

ABB machinery drives

Hardware manual ACS880-M04 drive



List of related manuals

Drive manuals and guides

<i>ACS880-M04 firmware manual</i>	3AXD50000030629
<i>ACS880-M04 hardware manual</i>	3AXD50000028613
<i>ACS880-M04 quick installation guide</i>	3AXD50000032345

Option manuals and guides

<i>ACX-AP-X Assistant control panels user's manual</i>	3AUA0000085685
<i>ACS-BP-S Basic control panel user's manual</i>	3AXD50000032527
<i>ACS880-01 drives and ACS880-04 drive modules Common DC systems Application guide</i>	3AUA0000127818
<i>Drive (IEC 61131-3) application programming manual</i>	3AUA0000127808
<i>FDPI-02 diagnostics and panel interface user's manual</i>	3AUA0000113618
<i>FSO-12 safety functions module user's manual</i>	3AXD50000015612
<i>Technical Guide No. 3 – EMC Compliant Installation and Configuration for a Power Drive System</i>	3AFE61348280
<i>Converter module capacitor reforming instructions</i>	3BFE64059629
<i>Manuals and quick guides for I/O extension modules, fieldbus adapters, safety options, etc.</i>	

Tool and maintenance manuals and guides

<i>Drive composer PC tool user's manual</i>	3AUA0000094606
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You can find manuals and other product documents in PDF format on the Internet. See section [Document library on the Internet](#) on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

Hardware manual

ACS880-M04 machinery drive

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1

Safety instructions

Contents of this chapter

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

Use of warning and notes in this manual

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

The manual uses these warning symbols:

	Electricity warning tells about hazards from electricity which can cause injury or death, or damage to the equipment.
	General warning tells about conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.
	Electrostatic sensitive devices warning tells you about the risk of electrostatic discharge which can cause damage to the equipment.
	Hot surface warning warns you of component surfaces that may become hot enough to cause burns if touched.



General safety in installation, start-up and maintenance

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



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

- Handle the drive carefully.
- Use safety shoes with a metal toe cap to avoid foot injury.
- Keep the drive in its package or protect it otherwise from dust and burr from drilling and grinding until you install it.
- Protect also the installed drive against dust and burr. Electrically conductive debris inside the drive may cause damage or malfunction.
- Vacuum clean the area below the drive before the start-up to prevent the drive cooling fan from drawing the dust inside the drive.
- Do not cover the air inlet and outlet when the drive runs.
- Make sure that there is sufficient cooling. For more information, see sections [Checking the installation site](#) on page 51 and [Losses, cooling data and noise](#) on page 117.
- Before you connect voltage to the drive, make sure that the drive covers are on. Keep the covers on during the operation.
- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
- Before you activate automatic fault reset functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault.
- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors. The maximum number of times the circuit can charge is: 100000 (frames R1-R2) and 50000 (frames R3-R4).

If you have connected safety circuits to the drive (for example, emergency stop and Safe torque off), validate them at the start up.

Note:

- If you select an external source for start command and it is On, the drive will start immediately after fault reset, unless you configure the drive for pulse start.
- When the control location is not set to Local, the stop key on the control panel will not stop the drive.

Drives can be repaired only by an authorized person.

Electrical safety in installation, start-up and maintenance

■ Precautions before electrical work

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



WARNING! Follow these instructions. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do the electrical installation or maintenance work. Go through these steps before you begin any installation or maintenance work.

1. Clearly identify the work location.
2. Disconnect all possible voltage sources.
 - Open the main disconnecter at the power supply of the drive.
 - Make sure that reconnection is not possible. Lock the disconnecter to open position and attach a warning notice to it.
 - Disconnect any external power sources from the control circuits before you do work on the control cables.

CAUTION - Risk of electric shock. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.

3. Protect any other energized parts in the work location against contact.
 4. Take special precautions when close to bare conductors.
 5. Measure that the installation is de-energized.
 - Use a multimeter with an impedance of at least 1 Mohm.
 - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding terminal (PE) is close to 0 V.
 - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding terminal (PE) is close to 0 V.
 6. Install temporary grounding as required by the local regulations.
 7. Ask for a permit to work from the person in control of the electrical installation work.
-



Additional instructions and notes



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

- If you install the drive on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), disconnect the internal EMC filter; otherwise the system will be connected to ground potential through the EMC filter capacitors. This can cause danger or damage the drive. See page 76.
Note: Disconnecting the internal EMC filter increases the conducted emission and reduces the drive EMC compatibility considerably. See section [Compliance with the European EMC Directive](#) on page 134.
- If you install the drive on a corner-grounded TN system, disconnect the internal EMC filter; otherwise the system will be connected to ground potential through the EMC filter capacitors. This will damage the drive. See page 159.
Note: Disconnecting the internal EMC filter increases the conducted emission and reduces the drive EMC compatibility considerably. See section [Compliance with the European EMC Directive](#) on page 134.
- Use all ELV (extra low voltage) circuits connected to the drive only within a zone of equipotential bonding, that is, within a zone where all simultaneously accessible conductive parts are electrically connected to prevent hazardous voltages appearing between them. You can accomplish this by a proper factory grounding, that is, make sure that all simultaneously accessible conductive parts are grounded to the protective earth (PE) bus of the building.
- Do not do insulation or voltage withstand tests on the drive or drive modules.

Note:

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



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

■ Grounding

These instructions are for all personnel who are responsible for the electrical installation, including the grounding of the drive.



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

- If you are not a qualified electrician, do not do grounding work.
- Always ground the drive, the motor and adjoining equipment to the protective earth (PE) bus of the power supply. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) bus of the power supply.
- Make sure that the conductivity of the protective earth (PE) conductors is sufficient. See section [Selecting the power cables](#) on page 57. Obey the local regulations.
- Connect the power cable shields to the protective earth (PE) terminals of the drive.
- Make a 360° grounding of the power and control cable shields at the cable entries to suppress electromagnetic disturbances.

Note:

- You can use power cable shields as grounding conductors only when their conductivity is sufficient.
 - Standard IEC/EN 61800-5-1 (section 4.3.5.5.2.) requires that as the normal touch current of the drive is higher than 3.5 mA AC or 10 mA DC, you must use a fixed protective earth (PE) connection. In addition,
 - install a second protective earth conductor of the same cross-sectional area as the original protective earthing conductor,
 or
 - install a protective earth conductor with a cross-section of at least 10 mm² Cu or 16 mm² Al,
 or
 - install a device which automatically disconnects the supply if the protective earth conductor breaks.
-



Additional instructions for permanent magnet motor drives

■ Safety in installation, start-up and maintenance

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



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

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

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

- Stop the motor.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
- Measure that the installation is de-energized.
 - Use a multimeter with an impedance of at least 1 Mohm.
 - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is close to 0 V.
 - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
 - Make sure that the voltage between the drive DC terminals (UDC+, UDC-) and the grounding (PE) terminal is close to 0 V.
- Install temporary grounding to the drive output terminals (T1/U, T2/V, T3/W). Connect the output terminals together as well as to the PE.

Start-up and operation:

- Make sure that the operator cannot run the motor over the rated speed. Motor overspeed causes overvoltage that can damage or explode the capacitors in the intermediate circuit of the drive.
-



General safety in operation

These instructions are for all personnel that operate the drive.



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

- Do not control the motor with the disconnecter at the drive power supply; instead, use the control panel start and stop keys or commands through the I/O terminals of the drive.
- Give a stop command to the drive before you reset a fault. If you have an external source for the start command and the start is on, the drive will start immediately after the fault reset, unless you configure the drive for pulse start. See the firmware manual.
- Before you activate automatic fault reset functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault.

Note: When the control location is not set to Local, the stop key on the control panel will not stop the drive.







About the manual

Contents of this chapter

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.

Applicability

This manual applies to the ACS880-M04 drive module of frame sizes R1 to R4.

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 frame size

The ACS880-M04 drive is manufactured in frame sizes R1 to R4. Some instructions, technical data and dimensional drawings which concern only certain frame sizes are marked with the symbol of the frame size (R1, R2, R3, R4). The frame size is marked on the drive designation label. See also the frame size of each drive type in the ratings 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. See the + code selections listed in [Type designation label](#) on page 35.

Contents of the manual

This manual consists of the following chapters:

[Safety instructions](#) give safety instructions for the installation, commissioning, operation and maintenance of the drive.

[About the manual](#) describes the applicability and intended audience of this manual. It also includes a flow chart of steps to check the delivery of the drive for installing and commissioning.

[Operation principle and hardware description](#) describes the drive module.

[Planning the cabinet installation](#) 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.

[Start-up](#) refers to the start-up instructions of the drive.

[Maintenance](#) lists periodic maintenance actions along with work instructions.

[Technical data](#) contains technical specifications of the drive, for example, ratings, sizes, technical requirements and provisions for fulfilling the requirements for valid markings.

[The Safe torque off function](#) briefs the Safe torque off (STO) function of the drive modules and gives instructions for its use.

[Mains chokes](#) briefs the optional mains chokes available for the drive.

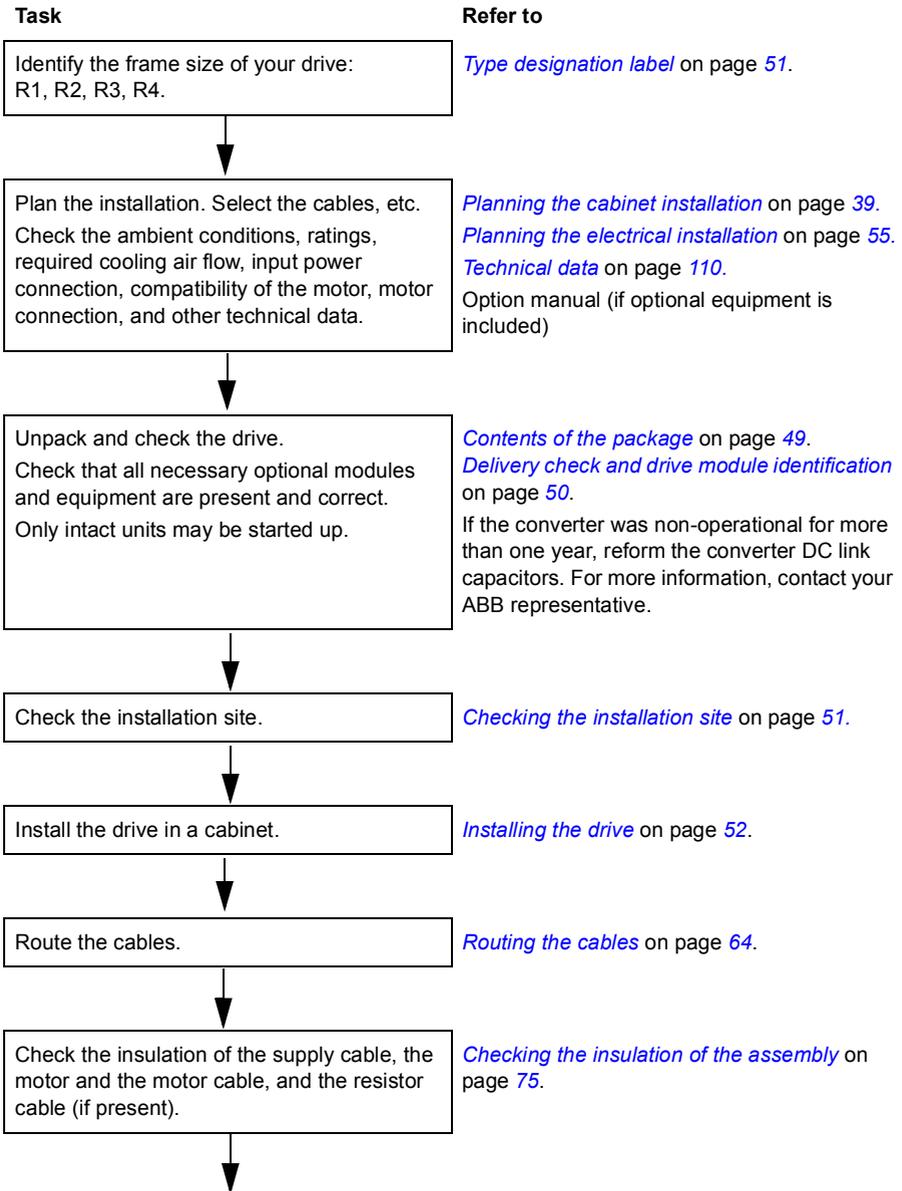
[EMC filters](#) briefs the EMC filtering options available for the drive.

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

Resistor braking describes how to select, protect and wire brake resistors.

Dimension drawings contains the dimensional drawings of the drive and connected equipment.

Quick installation and commissioning flowchart



Task	Refer to
If the drive is about to be connected to an IT (ungrounded) system, disconnect the internal varistors and EMC filters. Also note that using an EMC filter is not allowed in an IT (ungrounded) system.	Electrical safety in installation, start-up and maintenance on page 15. Checking the compatibility with IT (ungrounded) and corner-grounded TN systems on page 76.
Connect the power cables.	Connecting the power cables on page 77.
Connect the control and the auxiliary control cables.	Connecting the control unit on page 85. For optional equipment: Mains chokes on page 155. EMC filters on page 159. Resistor braking on page 173. Manuals for any optional equipment
Check the installation.	Installation checklist on page 99.
Commission the drive.	Start-up on page 101. Firmware manual [3AXD5000030629 (English)]
Commission the brake chopper if required.	Resistor braking on page 173.
Operate the drive: start, stop, speed control etc.	Firmware manual [3AXD5000030629 (English)]

Terms and abbreviations

Term/Abbreviation	Explanation
Brake chopper	Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
Brake resistor	Dissipates the drive surplus braking energy conducted by the brake chopper to heat. Essential part of the brake circuit. Refer to <i>Brake chopper</i> .
Control board	Circuit board in which the control program runs.
Capacitor bank	Refer to DC link capacitors.
DC link	DC circuit between rectifier and drive
DC link capacitors	Energy storage which stabilizes the intermediate circuit DC voltage
Drive	Frequency converter for controlling AC motors
EFB	Embedded fieldbus
EMC	Electromagnetic compatibility
FBA	Fieldbus adapter
FCAN-01/-01-M	Optional CANopen adapter module
FCNA-01	ControlNet adapter module
FDNA-01	Optional DeviceNet adapter module
FECA-01/-01-M	Optional EtherCAT adapter module
FENA-01/-11/-21/-21-M	Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols
FEPL-02	Ethernet POWERLINK adapter module
FPBA-01/-01-M	Optional PROFIBUS DP adapter module
Frame (size)	Refers to drive physical size, for example R1 and R2. The type designation label attached to the drive shows the frame of the drive, refer to Type designation key on page 34.
FSCA-0x	Optional Modbus/RTU adapter module
IGBT	Insulated Gate Bipolar Transistor; a voltage-controlled semiconductor type widely used in drives due to their easy controllability and high switching frequency.
I/O	Input/Output
JBR-xx	Series of optional brake resistors
JFI-xx	Series of optional EMC filters
JPU/RPU	Power unit; see the definition below.
Power unit	Contains the power electronics and connections of the drive module. The ZCU is connected to the power unit.

Term/Abbreviation	Explanation
RFI	Radio-frequency interference
ZMU	The memory unit attached to the control unit of the drive.
ZCU	The control unit of the drive module. The ZCU is installed on top of the power unit. The external I/O control signals are connected to the ZCU, or optional I/O extensions mounted on it.

3

Operation principle and hardware description

Contents of this chapter

The chapter describes the operating principle and construction of the drive module.

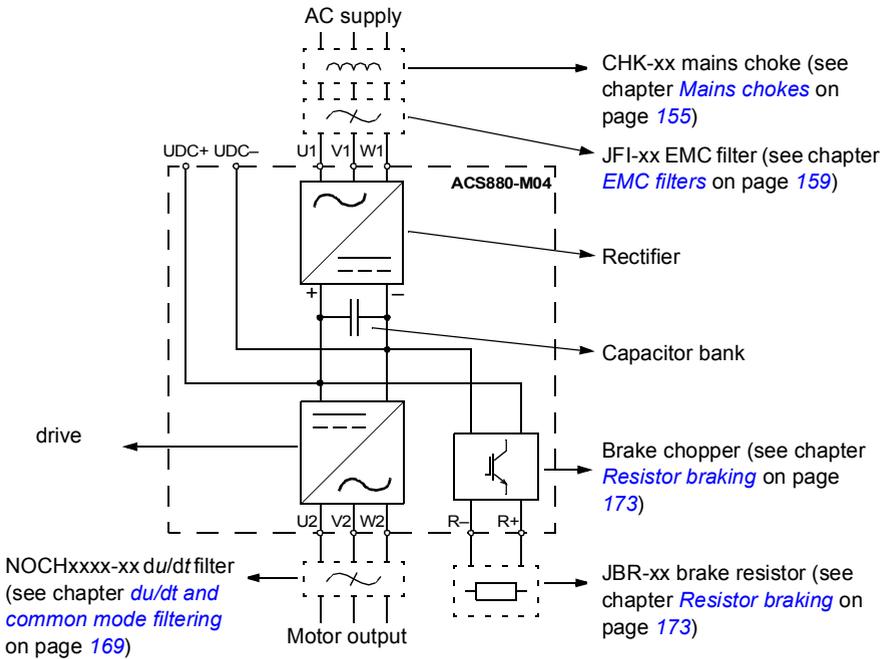
ACS880-M04 drive overview

The ACS880-M04 is an air-cooled IP20 drive module for controlling asynchronous induction motors, permanent magnet motors and ABB synchronous reluctance motors. It is optimized for cabinet mounting.

The drive is available in several frame sizes depending on the output power. All frame sizes use the same control unit of ZCU type.

Operation principle

Main circuit



Motor control

The motor control is based on direct torque control. Two phase currents and DC link voltage are measured and used for the control. The third phase current is measured for earth fault protection.

Layout

■ General

The DC input terminals are located at the top of the module and the AC output terminals are located at the bottom of the module.

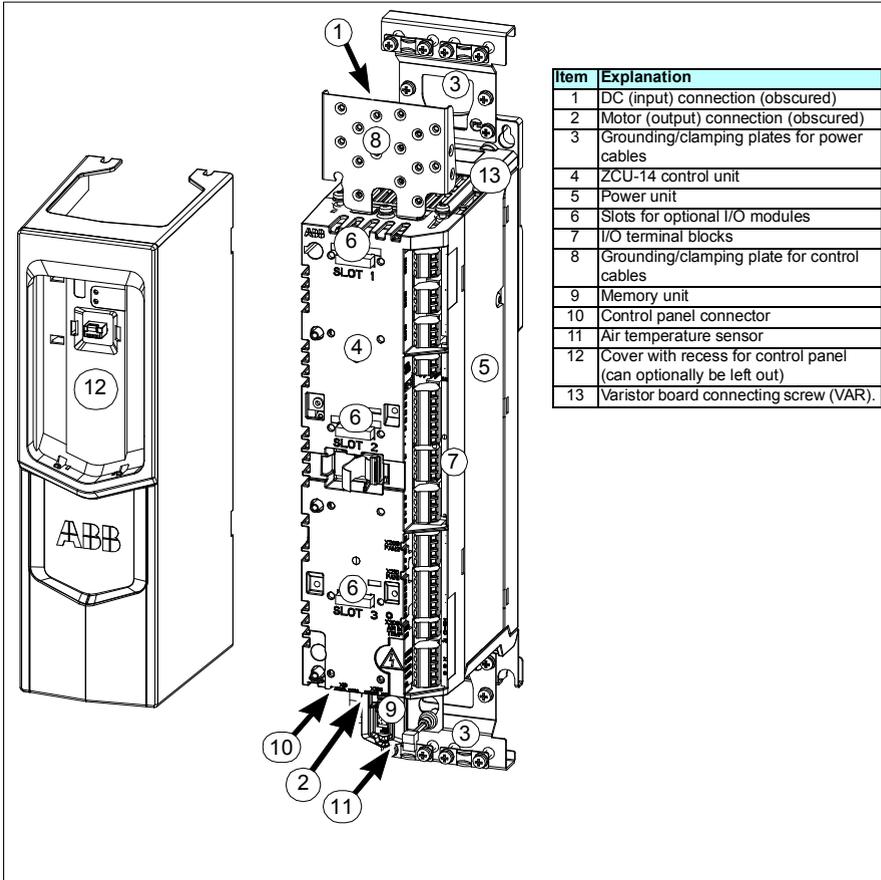
The ZCU-14 control unit is mounted onto the module. The control unit contains the basic I/Os and slots for optional I/O modules. For descriptions of the I/O terminals on the control unit, see [Connecting the control unit](#) on page 85.

Other optional equipments are primarily installed on separate mounting plates.

The modules are fitted with external DC fuses. The frames R1...R4 modules have an internal capacitor pre-charge circuit.

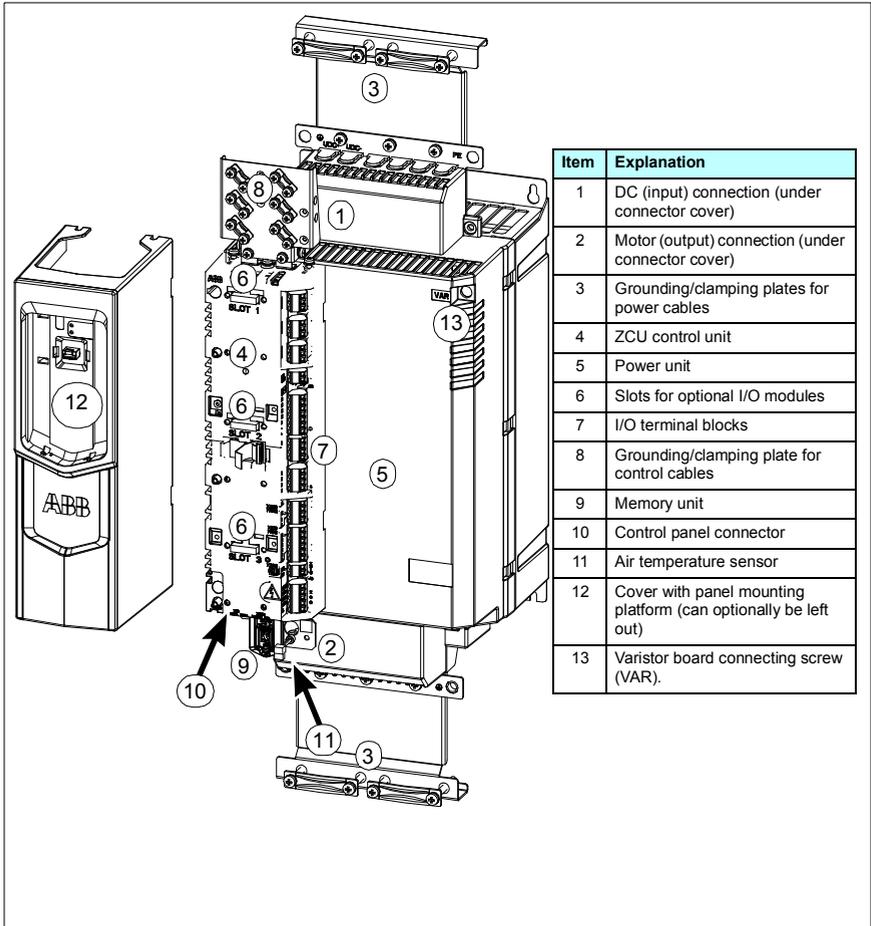
■ Module layout – Frame R1

(Note that frame R2 has a similar layout)

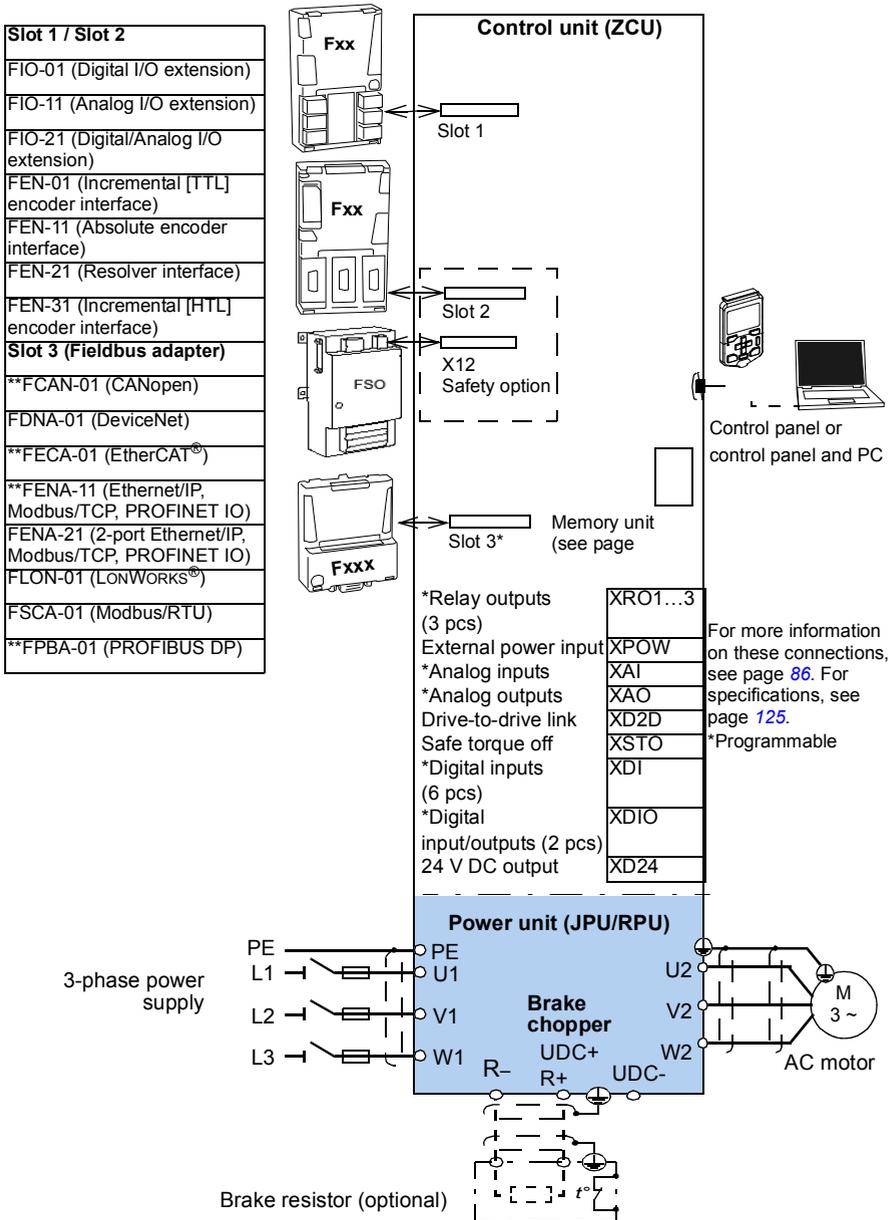


■ **Module layout – Frame R4**

(Note that frame R3 has a similar layout.)

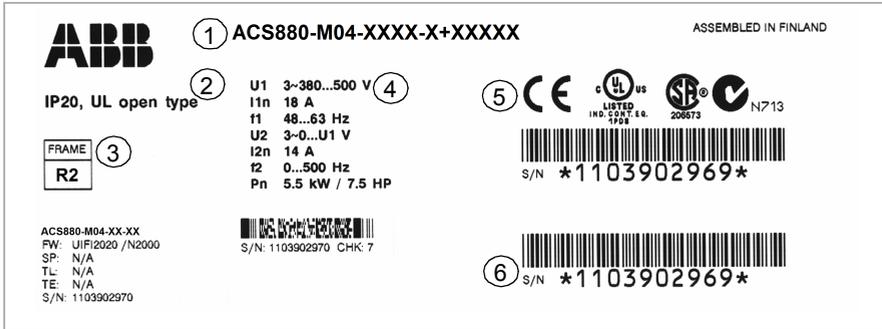


Power connections and control interfaces



Type designation label

This is a sample type designation label.



No.	Description
1	Type designation, see Type designation key below.
2	Degree of protection
3	Frame (size)
4	Nominal ratings, see Ratings on page 110.
5	Valid markings
6	S/N: Serial number in format MYYWWXXXX, where M: Manufacturer YY: Year of manufacture: 15, 16, 17, ... for 2015, 2016, 2017, ... W: Week of manufacture: 01, 02, 03, ... for week 1, week 2, week 3, ... XXXX: Running item number starting each week from 0001.

Type designation key

The type designation key tells you the specifications and configuration of the drive. The table shows the primary drive variants.

Sample type code: ACS880-M04-04A8-5+XXXX

- The first digits from left indicate the basic configuration (ACS880-M04-04A8-5).
- The optional selections are given thereafter, preceded by + signs (e.g. +L501).

The main selections are described below.

Note: Not all selections are necessarily available for all types; refer to *ACS880-M04 ordering information*, available on request.

Selection	Alternatives	
Product series	ACS880	
Type	M04	Drive module. When no options are selected: IP20 (UL Open Type), plain front cover, no control panel, no mains choke (frames R1 and R2), internal mains choke (frames R3 and R4), no EMC filter, internal brake chopper, coated boards, Safe torque off, Primary control program, <i>Quick installation and start-up Guide</i> .
Current rating	04A8	For example, 04A8 refers to a nominal output current of 4.8 A. See Ratings on page 110.
Voltage range	2 5	200...240 V 380...500 V
Option codes (plus codes)		
Filters	E...	+E200: EMC filter, C3, 2nd Environment, Unrestricted (Earthed network) (External with frames R1 and R2, internal with frames R3 and R4)
Control panel and front cover options	J...	+0C168: No drive module front cover, no control panel +J400: Control panel mounted on drive module front cover +J410: Control panel with door mounting platform kit including 3 m cable +J414: Control panel mounting platform on drive module (no control panel included)
Fieldbus	K...	+K451: FDNA-01 DeviceNet adapter module +K452: FLON-01 LonWorks® adapter module +K454: FPBA-01 PROFIBUS DP adapter module +K457: FCAN-01 CANopen adapter module +K458: FSCA-01 Modbus/RTU adapter module +K473: FENA-11 Ethernet/IP™, Modbus/TCP and PROFINET IO adapter module +K469: FECA-01 EtherCAT® adapter module

Selection	Alternatives	
I/O extensions and feedback interfaces	L...	+L500: FIO-11 analog I/O extension module +L501: FIO-01 digital I/O extension module +L502: FEN-31 HTL encoder interface module +L516: FEN-21 resolver interface module +L517: FEN-01 TTL encoder interface module +L518: FEN-11 absolute TTL encoder interface module +L519: FIO-21 analog/digital I/O extension module
Programs	N...	+N5050: Crane control program Note: The following technology library is required with the Crane control program: +N3050: Crane technology library +N5000: Winder control program +N8200 High-speed control program
Specialties		+P904: Extended warranty
Printed hardware and firmware manuals in specified language (The delivered manual set can include manuals in English if the translation is not available.)	R...	+R700: English +R701: German +R702: Italian +R703: Dutch +R704: Danish +R705: Swedish +R706: Finnish +R707: French +R708: Spanish +R709: Portuguese +R710: Portuguese spoken in Brazil +R711: Russian +R714: Turkish

4

Planning the cabinet installation

Contents of this chapter

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: The installation examples in this manual are provided only to help the installer in designing the installation.



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

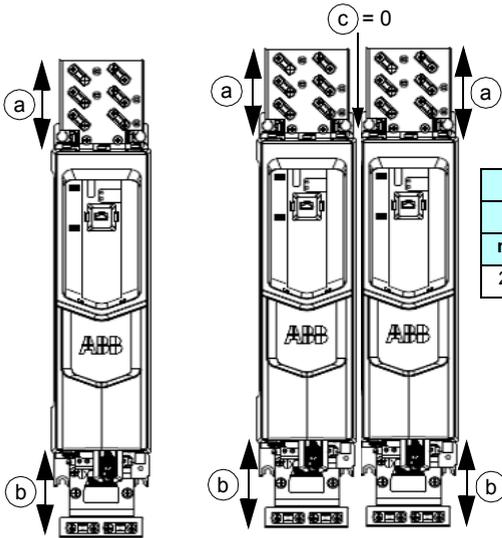
■ Cabinet frame	
Make sure...	<input checked="" type="checkbox"/>
The cabinet frame is sturdy enough to carry the weight of the drive components, control circuitry and other equipment installed in it.	<input type="checkbox"/>
The cabinet protects the drive module against contact and meets the requirements for dust and humidity. See data for relative humidity and contamination under <i>Ambient conditions</i> on page 130.	<input type="checkbox"/>
■ Disposition of devices	
Check that ...	
The layout is spacious enough for easy installation and maintenance. There should be sufficient space for cooling air flow, obligatory clearances, cables and cable support structures. See the layout example in <i>Cooling and degrees of protection</i> on page 44.	<input type="checkbox"/>
■ Grounding of mounting structures	
Make sure ...	
Proper grounding of <ul style="list-style-type: none"> • all cross-members or shelves on which the drive system components are mounted • the components through their fastening points to the installation base. Note: It is recommended to mount the EMC filter (if present) and the drive module on the same mounting plate.	<input type="checkbox"/>
The connecting surfaces are left unpainted.	<input type="checkbox"/>

Free space requirements

The drive modules can be installed side by side. The alternate ways to install the modules are illustrated below. See the free space requirements table below.

For dimensions of the drive modules, refer to chapter *Dimension drawings* on page 181.

Vertically alone or side by side

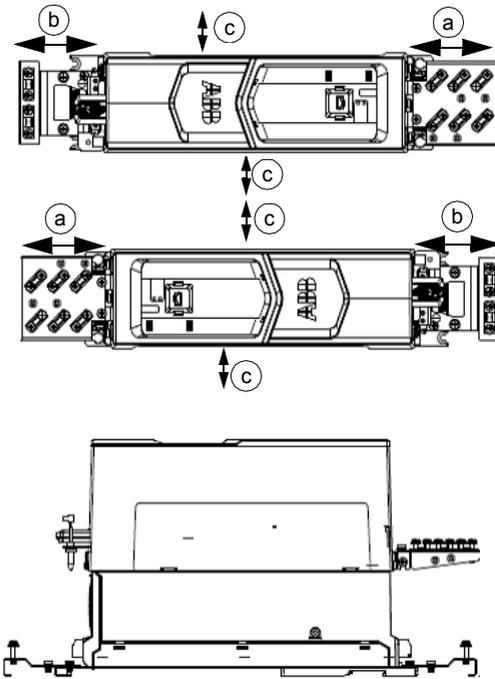


Free space requirement					
Above (a)		Below (b)		On the sides (c)	
mm	in	mm	in	mm	in
200	7.9	300	12	0	0

Do not install the drive upside down.

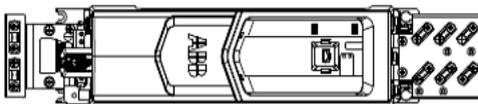


■ **Horizontally alone or side by side back installation**

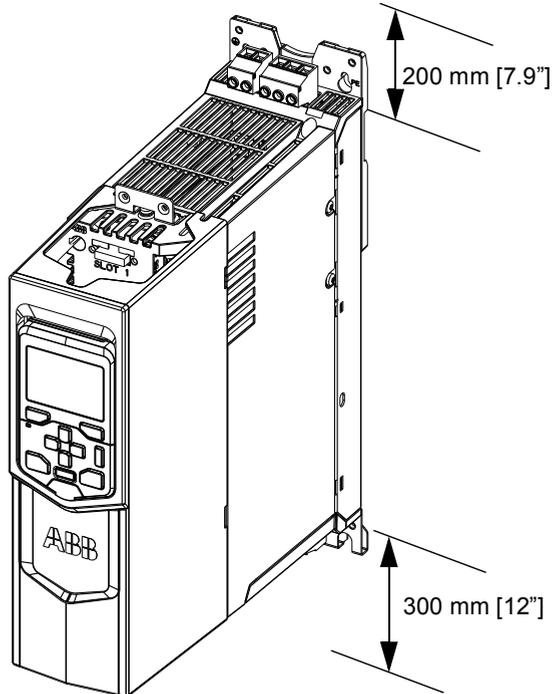


■ **Horizontally alone side installation**

This installation is recommended only with the R1 frame. For this kind of installation with other frames, use additional support.

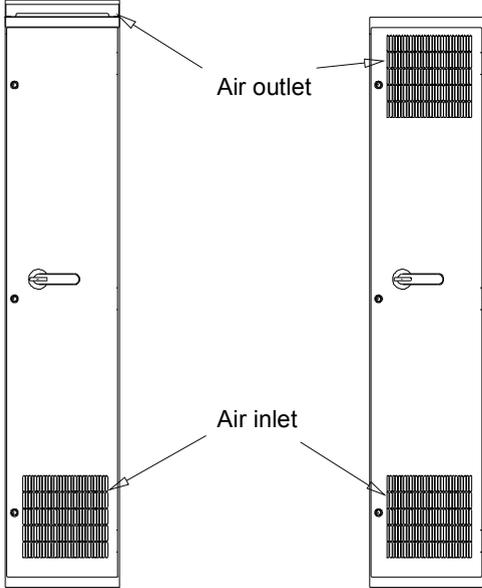


Note: EMC filters of type JFI-x1 mounted directly above the drive module do not increase the free space requirements. (For EMC filters of type JFI-0x, see the dimension drawing of the filters on page 189.)

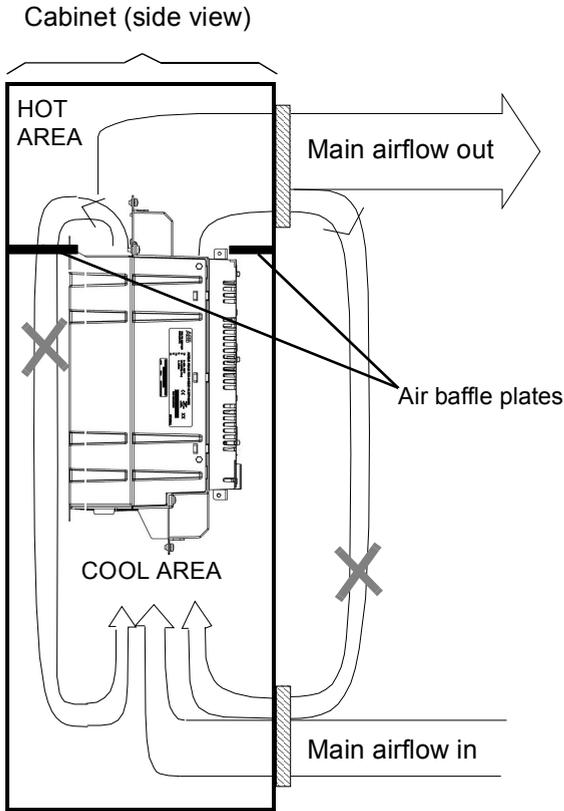


Note: The temperature of the cooling air entering the unit must not exceed the maximum allowed ambient temperature (see [Ambient conditions](#) on page 130). Consider this when installing heat-generating components (such as other drives, mains chokes and brake resistors) nearby.

Cooling and degrees of protection

<p>Check that...</p>	<input checked="" type="checkbox"/>
<p>The cabinet has enough free space for the components for sufficient cooling. Observe the minimum clearances given for each component.</p>	<input type="checkbox"/>
<p>The air inlets and outlets are equipped with gratings that guide the airflow, protect against contact, and prevent water splashes from entering the cabinet.</p> <p>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.</p>  <p>The diagram illustrates two cabinet cooling solutions. On the left, a cabinet is shown with an air inlet at the bottom and an air outlet at the top. On the right, a cabinet is shown with an air inlet at the bottom and an air outlet on the upper part of the door. Both cabinets have a door with a handle and a lock. Labels 'Air outlet' and 'Air inlet' point to the respective components.</p>	<input type="checkbox"/>
<p>The air inlets and outlets are sufficient in size.</p> <p>Note: In addition to the power loss of the drive module, ventilate the heat dissipated by cables and other additional equipment.</p>	<input type="checkbox"/>
<p>Cooling of the modules is arranged such that the requirements meet the data in Losses, cooling data and noise on page 117.</p> <p>Note: The values apply to continuous nominal load. If the load is less than nominal, less cooling air is required.</p>	<input type="checkbox"/>
<p>Ambient temperature is within the limits specified in Ambient conditions on page 130.</p>	<input type="checkbox"/>
<p>The installation site is sufficiently ventilated.</p>	<input type="checkbox"/>
<p>In IP22 cabinets, the internal cooling fans of the modules are usually sufficient to keep the component temperatures low enough.</p>	<input type="checkbox"/>
<p>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.</p>	<input type="checkbox"/>

■ Preventing recirculation of hot air



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 airflow 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

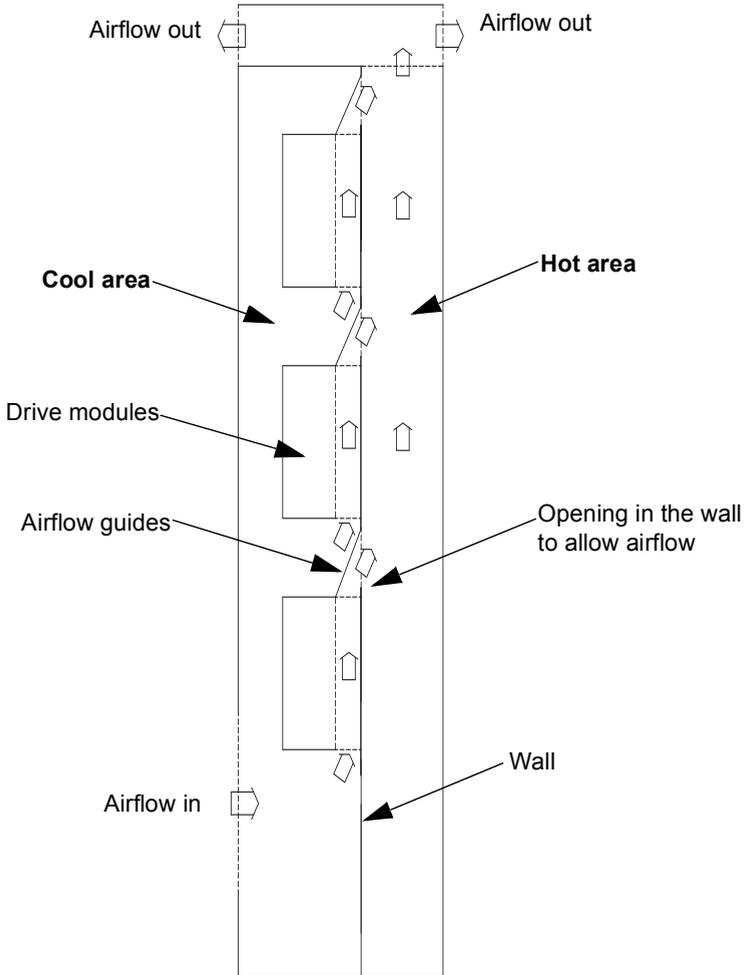
Prevent hot air circulation inside the cabinet with leak-proof air baffle plates. No gaskets are usually required.

■ Cabinets with multiple modules

The hot air from a drive module must not enter another module. In a cabinet with multiple modules, the practical way is to install a wall to separate the cool area (at the front part of the cabinet) from the hot area (back part). The wall can be fastened to two vertical pillars on both left and right.

Since the air outlet at the top of the modules points directly upwards, the air must be guided to the hot area using separate airflow guides. See the example below.

SIDE VIEW



■ **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.

5

Mechanical installation

Contents of this chapter

The chapter describes the mechanical installation procedure of the drive.

Contents of the package

The drive is delivered in a cardboard box. To open, remove any banding and lift the top off the box.





Check that the box contains...	<input checked="" type="checkbox"/>
ACS880-M04 drive module, with factory-installed options	<input type="checkbox"/>
Three cable clamp plates (two for power cabling, one for control cabling) with screws	<input type="checkbox"/>
Screw-type terminal blocks to be attached to the headers on the ZCU control unit and the power unit	<input type="checkbox"/>
EMC filter (+E200) if ordered (with frames R1 and R2 only)	<input type="checkbox"/>
Control panel mounting kit (+J410) if ordered	<input type="checkbox"/>
Printed quick guides	<input type="checkbox"/>
Printed manuals if ordered	<input type="checkbox"/>

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. See [Type designation label](#) on page 35.

Before installing the drive

■ Checking the installation site

Before installation, check the installation site according to the requirements below. For frame details, refer to [Dimension drawings](#) on page 181.

Check that...	<input checked="" type="checkbox"/>
The frame details are according to the Dimension drawings from page 181.	<input type="checkbox"/>
The operational conditions of the drive meets the Ambient conditions on page 130.	<input type="checkbox"/>
The surface on which the drive is to be mounted on is <ul style="list-style-type: none"> • even as possible • of non-flammable material • strong enough to carry the weight of the drive. See sections Dimensions and weights (page 116) and Free space requirements (page 41).	<input type="checkbox"/>
The installation site is sufficiently ventilated or cooled to transfer away the drive losses. See section Losses, cooling data and noise on page 117.	<input type="checkbox"/>
The floor/material below the installation is non-flammable.	<input type="checkbox"/>
There is enough free space above and below the drive to enable cooling air flow, service and maintenance. See the required Free space requirements (page 41) for each of the different mounting alignments and Cooling and degrees of protection (page 44).	<input type="checkbox"/>

■ Required tools for installing the drive

To install the drive mechanically, you need the following tools:

- A drill and suitable drill bits
- A screwdriver or wrench with a set of suitable bits (as appropriate for the installation hardware used)
- A tape measure and spirit level
- Personal protective equipment.



Installing the drive

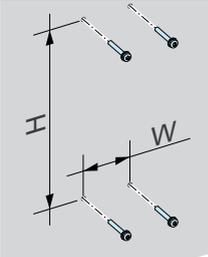
You can install the drive:

- With screws on to a wall
- To a DIN installation rail with the integrated lock.

See the possible installation directions and free space requirements on page [41](#).

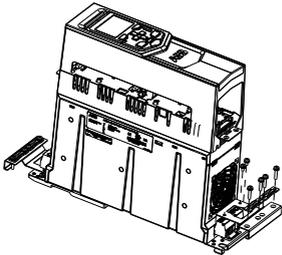
■ Installing the drive with screws

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 surface.

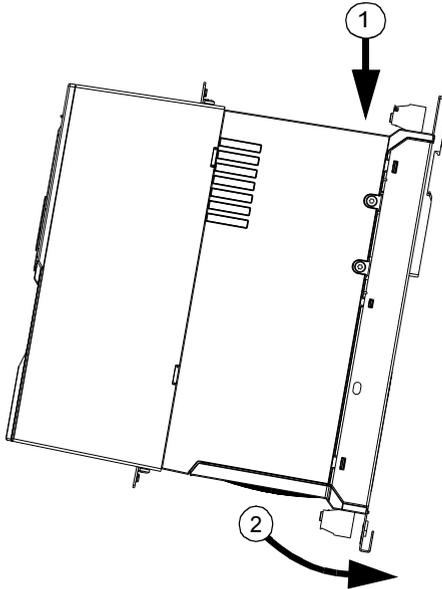
Note: Lift the drive only by its chassis.



4. Tighten the screws.

■ Installing drive to a DIN installation rail – Frames R1 and R2 only

1. Click the drive to the rail. To detach the drive, press the release lever on top of the drive as shown in the figure.
2. Fasten the lower edge of the drive to the mounting base through the two fastening points.



Installing mains choke

See chapter [Mains chokes](#) on page 155.

Installing EMC filter

See chapter [EMC filters](#) on page 159.

Installing brake resistor

See chapter [Resistor braking](#) on page 173.



6

Planning the electrical installation

Contents of this chapter

This chapter contains instructions for planning the electrical installation of the drive, for example, for checking the compatibility of the motor and drive, selecting cables, protections and cable routing.



Installation must be designed and done according to the applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations.

If recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Checking the compatibility of the motor and drive

Use an asynchronous AC induction motor or a permanent magnet motor with the drive. Several induction motors can be connected to the drive at a time but only one permanent magnet motor can be connected to the drive at a time.

Make sure that the motor and the drive are compatible according to the [Ratings](#) on page [110](#). The ratings table lists the typical motor power for each drive type.

Selecting the supply disconnecting device

According to safety regulations, equip each drive with a supply disconnecting device. Install a hand-operated input disconnecting device between the AC power source and the drive.

Note: You must be able to lock the disconnecting device to the open position for installation and maintenance work.

■ Requirements in European Union (EU) countries

To meet the European Union Directives, according to standard EN 60204-1, Safety of Machinery, the disconnecting device must be one of the following types:

- switch-disconnector of utilization category AC-23B (EN 60947-3)
- 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)
- circuit breaker suitable for isolation in accordance with EN 60947-2.

■ Requirements in non-EU countries

The disconnecting device must conform to the applicable local safety regulations.

Selecting the power cables

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

- The input power and the motor cables must be able to carry the corresponding load currents. For rated currents, see [Ratings](#) on page 110.
- The cable must be rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use. For the US, see [Additional US requirements](#) on page 60.
- The conductivity of the PE conductor must be sufficient, see the table on page 57.
- A 600 V AC cable is accepted for up to 500 V AC.

To comply with the EMC requirements of the CE mark, use an approved cable type in [Recommended power cable types](#) on page 59.

Use symmetrical shielded cable to reduce the following properties:

- electromagnetic emission of the drive system
- stress on motor insulation
- bearing currents
- general drive wear.

The protective conductor must always have an adequate conductivity. The table below shows the minimum cross-sectional area related to the phase conductor size according to IEC 61439-1 when the phase conductor and the protective conductor are made of the same metal.

Cross-sectional area of the phase conductors S (mm ²)	Minimum cross-sectional area of the corresponding protective conductor S _p (mm ²)
S ≤ 16	S
16 < S ≤ 35	16
35 < S	S/2

Note: See the IEC/EN 61800-5-1 requirement on grounding (page 17).

■ Typical power cable sizes

The table below gives copper cable types with concentric copper shield for the drives with nominal current. The value separated by the plus sign means the diameter of the PE conductor.

Drive type ACS880-M04	Frame size	IEC ¹⁾	US
		Cu cable type	
		mm ²⁾	AWG/kcmil
-03A0-2/5	R1	3×1.5 + 1.5	16
-03A6-2/5	R1	3×1.5 + 1.5	16
-04A8-2/5	R1	3×1.5 + 1.5	16
-06A0-2/5	R1	3×1.5 + 1.5	16
-08A0-2/5	R1	3×1.5 + 1.5	16
-010A-2/5	R2	3×1.5 + 1.5	16
-014A-2/5	R2	3×2.5 + 2.5	14
-018A-2/5	R2	3×4 + 4 ²⁾	14
-025A-2/5	R3	3×10 + 10	6
-030A-2/5	R3	3×10 + 10	6
-035A-2/5	R3	3×10 + 10	6
-044A-2/5	R3	3×10 + 10	6
-050A-2/5	R3	3×10 + 10	6
-061A-2/5	R4	3×10 + 10	6
-078A-2/5	R4	3×10 + 10	6
-094A-2/5	R4	3×10 + 10	6

3AXD10000434191.xls

¹⁾The cable sizing is based on max. 6 cables laid on a cable ladder side by side, ambient temperature 30 °C, PVC insulation, surface temperature 70 °C.

For other conditions, size of the cables according to local safety regulations, appropriate input voltage and load current of the drive, see page 110 for the accepted cable sizes of the drive.

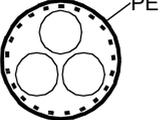
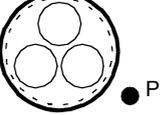
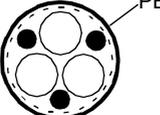
²⁾Without additional choke

See also [Supply cable fuses](#) on page 118.

Alternative power cable types

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

Recommended power cable types

	<p>Symmetrical shielded cable with three phase conductors and a concentric PE conductor as the shield. The shield must meet the requirements of IEC 61439-1, see page 57. Check with local/state/country electrical codes for allowance.</p>
	<p>Symmetrical shielded cable with three phase conductors and a concentric PE conductor as the shield. A separate PE conductor is required if the shield does not meet the requirements of IEC 61439-1, see page 57.</p>
	<p>Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must meet the requirements of IEC 61439-1, see page 57.</p>

Power cable types for limited use

	<p>A four-conductor system (three phase conductors and a protective conductor on a cable tray) is not allowed for motor cabling (it is allowed for input cabling).</p>
	<p>A four-conductor system (three phase conductors and a PE conductor in a PVC conduit) is allowed for input cabling with phase conductor cross-section less than 10 mm² (8 AWG) or motors ≤ 30 kW (40 hp). Not allowed in the USA.</p>
	<p>Corrugated or EMT cable with three phase conductors and a protective conductor is allowed for motor cabling with phase conductor cross section less than 10 mm² (8 AWG) or motors ≤ 30 kW (40 hp).</p>

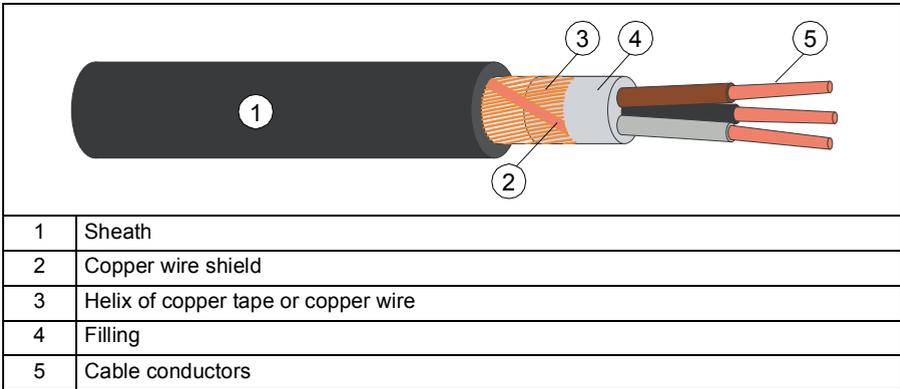
Not allowed power cable types

	<p>Symmetrical shielded cable with individual shields for each phase conductor is not allowed on any cable size for input or motor cabling.</p>
---	---

Motor cable shield

If the motor cable shield is used as the sole protective earth conductor of the motor, make sure that the conductivity of the shield is sufficient. See [Selecting the power cables](#) on page 57 or see IEC 61439-1.

To effectively suppress radiated and conducted radio-frequency emissions, the cable shield conductivity must be at least 1/10 of the phase conductor conductivity. To meet the requirements, use a copper or an aluminum shield. The figure shows the minimum requirements for the motor cable shield. It has a concentric layer of copper wires with an open helix of copper tape or copper wire. The better and tighter the shield, the lower the emission level and bearing currents.



Additional US requirements

Use type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable for the motor cables if metallic conduit is not used. For the North American market, 600 V AC cable is accepted for up to 500 V AC. A 1,000 V AC cable is required above 500 V AC (below 600 V AC). The power cables must be rated for 75 °C (167 °F).

Conduit

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

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

Armored cable / shielded power cable

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

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

Shielded power cables are available from the following suppliers:

- Belden
 - LAPPKABEL (ÖLFLEX)
 - Pirelli.
-

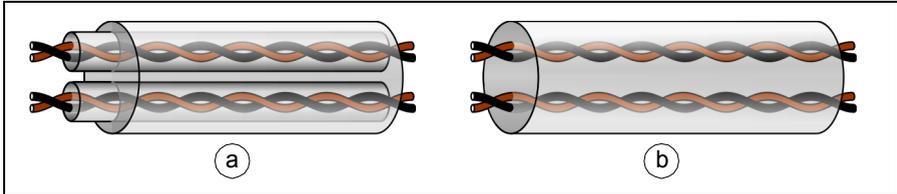
Selecting the control cables

Shielding

Use only shielded control cables.

Use a double-shielded twisted pair cable (figure *a* below) for analog signals. Use one individually shielded pair for each signal. Do not use common return for different analog signals.

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



Signals in separate cables

Run analog and digital signals in separate, shielded cables.

Do not mix 24 V AC/DC and 115/230 V AC signals in the same cable.

Signals run in the same cable

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

Relay cable

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

Control panel cable

In remote use, the cable connecting the control panel to the drive must not exceed 100 m (330 ft). If multiple panels or drives are connected, the total length of the panel bus must not exceed 100 m (330 ft).

The cable type tested and approved by ABB is used in control panel option kits. Suitable cables are CAT 5e unshielded or shielded twisted pair cables.

■ Drive composer PC tool cable

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

■ FPBA-01 PROFIBUS DP adapter module connectors

Frames R1...R4: The following connector types were tested to fit in the tight space for option slot 1.

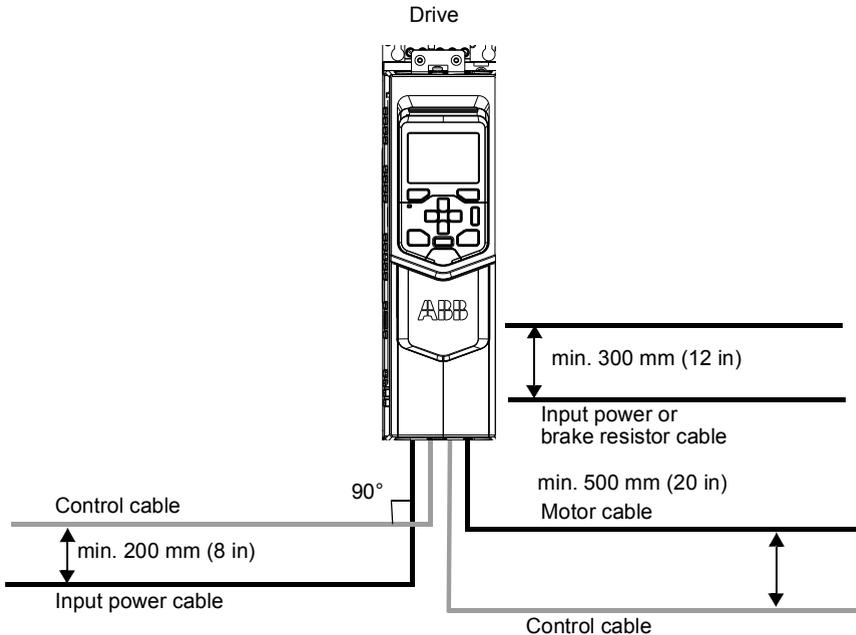
- Phoenix Contact SUBCON-PLUS-PROFIB/PG/SC2, part number 2708245. Lead the cable through the control cable hole on the right in the lead-through plate (1).
 - Siemens, part number 6GK1 500 0EA02. Lead the cable through the middle control cable hole in the lead-through plate (2).
-

Routing the cables

■ General rules

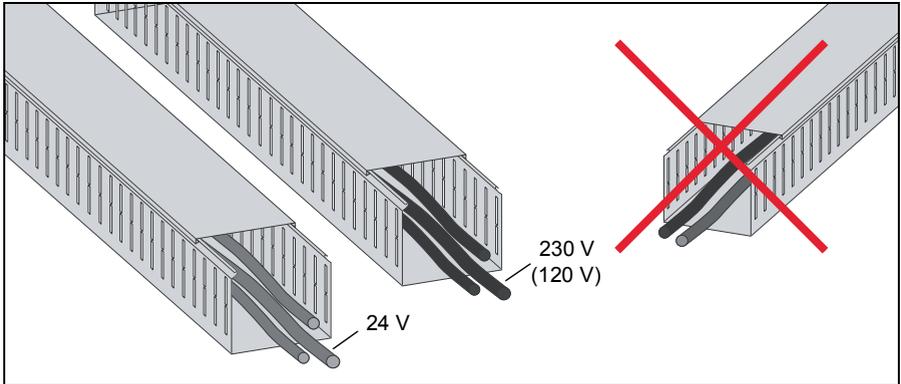
- Route the motor cable away from other cables. The motor cables of several drives can be put in parallel next to each other.
- Install the motor cable, input power cable and control cables on separate trays.
- Avoid long parallel runs of motor cables with other cables to decrease electromagnetic interference 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.
- Make sure the cable trays have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

■ Cable routing diagram



■ Separate control cable ducts

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



■ Continuous motor cable shield or enclosure for equipment on the motor cable

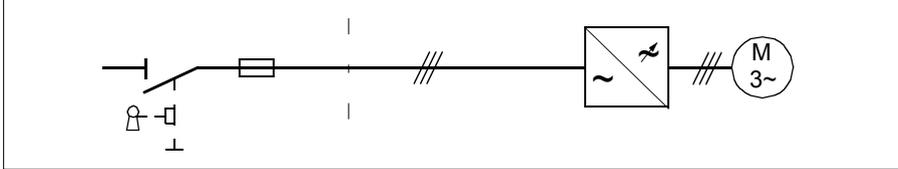
To minimize the emission level when there are safety switches, contactors, connection boxes or similar equipments on the motor cable between the drive and the motor:

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

Implementing thermal overload and short-circuit protection

■ Protecting the drive and input power cable in short-circuits

Protect the drive and input cable with fuses as follows:



Size the fuses at the distribution board according to instructions given in chapter [Technical data](#) on page 109. The fuses 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.

Note: If you want to use circuit breakers, contact ABB for more information.

■ Protecting the motor and motor cable in short-circuits

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

■ Protecting the drive and the input power and motor cables against thermal overload

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



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

■ Protecting the motor against thermal overload

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

The most common temperature sensors are:

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

For more information, see *ACS880-M04 firmware manual* (3AXD50000030629 [English]).

Protecting the drive against ground faults

The drive is equipped with an internal ground fault protective function to protect the unit against ground faults in the motor and motor cable. This is not a personnel safety or a fire protection feature. The ground fault protective function can be reduced with a parameter 31.20 Earth fault.

For more information, see *ACS880-M04 firmware manual* (3AXD50000030629 [English]).

■ Residual current device compatibility

The drive is suitable to be used with residual current devices of Type B.

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

Implementing the Emergency stop function

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

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.

Implementing the Safe torque off function

See chapter [The Safe torque off function](#) on page 141.

Implementing the Power-loss ride-through function

See *ACS880-M04 firmware manual (3AXD50000030629 (English))*.

Using a safety switch between the drive and the motor

Install a safety switch between the permanent magnet motor and the drive output. The safety switch isolates the motor from the drive during maintenance work on the drive.

Using a contactor between the drive and the motor

The control of the output contactor depends on how you use the drive. See also [Implementing a bypass connection](#) on page 68.

When you use the vector control mode and motor ramp stop, open the contactor as follows:

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

When you use the vector control mode and motor coast stop or the scalar control mode, open the contactor as follows:

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



WARNING! In vector control mode, do not open the output contactor when the drive controls the motor. The vector control operates faster than the contactor opens its contacts.

If the contactor starts to open when the drive controls the motor, the vector control tries to maintain the load current and increases the drive output voltage to the maximum. This can cause damage to the contactor.

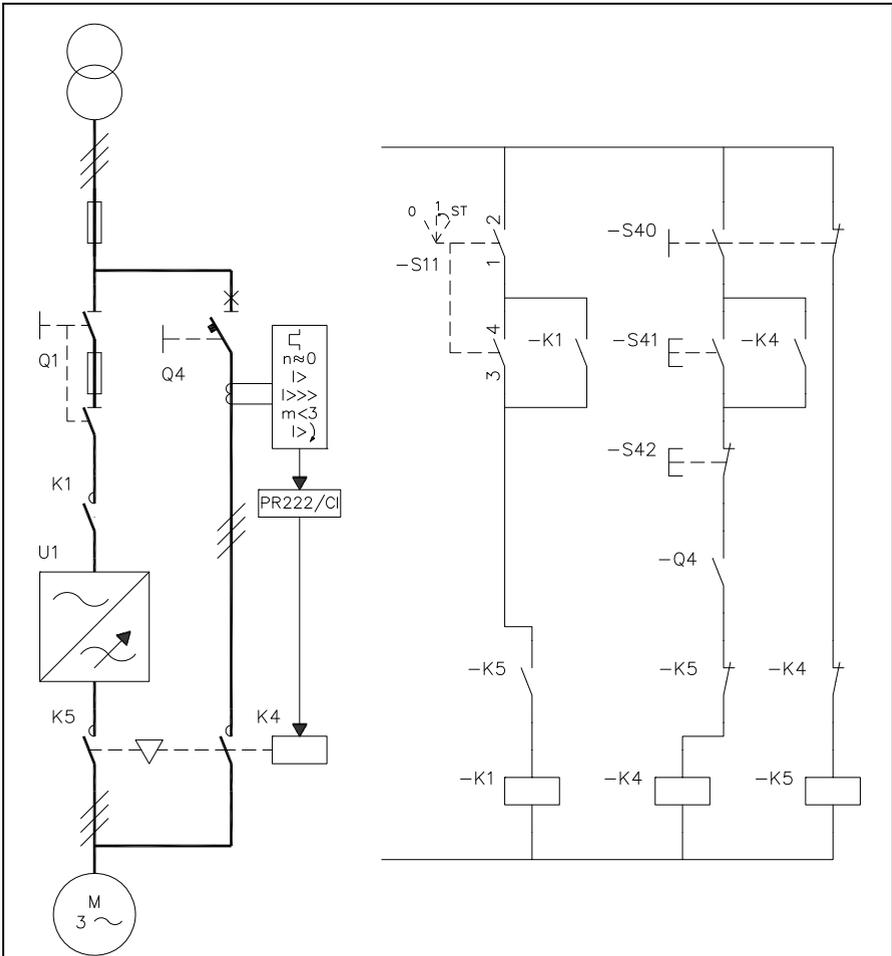
Implementing a bypass connection

If the drive needs to be bypassed frequently, use mechanically or electrically interlocked contactors between the motor and the drive and between the motor and the power line. Make sure with interlocking that the contactors cannot be closed simultaneously. See the example below.



WARNING! Do not connect the drive output to the electrical power network. This can cause damage to the drive.

■ Example of a bypass connection



Q1	Drive main switch	S11	Drive main contactor on/off control
Q4	Bypass circuit breaker	S40	Motor power supply selection (drive or direct-on-line)
K1	Drive main contactor	S41	Start when motor is connected direct-on-line
K4	Bypass contactor	S42	Stop when motor is connected direct-on-line
K5	Drive output contactor		

■ **Changing the motor power supply from the drive to direct-on-line**

1. Stop the drive and the motor with the drive control panel (drive in local control mode) or with the external stop signal (drive in remote control mode).
2. Open the main contactor of the drive with S11.
3. Change the motor power supply from the drive to direct-on-line with S40.
4. Wait for 10 seconds to allow the motor magnetization to decrease.
5. Start the motor with S41.

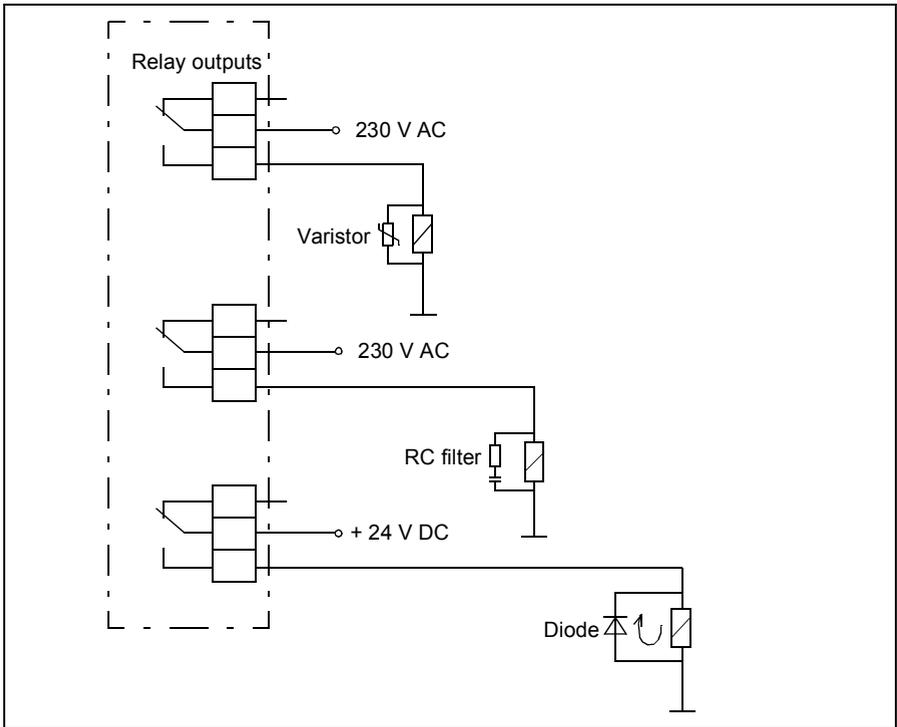
■ **Changing the motor power supply from direct-on-line to the drive**

1. Stop the motor with S42.
 2. Change the motor power supply from direct-on-line to the drive with S40.
 3. Close the main contactor of the drive with switch S11 (-> turn to position ST for two seconds and leave in position 1).
 4. Start the drive and the motor with the drive control panel (drive in local control mode) or with the external start signal (drive in remote control mode).
-

Protecting the contacts of relay outputs

Inductive loads (relays, contactors, motors) cause voltage transients when switched off. The voltage transients can connect capacitively or inductively to other conductors and cause a malfunction in the system. To protect the contacts of relay outputs,

- Use a noise attenuating circuit (varistors, RC filters [AC] or diodes [DC]) which minimizes the EMC emission of inductive loads at switch-off.
- Install the noise attenuating circuit as close as possible to the inductive load.
- Do not install a noise attenuating circuit at the relay output.





Electrical installation

Contents of this chapter

The chapter describes the electrical installation procedure of the drive.



WARNING! Only qualified electricians are allowed to do the work described in this chapter. Follow the [Safety instructions](#) on page 13. If you ignore them, injury or death, or damage to the equipment can occur.

Make sure that the drive is disconnected from the input power during installation. If the drive is already connected to the input power, wait for 5 minutes after disconnecting the input power.



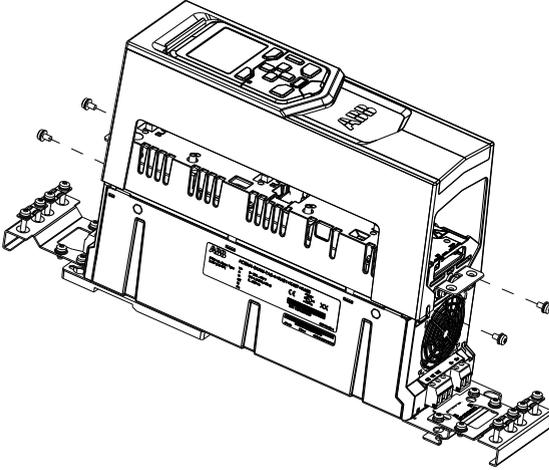
WARNING! Installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation that breaches the local laws and/or other regulations.

If recommendations given by ABB are not followed, the drive system may experience problems that the warranty does not cover.

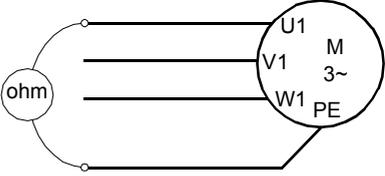
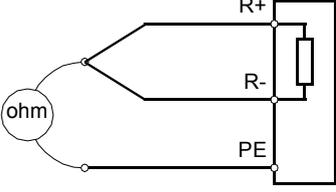


Removing the cover assembly

Remove the cover assembly from the ZCU control unit, before installing the option modules or before connecting the control cables. See also the module layout diagram on page [31](#).



Checking the insulation of the assembly

<p>Drives</p>	<input checked="" type="checkbox"/>
<p> Do not make any voltage tolerance or insulation resistance tests on any part of the drive as testing can damage the drive.</p> <p>Every drive has been tested for insulation between the main circuit and the chassis at the factory. There are also, voltage-limiting circuits inside the drive which cuts down the testing voltage automatically.</p>	<input type="checkbox"/>
<p>Input power cable</p>	
<p>Check the insulation of the input cable according to local regulations before connecting it to the drive.</p>	<input type="checkbox"/>
<p>Motor and motor cable insulation</p>	
<p>Check that the motor cable is disconnected from the drive output terminals T1/U, T2/V and T3/W.</p>	<input type="checkbox"/>
<p>Measure the insulation resistance between the phase conductors and between each phase conductor and the Protective Earth conductor. Use a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, please consult the manufacturer's instructions.</p> <p>Note: Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.</p> 	<input type="checkbox"/>
<p>Break resistor assembly insulation</p>	
<p>Check that the resistor cable is connected to the resistor, and disconnected from the drive output terminals R+ and R-.</p>	<input type="checkbox"/>
<p>At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm..</p> 	<input type="checkbox"/>



Checking the compatibility with IT (ungrounded) and corner-grounded TN systems

The internal EMC filter is not suitable for use on an IT (ungrounded) system or on a corner-grounded TN system. Disconnect the EMC filter before connecting the drive to the supply network. For instructions on how to do this, see page [76](#).



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

Do not install the drive with the internal EMC filter connected on a corner-grounded TN system, otherwise the drive will be damaged.

Note: When the internal EMC filter is disconnected, the drive EMC compatibility is considerably reduced. See section [Compliance with the European EMC Directive](#) on page [134](#).

■ Disconnecting the internal EMC filter – all frame sizes

To disconnect the internal varistors and EMC filter (option +E200), in an IT (ungrounded) or corner-grounded TN system, do as follows:

1. Switch off the power from the drive.
2. Remove the following screws:
 - VAR (frames R1 and R2, located close to the supply terminals)
 - EMC, VAR1 and VAR2 (frames R3 and R4, located on the front of the power unit).



Connecting the power cables

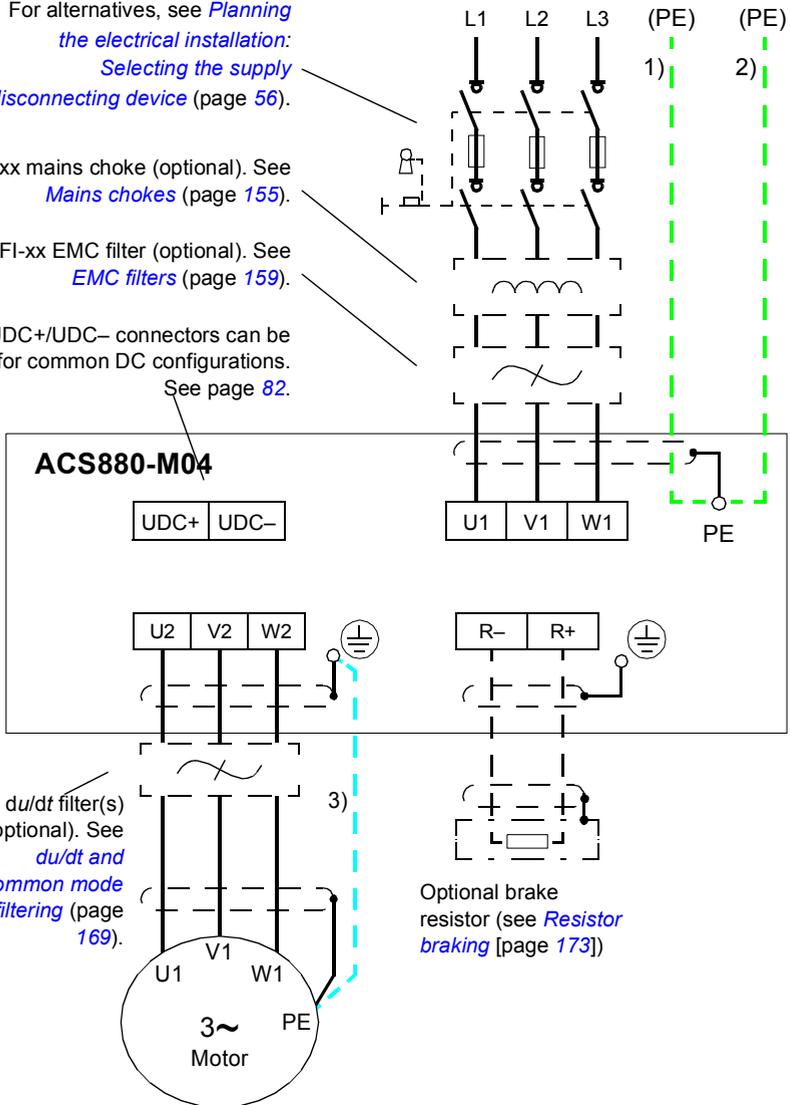
Power cable connection diagram

For alternatives, see [Planning the electrical installation: Selecting the supply disconnecting device](#) (page 56).

CHK-xx mains choke (optional). See [Mains chokes](#) (page 155).

JFI-xx EMC filter (optional). See [EMC filters](#) (page 159).

The UDC+/UDC- connectors can be used for common DC configurations. See page 82.



Notes:

- If shielded supply (input) cable is used, and the conductivity of the shield is not sufficient (see [Motor cable shield](#) on page 60), 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 not sufficient (see [Motor cable shield](#) on page 60) and the cable has no symmetrical ground conductors.



■ Power cable connection procedure

See cabling drawing with tightening torques for all frame sizes on page [81](#).



WARNING! Follow all [Safety instructions](#) on page [13](#). If you ignore them, injury or death, or damage to the equipment can occur.

1. Frame sizes R3 and R4 only: Remove the two plastic connector covers at the top and bottom of the drive. Each cover is fastened with two screws.
2. On IT (ungrounded) systems and corner grounded TN systems, remove the following screws to disconnect the internal varistors and EMC filters (option +E200):
 - VAR (frames R1 and R2, located close to the supply terminals)
 - EMC, VAR1 and VAR2 (frames R3 and R4, located on the front of the power unit).



WARNING! If a drive whose varistors/filters are not disconnected is installed on an IT system (an ungrounded power system or a high resistance grounded [over 30 ohms] power system), the system is connected to ground potential through the varistors/filters of the drive. This may cause danger or damage to the drive. If a drive whose varistors/filters are not disconnected is installed on a corner grounded TN system, the drive will be damaged.

3. Fasten the two cable clamp plates included to the drive (see page [80](#)), one at the top, one at the bottom. The clamp plates are identical. Using the cable clamp plates as shown below will provide better EMC compliance, as well as act as a strain relief for the power cables.
 4. Strip the power cables so that the shields are bare at the cable clamps.
 5. Twist the ends of the cable shield wires into pigtails.
 6. Strip the ends of the phase conductors.
 7. Connect the following:
 - phase conductors of the supply cable to U1, V1 and W1 terminals of the drive.
 - phase conductors of the motor cable to U2, V2 and W2 terminals.
 - conductors of the resistor cable (if present) to R+ and R– terminals.

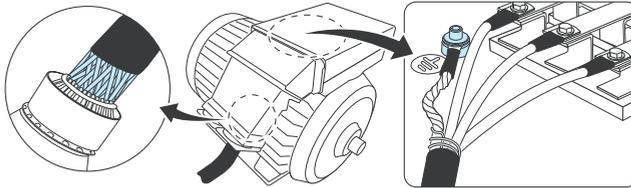
With frame size R3 or R4: attach the screw terminal lugs included to the conductors first. Crimp lugs can be used instead of screw lugs.
 8. Tighten the cable clamps onto the bare cable shields.
-



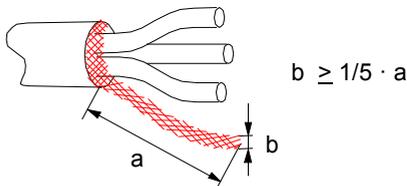
9. Crimp a cable lug onto each shield pigtail. Fasten the lugs to ground terminals.
Note: Try to work out a compromise between the length of the pigtail and the length of unshielded phase conductors as both should ideally be as short as possible.
10. Cover visible bare shield and pigtail with insulating tape.
11. With frame size R3 or R4, cut suitable slots on the edges of the connector covers to accommodate the supply and motor cables. Install the covers again. (Tighten the screws to 3 N·m [25 lbf·in]).
12. Secure the cables outside the unit mechanically.
13. Ground the other end of the supply cable shield or PE conductor(s) at the distribution board. In case a mains choke and/or an EMC filter (option +E200) is installed, make sure the PE conductor is continuous from the distribution board to 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



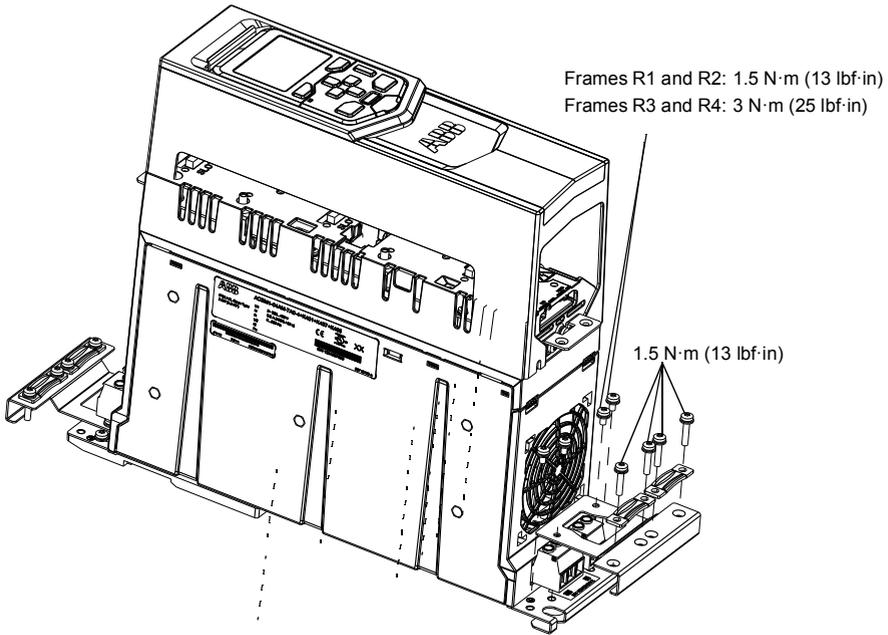
or ground the cable by twisting the shield so that the flattened shield is wider than 1/5 of its length.



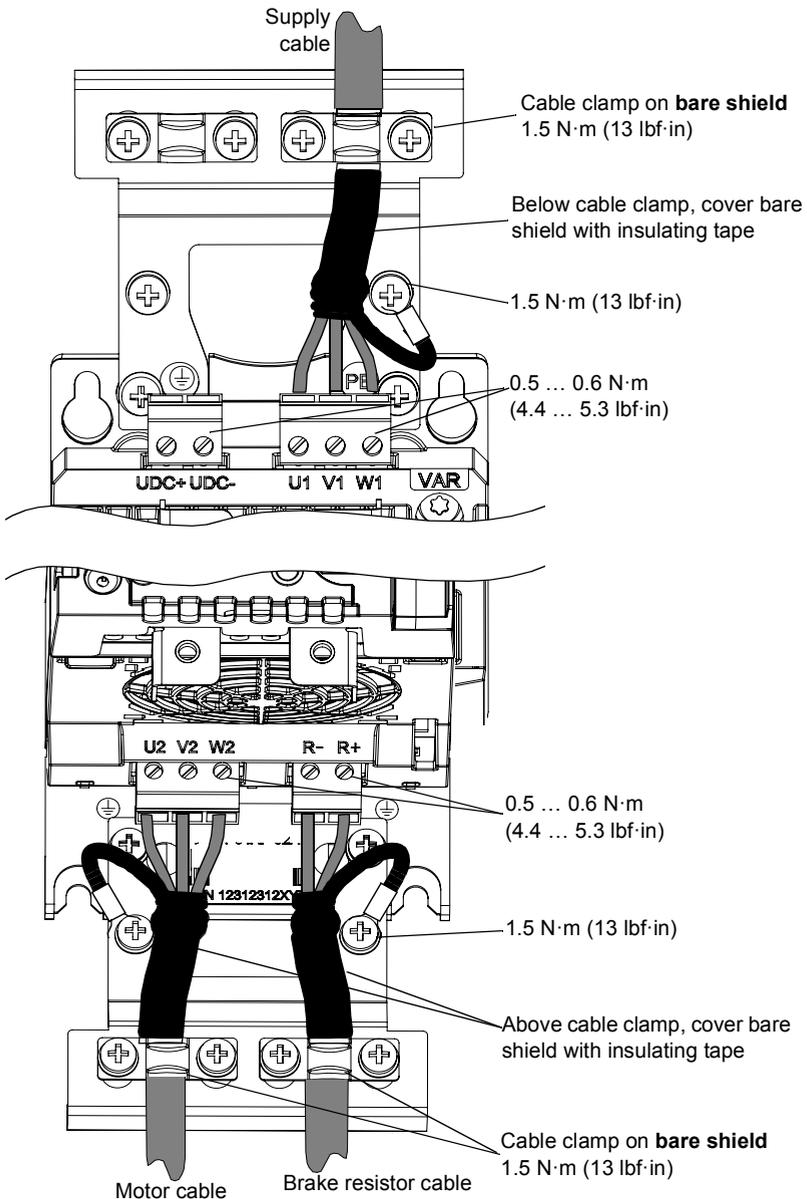
■ Installing the power cable clamp plates

Two identical power cable clamp plates are included with the drive. The picture below depicts a frame size R1 drive; the installation is similar with other frame sizes.

Note: Support the cables adequately within the installation enclosure, especially if not using the cable clamps.



■ Power cable connections

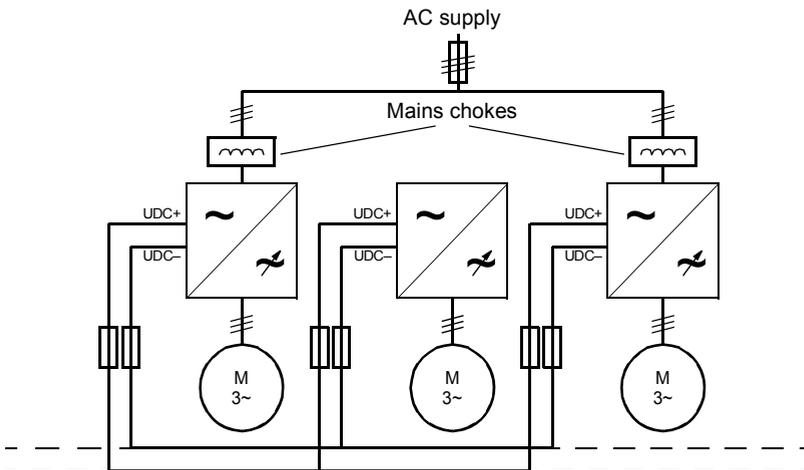
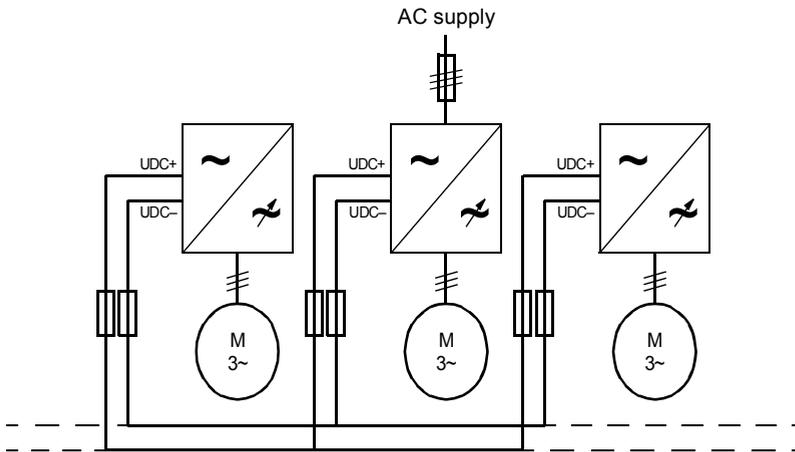


For details of terminal wire size capacity, see [Terminal and lead-through data for power cables](#) on page 116 .

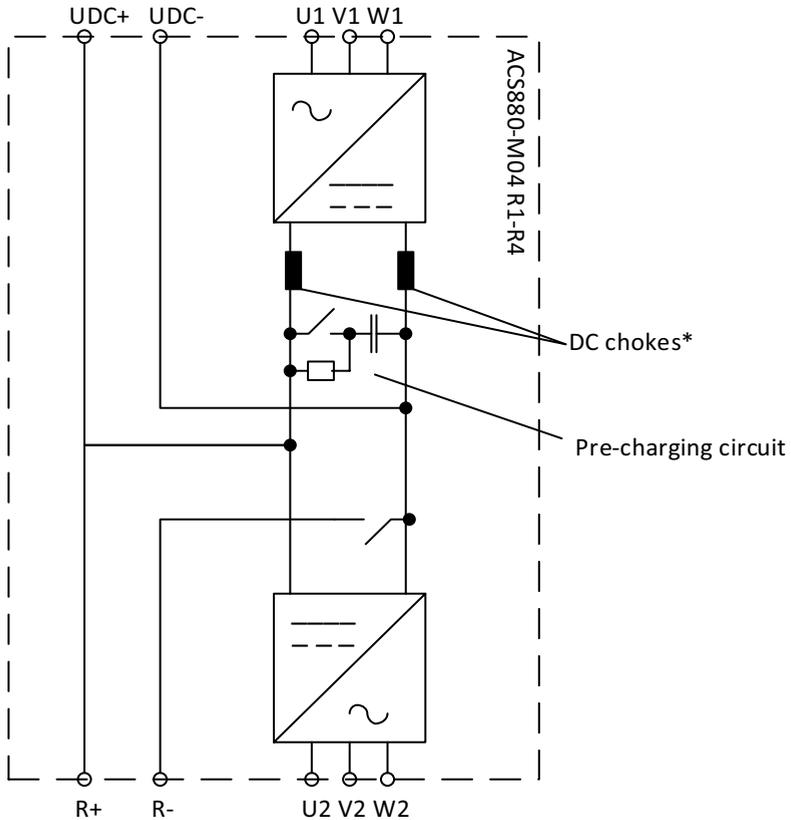
DC connection

The UDC+ and UDC– terminals are intended for common DC configurations of a number of ACS880-M04 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 R1-R2 frames are connected to the AC supply, each AC connection must be equipped with a mains choke to ensure even current distribution between the rectifiers. The diagram below shows two configuration examples.



Each drive has an independent DC capacitor pre-charging circuit.



* only for frames R3 and R4.

See [DC connection](#) ratings on page [123](#).

For more information on common DC configurations, see *ACS880-01 drives and ACS880-04 drive modules Common DC systems Application guide* (3AUA0000127818 [English]).



Installing the optional modules

Optional modules such as fieldbus adapters, I/O extensions and encoder interfaces ordered using option codes (see [Type designation key](#) on page 36) are pre-installed at the factory. Instructions for installing additional modules into the slots on the ZCU control unit (see page 34 for the available slots) are presented below.

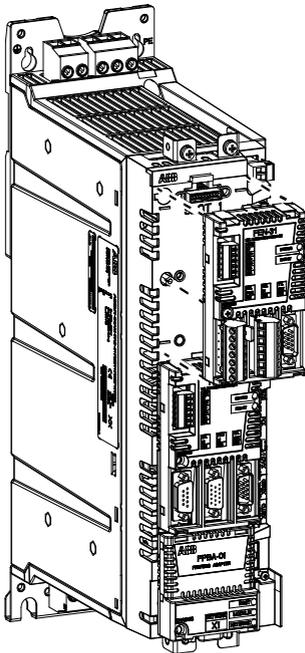
To install the optional modules, proceed as follows:

1. Remove the cover assembly from the ZCU control unit. See [Removing the cover assembly](#) on page 74.
2. Remove the protective cover (if present) from the connector of the slot.
3. Insert the module carefully into its position on the drive.
4. Fasten the screw.

Note: Fix the screws correctly for fulfilling the EMC requirements and for proper operation of the module.

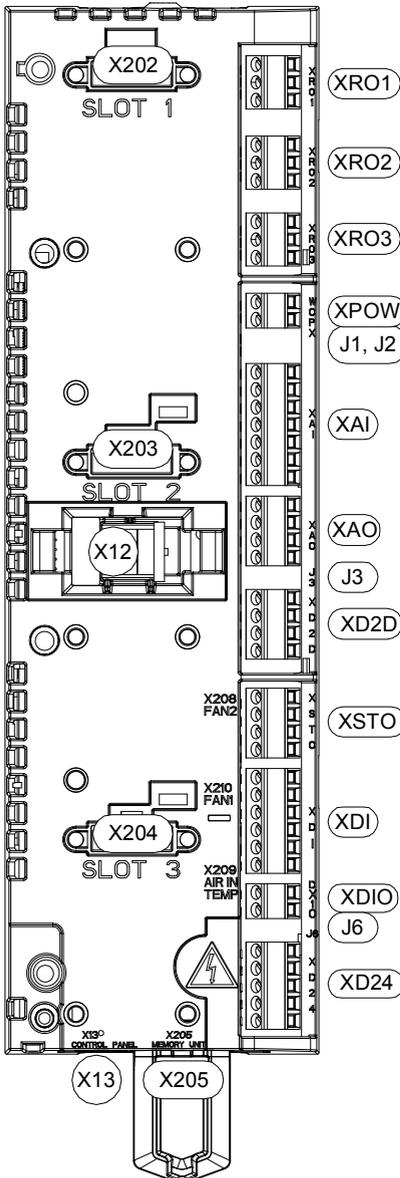
5. Install the cover assembly again after any specific installation and wiring of the module is complete.

See [Ground isolation diagram \(ZCU\)](#) on page 94 and the appropriate option manual for specific installation and wiring instructions.



Connecting the control unit

ZCU-14 layout and connections



Connections	Description
XPOW	External power input
XAI	Analog inputs
XAO	Analog outputs
XD2D	Drive to drive link
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XPOW J1, J2	Start interlock connection (DIIL) and +24 V output
XDIO	Digital input/outputs
XDI	Digital inputs
XSTO	Safe torque off connection
X12	Connector for FSO-xx safety functions module (optional)
X13	Control panel connection
X202	Option slot 1
X203	Option slot 2
X204	Option slot 3
X205	Memory unit connection (memory unit inserted in the drawing)
J1, J2	Voltage/Current selection jumpers (J1, J2) for analog inputs
J3	Drive-to-drive link termination jumper (J3)
J6	Common digital input ground selection jumper (J6). See the Ground isolation diagram (ZCU) (page 94).
XD24	



Control connections to the ZCU control unit

Relay outputs		XRO1...XRO3	
Ready 250 V AC / 30 V DC 2 A		NO	13
		COM	12
		NC	11
Running 250 V AC / 30 V DC 2 A		NO	23
		COM	22
		NC	21
Faulted(-1) 250 V AC / 30 V DC 2 A		NO	33
		COM	32
		NC	31
External power input		XPOW	
24 V DC, 2 A min. (without optional modules)		GND	2
		+24VI	1
Reference voltage and analog inputs		J1, J2, XAI	
AI1/AI2 current/voltage selection		AI1: U	AI2: U
By default not in use.		AI1: I	AI2: I
0(4)...20 mA, $R_{in} = 100 \text{ ohm}$ ¹⁾		AI2-	7
		AI2+	6
Speed reference		AI1-	5
0(2)...10 V, $R_{in} > 200 \text{ kohm}$ ²⁾		AI1+	4
Ground		AGND	3
-10 V DC, $R_L 1...10 \text{ kohm}$		-VREF	2
10 V DC, $R_L 1...10 \text{ kohm}$		+VREF	1
Analog outputs		XAO	
Motor current 0...20 mA, $R_L < 500 \text{ ohm}$		AGND	4
		AO2	3
Motor speed rpm 0...20 mA, $R_L < 500 \text{ ohm}$		AGND	2
		AO1	1
Drive-to-drive link		XD2D	
		Shield	4
		BGND	3
		A	2
		B	1
Drive-to-drive link termination ³⁾		J3	
Safe torque off		XSTO	
Safe torque off. Both circuits must be closed for the drive to start. ⁴⁾		IN2	4
		IN1	3
		SGND	2
		OUT	1
Digital inputs		XDI	
By default not in use.		DI6	6
Constant speed 1 select (1 = on) ⁵⁾		DI5	5
Acceleration & deceleration select ⁶⁾		DI4	4
Reset		DI3	3
Forward (0) / Reverse (1)		DI2	2
Stop (0) / Start (1)		DI1	1
Digital input/outputs		XDIO	
Output: Running		DIO2	2
Output: Ready		DIO1	1
Ground selection ⁷⁾		J6	
Auxiliary voltage output, digital interlock ⁸⁾		XD24	
Digital input/output ground		DIOGND	5
+24 V DC 200 mA ⁹⁾		+24VD	4
Digital input ground		DICOM	3
+24 V DC 200 mA ⁹⁾		+24VD	2
Run enable ⁸⁾		DILL	1
Safety functions module connection		X12	
Control panel connection		X13	
Memory unit connection		X205	

Note: The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 ... 2.5 mm² (24...12 AWG). The torque is 0.5 N·m (5 lbf·in).

- 1) Current [0(4)...20 mA, $R_{in} = 100 \text{ ohm}$] or voltage [0(2)...10 V, $R_{in} > 200 \text{ kohm}$] input selected by jumper **J2**.
Note: Changing the setting requires reboot of control unit.
- 2) Current [0(4)...20 mA, $R_{in} = 100 \text{ ohm}$] or voltage [0(2)...10 V, $R_{in} > 200 \text{ kohm}$] input selected by jumper **J1**.
Note: Changing the setting requires reboot of control unit
- 3) See section [Drive-to-drive link](#) (page 90).
- 4) See chapter [The Safe torque off function](#) (page 141).
- 5) Constant speed 1 is defined by parameter 22.26.
- 6) 0 = Acceleration/deceleration ramps defined by parameters 23.12/23.13 in use.
1 = Acceleration/deceleration ramps defined by parameters 23.14/23.15 in use.
- 7) Jumper/switch J6. Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats; in practice, selects whether the digital inputs are used in current sinking or sourcing mode). See [Ground isolation diagram \(ZCU\)](#) (page 94).
- 8) See section [DILL input](#) (page 89)
- 9) Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.

■ External power supply for the control unit (XPOW)

By default, the ZCU control unit is powered from the power module. An external 24 V DC, 2 A power supply for the control unit can be connected to terminal block XPOW.

It is recommended to use an external supply if

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

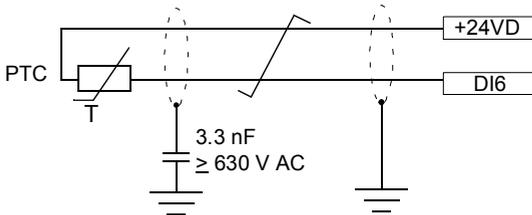
See also description of parameter *95.04 Control board supply* in the firmware manual.



■ DI6 as a PTC sensor input

A PTC sensor can be connected to digital input DI6 for motor temperature measurement. See the example connection diagram below.

- Alternatively, the sensor can be connected to FEN-xx encoder interface module.
- Do not connect both ends of the cable shield directly to ground.
- If a capacitor cannot be used at one end, leave that end of the shield unconnected.
- See firmware manual for parameter settings.



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.

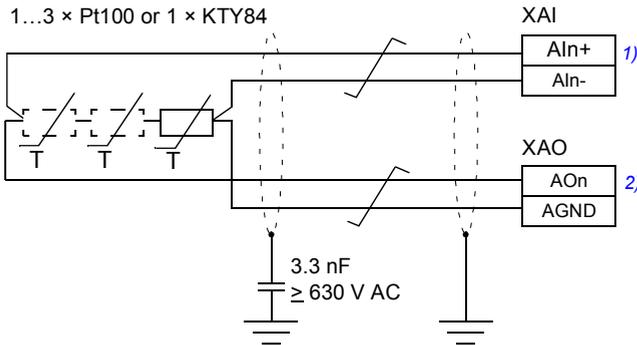
If the assembly does not fulfill the requirement, make sure of the following:

- the I/O board terminals is protected against contact
- the I/O board terminals is not be connected to other equipments
- the temperature sensor is isolated from the I/O terminals.



AI1 or AI2 as a Pt100 or KTY84 sensor input

Three Pt100 sensors or one KTY84 sensor for motor temperature measurement can be connected between an analog input and output as shown below. (Alternatively, you can connect the KTY to FEN-11 analog I/O extension module or FEN-xx encoder interface module.) 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.



- 1) For AI1, set input type to voltage with switch/jumper J1 (ZCU) or switch AI1 (BCU). For AI2, set input type with J2 (ZCU) or AI2 (BCU). Set the appropriate analog input unit to V (volt) in parameter group 12 *Standard AI*.
- 2) Select the excitation mode in parameter group 13 *Standard AO*.



WARNING! As the inputs pictured above are not insulated according to IEC 60664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor. If the assembly does not fulfill the requirement, the I/O board terminals must be protected against contact and must not be connected to other equipment or the temperature sensor must be isolated from the I/O terminals.



DIIL input

The DIIL input can be used for the connection of safety circuits. By default, the input is parametrized to stop the unit when the input signal is lost.

■ Drive-to-drive link

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. Enable bus termination on the drives at the ends of the drive-to-drive link. On intermediate drives, disable bus termination.

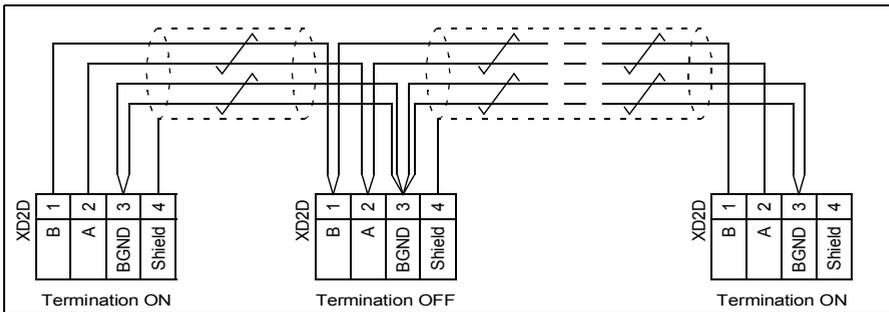
The settings for each type of control unit are:

Control unit type	Switch/jumper designation	Settings
ZCU-14 (frame sizes R1...R4)	J3	<input type="checkbox"/> • Termination enabled
		<input checked="" type="checkbox"/> • Termination disabled

Cables for drive-to-drive connection

- Use shielded twisted-pair cable (~100 ohm, for example, PROFIBUS-compatible cable) for the wiring. For best immunity, high quality cable is recommended.
- Keep the cable as short as possible. The maximum length of the link is 50 meters (164 ft).
- Avoid unnecessary loops and running the cable near power cables (such as motor cables).
- Ground the cable shields as described in section [Connecting the control cables – all frame sizes](#) on page 96.

Example wiring diagram of drive-to-drive link



■ Safe torque off

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

For information on the implementation of Safe torque off function, see chapter [The Safe torque off function](#) (page 141).

■ Safety functions (X12)

See the connections to the safety functions module on page 85 and *FSO-12 user's manual* (3AXD50000015612 [English])

■ Control unit connector data

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



Digital inputs/outputs

**DIO1 and DIO2
(XDIO:1 and XDIO:2)**

Input/output mode selection by parameters.

DIO1 can be configured as a frequency input (0...16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used).

DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual, parameter group 11.

Connector pitch 5 mm, wire size 2.5 mm²

As inputs:

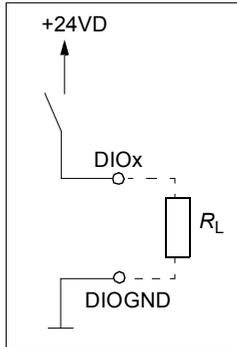
24 V logic levels: "0" < 5 V, "1" > 15 V

R_{in} : 2.0 kohm

Filtering: 0.25 ms (ZCU)

As outputs:

Total output current from +24VD is limited to 200 mA



Reference voltage for analog inputs +VREF and -VREF

(XAI:1 and XAI:2)

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

Current/voltage input mode selection by jumpers/switches.

Connector pitch 5 mm, wire size 2.5 mm²

10 V ±1% and -10 V ±1%, R_{load} 1...10 kohm

Connector pitch 5 mm, wire size 2.5 mm²

Current input: -20...20 mA, R_{in} = 100 ohm

Voltage input: -10...10 V, R_{in} > 200 kohm

Differential inputs, common mode range ±30 V

Sampling interval per channel: 0.25 ms

Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms

Resolution: 11 bit + sign bit

Inaccuracy: 1% of full scale range

Analog outputs AO1 and AO2 (XAO)

Connector pitch 5 mm, wire size 2.5 mm²

0...20 mA, R_{load} < 500 ohm

Frequency range: 0...300 Hz (ZCU)

Resolution: 11 bit + sign bit

Inaccuracy: 2% of full scale range

Drive-to-drive link (XD2D)

Connector pitch 5 mm, wire size 2.5 mm²

Physical layer: RS-485

Termination by switch or jumper

Safe torque off connection (XSTO)

Connector pitch 5 mm, wire size 2.5 mm²

Input voltage range: -3...30 V DC

Logic levels: "0" < 5 V, "1" > 17 V

For the drive to start, both connections must be "1"

Current consumption: 66 mA (continuous) per STO channel per drive module

EMC (immunity) according to IEC 61326-3-1



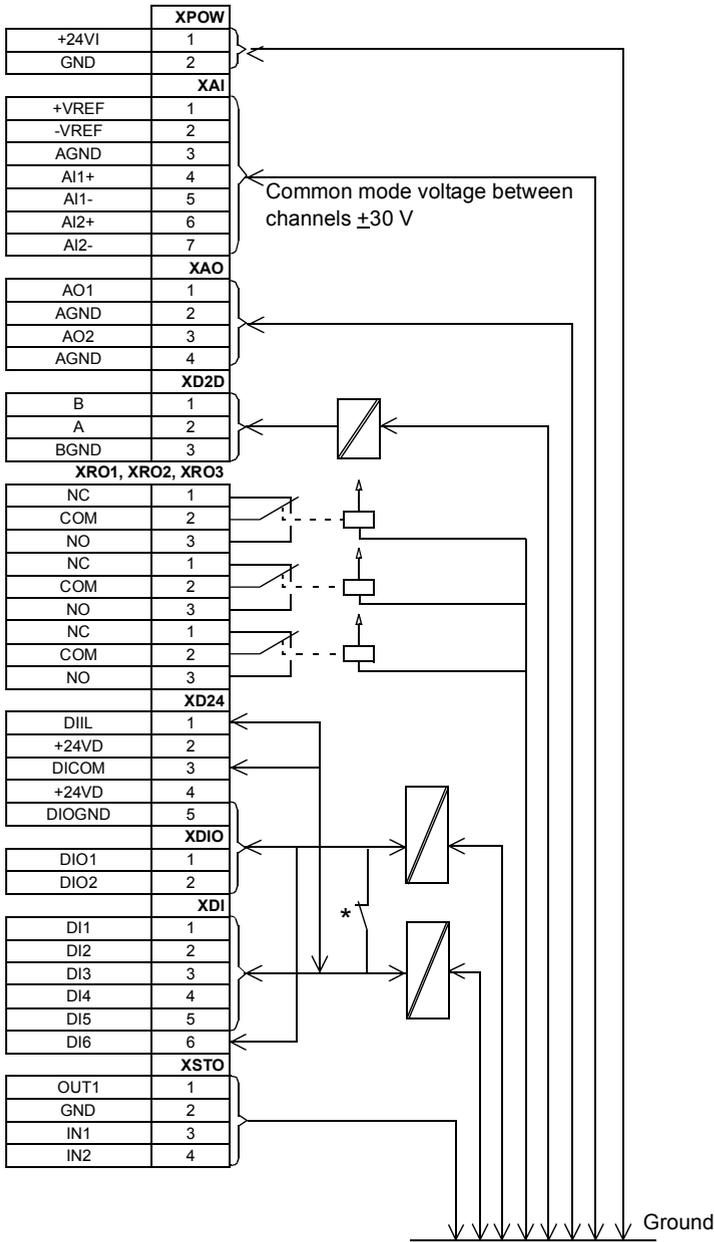
**Control panel
connection (X13)**

Connector: RJ-45
Cable length < 3 m

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



Ground isolation diagram (ZCU)



***Ground selector (J6) settings**

• •

All digital inputs share a common ground (DICOM connected to DIOGND). This is the default setting.

• •

Ground of digital inputs DI1...DI5 and DIIL (DICOM) is isolated from DIO signal ground (DIOGND). Isolation voltage 50 V.

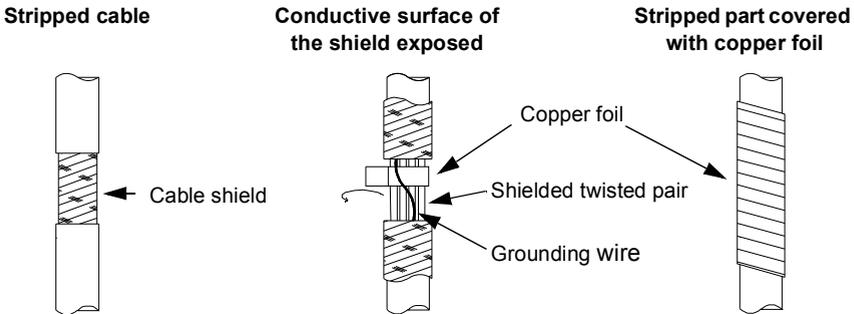


Connecting the control cables – all frame sizes

For technical data and default I/O connections of the drive control unit, refer to [Control connections to the ZCU control unit](#) (page 86).

1. In the cabinet, remove shrouding wherever necessary to allow access to the cable entries and any trunking inside the cubicle.
2. Run the control cables into the cubicle. If possible, arrange for a 360° grounding of the cable shield at the cable entry.

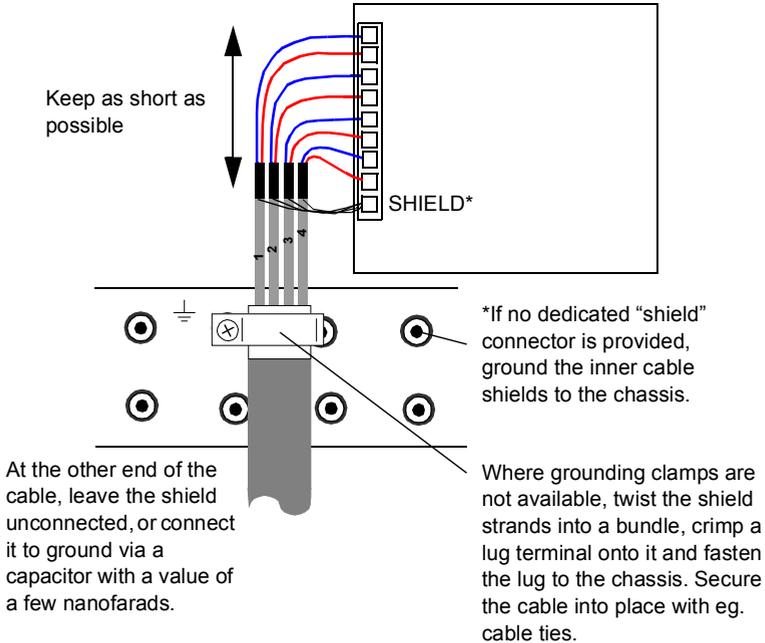
If the outer surface of the shield is non-conductive, turn the shield inside out as shown below and wrap copper foil around the cable to keep the shielding continuous. Do not cut the grounding wire (if present).



3. Run the cables to the control unit of the drive (or other connection point) using cable trunking wherever possible.
4. (Only when running the cable to the drive module) The drive control units have a clamp plate attached. Remove the outer sheathing of the cable at one of the clamps on the plate. Tighten the clamp onto the bare cable shield.
5. Cut the cables to suitable length.



- Strip the cable ends and conductors. When connecting to the drive I/O, also remove the shield along with the outer sheathing, and use electrical tape or shrink tubing to contain the strands. Elsewhere, twist the outer shield strands into a bundle, crimp a lug onto it and connect it to the nearest chassis grounding point.



- Connect the conductors to appropriate terminals (refer to chapter [Control connections to the ZCU control unit](#)).
- Refit any shrouds removed earlier.







Installation checklist

Contents of this chapter

This chapter contains a list for checking the mechanical and electrical installation of the drive module.

Checklist

Check the mechanical and electrical installation of the drive module 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 that...	<input checked="" type="checkbox"/>
MECHANICAL INSTALLATION	
The ambient operating conditions are allowable. (See Mechanical installation, Technical data: Ratings, Ambient conditions.)	<input type="checkbox"/>
The unit is fastened properly to the cabinet. (See Planning the cabinet installation and Mechanical installation.)	<input type="checkbox"/>
The cooling air will flow freely.	<input type="checkbox"/>
The motor and the driven equipment are ready for start. (See Planning the electrical installation, Technical data: Motor connection.)	<input type="checkbox"/>
ELECTRICAL INSTALLATION (See Planning the electrical installation, Electrical installation.)	
The VAR (frames R1 and R2) and EMC/VAR1/VAR2 (frames R3 and R4) screws are removed if the drive is connected to an IT (ungrounded) or a corner grounded TN supply network.	<input type="checkbox"/>
The capacitors are reformed if stored over one year (contact local ABB representative for more information).	<input type="checkbox"/>
The drive is grounded properly.	<input type="checkbox"/>
The supply (input power) voltage matches the drive nominal input voltage.	<input type="checkbox"/>

100 Installation checklist

Check that...	<input checked="" type="checkbox"/>
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.	<input type="checkbox"/>
Appropriate supply (input power) fuses and disconnectors are installed.	<input type="checkbox"/>
The motor is connected to U2/V2/W2, and the terminals are tightened to the specified torque.	<input type="checkbox"/>
The brake resistor (if present) is connected to R+/R-, and the terminals are tightened to specified torque.	<input type="checkbox"/>
The motor cable (and brake resistor cable, if present) is routed away from other cables.	<input type="checkbox"/>
There are no power factor compensation capacitors in the motor cable.	<input type="checkbox"/>
The external control connections to the ZCU control unit are OK.	<input type="checkbox"/>
There are no tools, foreign objects or dust from drilling inside the drive.	<input type="checkbox"/>
The supply (input power) voltage cannot be applied to the output of the drive through a bypass connection.	<input type="checkbox"/>
Motor connection box and other covers are in place.	<input type="checkbox"/>

9

Start-up

Contents of this chapter

This chapter refers to the start-up instructions of the cabinet-installed drive.

Start-up procedure

1. Make sure the installation of the drive is according to the [Installation checklist](#) on page [99](#).
2. Check that the motor and driven equipment are ready for start.
3. Perform the start-up tasks instructed by the cabinet-installer of the drive module.
4. Switch On the power.
5. Set-up the drive control program according to the start-up instructions in the *Firmware manual*.
6. Validate the Safe torque off function according to the [STO acceptance test procedure](#) on page [148](#).





10

Maintenance

Contents of this chapter

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.

You can also check on the Internet. Go to <http://www.abb.com/drivesservices>, select *Drive Services*, and *Maintenance and Field Services*.

Maintenance task/object	Interval	Instruction
DC capacitor reforming	Every year of storage	See <i>Reforming the capacitors</i> on page 107.
Heatsink temperature check and cleaning	Every 6 to 12 months depending on the dustiness of the environment	See <i>Heatsink</i> on page 104.
Inspection of tightness of power connections	Every year	See <i>Power cable connections</i> on page 81.
Visual inspection of cooling fan		See <i>Cooling fan</i> on page 105.



Maintenance task/object	Interval	Instruction
Cooling fan replacement	Every 3 years if used in clean operating environment. Yearly inspection is highly recommended if used in dusty, corroded or ambient temperature is higher than 40 °C (104 °F).	See <i>Cooling fan</i> on page 105.
DC capacitor replacement	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 .	Contact your local ABB Service representative.
Control panel battery replacement	Every 3 years	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. If the heatsink is not clean, the drive runs into overtemperature warnings and faults. In a normal environment, the heatsink should be checked annually and in a dusty environment it should be checked 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 dust entering the 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, it is recommended to replace the immediately after these symptoms start appearing.

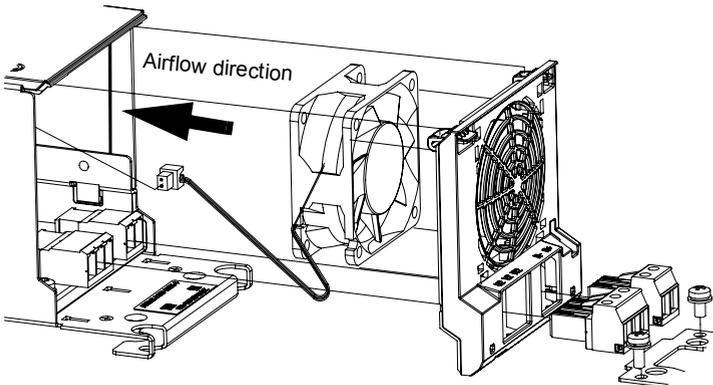
Note: Replacement fans are available from ABB. Do not use spare parts other than ABB-specified spare parts.

■ Replacing fan (Frames R1 and R2)

To replace the fan in frames R1 and R2, follow these steps:

1. Detach the power cable clamp plate and terminal blocks.
2. Release the retaining clips (arrowed) carefully using a screwdriver.
3. Pull the fan holder out.
4. Disconnect the fan cable.
5. Carefully bend the clips on the fan holder to free the fan.
6. Install the new fan in the reverse order.

Note: The airflow direction is bottom-to-top. Install the fan so that the airflow arrow points up.

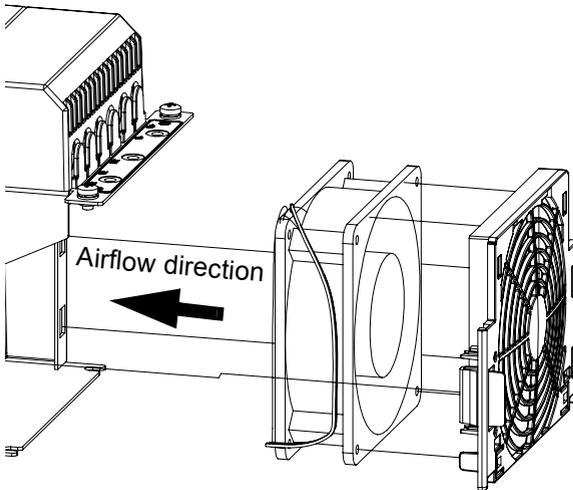


■ Replacing fan (Frames R3 and R4)

To replace the fan in frames R3 and R4, follow these steps:

1. Remove the fan by releasing the retaining clip (arrowed) carefully using a screwdriver.
2. Pull the fan holder out.
3. Disconnect the fan cable.
4. Carefully bend the clips on the fan holder to free the fan.
5. Install the new fan in the reverse order.

Note: The airflow direction is bottom-to-top. Install the fan so that the airflow arrow points up.



Reforming the capacitors

The capacitors must be reformed if the drive has been stored for a year or more. See manufacturing date on the [Type designation label](#) (see page 35).

For information on reforming the capacitors, see *Converter module capacitor reforming instructions* (3BFE64059629 [English]).

Memory unit

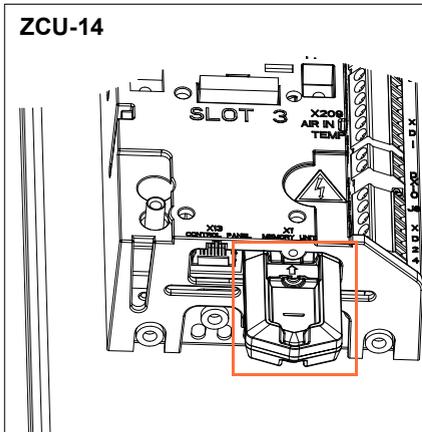
After replacing an inverter control unit, the existing parameter settings can be retained by transferring the memory unit from the defective unit to the new unit.



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

To remove the memory unit,

1. Undo the fastening screw.
2. Pull out the memory unit.



After power-up, the drive scans the memory unit. If a different control program or different parameter settings are detected, they are copied to the drive. This takes about 10 to 30 seconds.

Note: Drive does not respond while copying is in progress.





11

Technical data

Contents of this chapter

This chapter contains the following technical specifications of the drive:

Specifications	See page...
<i>Ratings</i>	110...112.
<i>Derating</i>	113
<i>Dimensions and weights</i>	116
<i>Losses, cooling data and noise</i>	117
<i>Supply cable fuses</i>	118
<i>Screwdrivers for the terminals of main circuit</i>	116
<i>Supply cable fuses</i>	119...121
<i>AC input (supply) connection</i>	122
<i>DC connection</i>	123
<i>Motor connection</i>	124
<i>ZCU control unit</i>	125
<i>Ground isolation diagram (ZCU)</i>	128
<i>Efficiency, Cooling, Protection classes, Ambient conditions</i>	129
<i>Materials</i>	132
<i>Applicable standards</i>	133
<i>CE marking, UL marking, RCM marking</i>	134, 138
<i>Compliance with the EN 61800-3:2004</i>	135



Ratings

Nominal ratings with 230 V AC supply

Drive type ACS880-M04	Frame size	Input ratings		Output ratings									
				Nominal		No-overload use		Light-overload use			Heavy-duty use		
		I_{1N} A	$*I_{1N}$ A	I_{2N} A	I_{Max} A	P_N		I_{Ld} A	P_{Ld} kW	P_{Ld} hp	I_{Hd} A	P_{Hd} kW	P_{Hd} hp
-03A0-2	R1	2.1	3.5	3.0	4.4	0.37	0.5	2.8	0.37	0.5	2.5	0.37	0.5
-03A6-2	R1	2.9	5.2	3.6	5.3	0.55	0.75	3.4	0.55	0.75	3.0	0.37	0.5
-04A8-2	R1	3.7	6.3	4.8	7.0	0.75	1	4.5	0.75	1	4.0	0.55	0.75
-06A0-2	R1	5.2	8.9	6.0	8.8	1.1	1.5	5.5	1.1	1.5	5.0	0.75	1
-08A0-2	R1	6.3	10.7	8.0	10.5	1.5	2	7.6	1.5	2	6.0	1.1	1.5
-010A-2	R2	8.3	13	10.5	13.5	2.2	3	9.7	2.2	3	9.0	1.5	2
-014A-2	R2	11	17	14	16.5	3	3	13.0	3	3	11.0	2.2	3
-018A-2	R2	15	21	18	21	4	5	16.8	4	5	14.0	3	3
-025A-2	R3	19	–	25	33	5.5	7.5	23	5.5	7.5	19.0	4	5
-030A-2	R3	26	–	30	36	7.5	10	28	7.5	10	24	5.5	7.5
-035A-2	R3	30	–	35	44	7.5	10	32	7.5	10	29	7.5	10
-044A-2	R3	35	–	44	53	11	15	41	11	15	35	7.5	10
-050A-2	R3	42	–	50	66	11	15	46	11	15	44	11	15
-061A-2	R4	54	–	61	78	15	20	57	15	20	52	11	15
-078A-2	R4	64	–	78	100	18.5	25	74	18.5	25	69	15	20
-094A-2	R4	81	–	94	124	22	30	90	22	30	75	18.5	25

3AXD10000434191

See symbol definitions on page 112.

Nominal ratings with 400 V AC supply

Drive type ACS880-M04	Frame size	Input ratings		Output ratings							
				Nominal		No-overload use		Light-overload use		Heavy-duty use	
		I_{1N} A	$*I_{1N}$ A	I_{2N} A	I_{Max} A	P_N kW	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW
-03A0-5	R1	2.3	3.8	3.0	4.4	1.1	1.1	2.8	1.1	2.5	0.75
-03A6-5	R1	3.1	5.6	3.6	5.3	1.5	1.5	3.4	1.5	3.0	1.1
-04A8-5	R1	4.0	6.8	4.8	7.0	2.2	2.2	4.5	1.5	4.0	1.5
-06A0-5	R1	5.5	9.4	6.0	8.8	2.2	2.2	5.5	2.2	5.0	2.2
-08A0-5	R1	6.6	11.2	8.0	10.5	3.0	3.0	7.6	3.0	6.0	2.2
-010A-5	R2	8.7	13	10.5	13.5	4.0	4.0	9.7	4.0	9.0	4.0
-014A-5	R2	12	18	14	16.5	5.5	5.5	13.0	5.5	11.0	5.5
-018A-5	R2	16	23	18	21	7.5	7.5	16.8	7.5	14.0	7.5
-025A-5	R3	20	–	25	33	11.0	11.0	23	11	19.0	7.5
-030A-5	R3	26	–	30	36	15.0	15.0	28	15	24	11.0
-035A-5	R3	30	–	35	44	18.5	18.5	32	15	29	15.0
-044A-5	R3	36	–	44	53	22	22	41	22	35	18.5



Drive type ACS880-M04	Frame size	Input ratings		Output ratings						
				Nominal		No-overload use	Light-overload use		Heavy-duty use	
		I_{1N} A	$*I_{1N}$ A	I_{2N} A	I_{Max} A	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW
-050A-5	R3	42	—	50	66	22	46	22	44	22
-061A-5	R4	55	—	61	78	30	57	30	52	22
-078A-5	R4	65	—	78	104	37	74	37	66	37
-094A-5	R4	82	—	94	124	45	90	45	75	37

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See symbol definitions on page 112.

■ Nominal ratings with 460 V AC supply

Drive type ACS880-M04	Frame size	Input ratings		Output ratings						
				Nominal		No-overload use	Light-overload use		Heavy-duty use	
		I_{1N} A	$*I_{1N}$ A	I_{2N} A	I_{Max} A	P_N hp	I_{Ld} A	P_{Ld} hp	I_{Hd} A	P_{Hd} hp
-03A0-5	R1	2.3	3.8	3.0	4.4	1.5	2.8	1.0	2.5	1.0
-03A6-5	R1	3.1	5.6	3.6	5.3	2.0	3.4	2.0	3.0	1.5
-04A8-5	R1	4.0	6.8	4.8	7.0	3.0	4.5	2.0	4.0	2.0
-06A0-5	R1	5.5	9.4	6.0	8.8	3.0	5.5	3.0	5.0	3.0
-08A0-5	R1	6.6	11.2	8.0	10.5	5.0	7.6	5.0	6.0	3.0
-010A-5	R2	8.7	13	10.5	13.5	5.0	9.7	5.0	9.0	5.0
-014A-5	R2	12	18	14	16.5	7.5	13.0	7.5	11.0	7.5
-018A-5	R2	16	23	18	21	10	16.8	10	14.0	10
-025A-5	R3	20	—	25	33	15	23	15	19.0	10
-030A-5	R3	26	—	30	36	20	28	20	24	15
-035A-5	R3	30	—	35	44	25	32	20	29	20
-044A-5	R3	36	—	44	53	30	41	30	35	25
-050A-5	R3	42	—	50	66	30	46	30	44	30
-061A-5	R4	55	—	61	78	40	57	40	52	40
-078A-5	R4	65	—	78	104	50	74	50	66	50
-094A-5	R4	82	—	94	124	60	90	60	75	50

3AXD10000434191

See symbol definitions on page 112.



Nominal ratings with 500 V AC supply

Drive type ACS880-M04	Frame size	Input ratings		Output ratings							
				Nominal		No-overload use		Light- overload use		Heavy- duty use	
		I_{1N} A	$*I_{1N}$ A	I_{2N} A	I_{Max} A	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW	
-03A0-5	R1	2.3	3.8	3.0	4.4	1.5	2.8	1.1	2.5	1.1	
-03A6-5	R1	3.1	5.6	3.6	5.3	1.5	3.4	1.5	3.0	1.5	
-04A8-5	R1	4.0	6.8	4.8	7.0	2.2	4.5	2.2	4.0	2.2	
-06A0-5	R1	5.5	9.4	6.0	8.8	3.0	5.5	3.0	5.0	2.2	
-08A0-5	R1	6.6	11.2	8.0	10.5	4.0	7.6	4.0	6.0	3.0	
-010A-5	R2	8.7	13	10.5	13.5	5.5	9.7	5.5	9.0	4.0	
-014A-5	R2	12	18	14	16.5	7.5	13.0	7.5	11.0	5.5	
-018A-5	R2	16	23	18	21	11.0	16.8	7.5	14.0	7.5	
-025A-5	R3	20	—	25	33	15.0	23	11.0	19.0	11.0	
-030A-5	R3	26	—	30	36	18.5	28	15.0	24	15.0	
-035A-5	R3	30	—	35	44	22	32	18.5	29	18.5	
-044A-5	R3	36	—	44	53	30	41	22	35	22	
-050A-5	R3	42	—	50	66	30	46	30	44	30	
-061A-5	R4	55	—	61	78	37	57	37	52	30	
-078A-5	R4	65	—	78	104	45	74	45	66	45	
-094A-5	R4	82	—	94	124	55	90	55	75	45	

3AXD10000434191

See symbol definitions below.

Definitions

I_{1N}	Nominal input current (rms) at 40 °C (104 °F). *Without mains choke.
I_{2N}	Nominal output current.
I_{Max}	Maximum output current. Available for at least 10 seconds at start, otherwise as long as allowed by drive temperature.
P_N	Typical motor power for no-overload use.
I_{Ld}	Continuous rms output current. 10% overload is allowed for 1 minute every 5 minutes.
P_{Ld}	Typical motor power for light-overload use.
I_{Hd}	Continuous rms output current. 50% overload is allowed for 1 minute every 5 minutes.
P_{Hd}	Typical motor power for heavy-duty use.

Note: 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.

The maximum allowed motor shaft power is limited to $1.5 \cdot P_{Hd}$, $1.1 \cdot P_N$ or $P_{cont.max}$ (whichever value is the greatest). If the limit is exceeded, motor torque and current are automatically restricted. The function protects the input bridge of the drive against overload.

Derating

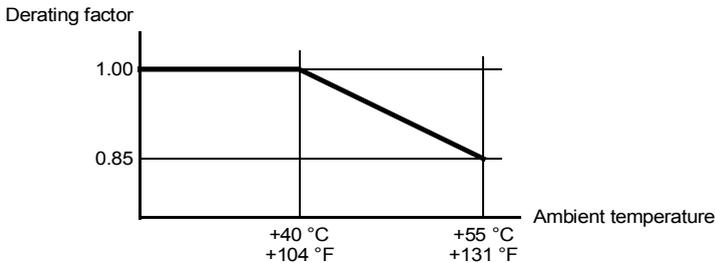
The continuous output currents stated above must be derated if any of the following conditions apply:

- ambient temperature exceeds 40 °C (+104°F)
- drive is installed higher than 1000 m above sea level
- parameter-adjustable motor noise level is set as low.

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:



■ 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.

■ Low motor noise derating

Low motor noise is activated with a drive parameter (see the *firmware manual*). With low motor noise, drive loadability is reduced and derating must be applied if a certain constant output current is needed. See the derated values in the below tables.

For definitions of symbols used in the below tables, see [Definitions](#) on page 112.



Deratings with 230 V AC supply in low motor noise mode

Drive type ACS880-M04	Frame size	Input ratings		Output ratings									
				Nominal		No-overload use		Light-overload use			Heavy-duty use		
		I_{1N} A	$*I_{1N}$ A	I_{2N} A	I_{Max} A	P_N kW hp		I_{Ld} A	P_{Ld} kW	P_{Ld} hp	I_{Hd} A	P_{Hd} kW	P_{Hd} hp
-03A0-2	R1	1.7	2.9	2.5	4.4	0.37	0.5	2.3	0.25	0.5	1.8	0.25	0.25
-03A6-2	R1	2.4	4.4	3	5.3	0.37	0.5	2.8	0.37	0.5	2.2	0.25	0.5
-04A8-2	R1	3.1	5.3	4	7.0	0.55	0.75	3.8	0.55	0.75	3.0	0.37	0.5
-06A0-2	R1	4.4	7.4	5	8.8	0.75	1	4.8	0.75	1	3.8	0.55	0.75
-08A0-2	R1	4.5	7.6	5.7	10.5	1.1	1	5.2	0.75	1	4.2	0.75	1
-010A-2	R2	7.5	11.5	9.5	13.5	1.5	2	9.0	1.5	2	6.8	1.1	2
-014A-2	R2	9.4	14	12	16.5	2.2	3	11.4	2.2	3	8.8	1.5	2
-018A-2	R2	11	15	13	21	3	3	12.2	2.2	3	9.9	2.2	3
-025A-2	R3	12	–	16	33	3	5	15.2	3	5	12	2.2	3
-030A-2	R3	17	–	20	36	4	5	19	4	5	14	3	3
-035A-2	R3	20	–	23	44	5.5	7.5	22	4	7.5	17	4	5
-044A-2	R3	23	–	29	53	5.5	10	27	5.5	7.5	22	5.5	7.5
-050A-2	R3	28	–	33	66	7.5	10	31	7.5	10	26	5.5	7.5
-061A-2	R4	37	–	42	78	7.5	15	37	7.5	10	31	7.5	10
-078A-2	R4	42	–	51	100	11	15	48	11	15	41	7.5	15
-094A-2	R4	53	–	61	124	15	20	58	15	20	45	11	15

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Deratings with 400 V AC supply in low motor noise mode

Drive type ACS880-M04	Frame size	Input ratings		Output ratings							
				Nominal		No-overload use		Light-overload use		Heavy-duty use	
		I_{1N} A	$*I_{1N}$ A	I_{2N} A	I_{Max} A	P_N kW		I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW
-03A0-5	R1	1.9	3.2	2.5	4.4	0.75		2.3	0.75	1.8	0.55
-03A6-5	R1	2.6	4.7	3	5.3	1.1		2.8	1.1	2.2	0.75
-04A8-5	R1	3.3	5.7	4	7.0	1.5		3.8	1.5	3	1.1
-06A0-5	R1	4.6	7.8	5	8.8	2.2		4.8	1.5	3.8	1.5
-08A0-5	R1	4.6	7.7	5.5	10.5	2.2		5.2	2.2	4.2	1.5
-010A-5	R2	7.9	12	9.5	13.5	4		9	4	6.8	3
-014A-5	R2	10	15	12	16.5	5.5		11.4	5.5	8.8	4
-018A-5	R2	11	16	13	21	5.5		12.2	5.5	9.4	4
-025A-5	R3	13	–	16	33	7.5		15	5.5	12	5.5
-030A-5	R3	17	–	20	36	7.5		19	7.5	14	5.5
-035A-5	R3	20	–	23	44	11		22	7.5	17	7.5
-044A-5	R3	24	–	29	53	11		27	11	21	7.5
-050A-5	R3	28	–	33	66	15		31	15	26	11
-061A-5	R4	36	–	40	78	18.5		37	18.5	31	15
-078A-5	R4	43	–	51	100	22		48	22	41	18.5
-094A-5	R4	53	–	61	124	30		58	30	44	22

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Deratings with 460 V AC supply in low motor noise mode

Drive type ACS880-M04	Frame size	Input ratings		Output ratings						
				Nominal		No-overload use		Light- overload use		Heavy-duty use
		I_{1N} A	$*I_{1N}$ A	I_{2N} A	I_{Max} A	P_N hp	I_{Ld} A	P_{Ld} hp	I_{Hd} A	P_{Hd} hp
-03A0-5	R1	1.6	2.7	2.1	4.4	1	1.9	0.75	1.5	0.5
-03A6-5	R1	2.3	4.1	2.6	5.3	1	2.4	1	1.9	0.75
-04A8-5	R1	2.8	4.8	3.4	7.0	2	3.2	1.5	2.6	1
-06A0-5	R1	4.0	6.7	4.3	8.8	2	4.1	2	3.3	1.5
-08A0-5	R1	4.0	6.7	4.8	10.5	3	4.4	2	3.6	2
-010A-5	R2	6.7	10	8	13.5	5	7.7	5	5.8	3
-014A-5	R2	9	13	10	16.5	5	9.7	5	7.6	5
-018A-5	R2	10	14	12	21	7.5	11	7.5	8	5
-025A-5	R3	11	–	14	33	10	13	7.5	11	7.5
-030A-5	R3	15	–	17	36	10	16	10	12	7.5
-035A-5	R3	18	–	21	44	15	20	10	15	10
-044A-5	R3	20	–	25	53	15	23	15	18	10
-050A-5	R3	24	–	29	66	20	27	20	22	15
-061A-5	R4	31	–	34	78	25	31	20	27	20
-078A-5	R4	36	–	43	100	30	41	30	34	25
-094A-5	R4	45	–	52	124	40	49	30	38	25

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Deratings with 500 V AC supply in low motor noise mode

Drive type ACS880-M04	Frame size	Input ratings		Output ratings						
				Nominal		No-overload use		Light- overload use		Heavy-duty use
		I_{1N} A	$*I_{1N}$ A	I_{2N} A	I_{Max} A	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW
-03A0-5	R1	1.6	2.7	2.1	4.4	0.75	1.9	0.75	1.5	0.55
-03A6-5	R1	2.3	4.1	2.6	5.3	1.1	2.4	1.1	1.9	0.75
-04A8-5	R1	2.8	4.8	3.4	7.0	1.5	3.2	1.5	2.6	1.1
-06A0-5	R1	4.0	6.7	4.3	8.8	2.2	4.1	1.5	3.3	1.5
-08A0-5	R1	4.0	6.7	4.8	10.5	2.2	4.4	2.2	3.6	1.5
-010A-5	R2	6.7	10	8	13.5	4	7.7	4	5.8	3
-014A-5	R2	9	13	10	16.5	5.5	9.7	4	7.6	4
-018A-5	R2	10	14	12	21	5.5	11	5.5	8	4
-025A-5	R3	11	–	14	33	7.5	13	5.5	11	5.5
-030A-5	R3	15	–	17	36	7.5	16	7.5	12	5.5
-035A-5	R3	18	–	21	44	11	20	11	15	7.5
-044A-5	R3	20	–	25	53	11	23	11	18	7.5
-050A-5	R3	24	–	29	66	15	27	15	22	11
-061A-5	R4	31	–	34	78	18.5	31	18.5	27	15
-078A-5	R4	36	–	43	100	22	41	22	34	18.5
-094A-5	R4	45	–	52	124	30	49	30	38	22

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Dimensions and weights

Frame size	H1 - Height (without cable clamp plates)		H2 - Height (with cable clamp plates)		W - Width		D - Depth (with control panel)		Weight	
	mm	in	mm	in	mm	in	mm	in	kg	lbs
R1	364	14.33	480	18.89	90	3.54	237	9.33	3.2	7.1
R2	380	14.97	480	18.89	100	3.94	315	12.40	5.4	11.9
R3	467	18.37	558	21.96	168	6.60	316	12.44	15.6	34.4
R4	467	18.37	644	25.34	223	8.76	316	12.44	21.3	47.0

See also the [Dimension drawings](#) from page 181.

Terminal and lead-through data for power cables

Input, motor, resistor and DC cable, maximum wire sizes (per phase) and terminal screw sizes and tightening torques (T) are given below.

Frame size	U1/2, V1/2, W1/2, UDC+/-, R+/-		Grounding terminals
	Max wire size	T	T
	mm ²	N·m	N·m
R1	4	0.5 ... 0.6	1.5
R2	10	1.2 ... 1.5	1.5
R3	70	15	3
R4	70	15	18

Screwdrivers for the terminals of main circuit

Frame size	Screwdrivers
R1	4 mm slot
R2	5 mm slot
R3	4 mm Allen key (hexagonal socket)
R4	4 mm Allen key (hexagonal socket)

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Losses, cooling data and noise

Drive type ACS880- M04	Power loss W (BTU/h)					Airflow m ³ /h (ft ³ /min)	Noise dB(A)
	Load						
	0%	25%	50%	75%	100%		
-03A0-2	66 (226)	71 (244)	77 (264)	84 (287)	91 (312)	24 (14)	47
-03A6-2	66 (226)	73 (247)	80 (272)	88 (300)	97 (332)	24 (14)	47
-04A8-2	72 (245)	80 (273)	90 (307)	101 (346)	114 (390)	24 (14)	47
-06A0-2	72 (245)	83 (284)	97 (332)	114 (390)	134 (457)	24 (14)	47
-08A0-2	72 (245)	87 (298)	106 (363)	129 (439)	154 (526)	24 (14)	47
-010A-2	72 (245)	91 (311)	116 (395)	147 (500)	183 (626)	48 (28)	39
-014A-2	76 (259)	100 (342)	132 (449)	170 (579)	215 (733)	48 (28)	39
-018A-2	76 (259)	109 (371)	152 (520)	208 (709)	274 (936)	48 (28)	39
-025A-2	92 (314)	137 (469)	191 (653)	254 (867)	325 (1109)	142 (84)	71
-030A-2	92 (314)	152 (520)	227 (776)	317 (1082)	421 (1438)	142 (84)	71
-035A-2	95 (323)	160 (545)	239 (816)	333 (1137)	442 (1507)	142 (84)	71
-044A-2	97 (332)	167 (570)	251 (856)	349 (1192)	462 (1576)	200 (118)	71
-050A-2	97 (332)	182 (620)	286 (975)	410 (1400)	555 (1894)	200 (118)	71
-061A-2	115 (393)	224 (763)	362 (1236)	531 (1812)	730 (2492)	290 (171)	70
-078A-2	115 (393)	249 (851)	423 (1444)	636 (2172)	889 (3034)	290 (171)	70
-094A-2	115 (393)	272 (929)	481 (1641)	741 (2530)	1054 (3597)	290 (171)	70
-03A0-5	68 (233)	75 (256)	83 (282)	91 (310)	100 (340)	24 (14)	47
-03A6-5	68 (233)	76 (261)	86 (292)	96 (326)	106 (363)	24 (14)	47
-04A8-5	74 (252)	84 (288)	97 (330)	110 (376)	126 (430)	24 (14)	47
-06A0-5	74 (252)	88 (302)	106 (361)	126 (429)	148 (504)	24 (14)	47
-08A0-5	74 (252)	93 (319)	116 (397)	142 (486)	172 (586)	24 (14)	47
-010A-5	77 (261)	101 (345)	132 (450)	169 (576)	212 (722)	48 (28)	39
-014A-5	80 (273)	112 (382)	151 (515)	197 (672)	250 (852)	48 (28)	39
-018A-5	80 (273)	122 (418)	176 (601)	241 (823)	318 (1084)	48 (28)	39
-025A-5	98 (333)	154 (525)	219 (747)	293 (1000)	375 (1282)	142 (84)	63
-030A-5	98 (333)	172 (588)	262 (893)	366 (1249)	485 (1654)	142 (84)	63
-035A-5	100 (342)	181 (619)	277 (947)	388 (1323)	513 (1750)	142 (84)	63
-044A-5	103 (351)	191 (651)	293 (1000)	410 (1398)	541 (1846)	200 (118)	71
-050A-5	103 (351)	209 (712)	335 (1142)	481 (1641)	646 (2205)	200 (118)	71
-061A-5	126 (430)	259 (884)	422 (1441)	616 (2101)	840 (2867)	290 (171)	70
-078A-5	126 (430)	290 (990)	494 (1685)	737 (2514)	1020 (3481)	290 (171)	70
-094A-5	126 (430)	317 (1081)	560 (1910)	854 (2915)	1200 (4096)	290 (171)	70



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](#) on page 55.

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

Drive type ACS880-M04	Input current (A)	IEC fuse			UL fuse			Cross-sectional area of cable	
		Rated current (A)	Volt- age (V)	Class	Rated current (A)	Volt- age (V)	UL class	mm ²	AWG
-03A0-2, -03A0-5	4.0*	6	500	gG	6	600	T	1.5...4	16...12
-03A6-2, -03A6-5	6.0*	6	500	gG	6	600	T	1.5...4	16...12
-04A8-2, -04A8-5	7.0*	10	500	gG	10	600	T	1.5...4	16...12
-06A0-2, -06A0-5	9.0*	10	500	gG	10	600	T	1.5...4	16...12
-08A0-2, -08A0-5	11*	16	500	gG	15	600	T	1.5...4	16...12
-010A-2, -010A-5	13*	16	500	gG	15	600	T	1.5...10	16...8
-014A-2, -014A-5	18*	20	500	gG	20	600	T	1.5... 0	16...8
-018A-2, -018A-5	23*	25	500	gG	25	600	T	1.5...10	16...8
-025A-2, -025A-5	20	25	500	gG	25	600	T	6...35	9...2
-030A-2, -030A-5	26	32	500	gG	35	600	T	6...35	9...2
-035A-2, -035A-5	30	40	500	gG	35	600	T	6...35	9...2
-044A-2, -044A-5	36	50	500	gG	45	600	T	6...35	9...2
-050A-2, -050A-5	42	50	500	gG	50	600	T	10...70	6...2/0
-061A-2, -061A-5	55	63	500	gG	70	600	T	10...70	6...2/0
-078A-2, -078A-5	65	80	500	gG	80	600	T	10...70	6...2/0
-094A-2, -094A-5	82	100	500	gG	100	600	T	10...70	6...2/0

*Without mains choke

AWG cable sizing is based on NEC Table 310-16 for copper wires, 75 °C (167 °F) wire insulation at 40 °C (104 °F) surrounding air temperature. Not more than three current-carrying conductors in raceway or cable or earth (directly buried). For other conditions, dimension the cables according to local safety regulations, appropriate input voltage and the load current of the drive.



■ gG fuses

Drive type ACS880-M04	*A	A ² s (@500V)	V	Manufacturer	Type	Fuse size DIN
UN = 230 V						
-03A0-2	6	110	500	ABB	OFAF000H6	000
-03A6-2	6	110	500	ABB	OFAF000H6	000
-04A8-2	10	360	500	ABB	OFAF000H10	000
-06A0-2	10	360	500	ABB	OFAF000H10	000
-08A0-2	16	750	500	ABB	OFAF000H16	000
-010A-2	16	750	500	ABB	OFAF000H16	000
-014A-2	20	1500	500	ABB	OFAF000H20	000
-018A-2	25	2550	500	ABB	OFAF000H25	000
-025A-2	25	2550	500	ABB	OFAF000H25	000
-030A-2	32	4500	500	ABB	OFAF000H35	000
-035A-2	40	7800	500	ABB	OFAF000H40	000
-044A-2	50	16000	500	ABB	OFAF000H50	000
-050A-2	50	16000	500	ABB	OFAF000H50	000
-061A-2	63	20000	500	ABB	OFAF000H63	000
-078A-2	80	37000	500	ABB	OFAF000H80	000
-094A-2	100	65000	500	ABB	OFAF000H100	000
UN = 400 V						
-03A0-5	6	110	500	ABB	OFAF000H6	000
-03A6-5	6	110	500	ABB	OFAF000H6	000
-04A8-5	10	360	500	ABB	OFAF000H10	000
-06A0-5	10	360	500	ABB	OFAF000H10	000
-08A0-5	16	750	500	ABB	OFAF000H16	000
-010A-5	16	750	500	ABB	OFAF000H16	000
-014A-5	20	1500	500	ABB	OFAF000H20	000
-018A-5	25	2550	500	ABB	OFAF000H25	000
-025A-5	25	2550	500	ABB	OFAF000H25	000
-030A-5	32	4500	500	ABB	OFAF000H35	000
-035A-5	40	7800	500	ABB	OFAF000H40	000
-044A-5	50	16000	500	ABB	OFAF000H50	000
-050A-5	50	16000	500	ABB	OFAF000H50	000
-061A-5	63	20000	500	ABB	OFAF000H63	000
-078A-5	80	37000	500	ABB	OFAF000H80	000
-094A-5	100	65000	500	ABB	OFAF000H100	000



 gR fuses

Drive type ACS880-M04	*A	A ² s (@500V)	V	Manufacturer	Type	Fuse size DIN
UN = 230 V						
-03A0-2	20	70	690	Bussmann	170M2693	00
-03A6-2	20	70	690	Bussmann	170M2693	00
-04A8-2	20	70	690	Bussmann	170M2693	00
-06A0-2	20	70	690	Bussmann	170M2693	00
-08A0-2	20	70	690	Bussmann	170M2693	00
-010A-2	20	70	690	Bussmann	170M2693	00
-014A-2	25	125	690	Bussmann	170M2694	00
-018A-2	32	275	690	Bussmann	170M2695	00
-025A-2	32	275	690	Bussmann	170M2695	00
-030A-2	32	275	690	Bussmann	170M2695	00
-035A-2	50	1000	690	Bussmann	170M2697	00
-044A-2	50	1000	690	Bussmann	170M2697	00
-050A-2	63	1800	690	Bussmann	170M2698	00
-061A-2	80	3600	690	Bussmann	170M2699	00
-078A-2	100	6650	690	Bussmann	170M2700	00
-094A-2	125	12000	690	Bussmann	170M2701	00
UN = 400 V						
-03A0-5	25	125	690	Bussmann	170M2694	00
-03A6-5	25	125	690	Bussmann	170M2694	00
-04A8-5	25	125	690	Bussmann	170M2694	00
-06A0-5	25	125	690	Bussmann	170M2694	00
-08A0-5	25	125	690	Bussmann	170M2694	00
-010A-5	25	125	690	Bussmann	170M2694	00
-014A-5	40	490	690	Bussmann	170M2696	00
-018A-5	40	490	690	Bussmann	170M2696	00
-025A-5	40	490	690	Bussmann	170M2696	00
-030A-5	40	490	690	Bussmann	170M2696	00
-035A-5	63	1800	690	Bussmann	170M2698	00
-044A-5	63	1800	690	Bussmann	170M2698	00
-050A-5	63	1800	690	Bussmann	170M2698	00
-061A-5	80	3600	690	Bussmann	170M2699	00
-078A-5	100	6650	690	Bussmann	170M2700	00
-094A-5	125	12000	690	Bussmann	170M2701	00



aR fuses

Drive type ACS880-M04	*A	A ² s (@500V)	V	Manufacturer	Type	Fuse size DIN
UN = 230 V						
-03A0-2	25	130	690	Bussmann	170M1561	000
-03A6-2	25	130	690	Bussmann	170M1561	000
-04A8-2	25	130	690	Bussmann	170M1561	000
-06A0-2	25	130	690	Bussmann	170M1561	000
-08A0-2	25	130	690	Bussmann	170M1561	000
-010A-2	25	130	690	Bussmann	170M1561	000
-014A-2	40	270	690	Bussmann	170M1563	000
-018A-2	40	270	690	Bussmann	170M1563	000
-025A-2	40	270	690	Bussmann	170M1563	000
-030A-2	40	270	690	Bussmann	170M1563	000
-035A-2	63	1450	690	Bussmann	170M1565	000
-044A-2	63	1450	690	Bussmann	170M1565	000
-050A-2	80	2550	690	Bussmann	170M1566	000
-061A-2	100	4650	690	Bussmann	170M1567	000
-078A-2	125	8500	690	Bussmann	170M1568	000
-094A-2	160	16000	690	Bussmann	170M1569	000
UN = 400 V						
-03A0-5	25	130	690	Bussmann	170M1561	000
-03A6-5	25	130	690	Bussmann	170M1561	000
-04A8-5	25	130	690	Bussmann	170M1561	000
-06A0-5	25	130	690	Bussmann	170M1561	000
-08A0-5	25	130	690	Bussmann	170M1561	000
-010A-5	25	130	690	Bussmann	170M1561	000
-014A-5	40	270	690	Bussmann	170M1563	000
-018A-5	40	270	690	Bussmann	170M1563	000
-025A-5	40	270	690	Bussmann	170M1563	000
-030A-5	40	270	690	Bussmann	170M1563	000
-035A-5	63	1450	690	Bussmann	170M1565	000
-044A-5	63	1450	690	Bussmann	170M1565	000
-050A-5	80	2550	690	Bussmann	170M1566	000
-061A-5	100	4650	690	Bussmann	170M1567	000
-078A-5	125	8500	690	Bussmann	170M1568	000
-094A-5	160	16000	690	Bussmann	170M1569	000



AC input (supply) connection

Voltage (U_1)	200...240 V AC +/-10%, 3-phase 380...500 V AC +10%/-15%, 3-phase
Network type	Grounded (TN, TT) or ungrounded (IT). 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.
Short-circuit withstand strength (IEC 60439-1)	100 kA when protected by fuses given in the Supply cable fuses on page 118. Frames R1 and R2: Thermal dimensioning of the DC capacitors is based on max. 5 kA short-circuit current. An input choke should be used to achieve 100 kA.
Short-circuit current protection (UL 61800-5-1, CSA C22.2 No. 274-13)	US and Canada: The drive is suitable for use on a circuit capable of delivering not more than 100 kA symmetrical amperes (rms) at 500 V maximum when protected by fuses given in the Supply cable fuses on page 118.
Frequency	50...60 Hz $\pm 5\%$
Imbalance	Max. $\pm 3\%$ of nominal phase to phase input voltage
Fundamental power factor ($\cos \phi_1$)	0.98 (at nominal load)
Terminals	Frame R1: Detachable screw terminal block for 0.25...4 mm ² wire. Frame R2: Detachable screw terminal block for 0.5...6 mm ² wire. Frames R3 and R4: Screw lugs for 6...70 mm ² wire included. Suitable crimp lugs can be used instead.



DC connection

Voltage 243...356 V DC (ACS880-M04-xxxx-2 drives)
 436...743 V DC (ACS880-M04-xxxx-5 drives)

Ratings, fuse recommendations

Drive type ACS880- M04 -xxxx-2/5	I_{dcN} (A)	C (μ F)	IEC fuse			UL fuse		
			Rated current (A)	Voltage (V)	Class	Rated current (A)	Voltage (V)	Class
-03A0	3.3	120	16	690	aR	12	690	URC
-03A6	3.9	120	16	690	aR	12	690	URC
-04A8	4.8	240	16	690	aR	12	690	URC
-06A0	6.5	240	16	690	aR	12	690	URC
-08A0	8.7	240	16	690	aR	12	690	URC
-010A	12	370	20	690	aR	16	690	URC
-014A	15	740	32	690	aR	32	690	URD
-018A	20	740	32	690	aR	32	690	URD
-025A	29	670	63	690	aR	63	690	URQ
-030A	38	670	63	690	aR	63	690	URQ
-035A	44	1000	100	690	aR	100	690	URQ
-044A	54	1000	100	690	aR	100	690	URQ
-050A	54	1000	100	690	aR	100	690	URQ
-061A	73	1340	160	690	aR	160	690	URQ
-078A	85	2000	160	690	aR	160	690	URQ
-094A	98	2000	160	690	aR	160	690	URQ

I_{dcN}	Average DC input current requirement when running a typical induction motor at P_N at a DC link voltage of 540 V (which corresponds to an AC input voltage of 400 V).
C	Capacitance of DC link.

Terminals

Frame R1: Detachable screw terminal block for 0.25...4 mm² wire.
 Frame R2: Detachable screw terminal block for 0.5...6 mm² wire.
 Frames R3 and R4: Screw lugs for 6...70 mm² wire included. Suitable crimp lugs can be used instead.



Motor connection

Motor types	Asynchronous induction motors, permanent magnet motors, ABB synchronous reluctance motors
Frequency	0...500 Hz
Current	See section Ratings .
Switching frequency	3 kHz (default)
Maximum motor cable length	Frames R1 and R2: 150 m (492 ft)* Frames R3 and R4: 300 m (984 ft)* *100 m with EN 61800-3 Category C3 filter
Terminals	Frame R1: Detachable screw terminal block for 0.25...4 mm ² wire. Frame R2: Detachable screw terminal block for 0.5...6 mm ² wire. Frames R3 and R4: Screw lugs for 6...70 mm ² wire included. Suitable crimp lugs can be used instead.



ZCU control unit

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



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

Input/output mode selection by parameters.

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

Connector pitch 5 mm, wire size 2.5 mm²

As inputs:

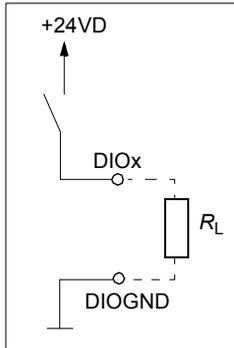
24 V logic levels: "0" < 5 V, "1" > 15 V

R_{in} : 2.0 kohm

Filtering: 0.25 ms (ZCU), 1 ms (BCU)

As outputs:

Total output current from +24VD is limited to 200 mA

**Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)****Analog inputs AI1 and AI2 (XAI:4 ... XAI:7)**

Current/voltage input mode selection by jumpers/switches.

Connector pitch 5 mm, wire size 2.5 mm²
10 V \pm 1% and -10 V \pm 1%, R_{load} 1...10 kohm

Connector pitch 5 mm, wire size 2.5 mm²
Current input: -20...20 mA, R_{in} = 100 ohm
Voltage input: -10...10 V, R_{in} > 200 kohm
Differential inputs, common mode range \pm 30 V
Sampling interval per channel: 0.25 ms
Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms

Resolution: 11 bit + sign bit

Inaccuracy: 1% of full scale range

Analog outputs AO1 and AO2 (XAO)

Connector pitch 5 mm, wire size 2.5 mm²
0...20 mA, R_{load} < 500 ohm
Frequency range: 0...300 Hz (ZCU), 0...500 Hz (BCU)

Resolution: 11 bit + sign bit

Inaccuracy: 2% of full scale range



**Drive-to-drive link
(XD2D)**

Connector pitch 5 mm, wire size 2.5 mm²
Physical layer: RS-485
Termination by switch or jumper

**Safe torque off connection
(XSTO)**

Connector pitch 5 mm, wire size 2.5 mm²
Input voltage range: -3...30 V DC
Logic levels: "0" < 5 V, "1" > 17 V
For the drive to start, both connections must be "1"

Current consumption: 66 mA (continuous) per
STO channel per drive module

EMC (immunity) according to IEC 61326-3-1

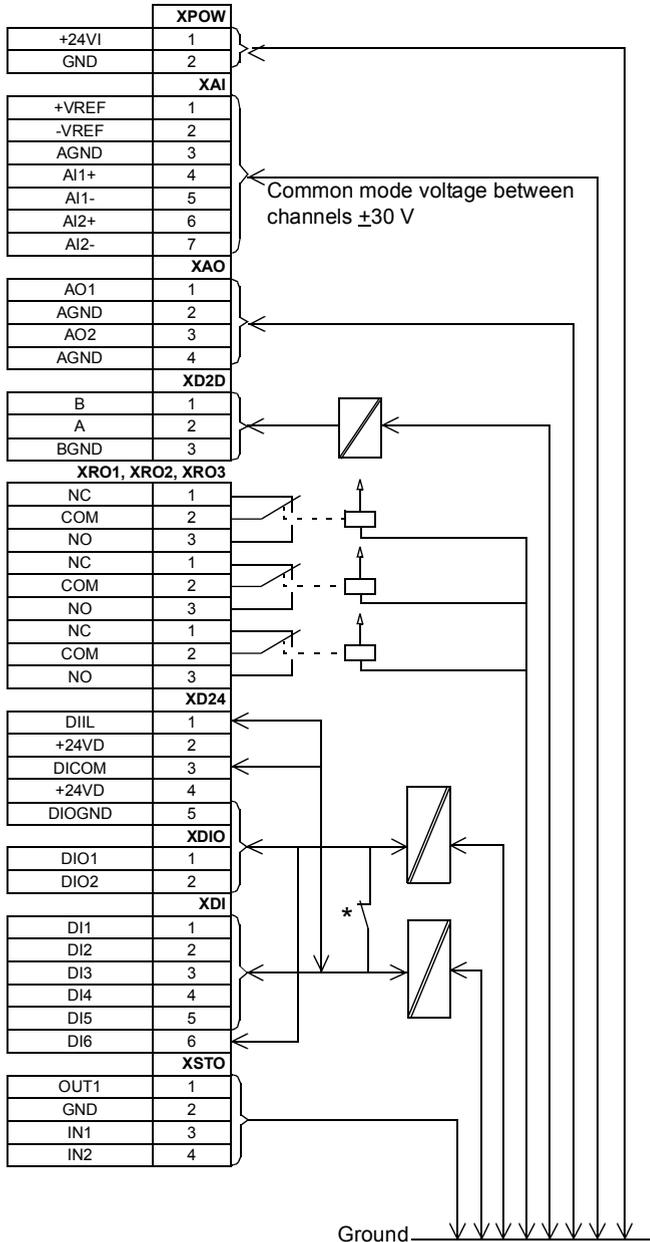
Control panel connection (X13)

Connector: RJ-45
Cable length < 3 m

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



Ground isolation diagram (ZCU)



***Ground selector (J6) settings**

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

Efficiency

Approximately 98% at nominal power level

Cooling

- Method** Internal fan, flow from bottom to top. Air-cooled heatsink. See [Cooling and degrees of protection](#) on page 44.
- Free space around the unit** See [Free space requirements](#) on page 41.

Protection classes

- Environmental limits for the drive are given below. The drive must be used in a heated, indoor, controlled environment.
- Degree of protection (IEC/EN 60529)** IP20 / UL open type. See [Cooling and degrees of protection](#) on page 44.
- Overvoltage category (IEC 60664-1)** III
- Pollution degree (IEC 60664-1)** 2



Ambient conditions

Environmental limits for the drive are given below. The drive must 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	<p><u>Non-corner grounded TN and TT systems</u>: 0 to 4000 m (13123 ft) above sea level.</p> <p><u>Other systems</u>: 0 to 2000 m (6561 ft) above sea level.</p> <p>Above 1000 m (3281 ft), see section Altitude derating on page 113.</p>	-	-
Air temperature	-10 to +55°C (14 to 131°F). No frost allowed. See section Derating on page 113.	-40 to +70°C (-40 to +158°F)	-40 to +70°C (-40 to +158°F)
Relative humidity	0 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.		
	<p>According to IEC 60721-3-3:</p> <p>Chemical gases: Class 3C2</p> <p>Solid particles: Class 3S2</p> <p>The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.</p>	<p>According to IEC 60721-3-1:</p> <p>Chemical cases: Class 1C2</p> <p>Solid particles: Class 1S2</p>	<p>According to IEC 60721-3-2:</p> <p>Chemical cases: Class 2C2</p> <p>Solid particles: Class 2S2</p>



Sinusoidal vibration (IEC 60721-3-3)	Tested according to IEC 60721-3-3, mechanical conditions: Class 3M4 2...9 Hz: 3.0 mm (0.12") 9...200 Hz: 10 m/s ² (33 ft/s ²)	–	–
Shock (IEC 60068-2-27, ISTA 1A)	–	According to ISTA 1A. Max. 100 m/s ² (330 ft/s ²), 11 ms	According to ISTA 1A. Max. 100 m/s ² (330 ft/s ²), 11 ms
Free fall	Not allowed	76 cm (30")	76 cm (30")



Materials

- Drive enclosure**
- PC/ABS, colour NCS 1502-Y (RAL 9002 / PMS 420 C)
 - hot-dip zinc coated steel sheet
 - extruded aluminium AISi.

Packaging Corrugated cardboard, PP bands.

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

Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and DC capacitors (C1-1 to C1-x) need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code.

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



Applicable standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standard EN 61800-5-1.

EN 61800-5-1:2007	<i>Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy.</i>
EN 61800-3:2004 + A1:2012	<i>Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.</i>
EN 60204-1:2006 + A1:2009 + AC:2010	<i>Safety of machinery. Electrical equipment of machines. Part 1: General requirements. Provisions for compliance:</i> The final assembler of the machine is responsible for installing <ul style="list-style-type: none"> • emergency-stop device • supply disconnecting device • the drive module into a cabinet
EN 60529:1991+A1:2000+A2:2013	<i>Degrees of protection provided by enclosures (IP code)</i>
UL 61800-5-1:2012	<i>UL Standard for Safety. Adjustable speed Electrical Power Drive Systems – Part 5-1: Safety Requirement – Electrical, Thermal and Energy.</i>
CSA C22.2 No. 274-13	<i>Adjustable speed drives</i>



CE marking

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage, EMC and RoHS Directives. The CE marking also verifies that the drive, in regard to its safety functions (such as Safe torque off), conforms with the Machinery Directive as a safety component.

■ Compliance with the European Low Voltage Directive

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

■ Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004) covers requirements stated for drives. See section [Compliance with the EN 61800-3:2004](#) below.

■ Compliance with the European ROHS Directive

The RoHS Directive defines the restriction of the use of certain hazardous substances in electrical and electronic equipment.

■ Compliance with the European Machinery Directive

The drive is an electronic product which is covered by the European Low Voltage Directive. However, the drive includes the Safe torque off function and can be equipped with other safety functions for machinery which, as safety components, are in the scope of the Machinery Directive. These functions of the drive comply with European harmonized standards such as EN 61800-5-2.



Compliance with the EN 61800-3:2004

■ Definitions

EMC stands for **E**lectromagnetic **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.

Environment/ Category	Description
First environment	Includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.
Second environment	Includes establishments connected to a network not supplying domestic premises.
Drive of category C2	Drive of rated voltage less than 1000 V and intended to be installed and started up only by a professional when used in the first environment. Note: A professional is a person or organization having necessary skills in installing and/or starting up power drive systems, including their EMC aspects.
Drive of category C3	Drive of rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment.
Drive of category C4	Drive of rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

■ Category C2

The drive complies with the standard with the following provisions:

1. The drive is equipped with external EMC filter JFI-0x (optional accessory to be ordered separately, see [EMC filters](#) on page 159).
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. The maximum motor cable length does not exceed 100 meters (328 ft).



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

Note: Do not install a drive with the internal or external EMC filter (+E200) on IT (ungrounded) systems. The supply network connects to the ground potential through the internal EMC filter capacitors which may cause danger or damage to the drive. For disconnecting the EMC filter, see instructions on page 76.



■ Category C3

The drive complies with the standard with the following provisions:

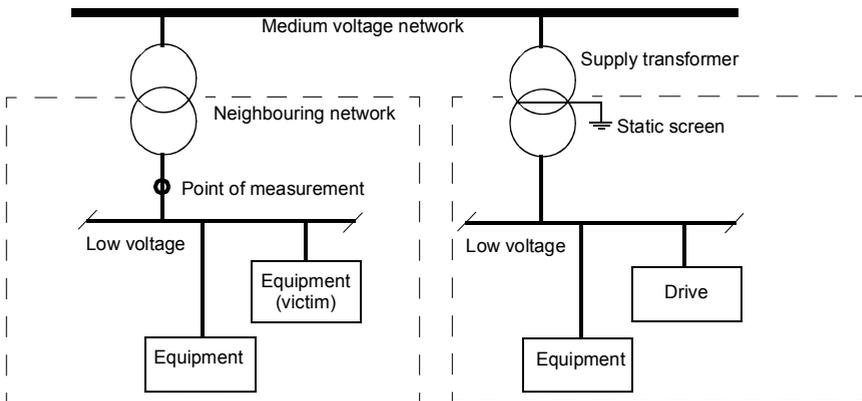
1. The drive is equipped with filtering option +E200.
2. The motor and control cables are selected as specified in this manual.
1. The drive is installed according to the instructions given in this manual.
3. Motor cable length does not exceed 100 metres (328 ft).

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

■ Category C4

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

1. It is ensured that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the inherent suppression in transformers and cables is sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.



2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available from the local ABB representative.
-

3. The motor and control cables are selected as specified in this manual.
4. The drive is installed according to the instructions given in this manual.



WARNING! A drive of category C4 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.



UL marking

UL marking pending.

■ UL checklist

Check the following	<input checked="" type="checkbox"/>
The drive type designation label includes the cULus listed marking. See <i>Type designation label</i> on page 35.	<input type="checkbox"/>
CAUTION - Risk of electric shock. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.	<input type="checkbox"/>
The drive must be used in a heated, indoor controlled environment. The drive must be installed in clean air according to the enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.	<input type="checkbox"/>
The maximum surrounding air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 55 °C (104 to 131 °F).	<input type="checkbox"/>
The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 500 V (or 240 V) maximum when protected by the UL fuses given in the table on page 118. The ampere rating is based on tests done according to the appropriate UL standard.	<input type="checkbox"/>
The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.	<input type="checkbox"/>
Integral solid state short circuit protection does not provide branch circuit protection. The input cable must be protected with fuses. See IEC fuses and UL classified fuses listed on page 118. These fuses provide branch circuit protection in accordance with the National Electrical Code (NEC) and Canadian Electrical Code. For installation in the United States, also obey any other additional local codes. For installation in Canada, also obey any additional provincial codes. Note: For installation in the United states, do not use circuit breakers without fuses. For suitable circuit breakers, contact your local ABB representative.	<input type="checkbox"/>
The drive provides motor overload protection. For the adjustments, see the <i>Firmware manual</i> .	<input type="checkbox"/>
For drive overvoltage category and pollution degree, see data on page 129.	<input type="checkbox"/>



RCM marking

RCM marking pending.

Disclaimers

■ Generic disclaimer

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

■ Cyber security disclaimer

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





12

The Safe torque off function

Contents of this chapter

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

Description

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

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

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



Compliance of STO function with the European Machinery Directive

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

Standard	Name
EN 60204-1:2006 + AC:2010	Safety of machinery – Electrical equipment of machines – Part 1: General requirements
IEC 61326-3-1:2008	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
IEC 61511:2003	Functional safety – Safety instrumented systems for the process industry sector
IEC/EN 61800-5-2:2007	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional
IEC/EN 62061:2005 + AC:2010	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems
EN ISO 13849-1:2008 + AC:2009	Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
EN ISO 13849-2:2012	Safety of machinery – Safety-related parts of control systems – Part 2: Validation

The function also corresponds to prevention of unexpected start-up as specified by EN 1037:1995 + A1:2008 and uncontrolled stop (stop category 0) as specified in EN 60204-1:2006 + AC:2010.



Connecting the STO

See STO control unit connections in [Connecting the control unit](#) on page 85.

The following diagrams present examples of Safe torque off wiring for

- a single drive unit (page 144)
- multiple drive units (page 145)
- multiple drive units when an external 24 V DC power supply is used (page 146).

■ Activation switch

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

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

■ Cable types and lengths

- Double-shielded twisted-pair cable is recommended.
- Maximum cable lengths:
 - 30 m (100 ft) between activation switch [K] and drive control unit
 - 60 m (200 ft) between multiple drive units
 - 60 m (200 ft) between external power supply and first drive unit

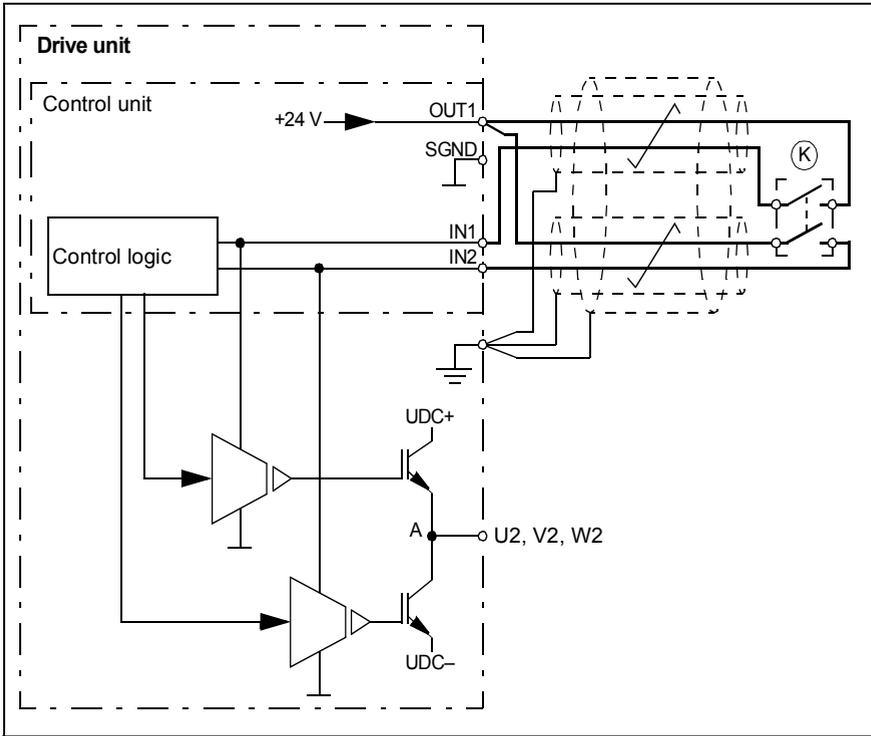
Note: The voltage at the INx terminals of each drive control unit must be at least 17 V DC to be interpreted as “1”.

■ Grounding of protective shields

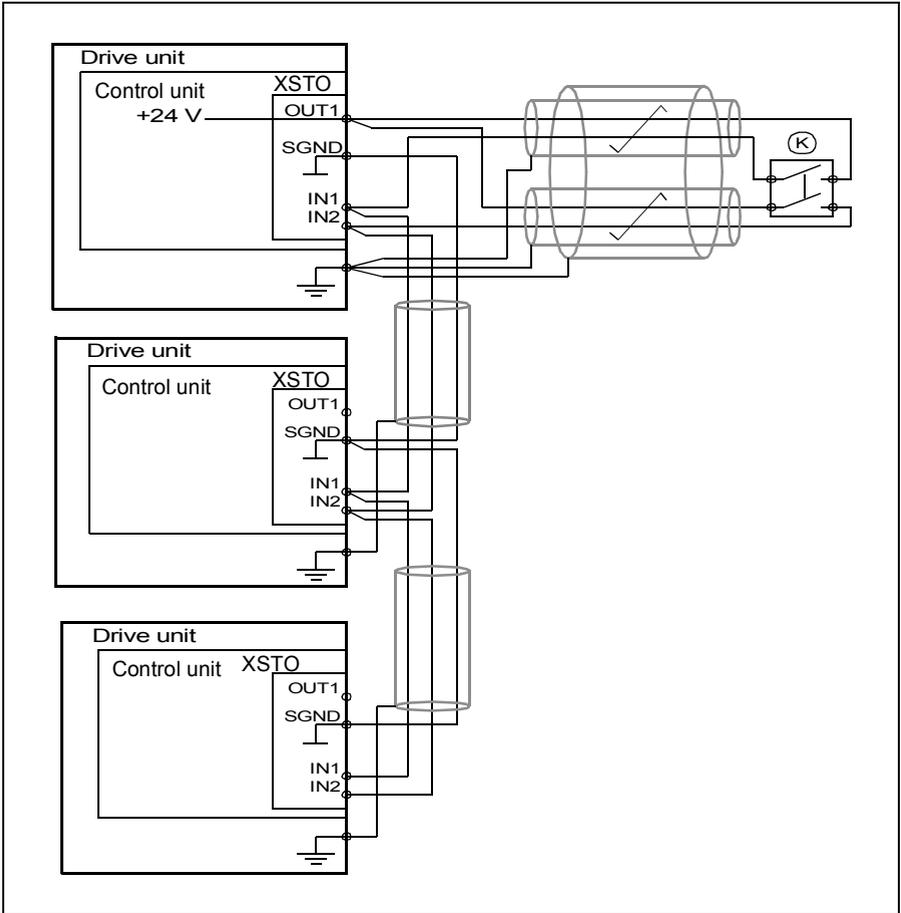
- Ground the shield in the cabling between the activation switch and the control unit at the control unit.
- Ground the shield in the cabling between two control units at one control unit only.



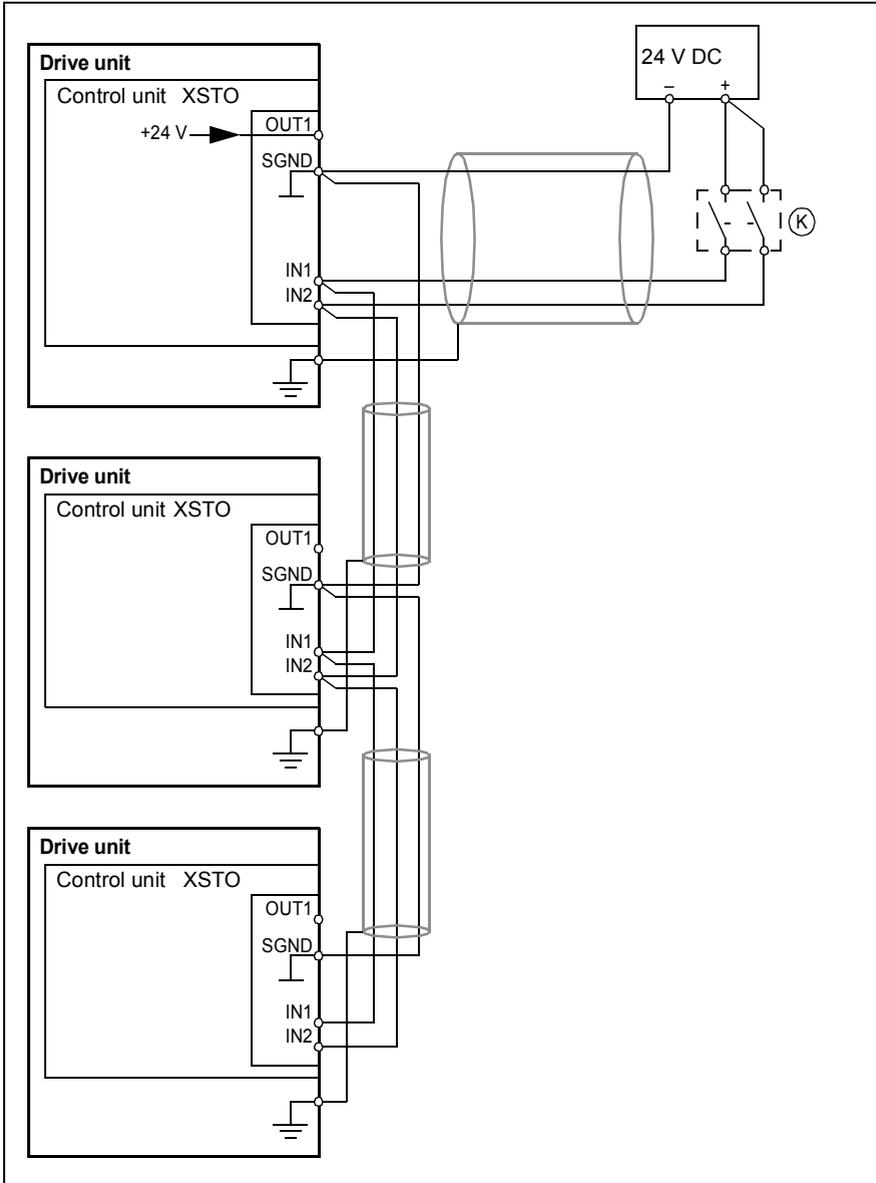
■ STO wiring – single drive unit (internal power supply)



■ STO wiring – multiple drive units (internal power supply)



■ STO wiring – multiple drive units (external power supply)



STO operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. The STO inputs on the drive control unit de-energize.
3. The control unit cuts off the control voltage from the drive IGBTs.
4. The control program generates an indication as defined by parameter 31.22 (refer to the firmware manual of the drive).
5. Motor coasts to a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a new start command is required to start the drive.

STO start-up and acceptance test

Make sure the safety functions are safe for operation by validating the functions. The final assembler of the machine must validate the function by performing an acceptance test. The acceptance test must be performed in these conditions:

- at initial start-up of the safety function
- after any changes related to the safety function (circuit boards, wiring, components, settings, etc.)
- after any maintenance work related to the safety function.

■ Competency for testing STO function

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

■ STO acceptance test reports

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



■ STO acceptance test procedure

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

- **Note:** If an FSO-xx safety functions module is installed, refer to its documentation.

Action	<input checked="" type="checkbox"/>
 WARNING! Follow the Safety instructions on page 13. Ignoring the instructions can cause physical injury or death, or damage to the equipment.	<input type="checkbox"/>
Make sure that the drive can be run and stopped freely during start-up.	<input type="checkbox"/>
Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnecter.	<input type="checkbox"/>
Check the Safe torque off circuit connections against the wiring diagram.	<input type="checkbox"/>
Close the disconnecter and switch the power on.	<input type="checkbox"/>
Testing the operation of STO function when motor is stopped.	
Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill.	<input type="checkbox"/>
Make sure that the drive operates as follows: <ol style="list-style-type: none"> 1. Open the STO circuit. <u>Expected outcome:</u> The drive generates an indication if parameter <i>31.22 STO indication run/stop</i> (see the firmware manual) is defined for 'stopped' state. 2. Give a start command to verify that the STO function blocks the operation of the drive. <u>Expected outcome:</u> The motor should not start. 3. Close the STO circuit. 4. Reset any active faults. 5. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
Testing the operation of STO function when motor is running.	
Start the drive and make sure the motor is running.	<input type="checkbox"/>
Make sure that the drive operates as follows: <ol style="list-style-type: none"> 1. Open the STO circuit. <u>Expected outcome:</u> The motor should stop. The drive generates an indication if parameter <i>31.22 STO indication run/stop</i> (see the firmware manual) is defined for 'running' state. 2. Reset any active faults and try to start the drive. 3. Make sure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. 4. Close the STO circuit. 5. Reset any active faults. 6. Restart the drive and check that the motor runs normally. 	<input type="checkbox"/>
Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.	<input type="checkbox"/>



Using the STO function

1. Open the activation switch, or activate the safety functionality that is wired to the STO connection.
 - The STO inputs on the drive control unit de-energize, and the drive control unit cuts off the control voltage from the drive IGBTs.
 - The control program generates an indication as defined by parameter 31.22 *STO indication run/stop* (refer to the firmware manual of the drive).
 - The motor coasts to a stop (if running).

Note: The drive does not restart while the activation switch or safety relay contacts are open.
2. Deactivate the STO by closing the activation switch, or resetting the safety functionality that is wired to the STO connection.
3. Reset any faults before restarting.



WARNING! The Safe torque off function does not disconnect the voltage of the main and auxiliary circuits from the drive.

You must carry out any maintenance work on electrical parts of the drive or the motor can only after isolating the drive from the main supply.



WARNING! The Safe torque off functionality is achieved only through the XSTO connector of the drive control unit.

True Safe torque off functionality is not achieved through the XSTO connectors of other control units, such as the supply control unit or the brake control unit.

The Safe torque off function is supported by any ACS880 drive or drive firmware. The function is not supported by supply or brake firmware.



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



Notes:

- If a running drive is stopped by using the Safe torque off function, the drive cuts-off the motor supply voltage and the motor coasts to a stop. If this causes danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.
- The Safe torque off function overrides all other functions of the drive unit.
- The Safe torque off function is ineffective against deliberate sabotage or misuse.
- The Safe torque off function was designed to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. The assembler of the machine must inform the final user about the residual risks.



STO function maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing as per the following maintenance intervals:

Mode of operation	Defined maintenance intervals
High demand	maximum 20 years
Low demand	maximum 2 years

See also [STO acceptance test procedure](#) on page 148.

Note: See also the Recommendation of CNB/M/11.050 (published by the European co-ordination of Notified Bodies) concerning dual-channel safety-related systems with electromechanical outputs. The proof test for the function must be performed at the following intervals, based on the safety integrity requirement:

Safety integrity	Defined maintenance intervals
SIL 3 or PL e (cat. 3 or 4)	at least every month
SIL 2 (HFT = 1) or PL d (cat. 3)	at least every 12 months

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

In addition to proof testing, it is a good practice to check the operation of the function when other maintenance procedures are carried out on the machinery. Include the Safe torque off operation test described above in the routine maintenance program of the machinery that the drive runs.

If any wiring or component change is needed after start up, or the parameters are restored, follow the [STO acceptance test procedure](#) on page 148. Record all maintenance and proof test activities in the machine logbook.

Note: Use only ABB approved spare parts.

■ Competency for STO operations

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



STO fault tracing

The indications given during the normal operation of the Safe torque off function are selected by drive parameter *31.22 STO indication run/stop*.

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

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

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

■ Relevant failure modes

The STO trips spuriously (safe failure) and does not activate when requested.

A fault exclusion on the failure mode “short circuit on printed circuit board” is made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures were analyzed.



STO data

■ Safety data

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

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

Frame size	SIL/SILCL	SC	PL	SFF (%)	PFH _D (T ₁ = 20 a) (1/h)	PFD (T ₁ = 2 a)	MTTF _d (a)	DC (%)	Cat.	HFT	CCF	Life time (a)
R1 to R4	3	3	e	98.8	3.23E-09	2.99E-06	24293	≥90	3	1	80	20

■ Temperature profile for safety value calculations

ΔT	Number of on/off cycles per year
71.66 °C	670 cycles
61.66 °C	1340 cycles
10.0 °C	30 cycles

Board temperature	% of time
32 °C	2.0%
60 °C	1.5%
85 °C	2.3%

■ STO indication data

Safety component	Type A, as defined in IEC 61508-2
STO reaction time (shortest detectable break)	1 ms
STO response time	Frame sizes R1...R4: 2 ms (typical), 5 ms (maximum)
Fault detection time	Channels in different states for longer than 200 ms
Fault reaction time	Fault detection time + 10 ms
STO fault indication (parameter 31.22) delay	< 500 ms
STO warning indication (parameter 31.22) delay	< 1000 ms



■ STO abbreviations

Abbreviation	Reference	Description
Cat.	EN ISO 13849-1	Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage
FIT	IEC 61508	Failure in time: 1E-9 hours
HFT	IEC 61508	Hardware fault tolerance
MTTF _d	EN ISO 13849-1	Mean time to dangerous failure: (The total number of life units) / (the number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD	IEC 61508	Probability of failure on demand
PFH _D	IEC 61508	Probability of dangerous failures per hour
PL	EN ISO 13849-1	Performance level. Levels a...e correspond to SIL
SC	IEC 61508	Systematic capability
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1...3)
SILCL	IEC/EN 62061	Maximum SIL (level 1...3) that can be claimed for a safety function or subsystem
SS1	IEC/EN 61800-5-2	Safe stop 1
STO	IEC/EN 61800-5-2	Safe torque off
T1	IEC 61508	Proof test interval. T1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of T1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. Note that any T1 values given cannot be regarded as a guarantee or warranty. See also section STO function maintenance (page 151).



13

Mains chokes

Contents of this chapter

This chapter describes how to select and install mains chokes for the drive module. The chapter also contains the relevant technical data.

When is a mains choke required?

With frames R1 and R2, the need for an external choke should be determined on a case-by-case basis. With frames R3 and R4, the drive modules have an internal mains choke.

The main choke typically

- reduces harmonics in the input current
- reduces the r.m.s. input current
- reduces supply disturbance and low-frequency interference
- increases the allowed DC bus continuous power
- ensures even current distribution in common DC configurations (see [DC connection](#) on page 82).



Selecting a mains choke

Drive type ACS880-M04	Type	Inductance μH
-03A0-2, -03A0-5	CHK-01	6370
-03A6-2, -03A6-5		
-04A8-2, -04A8-5	CHK-02	4610
-06A0-2, -06A0-5		
-08A0-2, -08A0-5		
-010A-2, -010A-5	CHK-03	2700
-014A-2, -014A-5		
-018A-2, -018A-5	CHK-04 (Internal choke as standard)	1475
-025A-2, -025A-5		
-030A-2, -030A-5		
-035A2, -035A-5		
-044A-2, -044A-5		
-050A-2, -050A-5		
-061A-2, -061A-5		
-078A-2, -078A-5		
-094A-2, -094A-5		

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The mains chokes are protected to IP20. For dimensions, wire sizes and tightening torques, refer [Mains choke – CHK-xx dimensions](#) on page 186.



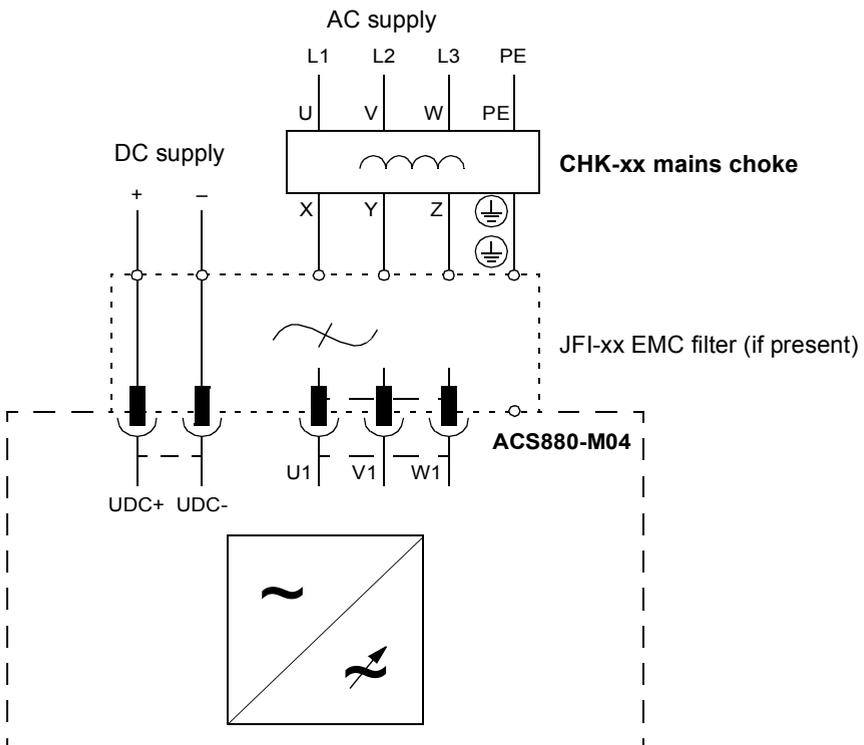
Guidelines for installing the mains choke

- If an EMC filter is also installed, the mains choke is connected between the supply and the EMC filter. See the connection diagram below.
- For optimal operation of the choke, the drive and the choke must be mounted on the same conductive surface.
- Ensure the choke does not block the airflow through the drive module, and that the air rising from the choke is deflected away from the air inlet of the drive module
- Keep the cable between the drive and the choke as short as possible.



WARNING! The surface of the mains choke becomes hot when in use.

Connecting the mains choke





14

EMC filters

Contents of this chapter

This chapter describes how to select and install EMC filters for the drive module. The chapter also contains the relevant technical data.

EMC standards

The EMC product standard (EN 61800-3:2004) covers the specific EMC requirements stated for drives (tested with motor and cable) within the EU.

Standard	Description
EN 55011 or EN 61000-6-3/4	These EMC standards <ul style="list-style-type: none"> • apply to industrial and household equipments and systems including drive components inside. • neither specify cable length nor require a motor to be connected as a load.
EN 61800-3	Drive units complying with this standard are always compliant with comparable categories in EN 55011 and EN 61000-6-3/4, but not necessarily vice versa.



EMC filter emission limits

The emission limits are comparable according to the following general EMC standards.

EN 61800-3:2004, product standard	EN 55011, product family standard for industrial, scientific and medical (ISM) equipment
Category C1	Group 1 Class B
Category C2	Group 1 Class A
Category C3	Group 2 Class A
Category C4	Not applicable

EMC filtering option

Filtering option +E200 is required to meet the category C3 level with the drive module installation, including a motor with a max. 100 m cable. This level corresponds to the A limits for Group 2 equipment according to EN 55011.

With frame sizes R1 and R2, option +E200 is an external filter of type JFI-A1 or JFI-B1.

With frame sizes R3 and R4, the EMC filter is internal.

An external EMC filter of the type JFI-0x is required in order to meet the category C2 level with the drive module installation, including a motor with a max. 100 m cable. This level corresponds to the A limits for Group 1 equipment according to EN 55011.



WARNING! An EMC filter must not be installed if the drive is connected to an IT power system (i.e. an ungrounded, or a high resistance grounded [over 30 ohm] power system) or a corner-grounded TN system.



Selecting EMC filters

Drive type ACS880-M04	Filter type	
	EN 61800-3:2004 Category C3	EN 61800-3: 2004 Category C2
-03A0-2, -03A0-5	Option code +E200 (external filter JFI-A1)	JFI-02*
-03A6-2, -03A6-5		
-04A8-2, -04A8-5		
-06A0-2, -06A0-5		
-08A0-2, -08A0-5		
-010A-2, -010A-5	Option code +E200 (external filter JFI-B1)	JFI-03*
-014A-2, -014A-5		
-018A-2, -018A-5		
-025A-2, -025A-5	Option code: +E200 (internal filter)	JFI-05*
-030A-2, -030A-5		
-035A2, -035A-5		
-044A-2, -044A-5		
-050A-2, -050A-5		
-061A-2, -061A-5		
-078A-2, -078A-5		
-094A-2, -094A-5		JFI-07*

*External filter; to be ordered separately

All EMC filters are protected to IP20. See dimension drawings of [EMC filters \(type JFI-x1\)](#) (page 187) and [EMC filters \(type JFI-0x\)](#) (page 189). For details of dimensions, wire sizes and tightening torques see [EMC filter – JFI-xx dimensions](#) on page 190.

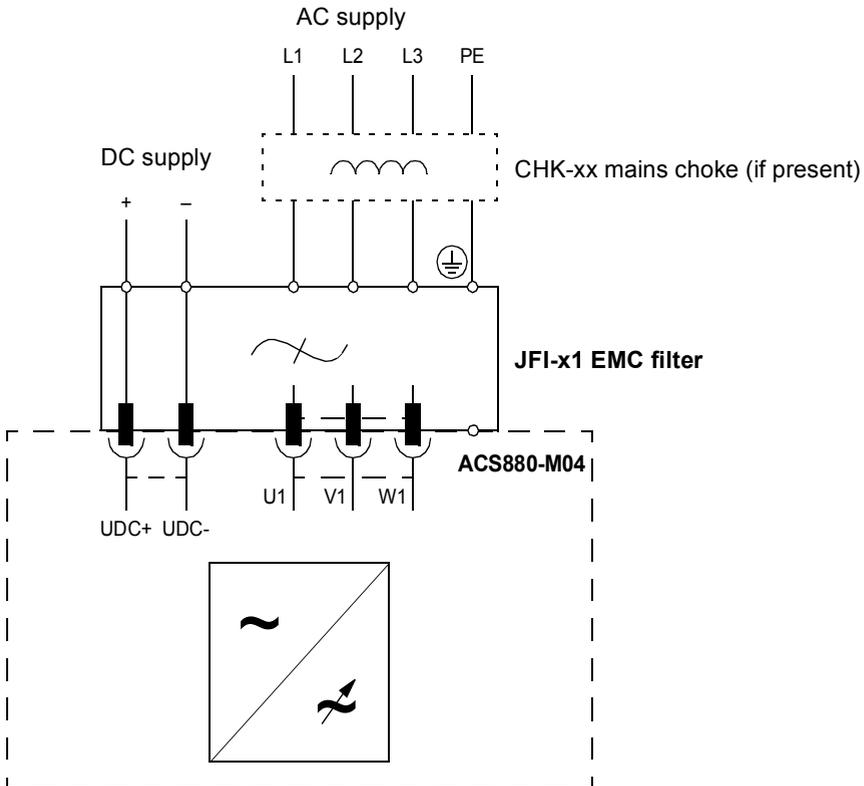


Installing EMC filters – JFI-A1/JFI-B1 (Frame R1/R2, category C3)

JFI-x1 filter installation guidelines

- Connect the filter directly to the drive input connectors.
- For optimal operation of the filter, mount the drive and the filter on the same conductive surface.

JFI-x1 filter connection diagram



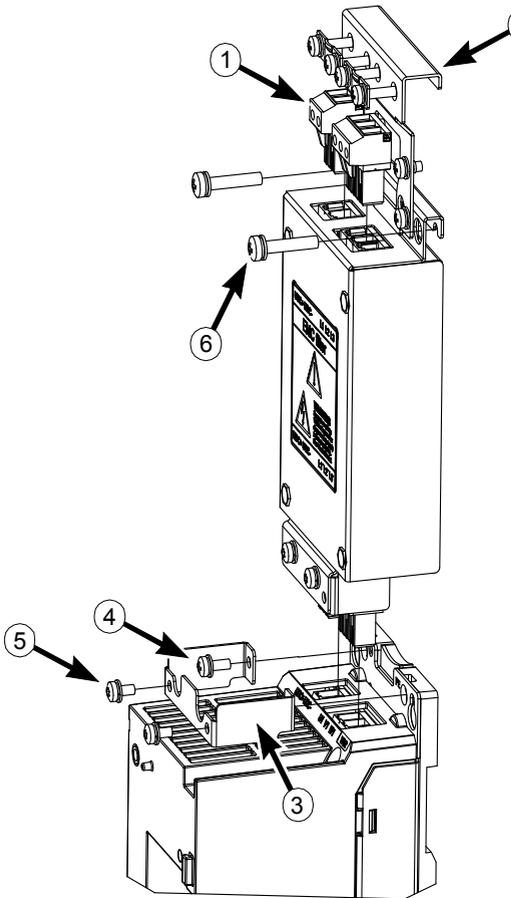
■ Installing the JFI-A1 filter

To install the JFI-A1 EMC filter,

1. Remove the UDC+/- and U1/V1/W1 terminal blocks (1), and the upper power cable clamp plate (2) from the drive.
2. Fasten the mounting bracket (3) to the drive module base with two screws (4). Tighten to 1.5 N·m (13 lbf·in).
3. Push the filter into place through the mounting bracket.
4. Fasten the filter to the mounting bracket with two screws (5). Tighten to 1.5 N·m (13 lbf·in).
5. Fasten the top edge of the filter to the mounting base with two screws (6).
6. Fasten the power cable clamp plate at the top of the filter. Tighten to 1.5 N·m (13 lbf·in).



7. Attach the terminal blocks to the filter.



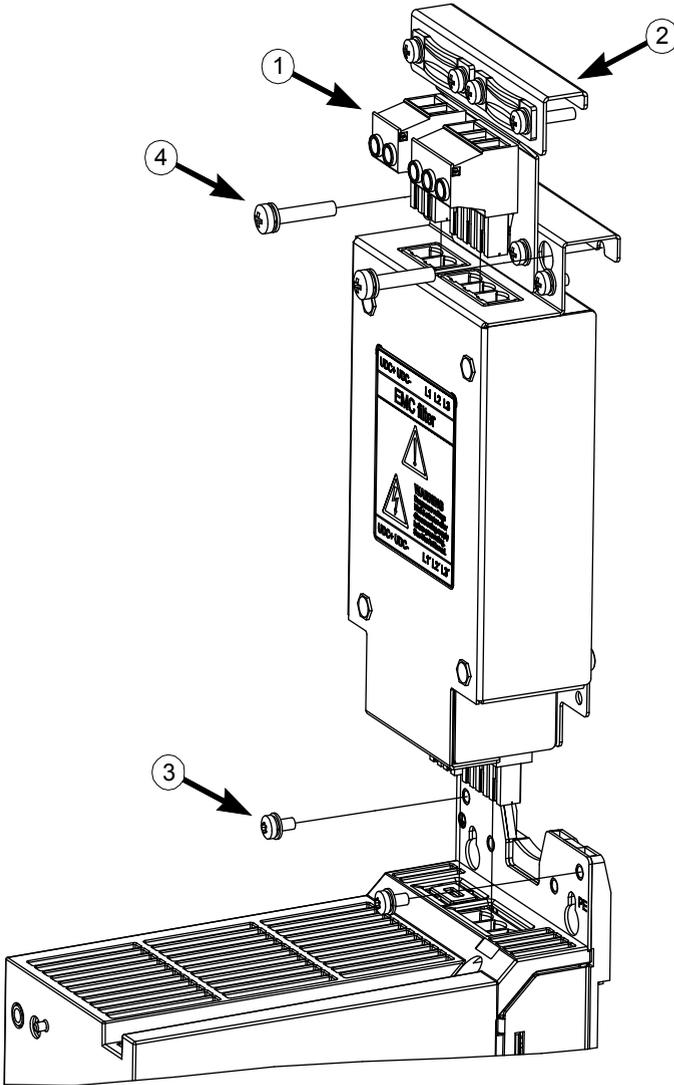
■ Installing the JFI-B1 filter

To install the JFI-B1 EMC filter,

1. Remove the UDC+/- and U1/V1/W1 terminal blocks (1), and the upper power cable clamp plate (2) from the drive.
2. Push the filter into the connectors.
3. Fasten the filter to the drive module base with two screws (3). Tighten to 1.5 N·m (13 lbf·in).
4. Fasten the top edge of the filter to the mounting base with two screws (4).
5. Fasten the power cable clamp plate at the top of the filter. Tighten to 1.5 N·m (13 lbf·in).



6. Attach the terminal blocks to the filter.

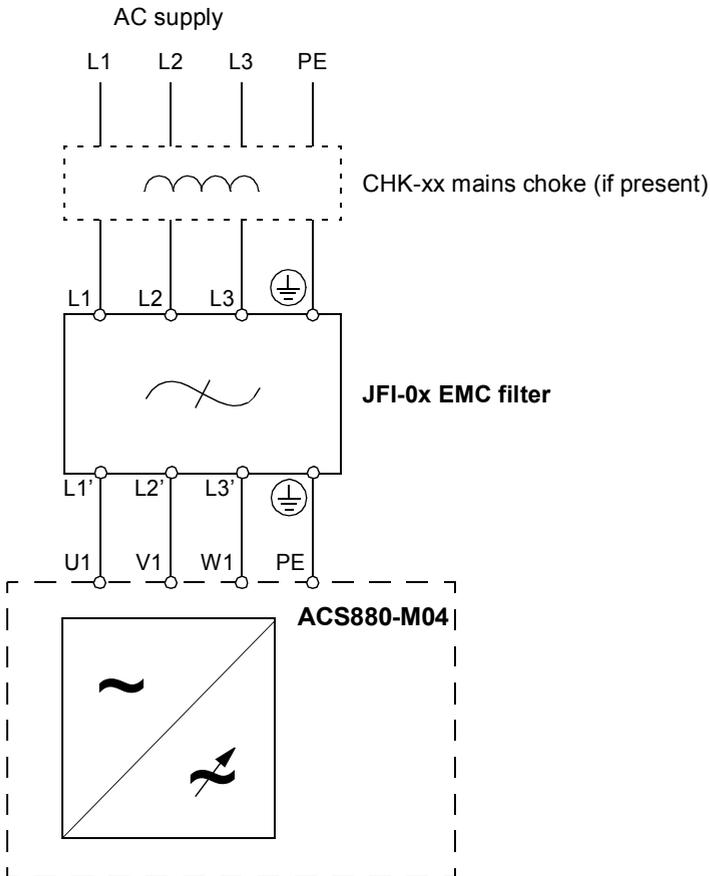


Installing EMC filter – JFI-0x (Frames R1...R4, category C2)

JFI-0x filter installation guidelines

- If a mains choke is also installed, the EMC filter is connected between the mains choke and the drive module. See the connection diagram below.
- For optimal operation of the filter, the drive and the filter must be mounted on the same conductive surface.
- Ensure the filter does not block the airflow through the drive module.
- Keep the cable between the drive and the filter as short as possible.

JFI-0x filter connection diagram





15

du/dt and common mode filtering

Contents of this chapter

This chapter describes how to select du/dt and common mode filtering for the drive module. 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 drive technology. The motor and motor cable insulation may undergo the following situation:

- 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.

Use the,

- optional ABB du/dt filters to avoid stress on motor insulation
- common mode filters to reduce bearing currents.

Note: To avoid damage to the motor bearings, select and install the cables according to the instructions given in [Electrical installation](#) on page 73.



Selecting the *du/dt* filters



Warning! Use the *du/dt* filtering, common mode filtering, and insulated N-end bearings according to the following table.

If you ignore these requirements, the motor life can shorten or damage to the motor bearings can occur, and the warranty is not applicable.

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.

Motor type	Nominal AC supply voltage	Requirement for	
		Motor insulation system	ABB <i>du/dt</i> and common mode filters, insulated N-end motor bearings
			$P_N < 100 \text{ kW}$ and frame size $< \text{IEC 315}$
			$P_N < 134 \text{ hp}$ and frame size $< \text{NEMA 500}$
ABB motors			
Random-wound M2_, M3_ and M4_	$U_N \leq 500 \text{ V}$	Standard	-
Form-wound HX_ and AM_	$U_N \leq 500 \text{ V}$	Standard	-
Old* form-wound HX_ and modular	$U_N \leq 500 \text{ V}$	Check with the motor manufacturer.	+ N + CMF
Random-wound HX_ and AM_ **	$0 \text{ V} < U_N \leq 500 \text{ V}$	Enamelled wire with fiber glass taping	+ N + CMF
Non-ABB motors			
Random-wound and form-wound	$U_N \leq 420 \text{ V}$	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	-
	$420 \text{ V} < U_N \leq 500 \text{ V}$	Standard: $\hat{U}_{LL} = 1300 \text{ V}$	+ <i>du/dt</i>
		or	
		Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$, 0.2 microsecond rise time	-

*manufactured before 1.1.1998

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

The abbreviations used in the table are defined below.

Abbreviation	Definition
U_N	Nominal AC line voltage
\hat{U}_{LL}	Peak line-to-line voltage at motor terminals which the motor insulation must withstand
P_N	Motor nominal power
du/dt	du/dt filter at the output of the drive
CMF	Common mode filter
N	N-end bearing: insulated motor non-drive end bearing

■ Additional requirements for ABB motors of types other than M2_, M3_, M4_, HX_ and AM_

Use the selection criteria given for non-ABB motors.

■ Additional requirements for the braking applications

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

Example: Select the motor insulation system for a 400 V AC line voltage application as if the drive were supplied with 480 V.

Installing du/dt and common mode filters

Follow the instructions provided with the filters.



du/dt filters data

du/dt filter types

Drive type ACS880-M04	Filter type
-03A0-2, -03A0-5	NOCH0016-60 (3-phase)
-03A6-2, -03A6-5	
-04A8-2, -04A8-5	
-06A0-2, -06A0-5	
-08A0-2, -08A0-5	
-010A-2, -010A-5	
-014A-2, -014A-5	
-018A-2, -018A-5	
-025A-2, -025A-5	NOCH0030-60 (3-phase)
-030A-2, -030A-5	
-035A2, -035A-5	
-044A-2, -044A-5	NOCH0070-60 (3-phase)
-050A-2, -050A-5	
-061A-2, -061A-5	
-078A-2, -078A-5	
-094A-2, -094A-5	NOCH0120-60 (1-phase; three filters included in kit)

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Common mode filter types

Contact your local ABB representative.

du/dt filters dimensions and weights

Filter type	Height mm (inches)	Width mm (inches)	Depth mm (inches)	Weight kg (lbs)
NOCH0016-60	195 (7.68)	140 (5.51)	115 (4.53)	2.4 (5.3)
NOCH0030-60	215 (8.46)	165 (6.50)	130 (5.12)	4.7 (10.4)
NOCH0070-60	261 (10.28)	180 (7.09)	150 (5.91)	9.5 (20.9)
NOCH0120-60*	200 (7.87)	154 (6.06)	106 (4.17)	7.0 (15.4)

*Dimensions given are per phase

du/dt filters degree of protection

IP00



16

Resistor braking

Contents of this chapter

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

Selecting brake choppers and resistors

■ Brake choppers

The ACS880-M04 (frames R1...R4) drives have a built-in brake chopper as standard equipment to handle the energy generated by a decelerating motor.

When the brake chopper is enabled and a resistor is connected, the chopper starts conducting when the DC link voltage of the drive reaches $U_{DC_BR} - 30$ V.

The maximum braking power is achieved at $U_{DC_BR} + 30$ V. Pre-selected resistors
 $U_{DC} = 1.35 \times \text{Used AC supply voltage}$

$$U_{DC_BR} = 1.25 \times U_{DC}$$

See the available ABB brake choppers shown in the [Brake choppers data table](#) on page 175.



■ Brake resistors

To select a brake resistor, calculate the following:

1. maximum power generated by the motor during braking
2. continuous power based on the braking duty cycle
3. braking energy during the duty cycle.

Pre-selected resistors are available from ABB as shown in the [Brake resistors data table](#) on page 177. If the listed resistor is not sufficient for the application, a custom resistor can be selected within the limits imposed by the internal brake chopper of the ACS880-M04. The following rules apply:

- The resistance of the custom resistor must be at least R_{\min} . The braking power capacity with different resistance values can be calculated from the following formula:

$$P_{\max} < \frac{(U_{\text{DC_BR}} + 30 \text{ V})^2}{R}$$

 **WARNING!** Never use a brake resistor with a resistance below the value specified for the particular drive type. The drive and the chopper are not able to handle the overcurrent caused by the low resistance.

- The maximum braking power must not exceed P_{brmax} at any point
- The average braking power must not exceed P_{brcont}
- The braking energy must not exceed the energy dissipation capacity of the selected resistor
- The resistor must be protected from thermal overload; see section [Contactor protection of drive](#) on page 179.



Brake choppers data table

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

Drive type ACS880-M04	Internal brake chopper							
	P_{br5} (kW)	P_{br5} (kW) L	P_{br10} (kW)	P_{br10} (kW) L	P_{brcont} (kW)	P_{brcont} (kW) L	P_{brmax} (kW)	R_{min} (ohm)
-03A0-2	0.5	0.2	0.5	0.2	0.45	0.15	2.75	120
-03A6-2	0.75	0.3	0.7	0.25	0.65	0.2		
-04A8-2	1.0	0.3	1.0	0.3	0.9	0.25		
-06A0-2	1.5	0.8	1.4	0.75	1.3	0.35		
-08A0-2								
-010A-2	2.8	1.0	2.7	0.9	2.25	0.75	4.0	80
-014A-2	4.1	1.3	3.9	1.2	3.3	1.1	7.3	40
-018A-2	5.3	1.7	5.1	1.6	4.25	1.4		
-025A-2	6.8	3.8	6.5	3.4	5.25	2.7	15.4	20
-030A-2	7.8	4.4	7.4	4.0	6	3.1		
-035A-2								
-044A-2	11.4	6.4	10.8	5.7	8.75	4.5	22.0	13
-050A-2								
-061A-2	20.2	14.0	20.0	11.8	18	8		
-078A-2								
-094A-2								
-03A0-5	1.0	0.4	1.0	0.4	0.9	0.3	5.5	120
-03A6-5	1.5	0.5	1.4	0.5	1.3	0.4		
-04A8-5	2.0	0.6	1.9	0.6	1.8	0.5		
-06A0-5	3.0	1.6	2.8	1.5	2.6	0.7		
-08A0-5								
-010A-5	5.5	1.9	5.3	1.8	4.5	1.5	7.9	80
-014A-5	8.2	2.6	7.8	2.4	6.6	2.1	14.6	40
-018A-5	10.5	3.4	10.1	3.2	8.5	2.7		
-025A-5	13.6	7.6	12.9	6.8	10.5	5.4	30.7	20
-030A-5	15.5	8.8	14.7	7.9	12	6.2		
-035A-5								
-044A-5	22.7	12.7	21.5	11.4	17.5	9	43.9	13
-050A-5								
-061A-5	40.4	28.0	40.0	23.6	36	16		
-078A-5								
-094A-5								

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L = Low motor noise mode. See section [Low motor noise derating](#) on page 113.

P_{br5} = The drive (drive and chopper) withstands this braking power for 5 seconds per minute.

P_{br10} = The drive (drive and chopper) withstands this braking power for 10 seconds per minute.



P_{brcont} = The drive (drive and chopper) withstands this continuous braking power. Braking is considered continuous if braking time exceeds 30 seconds.

P_{brmax} = Maximum braking power of the drive (drive and chopper). The drive (drive and chopper) withstands this braking power for 1 second within every 10 seconds.

Note: The listed resistors withstand this braking power for 1 second within every 120 seconds.

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



Brake resistors data table

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

Drive type ACS880-M04	Example brake resistor JBR-xx				Example brake resistor SACExxxxx			
	Type	R (ohm)	P_n (W)	E_{pulse} (kJ)	Type	R (ohm)	P_{Rcont} (kW)	E_R (kJ)
-03A0-2, -03A0-5	JBR-01	120	105	22	-	-	-	-
-03A6-2, -03A6-5								
-04A8-2, -04A8-5								
-06A0-2, -06A0-5								
-08A0-2, -08A0-5								
-010A-2, -010A-5	JBR-03	80	135	40	-	-	-	-
-014A-2, -014A-5	JBR-04	40	360	73	SACE08RE44	44	1	210
-018A-2, -018A-5								
-025A-2, -025A-5	JBR-05	20	570	77	SACE15RE22	22	2	420
-030A-2, -030A-5								
-035A-2, -035A-5								
-044A-2, -044A-5	JBR-06	13	790	132	SACE15RE13	13	2	435
-050A-2, -050A-5								
-061A-2, -061A-5								
-078A-2, -078A-5								
-094A-2, -094A-5								

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R = Resistance of the listed resistor.

P_n = Continuous power (heat) dissipation of the listed resistor when cooled naturally in a vertical position.

E_{pulse} = Energy pulse the listed resistor will withstand.

P_{Rcont} = Continuous power (heat) dissipation of the resistor when placed correctly. Energy E_R dissipates in 400 seconds.

E_R = Short energy pulse that the resistor assembly withstands every 400 seconds. This energy will heat the resistor element from 40°C (104°F) to the maximum allowable temperature.

Note: All brake resistors must be installed outside the drive module.

■ Brake resistors degree of protection

Resistor type	Degree of protection
JBR-xx	IP20
SACE	IP21

Note: The SACE resistors are not UL listed.



■ Brake resistors dimensions

See dimensions drawings of [Brake resistors \(type JBR-xx\)](#) on page [191](#). For details of dimensions, wire sizes and tightening torques, see [Brake resistor - JBR-xx dimensions](#) on page [192](#).



Installing and wiring brake resistors

All resistors must be installed outside the drive module in a place where they are cooled sufficiently, do not block the airflow to other equipment, or dissipate hot air into the air inlets of other equipment.



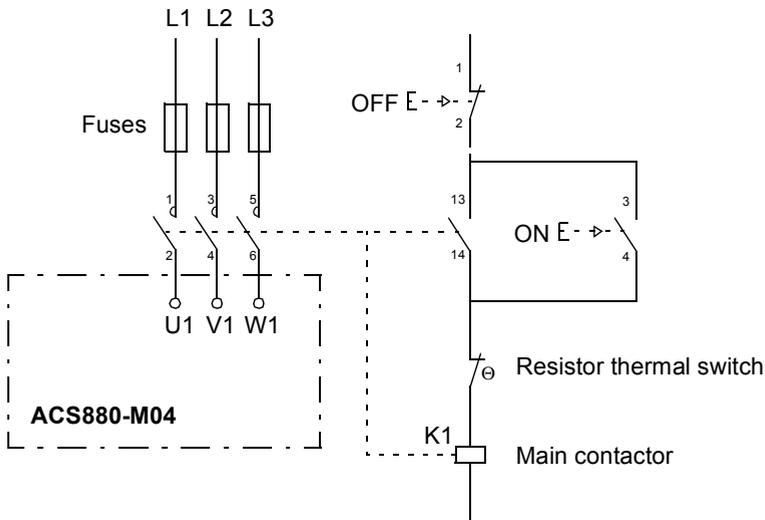
WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor may rise above 200 °C (400 °F), and the temperature of the air flowing from the resistor is hundreds of degrees Celsius. Protect the resistor against contact.

The maximum length of the resistor cable(s) is 20 m (65 ft). For the connections, see [Cable routing diagram](#) on page 64.

■ Contactor protection of drive

The drive must be equipped with a main contactor for safety reasons. Wire the contactor so that it opens in case the resistor overheats. This is essential for safety since the drive will not otherwise be able to interrupt the main supply if the chopper remains conductive in a fault situation.

Below is a simple example wiring diagram.



Commissioning the braking circuit

For more information, see the *firmware manual*.

1. Enable the brake chopper function. Please note that a brake resistor must be connected when the chopper is enabled from group 43 *Brake chopper*.
2. Switch Off the overvoltage control of the drive with parameter 30.30 *Overvoltage control*.
3. Adjust any other relevant parameters in group 43 *Brake chopper*.



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

Note: Some brake resistors are coated with oil film for protection. At the start-up, the coating burns off and produces a little bit of smoke. Ensure proper ventilation at the start-up.



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Dimension drawings

Contents of this chapter

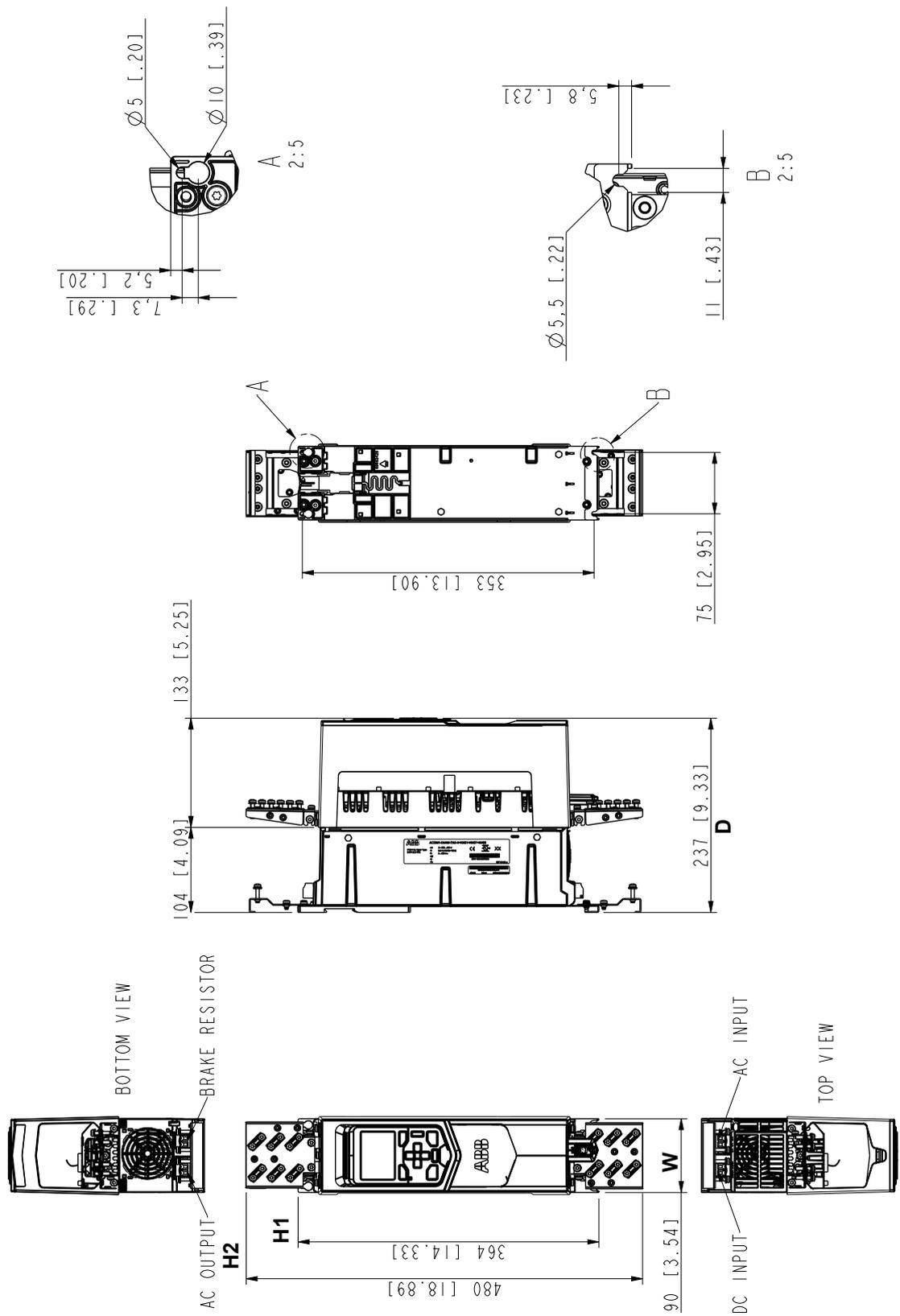
The dimension drawings of the ACS880-M04 drive (frame sizes R1, R2, R3 and R4) and the related accessories are show below. The dimensions are given in millimetres and inches.

See,

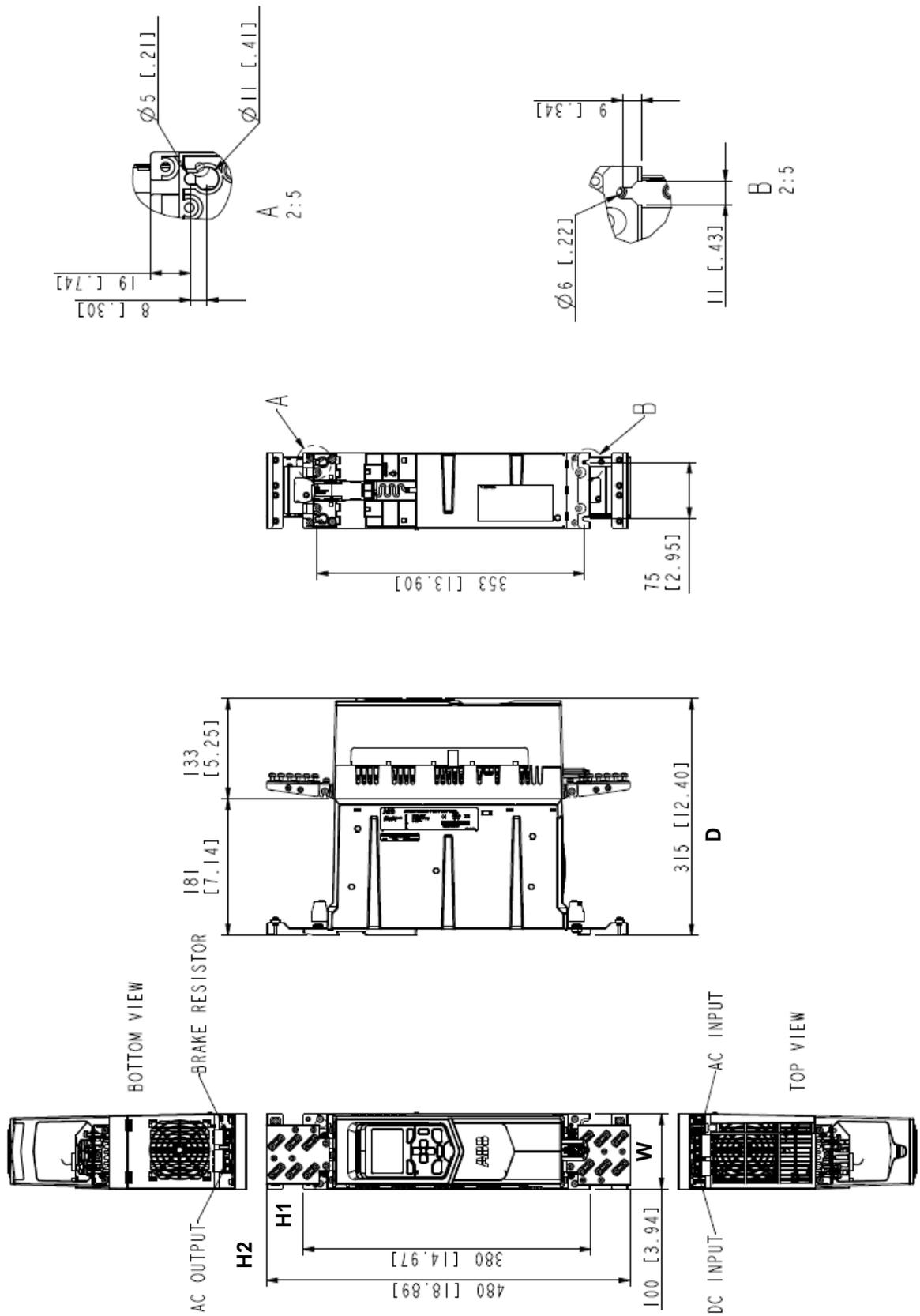
- [Frame size R1](#) on page [182](#)
- [Frame size R2](#) on page [183](#)
- [Frame size R3](#) on page [184](#)
- [Frame size R4](#) on page [185](#)
- [Mains chokes \(type CHK-0x\)](#) on page [186](#)
- [EMC filters \(type JFI-x1\)](#) on page [187](#)
- [EMC filters \(type JFI-0x\)](#) on page [189](#)
- [Brake resistors \(type JBR-xx\)](#) on page [191](#)



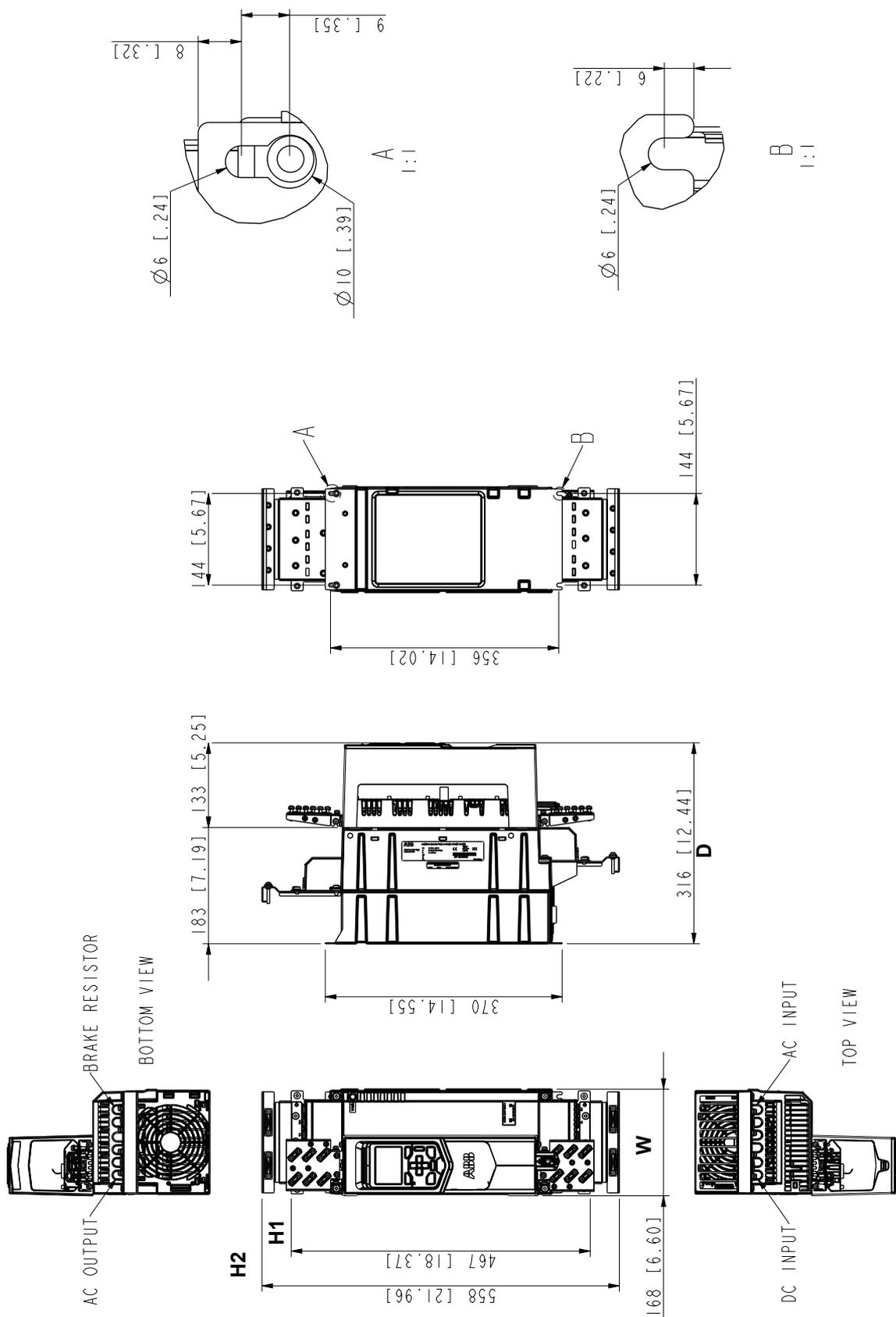
Frame size R1



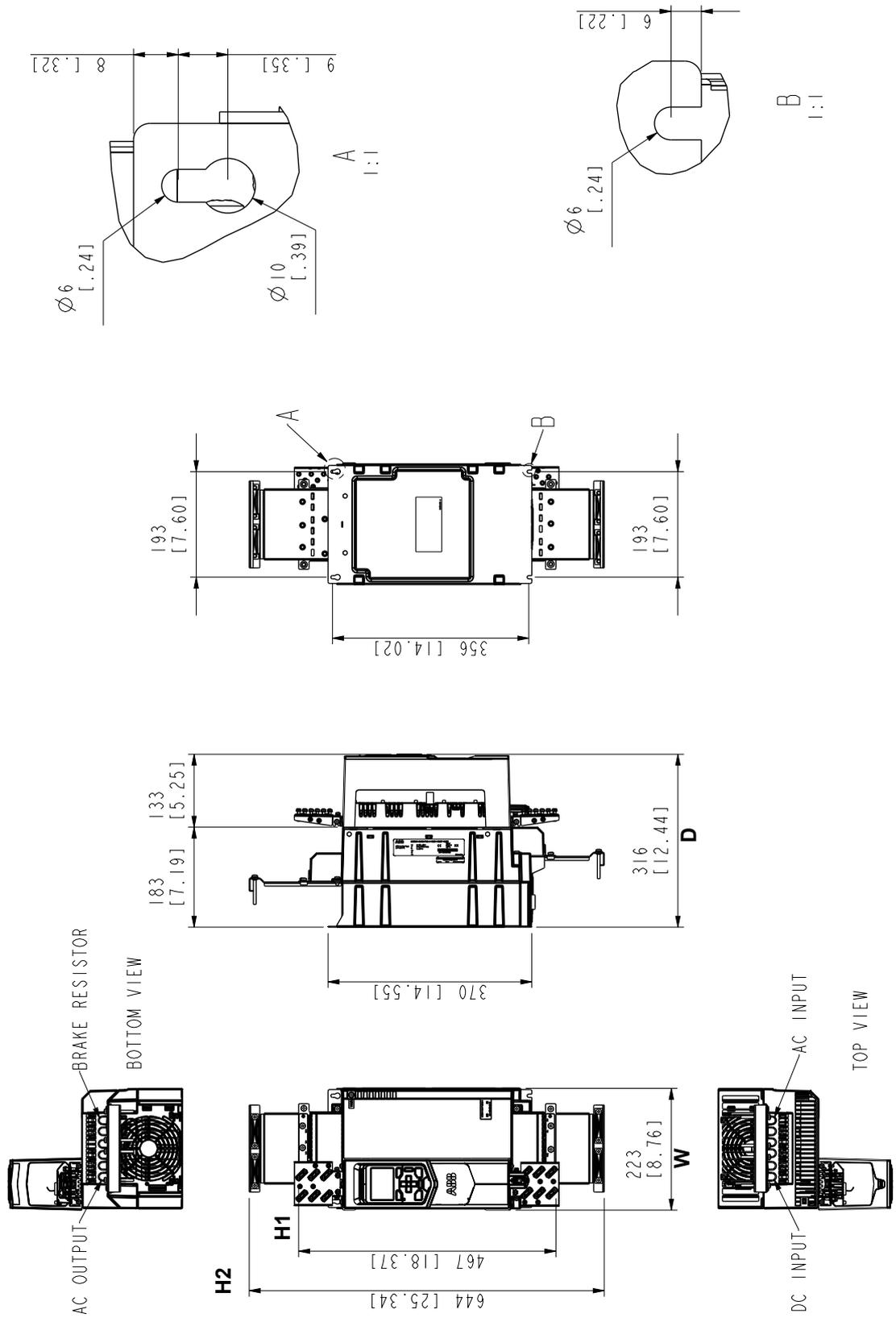
Frame size R2



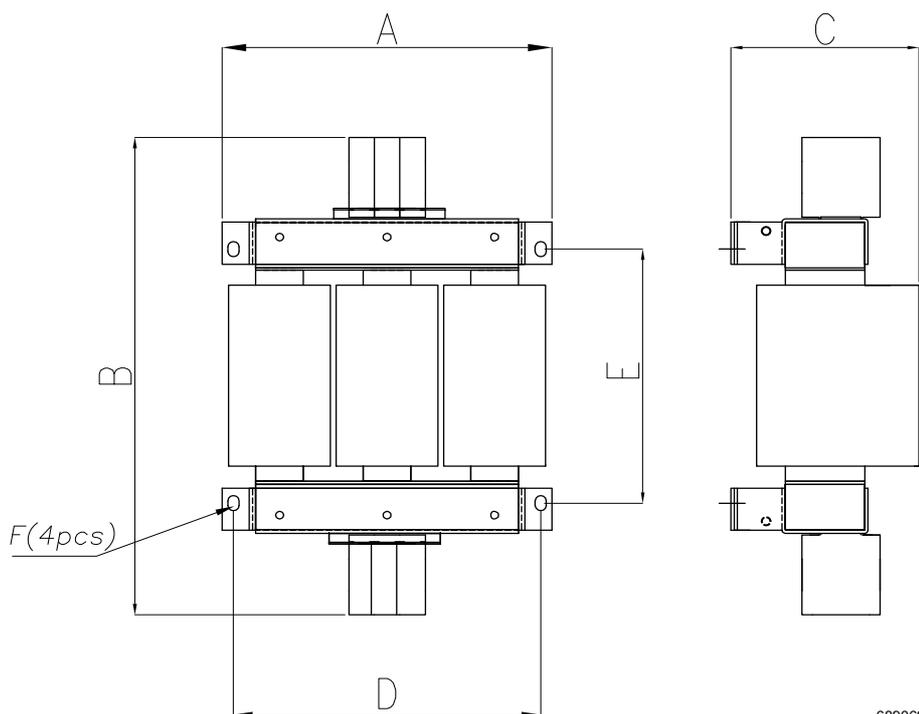
Frame size R3



Frame size R4



Mains chokes (type CHK-0x)

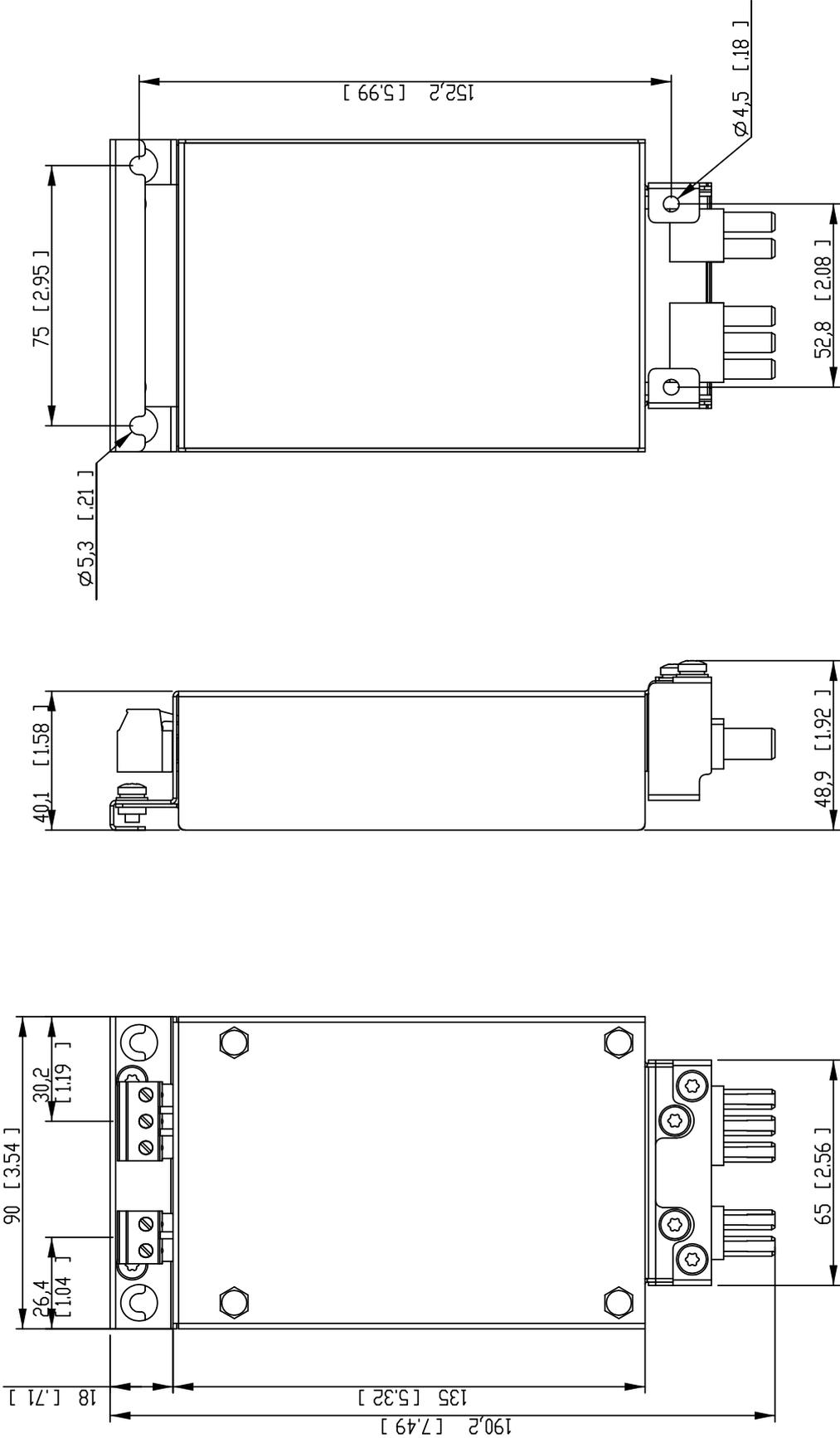


■ Mains choke – CHK-xx dimensions

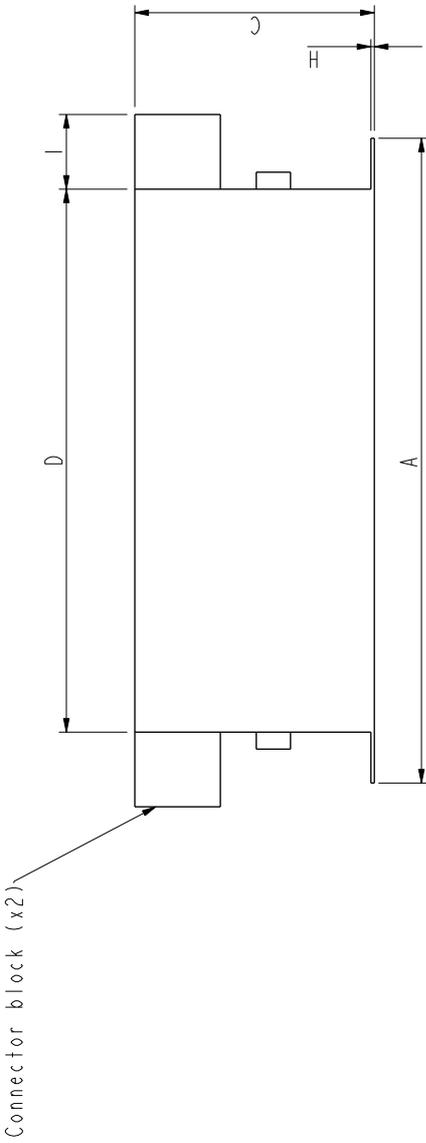
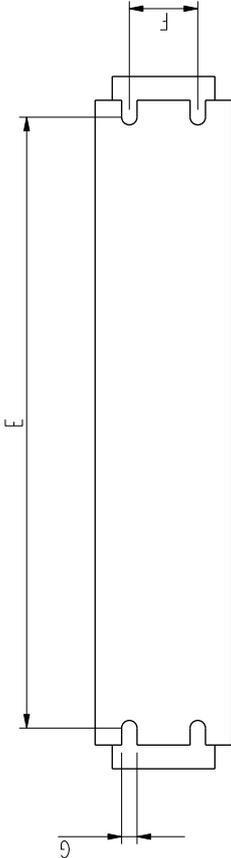
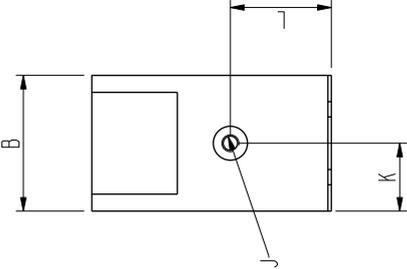
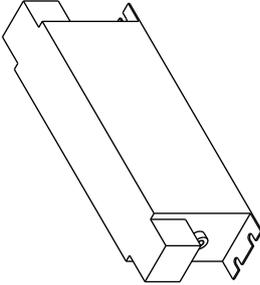
Parameter	Choke type			
	CHK-01	CHK-02	CHK-03	CHK-04
dim A mm (in.)	120 (4.72)	150 (5.91)	150 (5.91)	150 (5.91)
dim B mm (in.)	146 (5.75)	175 (6.89)	175 (6.89)	175 (6.89)
dim C mm (in.)	79 (3.11)	86 (3.39)	100 (3.94)	100 (3.94)
dim D mm (in.)	77 (3.03)	105 (4.13)	105 (4.13)	105 (4.13)
dim E mm (in.)	114 (4.49)	148 (5.83)	148 (5.83)	148 (5.83)
F screw size	M5	M5	M5	M5
Weight kg (lbs)	1.8 (4.0)	3.8 (8.4)	5.4 (11.9)	5.2 (11.5)
Wire size – Main terminals mm ² (AWG)	0.5 ... 10 (20...6)	0.5 ... 10 (20...6)	0.5 ... 10 (20...6)	0.5 ... 10 (20...6)
Tightening torque – Main terminals N·m (lbf·in)	1.5 (13)	1.5 (13)	1.5 (13)	1.5 (13)
PE/Chassis terminals	M4	M5	M5	M5
Tightening torque – PE/Chassis terminals N·m (lbf·in)	3 (26)	4 (35)	4 (35)	4 (35)

EMC filters (type JFI-x1)

JFI-A1



EMC filters (type JFI-0x)

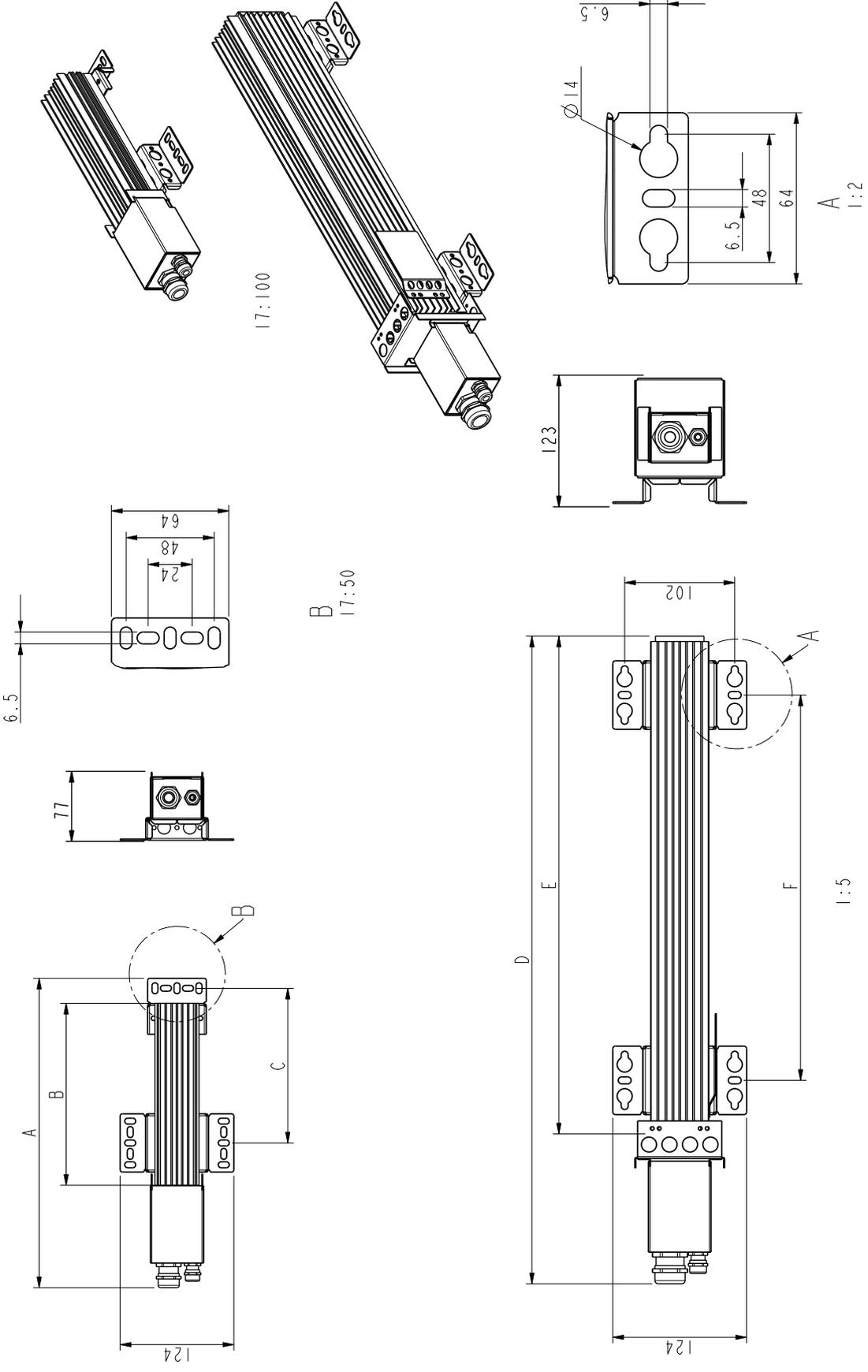


1:2

■ EMC filter – JFI-xx dimensions

Parameter	Filter type			
	JFI-02	JFI-03	JFI-05	JFI-07
Dim. A mm (in.)	250 (9.84)	250 (9.84)	250 (9.84)	270 (10.63)
Dim. B mm (in.)	45 (1.77)	50 (1.97)	85 (3.35)	90 (3.54)
Dim. C mm (in.)	70 (2.76)	85 (3.35)	90 (3.54)	150 (5.91)
Dim. D mm (in.)	220 (8.66)	240 (9.45)	220 (8.66)	240 (9.45)
Dim. E mm (in.)	235 (9.25)	255 (10.04)	235 (9.25)	255 (10.04)
Dim. F mm (in.)	25 (0.98)	30 (1.18)	60 (2.36)	65 (2.56)
Dim. G mm (in.)	5.4 (0.21)	5.4 (0.21)	5.4 (0.21)	6.5 (0.26)
Dim. H mm (in.)	1 (0.04)	1 (0.04)	1 (0.04)	1.5 (0.06)
Dim. I mm (in.)	22 (0.87)	25 (0.98)	39 (1.54)	45 (1.77)
Dim. J	M5	M5	M6	M10
Dim. K mm (in.)	22.5 (0.89)	25 (0.98)	42.5 (1.67)	45 (1.77)
Dim. L mm (in.)	29.5 (1.16)	39.5 (1.56)	26.5 (1.04)	64 (2.52)
Weight kg (lbs)	0.8 (1.75)	1.1 (2.4)	1.8 (4.0)	3.9 (8.5)
Wire size (solid) mm ² (AWG)	0.2 ... 10 (AWG24...8)	0.5 ... 16 (AWG20...6)	6...35 (AWG8...2)	16...50 (AWG4...1/0)
Wire size (stranded) mm ² (AWG)	0.2 ... 6 (AWG24...10)	0.5 ... 10 (AWG20...8)	10...25 (AWG6...4)	16...50 (AWG4...1/0)
Tightening torque of terminals N·m (lbf·in)	1.5 ... 1.8 (13.3 ... 15.9)	1.5 ... 1.8 (13.3 ... 15.9)	4.0 ... 4.5 (35 ... 40)	7...8 (60...70)

Brake resistors (type JBR-xx)



■ Brake resistor - JBR-xx dimensions

Parameter	Resistor type				
	JBR-01	JBR-03	JBR-04	JBR-05	JBR-06
Dim. A mm (in.)	295 (11.61)	340 (13.39)	–	–	–
Dim. B mm (in.)	155 (6.10)	200 (7.87)	–	–	–
Dim. C mm (in.)	125 (4.92)	170 (6.69)	–	–	–
Dim. D mm (in.)	–	–	345 (13.58)	465 (18.31)	595 (23.43)
Dim. E mm (in.)	–	–	210 (8.27)	330 (12.99)	460 (18.11)
Dim. F mm (in.)	–	–	110 (4.33)	230 (9.06)	360 (14.17)
Weight kg (lbs)	0.75 (1.7)	0.8 (1.8)	1.8 (4.0)	3.0 (6.6)	3.9 (8.6)
Max. wire size – Main terminals	10 mm ² (AWG6)				
Tightening torque – Main terminals	1.5 ... 1.8 N·m (13 ... 16 lbf·in)				
Max. wire size – Thermal switch terminals	4 mm ² (AWG12)				
Tightening torque – Thermal switch terminals	0.6 ... 0.8 N·m (5.3 ... 7.1 lbf·in)				



Further information

Product and service inquiries

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

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