ABB INDUSTRIAL DRIVES

ACS880-107LC inverter units

Hardware manual

ACS880-107LC inverter units

Hardware manual

3AXD50000196111 Rev D
EN
Original instructions
EFFECTIVE: 2023-06-30

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Introduction to the manual

Contents of this chapter

This chapter gives basic information on the manual.

Applicability

This manual is applicable to ACS880-107LC inverter units that form a part of a drive system.

Safety instructions

Obey all safety instructions delivered with the drive.

- Read the **complete safety instructions** before you install, commission, use or service the drive. The complete safety instructions are given in ACS880 liquid-cooled multidrive cabinets and modules safety instructions (3AXD50000048633 [English]).
- Read the **software-function-specific warnings and notes** before changing the default settings of a function. For each function, the warnings and notes are given in the section describing the related user-adjustable parameters.
- Read the **task-specific safety instructions** before starting the task. See the section describing the task.

Target audience

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

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

Categorization by frame size and option code

Some descriptions, instructions, technical data and other information that concern only a certain group of units may be marked with the frame size (such as "R8i", "4×R8i", etc.) The marking derives from the quantity and basic construction of the modules that form the unit. For example, the frame size "2×R8i" indicates that the unit consists of two frame size R8i modules connected in parallel.

The frame size is marked on the type designation labels. The frame size of each unit is also shown in the rating tables in chapter Technical data (page 135).

The information that concerns only certain optional selections is marked with option codes (such as +E205). The options included in the unit can be identified from the type code visible on the type designation label. The option selections are listed in section Inverter unit type designation key (page 29).

Use of component designations

Some device names in the manual include the component designation in brackets (for example, [Q20]). This will help you to identify the components in the circuit diagrams of the drive.

Related documents

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

	Manuals for ACS880 multidrives cabinets

Terms and abbreviations

Term	Description
BCU	Type of control unit
CIO	I/O module for controlling cooling fans
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
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
FIO-11	Optional analog I/O extension module
FPTC-01	Optional thermistor protection module
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres
Frame, frame size	Physical size of the drive or power module
FSO-12, FSO-21	Optional functional safety modules
IGBT	Insulated gate bipolar transistor
Inverter unit	Inverter module(s) under control of one control unit, and related components. One inverter unit typically controls one motor.
Power module	Common term for drive module, inverter module, supply module, brake chopper module etc.
RFI	Radio-frequency interference
STO	Safe torque off (IEC/EN 61800-5-2)
Supply unit	Supply module(s) under control of one control unit, and related components.

2

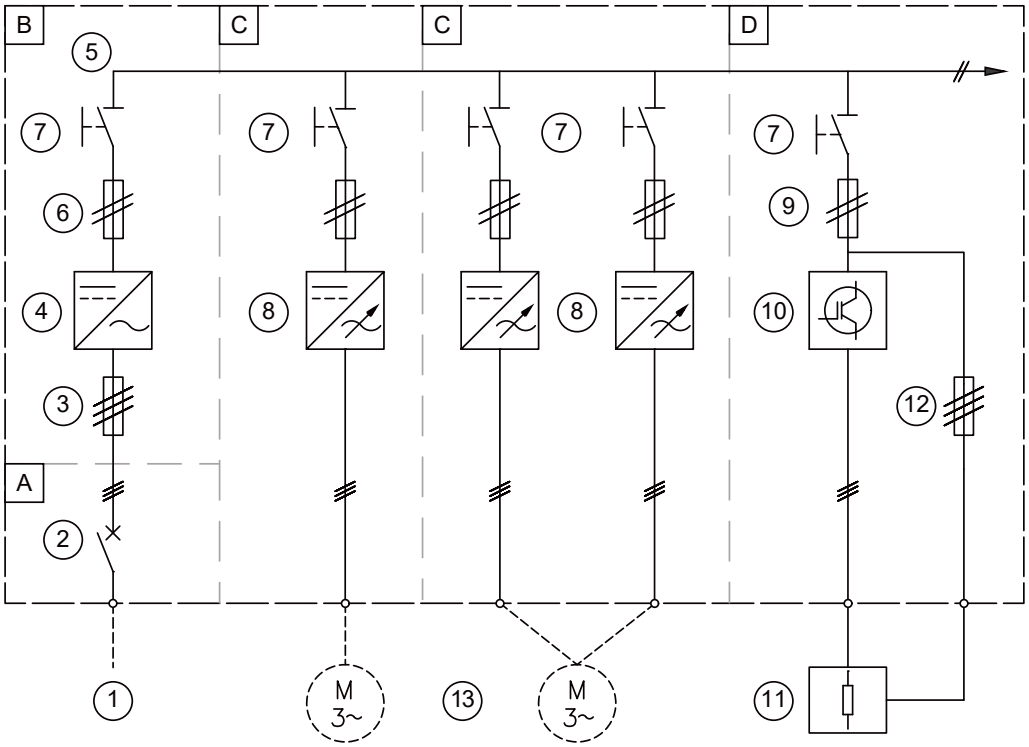
Operation principle and hardware description

Contents of this chapter

This chapter describes a typical drive system and the hardware of the inverter unit.

Overview diagram of the drive system

This diagram shows an example of a multidrive. The supply unit connects the drive to the AC supply network. It converts the AC voltage into DC. The DC voltage is distributed through the DC bus to all inverter units and optional brake units. The inverter unit converts the DC back to AC that rotates the motor. The brake unit (optional) conveys energy to brake resistors whenever needed.



A	Incoming unit
B	Supply unit
C	Inverter unit
D	Brake unit (optional)
1	AC supply
2	Main breaker, or main contactor and main switch-disconnector
3	Input (AC) fuses
4	Supply module
5	DC bus
6	Supply and inverter module DC fuses
7	DC switch/disconnector (optional)
8	Inverter modules
9	Brake chopper fuses
10	3-phase brake chopper module (optional)
11	Brake resistors (optional or acquired by user)
12	Fuses for the brake resistors
13	Motor(s) (acquired by user)

Inverter unit hardware

General

An inverter unit contains the components required to control one motor. These include one or more inverter modules connected in parallel, together with the necessary auxiliary equipment such as control electronics, fusing, cabling and switchgear.

ACS880-107LC inverter units range from 55 to 6000 kW in power. The units employ ACS880-104LC modules. Up to approximately 800 kW, inverter units consist of one module only; higher power ratings are achieved by connecting multiple modules in parallel.

All inverter modules have coated circuit boards as standard.

Inverter module hardware

Frame R7i

Frame R7i modules provide output power in the range of 55 to 355 kW.

Each module is mounted in an installation frame. The frame has quick connectors for both the DC and AC power connections, so the module can be easily extracted from the cabinet. The module is secured to its frame by a locking screw that is accessible from the front.

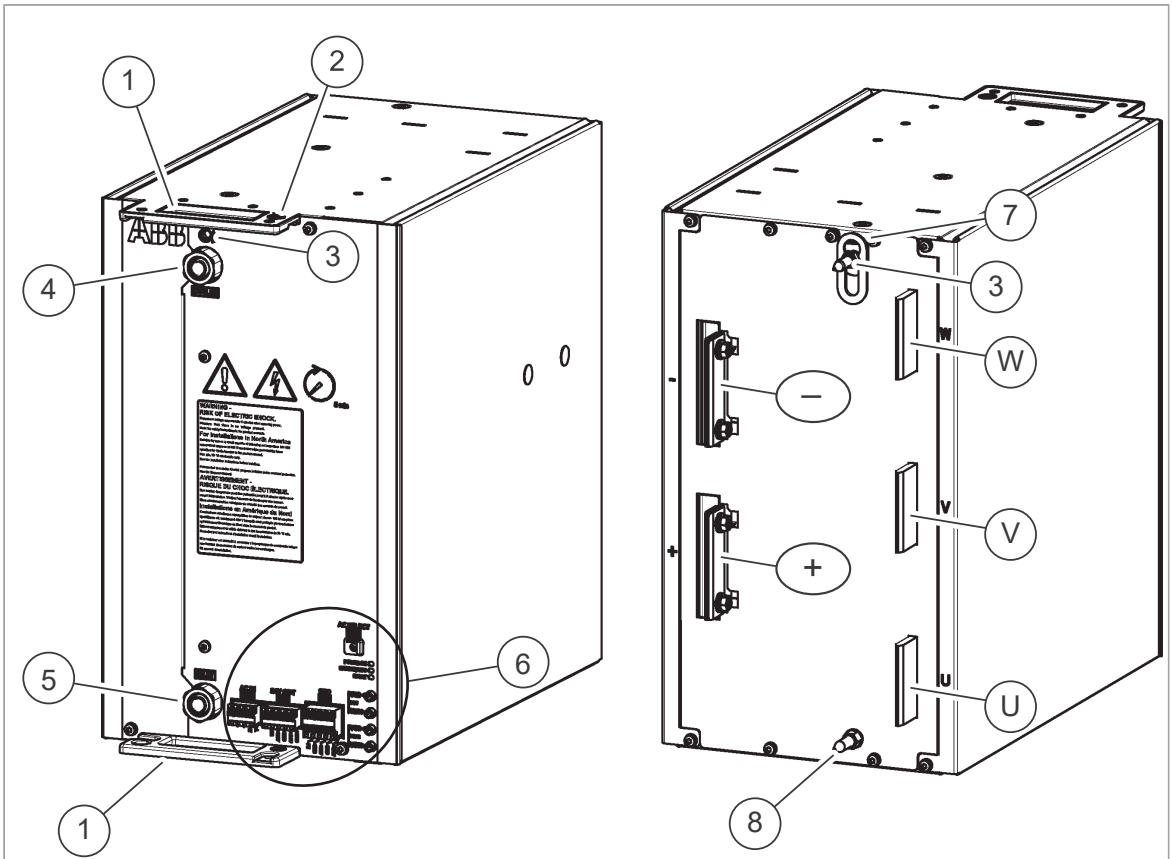
The front cover plate of the module can be pulled out for access to the circuit board compartment without removing the module.

690 volt modules have internal du/dt filtering by default. For 500 volt modules this is available as an option.

Control unit

R7i modules employ a separate control unit (BCU) that contains the BCON board with basic I/Os and slots for optional I/O modules. A fiber optic link connects the BCU to each inverter module. Any safety circuits utilizing the built-in Safe torque off functionality are connected to the BCU. The forwarding connector of the BCU is wired to the inverter module.

Module layout



1	Handle
2	Lifting eye, front
3	Locking screw (for 6 mm hex key). Torque: 5 N·m (3.7 lbf·ft) maximum.
4	Coolant out connector
5	Coolant in connector
6	Connectors X50, X52 and X53; fiber optic connectors; LEDs; auxiliary voltage selector X59.
7	Lifting ring, rear
8	Guide pin
+ –	DC connection busbars. The busbars engage with the quick connectors of the installation frame.
U V W	AC connection busbars. The busbars engage with the quick connectors of the installation frame.

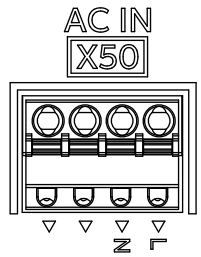
Coolant connectors

The coolant pipe inlet and outlet connectors are located at the bottom front and top front of the module respectively. The connectors are for 16/13 millimeter PA (polyamide) pipe.

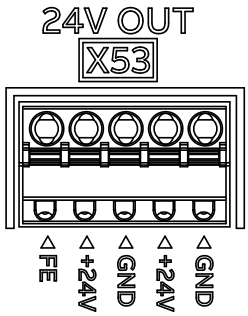
Connectors X50, X52 and X53; Auxiliary voltage selector X59

R7i modules contain a power supply board that provides 24 V DC for the circuit boards of the module.

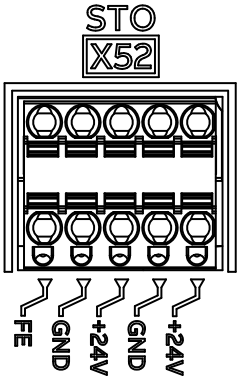
The power supply board of the module is powered internally from the DC link.



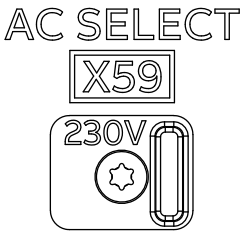
Auxiliary voltage input for internal power supply of module. Voltage selected by X59.



24 V DC output (for eg. BCU control unit)



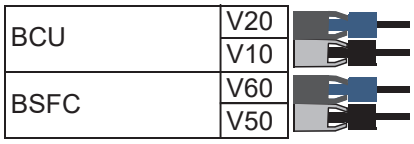
Incoming STO signals from BCU control unit



Auxiliary voltage: 230 V AC

Auxiliary voltage: 115 V AC

Fiber optic connectors



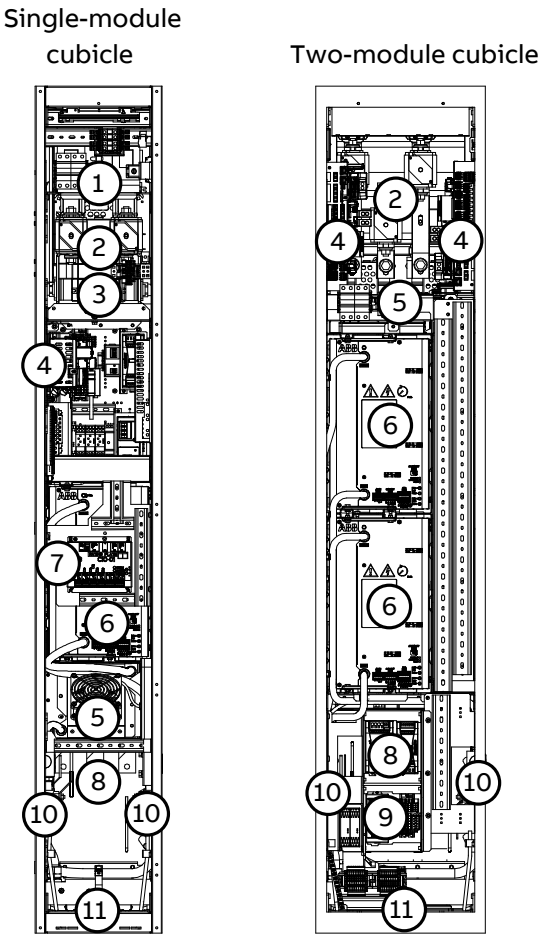
Name	Description
BCU	Control unit connection.
BSFC	Charging controller connection.

LEDs

LED	Color	Indication
FAULT	Continuous red	There is an active fault in the module.
ENABLE / STO	Continuous green	The module is ready for use.
ENABLE / STO	Continuous yellow	XSTO connectors are de-energized.
POWER OK	Continuous green	Supply voltage of the internal circuit boards is OK (> 21 V).

Cabinet layout

Frame R7i inverter units are available in two different cubicles, ie. a 300 mm wide cubicle for one module, and a 400 mm wide cubicle with two modules. Each module has its own control unit and output terminals.



No.	Description
1.	DC switch-disconnector (optional for one-module cubicle)
2.	DC fuses
3.	Charging switch (one-module cubicle with DC switch-disconnector)
4.	Control unit. In a two-module cubicle, each inverter module has its own control unit.
5.	Cooling fan and heat exchanger. Single-module cubicles have one fan, two-module cubicles have two fans.
6.	Inverter module
7.	CIO module for fan monitoring
8.	Output terminals. In a two-module cubicle, the set of busbars closer to the back wall are the output of the upper module.
9.	Mounting plate for control circuit components (present if required by option selection)
10.	Stop valves for incoming and outgoing coolant; drain valves and hoses
11.	Power and control cable entries

Frame R8i and multiples

Frame R8i modules are used to achieve output powers from approximately 350 kW upwards in single or parallel configurations.

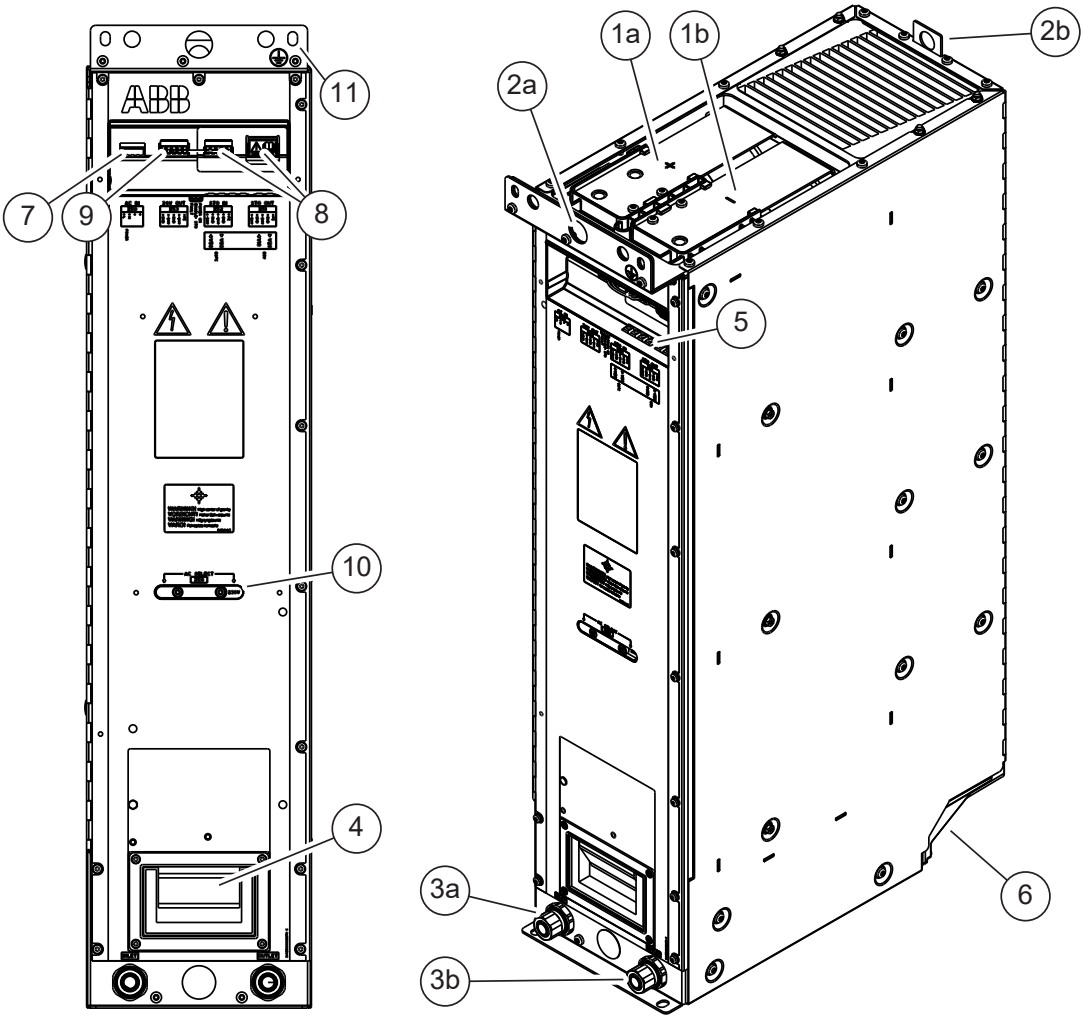
The DC connection of the module is by busbars and located at the top. The motor connection is via a quick connector at the back of the module that couples when the module is inserted into the cubicle. Each parallel-connected module is cabled separately to the motor, or connected by busbars to adjacent modules to reduce the number of cables. It is also possible to build an AC bus from each module to a separate output cubicle.

Internal du/dt filtering is mandatory with all 690 volt units and all parallel-connected modules. 690 volt modules have internal du/dt filtering as standard.

Control unit

Inverter units consisting of one or several R8i modules employ a separate control unit (BCU) that contains the BCON board with basic I/Os and slots for optional I/O modules. A fiber optic link connects the BCU to each inverter module. Any safety circuits utilizing the built-in Safe torque off functionality are connected to the BCU. The forwarding connector of the BCU is wired to the inverter module(s).

Module layout



No.	Description
1.	DC input busbars
2.	Lifting eyes, front (a) and back (b)
3.	Coolant in (a) and out (b) connectors. See section Coolant connectors.
4.	Handle
5.	Fiber optic connectors. See section Fiber optic connectors.
6.	Quick connector (AC output) (the counterpart fastened to the cabinet behind the module)
7.	Terminal block X50 (auxiliary power input for internal boards). See section Connectors X50…X59.
8.	Terminal block X51 and X52 (Safe torque off). See section Connectors X50…X59.
9.	Terminal block X53 (24 V DC power output). See section Connectors X50…X59.
10.	Auxiliary voltage selector (115 or 230 V). See section Connectors X50…X59.
11.	Unpainted fastening hole. The grounding point (PE) between module frame and cabinet frame.

Coolant connectors

The coolant pipe inlet and outlet connectors are located at the bottom front of the module. The connectors are for 16/13 millimeter PA (polyamide) pipe.

WARNING!
For a reliable connection, the end of the pipe entering the connector must be completely intact for a length of at least 5 cm (2”). Make sure the pipe is perfectly round where it enters the connector, and not deformed eg. by any bends nearby. The piping must not exert any tension or torque on the connector.

Connectors X50...X59

R8i modules contain a power supply (BDPS) that provides 24 V DC for the circuit boards of the module. The 24 V DC voltage provided by the BDPS is also available on X53, and can be used to power the BCU control unit of a single R8i inverter module.

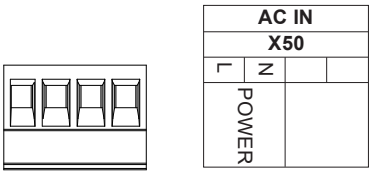
Note: With an inverter unit consisting of parallel-connected R8i modules, it is strongly recommended to use an external 24 V DC supply to power the BCU control unit.

The BDPS is powered internally from the DC link. An auxiliary voltage of 230 V AC or 115 V AC (selectable) can optionally be fed to terminal block X50 to power the BDPS even when the DC link is not live. The selection between 115 V and 230 V is made with selector plug X59. The setting can be changed by removing the two screws, turning the plug 180 degrees, and reinstalling the screws.

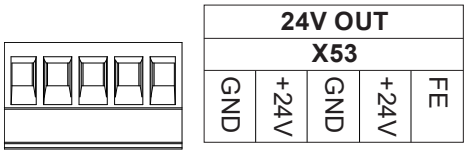
If the Safe torque off (STO) function is not used, the “24V” inputs on X52 must be connected to +24 V (on connector X53, for example) on each inverter module. On a new module, a jumper wire set installed at the factory makes this connection.

If the STO function is to be implemented, the jumper wire set must be removed – a mechanical interlocking device is factory-installed on connectors X51 and X52 to this effect.

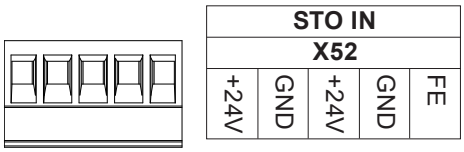
For STO, X52 (STO IN) is wired to the STO OUT connector on the BCU control unit. Connector X51 on the module is wired to connector X52 on the next module (if present). For details, see chapter The Safe torque off function (page 107).



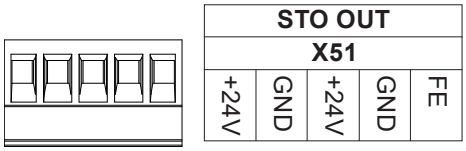
Auxiliary voltage inputs for internal power supply (BDPS)



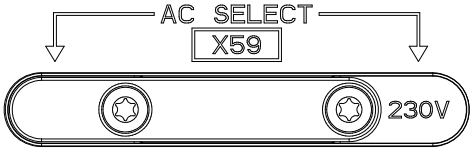
24 V DC output (for eg. BCU control unit)



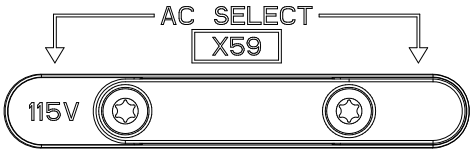
STO signals from BCU control unit



STO signal forwarding output to next inverter module (if present)



Auxiliary voltage: 230 V AC



Auxiliary voltage: 115 V AC

Fiber optic connectors

BSFC	V50←	
	V60→	
BCU	V10←	
	V20→	

Name	Description
BSFC	Reserved.
BCU	Control unit connection. Must be connected by the installer.

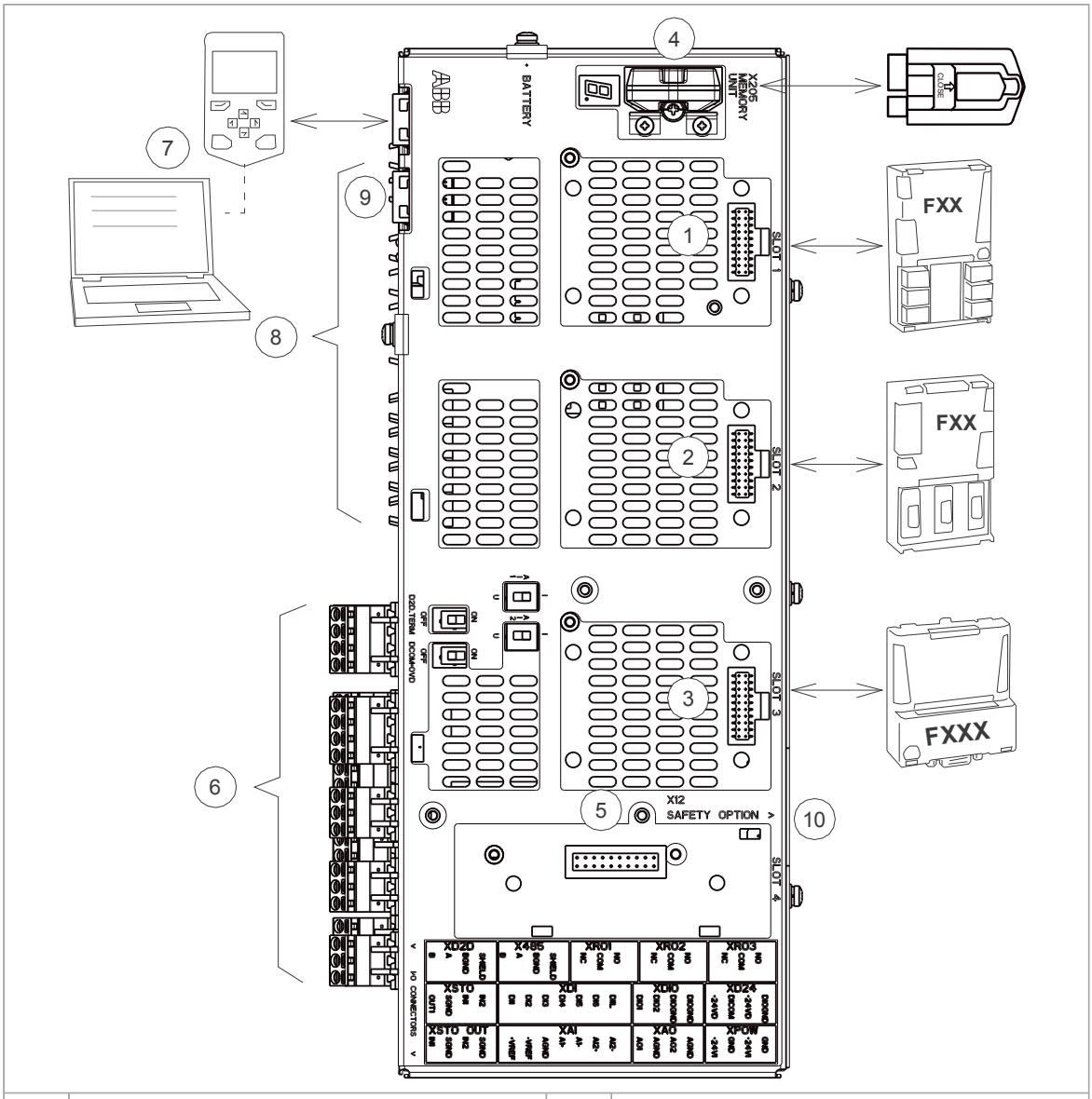
Cooling system

See chapter Internal cooling circuit (page 127).

Control interfaces

Overview of the control connections of the BCU control unit

The diagram shows the control connections and interfaces of the BCU control unit.



1 2 3	Analog and digital I/O extension modules and fieldbus communication modules can be inserted into slots 1, 2 and 3.	7	Control panel.
4	Memory unit	8	Fiber optic links to power modules (inverter, supply, brake or converter)
5	Slot 4 for RDCO-0x	9	Ethernet port. Not in use.
6	Terminal blocks.	10	Safety option interface. Only in use for the inverter units.

The control panel

The AC…-AP-… control panel is the user interface of the inverter unit, providing 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 inverter units through a panel link provided that each unit is equipped with panel holder or an FDPI-02 module.

Note: A control panel is required for the commissioning of an ACS880 drive system, even if the Drive composer PC tool is used.

For details on the control panel, see ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user's manual (3AUA0000085685 [English]).

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.

For more information, see section Connecting a PC.

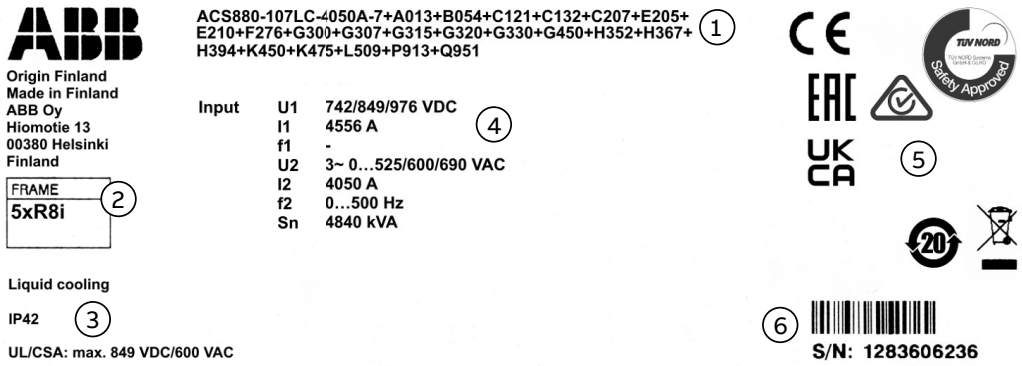
Type designation labels

Inverter unit type designation label

Each inverter unit has a type designation label attached onto the inside of the cubicle door. Note that an inverter unit may consist of several cubicles and inverter modules.

The type designation stated on the label contains information on the specifications and configuration of the unit. The first digits express the basic construction of the unit, for example “ACS880-107LC-0600A-7”. Any optional selections are given thereafter, separated by plus signs.

Quote the complete type designation and serial number when contacting technical support on the subject of individual inverter modules. An example of the label is shown below.



No.	Description
1	Type designation (see Inverter unit type designation key)
2	Frame size
3	Cooling method, degree of protection, additional UL/CSA specifications
4	Ratings (see also section Ratings (page 136))
5	Valid markings. See ACS880 liquid-cooled multidrive cabinets and modules electrical planning (3AXD50000048634 [English]).
6	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.

Inverter module type designation label

Each inverter module has a type designation label attached to it. The type designation stated on the label contains information on the specifications and configuration of the unit. The first digits express the basic construction of the unit, for example “ACS880-104LC-0850A-7”. Any optional selections are given thereafter, separated by plus signs.

Quote the complete type designation and serial number when contacting technical support on the subject of individual inverter modules.

Inverter unit type designation key

The type designation contains information on the specifications and configuration of the unit. The first digits from left express the basic configuration (for example, ACS880-107LC-0850A-7). The optional selections are given thereafter, separated by plus signs. The main selections are described below. Not all selections are available for all types.

Code	Description
B054	IP42 (UL Type 1 Filtered)
C121	Marine construction
C128	Air inlet through bottom of cabinet
C129	UL Listed (evaluated to both U.S. and Canadian safety requirements)
E205	du/dt filtering
E208	Common mode filtering
F286	DC switch-disconnector
G300	Cabinet and module heating elements (external supply)
G301	Cabinet lighting
G304	Control (auxiliary) voltage 115 V AC
G313	Output for motor space heater (external supply)
G330	Halogen-free wiring and materials
G338	Wire marking class A1
G339	Wire marking class A2
G340	Wire marking class A3
G341	Wire marking class B1
G342	Wire marking class C1
H353	Power cabling exit from top
H359	Common motor terminal cubicle
H366	Common output terminals (for inverter modules mounted in the same cubicle)
H394	Cable entry, Roxtec frame without sealing components
J400	ACS-AP-W control panel (with Bluetooth)
J410	Control panel mounting platform
K450	Panel bus (control of several units from one control panel)
K451	FDNA-01 DeviceNet™ adapter module
K452	FLON-01 LonWorks® adapter module
K454	FPBA-01 PROFIBUS DP® adapter module
K457	FCAN-01 CANopen® adapter module
K458	FSCA-01 RS-485 (Modbus/RTU) adapter module
K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCAT® adapter module
K470	FEPL-02 Ethernet POWERLINK adapter module
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
K480	Ethernet switch for PC tool or control network (for max. 6 inverter units)

Code	Description
K483	Ethernet switch with optical link for PC tool or control network (for max. 6 inverter units)
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
L505	Thermal protection with PTC relays (1 or 2 pcs)
L506	Thermal protection with Pt100 relays (3, 5 or 8 pcs)
L508	FDCO-02 optical DDCS communication adapter module
L513	ATEX-certified thermal protection with PTC relays (1 or 2 pcs)
L514	ATEX-certified thermal protection with Pt100 relays (3, 5 or 8 pcs)
L515	FEA-03 I/O extension adapter
L516	FEN-21 resolver interface module
L517	FEN-01 TTL incremental encoder interface module
L518	FEN-11 TTL absolute encoder interface module
L521	FSE-31 pulse encoder interface module
L525	FAIO-01 analog I/O extension module
L526	FDIO-01 digital I/O extension module
L536	FPTC-01 thermistor protection module
L537	FPTC-02 ATEX-certified thermistor protection module
M602	Starter for auxiliary motor fan, trip limit 2.5 … 4 A
M603	Starter for auxiliary motor fan, trip limit 4 … 6.3 A
M604	Starter for auxiliary motor fan, trip limit 6.3 … 10 A
M605	Starter for auxiliary motor fan, trip limit 10…16 A
M606	Starter for auxiliary motor fan, trip limit 16…20 A
M610	Starter for auxiliary motor fan, trip limit 20…25 A
N5000	Winder control program
N5050	Crane control program
N5100	Winch control program
N5200	PCP (Progressive Cavity Pump) control program
N5300	Test bench control program
N5450	Override control program
N5600	ESP (Electrical Submersible Pump) control program
N7502	Control program for synchronous reluctance motors (SynRM)
N8010	IEC 61131-3 application programmability
P902	Customized
P904	Extended warranty (30 months from delivery or 24 months from commissioning)
P912	Seaworthy packaging
P913	Special color (RAL Classic)
P929	Container packaging
P966	Special color (other than RAL Classic)
Q965	Safely-limited speed with FSO-21 and encoder

Code	Description
Q966	Safely-limited speed without encoder
Q971	ATEX-certified safe disconnection function
Q972	FSO-21 safety functions module
Q973	FSO-12 safety functions module
Q982	PROFIsafe with FSO safety functions module and FPNO-21 Ethernet adapter module
Q986	FSPS-21 PROFIsafe safety functions module

3

Electrical installation

Contents of this chapter

This chapter gives instructions on the wiring of the drive.

Electrical safety precautions

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

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

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

Do these steps before you begin any installation or maintenance work.

1. Clearly identify the work location and equipment.
2. Disconnect all possible voltage sources. Make sure that re-connection is not possible. Lock out and tag out.
   - Open the main disconnecting device of the drive.
   - Open the charging switch if present.
   - Open the disconnector of the supply transformer. (The main disconnecting device in the drive cabinet does not disconnect the voltage from the AC input power busbars of the drive cabinet.)
   - If the drive is equipped with a DC/DC converter unit (optional) or a DC feeder unit (optional): Open the DC switch-disconnector ([Q11], option +F286 or +F290) of the unit. Open the disconnecting device of the energy storage connected to the unit (outside the drive cabinet).

- Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
- In the liquid cooling unit (if present), open the switch-disconnector of the cooling pumps.
- If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
- Disconnect all dangerous external voltages from the control circuits.
- After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.

3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized. Use a quality voltage tester. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).
   - Before and after you measure the installation, verify the operation of the voltage tester on a known voltage source.
   - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is zero.
   - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is zero.
     Important! Repeat the measurement also with the DC voltage setting of the tester. Measure between each phase and ground. There is a risk of dangerous DC voltage charging due to leakage capacitances of the motor circuit. This voltage can remain charged for a long time after the drive power-off. The measurement discharges the voltage.
   - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding (PE) terminal is zero. In cabinet-built drives, measure between the drive DC busbars (+ and -) and the grounding (PE) busbar.

WARNING!
The busbars inside the cabinet of liquid-cooled drives are partially coated. Measurements made through the coating are potentially unreliable, so only measure at uncoated portions. Note that the coating does not constitute a safe or touch-proof insulation.

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.

General notes

Printed circuit boards

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

Optical components

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

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

Checking the insulation of the assembly

Inverter unit

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

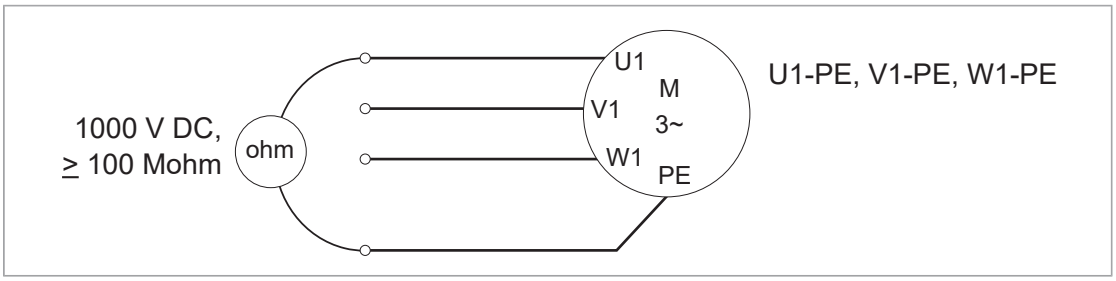
Measuring the insulation resistance of the motor and motor cable

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

1. Do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Make sure that the motor cable is disconnected from the drive output terminals.
3. Measure the insulation resistance between each phase conductor and the protective earth conductor. Use a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must be more than 100 Mohm (reference value at 25 °C

[77 °F]). For the insulation resistance of other motors, refer to the manufacturer's instructions.

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



Connecting the control cables

See the chapter on control units for the default I/O connections. Note that the default I/O connections can be affected by some options. See the circuit diagrams delivered with the drive for the actual wiring.

Control cable connection procedure

WARNING!
Obey the safety instructions given in ACS880 liquid-cooled multidrive cabinets and modules safety instructions (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

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

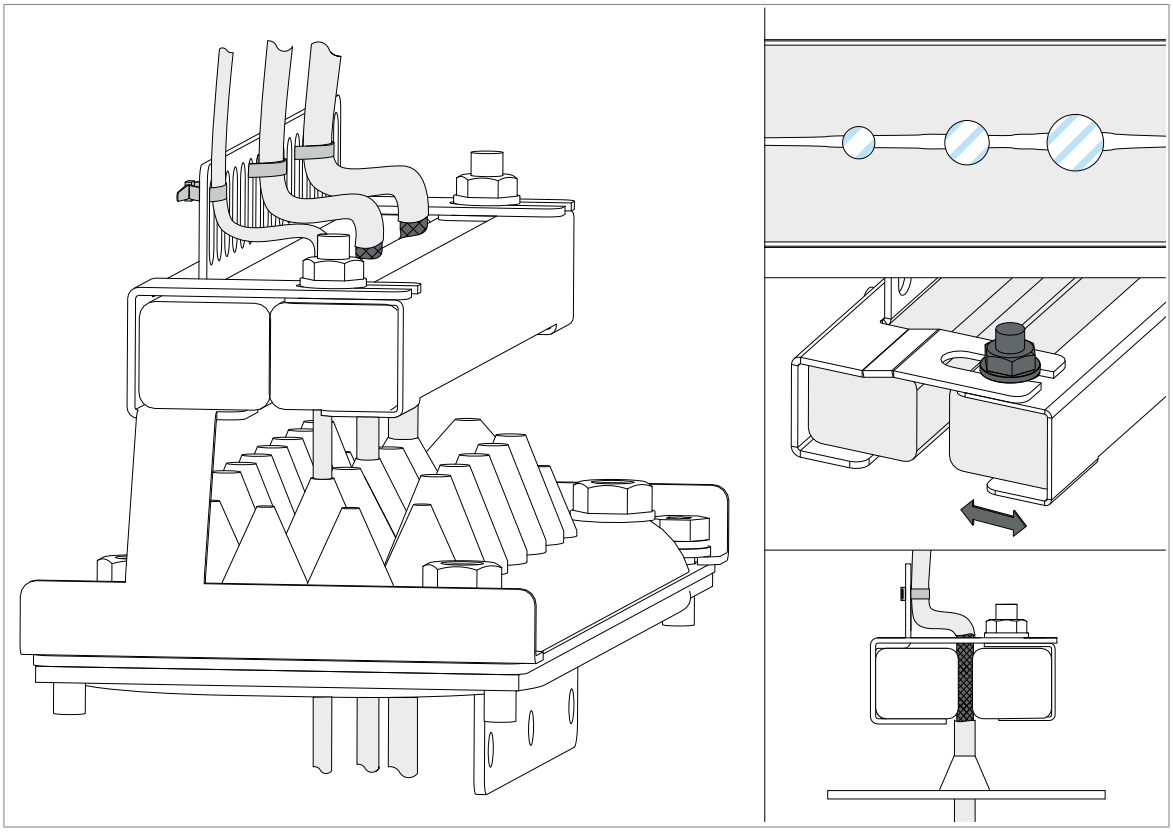
1. Stop the drive (if running) and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Run the control cables into the cabinet as described in section Grounding the outer shields of the control cables 360° at the cabinet entry below.
3. Route the control cables as described in section Routing the control cables inside the cabinet.
4. Connect the control cables as described in section Connecting control cabling.

Grounding the outer shields of the control cables 360° at the cabinet entry

Ground the outer shields of all control cables 360° with the EMI conductive cushions at the cabinet entry. The grounding principle is the same for top and bottom entry cables. The illustrations show the bottom entry. The actual design details can vary.

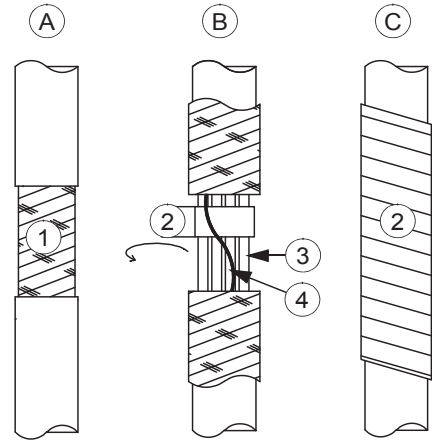
1. If necessary, remove the shrouding in front of the cable entry.
2. Put the cables in sequence from the smallest to the largest. This will help to achieve a good contact with the cushions.
3. Loosen the tightening bolts of the EMI conductive cushions and pull them apart.
4. Cut holes in the grommets and put the cables through the grommets.

5. Peel the insulation from the part of the cable that will be in contact with the EMI conductive cushion.
6. Put the cables between the cushions and attach them with cable ties for strain relief.
7. Move the cushions back together.
8. Tighten the bolts to make sure that the EMI conductive cushions press tightly around the peeled part of the cables.



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

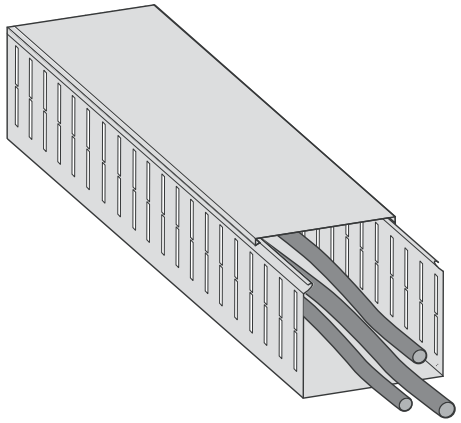
- Cut the shield at the midpoint of the peeled part. Be careful not to cut the conductors or the grounding wire.
- Turn the conductive side of the shield inside out over the insulation.
- Cover the exposed shield and the peeled cable with copper foil to keep the shielding continuous.



A	Stripped cable
B	Conductive surface of the shield exposed
C	Stripped part covered with copper foil
1	Cable shield
2	Copper foil
3	Shielded twisted pair
4	Grounding wire

Routing the control cables inside the cabinet

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



Connecting control cabling

Connect the conductors to the appropriate terminals. Refer to the wiring diagrams delivered with the drive.

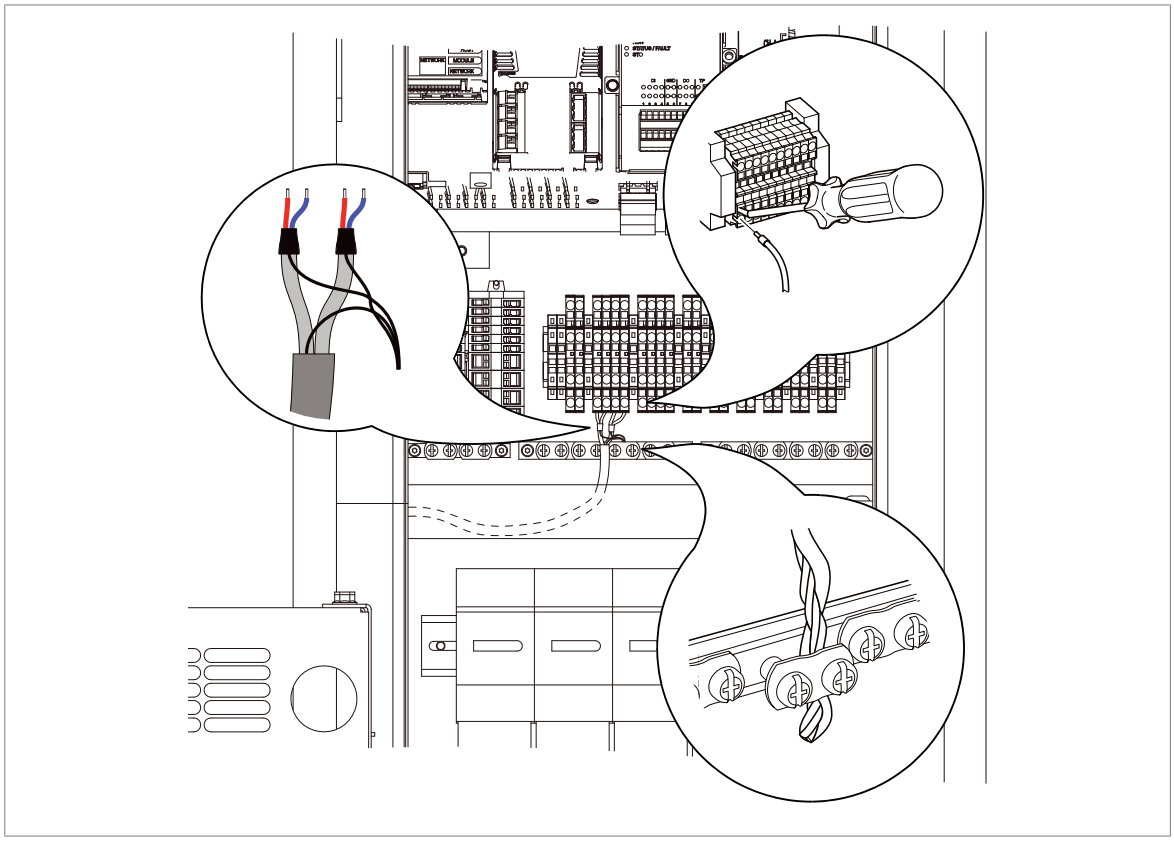
With option +L504, the terminals of the inverter control unit are available on terminal block X504.

Obey these instructions:

- Connect the inner twisted pair shields and all separate grounding wires to the grounding clamps near the terminals.
- Ground the outer shield of the cable at the cable entry, not at the grounding clamps near the terminals.
- 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.
- 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.

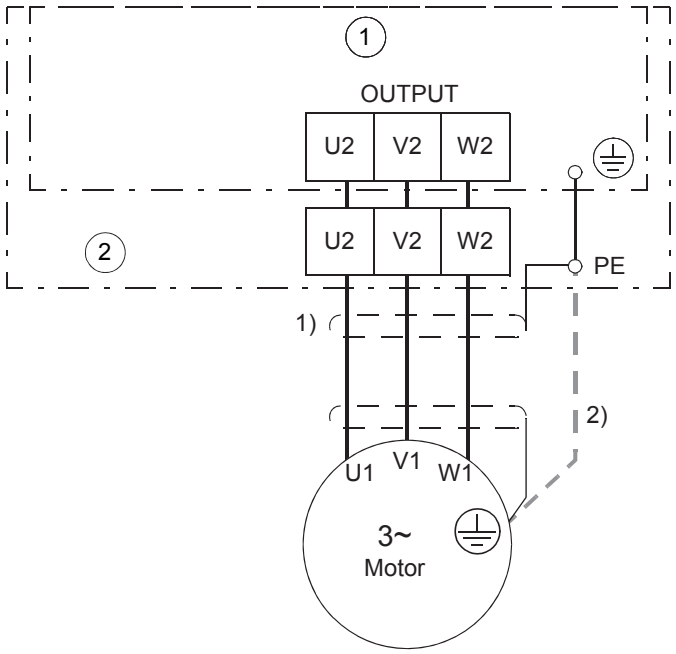
The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.

The drawing below represents the grounding of the control cabling when connecting to a terminal block inside the cabinet. The grounding is done in the same way when connecting directly to a component such as the control unit.



Frame R7i – Connecting the motor cables

Diagram



1. Inverter module
2. Cabinet

1) 360° grounding at cable lead-through

2) Use a separate grounding cable if the conductivity of the cable shield is less than 50% of the conductivity of the phase conductor in a cable with no symmetrically constructed grounding conductor (see the document ACS880 liquid-cooled multidrive cabinets and modules, Electrical planning instructions [3AXD50000048634 English]).

Note: If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.

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

Motor cable connection procedure

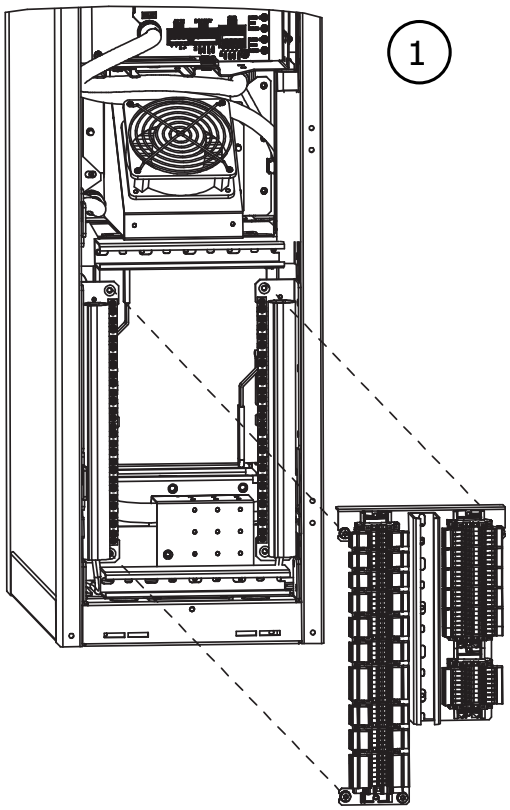
WARNING!
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.

WARNING!
Do the steps in section Electrical safety precautions (page 33) before you start the work.

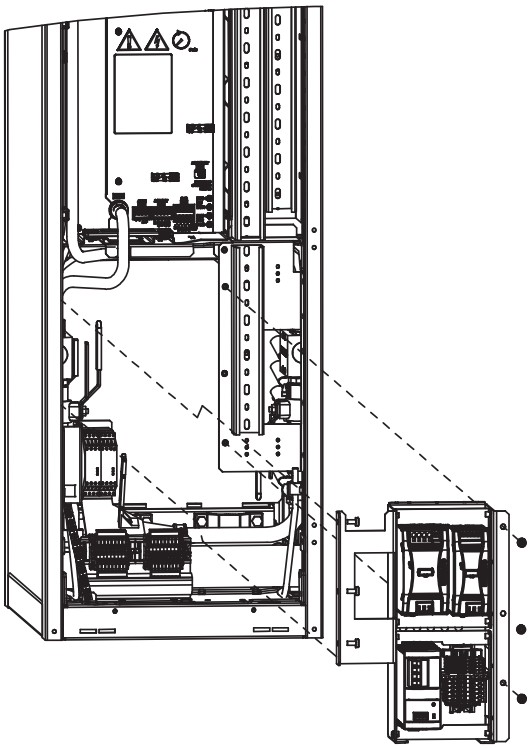
Removing the shrouding

1. Unplug the wiring coming to the lower mounting plate. Remove the plate.
2. Remove the shroud behind the mounting plate.

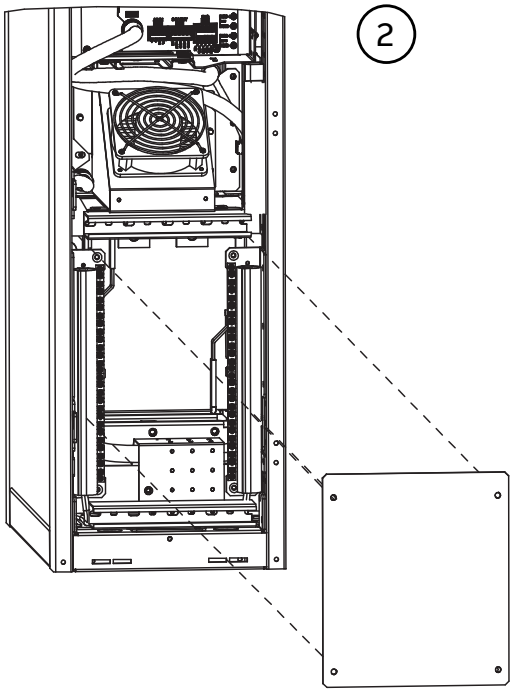
Single-module cubicle



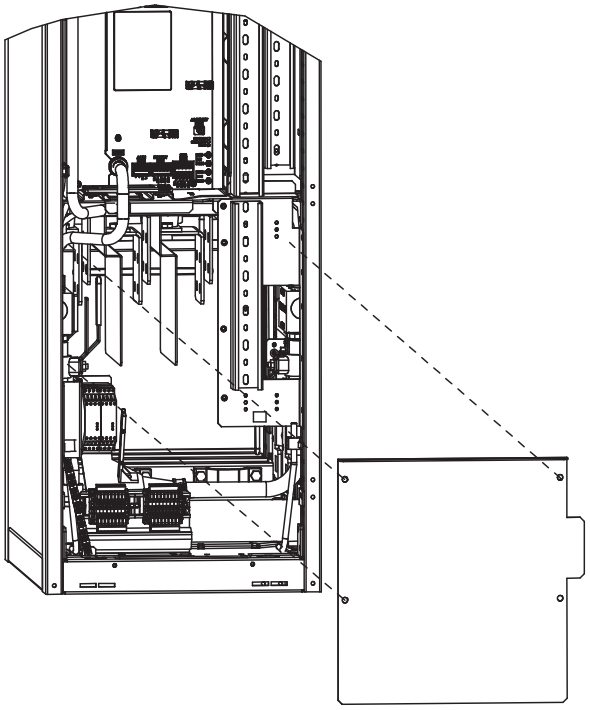
Two-module cubicle

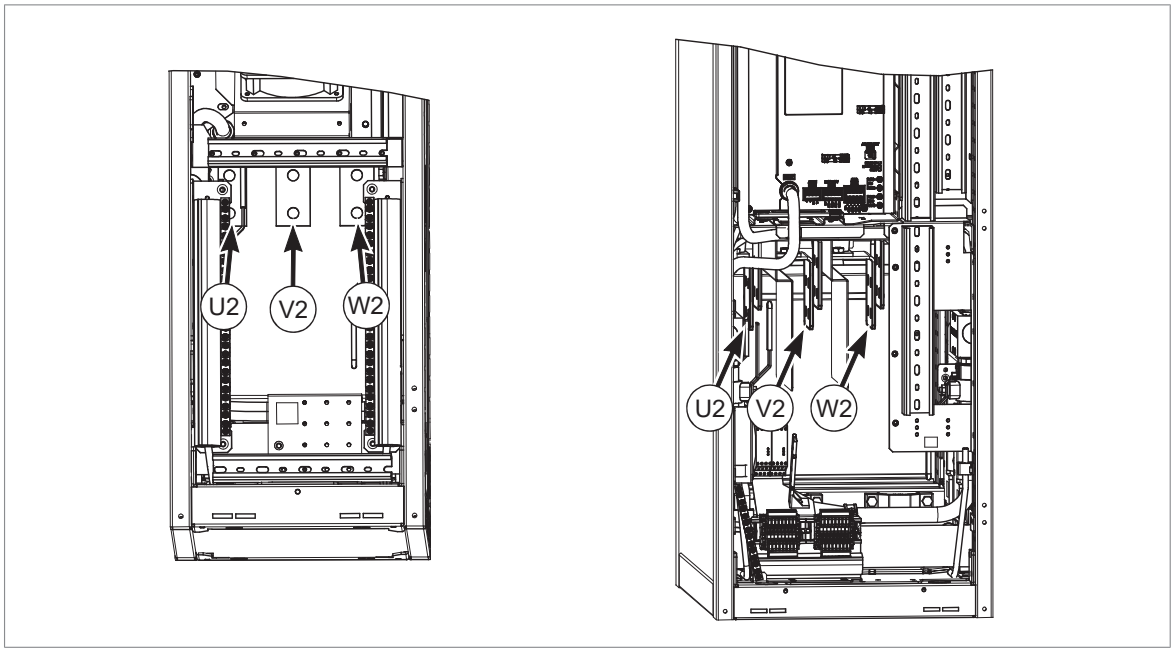


Single-module cubicle



Two-module cubicle

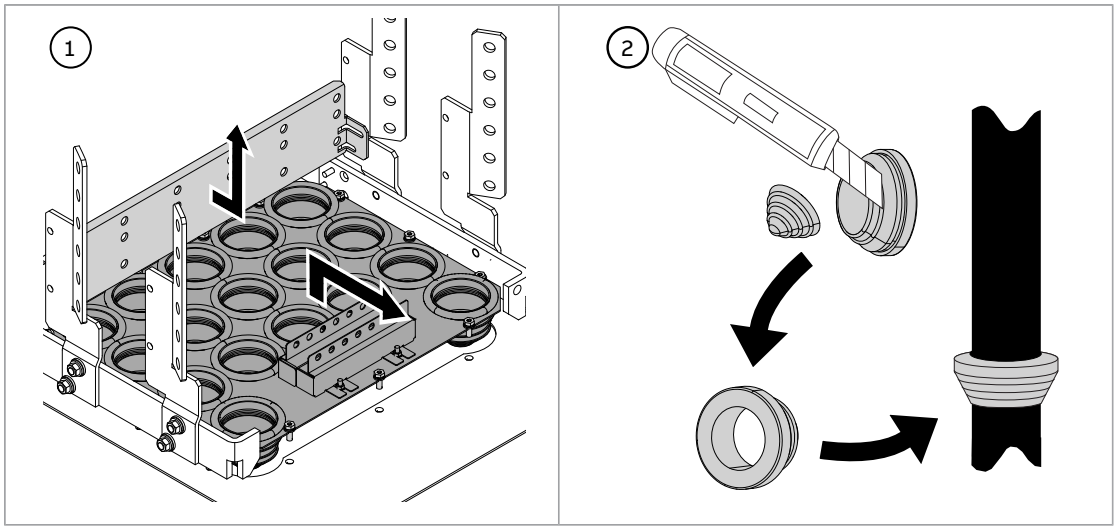




Connecting the cables

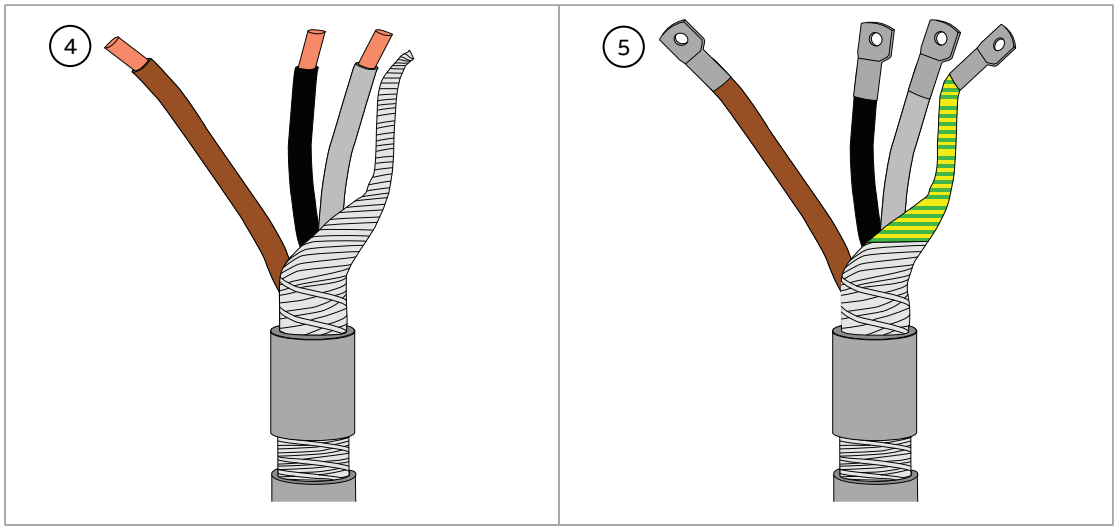
This section describes the power cable connecting procedure for a bottom cable entry with the standard cable entry plate. The standard cable entry plate has conductive sleeves for the 360 degree grounding of the cable shields. If the drive or unit has another type of cable entry plate, such as a Roxtec cable entry plate (option +H394), or cable gland plate (option +H358), refer also to the instruction of the related non-ABB installation accessories. For example, the Roxtec instructions or the instructions by the cable gland manufacturer.

1. IP54 cabinet: Remove the rear horizontal cable support and the cable entry plate.
2. IP54 cabinet: Remove a sealing grommet from the cable entry plate for each cable. Cut hole into the rubber grommet and slide it onto the cable.



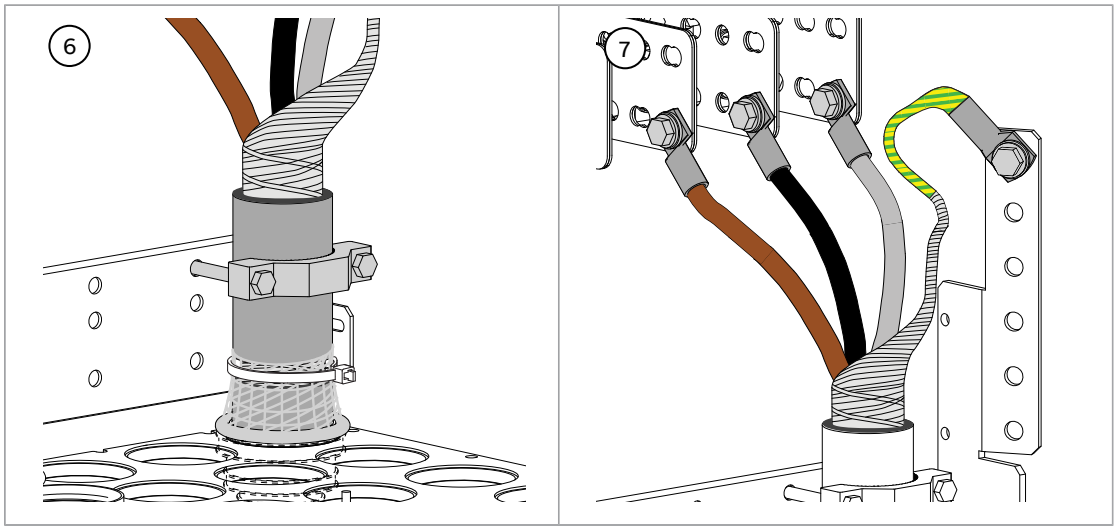
3. Lead the cables inside the cabinet through the cable entry plate. If there are several cables, use the rear 3 holes first.
   IP54 cabinet: Attach the the sealing grommets to the cable entry plate. Attach also the cable entry plate, and the cable support.

4. For each cable, strip off 3…5 cm (1.2 … 2 inches) of the outer insulation above the cable entry plate. Strip also the end of the cable, and the end of the phase conductors. Twist the shield to form a PE conductor, and mark it with yellow-green tape or heat-shrink tubing.
5. For each cable, attach cable lugs at the end of the PE conductor (twisted shield) and phase conductors.



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

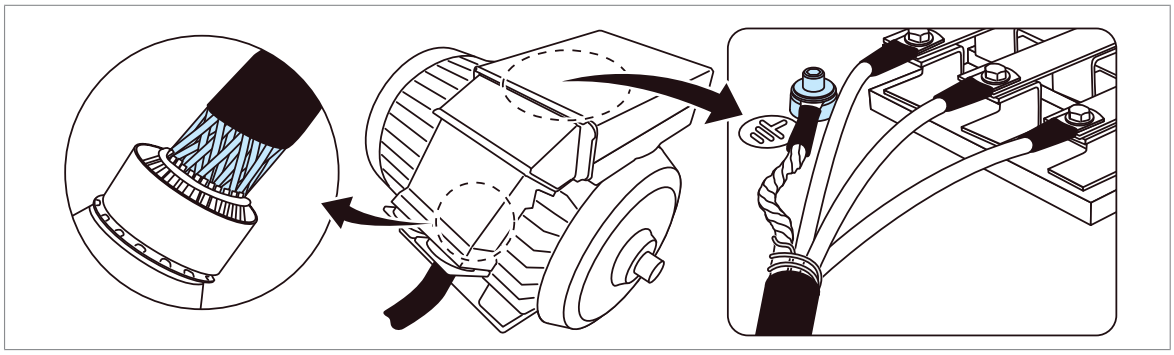
6. For each cable, attach the conductive sleeve to the bare cable shield with a cable tie. Attach the cable to the support bracket with a clamp.
7. For each cable, connect the PE conductor to the PE busbar, and the phase conductors to the phase terminals. Tighten the screws to the torque given in the technical data. Use the bolts and washers in the delivery. Refer to Use of fasteners in cable lug connections (page 54).



8. If there are more than 3 cables, attach additional cable support brackets for them.

Replacing the shrouding and connecting the motor

1. Refit any shrouding removed earlier and close the cubicle doors.
2. At the motor, connect the cables according to instructions from the motor manufacturer. Pay special attention to the phase order. For minimum radio-frequency interference, ground the cable shield 360 degrees at the lead-through of the motor terminal box, or ground the cable by twisting the shield so that the flattened shield is wider than 1/5 of its length.



Frame R8i and multiples – Connecting the motor cables (units without common motor terminal cubicle or sine output filter)

On units without a common motor terminal cubicle or a sine output filter, the motor cables connect to busbars located in the inverter module cubicles. To access the terminals, the cooling fans and other equipment in front of the terminals must be removed from the cubicle.

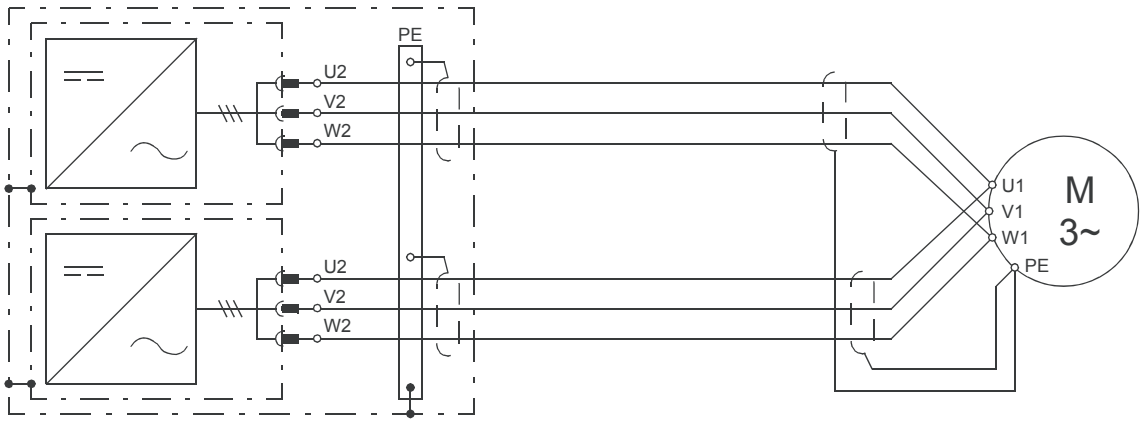
The location and dimensions of the busbars are visible in the dimension drawings delivered with the drive, as well as the example drawings presented in this manual in chapter Dimensions.

If the drive is equipped with a common motor terminal cubicle (option +H359) or a sine output filter (option +E206), follow the instructions in section Frame R8i and multiples – Connecting the motor cables (units with common motor terminal cubicle or sine output filter) (page 51).

Motor connection diagram (without option +H366)

All parallel-connected inverter modules are to be cabled separately to the motor.

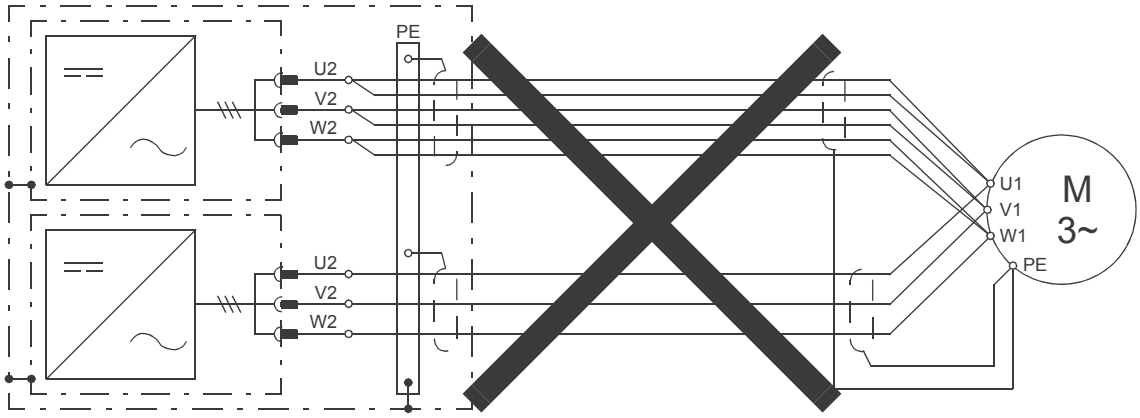
360° earthing is to be used at the cable entries.



Inverter unit cubicle(s)

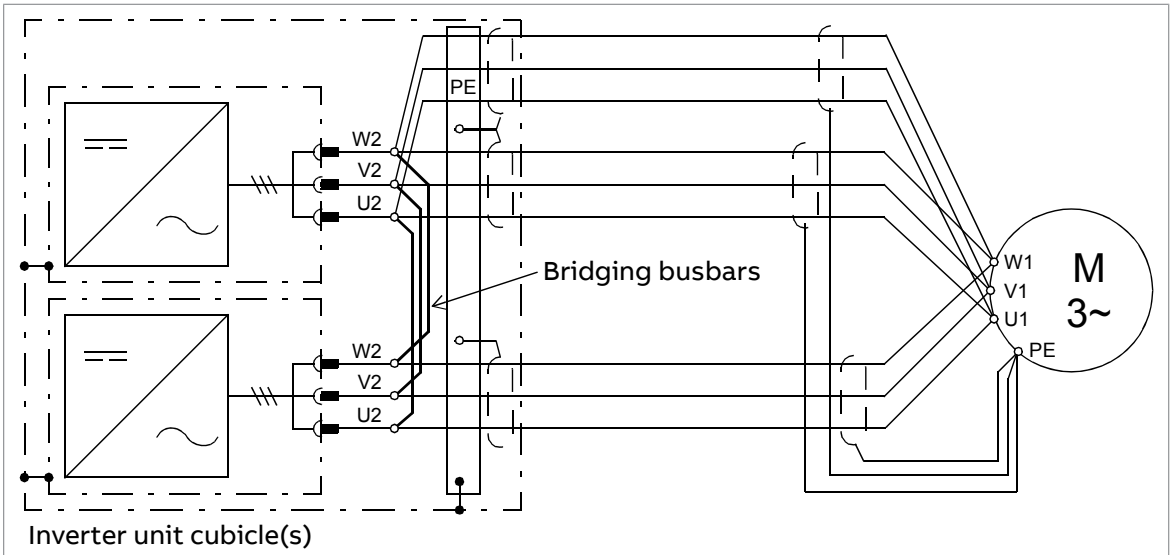
The recommended cable types are given in the technical data.

WARNING!
The cabling from all inverter modules to the motor must be physically identical considering cable type, cross-sectional area, and length.



Motor connection diagram (with option +H366)

With option +H366, the output busbars of the inverter modules within the same cubicle are connected by bridging busbars. The bridging balances the motor current between the modules, which allows more cabling options. For example, it is possible to use a number of cables that could not otherwise be evenly distributed between the inverter modules.



The recommended cable types are given in the technical data.

WARNING!
The bridging can carry the nominal output of one inverter module. In case of three parallel modules, ensure that the load capacity of the bridging is not exceeded. For example, if the cabling connects to the output busbars at one module only, use the module in the middle.

Note: The +H366 option only interconnects the outputs of inverter modules within the same cubicle, not modules installed in different cubicles. Therefore, when the drive has more than three inverter modules, make sure that the load is distributed evenly between the modules:

- In case of two inverter cubicles of two modules, connect the same number of cables to each cubicle.
- In case of one inverter cubicle with three modules and another with two, each cubicle requires a number of cables proportional to the number of modules within. For example, connect three out of five (or six out of ten, etc.) cables to the cubicle with three modules, the remaining two out of five (four out of ten) cables to the cubicle with two modules.

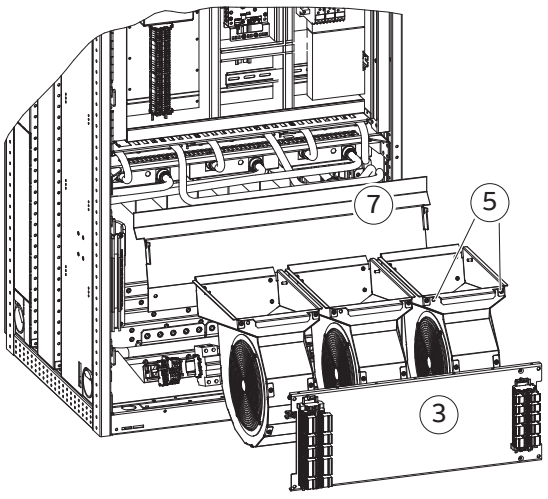
Procedure

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

WARNING!
Do the steps in section Electrical safety precautions (page 33) before you start the work.

Removing the shrouds and fan(s)

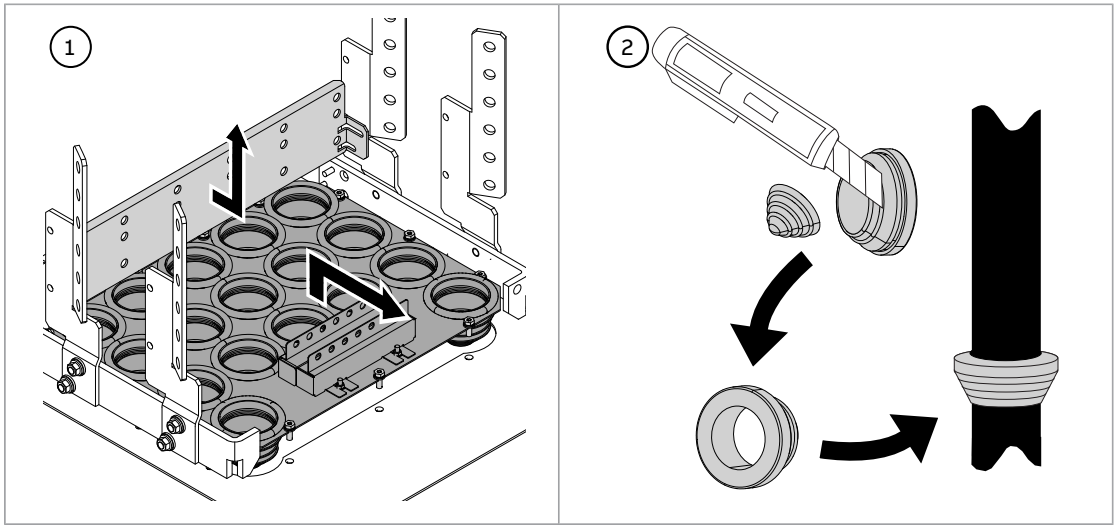
1. Open the inverter module cubicle door.
2. Remove the shrouding at the lower part of the cubicle (not shown).
3. Unplug the wiring from the lower front mounting plate. Remove the plate.
4. Disconnect the wiring from the cooling fans.
5. Undo the two retaining screws (a) of each fan.
6. Pull each fan outwards to separate them from the heat exchanger housing.
7. Remove the inner shroud.



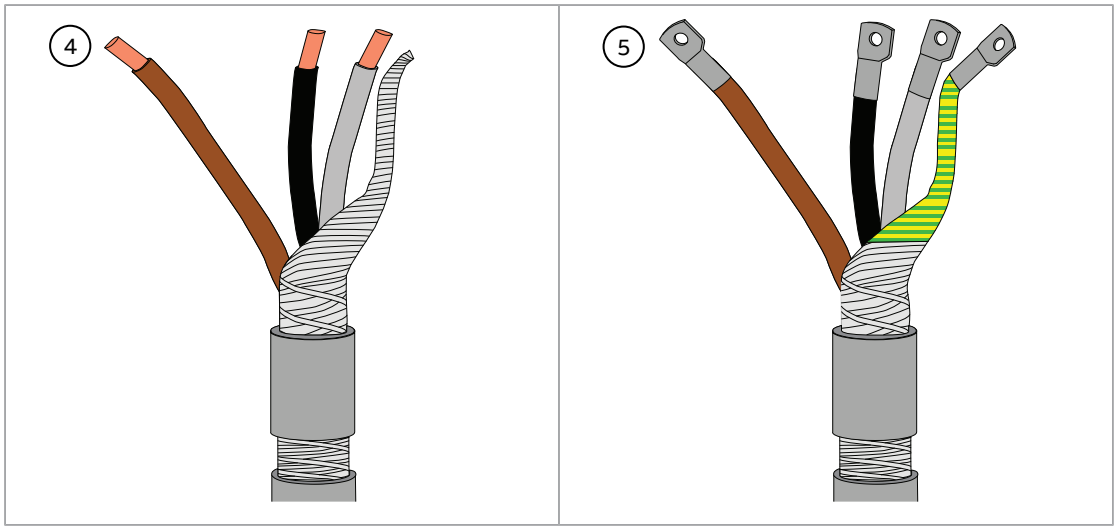
Connecting the cables

This section describes the power cable connecting procedure for a bottom cable entry with the standard cable entry plate. The standard cable entry plate has conductive sleeves for the 360 degree grounding of the cable shields. If the drive or unit has another type of cable entry plate, such as a Roxtec cable entry plate (option +H394), or cable gland plate (option +H358), refer also to the instruction of the related non-ABB installation accessories. For example, the Roxtec instructions or the instructions by the cable gland manufacturer.

1. IP54 cabinet: Remove the rear horizontal cable support and the cable entry plate.
2. IP54 cabinet: Remove a sealing grommet from the cable entry plate for each cable. Cut hole into the rubber grommet and slide it onto the cable.

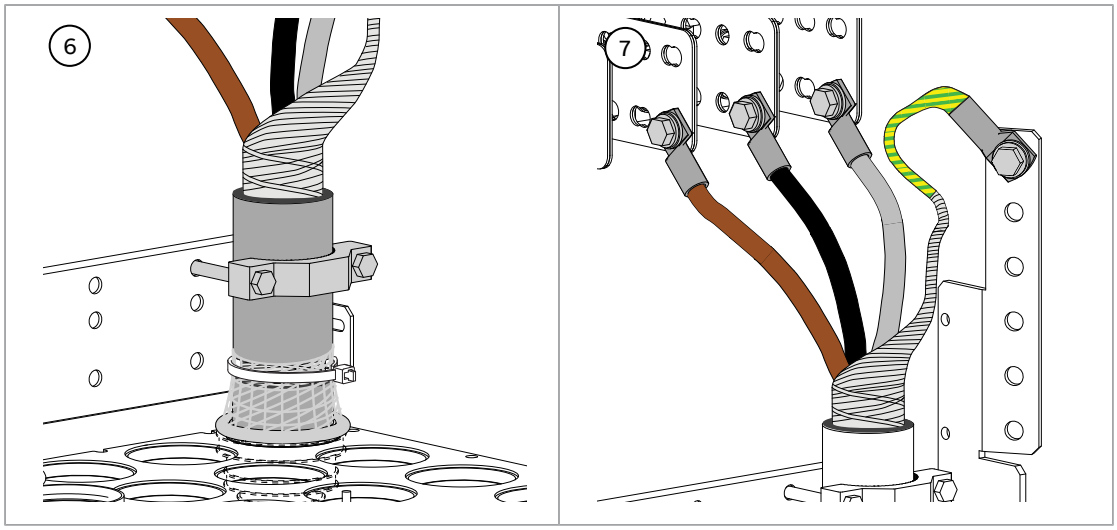


3. Lead the cables inside the cabinet through the cable entry plate. If there are several cables, use the rear 3 holes first.
   IP54 cabinet: Attach the the sealing grommets to the cable entry plate. Attach also the cable entry plate, and the cable support.
4. For each cable, strip off 3…5 cm (1.2 … 2 inches) of the outer insulation above the cable entry plate. Strip also the end of the cable, and the end of the phase conductors. Twist the shield to form a PE conductor, and mark it with yellow-green tape or heat-shrink tubing.
5. For each cable, attach cable lugs at the end of the PE conductor (twisted shield) and phase conductors.



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

6. For each cable, attach the conductive sleeve to the bare cable shield with a cable tie. Attach the cable to the support bracket with a clamp.
7. For each cable, connect the PE conductor to the PE busbar, and the phase conductors to the phase terminals. Tighten the screws to the torque given in the technical data. Use the bolts and washers in the delivery. Refer to Use of fasteners in cable lug connections (page 54).

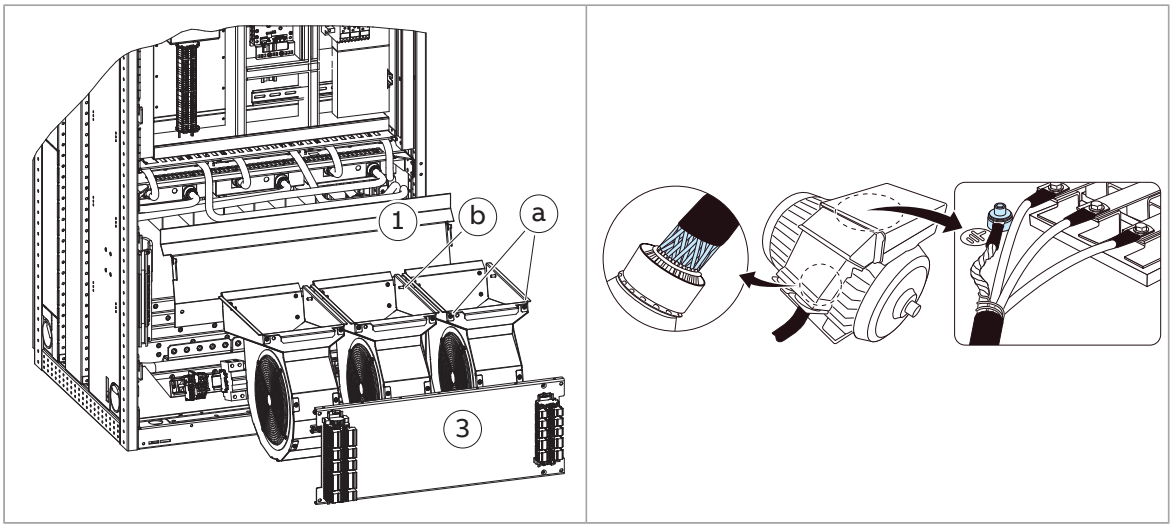


8. If there are more than 3 cables, attach additional cable support brackets for them.

Replacing shrouds and fans and connecting the motor

1. Refit the inner shroud.
2. With each fan, align the guide pins (b) at the rear of the fan cowling with the slots in the module bottom guide, then reinstall the retaining screws (a).

3. Refit the lower front mounting plate. Reconnect the wiring to the components on the mounting plate.
4. Refit the outer shroud (not shown).
5. Make sure there are no tools, debris or any other foreign objects in the cubicle. Close the cubicle door.
6. At the motor, connect the cables according to instructions from the motor manufacturer. Pay special attention to the phase order. For minimum radio-frequency interference, ground the cable shield 360 degrees at the cable entry of the motor terminal box, or ground the cable by twisting the shield so that the flattened shield is wider than 1/5 of its length.



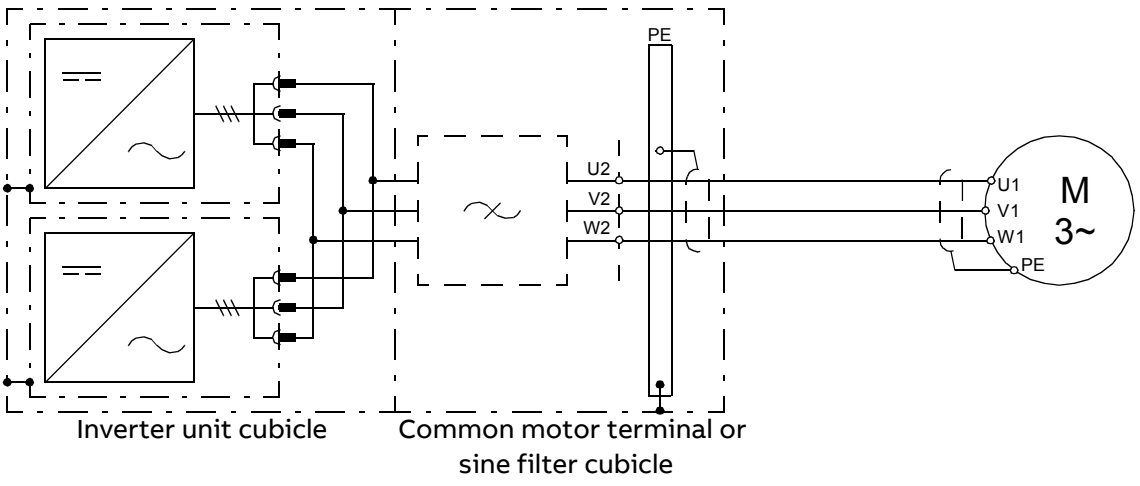
Frame R8i and multiples – Connecting the motor cables (units with common motor terminal cubicle or sine output filter)

Output busbars

If the drive is equipped with option +H359, the motor cables connect to a common motor terminal cubicle. Similarly, if the drive is equipped with option +E206 (sine output filter), the motor cables connect to the output busbars in the sine filter cubicle.

The location and dimensions of the busbars for either case are visible in the dimensional drawings delivered with the drive, as well as the example dimension drawings in the manual.

Connection diagram



The recommended cable types are given in chapter Technical data.

Procedure

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

WARNING!
Do the steps in section Electrical safety precautions (page 33) before you start the work.

Opening the door and removing the shrouding

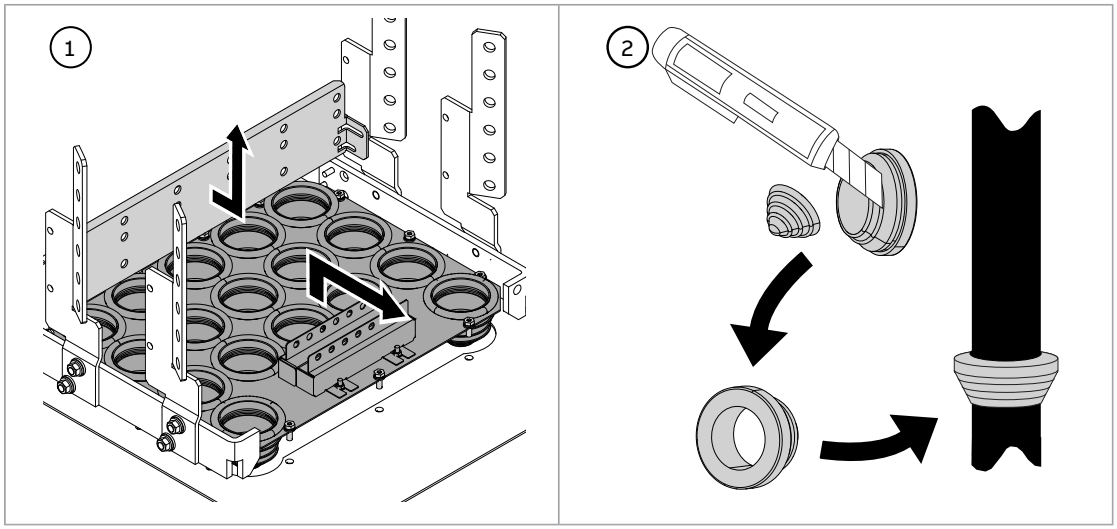
1. Open the door of the common motor terminal or sine filter cubicle.
2. Remove the shrouding.

Connecting the cables

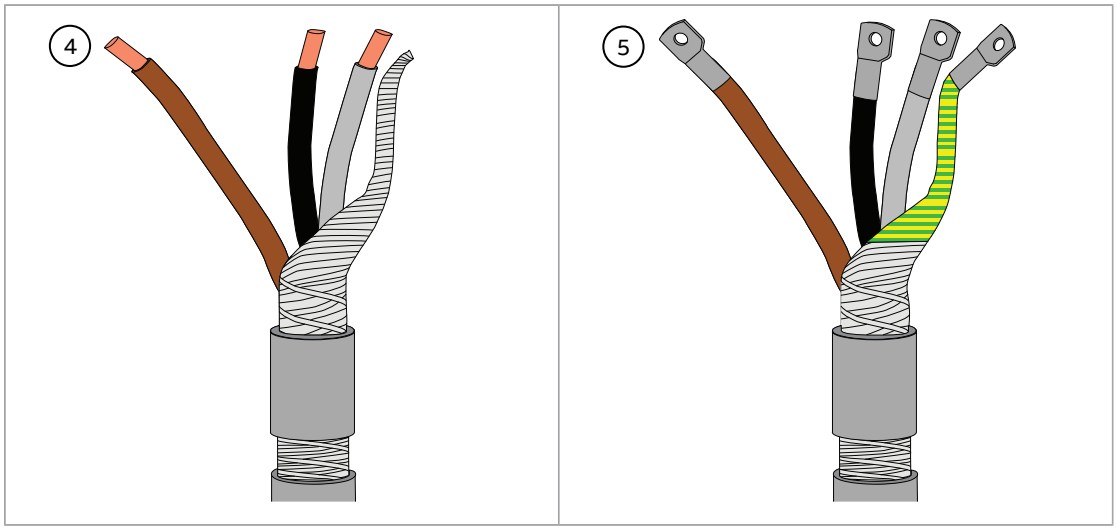
This section describes the power cable connecting procedure for a bottom cable entry with the standard cable entry plate. The standard cable entry plate has conductive

sleeves for the 360 degree grounding of the cable shields. If the drive or unit has another type of cable entry plate, such as a Roxtec cable entry plate (option +H394), or cable gland plate (option +H358), refer also to the instruction of the related non-ABB installation accessories. For example, the Roxtec instructions or the instructions by the cable gland manufacturer.

1. IP54 cabinet: Remove the rear horizontal cable support and the cable entry plate.
2. IP54 cabinet: Remove a sealing grommet from the cable entry plate for each cable. Cut hole into the rubber grommet and slide it onto the cable.

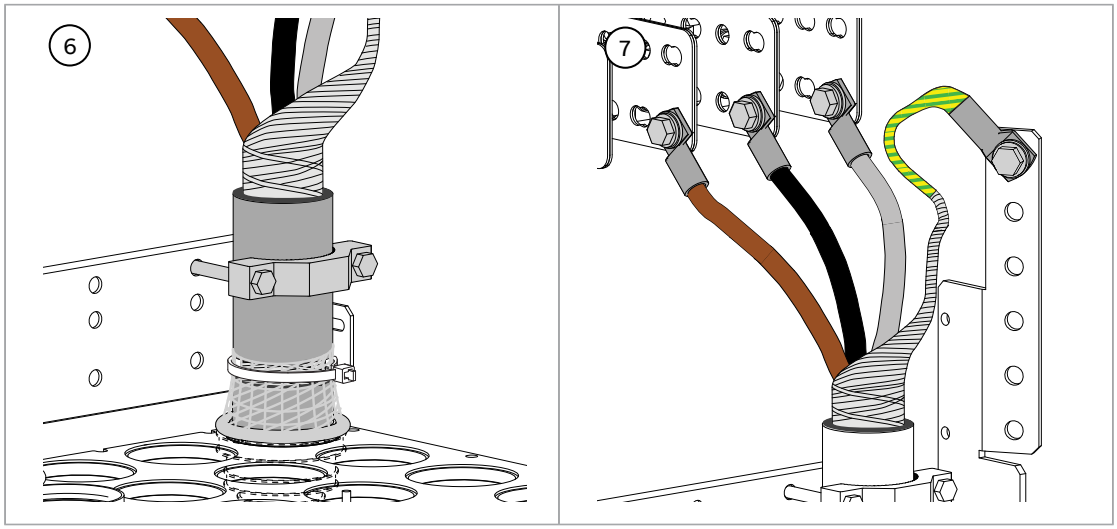


3. Lead the cables inside the cabinet through the cable entry plate. If there are several cables, use the rear 3 holes first.
   IP54 cabinet: Attach the the sealing grommets to the cable entry plate. Attach also the cable entry plate, and the cable support.
4. For each cable, strip off 3…5 cm (1.2 … 2 inches) of the outer insulation above the cable entry plate. Strip also the end of the cable, and the end of the phase conductors. Twist the shield to form a PE conductor, and mark it with yellow-green tape or heat-shrink tubing.
5. For each cable, attach cable lugs at the end of the PE conductor (twisted shield) and phase conductors.



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

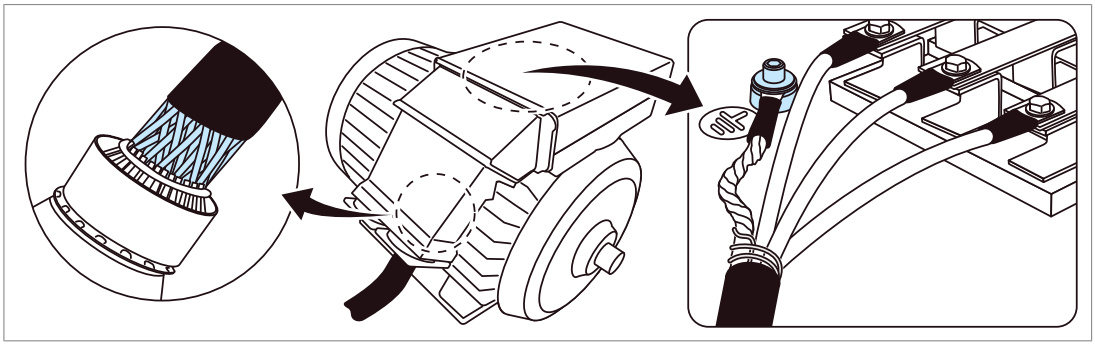
6. For each cable, attach the conductive sleeve to the bare cable shield with a cable tie. Attach the cable to the support bracket with a clamp.
7. For each cable, connect the PE conductor to the PE busbar, and the phase conductors to the phase terminals. Tighten the screws to the torque given in the technical data. Use the bolts and washers in the delivery. Refer to Use of fasteners in cable lug connections (page 54).



8. If there are more than 3 cables, attach additional cable support brackets for them.

Replacing the shrouding and connecting the motor

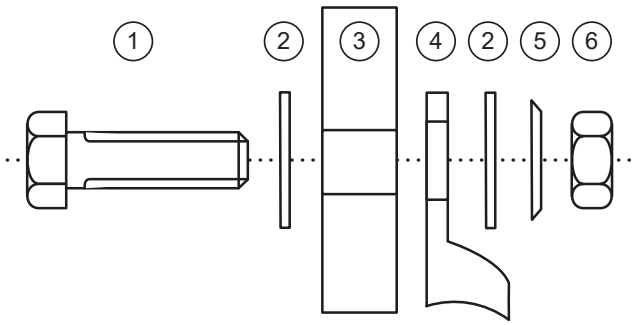
1. Refit any shrouding removed earlier and close the cubicle doors.
2. At the motor, connect the cables according to instructions from the motor manufacturer. Pay special attention to the phase order. For minimum radio-frequency interference, ground the cable shield 360 degrees at the lead-through of the motor terminal box, or ground the cable by twisting the shield so that the flattened shield is wider than 1/5 of its length.



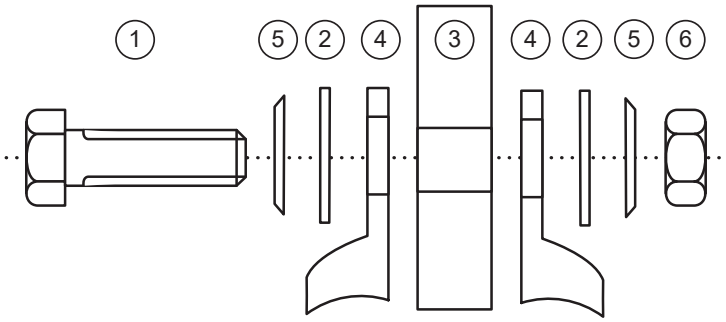
Use of fasteners in cable lug connections

Use the bolts, nuts and washers delivered with the drive. Install all the fasteners in the correct order. See the figure below. Tighten the cable lug to the torque specified for the connection.

Cable lug on one side of the busbar



Cable lugs on both sides of the busbar



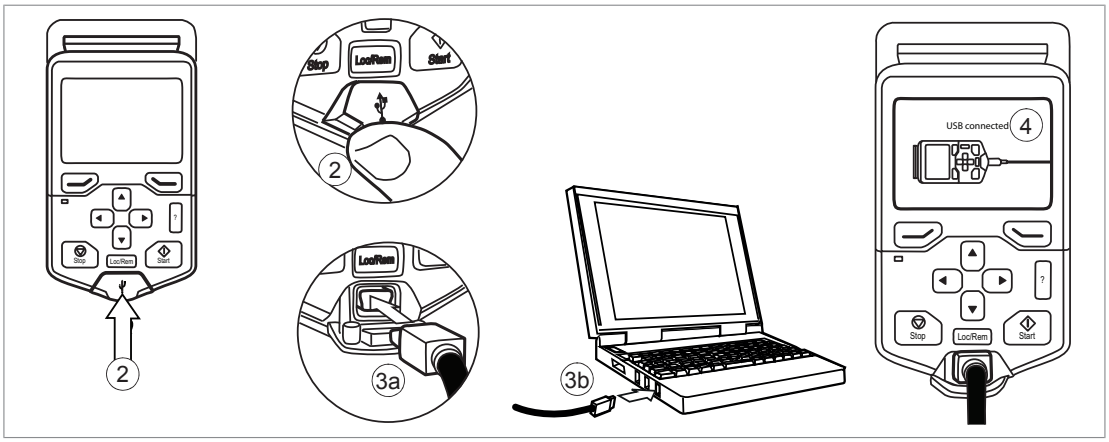
1	Bolt	4	Cable lug
2	Plain washer	5	Spring washer
3	Busbar	6	Nut

Connecting a PC

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

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

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



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

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

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

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

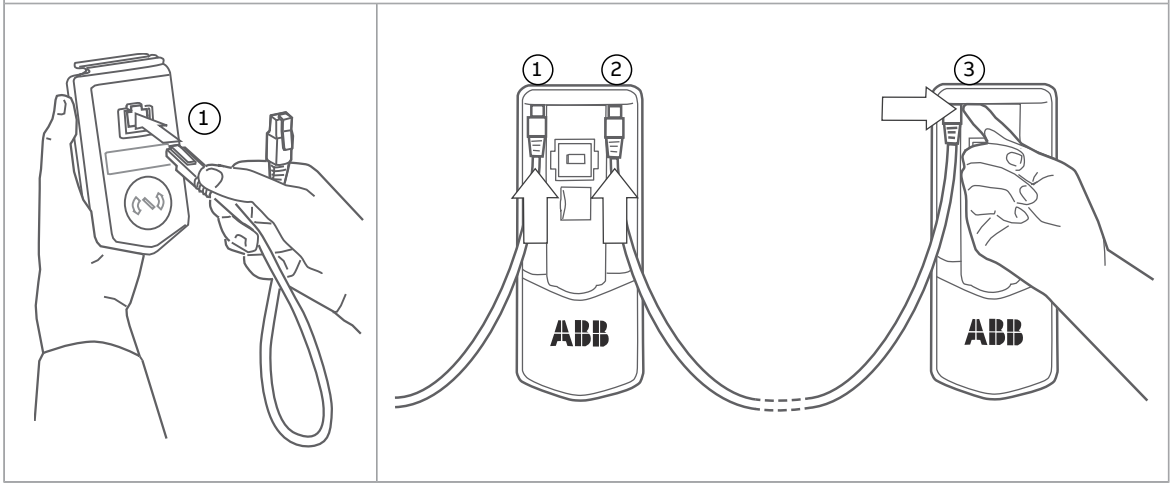
   *The parameter group is 149 with supply (line-side), brake or DC/DC converter units.

   Repeat the above for each drive.
2. With the panel connected to one unit, link the units using Ethernet cables.
3. Switch on the bus termination on the drive that is farthest from the control panel in the chain.
   - With drives that have the panel mounted on the front cover, move the terminating switch into the outer position.
   - With the FDPI-02 module: move termination switch S1 on the FDPI-02 module into the TERMINATED position.

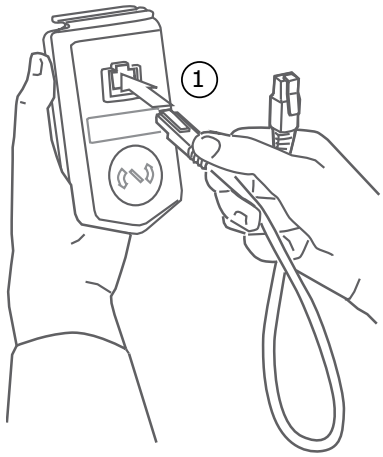
   Make sure that bus termination is off on all other drives.
4. On the control panel, switch on the panel bus functionality (Options - Select drive - Panel bus). The drive to be controlled can now be selected from the list under Options - Select drive.

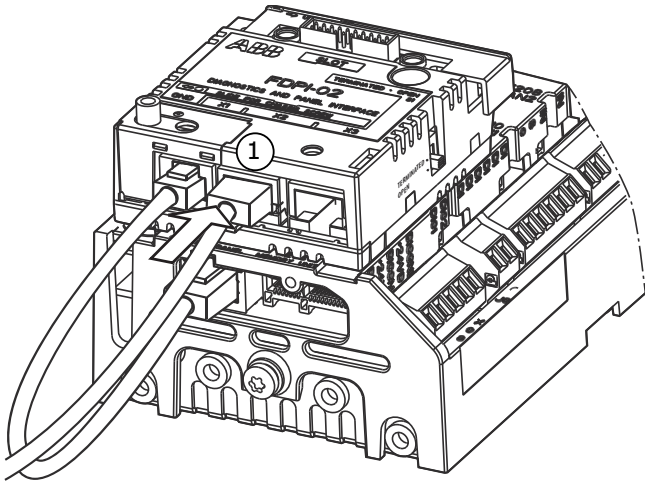
If a PC is connected to the control panel, the drives on the panel bus are automatically displayed in the Drive Composer PC tool.

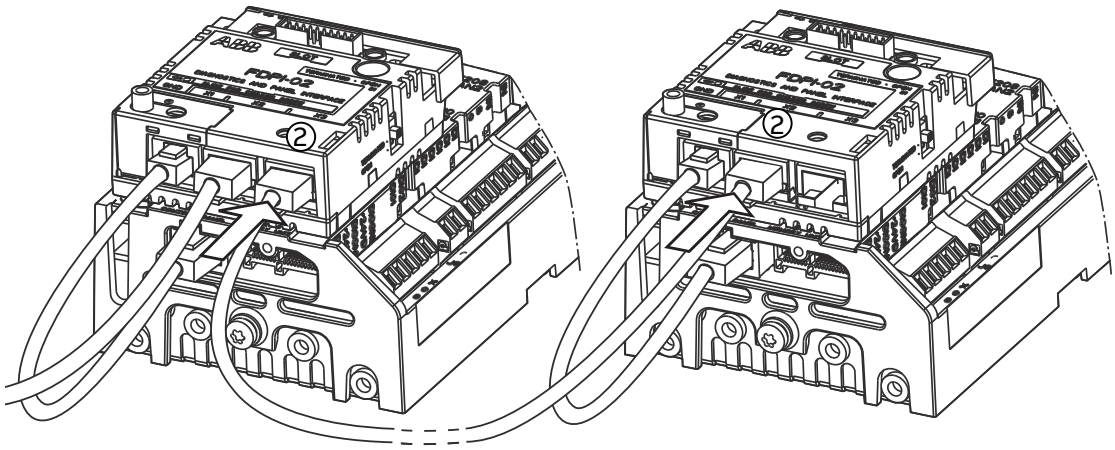
With twin connectors in the control panel holder:

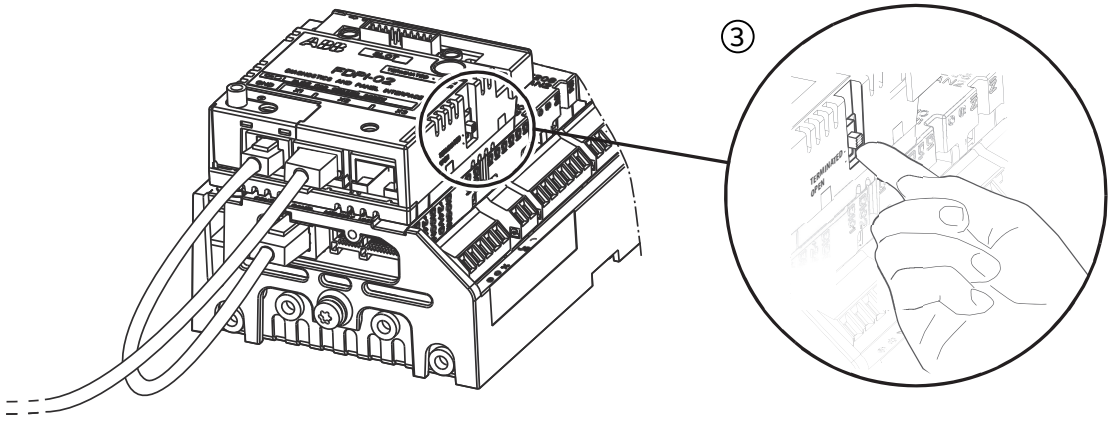


With FDPI-02 modules:









Installing option modules

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

See hardware description for the available slots for each module. Install the option modules as follows:

WARNING!
Obey the safety instructions given in ACS880 liquid-cooled multidrive cabinets and modules safety instructions (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Open the door of the auxiliary control cubicle (ACU).
3. Remove the shrouding at the top of the cubicle.
4. Locate the inverter control unit (A41).
5. Insert the module carefully into its position on the control unit.
6. Fasten the mounting screw.

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

Installation of an FSO safety functions module onto BCU

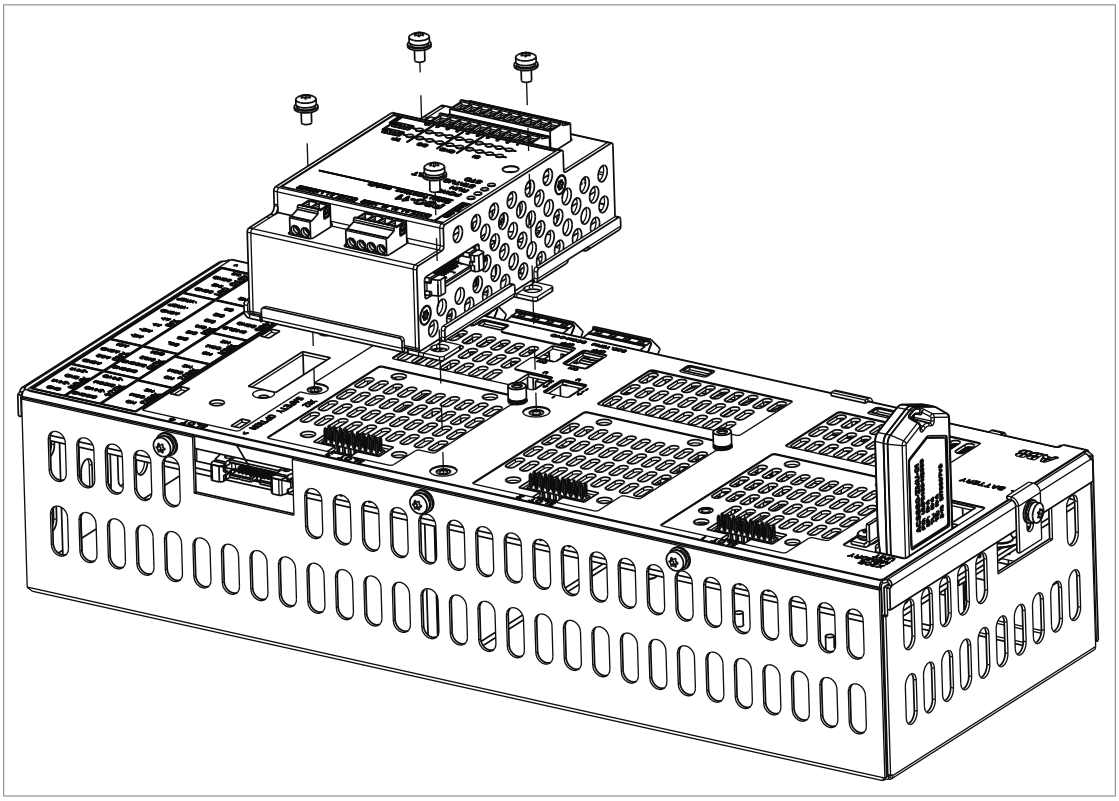
WARNING!
Obey the safety instructions given in ACS880 liquid-cooled multidrive cabinets and modules safety instructions (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

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

This procedure describes the installation of an FSO safety functions module onto the BCU control unit. As an alternative, the FSO module can be installed adjacent to the control unit, which is the standard method for factory-installed FSO modules. For instructions, refer to the applicable FSO module user's manual.

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. The FSO module comes with alternative bottom plates for installation onto different control units. For installation onto a BCU control unit, the mounting points should be located at the long edges of the module as shown in the illustration below. If necessary, replace the bottom plate of the FSO module.

3. Attach the FSO module onto slot 3 of the BCU control unit [A41] with four screws.

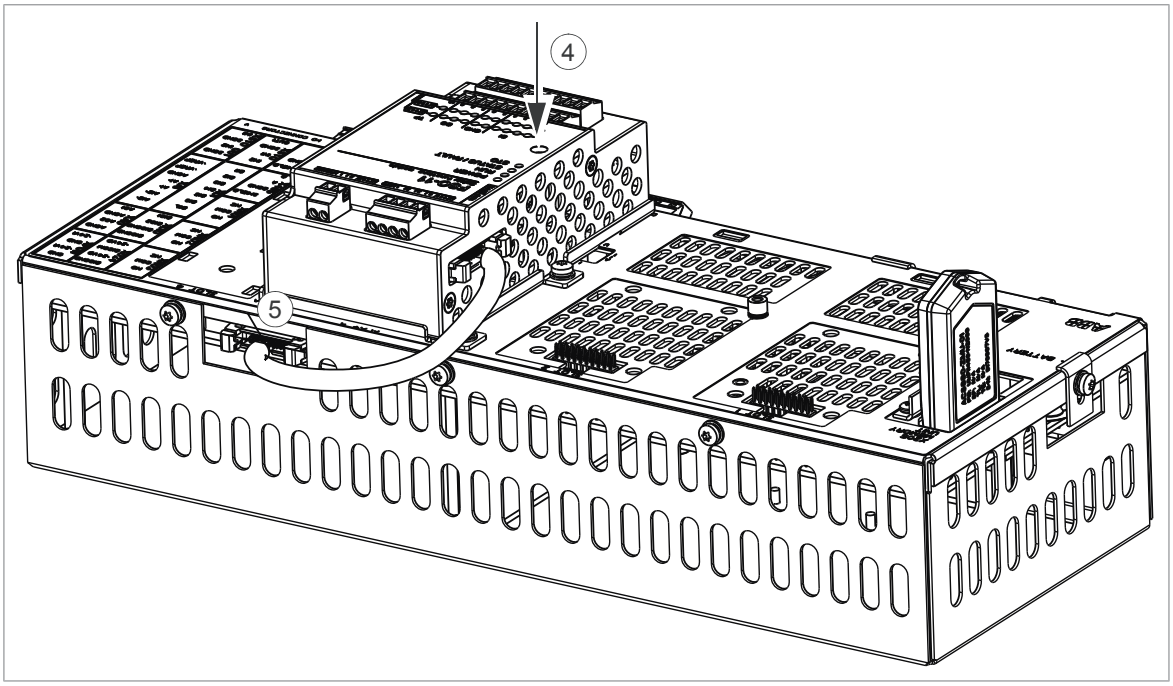


4. Tighten the FSO module electronics grounding screw.

   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 module data cable between FSO connector X110 and BCU connector X12.

6. To complete the installation, refer to the instructions in the applicable FSO module user's manual.



Wiring of optional modules

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

4

Installation checklist

Contents of this chapter

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

Checklist

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

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

WARNING!
Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.

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

Make sure that ...	☑
If the drive is connected to a network other than a symmetrically grounded TN-S system: You have done all the required modifications (for example, you may need to disconnect the EMC filter or ground-to-phase varistor). See the electrical installation instructions in the supply unit manual.	☐
There is an adequately sized protective earth (ground) conductor(s) between the drive and the switchboard, the conductor is connected to correct terminal, and the terminal is tightened to the correct torque. Grounding has also been measured according to the regulations.	☐
If the drive is equipped with a DC/DC converter unit: There is an adequately sized protective earth (ground) conductor between the energy storage and the DC/DC converter, the conductor has been connected to appropriate terminal, and the terminal has been tightened to the proper torque. Proper grounding has also been measured according to the regulations.	☐
If the drive is equipped with a DC/DC converter unit: The energy storage cable has been connected to the correct terminals of the DC/DC converter and energy storage, and the terminals have been tightened to the proper torque.	☐
If the drive is equipped with a DC/DC converter unit: The energy storage has been equipped with fuses for protecting energy storage cable in a cable short-circuit situation.	☐
If the drive is equipped with a DC/DC converter unit: The energy storage has been equipped with a disconnecting device.	☐
The input power cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.	☐
There is an adequately sized protective earth (ground) conductor between the motor and the drive. The conductor is connected to the correct terminal, and the terminal is tightened to the correct torque. Grounding has also been measured according to the regulations.	☐
The motor cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.	☐
The motor cable is routed away from other cables.	☐
No power factor compensation capacitors are connected to the motor cable.	☐
If an external brake resistor is connected to the drive: There is an adequately sized protective earth (ground) conductor between the brake resistor and the drive, and the conductor is connected to the correct terminal, and the terminals are tightened to the correct torque. Grounding has also been measured according to the regulations.	☐
If an external brake resistor is connected to the drive: The brake resistor cable is connected to the correct terminals, and the terminals are tightened to the correct torque.	☐
If an external brake resistor is connected to the drive: The brake resistor cable is routed away from other cables.	☐
The control cables are connected to the correct terminals, and the terminals are tightened to the correct torque.	☐
The voltage setting of the auxiliary voltage transformers (if any) is correct. See the electrical installation instructions.	☐
If a drive bypass connection will be used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically and/or electrically interlocked, that is, they cannot be closed at the same time. A thermal overload device must be used for protection when bypassing the drive. Refer to local codes and regulations.	☐
There are no tools, foreign objects or dust from drilling inside the drive.	☐
The terminal box cover of the motor is in place. Cabinet shrouds are in place and doors are closed.	☐
The motor and the driven equipment are ready for power-up.	☐
The coolant connections between cubicles (if any) and to the cooling circuit are tight.	☐
If the drive is equipped with a cooling unit: Make sure that the mechanical and electrical installation of the cooling unit is completed. Refer to the cooling unit documentation.	☐

5

Start-up

Contents of this chapter

This chapter describes the hardware commissioning of the inverter unit. For information on setting up the control program, refer to the appropriate firmware manual. For information on commissioning the supply unit, refer to its hardware manual.

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 the ACS880 liquid-cooled multidrive cabinets and modules safety instructions (3AXD50000048633 [English]).	☐
Pre-requisites	
The mechanical and electrical installation of the drive has been inspected and approved. See Installation checklist (page 61).	☐
The insulation resistance of the assembly has been checked according to instructions. See Electrical installation (page 33).	☐
The supply unit of the drive system has been started up according to the instructions in its hardware manual.	☐
Checks/Settings with no voltage connected	
Do the steps listed in Electrical safety precautions (page 33). Refer to the hardware manual of the supply unit for more information.	☐
Check the settings of breakers/switches in the auxiliary circuits. See the circuit diagrams delivered with the drive.	☐
Check that the auxiliary voltage selector [X59] on the front plate of the inverter modules is set according to actual auxiliary voltage (230 or 115 V AC).	☐
Disconnect any unfinished or uninspected auxiliary voltage (115/230 V AC) cables that lead from the terminal blocks to the outside of the equipment.	☐
Check that both channels of the Safe torque off circuit connected to the STO input of the inverter control unit (A41) are closed. Refer to the wiring diagrams delivered with the drive. With parallel-connected frame R8i inverter modules, check that the STO OUT output on the inverter control unit (A41) is chained to the STO inputs of all inverter modules. If the Safe torque off functionality is not used, check that the STO input on all inverter modules is correctly wired to +24 V and ground.	☐
Drives with Pt100 relays (option +(n)L506): • Check the connections against the circuit diagrams of the delivery. • Set the alarm and trip levels of the Pt100 relays. Set the alarm and trip levels of the Pt100 relay as low as possible based on the operating temperature and test results of the machine. The trip level can be set, for example, 10 °C higher than what the temperature of the machine is at maximal load in the maximum environmental temperature. We recommend to set the operating temperatures of the relay, typically for example, as follows: • 120…140 °C when only tripping is in use • alarm 120…140 °C and trip 130…150 °C when both alarm and tripping are used.	☐
Powering up the auxiliary circuit of the drive	
Make sure that it is safe to connect voltage. Ensure that • nobody is working on the drive or circuits that have been wired from outside into the drive cabinet • the cover of the motor terminal box is in place.	☐
Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits.	☐
Close the cabinet doors.	☐
Close the main breaker of the supply transformer.	☐
Switch on the auxiliary voltage.	☐
Setting up the inverter unit parameters, and performing the first start	
Set up the inverter control program. See the appropriate start-up guide and/or firmware manual. There is a separate start-up guide only for some control programs.	☐

Action	☑
With inverter units consisting of frame R7i or R8i modules, check the setting of parameter 95.09 Switch fuse controller.	☐
Drives with an 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.	☐
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.	☐
Powering up the main circuit of the drive	
Start the supply unit according to the instructions in its hardware manual.	☐
On-load checks	
Start the motor to perform the ID run.	☐
Check that the cooling fans rotate freely in the right direction, and the air flows upwards.	☐
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 Validation test procedure (page 116).	☐

6

Maintenance

Contents of this chapter

This chapter contains maintenance instructions.

Maintenance intervals

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

Description of symbols

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

Recommended maintenance intervals after start-up

Maintenance task/object	Years from start-up													
	0	1	2	3	4	5	6	7	8	9	10	11	12	...
Coolant														
Checking coolant antifreeze concentration		P	P	P	P	P	P	P	P	P	P	P	P	
Checking coolant quality			P		P		P		P		P		P	
Coolant draining and replacement							R						R	
ABB cooling unit (if present)	See ACS880-1007LC cooling unit user's manual (3AXD50000129607 [English]).													
Cooling fans														
Cooling fans 230 V AC 50/60 Hz and 24 V DC										R				
Cooling fans 115 V AC 50/60 Hz							R						R	
Frame R7i: Internal cooling fan for circuit boards										R				
CIO module for fan control (230 V AC) [1]										R				
CIO module for fan control (115 V AC) [1]							I/R						R	
Batteries														
Control unit battery							R						R	
Control panel battery										R				
Cabinet auxiliary power supplies													R	
Connections and environment														
Quality of supply voltage		P	P	P	P	P	P	P	P	P	P	P	P	P
Spare parts														
Spare parts		I	I	I	I	I	I	I	I	I	I	I	I	I
DC circuit capacitor reforming (spare modules and spare capacitors)		P	P	P	P	P	P	P	P	P	P	P	P	P
Inspections														
Checking tightness of cable and busbar terminals. Tightening if needed.		I	I	I	I	I	I	I	I	I	I	I	I	I
Checking ambient conditions (dustiness, corrosion, temperature)		I	I	I	I	I	I	I	I	I	I	I	I	I
Checking coolant pipe connections		I	I	I	I	I	I	I	I	I	I	I	I	I
Functional safety														
Safety function test	I See the maintenance information of the safety function.													
Safety component expiry (Mission time, T_M)	20 years													
														3AXD10000578918 rev S

[1] To replace CIO module or to reset fan counters, see CIO-01 I/O module for distributed I/O bus control user's manual (3AXD50000126880 [English]).

Note:

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

Maintenance timers and counters

The control program has maintenance timers and counters that can be configured to generate a warning when a pre-defined limit is reached. Each timer/counter can be set to monitor any parameter. This feature is especially useful as a service reminder. For more information, see the firmware manual.

Cooling fans

The lifespan of the cooling fans of the drive depends on running time, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. Reset the running time signal after fan replacement. See also CIO-01 I/O module for distributed I/O bus control user's manual (3AXD50000126880 [English]).

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

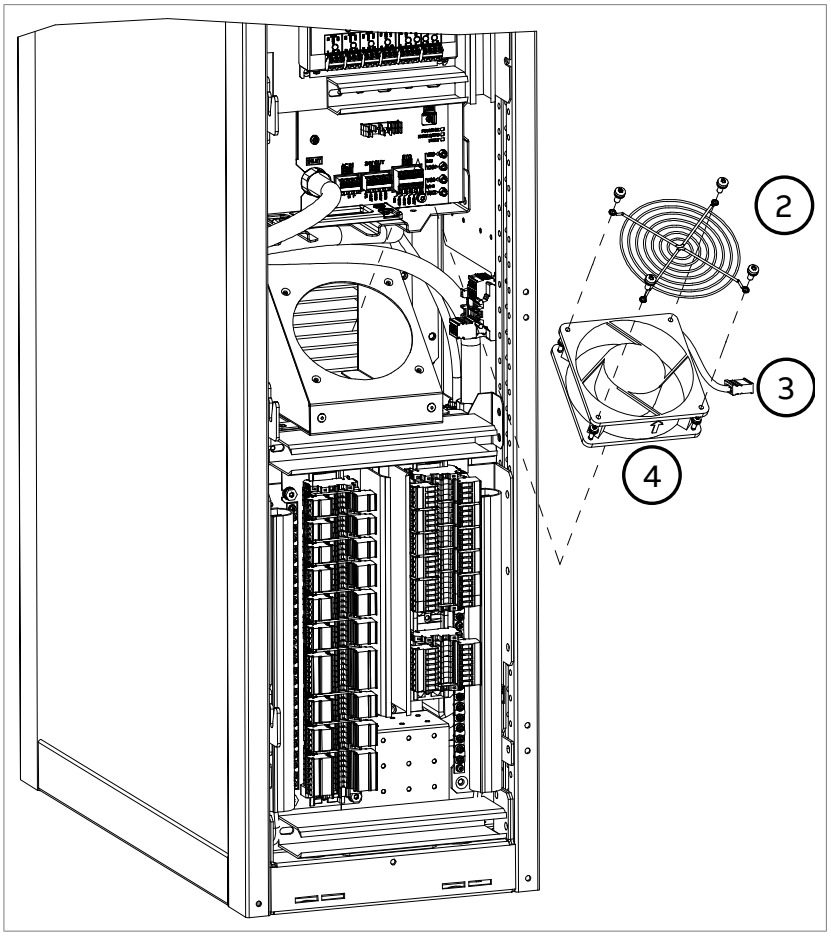
Frame R7i cabinet fan replacement

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

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

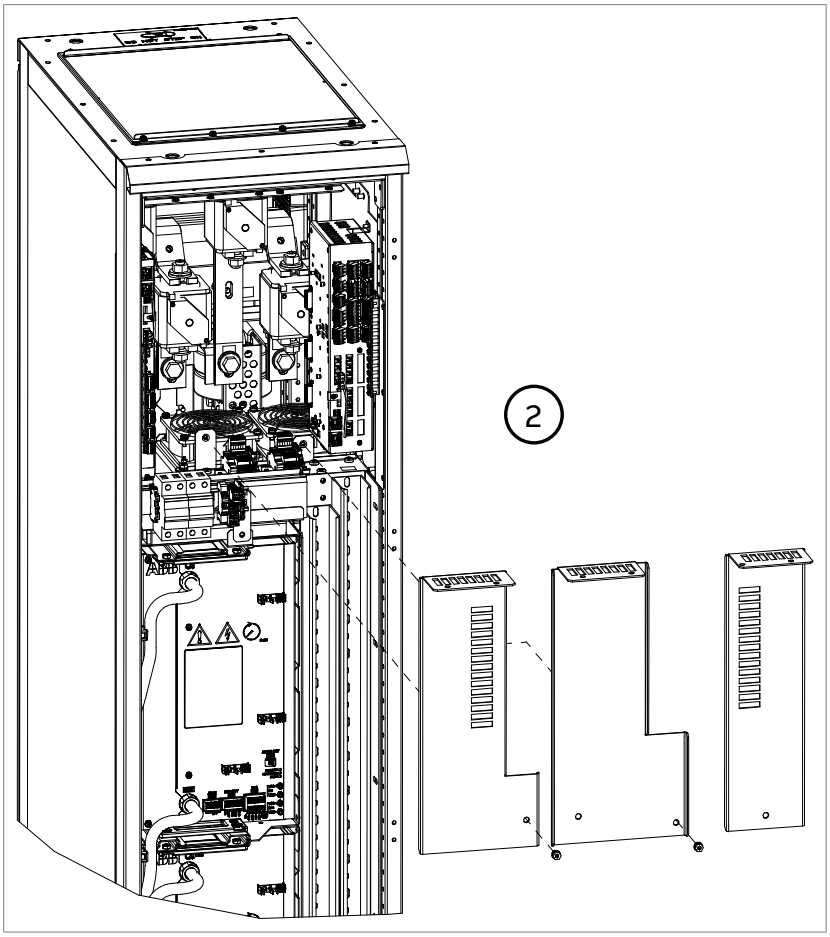
Inverter module cubicle with one module

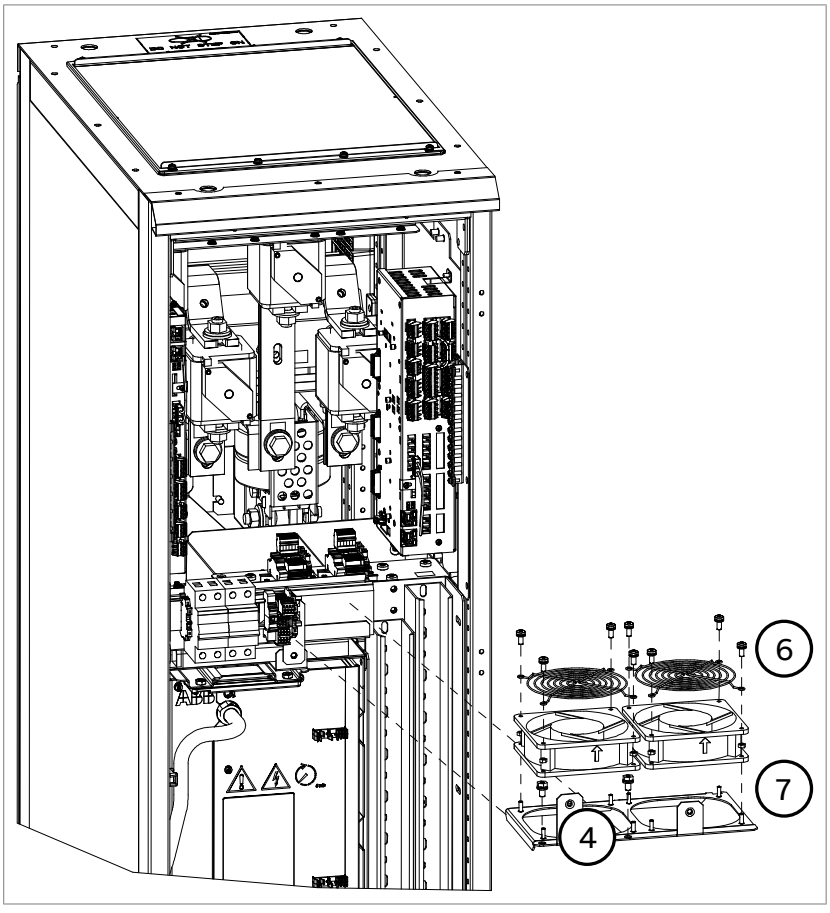
1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Remove the four screws that hold the finger guard to the fan. Remove the finger guard.
3. Disconnect the wiring of the fan.
4. Remove the four screws that hold the fan. Remove the fan.
5. Install a new fan in reverse order to the above. Note that the direction of airflow is up.



Inverter module cubicle with two modules

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. At the top part of the cubicle, remove the three shrouds shown.
3. Disconnect the wiring of the fans.
4. Remove the two screws that hold the base plate.
5. Remove the base plate from the cubicle, along with the fans.
6. Remove the finger guards from each fan (four screws each).
7. Undo the nuts that hold the fans to their base plate (four nuts each).
8. Install new fans in reverse order to the above. Note that the direction of airflow is up.


2

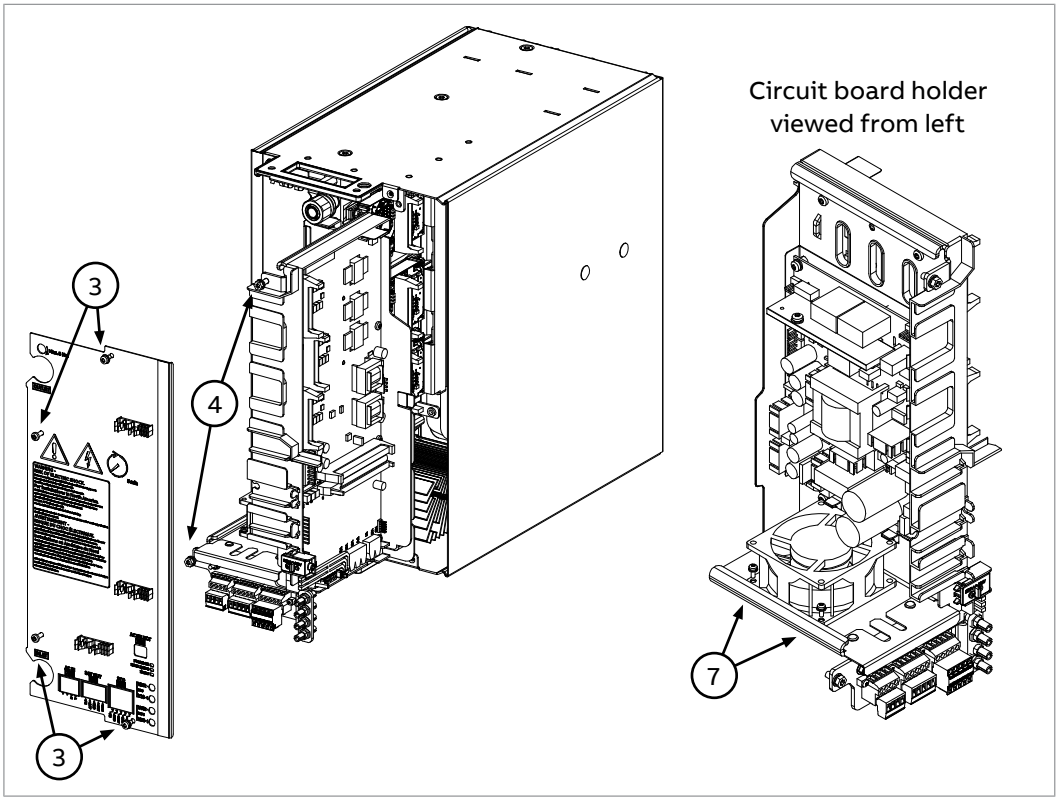

6
7
4

Frame R7i – internal module fan replacement

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

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Detach and move aside the wiring in front of the module.
3. Remove the four screws that hold the faceplate of the module. Remove the faceplate.
4. Remove the two screws that attach the circuit board holder to the module frame.
5. Carefully pull the circuit board holder outward until you have access to the cooling fan at the bottom of the holder. Detach the wiring coming to the circuit boards if necessary.
6. Disconnect the wiring of the fan.
7. Remove the two screws that hold the fan. Remove the fan.
8. Install a new fan in reverse order to the above. Note that the direction of airflow is up.

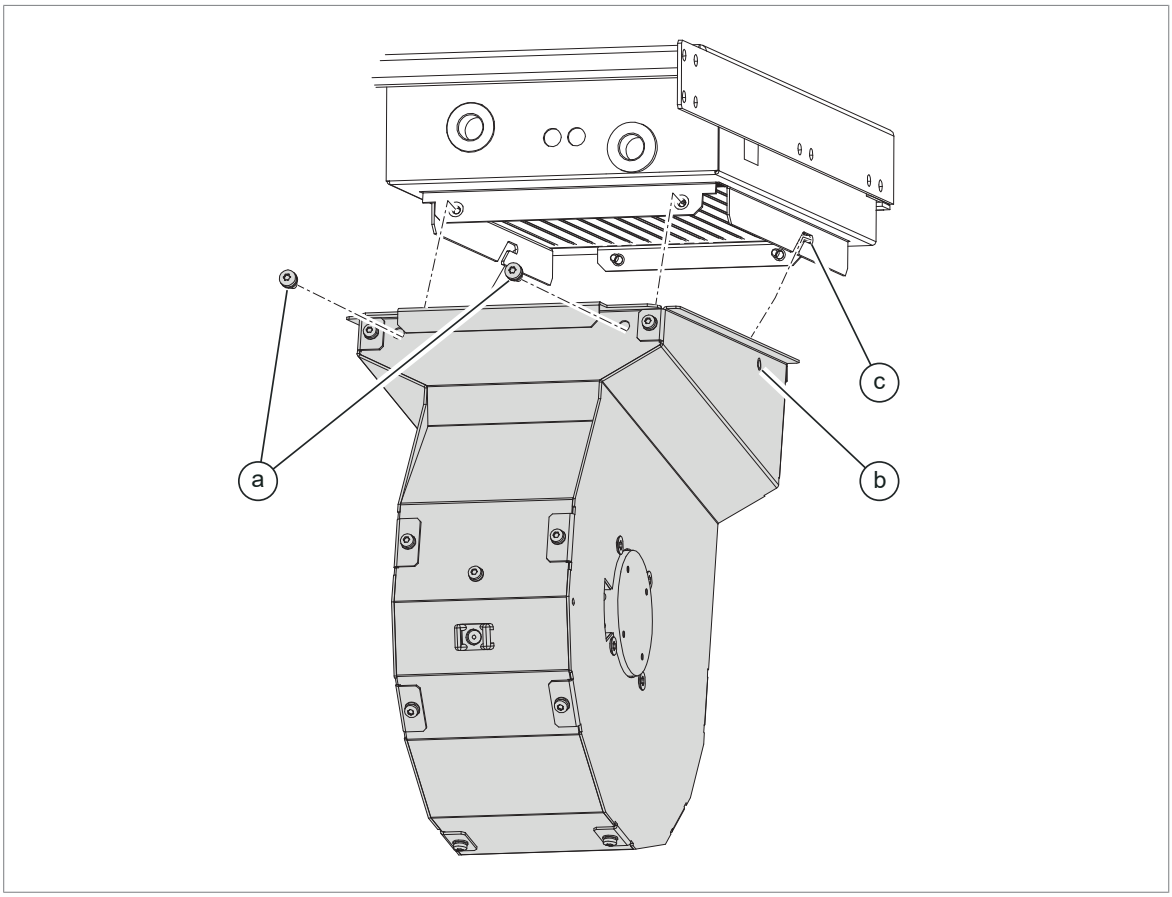


Frame R8i fan replacement

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

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Remove any shrouding in front of the cooling fan in case of marine construction (+C121).
3. Disconnect the fan wiring. Remove the CIO module.
4. Undo the two retaining screws (a).
5. Pull the fan outwards to separate it from the heat exchanger housing.
6. Install new fan in reverse order. Align the guide pins (b) at the rear of the fan cowling with the slots (c) in the module bottom guide, then reinstall the retaining screws (a).

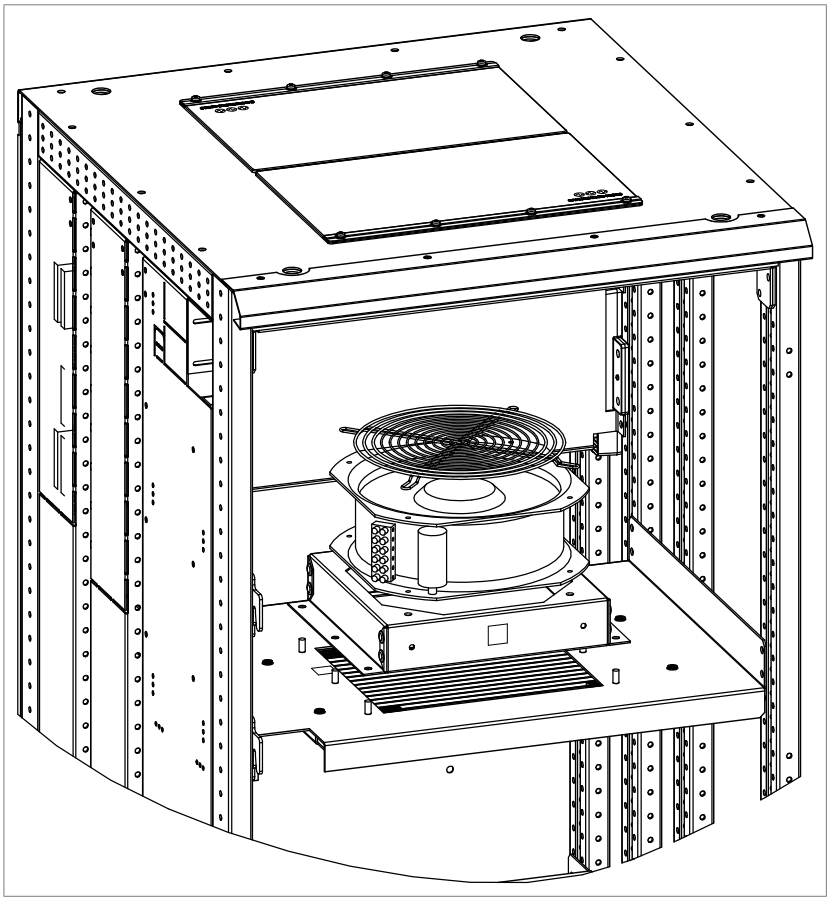


Replacing the common motor terminal cubicle fan

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

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Remove any shrouding in front of the cooling fan.
3. Disconnect the fan wiring. Remove the CIO module.
4. Undo the fastening screws.
5. Pull the fan housing up and out.
6. Install a new fan in reverse order to the above.



Inverter modules

Frame R7i

Replacing an R7i inverter module

WARNING!
Obey the safety instructions given in ACS880 liquid-cooled multidrive cabinets and modules safety instructions (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

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

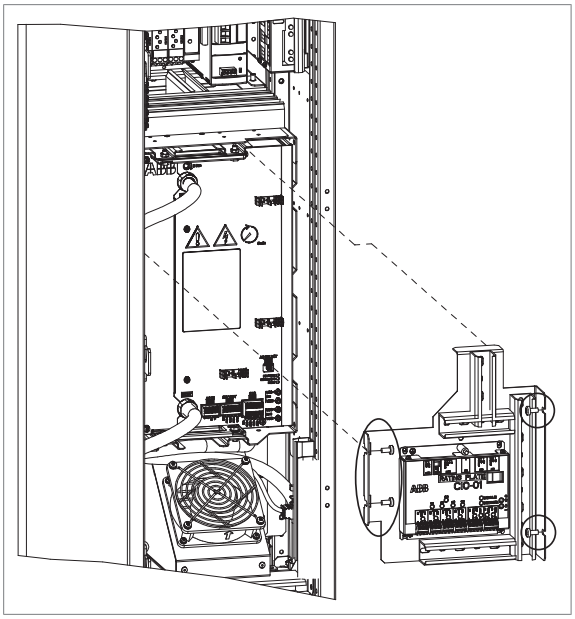
WARNING!
Make sure that the replacement module has exactly the same type code as the old module.

WARNING!
Beware of hot coolant. Do not work on the liquid cooling system until the pressure is lowered down by stopping the pumps and draining the coolant. High-pressure warm coolant (6 bar, max. 50 °C) is present in the internal cooling circuit when it is in operation.

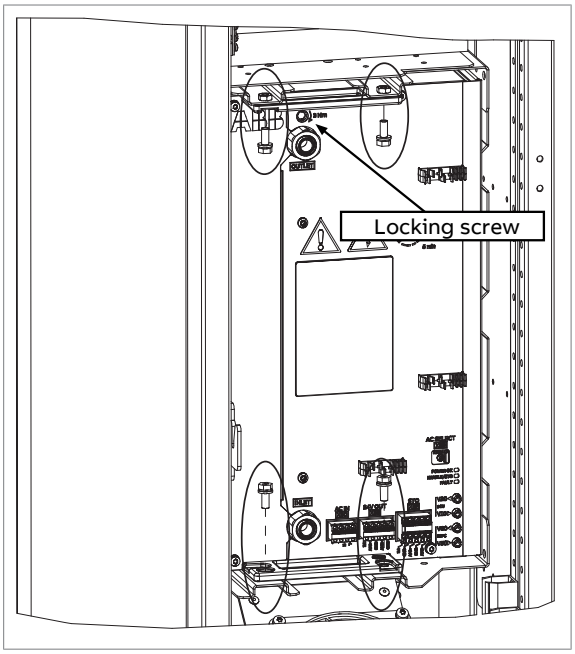
WARNING!
Use the required personal protective equipment. Wear protective gloves and long sleeves. Some parts have sharp edges.

Removing the module

1. Do the steps in section Electrical safety precautions (page 33).
2. Disconnect the wiring from the CIO module and the R7i module. Move the wiring aside. Use cable ties to keep the wiring out of the way.
3. Remove the CIO module mounting plate.

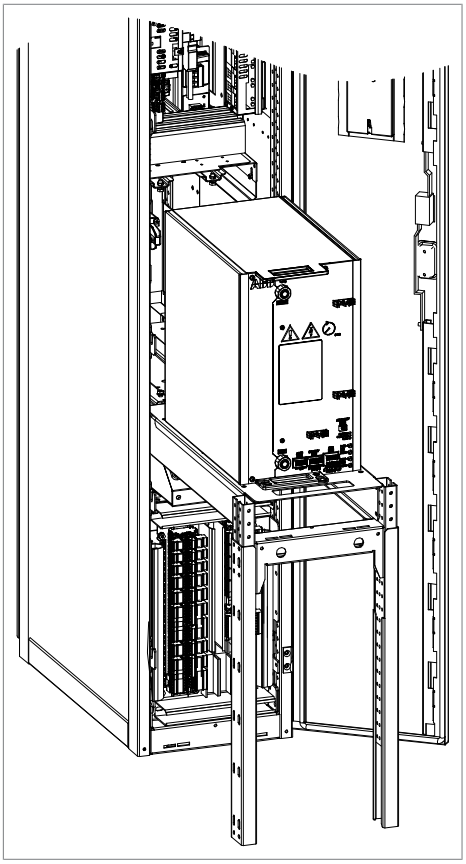


4. Close the inlet and outlet valves of the cubicle.
5. Lead the drain hoses (on the left-hand and right-hand sides of the cubicle) into a suitable container. Open the drain valves. This will drain all the equipment in the cubicle.
6. After the module has drained, disconnect the coolant piping from the module.
7. Assemble and install the service platform included in the delivery. Instructions are included in the platform kit. See also section Assembling the service platform (page 78).
8. Remove the module retaining screws at the top and the bottom of the module (two screws each). Undo the locking screw (6 mm hex key) at the top of the module.



9. Pull the module carefully out onto the service platform.

WARNING! Move the module with another person as it is heavy. Keep the module secured to a hoist or equivalent to prevent the module from falling.



Reinstalling the module

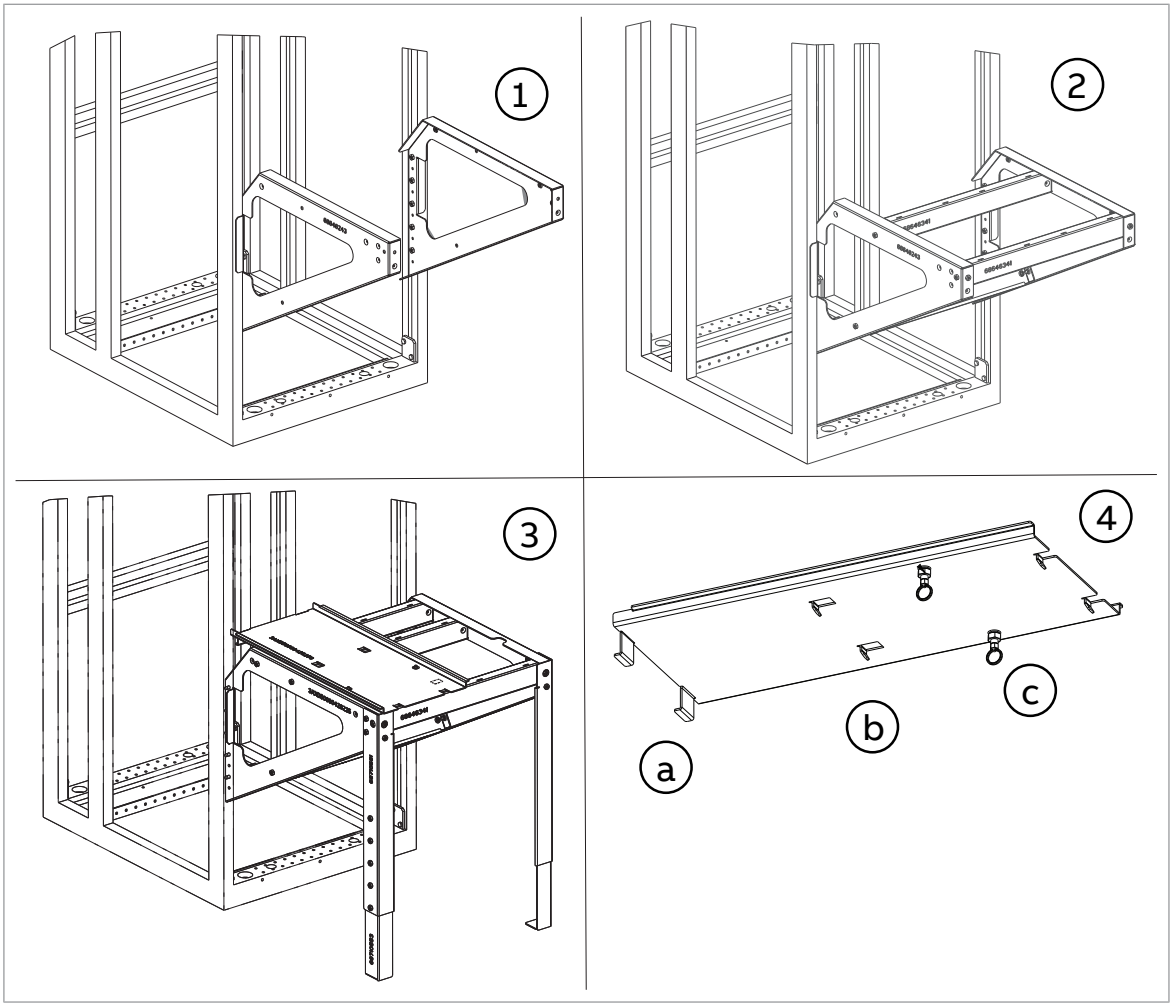
1. Push the module carefully into its bay.
2. Tighten the locking screw (6 mm hex key) at the top of the module to 5 N·m (3.6 lbf·ft) maximum.
3. Fasten the module retaining screws at the top and the bottom of the module (two screws each).
4. Reconnect the coolant pipes to the module. Tighten to 20 N·m (14.75 lbf·ft).
5. Reconnect the control wiring to the module.
6. Reinstall the CIO module mounting plate and reconnect the CIO wiring.
7. Fill up the cooling system. For instructions, see section Filling up and bleeding the internal cooling circuit.
8. If the Safe torque off function is in use, perform a validation test as described under Start-up including validation test (page 116).

Frame R8i

Assembling the service platform

The service platform is included in the cabinet delivery. It can be used when installing or servicing liquid-cooled R8i modules.

1. Fasten the triangular supports to the cabinet frame (5 × M6 screws for each support). Make sure that the guide pins are properly inserted in the holes of the frame. Tighten the screws to torque (max 5.5 N·m / 4 lb·ft).
2. Select the braces (4 pcs) according to the width of the cubicle and attach them to the supports.
3. Attach the support feet to the platform and adjust them to the correct height.
4. Attach the slide plate. Put the hooks (a) at the back of the slide plate through the holes in the cabinet frame. Align the slots (b) in the slide plate with the braces.
5. Fix the slide plate into place with the index screws (c) at the bottom of the slide plate.



WARNING!
Obey the safety instructions given in ACS880 liquid-cooled multidrive cabinets and modules safety instructions (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

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

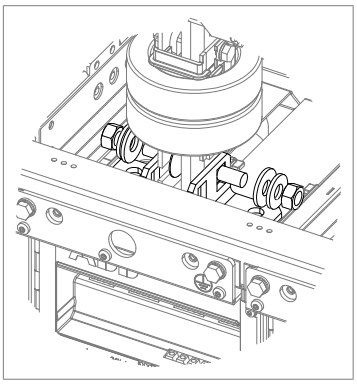
WARNING!
Make sure that the replacement module has exactly the same type code as the old module.

WARNING!
Beware of hot coolant. Do not work on the liquid cooling system until the pressure is lowered down by stopping the pumps and draining the coolant. High-pressure warm coolant (6 bar, max. 50 °C) is present in the internal cooling circuit when it is in operation.

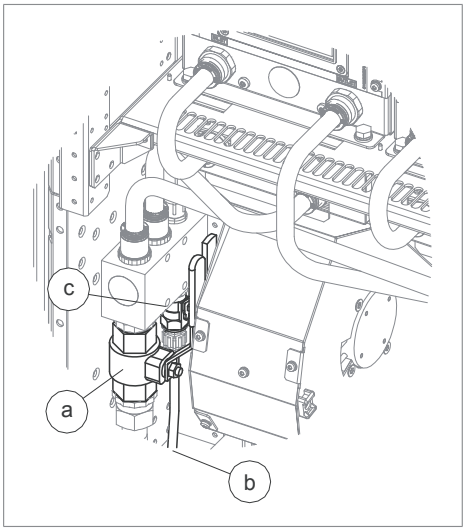
WARNING!
Use the required personal protective equipment. Wear protective gloves and long sleeves. Some parts have sharp edges.

Removing the module

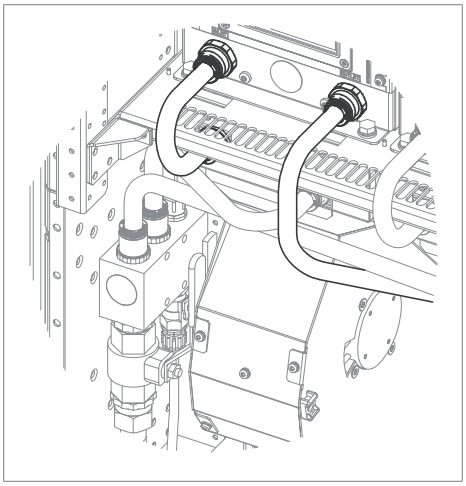
1. Do the steps in section Electrical safety precautions (page 33).
2. Assemble the service platform delivered with the drive. Refer to section Assembling the service platform (page 78).
3. Remove the shrouding in front of the module.
4. Remove the locking screws of the swing-out frame (if present) and open it.
5. Disconnect the wiring from the module and move it aside. Use cable ties to keep the wiring out of the way.
6. Remove the L-shaped DC busbars at the top of the module. Make note of the orientation of the screws as well as the order of the washers.



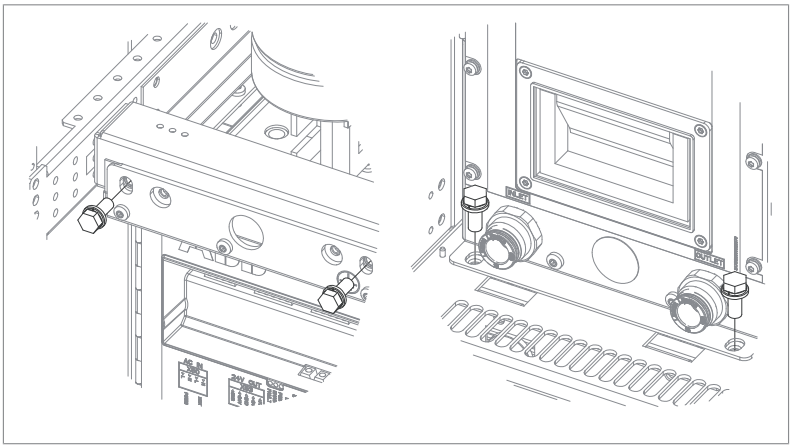
7. Close the inlet valve (a) and outlet valve (located on the right-hand side of the cubicle). Lead the drain hoses (b, on both sides of the cubicle) into a suitable container. Open the drain valves (c, on both sides of the cubicle). This will drain all modules in the cubicle.



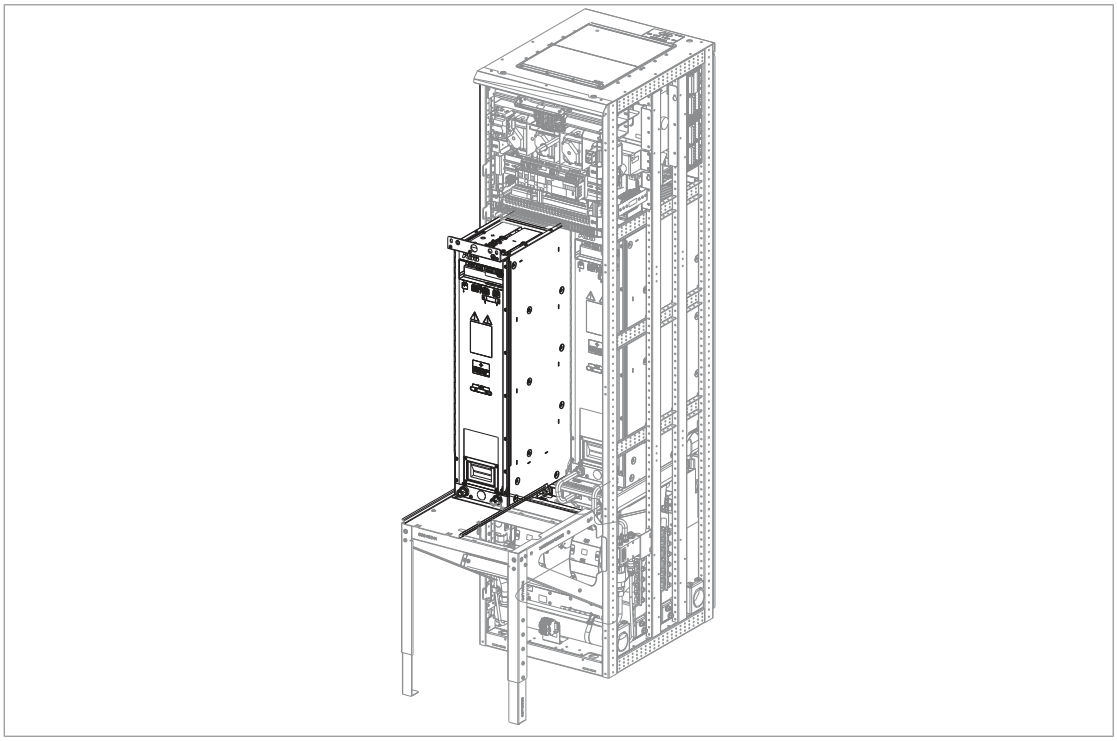
8. After the module has drained, disconnect the piping from the module.



9. Remove the module retaining screws at the top and the bottom of the module.



10. Pull the module carefully out onto the service platform. Keep the module secured to a hoist or equivalent to prevent the module from falling. For information on using the lifting device, see Converter module lifting device for drive cabinets hardware manual (3AXD50000210268 [English]).



Reinstalling the module

1. Push the module carefully into its bay.
2. Fasten the retaining screws at the top and the bottom of the module.
3. Reinstall the DC busbars at the top of the module.
4. Reconnect the coolant pipes to the module. Tighten to specified torque. R8i module coolant connections: 15 N·m (11.1 lbf·ft). Other connections: 20 N·m (14.75 lbf·ft).
5. Reconnect the control wiring to the module.
6. Fill up the cooling system. For instructions, see section Filling up and bleeding the internal cooling circuit.

7. Close the swing-out frame (if present). Reinstall all shrouds removed earlier.
8. If the Safe torque off function is in use, perform a validation test as described under Start-up including validation test (page 116).

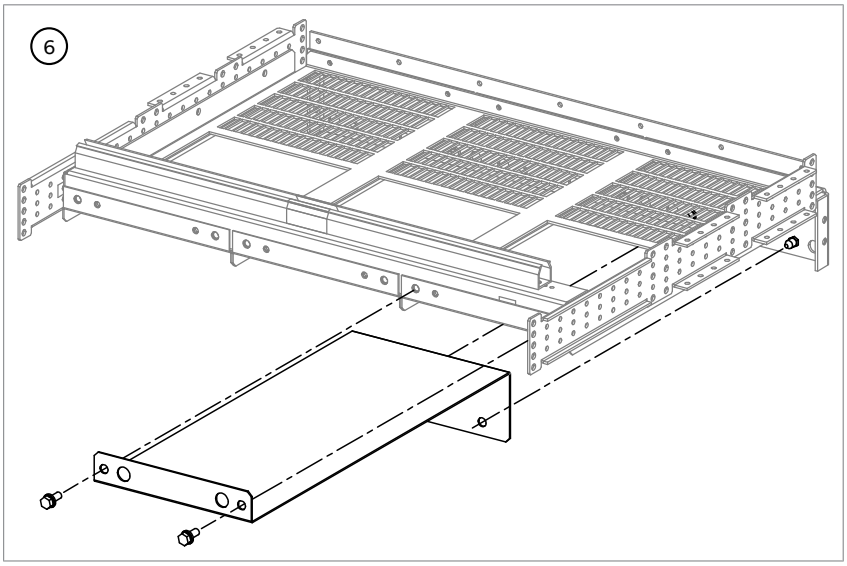
Activating the reduced run of the inverter unit

A “reduced run” function is available for inverter units consisting of parallel-connected inverter modules. The function makes it possible to continue operation with limited current even if one (or more) module is out of service, for example, because of maintenance work. In principle, reduced run is possible with only one module, but the physical requirements of operating the motor still apply; for example, the modules remaining in use must be able to provide the motor with enough magnetizing current.

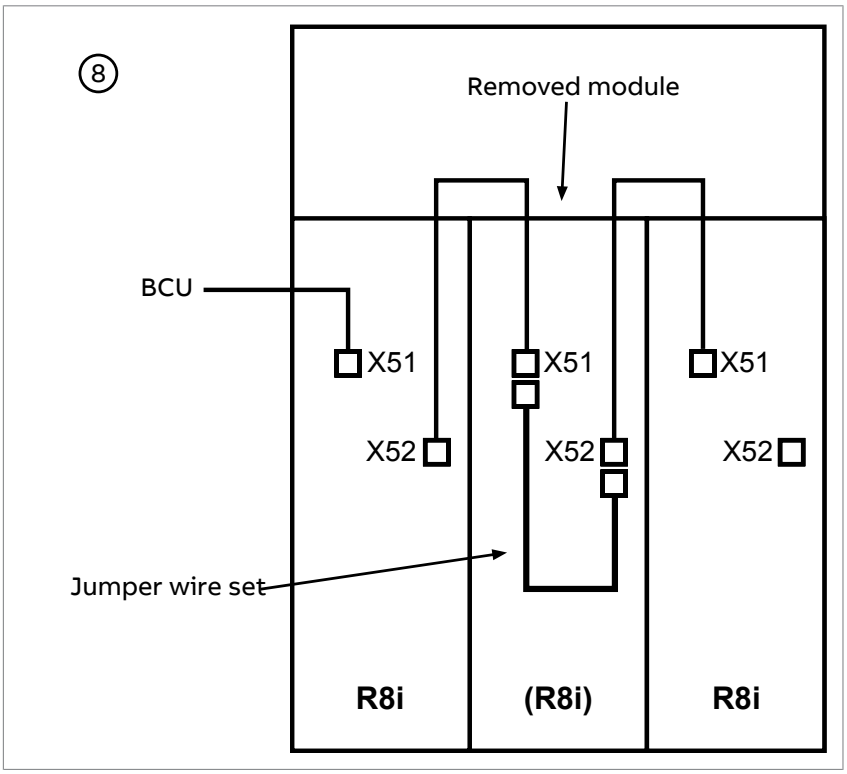
Note: The wiring accessories and the air baffle needed during the procedure are included in the delivery, and separately available from ABB.

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Remove the shrouding above the module bay (in front of the DC fuses).
3. Remove the DC fuses and the busbar assembly connecting the fuses to the inverter module. Store these parts – they are to be reinstalled only with the inverter module. Make note of the order of washers.
4. Remove the faulty module from its bay. See the module replacement instructions.
5. Plug the coolant pipes disconnected from the module using the plugs that are included in the drive delivery.
6. Install the air baffle (included) to the underside of the top module guide. Align the holes at the rear edge of the baffle with the guide pins of the rear support. Fasten the front edge of the baffle to the module mounting holes using the module mounting screws (2 × M8). Tighten to 9 N·m (6.6 lbf·ft).



7. If the inverter control unit (A41) is powered from the faulty module, connect the power supply wiring to another module using the extension wire set included.
8. If the Safe torque off (STO) function is in use, install the jumper wire set included in the STO wiring in place of the missing module. (This is not needed if the module was the last on the STO wire chain.)



9. Open the circuit breaker of the cooling fan of the removed module. Disconnect the control and power wiring of the fan.
10. Cover or remove the cooling fan.
11. Deactivate the control IOs of the fan in parameters 206.20 … 206.23.
12. Reinstall all shrouding removed earlier.

    Note: Do not reinstall the DC fuses or busbars but store them elsewhere until the module can be reinstalled.
13. In case the inverter unit has a DC switch/disconnector with a charging circuit, locate the BSFC-xx charging controller. On the controller, disable the channel of the removed module by using the appropriate DIP switch.
14. Switch on the power to the drive.
15. Enter the number of inverter modules present into parameter 95.13 Reduced run mode.
16. Reset all faults and start the drive.
17. If the Safe torque off (STO) function is in use, perform a validation test. See the instructions in chapter The Safe torque off function (page 107).

The maximum current is now automatically limited according to the new inverter configuration. A mismatch between the number of detected modules (parameter 95.14) and the value set in 95.13 will generate a fault.

Returning the module

1. Install the module in reverse order. Use the following tightening torques:
   - DC busbar assembly to upper insulators (2 × M8): 9 N·m (6.6 lbf·ft)
   - DC busbar assembly to lower insulators (2 × M10): 18 N·m (13.3 lbf·ft)
   - Fuses to DC busbars: 50 N·m (37 lbf·ft) (Bussmann), 46 N·m (34 lbf·ft) (Mersen/Ferraz-Shawmut)
   - Module to cabinet frame (4 × M8): 22 N·m (16 lbf·ft)
   - DC busbar assembly to module DC input (2 × M12): 70 N·m (52 lbf·ft)
2. Remove the plugs from the coolant pipes and reconnect the pipes to the module. See the module replacement instructions.
3. Restore the original wiring (STO and control unit power supply whenever needed).
4. Reinstall any removed fan(s). Reconnect the control and power supply wiring of the fan.
5. Set parameter 95.13 to 0 to disable the reduced run function.
6. Activate the control IOs of the fan in parameters 206.20 … 206.23.
7. If the Safe torque off (STO) function is in use, perform an acceptance test. See the instructions in chapter The Safe torque off function (page 107).

Capacitors

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

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

Reforming the capacitors

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

DC fuses

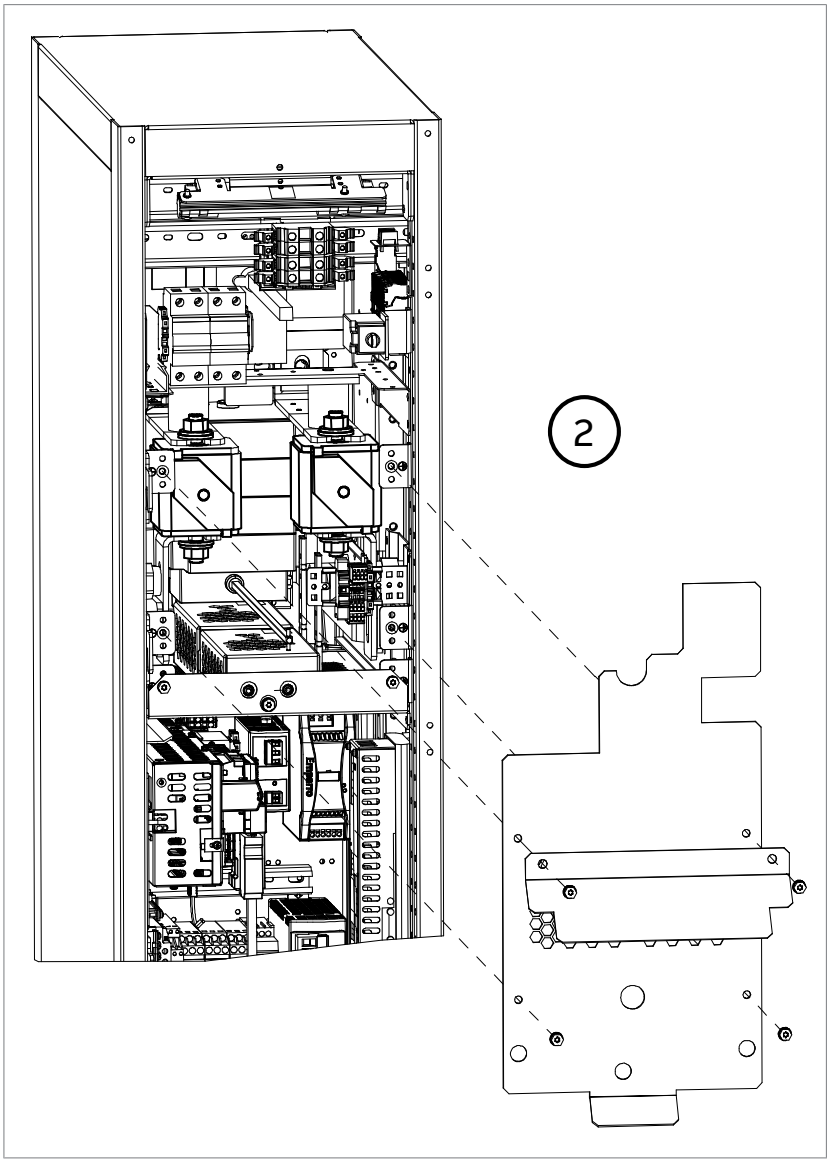
Frame R7i

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

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

Inverter module cubicle with one module

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Open the cubicle door. At the top part of the cubicle, remove the shroud shown.
3. Slacken the nuts of the headless screws of the fuses so that you can slide out the fuse blocks. Make note of the order of the washers on the screws.
4. Remove the screws, nuts and washers from the old fuses and attach them to the new fuses. Make sure to keep the washers in the original order.
5. Insert the new fuses into their slots in the cubicle. Pre-tighten the nuts first by hand or by applying a torque of no more than 5 N·m (3.7 lbf·ft).
6. Tighten the nuts to torque as follows:
   - Bussmann fuses: 50 N·m (37 lbf·ft)
   - Mersen (Ferraz Shawmut) fuses: 46 N·m (34 lbf·ft)
   - Other fuses: Refer to fuse manufacturer's instructions.
7. Reinstall the shrouding removed earlier and close the door.

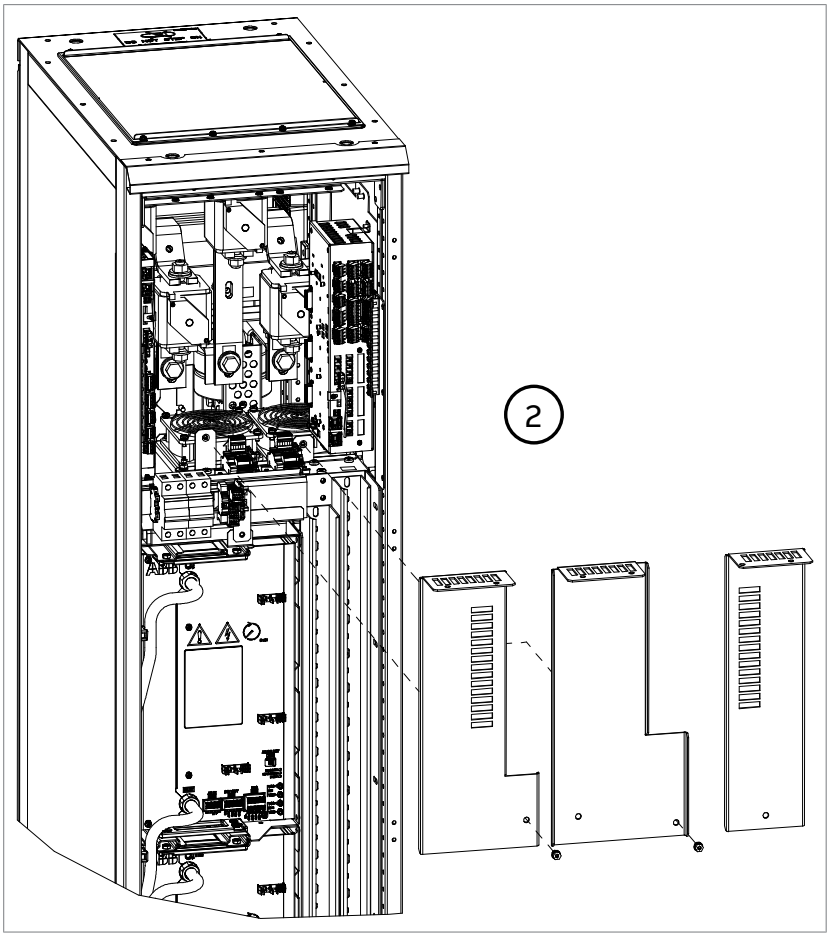


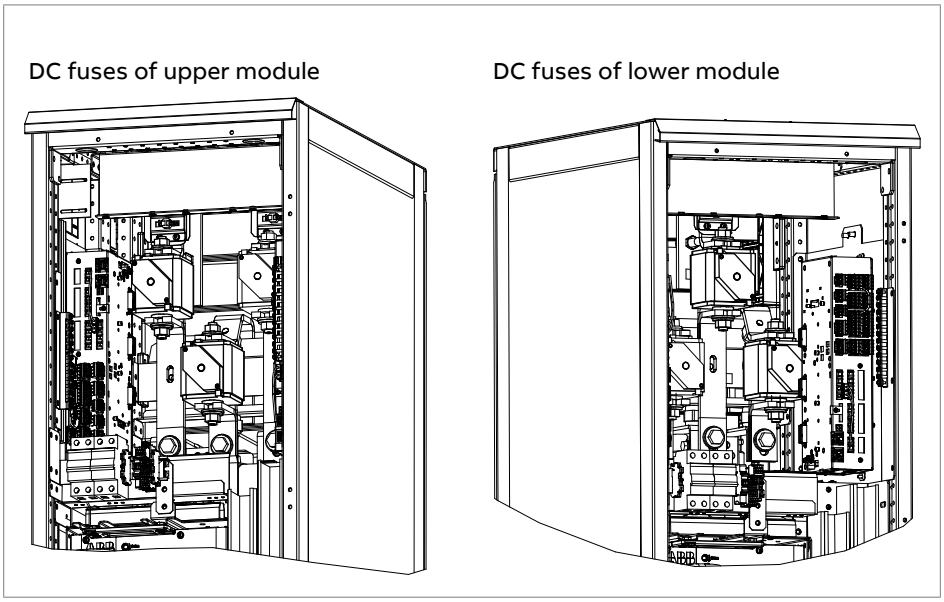
Inverter module cubicle with two modules

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Open the cubicle door. At the top part of the cubicle, remove the three shrouds shown.
3. Locate the fuses. The two leftmost fuses are for the upper module, the two rightmost for the lower module.
4. Slacken the nuts of the headless screws of the fuses so that you can slide out the fuse blocks. Make note of the order of the washers on the screws.
5. Remove the screws, nuts and washers from the old fuses and attach them to the new fuses. Make sure to keep the washers in the original order.
6. Insert the new fuses into their slots in the cubicle. Pre-tighten the nuts first by hand or by applying a torque of no more than 5 N·m (3.7 lbf·ft).
7. Tighten the nuts to torque as follows:

- Bussmann fuses: 50 N·m (37 lbf·ft)
- Mersen (Ferraz Shawmut) fuses: 46 N·m (34 lbf·ft)
- Other fuses: Refer to fuse manufacturer's instructions.

8. Reinstall the shrouding removed earlier and close the door.

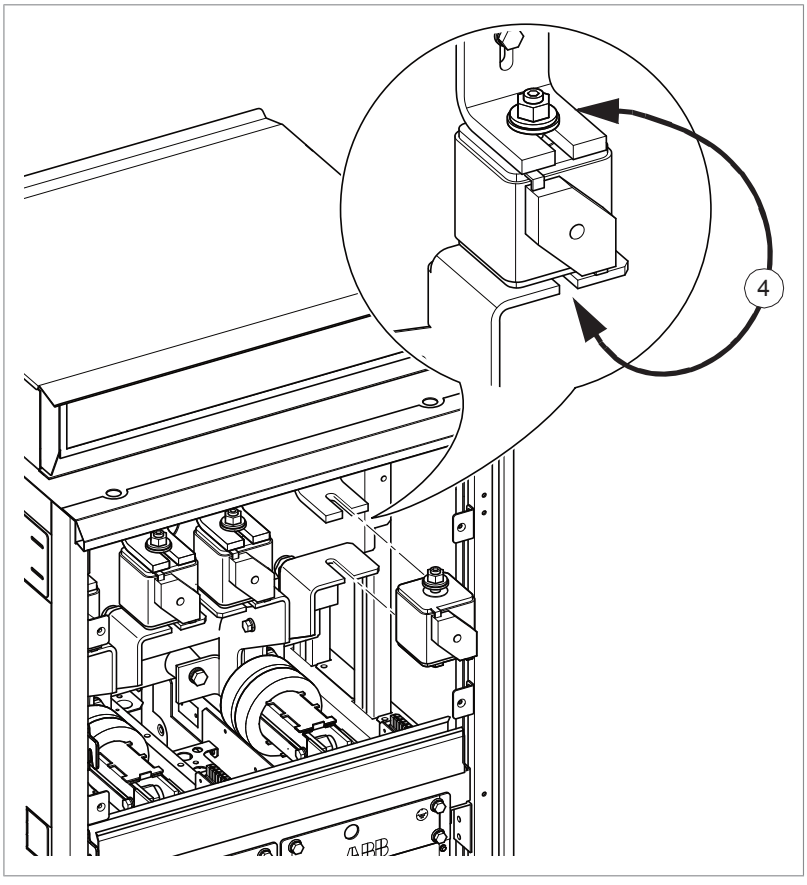




Frame R8i and multiples

WARNING!
Read the safety instructions given in ACS880 liquid-cooled multidrive cabinets and modules safety instructions (3AXD50000048633 [English]). If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Open the door of the cubicle in which the fuses are.
3. Remove the shrouding from in front of the fuses.
4. Slacken the nuts of the headless screws of the fuses so that you can slide out the fuse blocks. Make note of the order of the washers on the screws.
5. Remove the screws, nuts and washers from the old fuses and attach them to the new fuses. Make sure to keep the washers in the original order.
6. Insert the new fuses into their slots in the cubicle. Pre-tighten the nuts first by hand or by applying a torque of no more than 5 N·m (3.7 lbf·ft).
7. Tighten the nuts to torque as follows:
   - Bussmann fuses: 50 N·m (37 lbf·ft)
   - Mersen (Ferraz Shawmut) fuses: 46 N·m (34 lbf·ft)
   - Other fuses: Refer to fuse manufacturer's instructions.
8. Reinstall the shroud and close the door.



Control panel

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

Control units

BCU control unit types

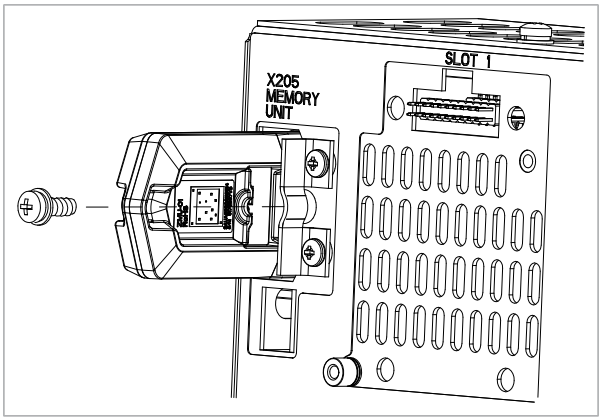
There are three variants of the BCU control unit used in ACS880 drives: BCU-02, BCU-12 and BCU-22. These have a different number of converter module connections (2, 7 and 12 respectively) but are otherwise identical. The three BCU types are interchangeable as long as the number of connections is sufficient. For example, the BCU-22 can be used as a direct replacement for both BCU-02 and BCU-12.

Replacing the memory unit

After replacing a control unit, you can keep the existing parameter settings by transferring the memory unit from the defective control unit to the new control unit.

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

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Make sure that the control unit is not powered.
3. Remove the fastening screw and pull the memory unit out.
4. Install a memory unit in reverse order.

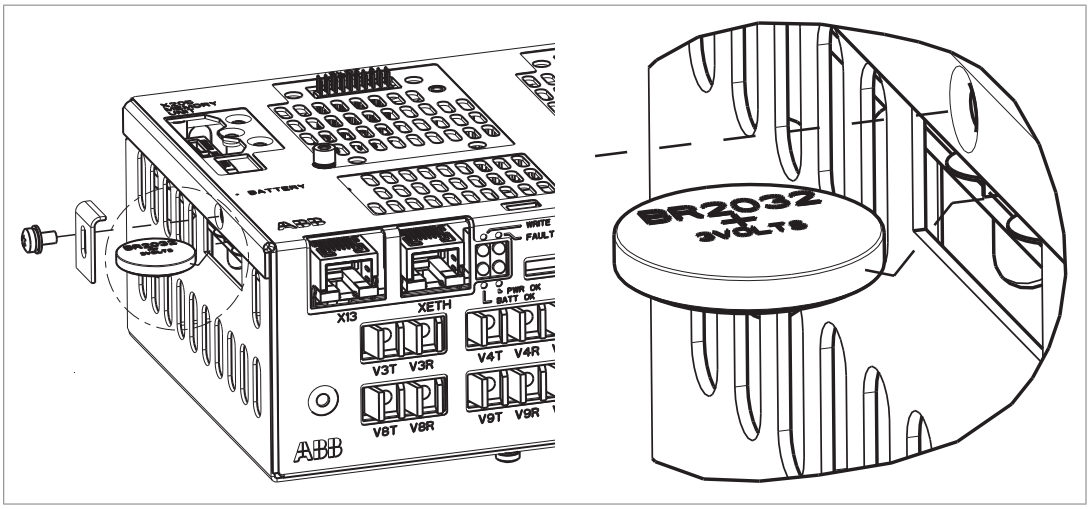


Replacing the BCU control unit battery

Replace the real-time clock battery if the BATT OK LED is not illuminated when the control unit is powered.

1. Stop the drive and do the steps in section Electrical safety precautions (page 33) before you start the work.
2. Undo the fastening screw and remove the battery.
3. Replace the battery with a new BR2032 battery.

4. Dispose of the old battery according to local disposal rules or applicable laws.
5. Set the real-time clock.



Functional safety components

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

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

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

Note that some of the components may already have been renewed earlier, restarting their mission time. The remaining mission time of the whole circuit is however determined by its oldest component.

Contact your local ABB service representative for more information.

7

Control units of the drive

Contents of this chapter

This chapter

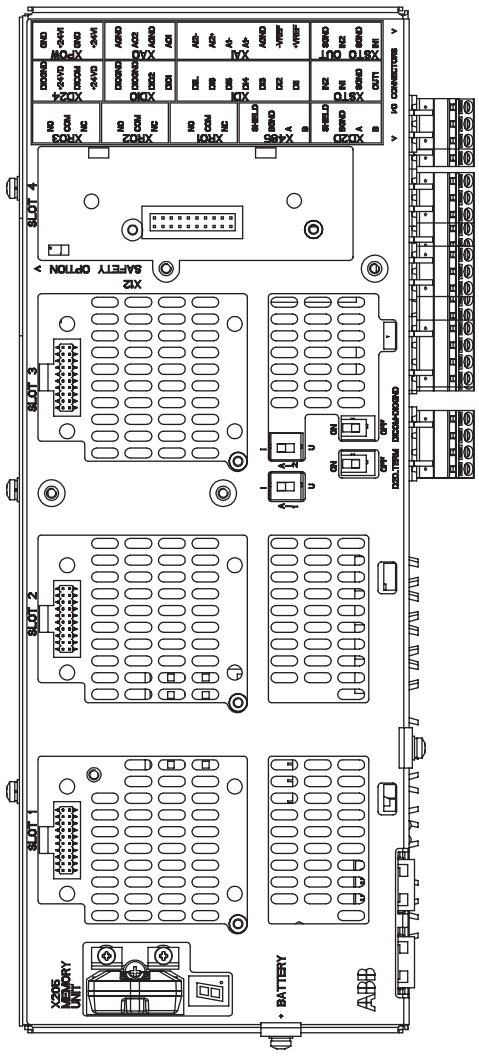
- describes the connections of the control unit(s) used in the drive,
- contains the specifications of the inputs and outputs of the control unit(s).

General

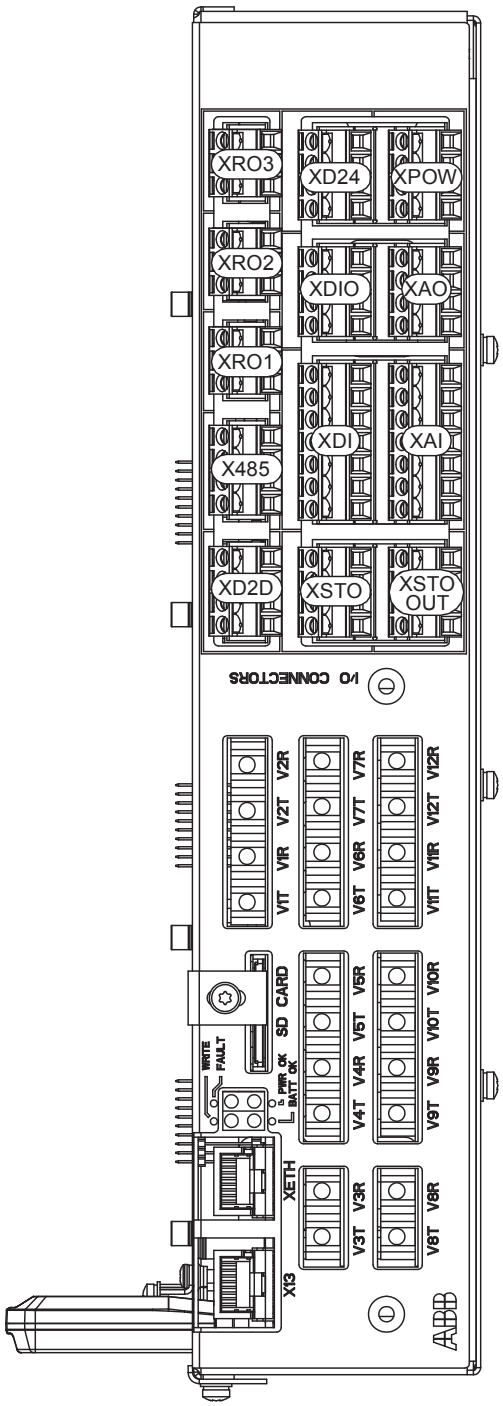
The BCU-x2 is used with frame sizes R7i and R8i in single and parallel configurations. The BCU-x2 consists of a BCON-12 control board (and a BIOC-01 I/O connector board and power supply board) built in a metal housing. The control unit is connected to the inverter module(s) by fiber optic cables.

In this manual, the name “BCU-x2” represents the control unit types BCU-02, BCU-12 and BCU-22. These have a different number of power module connections (2, 7 and 12 respectively) but are otherwise similar.

BCU-x2 layout



	Description
I/O	I/O terminals (see following diagram)
SLOT 1	I/O extension, encoder interface or fieldbus adapter module connection. (This is the sole location for an FDPI-02 diagnostics and panel interface.)
SLOT 2	I/O extension, encoder interface or fieldbus adapter module connection
SLOT 3	I/O extension, encoder interface, field-bus adapter or FSO safety functions module connection
SLOT 4	RDCO-0x DDCS communication option module connection
X205	Memory unit connection
BATTERY	Holder for real-time clock battery (BR2032)
AI1	Mode selector for analog input AI1 (I = current, U = voltage)
AI2	Mode selector for analog input AI2 (I = current, U = voltage)
D2D TERM	Termination switch for drive-to-drive link (D2D)
DICOM= DIOGND	Ground selection. Determines whether DICOM is separated from DIOGND (ie. the common reference for the digital in-puts floats). See the ground isolation diagram.
7-segment display Multicharacter indications are displayed as repeated sequences of characters	
	(“U” is indicated briefly before “o”.) Control program running
	Control program startup in progress
	(Flashing) Firmware cannot be started. Memory unit missing or corrupted
	Firmware download from PC to control unit in progress
	At power-up, the display may show short indications of eg. “1”, “2”, “b” or “U”. These are normal indications immedi-ately after power-up. If the display ends up showing any other value than those described, it indicates a hardware failure.



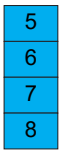
	Description
XAI	Analog inputs
XAO	Analog outputs
XDI	Digital inputs, Digital input interlock (DIIL)
XDIO	Digital input/outputs
XD2D	Drive-to-drive link
XD24	+24 V output (for digital inputs)
XETH	Ethernet port – Not in use
XPOW	External power input
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XSTO	Safe torque off connection (input signals)
XSTO OUT	Safe torque off connection (to inverter modules)
X12	(On the opposite side) Connection for FSO safety functions module (optional)
X13	Control panel / PC connection
X485	Not in use
V1T/V1R, V2T/V2R	Fiber optic connection to modules 1 and 2 (VxT = transmitter, VxR = receiver)
V3T/V3R … V7T/V7R	Fiber optic connection to modules 3…7 (BCU-12/22 only) (VxT = transmitter, VxR = receiver)
V8T/V8R … V12T/V12R	Fiber optic connection to modules 8…12 (BCU-22 only) (VxT = transmitter, VxR = receiver)
SD CARD	Data logger memory card for inverter module communication
BATT OK	Real-time clock battery voltage is higher than 2.8 V. If the LED is off when the control unit is powered, replace the battery.
FAULT	The control program has generated a fault. See the firmware manual of the supply/inverter unit.
PWR OK	Internal voltage supply is OK
WRITE	Writing to memory card in progress. Do not remove the memory card.

Default I/O diagram of the inverter control unit (BCU-x2)

The table below describes the use of the connections in the inverter unit. Under normal circumstances, the factory-made wiring should not be changed.

The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 … 2.5 mm² (22…12 AWG). The tightening torque is 0.45 N·m (4 lbf·in).

Terminal			Description	
XD2D			Drive-to-drive link	
1 2 3 4	1	B	Drive-to-drive link. Refer to section The XD2D connector (page 100).	
	2	A		
	3	BGND		
	4	Shield		
ON OFF	D2D.TERM		Drive-to-drive link termination switch. Must be set to ON when the inverter unit is the first or last unit in the drive-to-drive (D2D) link. On intermediate units, set termination to OFF.	
X485			RS485 connection	
5 6 7 8	5	B	Not in use by default	
	6	A		
	7	BGND		
	8	Shield		
XRO1, XRO2, XRO3			Relay outputs	
11 12 13 21 22 23 31 32 33	11	NC	Norm. closed	XRO1: **Ready** (Energized = Ready) 250 V AC / 30 V DC, 2 A
	12	COM	Common	
	13	NO	Norm. open	
	21	NC	Norm. closed	XRO2: **Running** (Energized = Running) 250 V AC / 30 V DC, 2 A
	22	COM	Common	
	23	NO	Norm. open	
	31	NC	Norm. closed	XRO3: **Fault (-1)** (Energized = No fault) 250 V AC / 30 V DC, 2 A
	32	COM	Common	
	33	NO	Norm. open	
XSTO, XSTO OUT			Safe torque off	
1 2 3 4 5 6 7 8	1	OUT	XSTO: Factory connection. Both circuits must be closed for the drive to start (IN1 and IN2 must be connected to OUT). Refer to chapter The Safe torque off function.	
	2	SGND		
	3	IN1		
	4	IN2		
	5	IN1	XSTO OUT: Safe torque off output to inverter modules.	
	6	SGND		
	7	IN2		
	8	SGND		
XDI			Digital inputs	

Terminal			Description
	1	DI1	Stop (0) / Start (1)
	2	DI2	Forward (0) / Reverse (1)
	3	DI3	Reset
	4	DI4	Acceleration & deceleration select [1]
	5	DI5	Constant speed 1 select (1 = on) [2]
	6	DI6	Not in use by default.
	7	DIIL	Run enable [3]
XDIO			Digital input/outputs
	1	DIO1	Output: Ready
	2	DIO2	Output: Running
	3	DIOGND	Digital input/output ground
	4	DIOGND	Digital input/output ground
XD24			Auxiliary voltage output
	5	+24VD	+24 V DC 200 mA [4]
	6	DICOM	Digital input ground
	7	+24VD	+24 V DC 200 mA [4]
	8	DIOGND	Digital input/output ground
	DICOM=DIOGND		Ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.
XAI			Analog inputs, reference voltage output
	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 [5]
	5	AI1-	
	6	AI2+	Not in use by default. 0(4)…20 mA, R_{in} = 100 ohm [6]
	7	AI2-	
	AI1		AI1 current/voltage selection switch
	AI2		AI2 current/voltage selection switch
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	
XPOW			External power input
	1	+24VI	24 V DC, 2.05 A Two supplies can be connected for redundancy.
	2	GND	
	3	+24VI	
	4	GND	
X12			Safety functions module connection
X13			Control panel connection

Terminal	Description
X205	Memory unit connection

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

2) Constant speed 1 is defined by parameter 22.26.

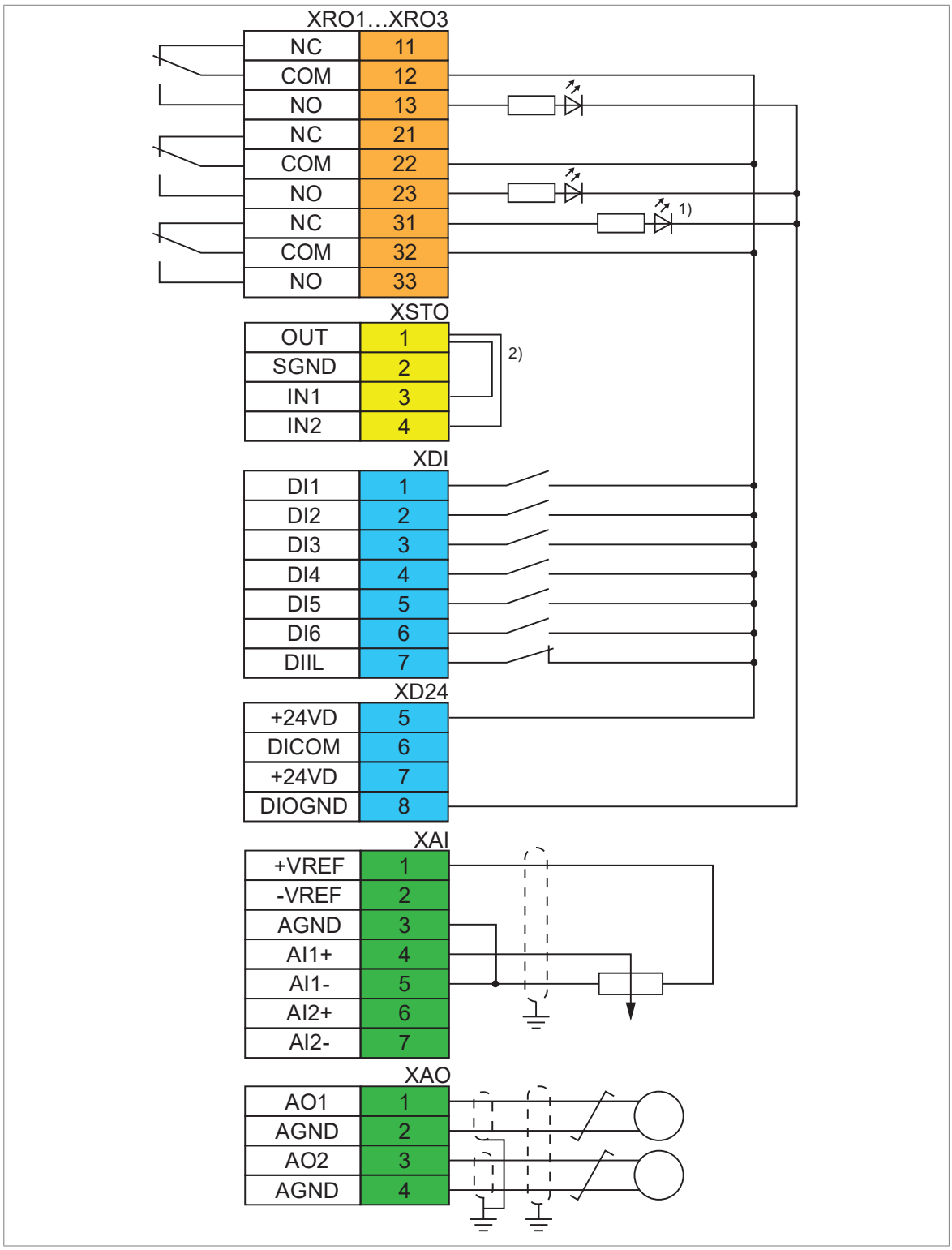
3) The DIIL input is configured to stop the unit when the input signal is removed. This input does not have a SIL or PL classification.

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

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

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

The diagram below shows the default I/O connections on the inverter control unit (A41).



1) Fault

2) If necessary, you can connect an emergency stop button to the XSTO terminal. Refer to chapter The Safe torque off function.

Additional information on the connections

Connecting motor temperature sensors to the drive

IEC/EN 60664 requires double or reinforced insulation between the control unit and the live parts of the motor. To achieve this, use an FPTC-01 or FPTC-02 protection module or an FAIO-01 extension module. See ACS880 liquid-cooled multidrives cabinets and modules electrical planning instructions (3AXD50000048634) and the module manual.

Power supply for the control unit (XPOW)

The control unit is powered from a 24 V DC, 2 A supply through terminal block XPOW. With a type BCU/UCU control unit, a second supply can be connected to the same terminal block for redundancy.

Using a second supply is recommended, if:

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

DIIL input

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

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

The XD2D connector

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

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

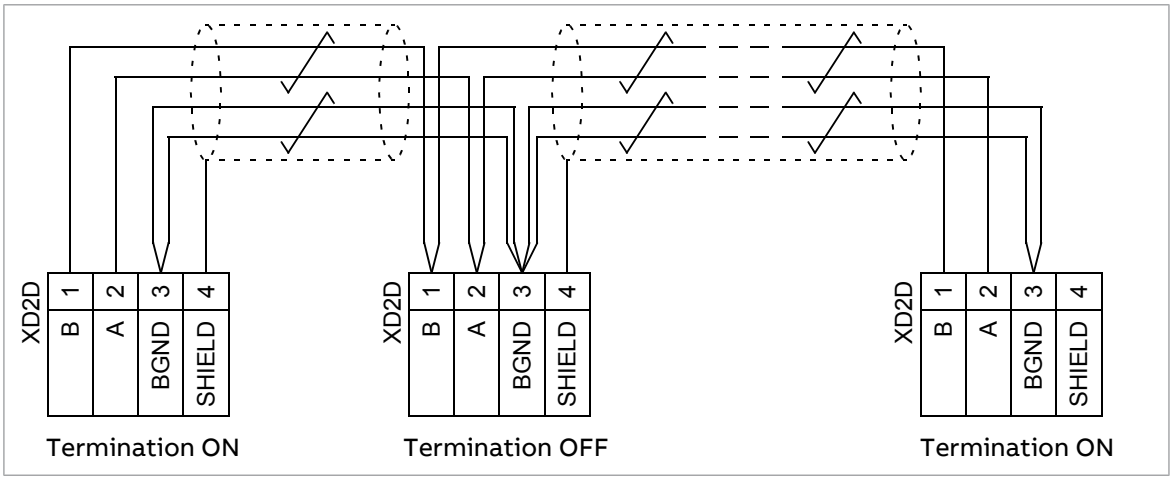
See the firmware manual of the drive for the related parameter settings.

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

Use a high-quality shielded twisted-pair cable for the wiring, for example, Belden 9842. The nominal impedance of the cable should be 100…165 ohm. You can use one pair for the data wiring and another pair or a wire for the grounding. Avoid unnecessary loops and parallel runs near power cables.

The following diagram shows the wiring between control units.

BCU-x2



Safe torque off (XSTO, XSTO OUT)

See chapter The Safe torque off function (page 107).

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

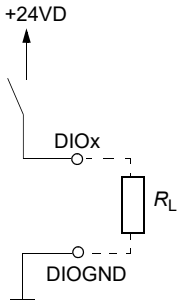
FSO safety functions module connection (X12)

Refer to the applicable FSO module user's manual. Note that the FSO safety functions module is not used in supply, DC/DC converter or brake units.

SDHC memory card slot

The BCU-x2 has an on-board data logger that collects real-time data from the power modules to help fault tracing and analysis. The data is stored onto the SDHC memory card inserted into the SD CARD slot and can be analyzed by ABB service personnel.

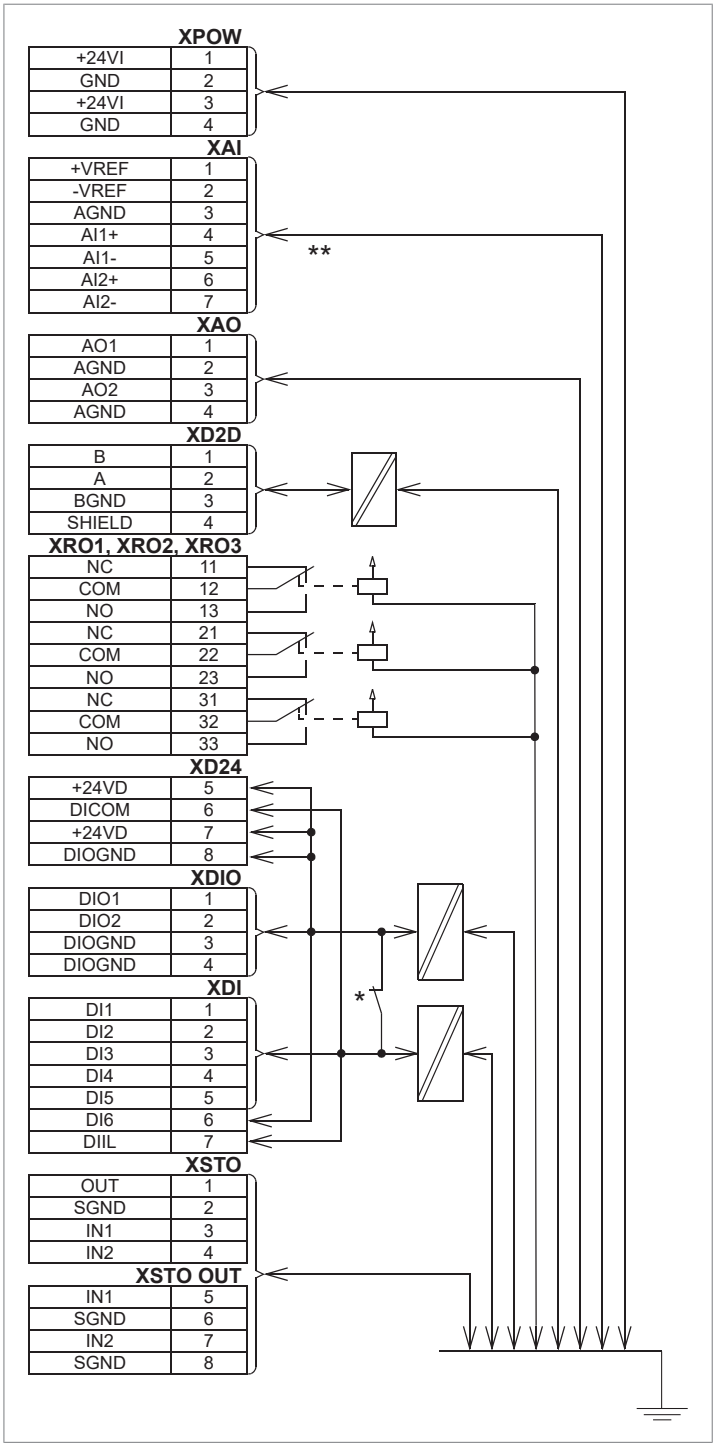
Connector data

Power supply (XPOW)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 24 V (±10%) DC, 2 A External power input. Two supplies can be connected to the BCU-x2 for redundancy.
Relay outputs RO1…RO3 (XRO1…XRO3)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 250 V AC / 30 V DC, 2 A Protected by varistors
+24 V output (XD24:2 and XD24:4)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
Digital inputs DI1…DI6 (XDI:1…XDI:6)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 24 V logic levels: “0” < 5 V, “1” > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP (DI1…DI5), PNP (DI6) Hardware filtering: 0.04 ms, digital filtering up to 8 ms DI6 (XDI:6) can alternatively be used as an input for a PTC sensor. "0" > 4 kohm, "1" < 1.5 kohm. I_{max}: 15 mA (DI1…DI5), 5 mA (DI6)
Start interlock input DIIL (XDI:7)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 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, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) As inputs: 24 V logic levels: "0" < 5 V, "1" > 15 V. R_{in}: 2.0 kohm. Filtering: 1 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, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 10 V ±1% and -10 V ±1%, R_{load} 1…10 kohm Maximum output current: 10 mA

Analog inputs AI1 and AI2 (XAI:4 … XAI:7). Current/voltage input mode selection by switches	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Current input: -20…20 mA, R_{in} = 100 ohm Voltage input: -10…10 V, R_{in} > 200 kohm Differential inputs, common mode range ±30 V Sampling interval per channel: 0.25 ms Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range
Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) 0…20 mA, R_{load} < 500 ohm Frequency range: 0…500 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
XD2D connector	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Physical layer: RS-485 Transmission rate: 8 Mbit/s Cable type: Shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 … 165 ohm, for example Belden 9842) Maximum length of link: 50 m (164 ft) Termination by switch
RS-485 connection (X485)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Physical layer: RS-485 Cable type: Shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 … 165 ohm, for example Belden 9842) Maximum length of link: 50 m (164 ft)
Safe torque off connection (XSTO)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) Input voltage range: -3…30 V DC Logic levels: "0" < 5 V, "1" > 17 V. **Note:** For the unit to start, both connections must be “1”. This applies to all control units (including drive, inverter, supply, brake, DC/DC converter etc. control units), but SIL/PL classified Safe torque off functionality is only achieved through the XSTO connector of the drive/inverter control unit. Current consumption: 66 mA (continuous) per STO channel per inverter module Current consumption: 66 mA (continuous) per STO channel per inverter module EMC (immunity) according to IEC 61326-3-1 and IEC 61800-5-2 See also chapter The Safe torque off function (page 107).
Safe torque off output (XSTO OUT)	Connector pitch 5 mm, wire size 0.5 … 2.5 mm^2 (22…12 AWG) Maximum tightening torque 0.45 N·m (4 lbf·in) To STO connector of inverter module.
Control panel connection (X13)	Connector: RJ-45 Cable length < 100 m (328 ft)

Ethernet connection (XETH)	Connector: RJ-45 This connection is not supported by the firmware
SDHC memory card slot (SD CARD)	Memory card type: SDHC Maximum memory size: 4 GB
Battery	Real-time clock battery type: BR2032
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.	

BCU-x2 ground isolation diagram



*Ground selector (DICOM=DIOGND) settings

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

**The maximum common mode voltage between each AI input and AGND is +30 V

8

The Safe torque off function

Contents of this chapter

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

Note: In this chapter, the term 'drive' refers to one inverter unit of the drive system.

Description

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

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

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

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

The Safe torque off function complies with these standards:

Standard	Name
IEC 60204-1:2021 EN 60204-1:2018	Safety of machinery – Electrical equipment of machines – Part 1: General requirements
IEC 61000-6-7:2014	Electromagnetic compatibility (EMC) – Part 6-7: Generic standards – Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations
IEC 61326-3-1:2017	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
IEC 61511-1:2017	Functional safety – Safety instrumented systems for the process industry sector
IEC 61800-5-2:2016 EN 61800-5-2:2007	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional
EN IEC 62061:2021	Safety of machinery – Functional safety of safety-related control systems
EN ISO 13849-1:2015	Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
EN ISO 13849-2:2012	Safety of machinery – Safety-related parts of control systems – Part 2: Validation

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

Compliance with the European Machinery Directive and the UK Supply of Machinery (Safety) Regulations

See Electrical planning instructions for ACS880 liquid-cooled multidrive cabinets and modules (3AXD50000048634 [English]).

Wiring

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

Activation switch

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

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

Cable types and lengths

- ABB recommends double-shielded twisted-pair cable.
- Maximum cable lengths:
  - 300 m (1000 ft) between activation switch [K] and drive control unit
  - 60 m (200 ft) between multiple drives
  - 60 m (200 ft) between external power supply and first control unit
  - 30 m (100 ft) between control unit and last inverter module in the chain.

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

Note: The voltage at the STO input terminals of the control unit (or frame R8i inverter module) must be at least 17 V DC to be interpreted as “1”.

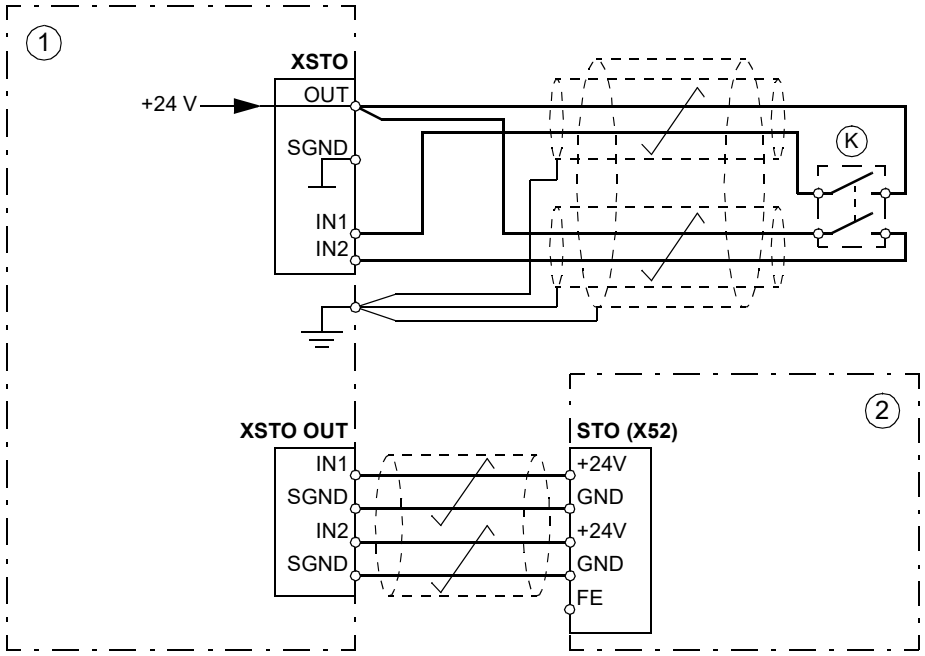
The pulse tolerance of the input channels is 1 ms.

Grounding of protective shields

- Ground the shield in the cabling between the activation switch and the control unit at the control unit only.
- Ground the shield in the cabling between two control units at one control unit only.
- Do not ground the shield in the cabling between control unit and inverter module, or between inverter modules.

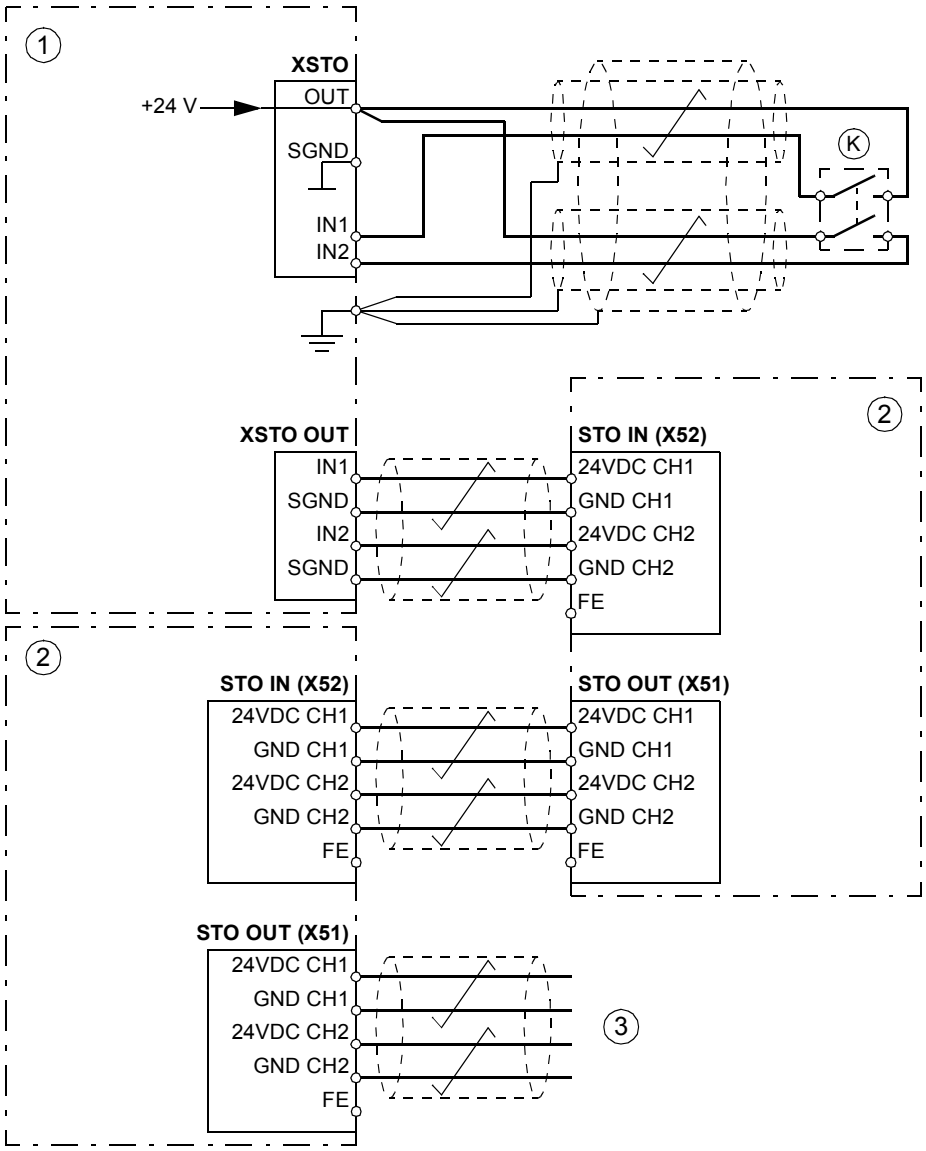
Dual-channel connection with internal power supply

Frame R7i



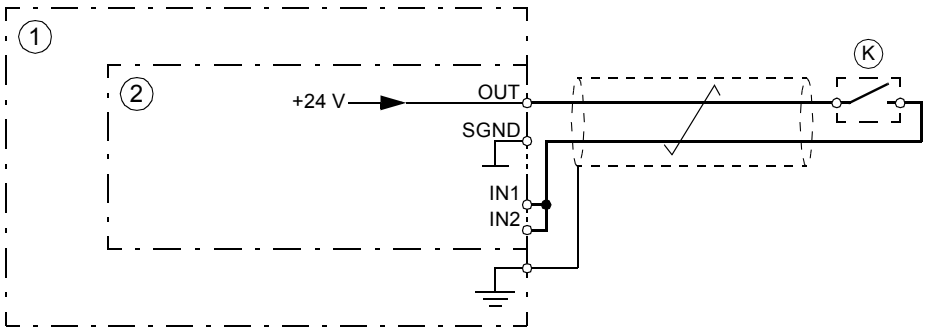
1	Drive control unit
2	Inverter module
K	Activation switch

Frame R8i and multiples



1	Drive control unit
2	Inverter module(s)
3	To remaining inverter modules
K	Activation switch

Single-channel connection of activation switch



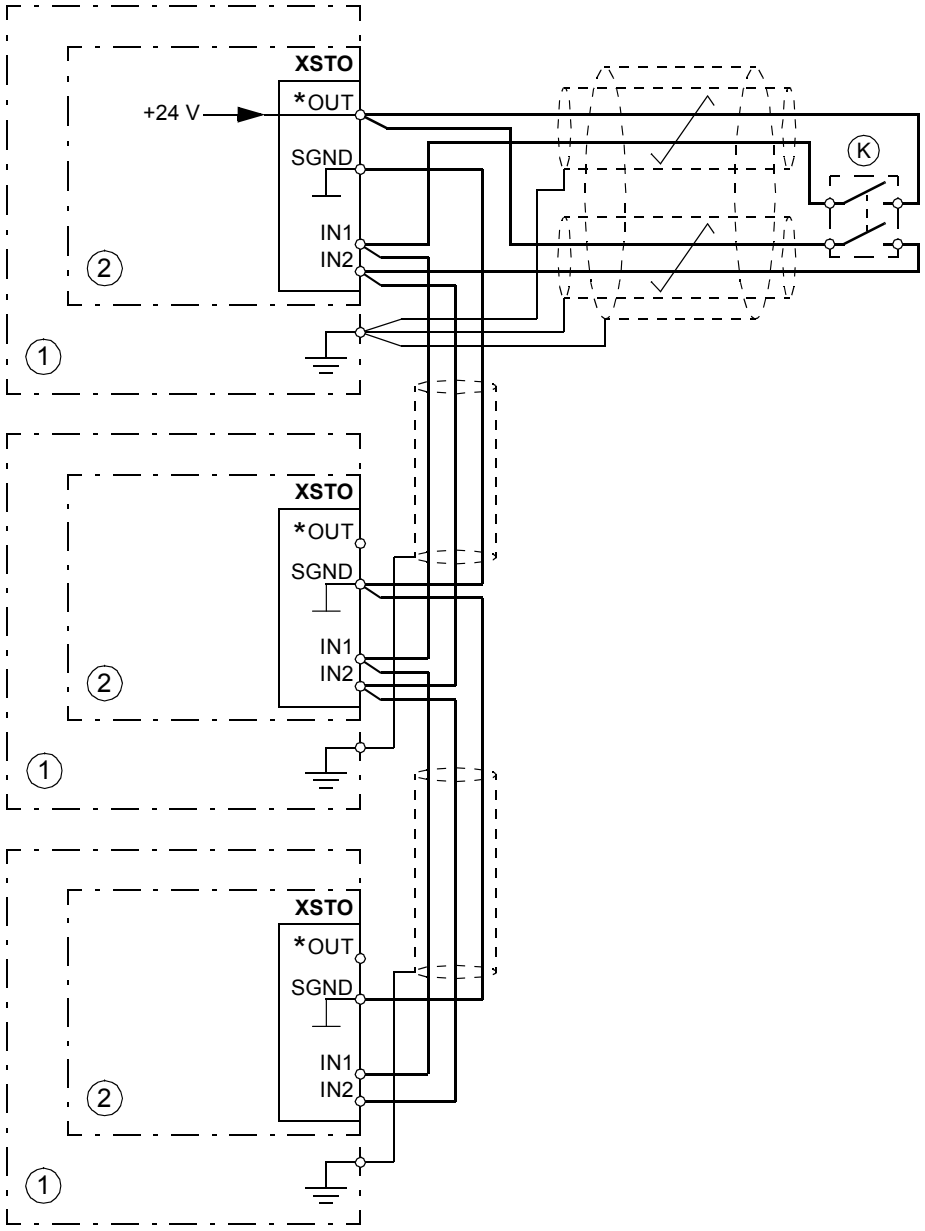
Note:

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

1	Drive
2	Control unit
K	Activation switch **Note:** A single-channel activation switch can limit the SIL/PL capability of the safety function to a lower level than the SIL/PL capability of the STO function of the drive.

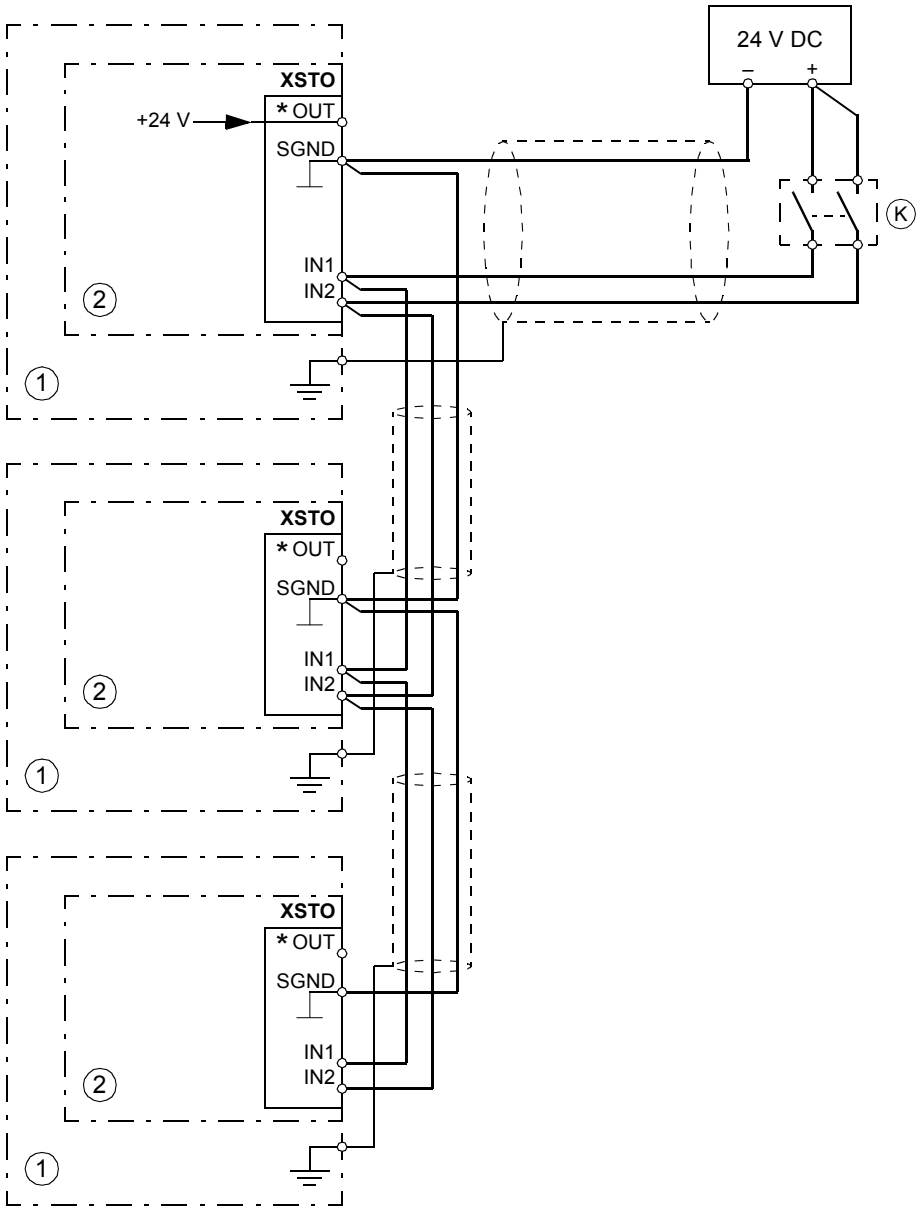
Multiple drives

Internal power supply



1	Drive
2	Control unit
K	Activation switch
* Terminal designation may vary depending on drive type	

External power supply



1	Drive
2	Control unit
K	Activation switch
* Terminal designation may vary depending on drive type	

Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. The STO inputs of the drive control unit de-energize.
3. The control unit cuts off the control voltage from the output IGBTs.
4. The control program generates an indication as defined by parameter 31.22 (see the firmware manual of the drive).
   The parameter selects which indications are given when one or both STO signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.

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

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

Start-up including validation test

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

1. at initial start-up of the safety function
2. after any changes related to the safety function (circuit boards, wiring, components, settings, replacement of inverter module, etc.)
3. after any maintenance work related to the safety function
4. after a drive firmware update
5. at the proof test of the safety function.

Competence

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

Validation test reports

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

Validation test procedure

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

Note: If the drive is equipped with safety option +L513, +L514, +L536, +L537, +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q965, +Q966, +Q978, +Q979 or +Q984, also do the procedure shown in the documentation of the option.

If an FSO or FSPS module is installed, refer to its documentation.

Note: All inverter modules of the drive must be powered and connected to the STO circuit during the validation test.

Action	☑
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Make sure that the motor can be run and stopped freely during start-up.	☐
Stop the drive (if running), switch the input power off and isolate the drive from the power line using a disconnector.	☐
Check the STO circuit connections against the wiring diagram.	☐
Close the disconnector and switch the power on.	☐
In case the drive consists of parallel-connected modules, check that the number of modules detected (parameter 95.14) matches the actual number of modules, and that the drive type is correctly set in parameter 95.31.	☐

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

Use

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

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

WARNING!
The Safe torque off functionality is only achieved through the XSTO connector of the inverter control unit (A41). True Safe torque off functionality is not achieved through the XSTO connectors of other control units (such as the supply control unit or the brake control unit).

The Safe torque off function is supported by any ACS880 inverter or drive control program. It is not supported by supply, DC/DC converter or brake firmware.

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

WARNING!
Permanent magnet or synchronous reluctance [SynRM] motors only:

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

Notes:

- If a running drive is stopped by using the Safe torque off function, the drive will cut off the motor supply voltage and the motor will coast to a stop. If this causes

danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.

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

Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 10 years; see section Safety data (page 123).

There are two alternative procedures for proof testing:

1. Perfect proof testing. It is assumed that all dangerous failures of the STO circuit are detected during the test. PFD_{avg} values for STO with the perfect proof testing procedure are given in the safety data section.
2. Simplified proof testing. This procedure is faster and simpler than perfect proof testing. Not all dangerous failures of the STO circuit are detected during the test. The PFD_{avg} value for STO with the simplified proof testing procedure is given in the safety data section.

Note: The proof testing procedures are only valid for proof testing (periodic test, item 5 under section Start-up including validation test) but not for re-validation after changes made in the circuit. Re-validation (items 1…4 under Start-up including validation test) must be done according to the initial validation procedure.

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

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

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

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

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

If any wiring or component change is needed after start-up, or the parameters are restored, do the test given in section Validation test procedure (page 116).

Use only spare parts approved by ABB.

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

Competence

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

Perfect proof test procedure

Action	☑
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Test the operation of the STO function. If the motor is running, it will stop during the test. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the failure detection of the drive. The motor can be stopped or running. • Open the 1st input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA81 fault indication (see the firmware manual). • Open the STO circuit (both channels). • Give a reset command. • Close the STO circuit (both channels). • Reset any active faults. • Open the 2nd input channel of the STO circuit. If the motor was running, it should coast to a stop. The drive generates an FA82 fault indication (see the firmware manual). • Open the STO circuit (both channels). • Give a reset command. • Close the STO circuit (both channels). • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Document and sign the test report to verify that the safety function has been tested according to the procedure.	☐

Simplified proof test procedure

Action	☑
WARNING! Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Test the operation of the STO function. If the motor is running, it will stop during the test. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter 31.22 (see the firmware manual). • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Document and sign the test report to verify that the safety function has been tested according to the procedure.	☐

Fault tracing

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

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an FA81 or FA82 fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, will trigger the same reaction.

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

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

Safety data

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

Note: The safety data is calculated for redundant use, and applies only if both STO channels are used.

Frame size	SIL	SC	PL	PFH (T_1 = 20 a) (1/h)	PFD_{avg}			$MTTF_D$ (a)	DC (%)	SFF (%)	Cat.	HFT	CCF	T_M (a)	PFH_{diag} (1/h)	λ_{Diag_s} (1/h)	λ_{Diag_d} (1/h)
					Perfect proof test		Simplified proof test										
					T_1 = 5 a	T_1 = 10 a	T_1 = 5 or 10 a										
R7i	3	3	e	1.30E-10	2.86E-06	5.71E-06	1.14E-05	23970	≥90	>99	3	1	80	20	2.13E-09	1.84E-07	2.14E-07
R8i	3	3	e	1.30E-10	2.86E-06	5.71E-06	1.14E-05	23970	≥90	>99	3	1	80	20	2.13E-09	1.84E-07	2.14E-07
2×R8i	3	3	e	1.39E-10	3.06E-06	6.11E-06	1.22E-05	16330	≥90	>99	3	1	80	20	2.92E-09	3.02E-07	2.92E-07
3×R8i	3	3	e	1.48E-10	3.26E-06	6.51E-06	1.30E-05	12390	≥90	>99	3	1	80	20	3.71E-09	4.19E-07	3.71E-07
4×R8i	3	3	e	1.57E-10	3.46E-06	6.91E-06	1.38E-05	9980	≥90	>99	3	1	80	20	4.50E-09	5.36E-07	4.50E-07
5×R8i	3	3	e	1.66E-10	3.66E-06	7.31E-06	1.46E-05	8360	≥90	>99	3	1	80	20	5.28E-09	6.54E-07	5.29E-07
6×R8i	3	3	e	1.76E-10	3.86E-06	7.71E-06	1.54E-05	7190	≥90	>99	3	1	80	20	6.07E-09	7.71E-07	6.07E-07
7×R8i	3	3	e	1.85E-10	4.07E-06	8.10E-06	1.62E-05	6310	≥90	>99	3	1	80	20	6.86E-09	8.88E-07	6.86E-07
8×R8i	3	3	e	1.94E-10	4.27E-06	8.50E-06	1.70E-05	5620	≥90	>99	3	1	80	20	7.65E-09	1.01E-06	7.65E-07

- The STO is a type B safety component as defined in IEC 61508-2.
- Relevant failure modes:
  - The STO trips spuriously (safe failure)
  - The STO does not activate when requested
  - A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- STO response times:
  - STO reaction time (shortest detectable break): 1 ms
  - STO response time: 2 ms (typical), 25 ms (maximum)
  - Fault detection time: Channels in different states for longer than 200 ms
  - Fault reaction time: Fault detection time + 10 ms.
- Indication delays:
  - STO fault indication (parameter 31.22) delay: < 500 ms
  - STO warning indication (parameter 31.22) delay: < 1000 ms.

Terms and abbreviations

Term or abbreviation	Reference	Description
Cat.	EN ISO 13849-1	Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage (%)
HFT	IEC 61508	Hardware fault tolerance
$MTTF_D$	EN ISO 13849-1	Mean time to dangerous failure: (Total number of life units) / (Number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD_{avg}	IEC 61508	Average probability of dangerous failure on demand, that is, mean unavailability of a safety-related system to perform the specified safety function when a demand occurs
PFH	IEC 61508	Average frequency of dangerous failures per hour, that is, average frequency of a dangerous failure of a safety related system to perform the specified safety function over a given period of time
PFH_{diag}	IEC/EN 62061	Average frequency of dangerous failures per hour for the diagnostic function of STO
PL	EN ISO 13849-1	Performance level. Levels a…e correspond to SIL
Proof test	IEC 61508, IEC 62061	Periodic test performed to detect failures in a safety-related system so that, if necessary, a repair can restore the system to an "as new" condition or as close as practical to this condition
SC	IEC 61508	Systematic capability (1…3)
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1…3)
STO	IEC/EN 61800-5-2	Safe torque off

Term or abbreviation	Reference	Description
T_1	IEC 61508-6	Proof test interval. T_1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of T_1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. See also section Maintenance.
T_M	EN ISO 13849-1	Mission time: the period of time covering the intended use of the safety function/device. After the mission time elapses, the safety device must be replaced. Note that any T_M values given cannot be regarded as a guarantee or warranty.
λ_{Diag_d}	IEC 61508-6	Dangerous failure rate (per hour) of the diagnostics function of STO
λ_{Diag_s}	IEC 61508-6	Safe failure rate (per hour) of the diagnostics function of STO

TÜV certificate

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

9

Internal cooling circuit

Contents of this chapter

The cooling system of a liquid-cooled drive consists of two circuits: the internal cooling circuit and the external cooling circuit. The internal cooling circuit covers the heat-generating electrical components of the drive and transfers the heat to the cooling unit. In the cooling unit, the heat is transferred to the external cooling circuit which is usually part of a larger external cooling system. This chapter deals with the internal cooling circuit.

Applicability

The information in this chapter is applicable to cabinet-built ACS880 liquid-cooled drives. Except where otherwise indicated, the information is also applicable to drives built out of ACS880 liquid-cooled multidrives modules.

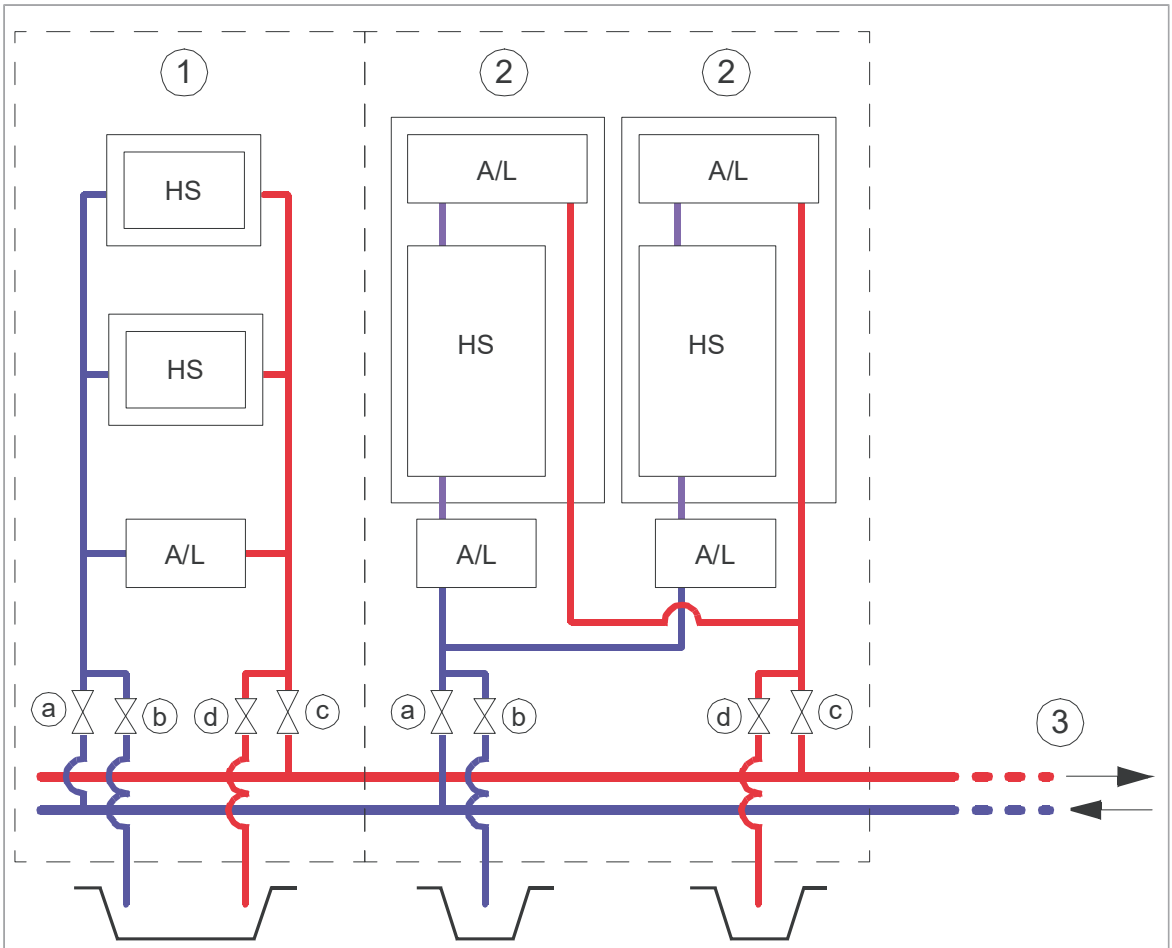
Internal cooling system

Each cubicle has an inlet and an outlet manifold, fitted with a stop valve and a drain valve. The stop valves can be closed to isolate all modules in the cubicle from the main cooling circuit.

In cabinet line-ups built by ABB, valves are color-coded:

- Blue – Open during operation
- Red – Closed during operation

The following diagram shows the coolant pipe connections in a drive system consisting of a supply unit and an inverter unit. Other units, such as brake units, DC/DC converter units have similar cooling arrangements. Other cubicles containing components that require cooling may also contain heat exchangers.



1	Supply modules. The drawing shows the configuration of a diode supply unit with two modules, ie. there is a common air-to-liquid exchanger in the cubicle. With an IGBT supply unit, each module has a dedicated air-to-liquid exchanger as shown for item 2.
2	Inverter modules
3	To/From cooling unit
A/L	Air-to-liquid heat exchanger
HS	Heat sink
a	Inlet valve
b	Inlet-side drain valve
c	Outlet valve
d	Outlet-side drain valve

The coolant used with ACS880 liquid-cooled drive systems is Antifrogen® L 25% or 50% mixture. See Coolant specification (page 132).

Connection to a cooling unit

Connection to an ACS880-1007LC cooling unit

Refer to ACS880-1007LC cooling unit user's manual (3AXD50000129607 [English]).

Connection to a custom cooling unit

General requirements

Equip the system with an expansion vessel to damp pressure rise due to volume changes when the temperature varies. Equip the system with a pump that provides a nominal flow and pressure. Keep the pressure within the limits specified in Technical data (page 132). Install a pressure regulator to make sure that the maximum permissible operating pressure is not exceeded.

Install a bleed valve at the highest point of the cooling circuit, and a drain valve at the lowest point.

The materials that can be used are listed in Cooling circuit materials (page 134).

Coolant temperature control

The temperature of the coolant in the internal cooling circuit must be kept within the limits specified in Technical data (page 132). Note that the minimum temperature is dependent on ambient temperature and relative humidity.

Filling up and bleeding the internal cooling circuit

Both the drive and coolant must be at room temperature before filling up the cooling circuit.

WARNING!
Make sure that the maximum permissible operating pressure is not exceeded. When necessary regulate the pressure to appropriate level by draining excess coolant out of the system.

WARNING!
Bleeding of the cooling circuit is very important and has to be done with great care. Air bubbles in the cooling circuit may reduce or completely block coolant flow and lead to overheating. Let the air out of the cooling system while filling in coolant and, eg. after any power module replacements.

Drive line-ups with an ACS880-1007LC cooling unit

Obey the filling up and bleeding instructions in ACS880-1007LC cooling unit user's manual (3AXD50000129607 [English]).

Drive line-ups with a custom cooling unit

Note:

- In filling up the system, the drain valves in the line-up are used only to vent the air from the circuit so that it can be displaced by the coolant. The actual bleeding of the circuit must be done via an external bleed valve installed at the highest point of the cooling circuit. The most practical location for the valve is usually near or at the cooling unit.
- Observe the instructions given by the manufacturer of the cooling unit. Pay special attention to filling up and bleeding the pumps properly as they may be damaged if operated when dry.
- Draining coolant into the sewer system is not allowed.

1. Open the bleed valve at the cooling unit.
2. Open the inlet valve and the outlet-side drain valve of one cubicle. Keep the outlet valve and the inlet-side drain valve closed.
3. Attach a hose to the outlet-side drain valve and lead it into a suitable container.
4. Fill the circuit with coolant. For the coolant specification, refer to section Coolant specification (page 132).
   To minimize foaming, do not exceed the filling flow rate of 5 l/min (1.3 US gallon/min).
5. As the piping and modules in the cubicle fills up, coolant starts to flow from the hose. Let some coolant flow out, then close the drain valve.
6. Close the inlet valve.
7. Repeat steps 2…6 for all cubicles in the line-up.
8. Open the inlet and outlet valves in all cubicles. Let any air remaining in the system out through the bleed valve at the cooling unit.

9. Close the bleed valve at the cooling unit.
10. Continue to fill in coolant until a base pressure of approximately 250 kPa is achieved.
11. Open the bleed valve of the pump to let out any air.
12. Re-check the pressure and add coolant if necessary.
13. Start the coolant pump. Let any air remaining in the system out through the bleed valve at the cooling unit.
14. After one to two minutes, stop the pump or block the coolant flow with a valve.
15. Re-check the pressure and add coolant if necessary.
16. Repeat steps 13…15 a few times until all air is let out of the cooling circuit. Listen for a humming sound and/or feel the piping for vibration to find out if there is still air left in the circuit.

Draining the internal cooling circuit

The modules in each cubicle can be drained through the drain valves without draining the whole internal cooling circuit.

WARNING!
Hot, pressurized coolant can be present in the cooling circuit. Do not work on the cooling circuit before the pressure is released by stopping the pumps and draining coolant.

1. Attach hoses to each drain valve in the cubicle to be drained. Lead the hoses into a suitable container. Make sure the ends of the hoses are not immersed in coolant at any point so that air can displace the coolant in the system.
2. Open the drain valves. Wait until all coolant has drained.

   Note: Draining coolant into the sewer system is not allowed.
3. If required, dry the piping with compressed oil-free air of less than 6 bar.
4. If the drive is to be stored in temperatures below 0 °C (32 °F),
   - dry the cooling circuit with air,
   - fill the cooling circuit with coolant specified under Coolant specification (page 132).
   - drain the cooling circuit again.

Maintenance intervals

As a general rule, the quality of the coolant should be checked at intervals of two years. This can be done by distributors of Antifrogen® L (see www.clariant.com) if a 250 milliliter sample is provided.

Technical data

Coolant specification

Coolant type

Antifrogen® L (by Clariant International Ltd, www.clariant.com) 25% or 50% mixture, available from Clariant distributors and ABB Service representatives.

Note: Do not dilute the coolant. It is ready to use.

Antifrogen® L 25% mixture is usable in storage temperatures down to -16 °C (3.2 °F). Antifrogen® L 50% mixture is usable in storage temperatures down to -40 °C (-40 °F).

Note that operation below 0 °C (32 °F) is not permitted regardless of the freezing point of the coolant.

WARNING!
The warranty does not cover damage that occurs from the use of incorrect coolant.

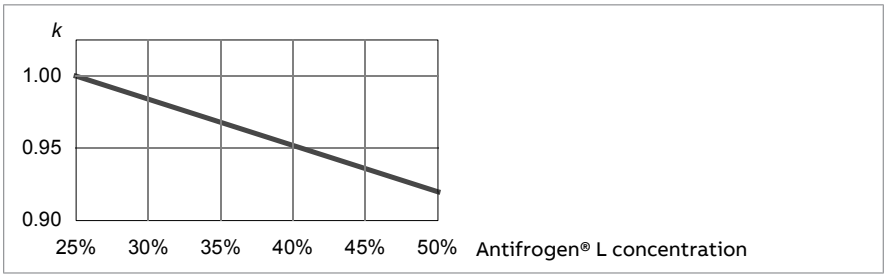
Temperature limits

Ambient temperature: See the technical data of the drive/unit.

Freeze protection: The freezing point of the coolant is determined by the concentration of heat transfer fluid in the mixture.

The higher the concentration of heat transfer fluid, the higher the viscosity of the coolant. This results in a higher pressure loss in the system. See Pressure limits (page 134).

The nominal current ratings of drive system modules apply to an Antifrogen® L / water solution of 25/75% (volume). With the Antifrogen® L concentration between 25% and 50%, the drive output current must be derated by 1/3 percentage point per 1 p.p. increase in Antifrogen® L concentration. The drawing below shows the derating factor *(k)* in relation to Antifrogen® L concentration.



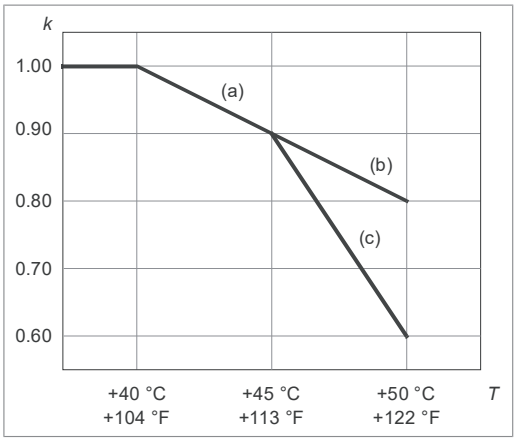
Incoming coolant temperature:

- 0…40 °C (32…104 °F): no drive output current derating required
- 40…45 °C (104…113 °F): drive output current must be derated by 2 percentage points per 1 °C (1.8 °F) temperature increase, as shown by curve (a).
- 45…50 °C (113…122 °F):
  - If components with a maximum operating temperature of 55 °C (131 °F) are installed in the same space as the drive modules, drive output current must

be derated by 6 percentage points per 1 °C (1.8 °F) temperature increase, as shown by curve (c).

- If there are no components with a maximum operating temperature of 55 °C (131 °F) installed in the same space as the drive modules, drive output current must be derated by 2 percentage points per 1 °C (1.8 °F) temperature increase, as shown by curve (b).

The drawing below shows the derating factor *(k)* in relation to coolant temperature.



Condensation is not permitted. The minimum coolant temperature to avoid condensation (at an atmospheric pressure of 1 bar) is shown below as a function of relative humidity (RH) and ambient temperature (T_{air}).

T_{air} (°C)	Min. $T_{coolant}$ (°C)				
	RH = 95%	**RH = 80%**	**RH = 65%**	**RH = 50%**	**RH = 40%**
5	4.3	1.9	-0.9	-4.5	-7.4
10	9.2	6.7	3.7	-0.1	-3.0
15	14.2	11.5	8.4	4.6	1.5
20	19.2	16.5	13.2	9.4	6.0
25	24.1	21.4	17.9	13.8	10.5
30	29.1	26.2	22.7	18.4	15.0
35	34.1	31.1	27.4	23.0	19.4
40	39.0	35.9	32.2	27.6	23.8
45	44.0	40.8	36.8	32.1	28.2
50	49.0	45.6	41.6	36.7	32.8
55	53.9	50.4	46.3	42.2	37.1

	= Not permitted as standard but the coolant temperature must be 0 °C (32 °F) or more.
Example:	At an air temperature of 45 °C and relative humidity of 65% the coolant temperature must not be less than +36.8 °C

Maximum temperature rise: Depends on heat losses and mass flow. Typically 10 °C (18 °F) with nominal losses and flow.

Pressure limits

Base pressure: 250 kPa (recommended); 300 kPa (maximum). “Base pressure” denotes the pressure of the system compared with the atmospheric pressure when the cooling circuit is filled with coolant.

Air counterpressure in expansion vessel (with ACS880-1007LC cooling unit): 80 kPa

Design pressure (PS): 600 kPa

Nominal pressure difference: 120 kPa with Antifrogen® L 25% coolant solution, 140 kPa with Antifrogen® L 50% coolant solution. This has to be taken into account when dimensioning the liquid cooling circuit.

Maximum pressure difference: 160 kPa

Coolant flow rate limits

The maximum coolant flow rate for all drive equipment is 1.3 × nominal. See the technical data chapter for nominal values.

Cooling circuit materials

Materials used in the internal cooling circuit are listed below.

- stainless steel AISI 316L (UNS 31603)
- heavy gauge aluminum
- plastic materials such as PA, PEX and PTFE

  Note: PVC hoses are not suitable for use with antifreeze.
- rubber gasketing NBR (nitrile rubber).

WARNING!
If you connect external piping to the internal cooling circuit, use only materials that are specified above. Other materials can cause galvanic corrosion. If the external piping contains other materials, use a cooling unit with a heat exchanger (for example, ACS880-1007LC) to keep the external piping separate from the internal cooling circuit.

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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

ACS880-107LC-...	Input	Output										
		I_{max}	No-overload use				Light-overload use			Heavy-duty use		
	I_1		I_2	P_N		S_N	I_{Ld}	P_{Ld}		I_{Hd}	P_{Hd}	
	A	A	A	kW	hp	kVA	A	kW	hp	A	kW	hp
U_N = 500 V												
0094A-5	106	150	94	55	60	81	90	55	60	70	45	50
0120A-5	129	180	115	75	75	100	110	75	75	86	55	60
0140A-5	158	210	140	90	100	121	134	90	100	105	55	75
0170A-5	191	260	170	110	125	147	163	110	125	127	75	100
0200A-5	225	300	200	132	150	173	192	132	150	150	90	100
0240A-5	270	360	240	160	200	208	230	160	200	180	110	150
0300A-5	340	460	302	200	250	262	290	200	200	226	132	150
0380A-5	428	570	380	250	300	329	365	200	250	284	160	200
0460A-5	519	700	461	315	400	399	443	315	350	345	200	250
U_N = 690 V												
0062A-7	70	93	62	55	60	74	60	55	60	46	45	40
0082A-7	92	130	82	75	75	98	79	75	75	61	55	50
0100A-7	111	150	99	90	100	118	95	90	75	74	55	60
0130A-7	141	190	125	110	125	149	120	110	100	94	75	75
0140A-7	162	220	144	132	150	172	138	132	125	108	90	100
0190A-7	216	290	192	160	200	229	184	160	150	144	132	125
0220A-7	244	330	217	200	250	259	208	200	200	162	160	150
0290A-7	325	440	289	250	300	345	277	250	250	216	200	200
0340A-7	383	510	340	315	350	406	326	250	300	254	200	250
0389A-7	439	590	390	355	400	466	374	355	350	292	250	300
0390A-7	439	590	390	355	400	466	374	355	350	292	250	300
0430A-7	484	650	430	400	450	514	413	355	450	322	250	300
0480A-7	540	720	480	450	500	574	461	400	450	359	315	350
0530A-7	596	800	530	500	550	633	509	450	500	396	355	400
0600A-7	675	900	600	560	600	717	576	560	600	449	400	450
0670A-7	754	1010	670	630	700	801	643	630	700	501	450	500
0750A-7	844	1130	750	710	800	896	720	710	700	561	500	600
0850A-7	956	1280	850	800	900	1016	816	800	900	636	560	600
1030A-7	1159	1550	1030	1000	1000	1231	989	900	1000	770	710	800
1170A-7	1316	1760	1170	1100	1250	1398	1123	1100	1250	875	800	900
1310A-7	1474	1970	1310	1200	1250	1566	1258	1200	1250	980	900	1000
1470A-7	1654	2210	1470	1400	1500	1757	1411	1200	1500	1100	1000	1000
1660A-7	1868	2490	1660	1600	1750	1984	1594	1400	1750	1242	1200	1250
1940A-7	2183	2910	1940	1800	2000	2319	1862	1800	2000	1451	1400	1500
2180A-7	2453	3270	2180	2000		2605	2093	2000		1631	1400	1750
2470A-7	2779	3710	2470	2300		2952	2371	2300		1848	1800	2000

ACS880-107LC-...	Input	Output										
		I_{max}	No-overload use				Light-overload use			Heavy-duty use		
	I_1		I_2	P_N		S_N	I_{Ld}	P_{Ld}		I_{Hd}	P_{Hd}	
	A	A	A	kW	hp	kVA	A	kW	hp	A	kW	hp
2880A-7	3240	4320	2880	2700		3442	2765	2700		2154	2000	
3260A-7	3668	4890	3260	3000		3896	3130	3000		2438	2300	
3580A-7	4028	5370	3580	3400		4279	3437	3200		2678	2600	
4050A-7	4556	6080	4050	3800		4840	3888	3800		3029	2800	
4840A-7	5445	7260	4840	4400		5784	4646	4400		3620	3500	
5650A-7	6356	8480	5650	5200		6752	5424	5200		4226	4000	
6460A-7	7268	9690	6460	6000		7720	6202	6000		4832	4700	

Definitions

U_N	Nominal AC supply voltage of drive system
I_1	Nominal rms input current
I_2	Nominal output current (available continuously with no over-loading)
P_N	Typical motor power in no-overload use The horsepower ratings are typical NEMA motor sizes at 460 V (ACS880-107LC-xxxxA-5) and 575 V (ACS880-107LC-xxxxA-7) respectively.
S_N	Apparent 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; otherwise as long as allowed by drive temperature.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
P_{Hd}	Typical motor power in heavy-duty use

Note:

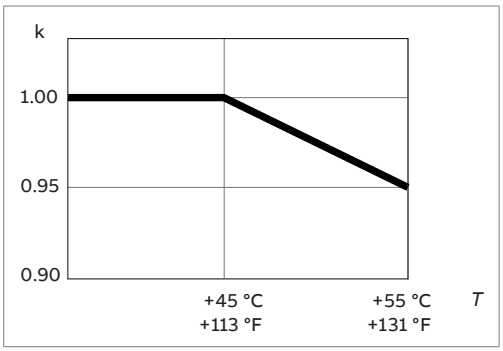
- The ratings apply at an ambient temperature of 40 °C (104 °F).
- The ratings apply at an ambient temperature of 45 °C (113 °F) and a coolant temperature of 40 °C (104 °F).
- To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.
- The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.

Derating

Surrounding air temperature derating

In the temperature range +45…55 °C (+113…131 °F), the rated output current is derated by 0.5 percentage points 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)*:



Coolant temperature derating

See section Temperature limits (page 132).

Antifreeze content derating

See section Temperature limits (page 132).

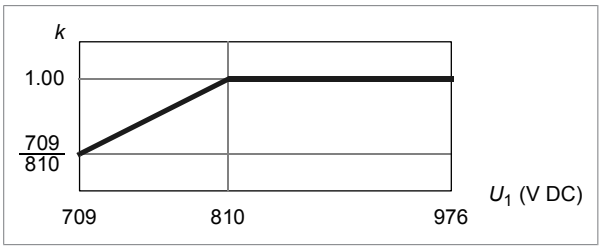
Altitude derating

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

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

Supply voltage derating (frame n×R8i inverter units with diode supply unit)

If the DC supply voltage of the inverter unit (U_1) is below 810 V (which corresponds to a drive supply voltage of 600 V AC when a diode supply unit is used), the rated output current must be derated by multiplying by U_1/810 (represented by *k* in the diagram).



Switching frequency derating

In the switching frequency range 3.0 … 7.5 kHz, the output current is derated by 8 percentage points for each kHz. For example, the derating factor for 5 kHz is 0.84.

Output frequency derating

Below the output frequency of 12 Hz, the output current is derated by 3.5 percentage points per each Hz. For example, the derating factor for 9 Hz is 0.895.

Above the output frequency of 150 Hz, the output current is derated by 1 percentage point per each 10 Hz. For example, the derating factor for 175 Hz is 0.975.

Note that this concerns continuous or frequent use in this frequency range. Temporary use in frequency range below 12 Hz does not cause need for derating.

Inverter unit frame sizes and modules used

ACS880-107LC-...	Frame size	Module(s) used	
		Qty	Type
U_N = 500 V			
0094A-5	R7i	1	ACS880-104LC-0094A-5(+E205)
0120A-5	R7i	1	ACS880-104LC-0120A-5(+E205)
0140A-5	R7i	1	ACS880-104LC-0140A-5(+E205)
0170A-5	R7i	1	ACS880-104LC-0170A-5(+E205)
0200A-5	R7i	1	ACS880-104LC-0200A-5(+E205)
0240A-5	R7i	1	ACS880-104LC-0240A-5(+E205)
0300A-5	R7i	1	ACS880-104LC-0300A-5(+E205)
0380A-5	R7i	1	ACS880-104LC-0380A-5(+E205)
0460A-5	R7i	1	ACS880-104LC-0460A-5(+E205)
U_N = 690 V			
0062A-7	R7i	1	ACS880-104LC-0062A-7+E205
0082A-7	R7i	1	ACS880-104LC-0082A-7+E205
0100A-7	R7i	1	ACS880-104LC-0100A-7+E205
0130A-7	R7i	1	ACS880-104LC-0130A-7+E205
0140A-7	R7i	1	ACS880-104LC-0140A-7+E205
0190A-7	R7i	1	ACS880-104LC-0190A-7+E205
0220A-7	R7i	1	ACS880-104LC-0220A-7+E205
0290A-7	R7i	1	ACS880-104LC-0290A-7+E205
0340A-7	R7i	1	ACS880-104LC-0340A-7+E205
0389A-7	R7i	1	ACS880-104LC-0389A-7+E205
0390A-7	R8i	1	ACS880-104LC-0390A-7+E205
0430A-7	R8i	1	ACS880-104LC-0430A-7+E205
0480A-7	R8i	1	ACS880-104LC-0480A-7+E205
0530A-7	R8i	1	ACS880-104LC-0530A-7+E205
0600A-7	R8i	1	ACS880-104LC-0600A-7+E205
0670A-7	R8i	1	ACS880-104LC-0670A-7+E205
0750A-7	R8i	1	ACS880-104LC-0750A-7+E205
0850A-7	R8i	1	ACS880-104LC-0850A-7+E205
1030A-7	2 × R8i	2	ACS880-104LC-0530A-7+E205
1170A-7	2 × R8i	2	ACS880-104LC-0600A-7+E205
1310A-7	2 × R8i	2	ACS880-104LC-0670A-7+E205
1470A-7	2 × R8i	2	ACS880-104LC-0750A-7+E205
1660A-7	2 × R8i	2	ACS880-104LC-0850A-7+E205
1940A-7	3 × R8i	3	ACS880-104LC-0670A-7+E205
2180A-7	3 × R8i	3	ACS880-104LC-0750A-7+E205
2470A-7	3 × R8i	3	ACS880-104LC-0850A-7+E205
2880A-7	4 × R8i	4	ACS880-104LC-0750A-7+E205
3260A-7	4 × R8i	4	ACS880-104LC-0850A-7+E205

ACS880-107LC-...	Frame size	Module(s) used	
		Qty	Type
3580A-7	5 × R8i	5	ACS880-104LC-0750A-7+E205
4050A-7	5 × R8i	5	ACS880-104LC-0850A-7+E205
4840A-7	6 × R8i	6	ACS880-104LC-0850A-7+E205
5650A-7	7 × R8i	7	ACS880-104LC-0850A-7+E205
6460A-7	8 × R8i	8	ACS880-104LC-0850A-7+E205

Cooling data and noise

ACS880-107LC-...	Coolant volume				Coolant flow rate		Heat dissipation*		Noise
	Modules including heat exchanger		Cabinet piping		l/min	US gal/min	Into coolant	Into air surrounding cabinet	dB(A)
	l	US qt	l	US qt			W	W	
U_N = 500 V									
0094A-5	0.5**	0.5**	1.9**	2.0**	13***	3.4***	970	20	63
0120A-5	0.5**	0.5**	1.9**	2.0**	13***	3.4***	1200	20	63
0140A-5	0.5**	0.5**	1.9**	2.0**	13***	3.4***	1500	20	63
0170A-5	0.5**	0.5**	1.9**	2.0**	13***	3.4***	1700	30	63
0200A-5	0.5**	0.5**	1.9**	2.0**	13***	3.4***	2000	30	63
0240A-5	0.5**	0.5**	1.9**	2.0**	13***	3.4***	2500	40	63
0300A-5	0.5**	0.5**	1.9**	2.0**	13***	3.4***	3300	50	63
0380A-5	0.5**	0.5**	1.9**	2.0**	13***	3.4***	4600	60	63
0460A-5	0.5**	0.5**	1.9**	2.0**	13***	3.4***	6100	80	63
U_N = 690 V									
0062A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	1150	60	63
0082A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	1420	70	63
0100A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	1680	70	63
0130A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	2100	80	63
0140A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	2400	80	63
0190A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	3200	90	63
0220A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	3700	100	63
0290A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	4500	120	63
0340A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	5500	130	63
0389A-7	0.5**	0.5**	1.9**	2.0**	13***	3.4***	6700	140	63
0390A-7	1.9	2.0	2.4	2.5	16	4.2	5100	100	63
0430A-7	1.9	2.0	2.4	2.5	16	4.2	5600	100	63
0480A-7	1.9	2.0	2.4	2.5	16	4.2	6400	100	63
0530A-7	1.9	2.0	2.4	2.5	16	4.2	7200	100	63
0600A-7	1.9	2.0	2.4	2.5	16	4.2	8200	100	63
0670A-7	1.9	2.0	2.4	2.5	16	4.2	9400	100	63
0750A-7	1.9	2.0	2.4	2.5	16	4.2	10800	100	63
0850A-7	1.9	2.0	2.4	2.5	16	4.2	12700	100	63
1030A-7	3.8	4.0	4.0	4.2	32	8.5	14000	300	66
1170A-7	3.8	4.0	4.0	4.2	32	8.5	16000	300	66
1310A-7	3.8	4.0	4.0	4.2	32	8.5	18400	300	66
1470A-7	3.8	4.0	4.0	4.2	32	8.5	21200	300	66
1660A-7	3.8	4.0	4.0	4.2	32	8.5	24800	300	66
1940A-7	5.7	6.0	5.7	6.0	48	12.7	27200	300	68

ACS880-107LC-...	Coolant volume				Coolant flow rate		Heat dissipation*		Noise
	Modules including heat exchanger		Cabinet piping		l/min	US gal/min	Into coolant	Into air surrounding cabinet	dB(A)
	l	US qt	l	US qt			W	W	
2180A-7	5.7	6.0	5.7	6.0	48	12.7	31400	400	68
2470A-7	5.7	6.0	5.7	6.0	48	12.7	36900	400	68
2880A-7	7.6	8.0	8.0	8.5	64	16.9	41500	500	69
3260A-7	7.6	8.0	8.0	8.5	64	16.9	48700	700	69
3580A-7	9.5	10.0	9.7	10.2	80	21.1	51600	700	70
4050A-7	9.5	10.0	9.7	10.2	80	21.1	60500	900	70
4840A-7	11.4	12.0	11	11.6	96	25.4	72300	900	71
5650A-7	13.3	14.1	14	14.8	112	29.6	84400	1000	72
6460A-7	15.2	16.1	15	15.9	128	33.8	96500	1200	72

*These losses are not calculated according to IEC 61800-9-2.

**In single-module cabinet configuration.

***In single-module cabinet configuration (28 l/min or 7.4 US gal/min in two-module cabinet configuration).

DC fuses

The inverter unit has DC fuses at the input of each inverter module.

Notes:

- Fuses with higher current rating than the recommended ones must not be used.
- Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.
- The fuses listed are UL Recognized.

ACS880-107LC-...	DC fuses at inverter module input				
	Qty	A	V	Manufacturer	Type
U_N = 500 V					
0094A-5	2	160	1250	Bussmann	170M4388
0120A-5	2	200	1250	Bussmann	170M4389
0140A-5	2	250	1250	Bussmann	170M4390
0170A-5	2	315	1250	Bussmann	170M4391
0200A-5	2	400	1250	Bussmann	170M4393
0240A-5	2	450	1250	Bussmann	170M6541
0300A-5	2	550	1250	Bussmann	170M6543
0380A-5	2	700	1250	Bussmann	170M6545
0460A-5	2	900	1100	Bussmann	170M6547
U_N = 690 V					
0062A-7	2	125	1250	Bussmann	170M3392
0082A-7	2	160	1250	Bussmann	170M4388
0100A-7	2	200	1250	Bussmann	170M4389
0130A-7	2	250	1250	Bussmann	170M4390
0140A-7	2	315	1250	Bussmann	170M4391
0190A-7	2	350	1250	Bussmann	170M4392
0220A-7	2	400	1250	Bussmann	170M4393
0290A-7	2	550	1250	Bussmann	170M6543
0340A-7	2	630	1250	Bussmann	170M6544
0389A-7	2	700	1250	Bussmann	170M6545
0390A-7 0430A-7	2	800	1250	Bussmann	170M6546
0480A-7	2	900	1100	Bussmann	170M6547
0530A-7	2	1000	1100	Bussmann	170M6548
0600A-7	2	1100	1000	Bussmann	170M6549
0670A-7	2	1250	1100	Bussmann	170M6500
0750A-7 0850A-7	2	1400	1100	Bussmann	170M6501
1030A-7	4	1000	1100	Bussmann	170M6548
1170A-7	4	1100	1000	Bussmann	170M6549
1310A-7	4	1250	1100	Bussmann	170M6500

ACS880-107LC-...	DC fuses at inverter module input				
	Qty	A	V	Manufacturer	Type
1470A-7	4	1400	1100	Bussmann	170M6501
1660A-7					
1940A-7	6	1250	1100	Bussmann	170M6500
2180A-7	6	1400	1100	Bussmann	170M6501
2470A-7	6				
2880A-7	8				
3260A-7	8				
3580A-7	10				
4050A-7	10				
4840A-7	12				
5650A-7	14				
6460A-7	16				

Dimensions and weights

See chapter Dimensions (page 155).

Free space requirements

The values are as required by cooling, maintenance and/or operation of the pressure relief (if present). Also obey the general mechanical installation instructions.

Front		Sides		Above	
mm	in.	mm	in.	mm	in.
1000	39	0	0	250	9.85

Typical power cable sizes

The tables below give current carrying capacity (I_{Lmax}) for aluminum and copper PVC/XLPE insulated cables. A correction factor K = 0.70 is used. Time const is the temperature time constant of the cable.

The cable sizing is based on max. 9 cables laid on the cable trays side by side, three ladder type trays one on top of the other, ambient temperature 30 °C (EN 60204-1 and IEC 60364-5-52).

Aluminum cable		**PVC insulation Conductor temperature 70 °C**		**XLPE insulation Conductor temperature 90 °C**	
Size	**Ø [mm]**	**I_{Lmax} [A]**	**Time const. [s]**	**I_{Lmax} [A]**	**Time const. [s]**
3 × 35 + 10 Cu	26	67	736	84	669
3 × 50 + 15 Cu	29	82	959	102	874
3 × 70 + 21 Cu	32	105	1182	131	1079
3 × 95 + 29 Cu	38	128	1492	159	1376
3 × 120 + 41 Cu	41	148	1776	184	1637
3 × 150 + 41 Cu	44	171	2042	213	1881
3 × 185 + 57 Cu	49	196	2422	243	2237
3 × 240 + 72 Cu	54	231	2967	286	2740
3 × 300 + 88 Cu	58	267	3478	330	3229
2 × (3 × 70 + 21 Cu)	2 × 32	210	1182	262	1079
2 × (3 × 95 + 29 Cu)	2 × 38	256	1492	318	1376
2 × (3 × 120 + 41 Cu)	2 × 41	297	1776	368	1637
2 × (3 × 150 + 41 Cu)	2 × 44	343	2042	425	1881
2 × (3 × 185 + 57 Cu)	2 × 49	392	2422	486	2237
2 × (3 × 240 + 72 Cu)	2 × 54	462	2967	572	2740
2 × (3 × 300 + 88 Cu)	2 × 58	533	3478	659	3229
3 × (3 × 150 + 41 Cu)	3 × 44	514	2042	638	1881
3 × (3 × 185 + 57 Cu)	3 × 49	588	2422	728	2237
3 × (3 × 240 + 72 Cu)	3 × 54	693	2967	859	2740
3 × (3 × 300 + 88 Cu)	3 × 58	800	3478	989	3229
4 × (3 × 185 + 57 Cu)	4 × 49	784	2422	971	2237
4 × (3 × 240 + 72 Cu)	4 × 54	924	2967	1145	2740
4 × (3 × 300 + 88 Cu)	4 × 58	1067	3478	1319	3229
5 × (3 × 185 + 57 Cu)	5 × 49	980	2422	1214	2237
5 × (3 × 240 + 72 Cu)	5 × 54	1155	2967	1431	2740
5 × (3 × 300 + 88 Cu)	5 × 58	1333	3478	1648	3229
6 × (3 × 240 + 72 Cu)	6 × 54	1386	2967	1718	2740
6 × (3 × 300 + 88 Cu)	6 × 58	1600	3478	1978	3229
7 × (3 × 240 + 72 Cu)	7 × 54	1617	2967	2004	2740
7 × (3 × 300 + 88 Cu)	7 × 58	1867	3478	2308	3229
8 × (3 × 240 + 72 Cu)	8 × 54	1848	2967	2290	2740
8 × (3 × 300 + 88 Cu)	8 × 58	2133	3478	2637	3229
9 × (3 × 240 + 72 Cu)	9 × 54	2079	2967	2577	2740
9 × (3 × 300 + 88 Cu)	9 × 58	2400	3478	2967	3229
10 × (3 × 240 + 72 Cu)	10 × 54	2310	2967	2867	2740
10 × (3 × 300 + 88 Cu)	10 × 58	2667	3478	3297	3229

Copper cable		PVC insulation Conductor temperature 70 °C		XLPE insulation Conductor temperature 90 °C	
Size	**Ø [mm]**	**I_{Lmax} [A]**	**Time const. [s]**	**I_{Lmax} [A]**	**Time const. [s]**
3 × 1.5 + 1.5	13	13	85	16	67
3 × 2.5 + 2.5	14	18	121	23	88
(3 × 4 + 4)	16	24	175	30	133
3 × 6 + 6	18	30	251	38	186
3 × 10 + 10	21	42	359	53	268
3 × 16 + 16	23	56	514	70	391
3 × 25 + 16	24	71	791	89	598
3 × 35 + 16	26	88	1000	110	760
3 × 50 + 25	29	107	1308	134	990
3 × 70 + 35	32	137	1613	171	1230
3 × 95 + 50	38	167	2046	209	1551
3 × 120 + 70	41	193	2441	241	1859
3 × 150 + 70	44	223	2820	279	2139
3 × 185 + 95	50	255	3329	319	2525
3 × 240 + 120	55	301	4073	376	3099
3 × 300 + 150	58	348	4779	435	3636
2 × (3 × 70 + 35)	2 × 32	274	1613	342	1230
2 × (3 × 95 + 50)	2 × 38	334	2046	418	1551
2 × (3 × 120 + 70)	2 × 41	386	2441	482	1859
2 × (3 × 150 + 70)	2 × 44	446	2820	558	2139
2 × (3 × 185 + 95)	2 × 50	510	3329	638	2525
2 × (3 × 240 + 120)	2 × 55	602	4073	752	3099
2 × (3 × 300 + 150)	2 × 58	696	4779	869	3636
3 × (3 × 120 + 70)	3 × 41	579	2441	723	1859
3 × (3 × 150 + 70)	3 × 44	669	2820	837	2139
3 × (3 × 185 + 95)	3 × 50	765	3329	957	2525
3 × (3 × 240 + 120)	3 × 55	903	4073	1128	3099
3 × (3 × 300 + 150)	3 × 58	1044	4779	1304	3636
4 × (3 × 150 + 70)	4 × 44	892	2820	1116	2139
4 × (3 × 185 + 95)	4 × 50	1020	3329	1276	2525
4 × (3 × 240 + 120)	4 × 55	1204	4073	1504	3099
4 × (3 × 300 + 150)	4 × 58	1391	4779	1304	3636
5 × (3 × 185 + 95)	5 × 50	1275	3329	1595	2525
5 × (3 × 240 + 120)	5 × 55	1505	4073	1880	3099
5 × (3 × 300 + 150)	5 × 58	1739	4779	2173	3636
6 × (3 × 185 + 95)	6 × 50	1530	3329	1914	2525
6 × (3 × 240 + 120)	6 × 55	1806	4073	2256	3099
6 × (3 × 300 + 150)	6 × 58	2087	4779	2608	3636
7 × (3 × 240 + 120)	7 × 55	2107	4073	2632	3099
7 × (3 × 300 + 150)	7 × 58	2435	4779	3043	3636
8 × (3 × 240 + 120)	8 × 55	2408	4073	3008	3099
8 × (3 × 300 + 150)	8 × 58	2783	4779	3477	3636

Input power (DC) connection

Voltage (U_1)	ACS880-107LC-xxxxx-5: 513…707 V DC ±10%. This is indicated in the type designation label as typical input voltage levels (566/679/707 V DC). ACS880-107LC-xxxxx-7: 709…976 V DC ±10%. This is indicated in the type designation label as typical input voltage levels (742/849/976 V DC).
Drive AC supply network type	TN (grounded) and IT (ungrounded) systems, corner-grounded systems up to 600 V AC
Input terminals	See Terminal and cable entry data for the power cables (page 147).

Motor (AC) connection

Motor types	Asynchronous AC induction motors, permanent magnet synchronous motors and AC induction servomotors, ABB synchronous reluctance (SynRM) motors
Voltage (U_2)	0 to AC supply voltage of drive, 3-phase symmetrical, U_{max} at field weakening point
Frequency (f_2)	0…500 Hz • For higher operational output frequencies, please contact your local ABB representative. • Operation outside the range of 12…150 Hz requires derating. See section Derating (page 137).
Current	See section Ratings.
Switching frequency	3 kHz (typical). The switching frequency can vary per frame and voltage. For exact values, contact your local ABB representative.
Maximum motor cable length	500 m (1640 ft) **Note:** Longer cables cause a motor voltage decrease which limits the available motor power. The decrease depends on the motor cable length and characteristics. Contact ABB for more information.
Output terminals	See Terminal and cable entry data for the power cables (page 147).

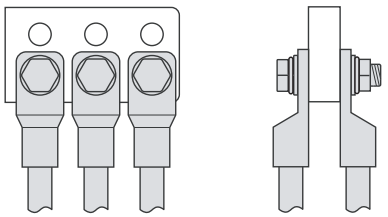
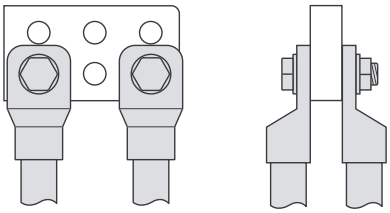
Terminal and cable entry data for the power cables

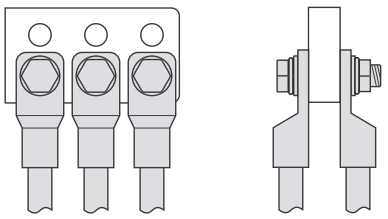
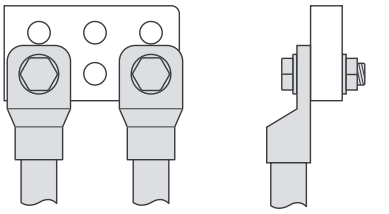
The locations and sizes of the cable entries are shown in the dimension drawings delivered with the drive, and the dimension drawing examples in this manual.

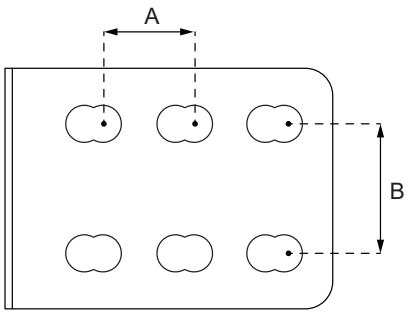
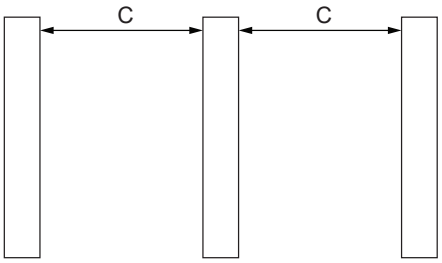
Busbar terminal material: Tin-plated copper.

Terminal data for the motor cables

The maximum number of motor cables depends on the cable size, cable material, number of inverter modules and on the inverter unit cubicle width. Before you select motor cable sizes, check the inverter unit construction from the project-specific dimension drawings and use the tables below to determine the connection capability.

Maximum number of 3-phase motor cables (copper) for each inverter module, n×R8i with cable exit from bottom					
Cable cross section (mm^2)	Copper compression cable lugs (DIN 46235)				Connection method
	1×R8i (300 mm cubicle)	1×R8i (400 mm cubicle)	2×R8i (500 mm cubicle)	3×R8i (700 mm cubicle)	
50	4 (6*)	6	5 (6*)	5 (6*)	
70	4 (6*)	6	5 (6*)	5 (6*)	
95	4 (6*)	6	5 (6*)	5 (6*)	
120	4	4	4	4	
150	4	4	4	4	
185	4	4	4	4	
240	4	4	4	4	
300	-	-	-	-	-
* Requires additional engineering. Standard cable entry plate not suitable.					

Maximum number of 3-phase motor cables (aluminum) for each inverter module, n×R8i with cable exit from bottom					
Cable cross section (mm^2)	Aluminum compression cable lugs (DIN 46329)				Connection method
	1×R8i (300 mm cubicle)	1×R8i (400 mm cubicle)	2×R8i (500 mm cubicle)	3×R8i (700 mm cubicle)	
50	4 (6*)	6	5 (6*)	5 (6*)	
70	4 (6*)	6	5 (6*)	5 (6*)	
95	4 (6*)	6	5 (6*)	5 (6*)	
120	4	6	5	5	
150	4	6	5	5	
185	4	6	5	5	
240	2	2	2	2	
300	2*	2*	2*	2*	
* Requires additional engineering. Standard cable entry plate not suitable.					

Output terminal dimensions, n×R8i							
Distance between adjacent holes, horizontal (A)		Distance between adjacent holes, vertical (B)		Maximum distance between terminal surfaces (C)		Maximum cable lug diameter (including possible shrink hose)	
mm	in	mm	in	mm	in	mm	in
30.5*	1.2*	44.5	1.75	67	2.63	29	1.14
Side view 				Front view 			
* The maximum cable lug width for the leftmost hole is 42 mm (1.65 in).							

Terminal data for the inverter control unit

See chapter Control units of the drive (page 93).

Efficiency

98.5 … 98.7% at nominal power level depending on drive type.

The efficiency is not calculated according to IEC 61800-9-2.

Energy efficiency data (ecodesign)

Energy efficiency data is not provided for the drive/unit. Multidrives and multidrive modules are not in the scope of the EU ecodesign requirements (Regulation EU/2019/1781) or the UK ecodesign requirements (Regulation SI 2021 No. 745).

Protection classes

Degrees of protection (IEC/EN 60529)	IP42 (standard), IP54 (option +B055)
Enclosure types (UL50)	UL Type 1 (standard), UL Type 12 (option +B055). For indoor use only.
Arcing class (IEC TR 61641)	B – ASSEMBLY providing personnel and ASSEMBLY protection under arcing conditions. Tested at the following voltage with an arcing current of 65 kA for 300 milliseconds: • 400 V units (indicated by "-3" in drive type): 420 V • 500 V units (indicated by "-5" in drive type): 550 V • 690 V units (indicated by "-7" in drive type): 760 V
Overvoltage category (IEC/EN 60664-1)	III, except for auxiliary power connections (fan, control, heating, lighting, cooling unit pump etc) which are category II.
Protective class (IEC/EN 61800-5-1)	I

Optical components

The specifications of the optic cable are as follows:

- Storage temperature: -55 … +85 °C (-67 … +185 °F)
- Installation temperature: -20 … +70 °C (-4 … +158 °F)
- Maximum short-term tensile force: 50 N (11.2 lbf)
- Minimum short-term bend radius: 25 mm (1.0 in)
- Minimum long-term bend radius: 35 mm (1.4 in)
- Maximum long-term tensile load: 1 N (3.6 ozf)
- Flexing: Max. 1000 cycles

ABB drive products in general utilize 5 and 10 MBd (megabaud) optical components from Avago Technologies' Versatile Link range. Note that the optical component type is not directly related to the actual communication speed.

Note: The optical components (transmitter and receiver) on a fiber optic link must be of the same type.

Plastic optical fiber (POF) cables can be used with both 5 MBd and 10 MBd optical components. 10 MBd components also enable the use of Hard Clad Silica (HCS®) cables, which allow longer connection distances thanks to their lower attenuation. HCS® cables cannot be used with 5 MBd optical components.

The maximum lengths of fiber optic links for POF and HCS® cables are 20 and 200 meters (65.6 ft and 656 ft) respectively.

Ambient conditions

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

	Operation installed for stationary use	**Storage in the protective package**	**Transportation in the protective package**
Installation site altitude	0…2000 m (0…6562 ft) above sea level. For altitudes over 2000 m, contact ABB. Output derated above 1000 m (3281 ft).	-	-
Air temperature	0 … +45 °C (+32 … +113 °F), no condensation allowed. Output derated in the range +45 … +55 °C (+113 … +131 °F). For UL and CSA compliant installations, the maximum surrounding air temperature is 40 °C (104 °F).	-40 … +70 °C (-40 … +158 °F)	-40 … +70 °C (-40 … +158 °F)
Relative humidity	Max. 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination	IEC/EN 60721-3-3:2002 Chemical gases: Class 3C2 Solid particles: Class 3S2. No conductive dust allowed.	IEC 60721-3-1:1997 Chemical gases: Class 1C2 Solid particles: Class 1S3 (packing must support this, otherwise 1S2)	IEC 60721-3-2:1997 Chemical gases: Class 2C2 Solid particles: Class 2S2
Pollution degree IEC/EN 60664-1	2		
Vibration IEC/EN 61800-5-1 IEC 60068-2-6:2007, EN 60068-2-6:2008	IEC/EN 60721-3-3:2002 10…57 Hz: max. 0.075 mm amplitude 57…150 Hz: 1 *g* Units with marine construction (option +C121): Max. 1 mm (0.04 in) (5 … 13.2 Hz), max. 0.7 *g* (13.2 … 100 Hz) sinusoidal	IEC/EN 60721-3-1:1997 10…57 Hz: max. 0.075 mm amplitude 57…150 Hz: 1 *g*	IEC/EN 60721-3-2:1997 2…9 Hz: max. 3.5 mm amplitude 9…200 Hz: 10 m/s^2 (32.8 ft/s^2)
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009	Not allowed	With packing max. 100 m/s^2 (328 ft/s^2) 11 ms	With packing max. 100 m/s^2 (328 ft/s^2) 11 ms

Colors

RAL 7035, RAL 9017.

Materials

Drive

Refer to Recycling instructions and environmental information for ACS880 cabinet-installed drives and multidrive modules (3AXD50000153909 [English]).

Packaging of drive

- Plywood[1)]
- Wood
- PET (strapping)
- PE (VCI film)
- Metal (fixing clamps, screws)
- VCI emitter capsules
- Clay desiccant.

1) Seaworthy package only

Packaging of options

- Cardboard
- Kraft paper
- PP (straps)
- PE (film, bubble wrap)
- Plywood, wood (only for heavy components).

Materials vary according to the item type, size and shape. Typical package consists of a cardboard box with paper filling or bubble wrap. ESD-safe packing materials are used for printed circuit boards and similar items.

Manuals

Printed product manuals are made of recyclable paper. Product manuals are available on the Internet.

Disposal

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

Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery.

Printed circuit boards and DC capacitors need selective treatment according to IEC 62635 guidelines.

To aid recycling, most plastic parts are marked with an appropriate identification code. In addition, components containing substances of very high concern (SVHCs) are listed in European Chemicals Agency's SCIP database. SCIP is the database for information on Substances of Concern In articles as such or in complex objects (Products) established under the Waste Framework Directive (2008/98/EC). For further information, contact your local ABB distributor or consult European Chemicals Agency's

SCIP database to find out which SVHCs are used in the drive, and to find out where those components are located.

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

For more information on ABB end of life services, see new.abb.com/service/end-of-lifeservices.

Applicable standards

See ACS880 liquid-cooled multidrive cabinets and modules electrical planning (3AXD50000048634 [English]).

Markings

See ACS880 liquid-cooled multidrive cabinets and modules electrical planning (3AXD50000048634 [English]).

Tightening torques

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

Electrical connections

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

Mechanical connections

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

Insulation supports

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

Cable lugs

Size	Max. torque	Strength class
M8	15 N·m (11 lbf·ft)	8.8 (A2-70 or A4-70)
M10	32 N·m (23.5 lbf·ft)	8.8
M12	50 N·m (37 lbf·ft)	8.8

Disclaimers

Generic disclaimer

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

Cyber security disclaimer

This product can be connected to and communicate information and data via a network interface. The HTTP protocol, which is used between the commissioning tool (Drive Composer) and the product, is an unsecured protocol. For independent and continuous operation of product such connection via network to commissioning tool is not necessary. However 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, prevention of physical access, 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.

Notwithstanding any other provision to the contrary and regardless of whether the contract is terminated or not, ABB and its affiliates are under no circumstances liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

11

Dimensions

Cabinet line-up dimensions

The drive consists of cubicles built into a cabinet line-up. The table below shows the nominal width and weight of each inverter type. The dimensions are in millimeters (for inches, divide by 25.4).

Notes:

- The side panels at the left and right ends of the line-up increase the nominal line-up width by 30 millimeters (1.2”).
- The standard depth of the cabinet line-up is 644 mm (25.35”) excluding protruding equipment such as handles.
- UL Listed (+C129) units are top cable entry/exit by default.
- Top cable exit increases the height (and free top space requirement) of the cabinet line-up by 50 mm (2"). Depending on the configuration, top cable exit will also increase either the width or depth of the cabinet line-up.
- The control electronics of the inverter unit may have to be housed outside the inverter module cubicles.

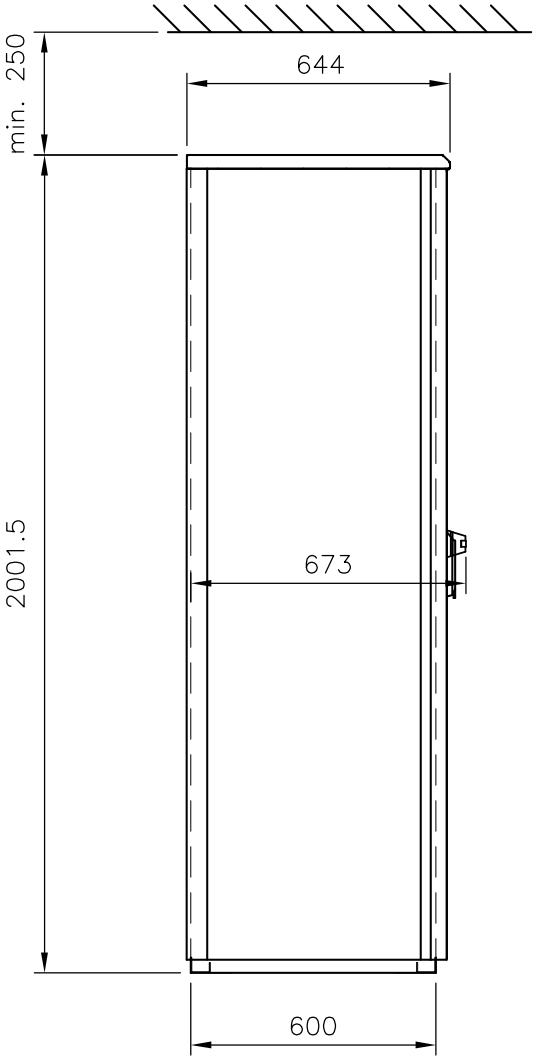
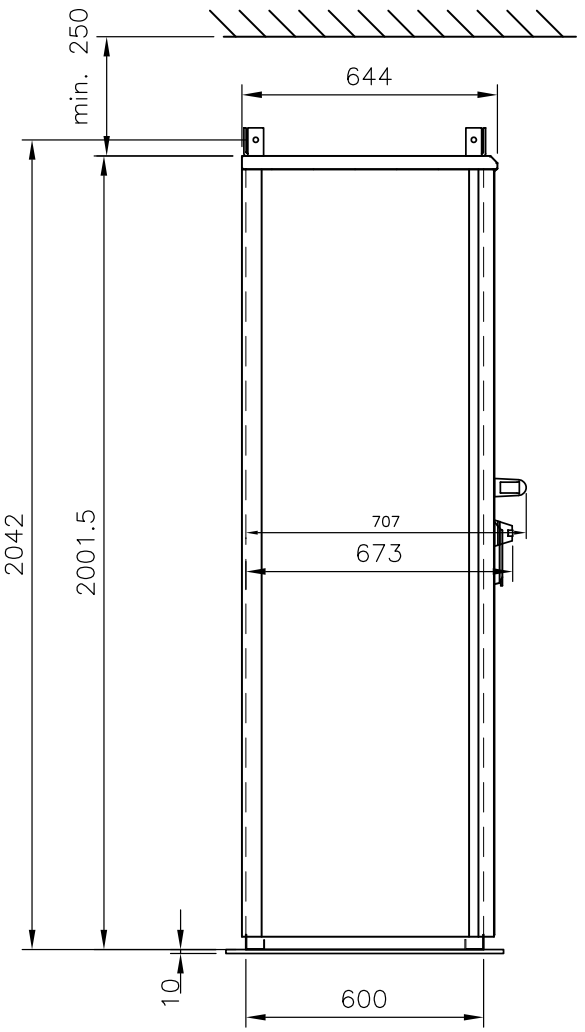
The table is followed by selected dimension drawing examples.

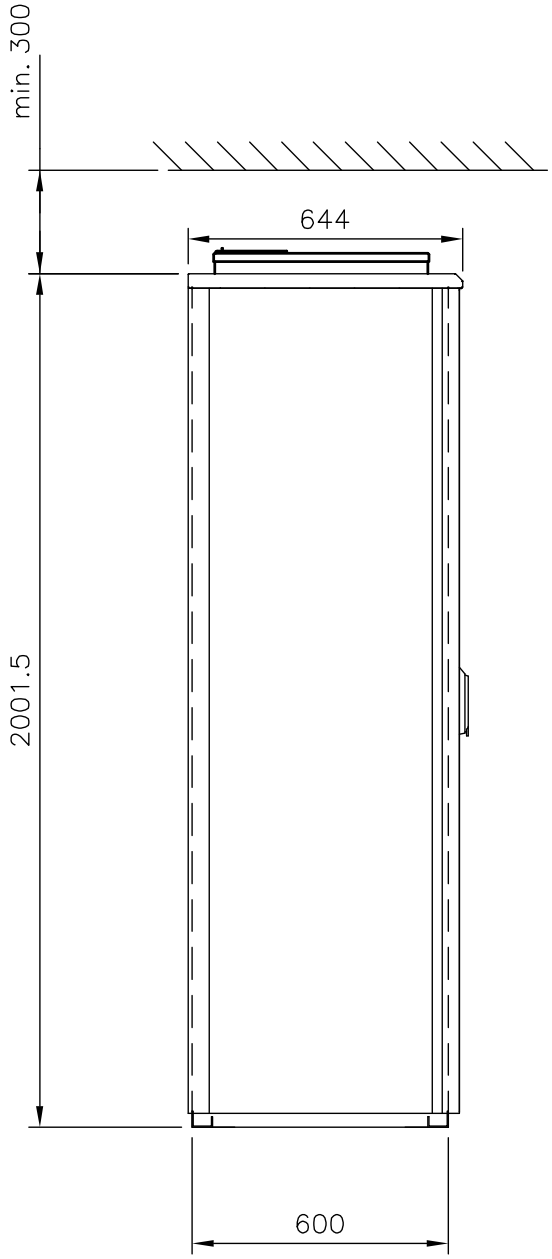
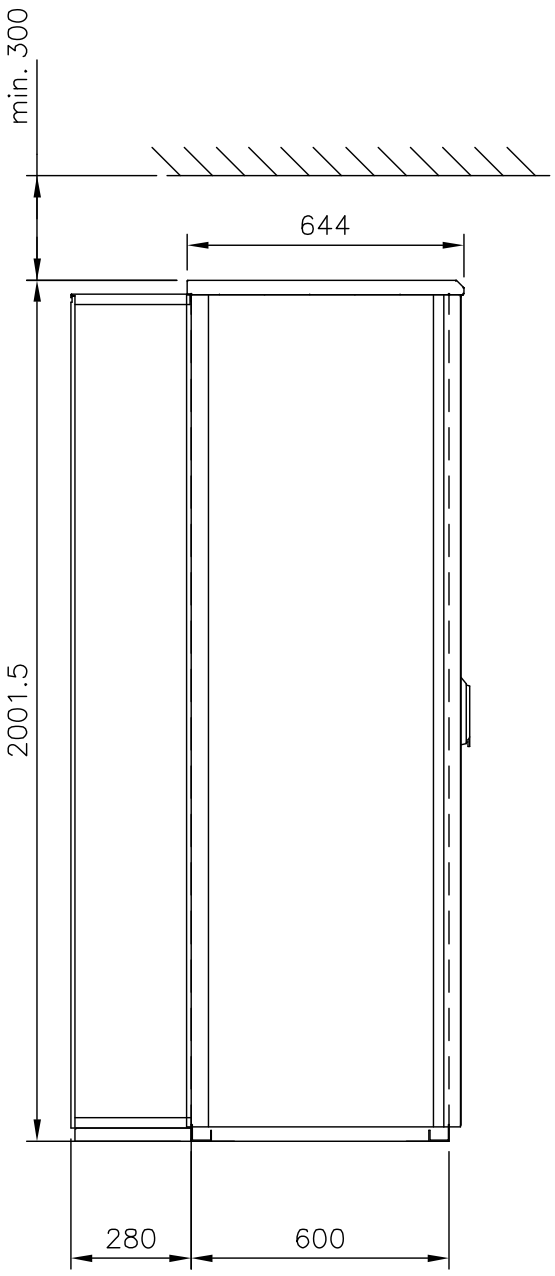
Dimensions and weights

ACS880-107LC-...	Cubicle widths	Total unit width	Total unit weight	
	mm	mm	kg	lbs
U_N = 690 V				
0062A-7 0082A-7 0100A-7 0130A-7 0140A-7 0190A-7 0220A-7 0290A-7 0340A-7 0389A-7	300 (1 module) 400 (2 modules)	300 (1 module) 400 (2 modules)	245 (1 module) 335 (2 modules)	540 (1 module) 740 (2 modules)
0390A-7 0430A-7 0480A-7 0530A-7 0600A-7 0670A-7 0750A-7 0850A-7	300	300	300	660
1030A-7 1170A-7 1310A-7 1470A-7 1660A-7	500	500	430	950
1940A-7 2180A-7 2470A-7	700	700	600	1320
2880A-7 3260A-7	500 + 500	1000	860	1900
3580A-7 4050A-7	700 + 500	1200	1030	2270
4840A-7	700 + 700	1400	1200	2650
5650A-7	700 + 500 + 500	1700	1460	3220
6460A-7	700 + 700 + 500	1900	1720	3790

Dimension drawing examples

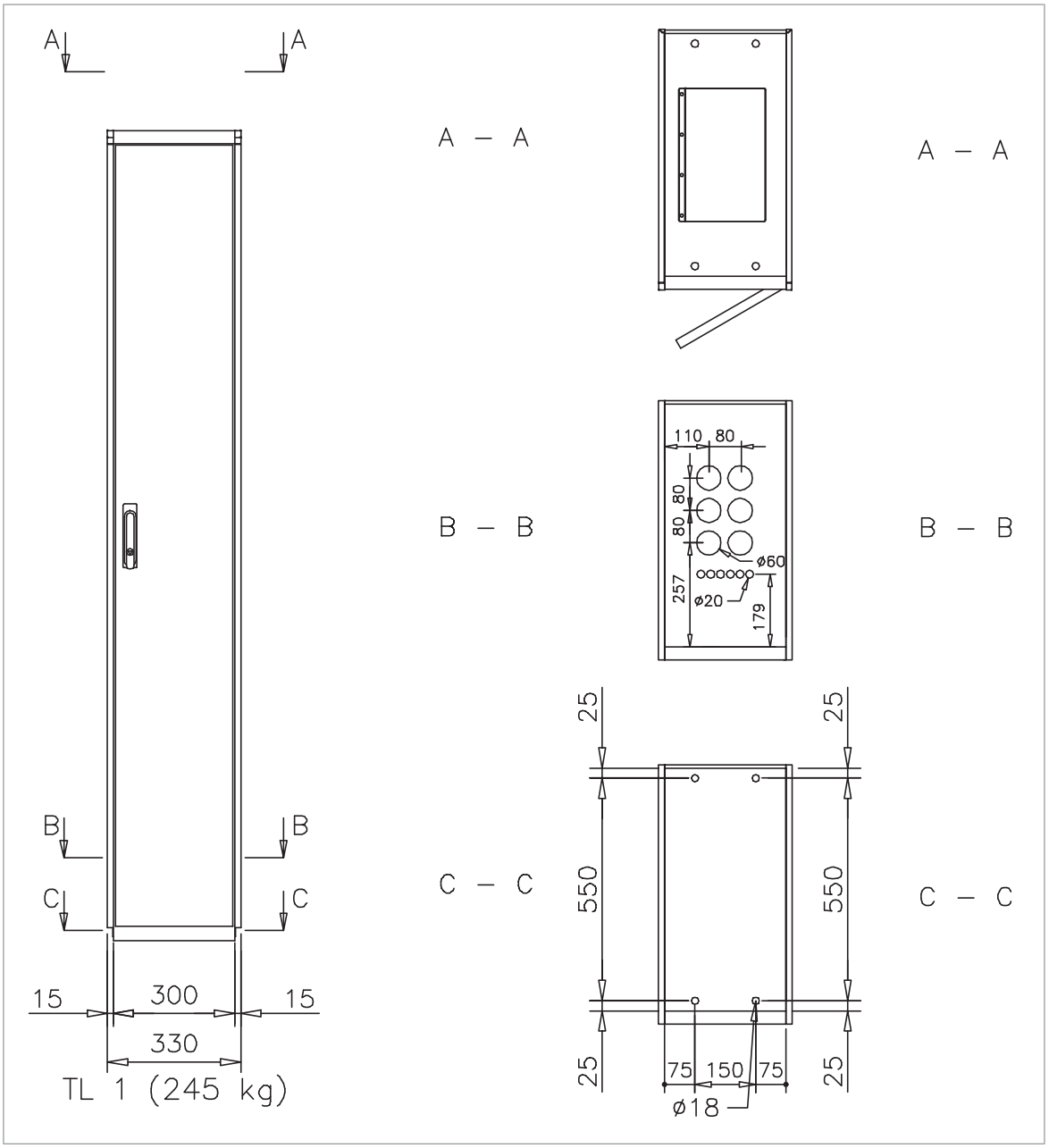
Cabinet height and depth

Side view, bottom cable exit	Side view, marine construction (option +C121), bottom cable exit
	

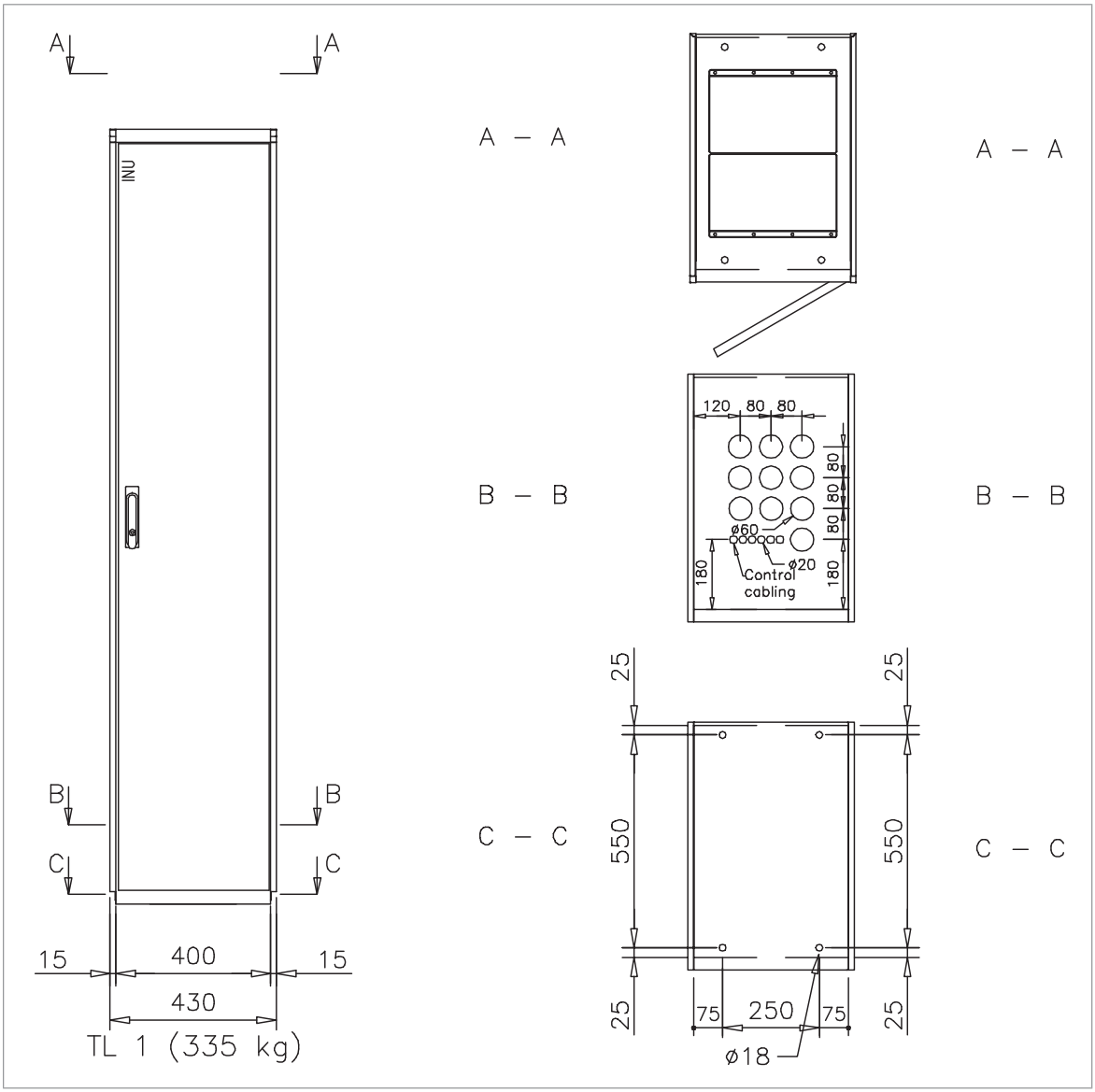
Side view, top cable exit with common motor terminal cubicle	Side view, top cable exit without common motor terminal cubicle
	

Frame R7i

Inverter module cubicle with one R7i module



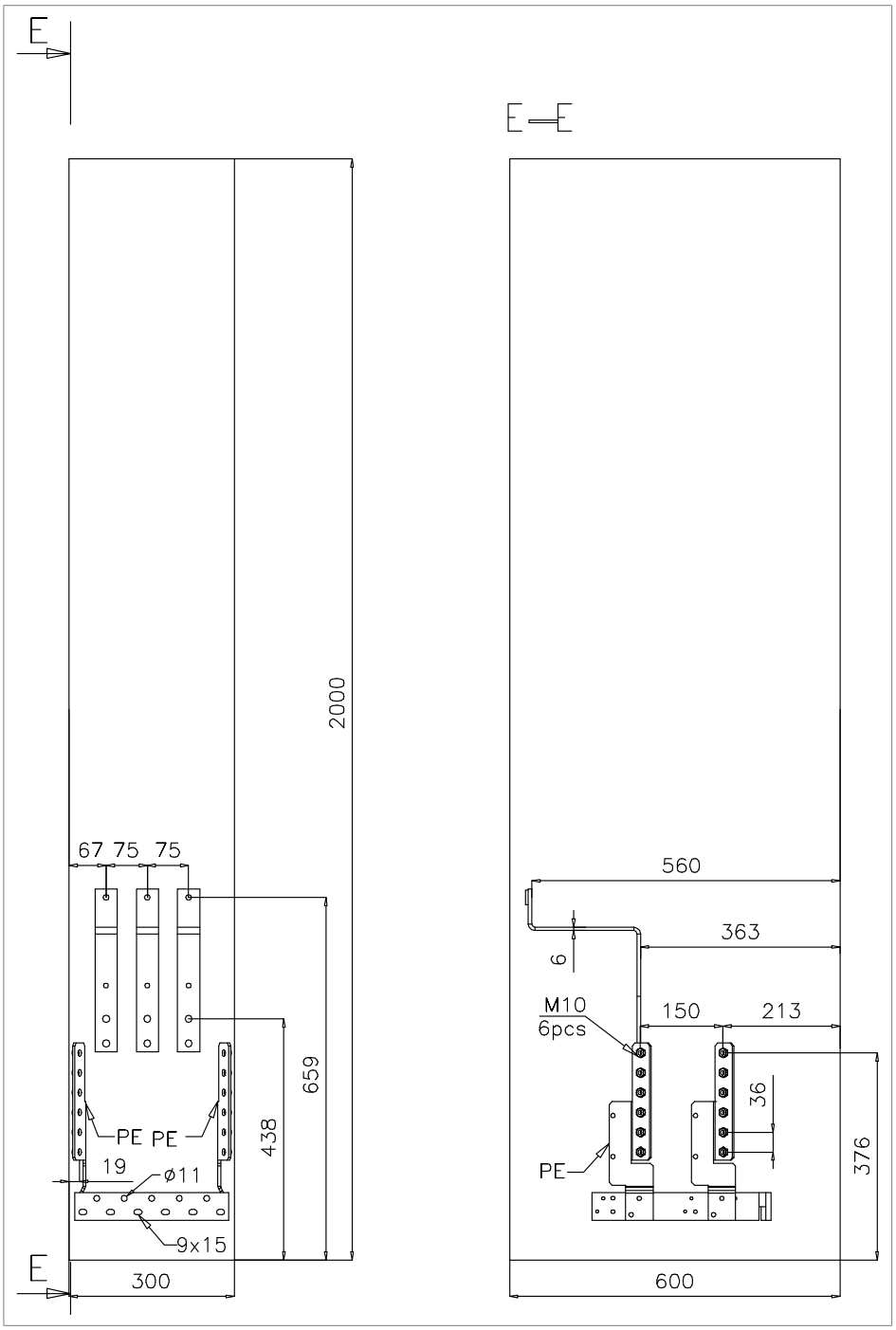
Inverter module cubicle with two R7i modules



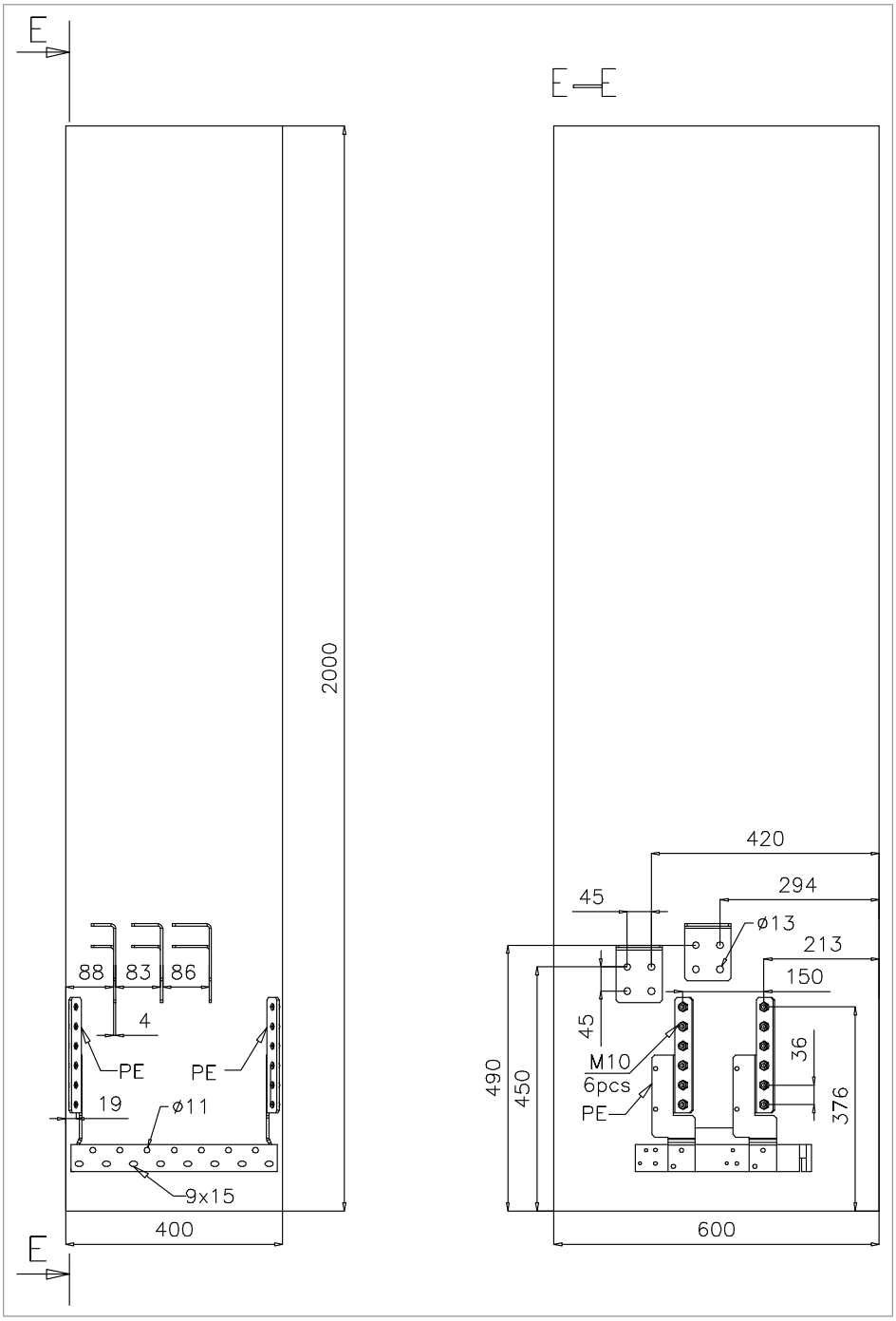
Location and size of output terminals

Units without common motor terminal cubicle

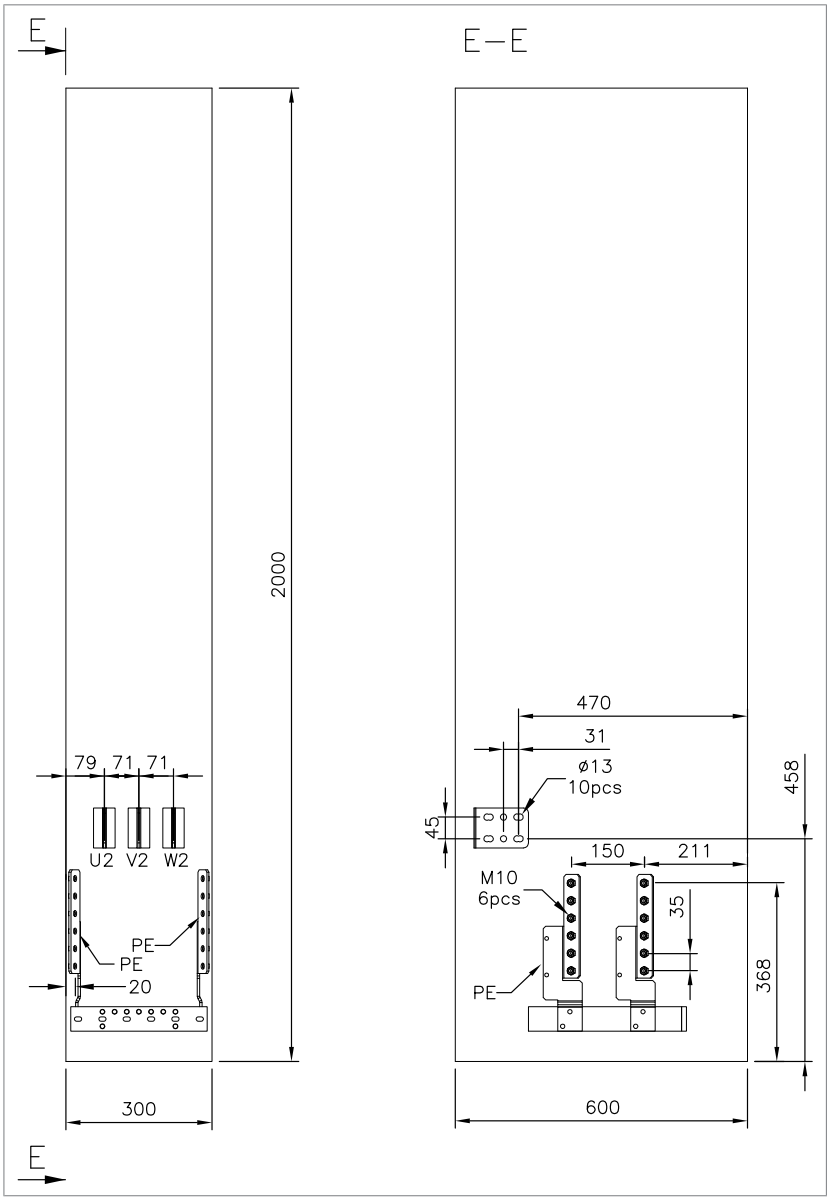
Inverter module cubicle with one R7i module, bottom cable exit



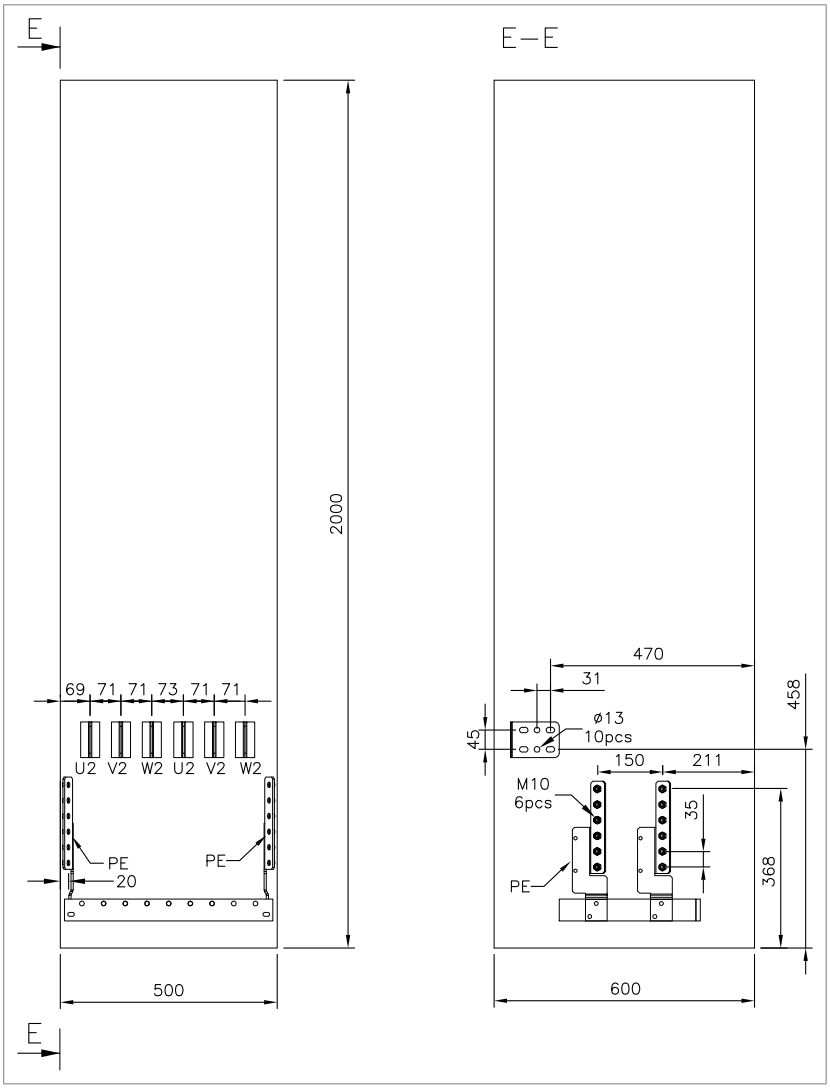
Inverter module cubicle with two R7i modules, bottom cable exit



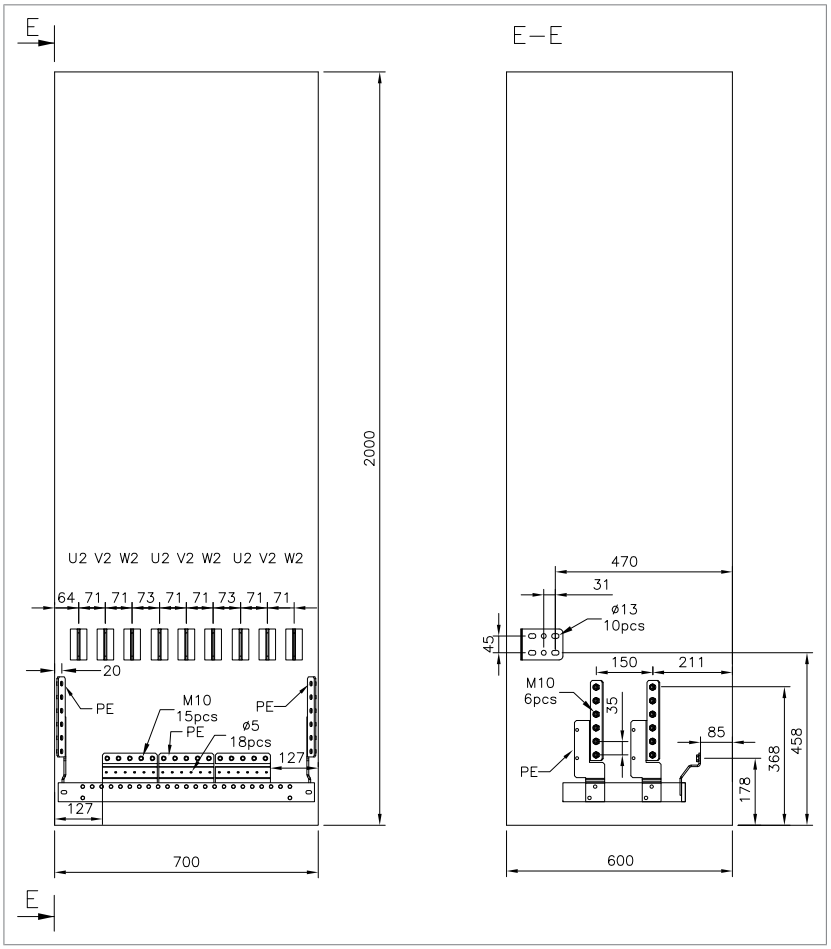
Inverter module cubicle with one R8i module, bottom cable exit



Inverter module cubicle with two R8i modules, bottom cable exit

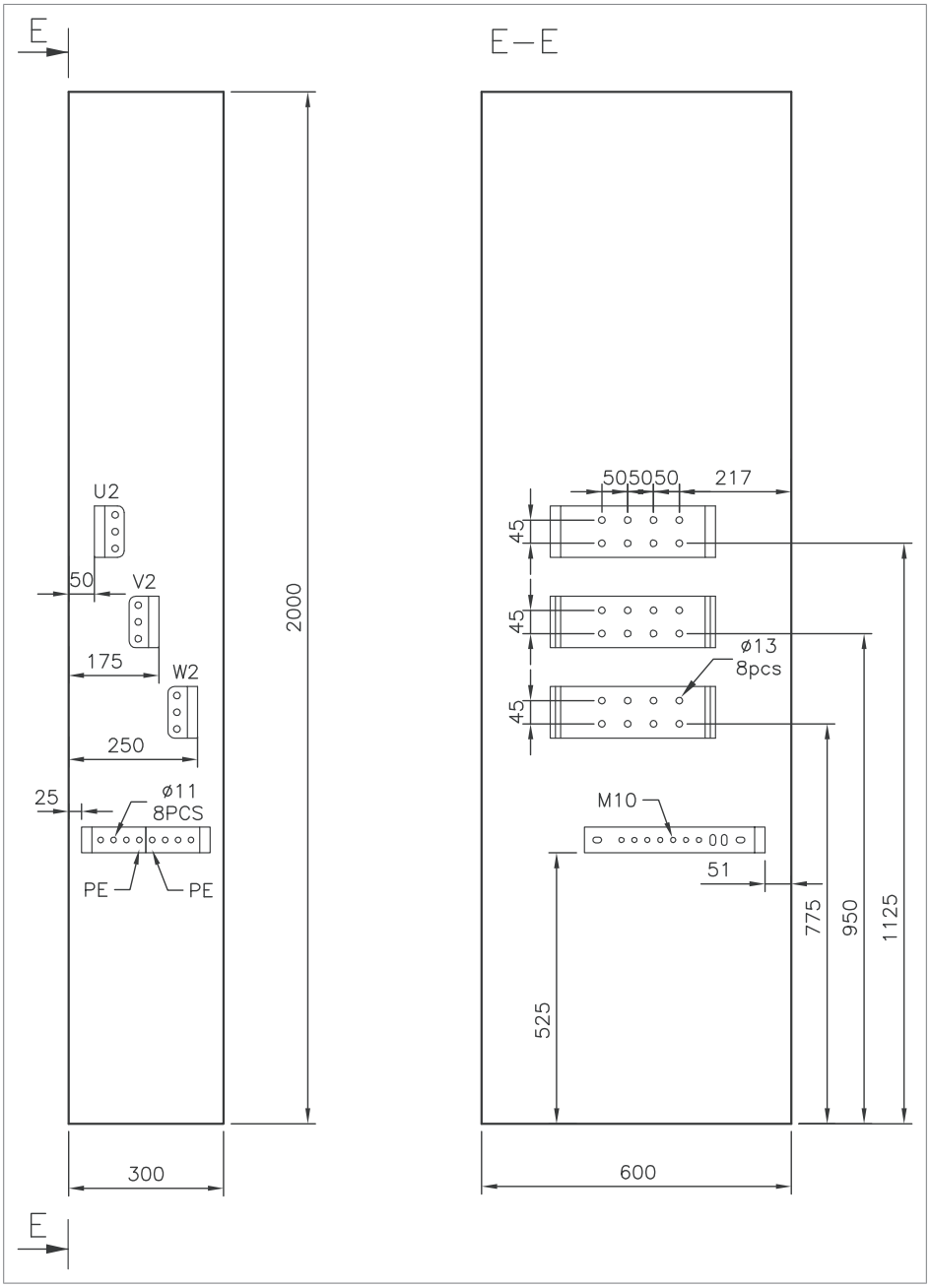


Inverter module cubicle with three R8i modules, bottom cable exit

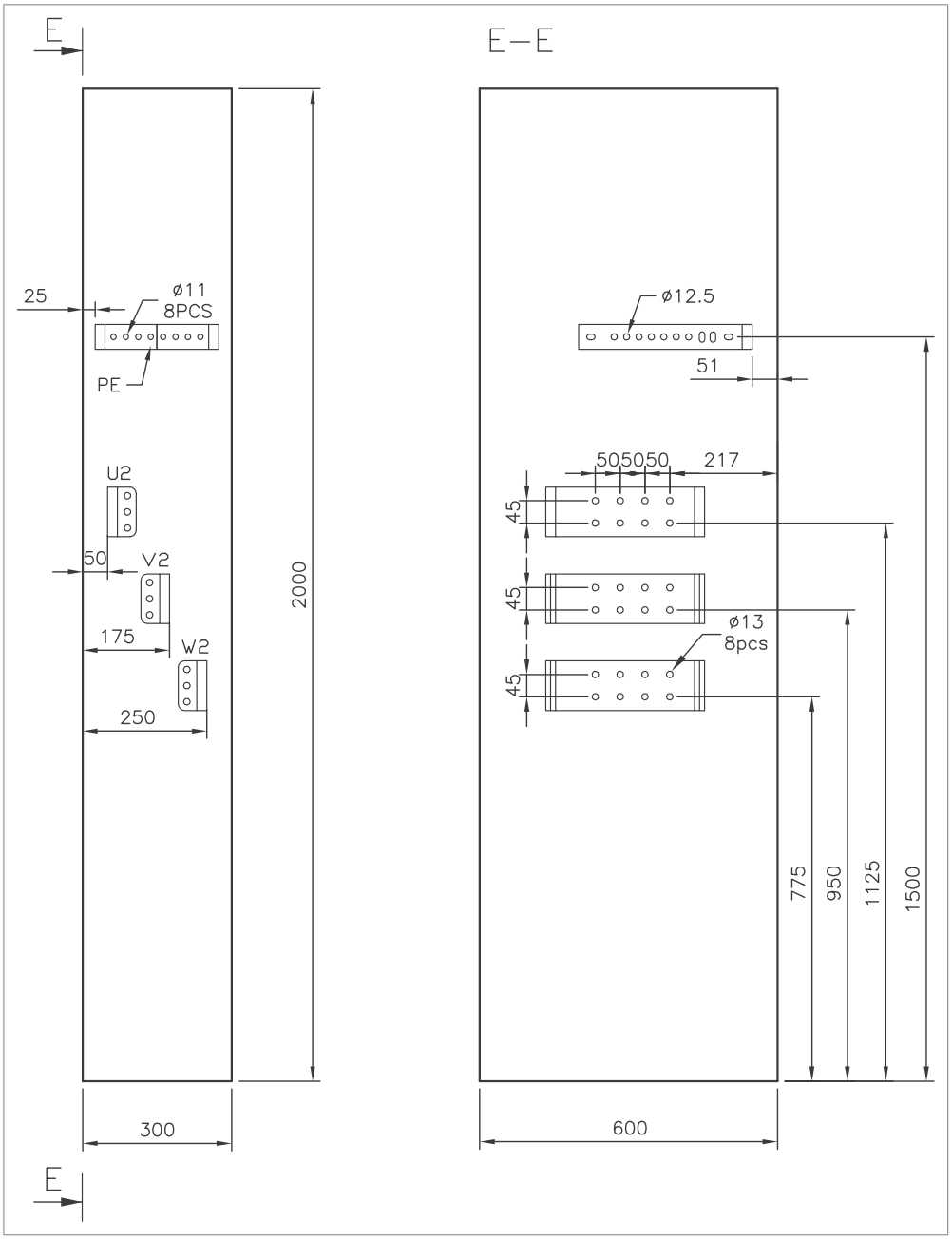


Units with common motor terminal cubicle (+H359)

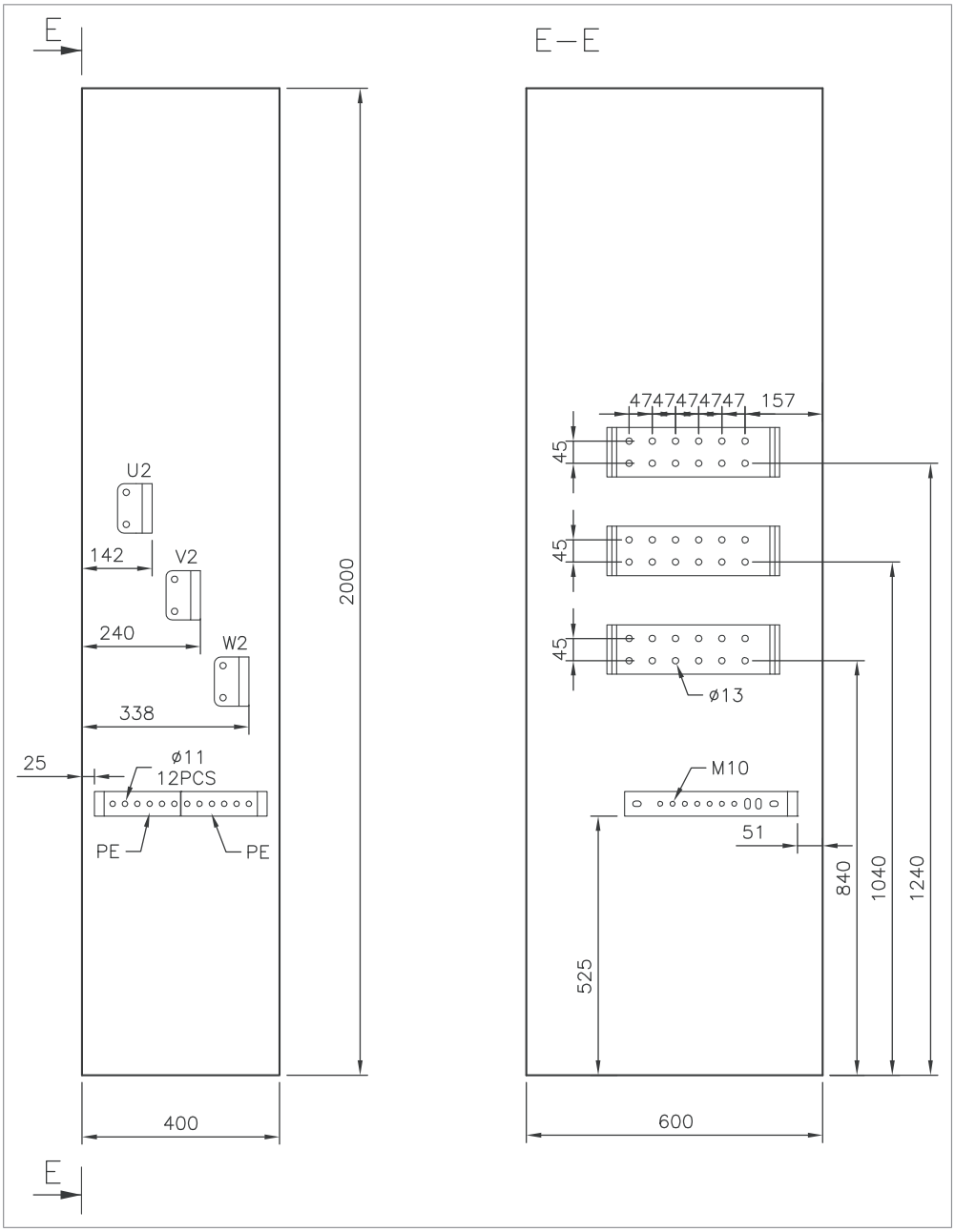
Cubicle width 300 mm, bottom cable exit



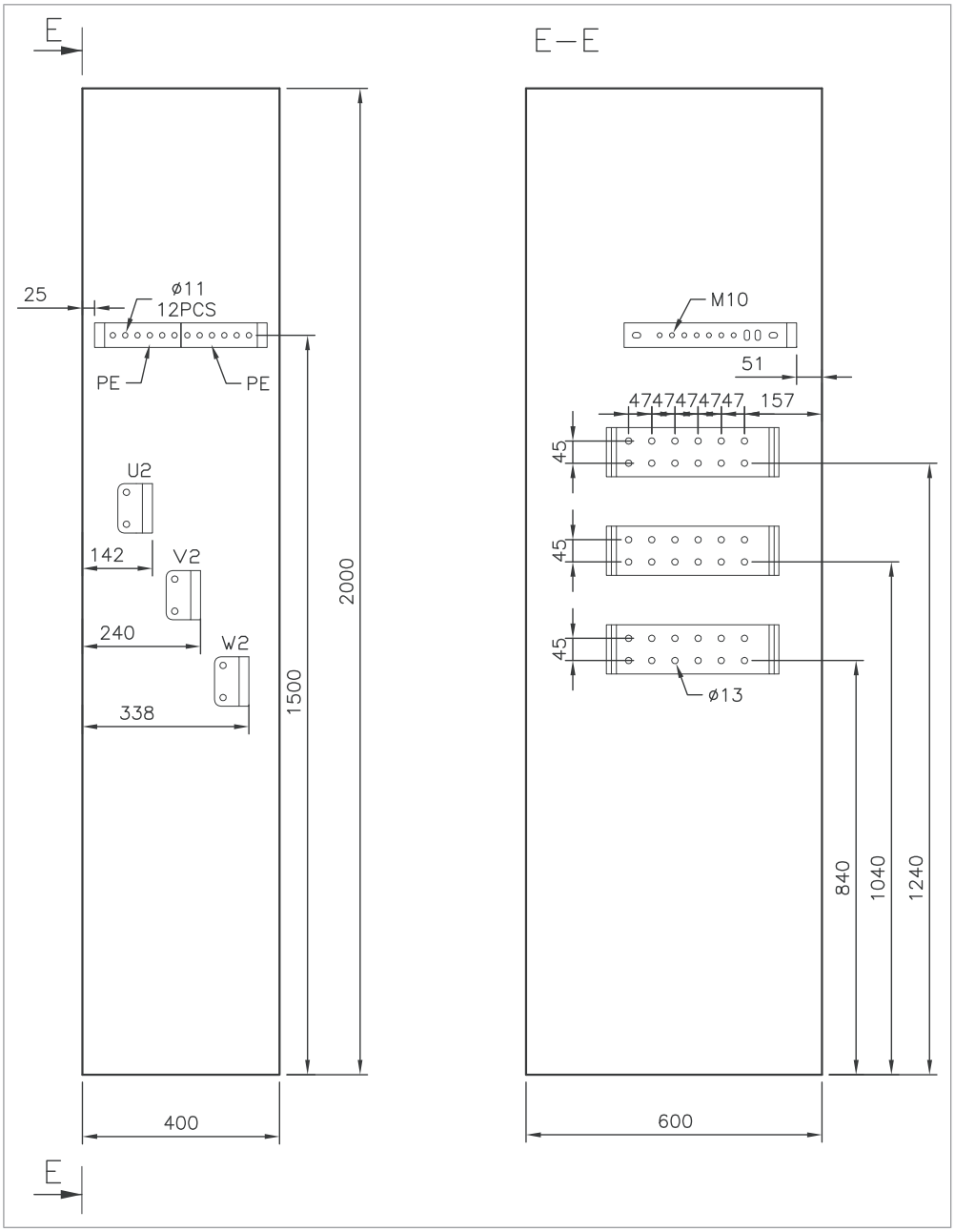
Cubicle width 300 mm, top cable exit



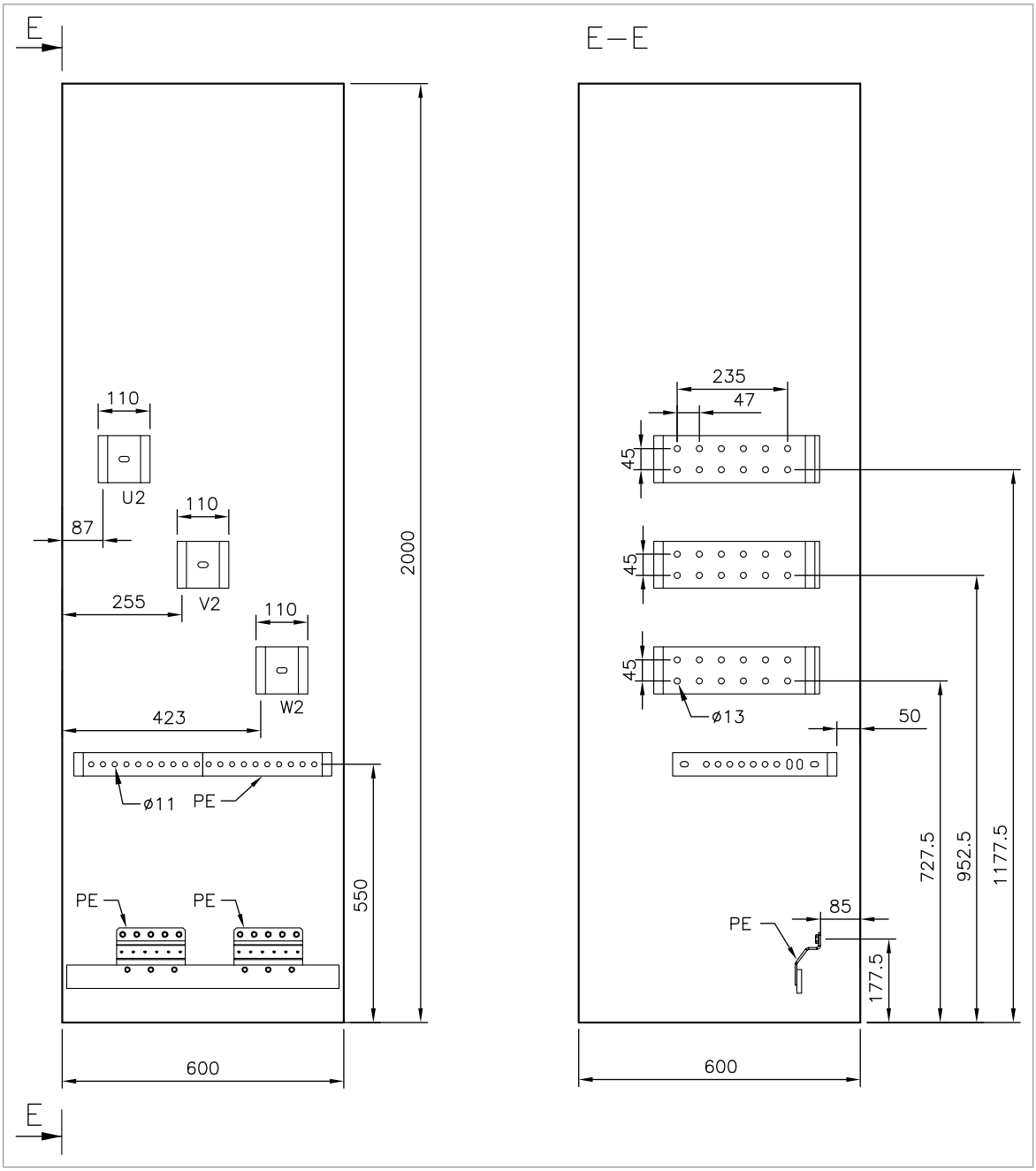
Cubicle width 400 mm, bottom cable exit



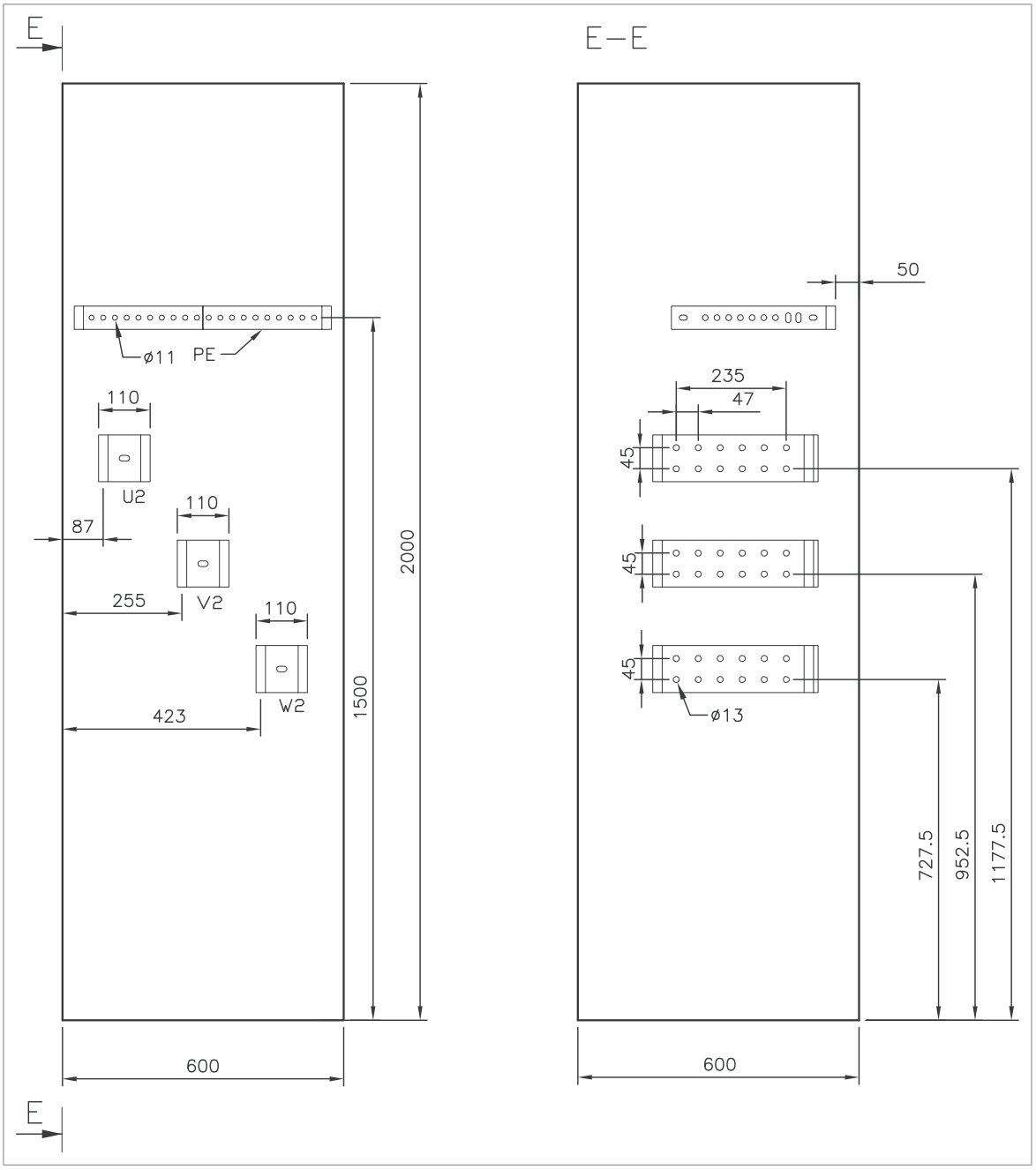
Cubicle width 400 mm, top cable exit



Cubicle width 600 mm, bottom cable exit



Cubicle width 600 mm, top cable exit



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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Document library on the Internet

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