ABB INDUSTRIAL DRIVES

ACS880-1607LC DC/DC converter units

Hardware manual

ACS880-1607LC DC/DC converter units

Hardware manual

3AXD50000431342 Rev A
EN
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1

Introduction to the manual

Contents of this chapter

This chapter gives basic information on the manual.

Applicability

The manual is applicable to ACS880-1607LC DC/DC converter units that form a part of an ACS880 multidrive system.

Safety instructions

Follow 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, start up and service the drive, or create instructions for the end user of the drive concerning the installation and maintenance of the drive.

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

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

Categorization by frame size and option module

Some descriptions, instructions and technical data which concern only certain module or frame sizes are marked with the size identifier (such as "2×R8i", etc.). The marking derives from the quantity and basic construction of the converter modules that form the converter unit. For example, frame size "2×R8i" indicates that the converter unit consists of two frame size R8i converter modules connected in parallel.

The frame size is marked on the type designation labels. The frame size of each drive module is also shown in the rating tables.

The instructions and technical data which concern only certain optional selections are marked with option codes (such as +E205). The options included in the drive can be identified from the option codes visible on the type designation label.

Use of component designations

Some device names in the manual include the item designation in brackets, for example [Q20], to make it possible to identify the components in the circuit diagrams of the drive.

Terms and abbreviations

Term	Description
BAMU	Auxiliary measurement unit
BCU	Type of control unit
BDCL	Series of L-filters, for example BDCL-14-5
CIO	I/O module for controlling cabinet fans
Control board	Circuit board in which the control program runs
Control unit	Control board built in a housing (often rail-mountable)
Cubicle	One section of a cabinet-installed drive. A cubicle is typically behind a door of its own.
DC/DC converter	Charges or discharges an external energy storage (such as a battery or capacitor bank) from or into the DC bus
DC/DC converter module	Converter power electronics, related components and DC capacitors enclosed in a metal frame or enclosure. Intended for cabinet installation.
DC/DC converter unit	DC/DC converter module(s) under control of one control board, and related components
DDC	DC/DC converter unit
DI	Digital input
DOL	Direct-on-line
Drive	Frequency converter for controlling AC motors
Energy storage	Device that stores electrical energy, for example, a battery or a super capacitor.
Frame, frame size	Physical size of the drive or power module
INU	Inverter unit
Inverter	Converts direct current and voltage to alternating current and voltage.
Inverter unit	Inverter module(s) under control of one control board, and related components. One inverter unit typically controls one motor.
Multidrive	Drive for controlling several motors which are typically coupled to the same machinery. Includes one supply unit, and one or several inverter units.
Parameter	In the drive control program, user-adjustable operation instruction to the drive, or signal measured or calculated by the drive. In some (for example fieldbus) contexts, a value that can be accessed as an object, eg, variable, constant, or signal.
PLC	Programmable logic controller
Single drive	Drive for controlling one motor

Term	Description
Supply unit	Supply module(s) under control of one control board, and related components.
UPS	Uninterruptible power supply

Related documents

Manual	Code
General manuals	
ACS880 liquid-cooled multidrive cabinets and modules safety instructions	3AXD50000048633
ACS880 liquid-cooled multidrive cabinets and modules electrical planning instructions	3AXD50000048634
ACS880 liquid-cooled multidrive cabinets mechanical installation instructions	3AXD50000048635
CIO-01 I/O module for distributed I/O bus control user's manual	3AXD50000126880
Supply unit manuals	
ACS880-207LC IGBT supply units hardware manual	3AXD50000174782
ACS880 IGBT supply control program firmware manual	3AUA0000131562
Inverter unit manuals	
ACS880-107LC inverter units hardware manual	3AXD50000196111
ACS880 primary control program firmware manual	3AUA0000085967
ACS880 primary control program quick start-up guide	3AUA0000098062
Manuals for application programs (Crane, Winder, etc.)	
Brake unit and DC/DC converter unit manuals	
ACS880-607LC 1-phase brake units hardware manual	3AXD50000481491
ACS880 (3-phase) brake control program firmware manual	3AXD50000020967
ACS880-1607LC DC/DC converter units hardware manual	3AXD50000431342
ACS880 DC/DC converter control program firmware manual	3AXD50000024671
Option manuals	
ACS880-1007LC liquid cooling unit user's manual	3AXD50000129607
ACS-AP-x assistant control panels user’s manual	3AUA0000085685
Drive composer start-up and maintenance PC tool user’s manual	3AUA0000094606
Manuals for I/O extension modules, fieldbus adapters, safety options etc.	

You can find manuals on the Internet. See www.abb.com/drives/documents. For manuals not available in the document library, contact your local ABB representative.

2

Operation principle and hardware description

Contents of this chapter

This chapter describes the DC/DC converter operation basics and the hardware of the converter.

Operation principle

The DC/DC converter unit (DDC) transfers energy from a common DC bus of a drive into an external energy storage and discharges energy back to the DC bus. The energy storage can be, for example, a battery or super capacitor. The energy storage media does not belong to the DC/DC module product offering.

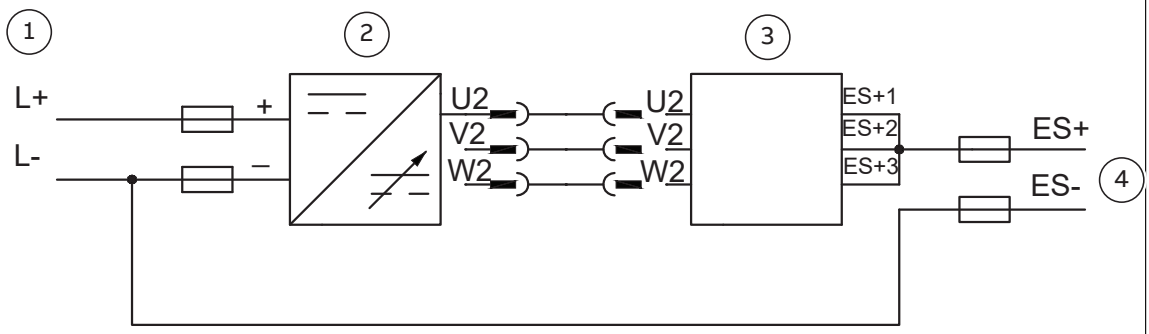
The DC/DC converter unit has a single converter module or parallel converter modules under the command of one control unit. Parallel DC/DC converter modules must have a common energy storage. Each parallel module must have the output cabling of its own. We also recommend that you use identical cablings (cable type, cross-sectional area, and length) and have identical load for each module. For other solutions, contact ABB.

Typically, the DC/DC converter is used in marine applications for heave compensation, peak load compensation, propulsion supply in harbors, energy storing instead of an additional generator and so on. The DC/DC converter can also be used in automotive applications such as electric car charging systems and also in several other applications where energy storing and reuse is needed.

Main circuit diagram

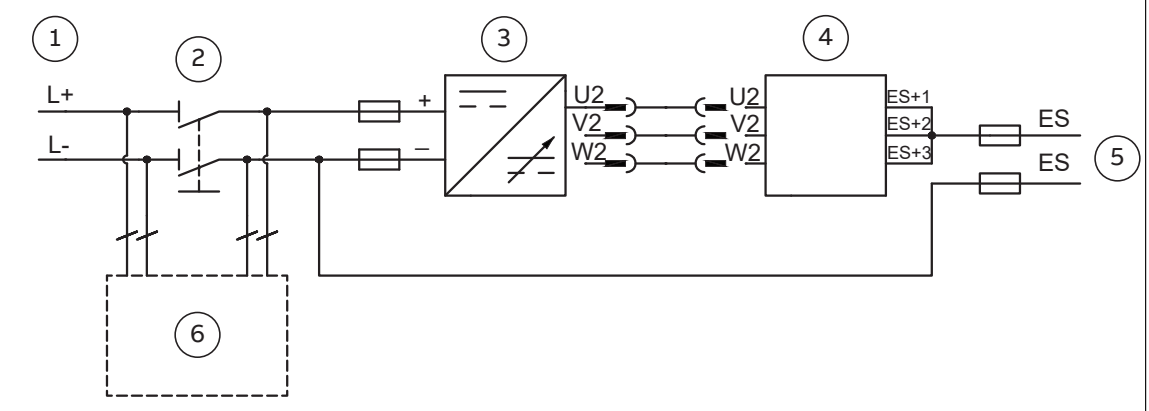
The DC/DC converter has output DC fuses and DC fuses on the drive DC-link side. You can also equip the converter with a DC switch/disconnector (option +F286).

This figure shows a simplified main circuit diagram of a DC/DC converter without a DC switch/disconnector and charging circuit.



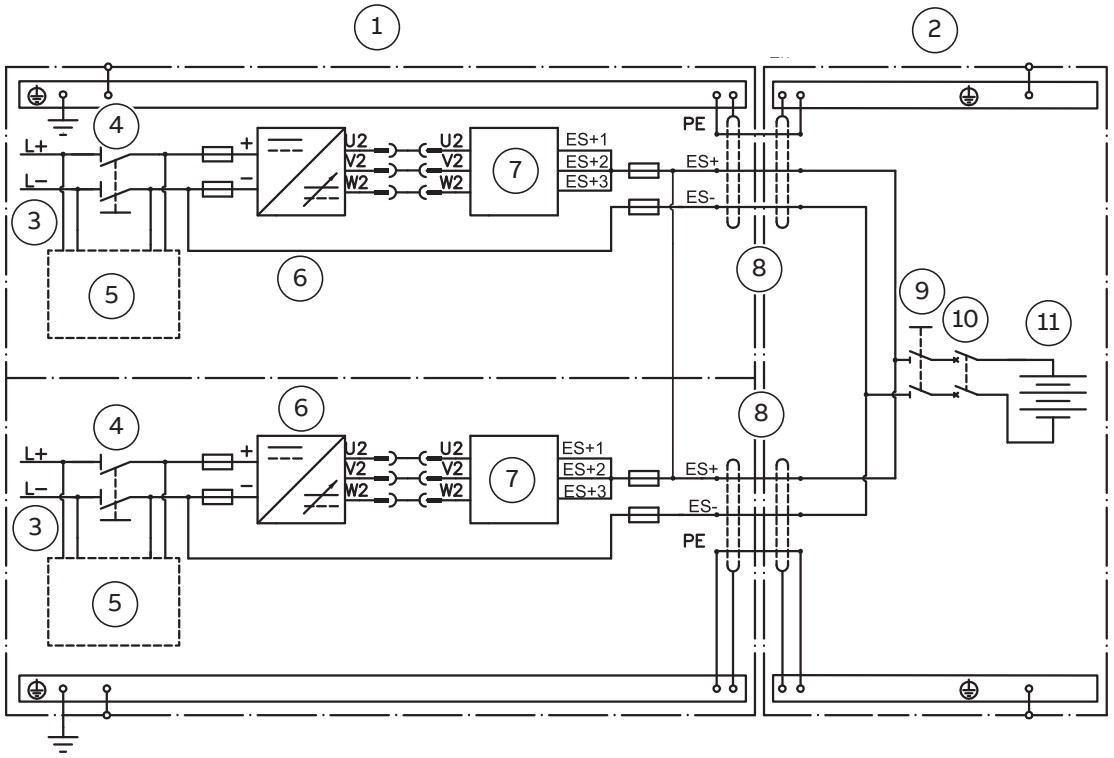
1	Drive DC bus
2	DC/DC converter module
3	Filter module
4	Energy storage

This figure shows a simplified main circuit diagram of a DC/DC converter with the DC switch/disconnector and charging circuit.



1	Drive DC bus
2	DC switch/disconnector
3	DC/DC converter module
4	Filter module
5	Energy storage
6	Charging components

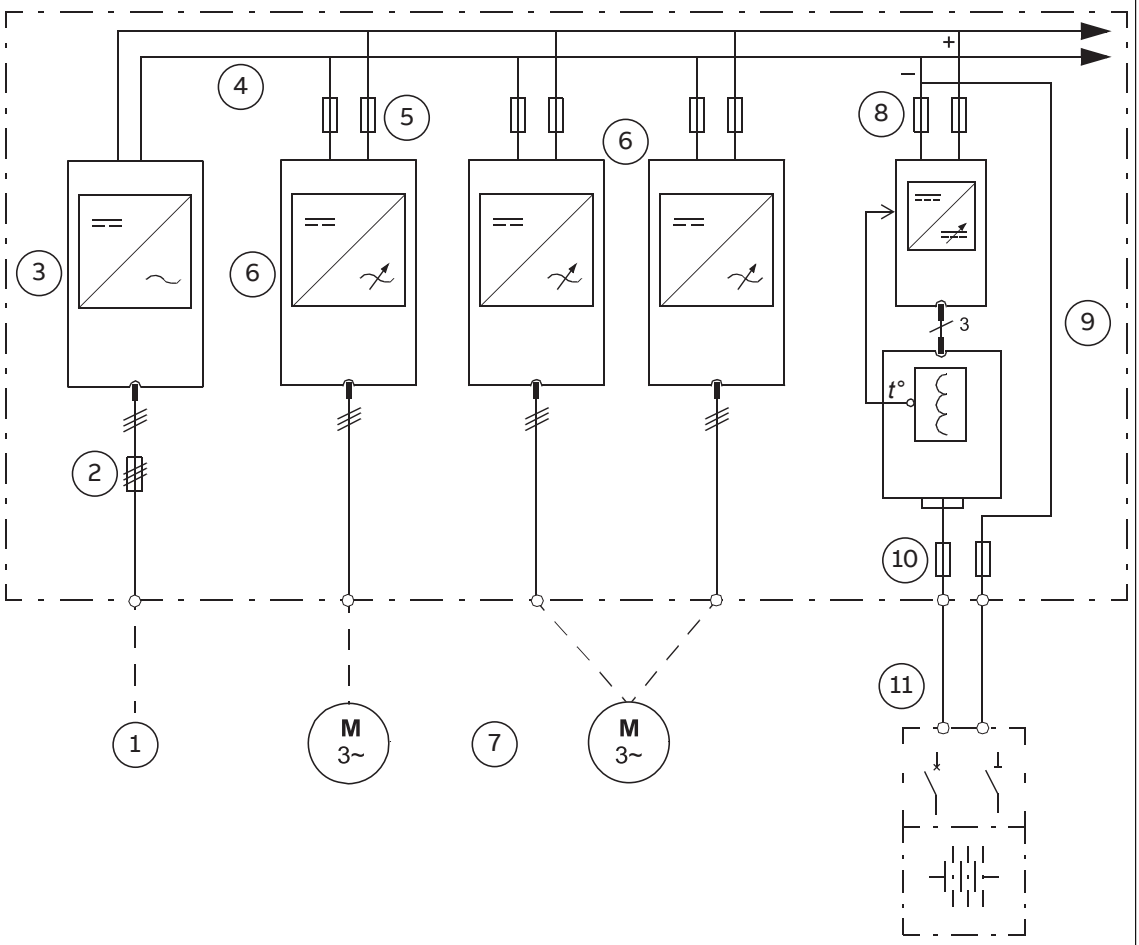
This figure shows a simplified main circuit diagram of parallel-connected DC/DC converter modules with the DC switch/disconnector (option +F286) and charging circuit. Also the energy storage and related cabling and equipment are visible.



1	DC/DC converter cubicles
2	Energy storage cabinet
3	Drive DC bus
4	DC switch/disconnector
5	Charging components
6	DC/DC converter module
7	Filter module
8	Cabling between DC/DC converter unit and energy storage
9	Energy storage disconnecting device
10	Energy storage protective circuit breaker
11	Energy storage

Overview diagram of a drive with a DC/DC converter unit

This diagram shows a possible application of a converter unit in an example system. The DC/DC converter unit includes a DC/DC converter module and a filter module.



1	AC supply
2	Input (AC) fuses
3	Supply module
4	DC bus (-,+)
5	Inverter DC fuses (with or without a DC switch/disconnector)
6	Inverter modules
7	Motors
8	DC fuses (DC bus side, with or without a DC switch/disconnector)
9	DC/DC converter unit (converter and filter module)
10	Output DC fuses
11	Customer-defined energy storage with disconnecting and protection devices

Converter unit hardware

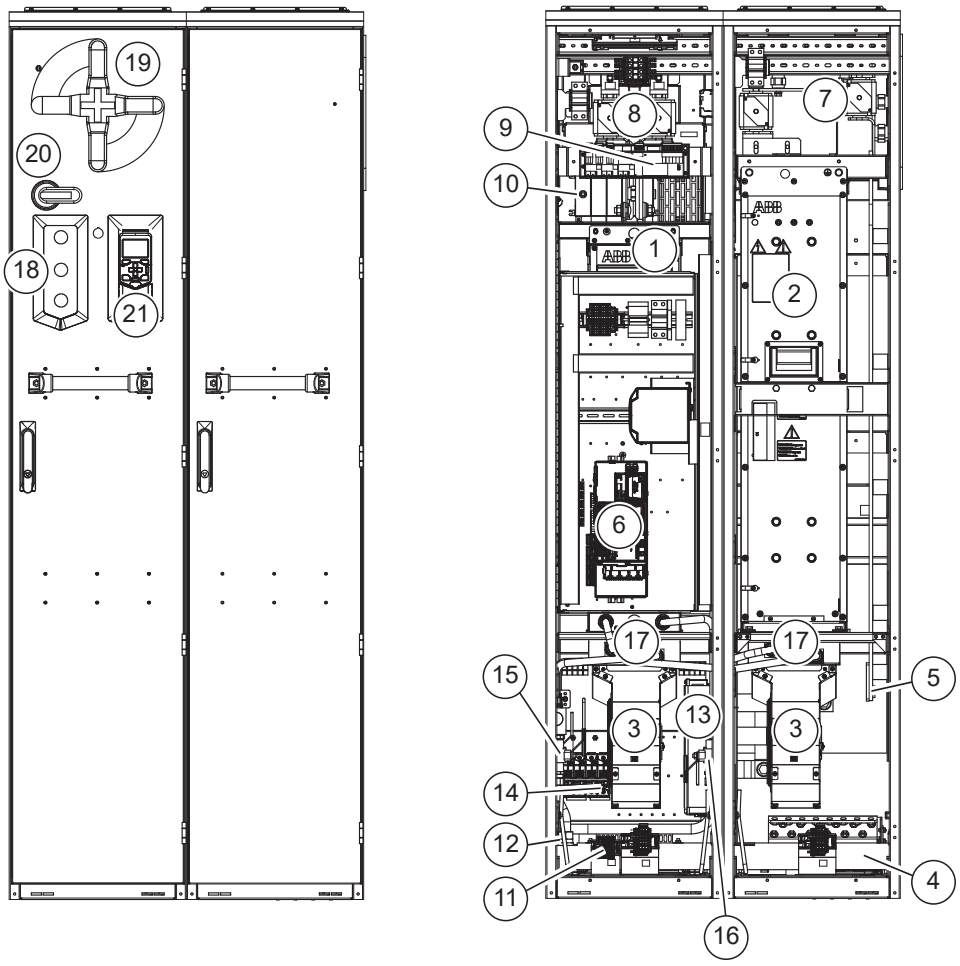
Cabinet layout

The DC/DC converter cubicle includes a converter module, a BDCL filter module and a BCU control unit. Each converter is equipped with DC fuses and a DC switch/disconnector (option +F286). A converter unit with the DC switch/disconnector also has a precharge circuit including a charging switch on the door.

The figure show the components of the converter unit cubicle with door closed, and with door open and shrouds removed. In this figure, the DC/DC converter unit cubicle has the DC switch/disconnector and charging circuit.

With DC switch/disconnector and charging

Door closed *Door open*



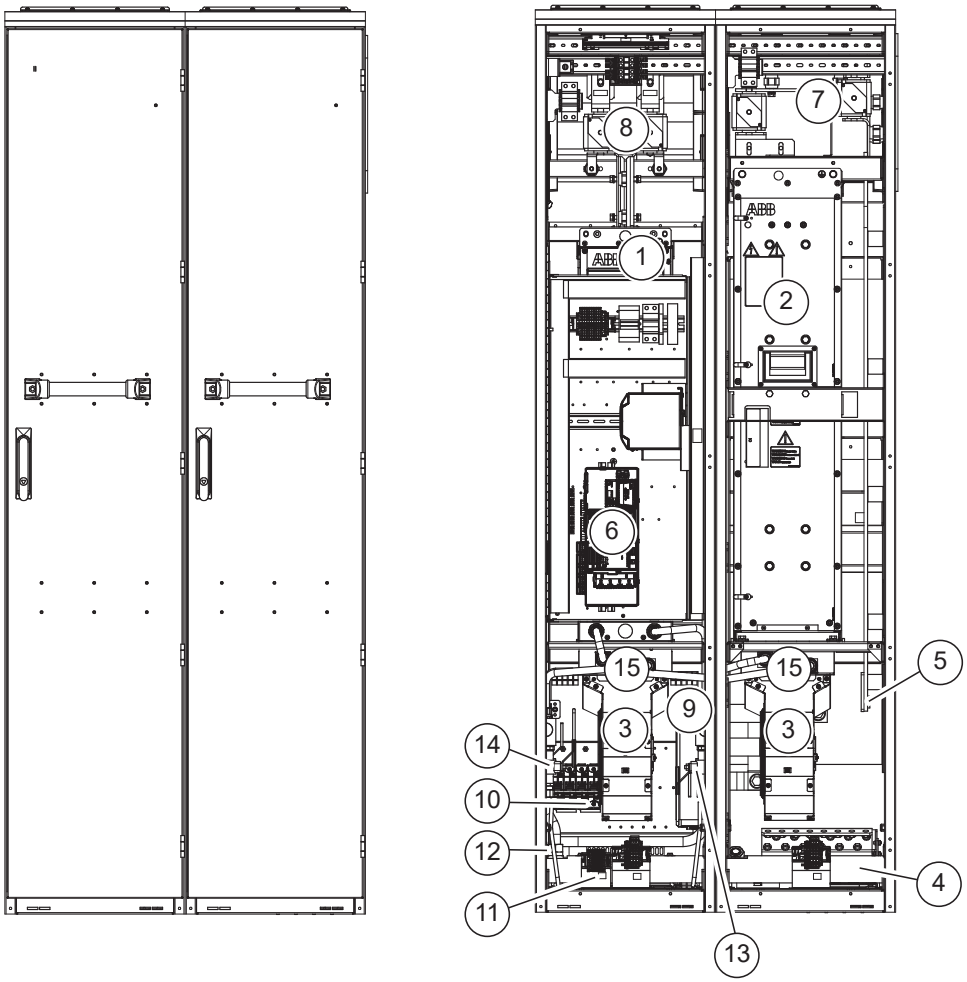
1	T11.1	R8i DC/DC converter module
2	R13.1	BDCL filter module
3	-	Module cooling fans
4	-	Cable entries for energy storage cables
5	ES+, ES-	Energy storage connection
6	A41	Control unit

7	F13.xx	Output DC fuses
8	F11.xx	DC fuses (DC bus side)
9	A11.1	Charging controller, charging resistors [R1.x…R4.x] are behind the charging controller
10	-	Charging switch [Q10.1] shaft
11	X33.1	Connection from the energy storage disconnecting device to the load disconnected indicator [P13.x]
12	-	Coolant IN Coolant OUT (back)
13	-	Auxiliary measurement unit
14	-	Auxiliary measurement unit fuses
15	-	Inlet manifold with stop and drain valves
16	-	Outlet manifold with stop and drain valves
17	-	Heat exchanger
18	P11.1…P13.1	Door lights: Charging OK ([P11.x], green), DC/DC converter disconnected ([P12.x], white), Load disconnected ([P13.x], white).
19	Q11.1	DC switch/disconnector handle
20	-	Charging switch handle
21	-	Control panel

The figure shows a converter unit cubicle without the DC switch/disconnector (option +F286) and charging circuit.

Without DC switch/disconnector

Door closed *Door open*



1	T11.1	R8i DC/DC converter module
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3	-	Module cooling fans
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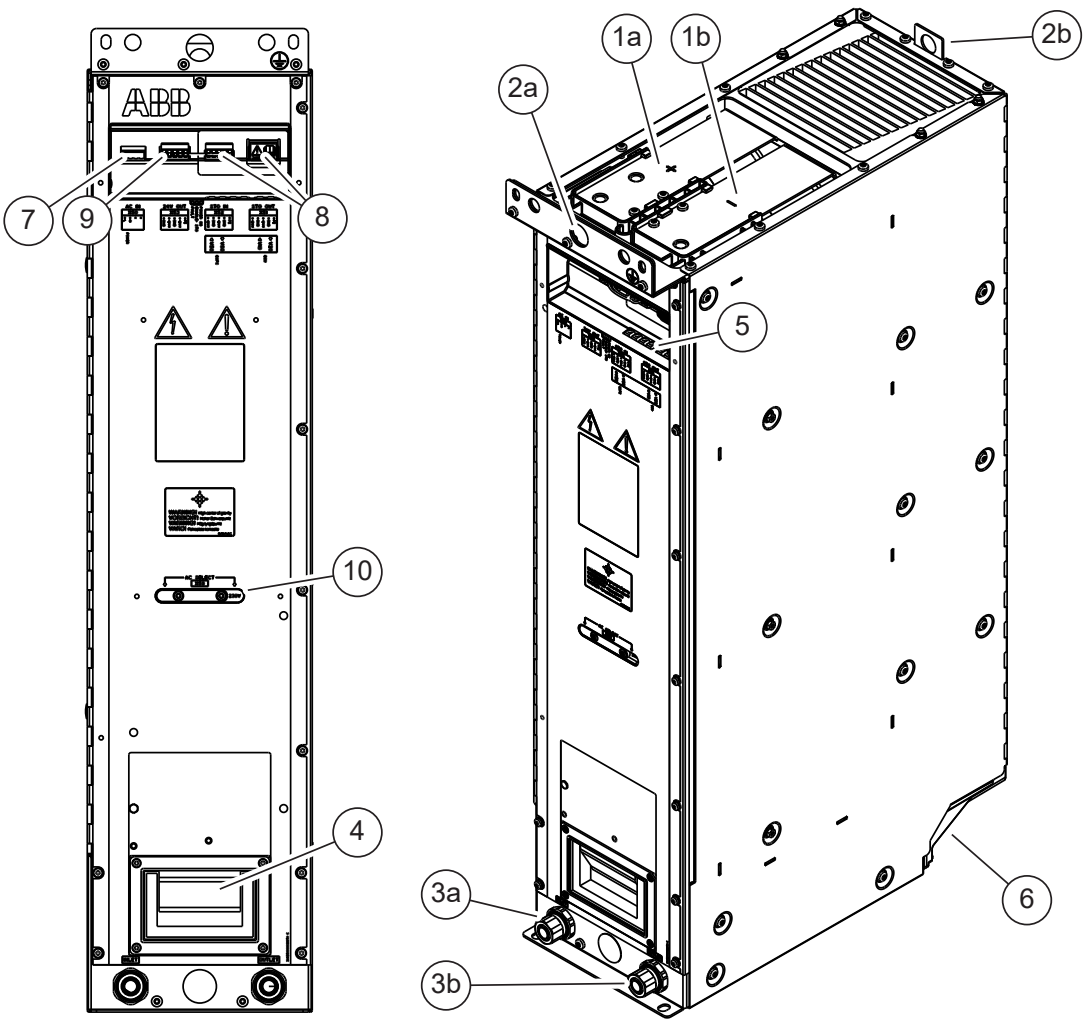
10	-	Auxiliary measurement unit fuses
11	X33.1	Connection from the energy storage disconnecting device to the load disconnected indicator [P13.x]
12	-	Coolant IN Coolant OUT (back)

13	-	Inlet manifold with stop and drain valves
14	-	Outlet manifold with stop and drain valves
15	-	Heat exchanger

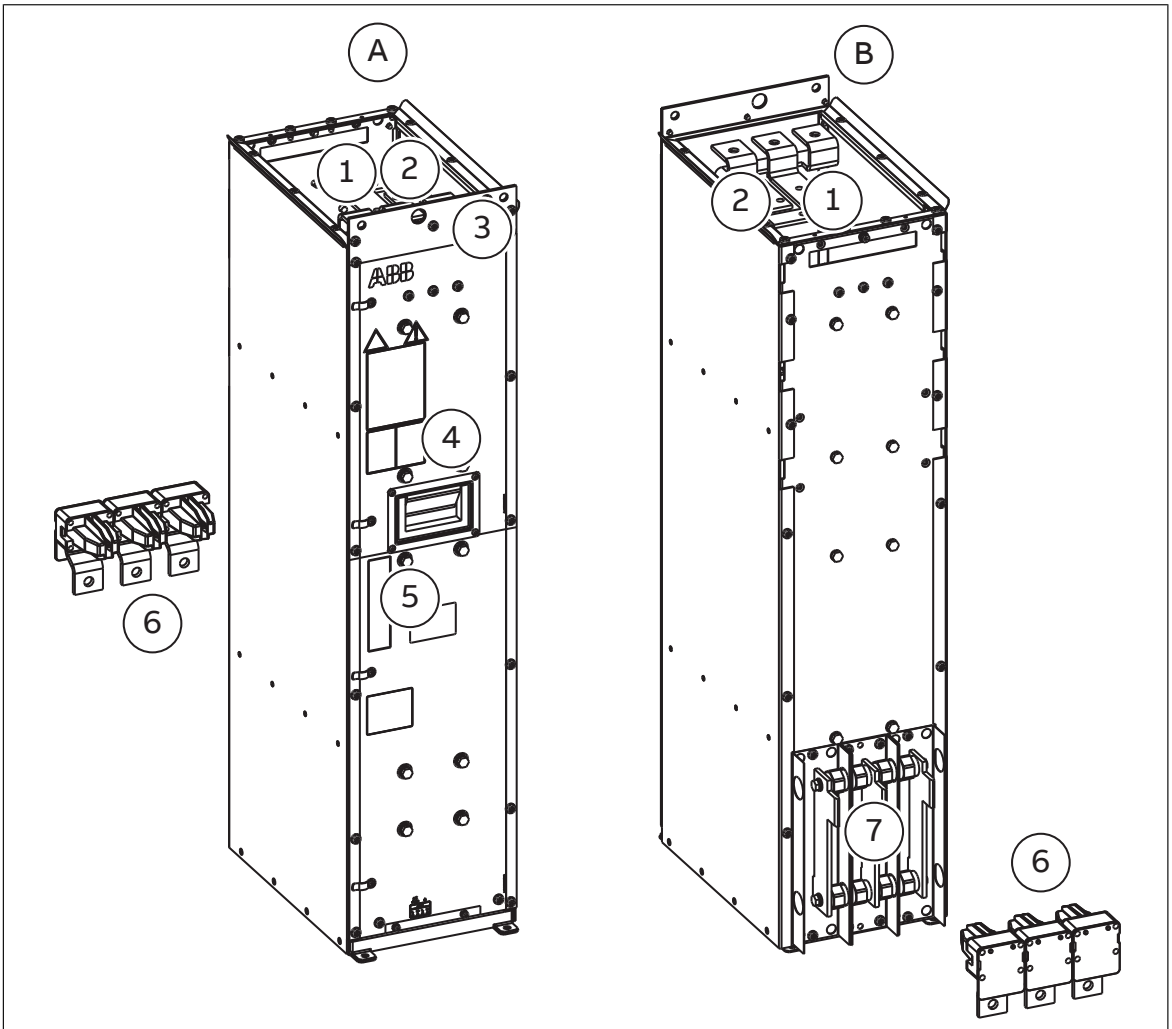
Converter module hardware

Module layout



1	DC connection busbars, + (a) and - (b)
2	Lifting eyes, front (a) and back (b)
3	Coolant in (a) and out (b) connectors
4	Handle
5	Fiber optic connectors
6	Quick connector (AC connection) (the counterpart fastened to the cabinet behind the module)
7	Terminal block X50 (auxiliary power input for internal boards)
8	Terminal block X51 and X52 (Safe torque off in inverter modules only)
9	Terminal block X53 (24 V DC power output)
10	Auxiliary voltage selector (115 or 230 V)
11	Unpainted fastening hole. The grounding point (PE) between module frame and cabinet frame.

BDCL filter module



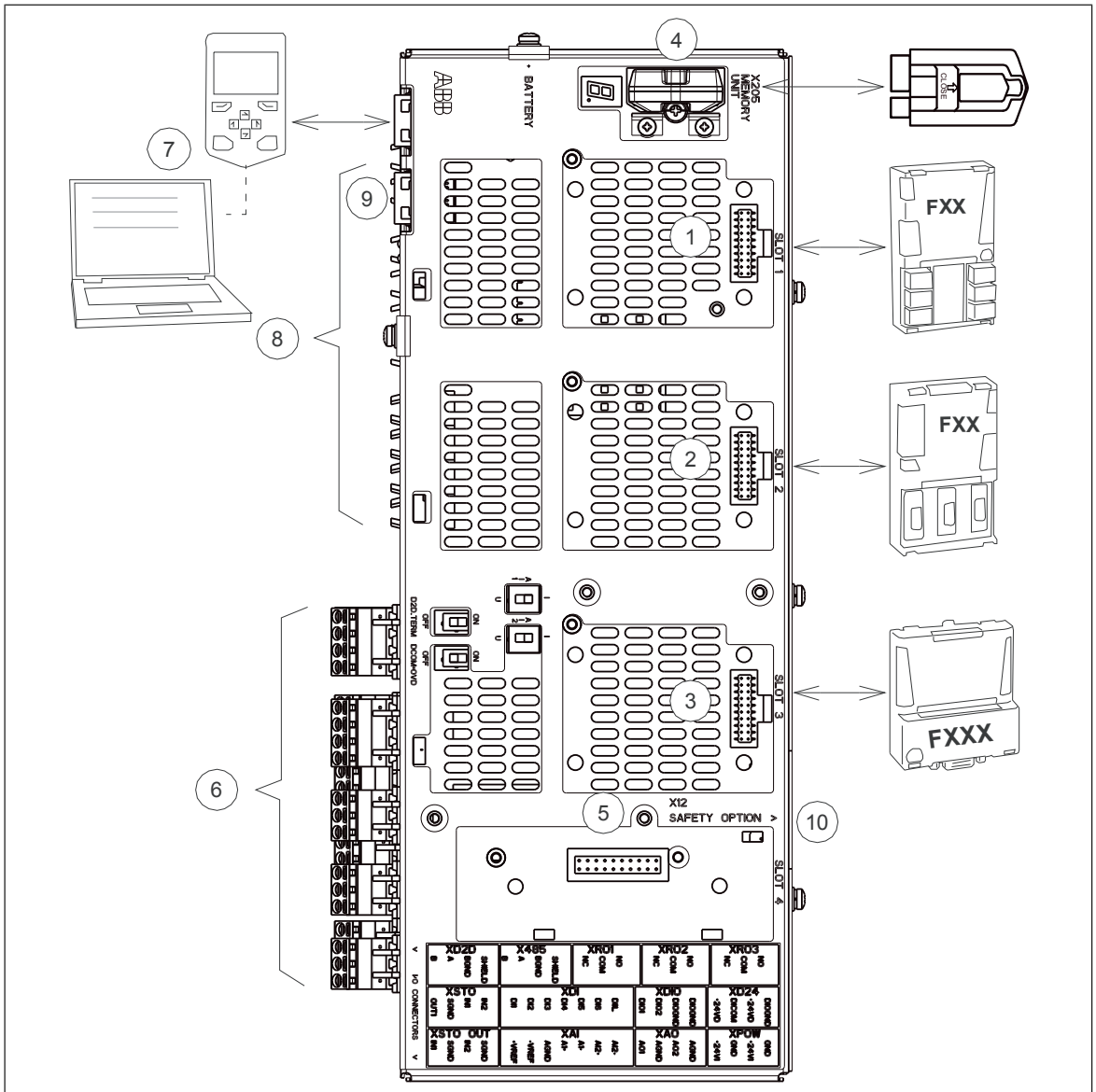
A	Filter module, front
B	Filter module, back
1	Energy storage connection
2	Terminal block [X30], temperature control
3	The unpainted grounding point
4	Handle
5	Type designation label of the module
6	Quick connector
7	Converter module connection

Overheating protection of the filter

By default, the BDCL filter is protected against overheating (caused by a faulty fan, for example) with a thermistor and the temperature monitoring function of the control program. If the filter temperature becomes too high, the temperature monitoring function stops the DC/DC converter module automatically.

Overview of the control connections of the BCU control unit

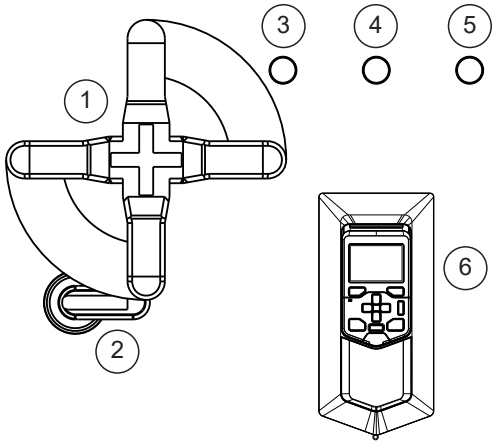
The diagram shows the control connections and interfaces of the BCU control unit.



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.

Converter unit control devices

The figure shows an example of the door control devices of the DC/DC converter. The selection and exact location of control devices varies in different deliveries.



1	DC switch/disconnector (option +F286)
2	Charging switch (option +F286)
3	Charging OK indicator, green (option +F286)
4	DC/DC converter disconnected indicator, white (option +F286)
5	Load disconnected indicator, white
6	ACS-AP-x control panel (option +J400)

DC switch/disconnector

The DC switch/disconnector [Q11] is optional (option +F286). The DC switch/disconnector has an operating handle on the cabinet door. A converter unit with a DC switch/disconnector also has a charging circuit including a charging switch on the door.

The DC switch/disconnector allows the isolation of the unit from the DC bus. Before the unit is connected to the DC bus, the capacitors of the converter modules must be charged through a charging circuit.

Charging switch

A converter unit with a DC switch/disconnector ([Q11], option +F286) also has a charging circuit and a charging switch [Q10] on the cubicle door. Before closing the DC switch/disconnector, close the charging switch. After the precharging is finished, the Charging OK indicator [P11] (green) on the cabinet door illuminates, and you can close the DC switch/disconnector [Q11], and open the charging switch.

Door lights

The load disconnected indicator ([P13], white) is always installed on the cabinet door. This indicator shows the state of the energy storage disconnecting device (user-defined).

The charging OK indicator ([P11], green) and DC/DC converter disconnected indicator ([P12], white) are installed when the converter has the DC switch/disconnector (option +F286).

ACX-AP-x control panel

The ACX-AP-x control panel is the user interface of the unit. With the control panel, you can:

- start and stop the unit
- view and reset the fault and warning messages, and view the fault history
- view actual signals
- change parameter settings
- change between local and external control.

To be able to start and stop the unit by the control panel, you must have the parameter-defined Run enable signal and Start enable signal on (1). The control panel must also be in local control mode.

To change between local and remote control mode, press the Loc/Rem key of the control panel. For the instructions on the use of the panel, see *ACX-AP-x Assistant control panels user's manual* (3AUA0000085685 [English]). For the parameter settings, see the firmware manual.

PC connection

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

Fieldbus control

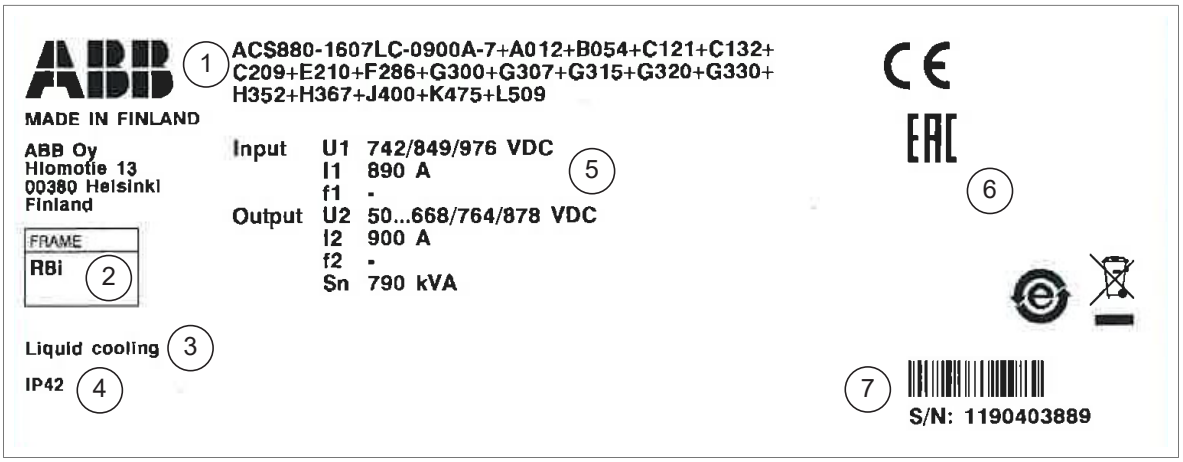
You can control the converter unit through a fieldbus interface if the unit is equipped with an optional fieldbus adapter, and when you have configured the control program for the fieldbus control with parameters. For more information on parameters, see *ACS880 DC/DC converter control program firmware manual* (3AXD50000024671 [English]).

Type designation labels

Type designation label of the DC/DC converter unit

Each converter unit has a type designation label attached onto the inside of the cubicle door. The type designation label includes the ratings, appropriate markings, a type designation and a serial number of the unit.

An example is shown below.

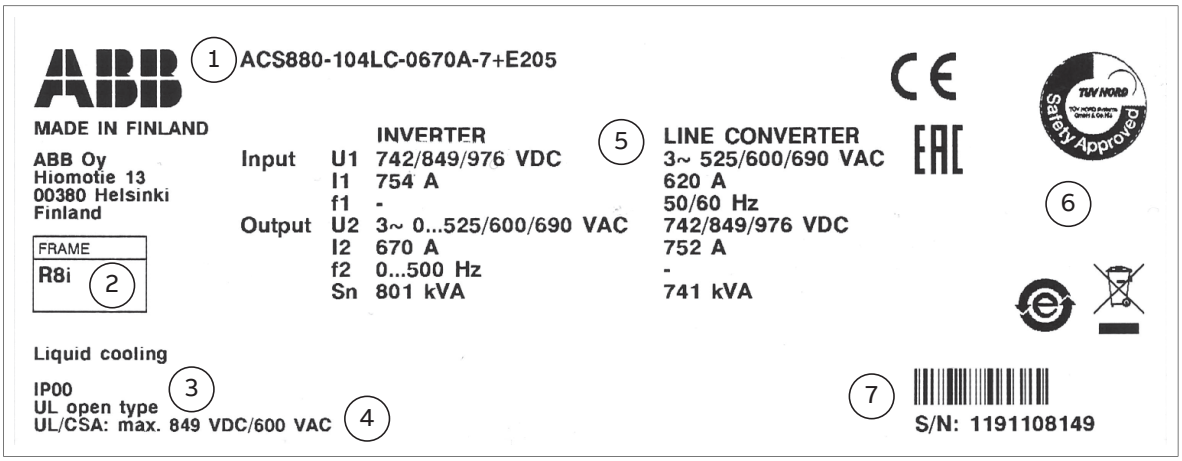


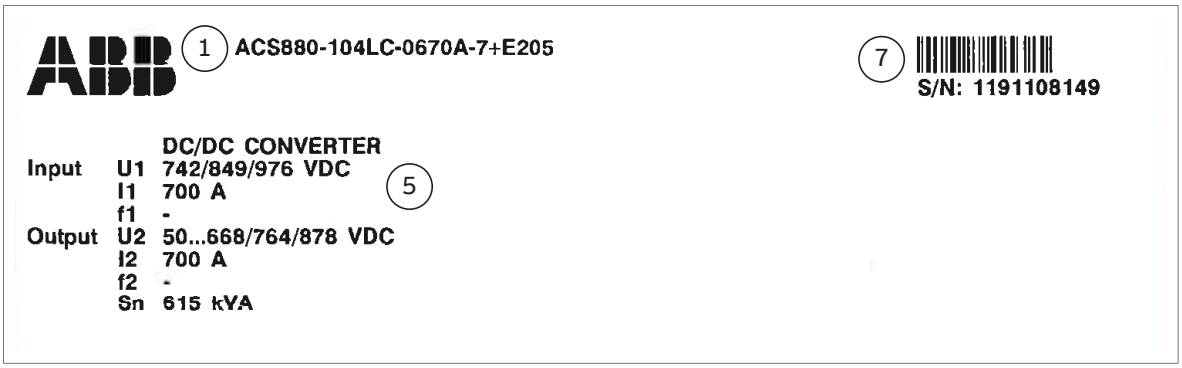
No.	Description
1.	Type designation
2.	Frame size
3.	Cooling system and other additional data
4.	Degree of protection
5.	Ratings
6.	Valid markings. See *Electrical planning instructions for ACS880 multidrives cabinets and modules* (3AUA0000102324 [English]).
7.	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.

Type designation labels of the DC/DC converter module

Each DC/DC converter module has type designation labels attached to it. The type designation stated on the labels contains information on the specifications and configuration of the unit.

Example labels are shown below.



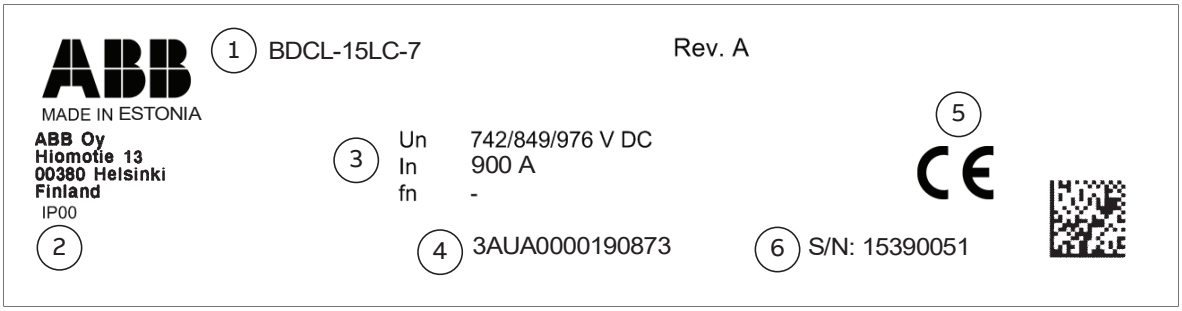


No.	Description
1.	Type designation
2.	Frame size
3.	Degree of protection
4.	UL/CSA data
5.	Ratings
6.	Valid markings. See *Electrical planning instructions for ACS880 multidrives cabinets and modules* (3AUA0000102324 [English]).
7.	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.

Type designation label of the BDCL filter module

Each filter module has a type designation label attached to it.

An example label is shown below.



No.	Description
1.	Type designation
2.	Degree of protection
3.	Ratings
4.	Code of the filter
5.	Valid markings. See *Electrical planning instructions for ACS880 multidrives cabinets and modules* (3AUA0000102324 [English]).
6.	Serial number

Type designation key

Type designation key of the converter unit

The type designation describes the composition of the unit in short. The type designation is visible on the label (sticker) which is attached to the cabinet. The complete designation code is divided in subcodes:

- The first 1…18 digits form the basic code. It describes the basic construction od the unit. The fields in the basic code are separated by hyphens.
- The plus codes follow the basic code. Each plus code starts with an identifying letter (common for the whole product series), followed by descriptive digits. The plus codes are separated by plus signs.

CODE	DESCRIPTION
Basic codes	
ACS880	Product series
1607LC	Construction: cabinet-installed liquid-cooled DC/DC converter unit. When no options are selected: Supply frequency 50 Hz, control voltage 230 V AC, IP42, EN/IEC industrial cabinet construction, power and control cabling through the bottom of the cabinet, DC busbar material tin plated copper, cable supply conductors, standard wiring material, ACS880 DC/DC converter control program, complete documentation in English in memory stick.
Size	
600A	Refer to ratings table in the technical data.
Voltage range	
7	DC voltage corresponding AC input voltages 3 ∽ 525…690 V. This is indicated in the type designation label as typical input voltage level 742 / 849 / 976 V DC.

Plus codes	
A012	Supply frequency 50 Hz
A013	Supply frequency 60 Hz
B054	IP42, UL type 1
B055	IP54, UL type 12
C121	Marine construction
C132	Marine type approved
C164	Plinth height 100 mm
C176	Door hinges on left
C179	Plinth height 200 mm
C205	Marine product certification issued by Der Norske-Veritas Germanisher Lloyd (DNV-GL)
C206	Marine product certification issued by American Bureau of Shipping (ABS)
C207	Marine product certification issued by Lloyd's Register (LR)
C209	Marine product certification issued by Bureau Veritas (BV)
C228	Marine product certification issued by China Classification Society (CCS)
C229	Marine product certification issued by Russian Maritime Register of Shipping (RS)
E210	EMC 2nd environment, C3, grounded (TN) and ungrounded (IT) networks
F286	DC switch
G300	Cabinet heater
G301	Cabinet lighting
G304	115 V AC control voltage
G315	DC busbar material tin plated copper
G320	230 V AC control voltage
G330	Halogen free wiring
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
G442	Voltage measurement with BAMU
H352	Bottom control cable exit
H358	Cable gland plates (Steel 3 mm, undrilled)
H364	Cable gland plates (Aluminum 3 mm, undrilled)
H365	Cable gland plates (Brass 3 mm, undrilled)
H367	Bottom control cabling
J400	Bluetooth control panel
J410	Control panel connection kit
J425	Non-Bluetooth Control panel
K450	Panel bus selected
K451	FDNA-01 DeviceNet™ adapter module
K454	FPBA-01 PROFIBUS DP adapter module
K457	FCAN-01 CANopen adapter module
K458	FSCA-01 RS-485 (Modbus/RTU) adapter module

K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCat adapter module
K470	FEPL-02 EtherPOWERLINK adapter module
K475	FENA-21 Ethernet adapter module for Ethernet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
K480	Ethernet switch for PC tool and control network
K483	Ethernet switch with optical link for PC tool and control network
K493	Ethernet switch for PROFINET
K494	Ethernet switch with optical link for PROFINET
L500	FIO-11, Analog I/O extension
L501	FIO-01, Digital I/O extension
L504	Additional I/O terminal block
L509	RDCO-04, DDCS Communication
L525	FAIO-01, Analog I/O extension
L526	FDIO-01, Digital I/O extension
P913	Special color, RAL colors
P966	Special color, other than RAL colors
Q951	Emergency Stop category 0 with opening main contactor/breaker
Q952	Emergency Stop category 1 with opening main contactor/breaker
Q963	Emergency Stop category 0 without opening main contactor/breaker
Q964	Emergency Stop category 1 without opening main contactor/breaker
Q979	Emergency Stop category configurable 0 or 1, with STO
R700	English manuals
R701	German manuals[1)]
R702	Italian manuals[1)]
R705	Swedish manuals[1)]
R706	Finnish manuals[1)]
R707	French manuals[1)]
R708	Spanish manuals[1)]
R711	Russian manuals[1)]
R712	Chinese manuals[1)]
Z2005	Drive Composer Pro DCPT-01 (WinXP, Vista, Win7 32/64-bit, Win 8 32/64-bit)
Z2006	Drive Composer Pro DCPT-01, multiuser license max. 10 users
Z2007	Drive Composer Pro DCPT-01, multiuser license max 20. users

[1)] The delivery includes manuals in English if the requested language is not available.

Type designation key of the module

Type designation describes the composition of the module in short. The complete designation code is divided in subcodes:

- The first digits form the basic code. It describes the basic construction of the module. The fields in the basic code are separated by hyphens.
- The plus codes follow the basic code. Each plus code starts with an identifying letter (common for the whole product series), followed by descriptive digits. The plus codes are separated by plus signs.

The subcodes are described below.

CODE	DESCRIPTION
Basic codes	
ACS880	Product series
104LC	Construction: Liquid-cooled inverter, supply, converter or brake module.
Size	
xxxxx	Refer to the ratings table in the technical data.
Voltage range	
7	DC voltage corresponding AC input voltages 3 ∽ 525…690 V. This is indicated in the type designation label as typical input voltage level 742 / 849 / 976 V DC.
Option codes (plus codes)	
E205	Internal d*u*/d*t* filtering. Standard with 690 V modules.

Type designation key of the filter module

The designation code of the BDCL filter is divided in subcodes:

- The first 4 letters and two numbers give the type of the filter, for example, **BDCL-15LC**-7.
- The plus codes follow the basic code. Each plus code starts with an identifying letter (common for the whole product series), followed by descriptive digits. The plus codes are separated by plus signs.

CODE	DESCRIPTION
Basic codes	
BDCL-15LC	Liquid-cooled BDCL filter
Voltage range	
7	DC voltage corresponding AC input voltages 3 ∽ 525…690 V. This is indicated in the type designation label as typical input voltage level 742 / 849 / 976 V DC.

3

Mechanical installation

Contents of this chapter

This chapter describes the mechanical installation of the converter units.

DC/DC converter units

For checking the installation site, moving the unit and installing cabinets, see *ACS800 liquid-cooled multidrive mechanical installation* (3AFE68715466 [English]).

Energy storage

Obey the energy storage manufacturer's instructions.

Internal cooling system

See chapter *Internal cooling circuit*.

4

Guidelines for planning electrical installation

Contents of this chapter

This chapter contains instructions on selecting, placing and protecting the DC/DC converter circuit components and cables.

Limitation of liability

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

Generic guidelines

See *Electrical planning instructions for ACS880 liquid-cooled multidrive cabinets and modules* (3AXD50000048634 [English]) for the generic guidelines for planning the electrical installation (selecting cables, routing cables, etc.) of multidrive cabinets and modules.

Selecting the energy storage

WARNING!
ABB is not responsible for the energy storage selection or protection of the energy storage.

The energy storage does not belong to the converter unit delivery. The customer (or the system integrator) must equip the DC/DC converter with a suitable energy storage system. The customer (or the system integrator) must also connect parallel modules (if any) to the same energy storage. Additional guidelines:

- Dimension the energy storage so that it withstands the required current cycles and the stored energy is sufficient. Take the depth of discharge into account in energy storage lifetime calculations.
- Make sure that the energy storage withstands the current ripple of the converter. See the technical data.
- The output voltage (energy storage voltage) is not allowed to exceed the DC/DC converter DC bus voltage. Add sufficient voltage margin in the design to prevent this in case of voltage dips or grid faults.
- The recommended energy storage operating voltage is:
  $U_{storage}$ = 150 V … 80% of U_{DC}
- Typical DC voltage values:
  - with diode supply units with modules (ACS880-304 +A003, ACS880-304 +A018):
    $U_{DC} = 1.35 \times U_{AC}$
  - with IGBT supply units with modules (ACS880-204):
    $U_{DC} = 1.41 \times U_{AC}$ (can be changed with supply unit parameter group *123 DC volt ref*.
  - where
    U_{DC} = Drive DC voltage (in the DC bus)
    U_{AC} = Drive input voltage (AC)
- We recommend to measure the energy storage voltage. If the energy storage is a super capacitor, voltage measurement is obligatory unless the capacitor withstands the maximum DC voltage of the drive or contains internal overvoltage protection.
  If the converter is equipped with the optional BAMU voltage/current measurement unit, the converter measures its output voltage (and thus also the energy storage voltage) automatically.
  If there is no BAMU, you must arrange the voltage measurement separately, and send the measured value to the converter control program, eg, via a fieldbus communication (if in use), or by some other means.
  For more information, see section *Energy storage voltage measurement and estimation* and parameter description in *ACS880 DC/DC converter control program firmware manual* (3AXD50000024671 [English]).
- Equip the energy storage with a circuit breaker capable of opening the circuit if there is a failure in the energy storage or cable. See *Selecting the protective circuit breaker of the energy storage* and *Energy storage disconnecting device*.

Implementing protections for the energy storage

General principles

The requirements for the customer-defined protections at the energy storage end:

- disconnecting device between drive and energy storage system (for example, isolation disconnector switch, withdrawable circuit breaker)
- proper overload and short circuit protection for the cabling (for example, circuit breaker with thermal or electromagnetic trip unit)
- proper overload and short circuit protection for the energy storage elements itself (for example, integrated overload protection in batteries).

Selecting the protective circuit breaker of the energy storage

WARNING!
ABB is not responsible for the energy storage selection or protection of the energy storage.

The customer (or the system integrator) must equip the energy storage with a protective circuit breaker. The breaker must be able to switch the load current on and off. The breaker must also provide the overload and short-circuit protection for the energy storage. If there is no other protection devices for the cables at the energy storage end, the breaker must also provide the overload and short-circuit protection for the cable(s).

The energy storage protective circuit breaker does not belong to the converter unit delivery.

The customer (or the system integrator) must verify the operation of the circuit breaker by short circuit calculations taking into account impedances of the converter, filter, cabling and energy storage, and minimum and maximum state of charge of the energy storage. The customer (or the system integrator) must take into account the impact of ageing to storage impedances.

Energy storage disconnecting device

The customer (or the system integrator) must equip the energy storage also with an energy storage disconnecting device. The disconnecting device does not belong to the converter unit delivery.

Overload protection of the system by the DC/DC converter

There is a thermal protection function in the DC/DC converter control program. For more information on the thermal protection function, see the firmware manual.

Protecting the energy storage cable

ABB equips the DC/DC converter unit with fuses as standard. The fuses protect the DC/DC converter and cables in a cable short-circuit situation.

The customer (or the system integrator) must equip the energy storage with overload and short circuit protection for the cable.

Energy storage discharging device

When necessary, the customer (or the system integrator) must equip the energy storage with a discharging device. If the energy storage is a super capacitor, we recommend to have it.

Implementing an interlocking between the disconnecting devices

The customer (or the system integrator) must implement an interlocking circuit between the DC switch/disconnector of the DC/DC converter unit and the energy storage disconnector. The user must not be able to close the energy storage disconnector before closing the DC switch/disconnector [Q11] of the DC/DC converter.

Selecting and routing the energy storage cables

Recommended cables

The customer (or the system integrator) must acquire and connect the energy storage cables. It is possible to use either 3-conductor shielded cable(s) or 4-conductor shielded cables:

- If you use a 4-conductor shielded cable, use 2 conductors for plus and 2 conductors for minus and the shield for PE.
- If you use a 3-conductor shielded cable, use 1 conductor for plus, 1 conductor for minus and 1 conductor and the shield for PE.

Typical cable sizes

See the technical data.

Minimizing electromagnetic interference

The customer (or the system integrator) must obey these rules in order to minimize the electromagnetic interference caused by rapid current changes in the energy storage cables:

- Shield the energy storage cabling completely, either by using shielded cable or a metallic enclosure. Unshielded single-core cable can only be used if it is routed inside a cabinet that efficiently suppresses radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance should be 0.3 meters.
- Cross other cables at right angles.

Keep the cable as short as possible in order to minimize the radiated emissions and stress on converter IGBT semiconductors. The longer the cable, the higher the radiated emissions, inductive load and voltage peaks over the IGBTs of the DC/DC converter.

Maximum cable length

The maximum cable length of the energy storage cable(s) is 100 m (328 ft).

EMC compliance of the complete installation

Note: ABB has not verified that the EMC requirements are fulfilled with external energy storage and its cabling. The EMC compliance of the complete installation must be considered by the customer (or the system integrator).

Parallel connection

It is possible to connect multiple DC/DC converter units in parallel. In the parallel connection, both the inputs and the outputs of the units must be connected together. The inputs are connected through the common DC bus of the multidrive as standard. The outputs (ES+ to ES+, ES- to ES-) must be connected together at the energy storage end by the customer (or the system integrator).

The customer (or the system integrator) must make sure that the load sharing is even between the parallel units. Depending on the case, this may require additional parameter tuning in DC/DC converter control programs of both units:

- If the operating mode selection (197.13) is *Power* or *Add*: The load between the units is inherently shared according to the power or current references. No additional settings are required.
- If the operating mode selection (197.13) is *DC voltage*: Tune the load sharing using the droop control function.
- Master/follower operation of the parallel units: The control program does not support the master/follower link between several units. However, it is possible to implement the Master/follower operation with an external PLC. In that case, one DC/DC converter unit, the master unit, operates in the DC voltage control mode and the other unit(s) in power control mode. The external PLC reads the output current reference of the master unit, and uses it as the current reference of the follower units.

The load sharing during an overvoltage or undervoltage control of the DC/DC converter can require tuning of the DC voltage offset value between the parallel units. See the firmware manual for details.

The customer (or the system integrator) must pay special attention to the protection concept in case of parallel units. The protection must operate reliably in all possible fault cases.

5

Electrical installation

Contents of this chapter

This chapter contains instructions on wiring the converter units.

Note:
The instructions do not cover all possible cabinet constructions and energy storage media.

Safety

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

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

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 electrician, do not do installation or maintenance work.

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

1. Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.
2. Clearly identify the work location and equipment.
3. Disconnect all possible voltage sources. 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): Open the DC switch/disconnector ([Q11], option +F286) of the DC/DC converter. Open the disconnecting device of the energy storage connected to the DC/DC converter 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 motor protective circuit breaker(s) 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.
   - Make sure that re-connection is not possible. Lock out and tag out.
   - Disconnect any dangerous external voltages from the control circuits.
   - After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
4. Protect any other energized parts in the work location against contact.
5. Take special precautions when close to bare conductors.
6. Measure that the installation is de-energized. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).
   - Use a multimeter with an impedance greater than 1 Mohm.
   - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.
   - If you have a permanent magnet motor connected to the drive, make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is close to 0 V.

WARNING!
The busbars inside the cabinet 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.

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

General notes

Printed circuit boards

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

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”).

Checking the insulation of the energy storage cable

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

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

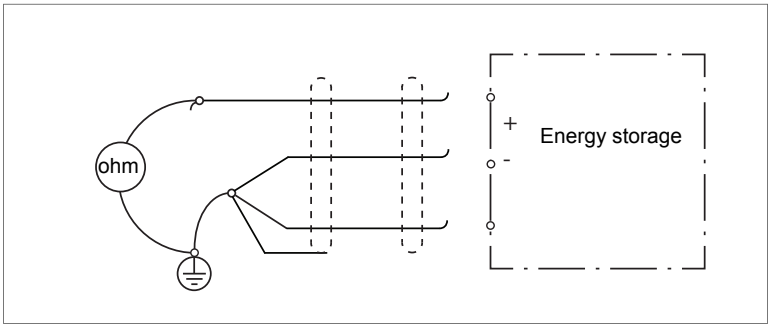
WARNING!
Open the DC switch/disconnector [Q11] (option +F286) of each DC/DC converter.

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

Check the insulation resistance of the energy storage as instructed by its manufacturer.

Check the energy storage cable as follows:

1. Make sure that the cable is disconnected from the DC/DC converter and energy storage: all conductors and the shield.
2. At the converter unit end, connect all conductors and shield of the cable together and to the grounding terminal (PE).
3. Disconnect one conductor and measure the insulation resistance between the conductor and the PE by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.
4. Reconnect the conductor, disconnect another conductor and measure its insulation resistance. Repeat this for all remaining conductors (including the cable shield).



Connecting the control cables for the converter unit

Default I/O connection diagram

User can connect the relay outputs to external monitoring circuits (not reserved for any internal use).

See *Control units of the drive*.

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 *Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules* (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

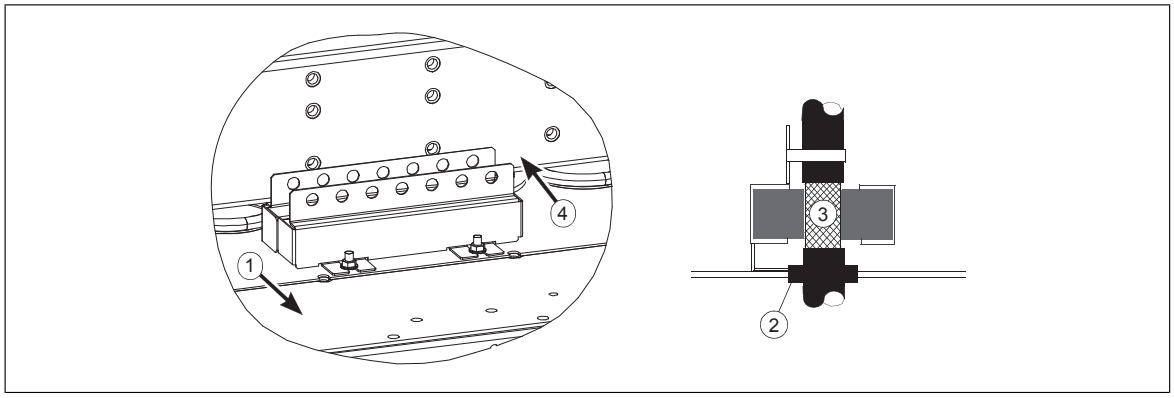
If you are not a qualified electrician, do not do installation or maintenance work.

1. Stop the drive (if running) and do the steps in section *Electrical safety precautions (page 39)* 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 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 at the cabinet entry

Ground the outer shields of all control cables 360 degrees at the EMI conductive cushions as follows (example constructions are shown below, the actual hardware may vary):

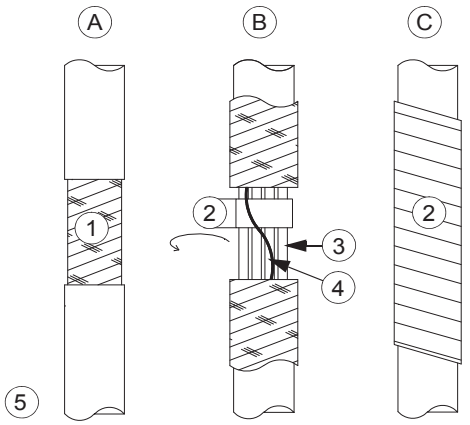
1. Loosen the tightening screws of the EMI conductive cushions and pull the cushions apart.
2. Cut adequate holes to the rubber grommets in the entry plate and put the cables through the grommets and the cushions.
3. Strip off the cable plastic sheath above the entry plate just enough to ensure proper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



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

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

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



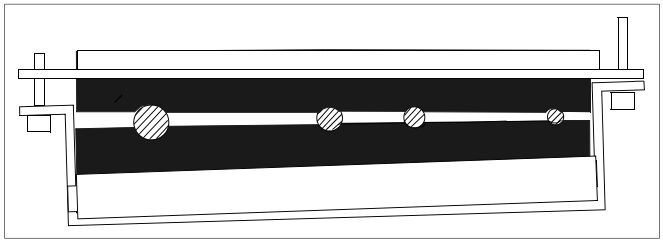
A	Stripped cable
B	Conductive surface of the shield exposed
C	Stripped part covered with copper foil
1	Cable shield
2	Copper foil
3	Shielded twisted pair
4	Grounding wire

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

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

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

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



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

Routing the control cables inside the cabinet

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

Connecting control cabling

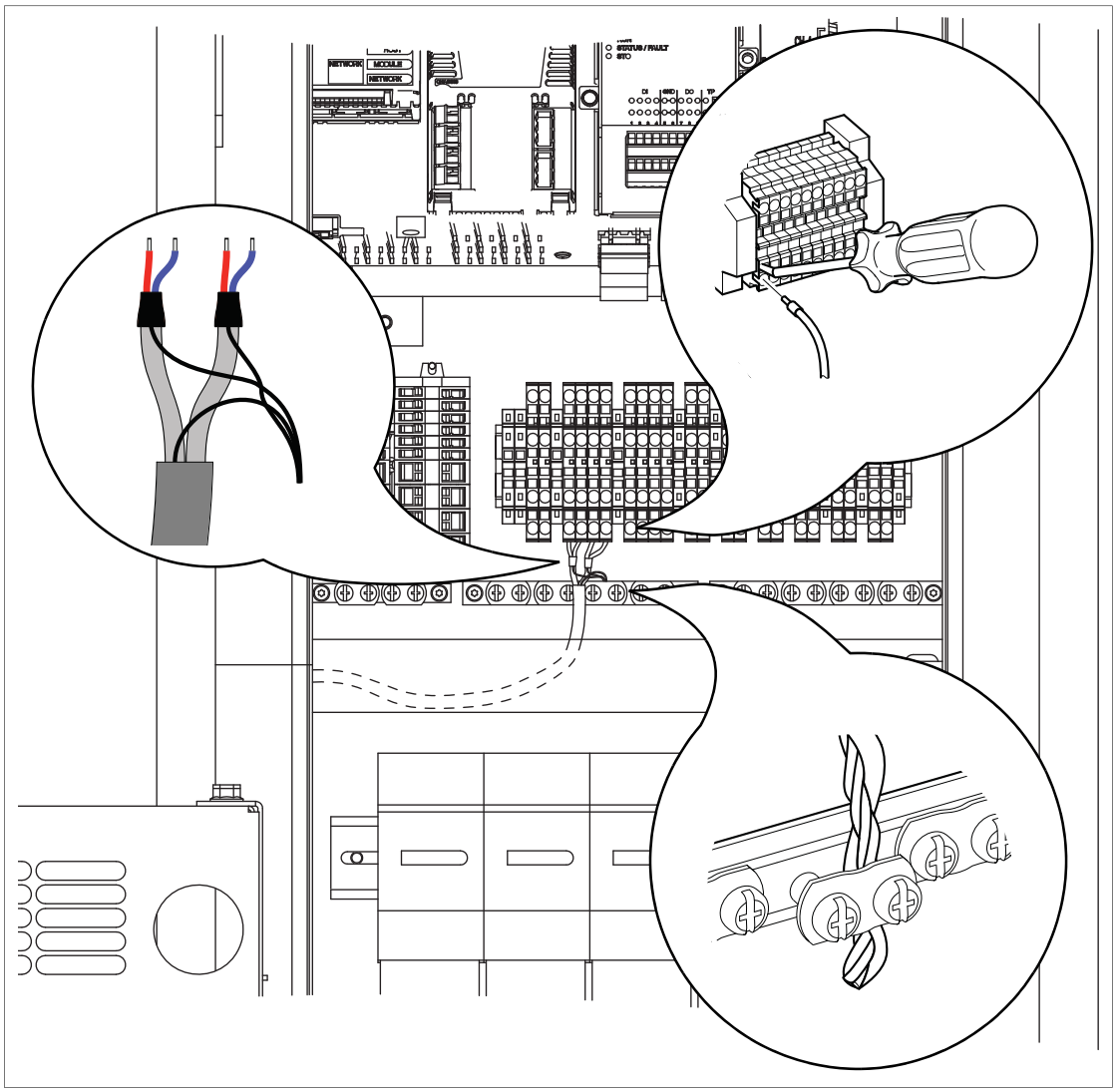
Connect the conductors to the appropriate terminals. Refer to the wiring diagrams delivered with the drive.

Connect the inner twisted pair shields and all separate grounding wires to the grounding clamps closest to the terminals.

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.

Notes:

- Do not ground the outer shield of the cable here since it is grounded at the lead-through.
- 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.



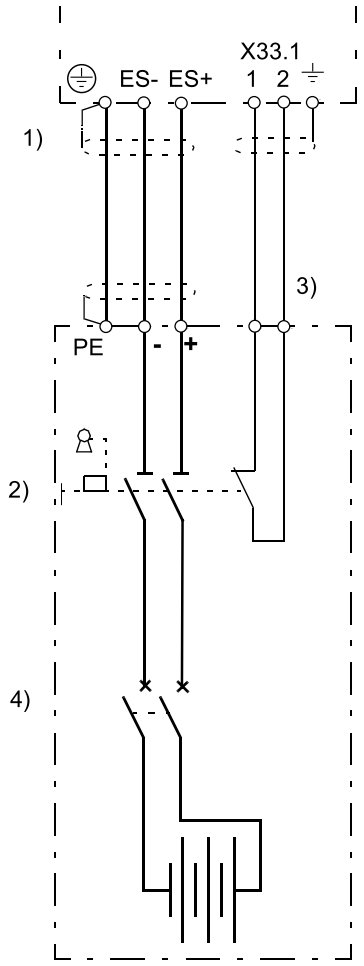
At the other end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, eg. 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.

Connecting the energy storage cable and load disconnected indicator cable

Connection diagram

This diagram shows the connections between the DC/DC converter unit and an energy storage.

Connection with 3-conductor cable



Note:

Connection of the DC/DC converter unit with a single DC/DC converter module. In case of parallel modules, each module must have the output cabling of its own. The cablings must also be identical (cable type, cross-sectional area, and length).

1) Shielded 3-conductor cable, and 360 degree grounding of the cable shield at the cable entry. When you use parallel cables, make sure they are identical (type, cross-sectional area, length etc).

2) Disconnecting device for service purposes

3) Connection to the load disconnected indicator [P13.x] on the cabinet door

4) Protective circuit breaker

Connection procedure of the energy storage cables

Make sure that the converter and filter modules, and other components of the DC/DC converter unit has been installed in a cabinet, in other words, the mechanical installation has been done.

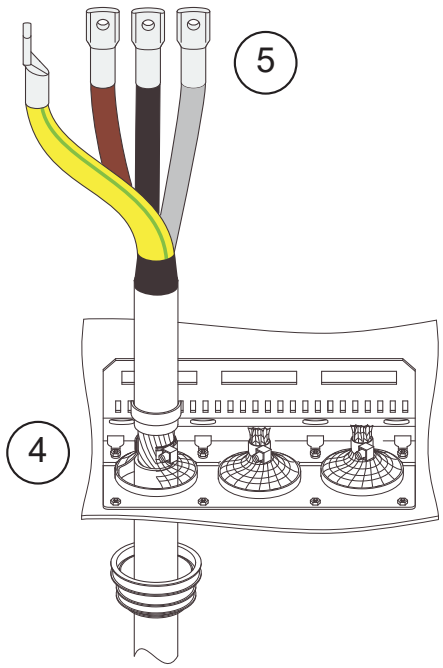
Make also sure that the electrical connections between the components of the DC/DC converter unit has been done.

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 electrician, do not do installation or maintenance work.

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 39)* before you start the work.
2. Open the door of the DC/DC converter cubicle and remove the shrouding (if any).
3. Lead the cables into the cubicle.
4. Ground the cable shield 360 degrees at the cable entry. An example grounding arrangement is shown below.
5. Cut the cables to suitable length. Strip the cables and conductors, and install the cable lugs at the end of the conductors.
6. Connect the conductors to appropriate terminals. See the delivery-specific connection diagram of the cabinet-installed unit. For the tightening torques, see the technical data.
7. Twist the cable shields into bundles and connect them to the protective grounding busbar (PE) of the cabinet.
8. Refit any shrouding removed earlier and close the cubicle doors.
9. At the energy storage, connect the cables according to the instructions of the energy storage manufacturer.



A cable entry example with 360 degrees grounding of the shield.

Connection procedure of the load disconnected indicator cable

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

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 39)* before you start the work.
2. Open the door of the DC/DC converter cubicle and remove the shrouding.
3. Run the load disconnected indicator cable inside the cubicle and connect to the appropriate terminal. Obey the general control cable connection instructions. See section *Connecting the control cables (page 43)*.

Installing optional modules

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

Note:
Pay attention to the free space required by the cabling or terminals coming to the optional modules.

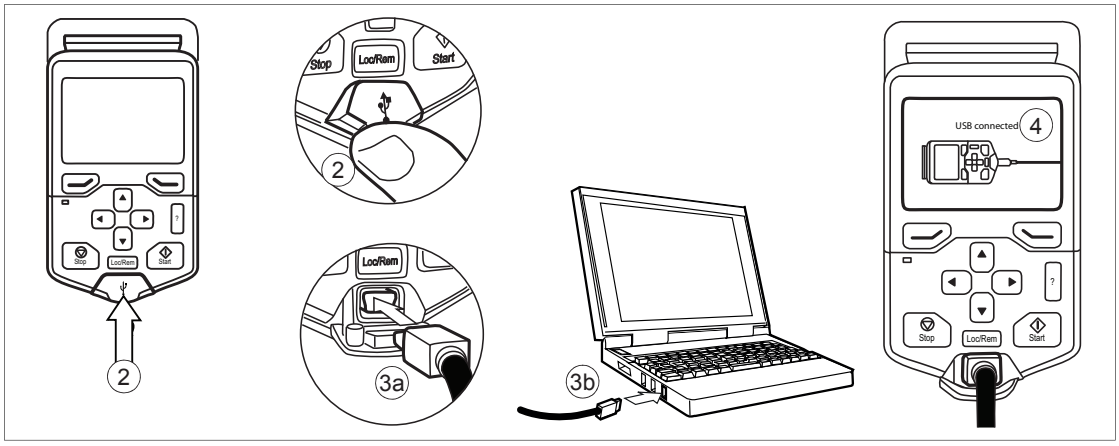
1. Repeat the steps described in section *Electrical safety precautions (page 39)*.
2. Ensure by measuring that the I/O terminals of the control unit (especially the relay output terminals) are safe.
3. Insert the module into a free option module slot on the control unit.
4. Fasten the module. For instructions, see the documentation of the optional module.
5. Connect the necessary wiring to the module following the instructions given in the documentation of the module.
6. Tighten the grounding screw to a torque of 0.8 N·m.

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

Connecting a PC

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

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



5. See the documentation of the PC tool for setup instructions.

6

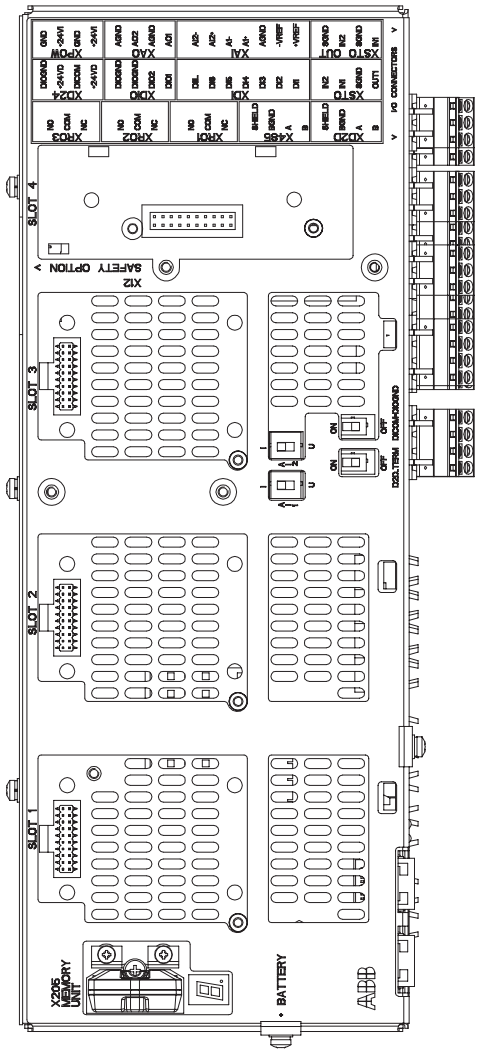
Control units of the drive

Contents of this chapter

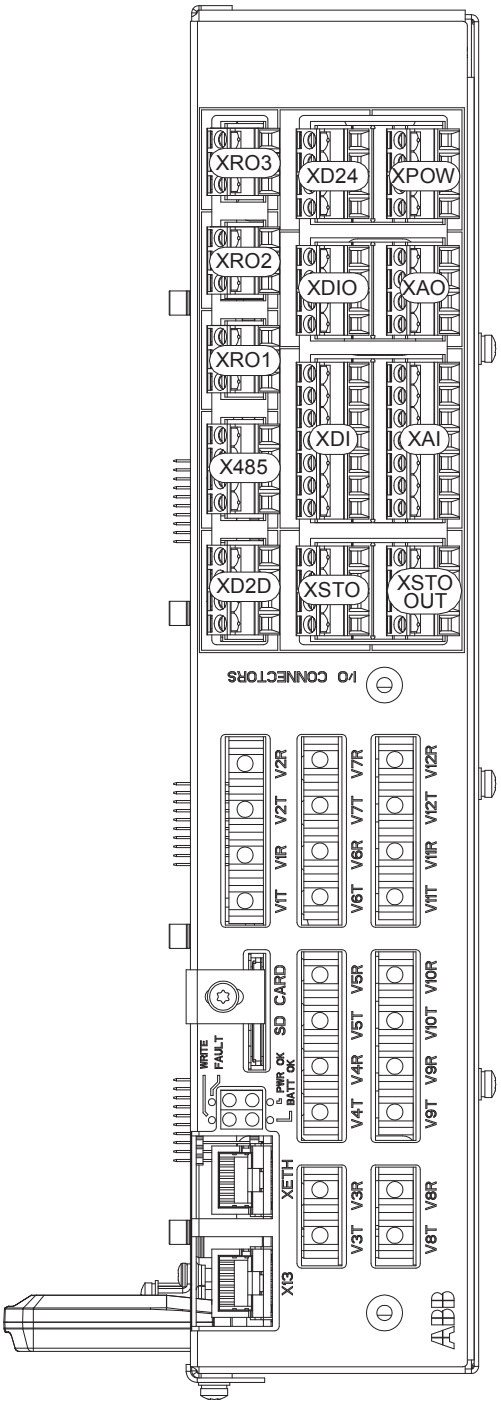
This chapter

- describes the connections of the control unit,
- contains the specifications of the inputs and outputs of the control unit.

BCU-x2 control unit layout and connections



	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, fieldbus adapter or FSO-xx 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 inputs floats). See the ground isolation diagram.
7-segment display Multicharacter indications are displayed as repeated sequences of characters	
o	(“U” is indicated briefly before “o”.) Control program running
U	Control program startup in progress
8	(Flashing) Firmware cannot be started. Memory unit missing or corrupted
1	Firmware download from PC to control unit in progress
2	At power-up, the display may show short indications of eg. “1”, “2”, “b” or “U”. These are normal indications immediately 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-xx safety functions module (optional) (On the opposite side) Not in use
X13	Control panel / PC connection
X485	Connection to CIO-01 (optional)
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 converter control unit

The diagram below shows the default I/O connections on the converter control unit, and describes the use of the signals/connections. 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 mm^2 (24…12 AWG). The torque is 0.5 N·m (5 lbf·in).

XD2D		**Drive-to-drive link**
1	B	Drive-to-drive link (not in use by default)
2	A	
3	BGND	
4	Shield	
X485		**RS485 connection**
5	B	CIO-01 connection (optional)
6	A	
7	BGND	
8	Shield	
XRO1…XRO3		**Relay outputs**
11	NC	XRO1: Not in use 250 V AC / 30 V DC / 2 A
12	COM	
13	NO	
21	NC	XRO2: **Fault(-1)** [1] (Energized = no fault) 250 V AC / 30 V DC / 2 A
22	COM	
23	NO	
31	NC	XRO3: **Fan control** (DC/DC converter running, fan control on) 250 V AC / 30 V DC / 2 A
32	COM	
33	NO	
XSTO		**XSTO connector**
1	OUT	XSTO connector. Both circuits (power module, control unit) must be closed for the unit to start. (IN1 and IN2 must be connected to OUT.) [6]
2	SGND	
3	IN1	
4	IN2	
5	IN1	Not in use
6	SGND	
7	IN2	
8	SGND	
XDI		**Digital inputs**
1	DI1	Temp fault [1] (0 = overtemperature)
2	DI2	Not in use by default.
3	DI3	
4	DI4	
5	DI5	
6	DI6	
7	DIIL	
XDIO		**Digital input/outputs**
1	DIO1	Not in use by default
2	DIO2	Not in use by default
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** [5]
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+	Not in use by default.
5	AI1-	0(2)…10 V, R_{in} > 200 kohm [2]
6	AI2+	Not in use by default.
7	AI2-	0(4)…20 mA, R_{in} = 100 ohm [3]
XAO		**Analog outputs**
1	AO1	**Zero** [1] 0…20 mA, R_L < 500 ohm (not in use by default)
2	AGND	
3	AO2	**Zero** [1] 0…20 mA, R_L < 500 ohm (not in use by default)
4	AGND	
XPOW		**External power input**
1	+24VI	24 V DC, 2.05 A
2	GND	
3	+24VI	
4	GND	
X12		**Safety functions module connection** (not in use in DDC)
X13		**Control panel connection**
X205		**Memory unit connection**

Notes:

1) Default use of the signal in the control program. The use can be changed by a parameter. See also the delivery-specific circuit diagrams.

2) 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.

3) 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.

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) Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats).
DICOM=DIOGND ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.

6) This input only acts as a true Safe torque off input in inverter control units. In other applications (such as a supply or brake unit), de-energizing the IN1 and/or IN2 terminal will stop the unit but not constitute a true safety function.

External power supply for the control unit (XPOW)

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

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 (not supported by the DC/DC converter control program).

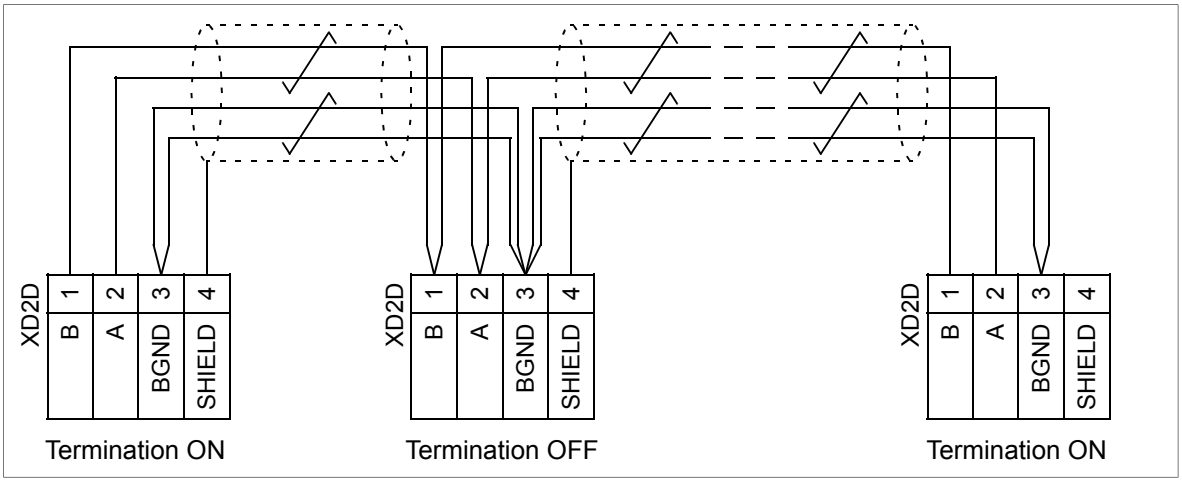
See the firmware manual of the drive for the related parameter settings.

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

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

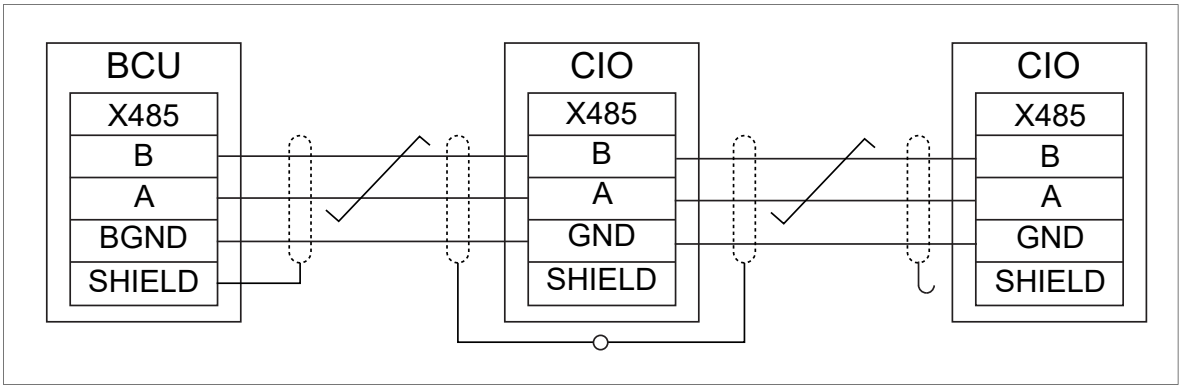
The following diagram shows the wiring between control units.

BCU-x2



The X485 connector

The X485 provides a connection for optional CIO-01 I/O module. The following diagram shows the wiring for the CIO module.



Safe torque off (XSTO, XSTO OUT)

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

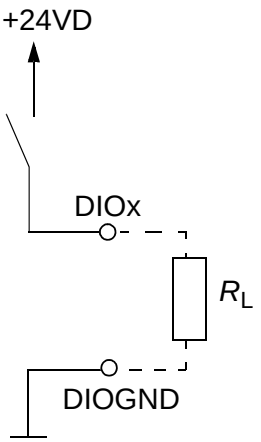
FSO-xx safety functions module connection (X12)

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

SDHC memory card slot

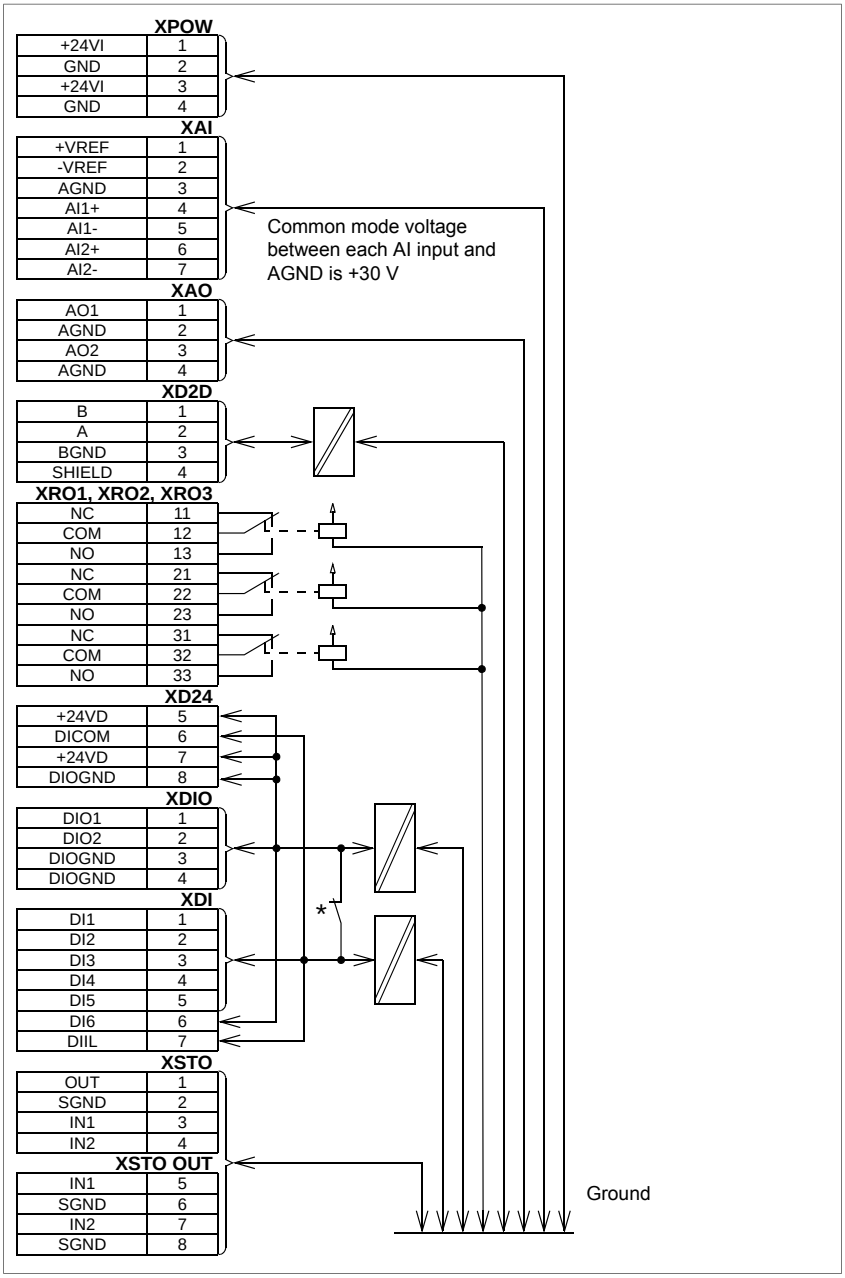
The BCU-x2 has an on-board data logger that collects real-time data from the power modules to help fault tracing and analysis. The data is stored onto the SDHC memory card inserted into the SD CARD slot and can be analyzed by ABB service personnel.

Connector data

Power supply (XPOW)	Connector pitch 5 mm, wire size 2.5 mm^2 24 V (±10%) DC, 2 A External power input. Two supplies can be connected for redundancy.
Relay outputs RO1…RO3 (XRO1…XRO3)	Connector pitch 5 mm, wire size 2.5 mm^2 250 V AC / 30 V DC, 2 A Protected by varistors
+24 V output (XD24:2 and XD24:4)	Connector pitch 5 mm, wire size 2.5 mm^2 Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
Digital inputs DI1…DI6 (XDI:1…XDI:6)	Connector pitch 5 mm, wire size 2.5 mm^2 24 V logic levels: “0” < 5 V, “1” > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP (DI1…DI5), NPN (DI6) Hardware filtering: 0.04 ms, digital filtering up to 8 ms DI6 (XDI:6) can alternatively be used as an input for a PTC sensor. “0” > 4 kohm, “1” < 1.5 kohm. I_{max}: 15 mA (DI1…DI5), 5 mA (DI6)
Start interlock input DIIL (XDI:7)	Connector pitch 5 mm, wire size 2.5 mm^2 24 V logic levels: “0” < 5 V, “1” > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP Hardware filtering: 0.04 ms, digital filtering up to 8 ms
Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2) Input/output mode selection by parameters. DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual of the supply/inverter unit, parameter group 111/11.	Connector pitch 5 mm, wire size 2.5 mm^2 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 2.5 mm^2 10 V ±1% and –10 V ±1%, R_{load} 1…10 kohm Maximum output current: 10 mA

Analog inputs AI1 and AI2 (XAI:4 … XAI:7). Current/voltage input mode selection by switches	Connector pitch 5 mm, wire size 2.5 mm^2 Current input: –20…20 mA, R_{in} = 100 ohm Voltage input: –10…10 V, R_{in} > 200 kohm Differential inputs, common mode range ±30 V Sampling interval per channel: 0.25 ms Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range
Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm, wire size 2.5 mm^2 0…20 mA, R_{load} < 500 ohm Frequency range: 0…500 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
XD2D connector	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485 Termination by switch
RS-485 connection (X485)	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485
Safe torque off connection (XSTO)	Connector pitch 5 mm, wire size 2.5 mm^2 Input voltage range: -3…30 V DC Logic levels: “0” < 5 V, “1” > 17 V. **Note:** For the unit to start, both connections must be “1”. This applies to all control units (including drive, inverter, supply, brake, DC/DC converter etc. control units), but true Safe torque off functionality is only achieved through the XSTO connector of the drive/inverter control unit. EMC (immunity) according to IEC 61326-3-1
Safe torque off output (XSTO OUT)	Connector pitch 5 mm, wire size 2.5 mm^2 To STO connector of inverter module.
Control panel connection (X13)	Connector: RJ-45 Cable length < 3 m
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
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.

7

Installation checklist of the drive

Contents of this chapter

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

Checklist

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

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

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

WARNING!
Stop the drive and do the steps in section *Electrical safety precautions (page 39)* before you start the work.

Make sure that …	☑
The ambient operating conditions meet the drive ambient conditions specification, and enclosure rating (IP code or UL enclosure type).	☐
The supply voltage matches the nominal input voltage of the drive. See the type designation label.	☐
The drive cabinet has been attached to floor, and if necessary due to vibration etc, also by its top to the wall or roof.	☐
If the drive is connected to a network other than a symetrically grounded TN-S system: Check the compatibility. See the electrical installation instructions in the supply unit manual.	☐
There is an adequately sized protective earth (ground) conductor between the drive and the switchboard, 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.	☐

Make sure that …	☑
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.	☐
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.	☐
The energy storage has been equipped with fuses for protecting energy storage cable in a cable short-circuit situation.	☐
The energy storage has been equipped with a disconnecting device.	☐
The input power cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened to the proper torque.	☐
There is an adequately sized protective earth (ground) conductor between the motor and the drive, and the conductor has been connected to appropriate terminal, and the terminal has been tightened to the proper torque. (Pull on the conductors to check.). Proper grounding has also been measured according to the regulations.	☐
The motor cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened to the proper torque.	☐
The motor cable has been routed away from other cables.	☐
No power factor compensation capacitors have been connected to the motor cable.	☐
The control cables have been connected to the appropriate terminals, and the terminals have been tightened to the proper 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, ie, cannot be closed simultaneously. 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.	☐
Cover(s) of the motor connection box are in place. Cabinet shrouds are in place and doors are closed.	☐
The motor and the driven equipment are ready for start.	☐
The coolant connections between cubicles (if any) and to the cooling circuit are tight.	☐
If the drive is equipped with a cooling unit: Refer to the cooling unit documentation for specific tasks.	☐

8

Start-up

Contents of this chapter

The underlined tasks are needed for certain cases only. The default device designations (if any) are given in square brackets, for example, DC switch/disconnector [Q11]. The same device designations are also used in the delivery-specific circuit diagrams.

Note:
Always refer to the delivery-specific circuit diagrams when proceeding with the start-up.

WARNING!
Only qualified by ABB electricians/engineers are allowed to do the work described in this chapter. In addition, the electrician/engineer must know the energy storage system he is about to take into use, and the DC/DC converter control program and operation principle. Obey all the safety instructions in *Safety instructions for ACS880 multidrive cabinets and modules* (3AUA0000102301 [English]) and *Electrical safety precautions (page 39)*. If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

Before you start, connect a control panel to the DC/DC converter unit. We recommend that you also have a PC with a drive commissioning tool (Drive composer) connected.

Start-up procedure

Tasks	☑
Safety	
 **WARNING!** Obey the safety instructions during the start-up procedure. See *Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules* (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do installation or maintenance work.	☐
Checks/Settings with no voltage connected	
Make sure that it is safe to start the work. Do the steps in section *Electrical safety precautions (page 39)*.	☐
Make sure that the disconnector of the supply transformer is locked to the off (0) position, that means no voltage is, or cannot be connected to drive inadvertently.	☐
Make sure that all external auxiliary circuits are switched off and disconnected. See the start-up instructions in the supply unit hardware manual.	☐
Make sure that the supply unit is switched off, and the drive system has been isolated from the supply network.	☐
DC/DC converter with the DC switch/disconnector [Q11] (option +F286): Make sure that the DC switch/disconnector [Q11] and the DC/DC converter charging switch [Q10] are open and locked.	☐
Make sure that the energy storage disconnecting device is open and locked to open position (customer or system integrator-installed device).	☐
Make sure that the mechanical and electrical installation of the converter unit has been inspected and is OK. See the installation checklist.	☐
Make sure that the drive is ready for the converter unit power up: • The supply and inverter units have been installed according to the instructions given in their hardware manuals. • The supply unit has been started up according to the instructions given in the appropriate supply unit manual. • The inverter units have been started up according to the instructions given in the hardware manual and appropriate firmware manual. For the supply and inverter unit hardware manuals, see *Related documents (page 11)*. **Note:** If the drive has been stored over one year: Reform the electrolytic DC capacitors in the DC bus of the drive. See the separate reforming instructions (available in the Internet or from your local ABB representative).	☐
See the circuit diagrams delivered with the drive. Close the auxiliary voltage circuit breakers of the converter unit [F21, F22]. Close also other circuit breakers of the converter auxiliary circuits: cabinet fans [F115] and BAMU voltage/current measurement [F7] if present and the auxiliary voltage switch of the drive supply unit. Make sure you have the circuit diagrams delivered with the drive at hand.	☐
Starting and checking the cooling system	
Fill up and bleed the internal cooling circuit. Start the cooling unit up. See *Filling up and bleeding the internal cooling circuit (page 84)*.	☐
Check the cooling system for leaks. Make sure that cooling circuit joints at the shipping split joining cubicles are tight and that all drain valves have been closed.	☐

Tasks	☑
Make sure that the coolant can flow freely in all cubicles.	☐
Close the cabinet doors.	☐
Connecting voltage to the drive and converter control unit	
Connect main AC voltage to the input terminals of the drive supply unit. (Close the main breaker of the supply transformer.)	☐
WARNING! When connecting voltage to the supply unit, the DC busbars will become live, as will all the converters connected to the DC bus. **WARNING!** Converter units with a DC switch/disconnector: Some types of the converter module may be energized through a charging circuit even when the DC switch/disconnector is open or the DC fuses are removed. Converter units without a DC switch/disconnector: If the converter unit only has DC fuses without a switch fuse, all the converter units with the DC fuses in place will be energized when the main breaker/contactor closes. To prevent this, remove the fuses from the converter units which are to remain unenergized before connecting voltage. **When the main breaker/contactor of the supply unit is closed (DC busbars are live), never remove or insert the DC fuses of a converter unit.** If the drive is equipped with a main switch/disconnector (option +F253): Close the main disconnecting device of the drive system.	☐
Close the auxiliary voltage switch [Q21] of the drive supply unit. The converter control unit will be powered. **Do not** close the main circuit breaker [Q1] (option +F255) or the main contactor [Q2] (option +F250) of the drive supply unit yet! You must not power up the drive DC bus yet.	☐
Setting the parameters	
Set the DC/DC converter parameters. See chapter Start-up in the *DC/DC converter control program firmware manual* (3AXD50000024671 [English]). If you need information on the use of the control panel, see *ACX-AP-x assistant control panels user's manual* (3AUA0000085685 [English]). See also *Drive composer start-up and maintenance PC tool user's manual* (3AUA0000094606 [English]).	☐
Charging the DC/DC converter and connecting voltage to the converter	
WARNING! Make sure that the energy storage disconnecting device is still open. Always keep the energy storage disconnected from DC/DC converter until the DC/DC converter is charged.	☐
Power up and charge the DC/DC converter: DC/DC converter with the DC switch/disconnector [Q11] (option +F286): 1. Start the supply unit and close the main contactor [Q2] (option +F255) or the main circuit breaker [Q1] (option +F255) of the drive supply unit. 2. Close the DC/DC converter charging switch [Q10.x]. The DC/DC converter disconnected indicator [P12.x] goes out. 3. After the Charging OK indicator [P11.x] illuminates, close the DC switch/disconnector [Q11]. 4. Open the DC/DC converter charging switch [Q10.x]. **Note:** The charging switch must be open before you can start the DC/DC converter. DC/DC converter without DC switch/disconnector (= no option +F286): 1. Start the supply unit and close the main contactor [Q2] (option +F255) or the main breaker [Q1] (option +F255) of the drive supply unit. The DC/DC converter is energized and gets charged.	☐

Tasks	☑
Connecting the energy storage to the DC/DC converter	
Set parameter *120.12 Run enable 1* to *Off*. This makes sure that the DC/DC converter does not start automatically or unexpectedly after you connect the energy storage.	☐
Switch the control panel to local control mode.	☐
Make sure that the energy storage voltage is below the drive DC link voltage.	☐
WARNING! Do not close the energy storage disconnecting device if the DC/DC converter is not connected to the drive DC link or not ready to use. Close the energy storage disconnecting device (customer or system integrator-installed device). The load disconnected indicator [P13.x] goes out.	☐
Close the energy storage protective circuit breaker (customer or system integrator-installed device).	☐
Testing the DC/DC converter operation	
Set parameter *120.12 Run enable 1* to *On*.	☐
Set parameter *122.01 User Power ref* to 0 A.	☐
Set current limits to low values, for example, • *130.119 Minimum current* to -50 A. • *130.120 Maximum current* to 50 A.	☐
Press the control panel Start key to start the converter. After start, increase slowly the value of parameter *122.01 User Power ref*.	☐
Check the following signals: • *102.01 DC voltage* • *102.02 ES voltage used* • *102.08 Total current* • *102.11 Modulation index %* • *130.101 DDC limit word 1*.	
Press the control panel Stop key to stop the converter.	☐

Disconnecting the DC/DC converter with DC switch/disconnector (option +F286)

Tasks	☑
Safety	
 **WARNING!** Obey the safety instructions during the start-up procedure. See *Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules* (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do installation or maintenance work.	☐
Stopping the DC/DC converter	
Press the control panel Stop key. Change the control panel to local mode (loc/rem key). To prevent accidental restart, set parameter *120.19 Enable start signal* to value *Off*.	☐
Disconnecting the energy storage	
Open the energy storage protective circuit breaker.	☐
Open the energy storage disconnecting device. Lock out and tag out. The load disconnected indicator [P13.x] is lit.	☐
Disconnecting the DC/DC converter	
Open the DC switch/disconnector [Q11] (option +F286). Lock out and tag out. The DC/DC converter disconnected indicator [P12.x] is lit.	☐
Working inside the DC/DC converter cubicle	
If you need to work inside the DC/DC converter cubicle, you must switch off and disconnect the whole multidrive system from any (AC, DC, main or auxiliary) power sources. Before you start the work, repeat also the necessary safety precautions. See *Electrical safety precautions (page 39)*.	☐

Reconnecting the DC/DC converter with DC switch/disconnector

Tasks	☑
Safety	
 **WARNING!** Obey the safety instructions during the start-up procedure. See *Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules* (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do installation or maintenance work.	☐
Reconnecting the DC/DC converter	
After you have finished the work inside the converter cubicle, reinstall any shrouds, and close the door. Reconnect the DC/DC converter and energy storage. See: • ***Connecting voltage to the drive and converter control unit*** *(page 65)* • ***Charging the DC/DC converter and connecting voltage to the converter*** *(page 65)* and • ***Connecting the energy storage to the DC/DC converter*** *(page 66)*.	☐
Starting the DC/DC converter	
Change the control panel to local mode (loc/rem key). Set parameter *120.19 Enable start signal* to value *On*. Press the control panel Start key. If you need information on the use of the control panel, see *ACX-AP-x assistant control panels user's manual* (3AUA0000085685 [English]). See also *Drive composer start-up and maintenance PC tool user's manual* (3AUA0000094606 [English]).	☐

9

Maintenance

Contents of this chapter

This chapter instructs how to maintain the DC/DC converter unit. The information is valid for cabinet-installed ACS880-1607LC DC/DC converter units.

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

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

Maintenance intervals

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

Component	Years from start-up												
	1	2	3	4	5	6	7	8	9	10	11	12	…
Cooling fans													
R8i 230 VAC						R						R	
R8i 115 VAC						R						R	
Coolant													
Coolant draining and refill						R						R	
Batteries													
Control panel battery									R				
Control unit battery						R						R	
Connections and environment													
Quality of supply voltage	P	P	P	P	P	P	P	P	P	P	P	P	P
Spare parts													
Spare part stock	I	I	I	I	I	I	I	I	I	I	I	I	I
Reforming DC circuit capacitors (spare modules and spare capacitors)	P	P	P	P	P	P	P	P	P	P	P	P	P
Other useful tasks													
Tightness of terminals	I	I	I	I	I	I	I	I	I	I	I	I	I
Dustiness, corrosion and temperature	I	I	I	I	I	I	I	I	I	I	I	I	I
Cooling liquid pipe connections	I	I	I	I	I	I	I	I	I	I	I	I	I
Coolant antifreeze concentration	P	P	P	P	P	P	P	P	P	P	P	P	P
Inspection of coolant quality		P		P		P		P		P		P	

Symbols

I **Inspection** (visual inspection and maintenance action if needed)

P **Performance** of on/off-site work (commissioning, tests, measurements or other work)

R **Replacement**

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

Note:

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

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.

Power connections

Retightening the power connections

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

1. Repeat the steps described in section *Electrical safety precautions (page 39)*.
2. Check the tightness of the cable connections. Use the tightening torques given in the technical data.

Fuses

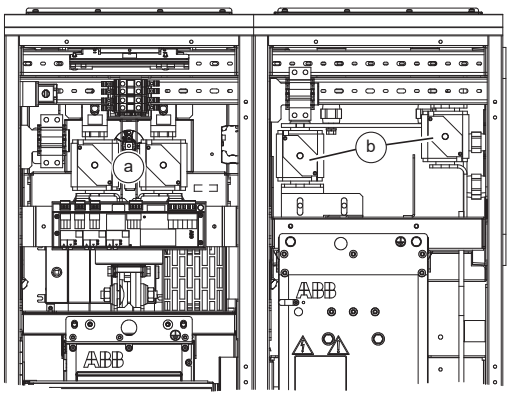
Checking and replacing the fuses

The DC/DC converter unit has two sets of fuses: output fuses on the energy storage side and fuses on the DC bus side.

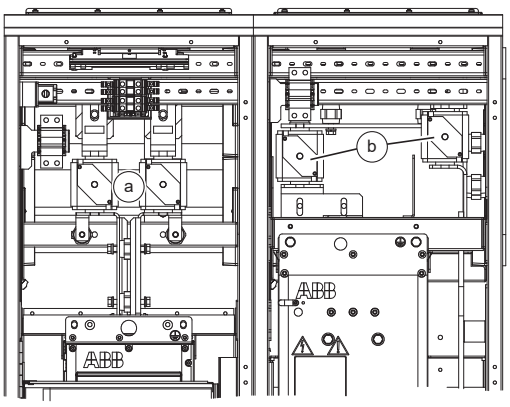
For the location of the fuses, see the figures:

- The converter fuses [F11.x] on the drive DC bus side (marked with **a** in the figure).
- The output fuses [F13.x] on the energy storage side are marked with **b** in the figure.

Converter unit with a DC switch/disconnector



Converter unit without a DC switch/disconnector



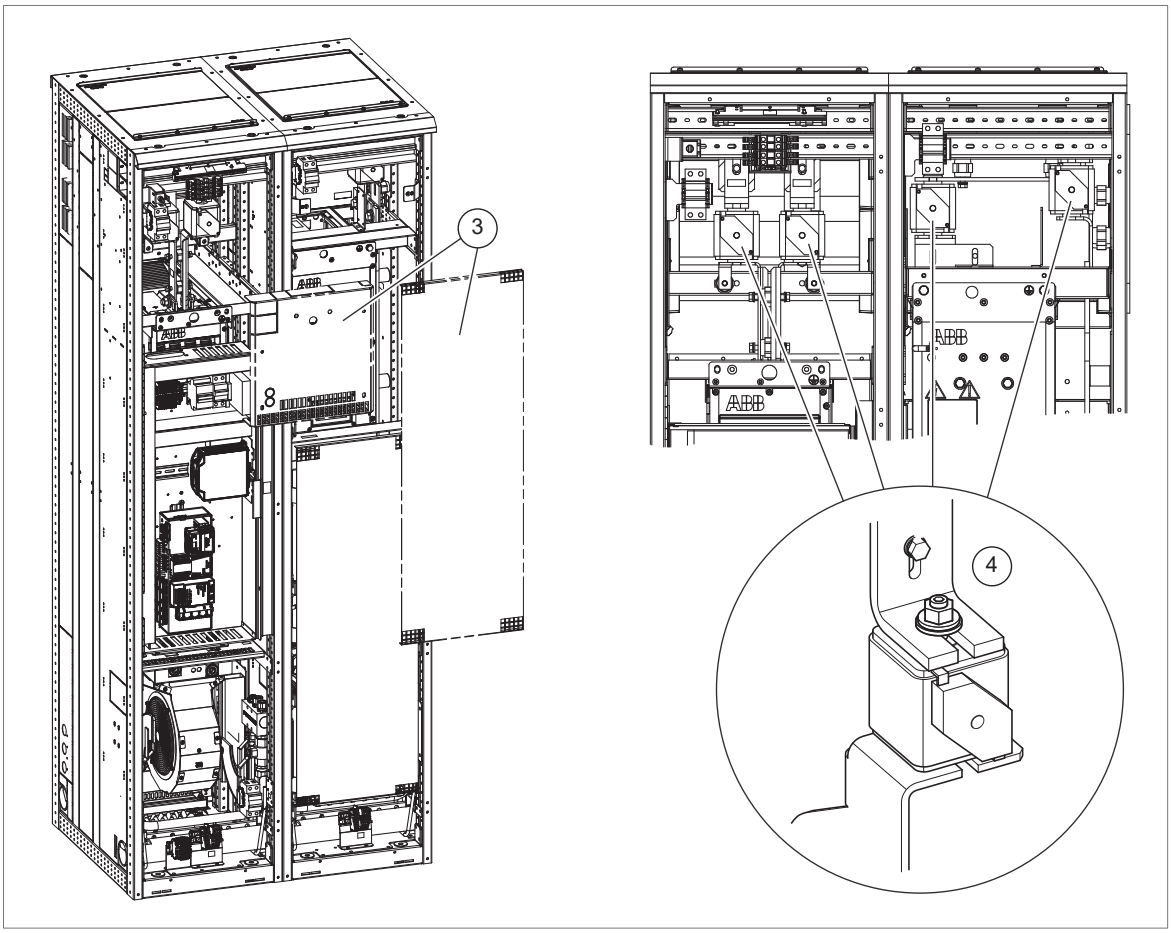
WARNING!
Obey the safety instructions given in *Safety instructions for ACS880 liquid-cooled multidrive cabinets and modules* (3AXD50000048633 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

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

Replace a blown fuse with a new one of the same type as follows. For tables of recommended fuses, see the technical data.

WARNING!
When the main breaker/contactor of the supply unit is closed (DC busbars are live), never remove or insert the DC fuses of a converter unit.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 39)* before you start the work. See .
2. Open the cubicle door.
3. Undo the screws of the shroud in the upper part of the cubicle. Remove the shrouds.
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.
7. Tighten the nuts to torque as follows:
   - Bussmann fuses: 50 N·m (37 lbf·ft)
   - Other: Refer to the fuse manufacturer's instructions.
8. Reinstall the shroud in reverse order to the above.



Fans

The lifespan of the cooling fan depends on the running time of the fan, ambient temperature and dust concentration. Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

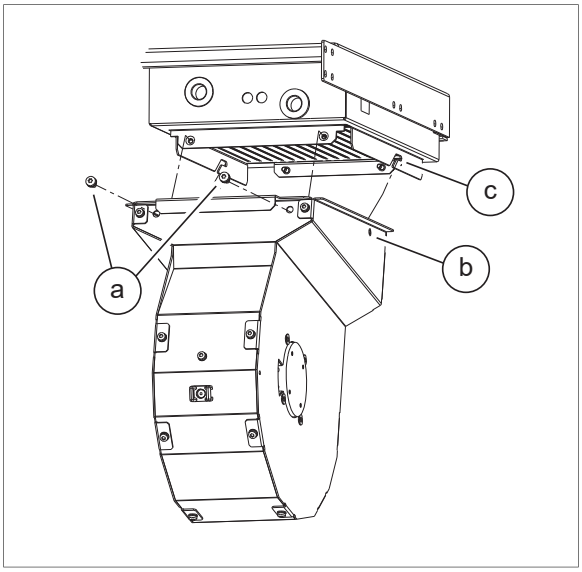
Replacing the cooling fans

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 electrician, do not do installation 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 39)* before you start the work.
2. Remove the shrouding in front of the fan (if any).
3. Disconnect the fan wiring.
4. Remove the two retaining screws (a).
5. Pull the fan outwards to separate it from the heat exchanger housing.
6. Install the 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).



DC/DC converter module

Replacing the R8i DC/DC converter module

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

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

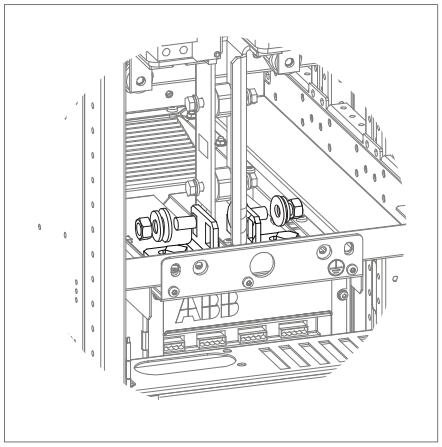
WARNING!
Make sure that the replacement module has exactly the same type code as the old module.

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.

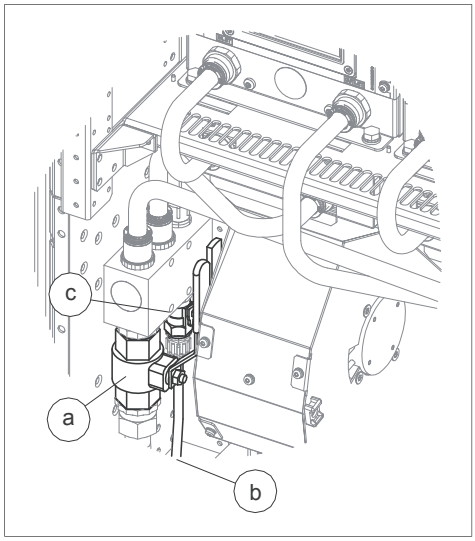
WARNING!
Use the required personal protective equipment. Wear protective gloves and long sleeves. Some parts have sharp edges.

Removing the module

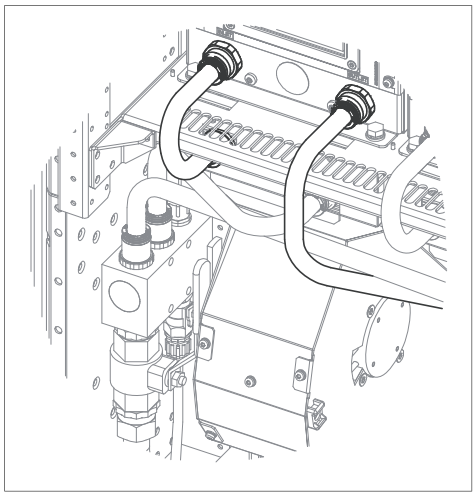
1. Repeat the steps described in section Electrical safety precautions.
2. Remove the shrouding in front of the module.
3. Undo the locking screws of the swing-out frame (if present) and open it.
4. Unplug the wiring from the module and move it aside. Use cable ties to keep the wiring out of the way.
5. 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.



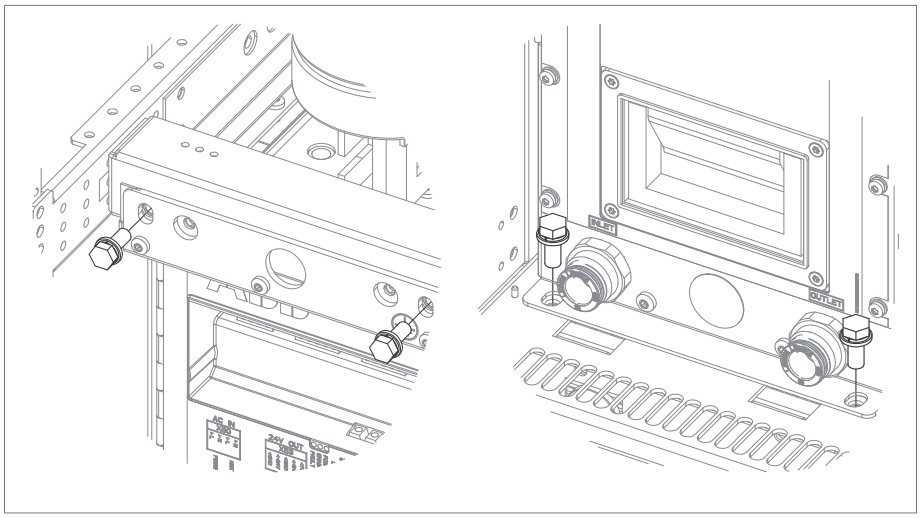
6. Close the inlet valve (a) and outlet valve (located on the right-hand side of the cubicle) valves. Lead the drain hoses (b, on both sides of the cubicle) into a suitable container. Open the drain valves (c, on both sides of the cubicle). This will drain all modules in the cubicle.



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



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



9. Pull the module carefully out onto a table or other 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.
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.

Capacitors

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

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

Reforming the capacitors

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

If the drive module has been stored for one to three years, turn on the mains power for 30 minutes without load, then continue as usual.

If the drive module has been stored for less than a year, continue as usual.

Control panel

For detailed information on the control panel, see *ACx-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).

Cleaning the control panel

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

Replacing the control panel battery

For instructions on how to replace the control panel battery, see the separate *ACx-AP-x assistant control panels user's manual* document (3AUA0000085685 [English]).

Control unit

BCU control unit types

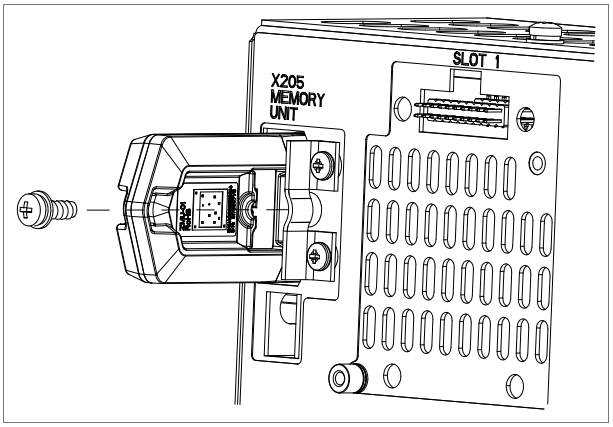
There are three variants of the BCU control unit used in ACS880: BCU-02, BCU-12 and BCU-22. These have a different number of converter module connections (2, 7 and 12 respectively) but are otherwise identical. The three BCU types are interchangeable as long as the number of connections is sufficient. 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 retain the existing parameter settings by transferring the memory unit from the defective control unit to the new control unit.

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 39)* before you start the work.
2. Make sure that the control unit is not powered.
3. Undo the fastening screw and pull the memory unit out.
4. Install a memory unit in reverse order.

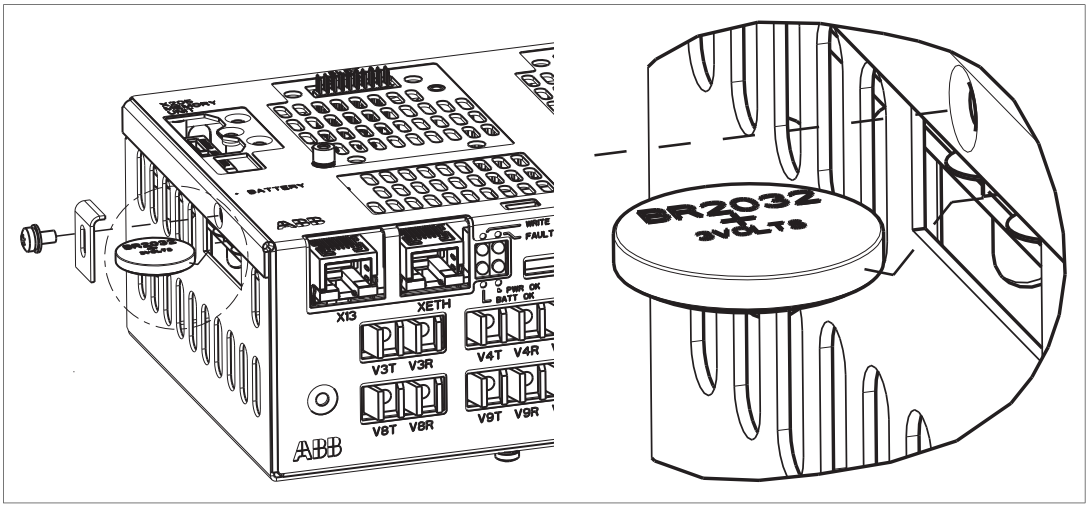


Replacing the BCU control unit battery

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 39)* 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.



LEDs and other status indicators

This section instructs how to interpret the status indications of the ACS880-1604LC DC/DC converter.

Warnings and faults reported by the control program are displayed on the control panel on the cabinet door. For further information, see the firmware manual.

The ACX-AP-x control panel has a status LED. The control panel mounting platform or holder has two status LEDs. For their indications, see the following table.

Location	LED	Indication
Control panel	Continuous green	The unit is functioning normally.
	Flickering green	Data is transferred between the PC and the unit through the USB connection of the control panel.
	Blinking green	There is an active warning in the unit.
	Continuous red	There is an active fault in the unit.
	Blinking red	There is a fault that requires the stopping and restarting of the drive/converter/inverter.
	Blinking blue (ACS-AP-W only)	The Bluetooth interface is enabled, in discoverable mode, and ready for pairing.
	Flickering blue (ACS-AP-W only)	Data is being transferred through the Bluetooth interface of the control panel.
Control panel mounting platform or holder (with the control panel removed)	Red	There is an active fault in the unit.
	Green	Power supply for the control unit is OK.

The cabinet has from one to three door lamps. For their indicators, see the following table.

Location	LED	Indication
Cabinet door lamps **Note:** When the white lamps are on, DC/DC converter is disconnected from both the DC bus and the energy storage.	Charging OK indicator (green)	The DC bus of the converter modules is charged. The unit is ready for connection to the common DC bus.
	DC/DC converter disconnected (white)	The DC/DC converter unit is disconnected from the main DC bus. **Note:** Auxiliary voltages are to be disconnected separately.
	Load disconnected indicator (white)	The disconnector of the energy storage is switched off.

10

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

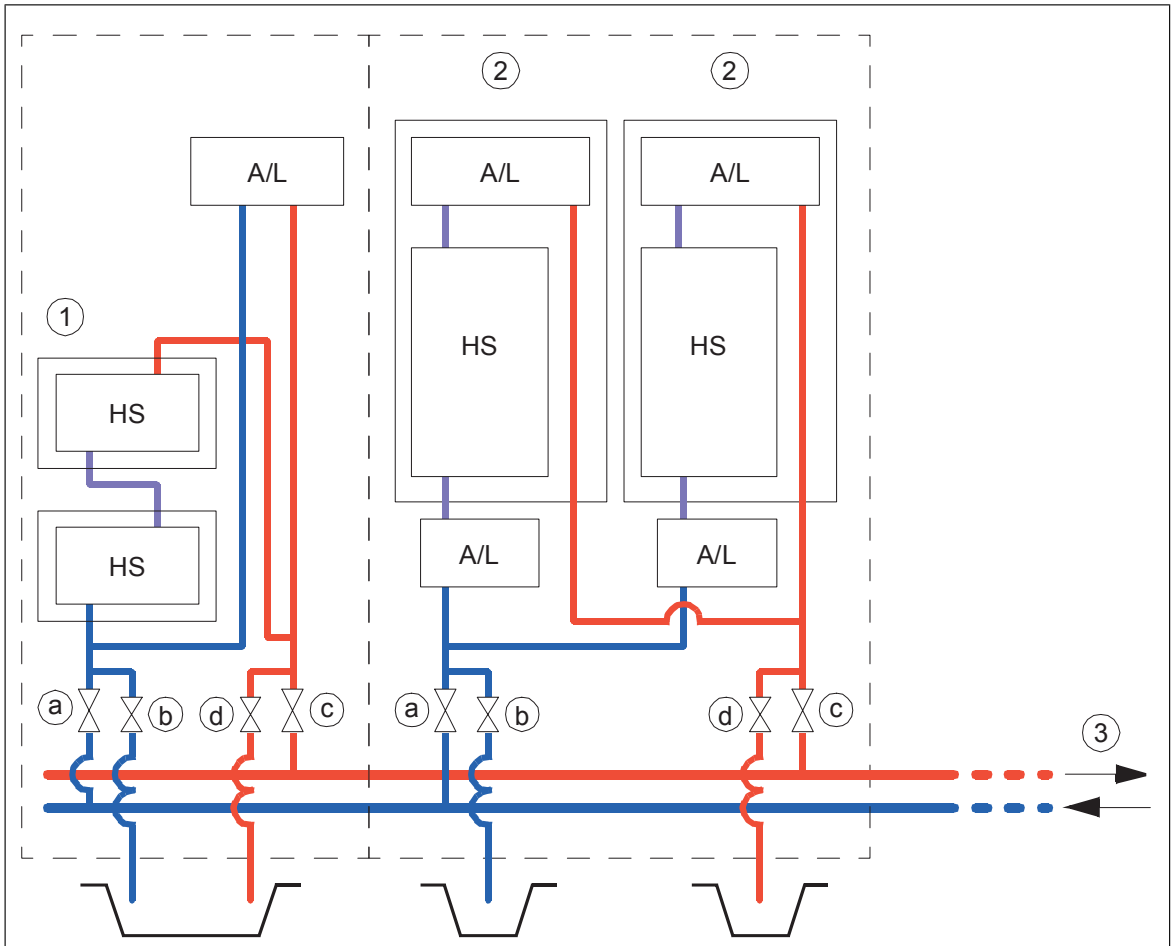
The information in this chapter is applicable to cabinet-built ACS880 liquid-cooled drives. Except where otherwise indicated, the information is also applicable to drives built out of ACS880 liquid-cooled multidrive modules.

Internal cooling system

Note: This section describes cabinet-built, liquid-cooled ACS880 drives. The information in this section can be used as guidelines for building a drive system out of ACS880 liquid-cooled modules.

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.

The following diagram shows the coolant pipe connections in a drive system consisting of a supply unit and an inverter unit.



1	Supply modules
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% water mixture. See *Coolant specification (page 86)*.

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 tank 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 86)*. 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 88)*.

Coolant temperature control

The temperature of the coolant in the internal cooling circuit must be kept within the limits specified in *Technical data (page 86)*. 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

Follow 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 coolant specification, see *Coolant specification (page 86)*.

   Note: 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 to 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 100…150 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 to 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 86)*.
   - 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% water mixture, available from Clariant distributors and ABB Service representatives.

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 allowed regardless of the freezing point of the coolant.

WARNING!
The warranty does not cover damage occurring from use of improper coolant.

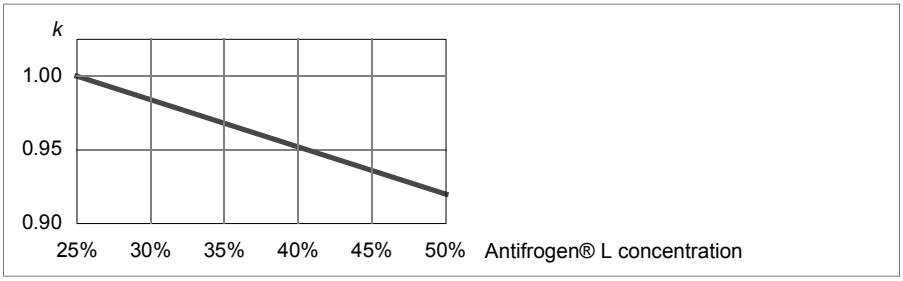
Temperature limits

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 88)*.

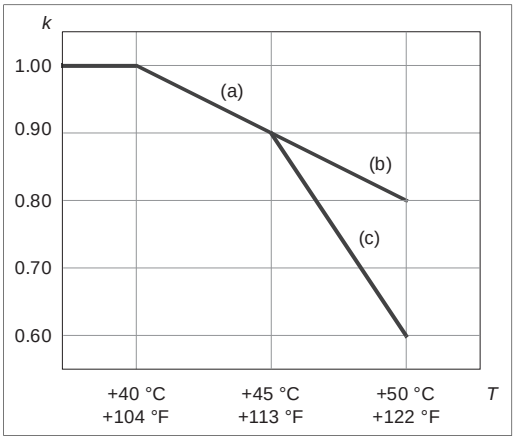
The nominal current ratings of drive system modules apply to an Antifrogen® L / water solution of 25/75% (volume). With the Antifrogen® L concentration between 25% and 50%, the drive output current must be derated by 1/3 percentage point per 1 p.p. increase in Antifrogen® L concentration. The drawing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

T_{air} (°C)	Min. $T_{coolant}$ (°C)				
	RH = 95%	**RH = 80%**	**RH = 65%**	**RH = 50%**	**RH = 40%**
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 allowed as standard but the coolant temperature must be 0 °C (32 °F) or above.				
Example:	At an air temperature of 45 °C and relative humidity of 65% the coolant temperature may not be below +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: 100 … 150 kPa (recommended); 200 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 the expansion tank: 40 kPa

Design pressure (PS): 600 kPa

Nominal pressure difference (between main in/out lines): 120 kPa with 25/75% (volume) coolant solution, 150 kPa with 50/50% (volume) coolant solution. This has to be taken into account when dimensioning the liquid cooling circuit.

Maximum pressure difference (between main in/out lines): 200 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. These are also the only materials that can be used in the external cooling circuit.

- 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 connecting external piping to the internal cooling circuit, use only materials that are specified above. Copper, brass or bronze must not be used under any circumstances. Even minor dissolution of copper can cause copper precipitation on aluminum and subsequent galvanic corrosion. The liquid cooling system must not contain any zinc (eg. galvanized pipes).

If the plant incorporates normal iron pipes or cast iron accessories (eg. motor housings), a cooling unit with a heat exchanger (such as the ACS880-1007LC) must be used to separate the systems.

11

Technical data

Contents of this chapter

This chapter contains the technical data for the DC/DC converter units.

Ratings

This table shows the DC/DC converter units for a drive with 690 V AC nominal input voltage.

ACS880-1607LC-…	Consists of module type ACS880-104LC-…	Frame	No-overload use						
			I_1	I_2	$P_{contmax}$	$P_{contmax}$	$I_{max\ output}$	I_{p2p}	f_{sw} out
			A (DC)	A (DC)	kW	HP	A (DC)	A	Hz
0400A-7	0480A-7	R8i	391	400	351	471	500	38	12000
0500A-7	0530A-7	R8i	490	500	439	589	625	38	12000
0600A-7	0600A-7	R8i	590	600	527	707	750	56	12000
0700A-7	0670A-7	R8i	690	700	615	824	875	56	12000
0800A-7	0750A-7	R8i	790	800	703	942	1000	56	12000
0900A-7	0850A-7	R8i	880	900	790	1060	1125	56	12000
1000A-7	0530A-7	2×R8i	980	1000	878	1178	1250	19	24000
1200A-7	0600A-7	2×R8i	1180	1200	1054	1413	1500	28	24000
1400A-7	0670A-7	2×R8i	1370	1400	1230	1649	1750	28	24000
1600A-7	0750A-7	2×R8i	1570	1600	1405	1884	2000	28	24000
1800A-7	0850A-7	2×R8i	1760	1800	1581	2120	2250	28	24000

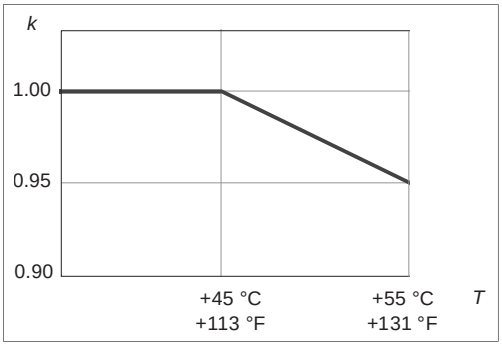
Definitions

I_1	Input current
I_2	Continuous output current (RMS)
$P_{contmax}$	Maximum continuous active power
$I_{max\ output}$	Maximum output current
S_N	Nominal apparent power
I_{p2p}	Peak-to-peak value of output current ripple measured after the filter
f_{sw} out	Switching frequency at output terminals (energy storage connection) measured after the filter

Derating

Ambient 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)*:



Altitude derating

At altitudes from 1000 to 4000 m (3281 to 13123 ft) above sea level, the output current derating is 1 percentage point for every added 100 m (328 ft). For example, the derating factor for 1500 m (4921 ft) is 0.95.

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

For coolant derating, see *Temperature limits (page 86)*.

Fuses

ACS880-1607LC-…	Rating	Type	Ordering code	Qty
0400A-7	630 A	170M6544	63903167	2
0500A-7	800 A	170M6546	63919128	2
0600A-7	1000 A	170M6548	63916749	2
0700A-7	1100 A	170M6549	68736021	2
0800A-7	1250 A	170M6500	63919462	2
0900A-7	1400 A	170M6501	3AUA0000086673	2
1000A-7	800 A	170M6546	63919128	4
1200A-7	1000 A	170M6548	63916749	4
1400A-7	1100 A	170M6549	68736021	4
1600A-7	1250 A	170M6500	63919462	4
1800A-7	1400 A	170M6501	3AUA0000086673	4

BDCL filters

Each DC/DC converter module has its own BDCL filter module.

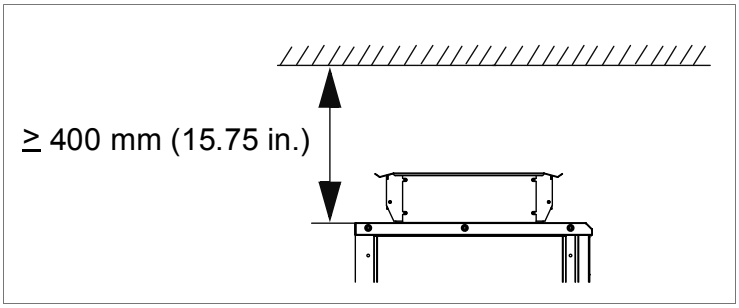
ACS880-1607LC-…	Frame	BDCL filter type	Ordering code
0400A-7	R8i	BDCL-14LC-7	3AXD50000332687
0500A-7	R8i	BDCL-14LC-7	3AXD50000332687
0600A-7	R8i	BDCL-15LC-7	3AUA0000190873
0700A-7	R8i	BDCL-15LC-7	3AUA0000190873
0800A-7	R8i	BDCL-15LC-7	3AUA0000190873
0900A-7	R8i	BDCL-15LC-7	3AUA0000190873
1000A-7	2×R8i	2×BDCL-14LC-7	3AXD50000332687
1200A-7	2×R8i	2×BDCL-15LC-7	3AUA0000190873
1400A-7	2×R8i	2×BDCL-15LC-7	3AUA0000190873
1600A-7	2×R8i	2×BDCL-15LC-7	3AUA0000190873
1800A-7	2×R8i	2×BDCL-15LC-7	3AUA0000190873

Dimensions and weights

ACS880-1607LC-…	Height	Width	Depth	Weight
	mm	mm	mm	mm
0400A-7	2010	800	644	680
0500A-7	2010	800	644	680
0600A-7	2010	800	644	710
0700A-7	2010	800	644	710
0800A-7	2010	800	644	710
0900A-7	2010	800	644	710
1000A-7	2010	1600	644	1425
1200A-7	2010	1600	644	1425
1400A-7	2010	1600	644	1425
1600A-7	2010	1600	644	1425
1800A-7	2010	1600	644	1425

Free space requirements

Leave 400.0 mm (15.75 in) free space above the basic roof level.



Losses and cooling data

ACS880-1607LC-…	Frame	Power loss		Coolant volume				Pressure loss	Efficiency
		P_{loss} module	P_{loss} filter	Power module(s)	Power module cabinet(s)	Filter cabinet(s)	Total		
		kW	kW	l	l	l	l	kPa	%
0400A-7	R8i	3.3	0.9	1.9	2.6	2.6	7.1	120	98.8
0500A-7	R8i	4.1	1.2	1.9	2.6	2.6	7.1	120	98.8
0600A-7	R8i	4.7	1.5	1.9	2.6	2.6	7.1	120	98.8
0700A-7	R8i	5.5	1.8	1.9	2.6	2.6	7.1	120	98.8
0800A-7	R8i	6.4	2.1	1.9	2.6	2.6	7.1	120	98.8
0900A-7	R8i	7.2	2.5	1.9	2.6	2.6	7.1	120	98.8
1000A-7	2×R8i	8.9	2.3	3.8	5.2	5.2	14.2	120	98.7
1200A-7	2×R8i	10.6	3.0	3.8	5.2	5.2	14.2	120	98.7
1400A-7	2×R8i	12.7	3.6	3.8	5.2	5.2	14.2	120	98.7
1600A-7	2×R8i	14.8	4.2	3.8	5.2	5.2	14.2	120	98.6
1800A-7	2×R8i	17.1	4.9	3.8	5.2	5.2	14.2	120	98.6

Tightening torques

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

Electrical connections

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

Mechanical connections

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

Insulation supports

Size	Max. torque	Note
M6	5 N·m (44 lbf·in)	Strength class 8.8

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

Cable lugs

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

Input power (DC bus) connection

Voltage (U_1)	ACS880-1607LC-xxxxx-7 = 742 … 976 V DC. This is indicated in the type designation label as typical input range 50…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	M12, maximum intrusion into module 20 mm (0.8"). Torque: 70 N·m (52 lbf·ft).

Output power (energy storage) connection

Voltage (U_2)	ACS880-1607LC-xxxxx-7 = Maximum output voltage 150 V…95% of U_{DC} (Drive DC voltage in the DC bus). This is indicated in the type designation label as typical output voltage range 50…688 / 764 / 878 V DC. Recommended output voltage 150 V…80% of U_{DC}.
Current	See section *Ratings*.

Control accuracy – Current and voltage control performance data

Current control dynamic response	Step response time < 10 ms for a reference step 0% to 50% of the drive nominal current
Current control accuracy (static)	Current error < 1% of the drive nominal current rating For the DC current ripple, see *Ratings*.
ES voltage control accuracy (static)	Voltage error < 1% of the drive nominal voltage (converter with the optional BAMU voltage/current measurement unit, option +G442 **Note:** If the converter does not include the BAMU voltage/current measurement unit, the voltage measurement accuracy depends on the customer's measurement device.

Coolant connections

Tube fitting, quick coupler for 16/13 mm polyamide (PA) pipe.

Optical components

The specifications of the optic cable are as follows:

- Storage temperature: -55 … +85 °C
- Installation temperature: -20 … +70 °C
- Maximum short-term tensile force: 50 N
- Minimum short-term bend radius: 25 mm
- Minimum long-term bend radius: 35 mm
- Maximum long-term tensile load: 1 N
- 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 respectively.

Protection classes

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

Ambient conditions

The unit is to be used in a heated indoor controlled environment.			
	Operation installed for stationary use	**Storage** in protective package	**Transportation** in protective package
Altitude above sea level	0…4000 m (13123 ft)* Output derated above 1000 m (3281 ft). See section Altitude derating. *Neutral-grounded TN and TT network systems, non-corner-grounded IT network systems. Corner-grounded TN, TT and IT network systems up to 600 V.	-	-

Air temperature	0 … +45 °C (+32 … +113 °F), no condensation allowed. Output derated in the range +45 … +55 °C (+113 … +131 °F).	-40 … +70 °C (-40 … +158 °F)	-40 … +70 °C (-40 … +158 °F)
Relative humidity	Maximum 95%, no condensation allowed	Maximum 95%, no condensation allowed	Maximum 95%, no condensation allowed
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination	IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations	IEC 60721-3-1	IEC 60721-3-2
Chemical gases	Class 3C2	Class 1C2	Class 2C2
Solid particles	Class 3S1	Class 1S3 (packing must support this, otherwise 1S2)	Class 2S2
	No conductive dust allowed.		
Vibration	IEC 61800-5-1 IEC 60068-2-6:2007, EN 60068-2-6:2008 Environmental testing Part 2: Tests -Test Fc: Vibration (sinusoidal) 10 … 57 Hz, max. 0.075 mm amplitude 57 … 150 Hz 1 *g* Tested in a typical cabinet assembly according to: Max. 1 mm (0.04 in.) (peak value, 5 … 13.2 Hz), max. 0.7 *g* (13.2 … 100 Hz) sinusoidal	IEC/EN 60721-3-1:1997	IEC/EN 60721-3-1:1997
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009 Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	Not allowed	With packing max. 100 m/s^2 (330 ft./s^2) 11 ms	With packing max. 100 m/s^2 (330 ft./s^2) 11 ms

Materials

Cabinet	• Zinc coated steel sheet • Polyester thermosetting powder coating on visible surfaces, color RAL 7035 and RAL 9017
Busbars for user power connections	Tin-plated copper
Liquid cooling system	See *Cooling circuit materials (page 88)*
Fire safety of materials (IEC 60332-1)	Insulating materials and non-metallic items: mostly self-extinctive
Package	Standard package: • timber, polyethylene sheet (thickness 0.15 mm), stretch film (thickness 0.023 mm), PP tape, PET strap, sheet metal (steel) • for land and air transport when planned storage time is less than 2 months or when storage can be arranged in clean and dry conditions less than 6 months • can be used when products will not be exposed to corrosive atmosphere during transport or storage Container package: • timber, VCI sheet film (PE, thickness 0.10 mm), VCI stretch film (PE, thickness 0.04 mm), VCI emitter bags, PP tape, PET strap, sheet metal (steel) • for sea transport in containers • recommended for land and air transport when storage time prior to installation exceeds 6 months or storage is arranged in partially weather-protected conditions Seaworthy package: • timber, plywood, VCI sheet film (PE, thickness 0.10 mm), VCI stretch film (PE, thickness 0.04 mm), VCI emitter bags, PP tape, PET strap, sheet metal (steel) • for sea transport with or without containerization • for long storage periods in environments where roofed and humidity-controlled storage cannot be arranged Cabinets are fastened to the pallet with screws and braced from the top end to the package walls to prevent swaying inside the package. Package elements are attached to each other with screws.
Disposal	The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated. Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and large electrolytic capacitors need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code. Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.

Applicable standards

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

Markings

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

Disclaimers

Generic disclaimer

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

Cybersecurity disclaimer

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

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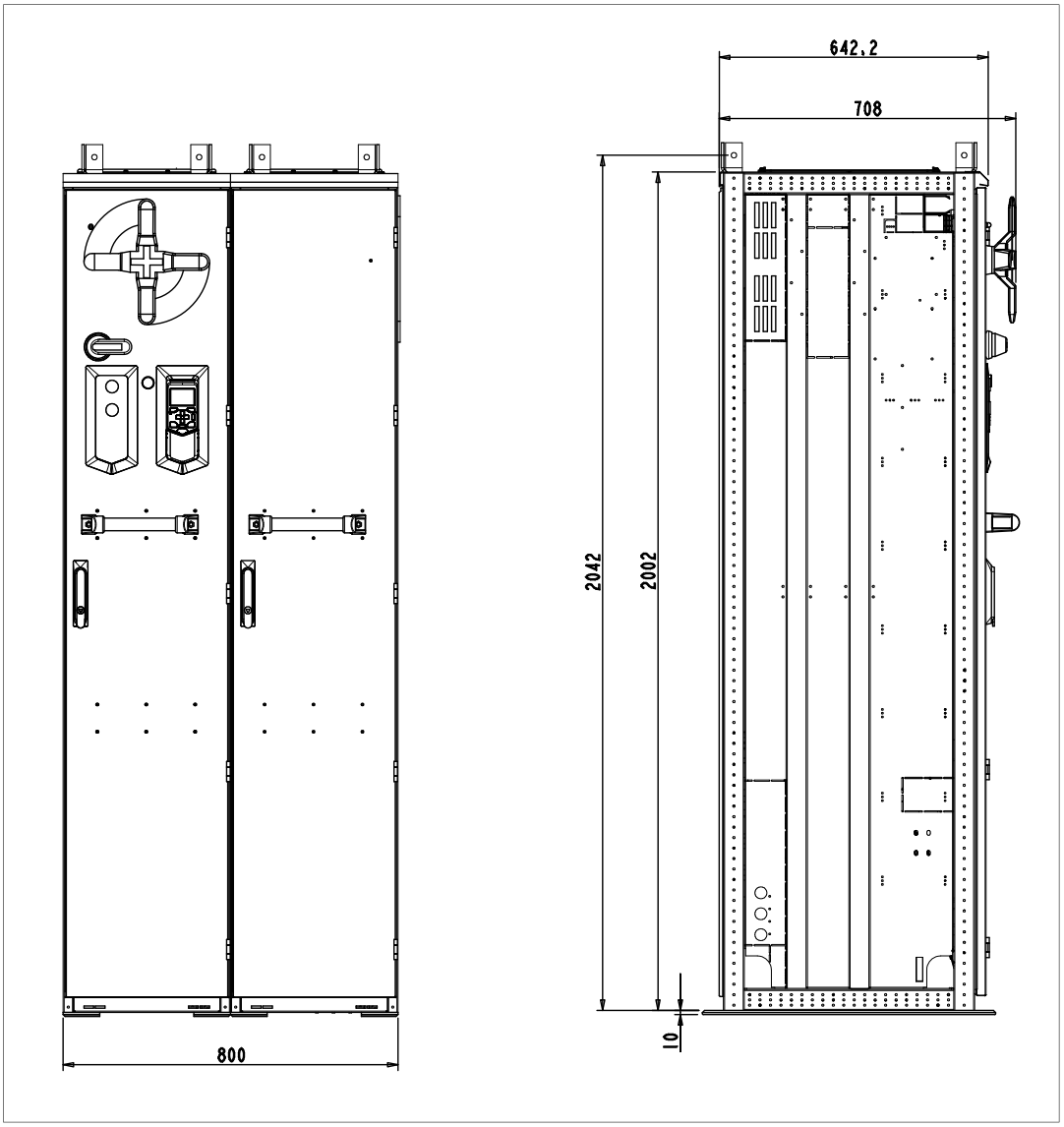
Dimension drawings

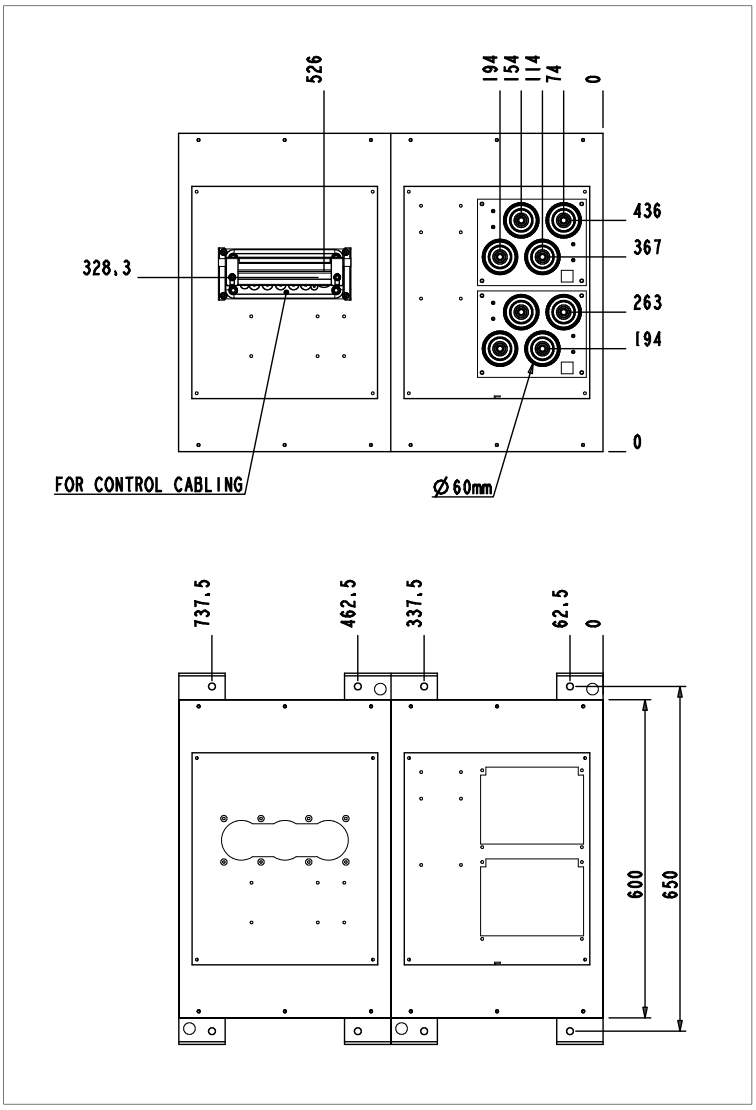
Contents of this chapter

This chapter contains the following dimension data:

- Dimension drawings of DC/DC converter unit
- Location and size of output terminals for energy storage cables

Unit with 1×R8i converter module




526
194
154
114
74
0
436
367
263
194
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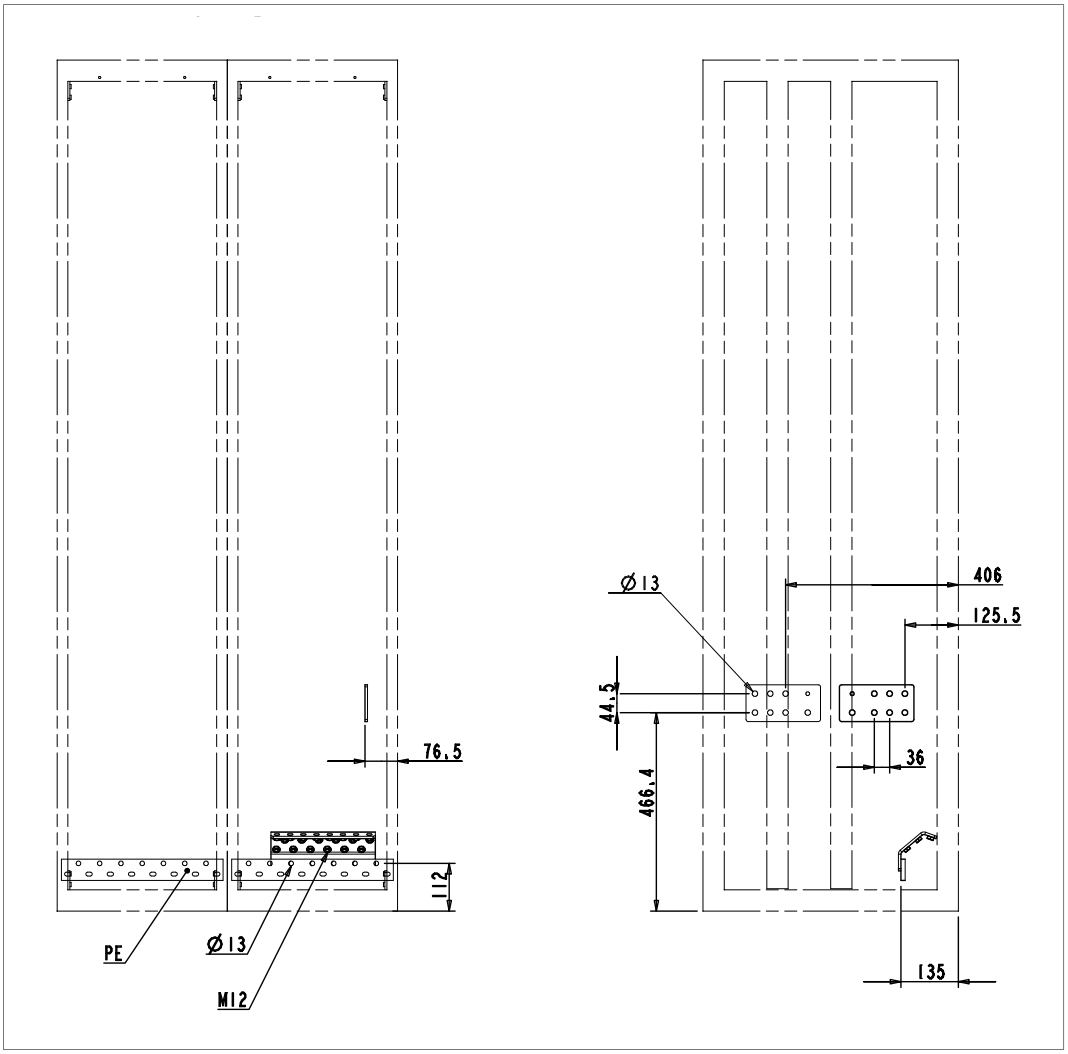
328.3
FOR CONTROL CABLING
Ø60mm
737.5
462.5
337.5
62.5
0
600
650

Location and size of energy storage connection terminals



Further information

Product and service inquiries

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

Product training

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

Providing feedback on ABB manuals

Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

Document library on the Internet

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

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