ABB industrial drives

Hardware manual
ACQ810-04 drive modules (55…160 kW, 75…200 hp)

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List of related manuals

Drive hardware manuals and guides	Code (English)	
ACQ810-04 drive modules (55…160 kW, 75…200 hp) hardware manual	*3AUA0000055161*	1)
Drive firmware manuals and guides		
ACQ810-04 drive modules start-up guide	*3AUA0000055159*	2)
ACQ810 standard pump control program firmware manual	*3AUA0000055144*	1)
Option manuals and guides		
ACS-CP-U control panel IP54 mounting platform kit (+J410) installation guide	*3AUA0000049072*	2)
Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.		2)

1) Delivered in PDF format on a manuals CD with the drive module.

2) Delivered as a printed copy with the drive or optional equipment.

All manuals are available in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover.

Hardware manual

ACQ810-04 drive modules (55…160 kW, 75…200 hp)

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1. Safety instructions

5. Mechanical installation

7. Electrical installation

3AUA0000055161 Rev A
EN
EFFECTIVE: 2009-09-18

1

Safety instructions

What this chapter contains

This chapter contains the safety instructions which you must follow when installing, operating and servicing the drive. If ignored, physical injury or death may follow, or damage may occur to the drive, the motor, or driven equipment. Read the safety instructions before you work on the unit.

Use of warnings and notes

There are four types of safety instructions used in this manual:

Dangerous voltage warning warns of high voltage which can cause physical injury and/or damage to the equipment.

General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

Electrostatic discharge warning warns of electrostatic discharge which can damage the equipment.

Hot surface warning warns of component surfaces that may become hot enough to cause burns if touched.

Installation and maintenance work

These warnings are intended for all who work on the drive, motor cable or motor.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

Only qualified electricians are allowed to install and maintain the drive.

- Never work on the drive, the motor cable or the motor when input power is applied. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, the motor or the motor cable.
  Always ensure by measuring with a multimeter (impedance at least 1 Mohm) that:
  1. There is no voltage between the drive input phases U1, V1 and W1 and the ground.
  2. There is no voltage between terminals UDC+ and UDC– and the ground.
  3. There is no voltage between terminals R+ and R– and the ground.
- Do not work on the control cables when power is applied to the drive or to the external control circuits. Externally supplied control circuits may carry dangerous voltages even when the input power of the drive is switched off.
- Do not make any insulation or voltage withstand tests on the drive.
- Disconnect the internal EMC filter of the drive (for directions, see page *50*) if the drive is to be installed on an IT power system (an ungrounded power system or a high resistance grounded [over 30 ohms] power system) or a corner-grounded power system.

Notes:

- Even when the motor is stopped, dangerous voltages are present at the power circuit terminals U1, V1, W1 and U2, V2, W2, and UDC+, UDC–, R+, R–.
- Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the terminals of the relay outputs of the drive.
- The drive supports the Safe torque off function. See page *39*.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

- Never attempt to repair a malfunctioning drive; contact your local ABB representative or Authorized Service Center.
- Make sure that dust from drilling does not enter the drive during the installation. Electrically conductive dust inside the drive may cause damage or lead to malfunction.
- Ensure sufficient cooling.

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

Start-up and operation

These warnings are intended for all who plan the operation of the drive, start up or operate the drive.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

- Before adjusting the drive and putting it into service, make sure that the motor and all driven equipment are suitable for operation throughout the speed range provided by the drive. The drive can be adjusted to operate the motor at speeds above and below the speed provided by connecting the motor directly to the power line.
- Do not activate automatic fault reset functions if dangerous situations can occur. When activated, these functions will reset the drive and resume operation after a fault.
- Do not control the motor with an AC contactor or disconnecting device (disconnecting means); instead, use the control panel or external commands via the I/O board of the drive or a fieldbus adapter. The maximum allowed number of charging cycles of the DC capacitors (i.e. power-ups by applying power) is one per two minutes.

Notes:

- If an external source for start command is selected and it is ON, the drive will start immediately after an input voltage break or a fault reset unless the drive is configured for 3-wire (pulse) start/stop.
- When the control location is not set to local, the stop key on the control panel will not stop the drive.

WARNING! The surfaces of drive system components may become hot when the system is in use.

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2

About this manual

What this chapter contains

This chapter describes the intended audience and contents of this manual. It contains a flowchart of steps in checking the delivery, installing and commissioning the drive. The flowchart refers to chapters/sections in this manual and other manuals.

Compatibility

The manual is compatible with ACQ810-04 drive modules of frame sizes E0 and E.

Intended audience

This manual is intended for people who plan the installation, install, commission, use and service the drive. Read the manual before working on the drive. The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

This manual is written for readers worldwide. Both SI and imperial units are shown wherever appropriate.

Categorization according to the frame size

Some instructions, technical data and dimensional drawings which concern only certain frame sizes are marked with the symbol of the frame size E0 or E. The frame size is marked on the drive designation label. The frame size of each drive type is also indicated in the rating tables in chapter *Technical data*.

Categorization according to the + code

The instructions, technical data and dimensional drawings which concern only certain optional selections are marked with + codes, e.g. +L500. The options included in the drive can be identified from the + codes visible on the type designation label of the drive. The + code selections are listed in chapter *Operation principle and hardware description* under *Type code*.

Contents

The chapters of this manual are briefly described below.

Safety instructions give safety instructions for the installation, commissioning, operation and maintenance of the drive.

About this manual lists the steps in checking the delivery and installing and commissioning the drive and refers to chapters/sections in this manual and other manuals for particular tasks.

Operation principle and hardware description describes the drive module.

Planning the cabinet assembly guides in planning the installation of the drive module into a user-defined cabinet.

Mechanical installation instructs how to place and mount the drive.

Planning the electrical installation instructs on the motor and cable selection, the protections and the cable routing.

Electrical installation instructs on how to wire the drive.

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

Maintenance lists periodic maintenance actions along with work instructions.

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

du/dt and common mode filtering lists the du/dt and common mode filtering options available for the drive.

Dimension drawings contains the dimensional drawings of the drive modules.

Installation and commissioning flowchart

Task	See
Plan the installation. Check the ambient conditions, ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data. Select the cables.	*Planning the cabinet assembly* (page *25*) *Planning the electrical installation* (page *35*) *Technical data* (page *83*) Option manual (if optional equipment is included)
Unpack and check the units. Check that all necessary optional modules and equipment are present and correct. Only intact units may be started up.	*Mechanical installation*: *Contents of the package* (page *31*) If the converter has been non-operational for more than one year, the converter DC link capacitors need to be reformed. Ask ABB for more information.
Check the installation site.	*Mechanical installation*: *Before installation* (page *32*) *Technical data* (page *83*)
If the drive is about to be connected to an IT (ungrounded) or corner-grounded system, check that the internal EMC filtering of the drive has been disconnected.	*Electrical installation*: *Connection to an IT (ungrounded) power system* (page *50*)
Install the drive in a cabinet.	*Mechanical installation*: *Installation procedure* (page *33*)
Route the cables.	*Planning the electrical installation*: *Routing the cables* (page *45*)
Check the insulation of the supply cable, the motor and the motor cable.	*Electrical installation*: *Checking the insulation of the assembly* (page *49*)

Task	See
Connect the power cables. Connect the control and the auxiliary control cables.	*Electrical installation*: *Power cable connection*: (page *61*) and *Connecting the control cables*: (page *67*) Manuals for any optional equipment
Check the installation.	*Installation checklist* (page *75*)
Commission the drive.	Appropriate *Firmware manual*
Operating of the drive: start, stop, speed control etc.	Appropriate *Firmware manual*

Terms and abbreviations

Term/Abbreviation	Explanation
EMC	Electromagnetic Compatibility.
FIO-11	Optional analog I/O extension for the ACQ810.
FIO-21	Optional analog/digital I/O extension for the ACQ810.
FIO-31	Optional digital I/O extension for the ACQ810.
FDNA-0x	Optional DeviceNet adapter for the ACQ810.
FENA-0x	Optional Ethernet/IP adapter for the ACQ810.
FLON-0x	Optional LONWORKS® adapter for the ACQ810.
FSCA-0x	Optional Modbus adapter for the ACQ810.
FPBA-0x	Optional PROFIBUS DP adapter for the ACQ810.
Frame (size)	Size of the drive module. This manual deals with ACQ810-04 frames E0 and E. To determine the frame size of a drive module, refer to the drive designation label attached to the drive, or the rating tables in chapter *Technical data*.
IGBT	Insulated Gate Bipolar Transistor; a voltage-controlled semiconductor type widely used in inverters due to their easy controllability and high switching frequency.
I/O	Input/Output.
JCU	The control unit of the drive module. The JCU is installed on top of the power unit. The external I/O control signals are connected to the JCU, or optional I/O extensions mounted on it.
JMU	The memory unit attached to the control unit of the drive.
RFI	Radio-frequency interference.

3

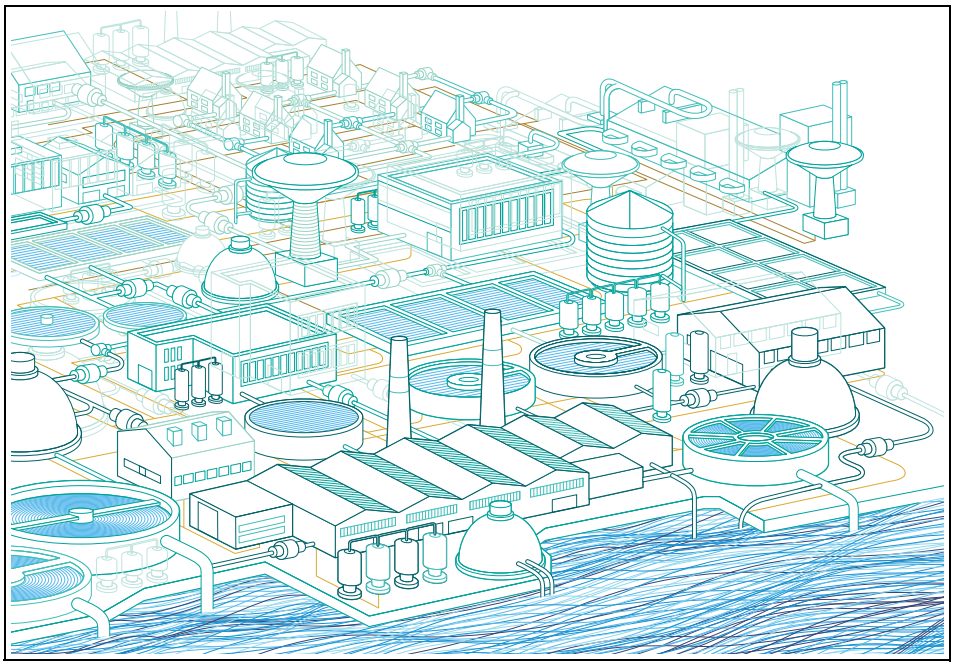
Operation principle and hardware description

What this chapter contains

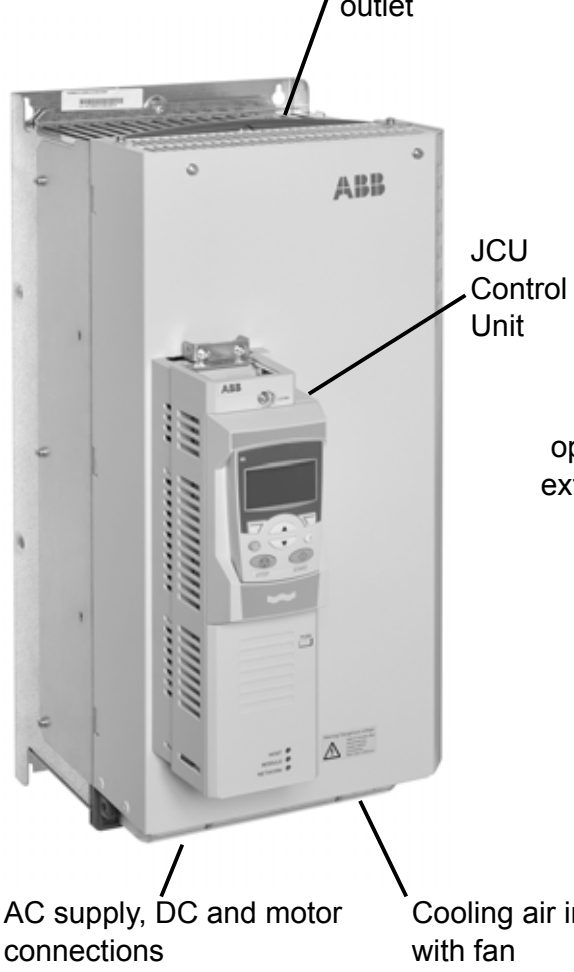
This chapter describes the construction and operating principle of the drive in short.

The ACQ810-04

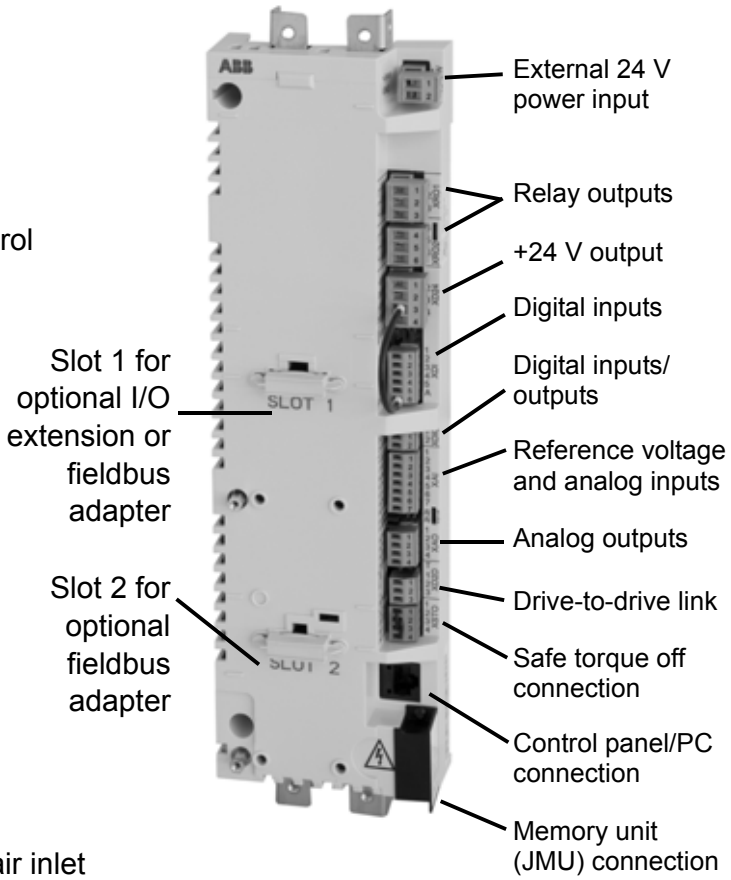
The ACQ810-04 is an IP20 drive module for controlling AC motors for water and waste water applications. It is to be installed into a cabinet by the customer. It is available in several frame sizes depending on output power. All frame sizes use the same control unit (type JCU).



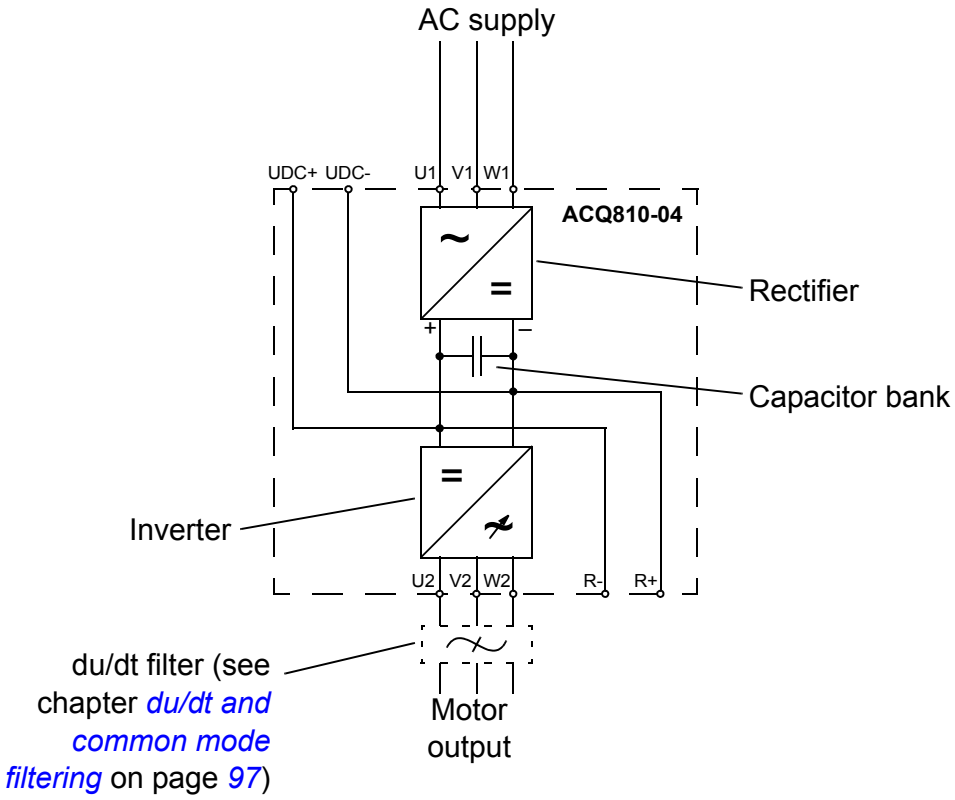
Layout



JCU Control Unit with cover assembly removed



Main circuit and operation

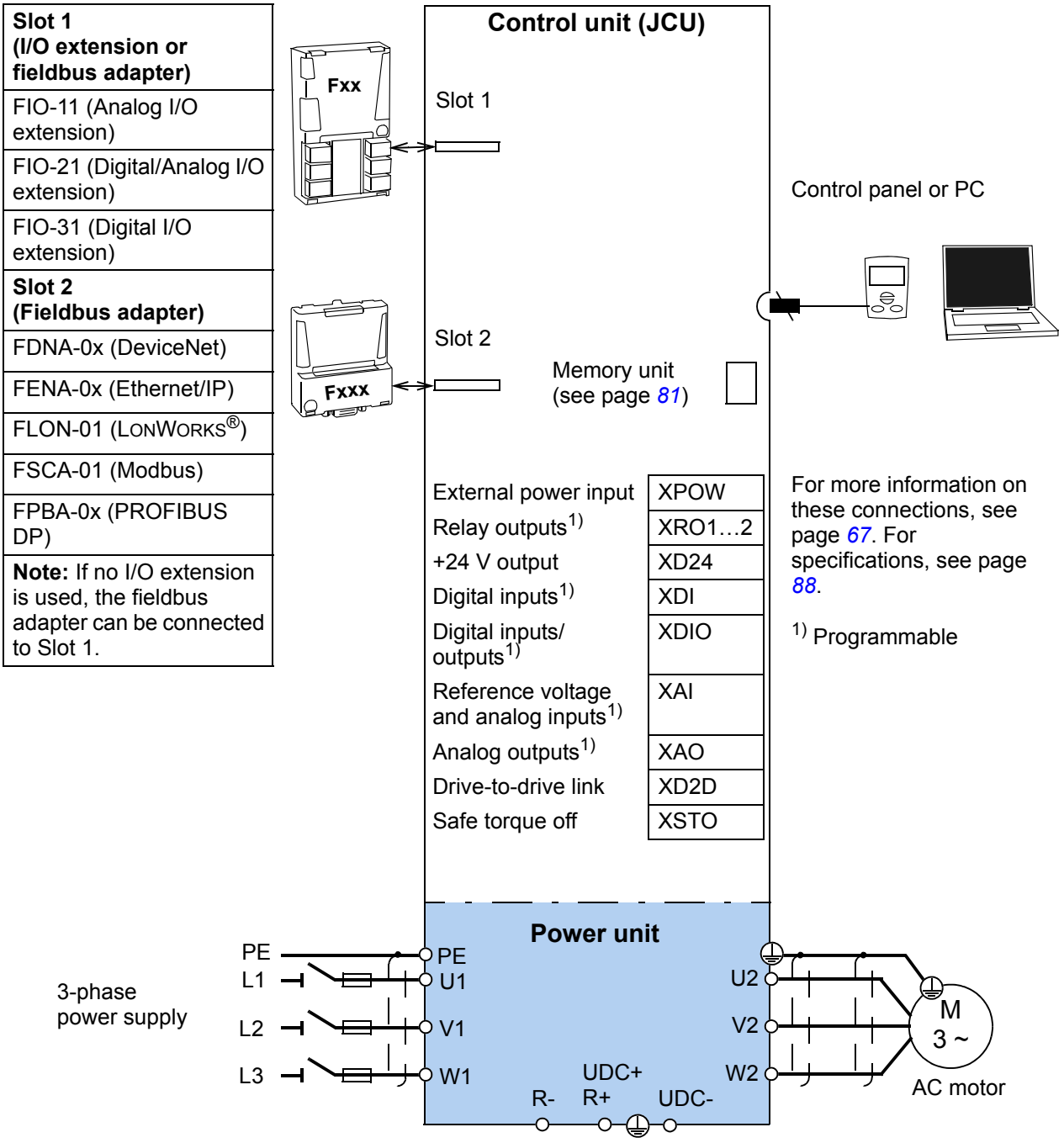


This table describes the operation of the main circuit in short.

Component	Description
Rectifier	Converts the three-phase AC voltage to DC voltage.
Inverter	Converts the DC voltage to AC voltage and vice versa. The motor is controlled by switching the IGBTs of the inverter.
Capacitor bank	Energy storage which stabilizes the intermediate circuit DC voltage.
du/dt filter	See page 97.

Power connections and control interfaces

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



Type code

The type code contains information on the specifications and configuration of the drive. The first digits from left express the basic configuration (e.g. ACQ810-04-203A-4). The optional selections are given thereafter, preceded by + signs (e.g. +L500). The main selections are described below. Not all selections are necessarily available for all types; refer to *ACQ810-04 Ordering Information*, available on request.

See also section *Delivery check and drive module identification* on page *31*.

Selection	**Alternatives**	
Product series	ACQ810 product series	
Type	04	Drive module. When no options are selected: IP20 (UL Open type), control panel, EMC filter for Category C3, in-built choke, boards with coating, Safe torque off function, ACQ810 standard pump control program, Start-up guide and CD containing all manuals
Size	Refer to *Technical data: Ratings*.	
Voltage range	4	380…480 V AC
+ options		
Filters	E…	+E202: EMC filter, C2, 1st Environment, Restricted (Earthed Network) +0E200: No EMC filter
Control panel and control unit mechanics	J…	+0J400: No control panel or panel holder +J410: Control panel with door mounting platform kit including IP54 kit and 3 m cable +0C168: No control unit cover, no control panel
Fieldbus	K...	+K451: FDNA-01 DeviceNet adapter +K454: FPBA-01 PROFIBUS DP adapter +K466: FENA-01 Ethernet/IP adapter +K458: FSCA-01 Modbus adapter +K452: FLON-01 LONWORKS® adapter
I/O extensions and feedback interfaces	L...	+L500: FIO-11 analog I/O extension +L519: FIO-21 analog/digital I/O extension +L511: FIO-31 digital I/O extension (4 relays)

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4

Planning the cabinet assembly

What this chapter contains

This chapter guides in planning the installation of a drive module into a user-defined cabinet. The issues discussed are essential for safe and trouble-free use of the drive system.

Note: Please note that the installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations.

Cabinet construction

The cabinet frame must be sturdy enough to carry the weight of the drive components, control circuitry and other equipment installed in it.

The cabinet must protect the drive module against contact and meet the requirements for dust and humidity (see chapter *Technical data*).

Disposition of the devices

For easy installation and maintenance, a spacious layout is recommended. Sufficient cooling air flow, obligatory clearances, cables and cable support structures all require space.

For layout examples, see section *Cooling and degrees of protection* below.

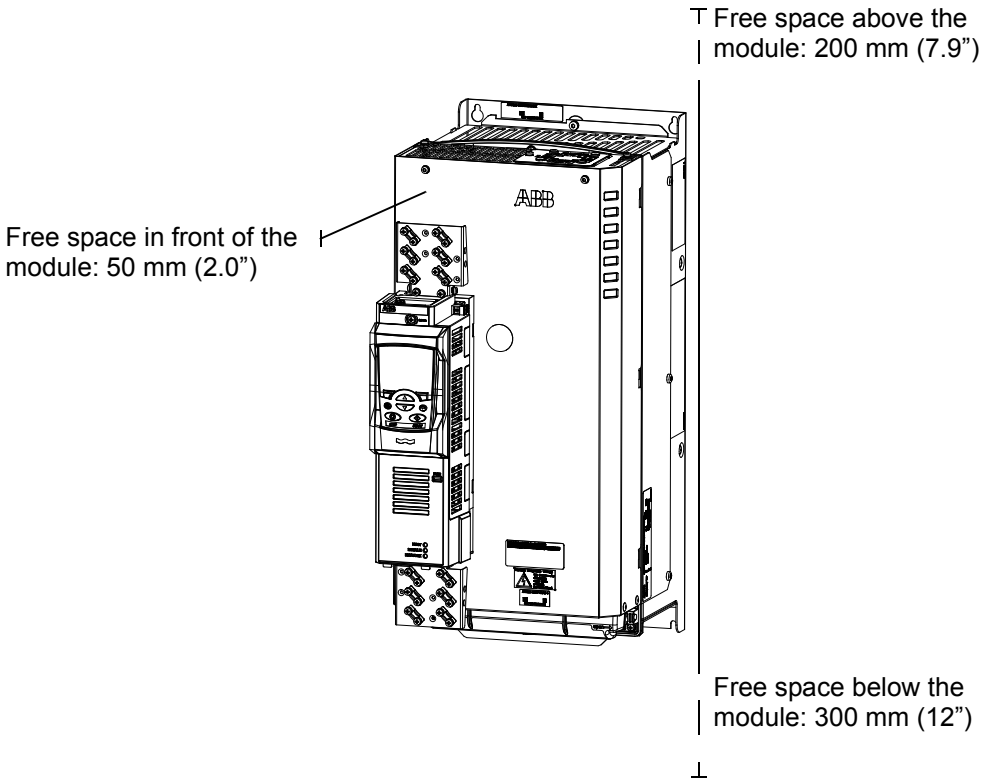
Grounding of mounting structures

Make sure all cross-members or shelves on which drive system components are mounted are properly grounded and the connecting surfaces left unpainted.

Note: Ensure that the components are properly grounded through their fastening points to the installation base.

Free space requirements

The modules can be installed side by side. The dimensions of the drive modules are presented in chapter *Dimension drawings*. The free space requirements (valid for both frame sizes) are shown below.



The temperature of the cooling air entering the unit must not exceed the maximum allowed ambient temperature (see *Ambient conditions* in the chapter *Technical data*). Consider this when installing heat-generating components (such as other drives and mains chokes) nearby.

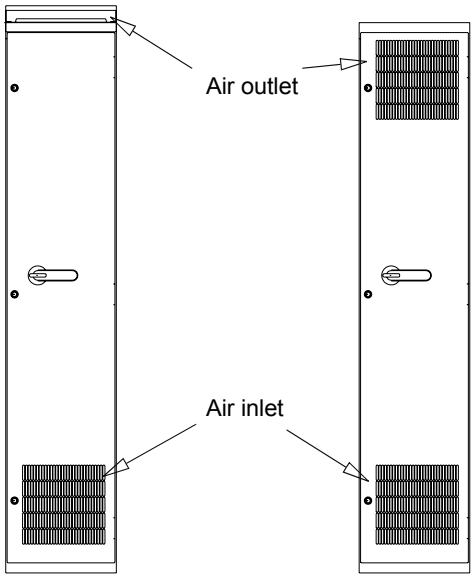
Cooling and degrees of protection

The cabinet must have enough free space for the components to ensure sufficient cooling. Observe the minimum clearances given for each component.

The air inlets and outlets must be equipped with gratings that

- guide the air flow
- protect against contact
- prevent water splashes from entering the cabinet.

The drawing below shows two typical cabinet cooling solutions. The air inlet is at the bottom of the cabinet, while the outlet is at the top, either on the upper part of the door or on the roof.



Arrange the cooling air flow through the modules so that the requirements given in chapter *Technical data* are met:

- cooling air flow
  Note: The values in *Technical data* apply to continuous nominal load. If the load is less than nominal, less cooling air is required.
- allowed ambient temperature.

Make sure the air inlets and outlets are sufficient in size. Please note that in addition to the power loss of the drive module, the heat dissipated by cables and other additional equipment must also be ventilated.

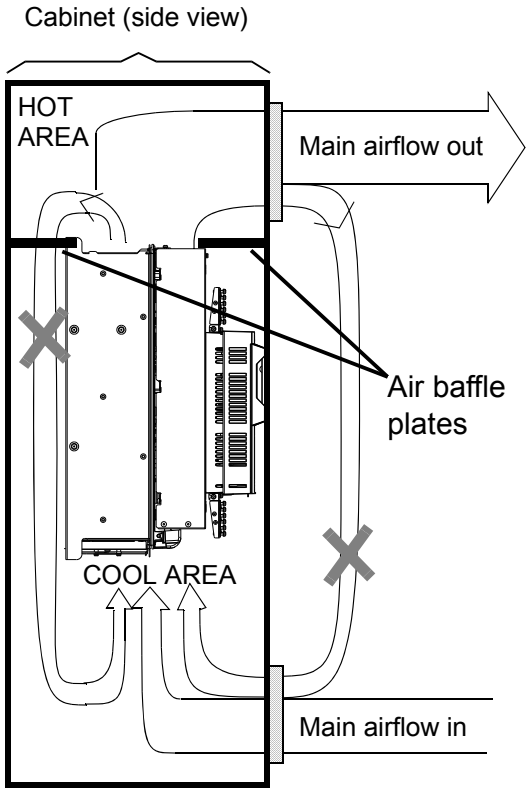
The internal cooling fans of the modules are usually sufficient to keep the component temperatures low enough in IP22 cabinets.

In IP54 cabinets, thick filter mats are used to prevent water splashes from entering the cabinet. This entails the installation of additional cooling equipment, such as a hot air exhaust fan.

The installation site must be sufficiently ventilated.

Preventing the recirculation of hot air

Typical vertical mounting



Outside the cabinet

Prevent hot air circulation outside the cabinet by leading the outcoming hot air away from the area where the inlet air to the cabinet is taken. Possible solutions are listed below:

- gratings that guide air flow at the air inlet and outlet
- air inlet and outlet at different sides of the cabinet
- cool air inlet in the lower part of the front door and an extra exhaust fan on the roof of the cabinet.

Inside the cabinet

Prevent hot air circulation inside the cabinet with leak-proof air baffle plates; make sure the air vents of the drive module remain clear. No gaskets are usually required.

Cabinet heaters

Use a cabinet heater if there is a risk of condensation in the cabinet. Although the primary function of the heater is to keep the air dry, it may also be required for heating at low temperatures. When placing the heater, follow the instructions provided by its manufacturer.

Planning the fastening of the cabinet

WARNING! Do not fasten the cabinet by electric welding. ABB does not assume any liability for damages caused by electric welding as the welding circuit may damage electronic circuits in the cabinet.

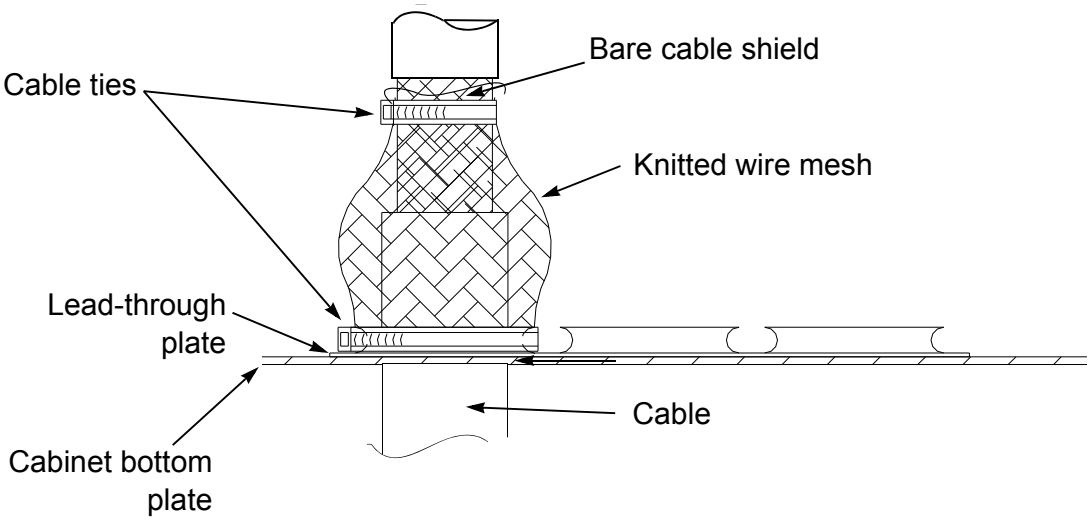
EMC requirements

Generally, the fewer and smaller the holes in the cabinet, the better the interference attenuation. The maximum recommended diameter of a hole in galvanic metal contact in the covering cabinet structure is 100 mm. Special attention must be paid to the cooling air inlet and outlet gratings.

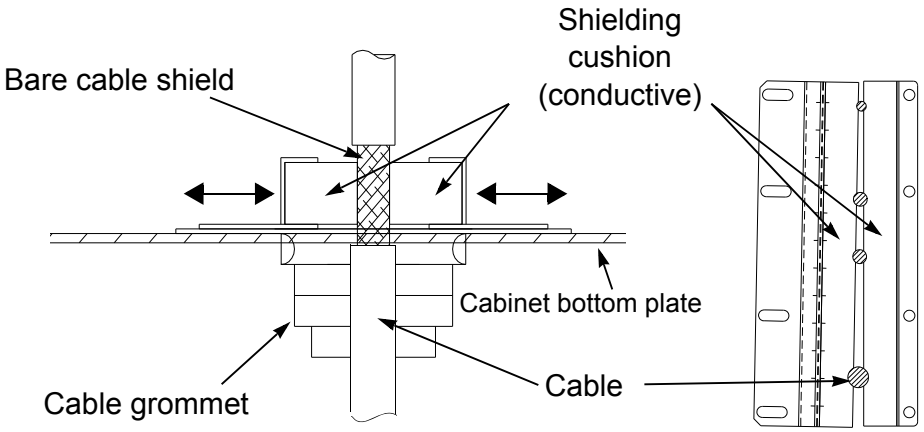
The best galvanic connection between the steel panels is achieved by welding them together as no holes are necessary. If welding is not possible, the seams between the panels **are recommended to be left unpainted** and equipped with special conductive EMC strips to provide adequate galvanic connection. Usually, reliable strips are made of flexible silicon mass covered with a metal mesh. The non-tightened touch-contact of the metal surfaces is not sufficient, so a conductive gasket between the surfaces is required. The maximum recommended distance between assembly screws is 100 mm.

Sufficient high-frequency grounding network must be constructed in the cabinet to avoid voltage differences and forming of high-impedance radiator structures. A good high-frequency grounding is made with short flat copper braids for low inductance. One-point high-frequency grounding cannot be used due to the long distances inside the cabinet.

First environment EMC compliance (defined under *Compliance with the European EMC Directive* in the chapter *Technical data)* of the drive requires 360° high frequency grounding of the motor cable shields at their entries. The grounding can be implemented by a knitted wire mesh shielding as shown below.



360° high frequency grounding of the control cable shields is recommended at their entries. The shields can be grounded by means of conductive shielding cushions pressed against the cable shield from both directions:



5

Mechanical installation

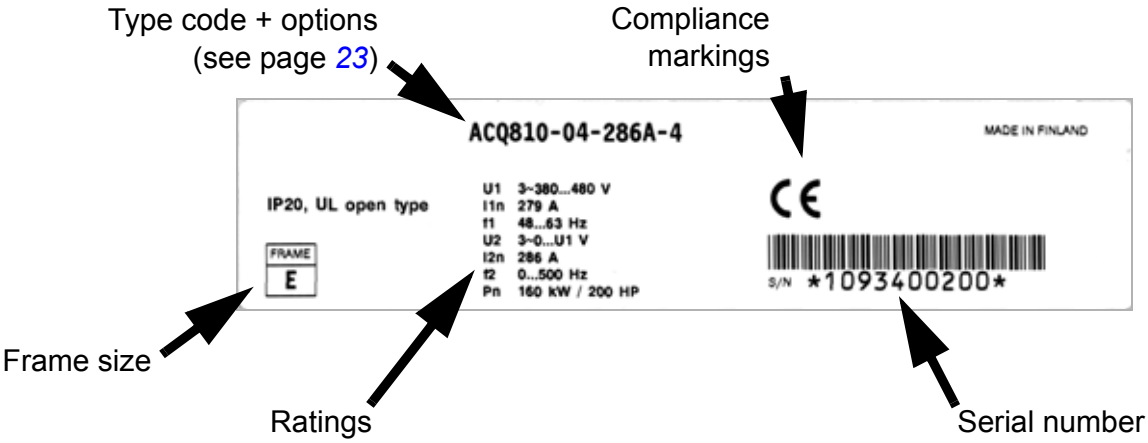
Contents of the package

The drive is delivered in a box made of plywood and cardboard. The box contains:

- drive module, with factory-installed options
- one cable clamp plate for control cabling with screws
- screw-type terminal blocks to be attached to the headers on the JCU Control Unit
- control panel mounting kit if ordered with option code +J410
- Start-up guide and manuals CD.

Delivery check and drive module identification

Check that there are no signs of damage. Before attempting installation and operation, check the information on the type designation label of the drive module to verify that the unit is of the correct type. The label is located on the left-hand side of the drive module.



The first digit of the serial number refers to the manufacturing plant. The 2nd and 3rd digit indicate the year of manufacture, while the 4th and 5th digits indicate the week. Digits 6 to 10 are a running integer starting every week at 00001.

Before installation

See *Technical data* for the allowed operation conditions of the drive. Refer to *Dimension drawings* for frame details.

The wall the drive is to be mounted on must be as even as possible, of non-flammable material and strong enough to carry the weight of the drive. The floor/material below the drive must be non-flammable.

Connection to an IT (ungrounded) or a corner-grounded power system

The internal EMC filter must be disconnected if the drive is to be supplied from a corner-grounded power system or an IT power system [an ungrounded power system or a high resistance-grounded (over 30 ohms) power system]. As the procedure involves the removal of drive module covers, it is convenient to perform it before the drive is installed.

See page 50 for directions.

Installation procedure

Direct wall mounting

1. Mark the locations for the four holes. The mounting points are shown in *Dimension drawings*.
2. Fix the screws or bolts to the marked locations.
3. Position the drive onto the screws on the wall. **Note:** Only lift the drive by its lifting holes.
4. Tighten the screws.

Planning the electrical installation

What this chapter contains

This chapter contains the instructions that you must follow when selecting the motor, cables, protections, cable routing and way of operation for the drive. If the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Note: The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations.

Motor selection and compatibility

Select the (3-phase AC induction) motor according to the rating table in the chapter *Technical data*. The table lists the typical motor power for each drive type.

Protecting the motor insulation and bearings

The output of the drive comprises – regardless of output frequency – pulses of approximately 1.35 times the equivalent mains network voltage with a very short rise time. This is the case with all drives employing modern IGBT inverter technology.

The voltage of the pulses can be almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This in turn can cause additional stress on the motor and motor cable insulation.

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

The stress on motor insulation can be avoided by using optional ABB du/dt filters. du/dt filters also reduce bearing currents.

To avoid damage to motor bearings, the cables must be selected and installed according to the instructions given in this manual. With a non-ABB motor, optional du/dt filtering is also recommended. An insulated N-end (non-drive end) bearing is recommended if the motor is random-wound, or if the motor power is above 100 kW. See requirements table on page 98.

Supply connection

Use a fixed connection to the AC power line.

WARNING! As the leakage current of the device typically exceeds 3.5 mA, a fixed installation is required according to IEC 61800-5-1.

Supply disconnecting device

Install a hand-operated input disconnecting device (disconnecting means) between the AC power source and the drive. The disconnecting device must be of a type that can be locked to the open position for installation and maintenance work.

Europe

If the drive is used in an application which must meet the European Union Machinery Directive according to standard EN 60204-1 Safety of Machinery, the disconnecting device must be one of the following types:

- a switch-disconnector of utilization category AC-23B (EN 60947-3)
- a disconnector that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector (EN 60947-3)
- a circuit breaker suitable for isolation in accordance with EN 60947-2.

Other regions

The disconnecting means must conform to the applicable safety regulations.

Thermal overload and short circuit protection

Thermal overload protection

The drive protects itself and the input and motor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. No additional thermal protection devices are needed.

WARNING! If the drive is connected to multiple motors, a separate thermal overload switch or a circuit breaker must be used for protecting each cable and motor. These devices may require a separate fuse to cut off the short-circuit current.

Protection against short-circuit in motor cable

The drive protects the motor cable and the motor in a short-circuit situation when the motor cable is dimensioned according to the nominal current of the drive. No additional protection devices are needed.

Protection against short-circuit in the supply cable or the drive

Protect the supply cable with fuses or circuit breakers. Fuse recommendations are given in the chapter *Technical data*. When placed at the distribution board, standard IEC gG fuses or UL type T fuses will protect the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short circuit inside the drive.

Operating time of the fuses and circuit breakers

The operating time depends on the type, the supply network impedance, and the cross-sectional area, material and length of the supply cable. US fuses must be of the “non-time delay” type.

Circuit breakers

The protective characteristics of circuit breakers depend on the supply voltage as well as the type and construction of the breakers. There are also limitations pertaining to the short-circuit capacity of the supply network. Your local ABB representative can help you in selecting the breaker type when the supply network characteristics are known.

Motor thermal protection

According to regulations, the motor must be protected against thermal overload and the current must be switched off when overloading is detected. The drive includes a motor thermal protection function that protects the motor and switches off the current when necessary. Depending on a drive parameter value, the function either monitors a calculated temperature value (based on a motor thermal model) or an actual temperature indication given by motor temperature sensors. The user can tune the thermal model further by feeding in additional motor and load data.

PTC sensors can be connected directly to the ACQ810-04. See page *70* in this manual, and the appropriate *Firmware manual* for the parameter settings concerning motor thermal protection.

Ground fault protection

The drive is equipped with an internal ground fault protective function to protect the unit against ground faults in the motor and the motor cable. This is not a personal safety or a fire protection feature. The ground fault protective function can be disabled with a parameter, refer to the appropriate *Firmware manual*.

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

Emergency stop devices

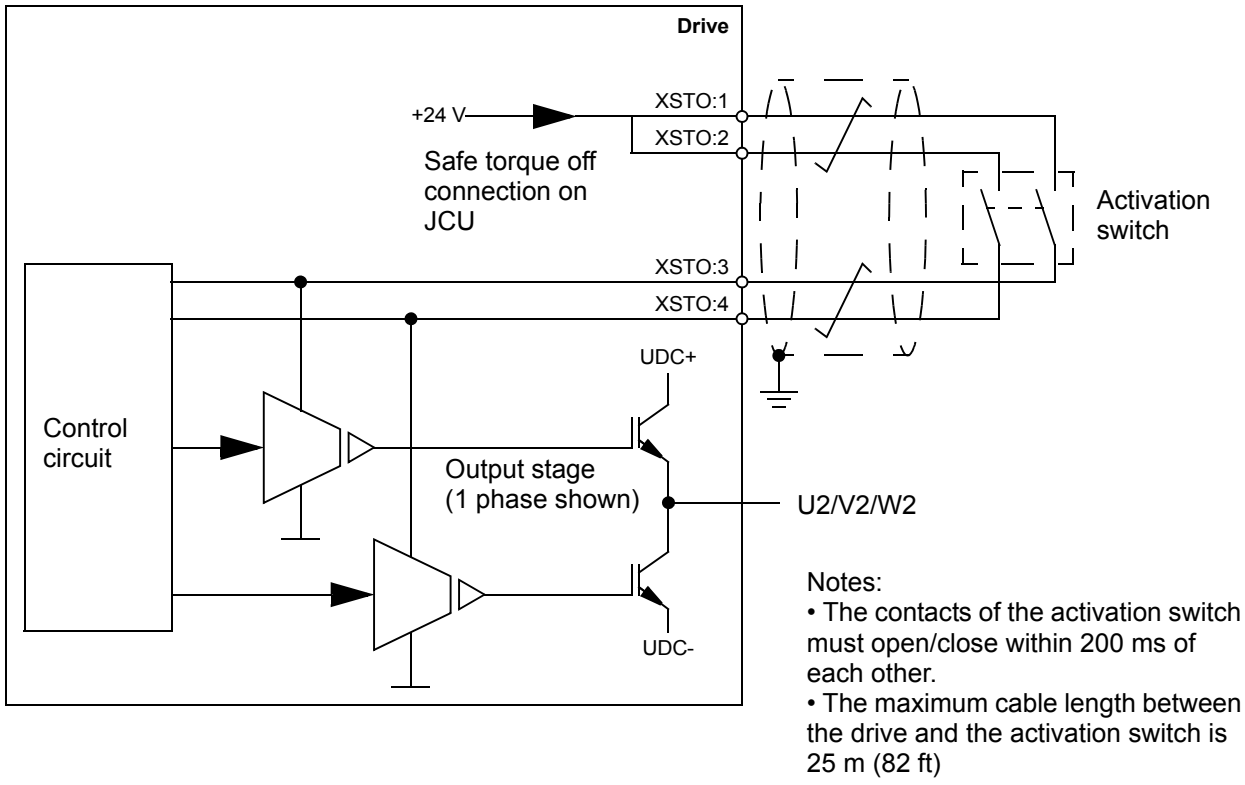
For safety reasons, install the emergency stop devices at each operator control station and at other operating stations where emergency stop may be needed.

Note: Pressing the stop key on the control panel of the drive does not generate an emergency stop of the motor or separate the drive from dangerous potential.

Safe torque off

The drive supports the Safe torque off function according to standards EN 61800-5-2:2007; EN 954-1:1997; IEC/EN 60204-1:1997; EN 61508:2002 and EN 1037:1996.

The Safe torque off function disables the control voltage of the power semiconductors of the drive output stage, thus preventing the inverter from generating the voltage required to rotate the motor (see diagram below). By using this function, short-time operations (like cleaning) and/or maintenance work on non-electrical parts of the machinery can be performed without switching off the power supply to the drive.



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

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

Selecting the power cables

General rules

Dimension the supply (input power) and motor cables **according to local regulations**.

- The cable must be able to carry the drive load current. See the chapter *Technical data* for the rated currents.
- The cable must be rated for at least 70 °C (US: 75 °C [167 °F]) maximum permissible temperature of conductor in continuous use.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- 600 V AC cable is accepted for up to 500 V AC.
- Refer to the chapter *Technical data* for EMC requirements.

Symmetrical shielded motor cable must be used (see the figure below) to meet the EMC requirements of the CE and C-tick marks.

A four-conductor system is allowed for input cabling, but shielded symmetrical cable is recommended. To operate as a protective conductor, the shield conductivity must be as follows when the protective conductor is made of the same metal as the phase conductors:

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

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

The motor cable and its PE pigtail (twisted shield) should be kept as short as possible in order to reduce electromagnetic emission, as well as stray currents outside the cable and capacitive current.

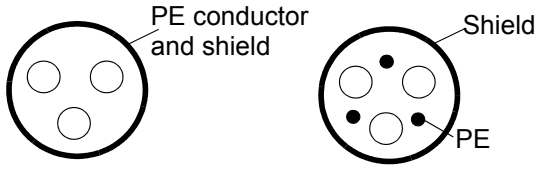
Alternative power cable types

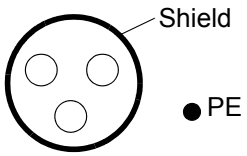
Power cable types that can be used with the drive are represented below.

Motor cable
(also recommended for supply cabling)

Symmetrical shielded cable: three phase conductors and a concentric or otherwise symmetrically constructed PE conductor, and a shield

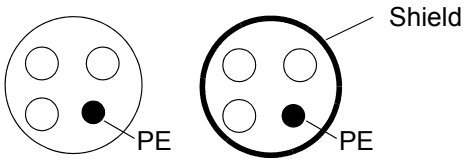
Note: A separate PE conductor is required if the conductivity of the cable shield is not sufficient for the purpose.





Allowed for supply cabling

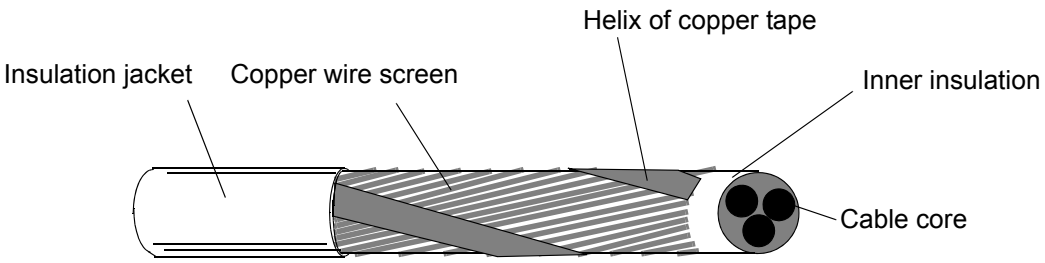
A four-conductor system: three phase conductors and a protective conductor.



Motor cable shield

To function as a protective conductor, the shield must have the same cross-sectional area as a phase conductor when they are made of the same metal.

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



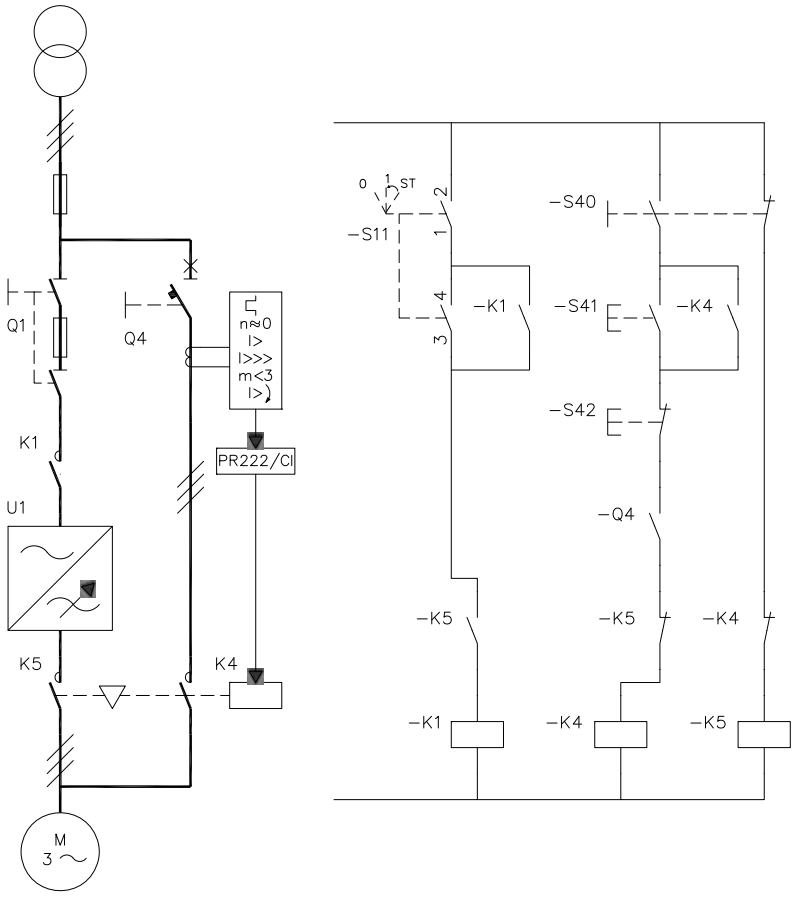
Implementing a bypass connection

If bypassing is required, employ mechanically or electrically interlocked contactors between the motor and the drive and between the motor and the power line. Ensure with the interlocking that the contactors cannot be closed simultaneously.

Follow this control sequence:

1. Stop the drive.
2. Stop the motor.
3. Open the contactor between the drive and the motor.
4. Close the contactor between the motor and the power line.

An example bypass connection is shown below.



Switch	Description
S11	Drive main contactor on/off control
S40	Motor power supply selection (drive or direct on line)
S41	Start when motor is connected on line
S42	Stop when motor is connected direct on line

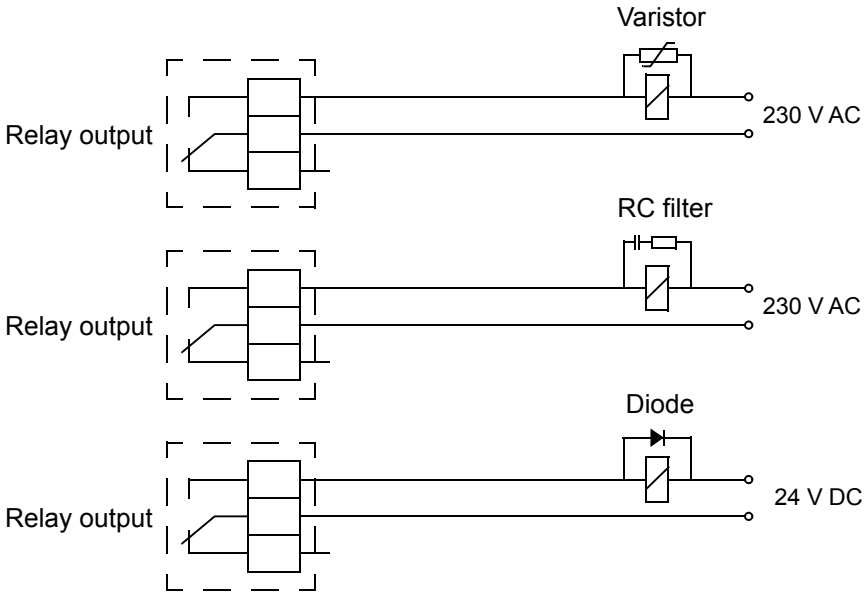
WARNING! Never connect the supply power to the drive output terminals U2, V2 and W2. Line voltage applied to the output can result in permanent damage to the unit.

Protecting the relay output contacts and attenuating disturbances in case of inductive loads

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

The relay outputs on the drive are protected with varistors (250 V) against overvoltage peaks. In addition, it is highly recommended to equip inductive loads with noise attenuating circuits (varistors, RC filters [AC] or diodes [DC]) in order to minimize the electromagnetic emissions 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, not at the relay output.



Considering the PELV requirements at sites above 2000 m (6562 ft)

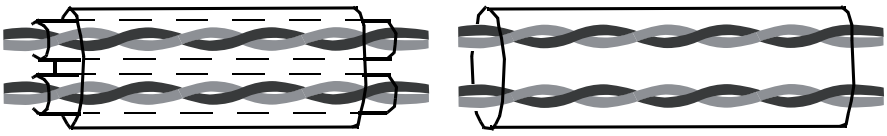
WARNING! Do not use a voltage greater than 48 V for the relay outputs of drive module at installation sites above 2000 meters (6562 feet). Use of a voltage greater than 48 V may damage the drive and can cause malfanction and physical injury. The Protective Extra Low Voltage (PELV) requirements are not fulfilled if a relay output is used with a voltage greater than 48 V.

Selecting the control cables

It is recommended that all control cables be shielded.

Double-shielded twisted pair cable is recommended for analog signals. For pulse encoder cabling, follow the instructions given by the encoder manufacturer. Use one individually-shielded pair for each signal. Do not use a common return for different analog signals.

Double-shielded cable is the best alternative for low-voltage digital signals but single-shielded twisted multipair cable (Figure *b*) is also usable.



a
Double-shielded twisted pair cable

b
Single-shielded twisted multipair cable

Run analog and digital signals in separate cables.

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

Never mix 24 V DC and 115/230 V AC signals in the same cable.

Relay cable

The cable type with braided metallic screen (e.g. ÖLFLEX by Lapp Kabel, Germany) has been tested and approved by ABB.

Control panel cable

The cable connecting the control panel to the drive must not exceed 3 metres in length. The cable type tested and approved by ABB is used in control panel option kits.

Connection of a motor temperature sensor to the drive I/O

See page 70.

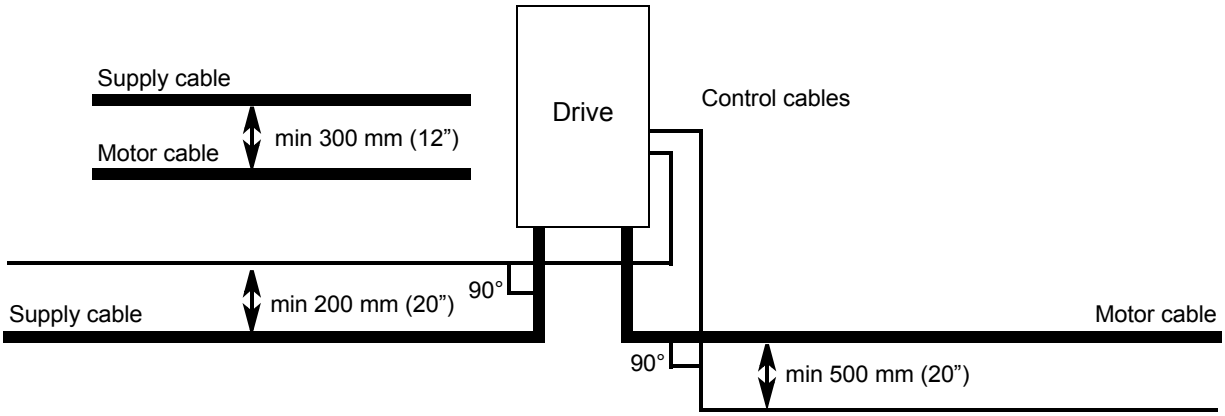
Routing the cables

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

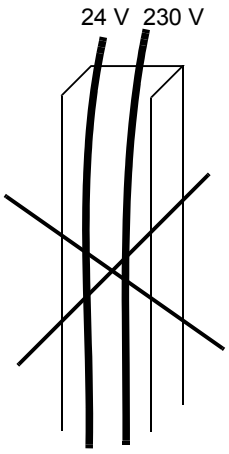
Where control cables must cross power cables make sure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the drive.

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

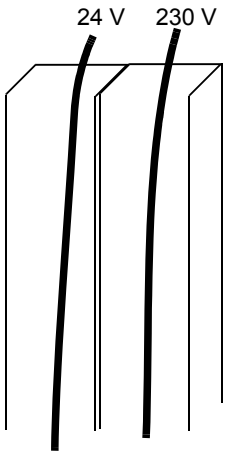
A diagram of the cable routing is below.



Control cable ducts



Not allowed unless the 24 V cable is insulated for 230 V or insulated with an insulation sleeving for 230 V.



Lead 24 V and 230 V control cables in separate ducts inside the cabinet.

7

Electrical installation

What this chapter contains

This chapter describes the electrical installation procedure of the drive.

WARNING! The work described in this chapter may only be carried out by a qualified electrician. Follow the *Safety instructions* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.
Make sure that the drive is disconnected from the supply (input power) during installation. If the drive is already connected to the supply, wait for 5 minutes after disconnecting the input power.

Removing the cover assembly

The cover assembly needs to be removed before the installation of optional modules and the connection of control cabling. Follow this procedure to remove the cover assembly. The numbers refer to the illustrations below.

- Press the tab (1) slightly with a screwdriver.
- Slide the lower cover plate slightly downwards and pull it out (2).
- Disconnect the panel cable (3) if present.
- Remove the screw (4) at the top of the cover assembly.
- Carefully pull the lower part of the base outwards by the two tabs (5).

Refit the cover in reverse order to the above procedure.

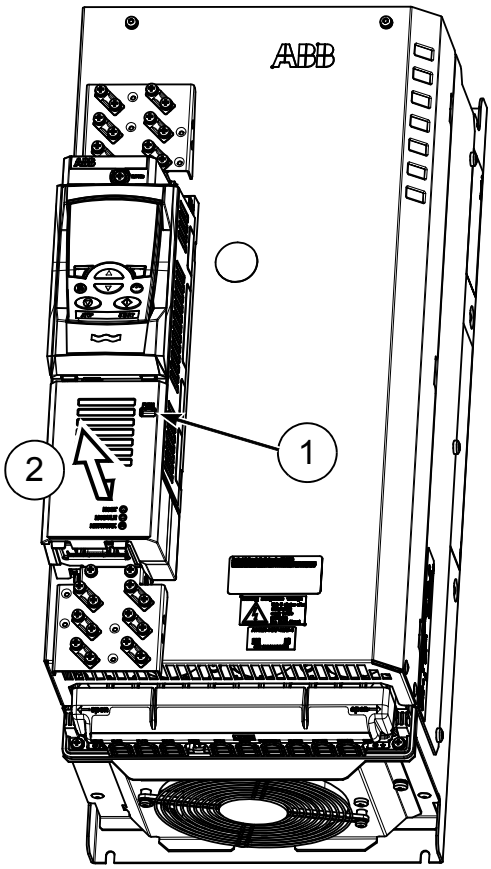
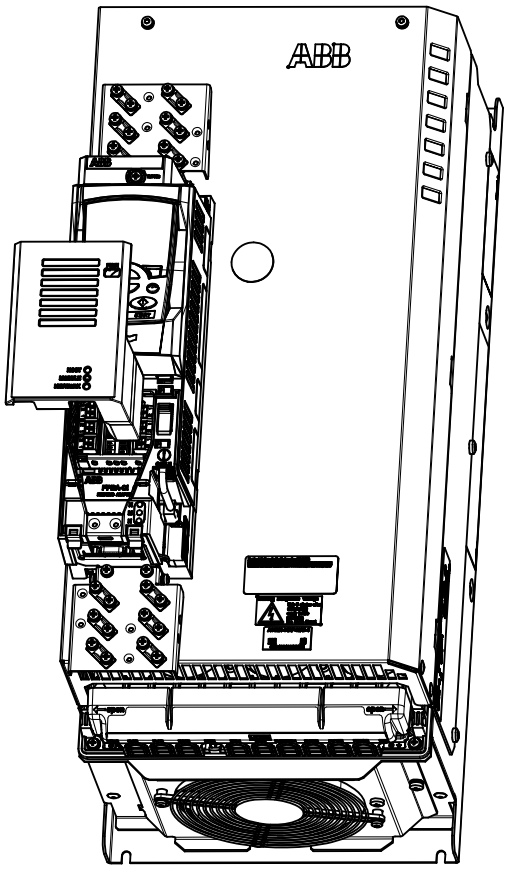


ABB
1
2



ABB

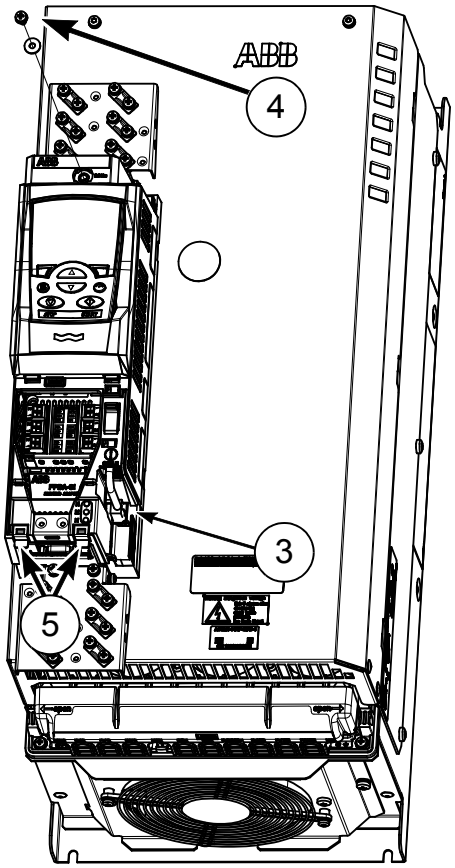
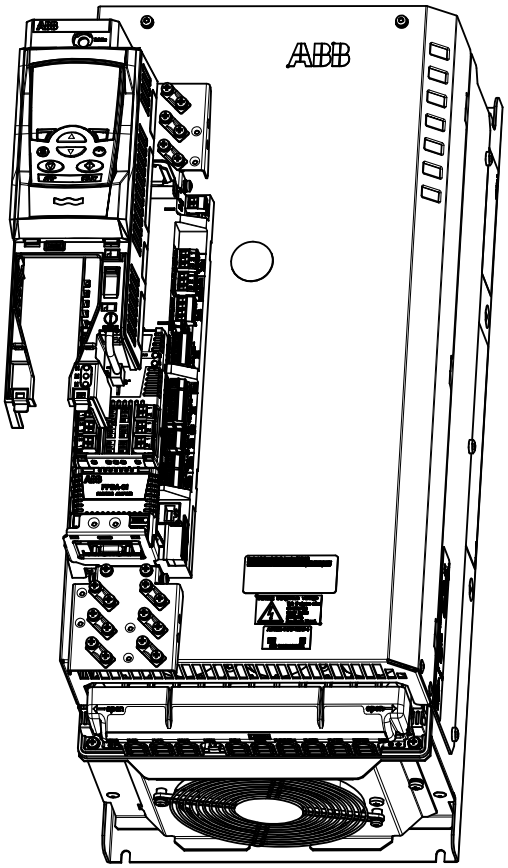


ABB
4
3
5



ABB

Checking the insulation of the assembly

Drive

Do not make any voltage tolerance or insulation resistance tests (e.g. hi-pot or megger) on any part of the drive as testing can damage the drive. Every drive has been tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the drive which cut down the testing voltage automatically.

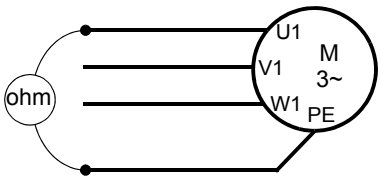
Supply cable

Check the insulation of the supply (input) cable according to local regulations before connecting to the drive.

Motor and motor cable

Check the insulation of the motor and motor cable as follows:

1. Check that the motor cable is connected to the motor, and disconnected from the drive output terminals U2, V2 and W2.
2. Measure the insulation resistance between each phase conductor and the Protective Earth conductor using a measuring voltage of 500 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, please consult the manufacturer's instructions. **Note:** Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.



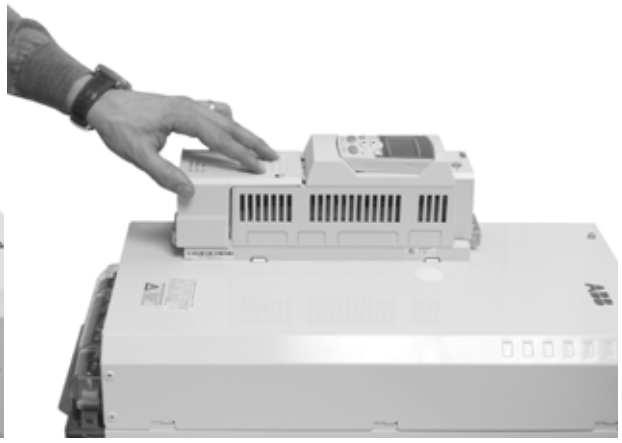
Connection to an IT (ungrounded) power system

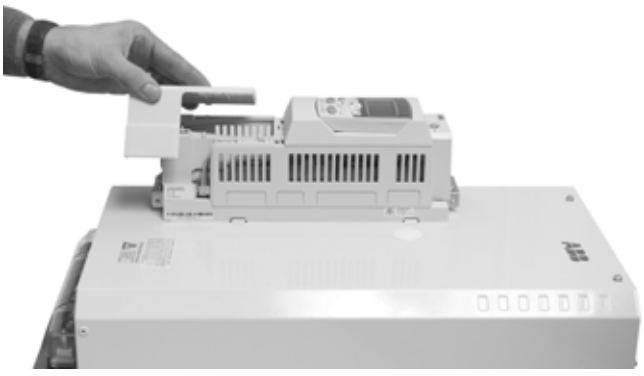
WARNING! Before connecting the drive to an IT power system [an ungrounded power system or a high resistance-grounded (over 30 ohms) power system] or a corner-grounded power system, the internal EMC filtering of the drive must be disconnected.

If a drive with its internal EMC filtering connected is installed on an IT system or a corner-grounded system, the drive system will be connected to earth potential through the EMC filter capacitors of the drive. This may cause danger or damage the unit. 1st environment EMC filtering (option +E202) must be disconnected, 2nd environment EMC filtering (as standard) can be connected.

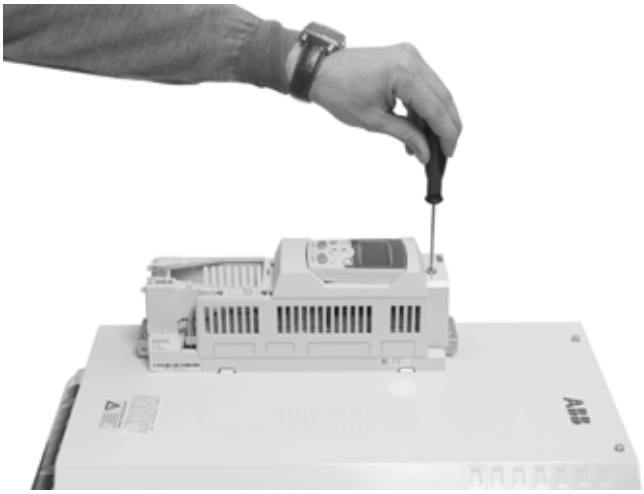
Frame size E0: Disconnection of internal EMC filtering (option +E202 included)

1. Place the drive module on its back on a level surface.
2. Press the tab slightly with a screwdriver.
3. Slide the lower cover plate slightly downwards and pull it out.

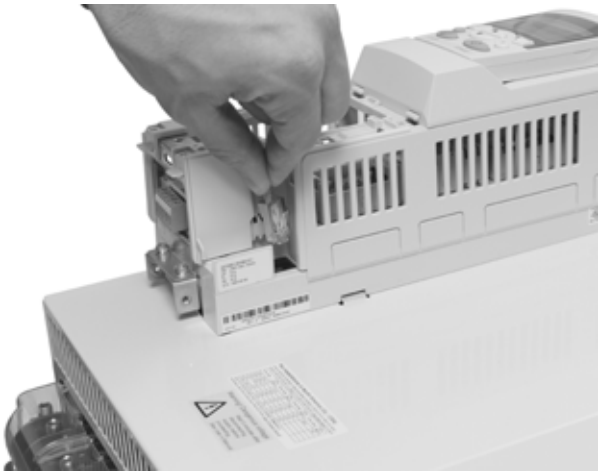




4. Remove the screw at the top of the cover assembly.

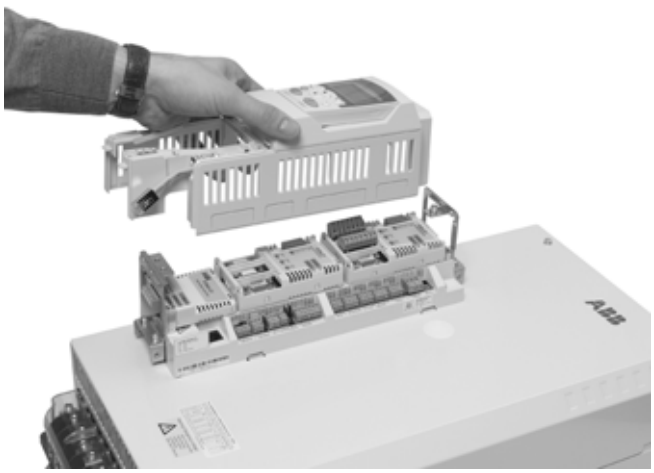


5. Disconnect the panel cable (if present).

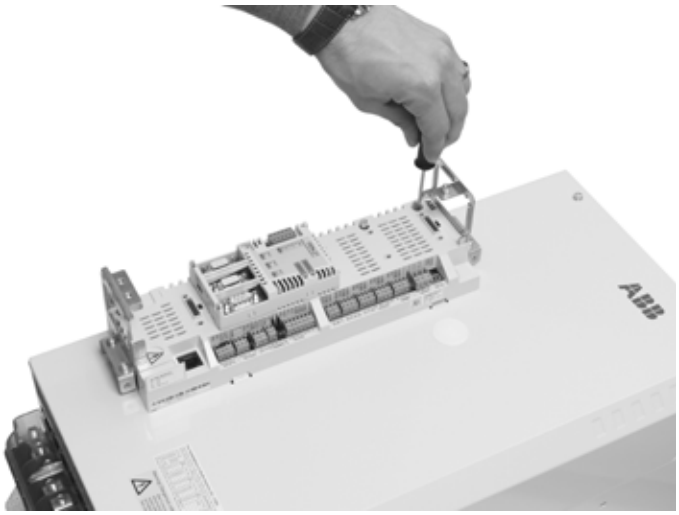


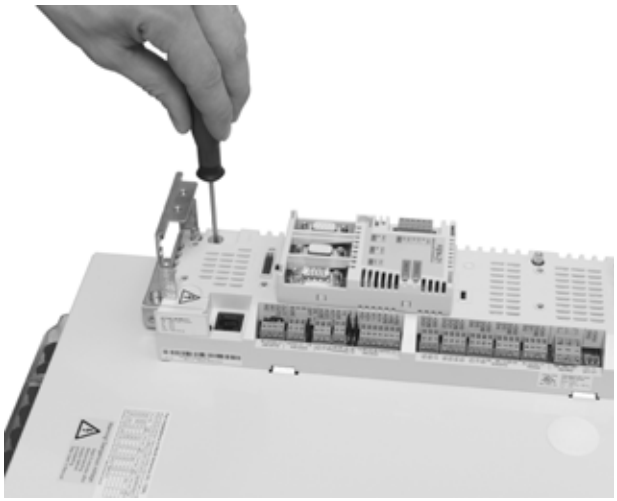
6. Carefully pull the lower part of the base outwards by the two tabs.

7. Lift the cover assembly up.

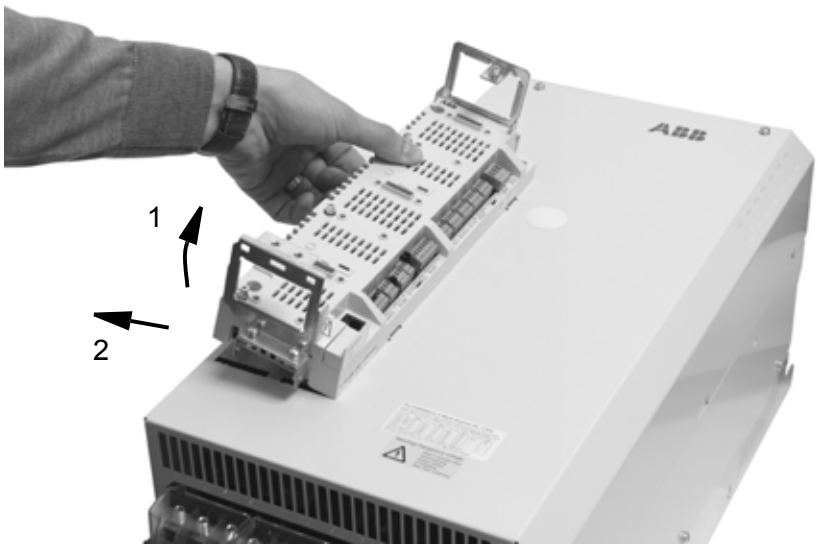


8. Release the two screws holding the JCU Control Unit.

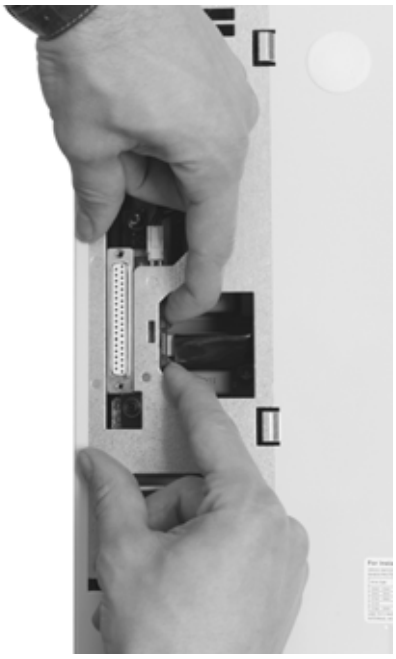




9. Lift the left-hand edge of the JCU Control Unit until the connector beneath disengages, then move JCU to the left to remove it.

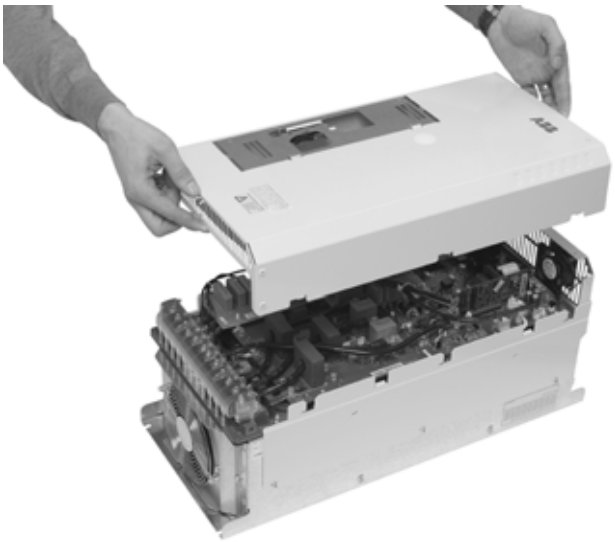


10. Disconnect the two cables coming to the mounting base of the JCU.

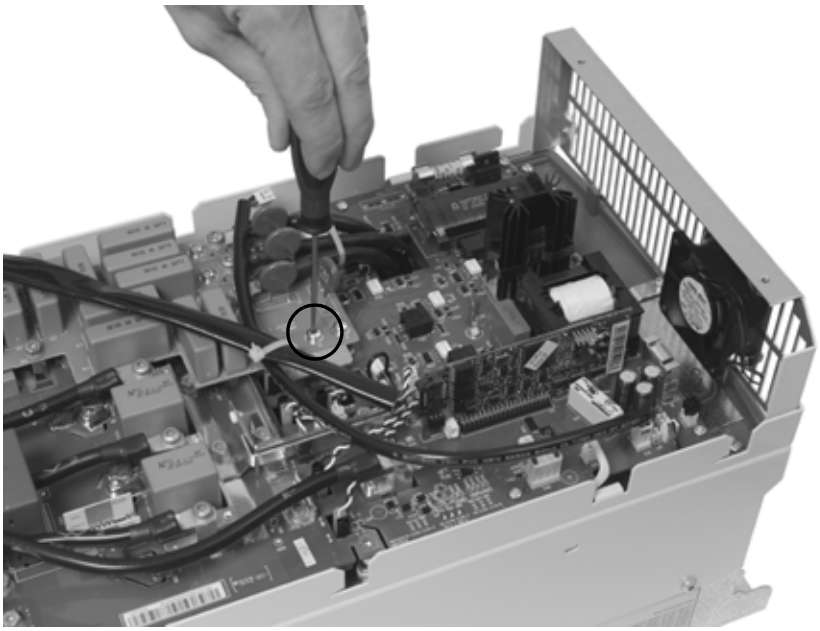


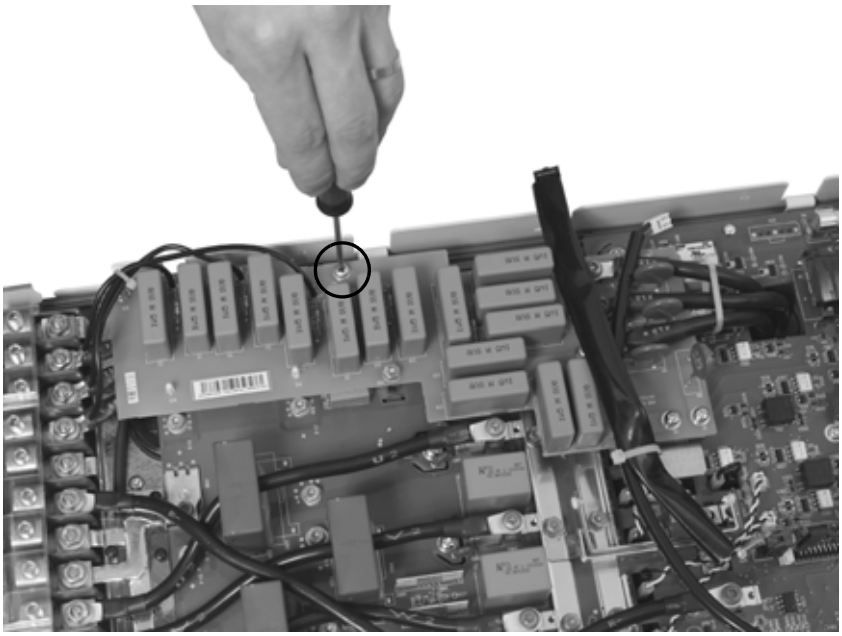
11. Remove the two screws holding the drive module cover.

12. First slide the cover a bit upwards, then lift off the cover.



13. Remove the two screws (marked X2 and X3) on top of the RRFC/RVAR circuit board.



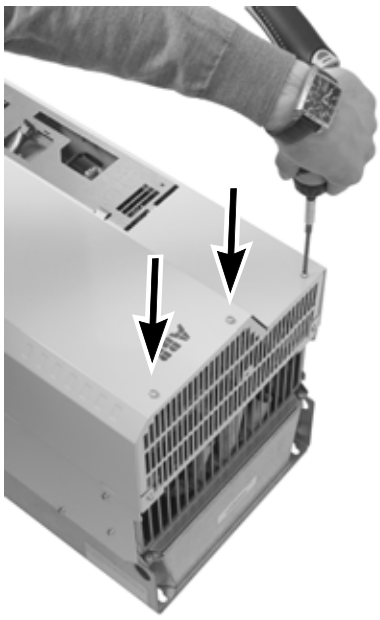


14. Refit the module cover and fasten using the screws removed at step 11.
15. Reconnect the cables that were disconnected at step 10.
16. Refit the JCU Control Unit.

Frame size E: Disconnection of internal EMC filtering (option +E202 included)

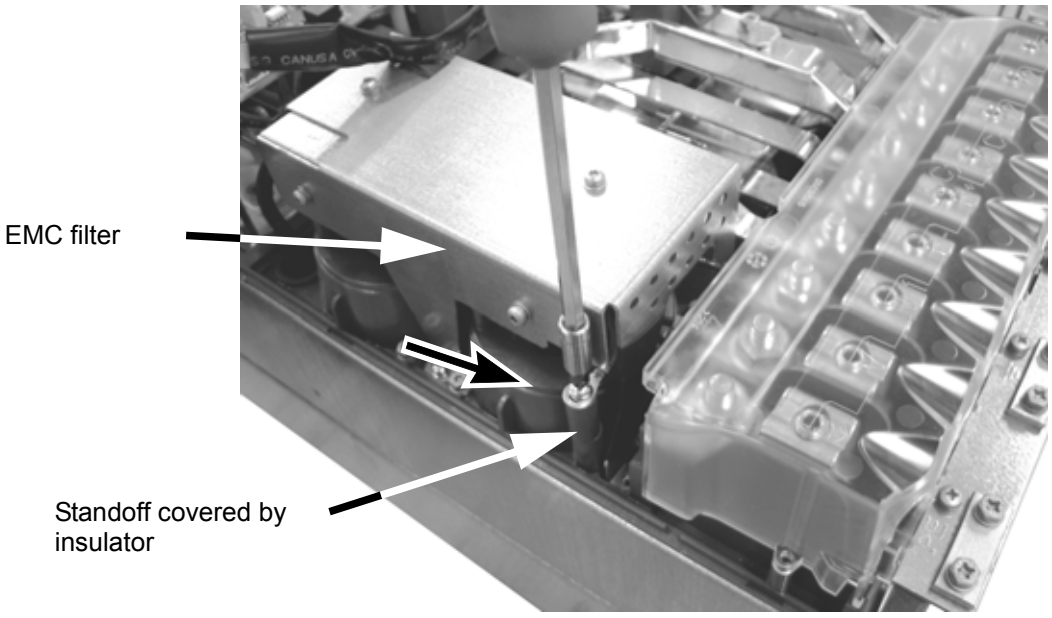
1. Place the drive module on its back on a level surface.
2. Remove the cover assembly and JCU Control Unit and disconnect the two cables. Follow the same instructions as with frame size E0, steps 1 to 10.
3. Remove the screw in the middle of the air outlet grating.

4. Remove the three screws holding the drive module cover.

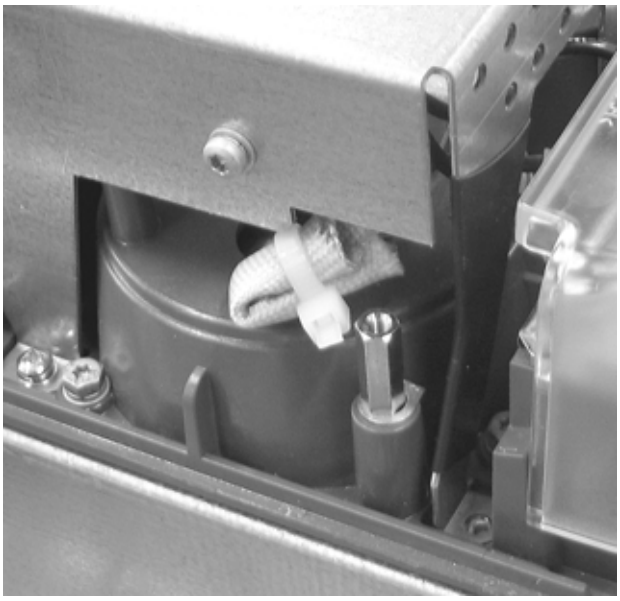


5. First slide the cover a bit upwards, then lift off the cover.

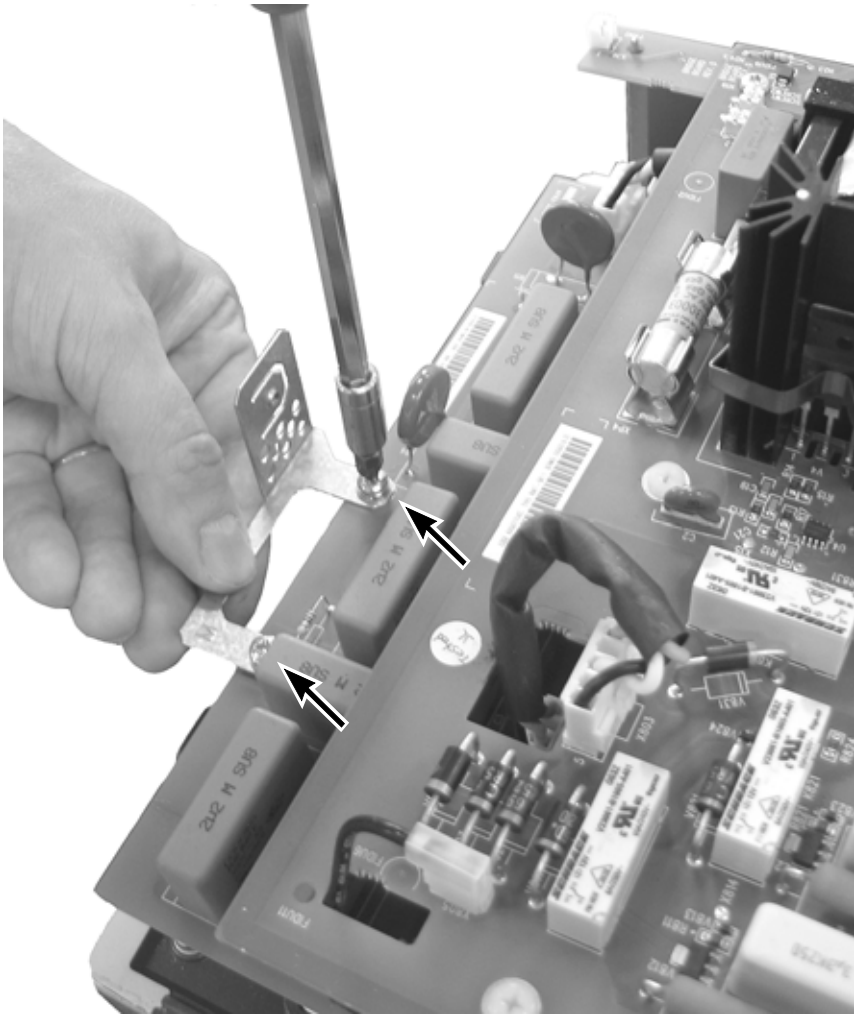
6. Undo the screw connecting the grounding wire to a standoff right next to the EMC filter. Cut off the lug. Discard the screw and the tubular insulator.



7. Insulate the end of the grounding wire reliably with insulating tape, tube sleeving and a cable tie.



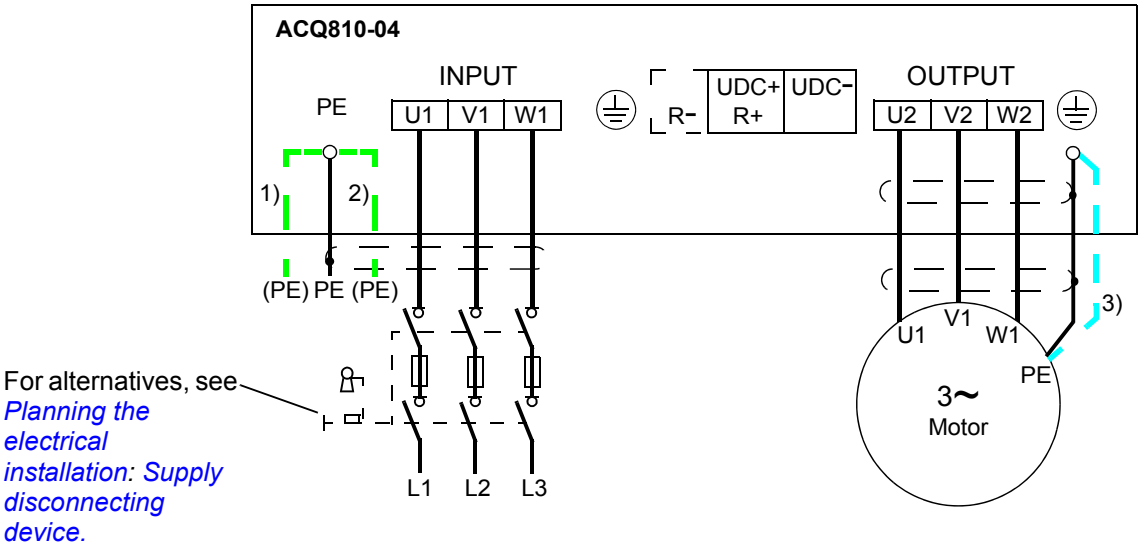
8. Near the top of the module, remove the grounding clip (held by two screws) that connects the varistor board to the module cover. Fasten the removed screws to mount the varistor board.



9. Refit the module cover (top edge first) and fasten using the screws removed at step 4. (The screw in the middle of the air outlet grating that was removed at step 3 is no longer needed.)
10. Reconnect the cables that were disconnected at step 2.
11. Refit the JCU Control Unit.

Power cable connection

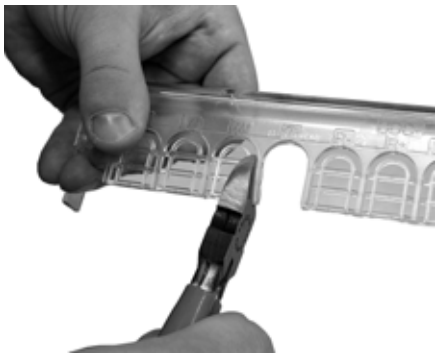
Power cable connection diagram



Notes:
– Do not use a non-shielded or asymmetrically-constructed motor cable. It is recommended to use a shielded cable also as an supply (input) cable.
– If shielded supply (input) cable is used, and the conductivity of the shield is less than 50% of the conductivity of a phase conductor, use a cable with a ground conductor (1) or a separate PE cable (2).
– For motor cabling, use a separate ground cable (3) if the conductivity of the cable shield is less than 50% of the conductivity of a phase conductor and the cable has no symmetrical ground conductors.
If there is a symmetrically-constructed ground conductor in the motor cable in addition to the conductive shield, connect it to the ground connectors at both the drive and motor ends.

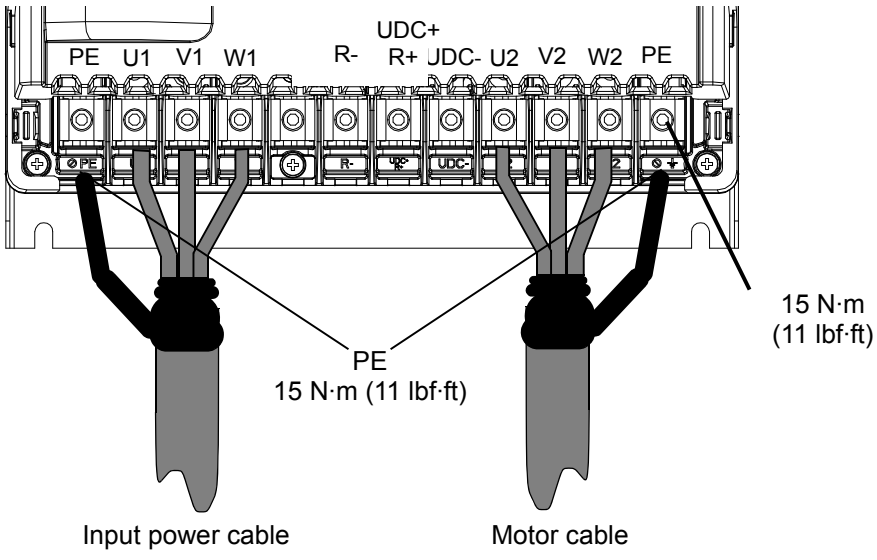
Procedure

1. Remove the plastic shroud covering the main terminals. Lift up with a screw driver from the corner.
2. Connect the twisted shields of the power cables and separate grounding conductors to the grounding terminals of the drive module.
3. Connect the phase conductors of the supply cable to the U1, V1 and W1 terminals, and the phase conductors of the motor cable to the U2, V2 and W2 terminals. The recommended stripping length is 16 mm (0.63”) for frame size E0 and 28 mm (1.1”) for frame size E.
4. Secure the cables mechanically outside the drive module.
5. Cut holes for the installed cables into the clear plastic shroud to accommodate the power cables. Press the shroud onto the terminals.

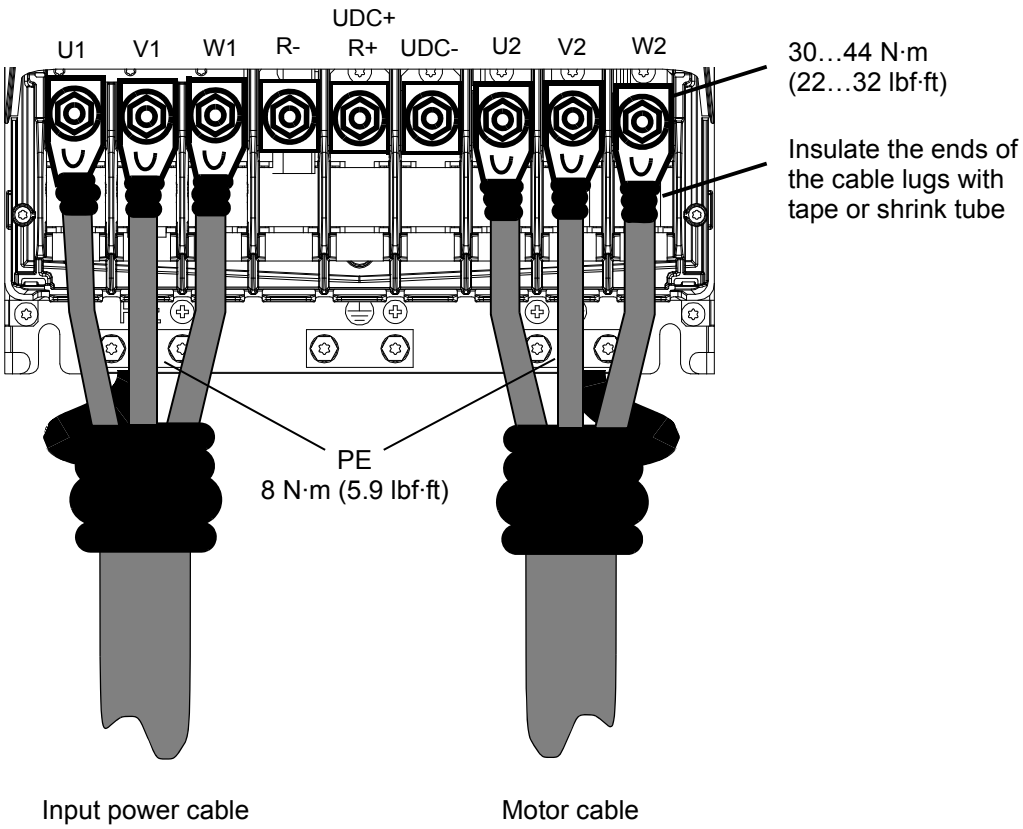


6. Connect the other ends of the power cables. To ensure safety, pay special attention to connection of the grounding conductors.

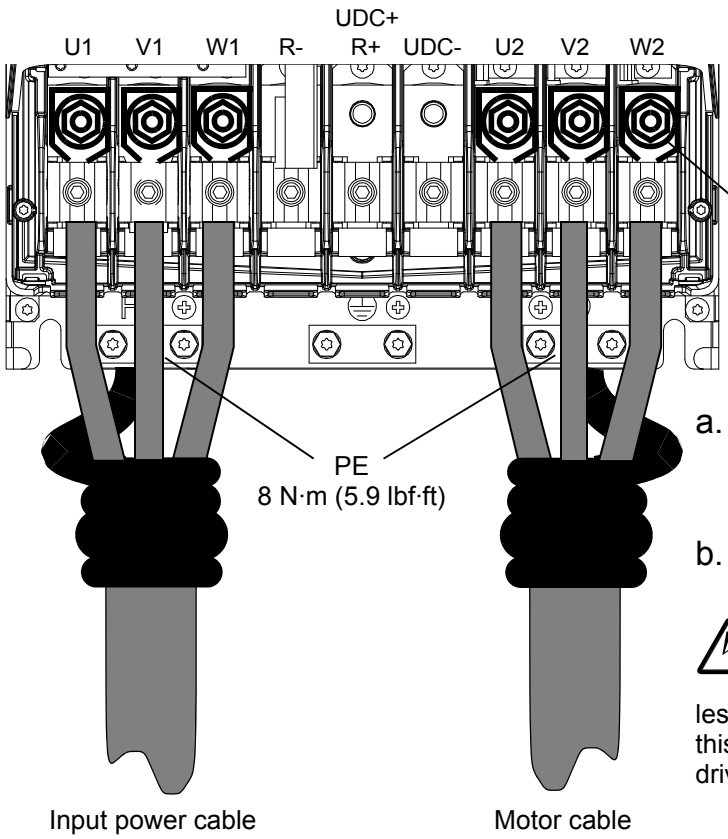
Frame size E0: Screw terminal installation

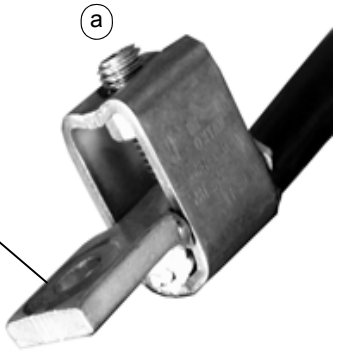


Frame size E: Cable lug installation (16 to 70 mm^2 [AWG6 to AWG2/0] cables)



Frame size E: Screw terminal installation (95 to 240 mm^2 [AWG3/0 to 500MCM] cables)





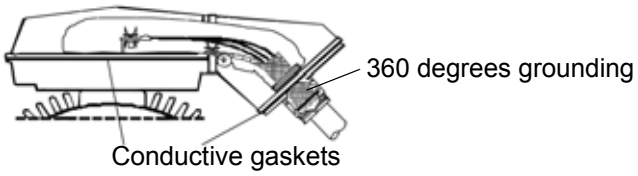
a. Connect the cable to the terminal. Tighten the Allen screw to 20…40 N·m (15…30 lbf·ft).

b. Connect the terminal to the drive. Tighten to 30…44 N·m (22…32 lbf·ft).

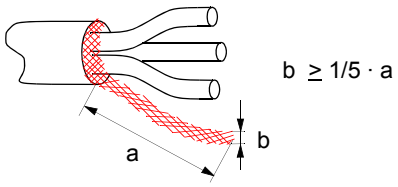
WARNING! If the wire size is less than 95 mm^2 (3/0 AWG), a crimp lug must be used. A cable of wire size less than 95 mm^2 (3/0 AWG) connected to this terminal will loosen and may damage the drive.

Grounding the motor cable shield at the motor end

For minimum radio frequency interference, ground the cable shield 360 degrees at the lead-through of the motor terminal box



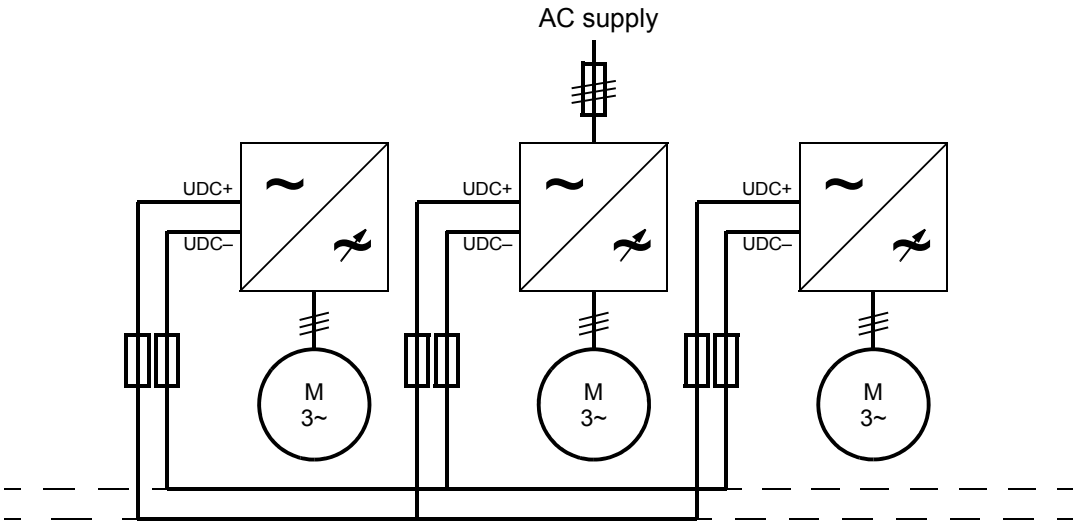
or ground the cable by twisting the shield so that the flattened shield is wider than 1/5 of its length.

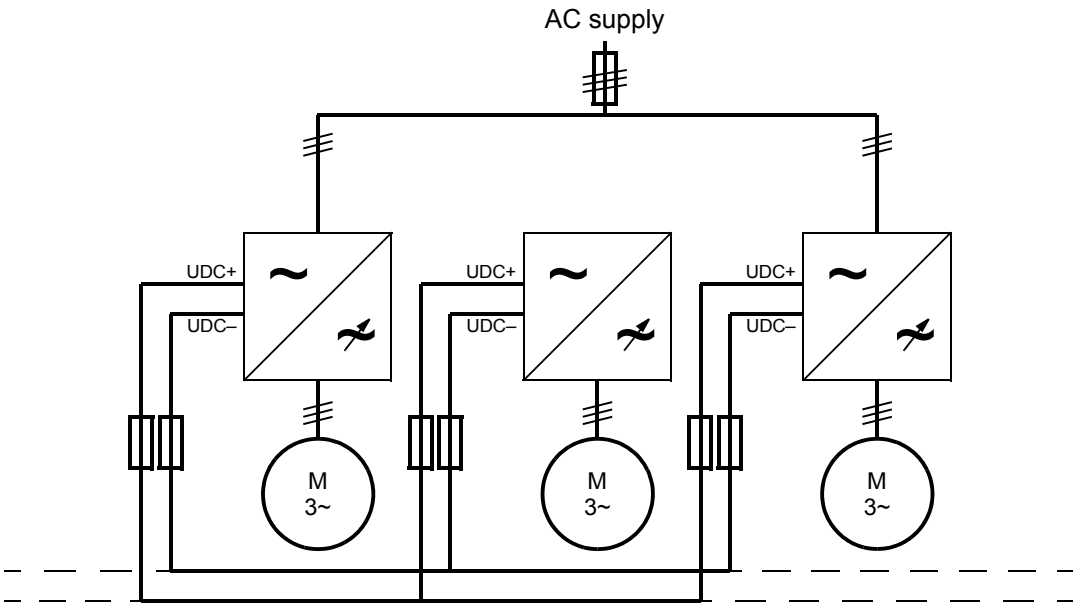


DC connection

The UDC+ and UDC– terminals are intended for common DC configurations of a number of ACQ810 drives, allowing regenerative energy from one drive to be utilised by the other drives in motoring mode.

One or more drives are connected to the AC supply depending on the power requirement. In case two or more drives are connected to the AC supply, each AC connection must be equipped with a mains choke (internal, not shown in the diagram below) to ensure even current distribution between the rectifiers. The diagram below shows two configuration examples.





The ratings of the DC connection are given on page *88*.

Connecting a PC

Connect the PC to connector X7 on the control unit (see page *20*) or to the connector in the control panel holder.

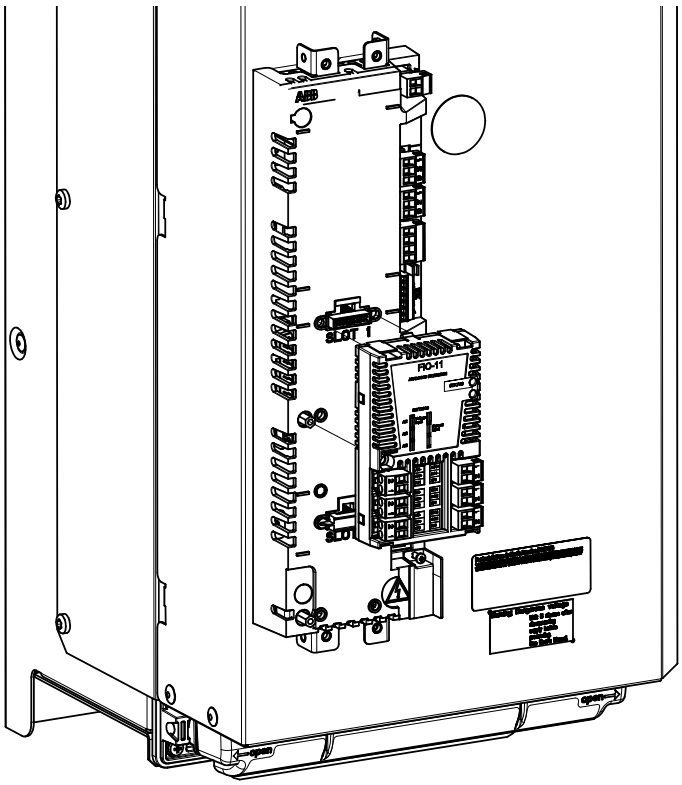
Installation of optional modules

Optional modules such as fieldbus adapters, I/O extensions and encoder interfaces ordered using option codes (see page 23) are pre-installed at the factory. Instructions for installing additional modules into the slots on the JCU Control Unit (see page 22 for the available slots) are presented below.

Mechanical installation

- Remove the cover assembly from on the JCU Control Unit (refer to page 47).
- Remove the protective cover (if present) from the connector of the slot.
- Insert the module carefully into its position on the drive.
- Fasten the screw.

Note: Correct installation of the screw is essential for fulfilling the EMC requirements and for proper operation of the module.

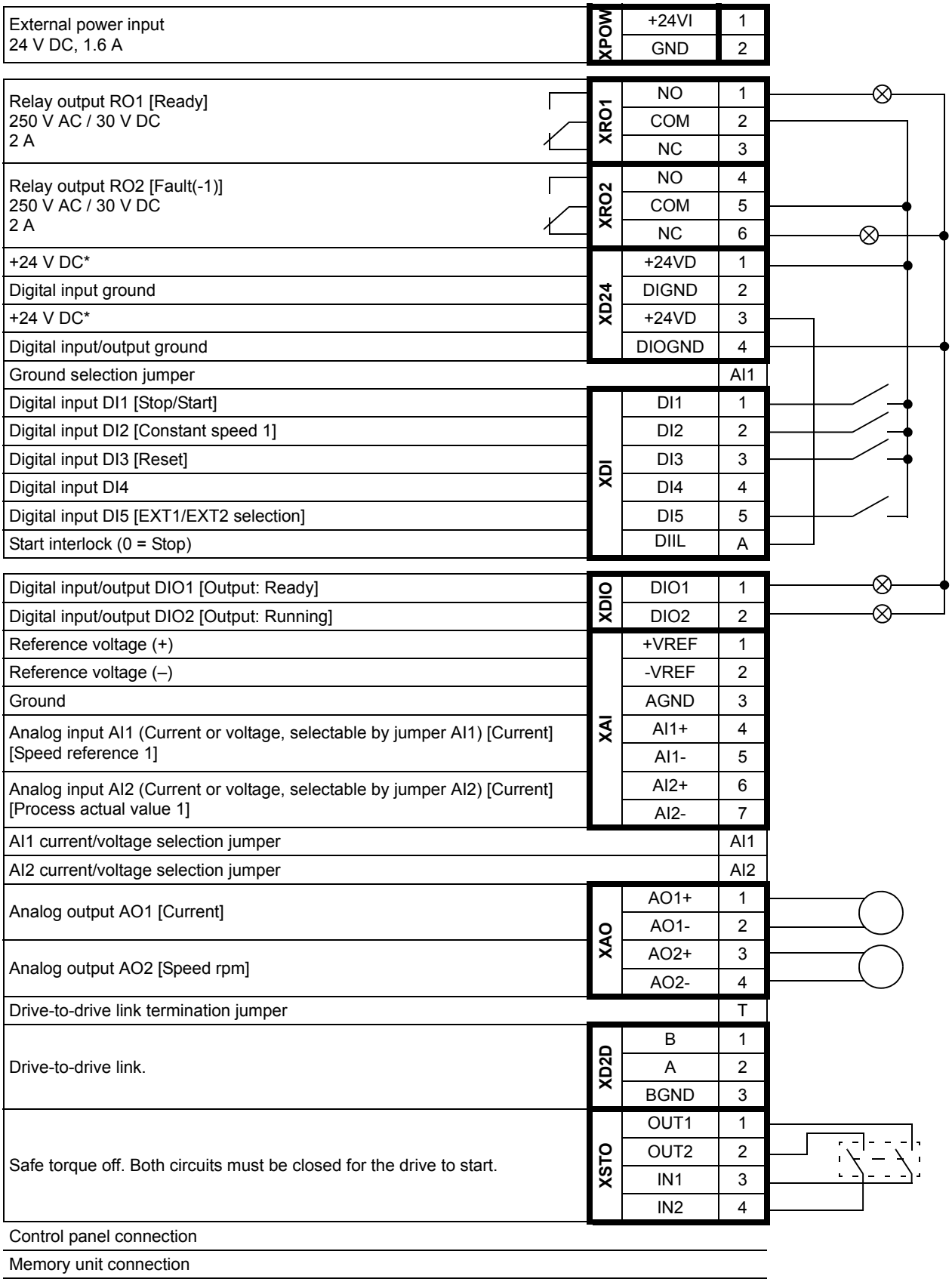


Electrical installation

See section *Grounding and routing the control cables* on page 72. See the appropriate option manual for specific installation and wiring instructions.

Connecting the control cables

Control connections to the JCU Control Unit



Notes: [Default setting with ACQ810 standard pump control program (Factory macro). See the *Firmware manual* for other macros.]

*Total maximum current: 200 mA

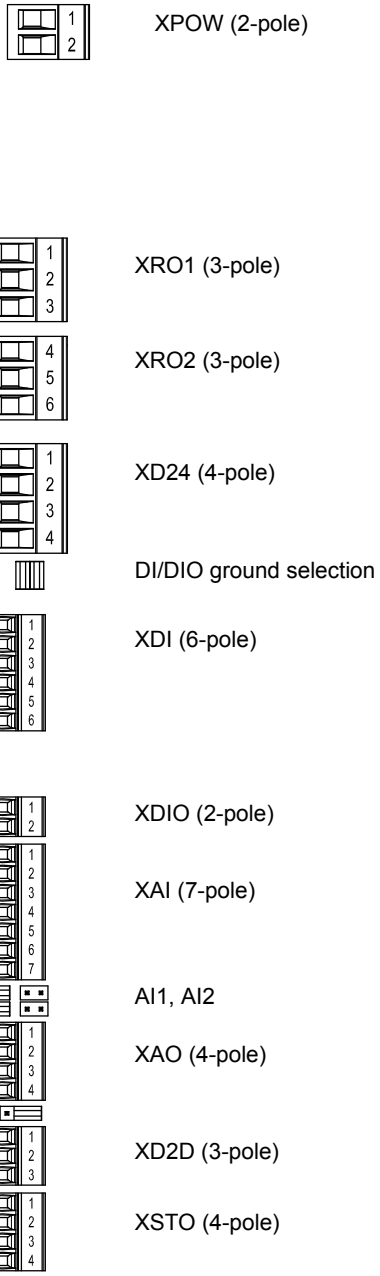
The wiring shown is for demonstrative purposes only. Further information of the usage of the connectors and jumpers are given in the text; see also the chapter *Technical data*.

Wire sizes and tightening torques:

XPOW, XRO1, XRO2, XD24:
0.5 … 2.5 mm^2 (24…12 AWG)
Torque: 0.5 N·m (5 lbf·in)

XDI, XDIO, XAI, XAO, XD2D, XSTO:
0.5 … 1.5 mm^2 (28…14 AWG)
Torque: 0.3 N·m (3 lbf·in)

Order of terminal headers and jumpers

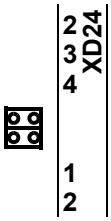


Jumpers

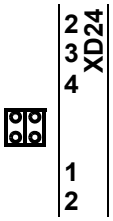
DI/DIO grounding selector (located between XD24 and XDI) – Determines whether the DIGND (ground for digital inputs DI1…DI4) floats, or if it is connected to DIOGND (ground for DI5, DIO1 and DIO2). (See the JCU isolation and grounding diagram on page *90*.)

If DIGND floats, the common of digital inputs DI1…DI4 should be connected to XD24:2. The common can be either GND or V_{CC} as DI1…DI4 are of the NPN/PNP type.

DIGND floats

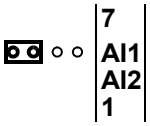


DIGND tied to DIOGND

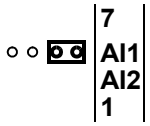


AI1 – Determines whether Analog input AI1 is used as a current or voltage input.

Current

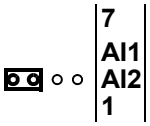


Voltage

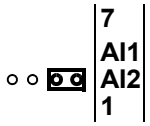


AI2 – Determines whether Analog input AI2 is used as a current or voltage input.

Current



Voltage



T – Drive-to-drive link termination. Must be set to the ON position when the drive is the last unit on the link.

Termination ON

Termination OFF

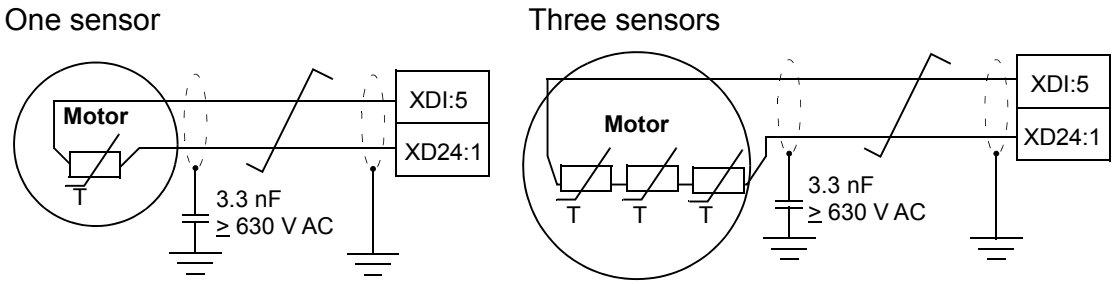
External power supply for the JCU Control Unit (XPOW)

External +24 V (minimum 1.6 A) power supply for the JCU Control Unit can be connected to terminal block XPOW. Using an external supply is recommended if

- the application requires fast start after connecting the drive to the main supply
- fieldbus communication is required when the input power supply is disconnected.

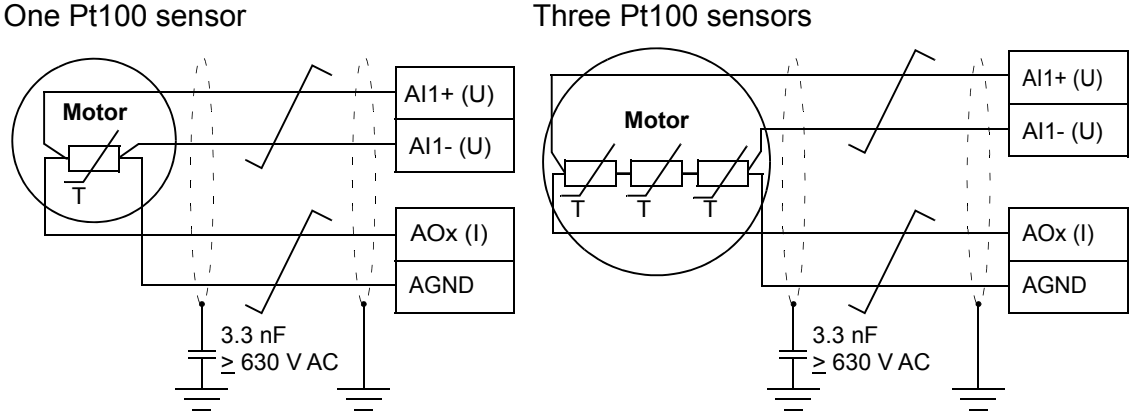
DI5 (XDI:5) as a thermistor input

1…3 PTC sensors can be connected to this input for motor temperature measurement.



Notes:

- Do not connect both ends of the cable shields directly to ground. If a capacitor cannot be used at one end, leave that end of the shield unconnected.
- The connection of temperature sensors involves parameter adjustment. See the *Firmware manual* of the drive.
- Pt100 sensors are not to be connected to the thermistor input. Instead, an analog input and an analog current output (located either on the JCU or on an I/O extension module) are used as shown below. The analog input must be set to voltage.



WARNING! As the inputs pictured above are not insulated according to IEC 60664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor. If the assembly does not fulfil the requirement,

- all I/O terminals must be protected against contact and must not be connected to other equipment

or

- the temperature sensor must be isolated from the I/O terminals.

Start interlock (XDI:A)

Terminal XDI:A must be jumpered to XD24:3 to enable the drive start.

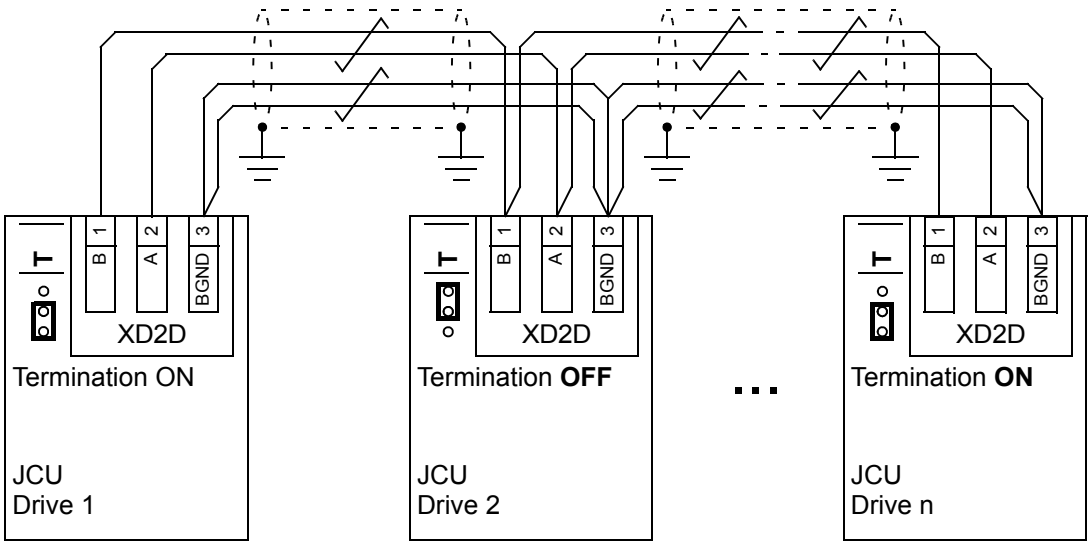
Drive-to-drive link (XD2D)

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

Termination activation jumper T (see section *Jumpers* above) next to this terminal block must be set to the ON position on the drives at the ends of the drive-to-drive link. On intermediate drives, the jumper must be set to the OFF position.

Shielded twisted-pair cable (~100 ohm, e.g. PROFIBUS-compatible cable) must be used for the wiring. For best immunity, high quality cable is recommended. The cable should be kept as short as possible; the maximum length of the link is 50 metres (164 ft). Unnecessary loops and running the cable near power cables (such as motor cables) must be avoided. The cable shields are to be grounded to the control cable clamp plate on the drive as shown on page 72.

The following diagram shows the wiring of the drive-to-drive link.



Safe torque off (XSTO)

For the drive to start, both connections (OUT1 to IN1, and OUT2 to IN2) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting an external Safe torque off circuitry to the drive. See page 39.

Grounding and routing the control cables

The shields of all control cables connected to the JCU Control Unit must be grounded at the control cable clamp plate. Use four M4 screws to fasten the plate as shown below (two of the screws are also used to hold the cover mounting bracket). The plate can be fitted either at the top or bottom of the drive.

Before connecting the wires, run the cables through the cover mounting bracket. The cables going to the terminal blocks on the control unit are to be run along the right-hand side of the drive module. See the drawings below.

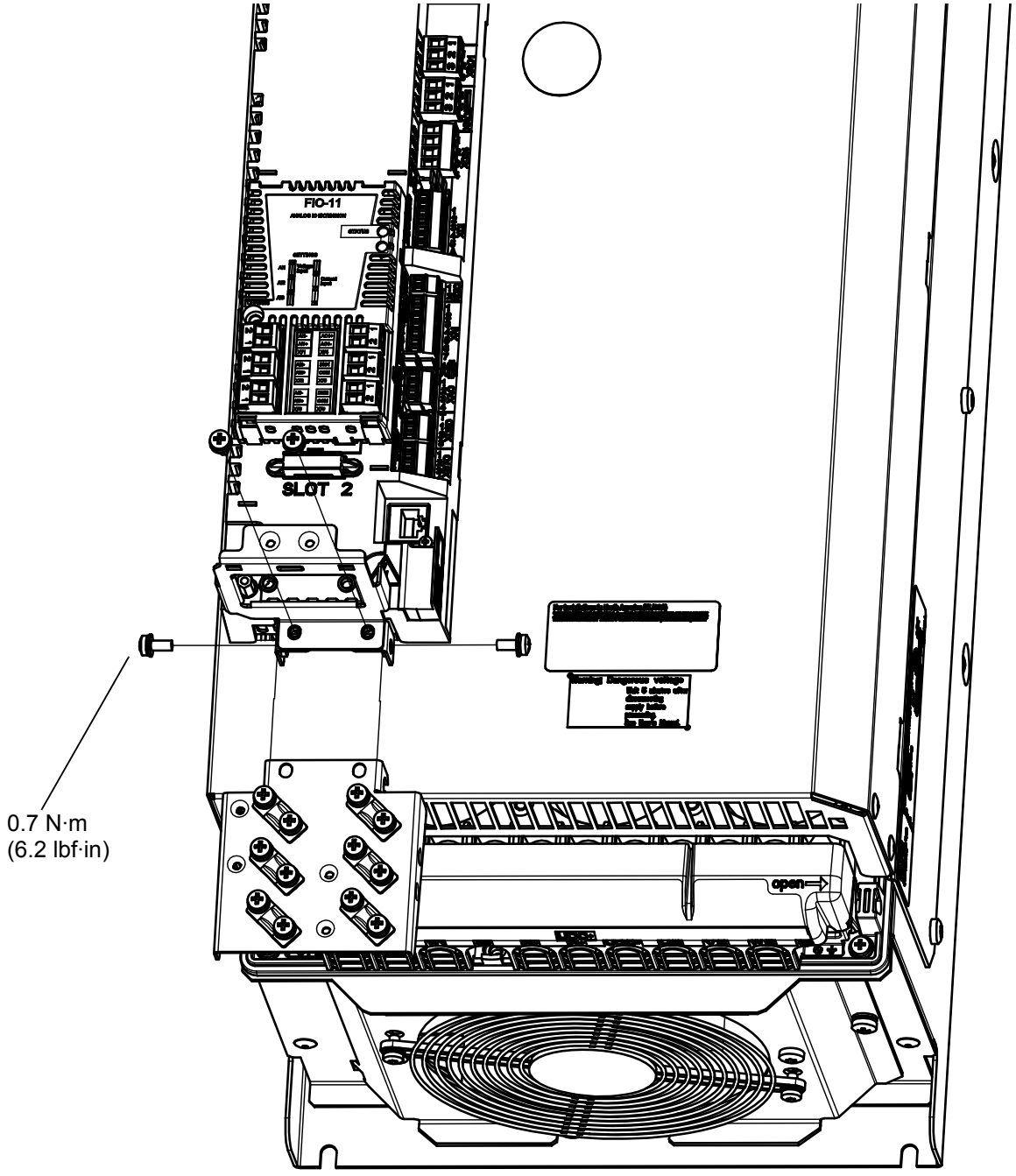
The shields should be continuous as close to the terminals of the JCU as possible. Only remove the outer jacket of the cable at the cable clamp so that the clamp presses on the bare shield. At the terminal block, use shrink tubing or insulating tape to contain any stray strands. The shield (especially in case of multiple shields) can also be terminated with a lug and fastened with a screw at the clamp plate. Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor (e.g. 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.

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.

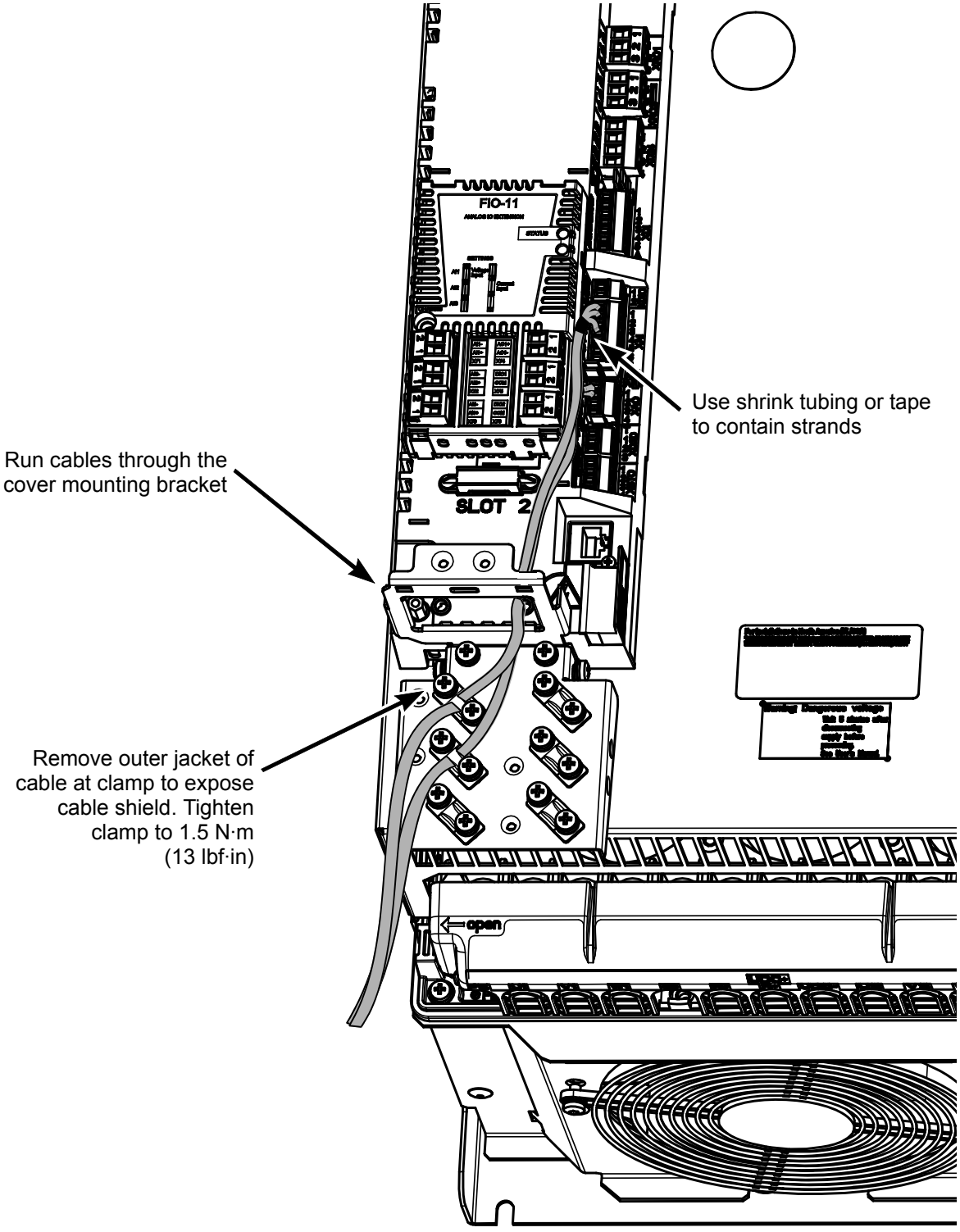
Before re-installing the cover assembly, remove the appropriate punch-outs on the right side of the cover base to create entries for the control cables going to the terminal blocks.

Re-install the cover assembly according to the instructions on page 47.

Mounting the clamp plate



Routing the control cables



Installation checklist

Checklist

Check the mechanical and electrical installation of the drive before start-up. Go through the checklist below together with another person. Read the *Safety instructions* on the first pages of this manual before you work on the unit.

	Check
	MECHANICAL INSTALLATION
☐	The ambient operating conditions are allowable. (See *Mechanical installation, Technical data: Ratings, Ambient conditions*.)
☐	The unit is fastened properly to the cabinet. (See *Planning the cabinet assembly* and *Mechanical installation.*)
☐	The cooling air will flow freely.
☐	The motor and the driven equipment are ready for start. (See *Planning the electrical installation, Technical data: Motor connection*.)
	ELECTRICAL INSTALLATION (See *Planning the electrical installation, Electrical installation.*)
☐	The internal C2 EMC filter (option + E202) is disconnected if the drive is connected to an IT (ungrounded) or corner-grounded supply network.
☐	The capacitors are reformed if stored over one year (ask local ABB representative for more information).
☐	The drive is grounded properly. 1) There is a proper PE connector, 2) PE connector is tightened properly, and 3) there is a proper galvanic connection between the drive frame and the cabinet (fastening points are unpainted).

	Check
☐	The supply (input power) voltage matches the drive nominal input voltage.
☐	The supply (input power) is connected to U1/V1/W1 (UDC+/UDC- in case of a DC supply) and the terminals are tightened to specified torque.
☐	Appropriate supply (input power) fuses and disconnector are installed.
☐	The motor is connected to U2/V2/W2, and the terminals are tightened to specified torque.
☐	The motor cable is routed away from other cables.
☐	There are no power factor compensation capacitors in the motor cable.
☐	The external control connections to the JCU Control Unit are OK.
☐	There are no tools, foreign objects or dust from drilling inside the drive.
☐	The supply (input power) voltage cannot be applied to the output of the drive through a bypass connection.
☐	Motor connection box and other covers are in place.

9

Maintenance

What this chapter contains

This chapter contains preventive maintenance instructions.

Safety

WARNING! Read the *Safety instructions* on the first pages of this manual before performing any maintenance on the equipment. Ignoring the safety instructions can cause injury or death.

Maintenance intervals

The table below lists the routine maintenance intervals recommended by ABB. Consult a local ABB Service representative for more details. In the Internet, go to www.abb.com/drives, select *Drive Services*, and *Maintenance and Field Services*.

Interval	Maintenance	Instruction
Every year of storage	DC capacitor reforming	See *Capacitors*.
Every 6 to 12 months depending on the dustiness of the environment	Heatsink temperature check and cleaning	See *Heatsink*.
Every year	Inspection of tightness of power connections	See pages *62*-*64.*
	Visual inspection of cooling fan	See *Cooling fan*.
Every 3 years if the ambient temperature is higher than 40 °C (104 °F). Otherwise, **every 6 years**.	Cooling fan replacement	See *Cooling fan*.
Every 3 years	Change of additional cooling fan **(only frame size E0)**	See *Additional fan replacement (frame E0).*
Every 6 years if the ambient temperature is higher than 40 °C (104 °F) or if the drive is subjected to cyclic heavy load or continuous nominal load. Otherwise, **every 9 years**	DC capacitor replacement	See *Capacitors*.
Every 10 years	Control panel battery replacement	The battery is housed on the rear of the control panel. Replace with a new CR 2032 battery.

Heatsink

The heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean. In a normal environment, the heatsink should be checked annually, in a dusty environment more often.

Clean the heatsink as follows (when necessary):

1. Remove the cooling fan (see section *Cooling fan*).
2. Blow clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust. **Note:** If there is a risk of the dust entering adjoining equipment, perform the cleaning in another room.
3. Refit the cooling fan.

Cooling fan

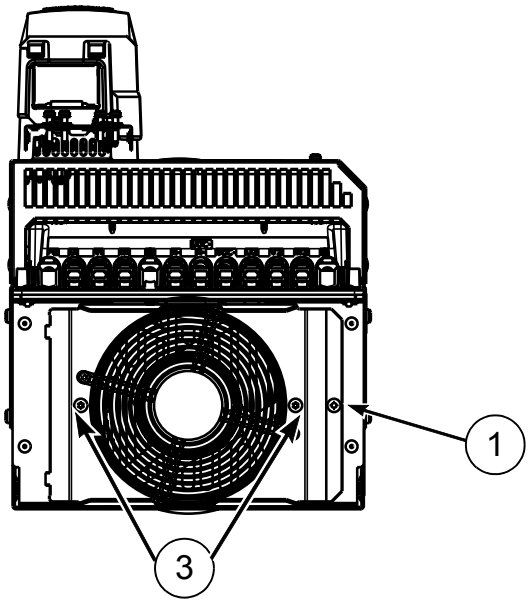
The actual lifespan of the cooling fan depends on the drive usage and ambient temperature. Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in the heatsink temperature in spite of heatsink cleaning. If the drive is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from ABB. Do not use other than ABB-specified spare parts.

Fan replacement (frame E0)

1. Undo the fixing screw of the cooling fan holder.
2. Remove the cooling fan holder and disconnect the cable.
3. Undo the fastening screws of the fan.

Install the new fan in reverse order.

Frame size E0, bottom view

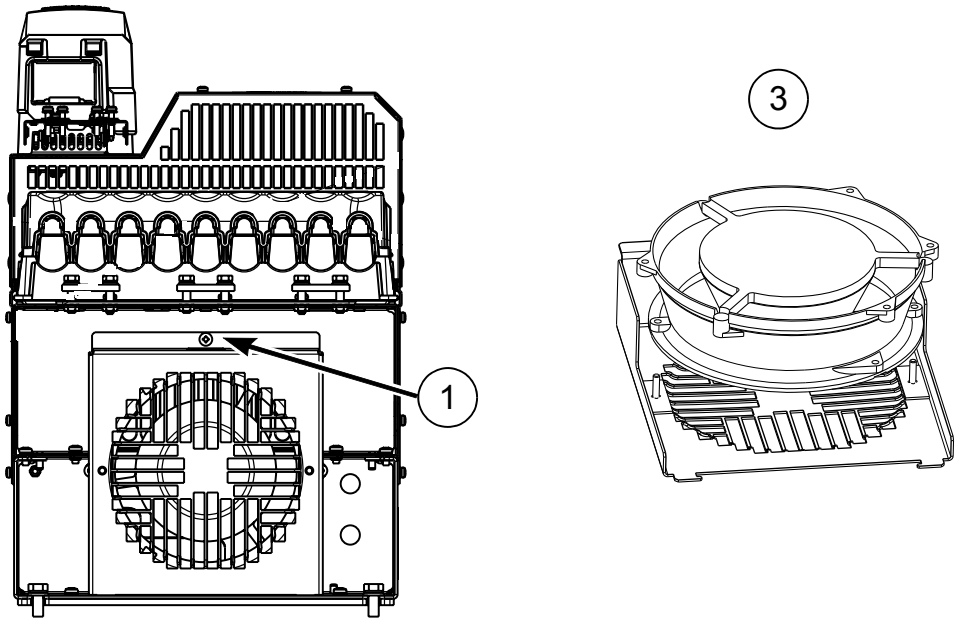


Fan replacement (frame E)

1. Undo the fixing screw of the cooling fan holder.
2. Slide out the cable connector and disconnect it.
3. Remove the cooling fan holder and replace the fan onto the holder's pins.

Install the cooling fan holder in reverse order.

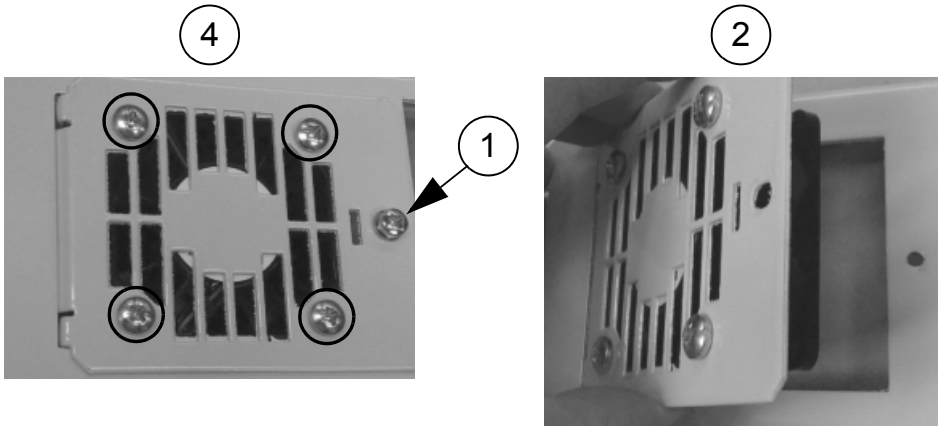
Frame size E, bottom view



Additional fan replacement (frame E0)

The fan is located on top of the module.

1. Undo the fixing screw of the cooling fan holder (1 pc PZ2 screw).
2. Pull the fan holder out.
3. Disconnect the fan cable.
4. Undo the fastening screws of the fan (4 pcs PZ2 screws, circled in the picture below) and remove the fan.
5. Install the new fan and tighten the fastening screws to 0,5 N·m.
6. Reconnect the fan cable, assemble the fan holder back and tighten the fixing screw to 1,2 N·m.



Capacitors

Reforming

The capacitors must be reformed if the drive has been stored for a year or more. See page *31* for information on finding out the manufacturing date. For information on reforming the capacitors, contact your local ABB representative.

Changing

The drive intermediate circuit employs several electrolytic capacitors. Their lifespan is from 45 000 to 90 000 hours depending on drive loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. Capacitor failure is usually followed by a mains fuse failure or a fault trip. Contact ABB if capacitor failure is suspected. Replacements are available from ABB. Do not use other than ABB specified spare parts.

Other maintenance actions

Transferring the memory unit to a new drive module

When a drive module is replaced, the parameter settings can be retained by transferring the memory unit from the defective drive module to the new module.

WARNING! Do not remove or insert a memory unit when the drive module is powered.

After power-up, the drive will scan the memory unit. If a different application program or different parameter settings are detected, they are copied to the drive. This takes about 10 to 30 seconds; the drive will not respond while copying is in progress.

10

Technical data

What this chapter contains

This chapter contains the technical specifications of the drive, e.g. the ratings, sizes and technical requirements, and provisions for fulfilling the requirements for CE and other markings.

Ratings

The nominal ratings for the drive with 400 V AC supply are given below.

Drive type ACQ810-04-…	Frame size	Input ratings	Output ratings						
			Nominal			IEC M2/M3		UL NEMA	
		I_{1N}	I_{2N}	I_{max}	I_{cont}	I	P	I	P
		A	A	A	A	A	kW	A	hp
098A-4	E0	95	98	138	103	98	55	96	75
138A-4	E0	136	138	170	144	138	75	124	100
162A-4	E	159	162	282	202	162	90	156	125
203A-4	E	199	203	326	225	203	110	180	150
240A-4	E	234	240	326	260	239	132	240	200
286A-4	E	279	286	348	290	286	160	-	-

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I_{1N}	Nominal input current (rms)
I_{2N}	Nominal output current. 110% overload 1 min / 5 min
I_{max}	Maximum output current. Available for 10 seconds at start, otherwise as long as allowed by drive temperature.
I_{cont}	Continuous rms output current with no overload capacity
P	Typical motor power

Note 1: The ratings apply at an ambient temperature of 40 °C (+104 °F). In lower temperatures the ratings are higher (except I_{max}).

Note 2: To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.

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

Derating

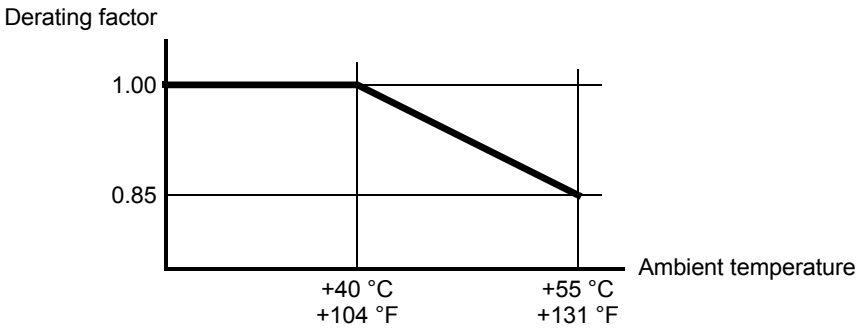
The continuous output currents stated above must be derated if any of the following conditions apply:

- the ambient temperature exceeds +40 °C (+104 °F)
- the drive is installed higher than 1000 m above sea level.

Note: The final derating factor is a multiplication of all applicable derating factors.

Ambient temperature derating

In the temperature range +40…55 °C (+104…131 °F), the rated output current is derated by 1% for every added 1 °C (1.8 °F) as follows:



The continuous rms output currents with no overload capacity at different ambient temperatures (45 °C, 50 °C and 55 °C) are given below.

Drive type ACQ810-04-…	**Frame size**	I_{cont45} A	I_{cont50} A	I_{cont55} A
098A-4	E0	98	93	88
138A-4	E0	137	130	122
162A-4	E	192	182	172
203A-4	E	214	203	191
240A-4	E	247	234	221
286A-4	E	276	261	247

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I_{contxx}	Continuous rms output current at specified temperature maximum, no overloading

Altitude derating

At altitudes from 1000 to 4000 m (3300 to 13123 ft) above sea level, the derating is 1% for every 100 m (328 ft). For a more accurate derating, use the DriveSize PC tool.

Note: If the installation site is higher than 2000 m (6600 ft) above sea level, connection of the drive to an ungrounded (IT) or corner-grounded delta network is not allowed.

Dimensions and weights

See also the chapter *Dimension drawings*.

Frame size	**Height** mm (in.)	**Width** mm (in.)	**Depth** (with control panel) mm (in.)	**Depth** (without control panel) mm (in.)	**Weight** kg (lbs)
E0	602 (23.7)	276 (10.9)	376 (14.8)	354 (14)	34 (75)
E	700 (27.6)	312 (12.3)	465 (18.3)	443 (17)	67 (148)

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Cooling characteristics, noise

Drive type ACQ810-04-…	Heat dissipation	Air flow		Noise
	W	m^3/h	ft^3/min	dB
098A-4	1190	168	99	65
138A-4	1440	405	238	65
162A-4	2310	405	238	65
203A-4	2810	405	238	65
240A-4	3260	405	238	65
286A-4	4200	405	238	65

Supply cable fuses

Fuses for short circuit protection of the supply cable are listed below. The fuses also protect the adjoining equipment of the drive in case of a short circuit. Check that the operating time of the fuse is below 0.5 seconds. The operating time depends on the supply network impedance and the cross-sectional area and length of the supply cable. See also chapter *Planning the electrical installation*.

Note: Fuses with a higher current rating must not be used.

Drive type ACQ810-04-…	Input current (A)	IEC fuse				UL fuse		Cross-sectional area of cable	
		gG		aR		UL recognised Class T			
		Rated current (A)	Voltage (V)	Rated current (A)	Voltage (V)	Rated current (A)	Voltage (V)	mm^2	AWG/MCM
098A-4	100	125	500	-	-	125	600	6…70	10…2/0
138A-4	142	160	500	-	-	150	600	6…70	10…2/0
162A-4	198	250	500	400	690	250	600	95…240	3/0…500MCM
203A-4	221	250	500	500	690	300	600	95…240	3/0…500MCM
240A-4	254	315	500	500	690	350	600	95…240	3/0…500MCM
286A-4	283	315	500	550	690	400	600	95…240	3/0…500MCM

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Low harmonic filters

A passive low harmonic filter is designed to decrease the Total Harmonic Distortion of incoming current (THDI) below 5%. Filter type Schaffner ECOsine™ is used with ACQ810. Filters are dimensioned to achieve THDI requirement at nominal load. THD increases at partial load and can be higher than 5% at no-load.

400 V / 50 Hz

Drive type ACQ810-04-…	Frame size	Nominal ratings	400 V/ 50 Hz	Height mm	Width mm	Depth mm	Weight kg
		P (kW)	Filter type				
098A-4	E0	55	FN 3410-110-35	750	320	300	86
138A-4	E0	75	FN 3410-150-40	950	450	420	118
162A-4	E	90	FN 3410-180-40	950	450	420	136
203A-4	E	110	FN 3410-210-40	950	450	420	154
240A-4	E	132	FN 3410-260-99	1000	500	500	201
286A-4	E	160	2 x FN 3410-180-40*	950	900	420	272

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* Special filters without parallel connection can be available.

460 V / 60 Hz

Drive type ACQ810-04-…	Frame size	Nominal ratings	460 V / 60 Hz	Height mm	Width mm	Depth mm	Weight kg
		P (hp)	Filter type				
098A-4	E0	75	FN 3412-105-35	750	320	300	77
138A-4	E0	100	FN 3412-130-35	750	320	300	87
203A-4	E	125	FN 3412-160-40	950	450	420	124
240A-4	E	150	FN 3412-190-40	950	450	420	132
286A-4	E	200	FN 3412-240-99	1000	500	500	185

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Note: If the supply voltage is 480 V, one step smaller filter must be used at the same power. E.g. at supply voltage 400 V and power 110 kW the filter selection is FN 3410-210-40, but at 480 V and 110 kW the selection is FN 3410-180-40.

For further information, see www.schaffner.com or contact your local ABB office.

AC input (supply) connection	
Voltage (U_1)	380 … 480 V AC +10%/-15%, 3-phase
Frequency	50 … 60 Hz ±5%
Network type	Grounded (TN, TT) or ungrounded (IT). **Note:** Connection to an ungrounded (IT) or corner-grounded delta network is not allowed at altitudes of 2000 m (6600 ft) or higher.
Imbalance	Max. ±3% of nominal phase to phase input voltage
Fundamental power factor (cos phi$_1$)	0.98 (at nominal load)
Terminals	Frame size E0: With cable sizes from 6 to 70 mm^2 (AWG10 to AWG2/0): Posts for crimp lugs (lugs not included). Frame size E: With cable sizes from 95 to 240 mm^2 (AWG3/0 to 500MCM): Screw lugs (included). Grounding clamps.

DC connection	
Voltage	436 … 743 V DC
Terminals	Frame E0: 6 to 70 mm^2 (AWG10 to AWG2/0) Frame E: 95 to 240 mm^2 (AWG3/0 to 500MCM)

Motor connection	
Motor types	Asynchronous induction motors
Voltage (U_2)	0 to U_1, 3-phase symmetrical, U_{max} at the field weakening point
Frequency	0 … 500 Hz
Current	See section *Ratings.*
Switching frequency	3 kHz as default.
Maximum motor cable length	General: 300 m (984 ft). **Note:** With cables longer than 100 m (328 ft), the EMC Directive requirements may not be fulfilled. See section *CE marking*.
Terminals	Frame size E0: With cable sizes from 6 to 70 mm^2 (AWG10 to AWG2/0): Posts for crimp lugs (lugs not included). Frame size E: With cable sizes from 95 to 240 mm^2 (AWG3/0 to 500MCM): Screw lugs (included). Grounding clamps.

JCU Control Unit	
Power supply	24 V (±10%) DC, 1.6 A Supplied from the power unit of the drive, or from an external power supply through connector XPOW (pitch 5 mm, wire size 2.5 mm^2).
Relay outputs RO1…RO2 (XRO1 … XRO2)	Connector pitch 5 mm, wire size 2.5 mm^2 250 V AC / 30 V DC, 2 A Protected by varistors **Note:** At installation sites between 2000 meters (6562 feet) and 4000 meters (13123 feet), the Protective Extra Low Voltage (PELV) requirements are not fulfilled if a relay output is used with a voltage greater than 48 V.
+24 V output (XD24)	Connector pitch 5 mm, wire size 2.5 mm^2

Digital inputs DI1…DI5 (XDI:1 … XDI:5)

Connector pitch 3.5 mm, wire size 1.5 mm^2
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Input type: NPN/PNP (DI1…DI4), NPN (DI5)
Filtering: 0.25 ms

DI5 (XDI:5) can alternatively be used as an input for 1…3 PTC thermistors.
“0” > 4 kohm, “1” < 1.5 kohm
I_{max}: 15 mA

Start interlock input DIIL (XDI:A)

Wire size 1.5 mm^2
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Input type: NPN/PNP
Filtering: 0.25 ms

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

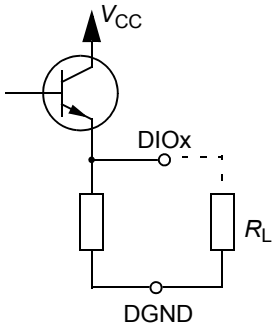
Input/output mode selection by parameters.

DIO1 can be configured as a frequency input (0…16 kHz) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the *Firmware manual,* parameter group 12.

Connector pitch 3.5 mm, wire size 1.5 mm^2

As inputs:
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Filtering: 0.25 ms

As outputs:
Total output current limited by auxiliary voltage outputs to 200 mA
Output type: Open emitter



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

Connector pitch 3.5 mm, wire size 1.5 mm^2
10 V ±1% and –10 V ±1%, R_{load} > 1 kohm

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

Current/voltage input mode selection by jumpers. See page *69*.

Connector pitch 3.5 mm, wire size 1.5 mm^2
Current input: –20…20 mA, $R_{in:}$ 100 ohm
Voltage input: –10…10 V, R_{in}: 200 kohm
Differential inputs, common mode ±20 V
Sampling interval per channel: 0.25 ms
Filtering: 0.25 ms
Resolution: 11 bit + sign bit
Inaccuracy: 1% of full scale range

Analog outputs AO1 and AO2 (XAO)

Connector pitch 3.5 mm, wire size 1.5 mm^2
0…20 mA, R_{load} < 500 ohm
Frequency range: 0…800 Hz
Resolution: 11 bit + sign bit
Inaccuracy: 2% of full scale range

Drive to drive link (XD2D)

Connector pitch 3.5 mm, wire size 1.5 mm^2
Physical layer: RS-485
Termination by jumper

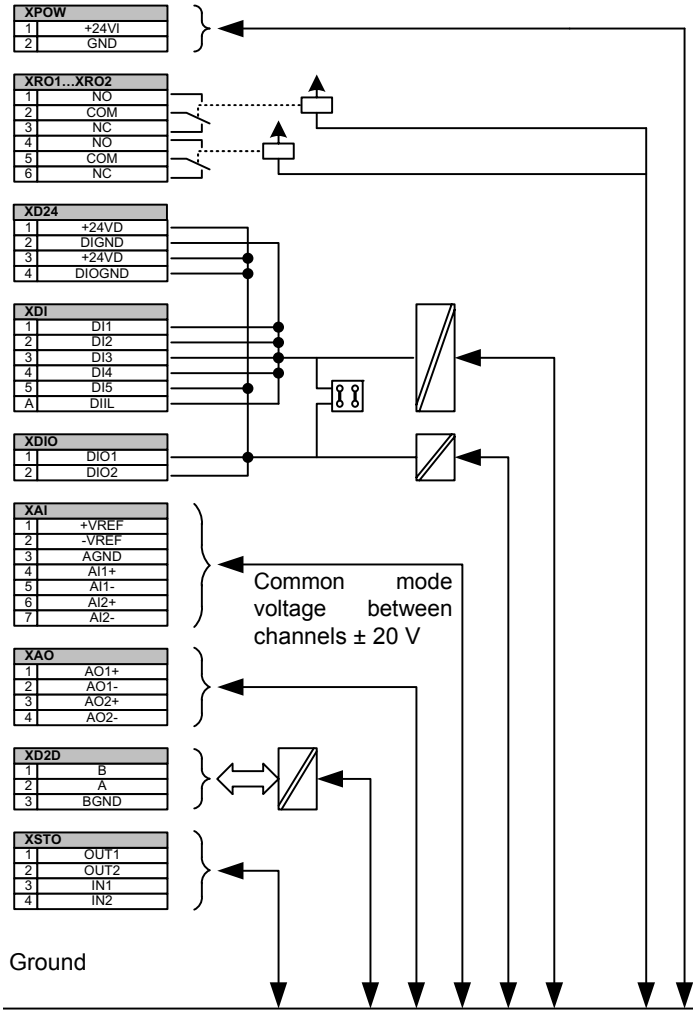
Safe torque off connection (XSTO)

Connector pitch 3.5 mm, wire size 1.5 mm^2
For the drive to start, both connections (OUT1 to IN1, and OUT2 to IN2) must be closed

Control panel / PC connection

Connector: RJ-45
Cable length < 3 m

Isolation and grounding diagram



Efficiency

Approximately 98% at nominal power level

Cooling

Method

Forced air cooling (internal fan, flow direction from bottom to top). On/off control to have cooling only, when drive is running.

Free space around the unit

See chapter *Planning the cabinet assembly*.

Degree of protection

IP20 (UL open type). *See chapter Planning the cabinet assembly.*

Ambient conditions

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

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	0 to 4000 m (13123 ft) above sea level. [See also section *Derating* on page *84*.]	-	-
Air temperature	-10 to +55 °C (14 to 131 °F). No frost allowed. See section *Derating* on page *84*.	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	5 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	Not allowed: -Conductive dust -Frost or condensation Contamination levels -EN50178: Level 2 -EN 60721-3-3: Chemical gases / Class3C2, solid particles / Class3S2 Climatic class -EN 60721-3-3: 3K3	Not allowed: -Conductive dust -Frost or condensation Contamination levels -EN50178: Level 2 -Transportation acc. EN 60721-3-2: Chemical gases / Class2C2, solid particles / Class2S2 -Storage acc. EN 60721-3-1: Chemical gases / Class1C2, solid particles / Class1S2 Climatic class -EN 60721-3-2: 2K4 -EN 60721-3-1: 1K3	Not allowed: -Conductive dust -Frost or condensation Contamination levels -EN50178: Level 2 -Transportation acc. EN 60721-3-2: Chemical gases / Class2C2, solid particles / Class2S2 -Storage acc. EN 60721-3-1: Chemical gases / Class1C2, solid particles / Class1S2 Climatic class -EN 60721-3-2: 2K4 -EN 60721-3-1: 1K3
Sinusoidal vibration (IEC 60721-3-3)	5…13,2 Hz / 1 mm, 13,2…100 Hz / 7 m/s^2	-	-
Insulation strength	Overvoltage category: -Class III to EN 60 664-1	-	-
Shock (IEC 60068-2-27, ISTA 1B)	-	According to ISTA 1B. Max. 100 m/s^2 (330 ft/s^2), 11 ms	According to ISTA 1B. Max. 100 m/s^2 (330 ft/s^2), 11 ms
Free fall	Not allowed	25 cm (10”)	25 cm (10”)

Materials

Drive enclosure	• JCU Control Unit housing: PC/ABS, colour NCS 1502-Y (RAL 9002 / PMS 420 C) • Sheet metal parts: Hot-dip zinc-coated steel. Front cover painted on the outside, colour NCS 1502-Y (RAL 9002 / PMS 420 C) • Heatsink: Extruded aluminium AlSi.
Packaging	Cardboard, plywood, PE-LD wrapping, PP or steel banding.

Disposal

The drive contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks.

If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors contain electrolyte, which is classified as hazardous waste within the EU. They must be removed and handled according to local regulations.

For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor.

Applicable standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standards EN 50178 and EN 60204-1.

• EN 50178:1997	Electronic equipment for use in power installations
• IEC 60204-1:2006	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. *Provisions for compliance:* The final assembler of the machine is responsible for installing - an emergency-stop device - a supply disconnecting device - the drive module into a cabinet.
• EN 60529:1991 (IEC 60529)	Degrees of protection provided by enclosures (IP code)
• IEC 60664-1:2007	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.
• EN 61800-3:2004	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.
• EN 61800-5-1:2003	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements. Electrical, thermal and energy *Provisions for compliance:* The final assembler of the machine is responsible for installing the ACQ810-04 in a cabinet that is protected to IP3X for top surfaces for vertical access.
• EN 61800-5-2:2007	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional
• UL 508C:2002, Third Edition	UL Standard for Safety, Power Conversion Equipment
• NEMA 250:2003	Enclosures for Electrical Equipment (1000 Volts Maximum)
• CSA C22.2 No. 14-05 (2005)	Industrial Control Equipment

CE marking

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage and EMC Directives.

Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standards EN 50178, EN 61800-5-1 and EN 60204-1.

Compliance with the European EMC Directive

The cabinet builder is in responsible for the compliance of the drive system with the European EMC Directive. For information on items to consider, see:

- Subsections *Compliance with EN 61800-3:2004, category C2*; *Compliance with EN 61800-3:2004, category C3*; and *Compliance with EN 61800-3:2004, category C4* below
- The chapter *Planning the electrical installation* in this manual
- *Technical Guide No. 3 – EMC Compliant Installation and Configuration for a Power Drive System* [3AFE61348280 (English)].

Definitions

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

First environment includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes all establishments other than those directly connected to a low-voltage network which supplies buildings used for domestic purposes.

Drive of category C2. Power drive system with rated voltage less than 1000 V which is neither a plug-in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by a professional.

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

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

Compliance with EN 61800-3:2004, category C2

The drive meets the requirements of the EMC Directive with the following provisions:

1. The drive is equipped with filtering option +E202.
2. The motor and control cables are selected as specified in the chapter *Planning the electrical installation*.
3. The drive is installed according to the instructions given in this manual.
4. Motor cable length does not exceed 100 metres (328 ft).

Note: It is not allowed to use the optional EMC filter on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage the drive.

Note: It is not allowed to use the optional EMC filter on a corner-grounded TN system as this would damage the drive.

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

Compliance with EN 61800-3:2004, category C3

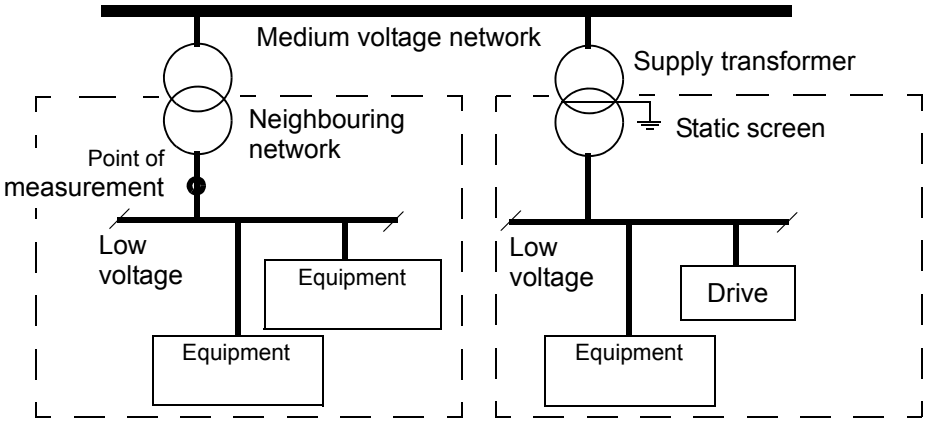
The drive meets the requirements of the EMC Directive with the following provisions:

1. The motor and control cables are selected as specified in the chapter *Planning the electrical installation*.
2. The drive is installed according to the instructions given in this manual.
3. Motor cable length does not exceed 100 metres (328 ft).

Compliance with EN 61800-3:2004, category C4

The drive meets the requirements of the EMC Directive with the following provisions:

1. The drive is equipped with filtering option +0E200.
2. It is ensured that no excessive emission is propagated to neighbouring low-voltage networks. In some cases, the natural suppression in transformers and cables is sufficient. If in doubt, a supply transformer with static screening between the primary and secondary windings can be used.



3. An EMC plan for preventing disturbances is drawn up for the installation. A template is available from the local ABB representative.
4. The motor and control cables are selected as specified in the chapter *Planning the electrical installation*.
5. The drive is installed according to the instructions given in this manual.

Compliance with the Machinery Directive

The drive is intended to be incorporated into machinery to constitute machinery covered by Machinery Directive and does therefore not in every respect comply with the provisions of the directive.

C-Tick marking

Pending.

UL marking

See the type designation label for the valid markings of your drive.

UL checklist

Input power connection – See section *AC input (supply) connection* on page *88*.

Disconnecting device (Disconnecting means) – See section *Supply disconnecting device* on page *36*.

Ambient conditions – The drive is to be used in a heated indoor controlled environment. See section *Ambient conditions* on page *91* for specific limits.

Input cable fuses – For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, use the UL classified fuses given in section *Supply cable fuses* on page *86*.

For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfil this requirement, use the UL classified fuses given in section *Supply cable fuses* on page *86*.

Power cable selection – See section *Selecting the power cables* on page *40*.

Power cable connections – For the connection diagram and tightening torques, see section *Power cable connection* on page *61*.

Control connections – For the connection diagram and tightening torques, see section *Connecting the control cables* on page *67*.

Overload protection – The drive provides overload protection in accordance with the National Electrical Code (US).

UL standards – See section *Applicable standards* on page *92*.

Product protection in the US

This product is protected by one or more of the following US patents:

4,920,306	5,301,085	5,463,302	5,521,483
5,532,568	5,589,754	5,612,604	5,654,624
5,799,805	5,940,286	5,942,874	5,952,613
6,094,364	6,147,887	6,175,256	6,184,740
6,195,274	6,229,356	6,252,436	6,265,724
6,305,464	6,313,599	6,316,896	6,335,607
6,370,049	6,396,236	6,448,735	6,498,452
6,552,510	6,597,148	6,600,290	6,741,059
6,774,758	6,844,794	6,856,502	6,859,374
6,922,883	6,940,253	6,934,169	6,956,352
6,958,923	6,967,453	6,972,976	6,977,449
6,984,958	6,985,371	6,992,908	6,999,329
7,023,160	7,034,510	7,036,223	7,045,987
7,057,908	7,059,390	7,067,997	7,082,374
7,084,604	7,098,623	7,102,325	7,109,780
7,164,562	7,176,779	7,190,599	7,215,099
7,221,152	7,227,325	7,245,197	7,250,739
7,262,577	7,271,505	7,274,573	7,279,802
7,280,938	7,330,095	7,349,814	7,352,220
7,365,622	7,372,696	7,388,765	7,408,791
7,417,408	7,446,268	7,456,615	7,508,688
7,515,447	7,560,894	D503,931	D510,319
D510,320	D511,137	D511,150	D512,026
D512,696	D521,466	D541,743S	D541,744S
D541,745S	D548,182S	D548,183S	D573,090S

Other patents pending.

11

du/dt and common mode filtering

What this chapter contains

This chapter describes how to select du/dt and common mode filtering for the ACQ810-04. The chapter also contains the relevant technical data.

When is du/dt or common mode filtering required?

The output of the drive comprises – regardless of output frequency – pulses of approximately 1.35 times the equivalent supply voltage with a very short rise time. This is the case with all drives employing modern IGBT inverter technology.

The voltage of the pulses can be almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This in turn can cause additional stress on the motor and motor cable insulation.

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

The stress on motor insulation can be avoided by using optional ABB du/dt filters. du/dt filters also reduce bearing currents. Common mode filtering mainly reduces bearing currents.

To avoid damage to the motor bearings, the cables must be selected and installed according to the instructions given in chapter *Electrical installation*. In addition, du/dt filtering, common mode filtering, and insulated N-end bearings must be used according to the following table.

Motor type	Supply voltage (U_N)	Motor insulation system	Requirement		
			du/dt filtering	Insulated N-end bearing	Common mode filtering
Random-wound ABB M2__, M3__ motors	$U_N \leq 500$ V	Any	–	–	–
Form-wound ABB HX_ or modular motor manufactured before 1 Jan 1998	$U_N \leq 500$ V	Any	Check with motor manufacturer	Yes	Yes
Random-wound ABB HX_ and AM_ motor manufactured before 1 Jan 1998	$U_N \leq 500$ V	Enamelled wire with fiberglass taping	Check with motor manufacturer		
Random-wound ABB HX_ and AM_ motor manufactured from 1 Jan 1998	$U_N \leq 500$ V	Enamelled wire with fiberglass taping	–	Yes	Yes
Other ABB motors, or random-wound or form-wound non-ABB motors	$U_N \leq 420$ V	Standard ($\hat{U}_{LL}$ = 1300 V)	–	–	–
	420 V < $U_N \leq$ 500 V	Standard ($\hat{U}_{LL}$ = 1300 V)	Yes	–	–
		Reinforced ($\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time)	–	–	–

du/dt filters are optional accessories and to be ordered separately. For more information on common mode filtering, contact your local ABB representative. Contact the motor manufacturer for information on the motor construction.

Filter types

du/dt filters

du/dt filters for ACQ810-04			
Drive type ACQ810-04-…	**Filter type**		
	IP00	**IP22**	**IP54**
098A-4	NOCH0120-60*	NOCH0120-62*	NOCH0120-65*
138A-4			
162A-4	NOCH0260-60*	-	-
203A-4	FOCH0260-70**		
240A-4			
286A-4			

* 1-phase; three filters included in kit

** 3-phase

Common mode filters

Contact your local ABB representative.

Technical data

du/dt filters

Dimensions and weights

Filter type	Height mm (inches)	Width mm (inches)	Depth mm (inches)	Weight kg (lbs)
NOCH0120-60*	106 (4.17)	154 (6.06)	200 (7.87)	7.0 (15.4)
NOCH0260-60*	111 (4.37)	185 (7.28)	383 (15.08)	12.0 (26.5)
FOCH0260-70	382 (15.04)	340 (13.39)	254 (10.00)	47.0 (103.6)
NOCH0120-62*	765 (30.12)	308 (12.13)	256 (10.07)	45 (99)
NOCH0120-65*	765 (30.12)	308 (12.13)	256 (10.07)	45 (99)

* Dimensions given are per phase

Degree of protection

IP00; IP22 and IP54 for frame size E0 only

Common mode filters

Contact your local ABB representative.

Installation

Follow the instructions included with the filters.

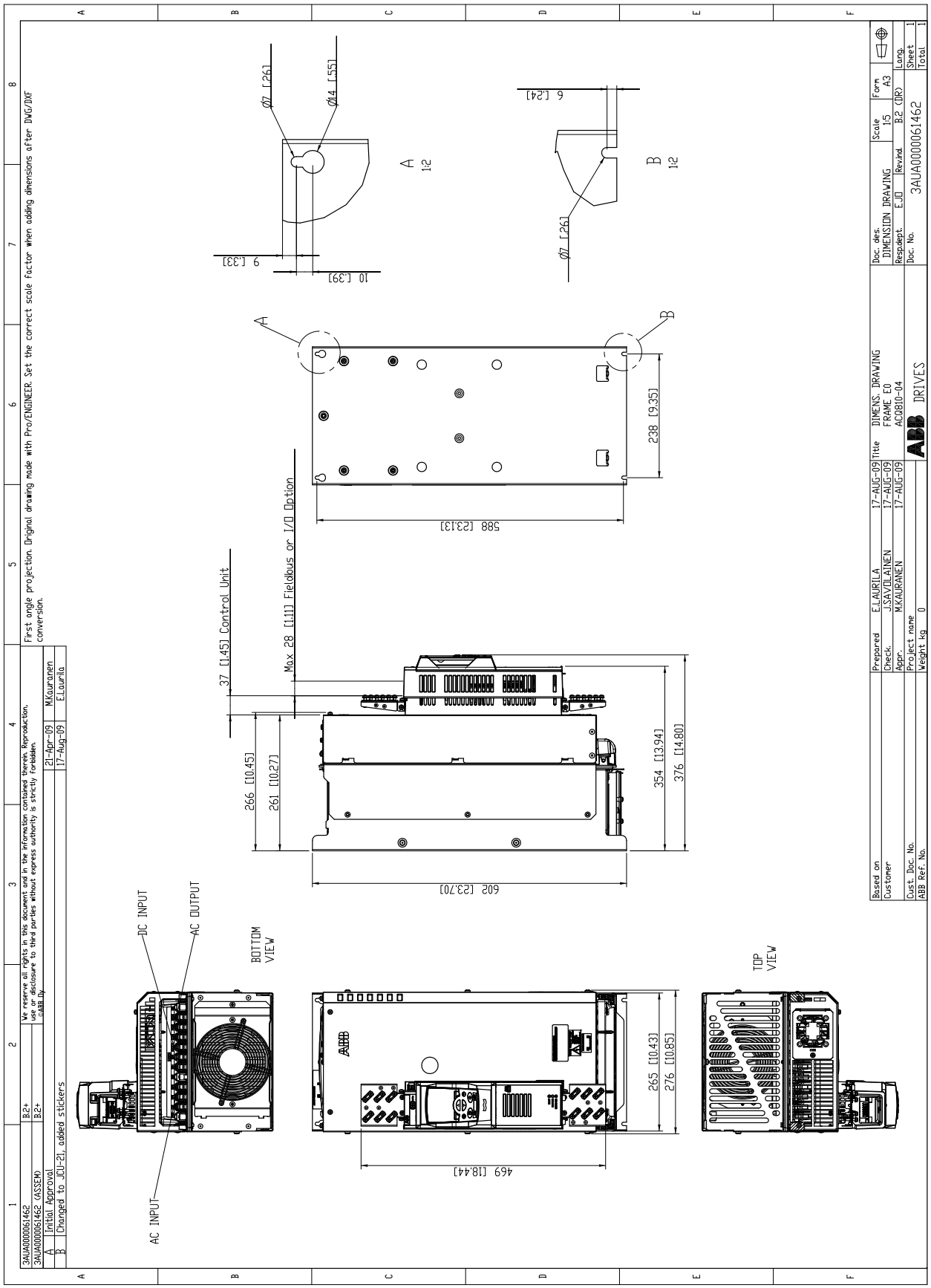
12

Dimension drawings

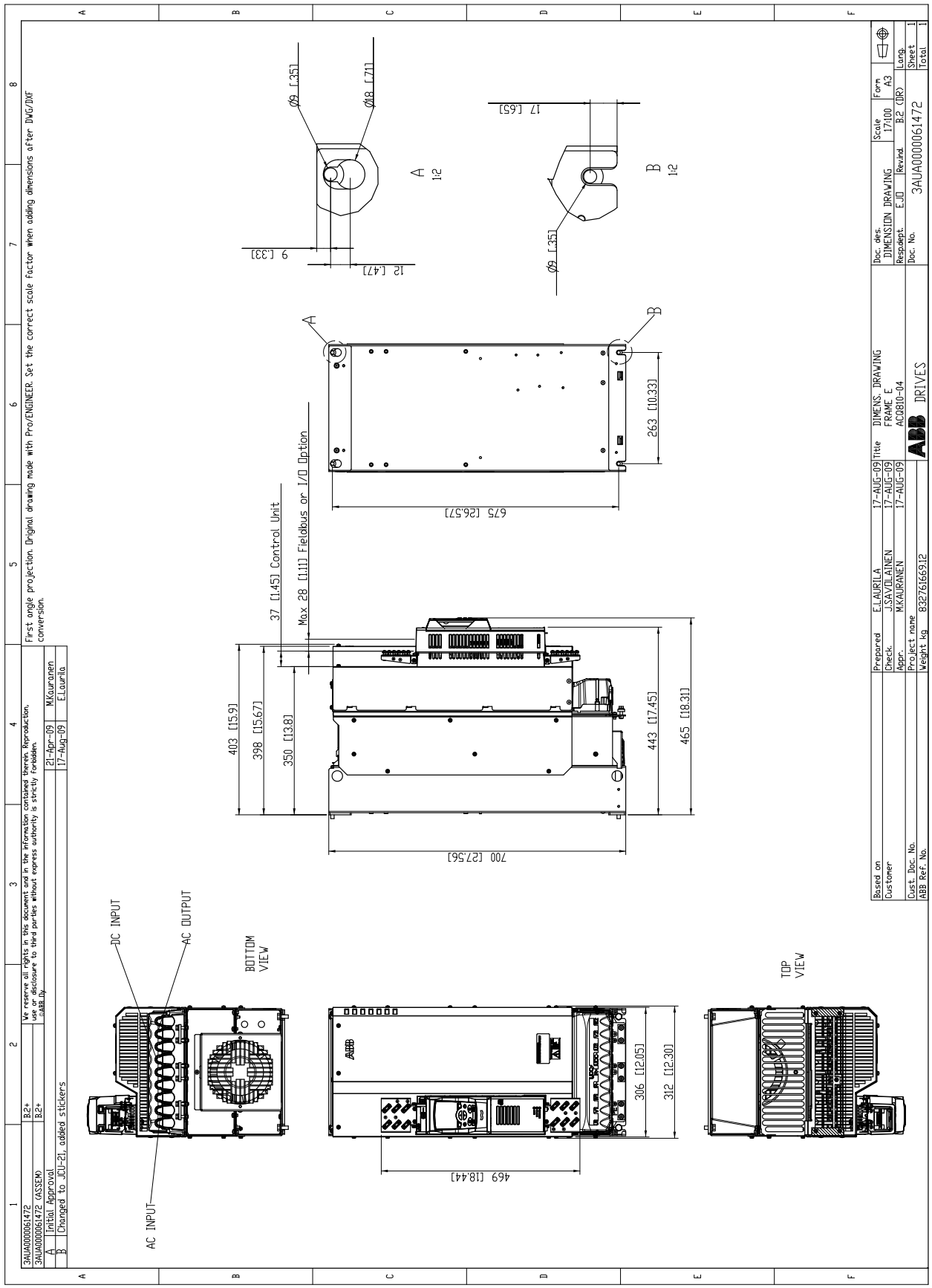
What this chapter contains

Dimension drawings of the drive modules (frame sizes E0 and E) are shown below. The dimensions are given in millimeters and [inches].

Drive module, frame size E0



Drive module, frame size E



Further information

Product and service inquiries

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

Product training

For information on ABB product training, navigate to www.abb.com/drives and select *Training courses*.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Go to www.abb.com/drives and select *Document Library – Manuals feedback form (LV AC drives)*.

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3AUA0000055161 Rev A / EN
EFFECTIVE: 2009-09-18

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