ABB INDUSTRIAL DRIVES

ACS880-04 drive modules (200 to 710 kW, 250 to 700 hp)

Hardware manual

ACS880-04 drive modules (200 to 710 kW, 250 to 700 hp)

Hardware manual

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Table of contents

4 Generic cabinet planning instructions

5 Guidelines for planning the mechanical installation

6 Mechanical installation

7 Guidelines for planning the electrical installation

8 Electrical installation

18 Dimension drawings

21 Resistor braking

22 Filters

1

Safety instructions

Contents of this chapter

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

Use of warnings and notes

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

The manual uses these warning symbols:

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

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

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

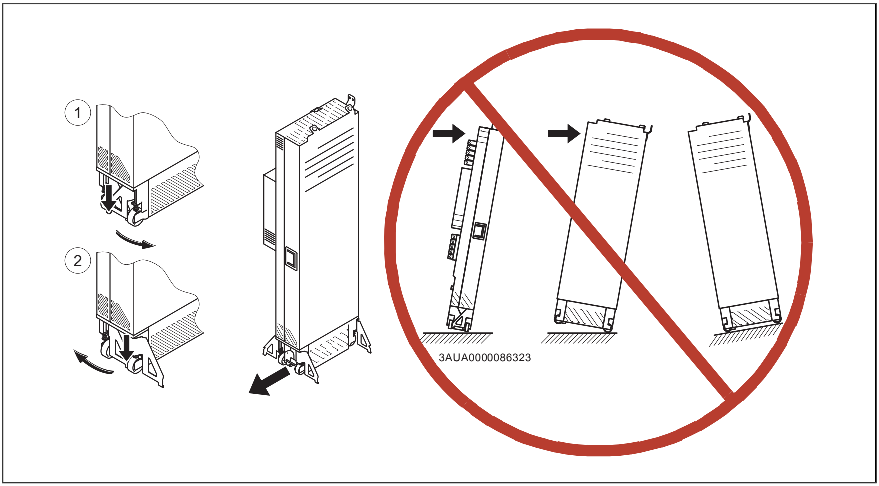
General safety in installation, start-up and maintenance

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

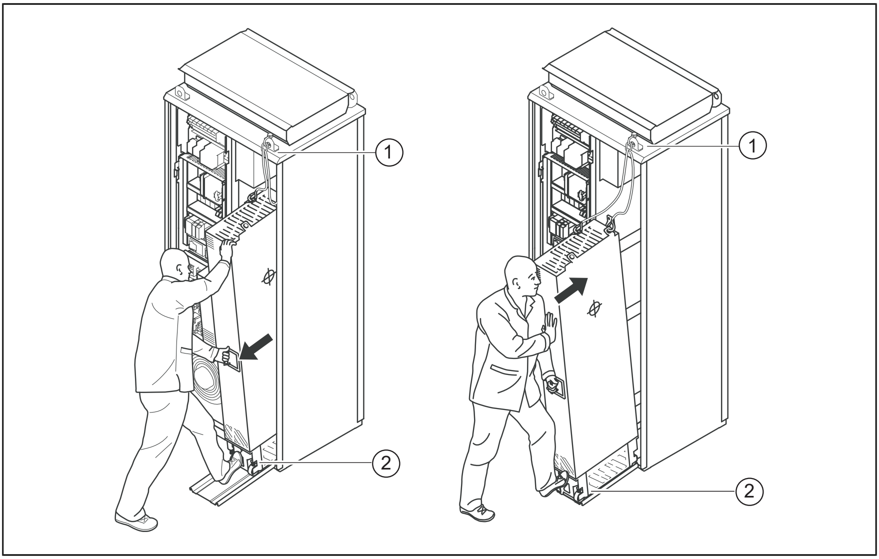
WARNING!
Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

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

- Do not use the module extraction/installation ramp with plinth heights which exceeds the maximum allowed height. See the technical data.
- Attach the module extraction/installation ramp carefully.
- Make sure that the module does not topple over when you move it on the floor: To open the support legs, press each leg a little down and turn it aside (1, 2). Whenever possible attach the module also with chains. Do not tilt the drive module. It is heavy and its center of gravity is high. The module overturns from a sideways tilt of 5 degrees. Do not leave the module unattended on a sloping floor.



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



- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, and brake resistors, remain hot for a while after disconnection of the electrical supply.

- Vacuum clean the area around the drive before the start-up to prevent the drive cooling fan from drawing the dust inside the drive.
- Make sure that debris from drilling, cutting and grinding 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. See the technical data.
- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists. If you cannot avoid working on a powered drive, obey the local laws and regulations on live working (including – but not limited to – electric shock and arc protection).
- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".
- The maximum drive power cycles is five times in ten minutes. Power cycling the drive too often can damage the charging circuit of the DC capacitors.
- If you have connected safety circuits to the drive (for example, Safe torque off or emergency stop), validate them at start-up. See separate instructions for the safety circuits.
- Beware of hot air exiting from the air outlets.
- Do not cover the air inlet or outlet when the drive is running.

Note:

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

Electrical safety in installation, start-up and maintenance

Electrical safety precautions

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

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

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

Go through these steps before you begin any installation or maintenance work.

1. Clearly identify the work location and equipment.
2. Disconnect all possible voltage sources. Make sure that re-connection is not possible. Lock out and tag out.
   - Open the main disconnecting device of the drive.
   - Open the charging switch if present.
   - Open the disconnector of the supply transformer. (The main disconnecting device in the drive cabinet does not disconnect the voltage from the AC input power busbars of the drive cabinet.)
   - Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
   - If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
   - Disconnect all dangerous external voltages from the control circuits.
   - After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).
   - Before and after measuring the installation, verify the operation of the voltage tester on a known voltage source.
   - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is zero.
   - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is zero.
   - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding (PE) terminal is zero.

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

Additional instructions and notes

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

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

- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.
- Make sure that the electrical power network, motor/generator, and environmental conditions agree with the drive data.
- Do not do insulation or voltage withstand tests on the drive.
- If you have a cardiac pacemaker or other electronic medical device, keep away from the area near motor, drive, and the drive power cabling when the drive is in operation. There are electromagnetic fields present which can interfere with the function of such devices. This can cause a health hazard.
- Remove the code labels attached to mechanical parts such as busbars, shrouds and sheet metal parts before installation. They may cause bad electrical connections, or, after peeling off and collecting dust in time, cause arcing or block the cooling air flow.

Note:

- 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.
- When the input power is on, the drive DC bus is at a dangerous voltage.
  If brake chopper and resistor are in use, they are at a dangerous voltage. (Option +D150)
- External wiring can supply dangerous voltages to the relay outputs of the control units of the drive.
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.

Optical components

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

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

Printed circuit boards

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

Grounding

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

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

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

- Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- Make sure that the conductivity of the protective earth (PE) conductors is sufficient. See the electrical planning instructions of the drive. Obey the local regulations.
- Connect the power cable shields to protective earth (PE) terminals 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 power supply.

Note:

- You can use power cable shields as grounding conductors only when their conductivity is sufficient.
- As the normal touch current of the drive is higher than 3.5 mA AC or 10 mA DC, you must use a fixed protective earth (PE) connection. The minimum size of the protective earth conductor must comply with the local safety regulations for high protective earth conductor current equipment. See standard IEC/EN 61800-5-1 (UL 61800-5-1) and the electrical planning instructions of the drive.

General safety in operation

These instructions are for all personnel that operate the drive.

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

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

Note:

- The maximum drive power cycles is five times in ten minutes. Power cycling the drive too often can damage the charging circuit of the DC capacitors. If you need to start or stop the drive, use the control panel keys or commands through the I/O terminals of the drive.
- If the drive is in remote control mode, you cannot stop or start the drive with the control panel.

Additional instructions for permanent magnet motor drives

Safety in installation, start-up, maintenance

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

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

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

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

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

- Stop the drive.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
- Do the steps in section *Electrical safety precautions (page 20)*.
- Install temporary grounding to the drive output terminals (T1/U, T2/V, T3/W). Connect the output terminals together as well as to the PE.

During the start up:

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

Safety in operation

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

2

Introduction to the manual

Contents of this chapter

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

Applicability

This manual applies to ACS880-04 drive modules intended for user-defined cabinet installations.

Target audience

This manual is intended for people who plan the installation, install, start up and do maintenance work on the drive, or create instructions for the end user of the drive concerning the installation and maintenance of the drive.

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

Purpose of the manual

This manual provides information needed for planning the installation, installing, and servicing the drive.

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, for example +E208. The options included in the drive can be identified from the option codes visible on the type designation label. The option selections are listed in section *Type designation key (page 47)*.

Quick installation, commissioning and operating flowchart

Task	See
Plan the mechanical and electrical installation and acquire the accessories needed (cables, fuses, etc.). Examine the ambient conditions, ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.	*Guidelines for planning the mechanical installation (page 63)* *Guidelines for planning the electrical installation (page 95)* *Technical data (page 213)* *Resistor braking (page 285)* Option manual (if optional equipment is included)
↓	
Unpack and examine the units. Make sure that all necessary optional modules and equipment are present and correct. Only intact units can be started up.	*Moving and unpacking the unit (page 80)* *Examining the installation site (page 80)* If the drive module has been non-operational for more than one year, the converter DC link capacitors need to be reformed. (*Reforming the capacitors (page 200)*)
↓	
Examine the installation site. Attach the base of the cabinet to the floor.	*Examining the installation site (page 80)* *Ambient conditions (page 233)*
↓	
Route the cables.	*Routing the cables (page 110)*
↓	
Measure the insulation of the supply cable, the motor and the motor cable and the resistor cable (if present).	*Measuring the insulation (page 124)*
↓	

Task	**See**
<u>Standard drive modules</u> • Install the additional components into the cabinet: eg, 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 brake resistors and 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.	*Mechanical installation (page 79)* *Connecting the power cables (page 126)* *Connecting the external control unit to the drive module (page 132)* *Attaching the external control unit (page 90)* Manuals for any optional equipment
⬇	
<u>Drive modules with optional cabling panels (+H381)</u> • Install the cabling panels into the cabinet • Install the additional components into the cabinet: eg, 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 brake resistors and 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 • <u>Drive modules with an external drive control unit:</u> Connect the cables from the drive module to the control unit and install the control unit into the cabinet.	*Mechanical installation (page 79)* *Connecting the power cables (page 126)* *Installing the drive module into the enclosure (page 172)* *Connecting the external control unit to the drive module (page 132)* *Attaching the external control unit (page 90)* Manuals for any optional equipment
⬇	

Task	See
Drive modules without full-size output cable connection terminals (option +0H371) and IP20 shrouds (option +0B051) • Install the additional components into the cabinet: eg, main PE busbar, main disconnector, main contactor, main AC fuses, etc. • Install the drive module into the cabinet • Connect the power cabling between the drive module and the rest of the main circuit components in the cabinet (if any) • Connect the input power cables and motor cables to the drive cabinet • Connect the brake resistors and DC connection cables (if any) to the drive cabinet • Drive modules with an external drive control unit: Connect the cables from the drive module to the control unit and install the control unit into the cabinet.	*Mechanical installation (page 79)* *Connecting the power cables (page 126)* *Installing the drive module into the enclosure (page 172)* *Connecting the external control unit to the drive module (page 132)* *Attaching the external control unit (page 90)* Manuals for any optional equipment
Connect the external control cables to the drive control unit.	*Connecting the control cables to the terminals of the external control unit (page 135)*
Examine the installation.	*Installation checklist (page 181)*
Commission the drive.	*Start-up (page 185)*
Commission the brake chopper (if used).	*Resistor braking (page 285)*
Operate the drive: start, stop, speed control etc.	Appropriate firmware manual

Terms and abbreviations

Term	Description
ACS-AP-I	Industrial assistant control panel
ACS-AP-W	Industrial assistant control panel with Bluetooth interface
BGDR	Gate driver board
DDCS	Distributed drives communication system protocol
DTC	Direct torque control, a motor control method
EMC	Electromagnetic compatibility

Term	Description
EMI	Electromagnetic interference
FAIO-01	Optional analog I/O extension module
FCAN	Optional CANopen® adapter module
FCNA-01	Optional ControlNet™ adapter module
FDCO-01	DDCS communication module with two pairs of 10 Mbit/s DDCS channels
FDIO-01	Optional digital I/O extension module
FDNA-01	Optional DeviceNet™ adapter module
FEA-03	Optional I/O extension adapter
FECA-01	Optional EtherCAT® adapter module
FEIP-21	Optional Ethernet adapter module
FEN-01	Optional TTL incremental encoder interface module
FEN-11	Optional TTL absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL incremental encoder interface module
FENA-21	Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP® and PROFINET IO® protocols, 2-port
FEPL-02	Optional Ethernet POWERLINK adapter module
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FMBT-21	Optional Ethernet adapter module for Modbus TCP protocol
FPBA-01	Optional PROFIBUS DP® adapter module
FPNO-21	Optional Profinet IO adapter module
FPTC-01	Optional thermistor protection module
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres
Frame, frame size	Physical size of the drive or power module
FSCA-01	Optional RS-485 (Modbus/RTU) adapter
FSE-31	Optional pulse encoder interface module for safety encoder
FSO-12, FSO-21	Optional functional safety modules
FSPS-21	Optional functional safety module
HTL	High-threshold logic
IGBT	Insulated gate bipolar transistor
IT system	Type of supply network that has no (low-impedance) connection to ground. See IEC 60364-5.
PLC	Programmable logic controller
SAFUR	Series of brake resistors
SOIA	Optical interface adapter board
STO	Safe torque off (IEC/EN 61800-5-2)
TN system	Type of supply network that provides a direct connection to ground
TTL	Transistor-transistor logic

Term	Description
ZBIB	Adapter board connected to the control board in the control unit (ZCU)
ZCU	Type of control unit
ZPOW	Power supply board

Related documents

Name	Code (English/Multilingual)	Code (Translation)
Drive hardware manuals and guides		
Drive/converter/inverter safety instructions	3AXD50000037978	
ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp) hardware manual	3AUA0000128301	
ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp) quick installation guide	3AXD50000009366	
ACx-AP-x Assistant control panels user's manual	3AUA0000085685	
ACS880 frames R1 to R11 EMC filter and ground-to-phase varistor disconnecting instructions	3AUA0000125152	
Recycling instructions and environmental information for ACS880-04, ACS880-14, ACS880-34, ACS580-04, ACH580-04, ACH580-34, ACQ580-04 and ACQ580-34 drives	3AXD50000137688	
Drive firmware manuals and guides		
ACS880 primary control program firmware manual	3AUA0000085967	
Quick start-up guide for ACS880 drives with primary control program	3AUA0000098062	
Option manuals and guides		
ACS880-01/04 +C132 marine type-approved drives supplement	3AXD50000010521	
DPMP-01 mounting platform for control panels installation guide	3AUA0000100140	
DPMP-02/03 mounting platform for control panels installation guide	3AUA0000136205	
DPMP-04 and DPMP-05 mounting platform for control panels installation guide	3AXD50000308484	
FSO-12 safety functions module user's manual	3AXD50000015612	
FSO-21 safety functions module user's manual	3AXD50000015614	
FSE-31 pulse encoder interface module user's manual	3AXD50000016597	
FSPS-21 PROFIsafe safety functions module user's manual	3AXD50000158638	
ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (+Q971) Application guide	3AUA0000132231	

Name	**Code (English/Multilingual)**	**Code (Translation)**
ACS880-01 drives and ACS880-04 drive modules common DC systems application guide	3AUA0000127818	
FOCH du/dt filters hardware manual	3AFE68577519	
Sine filters hardware manual	3AXD50000016814	
Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.		
Tool and maintenance manuals and guides		
Drive composer start-up and maintenance PC tool user's manual	3AUA0000094606	
Converter module capacitor reforming instructions	3BFE64059629	

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

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

ACS880-04 manuals

Videos:

http://fqrct.com/t/49004da

http://fqrct.com/t/a2081b9

3

Operation principle and hardware description

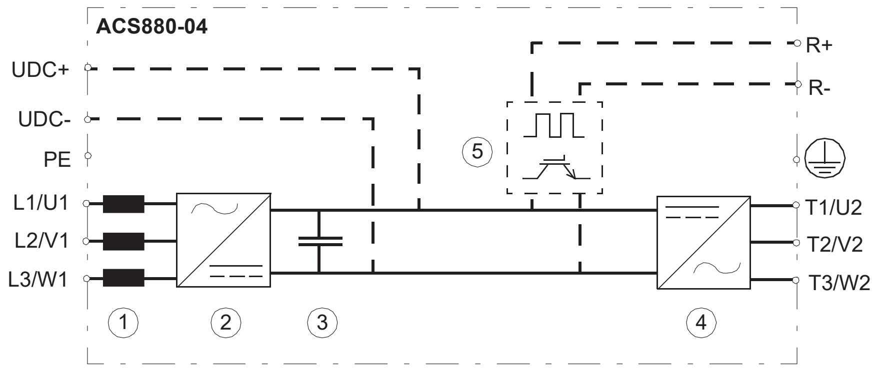
Contents of this chapter

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

Product overview

The ACS880-04 is a drive module for controlling asynchronous AC induction motors, permanent magnet motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors).

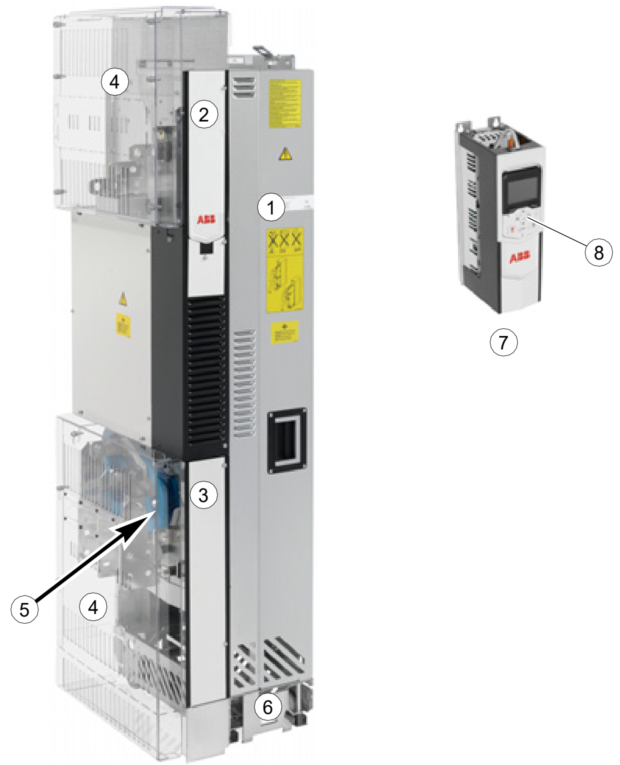
The main circuit of the drive module is shown below.



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

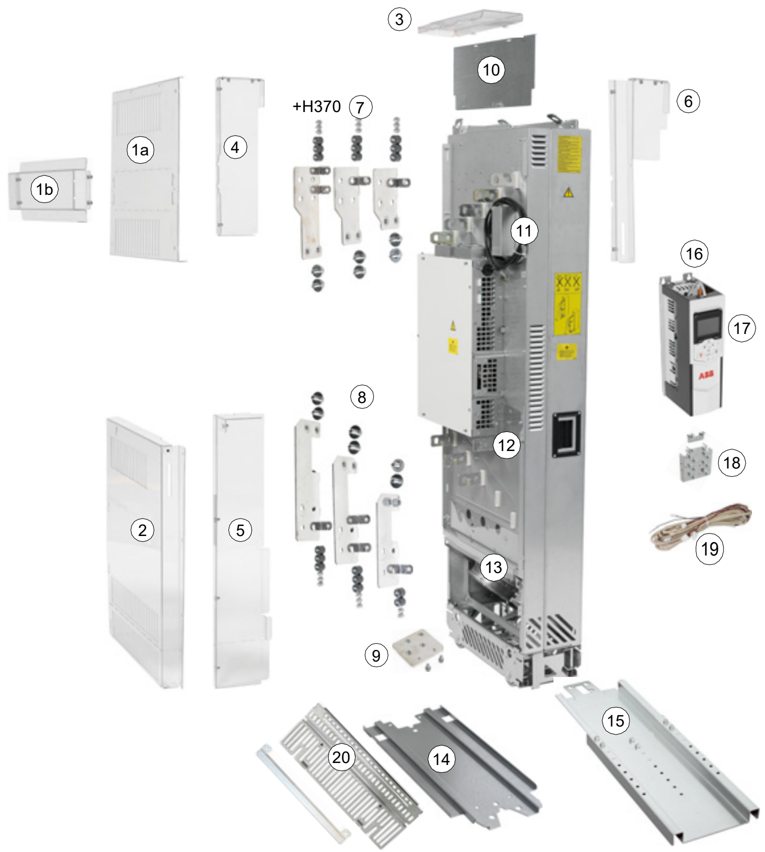
Layout

Standard drive module configuration with option +E208



1	Drive module	5	Optional common mode filter (+E208)
2	Upper front cover	6	Pedestal
3	Lower front cover	7	External control unit with control panel holder
4	Clear plastic shrouds attached	8	Control panel

See the next page for the part descriptions

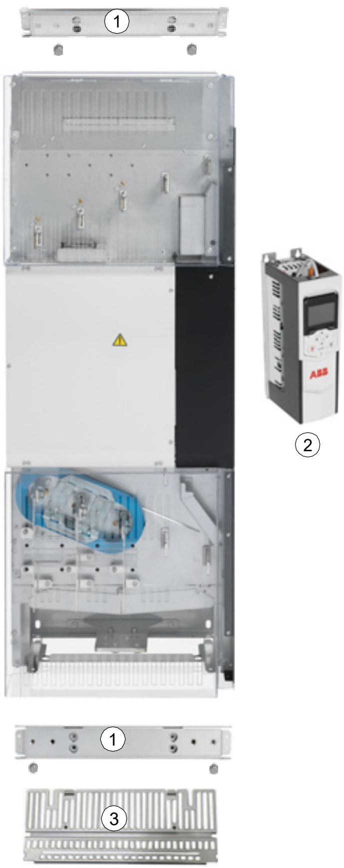


1	Clear plastic shroud to be attached onto the drive module input power cabling (a). Entry shroud for side cabling (b).	11	Fiber optic cables
2	Clear plastic shrouds to be attached onto the drive module output power cabling	12	PE (ground) terminal
3	Clear plastic shroud to be attached on top of the drive module (entry for top cabling)	13	Main cooling fans
4	Upper back clear plastic shroud	14	Pedestal guide plate
5	Lower back clear plastic shroud	15	Telescopic extraction/installation ramp
6	Front clear plastic shroud	16	External control unit. The control unit can also be inside the drive module (option +P905).

7	Input power cable connection terminals (option +H370)	17	Control panel
8	Output power cable connection terminals	18	Control cable clamp plate
9	Grounding terminal for output power cable shields	19	Cables for connecting the control unit to the drive module
10	Metallic shroud. With option +H370, the shroud includes a ground bar.	20	Bottom grille with mounting bracket

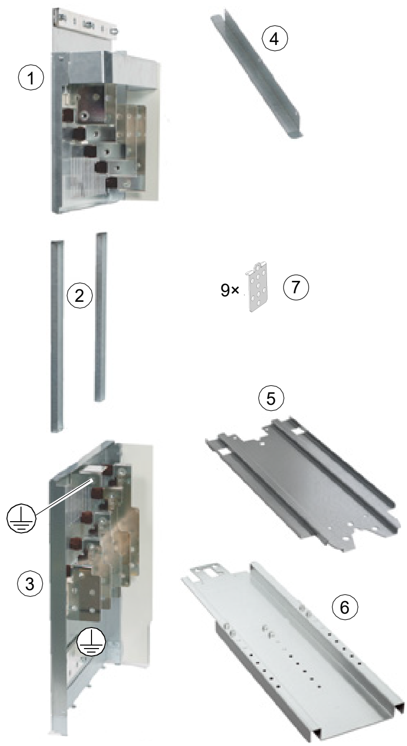
Drive module for flat mounting (option +C173)

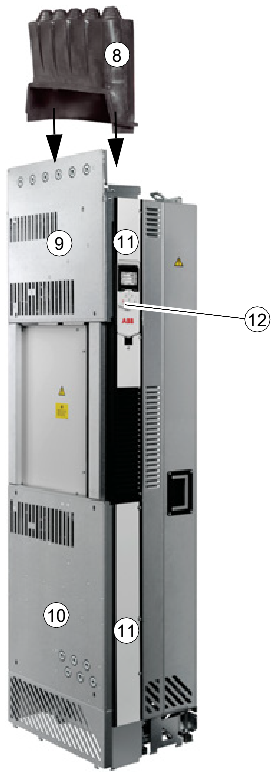
Front view of an assembled drive module for flat mounting is shown below. Option +C173 adds flat mounting brackets to the standard drive module configuration. Option +0H354 removes the pedestal and option +0P919 the installation ramp. You must cut the lower part of the output cabling clear plastic shroud off when no pedestal is in use.



Flat mounting position (front view)		Side view	
1	Flat mounting bracket (two pcs). The brackets are installed to the mounting plate with 2×8 screws. Four combi screws for installing the drive module to the brackets are included in the delivery.	3	Bottom grille to be installed to the base of the drive module for IP20 degree of protection
2	External control unit with control panel holder and control panel	4	Grounding terminal for output cabling
See section *Standard drive module configuration with option +E208* for the part descriptions.			

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

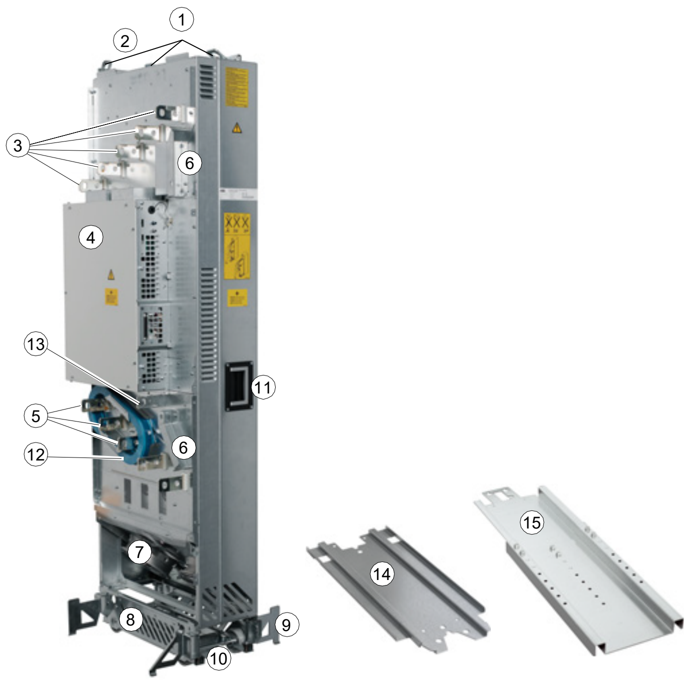




Accessories		Assembled drive module	
1	Input power cabling panel	8	Rubber grommet
2	Side guides	9	Input power cabling panel to be attached to the drive cabinet
3	Output power cabling panel	10	Output power cabling panel to be attached to the drive cabinet
4	Top guide plate	11	Front cover
5	Pedestal guide plate	12	integrated control unit (option +P905) and control panel holder mounted on the drive module (option +J414)
6	Telescopic extraction/installation ramp	-	-

7	Shim plates for Rittal VX25 enclosure (9 pcs)	-	-

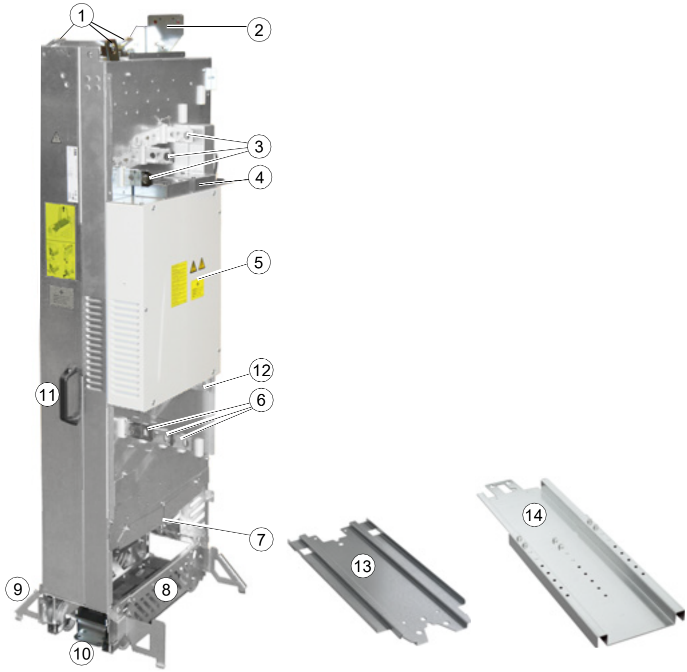
Drive module without full-size output cable connection terminals (option +0H371) and IP20 shrouds (option +0B051)



1	Lifting lugs
2	Fastening bracket
3	Input cable connection busbars (L1/U1, L2/V1, L3/W1) and DC+ and DC- busbars (UDC+, UCD with option +H356)
4	Circuit board compartment
5	Output cable connection busbars (T1/U2, T2/V2, T3/W2) and brake resistor connection busbars (R+ and R- with option +D150)
6	Control cable duct (not included with external control unit)
7	Main cooling fans
8	Pedestal
9	Retractable support legs
10	Base fastening screws

11	Handle for pulling the drive module out of the cabinet
12	Optional common mode filter (+E208)
13	PE busbar
14	Pedestal guide plate
15	Telescopic extraction/installation ramp
Note: The front covers are removed in this photo, see number 11 in section *Drive module with full power cabling panels (option +H381)*.	

Drive module configuration with power cable connection terminals on the right-hand side of the drive module (option +H391)



1	Lifting lugs
2	Fastening bracket
3	Input cable connection busbars (L1/U1, L2/V1, L3/W1) and DC+ and DC- busbars (UDC+, UCD with option +H356)
4	Circuit board compartment cooling fans
5	Circuit board compartment

6	Output cable connection busbars (T1/U2, T2/V2, T3/W2) and brake resistor connection busbars (R+ and R- with option +D150)
7	Main cooling fans
8	Pedestal
9	Retractable support legs
10	Base fastening screws
11	Handle for pulling the drive module out of the cabinet
12	PE busbar
13	Pedestal guide plate
14	Telescopic extraction/installation ramp
Note: The front covers are removed in this photo, see number 11 in section *Drive module with full power cabling panels (option +H381)*.	

Control unit

See section *Standard drive module configuration with option +E208*.

Control panel

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

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

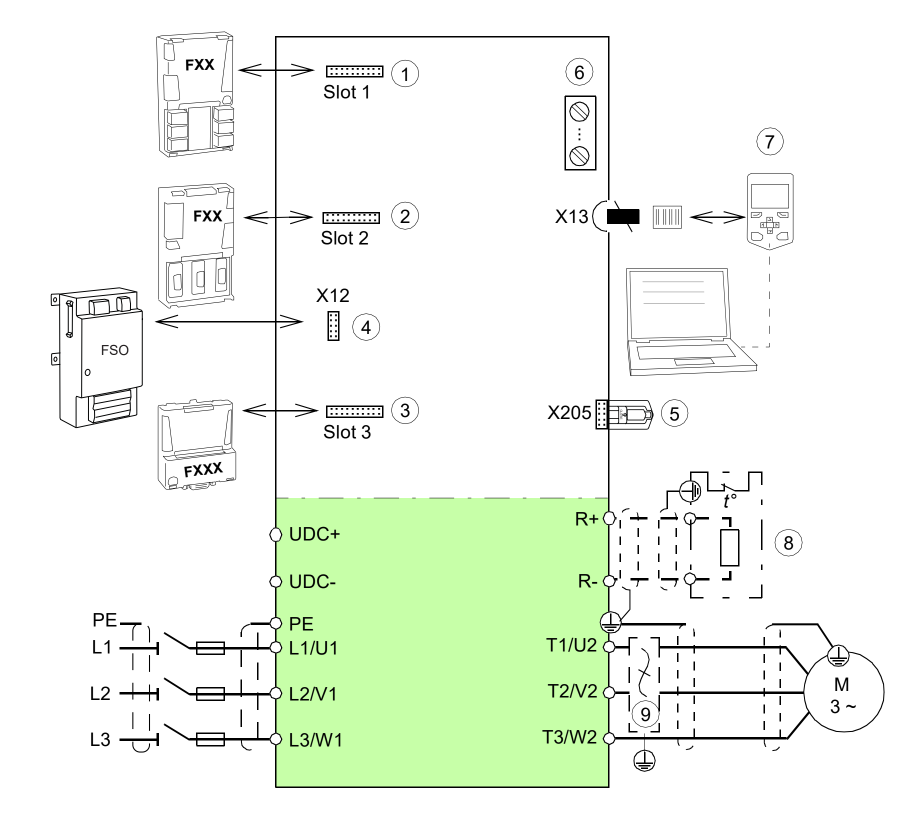
When the control unit is inside the drive module (option +P905), the control panel can be mounted on the drive module (option +J414).

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

For the control panel mounting platforms, see *Mounting the control panel on the cabinet door (page 61)*.

Overview of power and control connections

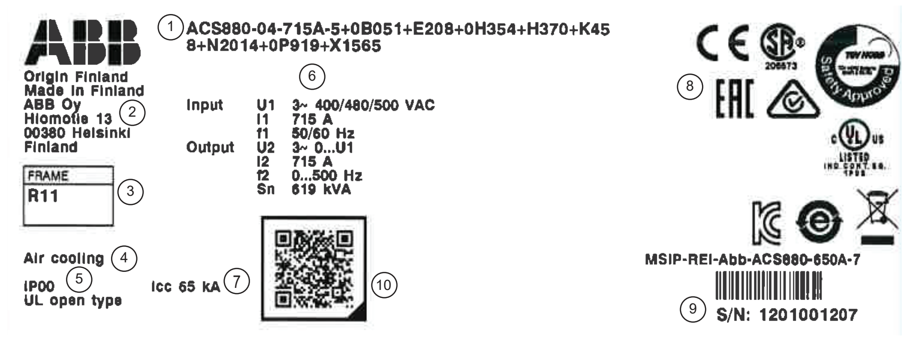
The diagram shows the power connections and control interfaces of the drive module.



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*.
4	Connector for the FSO-xx safety functions module (X12). The module can be installed on or above the control unit (see *Installing the FSO safety functions module (options +Q972 and +Q973)*).
5	Memory unit, see *Connecting memory unit*
6	I/O terminal blocks, see section *Default I/O connection diagram*
7	Control panel, see section *Connecting control panel*
8	Brake resistor (optional, see chapter *Resistor braking*)
9	du/dt or sine filter (optional, see chapter *Filters*)

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 (page 47)*.
2	Name and address of the manufacturer
3	Frame size
4	Cooling method
5	Degree of protection
6	Ratings, see *Ratings (page 213)*
7	Short-circuit withstand strength. See section *Electrical power network specification (page 230)*.
8	Valid markings
9	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.
10	Link to product information

Type designation key

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

Basic code

Code	Description
ACS880	Product series
Type	
-04	When no options are selected: drive module to be installed in a cabinet, IP20 (UL Type Open), bookshelf mounting with pedestal, external control unit, ACS-AP-W control panel and panel holder, build-in choke, full-size output cable connection terminals, no EMC filter, no 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.
Size	
-xxxxA	See the rating tables
Voltage range	
-3	380…415 V AC. This is indicated in the type designation label as typical input voltage level (3~ 400 V AC)
-5	380…500 V AC. This is indicated in the type designation label as typical input voltage levels (3~ 400/480/500 V AC)
-7	525…690 V AC. This is indicated in the type designation label as typical input voltage levels (3~ 525/600/690 V AC)

Option codes

Code	Description
0B051	No IP20 shrouds for cabling area (Not to be used with option +H381)
C132	Marine type approval. Refer to *ACS880 +C132 marine type-approved cabinet-built drives supplement* (3AXD50000039629 [English]).
C205	Marine product certification issued by DNV GL
C206	Marine product certification issued by the American Bureau of Shipping (ABS)
C207	Marine product certification issued by Lloyd's Register (LR)
C208	Marine product certification issued by Registro Italiano Navale (RINA)
C209	Marine product certification issued by Bureau Veritas
C210	Marine product certification issued by Nippon Kaiji Kyokai (NK)
C227	Marine product certification issued by Korean Register of Shipping (KR)
C228	Marine product certification issued by China Classification Society (CCS)
C229	Marine product certification issued by Russian Maritime Register of Shipping (RS)

Code	Description
D150	Brake choppers
E200	EMC filter for 2nd environment TN (grounded) system, category C3
E201	EMC filter for second environment IT (ungrounded) system, category C3
E202	EMC filter for 1st environment TN (grounded) system, category C2
E208	Common mode filter
0H354	No pedestal (requires also +0P919, no extraction/installation ramp)
0H371	No full size cable connection terminals for output power cables
H356	DC connection busbars
H370	Full-size input terminals
H381	Full power cabling panels to be attached to a cabinet. The drive module can be pulled out from the cabinet without disconnecting the power cables. IP20 degree of protection.
H391	Power cable terminals on the right-hand side. Includes accessories for mounting the drive module in the back to front position. Not to be used with options +P905, +H381 and +C173.
0J400	No control panel
J410	DPMP-01 door mounting kit
J413	DPMP-02 door mounting kit (surface mounting) for the panel
J414	Control panel holder integrated in the unit (requires option P905, integrated control unit)
J425	ACS-AP-I control panel
K451	FDNA-01 DeviceNet™ adapter module
K454	FPBA-01 PROFIBUS DP adapter module
K457	FCAN-01 CANopen adapter module
K458	FSCA-01 RS-485 (Modbus/RTU) adapter module
K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCat adapter module
K470	FEPL-02 EtherPOWERLINK adapter module
K475	FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
K490	FEIP-21 EtherNet/IP adapter module
K491	FMBT-21 Modbus/TCP adapter module
K492	FPNO-21 PROFINET IO adapter module

Code	Description
L500	FIO-11 analog I/O extension module (1, 2 or 3 pcs)
L501	FIO-01 digital I/O extension module
L502	FEN-31 HTL incremental encoder interface module
L503	FDCO-01 optical DDCS communication adapter module
L508	FDCO-02 optical DDCS communication adapter module
L515	FEA-03 I/O extension adapter
L516	FEN-21 resolver interface module
L517	FEN-01 TTL incremental encoder interface module
L518	FEN-11 TTL absolute encoder interface module
L521	FSE-31 pulse encoder interface module
L525	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
N5000	Winder control program
N5050	Crane control program
N5100	Winch control program
N5150	Centrifuge control program
N5200	PCP (Progressive Cavity Pump) control program
N5250	Rod pump control program
N5350	Cooling tower control program
N5450	Override control program
N5500	Spinning and traverse control program
N5600	ESP (Electrical Submersible Pump) control program
N5650	Tower crane control program
N7502	Control program for synchronous reluctance motors (SynRM)
N8010	Drive application programming
N8200	High speed license for > 598 Hz operation
0P919	No extraction/installation ramp
P904	Extended warranty 24/30

Code	Description
P905	Integrated control unit (inside drive module)
Q971	ATEX-certified safe disconnection 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
Q986	PROFIsafe safety functions module, FSPS-21
R700	Documentation/manuals in English
R701	German
R702	Italian
R703	Dutch
R704	Danish
R705	Swedish
R706	Finnish
R707	French
R708	Spanish
R709	Portuguese
R711	Russian
R712	Chinese
R713	Polish
R714	Turkish

4

Generic cabinet planning instructions

Contents of this chapter

This chapter contains generic cabinet planning instructions applicable to any user-defined cabinet system. The topics discussed are essential for the safe and trouble-free use of 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 followed, the drive may experience problems that the warranty does not cover.

Cabinet construction

Basic requirements for the cabinet construction are listed below. Make sure that:

- cabinet frame is sturdy enough to carry the weight of the components, control circuitry and other equipment installed in it
- cabinet protects the modules against contact and agrees with the requirements for dust and humidity
- cabinet frame and doors are strong enough to provide adequate protection against flames or pressure blast originating from inside the cabinet in case of arc flash or similar failure

- cabinet has air inlet and outlet gratings that allow free flow of cooling air through the modules inside the cabinet.

Disposition of the devices

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 (heatsink, air outlet of the drive module).

Grounding of mounting structures

Arrange the grounding of the module by leaving the contact surfaces of the fastening points unpainted (bare metal-to-metal contact). The module frame is 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 module and the PE busbar of the cabinet.

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

Busbar material and joints

ABB recommends tin-plated copper, but aluminum can also be used.

Note: Before joining aluminum busbars, remove the oxide layer and apply suitable anti-oxidant joint compound.

Shrouds

The installation of shrouds (touch protection) to fulfill applicable safety regulations is the responsibility of the drive system builder.

Ready-made shrouding parts are available from ABB for some cabinet designs, see the ordering information.

Tightening torques

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

Electrical connections

Size	Torque	Strength class
M3	0.5 N·m (4.4 lbf·in)	4.6...8.8
M4	1 N·m (9 lbf·in)	4.6...8.8
M5	4 N·m (35 lbf·in)	8.8
M6	9 N·m (6.6 lbf·ft)	8.8

Size	Torque	Strength class
M8	22 N·m (16 lbf·ft)	8.8
M10	42 N·m (31 lbf·ft)	8.8
M12	70 N·m (52 lbf·ft)	8.8
M16	120 N·m (90 lbf·ft)	8.8

Mechanical connections

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

Insulation supports

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

Cable lugs

Size	Max. torque	Strength class
M8	15 N·m (11 lbf·ft)	8.8
M10	32 N·m (23.5 lbf·ft)	8.8
M12	50 N·m (37 lbf·ft)	8.8

Cooling and degrees of protection

Planning the cooling

When you plan the cooling of the cabinet:

- make sure that the ventilation of the installation site is sufficient so that the cooling air flow and ambient temperature requirements of the module are met (see the technical data)

- leave enough free space around the components to ensure sufficient cooling. Observe the minimum clearances given for each component, see the technical data.

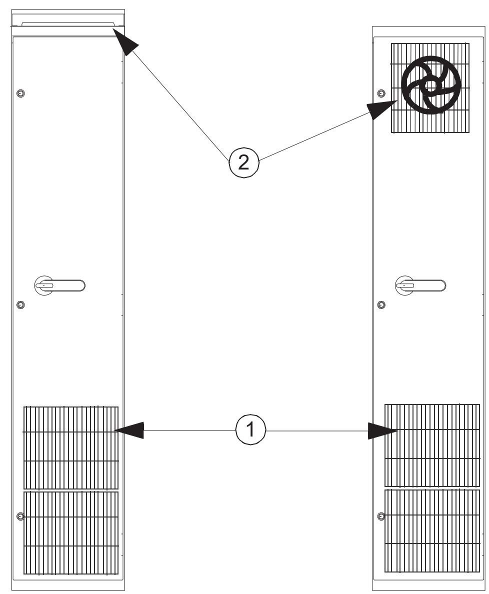
Air inlets and outlets

Equip the air inlets and outlets with gratings that:

- are large enough to allow sufficient air flow in and out of the cabinet (critical for correct cooling of the module)
- guide the air flow
- protect against contact
- prevent water splashes from entering the cabinet
- ensure adequate protection against flames or pressure blast originating from inside the cabinet in case of arc flash or similar failure.

The drawing below shows two typical cabinet cooling solutions. The air inlet is at the bottom of the cabinet. The outlet is on the roof or on the upper part of the door if room height is limited.

Note: Use an extra exhaust fan if the air outlet is on the cabinet door.



1	Air inlet	2	Air outlet

Arrange the cooling air flow through the components according to the technical data. See the specifications for:

- cooling air flow

  Note: The values stated for each component apply to continuous nominal load. If the load is cyclic or less than nominal, less cooling air may be required.

- allowed surrounding air temperature and temperature rise inside the cabinet
- allowed pressure drop over the cabinet that the cooling fan can overcome
- air inlet and outlet sizes required for cooling and recommended filter material (if used).

Note: The heat dissipated by cables and other additional equipment must also be ventilated.

The internal cooling fans of the converter modules and filters are usually sufficient to keep the component temperatures low enough in IP20 (UL Type 1) and IP42 (UL Type 1 filtered) cabinets. Additional fans are present in the example designs as needed. If you install additional heat-generating components to the cabinet, make sure to upgrade the cooling system accordingly.

In IP54 (UL Type 12) 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.

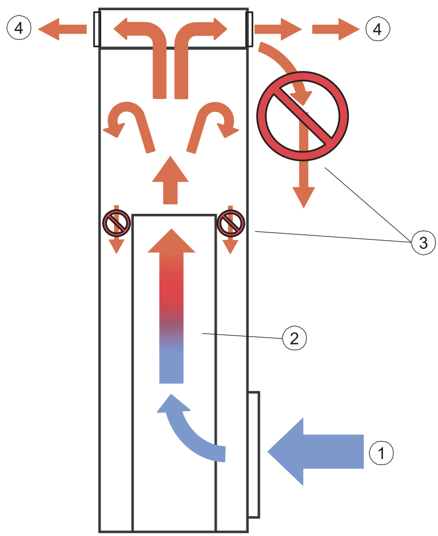
Preventing the recirculation of hot air

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

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

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

The drawing below shows the air flow inside and outside the cabinet.



1	Air flow in
2	Power module
3	Hot air circulation to be prevented
4	Air flow out

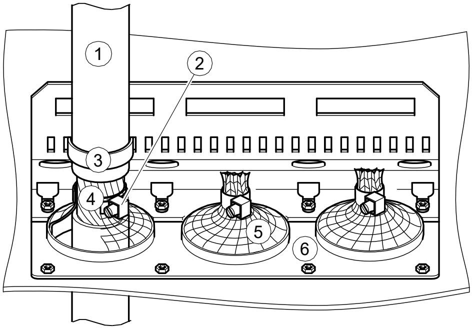
EMC requirements

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, ABB recommends 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

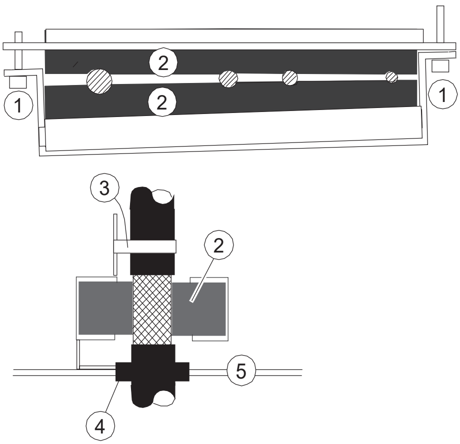
grounding is made with short flat copper braids for low inductance. One-point high-frequency grounding cannot be used due to the long distances inside the cabinet.

- 360° high-frequency grounding of the cable shields at the cable entries improves the EMC shielding of the cabinet.
- ABB recommends 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 Cabinet entry plate

- ABB recommends 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 Entry plate

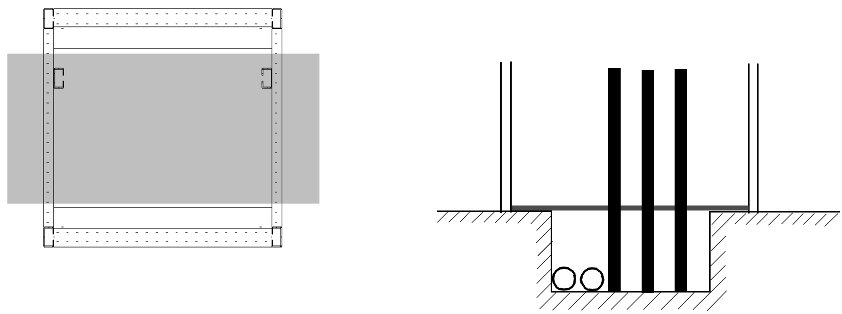
Attaching the cabinet

WARNING!
Do not attach 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.

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.



The supporting structure on a cable channel	Cabinet side view with a bottom plate

Heaters

Use a 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.

Mounting the control panel on the cabinet door

You can use a mounting platform to mount the control panel on the cabinet door. Mounting platforms for control panels are available as options from ABB. For more information, see

Manual	Code (English)
DPMP-01 mounting platform for control panels installation guide	3AUA0000100140
DPMP-02/03 mounting platform for control panels installation guide	3AUA0000136205
DPMP-04 and DPMP-05 mounting platform for control panels installation guide	3AXD50000308484
DPMP-06/07 mounting platform for control panels installation guide	3AXD50000289561

		
DPMP-01	DPMP-02	DPMP-04
IP54 (UL Type 12) when control panel is mounted IP20 (UL Type Open) when control panel is not mounted	IP65 (UL Type 12) when control panel is mounted IP20 (UL Type Open) when control panel is not mounted	IP66 (inside and outside the cabinet door)

5

Guidelines for planning the mechanical installation

Contents of this chapter

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

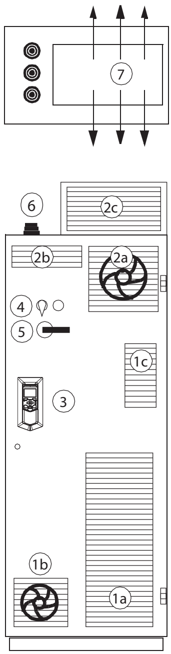
Installation positions of the drive module

You can install the drive module in the bookshelf or flat position or on its back in a cabinet.

Planning the layout

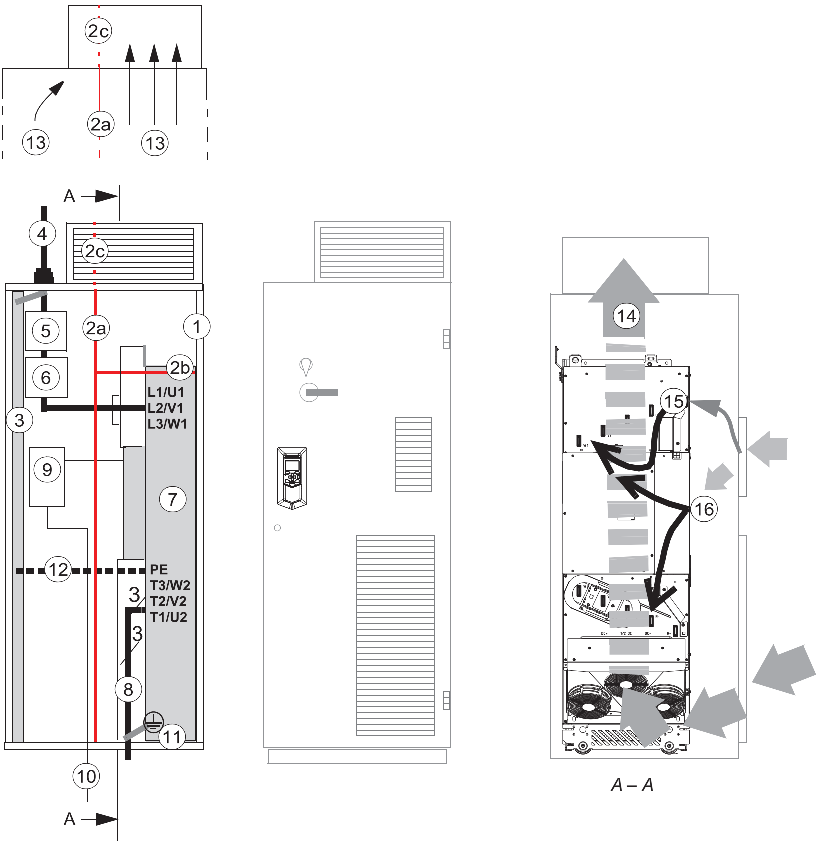
Layout example, door closed

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



1a*)	Air inlet for the drive module
1b	Air inlet for the other equipment. An extra fan is not necessary if an extra air baffle (2c) is used on the cabinet roof.
1c*)	Air inlet for circuit boards and DC and output busbars
2a*)	Air outlet with an extra exhaust fan for the drive module
2b*)	Air outlet for the other equipment
2c*)	Air outlet for the drive module and other equipment on the cabinet roof. An exhaust fan if needed. ABB recommends this alternative instead of 2a.
3	Drive control panel with DPMP-01 mounting platform (option +J410). The control panel is connected to the drive module control unit inside the cabinet.
4	Contactor control switch and emergency stop switch (connected to the contactor control circuit inside the cabinet)
5	Operating handle of the disconnector
6	Rubber grommets for degree of protection
7	Roof air flow viewed from top
*)	**Note:** The sizes of the air inlet and outlet gratings are critical for correct cooling of the drive module. For losses and cooling data requirements, see *Losses, cooling data and noise (page 227)*.

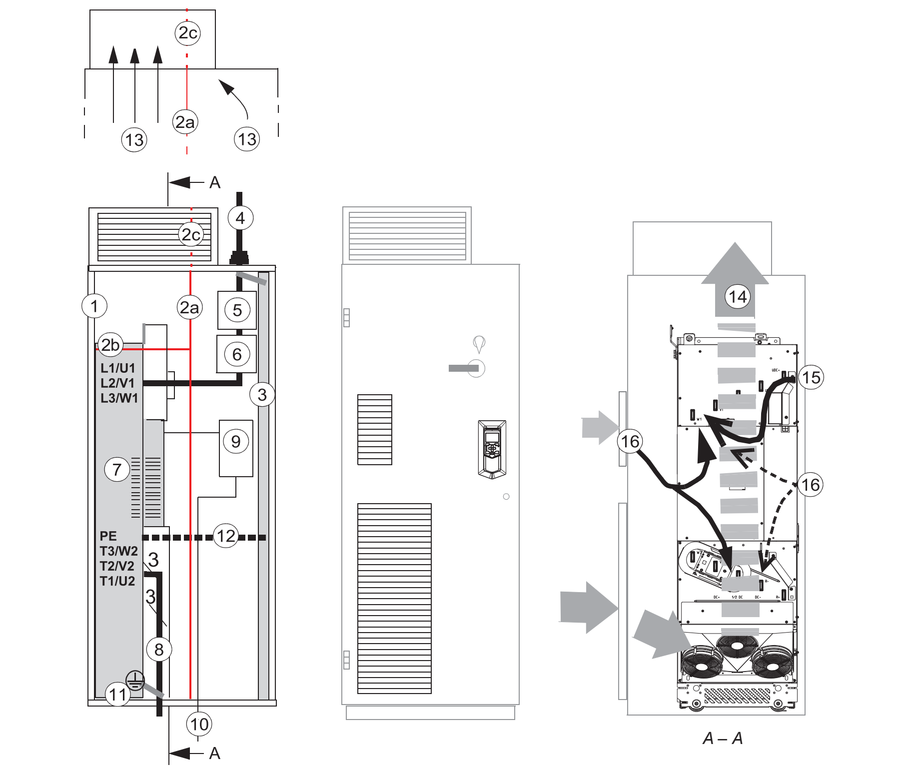
Layout example, door open (standard drive module configuration)



1	Supporting frame of the cabinet	8	Motor cable including the protective ground conductor of the drive module
2a 2b	Vertical (2a) and horizontal (2b) air baffles that separate the cool and hot areas (leakproof lead-throughs). See *Preventing the recirculation of hot air (page 57)*.	9	Drive module control unit. **Note**: With an integrated control unit (option +P905), the upper door air inlet is critical for proper cooling of the control board.
		10	External control cables
2c	Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see *1b (page 64)*)	11	Grounding screws
3	Cabinet grounding busbar (PE)	12	Alternative to grounding screws (11)
4	Input power cable including the protective ground conductor (PE) of the drive	13	Air flow to the roof

5	Disconnector and fuses	14	Air flow through the drive module
6	Contactor	15	Air flow to circuit boards and DC and output busbars
7	Drive module	16	Air flow to the brake option

Layout example, door open (option +H391)

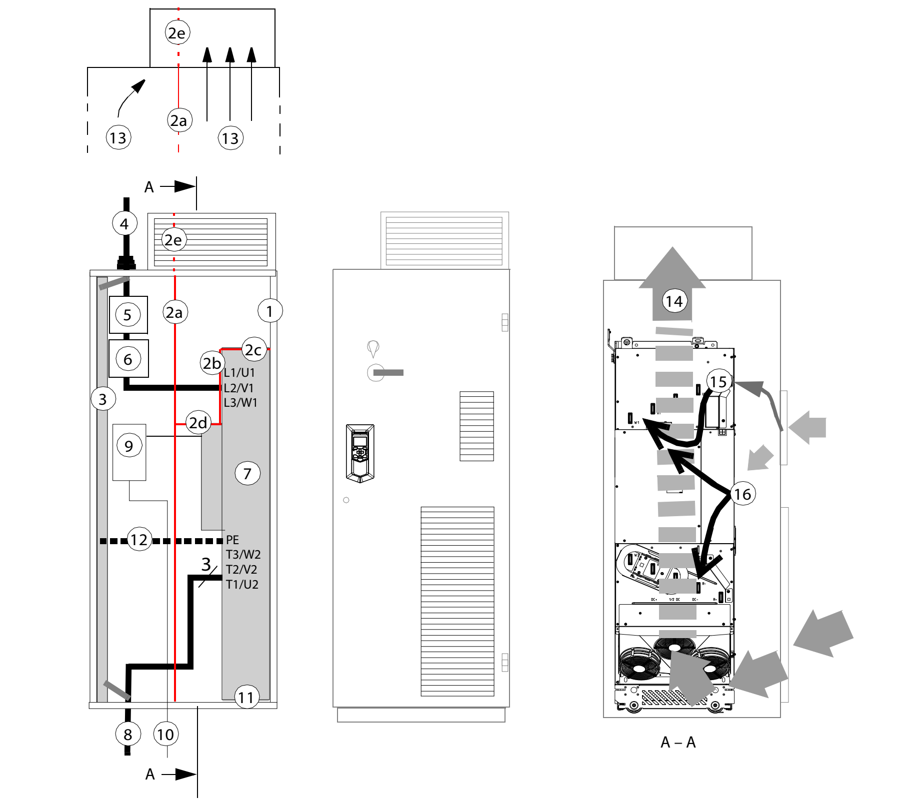


1	Supporting frame of the cabinet	8	Motor cable including the protective ground conductor of the drive module
2a 2b	Vertical (2a) and horizontal (2b) air baffles that separate the cool and hot areas (leakproof lead-throughs). See *Preventing the recirculation of hot air (page 57)*.	9	Drive module control unit. **Note:** With an integrated control unit (option +P905), the upper door air inlet is critical for proper cooling of the control board.
		10	External control cables
2c	Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see *1b (page 64)*)	11	Grounding screws
3	Cabinet grounding busbar (PE)	12	Alternative to grounding screws (11)

4	Input power cable including the protective ground conductor (PE) of the drive	13	Air flow to the roof
5	Disconnector and fuses	14	Air flow through the drive module
6	Contactor	15	Air flow to circuit boards and DC and output busbars
7	Drive module	16	Air flow to the brake option

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).



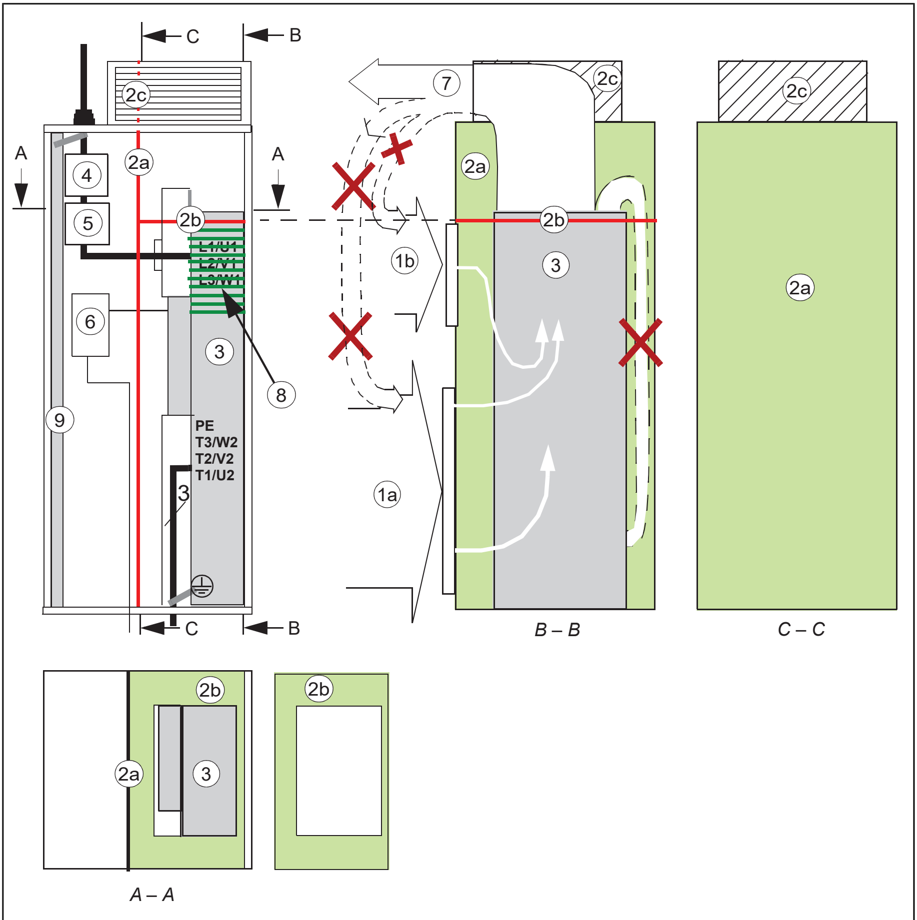
1	Supporting frame of the cabinet	8	Motor cable including the protective ground conductor of the drive module
2	Vertical (2a, 2b) and horizontal (2c, 2d) air baffles that separate the cool and hot areas (leakproof lead-throughs). See *Preventing the recirculation of hot air (page 57)*.	9	Drive module control unit. **Note:** With an integrated 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 (page 64)*)	10	External control cables
		11	Grounding screws
3	Cabinet grounding busbar (PE)	12	Alternative to grounding screws (11)

4	Input power cable including the protective ground conductor (PE) of the drive	13	Air flow to the roof
5	Disconnector and fuses	14	Air flow through the drive module
6	Contactor	15	Air flow to circuit boards and DC and output busbars
7	Drive module	16	Air flow to the brake option

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

Bookshelf mounting (standard drive module configuration)

This diagram shows the air baffle position inside an example cabinet. For dimensions of the baffle, see *Air baffles for the standard drive module and option +C173 (page 259)*.

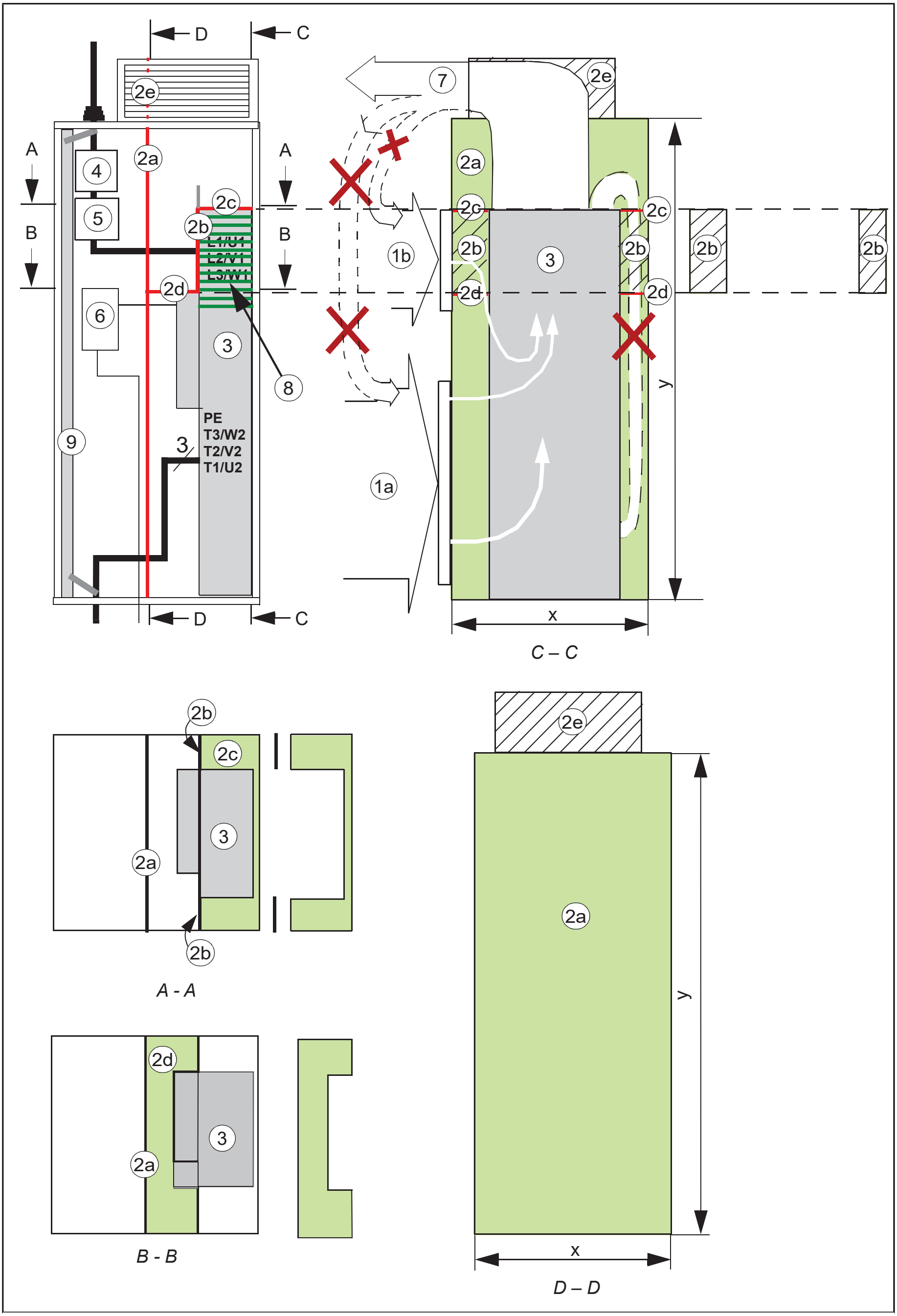


1a	Air flow to the drive module, max. 40 °C (104 °F)	4	Disconnector and fuses
1b	Air flow to the drive circuit boards and DC and output busbars	5	Contactor
2a	Vertical air baffle that separates the cool and hot areas in the cabinet	6	Drive module control unit
2b	Horizontal air baffle	7	Air flow out

2c	Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see *1b (page 64)*)	8	**Note:** The upper grating in the cabinet door must be located in the area marked with the horizontal shading lines for correctly directed cooling air flow to the circuit board compartment of the drive module.
3	Drive module	9	Cabinet grounding busbar (PE)

Bookshelf mounting (option +0B051)

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


D
C
2e
2a
4
5
A
B
2c
2b
L1/U1
L2/V1
L3/W1
2d
6
3
8
9
PE
T3/W2
T2/V2
T1/U2
7
1b
1a
y
x
C – C
A - A
B - B
D – D

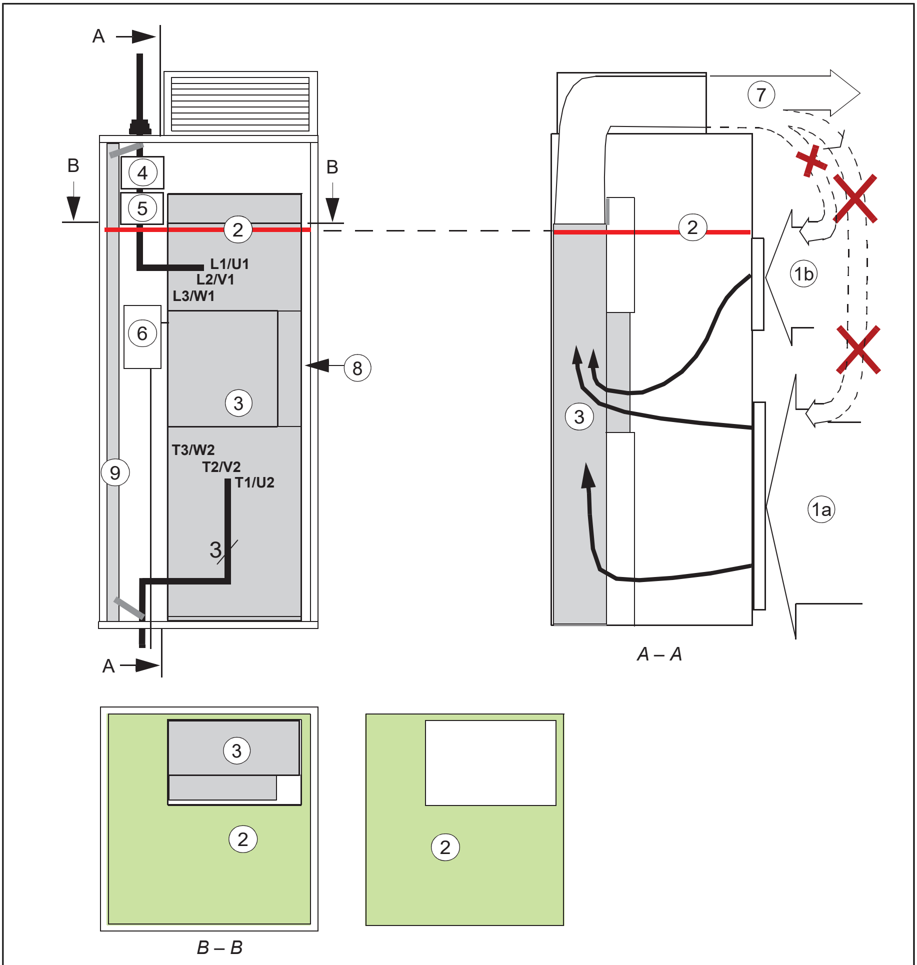
1a	Air flow to the drive module, max. 40 °C (104 °F)	3	Drive module
1b	Air flow to the drive circuit boards and DC and output busbars	4	Disconnector and fuses
2a	Vertical air baffle that separates the cool and hot areas in the cabinet	5	Contactor
2b	Vertical air baffle	6	Drive module control unit
2c	Upper horizontal air baffle	7	Air flow out
2d	Lower horizontal air baffle	8	**Note:** The upper grating in the cabinet door must be located in the area marked with the horizontal shading lines for correctly directed cooling air flow to the circuit board compartment of the drive module.
2e	Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see *1b (page 64)*)	9	Cabinet grounding busbar (PE)

Bookshelf mounting (option +H381)

See *Step-by-step drawings for installing full cabling panels (option +H381) in a Rittal 400 mm wide enclosure (page 305)* and *Air baffles for option +H381 in Rittal VX25 400 mm wide enclosure installation (page 260)*.

Flat mounting (option +C173)

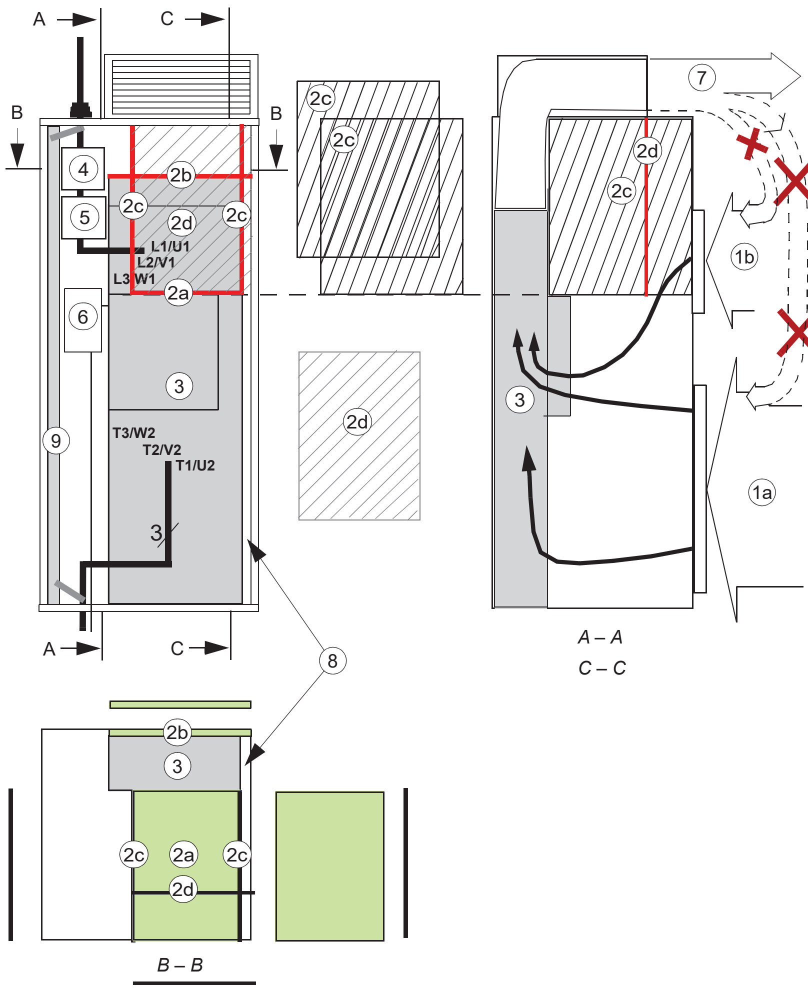
This diagram shows the air baffle position inside an example cabinet. For dimensions of the baffle, see *Air baffles for the standard drive module and option +C173 (page 259)*.



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

Flat mounting (option +C173 + 0B051)

This diagram shows the air baffle position inside an example cabinet.



1a	Air flow to the drive module, max. 40 °C (104 °F)	4	Disconnector and fuses
1b	Air flow to the drive circuit boards and DC and output busbars	5	Contactor
2a	Horizontal air baffles that guide cooling air flow	6	Drive module control unit
2b	Horizontal air baffle	7	Air flow out

2c	Vertical air baffle	8	Air gap between the drive module front and cabinet wall for cooling air flow
2d	Vertical air baffle that guides air flow to the inside the drive module	9	Cabinet grounding busbar (PE)
3	Drive module	-	-

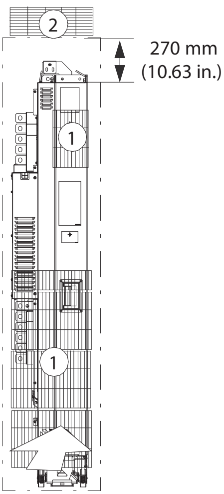
Free space requirements

Free space around the drive module is needed to make sure that sufficient cooling air flows through the module and the module cools correctly.

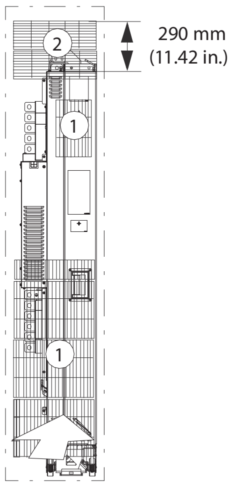
Free space at the top of the drive module

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

Air outlet on the cabinet roof



Air outlet in the upper part of the cabinet door



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 400 mm (15.75 in)
- width 500 mm (19.68 in)
- depth 600 mm (23.62 in)
- height 2000 mm (78.74 in).

Other installation positions than vertical

You can install the drive module on its back. Make sure that the hot cooling air that flows upwards from the module does not cause danger.

For other installation positions, contact ABB.

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). See section *Mounting the control panel on the cabinet door (page 61)*.

ABB air inlet and outlet kits

See *Cabinet ventilation (page 206)*.

6

Mechanical installation

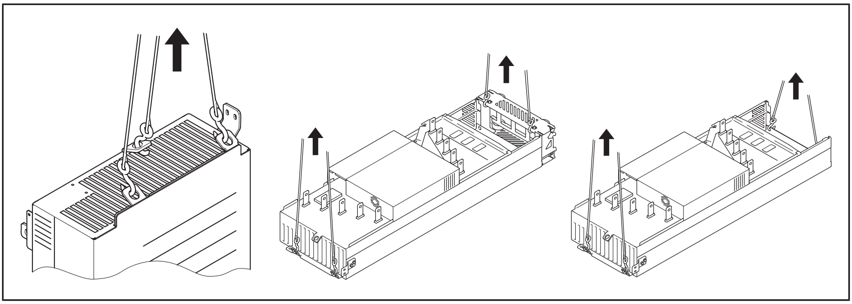
Contents of this chapter

This chapter describes how to install the drive module mechanically without the clear plastic shrouds. The shrouds are attached after the power cabling.

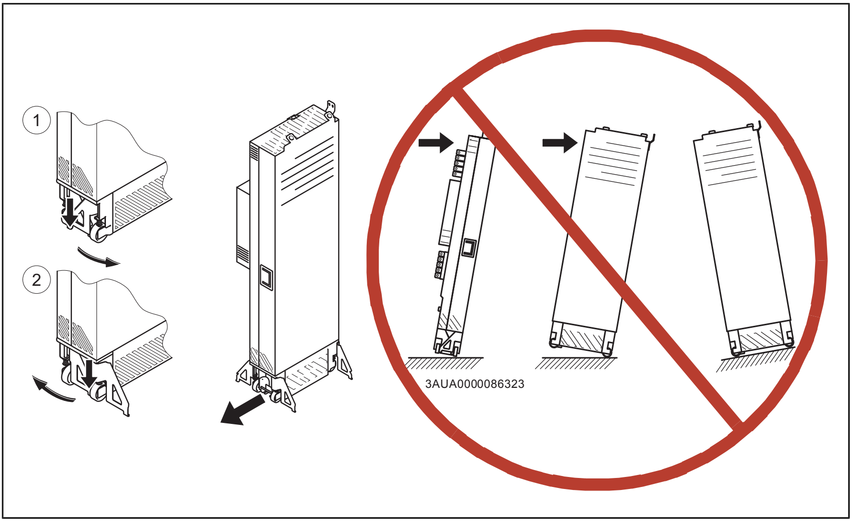
Safety

WARNING!

Lift the drive module only by the lifting lugs:



Make sure that the module does not topple over when you move it on the floor: To open the support legs, press each leg a little down (1, 2) and turn it aside. Whenever possible attach the module also with chains. Do not tilt the module. 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.



Examining the installation site

Examine the installation site. Make sure that:

- The installation site is sufficiently ventilated or cooled to remove heat from the drive. See the technical data.
- The ambient conditions of the drive meet the specifications. See the technical data.

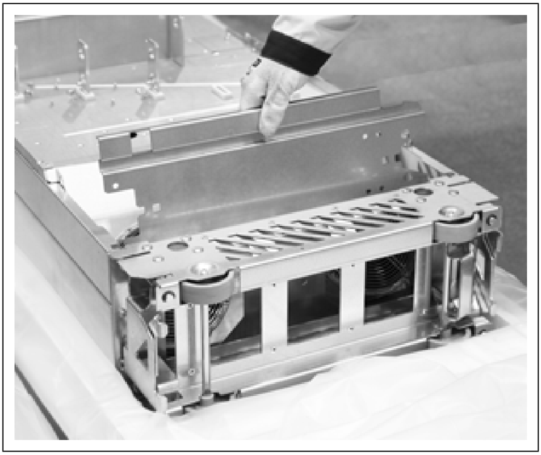
Moving and unpacking the unit

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

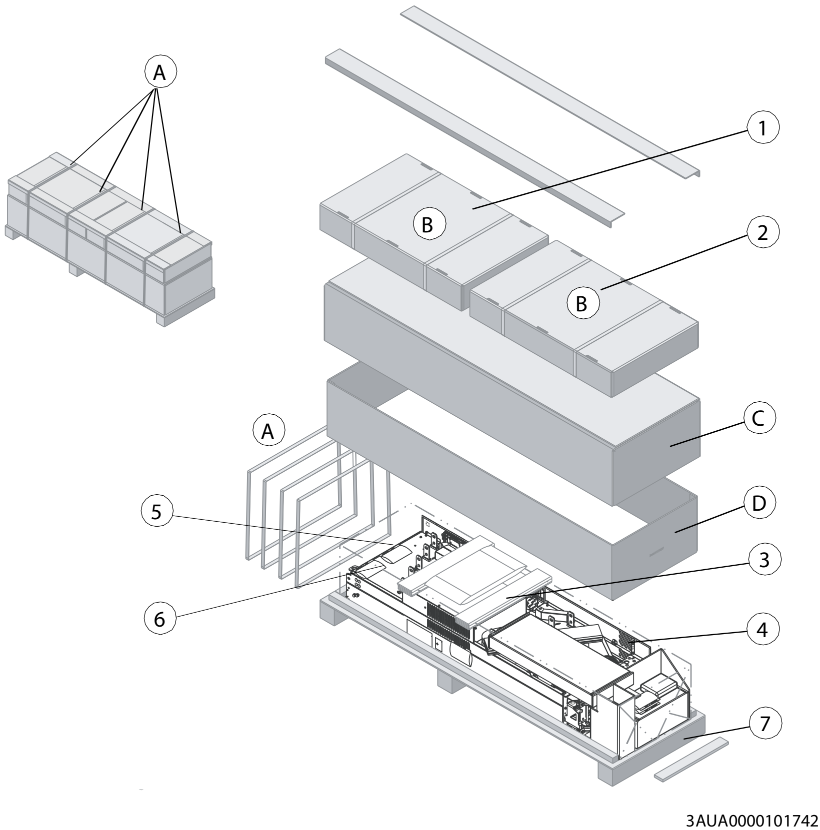
Move the transport package by pallet truck to the installation site.

Unpack the package as follows, see section *Package drawings (page 82)*:

- Cut the bands (A).
- Unpack the additional boxes (B).
- Remove the outer sheathing by lifting it (C).
- Remove the sheathing by lifting it (D).
- Remove the pedestal guide plate as shown below (not included with options +0H354 and +0P919).

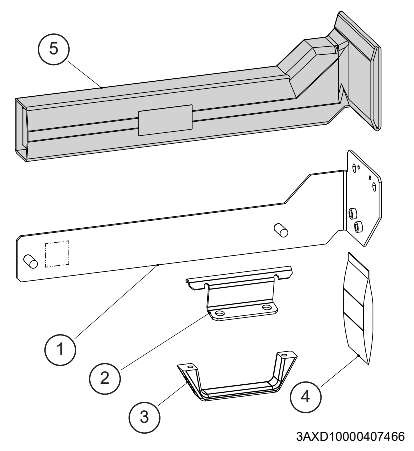


Package drawings

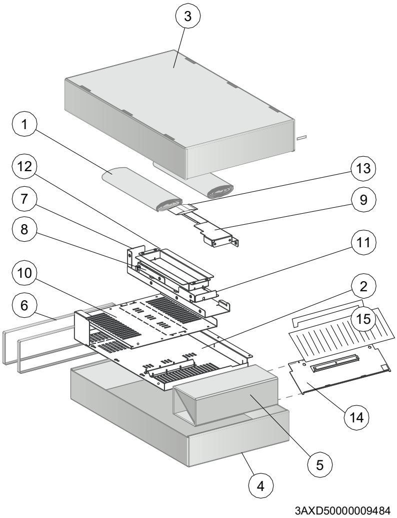


Transport package contents	
1	With standard drive module configuration: Clear plastic shrouds. With option +H381: Input cabling panel parts. See below for the box contents.
2	With standard drive module configuration: Output cable connection terminals. With option +H370 also input cable connection terminals. With option +H381: Output cabling panel parts. See below for the box contents.
3	Plywood support

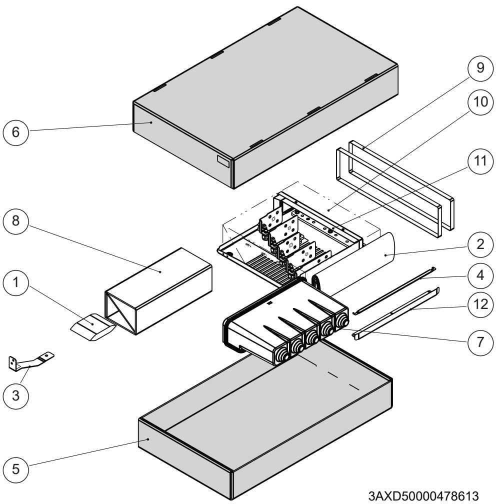
4	Drive module with factory installed options and multilingual residual voltage warning sticker, top guide plate, pedestal guide plate, telescopic ramp package, fastening screws in a plastic bag, external control unit with control cable clamp plate and factory installed optional modules, control panel 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.
5	With option +C173: Back fastening bars
6	With option +H391: Accessories for mounting
7	Pallet



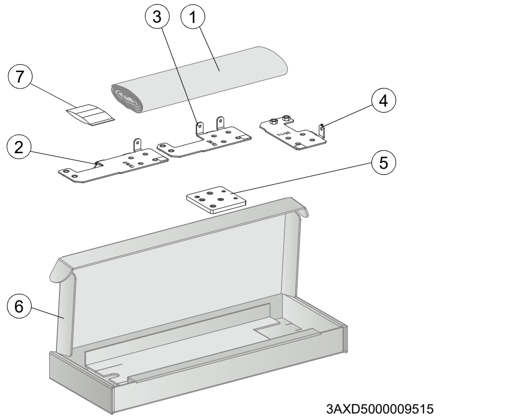
Option +H391: Top and bottom brackets and handle	
1	Top bracket
2	Bottom bracket
3	Handle
4	Screw package
5	Cardboard package



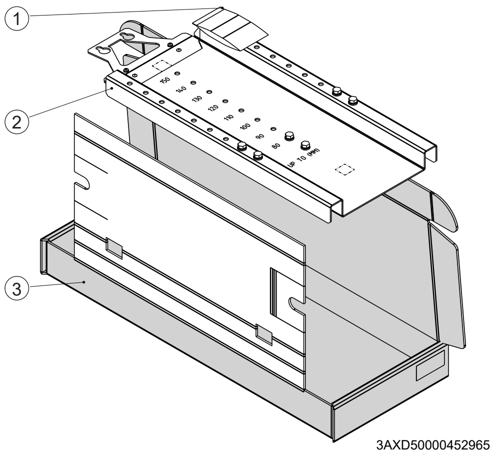
Box B1 contents (standard drive module configuration)	
1	Paper fill
2	Clear plastic shroud for output cabling
3	Cardboard box cover
4	Cardboard box bottom
5	Support
6	Bands
7	Back clear plastic shroud (lower)
8	Back clear plastic shroud (upper)
9	Front clear plastic shroud
10	Clear plastic shroud for 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



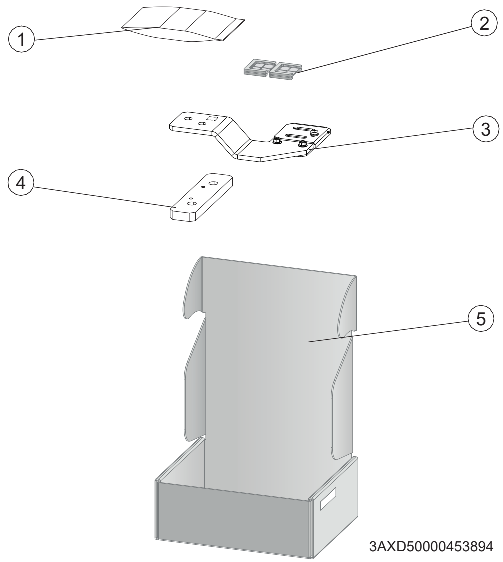
Box B1 contents with option +H381: Input power cabling panel parts	
1	Screw package
2	Paper fill
3	Grounding busbar to be connected to the input power cabling panel and the drive module
4	Bracket
5	Cardboard tray
6	Top cardboard cover
7	Rubber grommet
8	Support
9	Bands
10	Plastic bag
11	Input power cabling panel
12	Top guide



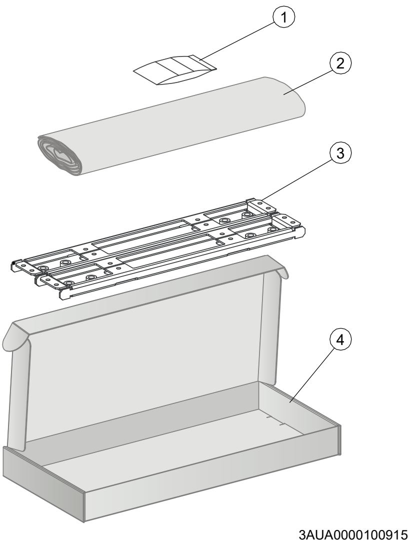
Box B2 contains this box with standard drive module configuration	
1	Paper fill
2	Output cable connection terminal T3/W2
3	Output cable connection terminal T2/V2
4	Output cable connection terminal T1/U2
5	Grounding terminal
6	Cardboard box
7	Screws and insulators in a plastic bag



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



Accessories box contents	
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



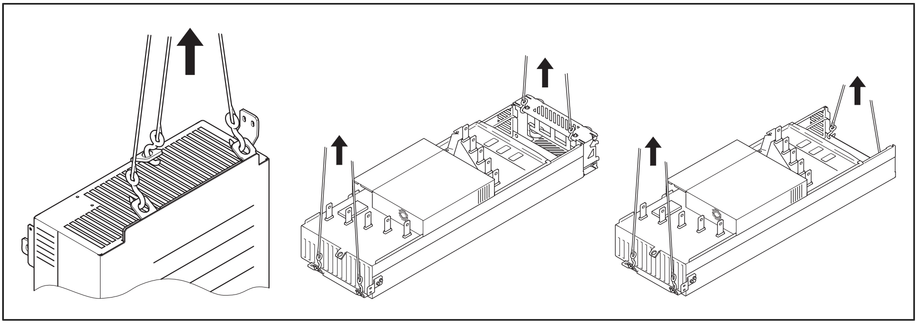
Flat installation box contents (option +C173)	
1	Screw package
2	Paper fill
3	Mounting bars for 600 mm wide Rittal VX25 enclosure
4	Cardboard box

Examining the delivery

Examine that all items are present in the drive package and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type.

Lifting the drive module

Lift the drive module only by the lifting lugs.



Installation alternatives

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

Standard drive module configuration (bookshelf mounting)

For an installation example on how to install the drive module with clear plastic shrouds into a Rittal VX25 enclosure, see *Installation example of the standard drive module configuration (page 157)*. See also *ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp) quick installation guide* (3AXD50000009366 [English]).

Drive module configuration for flat mounting (option +C173)

You can attach the module to the cabinet mounting plate in flat position

- with bolts through the mounting holes at the top and bottom of the module,
- or you can, first, attach the mounting brackets delivered with option +C173 to the cabinet mounting plate and then attach the drive module to the mounting brackets with screws.

See the dimension drawing for *R10 with options +0B051+C173+E208+H356+0H354+0H371 (page 246)* or for *R11 with options +0B051+C173+E208+H356+0H354+0H371 (page 255)*.

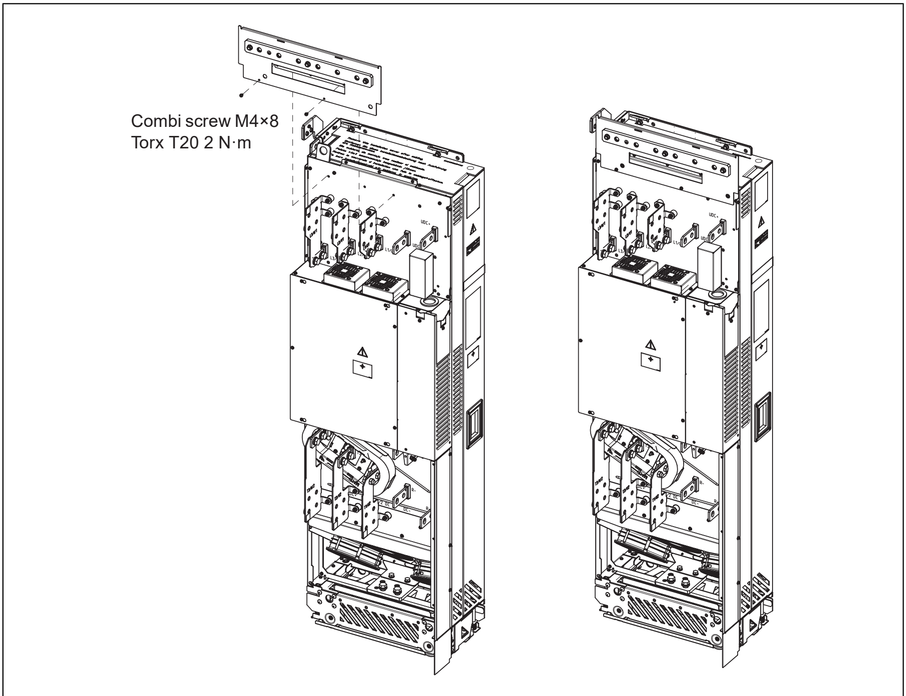
Note: For option +0H354 (no pedestal): Make sure that the cabinet mounting plate and frame are strong enough to carry the weight of the drive module. See section *Dimensions, weights and free space requirements (page 225)*.

For an installation example on how to install the drive module without pedestal in flat position in a Rittal VX25 enclosure, see *Step-by-step drawings for a flat installation example in a Rittal 600 mm wide enclosure (page 311)*.

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

Connect the input power cable connection terminals as shown in *Step-by-step drawings for an installation example of standard drive configuration with option +E208 in Rittal VX25 600 mm wide enclosure (page 299)*.

Install the metallic shroud with ground bar as shown below.



Drive module with full cabling panels (option +H381)

For an installation example of the drive module with full cabling panels (option +H381) into a Rittal enclosure including power cable connection procedure, see *Installation example with full cabling panels (option +H381) (page 165)*.

Note: This installation alternative is not possible without pedestal (with option +0H354).

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

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

Drive module configuration with power cable connection terminals on the right-hand side of the drive module (option +H391)

For an installation example of the drive module with option +H391 into a Rittal enclosure, see *Step-by-step drawings for option +H391 installation example in a Rittal 600 mm wide enclosure (page 313)*. Otherwise, install the drive module as the standard drive module configuration.

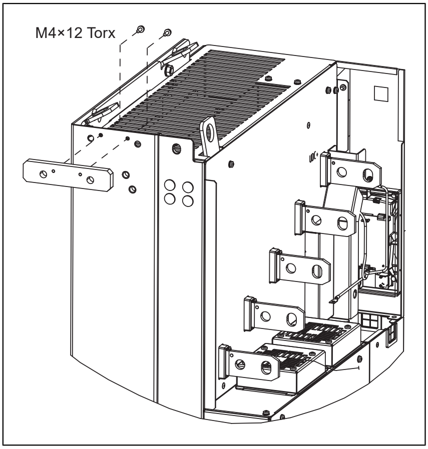
Drive module without pedestal (option +0H354)

The drive module without pedestal can be mounted on a wall or a cabinet with four screws through the fastening holes at the top and bottom of the module.

Make sure that the cabinet mounting plate and frame are strong enough to carry the weight of the drive module. See *Dimensions, weights and free space requirements (page 225)*.

Attaching the drive module to a mounting plate or wall

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



Attaching the drive module to a mounting plate or wall (option +H391)

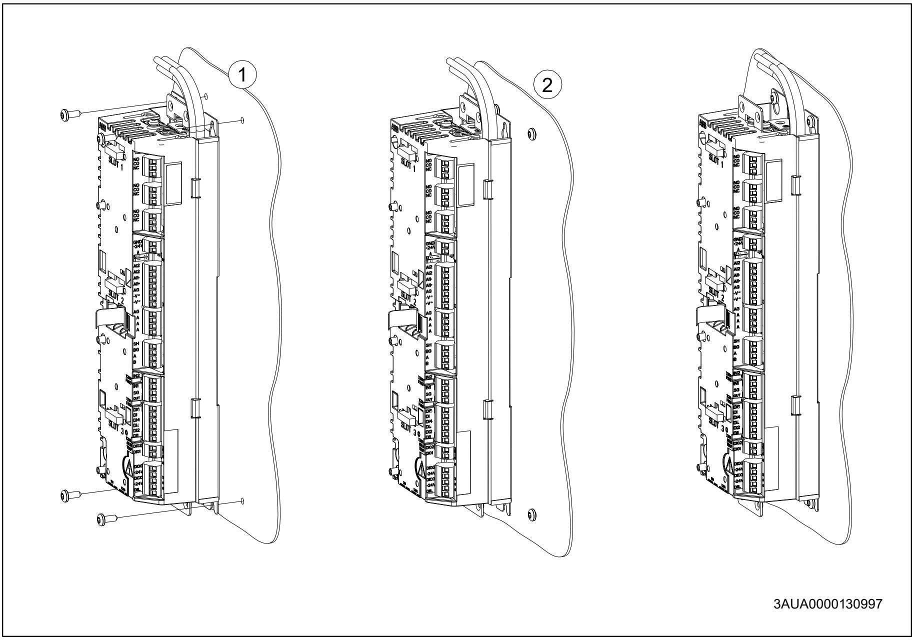
See *Step-by-step drawings for option +H391 installation example in a Rittal 600 mm wide enclosure (page 313)*.

Attaching 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.

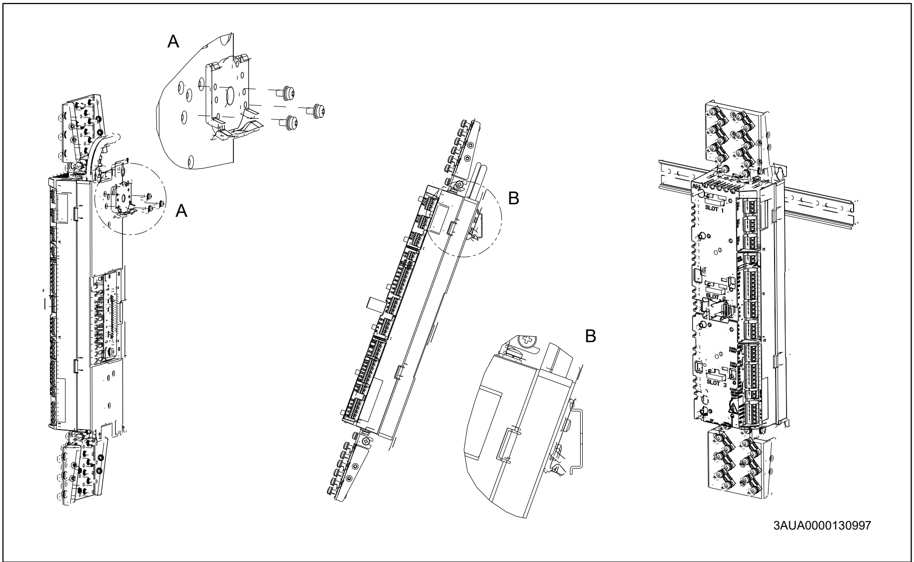
Attaching the external control unit to a mounting plate or wall

1. Attach the mounting screws in the wall.
2. Lift the control unit onto the screws and tighten the screws.



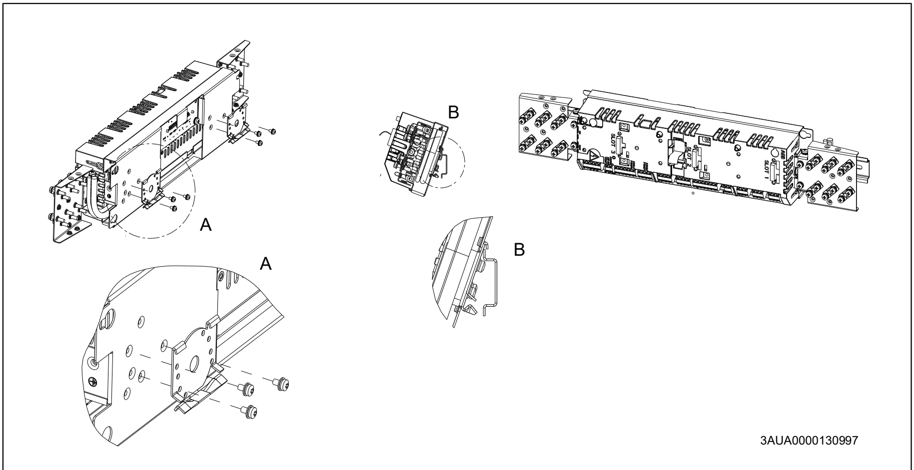
Attaching the external control unit vertically on a DIN rail

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



Attaching the external control unit horizontally on a DIN rail

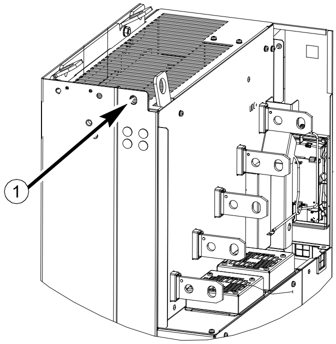
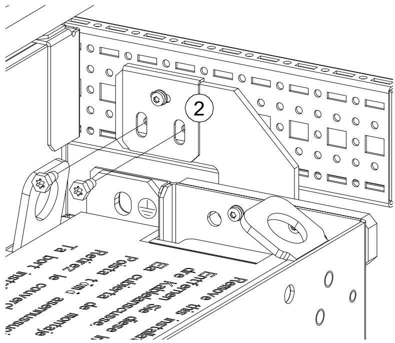
1. Attach the latches (A) to the back of the control unit with three screws.
2. Click the control unit to the rail as shown below (B).



Alternatives for grounding the drive module

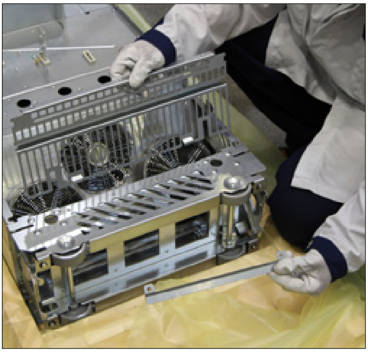
You can ground the drive module from its top back to the cabinet frame with these alternatives:

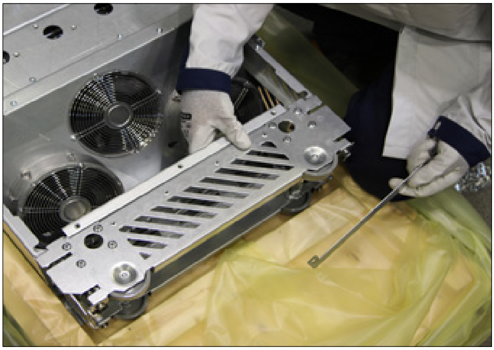
1. from the grounding hole
2. to a Rittal punched section: with fastening bracket.

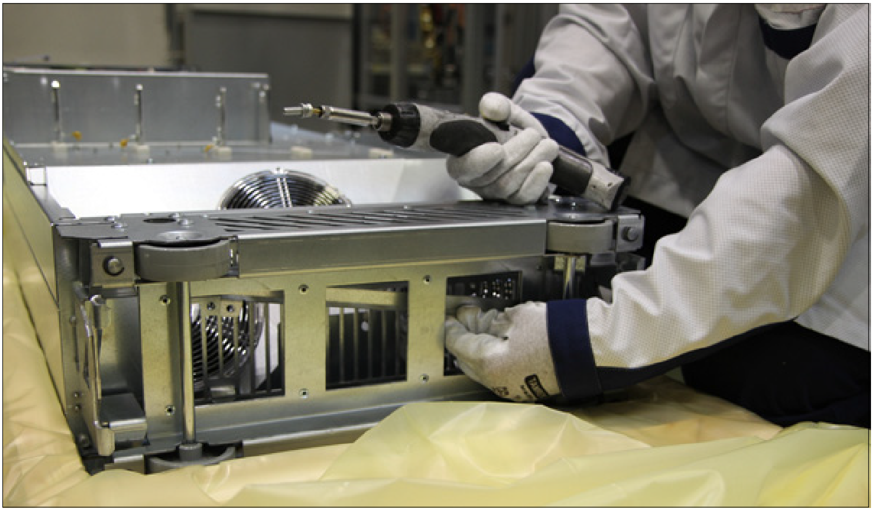
	
	Tapping screw M6×12 Torx T30 (Hex) 9 N·m

Installing the bottom grille for IP20 degree of protection

If IP20 degree of protection is needed from the bottom side, install the bottom grille as shown below.







7

Guidelines for planning the electrical installation

Contents of this chapter

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

Limitation of liability

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

Selecting the main supply disconnecting device

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

European Union

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

North America

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

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

Other regions

The disconnecting device must conform to the applicable local safety regulations.

Selecting the main contactor

You can equip the drive with a main contactor.

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

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

Examining the compatibility of the motor and drive

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

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

Make sure that the motor withstands the maximum peak voltage in the motor terminals. See *Requirements table (page 97)*. For basics of protecting the motor insulation and bearings in drive systems, see *Protecting the motor insulation and bearings (page 97)*.

Note:

- Consult the motor manufacturer before using a motor whose nominal voltage differs from the AC line voltage connected to the drive input.
- The voltage peaks at the motor terminals are relative to the supply voltage of the drive, not the drive output voltage.
- If the motor and drive are not of the same size, consider the operation limits of the drive control program for the motor nominal voltage and current. See the appropriate parameters in the firmware manual.

Protecting the motor insulation and bearings

The drive employs modern IGBT inverter technology. Regardless of frequency, the drive output comprises pulses of approximately the drive DC bus voltage with a very short rise time. The pulse voltage can almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This can cause additional stress on the motor and motor cable insulation.

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

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

Requirements table

These tables show how to select the motor insulation system and when a drive d*u*/d*t* and common mode filters and insulated N-end (non-drive end) motor bearings are required. Ignoring the requirements or improper installation may shorten motor life or damage the motor bearings and voids the warranty.

This table shows the requirements when an ABB motor is in use.

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**		
			P_n < 100 kW and frame size < IEC 315	**100 kW ≤ P_n < 350 kW or IEC 315 ≤ frame size < IEC 400**	**P_n ≥ 350 kW or frame size ≥ IEC 400**
			P_n < 134 hp and frame size < NEMA 500	**134 hp ≤ P_n < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580**	**P_n ≥ 469 hp or frame size > NEMA 580**
Random-wound M2_, M3_ and M4_	U_n ≤ 500 V	Standard	-	+ N	+ N + CMF
	500 V < U_n ≤ 600 V	Standard	+ d*u*/d*t*	+ N + d*u*/d*t*	+ N + d*u*/d*t* + CMF
		or			
		Reinforced	-	+ N	+ N + CMF
	600 V < U_n ≤ 690 V (cable length ≤ 150 m)	Reinforced	+ d*u*/d*t*	+ N + d*u*/d*t*	+ N + d*u*/d*t* + CMF
	600 V < U_n ≤ 690 V (cable length > 150 m)	Reinforced	-	+ N	+ N + CMF
Form-wound HX_ and AM_	380 V < U_n ≤ 690 V	Standard	n.a.	+ N + CMF	P_n < 500 kW: +N + CMF
					P_n ≥ 500 kW: +N + d*u*/d*t* + CMF
Old [1] form-wound HX_ and modular	380 V < U_n ≤ 690 V	Check with the motor manufacturer.	+ N + d*u*/d*t* with voltages over 500 V + CMF		
Random-wound HX_ and AM_ [2]	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.				

[1] manufactured before 1.1.1998

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

This table shows the requirements when a non-ABB motor is in use.

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**		
			P_n < 100 kW and frame size < IEC 315	**100 kW ≤ P_n < 350 kW or IEC 315 ≤ frame size < IEC 400**	**P_n ≥ 350 kW or frame size ≥ IEC 400**
			P_n < 134 hp and frame size < NEMA 500	**134 hp ≤ P_n < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580**	**P_n ≥ 469 hp or frame size > NEMA 580**
Random-wound and form-wound	U_n ≤ 420 V	Standard: $\hat{U}_{LL}$ = 1300 V	-	+ N or CMF	+ N + CMF
	420 V < U_n ≤ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ d*u*/d*t*	+ 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*	+ 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*	+ d*u*/d*t* + N	+ N + d*u*/d*t* + CMF
		Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 microsecond rise time [1)]	-	+ N + CMF	+ N + CMF

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

The abbreviations used in the tables are defined below.

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

Availability of d*u*/d*t* filter and common mode filter by drive type

Product type	Availability of du/dt filter	Availability of common mode filter (CMF)
ACS880-04	Ordered separately, see *du/dt filters (page 295)*	+E208

Additional requirements for explosion-safe (EX) motors

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

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

Use the selection criteria given for non-ABB motors.

Additional requirements for ABB high-output and IP23 motors

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347 (2001).

This table shows the requirements for protecting the motor insulation and bearings in drive systems for ABB random-wound motor series (for example, M3AA, M3AP and M3BP).

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

Additional requirements for non-ABB high-output and IP23 motors

The rated output power of high-output motors is higher than what is stated for the particular frame size in EN 50347 (2001).

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

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

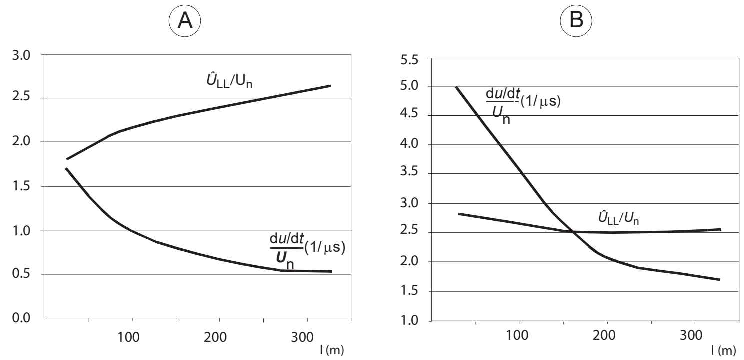
Nominal AC supply voltage	**Requirement for**		
	Motor insulation system	**ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings**	
		P_n < 100 kW or frame size < IEC 315	**100 kW < P_n < 350 kW or IEC 315 < frame size < IEC 400**
		P_n < 134 hp or frame size < NEMA 500	**134 hp < P_n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

[1)] If the intermediate DC circuit voltage of the drive is increased from the nominal level due to long term resistor braking cycles, check with the motor manufacturer if additional output filters are needed 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. If you need to calculate the actual peak voltage and voltage rise time considering the actual cable length, proceed as follows:

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



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

Additional note for sine filters

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

Selecting the power cables

General guidelines

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

- **Current:** Select a cable capable of carrying the maximum load current.
- **Temperature:** For an IEC installation, select a cable rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use. For North America, select a cable rated for at least 75 °C (167 °F).
- **Voltage:** 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. 1000 V AC cable is accepted for up to 690 V AC.

To comply with the EMC requirements of the CE mark, use one of the preferred cable types. See *Preferred power cable types (page 105)*.

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

Metal conduit reduces electromagnetic emission of the whole drive system.

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 of the protective conductor related to the phase conductor size according to IEC/UL 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 grounding 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 ≤ 16	S [1)]
16 < S ≤ 35	16
35 < S	S/2

[1)] To comply with standard IEC/EN 61800-5-1 (UL 61800-5-1)
- use a protective earth conductor with a minimum cross-sectional area of 10 mm^2 Cu or 16 mm^2 Al (as an alternative when aluminum cables are permitted),
  or
- use a second protective earth conductor of the same cross-sectional area as the original protective earth conductor,
  or
- use a device that automatically disconnects the supply if the protective earth conductor is damaged.

If the protective earth conductor is separate (that is, it does not form part of the input power cable or the input power cable enclosure), the minimum cross-sectional area must be:
- 2.5 mm^2 when the conductor is mechanically protected,
  or
- 4 mm^2 when the conductor is not mechanically protected.

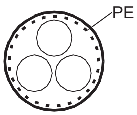
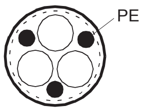
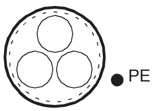
Typical power cable sizes

See the technical data.

Power cable types

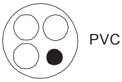
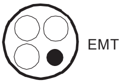
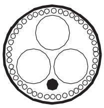
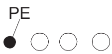
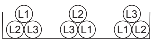
Preferred power cable types

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

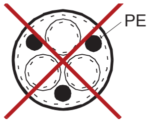
Cable type	Use as input power cabling	Use as motor cabling
 Symmetrical shielded (or armored) cable with three phase conductors and concentric PE conductor as shield (or armor)	Yes	Yes
 Symmetrical shielded (or armored) cable with three phase conductors and symmetrically constructed PE conductor and a shield (or armor)	Yes	Yes
 Symmetrical shielded (or armored) cable with three phase conductors and a shield (or armor), and separate PE conductor/cable [1]	Yes	Yes

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

Alternate power cable types

Cable type	Use as input power cabling	Use as motor cabling
 Four-conductor cabling in PVC conduit or jacket (three phase conductors and PE)	Yes with phase conductor smaller than 10 mm^2 (8 AWG) Cu.	Yes with phase conductor smaller than 10 mm^2 (8 AWG) Cu, or motors up to 30 kW (40 hp). **Note:** Shielded or armored cable, or cabling in metal conduit is always recommended to minimize radio frequency interference.
 Four-conductor cabling in metal conduit (three phase conductors and PE), eg, EMT, or four-conductor armored cable	Yes	Yes with phase conductor smaller than 10 mm^2 (8 AWG) Cu, or motors up to 30 kW (40 hp)
 Well-shielded (Al/Cu shield or armor) four-conductor cable (three phase conductors and a PE)	Yes	Yes with motors up to 100 kW (135 hp). A potential equalization between the frames of motor and driven equipment is required.
 A single-core cable system: three phase conductors and PE conductor on cable tray  Preferable cable arrangement to avoid voltage or current unbalance between the phases	Yes **WARNING!** If you use unshielded single-core cables in an IT network, make sure that the non-conductive outer sheath (jacket) of the cables have good contact with a properly grounded conductive surface. For example, install the cables on a properly grounded cable tray. Otherwise voltage may become present on the non-conductive outer sheath of the cables, and there is even a risk of an electric shock.	No

Not allowed power cable types

Cable type	Use as input power cabling	Use as motor cabling
 Symmetrical shielded cable with individual shields for each phase conductor	No	No

Additional guidelines, North America

ABB recommends the use of conduit for power wiring to the drive and between the drive and the motor(s). Due to the variety of application needs, metallic and non-metallic conduit can be used. ABB recommends the use of metallic conduit.

The following table shows examples of various materials and methods for wiring the drive in the intended application. See NEC 70 along with state and local codes for the appropriate materials for your application.

In all applications, ABB prefers the use of symmetrical shielded VFD cable between drive and motor(s).

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

Wiring method	Notes
Free air[2)]	
Enclosures, air handlers, etc.	Prefer symmetrical shielded VFD cable. Allowed internally in enclosures when in accordance with UL.

1) Metallic conduit may be used as an additional ground path, provided this path is a solid path capable of handling ground currents.

2) See NFPA NEC 70, UL, and local codes for your application.

3) Non-metallic conduit use underground is allowed; however, these installations inherently have an increased chance for nuisance problems due to the potential for water/moisture in the conduit. Water/moisture in the conduit increases the likelihood of VFD faults or warnings. Proper installation is required to make sure there is no intrusion of water/moisture.

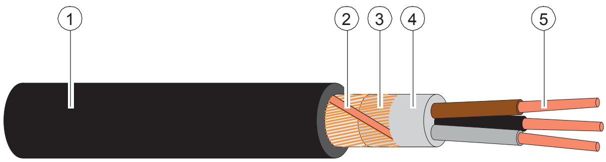
Metal conduit

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

Power cable shield

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

To effectively suppress radiated and conducted radio-frequency emissions, the cable shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminum shield. The minimum requirement of the motor cable shield of the drive is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape or copper wire. The better and tighter the shield, the lower the emission level and bearing currents.



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

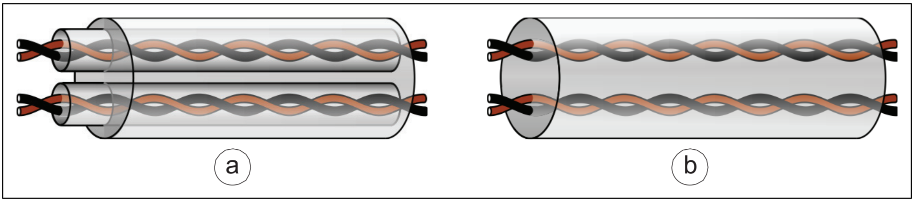
Selecting the control cables

Shielding

Only use shielded control cables.

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

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



Signals in separate cables

Run analog and digital signals in separate, shielded cables. Do not mix 24 V DC and 115/230 V AC signals in the same cable.

Signals that can be run in the same cable

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

Relay cable

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

Control panel to drive cable

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

PC tool cable

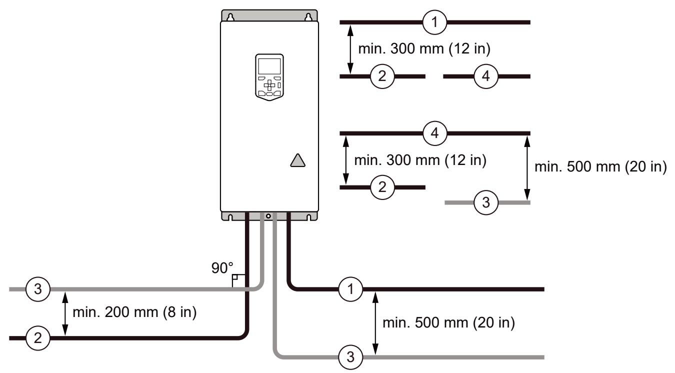
Connect the Drive composer PC tool to the drive through the USB port of the control panel. Use a USB Type A (PC) - Type Mini-B (control panel) cable. The maximum length of the cable is 3 m (9.8 ft).

Routing the cables

General guidelines – IEC

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

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



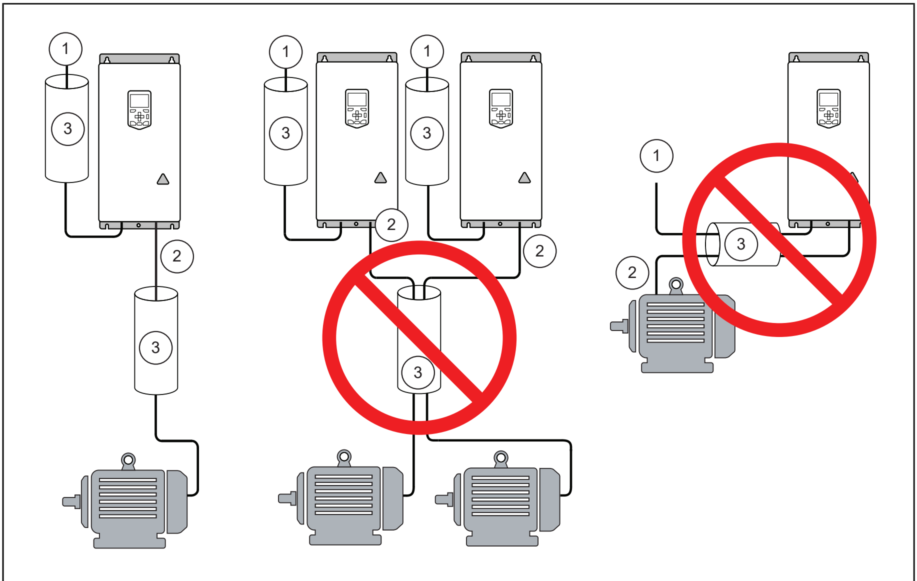
1	Motor cable
2	Input power cable
3	Control cable
4	Brake resistor or chopper cable (if any)

General guidelines – North America

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

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

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



1	Input power cabling
2	Motor cabling
3	Conduit

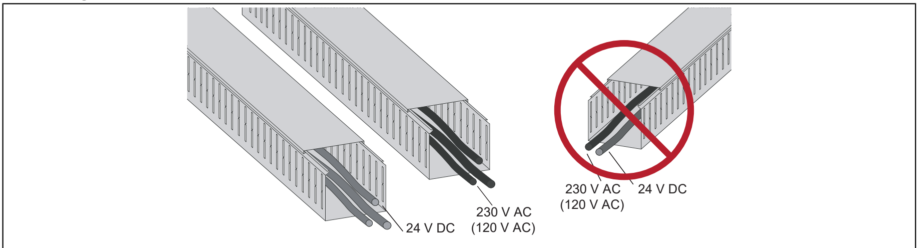
Continuous motor cable shield/conduit or enclosure for equipment on the motor cable

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

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

Separate control cable ducts

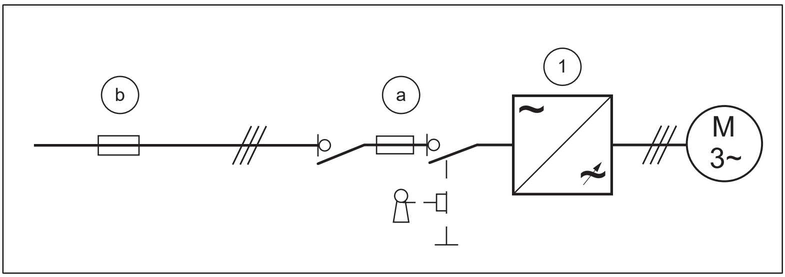
Put 24 V DC and 230 V AC (120 V AC) control cables in separate ducts, unless the 24 V DC cable is insulated for 230 V AC (120 V AC) or insulated with an insulation sleeving for 230 V AC (120 V AC).



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

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

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



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

Note: Circuit breakers must not be used without fuses.

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

Tested circuit breakers

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

Protecting the motor and motor cable in short-circuits

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

Protecting the motor cables against thermal overload

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

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

Protecting the motor against thermal overload

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

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

The most common temperature sensor types are thermal switch (for example Klixon), PTC or Pt100.

For more information, see the firmware manual.

Protecting the motor against overload without thermal model or temperature sensors

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

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

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

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

For more information, see drive firmware manual.

Protecting the drive against ground faults

The drive is equipped with an internal ground fault protective function to protect the unit against ground faults in the motor and motor cable. This function is not a personnel safety or a fire protection feature. See the firmware manual for more information.

Residual current device compatibility

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

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

Connecting drive modules to a common DC system

See *ACS880-01 drives and ACS880-04 drive modules common DC systems application guide* (3AUA0000127818 [English]).

Implementing a motor temperature sensor connection

WARNING!
IEC 60664 and IEC 61800-5-1 require double or reinforced insulation between live parts and accessible parts when:

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

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

You have these implementation alternatives:

1. If there is double or reinforced insulation between the sensor and the live parts of the motor: You can connect the sensor directly to the analog/digital input(s) of the drive. See the control cable connection instructions.
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 input(s) of the drive. All other circuits connected to the digital and analog inputs (typically extra-low voltage circuits) must be:
   - 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: Extra-low voltage circuits (for example, 24 V DC) typically do not meet these requirements.
   As an alternative, you can connect the sensor with basic insulation to the analog/digital input(s) of the drive, if you do not connect any other external control circuits to the drive digital and analog inputs.
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 *Connecting motor temperature sensor to the drive via an option module (page 115)*.
4. You can connect a sensor to a digital input of the drive via an external relay. The sensor and the relay must form a double or reinforced insulation between the motor live parts and the digital input of the drive.

Connecting 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 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
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 option module other than sensor connector must be left unconnected.
FPTC-xx [1]	Reinforced insulation between sensor connector and other connectors (including drive control unit connector).	x	-	-	No special requirement

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

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. Implement the emergency stop according to relevant standards.

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

Implementing the Safe torque off function

See *The Safe torque off function (page 267)*.

Implementing the functions provided by the FSO-xx safety functions module

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

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

The FSO-xx 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-xx.

See the appropriate manual for more information.

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

Using power factor compensation capacitors with the drive

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

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

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

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

Using a safety switch between the drive and the motor

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

Implementing an ATEX-certified motor thermal protection

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

- use an ATEX-certified Ex motor
- order an ATEX-certified thermistor protection module for the drive (option +L357), or acquire and install an ATEX-compliant protection relay
- do the necessary connections.

For more information, see:

User's manual	Manual code (English)
ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (+Q971) application guide	3AUA0000132231
FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual	3AXD50000027782

Implementing the power loss ride-through function

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

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

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

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

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

3. Enable the automatic restart of the motor after a short power supply break:
   - Set the start mode to automatic (parameter *21.01* or *21.19*, depending on the motor control mode being used).
   - Define the automatic restart time (parameter *21.18*).

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

Controlling a contactor between drive and motor

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

If you have the DTC motor control mode and the motor ramp stop mode selected, use this operation sequence to open the contactor:

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

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

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

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

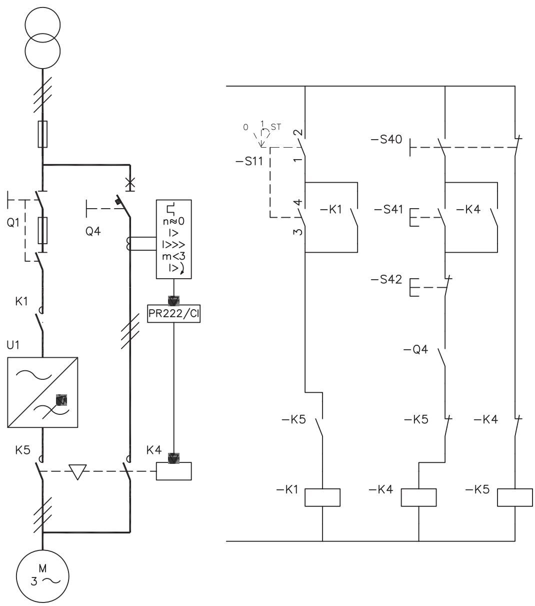
Implementing a bypass connection

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

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

Example bypass connection

An example bypass connection is shown below.



Q1	Drive main switch
Q4	Bypass circuit breaker
K1	Drive main contactor
K4	Bypass contactor
K5	Drive output contactor
S11	Drive main contactor on/off control
S40	Motor power supply selection (drive or direct-on-line)
S41	Start when motor is connected direct-on-line
S42	Stop when motor is connected direct-on-line

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

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

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

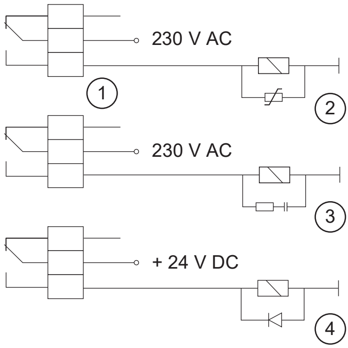
1. Stop the motor with S42.
2. Switch the motor power supply from direct-on-line to the drive with S40.
3. Close the main contactor of the drive with switch S11 (-> turn to position ST for two seconds and leave to position 1).
4. Start the drive and the motor with the drive control panel start key (drive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

Protecting the contacts of relay outputs

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

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

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



1	Relay output
2	Varistor
3	RC filter
4	Diode

8

Electrical installation

Contents of this chapter

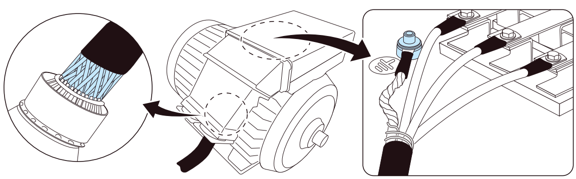
This chapter contains instructions for electrical installation of the drive module. The chapter refers to installation example chapters which contain instructions that depend on the selected drive configuration.

Safety

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

Grounding the motor cable shield at the motor end

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



Measuring the insulation

Measuring the insulation of the drive

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

Measuring the insulation of the input power cable

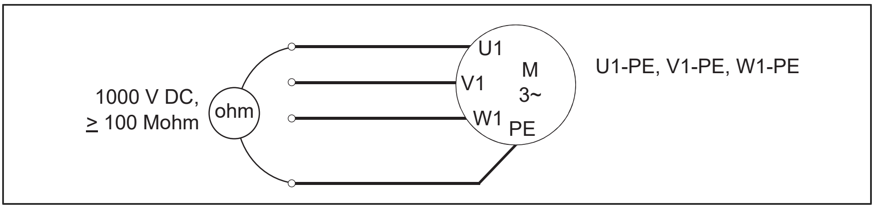
Before you connect the input power cable to the drive, measure its insulation according to local regulations.

Measuring the insulation of the motor and motor cable

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

1. Do the steps in section *Electrical safety precautions (page 20)* before you start the work.
2. Make sure that the motor cable is disconnected from the drive output terminals.
3. Measure the insulation resistance between each phase conductor and the protective earth conductor. Use a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must be more than 100 Mohm (reference value at 25 C [77°F]). For the insulation resistance of other motors, refer to the manufacturer's instructions.

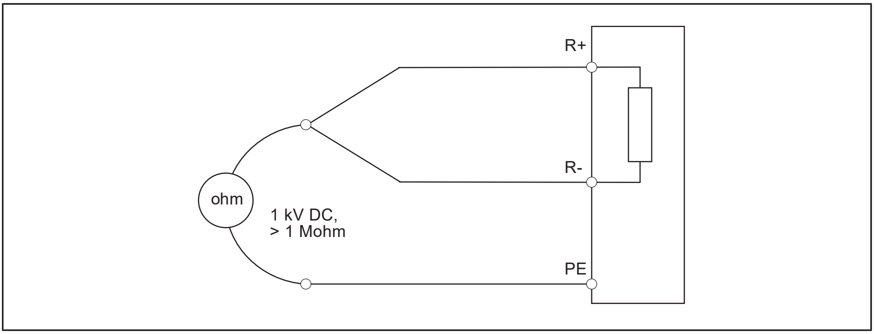
   Note: Moisture inside the motor casing reduces the insulation resistance. If you think that there is moisture in the motor, dry the motor and do the measurement again.



Measuring the insulation of the brake resistor circuit

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 20)* before you start the work.
2. Make sure that the resistor cable is connected to the resistor and disconnected from the drive output terminals.
3. At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the conductors and the PE conductor with a measuring voltage of 1000 V DC. The insulation resistance must be more than 1 Mohm.



Grounding system compatibility check

The standard drive with no EMC filter and 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 EMC filter and ground-to-phase varistor. See *ACS880 frames R1 to R11 EMC filter and ground-to-phase varistor disconnecting instructions* (3AUA0000125152 [English]).

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

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

Corner-grounded and midpoint-grounded 525…690 V delta systems

WARNING!
Do not install the drive on a 525…690 V corner-grounded or midpoint-grounded delta system. Disconnecting the EMC filter and ground-to-phase varistor does not prevent damage to the drive

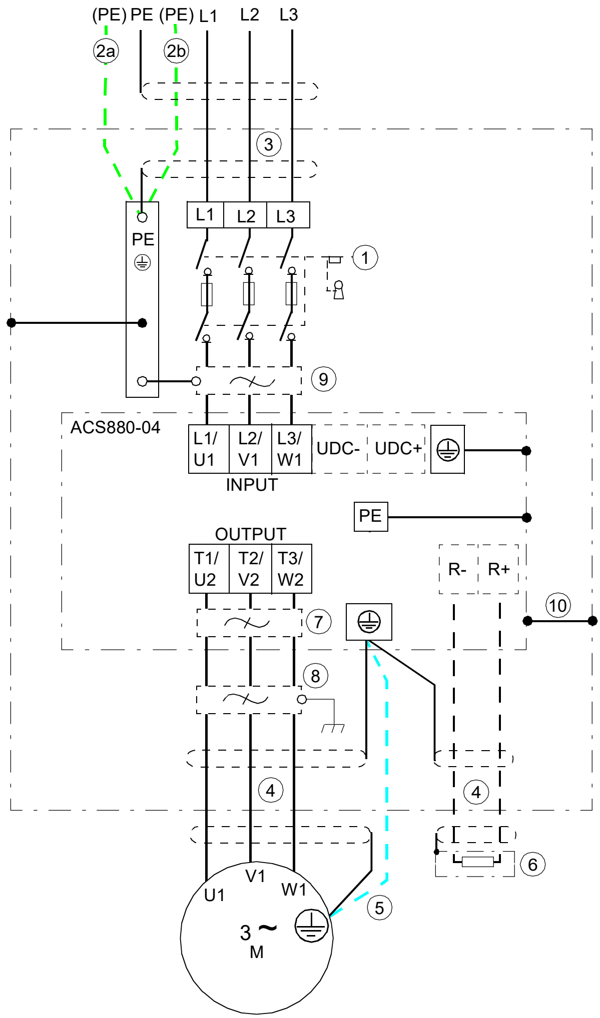
Installing the EMC filter (option +E202)

See *ARFI-10 EMC filter installation guide* (3AFE68317941 [English]).

Connecting the power cables

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

Power cable connection diagram

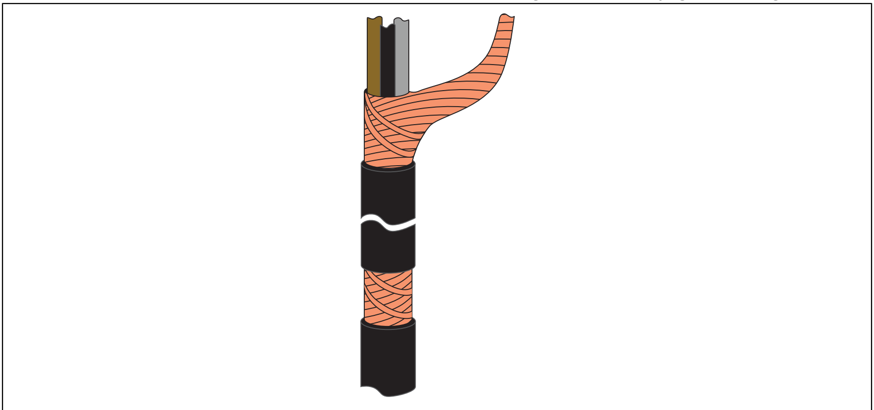


1	Disconnecting device, see *Selecting the main supply disconnecting device (page 95)*. In the installing example of this chapter, the disconnecting device is not in the same cubicle with the drive module.
2	If a shielded cable is used (not required but recommended) and the conductivity of the shield is < 50% of the conductivity of the phase conductor, use a separate PE cable (2a) or a cable with a grounding conductor (2b).

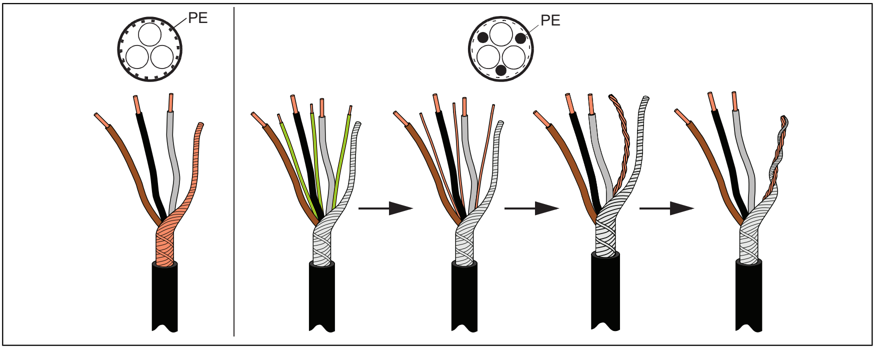
3	ABB recommends 360-degree grounding at the cabinet entry if a shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
4	ABB recommends 360-degree grounding at the cabinet entry, see EMC requirements on page *58*
5	Use a separate grounding cable 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 *Power cable types (page 105)*
6	External brake resistor (optional, see *Resistor braking (page 285)*)
7	Common mode filter (optional, see *Requirements table (page 97)*)
8	d*u*/d*t* filter (optional, see *du/dt filters (page 295)*)
9	EMC filter (option +E202, see section *Installing the EMC filter (option +E202) (page 126)*)
10	The drive module frame must be connected to the cabinet frame, see *Alternatives for grounding the drive module (page 92)*
Note: If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends. Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.	

Preparing the cable ends and making 360-degree grounding at the cable entry

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

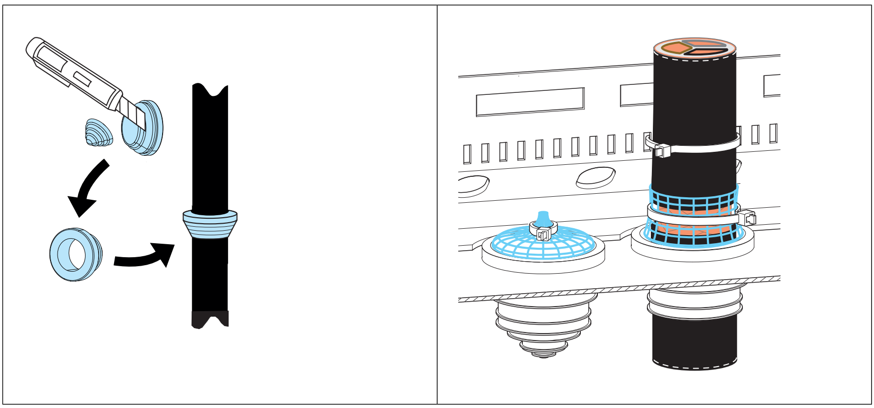


2. Prepare the ends of the cables.



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.

3. If fire insulation is used, make an opening in the mineral wool sheet according to the diameter of the cable.
4. Put the cables through the entry plate.
5. Remove rubber grommets from the entry plate for the cables to be connected. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Slide the cables through the entry plate and attach the grommets to the holes.
6. Attach the conductive sleeves to the cable shields with cable ties. Tie up the unused conductive sleeves with cable ties. An example of bottom entry is shown below. For top entry, place the grommet upwards.



Power cable connection procedure

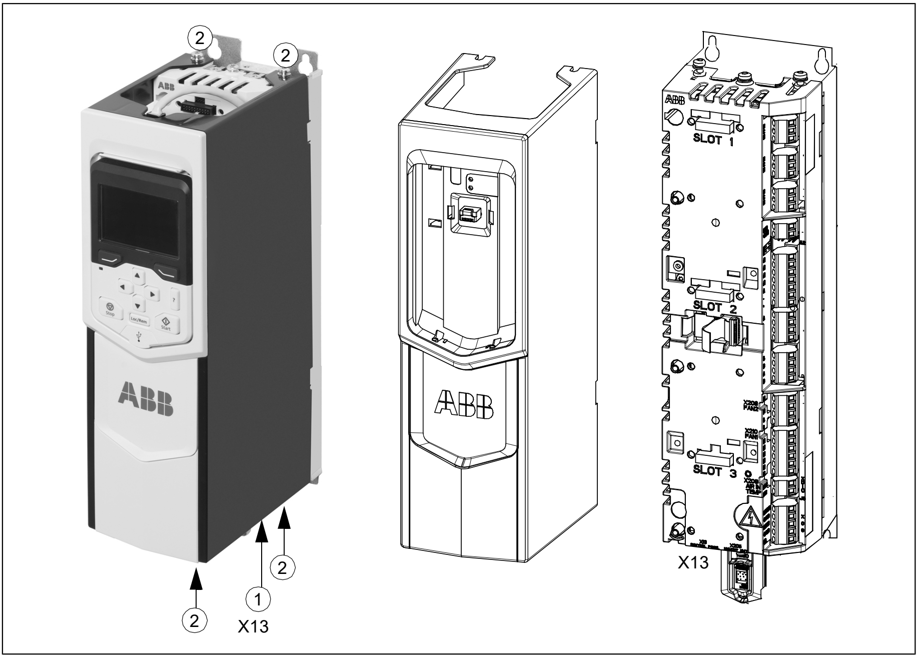
1. Connect the cable shields of the motor cables and any separate ground conductors or cables to the ground terminal of the drive module or to the cabinet ground bar.
2. Connect the phase conductors of the motor cables to terminals T1/U2, T2/V2 and T3/W2 of the drive module. For the tightening torques, see the technical data.
3. Drive modules with option +D150: Connect the brake resistor conductors to the R+ and R- terminals. For the tightening torques, see the technical data.
4. Connect the cable shields of the input cables and any separate ground conductors or cables to the drive module ground terminal or to the cabinet PE busbar.
5. Connect the phase conductors of the input cables to terminals L1/U1, L2/V1 and L3/W1 of the drive module. For the tightening torques, see the technical data.

DC connection

The UDC+ and UDC– terminals are intended for common DC configurations of a number of drives, allowing regenerative energy from one drive to be utilized by the other drives in the motoring mode. See *ACS880-01 drives and ACS880-04 drive modules common DC systems application guide* (3AUA0000127818 [English]).

Removing the control panel holder from the external control unit

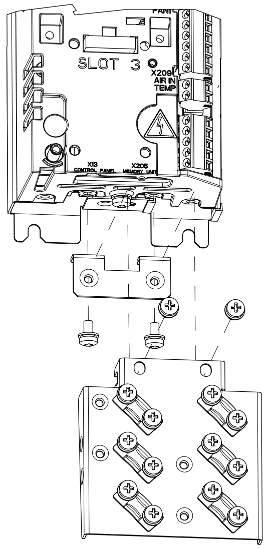
1. Disconnect the control panel cable from connector X13 on the control unit.
2. Loosen the mounting screws of the control panel holder and take the holder off.



Attaching the control cable clamp plate

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

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



Connecting the external control unit to the drive module

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.

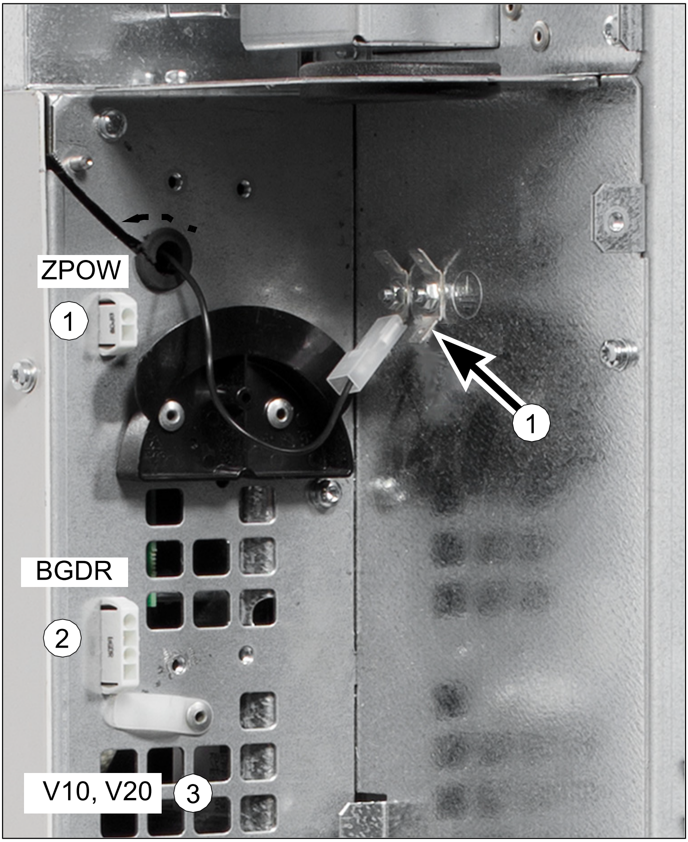
Routing the control unit cables into the drive module

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 (accessories box item 2, see *Package drawings (page 82)*).

Connections to the drive module

1. Connect power supply cable of the control unit to the ZPOW connector and the ground wire of the cable to the ground terminal.
2. Connect the BGDR cable to the BGDR connector.
3. Connect the fiber optic cables to the V20 and V10 connectors.

Secure the cables at the clamps.


ZPOW
1
1
BGDR
2
V10, V20
3

Connections to the control unit

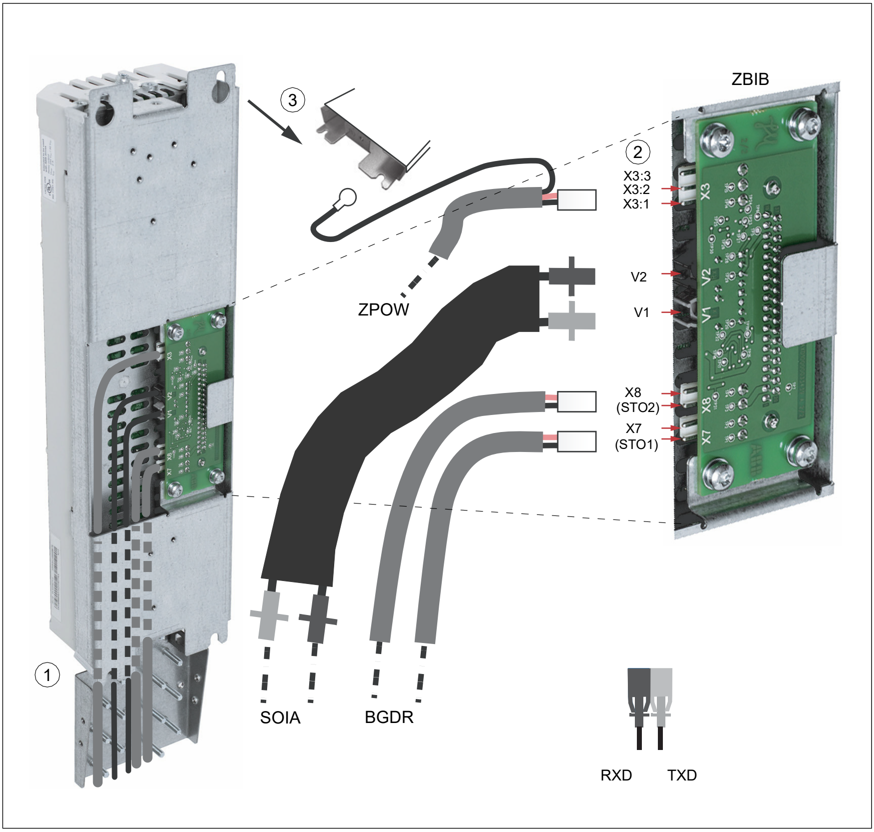
Connect the fiber optic, power supply and BGDR cables to the control unit as follows:

1. Thread the cables inside the back frame of the control unit.
2. Connect the cables to the ZBIB board terminals.

ZPOW	ZBIB
X3:1	X3:1
X3:2	X3:2
X3:3 (not used)	X3:3 (not used)
BGDR	**ZBIB**
X7 (STO1)	X7 (STO1)
X8 (STO2)	X8 (STO2)

SOIA	ZBIB
V10	V1
V20	V2

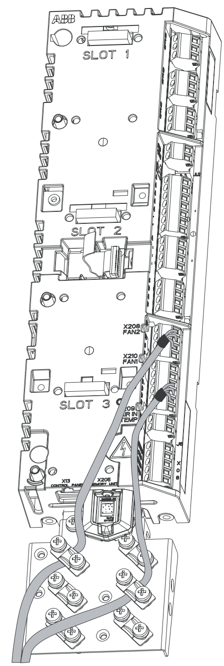
3. Connect the ZPOW cable grounding wire to the grounding terminal at the back top or bottom of the control unit.



RXD = receiver   TXD = transmitter

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

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



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

3. Connect the conductors to the appropriate detachable terminals of the control unit. See the default I/O diagram. Use shrink tubing or insulating tape to contain any strain strands.

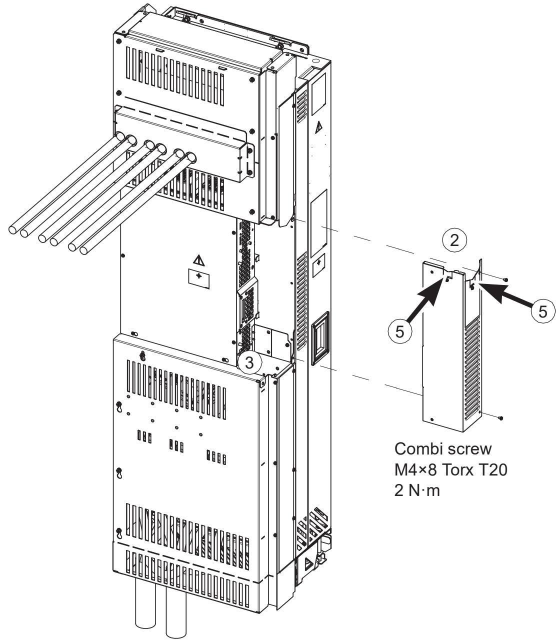
   Note: Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling. Keep the shields continuous as close to the terminals of the control unit as possible.

Connecting the control cables to the integrated 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. Attach the clamp plate to the top of the control unit with two screws from front, see *Attaching the control cable clamp plate (page 131)*.
4. Fasten the optional modules if not attached already.
5. Remove the cover plate from the control cable entry plate 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 to 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 external control unit (page 135)*.
7. Connect the conductors to the appropriate detachable terminals of the control unit (see *Default I/O diagram of the drive control unit (ZCU-1x) (page 149)*). 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.

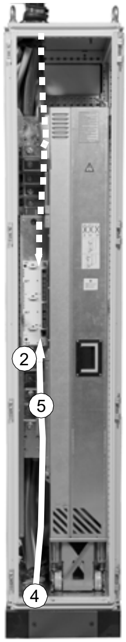


Connecting the control cables to the integrated control unit (options +P905 and +0B051)

1. Remove the middle front cover of the drive module.
2. Attach the clamp plate to the control unit with two screws from front, see *Attaching the control cable clamp plate (page 131)*.
3. Attach the optional modules if not fastened already.
4. Put 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 external control unit (page 135)*.
8. Connect the conductors to the appropriate detachable terminals of the control unit (see *Default I/O diagram of the drive control unit (ZCU-1x) (page 149)*). Use shrink

tubing or insulating tape to contain any stray strands. Tighten the screws to secure the connection.

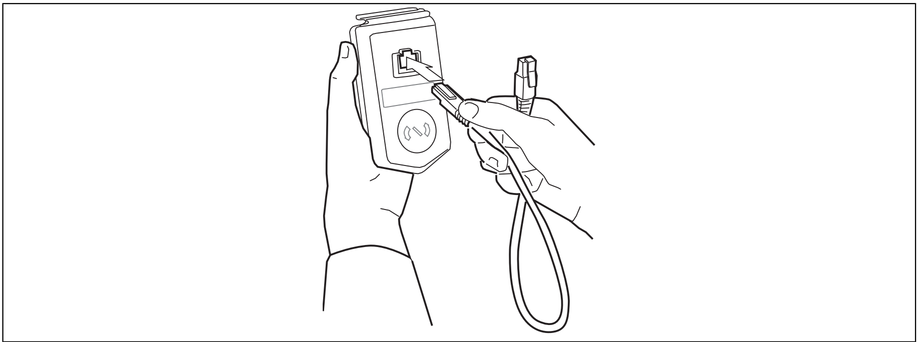
Note: Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.



Connecting a control panel

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

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



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

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

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

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

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

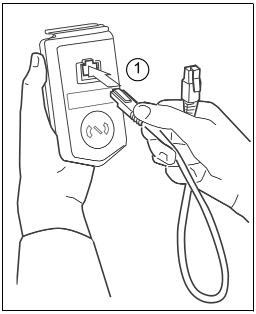
   *The parameter group is 149 with supply (line-side), brake or DC/DC converter units.
   Repeat the above for each drive.
2. With the panel connected to one unit, link the units using Ethernet cables.
3. Switch on the bus termination on the drive that is farthest from the control panel in the chain.
   - With drives that have the panel mounted on the front cover, move the terminating switch into the outer position.
   - With an FDPI-02 module, move termination switch S2 into the TERMINATED position.

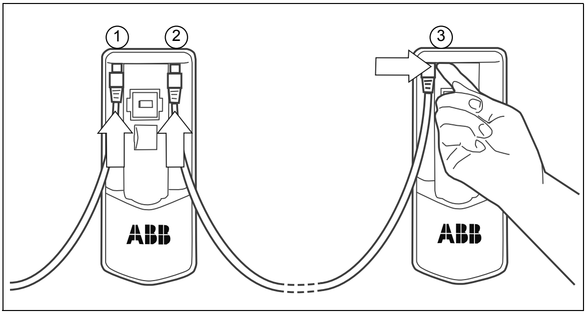
   Make sure that bus termination is off on all other drives.

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

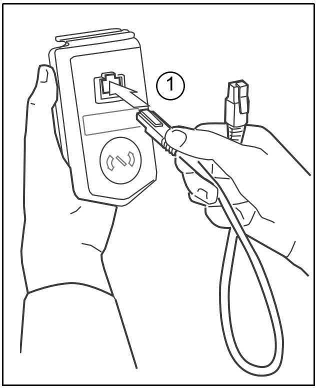
If a PC is connected to the control panel, the drives on the panel bus are automatically displayed in the Drive composer tool.

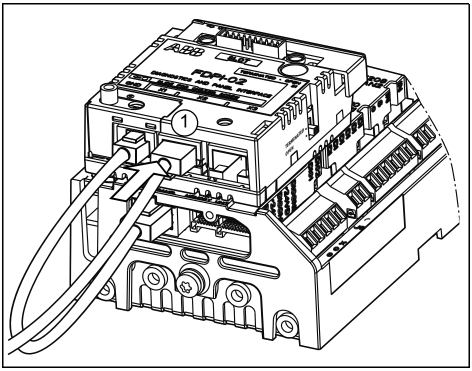
With twin connectors in the control panel holder:

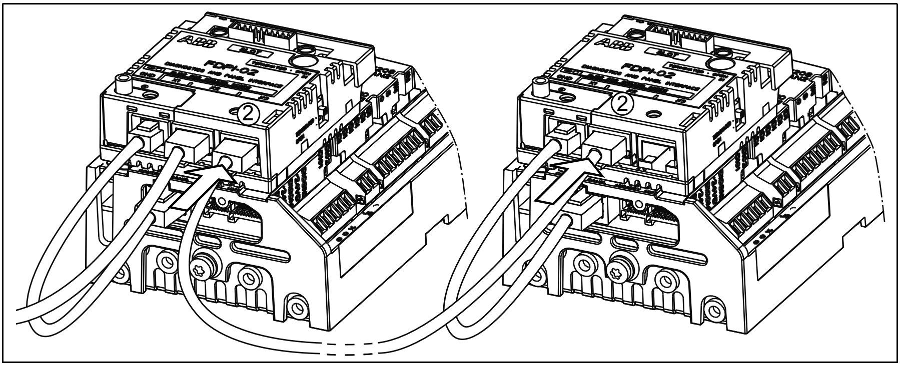


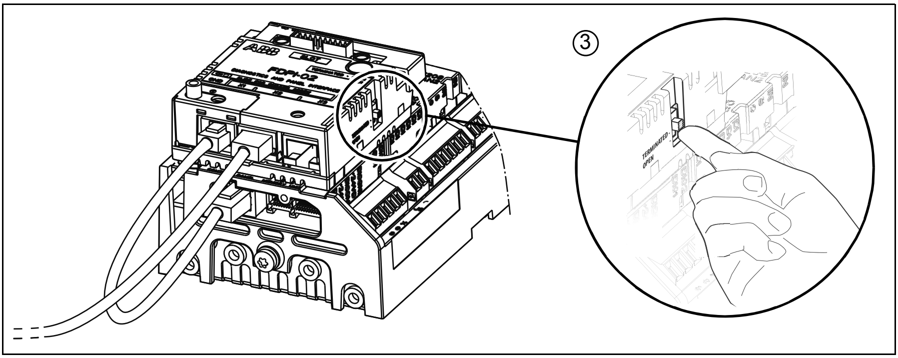


With FDPI-02 modules:







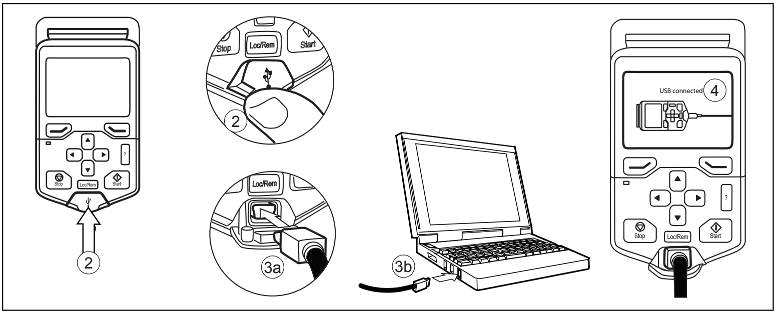


Connecting a PC

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

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

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



Installing option modules

Installing the FSO-xx safety functions module

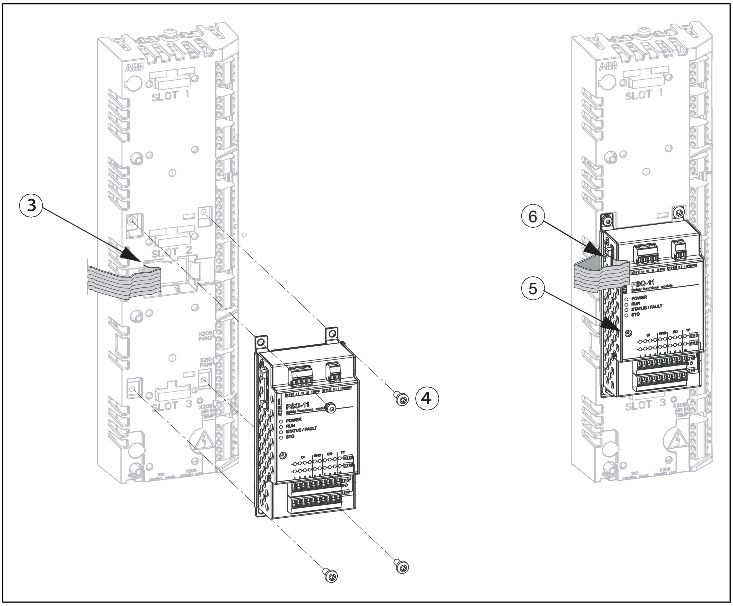
Install the FSO safety functions module in Slot 2 of the control unit as described below.

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 20)* before you start the work.

2. If the bottom plate of the FSO-xx module looks different from that in the drawing below, remove the bottom plate and attach the alternative bottom plate from the FSO package to module.
3. Connect the FSO-xx data cable to connector X12 on the control unit.
4. Attach the FSO-xx module to Slot 2 with four screws.
5. Tighten the FSO module electronics grounding screw to 0.8 N·m. Note: The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.
6. Connect the FSO-xx data cable to FSO-xx connector X110.
7. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.
8. Connect the external +24 V power supply cable to connector X112.
9. Connect the other wires as shown in *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

Installation on the external control unit



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

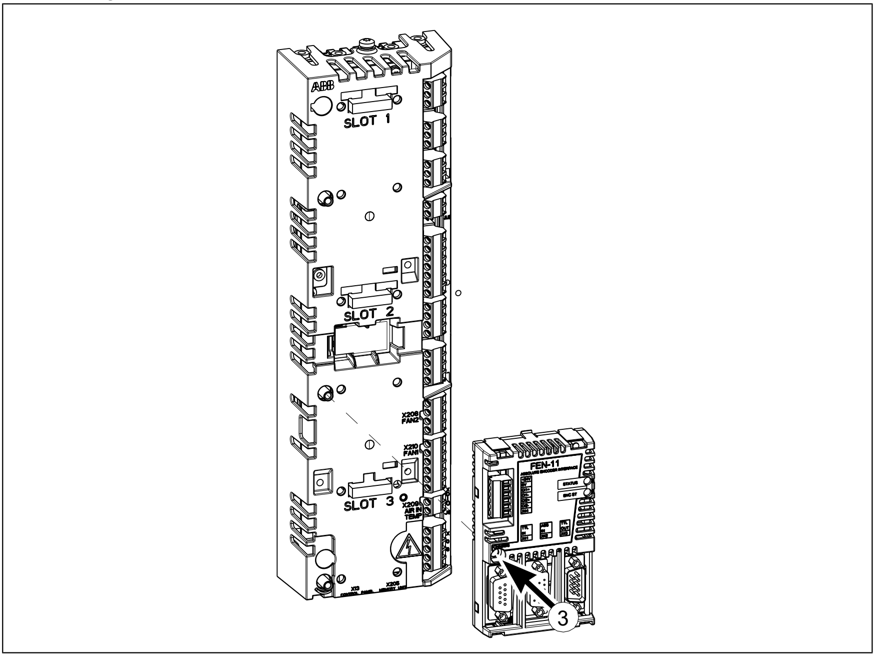
See section *Overview of power and control connections* for the available slots for each module.

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

---

1. Stop the drive and do the steps in section *Electrical safety precautions (page 20)* before you start work.
2. Insert the module carefully into its position on the control unit.
3. Tighten the grounding screw torque of 0.8 N·m.

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



Wiring the option modules

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

9

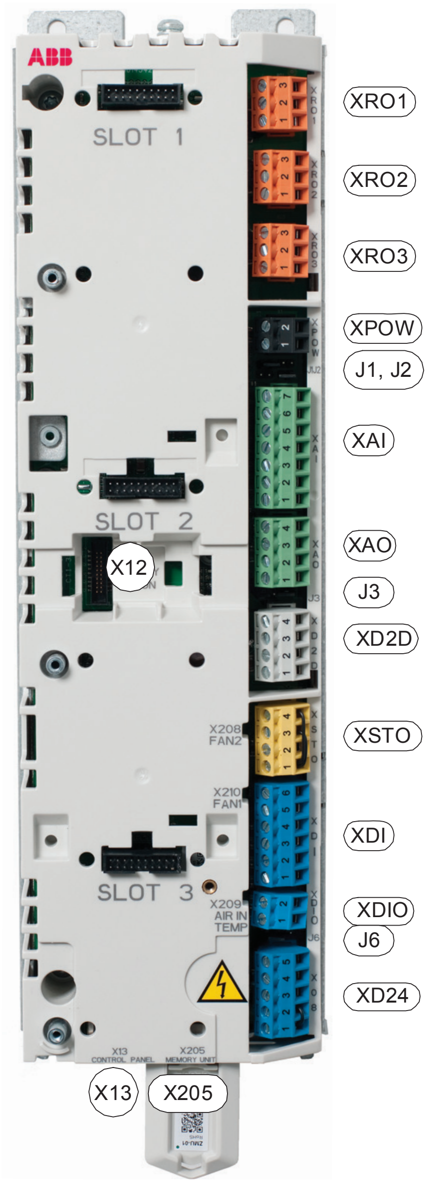
Control unit

Contents of this chapter

This chapter

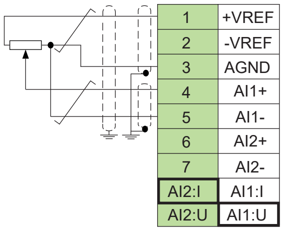
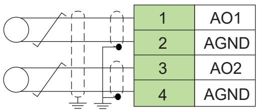
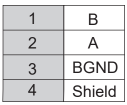
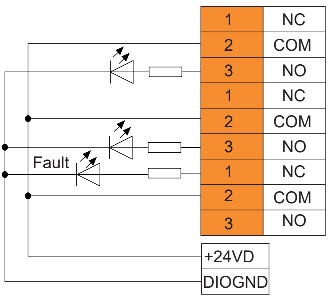
- describes the connections of the control unit(s) used in the drive,
- contains the specifications of the inputs and outputs of the control unit(s).

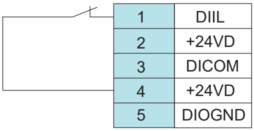
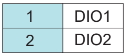
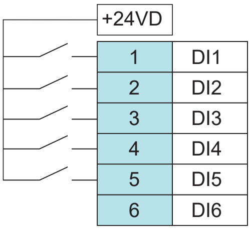
ZCU-14 layout



	Description
XPOW	External power input
XAI	Analog inputs
XAO	Analog outputs
XD2D	Drive-to-drive link
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XD24	Digital input interlock (DIIL) and +24 V output
XDIO	Digital input/outputs
XDI	Digital inputs
XSTO	Safe torque off connection (inverter unit only). **Note:** This connection only acts as a true Safe torque off input when the ZCU is controlling an inverter unit. When the ZCU is controlling a supply unit, de-energizing the inputs will stop the unit but will not constitute a true safety function.
X12	Connection for FSO-xx safety functions module (inverter unit only).
X13	Control panel connection
X202	Option slot 1
X203	Option slot 2
X204	Option slot 3
X205	Memory unit connection (memory unit inserted in the drawing)
J1, J2	Voltage/Current selection jumpers (J1, J2) for analog inputs
J3	Drive-to-drive link termination switch (J3)
J6	Common digital input ground selection jumper (J6).

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

Connection	Term	Description
XPOW External power input		
	+24VI	24 V DC, 2 A min. (without optional modules)
	GND	
J1, J2, XAI Reference voltage and analog inputs		
	+VREF	10 V DC, R_L 1…10 kohm
	-VREF	-10 V DC, R_L 1…10 kohm
	AGND	Ground
	AI1+	**Speed reference**
	AI1-	0(2)…10 V, R_{in} > 200 kohm [1)] selected by switch AI1.
	AI2+	By default not in use.
	AI2-	0(4)…20 mA, R_{in} = 100 ohm [2)]
	AI1: I	AI1/AI2 current/voltage selection
	AI1: U	
XAO Analog outputs		
	AO1	**Motor speed rpm**
	AGND	0…20 mA, R_L < 500 ohm
	AO2	**Motor current**
	AGND	0…20 mA, R_L < 500 ohm
XD2D Drive-to-drive link		
	B	Master/follower, drive-to-drive or embedded fieldbus connection [3)]
	A	
	BGND	
	Shield	
	J3	Drive-to-drive link termination [3)]
XRO1, XRO2, XRO3 Relay outputs		
	NC	**Ready run** 250 V AC / 30 V DC 2 A
	COM	
	NO	
	NC	**Running** 250 V AC / 30 V DC 2 A
	COM	
	NO	
	NC	**Fault (-1)** 250 V AC / 30 V DC 2 A
	COM	
	NO	

Connection	Term	Description
XD24 Auxiliary voltage output, digital interlock [4]		
	DIIL	Run enable [4]
	+24VD	+24 V DC 200 mA
	DICOM	Digital input ground
	+24VD	+24 V DC 200 mA [5]
	DIOGND	Digital input/output ground
XDIO Digital input/outputs		
	DIO1	Output: Ready run
	DIO2	Output: Running
	J6	Ground selection [6]
XDI Digital inputs		
	DI1	Stop (0) / Start (1)
	DI2	Forward (0) / Reverse (1)
	DI3	Reset
	DI4	Acc/Dec time select [7]
	DI5	Constant speed 1 (1 = On) [8]
	DI6	By default, not in use.
XSTO	Safe torque off circuits must be closed for the drive to start. [9]	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

1) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected by switch AI1. 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 switch AI2. Change of setting requires reboot of control unit.

3) See section *The XD2D connector (page 152)*

4) See section *DIIL input (page 152)*.

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

6) Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats; in practice, selects whether the digital inputs are used in current sinking or sourcing mode). See also *ZCU-1x ground isolation diagram (page 156)*. DICOM=DIOGND ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.

7) 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.

8) Constant speed 1 is defined by parameter *22.26*.

9) See chapter *The Safe torque off function (page 267)*.

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

Additional information on the connections

External power supply for the control unit (XPOW)

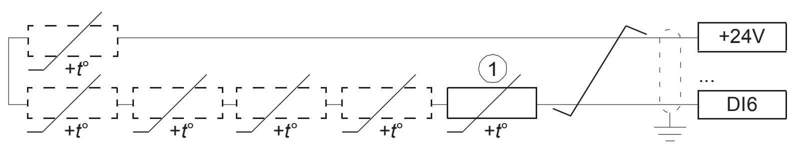
The control unit is powered from a 24 V DC, 2 A supply through terminal block XPOW.

Using an external supply is recommended if

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

DI6 as a PTC sensor input

PTC sensors can be connected to this input for motor temperature measurement as follows. The sensor can alternatively be connected to FEN-xx encoder interface module. At the sensor end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, for example 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points. See the firmware manual of the inverter unit for parameter settings.



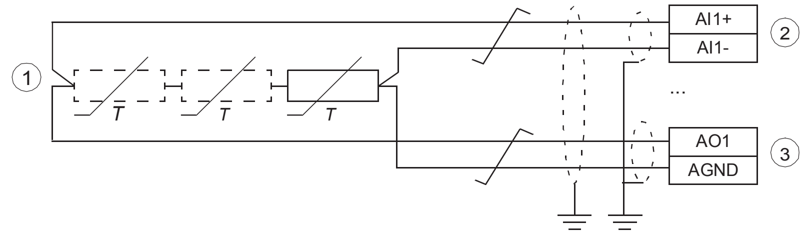
1	One to six PTC thermistors connected in series

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.

AI1 or AI2 as a Pt100, Pt1000, PTC or KTY84 sensor input

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

3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.



1	One, two or three Pt100, Pt1000 or PTC sensors; or one KTY84 sensor
2	Set the input type to voltage with the appropriate switch or jumper on the control unit. Make the corresponding setting in the control program in parameter group *12 Standard AI*.
3	Select the excitation mode in parameter group *13 Standard AO*.

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

DIIL input

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

Note: This input is NOT SIL or Pl certified.

The XD2D connector

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

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

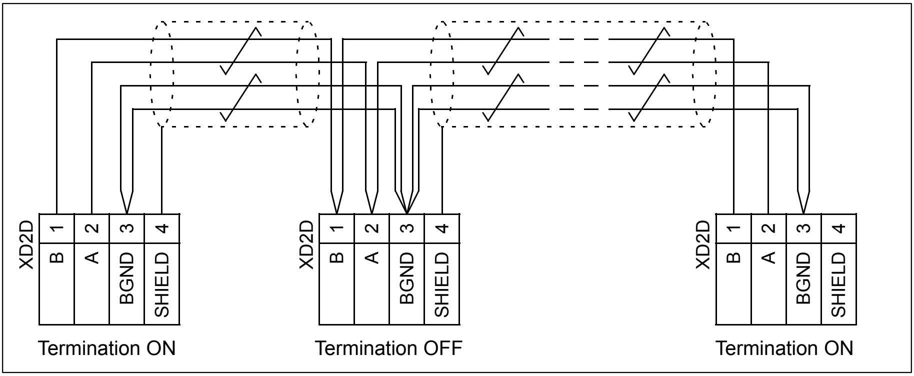
See the firmware manual of the drive for the related parameter settings.

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

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

The following diagram shows the wiring between control units.

ZCU-14



Safe torque off (XSTO)

See chapter *The Safe torque off function (page 267)*.

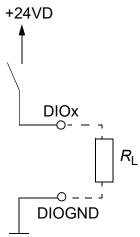
Note: The XSTO input only acts as a true Safe torque off input on the inverter control unit. De-energizing the IN1 and/or IN2 terminals of other units (supply, DC/DC converter, or brake unit) will stop the unit but not constitute a true safety function.

FSO-xx safety functions module connection (X12)

See the user manual of the FSO-xx module.

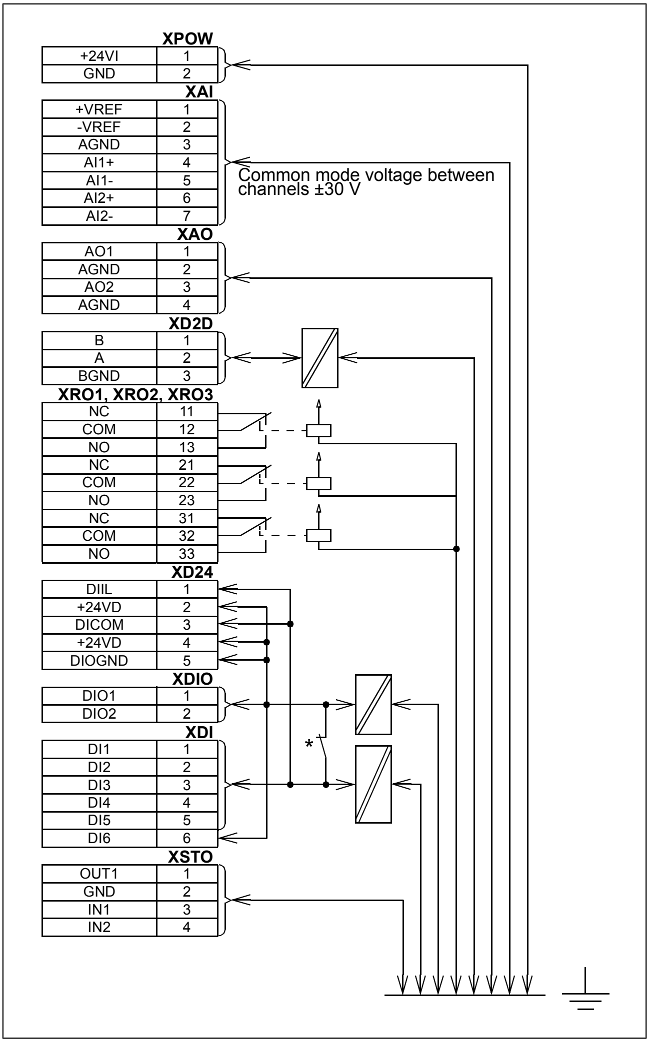
Connector data

This data applies also to integrated control unit (option +P905) connectors.

Power supply (XPOW)	Connector pitch 5 mm, wire size 2.5 mm^2 24 V (±10%) DC, 2 A External power input.
Relay outputs RO1…RO3 (XRO1…XRO3)	Connector pitch 5 mm, wire size 2.5 mm^2 250 V AC / 30 V DC, 2 A Protected by varistors
+24 V output (XD24:2 and XD24:4)	Connector pitch 5 mm, wire size 2.5 mm^2 Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
Digital inputs DI1…DI6 (XDI:1…XDI:6)	Connector pitch 5 mm, wire size 2.5 mm^2 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 a PTC sensor. “0” > 4 kohm, “1” < 1.5 kohm. I_{max}: 15 mA (DI1…DI5), 5 mA (DI6)
Start interlock input DIIL (XD24:1)	Connector pitch 5 mm, wire size 2.5 mm^2 24 V logic levels: “0” < 5 V, “1” > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP Hardware filtering: 0.04 ms, digital filtering up to 8 ms
Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2) Input/output mode selection by parameters. DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual, parameter group 111/11.	Connector pitch 5 mm, wire size 2.5 mm^2 <u>As inputs:</u> 24 V logic levels: “0” < 5 V, “1” > 15 V. R_{in}: 2.0 kohm. Filtering: 1 ms. <u>As outputs:</u> Total output current from +24VD is limited to 200 mA 
Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)	Connector pitch 5 mm, wire size 2.5 mm^2 10 V ±1% and –10 V ±1%, R_{load} 1…10 kohm Maximum output current: 10 mA

Analog inputs AI1 and AI2 (XAI:4 … XAI:7). Current/voltage input mode selection by jumpers	Connector pitch 5 mm, wire size 2.5 mm^2 Current input: –20…20 mA, R_{in} = 100 ohm Voltage input: –10…10 V, R_{in} > 200 kohm Differential inputs, common mode range ±30 V Sampling interval per channel: 0.25 ms Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range
Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm, wire size 2.5 mm^2 0…20 mA, R_{load} < 500 ohm Frequency range: 0…300 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
XD2D connector	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485 Transmission rate: 8 Mbit/s Cable type: Shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 … 165 ohm, for example Belden 9842) Maximum length of link: 50 m (164 ft) Termination by jumper
Safe torque off connection (XSTO)	Connector pitch 5 mm, wire size 2.5 mm^2 Input voltage range: -3…30 V DC Logic levels: “0” < 5 V, “1” > 17 V. **Note:** For the unit to start, both connections must be “1”. This applies to all control units (including drive, inverter, supply, brake, DC/DC converter etc. control units), but true Safe torque off functionality is only achieved through the XSTO connector of the drive/inverter control unit. EMC (immunity) according to IEC 61326-3-1
Control panel connection (X13)	Connector: RJ-45 Cable length < 3 m
The terminals of the control unit fulfill the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if a voltage higher than 48 V is connected to the relay output.	

ZCU-1x ground isolation diagram



* Ground selector (J6) settings

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

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

10

Installation example of the standard drive module configuration

Contents of this chapter

In this chapter, the drive module is installed in a 600 mm wide Rittal VX25 enclosure in a bookshelf way of mounting. The module is placed in an upright position on the enclosure bottom with its front facing the enclosure door. Available alternative ABB parts are also given.

Limitation of liability

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

Safety

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

Required parts

Drive module standard parts		
• Drive module • Fastening bracket • Pedestal guide plate • Telescopic extraction and insertion ramp • Fastening screws and insulators in a plastic bag • External control unit		
Rittal parts / Alternative ABB parts		
Rittal part code	**Qty (pcs)**	**Description**
VX 8606.000	1	Enclosure without mounting plate, bottom plates and side panels.
DK 7967.000 (one set = four pieces) ABB 3AUA0000117003 (IP20) ABB 3AUA0000117008 (IP42)	1	Spacers for roof plates. / ABB roof **Note:** For alternative ABB outlet kits, see section *Air outlet kits (page 208)*.
VX 8617.030	5	Punched section with mounting flange, outer mounting level for 600 mm horizontal
TS 4396.500		Support rails
SK 3243.200 / ABB 3AUA0000117003 (IP20) ABB 3AUA0000117008 (IP42)	4 / 2	Air filter 323 mm × 323 mm. Remove the filter mats. **Note:** For alternative ABB air filters, see section *Air inlet kits (page 206)*.
Customer-made parts (not ABB or Rittal products)		
Air baffles	2	See section *Preventing the recirculation of hot air (page 57)*.

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 into the enclosure (page 159)* and installation drawings
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 (page 57)*
3	Attach the drive module to the enclosure	*Step-by-step drawings for an installation example of standard drive configuration with option +E208 in Rittal VX25 600 mm wide enclosure (page 299)*
4	Connect the power cables and install the clear plastic shrouds to the drive module	*Connecting the power cables and installing the shrouds (page 160)*
5	Install the external control unit	*Attaching the external control unit (page 90)*
6	Connect the control cables	*Connecting the control cables to the terminals of the external control unit (page 135)*
7	Install the remaining parts, for example enclosure doors, side plates, etc.	The component manufacturer's instructions *Installing the roof and door (Rittal parts) (page 162)*

Installing the drive module into the enclosure

See a video of the installation at YouTube:

http://www.youtube.com/watch?v=IhKOSx3HmzQ

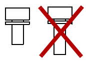
See *Step-by-step drawings for an installation example of standard drive configuration with option +E208 in Rittal VX25 600 mm wide enclosure (page 299)* and *ACS880-04 quick installation guide* (3AXD50000009366 [English]).

- Install the punched section to the back of the enclosure frame.
- Install the bottom grille to the drive module for IP20 degree of protection from bottom if there is no leak-proof bottom plate in the enclosure.
- Install the support rails and pedestal guide plate to the enclosure bottom frame.
- Install the telescopic insertion ramp to the pedestal guide plate.
- Remove the sheeting from the clear plastic shrouds from both sides.
- Install the top metallic shroud to the drive module.
- Install the back shrouds to the drive module.

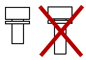
- To prevent the drive module from falling, attach its lifting lugs with chains to the enclosure frame.
- Push the drive module carefully into the enclosure along the telescopic insertion ramp.
- Remove the ramp.
- Attach the drive module to the pedestal guide plate.
- Attach the drive module from top to the punched section at the enclosure back.

  Note: The fastening bracket grounds the drive module to the enclosure frame.
- Install the air baffles.

Connecting the power cables and installing the shrouds

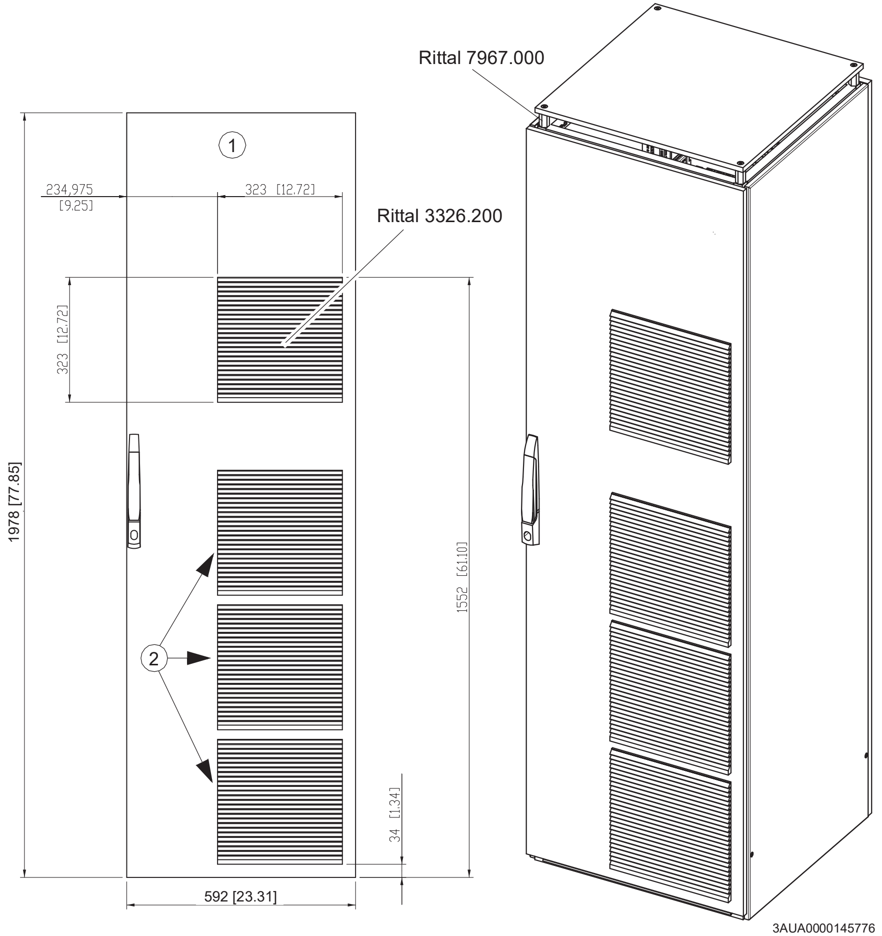
Step	Task (motor cables)
1	Install the grounding terminal to the drive module base.
2	Run the motor cables to the enclosure. Ground the cable shields 360 degrees at the enclosure entry.
3	Connect the twisted shields of the motor cables to the grounding terminal.
4	Screw in and tighten the insulators to the drive module by hand. Install the T3/W2 connection terminal to the insulators. **WARNING!** Do not use longer screws or bigger tightening torque than given in the installation drawing. They can damage the insulator and cause dangerous voltage to be present at the module frame. 
5	Connect the phase T3/W2 conductors to the T3/W2 terminal.
6	Install the T2/V2 connection terminal to the insulators. See the warning in step 4.
7	Connect the phase T2/V2 conductors to the T2/V2 connection terminal.
8	Install the T1/U2 connection terminal to the insulators. See the warning in step 4.
9	Connect the phase T1/U2 conductors to the T1/U2 terminal.
10	Remove the plastic sheeting from the 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 enclosure entry.
2	Connect the twisted shields of the input cables and separate ground cable (if present) to the enclosure grounding busbar.

3	Step drill carefully sufficiently big holes to the entry clear plastic shroud for the cables to be connected. Align the holes in the vertical direction according to the alignment holes in the shroud. Smooth the hole edges. Remove the plastic sheeting from both sides of the shroud. Attach the cables firmly to the enclosure frame to prevent chafing against the hole edges.
4	Put the conductors of the input cables through the drilled holes in the clear plastic shroud.
5	For drive modules without option +H370: Connect the input cable conductors to the drive module L1/U1, L2/V1 and L3/W1 connection busbars, Go to step 12.
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 6.
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 6.
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.
13	Install the side and top clear plastic shrouds to the drive module.

Installing the roof and door (Rittal parts)

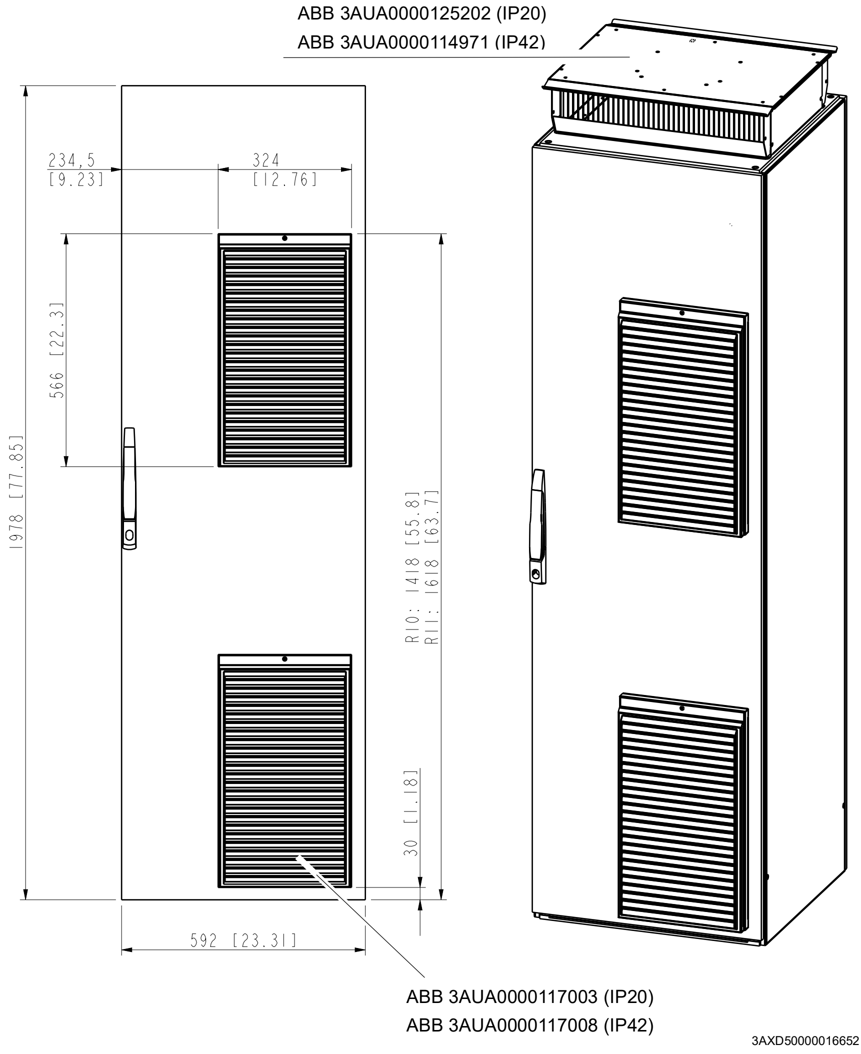
This drawing shows a layout tested by ABB.



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

Installing the roof and door (ABB air filters and roof)

This drawing shows a layout tested by ABB.



Removing the protective covering from the drive module air outlet

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

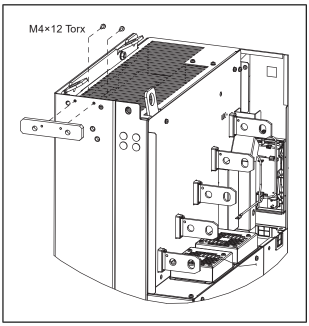
Miscellaneous

Input power cable entry from top

If you run the input cables from top to the drive module, drill the entry holes to the top clear plastic shroud.

Attaching the drive module to a mounting plate

Use the assembly support if you attach the drive module directly to the cabinet back plate. The support prevents the drive module screws from chafing the plate.



11

Installation example with full cabling panels (option +H381)

Contents of this chapter

In this chapter, the drive module is installed in a 400 mm wide Rittal VX25 enclosure in a bookshelf way of mounting. The module is placed in an upright position on the enclosure bottom with its front facing the enclosure door. Space for the additional components can be made by connecting two or more VX25 enclosures together. Available alternative ABB parts are also given.

Limitation of liability

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

Safety

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

Required parts

Drive module standard parts		
• Drive module • Top guide plate • Fastening bracket • Grounding busbar • Pedestal guide plate • 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
+P905	1	integrated control unit (inside the drive module)
Rittal parts / Alternative ABB parts		
Rittal part code	**Qty (pcs)**	**Description**
VX 8406.000	1	Enclosure without mounting plate, bottom plates and side panels
VX 8106.245	1	Side panels for the enclosure
DK 7967.000 (one set = four pieces) ABB 3AUA0000125201 (IP20) ABB 3AUA0000114967 (IP42)	1	Spacers for roof plate / ABB roof **Note:** For alternative ABB outlet kits, see section *Air outlet kits (page 208)*.
VX 8617.030	5	Punched section with mounting flange, outer mounting level for 600 mm horizontal
VX 8617.010	3	Punched section with mounting flange, outer mounting level for 400 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. **Note:** For alternative ABB air filters, see section *Air inlet kits (page 206)*.
TS 4396.500	3	Support rail (alternative to a customer-made bottom plate)
Customer-made parts (not ABB or Rittal products)		
Dimension drawing code	**Qty (pcs)**	**Description**
3AXD50000437368	2	Air baffles See section *Air baffles for option +H381 in Rittal VX25 400 mm wide enclosure installation (page 260)* for the dimension drawings of the air baffles required in the cabinet

3AXD50000433988	1	Cabinet bottom plate (alternative to Rittal support rails) See section *Bottom plate for option +H381 in Rittal VX25 400 mm wide enclosure installation (page 257)* 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 enclosure	*Installing the mechanical accessories into the enclosure (page 167)* and *Step-by-step drawings for installing full cabling panels (option +H381) in a Rittal 400 mm wide enclosure (page 305)*
2	Connect the power cables to the cabling panels	*Connecting the power cables (page 168)*
3	Install the drive module into the enclosure	*Installing the drive module into the enclosure (page 172)*
4	Install the external control unit	*Attaching the external control unit (page 90)*
5	Connect the control cables	*Connecting the control cables to the terminals of the external control unit (page 135)*
6	Install the remaining parts, for example enclosure doors, side plates, air baffles, etc.	The component manufacturer's instructions *Air baffles for option +H381 in Rittal VX25 400 mm wide enclosure installation (page 260)*

Installing the mechanical accessories into the enclosure

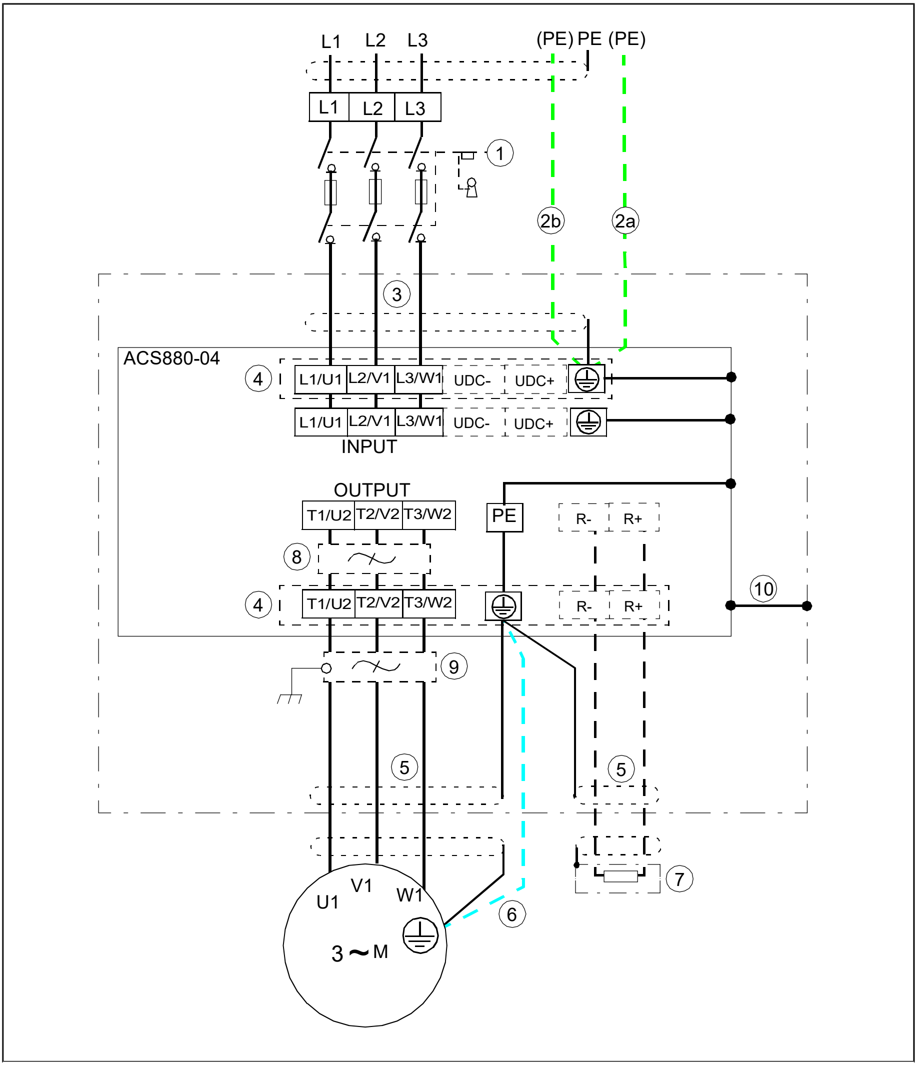
Install the mechanical accessories into the enclosure as shown in *Step-by-step drawings for installing full cabling panels (option +H381) in a Rittal 400 mm wide enclosure (page 305)*

If you do not use Rittal support rails on the bottom of the enclosure but make an own bottom plate instead, see chapter *Dimension drawings* for the correct dimensions of the bottom plate.

Note: If the thickness of the bottom plate is not 2.5 mm (0.1 in), adjust the dimensions accordingly.

Connecting the power cables

Power cable connection diagram



1	For alternatives, see section *Selecting the main supply disconnecting device (page 95)*. In the installing example of this chapter, the disconnecting device is not in the same cubicle with the drive module.
2	If a shielded cable is used (not required but recommended) and the conductivity of the shield is < 50% of the conductivity of the phase conductor, use a separate PE cable (2a) or a cable with a grounding conductor (2b).
3	ABB recommends 360-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	ABB recommends 360-degree grounding at the cabinet entry, see *EMC requirements (page 58)*
6	Use a separate grounding cable if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor and there is no symmetrically constructed grounding conductor in the cable, see section *Power cable types (page 105)*.
7	External brake resistor (optional, see *Resistor braking (page 285)*)
8	Common mode filter (optional, see *Requirements table (page 97)*)
9	d*u*/d*t* filter (optional, see *du/dt filters (page 295)*)
10	The drive module frame must be connected to the cabinet frame. See sections *Grounding of mounting structures (page 54)* and *Alternatives for grounding the drive module (page 92)*.
Note: If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends. Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.	

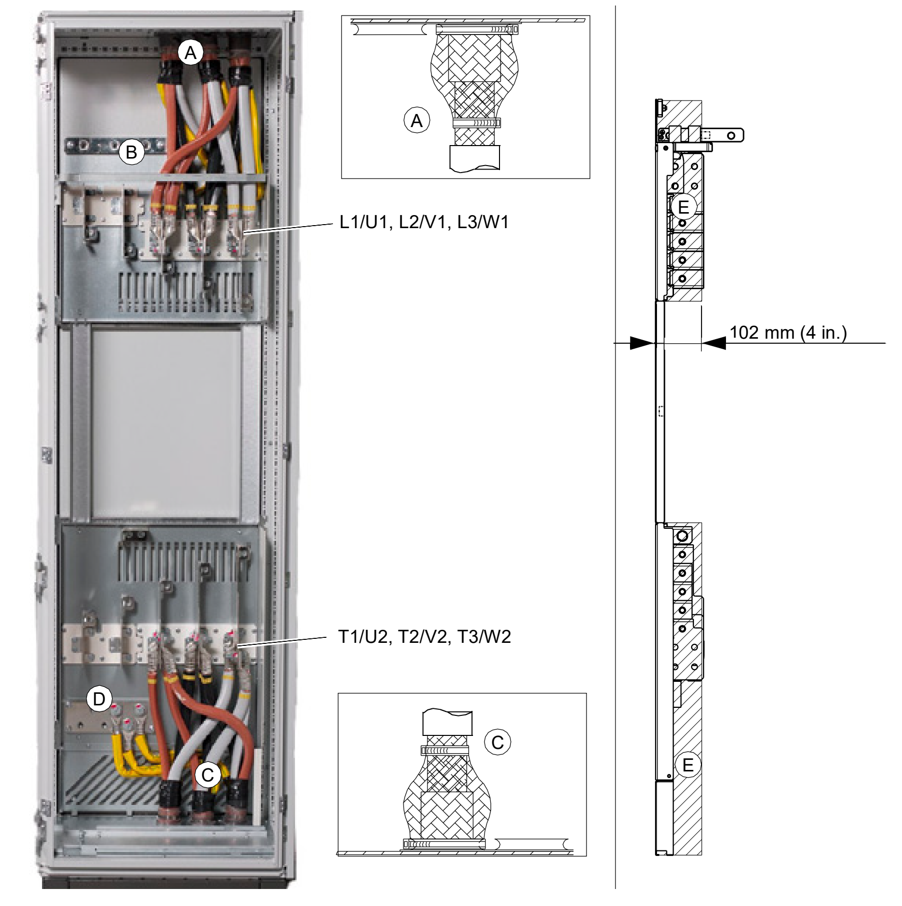
Power cable connection procedure

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

1. Run the motor cables from the motor to the enclosure. Ground the cable shields 360° at the entry plate.
2. Twist the cable shields of the motor cables into bundles and connect them and any separate ground conductors or cables to the ground terminal of the drive module or to the enclosure ground bar.
3. Connect the phase conductors of the motor cables to terminals T1/U2, T2/V2 and T3/W2 of the drive module. For the tightening torques, see the technical data.
4. Drive modules with option +D150: Run the power cables from the brake resistor to the cabinet. Ground the cable shield (if present) 360° at the entry plate. Connect the conductors to the R+ and R- terminals. For the tightening torques, see the technical data.

5. Make sure that all power is disconnected and reconnection is not possible. Use proper safe disconnect procedures according to local codes.
6. Run the input cables from the supply source to the enclosure. Ground the cable shields 360° at the entry plate.
7. 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.
8. Connect the phase conductors of the input cables to terminals L1/U1, L2/V1 and L3/W1 of the drive module. For the tightening torques, see the technical data.

An example installation is shown below.



View without cabinet side plate in place.

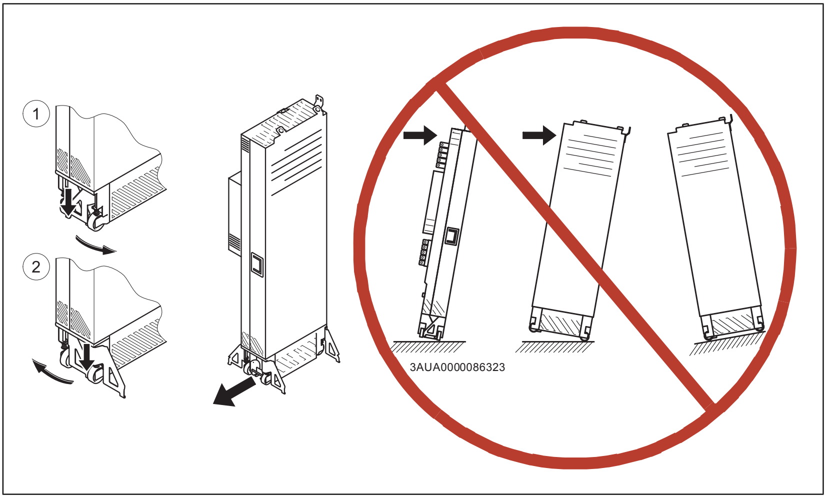
A)	360-degree grounding at the entry plate for the input power cables
B)	Grounding busbar of the input power cabling panel
C)	360-degree grounding at the entry plate for the output power cables
D)	Grounding busbar of the output power cabling panel
E)	Allowed space for power cables. **Note:** The input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

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

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

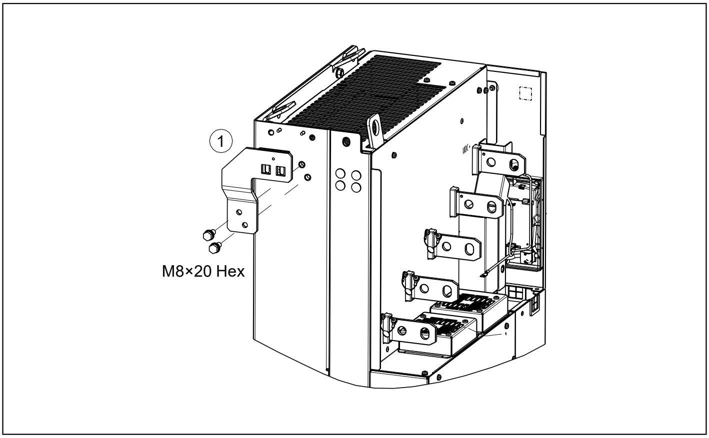
Do not tilt the drive module (A). It is heavy and its center of gravity is high. The module will overturn from a sideways tilt of 5 degrees. Do not leave the module unattended on a sloping floor.



Installation procedure

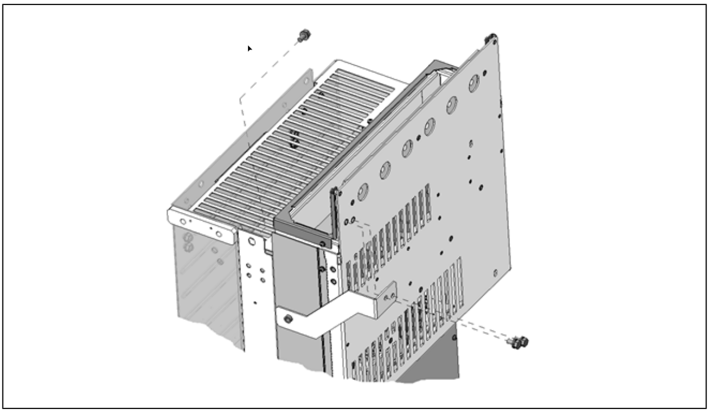
1. Attach the mounting bracket to the drive module.

   Note: This bracket will ground the drive module to the cabinet frame.



2. Install the telescopic extraction and insertion ramp to the cabinet base with two screws.
3. Remove the upper and lower left-hand side front covers of the drive module (M4×8 combi screws, 2 N·m).
4. Attach the drive module lifting lugs to the enclosure frame with chains.
5. Push the drive module carefully into to the enclosure preferably with the help from another person.
6. Attach the grounding busbar that has been previously attached to the input cabling panel to the drive module.

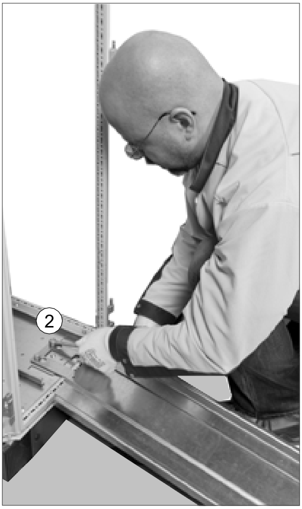
   Note: The design of the grounding busbar can be different from what is shown in the figure.



7. Connect the busbars of the drive module to the busbars of the cabling panels (M12 combi screw, 70 N·m [52 bf·ft]).
8. Attach the drive module to the enclosure from top and bottom, see *Assembly drawing of installing the drive module to the enclosure (frame R10) (page 176)* (frame R10) or *Assembly drawing of installing the drive module to the enclosure (frame R11) (page 177)* (frame R11).

   Note: The top fastening bracket grounds the drive module to the cabinet frame.
9. Attach the cabinet roof on the spacers and the side panels, see *Assembly drawing of installing the roof and door (page 178)*.
10. Remove the filter mats from the air filters according to Rittal's instructions. Install the filters to the cabinet door, see *Assembly drawing of installing the roof and door (page 178)*.
11. Drive modules with an external control unit: Put back the removed front covers of the drive module on the power cable sections, and connect the control cables (see *Connecting the control cables to the terminals of the external control unit (page 135)*.

    Drive modules with an integrated control unit (option +P905): Connect the control cables to the control unit (see *Connecting the control cables to the integrated control unit (options +P905 and +0B051) (page 138)*), connect the control panel cable and put back the removed front covers of the drive module.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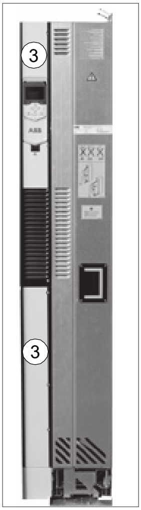
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3


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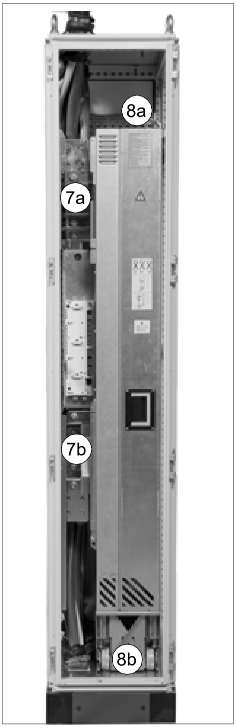
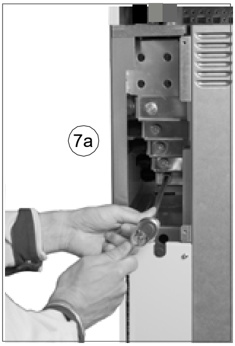
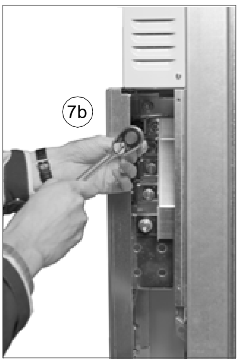
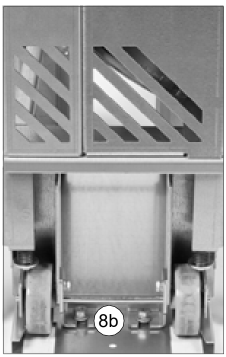
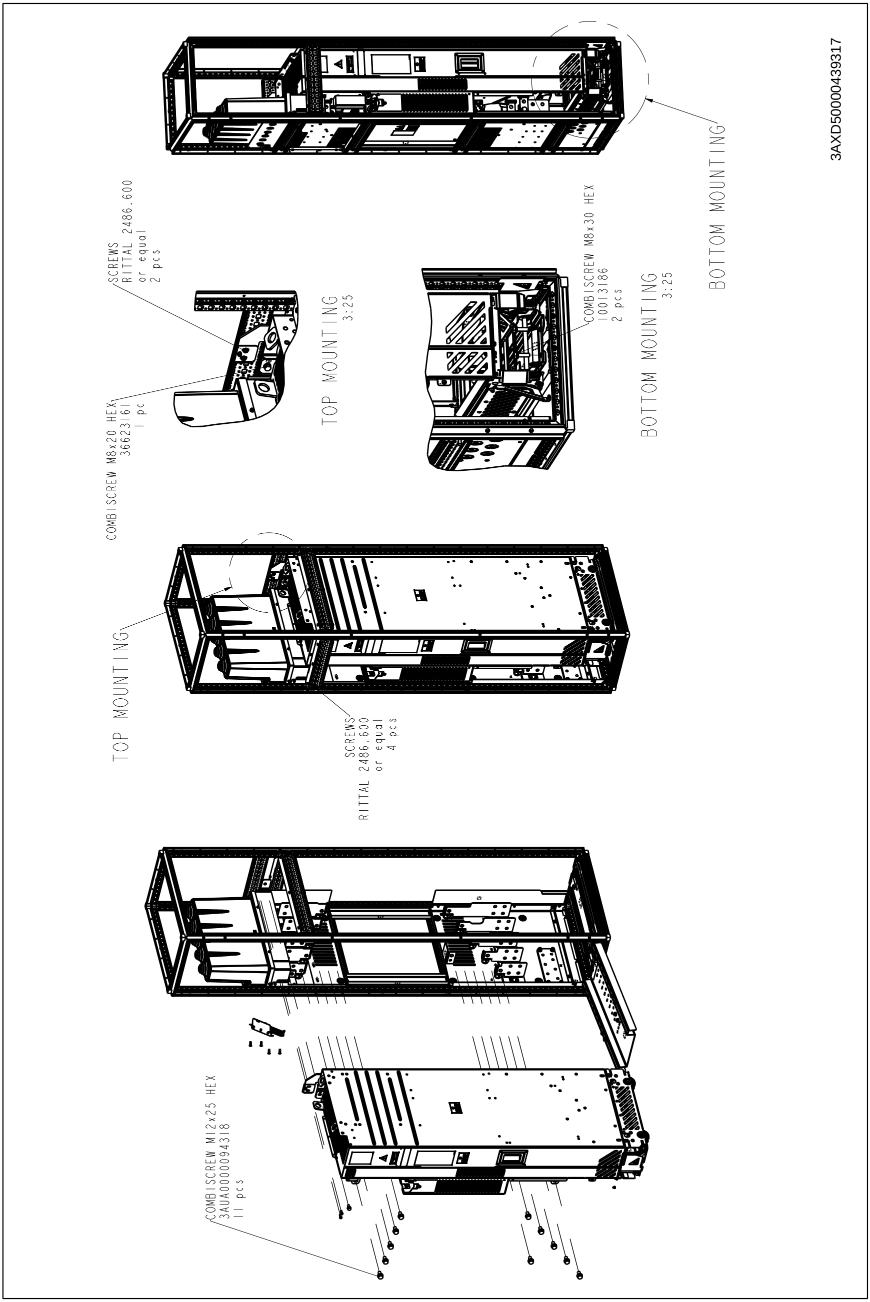

8a
7a
7b
8b


7a

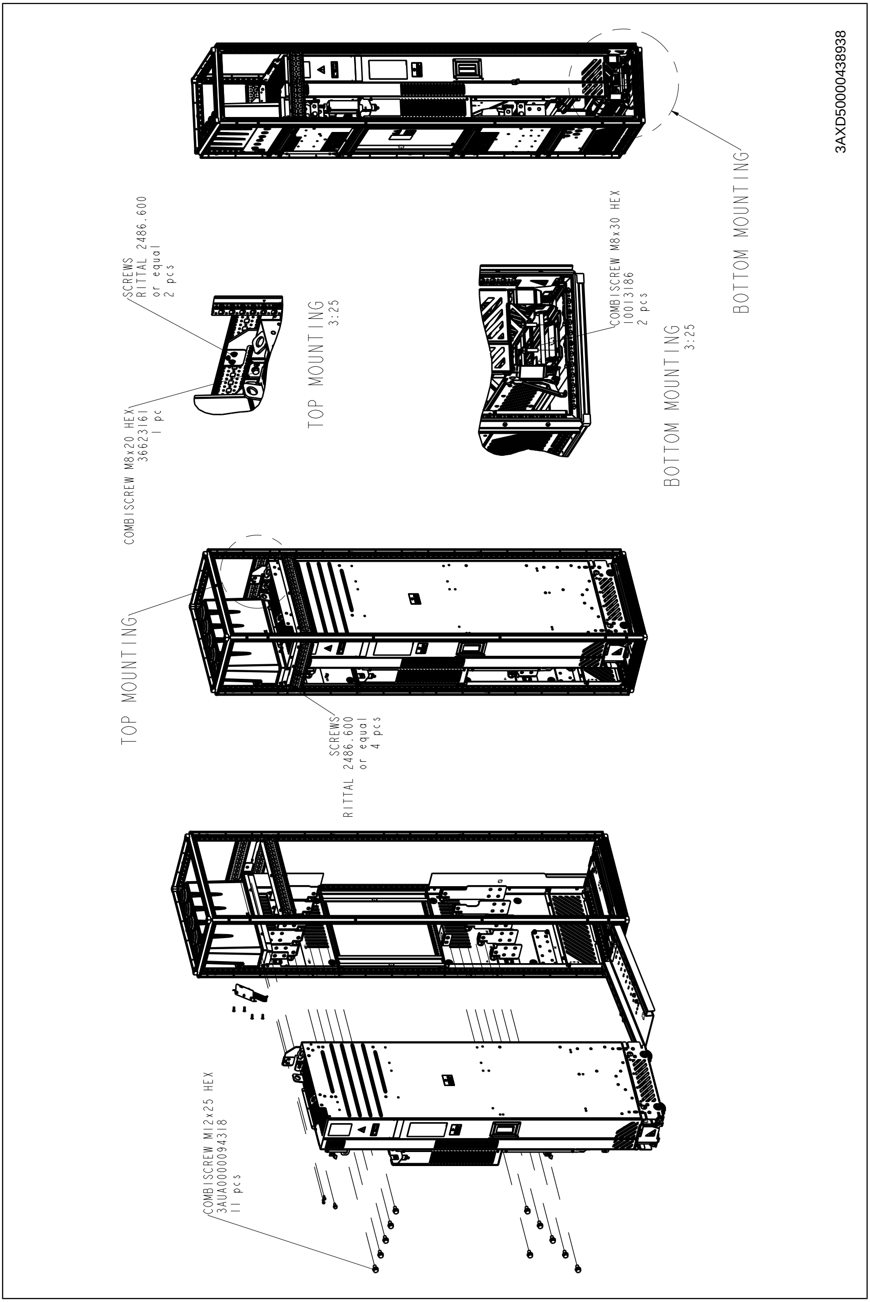

7b


8b

Assembly drawing of installing the drive module to the enclosure (frame R10)

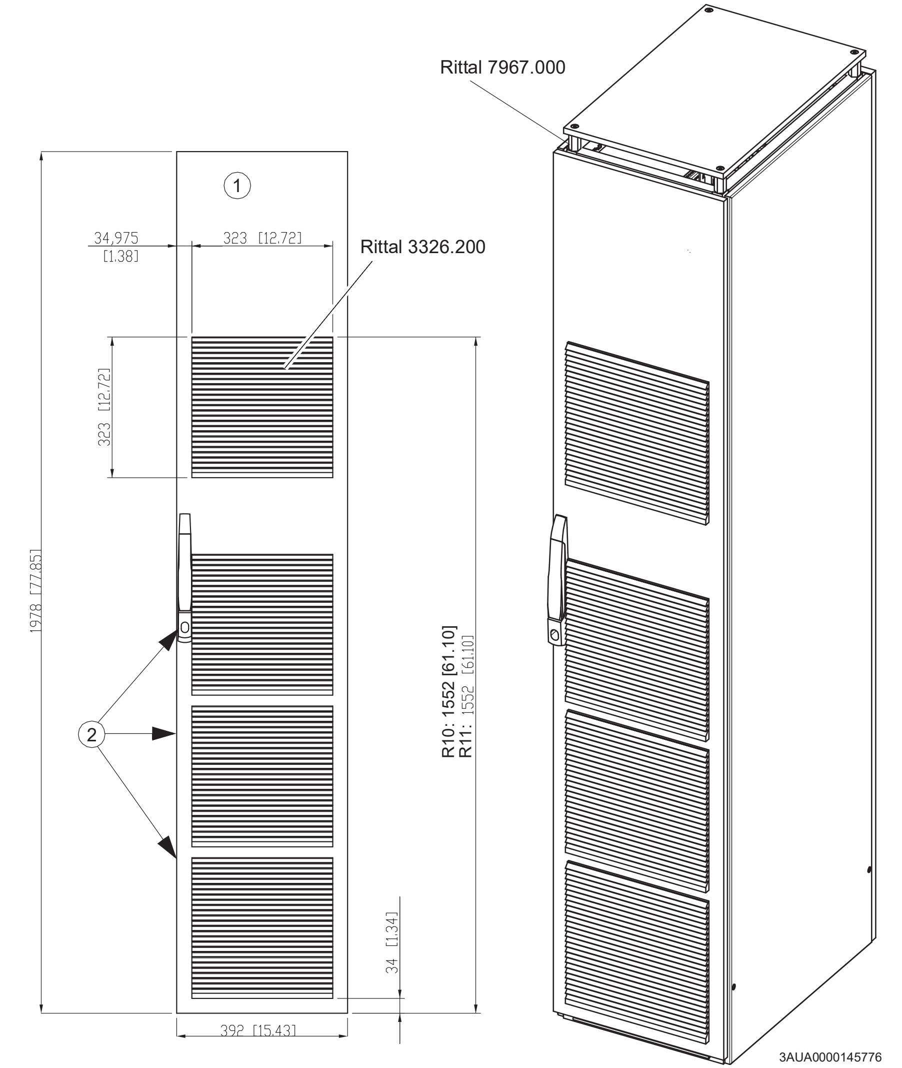


Assembly drawing of installing the drive module to the enclosure (frame R11)



Assembly drawing of installing the roof and door

This drawing shows a layout tested by ABB. If you use ABB air filters, place them vertically in the positions shown in *Installing the roof and door (ABB air filters and roof) (page 163)*.



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

Removing the protective covering from the drive module air outlet

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

Miscellaneous

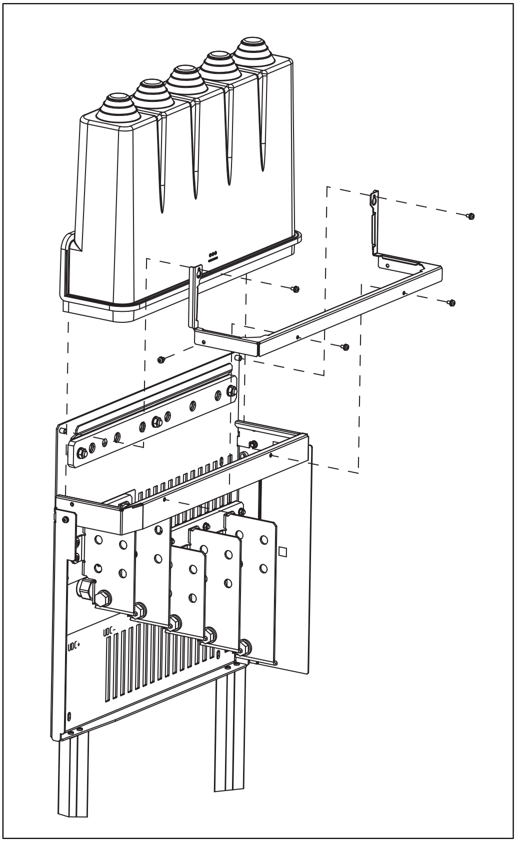
Installations with input and motor cables of size 4 × 240 mm^2 per phase

If resistor cables are to be connected, the lower side plate of the output cabling panel must be removed and the resistor cables lead from side to the terminals of the output cabling panel.

Installing the rubber grommet

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

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



12

Installation checklist

Contents of this chapter

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

Checklist

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

WARNING!
Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur. Do the steps in section *Electrical safety precautions (page 20)* before you start the work.

Make sure that …	☑
Cabinet construction	
The drive module is attached correctly to the cabinet.	☐
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)	☐

Make sure 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.	☐
Option modules and terminals are labeled 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. • Supply for brake resistor (if used) is ok.	☐
Cable types, cross-sections, colors and optional markings are correct.	☐
Cabling is not susceptible to interference. Examine the cables and cable routes for twisting.	☐
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	

Make sure that …	☑
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.	☐
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 the technical data.	☐
The cooling air will flow freely in and out of the drive cabinet, and air recirculation inside the cabinet will not be possible (air baffle plates are on place).	☐
If the drive module has been stored over one year: The electrolytic DC capacitors in the DC link of the drive have been reformed.	☐
There is an adequately sized protective ground conductor between the drive and the switchboard.	☐
There is an adequately sized protective earth 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. See 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 on 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 on the conductors to check.)	☐
The brake resistor (if present) has been connected to the appropriate terminals, and the terminals have been tightened. (Pull on 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 on the conductors to check.)	☐

Make sure that …	☑
If a drive bypass connection will be used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked, ie, cannot be closed simultaneously.	☐
There are no tools, foreign objects or dust from drilling inside the drive.	☐
All shrouds and cover of the motor connection box are in place. Cabinet doors have been closed.	☐
The motor and the driven equipment are ready for start.	☐

13

Start-up

Contents of this chapter

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

Start-up procedure

1. Only qualified electrical professionals are allowed to start-up the drive.
2. Make sure that the installation of the drive module has been checked according to the checklist in chapter *Installation checklist*, and that the motor and driven equipment are ready for start.
3. Perform the start-up tasks instructed by the cabinet-installer of the drive module.
4. Switch the power on, setup the drive control program, and perform the first start of the drive and motor. See *Quick start-up guide for ACS880 drives with primary control program* (3AUA0000098062 [English]) or *ACS880 primary control program firmware manual* (3AUA0000085967 [English]). If you need more information on the use of the control panel, see *ACx-AP-x Assistant control panels user's manual* (3AUA0000085685 [English]).
   - For drives with resistor braking (option +D150): See also section *Start-up* in *Resistor braking*.
   - For drives with ABB d*u*/d*t* filter: Check that bit 13 of parameter *95.20 HW options word 1* is switched on.
   - For drives with ABB sine filter: Check that parameter *95.15 Special HW settings* is set to ABB sine filter. For other sine filters: See *Sine filter hardware manual* (3AXD50000016814 [English]).

5. For drives with ABB motors in explosive atmospheres: See also *ACS880 drives with ABB motors in explosive atmospheres* (3AXD50000019585 [English]).
6. For drive modules in which the Safe torque off function is in use: Test and validate the operation of the Safe torque off function. See *Validation test procedure (page 275)*.
7. For drive modules with an FSO-xx safety functions module (options +Q972 and Q973): Test and validate the operation of the safety functions. See the delivery-specific circuit diagrams and *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

14

Fault tracing

Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

LEDs

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

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

Warning and fault messages

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

15

Maintenance

Contents of this chapter

This chapter contains maintenance instructions of the drive modules.

Maintenance intervals

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

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

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

Descriptions of symbols

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

Recommended annual maintenance actions by the user

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

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

Recommended maintenance intervals after start-up

Component	Years from start-up						
	3	6	9	12	15	18	21
Cooling							
Main cooling fan							
Main cooling fan (R10 and R11)			R			R	
Auxiliary cooling fan							
Circuit board compartment cooling fans (R10 and R11) LONG-LIFE			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 of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation or maintenance work.

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 20)* before you start the work.
2. Open the cabinet door.
3. Clean the interior of the cabinet. Use a vacuum cleaner and a soft brush.
4. Clean the air inlets of the fans and air outlets of the modules (top).
5. Clean the air inlet gratings (if any) on the door.
6. Close the door.

Heatsink

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

Cleaning the interior of the heatsink

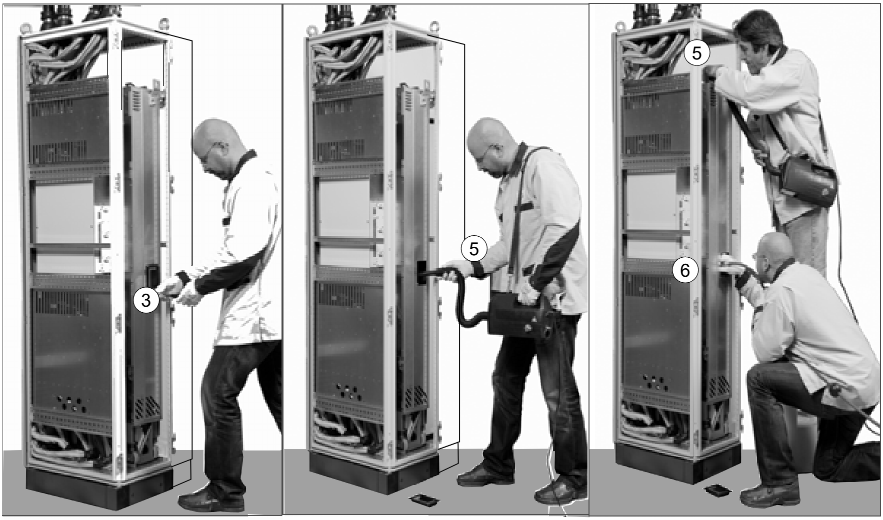
The module heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean.

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

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

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

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



Fans

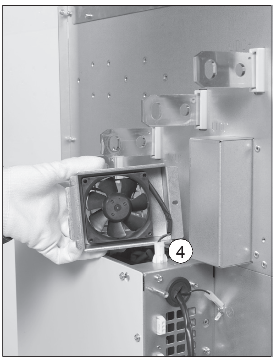
The lifespan of the cooling fans of the drive depends on the running time, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. Reset the running time signal after fan replacement.

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

Replacing the circuit board compartment cooling fans

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 20)* before you start the work.
2. Remove the drive module out of the cabinet as described in module replacement instructions.
3. Undo the fastening screw of the fan enclosure.
4. Unplug the power supply cable of the fan.
5. Install the new fan in reverse order to the above.
6. Reset the counter (if used) in group 5 in the control program.

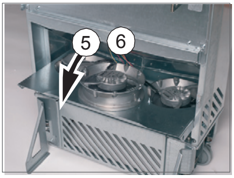


Replacing the main cooling fans

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 20)* before you start the work.
2. Remove the drive module out of the cabinet as described in module replacement instructions.
3. Open the support legs of the pedestal.
4. Undo the two screws that fasten the fan assembly plate.
5. Tilt the fan assembly plate down.
6. Disconnect the power supply wires of the fans.
7. Remove the fan assembly from the drive module.
8. Undo the fastening screws of the fan(s) and remove the fan(s) from the assembly plate.
9. Install the new fan in reverse order to the above.
10. Reset the counter (if used) in parameter group 5 in the control program.


4
4
3
3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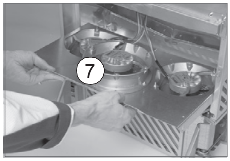
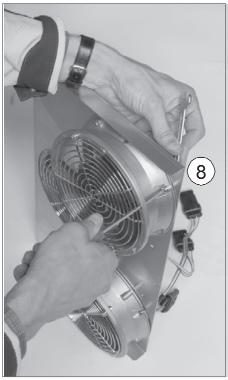

7


8

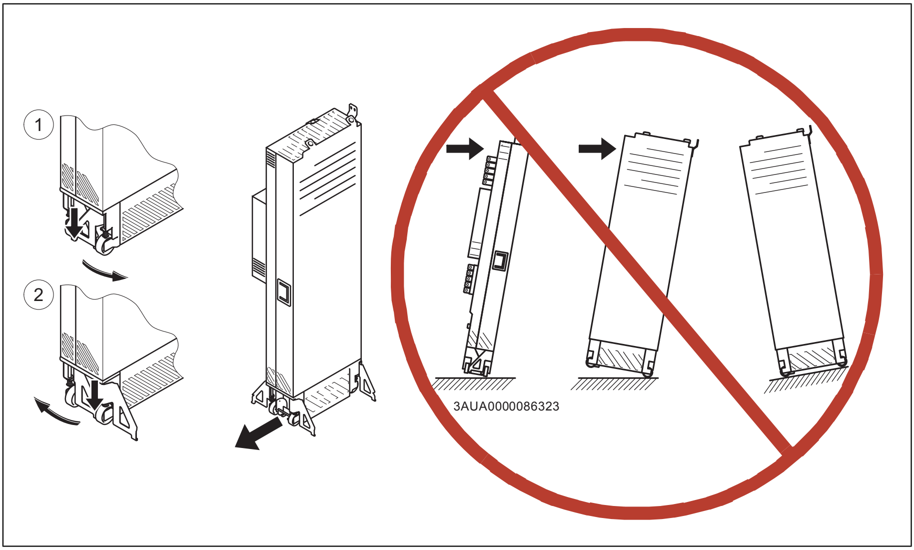
Replacing the standard drive module

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

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

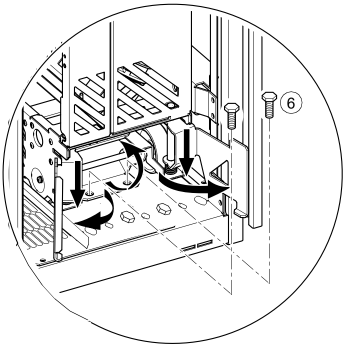
Handle the drive module carefully:

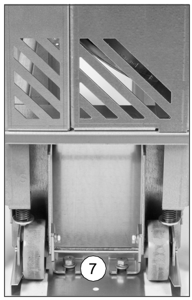
- Use safety shoes with a metal toe cap to prevent foot injury.
- Lift the drive module only by the lifting lugs.
- Make sure that the module does not topple over when you move it on the floor: To open the support legs, press each leg a little down and turn it aside (1, 2). Whenever possible secure the module also with chains.
- Do not tilt the drive module (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 *Electrical safety precautions (page 20)* before you start the work.
2. Remove the clear plastic shrouds on the power cables and parts in front of the drive module (if present).
3. Disconnect the power cables.

4. Disconnect the power supply, BGDR and fiber optic cables from the drive module.
5. Disconnect the power supply cable and the fiber optic cables from the external control unit and coil them on the top of the drive module.
6. Remove the screws that attach the drive module to the cabinet at the top and behind the front support legs.
7. Attach the extraction ramp to the cabinet base with two screws.
8. To prevent the drive module from falling, attach its top lifting lugs with chains 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.



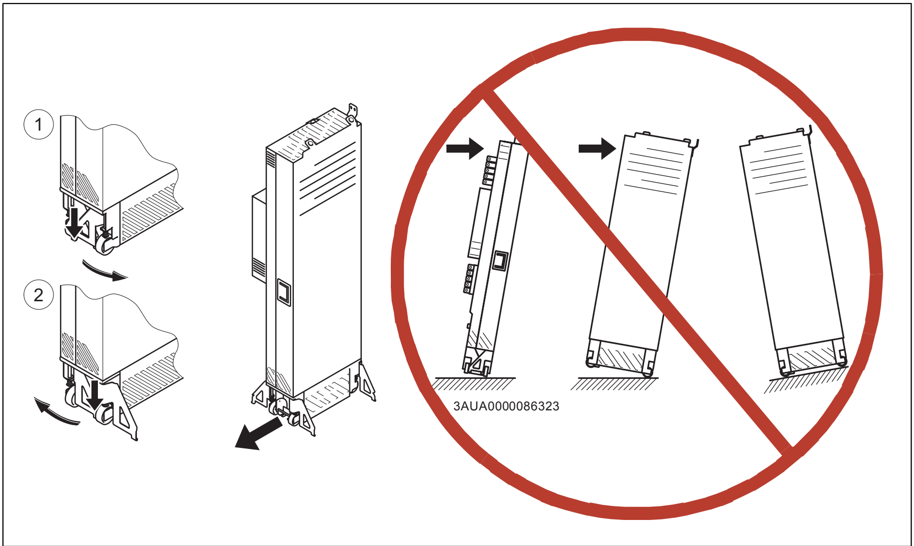


Replacing the drive module with option +H381

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

Handle the drive module carefully:

- Use safety shoes with a metal toe cap to prevent foot injury.
- Lift the drive module only by the lifting lugs.
- Make sure that the module does not topple over when you move it on the floor: To open the support legs, press each leg a little down and turn it aside (1, 2). When 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 *Electrical safety precautions (page 20)* before you start the work.
2. Remove the left-hand side upper and lower front covers of the drive module by undoing the fastening screws. M4×10 combi screws, 2 N·m.
   For drive modules with an integrated control unit (option +P905) and control panel (option +J414): Remove the control panel and the control panel cable from the integrated 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. Undo the screws that attach the drive module to the cabinet at the top (a) and behind the front support legs (b).
6. Remove the front air baffle.
7. Attach the extraction/installation ramp to the cabinet base with two screws.
8. Disconnect the power supply cable and the fiber optic cables from the external control unit and coil them on the top of the drive module.
   For drive modules with an integrated 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.)

9. To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet frame.
10. Pull the drive module carefully out of the cabinet preferably with help from another person.
11. Install the new module in reverse order to the above.

Capacitors

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

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

Reforming the capacitors

The capacitors must be reformed if the drive has not been powered (either in storage or unused) for a year or more. The manufacturing date is on the type designation label. For information on reforming the capacitors, see *Capacitor reforming instructions* (3BFE64059629 [English]) in the ABB Library (https://library.abb.com/en).

Control panel

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

Cleaning the control panel

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

Replacing the battery

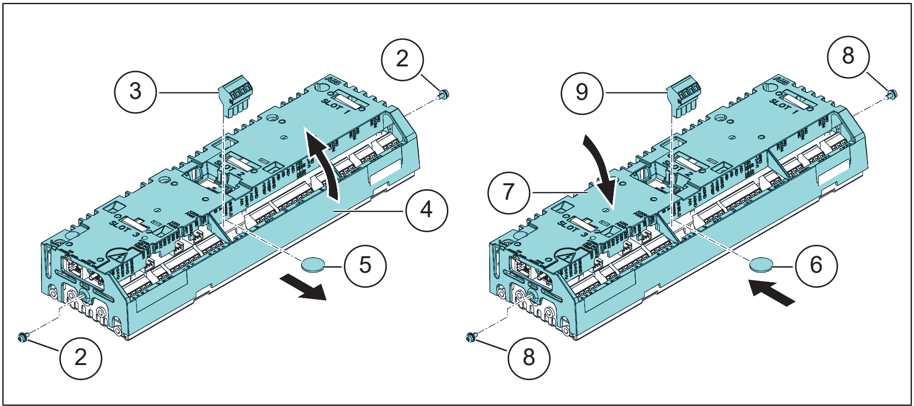
The instructions below describe how to replace the battery that powers the real-time clock of the control panel.

1. Turn the lid on the back of the control panel counter-clockwise until the lid opens.
2. Remove the battery gently.
3. Replace the battery with a new CR2032 battery. The battery holder has grip nails. First slide the battery and then press on the other side. The battery will snap in.
4. Make sure that the battery polarity shows positive on the upside.
5. Put the lid back and tighten it by turning it clockwise.
6. Dispose of the old battery according to local disposal rules or applicable laws.

Replacing the ZCU-14 control unit battery

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 20)* before you start the work.
2. Remove the M4×8 (T20) screws at the ends of the control unit.
3. To see the battery, remove the XD2D terminal block.
4. Carefully lift the edge of the control unit cover on the side with the I/O terminal blocks.
5. Carefully pull the battery out of the battery holder.
6. Carefully put a new CR2032 battery into the battery holder.
7. Close the control unit cover.
8. Tighten the M4×8 (T20) screws.
9. Install the XD2D terminal block.



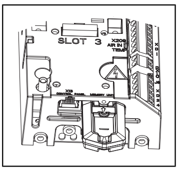
Replacing the memory unit of ZCU-14

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

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

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 20)* before you start the work.
2. Pull the clip of the memory forward.



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

Replacing safety functions modules FSO-12 (option +Q973) and FSO-21 (option +Q972)

Do not repair safety functions modules. Replace a faulty module with a new one as described in section *Installing the FSO-xx safety functions module (page 143)*.

16

Ordering information

Contents of this chapter

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

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

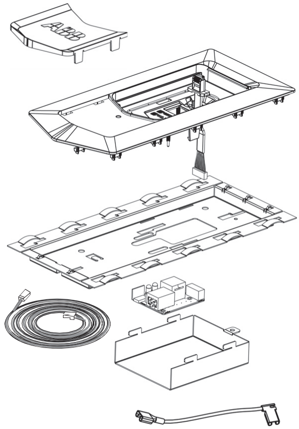
See the installation examples for Rittal enclosure tested by ABB in *Installing the roof and door (Rittal parts) (page 162)* and *Assembly drawing of installing the roof and door (page 178)*, or dimension your own cabinet.

Control panel

ACS-AP-W control panel is included with the drive module. A control panel is required for the commissioning of an ACS880 drive system, even if the Drive composer PC tool is used.

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

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

Type	Description	Ordering code	Illustration
ACS-AP-I	Control panel	3AUA0000088311	
DPMP-01	Door mounting kit for flush mounting. Includes a control panel mounting platform, an IP54 cover and a 3- meter panel connection cable.	3AUA0000108878	

Brake choppers and resistors

See chapter *Resistor braking (page 285)*.

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

See section *du/dt filters (page 295)*.

Sine filters

See section *Sine filters (page 296)*.

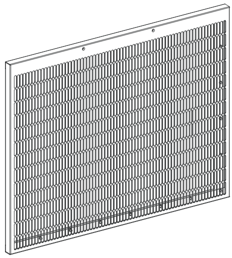
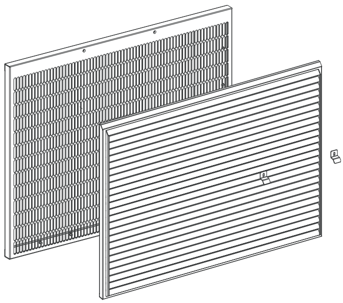
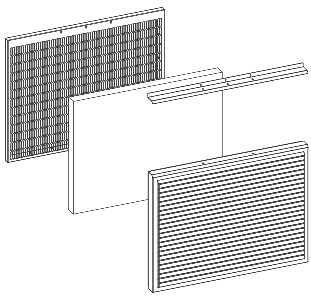
EMC filter ARFI-10

Ordering code: 68241561

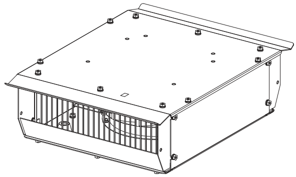
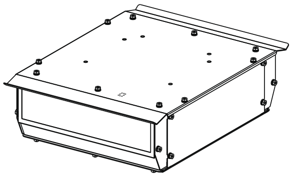
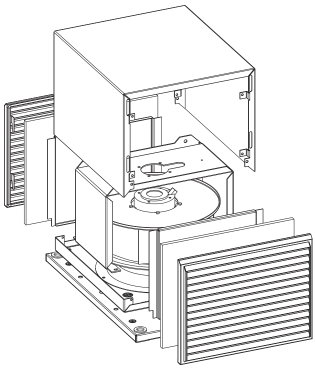
Cabinet ventilation

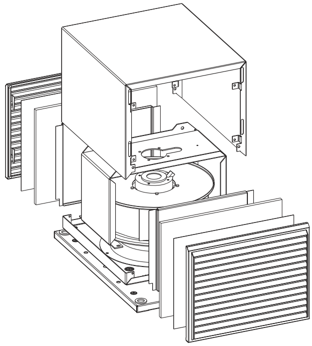
Air inlet kits

Mounting screws are included.

Enclosure width / Degree of protection	Kit code	Ordering code	Illustration
800 mm / IP20	A-8-X-023	3AUA0000117005	 Instruction code: 3AUA0000116887
800 mm / IP42	A-8-X-026	3AUA0000117009	 Instruction code: 3AUA0000116875
800 mm / IP54	A-8-X-029	3AXD50000009186	 Instruction code: 3AXD50000010001

Air outlet kits

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

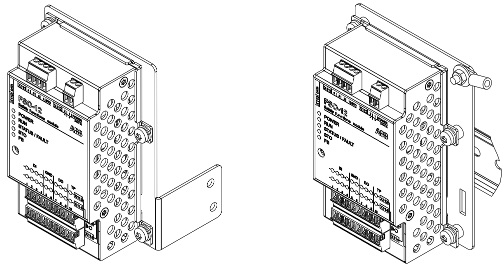
Enclosure width / Degree of protection	Qty	Kit code	Ordering code	Illustration
800 mm / IP54 (UL)	2	A-4-X-067	3AXD50000010362	 Instruction code: 3AXD50000010284 **Note:** Fan to be ordered separately

Cooling fans

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

Enclosure width / Degree of protection	Component		Qty	Ordering code
	Name	Data		
800 mm / IP20, IP42	Fan	R2E225-RA92-17 (230 V)	2	3AXD50000000514
	Capacitor	MSB MKP 3,5/603/E1679	2	3AXD50000000882
	Connector	SPB2,5/7 (2.5 mm^2, 12AWG)	2	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm^2, 12AWG)	2	3AXD50000000724
800 mm / IP54	Fan	RB4C-355/170	2	3AXD50000006934
	Capacitor	MSB MKP 6/603/E1679	2	3AXD50000006959
	Connector	SPB2,5/7 (2.5 mm^2, 12AWG)	2	3AXD50000000723
	Connector	SC 2,5-RZ/7 (2.5 mm^2, 12AWG)	2	3AXD50000000724

FSO accessories kit

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

Control panel mounting platforms

Kit	Ordering code
DPMP-02 control panel mounting platform	3AXD50000009374
DPMP-04 control panel mounting platform	3AXD50000217717

Retrofit accessory kits

Kit	Option code	Ordering code
Common mode filter kit	+E208	3AXD50000026145
Full size cable connection terminals for input power cables	+H370	3AXD50000019542
Full size cable connection terminals for output power cables	1)	3AXD50000019544
For frame R10: Full power cabling panels to be attached to a cabinet (IP20)	H381	3AXD50000489428
For frame R11: Full power cabling panels to be attached to a cabinet (IP20)	H381	3AXD50000489435
Power cable connection terminals on the right-hand side of the drive module	H391	3AXD50000025765
Flat mounting	C173	3AXD50000019535
For frame R10: IP20 shrouds for covering the input and motor cabling area	2)	3AXD50000019537

Kit	Option code	Ordering code
For frame R11: IP20 shrouds for covering the input and motor cabling area	2)	3AXD50000019538

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

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

17

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.

Marine type-approved drives (option +C132)

See *ACS880-01 /04+C132 marine type-approved drives supplement* (3AXD50000010521 [English]) for the ratings, marine-specific data and reference to valid marine type approvals.

Ratings

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

IEC RATINGS											
ACS880-04-…	Frame size	Input current	Output ratings								
			Nominal use					Light-duty use		Heavy-duty use	
		I_1	I_{max}	I_{max_start}	I_2	P_n	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	A	A	kW	kVA	A	kW	A	kW
U_n = 400 V											
505A-3	R10	505	560	671	505	250	350	485	250	361	200
585A-3	R10	585	730	828	585	315	405	575	315	429	250
650A-3	R10	650	730	954	650	355	450	634	355	477	250
725A-3	R11	725	1020	1100	725	400	502	715	400	566	315

IEC RATINGS											
ACS880-04-…	Frame size	Input current	Output ratings								
			Nominal use					Light-duty use		Heavy-duty use	
		I_1	I_{max}	I_{max_start}	I_2	P_n	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	A	A	kW	kVA	A	kW	A	kW
820A-3	R11	820	1020	1100	820	450	568	810	450	625	355
880A-3	R11	880	1100	1100	880	500	610	865	500	725*	400
U_n = 500 V											
460A-5	R10	460	560	671	460	315	398	450	315	330	200
503A-5	R10	505	560	671	503	355	436	483	315	361	250
583A-5	R10	585	730	828	583	400	505	573	400	414	250
635A-5	R10	650	730	954	635	450	550	623	450	477	315
715A-5	R11	725	850	1100	715	500	619	705	500	566	400
820A-5	R11	820	1020	1100	820	560	710	807	560	625	450
880A-5	R11	880	1100	1100	880	630	762	857	560	697**	500
U_n = 690 V											
330A-7	R10	330	480	510	330	315	394	320	315	255	250
370A-7	R10	370	520	650	370	355	442	360	355	325	315
430A-7	R10	430	540	720	430	400	514	420	400	360***	355
470A-7	R11	470	655	830	470	450	562	455	450	415	400
522A-7	R11	522	685	910	522	500	624	505	500	455	450
590A-7	R11	590	800	1010	590	560	705	571	560	505	500
650A-7	R11	650	825	1100	650	630	777	630	630	571**	560
721A-7	R11	721	825	1100	721	710	862	705	630	571**	560

UL/NEC RATINGS									
ACS880-04-…	Frame size	Input current	Max. current		Output ratings				
					App. power	Light-duty use		Heavy-duty use	
		I_1	I_{max}	I_{max_start}	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	A	kVA	A	hp	A	hp
U_n = 480 V									
460A-5	R10	460	560	671	-	-	-	-	-
503A-5	R10	503	560	671	435	483	400	361	300
583A-5	R10	583	730	828	504	573	450	414	350
635A-5	R10	635	730	954	549	623	500	477	400
715A-5	R11	715	850	1100	619	705	600	566	450
820A-5	R11	820	1020	1100	710	807	700	625	500
880A-5	R11	880	1100	1100	762	857	700	697**	600

UL/NEC RATINGS									
ACS880-04-...	**Frame size**	**Input current**	**Max. current**		**Output ratings**				
					App. power	**Light-duty use**		**Heavy-duty use**	
		I_1	I_{max}	I_{max_start}	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	**A**	**A**	**kVA**	**A**	**hp**	**A**	**hp**
U_n = 575 V									
330A-7	R10	330	480	510	393	336	350	255	250
370A-7	R10	370	520	650	441	382	400	325	300
430A-7	R10	430	520	720	513	424	450	360***	350
470A-7	R11	470	655	830	562	472	500	415	450
522A-7	R11	522	655	910	624	528	550	455	450
590A-7	R11	590	800	1010	705	571	600	505	500
650A-7	R11	650	820	1100	777	630	700	571***	600
721A-7	R11	721	820	1100	862	705	700	571***	600

U_n	Nominal voltage of the drive. For input voltage range, see *Type designation key (page 47)*.
I_1	Nominal input current (rms) at 40 °C (104 °F)
S_n	Apparent power (no overload)
I_{max}	Maximum output current. Available for 10 seconds at start, otherwise as long as allowed by drive temperature. 140% … 200% of I_{Hd}, depending on power rating.
I_{max_start}	Maximum output current at start. Available for two seconds only at start every five seconds if start current limit is activated by parameter *30.15 Maximum start current enable*.
I_2	Continuous rms output current. No overload capability at 40 °C (104 °F). This is indicated in the type designation label as output current I_2.
P_n	Typical motor power in no-overload use
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-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 **Continuous rms output current allowing 45% overload for 1 minute every 5 minutes ***Continuous rms output current allowing 44% overload for 1 minute every 5 minutes
P_{Hd}	Typical motor power for heavy-duty use

Note: To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. The power ratings apply to most IEC 34 motors at the nominal voltage of the drive.

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

Output derating

When is derating necessary

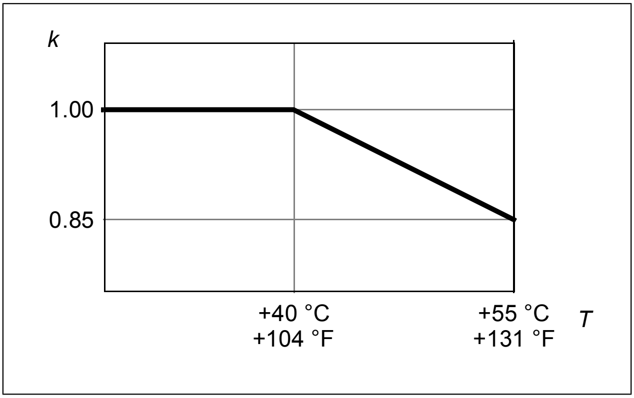
Derate the continuous output current of the drive if

- ambient temperature exceeds +40 °C (+104 °F) or
- drive is installed higher than 1000 m (3280 ft) above sea level
- switching frequency is other than default
- the minimum requirements of motor cable length are not met (see chapter *Filters (page 295)*).

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

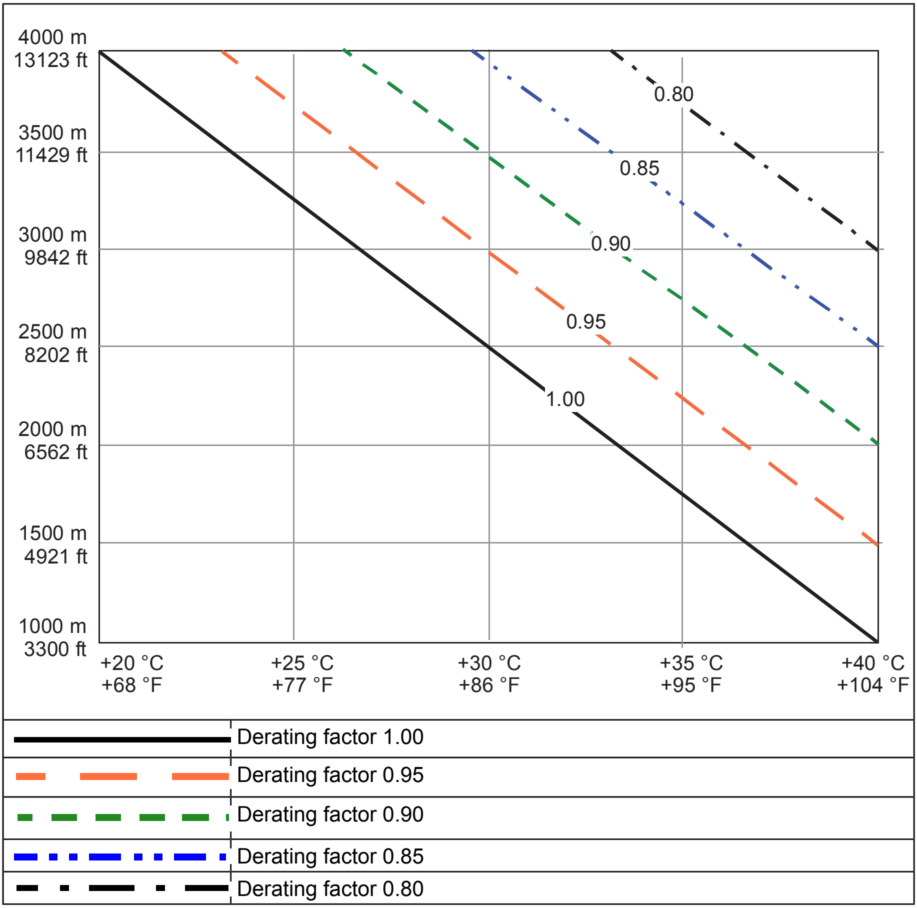
Ambient temperature derating

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



Altitude derating

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



Deratings for special settings in the drive control program

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

Ex motor, sine filter, low noise

Table below gives the deratings for these cases:

- drive is used with an ABB motor for explosive atmospheres (Ex) and **EX motor** in parameter *95.15 Special HW settings* is enabled
- sine filter given in the selection table (see section *Sine filters (page 296)*) is used and **ABB sine filter** in parameter *95.15 Special HW settings* is enabled

- **Low noise optimization** is selected in parameter *97.09 Switching freq mode*.

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

ACS880-04-…	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												
505A-3	479	250	459	345	470	250	450	340	390	200	370	290
585A-3	551	250	533	394	540	250	518	383	437	250	419	311
650A-3	612	315	590	438	600	315	576	425	485	250	466	346
725A-3	666	355	650	492	647	355	628	468	519	250	496	390
820A-3	753	400	736	544	731	400	712	517	587	315	562	431
880A-3	809	450	786	631	785	450	760	600	630	355	600	500*
U_n = 500 V												
460A-5	437	250	427	316	430	250	419	311	357	250	345	265
503A-5	478	315	458	345	470	315	450	340	390	250	370	290
583A-5	531	355	509	364	514	355	487	347	400	250	380	298
635A-5	579	400	553	419	560	400	530	400	410	250	392	298
715A-5	656	450	641	522	637	450	620	507	462	315	428	362
820A-5	752	500	734	576	730	500	710	560	530	355	490	400
880A-5	768	500	747	594	730	500	710	560	550	400	510	410
U_n = 690 V												
330A-7	310	250	300	217	303	250	293	204	232	200	222	157
370A-7	348	315	338	276	340	315	330	260	260	250	250	200
430A-7	378	355	368	315	360	355	350	300**	290	250	280	236**
470A-7	388	355	376	335	360	355	349	308	270	250	261	238
522A-7	430	400	417	370	400	355	388	342	300	250	290	262
590A-7	485	450	470	449	450	400	436	385	340	315	330	300
650A-7	575	500	555	480	550	500	530	450**	450	400	430	350**
721A-7	593	500	574	480	550	500	530	450**	450	400	430	350**

U_n	Nominal voltage of the drive
I_N	Nominal input current (rms) at 40 °C (104 °F)
P_n	Typical motor power in no-overload use
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes

I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes *Continuous rms output current allowing 40% overload for 1 minute every 5 minutes **Continuous rms output current allowing 44% overload for 1 minute every 5 minutes
Note: To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. The power ratings apply to most IEC 34 motors at the nominal voltage of the drive. ABB recommends to select the drive, motor and gear combination for the required motion profile with the DriveSize dimensioning tool available from ABB.	

High speed mode

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

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

ACS880-04-…	**Deratings with selection High speed mode of parameter 95.15 Special HW settings**									
	120 Hz output frequency					**Maximum output frequency**				
	Fre-quency	**Nominal use**		**Light-duty use**	**Heavy-duty use**	**Maxim-um fre-quency**	**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										
505A-3	120	505	250	485	361	500	390	200	370	290
585A-3	120	585	315	575	429	500	437	250	419	311
650A-3	120	650	355	634	477	500	485	250	466	346
725A-3	120	725	400	715	566	500	519	250	496	390
820A-3	120	820	450	810	625	500	587	315	562	431
880A-3	120	880	500	865	725*	500	630	355	600	500*
U_n = 500 V										
460A-5	120	460	315	450	330	500	357	250	345	265
503A-5	120	503	355	483	361	500	390	250	370	290
583A-5	120	583	400	573	414	500	400	250	380	298
635A-5	120	635	450	623	477	500	410	250	392	298
715A-5	120	715	500	705	566	500	462	315	428	362
820A-5	120	820	560	807	625	500	530	355	490	400

ACS880-04-…	Deratings with selection High speed mode of parameter 95.15 Special HW settings									
	120 Hz output frequency					Maximum output frequency				
	Fre-quency	Nominal use		Light-duty use	Heavy-duty use	Maxim-um fre-quency	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
880A-5	120	880	630	857	697**	500	550	400	510	410
U_n = 690 V										
330A-7	120	330	315	320	255	375	232	200	222	157
370A-7	120	370	355	360	325	375	260	250	250	200
430A-7	120	430	400	420	360***	375	290	250	280	236***
470A-7	120	470	450	455	415	375	270	250	261	238
522A-7	120	522	500	505	455	375	300	250	290	262
590A-7	120	590	560	571	505	375	340	315	330	300
650A-7	120	650	630	630	571***	375	450	400	430	350***
721A-7	120	721	710	705	571***	375	450	400	430	350***

f	Output frequency
f_{max}	Maximum output frequency with High speed mode
U_n	Nominal voltage of the drive
I_N	Continuous rms output current. No overload capability at 40 °C (104 °F).
P_n	Typical motor power in no-overload use
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes *Continuous rms output current allowing 40% overload for 1 minute every 5 minutes **Continuous rms output current allowing 45% overload for 1 minute every 5 minutes ***Continuous rms output current allowing 44% overload for 1 minute every 5 minutes

Fuses (IEC)

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

Ultrarapid (aR) fuses per drive module						
ACS880-04-...	Input current (A)	Fuse				
		A	A^2s	V	Type DIN 43653	Size
U_n = 400 V						
ACS880-04-505A-3	505	800	465000	690	170M6012	3
ACS880-04-585A-3	585	1000	945000	690	170M6014	3
ACS880-04-650A-3	650	1000	945000	690	170M6014	3
ACS880-04-725A-3	725	1250	1950000	690	170M6016	3
ACS880-04-820A-3	820	1600	3900000	690	170M6019	3
ACS880-04-880A-3	880	1600	3900000	690	170M6019	3
U_n = 500 V						
ACS880-04-460A-5	460	630	210000	690	170M6010	3
ACS880-04-503A-5	505	800	465000	690	170M6012	3
ACS880-04-583A-5	585	1000	945000	690	170M6014	3
ACS880-04-635A-5	650	1000	945000	690	170M6014	3
ACS880-04-715A-5	725	1250	1950000	690	170M6016	3
ACS880-04-820A-5	820	1600	3900000	690	170M6019	3
ACS880-04-880A-5	880	1600	3900000	690	170M6019	3
U_n = 690 V						
ACS880-04-330A-7	330	700	300000	690	170M6011	3
ACS880-04-370A-7	370	900	670000	690	170M6013	3
ACS880-04-430A-7	430	1000	945000	690	170M6014	3
ACS880-04-470A-7	470	1100	1300000	690	170M6015	3
ACS880-04-522A-7	522	1250	1950000	690	170M6016	3
ACS880-04-590A-7	590	1400	2450000	690	170M6017	3
ACS880-04-650A-7	650	1500	3100000	690	170M6018	3
ACS880-04-721A-7	721	1500	3100000	690	170M6018	3

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

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

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

Fuses (UL)

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

Fuse						
ACS880-04-…	Input current (A)	Fuse				
		A	V	Manufac-turer	UL class	Type
U_n = 480 V						
ACS880-04-460A-5	460	600	600	Bussmann	T	JJS-600
ACS880-04-503A-5	505	600	600	Bussmann	T	JJS-600
ACS880-04-583A-5	585	800	600	Ferraz	L	A4BY800
ACS880-04-635A-5	650	800	600	Ferraz	L	A4BY800
ACS880-04-715A-5	725	1000	600	Ferraz	L	A4BY1000
ACS880-04-820A-5	820	1000	600	Ferraz	L	A4BY1000
ACS880-04-880A-5	880	1000	600	Ferraz	L	A4BY1000
U_n = 575 V						
ACS880-04-330A-7	330	500	600	Bussmann	T	JJS-500
ACS880-04-370A-7	370	500	600	Bussmann	T	JJS-500
ACS880-04-430A-7	430	500	600	Bussmann	T	JJS-500
ACS880-04-470A-7	470	600	600	Bussmann	T	JJS-600
ACS880-04-522A-7	522	600	600	Bussmann	T	JJS-600
ACS880-04-590A-7	590	800	600	Ferraz	L	A4BY800
ACS880-04-650A-7	650	800	600	Ferraz	L	A4BY800
ACS880-04-721A-7	721	800	600	Ferraz	L	A4BY800

Notes:

1. The UL listed fuses in this hardware manual are the required branch circuit protection per NEC.
2. Fuses are required as part of the installation. Fuses are not included in the base drive configuration and must be provided by others.
3. Fuses with a higher current rating than specified must not be used.
4. Fuses with a lower current rating than specified may be used if they are of the same voltage and are UL 248 listed fast acting or high-speed fuses.
5. A fuse of a different class can be used at the high fault rating where the I_{peak} and I^2t of the new fuse is not greater than that of the specified fuse.

6 Recommended drive fuses must be used to maintain drive UL listing. Additional protection can be used. Refer to local codes and regulations.
7 When installing a drive always follow installation instructions and NEC requirements.
8 UL 248 listed, fast acting or high-speed fuses from other manufacturers can be used if they meet the rating requirements specified in the rules above.
9 Alternative fuses can be used if they meet certain characteristics. For acceptable fuses, see the manual supplement (3AXD50000645015).

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

Circuit breakers (IEC)

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

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

ACS880-04-...	**Frame size**	**ABB molded case circuit breaker (Tmax)**	
		Product ID (Type)	**kA** 1)
U_n = 400 V			
ACS880-04-505A-3	R10	1SDA054412R1 (T5H 630 PR221DS-LS/I In=630 3p F F)	30
ACS880-04-585A-3	R10	1SDA069428R1 (T6V 800 PR221DS-LS/I In=800 3p F F)	30
ACS880-04-650A-3	R10	1SDA069428R1 (T6V 800 PR221DS-LS/I In=800 3p F F)	30
ACS880-04-725A-3	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
ACS880-04-820A-3	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
ACS880-04-880A-3	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
U_n = 500 V			
ACS880-04-460A-5	R10	1SDA054412R1 (T5H 630 PR221DS-LS/I In=630 3p F F)	30
ACS880-04-503A-5	R10	1SDA054412R1 (T5H 630 PR221DS-LS/I In=630 3p F F)	30
ACS880-04-583A-5	R10	1SDA054412R1 (T5H 630 PR221DS-LS/I In=630 3p F F)	30

ACS880-04-635A-5	R10	1SDA069428R1 (T6V 800 PR221DS-LS/I In=800 3p F F)	30
ACS880-04-715A-5	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
ACS880-04-820A-5	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
ACS880-04-880A-5	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
U_n = 690 V			
ACS880-04-330A-7	R10	1SDA054412R1 (T5H 630 PR221DS-LS/I In=630 3p F F)	30
ACS880-04-370A-7	R10	1SDA054412R1 (T5H 630 PR221DS-LS/I In=630 3p F F)	30
ACS880-04-430A-7	R10	1SDA054412R1 (T5H 630 PR221DS-LS/I In=630 3p F F)	30
ACS880-04-470A-7	R11	1SDA054412R1 (T5H 630 PR221DS-LS/I In=630 3p F F)	30
ACS880-04-522A-7	R11	1SDA069428R1 (T6V 800 PR221DS-LS/I In=800 3p F F)	40
ACS880-04-590A-7	R11	1SDA069428R1 (T6V 800 PR221DS-LS/I In=800 3p F F)	40
ACS880-04-650A-7	R11	2)	2)
ACS880-04-721A-7	R11	2)	2)

1) Maximum allowed rated conditional short-circuit current (IEC 61439-1) of the electrical power network
2) Contact your local ABB representative

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

Dimensions, weights and free space requirements

Standard drive module configuration								
Frame size	**Height**		**Width**		**Depth**		**Weight***	
	mm	**in**	**mm**	**in**	**mm**	**in**	**kg**	**lb**
R10	1541	60.67	350	14.82	506	19.92	161	355
R11	1741	68.54	350	14.82	506	19.92	199	439

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
R10	1462	57.56	305	12.01	506	19.92	156	345
R11	1662	65.43	305	12.01	506	19.92	194	429

Optional selection +H381 (full power cabling panels)								
Frame size	Height		Width		Depth		Weight*	
	mm	in	mm	in	mm	in	kg	lb
R10	1590	62.62	329	12.95	516	19.92	196	432
R11	1740	68.58	329	12.95	516	19.92	233	514

* approximate (depends on the selected options)

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

Weight of optional selections														
Frame size	+H354		+E208		+D150		+H356		+0H371		+H370		+0B051	
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
R10	-7	-15	3	7	10	22	2	4	-2.9	-6	2.9	6	-1.5	-3
R11	-7	-15	3	7	9	20	2	4	-2.9	-6	2.9	6	-1.5	-3

Height of drive module without pedestal (option +H354)		
Frame size	mm	in
R10, R11	-100	-3.94

Additional depth with option +C173 when the mounting brackets are used: 18.5 mm (0.73 in)

Required free space around the drive module 200 mm top and bottom.

Losses, cooling data and noise

ACS880-04-…	Frame size	Air flow		Heat dissipation	Noise
		m^3/h	ft^3/min	W	dB(A)
U_n = 400 V					
ACS880-04-505A-3	R10	1200	707	5602	72
ACS880-04-585A-3	R10	1200	707	6409	72
ACS880-04-650A-3	R10	1200	707	8122	72
ACS880-04-725A-3	R11	1200	707	8764	72
ACS880-04-820A-3	R11	1200	707	9862	72
ACS880-04-880A-3	R11	1420	848	10578	71
U_n = 500 V					
ACS880-04-460A-5	R10	1200	707	4403	72
ACS880-04-503A-5	R10	1200	707	5602	72
ACS880-04-583A-5	R10	1200	707	6409	72
ACS880-04-635A-5	R10	1200	707	8122	72
ACS880-04-715A-5	R11	1200	707	8764	72
ACS880-04-820A-5	R11	1420	848	9862	71
ACS880-04-880A-5	R11	1420	848	10578	71
U_n = 690 V					
ACS880-04-330A-7	R10	1200	707	5140	72
ACS880-04-370A-7	R10	1200	707	5871	72
ACS880-04-430A-7	R10	1200	707	7070	72
ACS880-04-470A-7	R11	1200	707	6111	72
ACS880-04-522A-7	R11	1200	707	6888	72
ACS880-04-590A-7	R11	1200	707	8471	72
ACS880-04-650A-7	R11	1420	848	9480	71
ACS880-04-721A-7	R11	1420	848	10677	71

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.

Typical power cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for the drive modules with nominal current. See also *Terminal and entry data for the power cables (page 229)*.

ACS880-04-...	**IEC[1)]**		**US[2)]**	
	Cu cable type	**Al cable type**	**Cu cable type**	**Al cable type**
	mm^2	**mm^2**	**AWG/kcmil**	**AWG/kcmil**
U_n = 400 V				
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×(3×120)	3×(3×185)	2×600 MCM or 3×300 MCM	3×400 MCM or 4×250 MCM
650A-3	3×(3×150)	3×(3×240)	2×700 MCM or 3×350 MCM	3×400 MCM or 4×250 MCM
725A-3	3×(3×185)	4×(3×185)	3×500 MCM or 4×300 MCM	3×500 MCM or 4×300 MCM
820A-3	3×(3×240)	4×(3×240)	3×600 MCM or 4×400 MCM	3×700 MCM or 4×500 MCM
880A-3	3×(3×240)	4×(3×240)	3×600 MCM or 4×400 MCM	4×500 MCM
U_n = 500 V				
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
635A-5	3×(3×150)	3×(3×240)	2×700 MCM or 3×350 MCM	3×600 MCM or 4×400 MCM
715A-5	3×(3×185)	4×(3×185)	3×500 MCM or 4×300 MCM	3×600 MCM or 4×400 MCM
820A-5	3×(3×240)	4×(3×240)	3×600 MCM or 4×400 MCM	4×500 MCM
880A-5	3×(3×240)	4×(3×240)	3×600 MCM or 4×400 MCM	4×500 MCM
U_n = 690 V				
330A-7	2×(3×95)	2×(3×120)	2×300 MCM or 3×3/0	2×350 MCM or 3×4/0
370A-7	2×(3×95)	2×(3×120)	2×300 MCM or 3×3/0	2×400 MCM or 3×4/0
430A-7	2×(3×95)	2×(3×120)	2×350 MCM or 3×4/0	2×500 MCM or 3×250 MCM
470A-7	3×(3×95)	3×(3×150)	2×400 MCM or 3×4/0	2×600 MCM or 3×300 MCM

522A-7	3×(3×120)	3×(3×185)	2×500 MCM or 3×250 MCM	2×700 MCM or 3×350 MCM
590A-7	3×(3×150)	3×(3×185)	2×600 MCM or 3×300 MCM	3×500 MCM or 4×300 MCM
650A-7	3×(3×150)	3×(3×240)	2×700 MCM or 3×350 MCM	3×500 MCM or 4×300 MCM
721A-7	3×(3×185)	4×(3×185)	3×500 MCM or 4×300 MCM	3×600 MCM or 4×400 MCM

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.

Terminal and entry data for the power cables

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

Units with optional cabling panels (+H381)

The maximum accepted cable size is 4 × (3 × 240) mm^2 or 4 × (3 × 500 MCM). The cabling panels are connected to the drive module busbars with M12 serpress nuts, tightening torque 30 N·m (20 lbf·ft).

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] mm^2 or 4 ×[(3×500 MCM]) only with special cable lugs and additional insulation. For more information, contact your local ABB representative.

Terminal data for the control cables

See section *Default I/O diagram of the drive control unit (ZCU-1x) (page 149)*

Electrical power network specification

Voltage (U_1)	ACS880-04-xxxx-3 drives: 380…415 VAC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage level 3~400 V AC. ACS880-04-xxxx-5 drives: 380…500 V AC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage levels 3~400/480/500 V AC. ACS880-04-xxxx-7 drives: 525…690 V AC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage levels 3~525/600/690 V AC.
Network type	TN (grounded) and IT (ungrounded) systems
Rated conditional short-circuit current I_{CC} (IEC 61439-1)	Maximum allowable prospective short-circuit current is 65 kA when protected by the fuses given in the fuse table.
Prospective short-circuit current rating Pscc (IEC 61800-5-1)	Maximum allowable prospective short-circuit current is 65 kA when protected by the fuses given in the fuse table.
Prospective short-circuit current rating SCCR (UL 61800-5-1, CSA 22.2 No. 274-17)	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 the fuses given in the fuse table.
Short-circuit current protection (UL 61800-5-1, CSA C22.2 No. 274-17)	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
Fundamental power factor (cos phi_1)	0.98 (at nominal load)

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet motors and AC induction servomotors.
Voltage (U_2)	This is indicated in the type designation label as typical output voltage level 3~0…U_1.
Frequency (f_2)	0…500 Hz For drives with du/dt filter: 200 Hz For drives with sine filter: 120 Hz
Frequency resolution	0.01 Hz
Current	See section *Ratings (page 213)*.

Switching frequency	3 kHz (typically)
Maximum recommended motor cable length	DTC control: 500 m (1640 ft) Scalar control: 500 m (1640 ft) **Note:** With motor cables longer than 100 m (328 ft), the EMC Directive requirements may not be fulfilled. **Note:** Long 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.
Minimum recommended motor cable length	For drive modules without d*u*/d*t* filter: 2 m (7 ft) from each drive module to the motor or 4 m (13 ft) between the drive modules. The motor cabling must be symmetrical. See also section *du/dt filters (page 295)*

Brake resistor data

See section *Ratings (page 291)*.

d*u*/d*t* and sine filters

See section *Filters (page 295)*.

DC connection data

ACS880-04-...	I_{DC} (A)	Capacitance (mF)
U_n = 400 V		
ACS880-04-505A-3	640	14.0
ACS880-04-585A-3	714	14.0
ACS880-04-650A-3	870	14.0
ACS880-04-725A-3	909	21.0
ACS880-04-820A-3	1033	21.0
ACS880-04-880A-3	1120	21.0
U_n = 500 V		
ACS880-04-460A-5	487	14.0
ACS880-04-503A-5	640	14.0
ACS880-04-583A-5	714	14.0
ACS880-04-635A-5	870	14.0
ACS880-04-715A-5	906	21.0
ACS880-04-820A-5	1033	21.0
ACS880-04-880A-5	1120	21.0
U_n = 690 V		
ACS880-04-330A-7	429	4.7
ACS880-04-370A-7	481	4.7

ACS880-04-…	I_{DC} (A)	Capacitance (mF)
ACS880-04-430A-7	559	4.7
ACS880-04-470A-7	611	9.3
ACS880-04-522A-7	679	9.3
ACS880-04-590A-7	767	9.3
ACS880-04-650A-7	845	9.3
ACS880-04-721A-7	937	9.3

Control panel type

ACS-AP-W assistant control panel with Bluetooth connection.

Efficiency

Approximately 98% at nominal power level.

Protection classes for module

Degrees of protection (IEC/EN 60529)	IP00 (standard) IP20 (with option "IP20 shrouds for covering the input and motor cabling area") IP20 (with option "Full power cabling panels to be attached to a cabinet (IP20)") Heatsink: IP55
Enclosure types (UL 61800-5-1)	UL Type Open Heatsink: UL Type 12
Overvoltage category (IEC/EN 60664-1)	III
Protective class (IEC/EN 61800-5-1)	I

Ambient conditions

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

	Operation (installed for stationary use)	**Storage (in the protective package)**	**Transportation (in the protective package)**
Installation site altitude	For TN and TT neutral-grounded network systems and IT non-corner-grounded network systems: 0 to 4000 m (13123 ft) above sea level For corner-grounded network systems: 0 to 2000 m (6561 ft) above sea level Above 1000 m (3281 ft): see section *When is derating necessary (page 216)*	-	-
Surrounding air temperature	-15…+55 °C (5…131 °F). No frost allowed. See section *When is derating necessary (page 216)*	-40… 70 °C (-40…+158 °F)	-40…+70 °C (-40…+158 °F)
Relative humidity	5…95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels	IEC/EN 60721-3-3:2002	IEC 60721-3-1:1997	IEC 60721-3-2:1997
Chemical gases	Class 3C2	Class 1C2	Class 2C2
Solid particles	Class 3S2. No conductive dust allowed.	Class 1S3. (packing must support this, otherwise 1S2)	Class 2S2
Pollution degree IEC 62109-1	2		
Atmospheric pressure	70…106 kPa 0.7 … 1.05 atmospheres	70…106 kPa 0.7 … 1.05 atmospheres	60…106 kPa 0.6 … 1.05 atmospheres

	Operation (installed for stationary use)	**Storage (in the protective package)**	**Transportation (in the protective package)**
Vibration IEC 60068-2-6:2007, EN 60068-2-6:2008	Max. 0.1 mm (0.004 in) (10…57 Hz), max. 10 m/s^2 (33 ft/s^2) (57…150 Hz) sinusoidal	Max. 1 mm (0.04 in) (5 … 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2…100 Hz) sinusoidal	Max. 3.5 mm (0.14 in) (2…9 Hz), max. 15 m/s^2 (49 ft/s^2) (9…200 Hz) sinusoidal
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009	Not allowed	With packing max. 100 m/s^2 (330 ft/s^2), 11 ms	With packing max. 100 m/s^2 (330 ft/s^2), 11 ms
Free fall	Not allowed	100 mm (4 in) for weight over 100 kg (220 lb)	100 mm (4 in) for weight over 100 kg (220 lb)

Materials

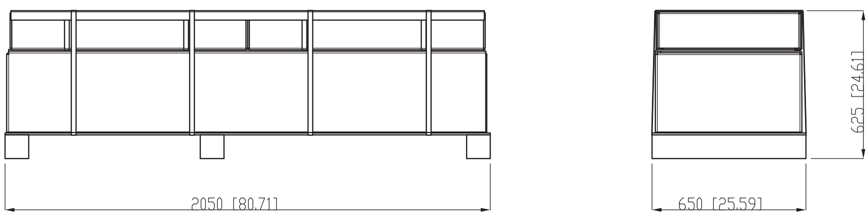
See *Recycling instructions and environmental information for ACS880-04, ACS880-04F, ACS880-14, ACS880-34, ACS580-04, ACH580-04, ACH580-34, ACQ580-04 and ACQ580-34 drives* (3AXD50000137688 [English]).

Color

RAL 9002

Package

Plywood and cardboard, bands PP.



3AUA0000101742

Disposal

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

Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and large electrolytic capacitors need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code.

Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.

Applicable standards

The drive complies with the following standards.

IEC/EN 61800-5-1:2007	*Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy*
EN 60204-1:2006 +A1:2010	*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. • emergency-stop device • supply disconnecting device • IP00 drive module into a cabinet.
IEC 60529:1989 + A1:1999 + A2:2013 EN 60529:1991 + A1:2000 + A2:2013	*Degrees of protection provided by enclosures (IP code)*
IEC 61800-3:2004 + A1:2011 EN 61800-3:2004 + A1:2012	*Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods*
UL 61800-5-1 First edition	*Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy*
CSA C22.2 No. 0-10	*General Requirements - Canadian Electrical Code, Part II*
CSA C22.2 No. 274-17	*Adjustable speed drives*

Markings

These markings are attached to the drive:

CE	CE mark Product complies with the applicable European Union legislation. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).
c UL us LISTED	UL Listed mark for USA and Canada Product has been tested and evaluated against the relevant North American standards by the Underwriters Laboratories. Valid with rated voltages up to 600 V.
TÜV NORD Safety Approved	TÜV Safety Approved mark (functional safety) Product contains Safe Torque Off and possibly other (optional) safety functions which are certified by TÜV according to the relevant functional safety standards. Applicable to drives and inverters; not applicable to supply, brake or DC/DC converter units or modules.

	CSA certification mark for USA and Canada Product has been tested and evaluated against the relevant North American standards by the CSA Group. Valid with rated voltages up to 600 V.
	EAC (Eurasian Conformity) mark Product complies with the technical regulations of the Eurasian Customs Union. EAC mark is required in Russia, Belarus and Kazakhstan.
	Electronic Information Products (EIP) green mark The product complies with *the People's Republic of China Electronic Industry Standard* (SJ/T 11364-2014). The product does not contain toxic and hazardous substances or elements above the maximum concentration values, and it is an environmentally-friendly product which can be recycled.
	RCM mark Product complies with Australian and New Zealand requirements specific to EMC, telecommunications and electrical safety. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).
	KC mark Product complies with Korea's product safety requirements for electrical and electronic equipment and components that utilize power from 50…1000 V AC.
	WEEE mark At the end of life the product should enter the recycling system at an appropriate collection point and not placed in the normal waste stream.

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

Definitions

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

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

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

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

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

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

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

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

Category C2

The drive complies with the standard with the following provisions:

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

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

Note: Do not install a drive equipped with EMC filter +E202/ARFI-10 on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage to the unit.

Note: Do not install a drive equipped with EMC filter +E202/ARFI-10 on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage to the unit.

Category C3

The drive complies with the standard with the following provisions:

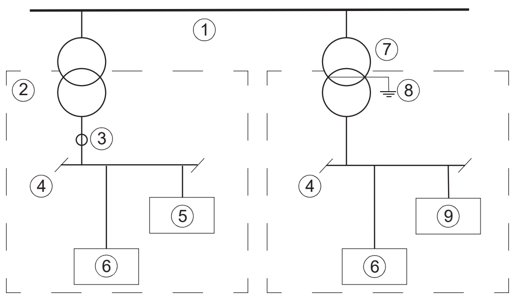
1. The drive is equipped with EMC filter +E200 or +E201.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 100 meters.

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

Category C4

The drive complies with the C4 category with these provisions:

1. It is ensured that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.



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

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

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

Compliance with the European Machinery Directive

The drive is an electronic product which is covered by the European Low Voltage Directive. However, the drive includes the Safe torque off function and can be equipped with other safety functions for machinery which, as safety components, are in the scope of the Machinery Directive. These functions of the drive comply with European harmonized standards such as EN 61800-5-2. The declaration of conformity is shown in chapter *The Safe torque off function (page 267)*.

UL and CSA checklist

WARNING!
Operation of this drive requires detailed installation and operation instructions provided in the hardware and software manuals. The manuals are provided in electronic format in the drive package or on the Internet. Keep the manuals with the drive at all times. Hard copies of the manuals can be ordered through the manufacturer.

- Make sure that the drive type designation label includes the applicable marking.
- **DANGER - Risk of electric shock.** After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.
- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to the enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.
- The maximum surrounding air temperature is 40 °C at rated output current. The output current is derated for 40 … 55 °C.
- The drive is suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes , 600 V maximum when protected by the UL fuses given elsewhere in this chapter.
- The cables located within the motor circuit must be rated for at least 75 °C in UL-compliant installations.
- The input cable must be protected with fuses or circuit breakers. These protective devices provide branch circuit protection in accordance with the national regulations (National Electrical Code (NEC) or Canadian Electrical Code). Obey also any other applicable local or provincial codes.

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

- The drive provides motor overload protection. This feature is not enabled when the drives leaves the ABB factory. For enabling this motor overload protection, see the firmware manual.
- The drive overvoltage category according to IEC 60664-1 is III

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.

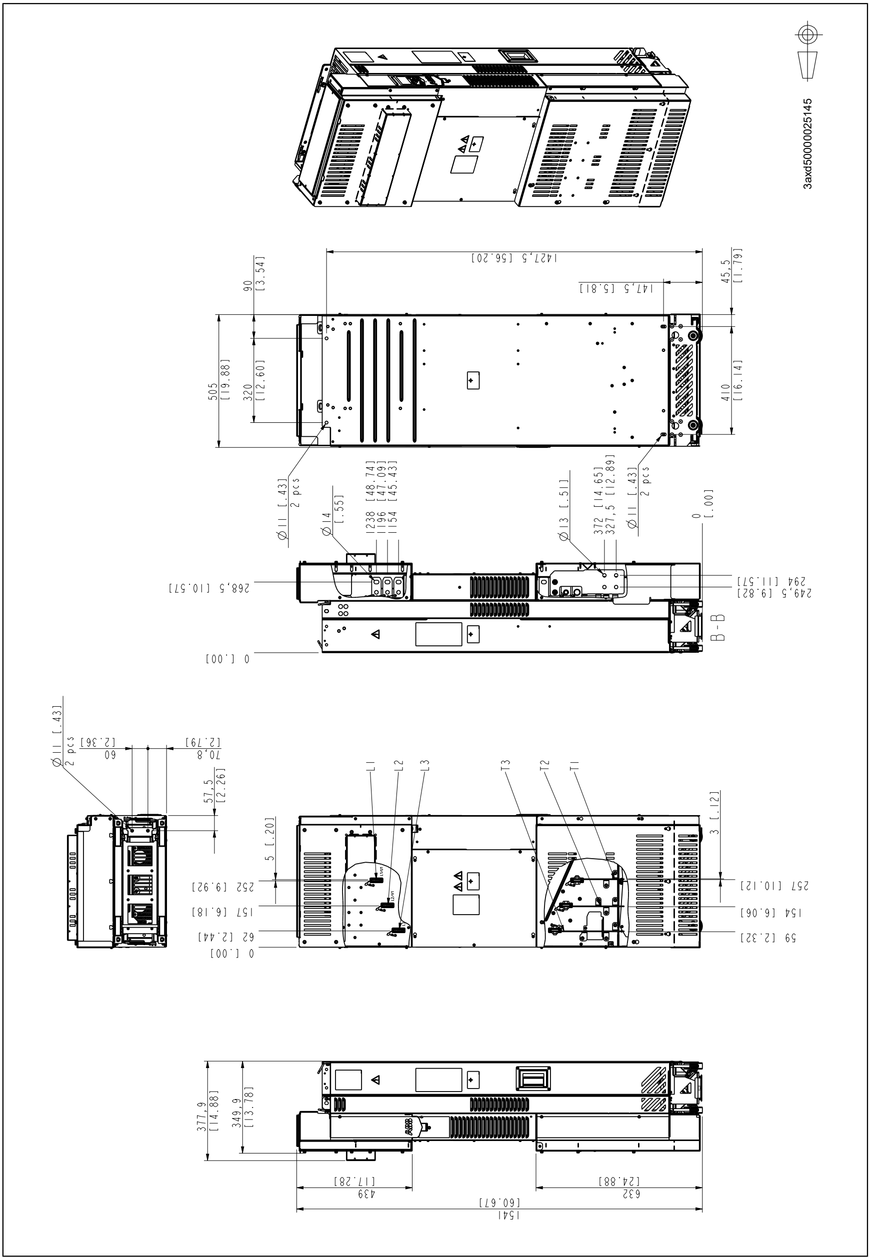
18

Dimension drawings

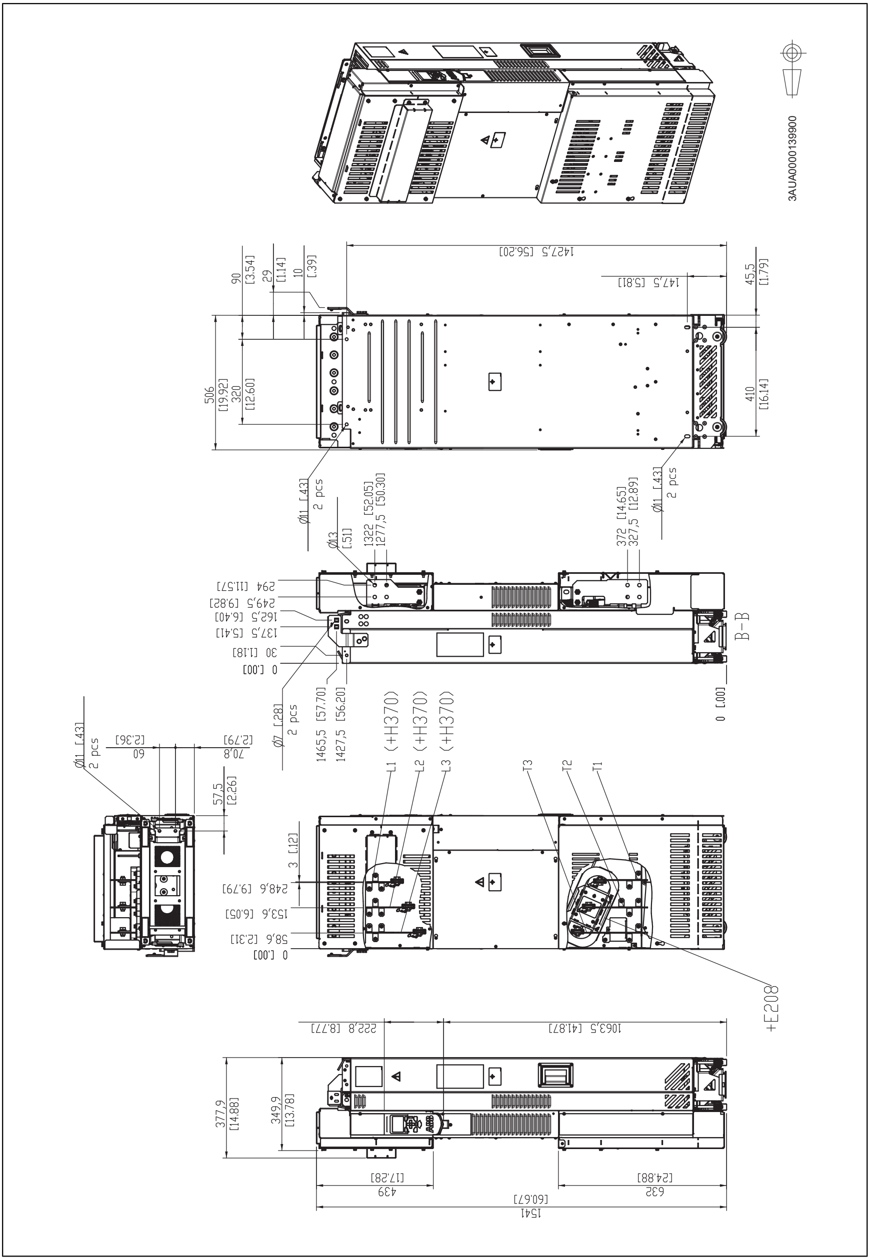
Contents of this chapter

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

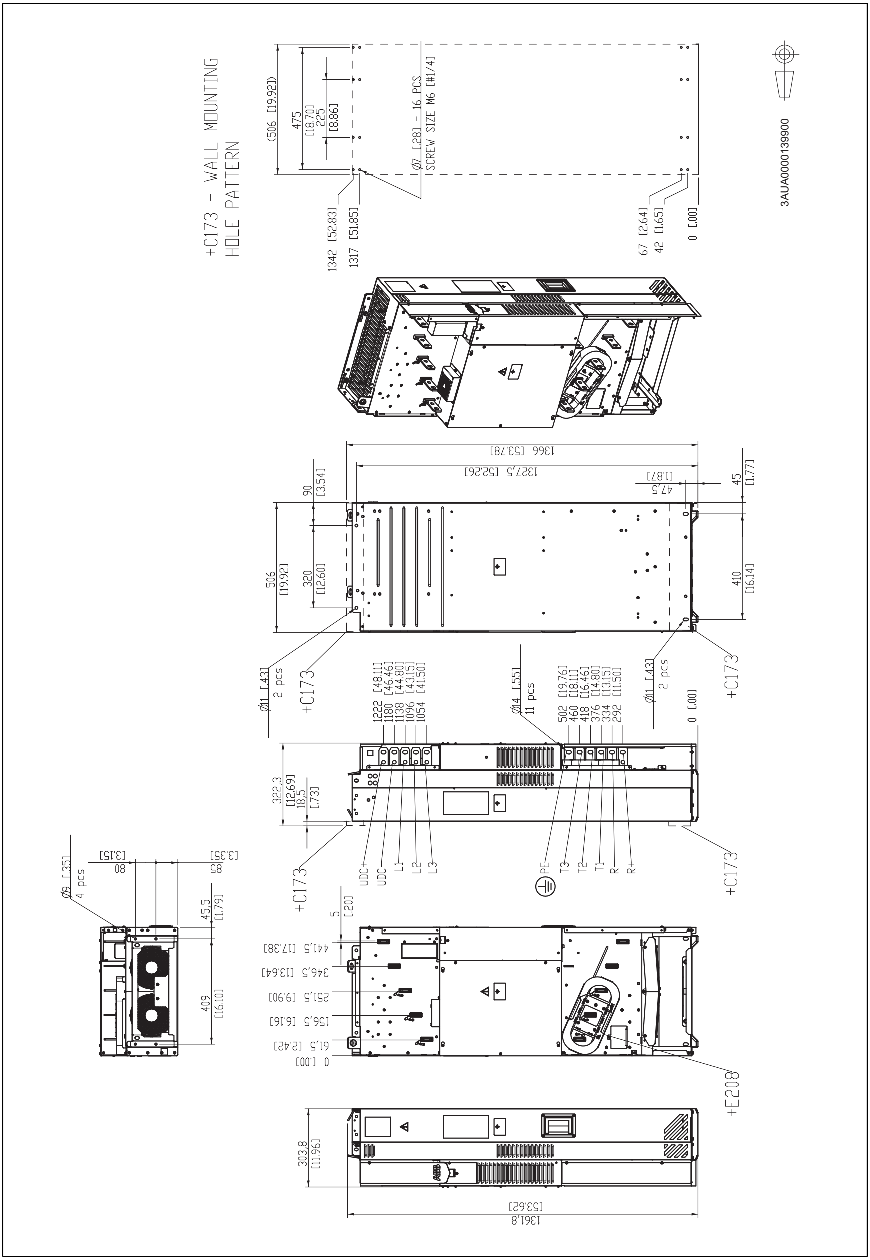
R10 – Standard configuration



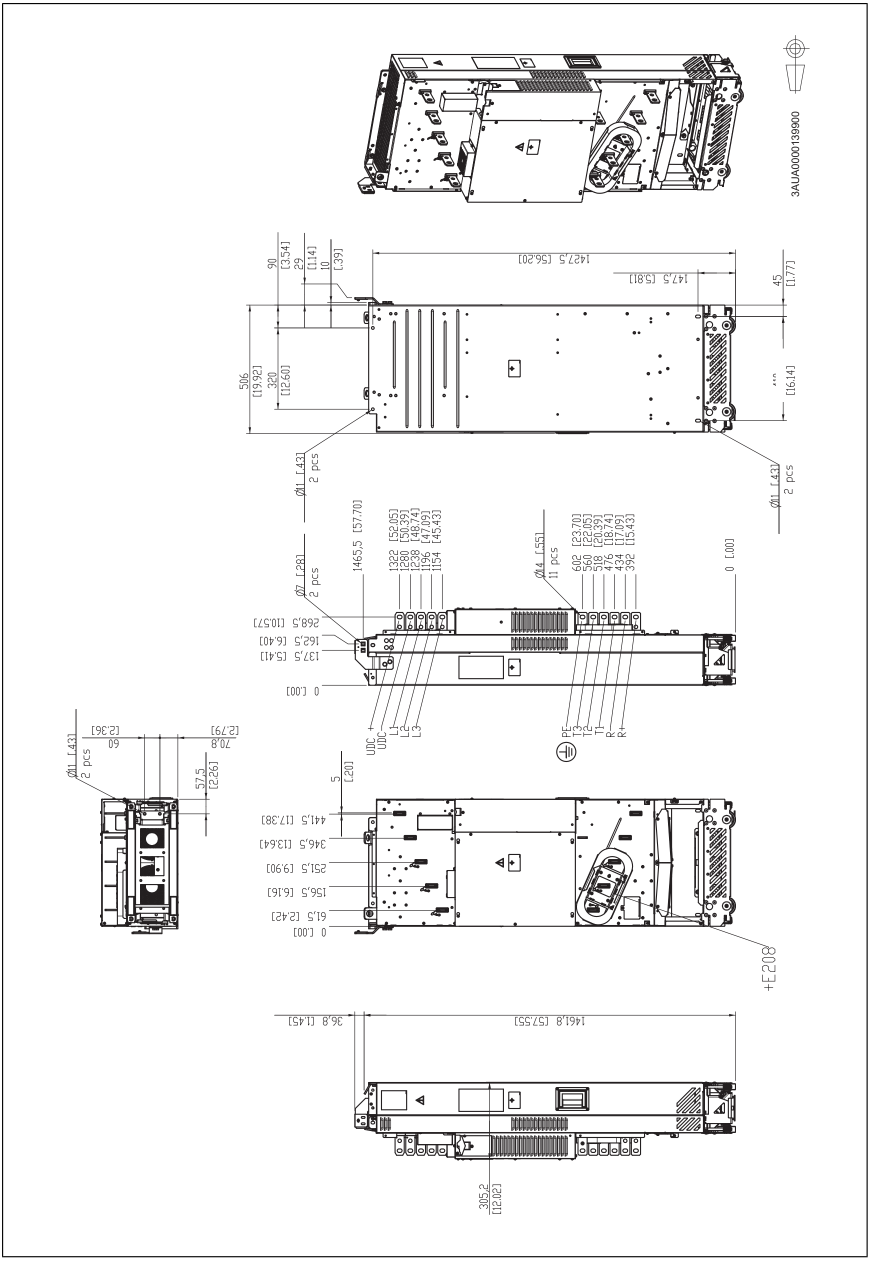
R10 with options +E208+H370+J414+P905



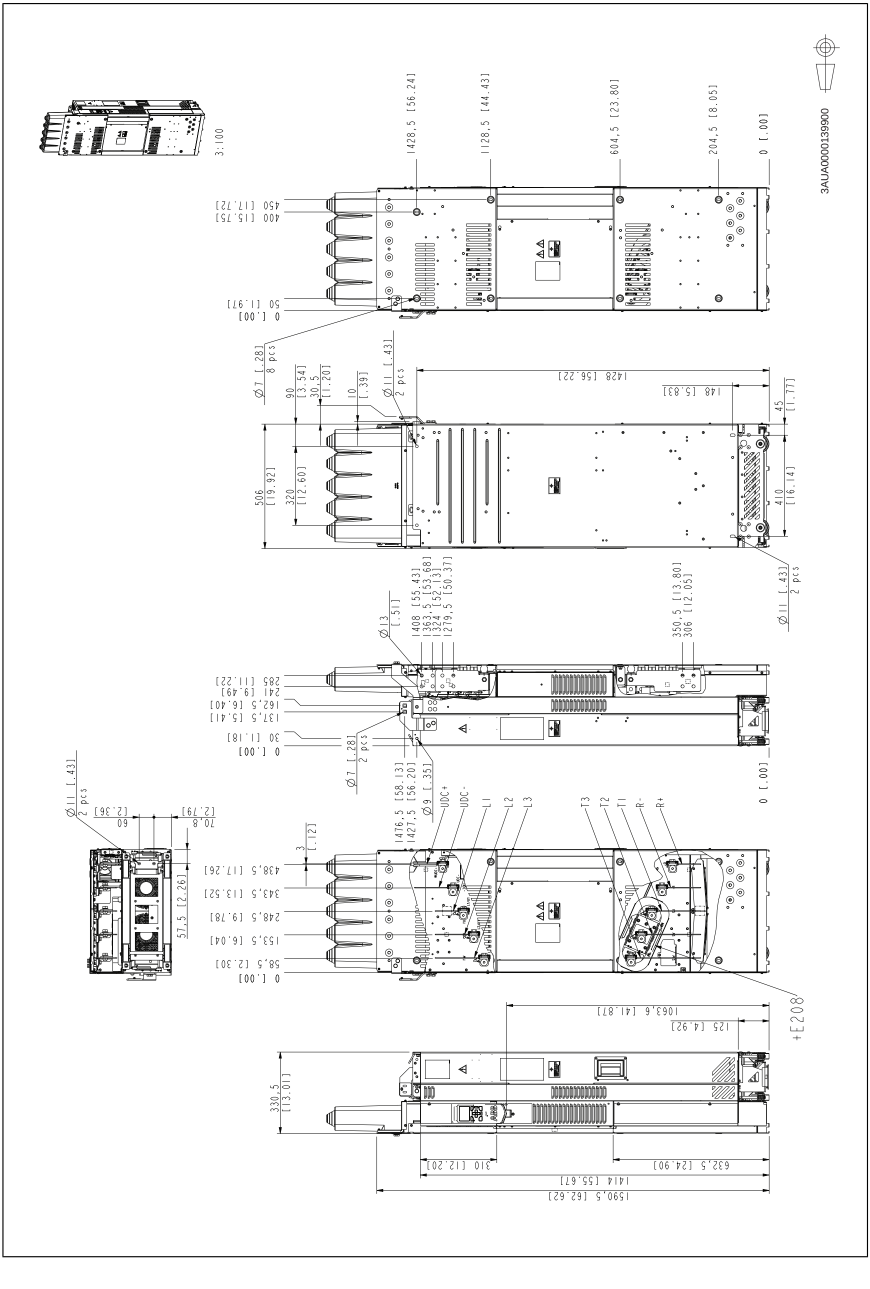
R10 with options +0B051+C173+E208+H356+0H354+0H371



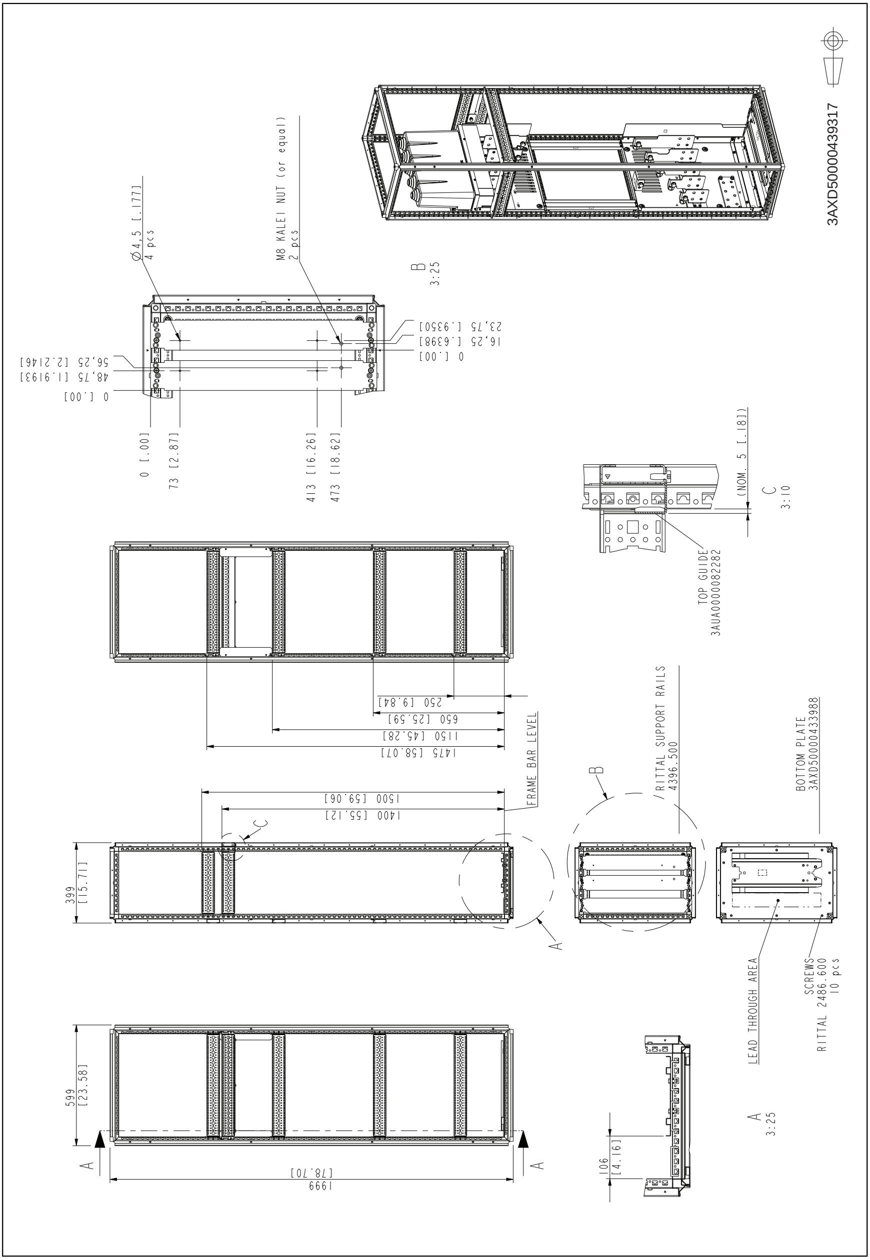
R10 with options +0B051+E208+H356+0H371



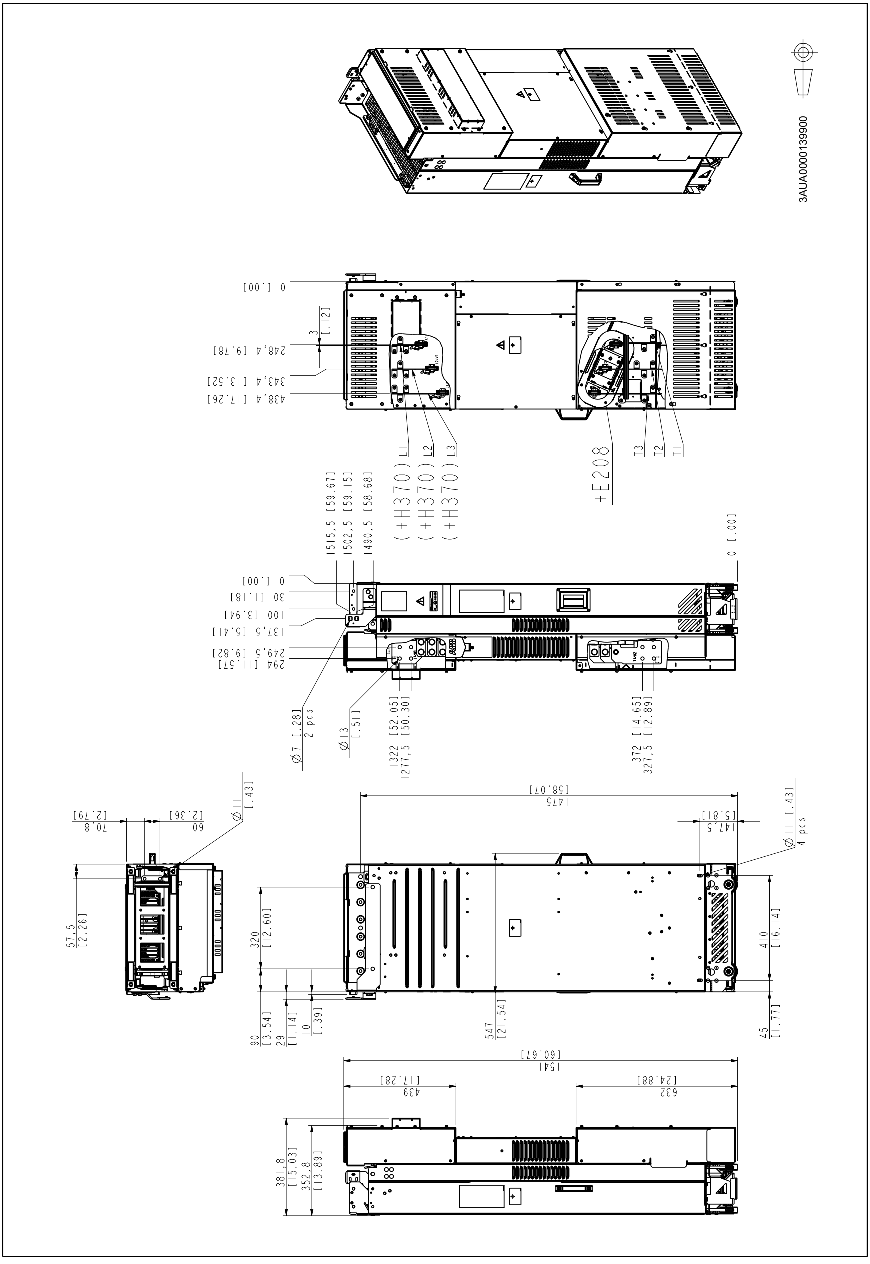
R10 with options +E208+H356+H381+J414+P905



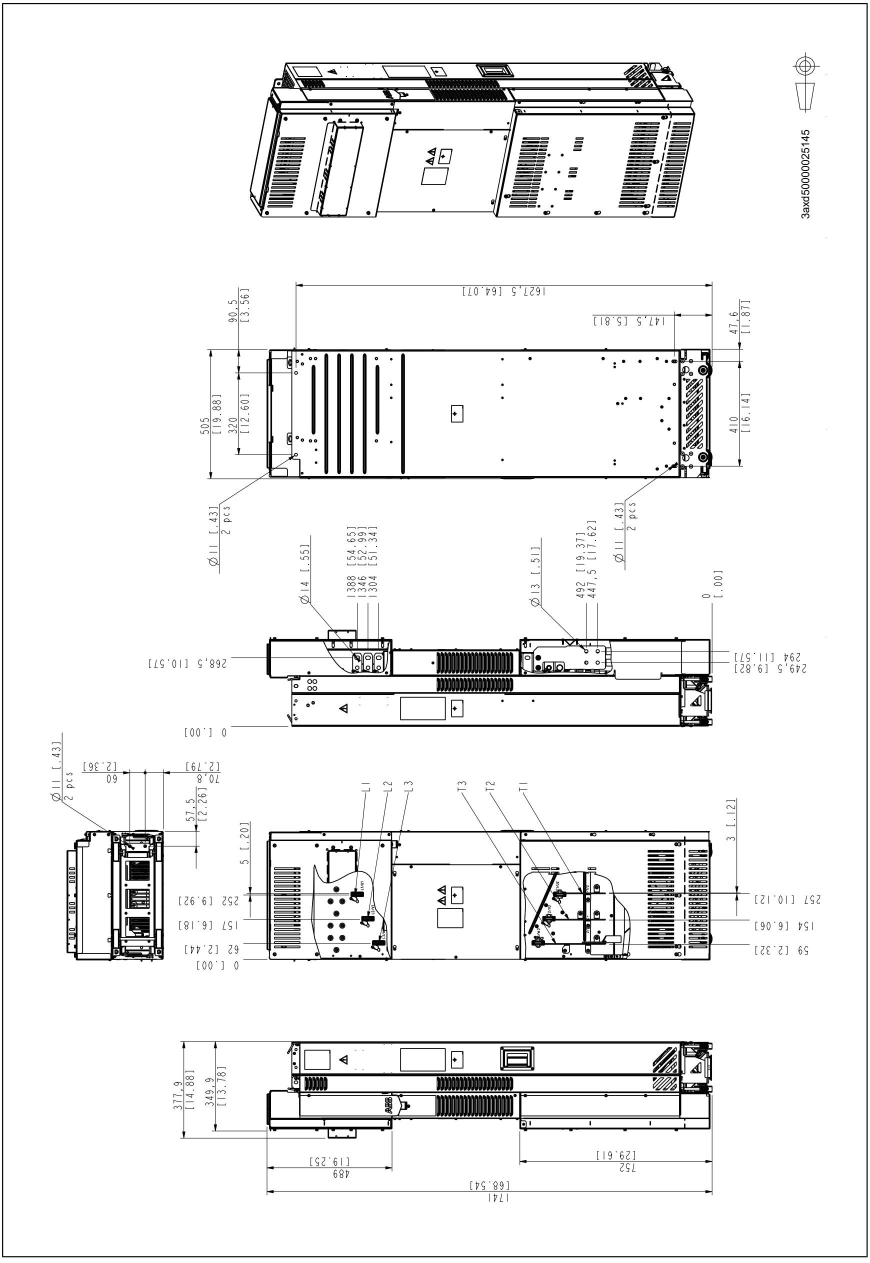
R10 – Cabling panels (+H381) installed into a Rittal VX25 enclosure



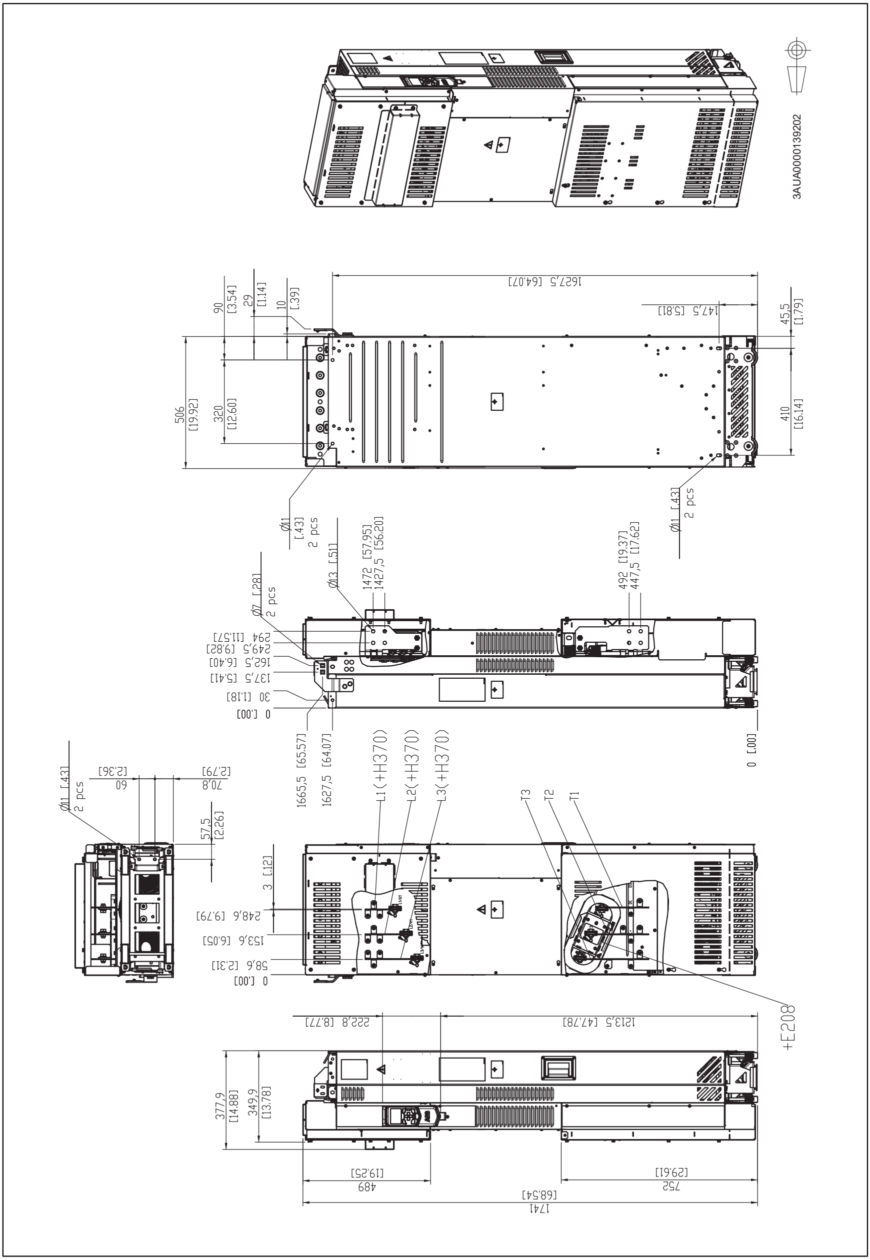
R10 with options +E208+H370+H391+0J400



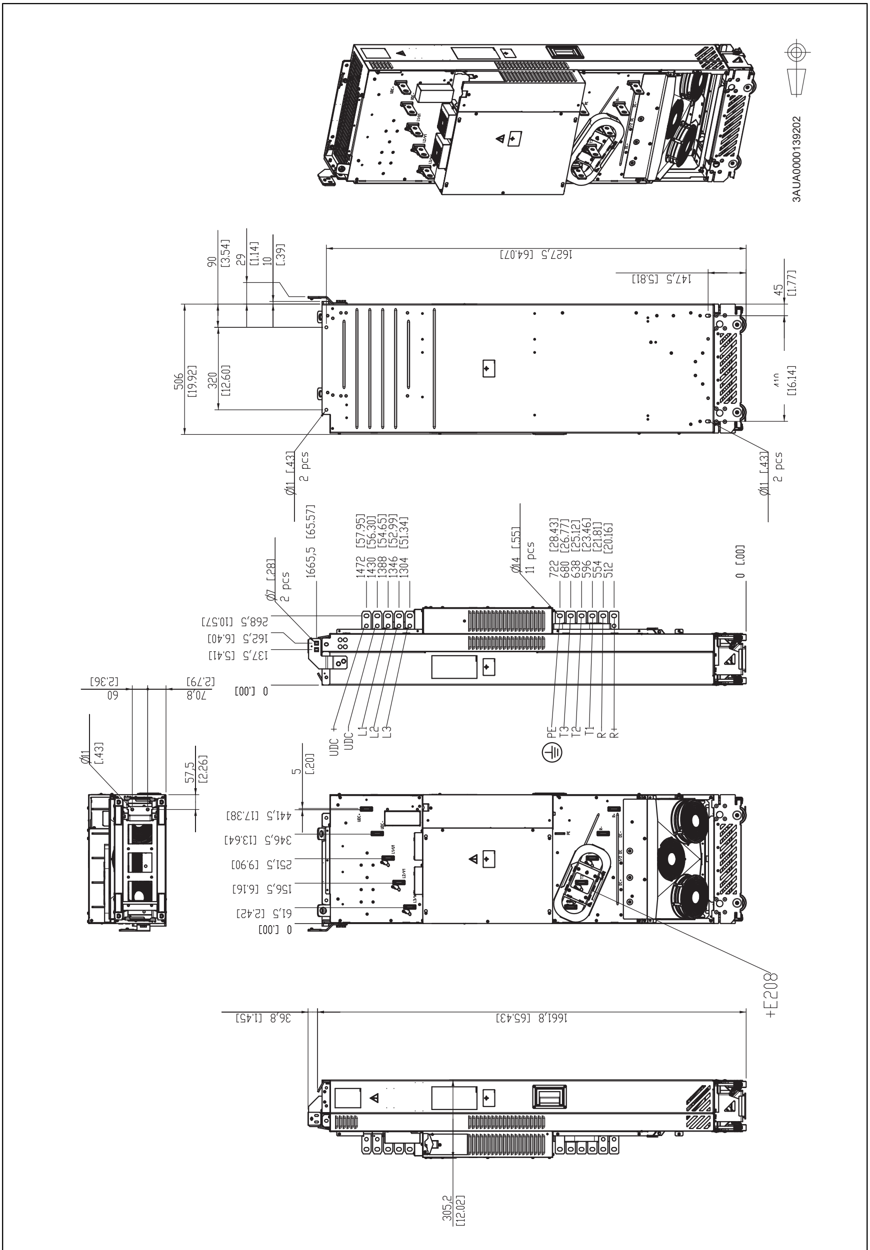
R11 – Standard configuration



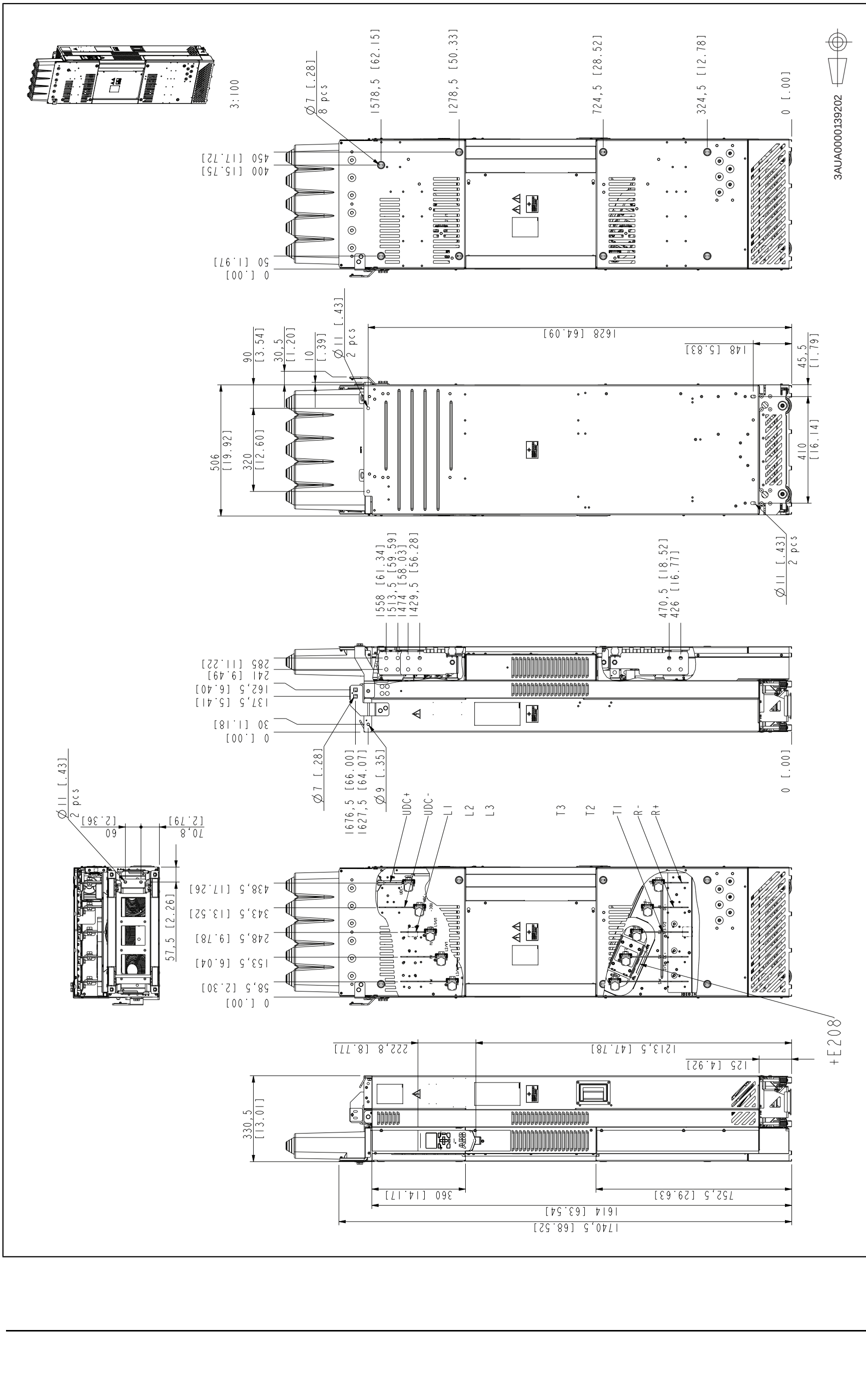
R11 with options +E208+H370+J414+P905



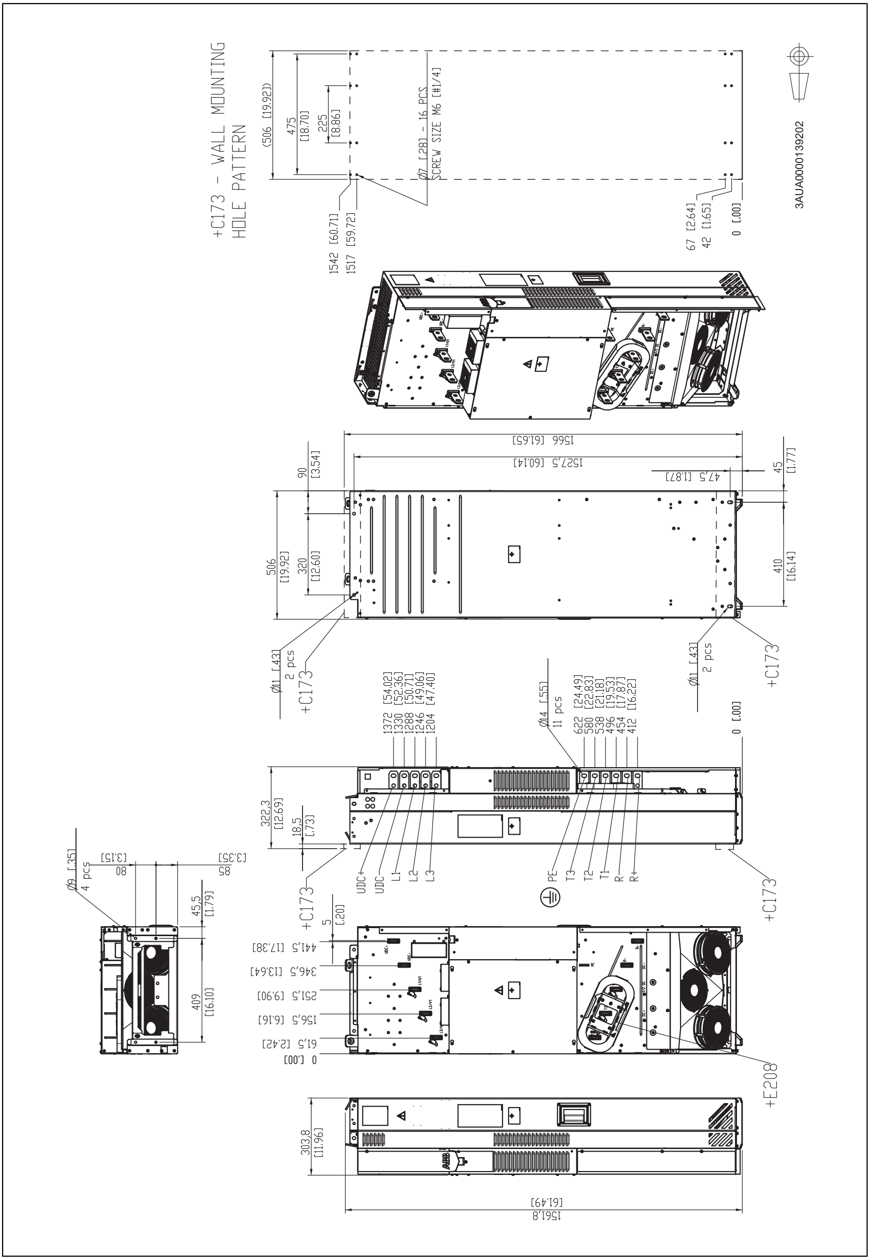
R11 with options +0B051+E208+H356+0H371



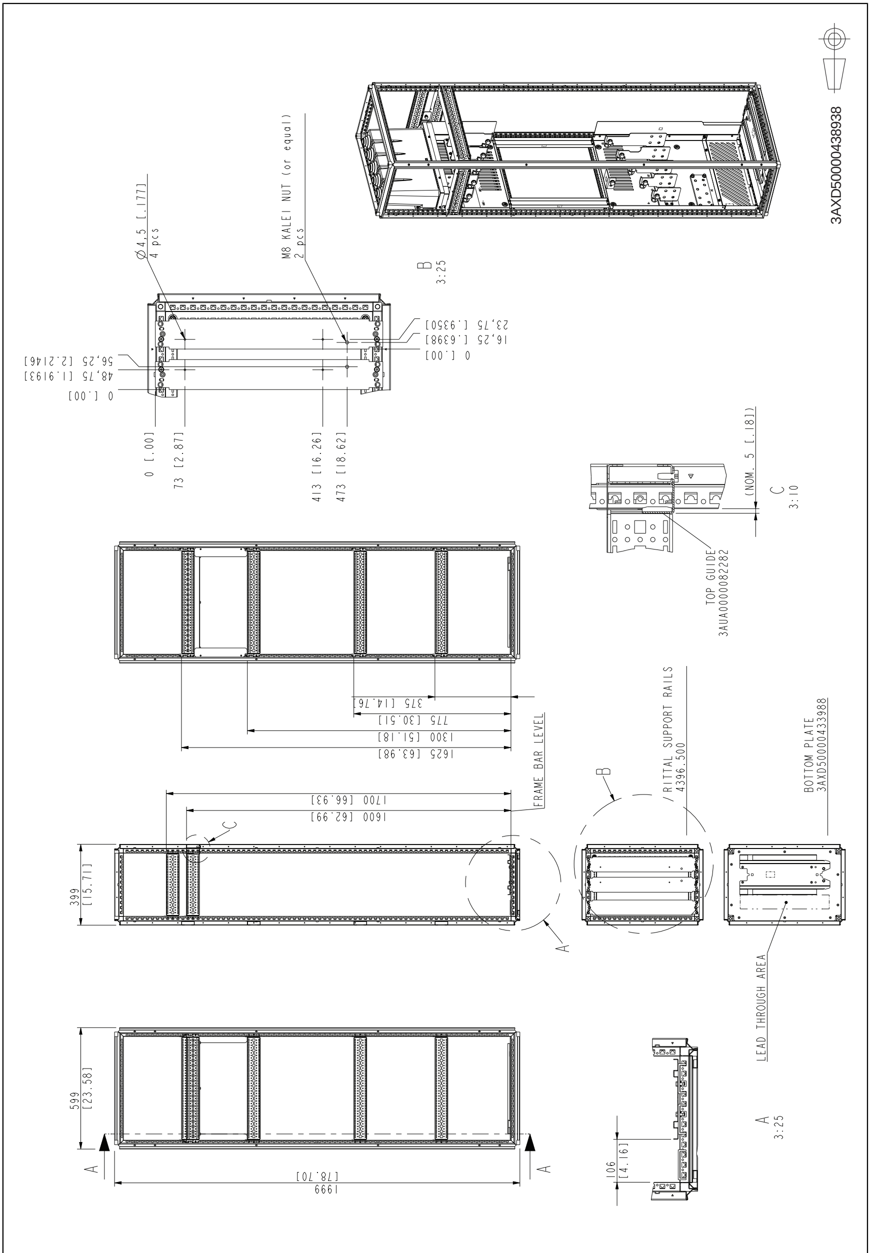
R11 with options +E208+H356+H381+J414+P905



R11 with options +0B051+C173+E208+H356+0H354+0H371

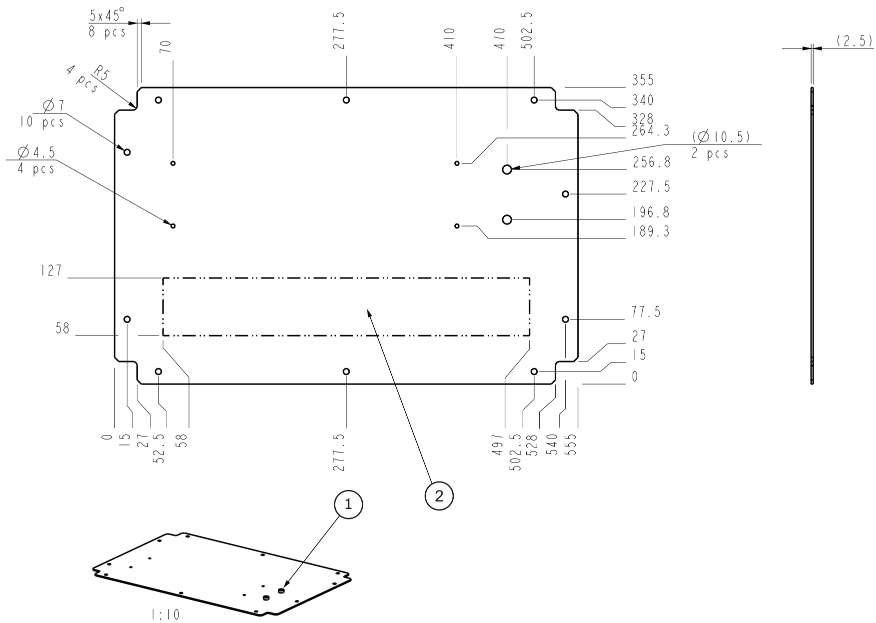


R11 – Cabling panels (+H381) installed into a Rittal VX25 enclosure



Bottom plate for option +H381 in Rittal VX25 400 mm wide enclosure installation

Note: The bottom plate is not an ABB part.



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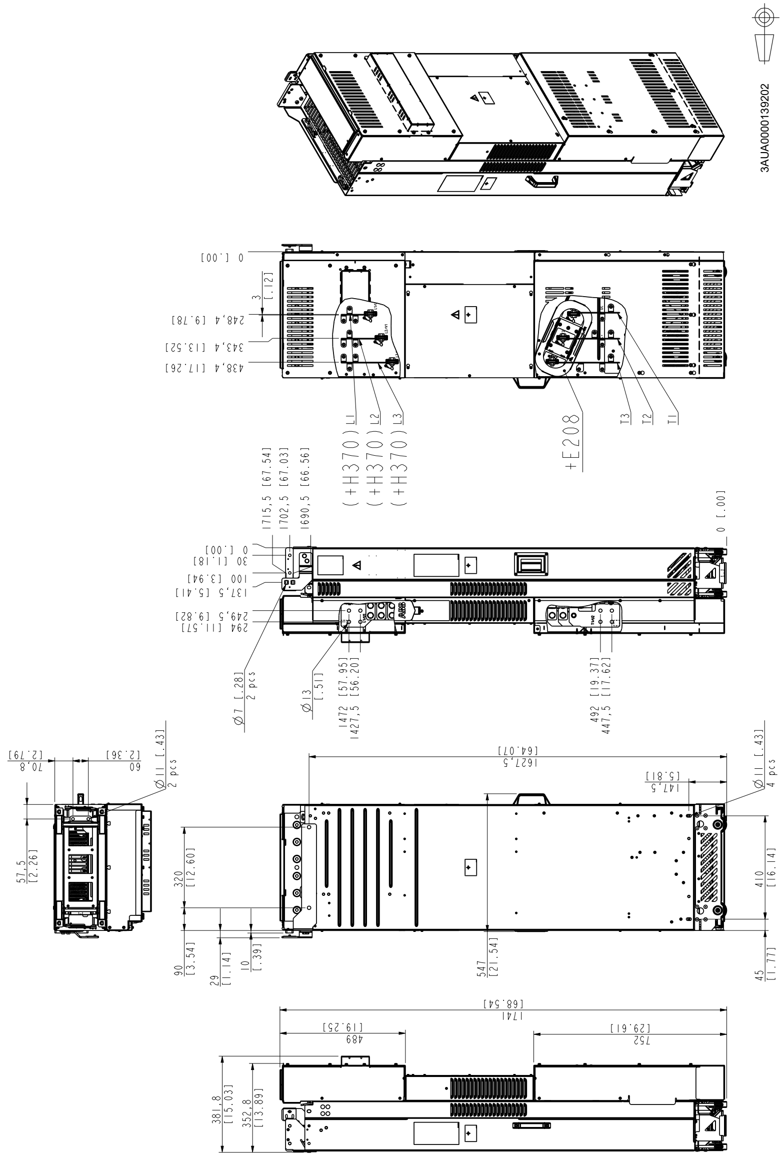
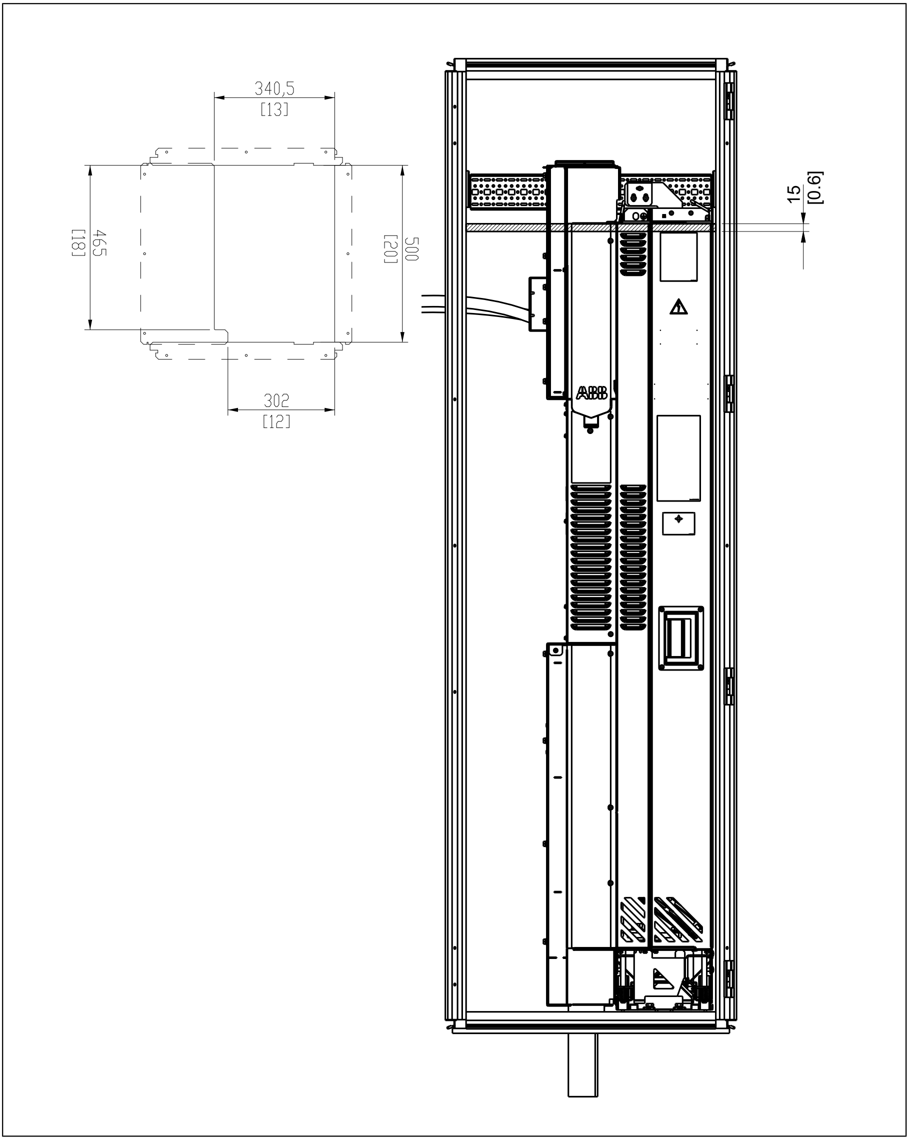
1	Insert nut PEM-S-M8-2 or equal (2 pcs)
2	Cable entry area

Frame R11 with options +E208+H370+H391+0J400



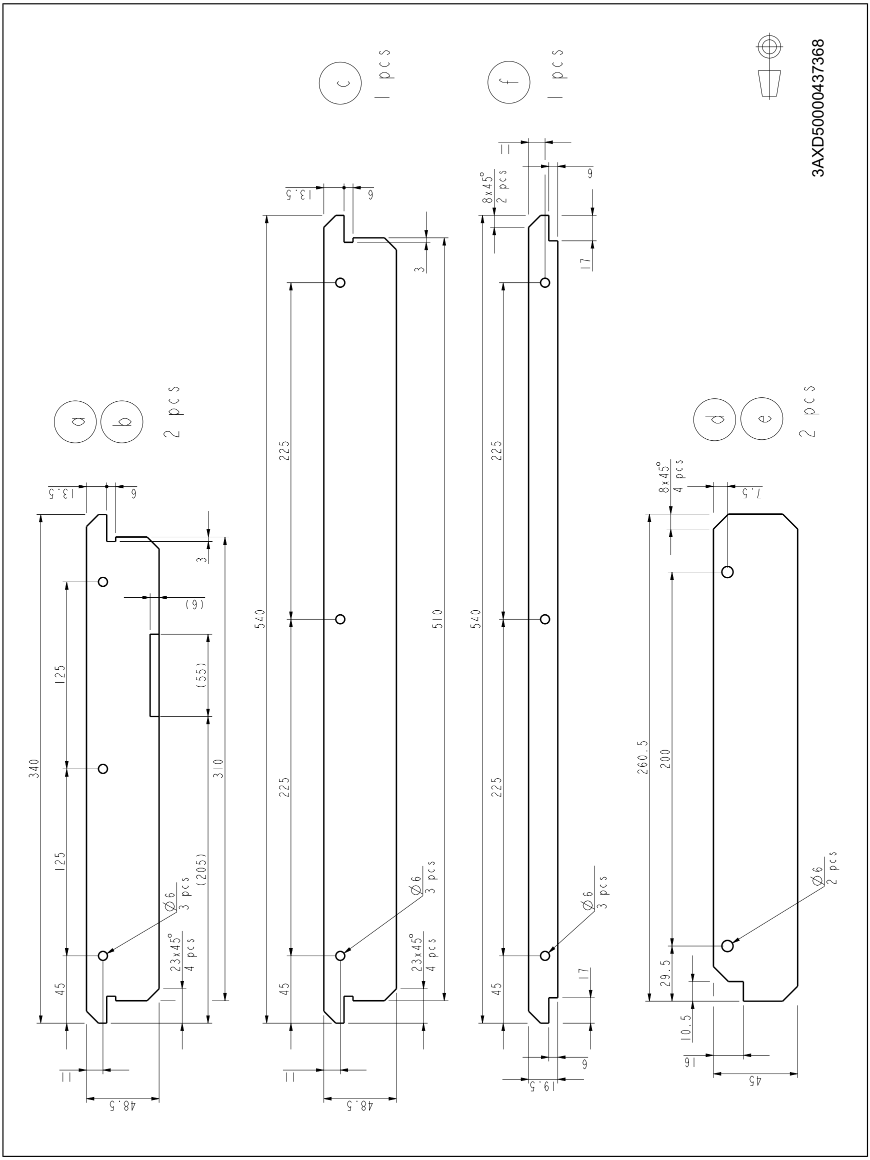
Air baffles for the standard drive module and option +C173

This drawing shows the dimensions of the hole in the air baffle around the standard drive module and flat mounting option +C173. The drawing also shows the correct vertical location area of the air baffle as measured from the top grill.



Air baffles for option +H381 in Rittal VX25 400 mm wide enclosure installation

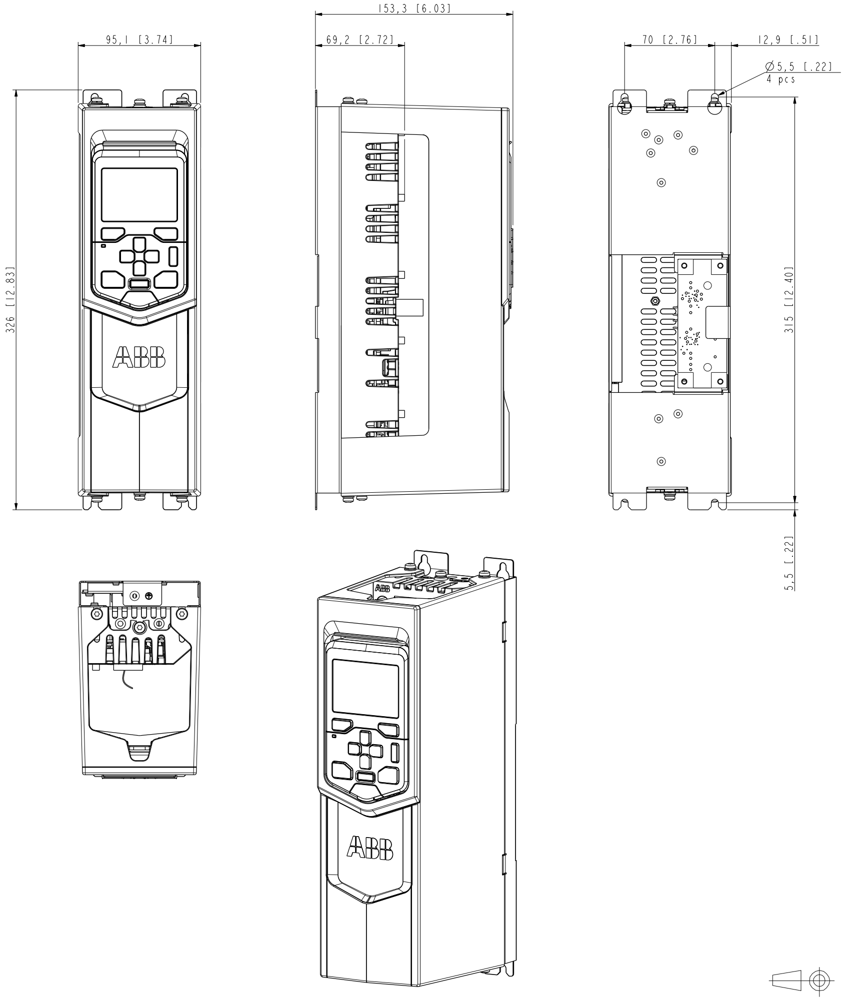
Note: These air baffles are not ABB parts.



Material of the air baffles

0.75 mm polycabonate (PC) film LEXAN® FR60 (GE) with UL94 V–0 listing, UV stability. Unmarked bend radii 0.6 mm.

External control unit



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19

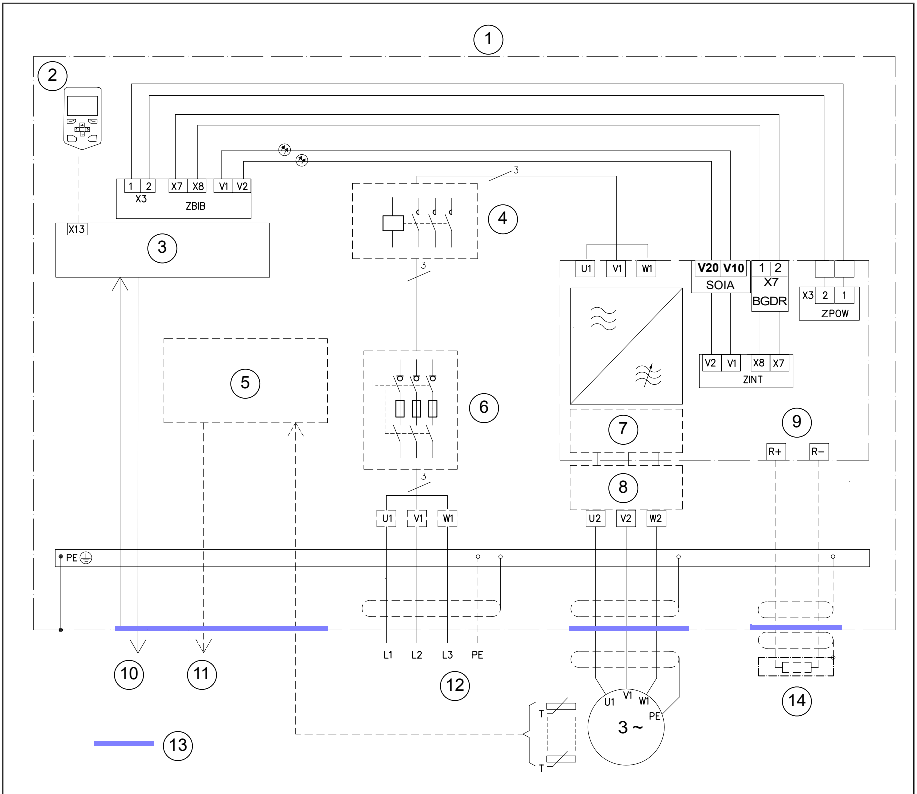
Example circuit diagram

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).



1	Cabinet
2	*ACS-CP-W control panel
3	ZCU control unit
4	***Main contactor
5	**Motor temperature supervision
6	***Switch fuse disconnector
7	*Common mode filter
8	***du/dt* filter or sine filter
9	Drive module
10	Input and output signals
11	Alarm
12	Supply

13	360 degree grounding recommended
14	**Brake resistor

20

The Safe torque off function

Contents of this chapter

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

Description

WARNING!
In case of parallel-connected drives or dual-winding motors, the STO must be activated on each drive to remove the torque from the motor.

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

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

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

The Safe torque off function complies with these standards:

Standard	Name
IEC 60204-1:2016 EN 60204-1:2018	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*
IEC 61000-6-7:2014	*Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*
IEC 61326-3-1:2017	*Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*
IEC 61508-1:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*
IEC 61508-2:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*
IEC 61511-1:2016	*Functional safety – Safety instrumented systems for the process industry sector*
IEC 61800-5-2:2016 EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
IEC 62061:2005 + A1:2012 + A2:2015 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 ISO 14118:2018 (ISO 14118:2017), and Uncontrolled stop (stop category 0) as specified in EN/IEC 60204-1.

Compliance with the European Machinery Directive

See the technical data.

The Declaration of conformity is shown at the end of this chapter.

Wiring

For the electrical specifications of the STO connection, see the technical data of the control unit.

Activation switch

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

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

Cable types and lengths

- Double-shielded twisted-pair cable is recommended.
- Maximum cable lengths:
  - 300 m (1000 ft) between activation switch [K] and drive control unit
  - 60 m (200 ft) between multiple drives
  - 60 m (200 ft) between external power supply and first control unit

Note: A short-circuit in the wiring between the switch and an STO terminal causes a dangerous fault. Therefore, it is recommended to use a safety relay (including wiring diagnostics) or a wiring method (shield grounding, channel separation) which reduces or eliminates the risk caused by the short-circuit.

Note: The voltage at the STO input terminals of the control unit must be at least 17 V DC to be interpreted as “1”.

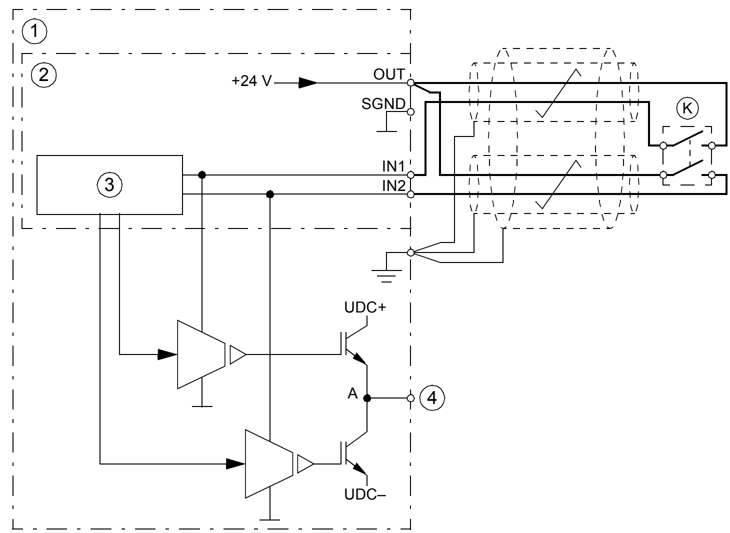
The pulse tolerance of the input channels is 1 ms.

Grounding of protective shields

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

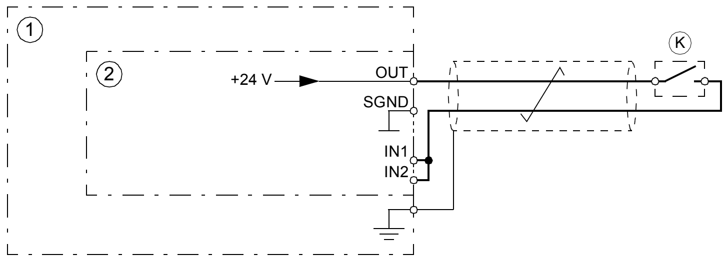
Single drive (internal power supply)

Dual-channel connection



1	Drive
2	Control unit
3	Control logic
4	To motor
K	Activation switch

Single-channel connection

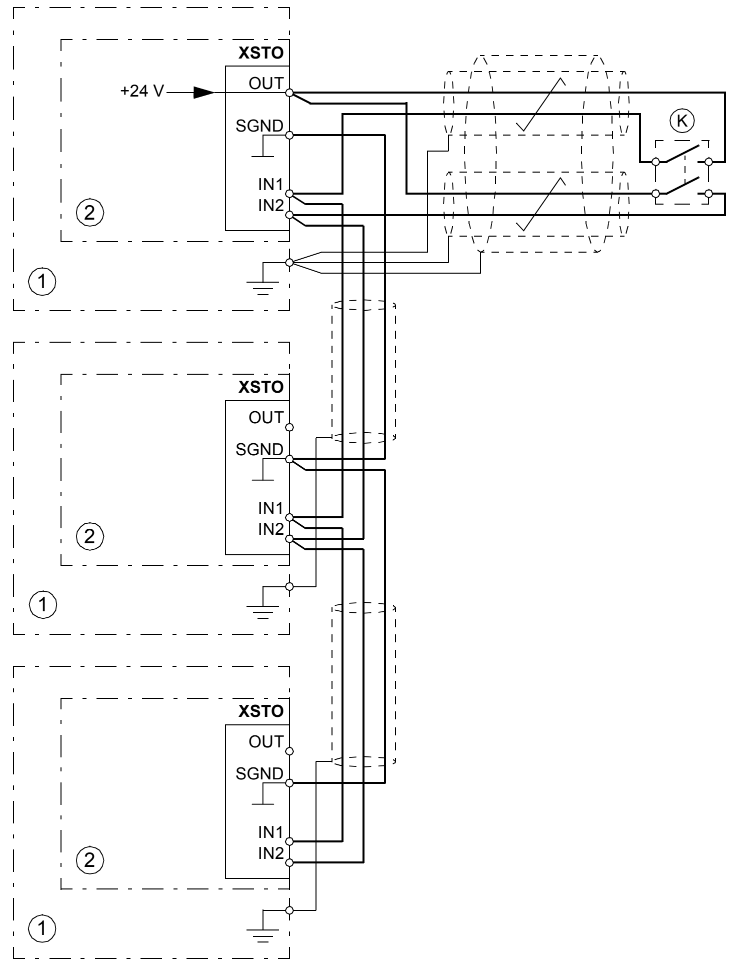


Note:
- Both STO inputs (IN1, IN2) must be connected to the activation switch. Otherwise, no SIL/PL classification is given.
- Pay special attention to avoiding any potential failure modes for the wiring. For example, use shielded cable. For measures for fault exclusion of wiring, see eg. EN ISO 13849-2:2012, table D.4.

1	Drive
2	Control unit
K	Activation switch

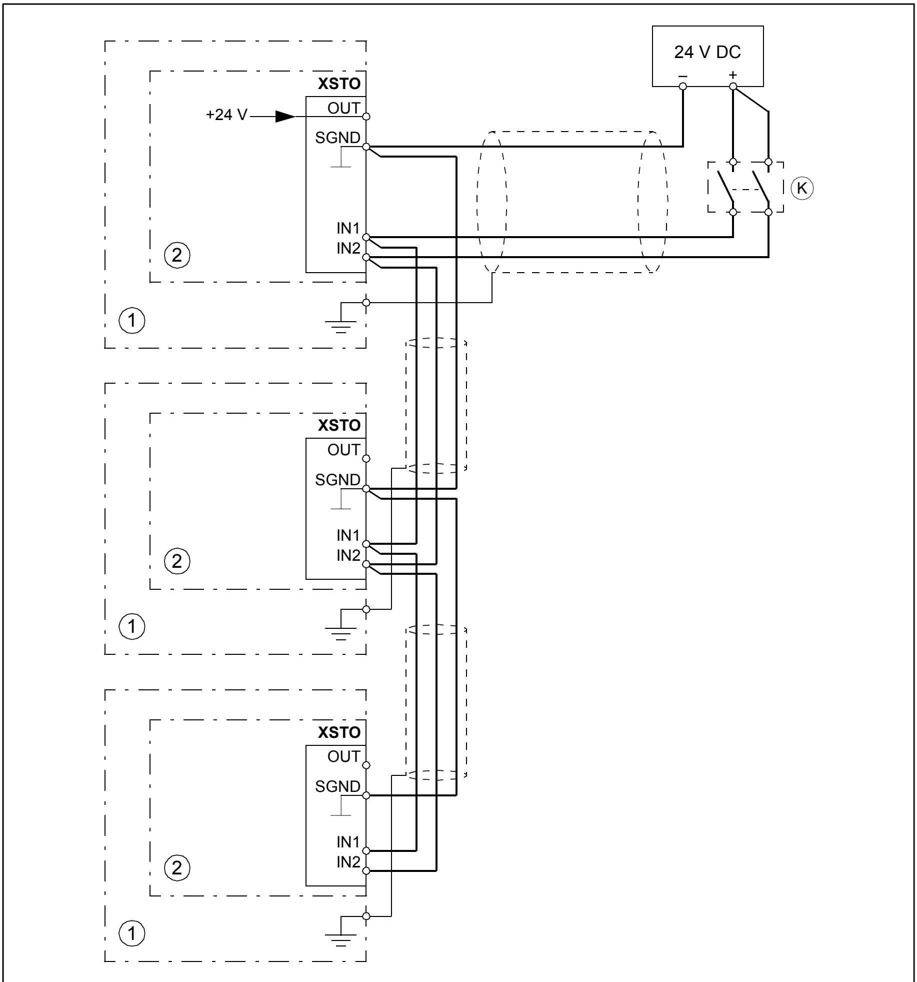
Multiple drives

Internal power supply



1	Drive
2	Control unit
K	Activation switch

External power supply



1	Drive
2	Control unit
K	Activation switch

Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. The STO inputs of the drive control unit de-energize.
3. The control unit cuts off the control voltage from the output IGBTs.
4. The control program generates an indication as defined by parameter *31.22* (see the firmware manual of the drive.

   The parameter selects which indications are given when one or both STO signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.

   Note: This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.

   Note: The loss of only one STO signal always generates a fault as it is interpreted as a malfunction of STO hardware or wiring.
5. The motor coasts to a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a reset may be needed (depending on the setting of parameter *31.22*). A new start command is required to start the drive.

Start-up including validation test

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

- 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
- after a drive firmware update.

Competence

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

Validation test reports

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

Validation test procedure

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

Note: If the drive is equipped with safety option +Q972, +Q973 or +Q982, also do the procedure shown in the FSO-xx module documentation.

Action	☑
⚠ **WARNING!** Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Make sure that the 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 using a disconnector.	☐
Check the STO circuit connections against the wiring diagram.	☐
Close the disconnector and switch the power on.	☐

Action	☑
Test the operation of the STO function when the motor is stopped. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter *31.22* (see the firmware manual). • Give a start command to verify that the STO function blocks the drive's operation. The drive generates a warning. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the STO function when the motor is running. • Start the drive and make sure the motor is running. • Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for the 'running' state in parameter *31.22* (see the firmware manual). • Reset any active faults and try to start the drive. • Make sure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the failure detection of the drive. The motor can be stopped or running. • Open the 1st channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates a *FA81 Safe Torque Off 1 loss* fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the drive's operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally. • Open the 2nd channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates a *FA82 Safe Torque Off 2 loss* fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the drive's operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Document and sign the validation test report which verifies that the safety function is safe and accepted for operation.	☐

Use

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

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

WARNING!
The drive cannot detect or memorize any changes in the STO circuitry when the drive control unit is not powered. If both STO circuits are closed and a level-type start signal is active when the power is restored, it is possible that the drive starts without a fresh start command. Take this into account in the risk assessment of the system.

WARNING!
(With permanent magnet or synchronous reluctance [SynRM] motors only)

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

Notes:

- If a running drive is stopped by using the Safe torque off function, the drive will cut off the motor supply voltage and the motor will coast to a stop. If this causes danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.

- The Safe torque off function overrides all other functions of the drive.
- The Safe torque off function is ineffective against deliberate sabotage or misuse.
- The Safe torque off function has been designed to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. The assembler of the machine must inform the final user about the residual risks.

Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 5 or 2 years; see section *Safety data (page 281)*. It is assumed that all dangerous failures of the STO circuit are detected by the proof test. To perform the proof test, do the *Validation test procedure (page 275)*.

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

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

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

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

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

If any wiring or component change is needed after start up, or the parameters are restored, do the test given in section *Validation test procedure (page 275)*.

Use only spare parts approved by ABB.

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

Competence

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

Fault tracing

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

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

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

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

Safety data

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

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

Frame size	SIL/ SILCL	PL	SFF (%)	PFH (T_1 = 20 a) (1/h)	PFD_{avg} (T_1 = 2 a)	PFD_{avg} (T_1 = 5 a)	$MTTF_D$ (a)	DC (%)	Cat.	SC	HFT	CCF	T_M (a)
R10 R11	3	e	99.65	3.65E-09	3.20E-05	8.00E-05	18327	≥90	3	3	1	80	20
													3AXD10000115366 H

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

- STO warning indication (parameter *31.22*) delay: < 1000 ms

Abbreviations

Abbr.	Reference	Description
Cat.	EN ISO 13849-1	Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage
HFT	IEC 61508	Hardware fault tolerance
$MTTF_D$	EN ISO 13849-1	Mean time to dangerous failure: (Total number of life units) / (Number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD_{avg}	IEC 61508	Average probability of dangerous failure on demand, that is, mean unavailability of a safety-related system to perform the specified safety function when a demand occurs
PFH	IEC 61508	Average frequency of dangerous failures per hour, that is, average frequency of a dangerous failure of a safety related system to perform the specified safety function over a given period of time
PL	EN ISO 13849-1	Performance level. Levels a…e correspond to SIL
SC	IEC 61508	Systematic capability
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1…3)
SILCL	IEC/EN 62061	Maximum SIL (level 1…3) that can be claimed for a safety function or subsystem
STO	IEC/EN 61800-5-2	Safe torque off
T_1	IEC 61508-6	Proof test interval. T_1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of T_1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. See also section Maintenance.
T_M	EN ISO 13849-1	Mission time: the period of time covering the intended use of the safety function/device. After the mission time elapses, the safety device must be replaced. Note that any T_M values given cannot be regarded as a guarantee or warranty.

TÜV certificate

The TÜV certificate is available on the Internet at www.abb.com/drives/documents.

Declaration of conformity

EU Declaration of Conformity

Machinery Directive 2006/42/EC

We

Manufacturer:	ABB Oy
Address:	Hiomotie 13, 00380 Helsinki, Finland.
Phone:	+358 10 22 11

declare under our sole responsibility that the following product:

Frequency converter(s)
ACS880-01/-11/-31
ACS880-04/-04F/-M04/-14/-34

with regard to the safety function(s)

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

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

The following harmonized standards have been applied:

EN 61800-5-2:2007	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional
EN 62061:2005 + 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, parts 1-2	Functional safety of electrical / electronic / programmable electronic safety-related systems
IEC 61800-5-2:2016	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional

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

Person authorized to compile the technical file:
Name and address: Jussi Vesti, Hiomotie 13, 00380 Helsinki, Finland.

Helsinki, 29.01.2020
Signed for and on behalf of:

Tuomo Tarula
Vice president,

Vesa Tuomainen
Product Engineering manager, ABB Oy

Document number 3AXD10000099646

Page 1 of 1

21

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.

When is resistor braking necessary?

Resistor braking is necessary for high capacity braking if a regenerative drive cannot be used.

Operation principle and hardware description

The drive can be equipped with optional built-in brake chopper (+D150). Brake resistors are available as add-on kits.

The brake chopper handles the energy generated by a decelerating motor. The extra energy increases the DC link voltage. 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

Generic guidelines

This section contains generic brake cable type, length and placing instructions, rules on how to minimize electromagnetic interference and descriptions and requirements for protections.

Resistor cables

Cable type

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.

Maximum cable length

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

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 is 0.3 meters (1 ft).
- Cross the other cables at 90 degree 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 greater the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

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

Protecting the resistor cable against short-circuits

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

Resistor thermal switch

Use a resistor with a thermal switch (standard in ABB resistors).

Make sure that the cable in the resistor thermal switch circuit meets the following requirements:

- shielded cable
- rated operating voltage between a core and ground > 750 (U_0)
- insulation test voltage > 2.5 kV
- jacket material for at least 90 °C (194 °F). Take into account further requirements due to resistor construction and temperature.

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 overload protection function which can be tuned by the user. See the firmware manual.

EMC compliance of the complete installation

ABB cannot test that the EMC requirements are fulfilled with custom brake resistors and cabling. The customer must consider the EMC compliance of the complete installation.

Placing the brake resistor

Install the resistor assembly outside the drive in a place where it is able to cool effectively.

Arrange the cooling of the resistor in a way that:

- no danger of overheating is caused to the resistor or nearby materials, and
- 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 in fault situations

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

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

Selecting the default brake system components

1. Calculate the maximum power generated by the motor during braking.
2. Select a suitable drive, brake chopper and brake resistor combination for the application from the brake ratings table below. The braking power of the chopper

must be greater than or equal to the maximum power generated by the motor during the braking.

3. Make sure that the resistor selection is correct: The energy generated by the motor during a 400-second period must not exceed the resistor heat dissipation capacity E_R.

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

Calculation example

Drive: ACS880-04-583A-5. Maximum continuous braking power (P_{brcont}) of the internal brake chopper = 315 kW. Preselected ABB resistor = 2×SAFUR200F50. Braking power of the motor is 300 kW. The duration of a braking cycle (T) is three minutes -> number of braking pulses in 400 seconds = 2.2. The braking time (t_{br}) is 20 seconds.

P_{br} = 300 kW < P_{brcont} = 315 kW. This is ok.

The energy generated by the motor during a 400-second period = 2.2 × 300 kW × 20 s = 13200 kJ. The brake resistor withstands an energy pulse of 10800 kJ in every 400 seconds period. 13200 kJ > 10800 kJ. -> The resistor is too small. -> Decrease the braking power or braking time or select a custom brake resistor as described in section *Selecting a custom brake resistor (page 288)*.

Selecting a custom brake resistor

If you use other than ABB resistor,

1. make sure that the resistance of the custom resistor is greater than or equal to the resistance of the default ABB resistor.

$$R \geq R_{min}$$

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

WARNING!
Never use a brake resistor with a resistance smaller than R_{min}. This will cause overcurrent that will damage the brake chopper and the drive.

2. make sure that the resistance of the custom resistor does not restrict the braking capability needed, ie.

$$P_{max} < \frac{U_{DC}^2}{R}$$

where

P_{max}	Maximum power generated by the motor during braking
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 1.35 · 1.2 · 690 V DC (when supply voltage is 525 to 690 AC)
R	Resistance of the custom resistor

3. make sure that the resistor can dissipate the energy transferred to it during the braking:

   - Braking energy is not greater than the resistor heat dissipation capacity (E_r) during the period specified. See the custom resistor specification.
   - The resistor is installed in a correctly ventilated and cooled space. Otherwise the resistor cannot meet its heat dissipation capacity and overheats.

4. make sure that the instantaneous load capacity of the custom resistor is greater than the maximum power taken by the resistor when it is connected to the drive intermediate DC circuit by the chopper:

$$P_{R,inst} > \frac{U_{DC}^2}{R}$$

where

$P_{R, inst}$	Instantaneous 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 1.35 · 1.2 · 690 V DC (when supply voltage is 525 to 690 AC)
R	Resistance of the custom resistor

Mechanical installation of resistors

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

Electrical installation

Measuring the insulation of the assembly

Obey the instructions given in section *Measuring the insulation of the brake resistor circuit (page 125)*.

Connection diagram

See section *Power cable connection diagram (page 127)*.

Connection procedure

- Connect the resistor cables to the R+ and R- terminals in the same way as the other power cables. If a shielded three-conductor cable is used, cut the third conductor and ground the twisted shield of the cable (protective earth conductor of the resistor assembly) at both ends.
- Wire the thermal switch to a digital input on the drive control unit as shown below.

+24VD	**x**
DIx	**x**

Start-up

Note: New brake resistors may be coated with storage grease. As the brake chopper operates for the first time, the grease burns off and may produce some smoke. Make sure there is sufficient ventilation.

Parameter settings

Set the following parameters:

- Disable the overvoltage control of the drive with parameter *30.30 Overvoltage control*.
- If the thermal switch is wired to the DIIL input, an overheating resistor will, by default, remove the Run enable signal from the drive. See also parameters *20.11 Run enabe stop mode*, *20.12 Run enable 1 source* and *95.20 HW options word 1*.
- If the thermal switch is wired to another digital input input, set the following parameters.

  1. Set the source of parameter *31.01 External event 1 source* to point to the digital input where the thermal switch of the brake resistor is wired.

  2. Enable the brake chopper by parameter *43.06 Brake chopper enable*. If Enabled with thermal model is selected, set also the brake resistor overload protection parameters *43.08* and *43.09* according to the application.

3. Set parameter *31.02 External event 1* type to Fault.
4. Set parameter *43.07 Brake chopper run enable* to Other [bit] and select from parameter *10.01 DI status* the digital input where the thermal switch of the brake resistor is wired.
5. Set the resistance value of the resistor to parameter *43.10 Brake resistance*.

With these parameter settings, the drive generates a fault and coasts to a stop on brake resistor overtemperature.

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

Technical data

Ratings

The table below gives the ratings for resistor braking.

ACS880-04-…	Internal brake chopper		Example brake resistor(s)			
	P_{brcont}	R_{min}	Type	R	E_R	P_{Rcont}
	kW	ohm		ohm	kJ	kW
U_n = 400 V						
505A-3	250	2.0	2×SAFUR125F500	2.0	7200	18
585A-3	315	1.3	2×SAFUR200F500	1.3	10800	27
650A-3	315	1.3	2×SAFUR200F500	1.3	10800	27
725A-3	400	0.7	3×SAFUR200F500	0.9	16200	40
820A-3	400	0.7	3×SAFUR200F500	0.9	16200	40
880A-3	400	0.7	3×SAFUR200F500	0.9	16200	40
U_n = 500 V						
460A-5	250	2.0	2×SAFUR125F500	2.0	7200	18
503A-5	250	2.0	2×SAFUR125F500	2.0	7200	18
583A-5	315	1.3	2×SAFUR200F500	1.3	10800	27
635A-5	315	1.3	2×SAFUR200F500	1.3	10800	27
715A-5	400	0.7	3×SAFUR200F500	0.9	16200	40
820A-5	400	0.7	3×SAFUR200F500	0.9	16200	40

ACS880-04-…	Internal brake chopper		Example brake resistor(s)			
	P_{brcont}	R_{min}	Type	R	E_R	P_{Rcont}
	kW	ohm		ohm	kJ	kW
880A-5	400	0.7	3×SAFUR200F500	0.9	16200	40
U_n = 690 V						
330A-7	285	2.2	SAFUR200F500	2.7	3600	13
370A-7	285	2.2	SAFUR200F500	2.7	3600	13
430A-7	285	2.2	SAFUR200F500	2.7	3600	13
470A-7	350	2.0	2×SAFUR125F500	2.0	7200	18
522A-7	350	2.0	2×SAFUR125F500	2.0	7200	18
590A-7	400	1.8	2×SAFUR125F500	2.0	7200	18
650A-7	400	1.8	2×SAFUR125F500	2.0	7200	18
721A-7	400	1.8	2×SAFUR125F500	2.0	7200	18

P_{brcont} Maximum continuous braking power. The braking is considered continuous if the braking time exceeds 30 seconds.

R_{min} The minimum allowed resistance value of the brake resistor

R Resistance value for the listed resistor assembly

E_R Short energy pulse that the resistor assembly withstands every 400 seconds

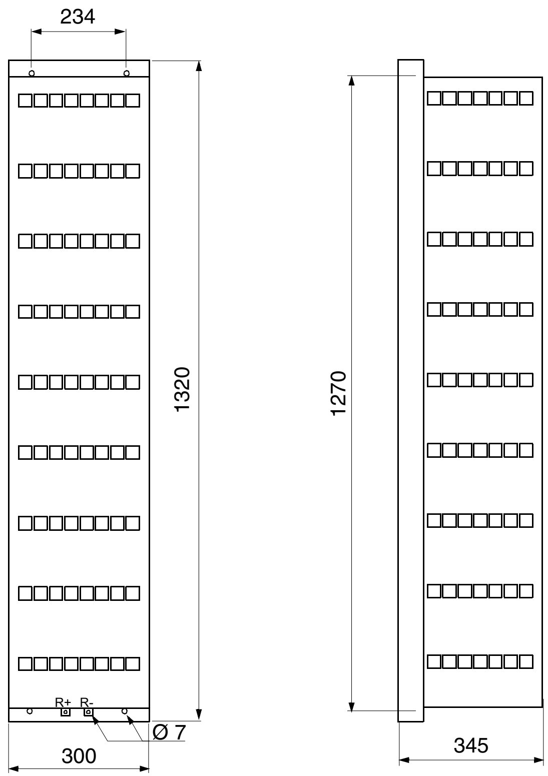
P_{Rrcont} Continuous power (heat) dissipation of the resistor when placed correctly

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

SAFUR resistors

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

Dimensions, weights and ordering codes



Brake resistor type	**Weight**	**ABB ordering code**
SAFUR125F500	25 kg (55 lb)	68759285
SAFUR200F500	30 kg (66 b)	68759340

Terminals and cable entry data

See section *Terminal and entry data for the power cables (page 229)*.

22

Filters

Contents of this chapter

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

d*u*/d*t* filters

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

See *Examining the compatibility of the motor and drive (page 96)*.

Selection table

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

ACS880-04-…	d*u*/d*t* filter type	ACS880-04-…	d*u*/d*t* filter type	ACS880-04-…	d*u*/d*t* filter type
U_n = 400 V		U_n = 500 V		U_n = 690 V	
505A-3	FOCH0610-70	460A-5	FOCH0610-70	330A-7	FOCH0610-70
585A-3	FOCH0610-70	503A-5	FOCH0610-70	370A-7	FOCH0610-70
650A-3	FOCH0610-70	583A-5	FOCH0610-70	430A-7	FOCH0610-70
725A-3	FOCH0875-70	635A-5	FOCH0610-70	470A-7	FOCH0610-70
820A-3	FOCH0875-70	715A-5	FOCH0875-70	522A-7	FOCH0610-70
880A-3	FOCH0875-70	820A-3	FOCH0875-70	590A-7	FOCH0610-70
-	-	880A-5	FOCH0875-70	650A-7	FOCH0875-70
-	-	-	-	721A-7	FOCH0875-70

Ordering codes

Filter type	ABB ordering code
FOCH0610-70	68550505
FOCH0875-70	3AUA0000129544

Description, installation and technical data of the FOCH filters

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

Sine filters

When is a sine filter necessary?

See *Examining the compatibility of the motor and drive (page 96)*.

Selection table

Sine filter types for the drive modules are given below.

ACS880-04-…	Sine filter type	ACS880-04-…	Sine filter type	ACS880-04-…	Sine filter type
U_n = 400 V		U_n = 500 V		U_n = 690 V	
505A-3	NSIN0900-6	460A-5	NSIN0485-6	330A-7	NSIN0485-6
585A-3	NSIN0900-6	503A-5	NSIN0900-6	370A-7	NSIN0485-6
650A-3	NSIN0900-6	583A-5	NSIN0900-6	430A-7	NSIN0485-6
725A-3	NSIN0900-6	635A-5	NSIN0900-6	470A-7	NSIN0485-6
820A-3	NSIN0900-6	715A-5	NSIN0900-6	522A-7	NSIN0485-6
880A-3	NSIN0900-6	820A-3	NSIN0900-6	590A-7	NSIN0900-6
-	-	880A-5	NSIN0900-6	650A-7	NSIN0900-6
-	-	-	-	721A-7	NSIN0900-6

Ordering codes

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

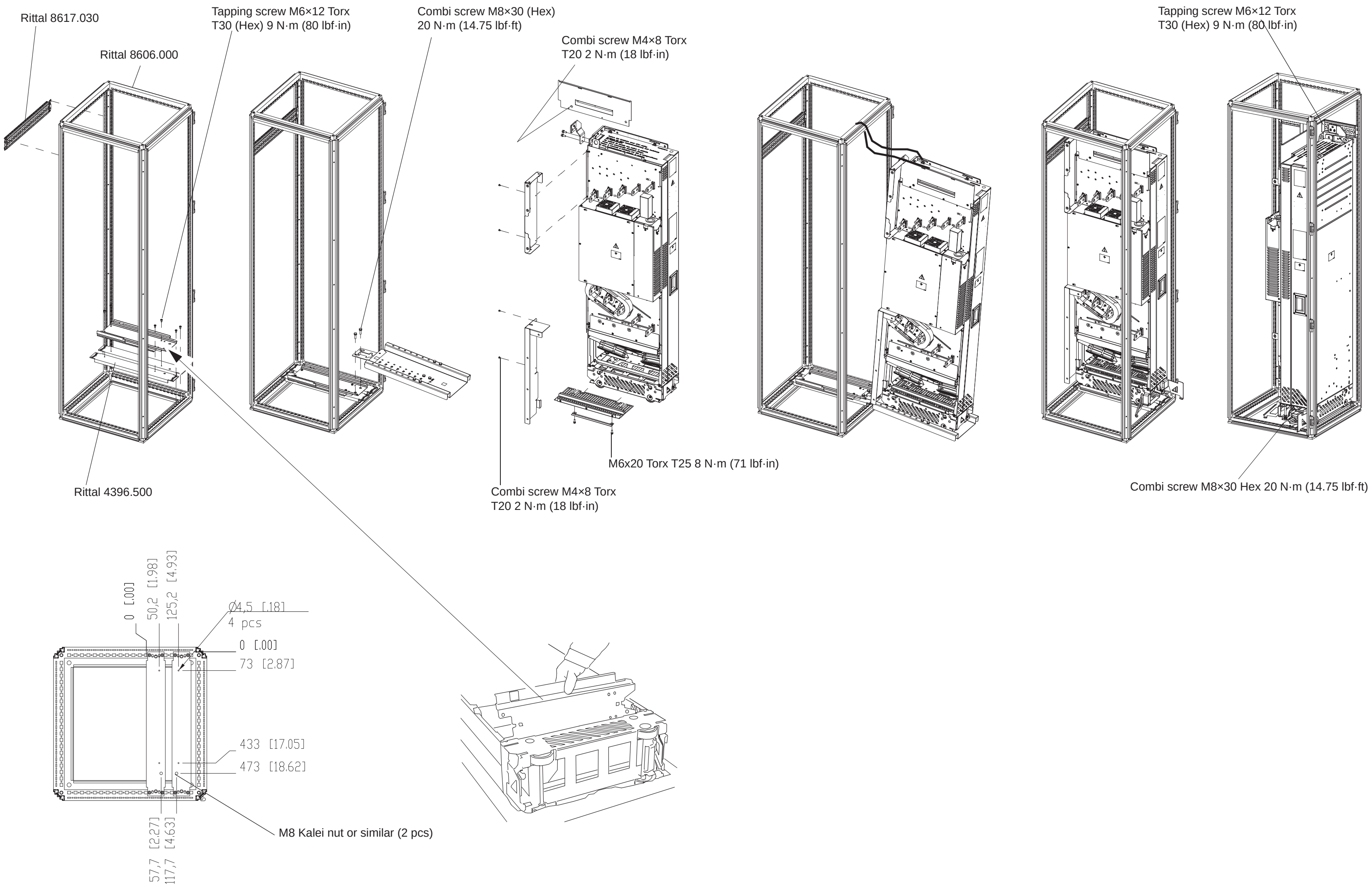
Derating

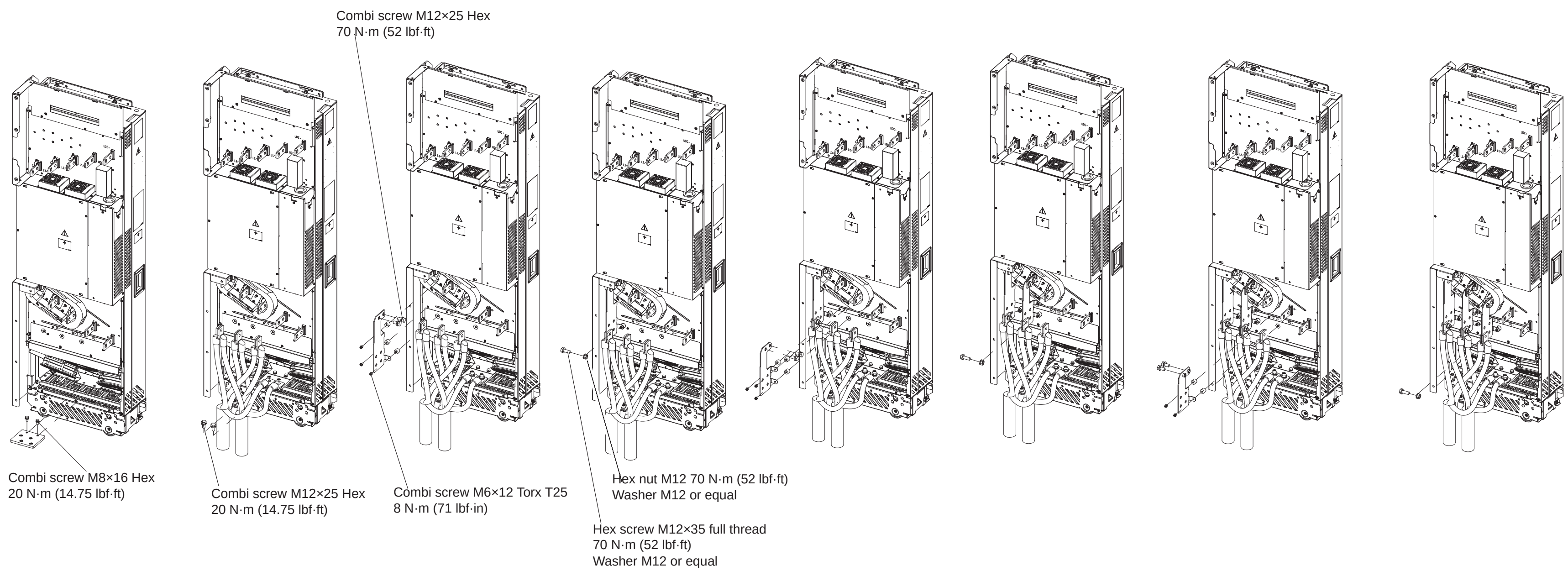
See section *Deratings for special settings in the drive control program (page 217)*.

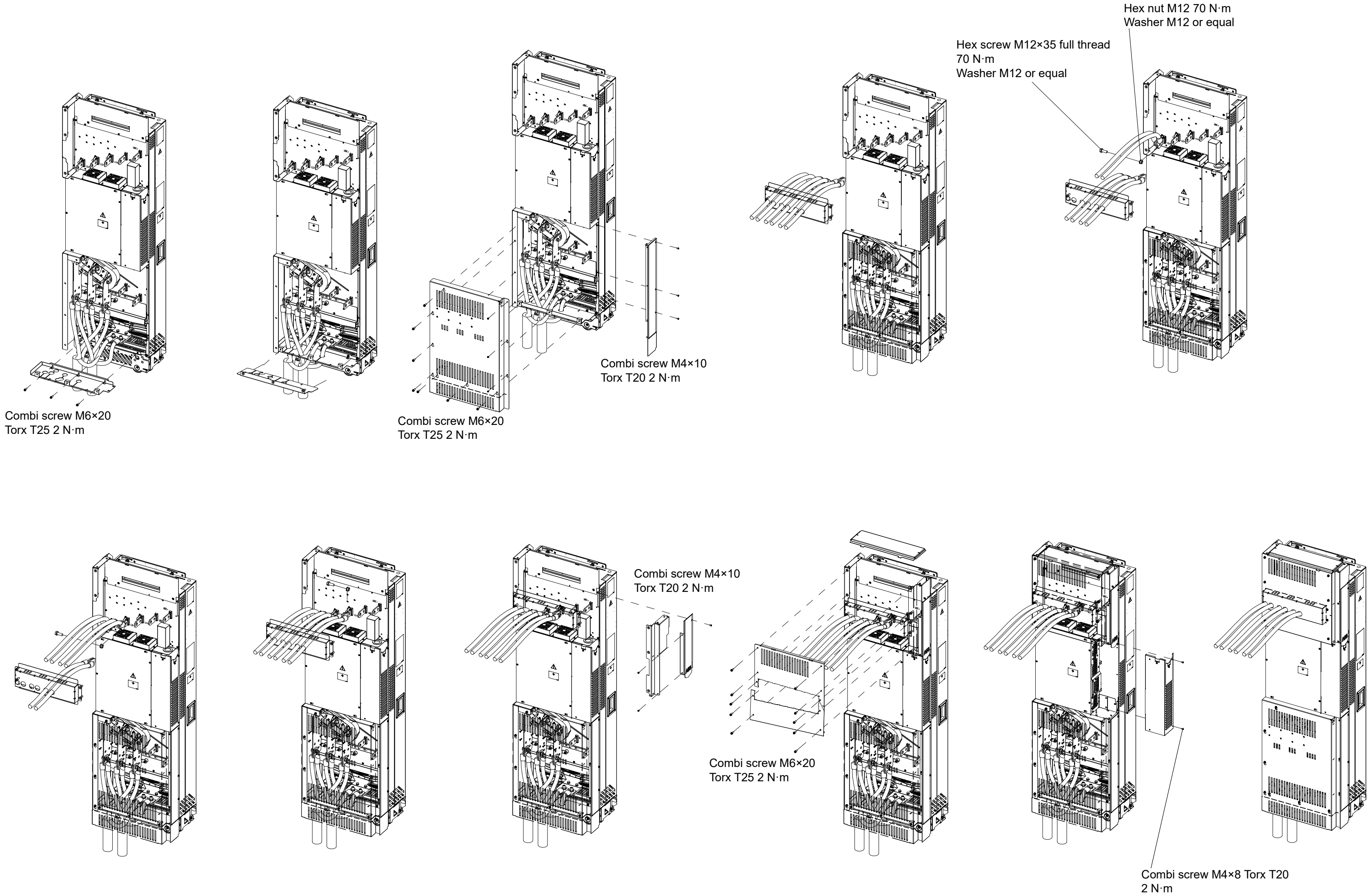
Description, installation and technical data of the sine filters

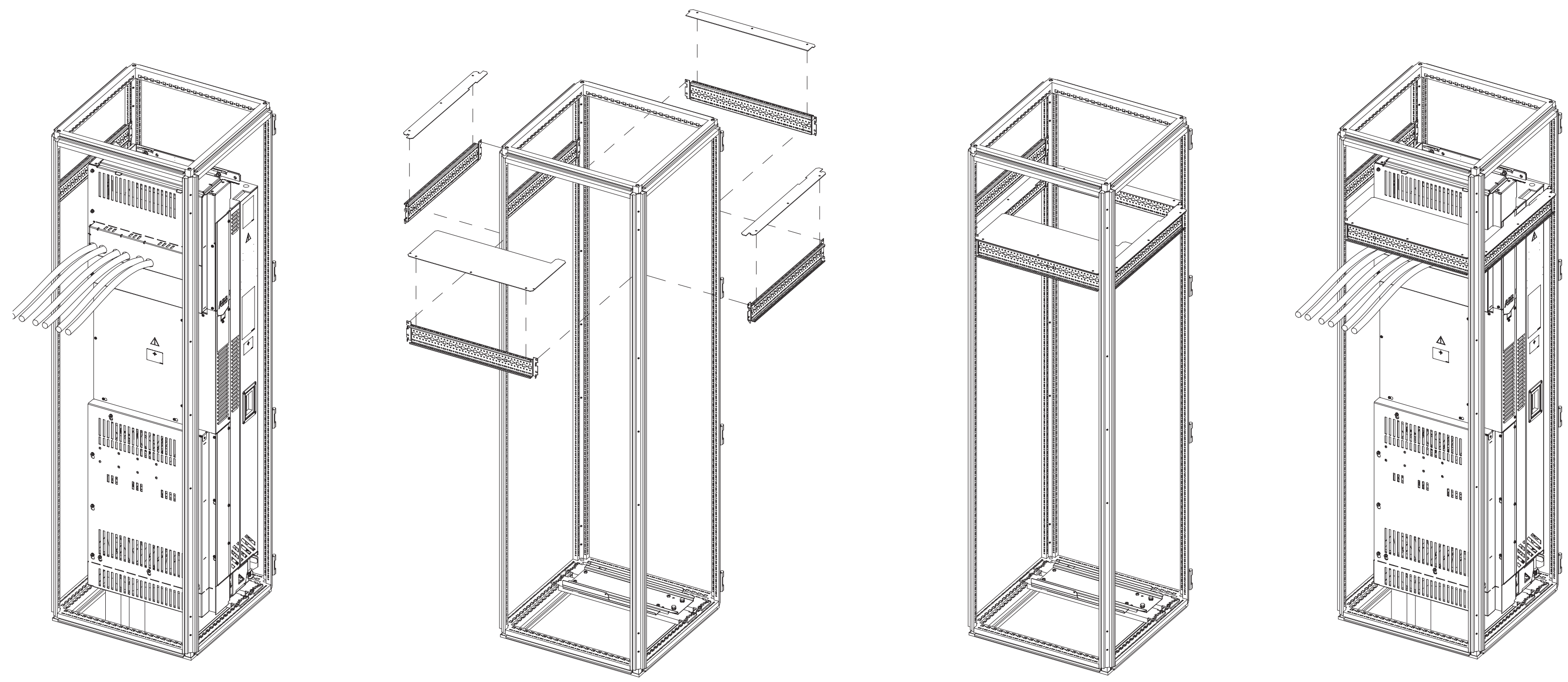
See *Sine filters hardware manual* (3AXD50000016814 [English]). For more information, contact ABB.

23. Step-by-step drawings for an installation example of standard drive configuration with option +E208 in Rittal VX25 600 mm wide enclosure


Rittal 8617.030
Tapping screw M6×12 Torx
T30 (Hex) 9 N·m (80 lbf·in)
Combi screw M8×30 (Hex)
20 N·m (14.75 lbf·ft)
Combi screw M4×8 Torx
T20 2 N·m (18 lbf·in)
Tapping screw M6×12 Torx
T30 (Hex) 9 N·m (80 lbf·in)
Rittal 8606.000
M6x20 Torx T25 8 N·m (71 lbf·in)
Rittal 4396.500
Combi screw M4×8 Torx
T20 2 N·m (18 lbf·in)
Combi screw M8×30 Hex 20 N·m (14.75 lbf·ft)
0 [.00]
50,2 [1.98]
125,2 [4.93]
Ø4,5 [.18]
4 pcs
0 [.00]
73 [2.87]
433 [17.05]
473 [18.62]
57,7 [2.27]
117,7 [4.63]
M8 Kalei nut or similar (2 pcs)

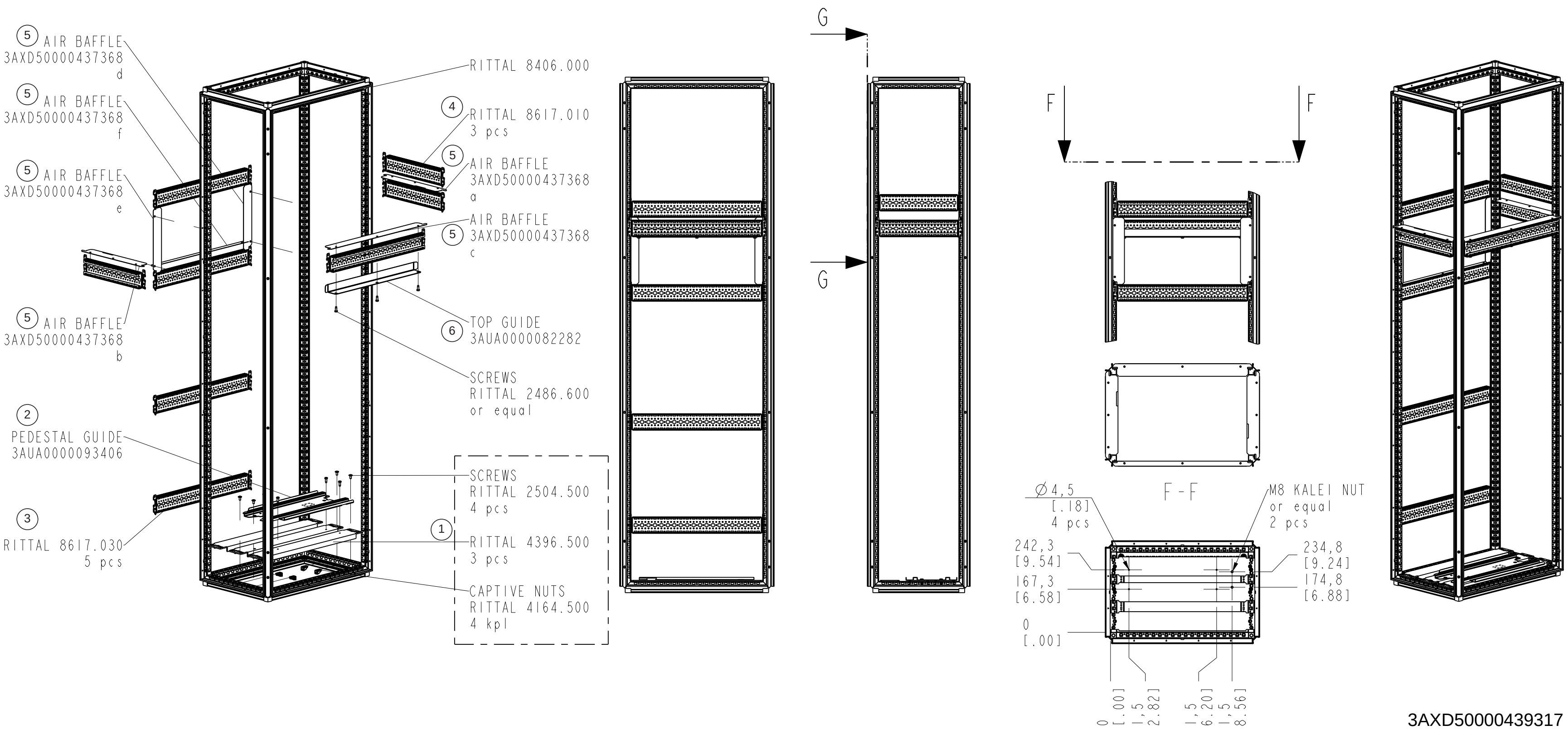

Combi screw M12×25 Hex
70 N·m (52 lbf·ft)
Combi screw M8×16 Hex
20 N·m (14.75 lbf·ft)
Combi screw M12×25 Hex
20 N·m (14.75 lbf·ft)
Combi screw M6×12 Torx T25
8 N·m (71 lbf·in)
Hex nut M12 70 N·m (52 lbf·ft)
Washer M12 or equal
Hex screw M12×35 full thread
70 N·m (52 lbf·ft)
Washer M12 or equal


Hex nut M12 70 N·m
Washer M12 or equal
Hex screw M12×35 full thread
70 N·m
Washer M12 or equal
Combi screw M6×20
Torx T25 2 N·m
Combi screw M6×20
Torx T25 2 N·m
Combi screw M4×10
Torx T20 2 N·m
Combi screw M4×10
Torx T20 2 N·m
Combi screw M6×20
Torx T25 2 N·m
Combi screw M4×8 Torx T20
2 N·m



Note: These air baffles are compatible with option +B051 only.
For the standard drive module configuration see section
Standard drive module configuration.

24. Step-by-step drawings for installing full cabling panels (option +H381) in a Rittal 400 mm wide enclosure

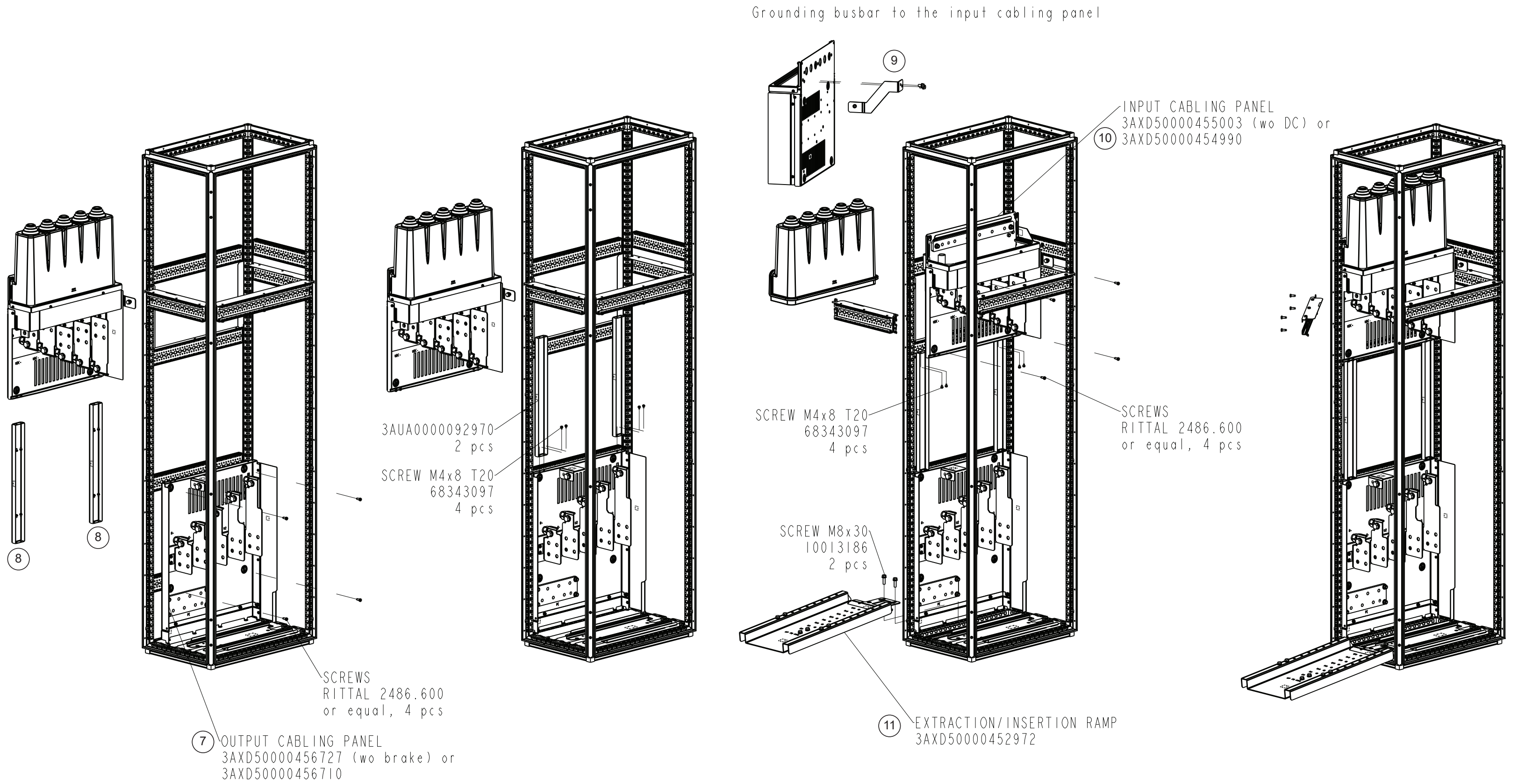


3AXD50000439317

ABB parts	
2	Pedestal guide plate
6	Top guide plate
Customer-made parts (not ABB or Rittal product)	
5	Air baffles

Installation procedure

1. Install three Rittal support rails (4396.500) on the bottom of the enclosure
2. Install the pedestal guide onto the support rails
3. Install the Rittal punched sections 8617.030 (5 pcs)
4. Install the Rittal punched sections 8617.010 (3 pcs)
5. Install the air baffles
6. Install the top guide plate



3AXD50000439317

Installation procedure (continued)

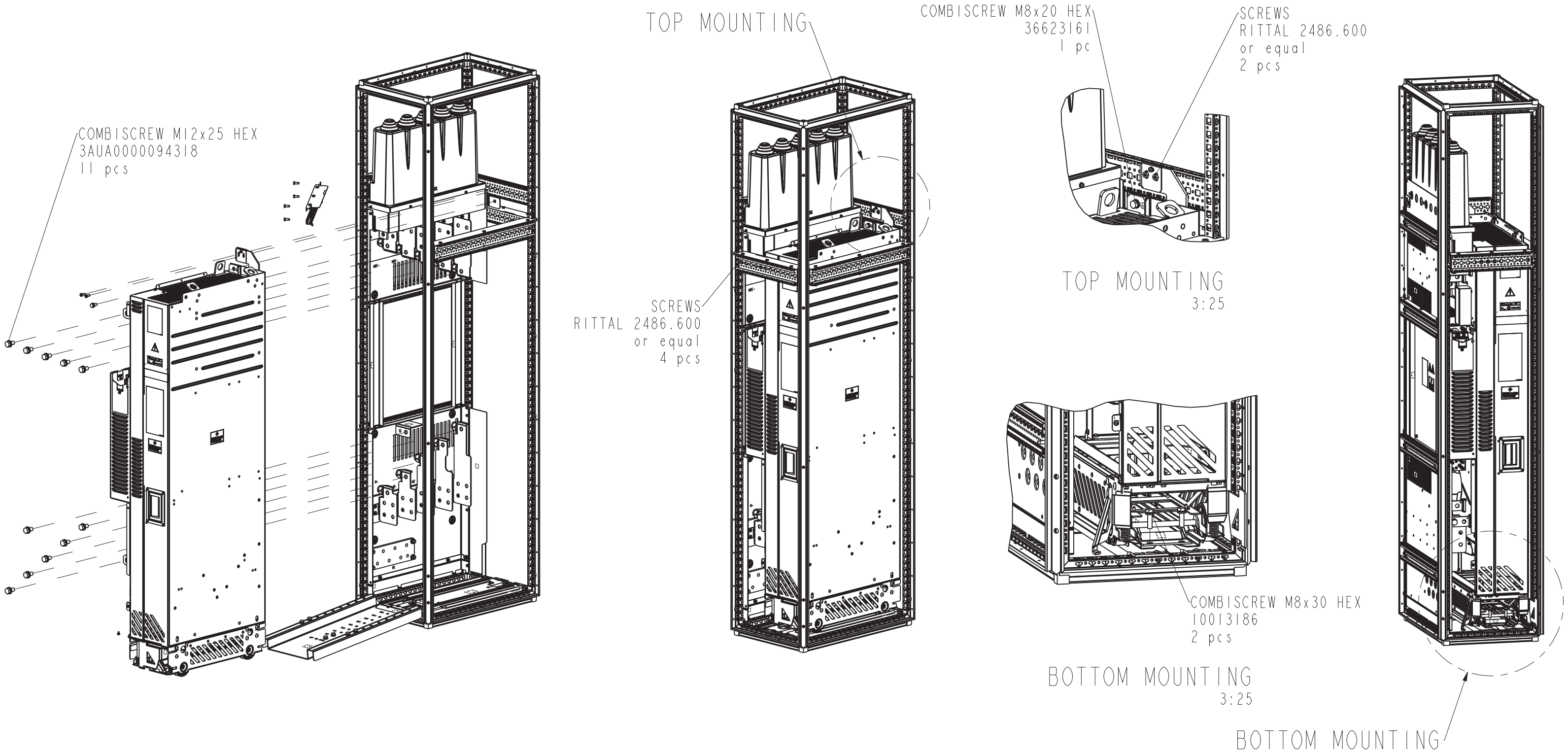
7. Install the output cabling panel

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

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

10. Attach the input cabling panel to the punched section

11. Install the telescopic extraction and insertion ramp.



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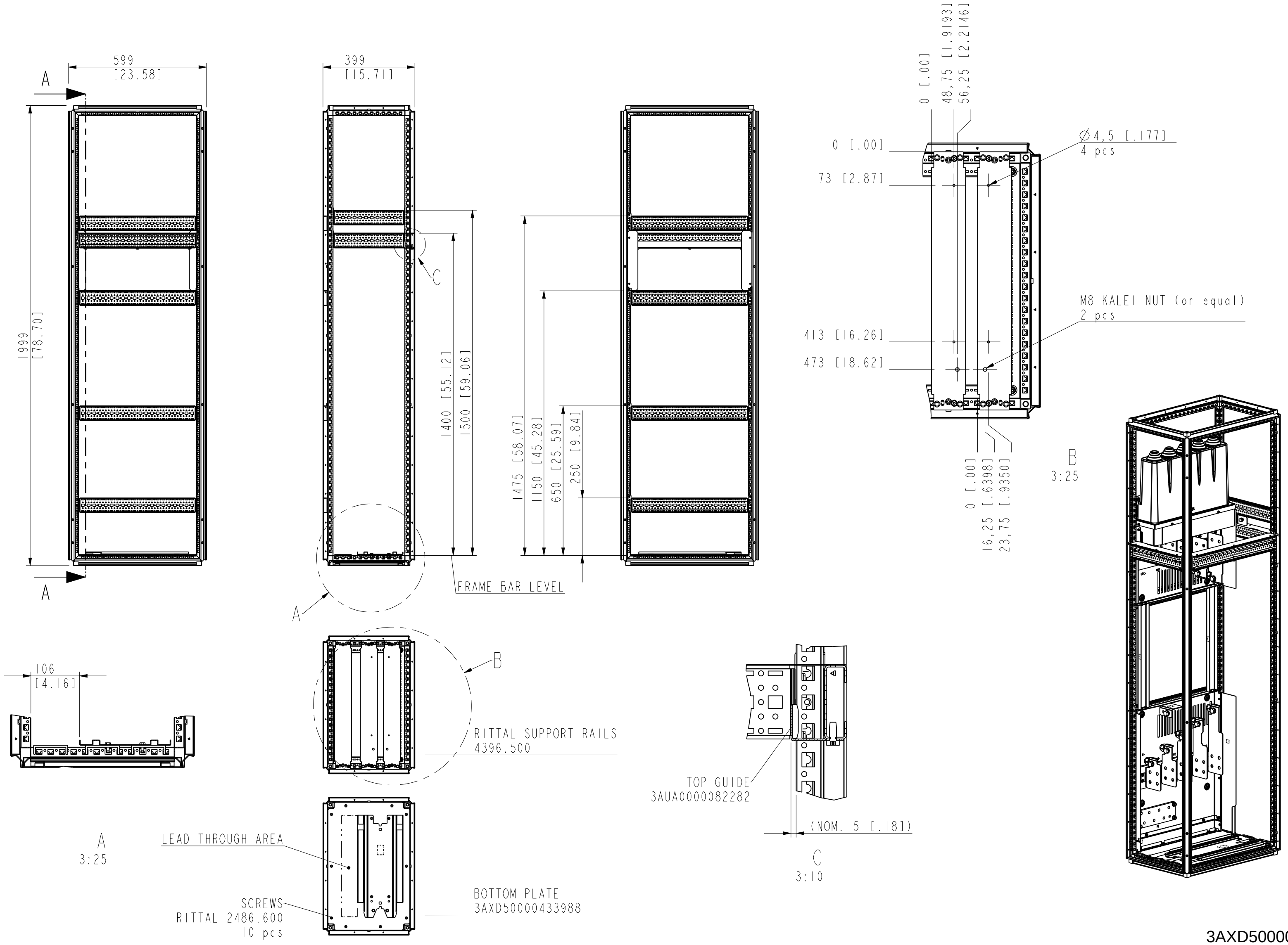

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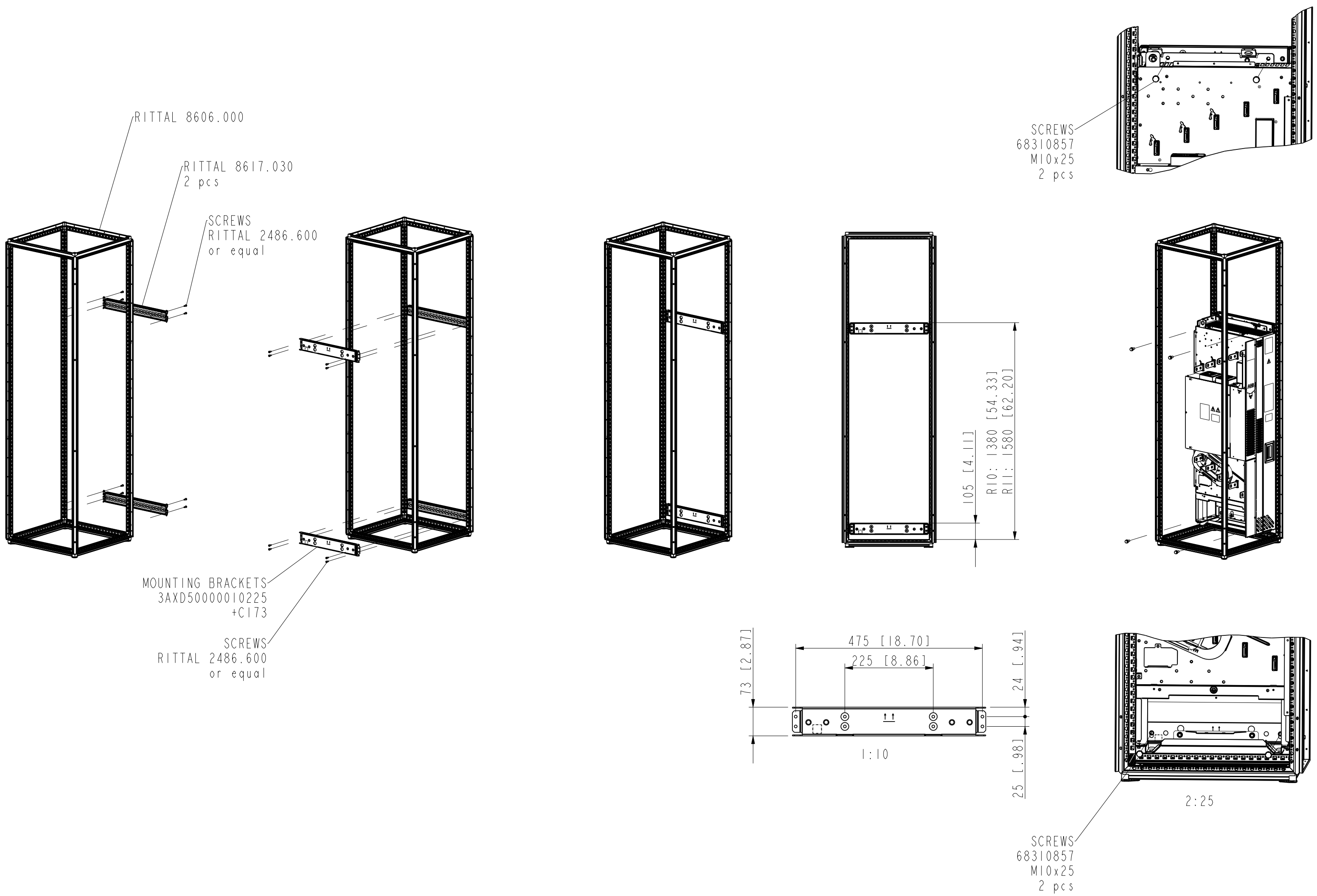
25. Step-by-step drawings for a flat installation example in a Rittal 600 mm wide enclosure



3AXD50000440559

26. Step-by-step drawings for option +H391 installation example in a Rittal 600 mm wide enclosure

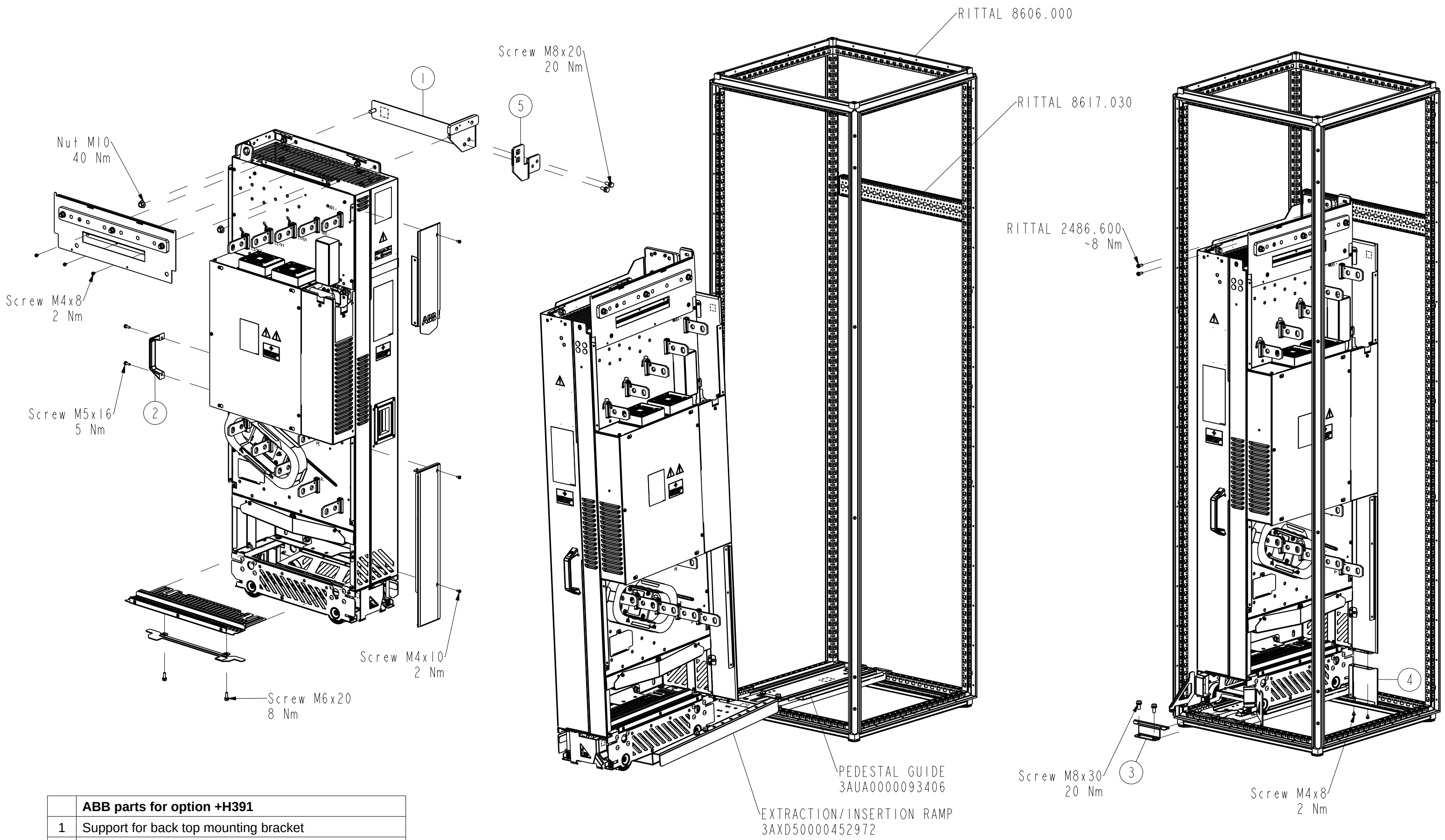


	ABB parts for option +H391
1	Support for back top mounting bracket
2	Handle
3	Bottom mounting bracket
	ABB standard parts
4	Lowest back cover plate
5	Back top mounting bracket

3AXD50000491667

Further information

Product and service inquiries

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

Product training

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

Providing feedback on ABB manuals

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

Document library on the Internet

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

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