

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

Table of contents



1. Safety instructions



4. Mechanical installation



6. Electrical installation



9. Start-up





# Table of contents

---

## 1 Safety instructions

Contents of this chapter .....	15
Use of warnings and notes .....	15
General safety in installation, start-up and maintenance .....	16
Electrical safety in installation, start-up and maintenance .....	17
Electrical safety precautions .....	17
Measuring the voltage .....	19
Additional instructions and notes .....	22
Optical components .....	23
Printed circuit boards .....	23
Grounding .....	23
General safety in operation .....	24
Additional instructions for permanent magnet motor drives .....	25
Safety in installation, start-up, maintenance .....	25
Safety in operation .....	25

## 2 Introduction to the manual

Contents of this chapter .....	27
Target audience .....	27
Categorization by frame size and option code .....	27
Quick installation, commissioning and operation flowchart .....	28
Terms and abbreviations .....	28
Related manuals .....	29

## 3 Operation principle and hardware description

Contents of this chapter .....	31
Operation principle .....	31
Single-line circuit diagram of the drive .....	32
Single-line diagram of R8 .....	32
Single-line diagram of R11 .....	33
Block diagram of the drive with brake options +D150 and +D151 .....	34
Line-side converter .....	35
AC voltage and current waveforms .....	35
Charging .....	35
Motor-side converter .....	35
Cabinet layout .....	36
Cabinet layout of R8 .....	36
Cabinet layout of R11 .....	39
Brake chopper cubicle option (+D150) .....	43
Overview of power and control connections .....	44
Connection overview of R8 .....	44
Connection overview of R11 .....	45
External control cable connection terminals (other than control unit terminals) .....	46
Connection terminals of R8 .....	46
Connection terminals of R11 .....	47

---

Door switches and lights .....	48
Main disconnecting device (Q1) .....	49
Other devices on the door .....	49
Control panel .....	49
Control by PC tools .....	49
Descriptions of options .....	50
Degree of protection .....	50
Definitions .....	50
IP22 (UL Type 1) .....	50
IP42 (UL Type 1 Filtered) (option +B054) .....	50
IP54 (UL Type 12) (option +B055) .....	50
Marine construction (option +C121) .....	50
Cooling air intake through bottom of cabinet (option +C128) .....	51
UL Listed (option +C129) .....	51
Channeled air outlet (option +C130) .....	51
CSA Approved (option +C134) .....	51
Plinth height (options +C164 and +C179) .....	51
Seismic design (option +C180) .....	51
Empty cubicles on right (options +C196...C198) .....	51
Empty cubicles on left (options +C199...C201) .....	51
Resistor braking (options +D150 and +D151) .....	52
du/dt filter (option +E205) .....	52
Sine filter (option +E206) .....	52
Common mode filter (option +E208) .....	52
Cabinet heater with external supply (option +G300) .....	52
Cabinet lighting (option +G301) .....	52
Terminals for external control voltage (option +G307) .....	52
Output for motor space heater (option +G313) .....	53
Ready/Run/Fault lights (options +G327...G329) .....	53
Halogen-free wiring and materials (option +G330) .....	53
V-meter with selector switch (option +G334) .....	53
A-meter in one phase (option +G335) .....	53
Wire markings .....	53
Standard wire markings .....	53
Additional wire markings .....	53
Bottom cable entry/exit options +H350 and +H352) .....	54
Top cable entry/exit (options +H351 and +H353) .....	54
Cable conduit entry (option +H358) .....	54
Additional terminal block X504 (option +L504) .....	54
Thermal protection with PTC relays (options +L505, +2L505, +L513, +2L513, +L536, +L537) .....	55
+L505, +2L505, +L513, +2L513 .....	55
+L536, +L537 .....	55
Thermal protection with Pt100 relays (options +nL506, +nL514) .....	56
Starter for auxiliary motor fan (options +M6xx) .....	56
What the option contains .....	56
Description .....	57
Type designation label .....	57
Type designation key .....	58
Basic codes .....	58
Option codes (plus codes) .....	58

#### 4 Mechanical installation

Contents of this chapter .....	63
Examining the installation site .....	63
Necessary tools .....	64
Examining the delivery .....	64
Moving and unpacking the drive .....	65
Moving the drive in its packaging – Frame R8 .....	65
Moving the drive in its packaging – Frame R11 .....	67
Lifting the crate with a forklift .....	67
Lifting the crate with a crane .....	68
Moving the crate with a forklift .....	69
Removing the transport package .....	69
Moving the unpacked drive cabinet .....	70
Lifting the cabinet with a crane .....	70
Moving the cabinet on rollers .....	71
Moving the cabinet on its back .....	71
Final placement of the cabinet .....	72
Installing the IP54 roof (option +B055) .....	73
Frame R8 .....	73
Frame R11 .....	74
Attaching the cabinet to the floor and wall or roof .....	75
General rules .....	75
Attaching the cabinet (non-marine units) .....	76
Alternative 1 – Clamping .....	76
Alternative 2 – Using the holes inside the cabinet .....	77
Attaching the cabinet (marine units) .....	78
Miscellaneous .....	79
Cable duct in the floor below the cabinet .....	79
Arc welding .....	79
Air inlet through the bottom of cabinet (option +C128) .....	79
Air outlet duct on the cabinet roof (option +C130) .....	80
Calculating the required static pressure difference .....	80
Lifting lugs and bars .....	82
Certificate of conformity .....	82
Declaration of Conformity .....	82

#### 5 Guidelines for planning the electrical installation

Contents of this chapter .....	85
Limitation of liability .....	85
Selecting the supply disconnecting device .....	85
Examining the compatibility of the motor and drive .....	86
Protecting the motor insulation and bearings .....	86
Requirements table .....	86
Availability of $du/dt$ filter and common mode filter by drive type .....	89
Additional requirements for explosion-safe (EX) motors .....	89
Additional requirements for ABB motors of types other than M2_, M3_, M4_, HX_ and AM_ .....	89
Additional requirements for ABB high-output and IP23 motors .....	89
Additional requirements for non-ABB high-output and IP23 motors .....	89
Additional data for calculating the rise time and the peak line-to-line voltage .....	90
Additional note for sine filters .....	91

Selecting the power cables .....	91
General guidelines .....	91
Typical power cable sizes .....	92
Power cable types .....	92
Preferred power cable types .....	92
Alternate power cable types .....	93
Not allowed power cable types .....	94
Additional guidelines, North America .....	94
Metal conduit .....	95
Power cable shield .....	95
Selecting the control cables .....	96
Shielding .....	96
Signals in separate cables .....	96
Signals that can be run in the same cable .....	96
Relay cable .....	96
Control panel to drive cable .....	96
PC tool cable .....	97
Routing the cables .....	97
General guidelines – IEC .....	97
General guidelines – North America .....	97
Continuous motor cable shield/conduit or enclosure for equipment on the motor cable .....	98
Separate control cable ducts .....	98
Implementing thermal overload and short-circuit protection .....	99
Protecting the drive and input power cable in short-circuits .....	99
Protecting the motor and motor cable in short-circuits .....	99
Protecting the drive and the power cables against thermal overload .....	99
Protecting the motor against thermal overload .....	100
Protecting the drive against ground faults .....	100
Residual current device compatibility .....	100
Implementing the emergency stop function .....	100
Implementing the Safe torque off function .....	100
Implementing an ATEX-certified motor thermal protection .....	100
Implementing the Prevention of unexpected start-up function .....	101
Implementing the functions provided by the FSO-xx safety functions module .....	101
Implementing the Power-loss ride-through function .....	102
Cabinets with line contactor (option +F250) .....	102
Implementing a bypass connection .....	102
Supplying power for the auxiliary circuits .....	102
Using power factor compensation capacitors with the drive .....	103
Using a safety switch between the drive and the motor .....	103
Implementing the control of a contactor between drive and motor .....	103
Protecting the contacts of relay outputs .....	103
Implementing a motor temperature sensor connection .....	104
Connecting motor temperature sensor to the drive via an option module .....	105

## 6 Electrical installation

Contents of this chapter .....	107
Warnings .....	107
Measuring the insulation .....	107
Measuring the insulation of the drive .....	107
Measuring the insulation of the input power cable .....	107

---

Measuring the insulation of the motor and motor cable .....	108
Compatibility with IT (ungrounded), corner-grounded delta, midpoint-grounded delta and TT systems .....	108
EMC filter (standard drive, options +E200 or +E202) .....	108
Ground-to-phase varistor .....	108
Corner-grounded and midpoint-grounded delta systems .....	109
Attaching the device stickers to the cabinet door .....	109
Settings the voltage range of auxiliary voltage transformers .....	109
Connecting the power cables .....	110
Connection diagram .....	110
Connection diagram of frame R8 .....	110
Connection diagram of frame R11 .....	111
Layout of power cable connection terminals and cable entries .....	112
Frame R8 .....	112
Frame R11 .....	113
Layout of power cable connection terminals (option +C129) .....	114
External resistor cable connection terminals and cable entries .....	115
Connection procedure (IEC) .....	115
Connection procedure (North America) .....	117
Grounding the motor cable shield at the motor end .....	120
Connecting the control cables .....	120
Routing the control cables inside the cabinet .....	120
Routing the control cables inside the cabinet .....	120
Frame R8 .....	120
Frame R11 .....	123
Connecting the external control cables to the drive control unit .....	127
Connecting a PC .....	127
Installing option modules .....	129
Mechanical installation of I/O extension, fieldbus adapter and pulse encoder interface modules .....	129
Installation of an FSO-xx safety functions module beside the ZCU-12 control unit ..	129
Installation of an FSO-xx safety functions module onto ZCU-14 .....	130
Safety functions module FSO-xx beside the ZCU-14 control unit .....	131
Installation of an FSPS-21 safety functions module .....	132

## **7 Control units of the drive**

Contents of this chapter .....	133
General .....	133
ZCU-12 layout .....	134
ZCU-14 layout .....	135
Default I/O diagram of the drive control unit (ZCU-1x) .....	136
Additional information on the connections .....	138
External power supply for the control unit (XPOW) .....	138
DI6 as a PTC sensor input .....	138
AI1 or AI2 as a Pt100, Pt1000, PTC or KTY84 sensor input .....	138
DIIL input .....	139
The XD2D connector .....	139
Safe torque off (XSTO) .....	140
FSO-xx safety functions module connection (X12) .....	140
Connector data .....	141
ZCU-1x ground isolation diagram .....	143

**8 Installation checklist of the drive**

Contents of this chapter .....	145
Checklist .....	145

**9 Start-up**

Contents of this chapter .....	147
Start-up procedure .....	147

**10 Fault tracing**

Contents of this chapter .....	151
LEDs .....	151
Warning and fault messages .....	151

**11 Maintenance**

Contents of this chapter .....	153
Maintenance intervals .....	153
Cabinet .....	155
Cleaning the interior of the cabinet .....	155
Cleaning the door air inlets (IP22 and IP42) .....	155
Replacing the inlet door filters (IP54) .....	156
Cleaning the roof outlet filters (IP54) .....	156
Replacing the outlet (roof) filters (IP54) .....	156
Cleaning the heatsink .....	157
Power connections .....	157
Retightening the power connections .....	157
Fans .....	157
Replacing the cabinet "door fan" .....	158
Replacing the internal cabinet cooling fans (frame R8) .....	159
Replacing the drive module main fan (frame R8) .....	161
Replacing the drive module main fans (frame R11) .....	161
Replacing the LCL filter module fan (frame R11) .....	163
Replacing the auxiliary cooling fan of the drive module (frame R8) .....	164
Replacing the auxiliary cooling fans of the drive module (frame R11) .....	165
Frame R8: Replacing the IP54 (UL Type 12) roof fan and chopper (option +D150) cubicle fan G101.2 .....	167
Frame R11 with options +B055 and +C128: Replacing the roof fan .....	168
Frame R11 with option +B055: Replacing the roof fan .....	169
Replacing the brake chopper (option +D150) cubicle fan .....	169
Replacing the sine filter cooling fan .....	170
Replacing the drive module (frame R8) .....	171
Required tools .....	171
Replacing the drive module (frame R8) .....	171
Replacing the drive and LCL filter modules (frame R11) .....	180
Required tools .....	180
Safety .....	180
Module handling .....	180
Replacing the drive module (frame R11) .....	182
Replacing the LCL filter module .....	191
Capacitors .....	193
Reforming the capacitors .....	193



Fuses .....	193
Replacing fuses (frame R8) .....	193
Replacing fuses (frame R11) .....	195
Replacing the DC fuses of the brake chopper (option +D150) .....	197
Control panel .....	198
Replacing the battery and cleaning .....	198
Control unit .....	198
Replacing the ZCU-14 control unit battery .....	198
Memory unit .....	198
Replacing the memory unit of the motor-side converter control unit (frame R8) ...	199
Replacing the memory unit of the motor-side converter control unit (frame R11) ..	201
Replacing the memory unit of the line-side converter control unit (frame R11) ...	202

## 12 Technical data

Contents of this chapter .....	203
Marine type-approved drives (option +C132) .....	203
Ratings .....	203
IEC ratings .....	203
UL (NEC) ratings .....	204
Definitions .....	205
Derating .....	205
Surrounding air temperature derating .....	205
Altitude derating .....	206
Deratings for special settings in the drive control program .....	207
Fuses (IEC) .....	211
Fuses (UL) .....	213
Dimensions and weights .....	214
Dimensions and weights of sine filter cabinet (option +E206) .....	214
Free space requirements .....	215
Cooling data, noise .....	216
Sine output filter data .....	217
Typical cable sizes .....	218
Tightening torques .....	219
Electrical connections .....	219
Mechanical connections .....	219
Insulation supports .....	219
Cable lugs .....	219
Terminal and exit data for the power cables .....	219
IEC .....	220
North America .....	220
Terminal data for the drive control unit .....	220
Electrical power network specification .....	220
Motor connection data .....	222
Control unit connection data .....	222
Efficiency .....	222
Protection classes .....	222
Ambient conditions .....	222
Auxiliary circuit power consumption .....	223
Materials .....	224
Applicable standards .....	225
Markings .....	225



CE marking .....	226
Compliance with the European Low Voltage Directive .....	226
Compliance with the European EMC Directive .....	226
Compliance with the European Machinery Directive .....	226
Compliance with EN 61800-3:2004 + A1:2012 .....	227
Definitions .....	227
Category C2 .....	227
Category C3 .....	227
Category C4 .....	228
UL and CSA checklist .....	229
Disclaimers .....	230
Generic disclaimer .....	230
Cybersecurity disclaimer .....	230

### 13 Dimension drawings

Contents of this chapter .....	231
R8 IP22 (UL Type 1) and option +B054 (IP42 [UL Type 1 Filtered]) .....	232
R8 IP54 (UL Type 12, option +B055), option +C129 .....	233
R8 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +D150, +D151 .....	234
R8 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +E206 .....	235
R8 IP22 (UL Type 1): option +E202 .....	236
R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054) .....	237
R11 IP54 (UL Type 12, option +B055) .....	238
R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +C129, +H350, +H352 .....	239
R11 IP54 (UL Type 12, option +B055): option +C128 .....	240
R11 IP54 (UL Type 12, option +B055): option +C129 .....	241
R11 IP54 (UL Type 12, option +B055): options +C129, +H350, +H352 .....	242
R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +D150 .....	243
R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +D150, +D151 .....	244
R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +E206 .....	245
R11 IP22 (UL Type 1): option +E202 .....	246
Location and size of power cable connection terminals .....	247
R8 input and motor cable terminal dimensions – bottom entry and exit .....	247
R8 input and motor cable terminal dimensions – top entry and exit (options +H351 and +H353) .....	248
R8 input and motor cable terminals .....	249
R11 input and motor cable terminal dimensions – bottom entry and exit .....	249
R11 input and motor cable terminal dimensions – top entry and exit (options +H351 and +H353) .....	250
R11 input cable terminals .....	250
R11 motor cable terminals .....	251
Terminals for connecting external resistors .....	251
Sine filter (+E206) cubicle, 400 mm: motor cable terminals .....	251
Sine filter (+E206) cubicle, 600 mm: motor cable terminals .....	252
Sine filter (+E206) cubicle, 1000 mm: motor cable terminals .....	252

### 14 The Safe torque off function

Contents of this chapter .....	253
--------------------------------	-----

Description .....	253
Compliance with the European Machinery Directive .....	254
Wiring .....	255
Activation switch .....	255
Cable types and lengths .....	255
Grounding of protective shields .....	255
Single ACS880-37 drive, internal power supply .....	256
Dual-channel connection .....	256
Single-channel connection .....	256
Multiple drives .....	257
Internal power supply .....	257
External power supply .....	258
Operation principle .....	259
Start-up including acceptance test .....	260
Competence .....	260
Acceptance test reports .....	260
Acceptance test procedure .....	260
Use .....	262
Maintenance .....	263
Competence .....	263
Fault tracing .....	264
Safety data .....	265
Abbreviations .....	265
TÜV certificate .....	266
Declaration of conformity .....	267

## **15 Resistor braking**

Contents of this chapter .....	269
Operation principle and hardware description .....	269
Planning the braking system .....	269
Selecting the default brake circuit components - ABB chopper and ABB resistor ...	269
Calculating the maximum allowed braking power for a custom duty cycle – ABB chopper and ABB resistor .....	270
Selecting the default brake circuit components - ABB brake chopper and custom resistor .....	270
Selecting custom resistors .....	271
Calculating the maximum allowed braking power for a custom duty cycle – ABB chopper and custom resistor .....	272
Example 1 .....	272
Example 2 .....	272
Selecting and routing brake resistor cables .....	273
Minimizing electromagnetic interference .....	273
Maximum cable length .....	273
EMC compliance of the complete installation .....	273
Placing the brake resistors .....	274
Protecting the system against thermal overload .....	274
Thermal protection of the resistors .....	274
Protecting the brake resistor cable against short-circuits .....	274
Mechanical installation of custom brake resistors .....	274
Electrical installation of custom brake resistors .....	275
Connection diagram .....	275
Measuring the insulation of the resistor circuit .....	275

---

14 *Table of contents*

Connection procedure .....	276
Start-up .....	276
Technical data .....	277
Factory-installed brake chopper and resistor types .....	277
Ratings for the factory-installed brake choppers and ABB brake resistors .....	277
Ratings for factory-installed brake choppers and custom resistors .....	278
DC fuses .....	278
Terminals and cable entry data of factory-installed chopper/resistor cubicles .....	279

*Further information*



# 1

## Safety instructions

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### Contents of this chapter

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

### Use of warnings and notes

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

The manual uses these warning symbols:

**WARNING!**

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

---

**WARNING!**

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

---

**WARNING!**

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

---

## General safety in installation, start-up and maintenance

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



### WARNING!

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

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



- Do not 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, remain hot for a while after disconnection of the electrical supply.
- Vacuum clean the area around the drive before the start-up to prevent the drive cooling fan from drawing the dust inside the drive.
- Make sure that debris from drilling, cutting and grinding does not enter the drive during the installation. Electrically conductive debris inside the drive may cause damage or malfunction.
- Make sure that there is sufficient cooling. See the technical data.
- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists. If you cannot avoid working on a powered drive, obey the local laws and regulations on live working (including – but not limited to – electric shock and arc protection).
- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.

- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".
- The maximum drive power cycles is five times in ten minutes. Power cycling the drive too often can damage the charging circuit of the DC capacitors.
- If you have connected safety circuits to the drive (for example, Safe torque off or emergency stop), validate them at start-up. See separate instructions for the safety circuits.
- Beware of hot air exiting from the air outlets.
- Do not cover the air inlet or outlet when the drive is running.

**Note:**

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



## **Electrical safety in installation, start-up and maintenance**

### **■ Electrical safety precautions**

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

---



**WARNING!**

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

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

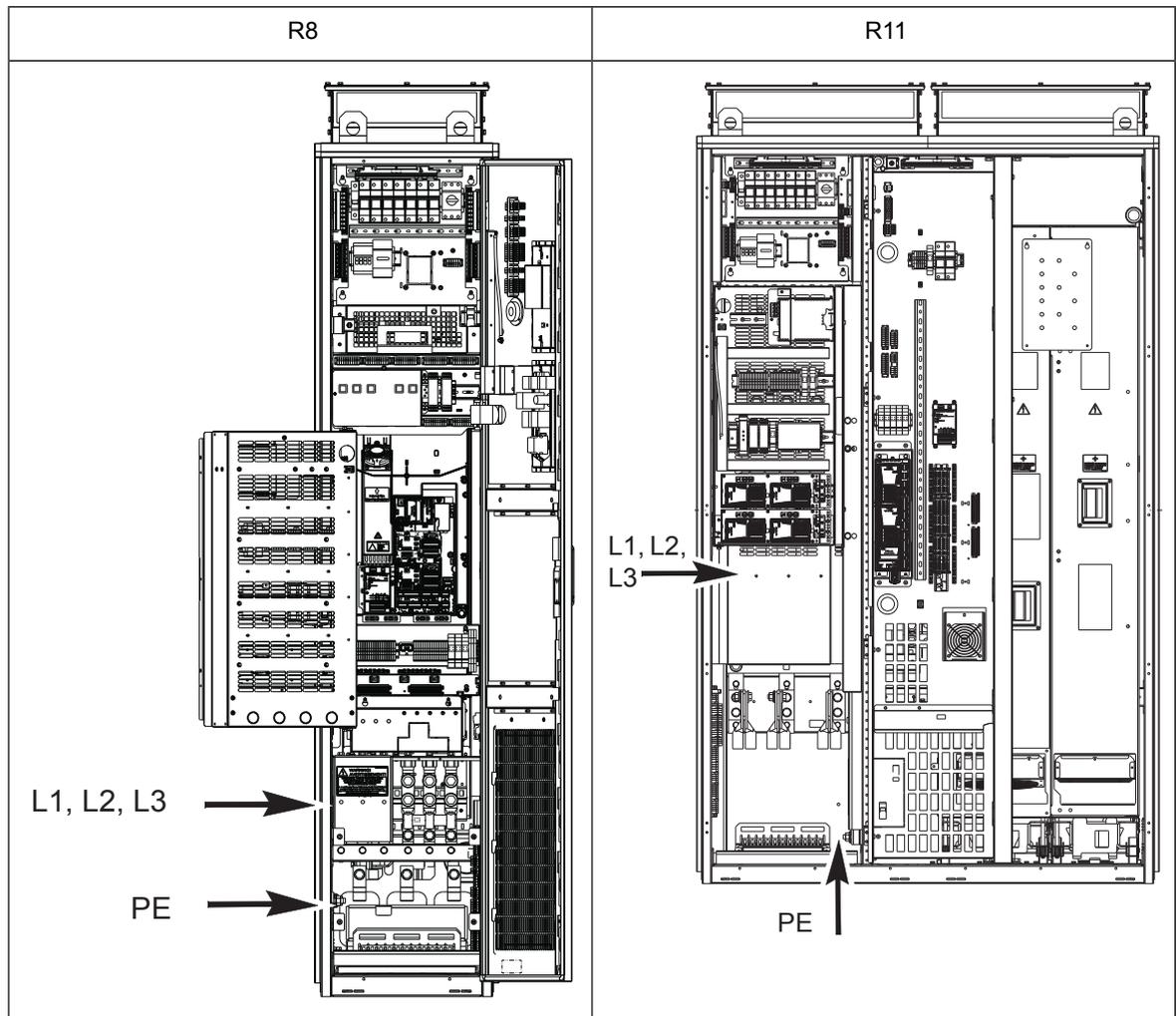
Go through these steps before you begin any installation or maintenance work.

1. Clearly identify the work location and equipment.
2. Disconnect all possible voltage sources. Make sure that re-connection is not possible. Lock out and tag out.
  - Open the main disconnecting device of the drive.
  - Open the charging switch if present.
  - Open the disconnecter of the supply transformer. (The main disconnecting device in the drive cabinet does not disconnect the voltage from the AC input power busbars of the drive cabinet.)
  - Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
  - If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
  - Disconnect any dangerous external voltages from the control circuits.
  - After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).
  - Use a multimeter with an impedance greater than 1 Mohm.
  - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
  - 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.
  - Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.
6. Install temporary grounding as required by the local regulations.
7. Ask the person in control of the electrical installation work for a permit to work.



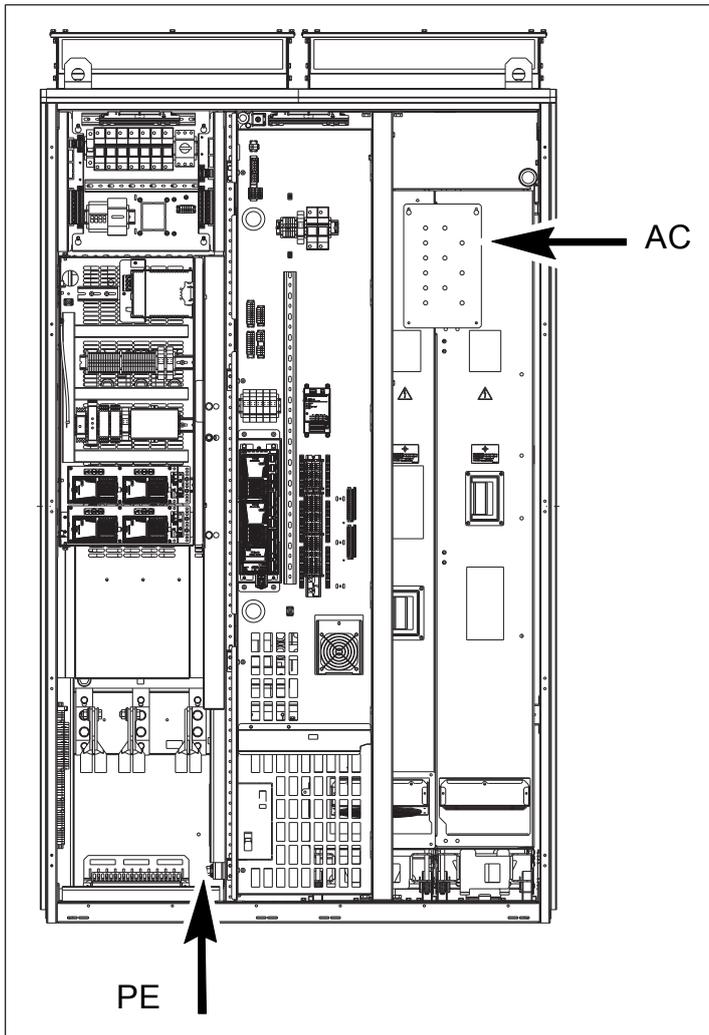
■ **Measuring the voltage**

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

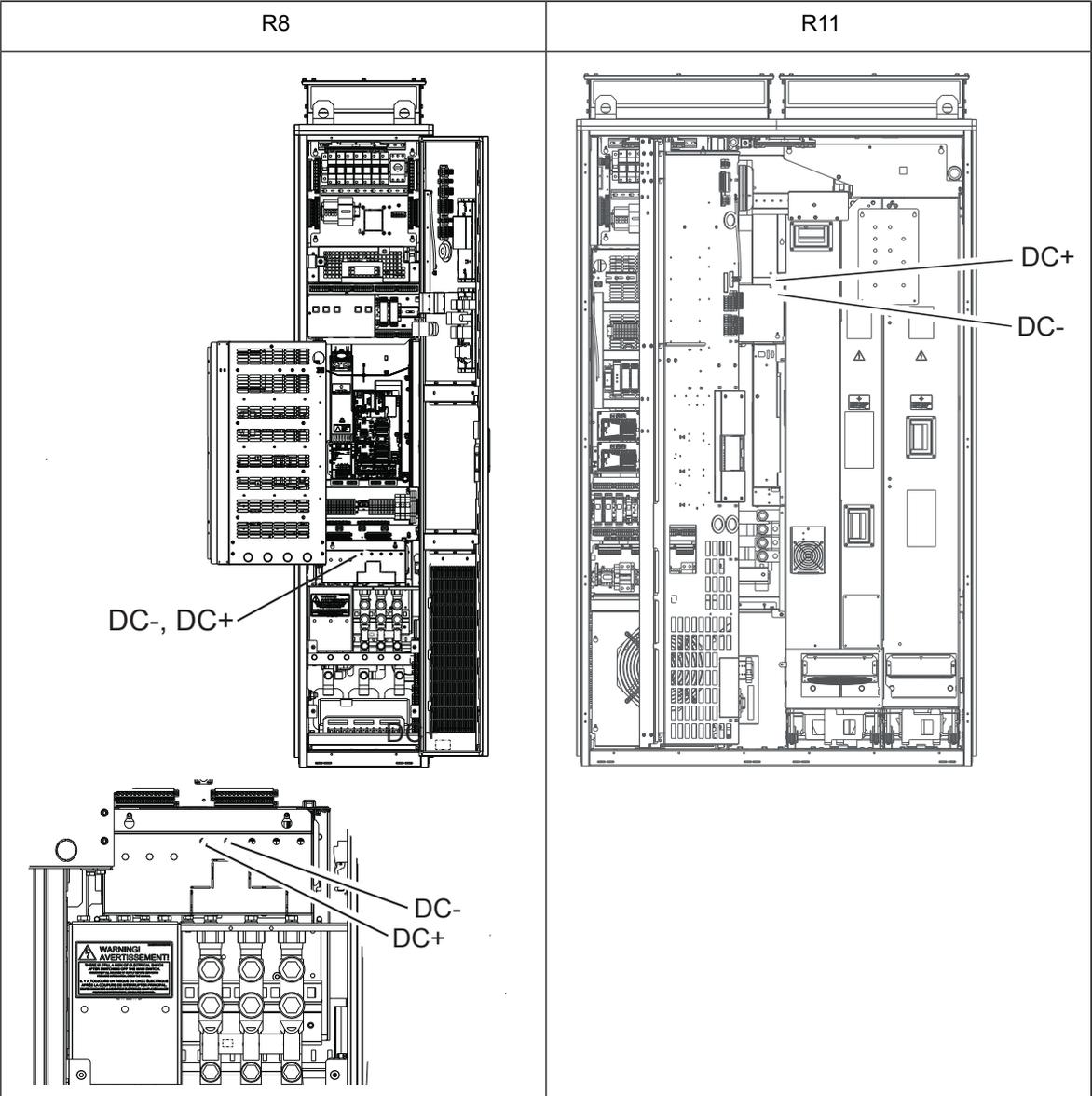


## 20 Safety instructions

**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.

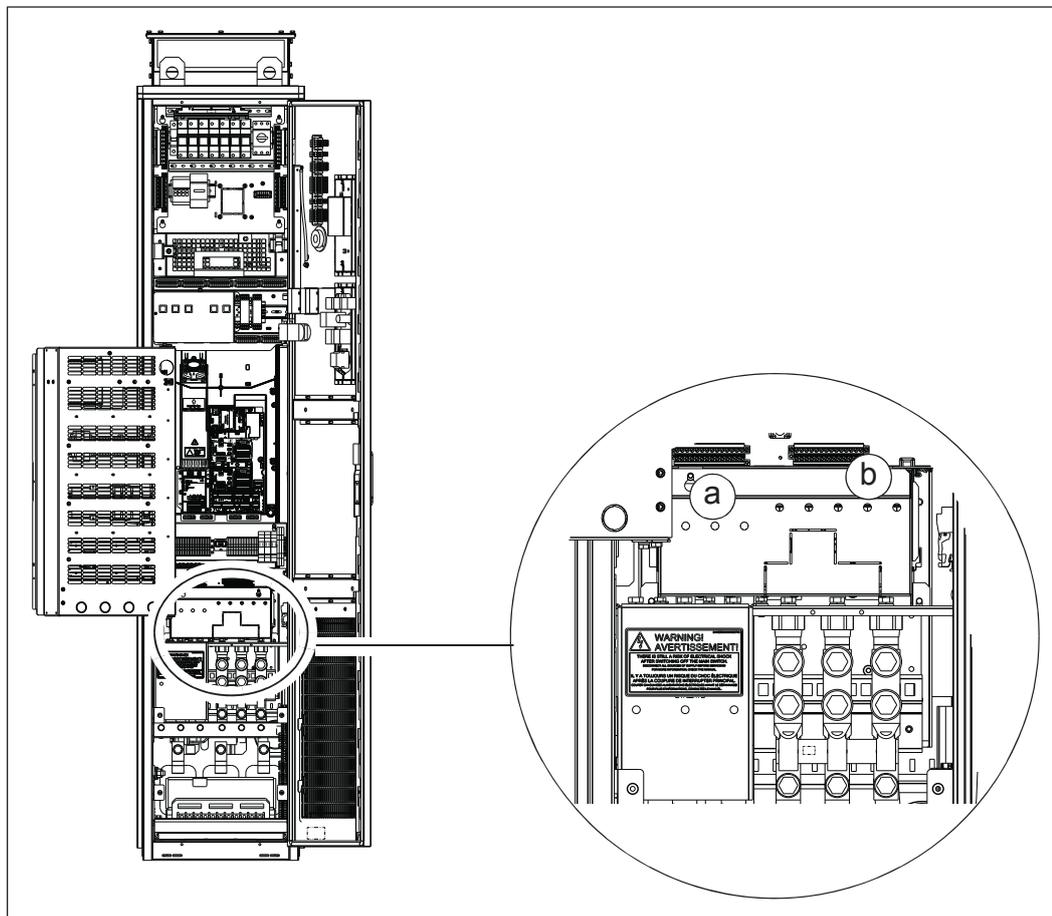


Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.



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

**Note:**

- The motor cable terminals of the drive are at a dangerous voltage when the input power is on, regardless of whether the motor is running or not.
- When the input power is on, the drive DC bus is at a dangerous voltage. If brake chopper and resistor are in use, they are at a dangerous voltage. (Options +D150 and +D151)
- External wiring can supply dangerous voltages to the relay outputs of the control units of the drive.
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.

**Optical components****WARNING!**

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

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

**Printed circuit boards****WARNING!**

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

## ■ Grounding

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

**WARNING!**

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

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

- Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- Make sure that the conductivity of the protective earth (PE) conductors is sufficient. See the electrical planning instructions of the drive. Obey the local regulations.
- Connect the power cable shields to protective earth (PE) terminals of the drive to make sure of personnel safety.
- Make a 360° grounding of the power and control cable shields at the cable entries to suppress electromagnetic disturbances.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) busbar of the power supply.

**Note:**

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

## General safety in operation

These instructions are for all personnel that operate the drive.



**WARNING!**

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

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

**Note:**

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



## Additional instructions for permanent magnet motor drives

### ■ Safety in installation, start-up, maintenance

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



#### **WARNING!**

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

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

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

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

- Stop the drive.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
- Do the steps in section [Electrical safety precautions \(page 17\)](#).
- Measure that the installation is de-energized.
  - Use a multimeter with an impedance greater than 1 Mohm.
  - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
  - 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.
  - Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.
- Install temporary grounding to the drive output terminals (T1/U, T2/V, T3/W). Connect the output terminals together as well as to the PE.

During the start up:

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

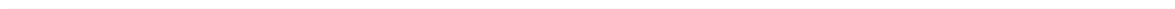
### ■ Safety in operation



#### **WARNING!**

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





# 2

## Introduction to the manual

---

### Contents of this chapter

This chapter describes the 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, start up and do maintenance work on the drive, or create instructions for the end user of the drive concerning the installation and maintenance of the drive.

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

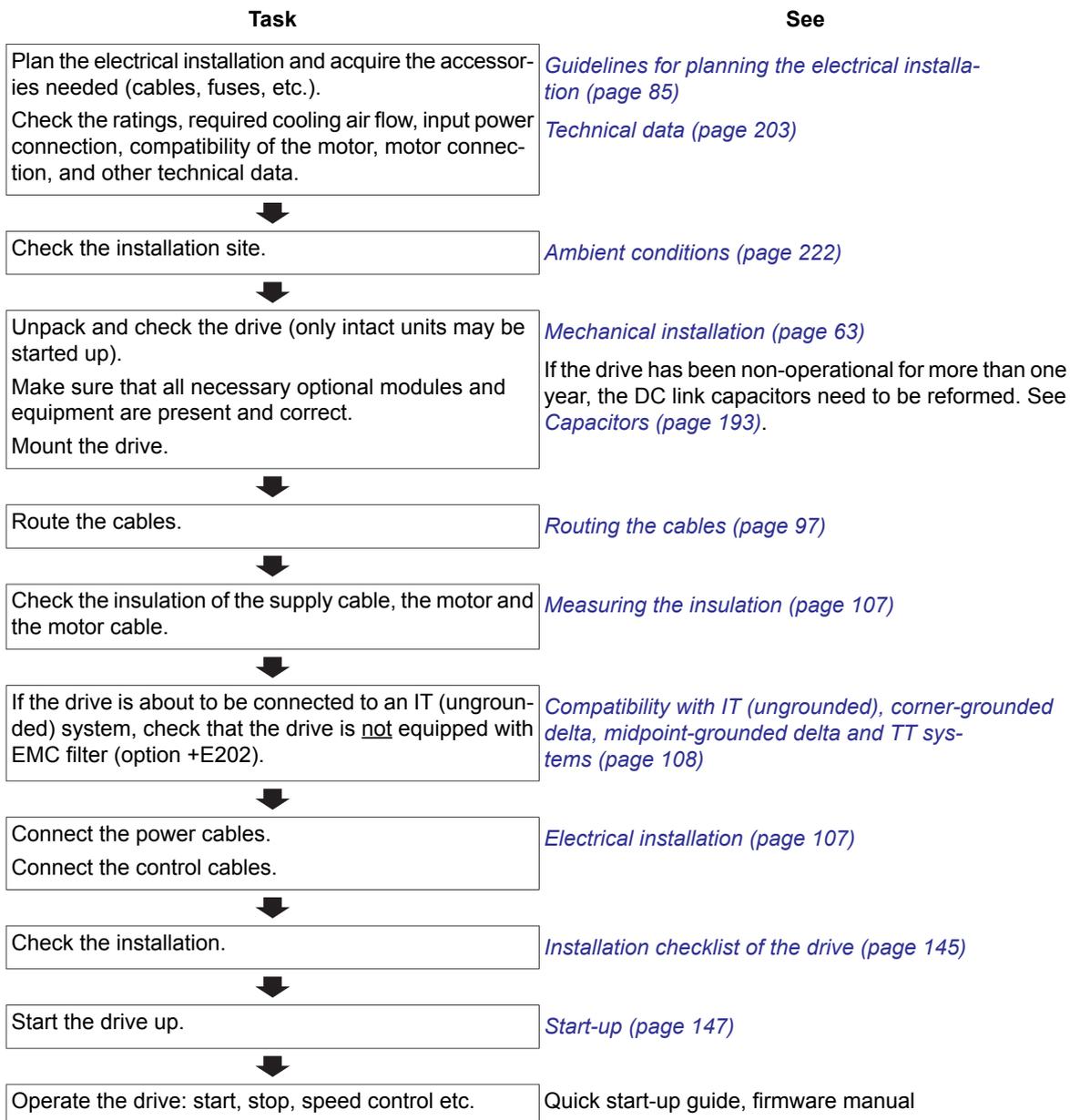
### Categorization by frame size and option code

Some instructions, technical data and dimension drawings which concern only certain frame sizes are marked with the symbol of the frame size, for example R11. The frame size is marked on the *Type designation label (page 57)*.

The instructions, technical data and dimension drawings which only concern certain optional selections are marked with option codes (such as +E205). The options included in the drive can be identified from the option codes visible on the type designation label (see page 57). The option selections are listed in section *Type designation key (page 58)*.

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## Quick installation, commissioning and operation flowchart



## Terms and abbreviations

Term	Description
ACS-AP-I	Industrial assistant 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 board	Circuit board in which the control program runs
Control unit	Control board built in a housing (often rail-mountable)
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility

Term	Description
EMI	Electromagnetic interference
EMT	Electrical metallic tubing, type of cable conduit
FAIO-01	Optional analog I/O extension module
FCAN	Optional CANopen® adapter module
FCNA-01	Optional ControlNet™ adapter module
FDCO-01	DDCS communication module with two pairs of 10 Mbit/s DDCS channels
FDNA-01	Optional DeviceNet™ adapter module
FECA-01	Optional EtherCAT® adapter module
FEN-01	Optional TTL incremental encoder interface module
FEN-11	Optional TTL absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL incremental encoder interface module
FENA-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
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	In a drive module, the converter between the AC supply network and the DC link
Motor-side converter	In a drive module, the converter between the DC link and 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 manuals

Name	Code
<b>Drive hardware manuals and guides</b>	
<i>Drive/converter/inverter safety instructions</i>	Multilingual code: 3AXD50000037978
<i>ACS880-37 drives (45...400 kW, 60...450 hp) hardware manual</i>	3AXD50000035159
<i>ACx-AP-x assistant control panels user's manual</i>	3AUA0000085685
<i>ACS880 frames R1 to R11 EMC filter and ground-to-phase varistor disconnecting instructions</i>	3AUA0000125152
<b>Drive firmware manuals and guides</b>	
<i>ACS880 primary control program firmware manual</i>	3AUA0000085967
<i>Quick start-up guide for ACS880 drives with primary control program</i>	3AUA0000098062
<i>ACS880 IGBT supply control program firmware manual</i>	3AUA0000131562
<b>Option manuals and guides</b>	
<i>Drive composer start-up and maintenance PC tool user's manual</i>	3AUA0000094606

<b>Name</b>	<b>Code</b>
<i>Bypass connection for ACS880-07, -17, -37 (40...1200 A) option description</i>	3AXD50000048959
<i>FSO-12 safety functions module user's manual</i>	3AXD50000015612
<i>FSO-21 safety functions module user's manual</i>	3AXD50000015614
<i>FSPS-21 PROFIsafe safety functions module module user's manual</i>	3AXD50000158638
<i>User's manual for Prevention of unexpected start-up (+Q950) for ACS880-07/17/37 drives</i>	3AUA0000145922
<i>User's manual for Emergency stop, stop category 0 (+Q951) for ACS880-07/17/37 drives</i>	3AUA0000119895
<i>User's manual for Emergency stop, stop category 1 (+Q952) for ACS880-07/17/37 drives</i>	3AUA0000119896
<i>User's manual for Prevention of unexpected start-up (+Q957) for ACS880-07/17/37 drives</i>	3AUA0000119910
<i>User's manual for Emergency stop, stop category 0 (+Q963) for ACS880-07/17/37 drives</i>	3AUA0000119908
<i>User's manual for Emergency stop, stop category 1 (+Q964) for ACS880-07/17/37 drives</i>	3AUA0000119909
<i>User's manual for Emergency stop, configurable stop category 0 or 1 (+Q978) for ACS880-07/17/37 drives</i>	3AUA0000145920
<i>Manuals and quick guides for I/O extension modules, fieldbus adapter, etc.</i>	

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



[ACS880-37 \(45...400 kW, 60...450 hp\) manuals](#)

See [www.abb.com/drives/documents](http://www.abb.com/drives/documents) for all manuals on the Internet.



# Operation principle and hardware description

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## Contents of this chapter

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

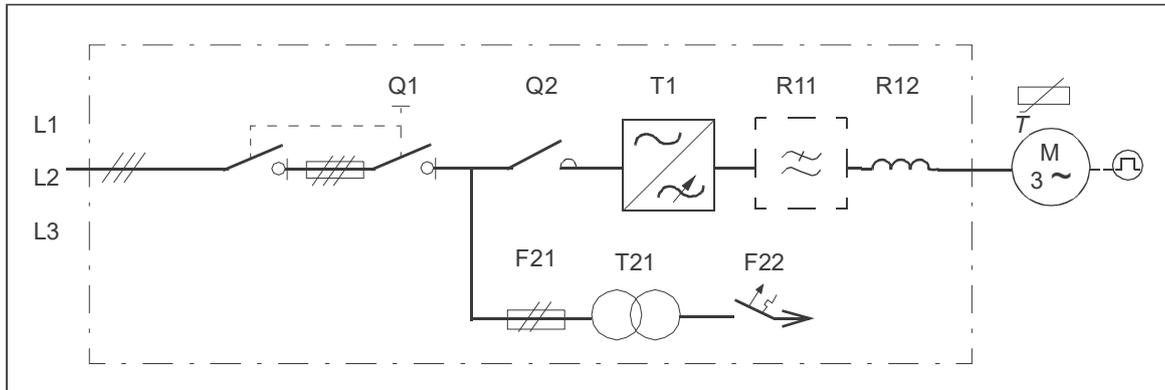
## Operation principle

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.

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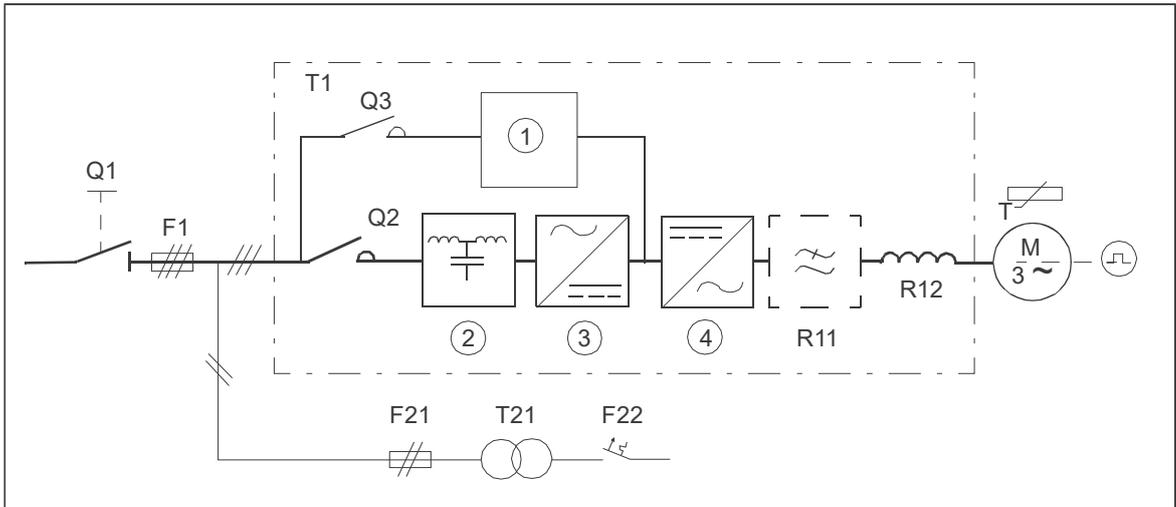
■ **Single-line circuit diagram of the drive**

**Single-line diagram of R8**



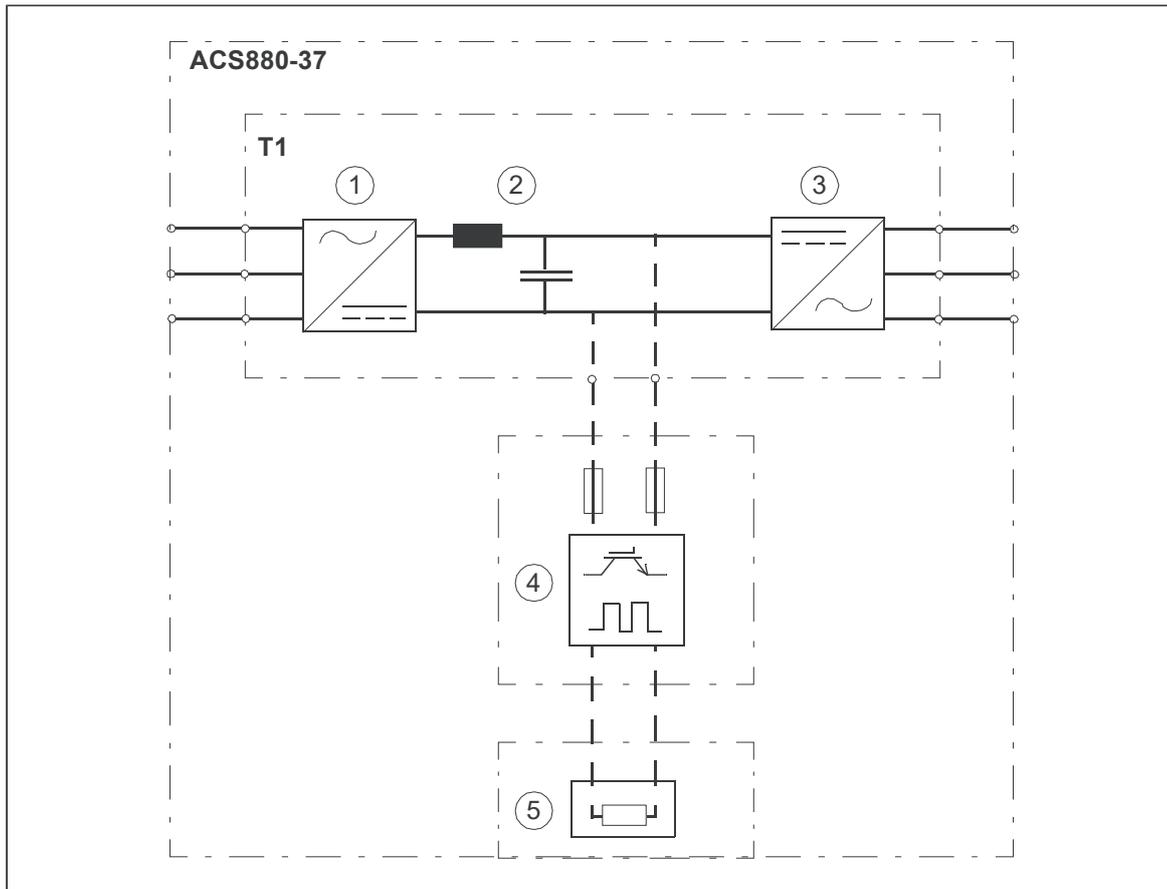
F21	Auxiliary voltage supply fuses
F22	Auxiliary circuit protection switch
Q1	Switch fuse
Q2	Line contactor with options +Q951, +Q952, +Q978
R11	Common mode filter (option +E208)
R12	du/dt filter (option +E205) or sine filter (option +E206)
T21	Auxiliary voltage transformer supplying 24 V and 230/115 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 +L205)
	PTC sensors for optional thermistor relay(s) (options +L205, +2L205) or Pt100 sensors for optional Pt100 relays (option +xL206)

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 switch (as standard)
R11	Common mode filter (option +E208, as standard in 690 V frame R11)
R12	du/dt 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)
	Motor temperature sensor

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

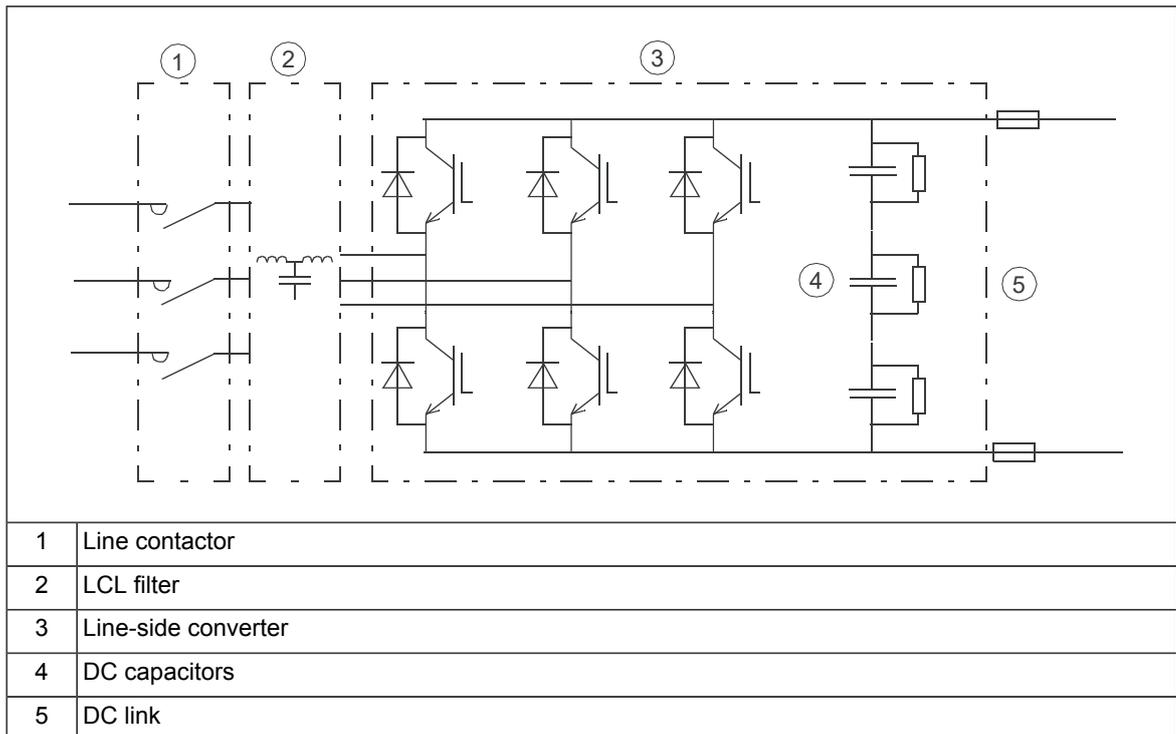


T1	Drive module
1	Line-side converter
2	DC circuit between the line-side converter and motor-side converter
3	Motor-side converter
4	Brake chopper (option +D150) is located in its own cubicle
5	Brake resistor (option +D151) is located in its own cubicle

## ■ Line-side converter

The line-side converter rectifies three-phase AC current to direct current for the intermediate DC link of the drive. The line-side converter is also capable of regenerating, that is, feeding braking energy back into the electrical power network.

The following diagram shows the simplified main circuit of the line-side converter. In R11, a ZCU control unit controls the line-side converter. See [Overview of power and control connections](#). In R8, a QCON-21 control board controls the line-side converter.



### 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 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.

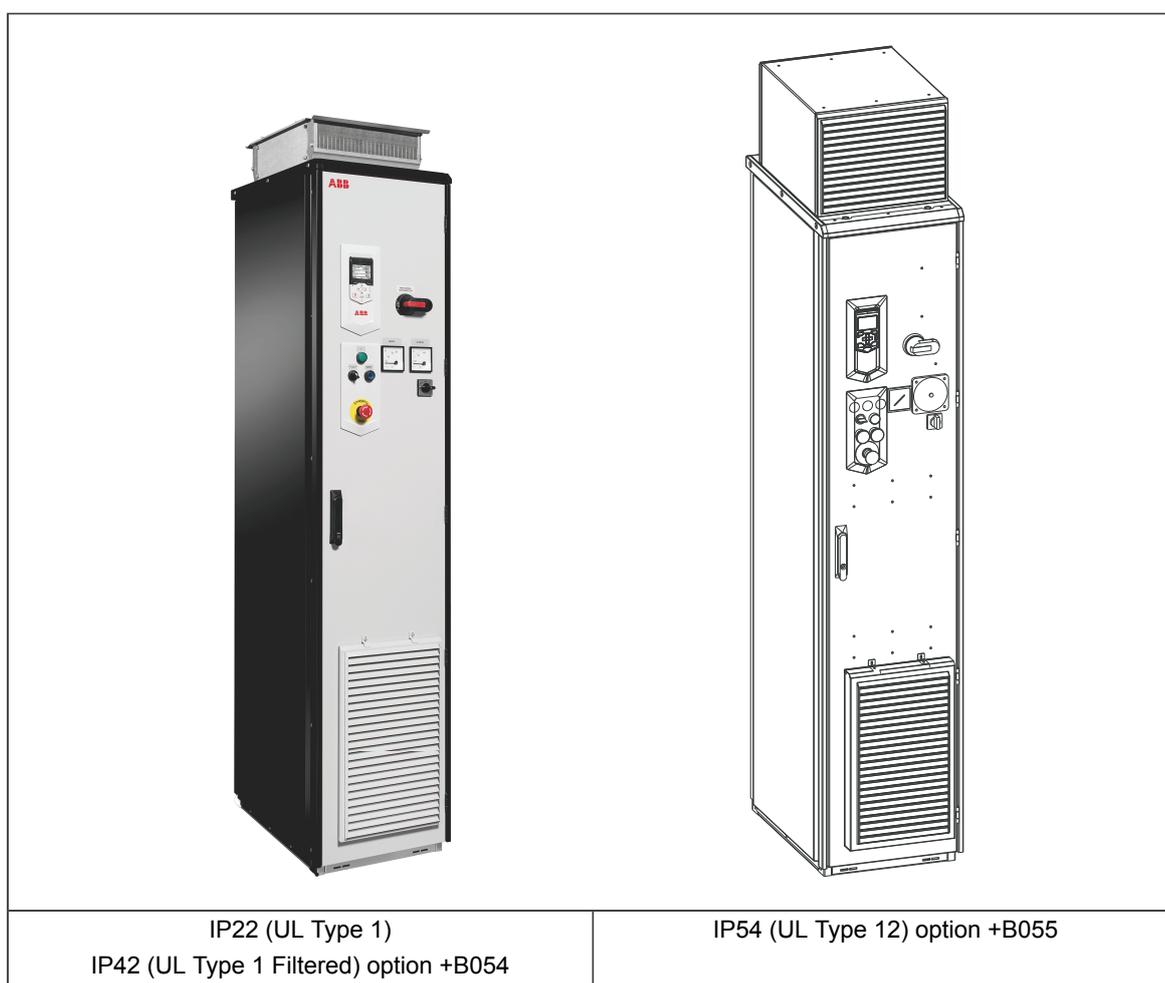
The control unit also controls the drive through the motor-side converter. In this manual, the term drive control unit refers to the motor-side converter control unit. For the location of the drive control unit, see [Cabinet layout](#) and [Overview of power and control connections](#).

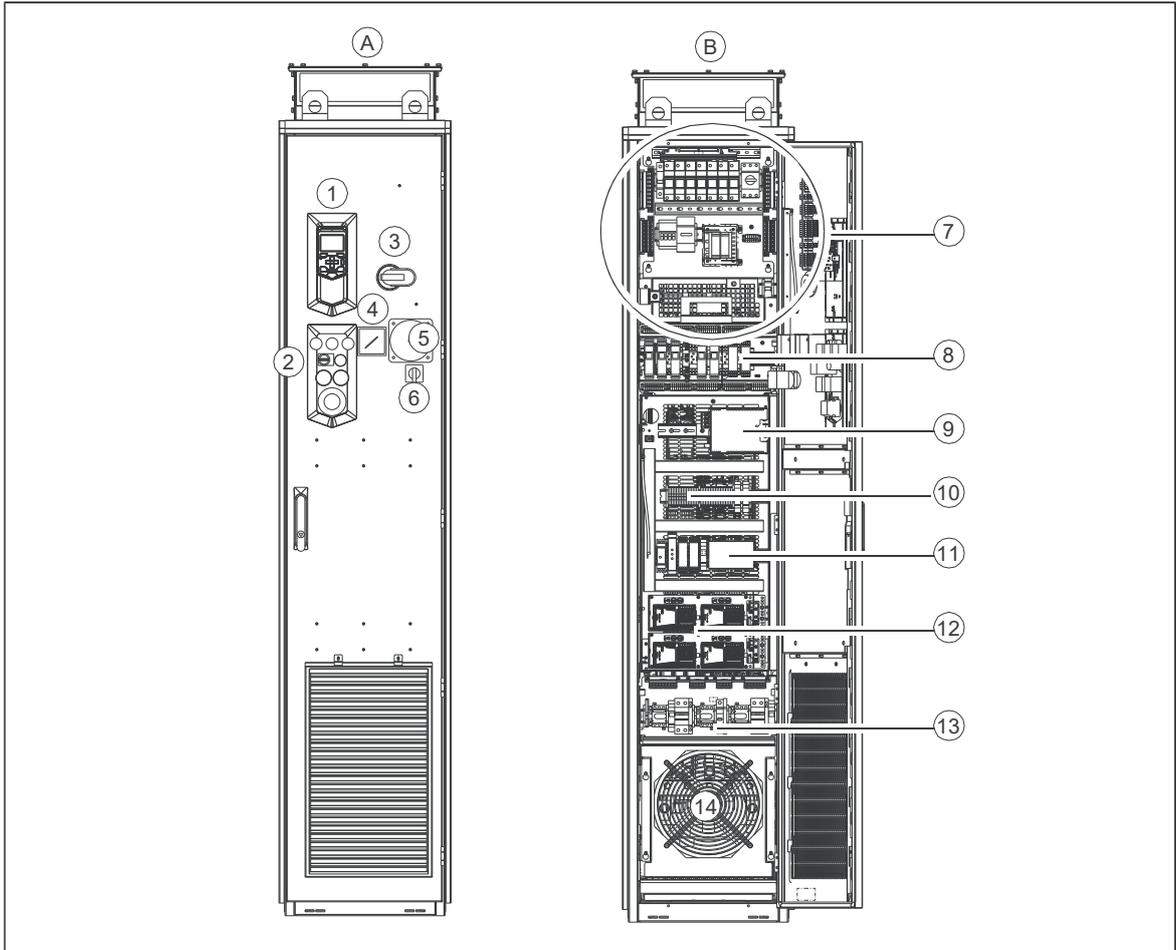
## Cabinet layout

The layout drawings give an example of the R8 and R11 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 du/dt 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.

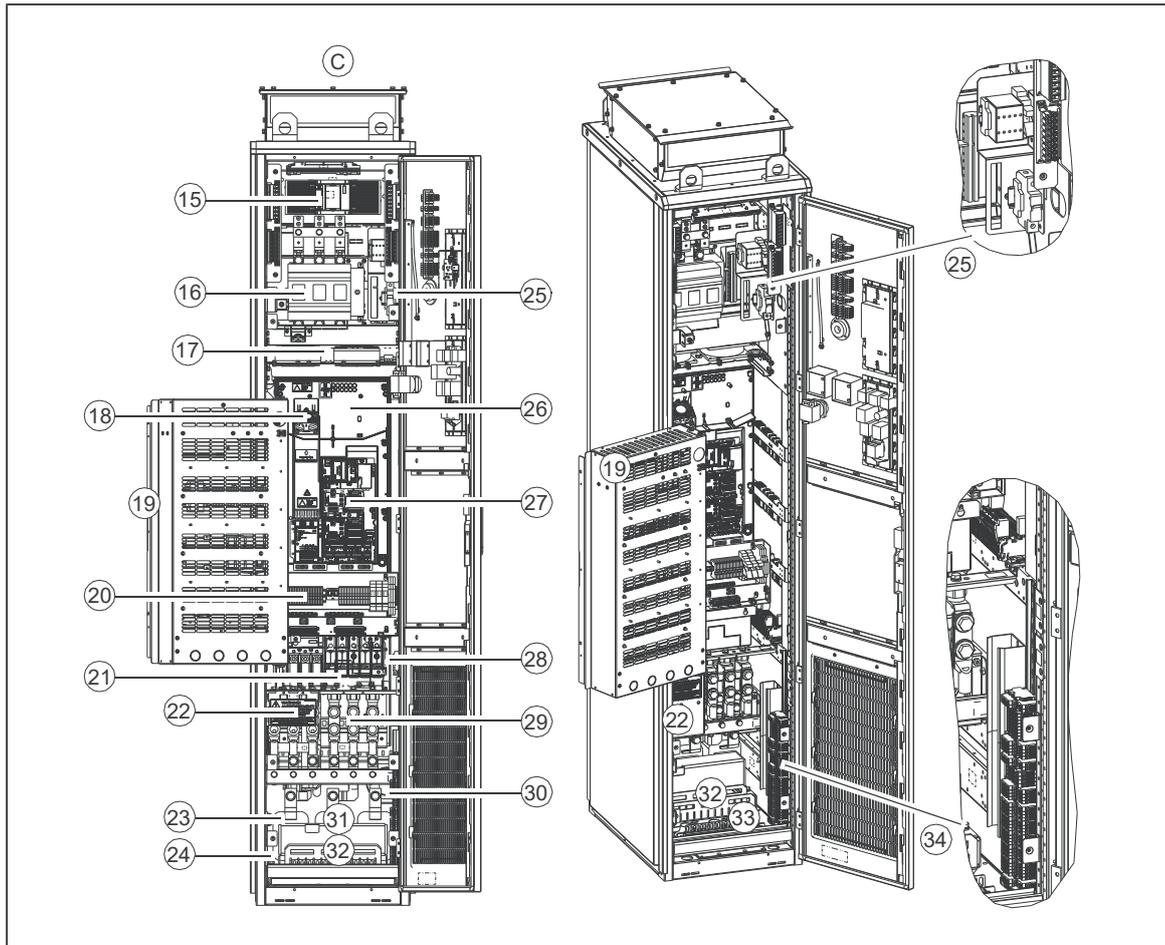
### ■ Cabinet layout of R8





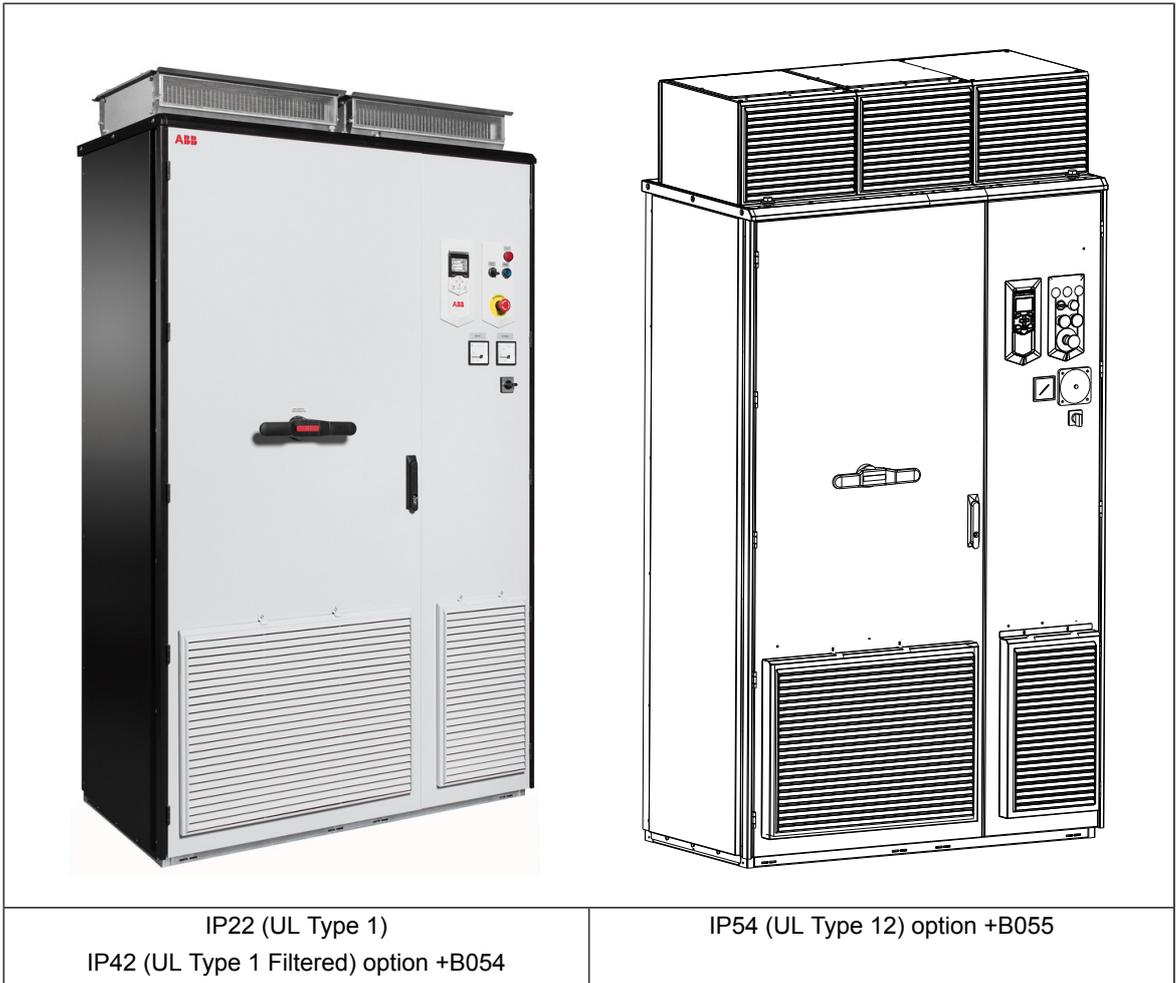
A	Drive module cubicle, door closed
B	Drive module cubicle, door open
1	Drive control panel
2	Operating buttons and door lights
3	Main switch handle
4	Indicators, for example, V-meter and A-meter
5	UL Type V-meter
6	V-meter switch
7	Main fuses for control devices, IP54 fan with option +B055, transformer 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"

### 38 Operation principle and hardware description

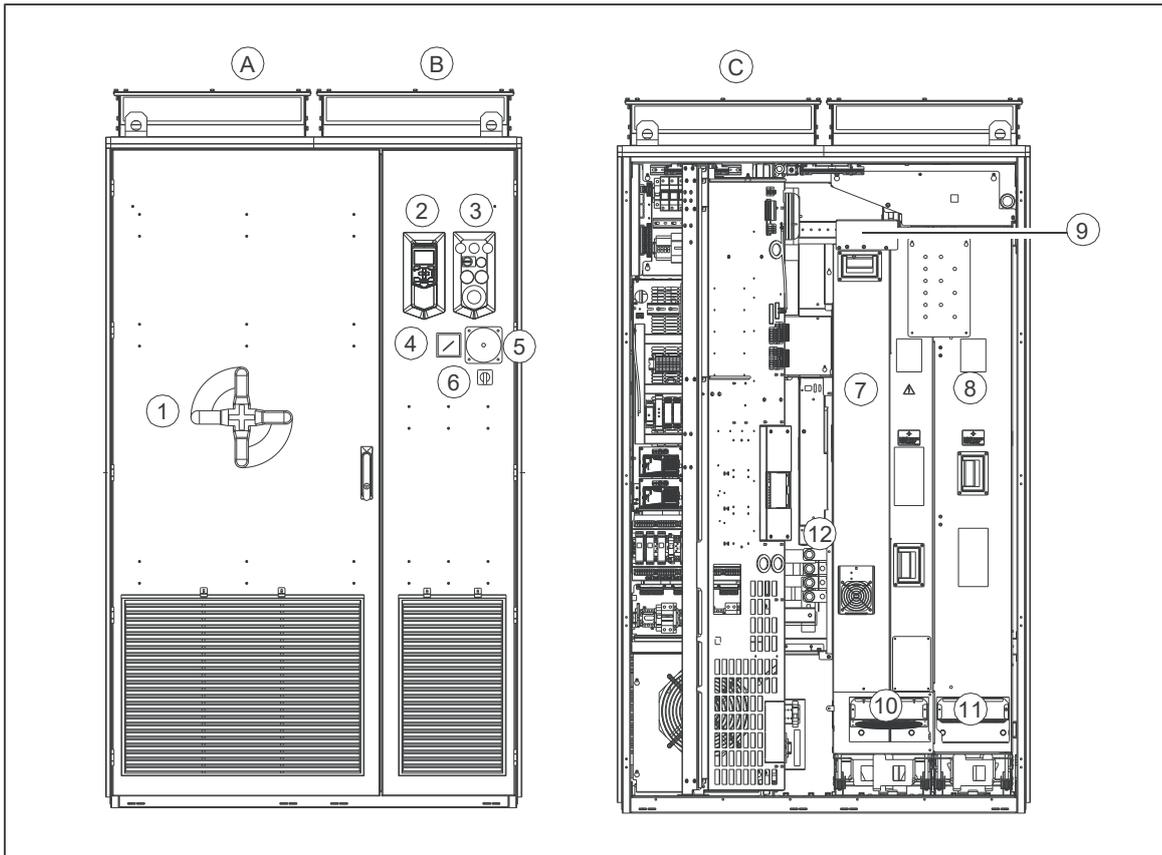


C	Swing-out frame open
15	Main contactor
16	Switch fuse (Q1)
17	Internal cabinet fans
18	Auxiliary cooling fan
19	Swing-out frame
20	Terminal block (X504, option +L504) for external control cable connections to the control unit
21	Module cooling fan
22	Input cable connection terminals behind the shroud (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	$du/dt$ filter (option +E205)
32	Power cable entry
33	Control cable entry
34	X250 terminal block

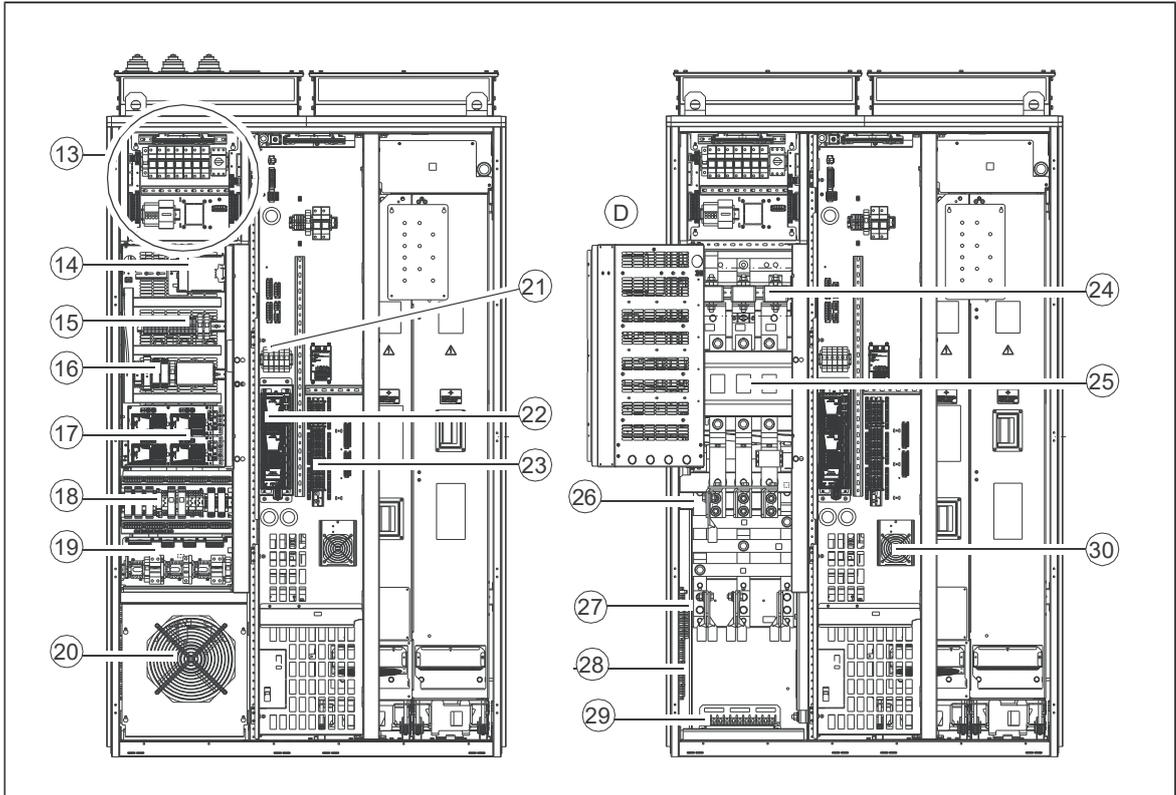
■ Cabinet layout of R11



40 Operation principle and hardware description

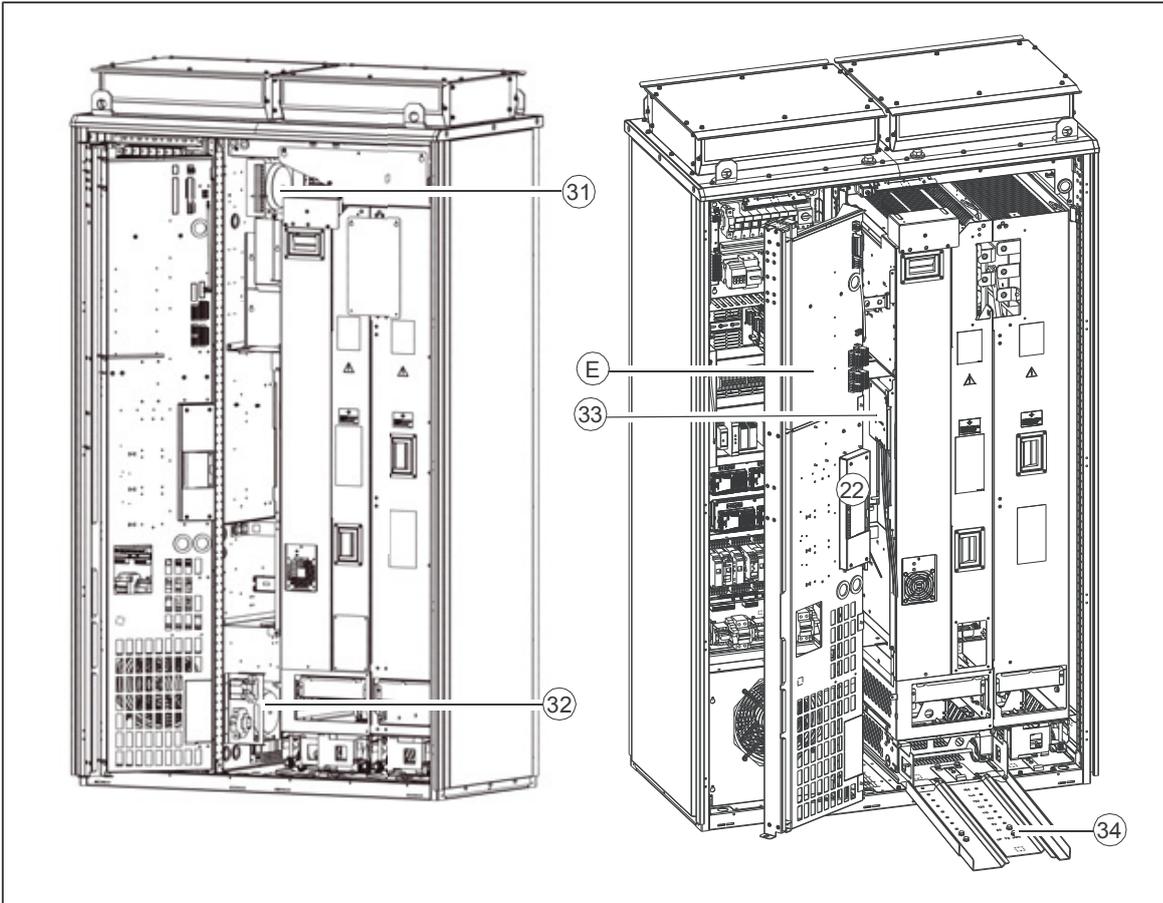


A	Main breaker and power cabling cubicle
B	Drive module cubicle
C	Swing-out frame on the drive module side open
1	Main switch-disconnector (Q1) handle
2	Drive control panel
3	Operating buttons and door lights
4	Indicators, for example, V-meter and A-meter
5	UL Type V-meter
6	V-meter switch
7	Drive module
8	LCL filter module
9	Charging switch/contactors (Q3)
10	Drive module main cooling fans (1...2 pcs, 690 V R11 module has only one fan)
11	LCL filter module cooling fan
12	Circuit board fan

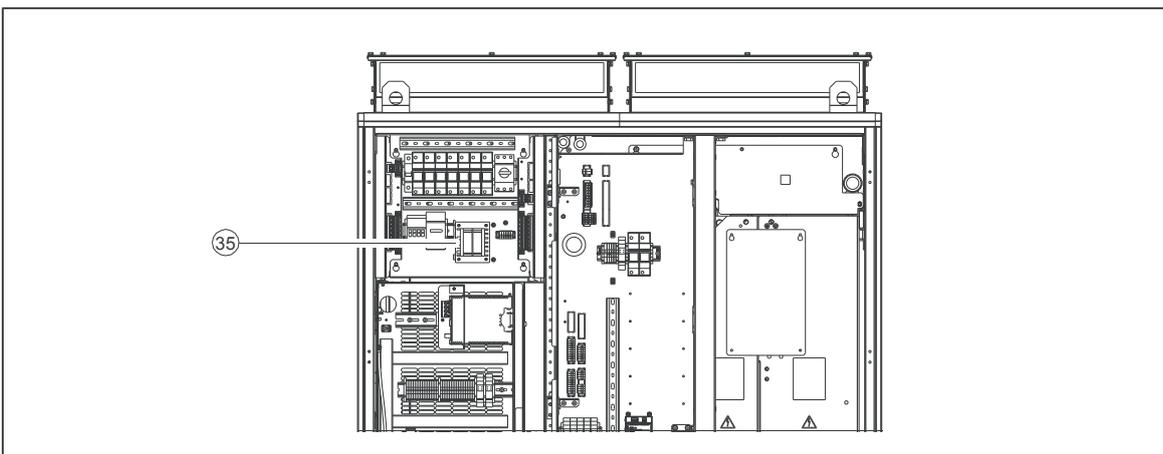


D	Swing-out frame
13	Main fuses for control devices, IP54 fan with option +B055, transformer with option +B055, V-meter (option +G334), starter for auxiliary motor fan (option +M600)
14	Buffering module and power supply unit
15	Terminal blocks X18 and X19
16	Ground fault monitoring and safety circuit 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

42 Operation principle and hardware description

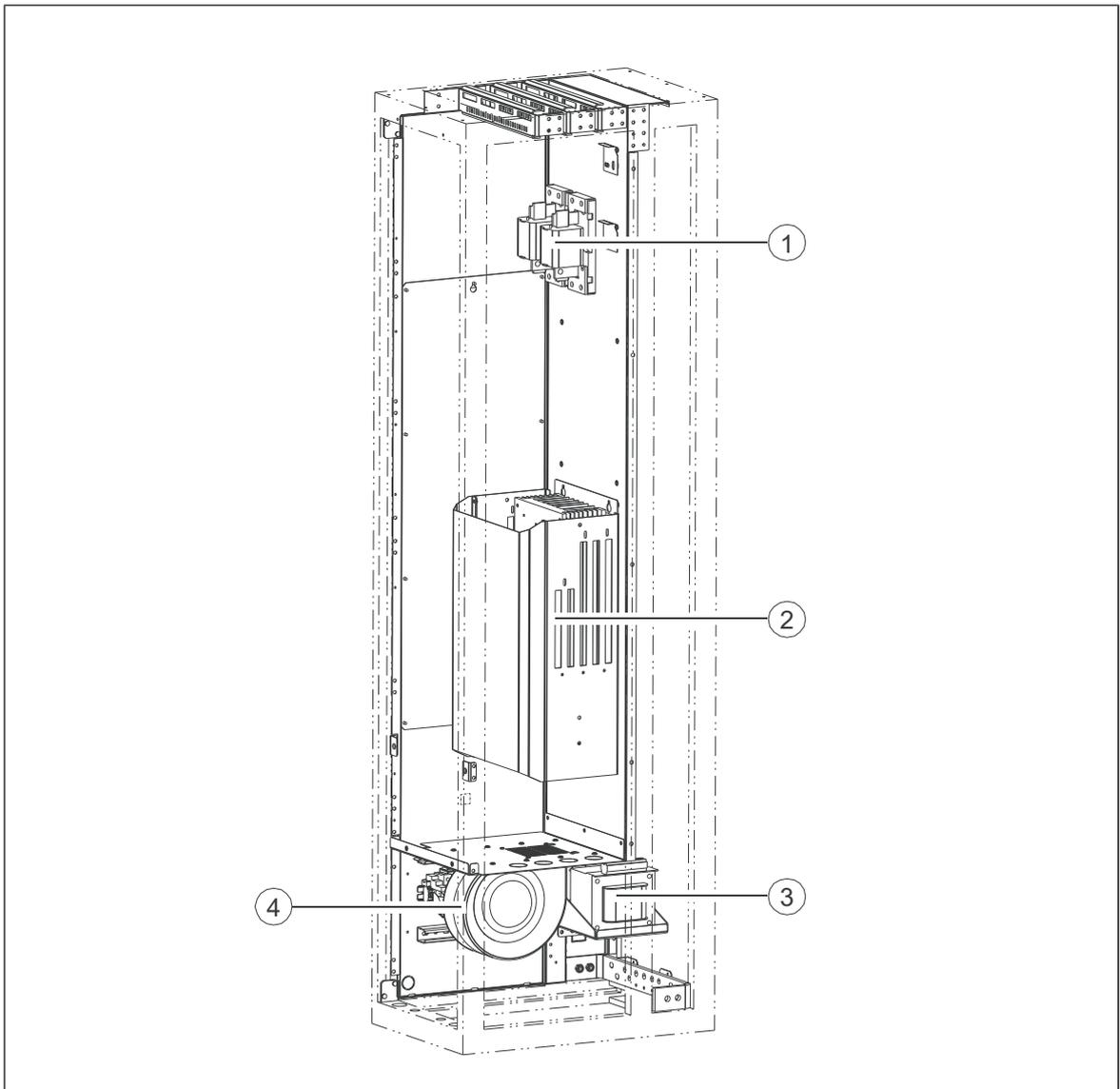


E	Swing-out frame
31	Auxiliary voltage transformer (T102) with option +B055 and distribution components
32	Auxiliary voltage transformer (T21) and distribution components
33	Line-side control unit
34	Extraction ramp



35	Auxiliary voltage transformer (T101) with options +B055 and +C128 and distribution components
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■ Brake chopper cubicle option (+D150)

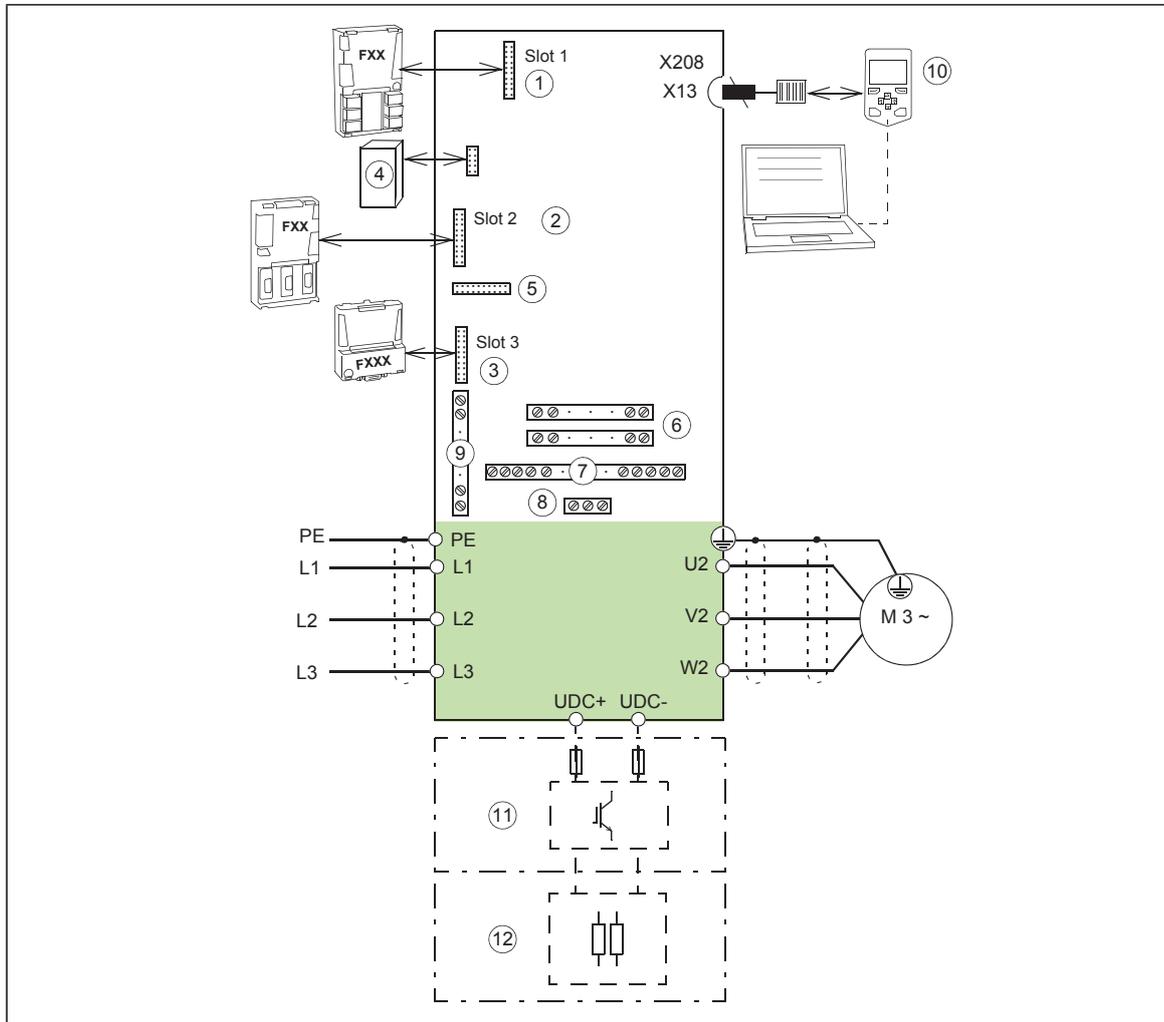


1	Fuses (F121.1...121.2)
2	Brake chopper module (T121.1)
3	Auxiliary voltage transformer (T121.11)
4	Fan (G121.1)

## Overview of power and control connections

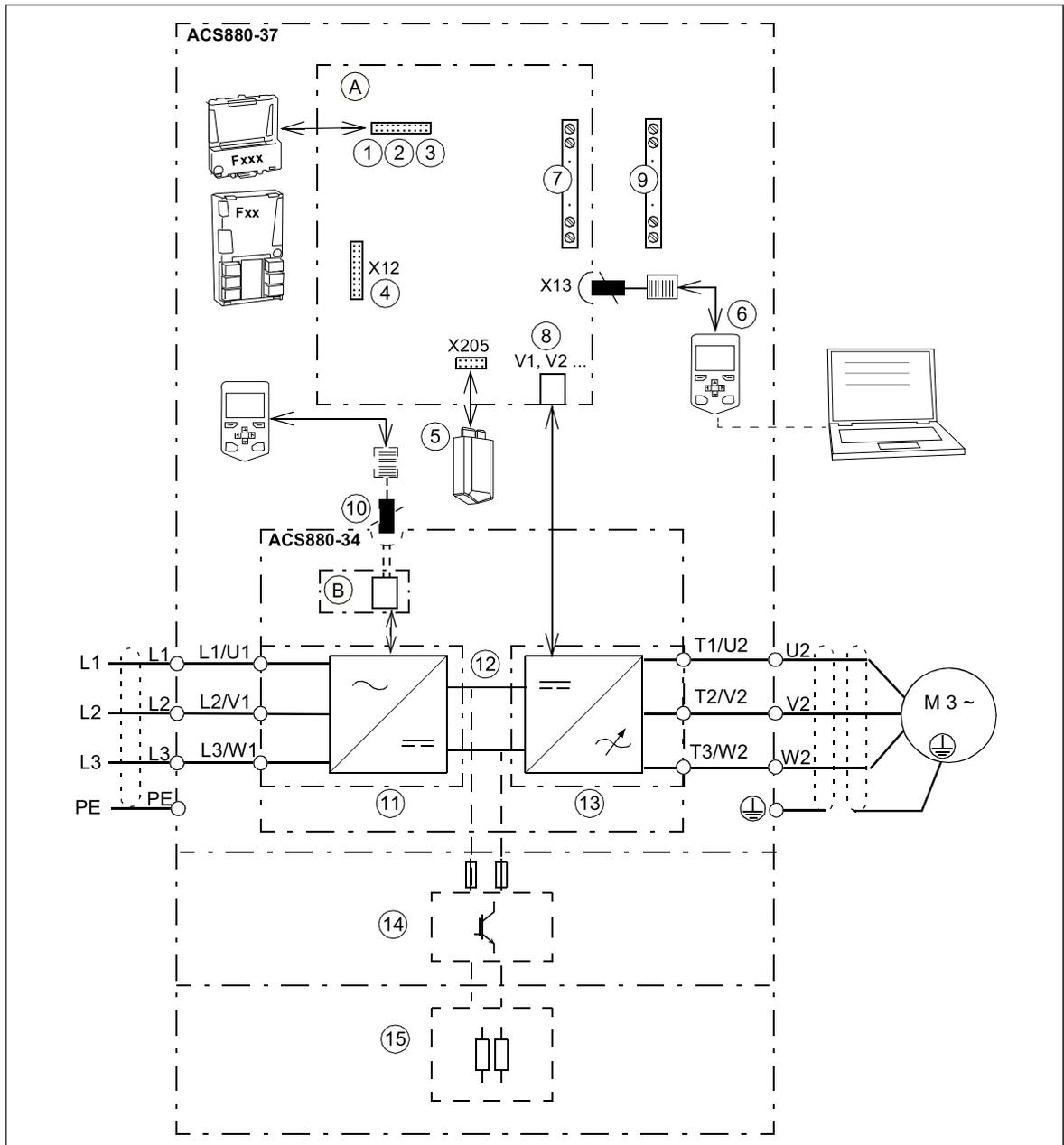
The diagram shows the power connections and control interfaces of the drive.

### ■ Connection overview of R8



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 <a href="#">Type designation key (page 58)</a> .
2	
3	
4	Memory unit
5	Connector for safety functions module
6	See <a href="#">Control units of the drive (page 133)</a> .
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 <a href="#">Control panel (page 49)</a> .
11	Brake chopper (option +D150)
12	Brake resistors (option +D151)

■ Connection overview of R11



A	Motor-side converter control unit (drive control unit)
B	Line-side converter control unit
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 <a href="#">Type designation key (page 58)</a> .
2	
3	
4	Connection for FSO-xx safety functions module
5	Memory unit
6	See <a href="#">Control panel (page 49)</a> .
7	Terminal blocks on the drive control unit. See <a href="#">Control units of the drive (page 133)</a> . 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.

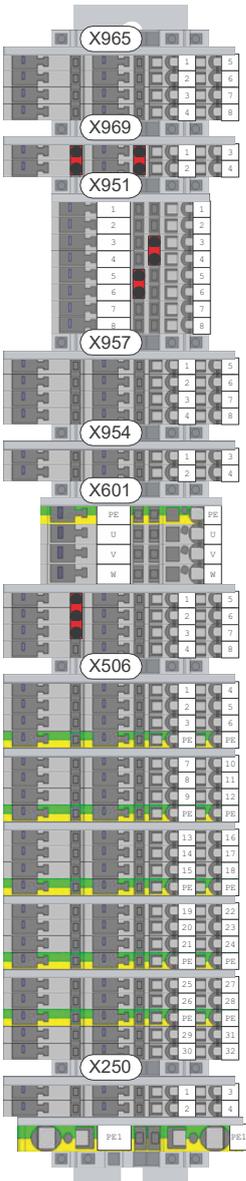
46 Operation principle and hardware description

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.

		<b>Terminals for</b>
	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 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.

		<b>Terminals for</b>
	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 switches and lights



	Label in English	Label in local language	Description				
1	READY	-	Ready light (option +G327)				
2	RUN	-	Run light (option+G328)				
3	FAULT	-	Fault light (option +G329)				
4	MAIN CONTACTOR OFF-ON 	-	Run enable signal switch for the line-side converter with options +Q951, +Q952 and +Q978 <table border="1" style="width: 100%;"> <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>	OFF	Run enable signal off (starting the line-side converter not allowed). Opens the charging contactor Q3.	ON	Run enable signal on (starting the line-side converter allowed). Closes the charging contactor Q3.
OFF	Run enable signal off (starting the line-side converter not allowed). Opens the charging contactor Q3.						
ON	Run enable signal on (starting the line-side converter allowed). Closes the charging contactor Q3.						
5	EMERGENCY STOP RE- SET	-	Emergency stop reset push button (with emergency stop options only)				
6	GROUND FAULT RESET	-	Ground (earth) fault light with option +Q954				
7	-	-	Reserved for order-based engineered equipment				
8	-	-	Emergency stop push button (with emergency stop options only)				

The layout depends on the options selected.

## ■ 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 (frame R11) or switch fuse (frame R8) to the 0/OFF position.



### **WARNING!**

The main disconnecting device does not isolate the input power terminals or V-meter (option +G334) from the power line. To isolate the input power terminals and V-meter, 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

- 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 *ACx-AP-x 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, do not coexist with certain other options, or may require additional engineering. Check actual availability with ABB.

### ■ Degree of protection

#### Definitions

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

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

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

#### **IP22 (UL Type 1)**

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

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

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

#### **IP54 (UL Type 12) (option +B055)**

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

### ■ Marine construction (option +C121)

The option includes the following accessories and features:

- 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.

Additional wire markings may be required for classification. See section [Wire markings \(page 53\)](#).

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

See section [Air inlet through the bottom of cabinet \(option +C128\) \(page 79\)](#).

### ■ **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.

The 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 \(option +C130\) \(page 80\)](#).

### ■ **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.

### ■ **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.

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### ■ Resistor braking (options +D150 and +D151)

See chapter [Resistor braking \(page 269\)](#).

### ■ du/dt filter (option +E205)

The du/dt filter protects the motor insulating system by reducing the voltage rise speed at the motor terminals. The filter also protects the motor bearings by reducing the bearing currents.

More information on when the option is required: See section [Examining the compatibility of the motor and drive \(page 86\)](#).

### ■ Sine filter (option +E206)

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

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

### ■ 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 \(page 86\)](#).

### ■ 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 humidity condensation inside the cabinet when the drive is not running. The power output of the semiconductor-type heating elements depends on the environmental temperature. The customer must switch the heating off when it is not needed by cutting the supply voltage off.

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:

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- [Supplying power for the auxiliary circuits \(page 102\)](#)
- circuit diagrams delivered with drive for the actual wiring.

#### ■ **Output for motor space heater (option +G313)**

The option contains:

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

When the drive is powered, 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 \(page 102\)](#)
- 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, red) lights installed on the cabinet door.

#### ■ **Halogen-free wiring and materials (option +G330)**

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

#### ■ **V-meter with selector switch (option +G334)**

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

#### ■ **A-meter in one phase (option +G335)**

The option contains an ammeter that reads the current flowing through one input phase.

#### ■ **Wire markings**

##### **Standard wire markings**

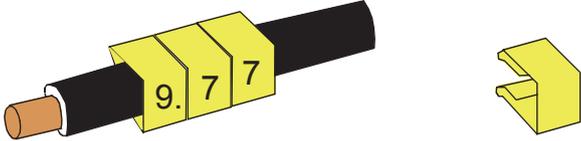
As standard, wires and terminals are marked as follows:

- Plug-in connectors of wire sets are labeled with designation (eg. "X1").
- To improve manufacturability, the majority of wires have designation and pin number printed on wire (eg. "X1:7")
- Fiber optic cable pairs have component and connector designations (eg. "A1:V1").
- Data cables have designation and pin number (eg. "A1:X1").
- Main input, output and PE terminals: Connector identifier (eg. "U1", "PE") marked on terminal, or on insulating material close to the terminal. PE cables are colored yellow/green, or marked with yellow/green tape.
- Customer-specific (engineered) wiring (option +P902) is not marked.

##### **Additional wire markings**

The following additional wire markings are available.

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Option	Additional markings
+G340 (class A3)	<p>Equipment pin identifiers are marked with snap-on markers (or equivalent) on conductors that connect to equipment, terminal blocks or detachable plug-type connectors, or are part of the wiring between power modules. Plug-type connector identifications are marked on labels near the connectors. The label holders are attached around conductor bundles. Main circuit conductors are marked with white tape or printing. (Short, obvious connections are not marked.)</p> 
+G342 (class C1)	<p>Equipment designations and pin identifiers of both ends are marked with snap-on markers (or equivalent) on conductors that connect to equipment, terminal blocks or detachable plug-type connectors, or are part of the wiring between power modules. Fiber optic cables are marked in the same way. Plug-type connector identifications are marked on labels near the connectors. The label holders are attached around conductor bundles. Main circuit conductors are marked with white tape or printing. Short and obvious connections are marked with printing (or equivalent) only.</p>  <p><b>Note:</b> Even wires with equipment and pin identifiers printed on the wire insulation are marked with rings or tubing.</p>

### ■ 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)

For non-UL Listed units, the default input and output cabling direction is through the bottom of the cabinet. 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.

For UL Listed (+C129) units, top entry/exit is the default cabling arrangement.

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

The option provides US/UK conduit plates (plain 3 mm thick steel plates without any ready-made holes). US/UK conduit plates are provided as standard with options +C129 and +C134 instead of the normal cable entries.

### ■ 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.

## ■ 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), the 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.

The output indication of the relay can be wired by the customer for example to

- the main contactor or breaker control circuit of the drive, to open it in case of motor overtemperature,
- the appropriate digital input of the drive, to trip the drive and generate a fault message in case of motor overtemperature, or
- an external monitoring circuit.

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 (+L537, also requires +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; FPTC-02 is Type Examined as a protective device within the scope of the European ATEX 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
  - *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English])
  - *FPTC-01 thermistor protection module (option +L536) for ACS880 drives user's manual* (3AXD50000027750 [English])
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- *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.

The standard Pt100 relay options include two (+2L506), three (+3L506), five (+5L506) or eight (+8L506) relays. The monitoring relays are connected to one to three auxiliary relays whose outputs are wired at the factory to a terminal block. The sensors are to be connected by the customer to the same terminal block.

As the temperature rises, the sensor resistance increases linearly. At an adjustable wake-up level, the monitoring relay de-energizes its output which then trips one of the auxiliary relays.

The output indication of the auxiliary relays can be wired by the customer for example to

- the main contactor or breaker control circuit of the drive, to open it in case of motor overtemperature,
- the appropriate digital input of the drive, to trip the drive and generate a fault message in case of motor overtemperature, or
- an external monitoring circuit.

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 +M6xx)

#### 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.

The number of connections must be specified when ordering. The maximum number of connections available depends on the current requirement. The lower current ratings allow

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up to four fan connections (eg. option +4M602), while the highest current rating only allows one (eg. +M610). For more information, refer to *ACS880-X7 single drives ordering information* (3AXD10000052815, available on request).

## 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.

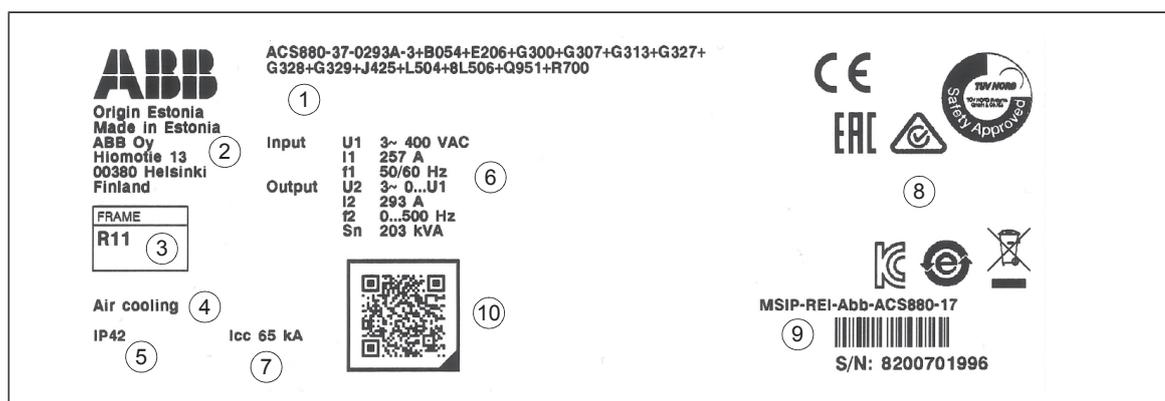
The statuses of both the starter switch and the fan contactor are wired to the terminal block. See the circuit diagrams delivered with the drive for the actual wiring.

## 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.

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

A sample label is shown below.



1	Type designation, see section <i>Type designation key</i> (page 58).
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 configuration (for example, ACS880-37-0650A-3). The optional selections are given thereafter, separated by plus signs, for example, +E202. The main selections are described below. Not all selections are available for all types. For more information, refer to ACS880 Ordering Information (3AXD10000052815, available on request).

### ■ Basic codes

Code	Description
ACS880	Product series
37	When no options are selected: cabinet-installed drive, IP22 (UL Type 1), switch fuse (R8), main switch-disconnector (R11), aR fuses, line contactor in frame 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, common mode filter for 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.
<b>Size</b>	
xxxx	Refer to the rating tables
<b>Voltage range</b>	
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 (plus codes)

Code	Description
<b>Supply connection</b>	
<b>Degree of protection</b>	
B054	IP42 (UL Type 1)
B055	IP54 (UL Type 12)
<b>Construction</b>	
C121	Marine construction. See section <i>Marine construction (option +C121) (page 50)</i> .
C128	Air inlet through bottom of cabinet. See section <i>Air inlet through the bottom of cabinet (option +C128) (page 79)</i> .
C129	UL Listed (evaluated to both U.S. and Canadian safety requirements). See section <i>UL Listed (option +C129) (page 51)</i> .
C130	Channeled air outlet. See section <i>Channeled air outlet (option +C130) (page 51)</i> .
C132	Marine type approval. Refer to ACS880 +C132 <i>marine type-approved cabinet-built drives supplement</i> (3AXD50000039629 [English]).
C134	CSA approved. See section <i>CSA Approved (option +C134) (page 51)</i> .
C164	Plinth height 100 mm. See section <i>Plinth height (options +C164 and +C179) (page 51)</i> .
C179	Plinth height 200 mm. See section <i>Plinth height (options +C164 and +C179) (page 51)</i> .

<b>Code</b>	<b>Description</b>
C180	Seismic design. See section <i>Seismic design (option +C180) (page 51)</i> .
C196	Empty 400 mm wide cubicle on right. See section <i>Empty cubicles on right (options +C196...C198) (page 51)</i> .
C197	Empty 600 mm wide cubicle on right. See section <i>Empty cubicles on right (options +C196...C198) (page 51)</i> .
C198	Empty 800 mm wide cubicle on right. See section <i>Empty cubicles on right (options +C196...C198) (page 51)</i> .
C199	Empty 400 mm wide cubicle on left. See section <i>Empty cubicles on left (options +C199...C201) (page 51)</i> .
C200	Empty 600 mm wide cubicle on left. See section <i>Empty cubicles on left (options +C199...C201) (page 51)</i> .
C201	Empty 800 mm wide cubicle on left. See section <i>Empty cubicles on left (options +C199...C201) (page 51)</i> .
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)
<b>Resistor braking</b>	
D150	Brake choppers
D151	Brake resistors
<b>Filters</b>	
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	du/dt filtering
E206	Sine output filter
E208	Common mode filtering (standard with frames R6i, R7i, R8i and multiples)
<b>Switching and grounding</b>	
<b>Cabinet equipment</b>	
G300	Cabinet and module heating elements (external supply). See section <i>Cabinet heater with external supply (option +G300) (page 52)</i> .
G301	Cabinet lighting. See section <i>Cabinet lighting (option +G301) (page 52)</i> .
G307	Terminals for connecting external control voltage (230 V AC or 115 V AC, eg. UPS). See section <i>Terminals for external control voltage (option +G307) (page 52)</i> .
G313	Output for motor space heater (external supply)
G327	Ready light on door, white
G328	Run light on door, green
G329	Fault light on door, red
G330	Halogen-free wiring and materials
G334	V-meter with selector switch
G335	A-meter in one phase

## 60 Operation principle and hardware description

Code	Description
G340	Additional wire markings. See section <i>Wire markings (page 53)</i> .
G342	
<b>Cabling</b>	
H350	Supply cabling direction down. See section <i>Bottom cable entry/exit (options +H350 and +H352) (page 54)</i> .
H351	Supply cabling direction up. See section <i>Top cable entry/exit (options +H351 and +H353) (page 54)</i> .
H352	Motor cabling direction down. See section <i>Bottom cable entry/exit (options +H350 and +H352) (page 54)</i> .
H353	Motor cabling direction up. See section <i>Top cable entry/exit (options +H351 and +H353) (page 54)</i> .
H358	Cable conduit entry (US/UK). See section <i>Cable conduit entry (option +H358) (page 54)</i> .
<b>Control panel</b>	
J425	ACS-AP-I control panel
<b>Fieldbus adapters, diverse communication options</b>	
K451	FDNA-01 DeviceNet™ adapter module
K454	FPBA-01 PROFIBUS DP adapter module
K457	FCAN-01 CANopen adapter module
K458	FSCA-01 RS-485 (Modbus/RTU) adapter module
K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCat adapter module
K470	FEPL-02 EtherPOWERLINK adapter module
K475	FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
K490	FEIP-21 Ethernet/IP adapter module, 2-port
K491	FMBT-21 Modbus/TCP adapter module, 2-port
K492	FPNO-21 PROFINET adapter module, 2-port
<b>I/O extensions and feedback interfaces</b>	
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 <i>Additional terminal block X504 (option +L504) (page 54)</i> .
L505	Thermal protection with PTC relays (1 or 2 pcs). See section <i>Thermal protection with PTC relays (options +L505, +2L505, +L513, +2L513, +L536, +L537) (page 55)</i> .
L506	Thermal protection with Pt100 relays (2, 3, 5 or 8 pcs). See section <i>Thermal protection with Pt100 relays (options +nL506, +nL514) (page 56)</i> .
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

Code	Description
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
<b>Starter for auxiliary motor fan</b> (see section <i>Descriptions of options (page 50)</i> )	
M600	Trip limit setting range: 1 ... 1.6 A
M601	Trip limit setting range: 1.6 ... 2.5 A
M602	Trip limit setting range: 2.5 ... 4 A
M603	Trip limit setting range: 4 ... 6.3 A
M604	Trip limit setting range: 6.3 ... 10 A
M605	Trip limit setting range: 10...16 A
<b>Control program</b>	
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
N7502	Control program for synchronous reluctance motors (SynRM)
N8010	IEC 61131-3 application programmability
<b>Specialties</b>	
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 RAL Classic color
P929	Container packaging
P948	Customized extended warranty
P952	Country of origin: Finland
P966	Special color (other than RAL Classic)
<b>Safety functions</b>	
Q950	Prevention of unexpected start-up with FSO-xx safety functions module, by activating the Safe torque off function
Q951	Emergency stop (category 0) with safety relays, by opening the main breaker/contactors
Q952	Emergency stop (category 1) with safety relays, by opening the main breaker/contactors
Q954	Earth fault monitoring for IT (ungrounded) systems
Q957	Prevention of unexpected start-up with safety relays, by activating the Safe torque off function

## 62 Operation principle and hardware description

Code	Description
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-xx safety functions module, by opening the main breaker/contactator
Q979	Emergency stop (configurable for category 0 or 1) with FSO-xx safety functions module, by activating the Safe torque off function
Q982	PROFIsafe with FSO-xx safety functions module and FENA-21 Ethernet adapter module
Q986	FSPS-21 PROFIsafe safety functions module
<b>Full set of printed manuals in the selected language</b>	
<b>Note:</b> The delivery may include manuals in English if the requested language is not available.	
R700	English
R701	German
R702	Italian
R703	Dutch
R704	Danish
R705	Swedish
R706	Finnish
R707	French
R708	Spanish
R709	Portuguese
R711	Russian
R712	Chinese
R713	Polish
R714	Turkish

# 4

## Mechanical installation

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### Contents of this chapter

This chapter describes the mechanical installation procedure of the drive.

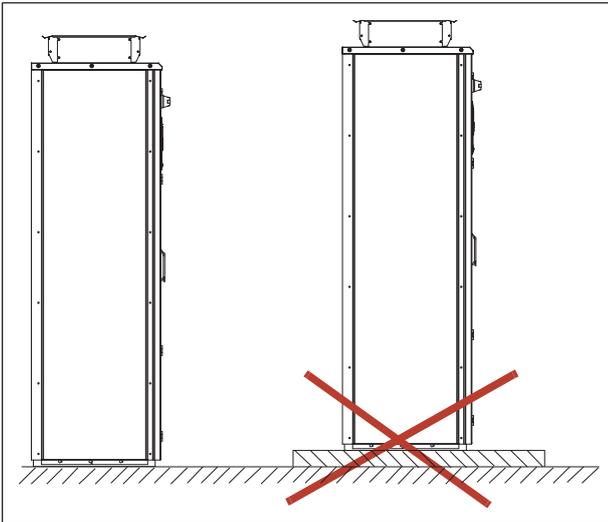
### Examining the installation site

Examine the installation site. Make sure that:

- The installation site is sufficiently ventilated or cooled to remove heat from the drive. See the technical data.
- The ambient conditions of the drive meet the specifications. See the technical data.
- There is sufficient free space above the drive for cooling, maintenance, and operation of the pressure relief (if present).
- The floor that the drive cabinet is installed on is of non-flammable material, as smooth as possible, and strong enough to support the weight of the unit. Check the floor flatness with a spirit level. The maximum allowed deviation from the surface level is 5 mm in every 3 meters. Level the installation site, if necessary, as the cabinet is not equipped with adjustable feet.



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



## Necessary tools

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

- crane, fork-lift or pallet truck (check load capacity!), slate/spud bar, jack and rollers
- Pozidriv and Torx screwdrivers
- torque wrench
- set of wrenches or sockets.

## Examining the delivery

The drive delivery contains:

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

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



## Moving and unpacking the drive

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

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

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

### ■ Moving the drive in its packaging – Frame R8

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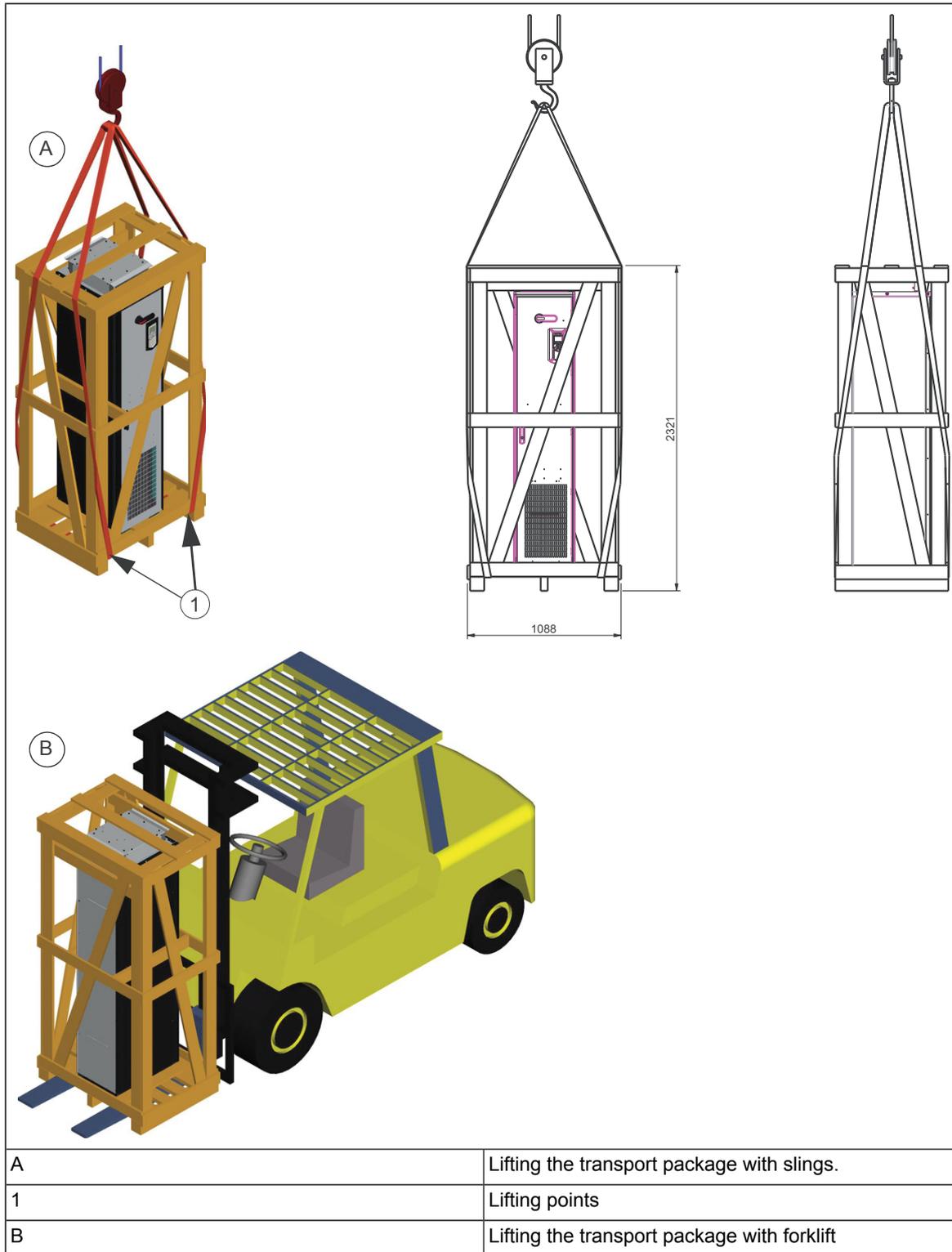


**WARNING!**

Incorrect lifting can cause danger or damage. Obey the local laws and regulations applicable to lifting, such as requirements for planning the lift, for capacity and condition of lifting equipment, and for training of personnel.

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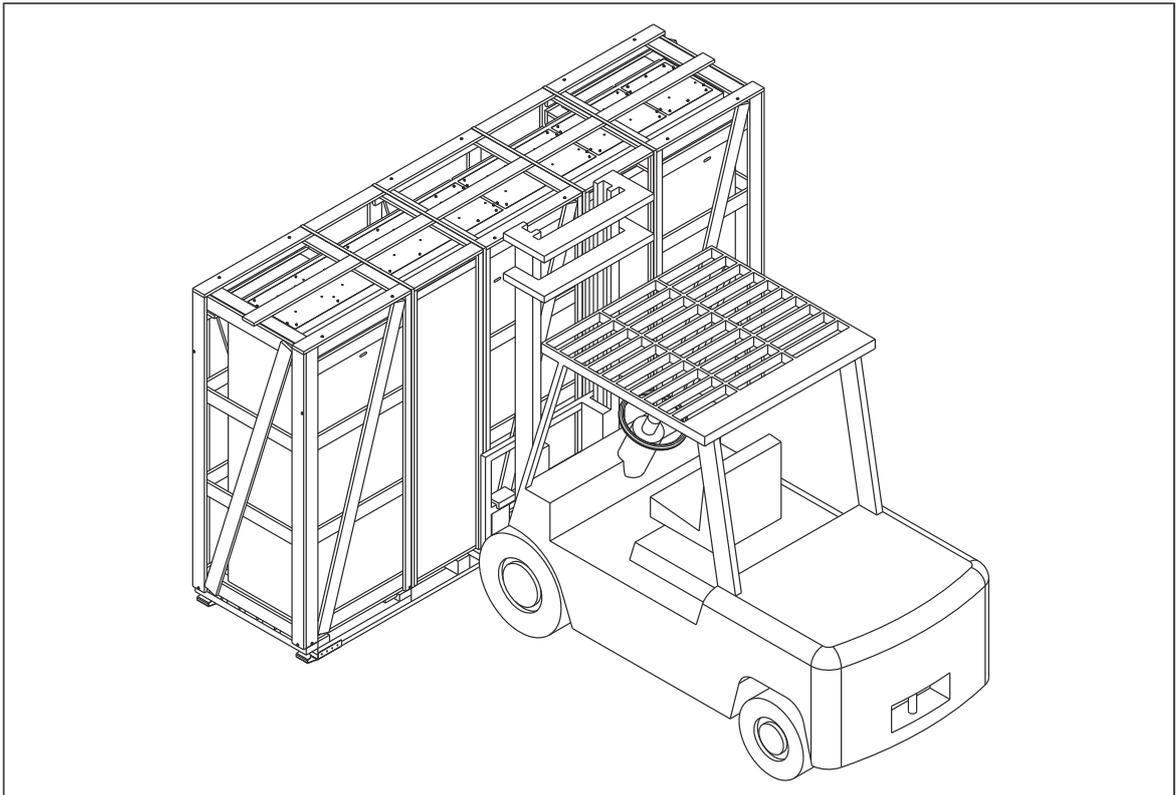
## ■ Moving the drive in its packaging – Frame R11

### Lifting the crate with a forklift



**WARNING!**

Incorrect lifting can cause danger or damage. Obey the local laws and regulations applicable to lifting, such as requirements for planning the lift, for capacity and condition of lifting equipment, and for training of personnel.

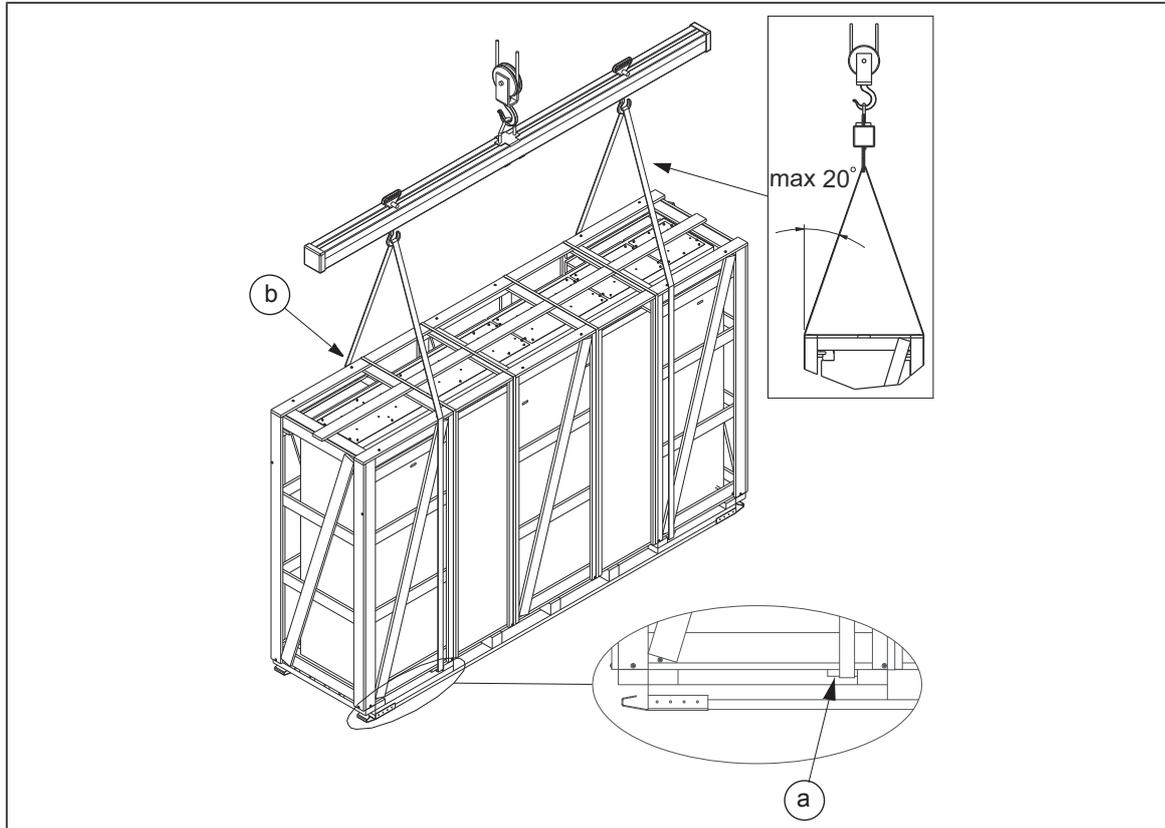


### Lifting the crate with a crane



**WARNING!**

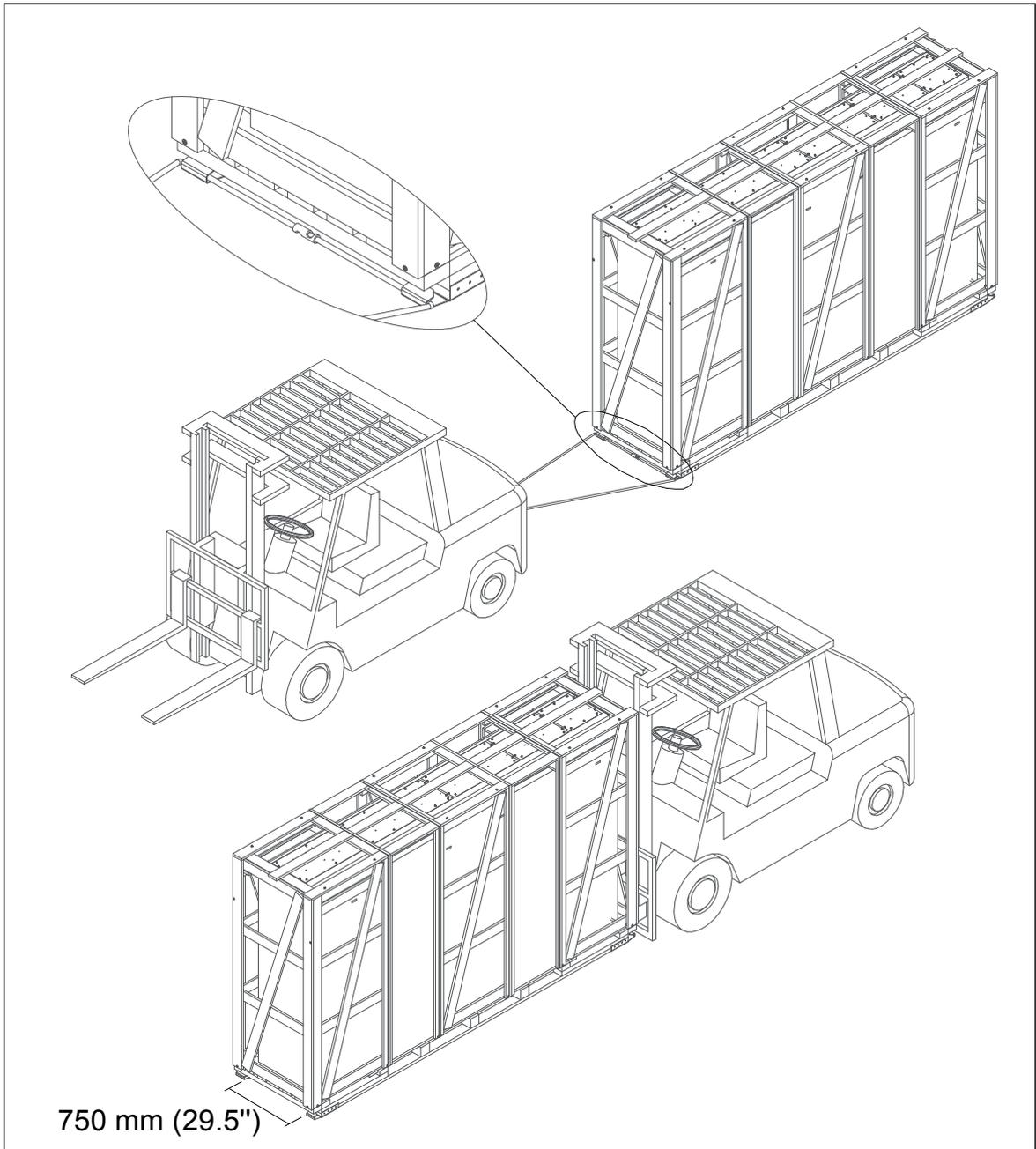
Incorrect lifting can cause danger or damage. Obey the local laws and regulations applicable to lifting, such as requirements for planning the lift, for capacity and condition of lifting equipment, and for training of personnel.



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

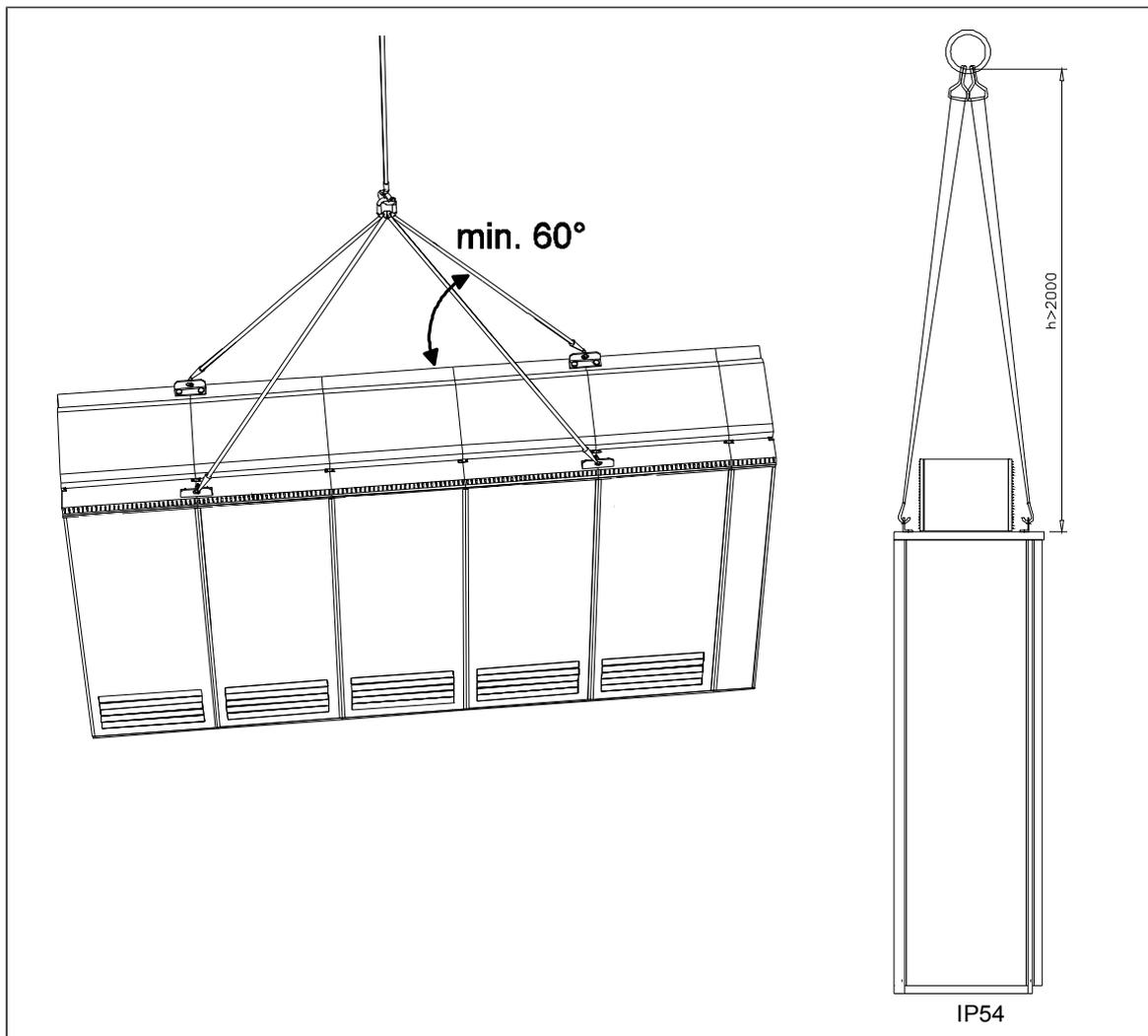


**WARNING!**

Incorrect lifting can cause danger or damage. Obey the local laws and regulations applicable to lifting, such as requirements for planning the lift, for capacity and condition of lifting equipment, and for training of personnel.

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").



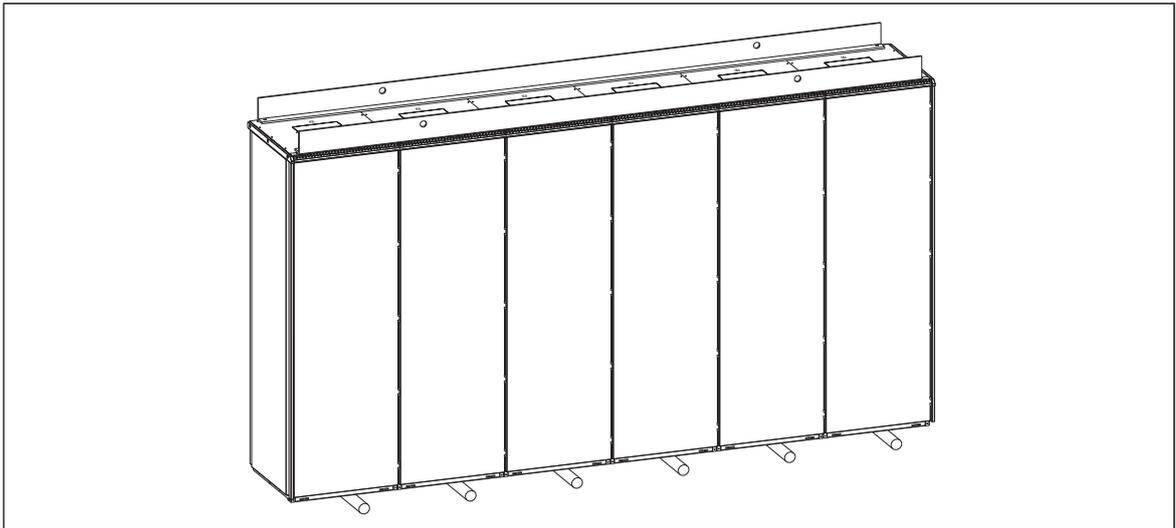
### Moving the cabinet on rollers



**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.



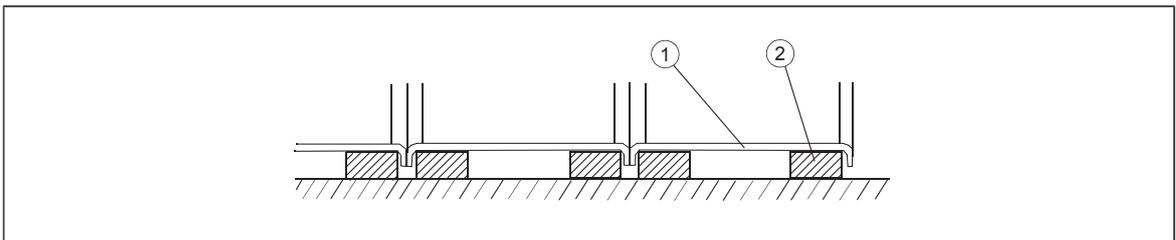
### Moving the cabinet on its back



**WARNING!**

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

Support the cabinet from below alongside the cubicle seams.

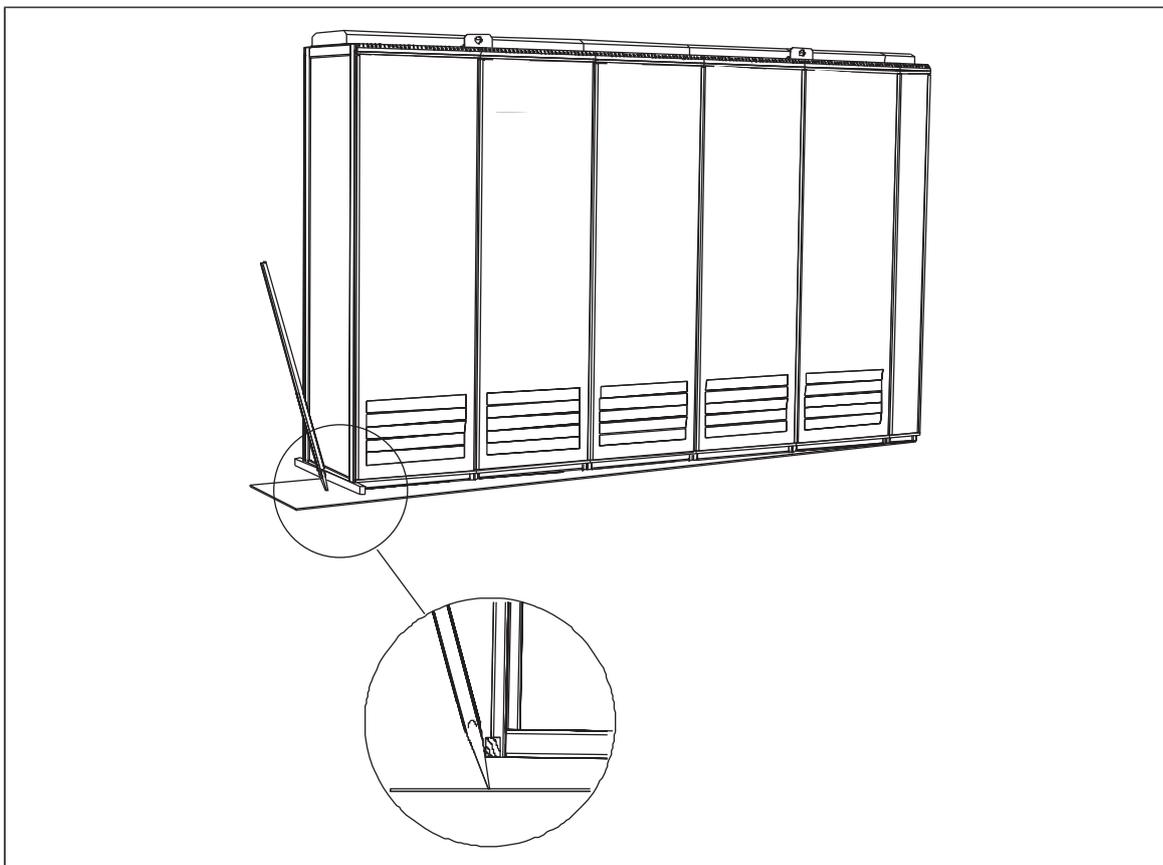


1	Cabinet back panel
2	Support



### Final placement of the cabinet

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

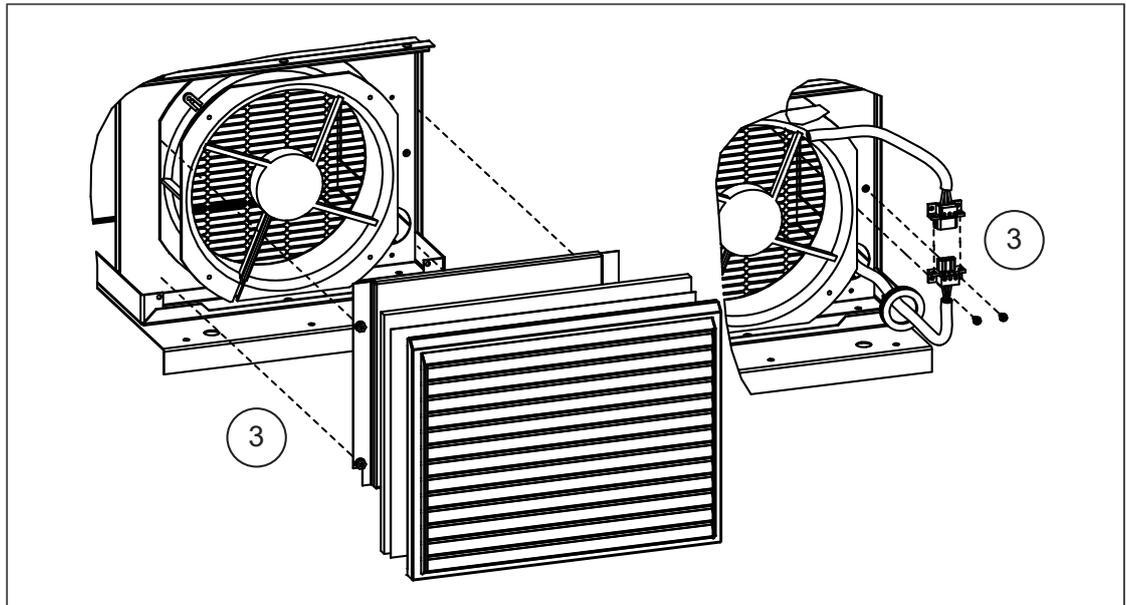


## Installing the IP54 roof (option +B055)

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.

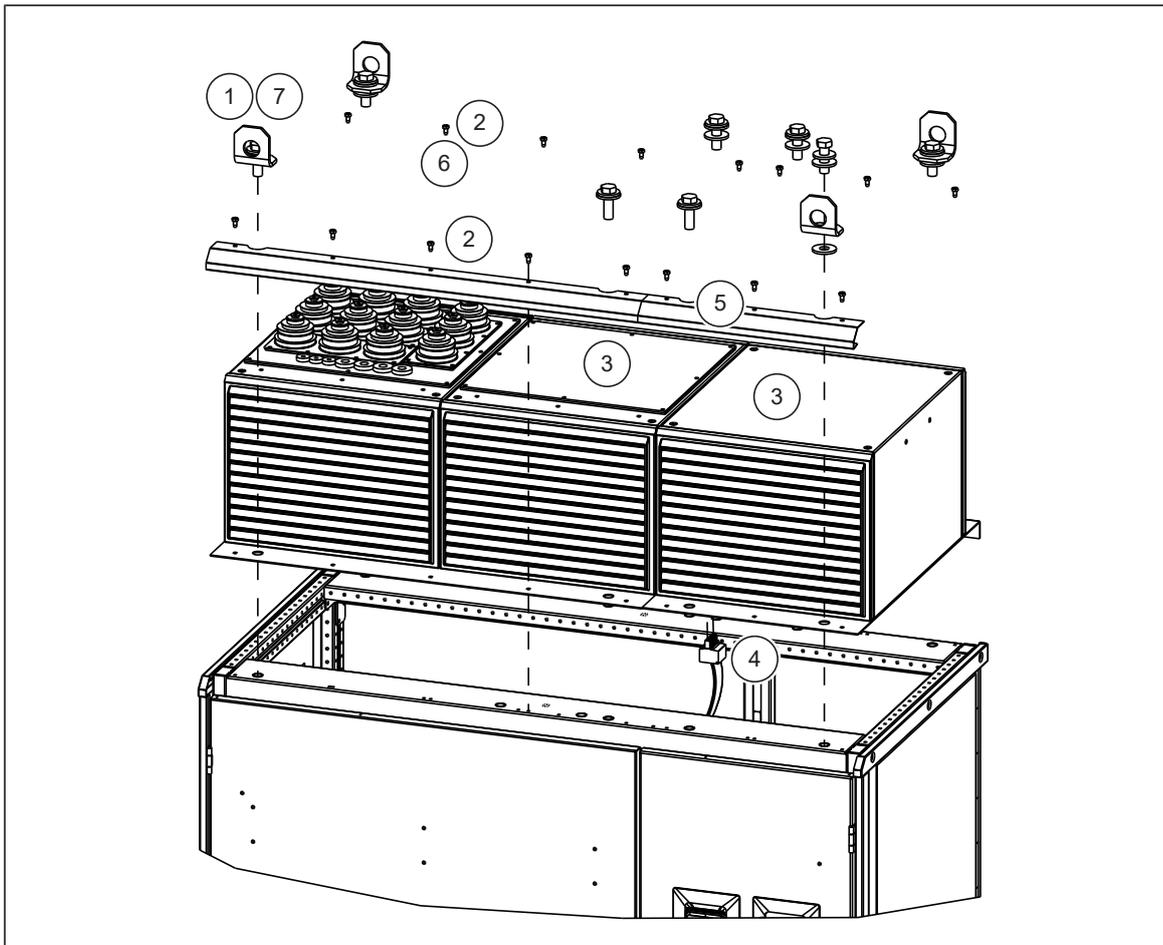


4. Install the front top profile of the cabinet in reverse order to step 2.
5. Attach the back mounting screws of the roof.
6. Install the IP54 filter grating.
7. Reinstall the mounting screws of the lifting eyes.



### ■ Frame R11

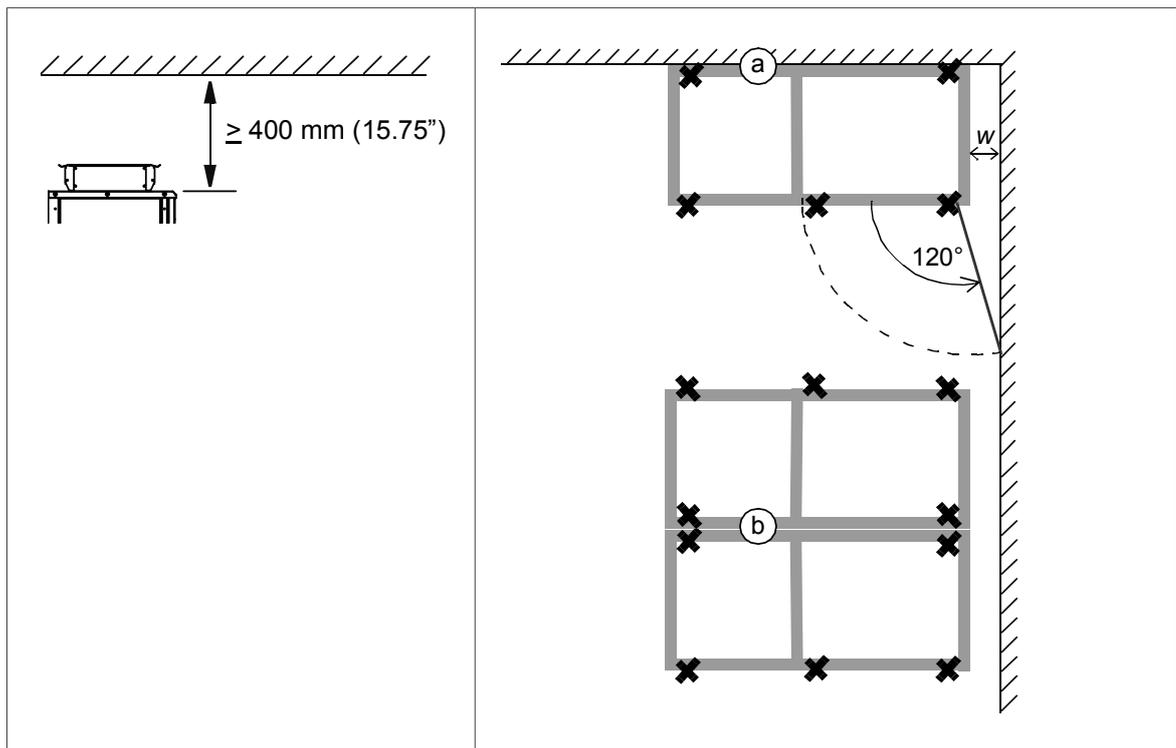
1. Undo the lifting eye screws and remove the lifting eyes.
2. To remove the top front profile of the cabinet, undo the mounting screws. Undo the back mounting screws.
3. Install the roof.
4. Connect the power supply wires to the fan.
5. Reinstall the front top profile of the cabinet in reverse order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



## Attaching the cabinet to the floor and wall or roof

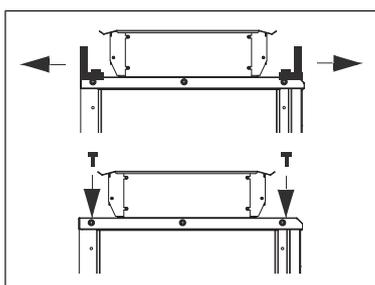
### ■ General rules

- The drive must be installed in an upright vertical position.
- Leave 400 mm (15.75") of free space above the basic roof level of the cabinet for cooling.
- The cabinet can be installed with its back against a wall (a), or back-to-back with another unit (b).
- Leave some space ( $w$ ) at the side where the cabinet outmost hinges are to allow the doors to open sufficiently. The doors must open  $120^\circ$  to allow supply or inverter module replacement.



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

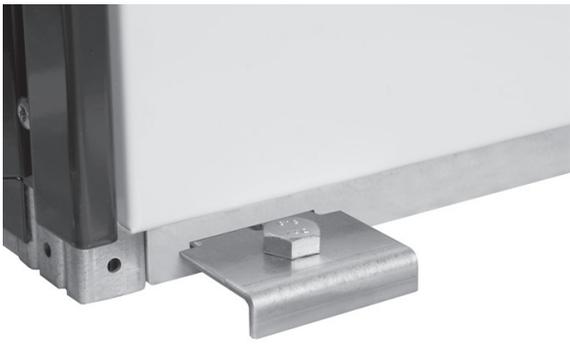
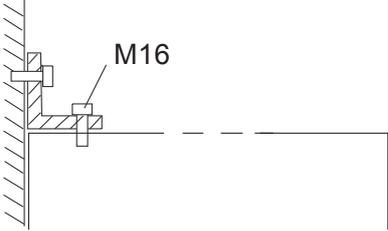
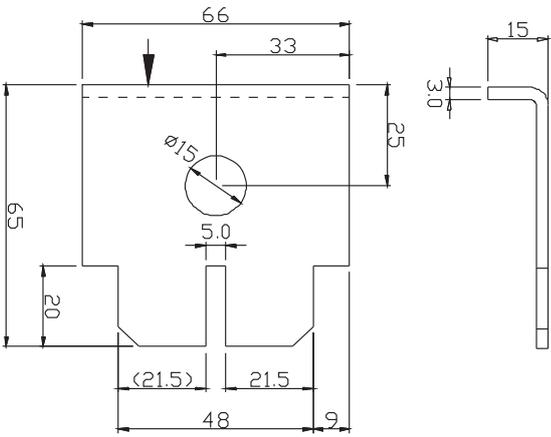
**Note 2:** Depending on the size of the cabinet, it has either bolt-on lifting eyes, or lifting bars with lifting holes. If the cabinet is delivered with lifting bars, remove them. Store the bars for decommissioning. Bolt-on lifting eyes need not be removed unless the holes are used for fastening the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



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

**Alternative 1 – Clamping**

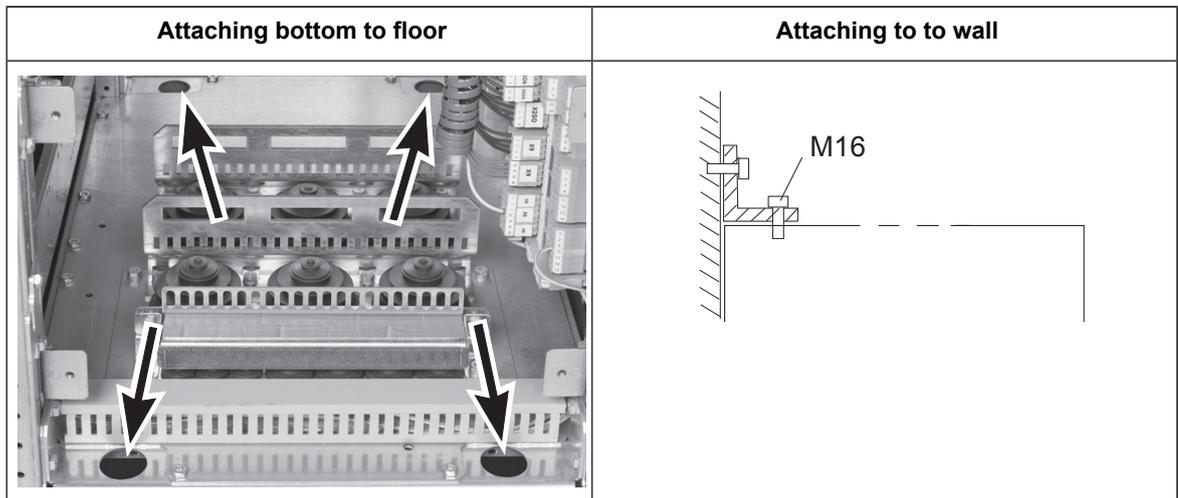
1. Insert the clamps (included) into the twin slots along the front and rear edges of the cabinet frame body and fasten them to the floor with a bolt. The recommended maximum distance between the clamps in the front edge is 800 mm (31.5”).
2. If floor mounting at the back is not possible, fasten the 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 M10 to M12 (3/8" to 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, fasten the top of the cabinet to the wall with L-brackets (not included in the delivery) bolted to the lifting eye/bar holes.

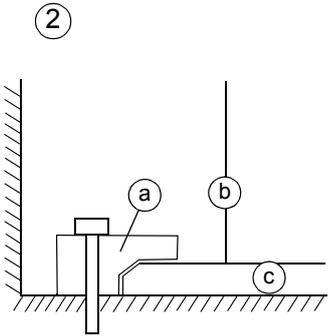
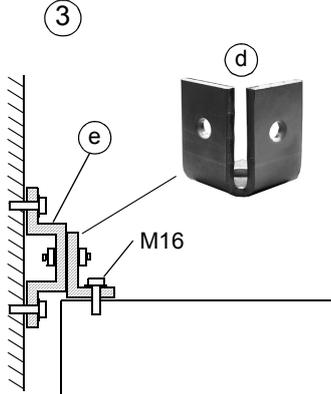


■ **Attaching the cabinet (marine units)**

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

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

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

	
<p>a Clamp (not included)</p>	<p>d Corner bracket (included)</p>
<p>b Back panel of cabinet</p>	<p>e U-bracket (not included)</p>
<p>c Flat bars at base of cabinet</p>	<p>- -</p>

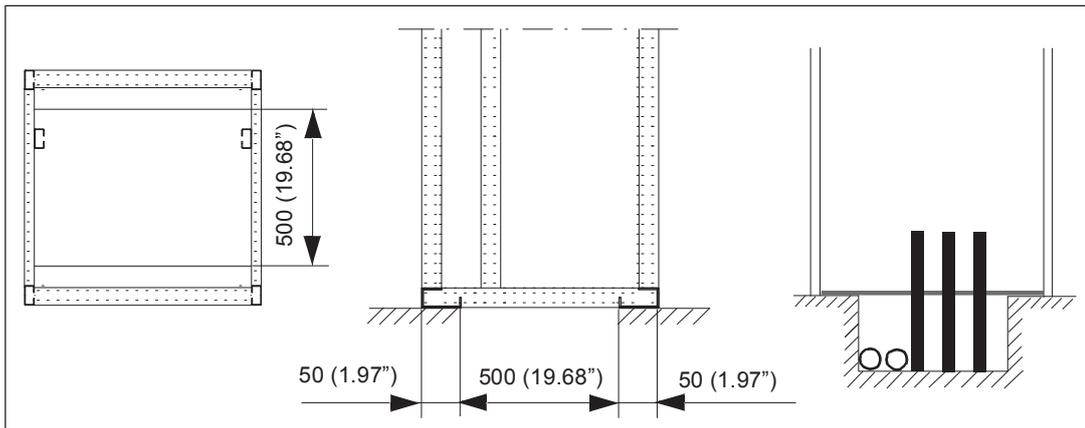


## Miscellaneous

### ■ 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 thickness of the zinc plating of the cabinet frame is 100...200 micrometers (4...8 mil).



#### **WARNING!**

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



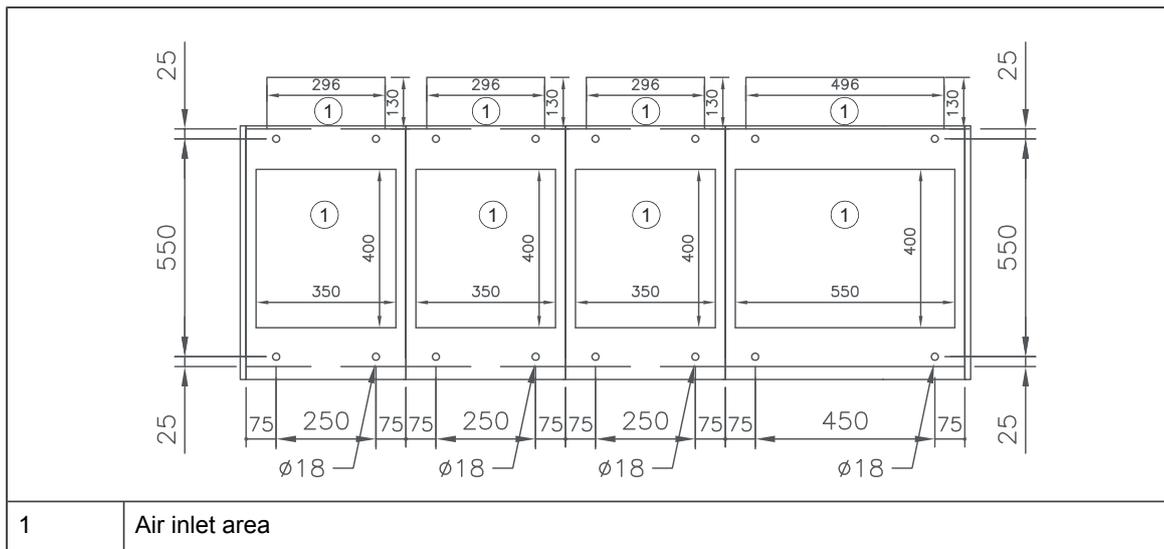
#### **WARNING!**

Do not inhale the welding fumes.

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

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

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



Support the plinth of the cabinet all round.

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

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



**WARNING!**

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

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

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

**Calculating the required static pressure difference**

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

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

where

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

$$v_m = q / A_c$$

$p_d$  Dynamic pressure

$\rho$  Air density (kg/m<sup>3</sup>)

$v_m$  Average air velocity in the exit duct(s) (m/s)

$q$  Rated air flow of the drive (m<sup>3</sup>/s)

$A_c$  Cross-sectional area of the exit duct(s) (m<sup>2</sup>)

**Example**

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

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

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

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

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



## Lifting lugs and bars

### ■ Certificate of conformity

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

### ■ Declaration of Conformity



## EU Declaration of Conformity

Machinery Directive 2006/42/EC

We

Manufacturer: ABB Oy

Address: Hiomotie 13, 00380 Helsinki, Finland.

Phone: +358 10 22 11

declare under our sole responsibility that the following products:

#### Lifting bars, identified with material codes

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

#### Lifting lugs, identified with material codes

64302621      64327151

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

**ACS800LC**      types -x7LC, LC multidrives, -x07LC

**ACS580, ACH580, ACQ580**      types -07

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

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

identified with serial numbers beginning with 1 or 8



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

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

Helsinki, 16 Dec 2019

Signed for and on behalf of:

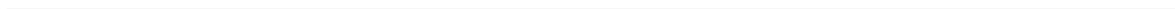


Peter Lindgren  
Vice President, ABB Oy



Vesa Tiihonen  
Manager, Product Engineering and Quality







# Guidelines for planning the electrical installation

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## 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.

## 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 drive or inverter unit hardware manual. You can also use the DriveSize PC tool.

Make sure that the motor withstands the maximum peak voltage in the motor terminals. See [Requirements table \(page 86\)](#). For basics of protecting the motor insulation and bearings in drive systems, see [Protecting the motor insulation and bearings \(page 86\)](#).

### Note:

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

### ■ Protecting the motor insulation and bearings

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

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

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

### ■ Requirements table

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

---

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

Motor type	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 and frame size < IEC 315	100 kW $\leq P_N < 350$ kW or IEC 315 $\leq$ frame size < IEC 400	$P_N \geq 350$ kW or frame size $\geq$ IEC 400
			$P_N < 134$ hp and frame size < NEMA 500	134 hp $\leq P_N < 469$ hp or NEMA 500 $\leq$ frame size $\leq$ NEMA 580	$P_N \geq 469$ hp or frame size > NEMA 580
Random-wound M2_, M3_ and M4_	$U_N \leq 500$ V	Standard	-	+ N	+ N + CMF
	$500$ V < $U_N \leq 600$ V	Standard	+ du/dt	+ N + du/dt	+ N + du/dt + CMF
		or	Reinforced	-	+ N
	$600$ V < $U_N \leq 690$ V (cable length $\leq 150$ m)	Reinforced	+ du/dt	+ N + du/dt	+ N + du/dt + CMF
	$600$ V < $U_N \leq 690$ V (cable length > 150 m)	Reinforced	-	+ N	+ N + CMF
Form-wound HX_ and AM_	$380$ V < $U_N \leq 690$ V	Standard	n.a.	+ N + CMF	$P_N < 500$ kW: +N + CMF
					$P_N \geq 500$ kW: +N + du/dt + CMF
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.

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

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

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

The abbreviations used in the tables are defined below.

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

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

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

**Additional requirements for explosion-safe (EX) motors**

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

**Additional requirements for ABB motors of types other than M2\_, M3\_, M4\_, HX\_ and AM\_**

Use the selection criteria given for non-ABB motors.

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

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

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

Nominal AC supply voltage	Requirement for			
	Motor insulation system	ABB du/dt and common mode filters, insulated N-end motor bearings		
		$P_N < 100 \text{ kW}$	$100 \text{ kW} \leq P_N < 200 \text{ kW}$	$P_N \geq 200 \text{ kW}$
		$P_N < 140 \text{ hp}$	$140 \text{ hp} \leq P_N < 268 \text{ hp}$	$P_N \geq 268 \text{ hp}$
$U_N \leq 500 \text{ V}$	Standard	-	+ N	+ N + CMF
$500 \text{ V} < U_N \leq 600 \text{ V}$	Standard	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
	or			
$600 \text{ V} < U_N \leq 690 \text{ V}$	Reinforced	-	+ N	+ N + CMF
	Reinforced	+ du/dt	+ du/dt + N	+ du/dt + N + CMF

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

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

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

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

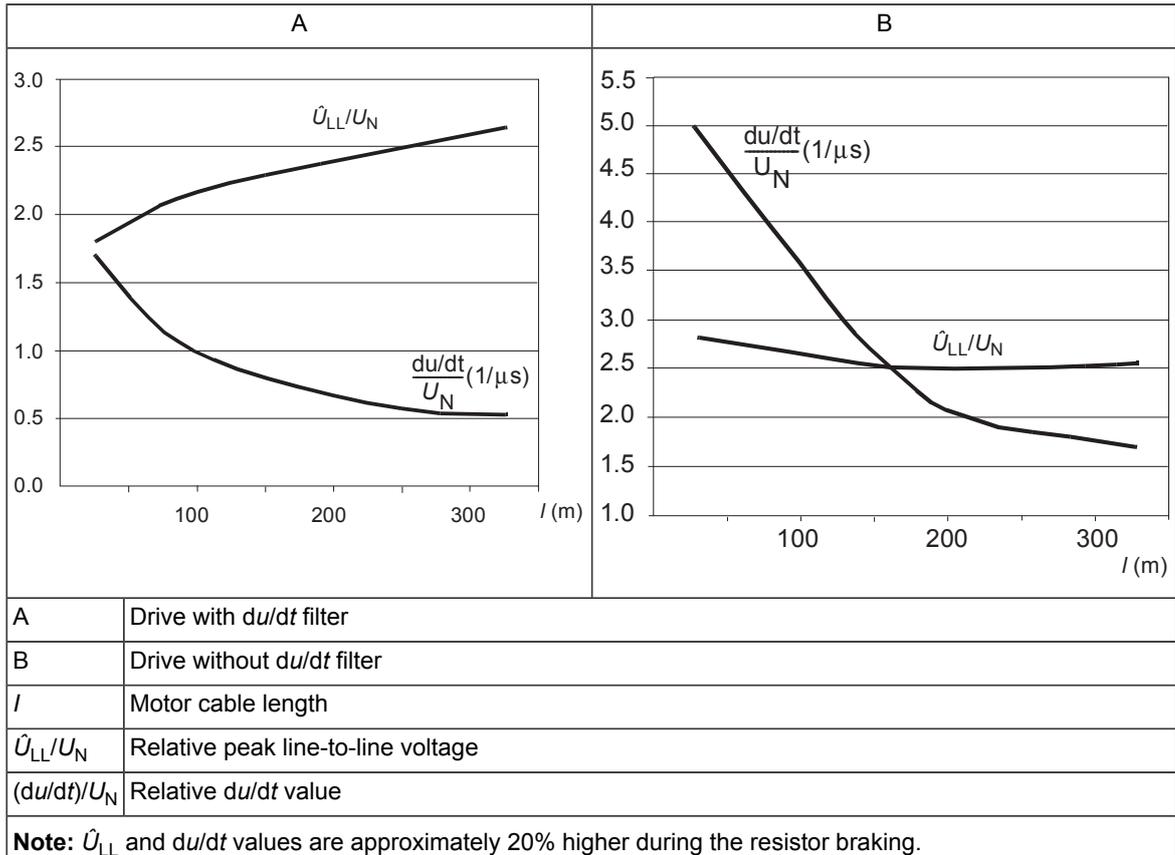
Nominal AC supply voltage	Requirement for		
	Motor insulation system	ABB du/dt and common mode filters, insulated N-end motor bearings	
		$P_N < 100 \text{ kW}$ or frame size $< \text{IEC 315}$	$100 \text{ kW} < P_N < 350 \text{ kW}$ or $\text{IEC 315} < \text{frame size} < \text{IEC 400}$
	$P_N < 134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

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

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

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

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



**Additional note for sine filters**

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

**Selecting the power cables**

■ **General guidelines**

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

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

To comply with the EMC requirements of the CE mark, use one of the preferred cable types. See [Preferred power cable types \(page 92\)](#).

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

Metal conduit reduces electromagnetic emission of the whole drive system.

The protective conductor must always have an adequate conductivity.

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

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

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

Cross-sectional area of the phase conductors $S$ (mm <sup>2</sup> )	Minimum cross-sectional area of the corresponding protective conductor $S_p$ (mm <sup>2</sup> )
$S \leq 16$	$S$ <sup>1)</sup>
$16 < S \leq 35$	16
$35 < S$	$S/2$

<sup>1)</sup> To comply with standard IEC/EN 61800-5-1 (UL 61800-5-1)

- use a protective earth conductor with a minimum cross-sectional area of 10 mm<sup>2</sup> Cu or 16 mm<sup>2</sup> Al (as an alternative when aluminum cables are permitted),  
or
- use a second protective earth conductor of the same cross-sectional area as the original protective earth conductor,  
or
- use a device that automatically disconnects the supply if the protective earth conductor is damaged.

If the protective earth conductor is separate (that is, it does not form part of the input power cable or the input power cable enclosure), the minimum cross-sectional area must be:

- 2.5 mm<sup>2</sup> when the conductor is mechanically protected,  
or
- 4 mm<sup>2</sup> when the conductor is not mechanically protected.

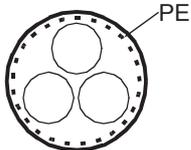
### ■ Typical power cable sizes

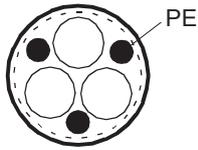
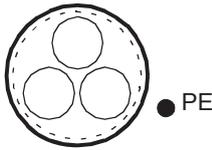
See the technical data.

### ■ Power cable types

#### Preferred power cable types

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

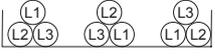
Cable type	Use as input power cabling	Use as motor cabling
 <p>Symmetrical shielded (or armored) cable with three phase conductors and concentric PE conductor as shield (or armor)</p>	Yes	Yes

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

<sup>1)</sup> 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
 <p>Four-conductor cabling in PVC conduit or jacket (three phase conductors and PE)</p>	Yes with phase conductor smaller than 10 mm <sup>2</sup> (8 AWG) Cu.	Yes with phase conductor smaller than 10 mm <sup>2</sup> (8 AWG) Cu, or motors up to 30 kW (40 hp). <b>Note:</b> Shielded or armored cable, or cabling in metal conduit is always recommended to minimize radio frequency interference.
 <p>Four-conductor cabling in metal conduit (three phase conductors and PE), eg, EMT, or four-conductor armored cable</p>	Yes	Yes with phase conductor smaller than 10 mm <sup>2</sup> (8 AWG) Cu, or motors up to 30 kW (40 hp)
 <p>Well-shielded (Al/Cu shield or armor) four-conductor cable (three phase conductors and a PE)</p>	Yes	Yes with motors up to 100 kW (135 hp). A potential equalization between the frames of motor and driven equipment is required.

Cable type	Use as input power cabling	Use as motor cabling
 <p>A single-core cable system: three phase conductors and PE conductor on cable tray</p>  <p>Preferable cable arrangement to avoid voltage or current unbalance between the phases</p>	<p>Yes</p>  <p><b>WARNING!</b> 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.</p>	<p>No</p>

**Not allowed power cable types**

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

■ **Additional guidelines, North America**

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

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

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

Wiring method	Notes
Conduit - Metallic <sup>1) 2)</sup>	
Electrical metallic tubing: Type EMT	Prefer symmetrical shielded VFD cable.
Rigid metal conduit: Type RMC	Use separate conduit run for each motor.
Liquid-tight flexible metal electrical conduit: Type LFMC	Do not run input power wiring and motor wiring in the same conduit.
Conduit - Non-metallic <sup>2) 3)</sup>	
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 <sup>2)</sup>	
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 <sup>2)</sup>	
Enclosures, air handlers, etc.	Prefer symmetrical shielded VFD cable. Allowed internally in enclosures when in accordance with UL.

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

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

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

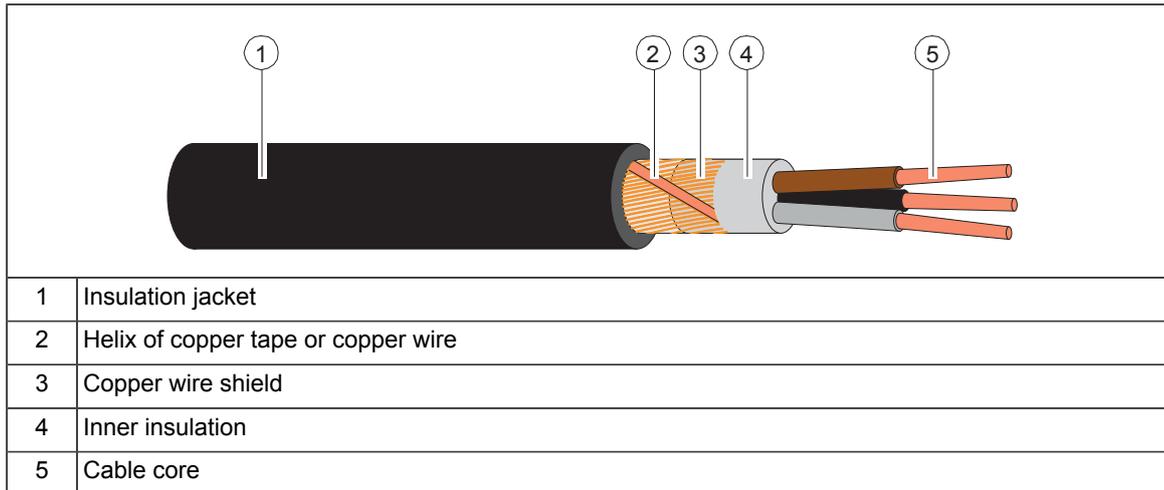
### Metal conduit

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

#### ■ Power cable shield

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

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



See chapter *Resistor braking* (page 269).

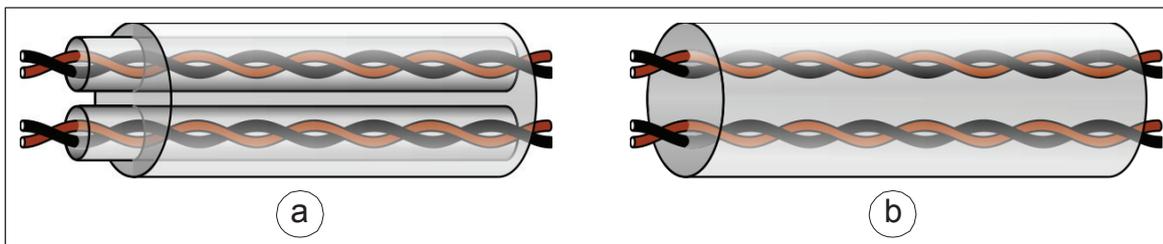
## Selecting the control cables

### ■ Shielding

Only use shielded control cables.

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

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



### ■ Signals in separate cables

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

### ■ Signals that can be run in the same cable

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

### ■ Relay cable

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

### ■ Control panel to drive cable

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

■ **PC tool cable**

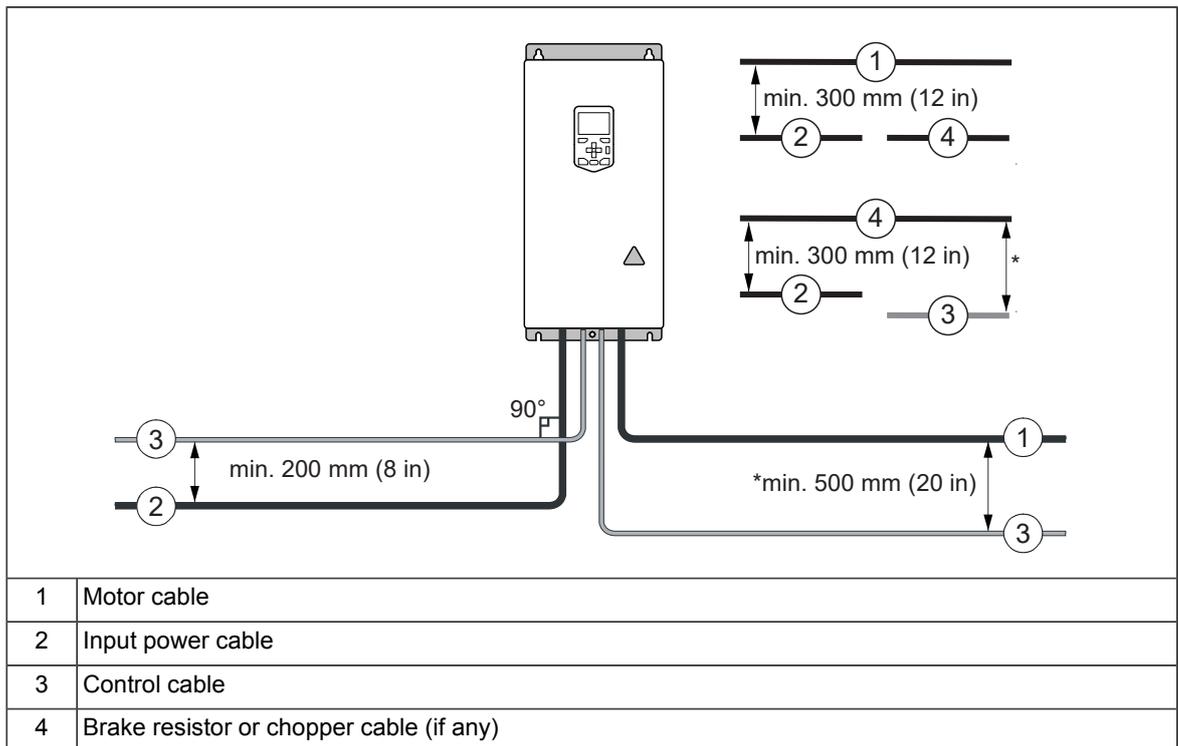
Connect the Drive composer PC tool to the drive through the USB port of the control panel. Use a USB Type A (PC) - Type Mini-B (control panel) cable. The maximum length of the cable is 3 m (9.8 ft).

**Routing the cables**

■ **General guidelines – IEC**

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

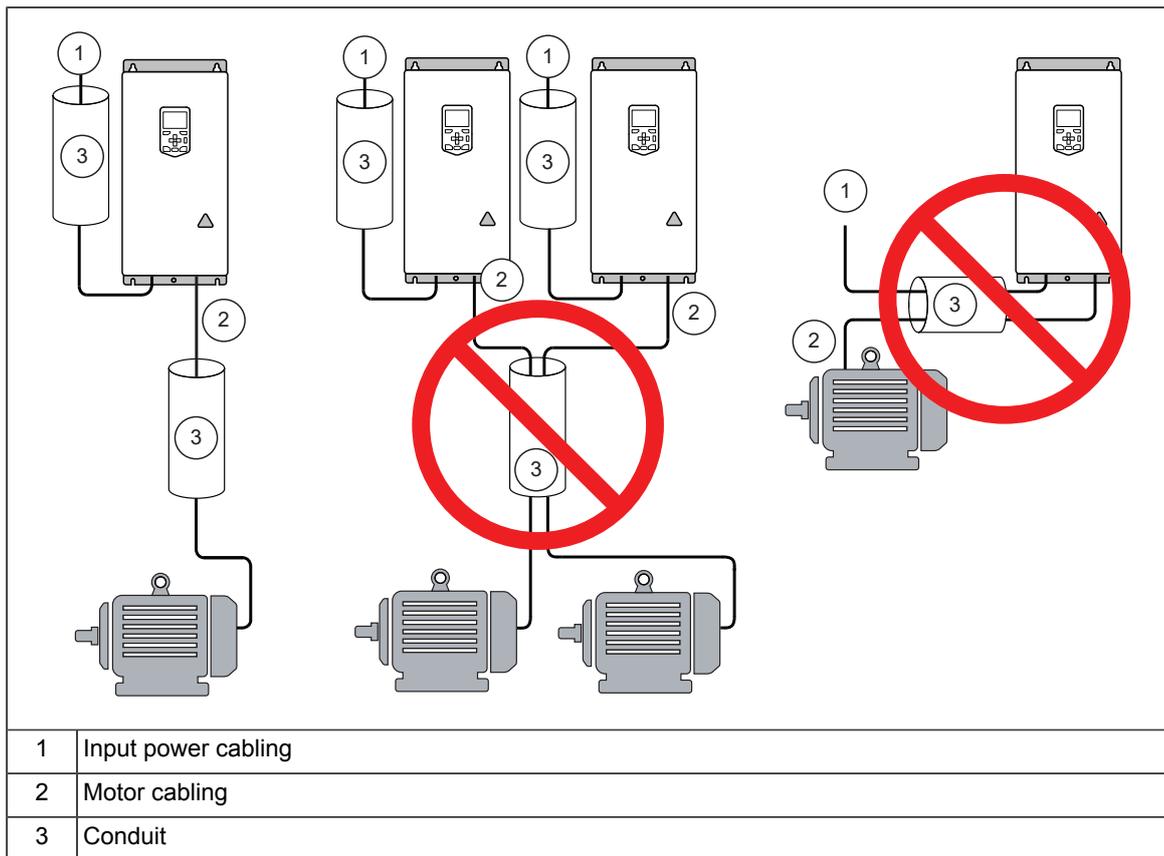
The following figure illustrates the cable routing guidelines with an example drive.



■ **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.



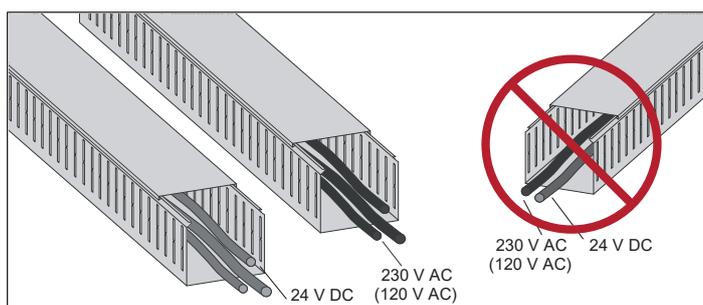
### ■ Continuous motor cable shield/conduit or enclosure for equipment on the motor cable

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

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

### ■ Separate control cable ducts

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



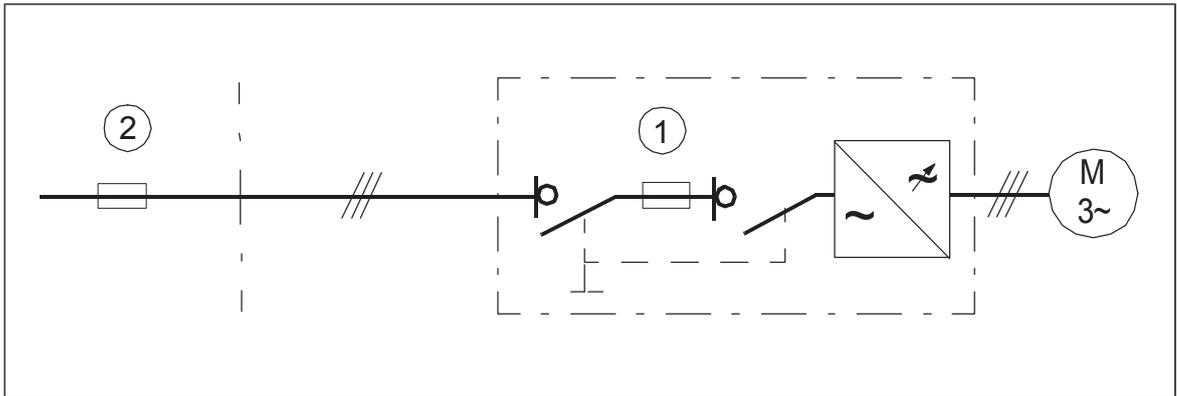
## Implementing thermal overload and short-circuit protection

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

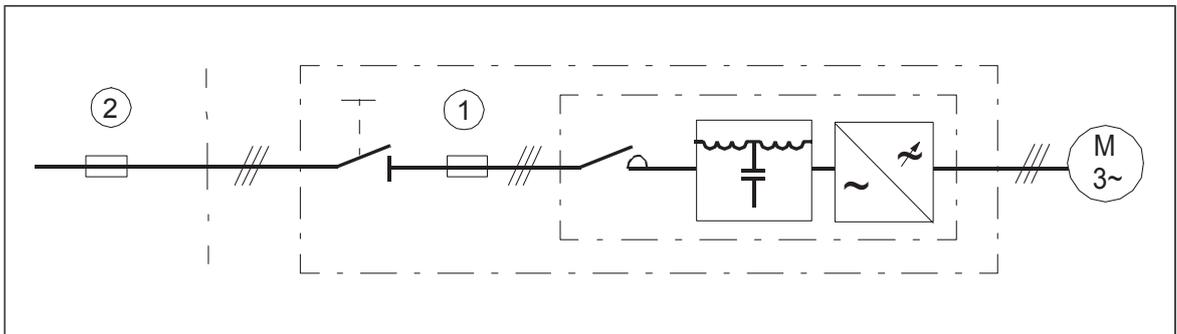
The drive is equipped with internal AC fuses (1) as standard. The fuses restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

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 the technical data).

R8



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 according to the nominal current of the drive. No additional protection devices are needed.

### ■ 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 thermal switch (for example Klixon), PTC or Pt100.

For more information, see the 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 to be used with residual current devices of Type B.

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

## ■ 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)	<a href="#">3AJA0000119895</a>
+Q952	Emergency stop, stop category 1 (using main contactor/breaker)	<a href="#">3AJA0000119896</a>
+Q963	Emergency stop, stop category 0 (using Safe torque off)	<a href="#">3AJA0000119908</a>
+Q964	Emergency stop, stop category 1 (using Safe torque off)	<a href="#">3AJA0000119909</a>
+Q978	Emergency stop, stop category 0 or 1 (using main contactor/breaker and Safe torque off)	<a href="#">3AJA0000145920</a>
+Q979	Emergency stop, stop category 0 or 1 (using Safe torque off)	<a href="#">3AJA0000145921</a>

## ■ Implementing the Safe torque off function

See chapter *The Safe torque off function (page 253)*.

## ■ Implementing an ATEX-certified motor thermal protection

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

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

For a cabinet-installed 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 an ATEX-compliant protection relay, either for PTC, or Pt100 temperature sensors.

For more information, see:

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

### ■ 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	<a href="#">3AUA0000145922</a>
+Q957	Prevention of unexpected start-up, with safety relay	<a href="#">3AUA0000119910</a>

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

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

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

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

See the appropriate manual for more information.

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

### ■ Implementing the Power-loss ride-through function

Power-loss ride-through function keeps the drive and motor in operation over a short input power break (max. few seconds). When the drive detects an input power break, it starts to decelerate the motor which generates energy back to the drive DC link.

If the power-loss situation lasts so long that the drive trips on undervoltage fault, the drive must be reset and started again to continue operation.

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

1. Enable the power-loss ride-through function of the drive (parameter 30.31).
2. If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.
3. Enable the automatic restart of the motor after a short power supply break:
  - Set the start mode to automatic (parameter 21.01.or 21.19, depends on the motor control mode in use).
  - Define the automatic restart time (parameter 21.18).



#### **WARNING!**

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

### Cabinets with line contactor (option +F250)

With external uninterruptible control voltage (option +G307), the main contactor remains closed in short power-loss situations. If the power-loss situation lasts so long that the drive trips on undervoltage fault, the drive must be reset and started again to continue operation.

### ■ 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!**

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

### ■ Supplying power for the auxiliary circuits

The drive is equipped with an auxiliary voltage transformer which supplies, for example, control unit(s) and cooling fan(s).

The user must supply these options from external power sources:

- +G300/+G301: Cabinet heaters and/or lighting (230 or 115 V AC; external fuse: 16 A gG)
- +G307: Connection for an external uninterruptible power supply (230 or 115 V AC; external fuse 16 A gG)
- +G313: Power supply connection for a motor space heater output (230 V AC; external fuse 16 A gG).

## ■ 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.

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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

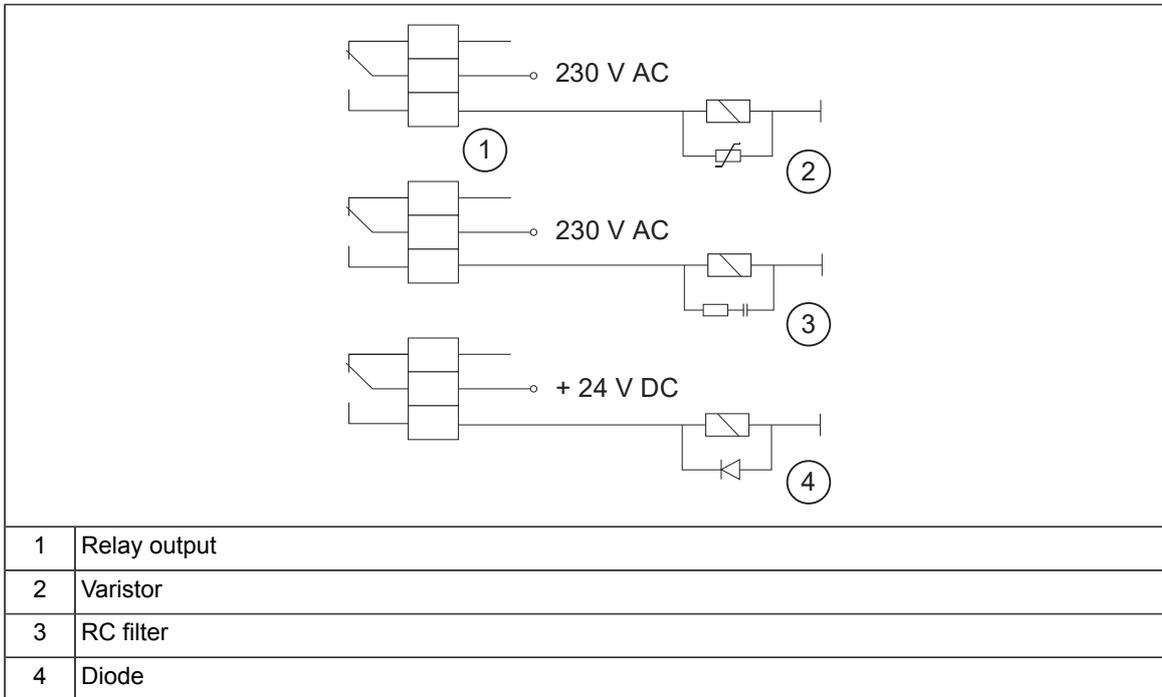
Inductive loads (relays, contactors, motors) cause voltage transients when switched off.

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

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or inductively to other conductors in the control cable and form a risk of malfunction in other parts of the system.

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



### ■ Implementing a motor temperature sensor connection



#### **WARNING!**

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

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

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

You have these implementation alternatives:

1. If there is double or reinforced insulation between the sensor and the live parts of the motor: You can connect the sensor directly to the analog/digital input(s) of the drive. See the control cable connection instructions.
2. If there is basic insulation between the sensor and the live parts of the motor: You can connect the sensor to the analog/digital input(s) of the drive. All other circuits connected to the digital and analog inputs (typically extra-low voltage circuits) must be:
  - protected against contact, and
  - insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit.

**Note:** Extra-low voltage circuits (for example, 24 V DC) typically do not meet these requirements.

As an alternative, you can connect the sensor with basic insulation to the analog/digital input(s) of the drive, if you do not connect any other external control circuits to the drive digital and analog inputs.

3. You can connect the sensor to the drive via an option module. The sensor and the module must form a double or reinforced insulation between the motor live parts and the drive control unit. See [Connecting motor temperature sensor to the drive via an option module \(page 105\)](#).
4. You can connect a sensor to a digital input of the drive via an external relay. The sensor and the relay must form a double or reinforced insulation between the motor live parts and the digital input of the drive.

### **Connecting motor temperature sensor to the drive via an option module**

This table shows:

- the option module types that you can use for the motor temperature sensor connection
  - the insulation or isolation level that each option module forms between its temperature sensor connector and other connectors
  - the temperature sensor types that you can connect to each option module
  - the 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.
-

106 Guidelines for planning the electrical installation

Option module		Temperature sensor type			Temperature sensor insulation requirement
Type	Insulation/Isolation	PTC	KTY	Pt100, Pt1000	
FIO-11	Galvanic isolation between sensor connector and other connectors (including drive control unit connector)	-	x	x	Reinforced insulation
FEN-xx	Galvanic isolation between sensor connector and other connectors (including drive control unit connector)	x	x	-	Reinforced insulation
FAIO-01	Basic insulation between sensor connector and drive control unit connector. No insulation between sensor connector and other I/O connectors.	x	x	x	Basic insulation. Connectors of option module other than sensor connector must be left unconnected.
FPTC-xx <sup>1)</sup>	Reinforced insulation between sensor connector and other connectors (including drive control unit connector).	x	-	-	No special requirement

<sup>1)</sup> Suitable for use in safety functions (SIL2 / PL c rated).

# 6

## Electrical installation

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### Contents of this chapter

This chapter gives instructions on the wiring the drive.

### Warnings

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**WARNING!**

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

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

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### Measuring the insulation

- **Measuring the insulation of the drive**

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**WARNING!**

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

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- **Measuring the insulation of the input power cable**

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

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## ■ Measuring the insulation of the motor and motor cable



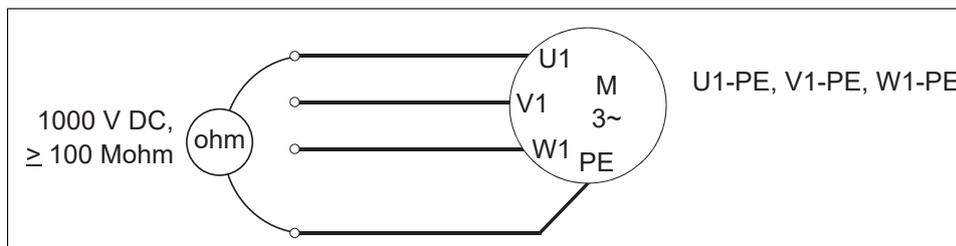
### WARNING!

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

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

1. Do the steps in section *Electrical safety precautions (page 17)* before you start the work.
2. Make sure that the motor cable is disconnected from the drive output terminals.
3. Measure the insulation resistance between each phase conductor and the protective earth conductor. Use a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must be more than 100 Mohm (reference value at 25 °C [77 °F]). For the insulation resistance of other motors, refer to the manufacturer's instructions.

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



## Compatibility with IT (ungrounded), corner-grounded delta, midpoint-grounded delta and TT systems

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]).

### ■ EMC filter (standard drive, options +E200 or +E202)

A standard drive and 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 +E200 or +E202 on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system). The system will be connected to ground potential through the EMC filter capacitors of the drive. This can cause danger, or damage the drive.

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

### ■ Ground-to-phase varistor

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

**WARNING!**

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

### ■ Corner-grounded and midpoint-grounded delta systems

**WARNING!**

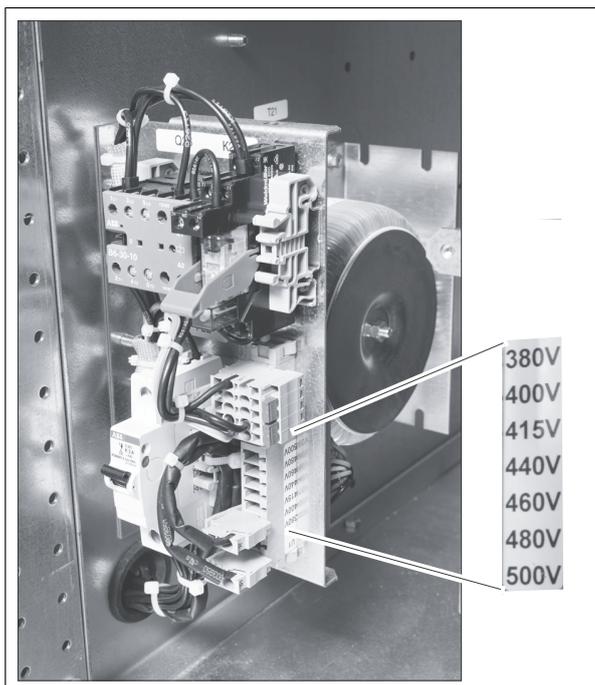
Do not install the drive on a 525...690 V corner-grounded or midpoint-grounded delta system. Disconnecting the EMC filter and ground-to-phase varistor does not prevent damage to the drive.

## 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 switches and lights (page 48)*.

## Settings the voltage range of auxiliary voltage transformers

Set the voltage tap in the auxiliary voltage transformer according to the power network voltage. This figure shows an example connection.



Transformer T21 is included as standard.

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

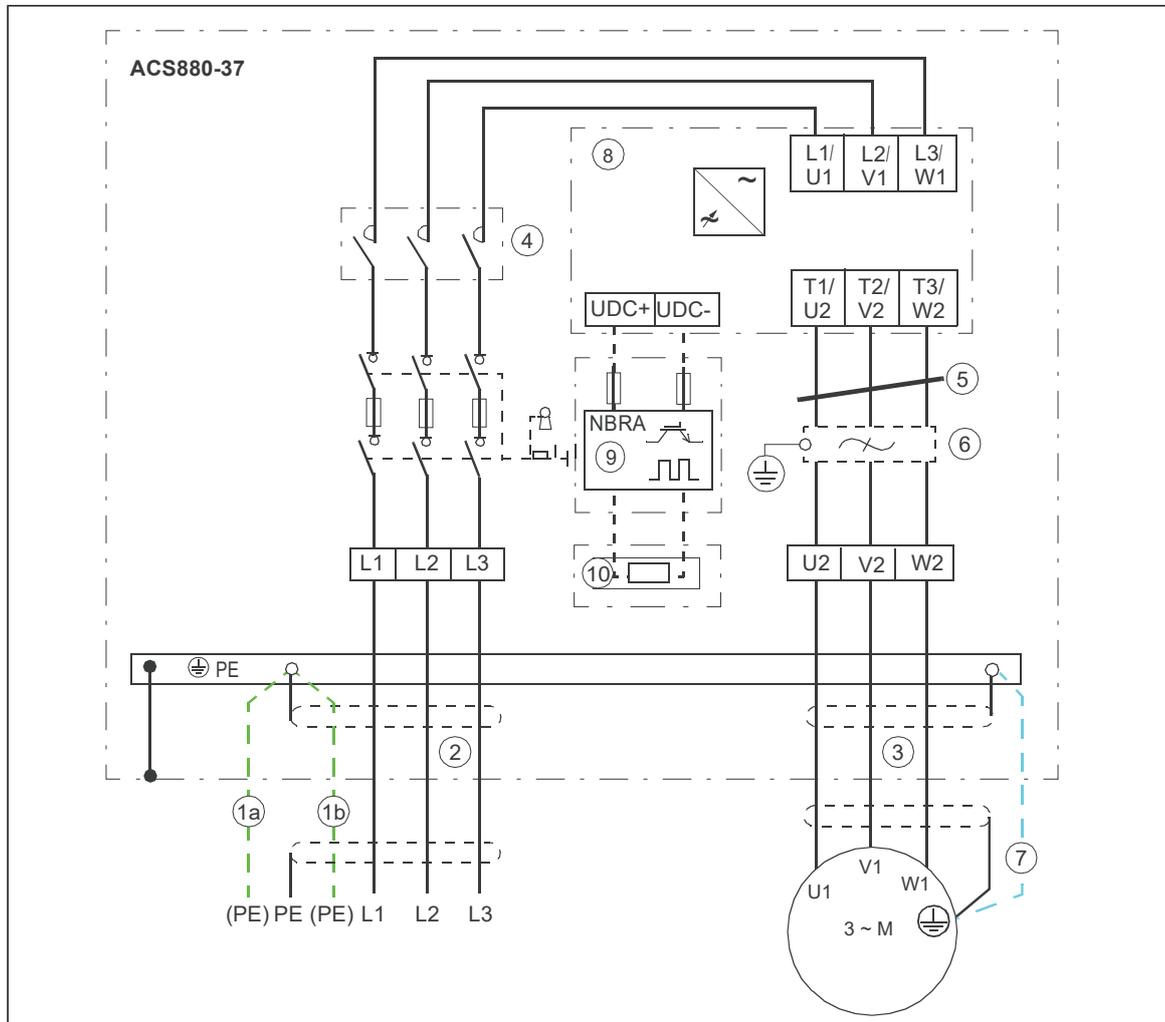
In frame R11, additional transformer T102 comes with options +B055 and +C128.

The locations of the transformers are shown in section *Cabinet layout (page 36)*.

## Connecting the power cables

### ■ Connection diagram

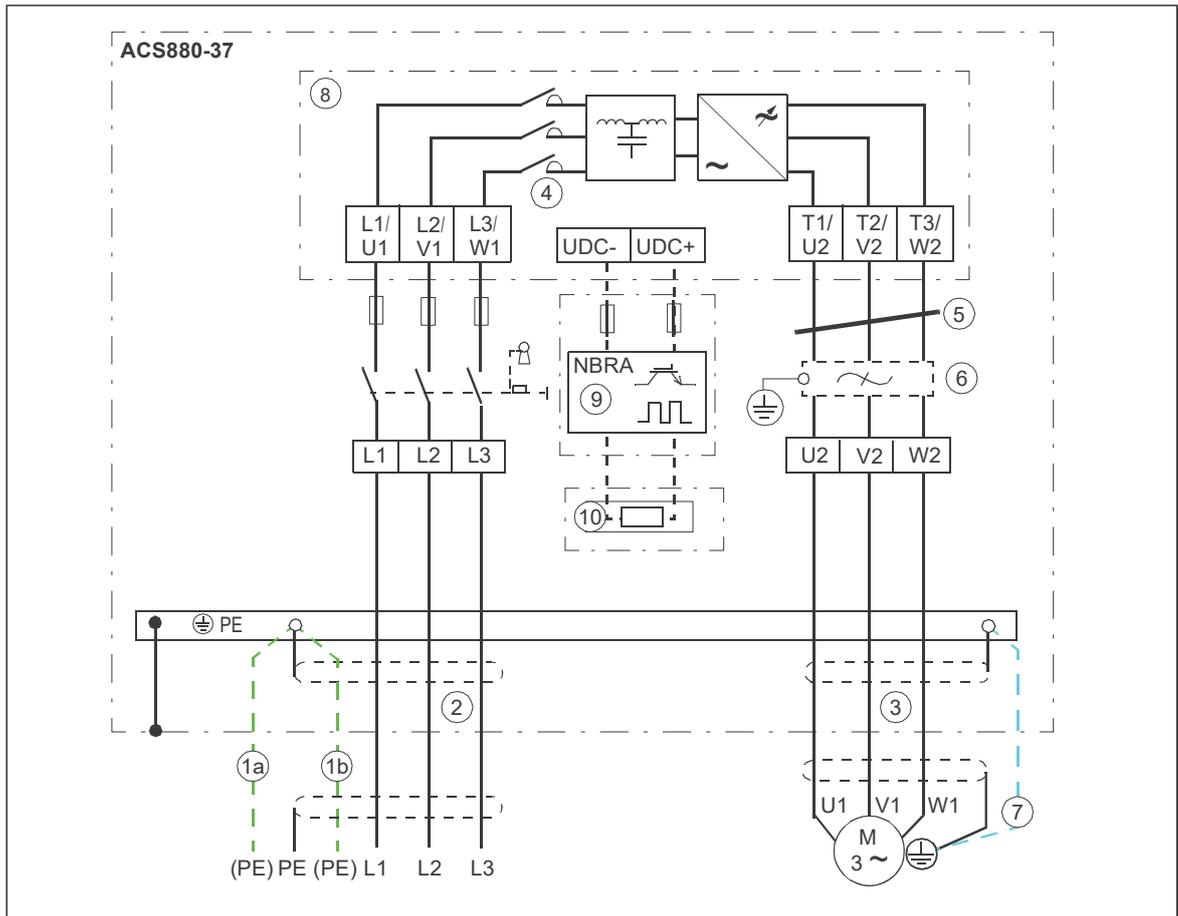
#### Connection diagram of frame R8



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 <a href="#">General guidelines (page 91)</a> .
2	360-degree 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-degree 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 <a href="#">General guidelines (page 91)</a> and <a href="#">Preferred power cable types (page 92)</a> .
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 <a href="#">General guidelines (page 91)</a>
2	360-degree 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-degree 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 <a href="#">General guidelines (page 91)</a> and <a href="#">Preferred power cable types (page 92)</a> .
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.

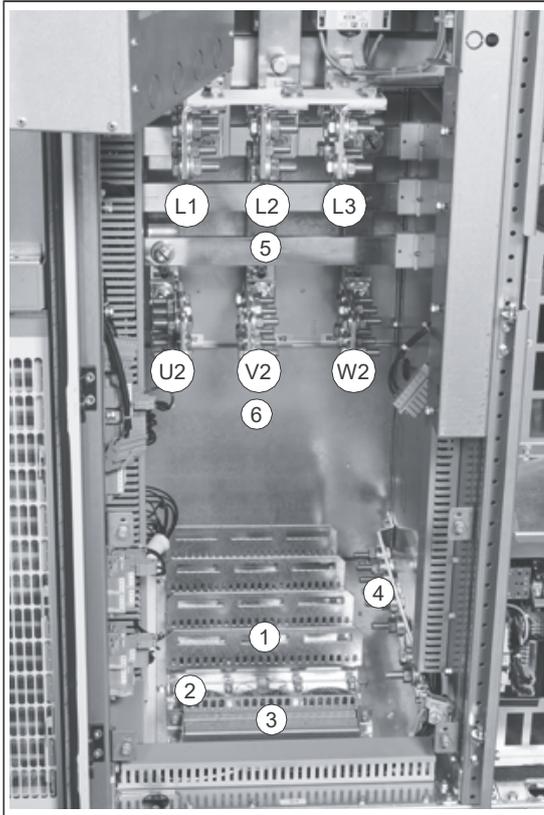
**Note:** You have to remove the “door fan” to gain access to the cable terminals and entries (see page 158).

**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



**Frame R11**

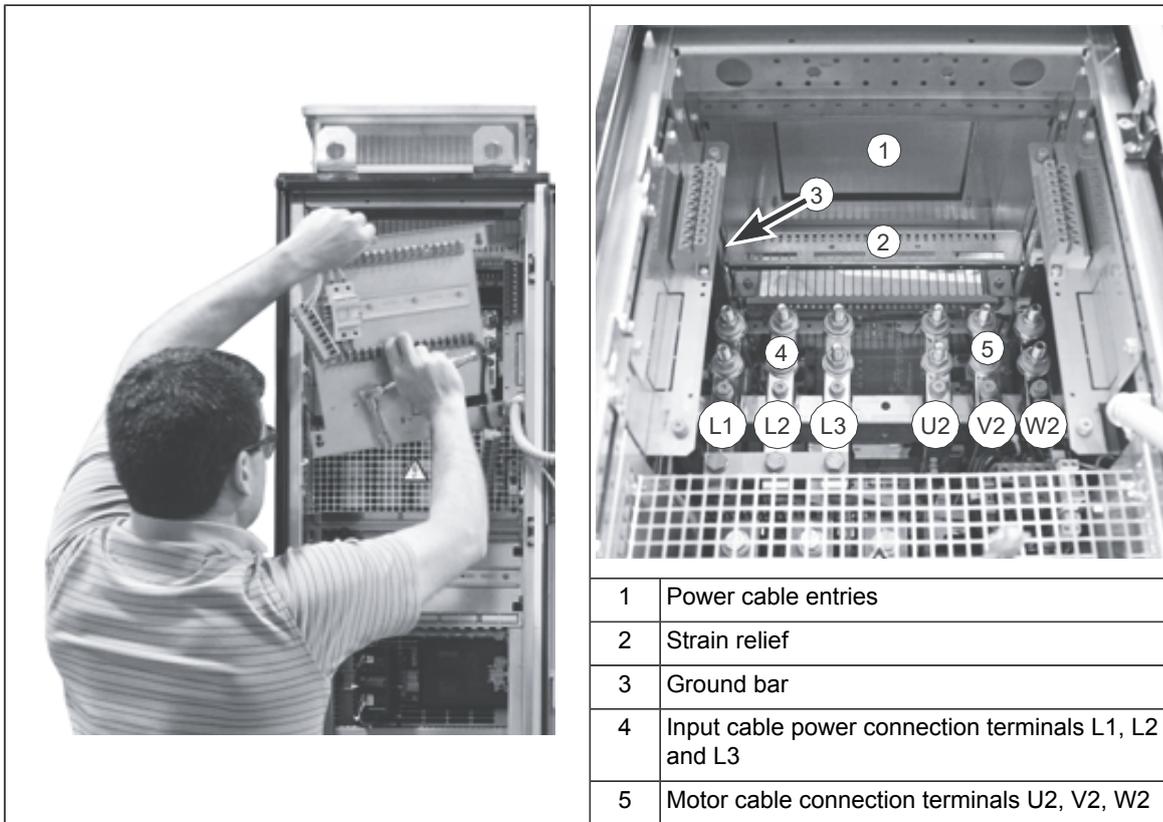


1	Strain relief
2	Power cable entries. Conductive sleeve under the grommet.
3	Control cable entry with EMI conductive cushions.
4	PE terminal
5	Input power cable terminals L1, L2 and L3
6	Motor cable terminals U2, V2, W2



### Layout of power cable connection terminals (option +C129)

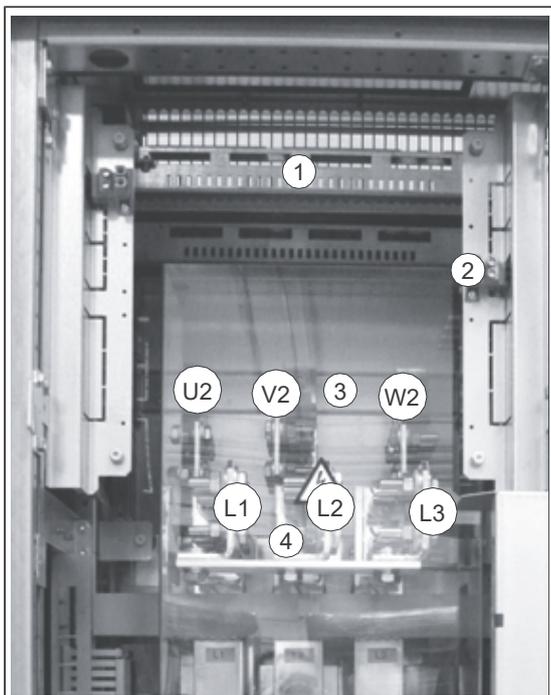
This figure shows the layout of the power cable connection terminals of frame R8.



The figure consists of two parts. On the left, a technician is shown from the back, working on the terminal block of a rack-mounted electrical cabinet. On the right, a detailed view of the terminal block layout is shown with numbered callouts (1-5) and terminal labels (L1, L2, L3, U2, V2, W2).

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 frame R11.



The figure shows a detailed view of the terminal block layout for frame R11. The terminals are labeled with callouts 1 through 4 and terminal labels L1, L2, L3, U2, V2, W2, and 3.

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 17)* 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 158)*.
  - 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 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 158)*.
  - 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.

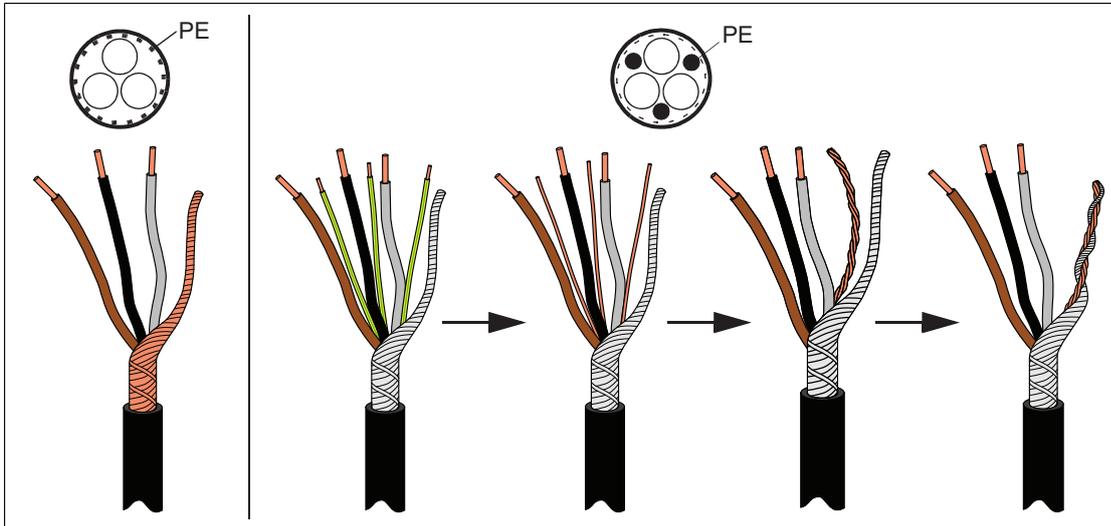


5. Prepare the ends of the cables.

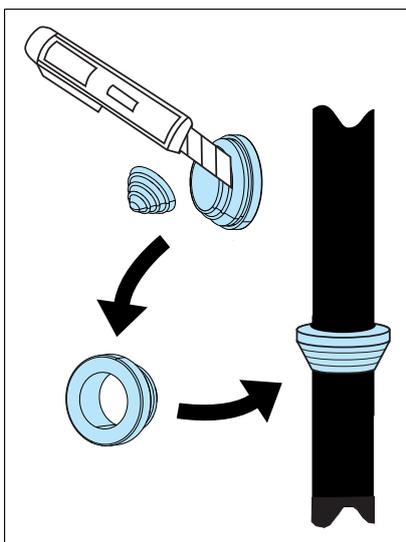


**WARNING!**

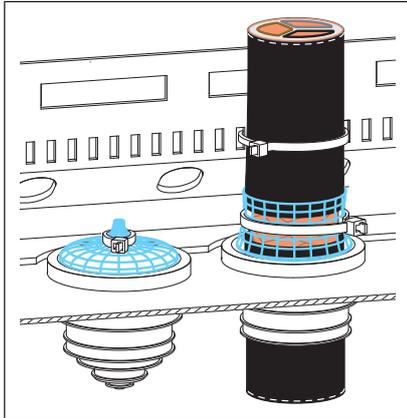
Apply grease to stripped aluminum conductors before attaching them to non-coated aluminum cable lugs. Obey the grease manufacturer's instructions. Aluminum-aluminum contact can cause oxidation in the contact surfaces.



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

1. Do the steps in section *Electrical safety precautions (page 17)* 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 158)*.
- 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 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 158)*.
- 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.

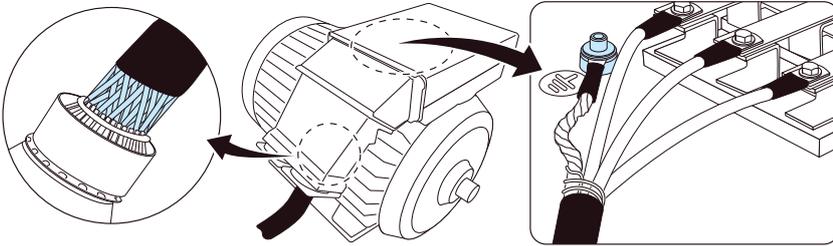


10. Drives with external brake resistors (option +D150 and no +D151):
  - Run the power cables from the brake resistor to the brake copper cubicle including the grounding cable.
  - Connect the ground cable to the ground bar at the bottom of the cabinet.
  - Connect the brake resistor power cables to 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 degrees at the cable entry of the motor terminal box.



## Connecting the control cables

See chapter *Control units of the drive* 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 120)*.
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 127)*.
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 wherever 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.

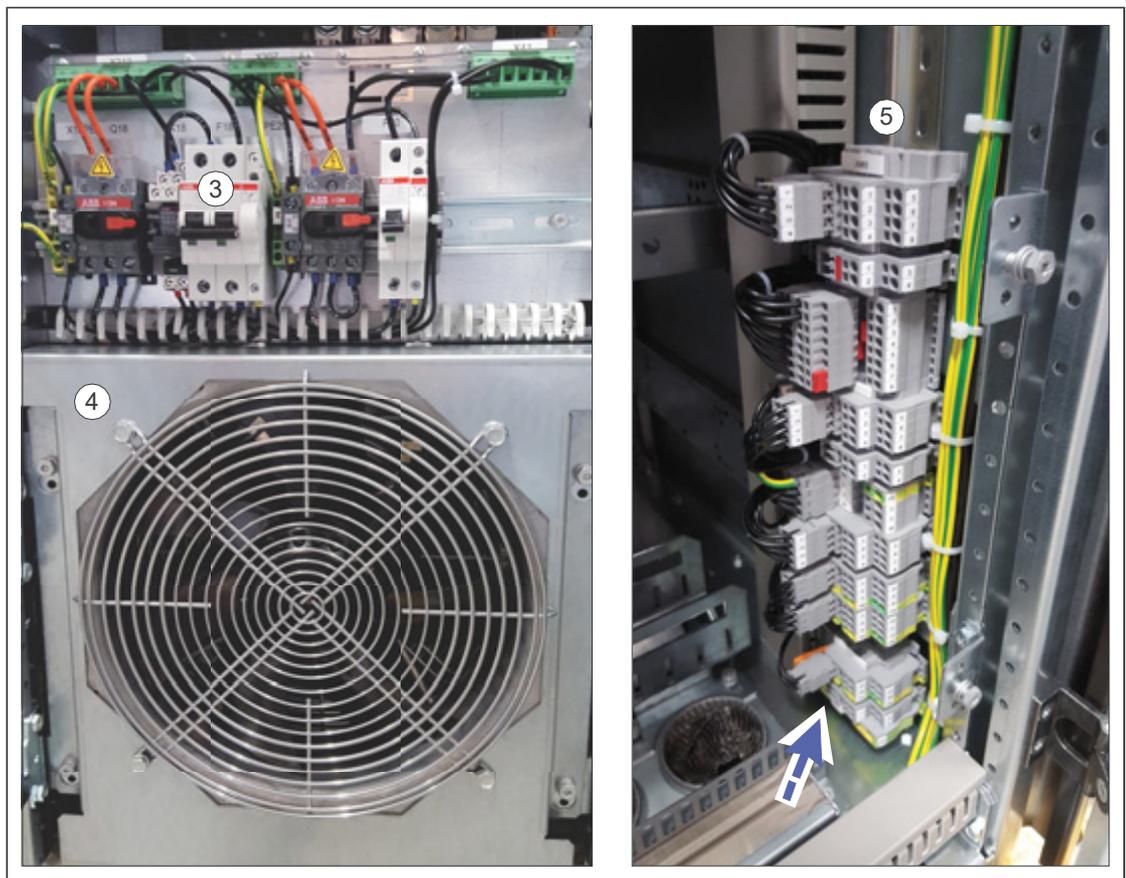
#### Frame R8

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* 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 158)*.

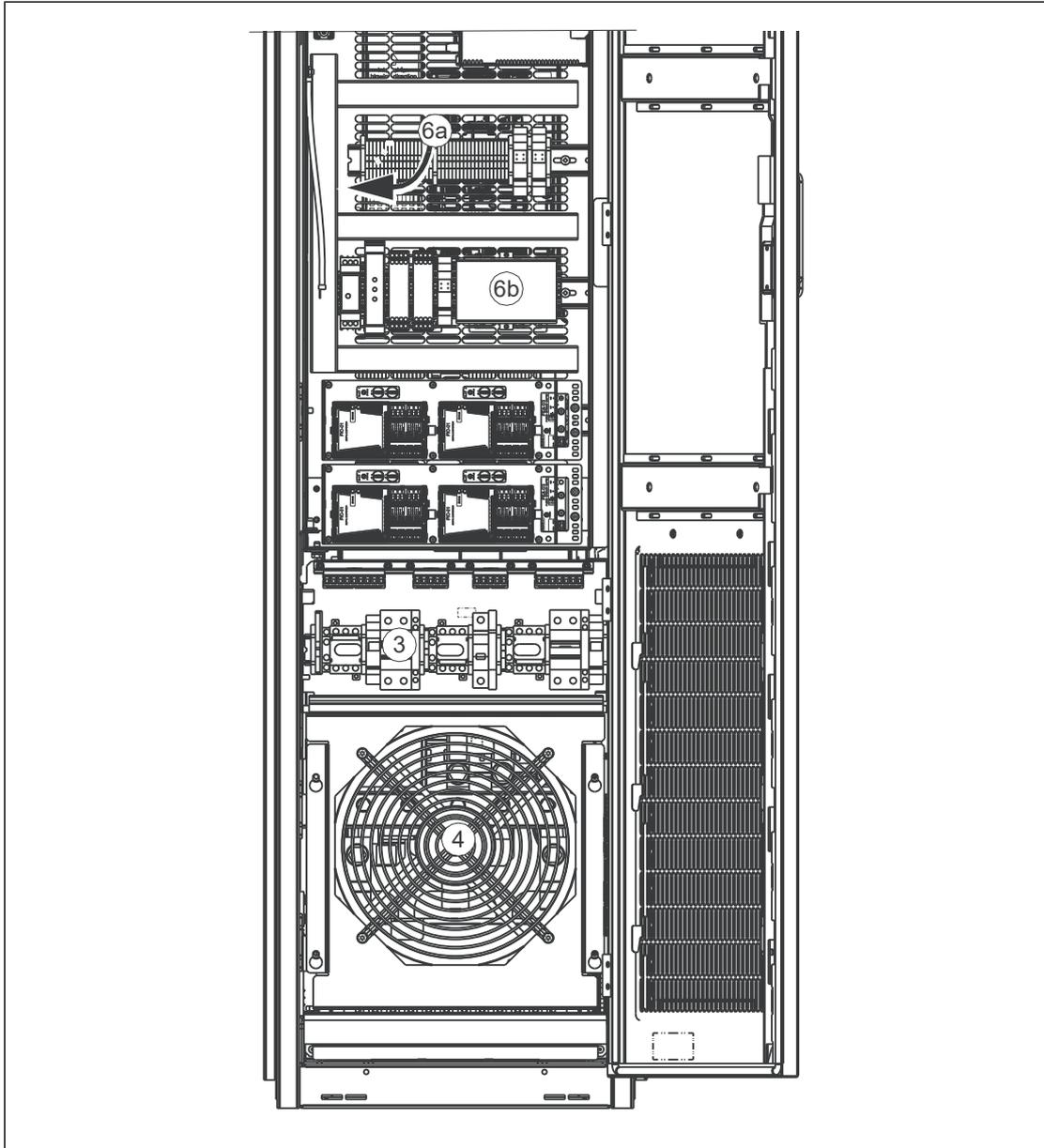


5. For bottom entry: Route the cables of these options to the connection terminals at the right-hand side of the cabinet as shown below. For top entry, see step 7.

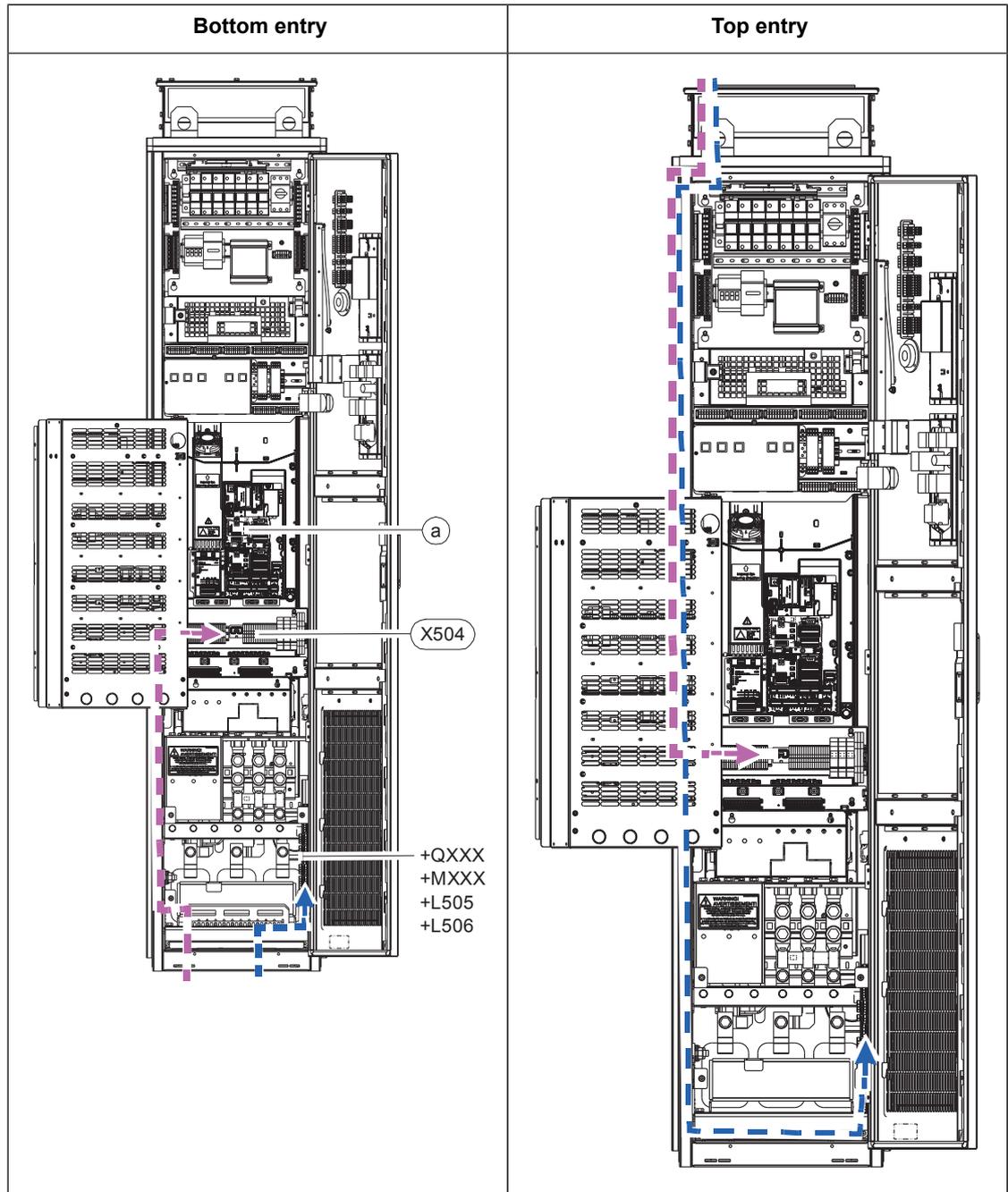
Terminal	Option
X250	Main switch feedback and line contactor feedback with options +Q951, +Q952 or +Q978 for customer
X506	Thermistor relay or Pt100 relays (option +L505 or +L506)
X601	Starter for auxiliary motor fan (options +M600...+M605)
X951	Push buttons for emergency stop options +Q951, +Q952, +Q963 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.

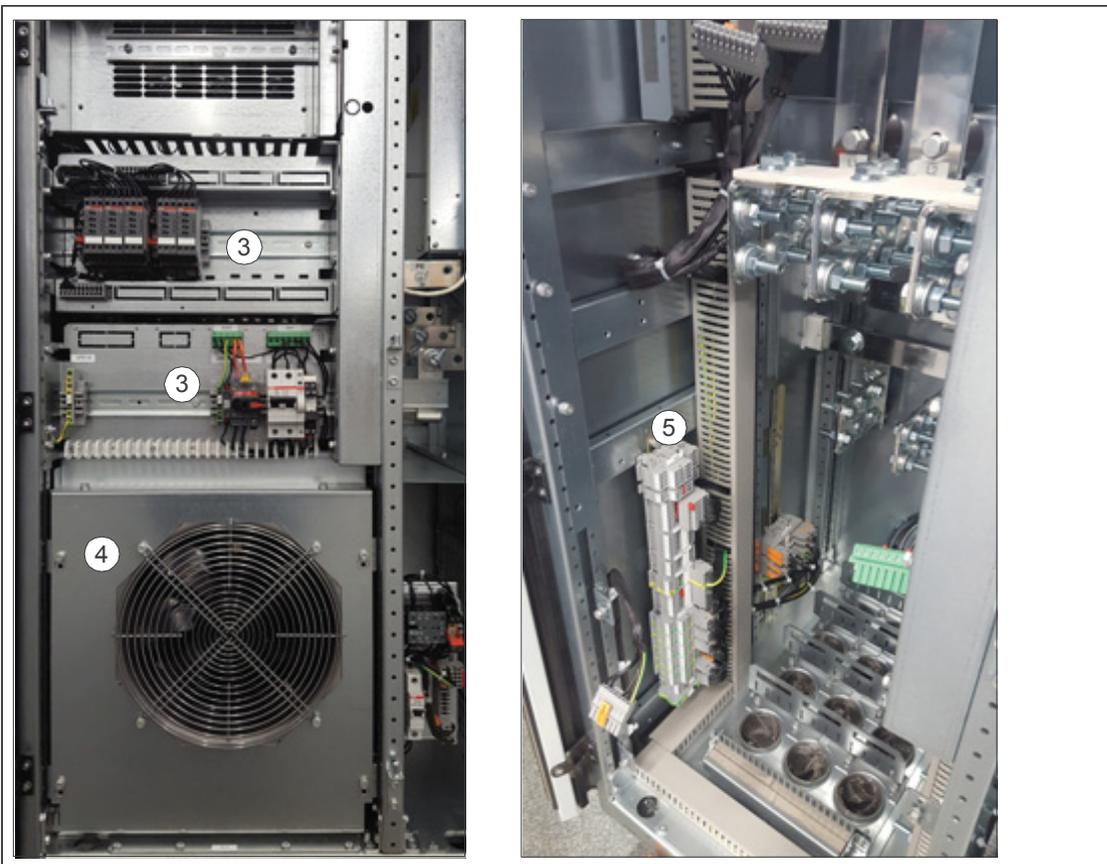


### Frame R11

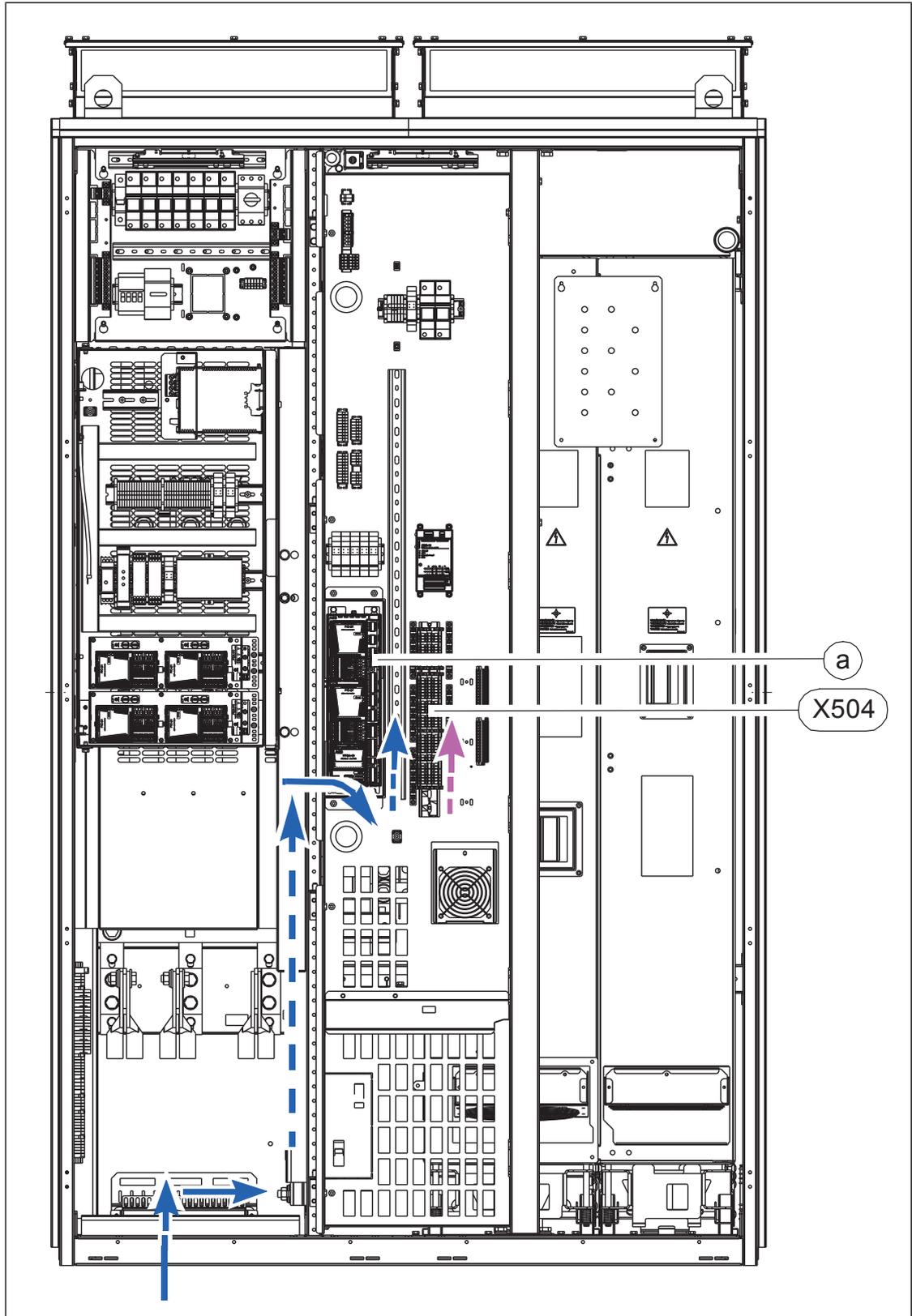
1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* before you start the work.
2. Open the cabinet door.
3. If there is a mounting plate/two plates above the "door fan", loosen the four screws of the plate and pull out the plate/s. Unplug the connectors and remove 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 158)*.

5. Bottom entry: Route the cables of these options to the connection terminals at the left-hand side of the cabinet as shown below.

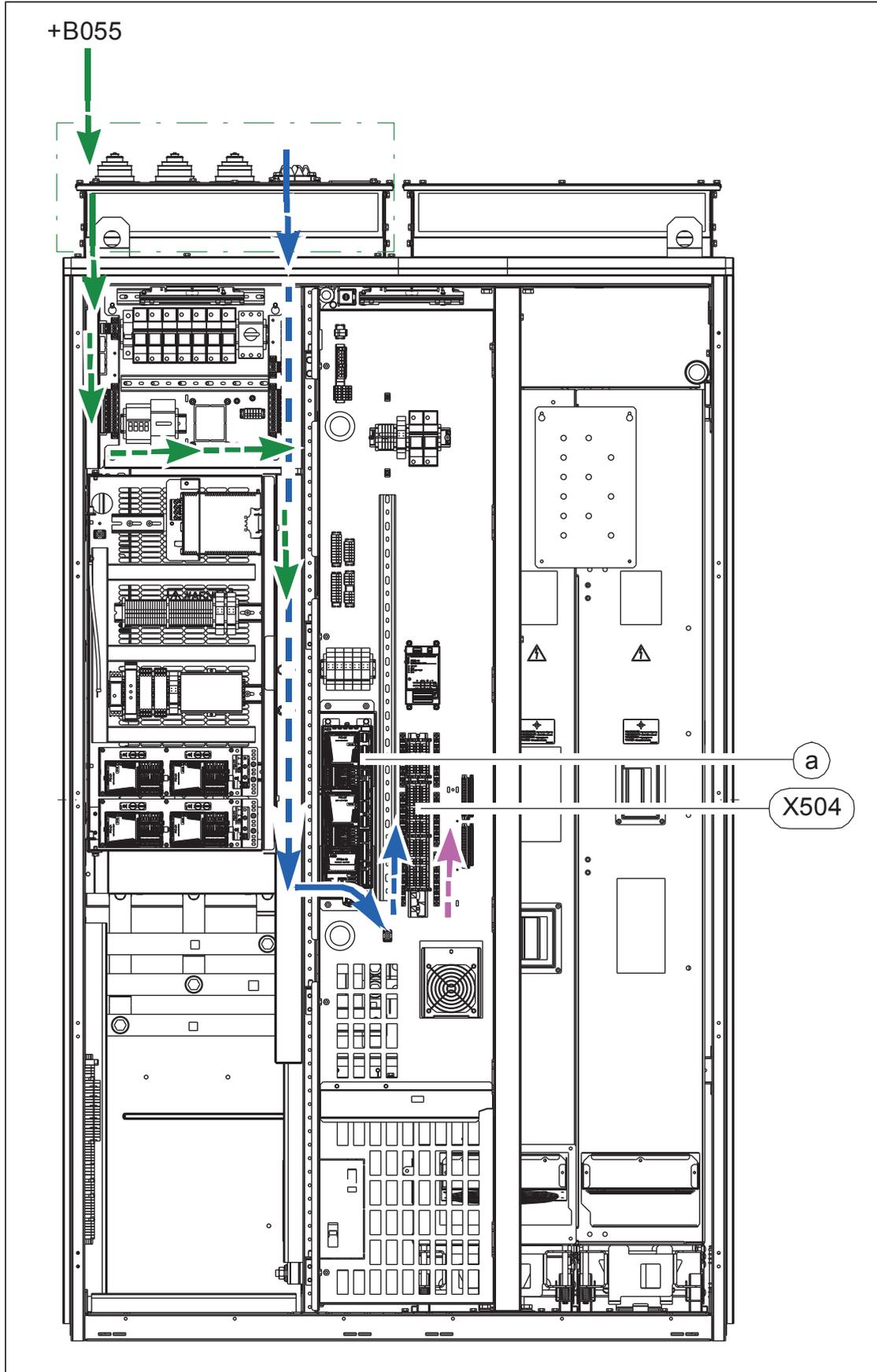
Terminal	Option
X250	Main switch and line contactor feedback for customer
X506	Thermistor relay or Pt100 relays (option +L505 or +L506)
X601	Starter for auxiliary motor fan (options +M600...+M605)
X951	Push buttons for emergency stop options +Q951, +Q952, +Q963 and +Q964
X954	Ground fault monitoring 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.



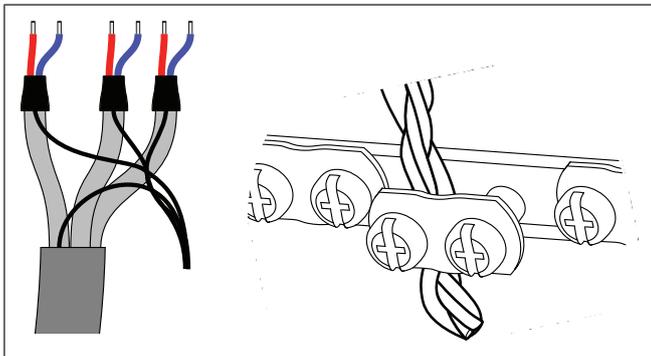
Top entry: Route the control cables to the control unit (a) and additional terminal block X504 (option +L504) as shown below (standard cabinet and option +B054 with blue color; option +B055 with green).



## ■ Connecting the external control cables to the drive control unit

See chapter *Control units of the drive* 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 optical 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



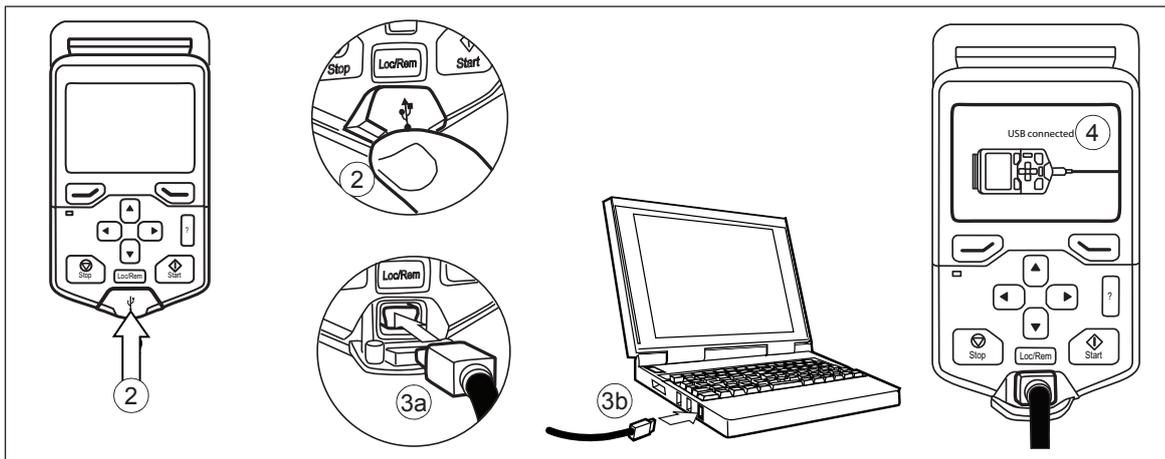
### WARNING!

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



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

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



## Installing option modules

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

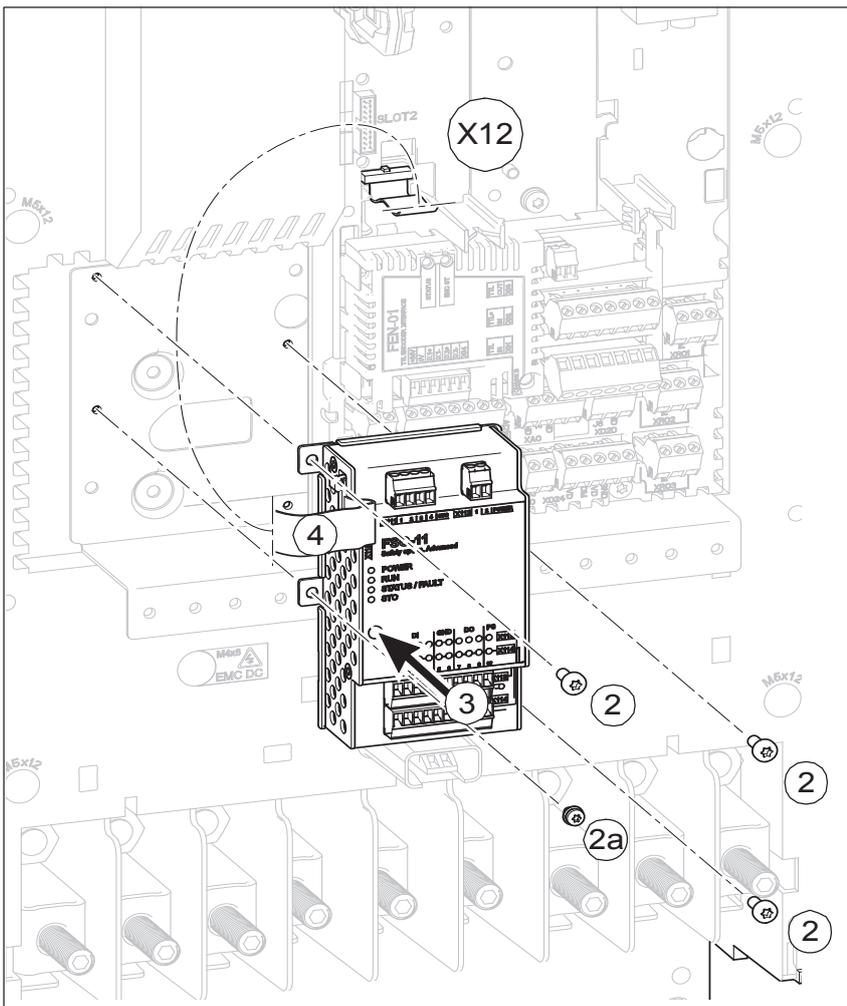
1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* before you start the work.
2. Insert the module carefully into its position on the control unit.
3. Tighten the mounting screw to **0.8 N·m**.

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

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* before you start the work.
2. Attach the FSO-xx safety functions module to the mounting plate with four screws.  
**Note:** Correct installation of the module enclosure grounding screw (2a) is essential for fulfilling the EMC requirements and for the correct operation of the module.
3. Tighten the grounding screw of the electronics to tightening torque of **0.8 N·m**.  
**Note:** The grounding screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and the correct operation of the module.
4. Connect the data communication cable to connector X110 on the module and to connector X12 on the drive control unit.
5. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.
6. Connect the external +24 V power supply cable to connector X112.
7. Connect the other wires as shown in the user's manual of the module.





■ Installation of an FSO-xx safety functions module onto ZCU-14

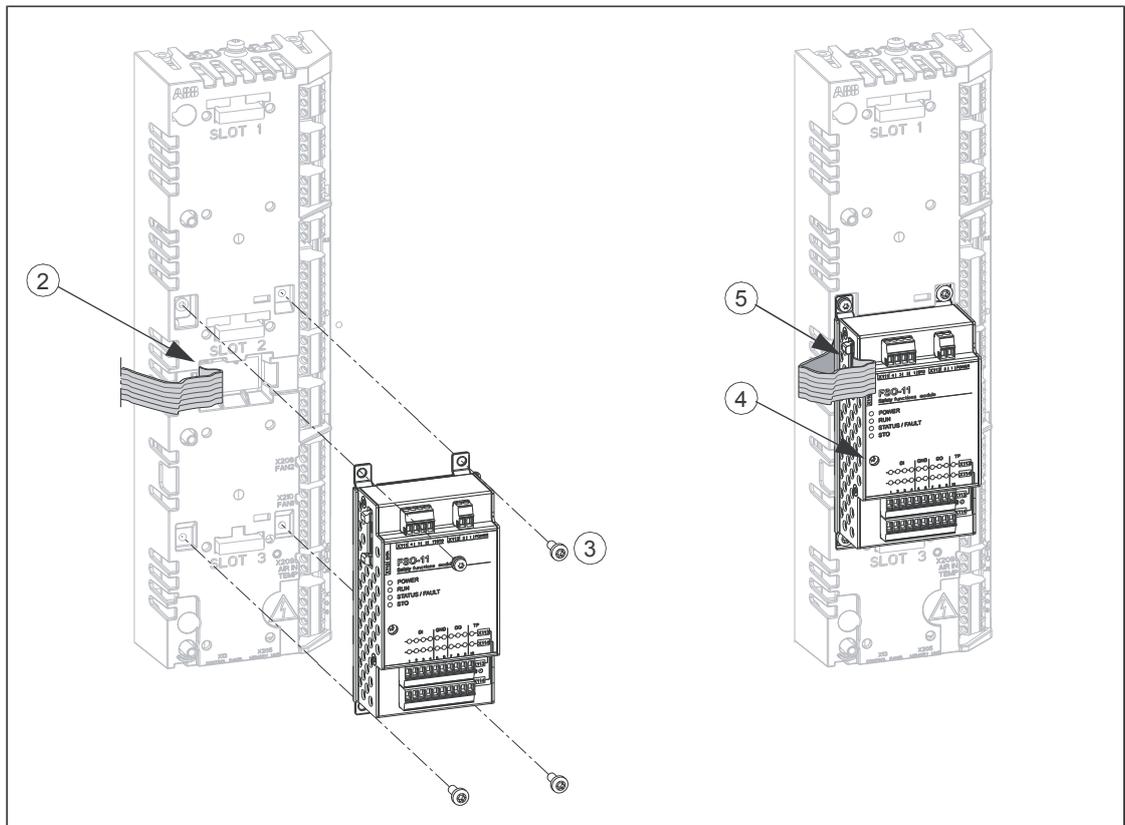


**WARNING!**

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* before you start the work.
2. The FSO-xx comes with alternative bottom plates for mounting on different units. For mounting on the ZCU-14, the mounting points should be located at the short edges of the module as shown. Replace the bottom plate of the FSO-xx if necessary. For mounting on the ZCU-12, the mounting points should be located at the long edges. Replace the bottom plate of the FSO-xx if necessary.
3. Connect the data cable to connector X12 on the control unit.
4. Put the FSO-xx into its position on slot 2 of the control unit.
5. Tighten the FSO-xx electronics grounding screw to tightening torque **0.8 N·m**.  
**Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.
6. Attach the module by the bottom plate with four screws.

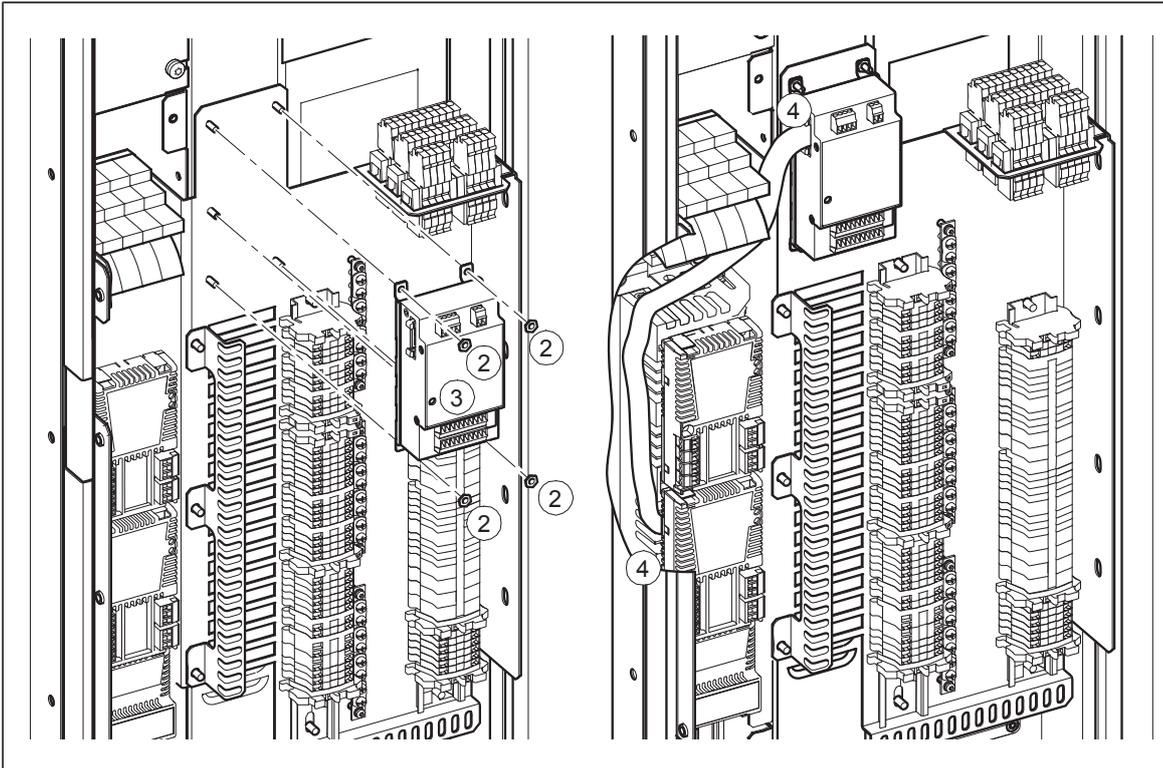
7. Connect the other end of the data cable to connector X110 on the FSO-xx.
8. To complete the installation, refer to the instructions in the user's manual delivered with the FSO-xx.



#### ■ Safety functions module FSO-xx beside the ZCU-14 control unit

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* before you start the work.
2. Attach the FSO-xx safety functions module to the mounting plate with four screws.
3. Tighten the mounting screw to **0.8 N·m**.  
**Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module
4. Connect the FSO-xx data cable to FSO-xx connector X110 and to connector X12 on the control unit.
5. To complete the installation, refer to the instructions in the user's manual delivered with the FSO-xx.





■ **Installation of an FSPS-21 safety functions module**

Install safety functions module FSPS-21 onto the drive control unit as described in its user's manual.





## Control units of the drive

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### Contents of this chapter

This chapter

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

### General

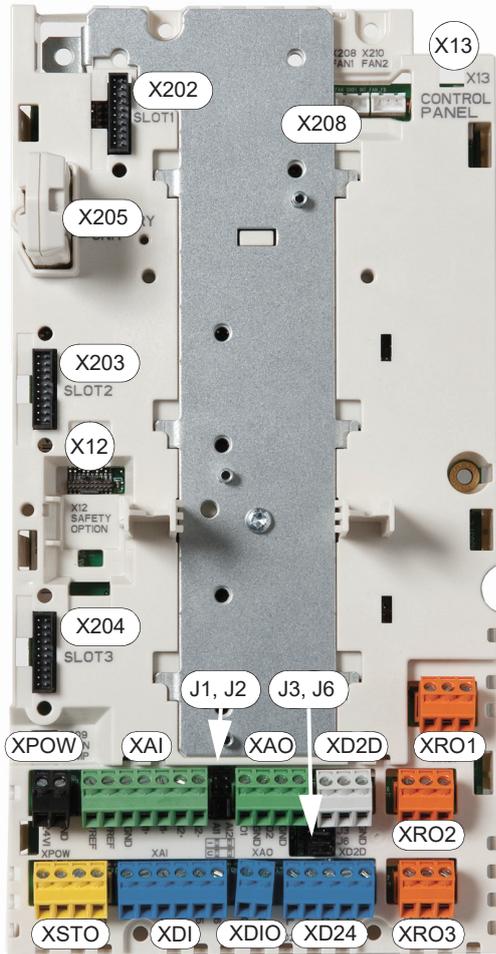
The drive utilizes ZCU-1x control units.

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.

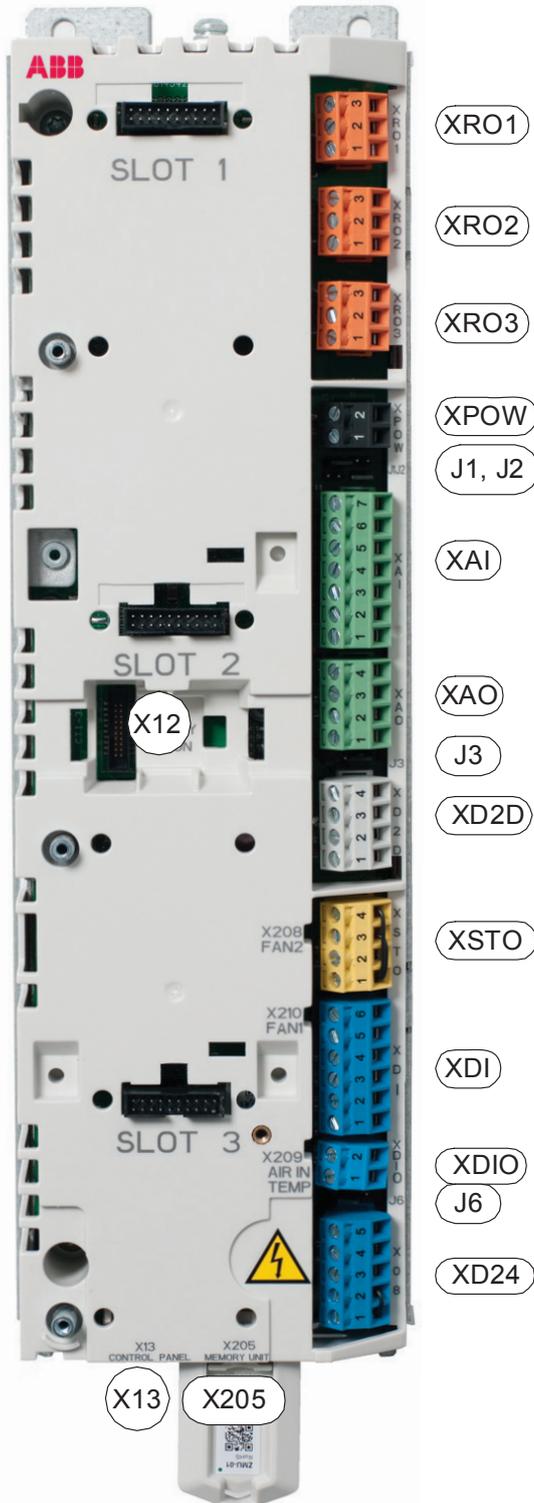
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## ZCU-12 layout



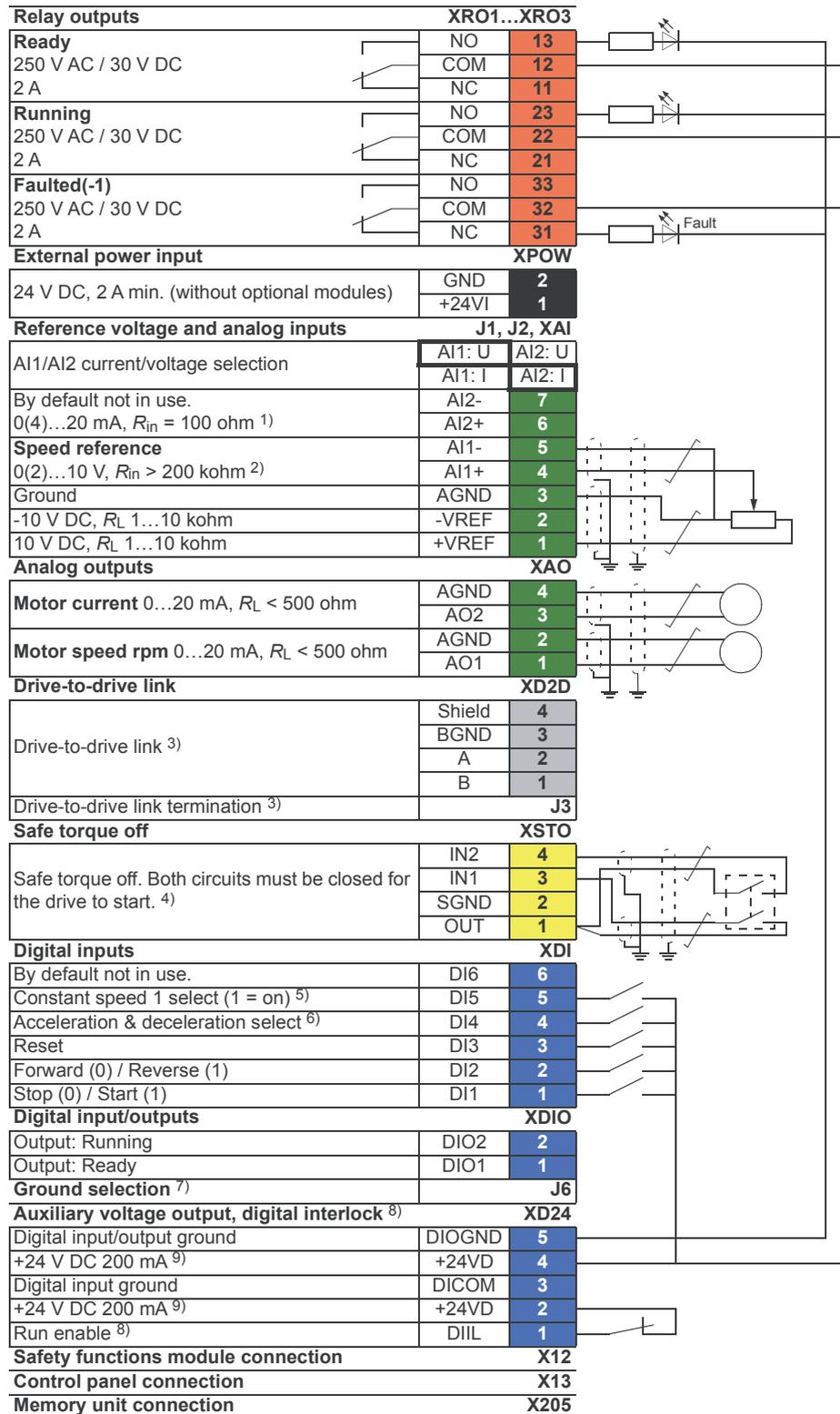
	Description
XAI	Analog inputs
XAO	Analog outputs
XDI	Digital inputs
XDIO	Digital input/outputs
XD24	Digital input interlock (DIIL) and +24 V output
XD2D	Drive-to-drive link
XPOW	External power input
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XSTO	Safe torque off connection
X12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

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



**Notes:**

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

- 1) Current [0(4)...20 mA,  $R_{in} = 100 \text{ ohm}$ ] or voltage [0(2)...10 V,  $R_{in} > 200 \text{ kohm}$ ] input selected by switch AI2. Change of setting requires reboot of control unit.
  - 2) Current [0(4)...20 mA,  $R_{in} = 100 \text{ ohm}$ ] or voltage [0(2)...10 V,  $R_{in} > 200 \text{ kohm}$ ] input selected by switch AI1. Change of setting requires reboot of control unit.
  - 3) See section [The XD2D connector \(page 139\)](#).
  - 4) See chapter [The Safe torque off function \(page 253\)](#).
  - 5) Constant speed 1 is defined by parameter 22.26.
  - 6) 0 = Acceleration/deceleration ramps defined by parameters 23.12/23.13 in use. 1 = Acceleration/deceleration ramps defined by parameters 23.14/23.15 in use.
  - 7) Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats; in practice, selects whether the digital inputs are used in current sinking or sourcing mode). See also [ZCU-1x ground isolation diagram \(page 143\)](#). DICOM=DIOGND ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.
  - 8) See section [DIIL input \(page 139\)](#).
  - 9) Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.
-

## Additional information on the connections

### ■ External power supply for the control unit (XPOW)

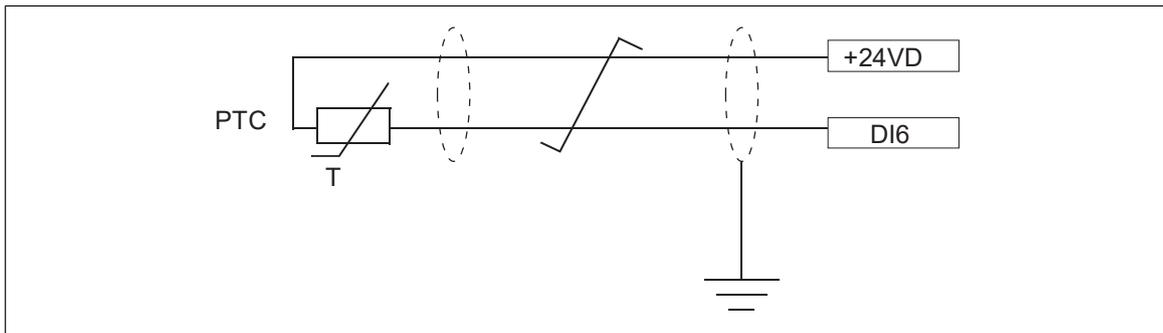
The control unit is powered from a 24 V DC, 2 A supply through terminal block XPOW.

Using an external supply is recommended if

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

### ■ DI6 as a PTC sensor input

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

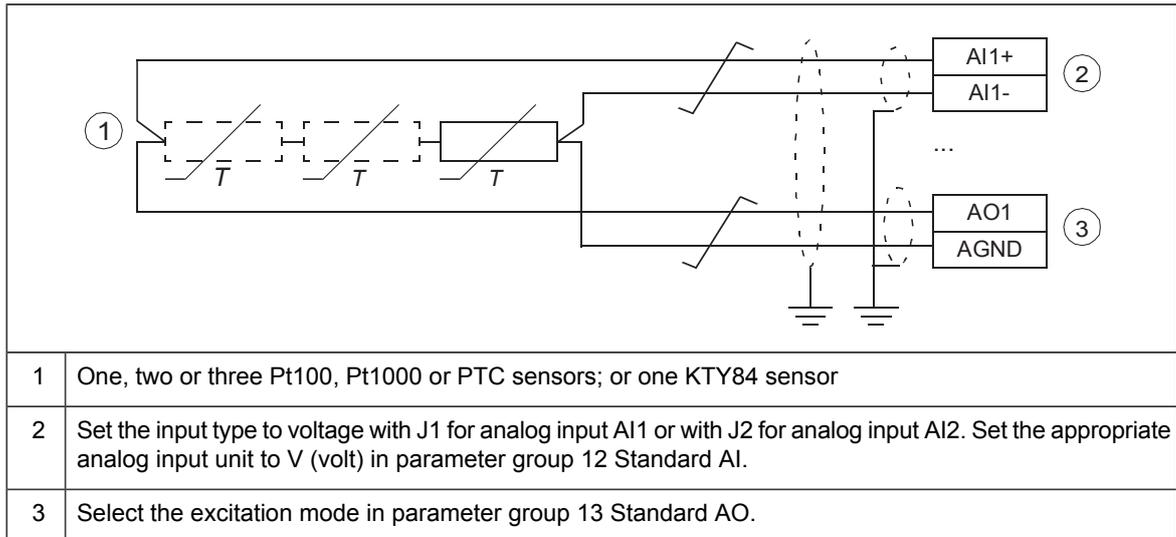


#### **WARNING!**

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

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

Sensors for motor temperature measurement can be connected between an analog input and output, an example connection is shown below. (Alternatively, you can connect the KTY to an FIO-11 or FAIO-01 analog I/O extension module or FEN-xx encoder interface module.) At the sensor end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, for example 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.



1) Set the input type to voltage with the appropriate switch or jumper on the inverter control unit. Make the corresponding setting in the inverter unit control program in parameter group **12 Standard AI**.

2) Select the excitation mode in parameter group **13 Standard AO** of inverter unit control program.



#### WARNING!

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

### ■ DIIL input

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

**Note:** This input is NOT SIL or PI certified.

### ■ The XD2D connector

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

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

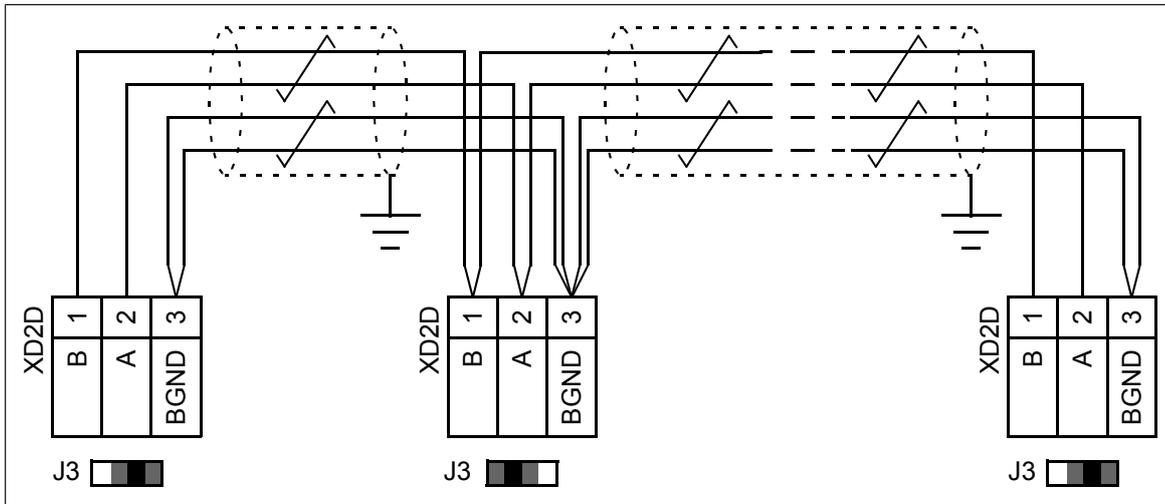
See the firmware manual of the drive for the related parameter settings.

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

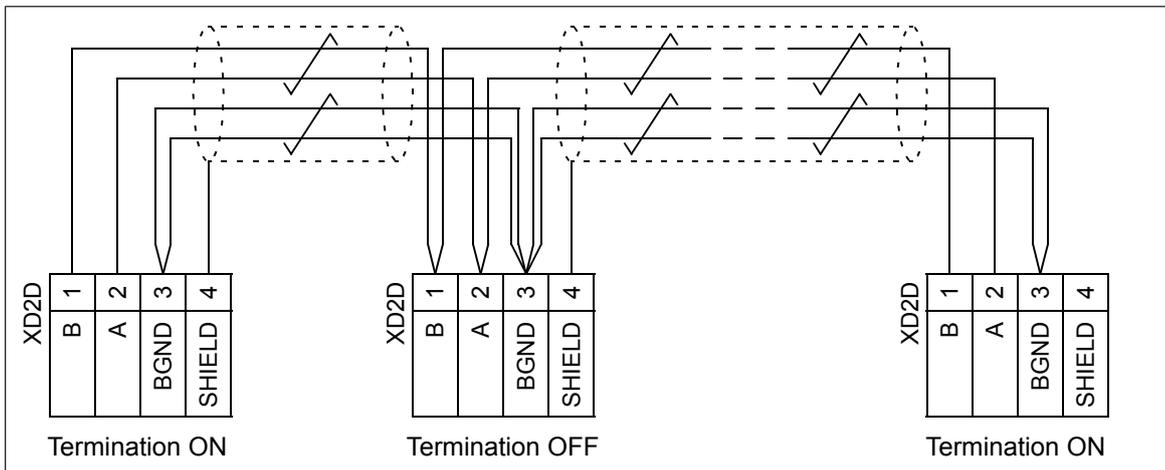
Use shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 to 165 ohm, for example Belden 9842) for the wiring. For best immunity, ABB recommends high quality cable. Keep the cable as short as possible. Avoid unnecessary loops and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

The following diagram shows the wiring between control units.

**ZCU-12**



**ZCU-14**



■ **Safe torque off (XSTO)**

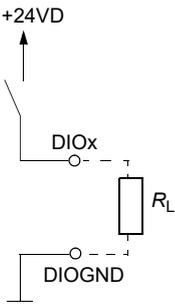
See chapter *The Safe torque off function (page 253)*.

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

■ **FSO-xx safety functions module connection (X12)**

See the user manual of the FSO-xx module. Note that the FSO-xx safety functions module is not in use in supply, DC/DC converter or brake units.

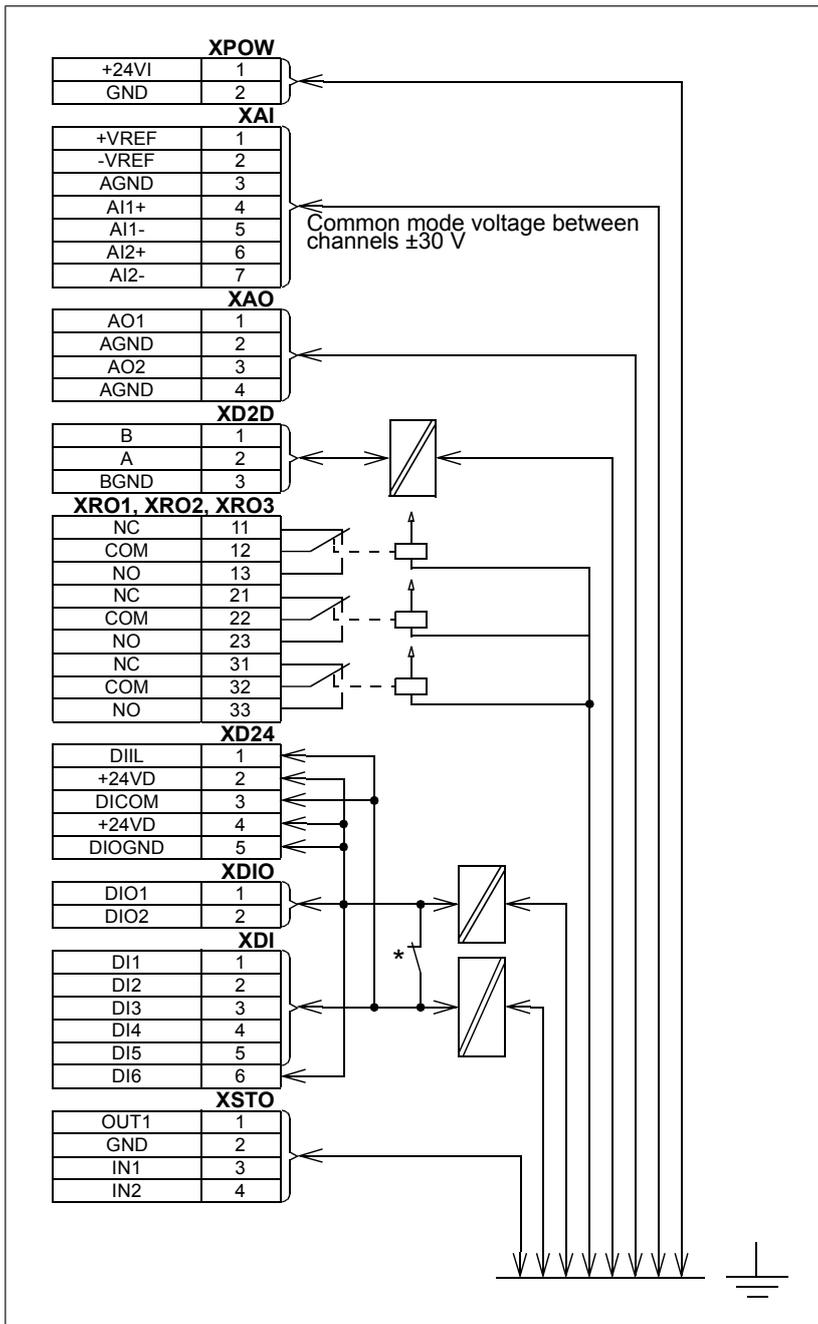
## Connector data

Power supply (XPOW)	Connector pitch 5 mm, wire size 2.5 mm <sup>2</sup> 24 V ( $\pm 10\%$ ) DC, 2 A External power input.
Relay outputs RO1...RO3 (XRO1...XRO3)	Connector pitch 5 mm, wire size 2.5 mm <sup>2</sup> 250 V AC / 30 V DC, 2 A Protected by varistors
+24 V output (XD24:2 and XD24:4)	Connector pitch 5 mm, wire size 2.5 mm <sup>2</sup> Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
Digital inputs DI1...DI6 (XDI:1...XDI:6)	Connector pitch 5 mm, wire size 2.5 mm <sup>2</sup> 24 V logic levels: "0" < 5 V, "1" > 15 V $R_{in}$ : 2.0 kohm Input type: NPN/PNP (DI1...DI5), NPN (DI6) Hardware filtering: 0.04 ms, digital filtering up to 8 ms DI6 (XDI:6) can alternatively be used as an input for a PTC sensor. "0" > 4 kohm, "1" < 1.5 kohm. $I_{max}$ : 15 mA (DI1...DI5), 5 mA (DI6)
Start interlock input DIIL (XD24:1)	Connector pitch 5 mm, wire size 2.5 mm <sup>2</sup> 24 V logic levels: "0" < 5 V, "1" > 15 V $R_{in}$ : 2.0 kohm Input type: NPN/PNP Hardware filtering: 0.04 ms, digital filtering up to 8 ms
Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2) Input/output mode selection by parameters. DIO1 can be configured as a frequency input (0...16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual, parameter group 111/11.	Connector pitch 5 mm, wire size 2.5 mm <sup>2</sup> <u>As inputs:</u> 24 V logic levels: "0" < 5 V, "1" > 15 V. $R_{in}$ : 2.0 kohm. Filtering: 1 ms. <u>As outputs:</u> Total output current from +24VD is limited to 200 mA 
Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)	Connector pitch 5 mm, wire size 2.5 mm <sup>2</sup> 10 V $\pm 1\%$ and -10 V $\pm 1\%$ , $R_{load}$ 1...10 kohm Maximum output current: 10 mA
Analog inputs AI1 and AI2 (XAI:4 ... XAI:7). Current/voltage input mode selection by jumpers	Connector pitch 5 mm, wire size 2.5 mm <sup>2</sup> Current input: -20...20 mA, $R_{in}$ = 100 ohm Voltage input: -10...10 V, $R_{in}$ > 200 kohm Differential inputs, common mode range $\pm 30$ V Sampling interval per channel: 0.25 ms Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range

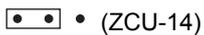
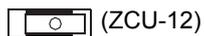
142 Control units of the drive

Analog outputs AO1 and AO2 (XAO)	<p>Connector pitch 5 mm, wire size 2.5 mm<sup>2</sup>          0...20 mA, <math>R_{load} &lt; 500</math> ohm          Frequency range: 0...300 Hz          Resolution: 11 bit + sign bit          Inaccuracy: 2% of full scale range</p>
XD2D connector	<p>Connector pitch 5 mm, wire size 2.5 mm<sup>2</sup>          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</p>
Safe torque off connection (XSTO)	<p>Connector pitch 5 mm, wire size 2.5 mm<sup>2</sup>          Input voltage range: -3...30 V DC          Logic levels: "0" &lt; 5 V, "1" &gt; 17 V.  <b>Note:</b> For the unit to start, both connections must be "1". This applies to all control units (including drive, inverter, supply, brake, DC/DC converter etc. control units), but true Safe torque off functionality is only achieved through the XSTO connector of the drive/inverter control unit.          EMC (immunity) according to IEC 61326-3-1</p>
Control panel connection (X13)	<p>Connector: RJ-45          Cable length &lt; 3 m</p>
<p>The terminals of the control unit fulfill the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if a voltage higher than 48 V is connected to the relay output.</p>	

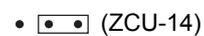
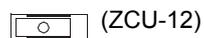
■ ZCU-1x ground isolation diagram



\* Ground selector (J6) settings



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



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

Isolation voltage 50 V.



## 8

# Installation checklist of the drive

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## Contents of this chapter

This chapter contains a checklist of 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 or maintenance work.



### WARNING!

Stop the drive and do the steps in section [Electrical safety precautions \(page 17\)](#) before you start the work.

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

146 Installation checklist of the drive

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

# 9

## Start-up

---

### Contents of this chapter

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

### Start-up procedure

The tasks which are needed in certain cases only are marked with underlining, and option codes are given in brackets. Default device designations (if any) are given in brackets after the name, for example “main switch-disconnector (Q1)”. The same device designations are 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 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. See the listing of manuals inside the front cover.

---



<b>Action</b>	<input checked="" type="checkbox"/>
<b>Safety</b>	
 <b>WARNING!</b> Obey the safety instructions during the start-up procedure. See chapter <i>Safety instructions</i> (page 15).	<input type="checkbox"/>
<b>Checks/Settings with no voltage connected</b>	
Ensure that the disconnecter of the supply transformer is locked to the off (0) position, ie. no voltage is, and cannot be connected to the drive inadvertently.	<input type="checkbox"/>
Check that the switch fuse (frame R8) (Q1) or main switch-disconnector (frame R11) (Q1) is switched off.	<input type="checkbox"/>
Check the mechanical and electrical installation of the drive. See <i>Installation checklist of the drive</i> (page 145).	<input type="checkbox"/>
Check the settings of breakers/switches in the auxiliary circuits. See the circuit diagrams delivered with the drive.	<input type="checkbox"/>
Check the tap settings of transformers T21 (standard) and T101, T111 (if present). See <i>Settings the voltage range of auxiliary voltage transformers</i> (page 109).	<input type="checkbox"/>
Disconnect any unfinished or uninspected auxiliary voltage (115/230 V AC) cables that lead from the terminal blocks to the outside of the equipment.	<input type="checkbox"/>
Check that both channels of the Safe torque off circuit connected to the STO inputs of drive control unit are closed. Refer to the wiring diagrams delivered with the drive.	<input type="checkbox"/>
<p>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.</p> <p>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.</p>	<input type="checkbox"/>
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 <i>IRDH275B Ground Fault Monitor Operating Manual</i> by Bender (code: TGH1386en).	<input type="checkbox"/>
<p>For drives with Pt100 relays (option +(n)L506):</p> <ul style="list-style-type: none"> <li>• Check the connections against the circuit diagrams of the delivery.</li> <li>• Set the alarm and trip levels of the Pt100 relays.</li> </ul> <p>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.</p> <p>We recommend to set the operating temperatures of the relay, typically for example, as follows:</p> <ul style="list-style-type: none"> <li>• 120...140 °C when only tripping is in use</li> <li>• alarm 120...140 °C and trip 130...150 °C when both alarm and tripping are used.</li> </ul>	<input type="checkbox"/>
<b>Powering up the auxiliary circuit of the drive</b>	
<p>Make sure that it is safe to connect voltage. Ensure that</p> <ul style="list-style-type: none"> <li>• nobody is working on the drive or circuits that have been wired from outside into the drive cabinet</li> <li>• the cover of the motor terminal box is in place.</li> </ul>	<input type="checkbox"/>
<u>Drives with a voltmeter (option +G334):</u> Make sure that the circuit breaker of the measuring circuit (F5) is closed.	<input type="checkbox"/>
Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits.	<input type="checkbox"/>
Close the cabinet doors.	<input type="checkbox"/>
Close the main breaker of the supply transformer.	<input type="checkbox"/>
Close the switch fuse (frame R8) (Q1) or main switch-disconnector (frame R11) (Q1). This will power up the main circuit of the drive as well as the auxiliary voltage circuit.	<input type="checkbox"/>
<b>Note:</b> Do not use excessive force. The switch fuse (frame R8) or main switch-disconnector (frame R11) can only be closed when the main input terminals (L1, L2, L3) are powered.	



<b>Action</b>	<input checked="" type="checkbox"/>
<b>Setting up the line-side converter parameters</b>	
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 <i>ACS880 primary control program firmware manual</i> (3AUA0000085967 [English]) or <i>ACS880 IGBT supply control program firmware manual</i> (3AUA0000131562 [English]).	<input type="checkbox"/>
<b>Setting up the motor-side converter parameters, and performing the first start</b>	
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 <i>ACx-AP-x assistant control panels user's manual</i> (3AUA0000085685 [English]).	<input type="checkbox"/>
<u>For drives with a sine output filter (option +E206):</u> Check that parameter 95.15, bit 1 has been activated.	<input type="checkbox"/>
<u>For drives with a fieldbus adapter module (optional):</u> Set the fieldbus parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the fieldbus adapter module, and the drive firmware manual. Check that the communication works between the drive and the PLC.	<input type="checkbox"/>
<u>For drives with an encoder interface module (optional):</u> Set the encoder parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the encoder interface module, and the drive firmware manual.	<input type="checkbox"/>
<b>Activating the Run enable signal of the line-side converter (with options +Q951,+Q952 and +Q978)</b>	
Turn the operating switch (S21) to the ON (1) position to activate the run enable signal for the lineside converter.	<input type="checkbox"/>
<b>On-load checks</b>	
Start the motor to perform the ID run.	<input type="checkbox"/>
Check that the cooling fans rotate freely in the right direction, and the air flows upwards. A paper sheet set on the intake (door) gratings stays. The fans run noiselessly.	<input type="checkbox"/>
Check that the motor starts, stops and follows the speed reference in the correct direction when controlled with the control panel.	<input type="checkbox"/>
Check that the motor starts, stops and follows the speed reference in the correct direction when controlled through the customer-specific I/O or fieldbus.	<input type="checkbox"/>
<u>Drives in which the Safe torque off control circuit is in use:</u> Test and validate the operation of the Safe torque off function. See section <i>Start-up including acceptance test (page 260)</i> .	<input type="checkbox"/>
<u>Drives with functional safety options +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q978, +Q979:</u> Refer to the respective manuals of the safety option for option-specific start-up instructions.	<input type="checkbox"/>





# 10

## Fault tracing

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

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# 11

## Maintenance

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### Contents of this chapter

This chapter contains preventive maintenance instructions.

### Maintenance intervals

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

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

Recommended annual actions by user	Tasks
<b>Connections and environment</b>	
IP54 air filters on the cabinet doors	R
Quality of supply voltage	P
<b>Spare parts</b>	
Spare parts	I
DC circuit capacitors reforming for spare modules and spare capacitors	P
<b>Inspections by user</b>	
IP22 and IP42 air inlet and outlet meshes on the cabinet doors	I
Tightness of terminals	I
Dustiness, corrosion and temperature	I

---

Recommended annual actions by user	Tasks
Cleaning of heatsinks	I
<b>Other</b>	
ABB-SACE air circuit breaker maintenance	I
4FPS10000239703	

Cooling	Years from start-up							
	3	6	9	12	15	18	21	...
<b>Main cooling fan</b>								
Main cooling fan (R8) LONGLIFE			R			R		
Main cooling fan (R11)			R			R		
<b>Auxiliary cooling fan</b>								
Auxiliary cooling fan for circuit boards (R8) LONGLIFE			R			R		
Circuit board compartment cooling fans (R11) LONGLIFE			R			R		
<b>Cabinet cooling fan</b>								
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		
<b>xSIN filter cooling fan</b>								
Filter cooling fan LONGLIFE			R			R		
<b>Aging</b>								
ZCU control unit battery (real-time clock)		R		R		R		
Control panel battery (real-time clock)			R			R		
4FPS10000239703								

## Legend:

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

**Note:**

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

## Cabinet

### ■ Cleaning the interior of the cabinet



#### **WARNING!**

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

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



#### **WARNING!**

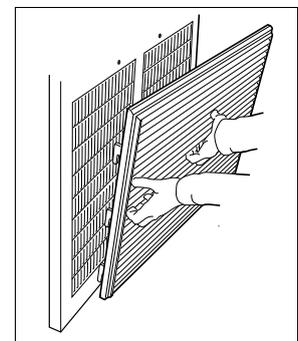
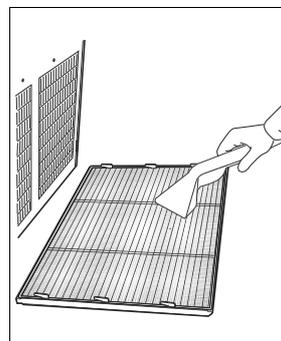
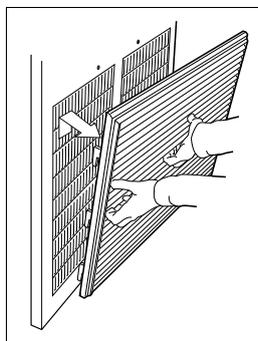
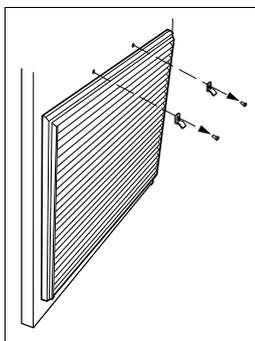
Use a vacuum cleaner with antistatic hose and nozzle, and wear a grounding wristband. Using a normal vacuum cleaner creates static discharges which can damage circuit boards.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* 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 door air inlets (IP22 and IP42)

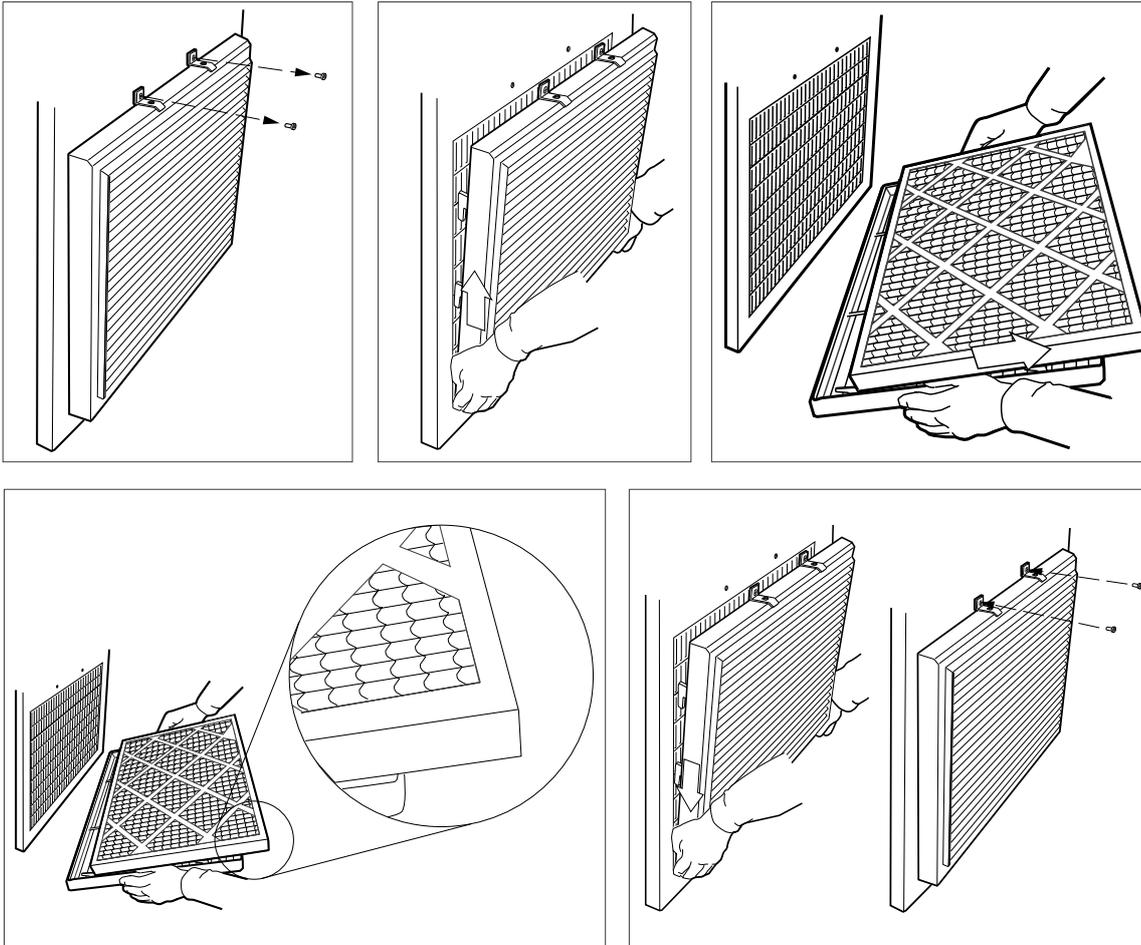
Check the dustiness of the air inlet meshes. If the dust cannot be removed by vacuum cleaning from outside through the grating holes with a small nozzle, proceed as follows:

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* 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 17)* before you start the work.
2. Remove the fasteners at the top of the grating.
3. Lift the grating and pull it away from the door.
4. Remove the air filter mat.
5. Place the new filter mat in the grating the metal wire side facing the door.
6. Reinstall the grating in reverse order.



■ **Cleaning the roof outlet filters (IP54)**

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

■ **Replacing the outlet (roof) filters (IP54)**

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

## Cleaning the heatsink

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



### WARNING!

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

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

---



### WARNING!

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

---

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* before you start the work.
2. Remove the drive module from the cabinet.
3. Remove the module cooling fan(s). See the separate instructions.
4. Blow dry, clean and oil-free compressed air from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust. If there is a risk of dust entering adjoining equipment, do the cleaning in another room.
5. Reinstall the cooling fan.

## Power connections

### ■ Retightening the power connections



### WARNING!

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

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

---

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* before you start the work.
2. Examine the tightness of the cable connections. Use the tightening torques given in the technical data.

## Fans

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

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

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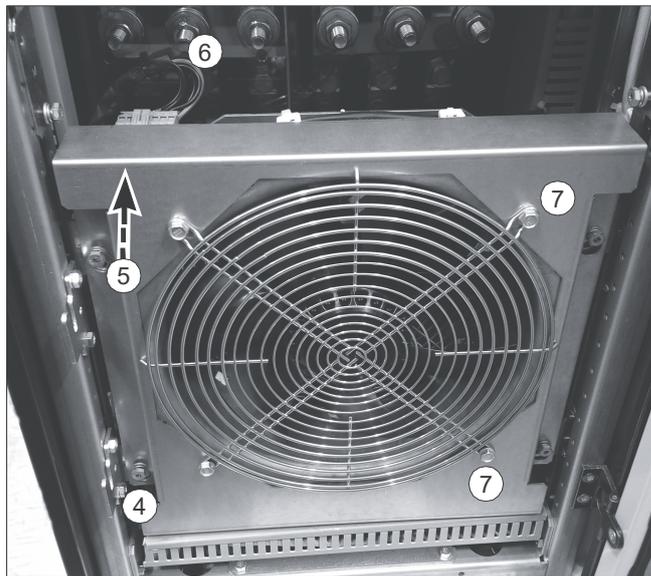
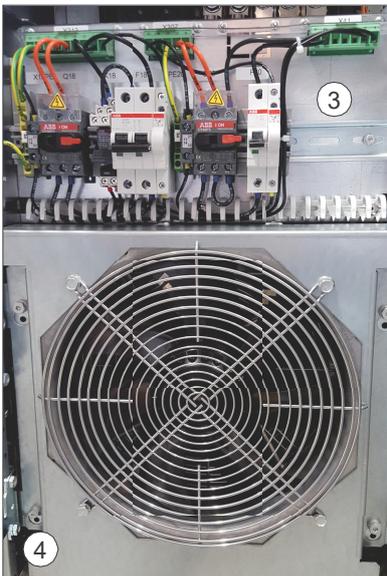
## ■ Replacing the cabinet “door fan”



### 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 17)* 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 180)*.
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.



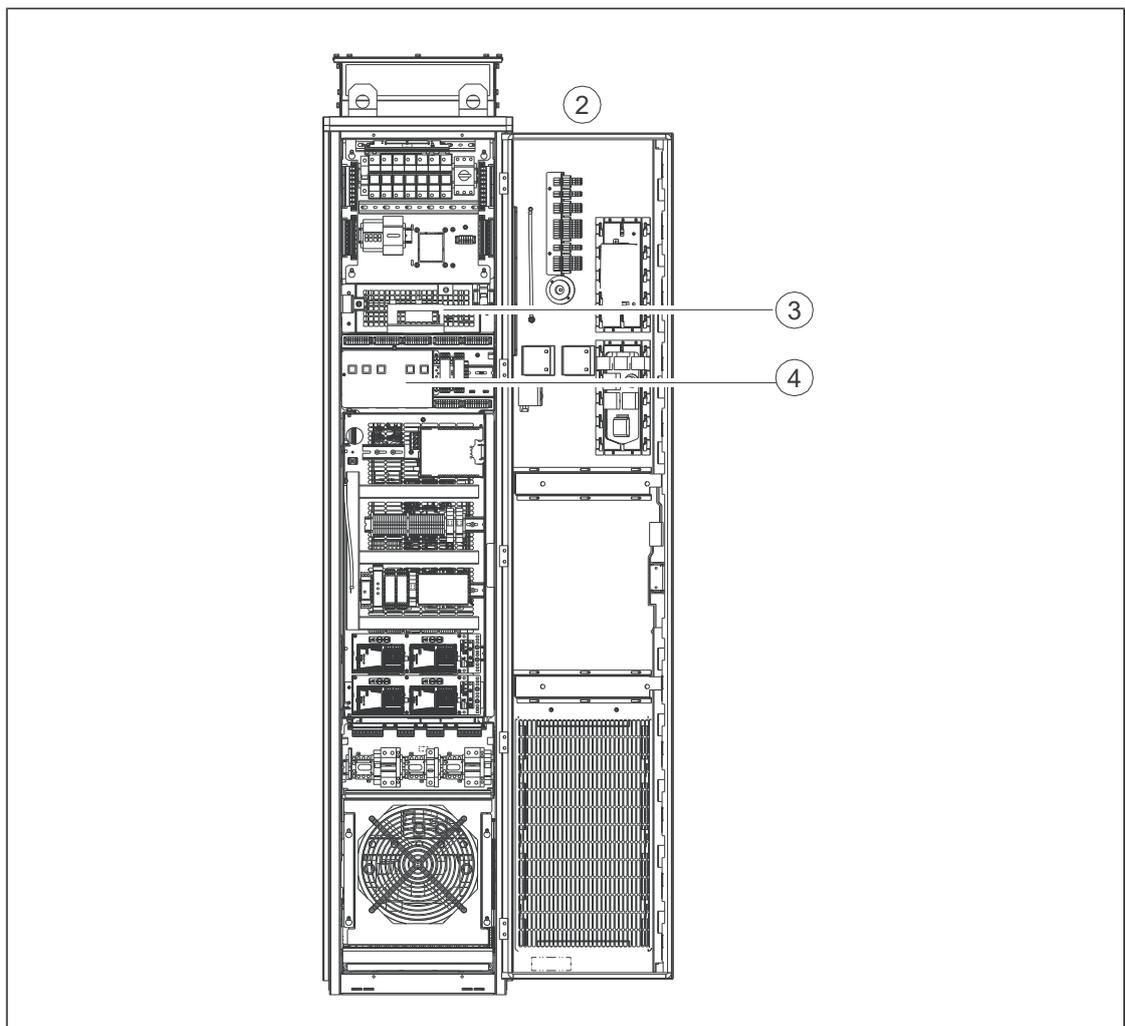
## ■ Replacing the internal cabinet cooling fans (frame R8)

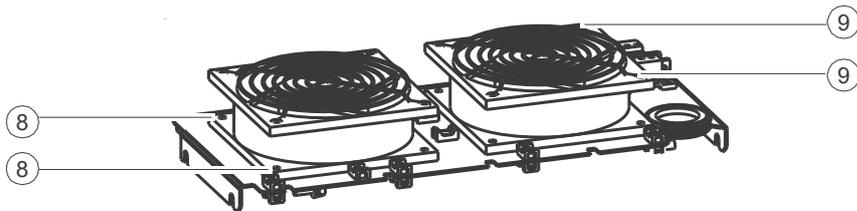
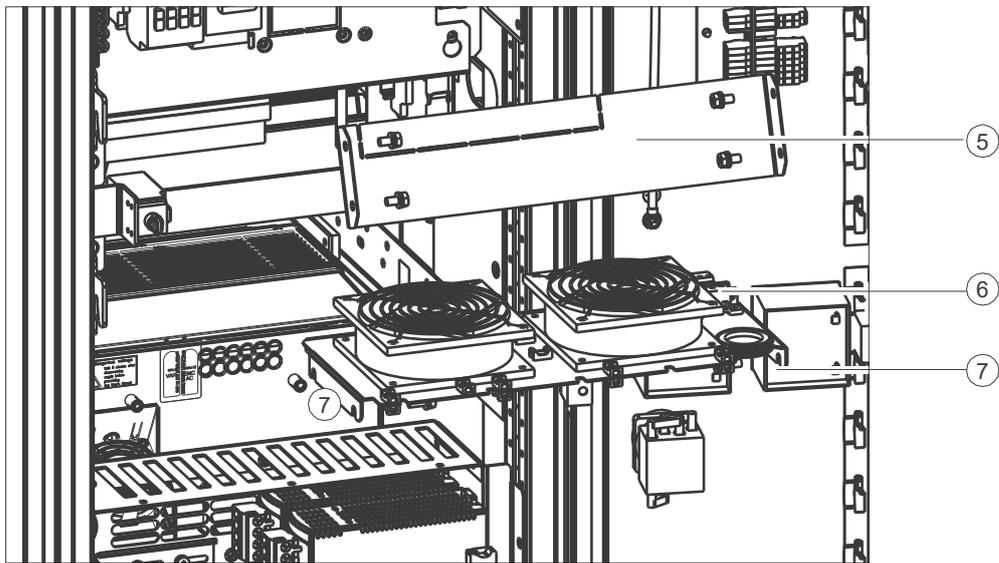
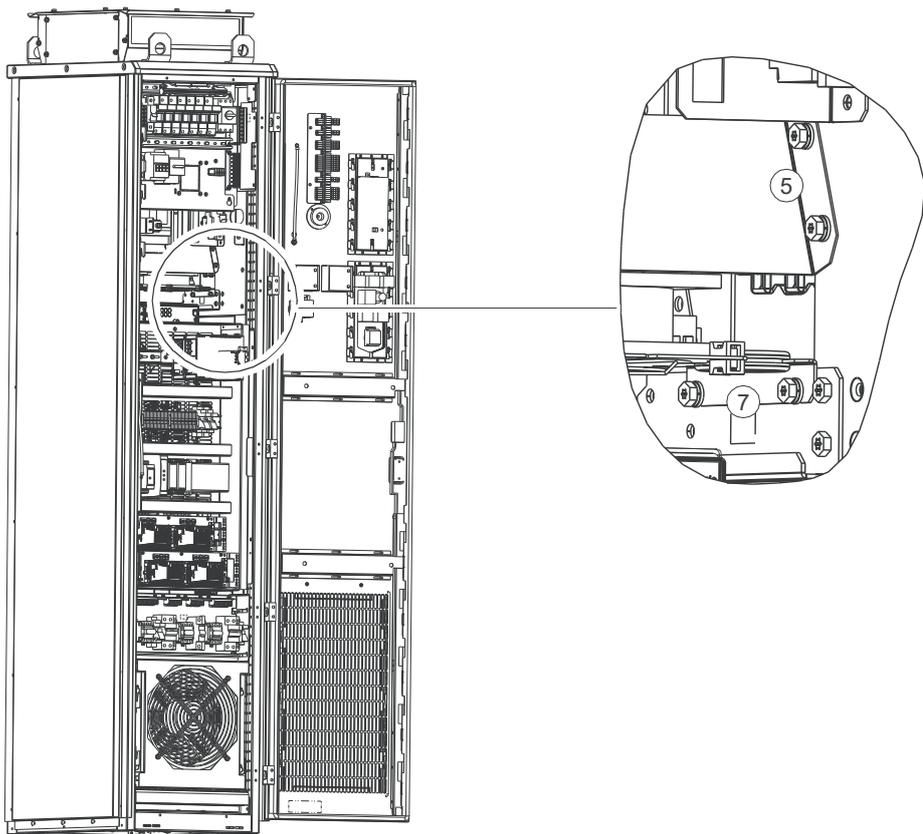


### WARNING!

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 17)* 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.





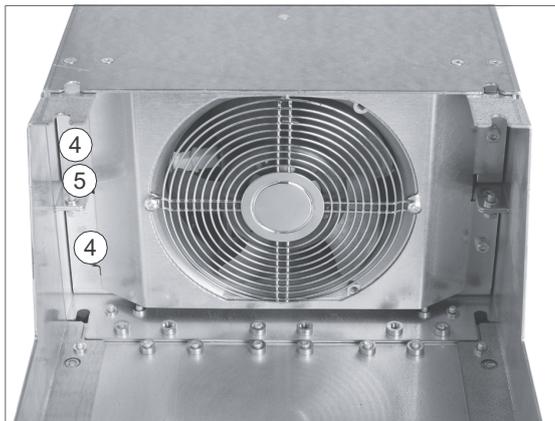
## ■ Replacing the drive module main fan (frame R8)



### 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 17)* 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 171)*.
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)



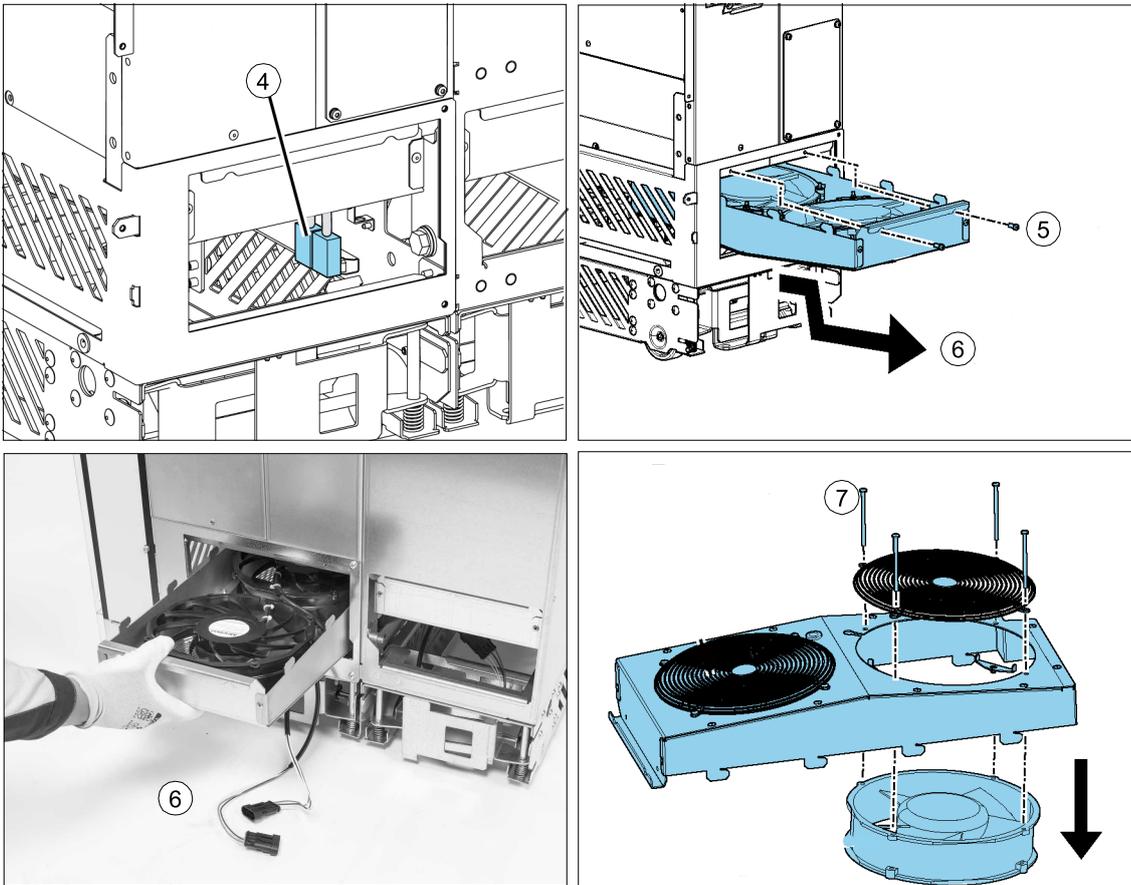
### WARNING!

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 17)* 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 180)*.
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 180)*.
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.



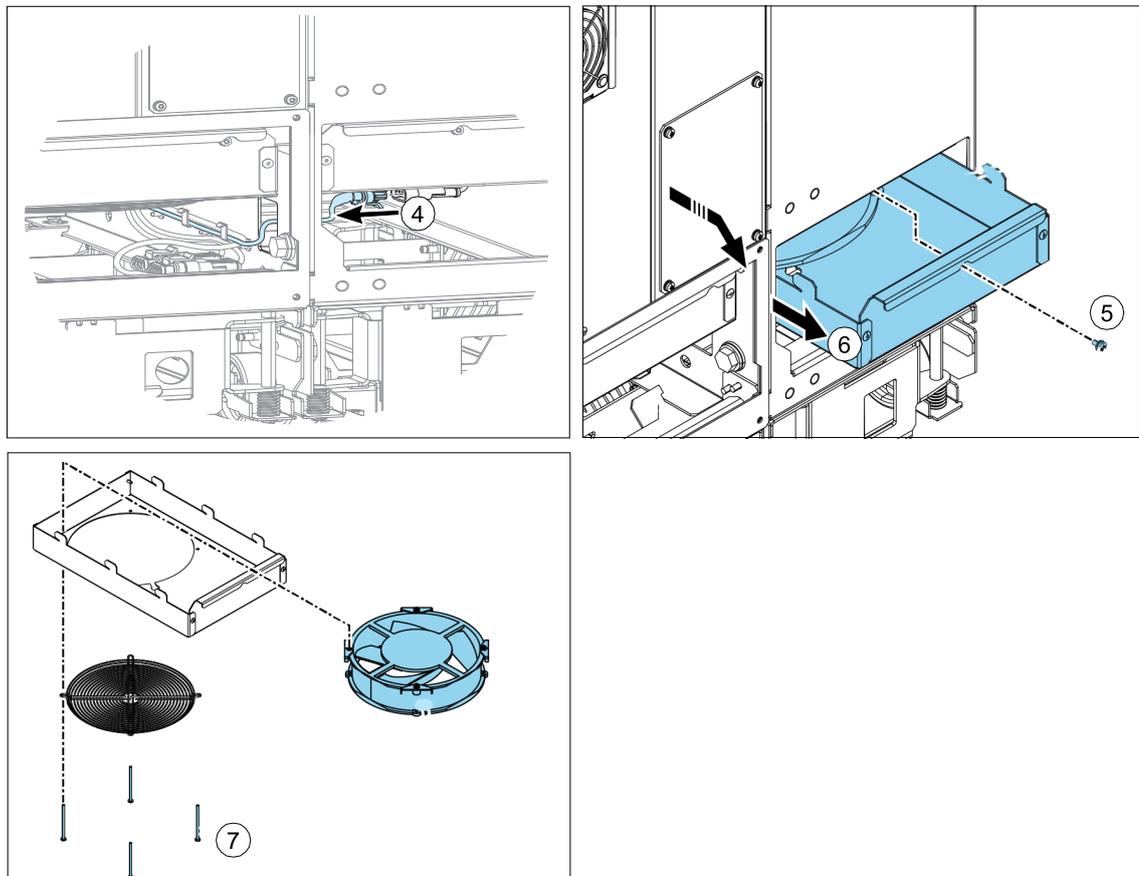
## ■ Replacing the LCL filter module fan (frame R11)



### WARNING!

Obeys 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 17)* 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 180)*.
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 180)*.
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.



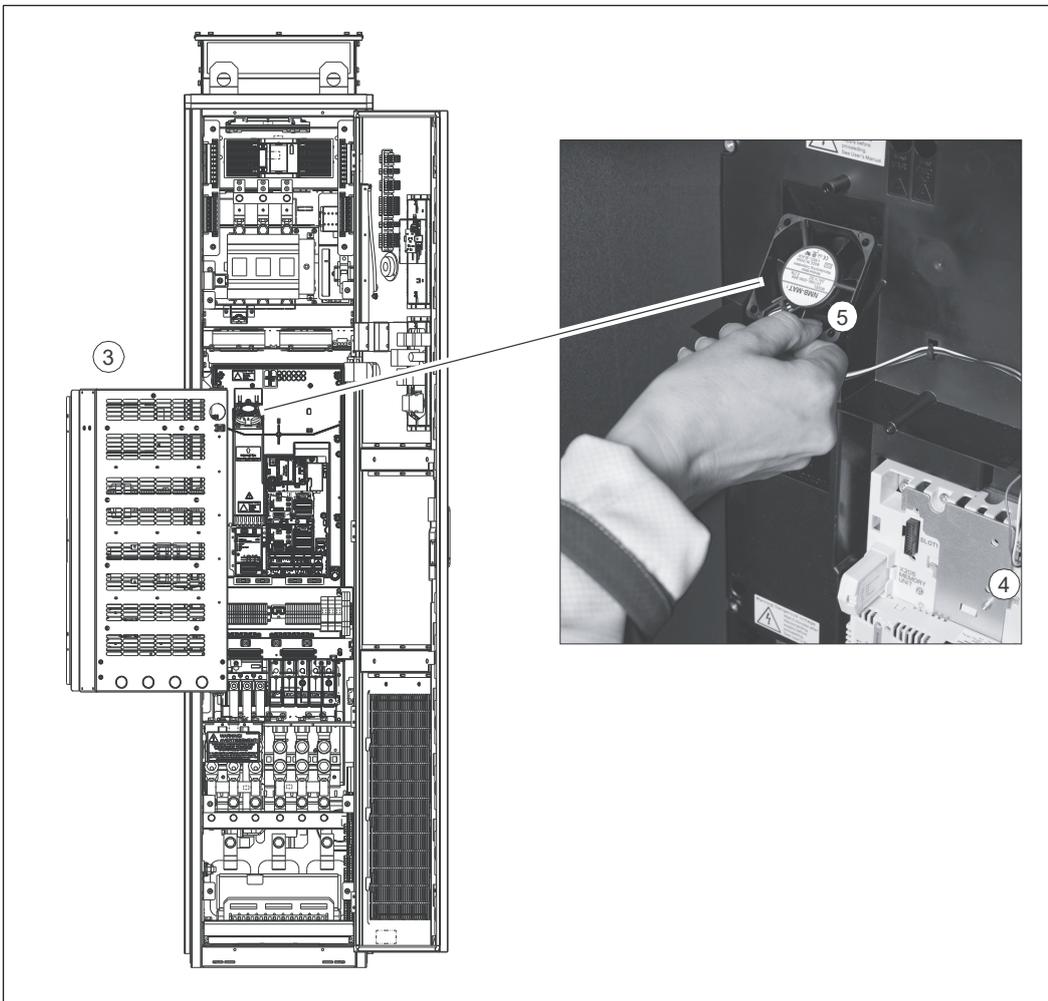
## ■ Replacing the auxiliary cooling fan of the drive module (frame R8)



### 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 17)* 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)

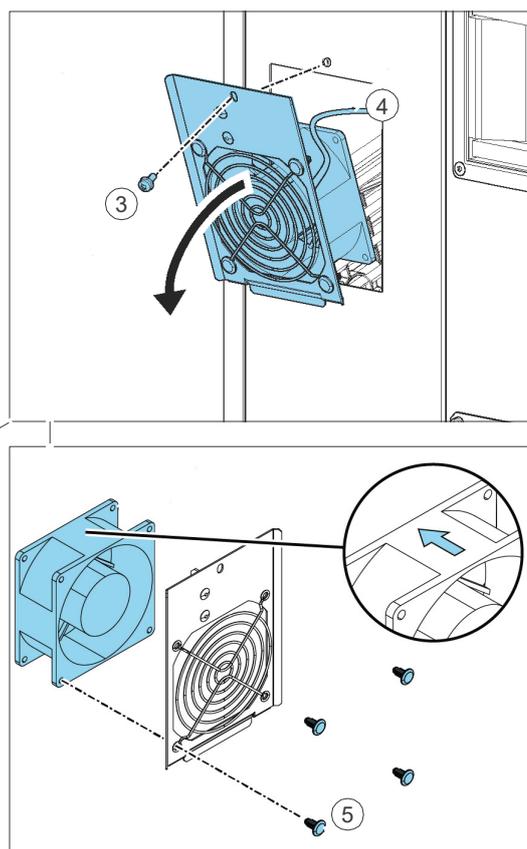
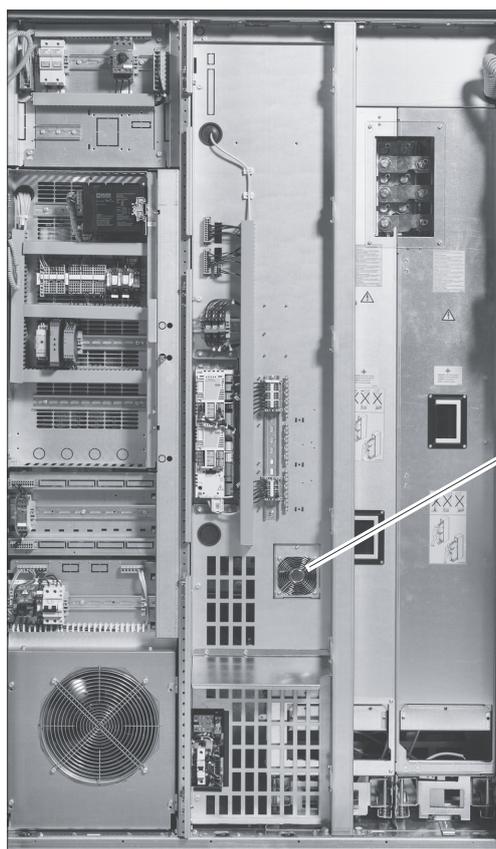


### WARNING!

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:

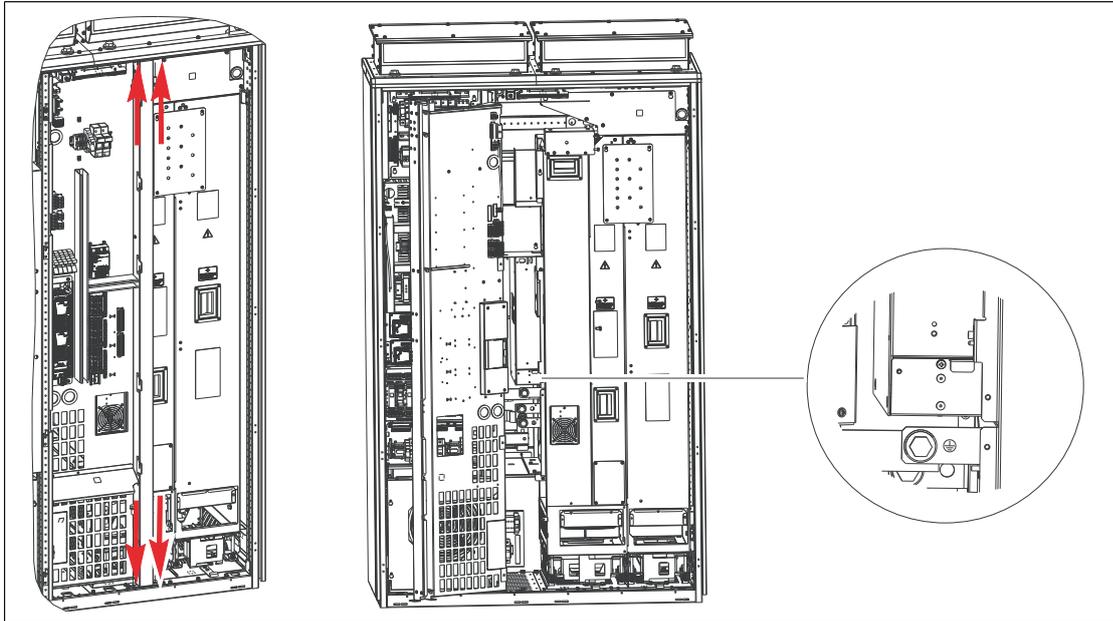
1. Stop the drive and do the steps in section [Electrical safety precautions \(page 17\)](#) before you start the work.
2. Open the cabinet doors.
3. Undo the mounting screw of the fan cassette.
4. Unplug the power supply cable of the fan.
5. Undo the mounting screws of the fan.
6. Install the new fan 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.



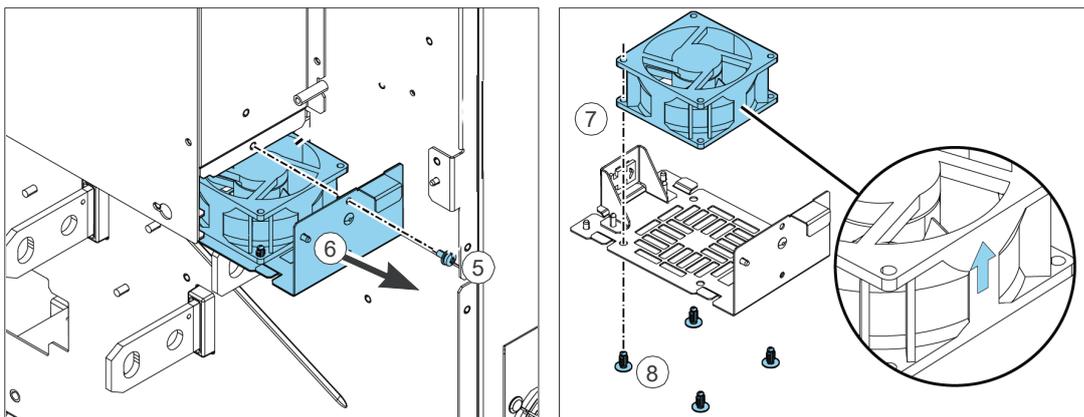
#### Fan at the bottom of the circuit board compartment:

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 17\)](#) 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 \(frame R11\) \(page 180\)](#).

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.



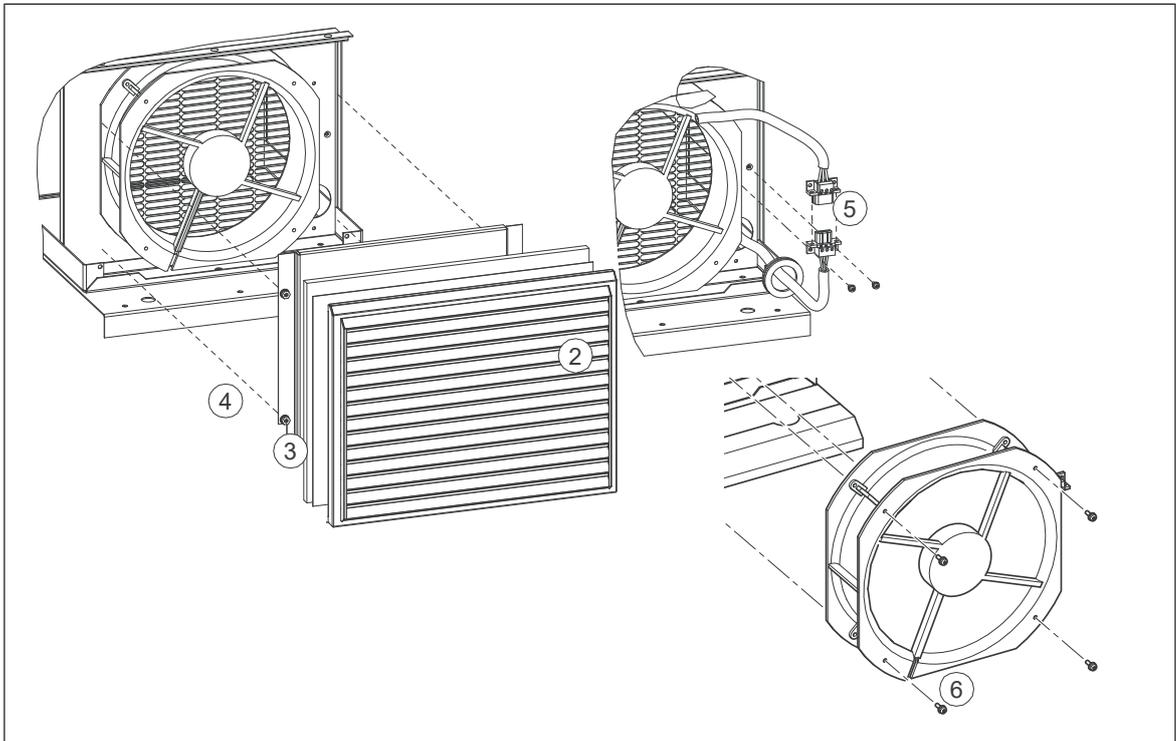
## ■ Frame R8: Replacing the IP54 (UL Type 12) roof fan and chopper (option +D150) cubicle fan G101.2



### 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 17)* 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.



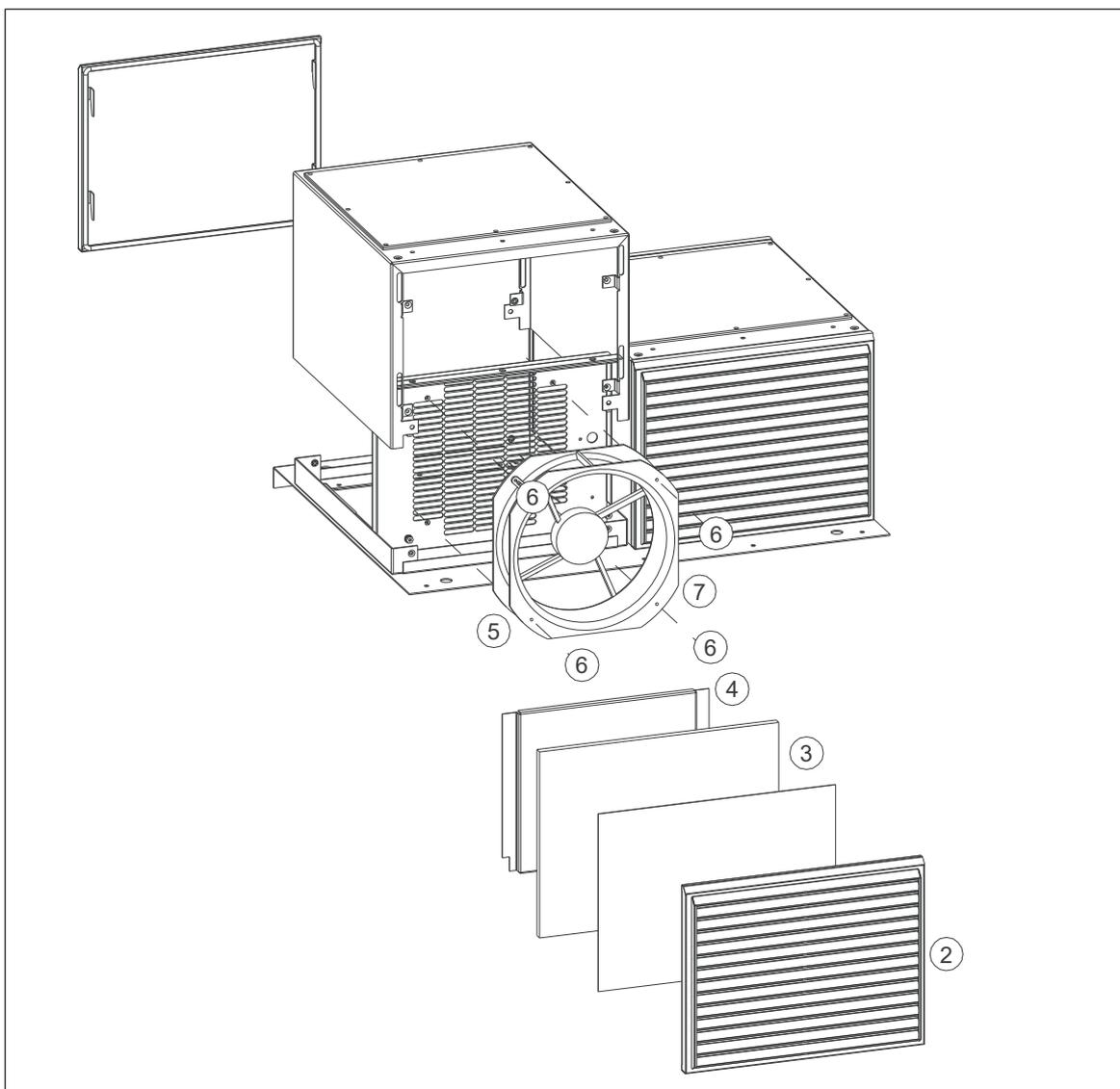
## ■ Frame R11 with options +B055 and +C128: Replacing the roof fan



### 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 17)* 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.



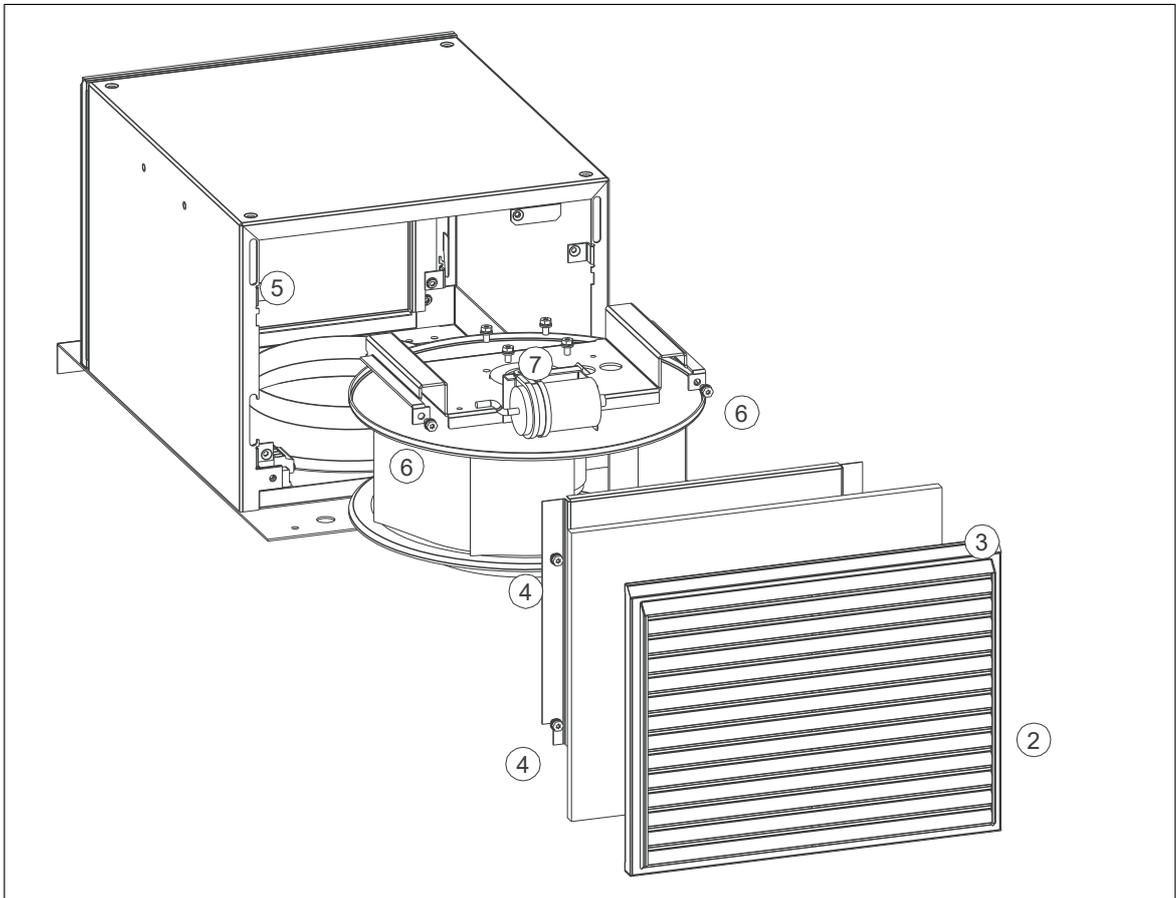
## ■ Frame R11 with option +B055: Replacing the roof fan



### 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 17)* 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

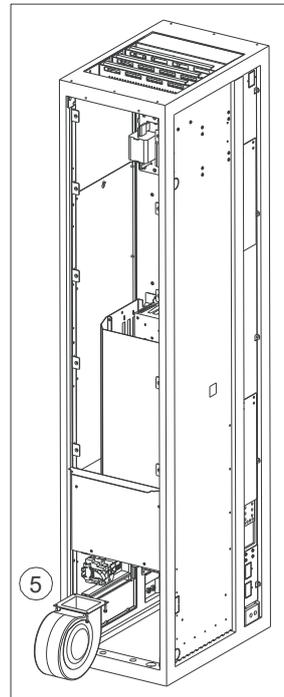
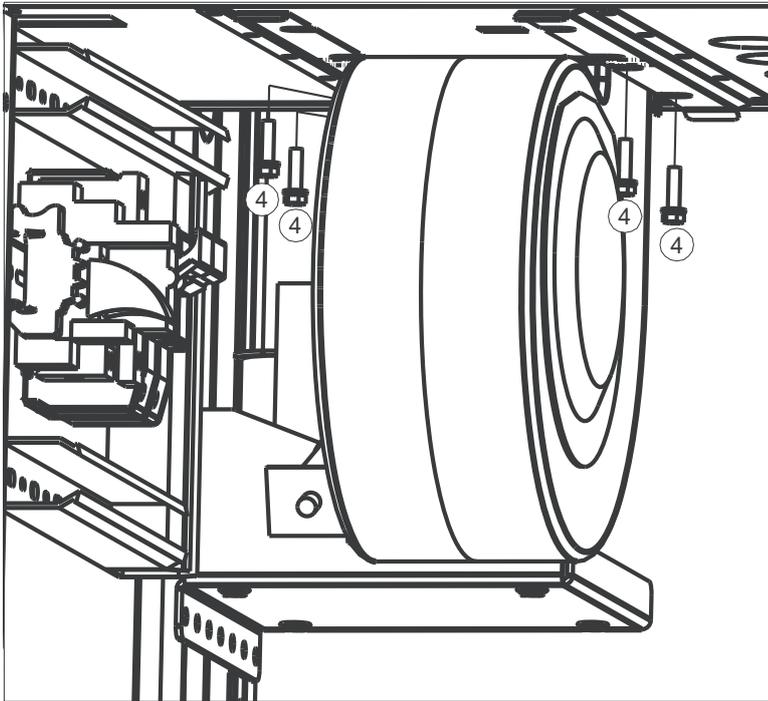


### WARNING!

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 17)* 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!**

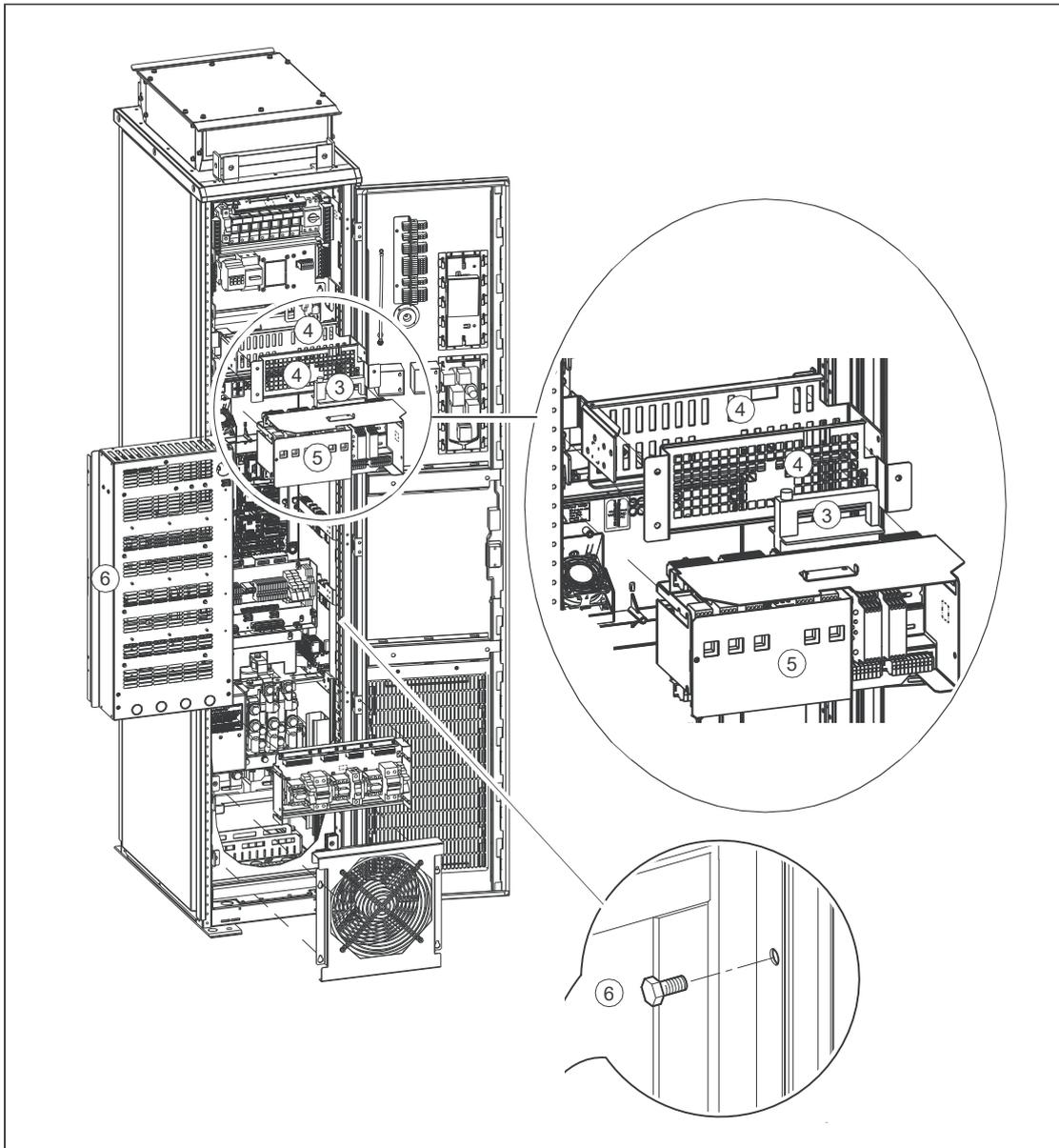
Obey the instructions in chapter Safety instructions. If you ignore them, injury or death, or damage to the equipment can occur. Secure the cabinet to the floor to prevent it from toppling over when you slide out the heavy drive module.

---

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions (page 17)* 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.

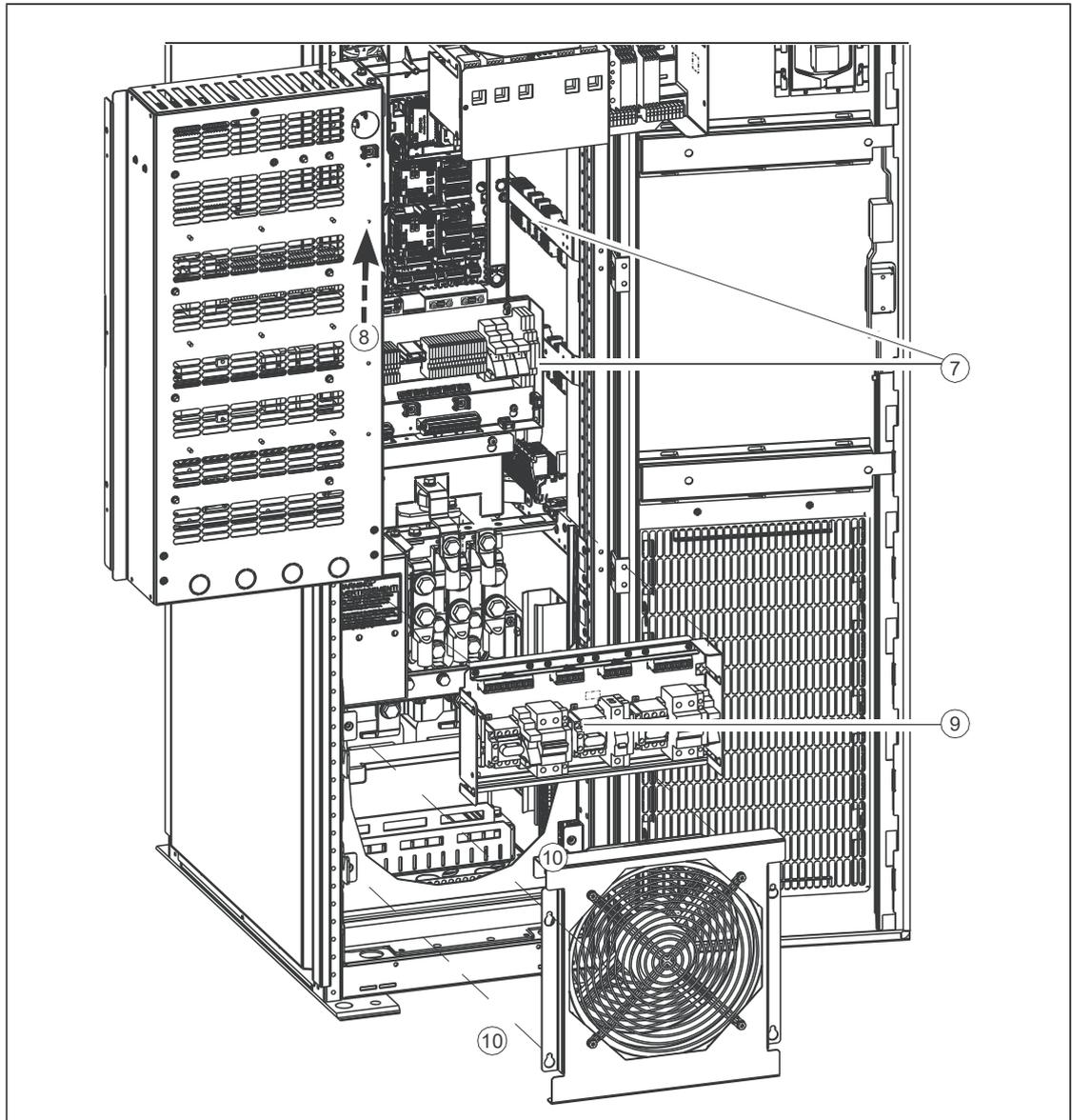
All drives: Undo the two M6 screws on the right side of the swing-out frame and open the swing-out frame or remove the shroud and four shroud fixing brackets if there is no swing-out frame.



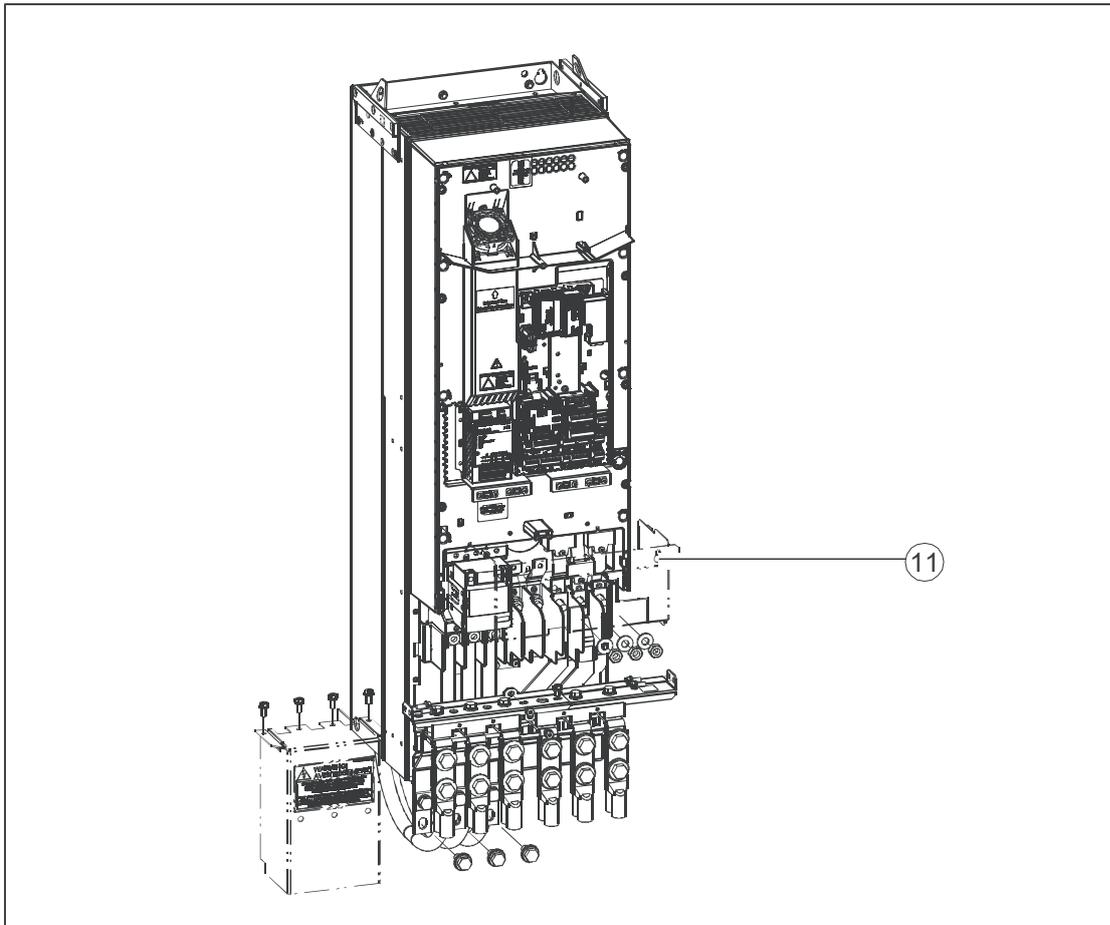
7. Disconnect the control panel cable from the module and the control wire terminals on the right side of the cabinet.
8. If the swing-out frame does not open enough to allow module replacement, undo the swing-out frame grounding wire and lift the swing-out frame off its hinges.
9. To remove the mounting 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.

10. Unplug the connector and remove the fan or remove the shroud if there is no fan.

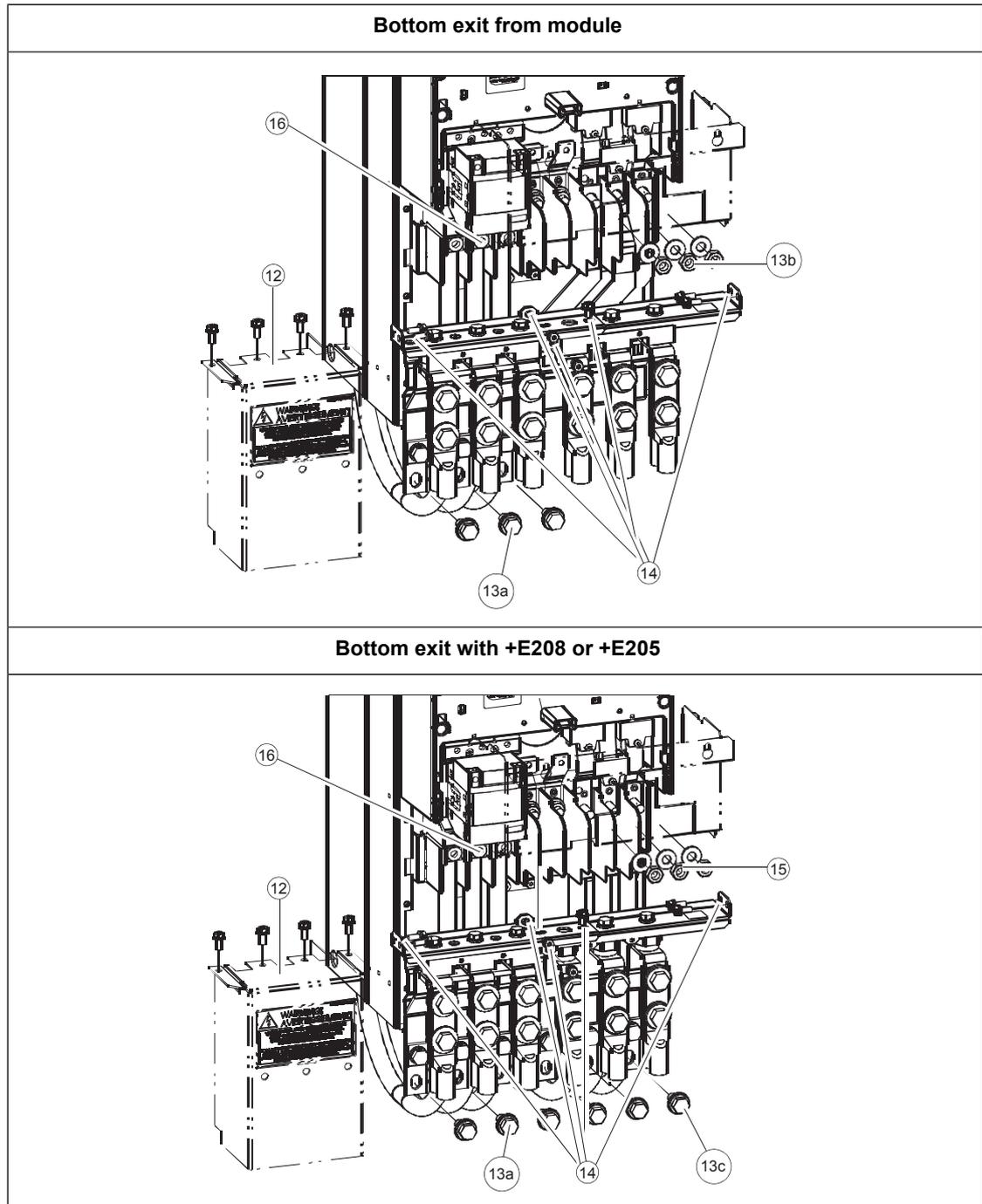


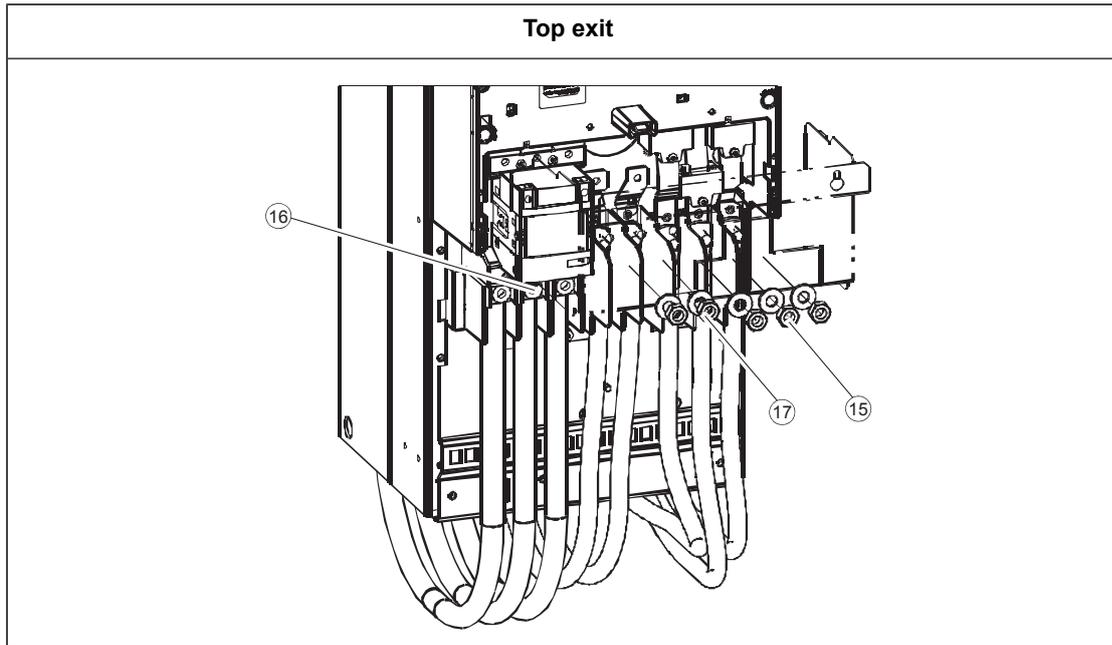
11. Loosen the four M5 screws and remove the plastic shroud.



12. For drives with bottom entry: Undo the four M6 combi screws and remove the plastic shroud.
13. 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 13a or 13c, you can disconnect the power cables of step 14 and remove the terminal subassembly.
  - Bottom exit from module (b): three M10 nuts
  - Bottom exit and common mode filter (option +E208) or du/dt filter (option +E205) (c): three M10 nuts
14. 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 13a or 13c, you can disconnect the power cables of step 14 and remove the terminal subassembly.
15. 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.
16. Loosen the three hex head screws, pull out three power cables and bend them down so that they do not disturb the module replacement.
-

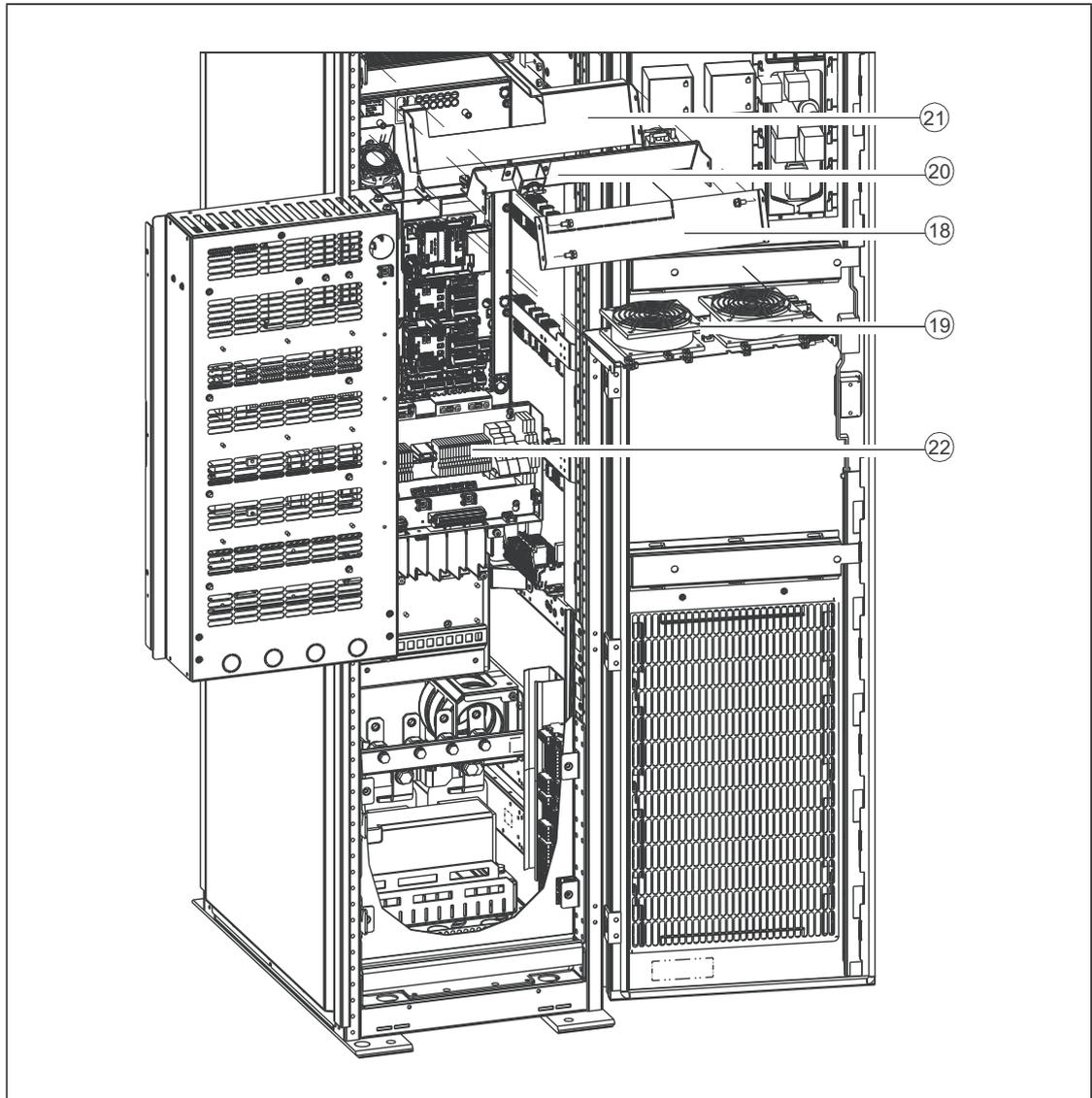
17. For drives with brake chopper (option +D150): Undo the two M10 nuts and bend the two power cables down so that they do not disturb the module replacement.





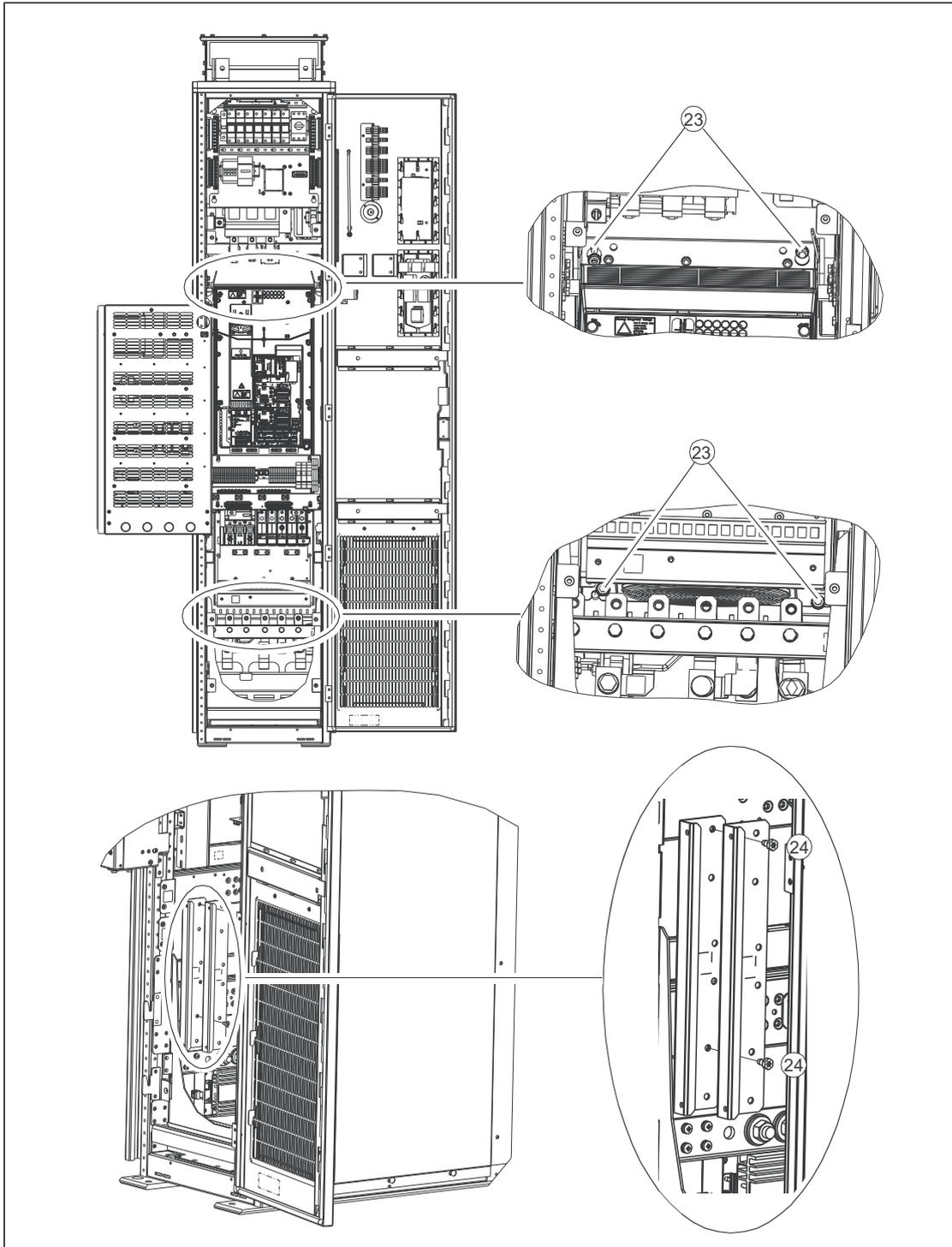
18. Undo the four M6 combi screws and remove the plastic air guide.
19. Loosen the four M6 combi screws, unplug the connector, lift the fan up a bit and remove the fan plate.
20. For easier removal of the module, undo the four M6 combi screws, disconnect the wires of the thermal switch and remove the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

22. Unplug the wires and connectors of X504 mounting plate.



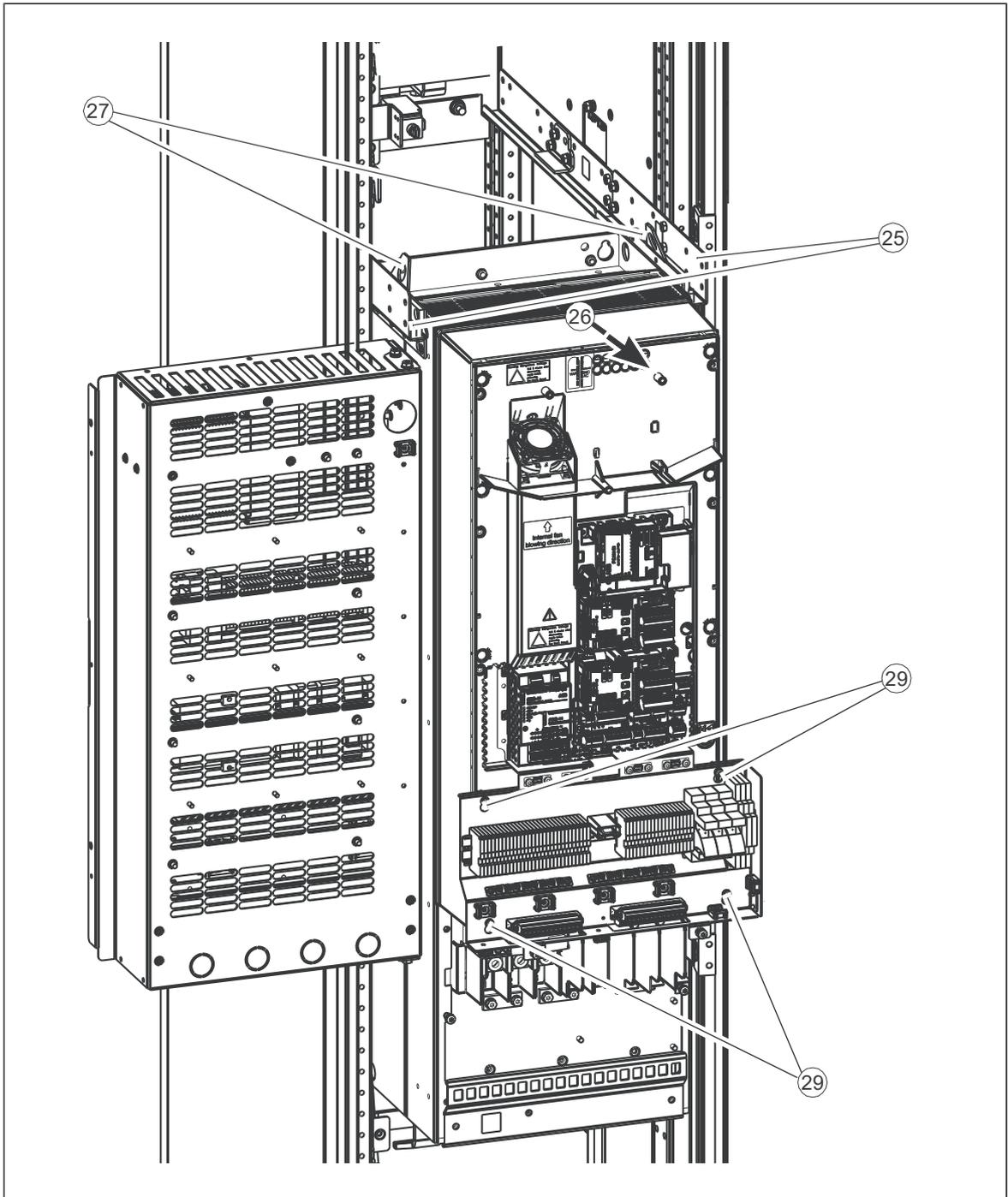
23. Undo the four M8 Serpress® nuts.

24. Undo the two M6 self-tapping screws in the bottom left side of the cabinet and remove the module slide extension rails.



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

31. Place X504 mounting plate to the new module and attach the M5 combi screws.
32. 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.

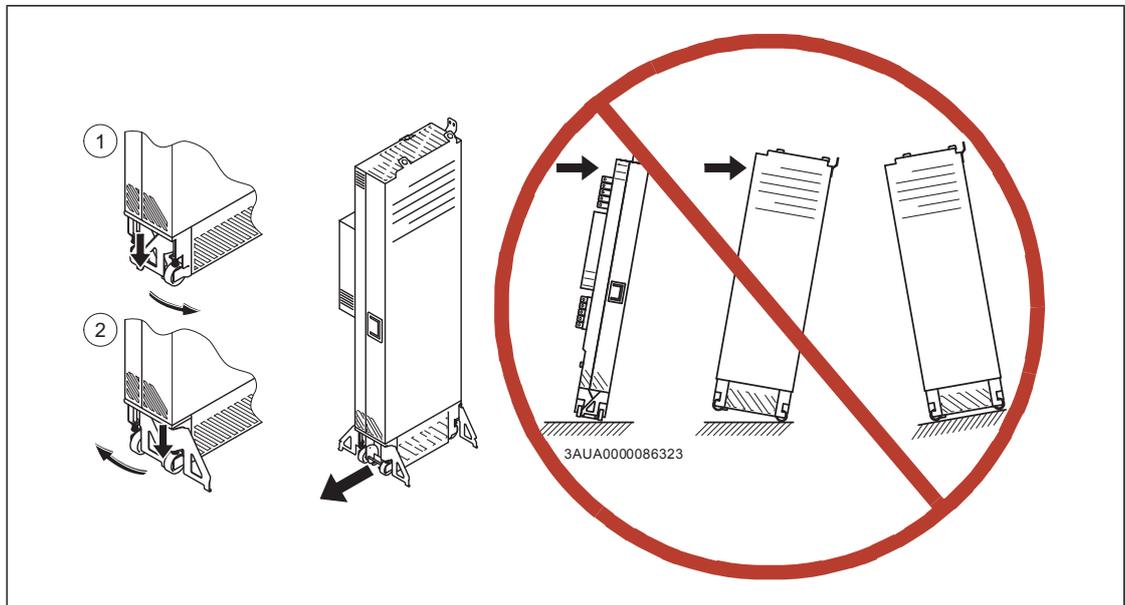
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Handle the drive and LCL filter modules carefully. Lift the module only by the lifting lugs.

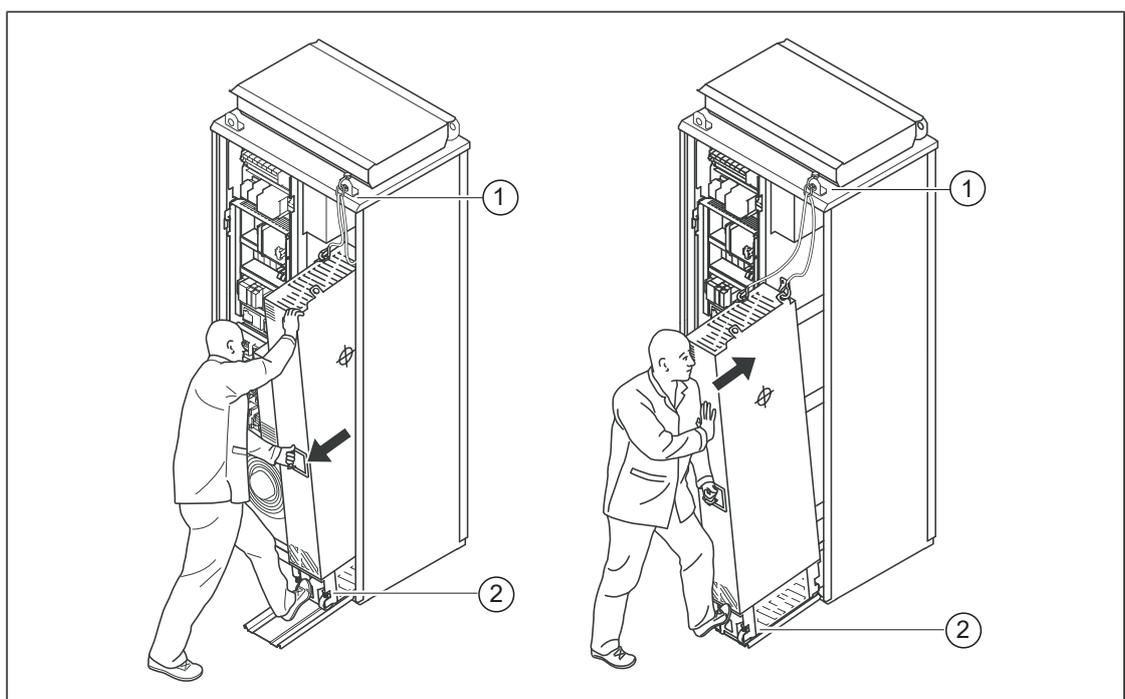
### **Module handling**

- Do not use the module installation ramp with plinth heights which exceeds the maximum allowed height. See the technical data.
  - Attach the module extraction/installation ramp carefully.
-

- Make sure that the module does not topple over when you move it on the floor: Open the support legs by pressing each leg a little down (1, 2) and turning it aside. Whenever possible attach the module also with chains. Do not tilt the drive module. It is heavy and its center of gravity is high. The module overturns from a sideways tilt of 5 degrees. Do not leave the module unattended on a sloping floor.



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



■ **Replacing the drive module (frame R11)**

Replacing the drive module requires preferably two persons.

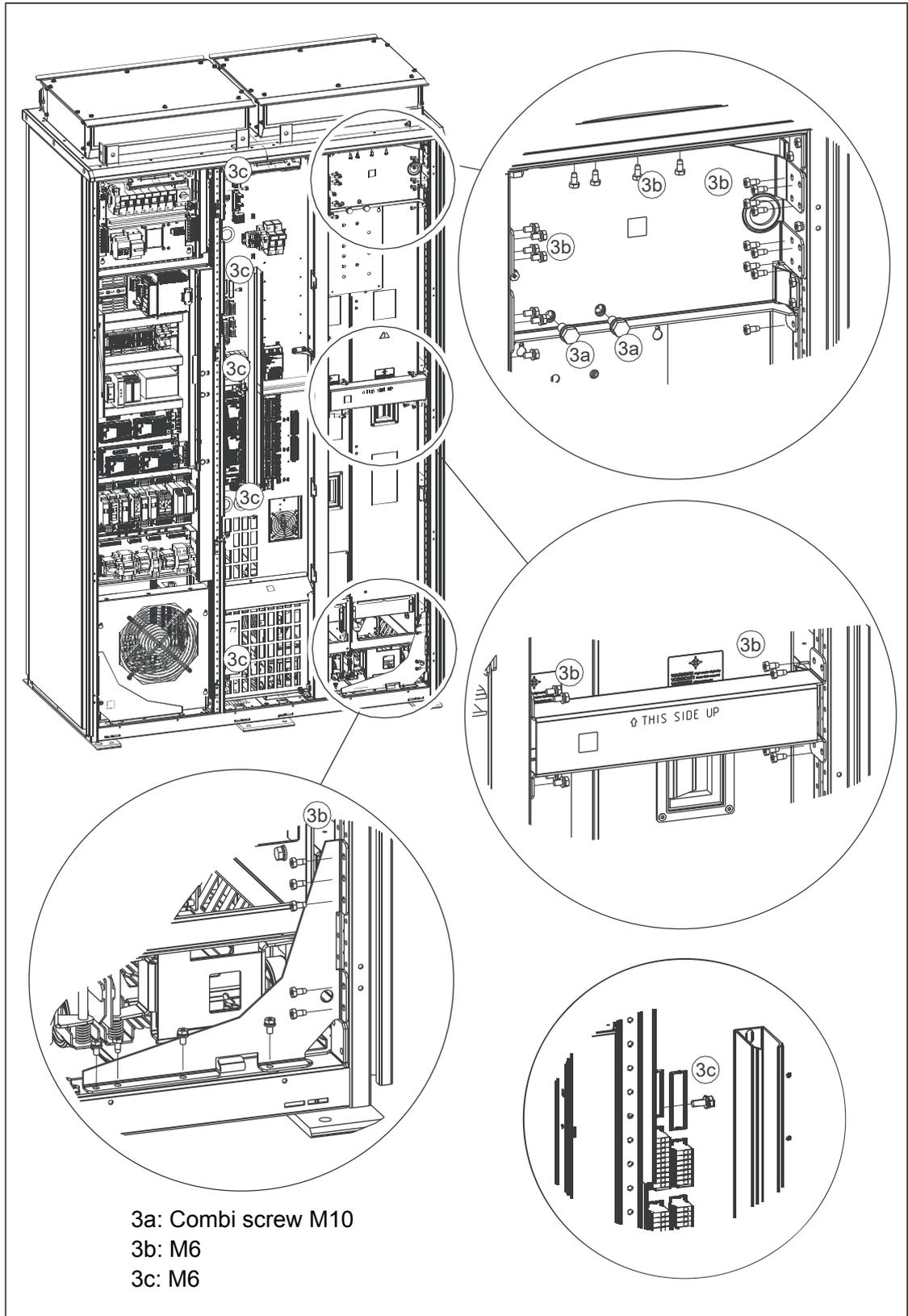
1. Stop the drive (if running) and do the steps in section *Electrical safety precautions (page 17)* before you start the work.
  2. Open the cabinet doors.
-

3. For drives with option +C121:

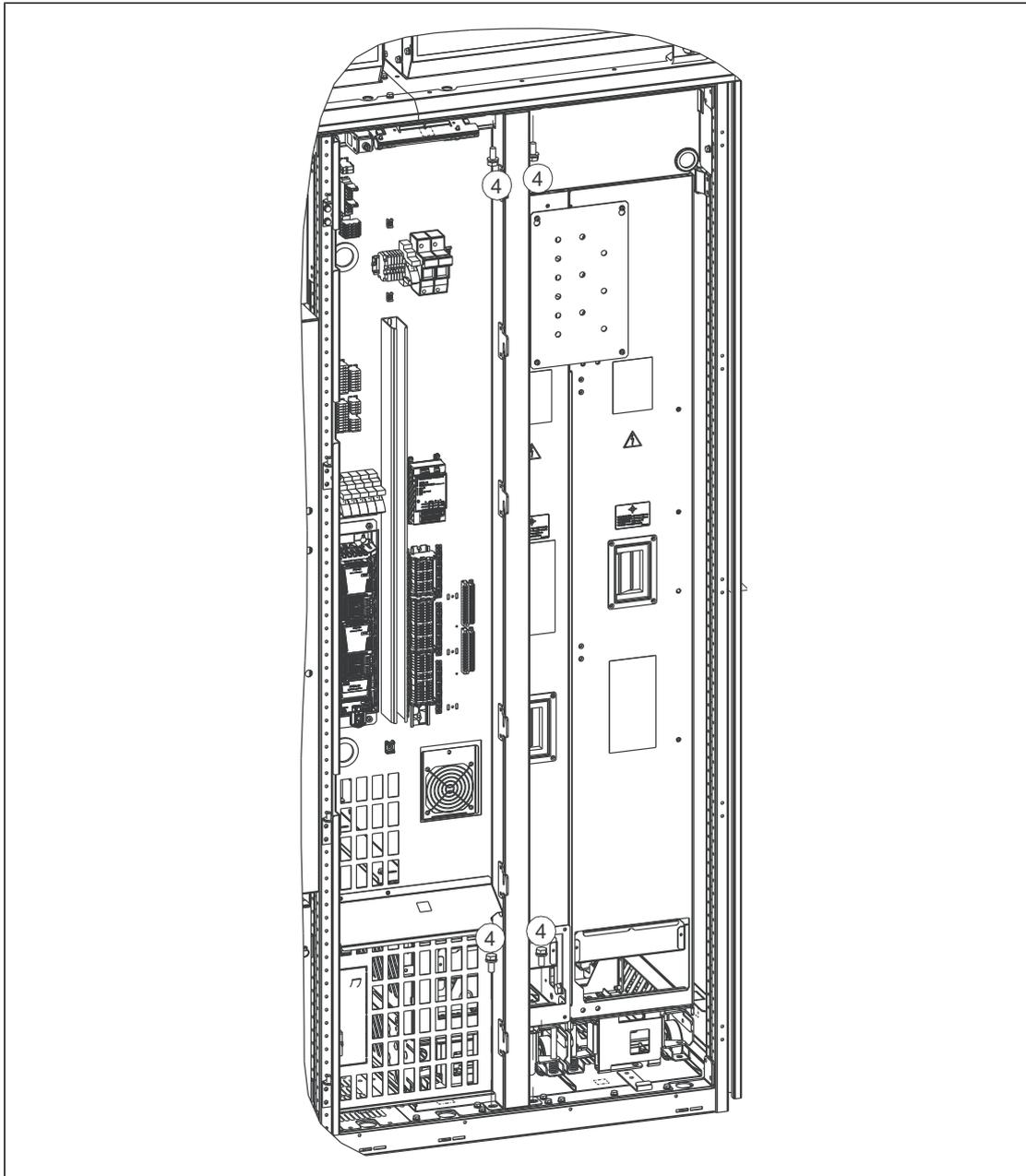
Undo the two module attaching screws (3a).

Undo the M6 screws and remove the three supports (3b).

Undo the five M6 screws on the left side of the swing-out frame (3c).

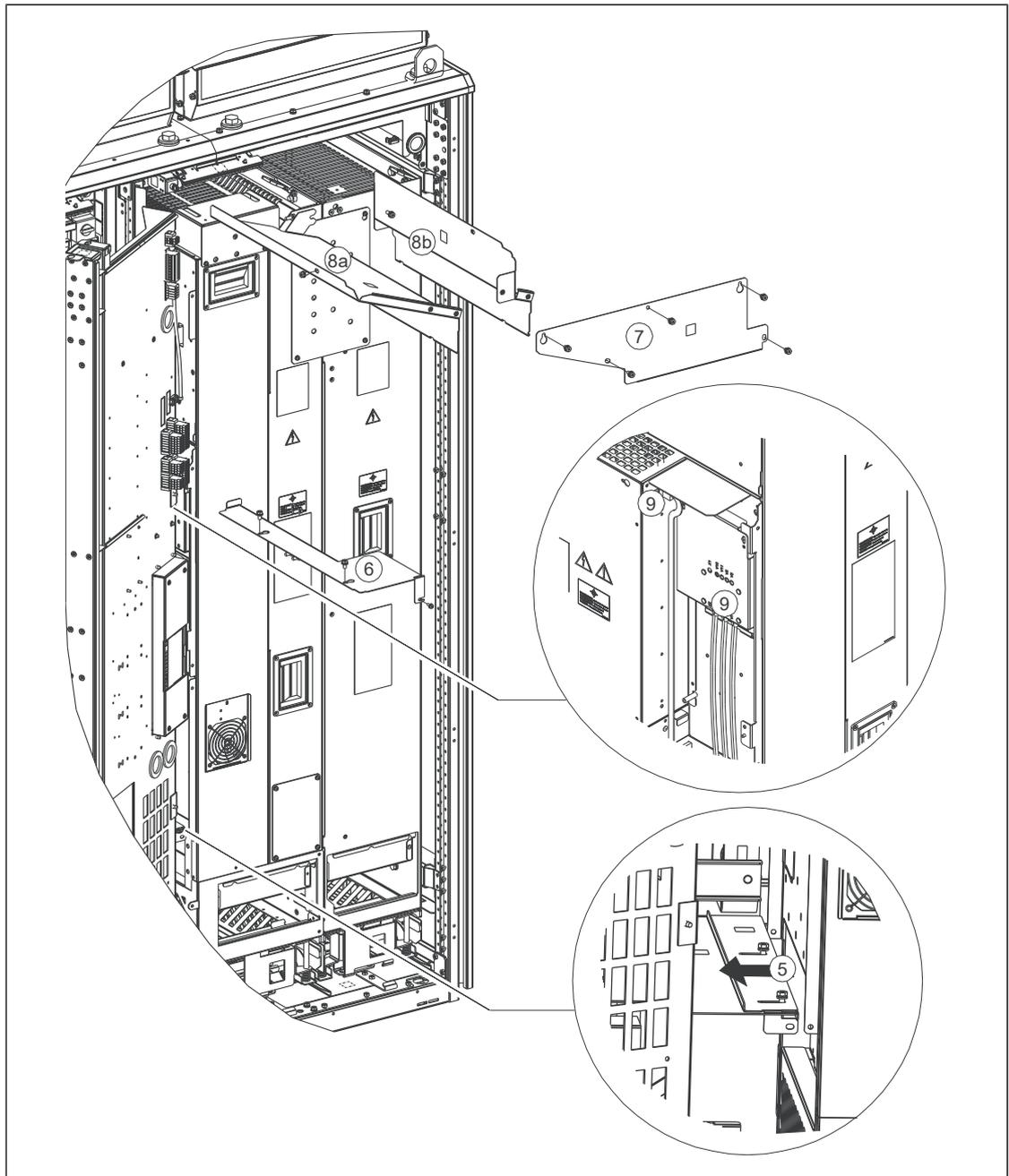


4. To open the module section swing-out frame, undo the M10 bolts from top and bottom (4 pcs).

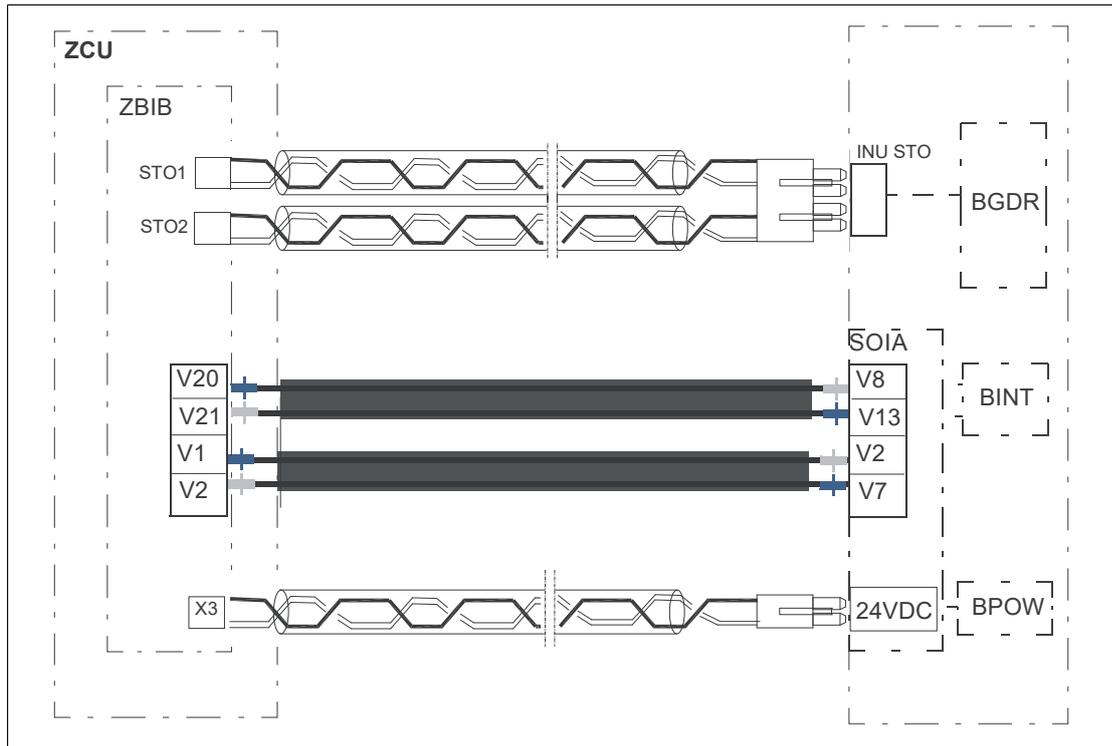


5. Loosen the two M6 screws of the air baffle and push it to the left. (Not for drives with option +C128.)
6. Remove the air baffle.
7. Remove the air baffle. (Not for drives with option +C121.)
8. Remove the air baffle: (8a) in IP22/IP42 drives, (8b) in IP54 drives.

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).

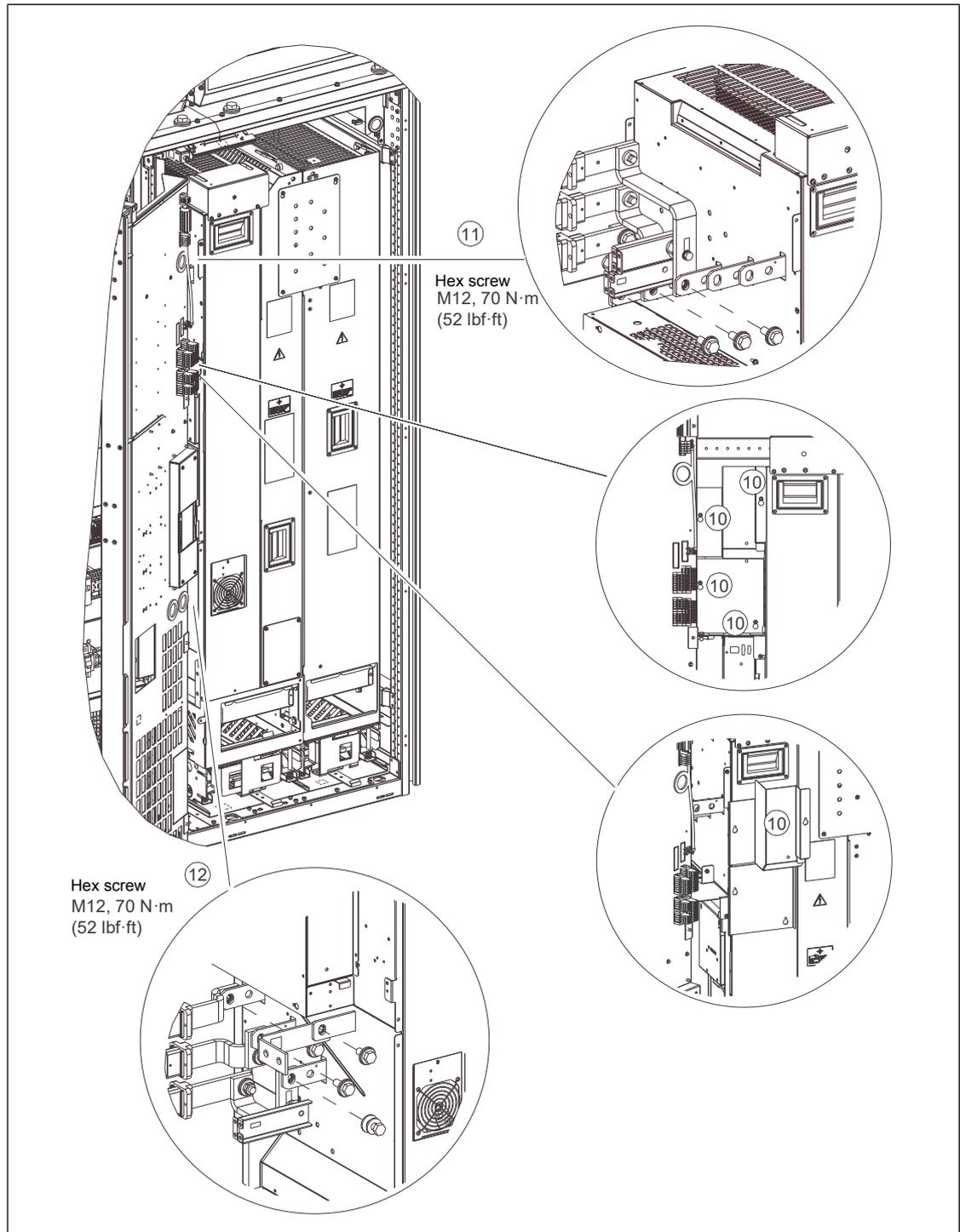


The connections between the line-side converter control unit and drive are shown below. The drive control unit remains in its place when you remove the drive module.



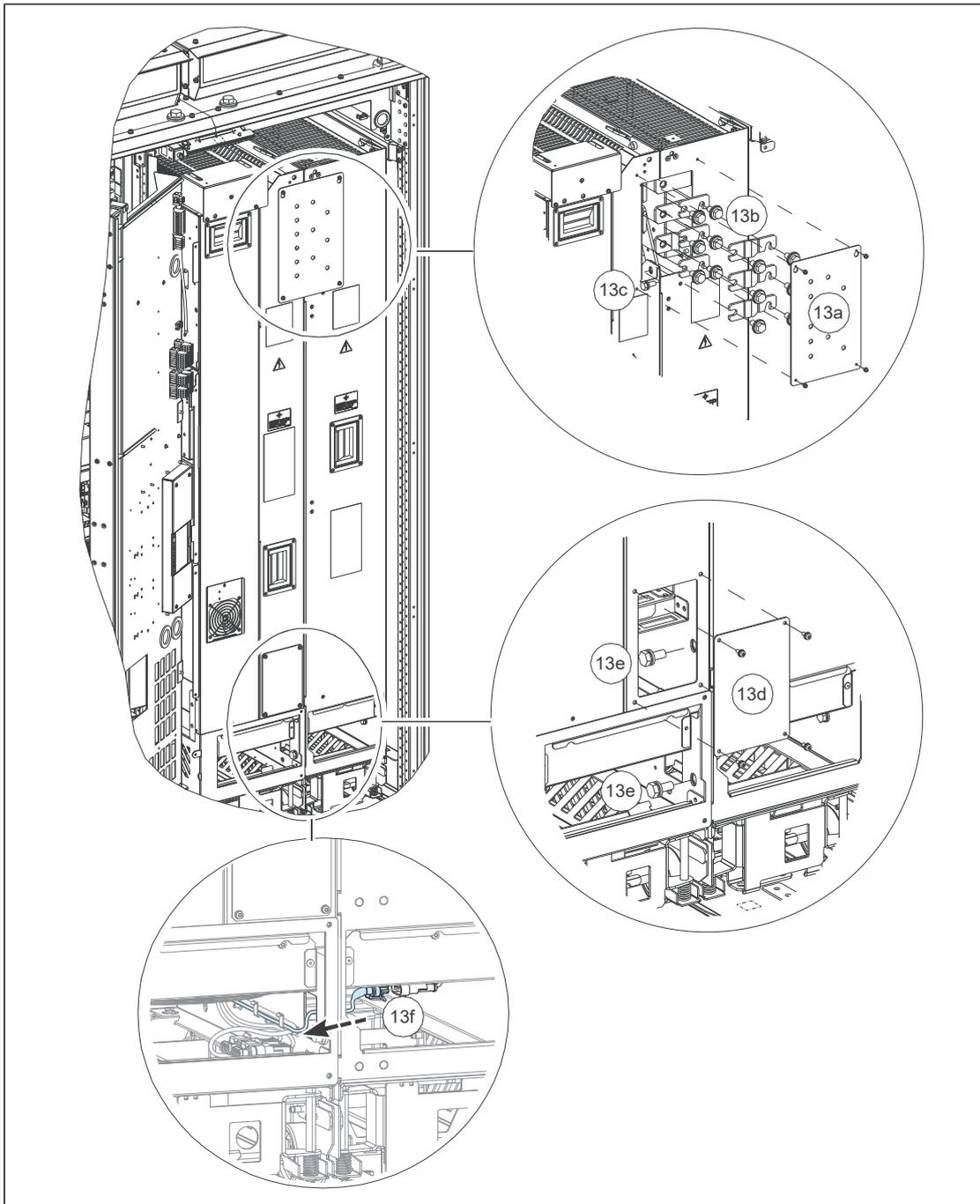
10. Loosen the M4 screws, lift the plastic shroud of the DC busbars up and remove it.
11. Disconnect the input power cabling busbars from the drive module busbar terminals.  
For drives with option +D150, disconnect the DC busbars also.

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:

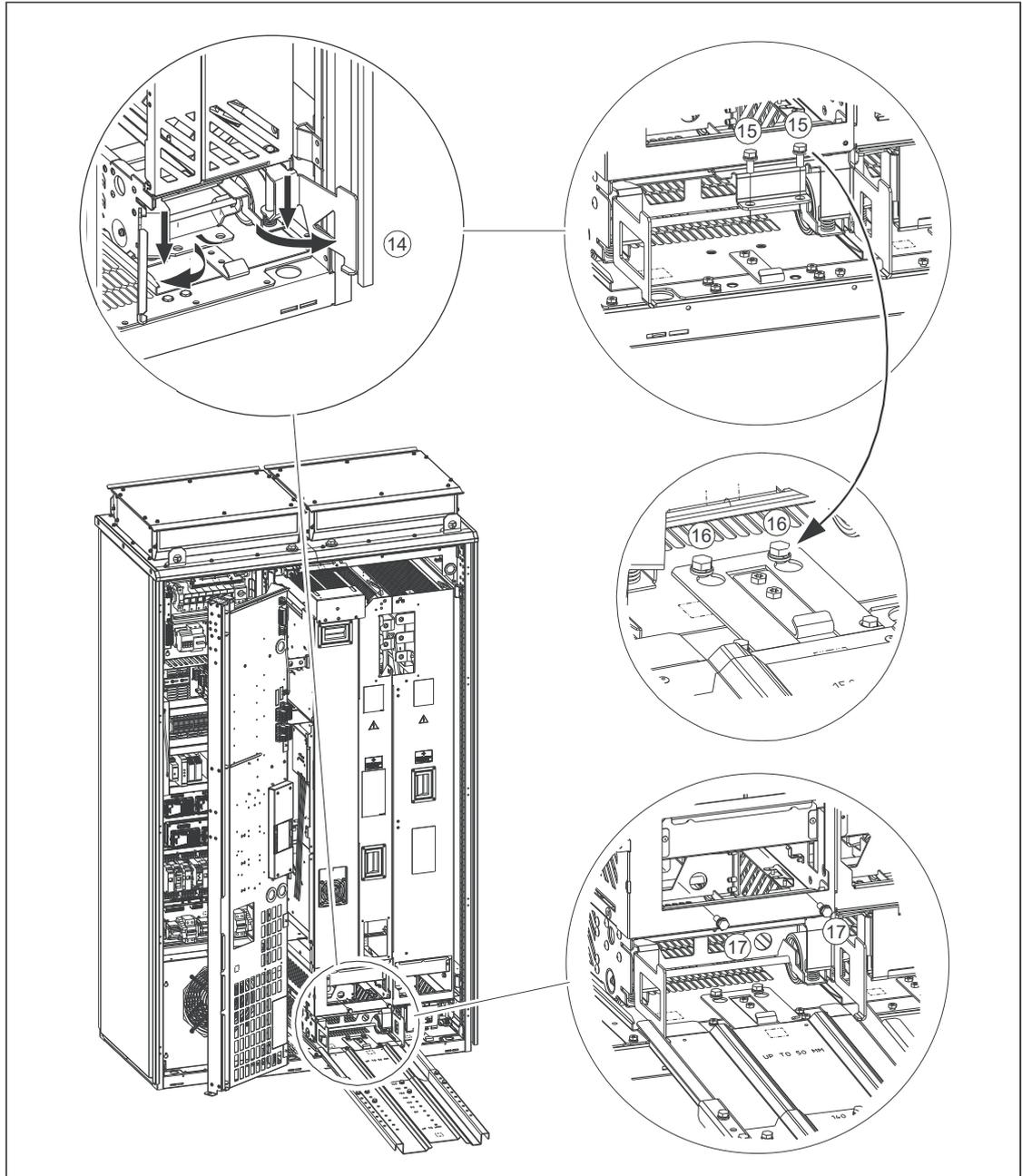
- (13a) Remove the shroud.
- (13b) Remove the bolts that connect the power busbars.
- (13c) Remove the attaching bolt.
- (13d) Remove the shroud.
- (13e) Remove the bolts.
- (13f) Disconnect the power wire of the LCL filter fan from connector FAN3:LCL.



14. To open the support legs 90 degrees, press each leg a little down and turn it aside.

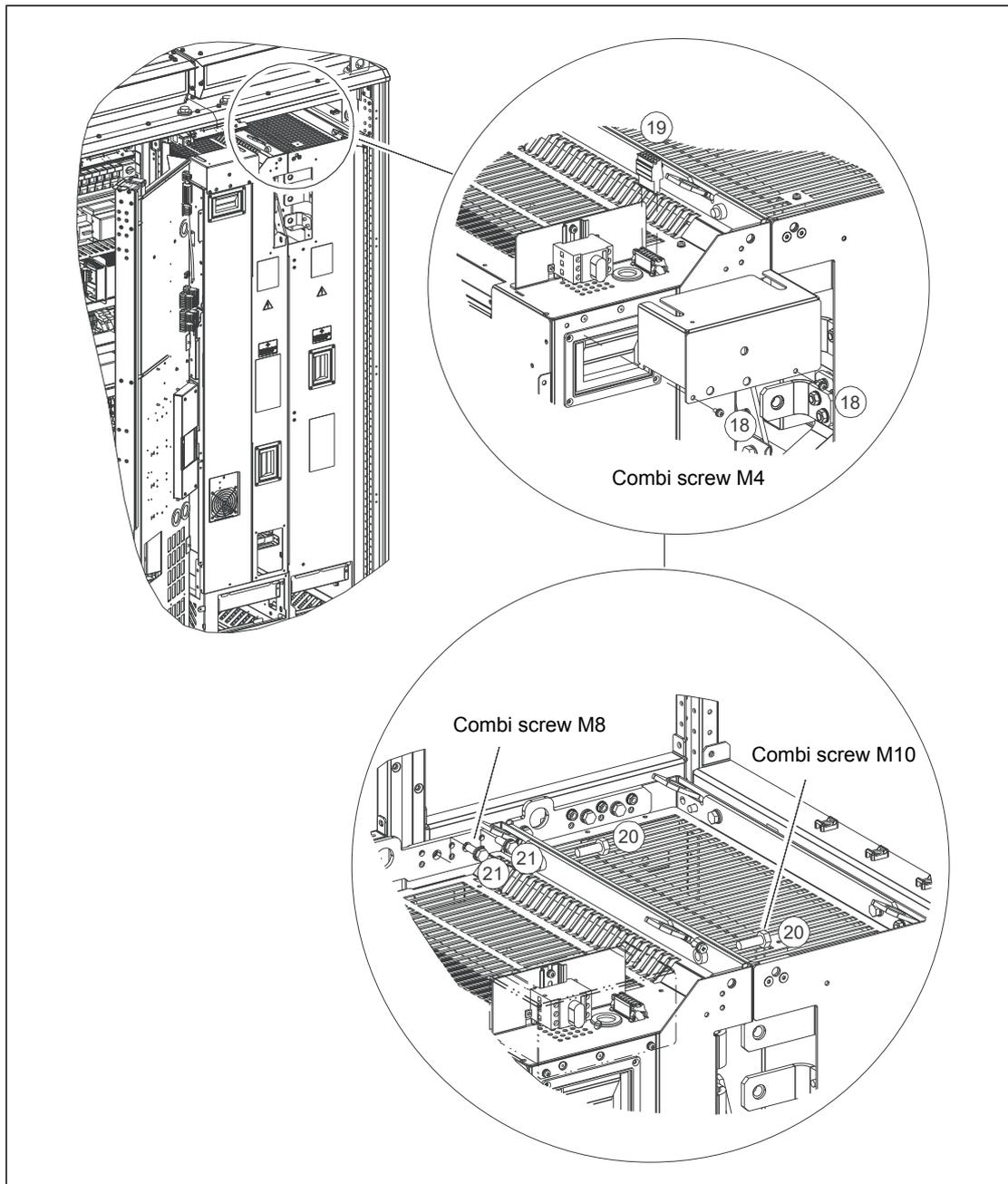
15. To remove the lower support bracket of the drive module, undo the two screws.

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. For drives with marine construction (option +C121): Remove the bolts that attach the drive module to the cabinet frame at the lower part.



18. To remove the shroud on the charging circuit switch/contactors, undo the two mounting screws.
19. Unplug the connector and auxiliary contact wires of the charging circuit switch/contactors.
20. Undo the two bolts that attach drive module to the LCL filter module.

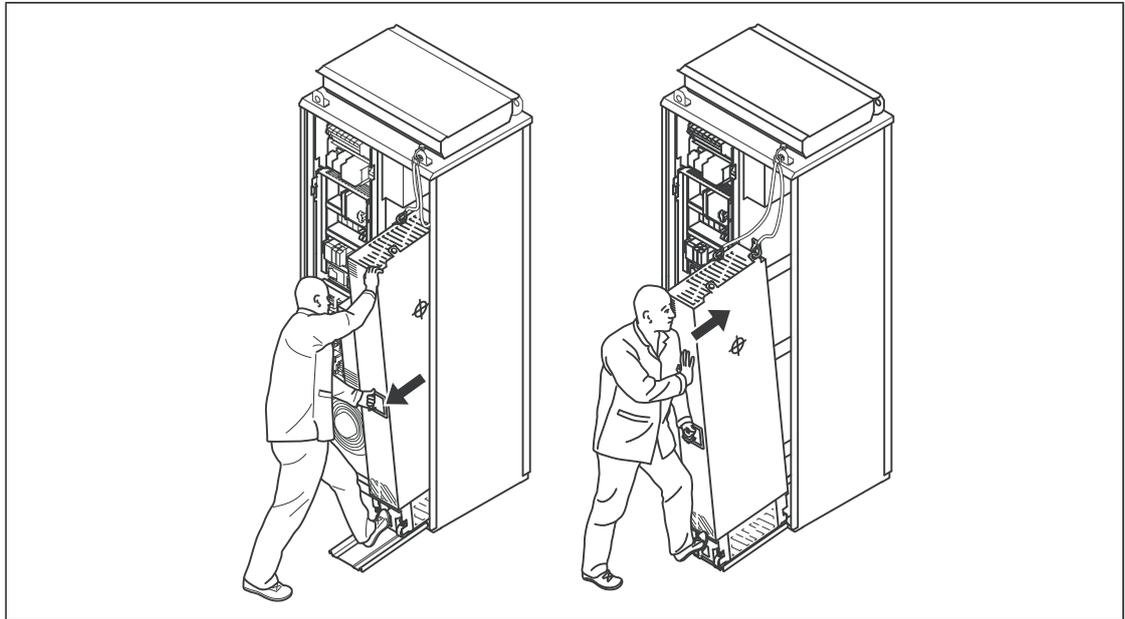
21. Undo the bolts that attach drive module from back to the cabinet frame.



22. Attach the lifting lugs of the module to be removed to the cabinet lifting lug with chains.

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

24. 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.
25. Install the new module in reverse order.

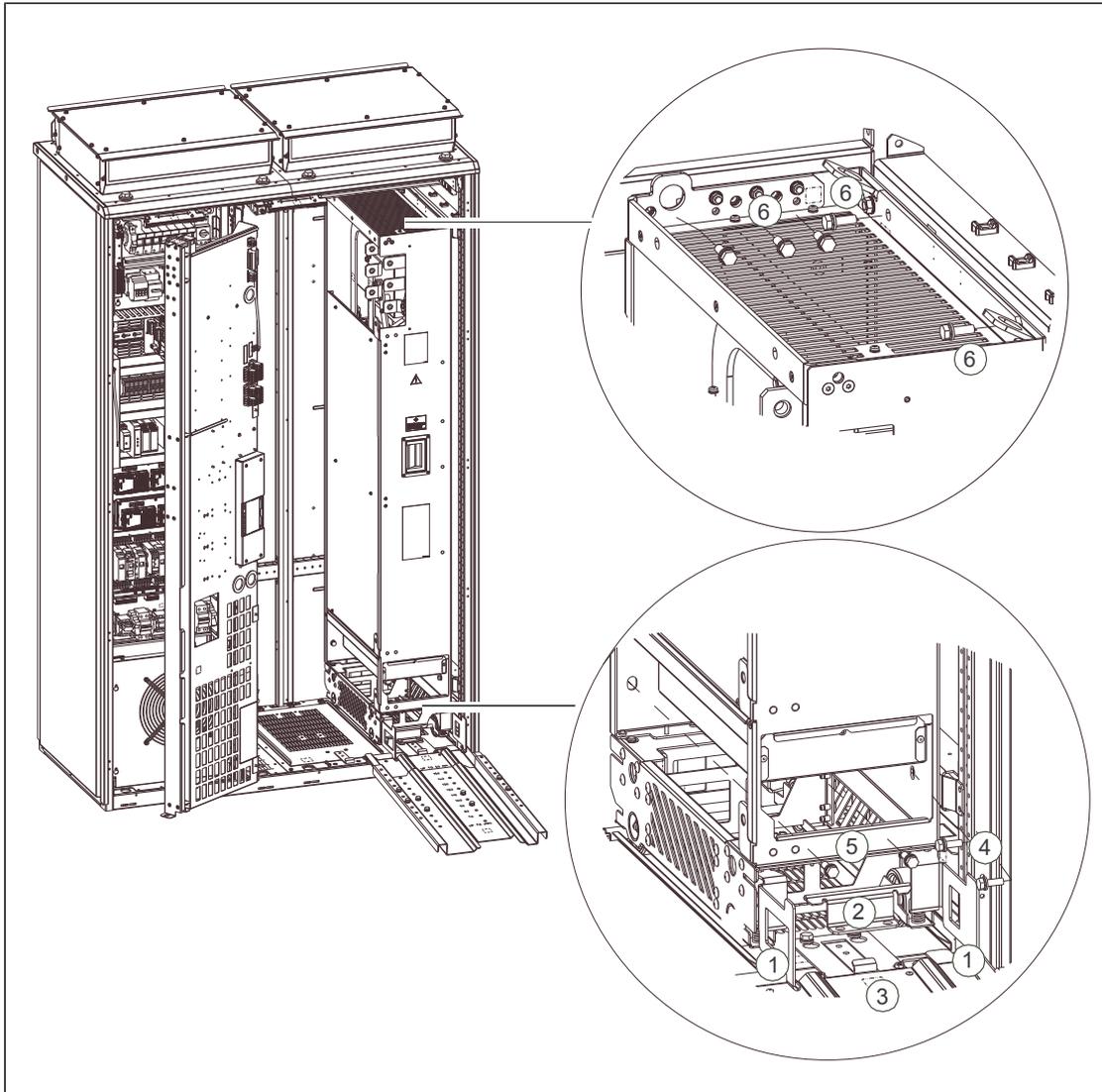


#### ■ Replacing the LCL filter module

If LCL filter module is also to be replaced:

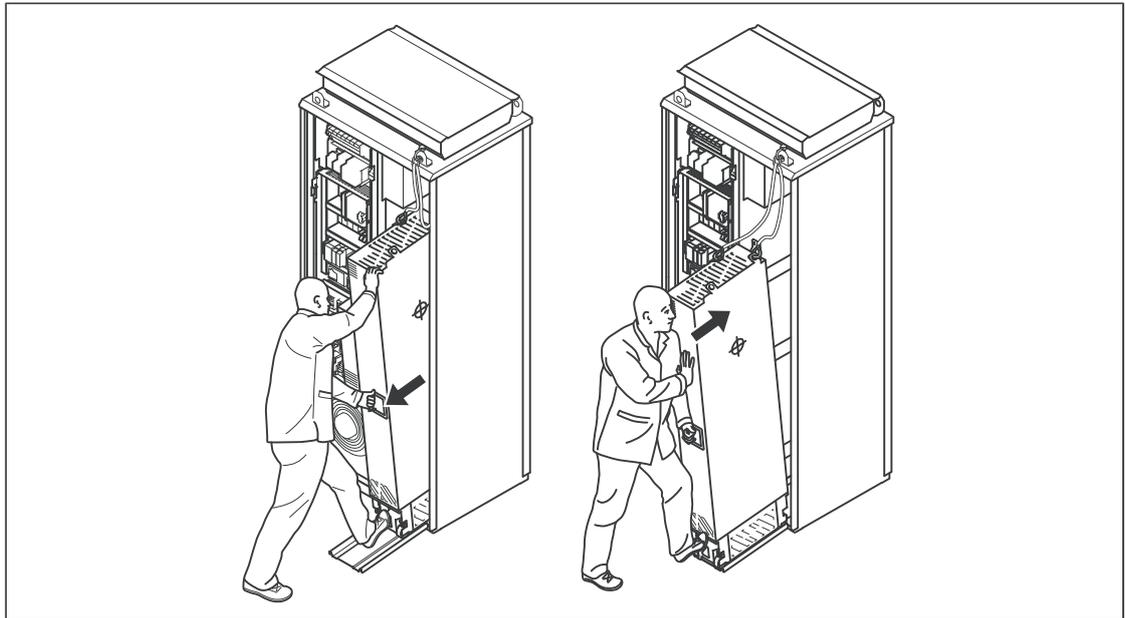
1. To open the support legs 90 degrees, press each leg a little down and turning it aside.
  2. To remove the lower support bracket of the LCL filter module, undo the two screws.
  3. Adjust the extraction ramp to the correct height and attach it to the cabinet base with the two mounting screws of the 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. For drives with marine construction (option +C121): 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.



## Capacitors

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

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

### ■ Reforming the capacitors

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

## Fuses

### ■ Replacing fuses (frame R8)



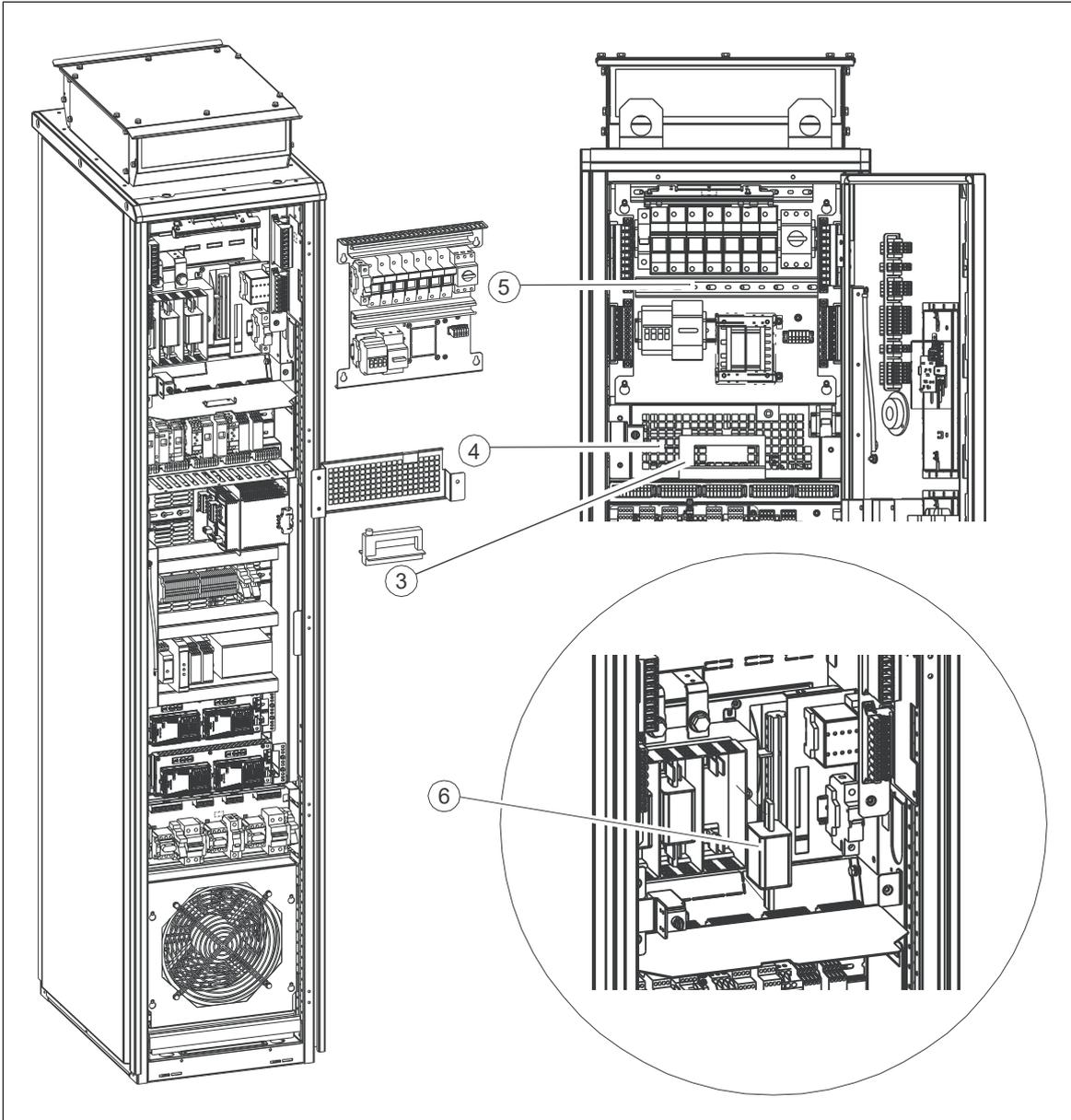
#### **WARNING!**

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 or maintenance work.

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions* (page 17) 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.



## ■ 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.

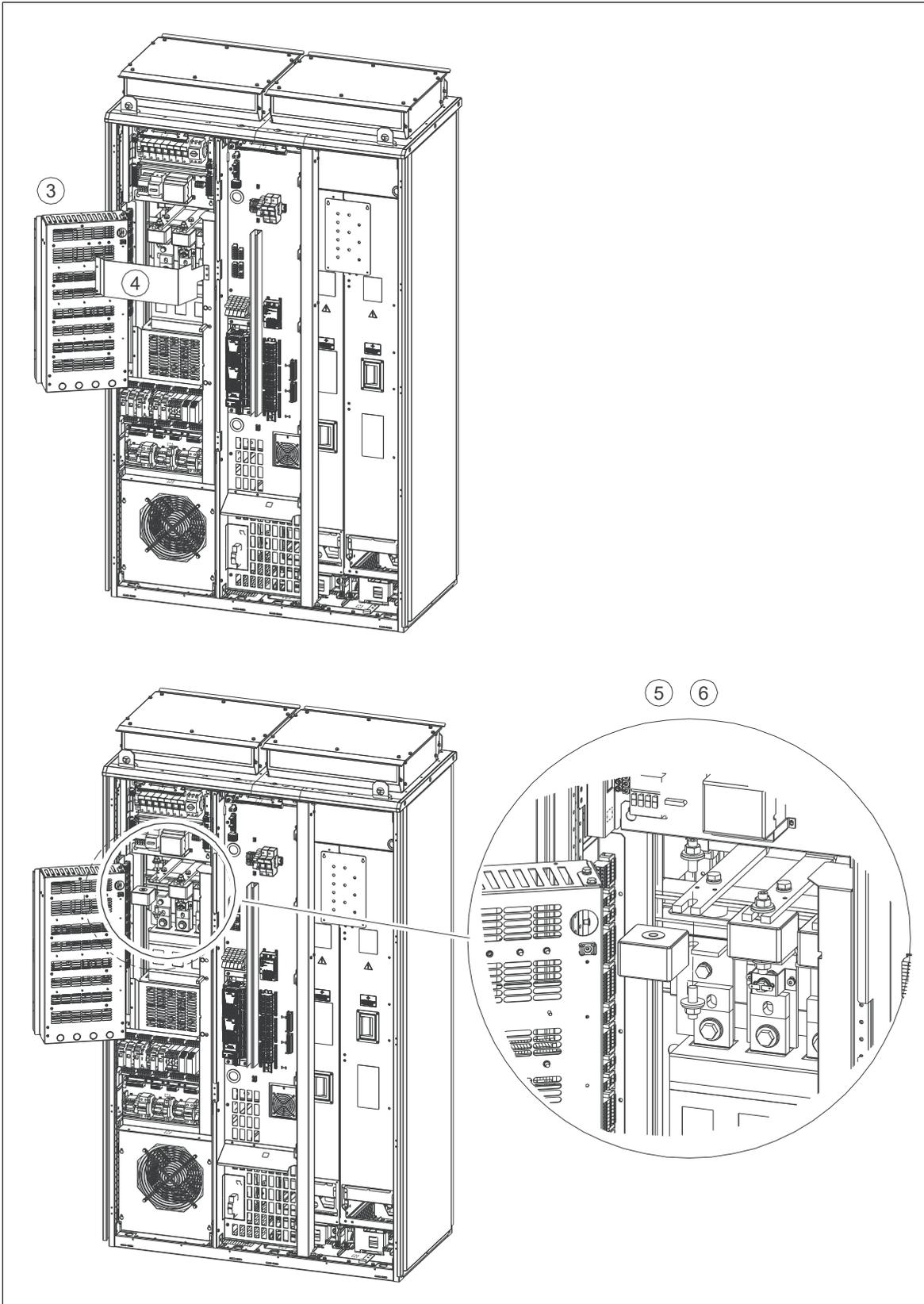
If you are not a qualified electrical professional, do not do installation or maintenance work.

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions (page 17)* 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. Reinstall the shrouds and mounting plate if removed earlier. Close the swing-out frame. Close the cabinet door.



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

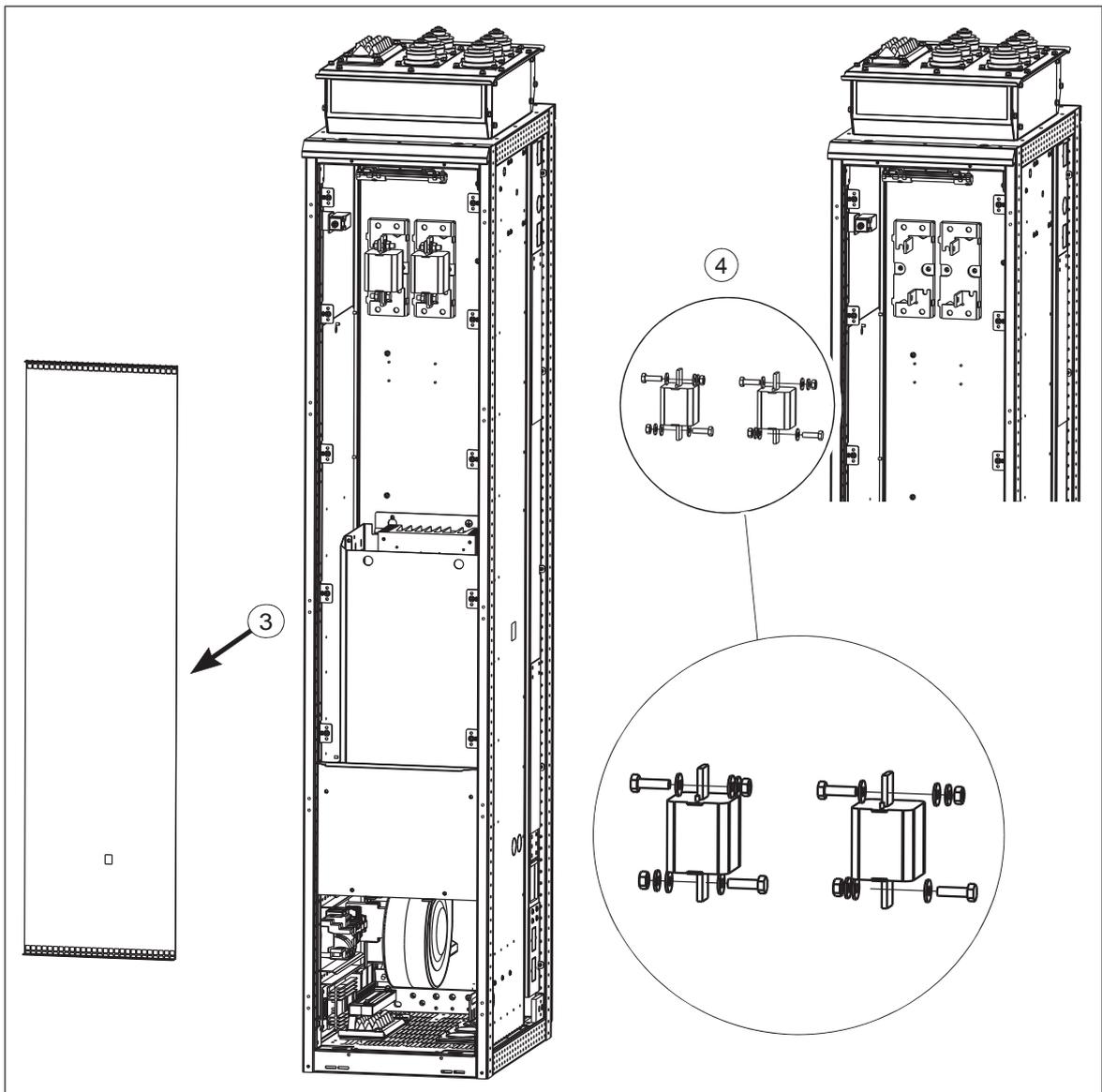


### WARNING!

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 or maintenance work.

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions (page 17)* 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 *ACx-AP-x assistant control panels user's manual* [3AUA0000085685 (English)].

## Control unit

### ■ Replacing the ZCU-14 control unit battery

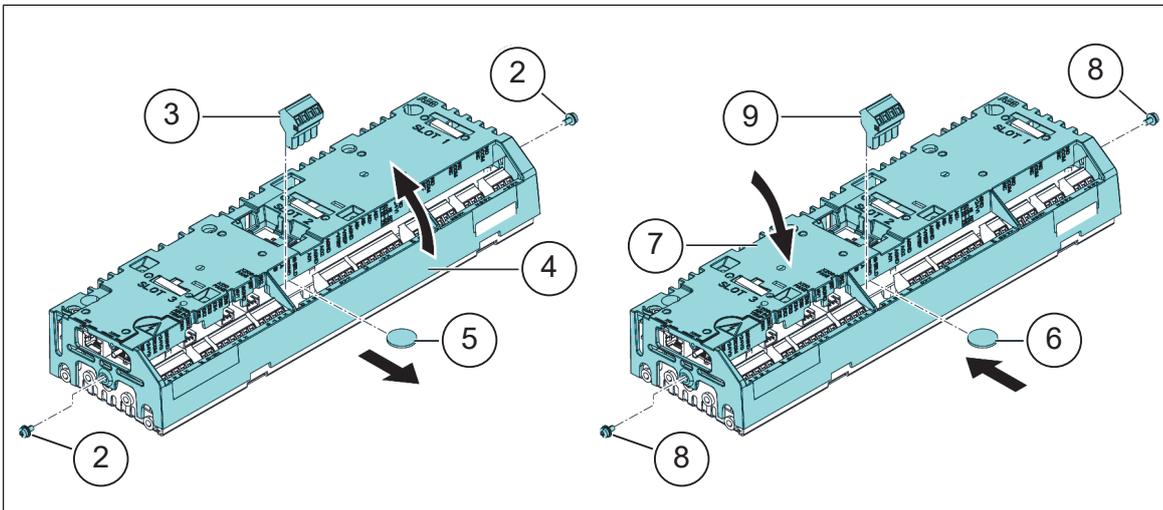


#### WARNING!

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

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* before you start the work.
2. Remove the M4×8 [T20] screws at the ends of the control unit.
3. To see the battery, remove the XD2D terminal block.
4. Carefully lift the edge of the control unit cover on the side with the I/O terminal blocks.
5. Carefully pull the battery out of the battery holder.
6. Carefully put a new CR2032 battery into the battery holder.
7. Close the control unit cover.
8. Tighten the M4×8 [T20] screws.
9. Install the XD2D terminal block.



### ■ Memory unit

When a drive is replaced, the parameter settings can be retained by transferring the memory unit from the defective drive to the new drive. One memory unit is located on the drive control unit (motor-side converter control unit), another on the line-side converter control unit.



#### WARNING!

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

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

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

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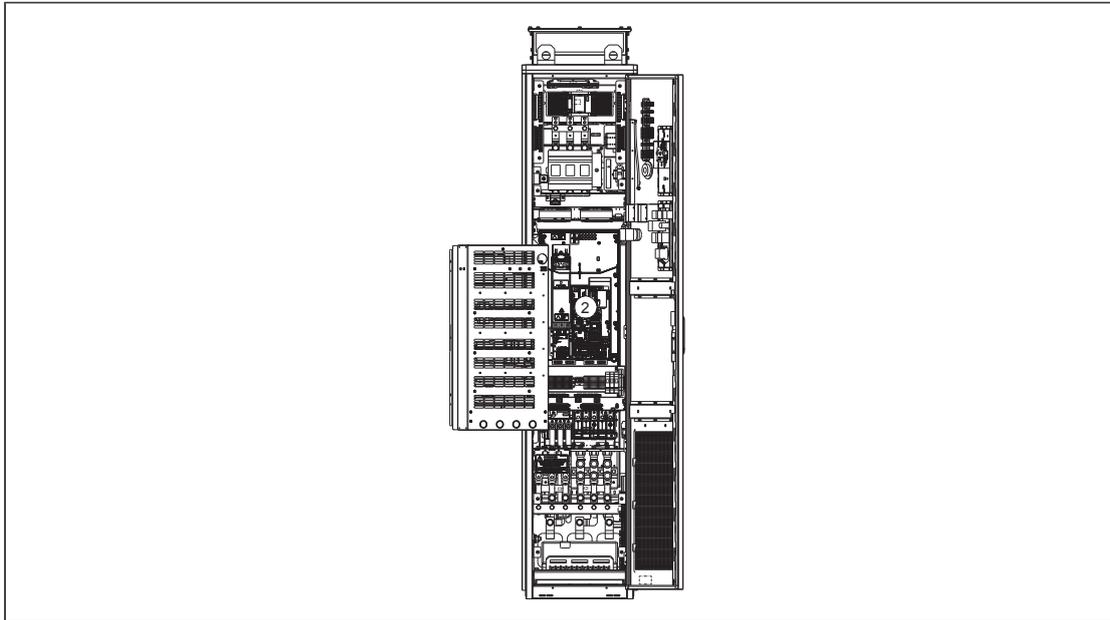
**WARNING!**

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

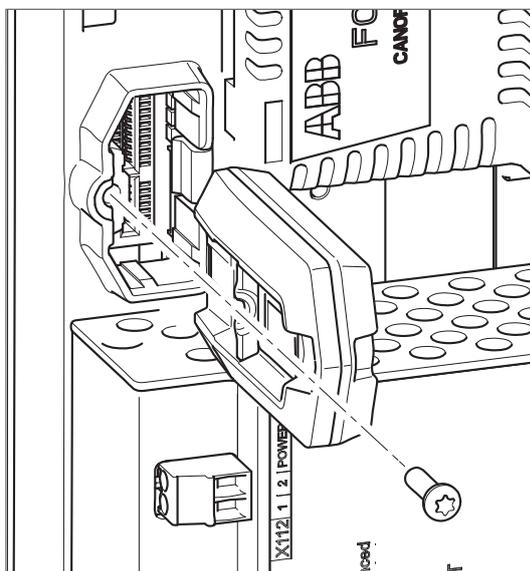
If you are not a qualified electrical professional, do not do installation or maintenance work.

---

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* 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.

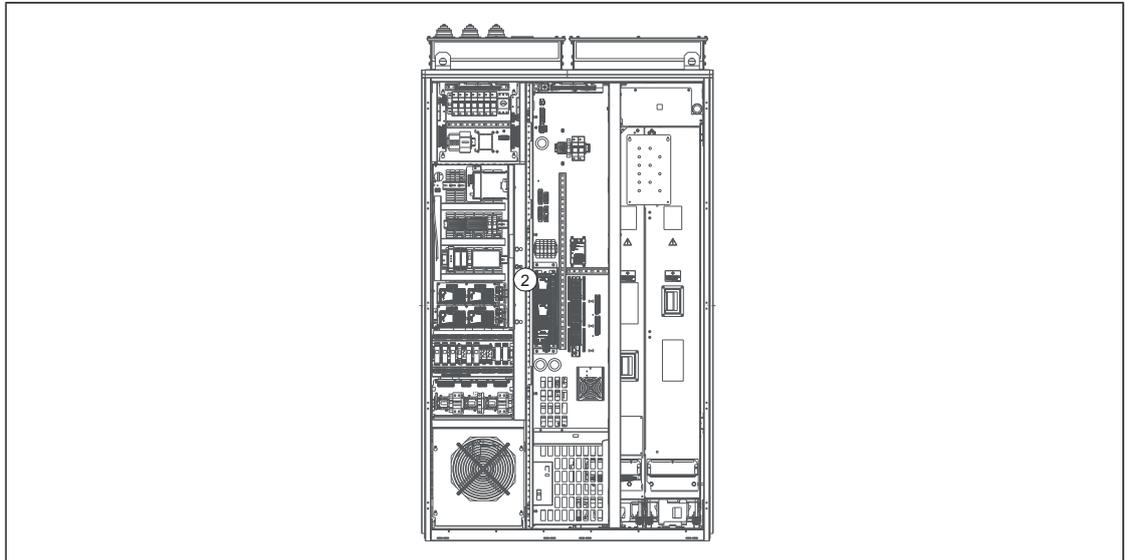


3. Undo the memory unit mounting screw and take the memory unit out. Replace the unit in reverse order. Note: There is a spare screw next to the memory unit slot.

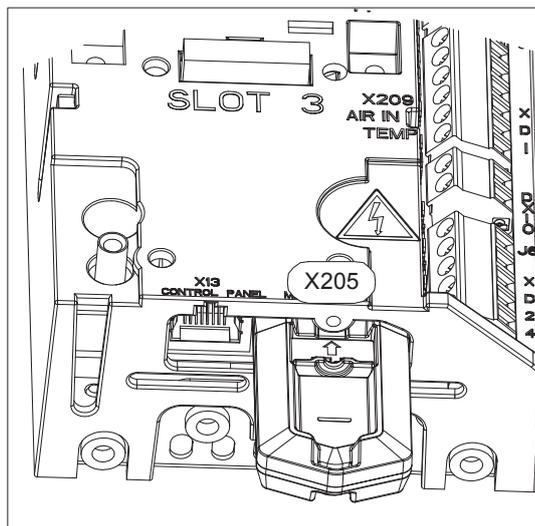


**Replacing the memory unit of the motor-side converter control unit (frame R11)**

1. Stop the drive and do the steps in section *Electrical safety precautions (page 17)* 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, see also section *Cabinet layout (page 36)*.



3. Remove the mounting screw.
4. Pull 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)

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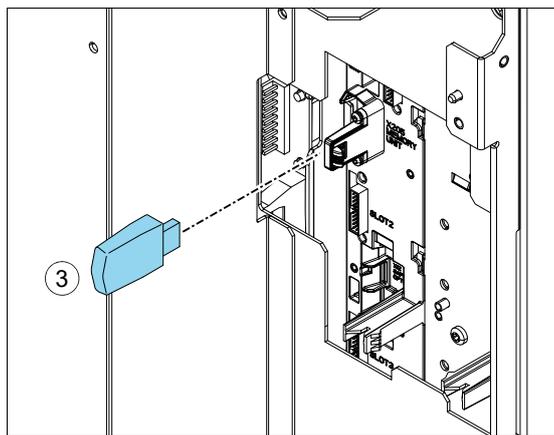
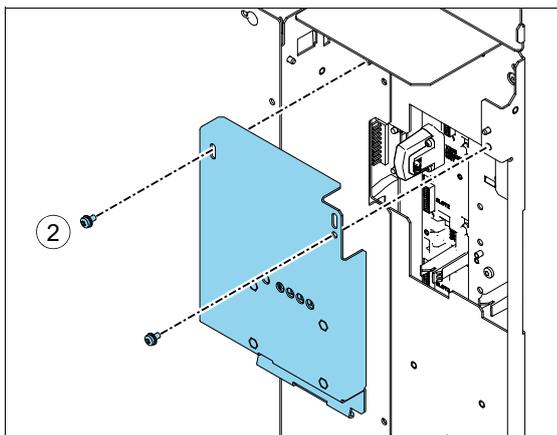
### WARNING!

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

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

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1. Stop the drive and do the steps in section [Electrical safety precautions \(page 17\)](#) 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.



# 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)

See *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 205)*.

#### ■ IEC ratings

Drive type ACS880-37-...	Frame size	Input current	Nominal ratings				Output ratings			
							Light-overload use		Heavy-duty use	
			$I_1$	$I_2$	$I_{max}$	$P_N$	$S_N$	$I_{Ld}$	$P_{Ld}$	$I_{Hd}$
A	A	A	kW	kVA	A	kW	A	kW		
$U_N = 400\text{ V}$										
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	Nominal ratings				Output ratings			
							Light-overload use		Heavy-duty use	
			$I_1$	$I_2$	$I_{max}$	$P_N$	$S_N$	$I_{Ld}$	$P_{Ld}$	$I_{Hd}$
A	A	A	kW	kVA	A	kW	A	kW		
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	545	250	306	420	250	363	200
0505A-3	R11	401	505	560	250	350	480	250	363	200
0585A-3	R11	505	585	730	315	405	556	315	442	250
0650A-3	R11	569	650	730	355	450	618	355	505	250
$U_N = 500\text{ V}$										
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
0260A-5	R11	205	260	418	160	225	247	160	240	132
0361A-5	R11	257	361	542	200	313	343	200	260	160
0414A-5	R11	321	414	542	250	359	393	250	361	200
0460A-5	R11	404	460	560	315	398	450	315	414	250
0503A-5	R11	455	503	560	355	436	492	355	460	315
$U_N = 690\text{ V}$										
0174A-7	R11	149	174	274	160	208	165	160	142	132
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	520	400	514	420	400	370	355
3AXD10000425795										

### ■ UL (NEC) ratings

Drive type ACS880-37-...	Frame size	Input cur- rent	Max cur- rent	App. power	Output ratings			
					Light-overload use		Heavy-duty use	
					$I_1$	$I_{max}$	$S_N$	$I_{Ld}$
A	A	kVA	A	hp	A	hp		
$U_N = 480\text{ V}$								
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
0260A-5	R11	205	418	225	260	200	240	200
0302A-5	R11	239	498	262	302	250	260	200

Drive type ACS880-37-....	Frame size	Input current	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
0361A-5	R11	257	542	313	361	300	302	250
0414A-5	R11	321	542	359	414	350	361	300
0460A-5	R11	404	560	398	430	350	414	350
0503A-5	R11	455	560	436	483	400	483	400
$U_N = 600 \text{ V}$								
0174A-7	R11	149	274	208	168	175	144	150
0210A-7	R11	186	384	251	200	200	174	175
0271A-7	R11	232	411	324	257	250	210	200
0330A-7	R11	293	480	394	320	300	271	250
0370A-7	R11	330	520	442	360	350	330	300
0430A-7	R11	375	520	514	420	450	370	350
3AXD10000425795								

## ■ 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 temperature.
$P_N$	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.

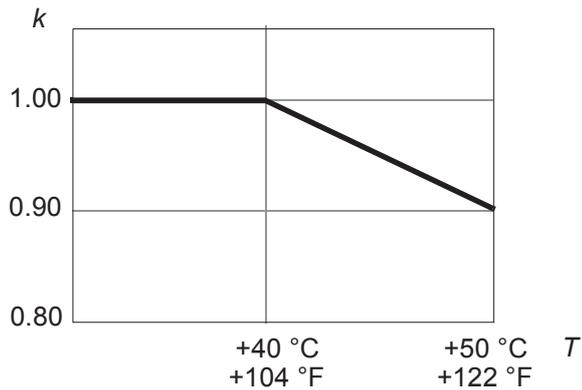
The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.

## ■ 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):



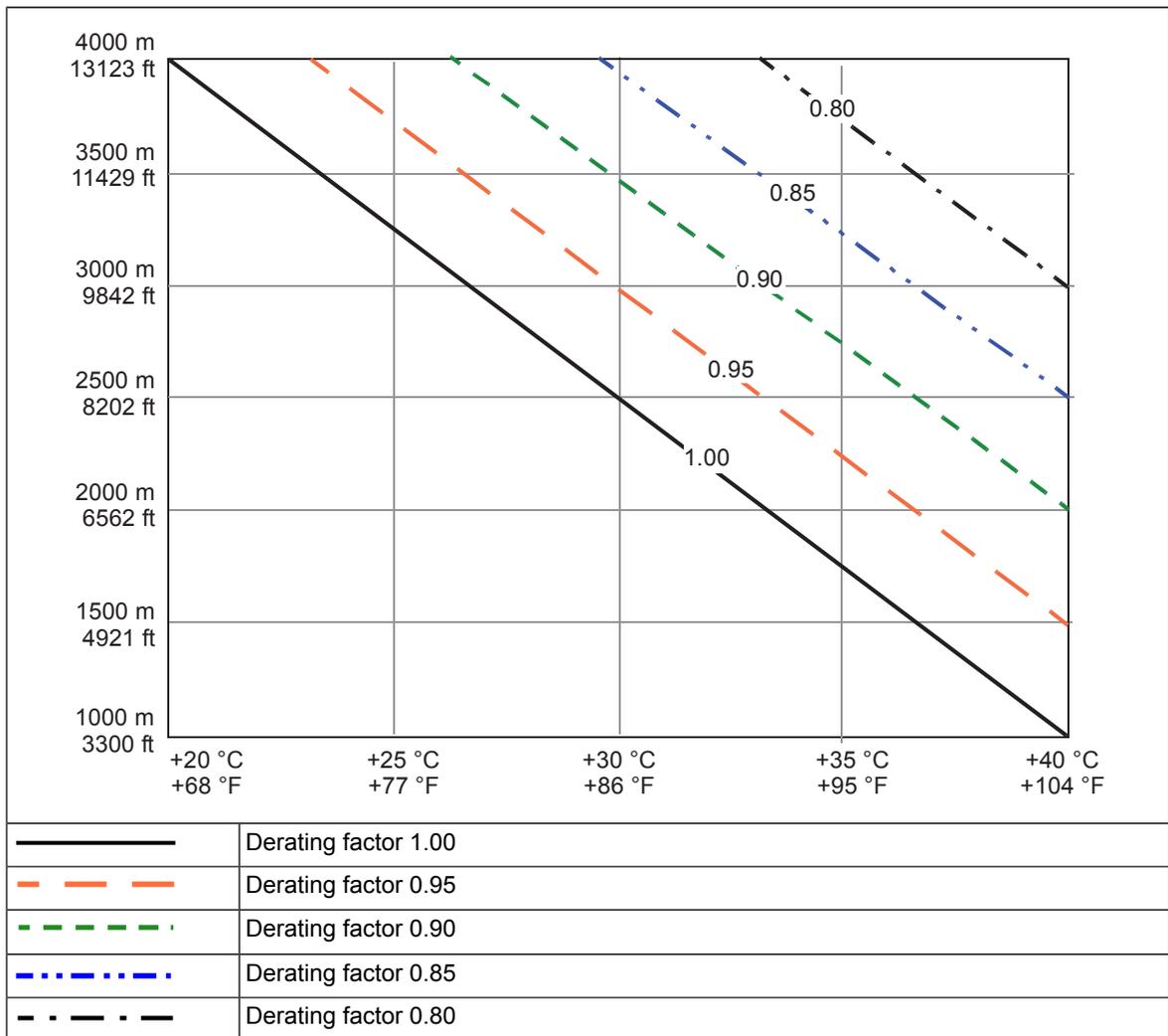
For example:

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

### Altitude derating

At altitudes 1000 ... 2000 m (3281 ... 6562 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. For altitudes above 2000 m (6562 ft), contact ABB.

If surrounding air temperature is below +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.

#### *Ex motor, sine filter, low noise*

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
$U_N = 400\text{ V}$												
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
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
$U_N = 500\text{ V}$												
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
0260A-5	247	160	235	228	234	160	222	216	229	160	216	210
0302A-5 ( $U_N = 480\text{ V}$ )	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
$U_N = 690\text{ V}$												
0174A-7	153	145	145	125	157	160	149	128	81	90	77	66
0210A-7	185	176	176	153	189	200	180	157	98	110	93	81
0271A-7	238	226	226	185	244	250	231	189	126	132	119	98
0330A-7	290	282	282	238	297	315	288	244	154	160	149	126
0370A-7	326	317	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
$U_N = 400\text{ V}$								
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
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
$U_N = 500\text{ V}$								
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
0260A-5	260	160	247	240	213	160	203	198
0302A-5 ( $U_N = 480\text{ V}$ )	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
$U_N = 690\text{ V}$								
0174A-7	174	160	165	142	100	110	95	82
0210A-7	210	200	200	174	121	132	115	100
0271A-7	271	250	257	210	156	160	148	121

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
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).	

## 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 <sup>2</sup> s	V	Manufacturer	Type	Size
<i>U<sub>N</sub></i> = 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
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
<i>U<sub>N</sub></i> = 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
0260A-5	205	400	74000	690	Bussmann	170M5408	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
<i>U<sub>N</sub></i> = 690 V							
0174A-7	149	400	74000	690	Bussmann	170M5408	2
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 <sup>2</sup> s	V	Manufacturer	Type	Size
<i>U<sub>N</sub></i> = 400 V							
0105A-3	88	-	-	-	-	-	-
0145A-3	120	-	-	-	-	-	-
0169A-3	144	-	-	-	-	-	-
0206A-3	176	-	-	-	-	-	-
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
<i>U<sub>N</sub></i> = 500 V							
0101A-5	71	-	-	-	-	-	-
0124A-5	96	-	-	-	-	-	-
0156A-5	115	-	-	-	-	-	-
0180A-5	141	-	-	-	-	-	-
0260A-5	205	-	-	-	-	-	-
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
<i>U<sub>N</sub></i> = 690 V							
0174A-7	149	-	-	-	-	-	-
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

**Note:**

- See also [Implementing thermal overload and short-circuit protection \(page 99\)](#).
- Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.
- Fuses from other manufacturers can be used if they 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 is equipped for 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. **Make sure that the operating time of the fuse is below 0.1 seconds.** The operating time depends on the fuse type, supply network impedance and the cross-sectional area, material and length of the supply cable. The fuses must be of the “non-time delay” type. Obey local regulations.

Drive type ACS880-37-...	Input current (A)	Fuse (one fuse per phase)				
		A	V	Manufacturer	Type	UL class / Size
$U_N = 400 \text{ V}$						
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
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
$U_N = 480 \text{ V}$						
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
0260A-5	205	400	600	Bussmann	170M5408	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
$U_N = 600 \text{ V}$						
0174A-7	146	315	600	Bussmann	170M4410	1
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

**Note:**

- See also [Implementing thermal overload and short-circuit protection \(page 99\)](#).
- Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.
- Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

**Dimensions and weights**

Frame size	Height <sup>1)</sup>				Width <sup>2)</sup>		Depth <sup>3)</sup>				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

- 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)**

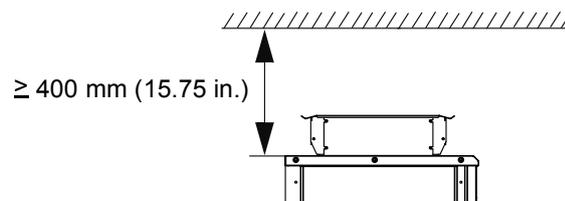
Frame size	Height				Width		Depth		Weight	
	IP22/42		IP54							
	mm	in	mm	in	mm	in	mm	in	kg	lb
$U_N = 400\text{ V}$										
0105A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0145A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0169A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0206A-3	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
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
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
$U_N = 500\text{ V}$										
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

Frame size	Height				Width		Depth		Weight	
	IP22/42		IP54		mm	in	mm	in	kg	lb
	mm	in	mm	in						
0180A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	330	728
0260A-5	2145	84.45	2315	91.14	600	23.62	646	25.43	340	750
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
$U_N = 690 \text{ V}$										
0174A-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

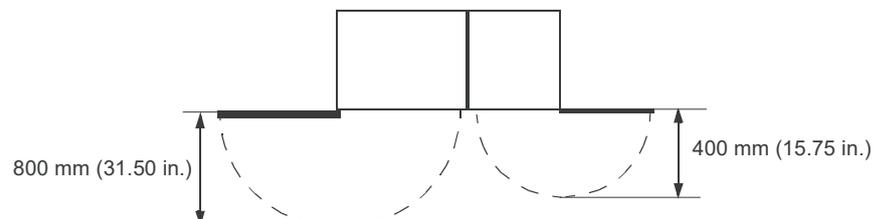
## Free space requirements

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 <sup>3)</sup>				Heat dissipation		Noise	
	-		+E206		-	+E206 <sup>1)</sup>	-	+E206 <sup>2)</sup>
	m <sup>3</sup> /h	ft <sup>3</sup> /min	m <sup>3</sup> /h	ft <sup>3</sup> /min	kW	kW	dB(A)	dB(A)
<b>U<sub>N</sub> = 400 V</b>								
0105A-3	700	412	*	*	2.22	0.63	70	70
0145A-3	700	412	*	*	3.33	0.55	70	70
0169A-3	700	412	*	*	3.57	0.55	70	70
0206A-3	805	474	*	*	4.44	0.9	70	70
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
<b>U<sub>N</sub> = 500 V</b>								
0101A-5	700	412	*	*	2.32	0.63	70	70
0124A-5	700	412	*	*	3.14	0.63	70	70
0156A-5	700	412	*	*	3.54	0.55	70	70
0180A-5	805	474	*	*	4.27	0.55	70	70
0260A-5	2100	1279	*	*	6.86	0.9	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
<b>U<sub>N</sub> = 690 V</b>								
0174A-7	2100	1279	*	*	6.86	0.93	77	77
0210A-7	2100	1279	*	*	8.46	0.93	77	77
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<sup>3</sup>/h (309 ft<sup>3</sup>/min).  
Air flow for the 800 mm (31.50 in) wide brake resistor cubicle: 2210 m<sup>3</sup>/h (1300 ft<sup>3</sup>/min).

\* Natural convection

## 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	
	Qty	Type		Heat dissipation	Air flow
			A	kW	m <sup>3</sup> /h (ft <sup>3</sup> /min)
$U_N = 400\text{ V}$					
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	*
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)
$U_N = 500\text{ V}$					
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	*
0260A-5	1	B84143V0230S229	234	0.90	*
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)
$U_N = 690\text{ V}$					
0174A-7	1	B84143V0207S230	157	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 cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for nominal current. For drawings of the terminals, see chapter *Dimension drawings (page 231)*.

Drive type ACS880-37-...	Frame size	IEC 1)		UL 2)
		Cu cable size	Al cable size	Cu cable size
		mm <sup>2</sup>	mm <sup>2</sup>	AWG/kcmil
<b><math>U_N = 400\text{ V}</math></b>				
0105A-3	R8	3×50	3×70	1
0145A-3	R8	3×95	3×120	2/0
0169A-3	R8	3×120	3×150	3/0
0206A-3	R8	3×150	3×240	250 MCM
0293A-3	R11	2 × (3×95)	2 × (3×120)	2 × 3/0
0363A-3	R11	2 × (3×120)	2 × (3×185)	2 × 4/0
0442A-3	R11	2 × (3×150)	3 × (3×120)	2 × 250
0505A-3	R11	3 × (3×95)	3 × (3×150)	2×500 MCM or 3×250 MCM
0585A-3	R11	3 × (3×120)	3 × (3×185)	2×600 MCM or 3×300 MCM
0650A-3	R11	3 × (3×150)	3 × (3×240)	2×700 MCM or 3×350 MCM
<b><math>U_N = 500\text{ V}</math></b>				
0101A-5	R8	3×50	3×70	1
0124A-5	R8	3×95	3×95	2/0
0156A-5	R8	3×120	3×150	3/0
0180A-5	R8	3×150	3×185	250 MCM
0260A-5	R11	2 × (3×70)	2 × (3×95)	2 × 2/0
0302A-5	R11	2 × (3×120)	2 × (3×185)	2 × 250 MCM
0361A-5	R11	2 × (3×120)	2 × (3×185)	2 × 250 MCM
0414A-5	R11	2 × (3×150)	2 × (3×240)	2 × 250 MCM
0460A-5	R11	2 × (3×185)	3 × (3×120)	2×400 MCM or 3×4/0
0503A-5	R11	3 × (3×95)	3 × (3×150)	2×500 MCM or 3×250 MCM
<b><math>U_N = 690\text{ V}</math></b>				
0174A-7	R11	3×120	2 × (3×70)	4/0
0210A-7	R11	3×185	2 × (3×95)	300 MCM
0271A-7	R11	3×240	2 × (3×120)	400 MCM
0330A-7	R11	2 × (3×95)	2 × (3×150)	2 × 250 MCM or 3×2/0
0370A-7	R11	2 × (3×120)	2 × (3×150)	2 × 300 MCM or 3×3/0
0430A-7	R11	2 × (3×185)	3 × (3×120)	3×120) 2 × 350 MCM or 3×4/0

- 1) The cable sizing is based on max. 9 cables laid on a cable ladder side by side, three ladder type trays one on top of the other, ambient temperature 30 °C, PVC insulation, surface temperature 70 °C (EN 60204-1 and IEC 60364-5-52/2001). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive.
- 2) The cable sizing is based on NEC Table 310-16 for copper wires, 75 °C (167 °F) wire insulation at 40 °C (104 °F) ambient temperature. Not more than three current-carrying conductors in raceway or cable or earth (directly buried). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

## Tightening torques

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

### ■ Electrical connections

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

### ■ Mechanical connections

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

### ■ Insulation supports

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

### ■ Cable lugs

Size	Max. torque	Note
M8	15 N·m (11 lbf-ft)	Strength class 8.8
M10	32 N·m (23.5 lbf-ft)	Strength class 8.8
M12	50 N·m (37 lbf-ft)	Strength class 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 \(page 231\)](#).

The location and size of power cable terminals are shown in [Dimension drawings \(page 231\)](#).

## ■ 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, UDC+/R+, UDC- and R-			Grounding terminals	
		Max. phase conductor size	Bolt size	Tightening torque	Bolt size	Tightening torque
		mm <sup>2</sup>				N·m
R8	6...12	185	M10	20...40 N·m	M12	50...75 N·m
R11	12	3×240 or 4×185	M12	50...75 N·m	M12	50...75 N·m

## ■ North America

Frame size	Terminals L1, L2, L3, U2, V2, W2, UDC+/R+, UDC- and R-			Grounding terminals	
	Max. phase conductor size	Busbar bolt size – Hole spacing	Tightening torque	Bolt size	Tightening torque
	AWG/kcmil		bf·ft		bf·ft
R8	350 MCM...1×500 MCM or 4×350 MCM	M12 (7/16") × 1 – 1.75"	15...30	M10 (3/8")	37...55
R11	1×500 MCM or 4×350 MCM	M12 (7/16") × 3 – 1.75"	37...55	M10 (3/8")	37...55

## Terminal data for the drive control unit

See chapter [Control units of the drive \(page 133\)](#).

## Electrical power network specification

<b>Voltage (<math>U_1</math>)</b>	<p>ACS880-37-xxxx-3 drives: 380...415 VAC 3-phase +10%...-15%. This is indicated in the type designation label as typical input voltage level. 3 ~ 400 V AC.</p> <p>ACS880-37-xxxx-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.</p> <p>ACS880-37-xxxx-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.</p>
<b>Network type</b>	TN (grounded) and IT (ungrounded) systems
<b>Frequency (<math>f_1</math>)</b>	50/60 Hz, Variation $\pm$ 5% of nominal frequency
<b>Imbalance</b>	Max. $\pm$ 3% of nominal phase-to-phase voltage
<b>Short-circuit withstand strength (IEC 61439-1)</b>	<p>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:</p> <ul style="list-style-type: none"> <li>• 400 A for frame R8</li> <li>• 1250 A for frame R11.</li> </ul>
<b>Short-circuit current protection (UL 508C)</b>	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.

<b>Short-circuit current protection (CSA C22.2 No. 14-13)</b>	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.						
<b>Power factor</b>	$\cos \phi_1 = 1$ , $\cos \phi$ (total) = 0.99						
<b>Harmonic distortion</b>	<p>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.</p> <p>The table below shows typical values of the drive for short-circuit ratio (<math>I_{sc}/I_1</math>) 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.</p> <table border="1" data-bbox="533 600 1433 707"> <thead> <tr> <th>Nominal bus voltage V at PCC</th> <th>THDi (%)</th> <th>THDv (%)</th> </tr> </thead> <tbody> <tr> <td><math>V \leq 690</math> V</td> <td>3*</td> <td>&lt; 3**</td> </tr> </tbody> </table> <p>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:</p> <p>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:</p> $THDv = \frac{\sqrt{\frac{\sum_{n=2}^{40} U_n^2}{2}}}{U_1} \cdot 100\%$ <p>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.</p> $THDi = \frac{\sqrt{\frac{\sum_{n=2}^{40} I_n^2}{2}}}{I_1} \cdot 100\%$ <p><math>I_{sc}/I_1</math> Short-circuit ratio  <math>I_{sc}</math> Maximum short-circuit current at PCC  <math>I_1</math> Continuous rms input current of the drive  <math>I_n</math> Amplitude of the current harmonic n  <math>U_1</math> Supply voltage  <math>U_n</math> Amplitude of the voltage harmonic n</p> <p>* The short-circuit ratio can influence the THDi value                  ** Other loads can influence the THDv value</p>	Nominal bus voltage V at PCC	THDi (%)	THDv (%)	$V \leq 690$ V	3*	< 3**
Nominal bus voltage V at PCC	THDi (%)	THDv (%)					
$V \leq 690$ V	3*	< 3**					

## Motor connection data

<b>Motor types</b>	Asynchronous AC induction motors, permanent magnet synchronous motors, AC induction servomotors, ABB synchronous reluctance (SynRM) motors
<b>Voltage (<math>U_1</math>)</b>	0 to $U_1$ , 3-phase symmetrical, This is indicated in the type designation label as typical output voltage level as $3 \sim 0 \dots U_1, U_{\max}$ at the field weakening point.
<b>Frequency (<math>f_1</math>)</b>	0...±500 Hz. Operation above 120 Hz can require type-specific derating, see section <a href="#">High speed mode (page 209)</a> . For drives with sine filter (option +E206): 120 Hz. For drives with du/dt filter (option +E205): 120 Hz.
<b>Current</b>	See section <a href="#">Ratings (page 203)</a> .
<b>Switching frequency</b>	3 kHz (typically)

## Control unit connection data

See chapter [Control units of the drive \(page 133\)](#).

## Efficiency

97% at nominal power level.

## Protection classes

<b>Degrees of protection (IEC/EN 60529)</b>	IP22 IP42 (option +B054) IP54 (option +B055)
<b>Overvoltage category (IEC/EN 60664-1)</b>	III
<b>Protective class (IEC/EN 61800-5-1)</b>	I

## Ambient conditions

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

	<b>Operation installed for stationary use</b>	<b>Storage in the protective package</b>	<b>Transportation in the protective package</b>
<b>Air temperature</b>	0 ... +40 °C (+32 ... +104 °F). No condensation allowed. Output derated in the range +40 ... +50 °C (+104 ... +122 °F).	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
<b>Relative humidity</b>	Max. 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		

	<b>Operation installed for stationary use</b>	<b>Storage in the protective package</b>	<b>Transportation in the protective package</b>
<b>Contamination</b>	IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations 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
<b>Pollution degree</b>	2		
<b>Vibration</b> IEC/EN 61800-5-1 IEC 60068-2-6:2007, EN 60068-2-6:2008 Environmental testing Part 2: Tests –Test Fc: Vibration (sinusoidal)	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 <sup>2</sup> (32.8 ft/s <sup>2</sup> )
<b>Shock</b> IEC 60068-2-27:2008, EN 60068-2-27:2009 Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	Not allowed	With packing max. 100 m/s <sup>2</sup> (328 ft/s <sup>2</sup> ) 11 ms	With packing max. 100 m/s <sup>2</sup> (328 ft/s <sup>2</sup> ) 11 ms

## Auxiliary circuit power consumption

<b>Cabinet heater and lighting (options +G300 and +G301)</b>	150 W
<b>External uninterruptible power supply (option +G307)</b>	150 W
<b>Motor heater (option +G313)</b>	According to heater type

## Materials

<b>Cabinet</b>	<ul style="list-style-type: none"> <li>• Zinc coated steel sheet</li> <li>• Polyester thermosetting powder coating on visible surfaces, color RAL 7035 and RAL 9017</li> </ul>
<b>Busbars for user power connections</b>	Tin-plated copper
<b>Air filters of IP54 units (option +B055)</b>	Inlet (door): Camfil/airComp 300-50 Outlet (roof): Camfil/airTex G150
<b>Fire safety of materials (IEC 60332-1)</b>	Insulating materials and non-metallic items: mostly self-extinctive
<b>Package</b>	<p>Standard package:</p> <ul style="list-style-type: none"> <li>• timber, polyethylene sheet (thickness 0.15 mm), stretch film (thickness 0.023 mm), PP tape, PET strap, sheet metal (steel)</li> <li>• for land and air transport when planned storage time is less than 2 months or when storage can be arranged in clean and dry conditions less than 6 months</li> <li>• can be used when products will not be exposed to corrosive atmosphere during transport or storage</li> </ul> <p>Container package:</p> <ul style="list-style-type: none"> <li>• timber, VCI sheet film (PE, thickness 0.10 mm), VCI stretch film (PE, thickness 0.04 mm), VCI emitter bags, PP tape, PET strap, sheet metal (steel)</li> <li>• for sea transport in containers</li> <li>• recommended for land and air transport when storage time prior to installation exceeds 6 months or storage is arranged in partially weather-protected conditions</li> </ul> <p>Seaworthy package:</p> <ul style="list-style-type: none"> <li>• timber, plywood, VCI sheet film (PE, thickness 0.10 mm), VCI stretch film (PE, thickness 0.04 mm), VCI emitter bags, PP tape, PET strap, sheet metal (steel)</li> <li>• for sea transport with or without containerization</li> <li>• for long storage periods in environments where roofed and humidity-controlled storage cannot be arranged</li> </ul> <p>Cabinets are fastened to the pallet with screws and braced from the top end to the package walls to prevent swaying inside the package. Package elements are attached to each other with screws.</p>
<b>Disposal</b>	<p>The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated. Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and large electrolytic capacitors need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code. Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.</p>

## Applicable standards

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

<b>European electrical safety requirements product standards</b>	
EN 61800-5-1:2007	<i>Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy</i>
IEC 60146-1-1:2009 EN 60146-1-1:2010	<i>Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements</i>
IEC 60204-1:2005+A1:2008	<i>Safety of machinery. Electrical equipment of machines. Part 1: General requirements.</i>
EN 60204-1:2006 +AC:2010	<i>Provisions for compliance: The final assembler of the machine is responsible for installing emergency-stop device.</i>
IEC 60529:1989 EN 60529:1991	<i>Degrees of protection provided by enclosures (IP code)</i>
IEC/EN 60664-1:2007	<i>Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests</i>
IEC/EN 61439-1:2011	<i>Low-voltage switchgear and control gear assemblies -- Part 1: General rules</i>
UL 50:2015	<i>Enclosures for Electrical Equipment, Non-Environmental Considerations, 13th edition</i>
UL 508A: 2016	<i>UL Standard for Safety, Power Conversion</i>
UL 508A: 2013	<i>UL Standard for Industrial Control Panels, second edition</i>
<b>EMC performance</b>	
IEC 61800-3:2004/A1:2011	<i>Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods</i>
EN 61800-3/A1:2012	

## 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).
	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.

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

## CE marking

A CE mark is attached to the drive to verify that the drive complies with the provisions of the European Low Voltage and EMC Directives. The CE marking also verifies that the drive, in regard to its safety functions (such as Safe torque off), conforms with the Machinery Directive as a safety component.

### ■ Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standard EN 61800-5-1.

### ■ Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004) covers requirements stated for drives. See section [Compliance with EN 61800-3:2004 + A1:2012 \(page 227\)](#) below.

### ■ Compliance with the European Machinery Directive

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

## 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. Maximum motor cable length is 100 meters (328 ft).



#### **WARNING!**

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

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

---

**Note:** Do not install a drive equipped with EMC filter +E202 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. Maximum motor cable length is 100 meters (328 ft).
-



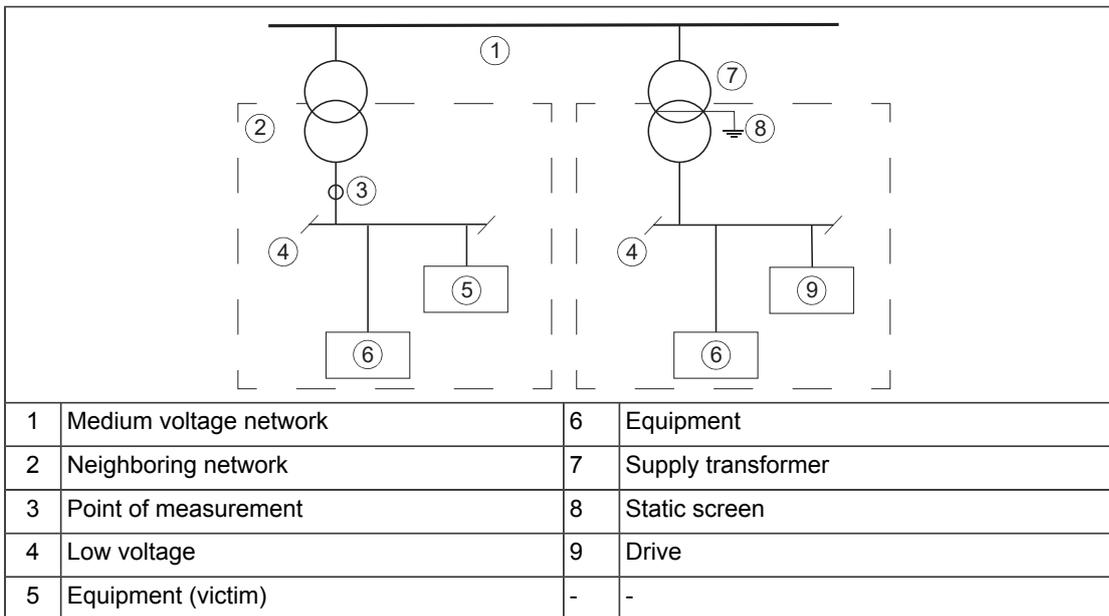
**WARNING!**

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

■ **Category C4**

The drive complies with the C4 category with these provisions:

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



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

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### 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.

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- Make sure that the drive type designation label includes the applicable marking.
  - **DANGER - Risk of electric shock.** After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.
  - The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to the enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.
  - The maximum surrounding air temperature is 40 °C (104 °F) at rated output current. The output current is derated for 40 ... 50 °C (104 ... 122 °F).
  - The drive is suitable for use in a circuit capable of delivering not more than 100000 rms symmetrical amperes, 600 V maximum when protected by the UL fuses given elsewhere in this chapter. The ampere rating is based on tests done according to the appropriate UL standard.
  - The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
  - The input cable must be protected with fuses. The fuses must 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.
- Note:** Circuit breakers must not be used without fuses in the USA. For suitable circuit breakers, contact your local ABB representative.
- 



### WARNING!

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

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- The drive is equipped with UL classified 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. For adjustments, 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.
-

## **Disclaimers**

### ■ **Generic disclaimer**

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

### ■ **Cybersecurity disclaimer**

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

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# 13

## **Dimension drawings**

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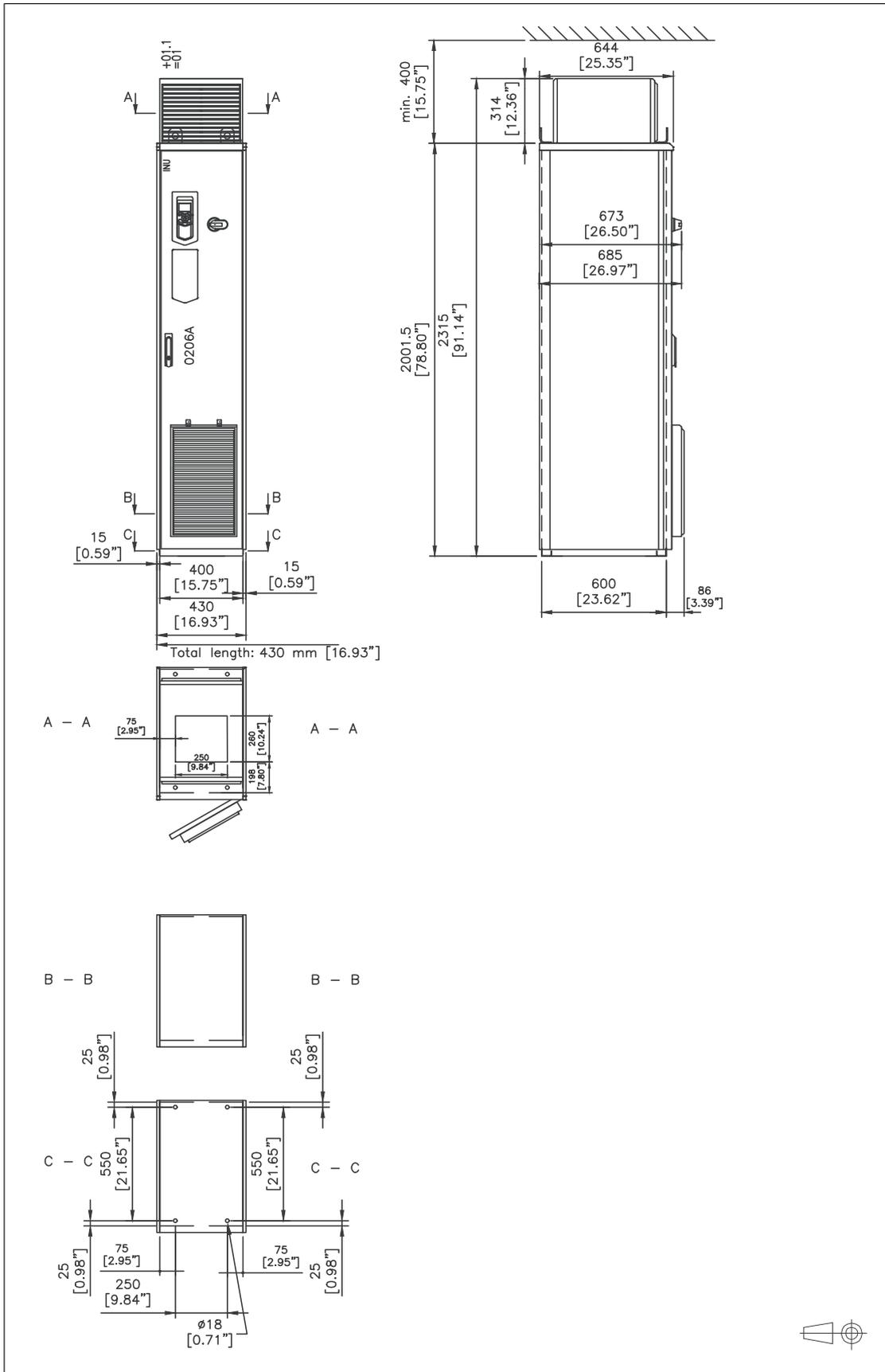
### **Contents of this chapter**

This chapter contains example dimension drawings.

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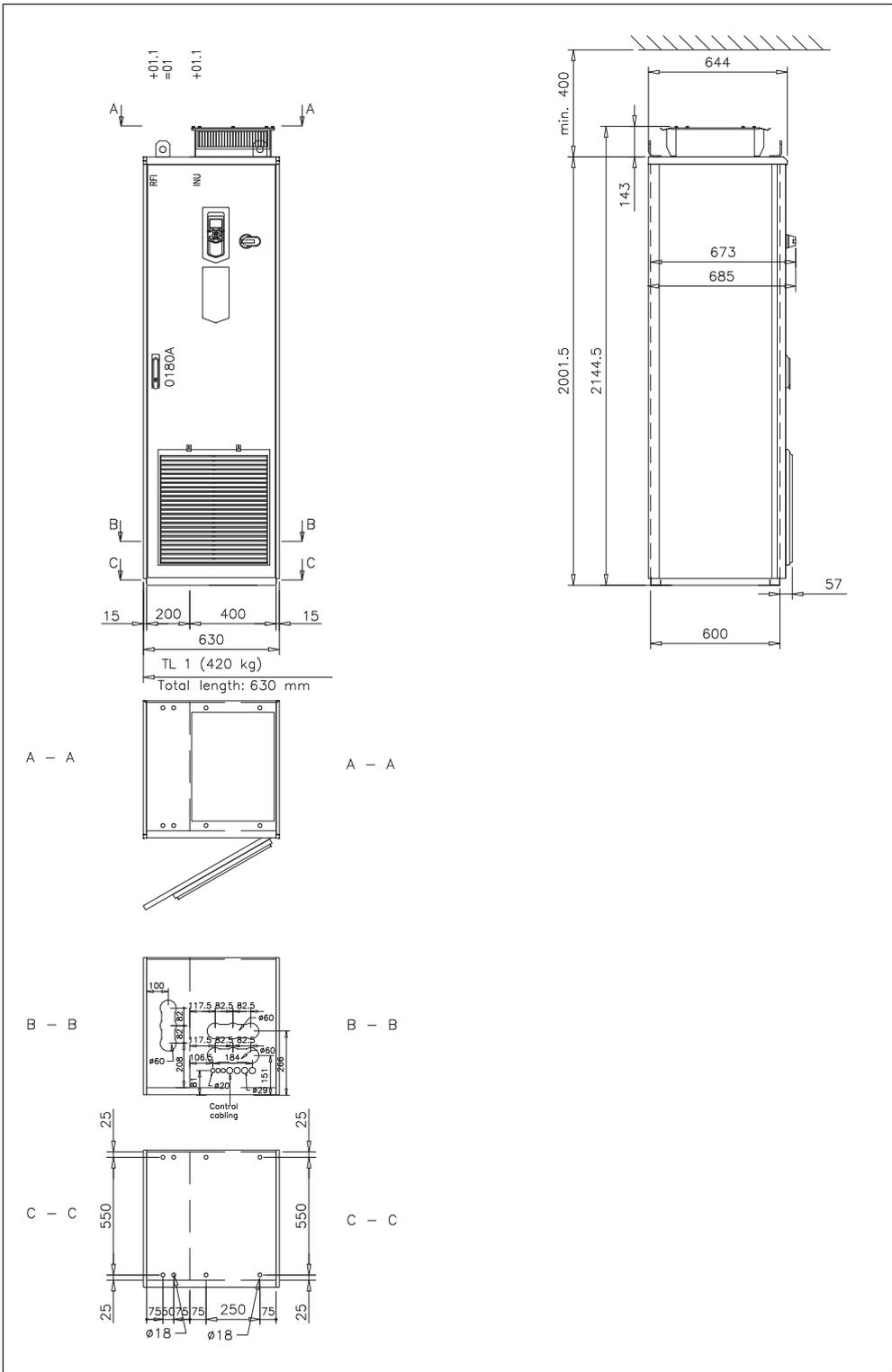
# R8 IP54 (UL Type 12, option +B055), option +C129



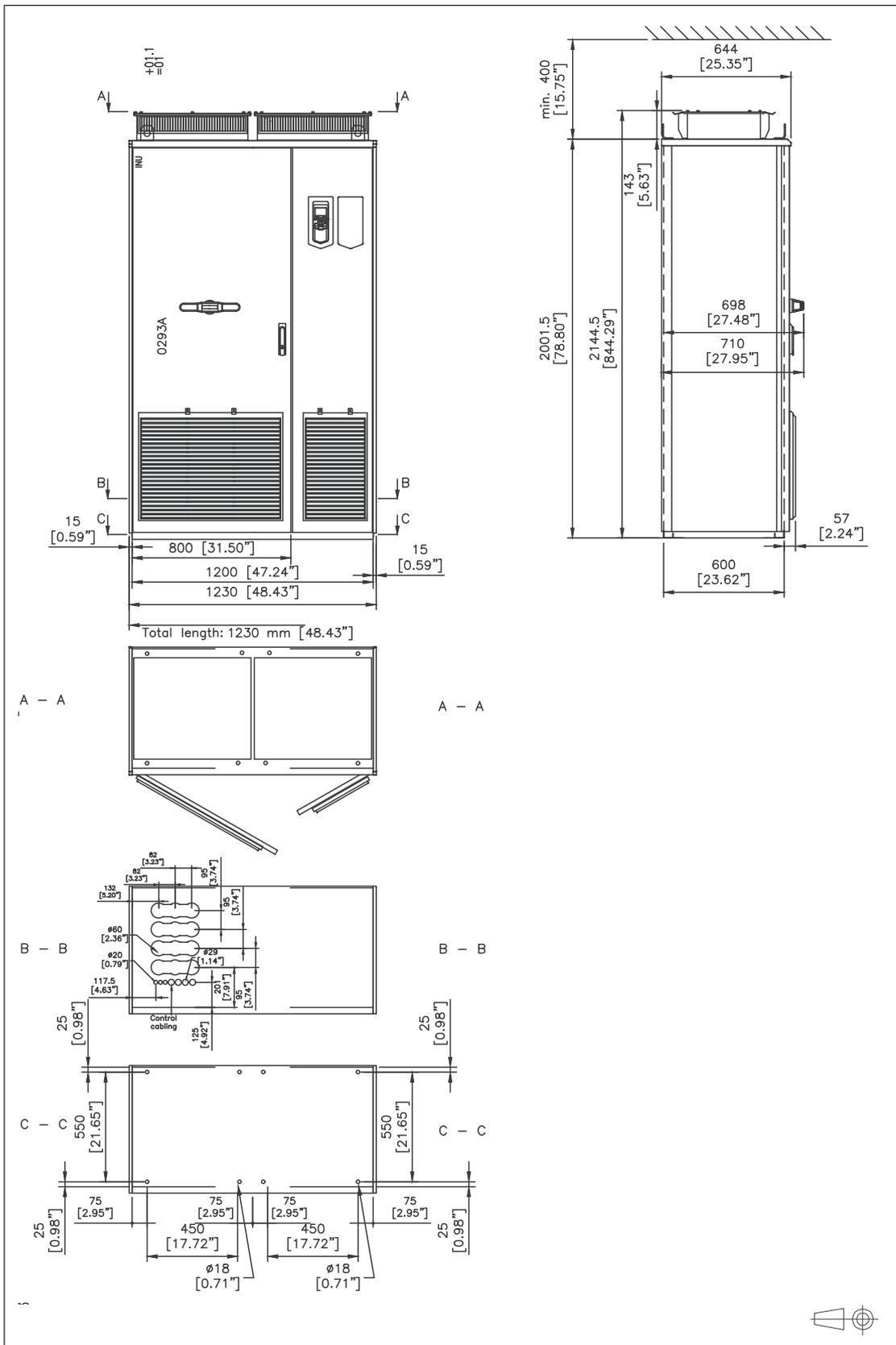




# R8 IP22 (UL Type 1): option +E202

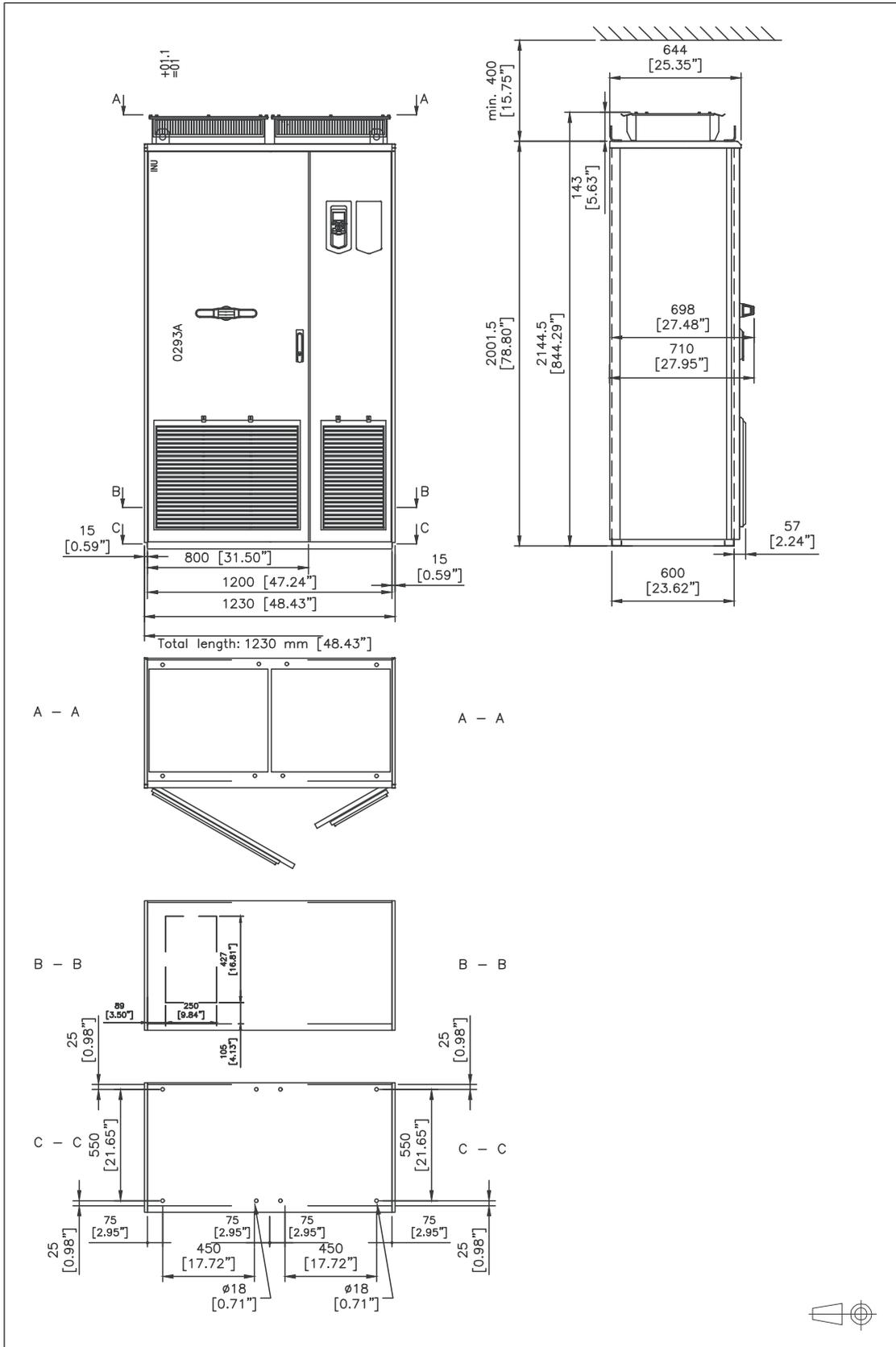


# R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054)



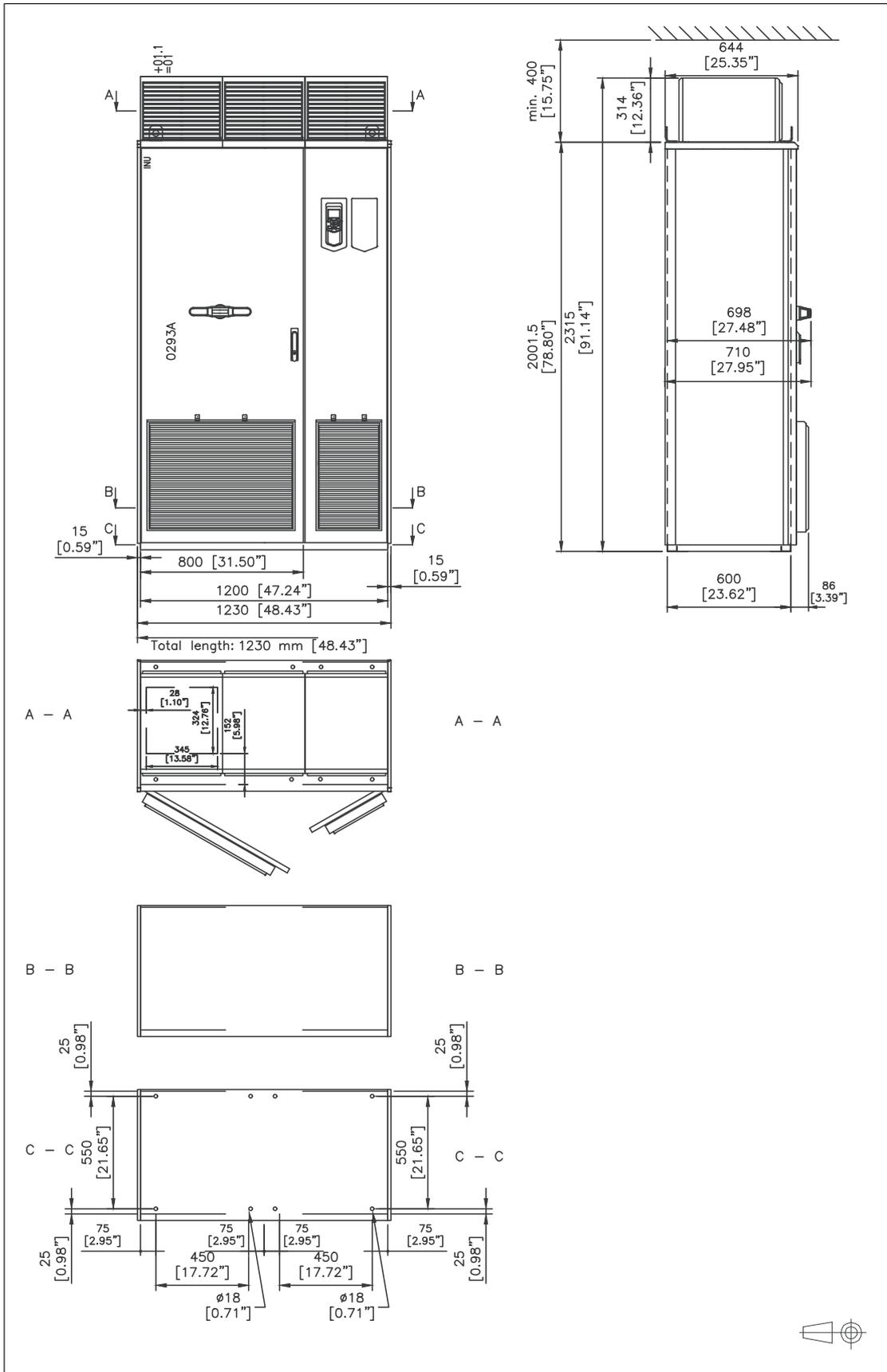


# R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): options +C129, +H350, +H352



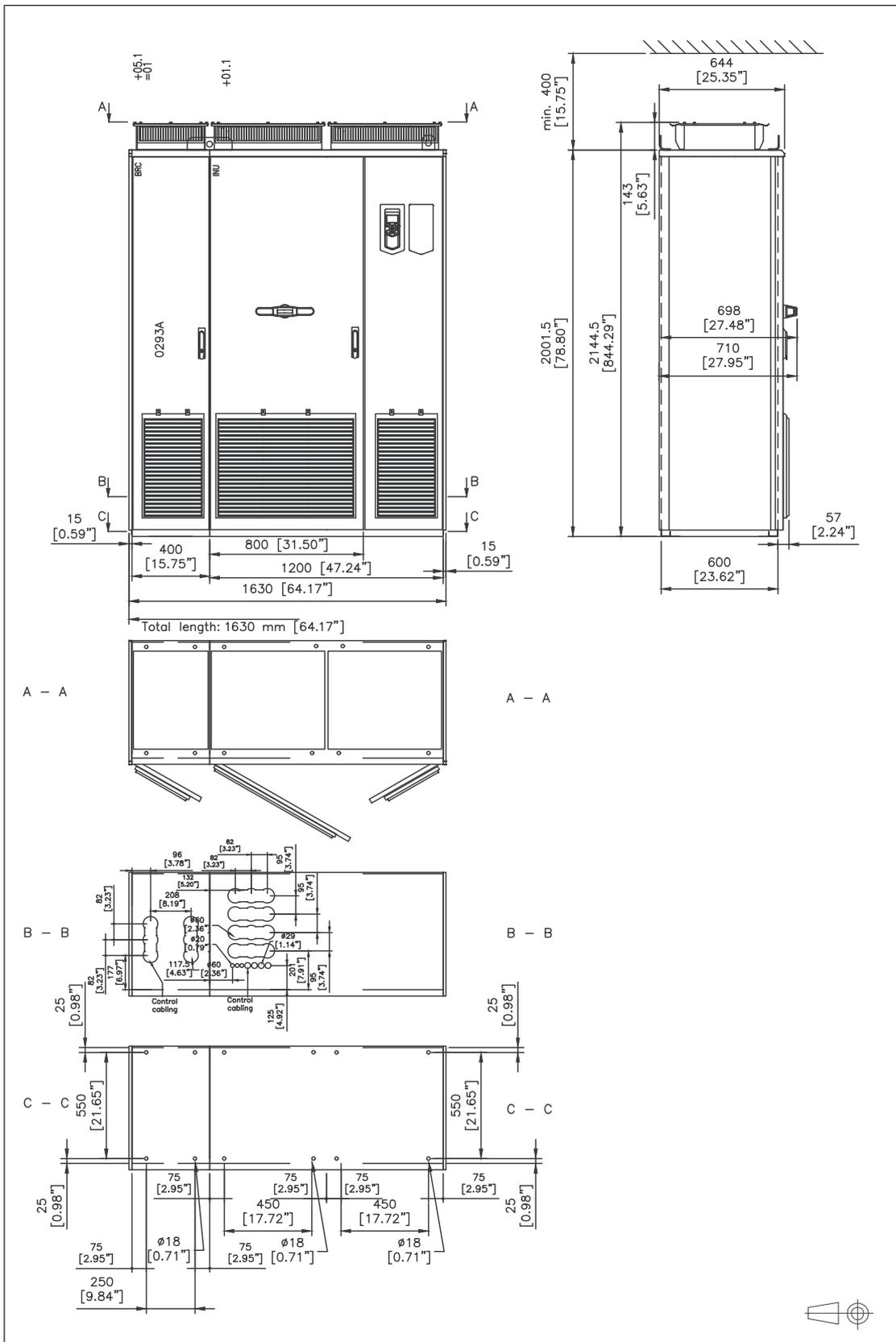


# R11 IP54 (UL Type 12, option +B055): option +C129



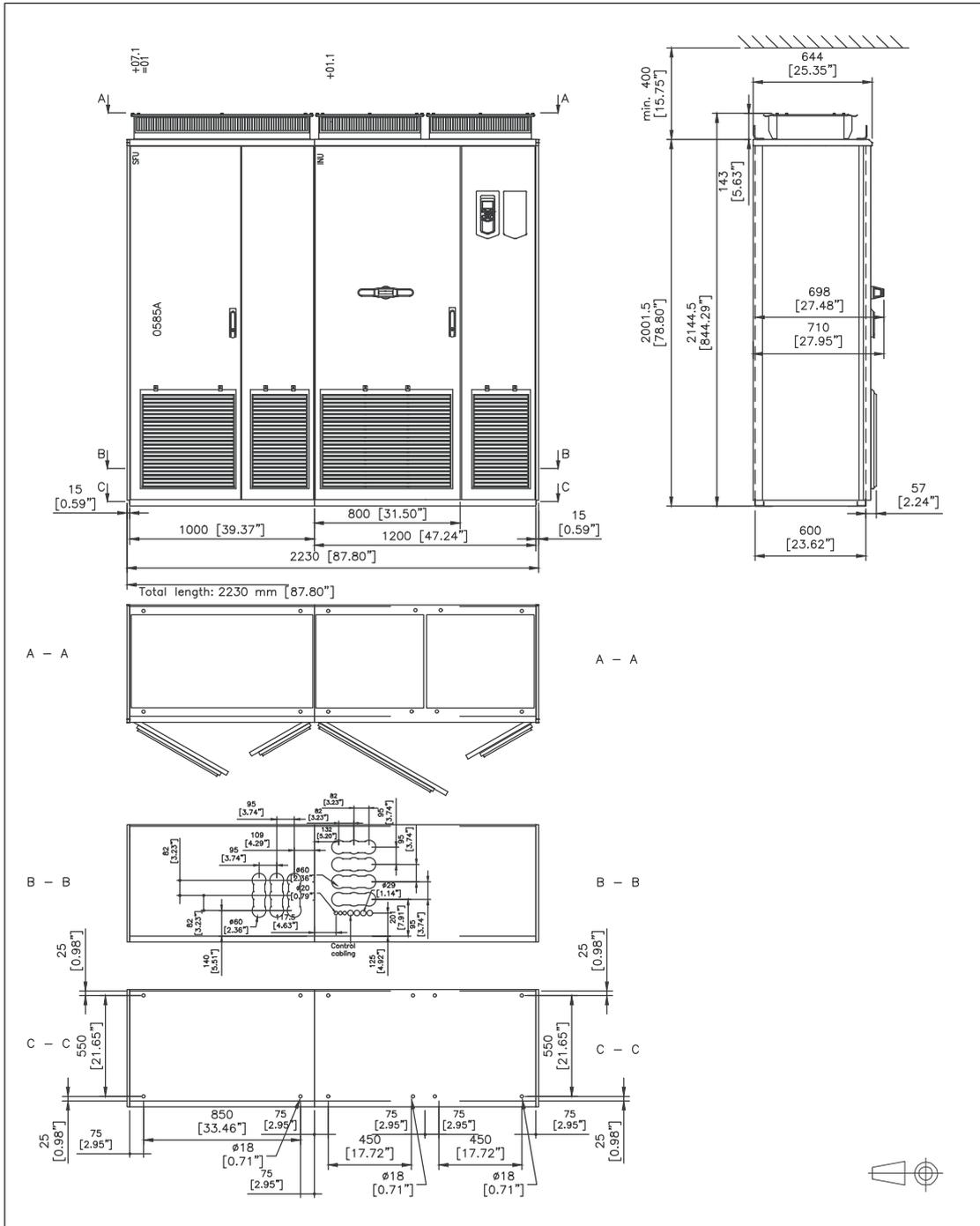


# R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +D150





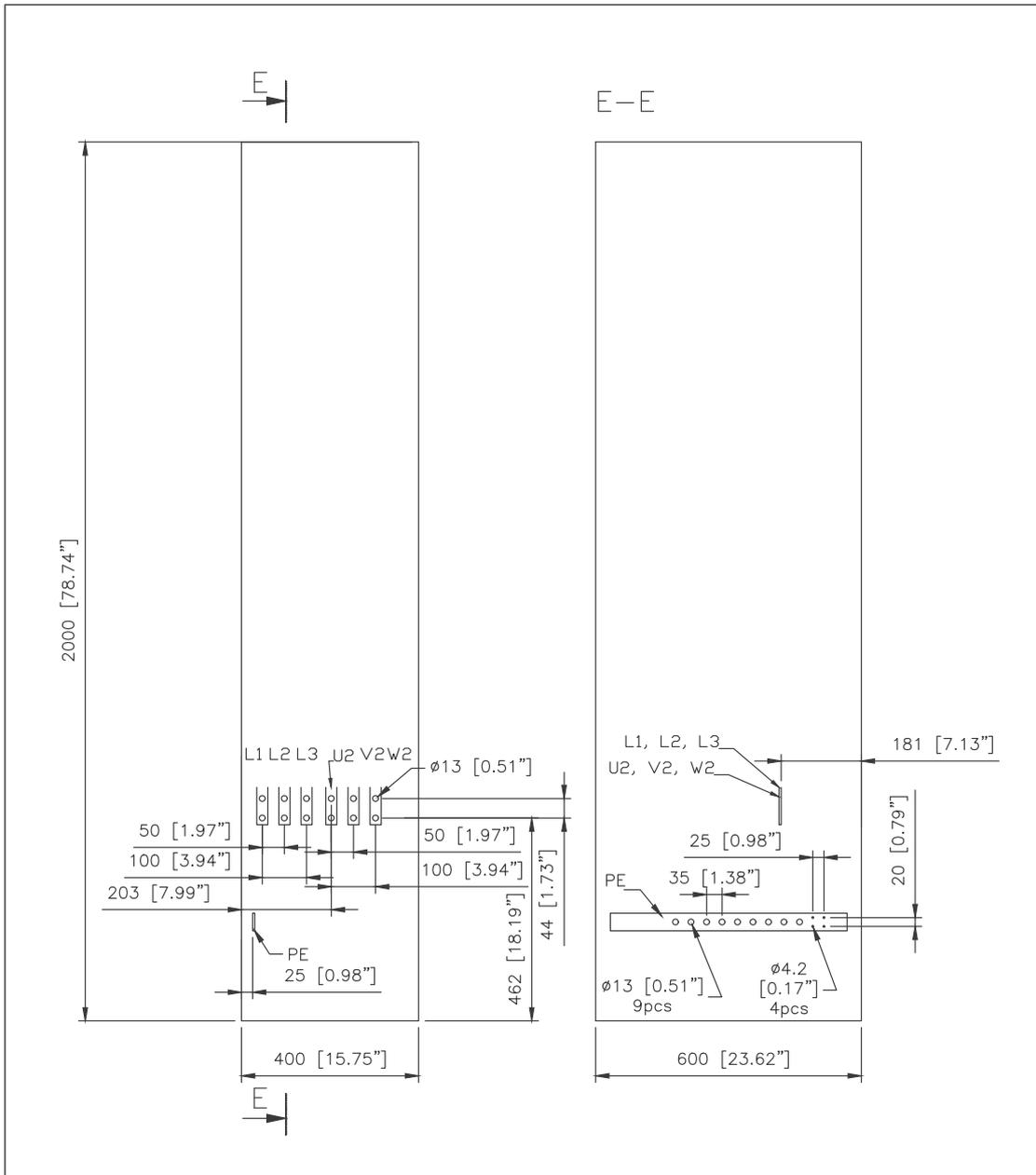
# R11 IP22 (UL Type 1) and IP42 (UL Type 1 Filtered, option +B054): option +E206



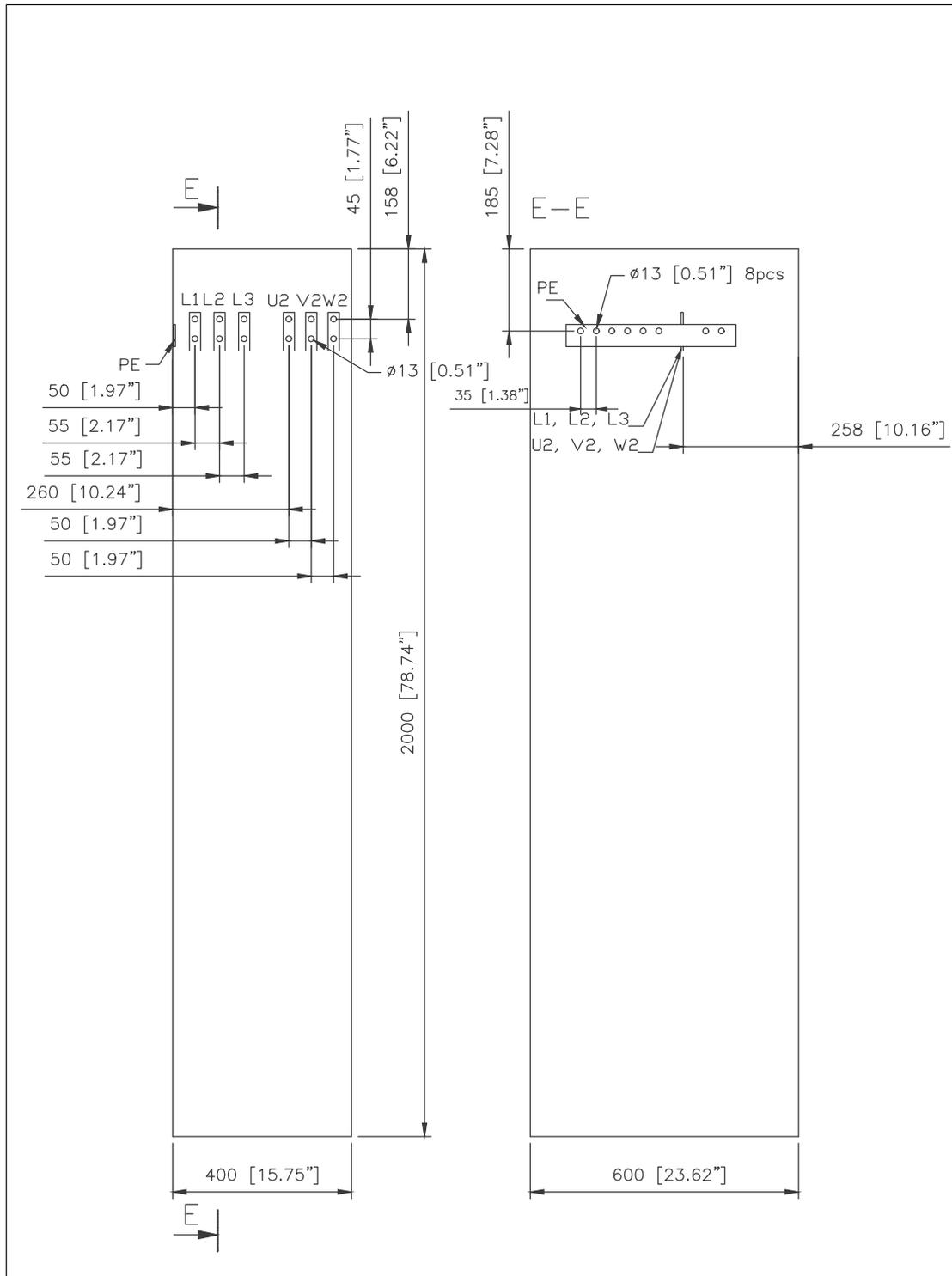


## Location and size of power cable connection terminals

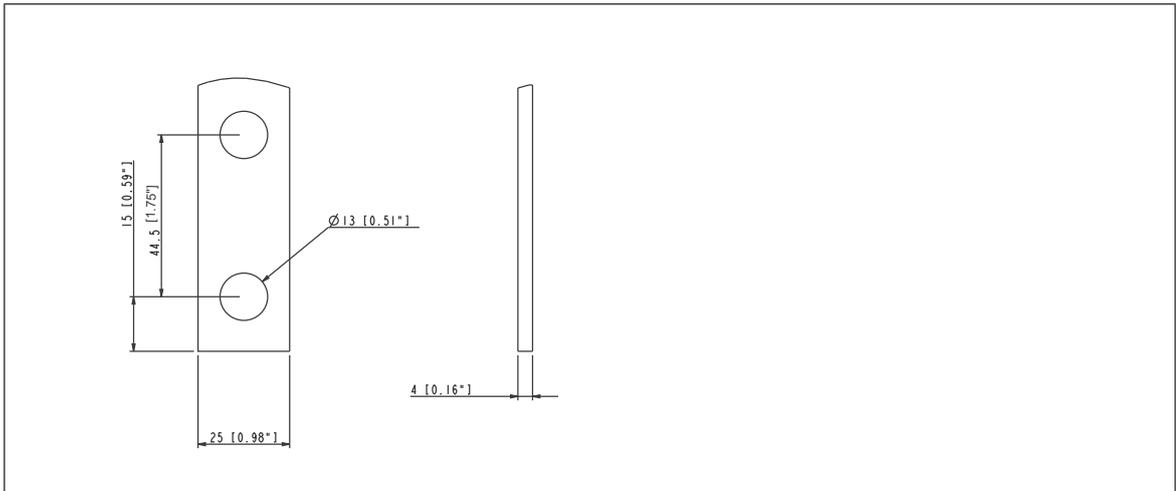
- R8 input and motor cable terminal dimensions – bottom entry and exit



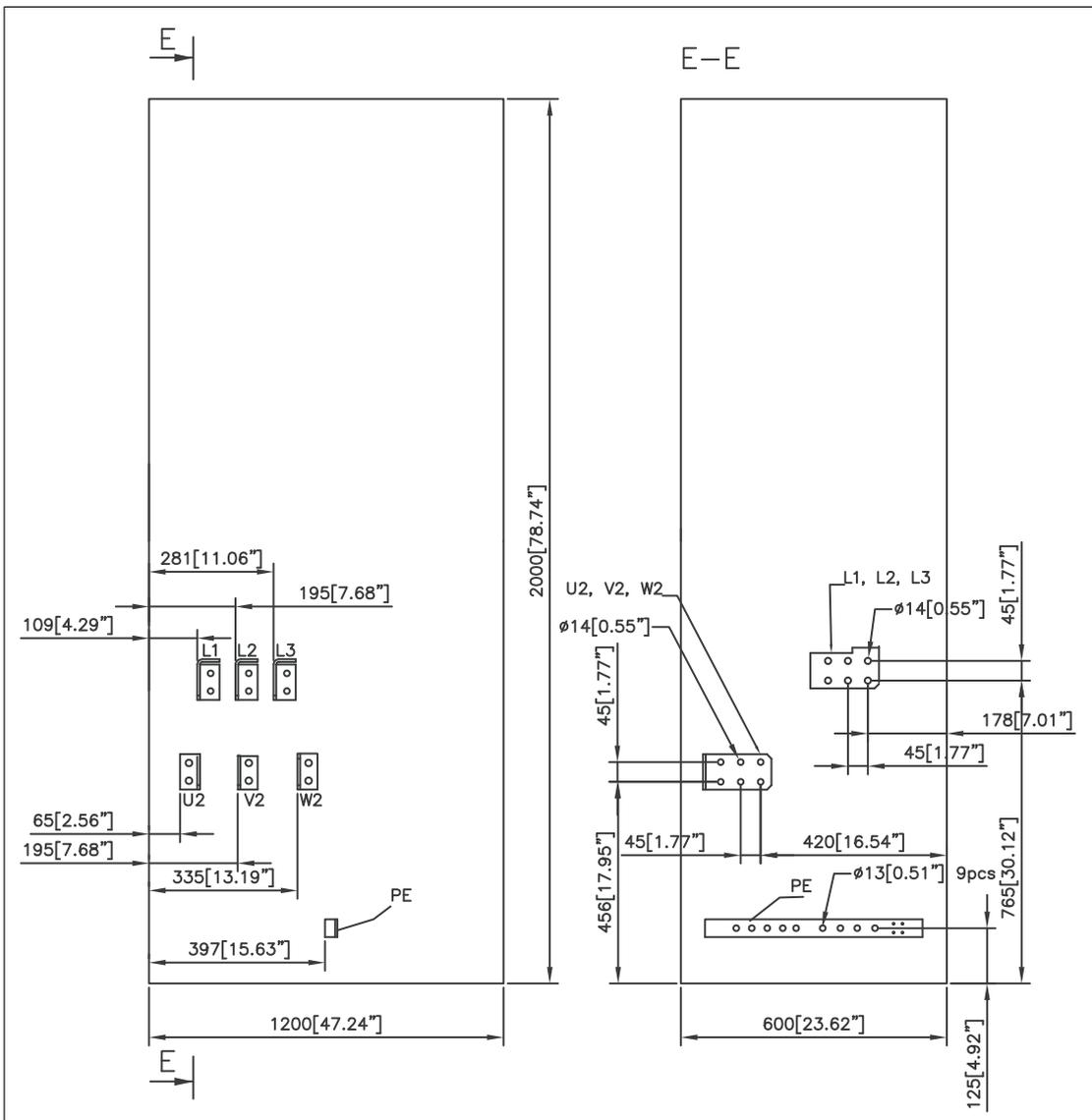
■ R8 input and motor cable terminal dimensions – top entry and exit (options +H351 and +H353)



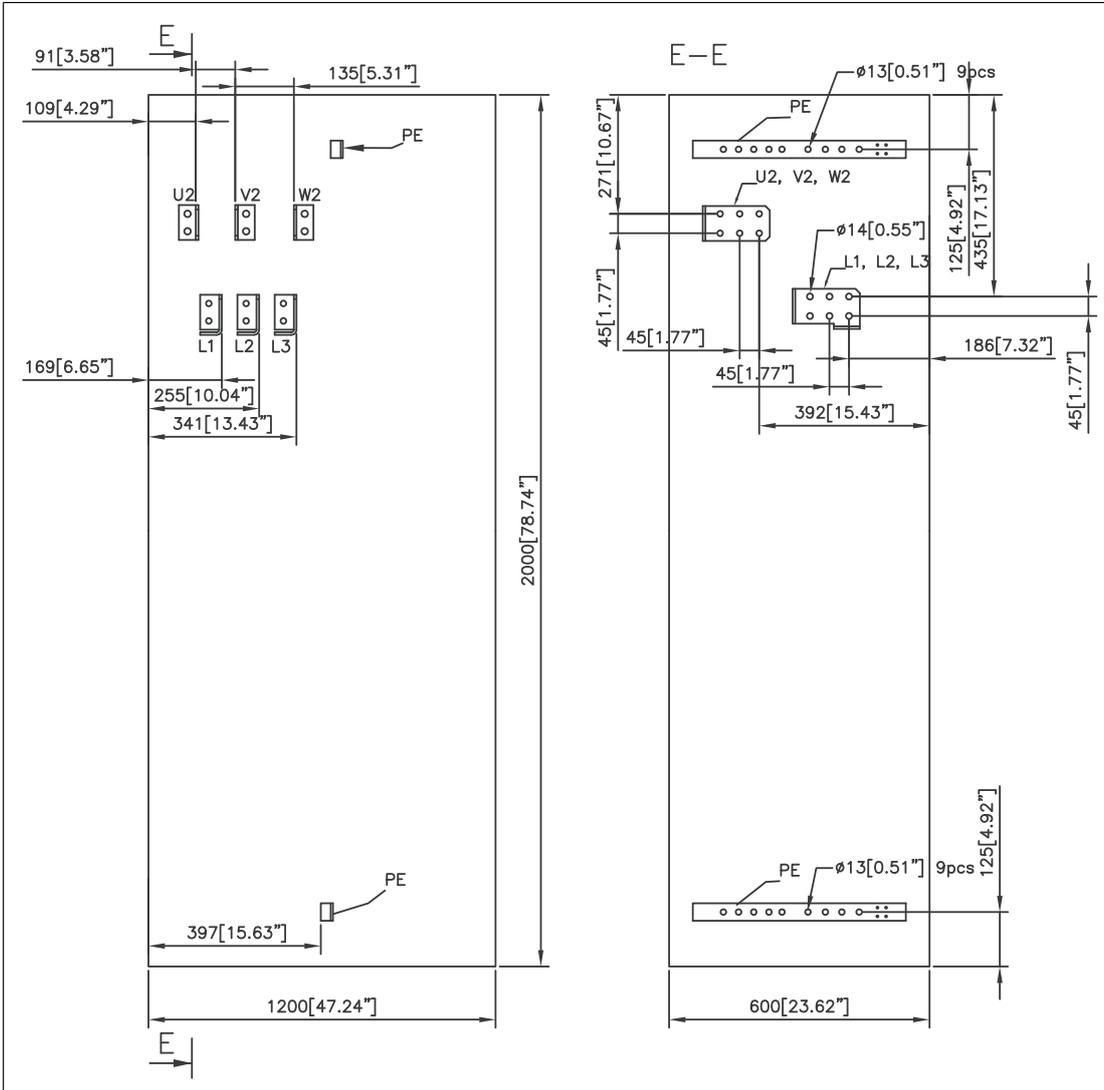
■ R8 input and motor cable terminals



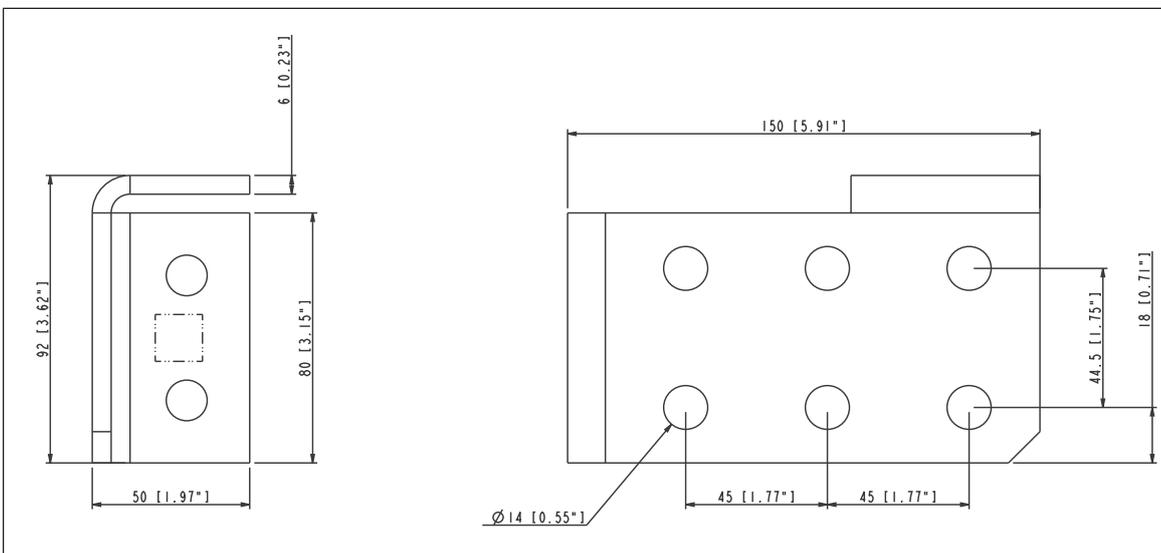
■ R11 input and motor cable terminal dimensions – bottom entry and exit



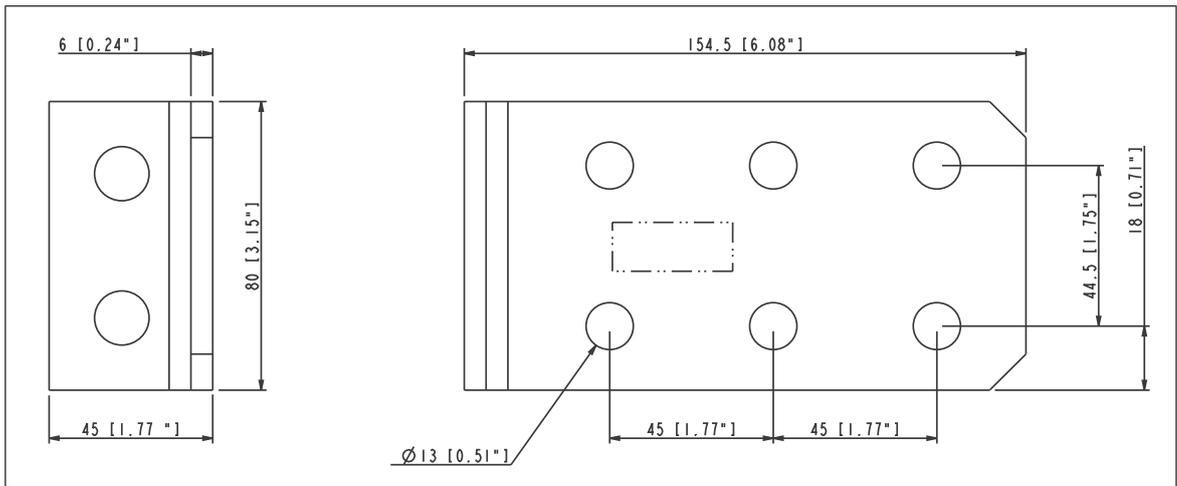
■ R11 input and motor cable terminal dimensions – top entry and exit (options +H351 and +H353)



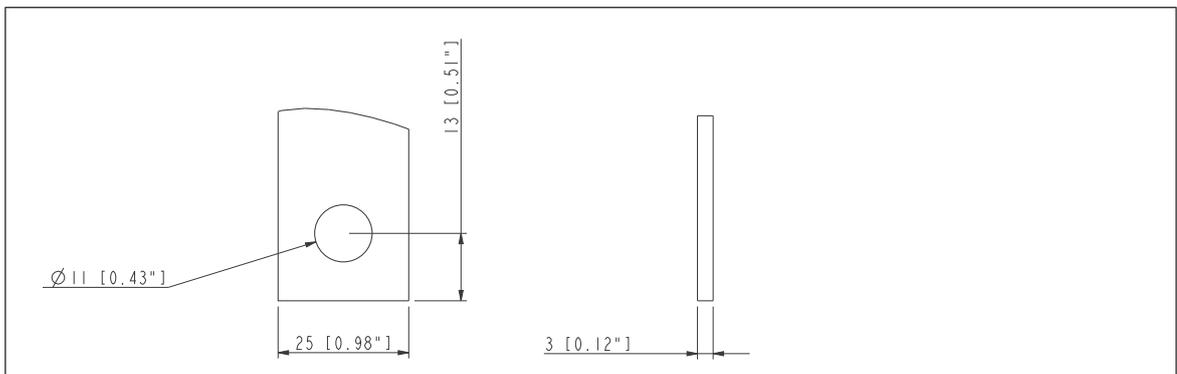
■ R11 input cable terminals



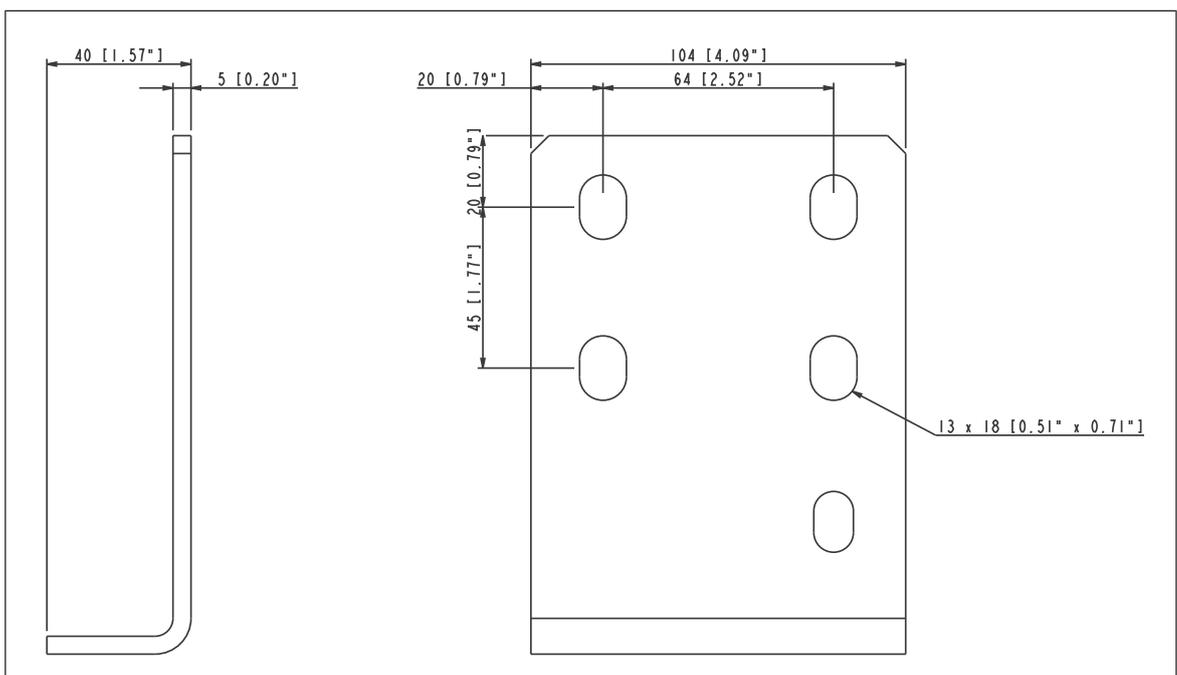
■ R11 motor cable terminals



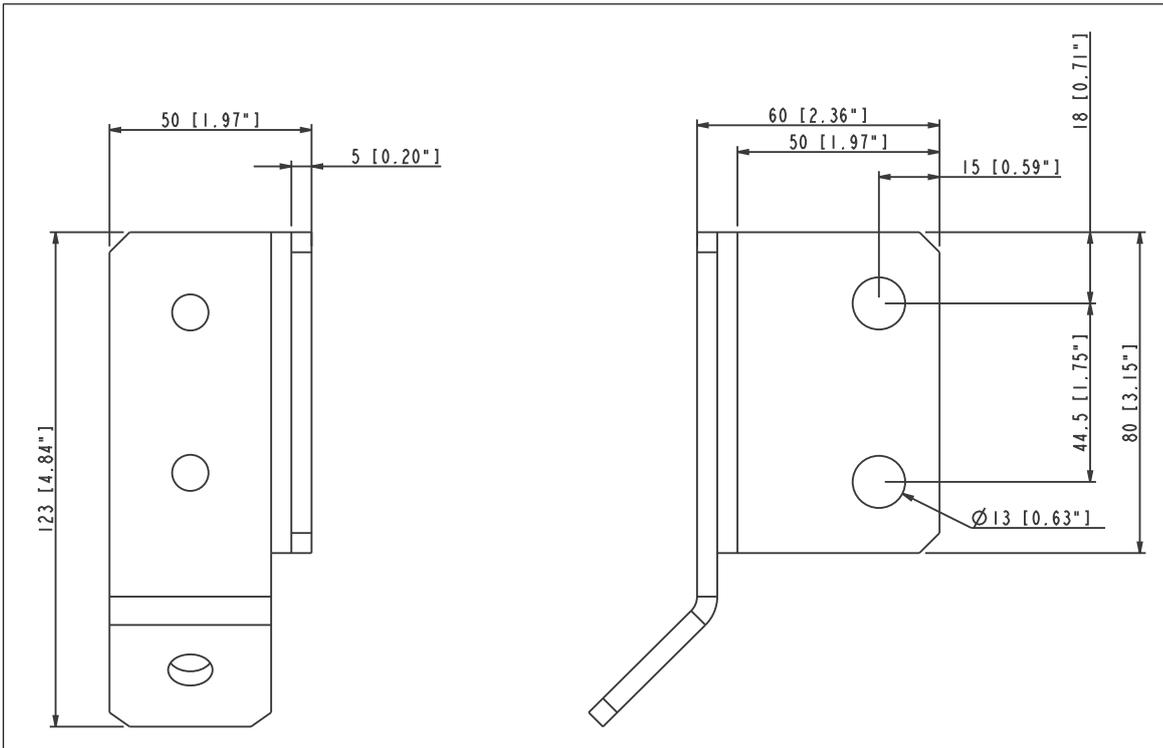
■ Terminals for connecting external resistors



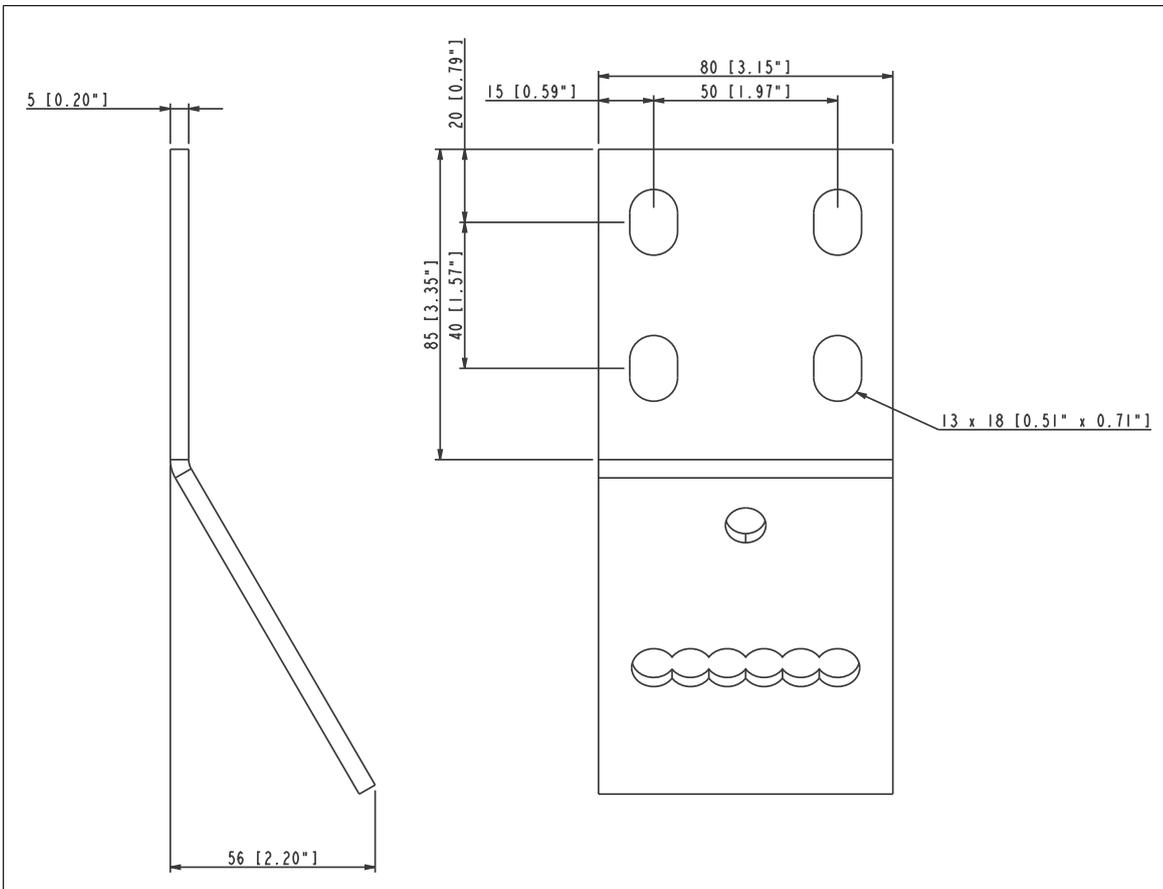
■ Sine filter (+E206) cubicle, 400 mm: motor cable terminals



■ Sine filter (+E206) cubicle, 600 mm: motor cable terminals



■ Sine filter (+E206) cubicle, 1000 mm: motor cable terminals



# 14

## The Safe torque off function

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### Contents of this chapter

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

### Description

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**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.

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

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

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

The Safe torque off function complies with these standards:

---

<b>Standard</b>	<b>Name</b>
IEC 60204-1:2016 EN 60204-1:2006 + A1:2009 + AC:2010	<i>Safety of machinery – Electrical equipment of machines – Part 1: General requirements</i>
IEC 61000-6-7:2014	<i>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</i>
IEC 61326-3-1:2017	<i>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</i>
IEC 61508-1:2010	<i>Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements</i>
IEC 61508-2:2010	<i>Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems</i>
IEC 61511-1:2016	<i>Functional safety – Safety instrumented systems for the process industry sector</i>
IEC 61800-5-2:2016 EN 61800-5-2:2007	<i>Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional</i>
IEC 62061:2005 + A1:2012 + A2:2015 EN 62061:2005 + AC:2010 + A1:2013 + A2:2015	<i>Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems</i>
EN ISO 13849-1:2015	<i>Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design</i>
EN ISO 13849-2:2012	<i>Safety of machinery – Safety-related parts of control systems – Part 2: Validation</i>

The function also corresponds to Prevention of unexpected start-up as specified by EN ISO 14118:2018 (ISO 14118:2017), and Uncontrolled stop (stop category 0) as specified in EN/IEC 60204-1.

### ■ **Compliance with the European Machinery Directive**

See the technical data.

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

## Wiring

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

### ■ Activation switch

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

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

### ■ Cable types and lengths

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

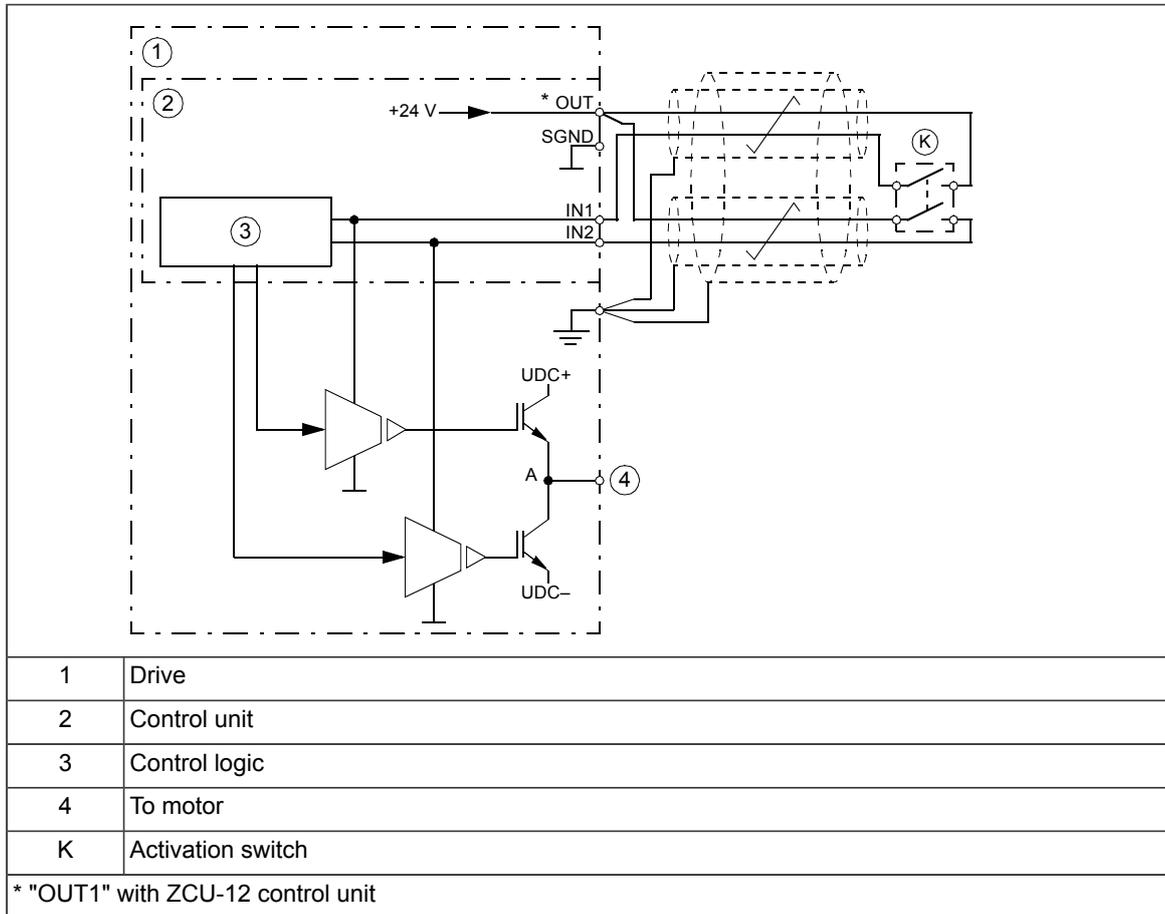
The pulse tolerance of the input channels is 1 ms.

### ■ Grounding of protective shields

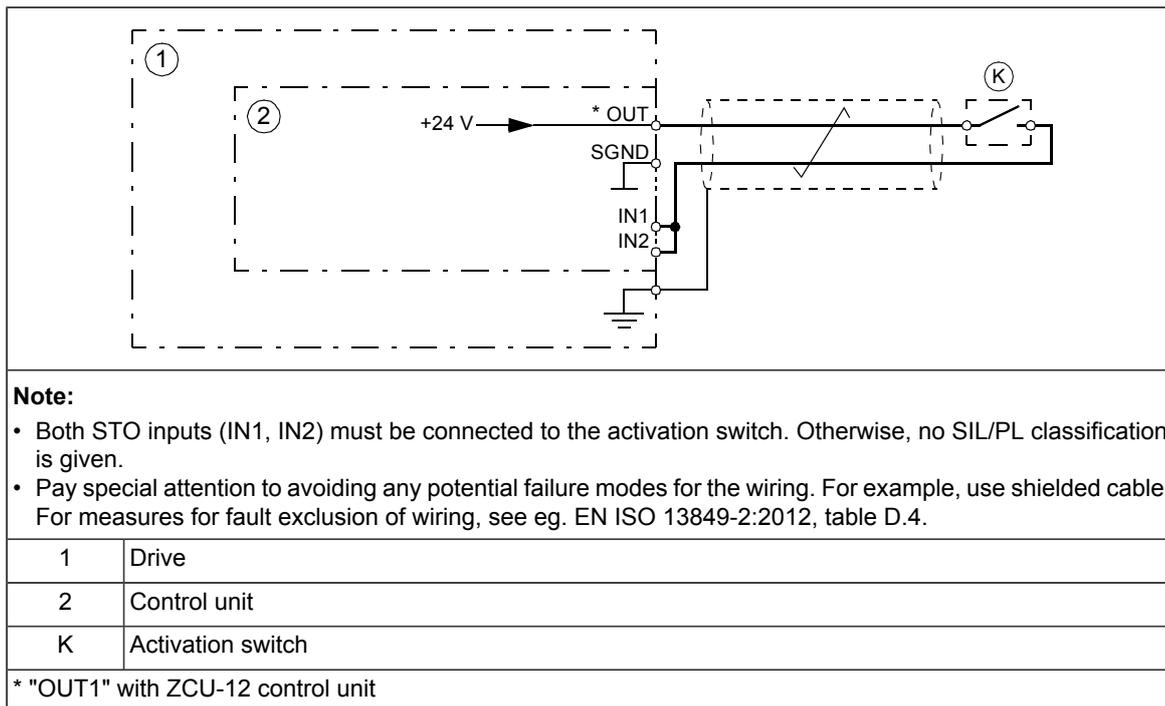
- Ground the shield in the cabling between the activation switch and the control unit at the control unit only.
  - Ground the shield in the cabling between two control units at one control unit only.
-

■ Single ACS880-37 drive, internal power supply

Dual-channel connection

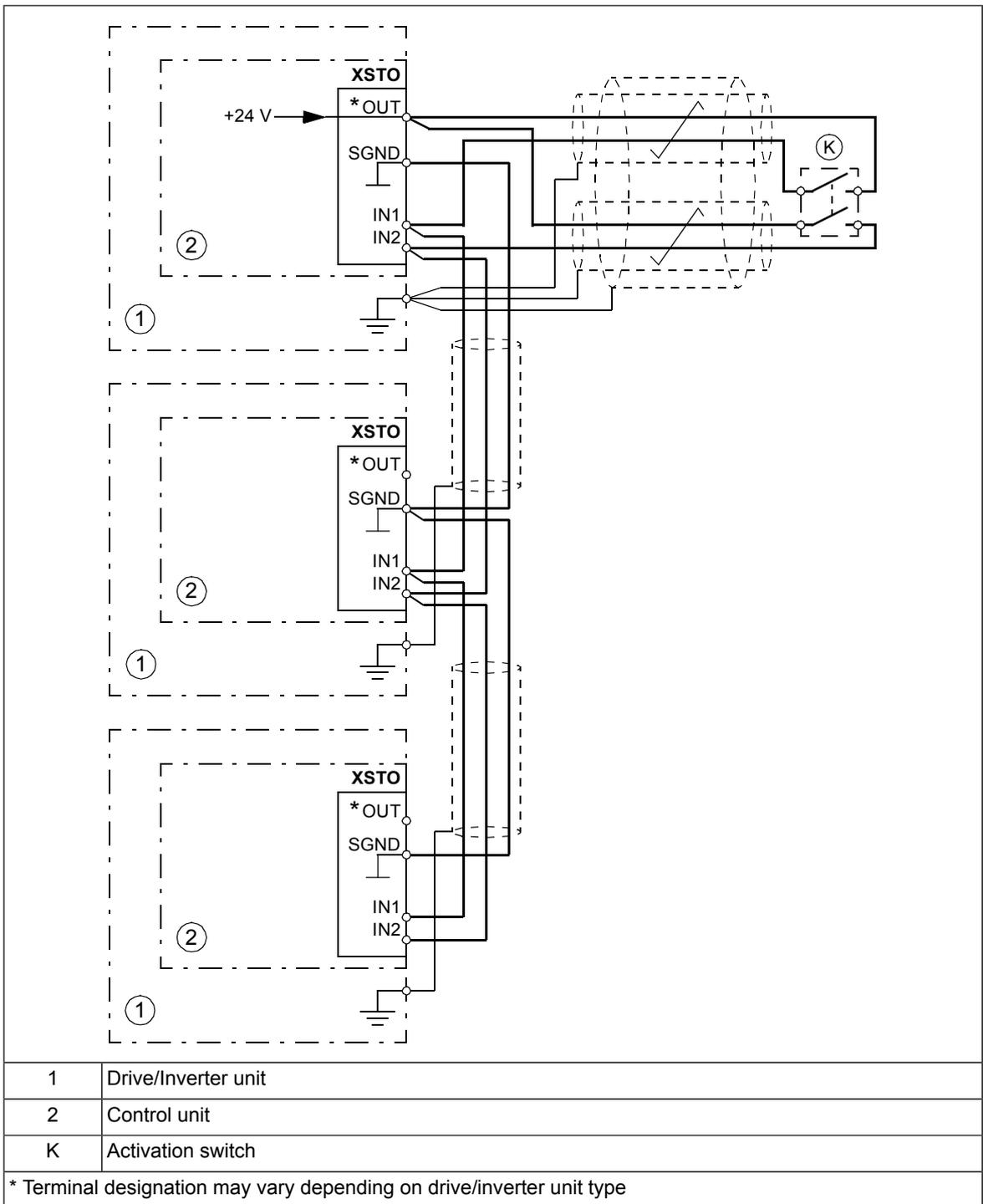


Single-channel connection

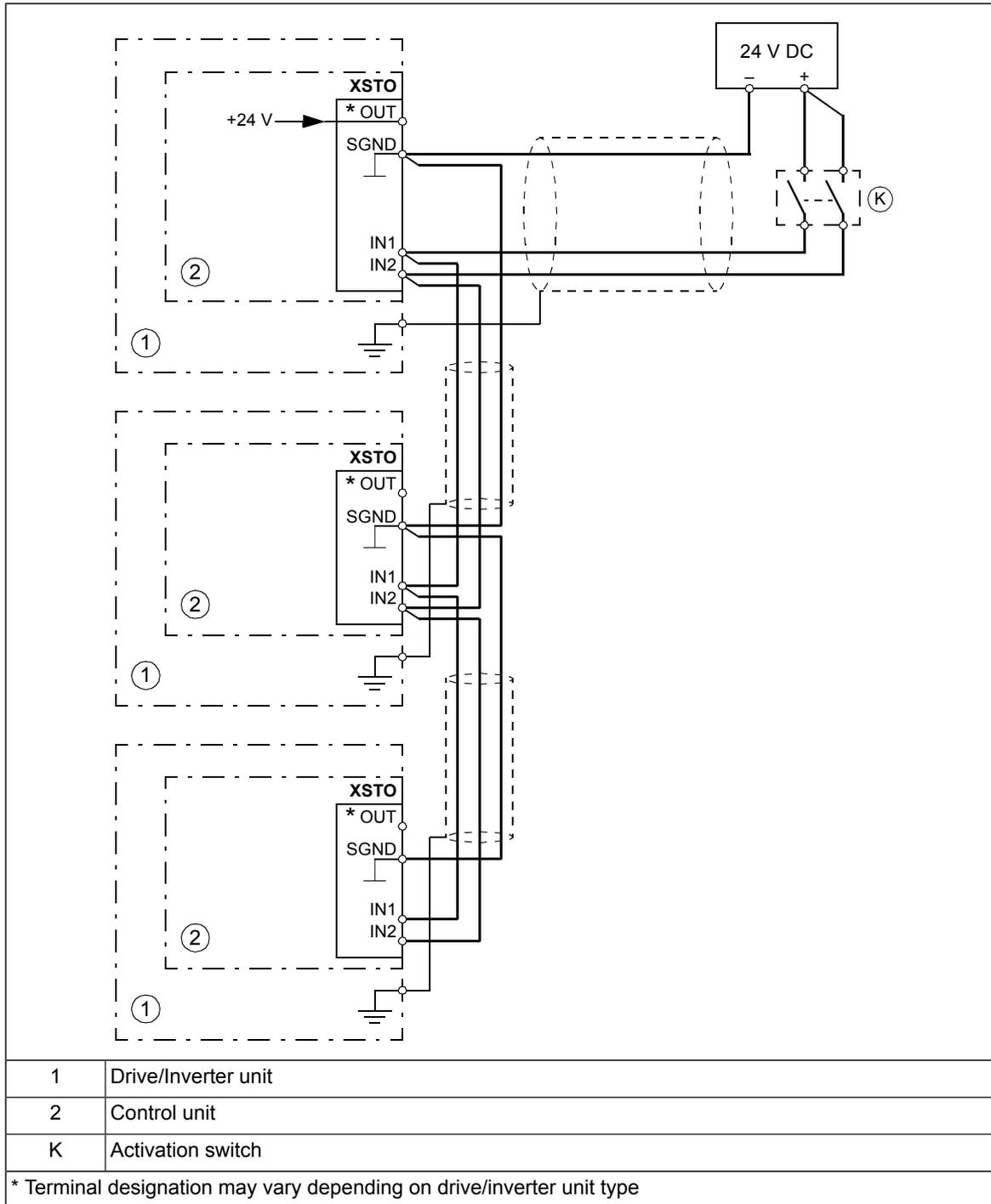


■ Multiple drives

Internal power supply



**External power supply**



## Operation principle

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

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

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

**Note:** The loss of only one STO signal always generates a fault as it is interpreted as a malfunction of STO hardware or wiring.

5. The motor coasts to a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a reset may be needed (depending on the setting of parameter 31.22). A new start command is required to start the drive.
-

## Start-up including acceptance test

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

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

### ■ Competence

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

### ■ Acceptance test reports

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

### ■ Acceptance test procedure

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

**Note:** If the drive is equipped with safety option +L536, +L537, +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q978 or +Q979, do the procedure shown in the documentation of the option.

<b>Action</b>	<input checked="" type="checkbox"/>
 <b>WARNING!</b> Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	<input type="checkbox"/>
Make sure that the drive can be run and stopped freely during start-up.	<input type="checkbox"/>
Stop the drive (if running), switch the input power off and isolate the drive from the power line using a disconnecter.	<input type="checkbox"/>
Check the STO circuit connections against the wiring diagram.	<input type="checkbox"/>
Close the disconnecter and switch the power on.	<input type="checkbox"/>
Test the operation of the STO function when the motor is stopped. <ul style="list-style-type: none"> <li>• Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill.</li> </ul> Make sure that the drive operates as follows: <ul style="list-style-type: none"> <li>• 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).</li> <li>• Give a start command to verify that the STO function blocks the drive's operation. The drive generates a warning. The motor should not start.</li> <li>• Close the STO circuit.</li> <li>• Reset any active faults. Restart the drive and check that the motor runs normally.</li> </ul>	<input type="checkbox"/>

<p><b>Action</b></p>	<input checked="" type="checkbox"/>
<p>Test the operation of the STO function when the motor is running.</p> <ul style="list-style-type: none"> <li>• Start the drive and make sure the motor is running.</li> <li>• 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).</li> <li>• Reset any active faults and try to start the drive.</li> <li>• 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.</li> <li>• Close the STO circuit.</li> <li>• Reset any active faults. Restart the drive and check that the motor runs normally.</li> </ul>	<input type="checkbox"/>
<p>Test the operation of the failure detection of the drive. The motor can be stopped or running.</p> <ul style="list-style-type: none"> <li>• Open the 1st channel of the STO circuit (wire coming to IN1). If the motor was running, it should coast to a stop. The drive generates a <i>FA81 Safe Torque Off 1 loss</i> fault indication (see the firmware manual).</li> <li>• Give a start command to verify that the STO function blocks the drive's operation. The motor should not start.</li> <li>• Close the STO circuit.</li> <li>• Reset any active faults. Restart the drive and check that the motor runs normally.</li> <li>• Open the 2nd channel of the STO circuit (wire coming to IN2). If the motor was running, it should coast to a stop. The drive generates a <i>FA82 Safe Torque Off 2 loss</i> fault indication (see the firmware manual).</li> <li>• Give a start command to verify that the STO function blocks the drive's operation. The motor should not start.</li> <li>• Close the STO circuit.</li> <li>• Reset any active faults. Restart the drive and check that the motor runs normally.</li> </ul>	<input type="checkbox"/>
<p>Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.</p>	<input type="checkbox"/>

## Use

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



### **WARNING!**

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

---



### **WARNING!**

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

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

---

### **Notes:**

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

## Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 5 or 2 years; see section [Safety data \(page 265\)](#). It is assumed that all dangerous failures of the STO circuit are detected by the proof test. To perform the proof test, do the [Acceptance test procedure \(page 260\)](#).

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

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

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

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

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

If any wiring or component change is needed after start up, or the parameters are restored, do the test given in section [Acceptance test procedure \(page 260\)](#).

Use only spare parts approved by ABB.

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

### ■ Competence

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

---

## **Fault tracing**

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

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

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

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

## Safety data

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

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

Frame size	SIL/ SILCL	PL	SFF (%)	PFH ( $T_1 = 20$ a) (1/h)	PFD <sub>avg</sub> ( $T_1 = 2$ a)	PFD <sub>avg</sub> ( $T_1 = 5$ a)	MTTF <sub>D</sub> (a)	DC (%)	Cat.	SC	HFT	CCF	T <sub>M</sub> (a)
R8	3	e	99.1	3.21E-09	2.67E-05	6.67E-05	9630	≥90	3	3	1	80	20
R11	3	e	99.66	3.65E-09	3.20E-05	8.00E-05	20219	≥90	3	3	1	80	20

3AXD10000006217 K, 3AXD10000481168 B

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with  $\Delta T = 71.66$  °C
  - 1340 on/off cycles per year with  $\Delta T = 61.66$  °C
  - 30 on/off cycles per year with  $\Delta T = 10.0$  °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time.
- The STO is a type A (frame R8) 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)
    - Frame R11: 26 ms (typical), 30 ms (maximum)
  - Fault detection time: Channels in different states for longer than 200 ms
  - Fault reaction time: Fault detection time + 10 ms
- Indication delays:
  - STO fault indication (parameter 31.22) delay: < 500 ms
  - STO warning indication (parameter 31.22) delay: < 1000 ms

### ■ Abbreviations

Abbr.	Reference	Description
Cat.	EN ISO 13849-1	Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.
CCF	EN ISO 13849-1	Common cause failure (%)

Abbr.	Reference	Description
DC	EN ISO 13849-1	Diagnostic coverage
HFT	IEC 61508	Hardware fault tolerance
MTTF <sub>D</sub>	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 <sub>avg</sub>	IEC 61508	Average probability of dangerous failure on demand, that is, mean unavailability of a safety-related system to perform the specified safety function when a demand occurs
PFH	IEC 61508	Average frequency of dangerous failures per hour, that is, average frequency of a dangerous failure of a safety related system to perform the specified safety function over a given period of time
PL	EN ISO 13849-1	Performance level. Levels a...e correspond to SIL
SC	IEC 61508	Systematic capability
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1...3)
SILCL	IEC/EN 62061	Maximum SIL (level 1...3) that can be claimed for a safety function or subsystem
STO	IEC/EN 61800-5-2	Safe torque off
T <sub>1</sub>	IEC 61508-6	Proof test interval. T <sub>1</sub> 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 <sub>1</sub> 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 <sub>M</sub>	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 <sub>M</sub> values given cannot be regarded as a guarantee or warranty.

## ■ TÜV certificate

The TÜV certificate is available on the Internet at [www.abb.com/drives/documents](http://www.abb.com/drives/documents).

## ■ Declaration of conformity



# EU Declaration of Conformity

Machinery Directive 2006/42/EC

We

Manufacturer: ABB Oy

Address: Hiomotie 13, 00380 Helsinki, Finland.

Phone: +358 10 22 11

declare under our sole responsibility that the following products:

### Frequency converters and frequency converter components

**ACS880-04, -14, -34** (frames nxR8i)

**ACS880-04XT, -04FXT**

**ACS880-07, -17, -37**

**ACS880-104**

**ACS880 multidrives**

**ACS880-104LC** (frames nxR8i)

**ACS880-07CLC**

**ACS880-17LC, -37LC, -107LC** (frames nxR8i)

**ACS880 liquid-cooled multidrives**

identified with serial numbers beginning with 1 or 8

with regard to the safety functions

### Safe torque off

**Safe motor temperature** with FPTC-01 module (option code +L536)

**Safe Stop 1 (SS1-t)** with FSPS-21 module (+Q986)

**Safe stop 1 (SS1-t and SS1-r), Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Prevention of unexpected start-up**, with FSO-12 module (option code +Q973)

**Safe stop 1 (SS1-t and SS1-r), Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Safe Speed monitor, Safe direction, Prevention of unexpected start-up**, with FSO-21 and FSE-31 modules (option codes +Q972 and +L521)



**ACS880-07, -17, -37, -07CLC and ACS880 multidrives: Prevention of unexpected start-up** (option codes +Q950; +Q957), **Emergency stop** (option codes +Q951; +Q952; +Q963; +Q964; +Q978; +Q979), **Safely-limited speed** (option codes +Q965; Q966)

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

The following harmonized standards have been applied:

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

The following other standard has been applied:

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

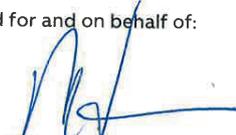
The products referred in this Declaration of conformity fulfil the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AXD10000497305.

Person authorized to compile the technical file:

Name and address: Vesa Tiihonen, Hiomotie 13, 00380 Helsinki, Finland

Helsinki, 16 Dec 2019

Signed for and on behalf of:

  
Peter Lindgren  
Vice President, ABB Oy

  
Vesa Tiihonen  
Manager, Product Engineering and Quality

# 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 \(page 270\)](#).

### ■ 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.
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:

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

$$n \times P_{br} \times t_{br} \leq P_{br,max} \times 40 \text{ s}$$

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 \(page 272\)](#). 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 \(page 271\)](#).
-

## 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!

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

2. 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:

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

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

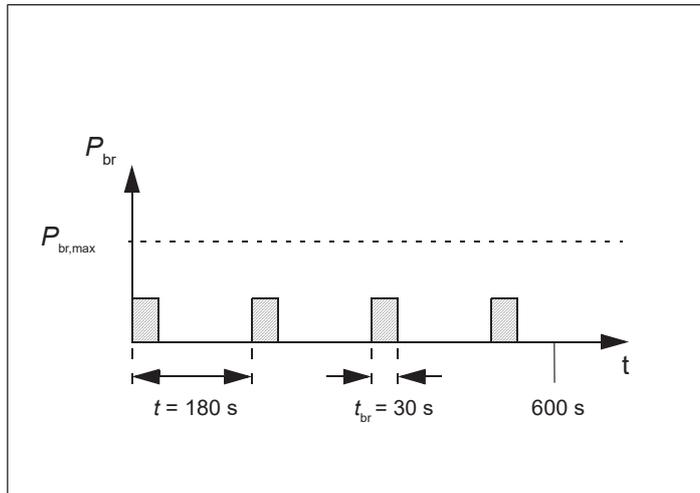
The duration of a braking cycle is three minutes. The braking time is 15 minutes.

1.  $P_{br} \leq P_{br,max}$
2.  $n \times P_{br} \times t_{br} \leq P_{br,max} \times 60 \text{ s}$   
 $1 \times P_{br} \times 600 \text{ s} \leq P_{br,max} \times 60 \text{ s}$   
 $P_{br} \leq P_{br,max} \times 60/600 \text{ s} = 0.1 \times P_{br,max}$   
 -> The allowed continuous braking power is 10% of the maximum braking power ( $P_{br,max}$ ). This fulfills also condition 1.

#### Example 2

The duration of a braking cycle ( $T$ ) is three minutes =  $3 \times 60 \text{ s} = 180 \text{ s}$ . 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

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

- Shield the braking power line completely, either by using shielded cable or a metallic enclosure. Unshielded single-core cable can only be used if it is routed inside a cabinet that efficiently suppresses the radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance is 0.3 meters (1 ft).
- Cross the other cables at 90 degree angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on chopper IGBTs. The longer the cable the greater the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

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

### ■ 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.

## ■ Placing the brake resistors

Install the resistors outside the drive in a place where they are able to cool effectively.

Arrange the cooling of the resistor in a way that

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

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



### **WARNING!**

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

---

## ■ Protecting the system 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 ( $U_0$ )  $\geq 750$  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.

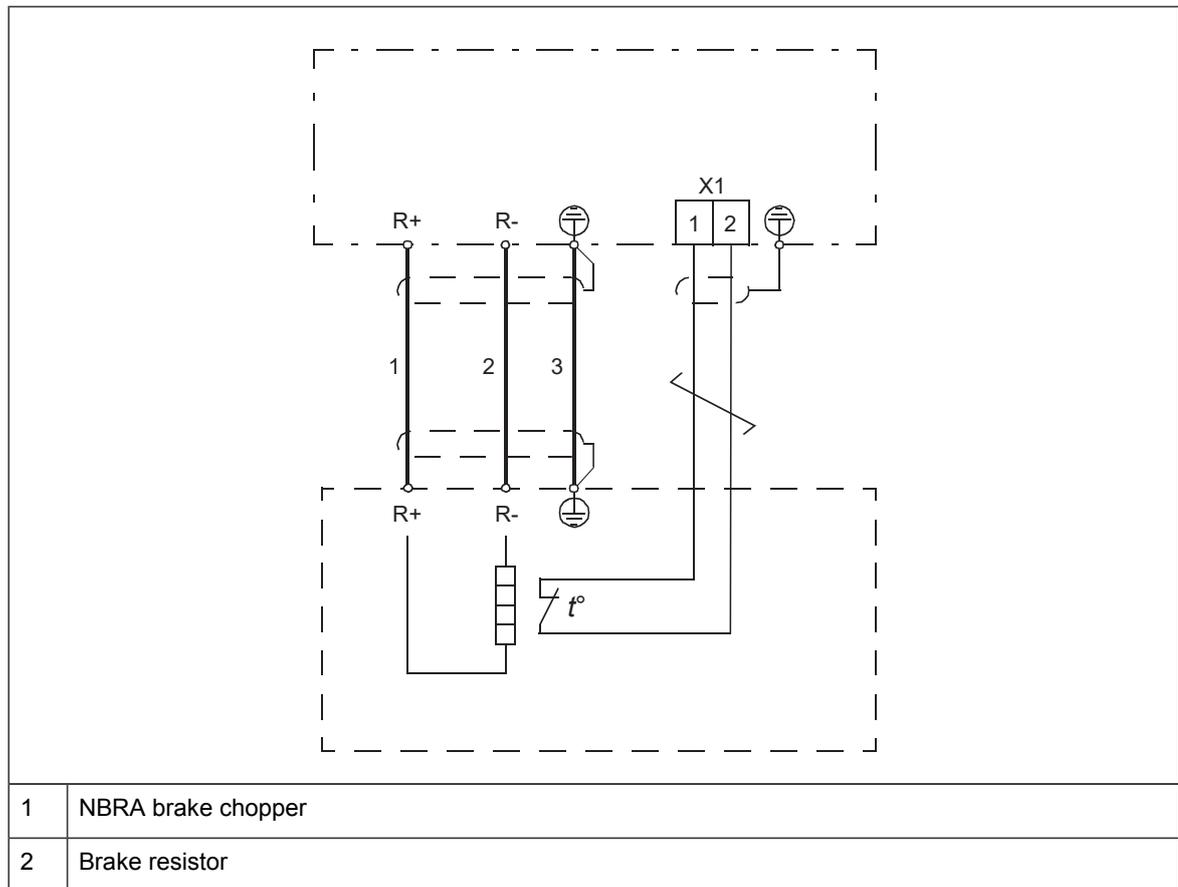
## **Mechanical installation of custom brake resistors**

Obey the resistor manufacturer's instructions.

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## Electrical installation of custom brake resistors

### ■ Connection diagram



### ■ Measuring the insulation of the resistor circuit



#### **WARNING!**

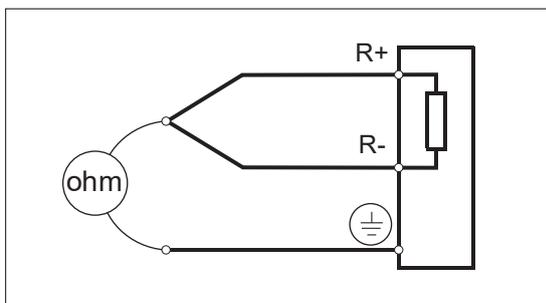
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrical professional, do not do installation 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 \(page 17\)](#) 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 or maintenance work.

- Do the steps in section [Electrical safety precautions \(page 17\)](#) 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 \(page 274\)](#). 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 ...	NBRA-658	2 x SAFUR210F575
	ACS880-37-0206A-3		
	ACS880-37-0293A-3 ...	NBRA-659	2 x SAFUR180F460
ACS880-37-0650A-3			
500 V	ACS880-37-0101A-5 ...	NBRA-658	2 x SAFUR125F500
	ACS880-37-0180A-5		
	ACS880-37-0260A-5 ...	NBRA-659	2 x SAFUR200F500
	ACS880-37-0503A-5		
690 V	ACS880-37-0174A-7 ...	NBRA-669	2 x SAFUR200F500
	ACS880-37-0430A-7		

### ■ 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  $P_{br,max}$

## 278 Resistor braking

$I_{rms}$  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.

$U_N$	Chopper 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 <sup>3</sup> /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
$U_N = 500 \text{ V}$			
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
$U_N = 690 \text{ V}$			
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.



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# Further information

## **Product and service inquiries**

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

## **Product training**

For information on ABB product training, navigate to [new.abb.com/service/training](http://new.abb.com/service/training).

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