ABB industrial drives

Hardware manual
ACS880-07 drives
(45 to 710 kW, 50 to 700 hp)

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List of related manuals

Drive hardware manuals and guides	Code (English)
Drive/converter/inverter safety instructions	Multilingual code: *3AXD50000037978*
ACS880-07 drives (45 to 710, 50 to 700 hp) hardware manual	*3AUA0000105718*
EMC filter and ground-to-phase varistor disconnecting instructions for ACS880 frames R1 to R11	*3AUA0000125152*
ACX-AP-x assistant control panels user's manual	*3AUA0000085685*
ACS880-07 lifting device user's manual	*3AUA0000131337*

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

Option manuals and guides	
Drive composer start-up and maintenance PC tool user's manual	*3AUA0000094606*
FSO-12 safety functions module user's manual	*3AXD50000015612*
FSO-21 safety functions module user's manual	*3AXD50000015614*
User's manual for Prevention of unexpected start-up (+Q950) for ACS880-07/17/37 drives	*3AUA0000145922*
User's manual for Emergency stop, stop category 0 (+Q951) for ACS880-07/17/37 drives	*3AUA0000119895*
User's manual for Emergency stop, stop category 1 (+Q952) for ACS880-07/17/37 drives	*3AUA0000119896*
User's manual for Prevention of unexpected start-up (+Q957) for ACS880-07/17/37 drives	*3AUA0000119910*
User's manual for Emergency stop, stop category 0 (+Q963) for ACS880-07/17/37 drives	*3AUA0000119908*
User's manual for Emergency stop, stop category 1 (+Q964) for ACS880-07/17/37 drives	*3AUA0000119909*
User's manual for FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537 +Q971) for ACS880 drives	*3AXD50000027782*
User's manual for Emergency stop, configurable stop category 0 or 1 (+Q978) for ACS880-07/17/37 drives	*3AUA0000145920*
User's manual for Emergency stop, configurable stop category 0 or 1 (+Q979) for ACS880-07/17/37 drives	*3AUA0000145921*
Bypass connection for ACS880-07, -17, and -37 drives (40...1200 A) option description	*3AXD50000048959*

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

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

ACS880-07 manuals

Hardware manual

ACS880-07 drives
(45 to 710 kW, 50 to 700 hp)

3AUA0000105718 Rev F
EN
EFFECTIVE: 2017-12-11

Update notice

Contents of the notice: Changed instructions and safety data

Notice code (EN): 3AXD50000434046 rev B

Valid: From 2019-05-20 until the next revision of the manual.

The notice concerns the ACS880-07 hardware manuals listed below.			
Manual code	**Revision**	**Language**	
3AUA0000125072	F	Danish	DA
3AUA0000125106	F	German	DE
3AUA0000105718	F	English	EN
3AUA0000125117	F	Spanish	ES
3AUA0000125118	F	Finnish	FI
3AUA0000125119	F	French	FR
3AUA0000125120	F	Italian	IT
3AUA0000125121	F	Dutch	NL
3AUA0000148631	F	Polish	PL
3AUA0000125122	F	Portuguese	PT
3AUA0000125123	F	Russian	RU
3AUA0000125124	F	Swedish	SV

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

For updated instructions, see the *ACS880 frames R1 to R11 EMC filter and ground-to-phase varistor disconnecting instructions* (3AUA0000125152 [English]).

CHANGED: Safe torque off: Safety data (SIL, PL)

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

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

Frame size	SIL/ SILCL	PL	SFF (%)	PFH (T_1 = 20 a) (1/h)	PFD_{avg} (T_1 = 2 a)	PFD_{avg} (T_1 = 5 a)	$MTTF_D$ (a)	DC (%)	Cat.	SC	HFT	CCF	T_M (a)
U_N = 380...500 V													
R6, R7	3	e	> 99	2.89E-09	2.41E-05	6.02E-05	10340	≥ 90	3	3	1	80	20
R8, R9	3	e	99.1	3.21E-09	2.67E-05	6.67E-05	9630	≥ 90	3	3	1	80	20
R10, R11	3	e	99.65	3.66E-09	3.20E-05	8.01E-05	19594	≥ 90	3	3	1	80	20
U_1 = 525...690 V													
R6…R9	3	e	99.1	3.21E-09	2.66E-05	6.66E-05	10008	≥ 90	3	3	1	80	20
R10, R11	3	e	99.65	3.66E-09	3.20E-05	8.01E-05	19594	≥ 90	3	3	1	80	20

3AXD10000006217 K, 3AXD10000083197 H, 3AXD10000115366 F

Table of contents

4. Mechanical installation

5. Guidelines for planning the electrical installation

6. Electrical installation

13. Technical data

14. Dimension drawings

15. Safe torque off function

16. Resistor braking

Further information

1

Safety instructions

Contents of this chapter

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

Use of warnings

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. The manual uses these warning symbols:

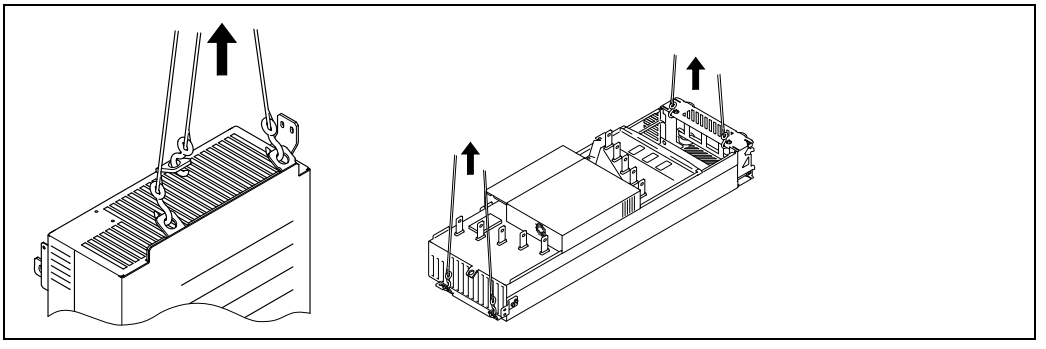
	**Electricity warning** tells about hazards from electricity which can cause injury or death, or damage to the equipment.
	**General warning** tells about conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.
	**Electrostatic sensitive devices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

General safety in installation, start-up and maintenance

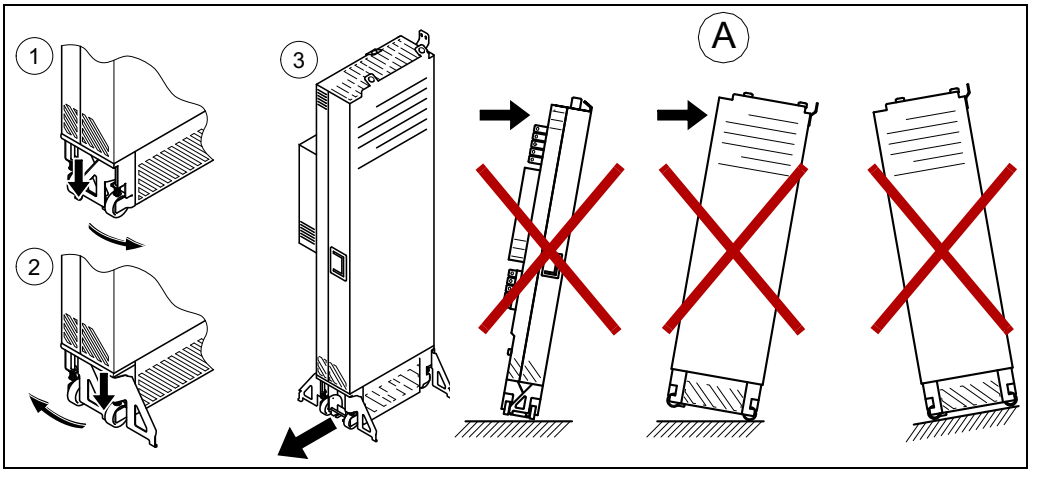
These instructions are for all personnel that install the drive and do maintenance work on it.

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

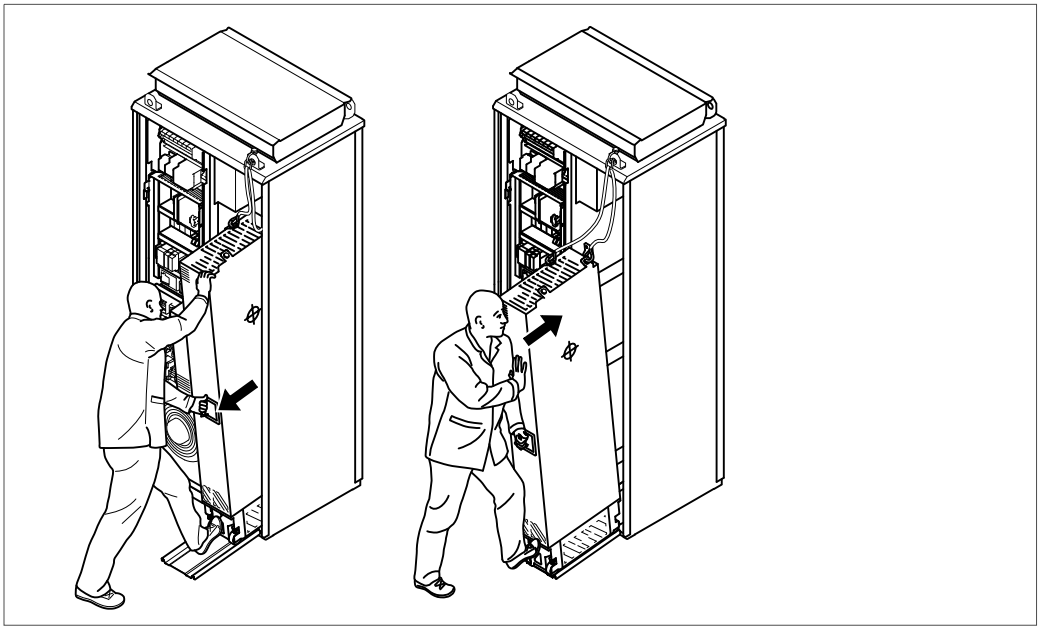
- Secure the cabinet to the floor (see chapter *Mechanical installation*) to prevent it from toppling over when you pull out the module. The drive module is heavy and has a high center of gravity.
- Wear protective gloves and long sleeves. Some parts have sharp edges.
- Handle the drive module carefully:
  - Use safety shoes with a metal toe cap to avoid foot injury.
- For frames R10 and R11:
  - Lift the module with a lifting device only. Use the designated lifting points.



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



- Do not use the module installation ramp with plinth heights which exceed the maximum height (50 mm [1.97 in]) marked on the ramp.
- Secure the module installation ramp carefully.
- To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet lifting lug before you push the module into the cabinet and pull it from the cabinet. Work carefully preferably with help from another person as shown below. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.



- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Keep the drive in its package or protect it otherwise from dust and burr from drilling and grinding until you install it. Protect also the installed drive against dust and burr. Electrically conductive debris inside the drive can cause damage or malfunction.
- Vacuum clean the area below the drive before the start-up to prevent the drive cooling fan from drawing the dust inside the drive.
- Make sure that there is sufficient cooling. See section *Examining the installation site* on page *61*.
- Before you connect voltage to the drive, make sure that the cabinet doors are closed. Keep the doors closed during the operation.
- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, “THIS MACHINE STARTS AUTOMATICALLY”.
- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.
- Make sure that any safety circuits (for example, emergency stop and Safe torque off) are validated in start-up. For the Safe torque off, see chapter *Safe torque off function* on page *239*. For other safety functions, see their separate instructions.

Note:

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

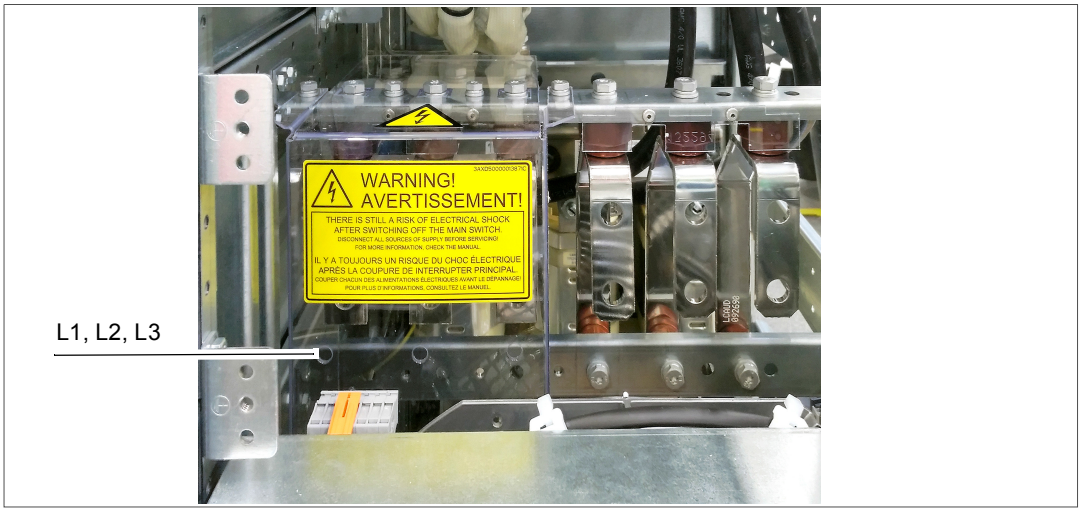
Electrical safety in installation, start-up and maintenance

Precautions before electrical work

These warnings are for all personnel 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 electrician, do not do installation or maintenance work. Go through these steps before you begin any installation or maintenance work.

1. Clearly identify the work location.
2. Disconnect all possible voltage sources.
   - Open the main switch-disconnector (Q1) of the drive.
   - Open the disconnector of the supply transformer as the main switch-disconnector (Q1) of the drive does not remove the voltage from the input busbars of the drive.
   - Make sure that reconnection is not possible. Lock the disconnectors to open position and attach a warning notice to them.
   - Disconnect any external power sources from the control circuits before you do work on the control cables.
   - After you disconnect the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized.
   - Use a multimeter with an impedance of at least 1 Mohm.
   - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V. Measuring holes of the standard drive in the shroud are shown below.



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

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

Additional instructions and notes

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

- If you are not a qualified electrician, do not do installation or maintenance work.
- Do not install a drive with EMC filter option +E200 or +E202 on an ungrounded power system or a high resistance-grounded (over 30 ohms) power system.
- Do not connect the drive to a voltage higher than what is on the type designation label. If you do, the brake chopper starts to operate which causes the overheating of the brake resistor (if present). Overvoltage can also cause the motor to rush to its maximum speed.
- We do not recommend that you secure the cabinet by arc welding. If you have to, obey the instructions in section *Arc welding* on page *75*.
- Do not do insulation or voltage withstand tests on the drive or drive modules.

Note:

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

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

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

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

Grounding

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

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

- If you are not a qualified electrician, do not do grounding work.
- Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- Make sure that the conductivity of the grounding conductors is sufficient. See section *Selecting the power cables* on page *84*. Obey the local regulations.
- Connect the power cable shields to protective earth (PE) of the drive to make sure of personnel safety.
- Make a 360° grounding of the power and control cable shields at the cable entries to suppress electromagnetic disturbances.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) busbar of the switch board or the transformer.

Note:

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

Additional instructions for permanent magnet motor drives

Safety in installation, start-up and maintenance

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

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

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

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

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

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

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

Contents of the manual

This manual contains the instructions and information for the basic drive configuration. The chapters of the manual are briefly described below.

Safety instructions gives safety instructions for the installation, start-up, operation and maintenance of the drive.

Introduction to the manual gives an introduction to this manual.

Operation principle and hardware description describes the operation principle and constructions of the drive.

Mechanical installation describes how to install the drive mechanically.

Guidelines for planning the electrical installation contains instructions for the motor and cable selection, protections and cable routing.

Electrical installation gives instructions on wiring the drive.

Control unit of frames R6 to R9 contains the default I/O connection diagrams, descriptions of the terminals and technical data for the control unit.

Control unit of frames R10 and R11 contains the default I/O connection diagrams and references for the descriptions of the terminals and technical data of the control unit.

Installation checklist contains a list for checking the mechanical and electrical installation of the drive.

Start-up describes the start-up procedure of the drive.

Fault tracing describes the fault tracing possibilities of the drive.

Maintenance contains preventive maintenance instructions.

Technical data contains the technical specifications of the drive, eg, the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings.

Dimension drawings contains example dimension drawings of the drive.

Safe torque off function describes the Safe torque off function of the drive and gives instructions on its implementing.

Resistor braking describes selection, protection and wiring of optional brake choppers and resistors. The chapter also contains technical data.

Related manuals

See *List of related manuals* on the inside of the front cover.

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 (R6, R7, R8, R9, R10 or R11). The frame size is marked on the type designation label (page *56*), and can also be determined from the type code.

The instructions, technical data and dimension drawings which concern only 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. The option selections are listed in section *Type designation key* on page *57*.

Quick installation, start-up and operating flowchart

Task	See
Plan the electrical installation and acquire the accessories needed (cables, fuses, etc.). Check the ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.	*Guidelines for planning the electrical installation* (page *77*) *Technical data* (page *195*)
↓	
Check the installation site.	*Ambient conditions* (page *219*)
↓	

Task	See
Unpack and check the units (only intact units may be started up). Make sure that all necessary option modules and equipment are present and correct. Install the drive mechanically.	*Mechanical installation* (page *61*)
↓	
Route the cables.	*Routing the cables* (page *89*)
↓	
Check the insulation of the supply cable, the motor and the motor cable.	*Checking the insulation of the assembly* (page *99*)
↓	
If the drive is about to be connected to an IT (ungrounded) system, check that the drive is not equipped with EMC filter +E200 or +E202.	*Checking the compatibility with IT (ungrounded) and corner-grounded delta systems (frames R6 to R9)* (page *101*)
↓	
Connect the power cables. Connect the control cables.	*Connecting the power cables* (page *107*), *Connecting the control cables* (page *117*),
↓	
Check the installation.	*Installation checklist* (page *153*) If the drive has been non-operational for more than one year, reform the DC link capacitors. See *Converter module capacitor reforming instructions* (3BFE64059629 [English].
↓	
Start the drive up.	*Start-up* (page *155*)
↓	
Operate the drive: start, stop, speed control etc.	ACS880 quick start-up guide, firmware manual

Terms and abbreviations

Term/ Abbreviation	Explanation
CMF	Common mode filtering
DDCS	Distributed drives communication system; a protocol used in optical fiber communication
Drive	Frequency converter for controlling AC motors. The drive consists of a rectifier and an inverter connected together by the DC link. In drives up to approximately 500 kW, these are integrated into a single module (drive module). Larger drives typically consist of separate supply and inverter units. This manual uses the term drive to refer converters and inverter as well.
DTC	Direct torque control
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
FAIO-01	Optional analog I/O extension module
FCAN-01	Optional FCAN-01 CANopen adapter module
FCNA-01	Optional ControlNet™ adapter module
FDCO-01	Optional DDCS communication module with two pairs of 10 Mbit/s DDCS channels
FDIO-01	Optional digital I/O extension module
FDNA-01	Optional DeviceNet™ adapter module
FEA-03	Optional I/O extension adapter
FECA-01	Optional EtherCAT adapter module
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-02	Optional Ethernet POWERLINK adapter module
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FLON-01	Optional LonWorks® adapter module
FPBA-01	Optional PROFIBUS DP adapter module
FPTC-01	Optional thermistor protection module
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres
FSCA-01	Optional Modbus/RTU adapter module
FSO-12, FSO-21	Optional functional safety module
Frame (size)	Physical size of the drive
HTL	High-threshold logic
I/O	Input/Output
IGBT	Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in drives due to their easy controllability and high switching frequency.
Inverter unit	Inverter module(s) under control of one control board, and related components. One inverter unit typically controls one motor.
IT system	Type of supply network that has no (low-impedance) connection to ground/earth
MCCB	Molded case circuit breaker

Term/ Abbreviation	Explanation
PLC	Programmable logic controller
Power module	Common term for drive module, inverter module, supply module, brake chopper module etc.
R6…R11	Frame size designation of the drive
RFI	Radio-frequency interference
SAFUR	Series of optional brake resistor
SAR	Safe acceleration range
SBC	Safe brake control
SLS	Safely-limited speed
SS1	Safe stop 1
SSE	Safe stop emergency
SSM	Safe speed monitor
STO	Safe torque off
Supply unit	Supply module(s) under control of one control board, and related components
TN system	Type of supply network that provides a direct connection to ground/earth
ZCU	Drive control unit. As standard, the external I/O control signals are connected to the control unit, or optional I/O extensions mounted on it.
ZGAB	Brake chopper adapter board
ZGAD, BGAD	Gate driver adapter board
ZINT	Main circuit board
ZMU	The memory unit attached to the control unit of the drive

3

Operation principle and hardware description

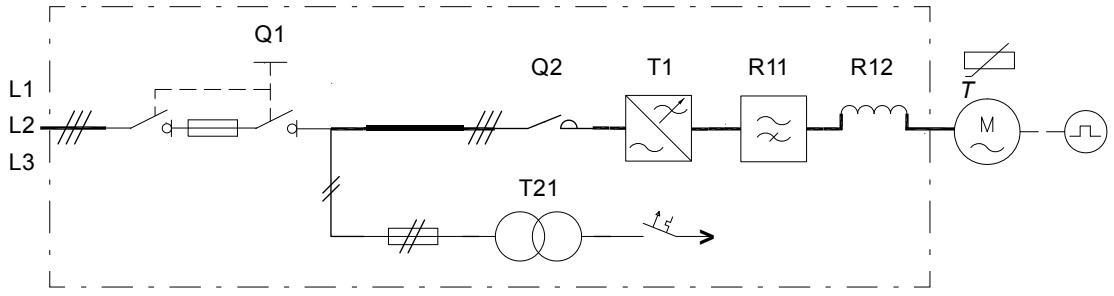
Contents of this chapter

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

Product overview

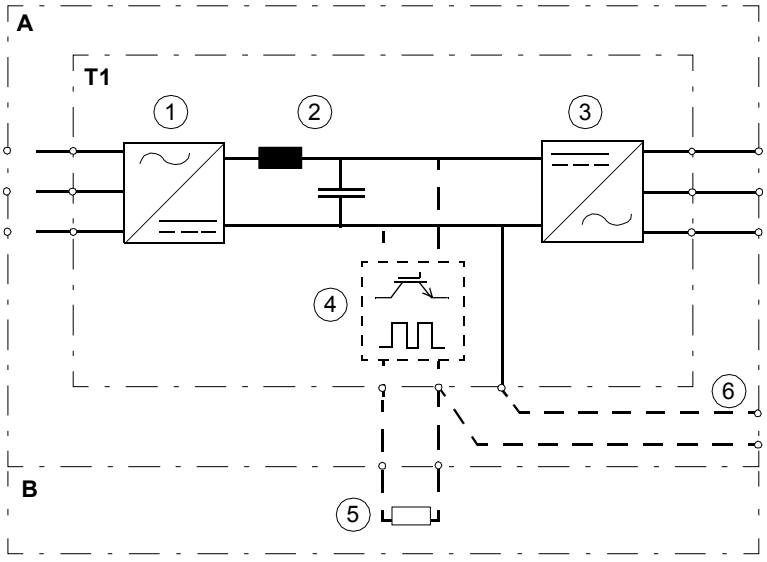
The ACS880-07 is an air-cooled cabinet-installed drive for controlling asynchronous AC induction motors, permanent magnet synchronous motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors) with option N7502.

Single-line circuit diagram of the drive



Q1	Main switch-disconnector (switch fuse in frames R6 to R8, switch-disconnector and separate fuses in frames R9 to R11, or molded case circuit breaker and separate fuses [option +F289 for US market only])
Q2	Optional line contactor (+F250)
T21	Auxiliary voltage transformer supplying 24 V and 230 V control voltage for, eg, cabinet fan(s), control devices and I/O extension adapter module.
T1	Drive module
R11	Optional common mode filter (+E208)
R12	Optional du/dt filter (+E205) or sine filter (+E206)
	HTL pulse encoder for optional FEN-31 HTL incremental encoder interface module (+L502)
T	PTC sensors for optional thermistor relay(s) (+L505, +2L505) or Pt100 sensors for optional Pt100 relays (+xL506)

Block diagram of the brake and DC options (+D150, +D151 and +H356)



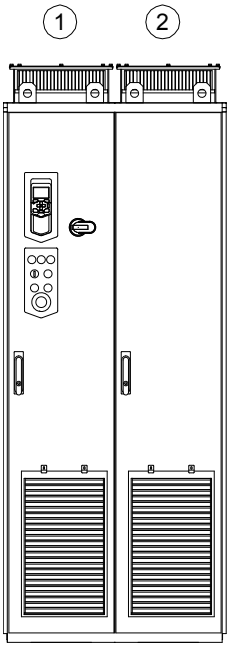
A	Drive module cubicle
T1	Drive module
B	Brake resistor cubicle
1	Rectifier. Converts alternating current and voltage to direct current and voltage.
2	DC link. DC circuit between rectifier and inverter. DC choke is included in frames R6 to R9. An AC input choke is included in frames R10 and R11.
3	Inverter. Converts direct current and voltage to alternating current and voltage.
4	Brake chopper (option +D150). Conducts the surplus energy from the intermediate DC 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. User obtains and installs the brake resistor when needed.
5	Brake resistor (option +D151)
6	Optional DC cable connection busbars (+H356). Not available with option +D150.

General information on the cabinet layout

IP22/IP42
UL Type 1 /
UL Type 1 Filtered

IP54
UL Type 12

UL Type 1 with molded case circuit breaker (option +F289 for US market only)



Example cabinet line-up	
1	Frames R6 to R8: drive module cubicle. Frames R9 to R11: two cubicles with one door (main switch and power cabling cubicle and drive module cubicle)
2	Brake resistor cubicle with option +D151

Cabinet layout of frames R6 to R8

The cabinet layout without shrouds is shown below.

1	Drive control panel	12	Control unit, see page *137*.
2	Door switches and lights, see page *46*.	13	Optional terminal block for external control unit connections (X504, option +L504)
3	Main switch handle	14	Power cable connection terminals and du/dt filter (option +E205) and common mode filter (option +E208) behind
4	Main switch-disconnector with fuses		
5	Thermistor and Pt100 relays (options +L505 and +L506)	15	Common mode filter (option +E208)
6	Buffer module C22	16	Connection terminals for options +F250, +Q951, +Q952, +Q963, +Q964+Q968, +Q954, +M600…+M605,+ L505, +L506. See page *45*.
7	Swing-out frame	17	Cabinet heater (option +G300)
8	Mounting plate with connection terminals for options +G300, +G307, +G313 at the back side of the plate	18	PE busbar
9	“Door” fan	19	Power cable entries
10	Auxiliary voltage transformer (T21)	20	Control cable entry
11	Drive module	-	-

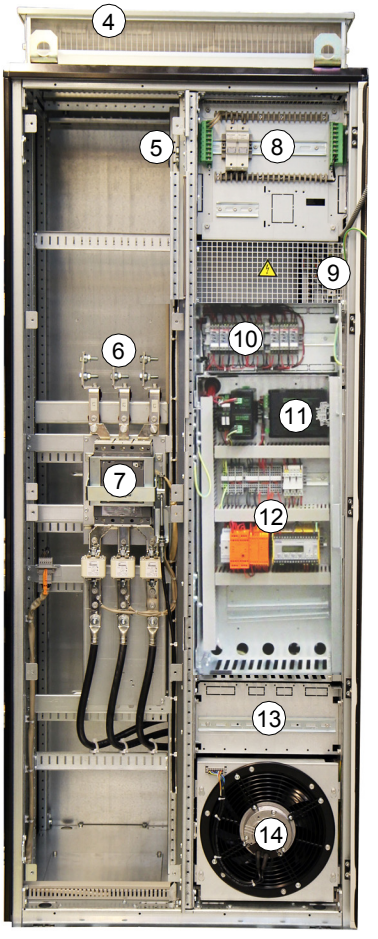
Cabinet layout of frames R6 to R8 with option +C129

The cabinet layout without shrouds is shown below.

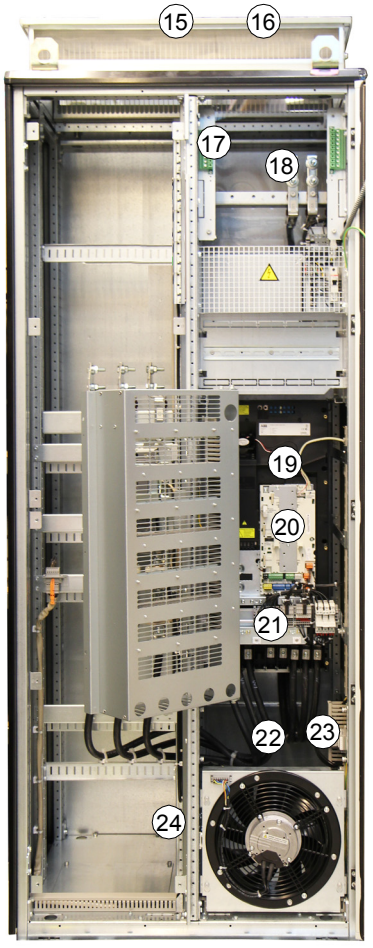
1	Drive control panel	11	Buffer module C22
2	Door switches and lights, see page *46*.	12	Swing-out frame
3	Main switch handle	13	Mounting plate with connection terminals for options +G300, +G307, +G313 at the back side of the plate
4	Power and control cable entries	14	“Door” fan
5	Ground bar	15	Drive module
6	Input cable connection terminals	16	Control unit, see page *137*.
7	Motor cable connection terminals	17	Optional terminal block for external control unit connections (X504, option +L504)
8	Auxiliary voltage transformer (T21)	18	Connection terminals for options +F250, +Q951, +Q952, +Q963, +Q964+Q968, +Q954, +M600…+M605,+ L505, +L506. See page *45*.
9	Main switch-disconnector with fuses	19	Cabinet heater (option +G300)
10	Thermistor and Pt100 relays (options +L505 and +L506)	-	-

Cabinet layout of frames R6 to R8 with options +C129 and +F289

Option +C129 +F289 is available for US market only. The cabinet layout without shrouds is shown below.



1	Drive control panel	9	Auxiliary voltage transformer (T21)
2	Door switches and lights, see page *46*.	10	Thermistor and Pt100 relays (options +L505 and +L506)
3	Main switch handle	11	Buffer module C22
4	Input power cable entries	12	Swing-out frame
5	Ground bar	13	Mounting plate with connection terminals for options +G300, +G307, +G313 at the back side of the plate
6	Input power cable terminals	14	“Door” fan
7	Molded case circuit breaker (option +F289)		
8	Main fuses for control devises, IP54 fan transformer (with option +B055), V-meter (option +G334), starter for auxiliary motor fan (option +M600)		



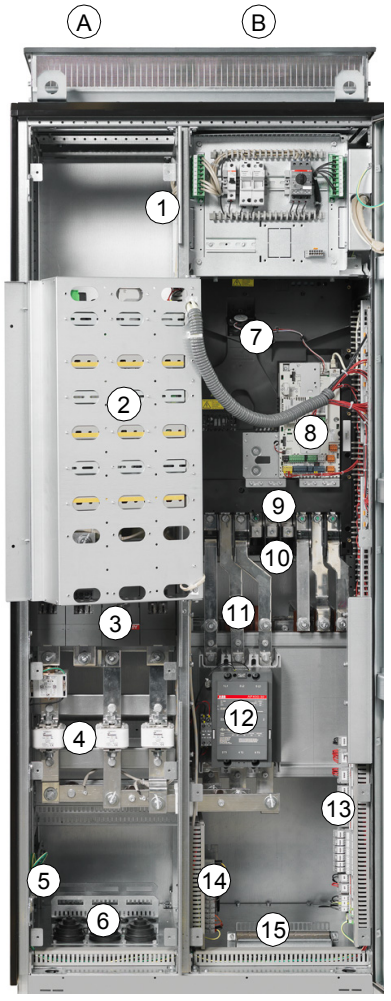
15	Control cable entries	20	Control unit, see page *137*.
16	Motor cable entries	21	Optional terminal block for external control unit connections (X504, option +L504)
17	Ground bar	22	Common mode filter (option +E208)
18	Motor cable connection terminals	23	Connection terminals for options +F250, +Q951, +Q952, +Q963, +Q964+Q968, +Q954, +M600…+M605,+ L505, +L506. See page *45*.
19	Drive module	24	Cabinet heater (option +G300)

Cabinet layout of frame R9

The cabinet layout is shown below. See also the next page.

A – Main breaker and power cabling cubicle		B – Drive module cubicle	
1	Drive control panel	9	Buffer module
2	Operating switch	10	Swing-out frame
3	Main switch handle	11	Thermistor and Pt100 relays (options +L505 and +L506)
4	Motor cable connection terminals	12	Mounting plate with connection terminals for options +G300, +G301, +G307, +G313 at the back side of the plate
5	du/dt filter (option +E205)	-	-
6	Input cable connection terminals	-	-
7	Main switch-disconnector	-	-
8	AC fuses	-	-

The cabinet layout without shrouds, with the swing-out frame open is shown below.



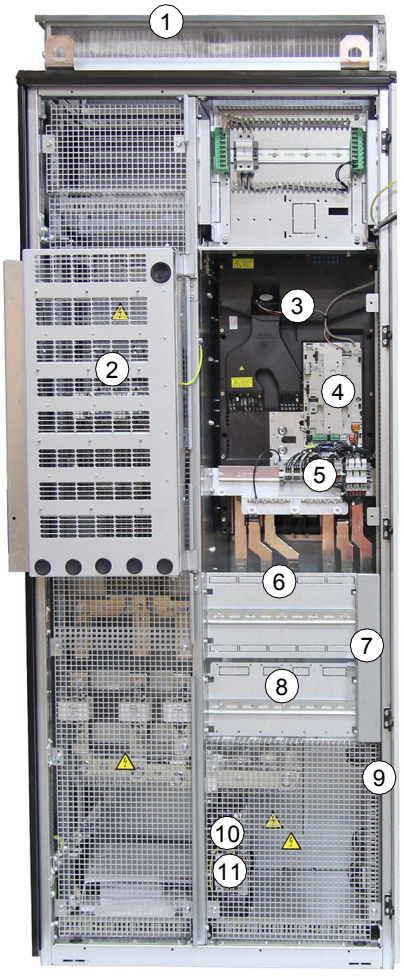
A – Main breaker and power cabling cubicle		B – Drive module cubicle	
1	Auxiliary voltage transformer (T21)	8	Control unit, see page *137*.
2	Swing-out frame	9	Optional terminal block for external control unit connections (X504, option +L504)
3	Main switch-disconnector or molded case circuit breaker with option +F289	10	Connection terminals for external brake resistor and DC cables
4	AC fuses	11	Common mode filter (option +E208) behind the busbars
5	PE-terminal	12	Line contactor (option +F250)
6	Power cable entries	13	Connection terminals for options +F250, +Q951, +Q952, +Q963, +Q964+Q968, +Q954, +M600…+M605,+ L505, +L506. See page *45*.
7	Drive module	14	Cabinet heater (option +G300)
-	-	15	Control cable entry

Cabinet layout of frame R9 with options +C129 and +F289

The cabinet layout is shown below. See also the next page.

A – Main breaker and power cabling cubicle		B – Drive module cubicle	
1	Drive control panel	10	Buffer module
2	Operating switch	11	Swing-out frame
3	Main switch handle	12	Thermistor and Pt100 relays (options +L505 and +L506)
4	Power cable entries		
5	Input cable connection terminals	13	Mounting plate with connection terminals for options +G300, +G301, +G307, +G313 at the back side of the plate
6	Motor cable connection terminals	-	-
7	Ground bar	-	-
8	Molded case circuit breaker (option +F289)	-	-
9	AC fuses	-	-

The cabinet layout with the swing-out frame open is shown below.



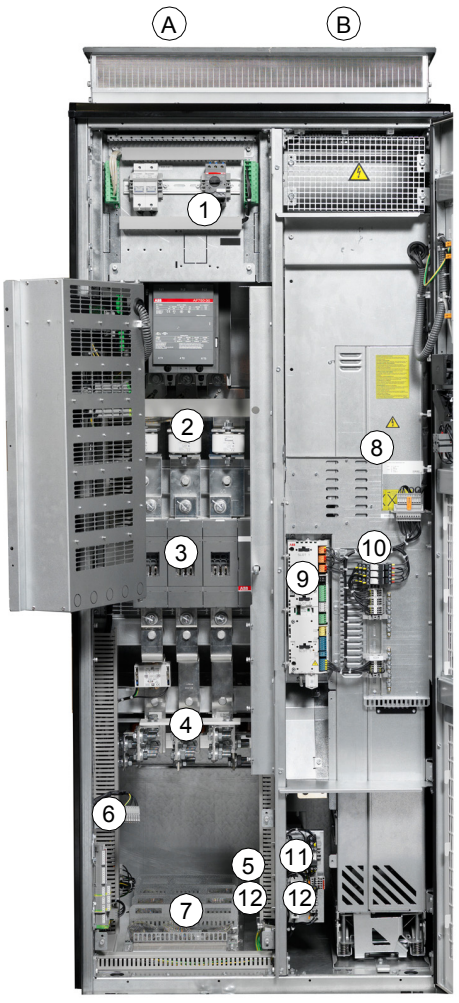
1	Control cable entry	7	Connection terminals for external brake resistor and DC cables
2	Swing-out frame	8	Line contactor (option +F250)
3	Drive module	9	Connection terminals for options +F250, +Q951, +Q952, +Q963, +Q964+Q968, +Q954, +M600…+M605,+ L505, +L506. See page *45*.
4	Control unit, see page *137*.	10	Cabinet heater (option +G300)
5	Optional terminal block for external control unit connections (X504, option +L504)	11	Auxiliary voltage transformer (T21)
6	Common mode filter (option +E208) behind the busbars	-	-

Cabinet layout of frames R10 and R11 – bottom entry and exit of cables

The cabinet layout is shown below. See also the next page.

A – Main breaker and power cabling cubicle		B – Drive module cubicle	
1	Drive control panel	-	See the next page.
2	Operating switch	-	-
3	Main switch handle	-	-
4	Buffer module	-	-
5	Swing-out frame	-	-
6	Thermistor and Pt100 relays (options +L505 and +L506)	-	-
7	Mounting plate with connection terminals for options +G300, +G301, +G307, +G313 at the back side of the plate	-	-
8	“Door” fan		

The cabinet layout without shrouds, with the swing-out frame open is shown below.



A – Main breaker and power cabling cubicle		B – Drive module cubicle	
1	Main fuses for control devises, IP54 fan transformer (with option +B055), V-meter (option +G334), starter for auxiliary motor fan (option +M600)	8	Drive module
2	AC fuses	9	Control unit, see page *147*.
3	Main switch-disconnector	10	Optional terminal block for external control unit connections (X504, option +L504)
4	Input and motor cable connection terminals	11	Auxiliary voltage transformer (T21)
5	PE-terminal	12	Cabinet heater
6	Connection terminals for options +F250, +Q951, +Q952, +Q963, +Q964+Q968, +Q954, +M600…+M605,+ L505, +L506. See page *45*.	-	-
7	Power and control cable entries	-	-

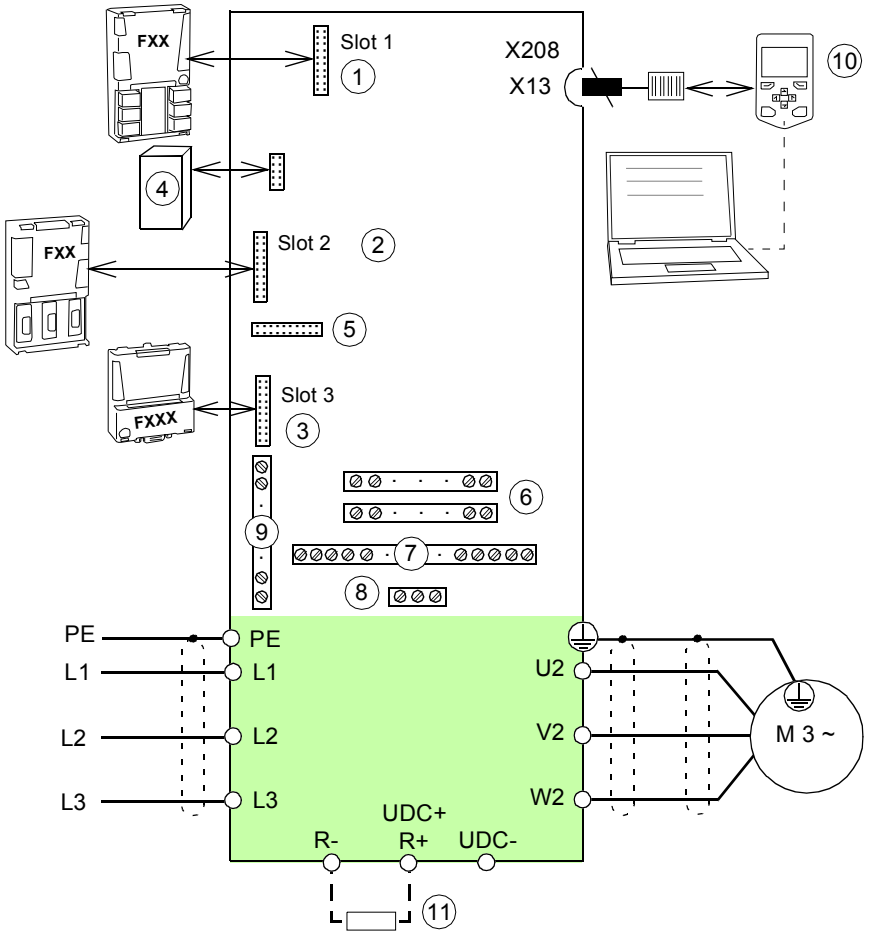
Cabinet layout of frames R10 and R11 – top entry and exit of cables (option +C129)

The cabinet layout is shown below.

A – Main breaker and power cabling cubicle		B – Drive module cubicle	
1	Main fuses for control devises, IP54 fan transformer (with option +B055), V-meter (option +G334), starter for auxiliary motor fan (option +M600)	8	Drive module
2	AC fuses	9	Control unit, see page *147*.
3	Main switch-disconnector	10	Optional terminal block for external control unit connections (X504, option +L504)
4	Input and motor cable connection terminals	11	Auxiliary voltage transformer (T21)
5	PE-terminal	12	Cabinet heater
6	Power and control cable entries	-	-
7	“Door” fan	-	-

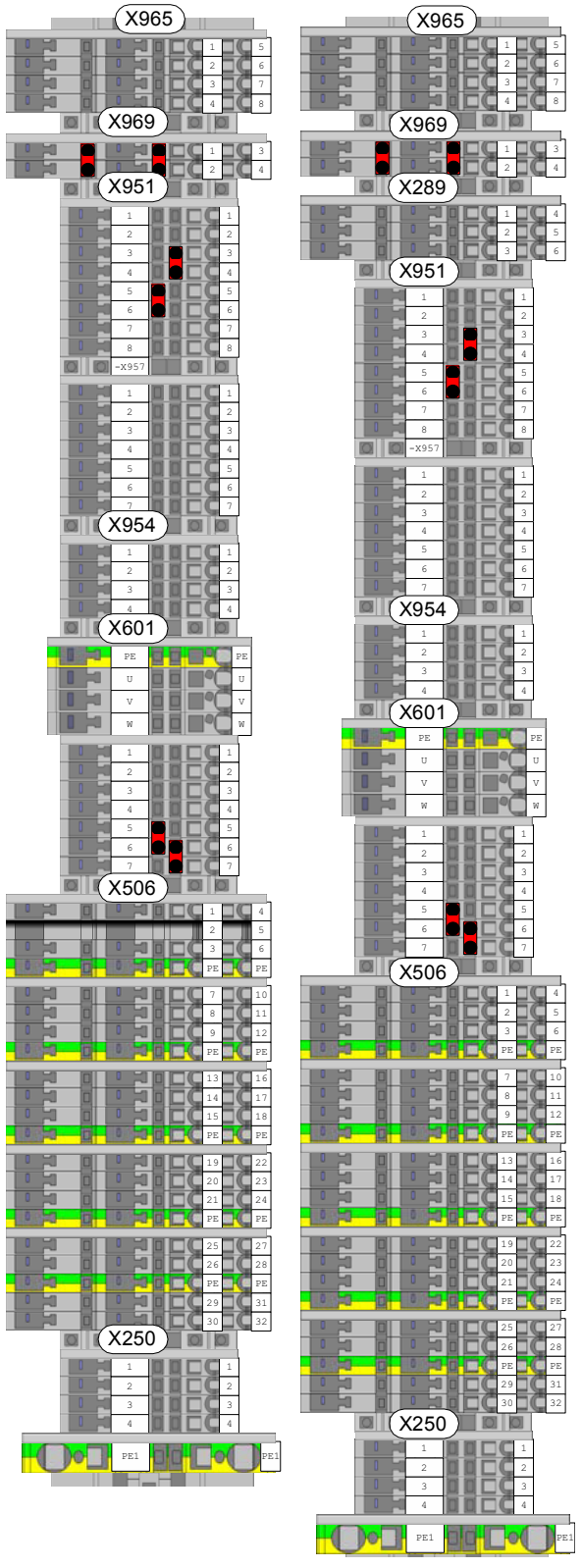
Overview of power and control connections

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



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 section *Type designation key* on page *57*.
2	
3	
4	Memory unit, see page *193*.
5	Connector for safety functions module
6	See *Control unit of frames R6 to R9* (page *137*) and *Control unit of frames R10 and R11* (page *147*).
7	Additional terminal block X504 for control cable connections to the control unit (option +L504)
8	Connection terminals for options +G300, +G307, +G313, see pages *124* and *128*.
9	Connection terminals for options, see page *45*.
10	See section *Control panel*, page *47*.
11	External brake resistor with brake chopper option (+D150) if brake resistor option +D151 is not selected.

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



	Terminals for
X250	Auxiliary contacts of optional line contactor (+F250)
X289	Auxiliary contacts of optional molded case circuit breaker (MCCB) (+F289)
X951, X952, X963 or X964	Push buttons for emergency stop options +Q951, +Q952, +Q963 and +Q964
X968	Safe torque off function with safety relay (option +Q968)
X954	Ground fault monitoring for IT (ungrounded) systems (option +Q954)
X969	External STO customer connection for safety options +Q951, +Q952, +Q963, +Q964, +Q957 and +Q971
X601, X602, X603, X604 or X605	Starter for auxiliary motor fan (options +M601…+M605)
X506	Thermistor relay or Pt100 relays (option +L505 or +L506)

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 CONT. OFF ON 	-	Operating switch with option +F250 0 Opens the main contactor (Q2) and disables starting of the drive 1 Closes the main contactor (Q2)
5	EMERGENCY STOP RESET	-	Emergency stop reset push button (with emergency stop options only)
6	GROUND FAULT RESET	-	Ground (earth) fault light with option +Q954
7	-	-	Reserved for application-engineered equipment
8	EMERGENCY STOP	-	Emergency stop push button (with emergency stop options only)
The layout depends on the options selected.			

Main switch-disconnector (Q1)

The switch-disconnector handle switches the main voltage to the drive on and off.

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 switch or breaker.
- AC current meter (option +G335) on one phase.

Control panel

The ACS-AP-I 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 control program.

One control panel can be used to control several drives through a panel link.

The control panel can be removed by pulling it forward from the top edge and reinstalled in reverse order. For the use of the control panel, see *ACX-AP -x assistant control panel 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
IP20	against ingress of solid foreign objects ≥ 12.5 mm diameter *	not protected against water
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 and UL Type 1 (standard)

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 and 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 and 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.

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

This option provides air intake to the drive through the cabinet bottom when the drive is installed on an air duct in the floor. The maximum ambient temperature is +40 °C (+104 °F).

See also section *Air inlet through the bottom of cabinet (option +C128+B055)* on page *73*.

Required options: IP54 degree of protection (+B055)

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)* on page *74*.

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 braces at the top of the cabinet.

Additional wire markings (see *Additional wire markings* (options +G340 and +G342)) may be required for classification.

UL listed (option +C129)

The cabinet is built according to UL 508C and contains the following accessories and features:

- top entry and exit with US cable conduit entries (plain plate without ready-made holes)
- all components UL Listed/Recognized
- maximum supply voltage 600 V
- main (air circuit) breaker whenever available for the particular drive type.

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.

The option is not available with +C121 (marine construction) or +E206 (sine output filter).

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 plinth
- flat bars at base of the cabinet for fastening.

Empty cubicles (options +C196...+C201)

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

These options are not available with +C128 (air inlet through bottom) and +C130 (channeled air outlet).

Resistor braking (options +D150 and +D151)

See chapter *Resistor braking* on page *251*.

EMC filters (options + E200, +E201, +E202, +E210)

See section *Type designation key* on page *57* and sections *Compliance with the European EMC Directive* on page *222* and *Compliance with the EN 61800-3:2004* on page *225*.

More information: *Technical Guide No. 3 – EMC Compliant Installation and Configuration for a Power Drive System* (3AFE61348280 [English]).

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* on page *78*.

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 it has a dedicated cooling fan. The filter increases width of the drive by 600 mm (23.62 in.) or 1000 mm (39.37 in.).

More information: see page 83.

Common mode filter (option +E208)

The common mode filter contains ferrite rings mounted around the motor output of the drive (R6 to R9) and around the output busbars in the power module (R10 and R11). 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* on page 78.

Line contactor (option +F250)

This option provides a line contactor with a manual operating switch on the cabinet door.

Flange mounted switch for MCCB (option +F277)

This option allows you to open and close the main switch from the side of the cabinet.

For US market only with option +F289.

Molded case circuit breaker (MCCB, option +F289)

This option replaces the standard main switch with a molded case circuit breaker. The breaker has inbuilt protection functions against overload and short-circuit. It is operated with a direct rotary handle on the cabinet door.

For US market only.

Cabinet heater with external supply (option +G300)

The option contains:

- heating elements in the cubicles where needed
- 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.

The option is not available with +C134 (CSA Approved).

See also sections:

- *Powering the heating and lighting equipment (options +G300, +G301 and +G313)*
- *Auxiliary circuit power consumption* on page *220*
- circuit diagrams delivered with drive for the actual wiring.

Cabinet lightning (option +G301)

This option contains LED lighting fixtures in each cabinet (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 external uninterruptible control voltage to the control unit and control devices when the drive is not powered.

See also sections:

- *Supplying power for the auxiliary circuits* on page *93*
- *Connecting the external 230 V or 115 V uninterruptible control voltage (UPS, option +G307)* on page *124*
- 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 external supply and heating element(s) connection.

The heater is off when the drive is running. The customer controls the heating elements in the motor windings on and off with the external supply. The power and voltage of the motor heater depend on the motor.

See also sections:

- *Supplying power for the auxiliary circuits* on page *93*
- *Powering the heating and lighting equipment (options +G300, +G301 and +G313)* on page *128*
- 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.

Additional wire markings (options +G340 and +G342)

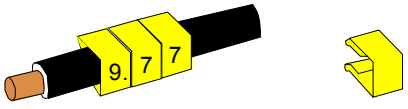
Standard wire markings

As standard, wires and terminals are marked as follows:

- Plug-in connectors of wire sets: Connectors labeled with designation (eg. "X1"). Both the connector and the individual wires are marked with pin numbers.
- Wires without a connector: Connector designation and pin number printed on wire (eg. "X1:7").
- Fiber optic pairs: Component and connector designation printed on marker tape.
- Main input, output and PE terminals: Connector identifier (eg. "U1", "PE") printed on sticker on terminal, or on insulating material close to the terminal. PE cables marked with yellow/green tape.

Additional wire markings

The following additional wire markings are available.

	Additional markings
+G340	Equipment pin numbers are marked with snap-on markers on wires between modules and on wires connected to equipment, terminal blocks and detachable screw terminals. Plug-in 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. 
+G342	Equipment identifications and terminal block pin numbers and remote addresses are marked with tubing or rings on wires between modules, and on wires connected to equipment, terminal blocks and detachable screw terminals. Plug-in connector identifications are marked on labels attached around the conductor bundles near the connectors. Main circuit conductors are marked with white tape or printing. **Note:** Even wires with equipment and pin identifiers ready printed on the wire insulation are marked with rings or tubing. Remote end addresses **are not** marked on wire ends that are connected to plug-in connectors. Short and obvious connections are marked with printing only. . 

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.

DC cable connection busbars (option +H356)

The option contains a busbar kit for DC cable connections. The option is not available with +D150.

US/UK 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 standard 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.

Cables accepted by the terminals:

- solid wire 0.08 to 4 mm^2 (28 to 12 AWG)
- stranded wire with ferrule 0.14 to 2.5 mm^2 (24 to 14 AWG)
- stranded wire without ferrule 0.08 to 2.5 mm^2 (28 to 14 AWG).

Stripping length: 10 mm (0.5 in).

Note: The optional modules inserted in the slots of the control unit (or optional FEA-03 extension adapter) 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 the 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])
- *FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual* (3AXD50000027782 [English])
- *Wiring the PTC thermistor relay(s) (options +L505, +2L505, +L513 and +2L513)* on page *125*
- circuit diagrams delivered with the drive for the actual wiring.

Thermal protection with Pt100 relays (options +nL506)

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), +5L514 (5 relays) and +8L514 (8 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])
- *Wiring the Pt100 relays (options +nL506)* on page *126* or *Wiring the Pt100 relays (option +nL514)* on page *126*
- Pt100 relay alarm and trip limit setting instructions in the start-up instructions
- circuit diagrams delivered with the drive for the actual wiring.

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

What the option contains

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

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

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 up to four fan connections (eg. option +4M602), while the highest current rating only allows one (eg. +M610). For more information, refer to *ACS-880-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.

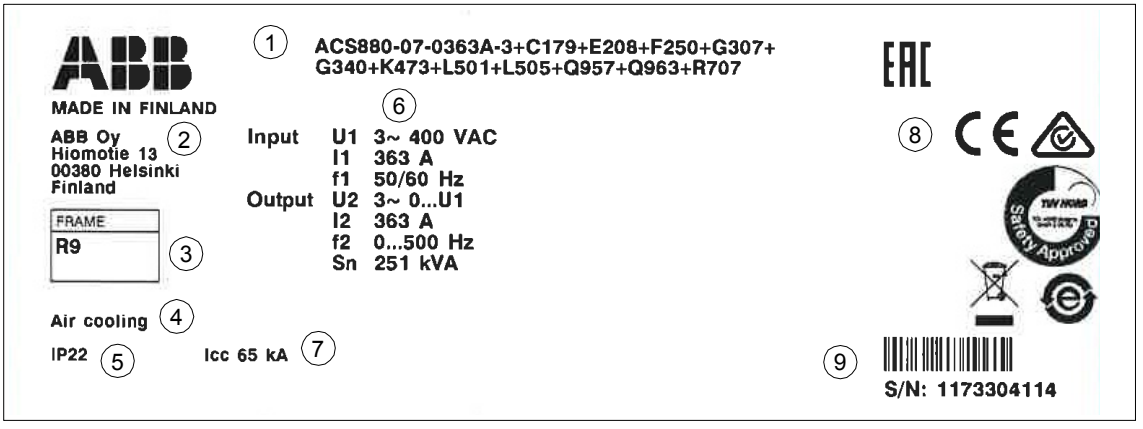
The statuses of both the starter switch and the fan contactor are wired to the terminal block.

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

Type designation label

The type designation label includes ratings, appropriate markings, a type designation and a serial number, which allow identification of each unit. The type designation label is located on the front cover. A sample label is shown below.

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



No.	Description
1	Type designation, see section *Type designation key* below.
2	Manufacturing address
3	Frame size
4	Cooling method
5	Degree of protection
6	Ratings, see also chapter *Technical data* on page *195*.
7	Short-circuit withstand strength, see section *Electrical power network specification* on page *218*.
8	Valid markings
9	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.

Type designation key

The type designation contains information on the specifications and configuration of the drive. The first digits from left express the basic configuration (eg, ACS880-07-240A-5). The optional selections are given thereafter, separated by plus signs, eg, +E202. The main selections are described below. Not all selections are available for all types. For more information, refer to *ACS880-X7 single drives ordering information* (3AXD10000052815, available on request).

CODE	DESCRIPTION
Basic codes	
ACS880	Product series
07	When no options are selected: cabinet-installed drive, IP22 (UL Type 1), main switch-disconnector (switch fuse with aR fuses), ACS-AP-I assistant control panel, no EMC filter, input DC choke (frames R6 to R9), input AC choke (frames R10 and R11), coated boards, ACS880 primary control program, Safe torque off function, bottom entry and exit of cables, multilingual device label sticker, USB memory stick containing circuit diagrams and all manuals.
Size	
xxxx	Refer to the rating tables, page *195*
Voltage range	
3	380…415 V. This is indicated in the type designation label as typical input voltage level 3 ~ 400 V AC.
5	380…500 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 400/480/500 V AC.
7	525…690 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 525/600/690 V AC.
Option codes (plus codes)	
Degree of protection	
B054	IP42 (UL Type 1)
B055	IP54 (UL Type 12)
Construction	
C121	Marine construction. See page *48*.
C128	Air inlet through bottom. Requires option +B055. See page *48*.
C129	UL Listed. See page *48*.
C130	Channeled air outlet. See page *48*.
C132	Marine type approval. Requires option +C121 marine construction.
C134	CSA approved. See page *49*.
C164	Plinth height 100 mm. See page *49*. **Note**: IP54 roof with option +B055 is packed in a separate package if the plinth height is 100 mm.
C179	Plinth height 200 mm. See page *49*.
C180	Seismic design. See page *49*.
C196	Empty cabinet 400 mm on right side. See page *49*.
C197	Empty cabinet 600 mm on right side. See page *49*.
C198	Empty cabinet 800 mm on right side. See page *49*.
C199	Empty cabinet 400 mm on left side. See page *49*.
C200	Empty cabinet 600 mm on left side. See page *49*.
C201	Empty cabinet 800 mm on left side. See page *49*.
Resistor braking	
D150	Brake choppers. See page *49*.
D151	Brake resistors. See page *49*.

CODE	DESCRIPTION
Filters	
E200	EMC/RFI filter for second environment TN (grounded) system, category C3. See page 49.
E201	EMC/RFI filter for second environment IT (ungrounded) system, category C3. See page 49.
E202	EMC/RFI filter for first environment TN (grounded) system, category C2. See page 49.
E205	du/dt filter (page 49)
E206	Sine output filter (page 50)
E208	Common mode filter (page 50)
E210	EMC/RFI filter for second environment TN and IT (grounded and ungrounded) systems, category C3. See page 49.
Line options	
F250	Line contactor. See page 50.
F277	Flange mounted switch for molded case circuit breaker (MCCB) for US market only. See page 50.
F289	Molded case circuit breaker (MCCB) for US market only. See page 50.
Heaters and auxiliary control voltage	
G300	Cabinet heater (external supply). See page 50.
G307	Terminals for connecting external control voltage (230 V AC or 115 V AC uninterruptible power supply). See page 51.
G313	Output for motor heater (external supply). See page 51.
Lights	
G301	Cabinet lighting. See page 51.
G327	Ready pilot light, white
G328	Run pilot light, green
G329	Fault pilot light, red
Materials	
G330	Halogen-free wiring and materials. See page 51.
Meters	
G334	V-meter with selector switch. See page 51.
G335	A-meter in one phase. See page 52.
Wire markings	
G340	Additional wire markings. See section *Additional wire markings (options +G340 and +G342)* on page 52.
G342	
Cabling	
H350	Bottom entry (only with +C129). See page 52.
H351	Top entry of cables (included with +C129). See page 53.
H352	Bottom exit (only with +C129). See page 52.
H353	Top exit of cables (included with +C129). See page 53.
H356	DC cable connection busbars. See page 53.
H358	Cable conduit entry (US/UK) (included with +C129 and +C134). See page 53.
Fieldbus adapters	
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

CODE	DESCRIPTION
K473	FENA-11 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols
K475	FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
I/O extensions and feedback interfaces	
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 page *53*.
L505	Thermistor relay (1 or 2 pcs). See page *53*.
L506	Pt100 relay (2, 3, 5 or 8 pcs). See page *54*.
L508	FDCO-02 optical DDCS communication adapter module
L513	ATEX-certified thermal protection with PTC relays (1 or 2 pcs, +Q971 required)
L514	ATEX-certified thermal protection with Pt100 relays (3 or 5 pcs, +Q971 required)
L515	FEA-03 I/O extension adapter (1 or 2 pcs, +L503 or +L508 required)
L516	FEN-21 resolver interface module
L517	FEN-01 TTL incremental encoder interface module
L518	FEN-11 TTL absolute encoder interface module
L521	FSE-31 pulse encoder interface (+Q972 required)
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 (+Q971 required)
Starter for auxiliary motor fan (see page *55*)	
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
Control program	
N5000	Winder control program
N5050	Crane control program
N5100	Winch control program
N5200	PCP/ESP control program
N5300	Test bench control program
N5450	Override control program
N7502	Control program for synchronous reluctance motors (SynRM)
N8010	IEC 61131-3 application programmability
Specialties	
P902	Customized
P904	Extended warranty
P912	Seaworthy packing
P913	Special color
P929	Container packing

CODE	DESCRIPTION
Safety functions	
Q950	Prevention of unexpected start-up with FSO-xx safety functions module
Q951	Emergency stop (category 0) with safety relays, by opening the main contactor/breaker
Q952	Emergency stop (category 1) with safety relays, by opening the main contactor/breaker
Q954	Ground fault monitoring for IT (ungrounded) systems
Q957	Prevention of unexpected start-up with safety relays
Q963	Emergency stop (category 0) with safety relays (without opening the main contactor/breaker)
Q964	Emergency stop (category 1) with safety relays (without opening the main contactor/breaker)
Q965	Safely-limited speed with encoder (+Q972 and +L521 required)
Q971	ATEX-certified safe disconnection function, EX II (2) GD
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 contactor/breaker
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
Printed documentation (manuals, dimensional drawings, circuit diagrams and manual language). **Note:** The delivered manual set may include manuals in English if the translation is not available.	
R700	English
R701	German
R702	Italian
R703	Dutch
R704	Danish
R705	Swedish
R706	Finnish
R707	French
R708	Spanish
R709	Portuguese
R711	Russian
R713	Polish

4

Mechanical installation

Contents of this chapter

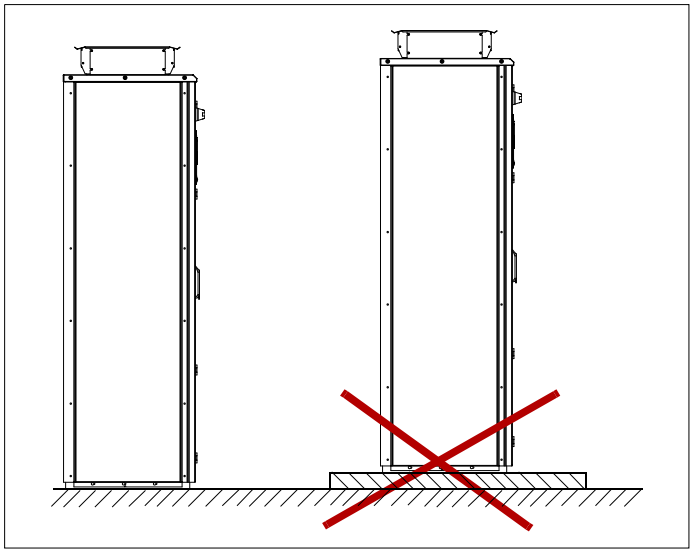
This chapter describes the mechanical installation procedure of the drive.

Examining the installation site

Examine the installation site:

- The installation site is sufficiently ventilated or cooled to transfer away the drive losses. See the technical data.
- The ambient conditions of the drive meet the specifications. See the technical data.
- The wall behind the unit is of non-flammable material.
- There is enough free space above the drive to enable cooling air flow, service and maintenance, and opening of the pressure relief lid.
- The floor that the unit 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 (0.2 in) in every 3 meters (10 ft). 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!), iron bar, jack and rollers
- Pozidriv and Torx (2.5…6 mm) screwdrivers
- torque wrench
- set of wrenches or sockets.

Checking 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 module manuals
- delivery documents.

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

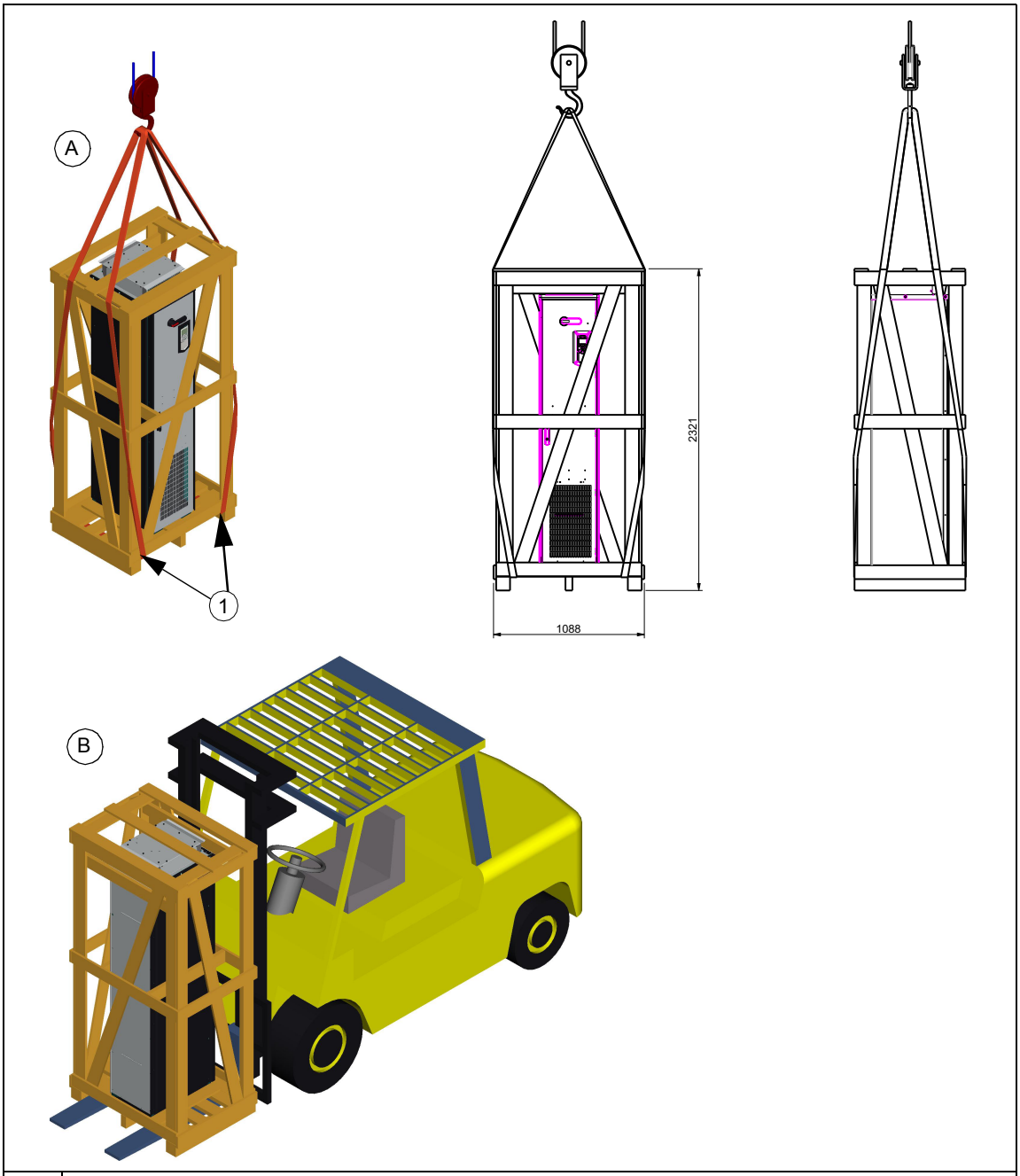
Moving and unpacking the drive

Move the drive in its original pallet, preferably in the original package 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



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

Removing the transport package

Remove the transport package as follows:

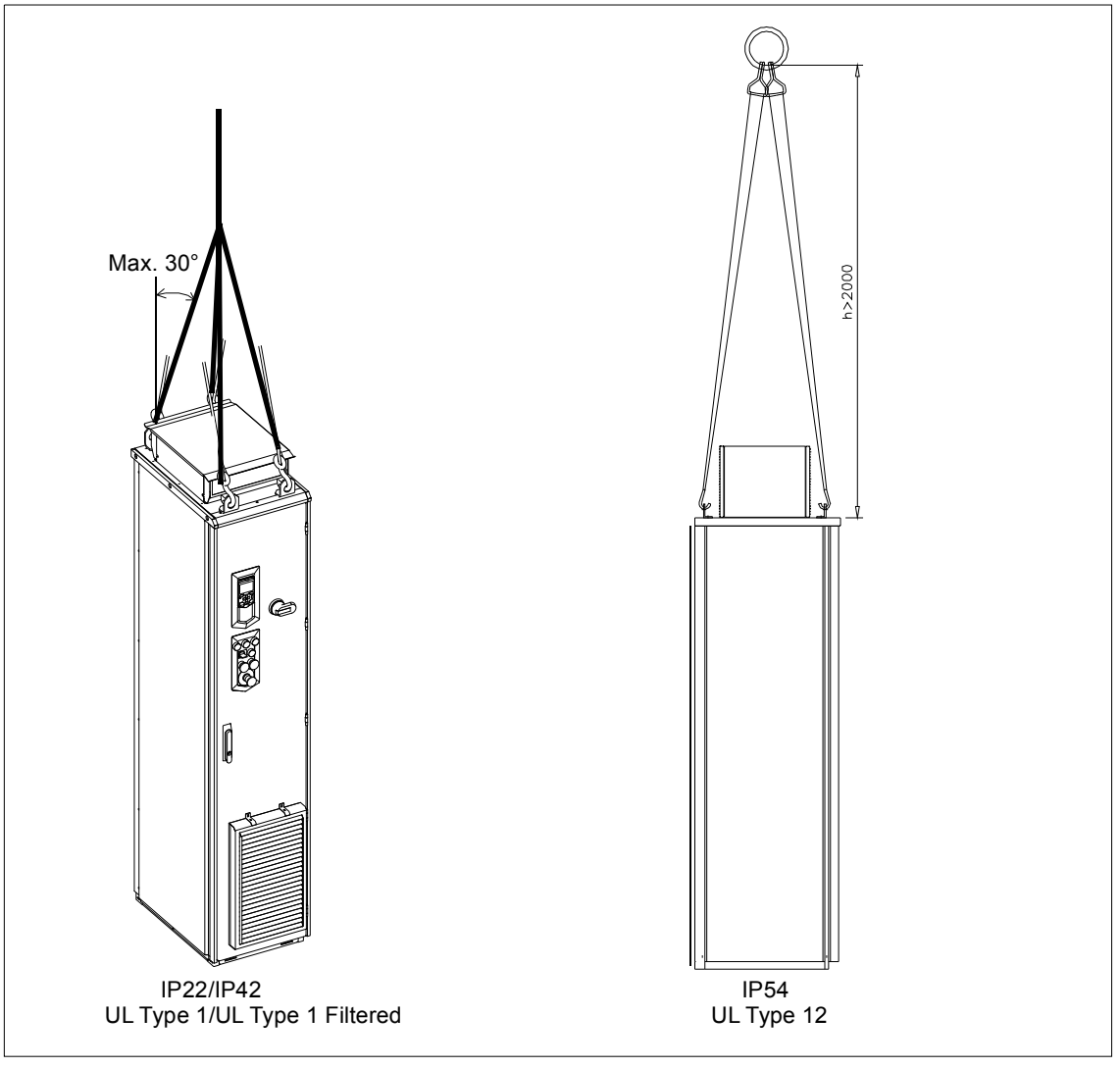
1. Undo the screws that attach the wooden parts of the transport crate to each other.
2. Remove the wooden parts.
3. Remove the clamps with which the drive cabinet is mounted onto the transport pallet by undoing the fastening screws.
4. Remove the plastic wrapping.

Moving the unpacked drive cabinet

Lifting the drive cabinet with a crane

Lift the drive cabinet using its lifting eyes. The lifting eyes can be removed after the cabinet is in its final position, but their mounting holes must be blocked to retain the degree of protection.

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



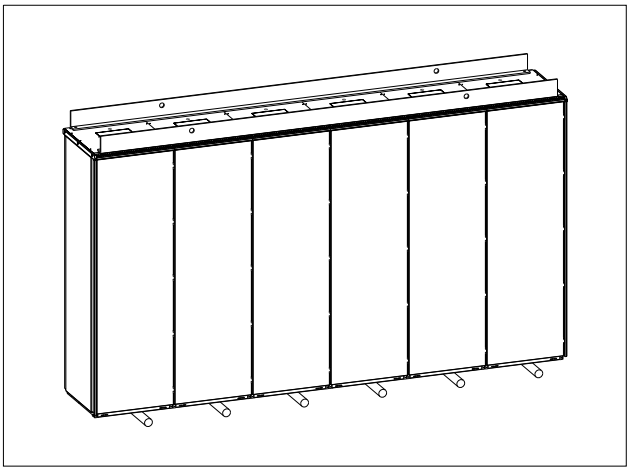
IP22/IP42
UL Type 1/UL Type 1 Filtered

IP54
UL Type 12

Moving the cabinet on rollers

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

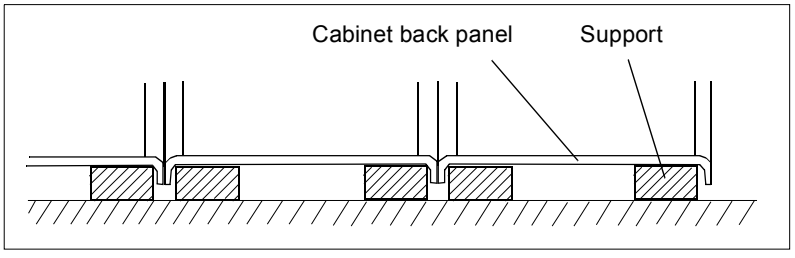
Lay the cabinet on the rollers and move it carefully until close to its final location. Remove the rollers by lifting the unit with a crane, forklift, pallet truck or jack.



Moving the cabinet on its back

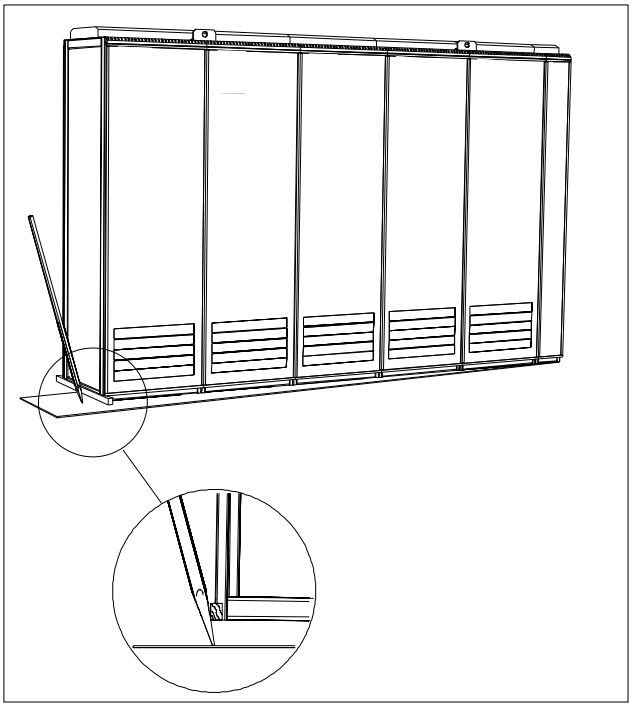
WARNING: Do not transport the drive with a sine filter (option +E206) on its back. It will damage the filter.

Support the cabinet from below alongside the cubicle seams.



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.

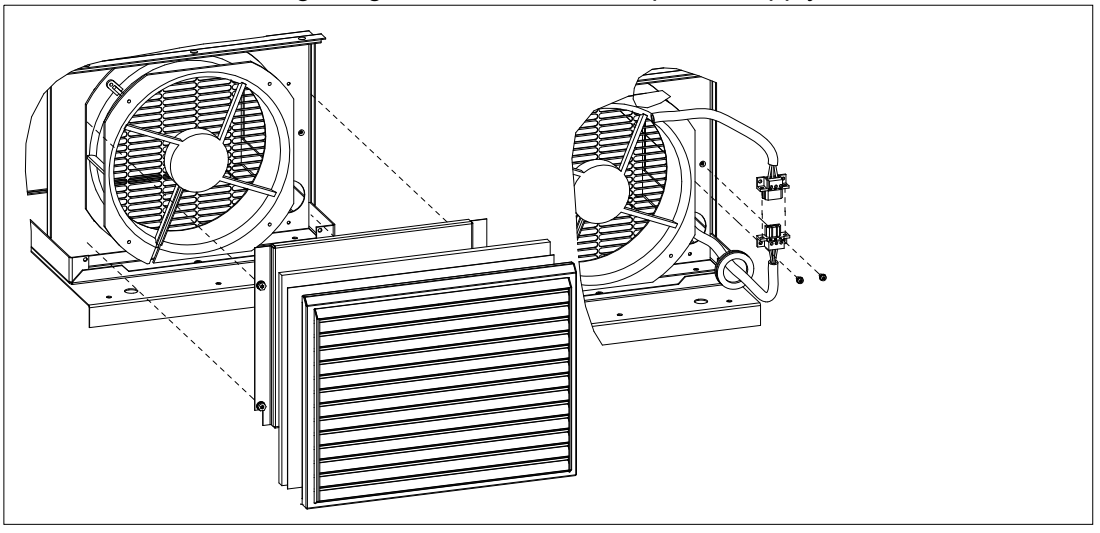


Installing the IP54 roof

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

Frames R6 to R8

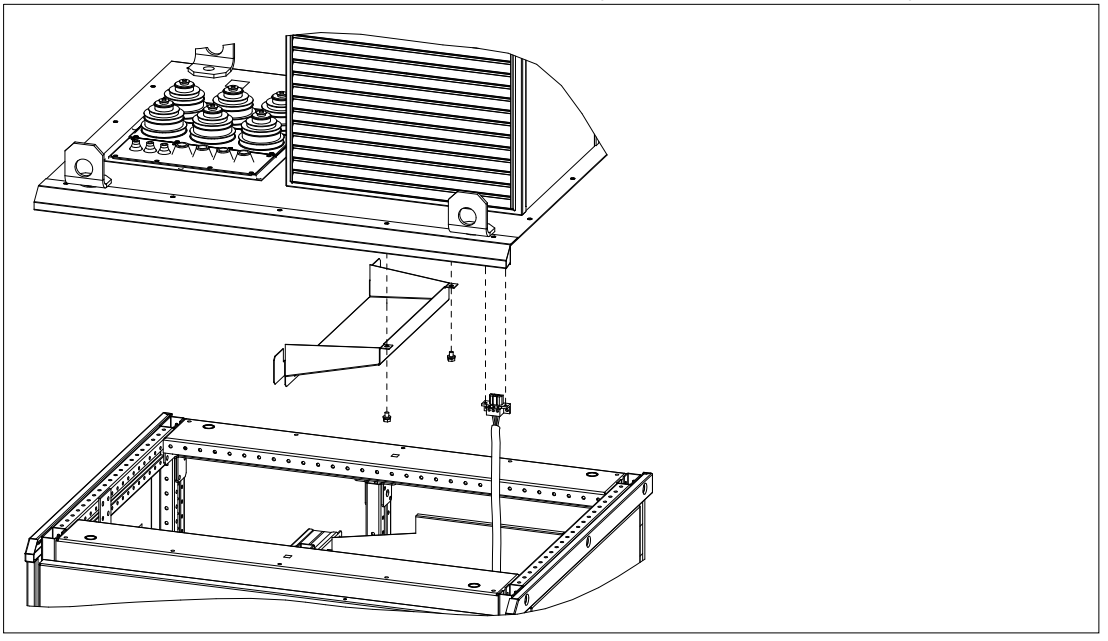
1. Undo the mounting screws of the front top profile of the cabinet and remove it. Undo the back mounting screws of the roof from the cabinet top. See step 1 under section *Frames R10 and R11* on page *69*.
2. Remove the IP54 filter grating and connect the fan power supply wires.



3. Install the front top profile of the cabinet in reverse order to step 1.
4. Fasten the back mounting screws of the roof.
5. Install the IP54 filter grating.

Frame R9

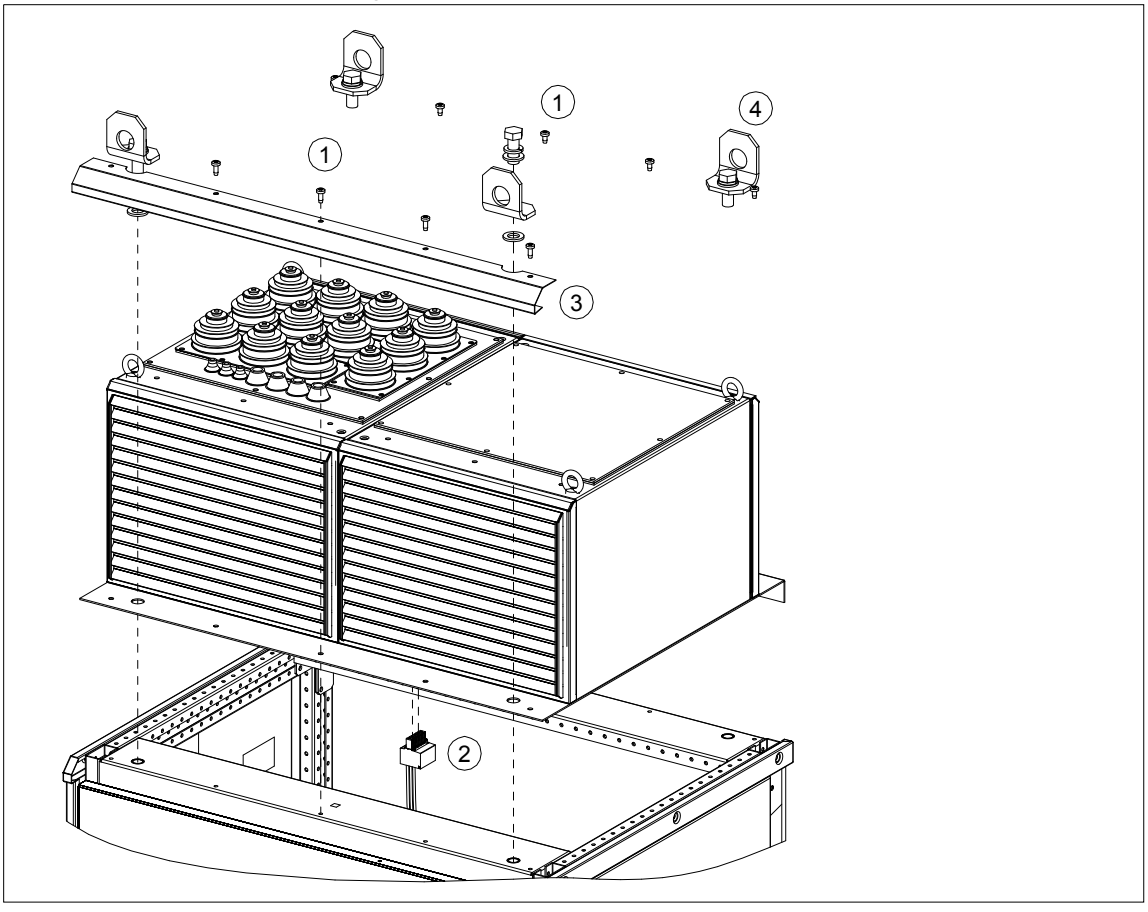
1. Undo the mounting screws of the front top profile of the cabinet and remove it. Undo the back mounting screws of the roof from the cabinet top. See step 1 under section *Frames R10 and R11* on page *69*.
2. Install the shroud to bottom of the fan assembly. Connect the fan supply wires.



3. Install the front top profile of the cabinet in reverse order to step 1.
4. Fasten the back mounting screws of the roof.

Frames R10 and R11

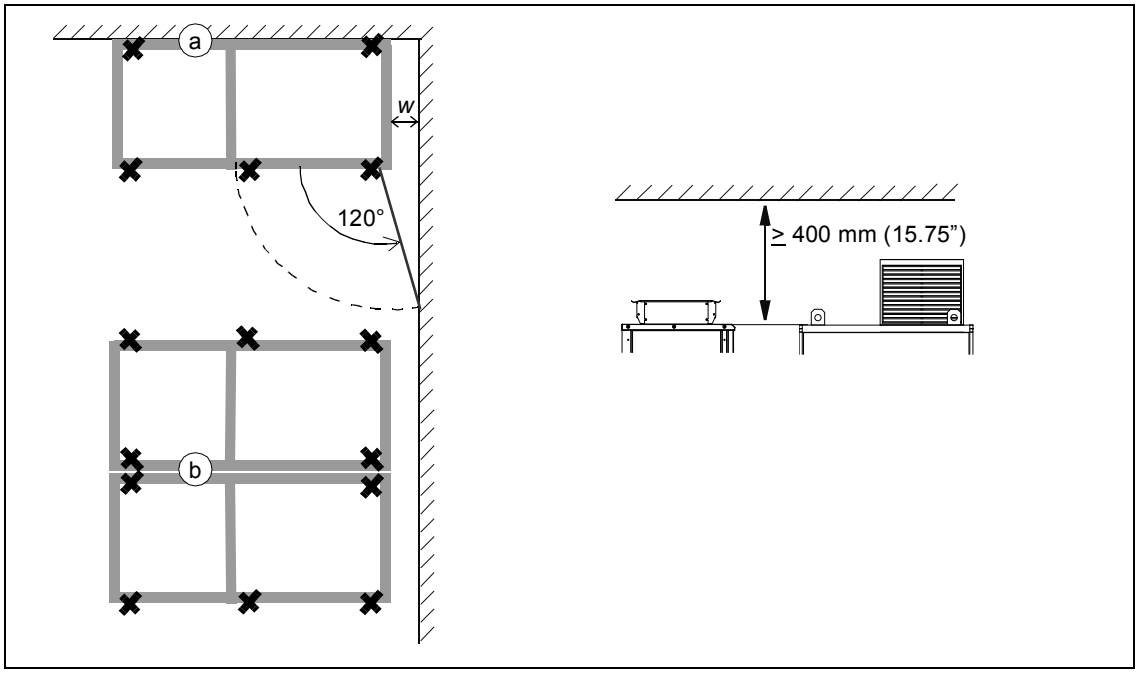
1. To remove the top front and back profile of the cabinet, undo the mounting screws.
2. Connect the power supply wires to the fan.
3. Install the front top profile of the cabinet in reverse order to step 1.
4. Fasten the back mounting screws of the roof.



Fastening the cabinet to the floor and wall or roof (non-marine units)

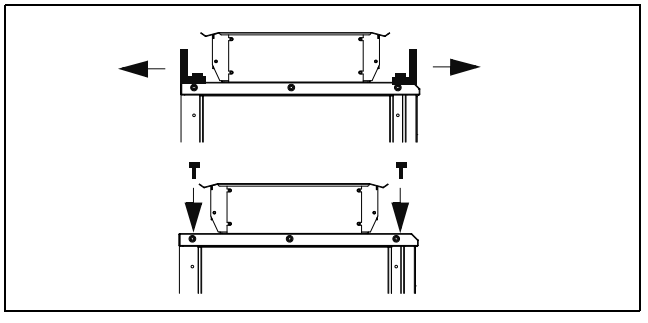
General rules

- The drive must be installed in an upright vertical position.
- The cabinet can be installed with its back against a wall (a), or back-to-back with another unit (b).
- Leave 400 mm (15.75 in) free space above the basic roof level of the cabinet for cooling. IP54 (UL Type 12) requires 320 mm (12.6 in) free space above.
- Leave some space (*w*) at the side where the cabinet outmost hinges are to allow the doors to open sufficiently. The doors must open 120° to allow the drive module replacement.



Note 1: Any height adjustment must be done before fastening the units or shipping splits together. Height adjustment can be done by using metal shims between the cabinet bottom and floor.

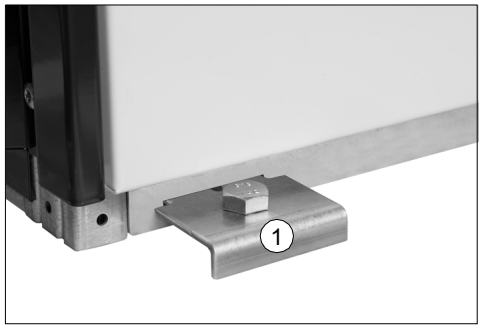
Note 2: If the lifting eyes are removed, refasten the bolts to retain the degree of protection of the cabinet.

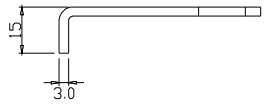


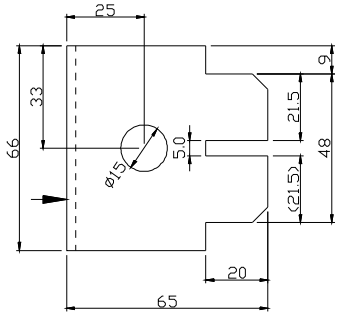
Fastening methods

Fasten the cabinet to the floor by using clamps included along the edge of the cabinet bottom, or by bolting the cabinet to the floor through the holes inside (if they are accessible).

Alternative 1 – Clamping

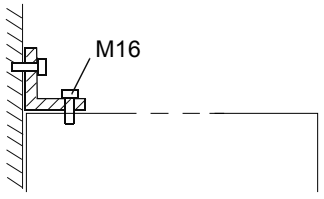




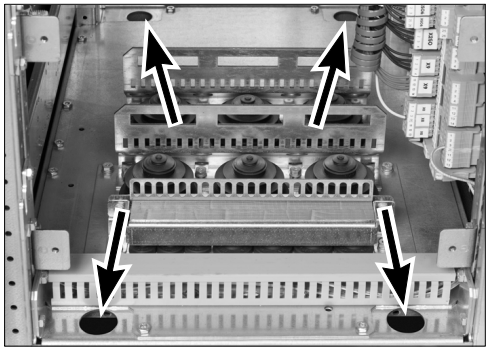


Clamp dimensions

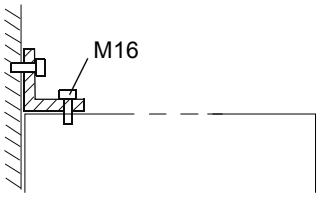
1. Insert the clamps into the twin slots along the front and rear edges of the cabinet frame body and fasten them to the floor with a bolt. The recommended maximum distance between the clamps in the front edge is 800 mm (31.5”).
2. If floor mounting at the back is not possible, fasten the top of the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



Alternative 2 – Using the holes inside the cabinet



1. Fasten 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 cabinet at the top to wall with L-brackets (not included in the delivery) using the lifting lug fastening holes.



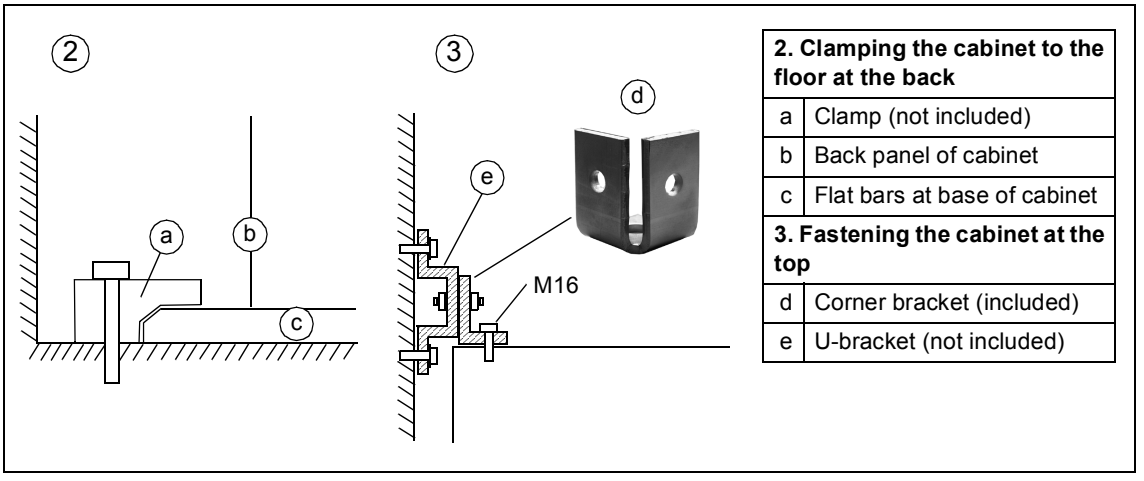
Fastening the cabinet to the floor and roof/wall (marine units)

Obey the general cabinet installation rules also in the installation of the marine variant. See section *General rules* on page *70*.

See the dimension drawing delivered with the drive for details of the fastening points. Top fastening brackets are included in the delivery.

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. Remove the lifting lugs and bolt the corner brackets (d) to the lifting lug holes. Fasten the corner brackets to the rear wall and/or roof with suitable hardware such as U-brackets (e).



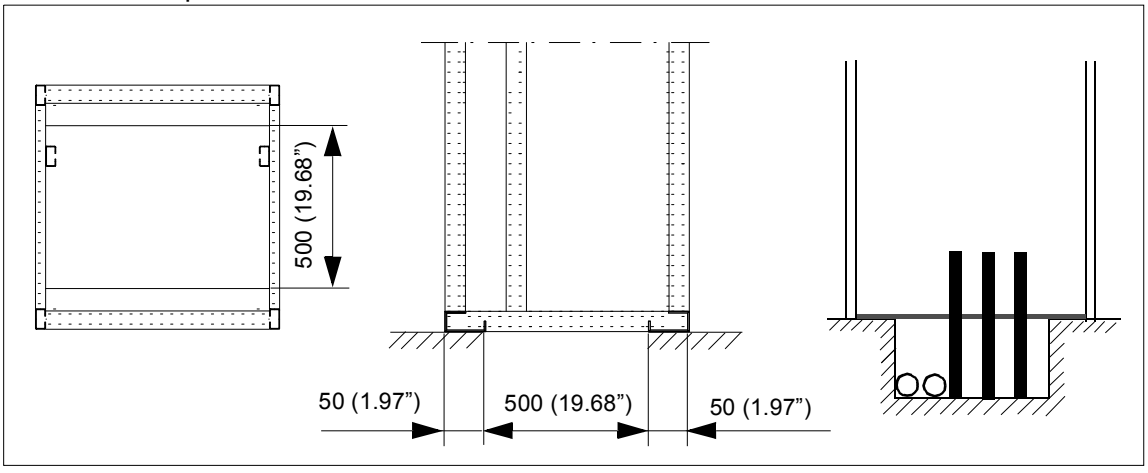
2. Clamping the cabinet to the floor at the back	
a	Clamp (not included)
b	Back panel of cabinet
c	Flat bars at base of cabinet
3. Fastening the cabinet at the top	
d	Corner bracket (included)
e	U-bracket (not included)

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.

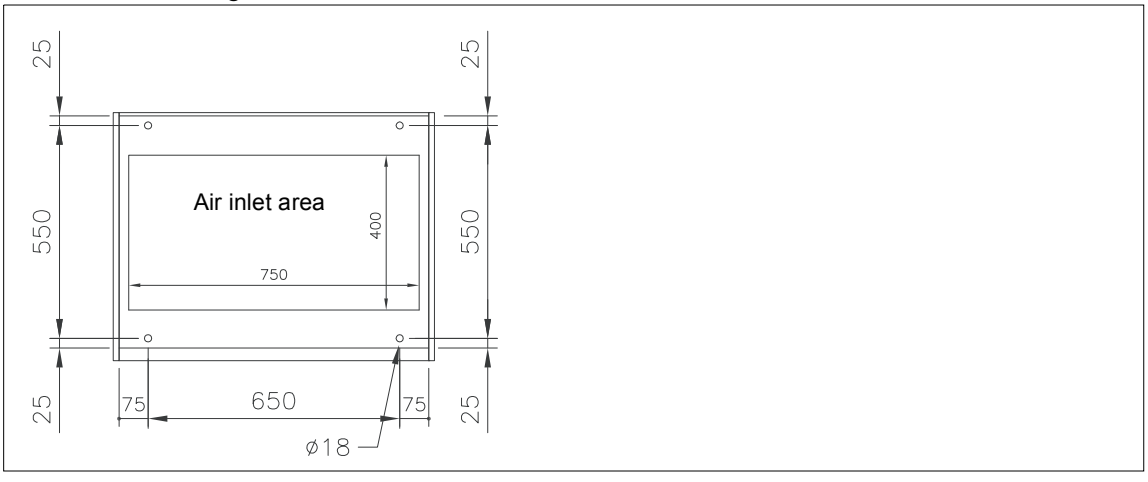
Prevent the cooling air flow from the cable duct to the cabinet by bottom plates. To ensure the degree of protection for the cabinet, use the original bottom plates delivered with the unit. With user-defined cable entries, take care of the degree of protection, fire protection and EMC compliance.



Air inlet through the bottom of cabinet (option +C128+B055)

Drives with air intake through the bottom of the cabinet (option +C128) are intended for installation on an air duct in the floor. Option +C128 requires also option +B055.

An example of the required air inlets in the floor 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. The minimum air flow values are given in section *Losses, cooling data and noise* on page *208*.

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:

$$\Delta p_s = (1.5\ldots2) \cdot p_d$$

where

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

$$v_m = q / A_c$$

p_d ≙ Dynamic pressure

ρ ≙ Air density (kg/m^3)

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

q ≙ Rated air flow of the drive (m^3/s)

A_c ≙ Cross-sectional area of the exit duct(s) (m^2)

Example

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

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

$v_m = q / A_c = 1.3 / 0.234 = 5.5$ m/s

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

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

For more information, contact ABB.

Arc welding

Fastening the cabinet by arc welding is not recommended. However, if the arc welding is the only mounting option, proceed as follows: Connect the return conductor of the welding equipment to the cabinet frame at the bottom within 0.5 meters (1.5 ft) of the welding point.

Note: The thickness of the zinc coating of the cabinet frame is 20 micrometers (0.79 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.

5

Guidelines for planning the electrical installation

Contents of this chapter

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

Limitation of liability

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

Selecting the supply disconnecting device

The drive is equipped with a main switch-disconnector as standard. The disconnector can be locked to the open position for installation and maintenance work.

Selecting the main contactor

The drive can be equipped with a line contactor (option +F250).

Examining the compatibility of the motor and drive

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

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

Make sure that the motor withstands the maximum peak voltage in the motor terminals. See section *Requirements table* on page *79*. For basics of protecting the motor insulation and bearings in drive systems, see section *Protecting the motor insulation and bearings* below.

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 following operation limits of the drive control program:
  - motor nominal voltage range 1/6 ... 2 · U_N
  - motor nominal current range 1/6 ... 2 · I_N of the drive in DTC control and 0 ... 2 · I_N in scalar control. The control mode is selected by a drive parameter.

Protecting the motor insulation and bearings

The drive 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.

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

Requirements table

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.

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

* manufactured before 1.1.1998

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

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

*** 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 table 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 (option +E205)
CMF	Common mode filter (option +E208)
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.

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 the braking applications

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

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

Additional requirements for 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 mains voltage (AC line voltage)	**Requirement for**			
	Motor insulation system	**ABB du/dt and common mode filters, insulated N-end motor bearings**		
		P_N < 100 kW	**100 kW ≤ P_N < 200 kW**	**P_N ≥ 200 kW**
		P_N < 140 hp	**140 hp ≤ P_N < 268 hp**	**P_N ≥ 268 hp**
$U_N \leq 500$ V	Standard	-	+ N	+ N + CMF
500 V < $U_N \leq 600$ V	Standard	+ d*u*/d*t*	+ N + d*u*/d*t*	+ N + d*u*/d*t* + CMF
	or			
	Reinforced	-	+ N	+ N + CMF
600 V < $U_N \leq 690$ V	Reinforced	+ d*u*/d*t*	+ N + d*u*/d*t*	+ N + d*u*/d*t* + 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.

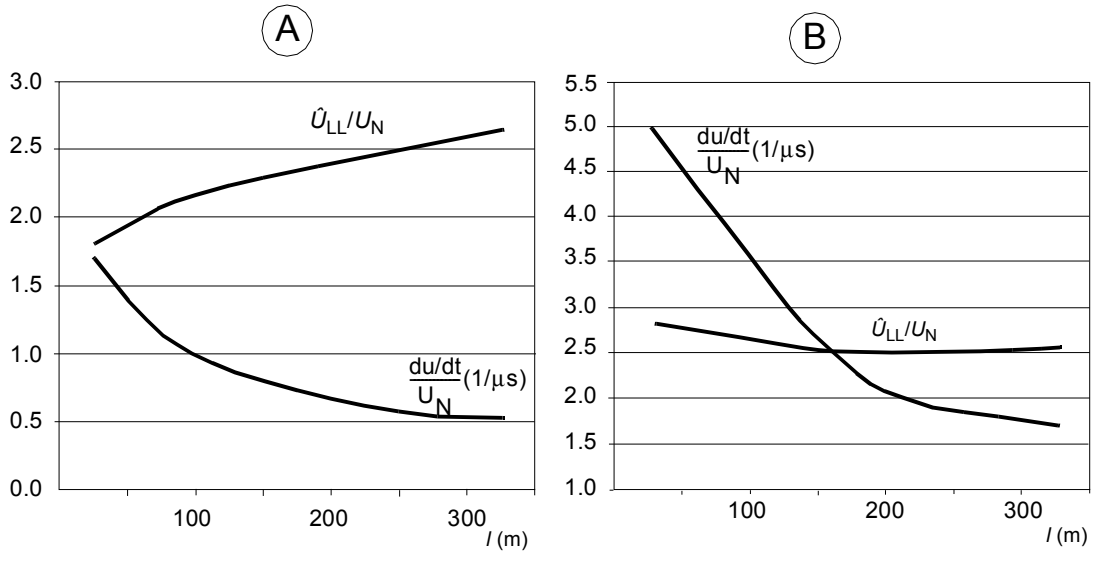
Nominal AC line voltage	**Requirement for**		
	Motor insulation system	**ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings**	
		P_N < 100 kW or frame size < IEC 315	**100 kW ≤ P_N < 350 kW or IEC 315 ≤ frame size < IEC 400**
		P_N < 134 hp or frame size < NEMA 500	**134 hp ≤ P_N 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

*** 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

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 appropriate 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 appropriate diagram below. Multiply the values by the nominal supply voltage (U_N) and substitute into equation $t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.



A	Drive with du/dt filter
B	Drive without du/dt filter
l	Motor cable length
$\hat{U}_{LL}/U_N$	Relative peak line-to-line voltage
(du/dt)/U_N	Relative du/dt value

Note: $\hat{U}_{LL}$ and du/dt values are approximately 20% higher during resistor braking.

Additional note for sine filters

A sine filter also protects the motor insulation system. Therefore, du/dt filter can be replaced with a sine filter. The peak phase-to-phase voltage with a sine filter is approximately $1.5 \cdot U_N$.

Sine filter is available as an option (+E206).

Selecting the power cables

General rules

Select the input power and motor cables according to local regulations. Obey these rules:

- Select a cable capable of carrying the drive nominal current. See section *Ratings* (page *195*) for the rated currents.
- Select a cable rated for at least 70 °C maximum permissible temperature of conductor in continuous use.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. For 690 V AC rated equipment, the rated voltage between the conductors of the cable should be at least 1 kV.
- With US installations, consider the additional US requirements. See *Additional US requirements*, page *87*.

Use symmetrical shielded motor cable (see page *86*). Ground motor cable shields 360° at both ends. Keep the motor cable and its PE pigtail (twisted shield) as short as possible to reduce high-frequency electromagnetic emissions.

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

ABB recommends symmetrical shielded cable for the input cabling, but a four-conductor system is also possible.

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

The protective conductor must always have an adequate conductivity.

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

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

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

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

Typical power cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for the drives with nominal current. For the cable sizes accepted by the drive cabinet entries and connection terminals, see page *210*.

Drive type	Frame size	IEC [1]		US [2]
		Cu cable type	Al cable type	Cu cable type
		mm²	mm²	AWG/kcmil per phase
U_N = 400 V				
ACS880-07-0105A-3	R6	3×50	3×70	1
ACS880-07-0145A-3	R6	3×95	3×120	2/0
ACS880-07-0169A-3	R7	3×120	3×150	3/0
ACS880-07-0206A-3	R7	3×150	3×240	250 MCM
ACS880-07-0246A-3	R8	2 × (3×70)	2 × (3×95)	300 MCM
ACS880-07-0293A-3	R8	2 × (3×95)	2 × (3×120)	2 × 3/0
ACS880-07-0363A-3	R9	2 × (3×120)	2 × (3×185)	2 × 4/0
ACS880-07-0430A-3	R9	2 × (3×150)	2 × (3×240)	2 × 250 MCM
ACS880-07-0505A-3	R10	3 × (3×95)	3 × (3×150)	2×500 MCM or 3×250 MCM
ACS880-07-0585A-3	R10	3 × (3×120)	3 × (3×185)	2×600 MCM or 3×300 MCM
ACS880-07-0650A-3	R10	3 × (3×150)	3 × (3×240)	2×700 MCM or 3×350 MCM
ACS880-07-0725A-3	R11	3 × (3×185)	4 × (3×185)	3×500 MCM or 4×300 MCM
ACS880-07-0820A-3	R11	3 × (3×240)	4 × (3×240)	3×600 MCM or 4×400 MCM
ACS880-07-0880A-3	R11	3 × (3×240)	4 × (3×240)	3×600 MCM or 4×400 MCM
U_N = 500 V				
ACS880-07-0096A-5	R6	3×50	3×70	1
ACS880-07-0124A-5	R6	3×95	3×95	2/0
ACS880-07-0156A-5	R7	3×120	3×150	3/0
ACS880-07-0180A-5	R7	3×150	3×185	250 MCM
ACS880-07-0240A-5	R8	2 × (3×70)	2 × (3×95)	300 MCM
ACS880-07-0260A-5	R8	2 × (3×70)	2 × (3×95)	2 × 2/0
ACS880-07-0302A-5	R9	2 × (3×95)	2 × (3×120)	2 × 3/0
ACS880-07-0361A-5	R9	2 × (3×120)	2 × (3×185)	2 × 250 MCM
ACS880-07-0414A-5	R9	2 × (3×150)	2 × (3×240)	2 × 250 MCM
ACS880-07-0460A-5	R10	3 × (3×95)	3 × (3×150)	2×400 MCM or 3×4/0
ACS880-07-0503A-5	R10	3 × (3×95)	3 × (3×150)	2×500 MCM or 3×250 MCM
ACS880-07-0583A-5	R10	3 × (3×120)	3 × (3×185)	2×600 MCM or 3×300 MCM
ACS880-07-0635A-5	R10	3 × (3×150)	3 × (3×240)	2×700 MCM or 3×350 MCM
ACS880-07-0715A-5	R11	3 × (3×185)	4 × (3×185)	3×500 MCM or 4×300 MCM
ACS880-07-0820A-5	R11	3 × (3×240)	4 × (3×240)	3×600 MCM or 4×400 MCM
ACS880-07-0880A-5	R11	3 × (3×240)	4 × (3×240)	3x600 MCM or 4x400 MCM
U_N = 690 V				
ACS880-07-0061A-7	R6	3×25	3×35	4
ACS880-07-0084A-7	R6	3×35	3×50	3
ACS880-07-0098A-7	R7	3×50	3×70	2
ACS880-07-0119A-7	R7	3×70	3×95	1/0
ACS880-07-0142A-7	R8	3×95 3)	3×120	2/0
ACS880-07-0174A-7	R8	3×120 3)	2 × (3×70)	4/0

Drive type	Frame size	IEC [1]		US [2]
		Cu cable type	Al cable type	Cu cable type
		mm^2	mm^2	AWG/kcmil per phase
ACS880-07-0210A-7	R9	3×185	2 × (3×95)	300 MCM
ACS880-07-0271A-7	R9	3×240	2 × (3×120)	400 MCM
ACS880-07-0330A-7	R10	2 × (3×120)	3 × (3×120)	2×250 MCM or 3×2/0
ACS880-07-0370A-7	R10	2 × (3×120)	3 × (3×120)	2×300 MCM or 3×3/0
ACS880-07-0430A-7	R10	2 × (3×95)	2 × (3×120)	2×350 MCM or 3×4/0
ACS880-07-0470A-7	R11	3 × (3×95)	3 × (3×150)	2×400 MCM or 3×4/0
ACS880-07-0522A-7	R11	3 × (3×120)	3 × (3×185)	2×500 MCM or 3×250 MCM
ACS880-07-0590A-7	R11	3 × (3×150)	3 × (3×185)	2×600 MCM or 3×300 MCM
ACS880-07-0650A-7	R11	3 × (3×150)	3 × (3×240)	2×700 MCM or 3×350 MCM
ACS880-07-0721A-7	R11	3 × (3×185)	4 × (3×185)	3×500 MCM or 4×300 MCM

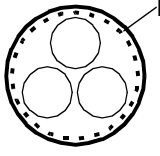
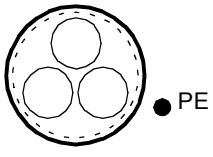
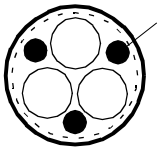
3AXD10000044776

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.

Alternative power cable types

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

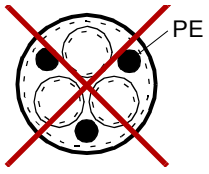
Recommended power cable types

	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. The shield must meet the requirements of IEC 61800-5-1, see page *84*. Check with local / state / country electrical codes for allowance.
	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. A separate PE conductor is required if the shield does not meet the requirements of IEC 61800-5-1 see page *84*.
	Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must meet the requirements of IEC 61800-5-1

Power cable types for limited use

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

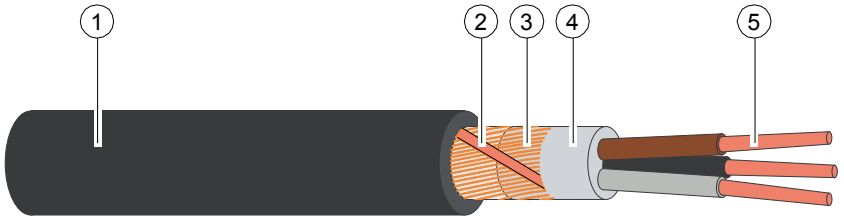
Not allowed power cable types

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

Motor cable shield

If the motor cable shield is used as the sole PE conductor, make sure that the conductivity agree with the PE conductor requirements. See subsection *General rules* on page *84*, or IEC 61800-5-1.

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



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

Additional US requirements

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

Conduit

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

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

Armored cable / shielded power cable

The motor cables can be run in the same cable tray as other 460 V or 600 V power wiring. Control and signal cables must not be run in the same tray as power cables.

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

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

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

Planning the resistor braking system

See chapter *Resistor braking*.

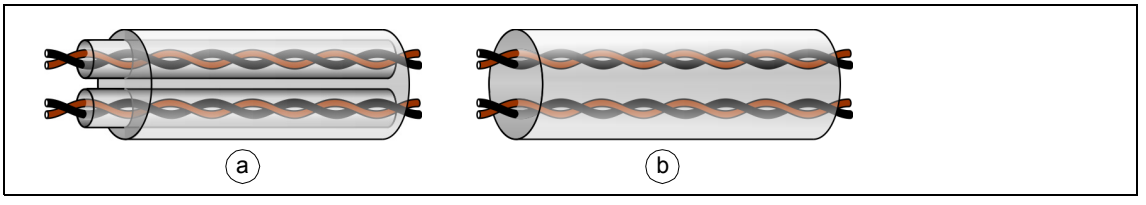
Selecting the control cables

Shielding

All control cables must be shielded.

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

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



Signals in separate cables

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

Signals allowed to be run in the same cable

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

Relay cable type

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

Control panel cable length and type

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

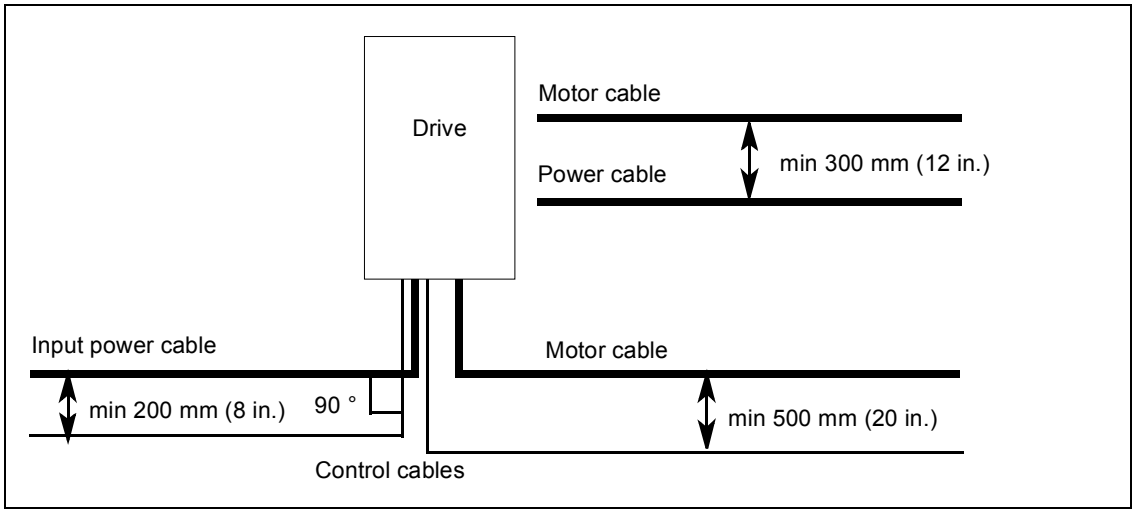
Routing the cables

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

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

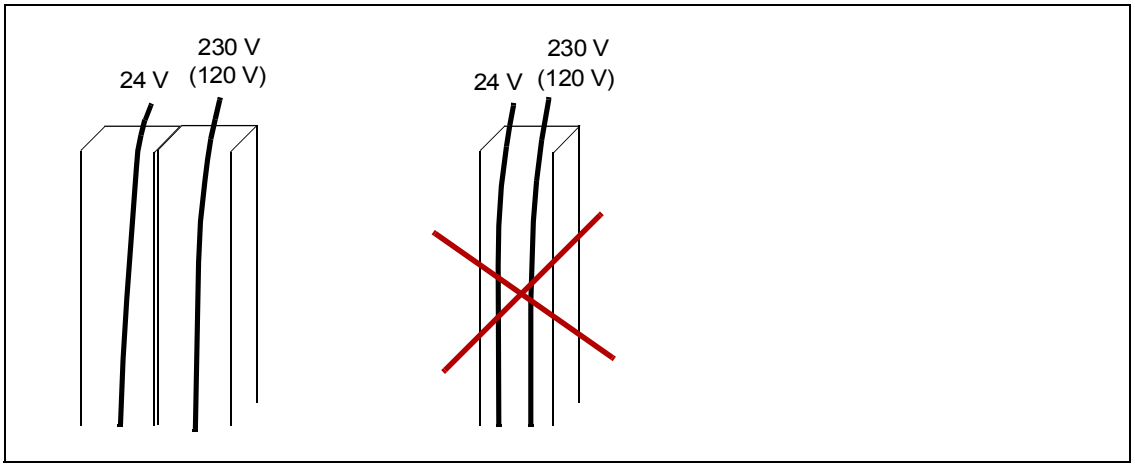
The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

A diagram of the cable routing is shown below.



Separate control cable ducts

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



Continuous motor cable shield or enclosure for equipment 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:

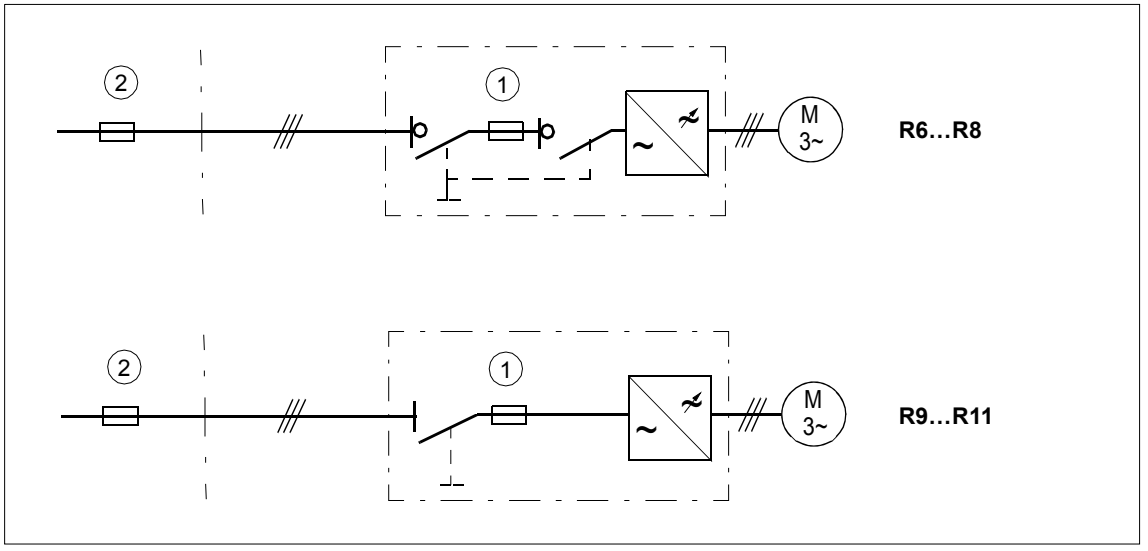
- European Union: Install the equipment in a metal enclosure with 360 degree grounding for the shields of both the incoming and outgoing cable, or connect the shields of the cables otherwise together.
- US: Install the equipment in a metal enclosure in a way that the conduit or motor cable shielding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

Implementing thermal overload and short-circuit protection

Protecting a 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 chapter *Technical data*).



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 input power and motor cables against thermal overload

The drive protects itself and the input and motor cables against thermal overload when the cables are 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 user can tune the thermal model further by feeding in additional motor and load data.

The most common temperature sensors are:

- motor sizes IEC180…225: thermal switch, eg, Klixon
- motor sizes IEC200…250 and larger: PTC or Pt100.

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

Protecting the drive against ground faults

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

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

Implementing the emergency stop function

You can order the drive with a category 0 or category 1 emergency stop function.

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

Note: Pressing the stop key ⊽ on the control panel of the drive, or turning the operating switch of the drive from position “1” to “0” does not generate an emergency stop of the motor or separate the drive from dangerous potential.

See the appropriate emergency stop user’s manual for the wiring, start-up and operation instructions.

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

Implementing the Safe torque off function

See chapter *Safe torque off function* on page *239*.

Implementing the Prevention of unexpected start-up function

The drive can be equipped with a Prevention of unexpected start-up (POUS) function either with an FSO-xx safety functions module (option +Q950) or with a safety relay (option +Q957).

The POUS function enables short-time maintenance work (like cleaning) on the non-electrical parts of the machinery without switching off and disconnecting the drive.

See the appropriate user’s manual for the wiring, start-up and operation instructions.

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

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

With option +Q971, the drive provides ATEX-certified safe motor disconnection without contactor using the drive Safe torque off function. For more information, see

- *ACS880 ATEX-certified safe disconnection function application guide* (3AUA0000132231 [English])
- *FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537)* user’s manual (3AXD50000027782 [English]).

Implementing the functions provided by the FSO-xx safety functions module (option +Q972 or +Q973)

The drive can be equipped with an FSO-xx safety functions module (option +Q972 or +Q973) which enables the implementation of functions such as Safe brake control (SBC),

Safe stop 1 (SS1), Safe stop emergency (SSE), Safely limited speed (SLS) and Safe maximum speed (SMS).

The settings of the FSO-xx are at default when delivered from the factory. The connectors of the module are pre-wired to terminal block X68. The wiring of the external safety circuit and configuration of the FSO-xx module are the responsibility of the machine builder.

The FSO-xx 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.

For wiring instructions, safety data and more information on the functions provided by the FSO-xx, refer to its manual.

Declaration of Conformity

See page *225*.

Implementing the Power-loss ride-through function

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

- Check that the power-loss ride-through function of the drive is enabled with parameter **30.31 Undervoltage control** in the ACS880 primary control program.

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.

Units with main contactor (option +F250)

The main contactor of the drive opens in a power-loss situation. When the power returns, the contactor closes. However, if the power-loss situation lasts so long that the drive trips on undervoltage, it must be reset and started again to continue operation. If the power-loss situation lasts so long that the auxiliary power buffer module (C22, see page *33* and *37*) runs out, the main contactor remains open and the drive operates only after reset and a new start.

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

Supplying power for the auxiliary circuits

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

The following options are to be supplied 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) to the control unit and control devices when the drive is not powered
- +G313: Power supply connection (230 V AC; external fuse 16 A gG) for a motor space heater output.

Using power factor compensation capacitors with the drive

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

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

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

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

Implementing a safety switch between the drive and the motor

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

Using a contactor between the drive and the motor

Implementing the control of the output contactor depends on how you select the drive to operate. See also section *Implementing a bypass connection* on page *95*.

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

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

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

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

WARNING! When the DTC motor control mode is in use, never open the output contactor while the drive controls the motor. The DTC motor control operates extremely fast, much faster than it takes for the contactor to open its contacts. When the contactor starts opening while the drive controls the motor, the DTC control will

try to maintain the load current by immediately increasing the drive output voltage to the maximum. This will damage, or even burn the contactor completely.

Implementing a bypass connection

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

Bypass connection is available as a factory-installed option for certain cabinet-built drive types. Consult ABB for more information.

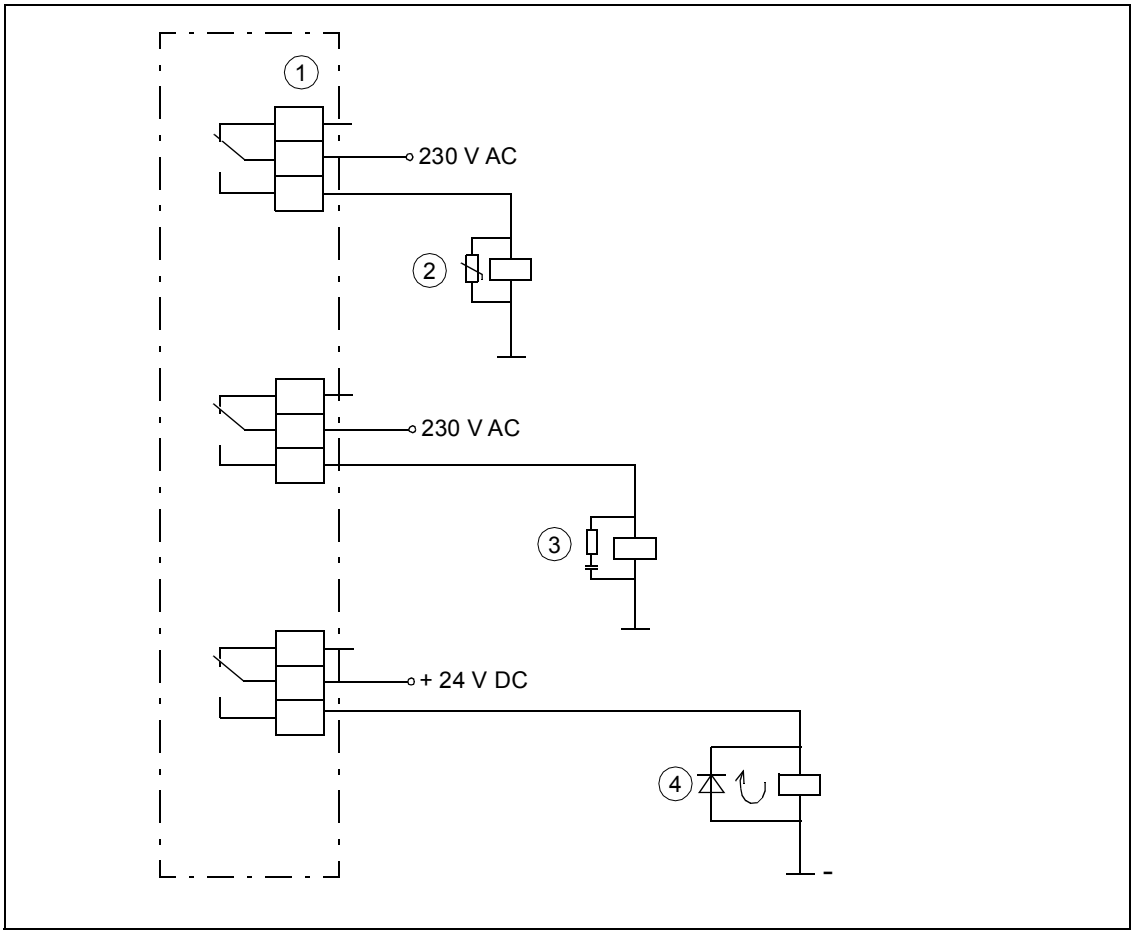
WARNING! Never connect the drive output to the electrical power network. The connection may damage the drive.

Protecting the contacts of relay outputs

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

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

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



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

Implementing a motor temperature sensor connection

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

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

1. If there is double or reinforced insulation between the sensor and the live parts of the motor, you can connect the sensor directly to the inputs of the drive.
2. If there is basic insulation between the sensor and the live parts of the motor, you can connect the sensor to the inputs of the drive if all circuits connected to the drive's digital and analog inputs (typically extra-low voltage circuits) are protected against contact and insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit. Note that extra-low voltage circuits (such as 24 V DC) typically do not meet these requirements.
3. You can connect the sensor to an extension module with basic insulation (eg, FAIO-01) orreinforced insulation (eg, FPTC-xx) between the sensor connector and the other

connectors of the module. See the table below for the sensor insulation requirement. For sensor connection to the extension module, see its manual.

4. You can connect a sensor to an external thermistor relay the insulation of which is rated for the main circuit voltage of the drive.

Drive I/O, I/O extension and encoder interface modules

See:

- section *AI1 and AI2 as Pt100, Pt1000, PTC and KTY84 sensor inputs (XAI, XAO)* on page *141*
- section *DI6 (XDI:6) as PTC sensor input* on page*142*
- *FPTC-01 thermistor protection module (option +L536) for ACS880 drives user's manual* (3AXD50000027750 [English])
- *FPTC-02 ATEX-certified thermistor protection module Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual* (3AXD50000027782 [English]).

This table shows what temperature sensor types you can connect to the drive I/O extension modules as well as the insulation requirement for the sensor.

Extension 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 extension module other than sensor connector must be left unconnected.
FPTC-xx	Reinforced insulation between sensor connector and other connectors (including drive control unit connector).	X	-	-	No special requirement

Note: The inaccuracy of the drive analog inputs for Pt100 sensors is 10 °C (18 °F). If a better accuracy is needed, use the FAIO-01 analog I/O extension module (option +L525).

6

Electrical installation

Contents of this chapter

This chapter gives instructions on the wiring the drive.

Warnings

WARNING! Only qualified electricians are allowed to carry out the work described in this chapter. Follow the safety instructions on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

Checking the insulation of the assembly

Drive

Do not make 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.

Input cable

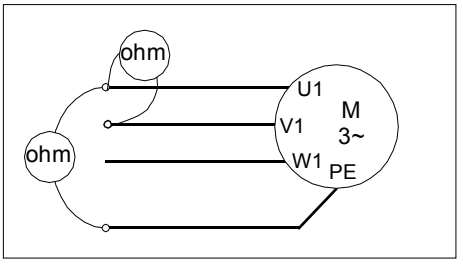
Check the insulation of the input cable according to local regulations before connecting it to the drive.

Motor and motor cable

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 *Precautions before electrical work* on page *18* before you start the work.
2. Check that the motor cable is disconnected from the drive output terminals U2, V2 and W2.
3. Measure the insulation resistance between each phase conductor and then between each phase conductor and the Protective Earth conductor using a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, consult the manufacturer's instructions.

   Note: Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.

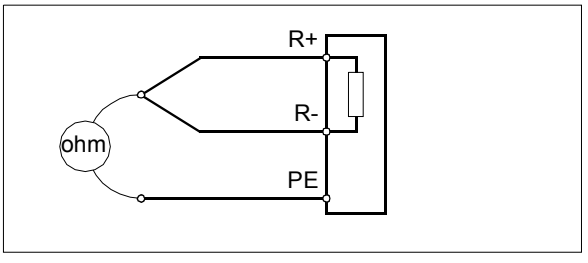


Custom brake resistor assembly

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

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 *Precautions before electrical work* on page *18* before you start the work.
2. Check that the resistor cable is connected to the resistor, and disconnected from the drive output terminals R+ and R-.
3. At the drive 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.



Checking the compatibility with IT (ungrounded) and corner-grounded delta systems (frames R6 to R9)

EMC filter

Drive EMC filters +E200 and +E202 are not suitable for use on an IT (ungrounded) system. The filters in frames R6 to R9 are also not suitable for use on corner-grounded and midpoint-grounded delta systems. See section *Disconnection table (frames R6 to R9)* on page *102*. Disconnect the filter before you connect the drive to the supply network.

WARNING! Do not install any drive frame size with EMC filter +E200 or +E202 on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), or frames R6 to R9 with EMC filter +E200 or +E202 on a corner-grounded or midpoint-grounded delta 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 internal EMC filter is disconnected, the drive EMC compatibility is considerably reduced.

Ground-to-phase varistor

The ground-to-phase varistor of the drive is not suitable for use on an IT (ungrounded) system. Disconnect it before you connect the drive to the supply network. Check the table on page *102*.

WARNING! Do not install the drive with the ground-to-phase varistor connected on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system). The varistor circuit can be damaged.

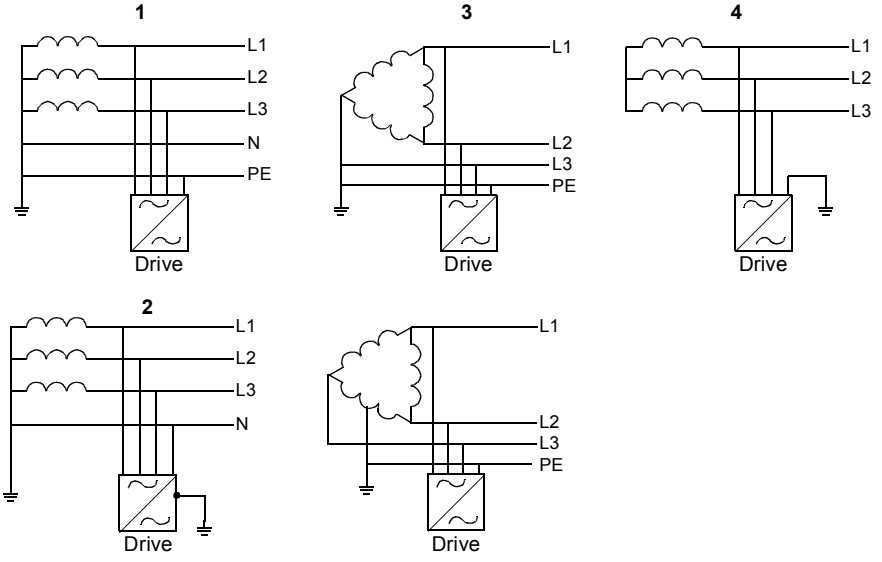
Corner-grounded and midpoint-grounded 690 V delta systems

WARNING! Do not install the drive on a 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.

Disconnection table (frames R6 to R9)

Check from this table if you have to disconnect the EMC filter (EMC AC and EMC DC screws) with options +E200 and +E202 or ground-to-phase varistor (VAR screw). For instructions on how to do this, see *EMC filter and ground-to-phase varistor disconnecting instructions for ACS880 frames R1 to R11* (3AUA0000125152 [English]).

Frame size	Symmetrically grounded TN systems (TN-S systems) [1] and TT systems [2]	Corner-grounded and midpoint-grounded delta systems [3] (≤ 600 V)	IT systems (ungrounded or high-resistance-grounded [>30 ohms]) [4]
R6…R9		Do not remove EMC AC or VAR. Remove EMC DC.	Remove EMC AC, EMC DC, VAR *)



*) With option +E201, EMC AC, EMC DC and VAR screws are removed at the factory from drives manufactured after 2018-01-01. For more information, contact ABB.
Note: These are the EMC filter and varistor screws of different drive frame sizes.

Frame size	EMC filter (+E200 and +E202) screws	Ground-to-phase varistor screws
R6…R9	EMC AC, EMC DC	VAR

Identifying different types of electrical power systems

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

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

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

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

Checking the compatibility with IT (ungrounded) and corner-grounded delta systems (frames R10 and R11)

EMC filter +E200 – 690 V drives

Drive internal EMC filter +E200 is not suitable for use on an IT (ungrounded) system. See section *Disconnection table (frames R10 and R11)* on page *105*. Disconnect the filter before you connect the drive to the supply network.

WARNING! Do not install any drive with EMC filter +E200 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 internal EMC filter is disconnected, the drive EMC compatibility is considerably reduced.

EMC filter +E202 (ARFI-10) – 400 V and 500 V drives

EMC filter +E202 (ARFI-10) is not suitable for use on an IT (ungrounded) system. See section *Disconnection table (frames R10 and R11)* on page *105*. Disconnect the filter before you connect the drive to the supply network.

WARNING! Do not install the drive with EMC filter +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. This can cause danger, or damage the drive.

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

Ground-to-phase varistor

The ground-to-phase varistor of the drive is not suitable for use on an IT (ungrounded) system. Disconnect it before you connect the drive to the supply network. Check the table on page *105*.

WARNING! Do not install the drive with the ground-to-phase varistor connected on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system). The varistor circuit can be damaged.

Corner-grounded and midpoint-grounded 690 V delta systems

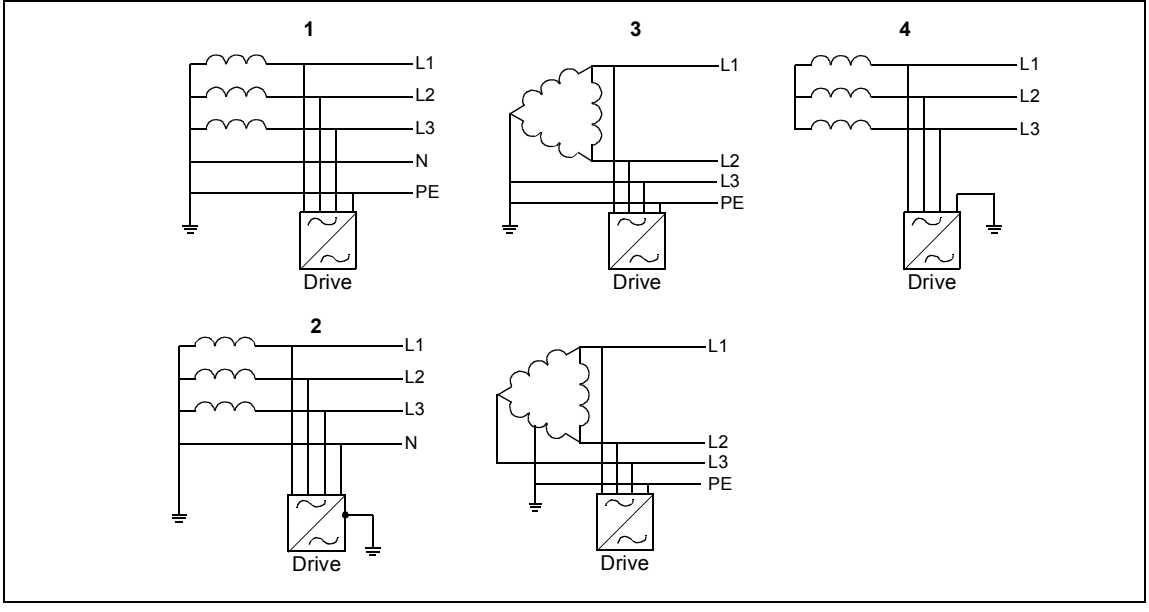
WARNING! Do not install the drive on a 690 V corner-grounded or midpoint-grounded delta system. Disconnecting the EMC filter and ground-to-phase varistor does not prevent damage to the drive.

Disconnection table (frames R10 and R11)

EMC filter +E200

Check from this table if you have to disconnect the EMC filter (EMC AC screw) with option +E200 or ground-to-phase varistor (VAR screw). For instructions on how to do this, see *EMC filter and ground-to-phase varistor disconnecting instructions for ACS880 frames R1 to R11* (3AUA0000125152 [English]).

Frame size	Symmetrically grounded TN systems (TN-S systems) [1] and TT systems [2]	Corner-grounded and midpoint-grounded delta systems [3] (≤ 600 V)	IT systems (ungrounded or high-resistance-grounded [>30 ohms]) [4]
R10, R11	Do not remove EMC AC or VAR.	Do not remove EMC AC or VAR.	Remove EMC AC, VAR.



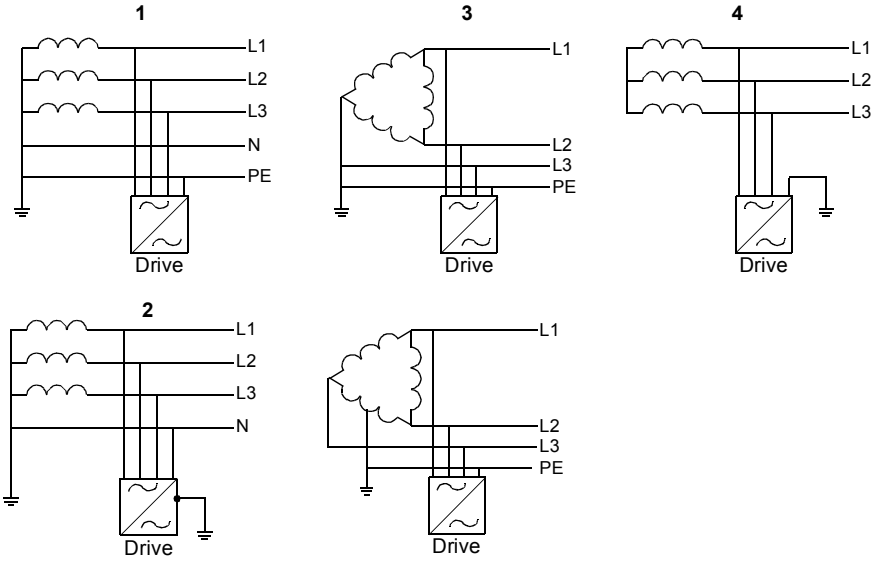
Note: These are the EMC filter and varistor screws of different drive frame sizes.

Frame size	EMC filter (+E200) screw	Ground-to-phase varistor screws
R10, R11	EMC AC	VAR

EMC filter +E202 and (ARFI-10)

Check from this table if you have to remove EMC filter +E202 (ARFI-10) or ground-to-phase varistor (VAR screw).

Frame size	Symmetrically grounded TN systems (TN-S systems) [1] and TT systems [2]	Corner-grounded and midpoint-grounded delta systems [3] (≤ 600 V)	IT systems (ungrounded or high-resistance-grounded [>30 ohms]) [4]
R10, R11	Do not remove ARFI-10 or VAR.	Do not remove ARFI-10 or VAR.	Remove ARFI-10 and VAR.



Note: These are the EMC filter and varistor screws of different drive frame sizes.

Frame size	EMC filter (+E202) screw	Ground-to-phase varistor screws
R10, R11	-	VAR

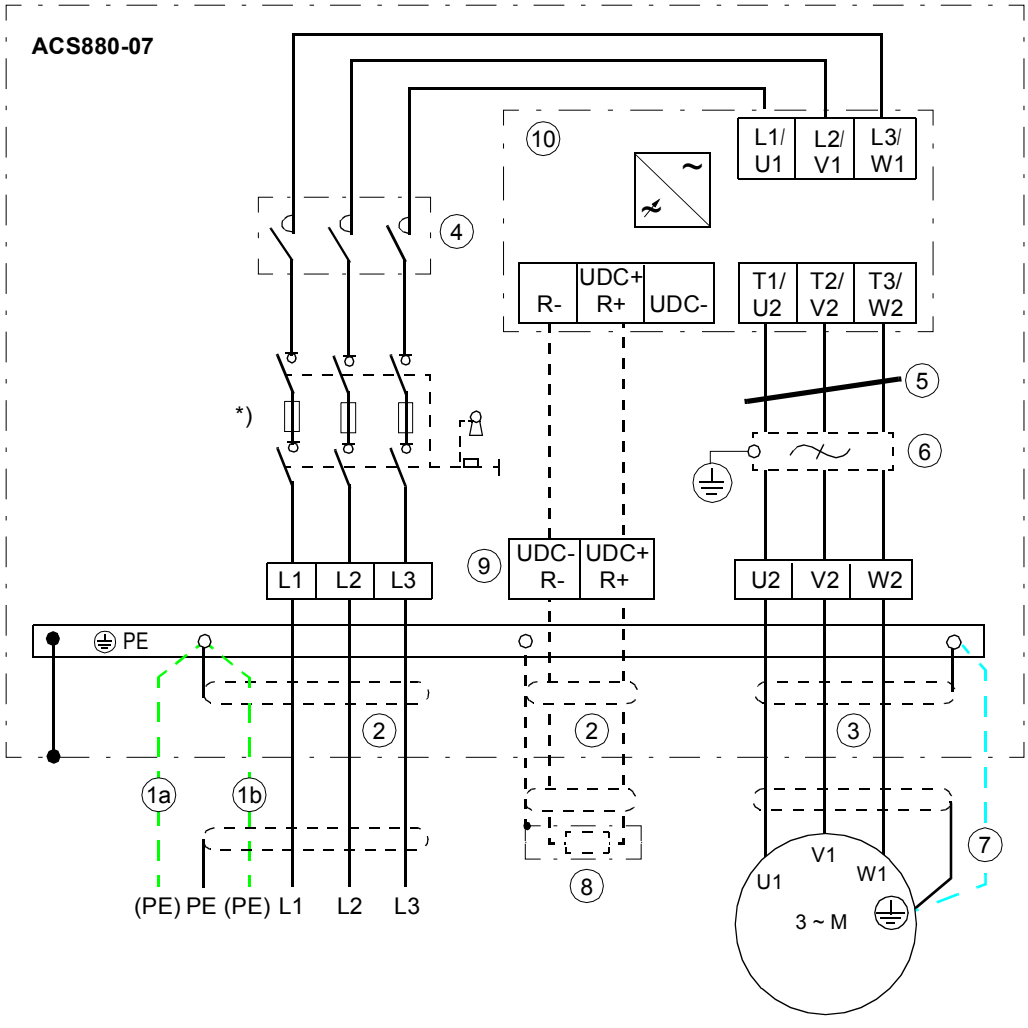
For identifying different types of electrical power systems, see instructions on page *103*.

Attaching the device stickers on the cabinet door

A multilingual device label sticker is delivered with the drive. Attach the stickers in the appropriate language on the English texts, see section *Door switches and lights* on page *46*.

Connecting the power cables

Connection diagram



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 page *84*).

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 +F250)

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 (see page *84*) and there is no symmetrically constructed grounding conductor in the cable (see page *86*).

8 External brake resistor

9 Terminals of frame R9 cabinet:

R-	UDC+ R+	UDC-

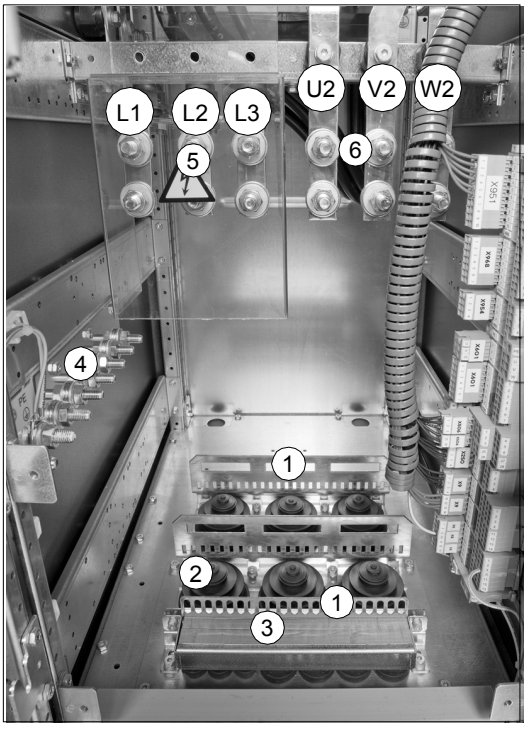
10 Drive module

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.
*) Switch-disconnector and separate fuses in frame R9

Layout of the power cable connection terminals and entries (frames R6 to R8)

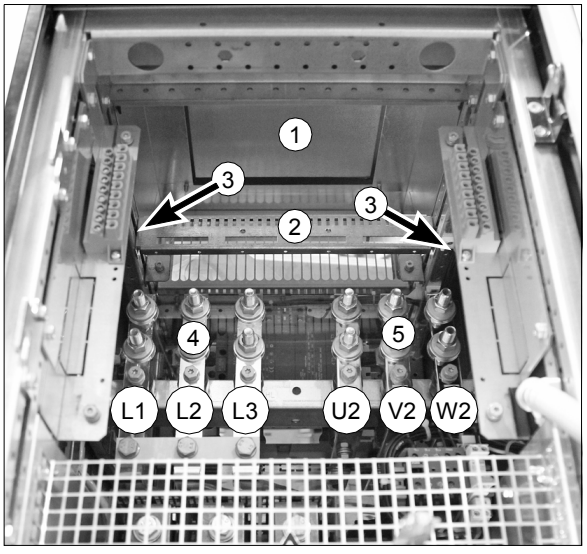
The layout of power cable connection terminals and cable entries of the standard drive is shown below.

Note: You have to remove the “door” fan to get access to the cable terminals and entries (see page 166).



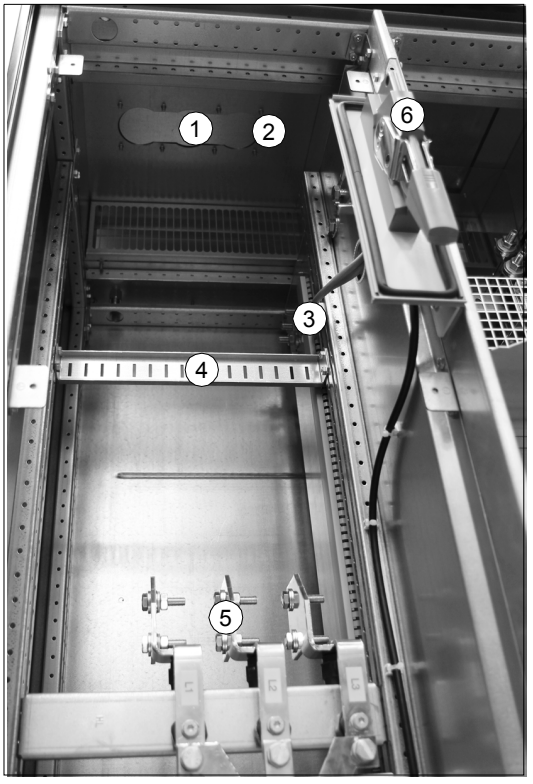
1	Strain relief
2	Power cable entries. Conductive sleeve under the grommet. The grommets are included in IP54 units only.
3	Control cable entry with EMI conductive cushions.
4	PE terminal
5	Input power cable terminals L1, L2 and L3
6	Motor cable terminals U2, V2, W2

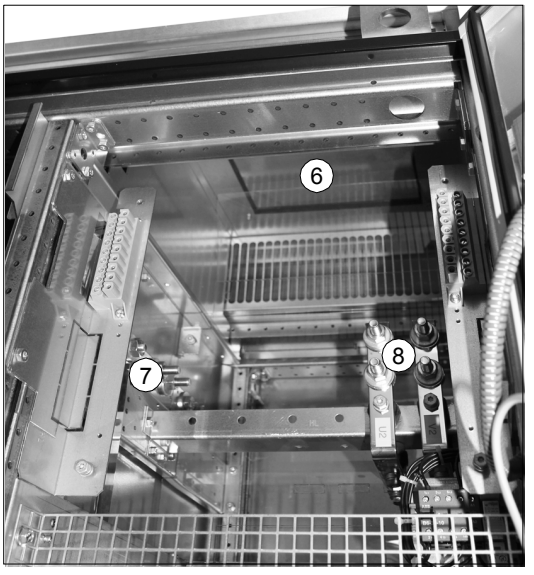
Layout of the power cable connection terminals and entries (frames R6 to R8 with option +C129



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

Layout of the power cable connection terminals and entries (frames R6 to R8 with options +C129+F277+F289)

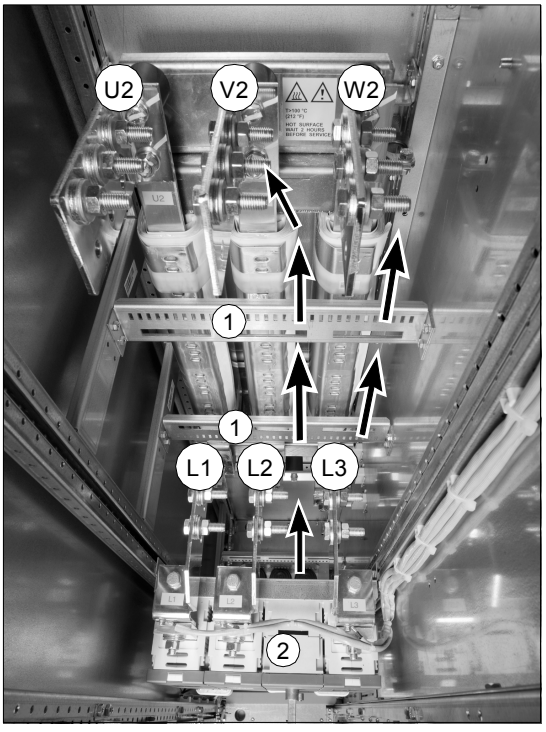




1	Input power cable entry
2	Control cable entry
3	Ground bar for input power cables
4	Strain relief
5	Input cable power connection terminals L1, L2
6	Flange mounted switch for molded case circuit breaker (+F277)

6	Motor cable entry
7	Ground bar for motor cables
8	Motor cable connection terminals U2, V2, W2

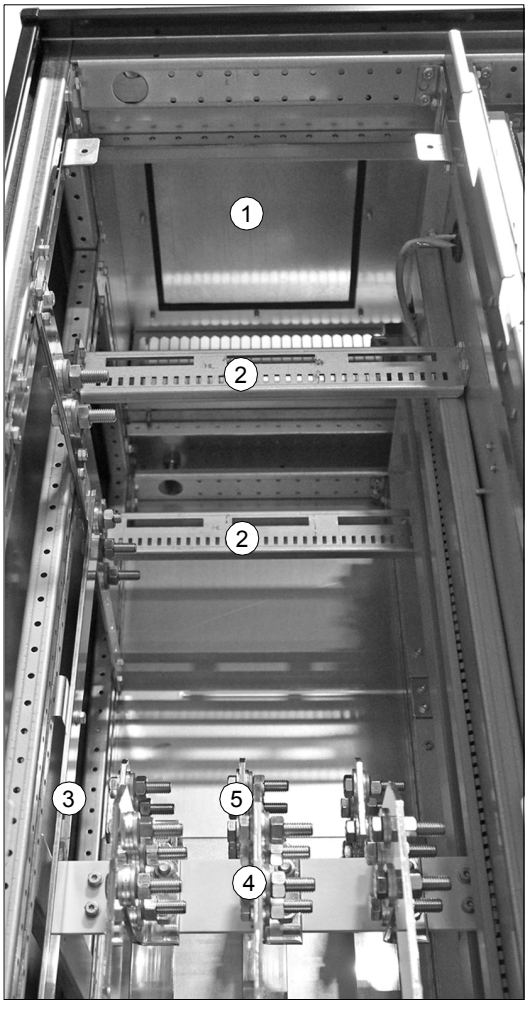
Layout of the input and motor cable connection terminals (frame R9)



1	Strain relief
L1, L2, L3	Input power cable terminals
U2, V2, W2	Motor cable terminals
2	Main switch-disconnector

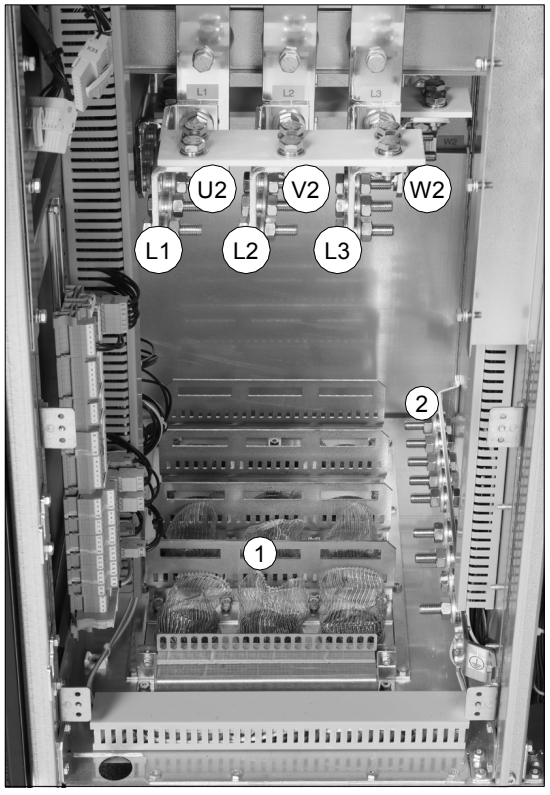
Cable routing from below is shown with the arrows.

Layout of the power cable connection terminals and entries (frame R9 with option +C129)



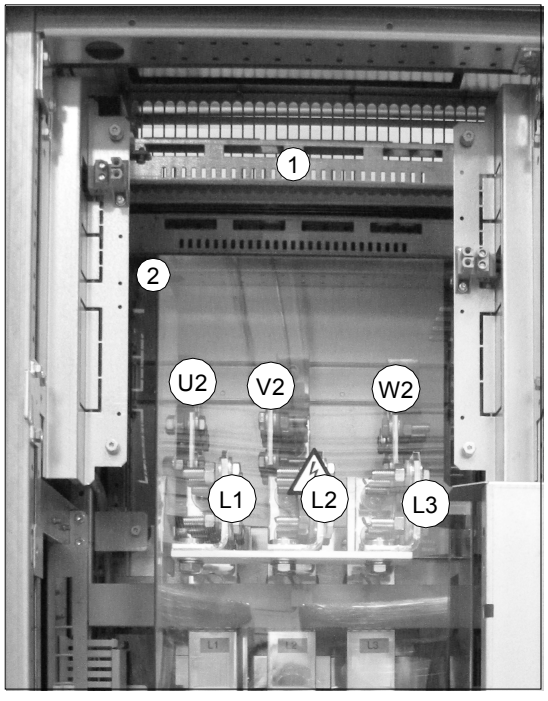
1	Power cable entry
2	Strain relief
3	Ground bar
4	Input cable power connection terminals L1, L2 and L3
5	Motor cable connection terminals U2, V2, W2

Layout of the input and motor cable connection terminals (frames R10 and R11)



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

Layout of the input and motor cable connection terminals (frames R10 and R11 with option +C129)



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

Entry of external resistor and DC cables

Run the external brake resistor cables and DC cables into the drive cabinet through the power cable entries at the base of the drive module cubicle. In frames R6 to R8 the connection terminals are in the drive module. In frame R9, the connection terminals are located below the drive module.

Connection procedure (IEC)

1. Do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Open the cabinet door.
3. Open the swing-out frame.
4. For frames R6 to R11: Remove the mounting plate(s) above the cabinet “door” fan by undoing the mounting screws. With options +G300, +G307, +G313: Unplug the connectors at the back of the mounting plate.
5. Remove the fan mounting plate by loosening the mounting screws and lifting it up. Unplug the fan supply cables.
6. For frames R9 to R11: Remove the shrouds on the power cable terminals.
7. Peel off 3 to 5 cm of the outer insulation of the cables above the entry plate for the 360° high-frequency grounding.
8. 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.

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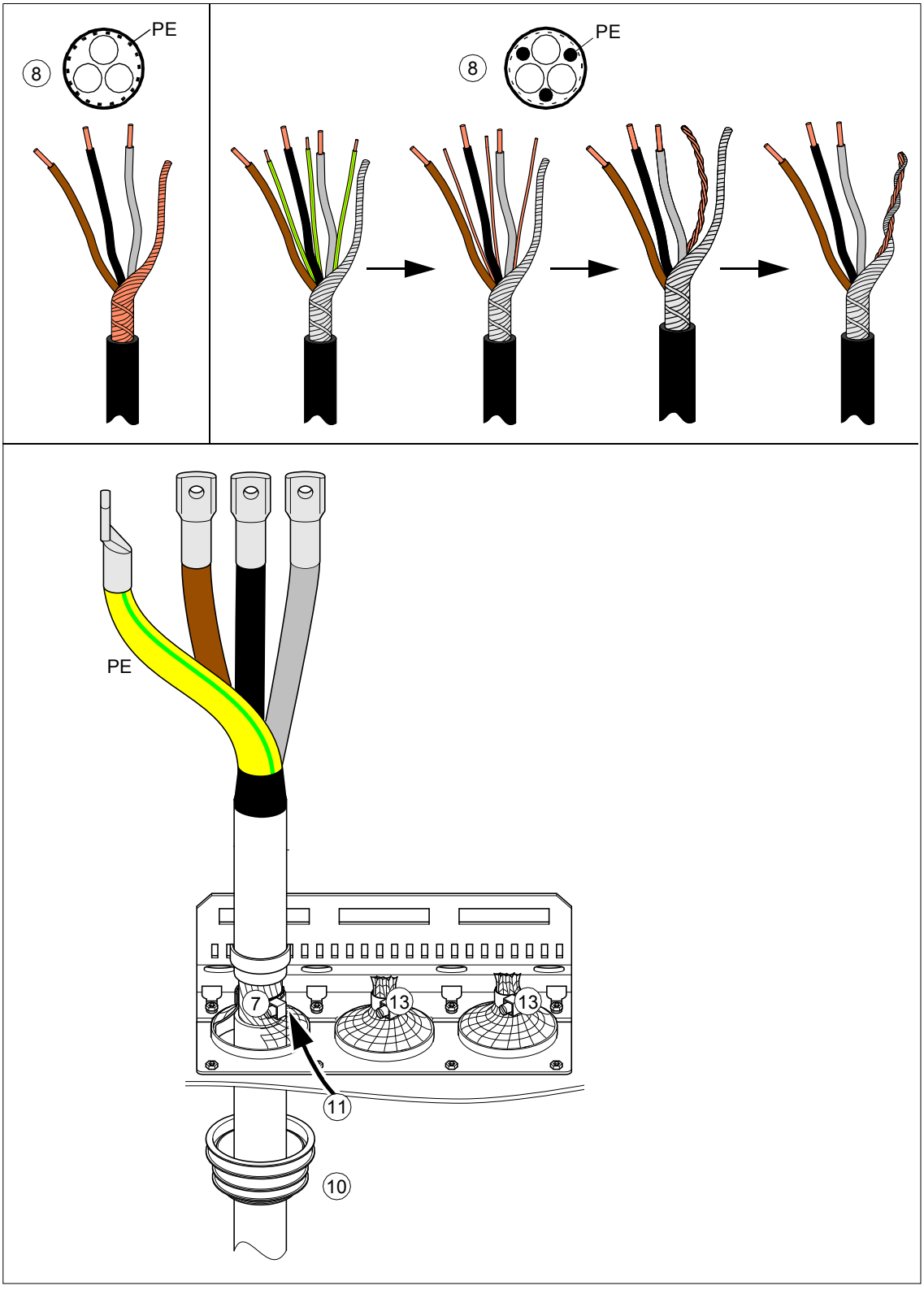
9. If fire insulation is used, make an opening in the mineral wool sheet according to the diameter of the cable.
10. Slide the cables through the entries with the conductive sleeves. Remove rubber grommets from the entry plate for the cables to be connected. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Slide the cables through the entries with the conductive sleeves and attach the grommets to the holes.
11. Fasten the conductive sleeves to the cable shields with cable ties.
12. Seal the slot between the cable and mineral wool sheet (if used) with sealing compound (eg, CSD-F, ABB brand name DXXT-11, code 35080082).
13. Tie up the unused conductive sleeves with cable ties.
14. Connect the twisted shields of the motor cables to the ground bar and the phase conductors to the U2, V2 and W2 terminals.
15. For drives with external brake resistors (option +D150 and no +D151): Connect the twisted shields of the resistor cables (if present) to the ground bar and the condutors to the R- and R+ terminals.
16. Connect the twisted shields of the input cables and separate ground cable (if present) to the PE terminal of the cabinet and the phase conductors to the L1, L2 and L3 terminals.

17. Tighten the power cable screws to the torque given in *Terminal and entry data for the power cables* on page *210*.
18. Reinstall the shroud(s) and mounting plates.



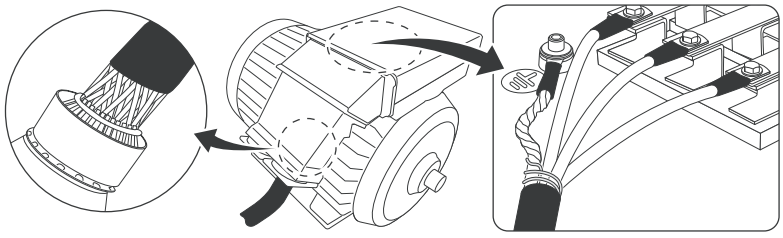
Connection procedure (US)

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 *Precautions before electrical work* on page *18* before you start the work.
2. Open the cabinet door.
3. Open the swing-out frame (if installed).
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.
9. Connect the motor phase conductors to the output power terminals U2, V2 and W2.
10. For drives with external brake resistors (option +D150 and no +D151):
    - Run the power cables from the brake resistor to the cabinet including the proper grounding cable.
    - Connect the ground cable to the ground bar at top of 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 top of cabinet.
14. Connect AC supply phase conductors to terminals L1, L2 and L3.
15. Reinstall the shroud(s) and mounting plates.

Grounding the motor cable shield at the motor end

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



See also *Continuous motor cable shield or enclosure for equipment on the motor cable* on page *90*.

DC connection (option +H356)

The UDC+ and UDC- terminals are intended for common DC configurations of a number of drives, allowing regenerative energy from one drive to be utilized by the other drives in motoring mode. Contact your local ABB representative for further instructions.

Connecting the control cables

See chapter *Control unit of frames R6 to R9* on page *137* or *Control unit of frames R10 and R11* on page *147* for the default I/O connections of the drive (with 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 cables as described under *Control cable connection procedure* on page *117*.

Control cable connection procedure

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 (if running) and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Frames R6 to R9: Remove the cabinet fan and mounting plate above it as described in section *Connecting the power cables* on page *107*.
3. Run the control cables into the drive module cubicle as described in section *Grounding the outer shields of the control cables at the cabinet entries* below.
4. Route the control cables as described in section *Routing the control cables inside the cabinet (frames R6 to R8)* on page *120* or *Routing the control cables inside the cabinet (frame R9)* on page *121* or *Routing the control cables inside the cabinet (frames R10 and R11)* on page *122*.
5. Connect the control cables as described in sections *Connecting the control unit cables* on page *122* … *Wiring ground fault monitoring for IT ungrounded systems (option +Q954)* on page *129*.

Grounding the outer shields of the control cables at the cabinet entries

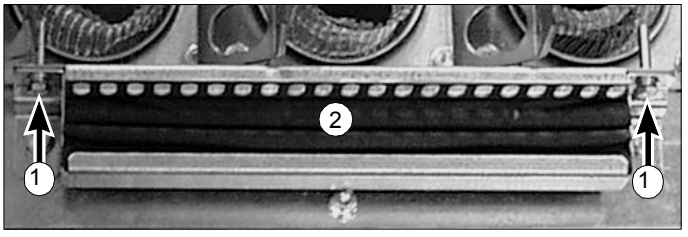
Applicability

This section applies to drives without solid cable conduit plate (no options +C129, +H351, +H353, +H358).

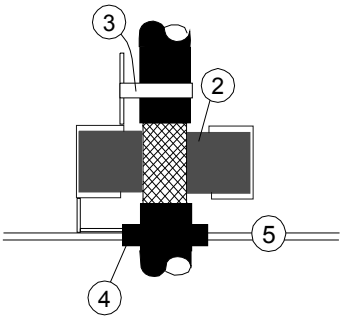
Procedure

Ground the outer shields of all control cables 360 degrees at the EMI conductive cushions as follows:

1. Loosen the tightening screws of the EMI conductive cushions and pull the cushions apart.
2. Cut adequate holes to the rubber grommets in the entry plate and lead the cables through the grommets and the cushions into the cabinet.
3. Strip off the cable plastic sheath above the entry plate just enough to ensure proper connection of the bare shield and the EMI conductive cushions.
4. Tighten the two tightening screws so that the EMI conductive cushions press tightly round the bare shield.



View from above

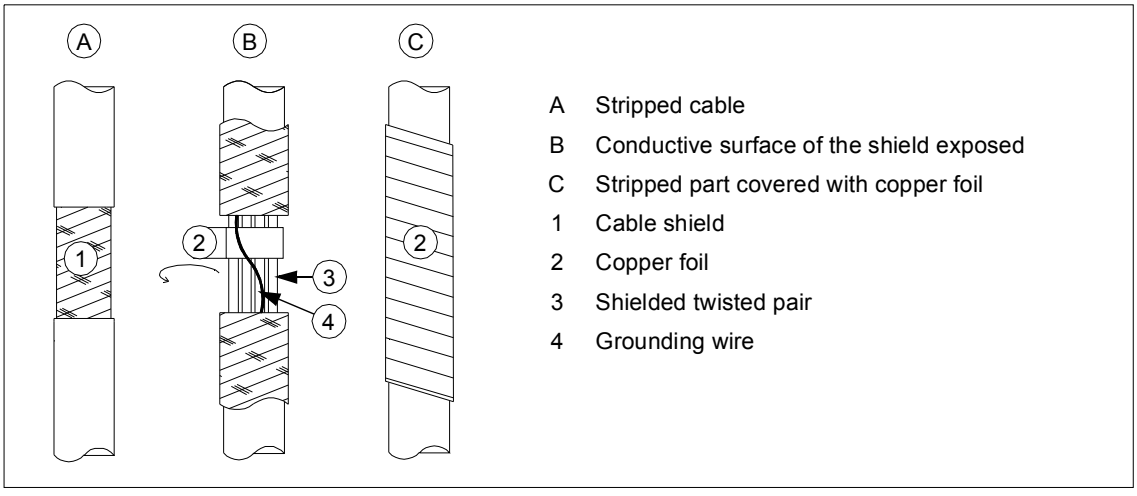


1 Tightening screw
2 EMI conductive cushion
3 Strain relief
4 Grommet
5 Entry plate

Note 1: Keep the shields continuous as close to the connection terminals as possible. Secure the cables mechanically at the entry strain relief.

Note 2: If the outer surface of the shield is non-conductive:

- Cut the shield at the midpoint of the bare part. Be careful not to cut the conductors or the grounding wire (if present).
- Turn the shield inside out to expose its conductive surface.
- Cover the turned shield and the stripped cable with copper foil to keep the shielding continuous.

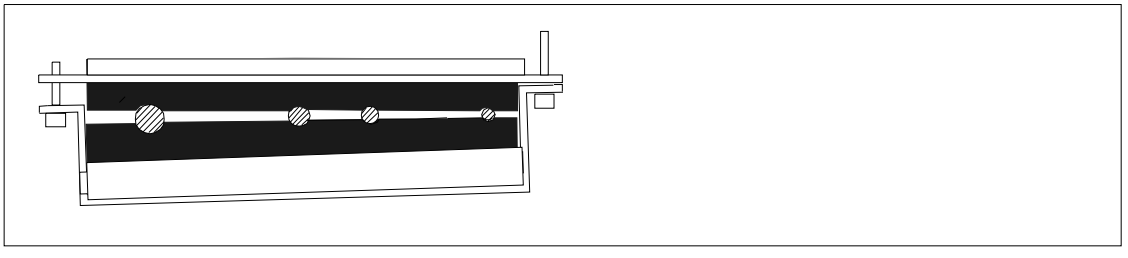


Note for top entry of cables: When each cable has its own rubber grommet, sufficient IP and EMC protection can be achieved. However, if very many control cables come to one cabinet, plan the installation beforehand as follows:

1. Make a list of the cables coming to the cabinet.
2. Sort the cables going to the left into one group and the cables going to the right into another group to avoid unnecessary crossing of cables inside the cabinet.
3. Sort the cables in each group according to size.
4. Group the cables for each grommet as follows ensuring that each cable has a proper contact to the cushions on both sides.

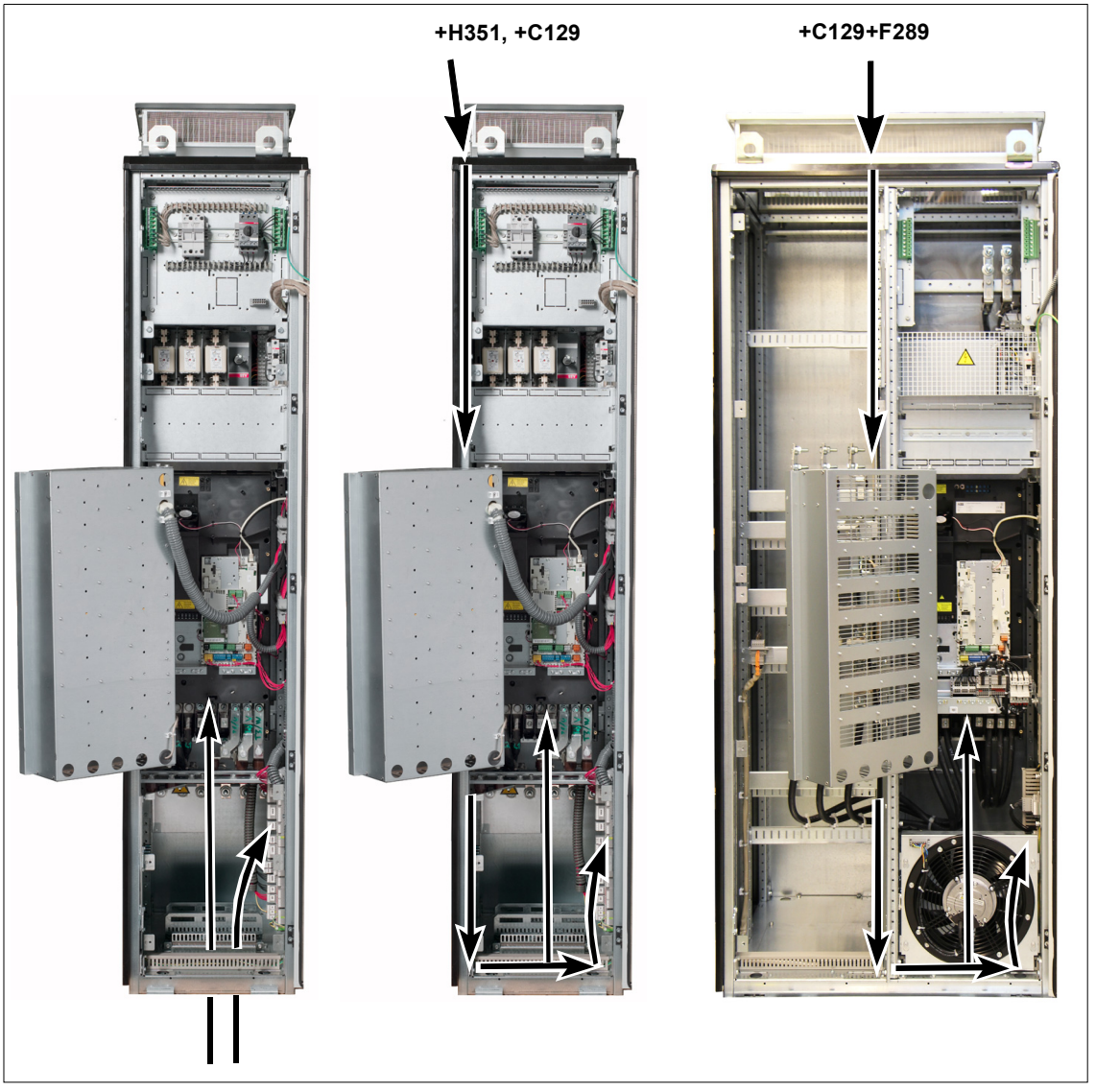
Cable diameter in mm	Max. number of cables per grommet
≤ 13	4
≤ 17	3
< 25	2
≥ 25	1

5. Arrange the bunches according to size from thickest to the thinnest between the EMI conductive cushions.



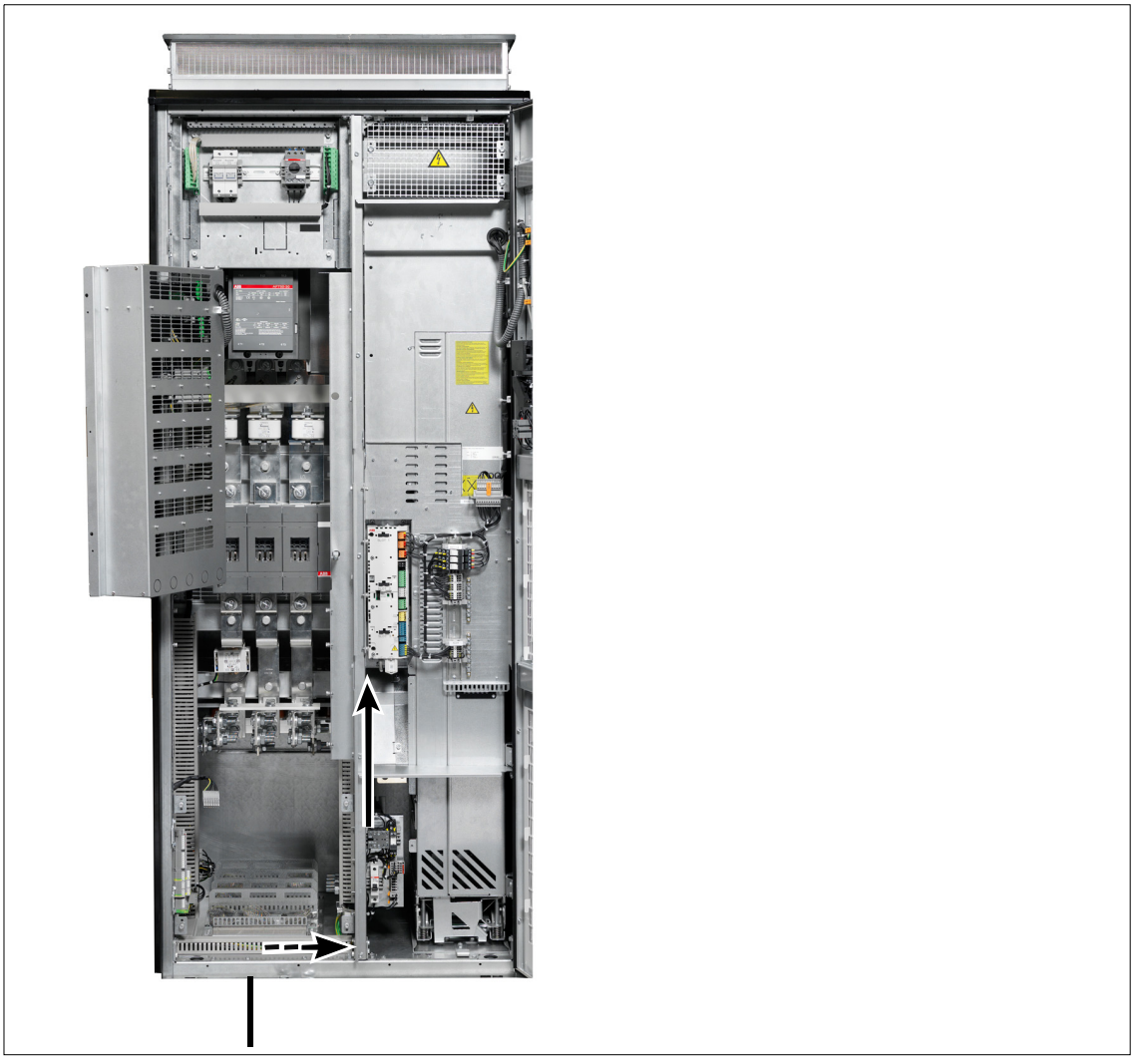
6. If more than one cable go through a grommet, seal the grommet by applying Loctite 5221 (catalogue number 25551) inside the grommet.

Routing the control cables inside the cabinet (frames R6 to R8)



Routing the control cables inside the cabinet (frame R9)

Routing the control cables inside the cabinet (frames R10 and R11)



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

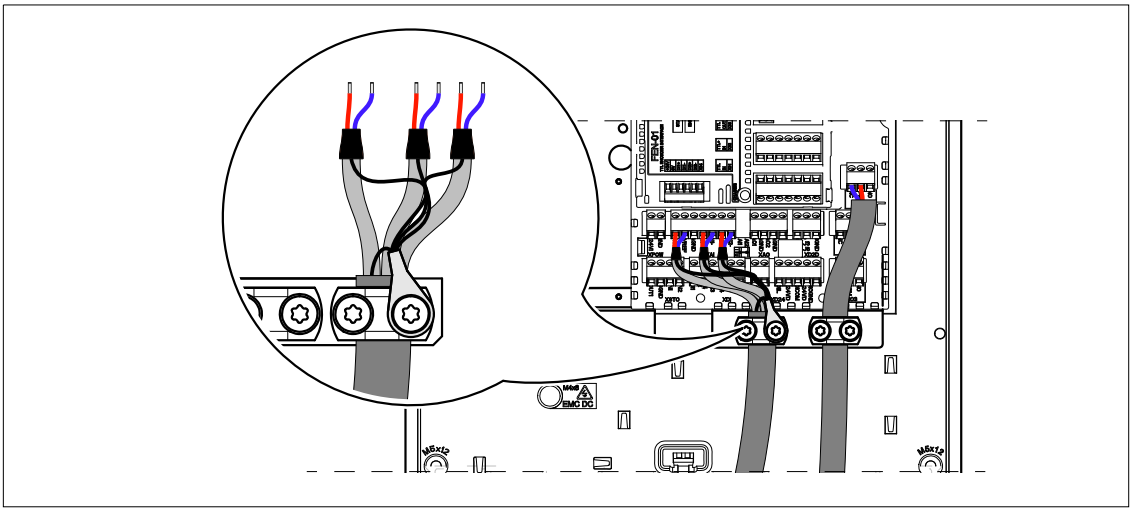
Note: Leave some slack in the control wiring to allow the removing of the control unit assembly plate when the drive module is replaced.

Connecting the control unit cables

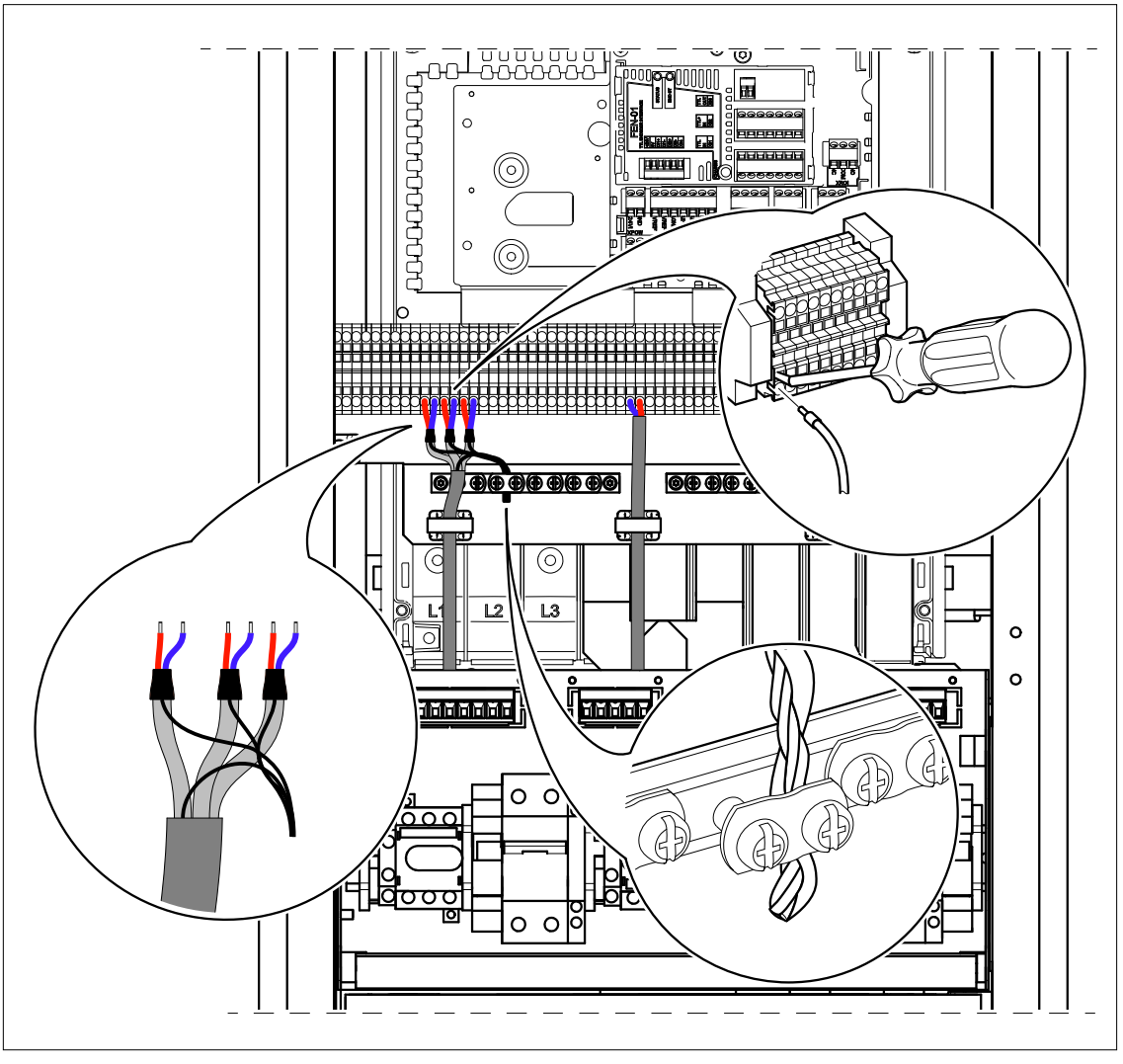
Note: Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

Note for frames R10 and R11: Leave slack to the control wires to make it possible to lift the control unit mounting plate a little when the drive module is replaced.

Units without additional I/O terminal block (option +L504): Ground the pair-cable shields and all grounding wires to the clamp below the control unit as shown below.



Units with additional I/O terminal block (option +L504): Ground the pair-cable shields and all grounding wires to the grounding clamp below the terminal block as shown below.

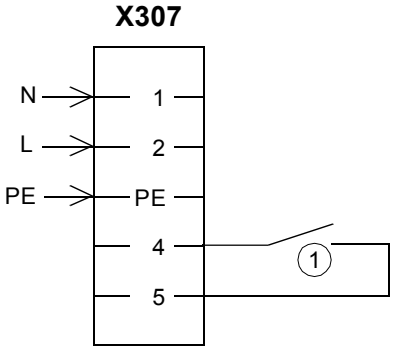


At the other end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, eg, 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.

Connect the conductors to the appropriate terminals (see page *139* or *149*) of the control unit or optional terminal block X504.

Connecting the external 230 V or 115 V uninterruptible control voltage (UPS, option +G307)

Wire the external control voltage to terminal block X307 at the back side of the mounting plate as shown below.



1 Internal wiring of UPS supervision: circuit breaker or fuse off/fault = contact open.

Connecting the emergency stop push buttons (options +Q951, +Q952, +Q963, +Q964, +Q978, +Q979)

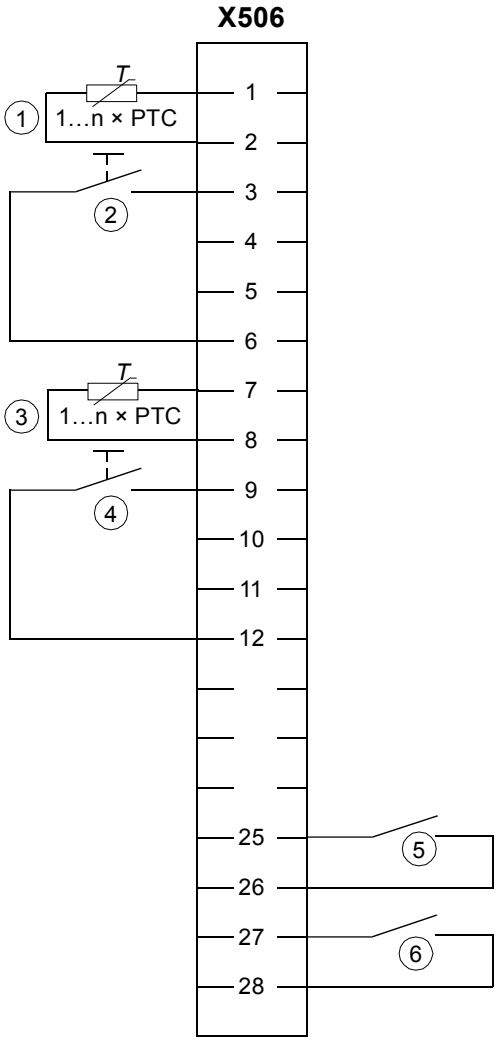
Connect external emergency stop push buttons to terminals according to the circuit diagrams delivered with the drive.

Wiring the starter for auxiliary motor fan (options +M600…+M605)

Connect the power supply wires for the auxiliary motor fan to terminal blocks X601…X605 according to the circuit diagrams delivered with the drive.

Wiring the PTC thermistor relay(s) (options +L505, +2L505, +L513 and +2L513)

The external wiring of option +2L505 and +2L513 (two thermistor relays) is shown below. For example, one relay can be used to monitor the motor windings, the other to monitor the bearings. The maximum contact load capacity is 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive. For instructions on commissioning options +L513 and +2L513, see *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).



1 PTC sensors monitored by relay K74.
$R_G = R_1 + R_2 + R_N \leq 1.5$ kohm.

2 External reset for relay K74

Note:
With +L505 and +2L505, the terminals can be bridged for automatic reset. However, this is not allowed by ATEX regulations.

3 PTC sensors monitored by relay K75.
$R_G = R_1 + R_2 + R_N \leq 1.5$ kohm.

4 External reset for relay K75

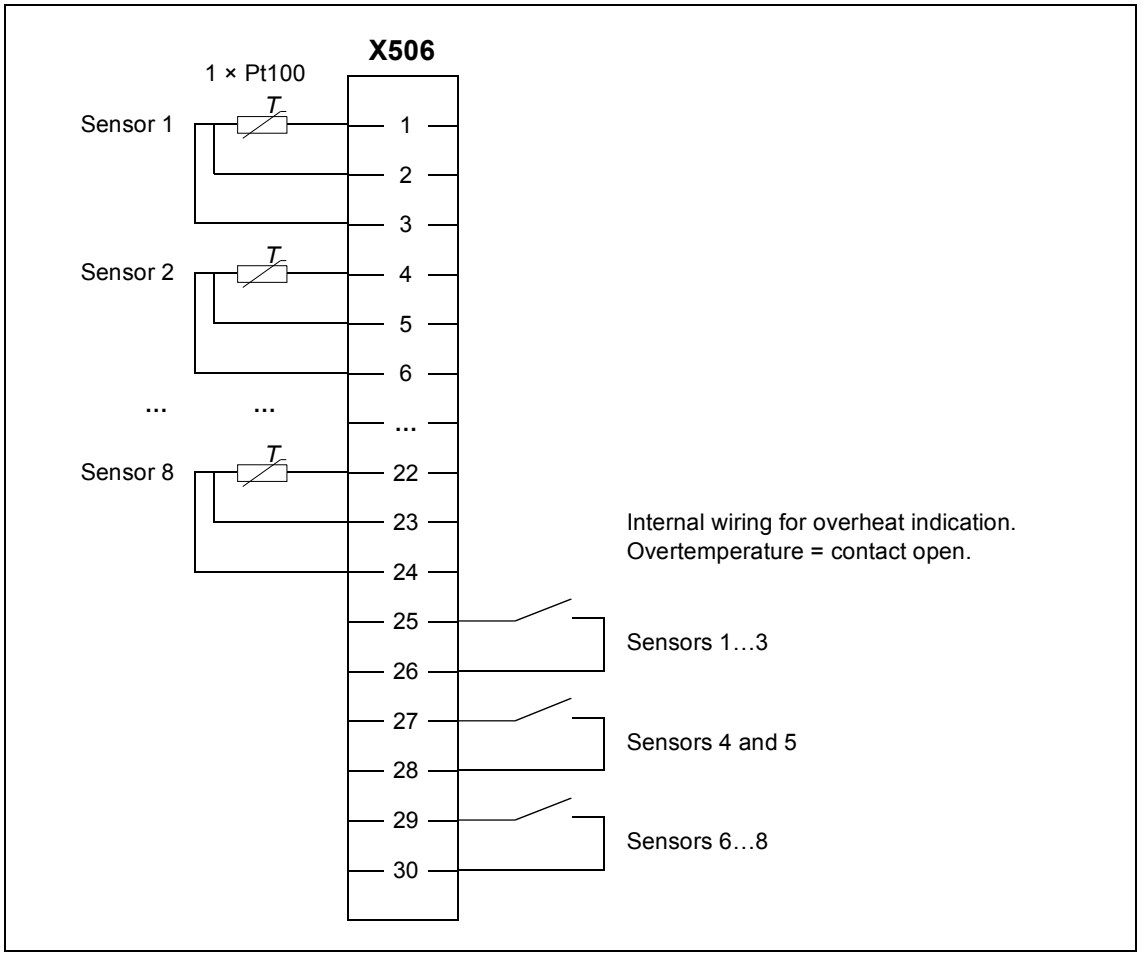
Note:
With +L505 and +2L505, the terminals can be bridged for automatic reset. However, this is not allowed by ATEX regulations.

5 Overheat indication from relay K74: overtemperature = contact open.

6 Overheat indication from relay K75: overtemperature = contact open.

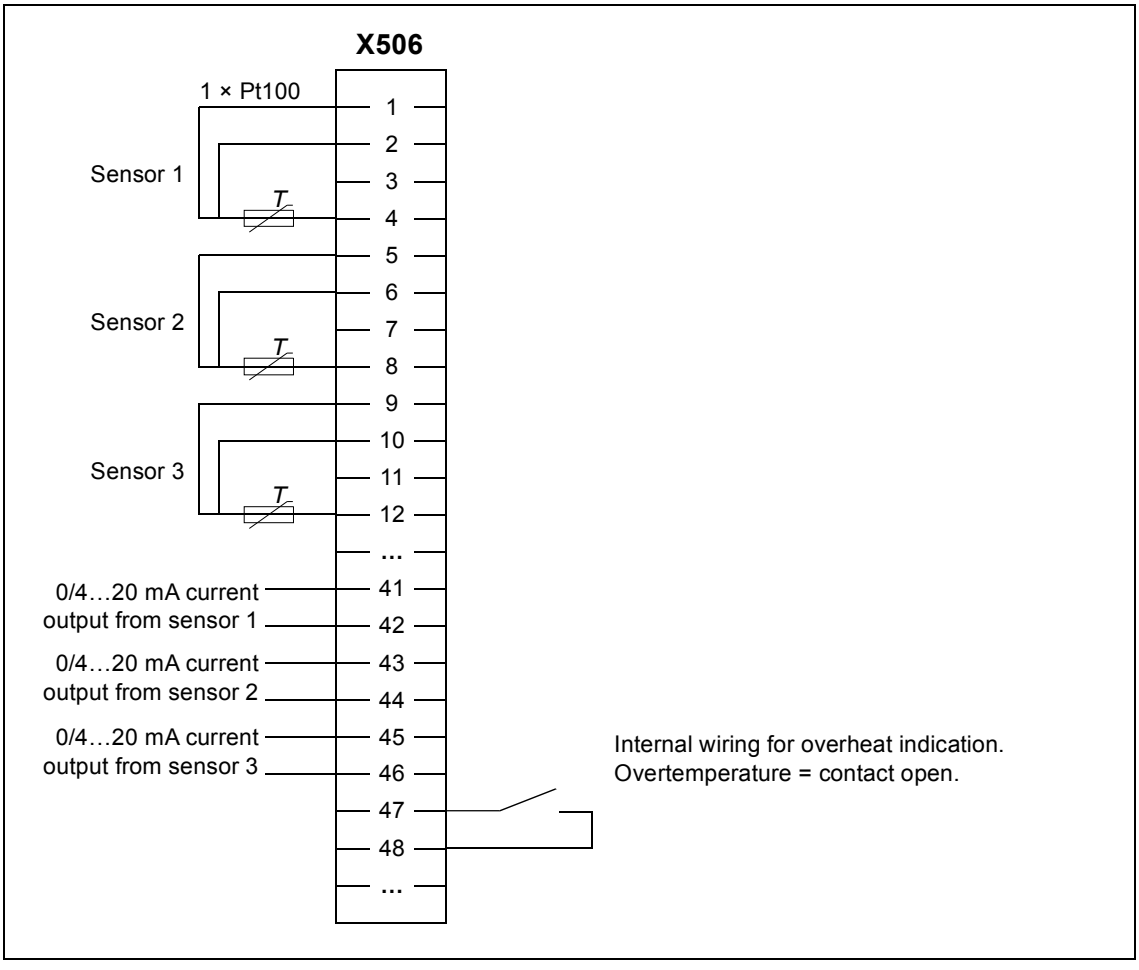
Wiring the Pt100 relays (options +nL506)

External wiring of eight Pt100 sensor modules is shown below. Contact load capacity is 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive.



Wiring the Pt100 relays (option +nL514)

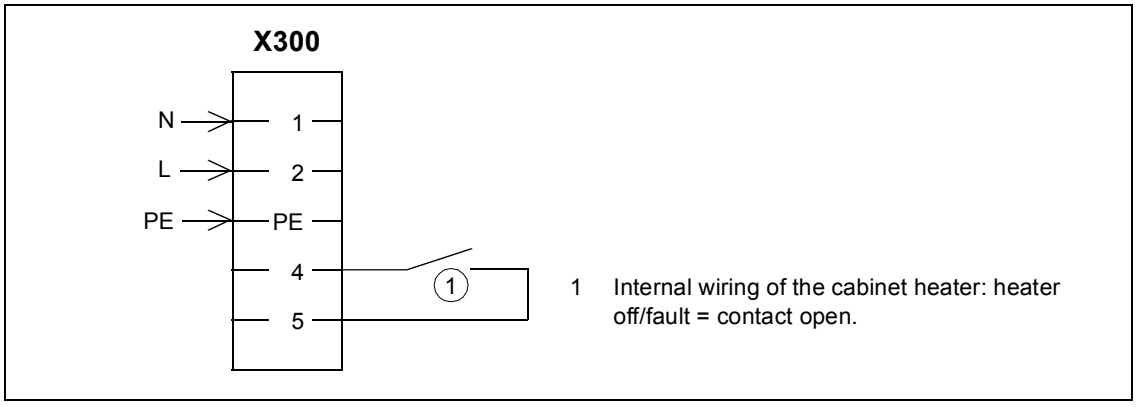
External wiring of three Pt100 sensors is shown below. The maximum contact load capacity is 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive. For instructions on commissioning option +nL514, see *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).


X506
1 × Pt100
Sensor 1
Sensor 2
Sensor 3
1
2
3
4
5
6
7
8
9
10
11
12
...
41
42
43
44
45
46
47
48
...
0/4…20 mA current output from sensor 1
0/4…20 mA current output from sensor 2
0/4…20 mA current output from sensor 3
Internal wiring for overheat indication.
Overtemperature = contact open.

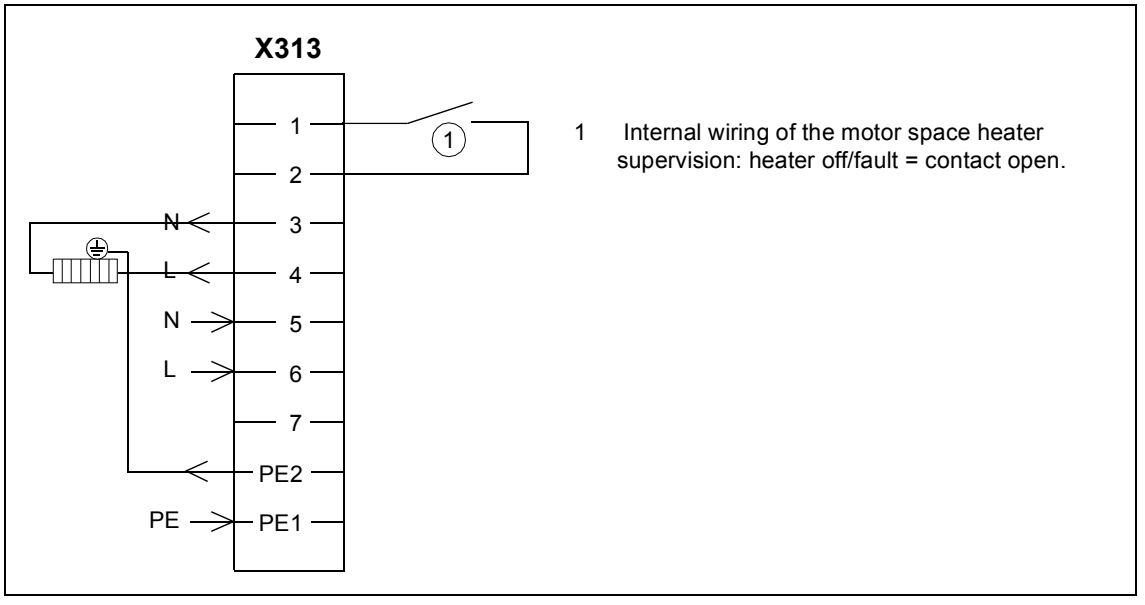
Powering the heating and lighting equipment (options +G300, +G301 and +G313)

See the circuit diagrams delivered with the drive.

Connect the external power supply wires for the cabinet heater and lighting to terminal block X300 at the back of the mounting plate.

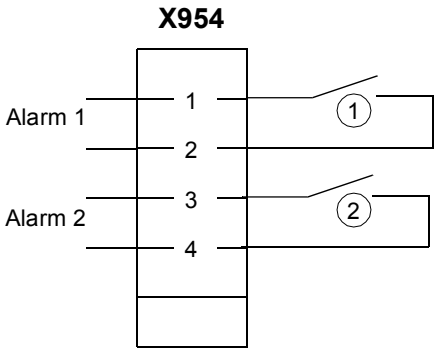


Connect the motor heater wiring to terminal block X313 as shown below. Maximum external power supply 16 A.



Wiring ground fault monitoring for IT ungrounded systems (option +Q954)

We recommend to connect Alarm 1 for drive tripping and Alarm 2 for alarm signals to avoid unnecessary trippings due to the ground fault monitor self testing with Alarm 2.

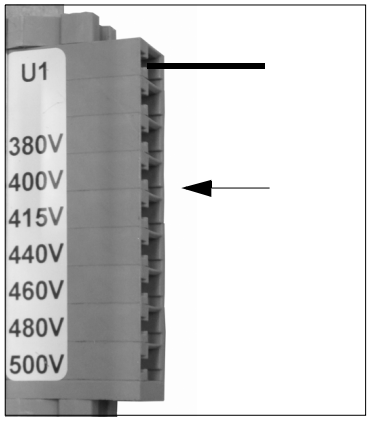


1 Internal wiring: Ground fault alarm 1. No ground fault = contact closed. Contact load capacity 250 V AC 2 A.

2 Internal wiring: Ground fault alarm 2: No ground fault = contact closed. Contact load capacity 250 V AC 8 A.

Setting the voltage range of the auxiliary control voltage transformer (T21)

Connect the power supply wires of the auxiliary control voltage transformer according to the power network voltage.



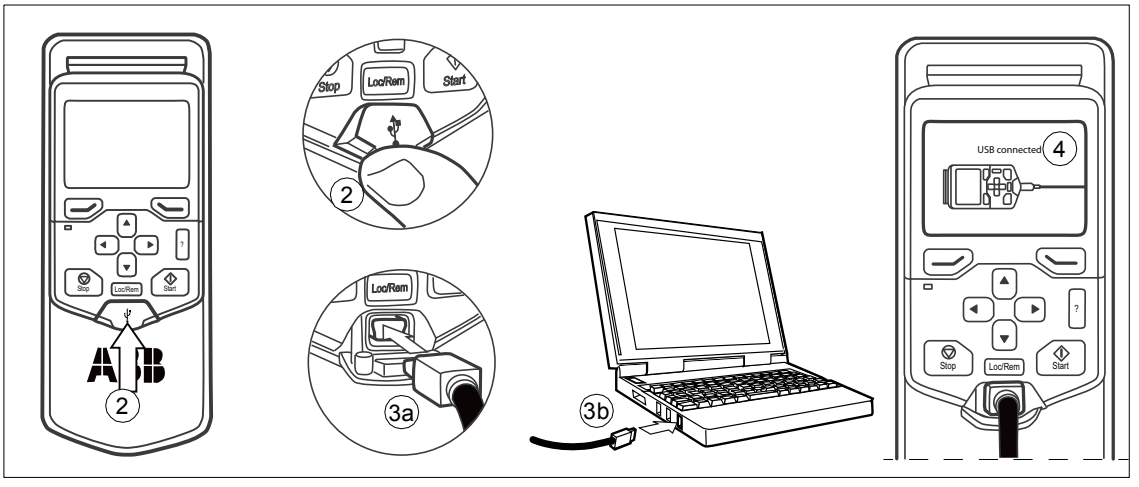
Connecting a PC

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

1. Connect an ACS-AP-I control panel to the drive either by using an Ethernet (eg. CAT5E) networking cable, or by inserting the panel into the panel holder (if present).

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

2. Lift the USB connector cover on the control panel from bottom upwards.
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.

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

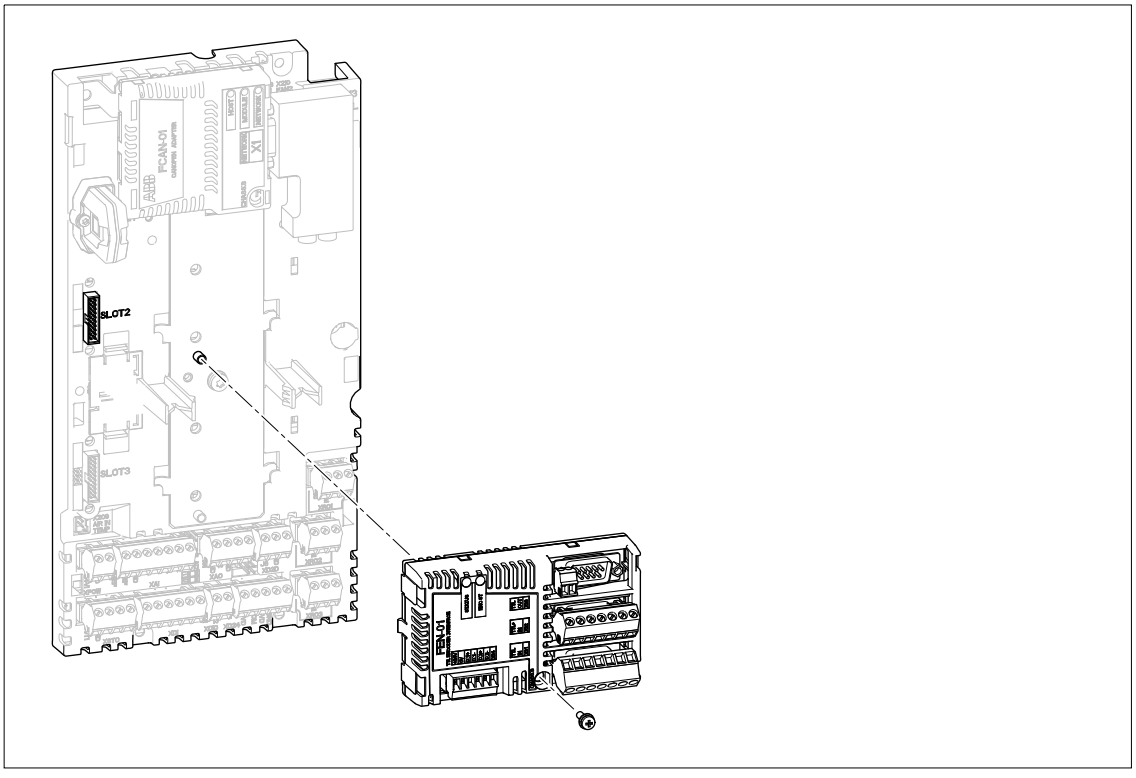
Installing option modules

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

See page *44* for the available slots for each module. Install the option modules as follows:

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 *Precautions before electrical work* on page *18* before you start the work.
2. Frames R6 to R9: Open the swing-out frame.
3. Insert the module carefully into its position on the control unit.
4. Tighten the mounting 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.



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

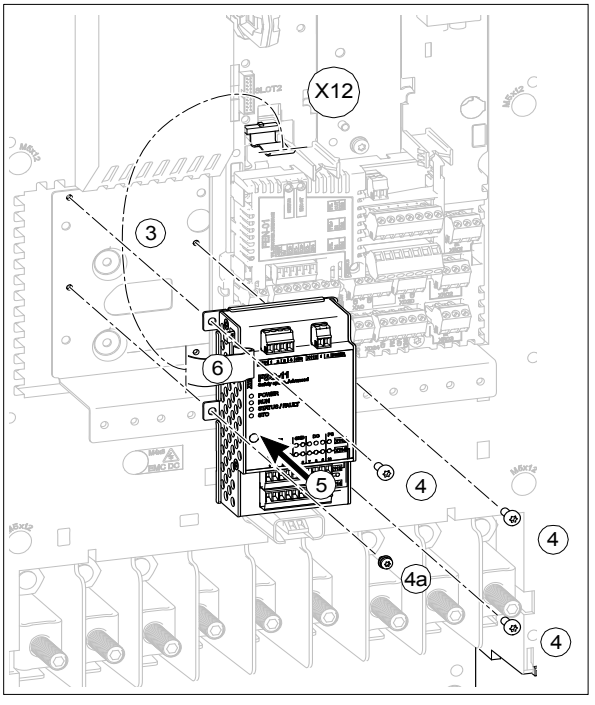
See the appropriate option module manual for specific installation and wiring instructions.

Installation of safety functions modules (frames R6 to R9)

Mount the safety functions module next to the control unit as described below.

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 *Precautions before electrical work* on page *18* before you start the work.
2. Open the swing-out frame.
3. Insert the module carefully into its position.
4. Attach the module with four screws. **Note:** Correct installation of the grounding screw (a) is essential for fulfilling the EMC requirements and for proper operation of the module.
5. Tighten the grounding screw of the electronics to tightening torque 0.8 N·m.
6. Connect the data communication cable to connector X110 on the module and to connector X12 on the drive control unit.
7. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.
8. Connect the external +24 V power supply cable to connector X112.
9. Connect the other wires as shown in *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]).



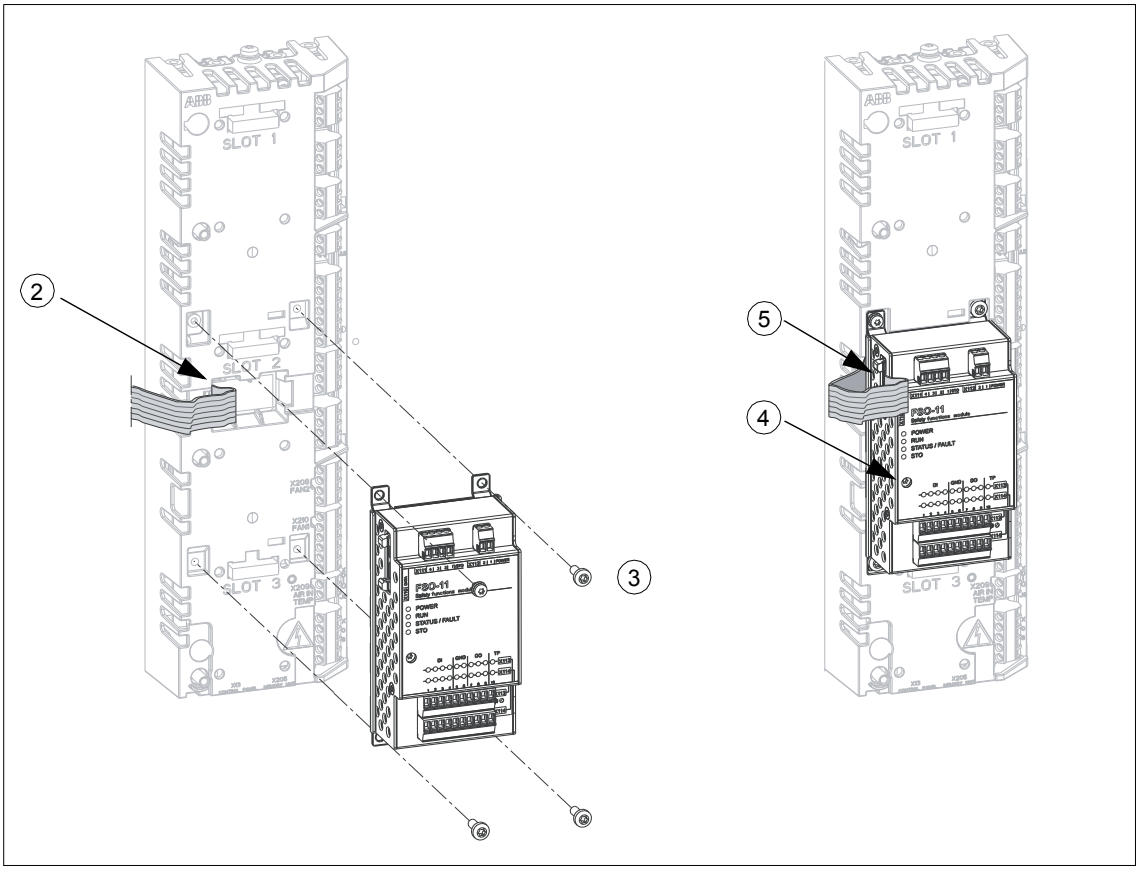
Installation of safety functions modules (frames R10 and R11)

Install the safety functions module next to the control unit as described below. Change the mounting plate of the module as shown in *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]).

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

Case 1: FSO-xx safety functions module on Slot 2

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Connect the FSO-xx data cable to connector X12 on the control unit.
3. Fasten the FSO-xx safety functions module to Slot 2 with four screws.
4. Tighten the FSO-xx module 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.
5. Connect the FSO-xx data cable to FSO-xx connector X110.
6. Connect the Safe torque off four-wire cable to connector X111 on the module and to connector XSTO on the drive module control unit.
7. Connect the external +24 V power supply cable to connector X112.
8. Connect the other wires as shown in *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]).

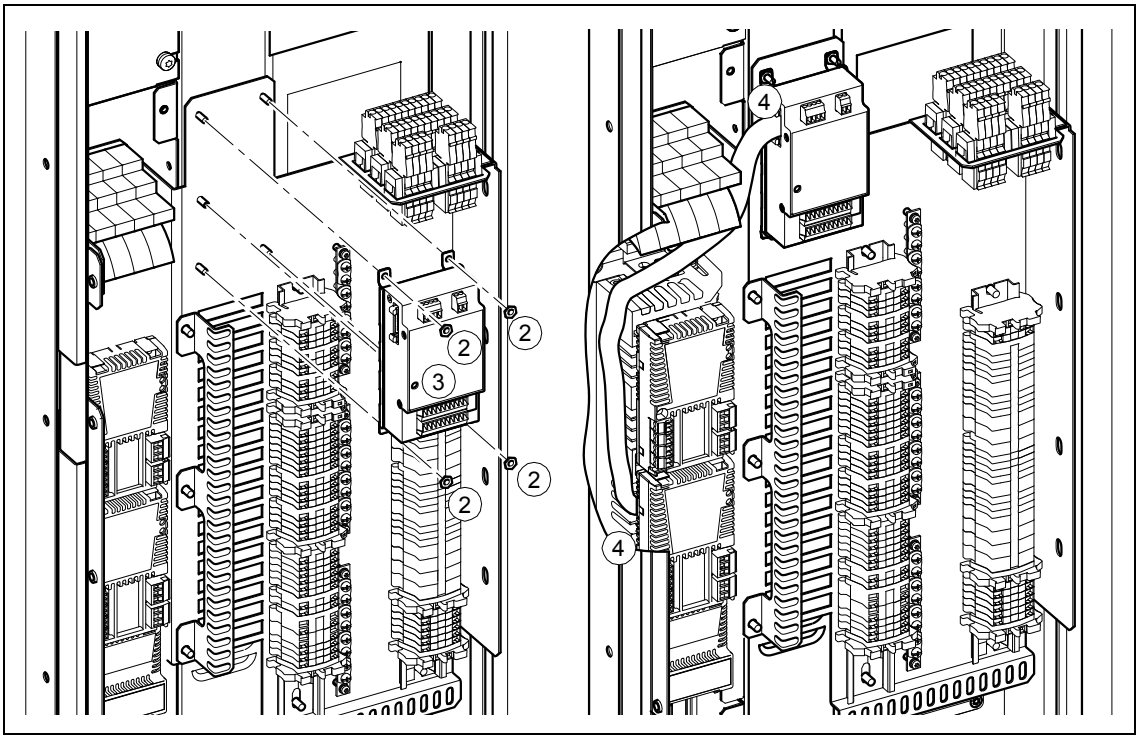

SLOT 1
SLOT 2
SLOT 3
FSO-11
POWER
RUN
STATUS / FAULT
STO
2
3
4
5

Case 2: FSO-xx safety functions module above the control unit

Install the safety functions module next to the control unit as described below. Change the original mounting plate of the module to the alternative plate included in the module package.

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 *Precautions before electrical work* on page *18* before you start the work.
2. Attach the FSO-xx safety functions module to the mounting plate with four screws.
3. 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.
4. Connect the FSO-xx data cable to FSO-xx connector X110 and to connector X12 on the control unit.



7

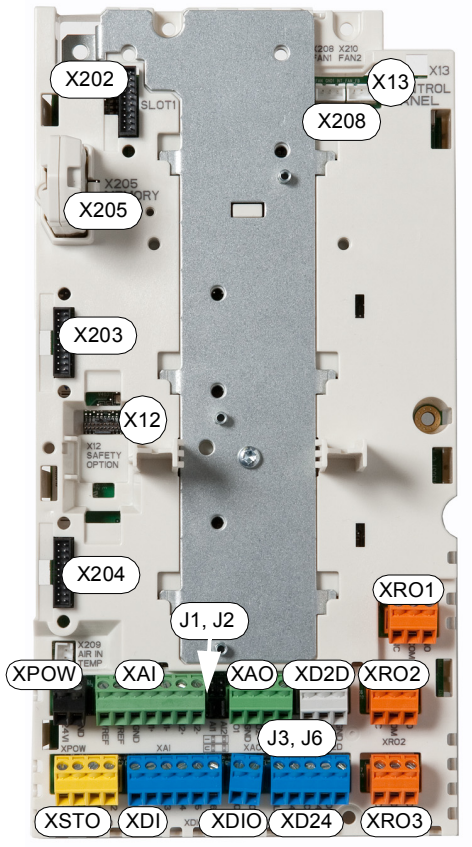
Control unit of frames R6 to R9

Contents of this chapter

This chapter contains the default I/O connection diagram, descriptions of the terminals and technical data for the control unit (ZCU-12) of drive frames R6 to R9.

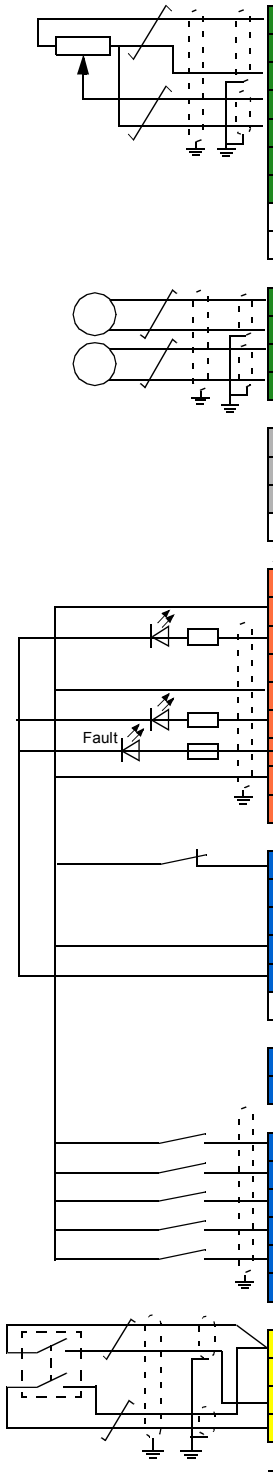
Layout

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



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

Default I/O connection diagram of frames R6 to R9



XPOW External power input

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

XAI Reference voltage and analog inputs

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

XAO Analog outputs

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

XD2D Drive-to-drive link

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

XRO1, XRO2, XRO3 Relay outputs

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

XD24 Digital interlock

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

XDIO Digital input/outputs

1	DIO1	Output: Ready
2	DIO2	Output: Running

XDI Digital inputs

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

XSTO Safe torque off

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

X12 Safety functions module connection

X13 Control panel connection

X205 Memory unit connection

Accepted control unit terminal wire sizes: 0.5 … 2.5 mm^2 (24…12 AWG). Tightening torques: 0.5 N·m (5 lbf·in) for both stranded and solid wiring. For terminal X504 (option +L504), see page *53*. See the page *140* for the notes.

Notes:

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

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

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

[4] 0 = open, 1 = closed

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

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

Further information on the usage of the connectors and jumpers is given in the sections below. For the technical data of the connectors, see section *Technical data* on page *143*.

Jumpers and switches

Jumper/ Switch	Description	Positions
J1 (AI1)	Determines whether analog input AI1 is used as a current or voltage input.	 Current (I)
		 Voltage (V)
J2 (AI2)	Determines whether analog input AI2 is used as a current or voltage input.	 Current (I)
		 Voltage (U)
J3	Drive-to-drive link termination. Must be set to terminated position when the drive is the last unit on the link.	 Bus is terminated.
		 Bus is not terminated.
J6	Common digital input ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). See the *Ground isolation diagram* on page *145*.	 DICOM and DIOGND connected (default).  DICOM and DIOGND separated.

External power supply for the control unit (XPOW)

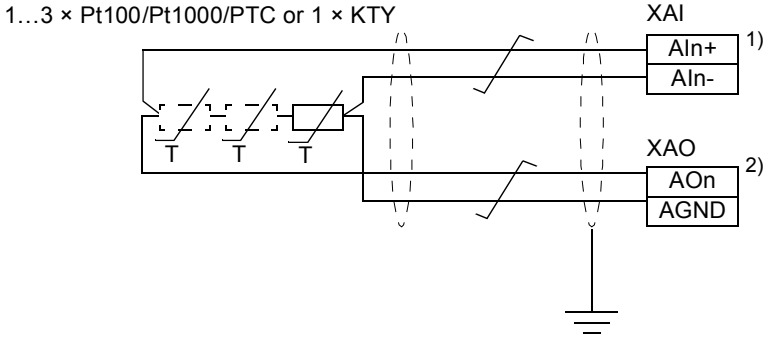
External +24 V (2 A) power supply for the control unit can be connected to terminal block XPOW. Using an external supply is recommended if

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

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

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

Three Pt100/Pt1000 or PTC sensors or one KTY84 sensor for motor temperature measurement can be connected between an analog input and output as shown below. (Alternatively, you can connect the KTY to 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, 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.



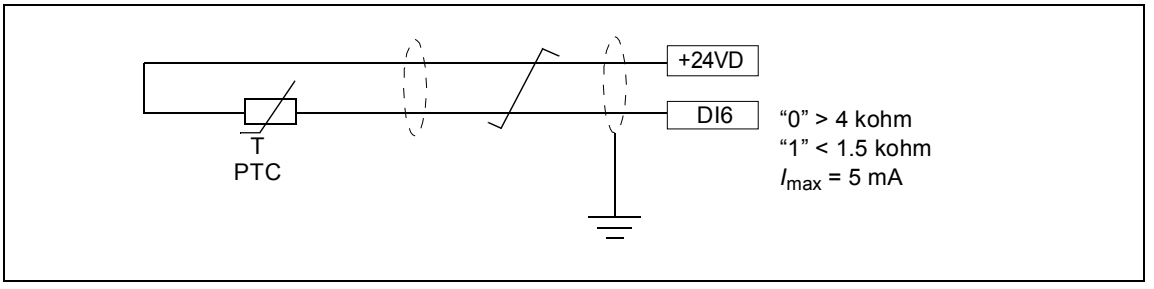
1. Set the input type to voltage with switch J1 for analog input AI1or with J2 for analog input AI2. Set the appropriate analog input unit to V (volt) in parameter group **12 Standard AI**.
2. Select the excitation mode in parameter group **13 Standard AO**.

WARNING! As the inputs pictured above are not insulated according to IEC/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.

DI6 (XDI:6) as PTC sensor input

A PTC sensor can be connected to this input for motor temperature measurement as follows. The sensor resistance must not exceed the threshold resistance of the digital input at the motor normal operating temperature. Do not connect both ends of the cable shield directly to ground. Leave the other end of the shield unconnected or ground it directly via a few nanofarads high-frequency capacitor, 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 for parameter settings.

Note: PTC sensors can alternatively be connected to FEN-xx encoder interface module.



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 (XD24:1)

The DIIL input can be selected as the source of, for example, an emergency stop command or an external event. See the firmware manual, for more information

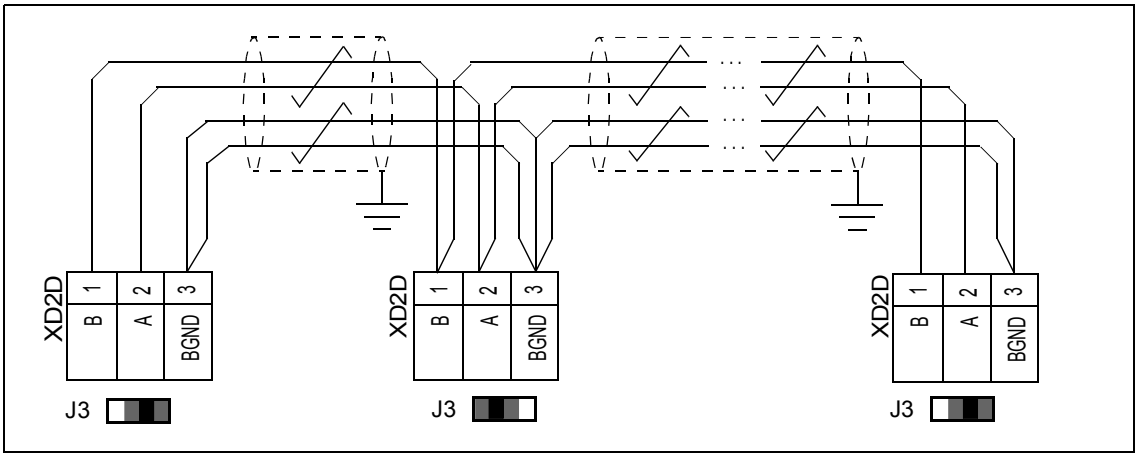
Drive-to-drive link (XD2D)

The drive-to-drive link is a daisy-chained RS-485 transmission line that allows basic master/follower communication with one master drive and multiple followers.

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

Use shielded twisted-pair cable (~100 ohm, for example, PROFIBUS-compatible cable) for the wiring. For best immunity, high quality cable is recommended. Keep the cable as short as possible; the maximum length of the link is 100 meters (328 ft). Avoid unnecessary loops and running the cable near power cables (such as motor cables).

This diagram shows the wiring of the drive-to-drive link for frames R6 to R9.



Safe torque off (XSTO)

For the drive to start, both connections (OUT1 to IN1 and IN2) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting an external Safe torque off circuit to the drive. For information on the implementation of a Safe torque off function, see chapter *Safe torque off function* on page *239*.

FSO-xx safety functions module connection (X12)

See section *Implementing the ATEX-certified safe motor disconnection function (option +Q971)* on page *92*, chapter *Safe torque off function* and *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

Technical data

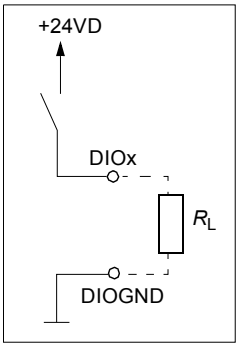
Power supply (XPOW)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG) 24 V (±10%) DC, 2 A Supplied from the power unit of the drive, or from an external power supply through connector XPOW. Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG).
Relay outputs RO1…RO3 (XRO1 … XRO3)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG) 250 V AC / 30 V DC, 2 A Protected by varistors
+24 V output (XD24:2 and XD24:4)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG) Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
Digital inputs DI1…DI6 (XDI:1 … XDI:6)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG) 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP (DI1…DI5), NPN (DI6) Hardware filtering: 0.04 ms, digital filtering up to 8 ms DI6 (XDI:6) can alternatively be used as an input for PTC sensors. "0" > 4 kohm, "1" < 1.5 kohm I_{max}: 15 mA (for DI6 5 mA)
Start interlock input DIIL (XD24:1)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG) 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP Hardware filtering: 0.04 ms, digital filtering up to 8 ms

Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2)

Input/output mode selection by parameters.

DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual, parameter group **11**.

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



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

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

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

Current/voltage input mode selection by jumpers. See page *140*.

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

Analog outputs AO1 and AO2 (XAO)

Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG)
0…20 mA, R_{load} < 500 ohm
Frequency range: 0…300 Hz
Resolution: 11 bit + sign bit
Inaccuracy: 2% of full scale range

Drive to drive link (XD2D)

Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG)
Physical layer: RS-485
Termination by switch

Safe torque off connection (XSTO)

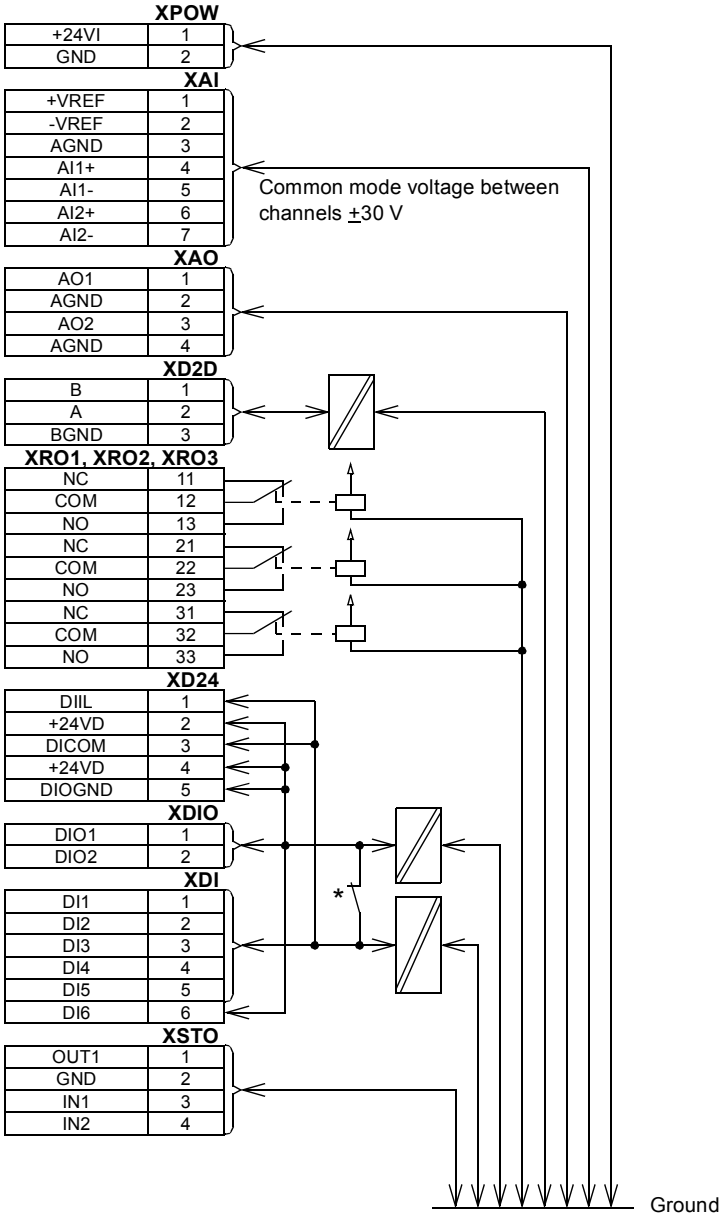
Connector pitch 5 mm (0.2 in), wire size 2.5 mm^2 (14 AWG)
Input voltage range: -3…30 V DC
Logic levels: “0” < 5 V, “1” > 17 V
For the drive to start, both connections must be closed (OUT1 to IN1 and IN2).
Current consumption of frames R1 to R7: 30 mA (+24 V DC, continuous) per STO channel
Current consumption of frames R8 and R9: 12 mA (+24 V DC, continuous) per STO channel
Maximum output current from OUT1 (24 V DC continuous): 100 mA
EMC (immunity) according to IEC 61326-3-1

Control panel / PC connection

Connector: RJ-45
Cable length < 3 m (10 ft)

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

Ground isolation diagram



***Ground selector (J6) settings**

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

8

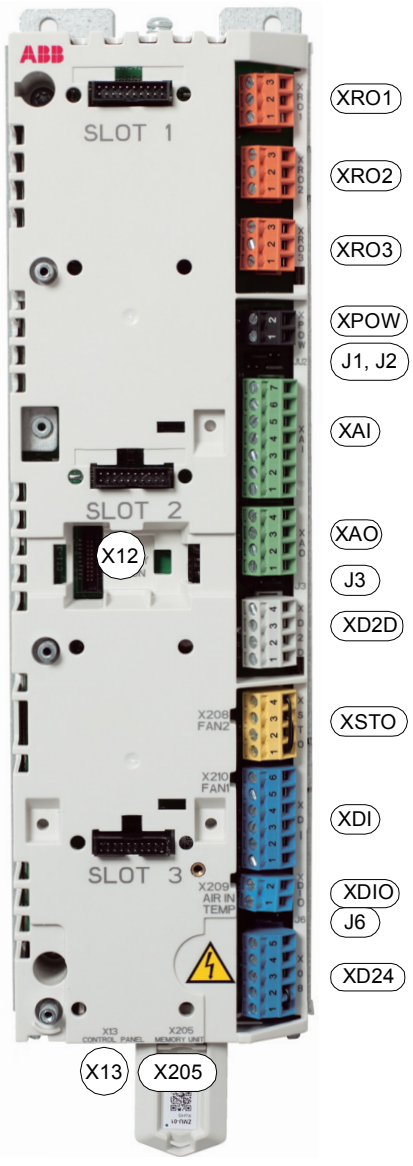
Control unit of frames R10 and R11

Contents of this chapter

This chapter contains the default I/O connection diagram, descriptions of the terminals and technical data for the control unit (ZCU-14) of drive frames R10 and R11.

Layout

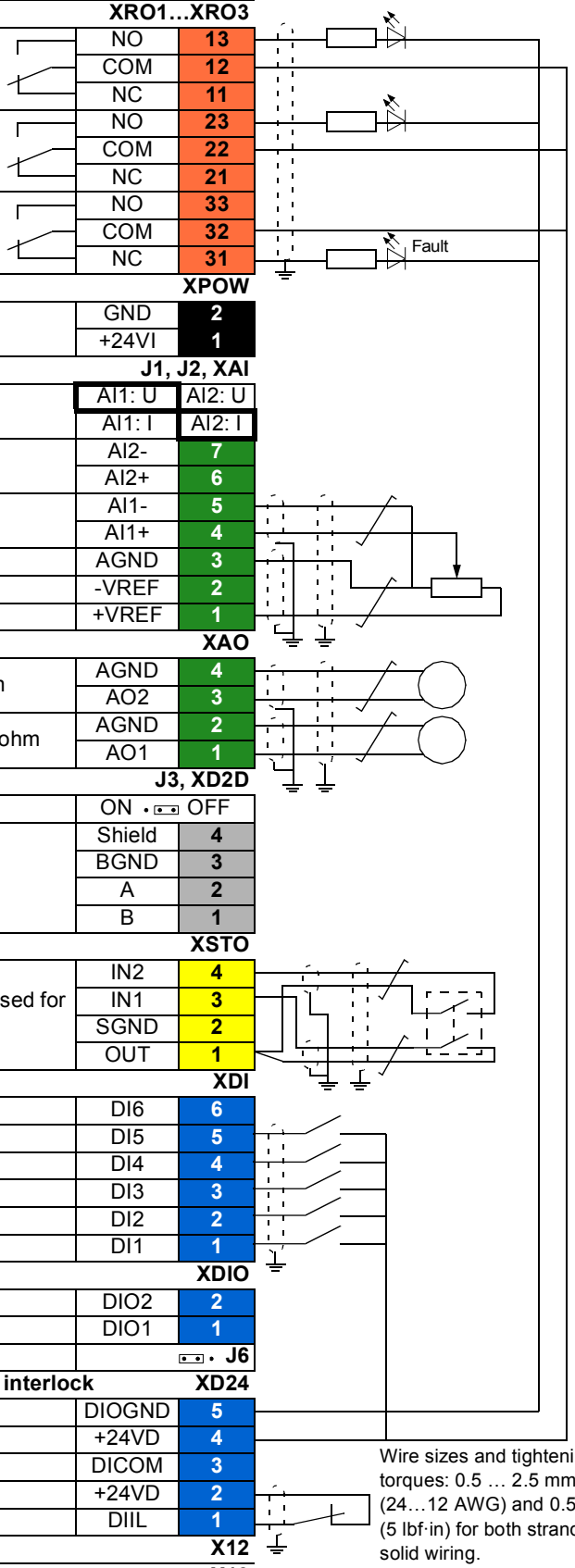
The layout of external control connection terminals of the control unit is shown below.



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

Default I/O connection diagram of frames R10 and R11

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



Wire sizes and tightening torques: 0.5 … 2.5 mm^2 (24…12 AWG) and 0.5 N·m (5 lbf·in) for both stranded and solid wiring.

See page 150 for notes.

Notes:

1) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected with jumper J1. Change of setting requires reboot of control unit.
2) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected with jumper J2. Change of setting requires reboot of control unit.
3) Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by tDIO1 and DIO2.
4) 0 = open, 1 = closed

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

5) Constant speed 1 is defined by parameter **22.26**.
6) Must be set to ON when the drive is the last unit on the drive-to-drive (D2D) link.
7) Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats).
• DICOM connected to DIOGND. • DICOM and DIOGND separate

Further information on the usage of the connectors and jumpers is given in the sections below.

See chapter *Control unit of frames R6 to R9* for the descriptions of

- External power supply for the control unit
- AI1 and AI2 as Pt100 and KTY84 sensor inputs (XAI, XAO)
- DI6 (XDI:6) as PTC sensor input
- DIIL input (XD24:1)
- Safe torque off (XSTO) 1)
- Safety functions (X12)
- Technical data of the connectors.

1) Current consumption of frames R10 and R11 is 50 mA (+24 V DC, continuous) per STO channel. Logic levels: “0” < 5 V, “1” > 19 V.

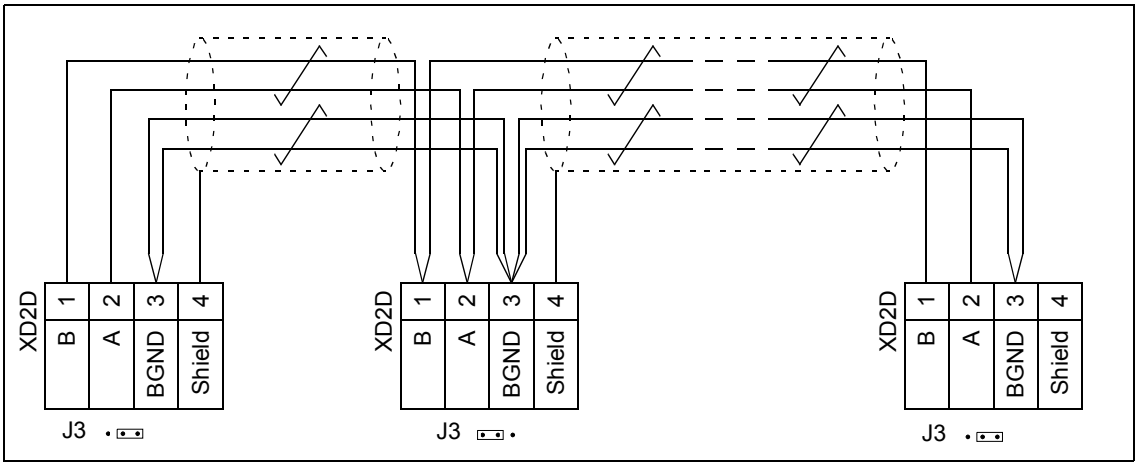
Drive-to-drive link (XD2D)

The drive-to-drive link is a daisy-chained RS-485 transmission line that allows basic master/follower communication with one master drive and multiple followers.

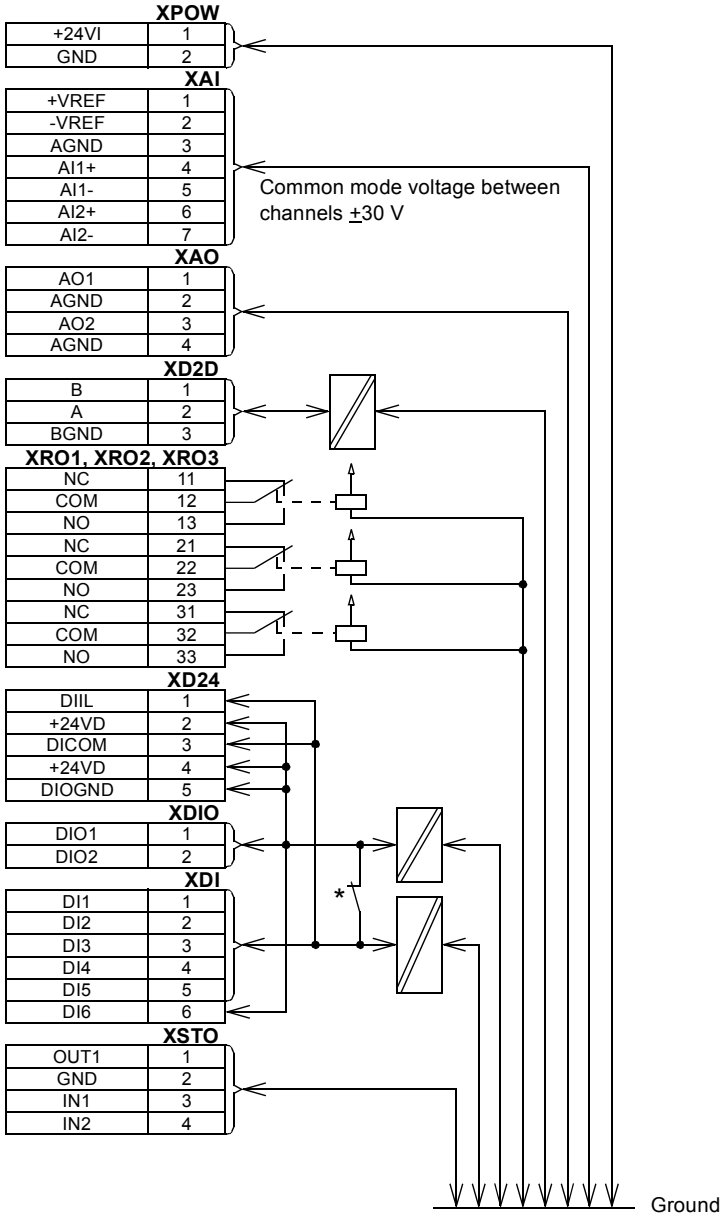
Set termination activation jumper J3 next to this terminal block to the ON position on the drives at the ends of the drive-to-drive link. On intermediate drives, set the jumper to the OFF position.

Use shielded twisted-pair cable (~100 ohm, for example, PROFIBUS-compatible cable) for the wiring. For best immunity, high quality cable is recommended. Keep the cable as short as possible; the maximum length of the link is 100 meters (328 ft). Avoid unnecessary loops and running the cable near power cables (such as motor cables). Ground the cable shields.

This diagram shows the wiring of the drive-to-drive link for frames R10 and R11.



Ground isolation diagram



***Ground selector (J6) settings**

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

9

Installation checklist

Contents of this chapter

This chapter contains an installation checklist which you must complete before you start up the drive.

Warnings

WARNING! Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur. Do the steps in section *Precautions before electrical work* on page *18* before you start the work. Go through the checklist together with another person.

Checklist

Check that …	☑
The ambient operating conditions meet the specifications given in chapter *Technical data*.	☐
The drive cabinet has been fixed to floor, and if necessary due to vibration etc, also from top to the wall or roof.	☐
The cooling air will flow freely in and out of the drive cabinet,	☐
If the drive will be connected to an IT (ungrounded) or a corner-grounded TN network: The optional EMC filter (+E200, +E202) of the drive (if any) has been disconnected. See the electrical installation instructions (page *101*).	☐
If the drive has been stored over one year: The electrolytic DC capacitors in the DC link of the drive have been reformed. See *Converter module capacitor reforming instructions* (3BFE64059629 [English]).	☐

Check that …	☑
There is an adequately sized protective earth (ground) conductor between the drive and the switchboard, and the conductor has been connected to appropriate terminal, and the terminal has been tightened. (Pull the conductor to check.) Proper grounding has also been measured according to the regulations.	☐
The input power cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.)	☐
There is an adequately sized protective earth (ground) conductor between the motor and the drive, and the conductor has been connected to appropriate terminal, and the terminal has been tightened. (Pull on the conductors to check.) Proper grounding has also been measured according to the regulations.	☐
The motor cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull on the conductors to check.)	☐
The motor cable (and brake resistor cable, if present) has been routed away from other cables.	☐
No power factor compensation capacitors have been connected to the motor cable.	☐
If an external brake resistor has been connected to the drive: There is an adequately sized protective earth (ground) conductor between the user-installed brake resistor and the drive, and the conductor has been connected to appropriate terminal. Proper grounding has also been measured according to the regulations.	☐
If an external brake resistor has been connected to the drive: The brake resistor has been connected to the appropriate terminals, and the terminals have been tightened. (Pull on the conductors to check.)	☐
If an external brake resistor has been connected to the drive: The brake resistor cable has been routed away from other cables.	☐
The control cables have been connected to the appropriate terminals, and the terminals have been tightened. (Pull on the conductors to check.)	☐
The supply voltage matches the nominal input voltage of the drive. Check the type designation label.	☐
The voltage setting of the auxiliary voltage transformer (T21) is correct. See the electrical installation instructions on page *129*.	☐
If a drive bypass connection will be used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked, ie, cannot be closed simultaneously.	☐
There are no tools, foreign objects or dust from drilling inside the drive.	☐
The area in front of the drive is clean: the drive cooling fan cannot draw any dust or dirt inside.	☐
All shrouds and cover of the motor connection box are in place. Cabinet doors have been closed.	☐
The motor and the driven equipment are ready for start.	☐

10

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 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 start-up.

WARNING!
Only qualified electricians are allowed to do the work described in this chapter.

Note:

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

Action	☑
Safety	
WARNING! Obey the safety instructions during the start-up procedure. See chapter *Safety instructions* on page *15*.	☐

Action	☑
Checks/Settings with no voltage connected	
Check the mechanical and electrical installation of the drive.See *Installation checklist* on page *153.*	☐
Drives with ground fault monitoring for IT (ungrounded) systems (option +Q954): Adjust the settings of the ground fault monitor to suit the installation. See the circuit diagrams of the delivery and *IRDH275B Ground Fault Monitor Operating Manual* by Bender (code: TGH1386en).	☐
Drives with Pt100 relays (options +L506): • Check the connections against the circuit diagrams of the delivery. • Set the alarm and trip levels of the Pt100 relays. Set the alarm and trip levels of the Pt100 relay as low as possible based on the operating temperature and test results of the machine. The trip level can be set, for example, 10 °C higher than what the temperature of the machine is at maximal load in the maximum environmental temperature. We recommend to set the operating temperatures of the relay, typically for example, as follows: • 120…140 °C when only tripping is in use • alarm 120…140 °C and trip 130…150 °C when both alarm and tripping are used.	☐
Powering up the drive	
Close the cabinet doors.	☐
Make sure that it is safe to connect voltage. Ensure that: • cabinet doors are closed • nobody is working on the drive or circuits that have been wired from outside into the drive cabinet • cover of the motor terminal box is in place.	☐
Close the main switch-disconnector (Q1).	☐
Setting up the drive parameters, and performing the first start	
Setup the drive control program. See the appropriate start-up guide and/or firmware manual. There is a separate start-up guide only for some control programs. For drives with resistor braking (optional): see also section *Brake system start-up* in chapter *Resistor braking*. For option +N7502, see also For option +N7502, see also *SynRM motor control program (option +N7502) for ACS880-01, ACS880-07, ACS850-04 and ACQ810-04 drives supplement* (3AXD50000026332 [English]). For drives with ABB sine filter, check that bit 1 (ABB sine filter) of parameter **95.15 Special HW settings** is activated. For other sine filters, see *Sine filter hardware manual* (3AXD50000016814 [English]). For drives with ABB motors in explosive atmospheres, see also *ACS880 drives with ABB motors in explosive atmospheres* (3AXD50000019585 [English]). If you need more information on the use of the control panel, see *ACS-AP-X Assistant control panels user's manual (3*AUA0000085685 (English)).	☐
Drives with main contactor (Q2, option +F250): Close the main contactor by turning the operating switch on the cabinet door from OFF into ON position.	☐
Perform the first start of the drive and motor.	☐
Stop the motor and drive.	☐
Drives with a fieldbus adapter module (optional): Set the fieldbus parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the fieldbus adapter module, and the drive firmware manual. Check that the communication works between the drive and the PLC.	☐

Action	☑
Drives with an encoder interface module (optional): Set the encoder parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the encoder interface module, and the drive firmware manual.	☐
On-load checks	
Check that the cooling fans rotate freely in the right direction, and the air flows upwards. A paper sheet set on the intake (door) gratings stays. The fans run noiselessly.	☐
Check that the motor starts, stops and follows the speed reference in the correct direction when controlled with the control panel.	☐
Check that the motor starts, stops and follows the speed reference in the correct direction when controlled through the customer-specific I/O or fieldbus.	☐
Drives in which the Safe torque off control circuit is in use: Test and validate the operation of the Safe torque off function. See section *Start-up including acceptance test* on page *245*.	☐
Drives with an emergency stop circuit (options +Q951, +Q952, +Q963, +Q964, +Q978 and +Q979): Test and validate the operation of the emergency-stop circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option (see page *91*).	☐
Drives with the Prevention of unexpected start-up with safety relay (option +Q957): Test and validate the operation of the Prevention of unexpected start-up circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option (see page *92*).	☐
Drives with the Prevention of unexpected start-up with FSO-xx (option +Q950): Test and validate the operation of the Prevention of unexpected start-up circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option (see page *92*).	☐

11

Fault tracing

Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

LEDs

This table shows the LEDs visible on the control panel mounting platform on cabinet door.

Where	LED	Color	Indication
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 drive control program warning and fault messages.

12

Maintenance

Contents of this chapter

This chapter contains 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/drivesservices). For more information, consult your local ABB Service representative (www.abb.com/searchchannels).

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

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

Descriptions of symbols

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

Recommended annual maintenance actions by the user

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

Recommended annual actions by the user	Annually
Connections and environment	
Cabinet door filters IP54	R
Quality of supply voltage	P
Spare parts	
Spare parts	I
DC circuit capacitors reforming, spare modules and spare capacitors	P
Inspections by the user	
IP22 and IP42 air inlet and outlet meshes	I
Tightness of terminals	I
Dustiness, corrosion and temperature	I
Heat sink cleaning	I
Other	
ABB-SACE Air circuit breaker maintenance	I

Recommended maintenance intervals after start-up

Component	Years from start-up						
	3	6	9	12	15	18	21
Cooling							
Main cooling fan							
Main cooling fan (R6 to R9) LONG-LIFE			R			R	
Main cooling fan (R10 and R11) *			R			R	
Auxiliary cooling fan							
Auxiliary cooling fan for circuit boards (R6 to R9) LONG-LIFE			R			R	
Auxiliary cooling fan IP55 (R8 and R9) LONG-LIFE			R			R	
Circuit board compartment cooling fans (R10 and R11) LONG-LIFE			R			R	
Cabinet cooling fan							
Internal LONG-LIFE 50 Hz			R			R	
Internal LONG-LIFE 60 Hz		R		R		R	
Door LONG-LIFE 50 Hz			R			R	
Door LONG-LIFE 60 Hz			R			R	
IP54 50 Hz *			R			R	
IP54 60 Hz *		R		R		R	
xSIN filter cooling fan							
Filter cooling fan			R			R	
* Fan has always been of type LONG-LIFE							
Aging							
ZCU control unit battery (real-time clock)		R		R		R	
Control panel battery (real-time clock)			R			R	

4FPS10000239703

Cabinet

Cleaning the interior of the cabinet

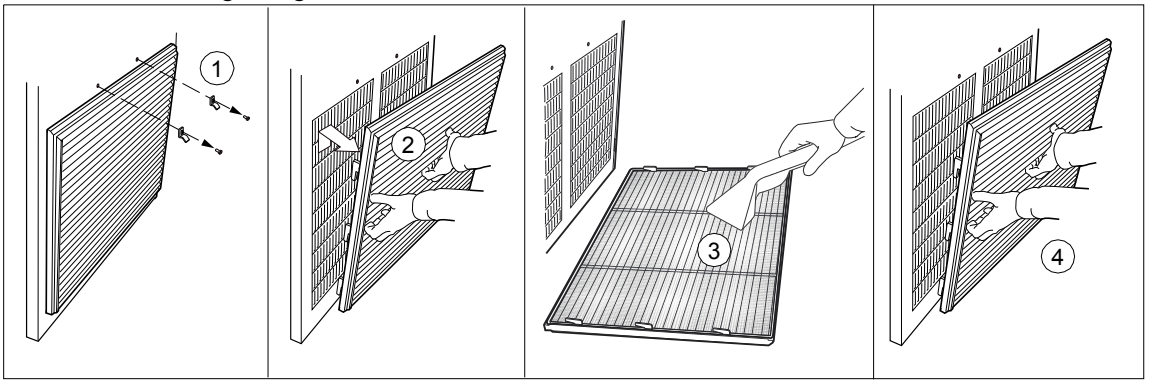
WARNING! Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

WARNING! Use a vacuum cleaner with an antistatic hose and nozzle, and wear a grounding wristband. Otherwise an electrostatic charge might build up and damage the circuit boards.

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Open the cabinet doors.
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 on the door (see below).
6. Close the doors.

Cleaning the door air inlets (IP22 / UL Type 1, IP42 / UL Type 1 Filtered)

1. Remove the fasteners at the top of the grating.
2. Lift the grating and pull it away from the door.
3. Vacuum clean or wash the grating on both sides.
4. Reinstall the grating in reverse order.

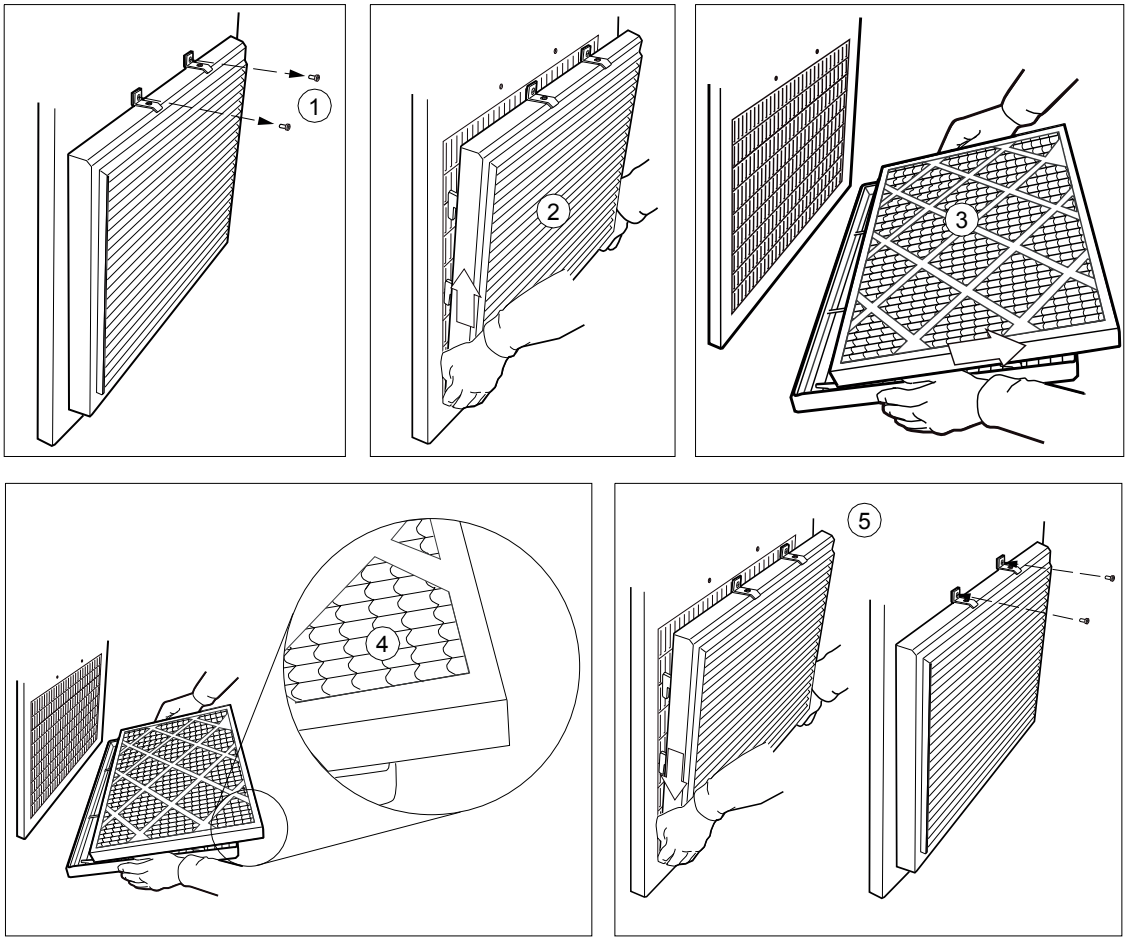


Replacing the air filters (IP54 / UL Type 12)

Check the air filters and replace if necessary (see page *220* for the correct filter types).

Inlet (door) filters (IP54 / UL Type 12)

1. Remove the fasteners at the top of the grating.
2. Lift the grating and pull it away from the door.
3. Remove the air filter mat.
4. Place the new filter mat in the grating the metal wire side facing the door.
5. Reinstall the grating in reverse order.



Outlet (roof) filters (IP54 / UL Type 12)

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 grating in reverse order.

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

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Remove the drive module from the cabinet.
3. Remove the module cooling fan(s). See section *Fans* below.
4. Blow dry, clean compressed air from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.
5. Reinstall the cooling fan.

Fans

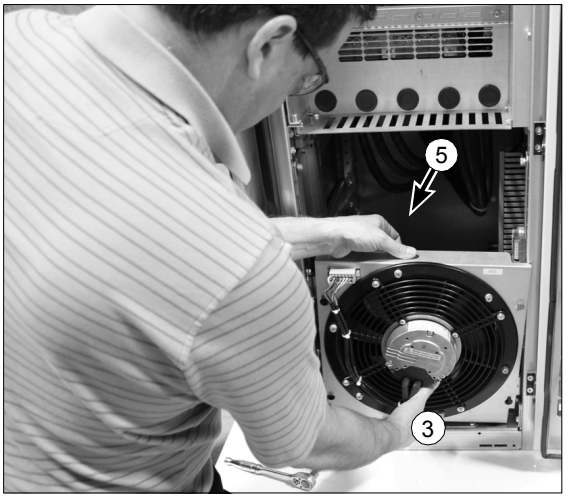
The lifespan of the cooling fans of the drive depends on the running time, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. Reset the running time signal after a fan replacement.

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

Replacing the cabinet “door” fans

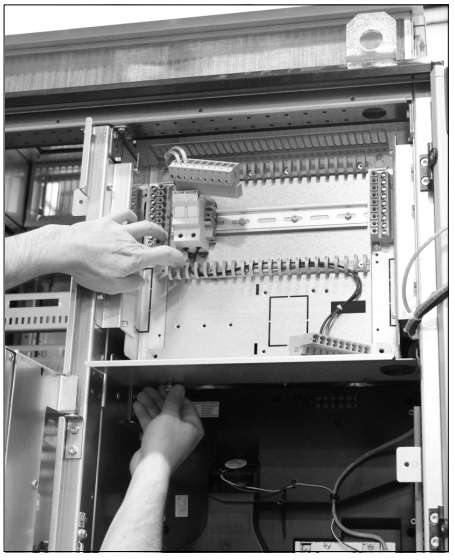
WARNING! Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Remove the mounting plate above the fan.
3. Loosen the four mounting screws of the fan mounting plate.
4. Lift the mounting plate upwards.
5. Unplug the power supply wires.
6. Lift the fan mounting plate off.
7. Remove the fan from the mounting plate.
8. Install the new fan in reverse order.



Replacing the cabinet fans (frames R6 to R9)

1. For removing the fan mounting plate, see section *Replacing the drive module (frames R6 to R8)* on page *176* (steps 1 to 3 and 13) or section *Replacing the drive module (frame R9)* on page *181* (steps 1, 9 and 10). For frame R9 with option +C129, see also below:

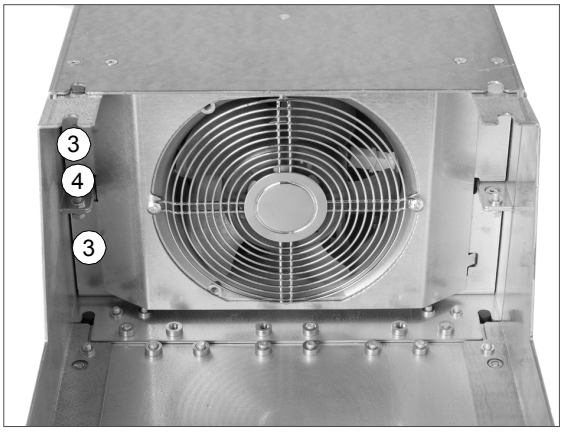


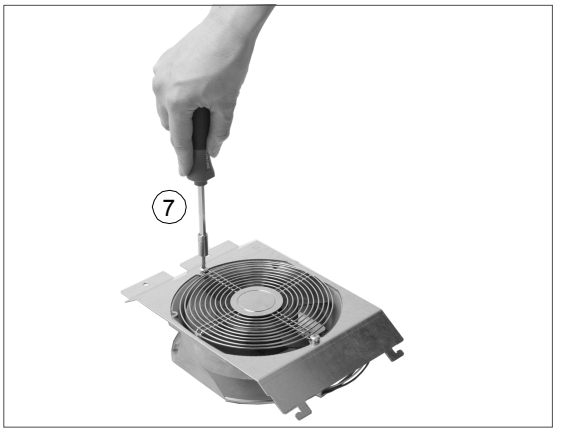
2. Remove the fan from the mounting plate.
3. Install the new fan in reverse order.

Replacing the drive module main fans (frames R6 to R8)

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 *Precautions before electrical work* on page *18* before you start the work.
2. Slide the drive module forward as described under *Replacing the drive module (frames R6 to R8)* on page *176*.
3. Undo the mounting screws of the fan mounting plate (view from bottom below).
4. Pull the fan mounting plate down from the side edge.
5. Unplug the power supply wires.
6. Lift the fan mounting plate off.
7. Remove the fan from the mounting plate.
8. Install the new fan in reverse order.
9. Reset the counter (if used) in group 5 in the primary control program.

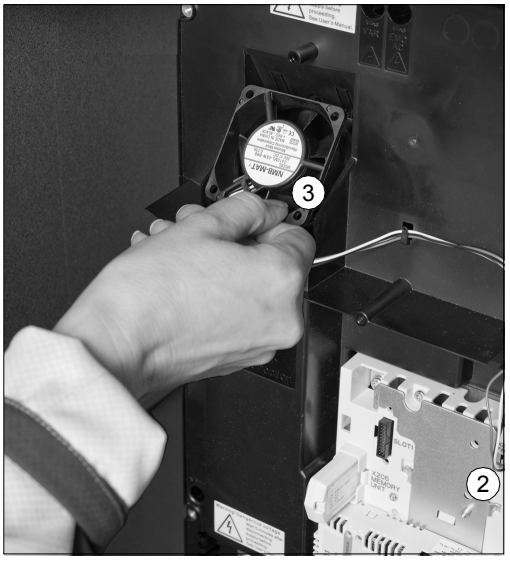




Replacing the auxiliary cooling fan of the drive module (frames R6 to R9)

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

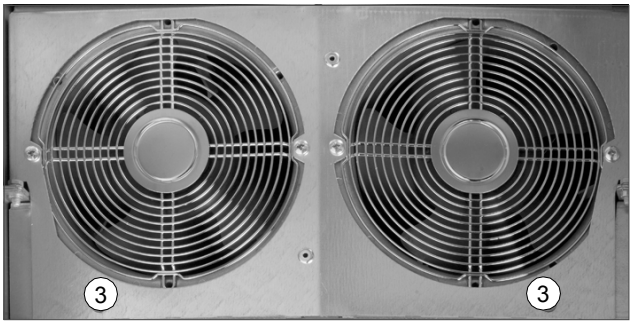
1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Unplug the power supply wires from the control unit terminal X208:FAN2.
3. Lift the fan up.
4. Install the new fan in reverse order. Make sure that the arrow on the fan points up.
5. Reset the counter (if used) in group 5 in the primary control program.

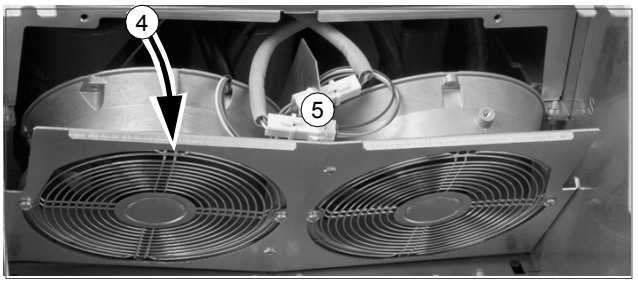


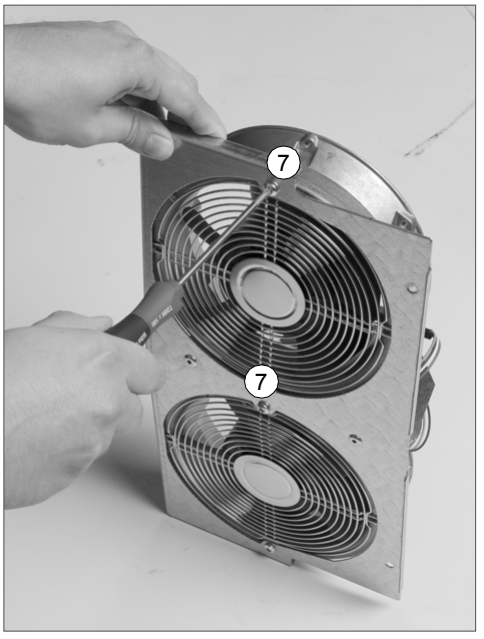
Replacing the drive module main fans (frame R9)

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 *Precautions before electrical work* on page *18* before you start the work.
2. Slide the drive module forward as described under *Replacing the drive module (frame R9)*, page *181*.
3. Undo the two mounting screws of the fan mounting plate (view from drive module bottom below).
4. Turn the mounting plate downwards.
5. Disconnect the fan power supply wires.
6. Remove the fan mounting plate.
7. Remove the fan by undoing the two mounting screws.
8. Install the new fan in reverse order.
9. Reset the counter (if used) in group 5 in the primary control program.



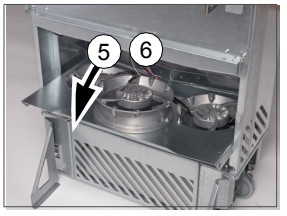


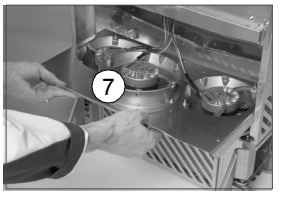


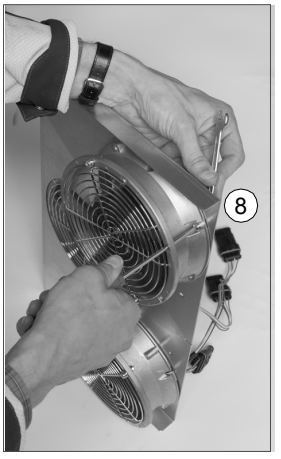
Replacing the drive module main fans (frames R10 and R11)

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 *Precautions before electrical work* on page *18* before you start the work.
2. Remove the drive module out of the cabinet as described in section *Replacing the drive module (frames R10 and R11)* on page *186*.
3. Open the support legs of the pedestal.
4. Undo the two screws that fasten the fan assembly plate.
5. Tilt the fan assembly plate down.
6. Disconnect the power supply wires of the fans.
7. Remove the fan assembly from the drive module.
8. Undo the fastening screws of the fan(s) and remove the fan(s) from the assembly plate.
9. Install the new fan(s) in reverse order.
10. Reset the counter (if used) in group 5 in the primary control program.



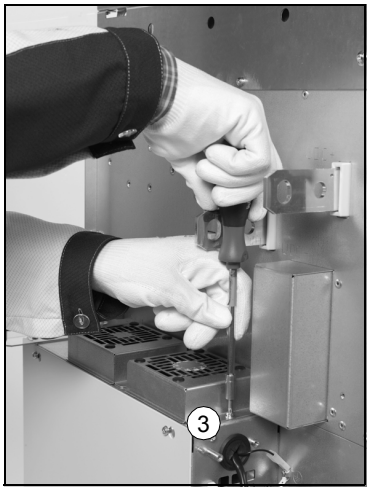


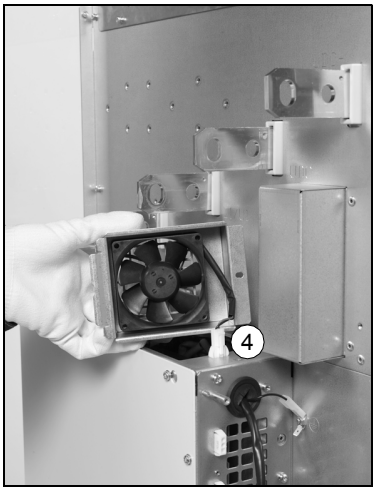


Replacing the circuit board compartment cooling fan (frames R10 and R11)

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 *Precautions before electrical work* on page *18* before you start the work.
2. Remove the drive module out of the cabinet as described in section *Replacing the drive module (frames R10 and R11)* on page *186*.
3. Undo the fastening screw of the fan enclosure.
4. Unplug the power supply cable of the fan.
5. Install the new fan in reverse order.
6. Reset the counter (if used) in group 5 in the primary control program.

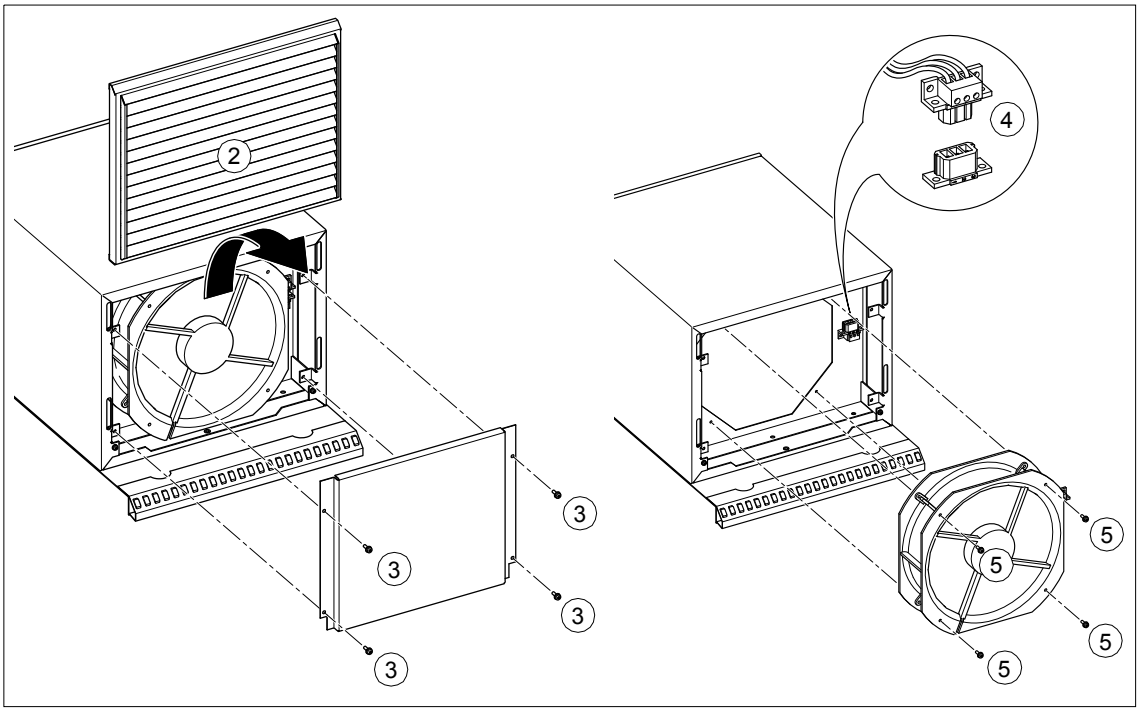




Replacing the IP54 (UL type 12) roof fan of frames R6 to R8

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

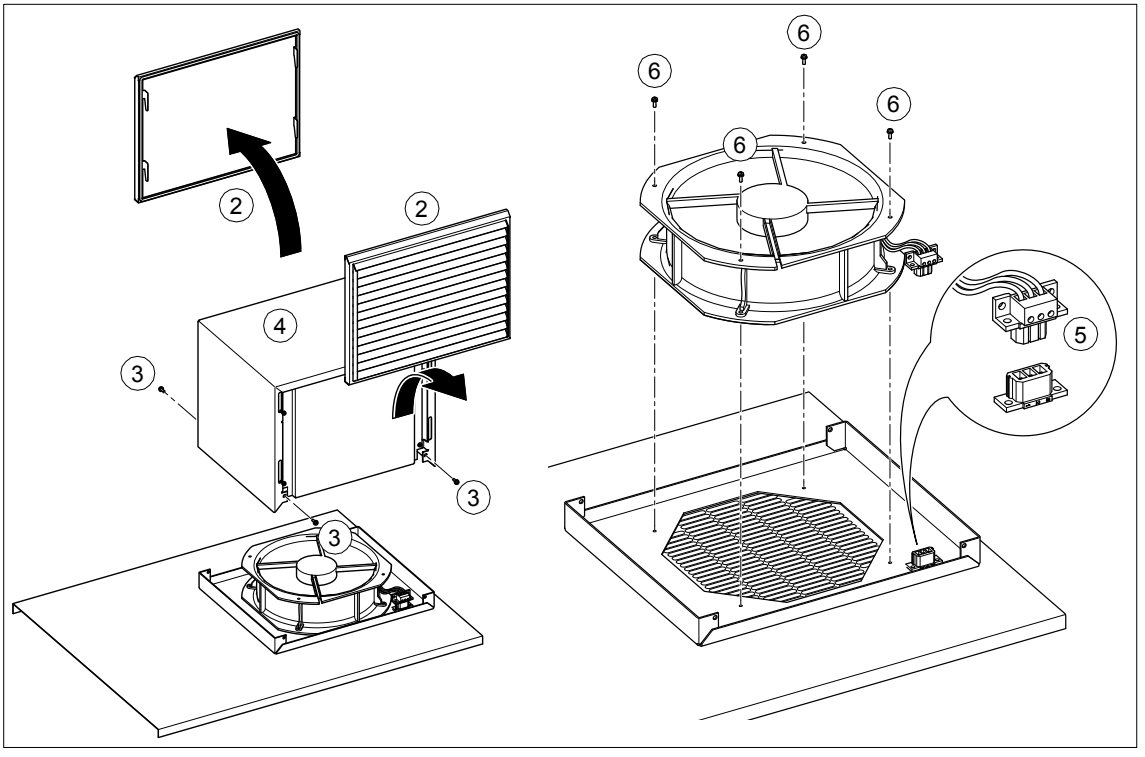
1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Lift the front grating upwards and remove it.
3. Loosen the fastening screws of the front plate. Remove the plate.
4. Disconnect the fan supply wires.
5. Loosen the mounting screws of the fan.
6. Pull the fan out.
7. Install the new fan in reverse order.



Replacing the IP54 (UL type 12) roof fan of frame R9

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

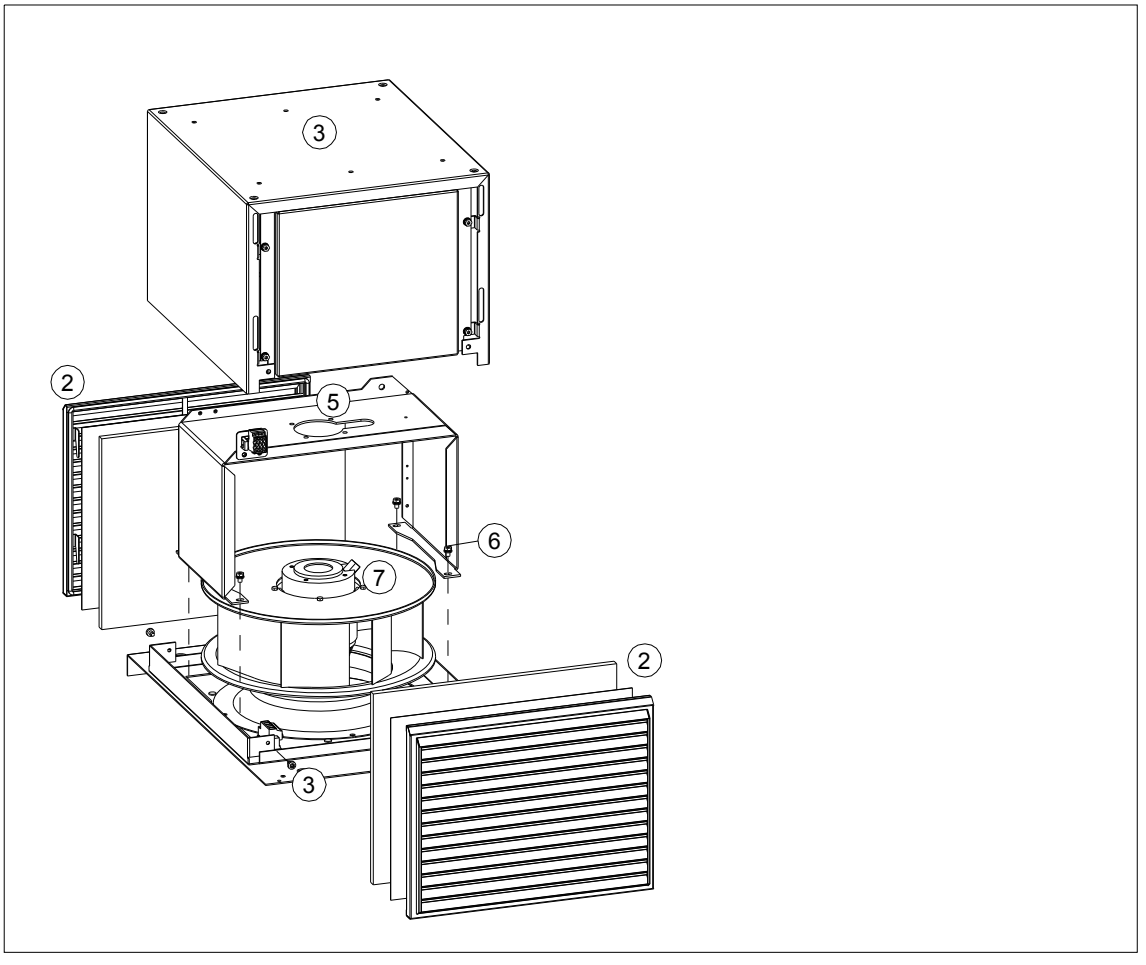
1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Lift the front and back gratings upwards and remove them.
3. Loosen the mounting screws of the fan cover.
4. Lift the cover off.
5. Disconnect the fan supply wires.
6. Loosen the mounting screws of the fan.
7. Lift the fan off.
8. Install the new fan in reverse order.



Replacing the IP54 (UL type 12) roof fan of frames R10 and R11

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 *Precautions before electrical work* on page *18* before you start the work.
2. Slide the front and back gratings upwards and remove them.
3. Remove the mounting screws of the upper cover and lift the cover off.
4. Disconnect the fan power supply wires.
5. Remove the mounting screws of the fan.
6. Remove the mounting screws of the fan cover.
7. Lift the fan off.
8. Install the new fan in reverse order.



Replacing the NSIN sine filter cooling fan

For replacing the NSIN sine filter cooling fan, see *Sine filters hardware manual* (3AXD50000016814 [English]).

Replacing the drive module (frames R6 to R8)

Required in this replacing procedure: preferably two persons, lifting chains, lifting device, a set of screw drivers and torque wrench with extension bar. A lifting device for ACS880-07 drive modules is available from ABB. For its installation and use, see *ACS880-07 lifting device user's manual* (3AUA0000131337 [English]).

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

WARNING! Make sure that the cabinet is secured to the floor. If not, the cabinet can topple over when the heavy drive module is slid forward in front of the cabinet. This can cause injury or death, and damage to the equipment.

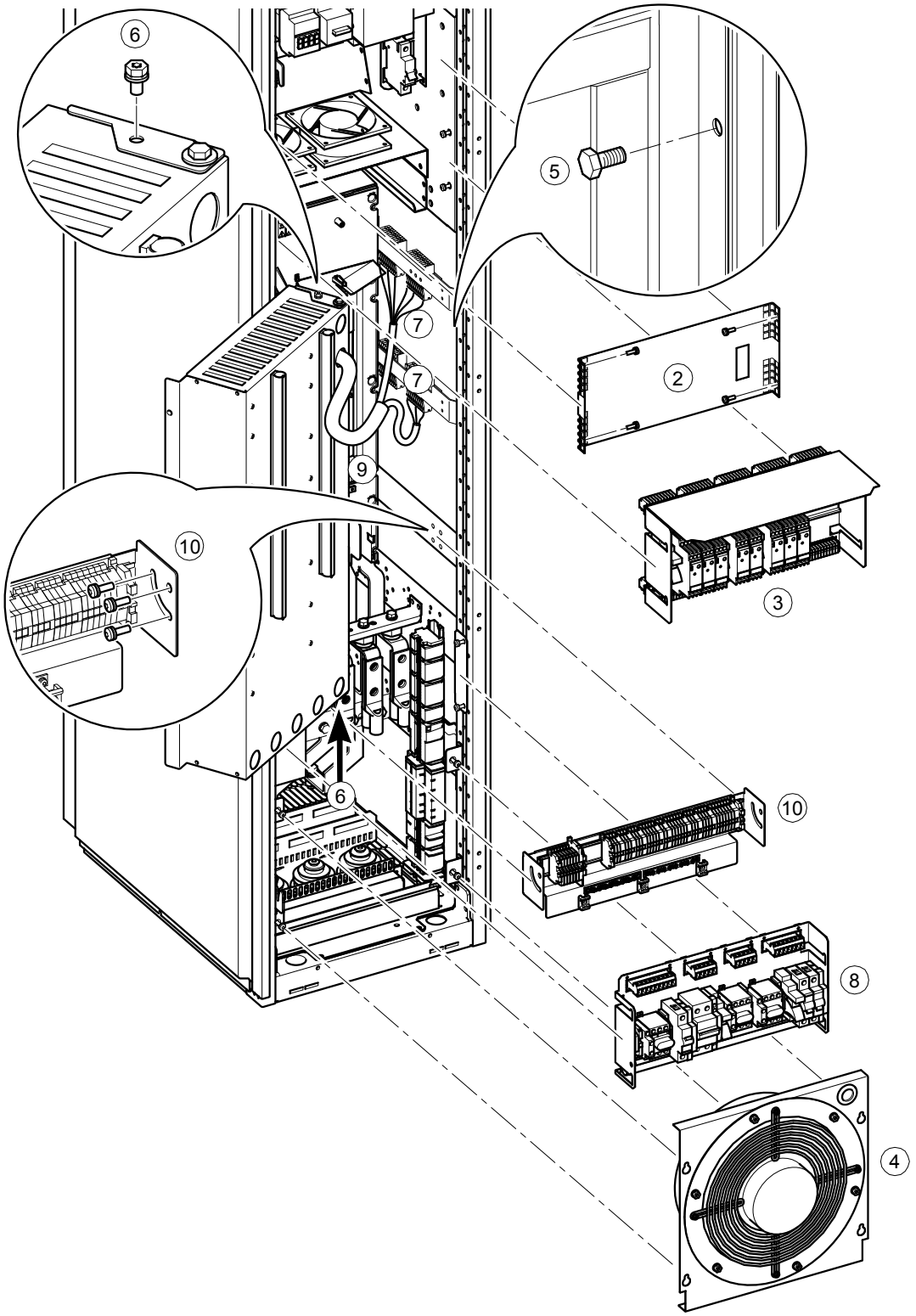
1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. For drives with options +L505 and +L506: Remove the shroud.
3. For drives with options +L505 and +L506: Remove the Pt100 and thermistor relay mounting plate by loosening the two mounting screws and lifting the mounting plate up.
4. Remove the drive module main fan (see page *168*).
5. Undo the screws on the right-hand side of the swing-out frame.
6. Undo the hinge screw at the top and bottom of the swing-out frame to enable the frame to open aside far enough.
7. Unplug the control wire terminals at the right-hand side of the cabinet.
8. See the warning below. Remove the mounting plate above the "door" fan by loosening the mounting screws and lifting the plate up.

WARNING! For drives with options +G300, +G301, +G307 and +G313: Before removing the mounting plate, disconnect the external power sources supplying the options. Unplug the control cable terminals at the back side of the mounting plate.

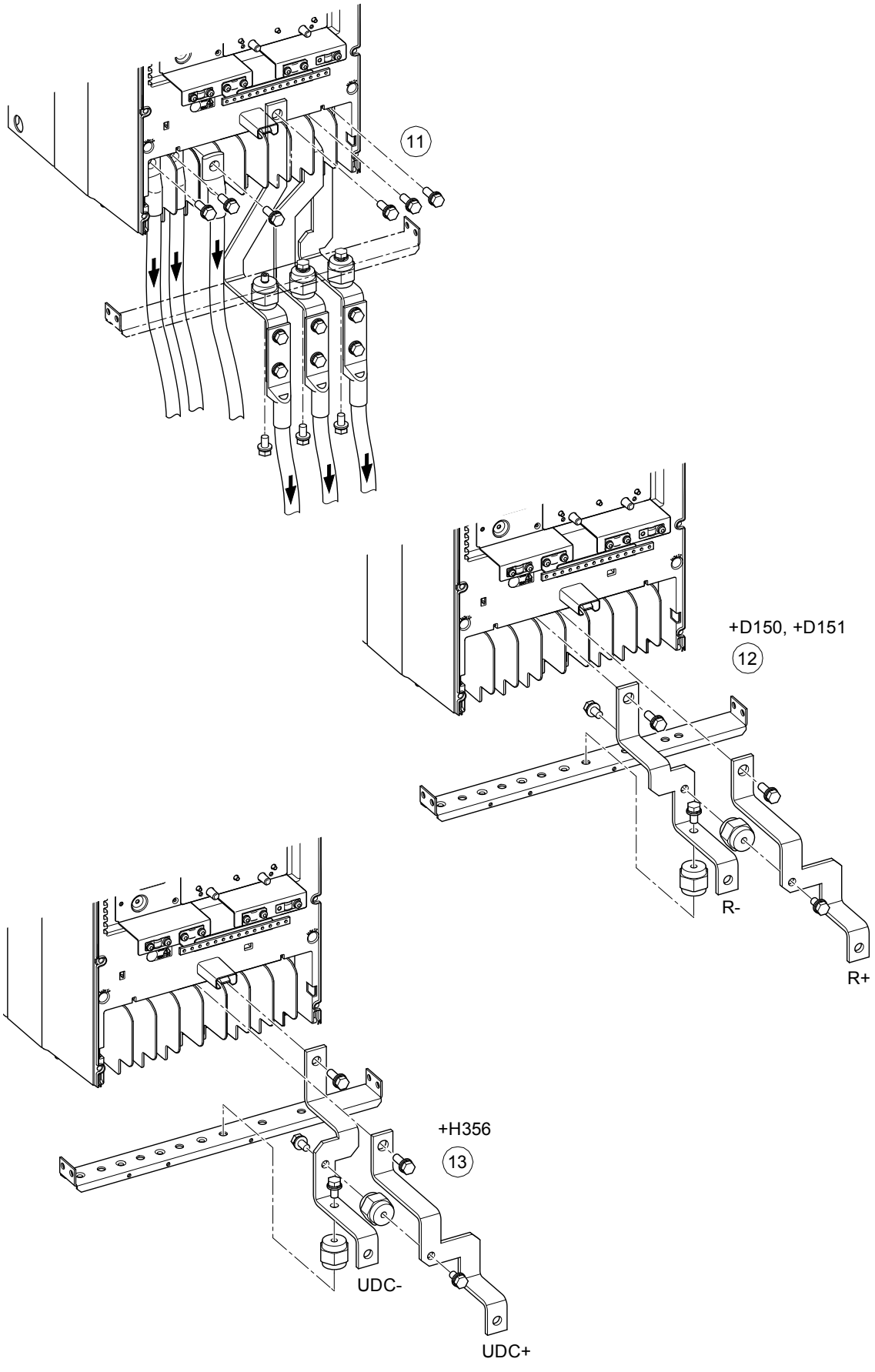
9. Unplug the control cable terminals from the control unit. Disconnect the control cables from the option modules on the control unit.
10. For drives with additional terminal block (option +L504): Disconnect the control cables from terminal block X504 and remove the terminal block by loosening the mounting screws and lifting it forwards.
11. Disconnect the input and motor cabling busbars from the drive module terminals.
12. Drives with option +D150 or +D151: Disconnect the resistor busbars from the drive module terminals.
13. Drives with option +H356: Disconnect the DC busbars from the drive module terminals.

14. Unplug the cabinet fan power supply cables and remove the fan assembly above the drive module.
15. Remove the slide extension rails from the left-hand side of the cabinet by undoing the mounting screws.
16. Install the extension rails at the end of the sliding bars.
17. Undo the upper mounting nuts of the drive module.
18. Undo the lower mounting nuts of the drive module.
19. Slide the drive module towards the end of the sliding bars.
20. Secure the drive module with chains from the lifting eyes.
21. Lift the module out of the cabinet with the lifting device.
22. Install the new module in reverse order.

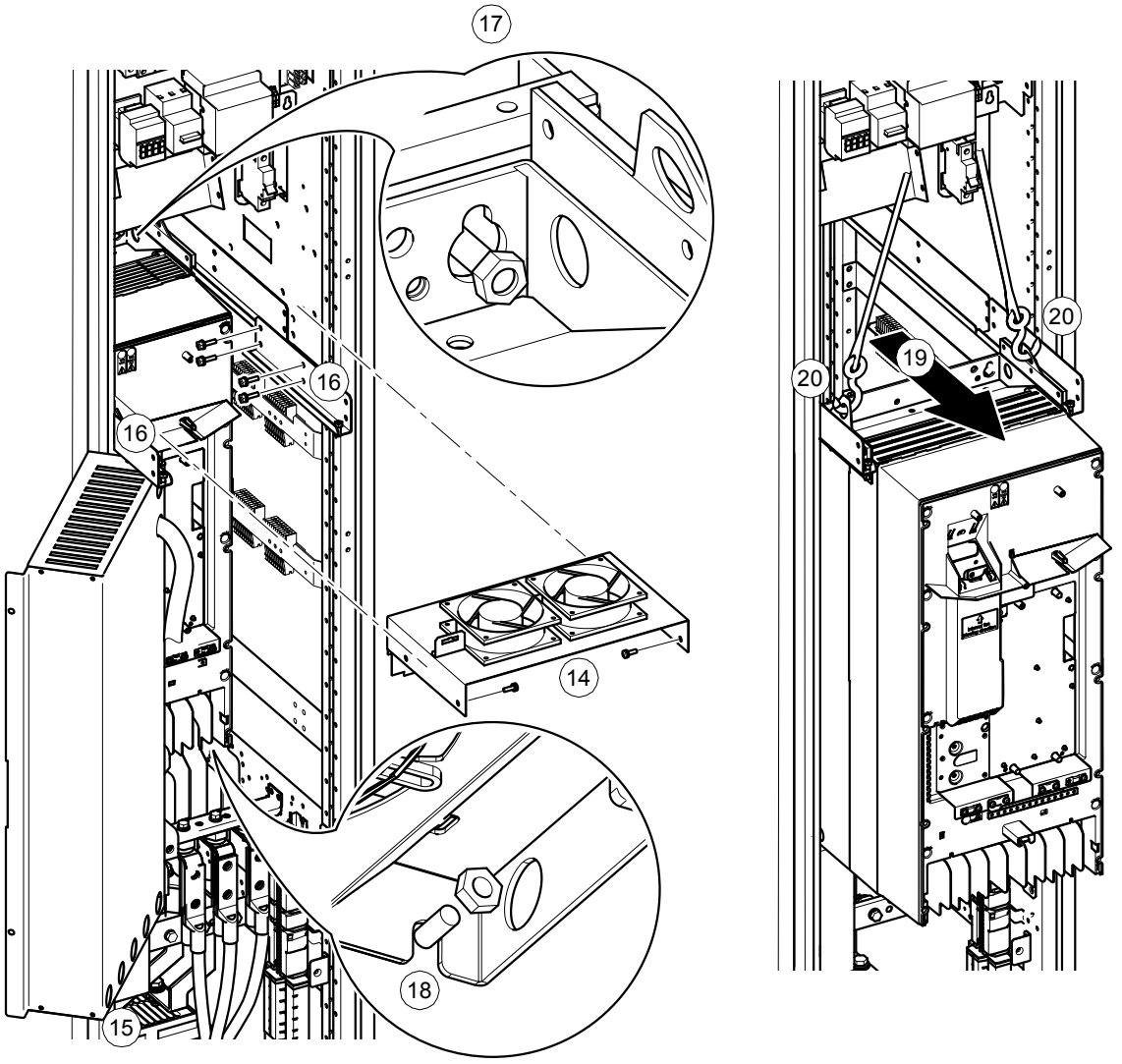
R6 to R8



R6 to R8



R6 to R8



Replacing the drive module (frame R9)

Required in the replacing procedure: preferably two persons, lifting chains, lifting device, a set of screw drivers and torque wrench with extension bar. A lifting device for ACS880-07 drive modules is available from ABB. For its installation and use, see *ACS880-07 lifting device user's manual* (3AUA0000131337 [English]).

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

WARNING! Make sure that the cabinet is secured to the floor. If not, the cabinet can topple over when the heavy drive module is slid forward in front of the cabinet. This can cause physical injury or death and damage to the equipment.

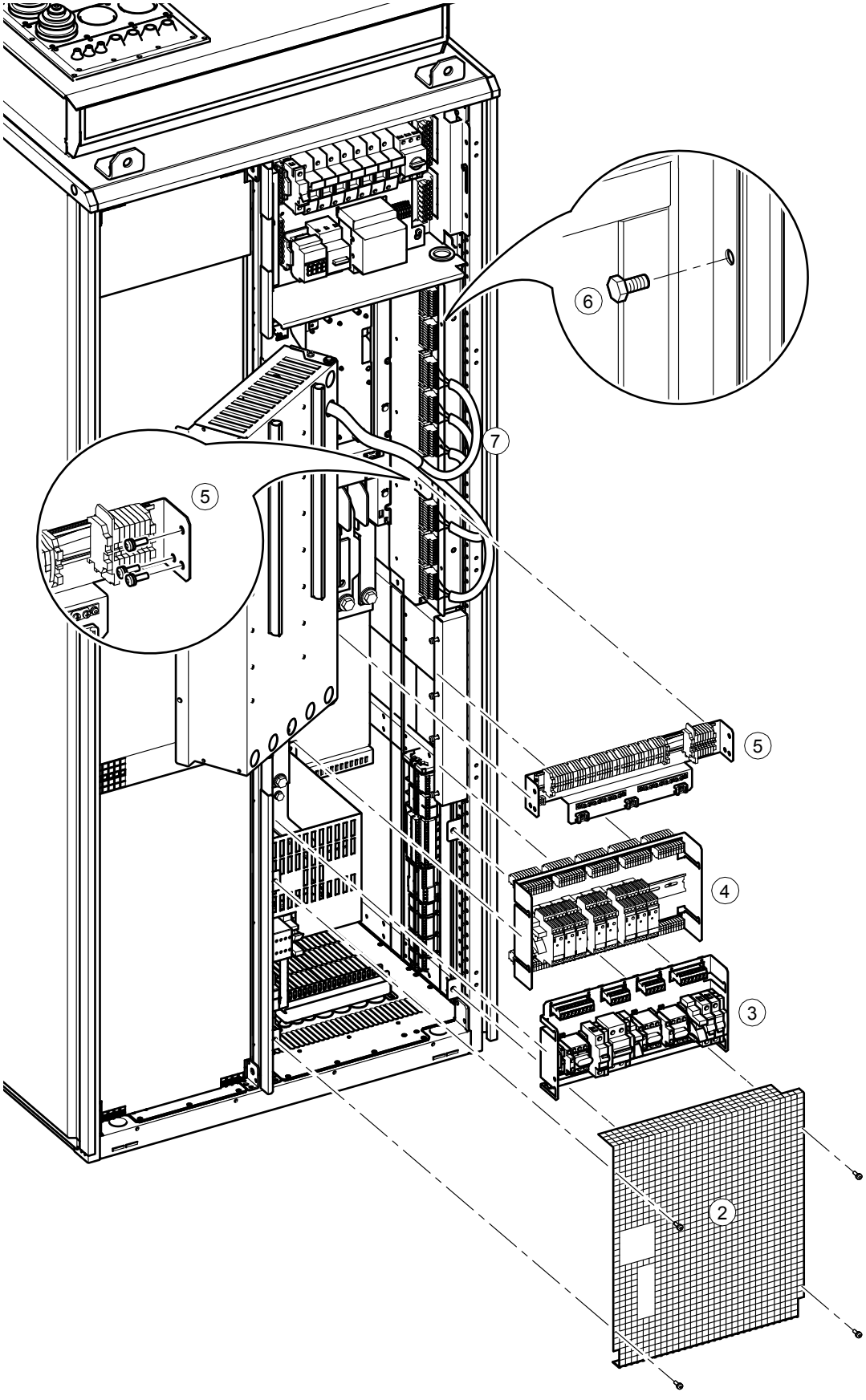
1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Remove the shroud.
3. See the warning below. Remove the mounting plate above the shroud by loosening the mounting screws and lifting the plate up.

WARNING! For drives with options +G300, +G301, +G307 and +G313: Before removing the mounting plate, disconnect the external power sources supplying the options. Unplug the control cable terminals at the back side of the mounting plate.

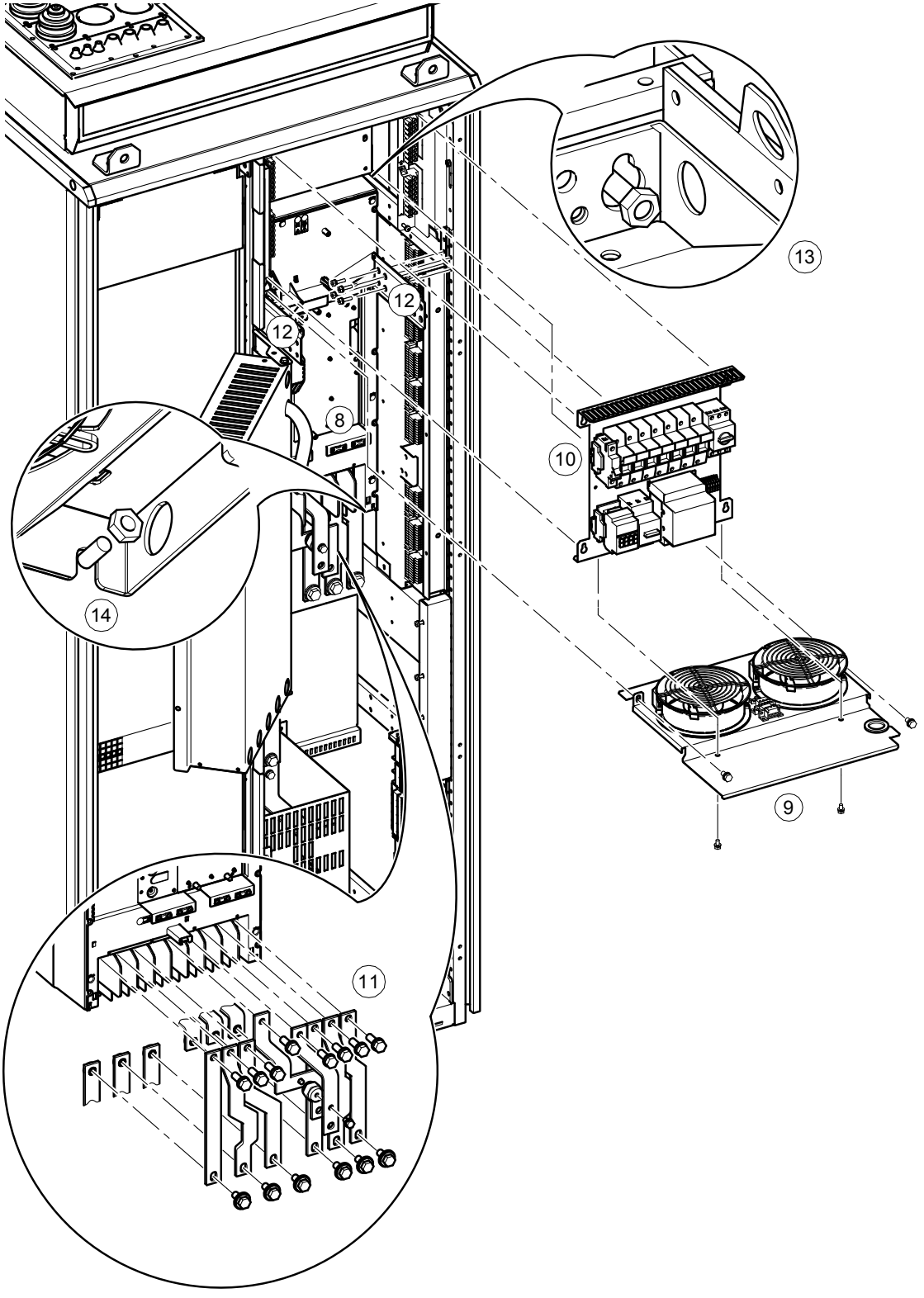
4. For drives with options +L505 and +L506: Remove the Pt100 and thermistor relay mounting plate by loosening the two mounting screws and lifting the mounting plate up.
5. For drives with additional terminal block (option +L504): Disconnect the control cables from terminal block X504. Loosen the mounting screws of the terminal block and remove it.
6. Loosen the screws on the right-hand side of the swing-out frame and open the swing-out frame.
7. Unplug the control wire terminals at the right-hand side of the cabinet.
8. Unplug the control cable terminals from the control unit. Disconnect the control cables from the option modules on the control unit.
9. Unplug the cabinet fan power supply cables and remove the fan assembly above the drive module.
10. Unplug the wire terminals and remove the mounting plate.
11. Disconnect the power cabling busbars from the drive module terminals.
12. Remove the slide extension rails (attached to the slide rails) by undoing the mounting screws. Install the extension rails at the end of the sliding rails.
13. Undo the upper mounting nuts of the drive module.

14. Undo the lower mounting nuts of the drive module.
15. Remove the two mounting screws of the top right mountig plate. Turn the plate to the horizontal position.
16. Slide the drive module towards the end of the sliding bars.
17. Secure the drive module with chains from the lifting eyes.
18. Lift the module out of the cabinet with the lifting device.
19. Install the new module in reverse order.

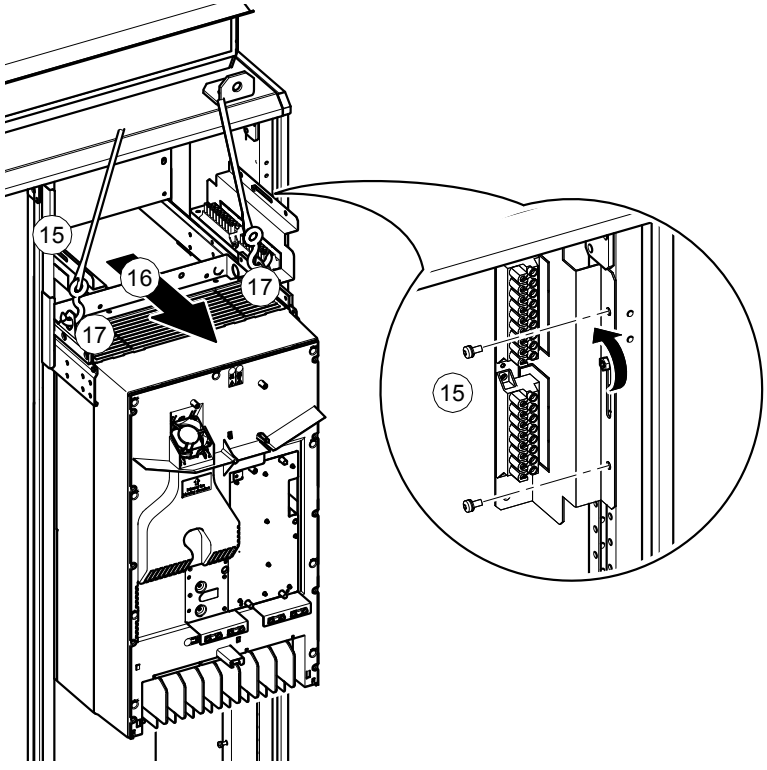
R9



R9



R9



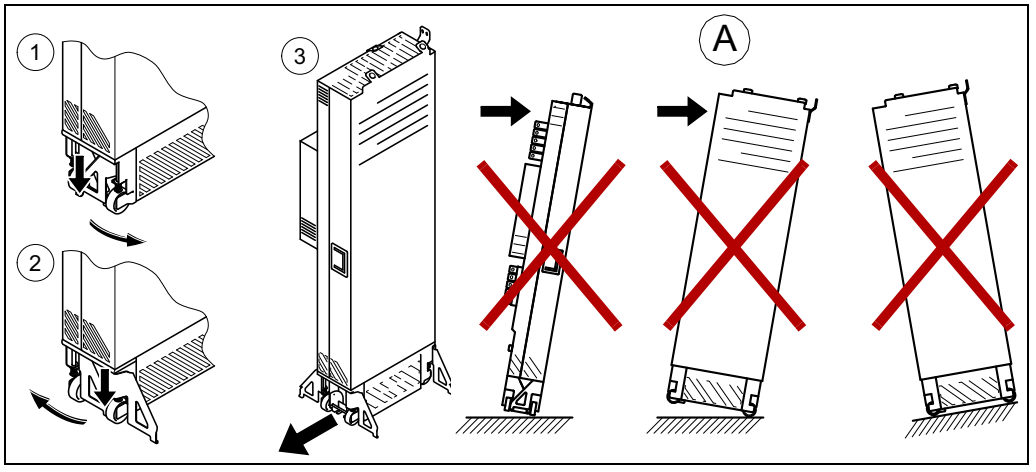
Replacing the drive module (frames R10 and R11)

This replacing procedure requires: preferably two persons, installation ramp, a set of screw drivers and a torque wrench with an extension bar.

The drawings show frame R11. The details in frame R10 are slightly different.

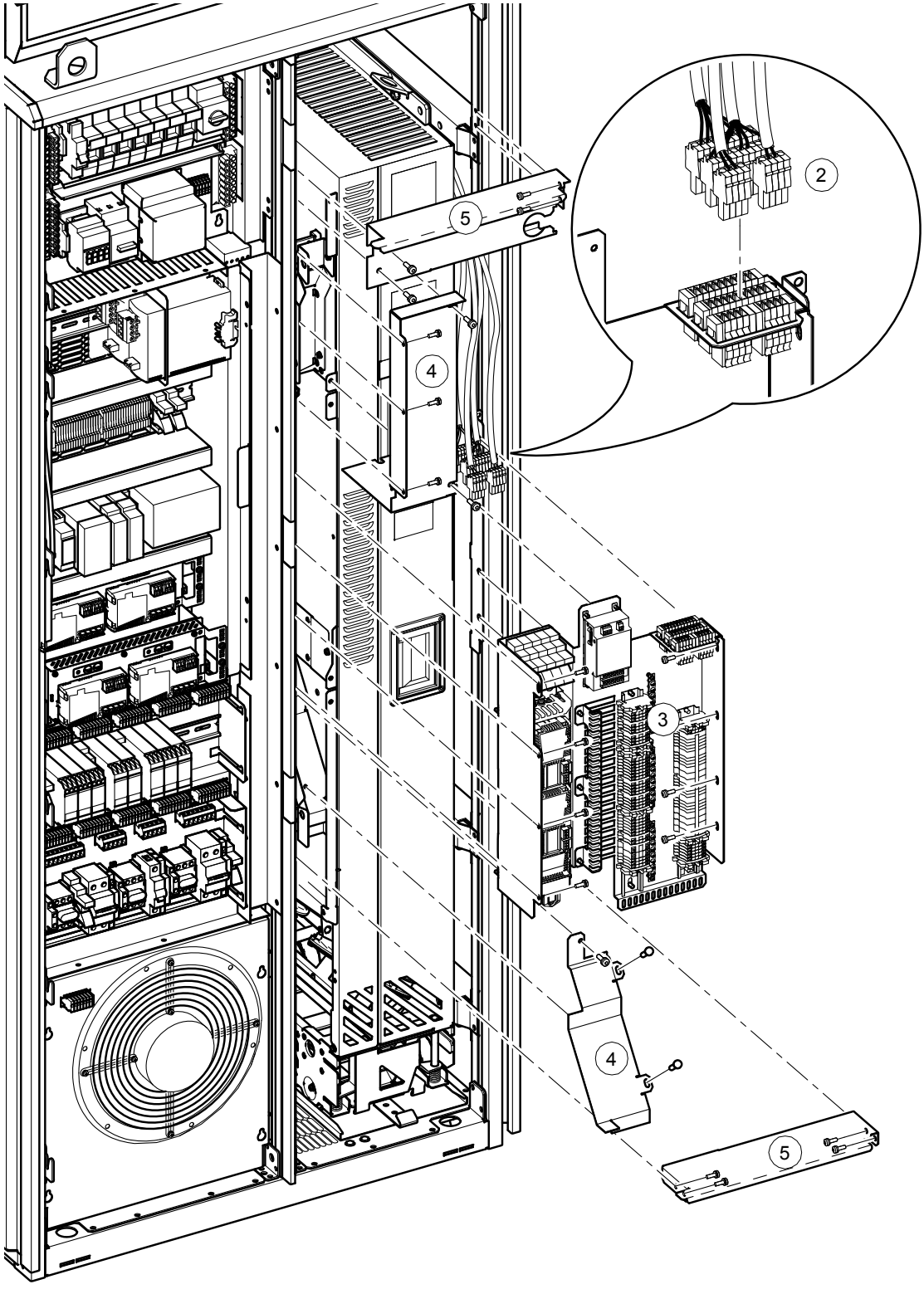
WARNING! Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

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

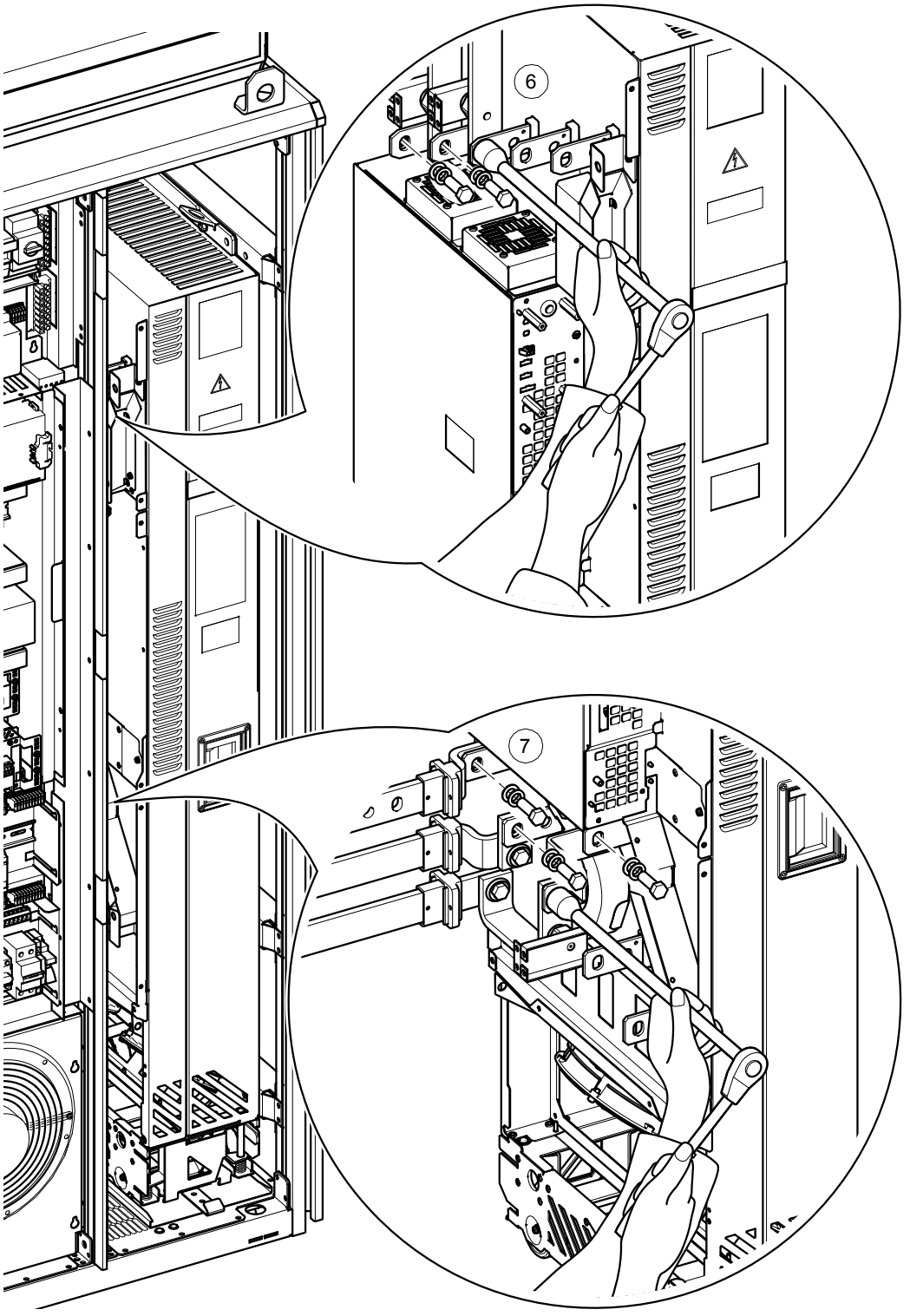


1. Stop the drive and do the steps in section *Precautions before electrical work* on page *18* before you start the work.
2. Unplug quick connector(s) at the right top corner of the control unit mounting plate.
3. Remove the control unit mounting plate.
4. Remove the shroud.
5. Remove the air baffle.
6. Disconnect the drive module input busbars. Combi screw M12, 70 N·m (52 lbf·ft).
7. Disconnect the drive module output busbars. Combi screw M12, 70 N·m (52 lbf·ft).
8. Undo the screws that fasten the drive module to the cabinet at the top and behind the front support legs.
9. Fasten the extraction ramp to the cabinet base with two screws.
10. Attach the drive module lifting lugs to the cabinet lifting lug with chains.
11. Pull the drive module carefully out of the cabinet preferably with help from another person.
12. Install the new module in reverse order.

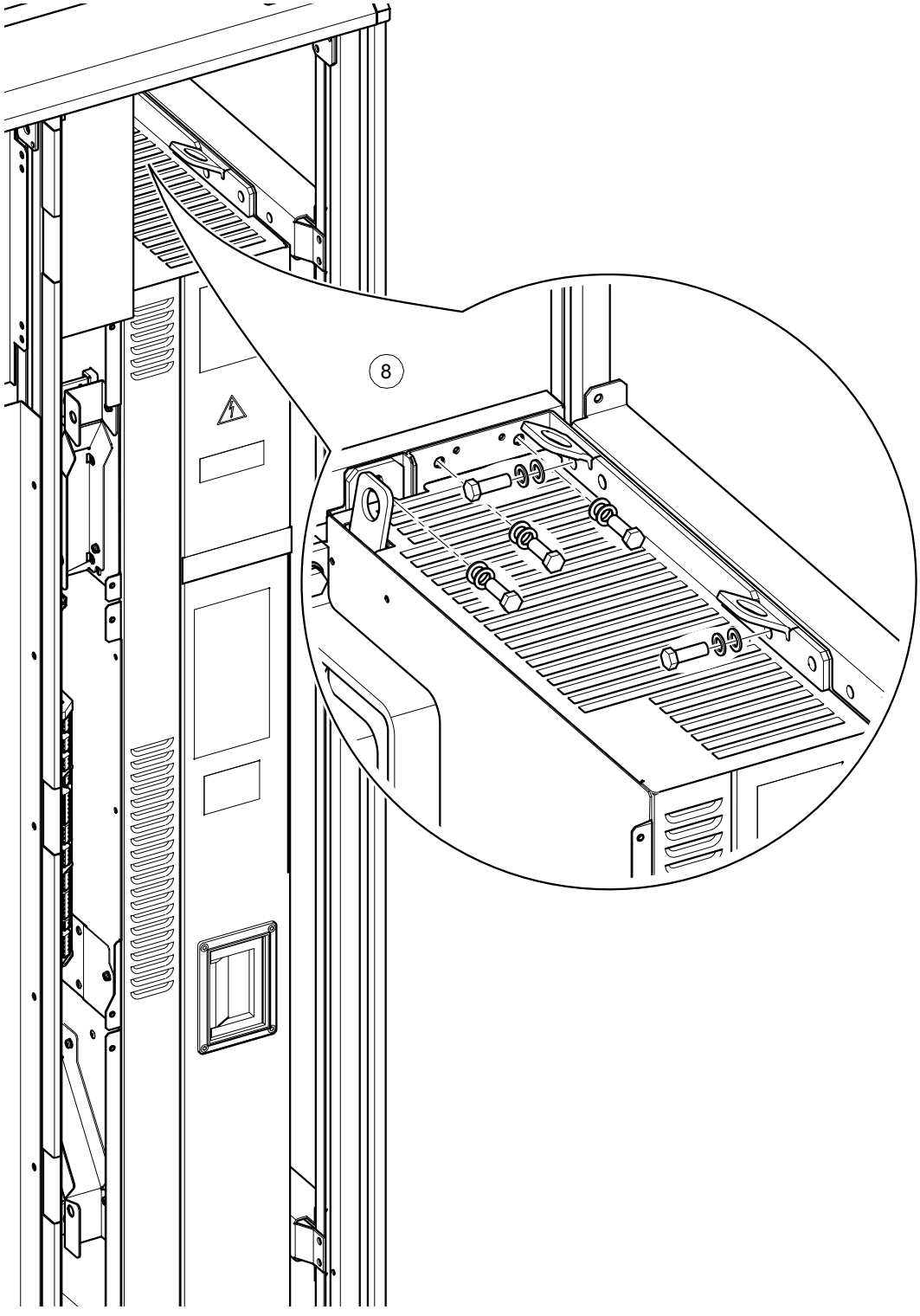
R10 and R11



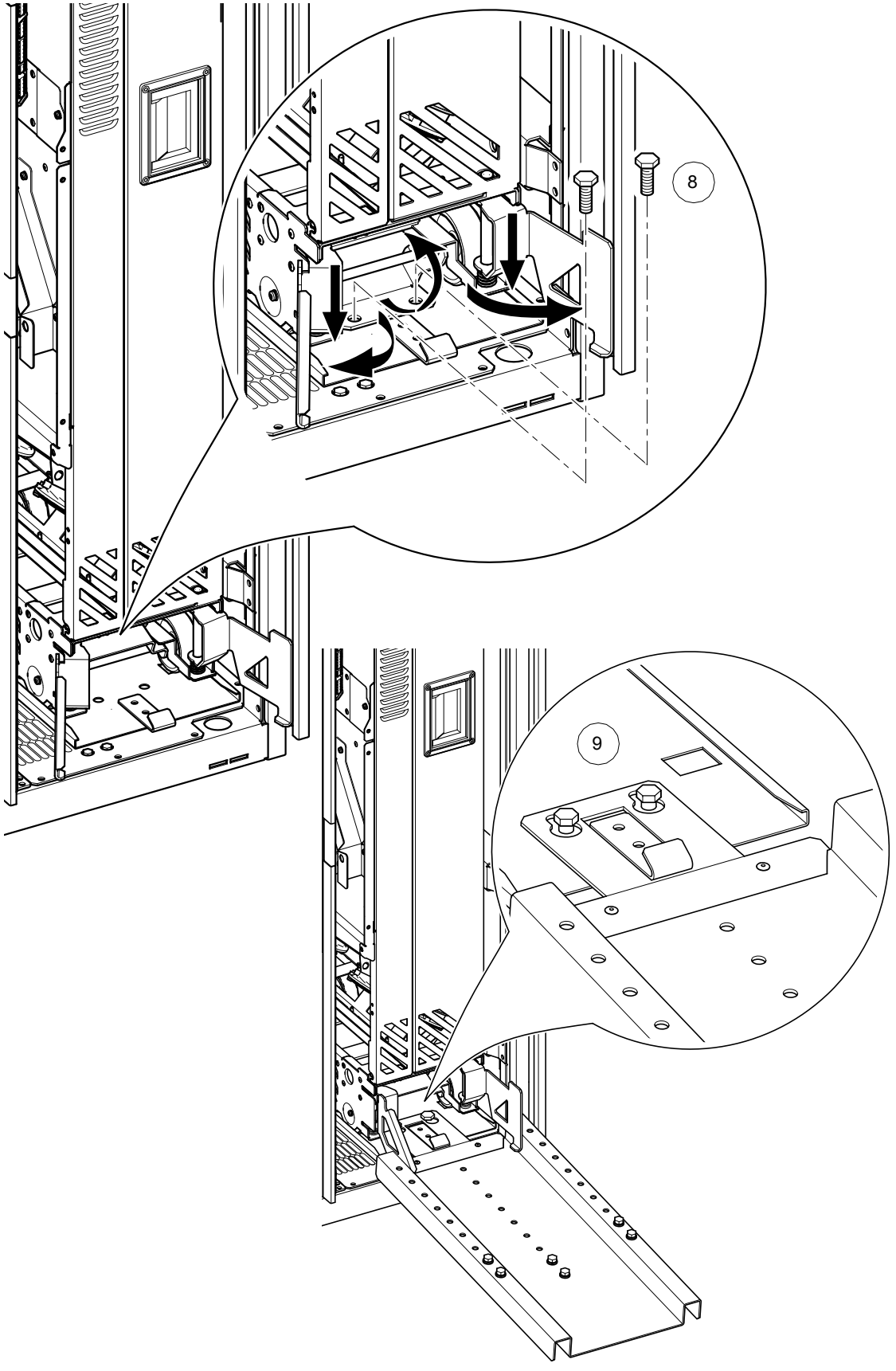
R10 and R11



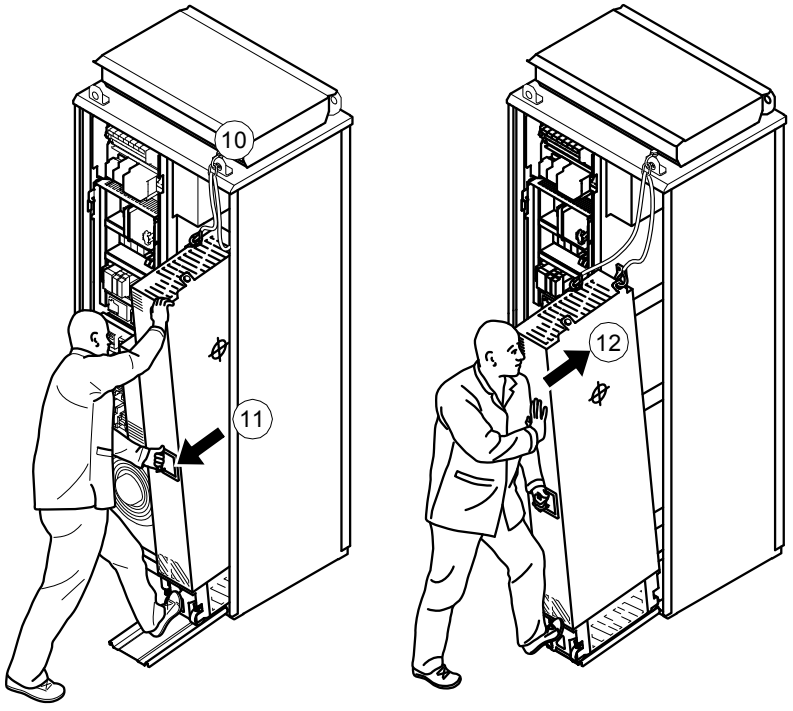
R10 and R11



R10 and R11



R10 and R11



Capacitors

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

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

Reforming the capacitors

The capacitors must re reformed if the drive has been stored for a year or more. The manufacturing date is on the type designation label. For information on reforming the capacitors, see *Converter module capacitor reforming instructions* (3BFE64059629 [English]).

Control panel

Replacing the control panel battery

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

Cleaning

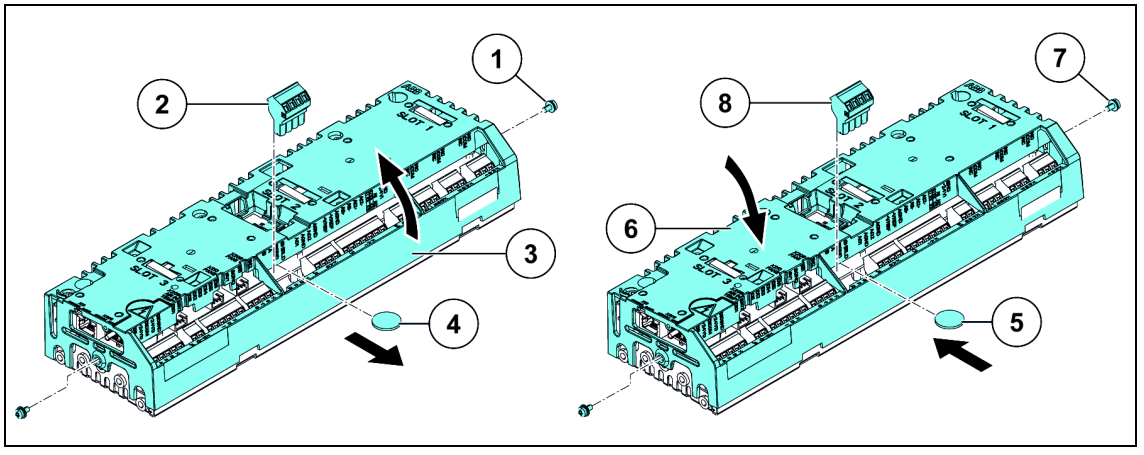
See *ACX-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).

Replacing the control unit battery

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

To replace the control unit battery:

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



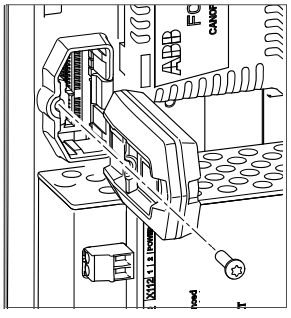
Memory unit

When a drive is replaced, the parameter settings can be retained by transferring the memory unit from the defective drive to the new drive. The memory unit is located on the control unit, see page *138* or *148*.

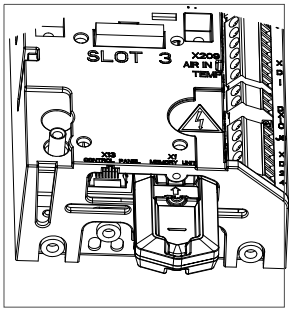
Transferring the memory unit

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 *Precautions before electrical work* on page *18* before you start the work.
2. Undo the memory unit mounting screw and take the memory unit out. Replace the unit in reverse order. **Note**: For frames R6 to R9, there is a spare screw next to the memory unit slot.



R6…R9



R10, R11

13

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.

Ratings

The nominal ratings for the drives with 50 Hz and 60 Hz supply are given below. The symbols are described below the table.

IEC RATINGS										
Drive type ACS880-07-	**Frame size**	**Input rating**	**Output ratings**							
			No-overload use				**Light-overload use**		**Heavy-duty use**	
		I_{1N}	I_{max}	I_N	P_N	S_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	**A**	**A**	**kW**	**kVA**	**A**	**kW**	**A**	**kW**
U_N = 400 V										
0105A-3	R6	105	148	105	55	73	100	55	87	45
0145A-3	R6	145	178	145	75	100	138	75	105	55
0169A-3	R7	169	247	169	90	117	161	90	145	75
0206A-3	R7	206	287	206	110	143	196	110	169	90
0246A-3	R8	246	350	246	132	170	234	132	206	110
0293A-3	R8	293	418	293	160	203	278	160	246*	132
0363A-3	R9	363	498	363	200	251	345	200	293	160
0430A-3	R9	430 [1)]	545	430 [1)]	250	298	400	200	363**	200
0505A-3	R10	505	560	505	250	350	485	250	361	200

IEC RATINGS										
Drive type ACS880-07-	**Frame size**	**Input rating**	**Output ratings**							
			No-overload use				**Light-overload use**		**Heavy-duty use**	
		I_{1N}	I_{max}	I_N	P_N	S_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	**A**	**A**	**kW**	**kVA**	**A**	**kW**	**A**	**kW**
0585A-3	R10	585	730	585	315	405	575	315	429	250
0650A-3	R10	650	730	650	355	450	634	355	477	250
0725A-3	R11	725	1020	725	400	502	715	400	566	315
0820A-3	R11	820	1020	820	450	568	810	450	625	355
0880A-3	R11	880	1100	880	500	610	865	500	725***	400
[1] At 25 °C (77 °F) ambient temperature the current is 451 A.										
U_N = 500 V										
0096A-5	R6	96	148	96	55	83	91	55	77	45
0124A-5	R6	124	178	124	75	107	118	75	96	55
0156A-5	R7	156	247	156	90	135	148	90	124	75
0180A-5	R7	180	287	180	110	156	171	110	156	90
0240A-5	R8	240	350	240	132	208	228	132	180	110
0260A-5	R8	260	418	260	160	225	247	160	240*	132
0361A-5	R9	361	542	361	200	313	343	200	302	200
0414A-5	R9	414	542	414	250	359	393	250	361**	200
0460A-5	R10	460	560	460	315	398	450	315	330	200
0503A-5	R10	503	560	503	355	436	483	315	361	250
0583A-5	R10	583	730	583	400	505	573	400	414	250
0635A-5	R10	635	730	635	450	550	623	450	477	315
0715A-5	R11	715	850	715	500	619	705	500	566	400
0820A-5	R11	820	1020	820	560	710	807	560	625	450
0880A-5	R11	880	1100	880	630	762	857	560	697*****	500
U_N = 690 V										
0061A-7	R6	61	104	61	55	73	58	55	49	45
0084A-7	R6	84	124	84	75	100	80	75	61	55
0098A-7	R7	98	168	98	90	117	93	90	84	75
0119A-7	R7	119	198	119	110	142	113	110	98	90
0142A-7	R8	142	250	142	132	170	135	132	119	110
0174A-7	R8	174	274	174	160	208	165	160	142	132
0210A-7	R9	210	384	210	200	251	200	200	174	160
0271A-7	R9	271	411	271	250	324	257	250	210	200
0330A-7	R10	330	480	330	315	394	320	315	255	250
0370A-7	R10	370	520	370	355	442	360	355	325	315
0430A-7	R10	430	520	430	400	514	420	400	360****	355
0470A-7	R11	470	655	470	450	562	455	450	415	400
0522A-7	R11	522	655	522	500	624	505	500	455	450
0590A-7	R11	590	800	590	560	705	571	560	505	500
0650A-7	R11	650	820	650	630	777	630	630	571****	560
0721A-7	R11	721	820	721	710	862	705	630	571****	560

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NEMA RATINGS										
Drive type ACS880-07-	**Frame size**	**Input rating**	**Max. current**	**App. power**	**Output ratings**					
					Light-overload use			**Heavy-duty use**		
		I_{1N}	I_{max}	S_N	I_{Ld}	P_{Ld}		I_{Hd}	P_{Hd}	
		A	**A**	**kVA**	**A**	**kW**	**hp**	**A**	**kW**	**hp**
U_N = 460 V										
0096A-5	R6	96	148	83	96	55	75	77	45	60
0124A-5	R6	124	178	107	124	75	100	96	55	75
0156A-5	R7	156	247	135	156	90	125	124	75	100
0180A-5	R7	180	287	156	180	110	150	156	90	125
0240A-5	R8	240	350	208	240	132	200	180	110	150
0302A-5	R9	302	498	262	302	200	250	260	132	200
0361A-5	R9	361	542	313	361	200	300	302	200	250
0414A-5	R9	414	542	359	414	250	350	361**	200	300
0503A-5	R10	503	560	436	483	315	400	361	250	300
0583A-5	R10	583	730	505	573	400	450	414	250	350
0635A-5	R10	635	730	550	623	450	500	477	315	400
0715A-5	R11	715	850	619	705	500	600	566	400	450
0820A-5	R11	820	1020	710	807	560	700	625	450	500
0880A-5	R11	880	1100	762	857	560	700	697***	500	600
U_N = 600 V										
0061A-7	R6	61	104	73	62	45	60	52	37	50
0084A-7	R6	84	124	100	77	55	75	62	45	60
0098A-7	R7	98	168	117	99	75	100	77	55	75
0119A-7	R7	119	198	142	125	90	125	99	75	100
0142A-7	R8	142	250	170	144	110	150	125	90	125
0174A-7 (See note 3 below)	R8	174	274	208	180	132	200	144	110	150
0210A-7	R9	210	384	251	242	160	250	192	132	200
0271A-7 (See note 4 below)	R9	271	411	324	271	200	250	242*	160	250
0330A-7	R10	330	480	394	336	315	350	255	250	250
0370A-7	R10	370	520	442	382	355	400	325	315	300
0430A-7	R10	430	520	514	424	400	450	360****	355	350
0470A-7	R11	470	655	562	472	450	500	415	400	450
0522A-7	R11	522	655	624	528	500	550	455	450	450
0590A-7	R11	590	800	705	571	560	600	505	500	500
0650A-7	R11	650	820	777	630	630	700	571****	560	600
0721A-7	R11	721	820	862	705	630	700	571****	560	600

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Definitions

U_N	Nominal voltage of the drive. For the input voltage range, see section *Electrical power network specification* on page *218*.
I_{1N}	Nominal rms input current
I_N	Nominal output current (available continuously with no over-loading)
S_N	Apparent power in no-ovarload use
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 in light-overload use
I_{max}	Maximum output current. Available for 10 seconds at start, then as long as allowed by drive temperature.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes. * Continuous rms output current allowing 30% overload for 1 minute every 5 minutes. ** Continuous rms output current allowing 25% overload for 1 minute every 5 minutes. *** Continuous rms output current allowing 40% overload for 1 minute every 5 minutes. **** Continuous rms output current allowing 44% overload for 1 minute every 5 minutes. ***** Continuous rms output current allowing 45% overload for 1 minute every 5 minutes.
P_{Hd}	Typical motor power in heavy-duty use

Note 1: The ratings apply at an ambient temperature of 40 °C (104 °F).

Note 2: 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.

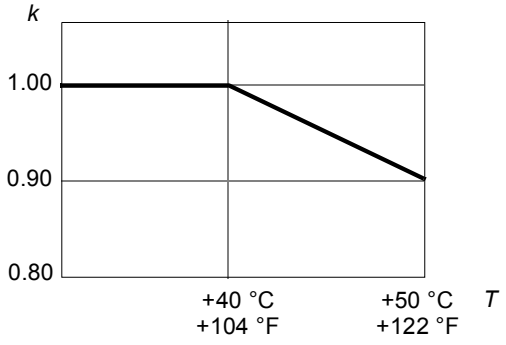
Note 3 – **ACS880-07-0174A-7 amp rating:** The drive can deliver 192 A continuously with no overload.

Note 4 – ACS880-07-0271A-7 power rating: The power rating is as per NEC Table 42.1. However, the drive can be used for a typical 4-pole motor rated to 300 hp meeting NEMA MG 1 Table 12-11 minimum efficiency standard (EPAct efficiency electrical motors) if motor full load current is not more than 271 A.

Derating

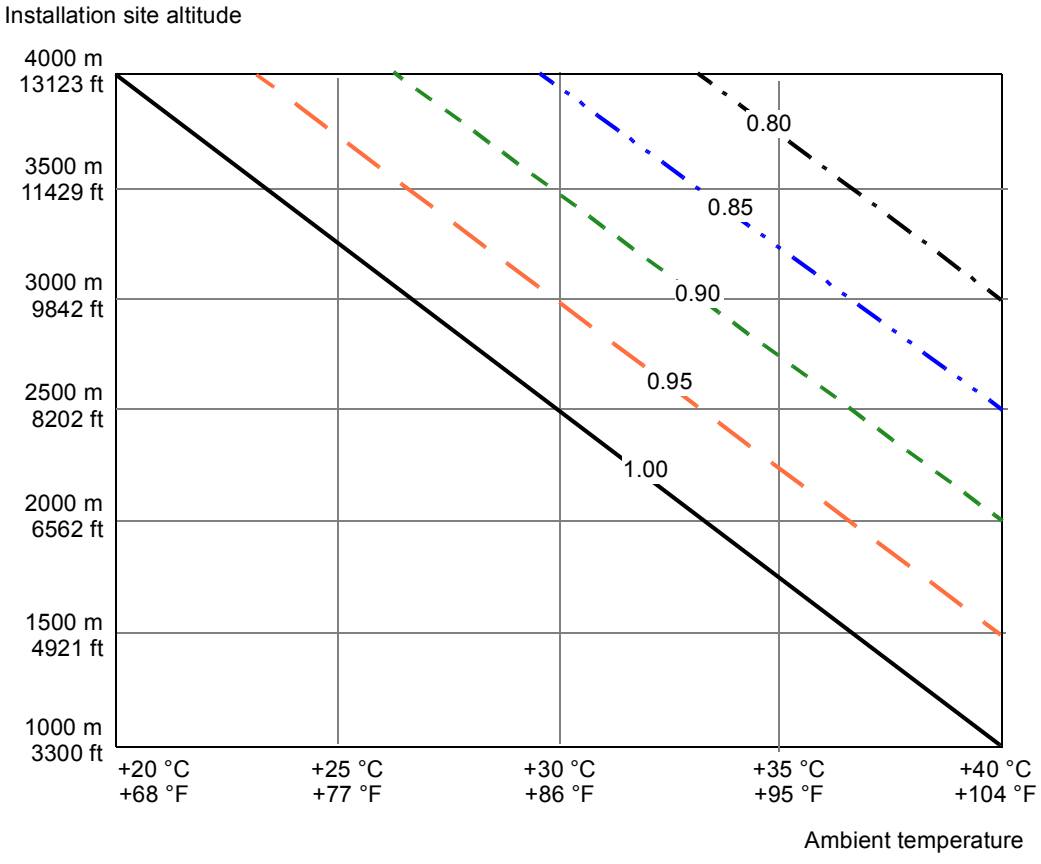
Ambient temperature derating

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). The output current can be calculated by multiplying the current given in the rating table by the derating factor (k):



Altitude derating

At altitudes from 1000 to 4000 m (3300 to 13123 ft) above sea level, the output current derating is 1% for every 100 m (328 ft). If ambient temperature is below +40 °C (+104 °F), the derating can be reduced by 1.5% for every 1 °C (1.8 °F) reduction in temperature. For a more accurate derating, use the DriveSize PC tool. A few altitude derating curves are shown below.



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

Switching frequency derating

Switching frequencies other than default can require output current derating. Contact ABB for more information.

Deratings for special settings in the drive control program

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

Ex motor, sine filter, low noise

The table below gives the deratings for these cases:

- drive is used with an ABB motor for explosive atmospheres (Ex) and **EX motor** in Parameter **95.15 Special HW settings** is enabled
- sine filter 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.

Drive type ACS880-07-	Output ratings for special settings											
	Ex motor (ABB Ex motor)				ABB sine filter				Low noise mode			
	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use
	I_N	P_N	I_{Ld}	I_{Hd}	I_N	P_N	I_{Ld}	I_{Hd}	I_N	P_N	I_{Ld}	I_{Hd}
	A	kW	A	A	A	kW	A	A	A	kW	A	A
U_N = 400 V												
0105A-3	97	45	92	87	91	45	86	77	86	37	82	67
0145A-3	134	55	127	97	126	55	120	91	118	55	112	86
0169A-3	160	75	152	134	152	75	144	126	146	75	139	118
0206A-3	195	90	185	160	186	90	177	152	178	90	169	146
0246A-3	225	110	214	195	209	110	199	186	194	90	184	178
0293A-3	269	132	256	225*	249	132	237	209*	236	132	224	194*
0363A-3	325	160	309	269	296	160	281	249	274	132	260	236
0430A-3	385	200	366	325**	352	160	334	296**	325	160	309	274**
0505A-3	479	250	459	345	470	250	450	340	390	200	370	290
0585A-3	551	250	533	395	540	250	518	383	437	250	419	311
0650A-3	613	315	591	438	600	315	576	425	485	250	466	346
0725A-3	667	355	650	493	647	355	628	468	519	250	496	390
0820A-3	753	400	737	544	731	400	712	517	587	315	562	431
0880A-3	809	450	786	631	785	450	760	600	630	355	600	500***
U_N= 500 V												
0096A-5	88	45	84	77	82	45	78	61	72	37	68	46
0124A-5	115	55	109	88	104	55	99	82	93	55	88	72
0156A-5	147	75	140	115	140	75	133	104	133	75	126	93
0180A-5	170	90	162	147	161	90	153	140	153	90	145	133
0240A-5	220	110	209	170	204	110	194	161	191	110	181	153
0260A-5	238	132	226	220*	221	110	210	204*	206	110	196	191*
0302A-5	270	160	257	238	242	132	230	221	206	110	196	191
0361A-5	322	200	306	270	289	160	275	242	258	160	245	206
0414A-5	370	200	352	322**	332	200	315	289**	296	160	281	258**
0460A-5	437	250	427	316	430	250	419	311	357	250	345	265
0503A-5	478	315	458	345	470	315	450	340	390	250	370	290
0583A-5	531	355	509	364	514	355	487	347	400	250	380	298

Drive type ACS880-07-	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
0635A-5	579	400	553	419	560	400	530	400	410	250	392	298
0715A-5	657	450	641	522	637	450	620	507	462	315	428	362
0820A-5	753	500	734	576	730	500	710	560	530	355	490	400
0880A-5	768	500	747	594	730	500	710	560	550	400	510	410
U_N= 690 V												
0061A-7	61	55	58	49	49	45	47	46	49	45	47	46
0084A-7	84	75	80	61	68	55	65	49	68	55	65	49
0098A-7	98	90	93	84	83	75	79	68	83	75	79	68
0119A-7	119	110	113	98	101	90	96	83	101	90	96	83
0142A-7	126	110	120	119	112	90	106	90	101	90	96	84
0174A-7	154	132	146	126	137	110	130	112	122	110	116	101
0210A-7	184	160	175	154	161	132	153	137	138	132	131	122
0271A-7	238	200	226	184	207	160	197	161	178	160	169	138
0330A-7	310	250	300	217	303	250	293	204	232	200	222	157
0370A-7	348	315	338	276	340	315	330	260	260	250	250	200
0430A-7	378	355	368	315	360	355	350	300*	290	250	280	236*
0470A-7	388	355	376	335	360	355	349	308	270	250	261	238
0522A-7	431	400	417	370	400	355	388	342	300	250	290	262
0590A-7	485	450	470	449	450	400	436	385	340	315	330	300
0650A-7	575	500	555	480	550	500	530	450*	450	400	430	350****
0721A-7	593	500	574	480	550	500	530	450*	450	400	430	350****

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U_N	Nominal voltage of the drive
I_N	Continuous rms output current. No overload capability at 40 °C (104 °F)
P_N	Typical motor power in no-overload use.
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes * Continuous rms output current allowing 30% overload for 1 minute every 5 minutes. ** Continuous rms output current allowing 25% overload for 1 minute every 5 minutes. *** Continuous rms output current allowing 40% overload for 1 minute every 5 minutes. **** Continuous rms output current allowing 44% overload for 1 minute every 5 minutes.
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. We recommend 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 the 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 ACS880-07-	Deratings with selection High speed mode of parameter 95.15 Special HW settings									
	120 Hz output frequency					Maximum output frequency				
		Nominal use		Light-duty use	Heavy-duty use		Nominal use		Light-duty use	Heavy-duty use
	f	I_N	P_N	I_{Ld}	I_{Hd}	f_{max}	I_N	P_N	I_{Ld}	I_{Hd}
	Hz	A	kW	A	A	Hz	A	kW	A	A
U_N = 400 V										
0105A-3	120	105	55	100	87	500	77	37	73	67
0145A-3	120	145	75	138	105	500	106	55	101	77
0169A-3	120	169	90	161	145	500	135	55	128	106
0206A-3	120	206	110	196	169	500	165	75	157	135
0246A-3	120	246	132	234	206	500	170	90	162	143
0293A-3	120	293	160	278	246*	500	202	110	192	170*
0363A-3	120	363	200	345	293	500	236	132	224	202
0430A-3	120	430	250	400	363**	500	280	160	266	236**
0505A-3	120	505	250	485	361	500	390	200	370	290
0585A-3	120	585	315	575	429	500	437	250	419	311
0650A-3	120	650	355	634	477	500	485	250	466	346
0725A-3	120	725	400	715	566	500	519	250	496	390
0820A-3	120	820	450	810	625	500	587	315	562	431
0880A-3	120	880	500	865	725***	500	630	355	600	500***
U_N= 500 V										
0096A-5	120	96	45	91	77	500	58	30	55	46
0124A-5	120	124	55	118	96	500	74	45	70	58
0156A-5	120	156	75	148	124	500	122	75	116	74
0180A-5	120	180	90	171	156	500	140	75	133	122
0240A-5	120	240	110	228	180	500	168	90	160	140
0260A-5	120	260	132	247	240*	500	182	110	173	168*
0302A-5	120	302	160	287	260	500	182	110	173	168
0361A-5	120	361	200	343	302	500	206	110	196	182
0414A-5	120	414	200	393	361**	500	236	132	224	206**
0460A-5	120	460	315	450	330	500	357	250	345	265
0503A-5	120	503	355	483	361	500	390	250	370	290
0583A-5	120	583	400	573	414	500	400	250	380	298
0635A-5	120	635	450	623	477	500	410	250	392	298

Drive type ACS880-07-	Deratings with selection High speed mode of parameter 95.15 Special HW settings									
	120 Hz output frequency					Maximum output frequency				
		Nominal use		Light-duty use	Heavy-duty use		Nominal use		Light-duty use	Heavy-duty use
	f	I_N	P_N	I_{Ld}	I_{Hd}	f_{max}	I_N	P_N	I_{Ld}	I_{Hd}
	Hz	A	kW	A	A	Hz	A	kW	A	A
0715A-5	120	715	500	705	566	500	462	315	428	362
0820A-5	120	820	560	807	625	500	530	355	490	400
0880A-5	120	880	630	857	697*****	500	550	400	510	410
U_N= 690 V										
0061A-7	120	61	55	58	49	500	44	37	42	40
0084A-7	120	84	75	80	61	500	53	45	50	44
0098A-7	120	98	90	93	84	500	68	55	65	53
0119A-7	120	119	110	113	98	500	83	75	79	68
0142A-7	120	142	132	135	119	500	83	75	79	72
0174A-7	120	174	160	165	142	500	96	90	91	83
0210A-7	120	210	200	200	174	500	101	90	96	83
0271A-7	120	271	200	257	210	500	130	110	124	101
0330A-7	120	330	315	320	255	375	232	200	222	157
0370A-7	120	370	355	360	325	375	260	250	250	200
0430A-7	120	430	400	420	360****	375	290	250	280	236****
0470A-7	120	470	450	455	415	375	270	250	261	238
0522A-7	120	522	500	505	455	375	300	250	290	262
0590A-7	120	590	560	571	505	375	340	315	330	300
0650A-7	120	650	630	630	571****	375	450	400	430	350****
0721A-7	120	721	710	705	571****	375	450	400	430	350****

3AXD00000588487

f	Output frequency
f_{max}	Maximum output frequency with High speed mode
U_N	Nominal voltage of the drive
I_N	Continuous rms output current. No overload capability at 40 °C (104 °F)
P_N	Typical motor power in no-overload use.
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-overload use.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes * Continuous rms output current allowing 30% overload for 1 minute every 5 minutes ** Continuous rms output current allowing 25% overload for 1 minute every 5 minutes *** Continuous rms output current allowing 40% overload for 1 minute every 5 minutes **** Continuous rms output current allowing 44% overload for 1 minute every 5 minutes ***** Continuous rms output current allowing 45% 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.

Drive type ACS880-07-	Input current (A)	Ultrarapid (aR) fuses (one fuse per phase)							
		A	A^2s	V	Bussmann type	Mersen type	Type with option +F289		Size
							Bussmann type	Mersen type	
U_N = 400 V									
0105A-3	105	160	8250	690	170M3814D		170M3414		1
0145A-3	145	250	31000	690	170M3816D		170M3416		1
0169A-3	169	250	31000	690	170M3816D		170M3416		1
0206A-3	206	315	52000	690	170M3817D		170M4410		1
0246A-3	246	400	79000	690	170M5808D		170M5408		2
0293A-3	293	500	155000	690	170M5810D		170M5410		2
0363A-3	363	630	210000	690	170M6410		170M6410		3
0430A-3	430	700	300000	690	170M6411		170M6411		3
0505A-3	505	800	465000	690	170M6412		170M6412		3
0585A-3	585	900	670000	690	170M6413		170M6413		3
0650A-3	650	1000	945000	690	170M6414	SC33AR69V10CTF	170M6414	SC33AR69V10CTF	3
0725A-3	725	1250	1950000	690	170M6416	SC33AR69V13CTF	170M6416	SC33AR69V13CTF	3
0820A-3	820	1250	1950000	690	170M6416	SC33AR69V13CTF	170M6416	SC33AR69V13CTF	3
0880A-3	880	1400	2450000	690	170M6417	SC33AR69V14CTF	170M6417	SC33AR69V14CTF	3
U_N = 500 V									
0096A-5	96	160	8250	690	170M3814D		170M3414		1
0124A-5	124	250	31000	690	170M3816D		170M3416		1
0156A-5	156	250	31000	690	170M3816D		170M3416		1
0180A-5	180	315	52000	690	170M3817D		170M4410		1
0240A-5	240	400	79000	690	170M5808D		170M5408		2
0260A-5	260	500	155000	690	170M5810D		170M5410		2
0361A-5	361	630	210000	690	170M6410		170M6410		3
0414A-5	414	700	300000	690	170M6411		170M6411		3
0460A-5	460	700	300000	690	170M6411		170M6411		3
0503A-5	503	800	465000	690	170M6412		170M6412		3
0583A-5	583	900	670000	690	170M6413		170M6413		3
0635A-5	635	1000	945000	690	170M6414	SC33AR69V10CTF	170M6414	SC33AR69V10CTF	3
0715A-5	715	1250	1950000	690	170M6416	SC33AR69V13CTF	170M6416	SC33AR69V13CTF	3
0820A-5	820	1250	1950000	690	170M6416	SC33AR69V13CTF	170M6416	SC33AR69V13CTF	3
0880A-5	880	1400	2450000	690	170M6417	SC33AR69V14CTF	170M6417	SC33AR69V14CTF	3
U_N = 690 V									
0061A-7	61	100	2600	690	170M3812D		170M3412		
0084A-7	84	160	8250	690	170M3814D		170M3414		1
0098A-7	98	160	8250	690	170M3814D		170M3414		1
0119A-7	119	250	31000	690	170M3816D		170M3416		1
0142A-7	142	250	31000	690	170M3816D		170M3416		1
0174A-7	174	315	52000	690	170M3817D		170M4410		1
0210A-7	210	315	42000	690	170M4410		170M4410		2
0271A-7	271	500	145000	690	170M5410		170M5410		2
0330A-7	330	630	210000	690	170M6410		170M6410		3
0370A-7	370	630	210000	690	170M6410		170M6410		3
0430A-7	430	700	300000	690	170M6411		170M6411		3

Drive type ACS880-07-	Input current (A)	Ultrarapid (aR) fuses (one fuse per phase)							
		A	A^2s	V	Bussmann type	Mersen type	Type with option +F289		Size
							Bussmann type	Mersen type	
0470A-7	470	800	465000	690	170M6412		170M6412		3
0522A-7	522	800	465000	690	170M6412		170M6412		3
0590A-7	590	900	670000	690	170M6413		170M6413		3
0650A-7	650	1000	945000	690	170M6414	SC33AR69V10CTF	170M6414	SC33AR69V10CTF	3
0721A-7	721	1250	1950000	690	170M6416	SC33AR69V13CTF	170M6416	SC33AR69V13CTF	3

Note 1: See also *Implementing thermal overload and short-circuit protection* on page *90*.

Note 2: Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.

Note 3: 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 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. **Check that the operating time of the fuse is below 0.5 seconds for frame size R6 and is below 0.1 seconds for frames R7 to R11.** 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 ACS880-07-	Input current (A)	Fuse (one fuse per phase)							
		A	V	Bussmann type	Mersen type	With option +F289			UL class / Size
						A	Bussmann type	Mersen type	
U_N = 460 V									
0096A-5	96	250	600	DFJ-250		160	170M3414		J/1
0124A-5	124	250	600	DFJ-250		250	170M3416		J/1
0156A-5	156	300	600	DFJ-300		250	170M3416		J/1
0180A-5	180	300	600	DFJ-300		315	170M4410		J/1
0240A-5	240	400	600	DFJ-400		400	170M5408		J/2
0260A-5	260	400	600	DFJ-400		500	170M5410		J/2
0302A-5	375	630	690	170M6410		630	170M6410		3
0361A-5	361	630	600	170M6410		630	170M6410		3
0414A-5	414	700	600	170M6411		700	170M6411		3
0460A-5	460	700	690	170M6411		700	170M6411		3
0503A-5	503	800	690	170M6412		800	170M6412		3
0583A-5	583	900	690	170M6413		900	170M6413		3
0635A-5	635	1000	690	170M6414	SC33AR69V10CTF	1000	170M6414	SC33AR69V10CTF	3
0715A-5	715	1250	690	170M6416	SC33AR69V13CTF	1250	170M6416	SC33AR69V13CTF	3
0820A-5	820	1250	690	170M6416	SC33AR69V13CTF	1250	170M6416	SC33AR69V13CTF	3
0880A-5	880	1400	690	170M6417	SC33AR69V14CTF	1400	170M6417	SC33AR69V14CTF	3

Drive type ACS880-07-	Input current (A)	Fuse (one fuse per phase)							
		A	V	Bussmann type	Mersen type	With option +F289			UL class / Size
						A	Bussmann type	Mersen type	
U_N = 600 V									
0061A-7	61	250	600	DFJ-250		100	170M3412		J/1
0084A-7	84	250	600	DFJ-250		160	170M3414		J/1
0098A-7	98	250	600	DFJ-250		160	170M3414		J/1
0119A-7	119	250	600	DFJ-250		250	170M3416		J/1
0142A-7	142	250	600	DFJ-250		250	170M3416		J/1
0174A-7	174	300	600	DFJ-300		315	170M4410		J/1
0210A-7	210	315	690	170M4410		315	170M4410		1
0271A-7	271	500	690	170M5410		500	170M5410		2
0330A-7	330	630	690	170M6410		630	170M6410		3
0370A-7	370	630	690	170M6410		630	170M6410		3
0430A-7	430	700	690	170M6411		700	170M6411		3
0470A-7	470	800	690	170M6412		800	170M6412		3
0522A-7	522	800	690	170M6412		800	170M6412		3
0590A-7	590	900	690	170M6413		900	170M6413		3
0650A-7	650	1000	690	170M6414	SC33AR69V10CTF	1000	170M6414	SC33AR69V10CTF	3
0721A-7	721	1250	690	170M6416	SC33AR69V13CTF	1250	170M6416	SC33AR69V13CTF	3

Note 1: See also *Implementing thermal overload and short-circuit protection* on page *90*.

Note 2: Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.

Note 3: 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.

Note 4: Circuit breakers must not be used without fuses.

Dimensions and weights

Frame size	Height 1)				Width 2)		Depth 3)		Weight	
	IP22/42		IP54							
	mm	in.	mm	in.	mm	in.	mm	in.	kg	lb
R6	2145	84.43	2315	91.16	430	16.93	673	26.50	240	530
R7	2145	84.43	2315	91.16	430	16.93	673	26.50	250	560
R8	2145	84.43	2315	91.16	430	16.93	673	26.50	265	590
R9	2145	84.43	2315	91.16	830	32.68	698	27.48	375	830
R10	2145	84.43	2315	91.16	830	32.68	698	27.48	530	1170
R11	2145	84.43	2315	91.16	830	32.68	698	27.48	580	1280

1) For marine construction (option +C121) extra height is 10 mm (0.39 in.) due to the fastening bars at the bottom of the cabinet.

2) Extra width with brake chopper (option +D150): 300 mm (11.81 in). Extra width with brake resistors (option +D151): SAFURxxxFxxx 400 mm (15.75 in.), 2×SAFURxxxFxxx 800 mm (19.68 in.). Extra width for frames R6 to R8 with EMC filter (option +E202): 200 mm (7.87 in.). Total width of R6 to R9 frame sizes with molded case circuit breaker (option +F289) is 830 mm (32.68 in.)

3) For drives with marine fastening bars (option +C121): Depth is 757 mm.

Dimensions and weights of sine filter cubicle (option +E206)

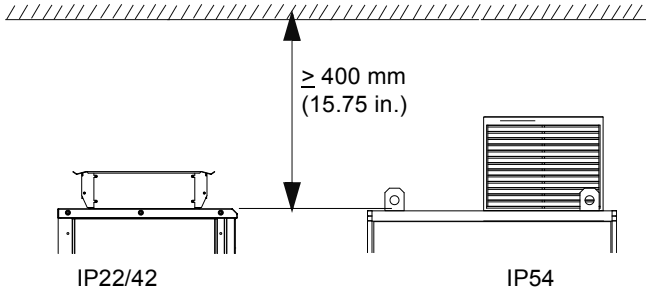
Frame size	Height				Width		Depth		Weight	
	IP22/42		IP54							
	mm	in.	mm	in.	mm	in.	mm	in.	kg	lb
R6	2145	84.43	2315	91.16	600	23.62	646	25.43	280 to 330 *	617 to 728 *
R7	2145	84.43	2315	91.16	600	23.62	646	25.43	310 to 340*	683 to 750 *
R8	2145	84.43	2315	91.16	600	23.62	646	25.43	330 to 430 *	728 to 948 *
R9	2145	84.43	2315	91.16	600	23.62	646	25.43	410 to 430 *	904 to 948 *
R10	2145	84.43	2315	91.16	1000	39.37	646	25.43	340 to 840 *	750 to 1852 *
R11	2145	84.43	2315	91.16	1000	39.37	646	25.43	340 to 840 *	750 to 1852 *

* Depends on the drive and sine filter type.

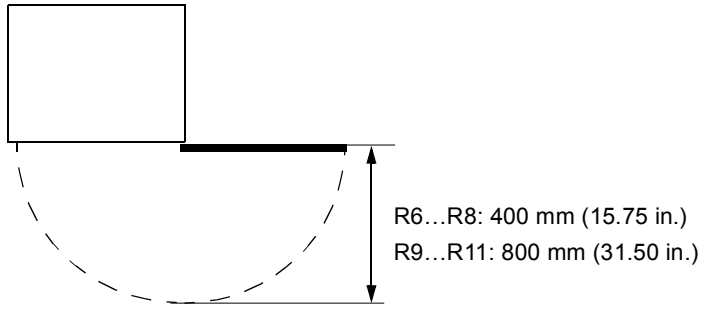
Free space requirements

Front		Side		Above*	
mm	in.	mm	in.	mm	in.
150	5.91	-	-	400	15.75

* measured from the base plate of the cabinet top. **Note**: 320 mm (12.28 in.) is required for IP54 cabinets.



Door opening:



Losses, cooling data and noise

Drive type	Frame	Air flow		Heat dissipation	Noise
		m^3/h	ft^3/min	W	dB (A)
U_N = 400 V					
ACS880-07-0105A-3	R6	1750	1130	1795	67
ACS880-07-0145A-3	R6	1750	1130	1940	67
ACS880-07-0169A-3	R7	1750	1130	2440	67
ACS880-07-0206A-3	R7	1750	1130	2810	67
ACS880-07-0246A-3	R8	1750	1130	3800	65
ACS880-07-0293A-3	R8	1750	1130	4400	65
ACS880-07-0363A-3	R9	1150	677	5300	68
ACS880-07-0430A-3	R9	1150	677	6500	68
ACS880-07-0505A-3	R10	2950	1837	6102	72
ACS880-07-0585A-3	R10	2950	1837	6909	72
ACS880-07-0650A-3	R10	2950	1837	8622	72
ACS880-07-0725A-3	R11	2950	1837	9264	72
ACS880-07-0820A-3	R11	2950	1837	10362	72
ACS880-07-0880A-3	R11	3170	1978	11078	71
U_N = 500 V					
ACS880-07-0096A-5	R6	1750	1130	1795	67
ACS880-07-0124A-5	R6	1750	1130	1940	67
ACS880-07-0156A-5	R7	1750	1130	2440	67
ACS880-07-0180A-5	R7	1750	1130	2810	67
ACS880-07-0240A-5	R8	1750	1130	3800	65
ACS880-07-0260A-5	R8	1750	1130	4400	65
ACS880-07-0302A-5	R9	1150	677	4700	68
ACS880-07-0361A-5	R9	1150	677	5300	68
ACS880-07-0414A-5	R9	1150	677	6500	68
ACS880-07-0460A-5	R10	2950	1837	4903	72
ACS880-07-0503A-5	R10	2950	1837	6102	72
ACS880-07-0583A-5	R10	2950	1837	6909	72
ACS880-07-0635A-5	R10	2950	1837	8622	72
ACS880-07-0715A-5	R11	2950	1837	9264	72
ACS880-07-0820A-5	R11	2950	1837	10362	71
ACS880-07-0880A-5	R11	2950	1837	11078	71
U_N = 690 V					
ACS880-07-0061A-7	R6	1750	1130	1795	67
ACS880-07-0084A-7	R6	1750	1130	1940	67
ACS880-07-0098A-7	R7	1750	1130	2440	67
ACS880-07-0119A-7	R7	1750	1130	2810	67
ACS880-07-0142A-7	R8	1750	1130	3800	65
ACS880-07-0174A-7	R8	1750	1130	4400	65
ACS880-07-0210A-7	R9	1150	677	4700	68
ACS880-07-0271A-7	R9	1150	677	5300	68
ACS880-07-0330A-7	R10	2950	1837	5640	72

Drive type	Frame	Air flow		Heat dissipation	Noise
		m^3/h	ft^3/min	W	dB (A)
ACS880-07-0370A-7	R10	2950	1837	6371	72
ACS880-07-0430A-7	R10	2950	1837	7570	72
ACS880-07-0470A-7	R11	2950	1837	6611	72
ACS880-07-0522A-7	R11	2950	1837	7388	72
ACS880-07-0590A-7	R11	2950	1837	8971	71
ACS880-07-0650A-7	R11	3170	1978	9980	71
ACS880-07-0721A-7	R11	3170	1978	11177	71

Cooling data and noise for drives with sine filter (option +E206)

Drive type ACS880-07-xxxxx-x+E206	Frame	Sine filter type	Heat dissi-pation	Air flow			Noise with sine filter (option +E206)
				Drive	Filter	Total	
			kW	m^3/h	m^3/h	m^3/h	dBA
U_N = 400 V							
ACS880-07-0105A-3	R6	B84143V0130R230	0.6	1750	*	1750	80
ACS880-07-0145A-3	R6	B84143V0162R229	0.55	1750	*	1750	80
ACS880-07-0169A-3	R7	B84143V0162R229	0.55	1750	*	1750	80
ACS880-07-0206A-3	R7	B84143V0230R229	0.9	1750	*	1750	80
ACS880-07-0246A-3	R8	B84143V0230R229	0.9	1750	*	1750	80
ACS880-07-0293A-3	R8	B84143V0390R229	1.6	1750	*	1750	80
ACS880-07-0363A-3	R9	B84143V0390R229	1.6	1150	*	1150	80
ACS880-07-0430A-3	R9	B84143V0390R229	1.6	1150	*	1150	80
ACS880-07-0505A-3	R10	NSIN0900-6	3.0	2950	2000	4950	80
ACS880-07-0585A-3	R10	NSIN0900-6	3.4	2950	2000	4950	80
ACS880-07-0650A-3	R10	NSIN0900-6	3.8	2950	2000	4950	80
ACS880-07-0725A-3	R11	NSIN0900-6	4.1	2950	2000	4950	80
ACS880-07-0820A-3	R11	NSIN0900-6	4.7	2950	2000	4950	80
ACS880-07-0880A-3	R11	NSIN0900-6	5.0	3170	2000	5170	80
U_N = 500 V							
ACS880-07-0096A-5	R6	B84143V0130R230	0.63	1750	*	1750	80
ACS880-07-0124A-5	R6	B84143V0130R230	0.63	1750	*	1750	80
ACS880-07-0156A-5	R7	B84143V0162R229	0.55	1750	*	1750	80
ACS880-07-0180A-5	R7	B84143V0162R229	0.55	1750	*	1750	80
ACS880-07-0240A-5	R8	B84143V0230R229	0.9	1750	*	1750	80
ACS880-07-0260A-5	R8	B84143V0230R229	0.9	1750	*	1750	80
ACS880-07-0361A-5	R9	B84143V0390R229	1.6	1150	*	1150	80
ACS880-07-0414A-5	R9	B84143V0390R229	1.6	1150	*	1150	80
ACS880-07-0460A-5	R10	NSIN0485-6	3.3	2950	700	3650	80
ACS880-07-0503A-5	R10	NSIN0900-6	3.6	2950	2000	4950	80
ACS880-07-0583A-5	R10	NSIN0900-6	3.9	2950	2000	4950	80
ACS880-07-0635A-5	R10	NSIN0900-6	4.3	2950	2000	4950	80

Drive type ACS880-07-xxxxx-x+E206	Frame	Sine filter type	Heat dissi-pation	Air flow			Noise with sine filter (option +E206)
				Drive	Filter	Total	
			kW	m^3/h	m^3/h	m^3/h	dBA
ACS880-07-0715A-5	R11	NSIN0900-6	4.9	2950	2000	4950	80
ACS880-07-0820A-5	R11	NSIN0900-6	5.6	2950	2000	4950	80
ACS880-07-0880A-5	R11	NSIN0900-6	5.6	2950	2000	4950	80
U_N = 690 V							
ACS880-07-0061A-7	R6	B84143V0056R230	0.3	1750	*	1750	78
ACS880-07-0084A-7	R6	B84143V0092R230	0.6	1750	*	1750	79
ACS880-07-0098A-7	R7	B84143V0092R230	0.61	1750	*	1750	79
ACS880-07-0119A-7	R7	B84143V0130R230	0.63	1750	*	1750	80
ACS880-07-0142A-7	R8	B84143V0130R230	0.6	1750	*	1750	80
ACS880-07-0174A-7	R8	B84143V0207R230	0.9	1750	*	1750	80
ACS880-07-0210A-7	R9	B84143V0207R230	0.9	1150	*	1150	80
ACS880-07-0271A-7	R9	B84143V0207R230	0.9	1150	*	1150	80
ACS880-07-0330A-7	R10	NSIN0485-6	2.2	2950	700	3650	80
ACS880-07-0370A-7	R10	NSIN0485-6	2.3	2950	700	3650	80
ACS880-07-0430A-7	R10	NSIN0485-6	2.4	2950	700	3650	80
ACS880-07-0470A-7	R11	NSIN0485-6	3.2	2950	700	3650	80
ACS880-07-0522A-7	R11	NSIN0485-6	3.6	2950	700	3650	80
ACS880-07-0590A-7	R11	NSIN0900-6	4.0	2950	2000	4950	80
ACS880-07-0650A-7	R11	NSIN0900-6	4.9	3170	2000	5170	80
ACS880-07-0721A-7	R11	NSIN0900-6	4.9	3170	2000	5170	80
* Natural convection Sine filter is not available for ACS880-07-0302A-5.							

Terminal and entry data for the power cables

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 mm^2	Bolt size	Tightening torque	Bolt size	Tightening torque N·m
R6	6	185	M10	20...40 N·m	M10	30...44 N·m
R7	6	185				
R8	6	1×240 or 2×185	M12	50...75 N·m		
R9	9	3×240				
R10	12	3×240 or 4×185				
R11	12	3×240 or 4×185				

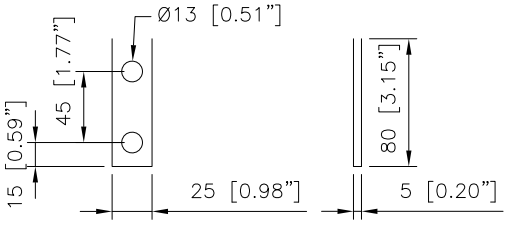
US

Frame size	Terminals L1, L2, L3, U2, V2, W2, UDC+/R+, UDC- and R-			Grounding terminals	
	Max. phase conductor size AWG/kcmil	Busbar bolt size – Hole spacing	Tightening torque bf·ft	Bolt size	Tightening torque bf·ft
R6	350 MCM	M10 (3/8”) × 2 – 1.75”	15…30	M10 (3/8”)	22…32
R7					
R8	1×500 MCM or 2×350 MCM	M12 (7/16") × 2 – 1.75”	37…55		
R9	2×500 MCM				
R10	1×500 MCM or 4×350 MCM	M12 (7/16") × 4 – 1.75”			
R11	1×500 MCM or 4×350 MCM				

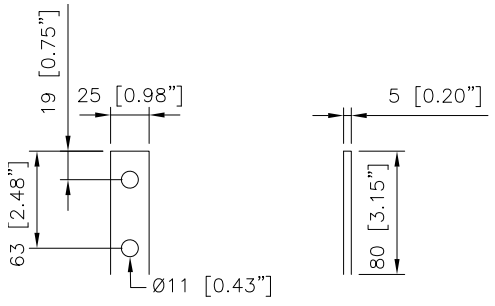
The location and size of power cable terminals are shown in the drawings below.

Input and motor cable terminal dimensions of frames R6 to R7

Bottom entry and exit:

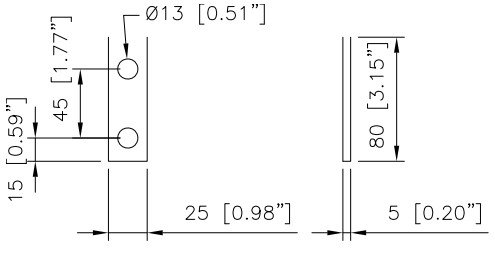


Top entry and exit:

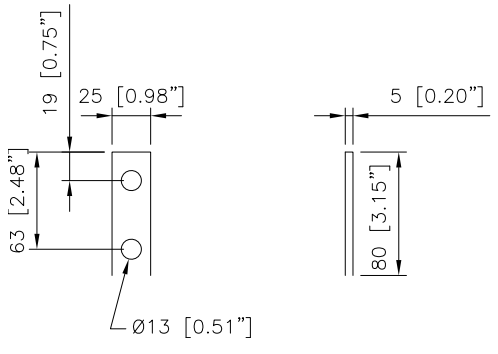


Input and motor cable terminal dimensions of frame R8

Bottom entry and exit:

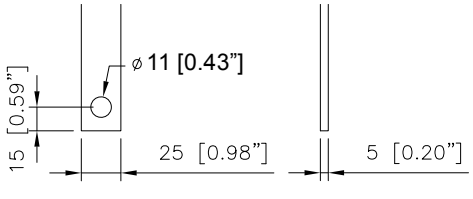


Top entry and exit:



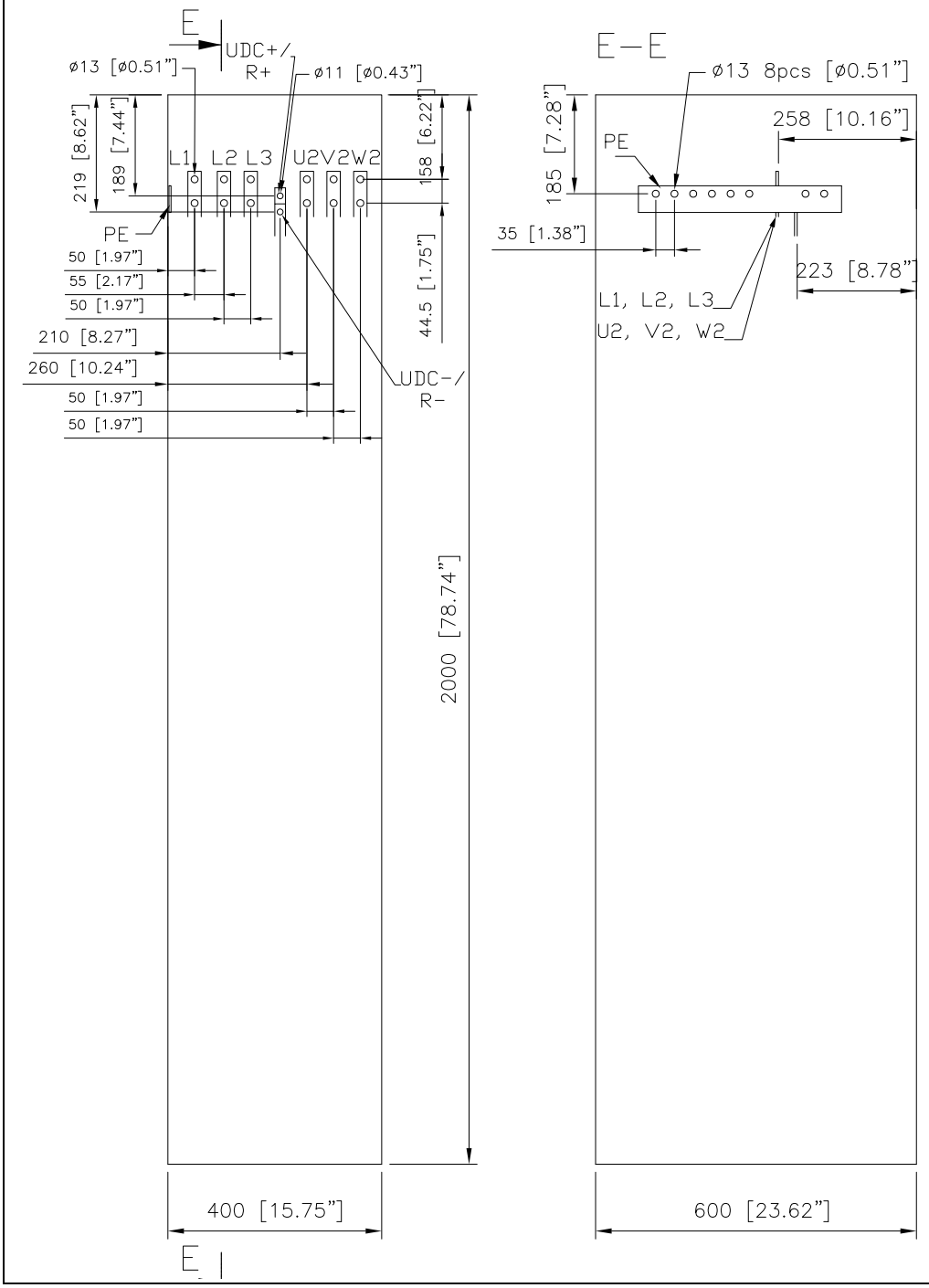
Resistor and DC cable terminal dimensions of frames R6 to R8

Bottom entry and exit:

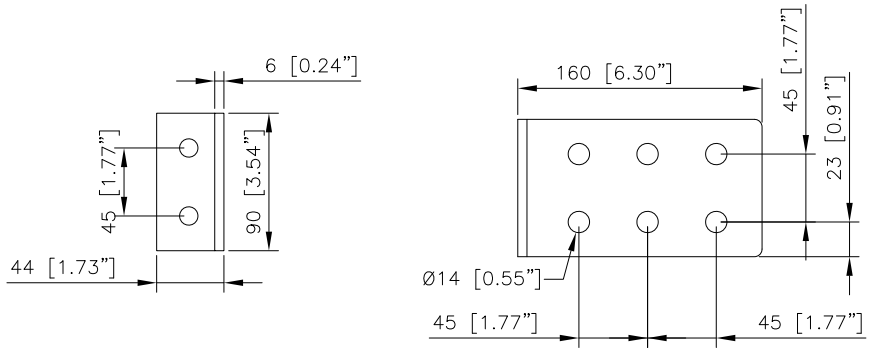


Power cable terminal dimensions of frame R8

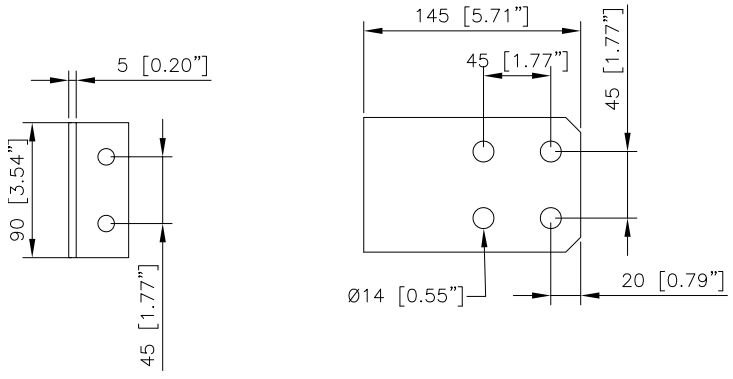
Top entry and exit:



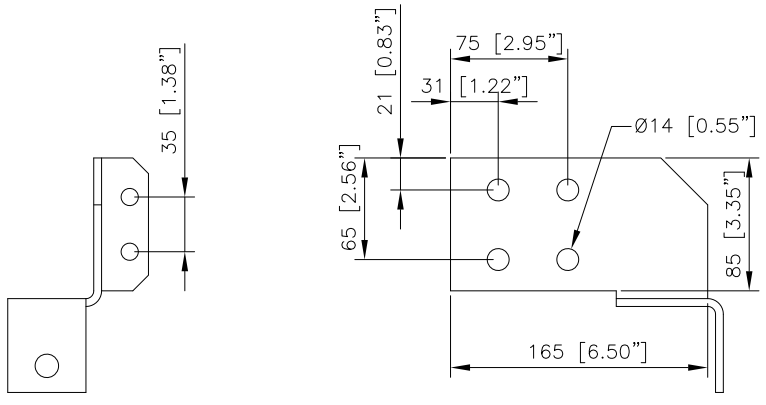
Motor cable terminal dimensions of frame R9 – Units with optional du/dt filter (+E205):



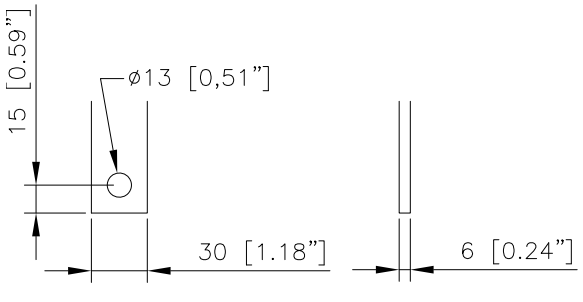
Motor cable terminal dimensions of frame R9 – Units without optional du/dt filter (+E205):



Input cable terminal dimensions of frame R9:

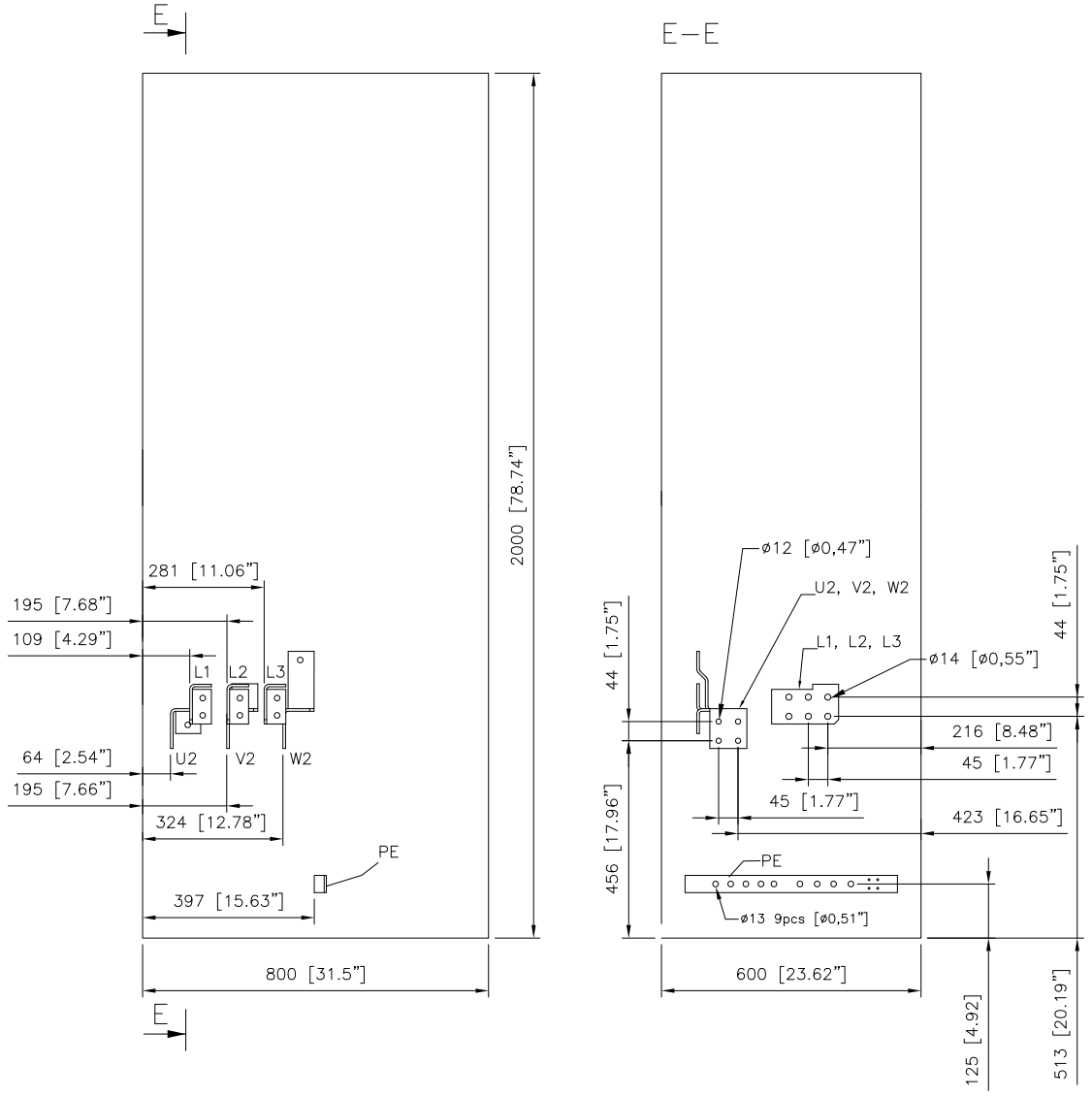


Resistor and DC cable terminal dimensions of frames R9



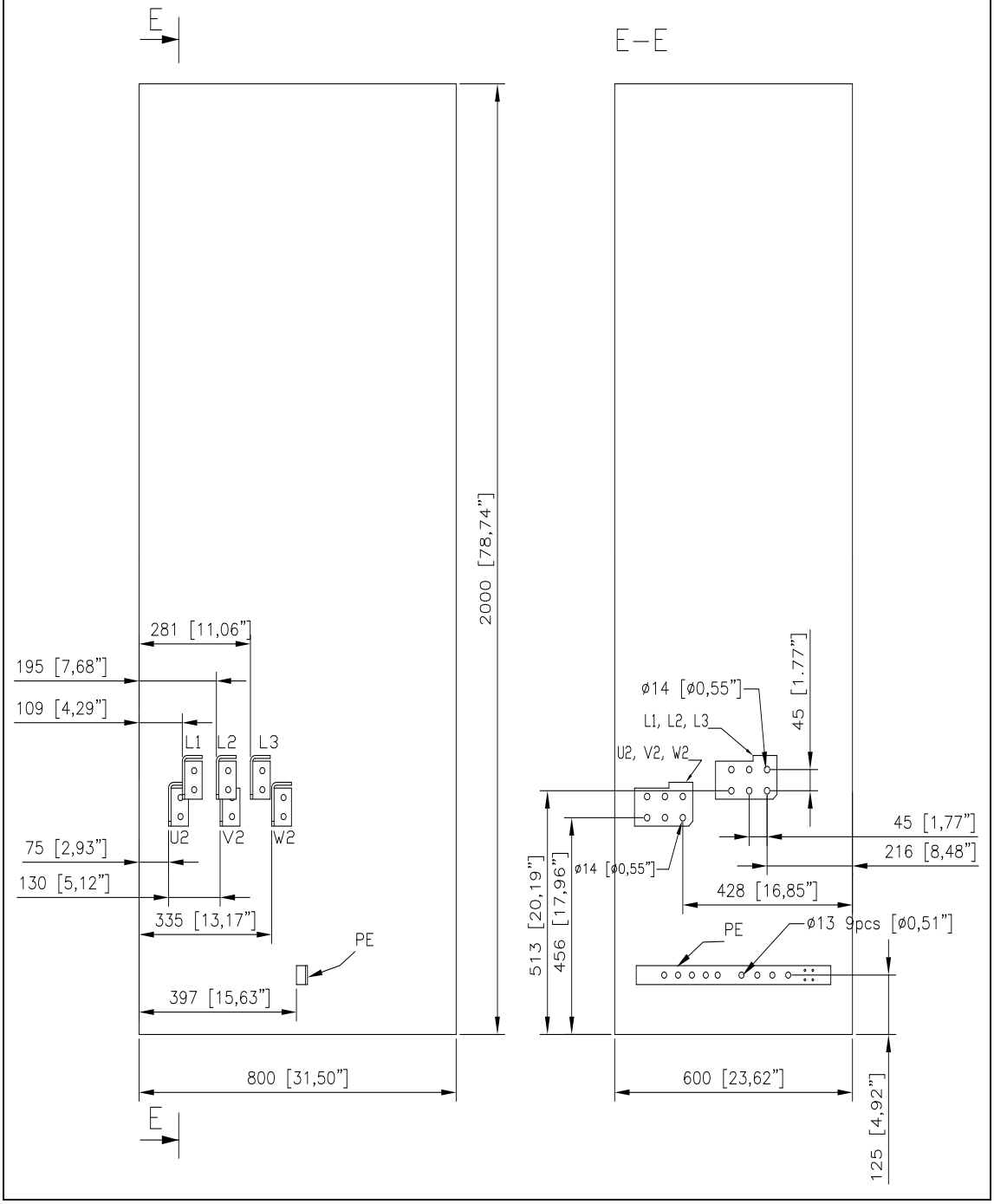
Input and motor cable terminal dimensions of frame R10

Bottom entry and exit:



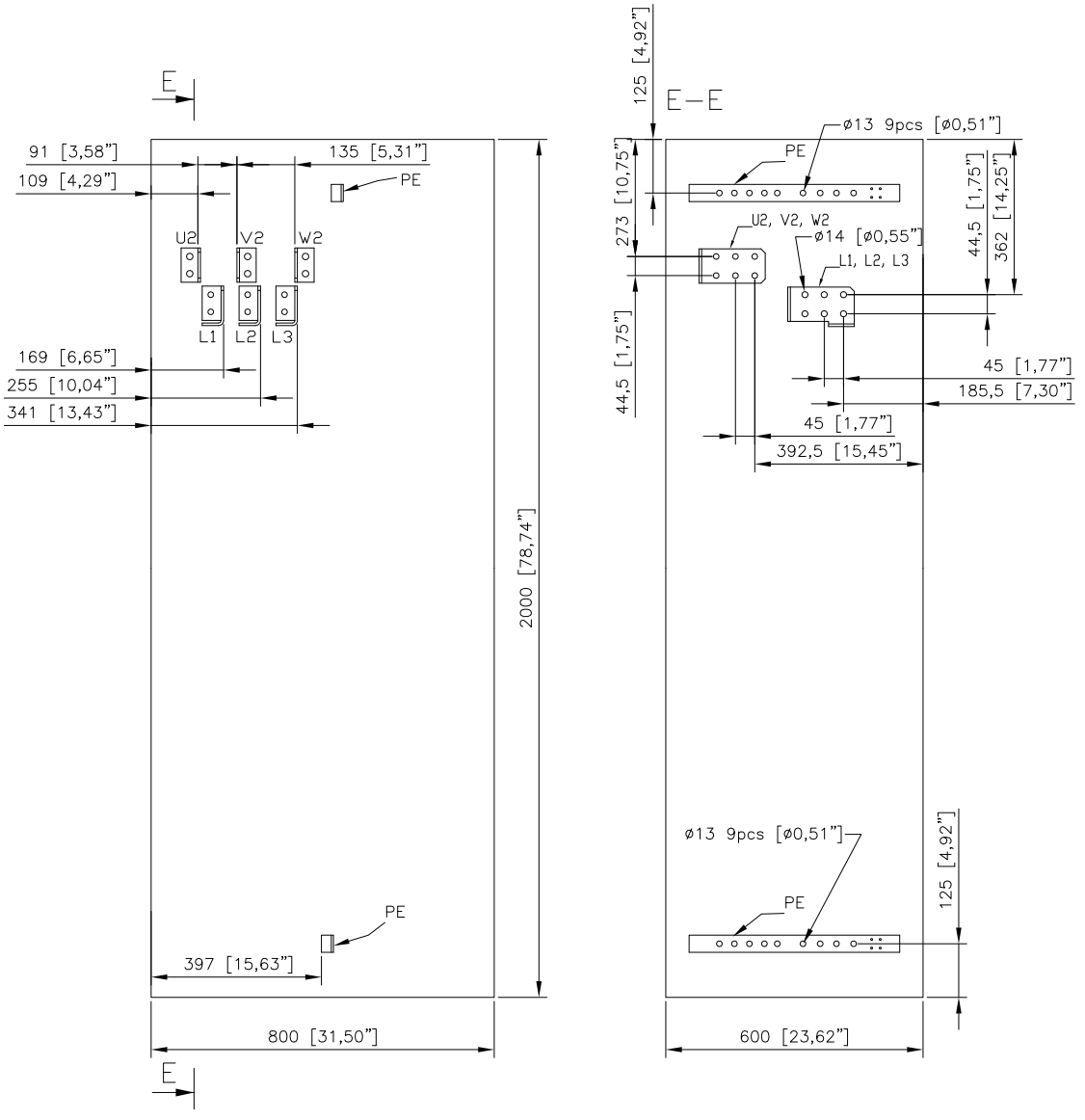
Input and motor cable terminal dimensions of frame R11

Bottom entry and exit:



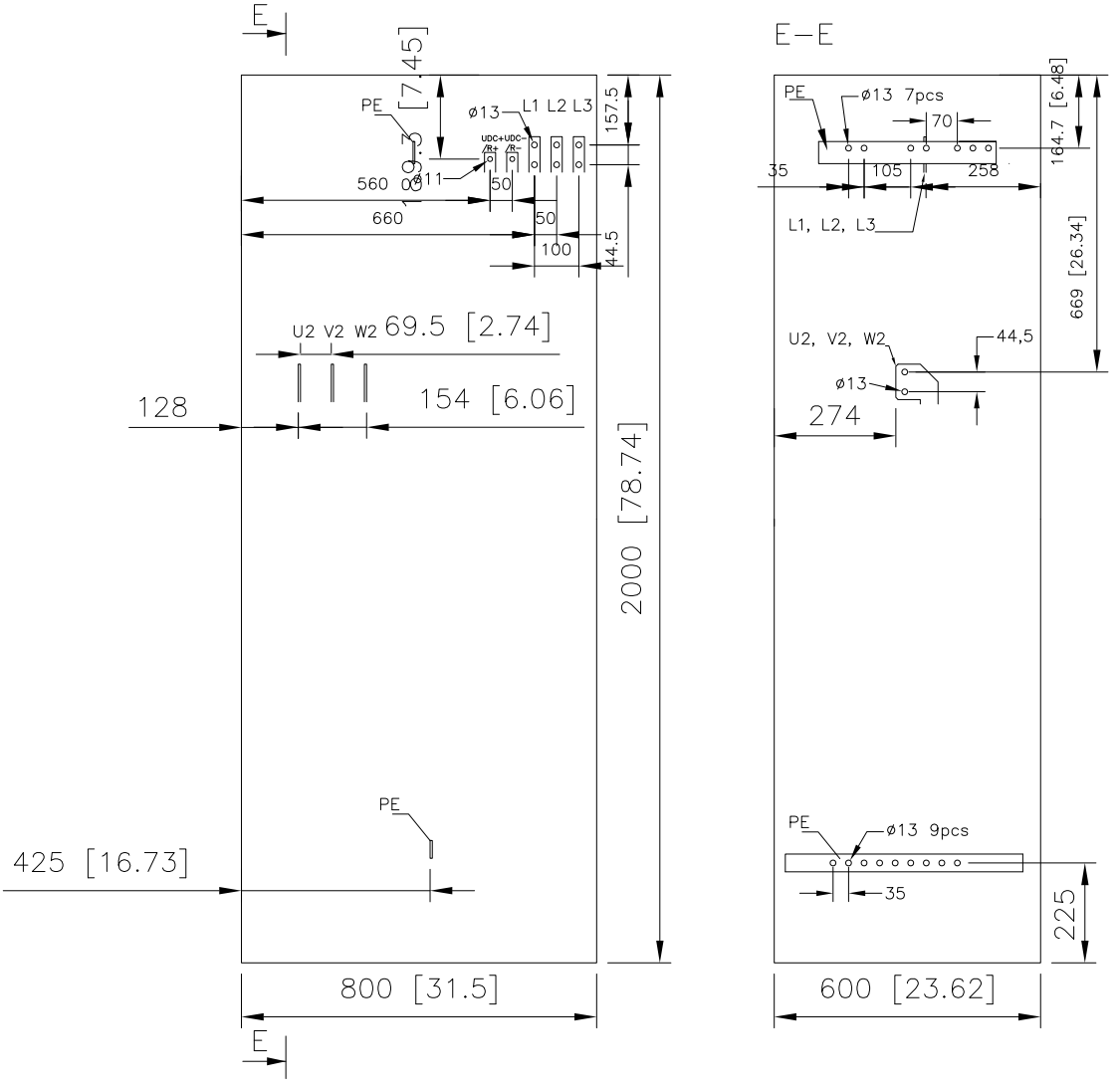
Input and motor cable terminal dimensions of frames R10 and R11

Top entry and exit (options +H351 and +H353):



Input and motor cable terminal dimensions of frames R10 and R11

Top entry and exit: +C129+F277+F289



Terminal data for the control cables

See chapter *Control unit of frames R6 to R9* on page *137* or *Control unit of frames R10 and R11* on page *147*.

Electrical power network specification

Voltage (U_1)	ACS880-07-xxxxx-3 drives: 380…415 V AC 3-phase +10%…-10%. This is indicated in the type designation label as typical input voltage level 3 ~ 400 V AC ACS880-07-xxxxx-5 drives: 380…500 V AC 3-phase +10%…-10%. This is indicated in the type designation label as typical input voltage levels 3 ~ 400/480/500 V AC ACS880-07-xxxxx-7 drives: 525…690 V AC 3-phase +10%…-10%. This is indicated in the type designation label as typical input voltage levels 3 ~ 525/600/690 V AC.
Network type	TN (grounded) and IT (ungrounded) systems
Short-circuit withstand strength (IEC/EN 61439-1)	Maximum allowable prospective short-circuit current is 65 kA when the input cable is protected with gG type fuses (IEC 60269) having maximum operating time of 0.1 seconds and maximum current rating as follows: • 400 A for frames R6 to R8 • 630 A for frame R9 • 1250 A for frames R10 and R11.
Short-circuit current protection (UL 508A)	The drive is suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes at 600 V maximum when the input cable is protected with T class fuses.
Short-circuit current protection (CSA C22.2 No. 14-05)	The drive is suitable for use on a circuit capable of delivering not more than 100 kA rms symmetrical amperes at 600 V maximum when the input cable is protected with T class fuses.
Frequency (f_1)	50/60 Hz. Variation ±5% of the nominal frequency.
Imbalance	Max. ± 3% of nominal phase-to-phase input voltage
Fundamental power factor (cos phi$_1$)	0.98 (at nominal load)

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet synchronous motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors) with option +N7502
Voltage (U_2)	0 to U_1, 3-phase symmetrical, This is indicated in the type designation label as typical output voltage level as 3 ~ 0…U_1, U_{max} at the field weakening point
Frequency (f_2)	0…500 Hz For drives with du/dt filter: 120 Hz (frames R6 to R9), 200 Hz (frames (R10 and R11) For drives with sine filter: 120 Hz
Current	See section *Ratings*.
Switching frequency	For frames R6 to R9: 2.7 kHz (typically) For frames R10 and R11: 3 kHz (typically) The switching frequency can vary per frame and voltage. For exact values, contact your local ABB representative.
Maximum recommended motor cable length	For frames R6 to R9: 300 m (984 ft). For frames R10 and R11: 500 m (1640 ft). **Note:** For frames R6 to R9 with motor cables longer than 150 m (492 ft) and for frames R10 and R11 with motor cables longer than 100 m (328 ft), the EMC Directive requirements may not be fulfilled.

Control unit connection data

See chapter *Control unit of frames R6 to R9* on page *137* or chapter *Control unit of frames R10 and R11* on page *147*.

Efficiency

Approximately 98% at nominal power level

Protection classes

Degrees of protection (IEC/EN 60529)	IP22, IP42, IP54
Enclosure types (UL50)	UL Type 1, UL Type 1 Filtered, UL Type 12. For indoor use only.
Overvoltage category (IEC/EN 60664-1)	III
Protective class (IEC/EN 61800-5-1)	I

Ambient conditions

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

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	0…2000 m (0…6562 ft) above sea level. For altitudes over 2000 m, contact ABB. Output derated above 1000 m (3281 ft). See section *Derating*.	-	-
Air temperature	-0 to +40 °C (32 to 104 °F). No condensation allowed. Output derated in the range +40 to +50 °C (+104 to +122 °F). See section *Derating*.	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	Max. 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		

Contamination	IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations	IEC 60721-3-1:1997	IEC 60721-3-2:1997
Chemical gases	Class 3C2	Class 1C2	Class 2C2
Solid particles	Class 3S2. No conductive dust allowed.	Class 1S3 (packing must support this, otherwise 1S2)	Class 2S2
Vibration 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^2 (32.8 ft/s^2)
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009 Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	Not allowed	With packing max. 100 m/s^2 (328 ft/s^2) 11 ms	With packing max. 100 m/s^2 (328 ft/s^2) 11 ms

Auxiliary circuit power consumption

Cabinet heater and cabinet lighting (options +G300 and +G301)	100 W
External uninterruptible power supply (option +G307	150 W
Motor heater (option +G313)	According to the heater type

Materials

Cabinet	Hot-dip zinc coated and/or aluminum-zinc coating 1.5 mm thick steel sheet (thickness of coating approximately 20 micrometers). Polyester thermosetting powder coating (thickness approximately 80 micrometers) on visible surfaces, color RAL 7035 and RAL 9017.
Busbars	Tin-plated copper
Air filters of IP54 drives	Inlet (door): airComp 300-50 288 mm x 521 mm (ABB code: 64640194) 688 mm x 521 mm (ABB code 64748017) Outlet (roof): airTex G150 2 pcs: 398 mm x 312 mm (ABB code: 64722166)

Fire safety of materials (IEC 60332-1)	Insulating materials and non-metallic items mostly self-extinctive
Package	Standard package: • timber, polyethylene sheet (thickness 0.15 mm), stretch film (thickness 0.023 mm), PP tape, PET strap, sheet metal (steel) • 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 • can be used when products will not be exposed to corrosive atmosphere during transport or storage Container package: • 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) • for sea transport in containers • recommended for land and air transport when storage time prior to installation exceeds 6 months or storage is arranged in partially weather-protected conditions Seaworthy package: • 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) • for sea transport with or without containerization • for long storage periods in environments where roofed and humidity-controlled storage cannot be arranged Cabinets are fastened to the pallet with screws and braced from the top end to the package walls to prevents swaying inside the package. Package elements are attached to each other with screws. For handling the packages, see section *Moving and unpacking the drive* on page *63*.
Disposal	The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated. Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and large electrolytic capacitors need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code. Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.

Applicable standards

	The drive complies with the standards below. The compliance with the European Low Voltage Directive is verified according to standard EN 61800-5-1.
IEC/EN 61800-5-1:2007	*Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy*
IEC 60146-1-1:2009 **EN 60146-1-1:2010**	*Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements*
IEC/EN 60664-1:2007	*Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests*
IEC 60529:1989 **EN 60529:1991**	*Degrees of protection provided by enclosures (IP code).*
IEC 60204-1:2005 + A1:2008 **EN 60204-1:2006 + AC:2010**	*Safety of machinery. Electrical equipment of machines. Part 1: General requirements.*
IEC/EN 61439-1:2009	*Low-voltage switchgear and controlgear assemblies -- Part 1: General rules*

IEC/EN 61800-3:2004	*Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods*
UL 508A 1st edition:2001	*Industrial Control Panels*
UL 50 12th edition:2007	*Enclosures for Electrical Equipment, Non-Environmental Considerations*
CSA C22.2 No. 14-13:2013	*Industrial control equipment*
CSA C22.2 No. 274-13:2013	*Adjustable speed drives*

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 the EN 61800-3:2004* 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. The declaration of conformity is shown below.

Declaration of Conformity (Safe torque off)

See also chapter *Safe torque off function* on page *239* and section *Implementing the ATEX-certified safe motor disconnection function (option +Q971)* on page *92*.

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

ACS880-07

ACS880-17, -37 (frames R11 and nxR8i)

ACS880-104, -107

ACS880 multidrives

ACS880-104LC (frames nxR8i)

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, 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, 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 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.

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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	Functional safety of electrical / electronic / programmable electronic safety-related systems

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, 13 Oct 2017

Manufacturer representative:

Peter Lindgren
Vice President, ABB Oy

Compliance with the EN 61800-3:2004

Definitions

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

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

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

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

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

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

Category C2

The drive complies with the standard with the following provisions:

1. The drive is equipped with EMC filter (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 150 meters (492 ft) for frames R6 to R9 and 100 meters (328 ft) for frames R10 and R11.

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

WARNING! Do not install a drive equipped with EMC filter E202 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:

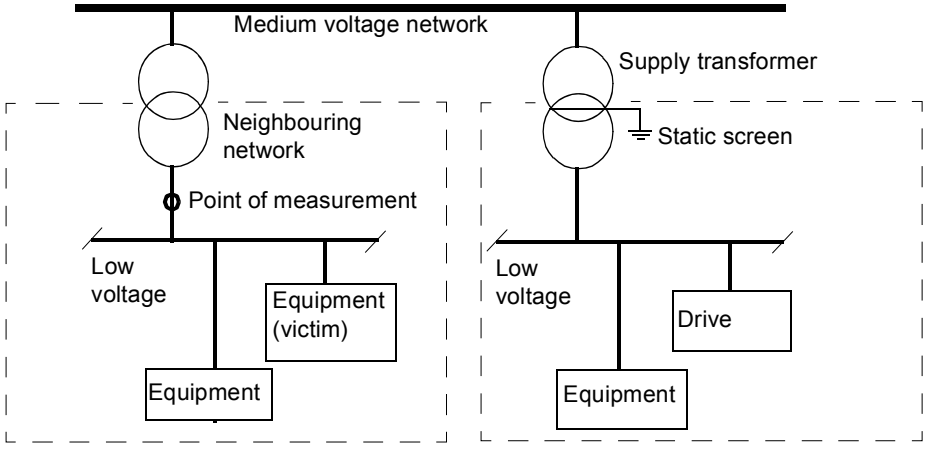
1. The drive is equipped with EMC filter +E200, +E201 or +E210.
2. The input power cables, motor cables and control cables are selected as specified in the appropriate drive manual(s).
3. The drive is installed according to the instructions given in the appropriate drive manual(s).
4. Maximum motor cable length is 150 meters (492 ft) for frames R6 to R9 and 100 meters (328 ft) for frames R10 and R11.

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

Category C4

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

1. It is ensured that no excessive emission is propagated to neighbouring 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 from the local ABB representative.
3. The input power cables, motor cables and control cables are selected as specified in the appropriate drive manual(s).
4. The drive is installed according to the instructions given in the appropriate drive manual(s).

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 marking

The drive is cULus Listed.

UL checklist

- Make sure that the drive type designation label includes the cULus Listed marking.
- **CAUTION - Risk of electric shock.** After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.
- The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust. (IP55)- UL Type 12 enclosure. This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.
- The maximum ambient air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 50 °C (104 to 122 °F).
- The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 V maximum when the input cable is protected with class T fuses. The ampere rating is based on tests done according to UL 508A.
- The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
- Protect the input cable with fuses. Circuit breakers must not be used without fuses in the USA. For suitable circuit breakers, contact your local ABB representative. Suitable IEC (class aR) fuses for drive protection are listed on page *204* and UL fuses on page *205*.
- For installation in the United States, provide branch circuit protection in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, use the UL classified fuses.
- For installation in Canada, provide branch circuit protection in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfill this requirement, use the UL classified fuses.
- The drive provides overload protection in accordance with the National Electrical Code (NEC).

CSA marking

The drive is CSA marked.

China RoHS marking

The *People's Republic of China Electronic Industry Standard* (SJ/T 11364-2014) specifies the marking requirements for hazardous substances in electronic and electrical products. The green mark is attached to the drive to verify that it does not contain toxic and hazardous substances or elements above the maximum concentration values, and that it is an environmentally-friendly product which can be recycled and reused.

RCM marking

RCM marking is required in Australia and New Zealand. An RCM mark is attached to the drive modules to verify compliance with the relevant standard (IEC 61800-3:2004), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

For fulfilling the requirements of the standard, see section *Compliance with the EN 61800-3:2004*.

WEEE marking

The drive is marked with the wheelie bin symbol. It indicates that at the end of life the drive should enter the recycling system at an appropriate collection point and not placed in the normal waste stream. See section *Disposal* on page *221*.

EAC (Eurasian Conformity) marking

The drive has EAC certification. EAC marking is required in Russia, Belarus and Kazakhstan.

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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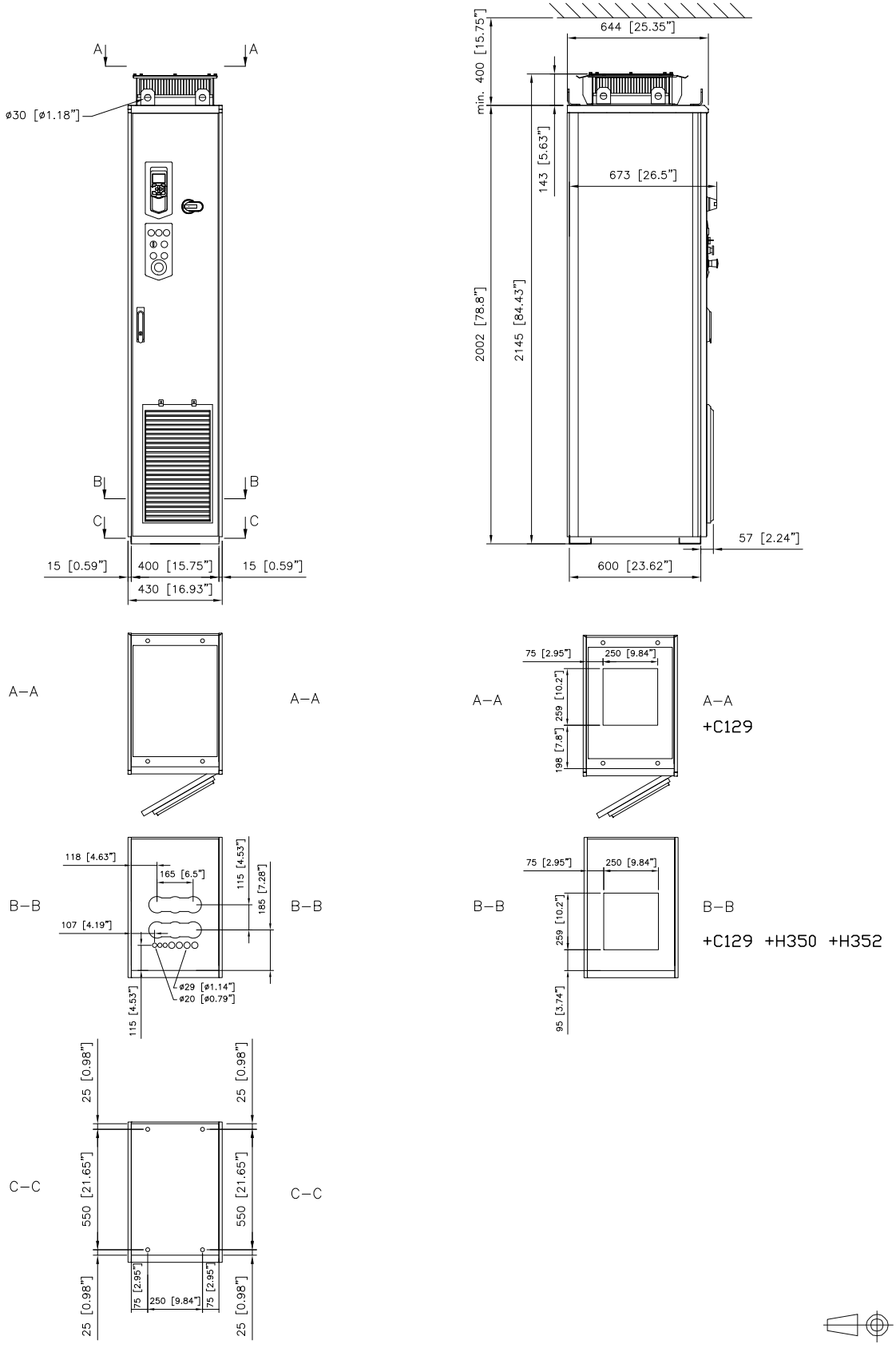
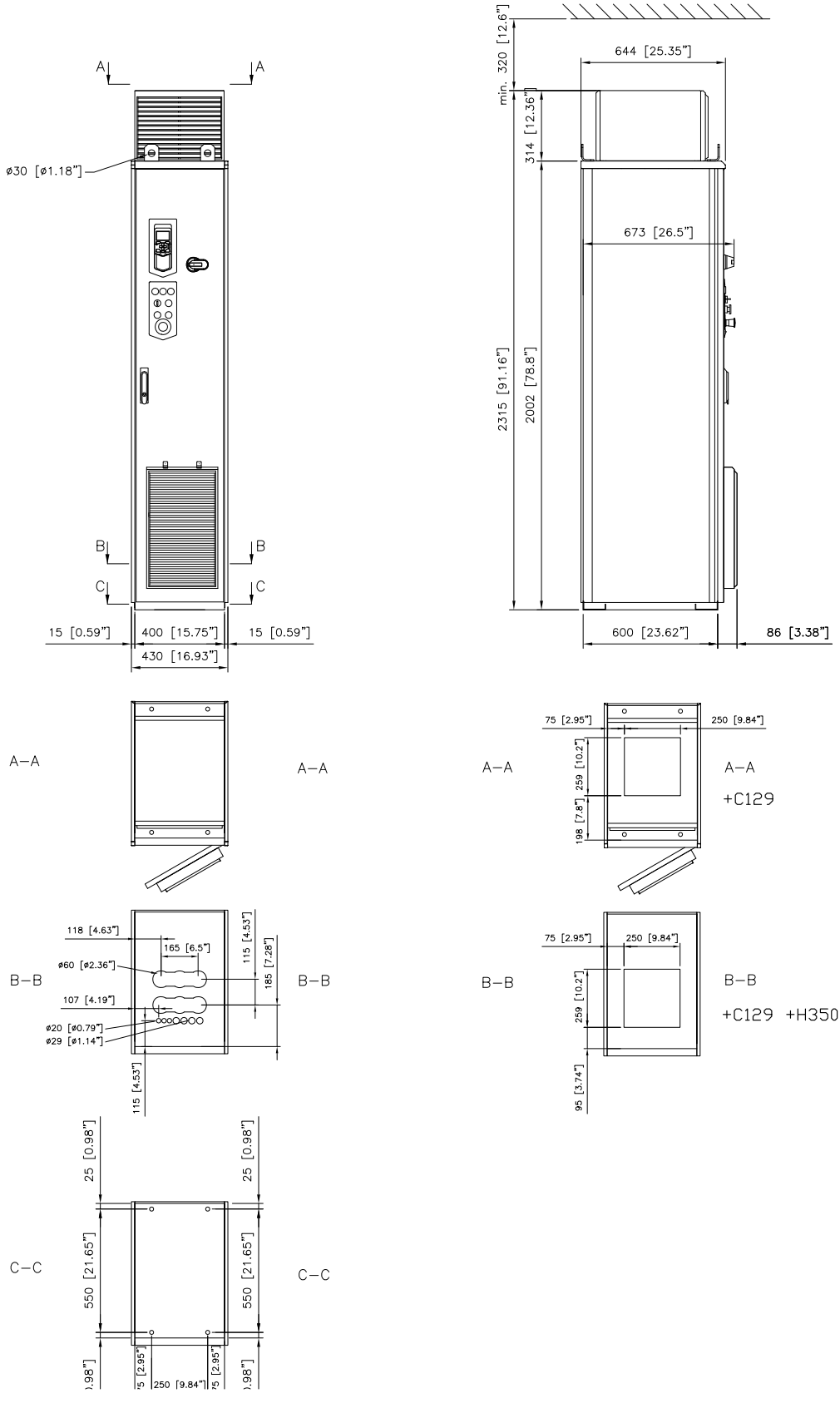
Dimension drawings

Example dimension drawings with dimensions in millimeters and [inches] are shown below.

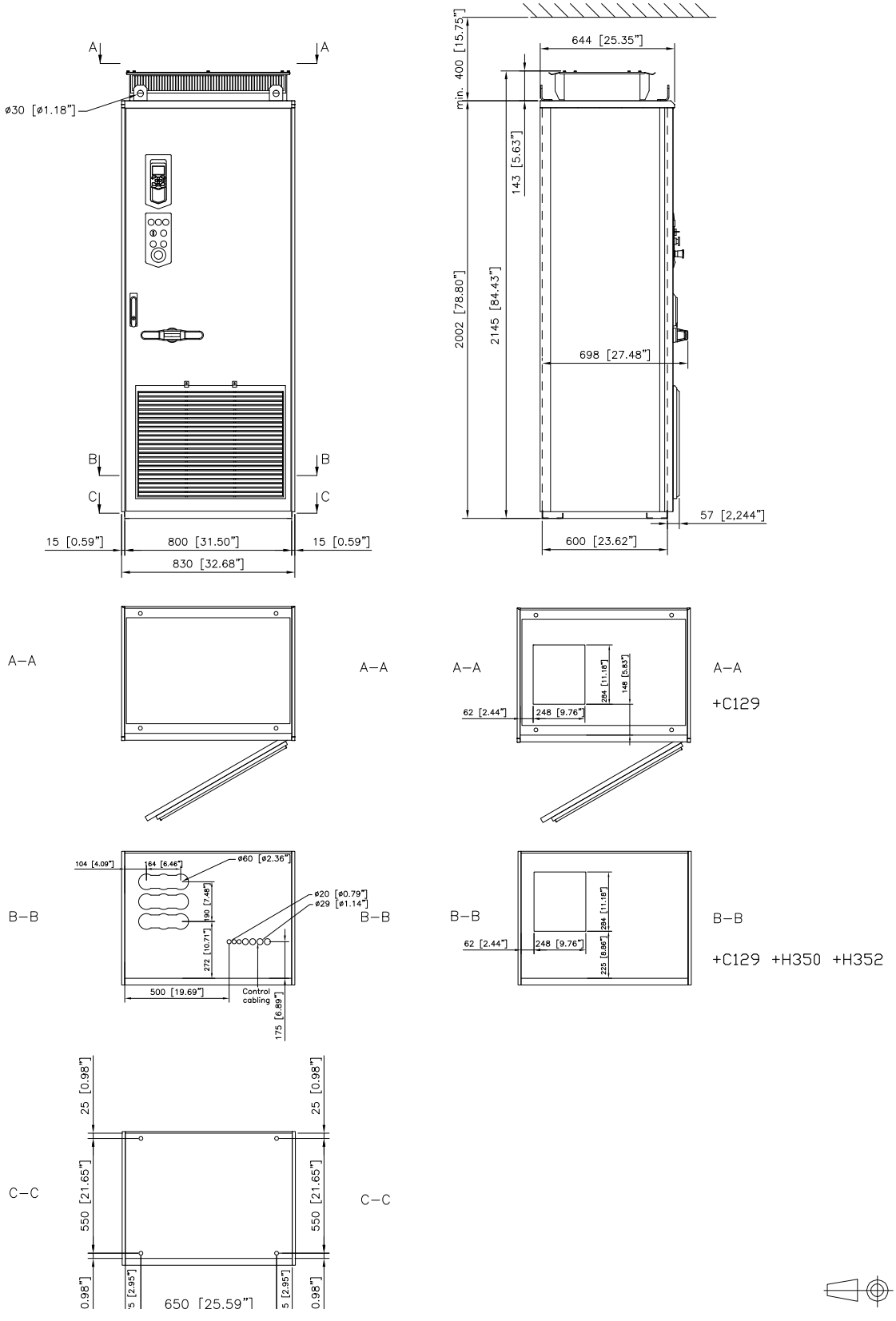
Frames R6 to R8 (IP22, IP42 [+B054], UL Type 1) – standard and options +C129, +H350, +H352



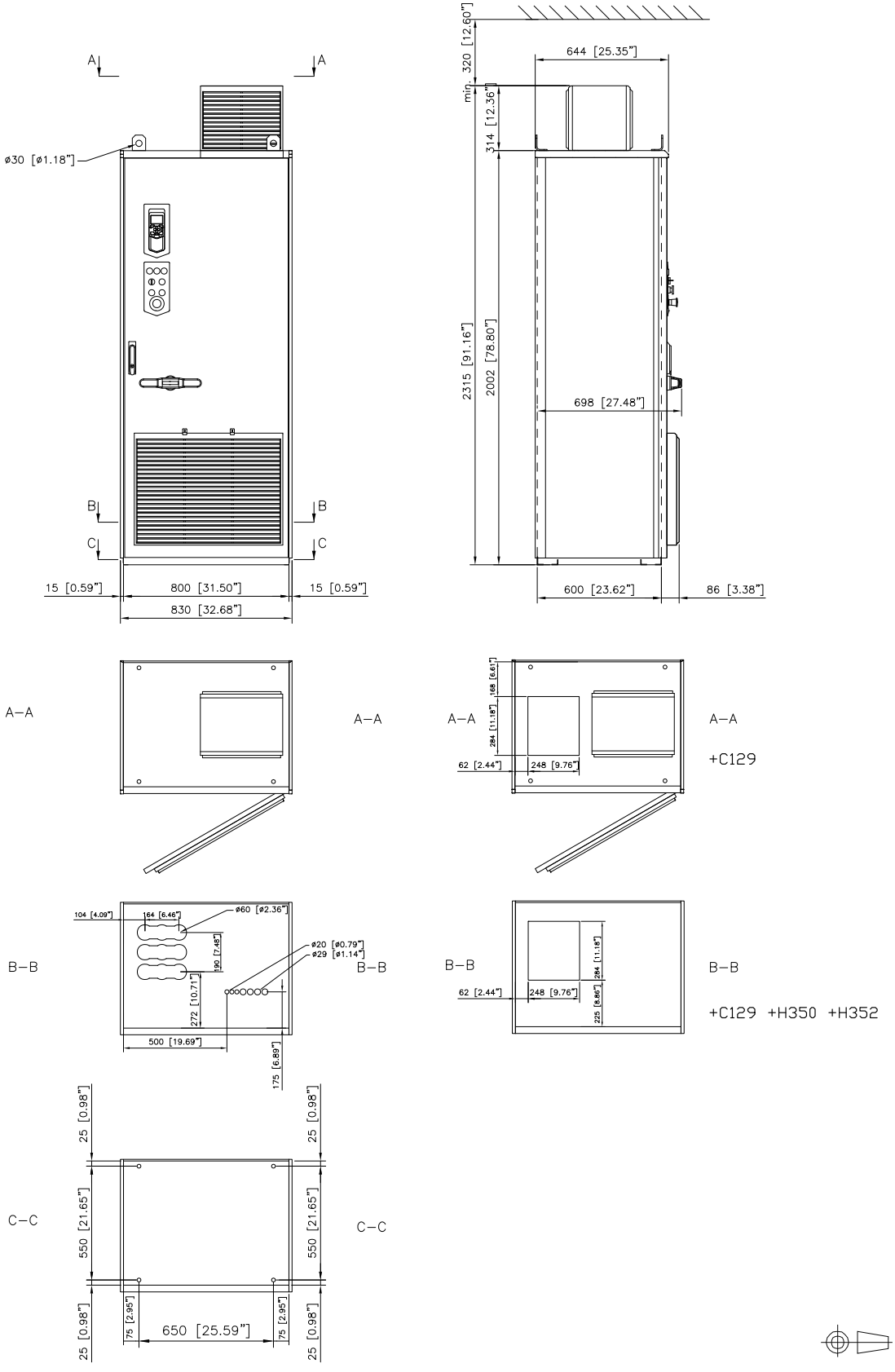
Frames R6 to R8 (IP54 / UL Type 12 [+B055]) – standard and options +C129, +H350, +H352



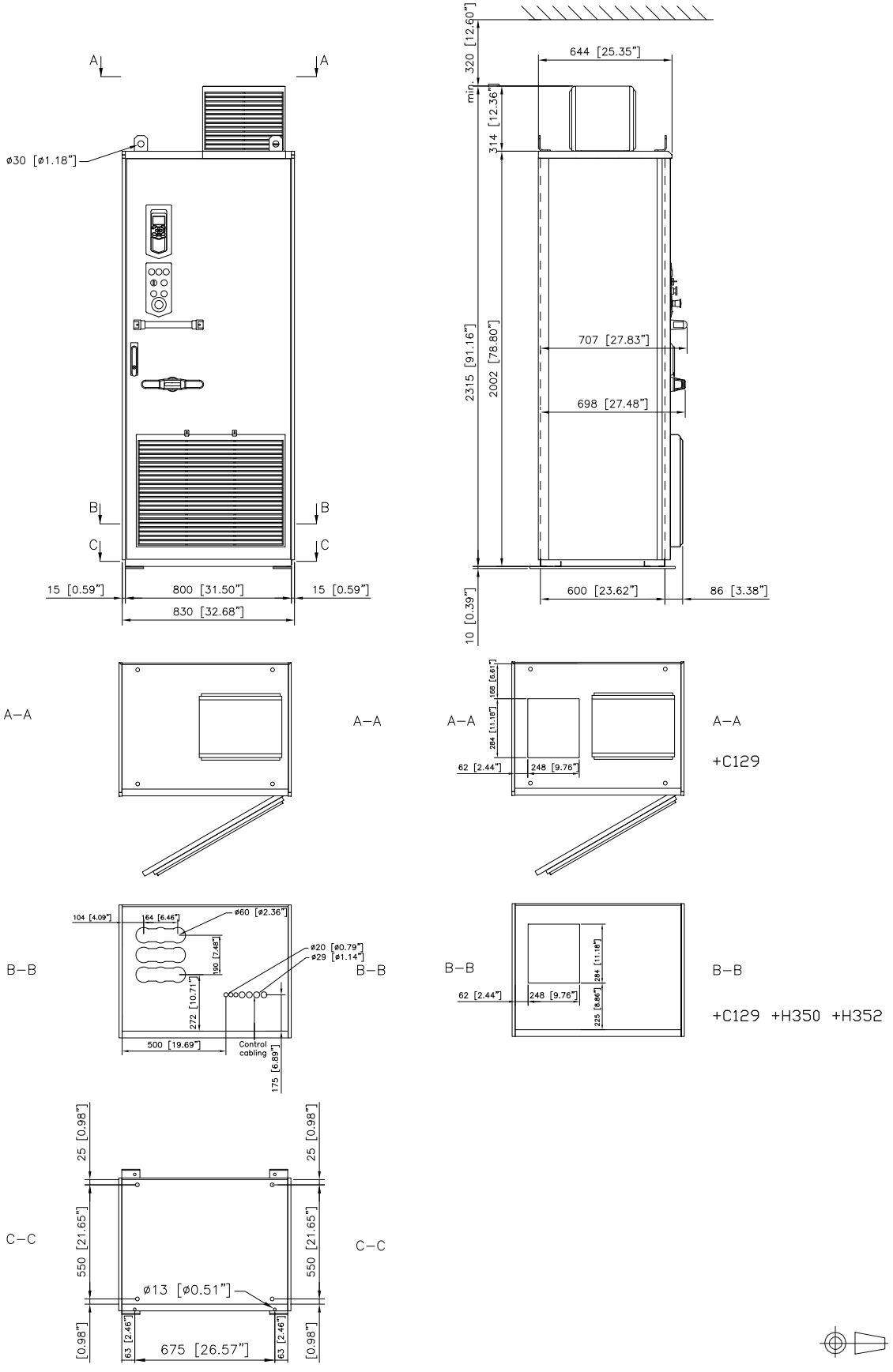
Frame R9 (IP22 and IP42 [+B054], UL Type 1) – standard and options +C129, +H350, +H352



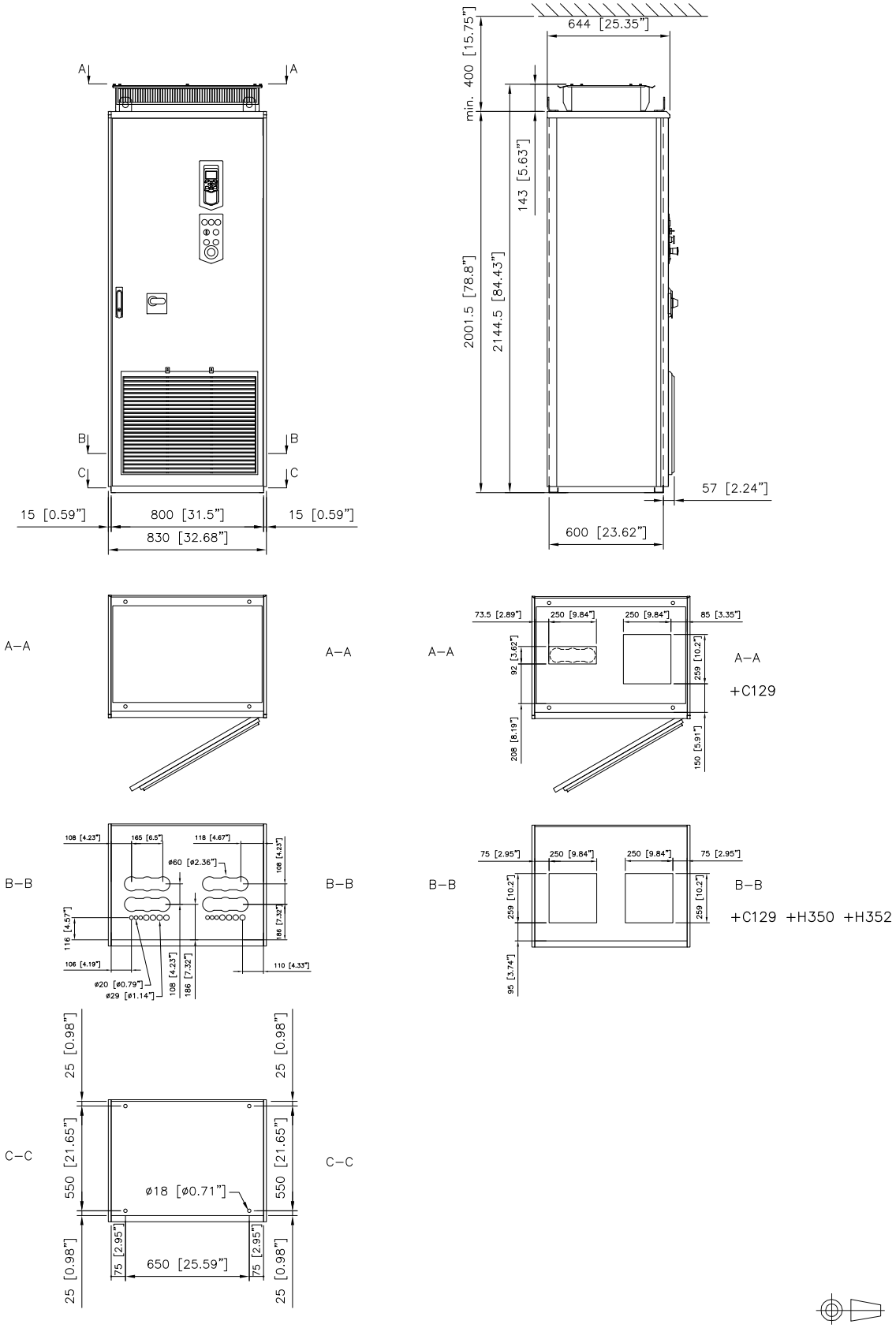
Frame R9 (IP54 / UL Type 12 [+B055]) – standard and options +C129, +H350, +H352



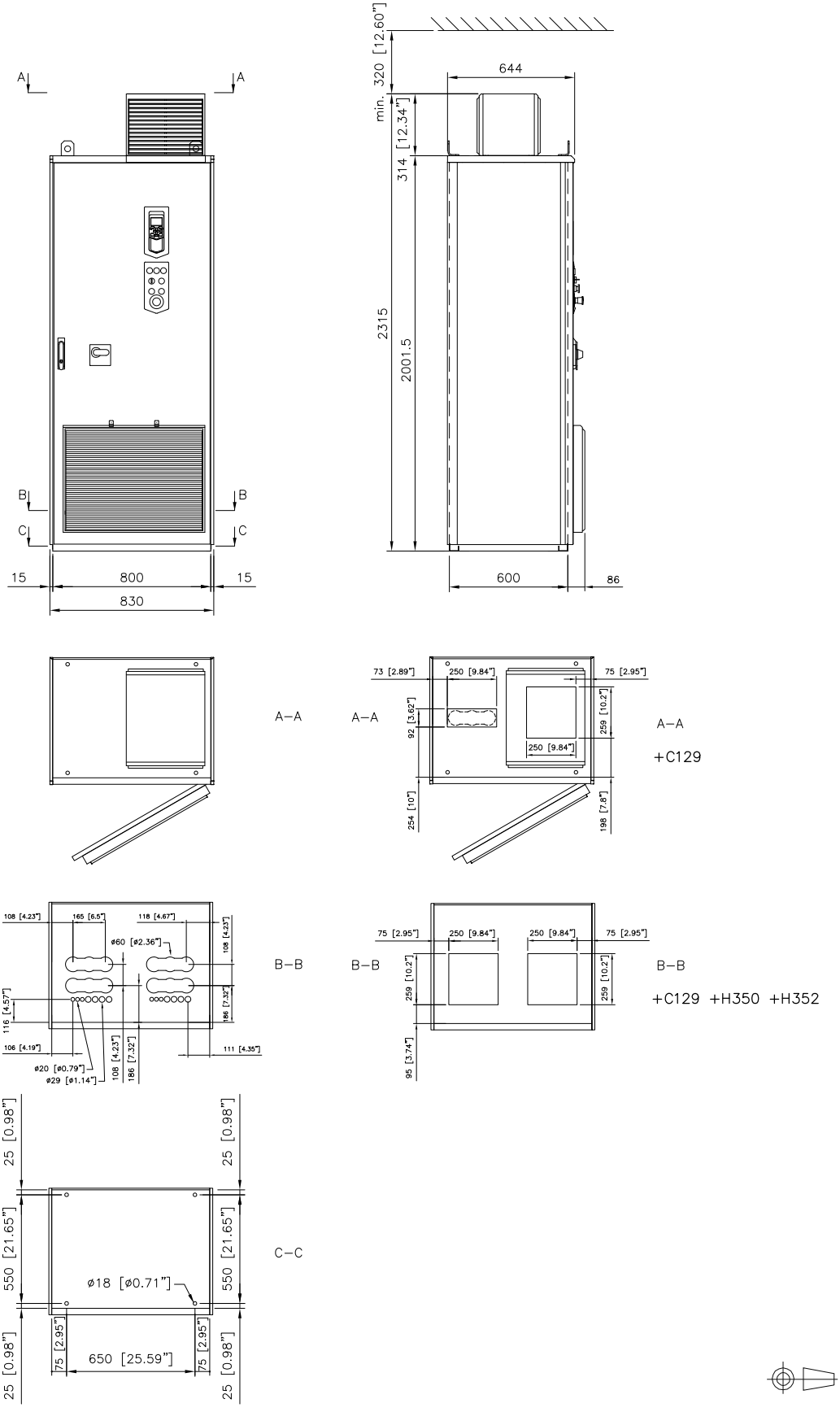
Frame R9 marine (option +C121) – standard and options +C129, +H350, +H352



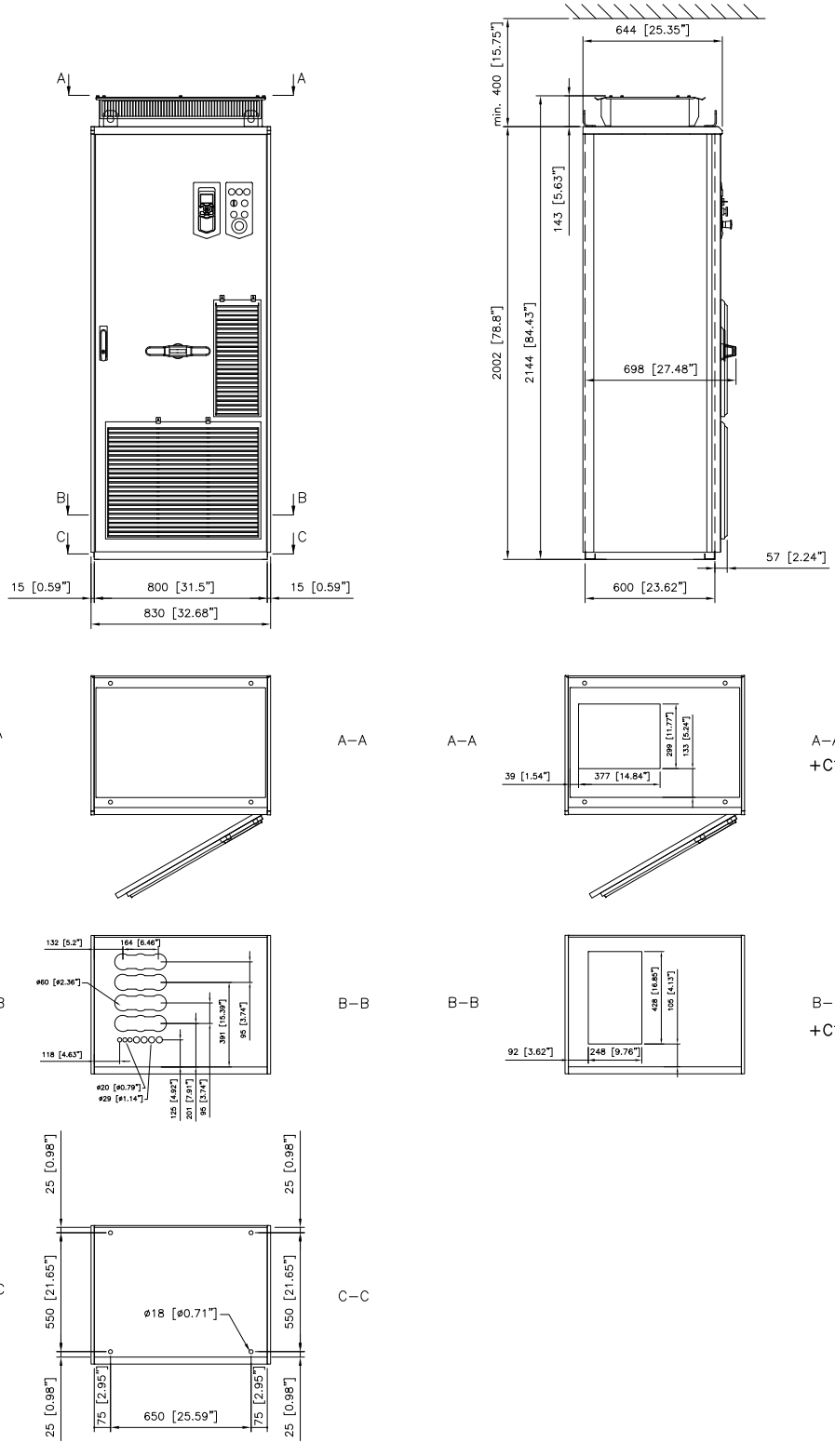
Frames R6 to R8 with options +F289, +C129, +H350, +H352 (UL Type 1)



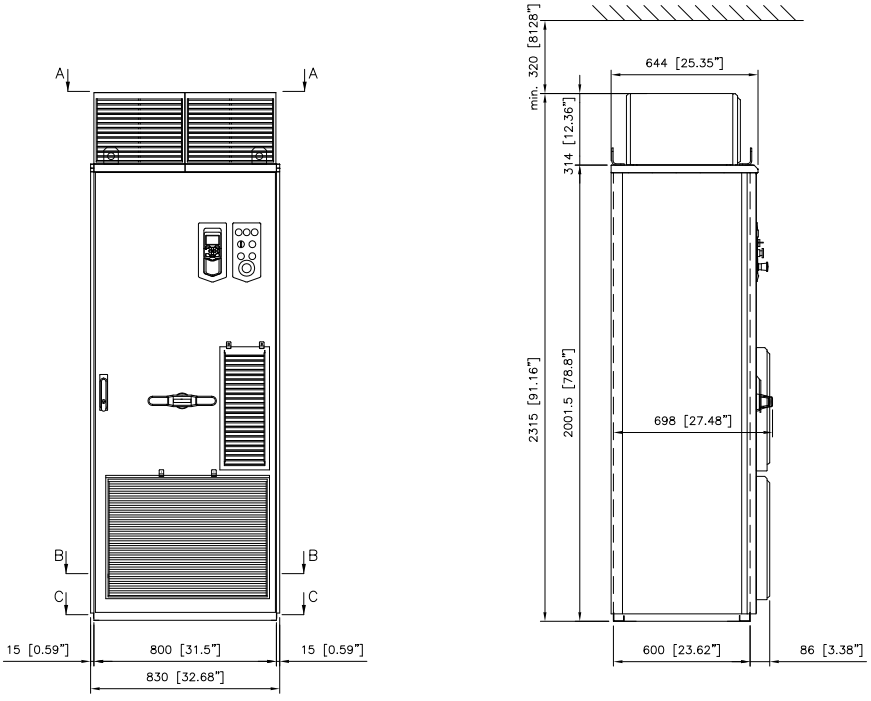
Frames R6 to R8 with options +F289, +C129, +H350, +H352 (UL Type 12 [+B055])

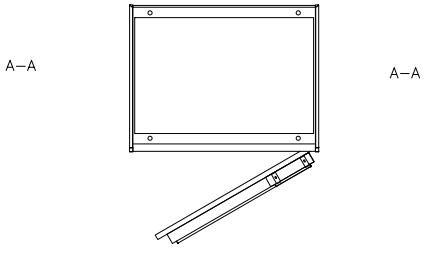


Frames R10 and R11 (IP22, IP42 [+B054], UL Type 1) – standard and options +C129, +H350, +H352

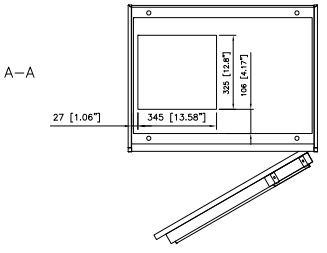


Frames R10 and R11 (IP54 / UL Type 12) – standard and options +C129, +H350, +H352

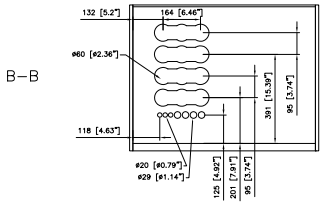




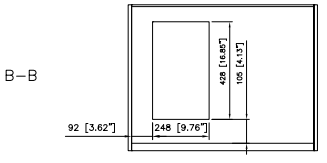
A–A



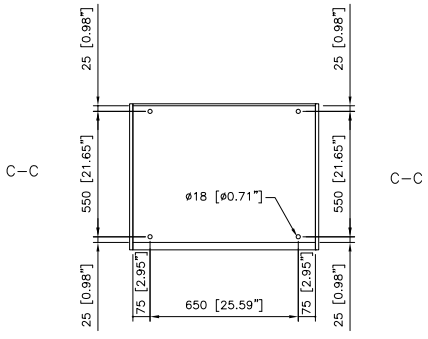
A–A
+C129



B–B



B–B
+C129 +H350 +H352



C–C

15

Safe torque off function

Contents of this chapter

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

Description

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

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

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

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

Standard	Name
EN 60204-1:2016	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*
IEC 61326-3-1:2008	*Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*

Standard	Name
IEC 61508-1:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*
IEC 61508-2:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*
IEC 61511-1:2016	*Functional safety – Safety instrumented systems for the process industry sector*
IEC 61800-5-2:2016 EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
IEC 62061:2015 EN 62061:2005 +AC:2010+A1:2013+A2:2015	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1:2015	*Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*
EN ISO 13849-2:2012	*Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

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

Compliance with the European Machinery Directive

See section *Compliance with the European Machinery Directive* on page *222*.

Wiring

The following diagrams present examples of Safe torque off wiring for

- a single drive (page *241*)
- multiple drives (page *243*)
- multiple drives when an external 24 V DC power supply is used (page *244*).

For the specification of the STO input, see section *Safe torque off (XSTO)* on page *143*.

Activation switch

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

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

Cable types and lengths

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

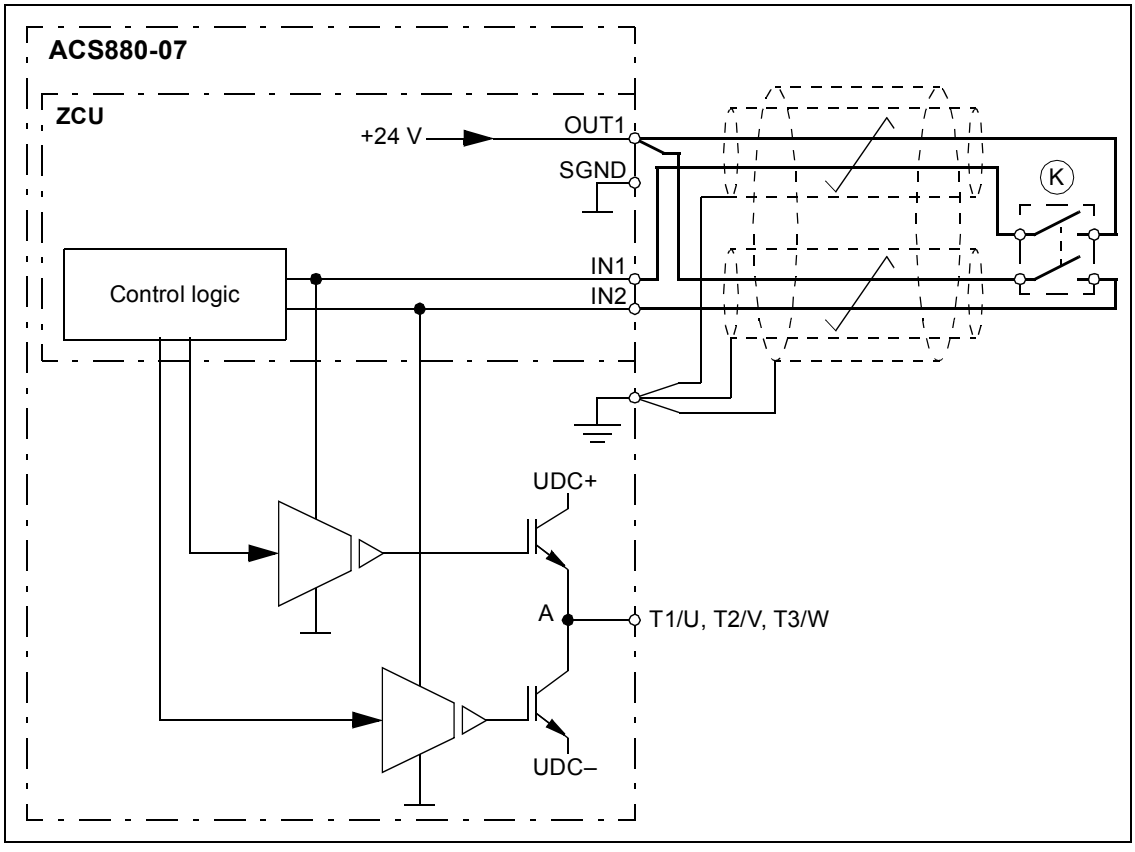
Note: The voltage at the INx terminals of each drive must be at least 17 V DC to be interpreted as “1”.

Grounding of protective shields

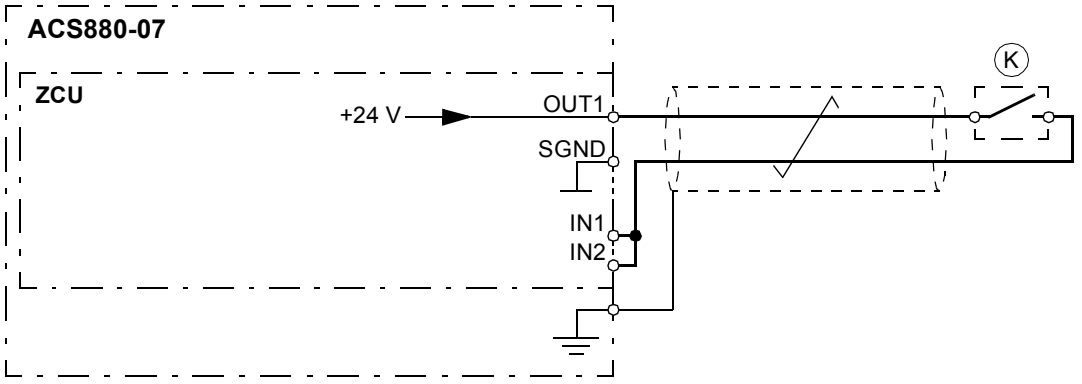
- Ground the shield in the cabling between the activation switch and the control unit at the control unit.
- Ground the shield in the cabling between two control units at one control unit only.

Single drive (internal power supply)

Dual-channel connection



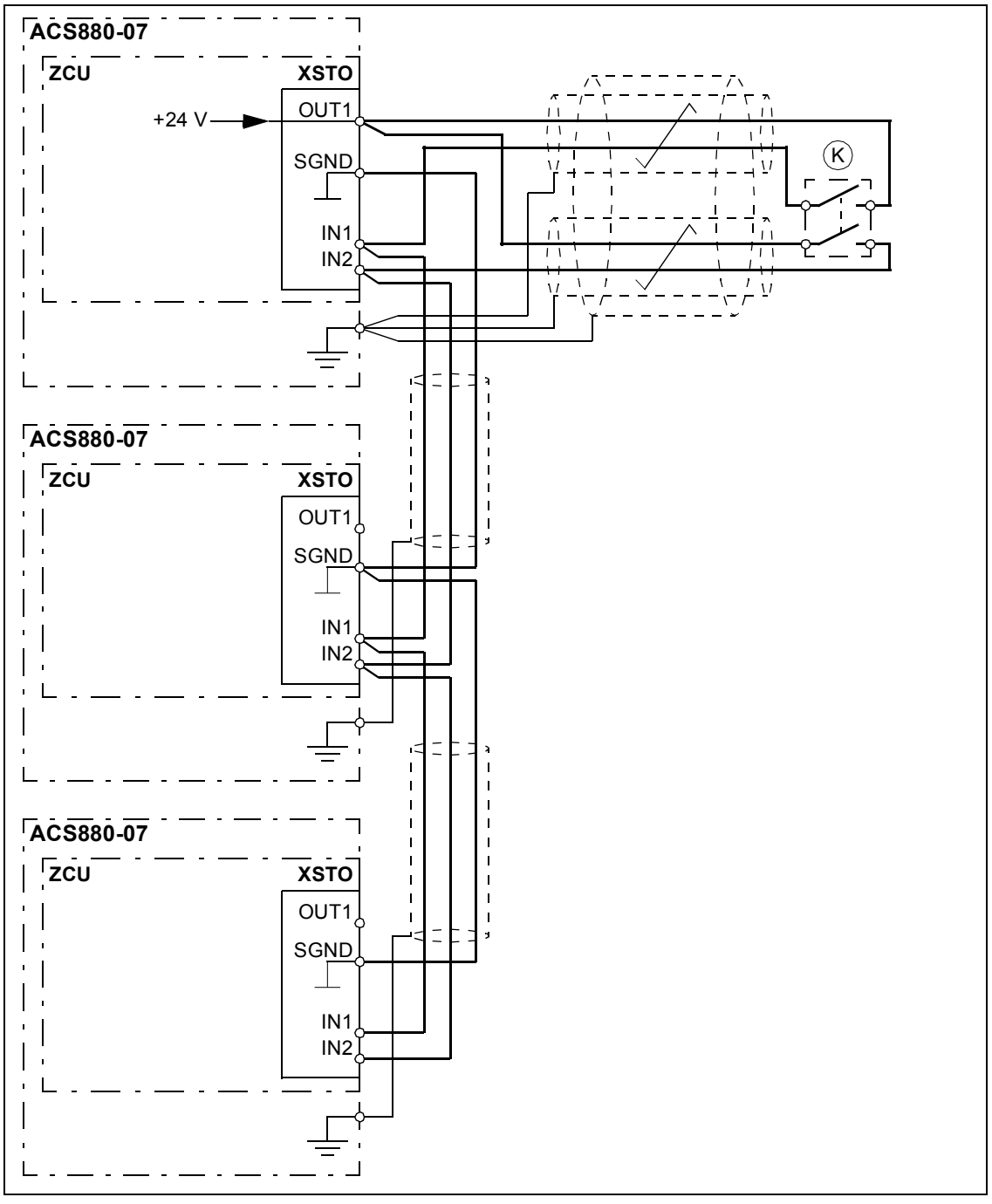
Single-channel connection



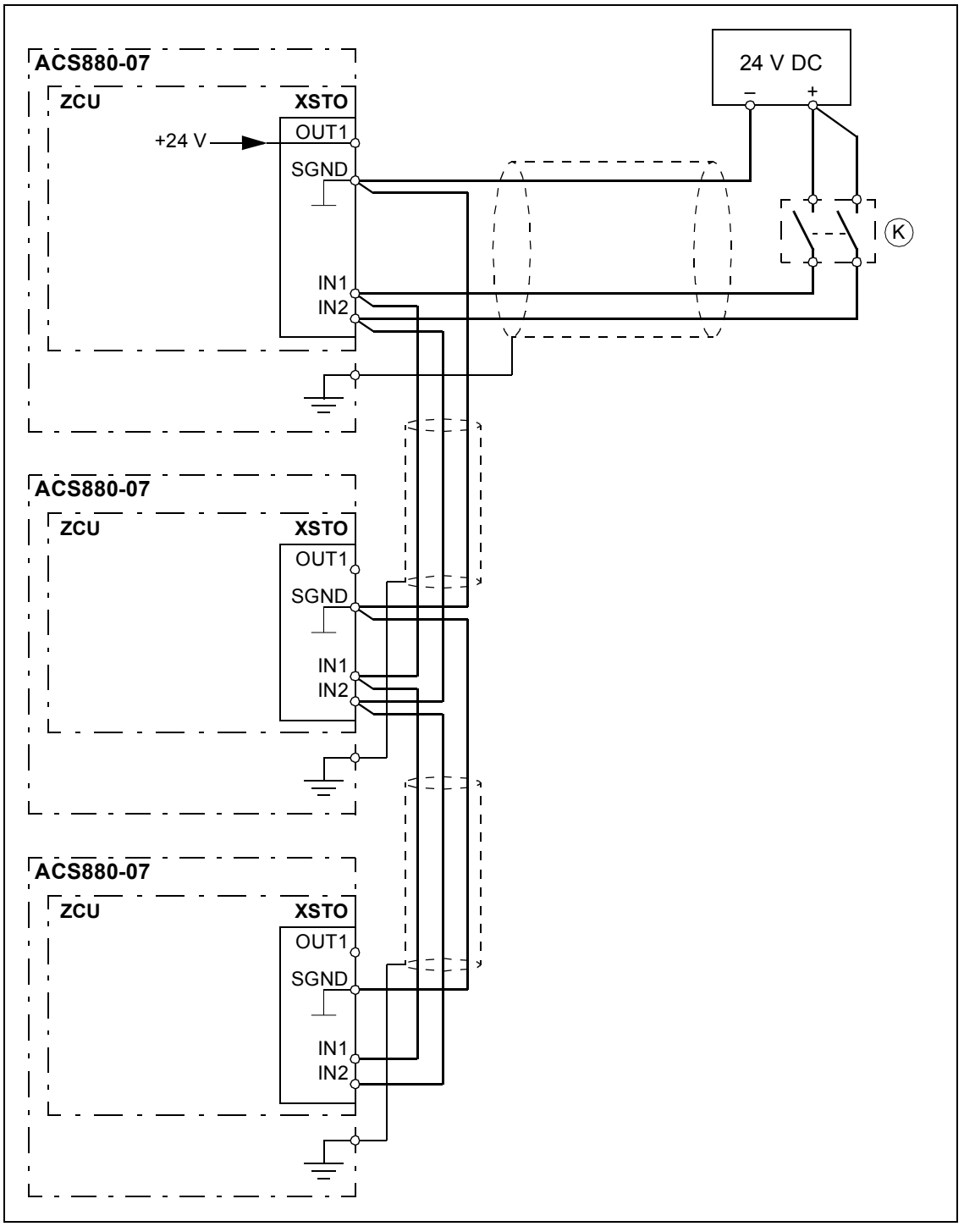
Notes:

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

Multiple drives (internal power supply)



Multiple drives (external power supply)



Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. The STO inputs on the drive control unit de-energize.
3. The control unit cuts off the control voltage from the drive IGBTs.
4. The control program generates an indication as defined by parameter **31.22** (refer to the firmware manual of the drive).
5. Motor coasts to a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, 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 +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q978 or +Q979, do the procedure shown in the documentation of the option.

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

Note: If an FSO-xx safety functions module or an FPTC-0x module is installed, refer to its documentation.

Action	☑
WARNING! Follow the *Safety instructions* on page *15*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.	☐
Make sure that the drive can be run and stopped freely during start-up.	☐

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

Use

1. Open the activation switch, or activate the safety functionality that is wired to the STO connection.
2. STO inputs on the drive control unit de-energize, and the drive control unit cuts off the control voltage from the drive IGBTs.
3. The control program generates an indication as defined by parameter **31.22** (refer to the firmware manual of the drive).
4. Motor coasts to 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 reseting the safety functionality that is wired to the STO connection.
6. Reset any faults before restarting.

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

WARNING! (With permanent magnet or synchronous reluctance [SynRM] motors only) In case of a multiple IGBT power semiconductor failure, the drive system can produce an alignment torque which maximally rotates the motor shaft by 180/*p* (with permanent magnet motors) or 180/2*p* (with synchronous reluctance [SynRM] motors) degrees 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 (SIL, PL)* (page *248*). 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 *245*).

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 does not contain any electromechanical components.

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

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

If any wiring or component change is needed after start up, or the parameters are restored, follow the test given in section *Acceptance test procedure* page *245*.

Use only ABB approved spare parts.

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

Competence

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

Fault tracing

The indications given during the normal operation of the Safe torque off function are selected by drive 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 drive firmware manual for the indications generated by the drive, and for details on directing fault and warning indications to an output on the control unit for external diagnostics.

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

Safety data (SIL, PL)

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

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

Frame size	SIL/ SILCL	SC	PL	SFF (%)	PFH (T_1 = 20 a) (1/h)	PFD_{avg} (T_1 = 2 a)	PFD_{avg} (T_1 = 5 a)	$MTTF_d$ (a)	DC* (%)	Cat.	HFT	CCF (%)	Lifetime (a)
U_1 = 380...500 V													
R6	3	3	e	> 99	2.89E-09	2.41E-05	6.02E-05	10340	≥ 90	3	1	80	20
R7	3	3	e	> 99	2.89E-09	2.41E-09	6.02E-05	10340	≥ 90	3	1	80	20

Frame size	SIL/ SILCL	SC	PL	SFF (%)	PFH (T_1 = 20 a) (1/h)	PFD_{avg} (T_1 = 2 a)	PFD_{avg} (T_1 = 5 a)	$MTTF_d$ (a)	DC* (%)	Cat.	HFT	CCF (%)	Lifetime (a)
R8	3	3	e	99.1	3.20E-09	2.66E-4	6.65E-05	10333	≥ 90	3	1	80	20
R9	3	3	e	99.1	3.20E-09	2.66E-4	6.65E-05	10333	≥ 90	3	1	80	20
R10	3	3	e	99.63	3.91E-09	3.43E-5	8.56E-05	18774	≥ 90	3	1	80	20
R11	3	3	e	99.63	3.91E-09	3.43E-5	8.56E-05	18774	≥ 90	3	1	80	20
U_1 = 525...690 V													
R6 to R9	3	3	e	99.1	3.20E-09	2.66E-4	6.65E-05	10333	≥ 90	3	1	80	20
R10, R11	3	3	e	99.63	3.91E-09	3.43E-5	8.56E-05	18774	≥ 90	3	1	80	20

* according to Table E.1 in EN/ISO 13849-1

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with $\triangle T$ = 71.66 °C
  - 1340 on/off cycles per year with $\triangle T$ = 61.66 °C
  - 30 on/off cycles per year with $\triangle T$ = 10.0 °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time.
- The safety data is calculated for redundant use, and does not apply if both channels are not used.
- Frames R6 to R9: The STO is a type A safety component as defined in IEC 61508-2. Frames R10 and R11: The STO is a type B safety component as defined in IEC 61508-2
- Relevant failure modes:
  - The STO trips spuriously (safe failure)
  - The STO does not activate when requested

  A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- STO reaction time (shortest detectable break): 1 ms
- STO response time: 2 ms (typical), 25 ms (maximum)
- Fault detection time: Channels in different states for longer than 200 ms
- Fault reaction time: Fault detection time + 10 ms
- STO fault indication (parameter **31.22**) delay: < 500 ms
- STO warning indication (parameter **31.22**) delay: < 1000 ms

Abbreviations

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

Abbr.	Reference	Description
FIT	IEC 61508	Failure in time: 1E-9 hours
HFT	IEC 61508	Hardware fault tolerance
$MTTF_d$	EN ISO 13849-1	Mean time to dangerous failure: (The total number of life units) / (the number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD_{avg}	IEC 61508	Average probability of dangerous failure on demand
PFH	IEC 61508	Average frequency of dangerous failures per hour
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
SS1	IEC/EN 61800-5-2	Safe stop 1
STO	IEC/EN 61800-5-2	Safe torque off
T1	IEC 61508-6	Proof test interval. T1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of T1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. Note that any T1 values given cannot be regarded as a guarantee or warranty. See also section *Maintenance* (page *161*).

16

Resistor braking

Contents of this chapter

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

Operation principle and hardware description

The drive can be equipped with an optional built-in brake chopper (+D150). Brake resistors are available as add-on kits or factory installed (+D151).

The brake chopper handles the energy generated by a decelerating motor. During the deceleration, motor generates energy back to the drive and the voltage in the drive intermediate DC link starts to rise. 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 brake circuit components

1. Calculate the maximum power generated by the motor during braking (P_{max}).
2. Select a suitable drive, brake chopper and brake resistor combination for the application from the rating table on page *256*. The braking power of the chopper must be greater or equal than the maximum power generated by the motor during the braking.
3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the heat dissipation capacity of the resistor ($E_{R)}$.

Note: If the E_R value of the resistor is not sufficient, it is possible to use a four-resistor assembly in which two resistors are connected in parallel, two in series. The E_R value of the four-resistor assembly is four times that of a single resistor.

Selecting a custom resistor

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

1. The resistance of the custom resistor is greater or equal than the resistance of the default resistor in the rating table on page *256*:

   $$R \geq R_{min}$$

   where

   R Resistance of the custom resistor.

   WARNING! Never use a brake resistor with a resistance below the value specifed for the particular drive / brake chopper / resistor combination. The drive and the chopper would not able to handle the overcurrent caused by the low resistance.

   R_{min} Resistance of the default resistor

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

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

   where

   P_r Load capacity of the custom resistor

   U_{DC} Drive DC link 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

Selecting and routing the cables of a custom resistor

Use the same cable type for the resistor cabling as for the drive input cabling to ensure that the input fuses also protect the resistor cable. Alternatively, a two conductor shielded cable with the same cross-sectional area can be used.

Minimizing electromagnetic interference

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

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

Maximum cable length

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

EMC compliance of the complete installation

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

Placing custom 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/water 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. The temperature of the air flowing from the resistor is of hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, ensure that the materials withstands high temperatures. Protect the resistor against contact.

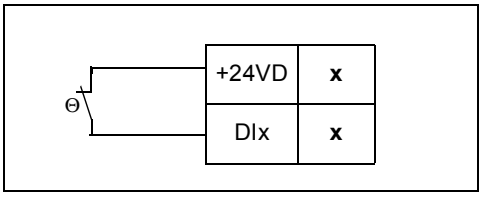
Protecting the brake system against thermal overload

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

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

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

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



Protecting the resistor cable against short-circuits

The input fuses of the drive will also protect the resistor cable provided that the resistor cable is of the same type as the input cable.

Mechanical installation of custom brake resistors

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

Electrical installation of custom brake resistors

Checking the insulation of the assembly

Follow the instructions given under *Custom brake resistor assembly* on page *100*.

Connection diagram

See section *Connection diagram* on page *107*.

Connection procedure

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

- Do the steps in section *Precautions before electrical work* in chapter *Safety instructions* before you start the work.
- Connect the resistor cables to the R+ and R- terminals in the same way as the other power cables. If a shielded three-conductor cable is used, cut the third conductor. Ground the twisted shield of the cable (protective earth conductor of the resistor assembly) at both ends.
- Connect the thermal switch of the brake resistor as described in section *Protecting the brake system against thermal overload* on page *253*.

Brake system start-up

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

Set the following parameters (ACS880 primary control program):

- Disable the overvoltage control of the drive by parameter **30.30 Overvoltage control**.
- Set parameter **31.01 External event 1 source** to point to the digital input where the thermal switch of the brake resistor is wired.
- Set parameter **31.02 External event 1 type** to **Fault**.
- Enable the brake chopper by parameter **43.06 Brake chopper function**. If **Enabled with thermal model** is selected, set also the brake resistor overload protection parameters **43.08** and **43.09** according to the application.
- Set parameter **43.07 Brake chopper run enable** to **Other [bit]** and select from parameter **10.01 DI status** the digital input where the thermal switch of the brake resistor is wired.
- Check the resistance value of parameter **43.10 Brake resistance**.
- With these parameter settings, the drive stops by coasting on brake resistor overtemperature.

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

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

Technical data

Ratings

Drive type	Internal brake chopper		Example brake resistor(s)			
	P_{brcont}	R_{min}	Type	R	E_R	P_{Rcont}
	kW	ohm		ohm	kJ	kW
U_N = 400 V						
ACS880-07-0105A-3	55	5.4	SAFUR80F500	6.0	2400	6
ACS880-07-0145A-3	75	5.4	SAFUR80F500	6.0	2400	6
ACS880-07-0169A-3	90	3.3	SAFUR125F500	4.0	3600	9
ACS880-07-0206A-3	110	3.3	SAFUR125F500	4.0	3600	9
ACS880-07-0246A-3	132	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-07-0293A-3	132	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-07-0363A-3	160	2.0	SAFUR200F500	2.7	5400	13.5
ACS880-07-0430A-3	160	2.0	SAFUR200F500	2.7	5400	13.5
ACS880-07-0505A-3	250	2.0	2×SAFUR125F500	2.00	7200	18
ACS880-07-0585A-3	315	1.3	2×SAFUR200F500	1.35	10800	27
ACS880-07-0650A-3	315	1.3	2×SAFUR200F500	1.35	10800	27
ACS880-07-0725A-3	400	0.7	3×SAFUR200F500	0.90	16200	40
ACS880-07-0820A-3	400	0.7	3×SAFUR200F500	0.90	16200	40
ACS880-07-0880A-3	400	0.7	3×SAFUR200F500	0.90	16200	40
U_N = 500 V						
ACS880-07-0096A-5	55	5.4	SAFUR80F500	6.0	2400	6
ACS880-07-0124A-5	75	5.4	SAFUR80F500	6.0	2400	6
ACS880-07-0156A-5	90	3.3	SAFUR125F500	4.0	3600	9
ACS880-07-0180A-5	110	3.3	SAFUR125F500	4.0	3600	9
ACS880-07-0240A-5	132	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-07-0260A-5	132	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-07-0302A-5	160	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-07-0361A-5	160	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-07-0414A-5	160	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-07-0460A-5	250	2.0	2×SAFUR125F500	2.00	7200	18
ACS880-07-0503A-5	250	2.0	2×SAFUR125F500	2.00	7200	18
ACS880-07-0583A-5	315	1.3	2×SAFUR200F500	1.35	10800	27
ACS880-07-0635A-5	315	1.3	2×SAFUR200F500	1.35	10800	27
ACS880-07-0715A-5	400	0.7	3×SAFUR200F500	0.90	16200	40
ACS880-07-0820A-5	400	0.7	3×SAFUR200F500	0.90	16200	40
ACS880-07-0880A-5	400	0.7	3×SAFUR200F500	0.90	16200	40

Drive type	Internal brake chopper		Example brake resistor(s)			
	P_{brcont}	R_{min}	Type	R	E_R	P_{Rcont}
	kW	ohm		ohm	kJ	kW
U_N = 690 V						
ACS880-07-0061A-7	55	13	SACE15RE13	13.0	435	2
ACS880-07-0084A-7	65	13	SACE15RE13	13.0	435	2
ACS880-07-0098A-7	90	8	SAFUR90F575	8.0	1800	4.5
ACS880-07-0119A-7	110	8	SAFUR90F575	8.0	1800	4.5
ACS880-07-0142A-7	132	6	SAFUR80F500	6.0	2400	6
ACS880-07-0174A-7	160	6	SAFUR80F500	6.0	2400	6
ACS880-07-0210A-7	200	4	SAFUR125F500	4.0	3600	9
ACS880-07-0271A-7	200	4	SAFUR125F500	4.0	3600	9
ACS880-07-0330A-7	285	2.2	SAFUR200F500	2.7	3600	13
ACS880-07-0370A-7	285	2.2	SAFUR200F500	2.7	3600	13
ACS880-07-0430A-7	285	2	SAFUR200F500	3	3600	13
ACS880-07-0470A-7	350	2	2xSAFUR125F500	2	7200	18
ACS880-07-0522A-7	350	2	2xSAFUR125F500	2	7200	18
ACS880-07-0590A-7	400	2	2xSAFUR125F500	2	7200	18
ACS880-07-0650A-7	400	1.8	2xSAFUR125F500	2	7200	18
ACS880-07-0721A-7	400	1.8	2xSAFUR125F500	2	7200	18

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

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

R Resistance value for the listed resistor assembly

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

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

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

Degree of protection of SAFUR resistors

The degree of protection of SAFUR resistors is IP00.

Terminals and cable entry data

See section *Terminal and entry data for the power cables* on page *210*.

Further information

Product and service inquiries

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

Product training

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

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