ABB INDUSTRIAL DRIVES

ACS880-37 drives (45…400 kW, 60…450 hp)

Hardware manual

ACS880-37 drives (45…400 kW, 60…450 hp)

Hardware manual

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Table of contents

1 Safety instructions

2 Introduction to the manual

3 Operation principle and hardware description

6 Electrical installation

7 Control unit

8 Installation checklist

9 Start-up

10 Fault tracing

11 Maintenance

13 Dimension drawings

14 The Safe torque off function

15 Resistor braking

Further information

1

Safety instructions

Contents of this chapter

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

Use of warnings and notes

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

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 persons 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.
- Use a lifting device to lift a heavy drive. Use the designated lifting points. Refer to the dimension drawings.
- Obey the local laws and regulations that apply to lifting, such as the requirements for planning the lift, the capacity and condition of the lifting equipment, and personnel training.
- Attach the drive cabinet to the floor to prevent it from falling over. The cabinet has a high center of gravity. When you pull out heavy components or power modules, there is a risk of overturning. Attach the cabinet also to the wall when necessary.

- Do not stand or walk on the cabinet roof. Make sure that nothing presses against the roof, side or back plates or door. Do not store anything on the roof while the drive is in operation.
- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, and brake resistors, can be hot for a period after operation.
- Before the start-up, vacuum clean the area around the drive to prevent the drive cooling fan from drawing dust inside the drive.
- Make sure that debris from drilling, cutting and grinding does not go into the drive during installation. Electrically conductive debris inside the drive can cause damage or malfunction.
- Make sure that there is sufficient cooling. Refer to the technical data.
- Keep the drive cabinet doors closed when the drive has electrical power. If the doors of the drive cabinet are open, there is a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.

- If you must do work on a drive that is connected to the power supply, obey the local laws and regulations on live electrical work. This includes, but is 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 break in the power supply. If these functions are activated, the installation must be clearly marked as defined in IEC/EN/UL 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".
- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.
- If the drive has connected safety circuits (for example, Safe torque off or emergency stop), validate them at start-up. Refer to separate instructions for the safety circuits.
- Beware of hot air flow from the cooling outlets.
- Do not cover the air inlet or air outlet when the drive operates.

Note:

- If you select an external source for the start command and it is on, the drive starts immediately after a fault reset unless you configure the drive for pulse start. Refer to 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 permitted to repair a faulty drive.

Electrical safety in installation, start-up and maintenance

Electrical safety precautions

These electrical safety precautions are for all persons 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 electrical installation or maintenance work. Do these steps before you do installation or maintenance work.

1. Prepare for the work.
    - Make sure that you have a work order.
    - Do an on-site risk assessment or job hazard analysis.
    - Make sure that you have the correct tools available.
    - Make sure that the workers are qualified.

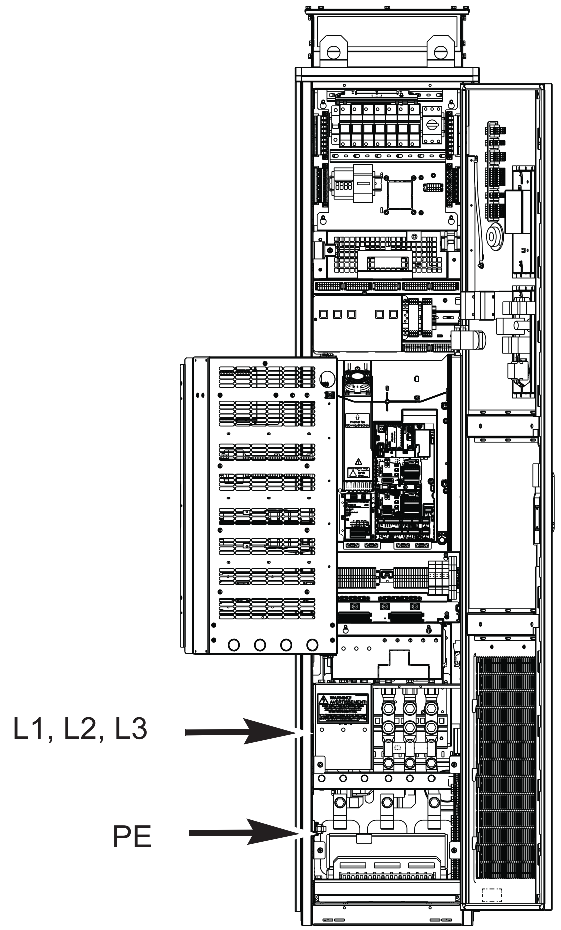
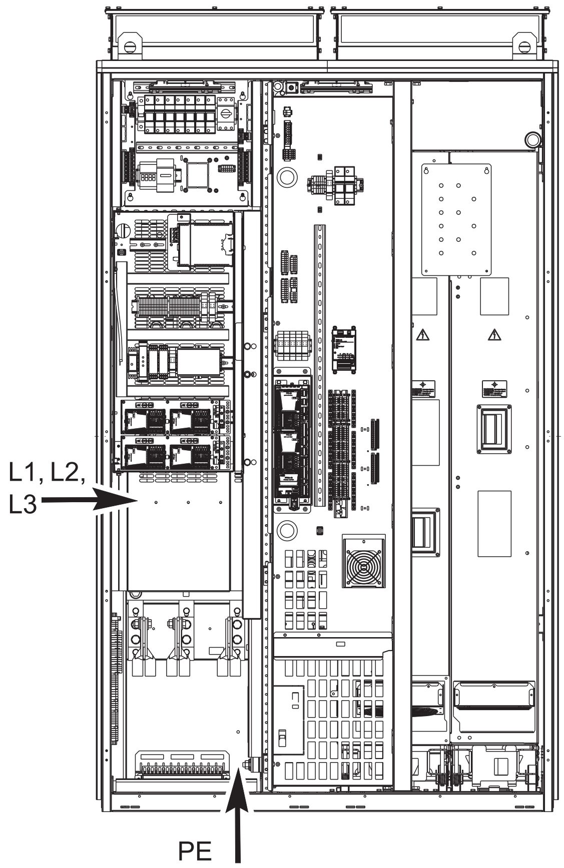
- Select the correct personal protective equipment (PPE).
- Stop the drive and motor(s).

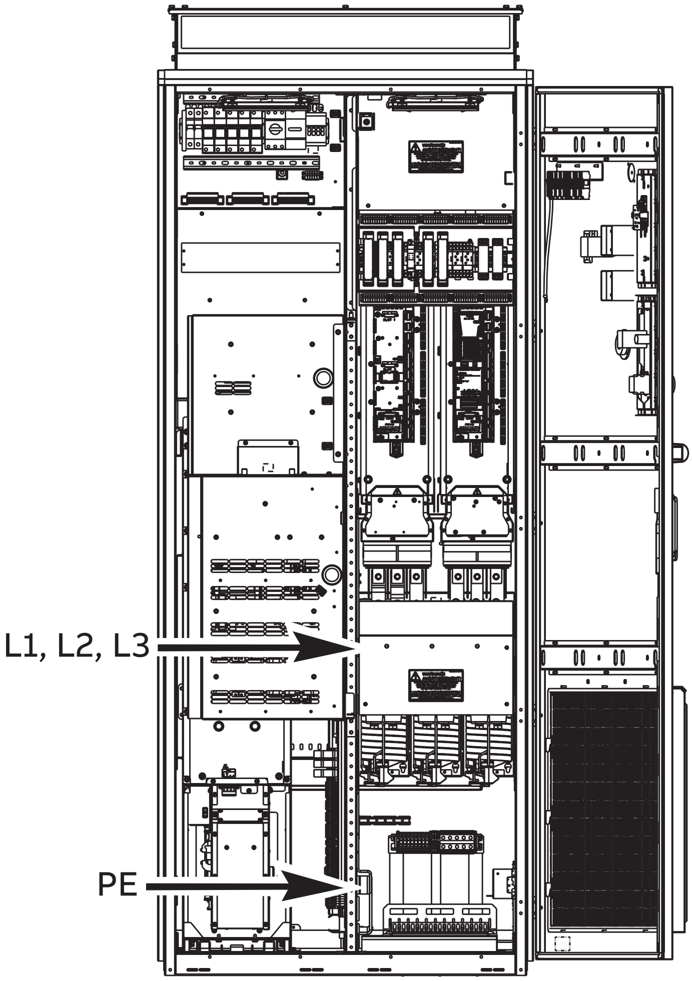
2. Clearly identify the work location and equipment.
3. Disconnect all possible voltage sources. Make sure that connection is not possible. Lock out and tag out.
   - Open the main disconnecting device of the drive.
   - Open the charging switch if it is present.
   - Open the disconnector of the supply 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 it is present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
   - If there is a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
   - Open the main isolating device of the drive.
   - Disconnect all dangerous external voltages from the control circuits.
   - After you disconnect power from the drive, wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
4. Protect other energized parts in the work location against contact and take special precautions when close to bare conductors.
5. Measure that the installation is de-energized. Use a high-quality voltage tester. If the measurement requires that you remove shrouding or other cabinet structures, obey the local laws and regulations applicable to live electrical work. This includes, but is not limited to, electric shock and arc protection.
   - Before and after you measure the installation, verify the operation of the voltage tester on a known voltage source.
   - Make sure that the voltage between the input power terminals of the drive (L1, L2, L3) and the grounding (PE) busbar is zero.
   - Make sure that the voltage between the output power terminals of the drive (U, V, W) and the grounding (PE) busbar is zero.

     Important! Repeat the measurement with the DC voltage setting of the voltage tester. Measure between each phase and ground. There is a risk of dangerous DC voltage charging due to leakage capacitances of the motor circuit. This voltage can remain charged for a long time after the drive power-off. The measurement discharges the voltage.
   - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding (PE) terminal is zero.
6. Install temporary grounding as required by the local regulations.
7. Ask for a permit to work from the person that is responsible for the electrical installation work.

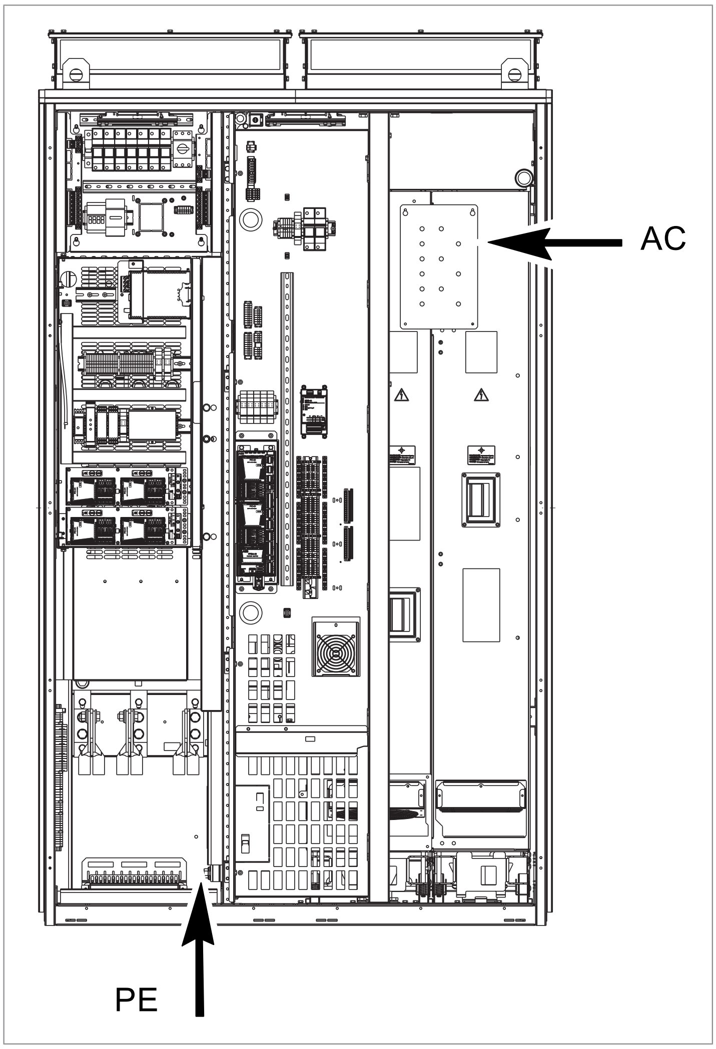
Measuring the voltage

Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.

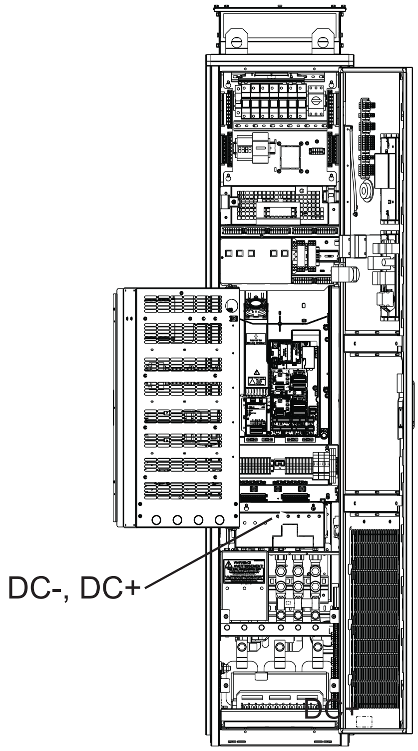
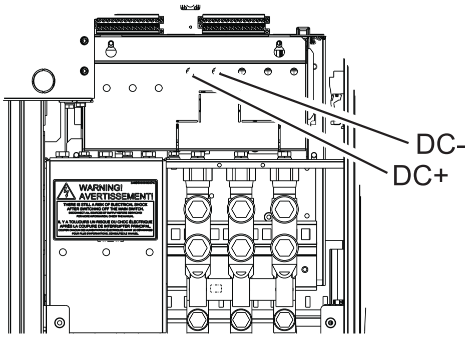
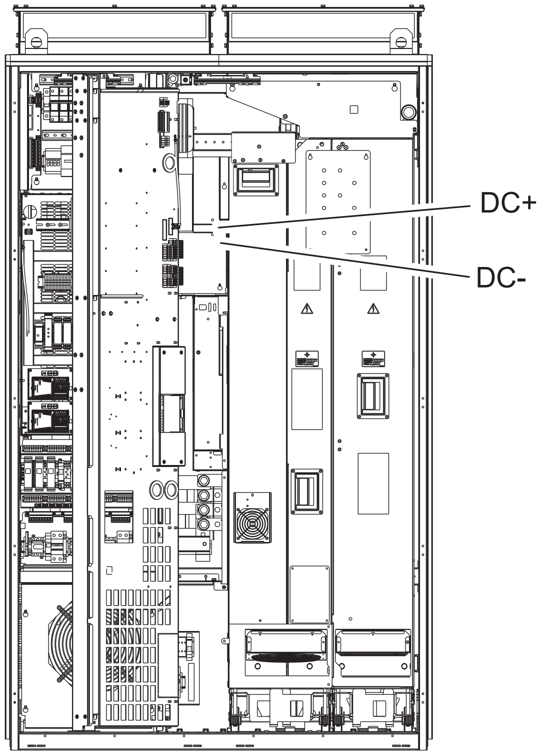
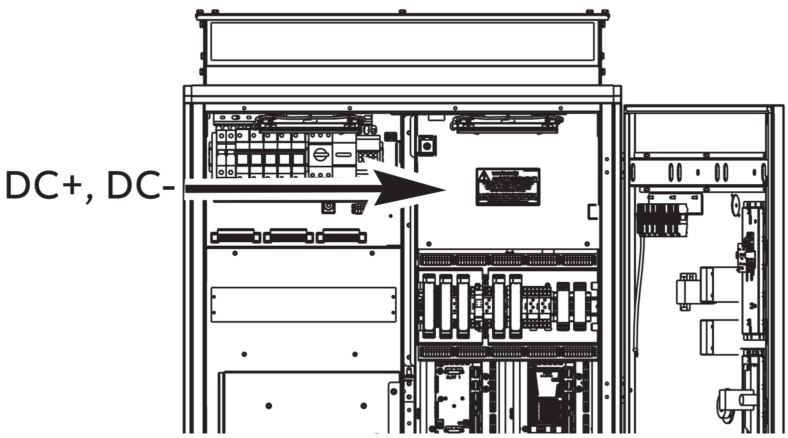
R8	R11
	

R6i+R6i and R7i+R7i


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

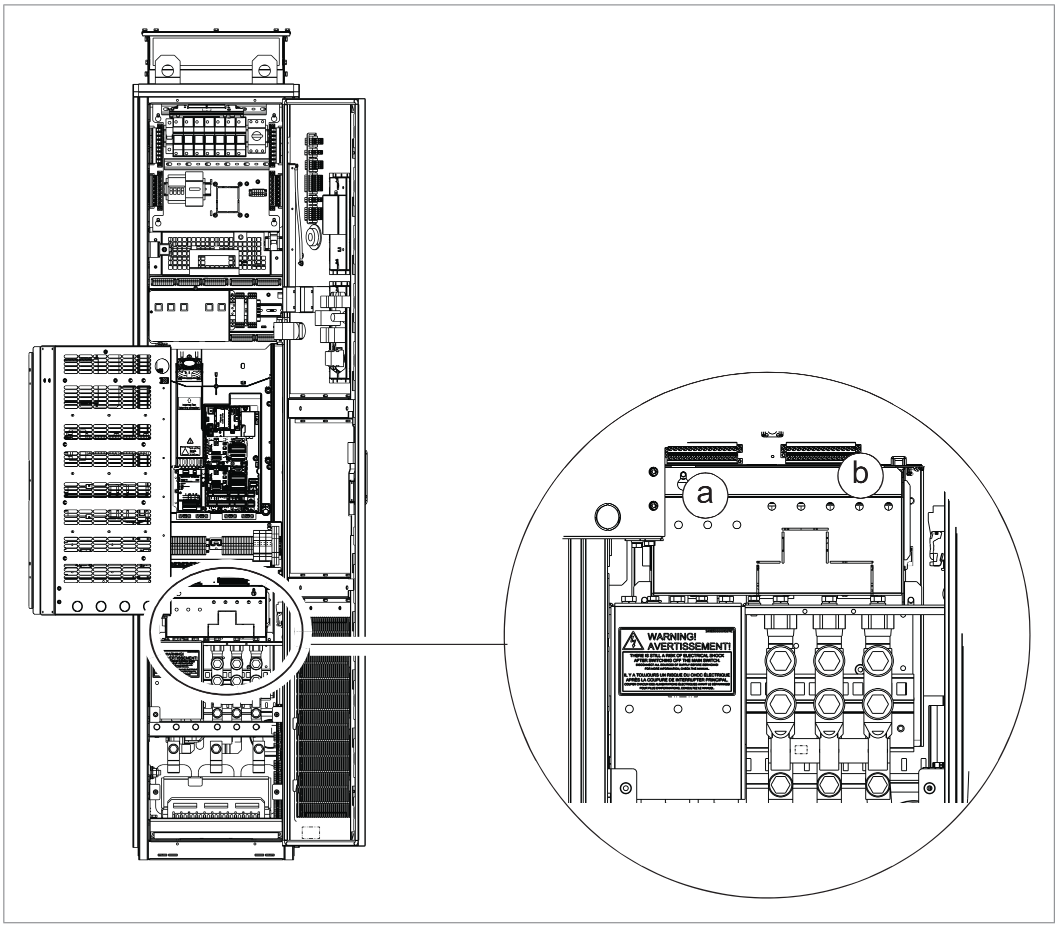


Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.

R8	R11
 	
R6i+R6i and R7i+R7i	
	

Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is close to 0 V.

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



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 has electrical power. If the doors the drive cabinet are open, there is 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, do not go near the motor, drive, and the drive power cabling when the drive is in operation. The

equipment produces electromagnetic fields that can cause interference in electronic medical devices. This can cause a health hazard.

- ABB does not recommend attaching the cabinet by arc welding. If you have to, obey the welding instructions in the drive manuals.

Note:

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

Printed circuit boards

WARNING!
Use ESD wristband when you handle printed circuit boards. Do not touch the boards unnecessarily. The boards are sensitive to electrostatic discharge.

Grounding

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

General safety in operation

These instructions are for all persons 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 has electrical power. If the doors the drive cabinet are open, there is 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, do not go near the motor, drive, and the drive power cabling when the drive is in operation. The equipment produces electromagnetic fields that can cause interference in electronic medical 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 starts immediately after the fault reset, unless you configure the drive for pulse start. Refer to 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 break in the power supply. If these functions are activated, the installation must be clearly marked as defined in IEC/EN/UL 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

Note:

- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors. If you need to start or stop the drive, use the control panel keys or commands through the I/O terminals of the drive or the fieldbus interface.
- 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 for 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 such as belt, nip, rope, etc.
- Do the steps in section Electrical safety precautions (page 19).
- Install temporary grounding to the drive output terminals (T1/U, T2/V, T3/W). Connect the output terminals together as well as to the PE.

During the start-up:

- Make sure that the motor cannot run at overspeed, for example, when it is driven by the load. Motor overspeed causes an overvoltage that can cause damage to the capacitors in the intermediate circuit of the drive.

Safety in operation

WARNING!
Make sure that the motor cannot run at overspeed, for example, when it is driven by the load. Motor overspeed causes an overvoltage that can cause damage to the capacitors in the intermediate circuit of the drive.

2

Introduction to the manual

Contents of this chapter

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

Target audience

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

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

Categorization by frame size and option code

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

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

Quick installation, commissioning and operation flowchart

Task	See
Plan the electrical installation and acquire the accessories needed (cables, fuses, etc.). Check the ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.	Guidelines for planning the electrical installation (page 97) Technical data (page 251)
⬇	
Check the installation site.	Ambient conditions (page 288)
⬇	
Unpack and check the drive (only intact units may be started up). Make sure that all necessary optional modules and equipment are present and correct. Mount the drive.	Mechanical installation (page 75) If the drive has been non-operational for more than one year, the DC link capacitors need to be reformed. See Capacitors (page 235).
⬇	
Route the cables.	Routing the cables (page 112)
⬇	
Check the insulation of the supply cable, the motor and the motor cable.	Measuring the insulation (page 125)
⬇	
If the drive is about to be connected to an IT (ungrounded) system, check that the drive is not equipped with EMC filter (option +E202).	Grounding system compatibility check (page 126)
⬇	
Connect the power cables. Connect the control cables.	Electrical installation (page 125)
⬇	
Check the installation.	Installation checklist (page 173)
⬇	
Start the drive up.	Start-up (page 175)
⬇	
Operate the drive: start, stop, speed control etc.	Quick start-up guide, firmware manual

Terms and abbreviations

Term	Description
ACS-AP-I	Industrial assistant non-Bluetooth control panel
ACS-AP-W	Industrial assistant control panel with Bluetooth interface
Brake chopper	Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
Brake resistor	Dissipates the drive surplus braking energy conducted by the brake chopper to heat
Control unit	Enclosure that contains control board and related connector boards. The term is also used as a synonym for the control board.
DC link	DC circuit between line-side converter and motor-side converter
Drive	Frequency converter for controlling AC motors

Term	Description
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EMT	Electrical metallic tubing, type of cable conduit
FAIO-01	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
FDNA-01	Optional DeviceNet™ adapter module
FECA-01	Optional EtherCAT® adapter module
FEN-01	Optional TTL incremental encoder interface module
FEN-11	Optional absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL incremental encoder interface module
FENA-11	Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP® and PROFINET IO® protocols
FENA-21	Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
FEPL-01	Optional Ethernet POWERLINK adapter module
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FPBA-01	Optional PROFIBUS DP® adapter module
Frame, frame size	Physical size of the drive or power module
FSCS-21	Optional functional safety module
FSO-21	Safety functions module which supports the FSE-31 module and the use of safety encoders
FSO-12	Safety functions module which does not support the use of encoders
FSPS-21	Optional functional safety module
IGBT	Insulated gate bipolar transistor
Line-side converter	Converts alternating voltage to direct voltage for the intermediate DC link of the drive
Motor-side converter	Converts intermediate DC link current to AC current for the motor
RFI	Radio-frequency interference
STO	Safe torque off (IEC/EN 61800-5-2)
ZCU	Type of control unit
ZMU	Type of memory unit, attached to the control unit

Related documents

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

	ACS880-37 (45…400 kW, 60…450 hp) manuals

3

Operation principle and hardware description

Contents of this chapter

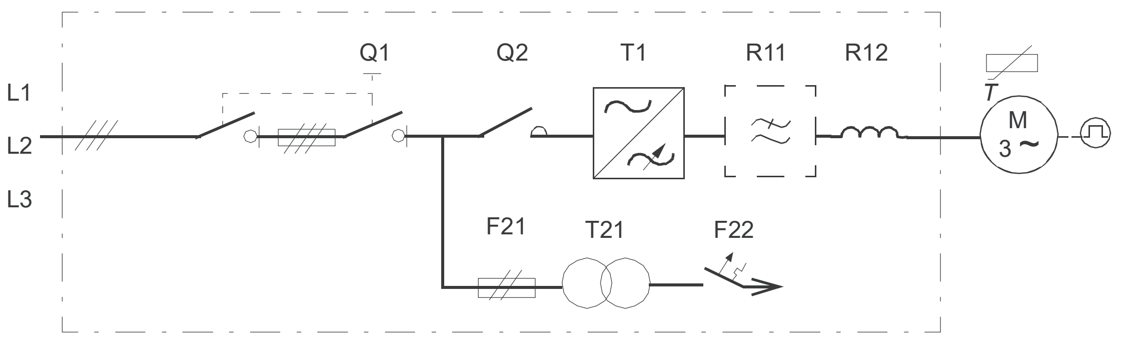
This chapter briefly describes the operation principle and construction of the drive.

Operation principle

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

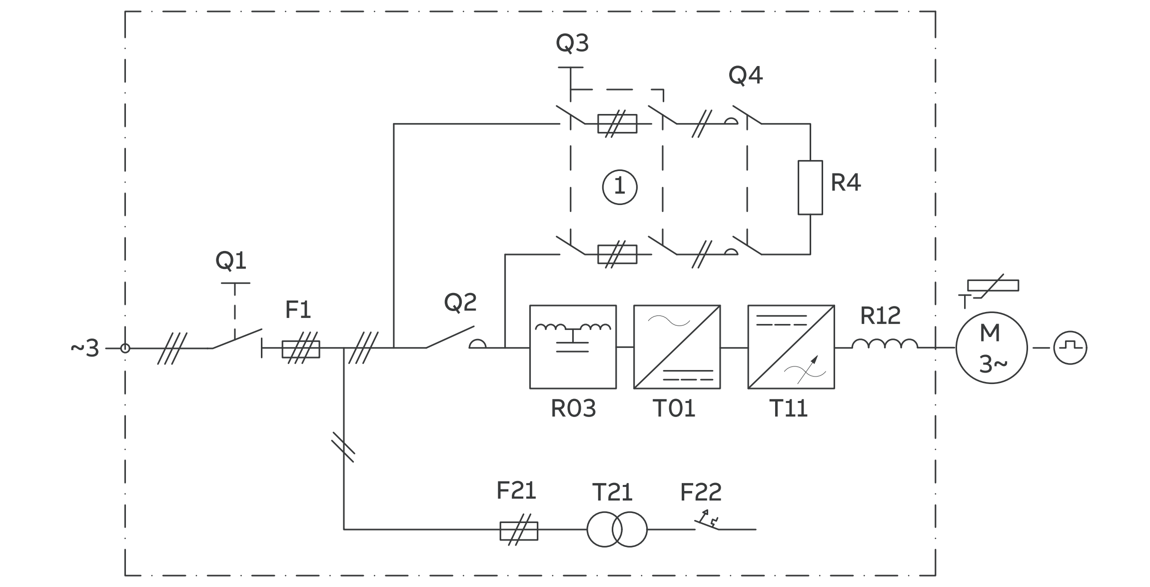
Single-line circuit diagram of the drive

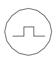
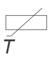
Single-line diagram of R8



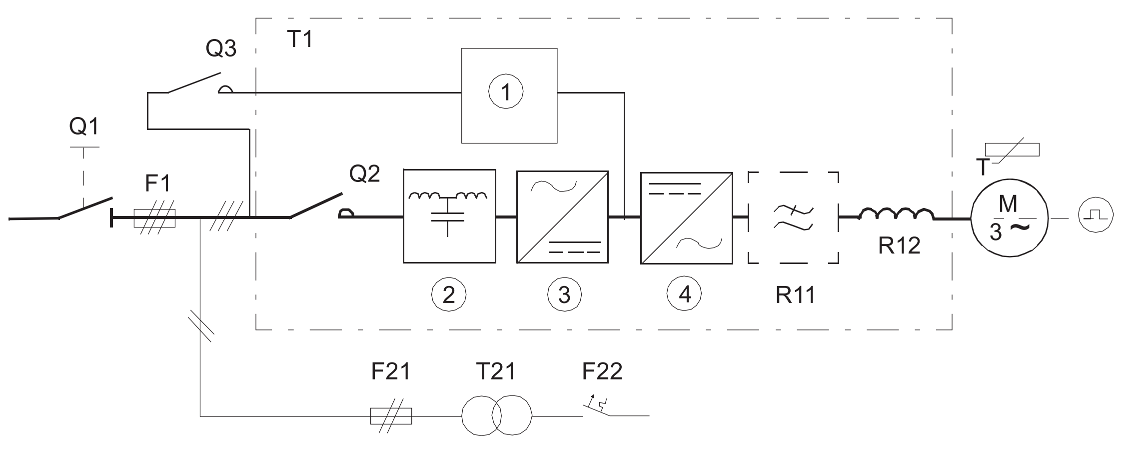
F21	Auxiliary voltage supply fuses
F22	Auxiliary circuit protection switch
Q1	Switch fuse
Q2	Line contactor with options +Q951, +Q952, +Q978
R11	Common mode filter (option +E208)
R12	d*u*/d*t* filter (option +E205) or sine filter (option +E206)
T21	Auxiliary voltage transformer supplying 24 V and 230/115 V control voltage for, for example, cabinet fan(s), control devices and I/O extension adapter module.
T1	Drive module
	HTL pulse encoder for optional FEN-31 HTL incremental encoder interface module (option +L502)
T	PTC sensors for optional thermistor relay(s) (options +L505, +2L505) or Pt100 sensors for optional Pt100 relays (option +xL506)

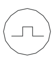
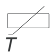
Single-line diagram of R6i+R6i and R7i+R7i



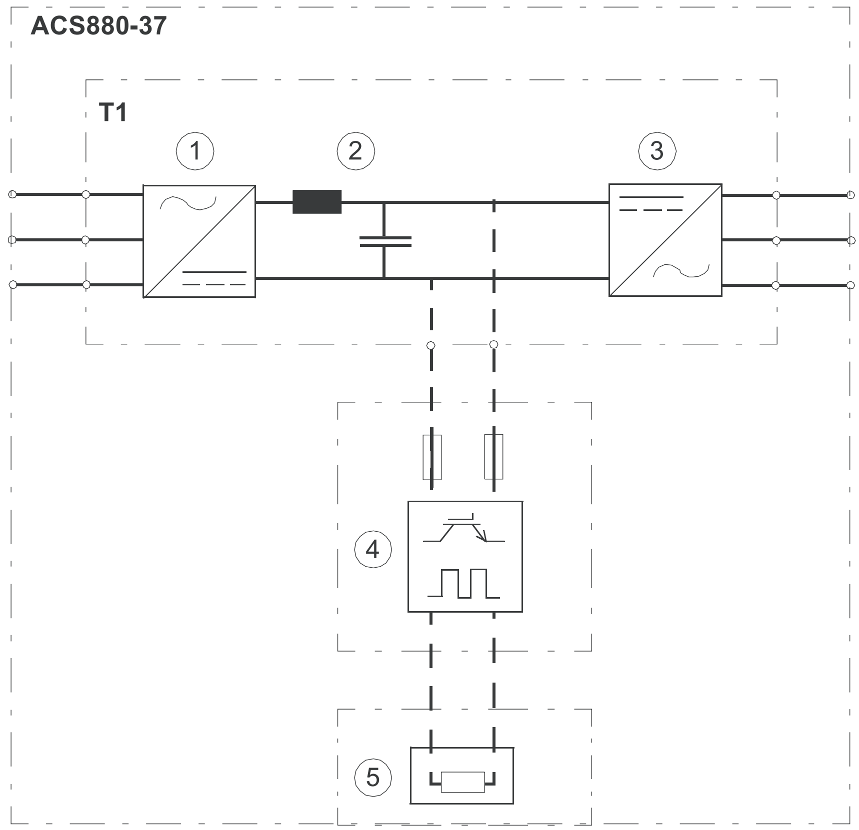
Q1	Main switch-disconnector (switch-disconnector and separate fuses)
F1	AC fuses
F21	Auxiliary voltage supply fuses
F22	Auxiliary circuit protection switch
Q2	Main contactor
Q4	Charging contactor
R03	LCL filter
R4	Charging resistor
R12	d*u*/d*t* filter (option +E205) or sine filter (option +E206)
T01	Supply module
T11	Inverter module.
1	Charging switch [Q3] and fuses [F3]
	Pulse encoder for FEN-31 HTL incremental encoder interface module (option +L502)
 T	PTC sensors for optional thermistor relay(s) (options +L505, +2L505) or Pt100 sensors for optional Pt100 relays (option +xL506)

Single-line diagram of R11



Q1	Main switch-disconnector (switch-disconnector and separate fuses)
F1	AC fuses
F21	Auxiliary voltage supply fuses
F22	Auxiliary circuit protection switch
Q2	Line contactor inside the drive module. Q2 is controlled by the line-side converter control unit. If Start (Running) command is given to the drive, Q2 is closed and the line-side converter starts to modulate.
Q3	Charging circuit contactor (with options +Q951, +Q952, +Q978) or X1 connector plug (as standard)
R11	Common mode filter (option +E208, as standard in 690 V frame R11)
R12	d*u*/d*t* filter (option +E205) or sine filter (option +E206)
T1	Drive module. Contains drive module (line-side converter + motor-side converter), LCL filter and line contactor.
T21	Auxiliary voltage transformer supplying 24 V and 230/115 V control voltage for, for example, cabinet fan(s), control devices and I/O extension adapter module.
1	Charging circuit
2	LCL filter
3	Line-side converter
4	Motor-side converter
	Pulse encoder for FEN-31 HTL incremental encoder interface module (option +L502)
	PTC sensors for optional thermistor relay(s) (options +L505, +2L505) or Pt100 sensors for optional Pt100 relays (option +xL506)

Block diagram of the drive with brake options +D150 and +D151

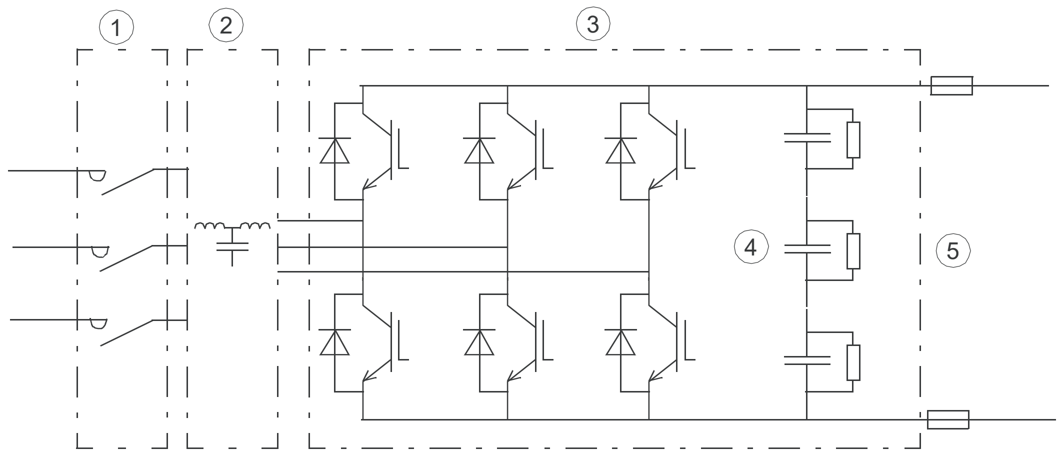


T1	Drive module
1	Line-side converter
2	DC circuit between the line-side converter and motor-side converter
3	Motor-side converter
4	Brake chopper (option +D150) is located in its own cubicle
5	Brake resistor (option +D151) is located in its own cubicle

Line-side converter

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

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



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

AC voltage and current waveforms

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

Charging

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

Motor-side converter

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

DC voltage boost function

The regenerative and ultra low harmonic drives can boost their DC link voltage. In other words, they can increase the operating voltage of the DC link from its default value.

To take the DC voltage boost function in use:

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

Benefits of the DC voltage boost

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

Impact of DC voltage boost on input current

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

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

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

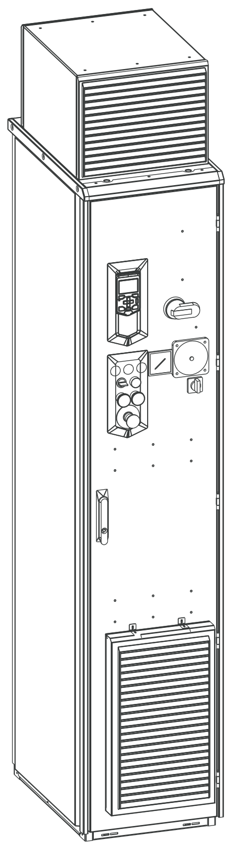
For more information, refer to ACS880-11, ACS880-31, ACS880-14, ACS880-34, ACS880-17, ACS880-37 drives product note on DC voltage boost (3AXD50000691838 [English]).

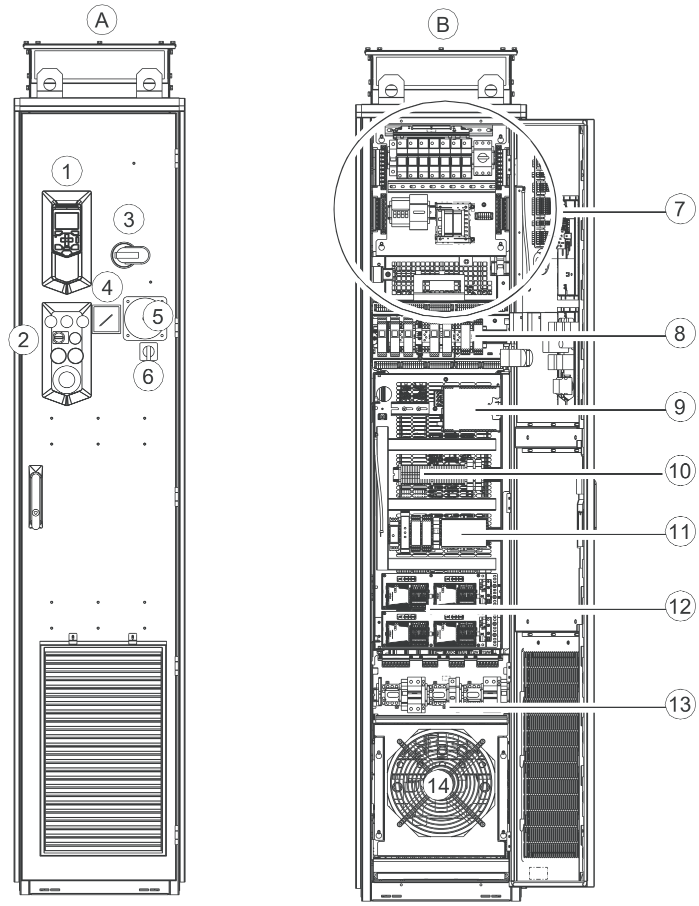
Cabinet layout

The layout drawings give an example of the cabinets. The contents of the cabinet depends on the ordered options. For example:

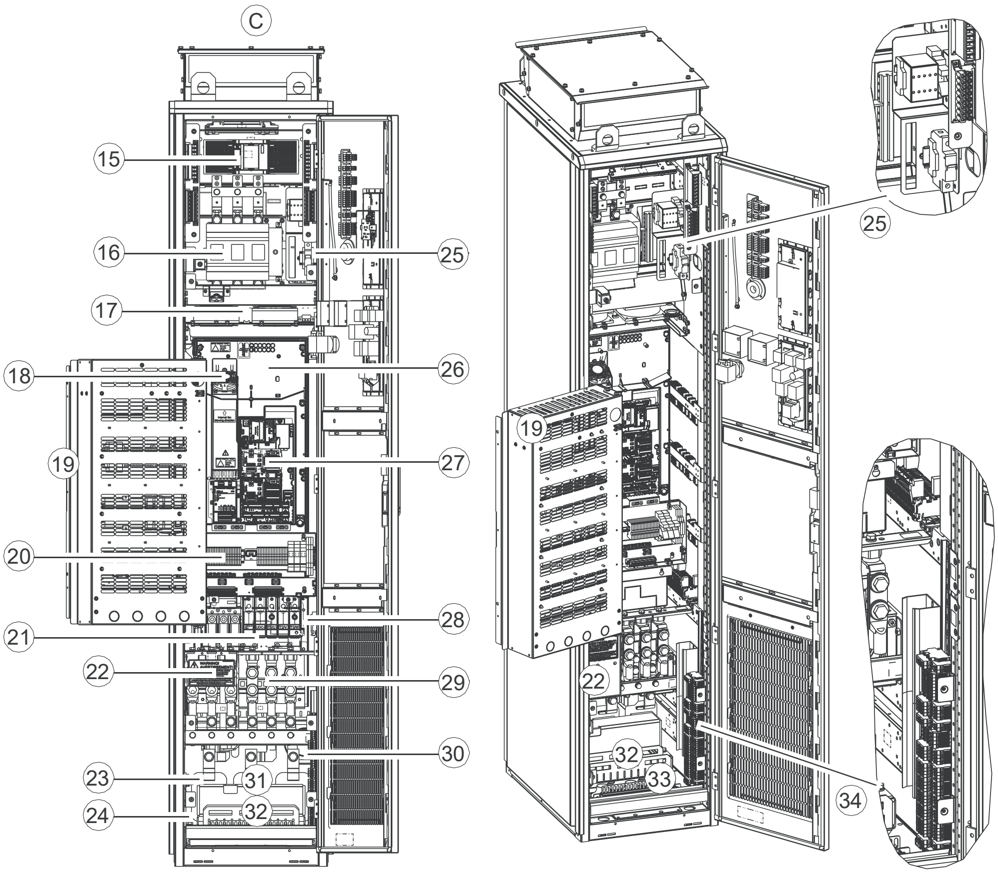
- In the lower power R8 and R11 cabinets with only a few options the “door fan” is replaced with a shroud (basic cabinet without 24 V auxiliary voltage supply, option +E205 d*u*/d*t* filter and option +E208 common mode filter).
- In R8 cabinets, the swing-out frame and mounting plate above the “door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

Cabinet layout of R8

	
IP22 (UL Type 1) IP42 (UL Type 1 Filtered) option +B054	IP54 (UL Type 12) option +B055



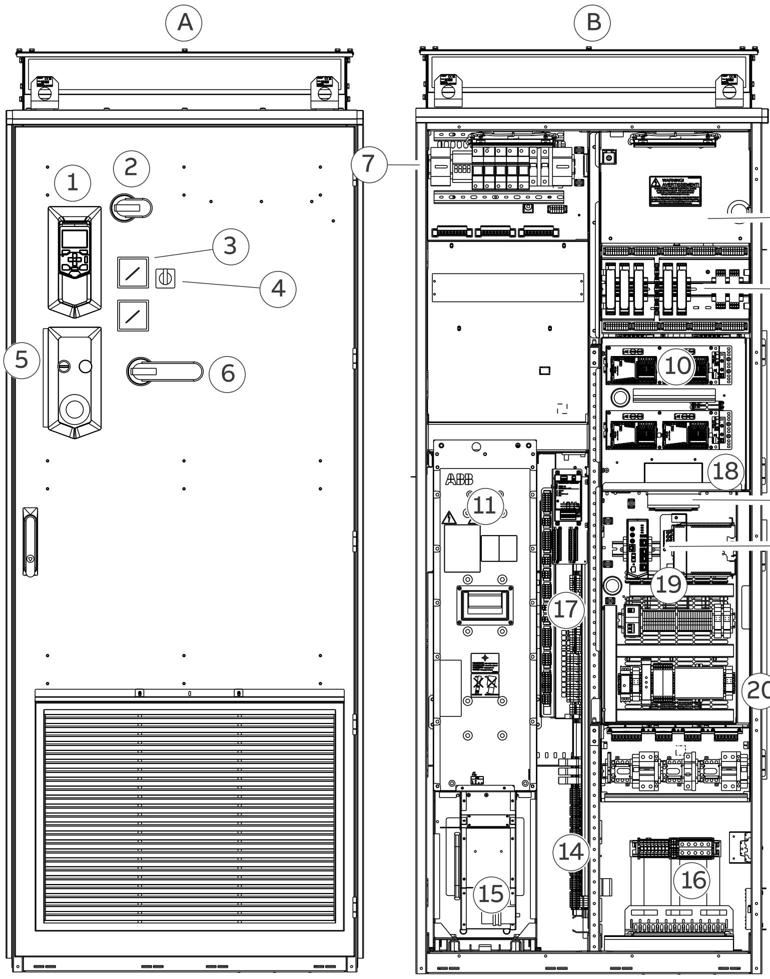
A	Drive module cubicle, door closed
B	Drive module cubicle, door open
1	Drive control panel
2	Operating buttons and door lights
3	Main switch handle
4	Indicators, for example, V-meter and A-meter
5	UL Type V-meter
6	V-meter switch
7	Main fuses for control devices, IP54 fan with option +B055, transformer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



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

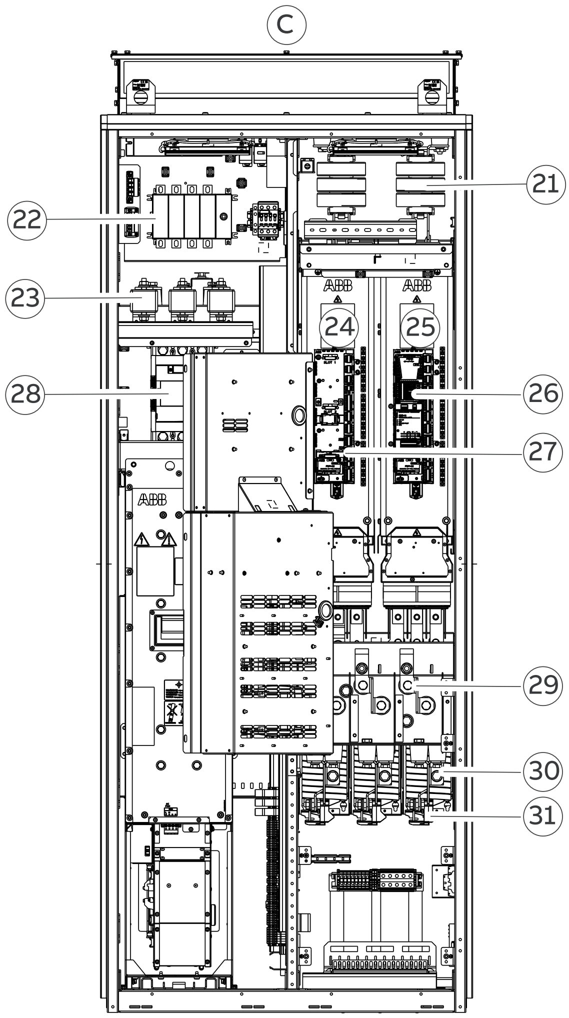
Cabinet layout of R6i+R6i and R7i+R7i

	
IP22 (UL Type 1) IP42 (UL Type 1 Filtered) option +B054	IP54 (UL Type 12) option +B055



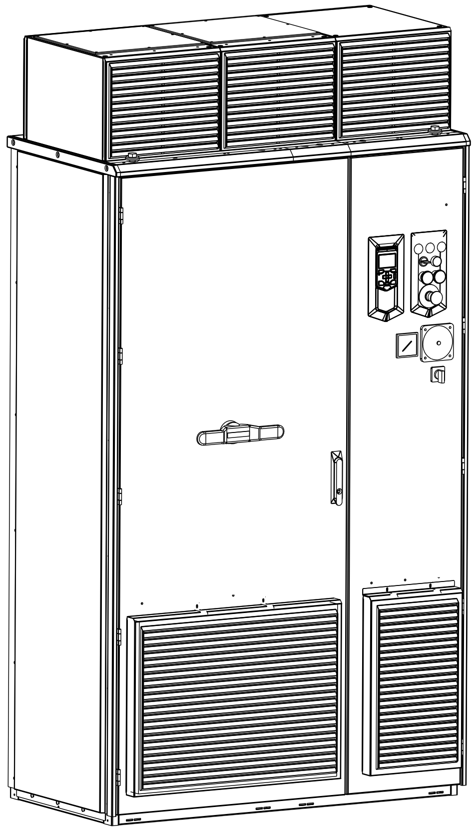
A	Drive module cubicle, door closed
B	Drive module cubicle, door open
1	Drive control panel
2	Charging switch (Q3)
3	Indicators, for example, V-meter and A-meter
4	V-meter switch
5	Operating buttons and door lights
6	Main switch-disconnector (Q1)
7	Main fuses for control devices, IP54 fan with option +B055, V-meter (option +G334), starter for auxiliary motor fan (option +M600)
8	Air baffles
9	Thermistor and Pt100 relays (options +L505, +L506)
10	Swing-out frame. Supply and inverter modules and control units are located behind the swing-out frame.
11	BLCL filter module
12	Cabinet cooling fan
13	EGW-02 Connectivity Edge Gateway
14	Terminal block (X504, option +L504) for external control cable connections to the control unit
15	BLCL filter module fan
16	T21 transformer

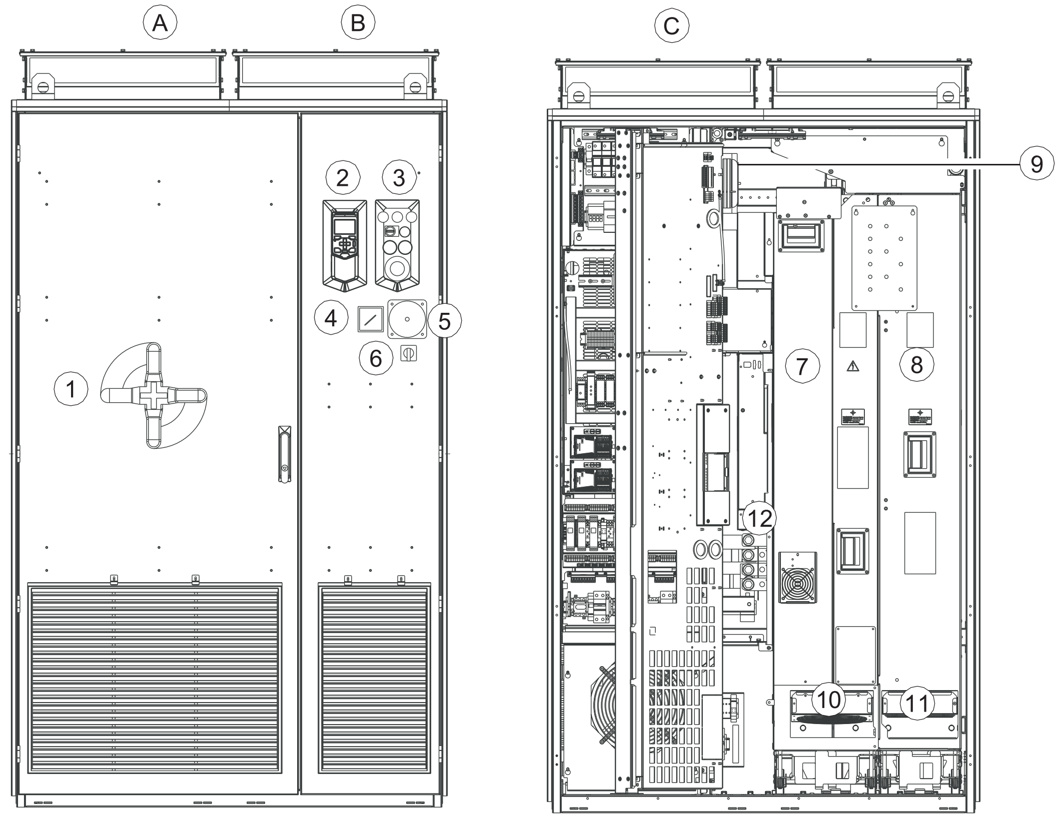
17	X250 terminal block
18	Buffering module and power supply unit
19	Terminal blocks X18 and X19
20	Components and connection terminals for options +G300, +G301, +G307, +G313



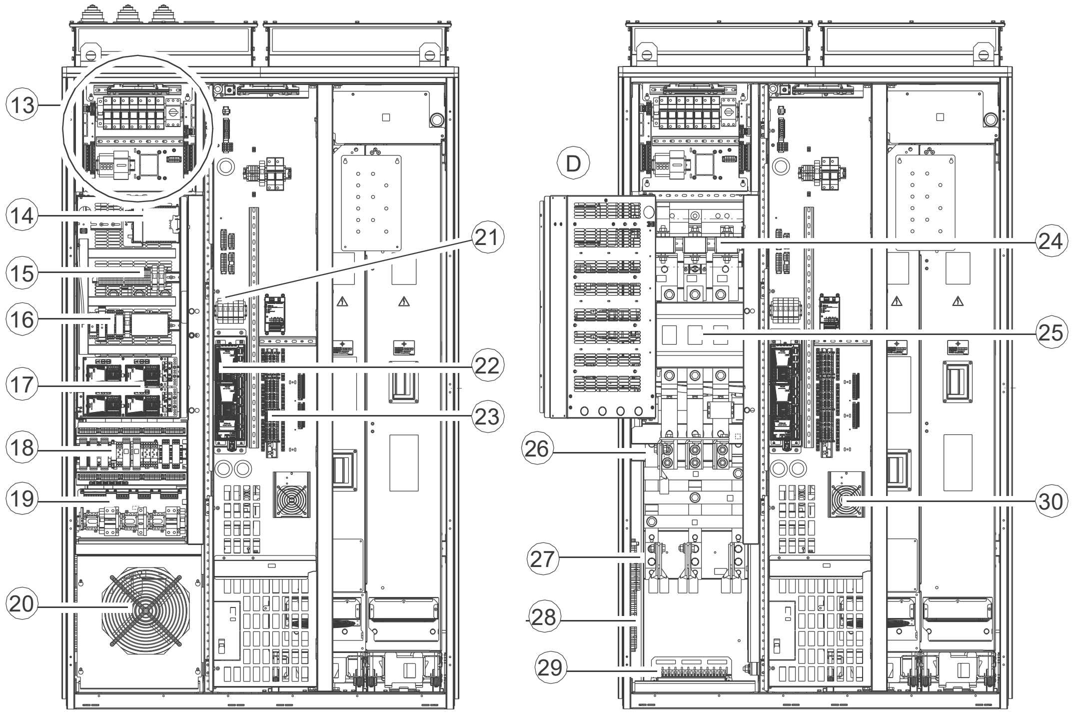
C	Swing-out frame open
21	Common mode filter (included by default)
22	Charging switch and fuses (behind the fuse plate)
23	Main AC fuses
24	Line-side converter unit
25	Motor-side converter unit
26	Motor-side converter control unit
27	Line-side converter control unit
28	Main contactor
29	Input cable connection terminals
30	Motor cable connection terminals
31	d*u*/d*t* filter (option +E205)

Cabinet layout of R11

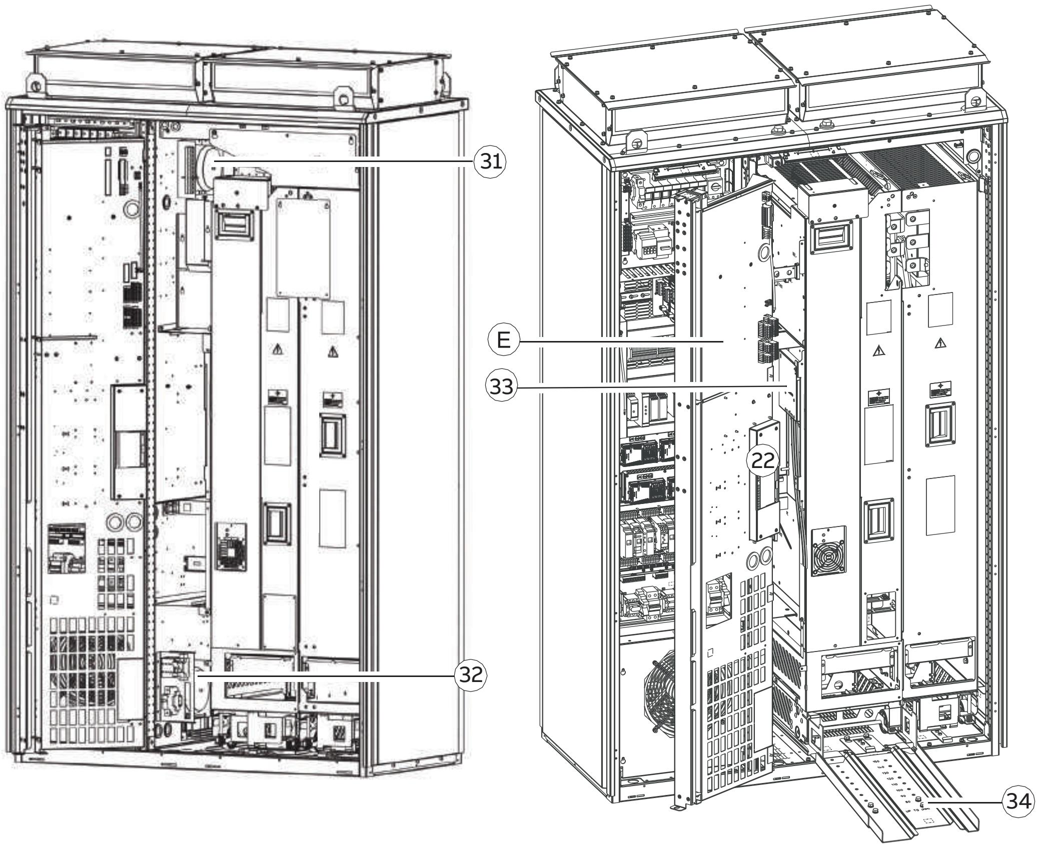
	
IP22 (UL Type 1) IP42 (UL Type 1 Filtered) option +B054	IP54 (UL Type 12) option +B055



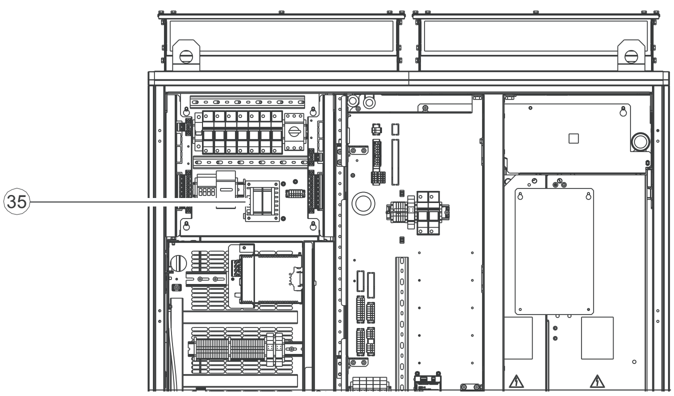
A	Main breaker and power cabling cubicle
B	Drive module cubicle
C	Swing-out frame on the drive module side open
1	Main switch-disconnector (Q1) handle
2	Drive control panel
3	Operating buttons and door lights
4	Indicators, for example, V-meter and A-meter
5	UL Type V-meter
6	V-meter switch
7	Drive module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



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

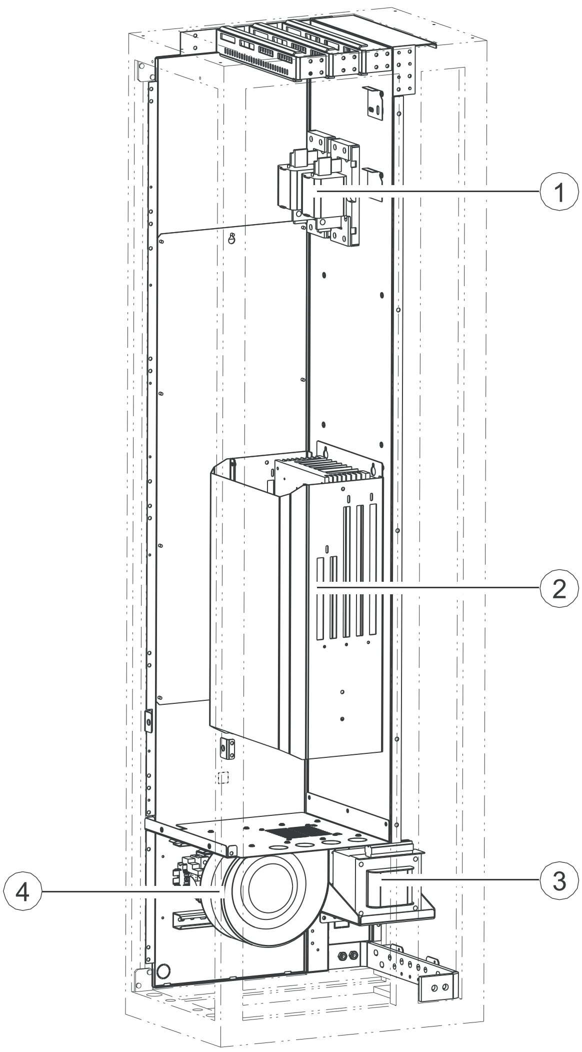


E	Swing-out frame
31	Auxiliary voltage transformer (T102) with option +B055 and distribution components
32	Auxiliary voltage transformer (T21) and distribution components
33	Line-side control unit
34	Extraction ramp



35	Auxiliary voltage transformer (T101) with options +B055 and +C128 and distribution components

Brake chopper cubicle option (+D150)

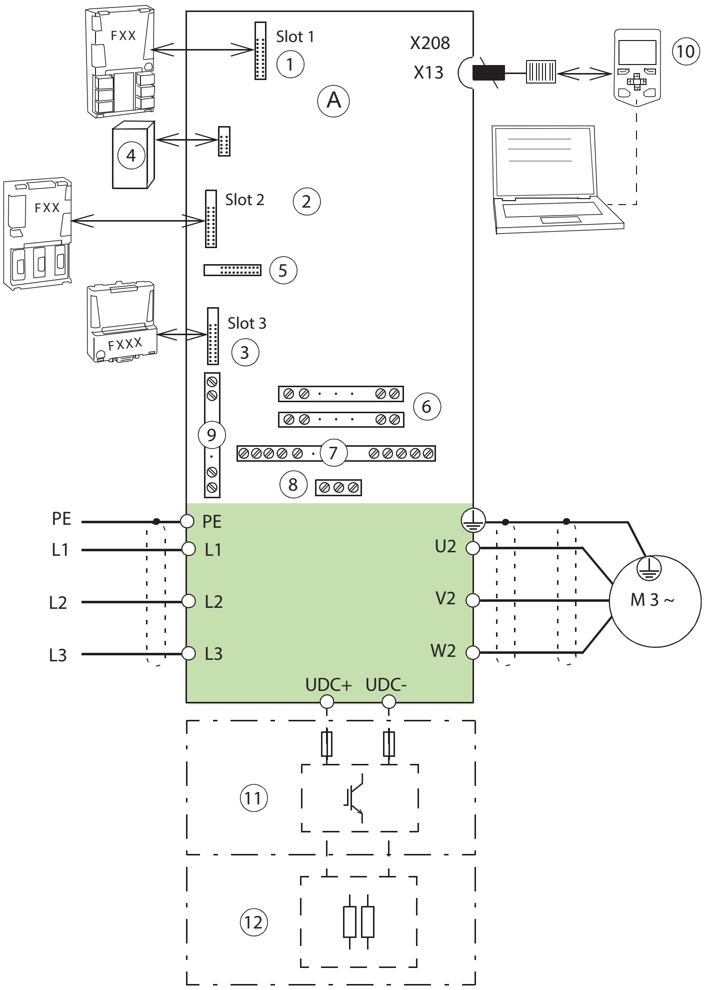


1	Fuses (F121.1…121.2)
2	Brake chopper module (T121.1)
3	Auxiliary voltage transformer (T121.11)
4	Fan (G121.1)

Overview of power and control connections

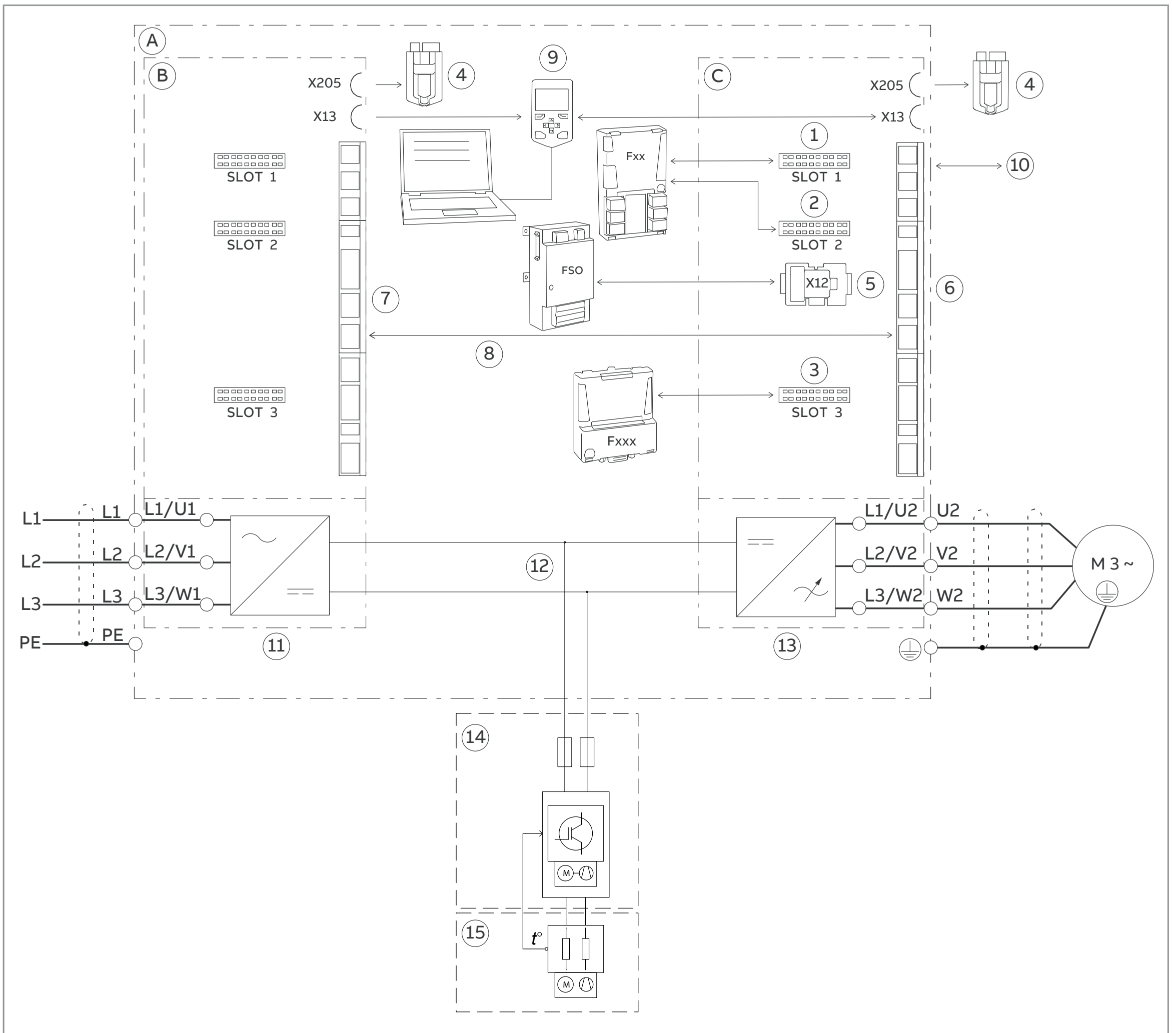
This section shows the power connections and control interfaces of the drive.

Connection overview – Frame R8



A	Drive control unit (ZCU-12). QCON-21 control board controls the line side-converter.
1 2 3	Analog and digital I/O extension modules, feedback interface modules and fieldbus communication modules can be inserted into slots 1, 2 and 3. See Type designation key (page 69).
4	Memory unit
5	Connector for safety functions module
6	Refer to chapter Control unit (page 161).
7	Additional terminal block X504 for control cable connections to the control unit (option +L504)
8	Connection terminals for options +G300, +G307, +G313
9	Connection terminals for options
10	See Control panel (page 58).
11	Brake chopper (option +D150)
12	Brake resistors (option +D151)

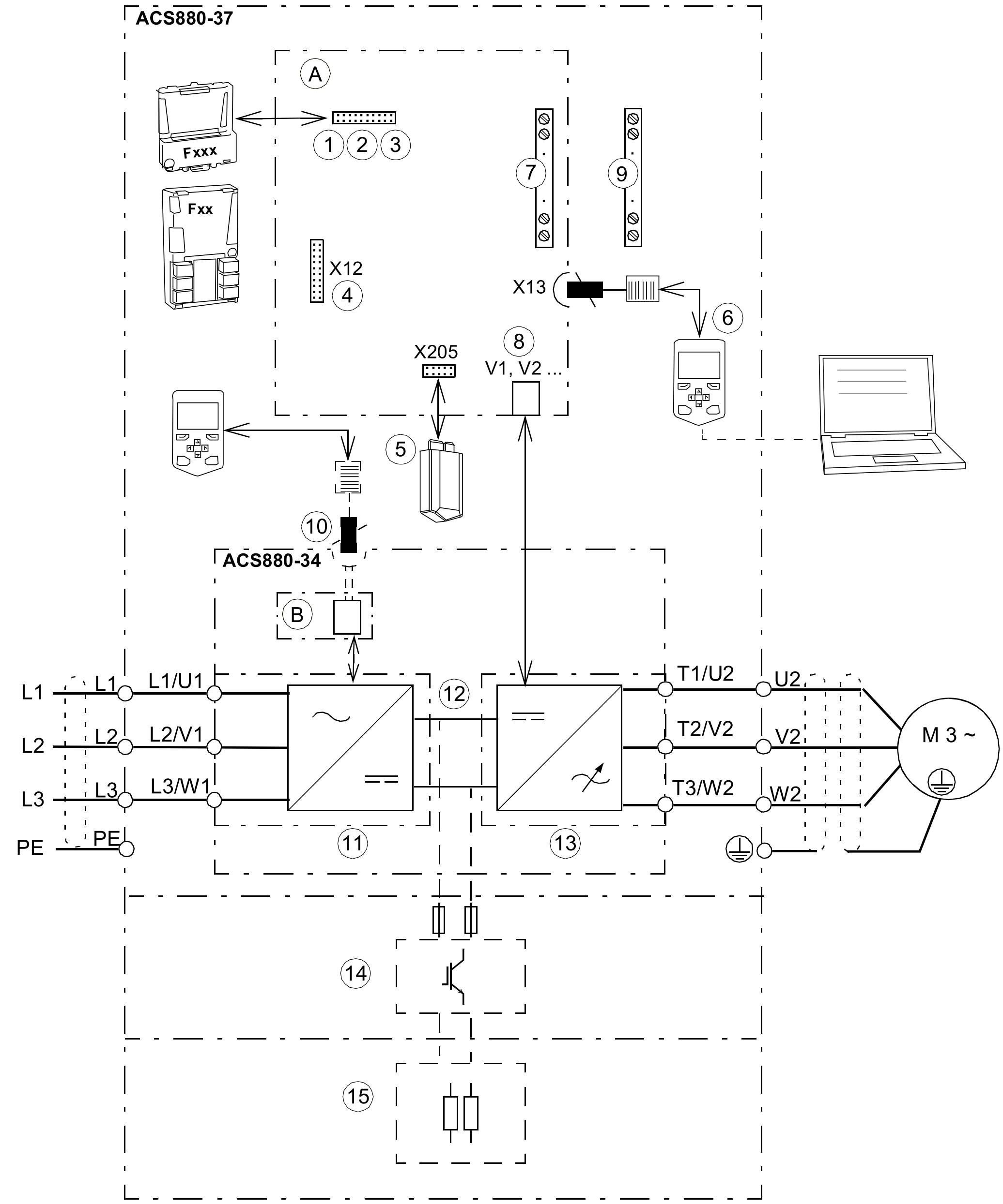
Connection overview – Frames R6i+R6i and R7i+R7i



<table>
<tr><td>A</td><td>Drive</td></tr>
<tr><td>B</td><td>Line-side converter control unit (A51) ZCU-14</td></tr>
<tr><td>C</td><td>Motor-side converter control unit (A41) ZCU-14</td></tr>
<tr><td>1
2
3</td><td>Option modules can be inserted into slots 1, 2 and 3 as follows:
<table><tr><th>Module type</th><th>Slots</th></tr><tr><td>Analog and digital I/O extension modules</td><td>1, 2, 3</td></tr><tr><td>Feedback interface modules</td><td>1, 2, 3</td></tr><tr><td>Fieldbus communication modules</td><td>1, 2, 3</td></tr><tr><td>FSO-xx safety functions module</td><td>2 (X12)</td></tr></table>
Note: When installed into the slot 3 of a ZCU-14 control unit, the module goes over the edge. ABB recommends to use slot 1 or 2 whenever possible.</td></tr>
<tr><td>4</td><td>Memory unit</td></tr>
<tr><td>5</td><td>Connector for FSO-xx safety functions module (X12). The module reserves slot 2 when connected.</td></tr>
<tr><td>6</td><td>Terminal blocks on the drive control unit. Refer to chapter Control unit (page 161). These terminals are optionally wired to terminal block X504 in the drive cabinet.</td></tr>
<tr><td>7</td><td>Supply unit control circuitry including door switches, charging circuit control, main contactor control, etc.</td></tr>
<tr><td>8</td><td>Supply unit to inverter unit D2D (drive-to-drive) link.</td></tr>
</table>

9	Control panel and PC connection. Refer to section Control panel (page 58).
10	Terminal blocks for customer connections installed in the drive cabinet. Wiring details are given in chapter Electrical installation (page 125).
11	Supply unit (consisting of one supply module).
12	DC intermediate link.
13	Inverter unit (consisting of one inverter module).
14	Brake chopper (option +D150)
15	Brake resistors (option +D151)

Connection overview – Frame R11



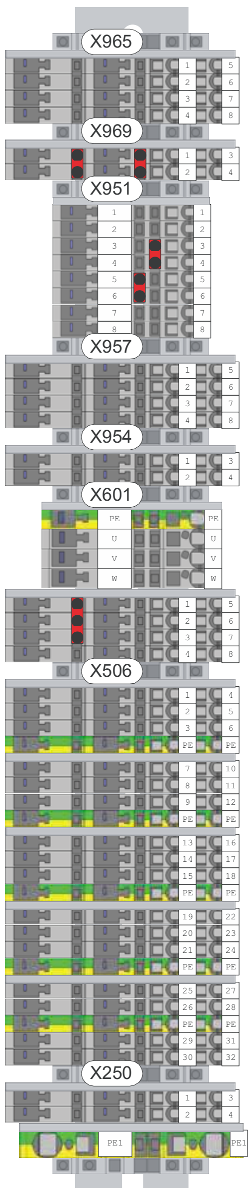
A	Motor-side converter control unit (drive control unit, ZCU-14)
B	Line-side converter control unit (ZCU-12)
1	Analog and digital I/O extension modules, feedback interface modules and fieldbus communication modules can be inserted into slots 1, 2 and 3. See Type designation key (page 69).
2	
3	
4	Connection for FSO-xx safety functions module
5	Memory unit
6	See Control panel (page 58).
7	Terminal blocks on the drive control unit. Refer to Control unit (page 161). These terminals are optionally wired to terminal block X504 in the drive cabinet.
8	Fiber optic link to the motor-side converter. Similarly, the line-side converter is connected to the line-side converter control unit with fiber optic cables.

9	Terminal blocks for customer connections installed in the drive cabinet. Wiring details are given in Electrical installation.
10	Socket for external line-side converter control
11	Line-side converter
12	DC link
13	Motor-side converter
14	Brake chopper (option +D150)
15	Brake resistors (option +D151)

External control cable connection terminals (other than control unit terminals)

Connection terminals of R8

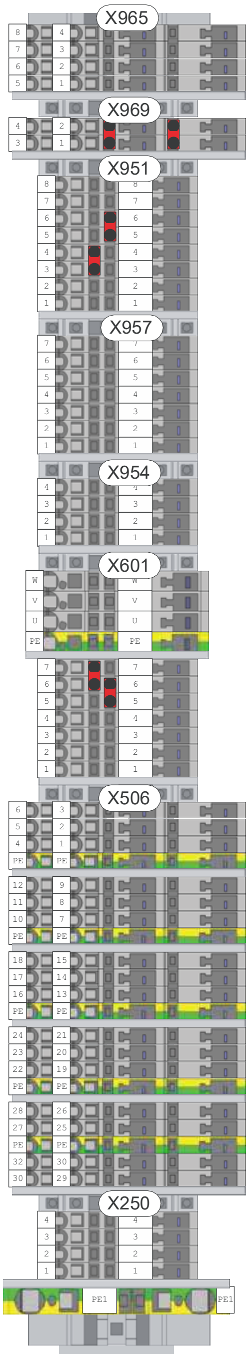
The layout of external control cable connection terminals at the right-hand side of the drive cabinet is shown below. The composition depends on the options selected.



	Terminals for
X250	Main switch feedback for customer and line contactor feedback with options +Q951, +Q952 or +Q978
X506	Thermistor relay or Pt100 relays (option +L505 or +L506)
X601	Starter for auxiliary motor fan (options +M600…M605)
X951	Push buttons for emergency stop options +Q951, +Q952, +Q963 and +Q964
X954	Ground fault monitoring for IT (ungrounded) systems (option +Q954)
X957	Prevention of unexpected start-up with safety relays (option +Q957)
X965	Safely limited speed with encoder (option +Q965)
X696	External STO customer connection for safety options +Q951, +Q952, +Q963, +Q964, +Q957 and +Q971

Connection terminals of R6i+R6i, R7i+R7i and R11

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



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

Door devices

<table>
<tr><th></th><th>Label in English</th><th>Label in local language</th><th>Description</th></tr>
<tr><td>1</td><td>READY</td><td>-</td><td>Ready light (option +G327)</td></tr>
<tr><td>2</td><td>RUN</td><td>-</td><td>Run light (option+G328)</td></tr>
<tr><td>3</td><td>FAULT</td><td>-</td><td>Fault light (option +G329)</td></tr>
<tr><td>4</td><td>ENABLE / RUN
0-1
</td><td>-</td><td>Run enable signal switch for the line-side converter with options +Q951, +Q952 and +Q978
Frames R6i+R6i and R7i+R7i: Run enable signal switch for the supply unit by default
<table>
<tr><td>OFF</td><td>Run enable signal off (starting the line-side converter not allowed). Opens the charging contactor Q3.</td></tr>
<tr><td>ON</td><td>Run enable signal on (starting the line-side converter allowed). Closes the charging contactor Q3.</td></tr>
</table></td></tr>
<tr><td>5</td><td>EMERGENCY STOP RESET</td><td>-</td><td>Emergency stop reset push button (with emergency stop options only)</td></tr>
<tr><td>6</td><td>GROUND FAULT RESET</td><td>-</td><td>Combined ground fault indicator light and reset push button with option +Q954</td></tr>
<tr><td>7</td><td>-</td><td>-</td><td>Reserved for order-based engineered equipment</td></tr>
<tr><td>8</td><td>-</td><td>-</td><td>Emergency stop push button (with emergency stop options only)</td></tr>
<tr><td colspan="4">The layout depends on the options selected.</td></tr>
</table>

Main disconnecting device (Q1)

The main disconnecting device switches the main supply to the drive on and off. To disconnect the main supply, turn the switch-disconnector (frames R6i+R6i, R7i+R7i and R11) or switch fuse (frame R8) to the 0/OFF position.

WARNING!
The main disconnecting device does not isolate the input power terminals from the power line. To isolate the terminals, open the main breaker of the supply transformer.

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

Other devices on the door

- Operating switch (S21)
- Voltmeter (option +G334); comes with a phase selector switch.

  Note: The voltage is measured on the supply side of the main disconnecting device.
- AC current meter (option +G335) on one phase.

Control panel

The ACS-AP-W is the user interface of the drive. It provides the essential controls such as Start/Stop/Direction/Reset/Reference, and the parameter settings for the inverter control program.

The control panel can be removed by pulling it forward by the top edge and reinstalled in reverse order. For the use of the control panel, see ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual (3AUA0000085685 [English]) and the firmware manual.



Control by PC tools

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

Descriptions of options

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

Degree of protection

Definitions

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

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

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

IP22 (UL Type 1)

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

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

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

IP54 (UL Type 12) (Standard)

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

Marine construction (option +C121)

The option includes the following accessories and features by default:

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

Marine product certifications may require additional wire markings. Refer to section Wire markings (page 63).

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

See section Air inlet through the bottom of the cabinet (option +C128) (page 91).

UL Listed (option +C129)

The cabinet contains the following accessories and features:

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

Channeled air outlet (option +C130)

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

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

See also section Air outlet duct on the cabinet roof (option +C130) (page 92).

CSA Approved (option +C134)

The option includes the following accessories and features:

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

Plinth height (options +C164 and +C179)

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

Seismic design (option +C180)

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

The option adds the following accessories and features:

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

Empty cubicles on right (options +C196…C198)

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

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

Empty cubicles on left (options +C199…C201)

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

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

Resistor braking (options +D150 and +D151)

See chapter Resistor braking (page 339).

EMC filter (option +E202)

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

d*u*/d*t* filter (option +E205)

The d*u*/d*t* filter protects the motor insulating system by reducing the voltage rise speed at the motor terminals. The filter also protects the motor bearings by reducing the bearing currents.

More information on when the option is required: See section Examining the compatibility of the motor and drive (page 98).

Sine filter (option +E206)

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

The sine filter option consists of three single-phase reactors and delta-connected capacitors at the output of the drive. The sine filter is fitted in a separate cubicle and has a dedicated cooling fan.

Common mode filter (option +E208)

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

More information on when the option is required: See section Examining the compatibility of the motor and drive (page 98).

Cabinet heater with external supply (option +G300)

The option contains:

- heating elements in the cubicles or supply/inverter modules
- load switch for providing electrical isolation during service

- miniature circuit breaker for overcurrent protection
- terminal block for external power supply.

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

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

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

Cabinet lighting (option +G301)

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

Terminals for external control voltage (option +G307)

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

See also:

- Supplying power for the auxiliary circuits (page 120)
- circuit diagrams delivered with drive for the actual wiring.

Output for motor space heater (option +G313)

The option contains:

- load switch for providing electrical isolation during service
- miniature circuit breaker for overcurrent protection
- terminal block for heater and external heater supply connection.

When the drive is running, the heater is switched off. Otherwise, the heater is controlled by the external supply voltage.

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

See also:

- Supplying power for the auxiliary circuits (page 120)
- circuit diagrams delivered with drive for the actual wiring.

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

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

Halogen-free wiring and materials (option +G330)

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

V-meter with selector switch (option +G334)

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

Wire markings

Standard wiring

Color

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

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

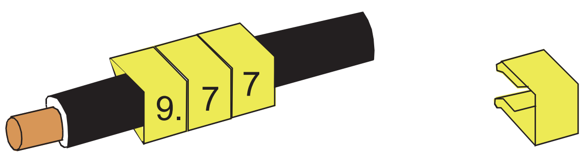
Markings

As standard, wires and terminals are marked as follows:

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

Additional wire markings

The following additional wire markings are available.

Option	Additional markings
+G340 (class A3)	Single wires not attached to plug-in connectors are marked with component pin numbers on snap-on or ring markers. Plug-in connectors are marked with an identification label placed on the wires near the connector (individual wires are not marked). Short, obvious connections are not marked. PE wires are not marked unless connected directly to components. 

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

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

For UL Listed (+C129) units, the default input and output cabling direction is through the roof of the cabinet. The bottom entry (+H350) and bottom exit (+H352) options provide power and control cable entries at the floor of the cabinet. The entries are equipped with grommets and 360° grounding hardware.

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

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

The top entry (+H351) and top exit (+H353) options provide power and control cable entries at the roof of the cabinet. The entries are equipped with grommets and 360° grounding hardware.

Cable conduit entry (option +H358)

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

Connectivity for wired remote monitoring (option +K496)

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

See the appropriate manual for more information.

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

Connectivity for wireless remote monitoring (option +K497)

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

See the appropriate manual for more information.

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

Additional terminal block X504 (option +L504)

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

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

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

- solid wire 0.2 … 2.5 mm^2 (24…12 AWG)
- stranded wire with ferrule 0.25 … 2.5 mm^2 (24…12 AWG)
- stranded wire without ferrule 0.2 … 2.5 mm^2 (24…12 AWG).

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

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

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

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

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

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

Option +L513 is an ATEX-certified thermal protection function that has the same external connectivity as +L505. In addition, +L513 comes with +Q971 (ATEX-certified safe disconnection function) as standard and is wired at the factory to activate the Safe torque off function of the drive in an overtemperature situation. A manual reset for the protection function is required by Ex/ATEX regulations. For more information, see ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual (3AXD50000014979 [English]).

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

+L536, +L537

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

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

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

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

See also

- firmware manual for parameter settings
- FPTC-01 thermistor protection module (option +L536) for ACS880 drives user's manual (3AXD50000027750 [English])
- FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual (3AXD50000027782 [English])
- circuit diagrams delivered with the drive for the actual wiring.

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

Pt100 temperature monitoring relays are used for overtemperature supervision of motors equipped with Pt100 sensors. For example, there can be three sensors to measure the temperature of the motor windings and two sensors for the bearings. As the temperature rises, the sensor resistance increases linearly. At an adjustable wake-up level, the monitoring relay de-energizes its output.

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

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

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

See also

- firmware manual for parameter settings
- ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual (3AXD50000014979 [English])
- Pt100 relay alarm and trip limit setting instructions in the start-up instructions
- circuit diagrams delivered with the drive for the actual wiring.

Starter for auxiliary motor fan (options +M600...M605)

What the option contains

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

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

Description

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

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

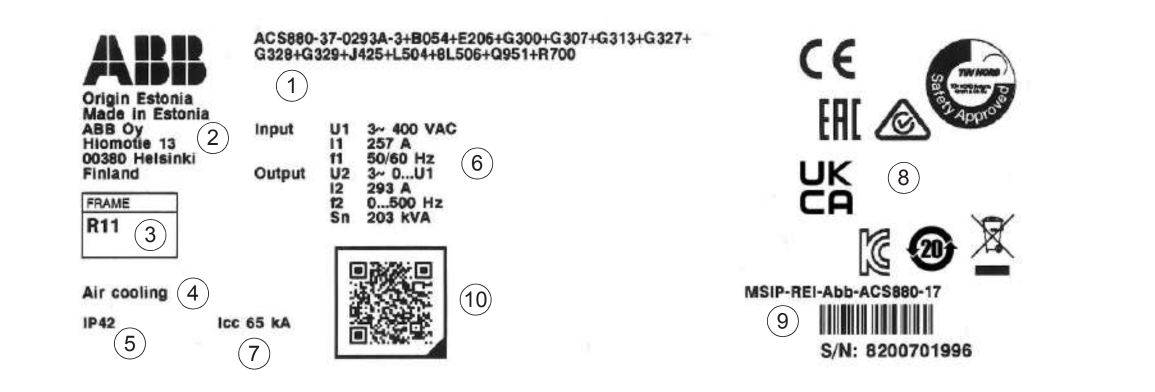
The statuses of both the starter switch and the fan contactor are wired to the terminal block.

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

Type designation label

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

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



1	Type designation, see section Type designation key (page 69).
2	Manufacturing address
3	Frame size
4	Cooling method
5	Degree of protection
6	Ratings
7	Short-circuit withstand strength
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 next, separated by plus signs. Codes that start with zero (eg. +0A123) indicate the absence of a specified feature. The main selections are described below. Not all selections are available for all types or in all regions. For more information, refer to the ordering instructions available on request.

Basic code

Code	Description
ACS880	Product series
37	The standard delivery includes: cabinet-installed drive, IP22 (UL Type 1), switch fuse (R8), main switch-disconnector (R6i+R6i, R7i+R7i, R11), aR fuses, line contactor in frames R6i+R6i, R7i+R7i and R11, ACS-AP-W Assistant control panel, EMC filter of category C3 for second environment TN (grounded) systems in R11, no EMC filter in R8, R6i+R6i, R7i+R7i, common mode filter for R6i+R6i, R7i+R7i and 690 V R11, ACS880 primary control program, Safe torque off function, coated circuit boards, bottom entry and exit of cables, USB memory containing circuit diagrams, dimension drawings and manuals. Refer to section Option codes (page 69) for options.
Size	
xxxx	Refer to the rating tables
Voltage range	
3	380…415 V. This is indicated in the type designation label as typical input voltage level 3 ~ 400 V AC.
5	380…500 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 400/480/500 V AC.
7	525…690 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 525/600/690 V AC.

Option codes

Code	Description
B054	IP42 (UL Type 1 Filtered)
B055	IP54 (UL Type 12)
C121	Marine construction. See section Marine construction (option +C121) (page 59).
C128	Air inlet through bottom of cabinet. See section Air inlet through the bottom of the cabinet (option +C128) (page 91).
C129	UL Listed (evaluated to both U.S. and Canadian safety requirements). See section UL Listed (option +C129) (page 60).
C130	Channeled air outlet. See section Channeled air outlet (option +C130) (page 60).
C132	Marine type approval. Refer to ACS880…+C132 marine type-approved cabinet-built drives supplement (3AXD50000039629 [English]).
C134	CSA approved. See section CSA Approved (option +C134) (page 60).
C164	Plinth height 100 mm. See section Plinth height (options +C164 and +C179) (page 60).
C179	Plinth height 200 mm. See section Plinth height (options +C164 and +C179) (page 60).
C180	Seismic design. See section Seismic design (option +C180) (page 60).
C196	Empty 400 mm wide cubicle on right. See section Empty cubicles on right (options +C196…C198) (page 61).

Code	Description
C197	Empty 600 mm wide cubicle on right. See section Empty cubicles on right (options +C196…C198) (page 61).
C198	Empty 800 mm wide cubicle on right. See section Empty cubicles on right (options +C196…C198) (page 61).
C199	Empty 400 mm wide cubicle on left. See section Empty cubicles on left (options +C199…C201) (page 61).
C200	Empty 600 mm wide cubicle on left. See section Empty cubicles on left (options +C199…C201) (page 61).
C201	Empty 800 mm wide cubicle on left. See section Empty cubicles on left (options +C199…C201) (page 61).
C205	Marine product certification issued by DNV GL
C206	Marine product certification issued by the American Bureau of Shipping (ABS)
C207	Marine product certification issued by Lloyd's Register (LR)
C209	Marine product certification issued by Bureau Veritas
C228	Marine product certification issued by China Classification Society (CCS)
C229	Marine product certification issued by Russian Maritime Register of Shipping (RS)
C259	Project based marine approval, marine class that does not have a type approval
D150	Brake choppers
D151	Brake resistors
E200	EMC/RFI filter for 2nd environment TN (grounded) system, category C3
E201	EMC/RFI filter for 2nd environment IT (ungrounded) system, category C3
E202	EMC/RFI filter for 1st environment TN (grounded) system, category C2
E205	d*u*/d*t* filtering
E206	Sine output filter
E208	Common mode filtering
G300	Cabinet and module heating elements (external supply). See section Cabinet heater with external supply (option +G300) (page 61).
G301	Cabinet lighting. See section Cabinet lighting (option +G301) (page 62).
G307	Terminals for connecting external control voltage (230 V AC or 115 V AC, eg. UPS). See section Terminals for external control voltage (option +G307) (page 62).
G313	Output for motor space heater (external supply)
G327	Ready light on door
G328	Run light on door
G329	Fault light on door
G330	Halogen-free wiring and materials
G334	V-meter with selector switch
G335	A-meter in one phase
G340	Wire marking class A3. See section Wire markings (page 63).
G342	Wire marking class C1. See section Wire markings (page 63).
H350	Power cabling entry from bottom. See section Bottom cable entry/exit (options +H350 and +H352) (page 64).
H351	Power cabling entry from top. See section Top cable entry/exit (options +H351 and +H353) (page 64).
H352	Power cabling exit from bottom. See section Bottom cable entry/exit (options +H350 and +H352) (page 64).

Code	Description
H353	Power cabling exit from top. See section Top cable entry/exit (options +H351 and +H353) (page 64).
H358	Cable gland plates (3 mm steel, undrilled)
J425	ACS-AP-I control panel (without Bluetooth)
K451	FDNA-01 DeviceNet™ adapter module
K454	FPBA-01 PROFIBUS DP® adapter module
K457	FCAN-01 CANopen® adapter module
K458	FSCA-01 RS-485 (Modbus/RTU) adapter module
K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCAT® adapter module
K470	FEPL-02 Ethernet POWERLINK adapter module
K475	FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
K490	FEIP-21 Ethernet adapter module for EtherNet/IP™
K491	FMBT-21 Ethernet adapter module for Modbus TCP
K492	FPNO-21 Ethernet adapter module for PROFINET IO
K496	Connectivity for wired remote monitoring. Includes NETA-21 remote monitoring tool with Ethernet connection, FMBT-21 Modbus/TCP adapter module (+K491). See section Connectivity for wired remote monitoring (option +K496) (page 64).
K497	Connectivity for wireless remote monitoring. Includes NETA-21 remote monitoring tool, FMBT-21 Modbus/TCP adapter module (+K491) and 4G modem. See section Connectivity for wireless remote monitoring (option +K497) (page 64).
L500	FIO-11 analog I/O extension module
L501	FIO-01 digital I/O extension module
L502	FEN-31 HTL incremental encoder interface module
L503	FDCO-01 optical DDCS communication adapter module
L504	Additional I/O terminal block. See section Additional terminal block X504 (option +L504) (page 65).
L505	Thermal protection with PTC relays (1 or 2 pcs). See section Thermal protection with PTC relays (options +L505, +2L505, +L513, +2L513, +L536, +L537) (page 65).
L506	Thermal protection with Pt100 relays (2, 3, 5 or 8 pcs). See section Thermal protection with Pt100 relays (options +nL506, +nL514) (page 66).
L508	FDCO-02 optical DDCS communication adapter module
L513	ATEX-certified thermal protection with PTC relays (1 or 2 pcs)
L514	ATEX-certified thermal protection with Pt100 relays (3 or 5 pcs)
L515	FEA-03 I/O extension adapter
L516	FEN-21 resolver interface module
L517	FEN-01 TTL incremental encoder interface module
L518	FEN-11 TTL absolute encoder interface module
L521	FSE-31 pulse encoder interface module
L525	FAIO-01 analog I/O extension module
L526	FDIO-01 digital I/O extension module
L536	FPTC-01 thermistor protection module
L537	FPTC-02 ATEX-certified thermistor protection module
M600	Starter for auxiliary motor fan, trip limit 1 … 1.6 A

Code	Description
M601	Starter for auxiliary motor fan, trip limit 1.6 … 2.5 A
M602	Starter for auxiliary motor fan, trip limit 2.5 … 4 A
M603	Starter for auxiliary motor fan, trip limit 4 … 6.3 A
M604	Starter for auxiliary motor fan, trip limit 6.3 … 10 A
M605	Starter for auxiliary motor fan, trip limit 10…16 A
N5000	Winder control program
N5050	Crane control program
N5100	Winch control program
N5150	Decanter/Centrifuge control program
N5200	PCP (Progressive Cavity Pump) control program
N5300	Test bench control program
N5450	Override control program
N5600	ESP (Electrical Submersible Pump) control program
N5700	Position control program
N5800	Offshore winch control program
N6000	Spooling control program
N7502	Control program for synchronous reluctance motors (SynRM)
N8010	IEC 61131-3 application programmability
P902	Customized
P904	Extended warranty (30 months from delivery or 24 months from commissioning)
P909	Extended warranty (42 months from delivery or 36 months from commissioning)
P911	Extended warranty (66 months from delivery or 60 months from commissioning)
P912	Seaworthy packaging
P913	Special color (RAL Classic)
P947	Safety data calculation and validation for tailored safety functions
P948	Customized extended warranty
P952	Country of origin: Finland
P966	Special color (other than RAL Classic)
Q950	Prevention of unexpected start-up with FSO safety functions module, by activating the Safe torque off function
Q951	Emergency stop (category 0) with safety relays, by opening the main breaker/contactor
Q952	Emergency stop (category 1) with safety relays, by opening the main breaker/contactor
Q954	Earth fault monitoring for IT (ungrounded) systems
Q957	Prevention of unexpected start-up with safety relays, by activating the Safe torque off function
Q963	Emergency stop (category 0) with safety relays, by activating the Safe torque off function
Q964	Emergency stop (category 1) with safety relays, by activating the Safe torque off function
Q965	Safely-limited speed with FSO-21 and encoder
Q971	ATEX-certified safe disconnection function
Q972	FSO-21 safety functions module
Q973	FSO-12 safety functions module
Q978	Emergency stop (configurable for category 0 or 1) with FSO safety functions module, by opening the main breaker/contactor

Code	Description
Q979	Emergency stop (configurable for category 0 or 1) with FSO safety functions module, by activating the Safe torque off function
Q982	PROFIsafe with FSO safety functions module and FPNO-21 Ethernet adapter module
Q986	FSPS-21 PROFIsafe safety functions module
Q989	FSCS-21 CIP Safety functions module
R700	Printed documents in English
R701	Printed documents in German[1)]
R702	Printed documents in Italian[1)]
R703	Printed documents in Dutch[1)]
R704	Printed documents in Danish[1)]
R705	Printed documents in Swedish[1)]
R706	Printed documents in Finnish[1)]
R707	Printed documents in French[1)]
R708	Printed documents in Spanish[1)]
R709	Printed documents in Portuguese[1)]
R711	Printed documents in Russian[1)]
R712	Printed documents in Chinese[1)]
R713	Printed documents in Polish[1)]
R714	Printed documents in Turkish[1)]

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

4

Mechanical installation

Contents of this chapter

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

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. Refer to the technical data.
- The ambient conditions of the drive meet the specifications. Refer to the technical data.
- The material behind, above, and below the drive is non-flammable.
- There is sufficient free space above the drive for cooling, maintenance work, and operation of the pressure relief (if present).
- The floor that the drive cabinet is installed on is of non-flammable material, as smooth as possible, and strong enough to hold the weight of the unit. Examine the flatness of the floor with a spirit level. The maximum permitted deviation from a level surface is 5 mm (0.2 in) for every 3 meters (10 ft). If it is necessary, level the installation site, as the cabinet does not have adjustable feet.

Necessary tools

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

- crane, fork-lift or pallet truck (check load capacity!), slate/spud bar, jack and rollers
- Pozidriv and Torx screwdrivers

- torque wrench
- set of wrenches or sockets.

Examining the delivery

The drive delivery contains:

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

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

Moving and unpacking the drive

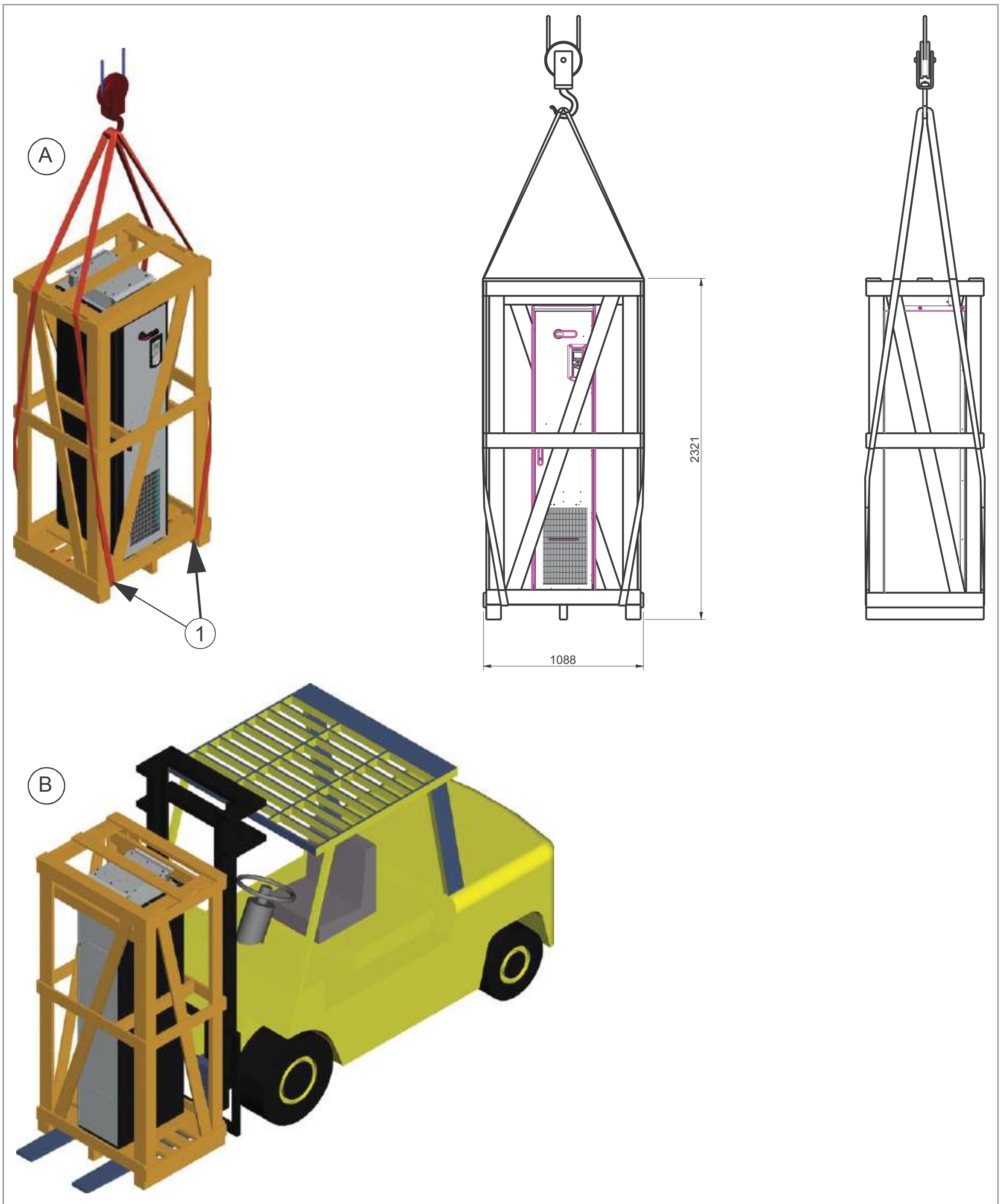
Move the drive in its original packaging to the installation site as shown below to avoid damaging the cabinet surfaces and door devices. When you are using a pallet truck, check its load capacity before you move the drive.

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

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

Moving the drive in its packaging – Frames R6i+R6i, R7i+R7i and R8

WARNING!
Obey the local laws and regulations that apply to lifting, such as the requirements for planning the lift, the capacity and condition of the lifting equipment, and personnel training.

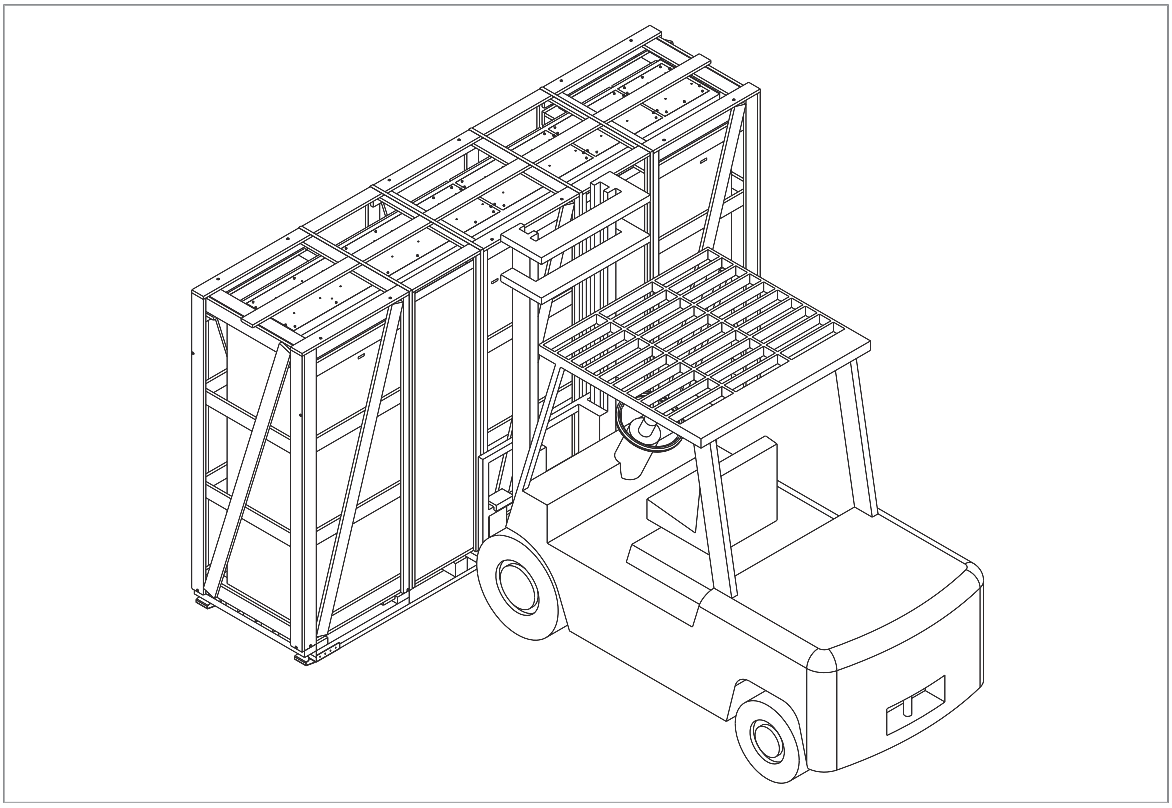


A	Lifting the transport package with slings.
1	Lifting points
B	Lifting the transport package with forklift

Moving the drive in its packaging – Frame R11

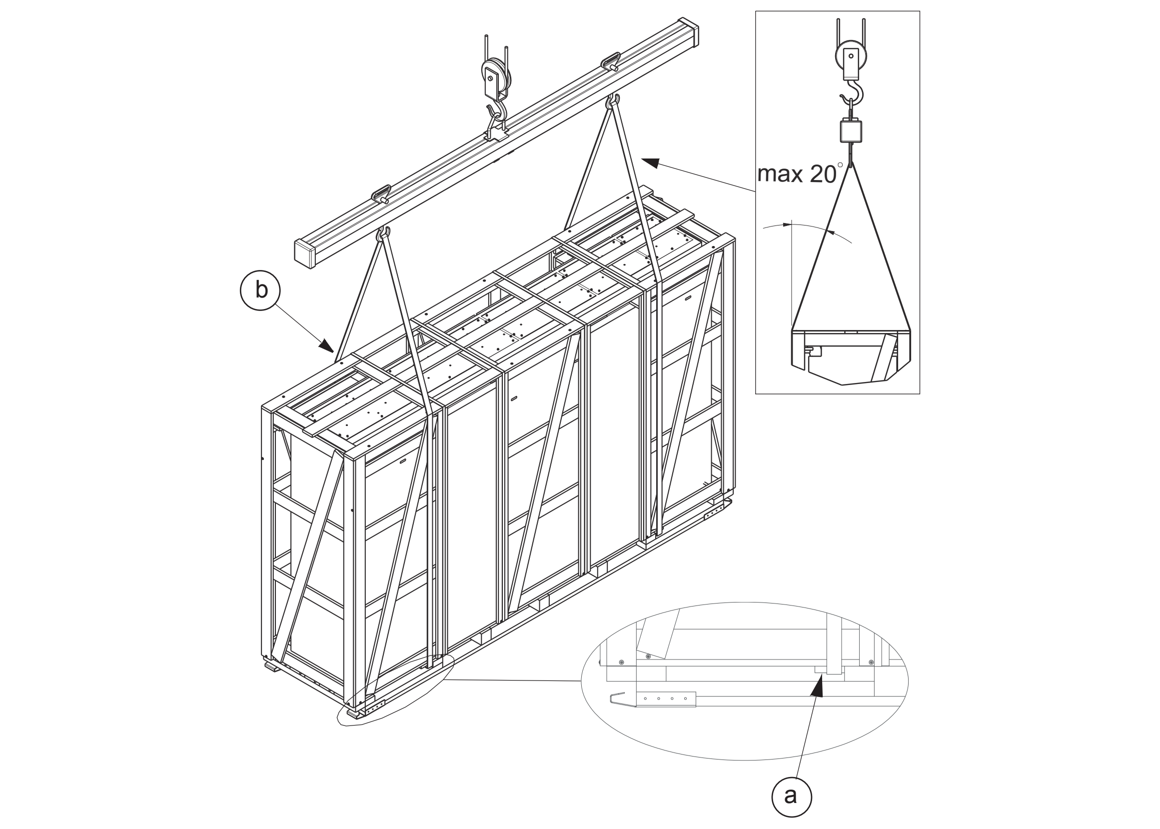
Lifting the crate with a forklift

WARNING!
Obey the local laws and regulations that apply to lifting, such as the requirements for planning the lift, the capacity and condition of the lifting equipment, and personnel training.



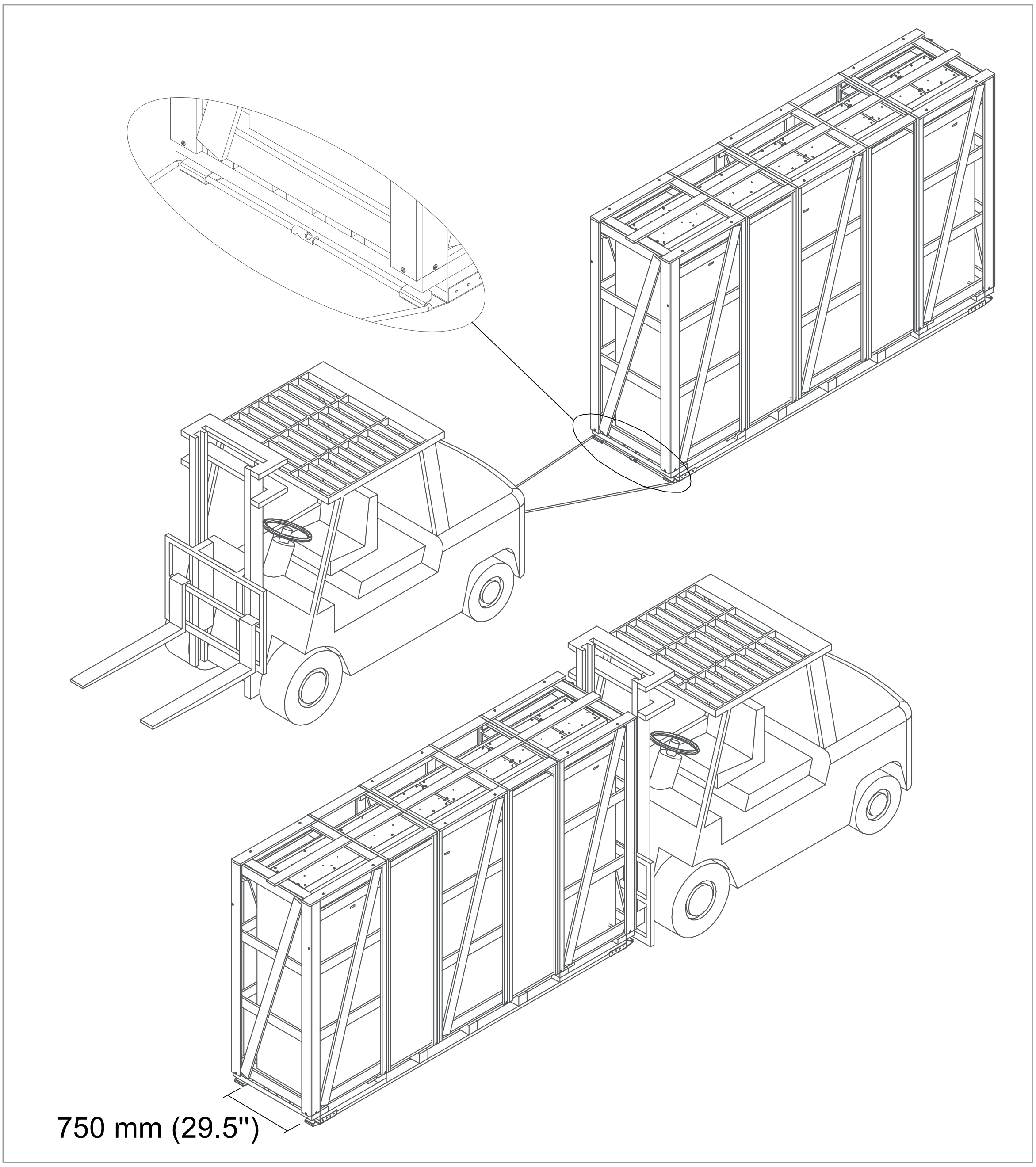
Lifting the crate with a crane

WARNING!
Obey the local laws and regulations that apply to lifting, such as the requirements for planning the lift, the capacity and condition of the lifting equipment, and personnel training.



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

Moving the crate with a forklift



Removing the transport package

Remove the transport package as follows:

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

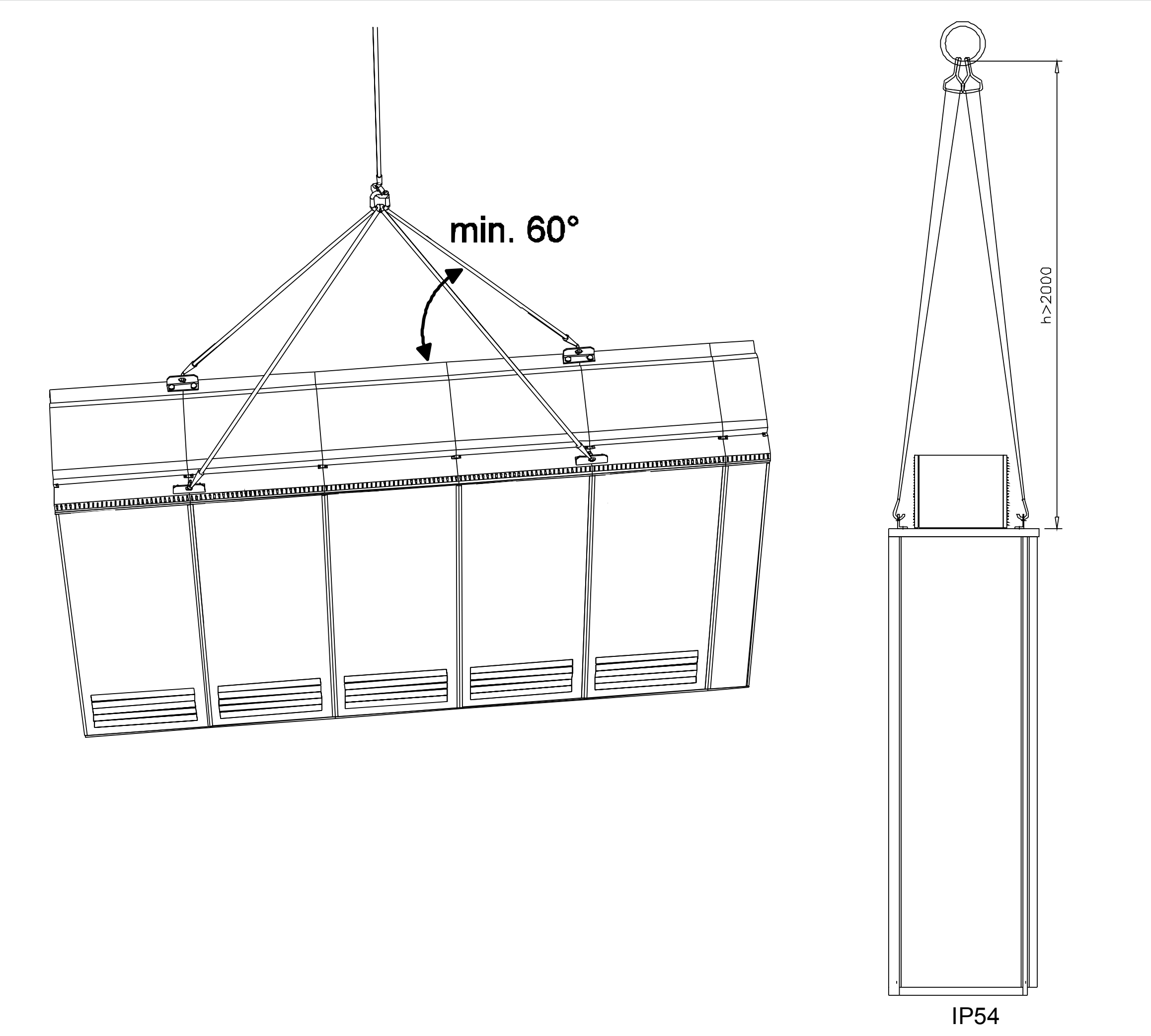
Moving the unpacked drive cabinet

Lifting the cabinet with a crane

WARNING!
Obey the local laws and regulations that apply to lifting, such as the requirements for planning the lift, the capacity and condition of the lifting equipment, and personnel training.

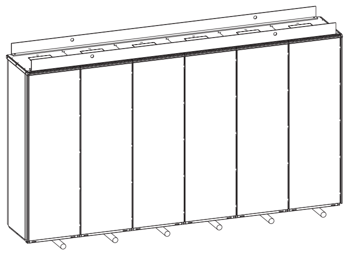
Lift the drive cabinet by its designated lifting points. Depending on the size of the cabinet, it has either bolt-on lifting lugs, or lifting bars with lifting holes.

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



Moving the cabinet on rollers

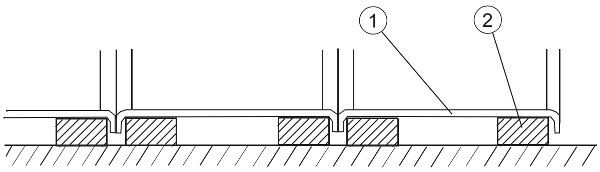
WARNING!
Do not move marine versions (option +C121) on rollers.

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

Moving the cabinet on its back

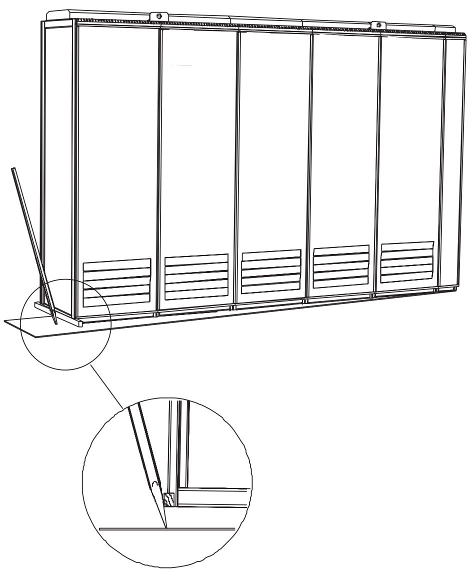
WARNING!
Transportation of the cabinet on its back is only allowed if it is packed for such transportation at the factory. Transportation of the cabinet on its back is only allowed with the sine filters (option +E206) removed from the cabinet. Transportation of the R6i+R6i and R7i+R7i on its back is only allowed with the BLCL filter module removed from the cabinet. Transportation of the R11 on its back is only allowed with the drive and LCL filter modules removed from the cabinet.

Support the cabinet from below alongside the cubicle seams.



1	Cabinet back panel
2	Support

Moving the cabinet to its final position

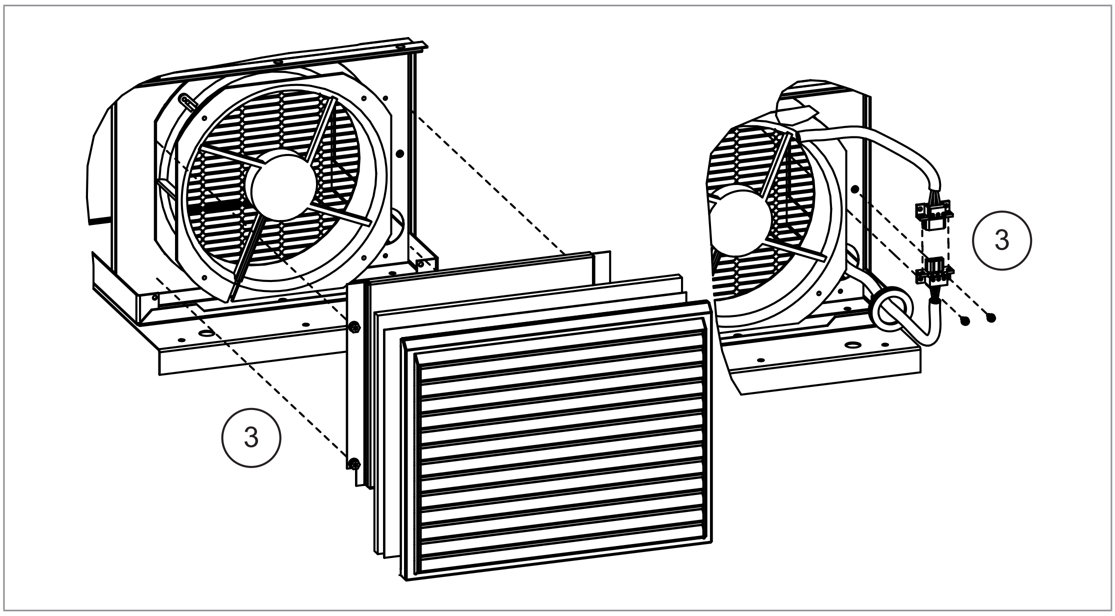
	Move the cabinet into its final position with a slate bar (spud bar). Put a piece of wood between the edge of the cabinet and the bar to protect the cabinet frame.

Installing the IP54 roof (option +B055)

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

Frame R8

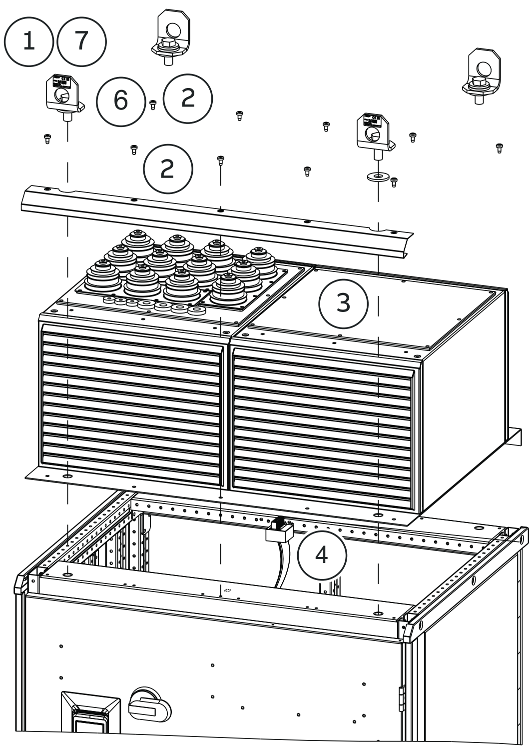
1. Undo the lifting eye screws and remove the lifting eyes.
2. To remove the top front profile of the cabinet, undo the mounting screws. Undo the back mounting screws.
3. Remove the IP54 filter grating and connect the fan power supply wires.



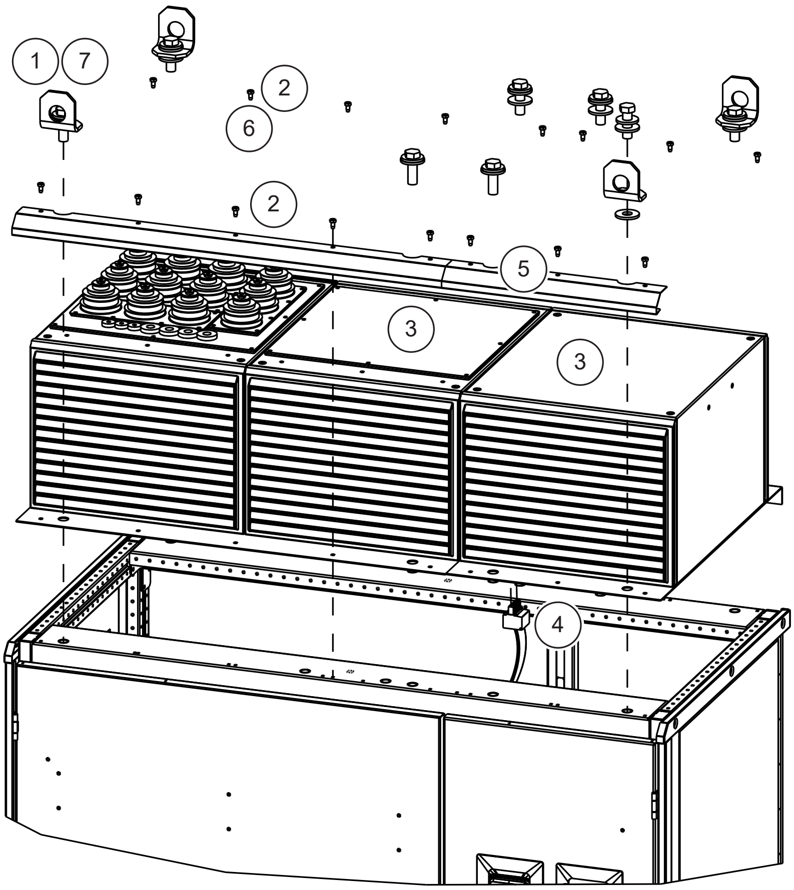
4. Install the front top profile of the cabinet in reverse order to step 2.
5. Attach the back mounting screws of the roof.
6. Install the IP54 filter grating.
7. Reinstall the mounting screws of the lifting eyes.

Frames R6i+R6i, R7i+R7i and R11

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

R6i+R6i and R7i+R7i


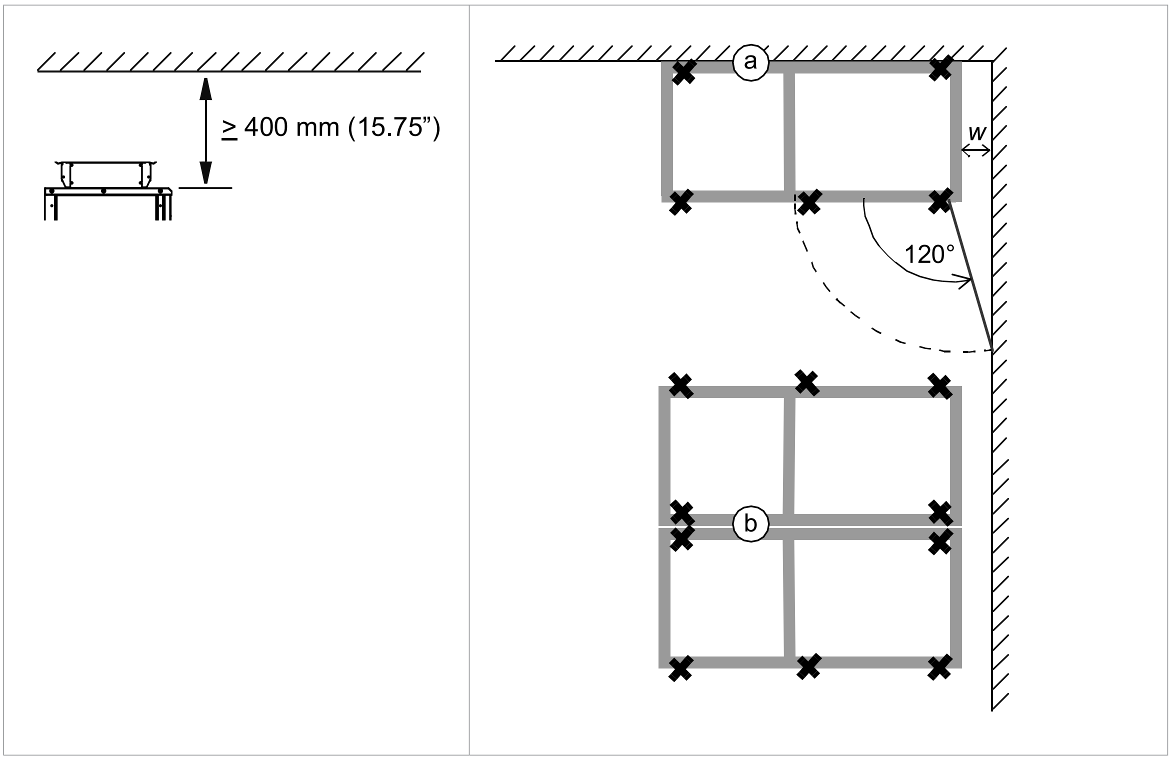
R11



Attaching the cabinet to the floor and wall or roof

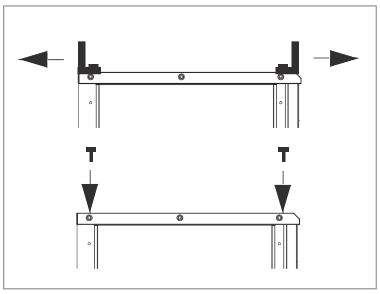
General rules

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



Note 1: Adjust the cabinet height before you attach the cabinet sections to the floor or to each other. To adjust the height, use metal shims between the cabinet bottom and floor.

Note 2: Depending on the size of the cabinet, it has either bolt-on lifting eyes, or lifting bars with lifting holes. Remove the bolt-on lifting eyes if you need to use the holes to attach the cabinet. If the cabinet is delivered with lifting bars, remove them and store them for decommissioning. Plug any unused holes using the existing bolts and sealing rings included. Tighten to 70 N·m (52 lbf·ft).

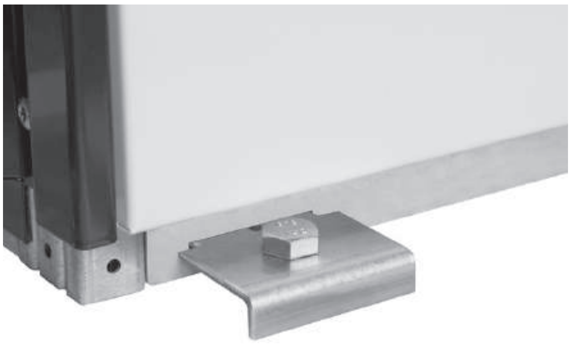
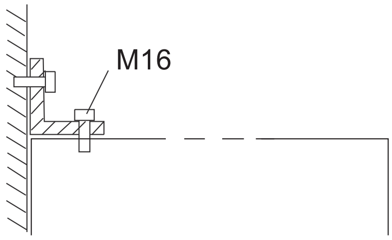
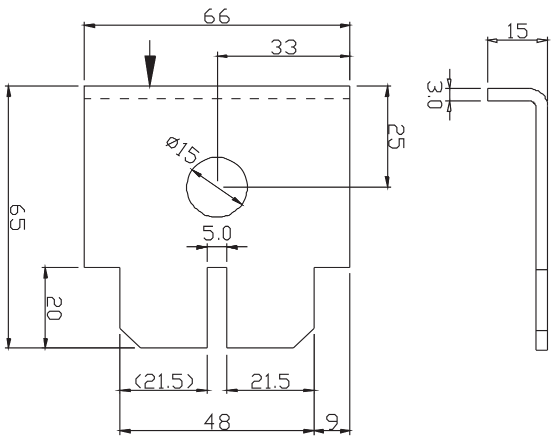


WARNING!
Do not stand or walk on the cabinet roof. Make sure that nothing presses against the roof, side or back plates or door. Do not store anything on the roof while the drive is in operation.

Attaching the cabinet (non-marine units)

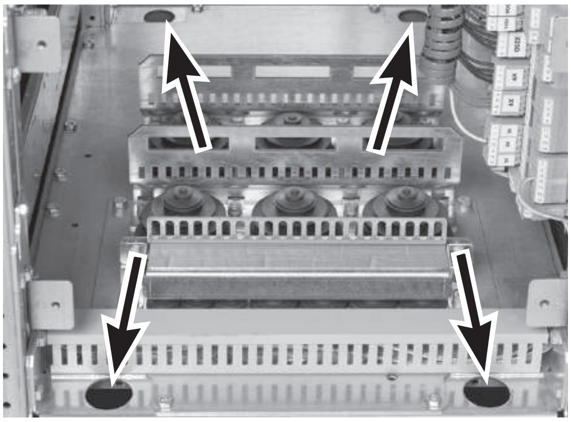
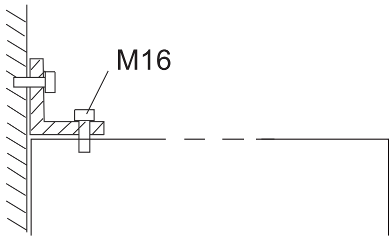
Alternative 1 – Clamping

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

Clamping bottom to floor	Attaching top to wall
	
	

Alternative 2 – Using the holes inside the cabinet

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

Attaching bottom to floor	Attaching cabinet top to wall
	

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

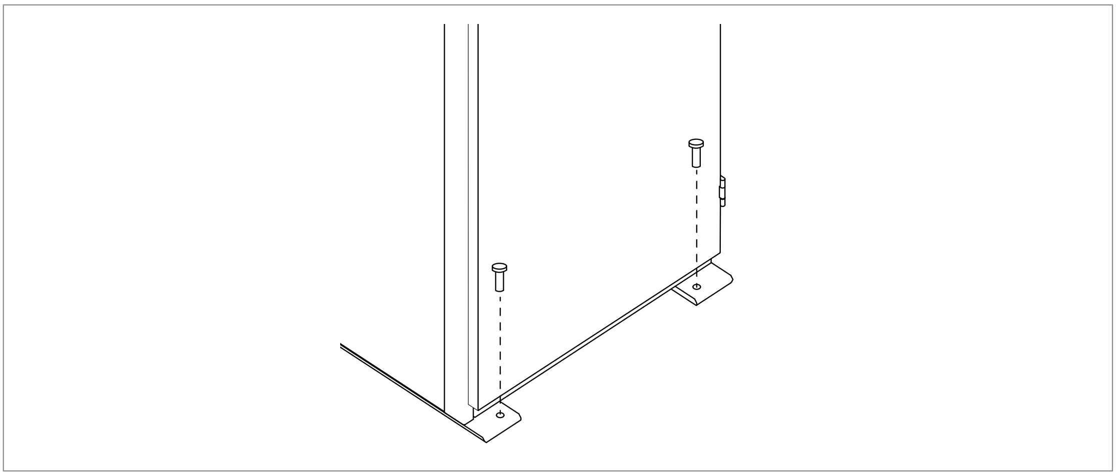
Attach the plinth to the floor with the L-brackets with which the cabinet is attached to the transportation pallet.

Attaching the cabinet (marine units, option +C121)

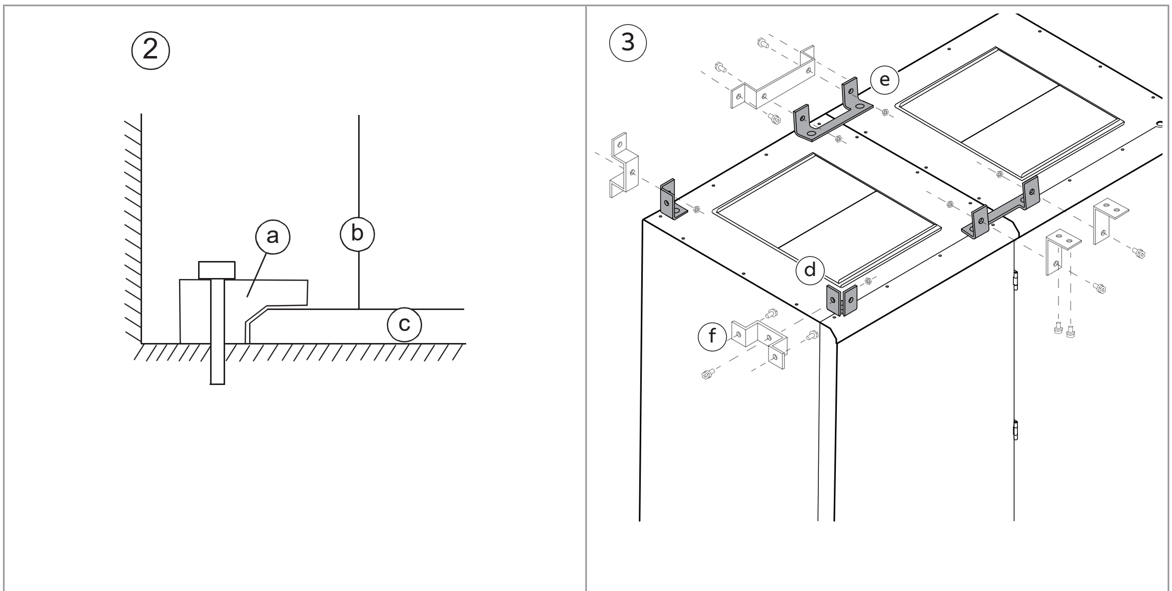
See the dimension drawing delivered with the drive for details of the fastening points.

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

1. Fasten the cabinet to the floor through the flat bars at the base of the back and the front of the cabinet. Use M10 or M12 screws.



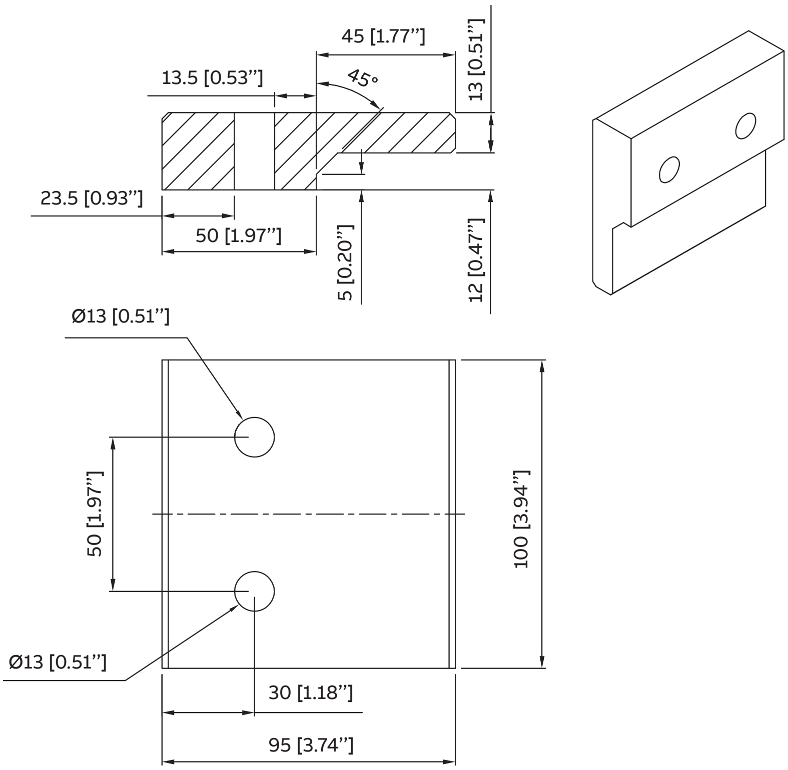
2. If there is not enough room behind the cabinet for installation, fasten the rear edges of the flat bars (c) to the floor with clamps (a). Refer to the figure below.
3. Attach corner brackets (d) to the roof of the cabinet. Use M16 screws and the lifting lug or lifting bar holes. Attach support brackets (e) between two cabinets. Fasten the brackets on the rear, front and corners of the cabinet to the wall and/or roof with suitable hardware such as L- and U-brackets (f). Refer to the figure below.



a	Clamp[2]. Refer to dimension drawing below	d	Corner bracket[1]
b	Back panel of cabinet	e	Support bracket between two cabinets[1]
c	Flat bars at base of cabinet	f	L- and U-bracket[2]

[1] In the delivery.
[2] Not in the delivery, must be acquired by the installer.

Dimension drawing for clamp (a), example.

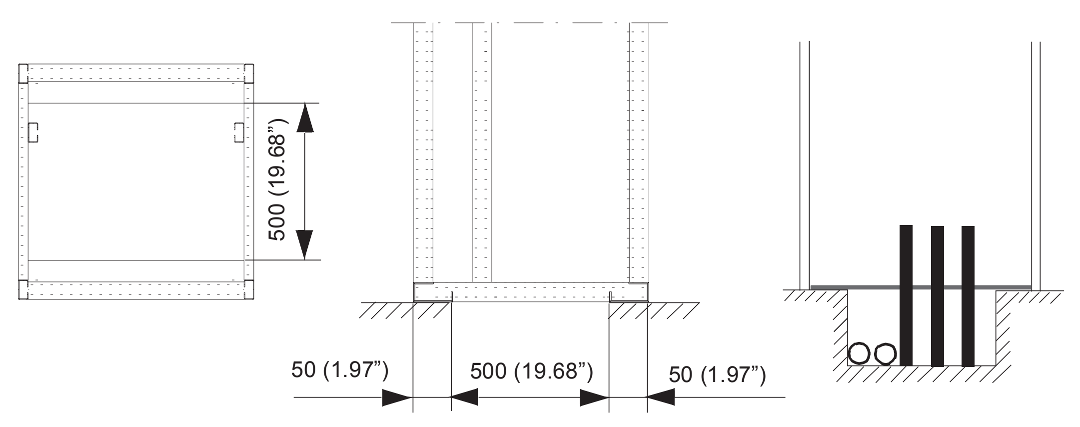


Miscellaneous

Cable duct in the floor below the cabinet

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

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



Arc welding

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

Note: The cabinet frame is zinc-plated.

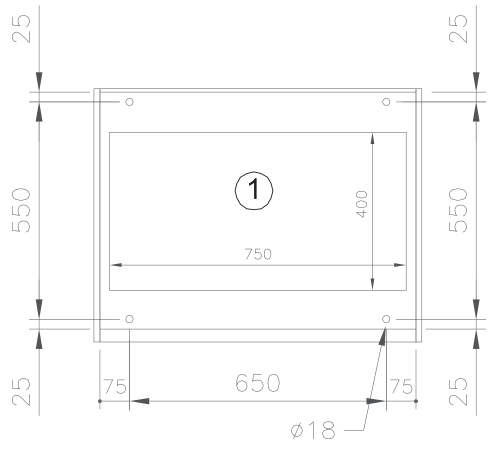
WARNING!
Make sure that the return wire is connected correctly. Welding current must not return via any component or cabling of the drive. If the welding return wire is connected incorrectly, the welding circuit can damage electronic circuits in the cabinet.

WARNING!
Do not inhale the welding fumes.

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

Drives with air inlet through the bottom of the cabinet (option +C128) are intended for installation on an air duct in the floor.

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



1	Air inlet area

Support the plinth of the cabinet all round.

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

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

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

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

Cubicle width (mm)	Outlet duct				Channel
	Veloduct type	**Outer diameter (mm)**	**Inner diameter (mm)**	**Cross-sectional area (m^2)**	**Recommended inner diameter (mm)**
300	BDEA-6-020	200	194	0.030	200.0 … 200.7
400[1]	BDEA-6-020	200	194	0.030	200.0 … 200.7
	BDEA-6-031	310	304	0.073	315.0 … 315.9
500	BDEA-6-031	310	304	0.073	315.0 … 315.9
600	BDEA-6-040	400	394	0.122	400.0 … 401.0
700	BDEA-6-040	400	394	0.122	400.0 … 401.0
800	2 × BDEA-6-031	310	304	0.145	315.0 … 315.9
1000	2 × BDEA-6-031	310	304	0.145	315.0 … 315.9

[1] Both 200 mm and 300 mm ducts are in use. Refer to the delivery-specific dimension drawings for the actual measure.

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

Calculating the required static pressure difference

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

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

where

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

$v_m = q / A_c$

p_d	Dynamic pressure
ρ	Air density (kg/m^3)
v_m	Average air velocity in the exit duct(s) (m/s)
q	Rated air flow of the drive (m^3/s)
A_c	Cross-sectional area of the exit duct(s) (m^2)

Example

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

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

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

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

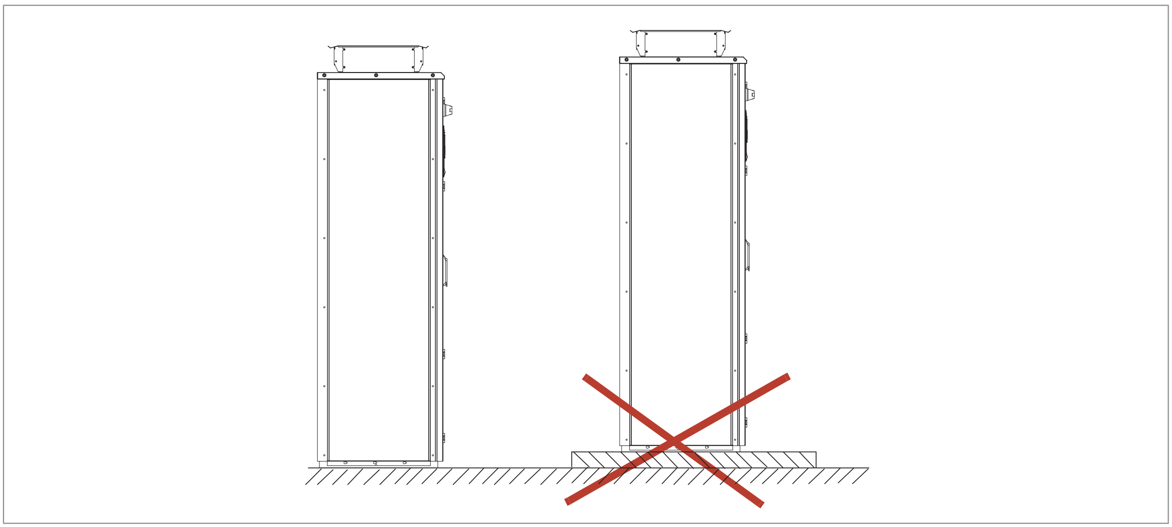
The required pressure in the exit air duct is then 1.5…2 · 17 Pa = 26…34 Pa below the pressure in the room.

Installation of the cabinet on an elevated platform or a recess

Do not install the drive cabinet on an elevated platform if you only have the default power module extraction/installation ramp. It is applicable only for the height of the cabinet plinth. This applies to both the deliveries with the standard cabinet plinth and the deliveries with optional cabinet plinths (options +C164, +C179).

If you must install the cabinet on an elevated platform, make sure that you obey these guidelines:

- The power module extraction/installation ramp meets these requirements:
  - The ramp is applicable for the total height of the plinth and the platform.
  - The slope of the ramp does not exceed 15 degrees.
  - The ramp can carry the weight of a heavy power module.
  - You can attach the ramp securely to the cabinet.
- There is enough space in front of the cabinet for the ramp. The higher the total height of the plinth and the platform is, the longer the ramp must be.
- The elevated platform complies with the installation floor specification for the drive cabinet.
- The drive cabinet is attached to the elevated platform as specified in the floor mounting instructions.



Lifting lugs and bars

Certificate of conformity

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

Declarations of conformity

Link to Declaration of conformity according to EU Machinery Directive 2006/42/EU (3AXD10000686042)

Link to Declaration of conformity according to UK Supply of Machinery (Safety) Regulations 2008 (3AXD10001329600)

5

Guidelines for planning the electrical installation

Contents of this chapter

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

Limitation of liability

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

North America

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

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

Selecting the supply disconnecting device

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

Examining the compatibility of the motor and drive

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

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

Make sure that the motor can be used with an AC drive. See Requirements tables (page 98). For basics of protecting the motor insulation and bearings in drive systems, see Protecting the motor insulation and bearings (page 98).

Note:

- Consult the motor manufacturer before using a motor with nominal voltage that differs from the AC line voltage connected to the drive input.
- The voltage peaks at the motor terminals are relative to the supply voltage of the drive, not to the drive output voltage.

Protecting the motor insulation and bearings

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

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

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

Requirements tables

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

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

See also Abbreviations (page 102).

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

1) manufactured before 1.1.1998

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

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

See also Abbreviations (page 102).

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

[1] manufactured before 1.1.1998

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

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

See also Abbreviations (page 102).

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

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

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

See also Abbreviations (page 102).

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

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

Abbreviations

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

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

Product type	Availability of du/dt filter	Availability of common mode filter (CMF)
ACS880-37	Option (+E205)	Standard in R6i+R6i, R7i+R7i and 690 V R11, option (+E208) in other frames

Additional requirements for explosion-safe (EX) motors

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

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

Use the selection criteria given for non-ABB motors.

Additional requirements for braking applications

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

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

Additional requirements for the regenerative and low harmonics drives

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

Additional requirements for ABB high-output and IP23 motors

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

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

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

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

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

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

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

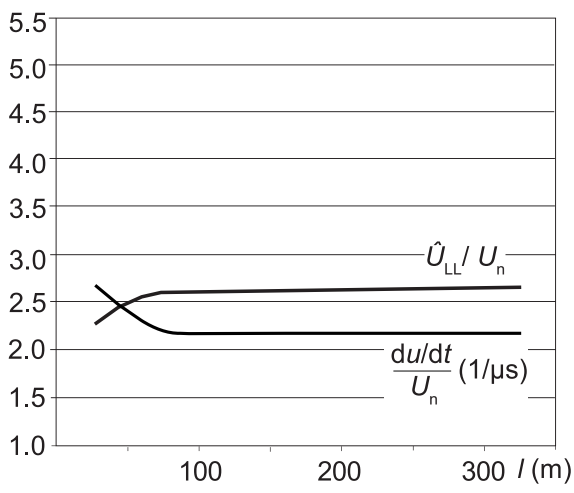
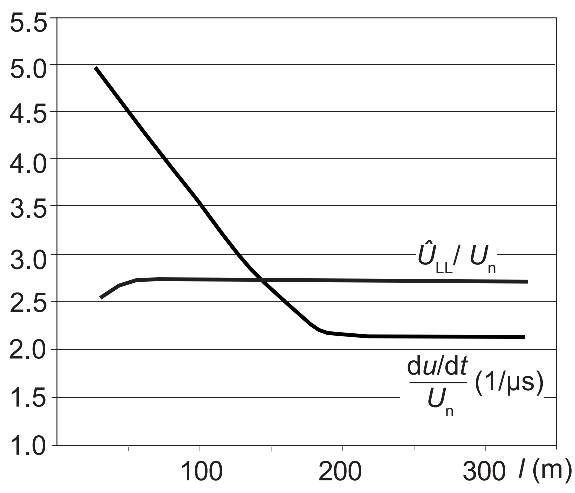
Nominal AC supply voltage	**Requirement for**		
	Motor insulation system	**ABB du/dt and common mode filters, insulated N-end motor bearings**	
		P_n < 100 kW or frame size < IEC 315	**100 kW < P_n < 350 kW or IEC 315 < frame size < IEC 400**
		P_n < 134 hp or frame size < NEMA 500	**134 hp < P_n < 469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

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

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

The diagrams below show the relative peak line-to-line voltage and rate of change of voltage as a function of the motor cable length. If you need to calculate the actual peak voltage and voltage rise time considering the actual cable length, proceed as follows:

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

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 during the 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

Power cable selection procedure and applicability check

Select each power cable as follows. Obey the local regulations.

1. Select the cable type. Obey the general guidelines and recommendations for the drive power cabling. Refer to General guidelines (page 106) and Power cable types (page 106) .
2. Select the cable size. Refer to the listing of typical power cable sizes given in the technical data.
3. Make sure that the short-circuit rating of the cable is sufficient. Take into account the disconnection time of the protective device. If the rating is not sufficient, select a larger cable, increase the number of parallel cables or change the cable to a type with higher conductor temperature rating.
4. Select the cable lugs.
5. Make sure that the cable can enter the cabinet through the cable entry plate. Refer to the dimension drawings of the drive delivery or technical data in the drive hardware manual. For special cable entry solutions, consult ABB.
6. Make sure that there is sufficient space to install the cable(s) and cable lugs to the terminals. Refer to the terminal and cable entry data given in the technical data.

General guidelines

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

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

To comply with the EMC requirements of the CE mark, use one of the preferred cable types. See Preferred power cable types (page 106).

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

Metal conduit reduces electromagnetic emission of the whole drive system.

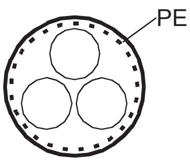
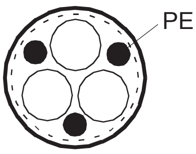
Typical power cable sizes

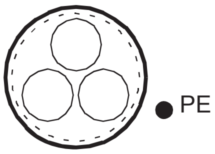
See the technical data in the appropriate hardware manual.

Power cable types

Preferred power cable types

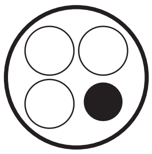
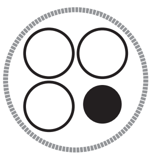
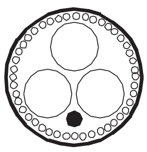
This section shows the preferred cable types. Make sure that the selected cable type also complies with local/state/country electrical codes.

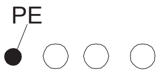
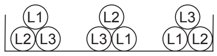
Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
 Symmetrical shielded (or armored) cable with three phase conductors and concentric PE conductor as shield (or armor)	Yes	Yes
 Symmetrical shielded (or armored) cable with three phase conductors and symmetrically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

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

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

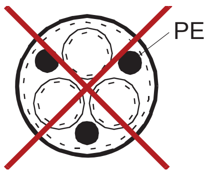
Alternate power cable types

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
 Four-conductor cable in plastic 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 armored cable (three phase conductors and PE)	Yes	Yes with phase conductor smaller than 10 mm^2 (8 AWG) Cu, or motors up to 30 kW (40 hp)
 Shielded (Al/Cu shield or armor)[1] four-conductor cable (three phase conductors and a PE)	Yes	Yes with motors up to 100 kW (135 hp). A potential equalization between the frames of motor and driven equipment is required.

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
 A single-core cable system: three phase conductors and PE conductor on cable tray  Preferable cable arrangement to avoid voltage or current unbalance between the phases	Yes **WARNING!** If you use unshielded single-core cables in an IT network, make sure that the non-conductive outer sheath (jacket) of the cables have good contact with a properly grounded conductive surface. For example, install the cables on a properly grounded cable tray. Otherwise voltage may become present on the non-conductive outer sheath of the cables, and there is even a risk of an electric shock.	No

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

Not allowed power cable types

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

Additional guidelines – North America

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

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

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

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

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

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

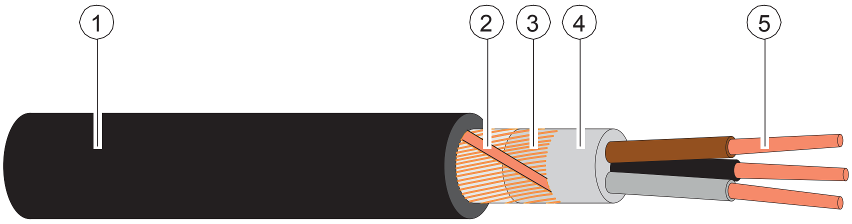
Metal conduit

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

Power cable shield

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

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



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

Grounding requirements

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

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

Unless local wiring regulations state otherwise, the cross-sectional area of the protective earth conductor must agree with the conditions that require automatic disconnection of the supply required in 411.3.2 of IEC 60364-4-41:2005 and be capable of withstanding the prospective fault current during the disconnection time of the protective device. The cross-sectional area of the protective earth conductor must be selected from the table below or calculated according to 543.1 of IEC 60364-5-54.

The table shows the minimum cross-sectional area of the protective earth conductor related to the phase conductor size according to IEC/UL 61800-5-1 when the phase conductor(s) and the protective earth conductor are made of the same metal. If they are different metals, the cross-sectional area of the protective earth conductor must be determined in a manner which produces a conductance equivalent to that which results from the application of this table.

Cross-sectional area of the phase conductors S (mm^2)	**Minimum cross-sectional area of the corresponding protective earth conductor S_p (mm^2)**
$S \leq 16$	S [1)]
$16 < S \leq 35$	16
$35 < S$	S/2

1) For the minimum conductor size in IEC installations, refer to Additional grounding requirements – IEC (page 111).

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

- 2.5 mm^2 if the conductor is mechanically protected,
  or
- 4 mm^2 if the conductor is not mechanically protected. If the equipment is cord-connected, the protective earth conductor must be the last conductor to be interrupted if there is a failure in the strain relief mechanism.

Additional grounding requirements – IEC

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

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

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

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

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

Additional grounding requirements – UL (NEC)

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

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

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

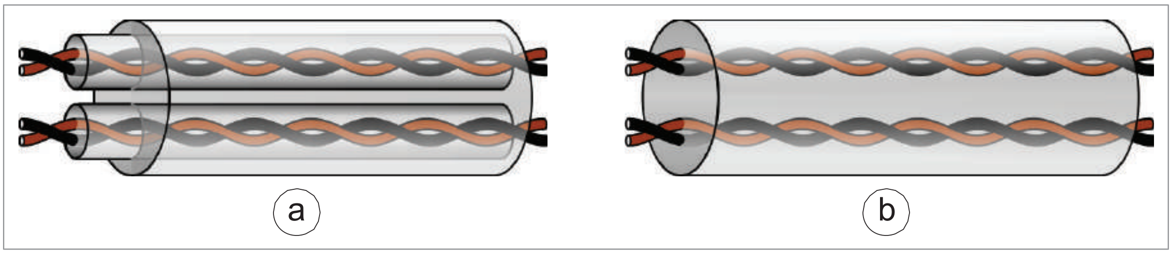
Selecting the control cables

Shielding

Only use shielded control cables.

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

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



Signals in separate cables

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

Signals that can be run in the same cable

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

Relay cable

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

Control panel to drive cable

Use EIA-485, Cat 5e (or better) cable with male RJ45 connectors. The maximum length of the cable is 100 m (328 ft).

PC tool cable

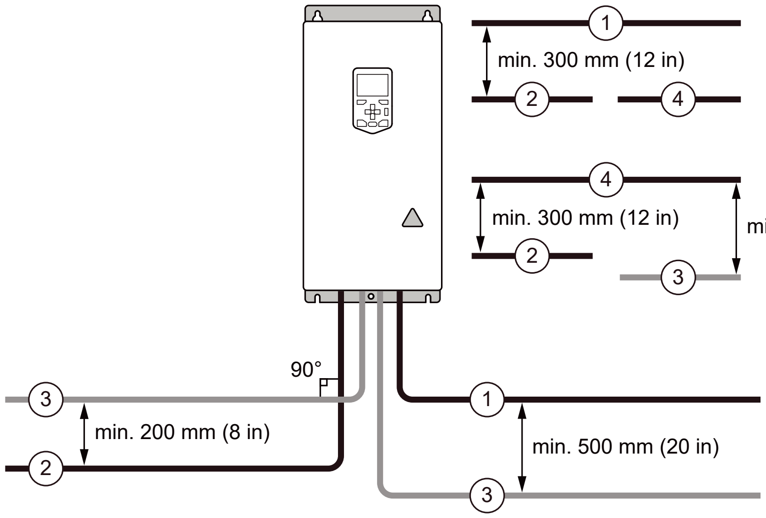
Connect the Drive Composer PC tool to the drive through the USB port of the control panel. Use a USB Type A (PC) - Type Mini-B (control panel) cable. The maximum length of the cable is 3 m (9.8 ft).

Routing the cables

General guidelines – IEC

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

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



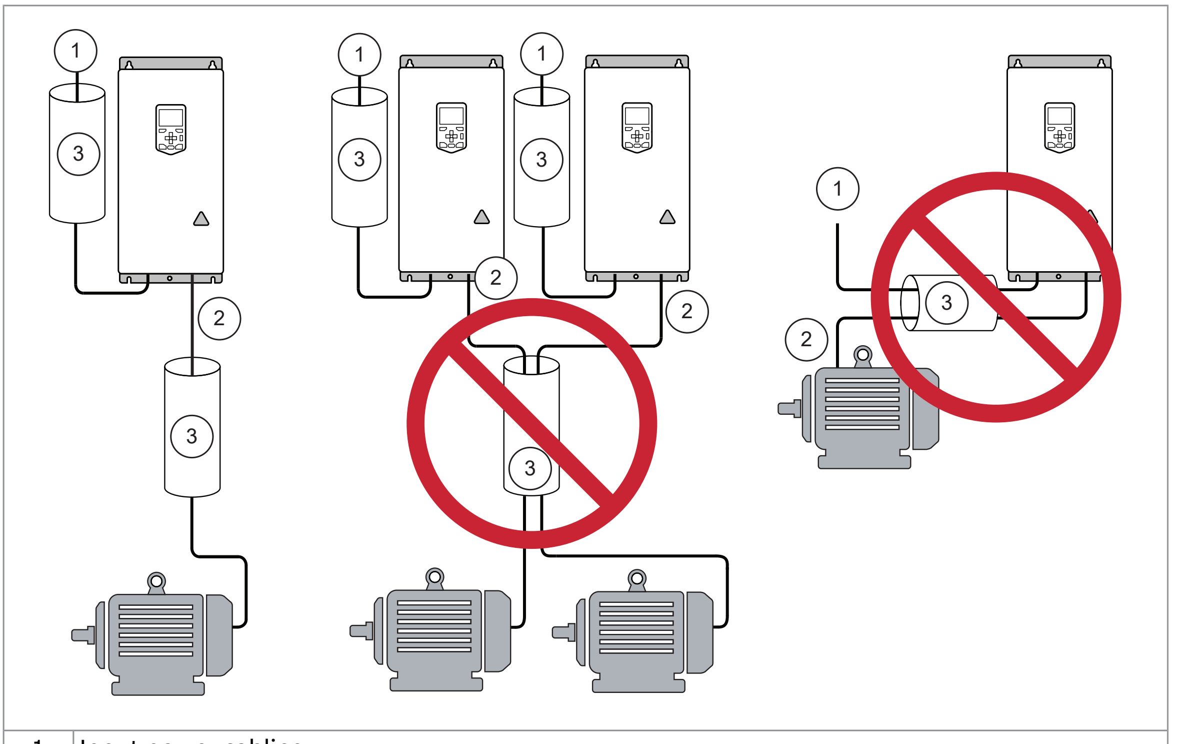
1	Motor cable
2	Input power cable
3	Control cable
4	Brake resistor or chopper cable (if any)

General guidelines – North America

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

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

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



1	Input power cabling
2	Motor cabling
3	Conduit

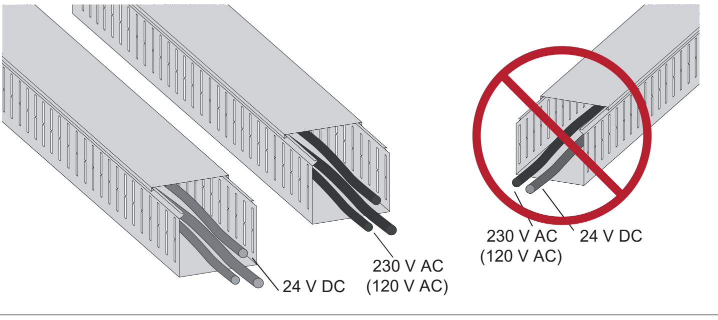
Continuous motor cable shield/conduit and metal enclosure for equipment on the motor cable

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

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

Separate control cable ducts

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

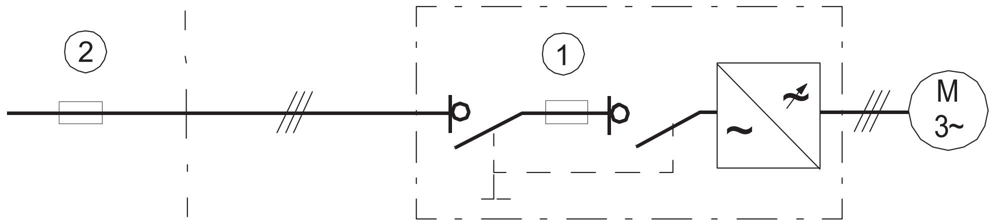
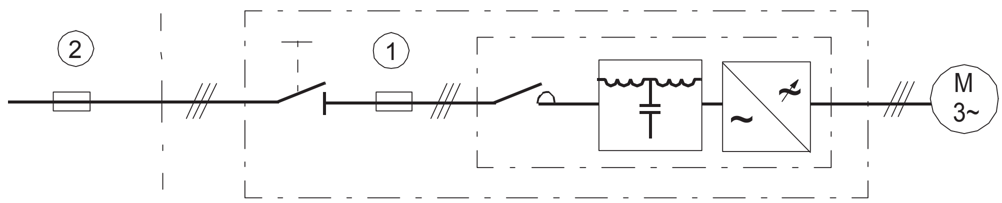


Protecting the drive, input power cable, motor and motor cable in short circuit situations and against thermal overload

Protecting the drive and input power cable in short-circuit situations

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

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

R8	
R6i+R6i, R7i+R7i, R11	

Protecting the motor and motor cable in short-circuits

The drive protects the motor cable and motor in a short-circuit situation when:

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

The electronic power output short-circuit protection circuitry meets the requirements of IEC 60364-4-41:2005 + AMD1:2017.

Protecting the drive and the power cables against thermal overload

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

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

Protecting the motor against thermal overload

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

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

The most common temperature sensor types are PTC or Pt100.

For more information, see the firmware manual.

Protecting the motor against overload without thermal model or temperature sensors

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

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

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

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

For more information, see drive firmware manual.

Protecting the drive against ground faults

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

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

Residual current device compatibility

The drive is suitable for use with residual current devices of Type B.

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

Implementing the emergency stop function

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

See the appropriate option manual for more information.

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

Implementing the Safe torque off function

See chapter The Safe torque off function (page 321).

Implementing an ATEX-certified motor thermal protection

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

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

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

For more information, see:

User's manual	Manual code (English)
ATEX-certified Safe disconnection function, Ex II (2) GD for ACS880 drives (+Q971) application guide	3AUA0000132231
FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual	3AXD50000027782
FPTC-02 ATEX-certified thermistor protection module, instructions for pairing the module with a drive with the ATEX-certified disconnection function (option +Q971)	3AXD50001096700

User's manual	Manual code (English)
ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual	3AXD50000014979

Implementing the Prevention of unexpected start-up function

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

See the appropriate option manual for more information.

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

Implementing the functions provided by the FSO safety functions module

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

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

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

See the appropriate manual for more information.

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

Implementing the functions provided by the FSPS-21 PROFIsafe safety functions module

You can order the drive with an FSPS-21 PROFIsafe safety functions module (option +Q986), which provides PROFINET and PROFIsafe connection to the drive and has two safety functions integrated into it: Safe torque off (STO) and Safe stop 1, time monitored (SS1-t). With the module, it is possible to control the drive via PROFINET and safely stop the drive via PROFIsafe.

The Safe torque off function can be controlled with PROFIsafe. When using FSPS-21 PROFIsafe safety functions module, other safety functions are not available. Use of PROFIsafe and PROFINET is also possible by using FPNO-21 and FSO option modules.

The settings of the module have default values when delivered from the factory. The wiring and configuration of the FSPS-21 module are the responsibility of the user.

For more information, see FSPS-21 PROFIsafe safety functions module user's manual (3AXD50000158638 [English]).

Implementing the functions provided by the FSCS-21 CIP Safety™ functions module

You can order the drive with FSCS-21 CIP Safety™ functions module (option +Q989). The module has two safety functions integrated into it: Safe torque off (STO) and Safe stop 1, time monitored (SS1-t). With the module, you can connect a drive to an Ethernet network and a safety PLC. The module supports the CIP Safety™ communication technology through the EtherNet/IP communication protocol. The intended use of the FSCS module is to safely stop the drive when necessary. A safety PLC can activate the safety functions of the module.

The settings of the FSCS module have default values when delivered from the factory. The wiring and configuration of the FSCS module are the responsibility of the user. The FSCS module reserves the standard Safe torque off (STO) connection of the drive (or inverter) control unit.

For more information, refer to FSCS-21 CIP Safety™ functions module user's manual (3AXD50001065478 [English]).

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.

The drive is equipped with a main contactor that restores the drive input power after a short break. The power supply for the contactor control circuit is buffered. It keeps the contactor closed in short power-loss situations. If the drive is equipped an external uninterruptible auxiliary power supply (option +G307), it keeps the main contactor closed in power-loss situations.

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

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

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

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

Implementing a bypass connection

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

WARNING!
Do not connect the drive output to the electrical power network. The connection may damage the drive.

Supplying power for the auxiliary circuits

The user must supply these options from external power sources:

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

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

Using power factor compensation capacitors with the drive

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

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

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

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

Using a safety switch between the drive and the motor

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

Implementing the control of a contactor between drive and motor

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

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

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

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

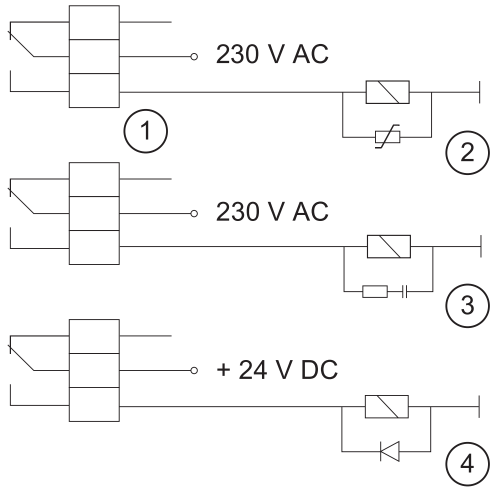
When you select the DTC motor control mode and the motor coast stop mode, you can open the contactor immediately after the drive has received the stop command. This is the case also if you use the scalar motor control mode.

Protecting the contacts of relay outputs

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

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

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



1	Relay output
2	Varistor
3	RC filter
4	Diode

Implementing a motor temperature sensor connection

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

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

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

You have these implementation alternatives:

1. If there is double or reinforced insulation between the sensor and the live parts of the motor: You can connect the sensor directly to the analog/digital input(s) of the drive. See the control cable connection instructions. Make sure that the voltage is not more than the maximum allowed voltage over the sensor.
2. If there is basic insulation between the sensor and the live parts of the motor, or if the insulation type is not known: You can connect the sensor to the drive via an option module. The sensor and the module must form a double or reinforced insulation between the motor live parts and the drive control unit. Refer toConnecting a motor temperature sensor to the drive through an option module (page 123). Make sure that the voltage does not exceed the maximum allowed voltage over the sensor.
3. If there is basic insulation between the sensor and the live parts of the motor, or if the insulation type is not known: You can connect a sensor to a digital input of the drive via an external relay. The sensor and the relay must form a double or reinforced insulation between the motor's live parts and the digital input of the drive. Make sure that the voltage does not exceed the maximum allowed voltage over the sensor.

Connecting a motor temperature sensor to the drive through an option module

This table shows:

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

Option module		**Temperature sensor type**			**Temperature sensor insulation requirement**
Type	**Insulation/Isolation**	**PTC**	**KTY**	**Pt100, Pt1000**	
FIO-11	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and other I/O connectors.	x	x	x	Reinforced insulation
FEN-01	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and TTL encoder emulation output.	x	-	-	Reinforced insulation
FEN-11	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and TTL encoder emulation output.	x	x	-	Reinforced insulation
FEN-21	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and TTL encoder emulation output.	x	x	-	Reinforced insulation
FEN-31	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and other connectors.	x	x	-	Reinforced insulation
FAIO-01	Basic insulation between sensor connector and drive control unit connector. No insulation between sensor connector and other I/O connectors.	x	x	x	Reinforced or basic insulation. With basic insulation, the other I/O connectors of the option module must be kept disconnected.
FPTC-01/02 [1)]	Reinforced insulation between sensor connector and other connectors (including drive control unit connector).	x	-	-	No special requirement

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

6

Electrical installation

Contents of this chapter

This chapter contains instructions on the wiring of the drive.

Warnings

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

Measuring the insulation

Measuring the insulation resistance of the drive

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

Measuring the insulation resistance of the input power cable

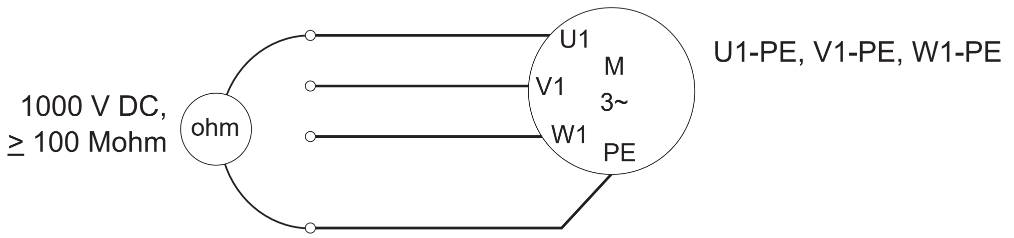
Before you connect the input power cable to the drive, measure its insulation resistance according to local regulations.

Measuring the insulation resistance of the motor and motor cable

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

1. Do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Make sure that the motor cable is disconnected from the drive output terminals.
3. Measure the insulation resistance between each phase conductor and the protective earth conductor. Use a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must be more than 100 Mohm (reference value at 25 °C [77 °F]). For the insulation resistance of other motors, refer to the manufacturer's instructions.

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



Grounding system compatibility check

Frames R8 and R11: The standard drive with ground-to-phase varistors connected can be installed to a symmetrically grounded TN-S system. If you install the drive to another systems, you may need to disconnect the EMC filter and ground-to-phase varistors. For instructions, see ACS880 frames R1 to R11 EMC filter and ground-to-phase varistor disconnecting instructions (3AUA0000125152 [English]).

Frames R6i+R6i and R7i+R7i: The standard drive can be installed to a symmetrically grounded TN-S system. If you install the drive to another systems, you may need to disconnect the EMC filter. For instructions, contact ABB.

EMC filter options +E200 and +E202

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

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

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

Ground-to-phase varistor – Frames R8 and R11

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

WARNING!
Do not install the drive with the ground-to-phase varistor connected to a system that the varistor is not suitable for. It can cause damage to the varistor circuit.

Corner-grounded and midpoint-grounded 525…690 V delta systems – Frames R8 and R11

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.

Attaching the device stickers to the cabinet door

A multilingual device label sticker is delivered with the drive. Attach the stickers in the local language on the English texts; see section Door devices (page 57).

Setting the voltage range of auxiliary voltage transformers

Set the voltage tap in the auxiliary voltage transformer according to the power network voltage. Transformer T21 is included as standard.

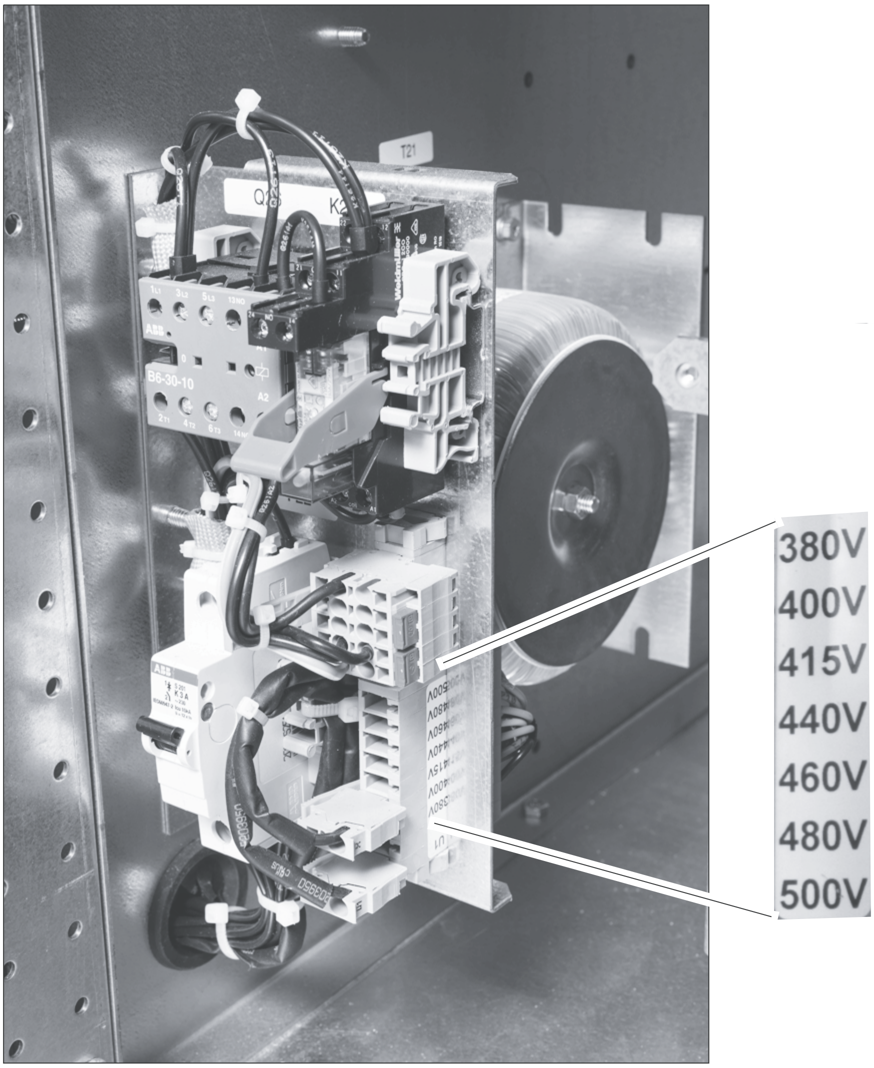
In frame R8, additional transformer T101 comes with options +B055 and +C128.

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

In frames R6i+R6i and R7i+R7i, transformer T21 is also used with additional options depending on the drive configuration.

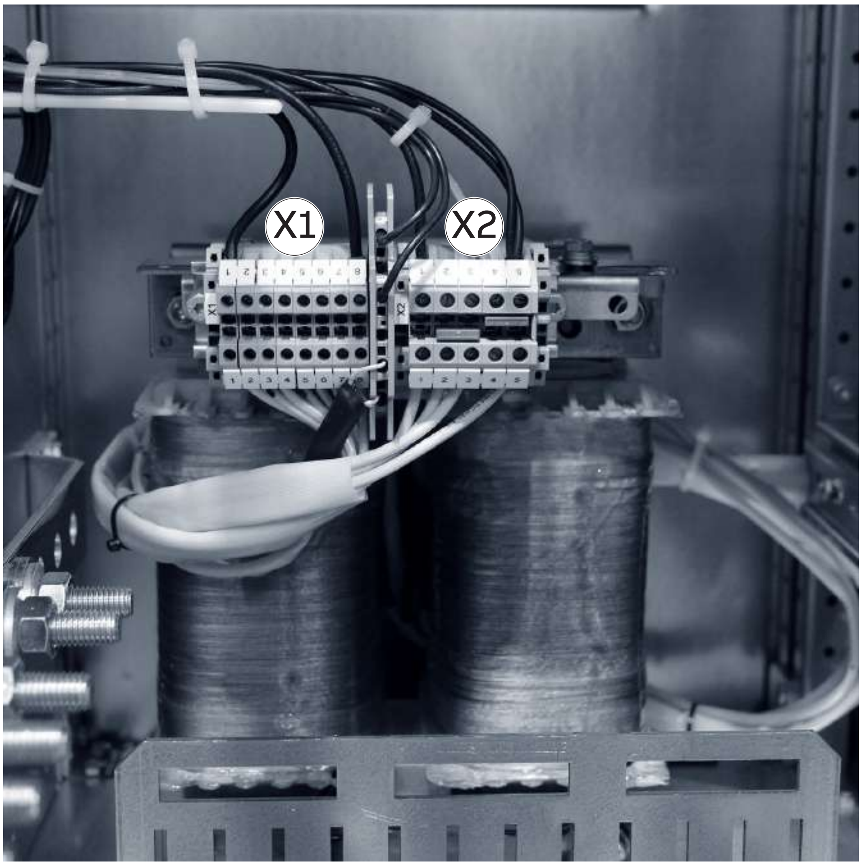
The locations of the transformers are shown in section Cabinet layout (page 40).

This figure shows an example connection (frames R8 and R11).

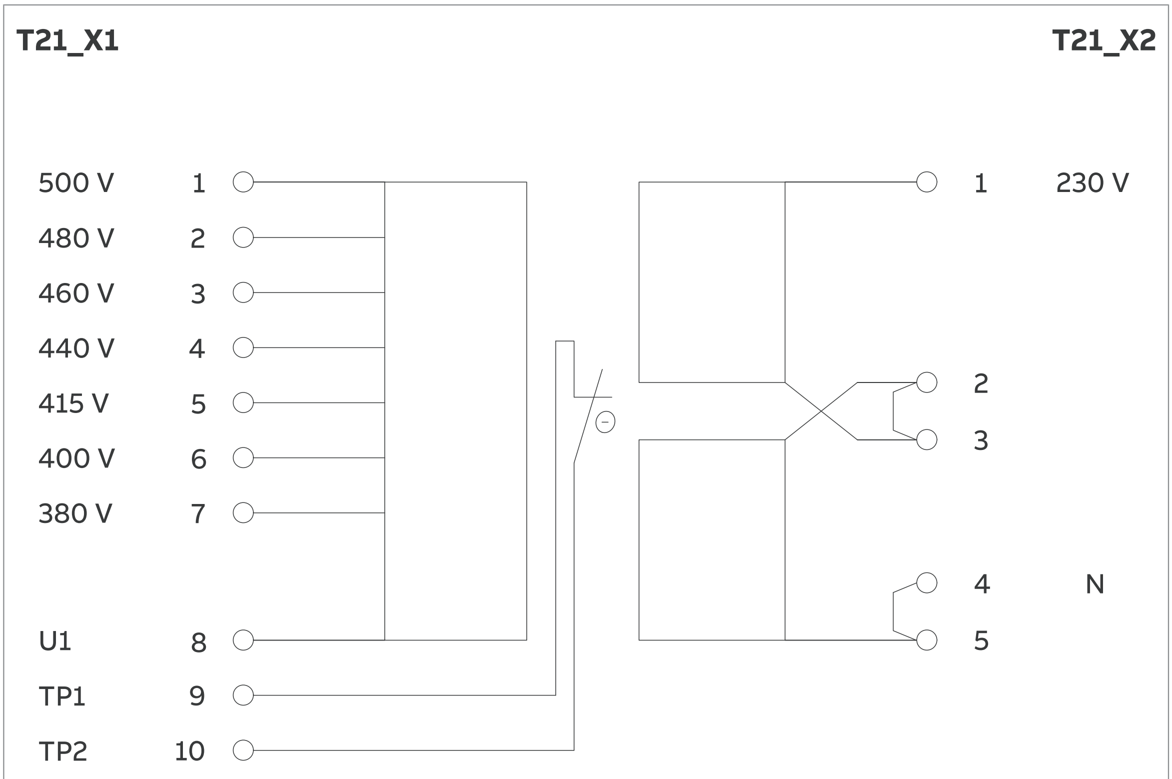


Frames R6i+R6i and R7i+R7i

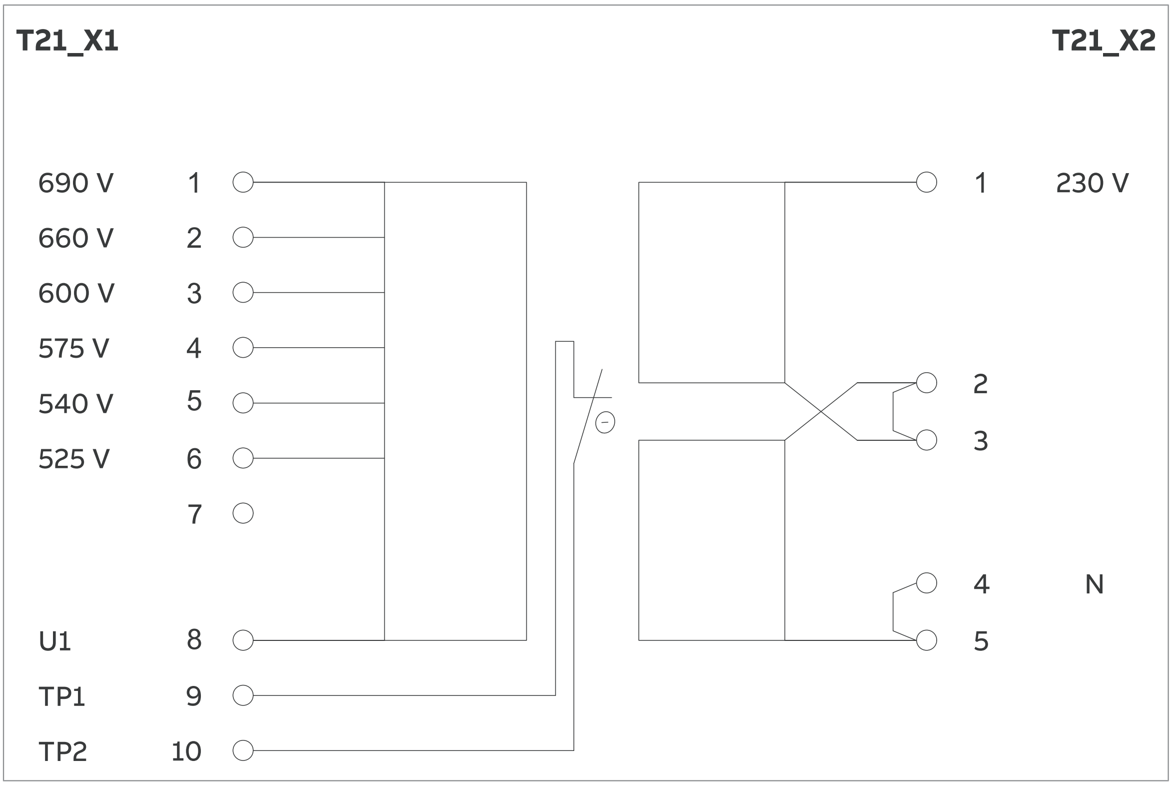
The voltage settings of transformer T21 are made at terminal blocks T21_X1/X2.



T21 tap settings (400…500 V)



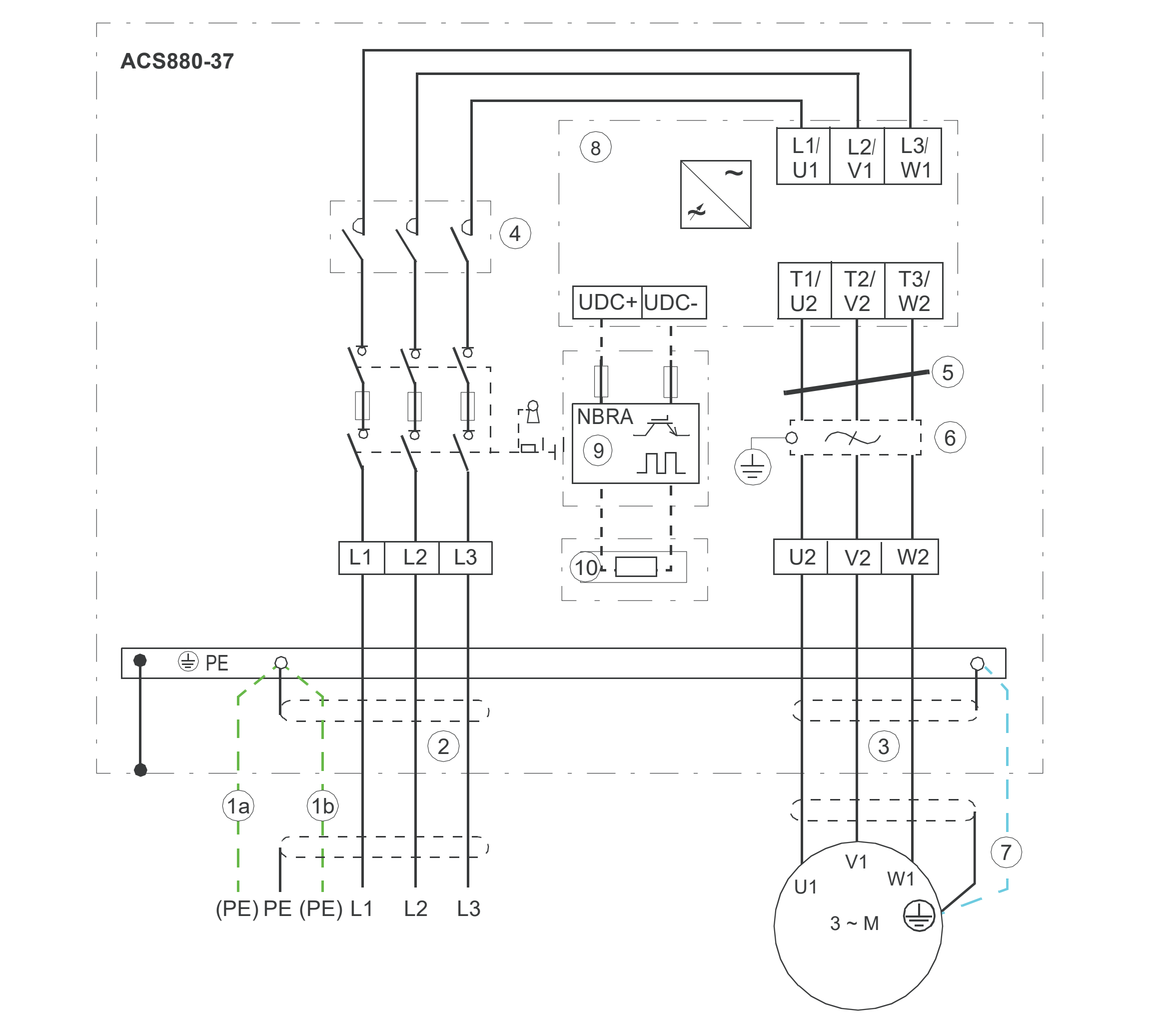
T21 tap settings (690 V)



Connecting the power cables

Connection diagram

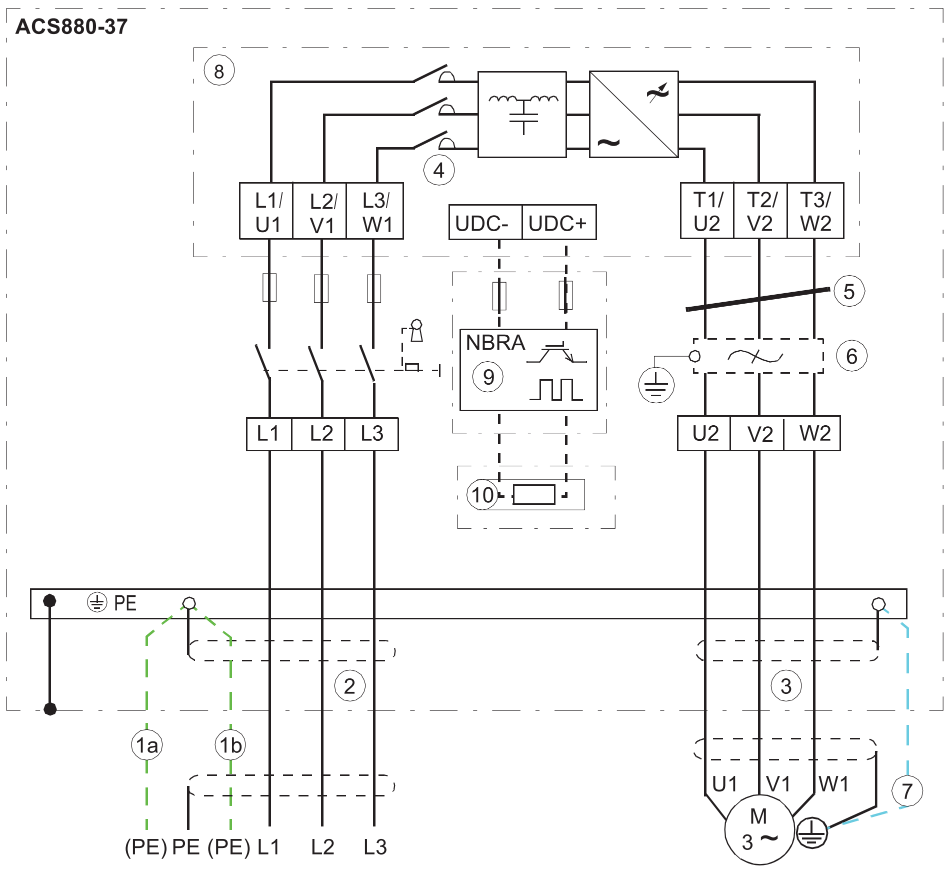
Connection diagram of frame R8



1	Use a separate grounding PE cable (1a) or a cable with a separate PE conductor (1b) if the conductivity of the shield does not meet the requirements for the PE conductor. See General guidelines (page 106).
2	360° grounding is recommended if shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
3	360° grounding is required.
4	Line contactor (option for +Q951, +Q952, +Q978)
5	Common mode filter (option +E208)
6	*du/dt* filter or sine filter (options +E205 and +E206)
7	Use a separate grounding cable if the shield does not meet the requirements of IEC 61439-1 and there is no symmetrically constructed grounding conductor in the cable. See General guidelines (page 106) and Preferred power cable types (page 106).
8	Drive module
9	Brake chopper (option +D150)
10	Brake resistor (option +D151)

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

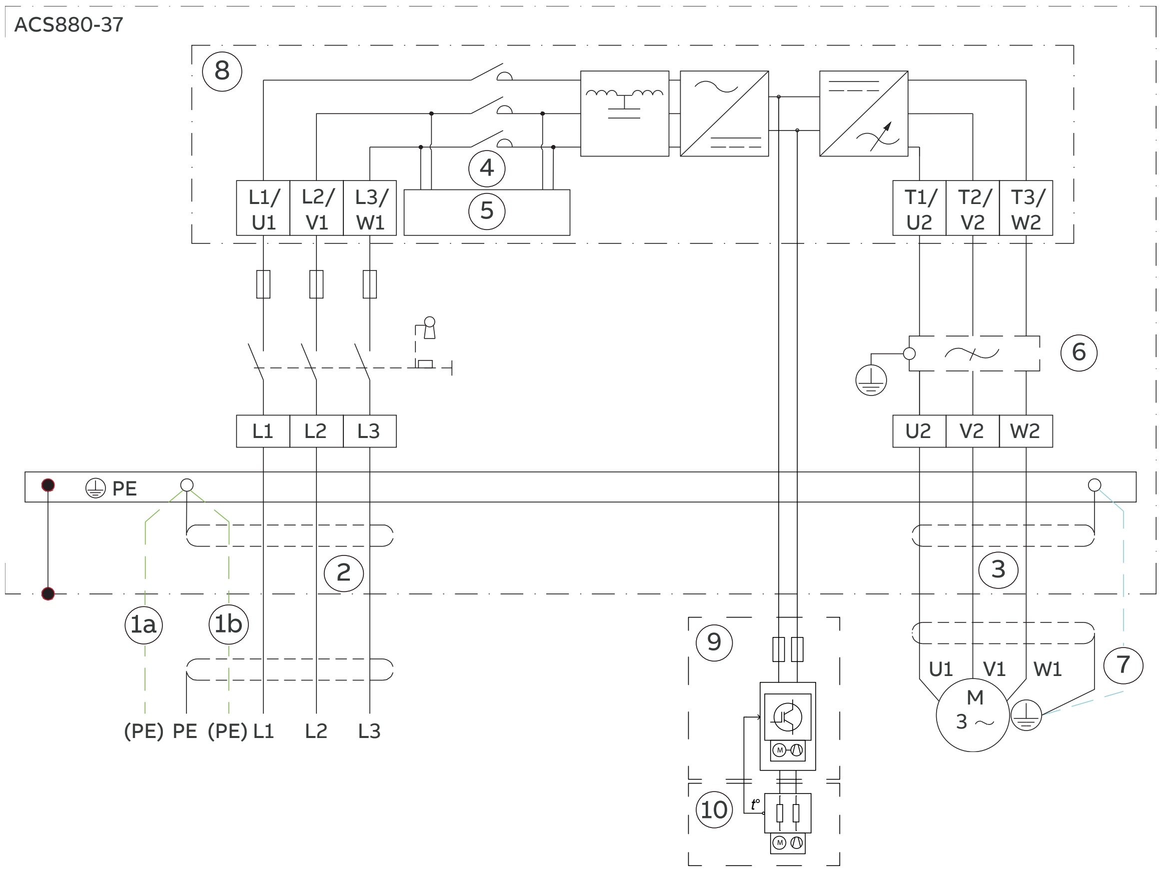
Connection diagram of frame R11



1	Use a separate grounding PE cable (1a) or a cable with a separate PE conductor (1b) if the conductivity of the shield does not meet the requirements for the PE conductor. See General guidelines (page 106)
2	360° grounding is recommended if shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
3	360° grounding is required.
4	Line contactor
5	Common mode filter (option +E208, as standard in 690 V units)
6	*du/dt* filter (option +E205) or sine filter (option +E206)
7	Use a separate grounding cable if the shield does not meet the requirements of IEC 61439-1 and there is no symmetrically constructed grounding conductor in the cable. See General guidelines (page 106) and Preferred power cable types (page 106).
8	Drive module
9	Brake chopper (option +D150)
10	Brake resistor (option +D151)

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

Connection diagram of frame R6i+R6i and R7i+R7i



1	Use a separate grounding PE cable (1a) or a cable with a separate PE conductor (1b) if the conductivity of the shield does not meet the requirements for the PE conductor. See General guidelines (page 106)
2	360° grounding is recommended if shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
3	360° grounding is required.
4	Line contactor
5	Components for charging circuit.
6	*du/dt* filter (option +E205) or sine filter (option +E206)
7	Use a separate grounding cable if the shield does not meet the requirements of IEC 61439-1 and there is no symmetrically constructed grounding conductor in the cable. See General guidelines (page 106) and Preferred power cable types (page 106).
8	Drive module
9	Brake chopper (option +D150)
10	Brake resistor (option +D151)

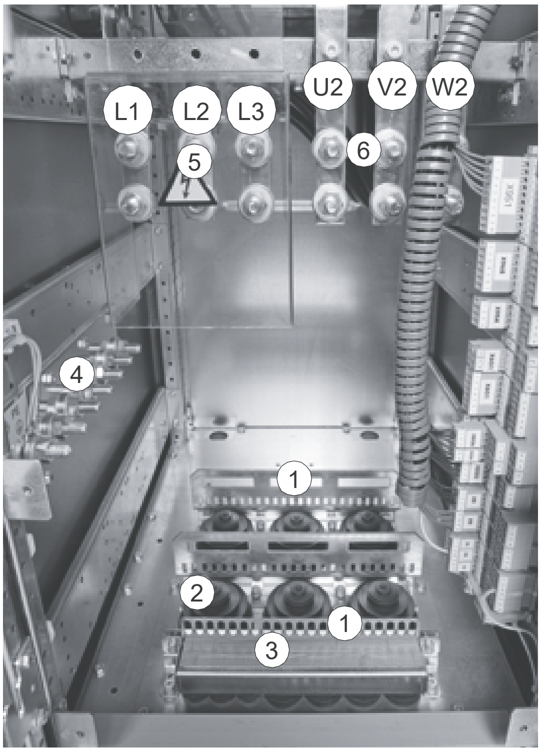
Note: If there is a symmetrically constructed grounding conductor on the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends. Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at the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

Layout of power cable connection terminals and cable entries

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

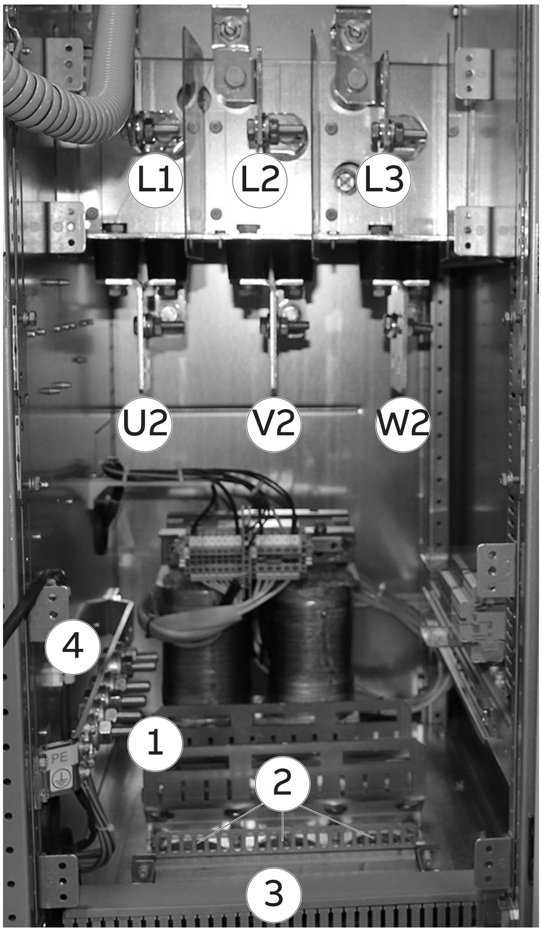
Note: You have to remove the “door fan” to gain access to the cable terminals and entries (see page 187).

Frame R8



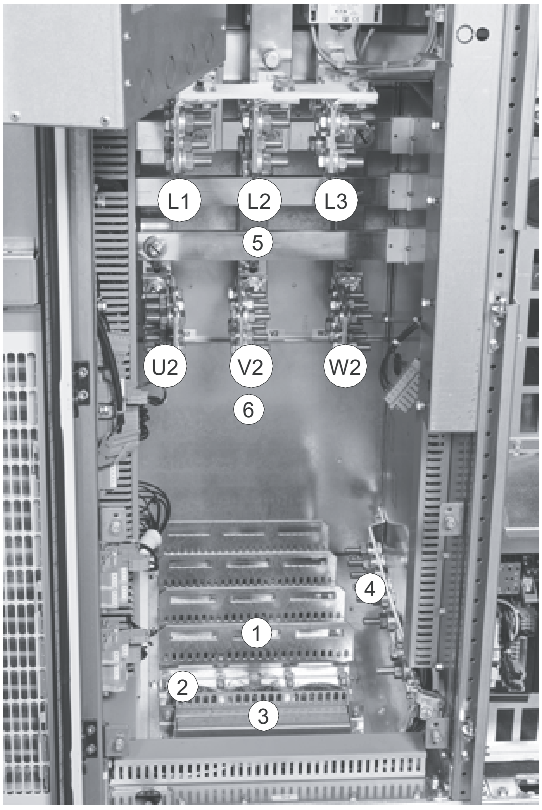
1	Strain relief
2	Power cable entries. Conductive sleeve under the grommet.
3	Control cable entry with EMI conductive cushions.
4	PE terminal
5	Input power cable terminals L1, L2 and L3
6	Motor cable terminals U2, V2, W2

Frames R6i+R6i and R7i+R7i



1	Strain relief
2	Power cable entries. Conductive sleeve under the grommet.
3	Control cable entry with EMI conductive cushions.
4	PE terminal

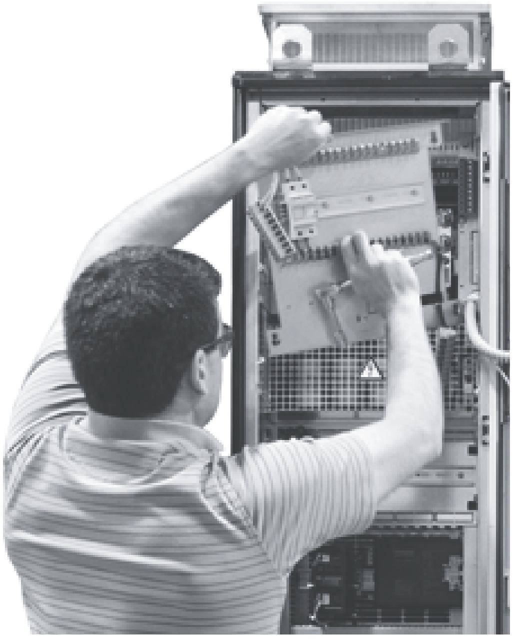
Frame R11

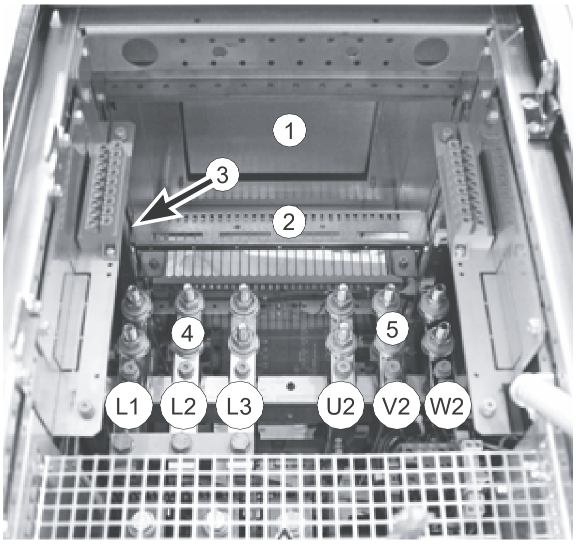


1	Strain relief
2	Power cable entries. Conductive sleeve under the grommet.
3	Control cable entry with EMI conductive cushions.
4	PE terminal
5	Input power cable terminals L1, L2 and L3
6	Motor cable terminals U2, V2, W2

Layout of power cable connection terminals (option +C129)

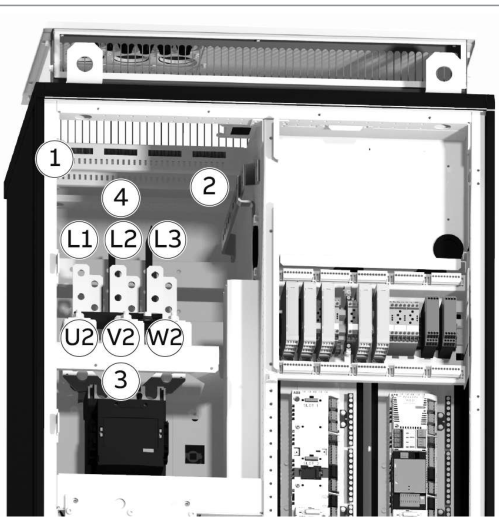
This figure shows the layout of the power cable connection terminals of frame R8.





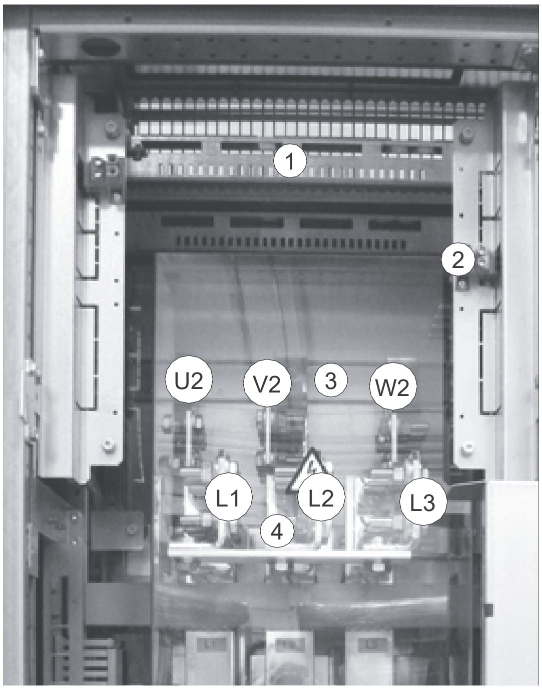
1	Power cable entries
2	Strain relief
3	Ground bar
4	Input cable power connection terminals L1, L2 and L3
5	Motor cable connection terminals U2, V2, W2

This figure shows the layout of the power cable connection terminals of frames R6i+R6i and R7i+R7i.



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

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



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

External resistor cable connection terminals and cable entries

External brake resistor cables are connected directly to the brake chopper (option +D150) terminals in the brake chopper cubicle. The delivery drawings show the location of the terminals and entries.

Connection procedure (IEC)

1. Do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. **For R8 bottom entry of cables:**
   - If there is a mounting plate above the fan, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   - If there is no mounting plate, but a shroud above the fan, undo the four screws and remove the shroud.
   - Remove the “door fan". See section Replacing the cabinet “door fan” (page 187).
   - Remove the plastic shroud in front of input terminals.

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

   For R6i+R6i and R7i+R7i bottom entry of cables:
   - Open the swing-out frame.
   - If there is a mounting plate under the swing-out frame, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   - If there is no mounting plate, but a shroud, undo the four screws and remove the shroud.
   - Undo the four screws and remove the bottom shroud.
   - Remove the plastic shroud in front of input terminals.

For R6i+R6i and R7i+R7i top entry of cables:

- Remove the steel shroud in front of fuses.
- Unplug the connectors at the top mounting plate, loosen the four screws and lift off the top mounting plate.
- Unplug the connectors at the charging plate, loosen the four screws and lift off the charging plate.
- Remove the plastic shroud in front of input terminals.

For R11 bottom entry of cables:

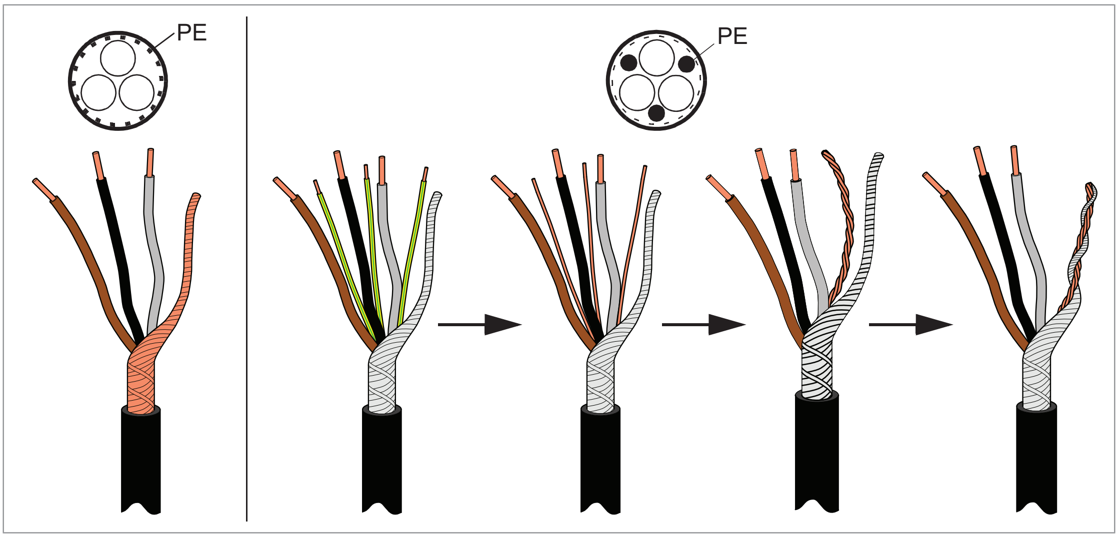
- If there is a mounting plate/two plates above the fan, loosen the four screws of the plate and pull out the plate/s. Unplug the connectors and remove the plate/s.
- If there is no mounting plate/s, but a shroud/s above the fan, undo the four screws and remove the shroud/s.
- Remove the “door fan”. See section Replacing the cabinet “door fan” (page 187).
- Marine drives (option +C121): Undo the three M6 screws on the left side of the swing-out frame.
- Undo the two screws and open the swing-out frame or remove the shroud if there is no swing-out frame.
- Remove the plastic shroud in front of input terminals.

For R11 top entry of cables:

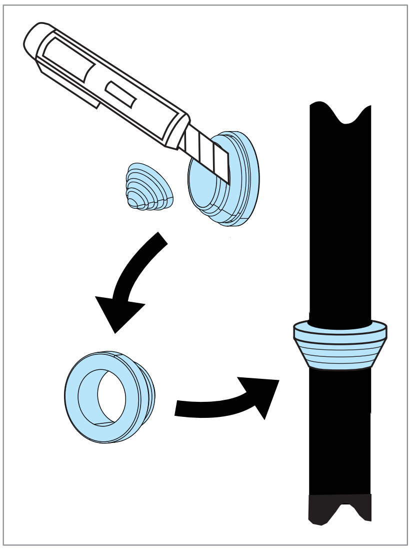
- Marine drives (option +C121): Undo the three M6 screws on the left side of the swing-out frame.
- Undo the two screws and open the swing-out frame or remove the shroud if there is no swing-out frame.
- Marine drives (option +C121): Undo the four M6 screws and remove the support in front of top fuse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

4. Peel off 3 to 5 cm of the outer insulation of the cables above the entry plate for the 360° high-frequency grounding.
5. Prepare the ends of the cables.

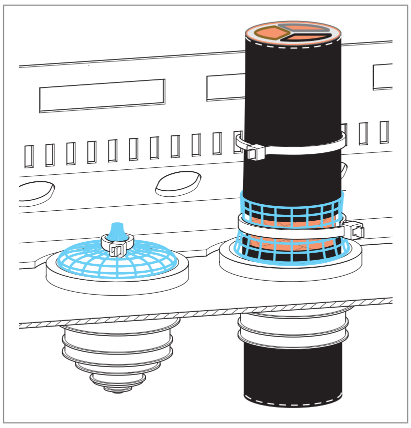
WARNING!
Apply grease to stripped aluminum conductors before you attach them to non-coated aluminum cable lugs. Obey the grease manufacturer's instructions. Aluminum-aluminum contact can cause oxidation in the contact surfaces.



6. If fire insulation is used, make an opening in the mineral wool sheet according to the diameter of the cable.
7. Remove rubber grommets from the entry plate for the cables to be connected. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Slide the cables through the entry with the conductive sleeves and attach the grommets to the holes.



8. Attach the conductive sleeves to the cable shields with cable ties.



9. Tie up the unused conductive sleeves with cable ties.
10. Connect the twisted shields of the motor cables to the ground bar and the phase conductors to the U2, V2 and W2 terminals.
11. Tighten the power cable screws to the torque given in the technical data.
12. Reinstall the shrouds and mounting plates.

Connection procedure (North America)

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

1. Do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. **For R8 bottom entry of cables:**
   - If there is a mounting plate above the fan, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   - If there is no mounting plate, but a shroud above the fan, undo the four screws and remove the shroud.
   - Remove the "door fan". See section Replacing the cabinet "door fan" (page 187).
   - Remove the plastic shroud in front of input terminals.

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

   For R6i+R6i and R7i+R7i bottom entry of cables:
   - Open the swing-out frame.
   - If there is a mounting plate under the swing-out frame, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   - If there is no mounting plate, but a shroud, undo the four screws and remove the shroud.
   - Undo the four screws and remove the bottom shroud.
   - Remove the plastic shroud in front of input terminals.

   For R6i+R6i and R7i+R7i top entry of cables:
   - Remove the steel shroud in front of fuses.
   - Unplug the connectors at the top mounting plate, loosen the four screws and lift off the top mounting plate.
   - Unplug the connectors at the charging plate, loosen the four screws and lift off the charging plate.
   - Remove the plastic shroud in front of input terminals.

   For R11 bottom entry of cables:
   - If there is a mounting plate/two plates above the fan, loosen the four screws of the plate and pull out the plate/s. Unplug the connectors and remove the plate/s.
   - If there is no mounting plate/s, but a shroud/s above the fan, undo the four screws and remove the shroud/s.
   - Remove the "door fan". See section Replacing the cabinet "door fan" (page 187).
   - Marine drives (option +C121): Undo the three M6 screws on the left side of the swing-out frame.
   - Undo the two screws and open the swing-out frame or remove the shroud if there is no swing-out frame.
   - Remove the plastic shroud in front of input terminals.

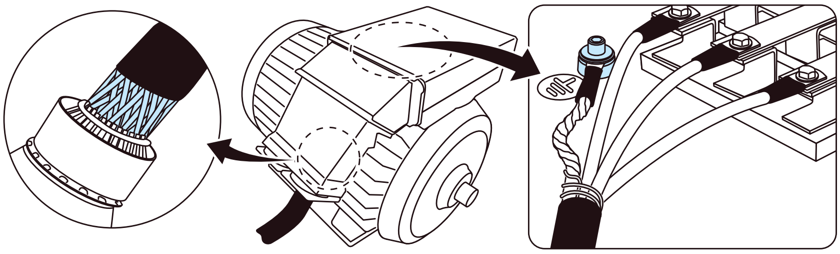
For R11 top entry of cables:

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

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

Grounding the motor cable shield at the motor end

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



Connecting the control cables

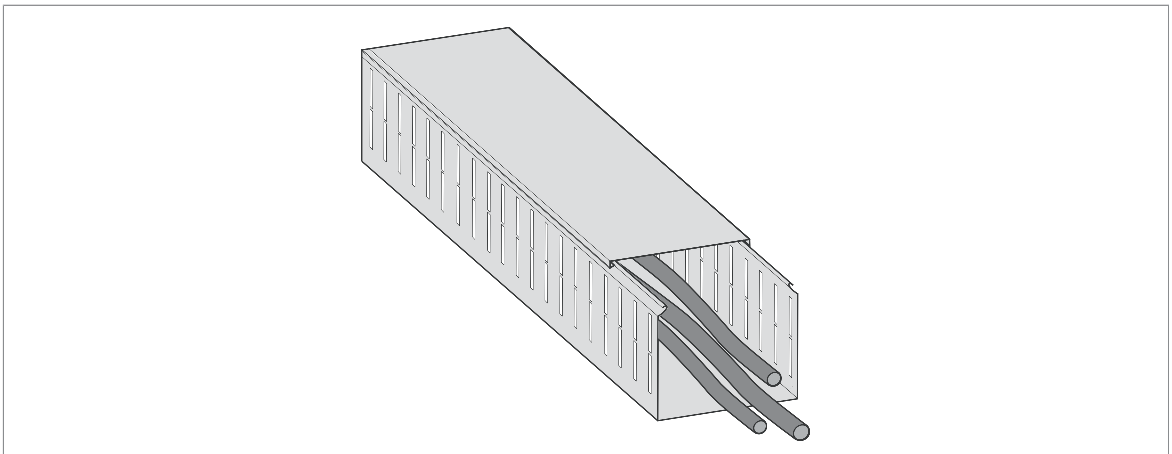
See chapter Control unit (page 161) for the default I/O connections of the drive control unit (with the ACS880 primary control program). The default I/O connections can be different with some hardware options, see the circuit diagrams delivered with the drive for the actual wiring. For other control programs, see their firmware manuals.

1. Run the control cables into the drive module cubicle.
2. Route the control cables as described in section Routing the control cables inside the cabinet (page 144).
3. For connecting the external control cables to the drive control unit, see section Connecting the external control cables to the drive control unit (page 152).
4. For connecting the external control cables to the option terminals, see the circuit diagrams delivered with the drive.

Routing the control cables inside the cabinet

Routing the control cables inside the cabinet

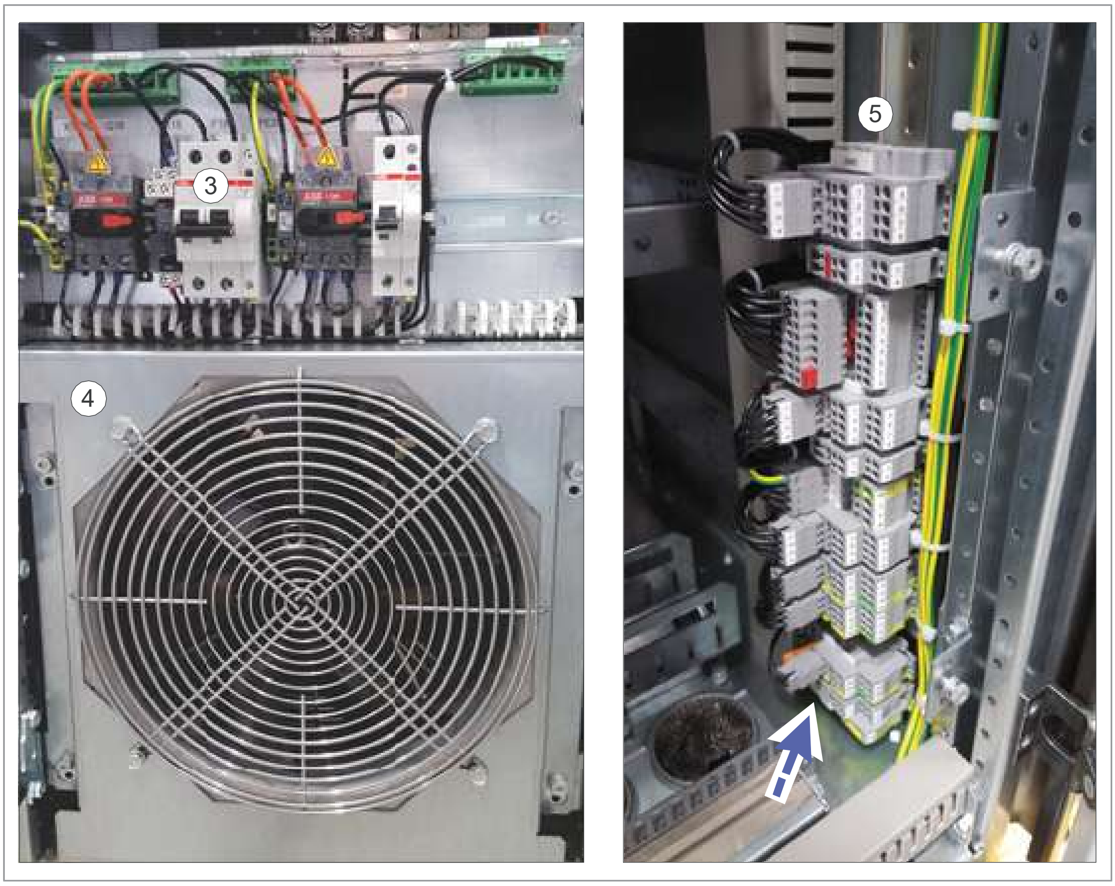
Use the existing trunking in the cabinet where possible. Use sleeving if cables are laid against sharp edges. When running cables to or from a swing-out frame, leave enough slack at the hinge to allow the frame to open fully.



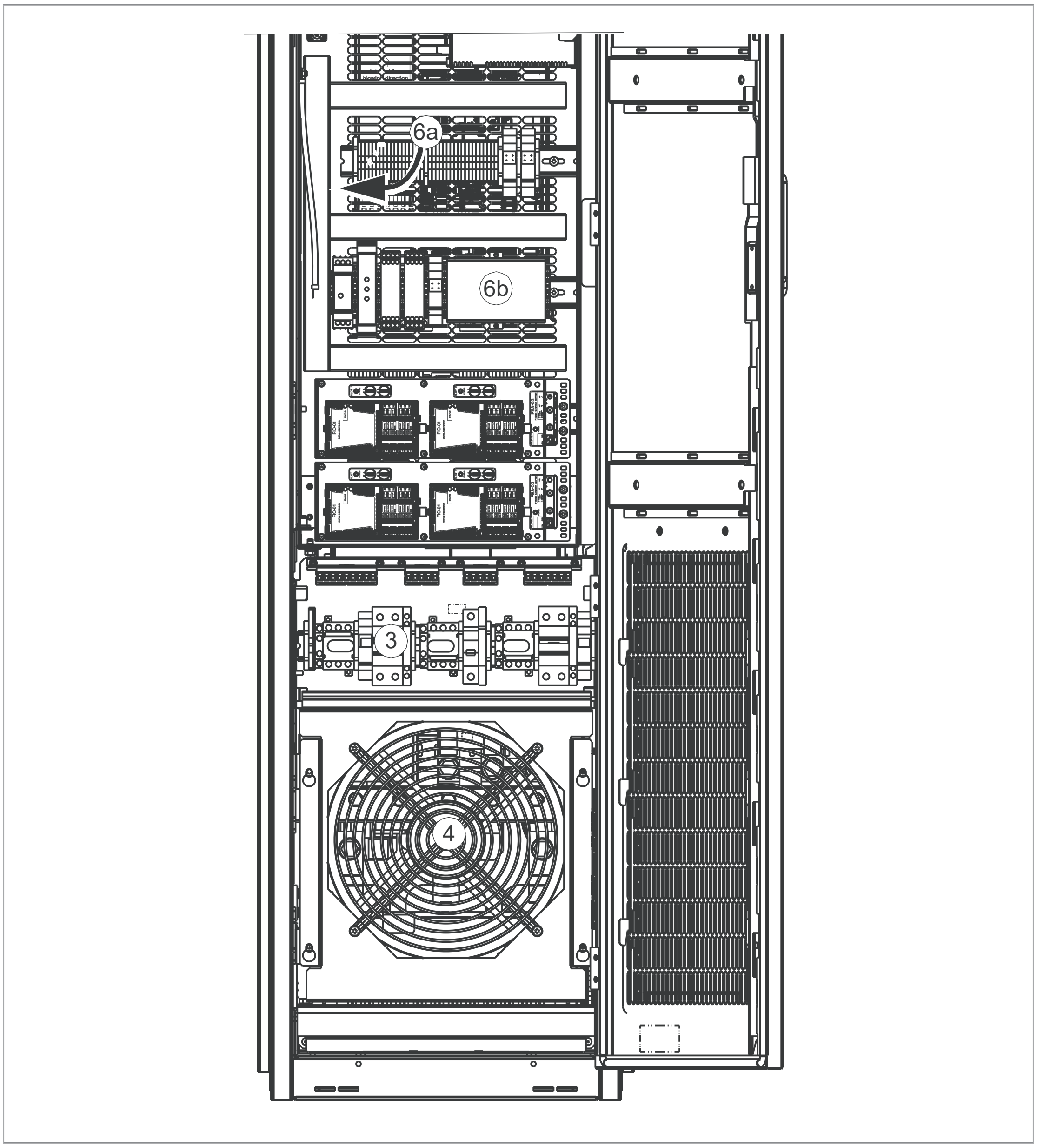
Frame R8

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. If there is a mounting plate above the fan, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   If there is no mounting plate, but instead a shroud above the "door fan", undo the four screws and remove the shroud.
4. Remove the "door fan”. See section Replacing the cabinet “door fan” (page 187).
5. For bottom entry: Route the cables of these options to the connection terminals at the right-hand side of the cabinet as shown below. For top entry, see step 7.

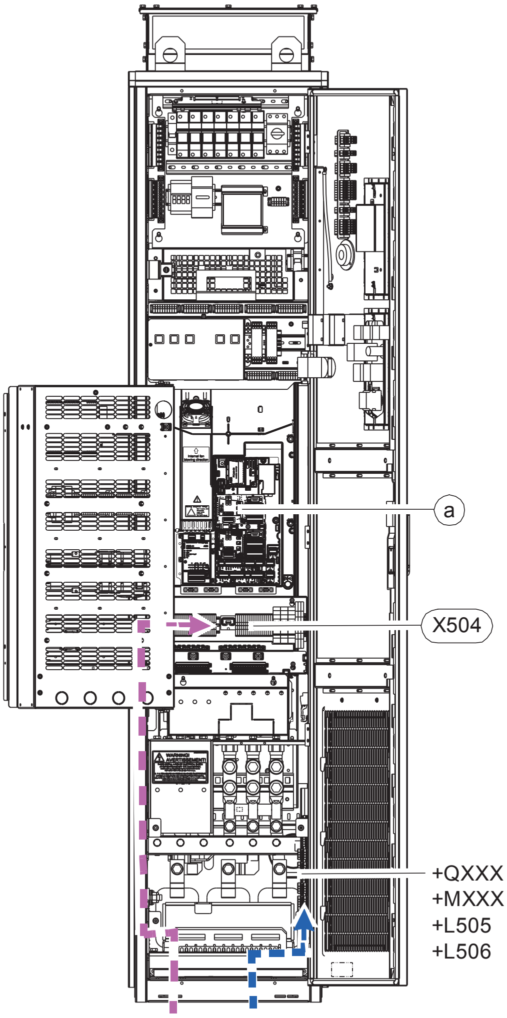
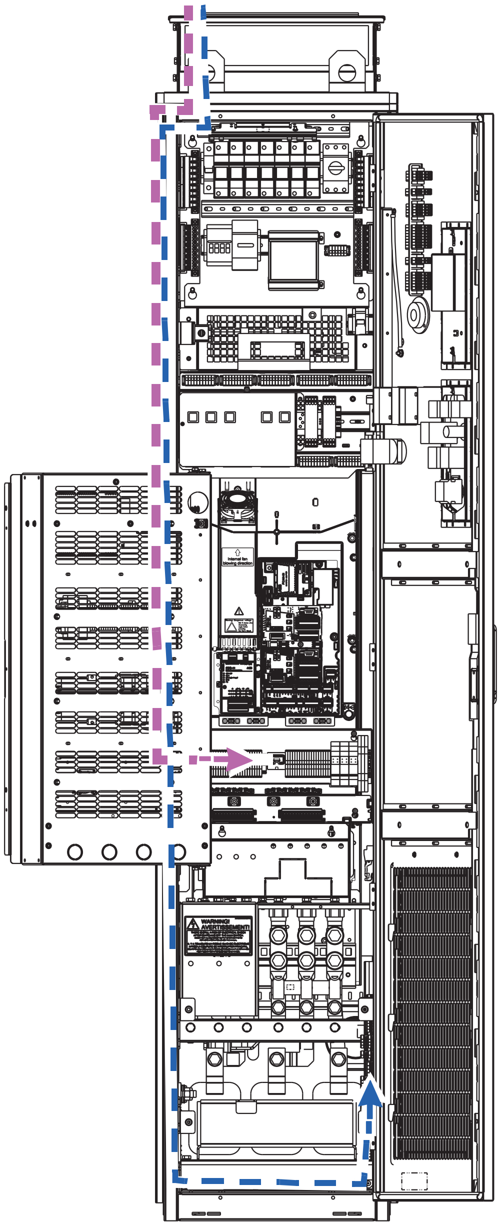
Terminal	Option
X250	Main switch feedback and line contactor feedback with options +Q951, +Q952 or +Q978 for customer
X506	Thermistor relay or Pt100 relays (option +L505 or +L506)
X601	Starter for auxiliary motor fan (options +M600…+M605)
X951	Push buttons for emergency stop options +Q951, +Q952, +Q963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



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



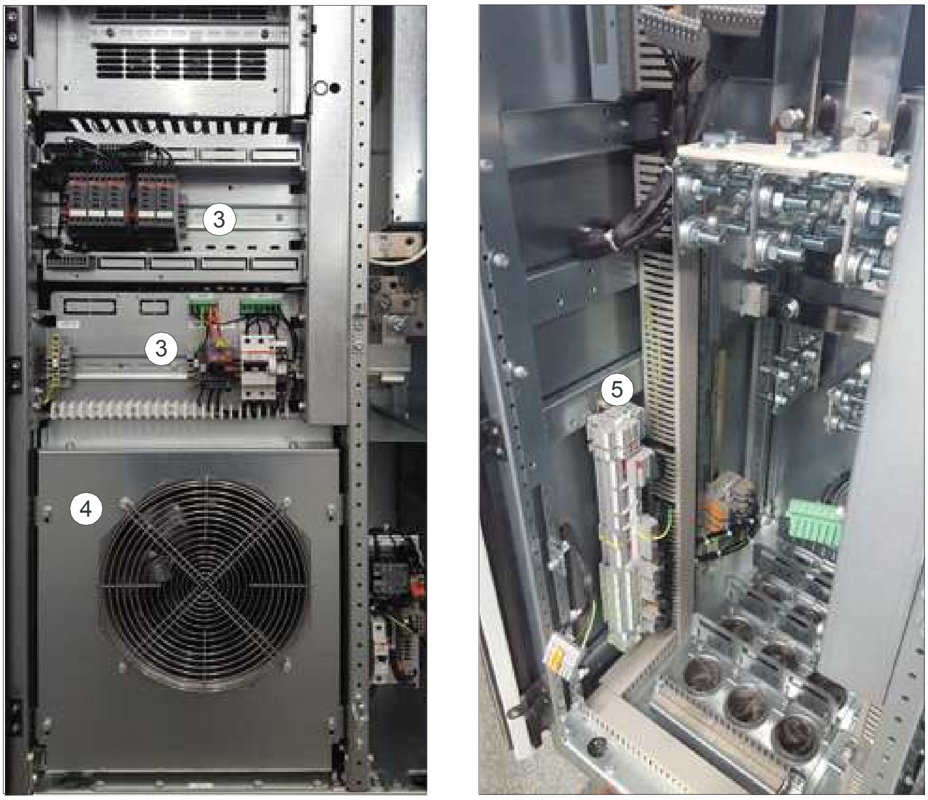
7. Route the cables to the control unit (a) and additional terminal block X504 (option +L504) and to options +QXXX, +MXXX, +L505 and +L506 as shown below.

Bottom entry	Top entry
	

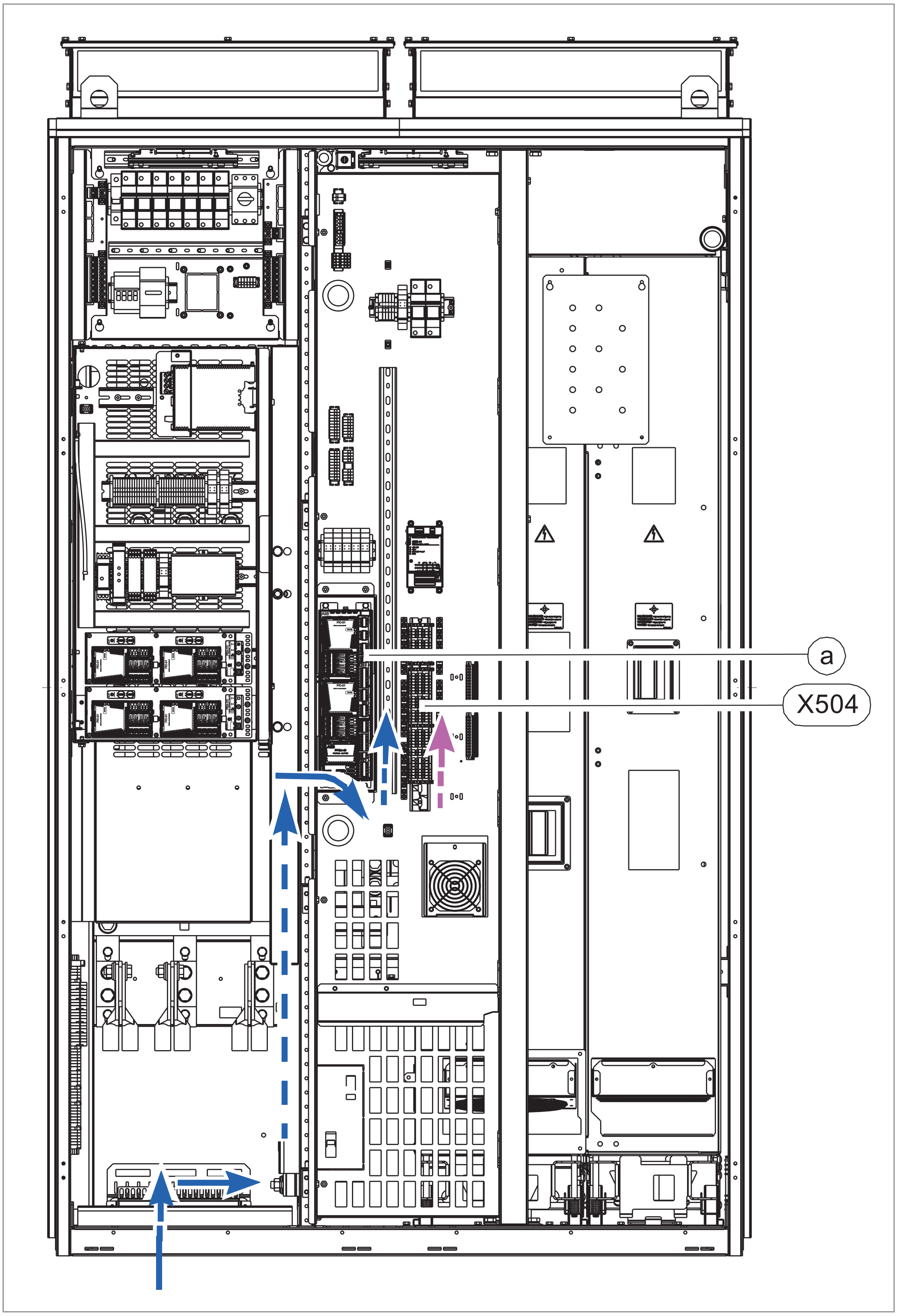
Frame R11

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. If there is a mounting plate/two plates above the "door fan", loosen the four screws of the plate and pull out the plate/s. Unplug the connectors and remove the plate/s.
   If there is no mounting plate/s, but instead a shroud/s above the fan, undo the four screws and remove the shroud/s.
4. Remove the "door fan”. See section Replacing the cabinet “door fan” (page 187).
5. Bottom entry: Route the cables of these options to the connection terminals at the left-hand side of the cabinet as shown below.

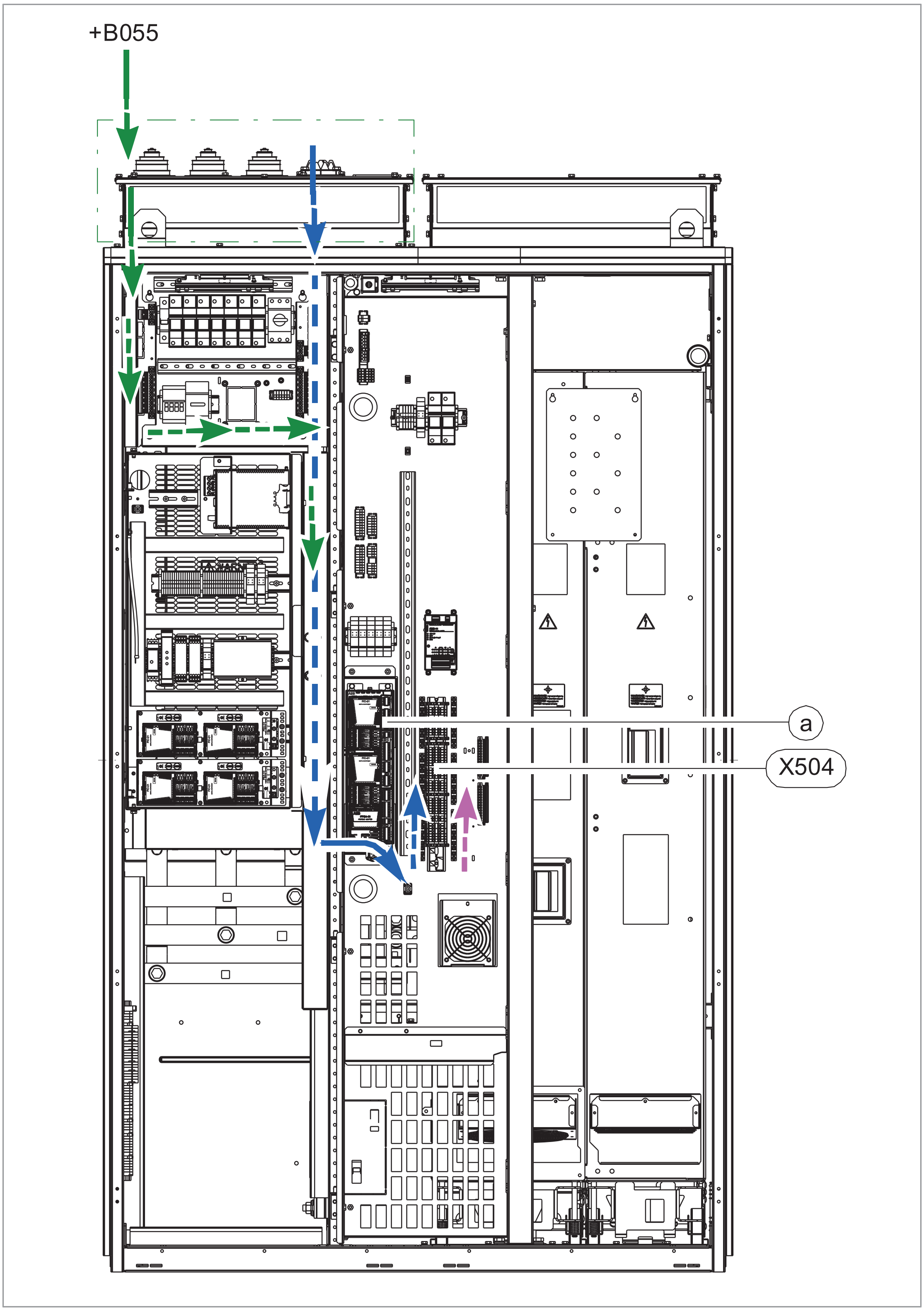
Terminal	Option
X250	Main switch and line contactor feedback for customer
X506	Thermistor relay or Pt100 relays (option +L505 or +L506)
X601	Starter for auxiliary motor fan (options +M600…+M605)
X951	Push buttons for emergency stop options +Q951, +Q952, +Q963 and +Q964
X954	Ground fault monitoring for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



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

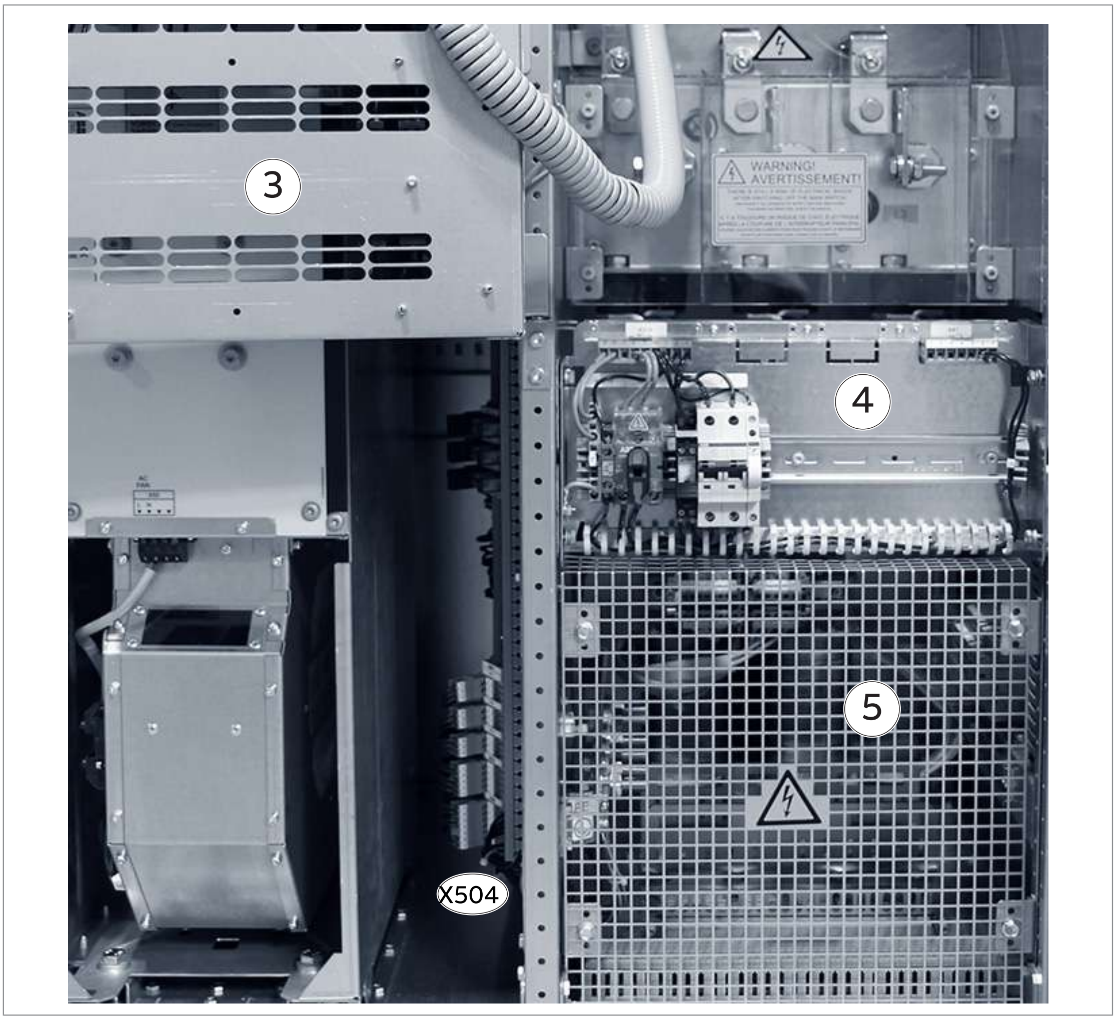


Top entry: Route the control cables to the control unit (a) and additional terminal block X504 (option +L504) as shown below (standard cabinet and option +B054 with blue color; option +B055 with green).

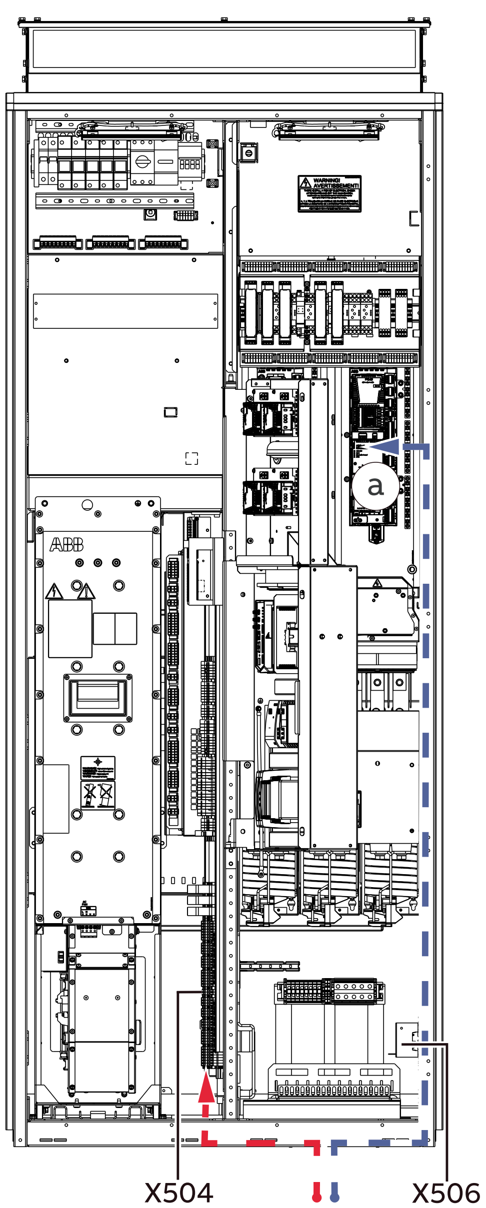
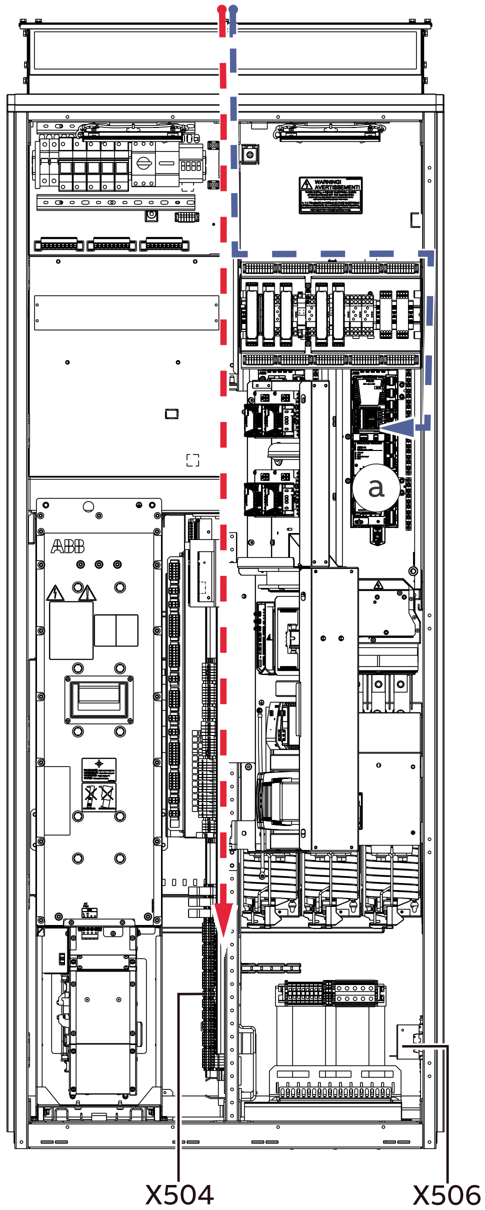


Frames R6i+R6i and R7i+R7i

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. Open the swing-out frame.
4. Bottom entry: If there is a mounting plate under the swing-out frame, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
5. Bottom entry: Undo the four screws and remove the bottom shroud.



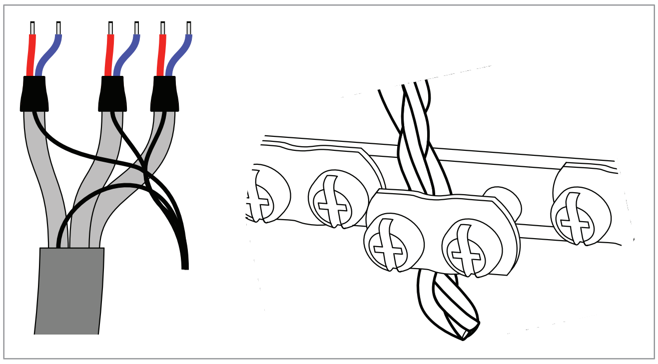
6. Route the cables to the control unit (a) and additional terminal block X504 (option +L504) as shown below.

Bottom entry	Top entry
	

Connecting the external control cables to the drive control unit

See chapter Control unit (page 161) for the default I/O connections of the drive control unit (with the ACS880 primary control program). The default I/O connections can be different with some hardware options, see the circuit diagrams delivered with the drive for the actual wiring. For other control programs, see their firmware manuals.

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



Note: At the other end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, eg. 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.

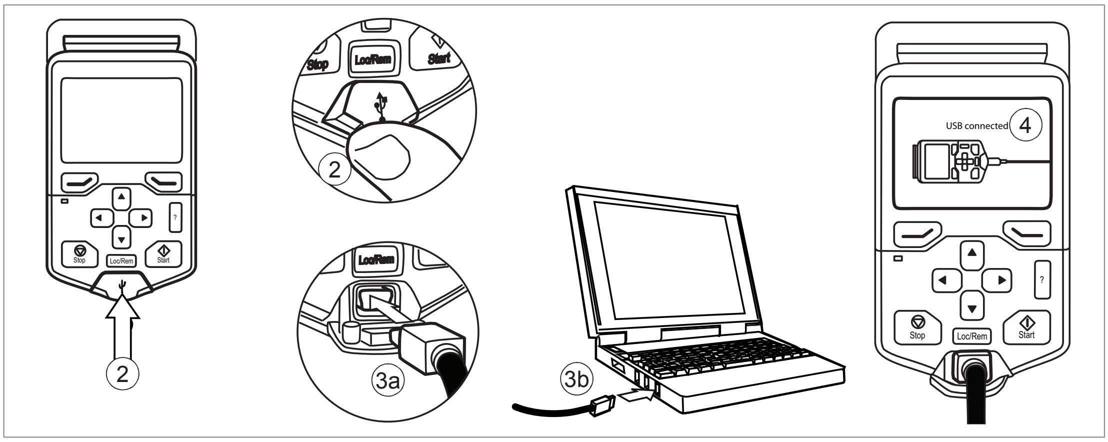
- Do not ground the outer shield of the cable here since it is grounded at the entry.
- Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

Connecting a PC

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

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

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



Installing option modules

Installing option modules

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

WARNING!
Use ESD wristband when you handle printed circuit boards. Do not touch the boards unnecessarily. The boards are sensitive to electrostatic discharge.

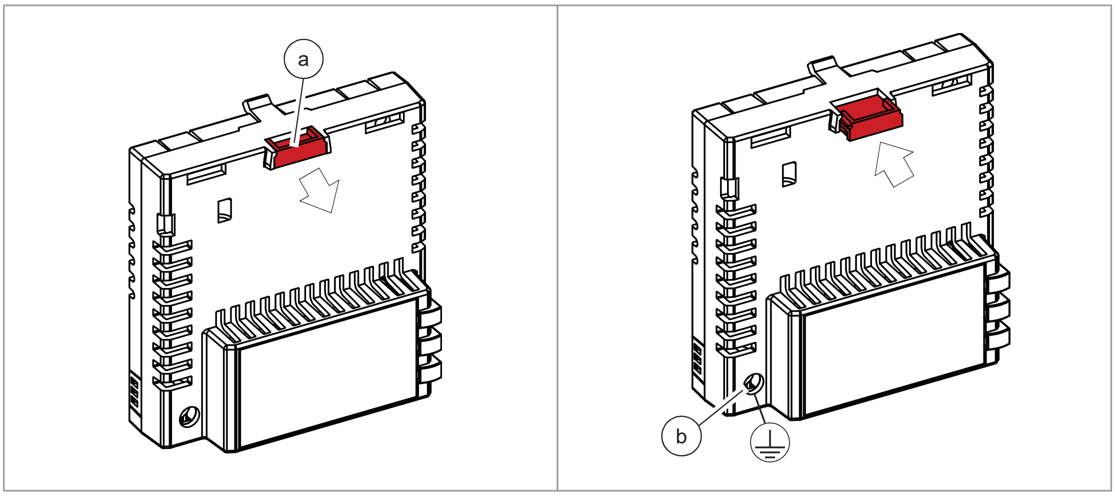
Pay attention to the free space required by the cabling or terminals coming to the option modules.

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Pull out the lock (a) with a screw driver.

   Note: The location of the lock depends on the module type.
3. Install the module to a free option module slot on the control unit.
4. Push in the lock (a).
5. Tighten the grounding screw (b) to a torque of 0.8 N·m (7 lbf·in).

   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.

   WARNING!
   Do not use excessive force, or leave the screw too loose. Over-tightening can cause damage to the screw or module. A loose screw can cause an operation failure.



6. Connect the wiring to the module. Obey the instructions given in the documentation of the module.

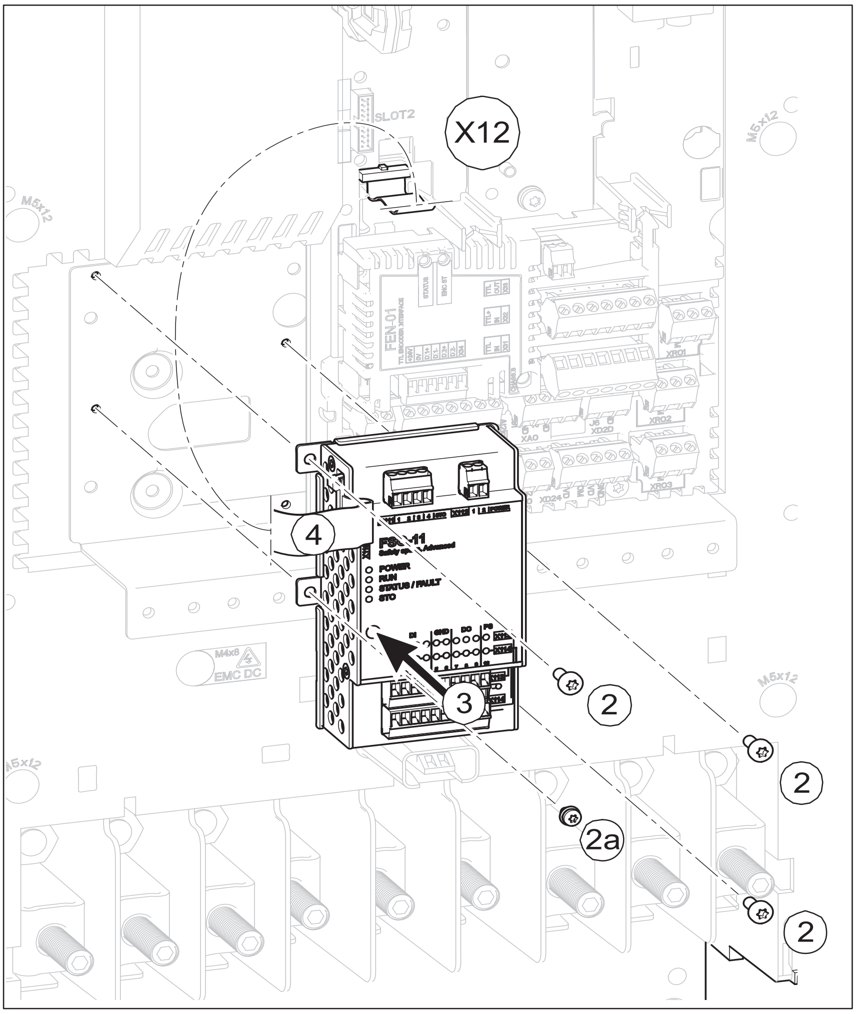
If you must remove the option module after it is installed into the drive, use a suitable tool (for example, small pliers) to carefully pull out the lock.

Installation of an FSO safety functions module beside the ZCU-12 control unit

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Attach the FSO module to the mounting plate with four screws.

   Note: Correct installation of the FSO module enclosure grounding screw (2a) is essential for fulfilling the EMC requirements and for the correct operation of the FSO module.
3. Torque the FSO module electronics grounding screw to 1.2 N·m (10.6 lbf·in).

   Note: The grounding screw tightens the connections and grounds the FSO module. It is essential for fulfilling the EMC requirements and the correct operation of the FSO module.
4. Connect the data communication cable to connector X110 on the FSO module and to connector X12 on the drive control unit.
5. Connect the Safe torque off four-wire cable to connector X111 on the FSO module and to connector XSTO on the drive module control unit.
6. Connect the power supply wires to the FSO module terminal X112.
7. To complete the installation, refer to the instructions in the FSO user's manual delivered with the FSO module.



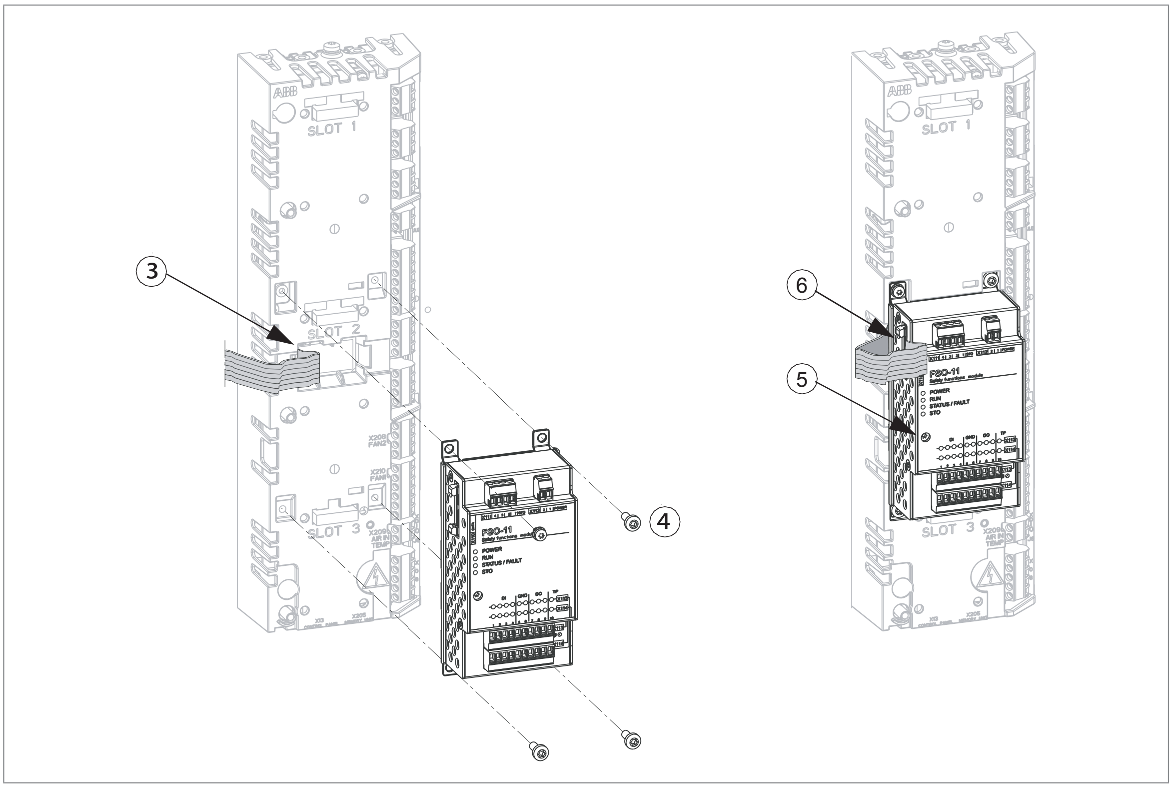
Installing an FSO safety functions module onto ZCU control unit

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. The FSO module comes with alternative bottom plates for mounting on different control units. Replace the bottom plate of the FSO module if necessary.
3. Connect the data cable to control unit connector X12.
4. Put the FSO module into its position on SLOT 2 of the control unit. Attach the FSO module by the bottom plate with four screws.
5. Torque the FSO module electronics grounding screw to 1.2 N·m (10.6 lbf·in).

   Note: The screw tightens the connections and grounds the FSO module. It is essential for fulfilling the EMC requirements and for proper operation of the FSO module.
6. Connect the other end of the data cable to connector X110 on the FSO module.

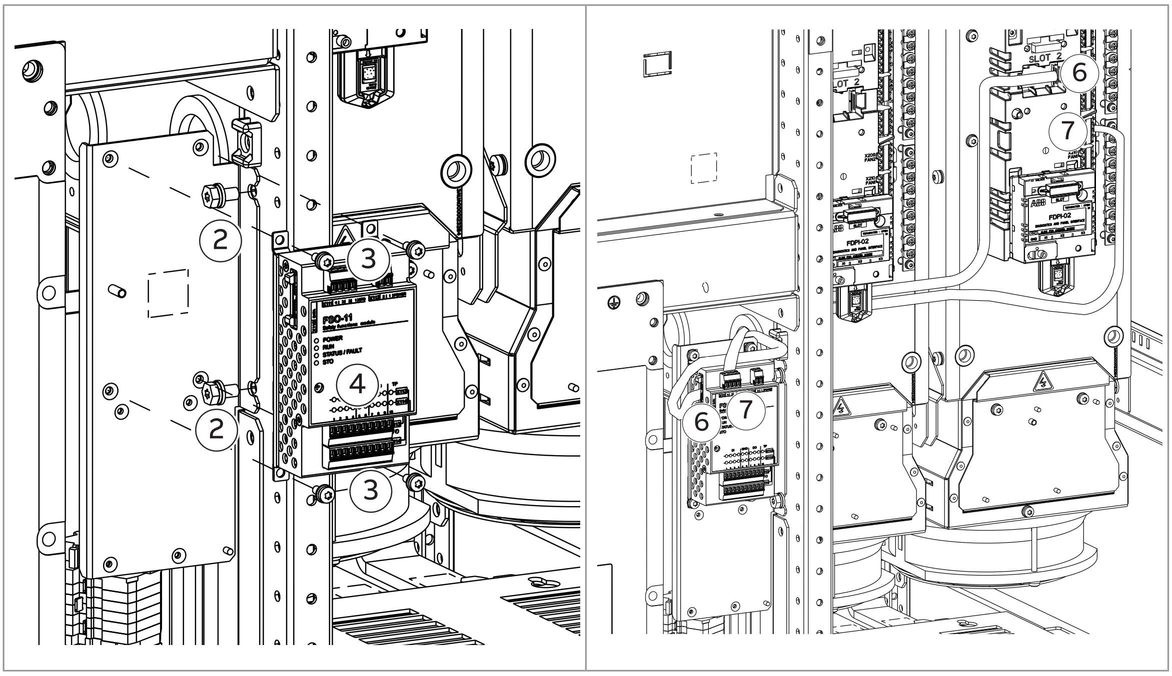
7. Connect the STO cable to FSO module connector X111 and to control unit connector XSTO.
8. Connect the power supply wires to the FSO module terminal X112.
9. Connect any user-defined signal cables to the FSO module according to the application requirements. Refer to the FSO module user's manual.



Installation of an FSO safety functions module beside the ZCU-14 control unit for frames R6i+R6i and R7i+R7i

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Attach the mounting plate to the cabinet with two screws and tighten to 5 N·m (3.7 lbf·ft).
3. Loosely attach the FSO module to the mounting plate with four screws.
4. Torque the FSO module electronics grounding screw to 1.2 N·m (10.6 lbf·in).

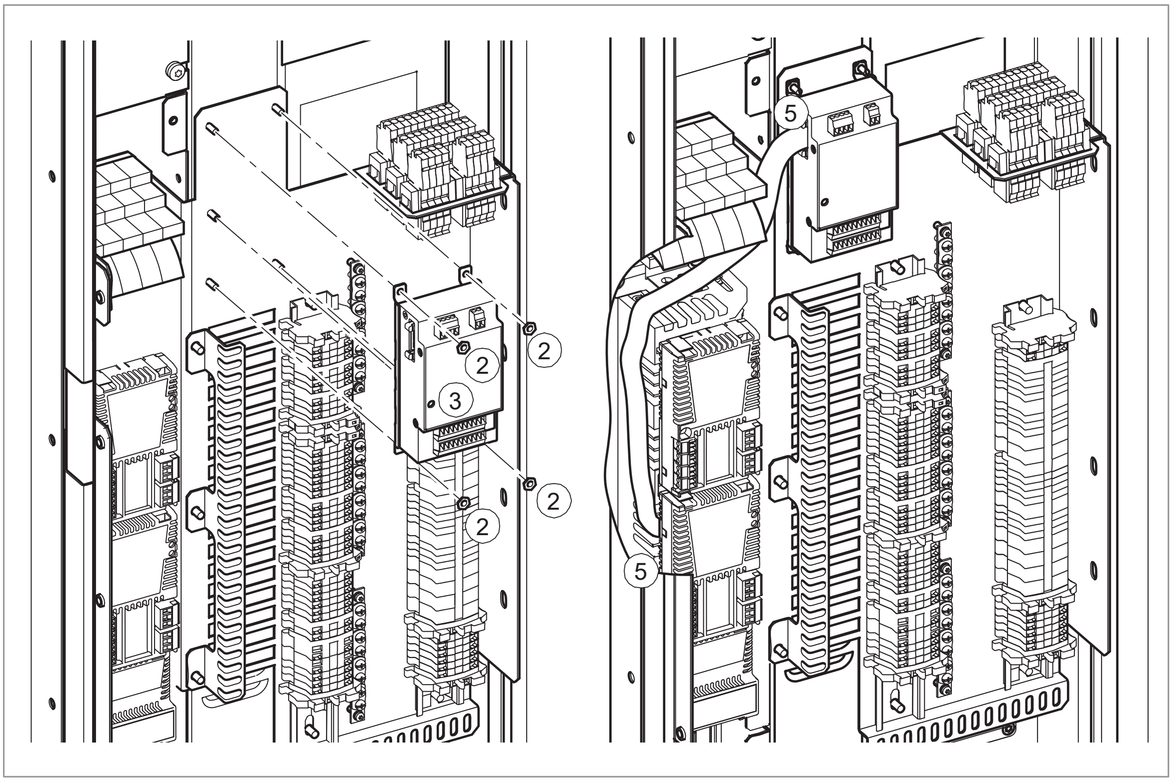
   Note: The screw tightens the connections and grounds the FSO module. It is essential for fulfilling the EMC requirements and for proper operation of the FSO module.
5. Torque the four screws to 1.2 N·m (10.6 lbf·in) to attach the FSO module to the mouting plate.
6. Connect the FSO module data cable to FSO module connector X110 and to connector X12 on the control unit.
7. Connect the STO cable to FSO module connector X111 and to control unit connector XSTO.
8. Connect the power supply wires to the FSO module terminal X112.
9. To complete the installation, refer to the instructions in the FSO user's manual delivered with the FSO module.



Installation of an FSO safety functions module beside the ZCU-14 control unit for frame R11

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Loosely attach the FSO module to the mounting plate with four screws.
3. Torque the FSO module electronics grounding screw to 1.2 N·m (10.6 lbf·in).

   Note: The screw tightens the connections and grounds the FSO module. It is essential for fulfilling the EMC requirements and for proper operation of the module.
4. Torque the four screws to 1.2 N·m (10.6 lbf·in) to attach the FSO module to the mouting plate.
5. Connect the FSO module data cable to FSO module connector X110 and to connector X12 on the control unit.
6. Connect the STO cable to FSO module connector X111 and to control unit connector XSTO.
7. Connect the power supply wires to the FSO module terminal X112.
8. To complete the installation, refer to the instructions in the FSO user’s manual delivered with the FSO module.



Installing the FSPS-21 safety functions module

To install safety functions module FSPS-21 onto the drive control unit, refer to FSPS-21 PROFIsafe safety functions module user's manual (3AXD50000158638 [English]).

Installing the FSCS-21 safety functions module

To install safety functions module FSCS-21 onto the drive control unit, refer to FSCS-21 CIP Safety™ functions module user's manual (3AXD50001065478 [English]).

7

Control unit

Contents of this chapter

This chapter

- gives information on the connections of the control unit, and
- has the specifications of the inputs and outputs of the control unit.

General

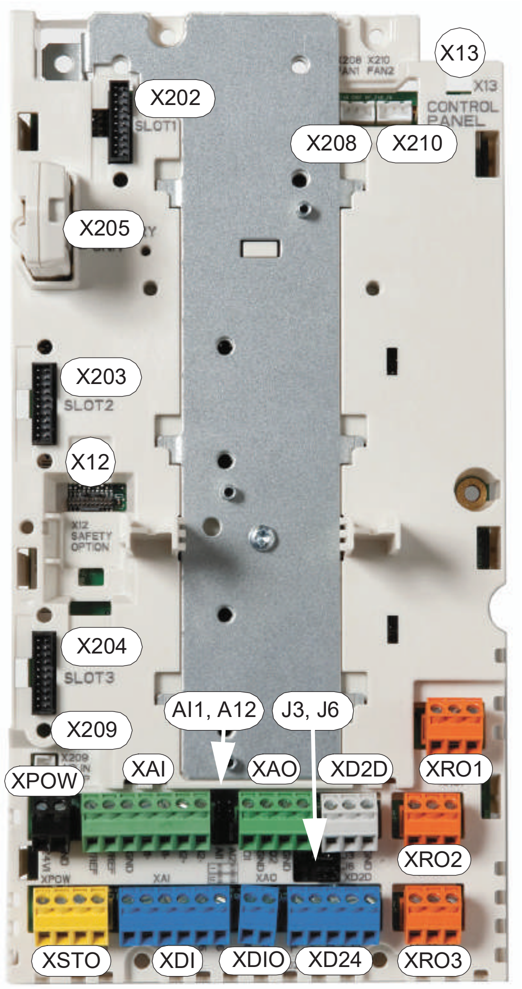
The drive utilizes ZCU-1x control units.

Frame R8 contains the ZCU-12 control unit. The ZCU control unit of frame R8 controls the motor-side converter, and control board QCON-21 controls the line-side converter.

Frame R11 contains two ZCU control units. One (ZCU-12) controls the line-side converter, the other (ZCU-14) the motor-side converter.

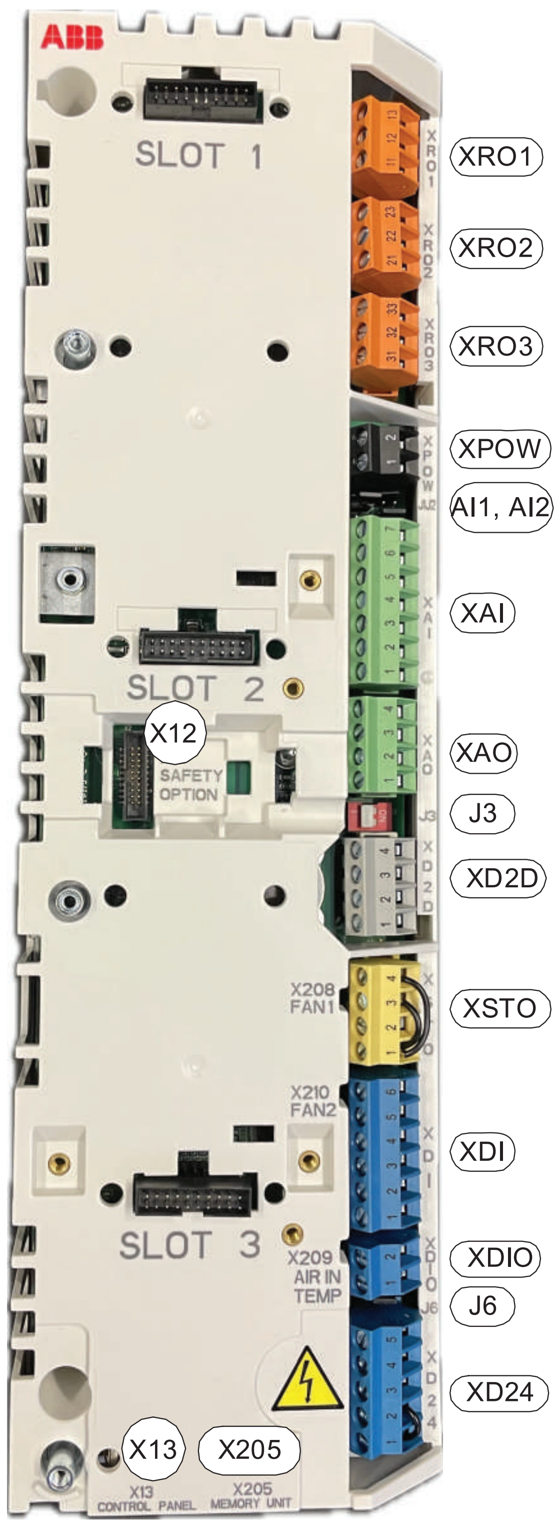
Frames R6i+R6i and R7i+R7i contain two ZCU-14 control units. One controls the line-side converter, the other the motor-side converter.

ZCU-12 layout



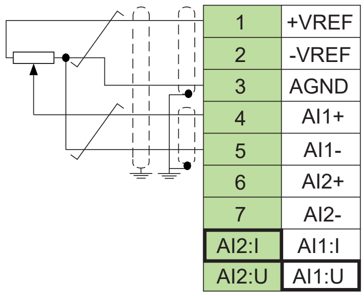
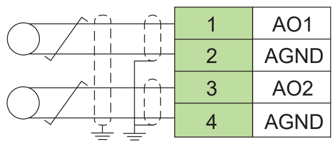
	Description
XAI	Analog inputs
XAO	Analog outputs
XDI	Digital inputs
XDIO	Digital input/outputs
XD24	Digital input interlock (DIIL) and +24 V output
XD2D	Drive-to-drive link
XPOW	External power input
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XSTO	Safe torque off connection
X12	Connection for FSO safety functions module
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 picture)
X208	Cooling fan 1 connection
X209	Connection for ambient temperature sensor (at air inlet). Connected at the factory.
X210	Cooling fan 2 connection
AI1, AI2	Current/Voltage selection jumpers (J1, J2) for analog inputs
J3	Drive-to-drive link termination switch (J3)
J6	Common digital input ground selection switch (J6)

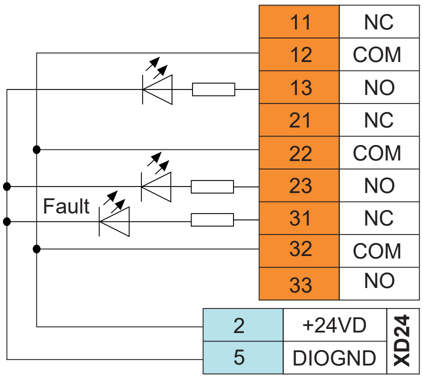
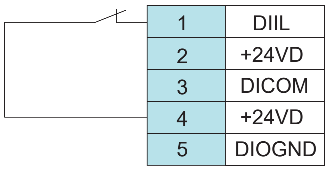
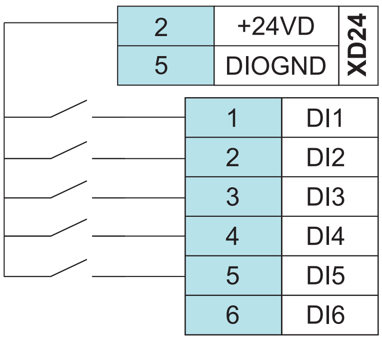
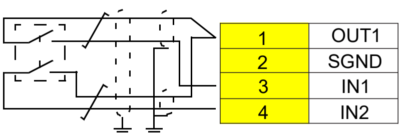
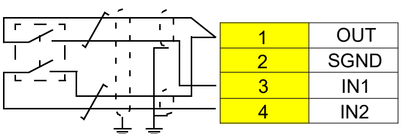
ZCU-14 layout



	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 safety functions module (inverter unit only).
X13	Control panel connection
X202	Option slot 1
X203	Option slot 2
X204	Option slot 3
X205	Memory unit connection (memory unit inserted in the drawing)
AI1, AI2	Voltage/Current selection jumpers (AI1, AI2) for analog inputs
J3	Drive-to-drive link termination switch (J3)
J6	Common digital input ground selection jumper (J6).

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

Connection	Term	Description
XPOW External power input		
1 +24VI 2 GND	+24VI	24 V DC, 2 A min. (without optional modules)
	GND	
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)
	AI2+	By default not in use.
	AI2-	0(4)…20 mA, R_{in} = 100 ohm1)
	AI1 (ZCU-12) J1 (ZCU-14)	Current (I) / voltage (U) selection jumper for AI1
	AI2 (ZCU-12) J2 (ZCU-14)	Current (I) / voltage (U) selection jumper for AI2
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		
ZCU-12: 1 B 2 A 3 BGND ZCU-14: 1 B 2 A 3 BGND 4 Shield	B	Master/follower, drive-to-drive or embedded fieldbus connection
	A	
	BGND	
	Shield (ZCU-14 only)	
	J3	Drive-to-drive link termination

Connection	Term	Description
XRO1, XRO2, XRO3 Relay outputs		
	NC	**Ready run**
	COM	250 V AC / 30 V DC
	NO	2 A
	NC	**Running**
	COM	250 V AC / 30 V DC
	NO	2 A
	NC	**Fault (-1)**
	COM	250 V AC / 30 V DC
	NO	2 A
XD24 Auxiliary voltage output, digital interlock		
	DIIL	Run enable
	+24VD	+24 V DC 200 mA [2]
	DICOM	Digital input ground
	+24VD	+24 V DC 200 mA [2]
	DIOGND	Digital input/output ground
XDIO Digital input/outputs		
	DIO1	Output: Ready run
	DIO2	Output: Running
	J6	Ground selection [3]
XDI Digital inputs		
	DI1	Stop (0) / Start (1)
	DI2	Forward (0) / Reverse (1)
	DI3	Reset
	DI4	Acc/Dec time select [4]
	DI5	Constant speed 1 (1 = On) [5]
	DI6	By default, not in use.
 (ZCU-12)	OUT1 (ZCU-12) OUT (ZCU-14)	Safe torque off circuits must be closed for the drive to start. [6]
	SGND	
	IN1	
 (ZCU-14)	IN2	
X12	Safety options connection	
X13	Control panel connection	

Connection	Term	Description
X205	Memory unit connection	

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

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

3) 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 ground isolation diagram (page 171). DICOM=DIOGND ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.

4) 0 = Acceleration/deceleration ramps defined by parameters *23.12*/*23.13* in use. 1 = Acceleration/deceleration ramps defined by parameters *23.14*/*23.15* in use.

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

6) See chapter The Safe torque off function (page 321).

Additional information on the connections

Connecting motor temperature sensors to the drive

Refer to the electrical planning instructions.

Power supply for the control unit (XPOW)

Power to the control unit is supplied internally through terminal block XPOW.

Refer to the control unit connector data for the current and voltage ratings of the power supply.

Connect an additional external power supply to the free +24 V and GND terminals of the XPOW terminal block if:

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

Digital interlock (DIIL)

Digital interlock input (DIIL) terminal is originally intended for interlock signals that stop the drive/unit when necessary. In the ACS880 primary control program, DIIL terminal is the source for the run enable signal by default. The inverter unit or drive cannot start, or it stops when there is no DIIL signal. In other control programs (and units), the default use of the DIIL terminal varies. Refer to firmware manual for more information.

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

The XD2D connector

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

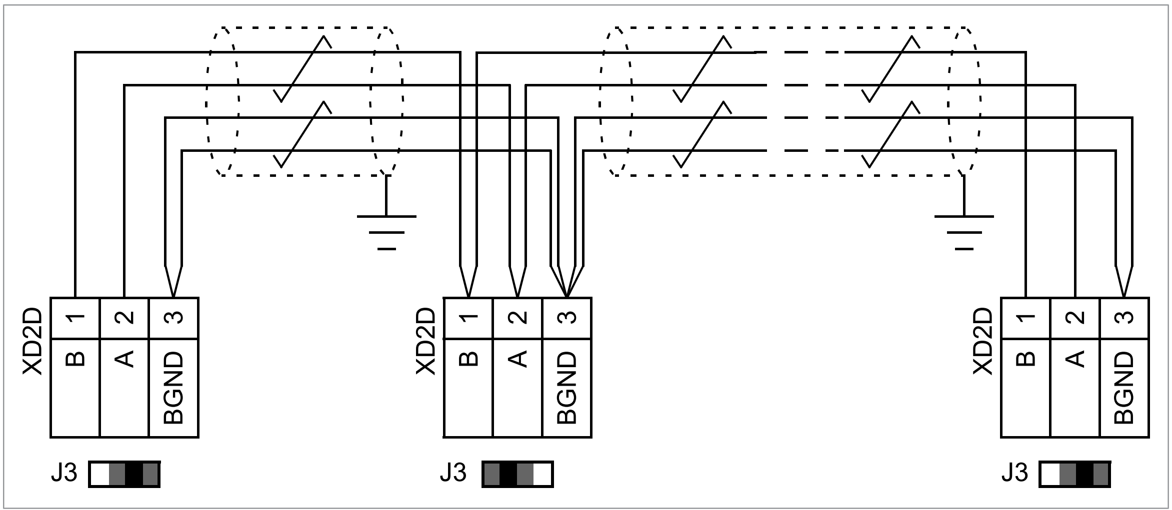
- basic master/follower communication with one master drive and multiple followers,
- fieldbus control through the embedded fieldbus interface (EFB), or
- drive-to-drive (D2D) communication implemented by application programming.

See the firmware manual for the related parameter settings.

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

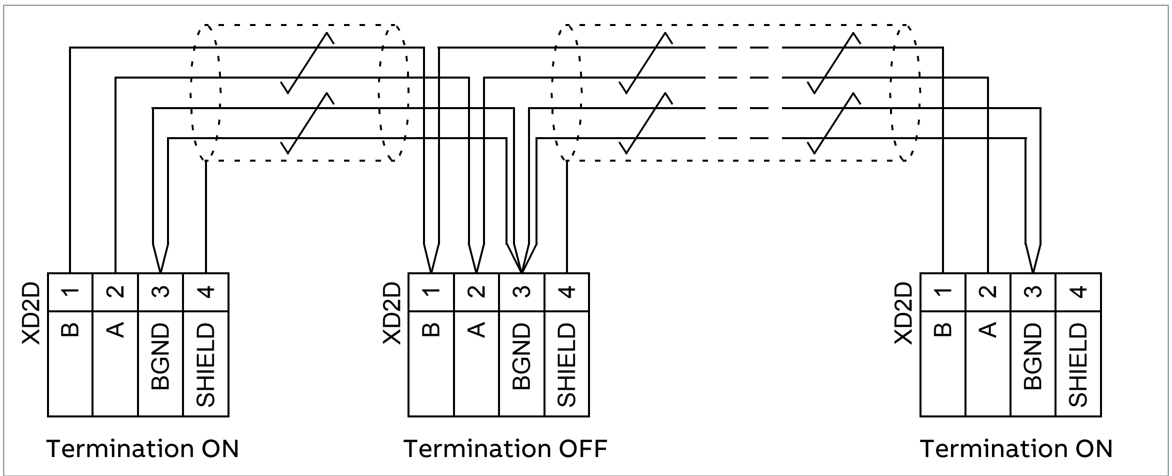
Use a shielded twisted-pair cable for data, and another pair or a wire for signal ground (nominal impedance 100…165 ohm, for example Belden 9842). For the best immunity, ABB recommends high quality cable. Keep the cable as short as possible. Avoid unnecessary loops and parallel runs near power cables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

The diagram that follows shows the wiring of the drive-to-drive link. The diagram is applicable to ZCU-12 control units.



The diagram that follows shows the wiring of the drive-to-drive link. The diagram is applicable to these control units:

- ZCU-14



Safe torque off (XSTO)

Refer to chapter The Safe torque off function.

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

FSO safety functions module connection (X12)

In drives or inverter units with a compatible control program, an optional FSO safety functions module can be connected to the X12 connector. The control program in supply, brake, and DC/DC converter units does not support the FSO safety functions module.

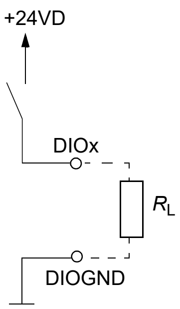
For more information on the FSO safety functions module, refer to the applicable FSO module user's manual.

Note: Inverter modules and control units that have a sticker with the text “No FSO support” are not compatible with the FSO safety functions module.

Connector data

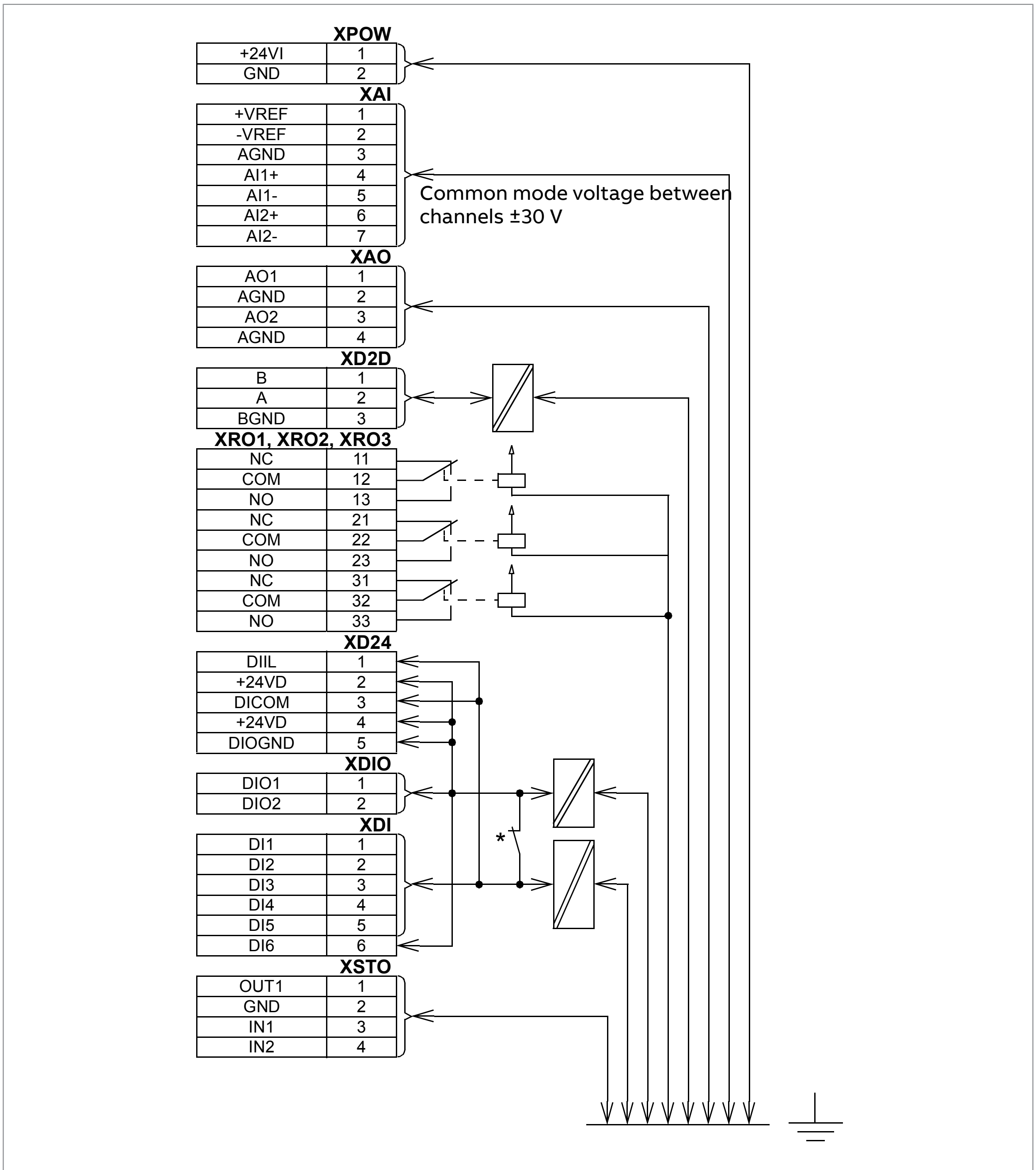
The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 … 2.5 mm^2 (22…12 AWG). Connector pitch is 5 mm.

The maximum tightening torque for screw terminals is 0.5 N·m (5 lbf·in).

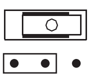
Power supply (XPOW)	24 V DC (±10%), 2 A External power input.
Relay outputs RO1…RO3 (XRO1…XRO3)	250 V AC / 30 V DC, 2 A Protected by varistors
+24 V output (XD24:5 and XD24:7)	Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
Digital inputs DI1…DI6 (XDI:1…XDI:6)	24 V logic levels: “0” < 5 V, “1” > 15 V R_{in}: 2.0 kohm (DI1…DI5) Input type: NPN/PNP (DI1…DI5), PNP (DI6) Hardware filtering: 0.04 ms, digital filtering up to 8 ms I_{max}: 15 mA (DI1…DI5), 5 mA (DI6)
Start interlock input DIIL (XD24:1)	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). In some control programs, DIO2 can be configured as a 24 V level square wave frequency output. Refer to the firmware manual, parameter group 11.	<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)	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	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 Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range
Analog outputs AO1 and AO2 (XAO)	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	Physical layer: RS-485 Transmission rate: 8 Mbit/s Cable type: Shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 … 165 ohm, for example Belden 9842) Maximum length of link: 50 m (164 ft) Termination by jumper
RS-485 connection (X485)	Physical layer: RS-485 Cable type: Shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 … 165 ohm, for example Belden 9842) Maximum length of link: 50 m (164 ft)
Safe torque off connection (XSTO)	Input voltage range: -3…30 V DC Logic levels: "0" < 5 V, "1" > 17 V. **Note:** Both circuits must be closed to enable start and operation (IN1 and IN2 must be connected to OUT). This applies to all control units (including drive, inverter, supply, brake, DC/DC converter etc. control units), but SIL/PL classified Safe torque off functionality is only achieved through the XSTO connector of the drive/inverter control unit. Current consumption: 12 mA (frame R8), 25 mA (frames R6i and R7i with option +V992) or 66 mA (frame R11) (continuous) per STO channel EMC (immunity) according to IEC 61326-3-1 and IEC 61800-5-2
Control panel connection (X13)	Connector: RJ-45 Cable length < 100 m (328 ft)
The terminals of the control unit fulfill the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if a voltage higher than 48 V is connected to the relay output.	

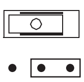
ZCU ground isolation diagram



* Ground selector (J6) settings


(ZCU-12)
(ZCU-14)

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


(ZCU-12)
(ZCU-14)

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

8

Installation checklist

Contents of this chapter

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

Checklist

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

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

WARNING!
Do the steps in section Electrical safety precautions (page 19) before you start the work.

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

9

Start-up

Contents of this chapter

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

Reforming the capacitors

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

Start-up procedure

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

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

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

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

Action	☑
Safety	
WARNING! Obey the safety instructions during the start-up procedure. See chapter Safety instructions (page 17).	☐
Checks/Settings with no voltage connected	
Ensure that the disconnector of the supply transformer is locked to the off (0) position, ie. no voltage is, and cannot be connected to the drive inadvertently.	☐
Check that the switch fuse (frame R8) (Q1) or main switch-disconnector (frames R6i+R6i, R7i+R7i and R11) (Q1) is switched off.	☐
Check the mechanical and electrical installation of the drive. See Installation checklist (page 173).	☐
Check the settings of breakers/switches in the auxiliary circuits. See the circuit diagrams delivered with the drive.	☐
Check the tap settings of transformers T21 (standard) and T101, T111 (if present). See Setting the voltage range of auxiliary voltage transformers (page 128).	☐
Disconnect any unfinished or uninspected auxiliary voltage (115/230 V AC) cables that lead from the terminal blocks to the outside of the equipment.	☐
Check that both channels of the Safe torque off circuit connected to the STO inputs of drive control unit are closed. Refer to the wiring diagrams delivered with the drive.	☐
If the Safe torque off functionality is used, check that the STO OUT output on the inverter control unit is chained to the STO inputs of all inverter modules. If the Safe torque off functionality is not used, check that the STO input on all inverter modules is correctly wired to +24 V and ground.	☐
For drives with ground fault monitoring for IT (ungrounded) systems (option +Q954): Adjust the settings of the ground fault monitor to suit the installation. See the circuit diagrams of the delivery and *IRDH275B Ground Fault Monitor Operating Manual* by Bender (code: TGH1386en).	☐
For drives with Pt100 relays (option +(n)L506): • Check the connections against the circuit diagrams of the delivery. • Set the alarm and trip levels of the Pt100 relays. Set the alarm and trip levels of the Pt100 relay as low as possible based on the operating temperature and test results of the machine. The trip level can be set, for example, 10 °C higher than what the temperature of the machine is at maximal load in the maximum environmental temperature. We recommend to set the operating temperatures of the relay, typically for example, as follows: • 120…140 °C when only tripping is in use • alarm 120…140 °C and trip 130…150 °C when both alarm and tripping are used.	☐
Powering up the auxiliary circuit of the drive	
Make sure that it is safe to connect voltage. Ensure that • nobody is working on the drive or circuits that have been wired from outside into the drive cabinet • the cover of the motor terminal box is in place.	☐
Drives with a voltmeter (option +G334): Make sure that the circuit breaker of the measuring circuit (F5) is closed.	☐
Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits.	☐
Close the cabinet doors.	☐
Close the main breaker of the supply transformer.	☐
Close the switch fuse (frame R8) (Q1) or main switch-disconnector (frames R6i+R6i, R7i+R7i and R11) (Q1). This powers up the auxiliary voltage circuit. **Note:** Do not use excessive force. The switch fuse (frame R8) or main switch-disconnector (frames R6i+R6i, R7i+R7i and R11) can only be closed when the main input terminals (L1, L2, L3) are powered.	☐

Action	☑
Setting up the line-side converter parameters	
The line-side converter control program parameters are set at the factory. Normally, there is no need to change them at the start-up. For more information on the line-side converter control parameters, see ACS880 primary control program firmware manual (3AUA0000085967 [English]) or ACS880 IGBT supply control program firmware manual (3AUA0000131562 [English]).	☐
Setting up the motor-side converter parameters, and performing the first start	
Set up the inverter control program. See the appropriate start-up guide and/or firmware manual. There is a separate start-up guide only for some control programs. If you need more information on the use of the control panel, see ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual (3AUA0000085685 [English]).	☐
For drives with a sine output filter (option +E206): Check that parameter 95.15, bit 1 has been activated.	☐
For drives with a fieldbus adapter module (optional): Set the fieldbus parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the fieldbus adapter module, and the drive firmware manual. Check that the communication works between the drive and the PLC.	☐
For drives with an encoder interface module (optional): Set the encoder parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the encoder interface module, and the drive firmware manual.	☐
Activating the Run enable signal of the line-side converter (with options +Q951,+Q952 and +Q978)	
Turn the operating switch (S21) to the ON (1) position to activate the run enable signal for the lineside converter. Frames R6i+R6i and R7i+R7i: Run enable signal switch for the supply unit by default.	☐
On-load checks	
Start the motor to perform the ID run.	☐
Check that the cooling fans rotate freely in the right direction, and the air flows upwards. A paper sheet set on the intake (door) gratings stays. The fans run noiselessly.	☐
Check that the motor starts, stops and follows the speed reference in the correct direction when controlled with the control panel.	☐
Check that the motor starts, stops and follows the speed reference in the correct direction when controlled through the customer-specific I/O or fieldbus.	☐
Drives in which the Safe torque off control circuit is in use: Test and validate the operation of the Safe torque off function. See section Start-up including validation test (page 329).	☐
Drives with functional safety options +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q978, +Q979: Refer to the respective manuals of the safety option for option-specific start-up instructions.	☐

10

Fault tracing

Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

LEDs

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

Warning and fault messages

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

11

Maintenance

Contents of this chapter

This chapter contains preventive maintenance instructions.

Maintenance intervals

The tables show the maintenance tasks that can be done by the end user. For the ABB Service offering, contact your local ABB Service representative (new.abb.com/contact-centers).

Description of symbols

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

Recommended maintenance intervals after start-up

Recommended annual actions by user	Tasks
Connections and environment	
IP54 air filters on the cabinet doors	R
Quality of supply voltage	P
Spare parts	
Spare parts	I
DC circuit capacitors reforming for spare modules and spare capacitors	P
Inspections by user	
IP22 and IP42 air inlet and outlet meshes on the cabinet doors	I
Tightness of terminals	I
Dustiness, corrosion and temperature	I
Cleaning of heatsinks	I
Other	
ABB-SACE air circuit breaker maintenance	I
4FPS10000239703, 4FPS10000292961	

Cooling	Years from start-up							
	3	6	9	12	15	18	21	...
Main cooling fan								
Main cooling fan (R6i + R6i, R7i + R7i and R8) LONGLIFE			R			R		
Main cooling fan (R11)			R			R		
Auxiliary cooling fan								
Auxiliary cooling fan for circuit boards (R8) LONGLIFE			R			R		
Circuit board compartment cooling fans (R11) LONGLIFE			R			R		
Cabinet cooling fan								
Internal LONGLIFE 50 Hz			R			R		
Internal LONGLIFE 60 Hz		R		R		R		
Door 50 Hz			R			R		
Door 60 Hz			R			R		
IP54 50 Hz			R			R		
IP54 60 Hz		R		R		R		
xSIN filter cooling fan								
Filter cooling fan LONGLIFE			R			R		
Aging								
ZCU control unit battery (real-time clock)		R		R		R		
Control panel battery (real-time clock)			R			R		
Functional safety								
Safety function test	I See the maintenance information of the safety function.							
Safety component expiry (Mission time, T_M)	20 years							
	4FPS10000239703, 4FPS10000292961							

Note:

- The maintenance and component replacement intervals are based on the assumption that the equipment operates within the specified ratings and ambient conditions. ABB recommends annual drive inspections to ensure the highest reliability and optimum performance.
- Long-term operation near the specified maximum ratings or ambient conditions may require shorter maintenance intervals for certain components. Contact your local ABB Service representative for additional maintenance recommendations.

Cabinet

Cleaning the interior of the cabinet

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

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

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

Cleaning the exterior of the drive

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

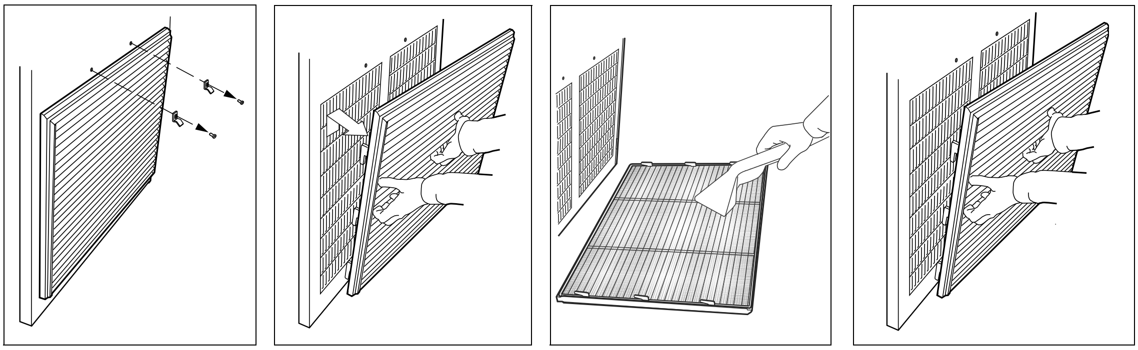
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Clean the exterior of the drive. Use:
   - vacuum cleaner with an antistatic hose and nozzle
   - soft brush
   - dry or damp (not wet) cleaning cloth. Moisten with clean water, or mild detergent (pH 5…9 for metal, pH 5…7 for plastic).

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

Cleaning the door air inlets (IP22 and IP42)

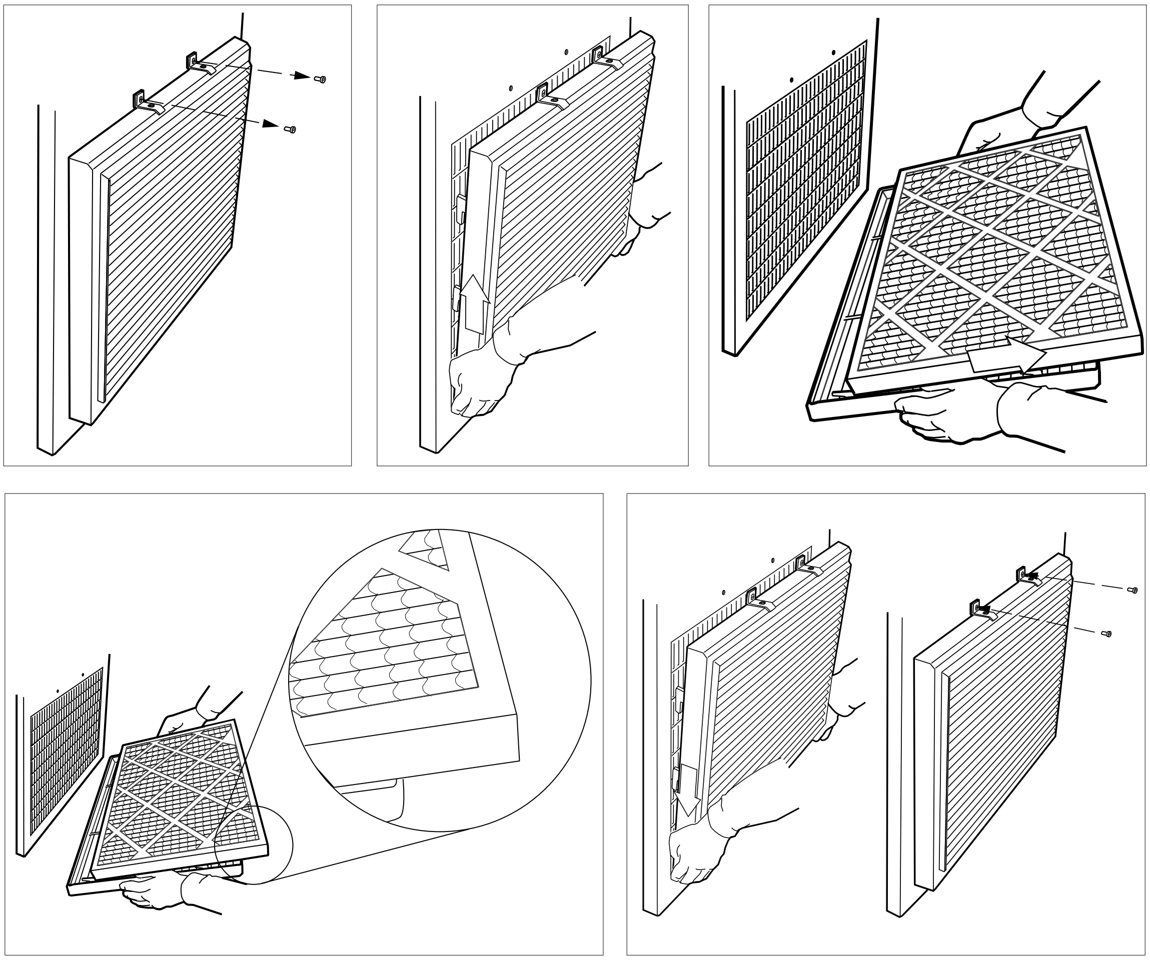
Check the dustiness of the air inlet meshes. If the dust cannot be removed by vacuum cleaning from outside through the grating holes with a small nozzle, proceed as follows:

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



Replacing the inlet door filters (IP54)

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



Cleaning the roof outlet filters (IP54)

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

Replacing the roof outlet filters (IP54)

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

Cleaning the heatsink

The heatsink of the power module (drive, supply, inverter, converter, etc.) pick up dust from the cooling air. This can cause overtemperature warnings and faults. When necessary, clean the heatsink as follows.

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

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Remove the power module from the cabinet.
3. Remove the module cooling fan(s). Refer to the separate instructions.
4. Protect the adjacent equipment from dust.
5. Blow dry, clean and oil-free compressed air from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.
6. Reinstall the cooling fan.

Fans

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

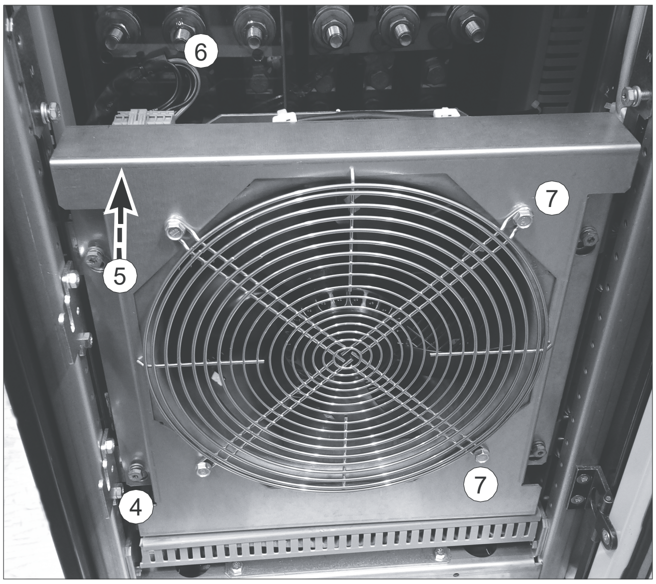
Replacement fans are available from ABB. Do not use other than ABB-specified spare parts.

Replacing the cabinet “door fan”

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. If there is a mounting plate/s above the fan, loosen the four screws and pull out the plate. Unplug the connectors and remove the plate.
   If there is no mounting plate/s, but instead a shroud/s above the fan, undo the four screws and remove the shroud/s.
   For frame R11 with option +C121: Undo the screws and remove the marine supports. See Replacing the drive and LCL filter modules (frame R11) (page 213).

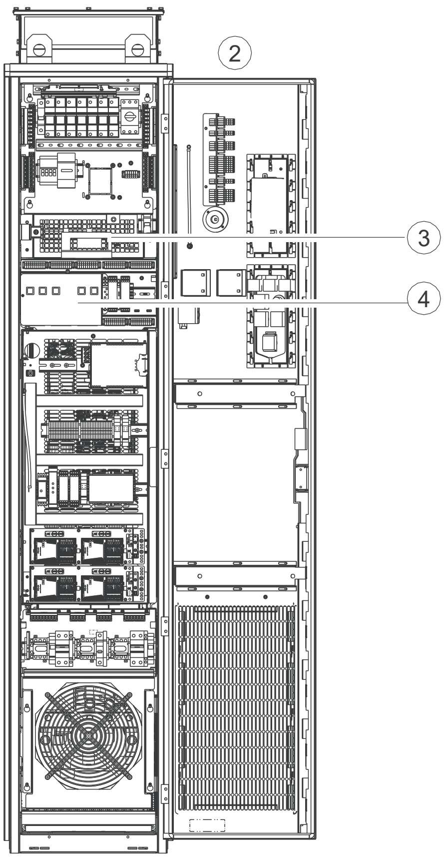
4. Loosen the four mounting screws of the fan mounting plate.
5. Lift the mounting plate upwards.
6. Unplug the fan supply wires.
7. Lift the fan mounting plate off.
8. Undo the four mounting screws of the fan and remove the fan from the mounting plate. The finger guard of the fan is attached by the same screws on its front side. Keep the finger guard for reuse.
9. Install the new fan in reverse order.

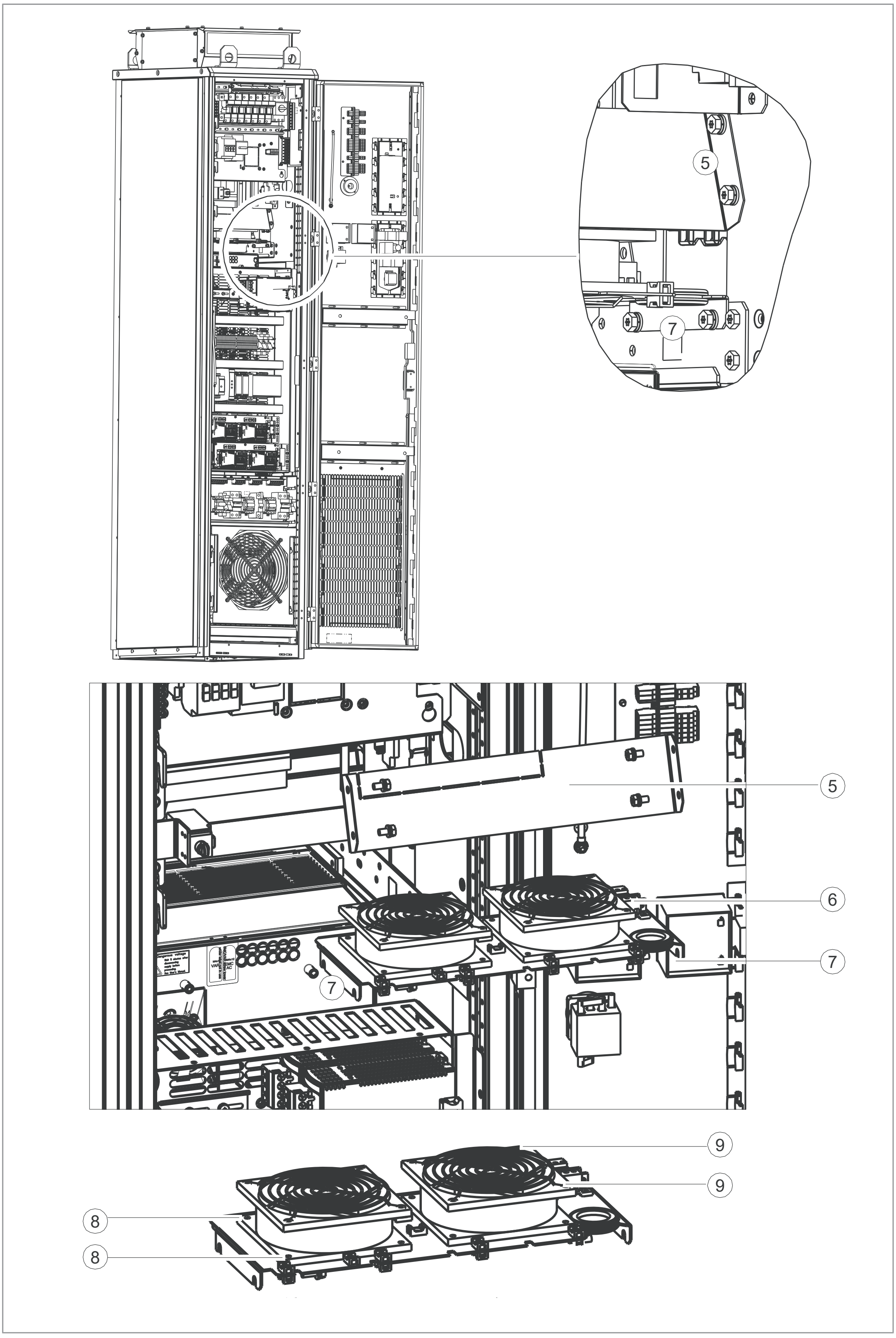


Replacing the internal cabinet cooling fans (frame R8)

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

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

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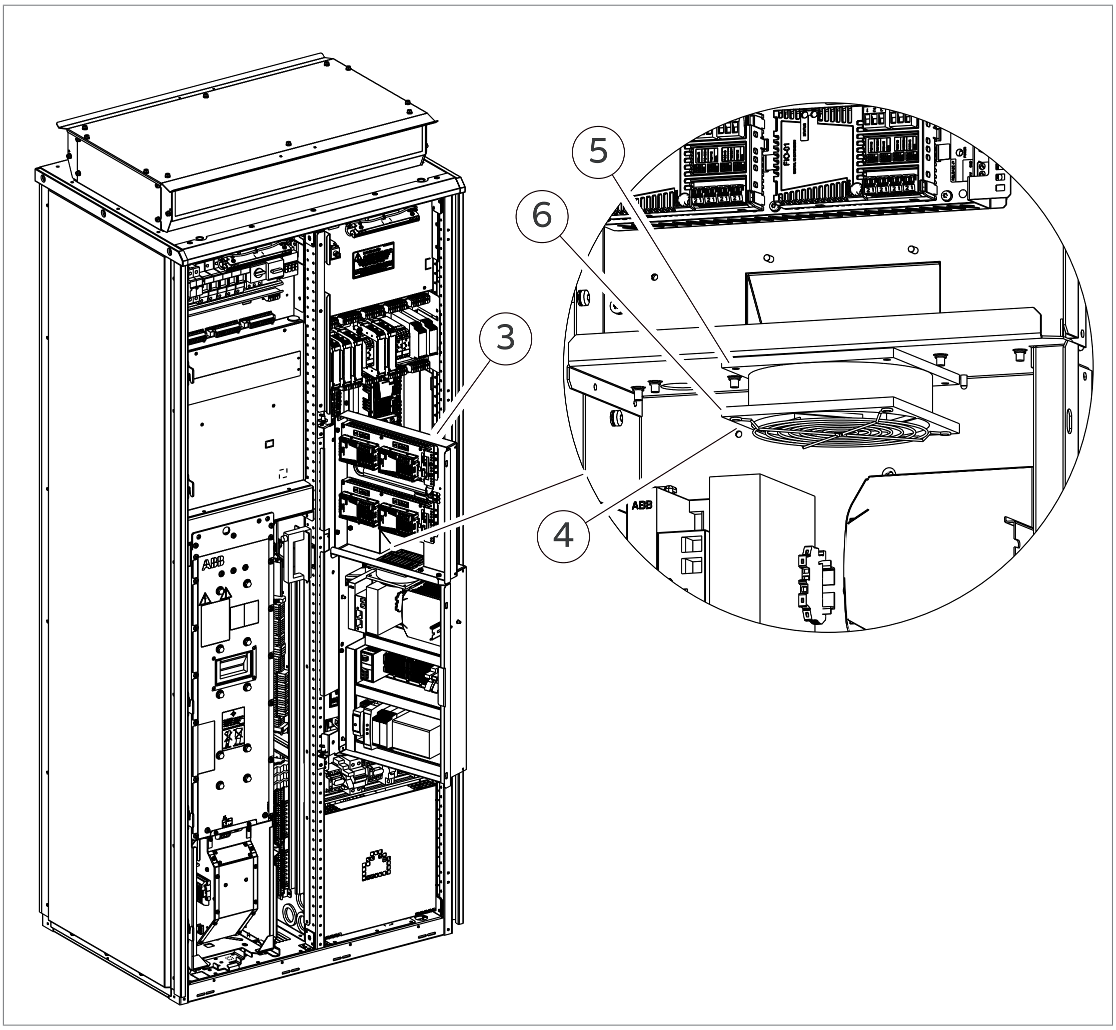
Replacing the internal cabinet cooling fans (frames R6i+R6i and R7i+R7i)

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. Open the swing-out frame.
4. Disconnect the fan connector.
5. Remove the four mounting screws of the fan and remove the fan from the swing-out frame.
6. Undo the four mounting screws of the finger guard of the fan. Keep the finger guard for reuse.

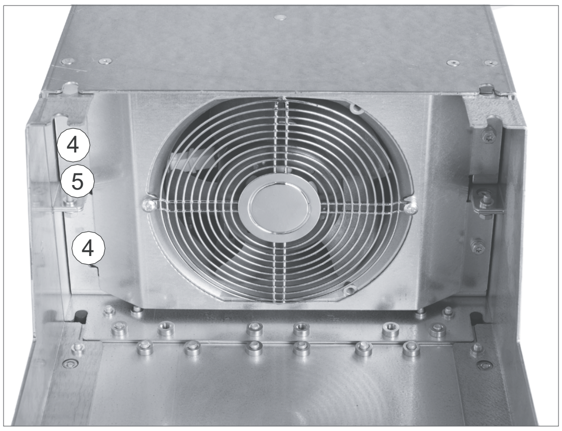


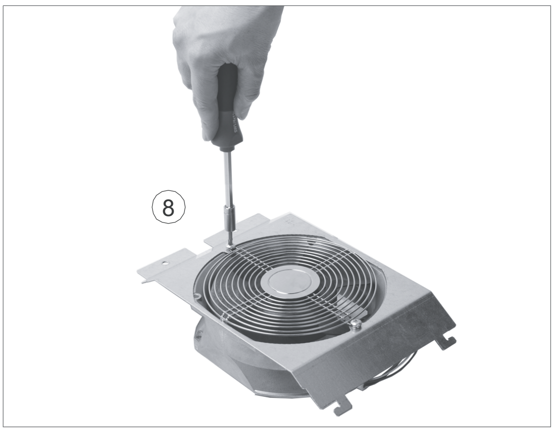
7. Install the new fans in reverse order.

Replacing the drive module main fan (frame R8)

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. Slide the drive module forward as described under Replacing the drive module (frame R8) (page 204).
4. Undo the mounting screws of the fan mounting plate (view from bottom below).
5. Pull the fan mounting plate down from the side edge.
6. Unplug the power supply wires.
7. Lift the fan mounting plate off.
8. Remove the fan from the mounting plate. The finger guard of the fan is attached by the same screws and is removed at the same time. Keep the finger guard for reuse.
9. Install the new fan in reverse order.
10. Close the cabinet door.
11. Reset the counter (if used) in group 5 in the primary control program.





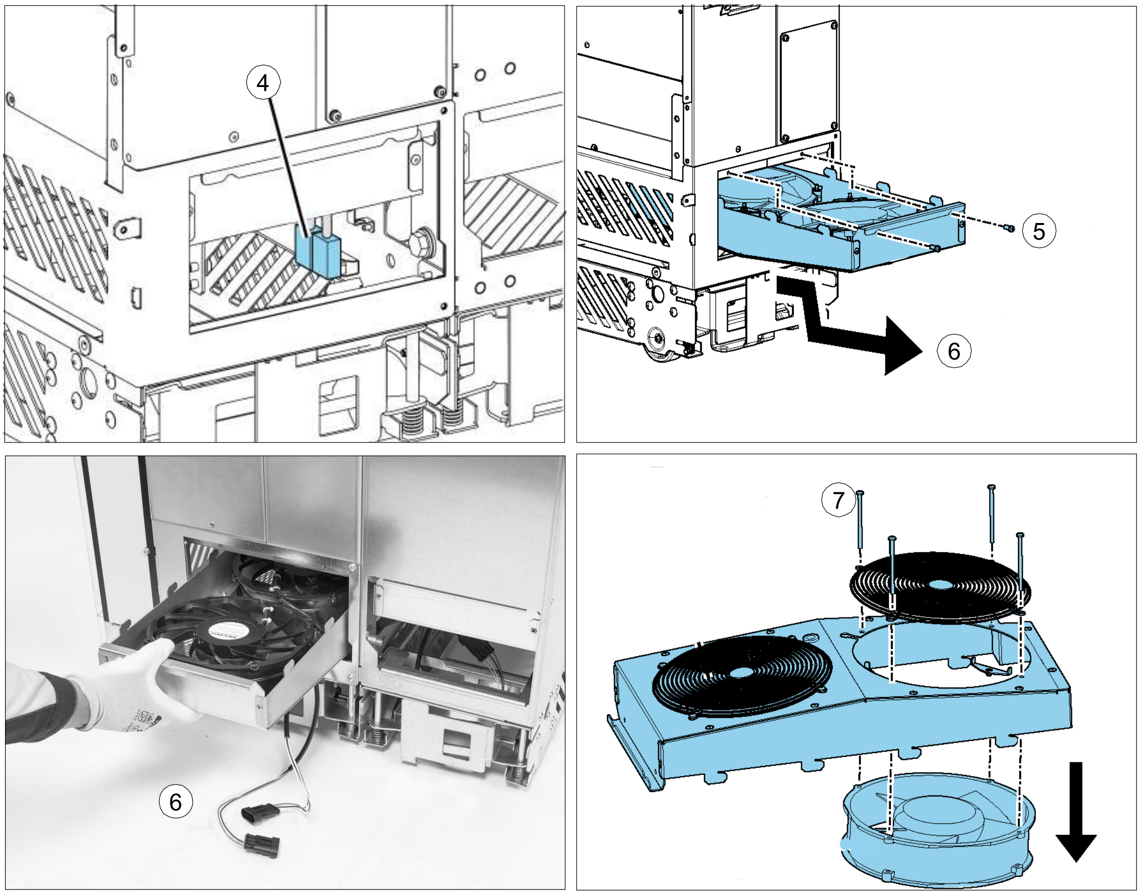
Replacing the drive module main fans (frame R11)

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. To remove the marine supports in drives with option +C121, see Replacing the drive and LCL filter modules (frame R11) (page 213).

3. To open the module section swing-out frame, undo the M10 bolts from top and bottom (4 pcs). See Replacing the drive and LCL filter modules (frame R11) (page 213).
4. Disconnect the power supply wires of the fans from the connectors FAN1:PWR1 and FAN2:PWR2.

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



Replacing the R6i+R6i and R7i+R7 module cooling fan

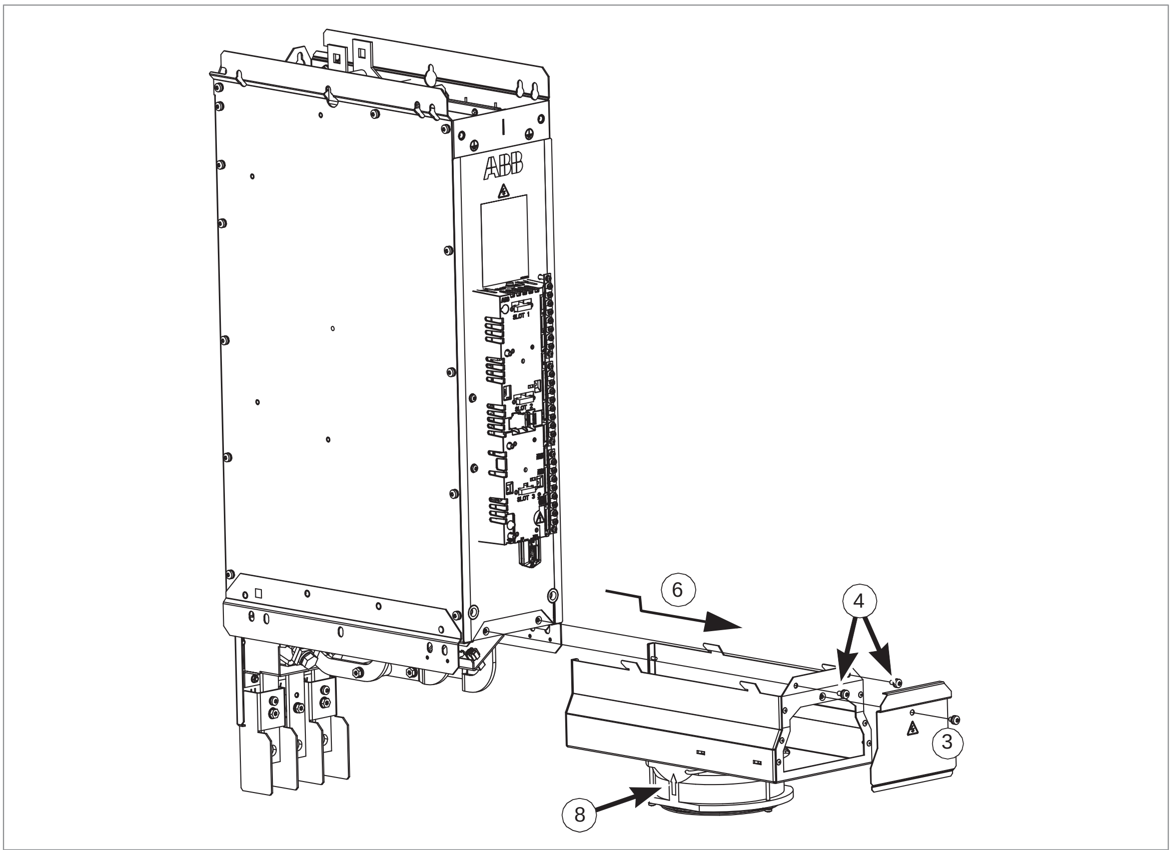
Frame R6i module has one fan, R7i module has two.

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

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the door and the turnframe.
3. Remove the front plate.
4. Remove the two screws that lock the fan unit.
5. Disconnect the power supply wire(s) of the fan(s).
6. To free the fan holder, pull it slightly outwards (about 5 mm), then downwards.
7. Remove the fan(s) from the fan holder.
8. Install new fan(s) in reverse order to the above.

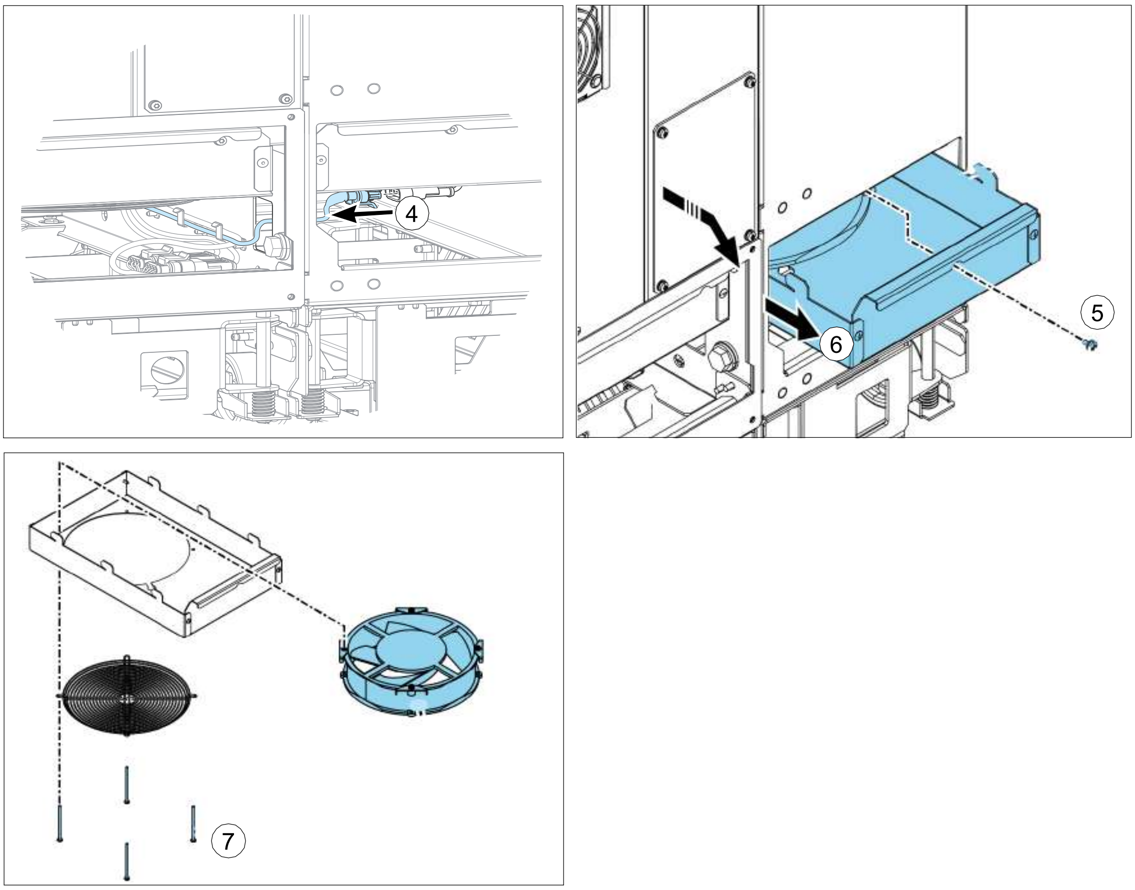
Note: The airflow direction is bottom-to-top. Make sure that the airflow direction arrow on the fan points up.



Replacing the LCL filter module fan (frame R11)

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

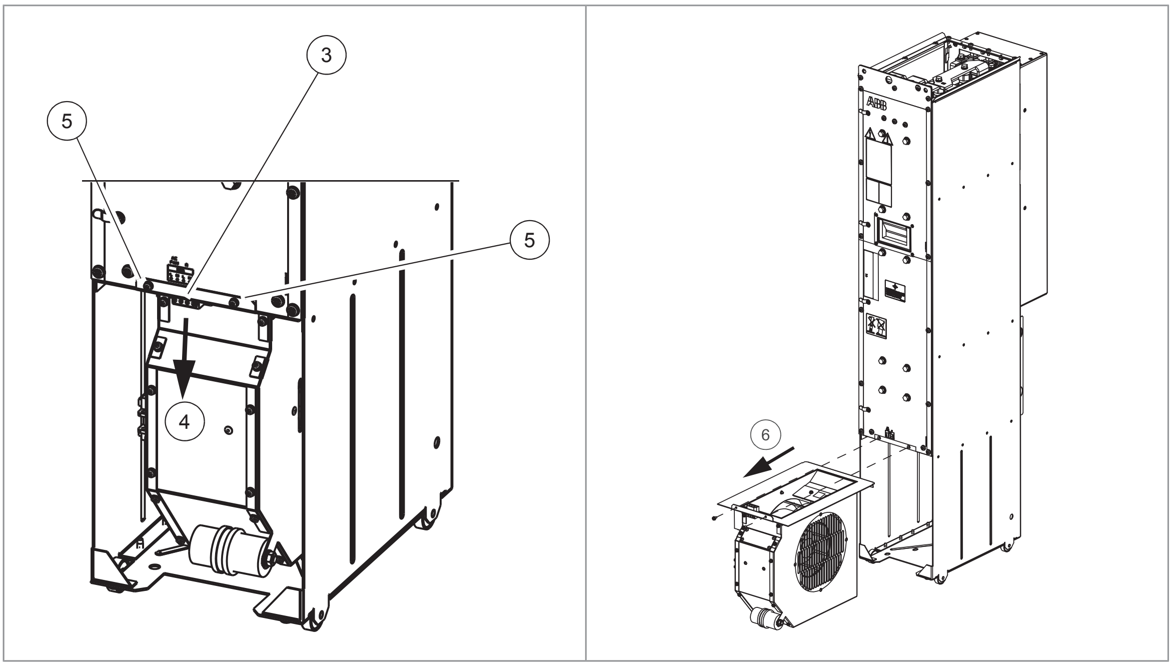
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. To remove the marine supports in drives with option +C121, see Replacing the drive and LCL filter modules (frame R11) (page 213).
3. To open the module section swing-out frame, undo the M10 bolts from top and bottom (4 pcs). See Replacing the drive and LCL filter modules (frame R11) (page 213).
4. Disconnect the power supply wire of the fan from connector FAN3:LCL.
5. Undo the mounting screw of the fan cassette.
6. Pull the fan cassette out.
7. Undo the mounting screws of the fan. The finger guard of the fan is attached by the same screws and is removed at the same time. Keep the finger guard for reuse.
8. Install the new fan in reverse order to the above. Make sure that the arrow in the fan points up.
9. Close the swing-out frame, reinstall the 4 screws and marine supports (option +C121) and close the cabinet doors.



Replacing the BLCL filter module fan (frames R6i+R6i and R7i+R7i)

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

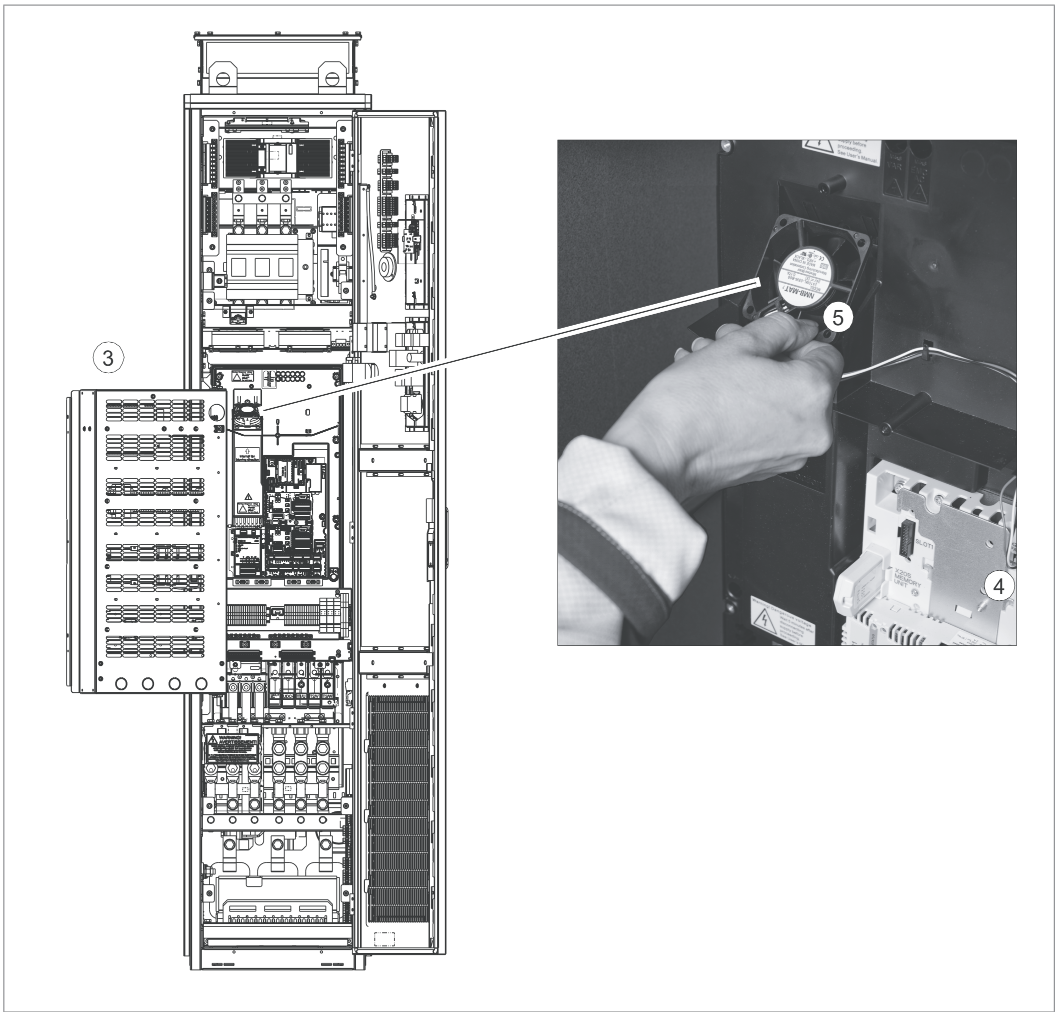
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the door.
3. Remove the two locking screws of fan supply plug connector.
4. Pull the plug connector downwards to unplug the fan wiring.
5. Remove two screws in front of the fan unit.
6. Pull the fan unit out.
7. Install a new fan in reverse order.



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

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

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

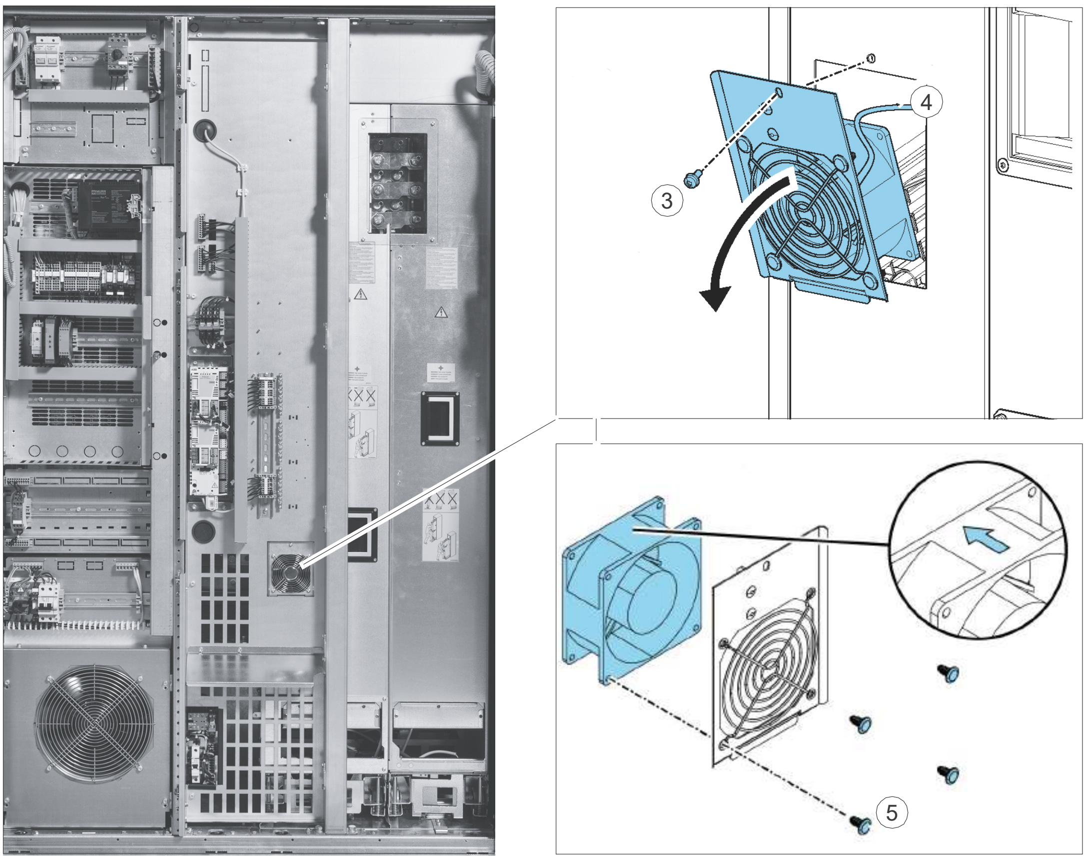


Replacing the auxiliary cooling fans of the drive module (frame R11)

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

Fan in the front panel:

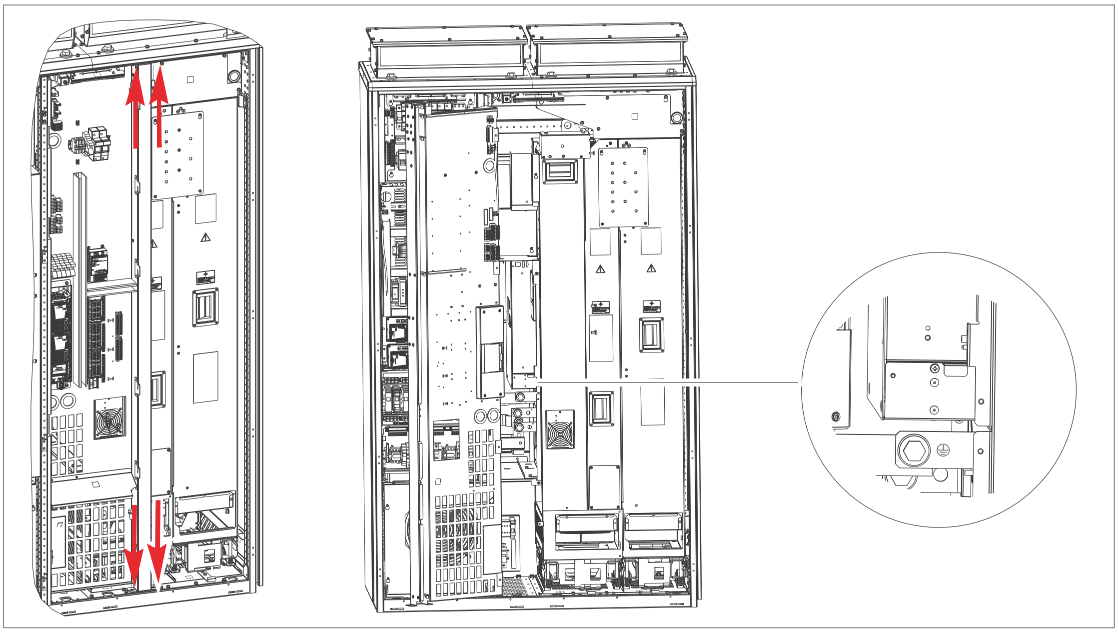
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet doors.
3. Undo the mounting screw of the fan cassette.
4. Unplug the power supply cable of the fan.
5. Undo the mounting screws of the fan.
6. Install the new fan in reverse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



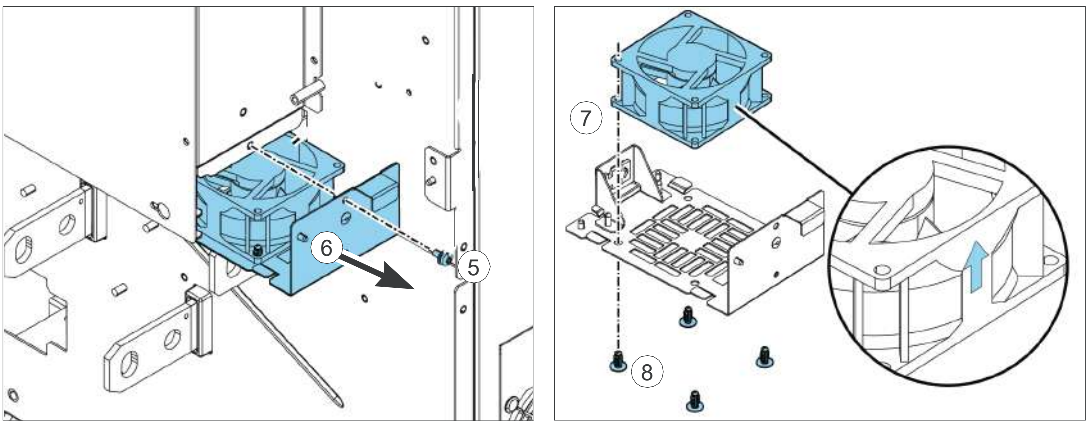
Fan at the bottom of the circuit board compartment:

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

3. Drives with option +C121: Remove the marine supports. See Replacing the drive and LCL filter modules (frame R11) (page 213).
4. To open the swing-out frame, undo the M10 bolts from top and bottom (4 pcs). The fan locates in the bottom part of drive module circuit board compartment.



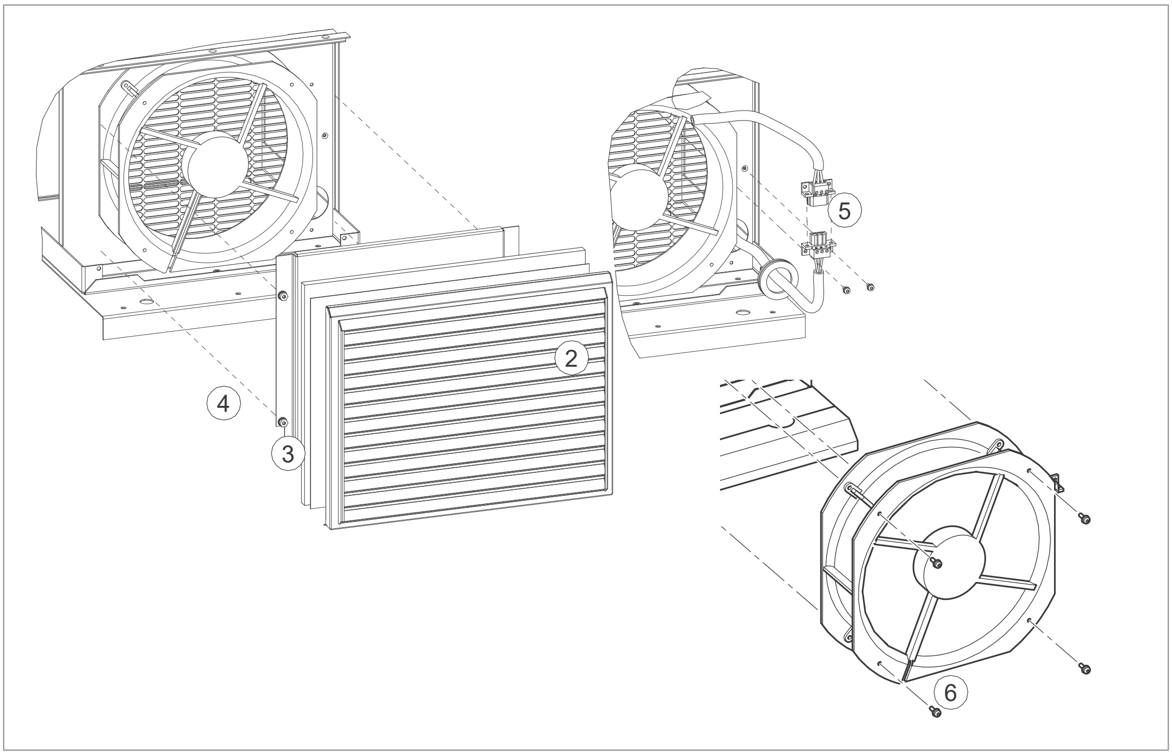
5. Undo the mounting screw of the fan cassette.
6. Pull the fan cassette out.
7. Unplug the power supply cable of the fan.
8. Undo the mounting screws of the fan.
9. Install the new fan in reverse order to the above. Make sure that the arrow in the fan points up.
10. Close the swing-out frame, reinstall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



■ Frame R8: Replacing the IP54 (UL Type 12) roof fan and chopper (option +D150) cubicle fan G101.2

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

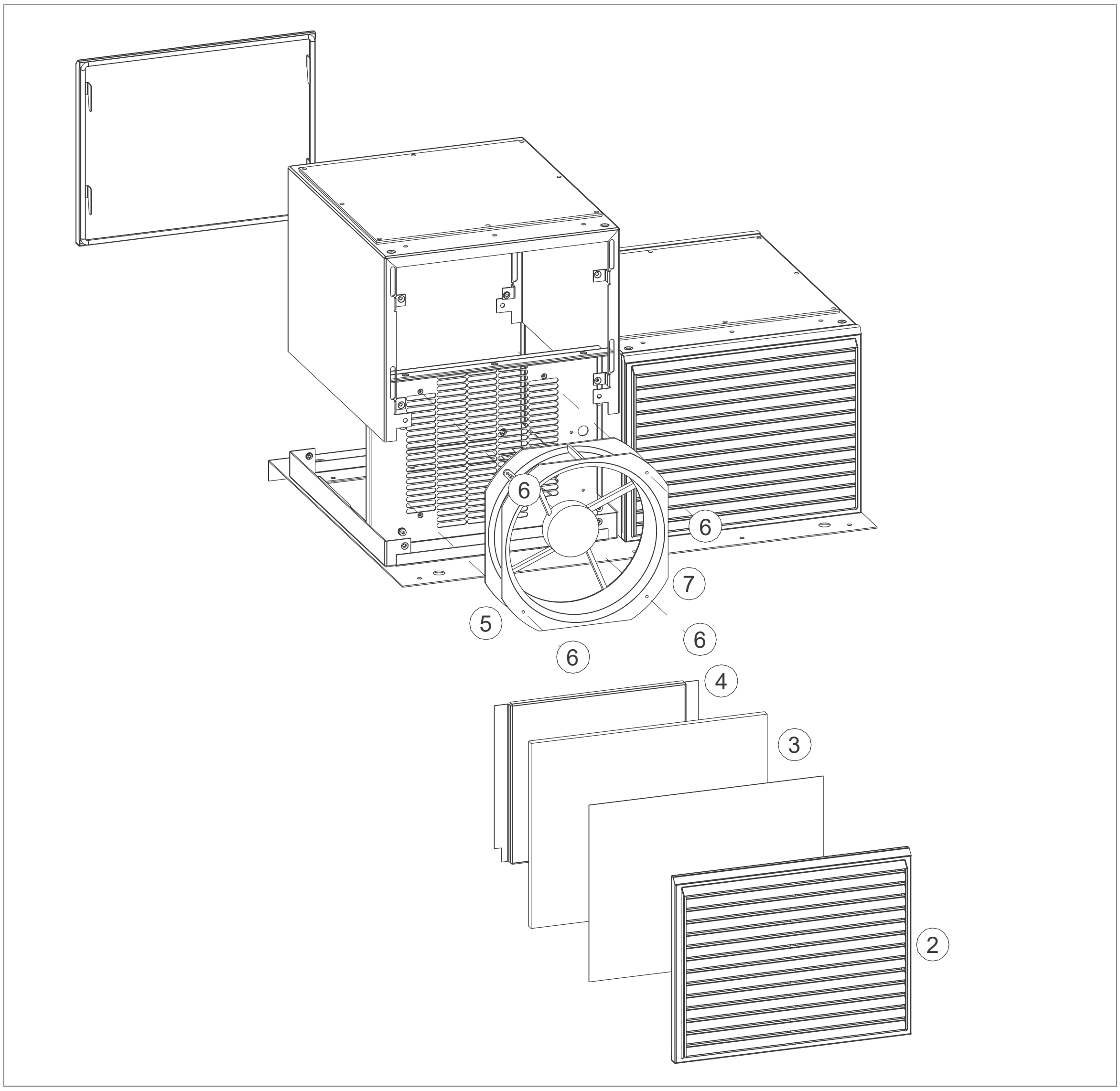
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Slide the front grating upwards and remove it.
3. Remove the air filter.
4. Loosen the mounting screws of the front mesh. Remove the mesh.
5. Disconnect the fan supply wires.
6. Undo the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



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

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

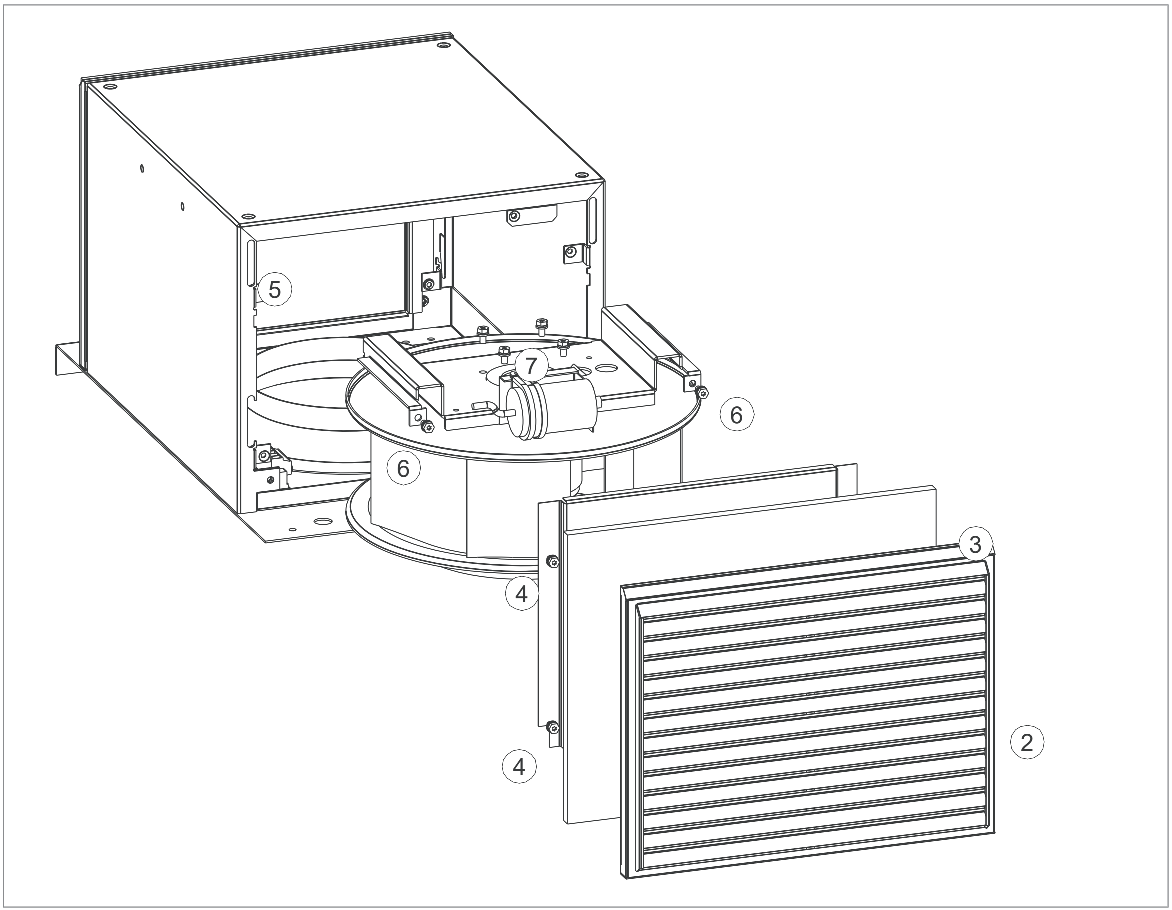
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Slide the front gratings upwards and remove them.
3. Remove air filters.
4. To remove the wire mesh, undo the mounting screws.
5. Disconnect the fan power supply wires.
6. Remove the mounting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



Frames R6i+R6i and R7i+R7i and frame R11 with option +B055: Replacing the roof fan

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

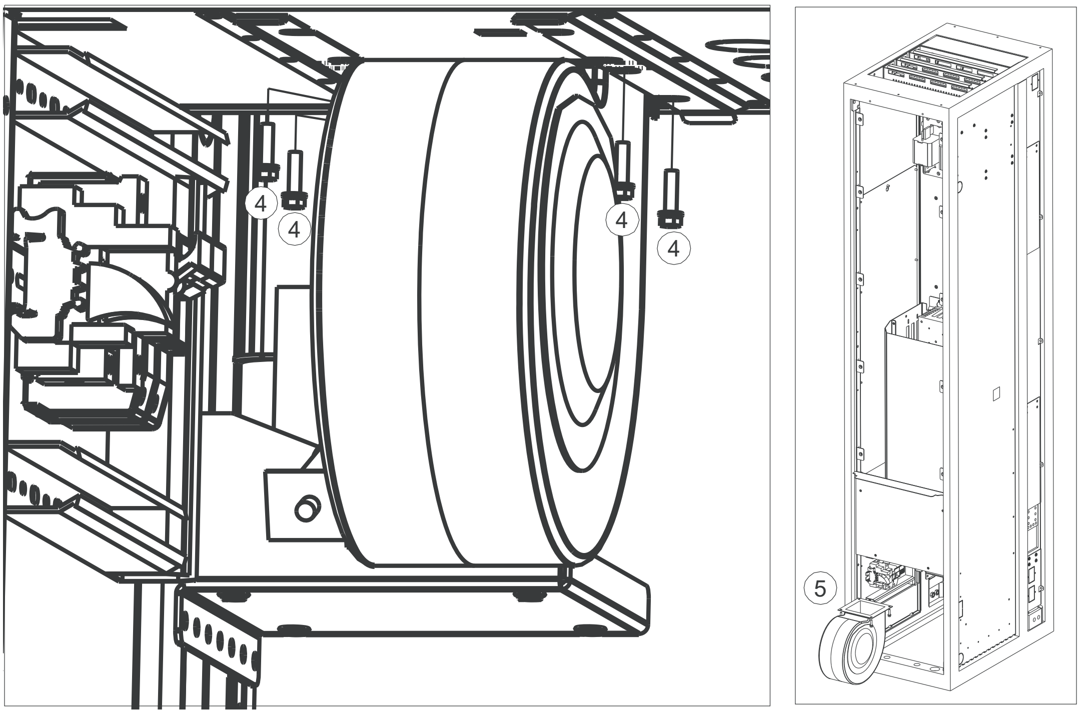
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Slide the front grating upwards and remove it.
3. Remove the air filter.
4. Undo the four M6 combi screws and remove the mesh.
5. Disconnect the fan power supply wires.
6. Undo the two M6 combi screws, lift the fan assembly upwards and slide it out.
7. Remove the mounting screws of the fan and replace the fan.



Replacing the brake chopper (option +D150) cubicle fan

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. Unplug fan socket.
4. Unscrew fan mounting screws (4 pcs).
5. Slide the fan out.
6. Install the new fan in reverse order.



Replacing the sine filter cooling fan

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

Replacing the drive module (frame R8)

Required tools

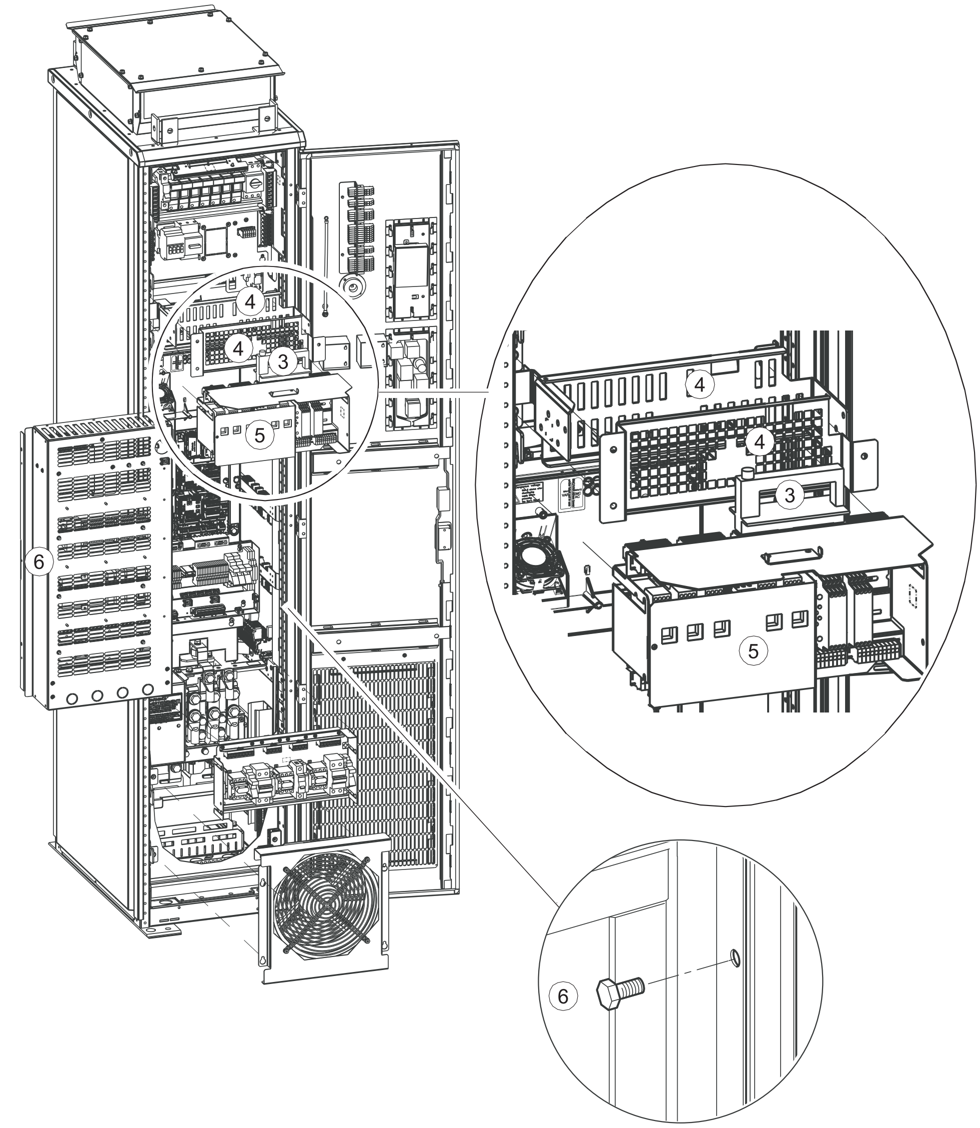
- lifting device
- set of screw drivers
- torque wrench with an extension bar
- lifting chains.

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

Replacing the drive module (frame R8)

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

1. Stop the drive (if running) and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. Remove the fuse replacement handle.
4. Remove the shroud. For drives with option +C121: Remove the marine shroud.
5. Unplug the connectors and remove the mounting plate.
6. For drives with option +C121: Undo the three M6 screws on the left side of the swing-out frame.
   All drives: Undo the two M6 screws on the right side of the swing-out frame and open the swing-out frame or remove the shroud and four shroud fixing brackets if there is no swing-out frame.



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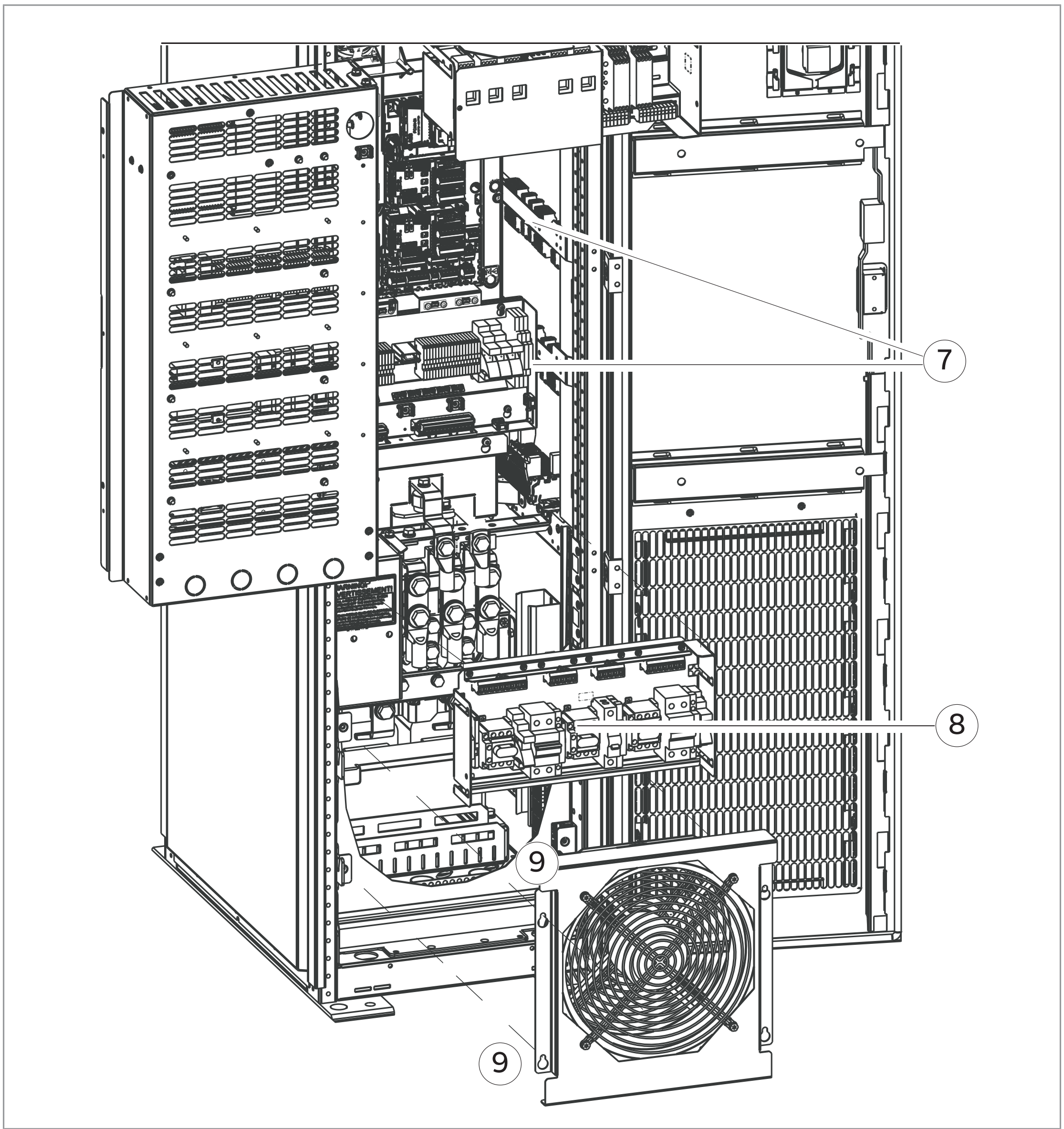
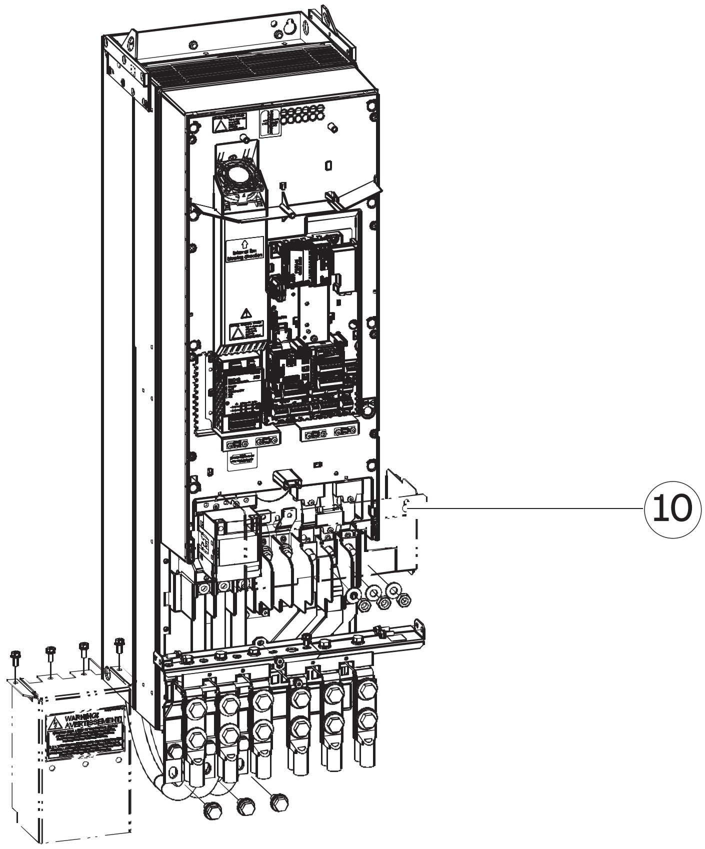
7. Disconnect the control panel cable from the module and the control wire terminals on the right side of the cabinet.
8. To remove the mounting plate above the “door fan”, loosen the mounting screws and lift the plate up or remove the shroud and four fixing brackets if there is no mounting plate.
   For drives with options +G300, +G301, +G307 and +G313: Disconnect the control cable terminals at the back side of the mounting plate.
9. Unplug the connector and remove the fan or remove the shroud if there is no fan.



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

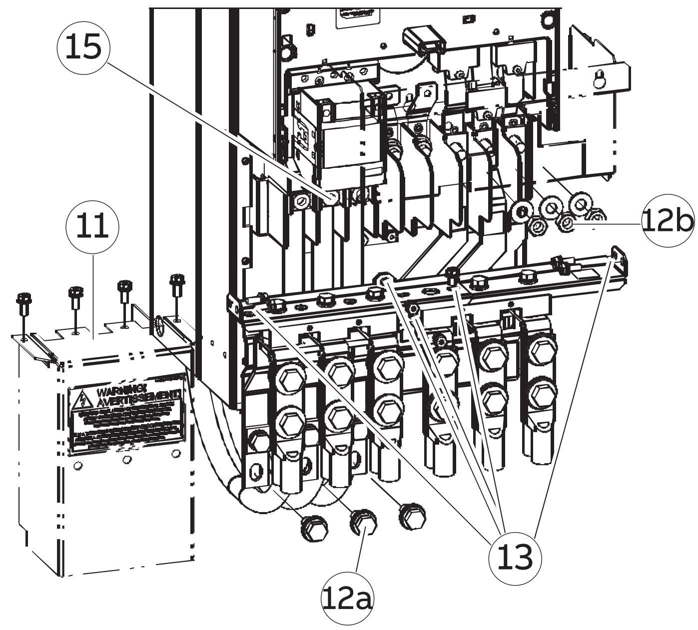
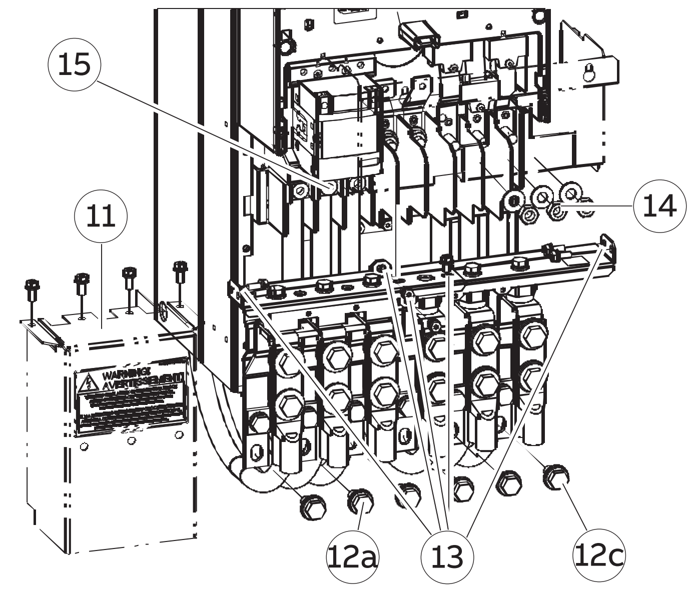


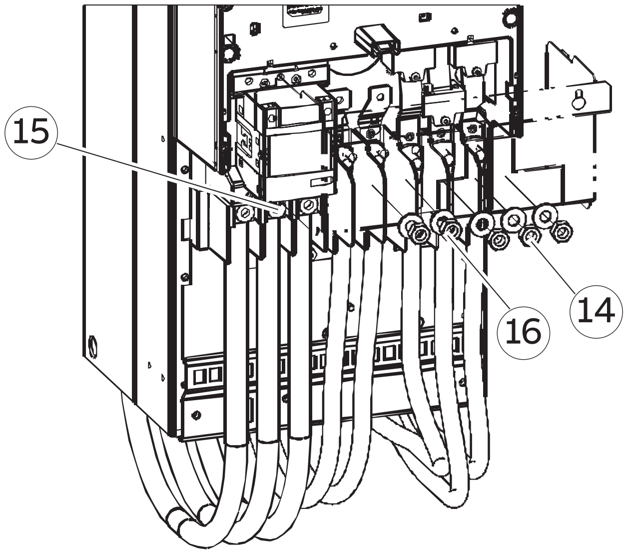
11. For drives with bottom entry: Undo the four M6 combi screws and remove the plastic shroud.
12. For drives with bottom entry or exit: Remove the connection terminal subassembly: Undo the screws or nuts:
    - Bottom entry (a): three M10 screws

      Note: If you find it difficult to access the screws of steps 12a or 12c, you can disconnect the power cables of step 13 and remove the terminal subassembly.
    - Bottom exit from module (b): three M10 nuts
    - Bottom exit and common mode filter (option +E208) or d*u*/d*t* filter (option +E205) (c): three M10 nuts
13. For drives with bottom entry or exit: Undo the 7 M6 screws and bend down the left half of the connection terminal subassembly. Then bend down the right half of the subassembly so that the power cables do not disturb the module replacement.

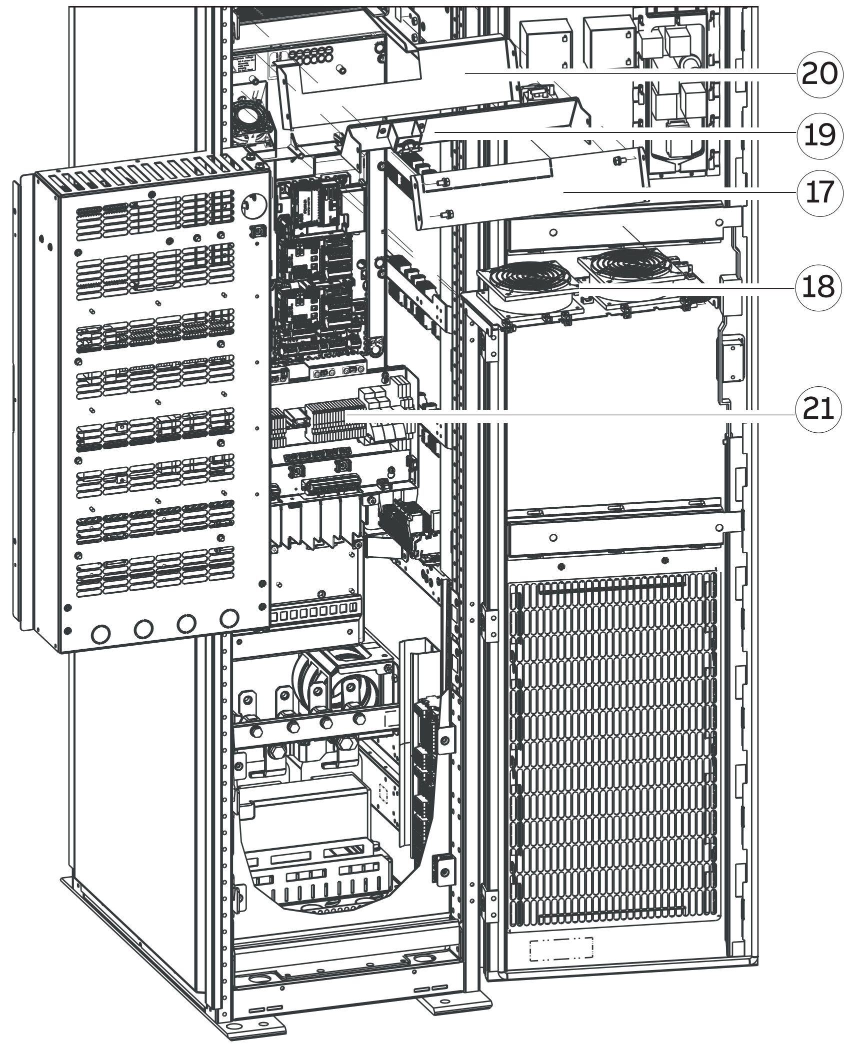
    Note: If you find it difficult to access the screws of steps 12a or 12c, you can disconnect the power cables of step 13 and remove the terminal subassembly.
14. Top exit or bottom exit and option +E208 or E205: Undo the three M10 nuts. Bend the three motor cables down so that they do not disturb the module replacement.
15. Loosen the three hex head screws, pull out three power cables and bend them down so that they do not disturb the module replacement.

16. For drives with brake chopper (option +D150): Undo the two M10 nuts and bend the two power cables down so that they do not disturb the module replacement.

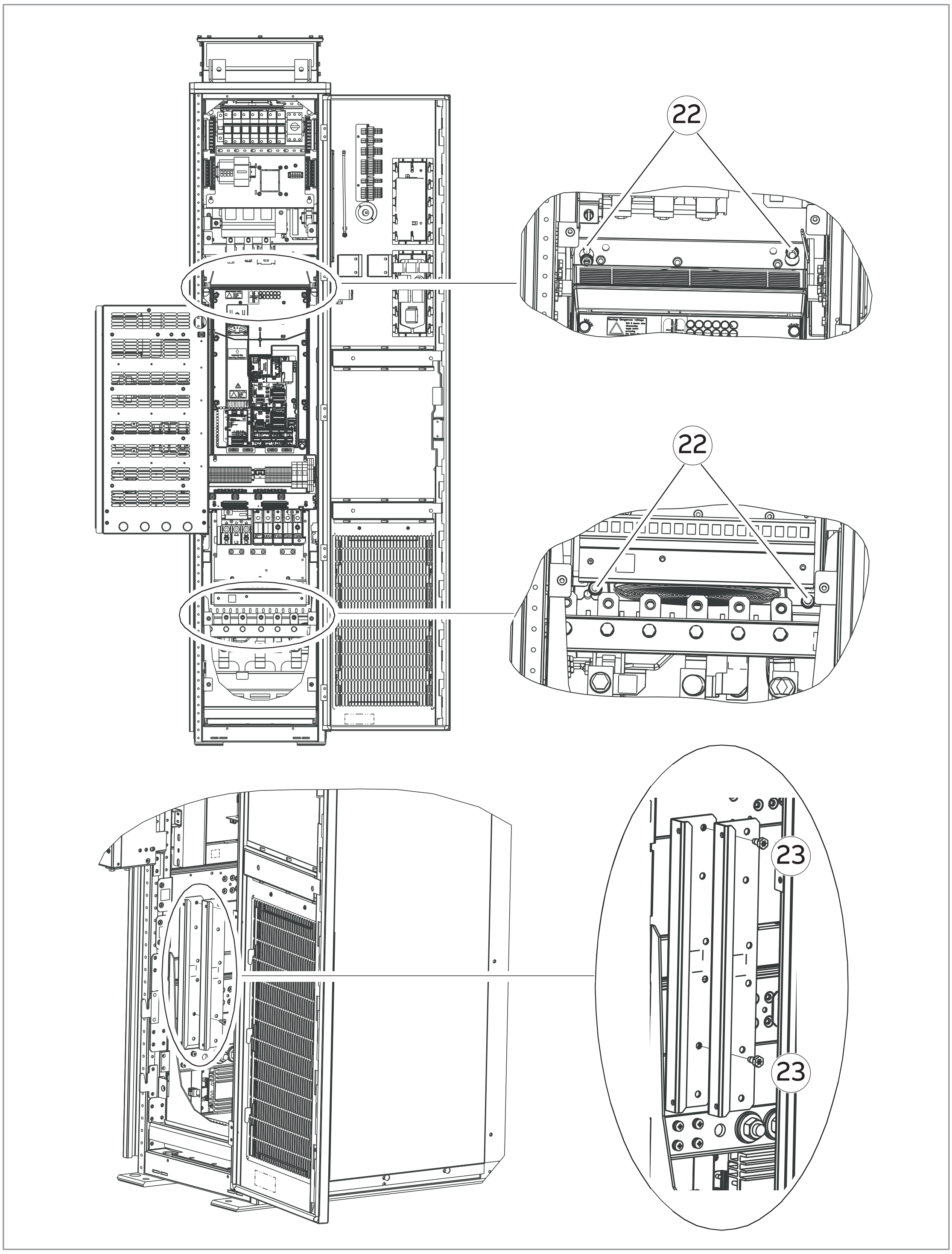
Bottom exit from module

Bottom exit with +E208 or +E205


Top exit


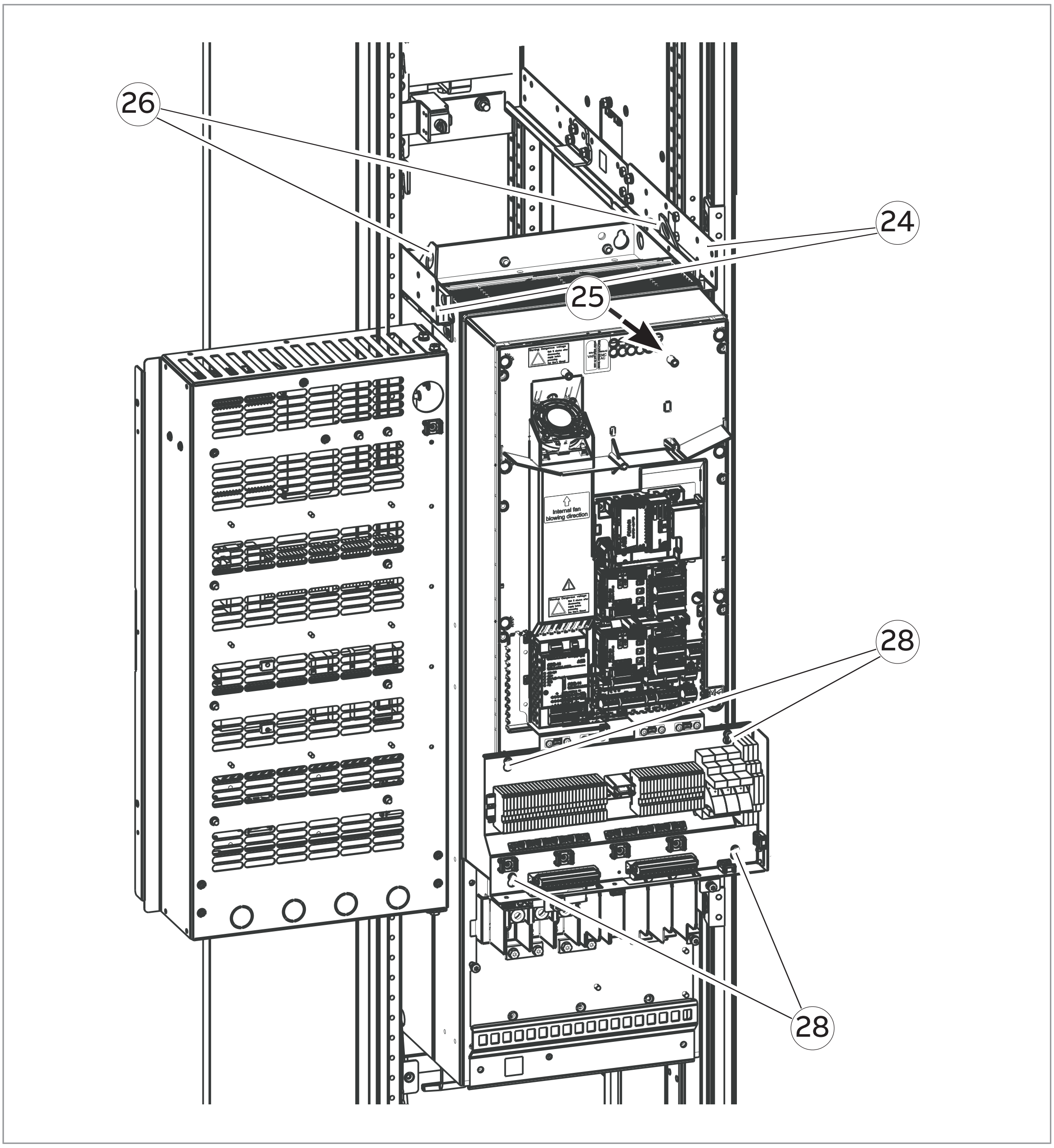
17. Undo the four M6 combi screws and remove the plastic air guide.
18. Loosen the four M6 combi screws, unplug the connector, lift the fan up a bit and remove the fan plate.
19. For easier removal of the module, undo the four M6 combi screws, disconnect the wires of the thermal switch and remove the plastic air guide.
20. For easier removal of the module, undo the four M6 combi screws and remove the plastic air guide.
21. Unplug the wires and connectors of X504 mounting plate.



22. Undo the four M8 Serpress® nuts.
23. Undo the two M6 self-tapping screws in the bottom left side of the cabinet and remove the module slide extension rails.



24. Install the extension rails at the end of the sliding bars.
25. Slide the drive module towards the end of the sliding bars.
26. Secure the drive module with chains from the lifting eyes.
27. Lift the module out of the cabinet with a lifting device.
28. Loosen the four M5 combi screws and remove X504 mounting plate.
29. Remove the four M4 standoffs and place them to a new module.
30. Place X504 mounting plate to the new module and attach the M5 combi screws.
31. Install the new module in reverse order.



Replacing the drive and LCL filter modules (frame R11)

Required tools

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

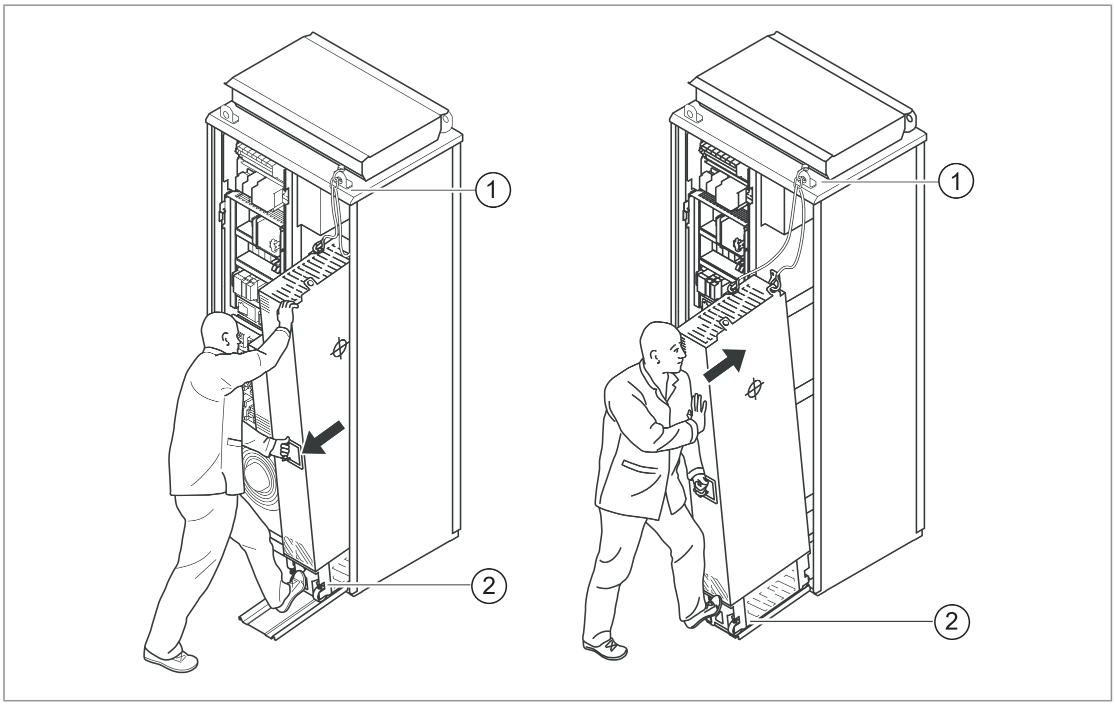
Safety

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

Handle the drive and LCL filter modules carefully. Lift the module only by the lifting lugs.

Module handling

- Do not use the module extraction/installation ramp with plinth heights that are more than the ramp maximum allowed height.
- Attach the module extraction/installation ramp carefully.
- To prevent the drive module from falling over, attach its top lifting lugs with chains to the cabinet (1) before you move the drive module into or out of the drive cabinet. Use two persons to move the drive module. Be careful. Keep a constant pressure with one foot on the base of the module (2) to prevent the module from falling on its back.



- Make sure that the module does not fall over when you move it on the floor.

- Use the support legs when applicable. To open the support legs, push each leg down and turn it out (1, 2).
- Use chains to support the module whenever possible.
- Do not tilt the module. It is heavy and its center of gravity is high.
- Do not leave unattended on a sloping floor.
- **WARNING!**
  Do not move the module on its wheels for long distances. It can cause damage to the wheels. Also, there is a risk of the module falling over.

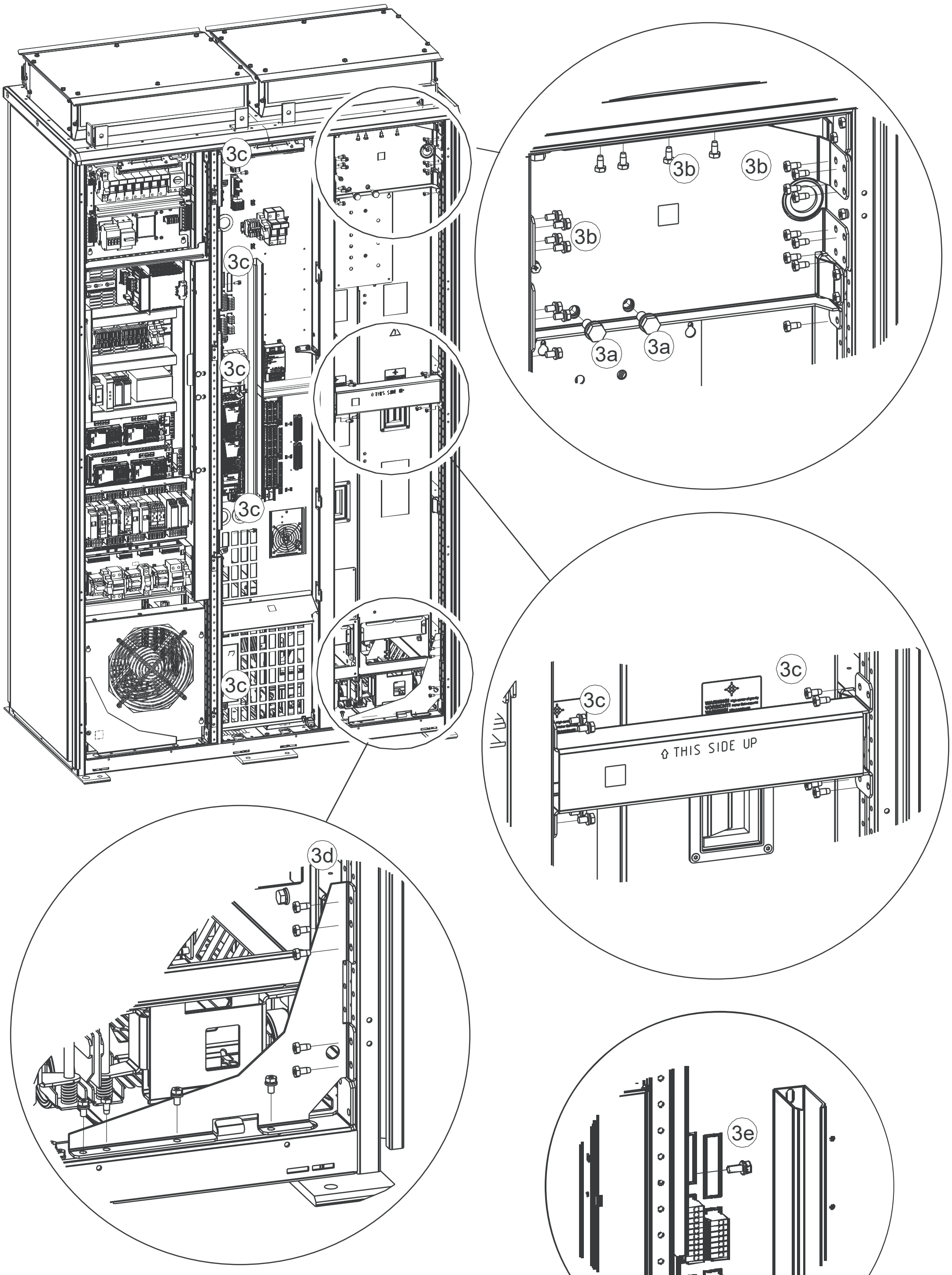
Spare part module options

Spare part modules can be delivered with the LCL filter module (option +P941) or without the LCL filter module (option +P965).

Replacing the drive module (frame R11)

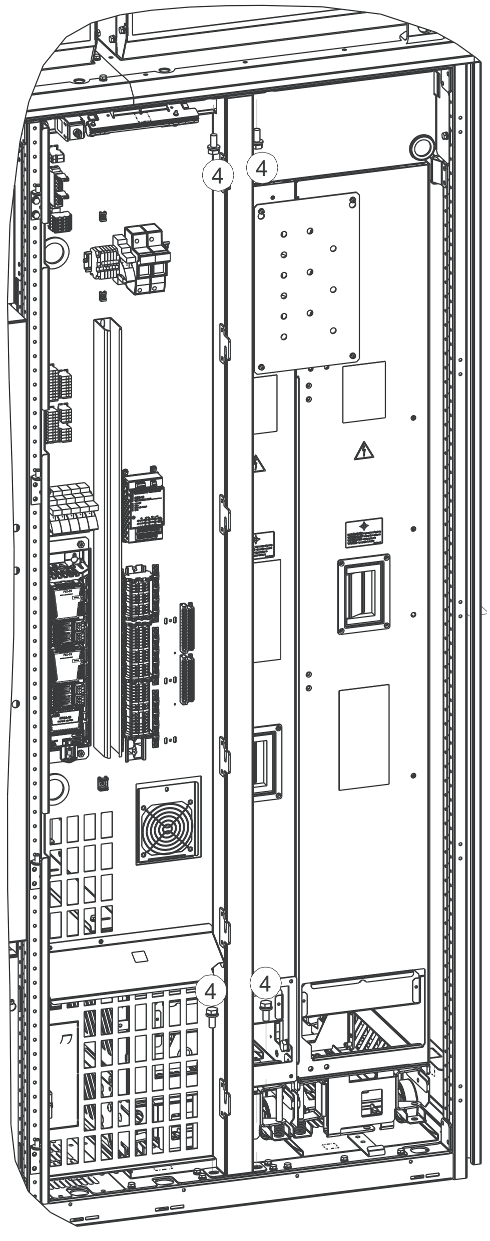
Replacing the drive module requires preferably two persons.

1. Stop the drive (if running) and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet doors.
3. For drives with option +C121:
   Undo the two module attaching screws (3a).
   Undo the M6 screws and remove the three supports (3b, 3c and 3d).
   Undo the five M6 screws on the left side of the swing-out frame (3e).
   For drives with option +C180:
   Undo the M6 screws and remove the support (3d).
   Undo the five M6 screws on the left side of the swing-out frame (3e).



3a: Combi screw M10
3b, 3c, 3d and 3e: M6

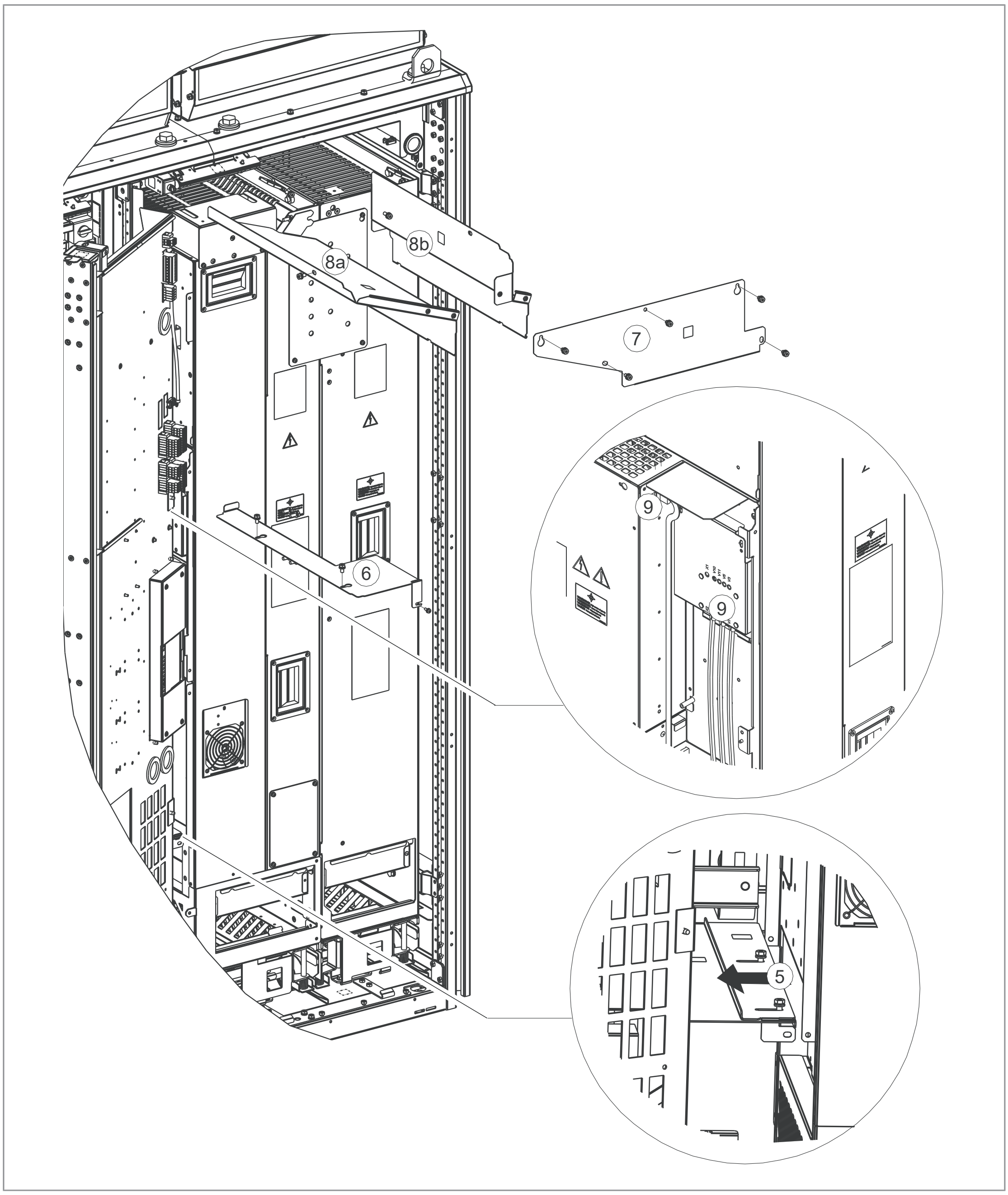
4. To open the module section swing-out frame, undo the M10 bolts from top and bottom (4 pcs).



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

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

- Handle the fiber optic cables with care.
- When you unplug the cables, always hold the connector, not the cable itself.
- Do not touch the ends of the fibers with bare hands as the ends are extremely sensitive to dirt.
- Do not bend the fiber optic cables too tightly. The minimum allowed bend radius is 35 mm (1.4 in).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8a
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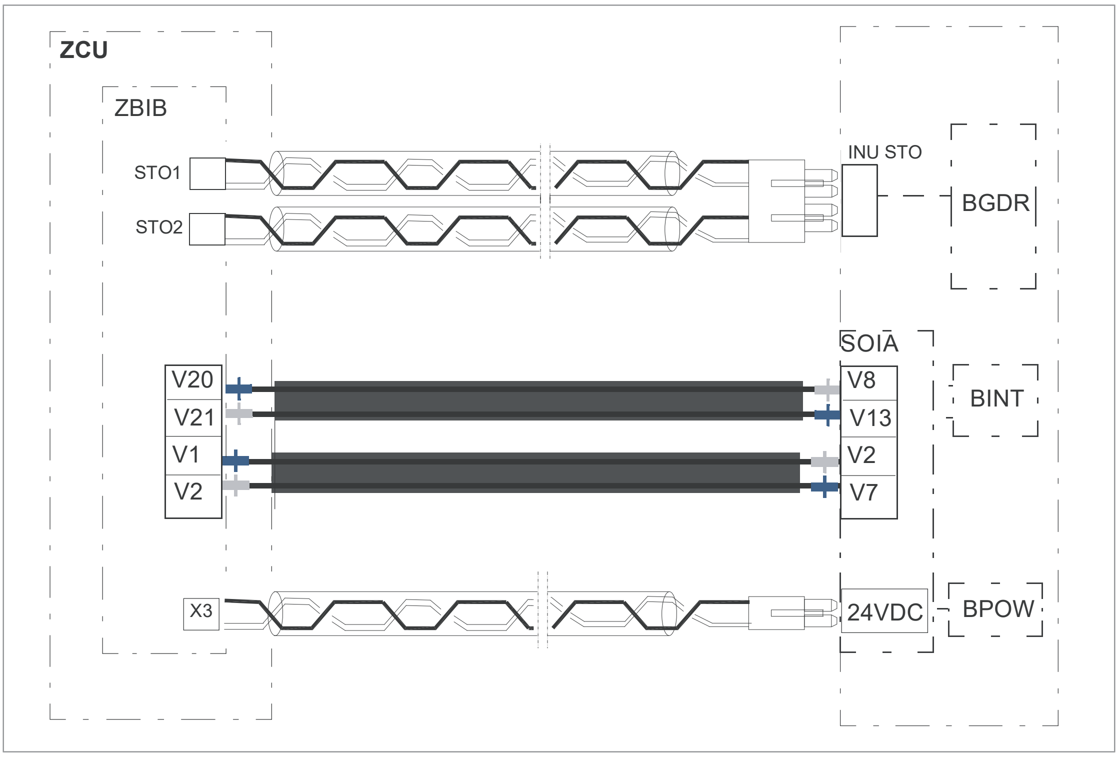
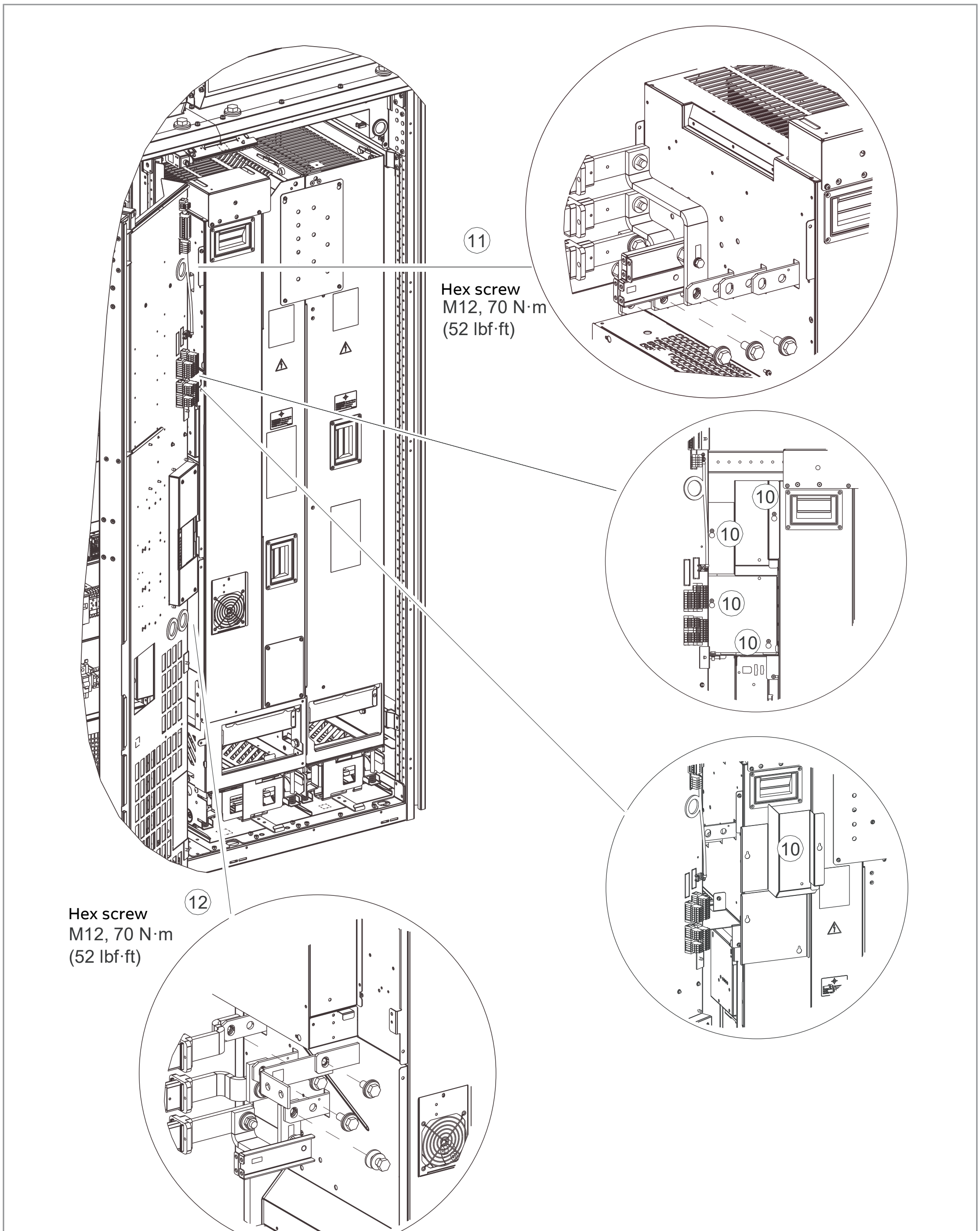
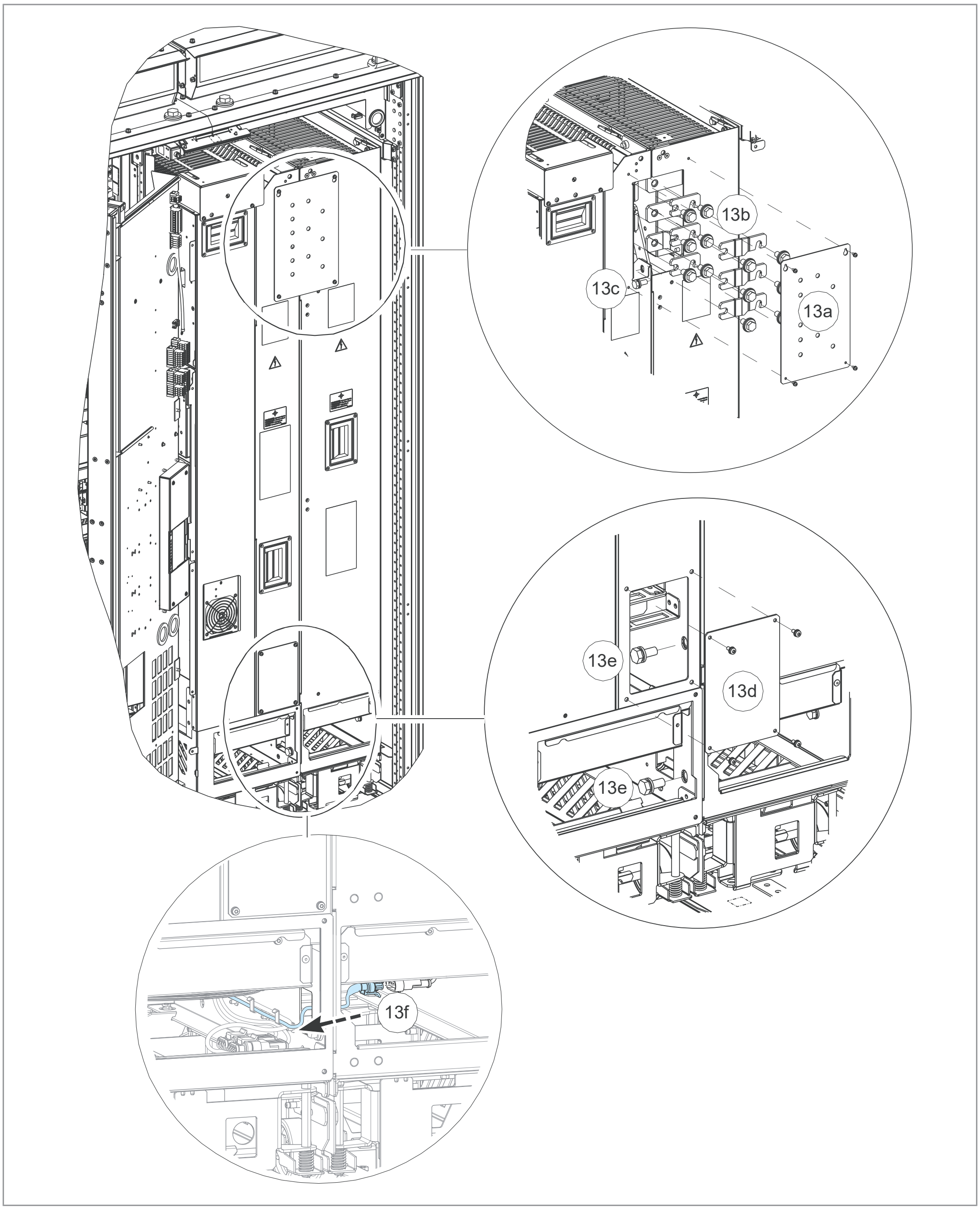
The connections between the line-side converter control unit and drive are shown below. The drive control unit remains in its place when you remove the drive module.



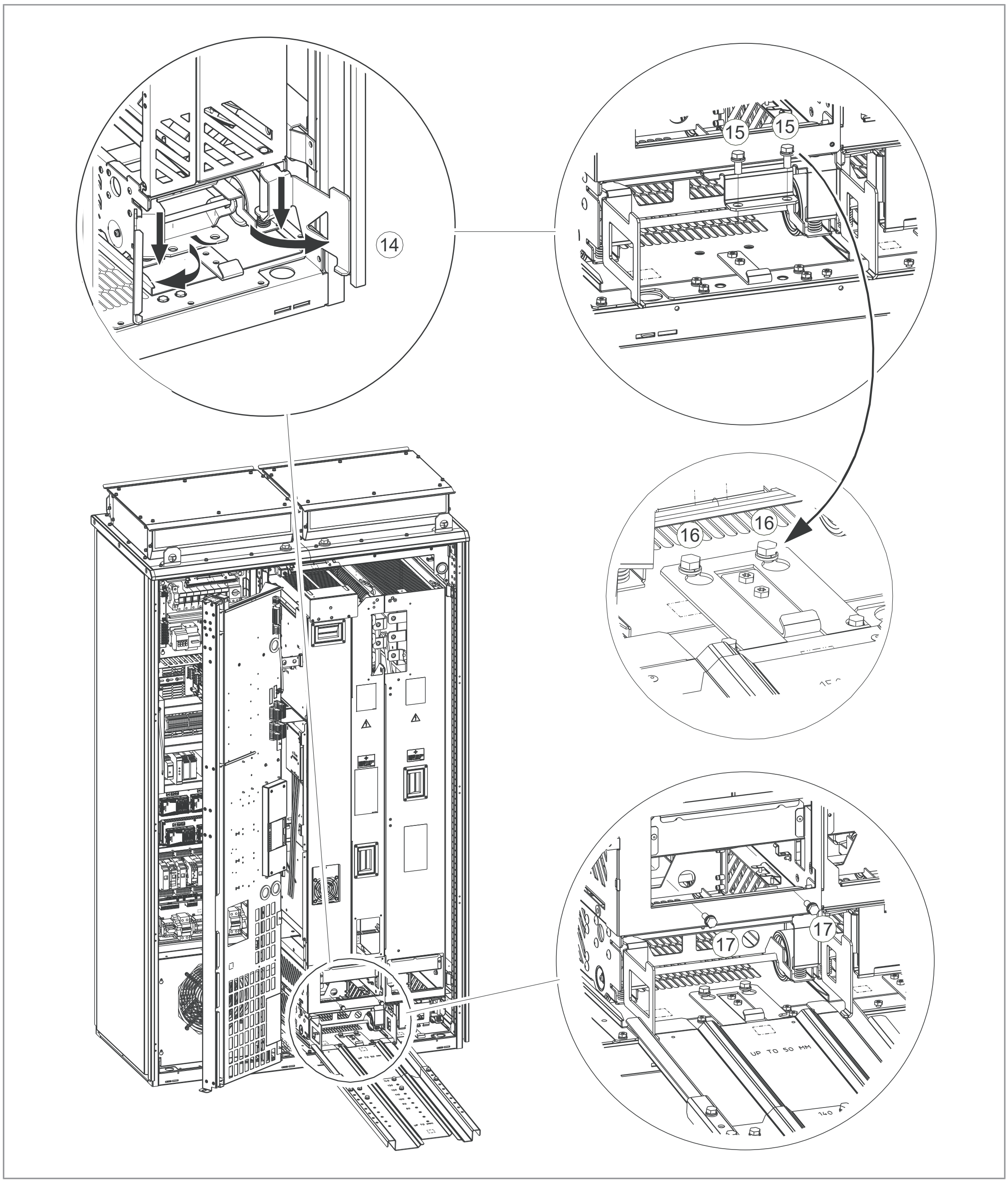
10. Loosen the M4 screws, lift the plastic shroud of the DC busbars up and remove it.
11. Disconnect the input power cabling busbars from the drive module busbar terminals.
    For drives with option +D150: disconnect the DC busbars also.
12. Disconnect the output power cabling and PE busbars from the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



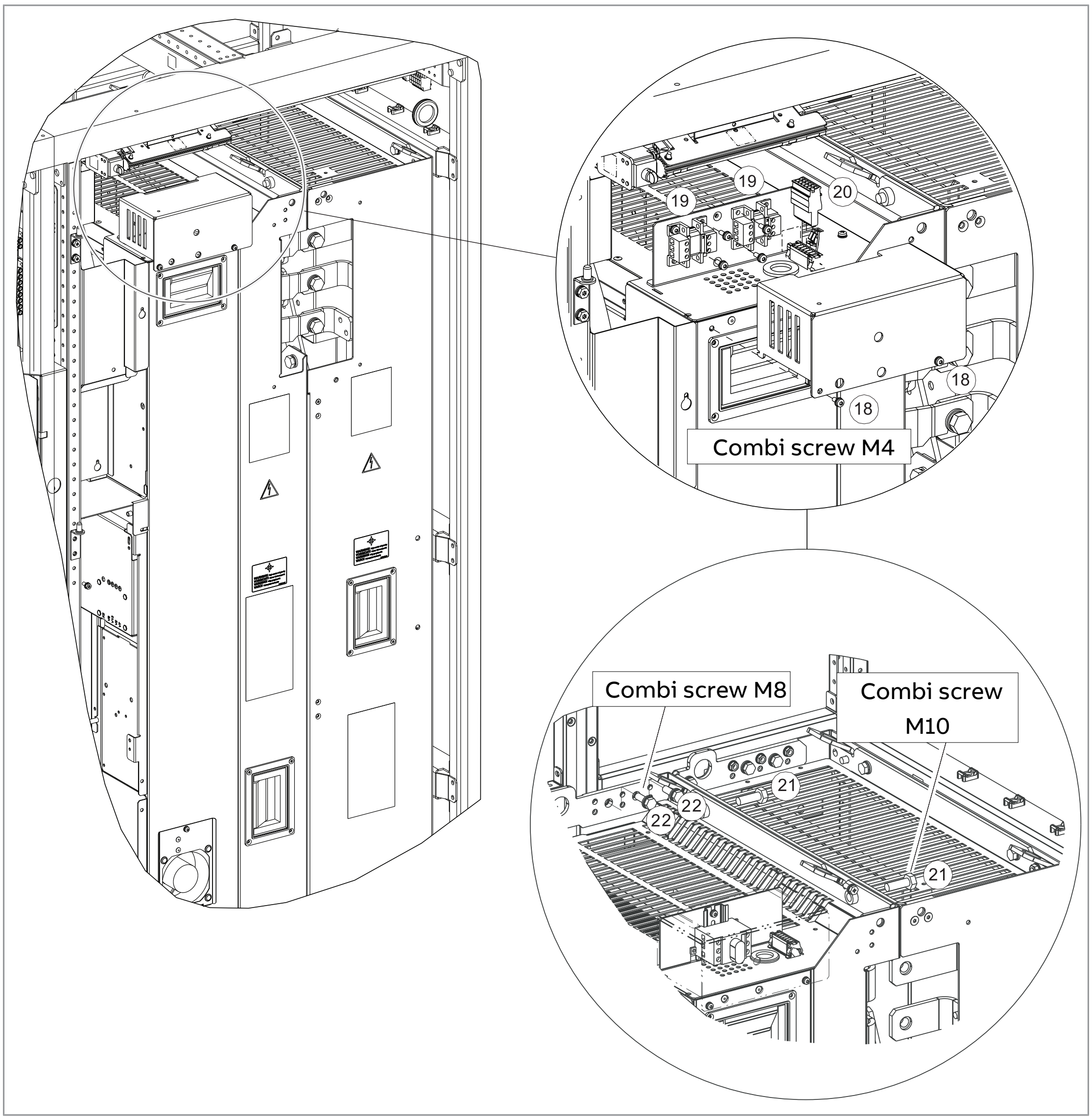
13. To disconnect the drive module from the LCL filter module:
    - (13a) Remove the shroud.
    - (13b) Remove the bolts that connect the power busbars.
    - (13c) Remove the attaching bolt.
    - (13d) Remove the shroud.
    - (13e) Remove the bolts.
    - (13f) Disconnect the power wire of the LCL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



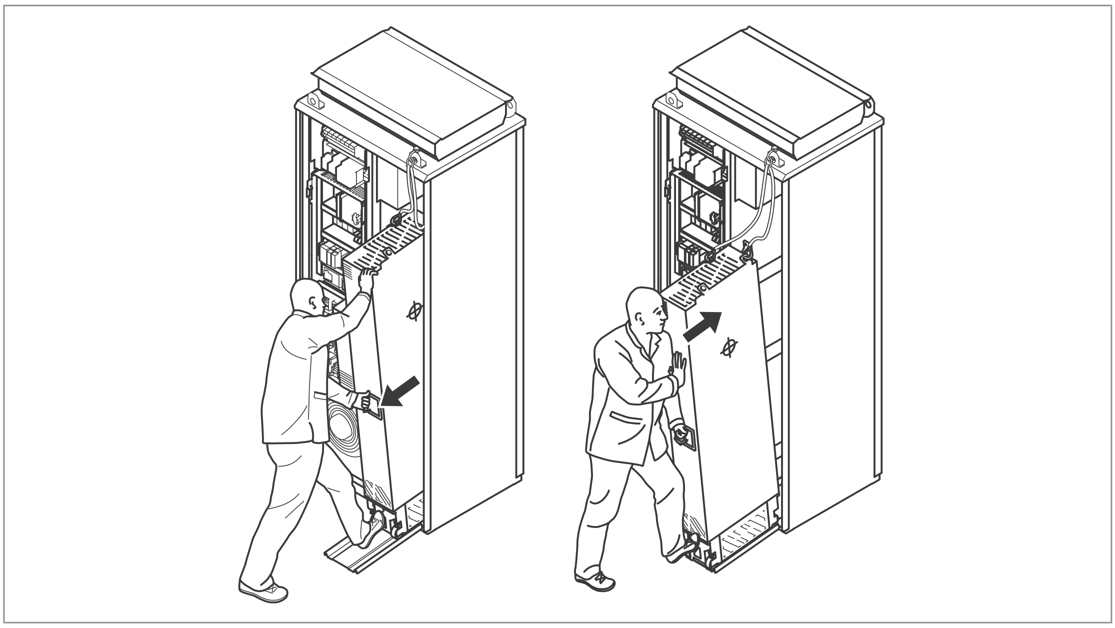
14. To open the support legs 90 degrees, press each leg a little down and turn it aside.
15. To remove the lower support bracket of the drive module, undo the two screws.
16. Adjust the extraction ramp to the correct height and attach it to the cabinet base with the two mounting screws of the support bracket that was removed.
17. <u>For drives with option +C121 or option +C180:</u> Remove the bolts that attach the drive module to the cabinet frame at the lower part.



18. To remove the shroud on the X1 connector(s), undo the two mounting screws.
19. <u>For drives with charging contactor (Q3)</u>: Undo the screws of the X1 connectors and remove the charging contactor wires.
20. Unplug the connector and auxiliary contact wires of the charging circuit contactor.
21. Undo the two bolts that attach drive module to the LCL filter module.
22. Undo the bolts that attach drive module from back to the cabinet frame.



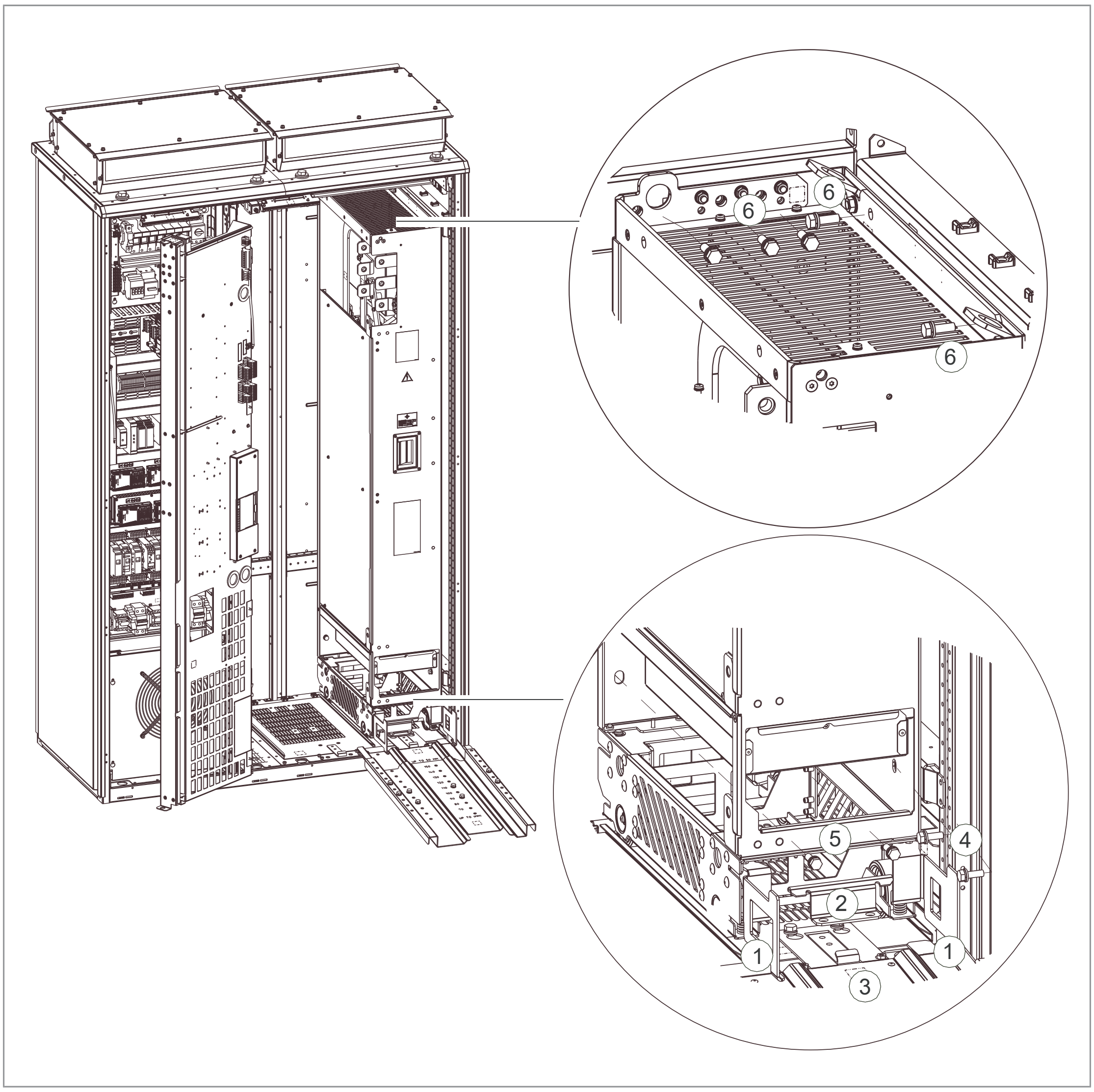
23. Attach the lifting lugs of the module to be removed to the cabinet lifting lug with chains.
24. Pull the module carefully out of the cabinet preferably with help from another person.
25. Before the module back wheels reach the attaching hook on the floor, open also the back support legs of the drive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



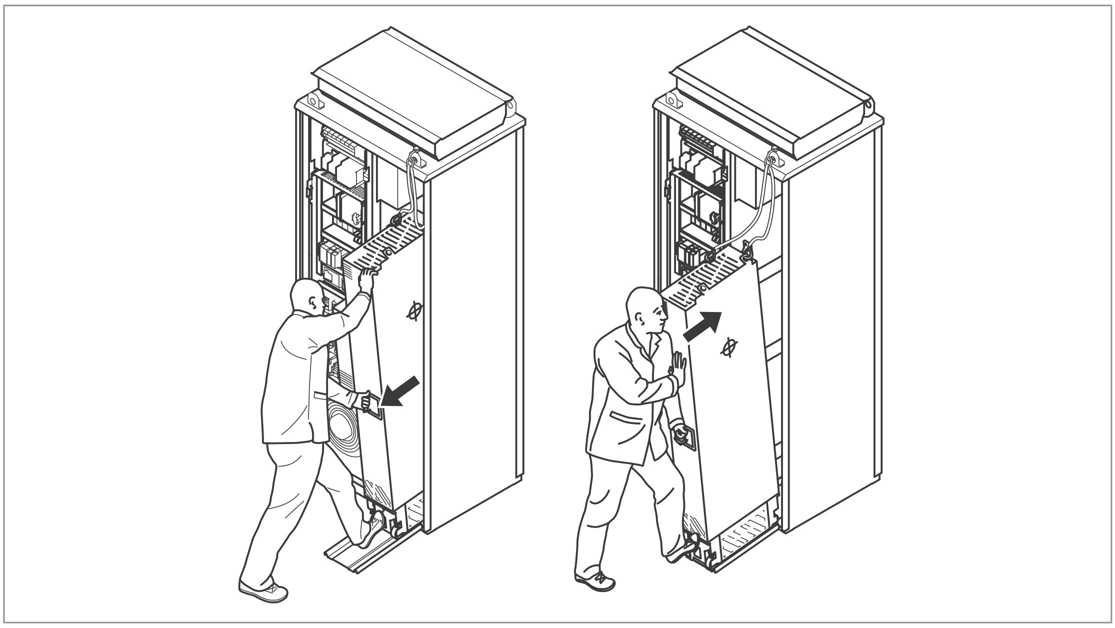
Replacing the LCL filter module (frame R11)

<u>If LCL filter module is also to be replaced:</u>

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



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

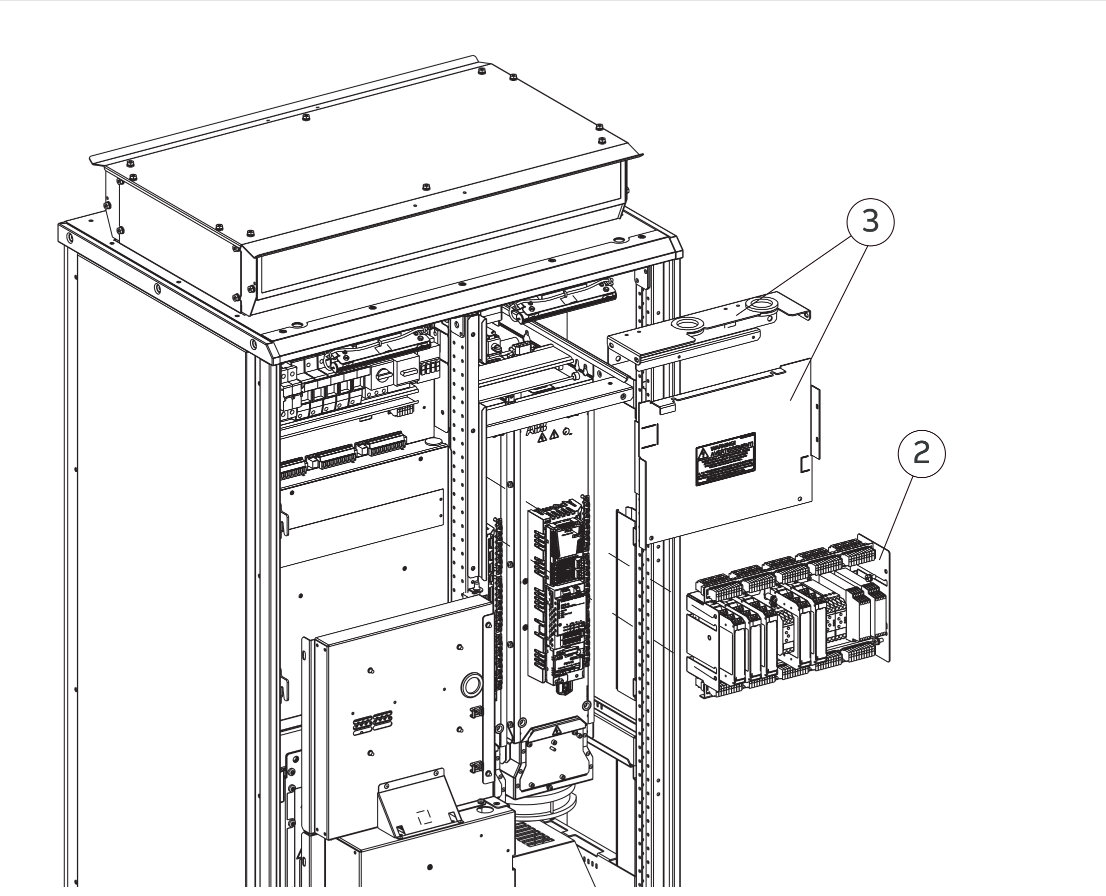


Replacing the converter modules and BLCL filter module (frames R6i+R6i and R7i+R7i)

Replacing the converter modules (frames R6i and R7i)

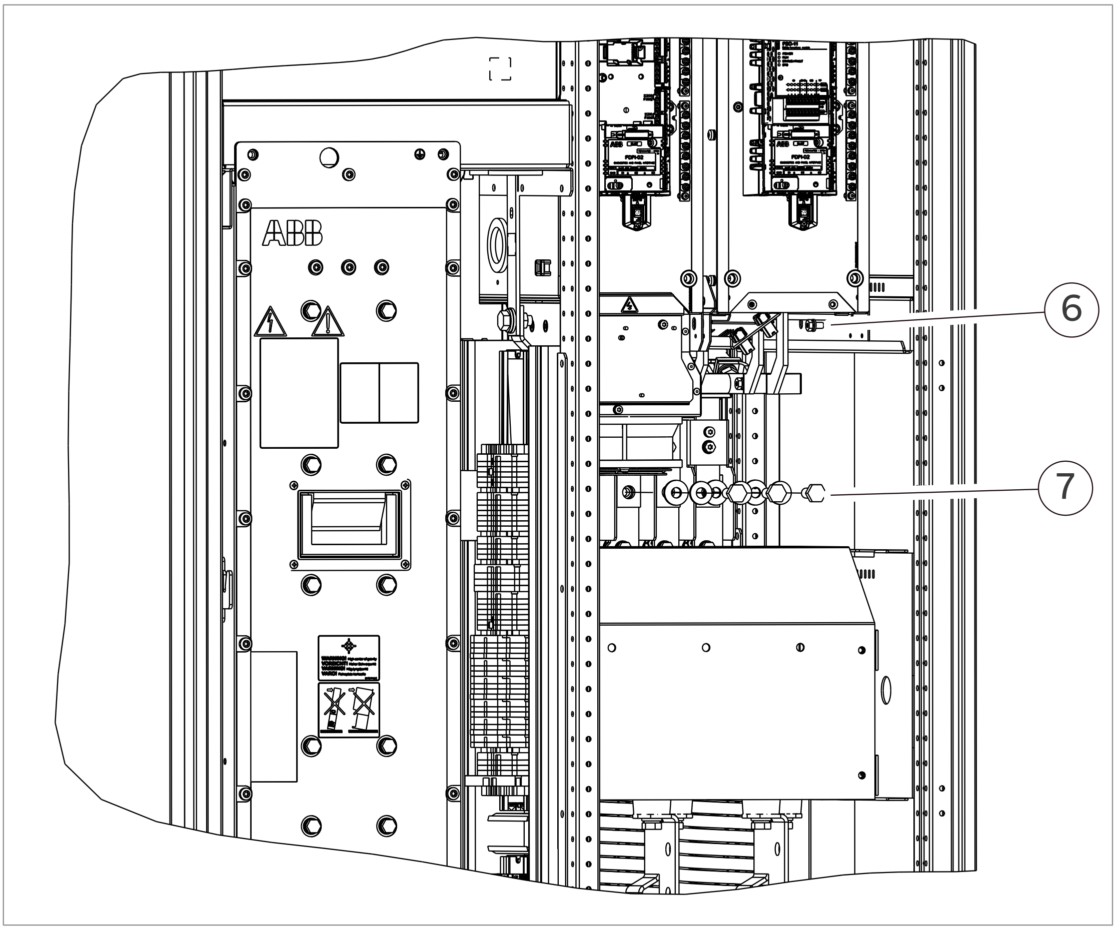
WARNING!
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Remove the assembly plate with thermistor relays or Pt100 relays.
3. Remove the air baffles at the top of the module.

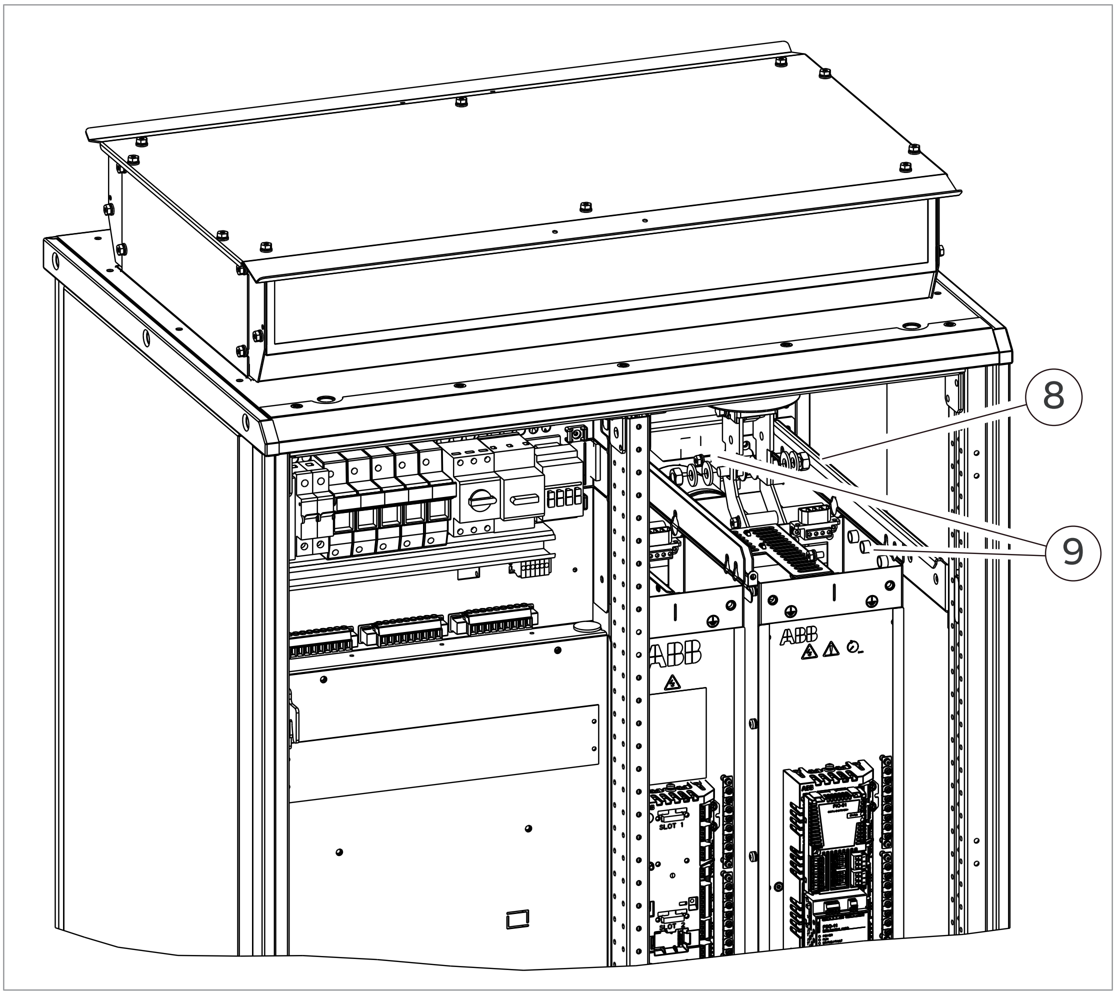


4. Remove the wiring from the inverter control unit.
5. Remove the fan(s). Refer to Replacing the internal cabinet cooling fans (frames R6i+R6i and R7i+R7i) (page 191).

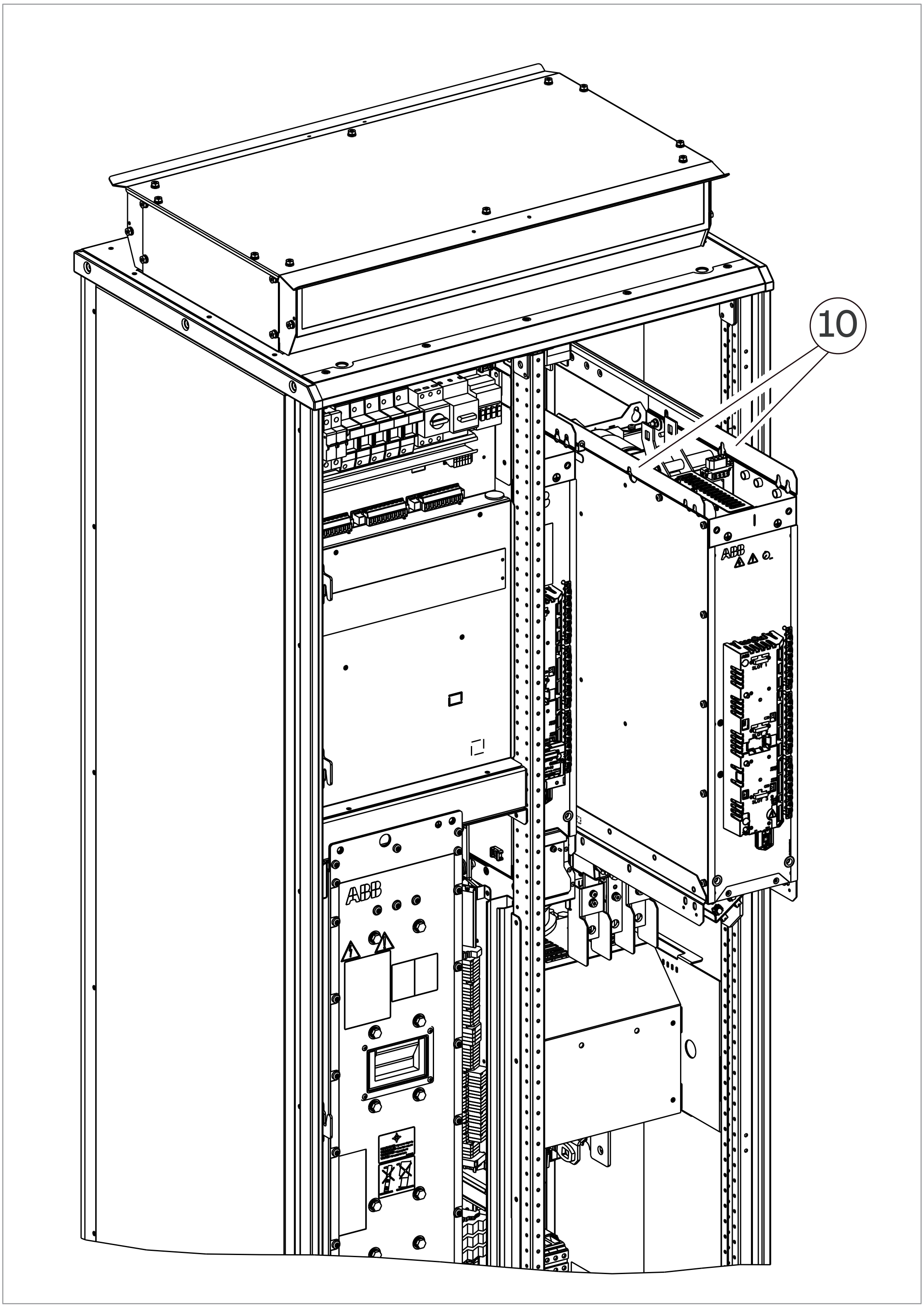
6. Remove the two screws holding the module at the bottom.
7. Remove the three screws to disconnect the AC busbars.



8. Remove the two screws holding the module at the top.
9. Remove the two screws to disconnect the DC busbars.



10. Pull the module out until the lifting eyes at each side of the module are accessible.

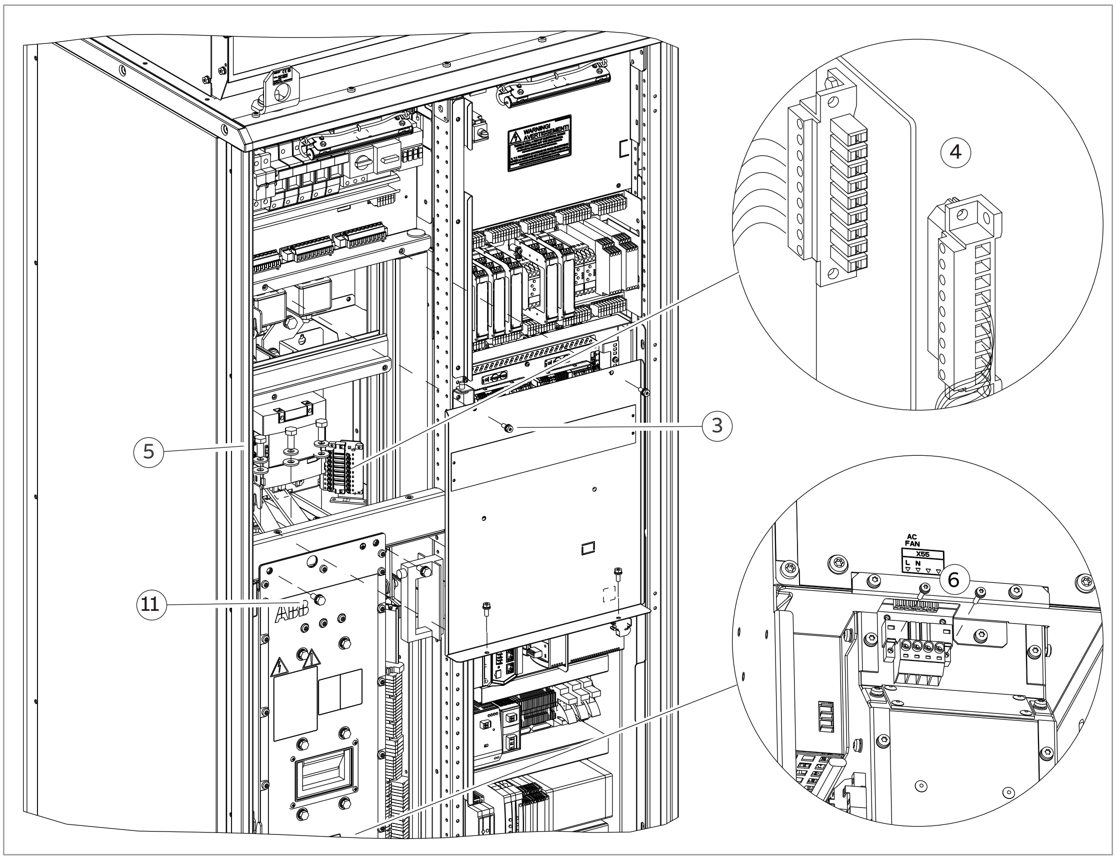


11. Attach a hoist to the lifting eyes and pull the module out. Install a new module in reverse order.

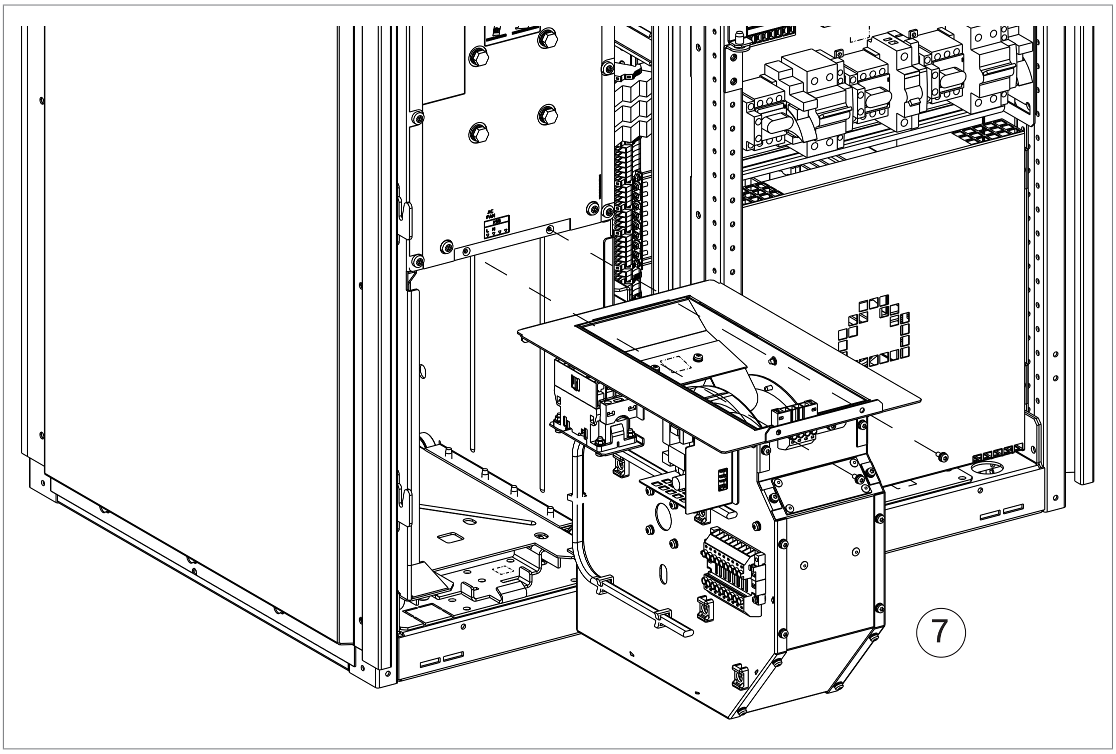
Replacing the BLCL filter module (frames R6i+R6i and R7i+R7i)

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

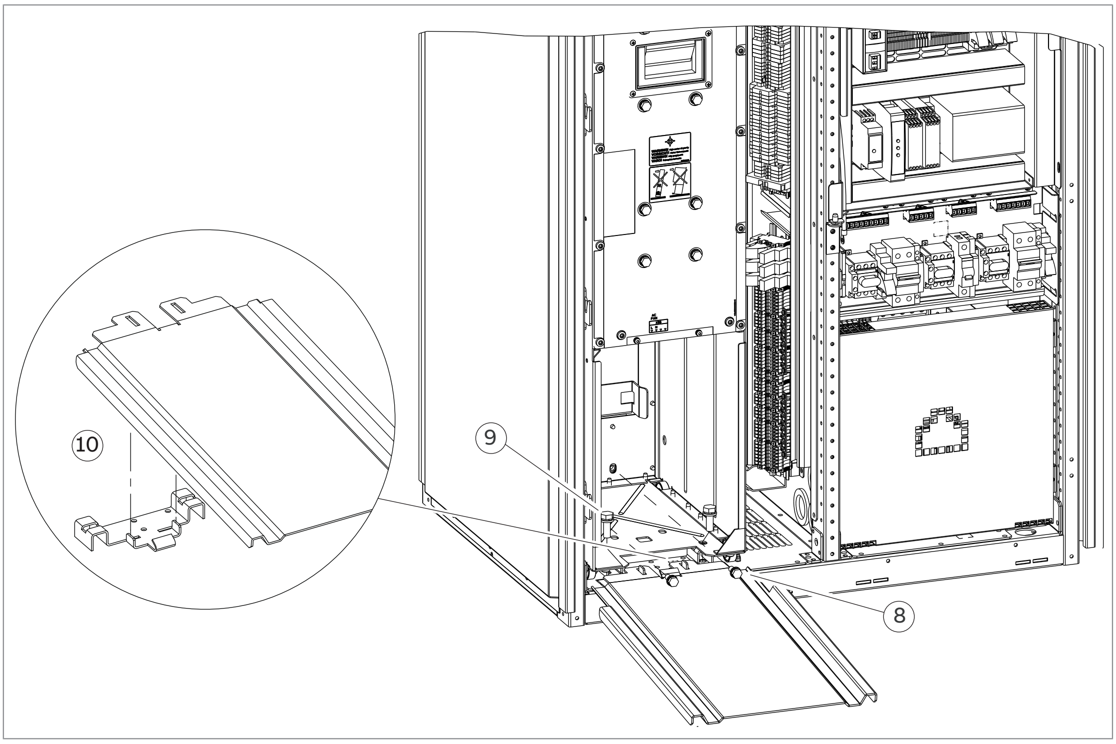
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. Remove the four screws of the shroud in the upper part of the cabinet. Remove the shroud.
4. Remove the signal connector cable on top of the module.
5. Remove the screws that connect the busbars to the top of the filter module. Be careful not to drop the screws into the module.
6. Remove the two screws and unplug the signal connector in front of the fan.



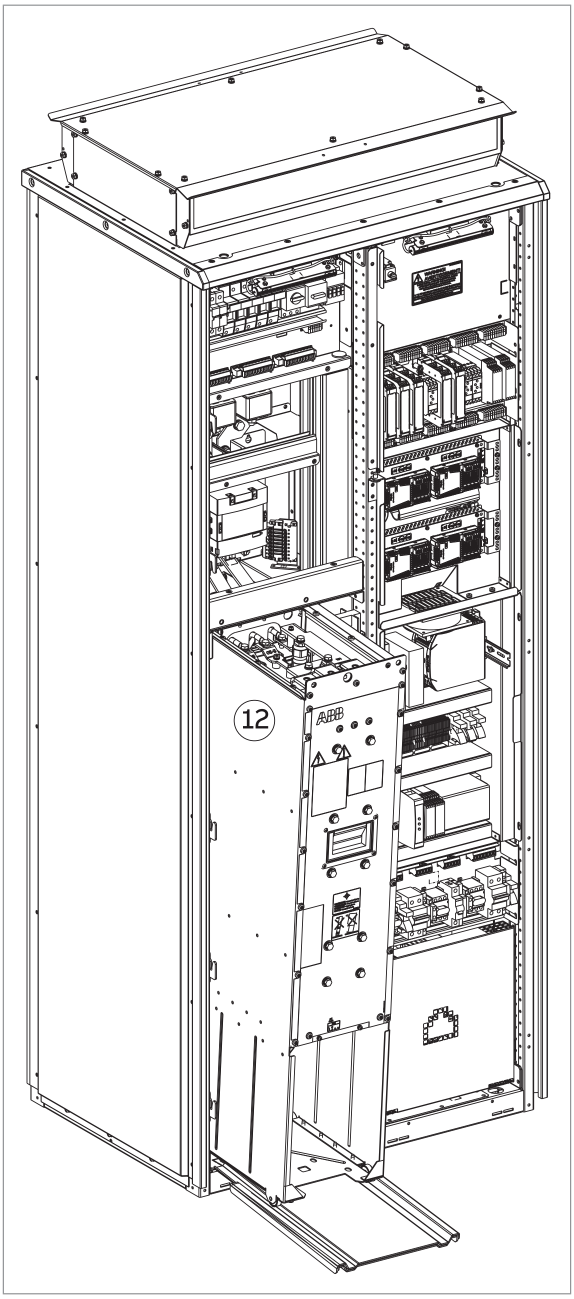
7. Remove the two screws and pull out the filter module fan.



8. Remove the two M8 screws on the back of the module.
9. Remove the two screws that attach the bottom of the module to the base of the cabinet.
10. Install the extraction/installation ramp: Lift the ramp against the cabinet base so that the hooks of the base go into the ramp's holes.
11. Remove the two fastening screws that fasten the top of the module to the cabinet frame.



12. Pull the module carefully out of the cabinet along the ramp. While you pull the handle, keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.



13. Install the new module in reverse order. Mind you fingers. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back. Be careful not to break the attaching screws: tighten the screws of the module to 22 N·m (16.2 lbf·ft) and bolts of the AC busbars to 42 N·m (31 lbf·ft). Plug the module signal wire set to the module signal connector. Install the shrouds.
14. Remove the module extraction/installation ramp.
15. Close the cabinet doors.

Capacitors

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

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

Reforming the capacitors

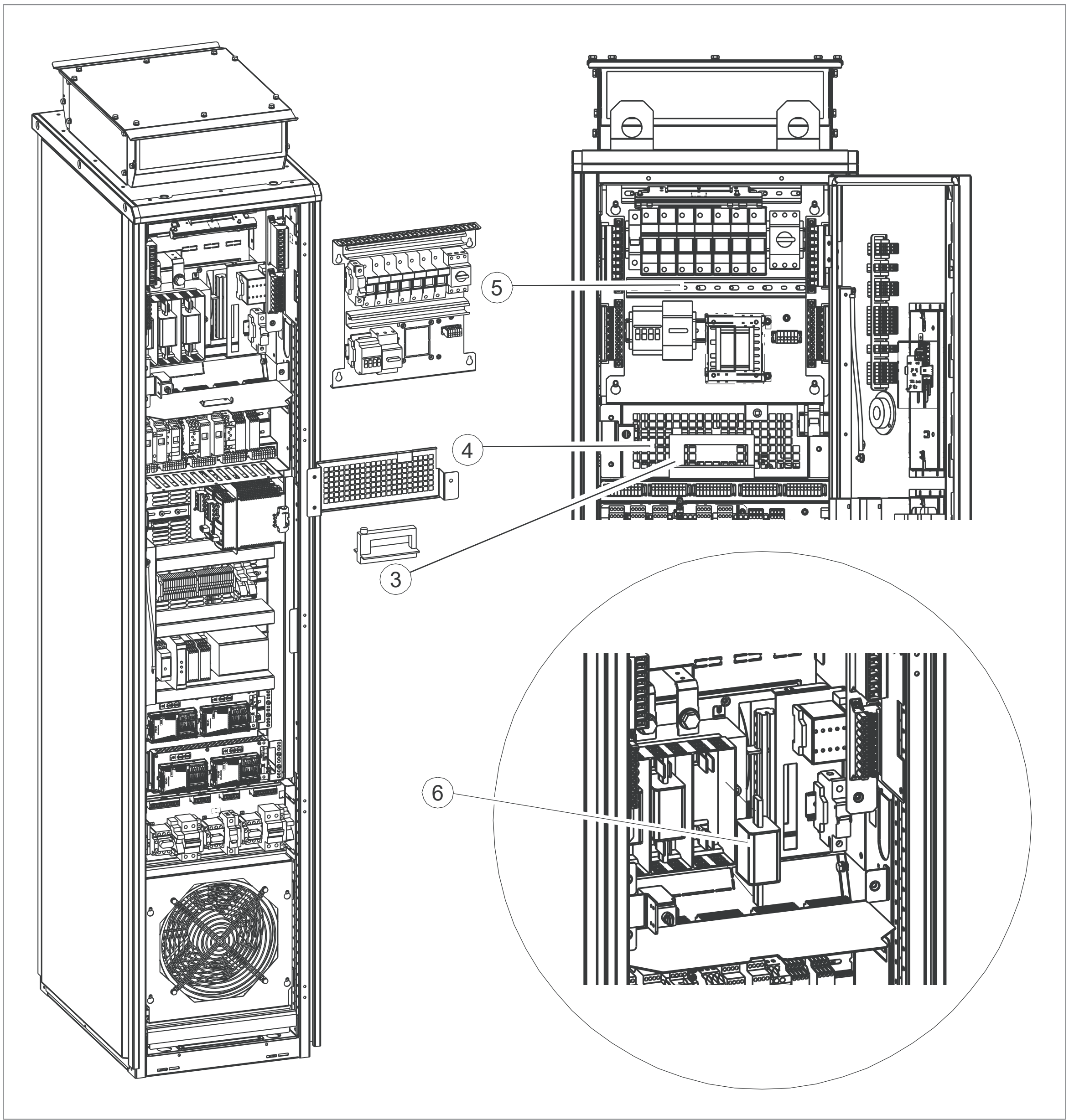
The capacitors must be reformed if the drive has not been powered (either in storage or unused) for a year or more. The manufacturing date is on the type designation label. For information on reforming the capacitors, refer to Capacitor reforming instructions (3BFE64059629 [English]).

Fuses

Replacing fuses (frame R8)

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

1. Stop the drive (if running) and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. Remove the fuse replacement handle.
4. Remove the shroud.
5. Remove the top mounting plate.
6. Pull out the fuses with the fuse handle and replace them with the new fuses.
7. Reinstall the mounting plate, shroud and fuse handle.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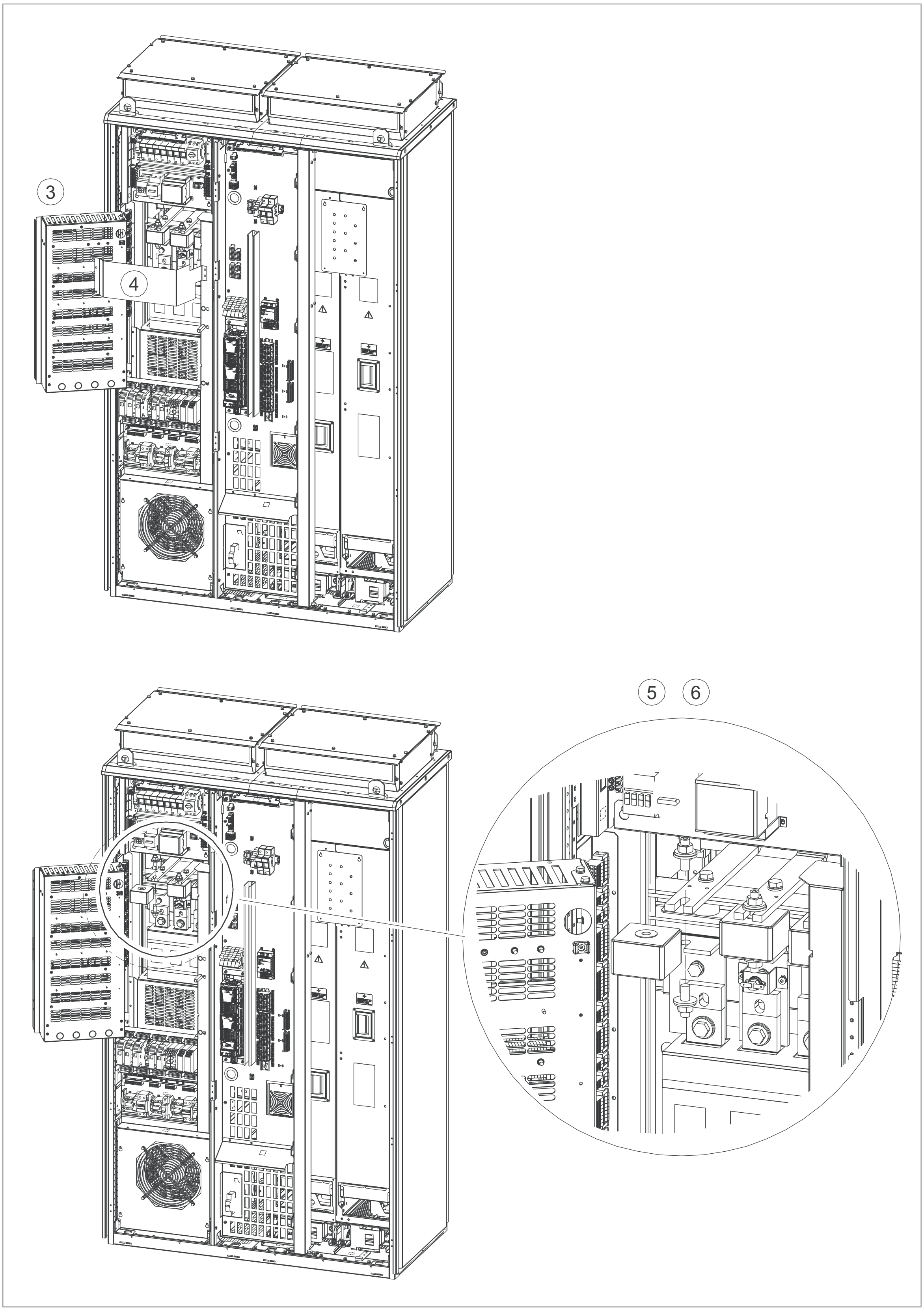
Replacing fuses (frame R11)

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

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

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

5. Slacken the nuts of the headless screws of the fuses so that you can slide out the fuse blocks. Make a note of the order of the washers on the screws.
6. Remove the screws, nuts and washers from the old fuses and attach them to the new fuses. Make sure to keep the washers in the original order.
7. Insert the new fuses into their slots in the cubicle.
8. Tighten the nuts to torque as follows:
   - Cooper-Bussmann fuses: 50 N·m (37 lbf·ft) if size 3; 40 N·m (30 lbf·ft) if size 2
   - Mersen (Ferraz-Shawmut): 46 N·m (34 lbf·ft) if size 33; 26 N·m (19 lbf·ft) if size 32
   - Other fuses: Refer to the fuse manufacturer's instructions.
9. Install the shrouds and mounting plate if removed earlier. Close the swing-out frame. Close the cabinet door.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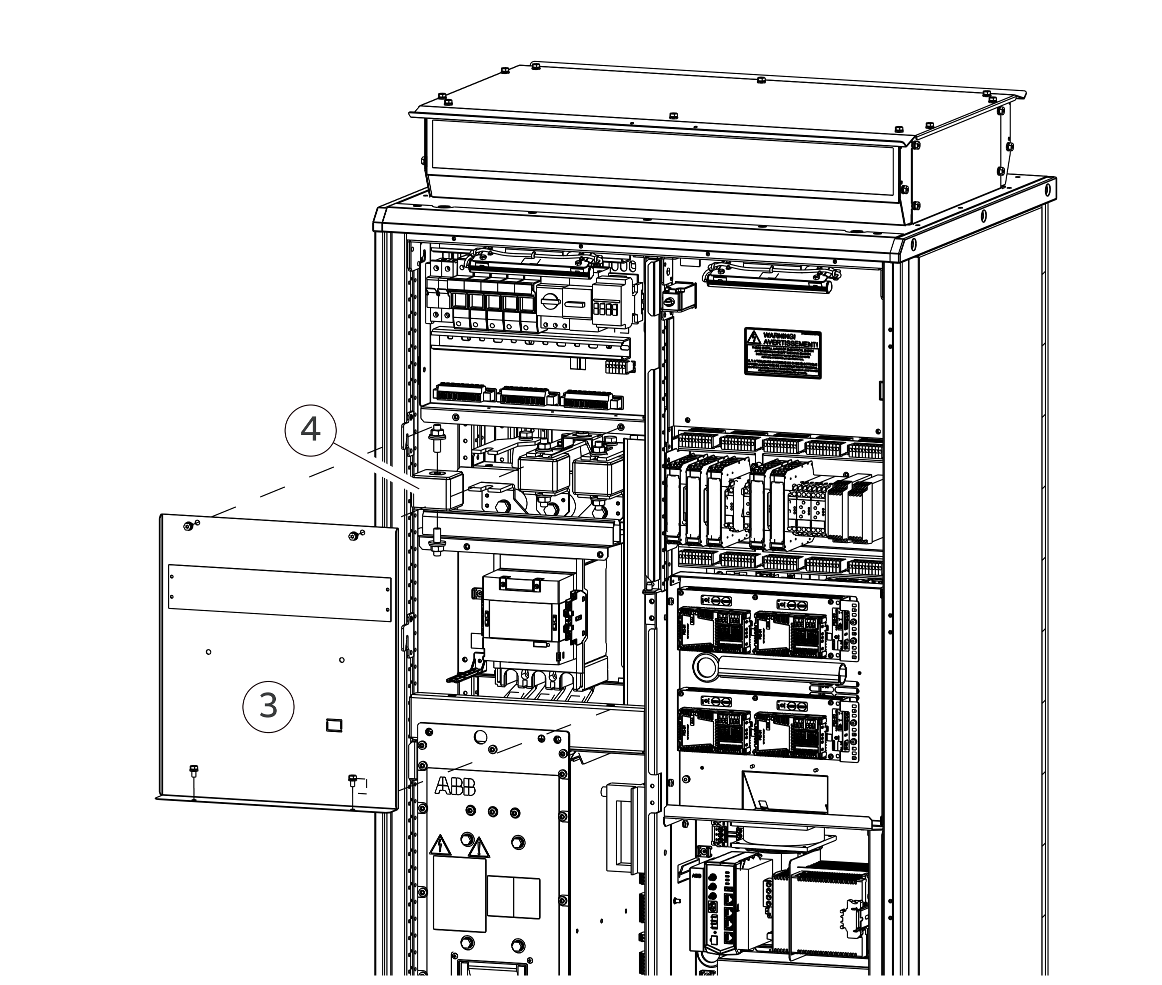
Replacing fuses (frames R6i+R6i and R7i+R7i)

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

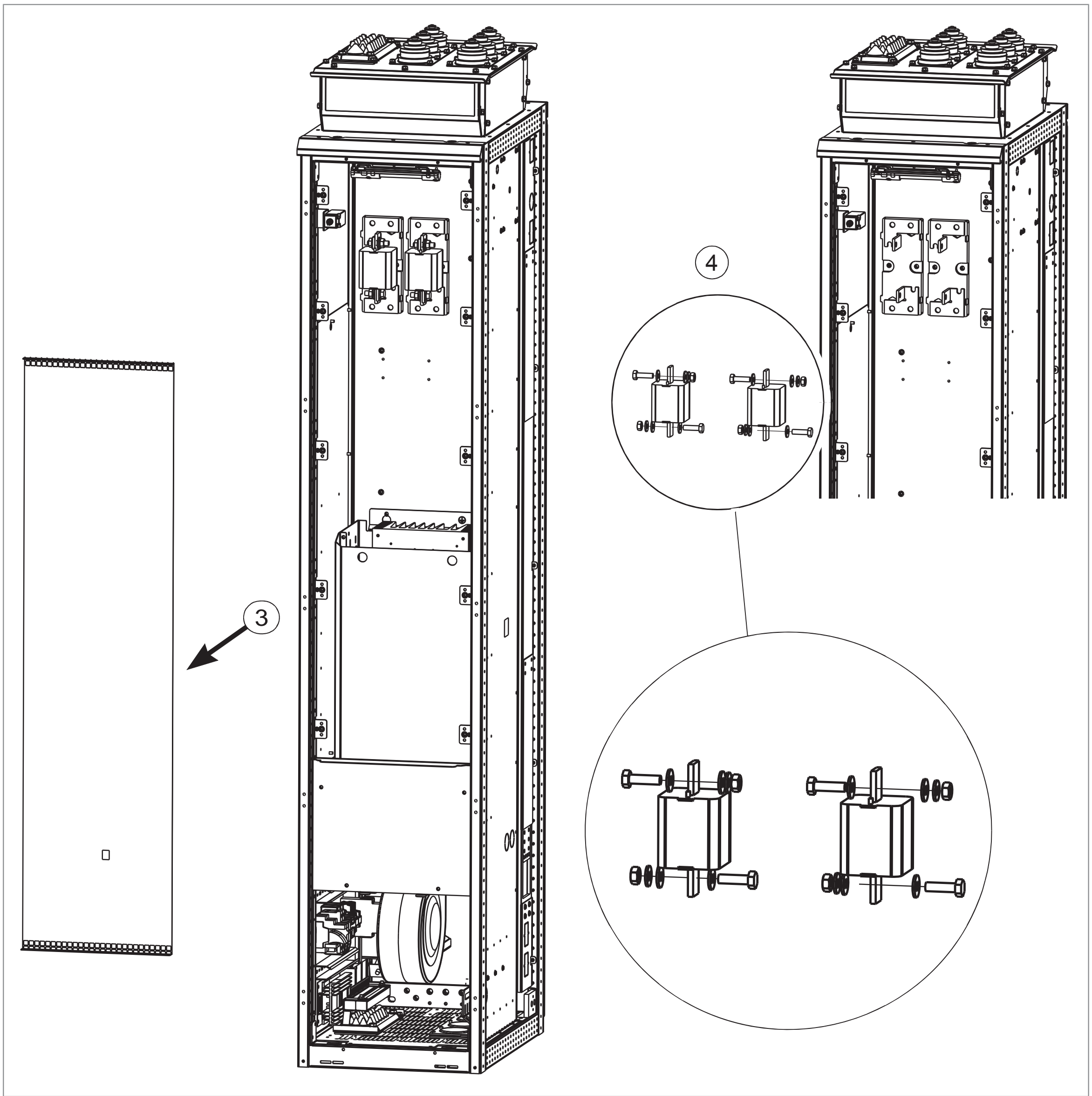
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door.
3. Remove the shroud in front of the fuses.
4. Loosen the nuts of the headless screws of the fuses. Remove the fuse blocks. Make a note of the order of the washers on the screws.
5. Remove the screws, nuts and washers from the old fuses and attach them to the new fuses. Make sure to keep the washers in the original order.
6. Put the new fuses into their slots.
7. Tighten the nuts to torque as follows:
   - Cooper-Bussmann fuses: 40 N·m (30 lbf·ft) for size 2, 20 N·m (15 lbf·ft) for size 1.
8. Install the removed shroud. Close the cabinet door.



Replacing the DC fuses of the brake chopper (option +D150)

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

1. Stop the drive (if running) and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the door of the brake chopper cubicle.
3. Remove the upper shroud: undo 10 pcs of M6 combi screws.
4. Remove the M10 bolts and nuts that fasten the fuses to fuse bases. Remove the fuses.
5. Install new fuses to the fuse bases. Make sure to keep the washers in original order. Tighten the screws to 42 N·m (31 lbf·ft).
6. Reinstall the shroud. Close the cabinet door.



Control panel

Replacing the battery and cleaning

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

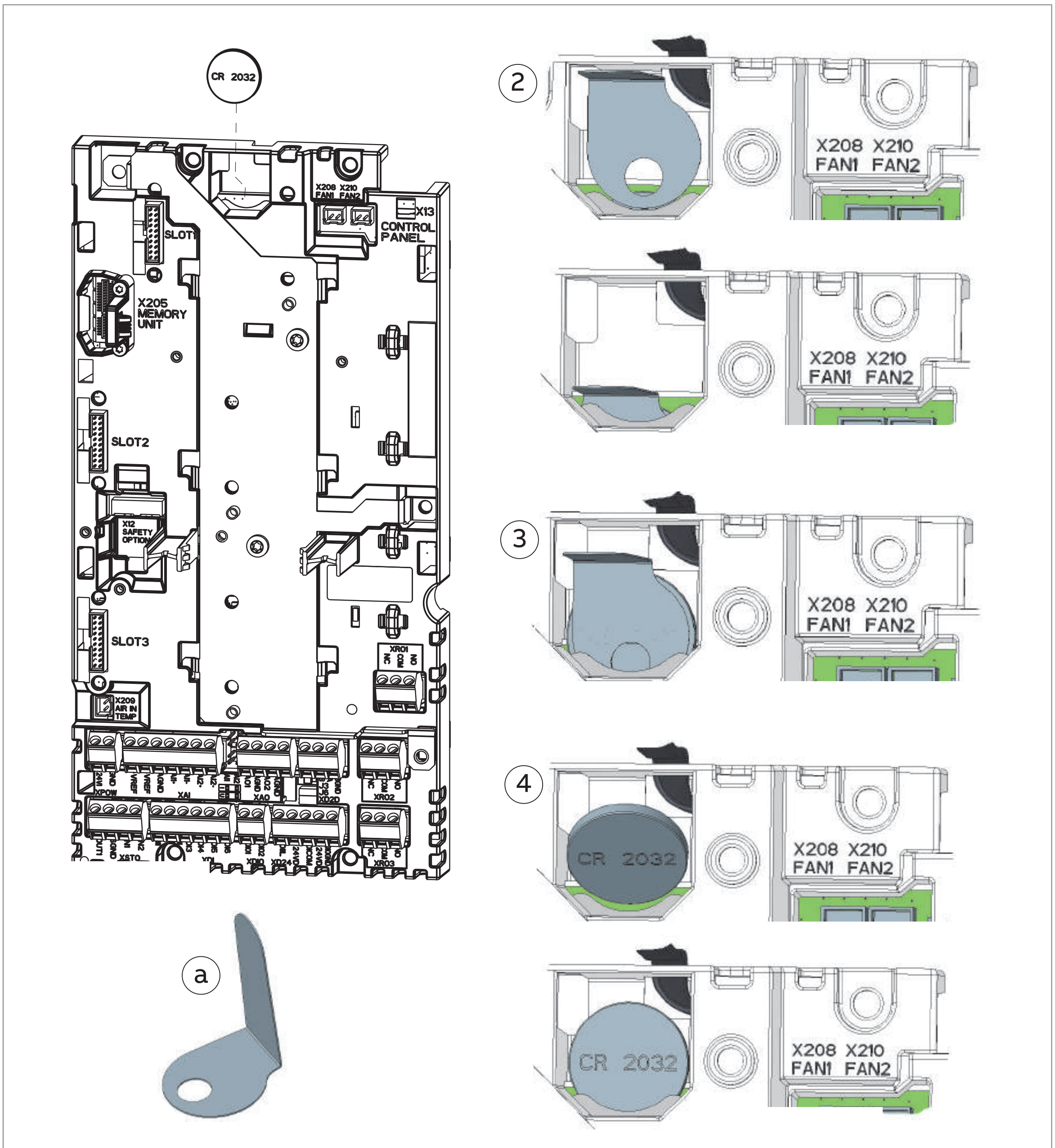
Control unit

Replacing the ZCU-12 control unit battery

The ZCU-12 control unit in R11 frames produced after week 13 2022 does not have a battery in it. For earlier revisions of the control unit, contact ABB service for instructions on how to replace the control unit battery.

You can change the control unit battery with a battery ejector (a in the drawing below) or, for example, with a flat screwdriver. You can order a battery replacement kit that contains a battery ejector and type CR2032 battery from ABB service.

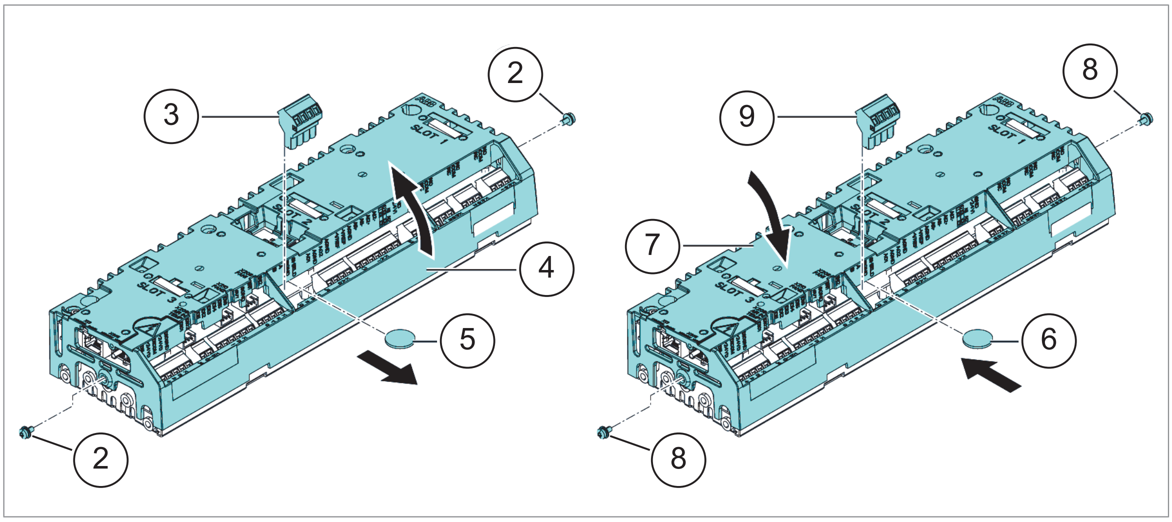
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Move the battery ejector into the battery slot on the battery.
3. Carefully pull the battery out of the battery holder.
4. Carefully put a new CR2032 battery into the battery holder.



Replacing the ZCU-14 control unit battery

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

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



Memory unit

One memory unit is located on the drive control unit (motor-side converter control unit), another on the line-side converter control unit. If you replace 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.

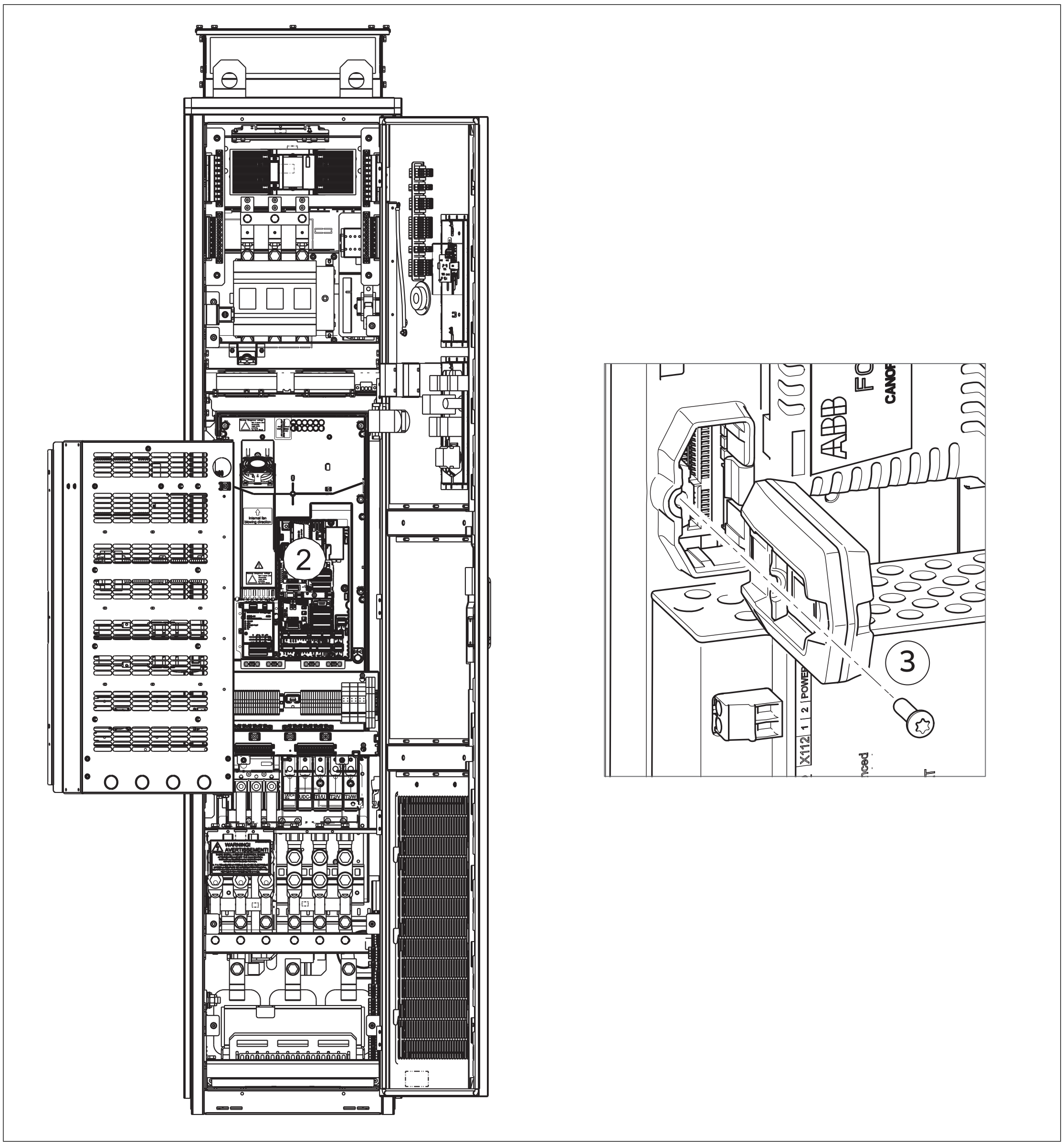
WARNING!
Do not remove or insert the memory unit when the control unit is powered.

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

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

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

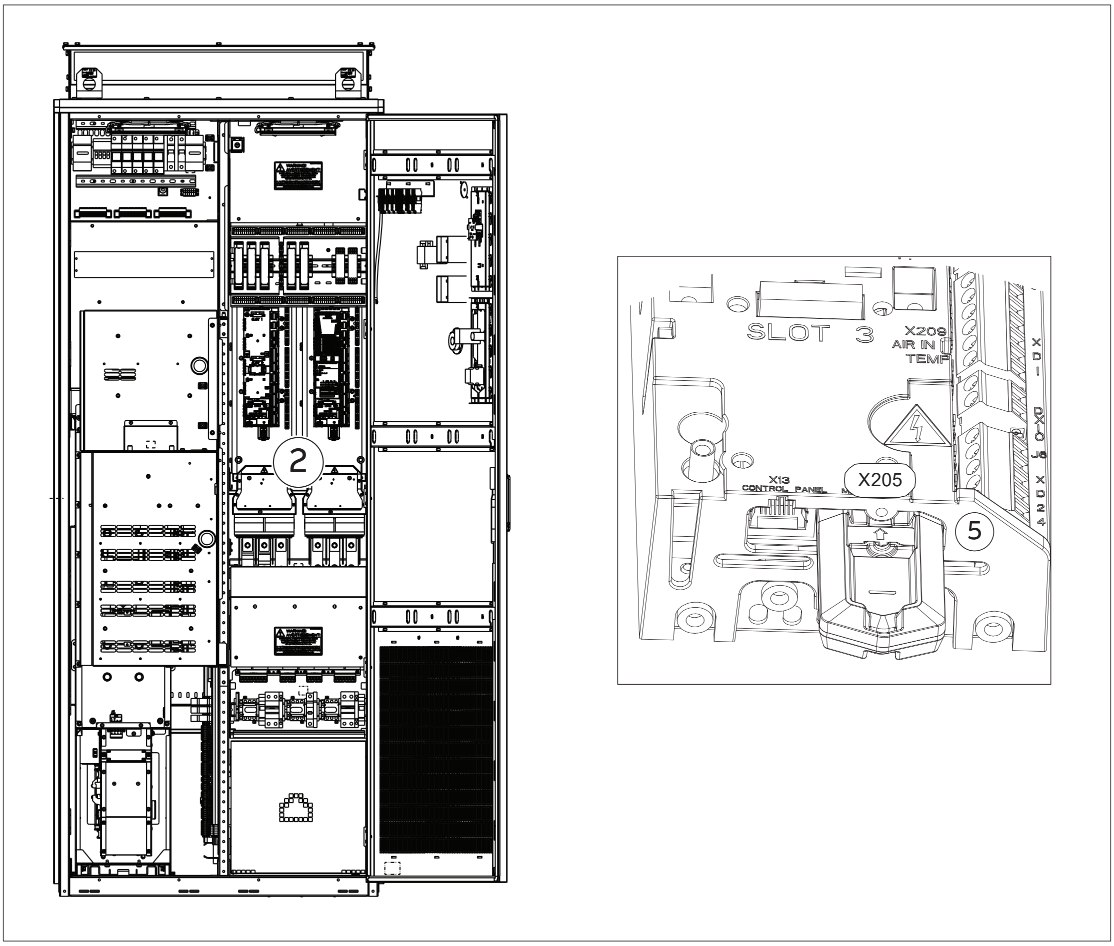
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door and swing-out frame or remove the shroud if there is no swing-out frame. The control unit is located behind swing-out frame or shroud.
3. Loosen the memory unit mounting screw and take the memory unit out. Install the new unit in reverse order. Note: There is a spare screw next to the memory unit slot.



Replacing the memory unit of the motor-side and line-side converter control unit (frames R6i+R6i and R7i+R7i)

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet door and swing-out frame or remove the shroud if there is no swing-out frame. The control unit is located behind swing-out frame or shroud.
3. Remove the memory unit mounting screw.
4. Take the memory unit out.
5. Install the new unit in reverse order. Note: There is a spare screw next to the memory unit slot.



After you have installed a new memory unit or a software update, upload the parameter backup file to the control unit. Make sure that the software identifies the Drive rating ID. If the software does not identify the Drive rating ID, it cannot determine the voltage rating and the drive does not start.

If you have an FSO module, you must upload an additional safety file into the software.

To examine the Drive rating ID:

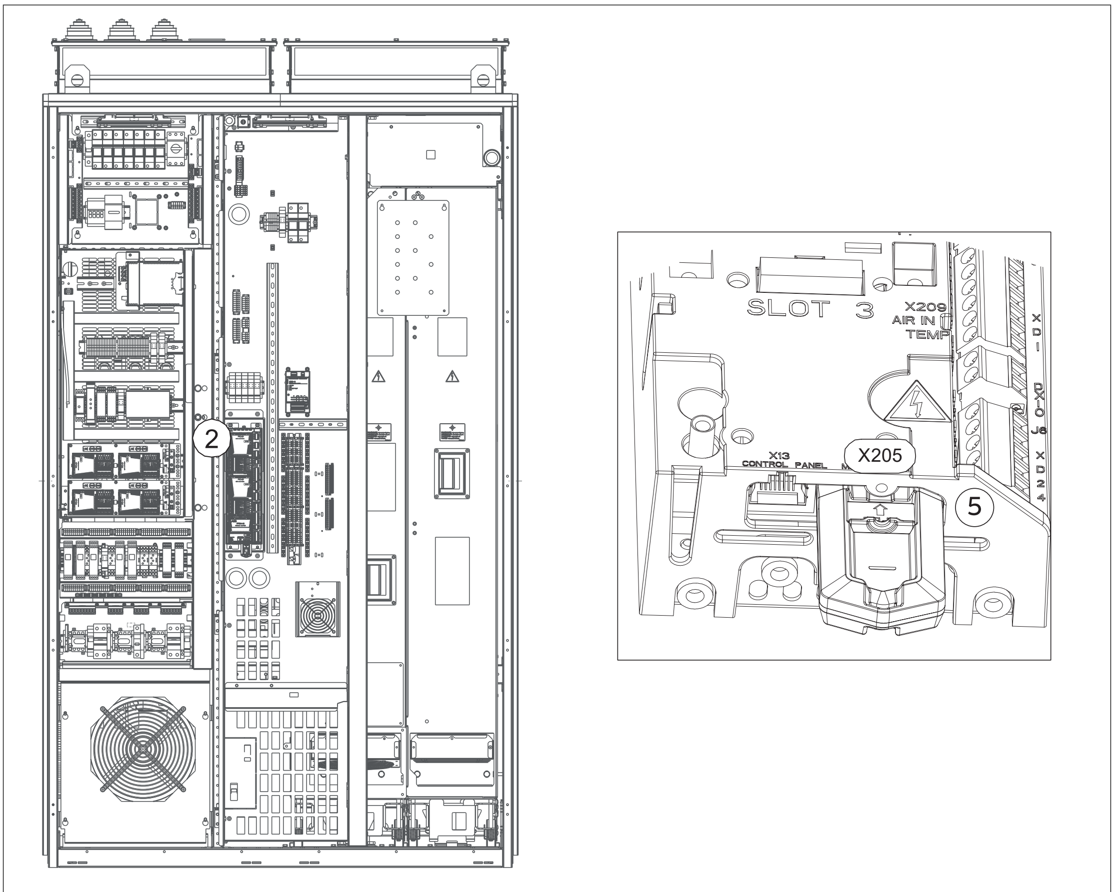
1. Make sure that the operating switch (S21) on the cabinet door is in ON position.
2. Close the main switch-disconnector (Q1).
3. Close the charging switch (Q3).
4. Set control panel to communicate with Supply Unit [ACS880 IGBT supply]. For more information on the control panel, refer to ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual (3AUA0000085685 [English].
5. Make sure that parameter 119.17 Local ctrl disable = NO.
6. Press the Loc/Rem key to turn the panel to local control mode.
7. Press Start key from control panel. Wait 10 seconds. The supply unit charging circuit energizes the drive DC link. Thee internal power supplies of the inverter and supply modules are also enegized.
8. Press Stop key from control panel.
9. Reboot the Supply Unit [ACS880 IGBT supply] either by cycling the power or with parameter 196.08 Control board boot = 1.
10. Make sure that parameter 107.03 Drive rating ID has a value other than 999[1)].
11. Set control panel to communicate with Inverter Unit [ACS880].
12. Reboot the Inverter Unit [ACS880] either by cycling the power or with parameter 96.08 Control board boot = 1.
13. Make sure that parameter 07.03 Drive rating ID has a value other than 999[1)].
14. Press Loc/Rem key to turn the panel to remote control mode (external motor control is possible).

[1)] If the value is 999, the software has not identified the Drive rating ID. Contact ABB.

If you do not have a parameter backup file, contact ABB for instructions on how to install the factory parameters.

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

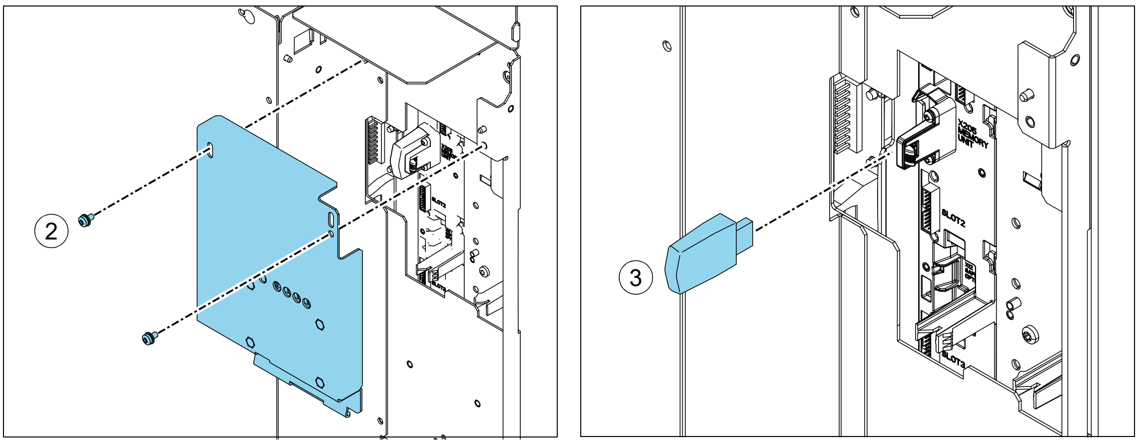
1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Open the cabinet doors. The control unit is located on the module-side swing-out frame. For the location, refer to section Cabinet layout (page 40).
3. Remove the memory unit mounting screw.
4. Take the memory unit out.
5. Install the new memory unit in reverse order. Note: There is a spare screw next to the memory unit slot.



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

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

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



Functional safety components

The mission time of functional safety components is 20 years which equals the time during which failure rates of electronic components remain constant. This applies to the components of the standard Safe torque off circuit as well as any modules, relays and, typically, any other components that are part of functional safety circuits.

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

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

Note that some of the components may already have been renewed earlier, restarting their mission time. The remaining mission time of the whole circuit is however determined by its oldest component. Also note that some components connected to the functional safety system such as main and charging contactors or breakers may have a shorter lifespan than 20 years, depending on their usage. These components must be replaced before the end of their lifetime.

Contact your local ABB service representative for more information.

12

Technical data

Contents of this chapter

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

Marine type-approved drives (option +C132)

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

Ratings

The nominal ratings for the drives with 50 Hz and 60 Hz supply are given below. The symbols are described in section Definitions (page 253).

IEC ratings

Drive type ACS880-37-...	Frame size	Input current[1]	Nominal ratings				Output ratings			
							Light-overload use		Heavy-duty use	
		I_1	I_2	I_{max}	P_n	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	A	kW	kVA	A	kW	A	kW
U_n = 400 V										
0105A-3	R8	88	105	148	55	73	100	55	87	45
0145A-3	R8	120	145	178	75	100	138	75	105	55
0169A-3	R8	144	169	247	90	117	161	90	145	75
0206A-3	R8	176	206	287	110	143	196	110	169	90

Drive type ACS880-37-...	Frame size	Input current[1)]	Nominal ratings				Output ratings			
							Light-overload use		Heavy-duty use	
		I_1	I_2	I_{max}	P_n	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	A	kW	kVA	A	kW	A	kW
0220A-3	R6i+R6i	204	220	290	132	152	211	110	165	90
0290A-3	R7i+R7i	269	290	380	160	201	278	132	217	110
0293A-3	R11	257	293	418	160	203	278	160	246	132
0363A-3	R11	321	363	498	200	251	345	200	293	160
0442A-3	R11	401	442	621	250	306	420	250	363	200
0505A-3	R11	401	505	631	250	350	480	250	363	200
0585A-3	R11	505	585	751	315	405	556	315	442	250
0650A-3	R11	569	650	859	355	450	618	355	505	250
U_n = 500 V										
0101A-5	R8	71	101	148	55	87	91	55	77	45
0124A-5	R8	96	124	178	75	107	118	75	96	55
0156A-5	R8	115	156	247	90	135	148	90	124	75
0180A-5	R8	141	180	287	110	156	171	110	156	90
0190A-5	R6i+R6i	176	190	250	132	165	182	110	142	90
0220A-5	R6i+R6i	204	220	290	160	191	211	132	165	110
0260A-5	R11	205	260	418	160	225	247	160	240	132
0280A-5	R7i+R7i	260	280	370	220	242	269	160	209	132
0361A-5	R11	257	361	542	200	313	343	200	260	160
0414A-5	R11	321	414	614	250	359	393	250	361	200
0460A-5	R11	404	460	660	315	398	450	315	414	250
0503A-5	R11	455	503	725	355	436	492	355	460	315
U_n = 690 V										
0100A-7	R6i+R6i	93	100	150	90	120	96	75	75	55
0120A-7	R6i+R6i	111	120	180	110	143	115	90	90	75
0150A-7	R6i+R6i	139	150	230	132	179	144	110	112	90
0174A-7	R11	149	174	274	160	208	165	160	142	132
0180A-7	R7i+R7i	167	180	270	160	215	173	132	135	110
0210A-7	R11	186	210	384	200	251	200	200	174	160
0271A-7	R11	232	271	411	250	324	257	250	210	200
0330A-7	R11	293	330	480	315	394	320	315	271	250
0370A-7	R11	330	370	520	355	442	360	355	330	315
0430A-7	R11	375	430	555	400	514	420	400	370	355

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

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

UL (NEC) ratings

Drive type ACS880-37-...	Frame size	Input current[1)]	Max current	App. power	Output ratings			
					Light-overload use		Heavy-duty use	
		I_1	I_{max}	S_n	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	kVA	A	hp	A	hp
U_n = 480 V								
0101A-5	R8	74	148	87	96	75	77	60
0124A-5	R8	100	178	107	124	100	96	75
0156A-5	R8	120	247	137	156	125	124	100
0180A-5	R8	147	287	156	180	150	156	125
0190A-5	R6i+R6i	179	250	165	182	150	142	125
0220A-5	R6i+R6i	207	290	191	211	200	165	150
0260A-5	R11	205	418	225	260	200	240	200
0280A-5	R7i+R7i	263	370	242	269	200	209	200
0302A-5	R11	239	498	262	302	250	260	200
0361A-5	R11	257	542	313	361	300	302	250
0414A-5	R11	321	614	359	414	350	361	300
0460A-5	R11	404	660	398	450	350	414	350
0503A-5	R11	455	725	436	492	400	483	400
U_n = 600 V								
0100A-7	R6i+R6i	95	150	120	96	100	75	75
0120A-7	R6i+R6i	113	180	143	115	125	90	100
0150A-7	R6i+R6i	141	230	179	144	150	112	125
0174A-7	R11	149	274	208	168	175	144	150
0180A-7	R7i+R7i	169	270	215	173	200	135	150
0210A-7	R11	186	384	251	192	200	168	175
0271A-7	R11	232	411	324	242	250	192	200
0330A-7	R11	293	480	394	289	300	242	250
0370A-7	R11	330	520	442	336	350	289	300
0430A-7	R11	375	555	514	412	450	336	350

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

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

Definitions

I_1	Nominal rms input current at 40 °C (104 °F)
I_2	Continuous rms output current. No overload capability at 40 °C (104 °F)
I_{max}	Maximum output current. Available for 10 seconds at start, then as long as allowed by drive tempera-ture.
P_n	Typical motor power in no-overload use

S_n	Apparent power in no-overload use
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes. 1) No overload
P_{Ld}	Typical motor power in light-overload use
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes.
P_{Hd}	Typical motor power in heavy-duty use

Note:

- The ratings apply at an ambient temperature of 40 °C (104 °F).
- To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.

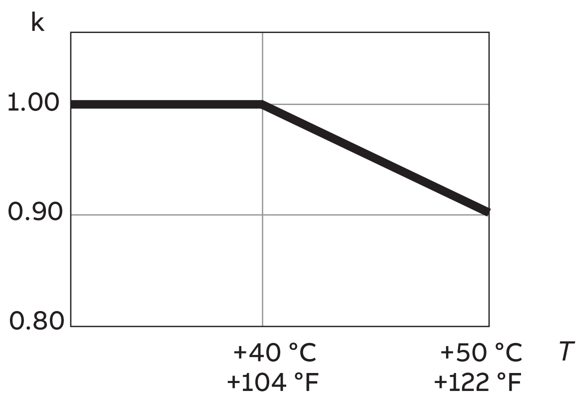
The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.

Derating

Surrounding air temperature derating

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

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



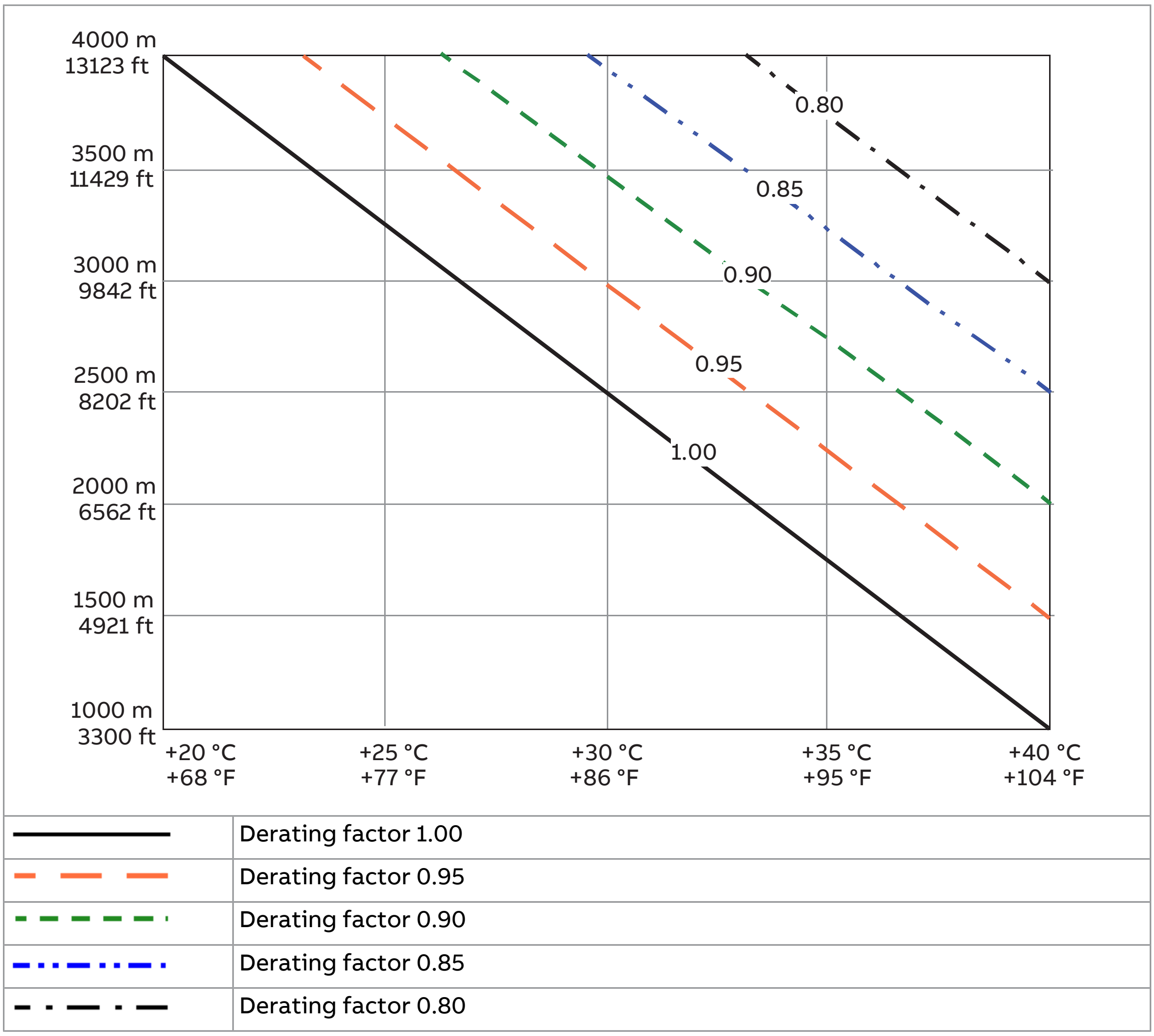
For example:

Temperature	Derated current		
40 ºC (104 ºF)	I_2	I_{Ld}	I_{Hd}
45 ºC (113 ºF)	$0.95 \cdot I_2$	$0.95 \cdot I_{Ld}$	$0.95 \cdot I_{Hd}$
50 ºC (122 ºF)	$0.90 \cdot I_2$	$0.90 \cdot I_{Ld}$	$0.90 \cdot I_{Hd}$

Altitude derating

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

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



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

Deratings for special settings in the drive control program

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

<u>Ex motor, sine filter, low noise</u>

The ratings in these cases are given in the table below:

- drive is used with an ABB motor for explosive atmospheres (Ex) and EX motor in parameter 95.15 Special HW settings is enabled
- sine filter option +E206 is selected and ABB sine filter in parameter 95.15 Special HW settings is enabled
- Low noise optimization is selected in parameter 97.09 Switching freq mode.

For non-ABB Ex motors, contact ABB.

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

Drive type ACS880-37-...	Output ratings for special settings											
	Ex motor (ABB Ex motor)				ABB sine filter				Low noise mode			
	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use
	I_n	P_n	I_{Ld}	I_{Hd}	I_n	P_n	I_{Ld}	I_{Hd}	I_n	P_n	I_{Ld}	I_{Hd}
	A	kW	A	A	A	kW	A	A	A	kW	A	A
U_n = 400 V												
0105A-3	105	55	100	87	105	55	100	87	105	-	100	87
0145A-3	145	75	138	105	145	75	138	105	145	-	138	105
0169A-3	169	90	161	145	169	90	161	145	169	-	161	145
0206A-3	206	110	196	169	206	110	196	169	206	-	196	169
0220A-3	220	132	208	184	220	132	208	184	220	132	208	171
0290A-3	286	160	271	214	280	160	266	209	258	160	243	193
0293A-3	278	160	264	234	264	160	251	221	258	160	243	215
0363A-3	345	200	328	278	327	200	310	264	320	200	301	256
0442A-3	420	250	399	345	398	250	378	327	390	250	367	317
0505A-3	480	315	456	345	455	250	432	327	445	250	419	317
0585A-3	556	315	528	420	527	315	500	398	516	315	485	386
0650A-3	618	355	587	480	585	355	556	455	573	315	539	441
U_n = 500 V												
0101A-5	101	45	91	45	101	45	91	45	101	-	91	77
0124A-5	124	55	118	55	124	55	118	55	124	-	118	96
0156A-5	156	75	148	75	156	75	148	75	156	-	148	124
0180A-5	180	90	171	90	180	90	171	90	180	-	171	156
0190A-5	190	132	180	147	190	132	180	147	180	132	171	137
0220A-5	220	160	209	179	220	160	209	179	220	160	209	166
0260A-5	247	160	235	228	234	160	222	216	229	160	216	210
0280A-5	280	200	269	215	280	200	266	211	260	200	179	194
0302A-5 (U_n = 480 V)	287	250 (hp)	287	247	272	250 (hp)	272	234	266	250 (hp)	264	227
0361A-5	343	200	326	247	325	200	309	234	318	200	300	227
0414A-5	393	250	373	343	373	250	354	325	365	250	343	315
0460A-5	437	315	428	393	414	315	405	373	406	250	393	362
0503A-5	478	355	467	437	453	315	443	414	443	315	430	402
U_n = 690 V												
0100A-7	100	90	96	74	100	90	96	74	100	90	95	64
0120A-7	120	110	115	93	120	110	115	93	120	110	114	81
0150A-7	150	132	144	112	150	132	144	112	150	132	142	124
0174A-7	153	160	145	125	157	160	149	128	81	90	77	66

Drive type ACS880-37-…	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
0180A-7	180	160	170	149	180	160	171	142	166	160	157	121
0210A-7	185	200	176	153	189	200	180	157	98	110	93	81
0271A-7	238	250	226	185	244	250	231	189	126	132	119	98
0330A-7	290	315	282	238	297	315	288	244	154	160	149	126
0370A-7	326	355	317	290	333	355	324	297	172	200	167	153
0430A-7	378	400	370	326	387	400	378	333	200	200	195	172

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

High speed mode

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

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

Drive type ACS880-37-…	Deratings with selection High speed mode of parameter *95.15 Special HW settings*							
	120 Hz output frequency (no derating)				Maximum output frequency 500 Hz			
	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use
	I_n	P_n	I_{Ld}	I_{Hd}	I_N	P_n	I_{Ld}	I_{Hd}
	A	kW	A	A	A	kW	A	A
U_n = 400 V								
0105A-3	105	55	100	87	105	-	100	87
0145A-3	145	75	138	105	145	-	138	105
0169A-3	169	90	161	145	156	-	148	122
0206A-3	206	110	196	169	192	-	180	155
0220A-3	220	132	209	184	192	110	180	144
0290A-3	290	160	275	224	214	132	204	160

Drive type ACS880-37-...	Deratings with selection High speed mode of parameter *95.15 Special HW settings*							
	120 Hz output frequency (no derating)				Maximum output frequency 500 Hz			
	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use
	I_n	P_n	I_{Ld}	I_{Hd}	I_N	P_n	I_{Ld}	I_{Hd}
	A	kW	A	A	A	kW	A	A
0293A-3	293	160	278	246	240	132	229	203
0363A-3	363	200	345	293	297	200	284	241
0442A-3	442	250	420	363	362	250	346	299
0505A-3	505	250	480	363	413	250	395	299
0585A-3	585	315	556	442	479	315	458	364
0650A-3	650	355	618	505	532	315	509	416
U_n = 500 V								
0101A-5	101	55	91	77	101	-	91	77
0124A-5	124	75	118	96	124	-	118	96
0156A-5	156	90	148	124	144	-	136	87
0180A-5	180	110	171	156	169	-	160	147
0190A-5	190	132	180	147	154	110	146	115
0220A-5	220	160	209	180	187	132	178	140
0260A-5	260	160	247	240	213	160	203	198
0280A-5	280	200	266	226	216	160	207	161
0302A-5 (U_N = 480 V)	302	250 (hp)	302	260	247	200 (hp)	249	214
0361A-5	361	200	343	260	295	250	283	214
0414A-5	414	250	393	361	339	250	324	297
0460A-5	460	315	450	414	376	315	371	341
0503A-5	503	355	492	460	412	315	405	379
U_n = 690 V								
0100A-7	100	90	94	74	59	75	56	44
0120A-7	120	110	114	94	75	90	71	56
0150A-7	150	132	142	124	115	110	108	86
0174A-7	174	160	165	142	100	110	95	82
0180A-7	180	160	170	144	104	110	97	78
0210A-7	210	200	200	174	121	132	115	100
0271A-7	271	250	257	210	156	160	148	121
0330A-7	330	315	320	271	190	200	184	156
0370A-7	370	355	360	330	213	250	207	190
0430A-7	430	400	420	370	247	250	241	213

f	Output frequency
f_{max}	Maximum output frequency with High speed mode
U_n	Nominal voltage of the drive
I_n	Continuous rms output current. No overload capability at 40 °C (104 °F)
P_n	Typical motor power in no-overload use.

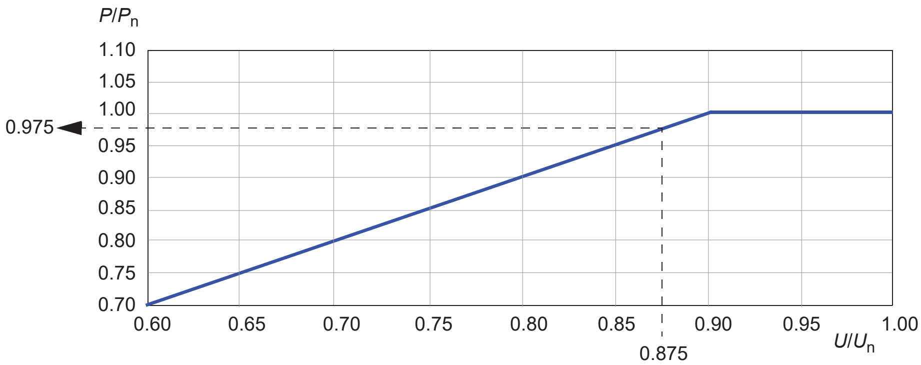
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-overload use
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
The ratings apply at an ambient temperature of 40 °C (104 °F).	

Derating for output voltage boost

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

400 V and 500 V drives

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



Example 1: P_n for ACS880-37-650A-3 is 355 kW. The input voltage (U) is 350 V. -> U/U_n = 350 V / 400 V = 0.875. -> P/P_n = 0.975 -> The derated power P = 0.975 × 355 kW = 346 kW.

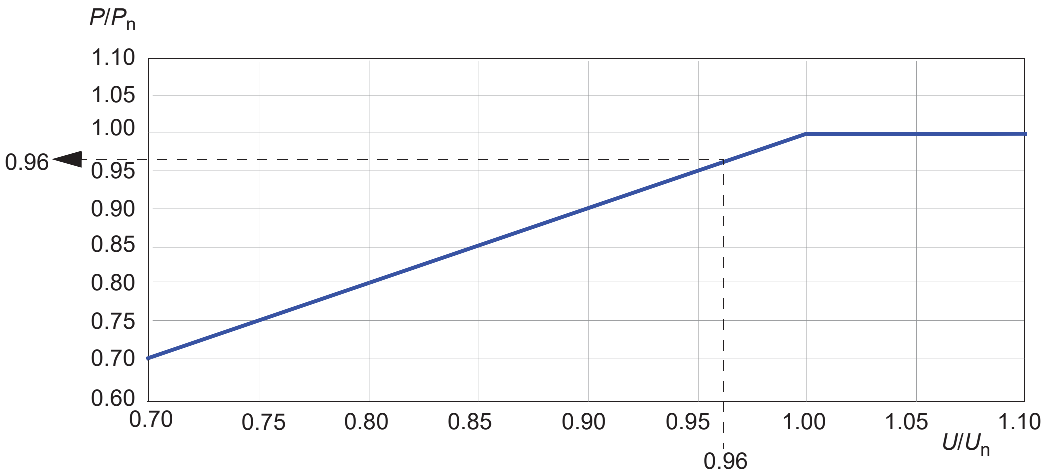
To boost the output voltage to correspond the nominal supply voltage 400 V, increase the DC voltage to 400 V × √2 = 567 V.

Example 2: P_n for ACS880-37-503A-5 is 355 kW. The input voltage (U) is 450 V. -> U/U_n = 450 V / 500 V = 0.9. -> P/P_n = 1.00 -> The derated power P = 1.00 × 355 kW = 355 kW.

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

575 V and 690 V drives

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



<u>Example 1</u>: P_n for ACS880-37-430A-7 is 400 kW. The input voltage (*U*) is 660 V. -> U/U_n= 660 V / 690 V = 0.96 -> P/P_n = 0.96 -> The derated power *P* = 0.96 × 400 kW = 384 kW.

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

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

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

Fuses (IEC)

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

Drive type ACS880-37-...	Input current (A)	Ultrarapid (aR) fuses (one fuse per phase)					
		A	A^2s	V	Manufacturer	Type	Size
U_n = 400 V							
0105A-3	88	160	8250	690	Bussmann	170M3814D	1
0145A-3	120	250	31000	690	Bussmann	170M3816D	1
0169A-3	144	250	31000	690	Bussmann	170M3816D	1
0206A-3	176	315	52000	690	Bussmann	170M3817D	1
0220A-3	204	400	74000	690	Bussmann	170M5408	2
0290A-3	269	500	145000	690	Bussmann	170M5410	2
0293A-3	257	500	145000	690	Bussmann	170M5410	2
0363A-3	321	630	210000	690	Bussmann	170M6410	3
0442A-3	401	700	300000	690	Bussmann	170M6411	3
0505A-3	401	800	465000	690	Bussmann	170M6412	3
0585A-3	505	900	670000	690	Bussmann	170M6413	3
0650A-3	569	1000	945000	690	Bussmann	170M6414	3
U_n = 500 V							
0101A-5	71	160	8250	690	Bussmann	170M3814D	1
0124A-5	96	250	31000	690	Bussmann	170M3816D	1
0156A-5	115	250	31000	690	Bussmann	170M3816D	1
0180A-5	141	315	52000	690	Bussmann	170M3817D	1
0190A-5	176	400	74000	690	Bussmann	170M5408	2
0220A-5	204	400	74000	690	Bussmann	170M5408	2
0260A-5	205	400	74000	690	Bussmann	170M5408	2
0280A-5	260	500	145000	690	Bussmann	170M5410	2
0361A-5	257	630	210000	690	Bussmann	170M6410	3
0414A-5	321	700	300000	690	Bussmann	170M6411	3
0460A-5	404	700	300000	690	Bussmann	170M6411	3
0503A-5	455	800	465000	690	Bussmann	170M6412	3
U_n = 690 V							
0100A-7	93	250	21000	690	Bussmann	170M4409	1
0120A-7	111	250	21000	690	Bussmann	170M4409	1
0150A-7	139	250	21000	690	Bussmann	170M4409	1
0174A-7	149	400	74000	690	Bussmann	170M5408	2
0180A-7	167	315	42000	690	Bussmann	170M4410	1
0210A-7	186	400	74000	690	Bussmann	170M5408	2
0271A-7	232	500	105000	690	Bussmann	170M5410	2
0330A-7	293	630	210000	690	Bussmann	170M6410	3
0370A-7	330	630	210000	690	Bussmann	170M6410	3
0430A-7	375	700	300000	690	Bussmann	170M6411	3

Drive type ACS880-37-...	Input current (A)	Ultrarapid (aR) fuses (one fuse per phase)					
		A	A^2s	V	Manufacturer	Type	Size
U_n = 400 V							
0105A-3	88	-	-	-	-	-	-
0145A-3	120	-	-	-	-	-	-
0169A-3	144	-	-	-	-	-	-
0206A-3	176	-	-	-	-	-	-
0220A-3	204	-	-	-	-	-	-
0290A-3	269	500	160000	690	Mersen	SC32AR69V500TF	2
0293A-3	257	500	160000	690	Mersen	SC32AR69V500TF	2
0363A-3	321	630	315000	690	Mersen	SC32AR69V630TF	2
0442A-3	401	700	442000	690	Mersen	SC32AR69V700TF	2
0505A-3	401	800	660000	690	Mersen	SC32AR69V800TF	2
0585A-3	505	900	805000	690	Mersen	SC33AR69V900TF	3
0650A-3	569	1000	1070000	690	Mersen	SC33AR69V10CTF	3
U_n = 500 V							
0101A-5	71	-	-	-	-	-	-
0124A-5	96	-	-	-	-	-	-
0156A-5	115	-	-	-	-	-	-
0180A-5	141	-	-	-	-	-	-
0190A-5	176	-	-	-	-	-	-
0220A-5	204	500	160000	690	Mersen	SC32AR69V500TF	2
0260A-5	205	-	-	-	-	-	-
0280A-5	260	500	160000	690	Mersen	SC32AR69V500TF	2
0361A-5	257	630	315000	690	Mersen	SC32AR69V630TF	2
0414A-5	321	700	442000	690	Mersen	SC32AR69V700TF	2
0460A-5	404	700	442000	690	Mersen	SC32AR69V700TF	2
0503A-5	455	800	660000	690	Mersen	SC32AR69V800TF	2
U_n = 690 V							
0100A-7	93	-	-	-	-	-	-
0120A-7	111	-	-	-	-	-	-
0150A-7	139	-	-	-	-	-	-
0174A-7	149	-	-	-	-	-	-
0180A-7	167	-	-	-	-	-	-
0210A-7	186	-	-	-	-	-	-
0271A-7	232	500	160000	690	Mersen	SC32AR69V500TF	2
0330A-7	293	630	315000	690	Mersen	SC32AR69V630TF	2
0370A-7	330	630	315000	690	Mersen	SC32AR69V630TF	2
0430A-7	375	700	442000	690	Mersen	SC32AR69V700TF	2

Notes:

1 Fuses with a higher current rating than specified must not be used.

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

Fuses (UL)

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

Drive type ACS880-37-...	Input current (A)	Fuse (one fuse per phase)				
		A	V	Manufacturer	Type	UL class / Size
U_n = 400 V						
0105A-3	88	250	600	Bussmann	DFJ-250	Class J
0145A-3	120	250	600	Bussmann	DFJ-250	Class J
0169A-3	144	250	600	Bussmann	DFJ-250	Class J
0206A-3	176	300	600	Bussmann	DFJ-300	Class J
0220A-3	204	400	690	Bussmann	170M5408	2
0290A-3	269	500	690	Bussmann	170M5410	2
0293A-3	257	500	690	Bussmann	170M5410	2
0363A-3	321	630	690	Bussmann	170M6410	3
0442A-3	401	700	690	Bussmann	170M6411	3
0505A-3	401	800	690	Bussmann	170M6412	3
0585A-3	505	1000	690	Bussmann	170M6414	3
0650A-3	569	1000	690	Bussmann	170M6414	3
U_n = 480 V						
0101A-5	74	250	600	Bussmann	DFJ-250	Class J
0124A-5	100	250	600	Bussmann	DFJ-250	Class J
0156A-5	120	250	600	Bussmann	DFJ-250	Class J
0180A-5	147	300	600	Bussmann	DFJ-300	Class J
0190A-5	176	400	690	Bussmann	170M5408	2
0220A-5	204	400	690	Bussmann	170M5408	2
0260A-5	205	400	600	Bussmann	170M5408	2
0280A-5	260	500	690	Bussmann	170M5410	2
0302A-5	239	500	690	Bussmann	170M5410	2
0361A-5	257	630	690	Bussmann	170M6410	3
0414A-5	321	700	690	Bussmann	170M6411	3
0460A-5	404	700	690	Bussmann	170M6411	3
0503A-5	455	800	690	Bussmann	170M6412	3
U_n = 600 V						
0100A-7	93	250	690	Bussmann	170M4409	1
0120A-7	111	250	690	Bussmann	170M4409	1
0150A-7	139	250	690	Bussmann	170M4409	1
0174A-7	146	315	600	Bussmann	170M4410	1
0180A-7	167	315	690	Bussmann	170M4410	1

Drive type ACS880-37-...	Input current (A)	Fuse (one fuse per phase)				
		A	V	Manufacturer	Type	UL class / Size
0210A-7	166	400	690	Bussmann	170M5408	2
0271A-7	208	500	690	Bussmann	170M5410	2
0330A-7	250	630	690	Bussmann	170M6410	3
0370A-7	291	700	690	Bussmann	170M6411	3
0430A-7	375	700	690	Bussmann	170M6411	3

Dimensions and weights

Frame size	Height 1)				Width 2)		Depth 3)				Weight	
	IP22/42		IP54				IP22/42		IP54			
	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
Standard cabinet												
R8	2145	84.45	2315	91.14	430	16.93	685	26.97	702	27.64	320	705
R11	2145	84.45	2315	91.14	1230	48.43	710	27.95	710	27.95	750	1653
R6i+R6i R7i+R7i	2145	84.45	2315	91.14	830	32.68	685	26.97	702	27.64	540	1190

1) For marine construction (option +C121) extra height is 10 mm (0.39 in) due to the attaching bars at the bottom of the cabinet.

2) Extra width with brake chopper (option +D150): 400 mm (15.75 in).
Extra width with brake resistors (option +D151): SAFURxxxFxxx 400 mm (15.75 in), 2×SAFURxxxFxxx 800 mm (19.68 in).
Extra width with EMC filter (option +E202): 200 mm (7.87 in) for frame R8 and 400 mm (15.75 in) for frame R11.

3) For drives with marine attaching bars (option +C121): Depth is 757 mm (29.80 in).

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

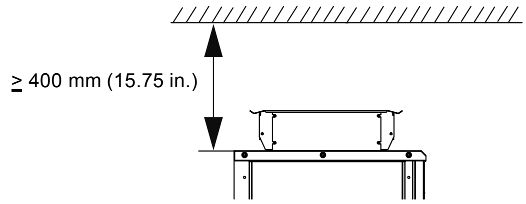
Frame size	Height				Width		Depth		Weight	
	IP22/42		IP54							
	mm	in	mm	in	mm	in	mm	in	kg	lb
U_N = 400 V										
0105A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0145A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0169A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0206A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0220A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	340	750
0290A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	430	948
0293A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	430	948
0363A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	430	948
0442A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	430	948
0505A-3	2145	84.45	2315	91.14	1000	39.37	646	25.43	840	1852

Frame size	Height				Width		Depth		Weight	
	IP22/42		IP54							
	mm	in	mm	in	mm	in	mm	in	kg	lb
0585A-3	2145	84.45	2315	91.14	1000	39.37	646	25.43	840	1852
0650A-3	2145	84.45	2315	91.14	1000	39.37	646	25.43	840	1852
U_N = 500 V										
0101A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0124A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0156A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0180A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0190A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	340	750
0220A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	340	750
0260A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	340	750
0280A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	430	948
0302A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	340	750
0361A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	430	948
0414A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	430	948
0460A-5	2145	84.45	2315	91.14	1000	39.37	646	25.43	840	1852
0503A-5	2145	84.45	2315	91.14	1000	39.37	646	25.43	840	1852
U_N = 690 V										
0100A-7	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0120A-7	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0150A-7	2145	84.45	2315	91.14	600	23.62	646	25.43	410	904
0174A-7	2145	84.45	2315	91.14	600	23.62	646	25.43	410	904
0180A-7	2145	84.45	2315	91.14	600	23.62	646	25.43	410	904
0210A-7	2145	84.45	2315	91.14	600	23.62	646	25.43	410	904
0271A-7	2145	84.45	2315	91.14	600	23.62	646	25.43	410	904
0330A-7	2145	84.45	2315	91.14	400	15.75	646	25.43	340	750
0370A-7	2145	84.45	2315	91.14	400	15.75	646	25.43	340	750
0430A-7	2145	84.45	2315	91.14	400	15.75	646	25.43	340	750

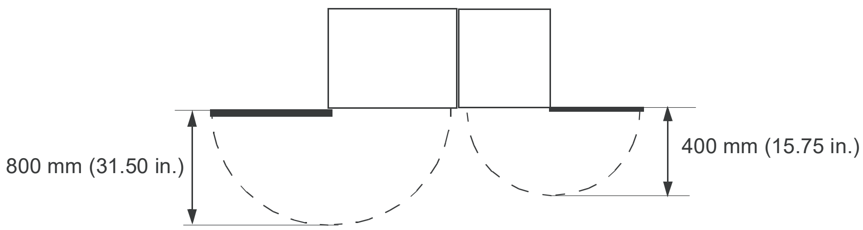
Free space requirements

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

* Measured from the base plate of the cabinet top.



Door opening:



Cooling data, noise

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

Drive type ACS880-37-...	Air flow 3)				Heat dissipation		Noise	
	-		+E206		-	+E206 1)	-	+E206 2)
	m^3/h	ft^3/min	m^3/h	ft^3/min	kW	kW	dB(A)	dB(A)
U_n = 400 V								
0105A-3	860	506	*	*	2.22	0.63	70	70
0145A-3	860	506	*	*	3.33	0.55	70	70
0169A-3	860	506	*	*	3.57	0.55	70	70
0206A-3	860	506	*	*	4.44	0.9	70	70
0220A-3	2200	1295	*	*	5.32	0.9	77	77
0290A-3	2780	1636	*	*	7.42	1.57	77	77
0293A-3	2100	1279	*	*	6.88	1.57	77	77
0363A-3	2100	1279	*	*	8.52	1.57	77	77
0442A-3	2100	1279	*	*	10.52	1.57	77	77
0505A-3	2100	1279	2000	1177	10.54	2.89	77	80
0585A-3	2100	1279	2000	1177	13.16	3.35	77	80
0650A-3	2100	1279	2000	1177	14.78	3.73	77	80
U_n = 500 V								
0101A-5	860	506	*	*	2.32	0.63	70	70
0124A-5	860	506	*	*	3.14	0.63	70	70
0156A-5	860	506	*	*	3.54	0.55	70	70
0180A-5	860	506	*	*	4.27	0.55	70	70
0190A-5	2200	1295	*	*	5.71	0.9	77	77
0220A-5	2200	1295	*	*	5.73	0.9	77	77
0260A-5	2100	1279	*	*	6.86	0.9	77	77
0280A-5	2780	1636	*	*	7.50	1.57	77	77
0302A-5	2100	1279	*	*	-	1.57	77	77
0361A-5	2100	1279	*	*	8.50	1.57	77	77
0414A-5	2100	1279	*	*	10.51	1.57	77	77
0460A-5	2100	1279	2000	1177	13.15	3.16	77	80
0503A-5	2100	1279	2000	1177	14.76	3.46	77	80
U_n = 690 V								
0100A-7	2200	1295	*	*	5.19	0.61	77	77
0120A-7	2200	1295	*	*	5.29	0.63	77	77
0150A-7	2200	1295	*	*	5.38	0.93	77	77
0174A-7	2100	1279	*	*	6.86	0.93	77	77
0180A-7	2780	1636	*	*	6.40	0.93	77	77
0210A-7	2100	1279	*	*	8.46	0.93	77	77

Drive type ACS880-37-...	Air flow[3)]				Heat dissipation		Noise	
	-		+E206		-	+E206 [1)]	-	+E206 [2)]
	m^3/h	ft^3/min	m^3/h	ft^3/min	kW	kW	dB(A)	dB(A)
0271A-7	2100	1279	*	*	10.49	0.93	77	77
0330A-7	2100	1279	700	412	13.09	2	77	80
0370A-7	2100	1279	700	412	14.71	2.2	77	80
0430A-7	2100	1279	700	412	16.53	2.6	77	80

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

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

3) Air flow for the 400 mm (15.75 in) wide brake resistor (option +D151) cubicle: 525 m^3/h (309 ft^3/min). Air flow for the 800 mm (31.50 in) wide brake resistor cubicle: 2210 m^3/h (1300 ft^3/min).

* Natural convection

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

Sine output filter data

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

Drive type ACS880-37-...	Sine filter(s) used		I_n	Cooling data	
				Heat dissipation	Air flow
	Qty	Type	A	kW	m^3/h (ft^3/min)
U_n = 400 V					
0105A-3	1	B84143V0130S230	105	0.63	*
0145A-3	1	B84143V0162S229	145	0.55	*
0169A-3	1	B84143V0162S229	169	0.55	*
0206A-3	1	B84143V0230S229	206	0.90	*
0220A-3	1	B84143V0230S229	220	0.90	*
0290A-3	1	B84143V0390S229	290	1.57	*
0293A-3	1	B84143V0390S229	264	1.57	*
0363A-3	1	B84143V0390S229	327	1.57	*
0442A-3	1	B84143V0390S229	398	1.57	*
0505A-3	1	NSIN0900-6	455	2.89	2000 (1177)
0585A-3	1	NSIN0900-6	527	3.35	2000 (1177)
0650A-3	1	NSIN0900-6	585	3.73	2000 (1177)
U_n = 500 V					
0101A-5	1	B84143V0130S230	101	0.63	*
0124A-5	1	B84143V0130S230	124	0.63	*
0156A-5	1	B84143V0162S229	156	0.55	*
0180A-5	1	B84143V0162S229	180	0.55	*
0190A-5	1	B84143V0230S229	190	0.90	*
0220A-5	1	B84143V0230S229	220	0.90	*

Drive type ACS880-37-...	Sine filter(s) used		I_n	Cooling data	
				Heat dissipa-tion	Air flow
	Qty	Type	A	kW	m³/h (ft³/min)
0260A-5	1	B84143V0230S229	234	0.90	*
0280A-5	1	B84143V0390S229	280	1.57	*
0302A-5	1	B84143V0390S229	272	1.57	*
0361A-5	1	B84143V0390S229	325	1.57	*
0414A-5	1	B84143V0390S229	373	1.557	*
0460A-5	1	NSIN0900-6	414	3.16	2000 (1177)
0503A-5	1	NSIN0900-6	453	3.46	2000 (1177)
U_n = 690 V					
0100A-7	1	B84143V0092R230	100	0.61	*
0120A-7	1	B84143V0130S230	120	0.63	*
0150A-7	1	B84143V0207S230	150	0.93	*
0174A-7	1	B84143V0207S230	157	0.93	*
0180A-7	1	B84143V0207S230	180	0.93	*
0210A-7	1	B84143V0207S230	189	0.93	*
0271A-7	1	B84143V0207S230	244	0.93	*
0330A-7	1	NSIN0485-6	297	2.0	700 (412)
0370A-7	1	NSIN0485-6	333	2.2	700 (412)
0430A-7	1	NSIN0485-6	387	2.6	700 (412)

* Natural convection

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

Typical power cable sizes

The tables below give the current carrying capacity (I_{Lmax}) and typical size for copper and aluminum cables with PVC or XLPE insulation. A correction factor K = 0.70 is used. Time const. is the temperature time constant of the cable.

The cable sizing is based on a maximum of 9 cables installed side by side on a ladder type cable tray, with three trays on top of each other (with 30 cm of space between the trays), and an ambient temperature of 30 °C (IEC 60364-5-52).

Conductor cross-section (copper)		PVC insulation Conductor temperature 70°		XLPE insulation Conductor temperature 90°		Typical dimensions of copper cable	
mm²	AWG / kcmil	I_{Lmax} (A)	Time const. (s)	I_{Lmax} (A)	Time const. (s)	Size	ø [mm]
1.5	16	13	85	16	67	3 × 1.5 + 1.5	13
2.5	12	18	121	23	88	3 × 2.5 + 2.5	14
4	12	24	175	30	133	3 × 4 + 4	16
6	10	30	251	38	186	3 × 6 + 6	18
10	8	42	359	53	268	3 × 10 + 10	21
16	6	56	514	70	391	3 × 16 + 16	23

Conductor cross-section (copper)		PVC insulation Conductor temperature 70°		XLPE insulation Conductor temperature 90°		Typical dimensions of copper cable	
mm²	AWG / kcmil	I_{Lmax} (A)	Time const. (s)	I_{Lmax} (A)	Time const. (s)	Size	ø [mm]
25	4	71	791	89	598	3 × 25 + 16	24
35	1	88	1000	110	760	3 × 35 + 16	26
50	1/0	107	1308	134	990	3 × 50 + 25	29
70	2/0	137	1613	171	1230	3 × 70 + 35	32
95	4/0	167	2046	209	1551	3 × 95 + 50	38
120	250	193	2441	241	1859	3 × 120 + 70	41
150	300	223	2820	279	2139	3 × 150 + 70	44
185	400	255	3329	319	2525	3 × 185 + 95	50
240	500	301	4073	376	3099	3 × 240 + 120	55
300	600	348	4779	435	3636	3 × 300 + 150	58

Conductor cross-section (aluminum)		PVC insulation Conductor temperature 70°		XLPE insulation Conductor temperature 90°		Typical dimensions of aluminum cable	
mm²	AWG / kcmil	I_{Lmax} (A)	Time const. (s)	I_{Lmax} (A)	Time const. (s)	Size	ø [mm]
35	1	67	736	84	669	3 × 35 + 10 Cu	26
50	1/0	82	959	102	874	3 × 50 + 15 Cu	29
70	2/0	105	1182	131	1079	3 × 70 + 21 Cu	32
95	4/0	128	1492	159	1376	3 × 95 + 29 Cu	38
120	250	148	1776	184	1637	3 × 120 + 41 Cu	41
150	300	171	2042	213	1881	3 × 150 + 41 Cu	44
185	400	196	2422	243	2237	3 × 185 + 57 Cu	49
240	500	231	2967	286	2740	3 × 240 + 72 Cu	54
300	600	267	3478	330	3229	3 × 300 + 88 Cu	58

Tightening torques

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

Electrical connections

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

Mechanical connections

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

Insulation supports

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

Cable lugs

Size	Max. torque	Strength class
M8	15 N·m (11 lbf·ft)	8.8 (A2-70 or A4-70)
M10	32 N·m (23.5 lbf·ft)	8.8
M12	50 N·m (37 lbf·ft)	8.8

Terminal and exit data for the power cables

The locations and sizes of exits are shown in the dimension drawings delivered with the drive, and in the dimension drawing examples in Dimension drawings (page 299).

Busbars for user power connections are tin-plated copper.

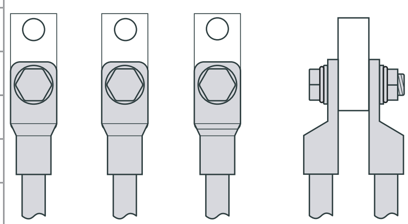
IEC

Frame size	Number of holes in the entry plate for the power cables. Hole diameter 60 mm.	Terminals L1, L2, L3, U2, V2, W2			Grounding terminals	
		Max. phase conductor size	Bolt size	Tightening torque	Bolt size	Tightening torque
		mm²				N·m
R8	6…12	185	M10	20…40 N·m	M12	50…75 N·m
R11	12	240	M12	50…75 N·m	M12	50…75 N·m
R6i+R6i R7i+R7i	6…12	240	M12	50…75 N·m	M12	50…75 N·m

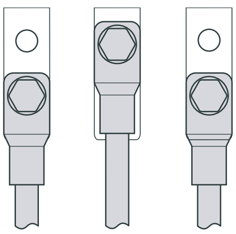
North America

Frame size	Terminals L1, L2, L3, U2, V2, W2			Grounding terminals	
	Max. phase conductor size	Busbar bolt size – Hole spacing	Tightening torque	Bolt size	Tightening torque
	AWG/kcmil		lbf·ft		lbf·ft
R8	350 MCM	M12 (7/16") × 1 – 1.75”	15…30	M10 (3/8")	37…55
R11	500 MCM	M12 (7/16") × 3 – 1.75”	37…55	M10 (3/8")	37…55
R6i+R6i R7i+R7i	500 MCM	M12 (7/16") × 1 – 1.75”	37…55	M10 (3/8")	37…55

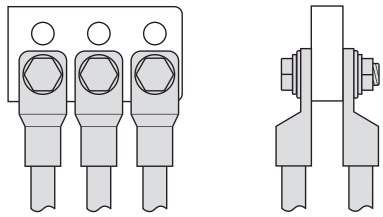
Maximum number of supply and motor cables

Frame R8			
Cable cross section (mm^2)	Copper compression cable lugs (DIN 46235)	Aluminum compression cable lugs (DIN 46329)	Connection method
50	2	2	
70	2	2	
95	2	2	
120	2	2	
150	2	2	
185	2*	2	
240	-	-	
300	-	-	-

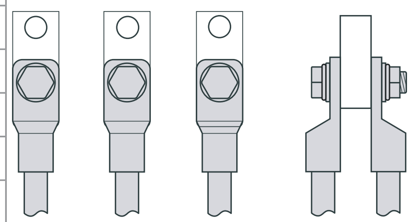
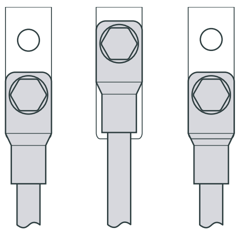
* Use holes of different height level for adjacent phases



Maximum cable lug diameter (including possible shrink hose) for R8: 38 mm (1.5 in) for drives without option +E202 and 33 mm (1.3 in) for drives with option +E202.

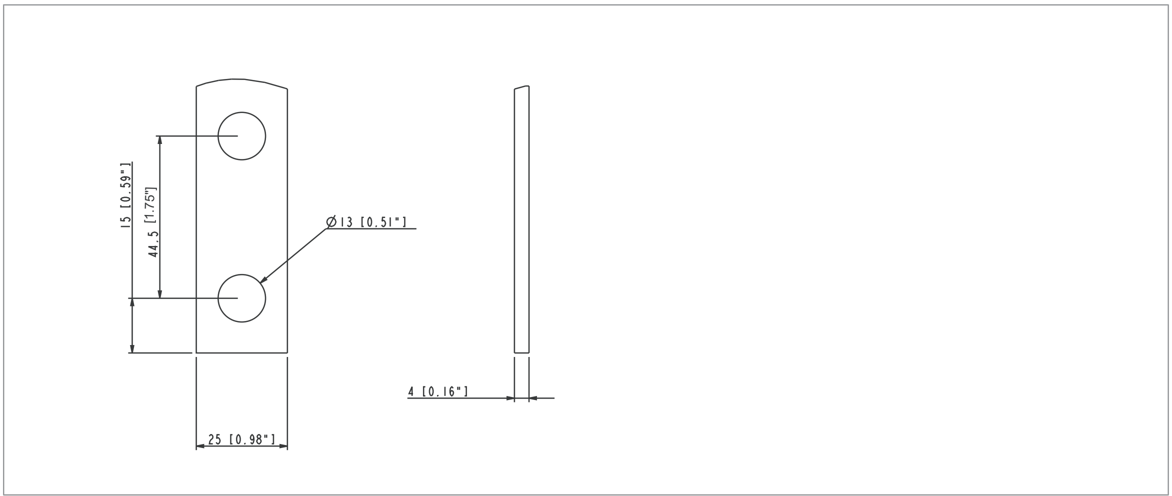
Frame R11			
Cable cross section (mm²)	**Copper compression cable lugs (DIN 46235)**	**Aluminum compression cable lugs (DIN 46329)**	**Connection method**
50	6	6	
70	6	6	
95	6	6	
120	6	6	
150	6	6	
185	6	6	
240	6	6	
300	-	-	-

Maximum cable lug diameter (including possible shrink hose) for R11 is 33 mm (1.3 in).

Frame R6i+R6i and R7i+R7i			
Cable cross section (mm²)	**Copper compression cable lugs (DIN 46235)**	**Aluminum compression cable lugs (DIN 46329)**	**Connection method**
50	2	2	
70	2	2	
95	2	2	
120	2	2	
150	2	2	
185	2	2	
240	2	2	
300	-	-	-
* Use holes of different height level for adjacent phases 			

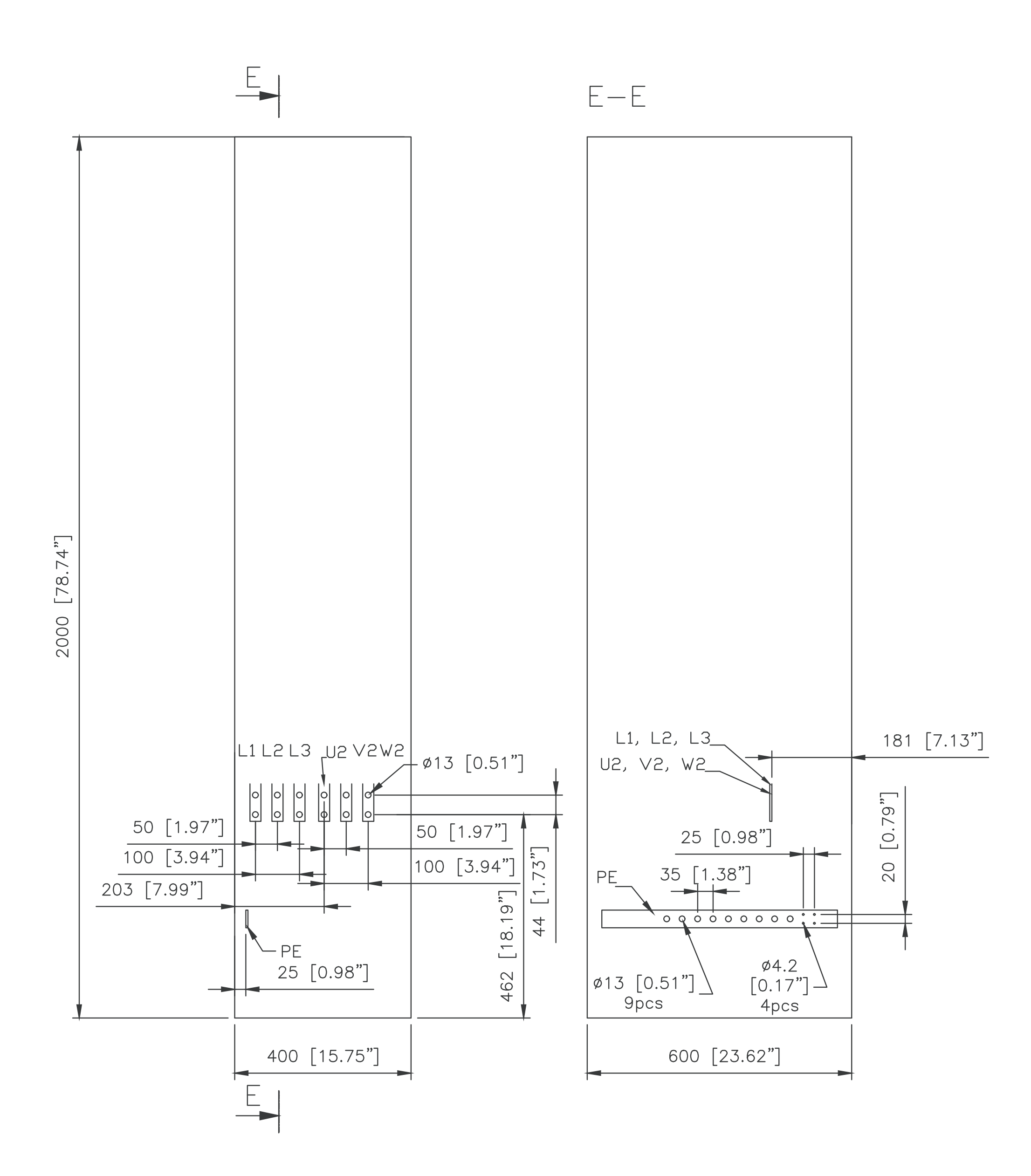
Location and size of power cable connection terminals

R8 input and motor cable terminals

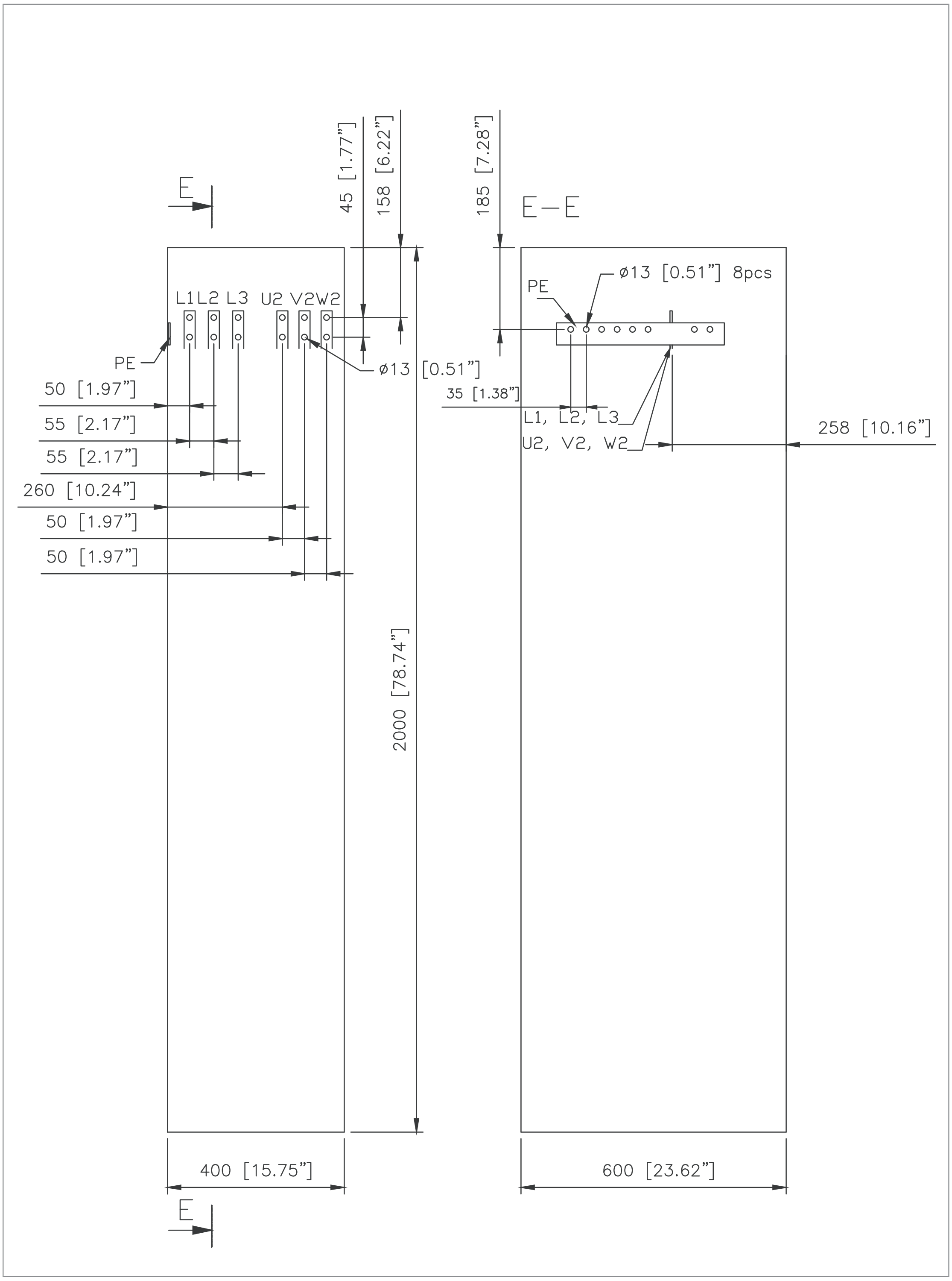


Distance between adjacent terminals is 25 mm (0.98 in) for drives without option +E202 and 50 mm (1.97 in) for drives with option +E202.

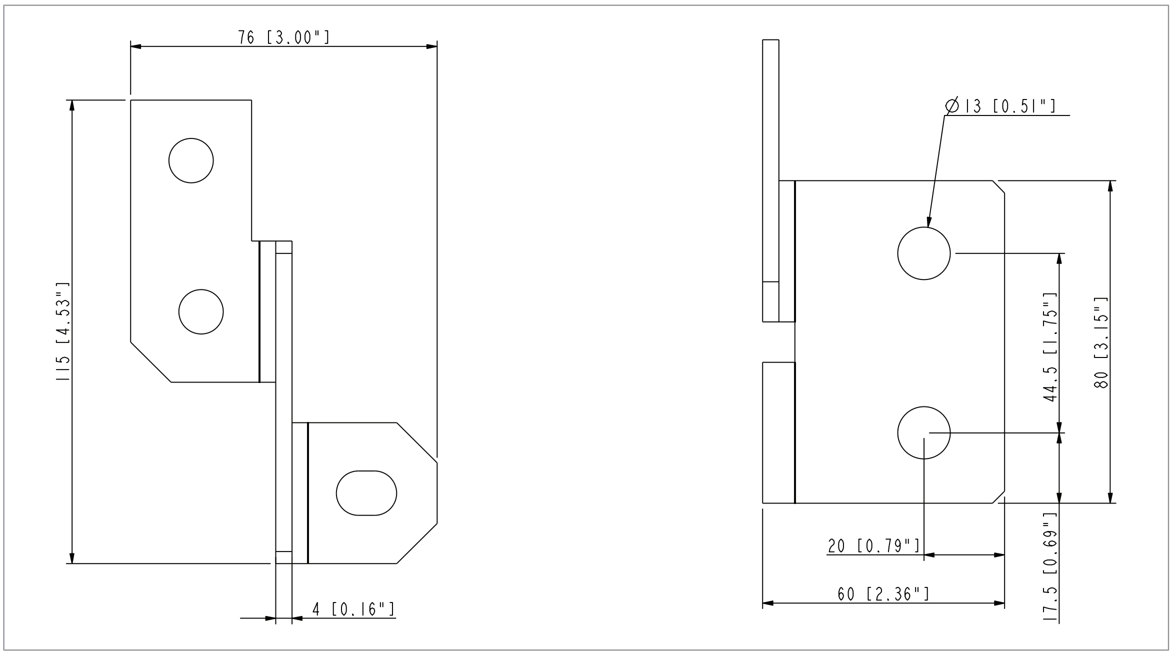
R8 input and motor cable terminal dimensions – bottom entry and exit



R8 input and motor cable terminal dimensions – top entry and exit (options +H351 and +H353)

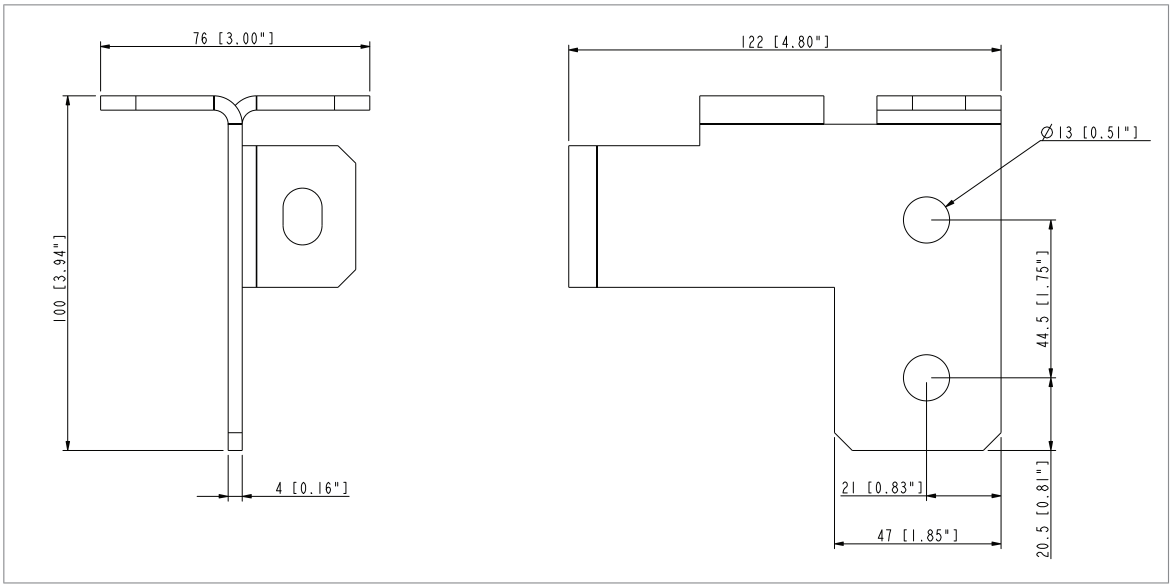


R6i+R6i and R7i+R7i input cable terminal - bottom entry



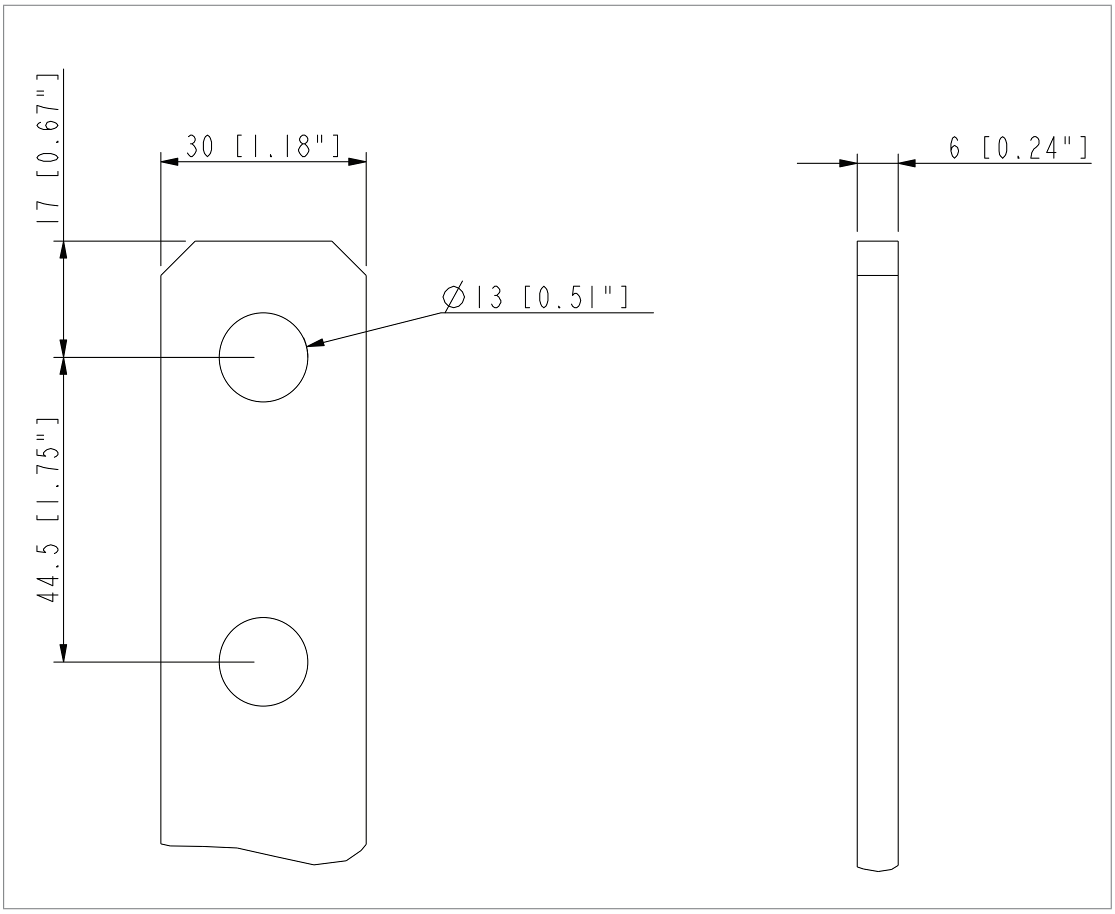
Distance between adjacent terminals is 100 mm (3.94 in).

R6i+R6i and R7i+R7i motor cable terminal - bottom exit



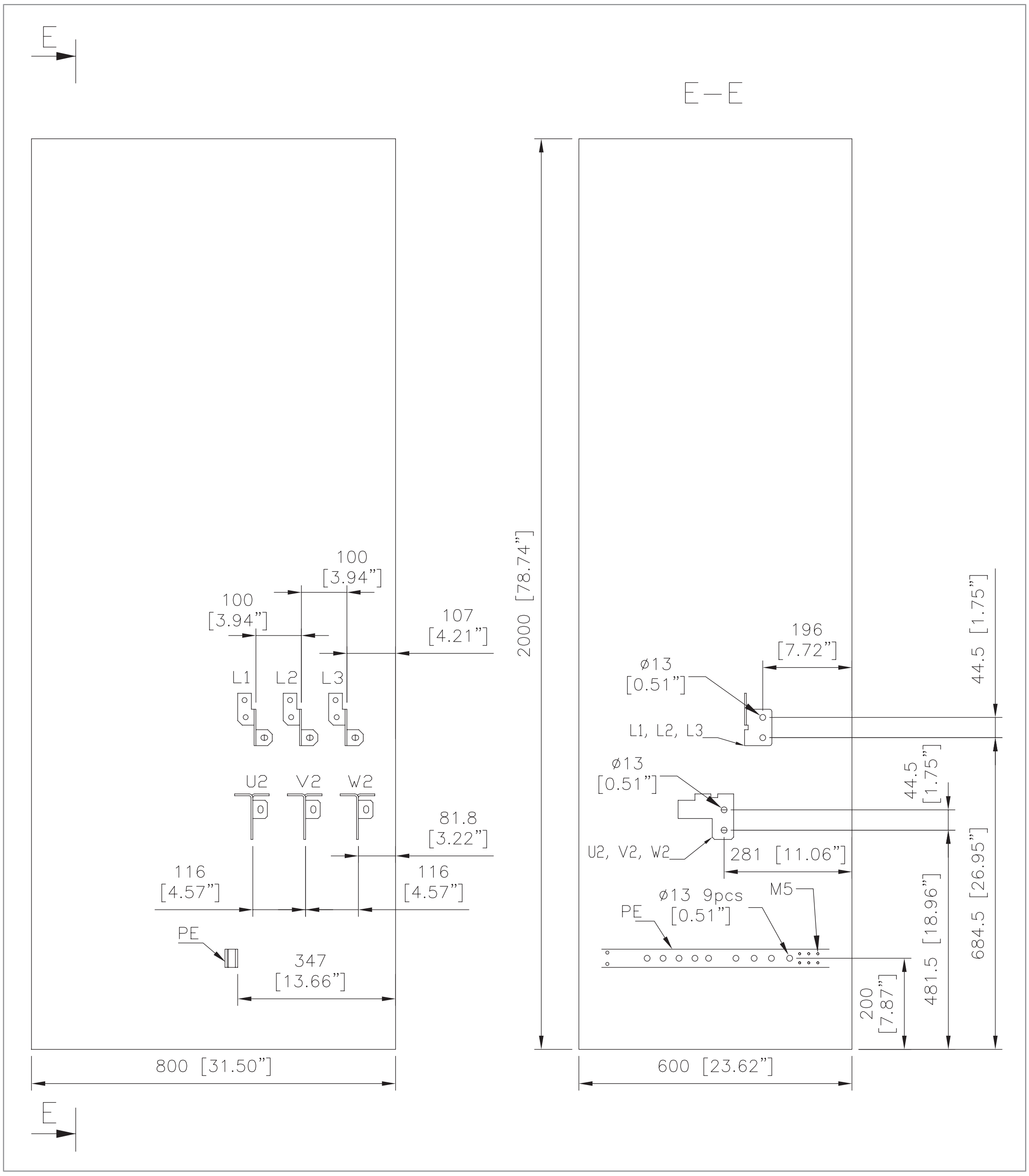
Distance between adjacent terminals is 116 mm (4.57 in).

R6i+R6i and R7i+R7i input and motor cable terminal - top entry and exit

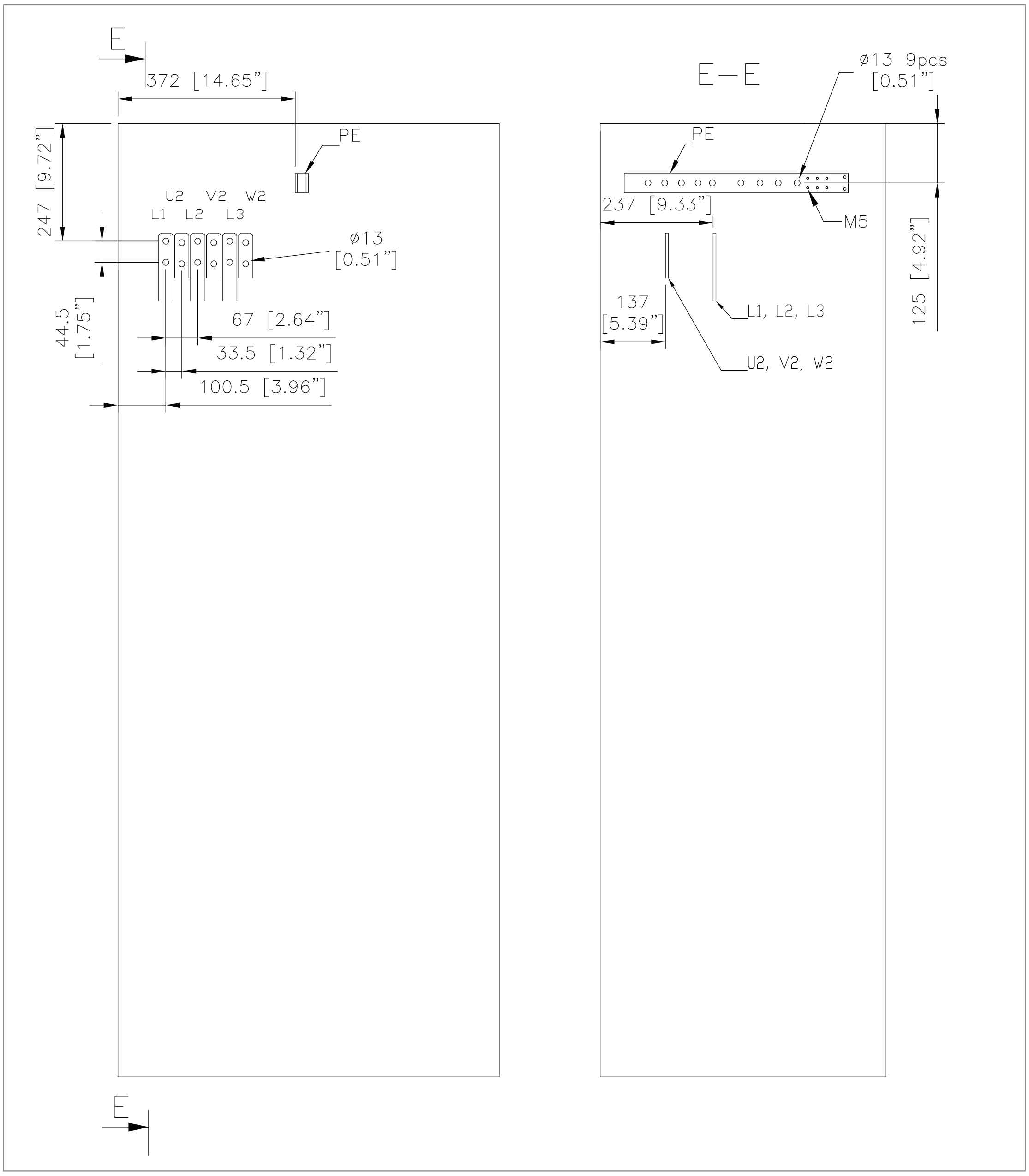


Distance between adjacent terminals is 67 mm (2.64 in).

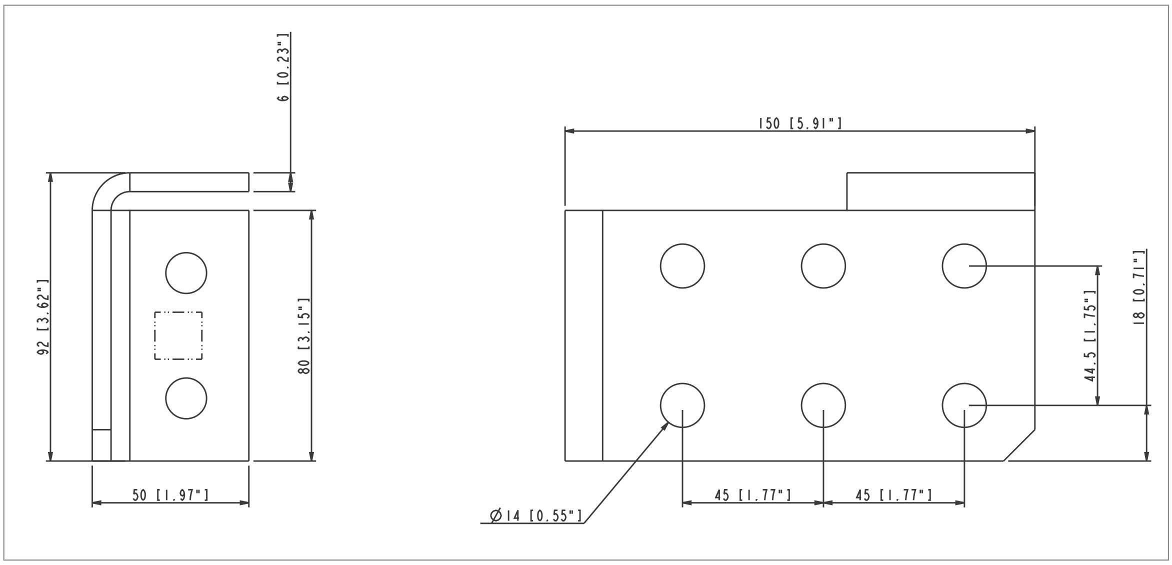
R6i+R6i and R7i+R7i input and motor cable terminal dimensions - bottom entry and exit



R6i+R6i and R7i+R7i input and motor cable terminal dimensions - top entry and exit (options +H351 and +H353)

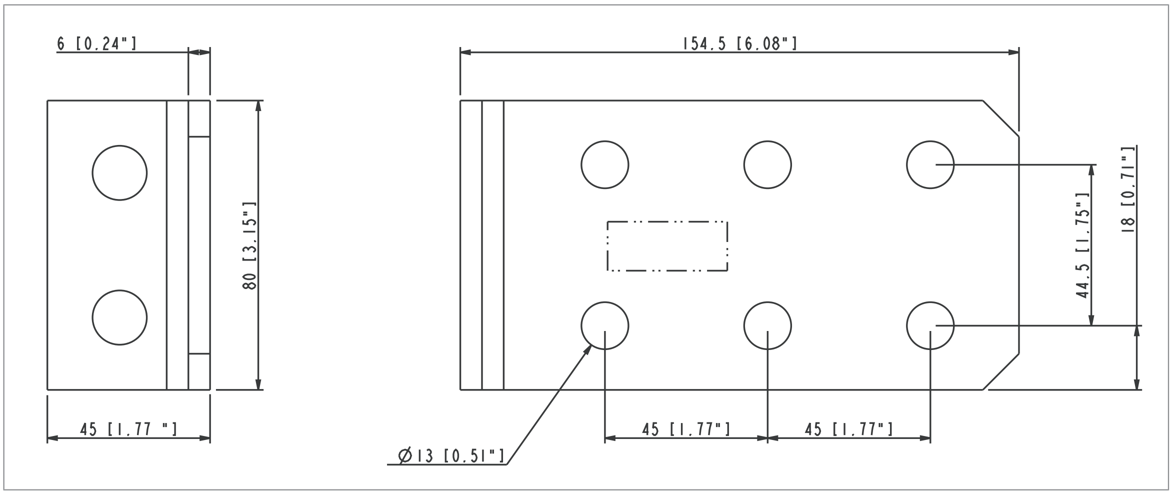


R11 input cable terminals



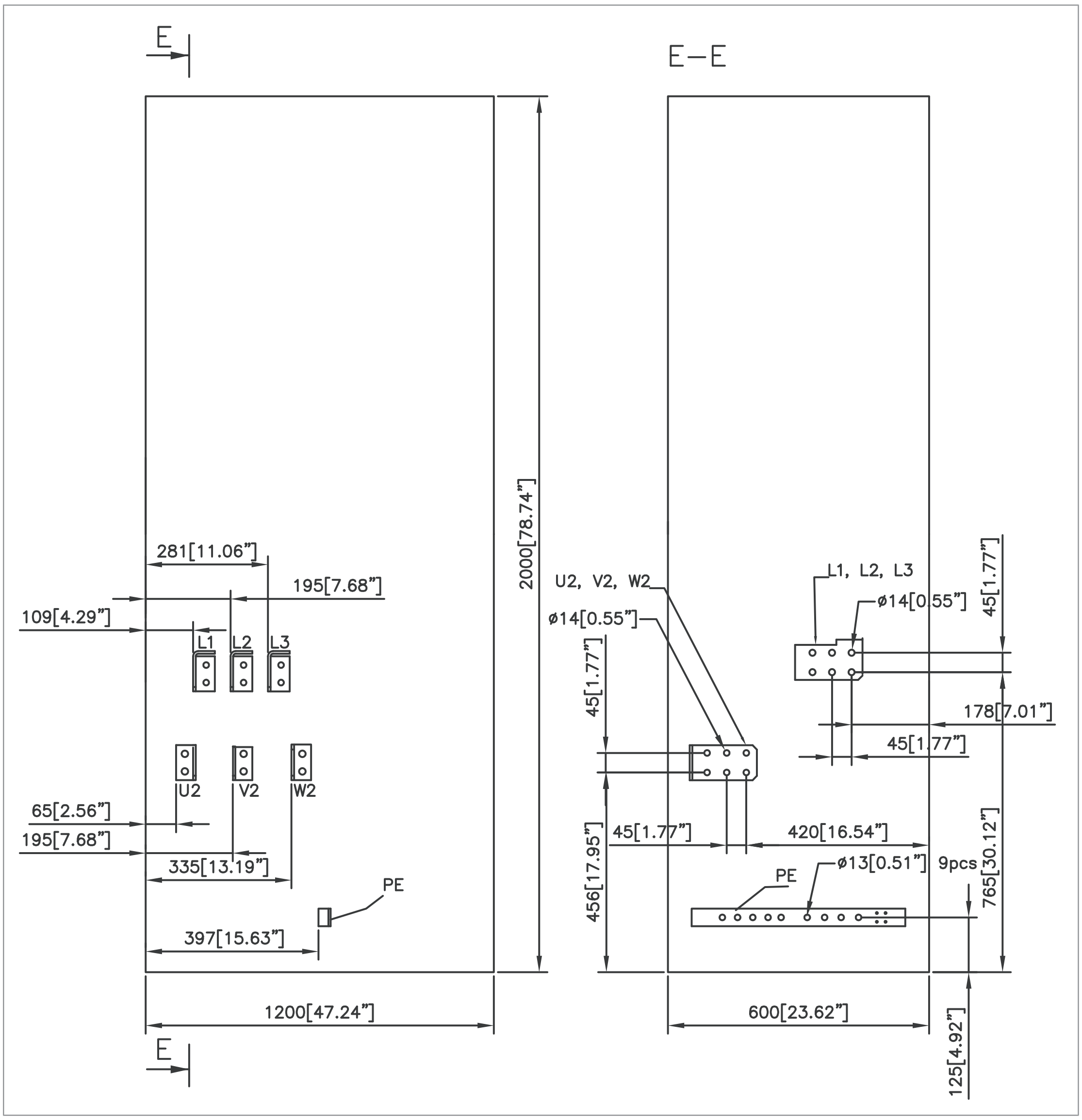
Distance between adjacent terminals is 80 mm (3.15 in).

R11 motor cable terminals

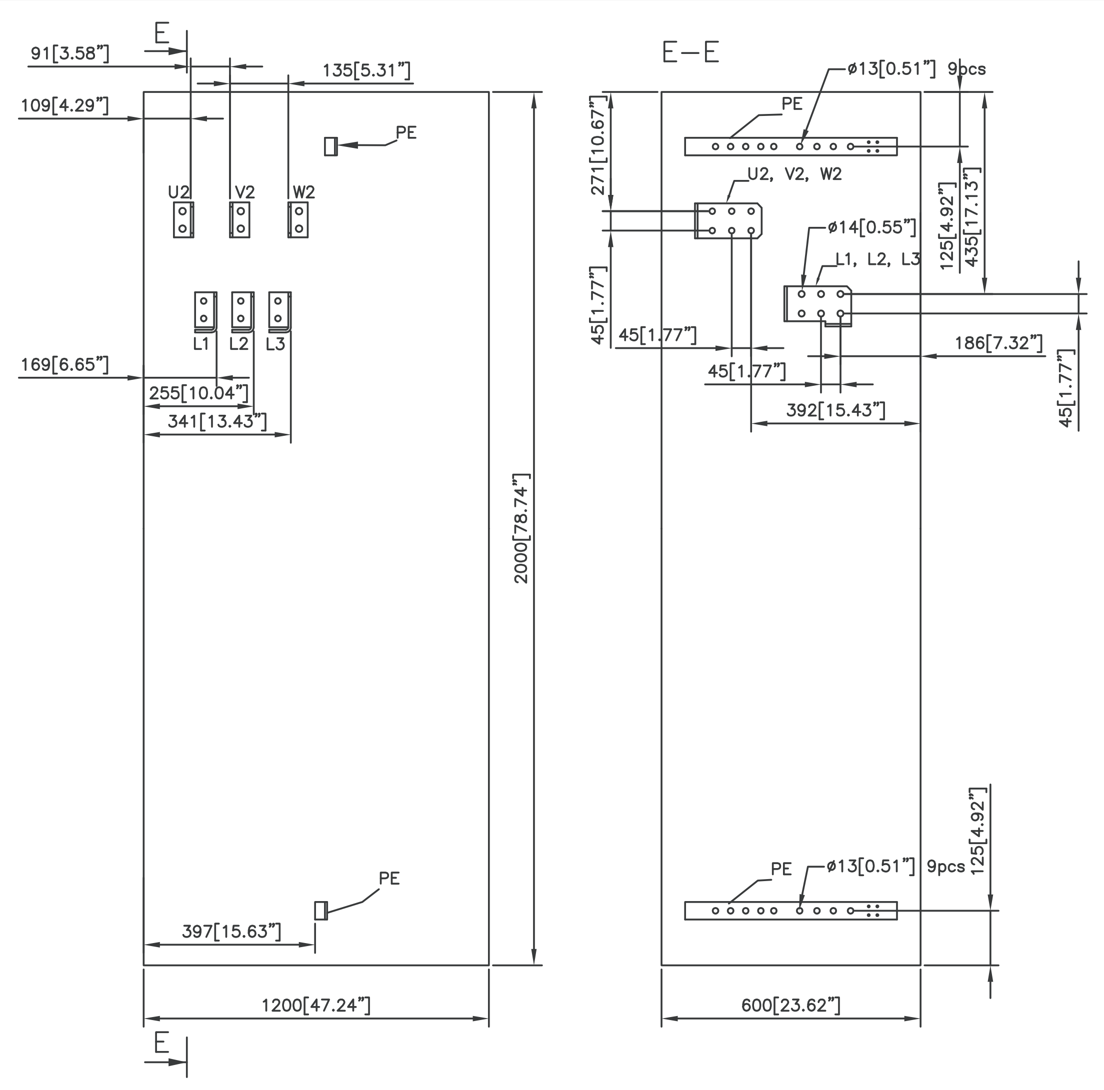


Distance between adjacent terminals is 80 mm (3.15 in).

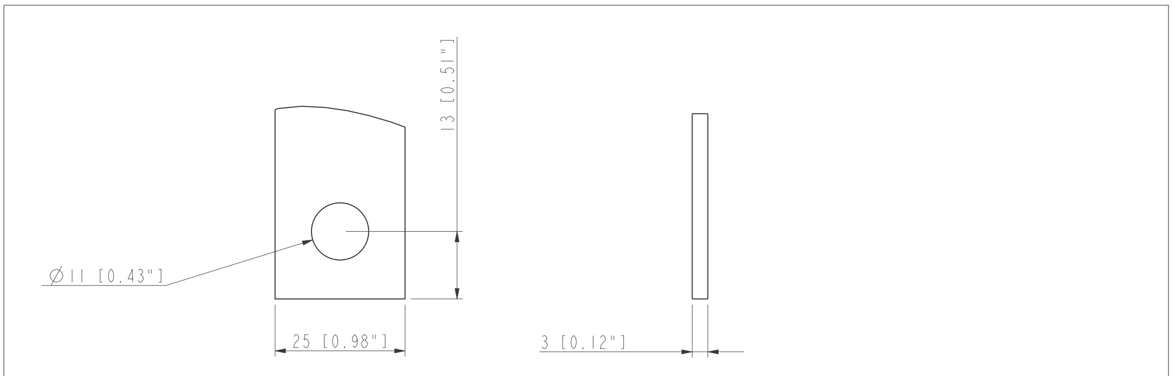
R11 input and motor cable terminal dimensions – bottom entry and exit



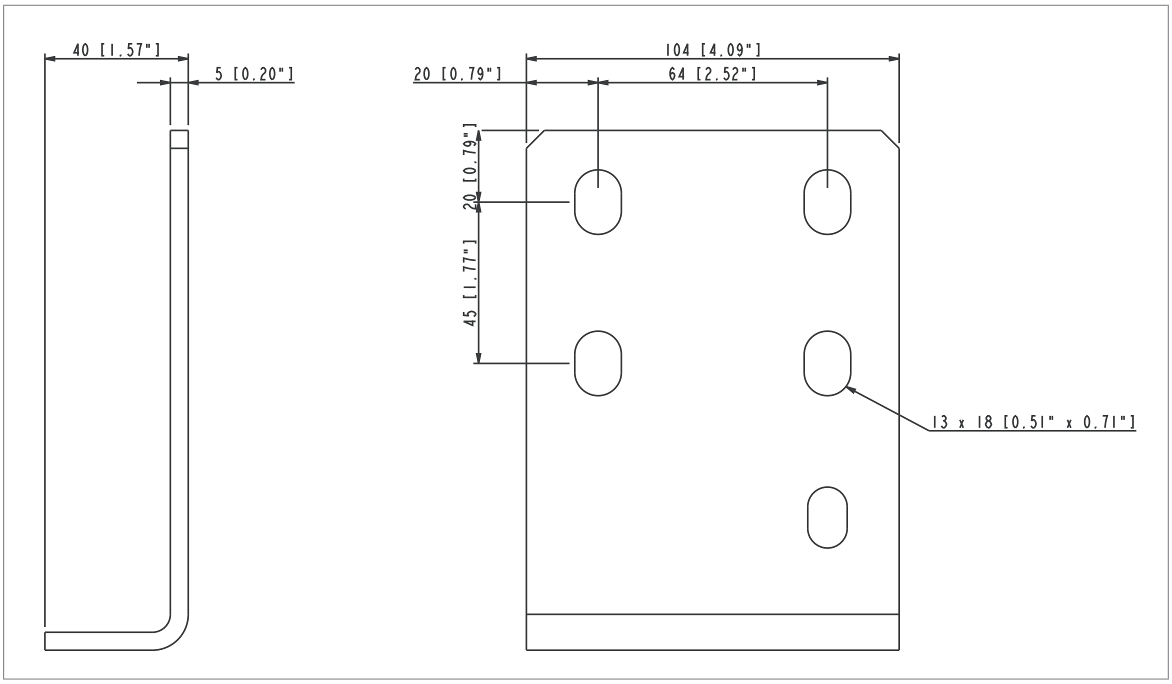
R11 input and motor cable terminal dimensions – top entry and exit (options +H351 and +H353)



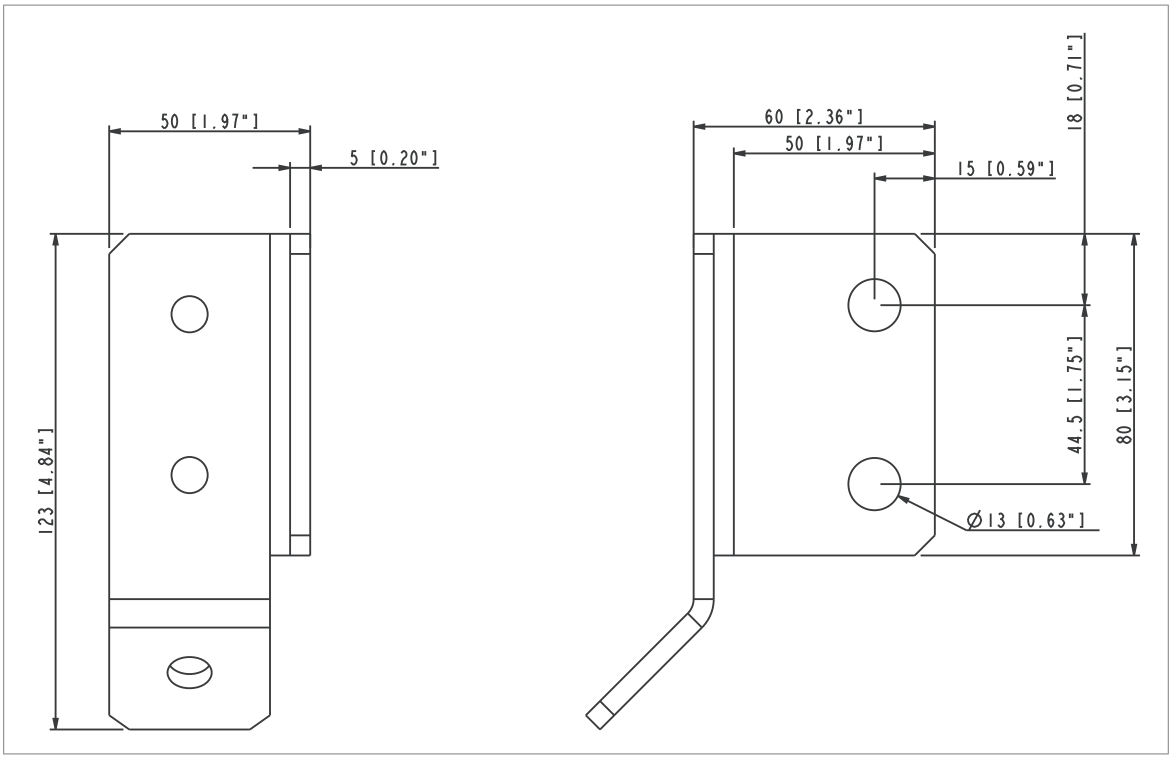
Terminals for connecting external resistors



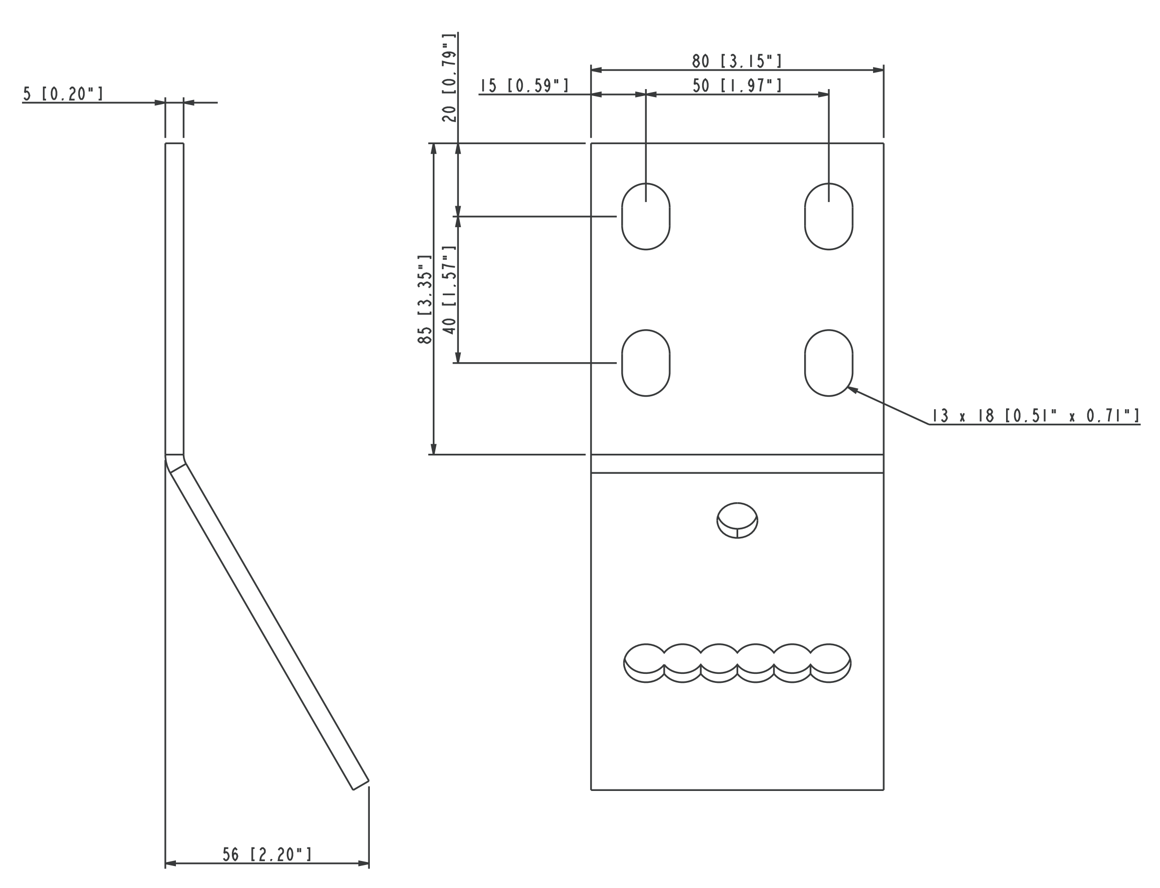
Sine filter (+E206) cubicle, 400 mm: motor cable terminals



Sine filter (+E206) cubicle, 600 mm: motor cable terminals



Sine filter (+E206) cubicle, 1000 mm: motor cable terminals



Terminal data for the drive control unit

Refer to Control unit (page 161).

Electrical power network specification

Voltage (U_1)	ACS880-37-xxxxx-3 drives: 380…415 VAC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage level. 3 ~ 400 V AC. ACS880-37-xxxxx-5 drives: 380…500 VAC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage levels. 3 ~ 400/480/500 V AC. ACS880-37-xxxxx-7 drives: 525…690 VAC 3-phase +10%…-15%. This is indicated in the type designation label as typical input voltage levels. 3 ~ 525/600/690 V AC.
Network type	TN (grounded) and IT (ungrounded) systems
Frequency (f_1)	50/60 Hz, Variation ± 5% of nominal frequency
Imbalance	Max. ± 3% of nominal phase-to-phase voltage
Short-circuit withstand strength (IEC/EN 61439-1)	Maximum allowable prospective short-circuit current is 65 kA when the input cable is protected with gG type fuses (IEC 60269) having maximum operating time of 0.1 seconds and maximum current rating as follows: • 400 A for frame R8 • 400 A for frame R6i+R6i and R7i+R7i (400 V AC, 500 V AC) • 315 A for frame R6i+R6i and R7i+R7i (690 V AC) • 1250 A for frame R11.

Short-circuit current protection (UL 508A)	The drive is suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes at 600 V maximum when the input cable is protected with class T fuses.
Short-circuit current protection (CSA C22.2 No. 286-17)	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 the input cable is protected with T class fuses.
Power factor	cos phi_1 = 1, cos phi (total) = 0.99
Harmonic distortion	Harmonics are below the limits defined in IEEE 519-2014, and G5/4. The drive complies with IEC 61000-3-2, IEC 61000-3-4 and IEC 61000-3-12.

The table below shows typical values of the drive for short-circuit ratio (I_{sc}/I_1) of 20 to 100. The values will be met if the supply network voltage is not distorted by other loads and when the drive operates at nominal load.

Nominal bus voltage V at PCC	THDi (%)	THDv (%)
V ≤ 690 V	3*	< 3**

PCC Point on a public power supply system, electrically nearest to a particular load, at which other loads are, or could be, connected. The PCC is a point located upstream of the considered installation.

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

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

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

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

I_{sc}/I_1 Short-circuit ratio

I_{sc} Maximum short-circuit current at PCC

I_1 Continuous rms input current of the drive

I_n Amplitude of the current harmonic n

U_1 Supply voltage

U_n Amplitude of the voltage harmonic n

* The short-circuit ratio can influence the THDi value

** Other loads can influence the THDv value

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet synchronous motors, AC induction servomotors, ABB synchronous reluctance (SynRM) motors
Voltage (U_1)	0 to U_1, 3-phase symmetrical, This is indicated in the type designation label as typical output voltage level as 3 ~ 0… U_1, U_{max} at the field weakening point.
Frequency (f_1)	0…±500 Hz. Operation above 120 Hz can require type-specific derating, see section High speed mode (page 257). For drives with sine filter (option +E206): 120 Hz. For drives with du/dt filter (option +E205): 120 Hz.
Current	See section Ratings (page 251).
Switching frequency	3 kHz (typically)
Maximum recommended motor cable length	R6i+R6i, R7i+R7i, R8: 300 m (984 ft) R11: 500 m (1640 ft) **Note:** For restrictions due to EMC compatibility, see section Compliance with EN 61800-3:2004 + A1:2012 (page 294). **Note:** Longer motor cables cause a motor voltage decrease which limits the available motor power. The decrease depends on the motor cable length and characteristics. Contact ABB for more information. Note that a sine filter (option +E206) at the drive output also causes a voltage decrease. **Note:** The maximum motor cable length for the EMC compliance is 100 m (328 ft).

Control unit connection data

Refer to Control unit (page 161).

Efficiency

97% at nominal power level.

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

Energy efficiency data (ecodesign)

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

Protection classes

Degrees of protection (IEC/EN 60529)	IP21 (standard), IP42 (option +B054), IP54 (option +B055)
Enclosure types (UL50)	UL Type 1 (standard), UL Type 1 (option +B054), UL Type 12 (Standard). For indoor use only.
Arcing class (IEC TR 61641)	B – ASSEMBLY providing personnel and ASSEMBLY protection under arcing conditions. Tested at the following voltage with an arcing current of 65 kA for 300 milliseconds: • 400 V units (indicated by "-4" in drive type): 420 V • 500 V units (indicated by "-5" in drive type): 550 V • 690 V units (indicated by "-7" in drive type): 760 V
Overvoltage category (IEC/EN 60664-1)	III, except for auxiliary power connections (fan, control, heating, lighting etc) which are category II.
Protective class (IEC/EN 61800-5-1)	I

Ambient conditions

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

	Operation installed for stationary use	**Storage in the protective package**	**Transportation in the protective package**
Installation site altitude	0…2000 m (0…6562 ft) above sea level. For altitudes over 2000 m, contact ABB. Output derated above 1000 m (3281 ft).	-	-
Air temperature	0 … +40 °C (+32 … +104 °F). No condensation allowed. Output derated in the range +40 … +50 °C (+104 … +122 °F). For UL and CSA compliant installations, the maximum surrounding air temperature is 40 °C (104 °F).	-40 … +70 °C (-40 … +158 °F)	-40 … +70 °C (-40 … +158 °F)
Relative humidity	Max. 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination	IEC/EN 60721-3-3:2002 Chemical gases: Class 3C2 Solid particles: Class 3S2 (3S1 with IP20). No conductive dust allowed.	IEC 60721-3-1:1997 Chemical gases: Class 1C2 Solid particles: Class 1S3 (packing must support this, otherwise 1S2)	IEC 60721-3-2:1997 Chemical gases: Class 2C2 Solid particles: Class 2S2
Pollution degree IEC/EN 60664-1	2		

	Operation **installed for stationary use**	**Storage** **in the protective package**	**Transportation** **in the protective package**
Vibration IEC/EN 61800-5-1 IEC 60068-2-6:2007, EN 60068-2-6:2008	IEC/EN 60721-3-3:2002 10…57 Hz: max. 0.075 mm amplitude 57…150 Hz: 1 *g* Units with marine construction (option +C121): Max. 1 mm (0.04 in) (5 … 13.2 Hz), max. 0.7 *g* (13.2 … 100 Hz) sinusoidal	IEC/EN 60721-3-1:1997 10…57 Hz: max. 0.075 mm amplitude 57…150 Hz: 1 *g*	IEC/EN 60721-3-2:1997 2…9 Hz: max. 3.5 mm amplitude 9…200 Hz: 10 m/s^2 (32.8 ft/s^2)
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009	Not allowed	With packing max. 100 m/s^2 (328 ft/s^2) 11 ms	With packing max. 100 m/s^2 (328 ft/s^2) 11 ms

Transportation

The table below specifies the transportation methods and conditions for the drive. The transportation conditions must also comply with the environmental limits specified in Ambient conditions (page 288). Seaworthy package (option +P912) is required for non-weather protected transportation conditions.

Package type	**Method**	**Weather-protected conditions (IEC 60721-3-2)**	**Non-weather protected conditions (IEC 60721-3-2)**
Standard package Wooden crate Vertical	Road, air, sea (in container). Special vehicle requirements: High-cube container. ABB recommends the use of container desiccant bags in sea transportation.	**2K12**: Transportation without temperature and humidity control allowed.	Not allowed.
Seaworthy package (option +P912) Wooden crate covered with plywood sheets Vertical	Road, air, sea (in container). Special vehicle requirements: High-cube container. ABB recommends the use of container desiccant bags in sea transportation.	**2K12**: Transportation without temperature and humidity control allowed.	**2K14:** Non-weather-protected transportation worldwide.
Standard package Cardboard box Horizontal[1)]	Road, rail, air, sea (in container). Special vehicle requirements: Preferred for air and courier. ABB recommends the use of container desiccant bags in sea transportation.	**2K12**: Transportation without temperature and humidity control allowed.	Not allowed.

Package type	Method	Weather-protected conditions (IEC 60721-3-2)	Non-weather protected conditions (IEC 60721-3-2)
Seaworthy package (option +P912) Wooden crate covered with plywood sheets Horizontal[1]	Road, rail, air, sea. Special vehicle requirements: Preferred for sea transportation. ABB recommends the use of container desiccant bags in sea transportation.	**2K12**: Transportation without temperature and humidity control allowed.	**2K14:** Non-weather-protected transportation worldwide.

[1] Drive widths up to 830 mm can be delivered in a horizontal package. Factory makes the final decision on the packing position. It depends, for example, on the drive size and options, and the transportation method.

Storage conditions

The table below specifies the storage conditions for the drive. Store the drive in its package. ABB recommends seaworthy package (option +P912) if the drive is in long-term storage. The storage conditions must also comply with the environmental limits specified in Ambient conditions (page 288).

Package type	Storage conditions (IEC 60721-3-1)
Standard package Wooden crate Vertical	**1K20:** Up to 24 months in enclosed conditions (full temperature and humidity control). **1K22:** Up to 6 months in enclosed conditions (no temperature or humidity control). **1K23, 1K24**: Up to 3 months in sheltered conditions (roof providing protection from direct rain and sun). **1K25…1K27:** Up to 48 hours between loading operations in open-air conditions (no protection).
Seaworthy package (option +P912) Wooden crate covered with plywood sheets Vertical	**1K20:** Up to 24 months in enclosed conditions (full temperature and humidity control). **1K22:** Up to 12 months in enclosed conditions (no temperature or humidity control). **1K23, 1K24:** Up to 12 months in sheltered conditions (roof providing protection from direct rain and sun). **1K25…1K27:** Up to 1 month in open-air conditions (no protection). Not recommended, but can be temporarily allowed.
Standard package Cardboard box Horizontal	**1K20:** Up to 24 months in enclosed conditions (full temperature and humidity control). **1K22:** Up to 6 months in enclosed conditions (no temperature or humidity control). **1K23, 1K24:** Up to 2 months in sheltered conditions (roof providing protection from direct rain and sun). **1K25…1K27:** Storing in open-air conditions (no protection) is not allowed.
Seaworthy package (option +P912) Plywood box Horizontal	**1K20:** Up to 24 months in enclosed conditions (full temperature and humidity control). **1K22:** Up to 12 months in enclosed conditions (no temperature or humidity control). **1K23, 1K24:** Up to 6 months in sheltered conditions (roof providing protection from direct rain and sun). **1K25…1K27:** Up to 1 month in open-air conditions (no protection). Not recommended, but can be temporarily allowed.

Auxiliary circuit power consumption

Cabinet heater and lighting (options +G300 and +G301)	150 W
External uninterruptible power supply (option +G307)	150 W 210 W with MCS-B 7.5-110-240/24 power supply unit or 220 W with EMPARRO 10-100-240/24 power supply unit
Motor heater (option +G313)	According to heater type

Color

Cabinet: RAL Classic 7035 and RAL Classic 9017.

Materials

Drive

Cabinet

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

Modules

For R8 modules, refer to ACS880-11, ACS880-31, ACH580-31 and ACQ580-31 drives Recycling instructions and environmental information (3AXD50000137671 [English]).

For R11 modules, refer to ACS880-04, ACS880-14, ACS880-34, ACS580-04, ACH580-04, ACH580-34, ACQ580-04 and ACQ580-34 drives Recycling instructions and environmental information (3AXD50000137688 [English]).

For R6i and R7i modules, refer to Recycling instructions and environmental information for ACS880 cabinet-installed drives and multidrive modules (3AXD50000153909 [English]).

Package

- Cardboard heavy duty quality with wet strength glue
- Plywood [1)]
- Wood
- PET (strapping)
- PE (VCI film)
- Metal (fixing clamps, screws)
- Clay desiccant.

1) Horizontal package only: Also cardboard hoods are used instead.

Package materials for options, accessories and spare parts

- Cardboard
- Kraft paper

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

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

Materials of manuals

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

Disposal

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

Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery.

Printed circuit boards and DC capacitors need selective treatment according to IEC 62635 guidelines.

To aid recycling, most plastic parts are marked with an appropriate identification code. In addition, components containing substances of very high concern (SVHCs) are listed in European Chemicals Agency's SCIP database. SCIP is the database for information on Substances of Concern In articles as such or in complex objects (Products) established under the Waste Framework Directive (2008/98/EC). For further information, contact your local ABB distributor or consult European Chemicals Agency's SCIP database to find out which SVHCs are used in the drive, and to find out where those components are located.

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

For more information on ABB end of life services, refer to new.abb.com/service/end-of-life-services.

Applicable standards

Standard	Information
European electrical safety	
EN 61800-5-1:2007 + A1:2017 + A11:2021 IEC 61800-5-1:2007 + Amd1:2016	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements – Electrical, thermal and energy
EMC performance	
EN 61800-3:2004 + A1:2012 IEC 61800-3:2004 + A1:2011 IEC 61800-3:2017	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
IEC 60533:2015	Electrical and electronic installations in ships - Electromagnetic compatibility (EMC) - Ships with a metallic hull
IEC 62742:2021	Electrical and electronic installations in ships - Electromagnetic compatibility (EMC) - Ships with a non-metallic hull [1)]
Product requirements in North America	
UL 508A: 3rd edition	Industrial Control Panels
CSA C22.2 No. 286-17, 1st edition	Industrial Control Equipment
Enclosure and environmental protection	
EN 60529:1991 + A2:2013 + AC:2019 IEC 60529:1989 + AMD1:1999 + AMD2:2013+COR1:2019	Degrees of protection provided by enclosures (IP code)
UL 50: 12th edition	Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 50E: 1st edition	Enclosures for Electrical Equipment, Environmental Considerations
CSA C22.2 No. 94.1-15	Enclosures for Electrical Equipment, Non-Environmental Considerations
CSA C22.2 No. 94.2-15	Enclosures for Electrical Equipment, Environmental Considerations

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

Markings

	CE mark Product complies with the applicable European Union legislation. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).

	UKCA (UK Conformity Assessed) mark Product complies with the applicable United Kingdom’s legislation (Statutory Instruments). Marking is required for products being placed on the market in Great Britain (England, Wales and Scotland).

	UL Listed mark for USA and Canada Product has been tested and evaluated against the relevant North American standards by the Underwriters Laboratories. Valid with rated voltages up to 600 V.

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.

EAC (Eurasian Conformity) mark

Product complies with the technical regulations of the Eurasian Customs Union. EAC mark is required in Russia, Belarus and Kazakhstan.

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).

Electronic Information Products (EIP) symbol including an Environment Friendly Use Period (EFUP).

Product is compliant with the People's Republic of China Electronic Industry Standard (SJ/T 11364-2014) about hazardous substances. The EFUP is 20 years. China RoHS II Declaration of Conformity is available from https://library.abb.com.

KC mark

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

WEEE mark

At the end of life the product should enter the recycling system at an appropriate collection point and not placed in the normal waste stream.

Compliance with EN 61800-3:2004 + A1:2012

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 option +E202.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Frame R8: maximum motor cable length is 100 meters (328 ft).
   Frame R11: maximum motor cable length is 150 meters (492 ft).
   Frames R6i+R6i and R7i+R7i: maximum motor cable length is 300 meters (984 ft).

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

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

Category C3

The drive complies with the standard with the following provisions:

1. Frame R8: The drive is equipped with EMC filter option +E200 or +E201.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Frame R8: maximum motor cable length is 150 meters (492 ft).
   Frame R11: maximum motor cable length is 150 meters (492 ft).
   Frames R6i+R6i and R7i+R7i: maximum motor cable length is 300 meters (984 ft).

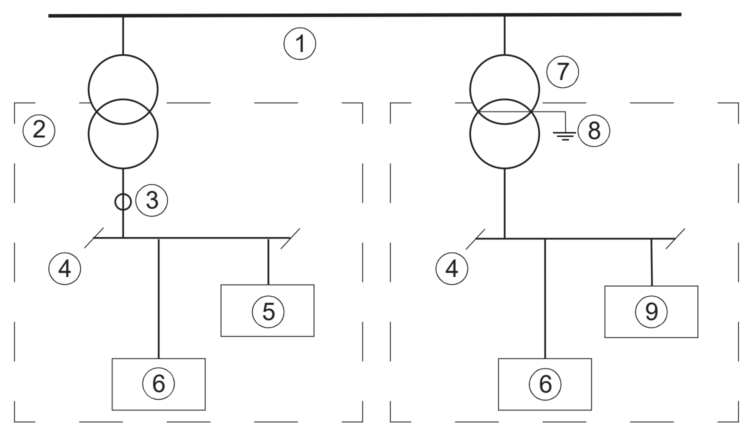
WARNING!
A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Category C4

The drive complies with the C4 category with these provisions:

1. It is made sure that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the natural suppression in transformers

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



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

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

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

UL 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.
- For UL and CSA compliant installations, the maximum surrounding air temperature is 40 °C (104 °F).
- The drive is suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes, 600 V maximum when protected by the UL fuses given elsewhere in this chapter.
- The cables located within the motor circuit must be rated for at least 75 °C in UL-compliant installations.
- The input cable must be protected with fuses or circuit breakers. These protective devices provide branch circuit protection in accordance with the national regulations (National Electrical Code (NEC) or Canadian Electrical Code). Obey also any other applicable local or provincial codes.

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

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

Approvals

The drive is marine type-approved. For more information, refer to ACS880…+C132 marine type-approved cabinet-built drives and units supplement (3AXD50000039629 [English]).

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.

Cyber security 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.

Declarations of conformity

Link to Declaration of conformity according to EU Machinery Directive 2006/42/EU (3AXD10000105027)

Link to Declaration of conformity according to UK Supply of Machinery (Safety) Regulations 2008 (3AXD10001326695)

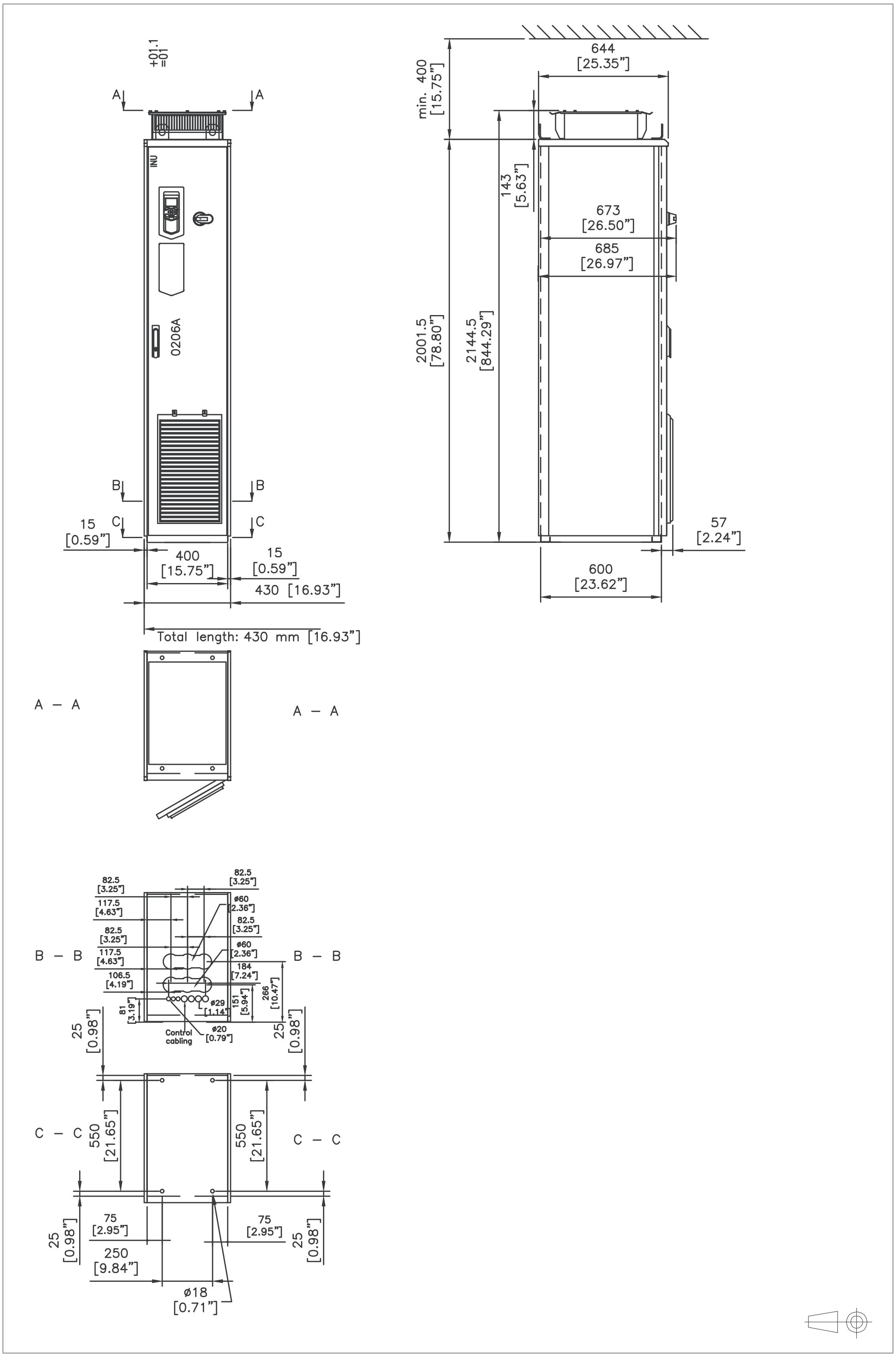
13

Dimension drawings

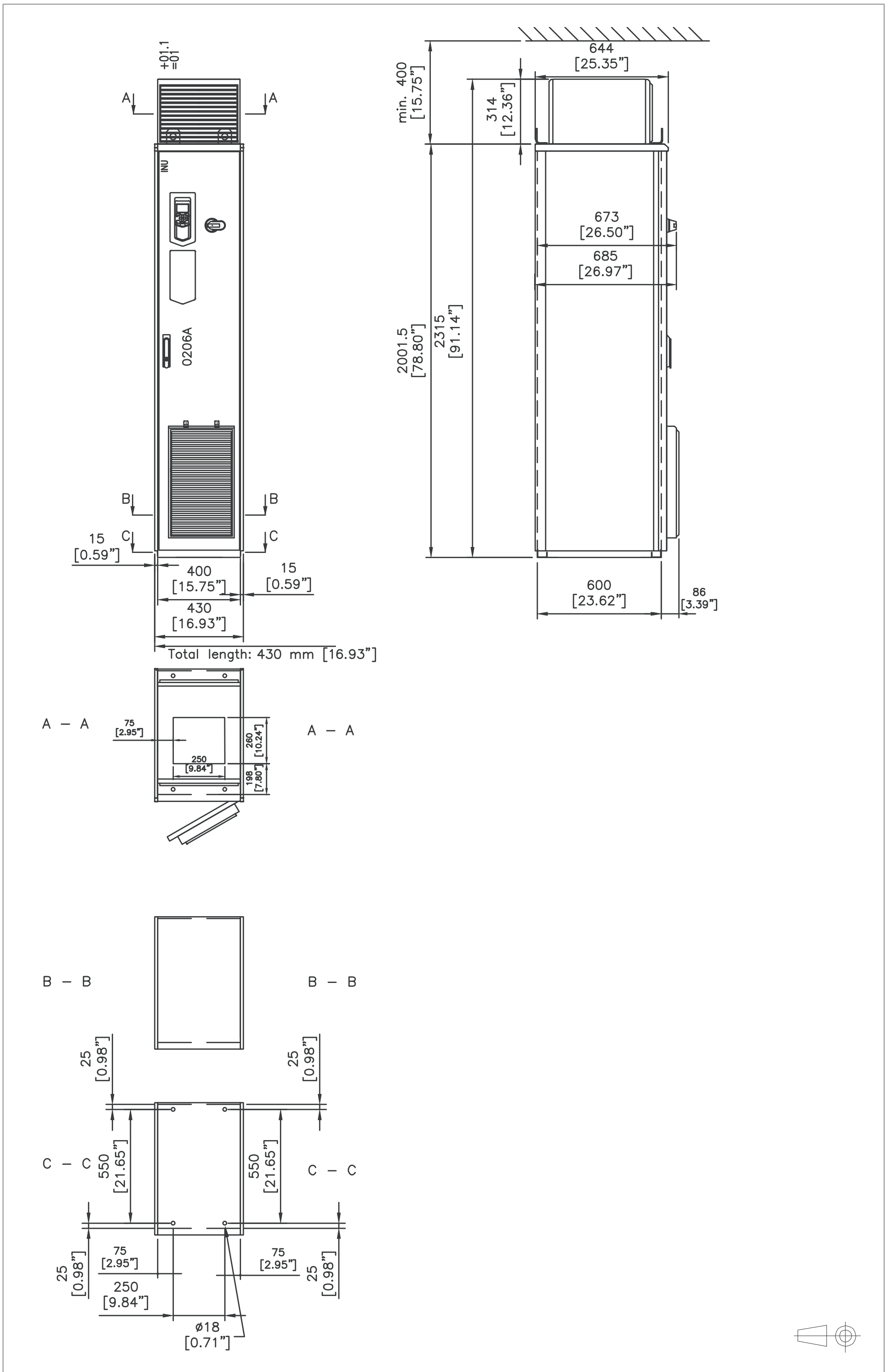
Contents of this chapter

This chapter contains example dimension drawings.

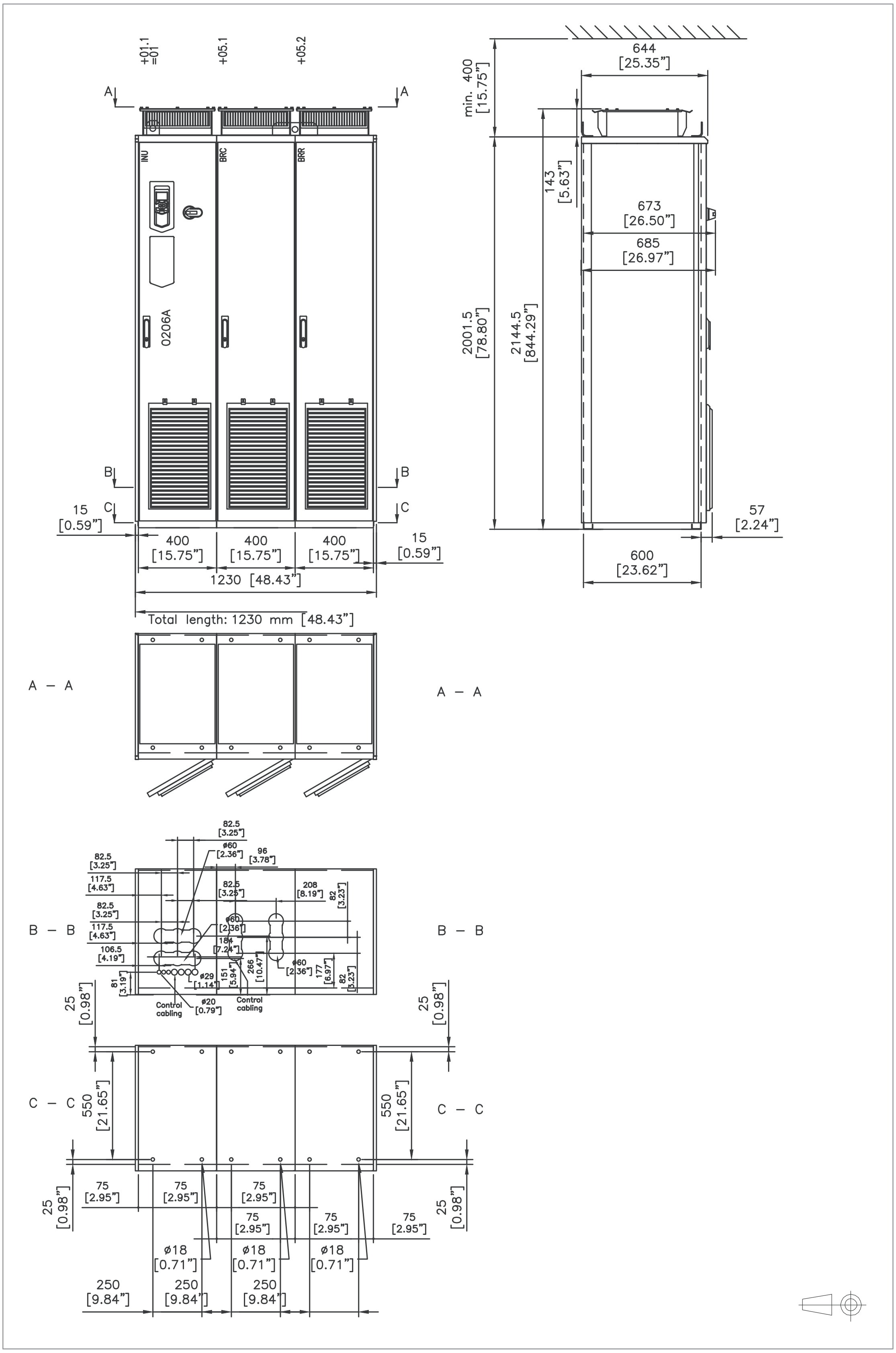
R8 IP22 (UL Type 1) and option +B054 (IP42 [UL Type 1 Filtered])



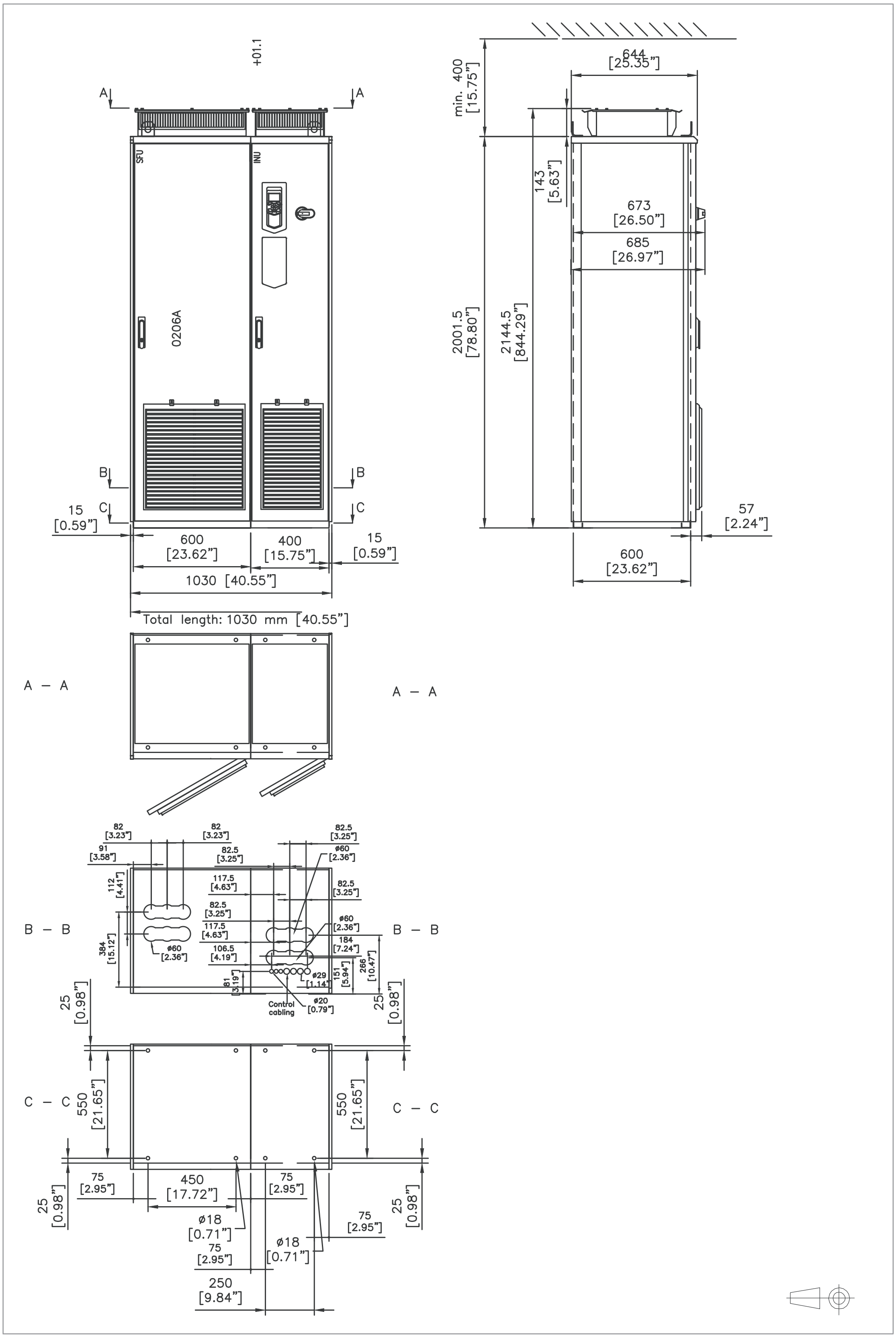
R8 IP54 (UL Type 12, option +B055), option +C129



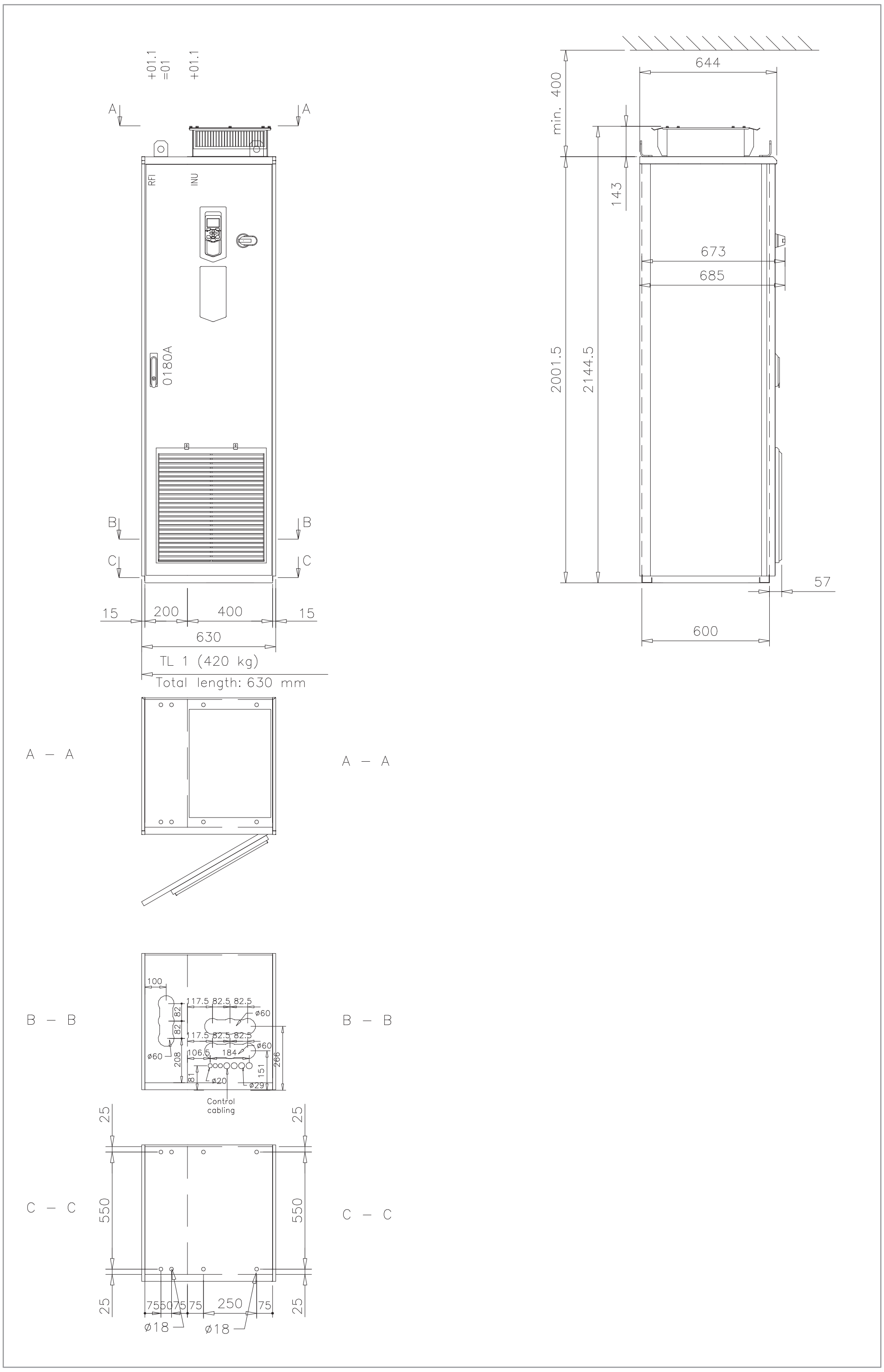
R8 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +D150, +D151



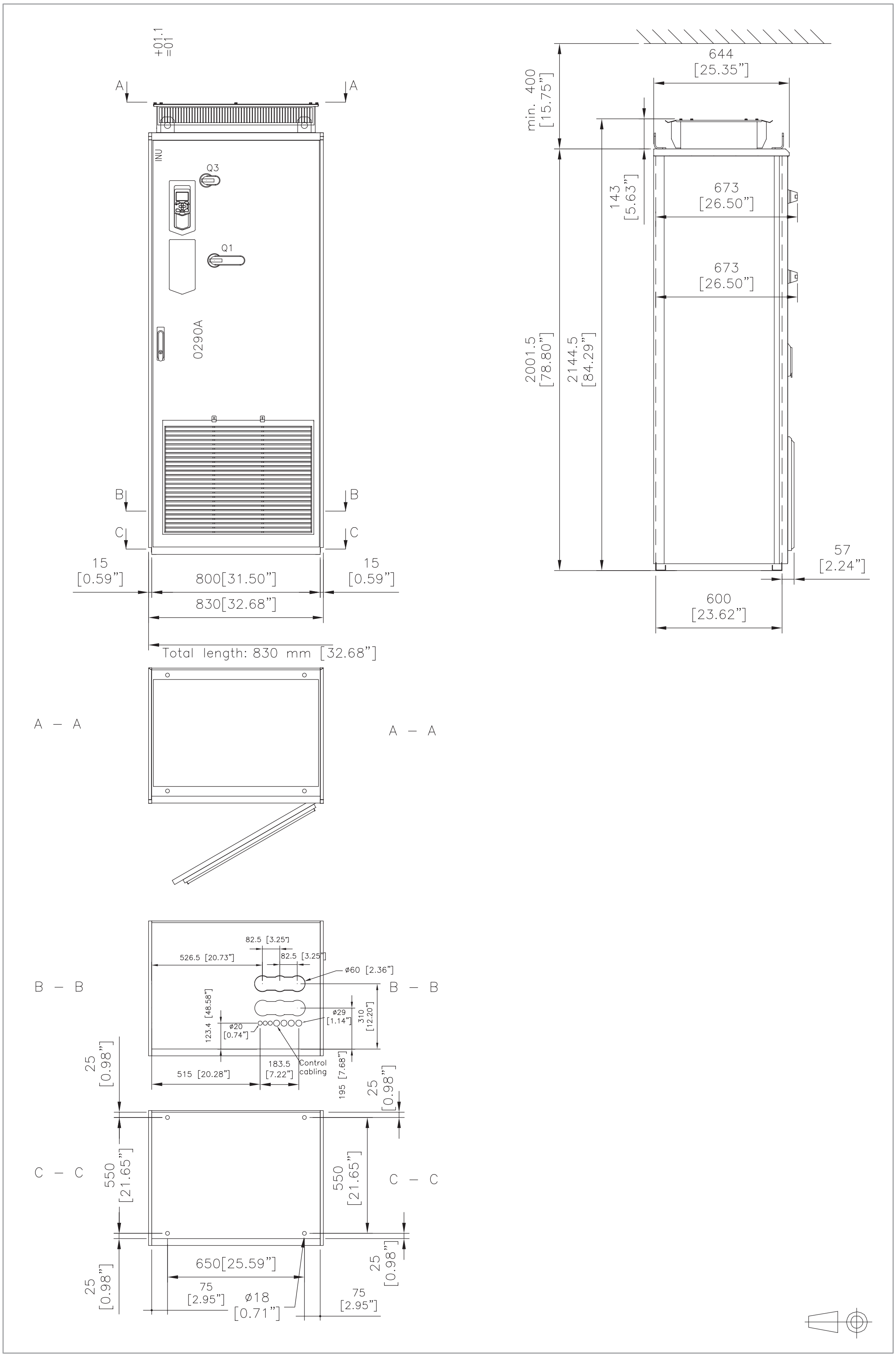
R8 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +E206



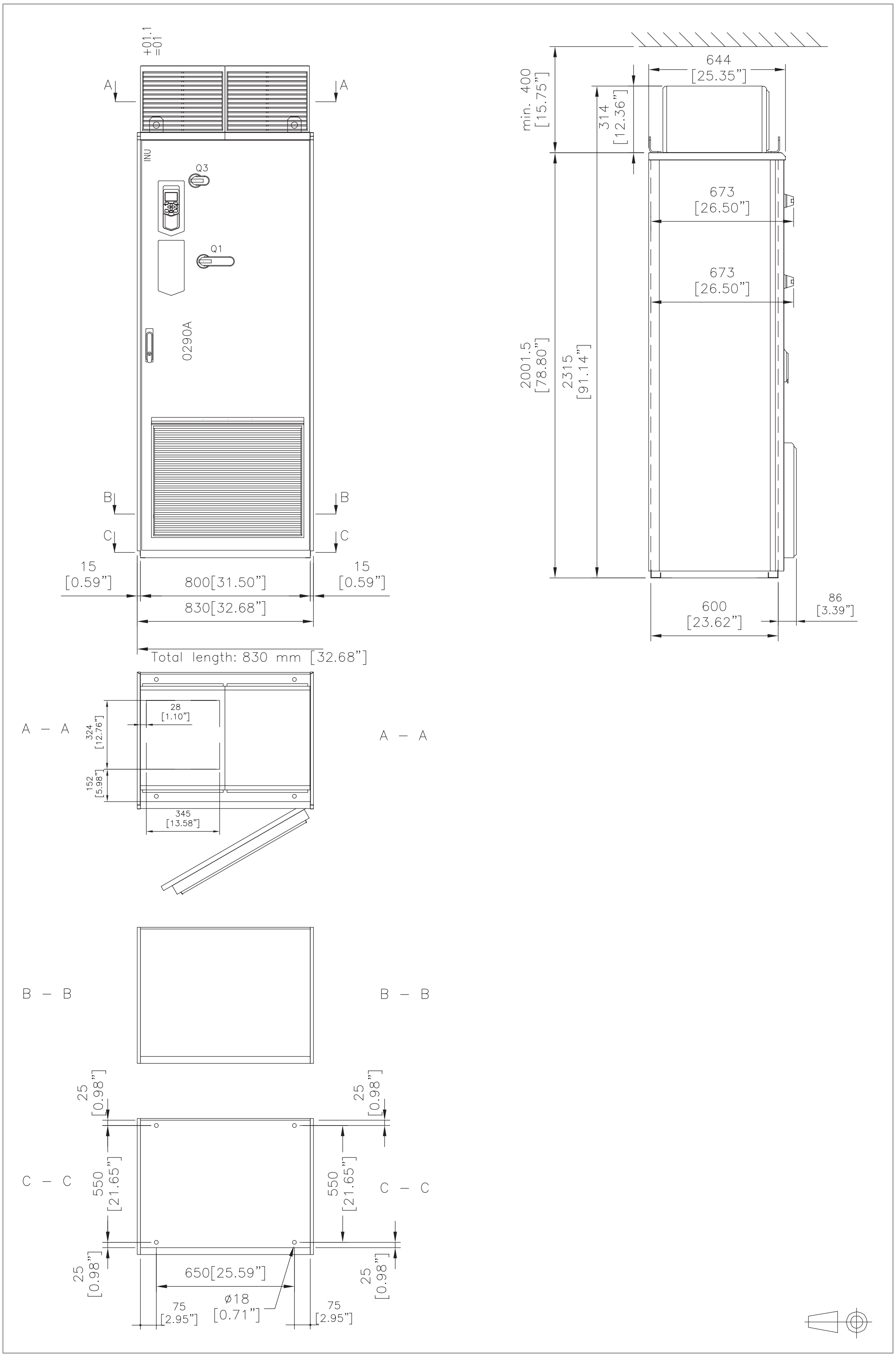
R8 IP22 (UL Type 1): option +E202



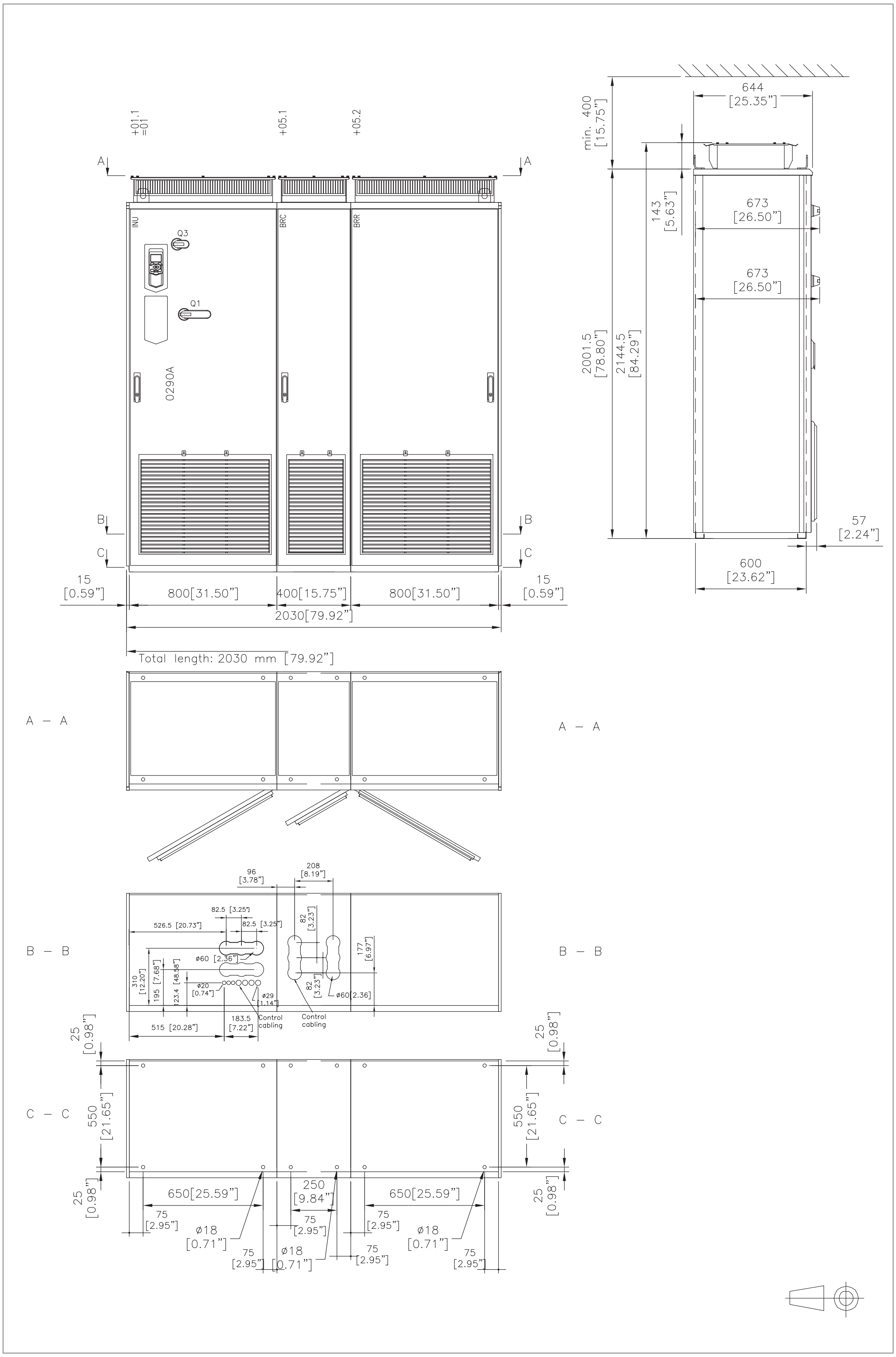
R6i+R6i and R7i+R7i IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054)



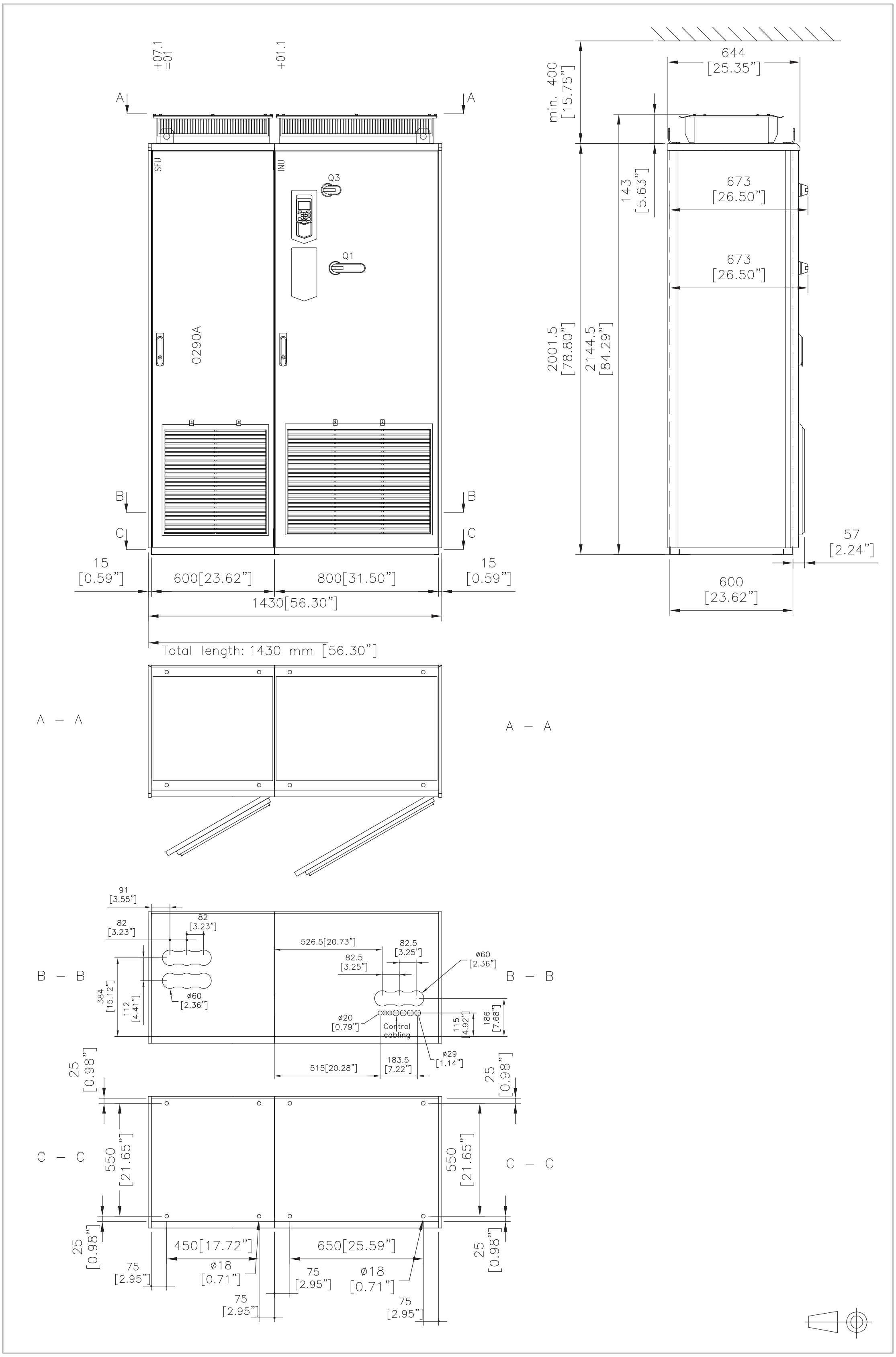
R6i+R6i and R7i+R7i IP54 (UL Type 12, option +B055): option +C129



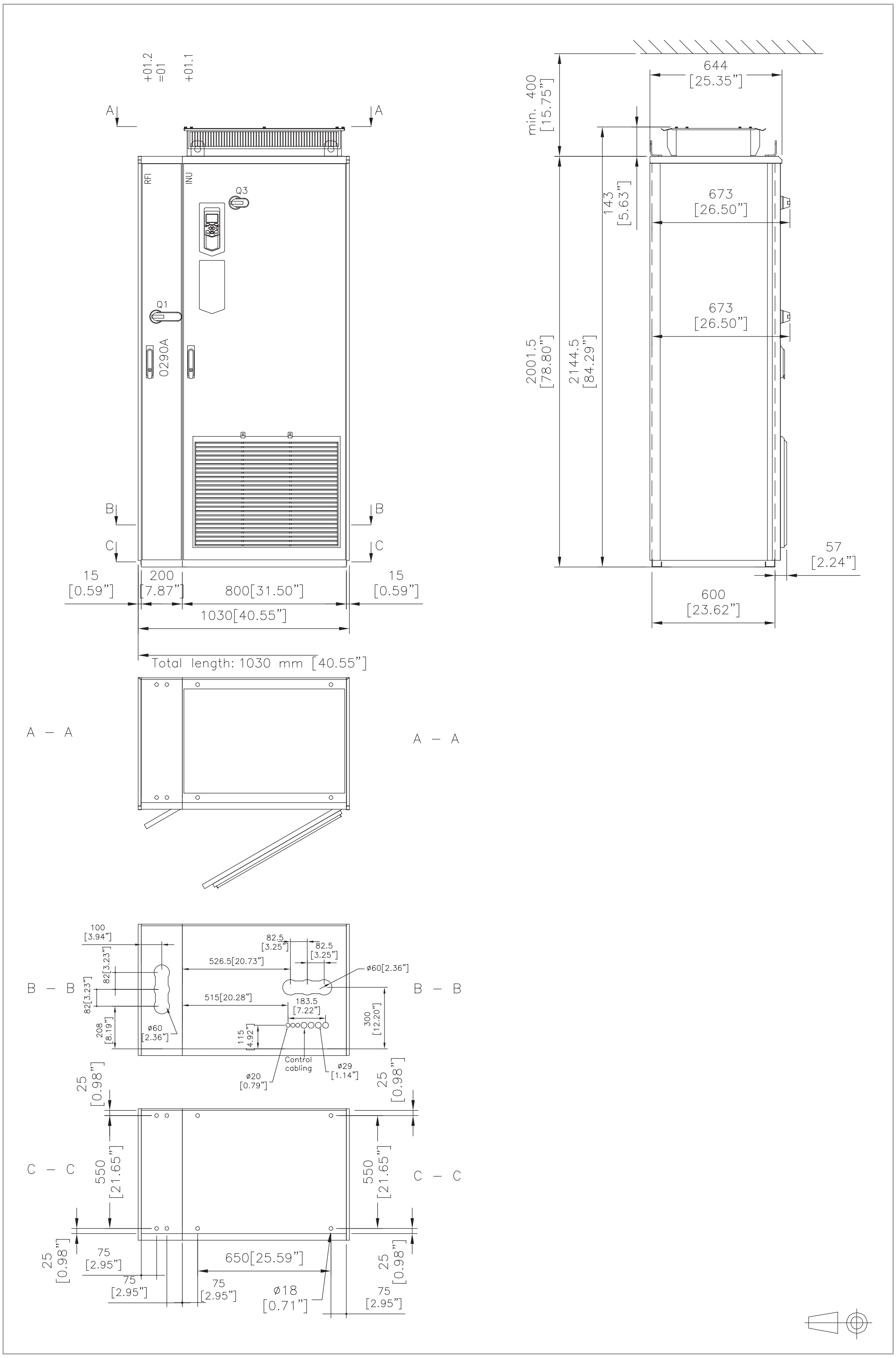
R6i+R6i and R7i+R7i IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +D150, +D151



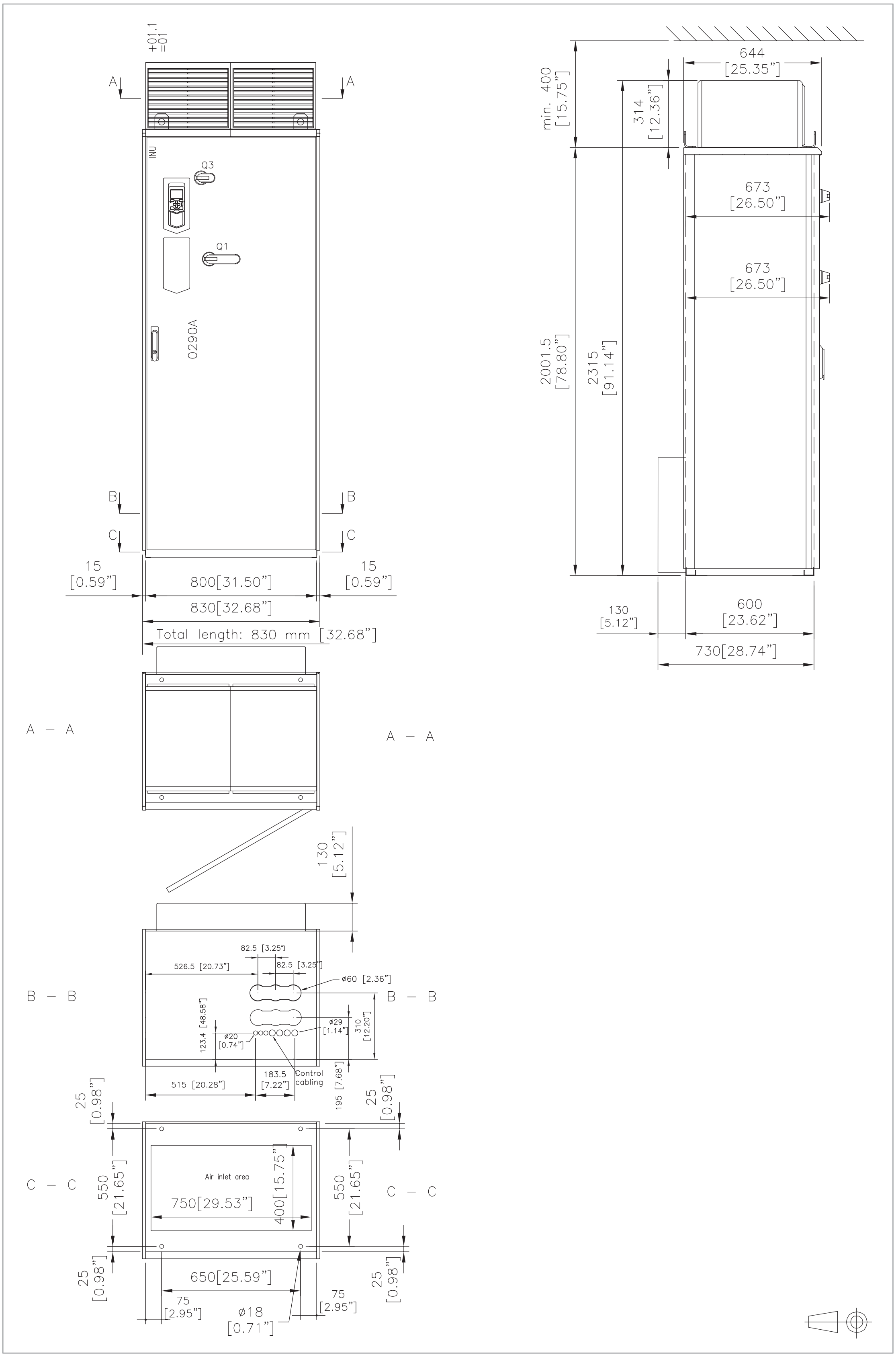
R6i+R6i and R7i+R7i IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +E206



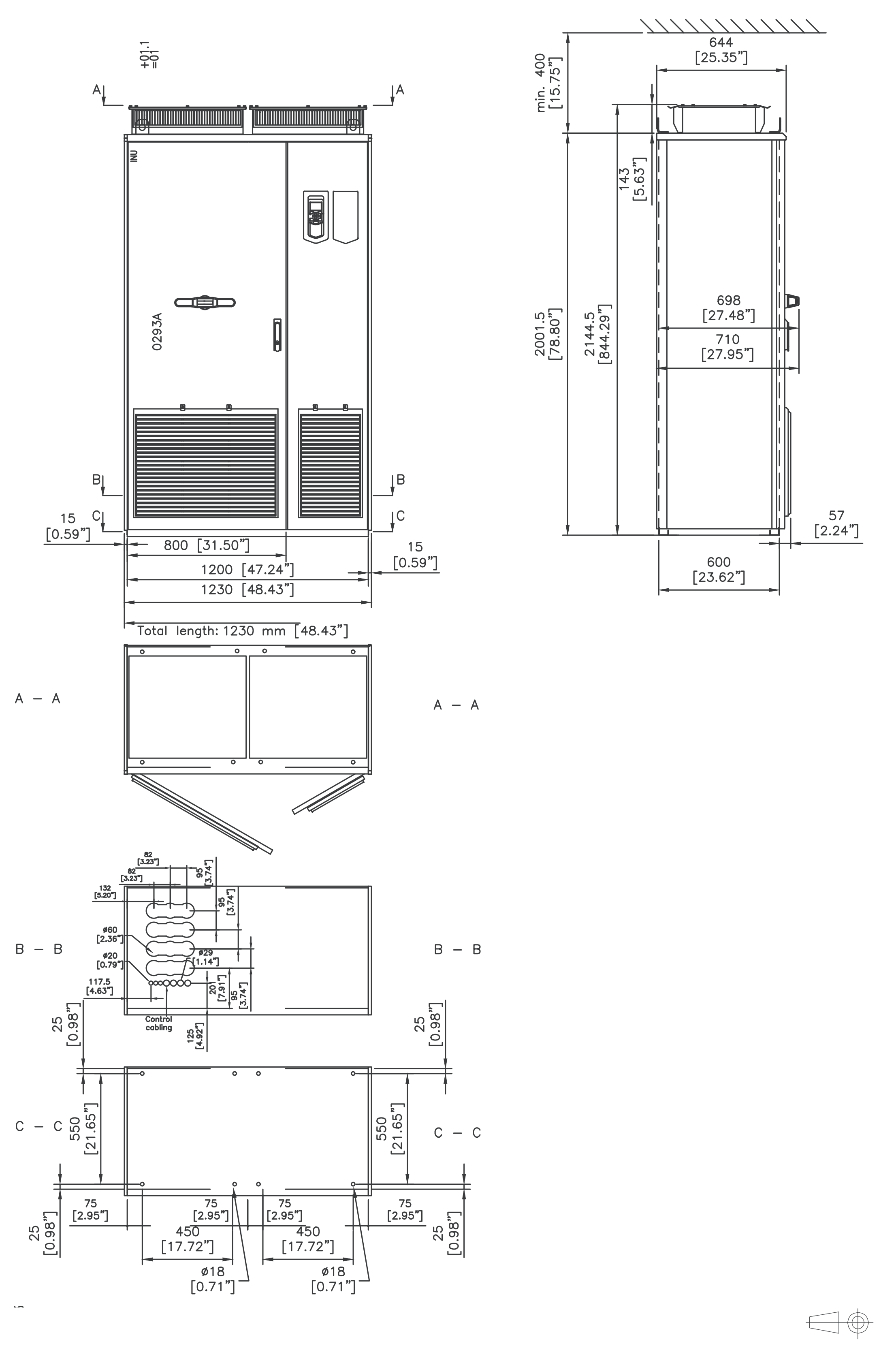
R6i+R6i and R7i+R7i IP22 (UL Type 1): option +E202



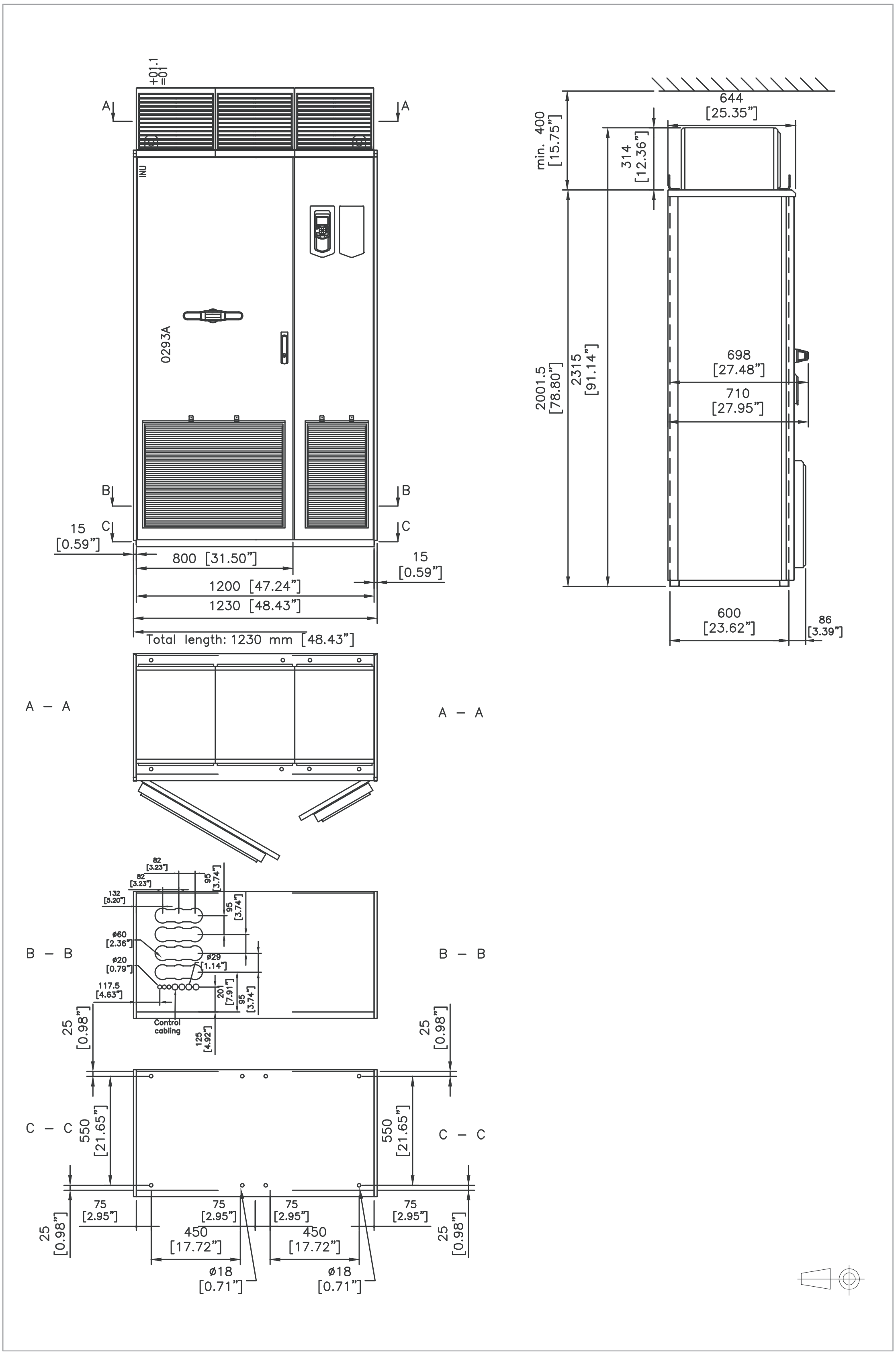
R6i+R6i and R7i+R7i IP54 (UL Type 12, option +B055): option +C128



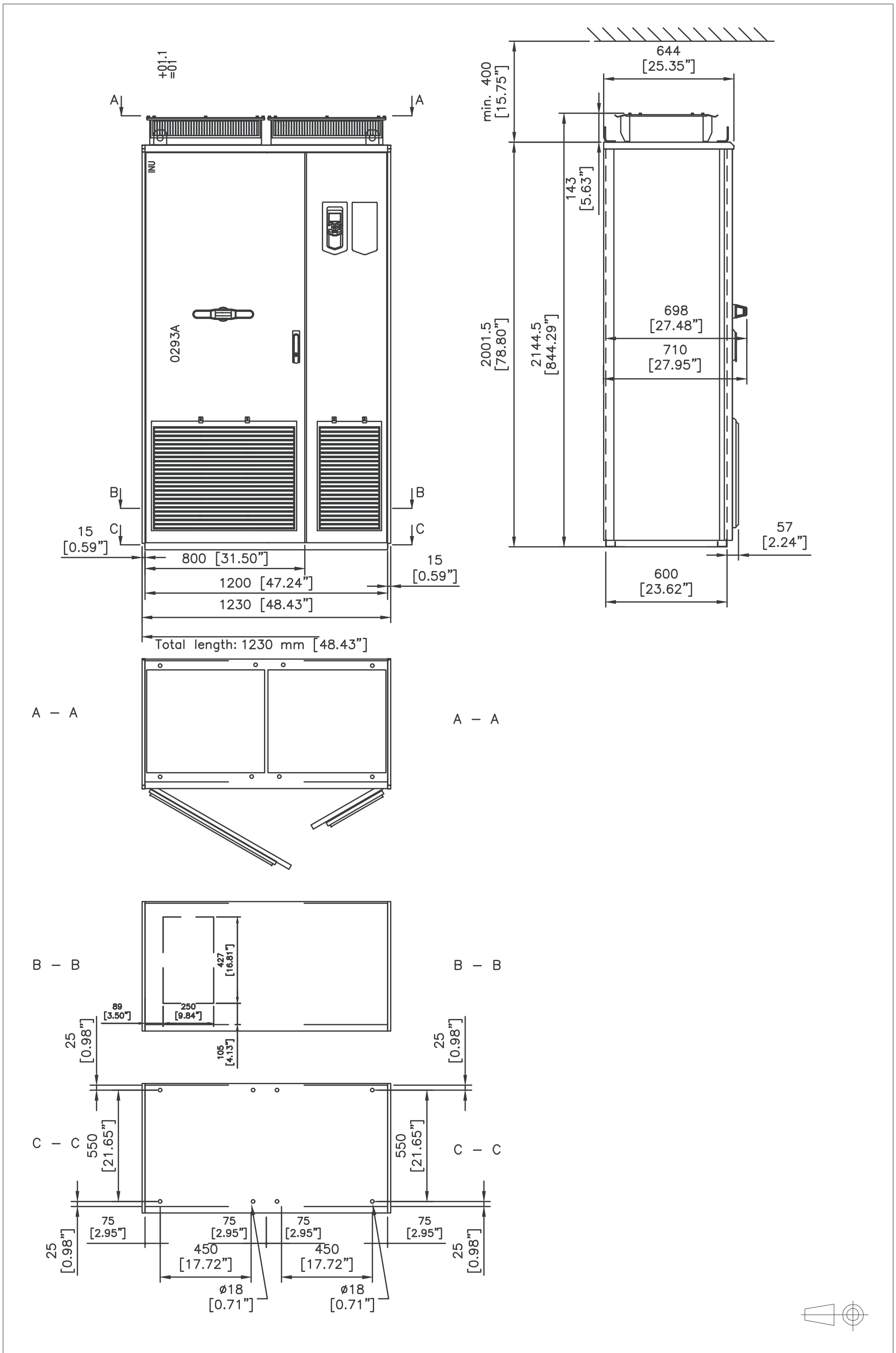
R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054)



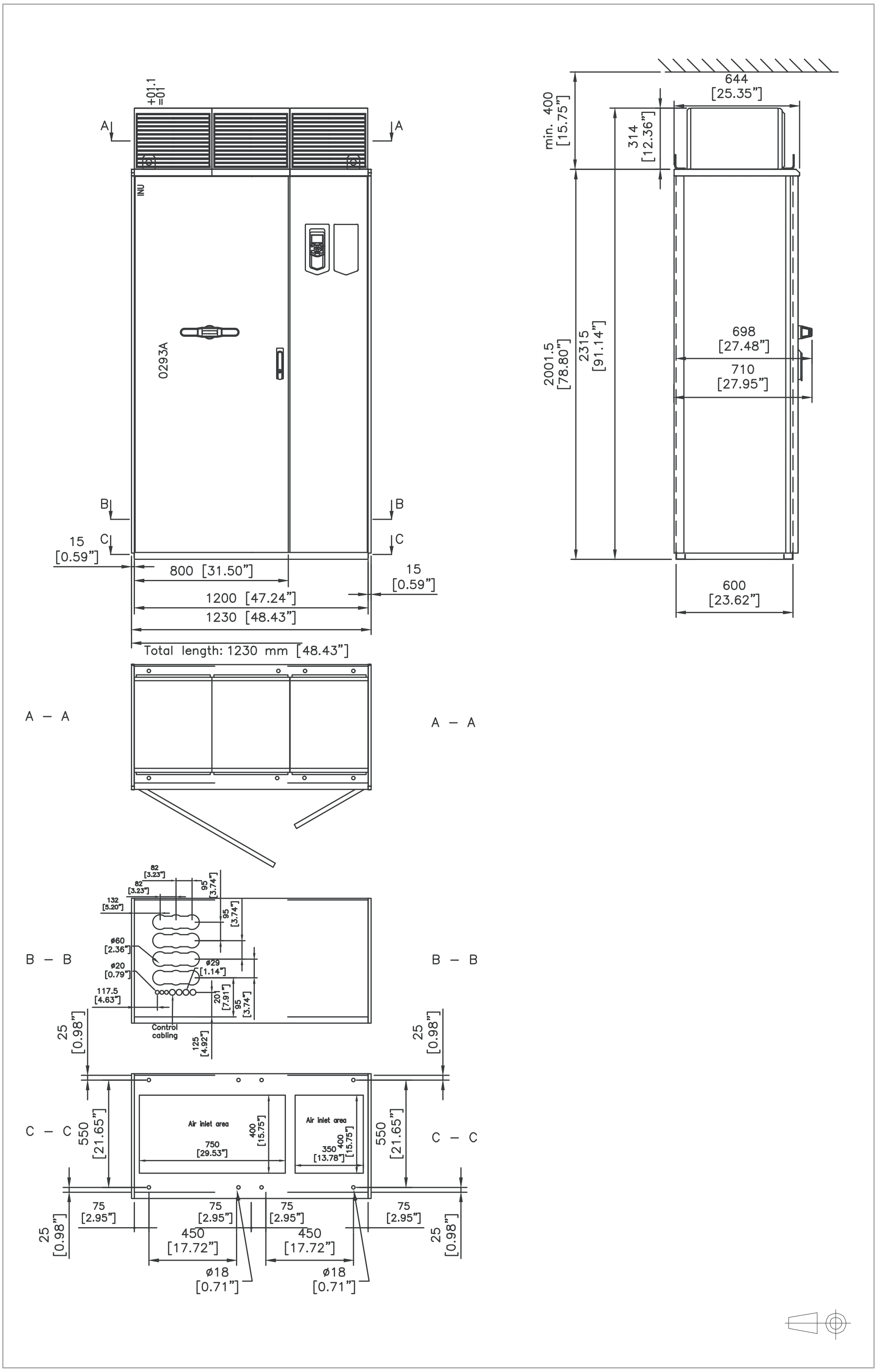
R11 IP54 (UL Type 12, option +B055)



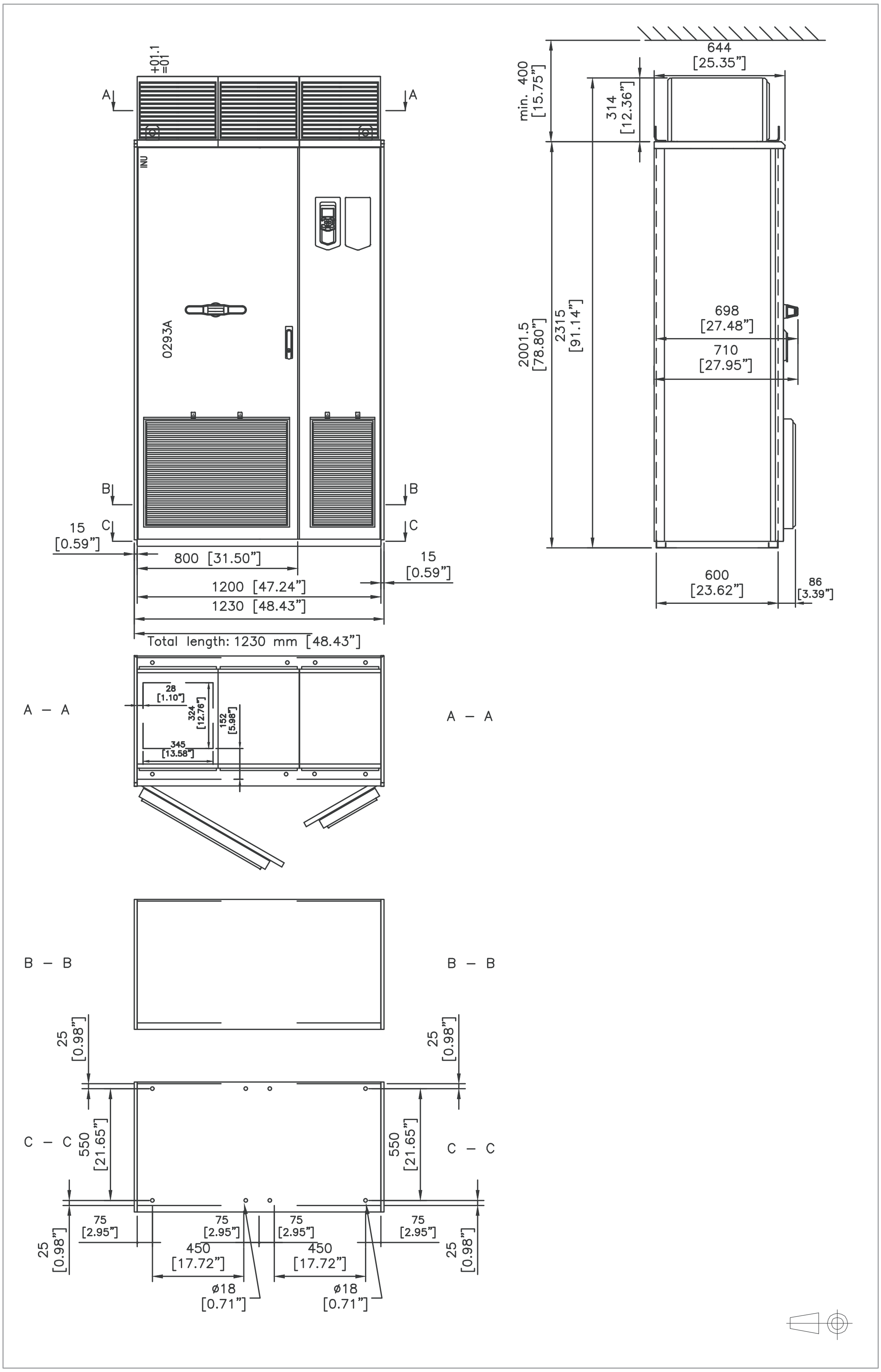
R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +C129, +H350, +H352



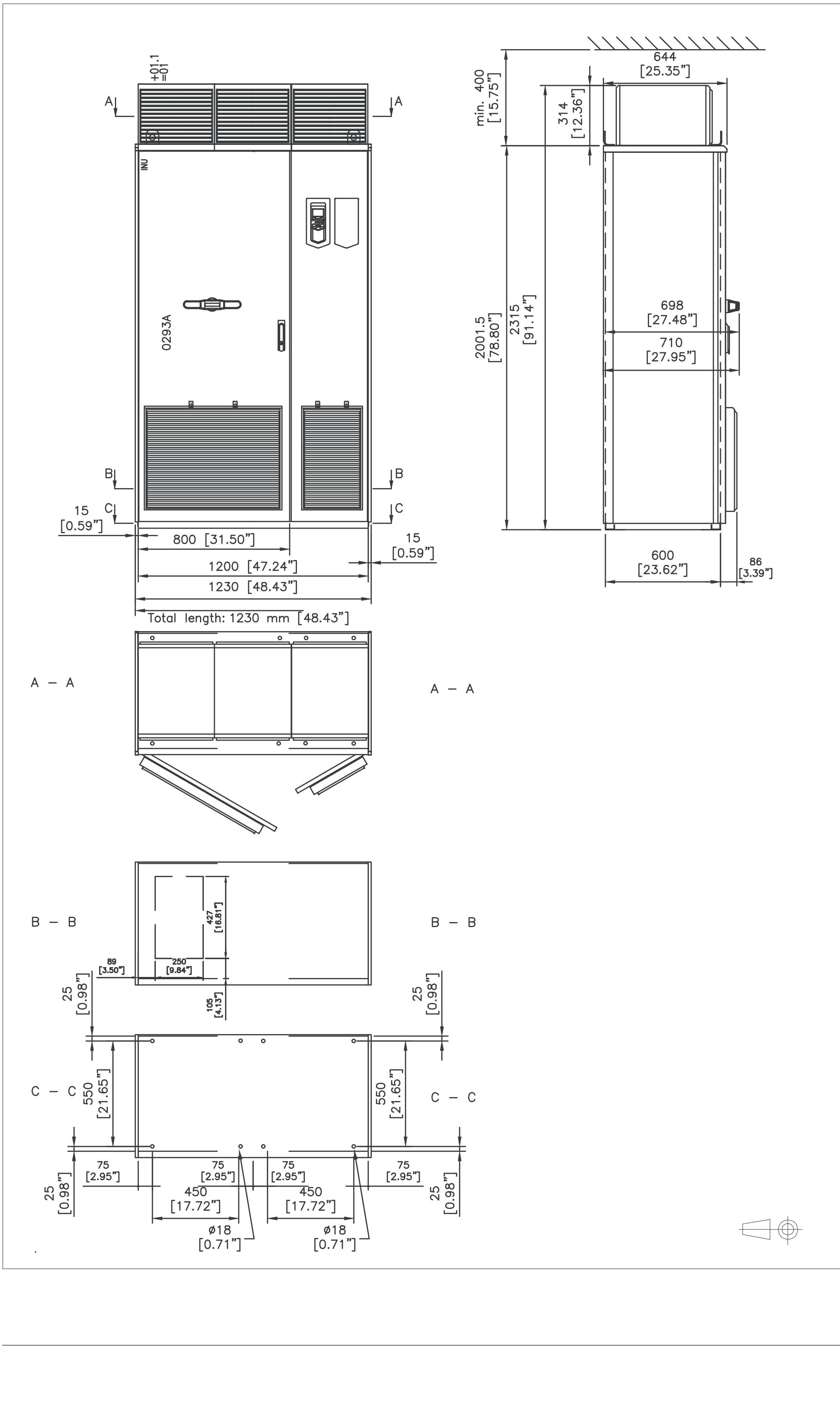
R11 IP54 (UL Type 12, option +B055): option +C128



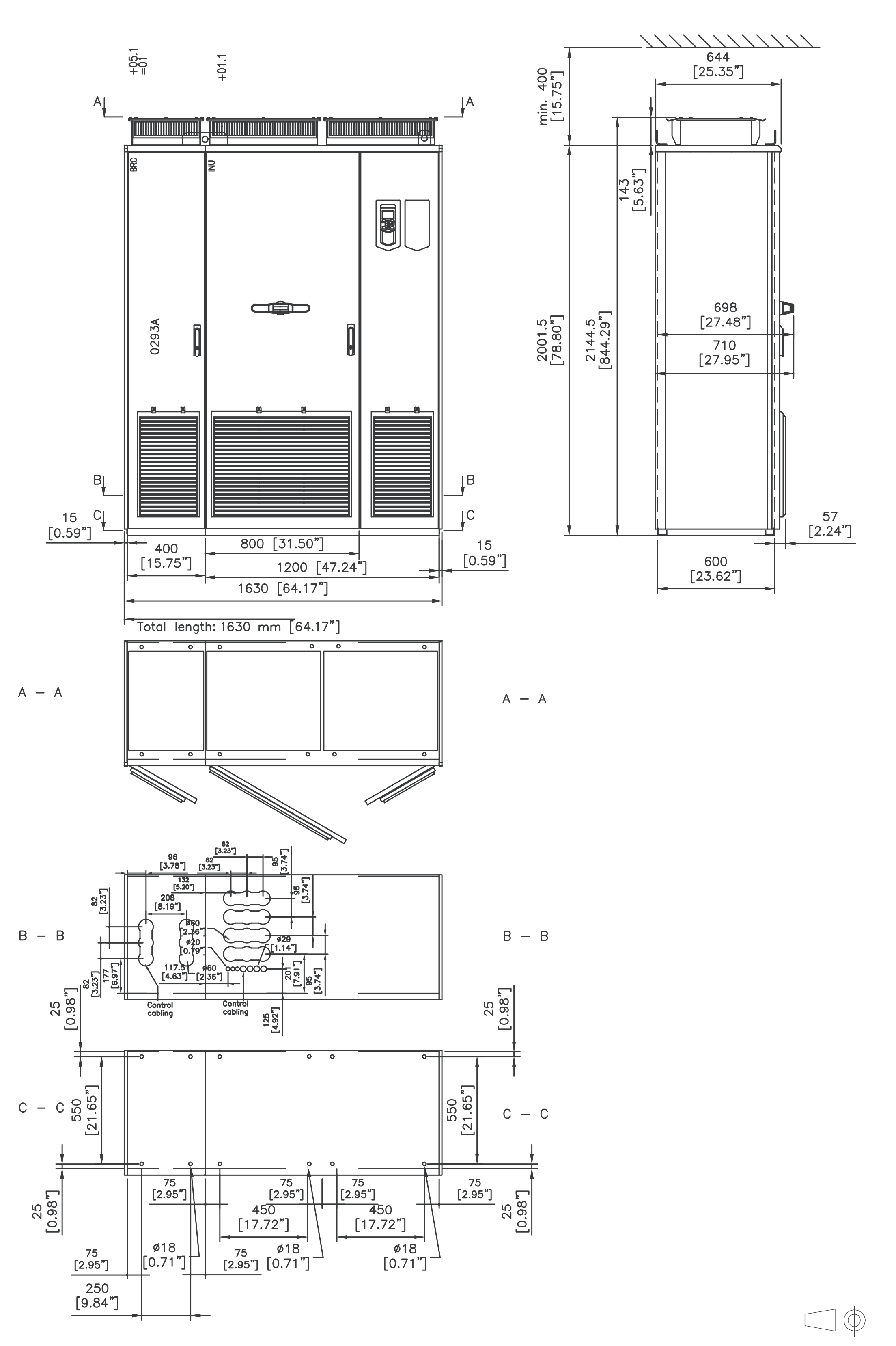
R11 IP54 (UL Type 12, option +B055): option +C129



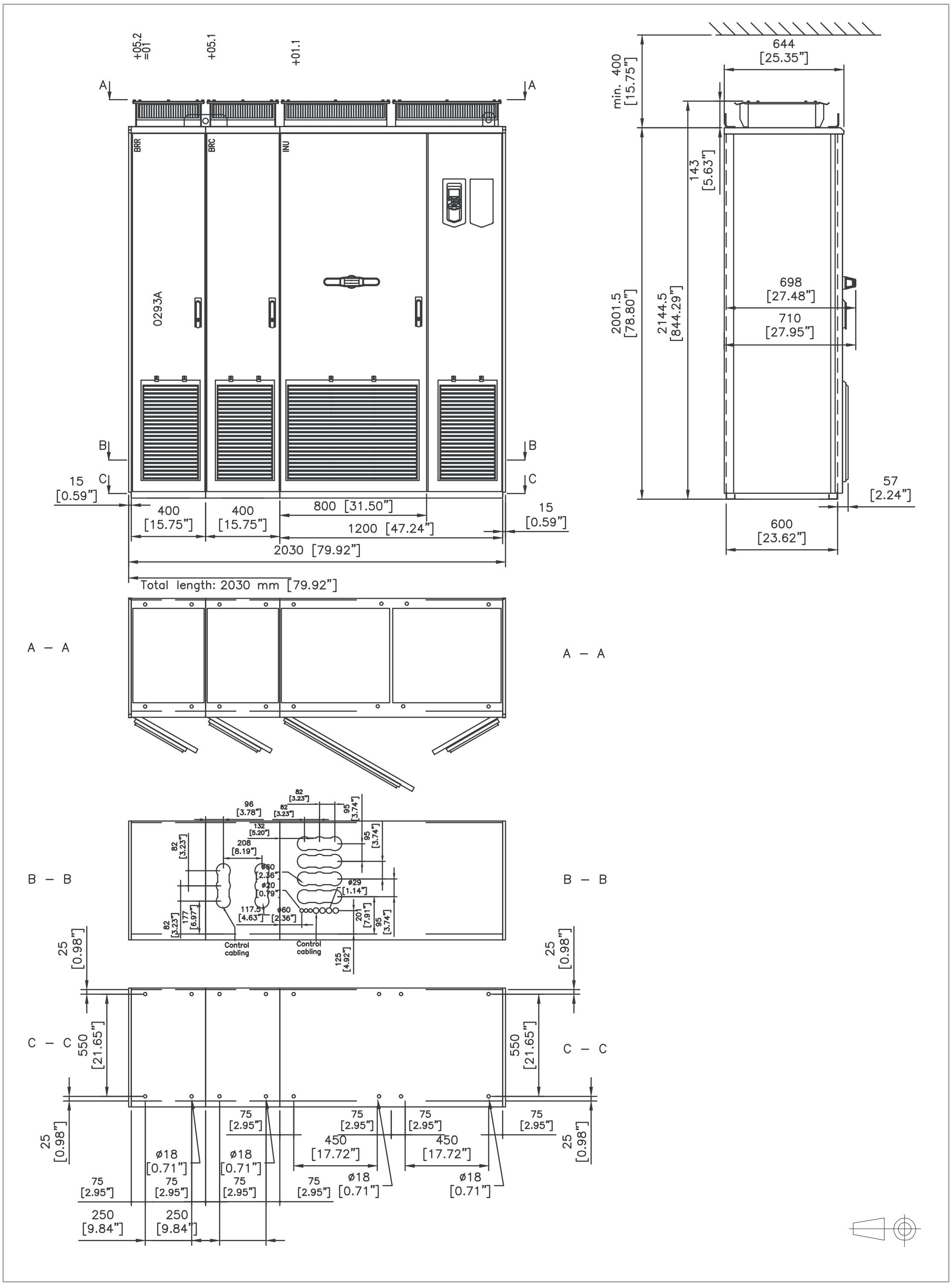
R11 IP54 (UL Type 12, option +B055): options +C129, +H350, +H352



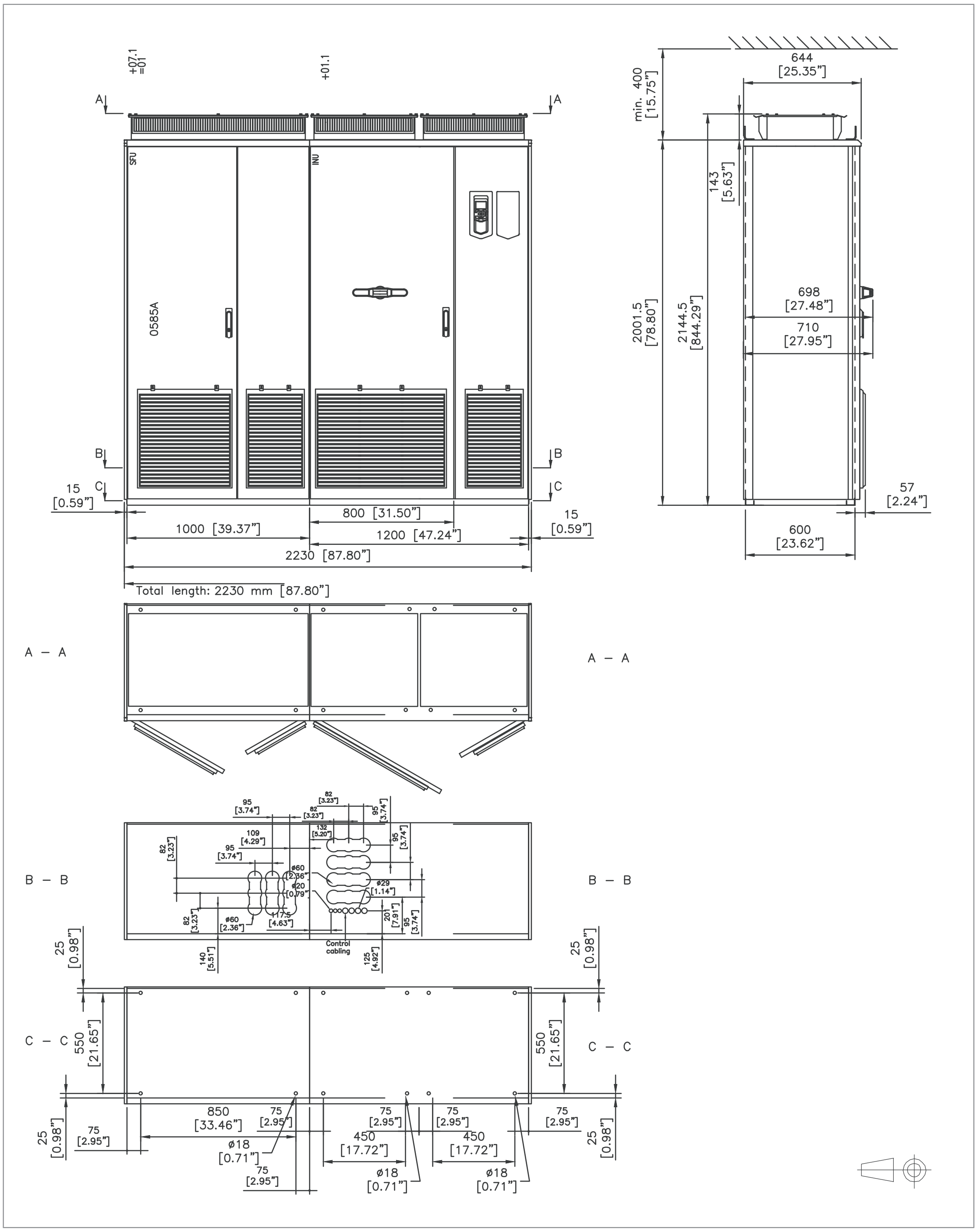
R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +D150



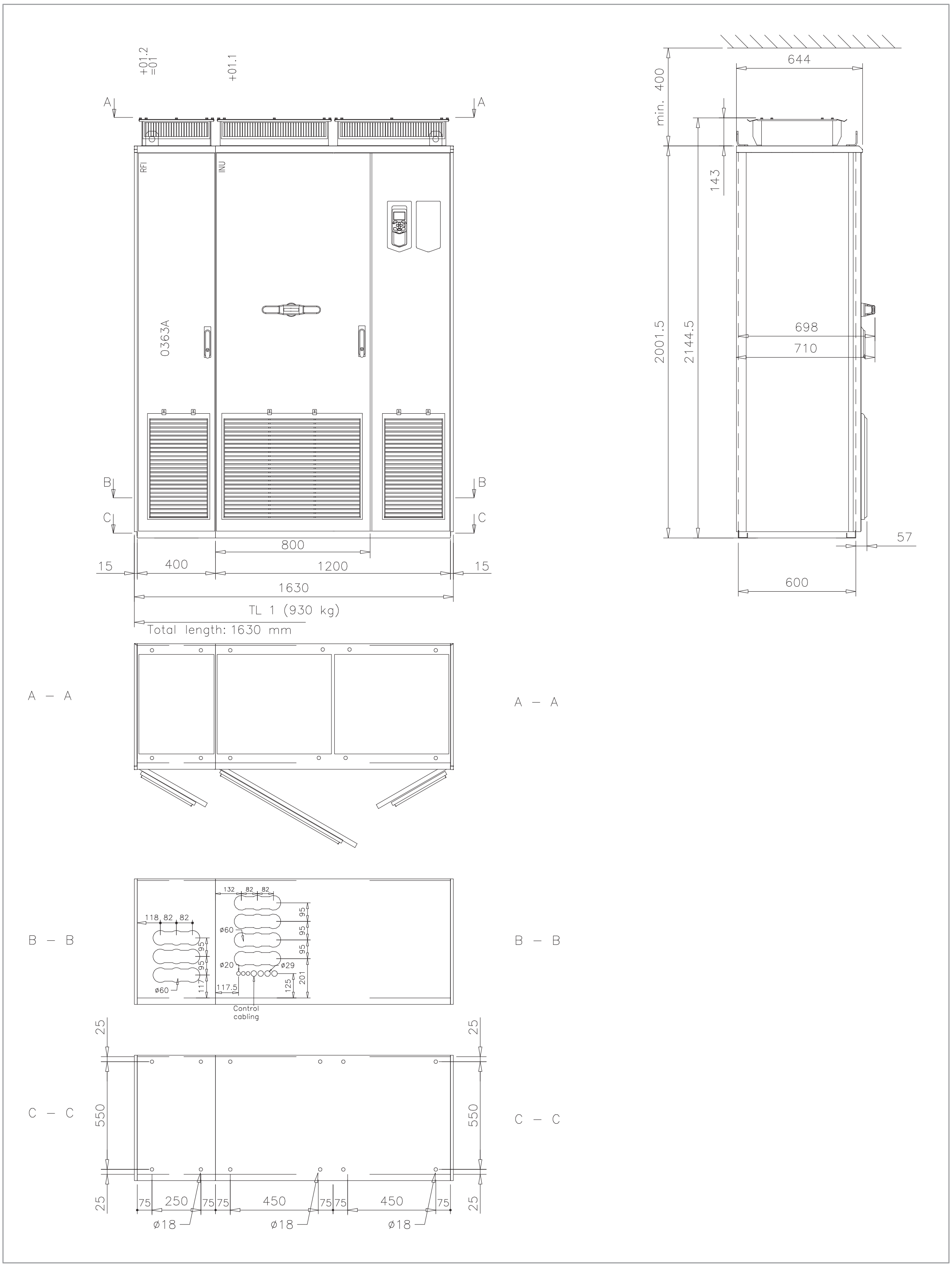
R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +D150, +D151



R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +E206



R11 IP22 (UL Type 1): option +E202



14

The Safe torque off function

Contents of this chapter

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

Description

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

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

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

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

The Safe torque off function complies with these standards:

Standard	Name
IEC 60204-1:2021 EN 60204-1:2018	Safety of machinery – Electrical equipment of machines – Part 1: General requirements

Standard	Name
IEC 61000-6-7:2014	Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations
IEC 61326-3-1:2017	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
IEC 61511-1:2017	Functional safety – Safety instrumented systems for the process industry sector
IEC 61800-5-2:2016 EN 61800-5-2:2007	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional
EN IEC 62061:2021	Safety of machinery – Functional safety of safety-related control systems
EN ISO 13849-1:2015	Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
EN ISO 13849-2:2012	Safety of machinery – Safety-related parts of control systems – Part 2: Validation

The function also corresponds to Prevention of unexpected start-up as specified by EN ISO 14118:2018 (ISO 14118:2017), and Uncontrolled stop (stop category 0) as specified in EN/IEC 60204-1.

Compliance with the European Machinery Directive and the UK Supply of Machinery (Safety) Regulations

Refer the technical data.

Wiring

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

Activation switch

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

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

Cable types and lengths

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

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

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

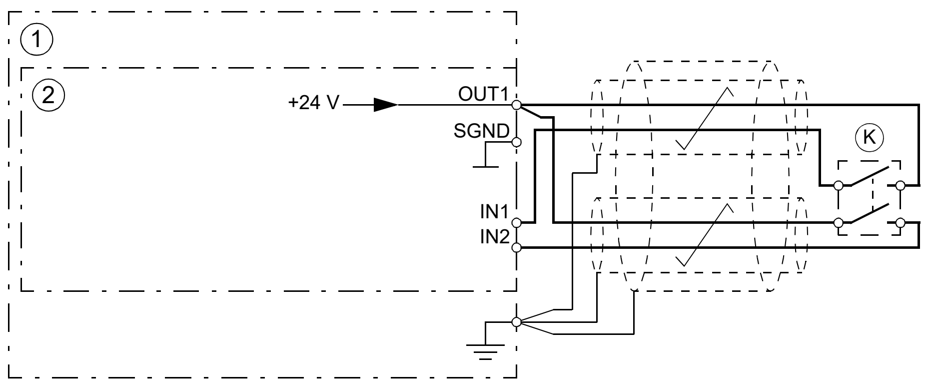
The pulse tolerance of the input channels is 1 ms.

Grounding of protective shields

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

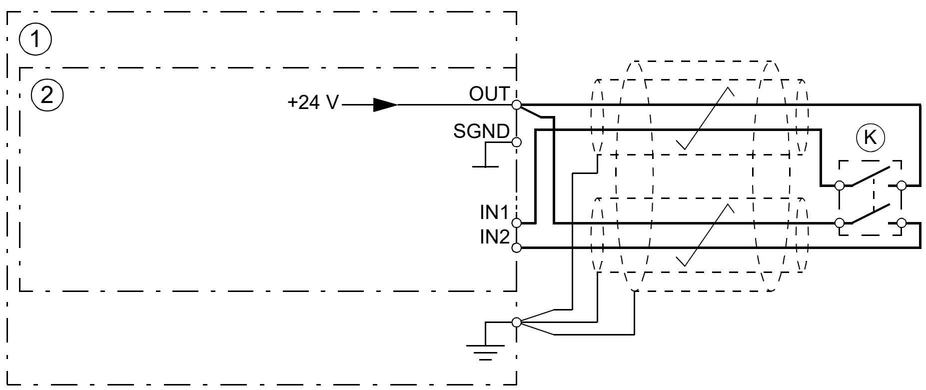
Single ACS880-37 drive, internal power supply

Dual-channel connection of activation switch (ZCU-12)



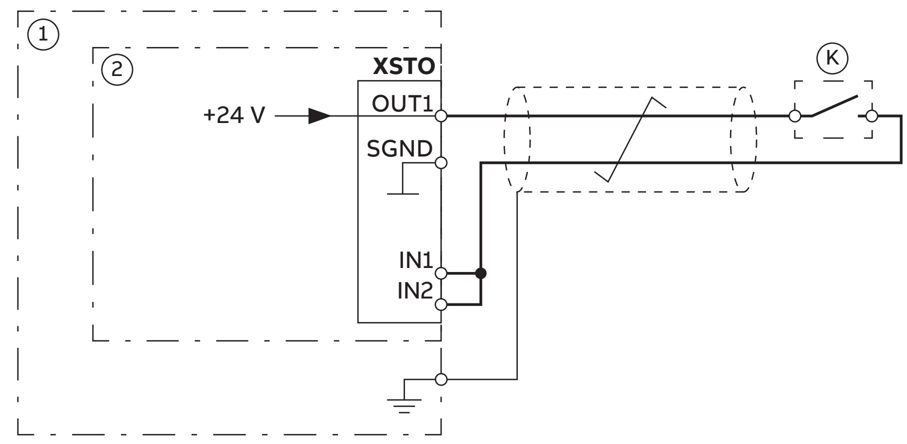
1	Drive
2	Control unit
K	Activation switch

Dual-channel connection of activation switch (ZCU-14)



1	Drive
2	Control unit
K	Activation switch

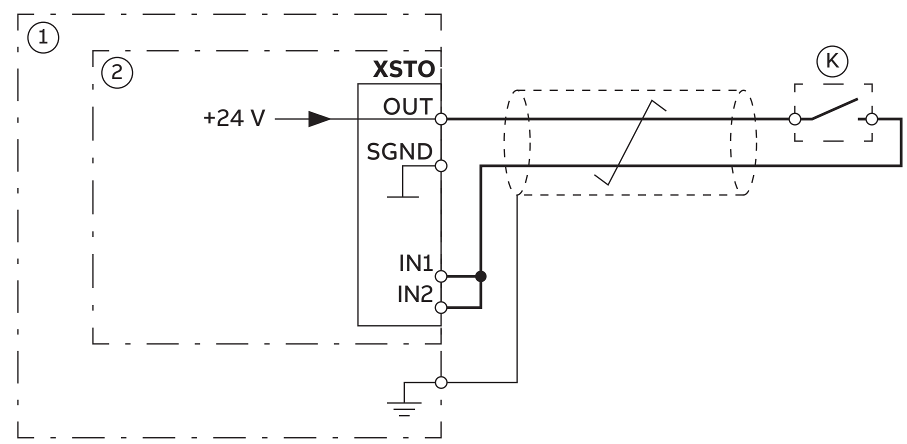
Single-channel connection of activation switch (ZCU-12)



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

1	Drive
2	Control unit
K	Activation switch **Note:** A single-channel activation switch can limit the SIL/PL capability of the safety function to a lower level than the SIL/PL capability of the STO function of the drive.

Single-channel connection of activation switch (ZCU-14)

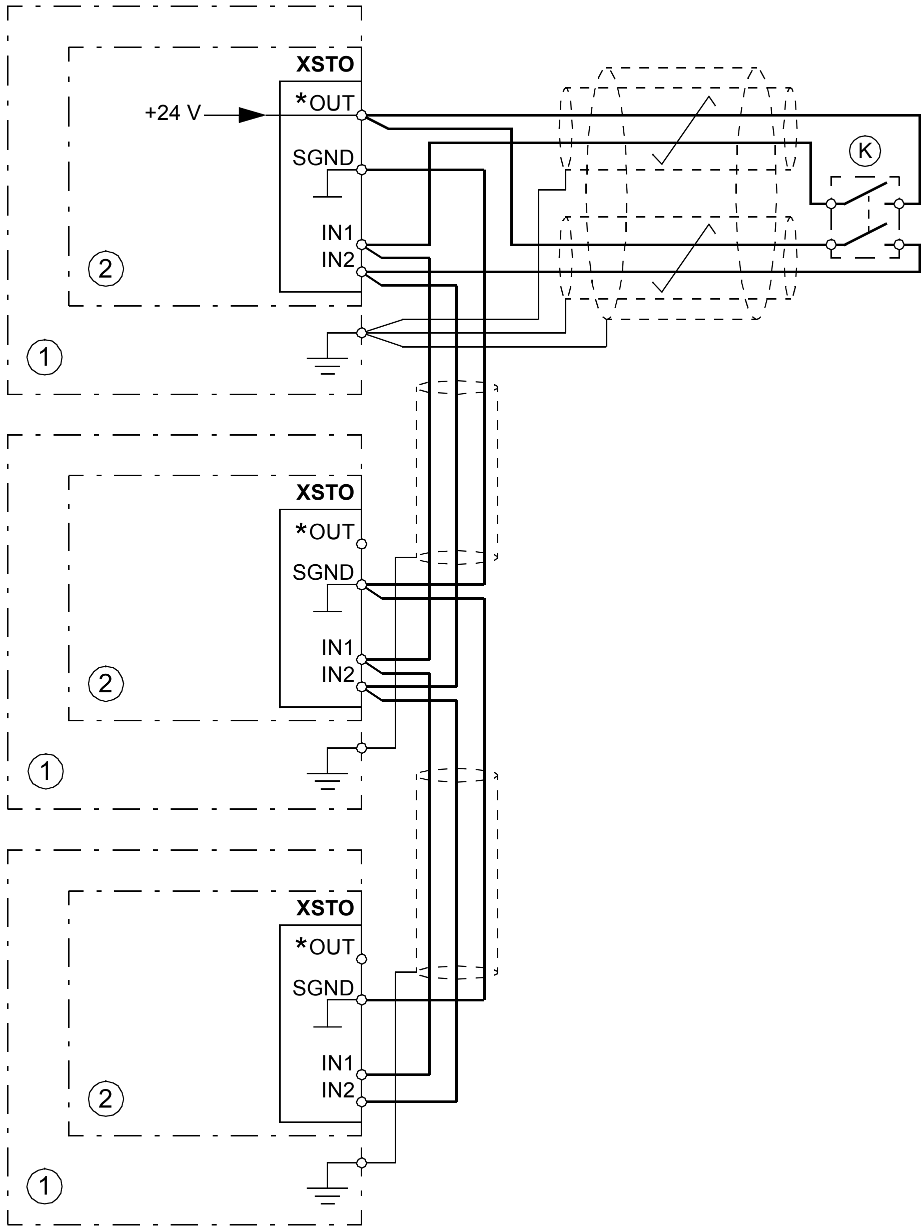


Note:
- Both STO inputs (IN1, IN2) must be connected to the activation switch. Otherwise, no SIL/PL classification is given.
- Pay special attention to avoiding any potential failure modes for the wiring. For example, use shielded cable. For measures for fault exclusion of wiring, see eg. EN ISO 13849-2:2012,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

1	Drive
2	Control unit
K	Activation switch **Note:** A single-channel activation switch can limit the SIL/PL capability of the safety function to a lower level than the SIL/PL capability of the STO function of the drive.

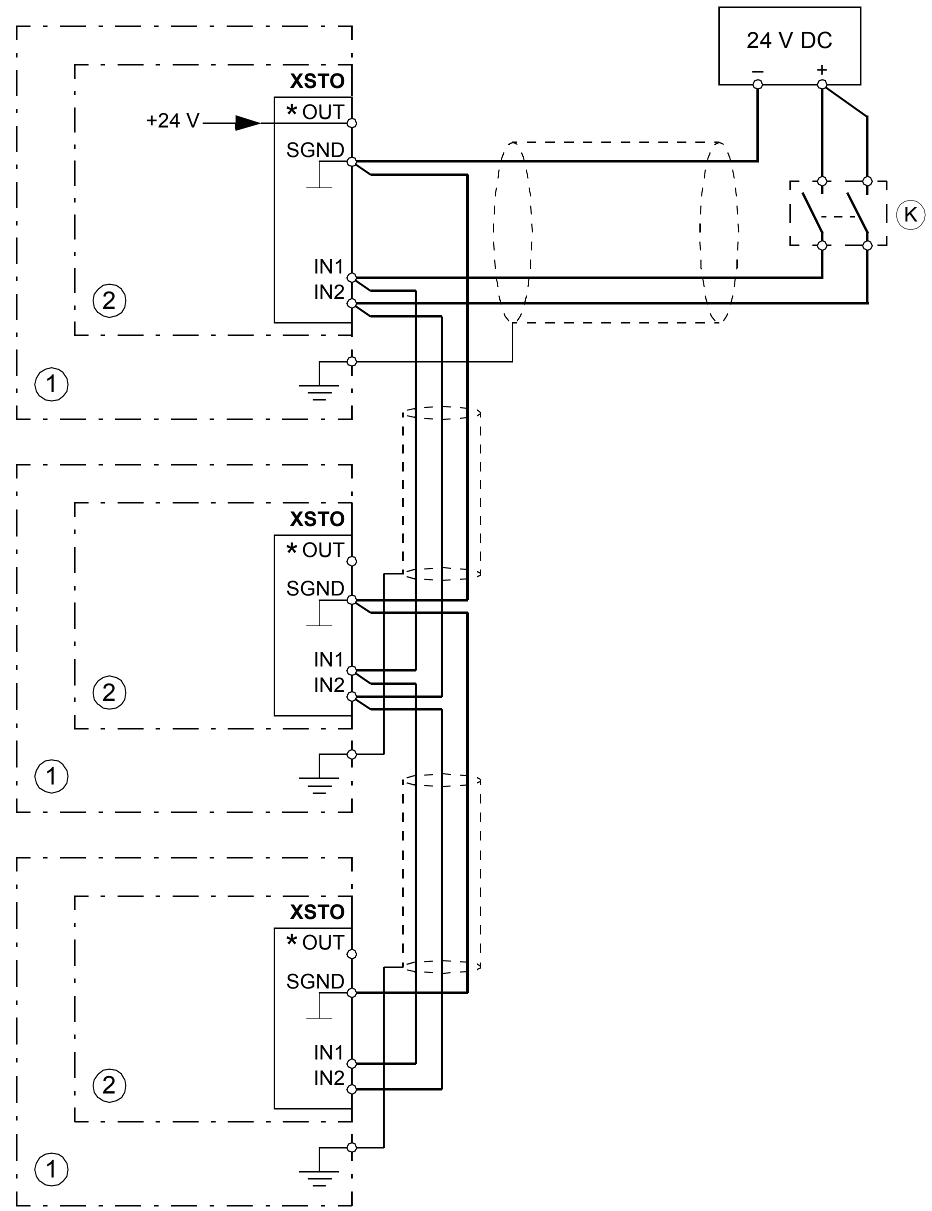
Multiple drives

Internal power supply



1	Drive
2	Control unit
K	Activation switch
* "OUT1" in drives with ZCU-12 control unit	

External power supply



1	Drive
2	Control unit
K	Activation switch
* "OUT1" in drives with ZCU-12 control unit	

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

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

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

Start-up including validation test

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

1. at initial start-up of the safety function
2. after any changes related to the safety function (circuit boards, wiring, components, settings, replacement of inverter module, etc.)
3. after any maintenance work related to the safety function
4. after a drive firmware update
5. at the proof test of the safety function.

Competence

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

Validation test reports

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

Validation test procedure

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

Note: If the drive is equipped with safety option +L513, +L514, +L536, +L537, +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q965, +Q978 or +Q979, also do the procedure shown in the documentation of the option.

If an FSO safety functions module, FSCS-21, FSPS-21 or FPTC module is installed, refer to its documentation.

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

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

Use

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

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

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

WARNING!
Permanent magnet or synchronous reluctance [SynRM] motors only:

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

Notes:

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

Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 10 years; refer section Safety data (page 335).

There are two alternative procedures for proof testing:

1. Perfect proof testing. It is assumed that all dangerous failures of the STO circuit are detected during the test. PFD_{avg} values for STO with the perfect proof testing procedure are given in the safety data section.
2. Simplified proof testing. This procedure is faster and simpler than perfect proof testing. Not all dangerous failures of the STO circuit are detected during the test. The PFD_{avg} value for STO with the simplified proof testing procedure is given in the safety data section.

Note: The proof testing procedures are only valid for proof testing (periodic test, item 5 under section Start-up including validation test) but not for re-validation after changes made in the circuit. Re-validation (items 1…4 under Start-up including validation test) must be done according to the initial validation procedure.

Note: Refer 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 329).

Use only spare parts approved by ABB.

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

Competence

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

Perfect proof test procedure

Action	☑
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Test the operation of the STO function. If the motor is running, it will stop during the test. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the failure detection of the drive. The motor can be stopped or running. • Open the 1st input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA81 fault indication (see the firmware manual). • Open the STO circuit (both channels). • Give a reset command. • Close the STO circuit (both channels). • Reset any active faults. • Open the 2nd input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA82 fault indication (see the firmware manual). • Open the STO circuit (both channels). • Give a reset command. • Close the STO circuit (both channels). • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Document and sign the test report to verify that the safety function has been tested according to the procedure.	☐

Simplified proof test procedure

Action	☑
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Test the operation of the STO function. If the motor is running, it will stop during the test. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Document and sign the test report to verify that the safety function has been tested according to the procedure.	☐

Fault tracing

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

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an FA81 or FA82 fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, will trigger the same reaction.

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

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

Safety data

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

Note: The safety data is calculated for redundant use, and applies only if both STO channels are used.

Frame size	SIL	SC	PL	PFH (T_1 = 20 a) (1/h)	PFD_{avg} Perfect proof test		PFD_{avg} Simplified proof test	$MTTF_D$ (a)	DC (%)	SFF (%)	Cat.	HFT	CCF	T_M (a)	PFH_{diag} (1/h)	λ_{Diag_s} (1/h)	λ_{Diag_d} (1/h)
					T_1 = 5 a	T_1 = 10 a	T_1 = 5 or 10 a										
R8	3	3	e	3.21E-09	6.67E-05	1.34E-04	2.67E-04	6559	≥90	99.10	3	1	80	20	3.00E-12	1.91E-07	3.00E-10
R6i, R7i	3	3	e	3.87E-09	8.47E-05	8.97E-06	1.75E-05	6538	≥90	>99	3	1	80	20	1.54E-09	2.14E-07	1.54E-07
R11	3	3	e	3.65E-09	8.00E-05	1.60E-04	3.20E-04	18327	≥90	99.65	3	1	80	20	7.50E-11	7.70E-07	7.50E-09

3AXD10001609377 B, 3AXD10001609379 A, 3AXD10000041323 K

- The STO is a type A (frames R8, R6i and R7i) or type B (frame R11) 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:
    - Frame R8: 2 ms (typical), 5 ms (maximum)
    - Frames R6i and R7i: 7 ms (typical), 10 ms (maximum)
    - Frame R11: 2 ms (typical), 30 ms (maximum)
  - Fault detection time: Channels in different states for longer than 200 ms
  - Fault reaction time: Fault detection time + 10 ms.
- Indication delays:
  - STO fault indication (parameter 31.22) delay: < 500 ms
  - STO warning indication (parameter 31.22) delay: < 1000 ms.

Terms and abbreviations

Term or abbreviation	Reference	Description
Cat.	EN ISO 13849-1	Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage (%)
HFT	IEC 61508	Hardware fault tolerance
$MTTF_D$	EN ISO 13849-1	Mean time to dangerous failure: (Total number of life units) / (Number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD_{avg}	IEC 61508	Average probability of dangerous failure on demand, that is, mean unavailability of a safety-related system to perform the specified safety function when a demand occurs
PFH	IEC 61508	Average frequency of dangerous failures per hour, that is, average frequency of a dangerous failure of a safety related system to perform the specified safety function over a given period of time
PFH_{diag}	IEC/EN 62061	Average frequency of dangerous failures per hour for the diagnostic function of STO
PL	EN ISO 13849-1	Performance level. Levels a…e correspond to SIL
Proof test	IEC 61508, IEC 62061	Periodic test performed to detect failures in a safety-related system so that, if necessary, a repair can restore the system to an "as new" condition or as close as practical to this condition
SC	IEC 61508	Systematic capability (1…3)
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1…3)

Term or abbreviation	Reference	Description
STO	IEC/EN 61800-5-2	Safe torque off
T_1	IEC 61508-6	Proof test interval. T_1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of T_1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. See also section Maintenance.
T_M	EN ISO 13849-1	Mission time: the period of time covering the intended use of the safety function/device. After the mission time elapses, the safety device must be replaced. Note that any T_M values given cannot be regarded as a guarantee or warranty.
λ_{Diag_d}	IEC 61508-6	Dangerous failure rate (per hour) of the diagnostics function of STO
λ_{Diag_s}	IEC 61508-6	Safe failure rate (per hour) of the diagnostics function of STO

TÜV certificate

The TÜV certificate is available on the Internet.

15

Resistor braking

Contents of this chapter

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

Operation principle and hardware description

The drive can be equipped with a brake chopper (option +D150) and brake resistors (option +D151) in own cubicles. The customer can also connect custom brake resistors to the brake chopper.

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

Planning the braking system

Selecting the default brake circuit components - ABB chopper and ABB resistor

1. Calculate the maximum power generated by the motor during braking and define the braking cycle.
2. Select a drive according to motor load cycle considering also the braking cycle. See the drive ratings.
3. See the pre-selected chopper and the pre-selected resistor for the drive from the technical data of the ABB brake choppers and resistors.
4. Check the pre-selection of the chopper and resistor: Is your braking cycle 1/5 min or 10/60 s?

a. If yes: Is your braking power smaller than the value for the cycle given in the ratings of the ABB resistors? If yes: the pre-selected chopper and resistor combination is ok for the drive.
b. If no: Verify the pre-selected chopper and resistor according to the instructions given in section Calculating the maximum allowed braking power for a custom duty cycle – ABB chopper and ABB resistor (page 340).

Calculating the maximum allowed braking power for a custom duty cycle – ABB chopper and ABB resistor

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

1. The braking power of the custom duty cycle must not be greater than the maximum braking power given in the ratings of the ABB choppers and resistors.

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

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

$$n \times P_{br} \times t_{br} \leq P_{br,max} \times 40\ s$$

where

n	Number of the braking pulses during the 600-second period
P_{br}	Braking power of the custom duty cycle in kW
t_{br}	Braking time within the custom duty cycle in seconds
$P_{br,max}$	Maximum braking power allowed for 40 seconds every 600 seconds. See the value in the ratings of the ABB choppers and resistors. (The ABB resistor does not withstand the 60-second cycle of the brake chopper.)

Selecting the default brake circuit components - ABB brake chopper and custom resistor

1. Calculate the maximum power generated by the motor during braking and define the braking cycle.
2. Select a drive and brake chopper combination. The reference braking cycle is 60 seconds in every 600 seconds.
3. Verify the selection. See section Calculating the maximum allowed braking power for a custom duty cycle – ABB chopper and custom resistor (page 342). If necessary, repeat the pre-selection and verification until you find a suitable drive and chopper combination.
4. Select a custom brake resistor. See Selecting custom resistors (page 341).

Selecting custom resistors

If you use other than ABB resistor,

1. make sure that the resistance of the custom resistor is greater or equal than the resistance of the default resistor in the ratings of the custom resistors:

   $$R \geq R_{min}$$

   where,

R	Resistance of the custom resistor
R_{min}	Resistance of the default resistor

   WARNING!
   Do not use a brake resistor with a resistance lower than the specified minimum value. It causes overcurrent that damages the brake chopper and the drive.

2. the resistance of the custom resistor does not restrict the braking capacity 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 · 1.25 · 415 V DC (when supply voltage is 380 to 415 V AC) 1.35 · 1.25 · 500 V DC (when supply voltage is 440 to 500 V AC) or 1.35 · 1.25 · 690 V DC (when supply voltage is 525 to 690 V AC)
R	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 properly 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 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 · 1.25 · 415 V DC (when supply voltage is 380 to 415 V AC) 1.35 · 1.25 · 500 V DC (when supply voltage is 440 to 500 V AC) or 1.35 · 1.25 · 690 V DC (when supply voltage is 525 to 690 V AC)
R	Resistance of the custom resistor

Calculating the maximum allowed braking power for a custom duty cycle – ABB chopper and custom resistor

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

1. The braking power of the custom duty cycle must not be greater than the maximum braking power given in the ratings of the factory-installed brake choppers and custom resistors:

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

2. The braking energy transferred during any 600-second period must be smaller than or equal to the energy that is transferred during the reference braking cycle of 60 seconds every 600 seconds:

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

   where,

n	Number of the braking pulses during the 600-second period
P_{br}	Braking power of the custom duty cycle in kW
t_{br}	Braking time within the custom duty cycle in seconds
$P_{br,max}$	Maximum braking power allowed for 60 seconds every 600 seconds. See the value in the ratings of the factory-installed brake choppers and custom resistors.

Example 1

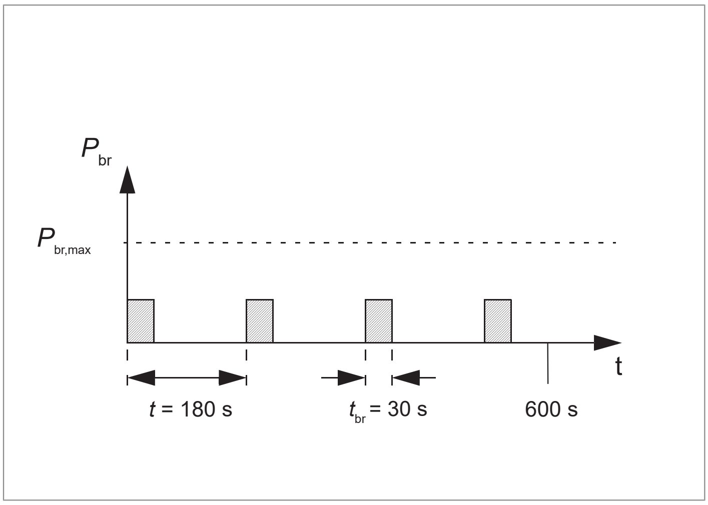
The duration of a braking cycle is three minutes. The braking time is 15 minutes.

1. $P_{br} \leq P_{br,max}$
2. $n \times P_{br} \times t_{br} \leq P_{br,max} \times 60$ s
   $1 \times P_{br} \times 600\text{ s} \leq P_{br,max} \times 60$ s
   $P_{br \leq P_{br,max}} \times 60/600\text{ s} = 0.1\times P_{br,max}$
   -> The allowed continuous braking power is 10% of the maximum braking power ($P\text{b}_{r,max}$). This fulfills also condition 1.

Example 2

The duration of a braking cycle (T) is three minutes = 3 × 60 s = 180 s. The braking time (t_{br}) is 30 seconds.

1. $P_{br} \leq P_{br,max}$
2. $P_{br} \leq (P_{br,max} \times 60\text{ s})/(4 \times 30\text{ s}) = 0.5 \times P_{br,max}$



-> The maximum allowed braking power for the cycle is 50% of the rated value given for the reference cycle. This fulfills also condition 1.

Selecting and routing brake resistor cables

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

Minimizing electromagnetic interference

Make sure that the installation is compliant with the EMC requirements. Obey these rules in order to minimize electromagnetic interference caused by the rapid voltage and current changes in the resistor cables:

- Shield the brake resistor cable. Use shielded cable or a metallic enclosure. If you use unshielded single-core cables, route them inside a cabinet that efficiently suppresses the radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance is 0.3 meters (1 ft).
- Cross the other cables at 90° angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on the brake chopper. The longer the cable the greater the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

Maximum cable length

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

EMC compliance of the complete installation

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.

Selecting the installation location for the brake resistors

Protect the open (IP00) brake resistors against contact. Install the brake resistor in a place where it cools effectively. Arrange the cooling of the resistor so that:

- no danger of overheating is caused to the resistor or nearby materials, and
- the temperature of the space that the resistor is in does not go above the allowed maximum value.

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

Protecting the 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.

Thermal protection of the resistors

The standard resistors available as option +D151 are equipped with a thermal switch. The switches of the resistors are wired in series and connected to the Enable input of the brake chopper. The relay output of the chopper is wired to the line-side control unit of the drive so that a chopper fault condition stops the line-side converter.

With custom resistors, a similar protection must be implemented. Use cable rated as follows:

- twisted pair, shielding recommended
- rated operating voltage between a conductor and ground (U_0) ≥ 750 V
- insulation test voltage > 2.5 kV.

Keep the cable as short as possible.

Protecting the brake resistor cable against short-circuits

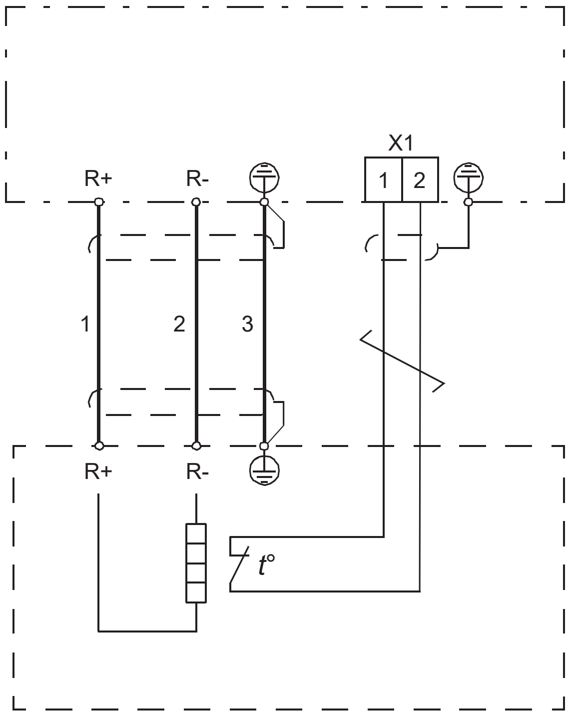
The DC fuses for the brake chopper protection protect also the resistor cable against short-circuits.

Mechanical installation of custom brake resistors

Obey the resistor manufacturer’s instructions.

Electrical installation of custom brake resistors

Connection diagram



1	NBRA brake chopper
2	Brake resistor

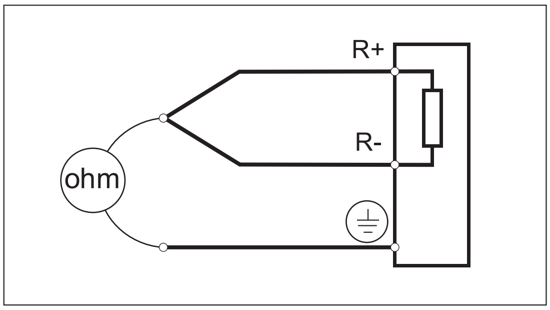
Measuring the insulation of the resistor circuit

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, commissioning or maintenance work.

Do not make any voltage tolerance or insulation resistance tests on the brake chopper modules. Every brake chopper module has been tested for insulation between the main circuit and the chassis at the factory.

Measure the insulation of the brake resistor assembly as follows:

1. Stop the drive and do the steps in section Electrical safety precautions (page 19) before you start the work.
2. Make sure that the resistor cable is connected to the resistor, and disconnected from the chopper output terminals R+ and R-.
3. At the brake unit end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



Connection procedure

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

- Do the steps in section Electrical safety precautions (page 19) before you start the work.
- Connect the resistor cable to the R+ and R- terminals of the chopper.
- Connect the thermal switch of the brake resistor to the enable input (X1) on the brake chopper control board. Use cable specified under Thermal protection of the resistors (page 344). If there are multiple thermal switches, connect them in series.

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

Start-up

Set the following parameters (ACS880 primary control program): Make sure that

- parameter 30.30 Overvoltage control is disabled.

You can activate and configure an additional thermal protection function for the chopper and resistor. See the firmware manual.

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

Technical data

Factory-installed brake chopper and resistor types

This table shows the brake chopper and resistor types of the drives.

U_N	ACS880-37 type	Brake chopper type (+D150)	Brake resistor type (+D151)
400 V	ACS880-37-0105A-3 … ACS880-37-0206A-3	NBRA-658	2 x SAFUR210F575
	ACS880-37-0293A-3 … ACS880-37-0650A-3	NBRA-659	2 x SAFUR180F460
500 V	ACS880-37-0101A-5 … ACS880-37-0180A-5	NBRA-658	2 x SAFUR125F500
	ACS880-37-0260A-5 … ACS880-37-0503A-5	NBRA-659	2 x SAFUR200F500
690 V	ACS880-37-0174A-7 … ACS880-37-0430A-7	NBRA-669	2 x SAFUR200F500

Ratings for the factory-installed brake choppers and ABB brake resistors

This table shows the ratings for the factory installed brake chopper and resistor combinations with duty cycles of 10 seconds every 60 seconds and 1 minute every 5 minutes. For calculating the maximum allowed braking power with a custom duty cycle, see the braking system planning instructions for factory-installed brake chopper and ABB resistor.

U_N	Brake chopper	Resistors	R (ohm)	$P_{br,max}$ (kW) 40 s	$P_{br,cont}$ (kW)	I_{max} (A)	Duty cycle (10/60 s)		Duty cycle (1/5 min)	
							P_{br} (kW)	I_{rms} (A)	P_{br} (kW)	I_{rms} (A)
400 V	NBRA-658	2 x SAFUR210F575	1.7	230	42	345	224	336	130	195
	NBRA-659	2 x SAFUR180F460	1.2	355	60	532	287	430	167	250
500 V	NBRA-658	2 x SAFUR125F500	2	268	36	334	192	239	111	138
	NBRA-659	2 x SAFUR200F500	1.35	403	54	502	287	357	167	208
690 V	NBRA-669	2 x SAFUR200F500	1.35	403	54	364	287	259	167	151

U_N	Nominal voltage
R	Resistance of specified resistors. This is also the minimum allowed resistance of the resistor assembly.
$P_{br,max}$	Maximum braking power allowed for 40 seconds every 600 seconds
$P_{br,cont}$	Maximum continuous braking power
I_{max}	Maximum current
P_{br}	Braking power for the specified duty cycle. This value may be limited by $P_{br,max}$

I_{rms}	rms current for the specified duty cycle

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

Ratings for factory-installed brake choppers and custom resistors

This table shows the ratings for the brake choppers (option +D150) with example duty cycles for custom resistor assemblies.

U_N	Chop-per type	$P_{br,max}$ (kW) 40 s	P_{cont} (kW)	I_{max} (A)	I_{rms} (A)	R (ohm)	Duty cycle (10/60 s)		Duty cycle (1/5 min)		$U_{br,on}$ (V)	$U_{br,off}$ (V)	Air flow (m^3/h)
							P_{br} (kW)	I_{rms} (A)	P_{br} (kW)	I_{rms} (A)			
400 V	NBRA-658	230	70	384	109	1.7	230	355	230	355	674	660	660
	NBRA-659	355	96	542	149	1.2	353	545	303	468			
500 V	NBRA-658	268	81	380	101	2.15	268	331	268	331	811	795	
	NBRA-659	403	109	571	136	1.43	403	498	317	391			
690 V	NBRA-669	403	119	414	107	2.72	404	361	298	267	1120	1096	

U_N	Nominal voltage
$P_{br,max}$	Maximum braking power allowed for 40 seconds every 600 seconds.
$P_{br,cont}$	Maximum continuous braking power
I_{max}	Maximum current
I_{rms}	ms current
R	Recommended resistance
P_{br}	Braking power for the specified duty cycle.
$U_{br,on}$	DC voltage at which chopper starts conducting
$U_{br,off}$	DC voltage at which chopper stops conducting

The airflow is required for cooling the chopper.

DC fuses

This table shows DC fuses for brake chopper protection.

Drive type ACS880-37-	Fuses		
	A	Manufacturer	Type
U_N = 400 V			
0105A-3	400	Bussmann	170M5142
0145A-3	400	Bussmann	170M5142
0169A-3	400	Bussmann	170M5142
0206A-3	400	Bussmann	170M5142
0293A-3	630	Bussmann	170M8635
0363A-3	630	Bussmann	170M8635
0442A-3	630	Bussmann	170M8635

Drive type ACS880-37-	Fuses		
	A	Manufacturer	Type
0505A-3	630	Bussmann	170M8635
0585A-3	630	Bussmann	170M8635
0650A-3	630	Bussmann	170M8635
U_N = 500 V			
0101A-5	400	Bussmann	170M5142
0124A-5	400	Bussmann	170M5142
0156A-5	400	Bussmann	170M5142
0180A-5	400	Bussmann	170M5142
0260A-5	630	Bussmann	170M8635
0302A-5	630	Bussmann	170M8635
0361A-5	630	Bussmann	170M8635
0414A-5	630	Bussmann	170M8635
0460A-5	630	Bussmann	170M8635
0503A-5	630	Bussmann	170M8635
U_N = 690 V			
0174A-7	400	Bussmann	170M5142
0210A-7	400	Bussmann	170M5142
0271A-7	400	Bussmann	170M5142
0330A-7	400	Bussmann	170M5142
0370A-7	400	Bussmann	170M5142
0430A-7	400	Bussmann	170M5142

Terminals and cable entry data of factory-installed chopper/resistor cubicles

See the dimension drawings delivered with the drive.

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/contact-centers.

Product training

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

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