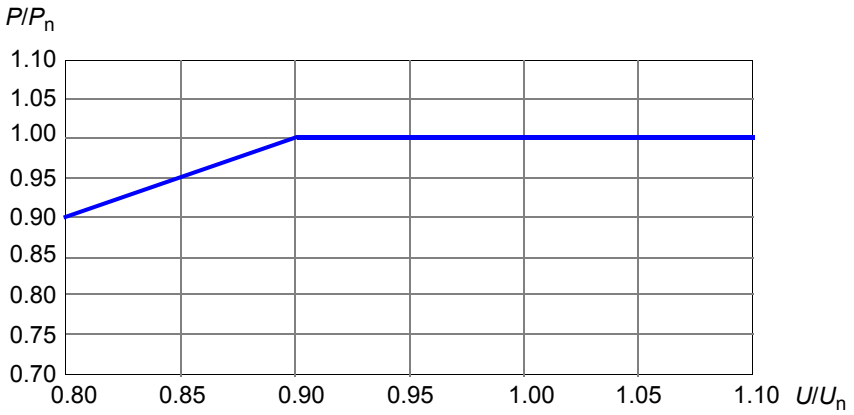
f	Output frequency
f_{max}	Maximum output frequency with High speed mode
U_N	Nominal voltage of the drive
I_N	Continuous rms output current. No overload capability at 40 °C (104 °F)

P_N	Typical motor power in no-overload use.
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-overload use.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
*	Continuous rms output current allowing 40% overload for 1 minute every 5 minutes

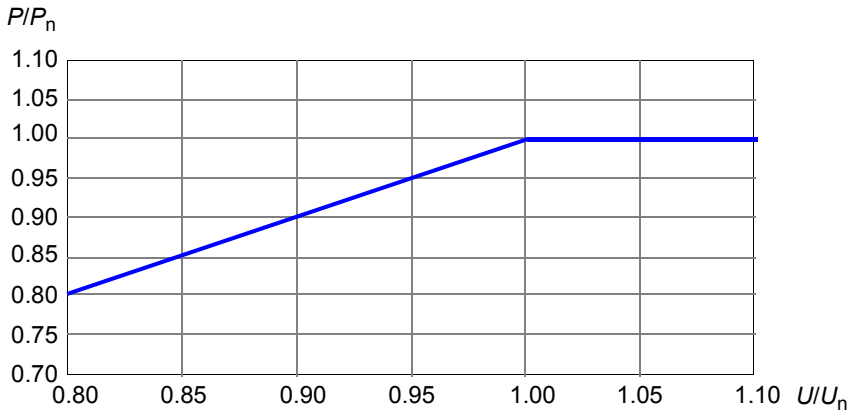
Derating for output voltage boosting

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

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



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



U	Typical motor power in no-overload use
U_n	Nominal supply voltage of the drive. For -3 types U_n = 400 V, for -5 types U_n = 500 V. For -7 types U_n = 690 V but 575 V when P_n refers to nominal power ratings in the UL 575 V rating tables.
P	Derated ouput power of the drive
P_n	Nominal power rating of the drive

Fuses (IEC)

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

Ultrarapid (aR) fuses							
Drive type ACS880-34-	**Input current (A)**	**Fuse**					
		A	**A^2s**	**V**	**Manufacturer**	**Type DIN 43653**	**Size**
U_N = 400 V							
246A-3	212	400	74 000	690	Bussmann	170M5408	2
293A-3	257	500	145 000	690	Bussmann	170M5410	2
363A-3	321	630	210 000	690	Bussmann	170M6410	3
442A-3	401	700	300 000	690	Bussmann	170M6411	3
505A-3	401	800	465 000	690	Bussmann	170M6412	3
585A-3	505	1000	945 000	690	Bussmann	170M6414	3
650A-3	569	1000	945 000	690	Bussmann	170M6414	3
U_N = 500 V							
240A-5	169	315	42 000	690	Bussmann	170M4410	1
260A-5	205	400	74 000	690	Bussmann	170M5408	2
302A-5	257	500	145 000	690	Bussmann	170M5410	2
361A-5	321	630	210 000	690	Bussmann	170M6410	3
414A-5	404	700	300 000	690	Bussmann	170M6411	3
460A-5	455	700	300 000	690	Bussmann	170M6411	3
503A-5	513	800	465 000	690	Bussmann	170M6412	3
U_N = 690 V							
142A-7	123	250	21 000	690	Bussmann	170M4409	1
174A-7	149	315	42 000	690	Bussmann	170M4410	1
210A-7	186	400	74 000	690	Bussmann	170M5408	2
271A-7	232	500	145 000	690	Bussmann	170M5410	2
330A-7	293	630	210 000	690	Bussmann	170M6410	3
370A-7	330	700	300 000	690	Bussmann	170M6411	3
430A-7	375	700	300 000	690	Bussmann	170M6411	3

3AXD00000588487

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

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

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

Note 4: Fuses from other manufacturers can be used if they agree with the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

Fuses (UL Recognized)

UL Recognized fuses for branch circuit protection per NEC are listed below. **Check that the operating time of the fuse is below 0.1 seconds.** The operating time depends on the fuse type, supply network impedance and the cross-sectional area, material and length of the supply cable. The fuses must be of the “non-time delay” type. Obey local regulations.

Drive type ACS880-34-	Input current (A)	Fuse				
		A	V	Manufacturer	Size	Type DIN 43653
U_N = 400 V						
246A-3	212	400	690	Bussmann	2	170M5408
293A-3	257	500	690	Bussmann	2	170M5410
363A-3	321	630	690	Bussmann	3	170M6410
442A-3	401	700	690	Bussmann	3	170M6411
505A-3	401	800	690	Bussmann	3	170M6412
585A-3	505	1000	690	Bussmann	3	170M6414
650A-3	569	1000	690	Bussmann	3	170M6414
U_N = 500 V						
240A-5	169	315	690	Bussmann	1	170M4410
260A-5	205	400	690	Bussmann	2	170M5408
302A-5	239	500	690	Bussmann	2	170M5410
361A-5	257	630	690	Bussmann	3	170M6410
414A-5	321	700	690	Bussmann	3	170M6411
460A-5	404	700	690	Bussmann	3	170M6411
503A-5	455	800	690	Bussmann	3	170M6412
U_N = 600 V						
142A-7	125	250	690	Bussmann	1	170M4409
174A-7	146	315	690	Bussmann	1	170M4410
210A-7	166	400	690	Bussmann	2	170M5408
271A-7	208	500	690	Bussmann	2	170M5410
330A-7	250	630	690	Bussmann	3	170M6410
370A-7	291	700	690	Bussmann	3	170M6411
430A-7	375	700	690	Bussmann	3	170M6411

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

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

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

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

Dimensions, weights and free space requirements

Standard drive module configuration (drive module + LCL filter module)								
Frame size	Height		Width		Depth		Weight*	
	mm	in	mm	in	mm	in	kg	lb
R11	1741	68.54	713	28.07	512	20.16	365	805

Optional selection +0B051+0H371 (without shrouds and full-size output power cable connection terminals)								
Frame size	Height		Width		Depth		Weight*	
	mm	in	mm	in	mm	in	kg	lb
R11	1733	68.20	401	15.77.	506	19.92	161	355

Optional selection +H381 (full power cabling panels)								
Frame size	Height		Width		Depth		Weight*	
	mm	in	mm	in	mm	in	kg	lb
R11	1780	70.08	709	27.91	500	19.69	495	871

* approximate (depends on the selected options)

Weight of the LCL filter module: 180 kg (396 lb)

The weight of the cabling panels of option +H381 is 30 kg (66 lb)

Weight of optional selections										
Frame size	+E208		+H356		+0H371		+H370		+0B051	
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
R11	3	7	2	4	-2.9	-6	2.9	6	-1.5	-3

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

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).

Drive type	Frame size	Air flow		Heat dissipation	Noise
		m^3/h	ft^3/min	W	dB(A)
U_N = 400 V					
ACS880-34-246A-3	R11	2100	1279	5 280	75
ACS880-34-293A-3	R11	2100	1279	6 400	75
ACS880-34-363A-3	R11	2100	1279	8 000	75
ACS880-34-442A-3	R11	2100	1279	10 000	75
ACS880-34-505A-3	R11	2100	1279	10 000	75
ACS880-34-585A-3	R11	2100	1279	12 600	75
ACS880-34-650A-3	R11	2100	1279	14 200	75
U_N = 500 V					
ACS880-34-240A-5	R11	2100	1279	5 280	75
ACS880-34-260A-5	R11	2100	1279	6 400	75
ACS880-34-302A-5	R11	2100	1279	8 000	75
ACS880-34-361A-5	R11	2100	1279	8 000	75
ACS880-34-414A-5	R11	2100	1279	10 000	75
ACS880-34-460A-5	R11	2100	1279	12 600	75
ACS880-34-503A-5	R11	2100	1279	14 200	75

Drive type	Frame size	Air flow		Heat dissipation	Noise
		m^3/h	ft^3/min	W	dB(A)
ACS880-34-142A-7	R11	2100	1279	5 280	75
ACS880-34-174A-7	R11	2100	1279	6 400	75
ACS880-34-210A-7	R11	2100	1279	8 000	75
ACS880-34-271A-7	R11	2100	1279	10 000	75
ACS880-34-330A-7	R11	2100	1279	12 600	75
ACS880-34-370A-7	R11	2100	1279	14 200	75
ACS880-34-430A-7	R11	2100	1279	16 000	75

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

Terminal and entry data for the power cables

The maximum accepted cable size is 4 × (3 × 240) mm^2 or 4 × (3 × 500 AWG). Screw size for connecting busbars to the drive module input and output busbars: M12, tightening torque 50...75 N·m.

Units with optional cabling panels (+H381)

The maximum accepted cable size is 4 × (3 × 240) mm^2 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 page *115* or *128*.

Electrical power network specification

Voltage (U_1)	ACS880-34-xxxx-3 drive modules: 380…415 V AC phase +10%/-15%. This is indicated in the type designation label as typical input voltage level 3 ~ 400 V AC. ACS880-34-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. ACS880-34-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 (600 UL, CSA) V AC .

Network type	TN (grounded) and IT (ungrounded) systems
Short-circuit withstand strength (IEC 61439-1)	Maximum allowable prospective short-circuit current is 65 kA when by the fuses given in the fuse table. For the maximum allowable prospective short-circuit current with circuit breakers, see section *Protecting the drive and input power cable in short-circuits* on page 69.
Short-circuit current protection (UL 61800-5-1)	The drive is suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes at 600 V maximum when protected by fuses given in the fuse table.
Short-circuit current protection (CSA C22.2 No. 14-05)	The drive is suitable for use on a circuit capable of delivering not more than 100 kA rms symmetrical amperes at 600 V maximum when by the fuses given in the fuse table.
Frequency (f_1)	50/60 Hz, Variation ± 5% of nominal frequency.
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Power factor	cos phi$_1$ = 1, cos phi (total) = 0.99
Harmonic distortion	Harmonics are below the limits defined in IEEE519, IEC61000-3-12 and G5/4 standards. The table below shows typical results on indicated networks. Values are measured at the input terminals of the drive.

R_{sc}	THD voltage (%)	THD current (%)
20	3	2.5*
100	01.9	2.5*

$$THD = \sqrt{\sum_{2}^{50} \left(\frac{I_n}{I_{1contmax}} \right)^2}$$

THD	Total harmonic distortion. The voltage THD depends on the short-circuit ratio (Rsc). The spectrum of the distortion also contains interharmonics.
I_n	nth harmonic component
R_{sc}	Short-circuit ratio. $R_{sce} = I_{sc}/I_N$
I_{sc}	Short-circuit current at point of common coupling (PCC)
$I_{1contmax}$	Continuous maximum input current of the line-side converter
I_L	Maximum demand load current

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors)
Voltage (U_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 *Ratings*.
Frequency (f_2)	0…500 Hz For drives with du/dt filter: Contact ABB For drives with sine filter: Contact ABB
Switching frequency	3 kHz (typically)

Maximum recommended motor cable length	**DTC control**	**Scalar control**
	500 m (1640 ft)	500 m (1640 ft)

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

Note 2: Longer motor cables cause a motor voltage decrease which limits the available motor power. The decrease depends on the motor cable length and characteristics. Contact ABB for more information. Note that a sine filter (optional) at the drive output also causes a voltage decrease.

DC connection data

Drive type	Capacitance (mF)
U_N = 400 V	
ACS880-34-246A-3	10,5
ACS880-34-293A-3	10,5
ACS880-34-363A-3	10,5
ACS880-34-442A-3	10,5
ACS880-34-505A-3	10,5
ACS880-34-585A-3	14,0
ACS880-34-650A-3	14,0
U_N = 500 V	
ACS880-34-240A-5	10,5
ACS880-34-260A-5	10,5
ACS880-34-302A-5	10,5
ACS880-34-361A-5	10,5
ACS880-34-414A-5	10,5
ACS880-34-460A-5	14,0
ACS880-34-503A-5	14,0
U_N = 690 V	
ACS880-34-142A-7	5,3
ACS880-34-174A-7	5,3
ACS880-34-210A-7	5,3
ACS880-34-271A-7	5,3
ACS880-34-330A-7	5,3
ACS880-34-370A-7	5,3
ACS880-34-430A-7	5,3

Control panel type

ACS-AP-W assistant control panel

Efficiency

Approximately 96.5% at nominal power level

Protection classes

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

Degree of protection

IP20 (UL Open Type),. With option +0B051: IP00 (UL Open Type).

Ambient conditions

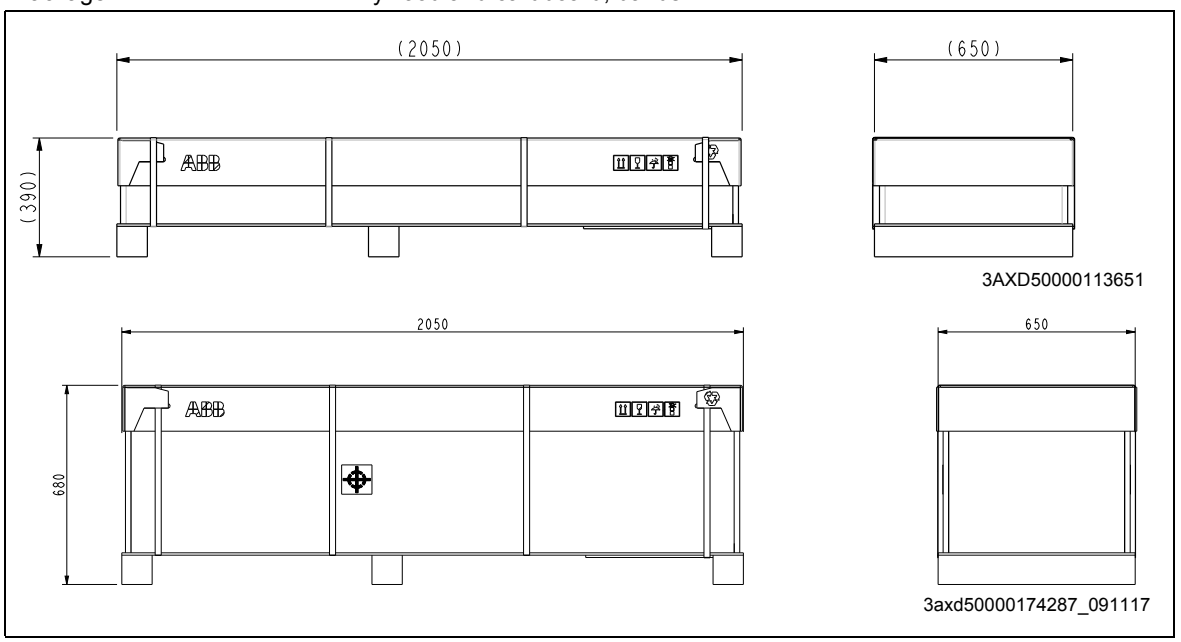
Environmental limits for the drive are given below. The drive is to be used in a heated, indoor, controlled environment.

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	For neutral-grounded TN and TT systems and IT (unrounded) systems: 0 to 4000 m (13123 ft) above sea level Above 1000 m [3281 ft]), see page *185*.	-	-
Air temperature	-15 to +55 °C (5 to 131 °F). No frost allowed. See page *185*.	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	5 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels	IEC/EN 60721-3-3:2002: Classification of environmental conditions- Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations	IEC 60721-3-1:1997	IEC 60721-3-2:1997
Chemical gases	Class 3C2	Class 1C2	Class 2C2
Solid particles	Class 3S2. No conductive dust allowed.	Class 1S3. (packing must support this, otherwise 1S2)	Class 2S2
Pollution degree	2		
Atmospheric pressure	70 to 106 kPa 0.7 to 1.05 atmospheres	70 to 106 kPa 0.7 to 1.05 atmospheres	60 to 106 kPa 0.6 to 1.05 atmospheres
Vibration IEC 60068-2-6:2007, EN 60068-2-6:2008 *Environmental testing Part 2-6: Tests –Test Fc: Vibration (sinusoidal)*	Max. 0.1 mm (0.004 in.) (10 to 57 Hz), max. 10 m/s^2 (33 ft/s^2) (57 to 150 Hz) sinusoidal	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s^2 (49 ft/s^2) (9 to 200 Hz) sinusoidal
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009 *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock*	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.)	100 mm (4 in.)

Materials

Drive enclosure	• PC/ABS 2.5 mm, color NCS 1502-Y (RAL 9002 / PMS 420 C) • hot-dip zinc coated steel sheet 1.5 to 2.5 mm, thickness of coating 100 micrometers, color NCS 1502-Y
Air baffles for RIttal cabinet	See section *Material of the air baffles* on page *213*.

Package	Plywood and cardboard, bands PP.



Disposal	The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated. Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and DC capacitors (C1-1 to C1-x) need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code. Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.

Applicable standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standard EN 61800-5-1.

EN 60204-1:2006 + AI:2009 + AC:2010	*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.
IEC/EN 60529:1981 +A1:1999 + A2: 2013	*Degrees of protection provided by enclosures (IP code)*
EN 61000-3-12:2011	*Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current* The standard is met with a Rsce (transformer short circuit ratio) of 350 or higher.
IEC/EN 61800-3:2004 + A1:2012	*Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods*
IEC/EN 61800-5-1:2007	*Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy*
IEC/EN 60664-1:2007	*Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.*
UL 61800-5-1: First edition 2012	*Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy*
NEMA 250:2014	*Enclosures for Electrical Equipment (1000 Volts Maximum)*
CSA C22.2 No. 274-17	*Industrial control equipment*

Markings

These markings are attached to the drive:

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

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

Definitions

EMC stands for **E**lectro**m**agnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

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

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

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and started up only by a professional when used in the first environment.
Note: A professional is a person or organization having necessary skills in installing and/or starting up power drive systems, including their EMC aspects.

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

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

Category C2

The drive complies with the standard with the following provisions:

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

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

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

Category C3

The drive complies with the standard with the following provisions:

1. The drive is equipped with EMC filter +E210.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 100 meters.

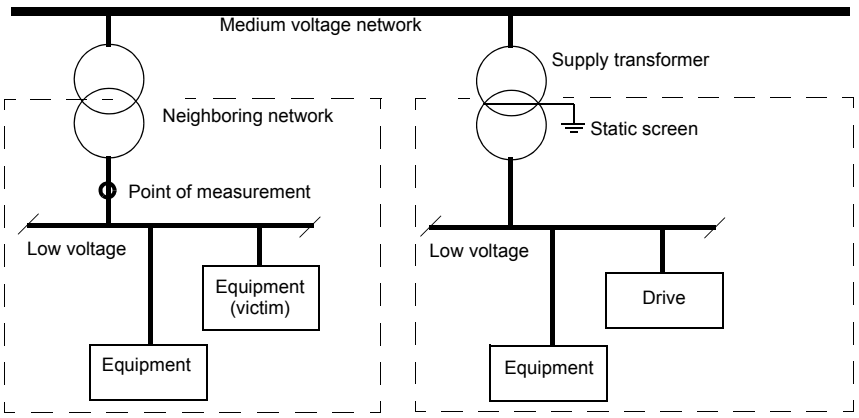
WARNING! A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Category C4

If the provisions under *Category C3* cannot be met, the requirements of the standard can be met as follows:

1. It is ensured that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the inherent suppression in transformers and cables is

sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.



2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available from the local ABB representative.
3. The motor and control cables are selected as specified in the hardware manual.
4. The drive is installed according to the instructions given in the hardware manual.

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

UL checklist

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

- Make sure that the drive type designation label includes the cULus Listed marking.
- **CAUTION - Risk of electric shock**. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.
- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust. See page *196*.
- The maximum ambient air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 55 °C (104 to 131 °F).
- The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 V maximum, when protected with fuses listed on page *191*. The ampere rating is based on tests done according to UL 61800-5-1.
- The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.

- The input cable must be protected with fuses. Suitable UL Recognized fuses are listed on page *191*. These fuses provide branch circuit protection in accordance with the National Electrical Code (NEC). For installation in the United States, obey any other applicable local codes. For installation in Canada, obey any applicable provincial codes.

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

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

- The drive provides overload protection in accordance with the National Electrical Code (NEC).
- For drive overvoltage category, see on page *195*. For pollution degree, see page *196*.

EU Declaration of Conformity (Machinery Directive)

The following harmonized standards have been applied:

EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional*
EN 62061:2005 + AC:2010 + A1:2013 + A2:2015	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1:2015	*Safety of machinery – Safety-related parts of control systems. Part 1: General requirements*
EN ISO 13849-2:2012	*Safety of machinery – Safety-related parts of the control systems. Part 2: Validation*
EN 60204-1: 2006 + A1:2009 + AC:2010	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

The following other standards have been applied:

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

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

Person authorized to compile the technical file:

Name and address: Ari Korpela, Hiomotie 13, 00380 Helsinki, Finland.

Helsinki, 29 Jan 2018

Manufacturer representative:

Vesa Kandell
Vice President, ABB Oy

Disclaimers

Generic disclaimer

The manufacturer shall have no obligation with respect to any product which (i) has been improperly repaired or altered; (ii) has been subjected to misuse, negligence or accident; (iii) has been used in a manner contrary to the manufacturer’s instructions; or (iv) has failed as a result of ordinary wear and tear.

Cybersecurity disclaimer

This product is designed to be connected to and to communicate information and data via a network interface. It is Customer's sole responsibility to provide and continuously ensure a secure connection between the product and Customer network or any other network (as the case may be). Customer shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

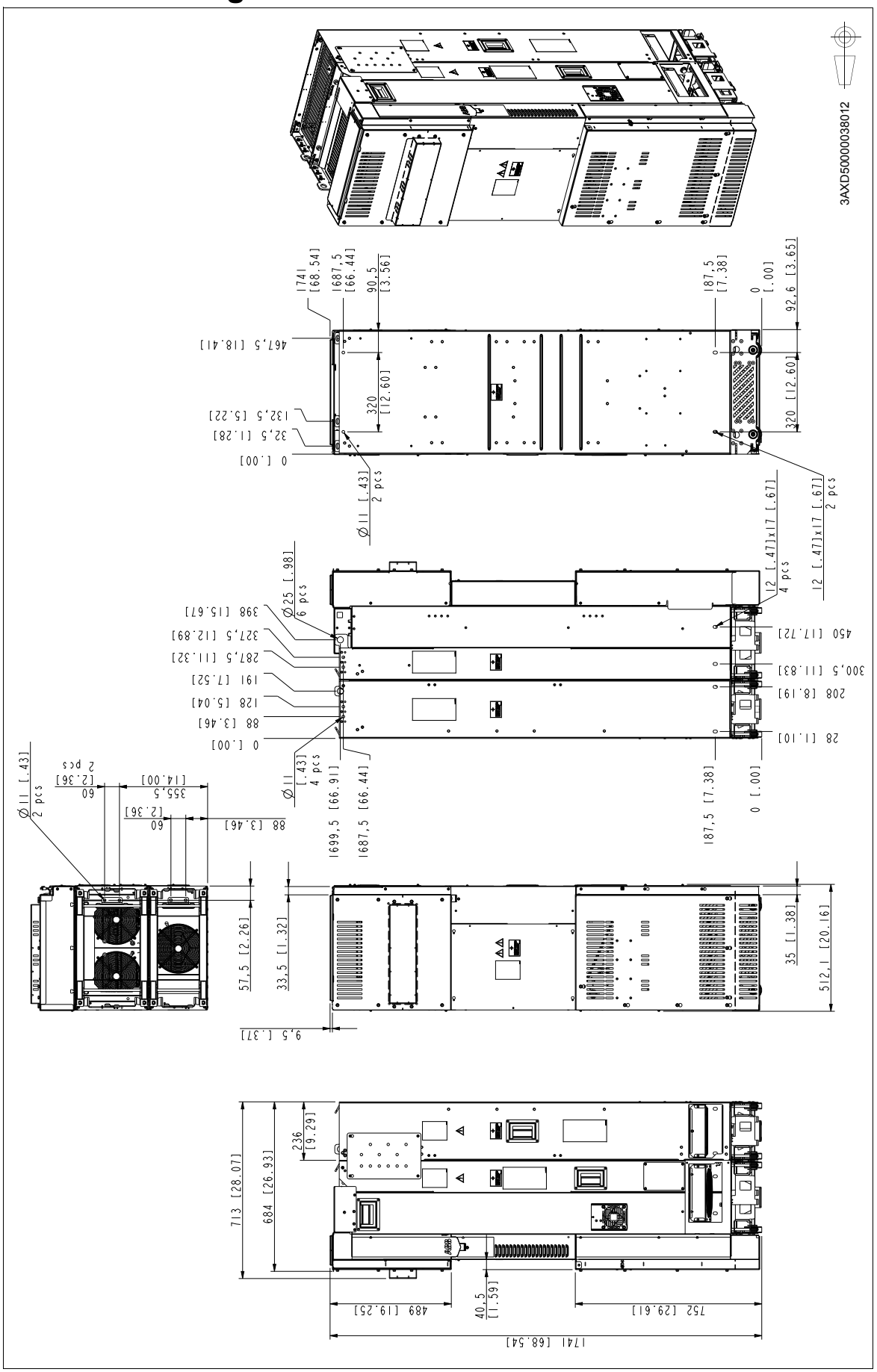
17

Dimension drawings

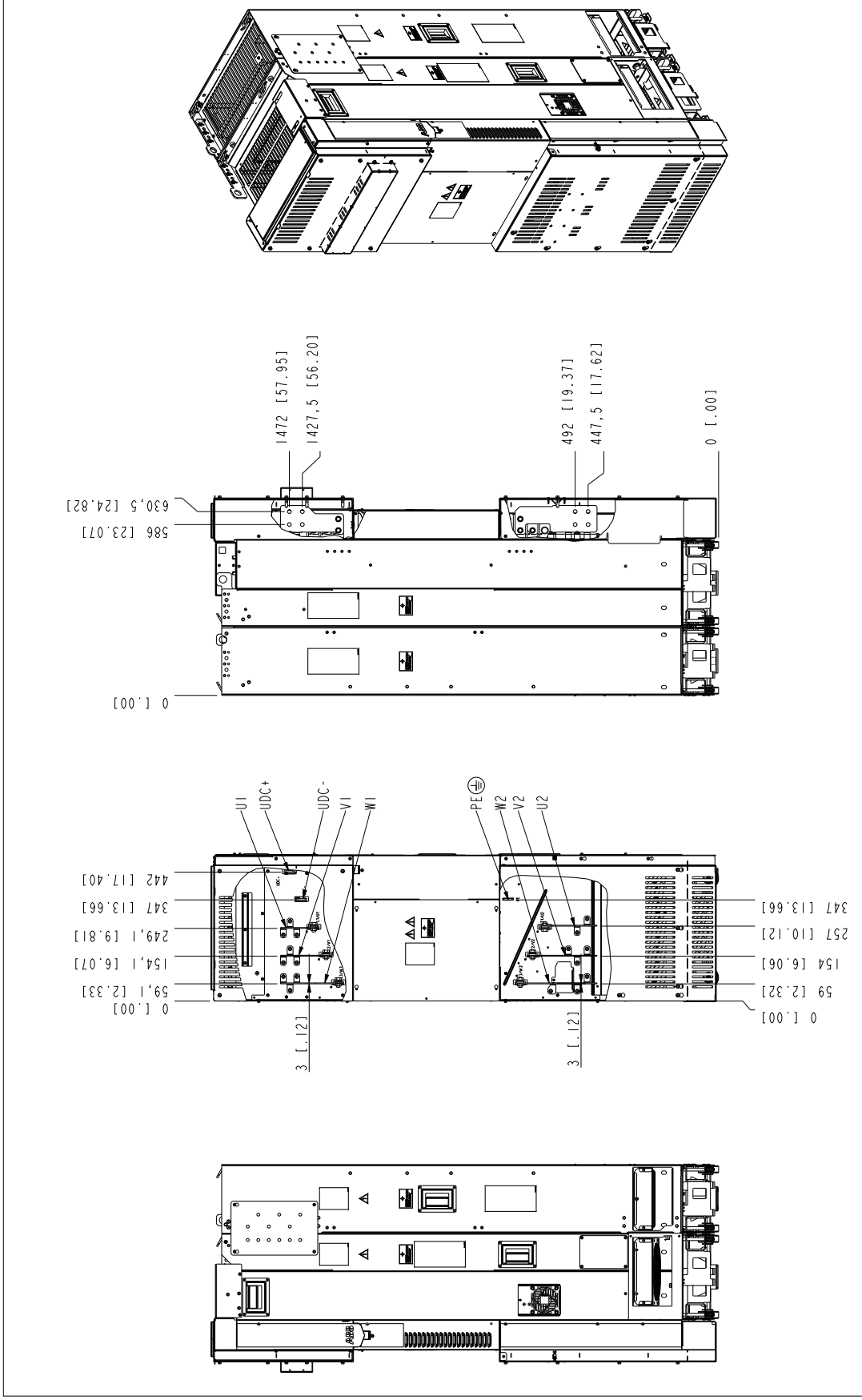
Contents of this chapter

This chapter contains dimension drawings of the drive modules with optional parts for Rittal TS 8 cabinet assembly.

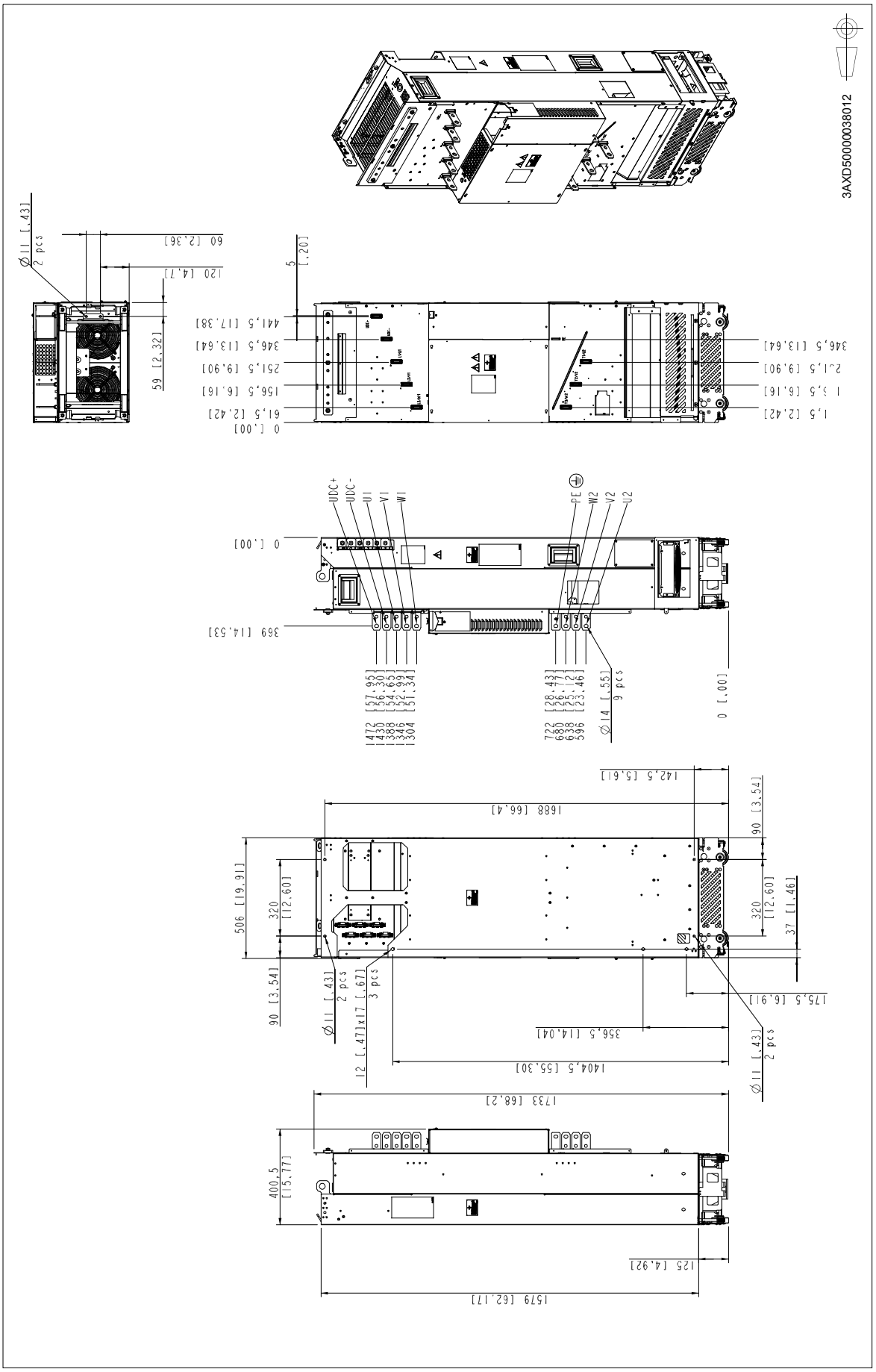
Standard configuration



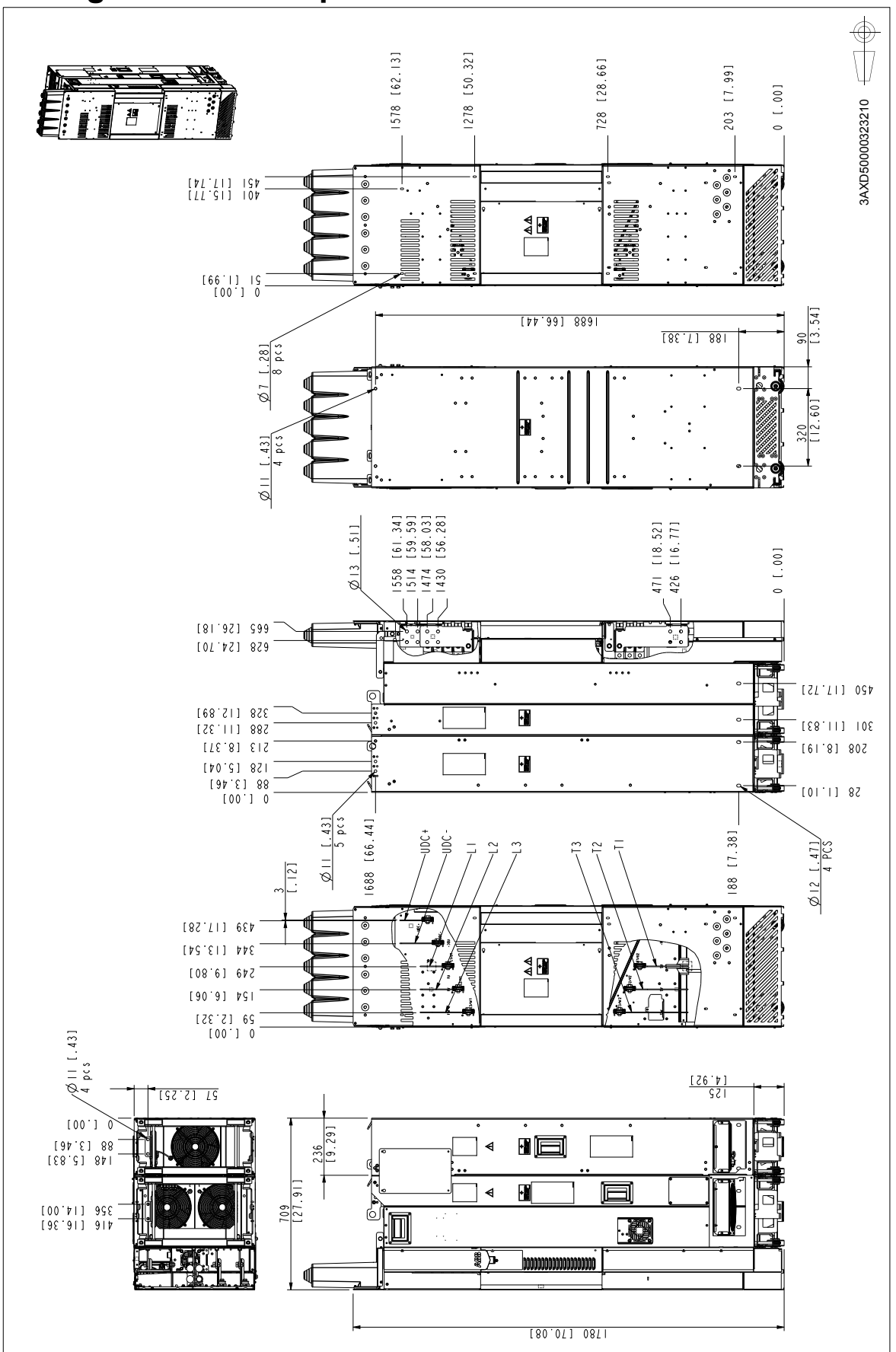
Location of power cable connection terminals with options +H370, +H356



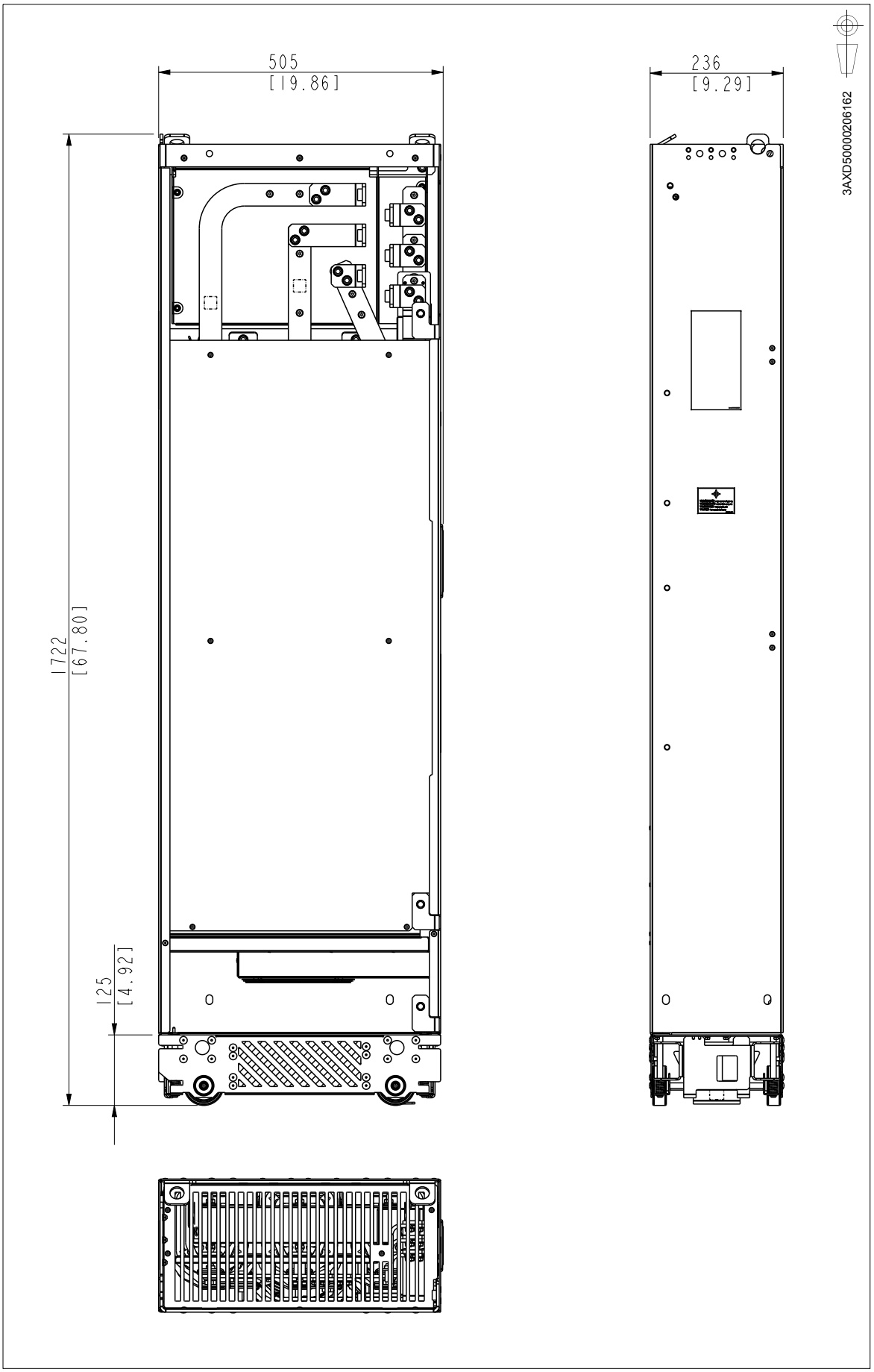
Drive module with options +0B051+H356+0H371



Configuration with option +H381

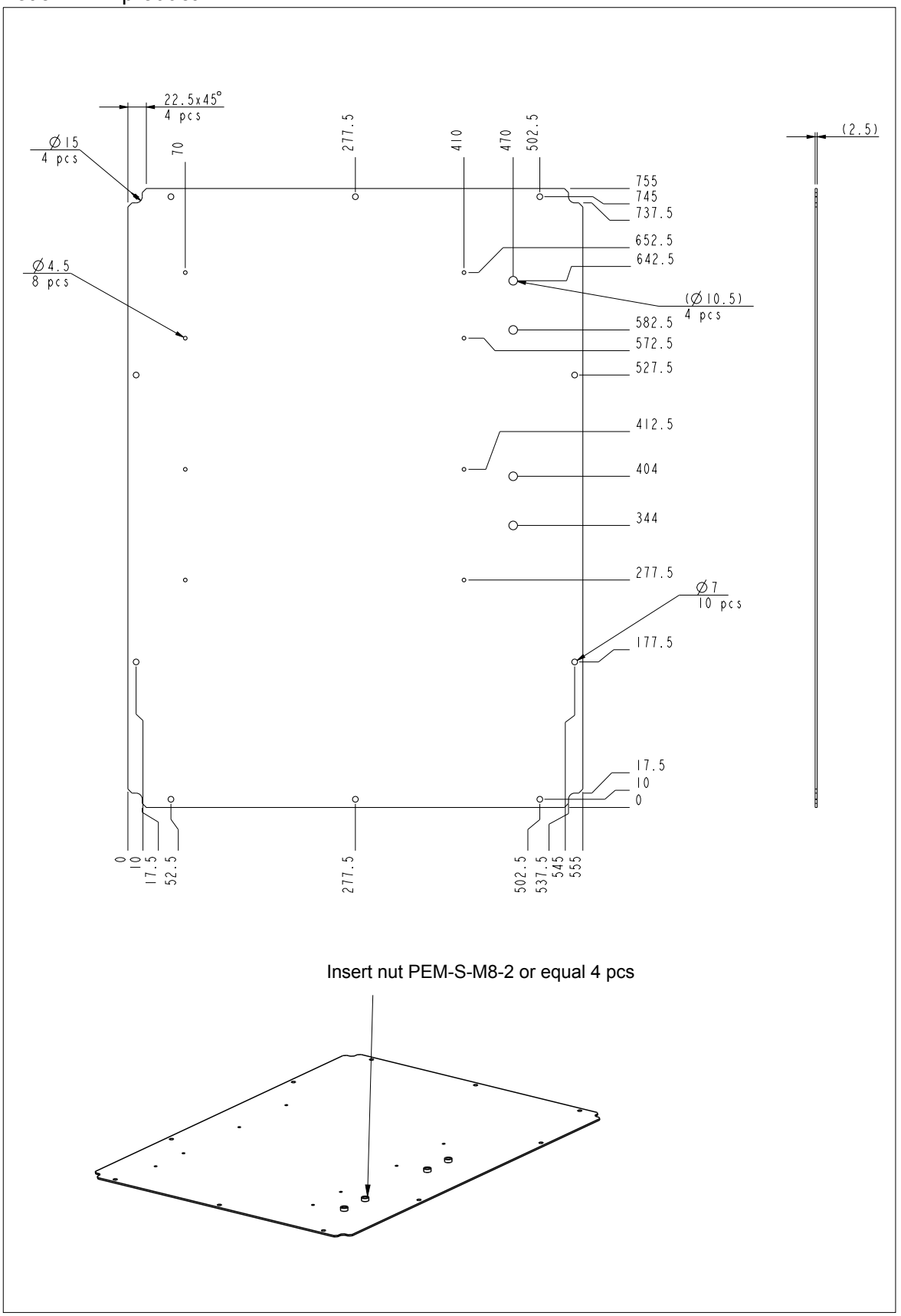


LCL filter module



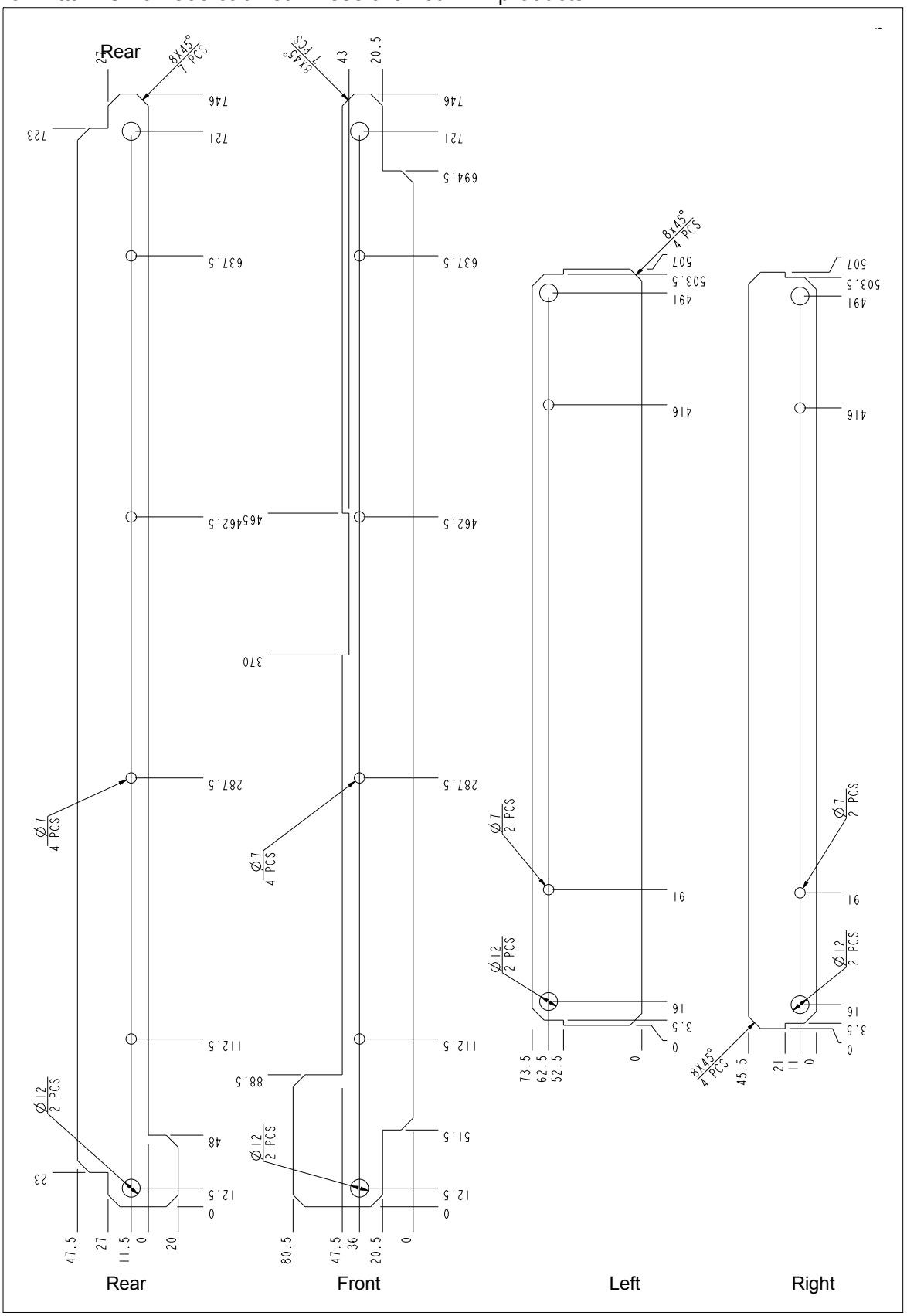
Bottom plate

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



Air baffles for the standard drive module

These drawing show the dimensions of the air baffles around the standard drive module for Rittal TS 131 800 cabinet. These are not ABB products.

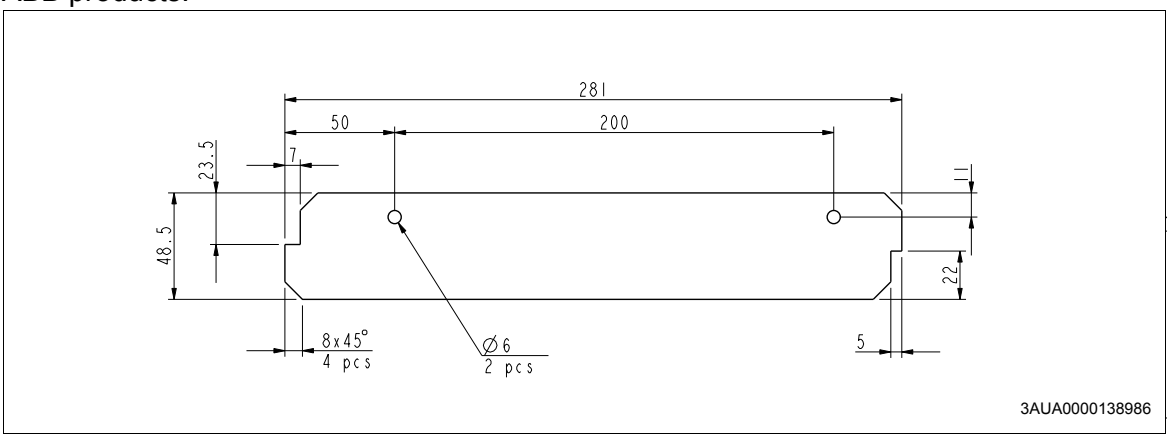


Material of the air baffles

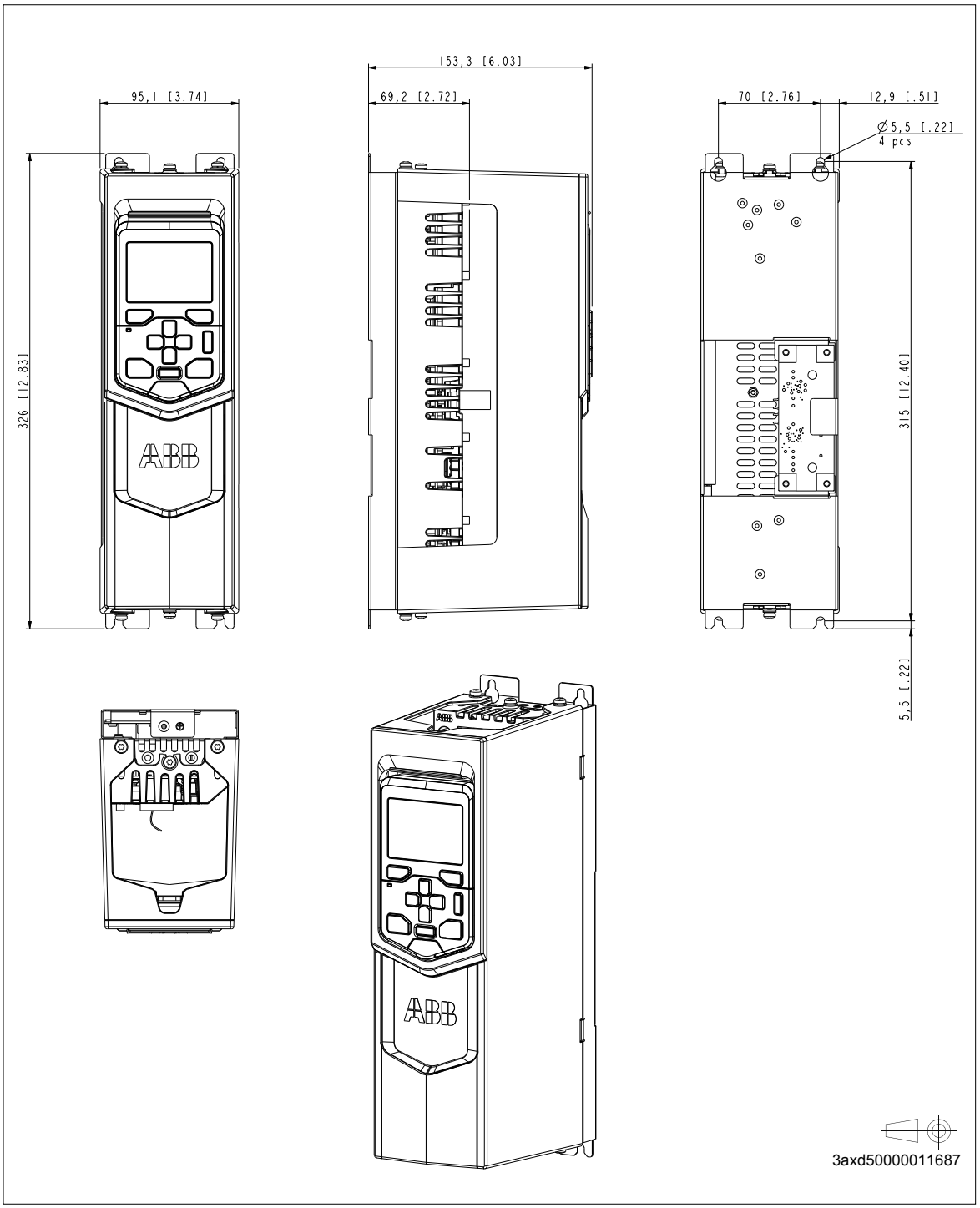
0.75 mm polycabonate (PC) film LEXAN® FR60 (GE) with UL94 V–0 listing, UV stability. (LEXAN® FR700 or Valox FR1 only with special permission). Unmarked bend radii 0.6 mm.

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

Additional air baffles for the cabling panels are shown below. Two pieces. These are not ABB products.



External control unit



18

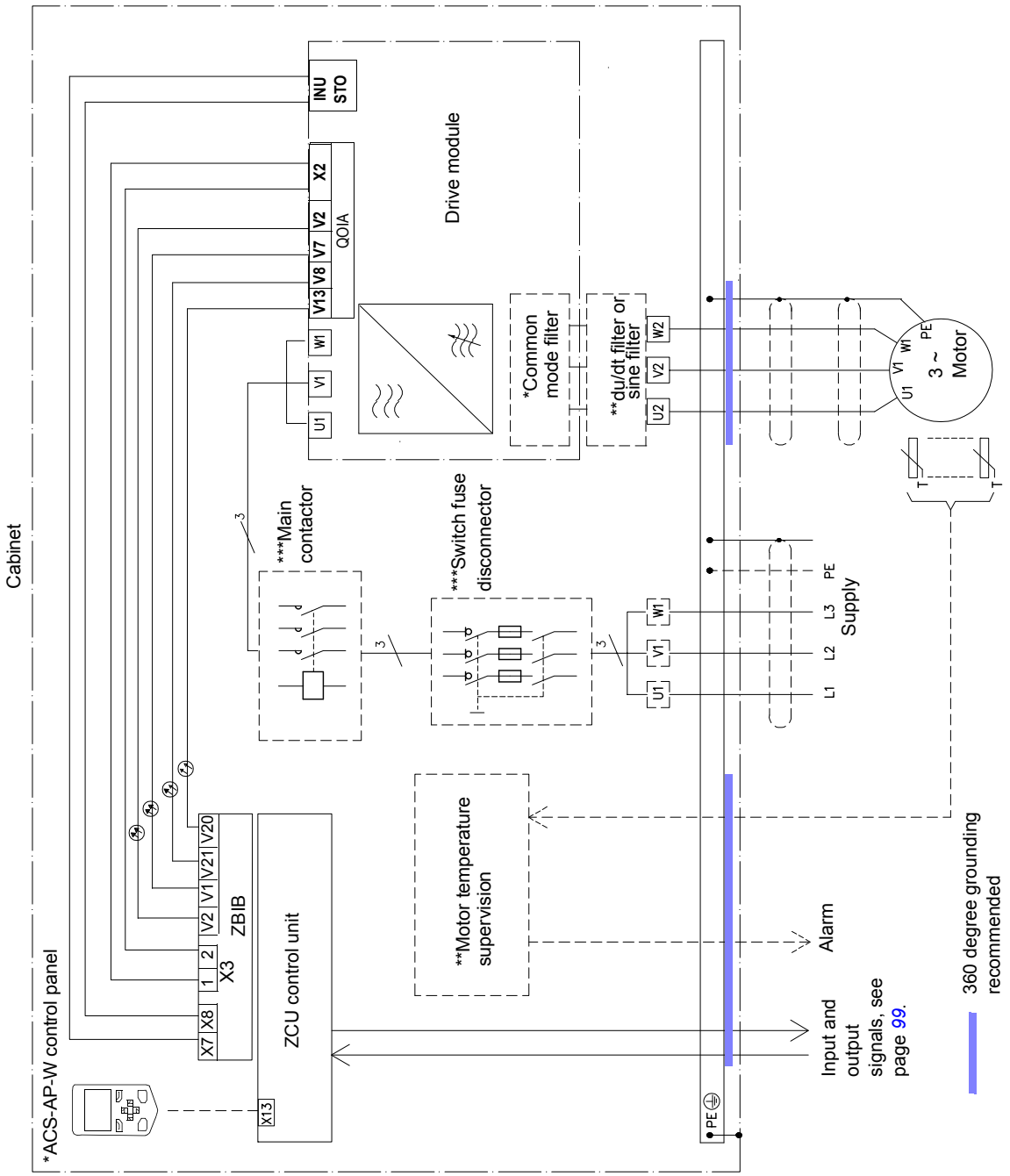
Example circuit diagram

Contents of this chapter

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

Example circuit diagram

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



19

Safe torque off function

Contents of this chapter

This chapter describes the Safe torque off (STO) function of the drive and gives instructions for its use.

Description

The Safe torque off function can be used, for example, to construct safety or supervision circuits that stop the drive in case of danger (such as an emergency stop circuit). Another possible application is a prevention of unexpected start-up switch that enables short-time maintenance operations like cleaning or work on non-electrical parts of the machinery without switching off the power supply to the drive.

When activated, the Safe torque off function disables the control voltage of the power semiconductors of the drive output stage (A, see diagram below), thus preventing the drive from generating the torque required to rotate the motor. If the motor is running when Safe torque off is activated, it coasts to a stop.

The Safe torque off function has a redundant architecture, that is, both channels must be used in the safety function implementation. The safety data given in this manual is calculated for redundant use, and does not apply if both channels are not used.

The Safe torque off function of the drive complies with these standards:

Standard	Name
EN 60204-1:2016	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*
IEC 61326-3-1:2008	*Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*
IEC 61508-1:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*
IEC 61508-2:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*
IEC 61511-1:2016	*Functional safety – Safety instrumented systems for the process industry sector*
IEC 61800-5-2:2016 EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
IEC 62061:2015 EN 62061:2005 +AC:2010+A1:2013+A2:2015	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1:2015	*Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*
EN ISO 13849-2:2012	*Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

The function also corresponds to Prevention of unexpected start-up as specified by EN 1037:1995 + A1:2008 and Uncontrolled stop (stop category 0) as specified in EN/IEC 60204-1.

Compliance with the European Machinery Directive

See section *EU Declaration of Conformity (Machinery Directive)* on page *202*.

Wiring

The following diagrams show examples of Safe torque off wiring for

- a single drive (page *220*)
- multiple drives (page *221*)
- multiple drives when an external 24V DC power supply is used (page *222*).

For drives with option +L537+Q971, see ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (option +Q971) application guide (3AUA0000074343 [English] and FPTC-02 ATEX-certified thermistor relay module, Ex II (2) GD (+L537+Q971) for ACS880 drives user's manual (3AXD50000027782 [English])

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

Activation switch

In the wiring diagrams below, the activation switch has the designation [K]. This represents a component such as a manually operated switch, an emergency stop push button switch, or the contacts of a safety relay or safety PLC.

- In case a manually operated activation switch is used, the switch must be of a type that can be locked out to the open position.
- The contacts of the switch or relay must open/close within 200 ms of each other.
- An FSO-xx safety functions module or an FPTC-0x thermistor protection module can also be used. For more information, see the FSO-xx module documentation.

Cable types and lengths

We recommend double-shielded twisted-pair cable (see page *67*).

Maximum cable lengths:

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

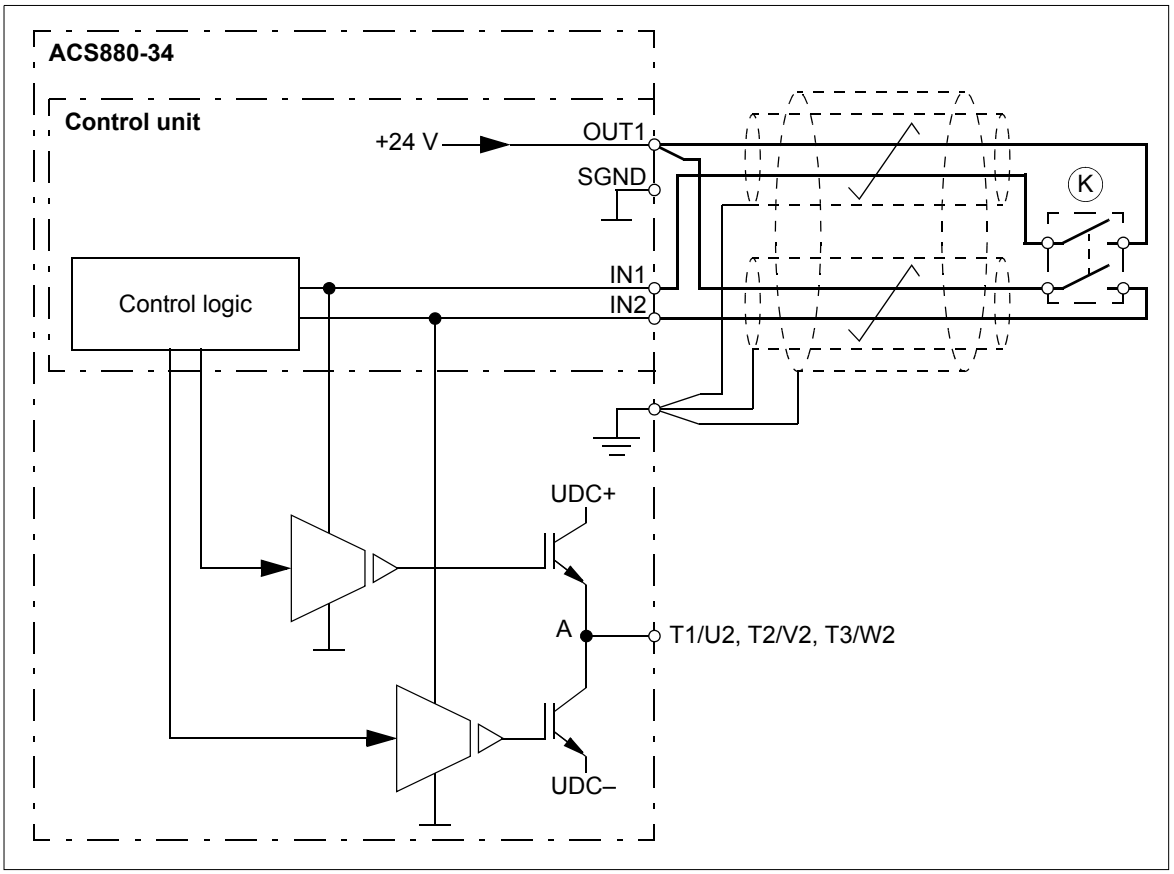
Note that the voltage at the INx terminals of each control unit must be at least 17 V DC to be interpreted as “1”.

Grounding of protective shields

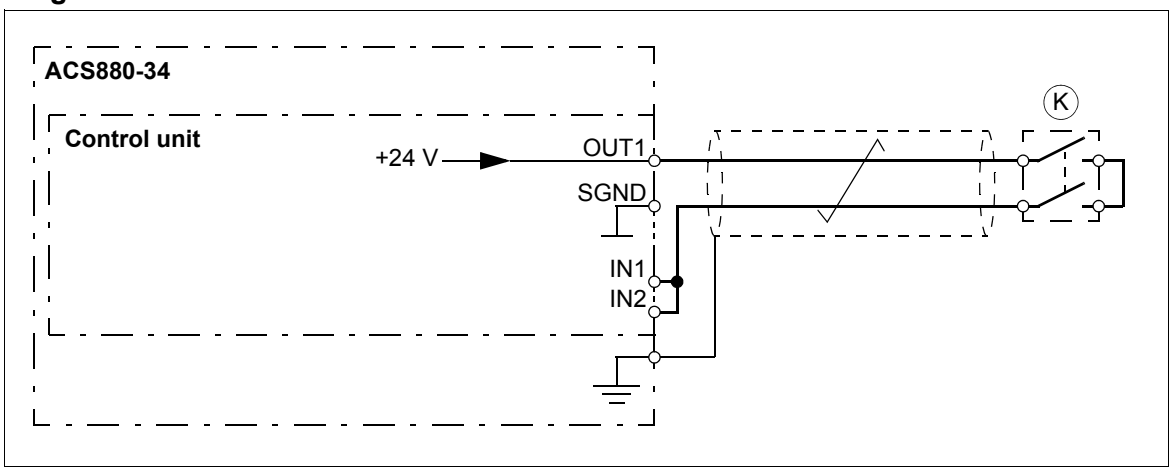
- Ground the shield in the cabling between the activation switch and the control unit at the control unit.
- Ground the shield in the cabling between two control units at one control unit only.

Single drive (internal power supply)

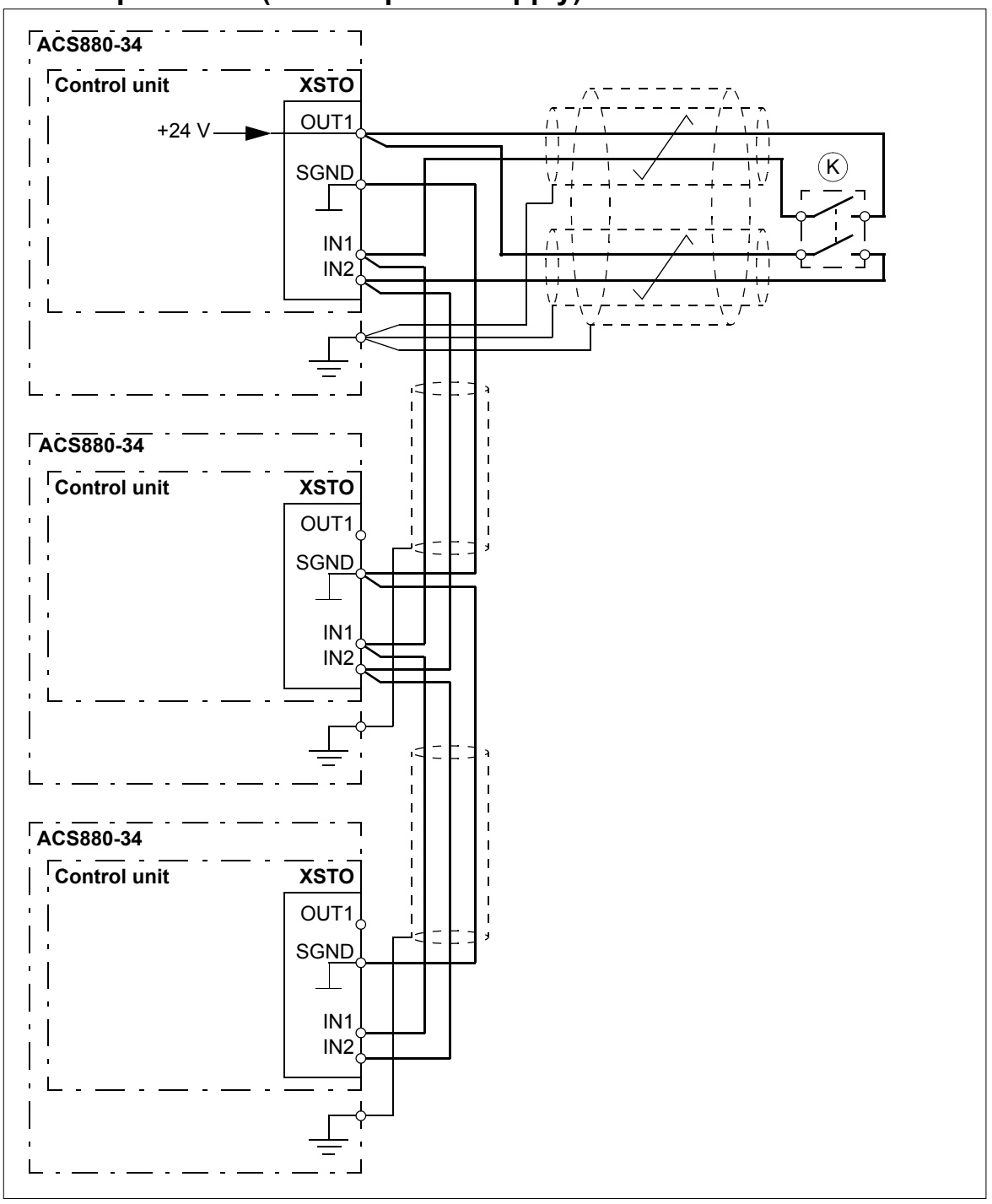
Dual-channel connection



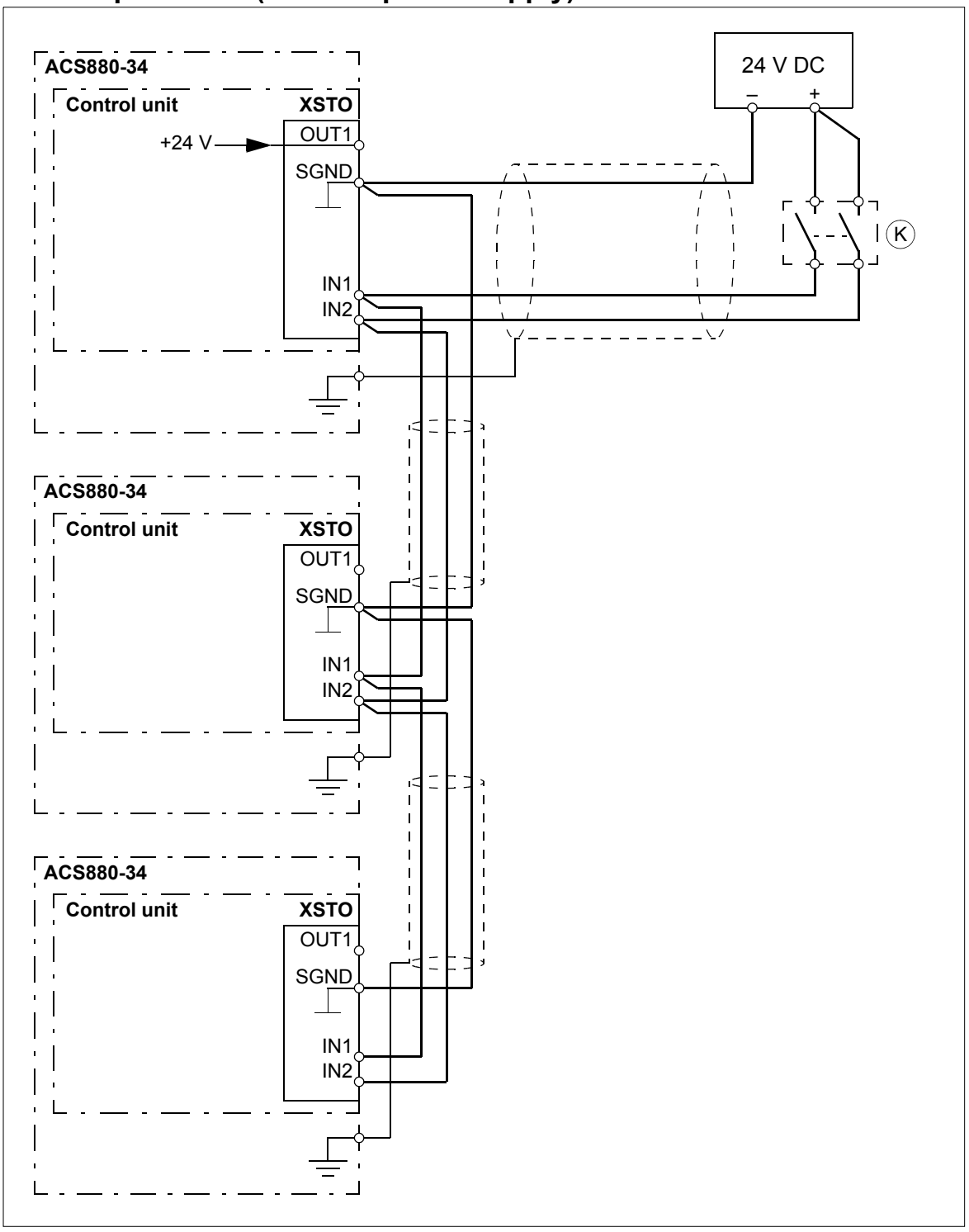
Single-channel connection



Multiple drives (internal power supply)



Multiple drives (external power supply)



Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. STO inputs on the drive control unit de-energize.
3. The control unit cuts off the control voltage from the output IGBTs.
4. The control program generates an indication as defined by parameter **31.22** (refer to the firmware manual of the drive).
5. Motor coasts to stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a reset may be needed (depending on the setting of parameter 31.22), A new start command is required to start the drive.

Start-up including acceptance test

To ensure the safe operation of a safety function, validation is required. The final assembler of the machine must validate the function by performing an acceptance test. The acceptance test must be performed

- at initial start-up of the safety function
- after any changes related to the safety function (circuit boards, wiring, components, settings, etc.)
- after any maintenance work related to the safety function.

Competence

The acceptance test of the safety function must be carried out by a competent person with adequate expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6. The test procedures and report must be documented and signed by this person.

Acceptance test reports

Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentation of start-up activities and test results, references to failure reports and resolution of failures. Any new acceptance tests performed due to changes or maintenance shall be logged into the logbook.

Acceptance test procedure

After wiring the Safe torque off function, validate its operation as follows.

Note: If the drive is equipped with safety option +Q972, +Q973 or +Q982, do the procedure shown in the FSO module documentation. If an FSO-xx safety functions module or an FPTC-0x module is installed, refer to its documentation..

Action	☑
WARNING! Obey the safety instructions in chapter *Safety instructions.* If you ignore them, injury or death, or damage to the equipment can occur.	☐
Ensure that the drive can be run and stopped freely during start-up.	☐
Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.	☐

Action	☑
Check the Safe torque off circuit connections against the wiring diagram.	☐
Close the disconnector and switch the power on.	☐
Test the operation of the STO function when the motor is stopped. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Ensure that the drive operates as follows: • Open the STO circuit. The drive generates an indication if one is defined for ‘stopped’ state in parameter 31.22 (see the firmware manual). • Give a start command to verify that the STO function blocks the operation of the drive. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the STO function when the motor is running. • Start the drive and ensure the motor is running. • Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for ‘running’ state in parameter 31.22 (see the firmware manual). • Reset any active faults and try to start the drive. • Ensure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the failure detection of the drive. The motor can be stopped or running. • Open the 1st channel of the STO circuit (wire coming to IN1). If the motor was running, it should coast to a stop. The drive generates a *FA81 Safe torque off 1 loss* fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally. • Open the 2nd channel of the STO circuit (wire coming to IN2). If the motor was running, it should coast to a stop. The drive generates a *FA82 Safe torque off 2 loss* fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	
Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.	☐

Use

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

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

WARNING! (With permanent magnet motors or synchronous reluctance [SynRM] motors only) In case of a multiple IGBT power semiconductor failure, the drive system can produce an alignment torque which maximally rotates the motor shaft by 180/*p* degrees (with permanent magnet motors) or 180/2p degrees (with synchronous reluctance [SynRM] motors) regardless of the activation of the Safe torque off function. *p* denotes the number of pole pairs.

Notes:

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

Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 5 or 2 years, see section *Safety data (SIL, PL)* (page *226*). It is assumed that all dangerous failures of the STO circuit are detected by the proof test. To perform the proof test, do the *Acceptance test procedure* (page *223*).

Note: See also the Recommendation of Use CNB/M/11.050 published by the European co-ordination of Notified Bodies concerning dual-channel safety-related systems with electromechanical outputs:

- When the safety integrity requirement for the safety function is SIL 3 or PL e (cat. 3 or 4), the proof test for the function must be performed at least every month.
- When the safety integrity requirement for the safety function is SIL 2 (HFT = 1) or PL d (cat. 3), the proof test for the function must be performed at least every 12 months.

The STO function of the drive does not contain any electromechanical components.

In addition to proof testing, it is a good practice to check the operation of the function when other maintenance procedures are carried out on the machinery.

Include the Safe torque off operation test described above in the routine maintenance program of the machinery that the drive runs.

If any wiring or component change is needed after start-up, or the parameters are restored, follow the test given in section *Acceptance test procedure* on page *223*.

Use only ABB approved spare parts.

Record all maintenance and proof test activities in the machine logbook.

Competence

The maintenance and proof test activities of the safety function must be carried out by a competent person with adequate expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6.

Fault tracing

The indications given during the normal operation of the Safe torque off function are selected by drive parameter **31.22**.

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an “STO hardware failure” fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, triggers the same reaction.

See the drive firmware manual for the indications generated by the drive, and for details on directing fault and warning indications to an output on the control unit for external diagnostics.

Any failures of the Safe torque off function must be reported to ABB.

Safety data (SIL, PL)

The safety data for the Safe torque off function is given below.

Note: The safety data is calculated for redundant use, and does not apply if both STO channels are not used.

Frame	SIL/ SILCL	PL	SFF (%)	PFH (1/h)	PFD_{avg} (T_1 = 2 a)	PFD_{avg} (T_1 = 5 a)	$MTTF_D$ (a)	DC* (%)	Cat.	HFT	CCF (%)	T_M (a)
R11	3	e	99.66	3.65E-09	3.20E-05	8.00E-05	20219	$\geq$ 90	3	1	80	20

3AXD10000481168 rev A

* According to Table E1 EN/ISO 13849-1

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with $\triangle T$ = 71.66 °C
  - 1340 on/off cycles per year with $\triangle T$ = 61.66 °C
  - 30 on/off cycles per year with $\triangle T$ = 10.0 °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time
- The STO is a type A safety component as defined in IEC 61508-2.
- Relevant failure modes:
  - The STO trips spuriously (safe failure)
  - The STO does not activate when requested

  A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- 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
- STO fault indication (parameter 31.22) delay: < 500 ms
- STO warning indication (parameter 31.22) delay: < 1000 ms

Abbreviations

Abbr.	Reference	Description
Cat.	EN ISO 13849-1	Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage
FIT	IEC 61508	Failure in time: 1E-9 hours
HFT	IEC 61508	Hardware fault tolerance
$MTTF_D$	EN ISO 13849-1	Mean time to dangerous failure: (The total number of life units) / (the number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD_{avg}	IEC 61508	Average probability of 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
PL	EN ISO 13849-1	Performance level. Levels a…e correspond to SIL
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1…3)
SILCL	IEC/EN 62061	Maximum SIL (level 1…3) that can be claimed for a safety function or subsystem
SS1	IEC/EN 61800-5-2	Safe stop 1
STO	IEC/EN 61800-5-2	Safe torque off

Abbr.	Reference	Description
T_1	IEC 61508	Proof test interval. T1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of T1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. See also section *Maintenance* (page *225*).
T_M	EN ISO 13849-1	Mission time, ie, period of time that covers the intended use of safety function/device. After the mission time the safety device(s) must be replaced. Note that any T_M values given cannot be regarded as a guarantee or warranty.

20

Resistor braking

Contents of this chapter

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

Operation principle and hardware description

Brake choppers and resistors are available as add-on kits for the drive modules.

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

Planning the braking system

Selecting the default brake circuit components

1. Calculate the maximum power generated by the motor during braking (P_{max}).
2. Select a suitable drive, brake chopper and brake resistor combination for the application, see section *Technical data* on page *232*. The braking power of the chopper and drive combination must be greater than or equal to the maximum power generated by the motor during the braking ($P_{br,max} \geq P_{max}$).
3. Check the resistor selection. The energy generated by the motor during a 600-second period must not exceed the resistor heat dissipation capacity E_R.
   Note: If the E_R value is not sufficient, you can use a four-resistor assembly in which two standard resistors are connected in parallel, two in series. The E_R value of the four-resistor assembly is four times the value specified for the standard resistor.

Selecting custom resistors

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

1. The resistance of the custom resistor is greater than or equal to the resistance of the default resistor in section *Brake resistors* on page *233*:

   $$R \geq R_{min}$$

   where

   R Resistance of the custom resistor

   WARNING! Never use a brake resistor with a resistance smaller than R_{min}. The drive and the chopper are not able to handle the overcurrent caused by the small resistance.

   R_{min} Resistance of the default resistor

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

   $$P_r > \frac{U_{DC}^2}{R}$$

   where

   P_r Load capacity of the custom resistor

   U_{DC} Drive intermediate DC circuit voltage.
   1.35 · 1.2 · 415 V DC (when supply voltage is 380 to 415 V AC)
   1.35 · 1.2 · 500 V DC (when supply voltage is 440 to 500 V AC) or

   R Resistance of the custom resistor

Selecting and routing external brake resistor cables

Use the same cable type for the resistor cabling as for the drive input cabling, or, alternatively, a two conductor shielded cable with the same cross-sectional area.

Minimizing electromagnetic interference

Obey these rules in order to minimize electromagnetic interference caused by the rapid current changes in the resistor cables:

- Shield the braking power line completely, either by using shielded cable or a metallic enclosure. Unshielded single-core cable can only be used if it is routed inside a cabinet that efficiently suppresses the radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance should be 0.3 meters (1 ft).
- Cross the other cables at right angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on chopper IGBTs. The longer the cable the higher the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

Maximum cable length

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

EMC compliance of the complete installation

Note: ABB has not verified that the EMC requirements are fulfilled with external custom brake resistors and cabling. The customer must consider the EMC compliance of the complete installation.

Placing the brake resistors

Install the brake resistors outside the drive module in a place where they will cool.

Arrange the cooling of the resistor in a way that:

- no danger of overheating is caused to the resistor or nearby materials
- the temperature of the room the resistor is located in does not exceed the allowed maximum.

Supply the resistor with cooling air or coolant according to the resistor manufacturer's instructions.

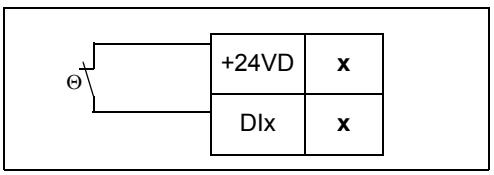
WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, make sure that the material withstands high temperatures.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

Protecting the system against thermal overload

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

ABB requires:

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



Protecting the resistor cable against short-circuits

The DC fuses for the brake chopper protection protect the resistor cable against short-circuits.

Mechanical installation of brake resistors

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

Electrical installation

Checking the insulation of the assembly

Obey the instructions given in section *Brake resistor and resistor cable* on page *86*.

Connection diagram

See section *Power cable connection diagram* on page *94*.

Connection procedure

- Connect the brake chopper via fuses (see section *Brake choppers* on page *232*) to drive module terminals UDC+ and UDC-.
- Connect the resistor cables to the brake chopper terminals. If a shielded three-conductor cable with shield conductivity good enough for the protective earth (ground) conductor is used, cut the third conductor. If the shield conductivity is not good enough, use the third conductor as the PE conductor. Ground the twisted shield of the cable (protective earth conductor of the resistor assembly) as well as any separate PE conductor (if present) at both ends.
- Connect the thermal switch of the brake resistor as described in section *Protecting the system against thermal overload* on page *231*.

WARNING! The ENABLE input terminal block of the brake chopper is at intermediate circuit potential when the line-side converter of the drive is running. This voltage is extremely dangerous and can cause serious damage or injury if the isolation level and protection conditions for the thermal switches are not sufficient. Insulate the thermal switches correctly (over 2.5 kV) and shroud them against contact.

Start-up

Set the following parameters (ACS880 primary control program):

- Disable the overvoltage control of the drive by parameter **30.30 Overvoltage control**.

For settings of other control programs, see the appropriate firmware manual.

Note: Some brake resistors are coated with oil film for protection. At the start-up, the coating burns off and produces a little bit of smoke. Make sure there is sufficient ventilation at the start-up.

Technical data

Ratings

Brake choppers

This table shows the optional default brake choppers of the drive with the ratings and fuses for the brake choppers. Cubicle width 400 mm.

Drive module type ACS880-34-	Fuses			Cable (chopper –drive)	Brake chopper			
		Manufacturer	Type		Type	$P_{br,max,40\ s}$	I_{max}	E_r
	A			mm^2		kW	A	kJ
U_N = 400 V								

Drive module type ACS880-34-	Fuses			Cable (chopper –drive)	Brake chopper			
		Manufacturer	Type		Type	$P_{br,max,40\ s}$	I_{max}	E_r
	A			mm^2		kW	A	kJ
246A-3	400	Bussmann	170M5142	70	NBRA-658	230	345	9200
293A-3	630	Bussmann	170M8635	120	NBRA-659	355	532	14200
363A-3	630	Bussmann	170M8635	120	NBRA-659	355	532	14200
442A-3	630	Bussmann	170M8635	120	NBRA-659	355	532	14200
505A-3	630	Bussmann	170M8635	120	NBRA-659	355	532	14200
585A-3	630	Bussmann	170M8635	120	NBRA-659	355	532	14200
650A-3	630	Bussmann	170M8635	120	NBRA-659	355	532	14200
U_N = 500 V								
240A-5	400	Bussmann	170M5142	70	NBRA-658	268	334	10720
260A-5	630	Bussmann	170M8635	120	NBRA-659	403	502	16120
302A-5	630	Bussmann	170M8635	120	NBRA-659	403	502	16120
361A-5	630	Bussmann	170M8635	120	NBRA-659	403	502	16120
414A-5	630	Bussmann	170M8635	120	NBRA-659	403	502	16120
460A-5	630	Bussmann	170M8635	120	NBRA-659	403	502	16120
503A-5	630	Bussmann	170M8635	120	NBRA-659	403	502	16120
U_N = 690 V								
142A-7	400	Bussmann	170M5142	120	NBRA-669	403	364	16120
174A-7	400	Bussmann	170M5142	120	NBRA-669	403	364	16120
210A-7	400	Bussmann	170M5142	120	NBRA-669	403	364	16120
271A-7	400	Bussmann	170M5142	120	NBRA-669	403	364	16120
330A-7	400	Bussmann	170M5142	120	NBRA-669	403	364	16120
370A-7	400	Bussmann	170M5142	120	NBRA-669	403	364	16120
430A-7	400	Bussmann	170M5142	120	NBRA-669	403	364	16120

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Nominal voltage

Maximum braking power allowed for 40 seconds every 600 seconds. This is for default brake chopper + default brake resistors combination.

Maximum current

E_r Energy pulse that the brake chopper withstands every 600 seconds

Brake resistors

This table shows the ratings for the optional default brake resistors and example duty cycles. (For other duty cycles, see section *Calculating the maximum allowed braking power for a custom duty cycle* on page *234*.) Cubicle width 800 mm.

Drive module type ACS880-34-	Brake resistor type	Ratings			Cable (chopper–resistor)	Duty cycle (10/60 s)		Duty cycle (1/5 min)	
		R	E_r	$P_{br,cont}$		P_{br}	I_{rms}	P_{br}	I_{rms}
		ohm	kJ	kW		kW	A	kW	A
U_N = 400 V									
246A-3	2xSAFUR210F575	1,7	8400	42	2×2 (70 mm^2)	224	336	130	195
293A-3	2xSAFUR180F460	1,2	12000	60	2×2 (70 mm^2)	287	430	167	250
363A-3	2xSAFUR180F460	1,2	12000	60	2×2 (70 mm^2)	287	430	167	250

Drive module type ACS880-34-	Brake resistor type	Ratings			Cable (chopper–resistor)	Duty cycle (10/60 s)		Duty cycle (1/5 min)	
		R	E_r	$P_{br,cont}$		P_{br}	I_{rms}	P_{br}	I_{rms}
		ohm	kJ	kW		kW	A	kW	A
442A-3	2xSAFUR180F460	1,2	12000	60	2×2 (70 mm^2)	287	430	167	250
505A-3	2xSAFUR180F460	1,2	12000	60	2×2 (70 mm^2)	287	430	167	250
585A-3	2xSAFUR180F460	1,2	12000	60	2×2 (70 mm^2)	287	430	167	250
650A-3	2xSAFUR180F460	1,2	12000	60	2×2 (70 mm^2)	287	430	167	250
U_N = 500 V									
240A-5	2xSAFUR125F500	2	7200	192	2×2 (70 mm^2)	239	111	138	36
260A-5	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	357	167	208	54
302A-5	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	357	167	208	54
361A-5	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	357	167	208	54
414A-5	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	357	167	208	54
460A-5	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	357	167	208	54
503A-5	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	357	167	208	54
U_N = 690 V									
142A-7	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	259	167	151	54
174A-7	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	259	167	151	54
210A-7	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	259	167	151	54
271A-7	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	259	167	151	54
330A-7	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	259	167	151	54
370A-7	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	259	167	151	54
430A-7	2xSAFUR200F500	1	10800	287	2×2 (70 mm^2)	259	167	151	54

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U_N	Nominal voltage
R	Resistance of specified resistors. This is also the minimum allowed resistance of the resistor assembly.
$P_{br,cont}$	Maximum continuous braking power. The braking is considered continuous if the braking time exceeds 30 seconds.
P_{br}	Braking power for the specified duty cycle
I_{rms}	rms current for the specified duty cycle
E_r	Energy pulse that the resistor withstands every 600 seconds

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

Calculating the maximum allowed braking power for a custom duty cycle

The maximum allowed braking power for the customer braking cycle must meet both of the conditions 1 and 2. below.

1. The braking power of the custom duty cycle must not exceed the maximum braking power given in the table under *Brake choppers* on page *232*.

   $P_{br} \leq P_{br,max}$

2. The braking energy transferred during any 600-seconds period must be less than or equal to the energy that is transferred during the reference braking cycle of 40 seconds every 600 seconds:.

   $n \times P_{br} \times t_{br} \leq P_{br,max} \times 60\ s$

where

n	Number of the braking pulses during the 600-second period
P_{br}	Braking power for the custom duty cycle in kW
t_{br}	Braking time within the custom duty cycle in seconds
$P_{br,max}$	Maximum braking power allowed for 40 seconds every 600 seconds. See the value in the table under *Brake choppers* on page *232*.

Example 1

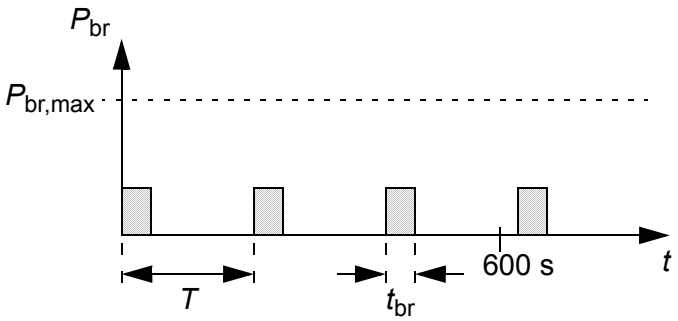
The duration of a braking cycle is 30 minutes. The braking time is 15 minutes.

Result: If the braking time exceeds 10 minutes, the braking is considered continuous. The allowed continuous braking power is 10% of the maximum braking power ($P_{br,max}$).

Example 2

The duration of a braking cycle (T) is three minutes. The braking time (t_{br}) is 40 seconds.

1. $P_{br} \leq \frac{P_{br,max} \text{ x } 60\ s}{3 \text{ x } 40\ s} = 0.5 \text{ x } P_{br,max}$



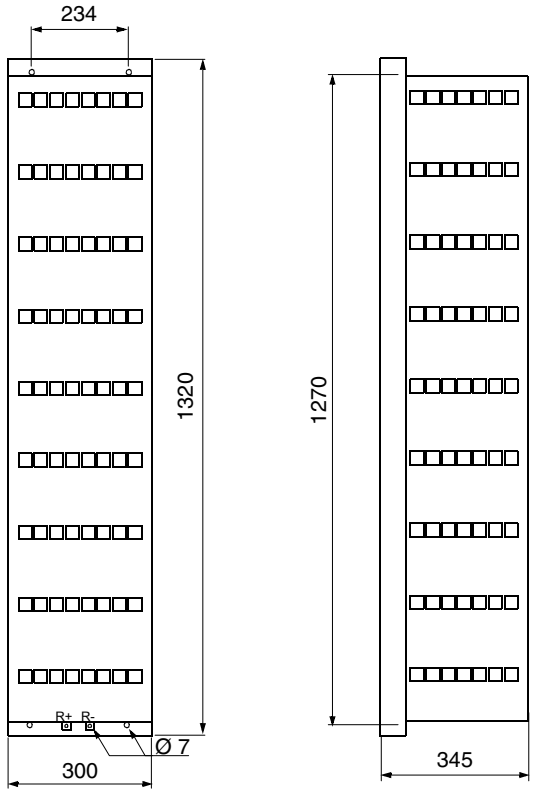
2. $P_{br} \leq P_{br,max}$

Result: The maximum allowed braking power for the cycle is 50% of the rated value given for the reference cycle.

SAFUR resistors

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

Dimensions and weights



Brake resistor type	Weight
SAFUR125F500	25 kg (55 lb)
SAFUR200F500	30 kg (66 lb)

Ordering codes

Brake resistor type	ABB ordering code
SAFUR125F500	68759285
SAFUR200F500	68759340

Brake chopper type	ABB ordering code
U_N = 400 V	
NBRA-658	59006428
NBRA-659	59006436
NBRA-659	59006436
NBRA-659	59006436
NBRA-659	59006436
NBRA-659	59006436
NBRA-659	59006436
U_N = 500 V	
NBRA-658	59006428
NBRA-659	59006436
NBRA-659	59006436
NBRA-659	59006436
NBRA-659	59006436
NBRA-659	59006436
NBRA-659	59006436
U_N = 690 V	
NBRA-669	59012517
NBRA-669	59012517
NBRA-669	59012517
NBRA-669	59012517
NBRA-669	59012517
NBRA-669	59012517
NBRA-669	59012517

Terminals and cable entry data

See section *Terminal and entry data for the power cables* on page *193*.

21

d*u*/d*t* and sine 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 needed?

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

Selection table

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

Drive module type ACS880-34-	d*u*/d*t* filter type	Drive module type ACS880-34-	d*u*/d*t* filter type	Drive module type ACS880-34-	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	FOCH-0610-70	414A-5	FOCH0320-5x	330A-7	FOCH-0610-70
585A-3	FOCH-0610-70	460A-5	FOCH0320-5x	370A-7	FOCH-0610-70
650A-3	FOCH-0610-70	503A-5	FOCH-0610-70	430A-7	FOCH-0610-70

3AXD00000588487

Ordering codes

Filter type	Degree of protection	ABB ordering code
FOCH0320-50	IP00	68612209
FOCH0320-52	IP22	3AXD50000030047
FOCH0260-70	IP00	68490308
FOCH0260-72	IP22	3AXD50000030048
FOCH-0610-70	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 needed?

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

Selection table

Sine filter types for the drive modules are given below.

Drive module type ACS880-34-	Sine filter type	Drive module type ACS880-34-	Sine filter type	Drive module type ACS880-34-	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	NSIN900-6	414A-5	B84143V0390S229	330A-7	NSIN485-6
585A-3	NSIN900-6	460A-5	NSIN900-6	370A-7	NSIN485-6
650A-3	NSIN900-6	503A-5	NSIN900-6	430A-7	NSIN485-6

3AXD00000588487

* Combined value for drive and filter

ABB ordering codes

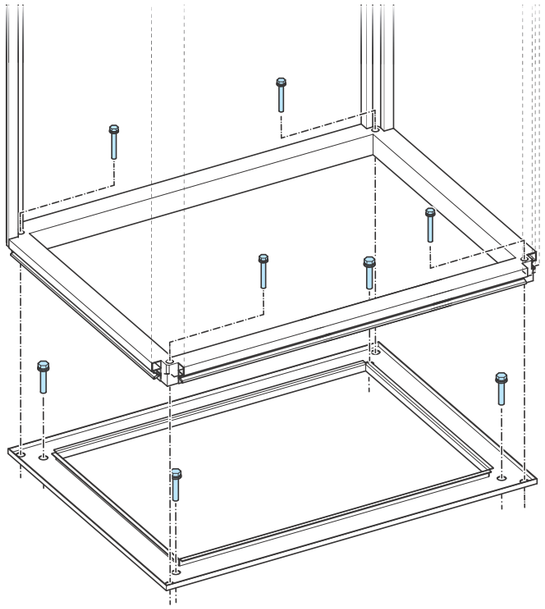
Filter type	ABB ordering code
NSIN485-6	64254936
NSIN900-6	64254961

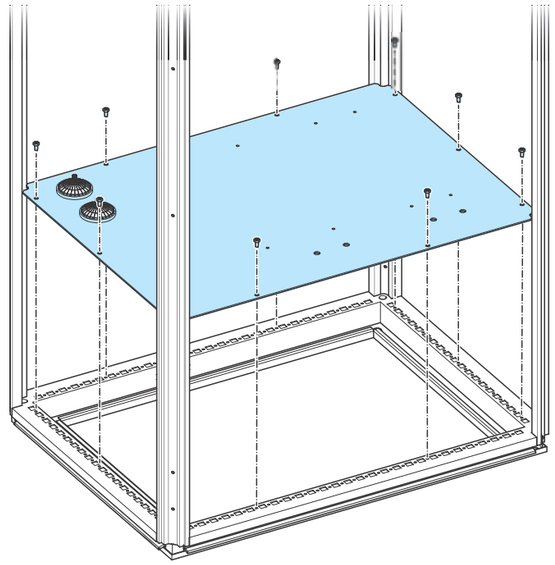
Derating

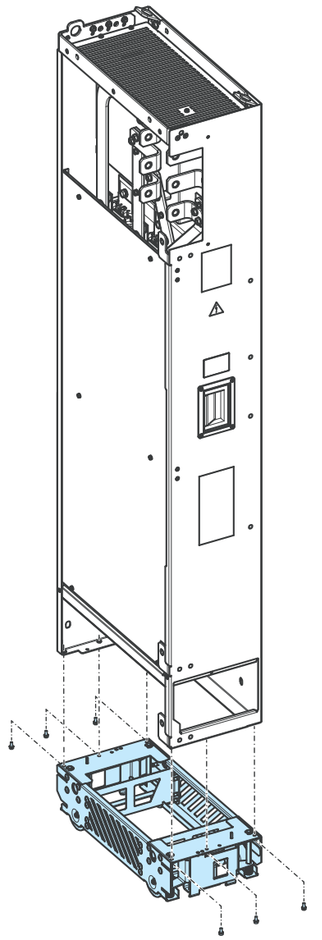
See section *Deratings for special settings in the drive control program* on page *186*.

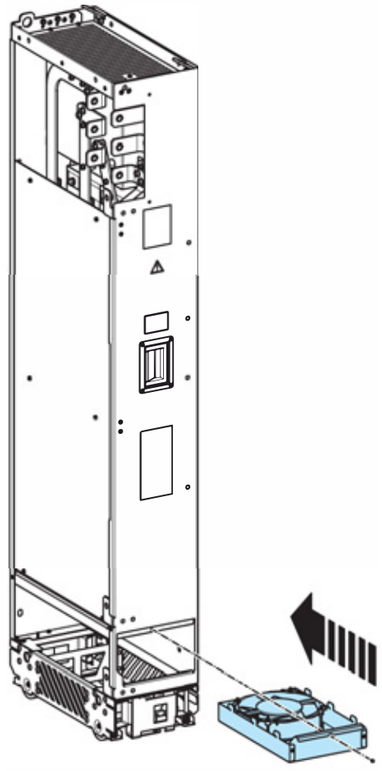
Description, installation and technical data of the sine filters

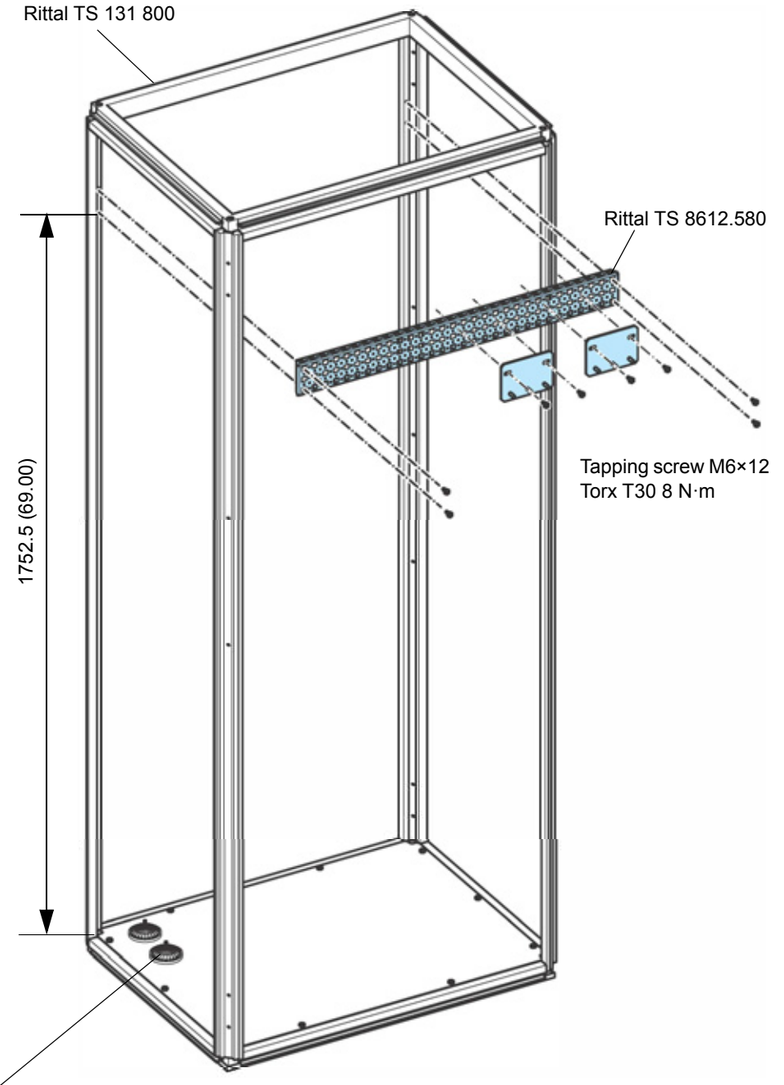
See *Sine filters hardware manual* (3AXD50000016814 [English]) and manuafacturer's site on the Internet https://en.tdk.eu/tdk-en/1029890/products/product-catalog/emc-components/output-filters--epcos-.

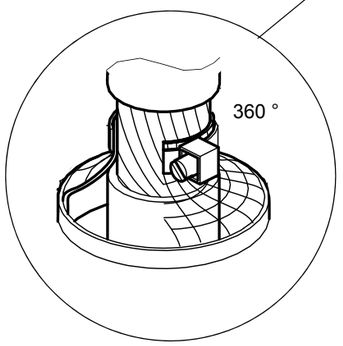


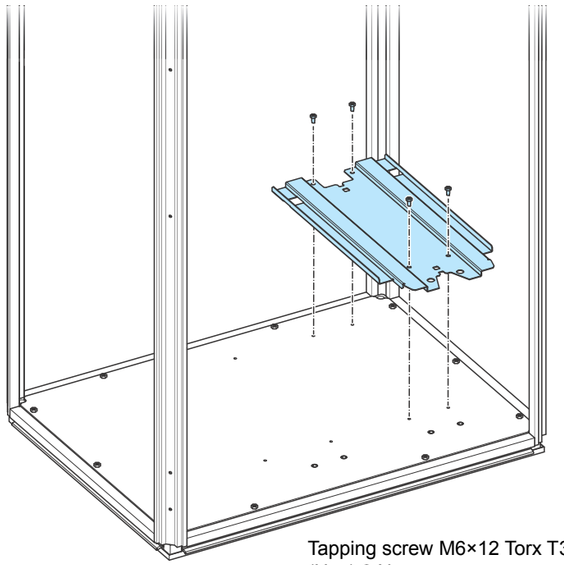




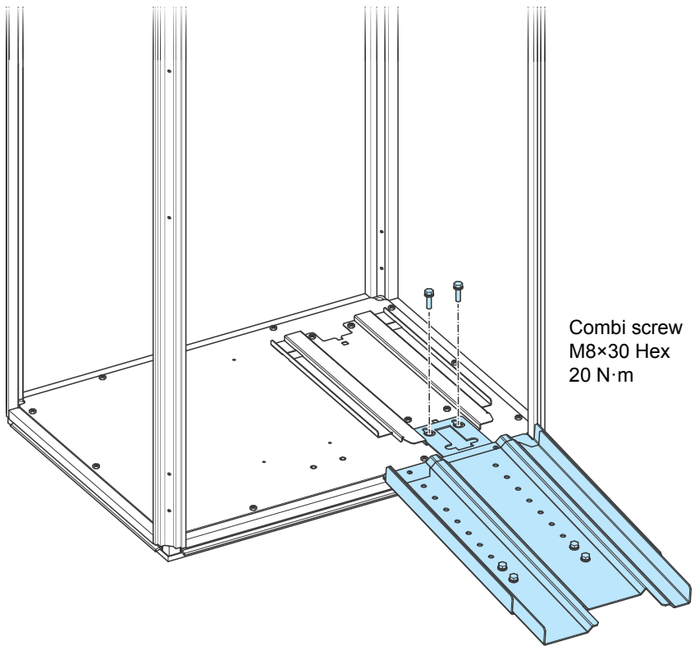



Rittal TS 131 800
Rittal TS 8612.580
Tapping screw M6×12
Torx T30 8 N·m
1752.5 (69.00)

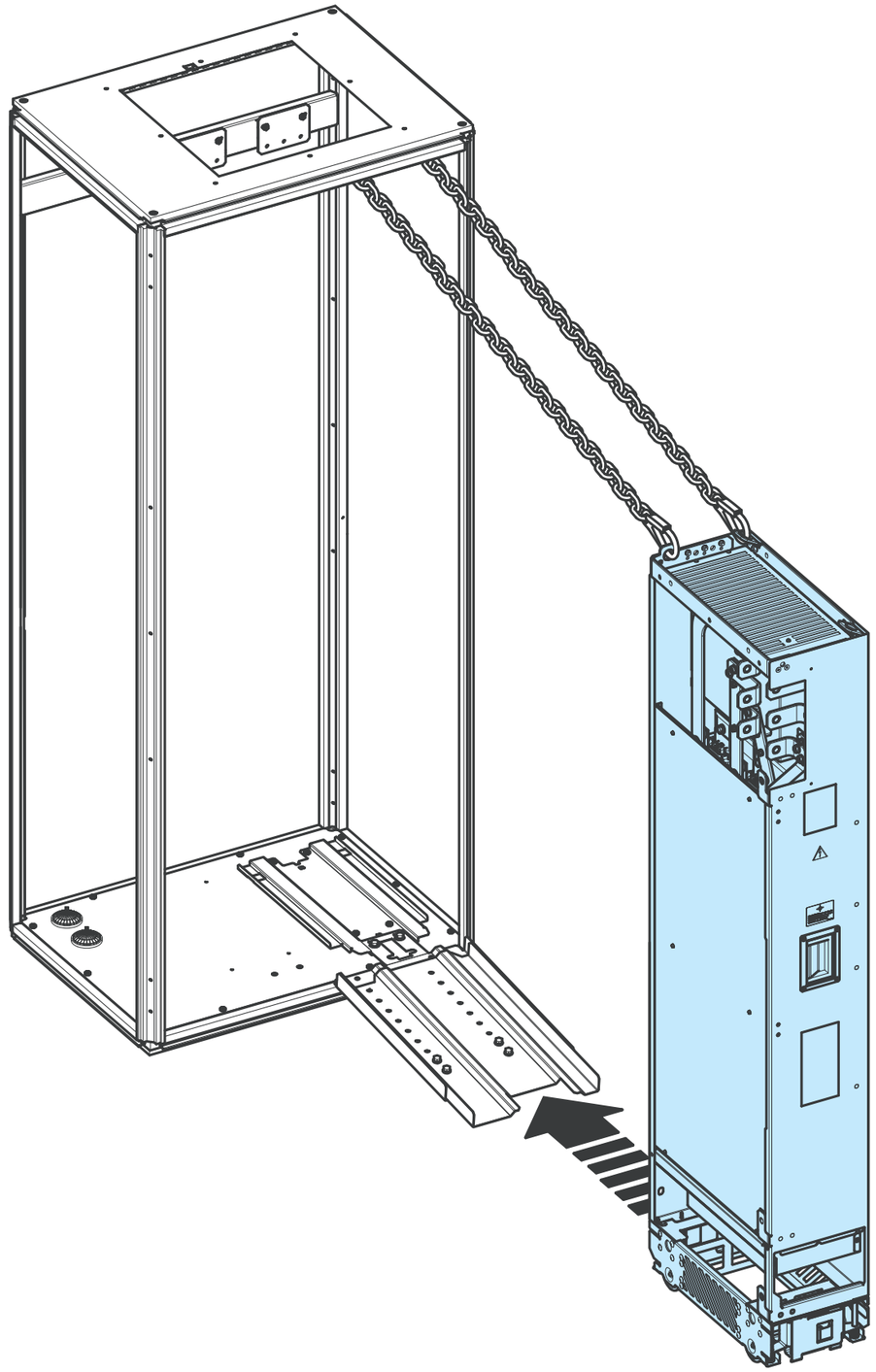

360 °

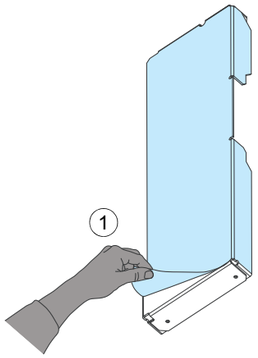


Tapping screw M6×12 Torx T30
(Hex) 8 N·m



Combi screw
M8×30 Hex
20 N·m

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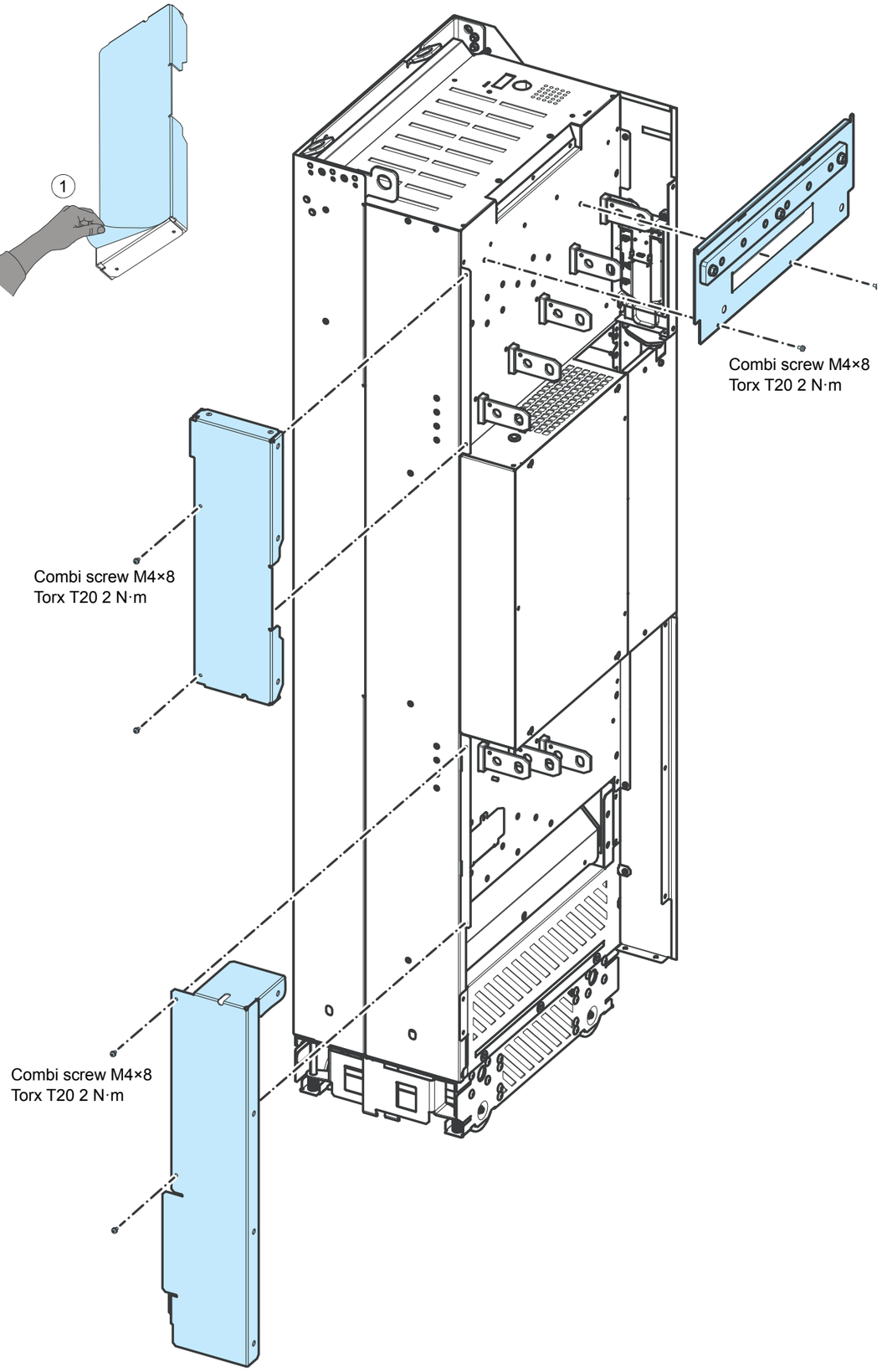
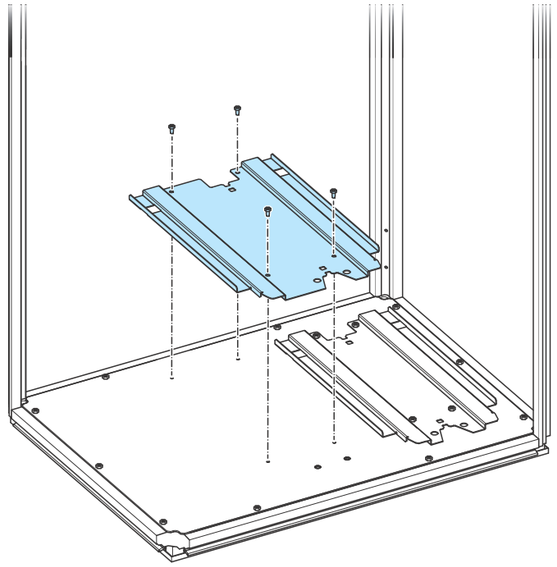
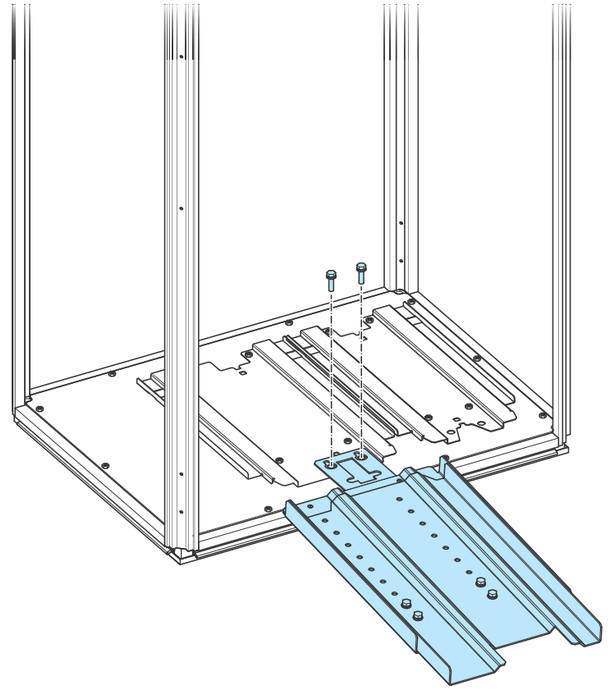
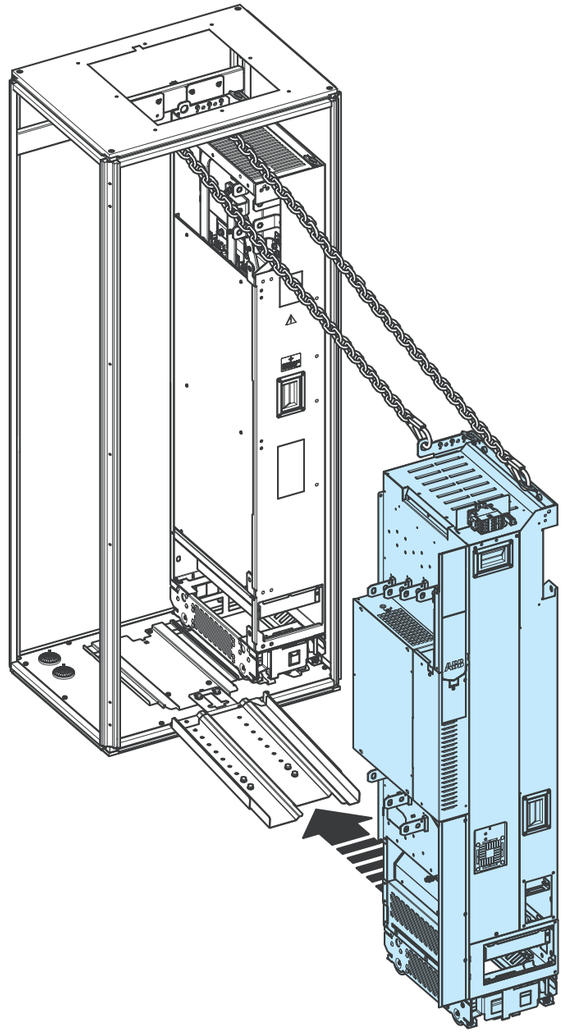
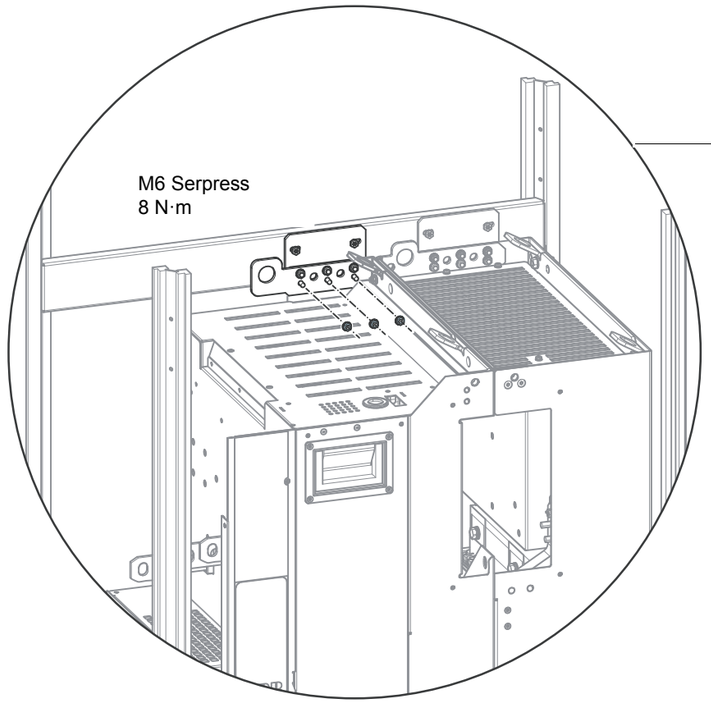
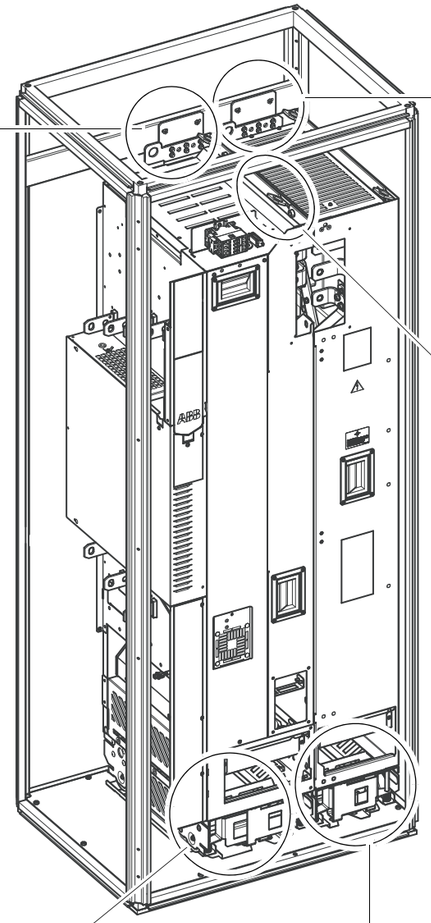

Combi screw M4×8
Torx T20 2 N·m
Combi screw M4×8
Torx T20 2 N·m
Combi screw M4×8
Torx T20 2 N·m

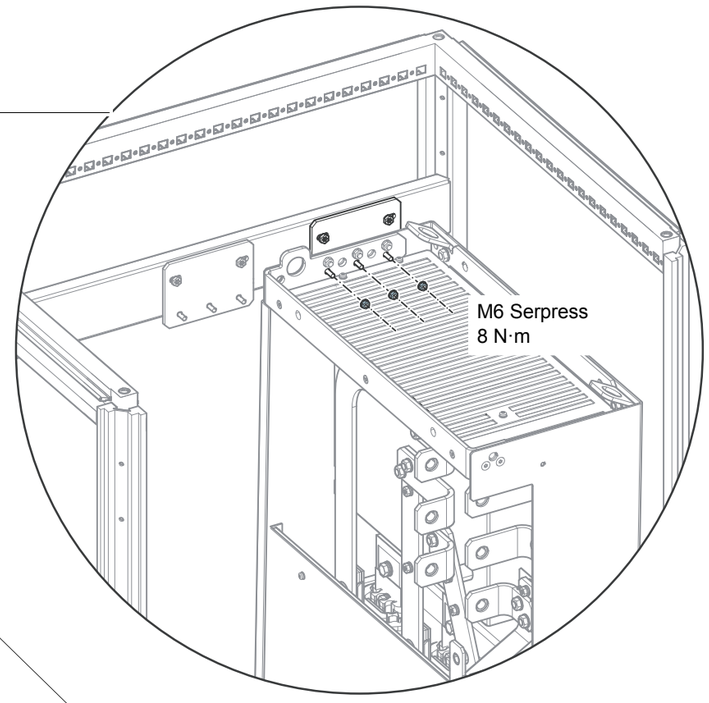


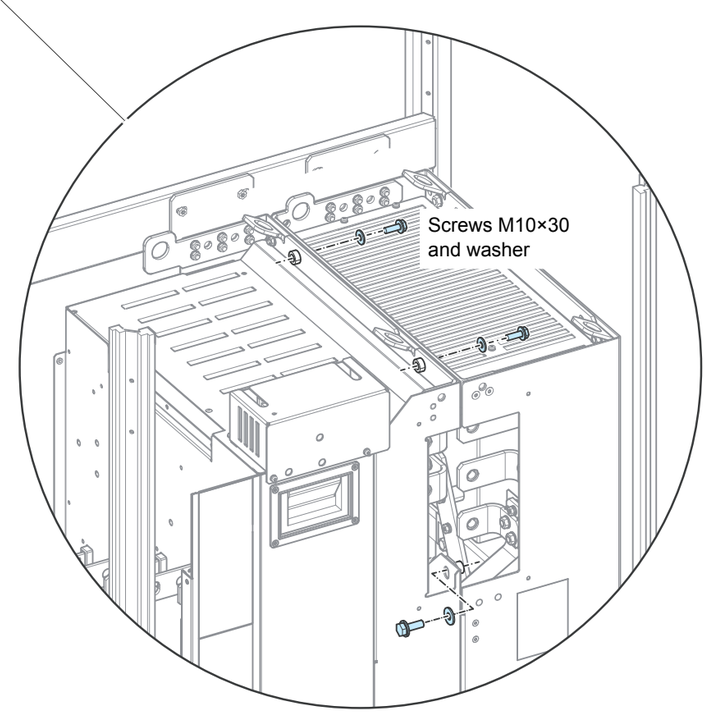


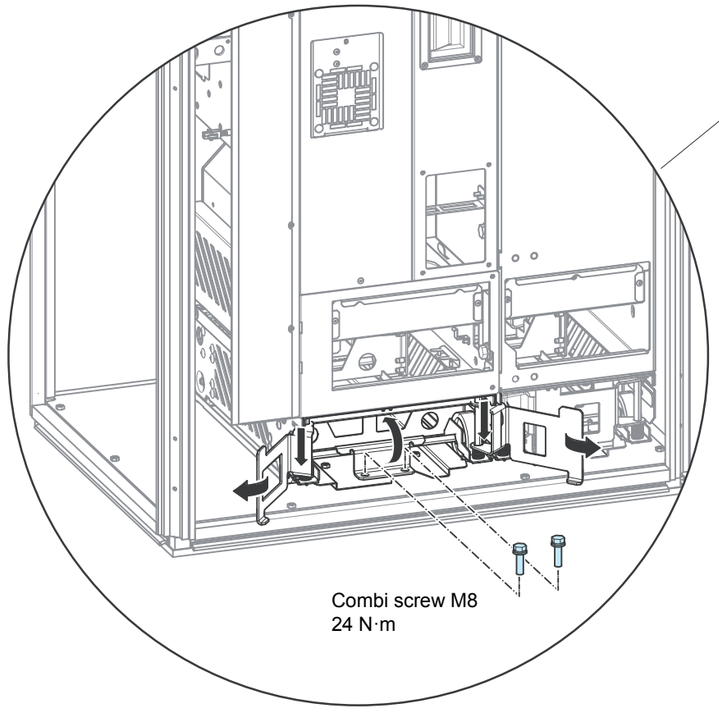


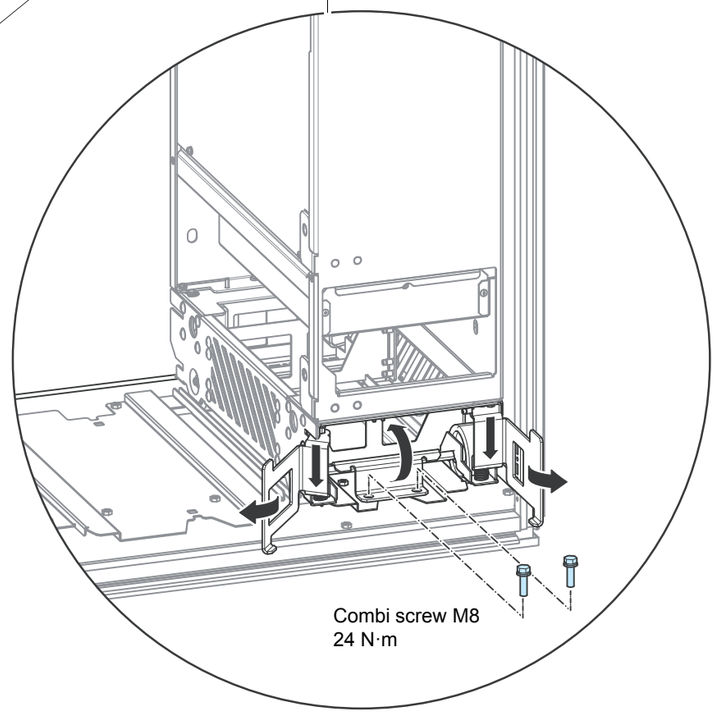

M6 Serpress
8 N·m

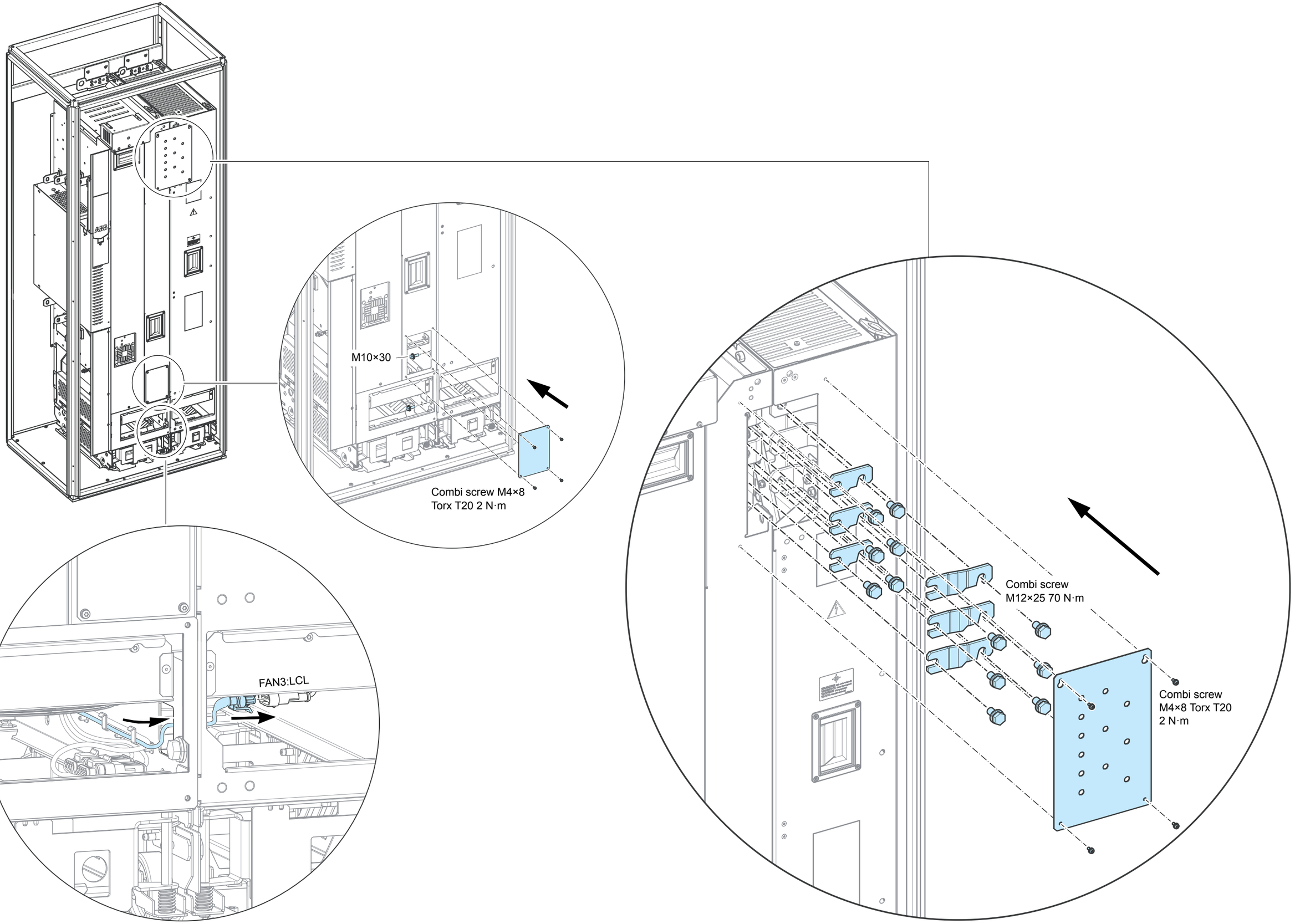


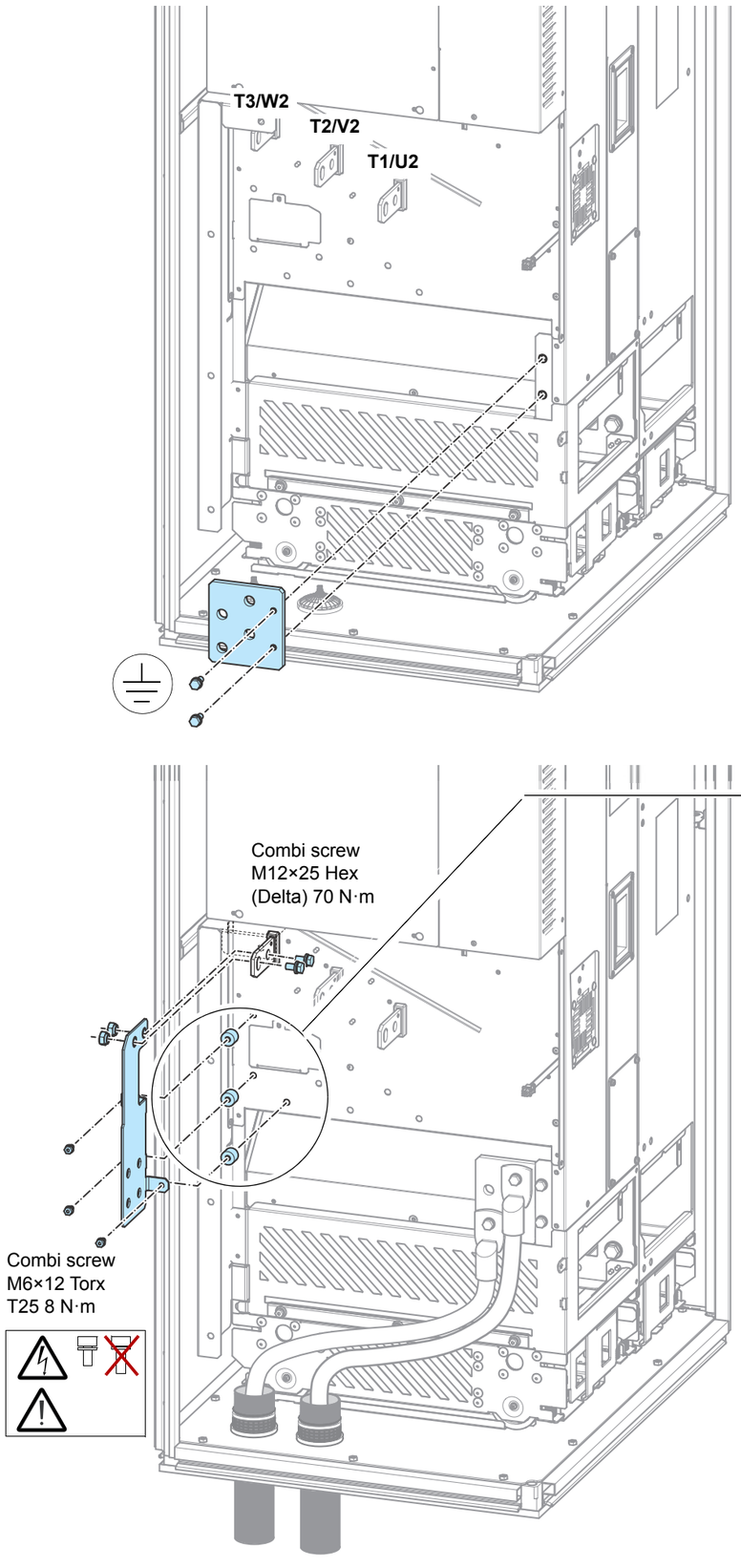

M6 Serpress
8 N·m

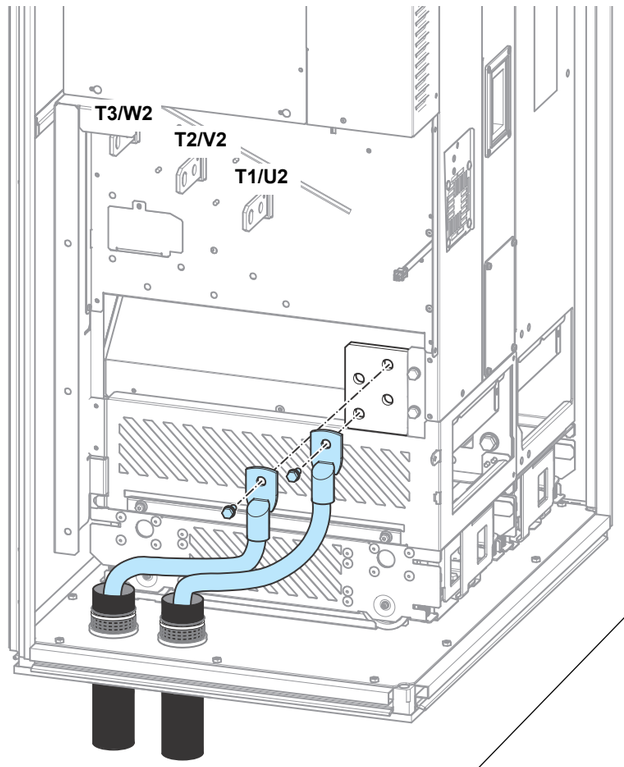

Screws M10×30
and washer

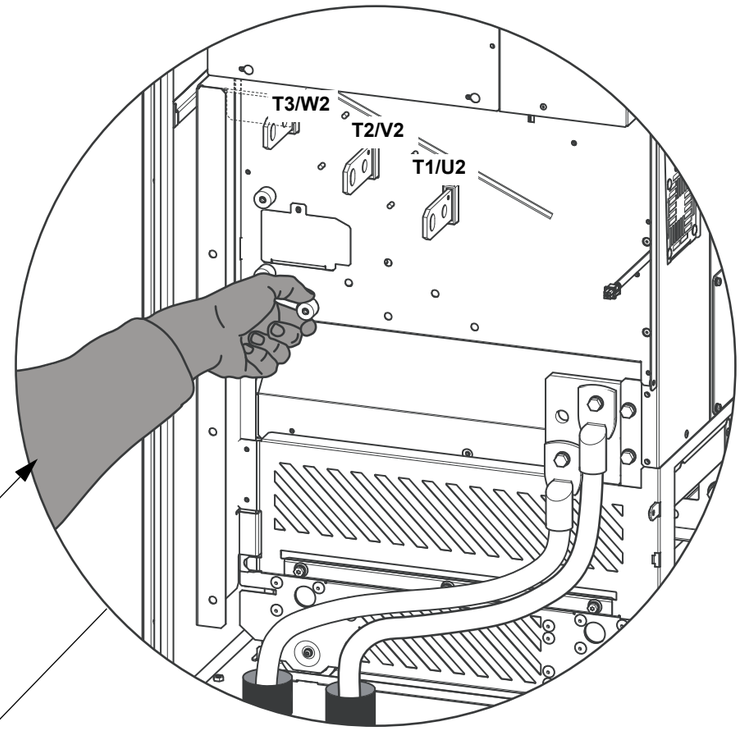

Combi screw M8
24 N·m

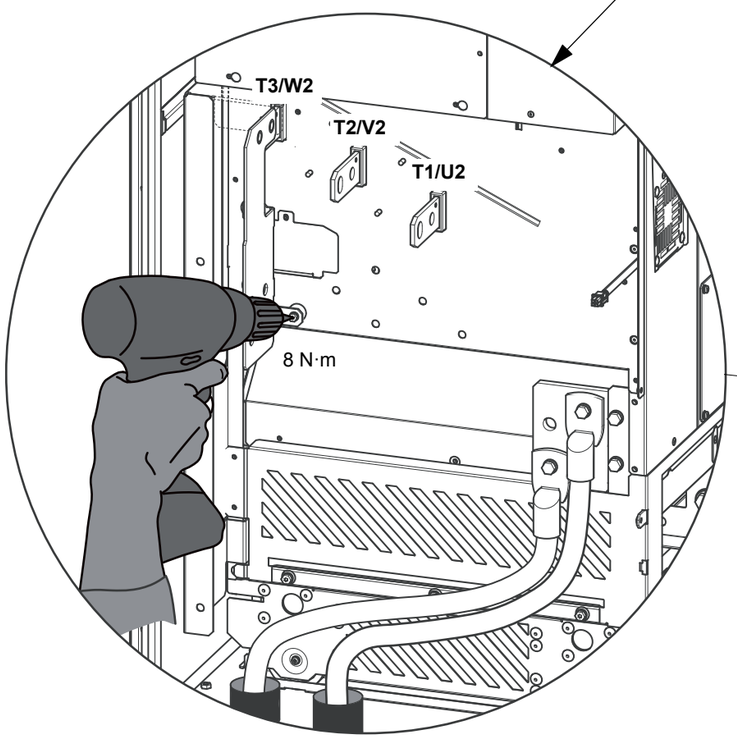

Combi screw M8
24 N·m

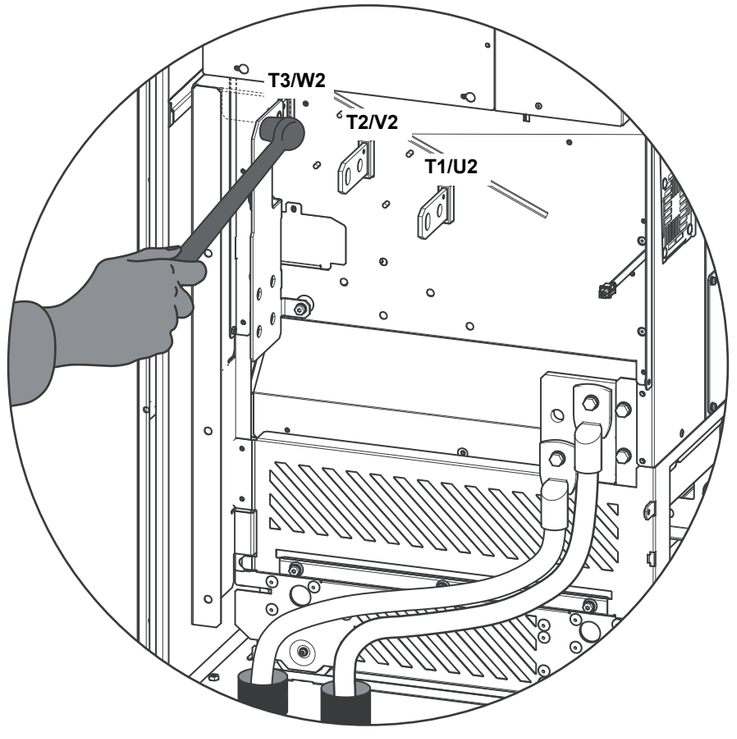

M10×30
Combi screw M4×8
Torx T20 2 N·m
FAN3:LCL
Combi screw
M12×25 70 N·m
Combi screw
M4×8 Torx T20
2 N·m

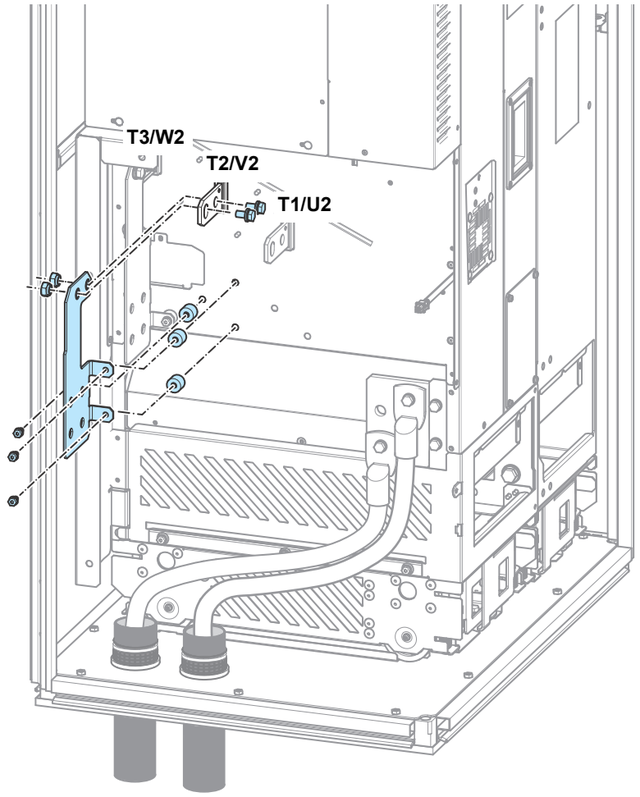

T3/W2
T2/V2
T1/U2
Combi screw
M12×25 Hex
(Delta) 70 N·m
Combi screw
M6×12 Torx
T25 8 N·m

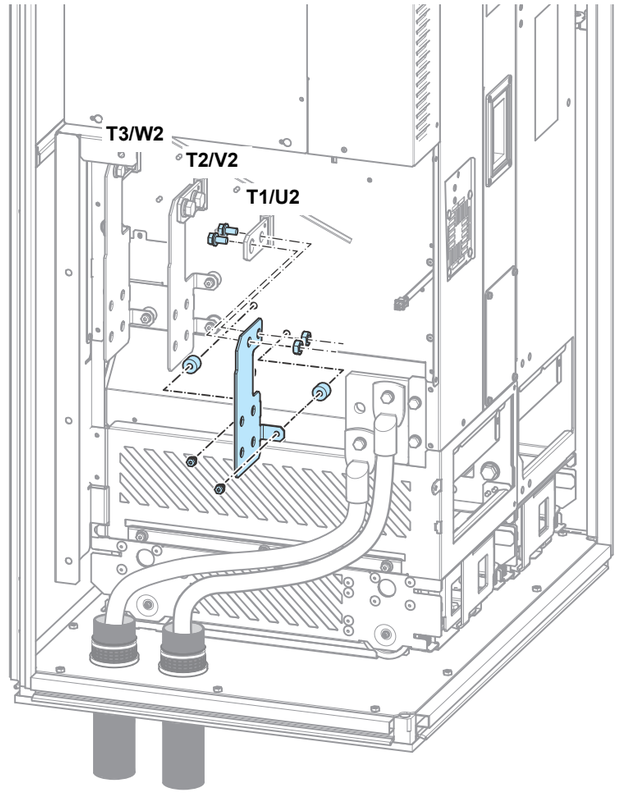

T3/W2
T2/V2
T1/U2

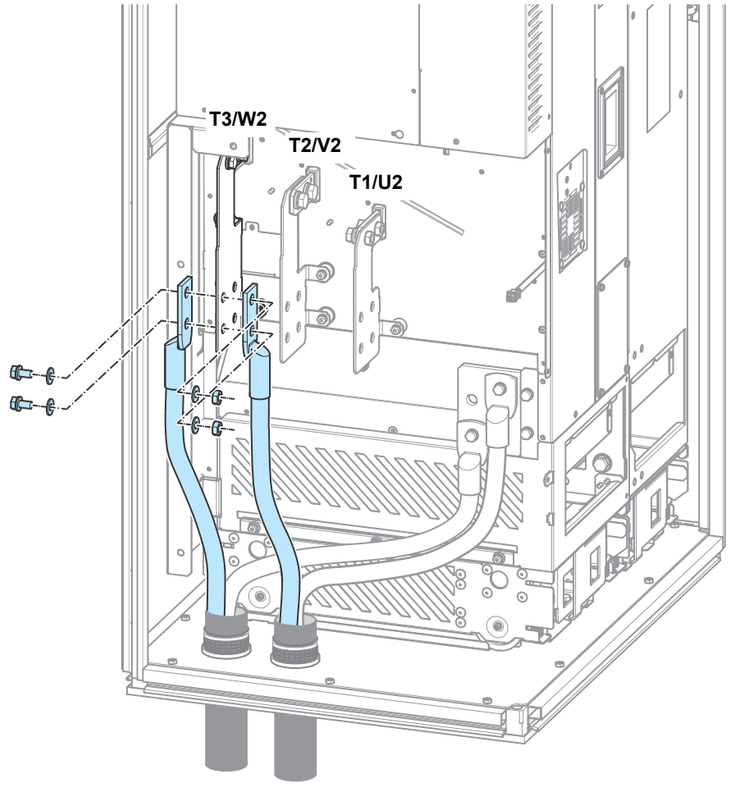

T3/W2
T2/V2
T1/U2

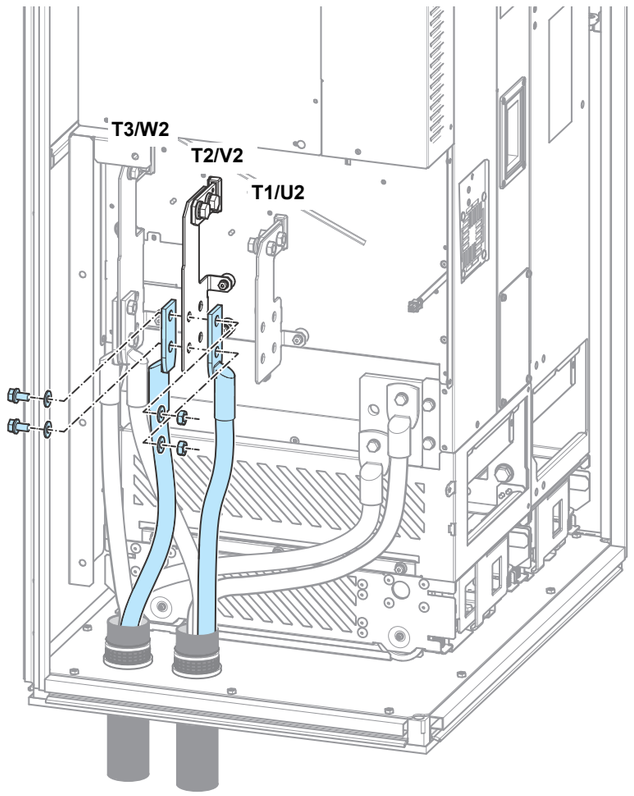

T3/W2
T2/V2
T1/U2
8 N·m

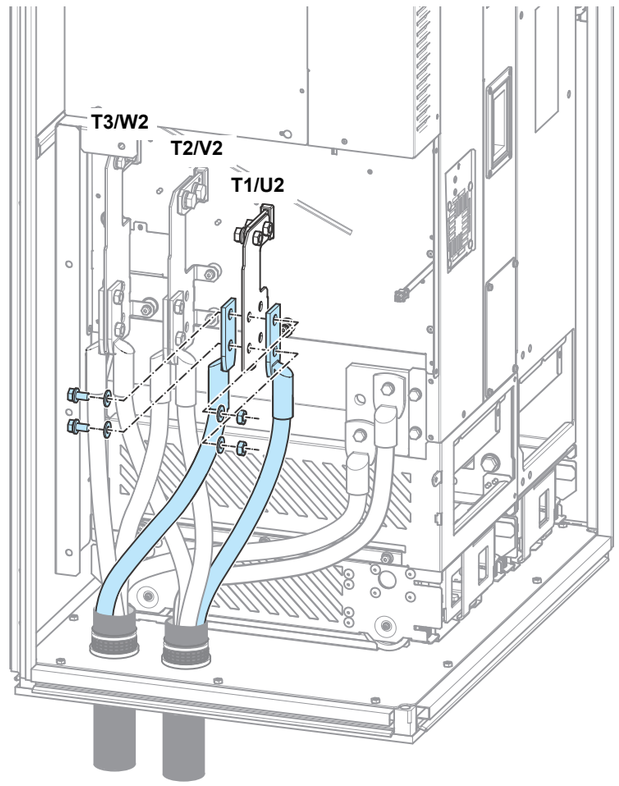

T3/W2
T2/V2
T1/U2

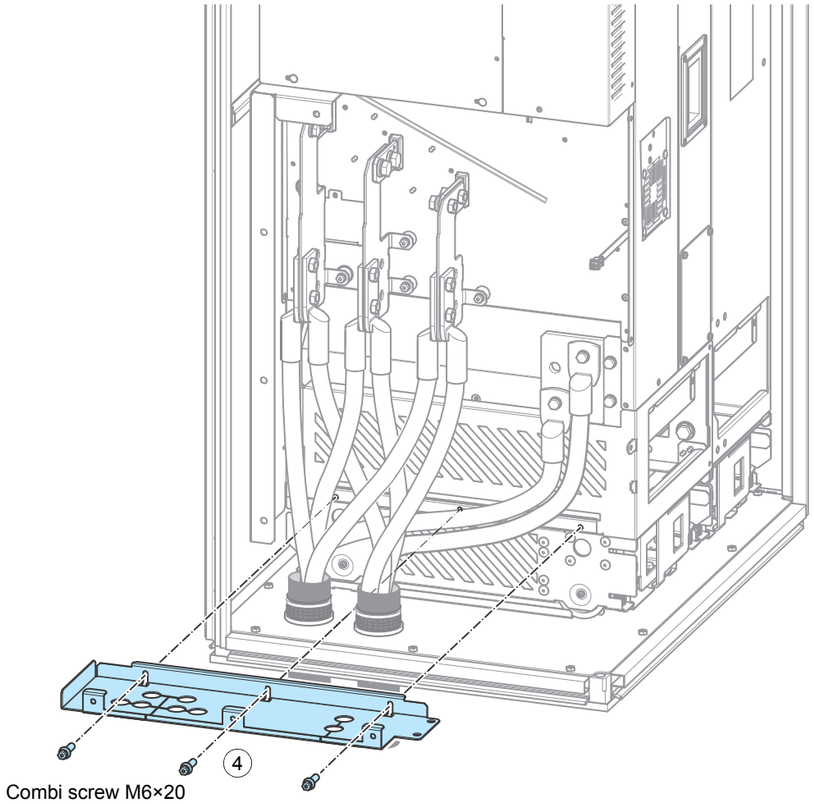

T3/W2
T2/V2
T1/U2

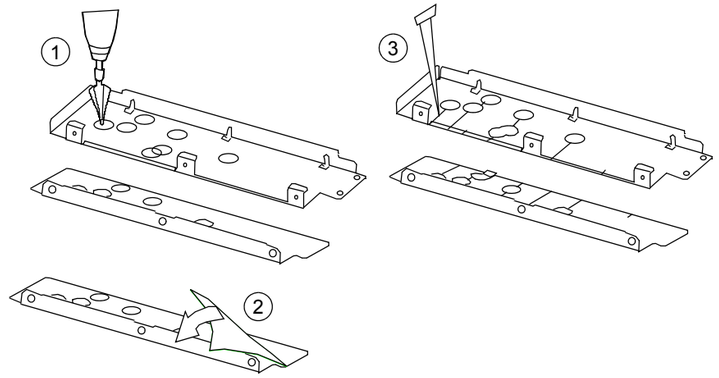

T3/W2
T2/V2
T1/U2

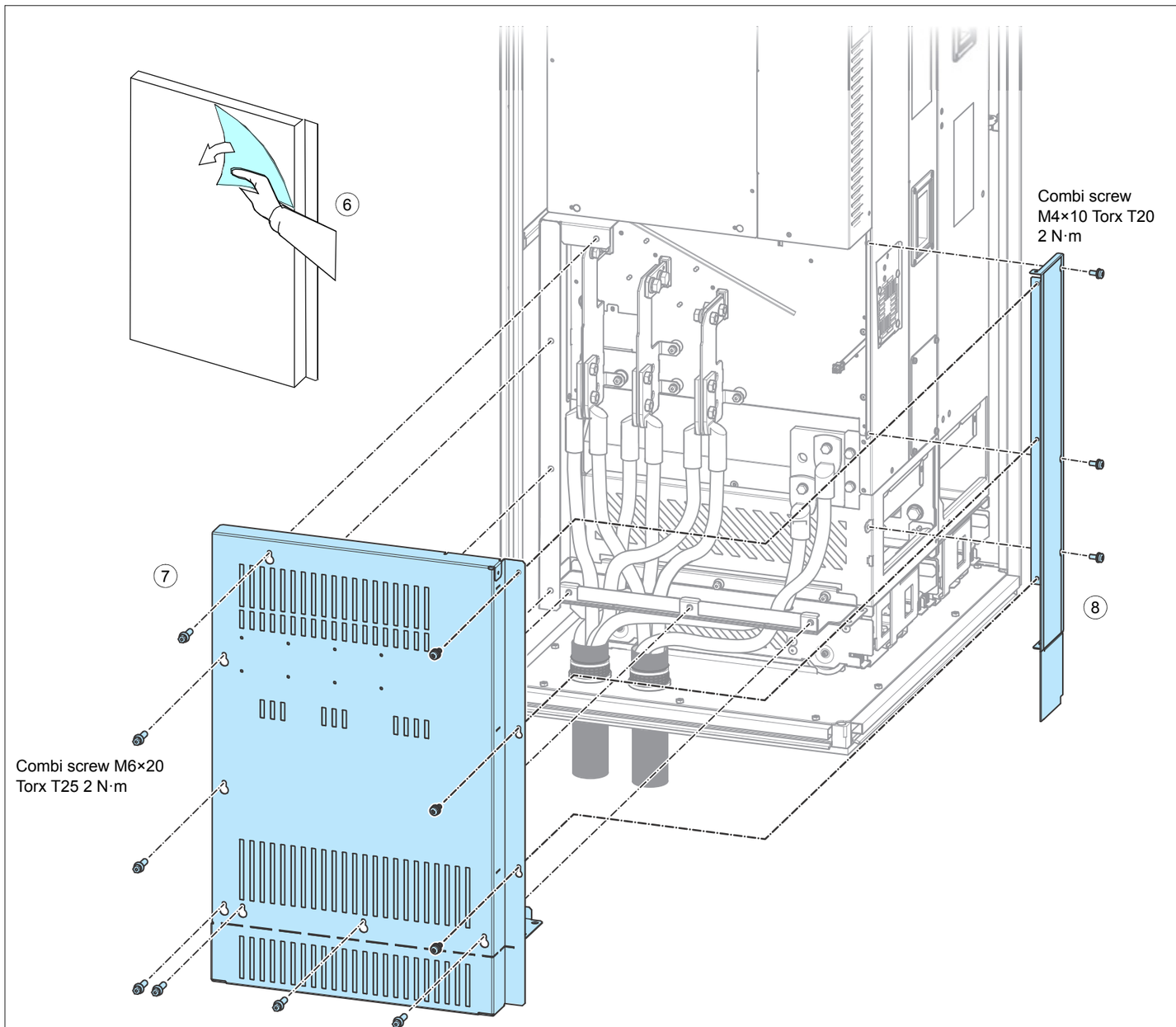

T3/W2
T2/V2
T1/U2

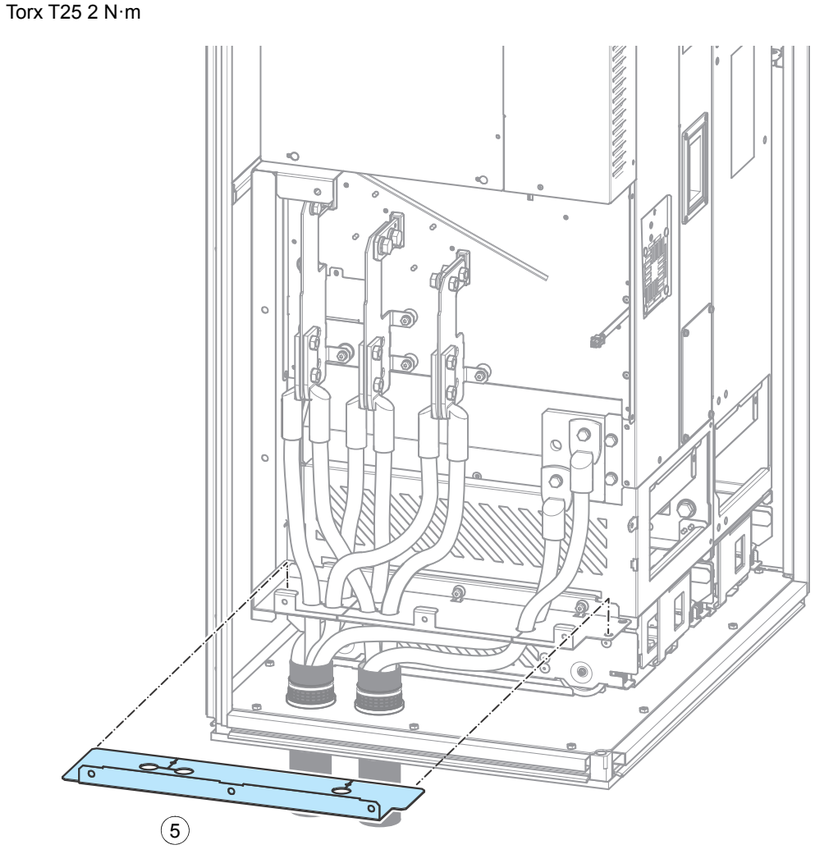

T3/W2
T2/V2
T1/U2


T3/W2
T2/V2
T1/U2


4
Combi screw M6×20
Torx T25 2 N·m


1
2
3


6
7
8
Combi screw M4×10 Torx T20
2 N·m
Combi screw M6×20
Torx T25 2 N·m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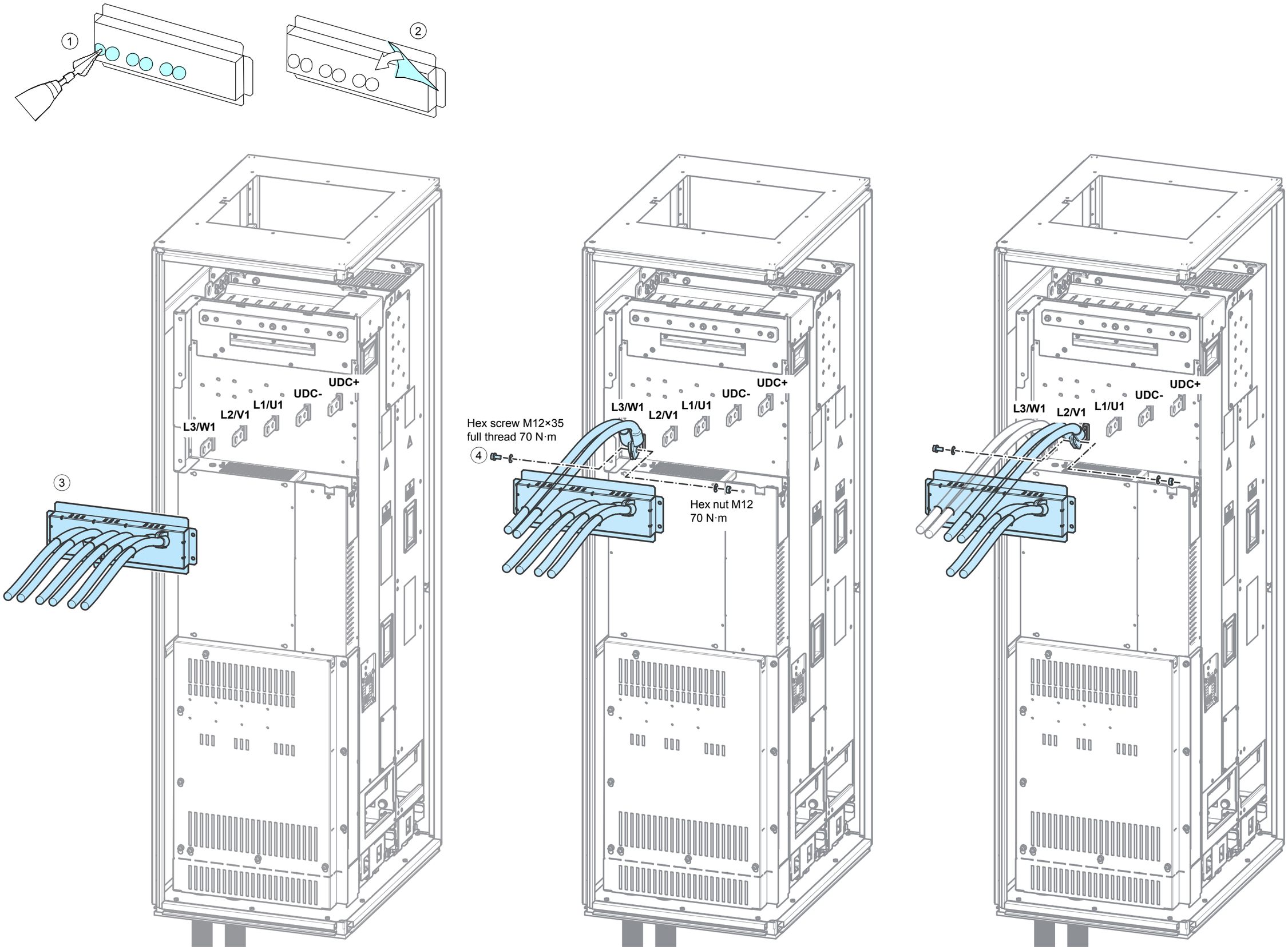
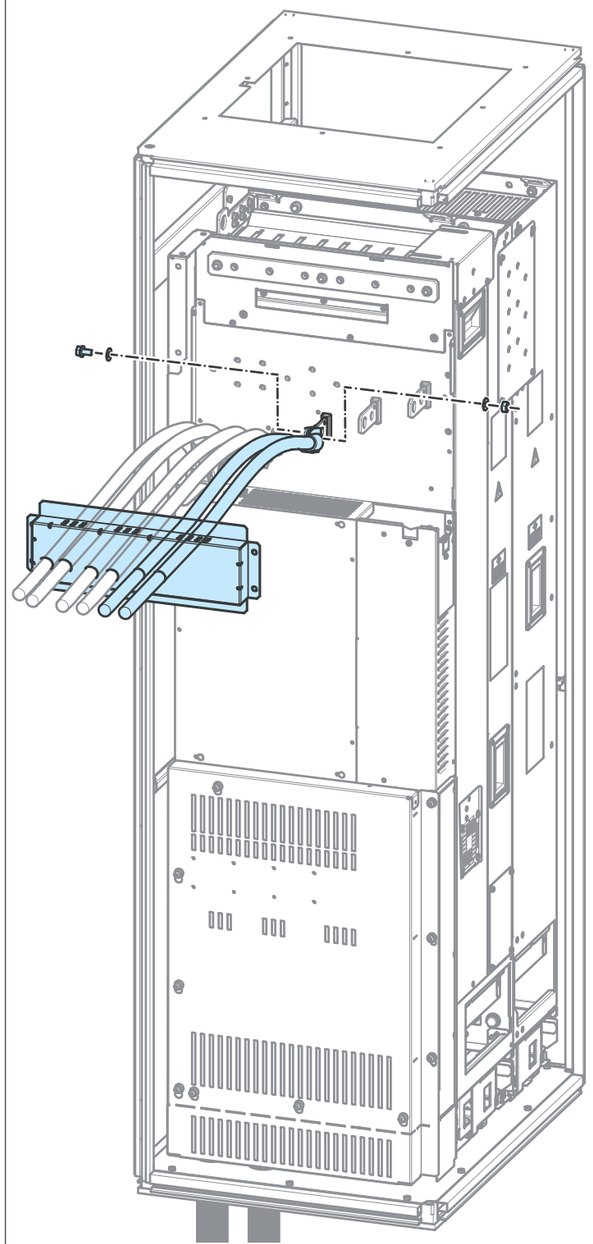
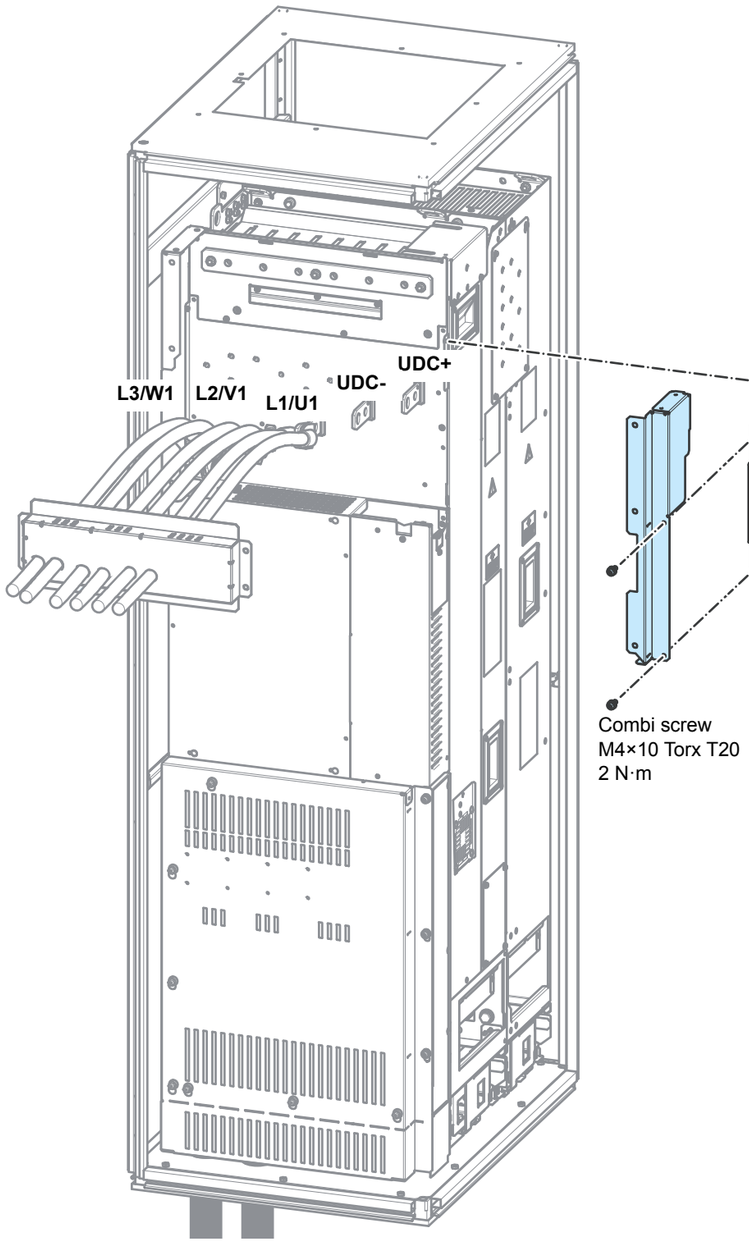
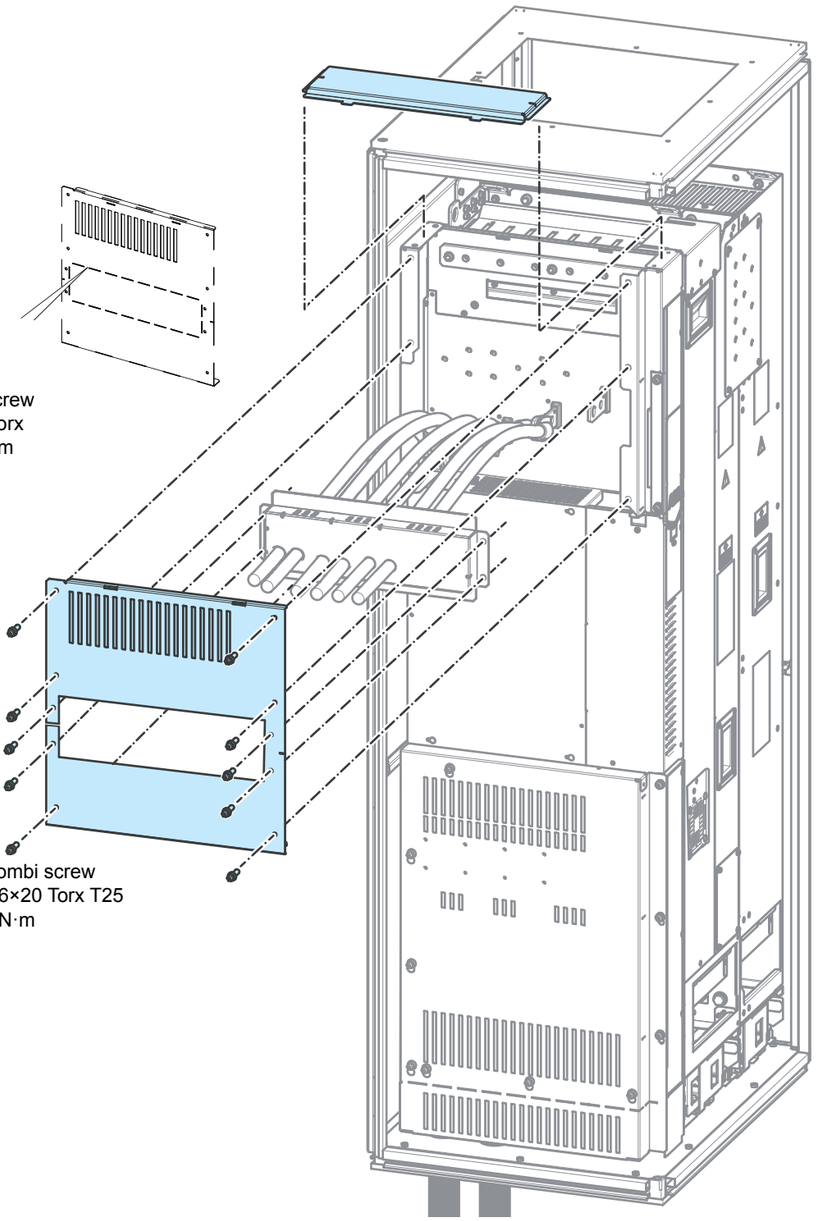
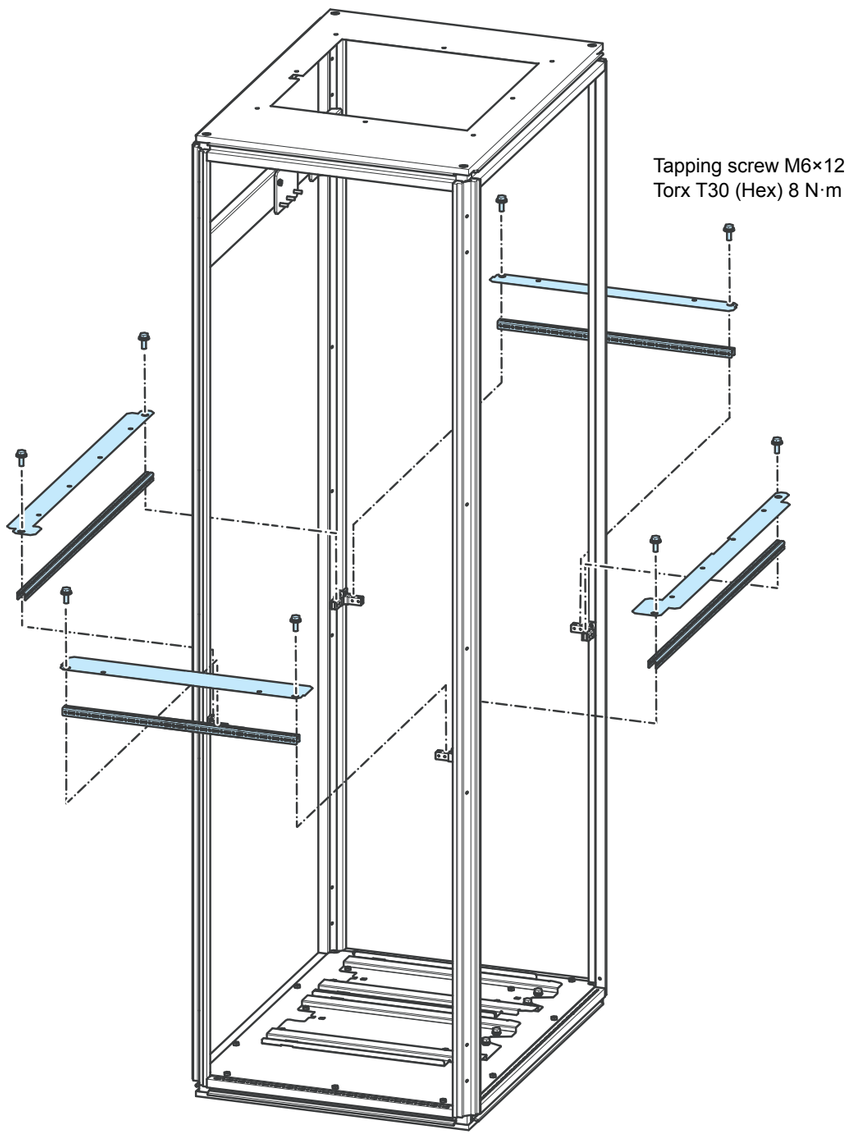
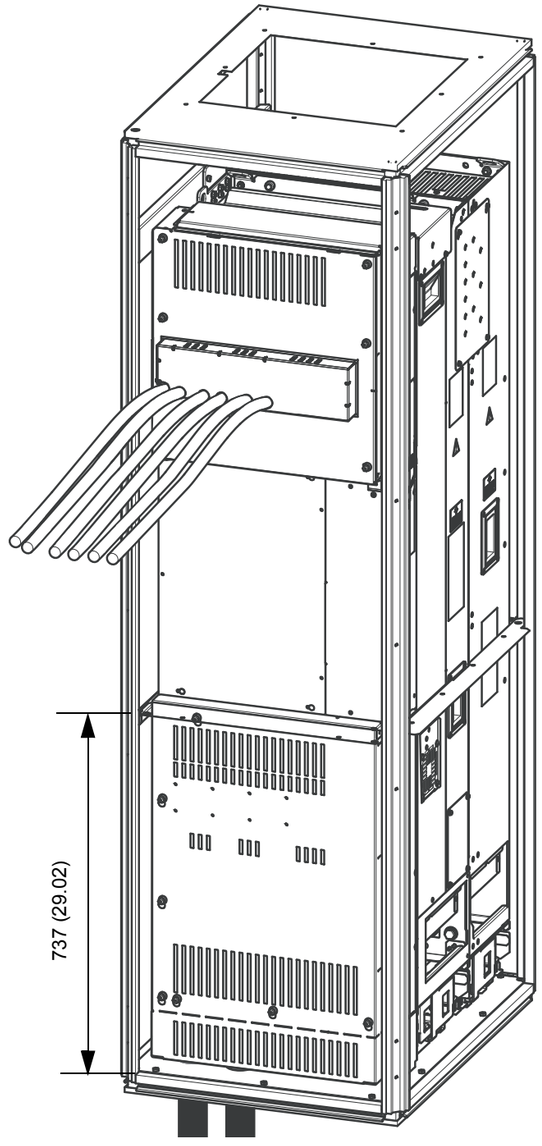

1
2
L3/W1
L2/V1
L1/U1
UDC-
UDC+
3
Hex screw M12×35
full thread 70 N·m
4
Hex nut M12
70 N·m




L3/W1
L2/V1
L1/U1
UDC-
UDC+
Combi screw
M4×10 Torx T20
2 N·m


Combi screw
M4×10 Torx
T20 2 N·m
Combi screw
M6×20 Torx T25
2 N·m


Tapping screw M6×12
Torx T30 (Hex) 8 N·m


737 (29.02)

Further information

Product and service inquiries

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

Product training

For information on ABB product training, navigate to www.abb.com/drives and select *ABB University*.

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