ABB INDUSTRIAL DRIVES

ACS880-07 drives (560 to 2800 kW)

Hardware manual

ACS880-07 drives (560 to 2800 kW

Hardware manual

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1

Safety instructions

Contents of this chapter

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

Use of warnings and notes

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

The manual uses these warning symbols:

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

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

WARNING!
Electrostatic sensitive devices warning tells you about the risk of electro

General safety in installation, start-up and maintenance

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

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

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

- Do not stand or walk on the cabinet roof. Make sure that nothing presses against the roof, side or back plates or door. Do not store anything on the roof while the drive is in operation.
- Do not use the module extraction/installation ramp with plinth heights which exceeds the maximum allowed height.
- Secure the module extraction/installation ramp carefully.
- Push the module into the cabinet and pull it from the cabinet carefully preferably with help from another person. Keep a constant pressure with one foot on the

max.

- Do not move the module on its wheels for long distances. It can cause damage the wheels. Also, there is a risk of the module falling over.
- Be careful when handling a tall module. The module overturns easily because it heavy and has a high center of gravity. Whenever possible, secure the module chains. Do not leave an unsupported module unattended especially on a sl floor.

- Wear protective gloves and long sleeves! Some parts have sharp edges.
- Beware of hot surfaces. Some parts, such as heatsinks of power semiconducto and brake resistors, remain hot for a while after disconnection of the electri supply.
- Vacuum clean the area around the drive before the start-up to prevent the drive cooling fan from drawing dust inside the drive.
- Make sure that debris from drilling, cutting and grinding does not go into the drive during installation. Electrically conductive debris inside the drive can damage or malfunction.
- Make sure that there is sufficient cooling. See the technical data.

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

Note:

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

Electrical safety in installation, start-up and maintenan

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 th equipment can occur.

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

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

1. Prepare for the work.
   - Make sure that you have a work order.
   - Do an on-site risk assessment or job hazard analysis.
   - Make sure that you have the correct tools available.
   - Make sure that the workers are qualified.
   - Select the correct personal protective equipment (PPE).
   - Stop the motor(s).
2. Clearly identify the work location and equipment.
3. Disconnect all possible voltage sources. Make sure that re-connection is no possible. Lock out and tag out.
   - Open the main disconnecting device of the drive.
   - Open the charging switch if present.
   - Open the disconnector of the supply transformer. (The main disconnec device in the drive cabinet does not disconnect the voltage from the AC inp power busbars of the drive cabinet.)
   - Close the grounding switch or switches ([Q9], option +F259) if present not use excessive force as the switch has electromagnetic interlocking
   - Open the auxiliary voltage switch-disconnector (if present), and all othe possible disconnecting devices that isolate the drive from dangerous v sources.
   - If you have a permanent magnet motor connected to the drive, disconn the motor from the drive with a safety switch or by other means.
   - Open the main isolating device of the drive.
   - Disconnect all dangerous external voltages from the control circuits.
   - After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
4. Protect other energized parts in the work location against contact and take spec precautions when close to bare conductors.
5. Measure that the installation is de-energized. Use a quality voltage tester. I measurement requires removal or disassembly of shrouding or other cabin structures, obey the local laws and regulations applicable to live working (includ

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

  Important! Repeat the measurement also with the DC voltage setting of the tester. Measure between each phase and ground. There is a risk of dangerous DC voltage charging due to leakage capacitances of the motor circuit. This voltage can remain charged for a long time after the drive power-off. The measurement discharges the voltage.
- Make sure that the voltage between the drive DC busbars and the grounding (PE) busbar is zero.

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

Additional instructions and notes

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

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

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

Note:

- When the drive is connected to the input power, the motor cable terminals and the DC bus are at a dangerous voltage.

  The brake circuit, including the brake chopper (option +D150) and brake resistor (option +D151) are also at a dangerous voltage.

  After disconnecting the drive from the input power, these remain at a dangerous voltage until the intermediate circuit capacitors have discharged.
- External wiring can supply dangerous voltages to the relay outputs of the control units of the drive.
- The Safe torque off function does not remove the voltage from the main and

Printed circuit boards

WARNING!
Use a grounding wristband when you handle printed circuit boards. Do n
touch the boards unnecessarily. The boards contain components sensit
electrostatic discharge.

Grounding

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

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

If you are not a qualified electrical professional, do not do grounding wo

- Always ground the drive, the motor and adjoining equipment. This is neces for the personnel safety.
- Make sure that the conductivity of the protective earth (PE) conductors is suffici and that other requirements are met. See the electrical planning instruction the drive. Obey the applicable national and local regulations.
- When using shielded cables, make a 360° grounding of the cable shields at the cable entries to reduce electromagnetic emission and interference.
- In a multiple-drive installation, connect each drive separately to the protecti earth (PE) busbar of the power supply.

General safety in operation

These instructions are for all personnel that operate the drive.

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

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

Note:

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

Additional instructions for permanent magnet motor drives

Safety in installation, start-up, maintenance

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

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

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

- Stop the drive.
- Disconnect the motor from the drive with a safety switch or by other means
- If you cannot disconnect the motor, make sure that the motor cannot rotate duri work. Make sure that no other system, like hydraulic crawling drives, can ro the motor directly or through any mechanical connection like belt, nip, rope
- Do the steps in section Electrical safety precautions (page 21).
- Install temporary grounding to the drive output terminals (T1/U, T2/V, T3/W Connect the output terminals together as well as to the PE.

During the start-up:

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

Safety in operation

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

2

Introduction to the manual

Contents of this chapter

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

Target audience

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

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

Categorization by frame size and option code

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

Use of component designations

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

Quick installation, commissioning and operation flowchart

Task	See
Plan the electrical installation and acquire the accessories needed (cables, fuses, etc.). Check the ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.	Guidelines for planning the electrica stallation (page 89) Technical data (page 223)
Check the installation site.	Ambient conditions (page 239)
Unpack and check the drive (only intact units may be started up). Make sure that all necessary optional modules and equipment are present and correct. Install the drive mechanically.	Mechanical installation (page 67)
Route the cables.	Routing the cables (page 105)
If the drive is about to be connected to an IT (ungrounded) system, check that the drive is not equipped with EMC filter +E202.	Compatibility check - IT (grounde earthing system (page 116)
Connect the power cables. Connect the control cables.	Electrical installation (page 115)
Check the installation.	Installation checklist (page 171) If the drive has been non-operationa more than one year, reform the DC lin capacitors. See Converter module citor reforming instructions (3BFE64059629 [English]).

Terms and abbreviations

Term	Description
ATEX	Directives 2014/34/EU and 1999/92/EC are commonly referred to directives (from "Atmosphères Explosibles")
BCU	Type of control unit
CMF	Common mode filtering
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
FAIO-01	Analog I/O extension module
FEN-01	Optional TTL incremental encoder interface module
FEN-11	Optional absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL incremental encoder interface module
FIO-11	Optional analog I/O extension module
FPTC-01	Optional thermistor protection module
FPTC-02	Optional ATEX-certified thermistor protection module for poter atmospheres
Frame, frame size	Physical size of the drive or power module
FSO-12, FSO-21	Optional functional safety modules
IGBT	Insulated gate bipolar transistor
Inverter unit	Inverter module(s) under control of one control unit, and relate One inverter unit typically controls one motor.
Power module	Common term for drive module, inverter module, supply modu chopper module etc.
RFI	Radio-frequency interference
STO	Safe torque off (IEC/EN 61800-5-2)
Supply unit	Supply module(s) under control of one control unit, and relatec
UCU	Type of control unit
USCA-02	Adapter for installing F-series option modules onto the UCU cc

Related documents

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

ACS880-07 (560 to 2800 kW) manuals

3

Operation principle and hardwar description

Contents of this chapter

This chapter briefly describes the operation principle and construction of t

Operation principle

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

The drive consists of several cubicles that contain the supply and motor term to 4 diode supply module(s), 2 to 5 inverter modules, and optional equipment actual arrangement of the cubicles varies from type to type and the selected

Overview circuit diagram of the drive

AC supply
5
6 6 9
1
12
2
4 7 7
3
13
11
8 M 3~

1 *Main switch-disconnector (Q1.1)

2 *AC fuses.

Frames 1×D8T + 2×R8i (6-pulse), 2×D7T + 2×R8i (12-pulse), 2×D8T + n×R8i(12-pulse) have AC fuses installed in the incoming cubicle (ICU) only. Frames 2×D8T + 2×R8i and above (6-pulse) and 4×D8T + n×R8i (12-pulse) have AC fuses installed for each supply module in the supply module cubicle(s). Additional common AC fuses are installed in the incoming cubicle (ICU) if optional main contactor (+F250) is present.

3 *Main contactor (Q2.1). Optional (+F250) with frames 2×D7T + 2×R8i, 2×D8T + 2×R8i and 2×D8T + 3×R8i. 12-pulse units have two contactors (Q2.1 and Q2.2).

*With larger units, an air circuit breaker is either optional (+F255) or standard, replacing items 1...3. Each supply module has dedicated AC fuses installed in the supply module cubicle(s).

4 Supply module. Converts alternating current and voltage to direct current and voltage.

The module contains an AC input choke.

The ACS880-07 has 1...4 supply modules connected in parallel. 12-pulse units have either one or two supply modules per each 6-pulse supply line.

5 DC bus

6 Inverter DC fuses

7 Inverter module. Converts direct current and voltage to alternating current and voltage. The ACS880-07 has 2...5 inverter modules connected in parallel.

8 Motor

13 Auxiliary voltage transformers (T21, T101, T111). T21 is standard; T101 and T111 are whenever required by the options ordered.

12-pulse connection (option +A004)

The figure below illustrates the difference between 6-pulse and 12-pulse AC s connections. 6-pulse connection is standard.

Some drive types are available as a 12-pulse version (option +A004).

The 12-pulse supply connection eliminates the fifth and seventh harmoni substantially reduces the harmonic distortion of the line current and the c emissions.

The 12-pulse connection requires a three-winding transformer, or two sep transformers. There is a phase shift of 30-degrees between the two 6-pulse s lines, which are connected to different supply modules through electricall switching equipment.

A

B

A 6-pulse connection

Cabinet line-up and layout examples

Frame 1×D8T+2×R8i

A B C D

3 4

2

1

Cabinet line-up example

A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section Auxiliary control cubicle (ACU) layout (page 42).
B	Incoming cubicle (ICU). Contains the power input cable terminals and switchgear.
C	Supply module cubicle. Contains the D8T supply module.
D	Inverter module cubicle. Contains two R8i inverter modules. As standard, the motor cables are

A

8 10

7

6

5

4

9 11

3

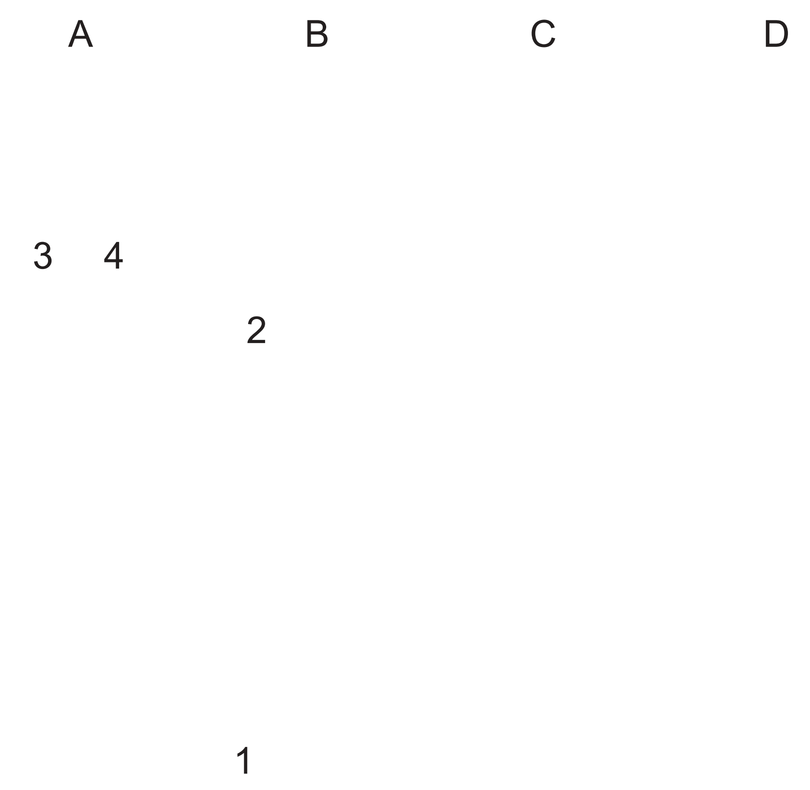
2

1

Cabinet layout example

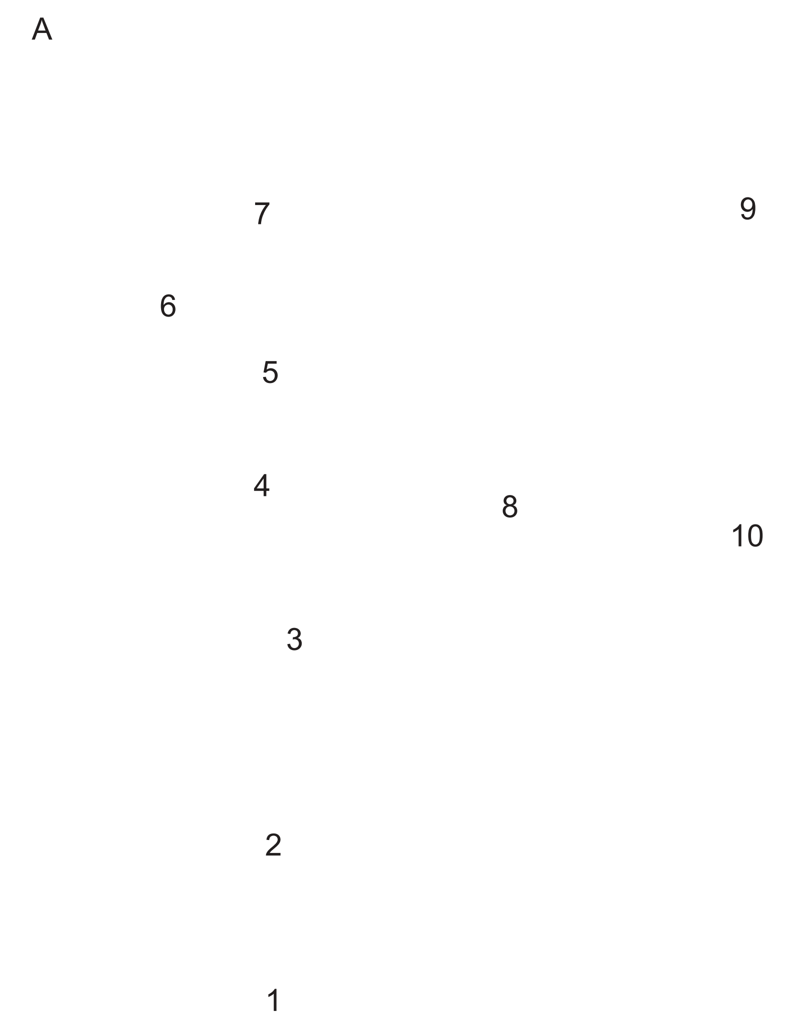
A	Auxiliary control cubicle (ACU). See section Auxiliary control cubicle (ACU) la
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Main switch-disconnector (Q1.1)
4	Grounding (earthing) switch (Q9.1) (optional)
5	AC fuses
6	Main contactor (Q2.1) (optional)
7	Auxiliary voltage switch (Q21) with fuses
8	Incoming cubicle cooling fan

Frame 2×D7T+2×R8i (12-pulse connection, option +A004)



Cabinet line-up example

A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section Auxiliary control cubicle (ACU) layout (page 42).
B	Incoming cubicle (ICU). Contains the power input cable terminals and switchgear. With option +F259 (grounding switch), there are two incoming cubicles, one for each 6-pulse supply line.
C	Supply module cubicle. Contains two D7T supply modules, each connected to a different 6-pulse supply line.
D	Inverter module cubicle. Contains two R8i inverter modules. As standard, the motor cables are run from each inverter module to the motor unless the drive is equipped with option +H359 (common motor terminal cubicle), +H366 (common output terminals) or +E206 (sine filters).
1	Main switch-disconnector (Q1.1)



Cabinet layout example

A	Auxiliary control cubicle (ACU). See section Auxiliary control cubicle (ACU) la
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Main switch-disconnector (Q1.1)
4	AC fuses
5	Main contactors (Q2.1 and Q2.2) (optional)
6	Auxiliary voltage switch (Q21) with fuses
7	Incoming cubicle cooling fans
8	Supply modules. Each module is connected to a different 6-pulse supply line.
9	Inverter DC fuses
10	Inverter modules. The output terminals are located behind each module. Each m be individually connected to the motor using separate cables unless the drive is equip

Frame 2×D8T+3×R8i

A B C D

3 4

2

1

Cabinet line-up example

A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section Auxiliary control cubicle (ACU) layout (page 42).
B	Incoming cubicle (ICU). Contains the power input cable terminals and switchgear.
C	Supply module cubicle. Contains two D8T supply modules.
D	Inverter module cubicle. Contains three R8i inverter modules. As standard, the motor cables are run from each inverter module to the motor unless the drive is equipped with option +H359 (common motor terminal cubicle) or +H366 (common output terminals).
1	Main switch-disconnector (Q1.1)
2	Auxiliary voltage switch (Q21)
3	Drive control panel. See section Control panel (page 50).
4	Door switches and lights. See section Door devices (page 48).

Cabinet layout example

A	Auxiliary control cubicle (ACU). See section Auxiliary control cubicle (ACU) la
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Main switch-disconnector (Q1.1)
4	Grounding (earthing) switch (Q9.1) (optional)
5	Common AC fuses (installed with optional main contactor)
6	Main contactor (Q2.1) (optional)
7	Auxiliary voltage switch (Q21) with fuses
8	Incoming cubicle cooling fans
9	Supply module AC fuses
10	Supply modules
11	Inverter DC fuses
12	Inverter modules. The output terminals are located behind each module. Each m be individually connected to the motor using separate cables unless the drive is equip option +H359 (common motor terminal cubicle) or +H366 (common output termi

Frame 3×D8T+4×R8i (with main breaker, option +F255)

A B C D E

3 4

2

1

Cabinet line-up example

A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section Auxiliary control cubicle (ACU) layout (page 42).
B	Incoming cubicle (ICU). Contains the power input cable terminals and switchgear.
C	Supply module cubicle. Contains three D8T supply modules.
D, E	Inverter module cubicles 1 and 2. Each cubicle contains two R8i inverter modules. As standard, the motor cables are run from each inverter module to the motor unless the drive is equipped with option +H359 (common motor terminal cubicle) or +H366 (common output terminals).
1	Main breaker (Q1) (option +F255)
2	Auxiliary voltage switch (Q21)
3	Drive control panel. See section Control panel (page 50).
4	Door switches and lights. See section Door devices (page 48).

A

6 7 9

5

4

8 10

3

2

1

Cabinet layout example

A	Auxiliary control cubicle (ACU). See section Auxiliary control cubicle (ACU) l
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Incoming cubicle cooling fans
4	Main breaker (Q1) (option +F255)
5	Auxiliary voltage switch (Q21) with fuses
6	Grounding (earthing) switch (Q9.1) (optional)
7	Supply module AC fuses
8	Supply modules
9	Inverter DC fuses
10	Inverter modules. The output terminals are located behind each module. Each m be individually connected to the motor using separate cables unless the drive is equip option +H359 (common motor terminal cubicle) or +H366 (common output termi

40 Operation principle and hardware description

Auxiliary control cubicle (ACU) layout

Auxiliary control cubicle (ACU) layout

A layout example of the auxiliary control cubicle (ACU) is shown below. On the left: Swing-out frame closed, detachable mounting plates in place. On the right: Swing-out frame open, without detachable mounting plates.

A layout example of the auxiliary control cubicle (ACU) is shown below.

Swing-out frame closed, detachable mounting plates in place

Swing-out frame open, without detachable mounting plates

1 2 3 4 5 6 7 8 10 11 9 12 13 14 15 16 17 18 19

20 21 22 23 24 27 25 9 26 25 30 28 34 32 31 33 29 35

1 Fuse-disconnectors F101. On the primary of transformer T101 (item 27).

1 Fuse-disconnectors F101. On the primary of transformer T101 (item 27).

2 Fuse-disconnectors (F27) for motor cooling fan outputs (options +M602...610)

2 Fuse-disconnectors F27 for motor cooling fan outputs (options +M602...610)

3 Supply control unit (A51). See chapter Control

19 Lead-through for control cables

19 Lead-through for control cables

20 Terminal block (X68) for FSO-xx safety functions module (option +Q972 or +Q973)

20 Terminal block X68 for FSO-xx safety function module (option +Q973)

21 I/O terminal block (option +L504). The I/O

6 Switch (F90) for ground fault monitoring (item 12)

7 FSO-xx safety functions module (option +Q972 or +Q973 and other options requiring FSO-xx)

8 Temperature monitoring relays (options +L505 and +L506). The terminals (X506) are located on the back of the detachable mounting plate.

9 Swing-out frame

10 Mounting rail for additional equipment

11 Safety relays for safety options (emergency stop, safe torque off)

12 Ground fault monitoring equipment for ungrounded systems (option +Q954)

13 FEA-03 extension adapter (option +L515).

14 Switch and circuit breaker for externally-supplied motor space heater (option +G313). The terminals (X313) are located on the back of the detachable mounting plate.

15 Switch and circuit breaker for externally-supplied control voltage (option +G307), eg. UPS. The terminals (X307) are located on the back of the detachable mounting plate.

16 Switch and circuit breaker for externally-supplied cabinet lighting and heating (options +G300 and +G301). The terminals (X300) are located on the back of the detachable mounting plate.

17 Fuse-disconnectors F21. On the primary of transformer T21 (item 28). Mounted on a detachable plate.

24 Motor fan starters and co
+M602...610)

25 Terminal blocks (X601) for
tions (options +M602...61

26 24 V DC power supply fo
(option +G301)

27 Auxiliary voltage transfor
back of the cubicle, not vi
IP54, brake chopper and
inet cooling fans (options +
+D151).

28 Auxiliary voltage transform
of the cubicle, not visible).
trol circuitry and the coolin
incoming unit (ICU) and th
unit (ACU).

29 Auxiliary voltage transfor
ized equipment only.)

30 Auxiliary voltage circuit b
F102. On the secondary of
(item 28) and T101 (item 2

31 Input voltage setting for a
transformer T101 (item 27

32 Input voltage setting for a
transformer T21 (item 28)

33 Input voltage setting for a
transformer T111 (item 29

34 Terminal blocks

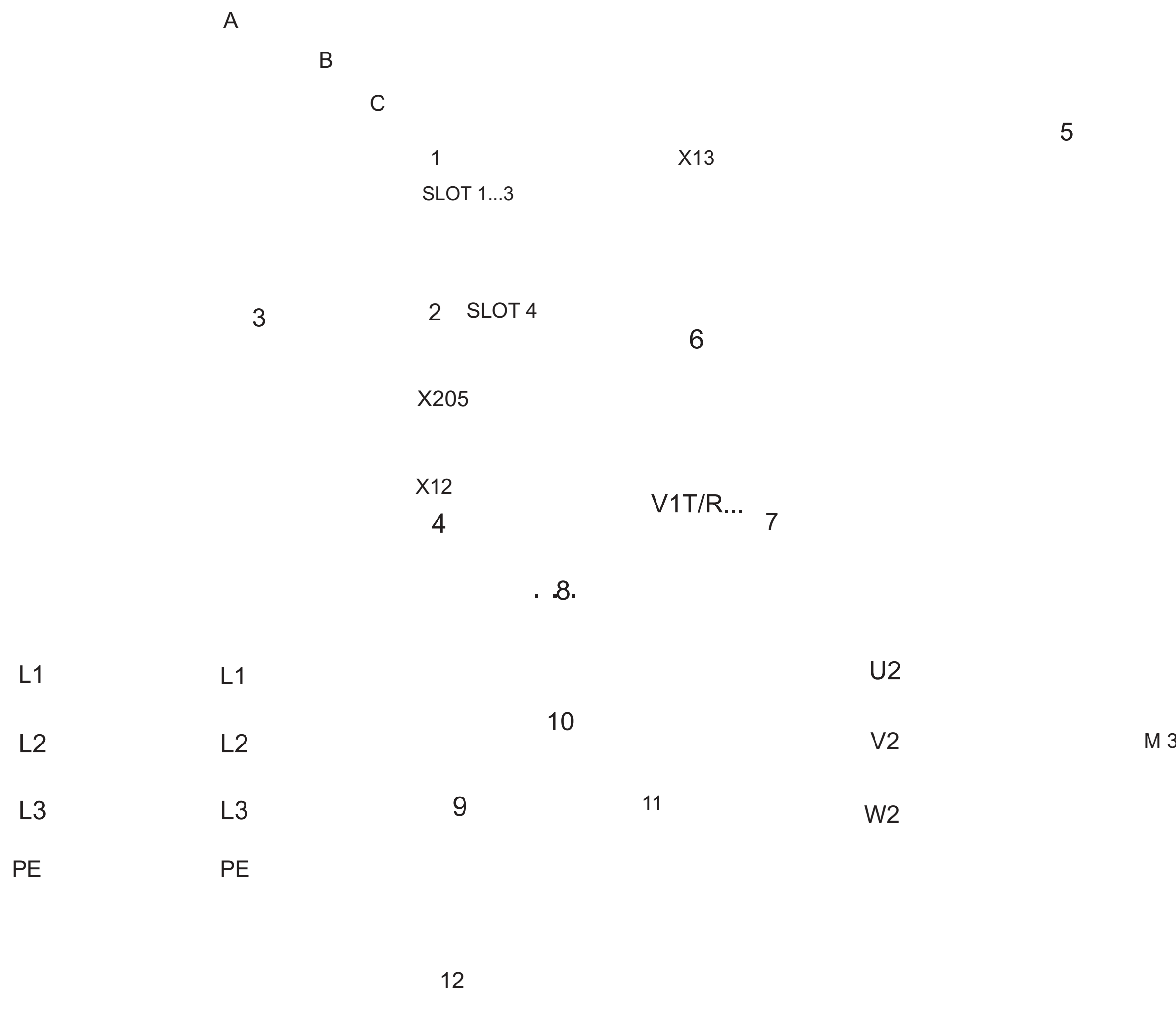
X250: indication of main s
and contactor status
X951: connection of extern
button
X954: ground fault alarm
X957: for connection of P
pected start-up switch.

Mounted on the left-hand

35 Cubicle heater element (
Mounted on the right-han

Overview of power and control connections (BCU-x2)

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



A Drive

B Supply control unit (A51)

C Inverter control unit (A41)

1 Option modules can be inserted into slots 1, 2, 3 and 4 as follows:

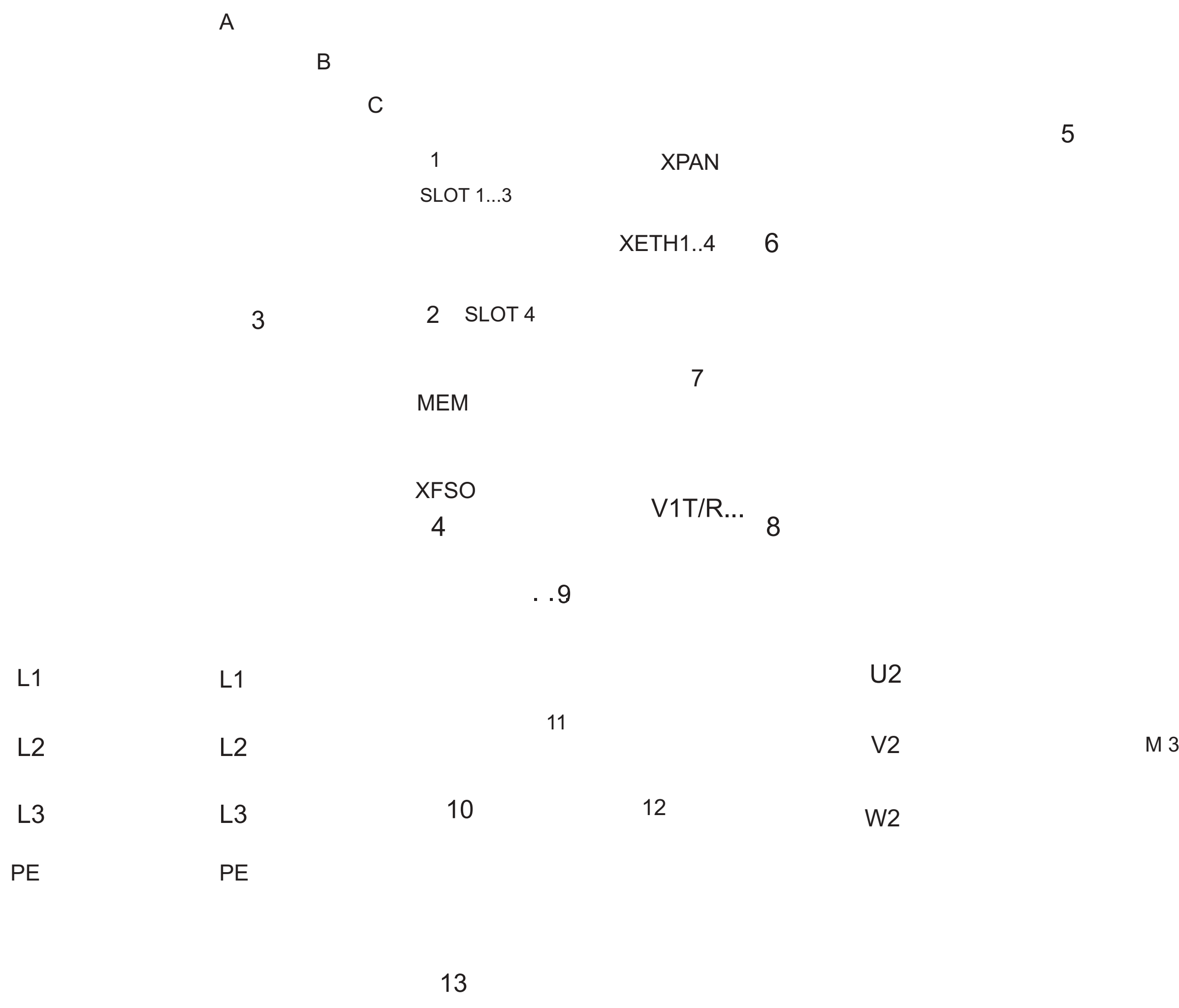
2

Module type	Slots
Analog and digital I/O extension modules	1, 2, 3

5	Control panel and PC connection
6	Terminal blocks on the inverter control unit. These terminals are optionally wired block X504 in the auxiliary control cabinet of the drive.
7	Fiber optic link to each inverter module. Similarly, each supply module is connec supply control unit by fiber optic cables.
8	Terminal blocks for customer connections installed in the drive cabinet. For the lo section Auxiliary control cubicle (ACU) layout (page 42).
9	Supply unit (consisting of one or more supply modules)
10	DC intermediate link
11	Inverter unit (consisting of two or more inverter modules)
12	Optional brake chopper (+D150) and resistors (+D151)

Overview of power and control connections (UCU-22...24)

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



A Drive

B Supply control unit (A51)

C Inverter control unit (A41)

1 Option modules can be inserted into slots 1, 2, 3 and 4 as follows:

2

Module type	Slots
Analog and digital I/O extension modules	1, 2, 3

5 Control panel and PC connection

6 Ethernet ports for fieldbus communication (XETH 1...2) and tool communication
Not in use.

7 Terminal blocks on the inverter control unit. These terminals are optionally wired
block X504 in the auxiliary control cabinet of the drive.

8 Fiber optic link to each inverter module. Similarly, each supply module is connec
supply control unit by fiber optic cables.

9 Terminal blocks for customer connections installed in the drive cabinet. For the lo
section Auxiliary control cubicle (ACU) layout (page 42).

10 Supply unit (consisting of one or more supply modules)

11 DC intermediate link

12 Inverter unit (consisting of two or more inverter modules)

13 Optional brake chopper (+D150) and resistors (+D151)

Door devices

	Label in English	Label in local language	Description
1	READY	-	Ready light (option +G327)
2	RUN	-	Run light (option +G328)
3	FAULT	-	Fault light (option +G329)
4	ENABLE / RUN 0-1	-	Run enable signal switch for the supply unit 0 Run enable signal off (starting the supply unit not allowed 1 Run enable signal on (starting the supply unit allowed). Close the main disconnecting device (if present).
5	E-STOP RESET	-	Emergency stop reset push button (with emergency stop options only)
6	EARTH FAULT	-	Ground (earth) fault light and reset push button (option +Q954)
7			Reserved for order-based engineered equipment

Main disconnecting device (Q1.1)

Depending on the configuration of the drive, the main disconnecting devic drive is either a switch-disconnector or a main circuit breaker. Units with a switch-disconnector also have a main contactor.

The main disconnecting device switches the main supply to the drive on and disconnect the main supply, turn the switch-disconnector to the 0 (OFF) p rack out the main breaker (whichever device is installed).

WARNING!
The main disconnecting device does not isolate the input power term voltage meters, or the auxiliary voltage circuit from the power line. To the auxiliary voltage circuit, open the auxiliary voltage switch (Q21). T the input power terminals and AC voltage meters, open the main brea the supply transformer.

To close the main disconnecting device, auxiliary voltage must be switched o the grounding switch (if present) must be open.

Auxiliary voltage switch [Q21]

The auxiliary voltage switch controls the supply to the internal auxiliary vo transformers. The transformer feeds the control circuits inside the drive su cooling fans, relays and measuring equipment.

Grounding (earthing) switch [Q9], optional

The grounding switch [Q9] (option +F259) connects the main AC power bus t busbar. Units with 12-pulse connection (option +A004), as well some of the la 6-pulse types, have two switches, [Q9.1] and [Q9.2], one for each 6-pulse su

To close the grounding switch, auxiliary voltage must be switched on, and the disconnecting device must be open.

WARNING!
The grounding switch does not ground the input power terminals of th or the auxiliary (control) voltage circuits.

Other devices on the door

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

  Note: The voltage is measured on the supply side of the main switch or bre

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

Control panel

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

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

Control by PC tools

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

Descriptions of options

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

Degree of protection

Definitions

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

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

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

IP22 (UL Type 1)

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

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

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

IP54 (UL Type 12) (option +B055)

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

Marine construction (option +C121)

The option includes the following accessories and features by default:

Marine product certifications may require additional wire markings. Refer to section Wire markings (page 54).

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

See section Air inlet through the bottom of the cabinet (option +C128) (page 8

UL Listed (option +C129)

The cabinet contains the following accessories and features:

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

Channeled air outlet (option +C130)

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

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

See also section Air outlet duct on the cabinet roof (option +C130) (page 83).

CSA Approved (option +C134)

The option includes the following accessories and features:

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

Plinth height (options +C164 and +C179)

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

Seismic design (option +C180)

The option involves seismic capability according to International building code 2012, test procedure ICC-ES AC-156. The installation level must not exceed 25% of the height

Empty cubicles on left (options +C199...C201)

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

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

Resistor braking (options +D150 and +D151)

See chapter Resistor braking (page 333).

EMC filter (option +E202)

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

Sine filter (option +E206)

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

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

Cabinet heater with external supply (option +G300)

The option contains:

- heating elements in the cubicles or supply/inverter modules
- load switch for providing electrical isolation during service
- miniature circuit breaker for overcurrent protection
- terminal block for external power supply.

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

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

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

Cabinet lighting (option +G301)

- Supplying power for the auxiliary circuits (page 111)
- circuit diagrams delivered with drive for the actual wiring.

Output for motor space heater (option +G313)

The option contains:

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

When the drive is powered (and not faulted), the heater is switched off. Otherwise, the heater is controlled by the external supply voltage.

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

See also:

- Supplying power for the auxiliary circuits (page 111)
- circuit diagrams delivered with drive for the actual wiring.

Supply connection by busbars (option +G317)

This option provides input (supply) terminals and a busbar entry that enable direct connection to busbar trunking systems.

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

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

Halogen-free wiring and materials (option +G330)

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

V-meter with selector switch (option +G334)

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

Wire markings

Standard wiring

Color

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

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

Additional wire markings

The following additional wire markings are available.

Option	Additional markings
+G340 (class A3)	Single wires not attached to plug-in connectors are marked with component pi on snap-on or ring markers. Plug-in connectors are marked with an identi placed on the wires near the connector (individual wires are not marked). Shor connections are not marked. PE wires are not marked unless connected c components.
	9. 7 7
+G342 (class C1)	Single wires connected to components, between modules, or to terminal b marked with component identification and pin numbers for both ends. The printed on sleeving or, if necessary, snap-on markers. Plug-in connectors with an identification label (or snap-on markers) placed on the wires near (individual wires are not marked). Short, obvious connections are not mar are not marked unless connected directly to components.

K 1 2 4 T 2 3 T2

K1 24 T2 3 T2

Common mode filter temperature monitoring (option +G4

This option contains thermal switches installed within the common mode

provide power and control cable entries at the floor of the cabinet. The entries are equipped with grommets and 360° grounding hardware.

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

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

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

Cable conduit entry (option +H358)

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

Common motor terminal cubicle (option +H359)

As standard, each inverter module must be individually cabled to the motor. This option provides an additional cubicle containing a single set of terminals for the motor cables.

The width of the cubicle and the size of the terminals within depend on the power rating of the drive.

Note that this option is not available with option +E206 (sine filters), In this case, the motor cables are connected to the sine filter cubicle.

Common output terminals (option +H366)

As standard, each inverter module must be individually cabled to the motor. This option adds bridging that connects the outputs of multiple (in practice, two or three) inverter modules mounted in the same cubicle. The bridging balances the motor current between the modules, which allows more cabling options. For example, it is possible to use a number of cables that could not otherwise be evenly distributed between the inverter modules.

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

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

Connectivity for wired remote monitoring (option +K496)

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

See the appropriate manual for more information.

Manual
NETA-21 remote monitoring tool user's manual
NETA-21 remote monitoring tool installation and start-up guide
FMBT-21 Modbus/TCP adapter module user's manual
FMBT-21 Modbus/TCP adapter module quick installation and start-up guide

Connectivity for wireless remote monitoring (option +K4

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

See the appropriate manual for more information.

Manual
NETA-21 remote monitoring tool user's manual
NETA-21 remote monitoring tool installation and start-up guide
FMBT-21 Modbus/TCP adapter module user's manual
FMBT-21 Modbus/TCP adapter module quick installation and start-up guide
InRouter 615-S commissioning guide

Additional terminal block X504 (option +L504)

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

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

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

- solid wire 0.2 ... 2.5 mm^2 (24...12 AWG)
- stranded wire with ferrule 0.25 ... 2.5 mm^2 (24...12 AWG)

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

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

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

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

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

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

+L536, +L537

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

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

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

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

See also

- firmware manual for parameter settings
- FPTC-01 thermistor protection module (option +L536) for ACS880 drives user's manual (3AXD50000027750 [English])
- FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option

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

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

Options +3L514 (3 relays), +5L514 (5 relays) and +8L514 (8 relays) are ATEX
thermal protection functions that have the same external connectivity as +
addition, each monitoring relay has a 0/4...20 mA output that is available
terminal block. Option +nL514 comes with +Q971 (ATEX-certified safe dis
function) as standard and is wired at the factory to activate the Safe torque of
of the drive in an overtemperature situation. As the monitoring relay does not
reset functionality, the manual reset required by Ex/ATEX regulations mus
implemented using drive parameters. For more information, see ATE
thermal protection functions for cabinet-built ACS880 drives (options +L5
and +L514+Q971) user's manual (3AXD50000014979 [English]).

See also

- firmware manual for parameter settings
- ATEX-certified motor thermal protection functions for cabinet-built AC
(options +L513+Q971 and +L514+Q971) user's manual (3AXD5000001
- Pt100 relay alarm and trip limit setting instructions in the start-up inst
- circuit diagrams delivered with the drive for the actual wiring.

Starter for auxiliary motor fan (options +M600...M610)

What the option contains

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

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

Description

The output for the auxiliary fan is wired from the 3-phase supply voltage to te
block X601 through a motor starter switch and a contactor. The contactor is c
by the drive. The 230 V AC control circuit is wired through a jumper on the te

Type designation label

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

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

1 4 5 2 3 7 6

1	Type designation (see section Type designation key)
2	Frame size
3	Short-time withstand current rating (see chapter Technical data (page 223)); degree of prote UL/CSA specifications
4	Ratings. See also chapter Technical data (page 223).
5	Valid markings
6	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.
7	Link to product information

Type designation key

The type designation contains information on the specifications and confi
of the drive. The first digits from left express the basic drive type. The optiona
selections are given thereafter, separated by plus signs, eg, +E202. Codes p
by a zero (eg. +0J400) indicate the absence of the specified feature. The main se
are described below. Not all selections are available for all types. For more in
refer to the ordering instructions available separately on request.

Code	Description
Basic code	
ACS880	Product series
ACS880-07	Default configuration: air-cooled cabinet-installed drive, IP22 (UL type 1), main nector (and contactor) or breaker, aR fuses, AC input choke, ACS-AP-W assista panel (with Bluetooth), EMC filter (category 3, 2nd Environment), du/dt filters, c filtering, standard wire markings, ACS880 primary control program, Safe torque coated circuit boards, bottom entry and exit of cables with lead-through-type en lingual door device label sticker, USB memory stick containing circuit diagrams, drawings and manuals.
Size	
xxxxx	Refer to the rating tables
Voltage range	
3	380...415 V AC. This is indicated in the type designation label as typical input v (3~ 400 V AC)
5	380...500 V AC. This is indicated in the type designation label as typical input v (3~ 400/480/500 V AC)
7	525...690 V AC. This is indicated in the type designation label as typical input v (3~ 525/600/690 V AC)

Option codes

Code	Description
A004	12-pulse supply connection
B054	IP42 (UL Type 1 Filtered)
B055	IP54 (UL Type 12)
C121	Marine construction. See section Marine construction (option +C121) (page
C128	Air inlet through bottom of cabinet. See section Air inlet through the botto (option +C128) (page 82).
C129	UL Listed (evaluated to both U.S. and Canadian safety requirements). See sect (option +C129) (page 52).
C130	Channeled air outlet. See section Channeled air outlet (option +C130) (page

Code	Description
C200	Empty 600 mm wide cubicle on left. See section Empty cubicles on left (options +C199...C201) (page 53).
C201	Empty 800 mm wide cubicle on left. See section Empty cubicles on left (options +C199...C201) (page 53).
C205	Marine product certification issued by DNV GL
C206	Marine product certification issued by the American Bureau of Shipping (ABS)
C207	Marine product certification issued by Lloyd's Register (LR)
C209	Marine product certification issued by Bureau Veritas
C228	Marine product certification issued by China Classification Society (CCS)
C229	Marine product certification issued by Russian Maritime Register of Shipping (RS)
D150	Brake choppers
D151	Brake resistors
E202	EMC/RFI filter for 1st environment TN (grounded) system, category C2
E206	Sine output filter
F250	Main (line) contactor
F255	Main circuit breaker
F259	Grounding (earthing) switch
G300	Cabinet and module heating elements (external supply). See section Cabinet heater wi ternal supply (option +G300) (page 53).
G301	Cabinet lighting. See section Cabinet lighting (option +G301) (page 53).
G307	Terminals for connecting external control voltage (230 V AC or 115 V AC, eg. UPS). See section Terminals for external control voltage (option +G307) (page 53).
G313	Output for motor space heater (external supply)
G317	Supply connection by busbars
G327	Ready light on door, white
G328	Run light on door, green
G329	Fault light on door, yellow
G330	Halogen-free wiring and materials
G334	V-meter with selector switch
G335	A-meter in one phase
G340	Wire marking class A3. See section Wire markings (page 54).
G342	Wire marking class C1. See section Wire markings (page 54).
G453	Common mode filter temperature monitoring. See section Common mode filter tempera monitoring (option +G453) (page 55).
H350	Power cabling entry from bottom. See section Bottom cable entry/exit (options +H350 an +H352) (page 55).

Code	Description
H366	Common output terminals (for inverter modules mounted in the same cubicle). Descriptions of options (page 51).
J425	ACS-AP-I control panel (without Bluetooth)
K451	FDNA-01 DeviceNet™ adapter module
K454	FPBA-01 PROFIBUS DP® adapter module
K457	FCAN-01 CANopen® adapter module
K458	FSCA-01 RS-485 (Modbus/RTU) adapter module
K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCAT® adapter module
K470	FEPL-02 Ethernet POWERLINK adapter module
K475	FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET 2-port
K490	FEIP-21 Ethernet adapter module for EtherNet/IP™
K491	FMBT-21 Ethernet adapter module for Modbus TCP
K492	FPNO-21 Ethernet adapter module for PROFINET IO
K496	Connectivity for wired remote monitoring. Includes NETA-21 remote monitoring Ethernet connection, FMBT-21 Modbus/TCP adapter module (+K491). See section for wired remote monitoring (option +K496) (page 57).
K497	Connectivity for wireless remote monitoring. Includes NETA-21 remote monitori 21 Modbus/TCP adapter module (+K491) and 4G modem. See section Con remote monitoring (option +K497) (page 57).
L500	FIO-11 analog I/O extension module
L501	FIO-01 digital I/O extension module
L502	FEN-31 HTL incremental encoder interface module
L503	FDCO-01 optical DDCS communication adapter module
L504	Additional I/O terminal block. See section Additional terminal block X504 (+L504) (page 57).
L505	Thermal protection with PTC relays (1 or 2 pcs). See section Thermal protec (options +L505, +2L505, +L513, +2L513, +L536, +L537) (page 57).
L506	Thermal protection with Pt100 relays (2, 3, 5 or 8 pcs). See section Therr Pt100 relays (options +nL506, +nL514) (page 58).
L508	FDCO-02 optical DDCS communication adapter module
L513	ATEX-certified thermal protection with PTC relays (1 or 2 pcs)
L514	ATEX-certified thermal protection with Pt100 relays (3, 5 or 8 pcs)
L515	FEA-03 I/O extension adapter
L516	FEN-21 resolver interface module
L517	FEN-01 TTL incremental encoder interface module

Code	Description
M604	Starter for auxiliary motor fan, trip limit 6.3 ... 10 A
M605	Starter for auxiliary motor fan, trip limit 10...16 A
M606	Starter for auxiliary motor fan, trip limit 16...20 A
M610	Starter for auxiliary motor fan, trip limit 20...25 A
N5000	Winder control program
N5050	Crane control program
N5100	Winch control program
N5200	PCP (Progressive Cavity Pump) control program
N5300	Test bench control program
N5350	Cooling tower control program
N5450	Override control program
N5600	ESP (Electrical Submersible Pump) control program
N5700	Position control program
N5800	Offshore winch control program
N6000	Spooling control program
N8010	IEC 61131-3 application programmability
N8200	High speed (> 598 Hz) license
P902	Customized
P904	Extended warranty (30 months from delivery or 24 months from commissioning)
P909	Extended warranty (42 months from delivery or 36 months from commissioning)
P911	Extended warranty (66 months from delivery or 60 months from commissioning)
P912	Seaworthy packaging
P913	Special color (RAL Classic)
P947	Safety data calculation and validation for tailored safety functions
P948	Customized extended warranty
P952	Country of origin: Finland
P966	Special color (other than RAL Classic)
Q950	Prevention of unexpected start-up with FSO safety functions module, by activating the Safe torque off function
Q951	Emergency stop (category 0) with safety relays, by opening the main breaker/contactor
Q952	Emergency stop (category 1) with safety relays, by opening the main breaker/contactor
Q954	Earth fault monitoring for IT (ungrounded) systems
Q957	Prevention of unexpected start-up with safety relays, by activating the Safe torque off function
Q963	Emergency stop (category 0) with safety relays, by activating the Safe torque off function

Code	Description
Q982	PROFIsafe with FSO safety functions module and FPNO-21 Ethernet adapter r
Q986	FSPS-21 PROFIsafe safety functions module
R700	Printed documents in English
R701	Printed documents in German [1)]
R702	Printed documents in Italian [1)]
R703	Printed documents in Dutch [1)]
R704	Printed documents in Danish [1)]
R705	Printed documents in Swedish [1)]
R706	Printed documents in Finnish [1)]
R707	Printed documents in French [1)]
R708	Printed documents in Spanish [1)]
R709	Printed documents in Portuguese [1)]
R711	Printed documents in Russian [1)]
R712	Printed documents in Chinese [1)]
R713	Printed documents in Polish [1)]
R714	Printed documents in Turkish [1)]
V112	Module auxiliary and fan power supply connector change
V998	UCU-22...24 control unit

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

4

Mechanical installation

Contents of this chapter

This chapter tells how to examine the installation site, unpack and examine the deliv
and install the drive mechanically.

Examining the installation site

Examine the installation site. Make sure that:

- The installation site is sufficiently ventilated or cooled to remove heat from the drive. See the technical data.
- The ambient conditions of the drive meet the specifications. See the technical data.
- The material behind, above and below the drive is non-flammable.
- There is sufficient free space above the drive for cooling, maintenance, and operation of the pressure relief (if present).
- The floor that the drive cabinet is installed on is of non-flammable material, as smooth as possible, and strong enough to support the weight of the unit. Check the floor flatness with a spirit level. The maximum allowed deviation from the surface level is 5 mm (0.2 in) in every 3 meters (10 ft). Level the installation site, if necessary, as the cabinet is not equipped with adjustable feet.

Do not install the drive on an elevated platform or a recess. The module extraction/installation ramp included with the drive is only suitable for a height difference of 50 mm (2 in) maximum (ie. the standard plinth height of the drive).

Necessary tools

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

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

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

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

Moving and unpacking the drive

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

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

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

Moving the drive in its packaging

Lifting the crate with a forklift

WARNING!
Obey the local laws and regulations applicable to lifting, such as requiremen for planning the lifting, for capacity and condition of lifting equipment, ar for training of personnel.

Lifting the crate with a crane

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

b

a

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

Moving the crate with a forklift

Moving the crate with a forklift

750 mm (29.5")

Removing the transport package

Remove the transport package as follows:

1. Undo the screws that attach the wooden parts of the transport crate to each other.
2. Remove the wooden parts.
3. Remove the clamps with which the drive cabinet is mounted onto the trans

Removing the transport package

Remove the transport package as follows:

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

Moving the unpacked drive cabinet

Lifting the cabinet with a crane

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

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

Moving the unpacked drive cabinet

Lifting the cabinet with a crane

WARNING!

Obey the local laws and regulations applicable to lifting, such as requirements for planning the lifting, for capacity and condition of lifting equipment, and for training of personnel.

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

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

IP54

Moving the cabinet on rollers

WARNING!

Lay the cabinet on the rollers and move it
until close to its final location.

Remove the rollers by lifting the unit with a
forklift, pallet truck or jack.

Moving the cabinet on its back

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

Support the cabinet from below alongside the cubicle seams.

1 2

1	Cabinet back panel
2	Support

Moving the cabinet to its final position

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

Attaching the cabinet to the floor and wall or roof

General rules

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

a

> 400 mm (15.75")

w

120°

b

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

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

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

Attaching the cabinet (non-marine units)

Alternative 1 – Clamping

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

Clamping bottom to floor **Attaching top to wall**

M16

Alternative 2 – Using the holes inside the cabinet

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

Attaching bottom to floor

Attaching cabinet top to wall

M16

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

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

Attaching the cabinet (marine units)

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

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

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

2

3

d

e

a b

M16

c

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

Dimension drawing for clamp (a)

Joining cabinet sections together

Wide cabinet line-ups are delivered in multiple sections. The sections must be joined together at the installation site. There is a joining cubicle at the end of a section for this purpose. The screws for joining the sections are in a plastic bag inside the cabinet.

1. Attach the first section to the floor.
2. Remove any plates covering the rear post of the joining cubicle.
3. Align the two sections. The illustration below shows the placement of the sections.

a b c

a	First section
b	Joining cubicle
c	Second section

4. Attach the front and rear posts of the joining cubicle to the posts of the other section with 16 screws (8 per post). Tighten the screws to 5 N·m (3.7 lbf·ft).

5. Attach the second section to the floor.

6. Connect the PE (ground) busbars using the M10 bolts included. Tighten to 35...40 N·m (25...30 lbf·ft). If necessary, adjust the connection between two busbars with the spacer plates (included in the delivery).

a
b d e
c
e

a Bolt
b Spring washer
c Plain washer
d Self-clinching nut
e Spacer plate

7. Remove the shroud covering the DC busbars in the joining cubicle.

8. Connect the DC and AC busbars. Tighten the bolts to 55...70 N·m (40...50 lbf·ft).

Units with single DC busbars

Units with double DC busbars

Accessories kit identification:
Single DC busbars: 3AXD50000125876
Double DC busbars: 3AXD50000126361
Triple DC busbars (not shown): 3AXD50000126378

- a Joint piece
- b Plain washer with electroplated zinc coating and blue chromate passivation
- c Spring washer with mechanically sprayed zinc coating
- d Nut (M12)

Units with single AC busbars

c d e b
a f

Units with double AC busba

Accessories kit identification:
Single AC busbars: 3AXD50000126392
Double AC busbars: 3AXD50000126408
Triple AC busbars (not shown): 3AXD50000126514

a Bolt (M12)

b Bolt (M12)

c Joint piece

d Plain washer with electroplated zinc coating and blue chromate passivation

e Spring washer with mechanically sprayed zinc coating

f Nut (M12)

WARNING!
Make sure that you install the washers in the correct order, as shown in the illustration. For example, placing an unpassivated zinc-coated s washer directly against the joint piece will cause corrosion.

WARNING!
Do not use any joining parts other than those delivered with the unit. Th parts are carefully selected to match the material of the busbars. O parts or materials can form a galvanic couple and cause corrosion.

9. Reinstall any shrouding removed earlier.

10. Repeat procedure for any further sections.

Miscellaneous

Cable duct in the floor below the cabinet

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

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

50 (1.97") 500 (19.68") 50 (1.97")

Arc welding

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

Note: The cabinet frame is zinc-plated.

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

WARNING!
Do not inhale the welding fumes.

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

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

1 1 1 1

1 1 1 1

1 Air inlet area

Support the plinth of the cabinet all round.

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

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

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

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

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

Cubicle width (mm)	Outlet duct				
	Veloduct type	**Outer diameter (mm)**	**Inner diameter (mm)**	**Cross-sectional area (m ^{2})**	**R i**
300	BDEA-6-020	200	194	0.030	2
400	BDEA-6-031	310	304	0.073	
500	BDEA-6-031	310	304	0.073	
600	BDEA-6-040	400	394	0.122	4
700	BDEA-6-040	400	394	0.122	4
800	2 × BDEA-6-031	310	304	0.145	

or moist air is able to flow backward to the drive in any case, even during off-time or while servicing the drive or the ventilation system.

Calculating the required static pressure difference

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

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

where

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

$v_m = q / A_c$

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

Example

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

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

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

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

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

Lifting lugs and bars

Certificate of conformity

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

Declarations of conformity

Declaration of Conformity

Supply of Machinery (Safety) Regulations 2008

We
Manufacturer: ABB Oy
Address: Hiomotie 13, 00380 Helsinki, Finland.
Phone: +358 10 22 11

declare under our sole responsibility that the following products:

Lifting bars, identified with material codes

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

Lifting lugs, identified with material codes

64302621	64327151

used for lifting the following frequency converters and frequency converter components

ACS800LC	types –x7LC, LC multidrives, -x07LC
ACS580, ACH580, ACQ580	types -07
ACS880	types –x7, multidrives, -x07, -xx07
ACS880LC	types –x7LC, LC multidrives, -x07LC, -xx07

identified with serial numbers beginning with 1 or 8

are in conformity with all the relevant lifting accessory requirements of the Supply of Machinery (Safety) Regulations 2008.

Authorized to compile the technical file: ABB Oy, Hiomotie 13, 00380 Helsinki, Finland

Helsinki, 28 May 2021

Signed for and on behalf of:

Peter Lindgren	Vesa Tiihonen
Vice President, ABB Oy	Manager, Reliability and Quality, ABB Oy

5

Guidelines for planning the electr installation

Contents of this chapter

This chapter contains guidelines for planning the electrical installation of t

Limitation of liability

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

North America

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

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

Selecting the supply transformer

Basic guidelines

1. Define the apparent power of the transformer. You can use this rule of thumb:
   S_N (kVA) = 1.32 × sum of the motor shaft power (kW)
2. Define the nominal voltage for the transformer secondary winding according to the nominal input voltage of the drive. See the supply unit hardware manual.
3. Make sure that the transformer complies with the electrical power network specification of the drive. See the appropriate drive or supply unit hardware manual for:
   - nominal input voltage, allowed voltage variation and imbalance
   - nominal frequency and allowed variation
   - short-circuit withstand strength and short-circuit current protection requirements
   - etc.
4. Consider the additional notes below.
5. Contact the transformer manufacturer for more information on the transformer selection.

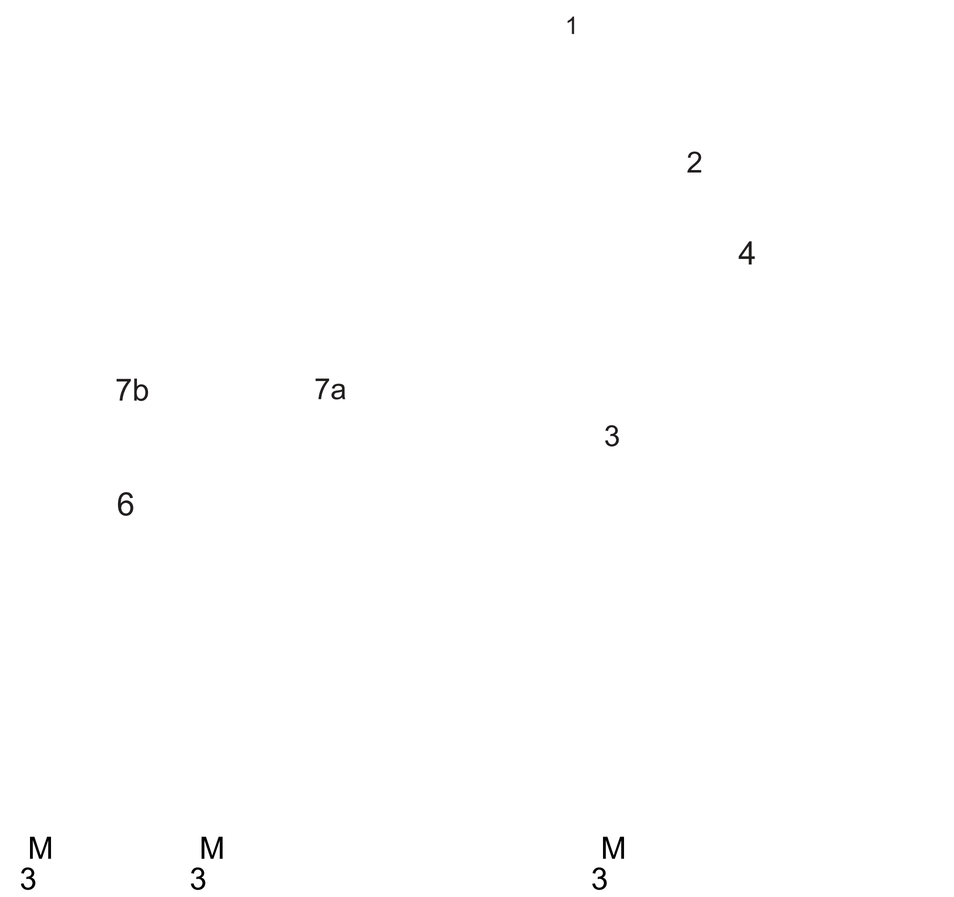
Additional notes

A drive with a 12-pulse diode supply unit

A 12-pulse diode supply unit cannot control the load sharing between its diode bridges. The load sharing depends on factors such as the transformer selection, actual state of the transformer (voltages, harmonics), supply network and cables. Load unbalance reduces the load capacity of the drive. To avoid it, and to achieve the optimal drive system performance, obey the guidelines in this section on the transformer selection and on other factors.

Use a three-winding transformer, or two two-winding transformers:

- Connection groups: three-winding transformer: Dy11d0 (or Dd0y1). Two two-winding transformers: Dy11 and Yy0.
- Phase shift between secondaries: 30° electrical
- Voltage difference between secondaries: < 0.5%
- Short-circuit impedance of secondaries: > 5%
- Short-circuit impedance difference between secondaries: < 3%
- No grounding of the secondary windings.
- Static shield is recommended.



1 Medium voltage network

2 Three-winding transformer

3 12-pulse drive

4 No grounding of transformer secondary windings is permitted

5 No load unbalance between transformer secondary windings is permitted

6 Large 6-pulse drives (possible sources of harmonics)

7 No (or only minimal) voltage distortion in medium voltage network is permitted.
   a. Path of harmful effect (harmonics) to one leg of the 12-pulse supply unit through t delta-delta connections
   b. Path of harmful effect (harmonics) to one leg of the 12-pulse supply unit through t delta-wye connections.

Use identical supply cables between the transformer secondary windings drive (type, size, length, quantity).

Make sure that there is no (or only minimal) voltage distortion in the medium system. The distortion has a negative effect on the operation of the transform the 12-pulse drive. Especially 5th and 7th order harmonics are harmful. They

If the three-winding transformer supplies power to multiple 12-pulse drives, derate the drive power rating from the nominal value according to the table below.

Number of 12-pulse drives	Drive power rating (%)
1	100
2	90
3	85
4	82
5	80

Selecting the supply disconnecting device

The drive is equipped with a main disconnecting device as standard. Depending on the size of the drive, and the selected options, the type of disconnecting device may vary. Examples: switch-disconnector, withdrawable air circuit breaker, etc.

Selecting the main contactor or breaker

Depending on the drive type and size, it is fitted with a main contactor or a main breaker by default. With certain drive types, you can select either of the two.

Examining the compatibility of the motor and drive

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

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

Make sure that the motor can be used with an AC drive. See Requirements tables (page 93). For basics of protecting the motor insulation and bearings in drive systems, see Protecting the motor insulation and bearings (page 92).

Note:

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

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

d u /d t filters protect motor insulation system and reduce bearing currents. C
mode filters reduce bearing currents. Insulated N-end (non-drive end) bearin
against bearing currents.

Requirements tables

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

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

See also Abbreviations (page 96).

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

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

See also Abbreviations (page 96).

Motor type	Nominal AC line voltage	Motor insulation system	Requirement for ABB du/dt and common mode filters, insulated N-end motor bearings	
			100 kW ≤ P_n < 350 kW or IEC 315 ≤ frame size < IEC 400	P_n ≥ 350 kW or frame size ≥ IEC 4
			134 hp ≤ P_n < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580	P_n ≥ 469 hp or frame size > NEMA
Random-wound M2_, M3_ and M4_	U_n ≤ 500 V	Standard	+ N	+ N + CMF
	500 V < U_n ≤ 600 V	Standard	+ N + du/dt	+ N + du/dt + CMF
		Reinforced	+ N	+ N + CMF
	600 V < U_n ≤ 690 V (cable length ≤ 150 m)	Reinforced	+ N + du/dt	+ N + du/dt + CMF
	600 V < U_n ≤ 690 V (cable length > 150 m)	Reinforced	+ N	+ N + CMF
Form-wound HX_ and AM_	380 V < U_n ≤ 690 V	Standard	+ N + CMF	P_n < 500 kW: +N + P_n ≥ 500 kW: +N du/dt + CMF
Old [1] form-wound HX_ and modular	380 V < U_n ≤ 690 V	Check with the motor manufacturer.	+ N + du/dt with voltages over 500 V + CMF	
Random-wound HX_ and AM_ [2]	0 V < U_n ≤ 500 V	Enamelled wire with fiber glass taping	+ N + CMF	
	500 V < U_n ≤ 690 V		+ N + du/dt + CMF	
HDP	Consult the motor manufacturer.			

1) manufactured before 1.1.1998

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

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

See also Abbreviations (page 96).

Motor type	Nominal AC line voltage	Motor insulation system [1]	Requirement for
			ABB d u /d t and common mode f
			N-end motor b
			P_n < 100 kW and frame si
			P_n < 134 hp and frame size
Random-wound and form-wound	$U_n \leq 420$ V	$\hat{U}_{LL}$ = 1300 V, 0.2 µs rise time	-
	420 V < $U_n \leq 500$ V	$\hat{U}_{LL}$ = 1300 V	+ d u /d t
		$\hat{U}_{LL}$ = 1600 V, 0.2 µs rise time	-
	500 V < $U_n \leq 600$ V	$\hat{U}_{LL}$ = 1600 V	+ d u /d t
		$\hat{U}_{LL}$ = 1800 V, 0.2 µs rise time	-
	600 V < $U_n \leq 690$ V	$\hat{U}_{LL}$ = 1800 V	+ d u /d t
		$\hat{U}_{LL}$ = 2000 V, 0.3 µs rise time	-

1) These are typical values. The network topology and grounding, drive type, cable type, cable length, a have an effect on the phase-to-phase and phase-to-ground voltages of the motor. For motor dimensio selection, refer to IEC 60034-18-41, IEC 60034-18-42 and IEC/TC 60034-25. For more information, c

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

See also Abbreviations (page 96).

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

1) These are typical values. The network topology and grounding, drive type, cable type, cable length, and motor type have an effect on the phase-to-phase and phase-to-ground voltages of the motor. For motor dimensioning and selection, refer to IEC 60034-18-41, IEC 60034-18-42 and IEC/TC 60034-25. For more information, contact ABB.

Abbreviations

Abbr.	Definition
U_n	Nominal AC line voltage
$\hat{U}_{LL}$	Peak line-to-line voltage at motor terminals which the motor insulation must withstand
P_n	Motor nominal power
d u /d t	d u /d t filter at the output of the drive
CMF	Common mode filter of the drive

Additional requirements for explosion-safe (EX) motors

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

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

Use the selection criteria given for non-ABB motors.

Additional requirements for braking applications

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

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

Additional requirements for ABB high-output and IP23 motors

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

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

Nominal AC supply voltage	Motor insulation system	Requirement for ABB du/dt and common mode filters, insulate bearings	
		$P_n < 100$ kW	100 kW ≤ $P_n <$ 200 kW
		$P_n < 140$ hp	140 hp ≤ $P_n <$ 268 hp
$U_n \leq 500$ V	Standard	-	+ N
500 V < $U_n \leq 600$ V	Standard	+ du/dt	+ du/dt + N
	Reinforced	-	+ N
600 V < $U_n \leq 690$ V	Reinforced	+ du/dt	+ du/dt + N

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

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

If you plan to use a non-ABB high-output motor or an IP23 motor, consider th additional requirements for protecting the motor insulation and bearings i

Nominal AC supply voltage	Motor insulation system 1)	Requirement for	
		ABB d u /d t and common mode filters, insulated N-end motor bearings	
		P_n < 100 kW or frame size < IEC 315	100 kW < P_n < 350 IEC 315 < frame size < 400
		P_n < 134 hp or frame size < NEMA 500	134 hp < P_n < 469 NEMA 500 < frame si NEMA 580
$U_n \leq 420$ V	$\hat{U}_{LL}$ = 1300 V, 0.2 μs rise time	+ N or CMF	+ N or CMF
420 V < U_n < 500 V	$\hat{U}_{LL}$ = 1300 V	+ d u /d t + (N or CMF)	+ N + d u /d t + CMF
	$\hat{U}_{LL}$ = 1600 V, 0.2 μs rise time	+ N or CMF	+ N or CMF
500 V < $U_n \leq 600$ V	$\hat{U}_{LL}$ = 1600 V	+ d u /d t + (N or CMF)	+ N + d u /d t + CMF
	$\hat{U}_{LL}$ = 1800 V, 0.2 μs rise time	+ N or CMF	+ N + CMF
600 V < $U_n \leq 690$ V	$\hat{U}_{LL}$ = 1800 V	+ N + d u /d t	+ N + d u /d t + CMF
	$\hat{U}_{LL}$ = 2000 V, 0.3 μs rise time	+ N + CMF	+ N + CMF

1) These are typical values. The network topology and grounding, drive type, cable type, cable length, and motor type have an effect on the phase-to-phase and phase-to-ground voltages of the motor. For motor dimensioning and selection, refer to IEC 60034-18-41, IEC 60034-18-42 and IEC/TC 60034-25. For more information, contact ABB.

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

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

- Peak line-to line voltage: Read the relative $\hat{U}_{LL}/U_n$ value from the diagram be and multiply it by the nominal supply voltage (U_n).
- Voltage rise time (t_r): Read the d u /d t value from the diagram below. Substitute the $\hat{U}_{LL}$ (in kV) and d u /d t values into equation $t_r = 0.8 \cdot \hat{U}_{LL}/(d u /d t)$.

A

3.0
2.5
2.0
1.5
1.0
0.5
0.0

$\hat{U}_{LL}/U_n$

$\frac{du/dt}{U_n}$ (1/ s)

0 50 100 150 200 250 300 35

l (m)

B

5.0
4.0
3.0
2.0
1.0
0.0

$\frac{du/dt}{U_n}$ (1/ s)

$\hat{U}_{LL}/U_n$

0 50 100 150 200 250 300 35

l (m)

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

Additional note for sine filters

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

Selecting the power cables

Power cable selection procedure and applicability check

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

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

General guidelines

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

- **Current: Select a cable capable of carrying the maximum load current and suitable** for the prospective short-circuit current provided by the supply network. The method of installation and ambient temperature affect the cable current carrying capacity. Obey local regulations and laws.
- **Temperature: For an IEC installation, select a cable rated for at least 70 °C (158 °F)** maximum permissible temperature of conductor in continuous use.

  For North America, select a cable rated for at least 75 °C (167 °F).

  Important: For certain product types or option configurations higher temperature rating may be required. See the technical data for details.
- **Voltage: 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted** for up to 600 V AC. 1000 V AC cable is accepted for up to 690 V AC.

To comply with the EMC requirements of the CE mark, use one of the preferred cable types. See Preferred power cable types (page 101).

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

Power cable types

Preferred power cable types

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

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

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

Alternate power cable types

Cable type	Use as input power cabling	Use as motor ca brake resistor
	Yes	Yes with phase

Cable type	Use as input power cabling	Use as motor cabling and as brake resistor cabling
Shielded (Al/Cu shield or armor) 1) four-conductor cable (three phase conductors and a PE)	Yes	Yes with motors up to 100 kW (135 hp). A potential equaliza between the frames of motor driven equipment is required.
PE A single-core cable system: three phase conductors and PE conductor on cable tray L1 L2 L3 L2 L3 L3 L1 L1 L2 Preferable cable arrangement to avoid voltage or current unbalance between the phases	Yes **WARNING!** If you use unshielded single-core cables in an IT network, make sure that the non-conductive outer sheath (jacket) of the cables have good contact with a properly grounded conductive surface. For example, install the cables on a properly grounded cable tray. Otherwise voltage may become present on the non-conductive outer sheath of the cables, and there is even a risk of an electric shock.	No

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

Not allowed power cable types

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

1 2 3 4 5

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

Grounding requirements

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

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

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

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

Cross-sectional area of the phase conductors S (mm^2)	Minimum cross-sectional area of protective earth co S_p (mm^2)
S ≤ 16	S 1)
16 < S ≤ 35	16
35 < S	S/2

1) For the minimum conductor size in IEC installations, refer to Additional grounding requiremen

Additional grounding requirements – IEC

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

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

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

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

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

Additional grounding requirements – UL (NEC)

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

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

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

Selecting the control cables

Shielding

Only use shielded control cables.

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

a

b

Signals in separate cables

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

Signals that can be run in the same cable

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

Relay cable

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

Control panel to drive cable

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

PC tool cable

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

Routing the cables

General guidelines – IEC

- Route the motor cable away from other cables. Motor cables of several d be run in parallel installed next to each other.
- Install the motor cable, input power cable and control cables on separate
- Avoid long parallel runs of motor cables with other cables.

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

1
min. 300 mm (12 in)
2
4
4
min. 300 mm (12 in)
min. 500 mm (20 in)
2
3
90°
3
min. 200 mm (8 in)
2
1
min. 500 mm (20 in)
3

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

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

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

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

■ Separate control cable ducts

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

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

Protecting the input cabling and the drive upon a short-circ

To protect the input cable in short-circuit situations, install fuses or a suita breaker at the supply side of the cabling.

The drive is equipped with fuses as standard. In case of a short-circuit inside the fuses protect the drive, restrict drive damage, and prevent damage to equipment.

Protecting the motor and motor cable in short-circuits

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

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

The electronic power output short-circuit protection circuitry meets the rec of IEC 60364-4-41 2005/AMD1.

Protecting the drive and the power cables against thermal o

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

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

Protecting the motor against thermal overload

According to regulations, the motor must be protected against thermal ov the current must be switched off when overload is detected. The drive include motor thermal protection function that protects the motor and switches of

Protecting the motor against overload without thermal model or temperature sensors

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

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

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

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

For more information, see drive firmware manual.

Protecting the drive against ground faults

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

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

Residual current device compatibility

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

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

Implementing the emergency stop function

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

See the appropriate option manual for more information.

Note: The UCU control unit does not support options +Q978 and +Q979.

Option code	User's manual	Manual co (Englis

Implementing the Safe torque off function

See chapter The Safe torque off function (page 307).

Implementing the Prevention of unexpected start function

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

See the appropriate option manual for more information.

Note: The UCU control unit does not support option +Q950.

Option code	User's manual
+Q950	Prevention of unexpected start-up, with FSO-xx safety functions module
+Q957	Prevention of unexpected start-up, with safety relay

Implementing an ATEX-certified motor thermal pro

With option +Q971, the drive provides ATEX-certified safe motor disconnectio contactor using the drive Safe torque off function. To implement the thermal p of a motor in explosive atmosphere (Ex motor), you must also:

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

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

For more information, see:

User's manual

Implementing the functions provided by the FSO safety functions module

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

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

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

See the appropriate manual for more information.

Note: The UCU control unit does not support options +Q973 and +Q972.

Name	Code
FSO-12 safety functions module user's manual	3AXD500000
FSO-21 safety functions module user's manual	3AXD500000

Implementing the power loss ride-through function

If the incoming supply voltage is cut off, the drive will continue to operate by utilizing the kinetic energy of the rotating motor. The drive will be fully operational as long as the motor rotates and generates energy to the drive.

If the drive is equipped with a main contactor or breaker, it restores the drive input power after a short break. The contactor re-connects after the break automatically. If the drive is equipped an external uninterruptible auxiliary power supply (option +G307), it keeps the main contactor closed in power-loss situations

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

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

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

WARNING!

installation must be clearly marked as defined in IEC/EN/UL 61800-5-1, subc
6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

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

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

Supplying power for the auxiliary circuits

The user must supply these options from external power sources:

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

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

Using power factor compensation capacitors wit drive

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

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

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

1. Do not connect a high-power capacitor to the power line while the drive i
connected. The connection will cause voltage transients that may trip or
damage the drive.
2. If capacitor load is increased/decreased step by step when the AC drive
connected to the power line, make sure that the connection steps are lov
not to cause voltage transients that would trip the drive.

Implementing the control of a contactor between drive and motor

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

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

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

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

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

Protecting the contacts of relay outputs

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

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

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

230 V AC

1

2

230 V AC

3

+ 24 V DC

4

1 Relay output

2 Varistor

3 RC filter

4 Diode

Implementing a motor temperature sensor conne

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

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

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

You have these implementation alternatives:

1. If there is double or reinforced insulation between the sensor and the live
of the motor: You can connect the sensor directly to the analog/digita
of the drive. See the control cable connection instructions. Make sure th
voltage is not more than the maximum allowed voltage over the sensor.
2. If there is basic insulation between the sensor and the live parts of the m
if the insulation type is not known: You can connect the sensor to the dri
option module. The sensor and the module must form a double or reinfo

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

This table shows:

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

Option module		Temperature sensor type			Temperature senso sulation requirem
Type	**Insulation/Isolation**	**PTC**	**KTY**	**Pt100, Pt1000**	
FIO-11	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and other I/O connectors.	x	x	x	Reinforced insula
FEN-01	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and TTL encoder emulation output.	x	-	-	Reinforced insula
FEN-11	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and TTL encoder emulation output.	x	x	-	Reinforced insula
FEN-21	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and TTL encoder emulation output.	x	x	-	Reinforced insula
FEN-31	Galvanic isolation between sensor connector and drive control unit connector. No isolation between sensor connector and other connect-ors.	x	x	-	Reinforced insula
FAIO-01	Basic insulation between sensor connector and drive control unit	x	x	x	Reinforced or basic lation. With basic in

6

Electrical installation

Contents of this chapter

This chapter contains instructions on the wiring of the drive.

Warnings

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

Measuring the insulation

Measuring the insulation resistance of the drive

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

Measuring the insulation resistance of the motor and motor cable

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

1. Do the steps in section Electrical safety precautions (page 21) before you start the work.
2. Make sure that the motor cable is disconnected from the drive output terminals.
3. Measure the insulation resistance between each phase conductor and the protective earth conductor. Use a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must be more than 100 Mohm (reference value at 25 °C [77 °F]). For the insulation resistance of other motors, refer to the manufacturer's instructions.

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

U1
M
U1-PE, V1-PE, W1-PE
V1
3~
1000 V DC,
> 100 Mohm
ohm
W1
PE

Measuring the insulation resistance of the input power cable

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

Compatibility check - IT (ungrounded) earthing system

Drives with a category 2, 1st environment EMC filter (option +E202) are not suitable for use in an IT (ungrounded) supply network system. If the drive is equipped with option +E202, disconnect the filter before connecting the drive to the IT supply network. Contact ABB for instructions.

WARNING!
Do not install a drive equipped with EMC filter +E202 on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system). The system will be connected to ground potential through the EMC filter capacitors of the drive. This can cause danger, or damage the drive.

Checking the settings of transformers T21, T101 and T

Check the tap settings of all auxiliary voltage transformers. Transformer T21 is stand equipment; T101 and T111 are present depending on drive configuration.

The voltage settings of transformers T21 and T101 are made at terminal blocks T21_X1/X2 and T101_X1/X2 respectively. The settings of transformer T111 are mad on the transformer itself. The locations of the transformers and the terminal bloc are shown in section Operation principle and hardware description (page

T21 and T101 tap settings (400...500 V units)

T21_X1
T101_X1

500 V	1	1
480 V	2	
460 V	3	
440 V	4	2
415 V	5	3
400 V	6	
380 V	7	4
U1	8	5
TP1	9	
TP2	10	

T21 and T101 tap settings (690 V units)

T21_X1
T101_X1

690 V	1
660 V	2
600 V	3
575 V	4
540 V	5
525 V	6
	7
U1	8
TP1	9
TP2	10

T21_X2
T101_X2

1	230 V
2	
3	
4	N
5	

T111 tap settings

3~ input

3~ output

Supply voltage	Terminals	3~ input: Tap settings A1–	B1–	C1–	3~ ou Term 400 V (50 Hz)
690 V	A1, B1, C1	C2	A2	B2	a1, b1, c1
660 V	A1, B1, C1	C2	A2	B2	a1, b1, c1
600 V	A1, B1, C1	C3	A3	B3	a1, b1, c1
575 V	A1, B1, C1	C3	A3	B3	a1, b1, c1
540 V	A1, B1, C1	C4	A4	B4	a1, b1, c1
525 V	A1, B1, C1	C4	A4	B4	a1, b1, c1
500 V	A1, B1, C1	C4	A4	B4	a1, b1, c1
480 V	A1, B1, C1	C5	A5	B5	a1, b1, c1

Connecting the control cables

See chapter Control units of the drive (page 143) for the default I/O connections of the inverter unit (with the ACS880 primary control program). The default I/O connections can be different with some hardware options. See the circuit diagrams delivered with the drive for the actual wiring. For other control programs, see their firmware manuals.

Control cable connection procedure

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

1. Do the steps in section Electrical safety precautions (page 21) before you start the work.
2. Run the control cables into the cabinet as described in section Grounding the outer shields of the control cables 360° at the cabinet entry (page 120).
3. Route the control cables as described in section Routing the control cables inside the cabinet (page 122).
4. Connect the control cables as described in section Connecting control cabling (page 122).

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

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

1. If necessary, remove the shrouding in front of the cable entry.
2. Put the cables in sequence from the smallest to the largest. This will help to achieve a good contact with the cushions.
3. Loosen the tightening bolts of the EMI conductive cushions and pull them apart.
4. Cut holes in the grommets and put the cables through the grommets.
5. Peel the insulation from the part of the cable that will be in contact with the EMI conductive cushion.
6. Put the cables between the cushions and attach them with cable ties for strain relief.
7. Move the cushions back together.
8. Tighten the bolts to make sure that the EMI conductive cushions press tightly around the peeled part of the cables.

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

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

A B C

1 2 3 4 2

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

Routing the control cables inside the cabinet

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

Connecting control cabling

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

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

Obey these instructions:

- Connect the inner twisted pair shields and all separate grounding wires to the grounding clamps near the terminals.
- Ground the outer shield of the cable at the cable entry, not at the grounding clamps near the terminals.
- Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.
- At the other end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, eg. 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.

The drawing below represents the grounding of the control cabling when conne
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.

Connecting the motor cables (units without commor motor terminal cubicle or sine output filter)

On units without a common motor terminal cubicle or a sine output filter, the mo
cables connect to busbars located behind the inverter module(s). The location a
dimensions of the busbars are shown in the dimension drawings delivered with
drive and in the example drawings in this manual.

Motor connection diagram (without option +H366)

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

360° grounding must be used at the cable entries.

Inverter unit cubicle(s)

The recommended cable types are given in the technical data.

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

Inverter unit cubicle(s)

Motor connection diagram (with option +H366)

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

PE

W2
V2
U2

Bridging busbars

W2
V2
U2

Inverter unit cubicle(s)

The recommended cable types are given in the technical data.

WARNING!
The bridging can carry the nominal output of one inverter module. In case of three parallel modules, make sure that the load capacity of the bridging is no exceeded. For example, if the cabling connects to the output busbars at one module only, use the module in the middle.

Note: The +H366 option only interconnects the outputs of inverter modules wit the same cubicle, not modules installed in different cubicles. Therefore, when the dri has multiple inverter cubicles (ie. two cubicles of two modules each), make sure that the motor cabling is identical for both cubicles.

Procedure

To get more space for cabling work, you can remove the inverter modules or the fan carriages of each module. Especially in the case of multiple inverter modules in the same cubicle, you can consider only removing the fan carriages. This is faster than removing the entire module, but gives less free space for the work than removing the module.

Removing an inverter module

Refer to section Removing an inverter module (page 202).

Removing the fan carriage of an inverter module

Refer to the drawings below.

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

3. Remove the screws holding the front cover plate. Lift the cover plate somewhat to release it.
4. Disconnect the wiring at the top of the fan carriage.
5. Remove the two screws at the bottom of the fan carriage.

   WARNING!
   Before you proceed, make sure the two screws holding the top of the inverter module are in place.

6. Remove the two screws at the top of the fan carriage. (During reassembly, tighten these screws to 22 N·m [16 lbf·ft].)

   Note: Units with marine or seismic design have an additional transverse bracket that is attached to the module with these screws. At this point, loosen the retaining screws of the bracket at the left and the right ends and remove it. (During reassembly, tighten the bracket retaining screws to 9 N·m [6.6 lbf·ft].)
7. Pull the fan carriage out.
8. Repeat the procedure for other fan carriages in the same cubicle.

Electrical ins

Electrical ins

4

5

6

Connecting the motor cables

Refer to the drawings below.

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

1. Do the steps in section Electrical safety precautions (page 21) before you start the work.
2. Remove the shroud in front of the output busbars.
3. For 360° grounding of the shield at the cable entry, remove the outer jacket of each cable where they pass through the cable entry (a).
4. Cut the cable to suitable length and strip the ends of the individual conductors. Twist the shield strands together to form a separate conductor and wrap it with tape.
5. Crimp suitable lug terminals onto the phase conductors and the ground conductor. The dimensions of the output busbars are shown in chapter Technical data.
6. Connect the phase conductors of the motor cable to the U2, V2 and W2 terminals. You can temporarily remove the plastic insulators (b) between the busbars to make the connecting work easier. See Use of fasteners in cable lug connections (page 135).

   WARNING!
   The plastic insulators (b) between the busbars must be in place when the inverter is powered.

7. Connect the shield (and any grounding conductors) of the cable to the PE busbar close to the cable entries.
8. Secure the cable mechanically.
9. Repeat the procedure for other modules (if any).
10. Refit the shroud removed earlier.
11. At the motor, connect the cables according to instructions from the motor manufacturer. Pay special attention to the phase order. For minimum radio-frequency interference, ground the cable shield 360° at the cable entry of the motor terminal box, or ground the cable by twisting the shield so that the flattened shield is wider than 1/5 of its length.

Electrical ins

360° groundin

5 6

b 7

PE

2 10

11

Installing the fan carriage of an inverter module

(If the inverter module was removed completely instead of only the fan carriage, proceed to section Installing an inverter module (page 207)).

The installation of the fan carriage is the removal procedure in reverse. See section Removing the fan carriage of an inverter module (page 125).

Installing an inverter module

Refer to section Installing an inverter module (page 207).

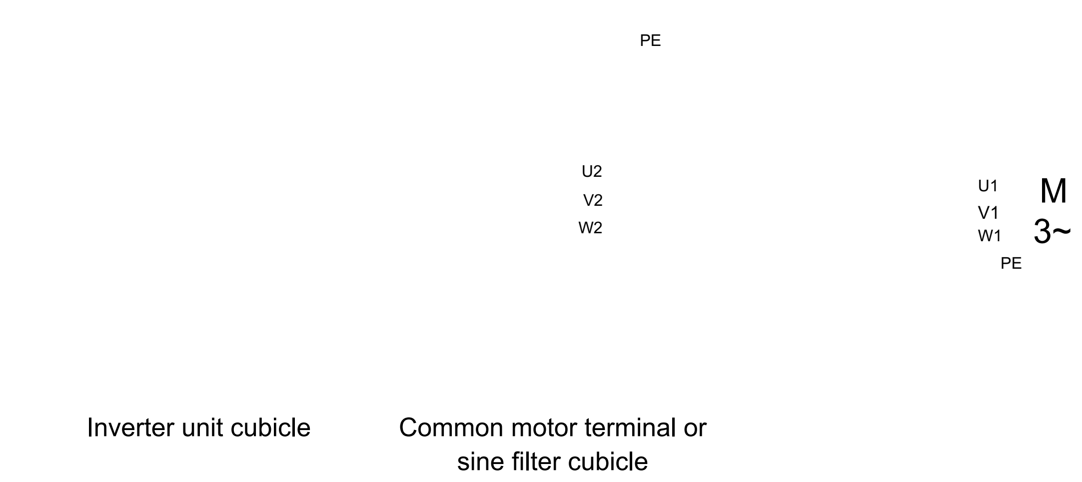
Connecting the motor cables (units with common motor terminal cubicle or sine output filter)

Output busbars

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

The location and dimensions of the busbars are visible in the dimensional drawings delivered with the drive.

Connection diagram



The recommended cable types are given in the technical data.

Procedure

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

1. Do the steps in section Electrical safety precautions (page 21) before you start

Grommet

4. Cut the cables to suitable length. Strip the cables and conductors.
5. Twist the cable screens into bundles and connect the bundles to the PE busbar in the cubicle.
6. Connect any separate ground conductors/cables to the PE busbar in the cu Refer to section Use of fasteners in cable lug connections (page 135)
7. Connect the phase conductors to the output terminals. Use the tightening torque specified in section Tightening torques (page 248).
8. Refit any shrouding removed earlier and close the cubicle doors.
9. At the motor, connect the cables according to instructions from the motor manufacturer. Pay special attention to the phase order. For minimum radio-frequency interference, ground the cable shield 360° at the cable entr the motor terminal box, or ground the cable by twisting the shield so that th flattened shield is wider than 1/5 of its length.

Connecting an external brake resistor assembly

See chapter Resistor braking (page 333).

For the location of the terminals, refer to the dimension drawings delivered with unit or the dimension drawing examples in this manual.

Connecting the input power cables

Connection diagram, 6-pulse units

1

L1

L2

L3

PE

2

1 Fuses or other protection means for short-circuit protection of the cable.

2 Grounding of the cable shield at the cable entry (360-degree grounding).

Additional information:

- See the technical data for the dimensions of the cable entries, and the dimensions and tightening torques of the terminals.
- Use a separate PE conductor in addition if the conductivity of the shields does not meet the requirement for the PE conductor.

Connection diagram, 12-pulse units

1

1L1

1L2

1L3

PE

2L1

2L2

2L3

PE

2

1 Fuses or other protection means for short-circuit protection of the cable.

2 Grounding of the cable shield at the cable entry (360-degree grounding).

Additional information:

- See the technical data for the dimensions of the cable entries, and the dimensions and tightening torques of the terminals.

Layout of the input cable connection terminals and cable entries

The location and dimensions of the busbars are visible in the dimensional drawi delivered with the drive. Alternatively, see the example dimension drawings in th manual.

Connection procedure

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

1. Do the steps in section Electrical safety precautions (page 21) before the work.
2. Open the door of the incoming cubicle.
3. Remove the shrouding covering the input terminals.
4. Peel off 3...5 cm (1.2 ... 2 inches) of the outer insulation of the cables above the cable entry plate for 360° high-frequency grounding.
5. Prepare the ends of the cables.

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

PE PE

6. Remove rubber grommets from the cable entries for the cables to be connected Cut adequate holes into the rubber grommets. Slide the grommets onto the cab Slide the cables into the cubicle through the conductive sleeves and attach the grommets to the holes.

7. Attach the conductive sleeves to the cable shields with cable ties. Tie up the unused conductive sleeves with cable ties.

8. Connect the twisted shields of the cables to the PE busbar of the cabinet.

9. Connect the phase conductors of the input cable to the L1, L2 and L3 terminals. (With 12-pulse connection, the terminals are 1L1, 1L2 and 1L3 for one 6-pulse supply line, 2L1, 2L2 and 2L3 for the other.) See Use of fasteners in cable lug connections (page 135). Tighten the screws to the torque given under Tightening

Use of fasteners in cable lug connections

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

Cable lug on one side of the busbar

1 2 3 4 2 5 6

Cable lugs on both sides of the busbar

1 5 2 4 3 4 2 5 6

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

Connecting a PC

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

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

1. To connect a control panel to the unit, either
   - insert the control panel into the panel holder or platform, or
   - use an Ethernet (eg, Cat 5e) networking cable.
2. Remove the USB connector cover on the front of the control panel.
3. Connect an USB cable (Type A to Type Mini-B) between the USB connector on

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

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

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

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

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

   Repeat the above for each drive.

2. With the panel connected to one unit, link the units using Ethernet cables.

3. Switch on the bus termination on the drive that is farthest from the control panel in the chain.
   - With drives that have the panel mounted on the front cover, move the terminating switch into the outer position.
   - With the FDPI-02 module and BCU-02 control unit: move termination switch S1 on the FDPI-02 module into the TERMINATED position.
   - With the FDPI-02 module and UCU-22...24 control unit: move termination switch S1 on the FDPI-02 module into the OPEN position. Move control panel connection termination switch XPAN TERM on the UCU-22...24 control unit to ON position.

   Make sure that bus termination is off on all other drives.

4. On the control panel, switch on the panel bus functionality (Options - Select drive - Panel bus). The drive to be controlled can now be selected from the list under Options - Select drive.

With twin connectors in the control panel holder:

1 2 3

1

With FDPI-02 modules and BCU control unit:

1

1

2

2

3

Installing option modules

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

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

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

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

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

Installation of an FSO safety functions module onto BCU

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

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

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

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

4. Torque the FSO module electronics grounding screw to 0.8 N·m (7.1 lbf·in).

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

5. Connect the FSO module data cable between FSO connector X110 and BCU connector X12.

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

Wiring of option modules

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

7

Control units of the drive

Contents of this chapter

This chapter

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

General

The drive utilizes either BCU-x2 control units or UCU-22...24 control units

The supply and inverter units of the drive are each controlled by a dedicated unit. The designation of the supply control unit is A51; the inverter control uni Both are connected to the power modules (ie. supply and inverter modules re by fiber optic cables.

In this manual:

- the name "BCU-x2" represents the control unit types BCU-02 and BCU- have a different number of power module connections (2 and 7 respectiv are otherwise similar.
- the name "UCU-22...24" represents the control unit types UCU-22 and U

BCU layout

	Description
I/O	I/O terminals (see following diagram)
SLOT 1	I/O extension, encoder interface or fieldbus adapter module connection. (This is the sole location for an FDPI-02 diagnostics and panel interface.)
SLOT 2	I/O extension, encoder interface or fieldbus adapter module connection
SLOT 3	I/O extension, encoder interface, fiel bus adapter or FSO safety functions module connection
SLOT 4	RDCO-0x DDCS communication opt 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 l (D2D)
DICOM= DIOGND	Ground selection. Determines wheth DICOM is separated from DIOGND (ie. the common reference for the digital puts floats). See the ground isolation diagram.

7-segment display

Multicharacter indications are displayed as repeated sequences of characters

	("U" is indicated briefly before "o".) Control program running
	Control program startup in progress
	(Flashing) Firmware cannot be starte Memory unit missing or corrupted
	Firmware download from PC to contr unit in progress

XRO3 XD24 XPOW

XRO2 XDIO XAO

XRO1

X485 XDI XAI

XD2D XSTO XSTO OUT

	Description
XAI	Analog inputs
XAO	Analog outputs
XDI	Digital inputs, Digital inp
XDIO	Digital input/outputs
XD2D	Drive-to-drive link
XD24	+24 V output (for digital
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 connecti
XSTO OUT	Safe torque off connecti modules)
X12	(On the opposite side) Co safety functions module
X13	Control panel / PC conn
X485	Not in use
V1T/V1R, V2T/V2R	Fiber optic connection to (VxT = transmitter, VxR =
V3T/V3R ... V7T/V7R	Fiber optic connection to (BCU-12/22 only) (VxT = transmitter, VxR =
V8T/V8R ... V12T/V12R	Fiber optic connection to (BCU-22 only) (VxT = transmitter, VxR =
SD CARD	Data logger memory car module communication
BATT OK	Real-time clock battery than 2.8 V. If the LED is o trol unit is powered, repl
FAULT	The control program has See the firmware manua verter unit.
PWR OK	Internal voltage supply i
WRITE	Writing to memory card not remove the memory

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

The diagram below shows the default I/O connections on the supply control unit (A51), and describes the use of the connections in the supply unit. Under normal circumstances, the factory-made wiring should not be changed.

The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 ... 2.5 mm^2 (22...12 AWG). The tightening torque is 0.45 N·m (4 lbf·in).

Terminal			**Description**	
XD2D			Drive-to-drive link	
1	1	B	Not in use by default	
2	2	A		
3	3	BGND		
4	4	Shield		
	D2D.TERM		Drive-to-drive link termination switch [1)]	
X485			RS485 connection	
5	5	B	Not in use by default	
6	6	A		
7	7	BGND		
8	8	Shield		
XRO1, XRO2, XRO3			Relay outputs	
11	11	NC	Norm. closed	XRO1: Running [2)] (Energized = runn 250 V AC / 30 V DC, 2 A
12	12	COM	Common	
13	13	NO	Norm. open	
21	21	NC	Norm. closed	XRO2: Fault (-1) [2)] (Energized = no 250 V AC / 30 V DC, 2 A
22	22	COM	Common	
23	23	NO	Norm. open	
31	31	NC	Norm. closed	XRO3: MCB ctrl [3)] (Energized = clos main contactor/breaker) 250 V AC / 30 V DC, 2 A
32	32	COM	Common	
33	33	NO	Norm. open	
XSTO, XSTO OUT			Safe torque off [4)]	
1	1	OUT	XSTO: Factory connection. Both circuits must be closed for the drive to start (IN1 and IN2 must be connected to OUT).	
2	2	SGND		
3	3	IN1		
4	4	IN2		
5	5	IN1		

Terminal			Description
1	1	DI1	**Temp fault** [2)] (0 = overtemperature)
2	2	DI2	**Run enable** [2)] (1 = run enable)
3	3	DI3	**MCB feedback** [3)] (0 = main contactor/breaker open)
4	4	DI4	**Auxiliary circuit breaker fault** [2)]
5	5	DI5	Not in use by default. Can be used for eg. earth fault monitorin
6	6	DI6	**Reset** [2)] (0 -> 1 = fault reset)
7	7	DIIL	Not in use by default. Can be used for eg. emergency stop.
XDIO			Digital input/outputs
1	1	DIO1	Not in use by default
2	2	DIO2	Not in use by default
3	3	DIOGND	Digital input/output ground
4	4	DIOGND	Digital input/output ground
XD24			Auxiliary voltage output
5	5	+24VD	+24 V DC 200 mA [5)]
6	6	DICOM	Digital input ground
7	7	+24VD	+24 V DC 200 mA [5)]
8	8	DIOGND	Digital input/output ground
	DICOM=DIOGND		Ground selection switch [6)]
XAI			Analog inputs, reference voltage output
1	1	+VREF	10 V DC, R_L 1...10 kohm
2	2	-VREF	-10 V DC, R_L 1...10 kohm
3	3	AGND	Ground
4	4	AI1+	Not in use by default. 0(2)...10 V, R_{in} > 200 kohm [7)]
5	5	AI1-	
6	6	AI2+	Not in use by default. 0(4)...20 mA, R_{in} = 100 ohm [8)]
7	7	AI2-	
	AI1		AI1 current/voltage selection switch
	AI2		AI2 current/voltage selection switch
XAO			Analog outputs
1	1	AO1	**Zero (no signal indicated)** [2)] 0...20 mA, R_L < 500 ohm
2	2	AGND	
3	3	AO2	**Zero (not signal indicated)** [2)] 0...20 mA, R_L < 500 ohm
4	4	AGND	

Terminal	Description
X205	Memory unit connection

1) Must be set to ON when the supply unit is the first or last unit on the drive-to-drive (D2D) link. On intermediate units, set termination to OFF.
2) Default use of the signal in the control program. The use can be changed by a parameter. See also the delivery-specific circuit diagrams.
3) Use of the signal in the control program (fixed). See also the delivery-specific circuit diagrams.
4) This input only acts as a true Safe torque off input in inverter 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.
5) Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.
6) Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.
7) Current [0(4)...20 mA, R_{in} = 100 ohm] or voltage [0(2)...10 V, R_{in} > 200 kohm] input selected by switch AI1. Cha of setting requires reboot of control unit.
8) Current [0(4)...20 mA, R_{in} = 100 ohm] or voltage [0(2)...10 V, R_{in} > 200 kohm] input selected by switch AI2. Cha of setting requires reboot of control unit.

Default I/O diagram of the inverter control unit (BC

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

The wire size accepted by all screw terminals (for both stranded and solid wi 0.5 ... 2.5 mm ^{2} (22...12 AWG). The tightening torque is 0.45 N·m (4 lbf·in).

Terminal			Description	
XD2D			Drive-to-drive link	
1 2 3 4	1	B	Drive-to-drive link. Refer to section The XD2D connect	
	2	A		
	3	BGND		
	4	Shield		
	D2D.TERM		Drive-to-drive link termination switch. Must be set to ON wl unit is the first or last unit in the drive-to-drive (D2D) link. On in units, set termination to OFF.	
X485			RS485 connection	
5 6 7 8	5	B	Not in use by default	
	6	A		
	7	BGND		
	8	Shield		
XRO1, XRO2, XRO3			Relay outputs	
11 12 13 21 22 23 31 32 33	11	NC	Norm. closed	XRO1: Ready (Energiz 250 V AC / 30 V DC, 2 A
	12	COM	Common	
	13	NO	Norm. open	
	21	NC	Norm. closed	XRO2: Running (Energ 250 V AC / 30 V DC, 2 A
	22	COM	Common	
	23	NO	Norm. open	
	31	NC	Norm. closed	XRO3: Fault (-1) (Ener 250 V AC / 30 V DC, 2 A
	32	COM	Common	
	33	NO	Norm. open	
XSTO, XSTO OUT			Safe torque off	
1 2 3 4 5	1	OUT	XSTO: Factory connection. Both circuits must be closed fo start (IN1 and IN2 must be connected to OUT). Refer to chapte torque off function.	
	2	SGND		
	3	IN1		
	4	IN2		
	5	IN1		

Terminal			Description
	1	DI1	Stop (0) / Start (1)
1	2	DI2	Forward (0) / Reverse (1)
2			
3	3	DI3	Reset
4	4	DI4	Acceleration & deceleration select 1)
5	5	DI5	Constant speed 1 select (1 = on) 2)
6	6	DI6	Not in use by default.
7	7	DIIL	Run enable 3)
XDIO			Digital input/outputs
1	1	DIO1	Output: Ready
2	2	DIO2	Output: Running
3	3	DIOGND	Digital input/output ground
4	4	DIOGND	Digital input/output ground
XD24			Auxiliary voltage output
5	5	+24VD	+24 V DC 200 mA 4)
6	6	DICOM	Digital input ground
7	7	+24VD	+24 V DC 200 mA 4)
8	8	DIOGND	Digital input/output ground
	DICOM=DIOGND		Ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). ON: DICOM con nected to DIOGND. OFF: DICOM and DIOGND separate.
XAI			Analog inputs, reference voltage output
	1	+VREF	10 V DC, R_L 1 ... 10 kohm
1	2	-VREF	-10 V DC, R_L 1 ... 10 kohm
2			
3	3	AGND	Ground
4	4	AI1+	Speed reference. 0(2)...10 V, R_{in} > 200 kohm 5)
5	5	AI1-	
6	6	AI2+	Not in use by default. 0(4)...20 mA, R_{in} = 100 ohm 6)
7	7	AI2-	
	AI1		AI1 current/voltage selection switch
	AI2		AI2 current/voltage selection switch
XAO			Analog outputs
1	1	AO1	**Motor speed rpm 0 ... 20 mA, R** $_L$ < 500 ohm
2	2	AGND	
3	3	AO2	

Terminal	Description
X205	Memory unit connection

1) 0 = Acceleration/deceleration ramps defined by parameters 23.12/23.13 in use.
1 = Acceleration/deceleration ramps defined by parameters 23.14/23.15 in use.
2) Constant speed 1 is defined by parameter 22.26.
3) The DIIL input is configured to stop the unit when the input signal is removed. This input does not have a SIL classification.
4) Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.
5) Current [0(4)...20 mA, R_{in} = 100 ohm] or voltage [0(2)...10 V, R_{in} > 200 kohm] input selected by of setting requires reboot of control unit.
6) Current [0(4)...20 mA, R_{in} = 100 ohm] or voltage [0(2)...10 V, R_{in} > 200 kohm] input selected by of setting requires reboot of control unit.

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

	XRO1...XRO3
NC	11
COM	12
NO	13
NC	21
COM	22
NO	23
NC	31
COM	32
NO	33
	XSTO
OUT	1
SGND	2
IN1	3
IN2	4
	XDI
D1 I	1
D2 I	2
D3 I	3
DI4	4
DI5	5
D6 I	6
DIIL	7
	XD24
+24VD	5
DC I OM	6
+24VD	7
I D OGND	8
	XAI
+VREF	1
V - REF	2
AGND	3
AI1+	4
AI1-	5
AI2+	6
AI2-	7
	XAO
AO1	1
AGND	2

1)

2)

UCU-22...24 layout

	Description
I/O	I/O terminals
SLOT 1	I/O extension, encoder ir adapter module connecti modules with USCA-02 a
SLOT 2	I/O extension, encoder ir adapter module connecti modules with USCA-02 a
SLOT 3	I/O extension, encoder ir adapter module connecti modules with USCA-02 a
SLOT 4	RDCO-0x DDCS commu module connection
MEM	UMU-01 memory unit co microSDHC memory car communication is inside
BAT	Holder for real-time clock
XD2D TERM	Termination switches for (XD2D)
X485 TERM	RS-485 link termination s
X485 BIAS	RS-485 link bias switch.
DICOM= DIOGND	Ground selection. Deterr is separated from DIOGN reference for the digital ir to the ground isolation di

LED	Description
PWR	When the PWR LED is on, is sufficient.
BAT	When the BAT LED is on, t battery voltage is higher th is off, replace the battery
WRITE	When the WRITE LED is o microSDHC memory car not remove the microSDI
FAULT	The control program has Refer to the firmware ma
FS COMM	Reserved.
FS STATUS	Reserved.

XRO4 XD24 XPOW

XRO3 XDIO XAO

XRO2

XDI XAI

XRO1

X485 XSTO XSTO OUT

XD2D XCAN

	Description
XAI	Analog input
XAO	Analog output
XCAN	Not in use
XCAN TERM	CAN bus termination switch
XDI	Digital input
XDIO	Digital input/output
XD2D	Drive-to-drive link
XD24	+24 V output (for digital input)
XETH1 XETH2	Ethernet ports for fieldbus, internal switch
XETH3 XETH4	Ethernet ports for tool communication, interr switch
XPAN	Control panel connection
XPAN TERM	Panel bus termination switch
XPOW	External power input
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XRO4	Relay output RO4, reserved.
XSTO	Safe torque off connection (input signals)
XSTO OUT	Safe torque off connection (to inverter modu
X485	RS-485 link
V1T/V1R ... V14T/V14R	Fiber optic connections to converter module (VxT = transmitter, VxR = receiver)

1

	Description
XFSO	Not in use
Environmental sensors (1)	Humidity and temperature r

XFSO

Default I/O diagram of the supply control unit (UCU-22...24)

The diagram below shows the default I/O connections on the supply control unit (A51), and describes the use of the connections in the supply unit. Under normal circumstances, the factory-made wiring should not be changed.

The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 ... 2.5 mm^2 (22...12 AWG). The tightening torque is 0.45 N·m (4 lbf·in).

Terminal			**Description**
XD2D			Drive-to-drive link
1	1	B	Not in use by default
2	2	A	
3	3	BGND	
4	4	SHIELD	
	XD2D TERM		Drive-to-drive link termination switch.
X485			RS485 connection
5	5	B	Not in use by default
6	6	A	
7	7	BGND	
8	8	SHIELD	
	X485 BIAS		X485 bias selection switch
	X485 TERM		X485 termination switch
XCAN			CAN bus
9	9	CANH	Not supported
10	10	CANL	
11	11	CGND	
12	12	SHIELD	Control cable shield
	XCAN TERM		CANopen termination switch
XRO1			Relay output 1
11	11	NC1	Norm. closed

XRO1: Running [1] (Energized = runn

Terminal			Description	
31	31	NC3	Norm. closed	XRO3: MCB ctrl [2] (E
32	32	COM3	Common	main contactor/breake
33	33	NO3	Norm. open	250 V AC / 30 V DC, 2 A
XRO4			Relay output 4	
41	41	NC4	Norm. closed	XRO4: Not supported
42	42	COM4	Common	250 V AC / 30 V DC, 2 A
43	43	NO4	Norm. open	
XSTO			Safe torque off [3]	
1	1	OUT	XSTO: Factory connection. Both circuits must be closed for the to start (STO1 and STO2 must be connected to OUT).	
2	2	SGND		
3	3	STO1		
4	4	STO2		
XSTO OUT			Safe torque off connection	
5	5	OUT1	XSTO OUT: Not in use.	
6	6	SGND		
7	7	OUT2		
8	8	SGND		
XDI			Digital inputs	
1	1	DI1	Temp fault [1] (0 = overtemperature)	
2	2	DI2	Run / enable [1] (1 = run / enable)	
3	3	DI3	MCB feedback [2] (0 = main contactor/breaker open)	
4	4	DI4	Auxiliary circuit breaker fault [1]	
5	5	DI5	Not in use by default. Can be used for eg, earth fault monitorin	
6	6	DI6	Reset [1] (0 -> = fault reset)	
7	7	DIIL	Not in use by default. Can be used for eg, emergency stop.	
XDIO			Digital input/outputs	
1	1	DIO1	Not in use by default	
2	2	DIO2	Not in use by default	
3	3	DIOGND	Digital input/output ground	
4	4	DIOGND	Digital input/output ground	
XD24			Auxiliary voltage output	
5	5	+24VD	+24 V DC 200 mA [4]	
6	6	DICOM	Digital input ground	

Terminal			**Description**
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. 0(2)...10 V, R_{in} > 200 kohm [5]
	5	AI1-	
	6	AI2+	Not in use by default. 0(4)...20 mA, R_{in} = 100 ohm [6]
	7	AI2-	
XAO			Analog outputs
	1	AO1	Zero (no signal indicated) [1] 0...20 mA, R_L < 500 ohm
	2	AGND	
	3	AO2	Zero (not signal indicated) [1] 0...20 mA, R_L < 500 ohm
	4	AGND	
XPOW			External power input
	1	+24V	24 V DC, 2.05 A
	2	GND	
	3	+24V	
	4	GND	
XFSO			Safety functions module connection. Not in use by default.
XETH1			Ethernet ports for fieldbus. Not in use by default.
XETH2			
XETH3			Ethernet ports for tool communication. Not in use by default.
XETH4			
XPAN			Control panel connection
	XPAN TERM		Control panel connection termination switch
MEM			Memory unit connection

1) Default use of the signal in the control program. The use can be changed by a parameter. For the delivery-specific use, see the delivery-specific circuit diagrams.
2) Use of the signal in the control program. The use is fixed and it cannot be changed by a parameter.
3) This input only acts as a true Safe torque off input in inverter units. In other applications (such as a supply or brake unit), de-energizing the STO1 and/or STO2 terminal will stop the unit but not constitute a SIL/PL classified safety function.
4) Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.
5) Current [0(4)...20 mA, R_{in} = 100 ohm] or voltage [0(2)...10 V, R_{in} > 200 kohm]. Change of setting requires reboo control unit.
6) Current [0(4)...20 mA, R_{in} = 100 ohm] or voltage [0(2)...10 V, R_{in} > 200 kohm]. Change of setting requires reboo control unit.

Default I/O diagram of the inverter control unit (UCU-22...24)

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

The wire size accepted by all screw terminals (for both stranded and solid wir
0.5 ... 2.5 mm^2 (22...12 AWG). The tightening torque is 0.45 N·m (4 lbf·in).

Terminal			Description	
XD2D			Drive-to-drive link	
1	1	B	Drive-to-drive link. Refer to section The XD2D connect	
2	2	A		
3	3	BGND		
4	4	SHIELD		
	XD2D.TERM		Drive-to-drive link termination switch.	
X485			RS485 connection	
5	5	B	Not in use by default	
6	6	A		
7	7	BGND		
8	8	SHIELD		
	X485 BIAS		X485 bias selection switch	
	X485 TERM		X485 termination switch	
XCAN			CAN bus	
9	9	CANH	Not supported	
10	10	CANL		
11	11	CGND		
12	12	SHIELD	Control cable shield	
	XCAN TERM		CANopen termination switch	
XRO1			Relay output 1	
11	11	NC1	Norm. closed	XRO1: Ready (Energiz 250 V AC / 30 V DC, 2 A
12	12	COM1	Common	

Terminal			Description	
31	31	NC3	Norm. closed	XRO3: Fault (-1) (Energized = No fault)
32	32	COM3	Common	250 V AC / 30 V DC, 2 A
33	33	NO3	Norm. open	
XRO4			Relay output 4	
41	41	NC4	Norm. closed	XRO4: Not supported
42	42	COM4	Common	250 V AC / 30 V DC, 2 A
43	43	NO4	Norm. open	
XSTO			Safe torque off	
1	1	OUT	XSTO: Factory connection. Both circuits (power module, control unit) mus be closed for the drive to start (STO1 and STO2 must be connected to OUT). Refer to chapter The Safe torque off function (page 307).	
2	2	SGND		
3	3	STO1		
4	4	STO2		
XSTO OUT			Safe torque off connection (to inverter modules)	
5	5	OUT1	XSTO OUT: Safe torque off output to inverter modules	
6	6	SGND		
7	7	OUT2		
8	8	SGND		
XDI			Digital inputs	
1	1	DI1	Stop (0) / Start (1)	
2	2	DI2	Forward (0) / Reverse (1)	
3	3	DI3	Reset	
4	4	DI4	Acceleration & deceleration select [1)]	
5	5	DI5	Constant speed 1 select (1 = on) [2)]	
6	6	DI6	Not in use by default.	
7	7	DIIL	Run enable [3)]	
XDIO			Digital input/outputs	
1	1	DIO1	Output: Ready	
2	2	DIO2	Output: Running	
3	3	DIOGND	Digital input/output ground	
4	4	DIOGND	Digital input/output ground	
XD24			Auxiliary voltage output	
5	5	+24VD	+24 V DC 200 mA [4)]	
6	6	DICOM	Digital input ground	

Terminal				Description
XAI				Analog inputs, reference voltage output
	1	1	+VREF	10 V DC, R_L 1...10 kohm
	2	2	-VREF	-10 V DC, R_L 1...10 kohm
	3	3	AGND	Ground
	4	4	AI1+	Speed reference. 0(2)...10 V, R_{in} > 200 kohm 5)
	5	5	AI1-	
	6	6	AI2+	Not in use by default. 0(4)...20 mA, R_{in} = 100 ohm 6)
	7	7	AI2-	
XAO				Analog outputs
	1	1	AO1	Motor speed rpm 0 ... 20 mA, R_L < 500 ohm
	2	2	AGND	
	3	3	AO2	Motor current 0 ... 20 mA, R_L < 500 ohm
	4	4	AGND	
XPOW				External power input
		1	+24V	24 V DC, 2.05 A
		2	GND	
		3	+24V	Two supplies can be connected for redundancy.
		4	GND	
XFSO				Safety functions module connection. Not in use by default.
XETH1				Ethernet ports for fieldbus. Not in use by default.
XETH2				
XETH3				Ethernet ports for tool communication. Not in use by defau
XETH4				
XPAN				Control panel connection
		XPAN TERM		Control panel connection termination switch
MEM				Memory unit connection

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

2) Constant speed 1 is defined by parameter 22.26.

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

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

5) Current [0(4)...20 mA, R_{in} = 100 ohm] or voltage [0(2)...10 V, R_{in} > 200 kohm]. Change of settin control unit.

6) Current [0(4)...20 mA, R_{in} = 100 ohm] or voltage [0(2)...10 V, R_{in} > 200 kohm]. Change of settin control unit.

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

	XRO1...XRO4
NC1	11
COM1	12
NO1	13
NC2	21
COM2	22
NO2	23
NC3	31
COM3	32
NO3	33
NC4	41
COM4	42
NO4	43
	XSTO
OUT	1
SGND	2
STO1	3
STO2	4
	XDI
DI1	1
DI2	2
DI3	3
DI4	4
DI5	5
DI6	6
DIIL	7
	XD24
+24VD	5
DICOM	6
+24VD	7
DIOGND	8
	XAI
+VREF	1
V-REF	2
AGND	3
AI1+	4
AI1-	5
AI2+	6
AI2-	7

1)

2)

Additional information on the connections

Power supply for the control unit (XPOW)

The control unit is powered from a 24 V DC, 2 A supply (ZCU, BCU) or a 24 V DC, 2.9
supply (UCU) through terminal block XPOW. With a type BCU/UCU control u
second supply can be connected to the same terminal block for redundancy.

Using a second supply is recommended, if:

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

DIIL input

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

A jumper wire set installed at the factory connects the DIIL input to +24 V, wh enables the drive to start. If this function is used as a part of safety function implementation, the jumper wire set must be removed.

Note: This input is not SIL or PL classified.

The XD2D connector

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

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

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

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

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

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

- BCU-02/12/22
- UCU-22...24

Termination ON Termination OFF Termination ON

Safe torque off (XSTO, XSTO OUT)

See chapter The Safe torque off function (page 307).

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

FSO safety functions module connection (X12, with BCU only)

Refer to the applicable FSO module user's manual.

Note: Control units that have a sticker with the text "No FSO support" are not compatible with the FSO safety functions module.

SDHC memory card slot

The BCU control unit 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.

MicroSDHC memory card slot

The UCU-22...24 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

Connector data

Power supply (XPOW)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm Maximum tightening torque 0.45 N·m (4 lbf·in) 24 V (±10%) DC, 2 A (BCU) 19...32 V DC, 2.9 A (UCU-22...24) External power input. Two supplies can be connected to the BCU and U control units for redundancy.
Relay outputs RO1...RO3 (XRO1...XRO3 [BCU]) Relay outputs RO1...RO4 (XRO1...XRO4 [UCU-22...24])	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm Maximum tightening torque 0.45 N·m (4 lbf·in) 250 V AC / 30 V DC, 2 A Protected by varistors
+24 V output (XD24:2 and XD24:4)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm Maximum tightening torque 0.45 N·m (4 lbf·in) Total load capacity of these outputs is 4.8 W (200 minus the power taken by DIO1 and DIO2.
Digital inputs DI1...DI6 (XDI:1...XDI:6)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm Maximum tightening torque 0.45 N·m (4 lbf·in) 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP (DI1...DI5), PNP (DI6) Hardware filtering: 0.04 ms, digital filtering up t I_{max}: 15 mA (DI1...DI5), 5 mA (DI6)
Start interlock input DIIL (XDI:7)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm Maximum tightening torque 0.45 N·m (4 lbf·in) 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP Hardware filtering: 0.04 ms, digital filtering up t
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). (BCU) DIO1 can be configured as a frequency input (0...100 kHz with hardware	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm Maximum tightening torque 0.45 N·m (4 lbf·in) As inputs: 24 V logic levels: "0" < 5 V, "1" > 15 V. R Filtering: 1 ms. As outputs: Total output current from +24VD is mA +24VD DIOx

Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm^2 (22...12 A Maximum tightening torque 0.45 N·m (4 lbf·in) 10 V ±1% and -10 V ±1%, R_{load} 1...10 kohm Maximum output current: 10 mA
Analog inputs AI1 and AI2 (XAI:4 ... XAI:7). Current/voltage input mode selection by switches (BCU) Current/voltage input mode selection by parameters 12.15 AI1 unit selection and 12.25 AI2 unit selection (UCU)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm^2 (22...12 A Maximum tightening torque 0.45 N·m (4 lbf·in) Current input: -20...20 mA, R_{in} = 100 ohm Voltage input: -10...10 V, R_{in} > 200 kohm Differential inputs, common mode range ±30 V Sampling interval per channel: 0.25 ms Hardware filtering: 0.25 ms Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range
Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm^2 (22...12 A Maximum tightening torque 0.45 N·m (4 lbf·in) 0...20 mA, R_{load} < 500 ohm Frequency range: 0...500 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
XD2D connector	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm^2 (22...12 A Maximum tightening torque 0.45 N·m (4 lbf·in) Physical layer: RS-485 Transmission rate: 8 Mbit/s Cable type: Shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 ... 165 ohm, for example Belden 9842) Maximum length of link: 50 m (164 ft) Termination by switch
RS-485 connection (X485)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm^2 (22...12 A Maximum tightening torque 0.45 N·m (4 lbf·in) Physical layer: RS-485 Cable type: Shielded twisted-pair cable with a twisted pair for data and a wire or another pair for signal ground (nominal impedance 100 ... 165 ohm, for example Belden 9842) Maximum length of link: 50 m (164 ft) Termination and bias by switch (X485 TERM and X485 BIAS) (UCU-22...24)
CAN connection (XCAN [UCU-22...24])	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm^2 (22...12 A Maximum tightening torque 0.45 N·m (4 lbf·in) Termination by switch (XCAN TERM) This connection is not supported by the firmware.

Safe torque off connection (XSTO)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm Maximum tightening torque 0.45 N·m (4 lbf·in) Input voltage range: -3...30 V DC Logic levels: "0" < 5 V, "1" > 17 V. **Note: For the unit to start, both connections must** applies to all control units (including drive, inverter DC/DC converter etc. control units), but SIL/PL torque off functionality is only achieved through nector of the drive/inverter control unit. Current consumption: 10 mA (continuous) per (UCU-22...24). The number of parallel drive/inv does not have an effect on the current consump Current consumption: 66 mA (continuous) per drive/inverter module (BCU) EMC (immunity) according to IEC 61326-3-1 and I See also chapter The Safe torque off function
Safe torque off output (XSTO OUT)	Connector pitch 5 mm, wire size 0.5 ... 2.5 mm Maximum tightening torque 0.45 N·m (4 lbf·in) To STO connector of inverter module.
Control panel connection (X13 [BCU]) Control panel connection (XPAN [UCU-22...24])	Connector: RJ-45 Cable length < 100 m (328 ft) (BCU) Cable length < 50 m (164 ft) (UCU-22...24) Termination by switch (XPAN TERM) (UCU-22.
Ethernet connection (XETH [BCU]) Fieldbus Ethernet connection with internal switch (XETH1 and XETH2 [UCU-22...24]) Tool Ethernet connection with internal switch (XETH3 and XETH4 [UCU-22...24])	Connector: RJ-45 This connection is not supported by the firmwar Cable type: minimum requirement CAT5e (UCU
SDHC memory card slot (SD CARD [BCU])	Memory card type: SDHC Maximum memory size: 4 GB
microSDHC memory card slot (microSDHC CARD [UCU-22...24])	Memory card type: microSDHC (minimum of class Supported memory size: 4 GB...32 GB
Battery	Real-time clock battery type: BR2032

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

BCU ground isolation diagram

	XPOW
+24VI	1
GND	2
+24VI	3
GND	4
	XAI
+VREF	1
-VREF	2
AGND	3
AI1+	4
AI1-	5
AI2+	6
AI2-	7
	XAO
AO1	1
AGND	2
AO2	3
AGND	4
	XD2D
B	1
A	2
BGND	3
SHIELD	4
XRO1, XRO2, XRO3	
NC	11
COM	12
NO	13
NC	21
COM	22
NO	23
NC	31
COM	32
NO	33
	XD24
+24VD	5
DICOM	6
+24VD	7
DIOGND	8
	XDIO
DIO1	1
DIO2	2
DIOGND	3
DIOGND	4
	XDI
DI1	1
DI2	2
DI3	3
DI4	4
DI5	5
DI6	6
DIIL	7
	XSTO
OUT	1
SGND	2
IN1	3
IN2	4
	XSTO OUT
IN1	5
SGND	6
IN2	7
SGND	8

**

*

UCU-22...24 ground isolation diagram

XPOW

XAI *

XAO

XD2D

X485

XCAN

XETH1

XETH2

XETH3

XETH4

XPAN

XRO1-XRO4

NC1	11
COM1	12
NO1	13
…	
NC4	41
COM4	42
NO4	43

XD24

+24VD	5
DICOM	6
+24VD	7
DIOGND	8

XDIO

DIO1	1
DIO2	2
DIOGND	3
DIOGND	4

XDI **

DI1	1
DI2	2
DI3	3
DI4	4
DI5	5
DI6	6
DIIL	7

XSTO

XSTO OUT

Power supply ground

*The maximum common mode voltage between each AI input and AGND is ±

****Ground selector (DICOM=DIOGND) settings**

8

Installation checklist

Contents of this chapter

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

Checklist

Examine the mechanical and electrical installation of the drive before star
through the checklist together with another person.

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

WARNING!
Stop the drive and do the steps in section Electrical safety precau
before you start the work.

Make sure that ...

If the drive is connected to a network other than a symmetrically grounded TN-S system: You have done all the required modifications (for example, you may need to disconnect the EMC filter or ground-to-phase varistor) the electrical installation instructions.

There is an adequately sized protective earth (ground) conductor(s) between the drive and the switchboard, the conductor is connected to correct terminal, and the terminal is tightened to the correct torque.

Grounding has also been measured according to the regulations.

The input power cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.

There is an adequately sized protective earth (ground) conductor between the motor and the drive. The conductor is connected to the correct terminal, and the terminal is tightened to the correct torque.

Grounding has also been measured according to the regulations.

The motor cable is connected to the correct terminals, the phase order is correct, and the terminals are tightened to the correct torque.

The motor cable is routed away from other cables.

No power factor compensation capacitors are connected to the motor cable.

If an external brake resistor is connected to the drive: There is an adequately sized protective earth (ground) conductor between the brake resistor and the drive, and the conductor is connected to the correct terminal, and the terminals are tightened to the correct torque. Grounding has also been measured according to the regulations.

If an external brake resistor is connected to the drive: The brake resistor cable is connected to the correct terminals, and the terminals are tightened to the correct torque.

If an external brake resistor is connected to the drive: The brake resistor cable is routed away from other cables.

The control cables are connected to the correct terminals, and the terminals are tightened to the correct torque.

The voltage setting of the auxiliary voltage transformers (if any) is correct. See the electrical installation instructions.

If a drive bypass connection will be used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically and/or electrically interlocked, that is, they cannot be closed at the same time. A thermal overload device must be used for protection when bypassing the drive. Refer to local codes and regulations.

There are no tools, foreign objects or dust from drilling inside the drive.

The area in front of the drive is clean: the drive cooling fan cannot draw any dust or dirt inside.

The terminal box cover of the motor is in place. Cabinet shrouds are in place and doors are closed.

The motor and the driven equipment are ready for power-up.

9

Start-up

Contents of this chapter

This chapter contains the start-up and switch-off procedures of the drive.

Start-up procedure

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

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

WARNING!
Only qualified electrical professionals are permitted to do the work desc in this chapter.

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

Action
Safety

Action

Make sure that the disconnector of the supply transformer is locked to the open position (i.e., voltage is not connected to the drive, and cannot be connected to the drive accidentally).

Make sure that the main switch-disconnector [Q1.1] is open, or the main breaker [Q1] is racked out.

Some 12-pulse units (option +A004) have two switch-disconnectors or breakers. Make sure that both are open before you continue.

Close the grounding switch [Q9.1] (option +F259). Do not use too much force. Electrical interlocking can prevent closing of the grounding switch.

Note: 12-pulse units (option +A004) have two switches: Q9.1 and Q9.2.

Check the mechanical and electrical installation of the drive. See Installation checklist (page 171).

Check the settings of breakers/switches in the auxiliary circuits. See the circuit diagrams delivered with the drive.

Check the tap settings of transformers T21, T101 (if present) and T111 (if present). See section Checking the settings of transformers T21, T101 and T111 (page 117).

Disconnect any unfinished or uninspected auxiliary voltage (115/230 V AC) cables that lead from the terminal blocks to the outside of the equipment.

Check that both channels of the Safe torque off circuit connected to the STO inputs of both the supply control unit [A51] and the inverter control unit [A41] are closed. Refer to the wiring diagrams delivered with the drive.

Drives with ground fault monitoring for IT (ungrounded) systems (option +Q954): If necessary, adjust the settings of the device. See the circuit diagrams of the delivery and the manual of the device.

Drives with Pt100 relays (option +(n)L506):

- Check the connections against the circuit diagrams of the delivery.
- Set the alarm and trip levels of the Pt100 relays.

Set the alarm and trip levels of the Pt100 relay as low as possible based on the operating temperature and test results of the machine. The trip level can be set, for example, 10 °C higher than what the temperature of the machine is at maximal load in the maximum environmental temperature.

ABB recommends to set the operating temperatures of the relay, typically for example, as follows:

- 120...140 °C when only tripping is in use
- alarm 120...140 °C and trip 130...150 °C when both alarm and tripping are used.

Powering up the auxiliary circuit of the drive

Make sure that it is safe to connect voltage. Make sure that:

- nobody is working on the drive or circuits that have been wired from outside into the drive cabinet
- the cover of the motor terminal box is in place.

Drives with a voltmeter (option +G334): Make sure that the circuit breaker of the measuring circuit (F5.1) is closed.

Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits.

Close the cabinet doors.

Close the main breaker of the supply transformer.

Switch on the auxiliary voltage [Q21].

Setting up the supply unit parameters

Check the voltage range setting in parameter 195.01 Supply voltage.

Action

Setting up the inverter unit parameters, and performing the first start

Set up the inverter control program. See the appropriate start-up guide and/or firmware manual. There is a separate start-up guide only for some control programs.

Make sure that parameter 95.09 Switch fuse controller is set to Disabled.

Drives with a brake chopper (option +D150): See chapter Resistor braking (page 333).

Drives with a sine output filter (option +E206): Check that bit 1 of parameter 95.15 Special HW settings is activated.

Drives with an fieldbus adapter module (optional): Set the fieldbus parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the fieldbus adapter module, and the drive firmware manual. Check that the communication works between the drive and the PLC.

Drives with an encoder interface module (optional): Set the encoder parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the encoder interface module, and the drive firmware manual.

Powering up the main circuit of the drive

Switch off the grounding switch [Q9.1] (option +F259).

12-pulse units have two grounding switches, Q9.1 and Q9.2.

Close the main switch-disconnector [Q1.1] or main breaker [Q1].

Note: Do not use excessive force. The main switch-disconnector (or main breaker) can only be closed when:

- the main input terminals [L1, L2, L3] are powered, and
- auxiliary voltage is switched on [Q21], and
- the grounding switch [Q9.1, Q9.2] (option +F259) is open.

Turn the operating switch (S21) to the ON (1) position to activate the run enable signal. Depending on control source settings, this may also close the main contactor (if present). If a main contactor is present and does not close, refer to the circuit diagrams delivered by the drive as well as the appropriate firmware manuals.

On-load checks

Start the motor to perform the ID run.

Check that the cooling fans rotate freely in the right direction, and the air flows upwards.

Check that the motor starts. stops and follows the speed reference in the correct direction when controlled with the control panel.

Check that the motor starts. stops and follows the speed reference in the correct direction when controlled through the customer-specific I/O or fieldbus.

Drives in which the Safe torque off control circuit is in use: Test and validate the operation of the Safe torque off function. See section Start-up including validation test (page 318).

Drives with an emergency stop circuit (options +Q951, +Q952, +Q963, +Q964, +Q978, +Q979): Test and validate the operation of the emergency-stop circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.

Drives with the Prevention of unexpected start-up with safety relay (option +Q957): Test and validate the operation of the Prevention of unexpected start-up circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.

Drives with the Prevention of unexpected start with FSO safety functions module (option +Q950): Test and validate the operation of the Prevention of unexpected start-up circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.

Switching off the drive

1. Stop the motor.
2. Turn the Run enable switch (S21) to the off (0) position to deactivate the Run enable signal and to switch the main contactor/breaker off.

1

Fault tracing

Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

Control unit LEDs (BCU-x2)

LED	Color	Indication
BATT OK	Green	Battery voltage of the real-time clock is OK (hig When the LED is not lit, • battery voltage is below 2.8 V, • the battery is missing, or • the control unit is not powered.
PWR OK	Green	Internal voltage is sufficient.
FAULT	Red	The control program indicates that the equip See the appropriate firmware manual.
WRITE	Yellow	Writing to SD card in progress.

Control unit LEDs (UCU-22...24)

LED		Indication
BAT	Green	Battery voltage of the real-time clock is sufficient (higher than 2.5 V).
	Off	Battery voltage is below 2.5 V, the battery is missing or the control unit is not powered.
PWR	Green	Internal voltage is sufficient.
FAULT	Red	Control program indicates that the equipment is faulty. See the appropriate firmware manual.
WRITE	Yellow	Writing to microSDHC card in progress.
FS COMM	Green	Reserved
FS STATUS	Green	Reserved

Control panel and panel platform/holder LEDs

The ACS-AP-... 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.
	Flashing green	There is an active warning in the unit.
	Continuous red	There is an active fault in the unit.
	Flashing red	There is a fault that requires the stopping and restarting of the drive/converter/inverter.
	Flashing 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.

1

Maintenance

Contents of this chapter

This chapter contains maintenance instructions.

Handling fiber optic cables

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

- Handle the fiber optic cables with care.
- When you disconnect the fiber optic cables, always hold the connector, r
cable.
- Do not touch the ends of the fibers. They are sensitive to dirt.
- Do not bend the fiber optic cables too tightly. The minimum allowed benc
is 35 mm (1.4 in).

Maintenance intervals

The tables below show the maintenance tasks which can be done by the end user. For ABB Service offering, refer to www.abb.com/drivesservices or consult your local A Service representative (www.abb.com/searchchannels).

Description of symbols

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

Recommended maintenance intervals after start-up

Component	Years from start-up								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Cooling									
Supply and inverter module main cooling fans									R
Supply and inverter modules: circuit board compartment fan									R
Sine filter (option +E206) cooling fan									R
Door fan									R
Other cabinet cooling fans (50 Hz)									R
Other cabinet cooling fans (60 Hz)						R			
Batteries									
Control panel battery									R
Control unit battery						R			
Connections and environment									
Air inlet and outlet meshes (IP22/IP42)	I	I	I	I	I	I	I	I	I
Cabinet door filters (IP54)	R	R	R	R	R	R	R	R	R
Tightness of terminals	I	I	I	I	I	I	I	I	I
Ambient conditions (dustiness, moisture, corrosion, temperature)	I	I	I	I	I	I	I	I	I
Cleaning of heatsinks	I	I	I	I	I	I	I	I	I
Quality of supply voltage	P	P	P	P	P	P	P	P	P
Air circuit breaker maintenance (if present)	I	I	I	I	I	I	I	I	I
Spare parts									
Spare part stock	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
Functional safety									
Safety function test							I		
	See the maintenance information of the safety f								

Note:

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

Cabinet

Cleaning the interior of the cabinet

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

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

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

Cleaning the exterior of the drive

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

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

WARNING!