ABB industrial drives

Hardware manual
ACS880-04F drive modules

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List of related manuals

Drive hardware manuals and guides	Code (English)
Drive/Converter/Inverter safety instructions	Multilingual code: *3AXD50000037978*
ACS880-04F drive modules hardware manual	*3AXD50000034664*
ACS880-04F drive modules quick installation guide	*3AXD50000044913*
ACS-AP-x Assistant control panels user's manual	*3AUA0000085685*
ACS880-01/04 +C132 marine type-approved drives supplement	*3AXD50000010521*

Drive firmware manuals and guides	
ACS880 primary control program firmware manual	*3AUA0000085967*
Quick start-up guide for ACS880 drives with primary control program	*3AUA0000098062*

Option manuals and guides	
DPMP-01 mounting platform for ACS-AP control panel installation guide	*3AUA0000100140*
DPMP-02/03 mounting platform for ACS-AP-X control panels installation guide	*3AUA0000136205*
FSO-12 safety functions module user's manual	*3AXD50000015612*
ACS880 ATEX-certified Safe disconnection function application guide	*3AUA0000132231*
ACS880-01 drives and ACS880-04 drive modules common DC systems application guide	*3AUA0000127818*
FOCH du/dt filters hardware manual	*3AFE68577519*
Sine filters hardware manual	*3AXD50000016814*
Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.	

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.

The code below opens an on-line listing of the manuals applicable to this product.

ACS880-04 manuals

Hardware manual

ACS880-04F drive modules

3AXD50000034664 Rev A
EN
EFFECTIVE: 2016-12-28

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1

Safety instructions

Contents of this chapter

This chapter contains the safety instructions which you must obey 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 warnings and notes

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

The manual uses these warning symbols:

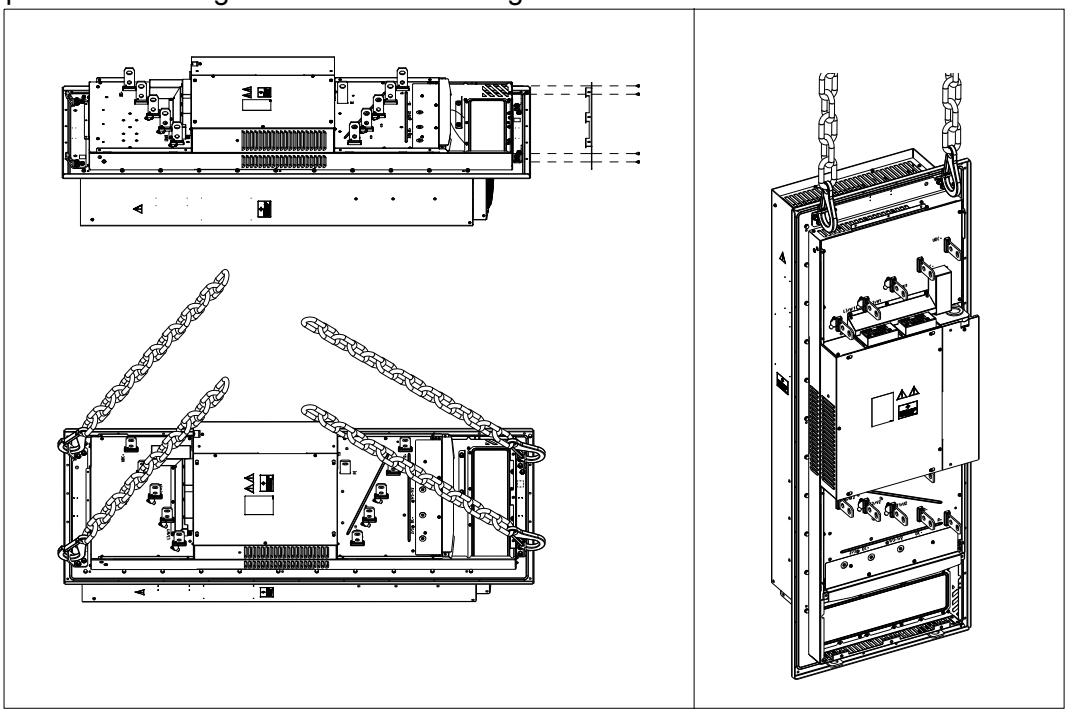
	**Electricity warning** tells about hazards from electricity which can cause injury or death, or damage to the equipment.
	**General warning** tells about conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.
	**Electrostatic sensitive devices warning** tells you about the risk of electrostatic discharge which can cause damage to the equipment.

General safety in installation, start-up and maintenance

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

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

- Use protective gloves when working on the drive module.
- Handle the drive module carefully:
  - Use safety shoes with a metal toe cap to prevent foot injury.
  - Lift the drive module only by the lifting lugs.
    Note: Before you lift the module horizontally, remove the bottom grille in order to prevent distorting. Reinstall it after lifting.



- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Make sure that debris from borings and grindings does not enter the drive during the installation. Electrically conductive debris inside the drive may cause damage or malfunction.
- Make sure that there is sufficient cooling.
- Before you connect voltage to the drive, make sure that the cabinet doors are closed. Keep the doors closed during the operation. Obey the panel builder’s instructions.
- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY”.

- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.
- Make sure that any safety circuits (for example, emergency stop and Safe torque off) are validated in start-up. See chapter *Start-up* for reference of the validation instructions.

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. See the firmware manual.
- When the control location is not set to Local, the stop key on the control panel will not stop the drive.

Electrical safety in installation, start-up and maintenance

Precautions before electrical work

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

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

1. Clearly identify the work location.
2. Disconnect all possible voltage sources.
   - Open the main disconnector of the drive.
   - Open the disconnector of the supply transformer as the main disconnector of the drive does not remove the voltage from the input busbars of the drive.
   - Make sure that reconnection is not possible. Lock the disconnectors to open position and attach a warning notice to them.
   - Disconnect any external power sources from the control circuits before you do work on the control cables.
   - After you disconnect the drive, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized.
   - Use a multimeter with an impedance of at least 1 Mohm.
   - Make sure that the voltage between the drive module input power terminals (L1/U1, L2/V1, L3/W1) and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive module UDC+ and UDC- terminals and the grounding (PE) busbar 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! Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- If you are not a qualified electrician, do not do installation or maintenance work.
- Do not install a drive with EMC filter option +E200 on an ungrounded power system or a high resistance-grounded (over 30 ohms) power system.
- Do not connect the drive to a voltage higher than what is on the type designation label. If you do, the brake chopper starts to operate which causes the overheating of the brake resistor (if present). Overvoltage can also cause the motor to rush to its maximum speed.
- We do not recommend that you secure the cabinet by arc welding.
- 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 bus 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 (XRO1, XRO2 and XRO3).
- 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 boards contain components sensitive to electrostatic discharge.

WARNING! Obey these instructions. If you ignore them, equipment malfunction and damage to the fiber optic cables can occur.

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

Grounding

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

WARNING! Obey 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. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- Make sure that the conductivity of the grounding conductors is sufficient. See section *Selecting the power cables* on page *62*. Obey the local regulations.
- Connect the power cable shields to protective earth (PE) of the drive to make sure of personnel safety.
- Make a 360° grounding of the power and control cable shields at the cable entries to suppress electromagnetic disturbances.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) busbar of the switch board or the transformer.

Note:

- You can use power cable shields as grounding conductors only when their conductivity is sufficient.
- 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 connection. See standard EN 61800-5-1, 4.3.5.5.2.

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! Obey these instructions. If you ignore them, injury or death and equipment malfunction can occur.

- Do not do work on the drive when the permanent magnet motor is rotating. 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/U2, T2/V2, T3/W2) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive input power terminals (L1/U1, L2/V1, L3/W1) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive module UDC+ and UDC- terminals and the grounding (PE) busbar is close to 0 V.
- Install temporary grounding to the drive output terminals (T1/U2, T2/V2, T3/W2). Connect the output terminals together as well as to the PE.
- Make sure that the operator cannot run the motor over the rated speed. Motor overspeed causes overvoltage can damage or explode the capacitors in the intermediate circuit of the drive.

2

Introduction to the manual

Contents of this chapter

This chapter describes the intended audience and contents of the 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.

Target audience

This manual is intended for persons who

- plan the cabinet assembly of the drive module and install the module into a user-defined cabinet
- plan the electrical installation of the drive cabinet
- make instructions for the end user of the drive concerning the mechanical installation of the drive cabinet, connection of power and control cables to the cabinet-installed drive and maintenance of the drive.

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

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

Contents of the manual

This manual contains the instructions and information for the basic drive module configuration. The chapters of the manual are briefly described below.

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

Introduction to the manual introduces the manual.

Operation principle and hardware description describes the drive module.

Guidelines for planning the mechanical installation guides in planning drive cabinets and installing the drive module into a user-defined cabinet. The chapter gives cabinet layout examples and free space requirements around the module for cooling.

Mechanical installation describes how to install the drive module mechanically.

Guidelines for planning the electrical installation instructs in the motor and cable selection, protections and cable routing.

Electrical installation gives instructions on the wiring of the drive.

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

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

Fault tracing describes the LED indications and refers to the fault tracing instructions of the drive.

Maintenance contains maintenance instructions.

Ordering information gives ordering information on additional components available from ABB for the drive module installation.

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

Dimension drawings contains dimension drawings of the drive module installed into a Rittal TS 8 cabinet.

Example circuit diagram shows an example circuit diagram for a cabinet-installed drive module.

Safe torque off function describes the Safe torque off function of the drive and gives instructions on its implementing.

Resistor braking describes selection, protection and wiring of optional brake choppers and resistors. The chapter also contains technical data.

du/dt and sine filters describes how to select d*u*/d*t* and sine filters for the drive.

Categorization by frame size and option code

The instructions, technical data and dimension drawings which concern only certain drive frame sizes are marked with the symbol of the frame size (R10 or R11). The frame size is marked on the type designation label.

The instructions and technical data which concern only certain optional selections are marked with option codes, eg, +J410. The options included in the drive can be identified from the option codes visible on the type designation label. The option selections are listed in section *Type designation key* on page *35*.

Quick installation, commissioning and operating flowchart

Task	See
Plan the mechanical and electrical installation and acquire the accessories needed (cables, fuses, etc.). Check the ambient conditions, ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.	*Guidelines for planning the mechanical installation* (page *37*) *Guidelines for planning the electrical installation* (page *57*) *Technical data* (page *119*) *Resistor braking* (page *165*) Option manual (if optional equipment is included)
↓	
Unpack and check the units. Check that all necessary optional modules and equipment are present and correct. Only intact units can be started up.	*Moving and unpacking the unit* (page *48*) *Installing the motor cable at the motor end* (page *77*) If the drive module has been non-operational for more than one year, the converter DC link capacitors need to be reformed. (*Reforming the capacitors*, page *114*)
↓	
Check the installation site. Fasten the base of the cabinet to the floor.	*Examining the installation site* (page *47*) *Ambient conditions* (page *132*) *Guidelines for planning the mechanical installation* (page *37*)
↓	
Route the cables.	*Routing the cables* (page *66*)
↓	
Check the insulation of the supply cable, the motor and the motor cable and the resistor cable (if present).	*Checking the insulation of the assembly* (page *78*)
↓	
Installing the drive module • Install the drive module into the cabinet. • Install the additional components into the cabinet: for example, main disconnector, main contactor, main AC fuses, etc. • Connect the motor cables to the drive module terminals. • Connect the brake resistor and DC connection cables (if any) to the drive module terminals. • If the main disconnector is installed into the cabinet, connect it to the drive module terminals and the input power cabling to the disconnector. • Connect the cables from the drive module to the external control unit and install the control unit into the cabinet.	*Mechanical installation* (page *47*) *Connecting the power cables* (page *80*) *Connecting the external control unit to the drive module* (page *86*) *Attaching the external control unit* (page *54*) *Overview of control cable connection process* (page *83*) Manuals for any optional equipment
↓	

Task	See
Connect the external control cables to the drive control unit.	*Connecting the control cables to the terminals of the control unit* (page *88*)
Check the installation.	*Installation checklist* (page *99*)
Commission the drive.	*Start-up* (page *103*)
Commission the brake chopper (if used).	*Resistor braking* (page *165*)
Operate the drive: start, stop, speed control etc.	Appropriate firmware manual

Terms and abbreviations

Term/Abbreviation	Explanation
AIBP	Input bridge protection board
BPOW	Power supply board
BFPS	Fan power supply board
BGDR	Gate driver board
CMF	Common mode filtering
DDCS	Distributed drives communication system; a protocol used in optical fiber communication
DTC	Direct torque control
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
FAIO-01	Optional analog I/O extension module
FCAN-01	Optional CANopen adapter module
FCNA-01	Optional ControlNet fieldbus adapter module
FDCO-0x	Optional optical DDCS communication module
FDIO-01	Optional digital I/O extension module
FDNA-01	Optional DeviceNet™ fieldbus adapter module
FECA-01	Optional EtherCAT adapter module
FEN-01	Optional TTL encoder interface module
FEN-11	Optional absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL encoder interface module
FENA-11	Optional high performance Ethernet/IP™, Modbus/TCP and PROFINET IO adapter module

Term/Abbreviation	Explanation
FENA-21	Optional high performance Ethernet/IP™, Modbus/TCP and PROFINET IO adapter module, 2-port
FEPL-01	Optional Ethernet POWERLINK fieldbus adapter module
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FPBA-01	Optional PROFIBUS DP adapter module
Frame (size)	Size of the drive module. The drive modules described in this manual are of frame size R10 and R11.
FSCA-01	Optional Modbus RTU adapter module
FSE-31	Pulse encoder interface module
FSO	Optional safety functions module
HTL	High-threshold logic
IGBT	Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in converters due to their easy controllability and high switching frequency.
I/O	Input/Output
IT system	Type of supply network that has no (low-impedance) connection to ground/earth.
PLC	Programmable logic controller
RFI	Radio-frequency interference
SAFUR	Series of optional brake resistors
STO	Safe torque off
SOIA	Optical interface adapter board
TN system	Type of supply network that provides a direct connection to ground (earth).
TTL	Transistor-transistor logic
ZBIB	Adapter board connected to the control board in the control unit (ZCU)
ZCU	Drive control unit. As standard, the external I/O control signals are connected to the control board, or optional I/O extensions installed on it.
ZINT	Main circuit board
ZMU	The memory unit attached to the control unit of the drive

3

Operation principle and hardware description

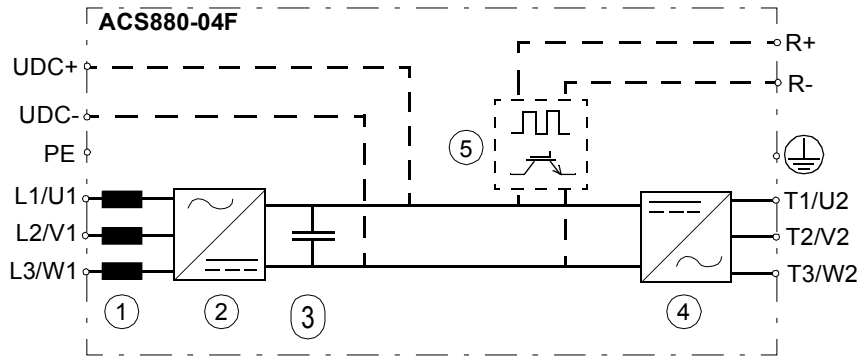
Contents of this chapter

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

Product overview

The ACS880-04F is a drive module for controlling asynchronous AC induction motors, permanent magnet motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors).

The main circuit of the drive module is shown below.



1	AC choke
2	Rectifier. Converts alternating current and voltage to direct current and voltage.
3	DC link. DC circuit between rectifier and inverter
4	Inverter. Converts direct current and voltage to alternating current and voltage.
5	Brake chopper (option +D150). 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.

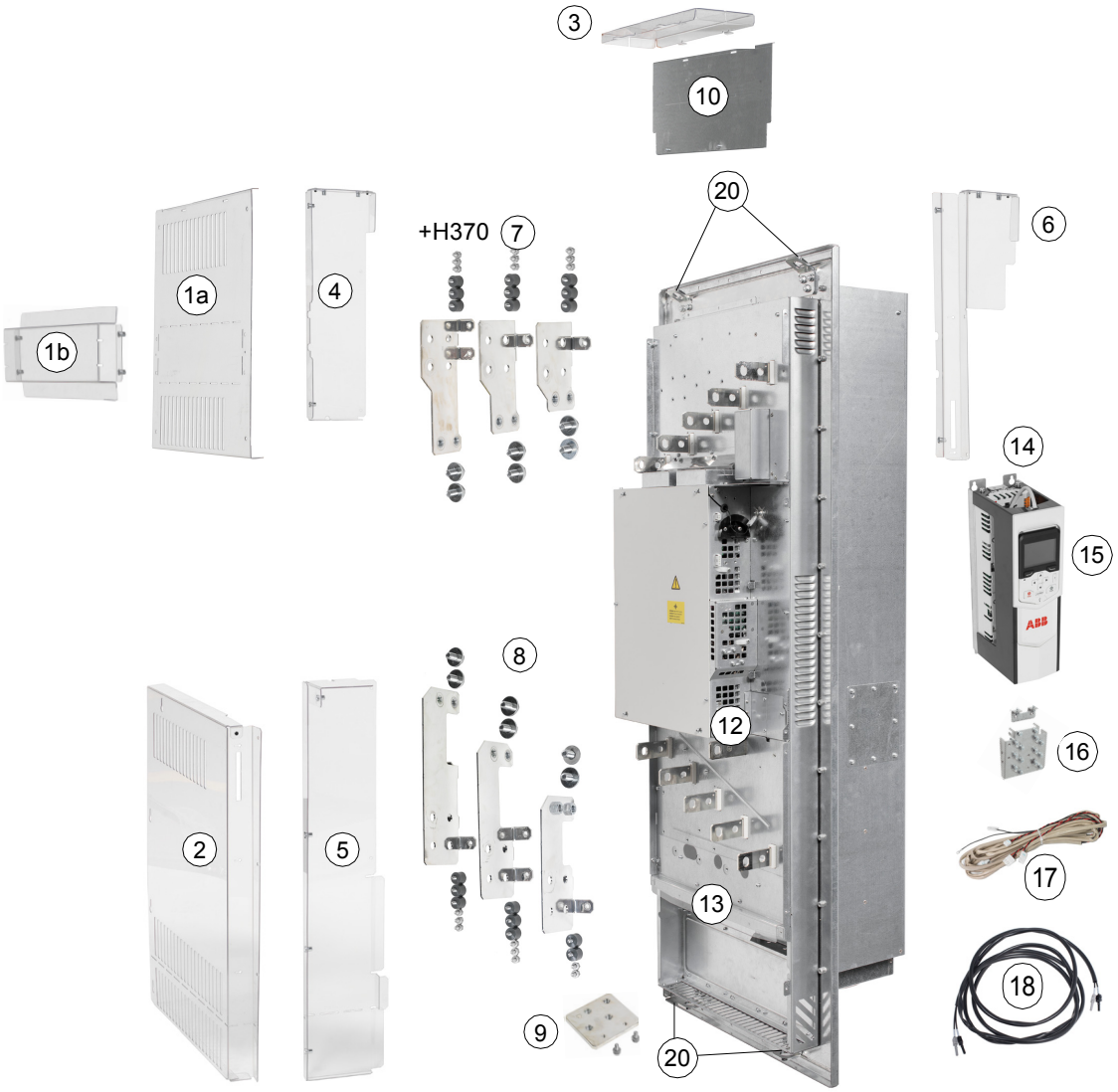
Layout

Standard drive module configuration

The assembled standard drive module configuration is shown below.

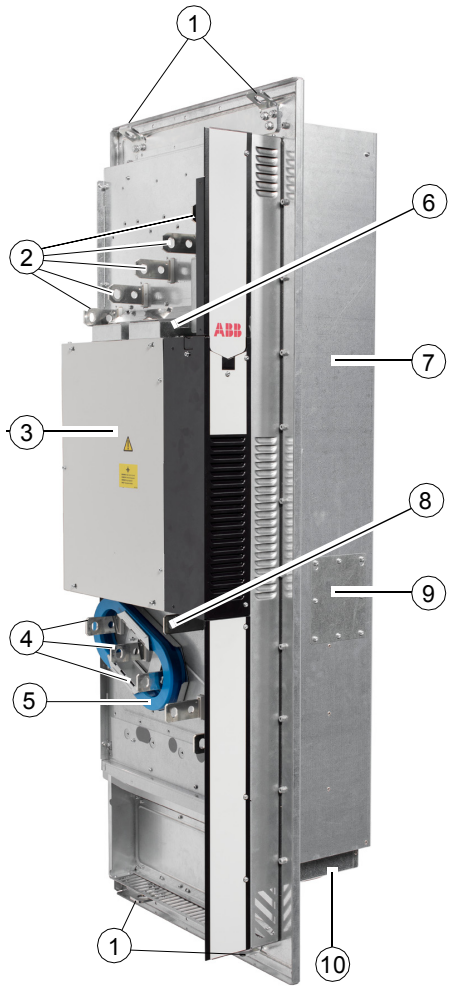
A	Front view	5	Heatsink cleaning hole cover
B	Back view	6	Flange
1	Drive module	7	Hood
2	Upper front cover	8	External control unit with control panel holder
3	Lower front cover	9	Control panel
4	Clear plastic shrouds attached	-	-

See the part descriptions below.



1	Clear plastic shroud to be attached onto the drive module input power cabling (a). Lead-through shroud for side cabling (b).	11	Fiber optic cables
2	Clear plastic shrouds to be attached onto the drive module output power cabling	12	PE (ground) terminal
3	Clear plastic shroud to be attached on top of the drive module (lead-through for top cabling)	13	Main cooling fans
4	Upper back clear plastic shroud	14	External control unit. The control unit can also be inside the drive module (option +P905)
5	Lower back clear plastic shroud	15	Control panel
6	Front clear plastic shroud	16	Control cable clamp plate
7	Input power cable connection terminals (option +H370)	17	Cables for connecting the control unit to the drive module
8	Output power cable connection terminals	18	Fiber optic cables
9	Grounding terminal for output power cable shields	19	Support brackets
10	Metallic shroud. With option +H370, the shroud includes a ground bar.	20	Lifting lugs

Drive module without full-size output cable connection terminals (option +0H371) and IP20 shrouds (option +0B051), with common mode filter (+E208)



1	Lifting lugs
2	Input cable connection busbars (L1/U1, L2/V1, L3/W1) and DC+ and DC- busbars (UDC+, UCD- with option +H356)
3	Circuit board compartment
4	Output cable connection busbars (T1/U2, T2/V2, T3/W2) and brake resistor connection busbars (R+ and R- with option +D150)
5	Common mode filter (option +E208)
6	Auxiliary cooling fans
7	Heatsink
8	PE busbar
9	Cover on heatsink cleaning hole
10	Main cooling fans

Control unit

See section *Standard drive module configuration* on page *27*.

Control panel

1	ACS-AP-W bluetooth control panel
2	DPMP-01 door mounting kit (option +J410)
3	DPMP-02 door mounting kit for surface mounting (option +J413)

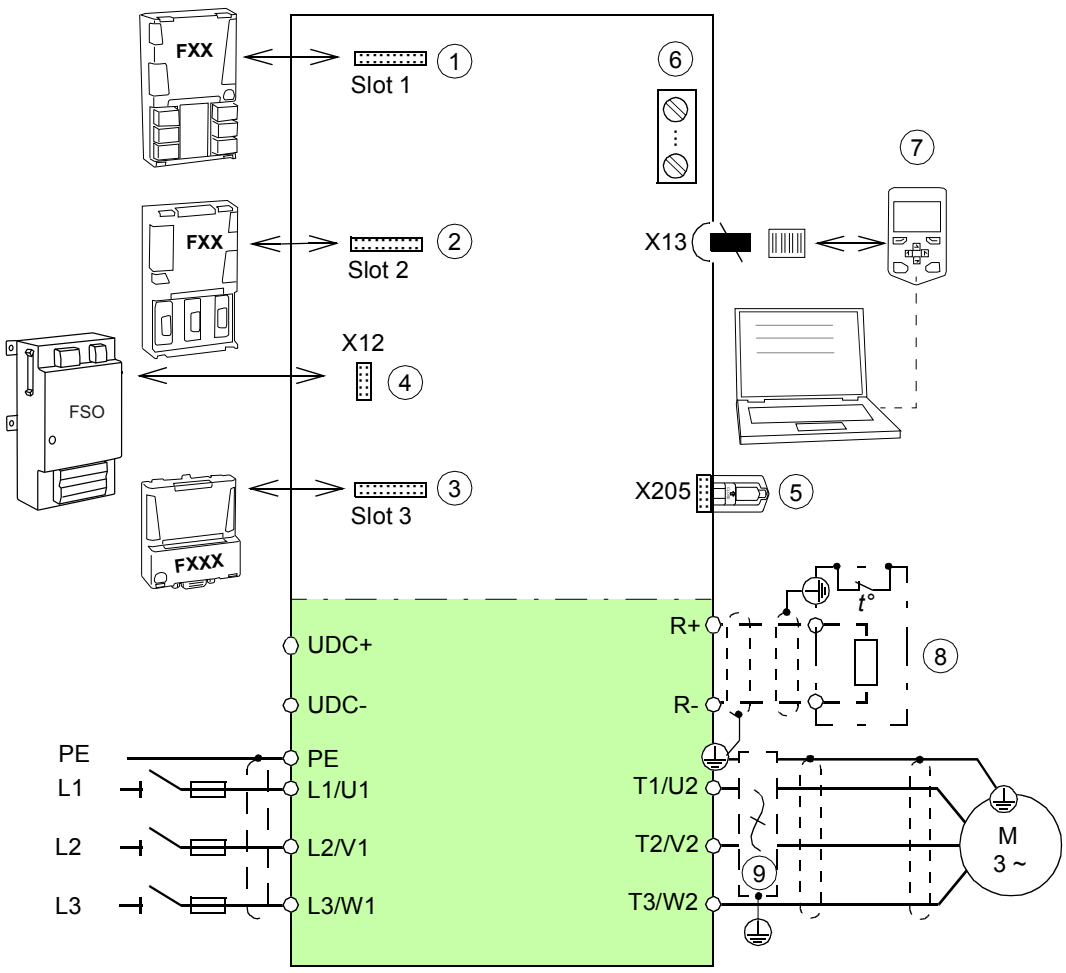
In the standard drive module configuration, the control panel is located in the control panel holder of the external control unit.

The control panel can be mounted on the cabinet door using a DPMP-01 mounting platform (option +J410) or a DPMP-02 mounting platform (option +J413).

For the use of the control panel, see the firmware manual or *ACS-AP-X assistant control panels user's manual* (3AUA0000085685 [English]).

Overview of power and control connections

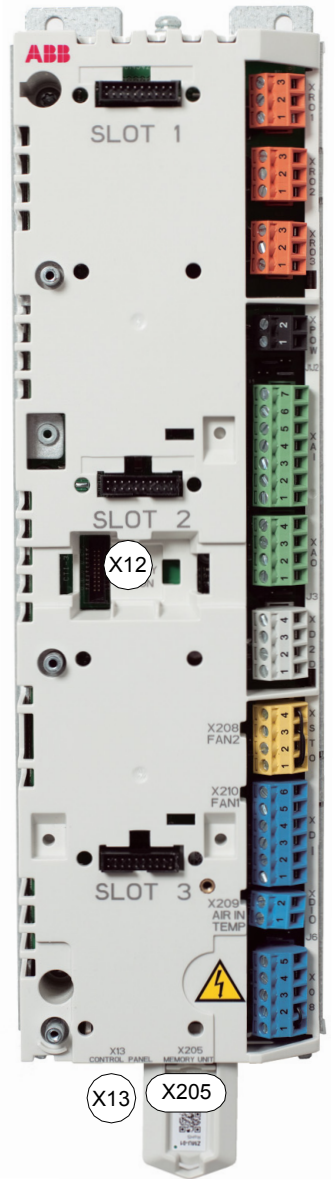
The diagram shows the power connections and control interfaces of the drive module.



1	Analog and digital I/O extension modules, feedback interface modules and fieldbus communication modules can be inserted into slots 1, 2 and 3.
2	
3	See section *Type designation key* on page *35*.
4	Connector for the FSO-xx safety functions module (X12). The module can be installed on or above the control unit (see page *95*).
5	Memory unit (see page *116*)
6	I/O terminal blocks. See section *External control connection terminals* below and section *Default I/O connection diagram* on page *89*.
7	Control panel (see page *94*)
8	Brake resistor (optional, see page *165*)
9	du/dt or sine filter (optional, see page *171*)

External control connection terminals

The layout of the external control connection terminals on the drive module control are shown below.

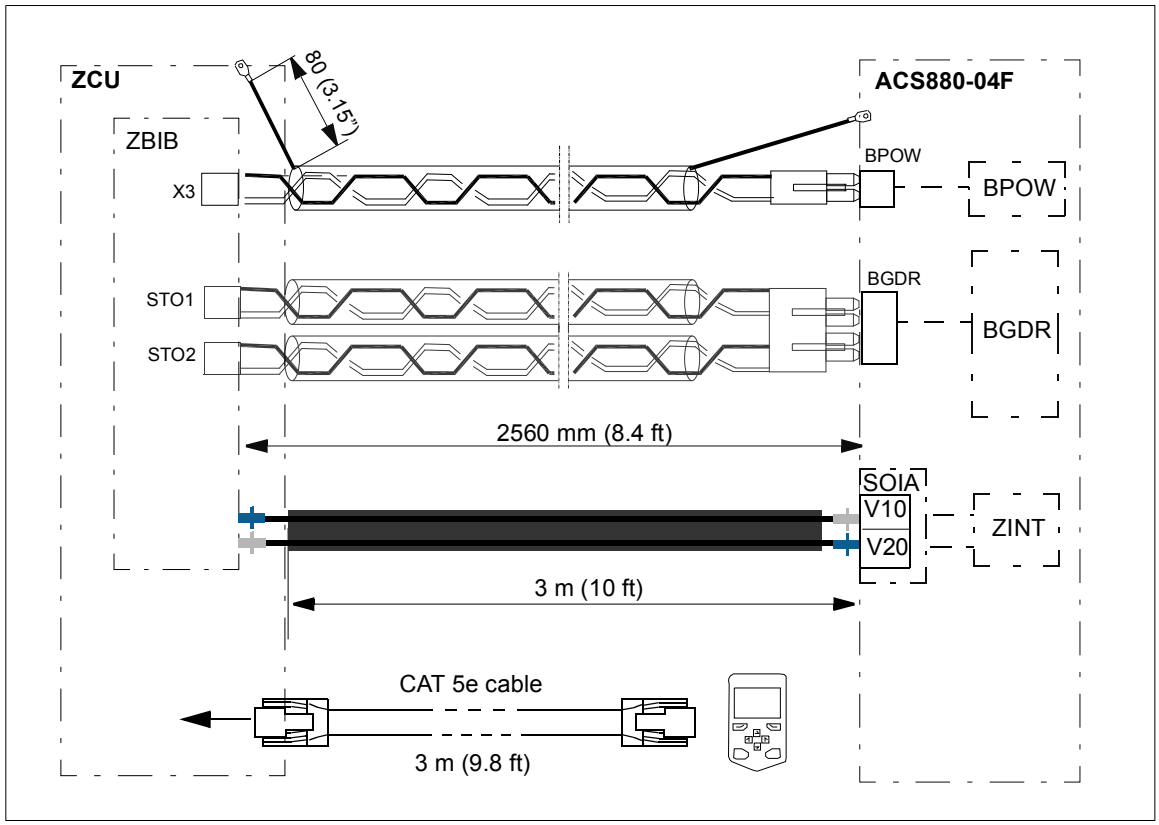


	Description
XPOW	External power input
XAI	Analog inputs *)
XAO	Analog outputs *)
XD2D	Drive to drive link
XRO1	Relay output RO1 *)
XRO2	Relay output RO2 *)
XRO3	Relay output RO3 *)
XD24	Start interlock connection (DIIL) *) and +24 V output
XDIO	Digital input/outputs *)
XDI	Digital inputs *)
XSTO	Safe torque off connection
X12	Connector for optional safety functions modules
X13	Control panel connection
Slot 1	Optional module
Slot 2	Optional module
Slot 3	Optional module
X205	Memory unit, see page *116*.
J1, J2	Voltage/Current selection jumpers (J1, J2) for analog inputs
J3	Drive-to-drive link termination jumper
J6	Common digital input ground selection jumper (J6). See *Ground isolation diagram)* (page *131*).

*) Programmable

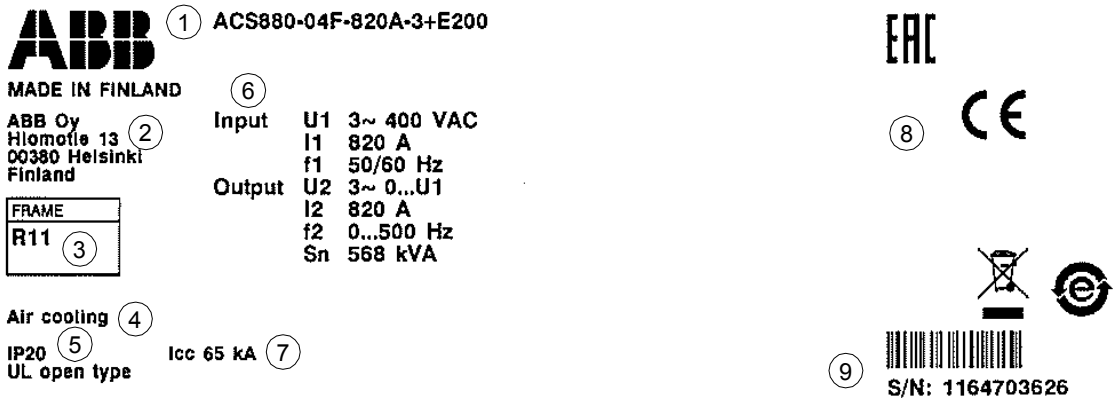
External control unit connection cables

The cables that are delivered with the drive module for connecting the drive module and control panel to the external control unit are shown below. See sections *Connecting the external control unit to the drive module* (page *86*) and *Connecting a control panel* (page *94*) for the actual connections.



Type designation label

The type designation label includes a rating, markings, a type designation and a serial number, which allow individual recognition of each drive module. The type designation label is located on the front cover. An example label is shown below.



1	Type designation, see section *Type designation key* on page *35*.
2	Manufacturing address
3	Frame size
4	Cooling method
5	Degree of protection
6	Ratings, see section *Ratings* on page *119*.
7	Short-circuit withstand strength, see section *Electrical power network specification* on page *127*.
8	Valid markings
9	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.

Type designation key

The type designation contains information on the specifications and configuration of the drive module. The first digits from left express the basic configuration. The optional selections are given thereafter, separated by plus signs, eg, +J410. The main selections are described below. Not all selections are available for all types. For more information, refer to *ACS880 Ordering Information* (3AXD10000014923), available on request.

Code	Description
Basic code, eg, ACS880-04F-880A-3	
Product series	
ACS880	ACS880 product series
Type	
-04F	When no options are selected: flange-mounted drive module to be installed in a an enclosure, IP20 (UL open type), flat mounting, no pedestal, external control unit, ACS-AP-W bluetooth control panel and panel holder, build-in choke, full-size output cable connection terminals, no EMC filter, no DC connection busbars, clear plastic shrouds for covering the input power and motor cable connections, ACS880 primary control program, Safe torque off function, coated boards, printed multilingual quick start-up and installation guides, CD containing all manuals with all available languages.
Size	
xxxA	Refer to the rating tables, page *119*.
Voltage range	
-3	380…415 V. This is indicated in the type designation label as typical input voltage level 3 ~ 400 V AC.
-5	380…500 V. This is indicated in the type designation label as typical input voltage levels 3 ~ 400/480/500 V AC.
Option codes (plus codes)	
Construction, pedestal and cabling	
0B051	No IP20 shrouds for cabling area
H356	DC connection busbars
H370	Full-size input power cable connection terminals and PE busbar.
0H371	No full-size output power cable connection terminals
C217	Wall mounting kit (to be used, if the module is mounted on the wall from its back instead of the flange)
Control panel and control unit	
0J400	No control panel and no control panel holder. **Note**: You need at least one loose control panel to be able to commission the drive.
J410	DPMP-01 door mounting kit (flush mounting) for the control panel. Includes a control panel mounting platform, an IP54 cover and a 3-meter panel connection cable.
J413	DPMP-02 door mounting kit (surface mounting) for the control panel. Includes a control panel mounting platform, an IP65 cover and a 3-meter panel connection cable.
Filters	
E200	EMC filter for second environment TN (grounded) system, category C3.
E201	EMC filter for second environment IT (ungrounded) system, category C3.
E208	Common mode filter
Resistor braking	
D150	Brake chopper
Fieldbus adapter modules	
K451	FDNA-01 DeviceNet™ fieldbus adapter module
K454	FPBA-01 PROFIBUS DP fieldbus adapter module
K457	FCAN-01 CANopen fieldbus adapter module
K458	FSCA-01 Modbus adapter module
K462	FCNA-01 ControlNet fieldbus adapter module

Code	Description
K469	FECA-01 EtherCAT® fieldbus adapter module
K470	FEPL-02 Ethernet POWERLINK fieldbus adapter module
K473	FENA-11 EtherNet/IP™, Modbus/TCP and PROFINET IO fieldbus adapter module
K475	FENA-21 EtherNet/IP™, Modbus/TCP and PROFINET IO fieldbus adapter module, 2-port
I/O extension and feedback interface modules	
L500	FIO-11 analog I/O extension module
L501	FIO-01 digital I/O extension module
L502	FEN-31 HTL encoder interface module
L503	FDCO-01 optical DDCS communication module
L508	FDCO-02 optical DDCS communication module
L515	FEA-03 I/O extension module
L516	FEN-21 resolver interface module
L517	FEN-01 TTL encoder interface module
L518	FEN-11 absolute encoder interface module
L521	FSE-31pulse encoder interface module. Requires option +Q972.
L525	FAIO-01 analog I/O extension module
L526	FDIO-01 digital I/O extension module
L536	FPTC-01 thermistor protection module
L537	FPTC-02 ATEX-certified thermistor protection module. Requires option +Q971.
Programmability	
N8010	Drive application programming (CODESYS)
Safety	
Q971	ATEX-certified Safe motor disconnection function using the drive Safe torque off function
Q972	FSO-21 safety functions module
Q973	FSO-12 safety functions module
Q982	PROFIsafe safety communication. Requires option +Q972 or +Q973 and +K475.
Warranty	
P904	Extended warranty 24/30
Paper manuals. Note: The delivered manual set can include manuals in English if the translation is not available.	
R700	English
R701	German
R702	Italian
R703	Dutch
R704	Danish
R705	Swedish
R706	Finnish
R707	French
R708	Spanish
R709	Portuguese (spoken in Portugal)
R711	Russian
R713	Polish
R714	Turkish

4

Guidelines for planning the mechanical installation

Contents of this chapter

This chapter guides in planning drive cabinets and installing the drive module into a user-defined cabinet. The chapter gives cabinet layout examples and free space requirements around the module for cooling. These guidelines are essential for the safe and trouble-free use of the drive system.

Limitation of liability

You must always plan and make the installation 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.

Installation alternatives

The drive module can be installed from the flange onto a cabinet wall or a mounting plate with the heatsink (degree of protection of IP55) in a cooling air channel or outdoors. The control circuit compartment side of the module (IP20 degree of protection) is to be placed in clean air. The drive module can also be installed from the heatsink with mounting brackets which are included in the delivery as standard.

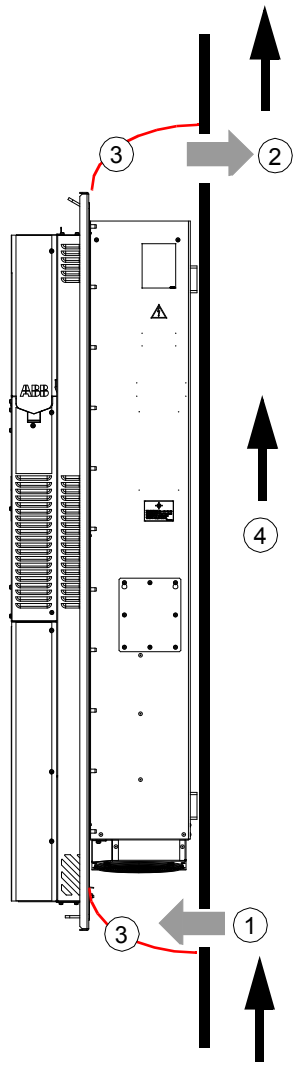
The drive module can be cabled from top or bottom to cable connection terminals or sideways with busbars directly to the module busbars at its side.

Channel installation

Basic requirements for the channel wall

The channel wall where the drive module is mounted on must be non-flammable and sturdy enough to carry the weight of the drive module.

Installation principle



1 Cool air in, max. 40 °C (104 °F)
2 Hot air out
3 Air guide
64 Air flow in the cooling air channel

Cabinet installation

Basic requirements for the cabinet

Use a cabinet which

- has a frame sturdy enough to carry the weight of the drive components, control circuitry and other equipment installed in it
- protects the user and drive module against contact and agrees with the requirements for dust and humidity
- has sufficient air inlet and outlet gratings that allow free flow of cooling air through the cabinet. This is critical for proper cooling of the drive module.

Planning the layout of the cabinet

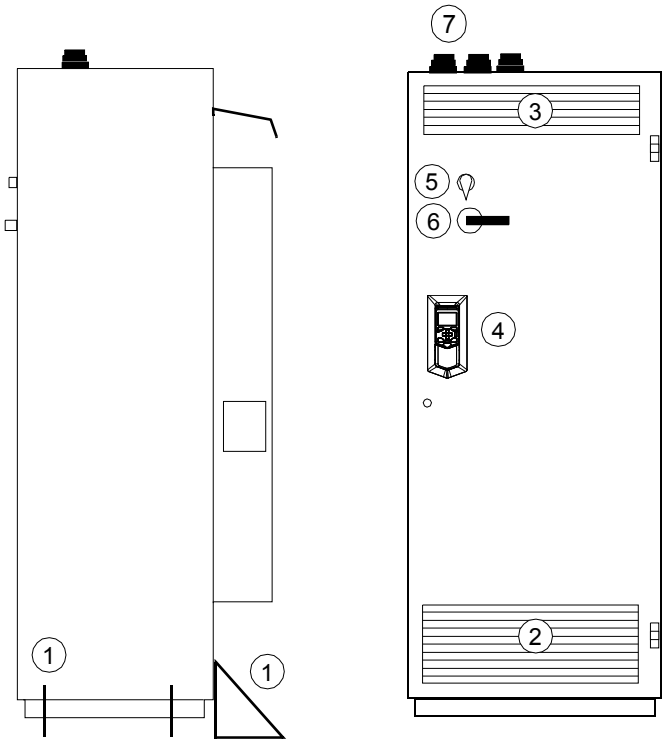
Plan a spacious layout to ensure easy installation and maintenance. Sufficient cooling air flow, obligatory clearances, cables and cable support structures all require space.

Place the control board(s) away from:

- main circuit components such as contactors, switches and power cables
- hot parts (heat sink, air outlet of the drive module).

Layout example, door closed

This diagram shows a cabinet layout example with the input power cable lead-through from top and the motor cable lead-through from bottom.



1 **WARNING!** Attach the cabinet to the floor or prop it up from the back. The module has its center of gravity at the back and the cabinet easily topples over.

2 Air inlet for the power cable connection and circuit board compartment part of drive module and for other equipment. For losses and cooling data requirements, see page *127*.

3 Air outlet for the he power cable connection and circuit board compartment part of drive module and other equipment

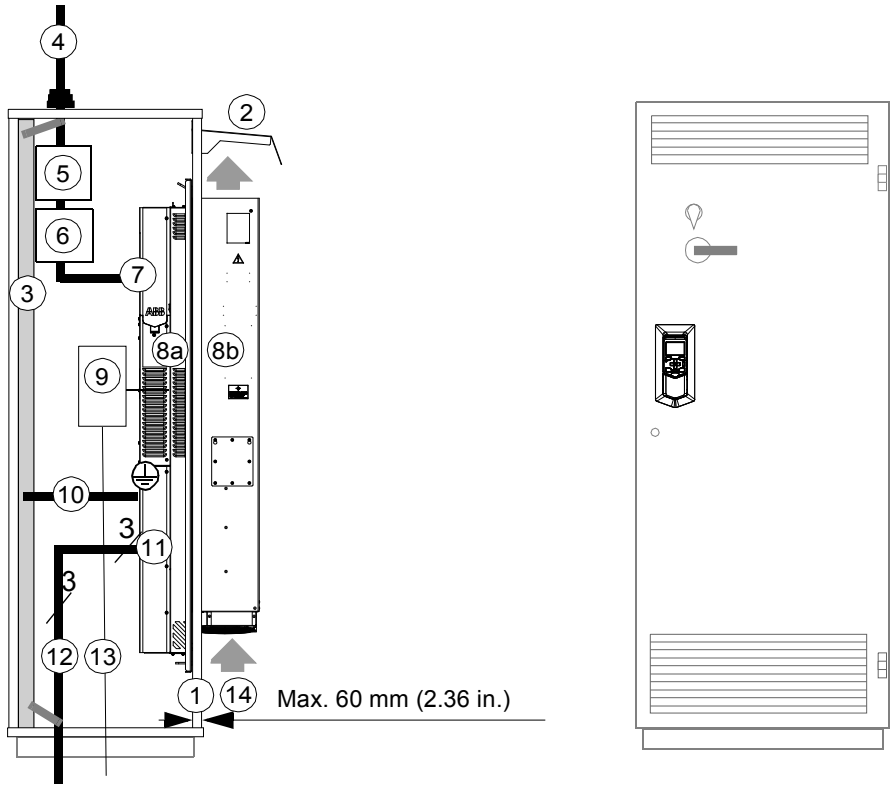
4 Drive control panel with DPMP-01 mounting platform (option +J410). The control panel is connected to the drive module control unit inside the cabinet.

5 Contactor control switch and emergency stop switch (connected to the contactor control circuit inside the cabinet)

6 Operating handle of the disconnector

7 Rubber grommets for degree of protection

Layout example, door open



1	Cabinet back plate. The maximum allowed depth of the back plate is 60 mm (2.36 in.) in order not to cover the air flow grate at the top off the heatsink.	8	Drive module front part (a), drive module heatsink part (b)
2	Hood	9	Drive module control unit. **Note**: With an internal control unit (option +P905), the upper door air inlet is critical for proper cooling of the control board.
3	Cabinet grounding busbar (PE)	10	Grounding conductor
4	Input power cable including the protective ground conductor (PE) of the drive	11	Motor cable connection terminals/busbars
5	Disconnector and fuses	12	Motor cable including the protective ground conductor of the drive module
6	Contactor	13	External control cables
7	Input power cable connection terminals/busbars	14	Air flow

WARNING! Attach the cabinet to the floor or prop it up from the back. The module has its center of gravity at the back and the cabinet easily topples over.

Note 1: The power cable shields can also be grounded to the drive module grounding terminals.

Note 2: See also section *Required free space*, page *45*.

Arranging the grounding inside the cabinet

Arrange the grounding of the drive module by leaving the contact surfaces of the fastening points unpainted (bare metal-to-metal contact). The module frame will be grounded to the

PE busbar of the cabinet via the fastening surfaces, screws and the cabinet frame. Alternatively, use a separate grounding conductor between the PE terminal of the drive module and the PE busbar of the cabinet.

Ground also the other components in the cabinet according to the principle above.

Selecting the busbar material and preparation of the joints

Note the following when you use busbars:

- Tin-plated copper is recommended but aluminum can also be used.
- The oxide layer from aluminum busbar joints must be removed and suitable anti-oxidant joint compound applied.

Tightening torques

Apply the following torques to grade 8.8 screws (with or without joint compound) that tighten electric contacts.

Screw size	Torque
M5	3.5 N·m (2.6 lbf·ft)
M6	9 N·m (6.6 lbf·ft)
M8	20 N·m (14.8 lbf·ft)
M10	40 N·m (29.5 lbf·ft)
M12	70 N·m (52 lbf·ft)
M16	180 N·m (133 lbf·ft)

Planning the fastening of the cabinet

Note the following when you plan the fastening of the cabinet:

- Fasten the cabinet to the floor from the front and to the floor or wall from the back.
- Always fasten the drive module from its fastening points to the cabinet. For details, see the module installation instructions.

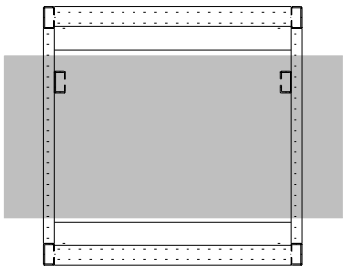
WARNING! Do not fasten the cabinet by electric welding. ABB does not assume any liability for damages caused by electric welding as the welding circuit can damage electronic circuits in the cabinet.

Planning the cabinet placement on a cable channel

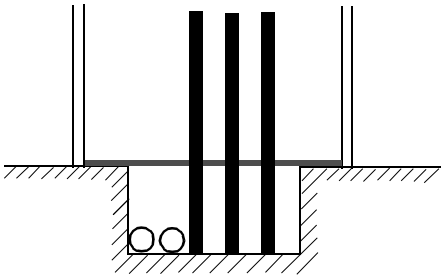
Note the following when you plan to place the cabinet on a cable channel:

- The cabinet structure must be sturdy enough. If the whole cabinet base is not supported from below, the cabinet weight will lie on the sections that the floor carries.
- Equip the cabinet with a sealed bottom plate and cable lead-throughs to ensure the degree of protection and to prevent the cooling air flow from the cable channel into the cabinet.

Note: When the bottom grille and clear plastic shrouds around the motor cables are installed, the degree of protection of the drive module from bottom side is IP20.



The carrying structure on a cable channel



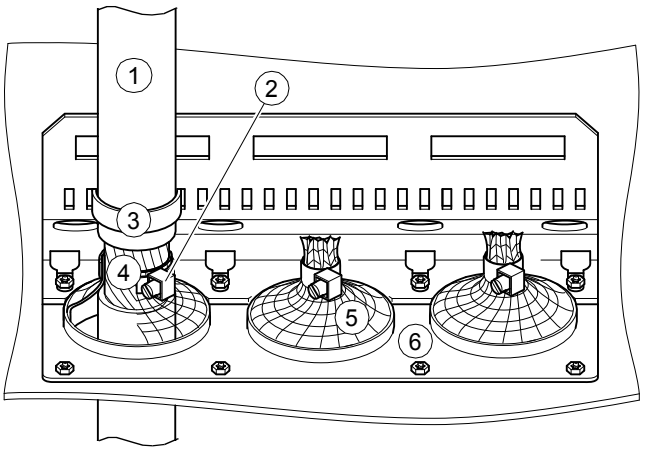
Cabinet side view with a bottom plate

Planning the electromagnetic compatibility (EMC) of the cabinet

Note the following when you plan the electromagnetic compatibility of the cabinet:

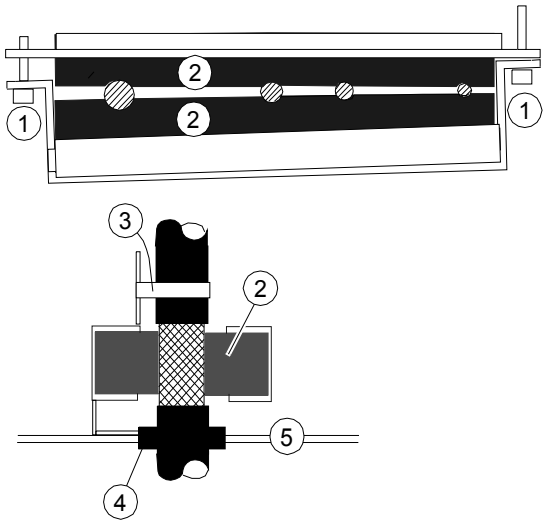
- Generally, the fewer and smaller the holes in the cabinet, the better the interference attenuation. The maximum recommended diameter of a hole in galvanic metal contact in the covering cabinet structure is 100 mm (3.94 in). Pay special attention to the cooling air inlet and outlet gratings.
- The best galvanic connection between the steel panels is achieved by welding them together as no holes are necessary. If welding is not possible, we recommend to leave the seams between the panels **unpainted** and equipped with special conductive EMC strips to provide adequate galvanic connection. Usually, reliable strips are made of flexible silicon mass covered with a metal mesh. The non-tightened touch-contact of the metal surfaces is not sufficient, so a conductive gasket between the surfaces is required. The maximum recommended distance between assembly screws is 100 mm (3.94 in).
- Construct sufficient high-frequency grounding network in the cabinet to avoid voltage differences and forming of high-impedance radiator structures. A good high-frequency grounding is made with short flat copper braids for low inductance. One-point high-frequency grounding cannot be used due to the long distances inside the cabinet.
- 360° high frequency grounding of the cable shields at the cable lead-throughs improves the EMC shielding of the cabinet.

- We recommend 360° high frequency grounding of the motor cable shields at their entries. The grounding can be implemented by a knitted wire mesh screening as shown below.



1 Cable
2 Cable tie
3 Strain relief
4 Bare cable shield
5 Knitted wire mesh
6 Cabinet lead-through plate

- We recommend 360° high frequency grounding of the control cable shields at their entries. The shields can be grounded by means of conductive shielding cushions pressed against the cable shield from both directions as shown below:



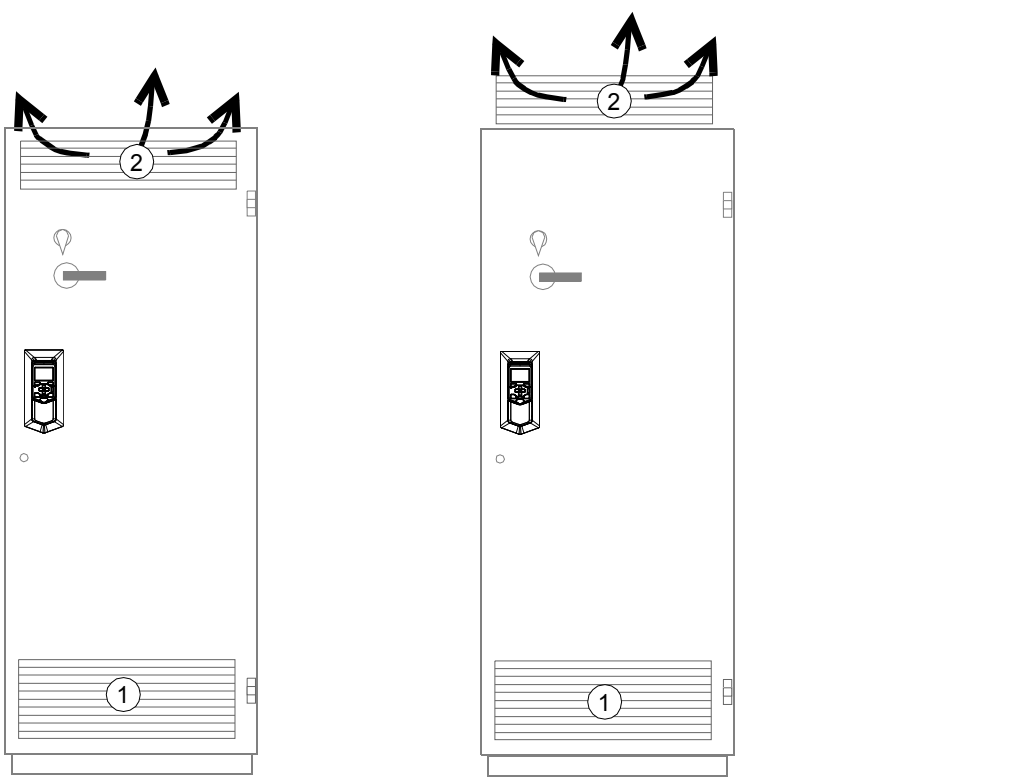
1 Tightening screw
2 EMI conductive cushion
3 Strain relief
4 Grommet
5 Lead-through plate

Planning the cooling

Note the following guidelines when you plan the cooling of the cabinet:

- Ventilate the installation site sufficiently so that the cooling air flow and ambient temperature requirements of the drive module are met, see pages *127* and *132*. The internal cooling fan of the drive module rotates at a constant speed thus blowing constant air flow through the module. Whether the same amount of air must be replaced all the time in the facility depends on how much heat must be removed.
- Leave enough free space around the components to ensure sufficient cooling. Observe the minimum clearances given for each component. For the required free space around the drive module, see page *45*.
- Also ventilate the heat dissipated by cables and other additional equipment.
- **Make sure that the air inlets and outlets are large enough to allow sufficient air flow in and out of the cabinet.** This is critical for proper cooling of the drive module.

- Equip the air inlets and outlets with gratings that
  - guide the air flow
  - protect against contact
  - prevent water splashes from entering the cabinet.
- The drawing below shows a typical cabinet cooling solution when the heatsink is outside the cabinet. 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. ABB recommends that the air outlet is on the cabinet roof.



Air inlets and outlets on the cabinet door

1	Air inlet
2	Air outlet

- The internal cooling fans of the drive modules and reactors/chokes are usually sufficient to keep the component temperatures low enough in IP22 cabinets.
- In IP54 cabinets, thick filter mats are used to prevent water splashes from entering the cabinet. This requires the installation of additional cooling equipment, such as a hot air exhaust fan.

Preventing the recirculation of hot air

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

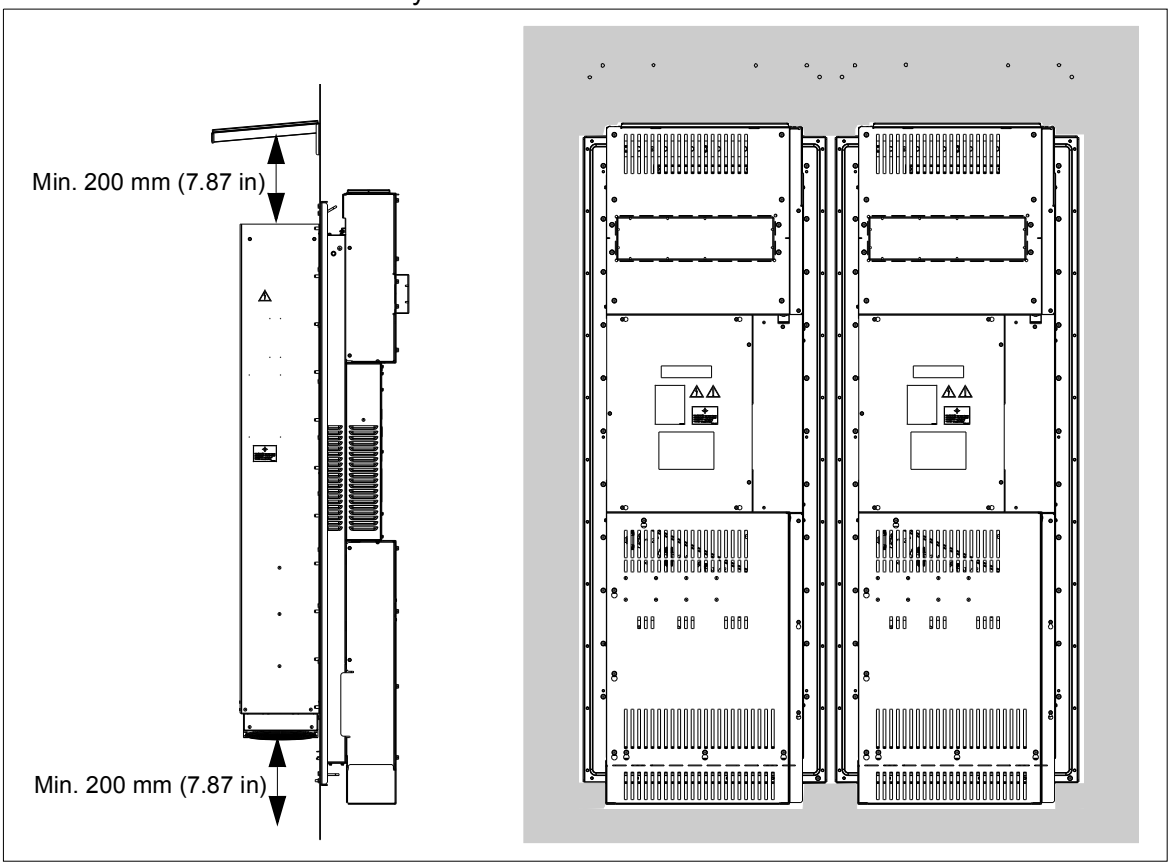
- gratings that guide air flow at the air inlet and outlet
- air inlet and outlet at different sides of the cabinet
- cool air inlet in the lower part of the front door, and an extra exhaust fan on the roof of the cabinet.

Prevent hot air circulation inside the cabinet with, for example, leak-proof air baffles. No gaskets are usually required.

Required free space

Free space around the drive module is needed for ensuring that sufficient cooling air flows through the module and the module cools correctly.

The required free space at the top and bottom of the drive module is shown below. The modules can be installed side by side.



Other installation positions

Contact your local ABB representative for more information.

Drive module on its back

If you install the drive module on its back, make sure that the hot cooling air that flows upwards from the module does not cause danger.

Planning the placement of the control panel

The control panel can be mounted onto the cabinet door using a control panel mounting platform (option +J410). For the installation instructions, refer to *DPMP-01 mounting platform for ACS-AP control panel* (3AUA0000100140 [English]) or *DPMP-02 mounting platform for ACS-AP-X control panel* (3AUA0000136205 [English]).

Planning the use of cubicle heaters

Use a cubicle 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.

5

Mechanical installation

Contents of this chapter

This chapter describes how to install the drive module mechanically without the clear plastic shrouds. The shrouds are attached after the power cabling.

Examining the installation site

Examine the installation site:

- The installation site is sufficiently ventilated or cooled to transfer away the drive losses. [1)]
- The ambient conditions of the drive meet the specifications. [1)]
- The material onto which the drive module is mounted must be non-flammable and strong enough to carry the weight of the module.
- There is enough free space above the drive to enable cooling air flow, service and maintenance.
- The floor that the drive is installed on is of non-flammable material, as smooth as possible, and strong enough to support the weight of the drive.

[1)] See section *Ambient conditions* on page *132* for the allowed ambient conditions and section *Losses, cooling data and noise* on page *127* for the required cooling air.

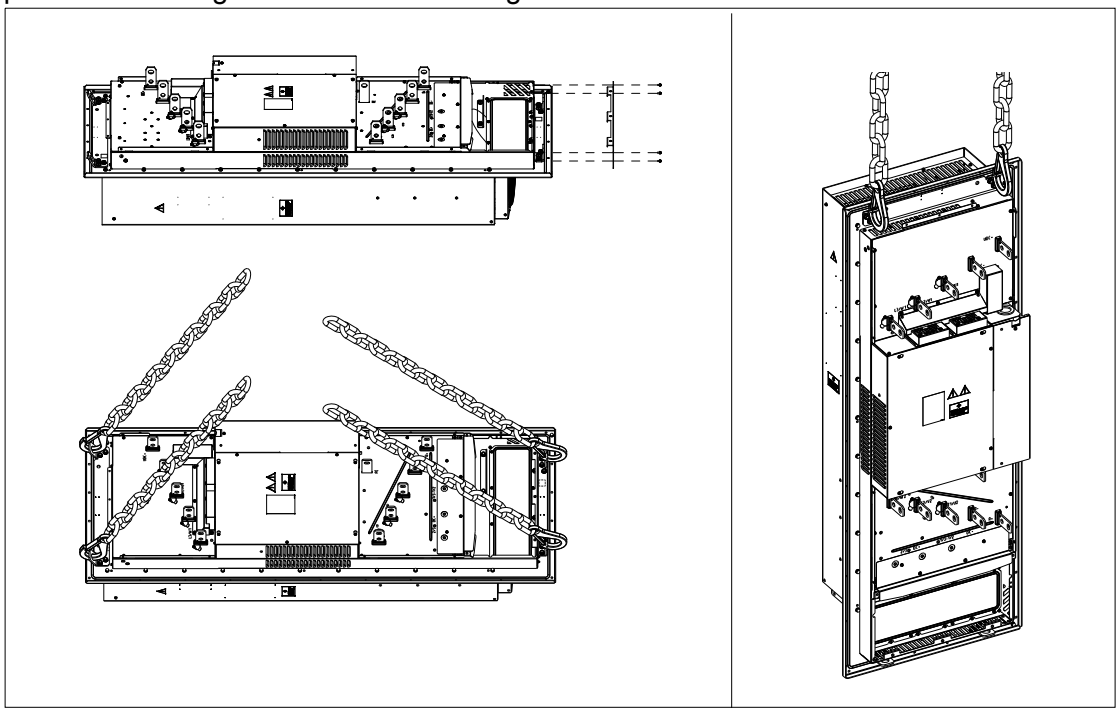
Moving and unpacking the unit

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

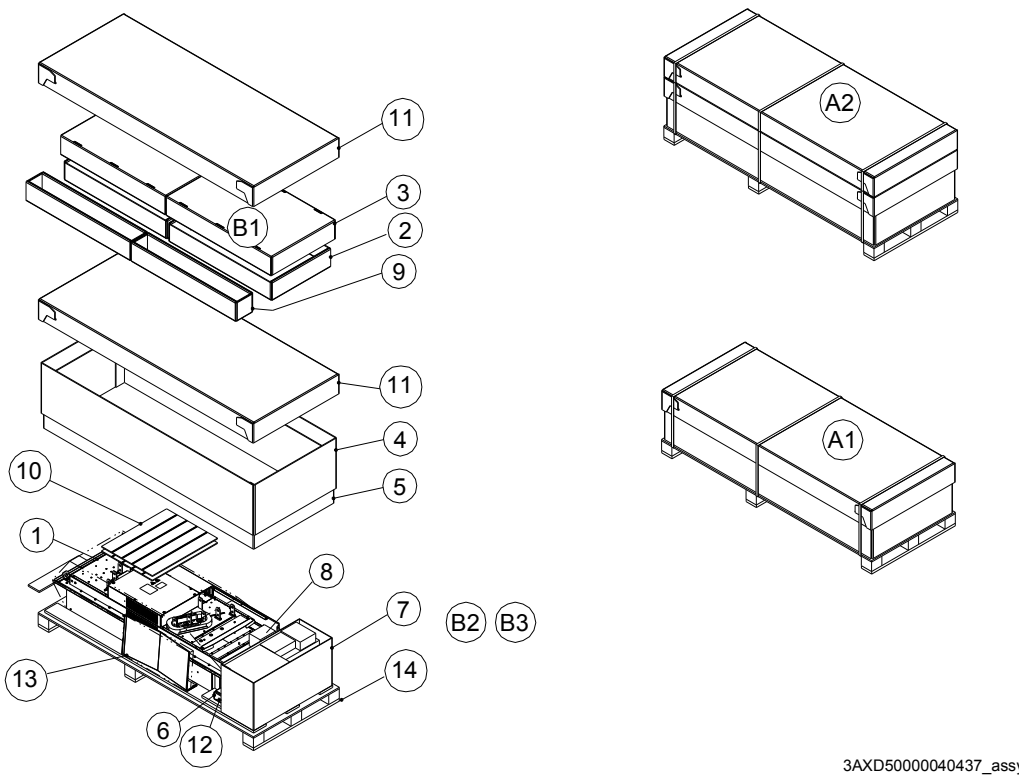
Move the transport package by pallet truck to the installation site.

Unpack the package as follows (see the package drawing on page *49*):

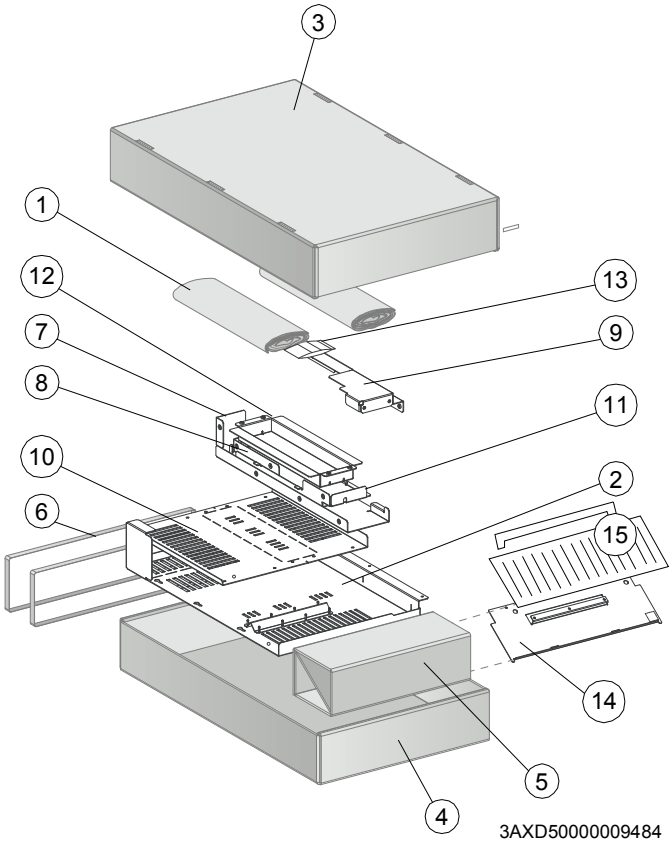
- Cut the bands.
- Lift the top lid. If top boxes (B1) are included, lift them off, and remove the lower lid.
- Lift the inner and outer sheathings.
- Remove the additional boxes and supports.
- Insert lifting hooks to the drive module lifting eyes and lift the module to the installation place.
  Note: Before you lift the module horizontally, remove the bottom grille in order to prevent distorting. Reinstall it after lifting.



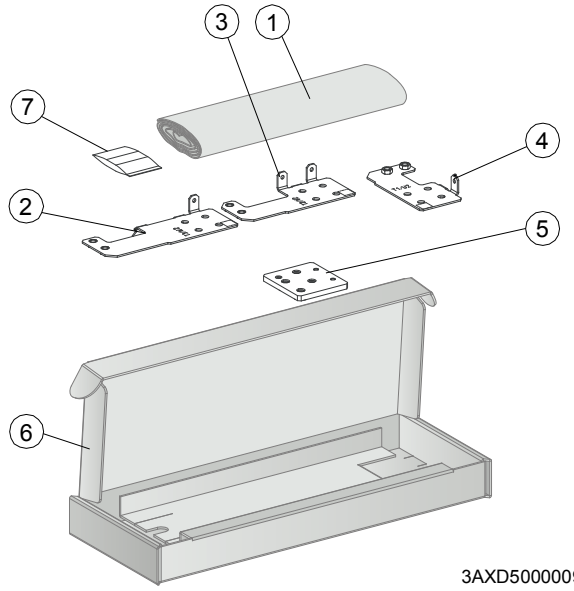
Package drawings



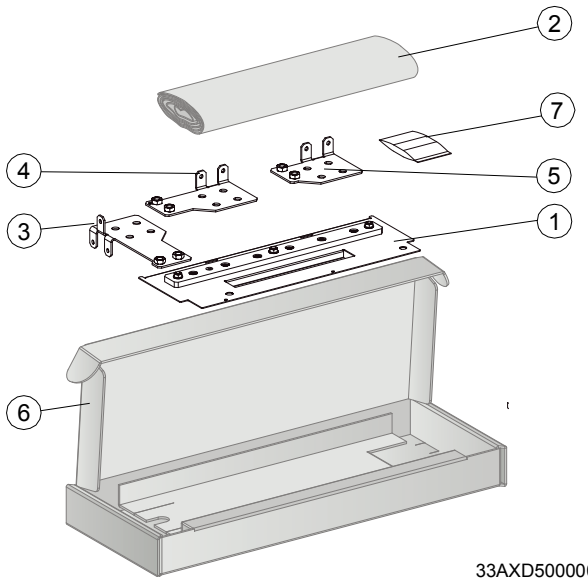
Transport package contents	
A1	Package with no IP20 shrouds for cabling area (option 0B051)
A2	Standard drive module package
1	Drive module with factory installed options (for example, +E208), delivery documents, multilingual residual voltage warning sticker, printed multilingual installation and start-up quick guides and manuals CD. Other printed manuals with option +R700.
2	Cardboard lids
3	Top box (with standard drive module configuration). Contains IP20 shrouds for cabling area. See below for the box B1 contents.
4	Outer sheathing
5	Inner sheathing
6	Accessories box Screw package, includes also spacers for FSO module installation, rubber grommets for control unit cable lead-through holes in the middle front cover of the drive module.
7	Accessory sleeve. Contains: • external control unit with control cable clamp plate and factory installed optional modules • output cable connection terminal box (B2, see below for the box contents) • input cable connection terminal box (option +H370, B3, see below for the box contents) • DPMP-02 door mounting kit (option +J413)
8	If all options do not fit in the accessory sleeve, the rest are packed in this space on the device.
9	Cardboard support tray
10	Cardboard support
11	Cardboard lid
12	Wall mounting brackets with screws for attaching the drive module heatsink by the top and bottom to a mounting plate or wall (option +C127). The brackets bring a gap for cooling air flow and prevent the drive module screws from chafing the plate. See section *Attaching the drive module by the heatsink* on page *53*.
13	Hood
14	Pallet



Box B1 contents (standard drive module configuration)	
1	Paper fill
2	Clear plastic shroud for output cabling
3	Cardboard box cover
4	Cardboard box bottom
5	Support
6	Bands
7	Back clear plastic shroud (lower)
8	Back clear plastic shroud (upper)
9	Front clear plastic shroud
10	Clear plastic shroud for input cabling
11	Top clear plastic shroud
12	Clear plastic shroud for input cable lead-through from side
13	Screws in a plastic bag
14	Metallic shroud without ground bar
15	Not in use



Box B2 contains this box with standard drive module configuration	
1	Paper fill
2	Output cable connection terminal T3/W2
3	Output cable connection terminal T2/V2
4	Output cable connection terminal T1/U2
5	Grounding terminal
6	Cardboard box
7	Screws and insulators a plastic bag



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Box B3 contains additionally this box with option +H370	
1	Metallic shroud with ground bar
2	Paper fill
3	Input cable connection terminal L3/W1
4	Input cable connection terminal L2/V1
5	Input cable connection terminal L1/U1
6	Cardboard box
7	Screws and insulators in a plastic bag

Checking the delivery

Check that all items listed in section *Moving and unpacking the unit* are present.

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

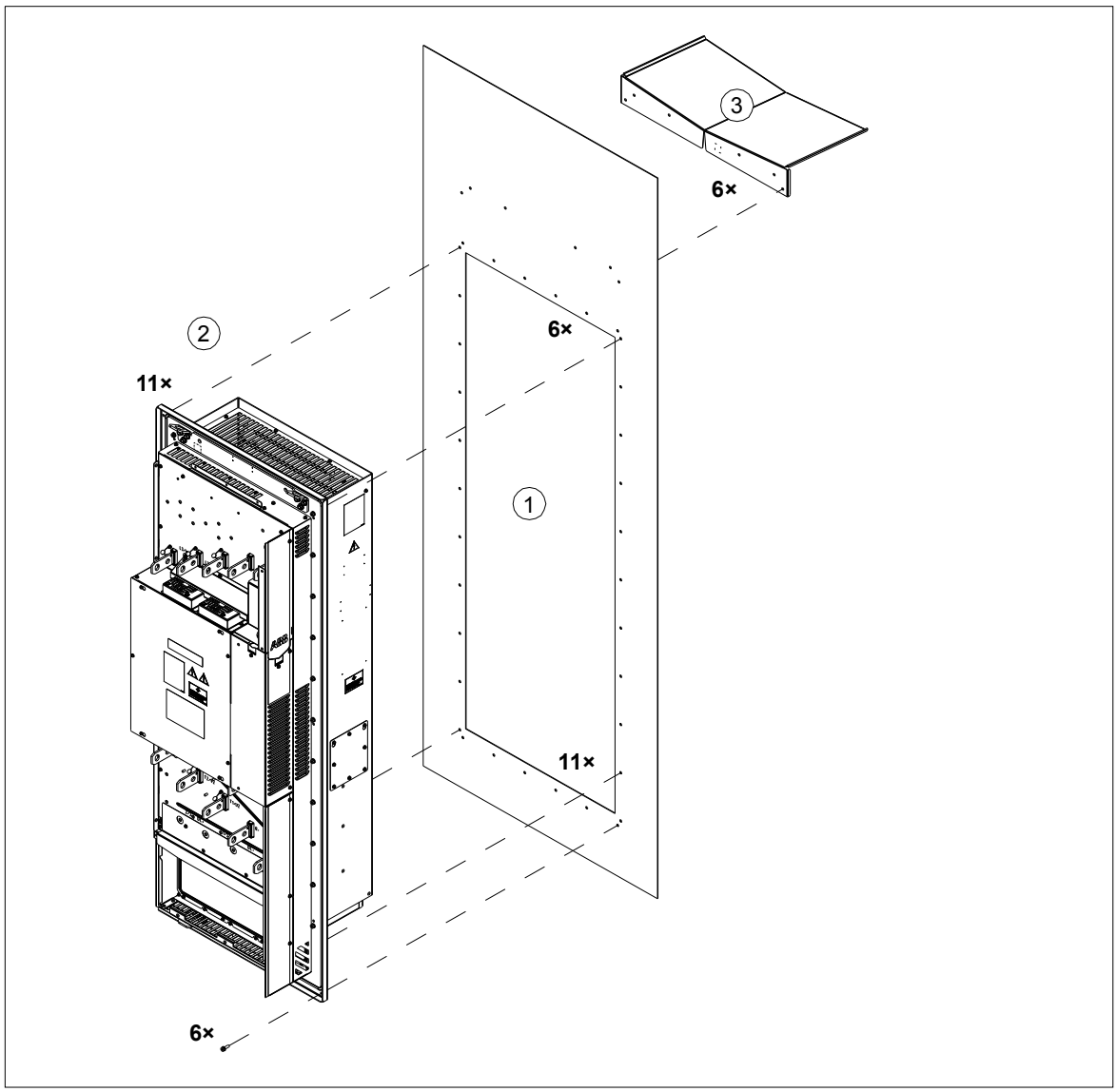
Attaching alternatives

The drive module can be attached by its flange or back (heatsink) to a mounting plate or wall.

Attaching the drive module by the flange

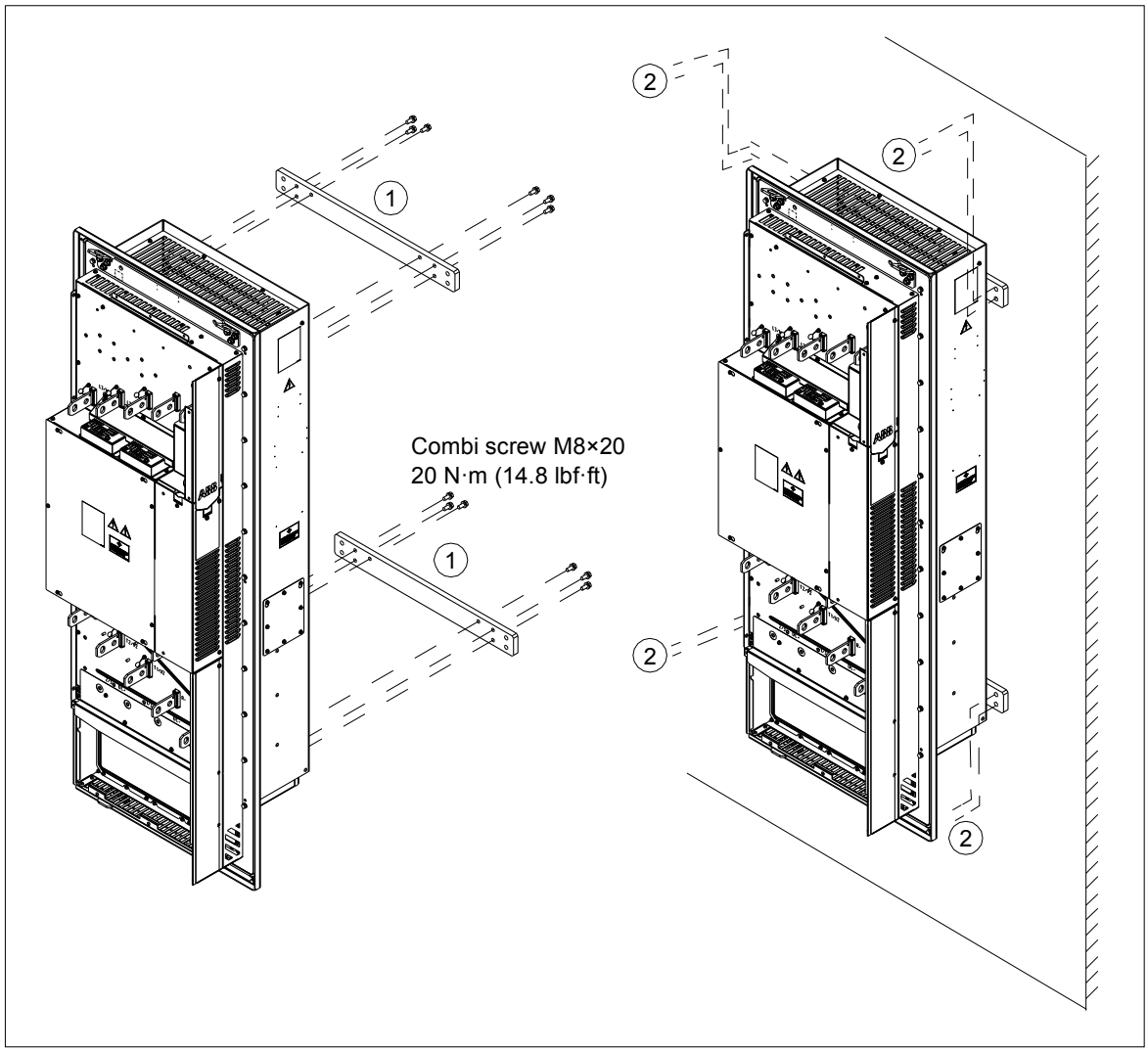
See in chapter *Dimension drawings* for the mounting point and mounting plate hole dimensions. A dimension drawing of a mounting plate for a Rittal TS 8 cabinet is also given.

1. Make a hole to the mounting plate for the drive module heatsink penetration.
2. Attach the drive module flange to the mounting plate with screws.
3. For NEMA 12 installations and if otherwise needed: Attach the hood.

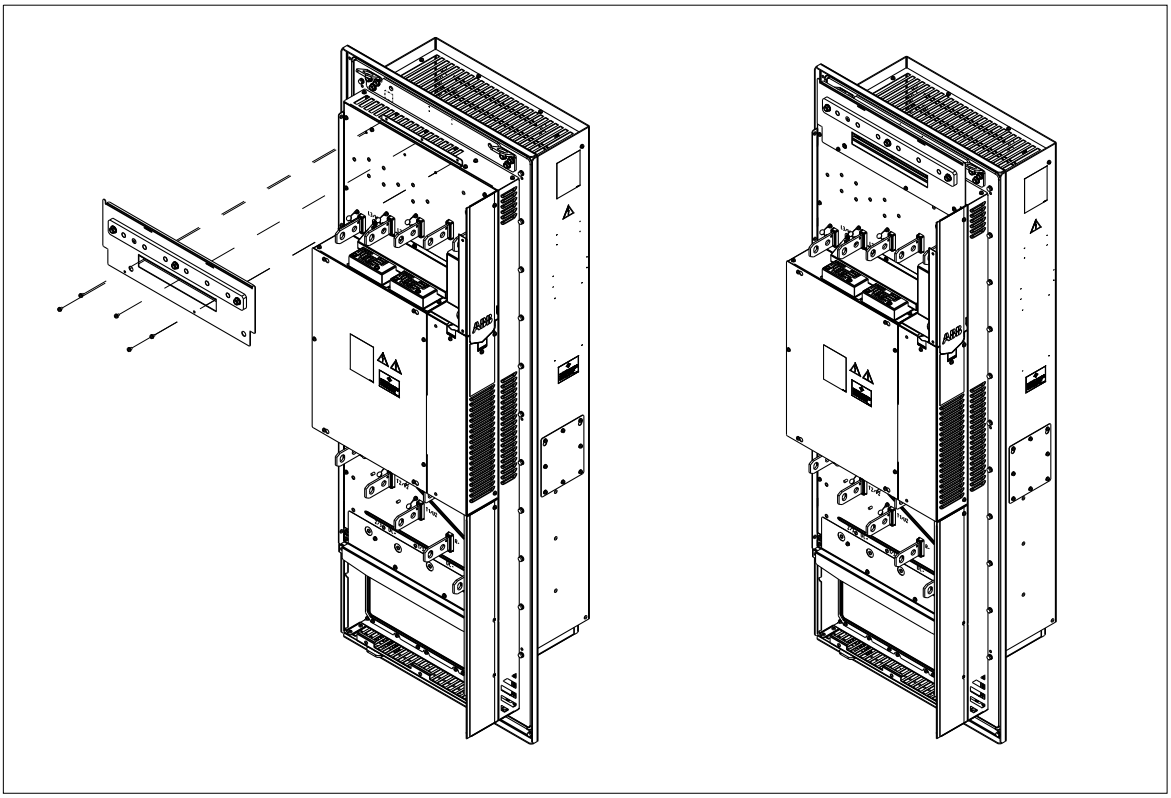


Attaching the drive module by the heatsink

1. Attach the support brackets to the heatsink back.
2. Attach the support brackets to the wall.



Attaching the metallic shroud (standard and with ground bar [option +H370])



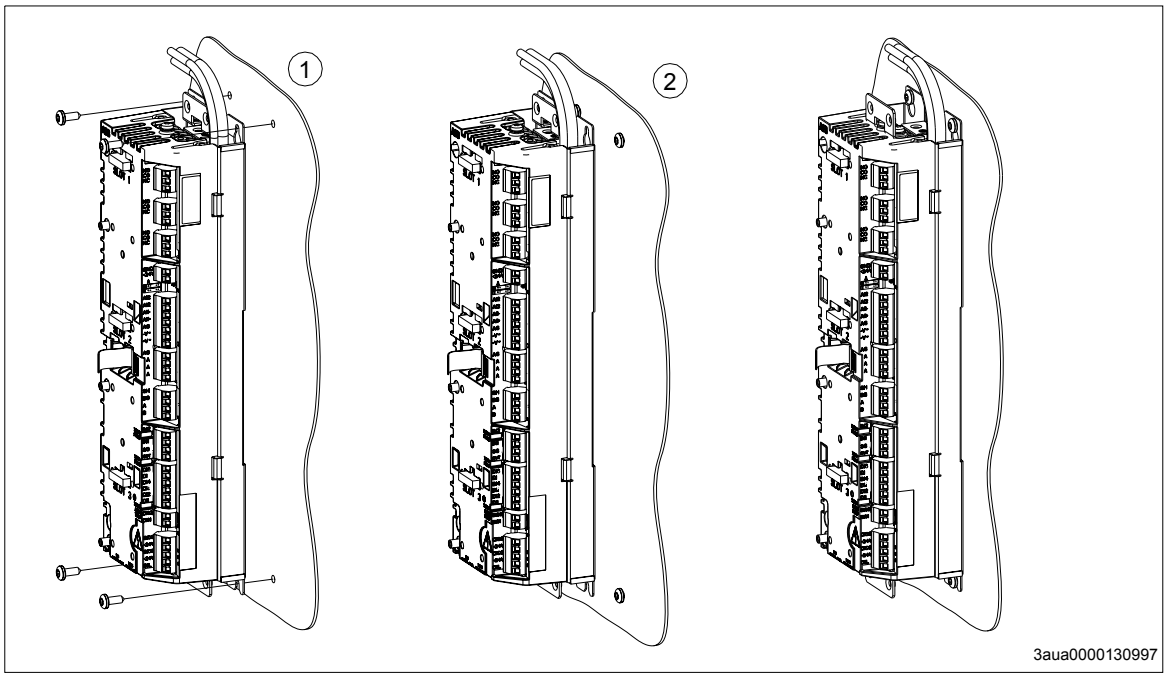
Attaching the external control unit

The drive control unit can be attached on a mounting plate or onto a DIN rail.

Note: Connect the fiber optic, power supply and BGDR cables from the drive module to the external control unit before you attach the control unit. See section *Connections to the control unit* on page *87*.

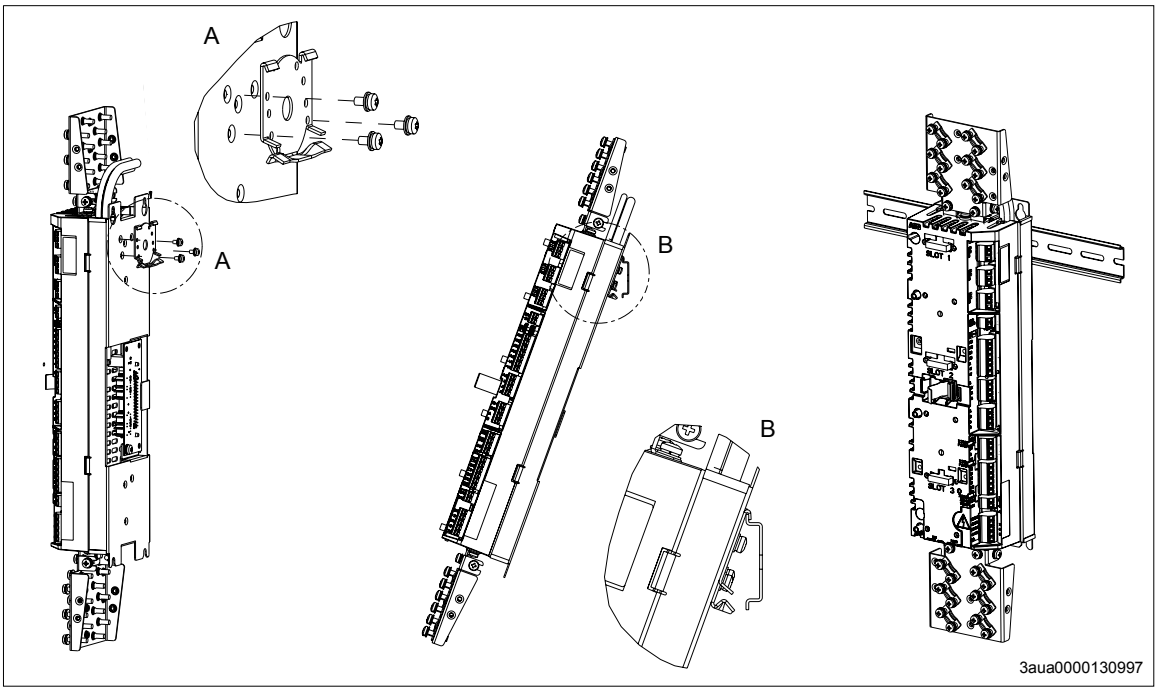
Attaching the external control unit to a mounting plate or wall

1. Attach the mounting screws in the wall.
2. Lift the unit onto the screws and tighten the screws.



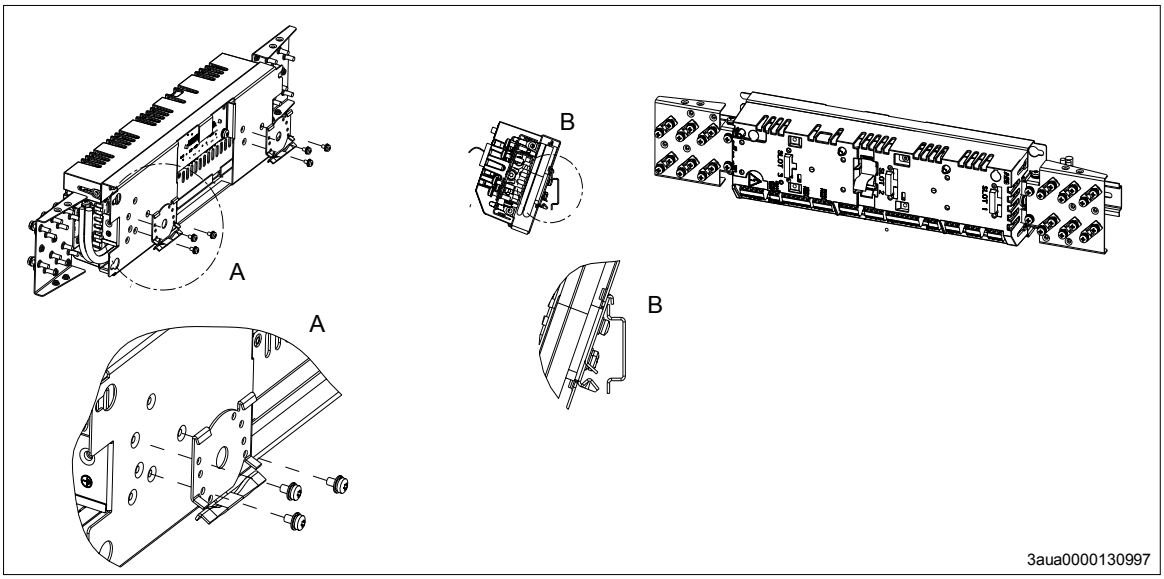
Attaching the external control unit vertically on a DIN rail

1. Attach the latch (A) to the back of the control unit with three screws.
2. Click the control unit to the rail as shown below (B).



Attaching the control unit horizontally on a DIN rail

1. Attach the latches (A) to the back of the control unit with three screws.
2. Click the control unit to the rail as shown below (B).



6

Guidelines for planning the electrical installation

Contents of this chapter

This chapter contains the instructions that you must obey when you select the motor, cables, protections, cable routing and way of operation for the drive system.

Limitation of liability

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

Selecting the supply disconnecting device

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

European Union

To agree with 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.

Other regions

The disconnecting device must conform to the applicable safety regulations.

Selecting the main contactor

If a main contactor is used, its utilization category (number of operations under load) must be AC-1 according to IEC 60947-4, *Low-voltage switchgear and controlgear*. Select the contactor according to the nominal voltage and current of the drive.

Examining the compatibility of the motor and drive

Use an asynchronous AC induction motor, permanent magnet motor, AC induction servomotor or ABB synchronous reluctance motor (SynRM motor) with the drive. Several induction motors can be connected at a time.

Select the motor size and drive type from the rating tables in chapter *Technical data* on basis of the AC line voltage and motor load. Use the DriveSize PC tool if you need to tune the selection more in detail.

Make sure that the motor withstands the maximum peak voltage in the motor terminals, see the *Requirements table* on page *59*. For basics of protecting the motor insulation and bearings in drive systems, refer to section *Protecting the motor insulation and bearings* below.

Note:

- Consult the motor manufacturer before you use a motor which nominal voltage differs from the AC line voltage connected to the drive input.
- The voltage peaks at the motor terminals are relative to the supply voltage of the drive, not the drive output voltage.
- If the motor and drive are not of the same size, consider the following operation limits of the drive control program:
  - motor nominal voltage range 1/6 ... 2 · U_N
  - motor nominal current range 1/6 ... 2 · I_N of the drive in DTC control and 0 ... 2 · I_N in scalar control. The control mode is selected by a drive parameter.

Protecting the motor insulation and bearings

The drive uses modern IGBT inverter technology. Regardless of frequency, the drive output has pulses of approximately the drive DC bus voltage with a very short rise time. Up to twice bus voltage can be at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. The increased voltage 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. This can gradually erode the bearing races and rolling elements.

Optional d*u*/d*t* filters protect motor insulation system and reduce bearing currents. Optional common mode filters mainly reduce bearing currents. Insulated N-end (non-drive end) bearings protect the motor bearings.

Requirements table

The following table shows how to select the motor insulation system and when optional ABB d*u*/d*t* filters, insulated N-end (non-drive end) motor bearings and ABB common mode filters are required. Failure of the motor to fulfill the following requirements or improper installation may shorten motor life or damage the motor bearings and voids the motor warranty.

Motor type	**Nominal AC supply voltage**	**Requirement for**	
		Motor insulation system	**ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings**
ABB motors			
Random-wound M2_, M3_ and M4_	$U_N \leq 500$ V	Standard	+ N + CMF
Form-wound HX_ and AM_	380 V < $U_N \leq 690$ V	Standard	$P_N < 500$ kW: +N + CMF
			$P_N \geq 500$ kW +N + d*u*/d*t* + CMF
Old* form-wound HX_ and modular	380 V < $U_N \leq 690$ V	Check with the motor manufacturer.	
Random-wound HX_ and AM_ **	0 V < $U_N \leq 500$ V	Enamelled wire with fiber glass taping	+ N + CMF
HDP	Consult the motor manufacturer.		

* manufactured before 1.1.1998

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

Motor type	Nominal AC supply voltage	Requirement for	
		Motor insulation system	ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings
Non-ABB motors			
Random-wound and form-wound	$U_N \leq 420$ V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N + CMF
	420 V < $U_N \leq$ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N + d*u*/d*t* + CMF
		or	
		Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	+ N + CMF

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
d*u*/d*t*	d*u*/d*t* filter at the output of the drive
CMF	Common mode filter (option +E208)
N	N-end bearing (Insulated motor non-drive end bearing)

Additional requirements for explosion-safe (EX) motors

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

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, the effect being similar to increasing the motor supply voltage by up to 20 percent. Consider this voltage increase when you specify the motor insulation requirements if the motor is braking a large part of its operation time.

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

Additional requirements for ABB high-output and IP23 motors

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347:2001. This table shows the requirements for ABB random-wound motor series (for example, M3AA, M3AP and M3BP).

Nominal AC supply voltage	Requirement for	
	Motor insulation system	ABB du/dt and common mode filters, insulated N-end motor bearings
$U_N \leq$ 500 V	Standard	+ N + CMF

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

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347:2001. The table below shows the requirements for random-wound

and form-wound non-ABB motors with nominal power smaller than 350 kW. For bigger motors, consult the motor manufacturer.

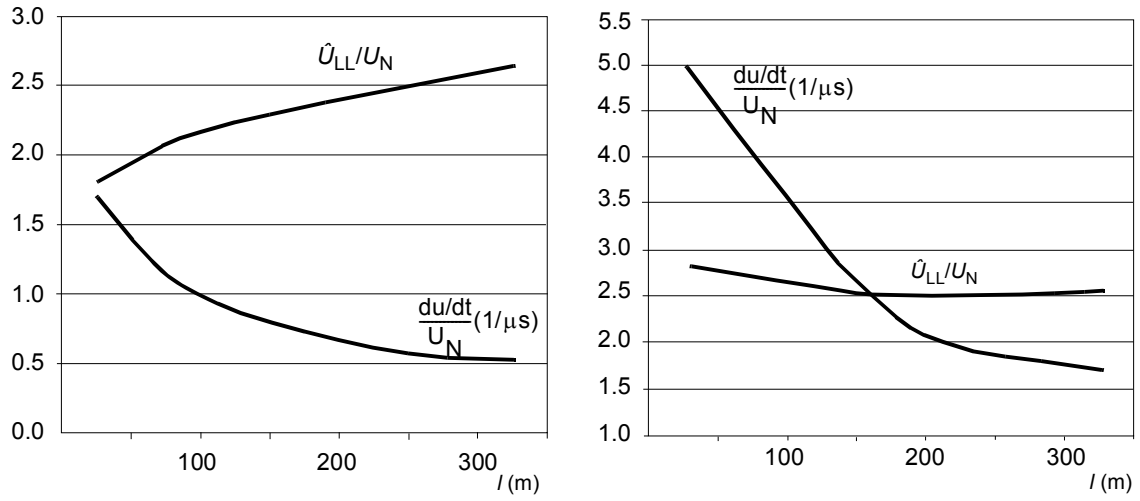
Nominal AC supply voltage	**Requirement for**	
	Motor insulation system	**ABB d*u*/d*t* filter, insulated N-end bearing and ABB common mode filter**
$U_N \leq 420$ V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N + CMF
420 V < $U_N \leq$ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N + d*u*/d*t* + CMF
	or	
	Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	+ N + CMF

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

The diagrams below show the relative peak line-to-line voltage and rate of change of voltage as a function of the motor cable length with and without a d*u*/d*t* filter in use.

To calculate the actual peak voltage for a certain cable length read the relative $\hat{U}_{LL}/U_N$ value from the appropriate diagram and multiply it by the nominal supply voltage (U_N).

To calculate the actual voltage rise time for a certain cable length read the relative values $\hat{U}_{LL}/U_N$ and (d*u*/d*t*)/U_N from the appropriate diagram. Multiply the values by the nominal supply voltage (U_N) and substitute into equation $t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.



Drive with d*u*/d*t* filter **Drive without d*u*/d*t* filter**

l	Motor cable length
$\hat{U}_{LL}/U_N$	Relative peak line-to-line voltage
d*u*/d*t* /U_N	Relative d*u*/d*t* value

Note: ÛLL and du/dt values are approximately 20% higher with resistor braking.

Additional note for sine filters

Sine filters protect the motor insulation system. Therefore, the d*u*/d*t* filter can be replaced with a sine filter. The peak phase-to-phase voltage with the sine filter is approximately $1.5 \cdot U_N$.

Additional note for common mode filters

Common mode filters are available as plus code option +E208.

Selecting the power cables

General rules

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

- Select a cable capable of carrying the drive nominal current. See section *Ratings* (page *119*) for the rated currents.
- Select a cable rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use. For US, see *Additional US requirements,* page *64*.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. For 690 V AC rated equipment, the rated voltage between the conductors of the cable should be at least 1 kV.

Use symmetrical shielded motor cables (see page *64*). Ground motor cable shields 360° at both ends. Keep the motor cable and its PE pigtail (twisted shield) as short as possible to reduce high-frequency electromagnetic emissions.

Note: When continuous metal conduit is employed, shielded cable is not required. The conduit must have bonding at both ends.

A four-conductor system is allowed for input cabling, but shielded symmetrical cable is recommended.

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

Unless local wiring regulations state otherwise, the cross-sectional area of the protective conductor must agree with the conditions that require automatic disconnection of the supply required in 411.3.2. of IEC 60364-4-41:2005 and be capable of withstanding the prospective fault current during the disconnection time of the protective device.

The cross-sectional area of the protective conductor can either be selected from the table below or calculated according to 543.1 of IEC 60364-5-54.

This table shows the minimum cross-sectional area related to the phase conductor size according to IEC 61800-5-1 when the phase conductor and the protective conductor are made of the same metal. If this is not so, the cross-sectional area of the protective earthing conductor shall be determined in a manner which produces a conductance equivalent to that which results from the application of this table.

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

Typical power cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for the drives with nominal current. See also *Terminal and lead-through data for the power cables* on page *127.*

Drive type ACS880-04-	IEC [1]		US [2]	
	Cu cable type	Al cable type	Cu cable type	Al cable type
	mm^2	mm^2	AWG/kcmil	AWG/kcmil
U_N = 400 V				
725A-3	3 × (3×185)	4 × (3×185)	3×500 MCM or 4×300 MCM	3×500 MCM or 4×300 MCM
820A-3	3 × (3×240)	4 × (3×240)	3×600 MCM or 4×400 MCM	3×700 MCM or 4×500 MCM
880A-3	3 × (3×240)	4 × (3×240)	3×600 MCM or 4×400 MCM	4×500 MCM
U_N = 500 V				
715A-5	3 × (3×185)	4 × (3×185)	3×500 MCM or 4×300 MCM	3×600 MCM or 4×400 MCM
820A-5	3 × (3×240)	4 × (3×240)	3×600 MCM or 4×400 MCM	4×500 MCM
880A-5	3 × (3×240)	4 × (3×240)	3×600 MCM or 4×400 MCM	4×500 MCM

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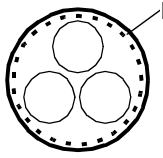
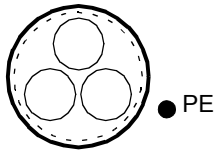
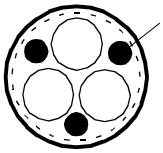
1) The cable sizing is based on max. 9 cables laid on a cable ladder side by side, three ladder type trays one on top of the other, ambient temperature 30 °C (86 °F) PVC insulation, surface temperature 70 °C (158 °F) (EN 60204-1 and IEC 60364-5-52). For other conditions, dimension the cables according to local safety regulations, appropriate input voltage and the load current of the drive.
2) The cable sizing is based on NEC Table 310-16 for copper wires, 75 °C (167 °F) wire insulation at 40 °C (104 °F) ambient 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.

Alternative power cable types

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

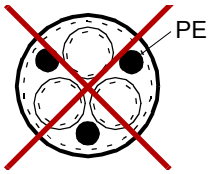
Recommended power cable types

	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. The shield must agree with the requirements of IEC 61800-5-1, see page *62*. Check with local / state / country electrical codes for allowance.
	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. A separate PE conductor is required if the shield does not agree with the requirements of IEC 61800-5-1, see page *62*.
	Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must agree with the requirements of IEC 61800-5-1, see page *62*.

Power cable types for restricted use

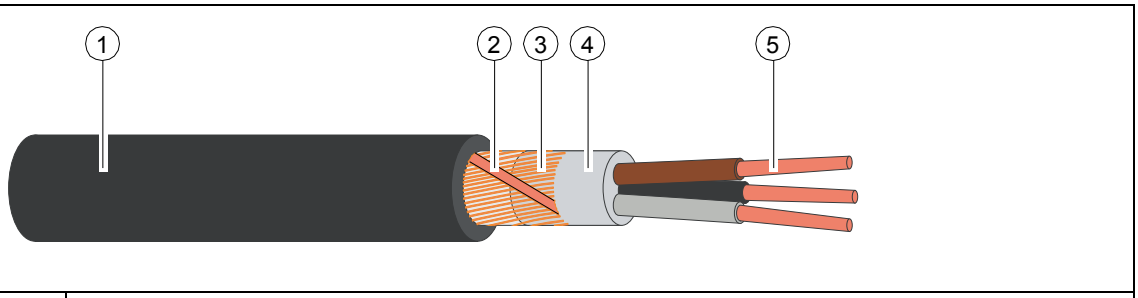
	A four-conductor system (three phase conductors and a protective conductor on a cable tray) is **not allowed for motor cabling** (allowed for input cabling).

Not allowed power cable types

	Symmetrical shielded cable with individual shields for each phase conductor is not allowed on any cable size for input and motor cabling.

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 subsection *General rules* above, or IEC 61800-5-1. To effectively suppress radiated and conducted radio-frequency emissions, the cable shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminum shield. The minimum requirement of the motor cable shield of the drive is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape or copper wire. The better and tighter the shield, the lower the emission level and bearing currents.



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

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. 1000 V AC cable is required above 500 V AC (below 600 V AC). For drives rated over 100 amperes, 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 employed, type MC continuous corrugated aluminum armor cable or shielded cable is not required. A dedicated ground cable is always required.

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

Armored cable / shielded power cable

Six conductor (3 phases and 3 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 Belden, LAPPKABEL (ÖLFLEX) and Pirelli.

Planning the braking system

See chapter *Resistor braking*.

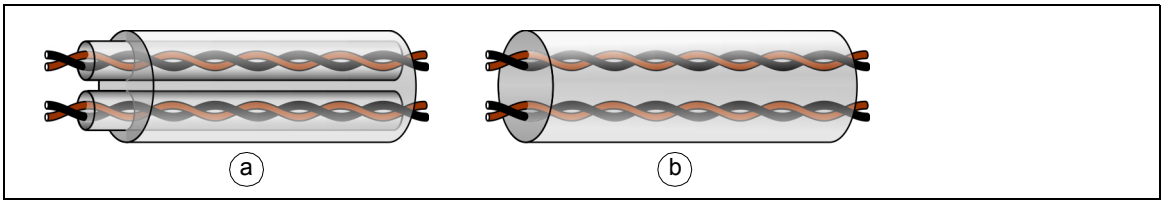
Selecting the control cables

Shielding

All control cables must be shielded.

Use a double-shielded twisted pair cable for analog signals. We recommend this type of cable for the pulse encoder signals also. Employ one individually shielded pair for each signal. Do not use common return for different analog signals.

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



Signals in separate cables

Run analog and digital signals in separate, shielded cables. Never mix 24 V DC and 115/230 V AC signals in the same cable.

Signals allowed to be run in the same cable

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

Relay cable type

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

Control panel cable length and type

In remote use, the cable connecting the control panel to the drive must not exceed three meters (10 ft). Cable type: shielded CAT 5e or better Ethernet patch cable with RJ-45 ends.

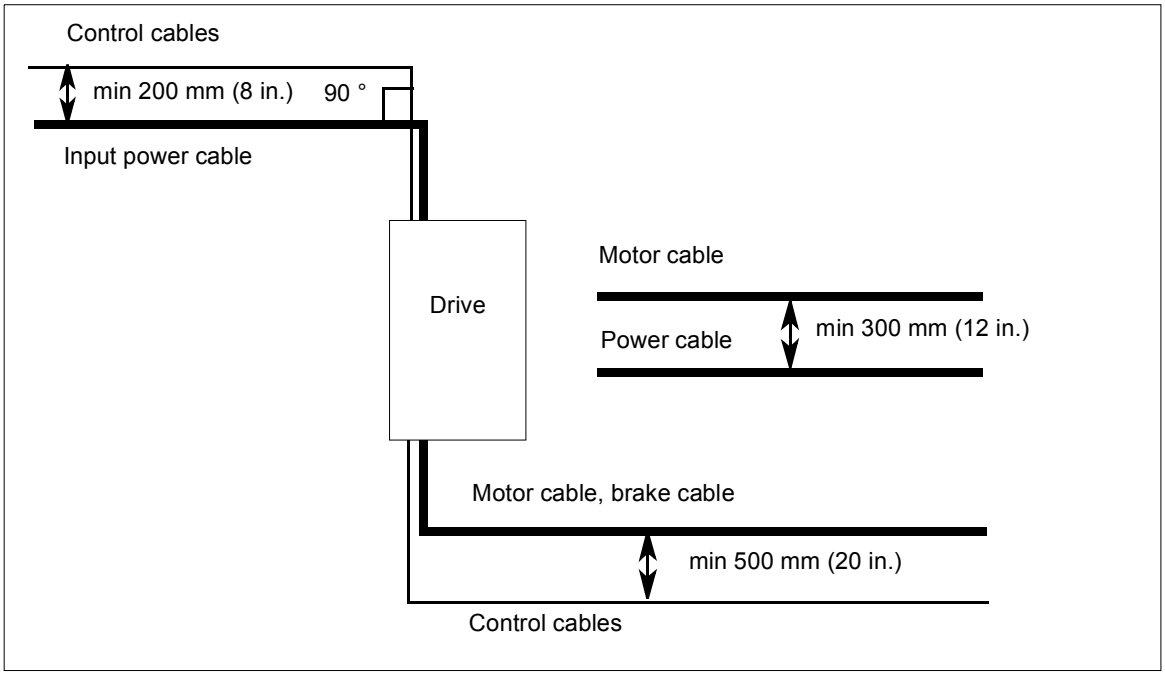
Routing the cables

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

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

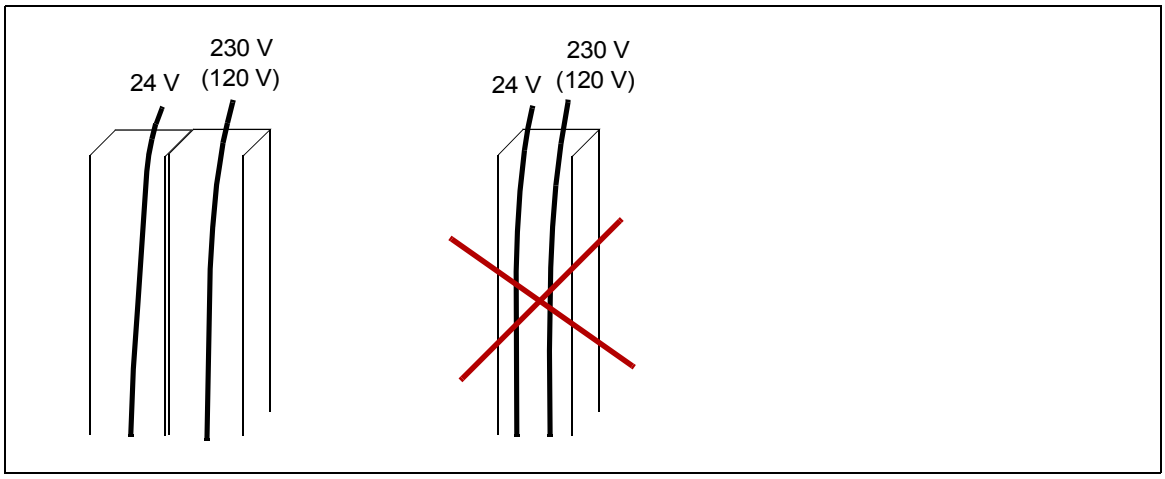
The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential

A diagram of the cable routing is shown below.



Separate control cable ducts

Lead 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 in the motor cable

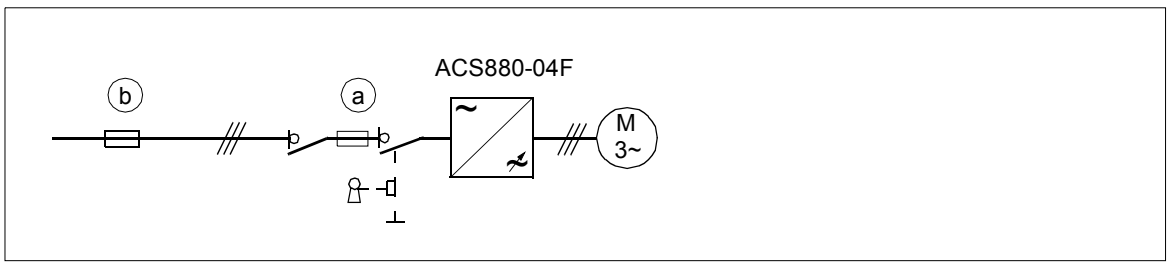
To minimize the emission level when safety switches, contactors, connection boxes or similar equipment are installed on the motor cable between the drive and the motor:

- 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 with fuses (a) and the input cable with fuses (b) or a circuit breaker as shown below:



Size the fuses or the circuit breaker at the distribution board according to local regulations for the input cable protection. Select the fuses for the drive according to the instructions given in chapter *Technical data*. The fuses for the drive protection will restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Note: If the fuses for the drive protection are placed at the distribution board and the input cable is dimensioned according to the nominal input current of the drive given in the rating table on page *119*, the fuses will protect also 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. No separate fuses for the input cable protection are needed.

Circuit breakers

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

You can use the circuit breakers listed below. Other circuit breakers can be used with the drive if they provide the same electrical characteristics. ABB does not assume any liability whatsoever for the correct function and protection with circuit breakers not listed below. Furthermore, if the recommendations given by ABB are not obeyed, the drive can experience problems that the warranty does not cover.

Note: Fuses must be used with circuit breakers in the USA.

Drive module type	Frame size	ABB molded case circuit breaker (Tmax)	
		Product ID (Type)	kA [1]
U_N = 400 V			
ACS880-04-725A-3	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
ACS880-04-820A-3	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
ACS880-04-880A-3	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
U_N = 500 V			
ACS880-04-715A-5	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
ACS880-04-820A-5	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50
ACS880-04-880A-5	R11	1SDA062770R1 (T7H 1000 PR231/P LS/I In=1000A 3p F F)	50

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[1] Maximum allowed rated conditional short-circuit current (IEC 61439-1) of the electrical power network

[2] Contact your local ABB representative

WARNING! Due to the inherent operating principle and construction of circuit breakers, independent of the manufacturer, hot ionized gases can escape from the breaker enclosure in case of a short-circuit. To ensure safe use, pay special attention to the installation and placement of the breakers. Obey the manufacturer's instructions.

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 dimensioned 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 dimensioned according to the nominal current of the drive. No additional thermal protection devices are needed.

WARNING! If the drive is connected to multiple motors, 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 IEC 180…225: thermal switch, eg, Klixon
- motor sizes IEC 200…250 and larger: PTC or Pt100.

See the firmware manual for more information on the motor thermal protection, and the connection and use of the temperature sensors.

Protecting the drive against ground faults

The drive is equipped with an internal ground fault protective function to protect the drive against ground faults in the motor and motor cable in TN (grounded) networks. This is not a personal safety or a fire protection feature. The ground fault protective function can be disabled with a parameter, refer to the firmware manual.

Measures for protection in case of direct or indirect contact, such as separation from the environment by double or reinforced insulation or isolation from the supply system by a transformer, can be applied.

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 can cause fault current circuit breakers to function.

Connecting drive modules to a common DC system

See *ACS880-01 drives and ACS880-04 drive modules common DC systems application guide* (3AUA0000127818 [English]).

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. You can implement the emergency stop function using the Safe torque off function of the drive module (see chapter *Safe torque off function* on page *153*). 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 *Safe torque off function* on page *153*.

Implementing the ATEX-certified Safe motor disconnection function (option +Q971)

With option +Q971, the drive provides ATEX-certified safe motor disconnection without contactor using the drive Safe torque off function. For more information,

- *ACS880 ATEX-certified Safe disconnection function application guide* (3AUA0000132231 [English])
- *FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537) user's manual* (3AXD50000027782 [English]).

Implementing safety functions provided by the FSO safety functions module (options +Q972 and +Q973)

The drive can be equipped with an FSO-xx safety functions module (option +Q971 or +Q973) which enables the implementation of functions such as Safe brake control (SBC), Safe stop 1 (SS1), Safe stop emergency (SSE), Safely limited speed (SLS) and Safe maximum speed (SMS).

The settings of the FSO module are at default when delivered from the factory. The wiring of the safety circuit and configuration of the FSO module are the responsibility of the machine builder.

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

For wiring instructions, safety data and more information on the functions provided by the option, see *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]).

Declaration of Conformity

See page *135*.

Implementing the Power loss ride-through function

Implement the power loss ride-through function as follows:

1. Check that the power-loss ride-through function of the drive is enabled with parameter **30.31 Undervoltage control** in the ACS880 primary control program.
2. If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.

WARNING! Make sure that the flying restart of the motor will not cause any danger. If you are in doubt, do not implement the power-loss ride-through function.

Using power factor compensation capacitors with the drive

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

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

If there are power factor compensation capacitors in parallel with the three phase input of the drive:

1. Do not connect a high-power capacitor to the power line while the drive is connected. The connection will cause voltage transients that may trip or even damage the drive.
2. If capacitor load is increased/decreased step by step when the AC drive is connected to the power line, ensure that the connection steps are low enough not to cause voltage transients that would trip the drive.
3. Check that the power factor compensation unit is suitable for use in systems with AC drives, ie, harmonic generating loads. In such systems, the compensation unit should typically be equipped with a blocking reactor or harmonic filter.

Implementing a safety switch between the drive and the motor

We recommended that you install a safety switch between the permanent magnet motor and the drive output. The switch is needed to isolate the motor during any maintenance work on the drive.

Using a contactor between the drive and the motor

Implementing the control of the output contactor depends on how you select the drive to operate. See also section *Implementing a bypass connection* on page *72*.

When you have selected to use DTC motor control mode and motor ramp stop, open the contactor as follows:

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

When you have selected to use DTC motor control mode and motor coast stop, or scalar control mode, open the contactor as follows:

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

WARNING! When the DTC motor control mode is in use, never open the output contactor while the drive controls the motor. The DTC motor control operates extremely fast, much faster than it takes for the contactor to open its contacts. When the contactor starts opening while the drive controls the motor, the DTC control will try to maintain the load current by immediately increasing the drive output voltage to the maximum. This will damage, or even burn the contactor completely.

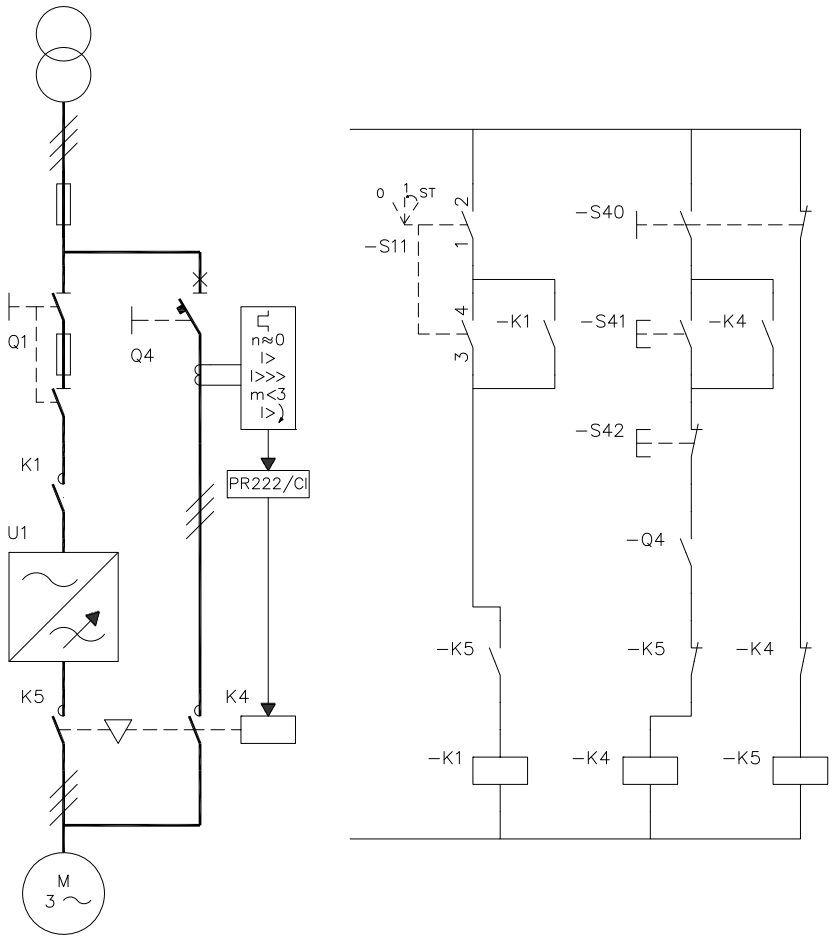
Implementing a bypass connection

If bypassing is required, employ mechanically or electrically interlocked contactors between the motor and the drive and between the motor and the power line. Ensure with interlocking that the contactors cannot be closed simultaneously. The installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

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

Example bypass connection

An example bypass connection is shown below.



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

Switching the motor power supply from drive to direct-on-line

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

Switching the motor power supply from direct-on-line to drive

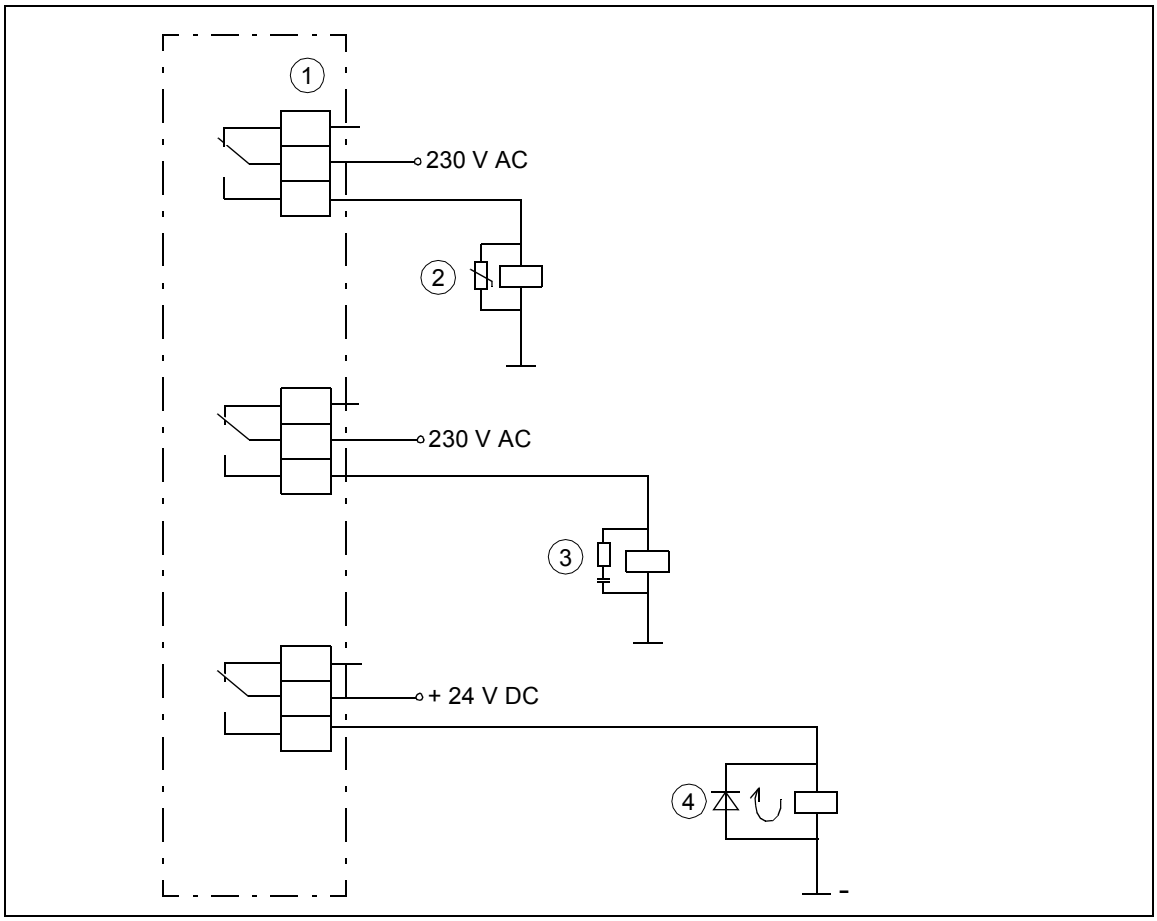
1. Stop the motor with S42.
2. Switch the motor power supply from direct-on-line to the drive with S40.
3. Close the main contactor of the drive with switch S11 (-> turn to position ST for two seconds and leave to position 1).
4. Start the drive and the motor with the drive control panel (drive in the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

Protecting the contacts of relay outputs

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

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

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



1) Relay outputs; 2) Varistor; 3) RC filter; 4) diode

Implementing a motor temperature sensor connection

WARNING! IEC 60664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

To connect a motor temperature sensor and other similar components to the drive, you have four alternatives:

1. If there is double or reinforced insulation between the sensor and the live parts of the motor, you can connect the sensor directly to the inputs of the drive.
2. If there is basic insulation between the sensor and the live parts of the motor, you can connect the sensor to the inputs of the drive if all circuits connected to the drive's digital and analog inputs (typically extra-low voltage circuits) are protected against contact and insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit. Note that extra-low voltage circuits (such as 24 V DC) typically do not meet these requirements.
3. You can connect the sensor to an extension module with basic insulation (eg, FAIO-01) or reinforced insulation (eg, FPTC-xx) between the sensor connector and the other connectors of the module. See the table below for the sensor insulation requirement. For sensor connection to the extension module, see its manual.
4. You can connect a sensor to an external thermistor relay the insulation of which is rated for the main circuit voltage of the drive.

Drive I/O, I/O extension and encoder interface modules

See:

- section *AI1 and AI2 as Pt100, Pt1000, PTC and KTY84 sensor inputs (XAI, XAO)* on page *91*,
- section *DI6 (XDI:6) as PTC sensor input* on page *92*,
- *FPTC-01 thermistor protection module (option +L536) for ACS880 drives user's manual* (3AXD50000027750 [English]),
- *FPTC-02 ATEX-certified thermistor protection module Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual* (3AXD50000027782 [English]).

This table shows what temperature sensor types you can connect to the drive I/O extension modules as well as the insulation requirement for the sensor.

Extension module		Temperature sensor type			Temperature sensor insulation requirement
Type	**Insulation/Isolation**	**PTC**	**KTY**	**Pt100, Pt1000**	
FIO-11	Galvanic isolation between sensor connector and other connectors (including drive control unit connector)	-	X	X	Reinforced insulation
FEN-xx	Galvanic isolation between sensor connector and other connectors (including drive control unit connector)	X	X	-	Reinforced insulation
FAIO-01	Basic insulation between sensor connector and drive control unit connector. No insulation between sensor connector and other IO connectors.	X	X	X	Basic insulation. Connectors of extension module other than sensor connector must be left unconnected.

Extension module		Temperature sensor type			Temperature sensor insulation requirement
Type	**Insulation/Isolation**	**PTC**	**KTY**	**Pt100, Pt1000**	
FPTC-xx	Reinforced insulation between sensor connector and other connectors (including drive control unit connector).	X	-	-	No special requirement

Note: The inaccuracy of the drive analog inputs for Pt100 sensors is 10 °C (50 °F). If more accuracy is needed, use the FAIO-01 analog I/O extension module (option +L525).

Example circuit diagram

See page *151*.

7

Electrical installation

Contents of this chapter

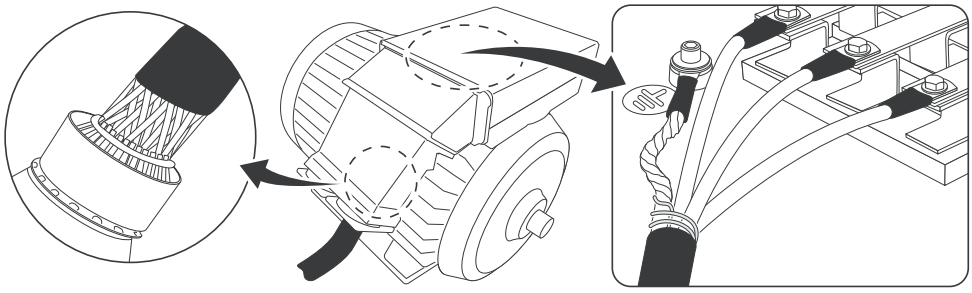
This chapter gives instructions on the wiring of the drive.

Safety

WARNING! If you are not a qualified electrician do not do the installation work described in this chapter. Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

Installing the motor cable at the motor end

Ground the motor cable shield 360 degrees at the lead-through of the motor terminal box.



Checking the insulation of the assembly

Drive

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

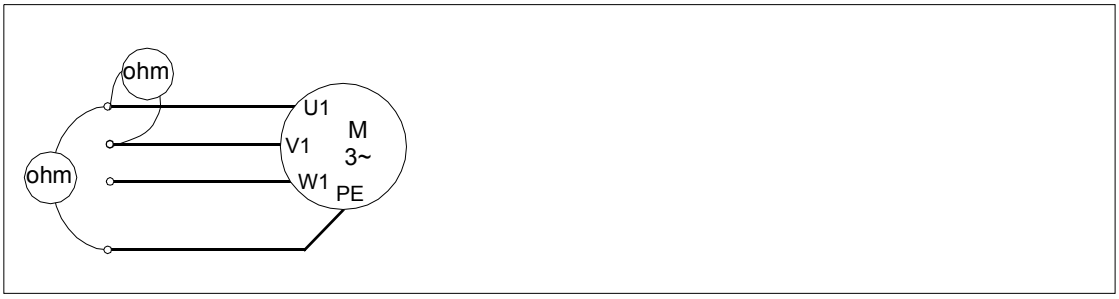
Input cable

Check the insulation of the input cable according to local regulations before connecting it to the drive.

Motor and motor cable

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start the work.
2. Check that the motor cable is disconnected from the drive output terminals T1/U2, T2/V2 and T3/W2.
3. Measure the insulation resistance between each phase conductor and then between each phase conductor and the Protective Earth conductor using 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, consult the manufacturer's instructions. **Note:** Moisture inside the motor casing will reduce the insulation resistance. If you suspect moisture, dry the motor and repeat the measurement.

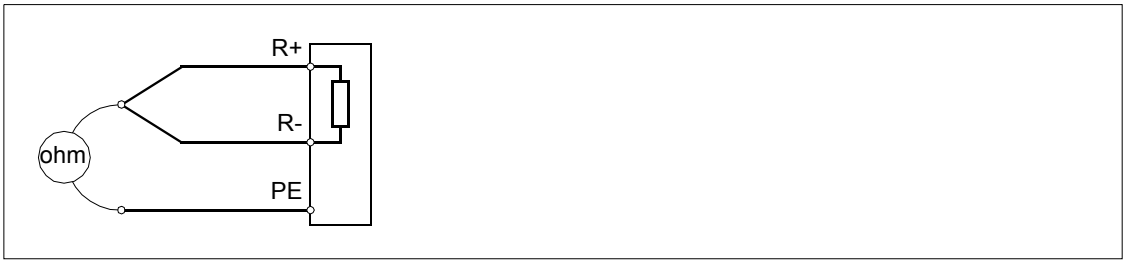


Brake resistor and resistor cable

Check the insulation of the brake resistor assembly (if present) as follows:

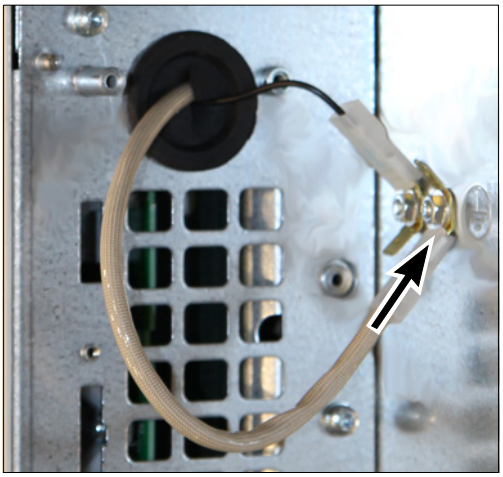
1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start the work.
2. Check that the resistor cable is connected to the resistor, and disconnected from the drive output terminals R+ and R-.
3. At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the conductors and the PE conductor by

using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



Checking the compatibility with IT (ungrounded) systems

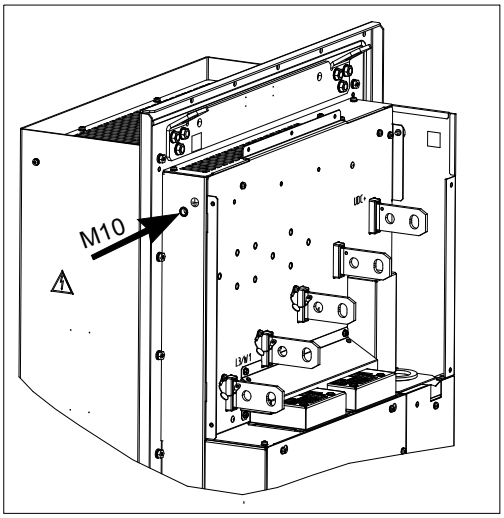
EMC filter +E200 is not suitable for use in an IT (ungrounded) system. If the drive is equipped with filter +E200, disconnect the filter grounding wire before connecting the drive to the supply network. Insulate the end of the wire and attach it. The wire is located behind the middle front cover.



WARNING! If a drive with EMC filter+E200 is installed on an IT system (an ungrounded power system or a high resistance-grounded [over 30 ohm] power system), the system will be connected to earth potential through the EMC filter capacitors of the drive. This can cause danger, or damage the drive.

Grounding the drive module

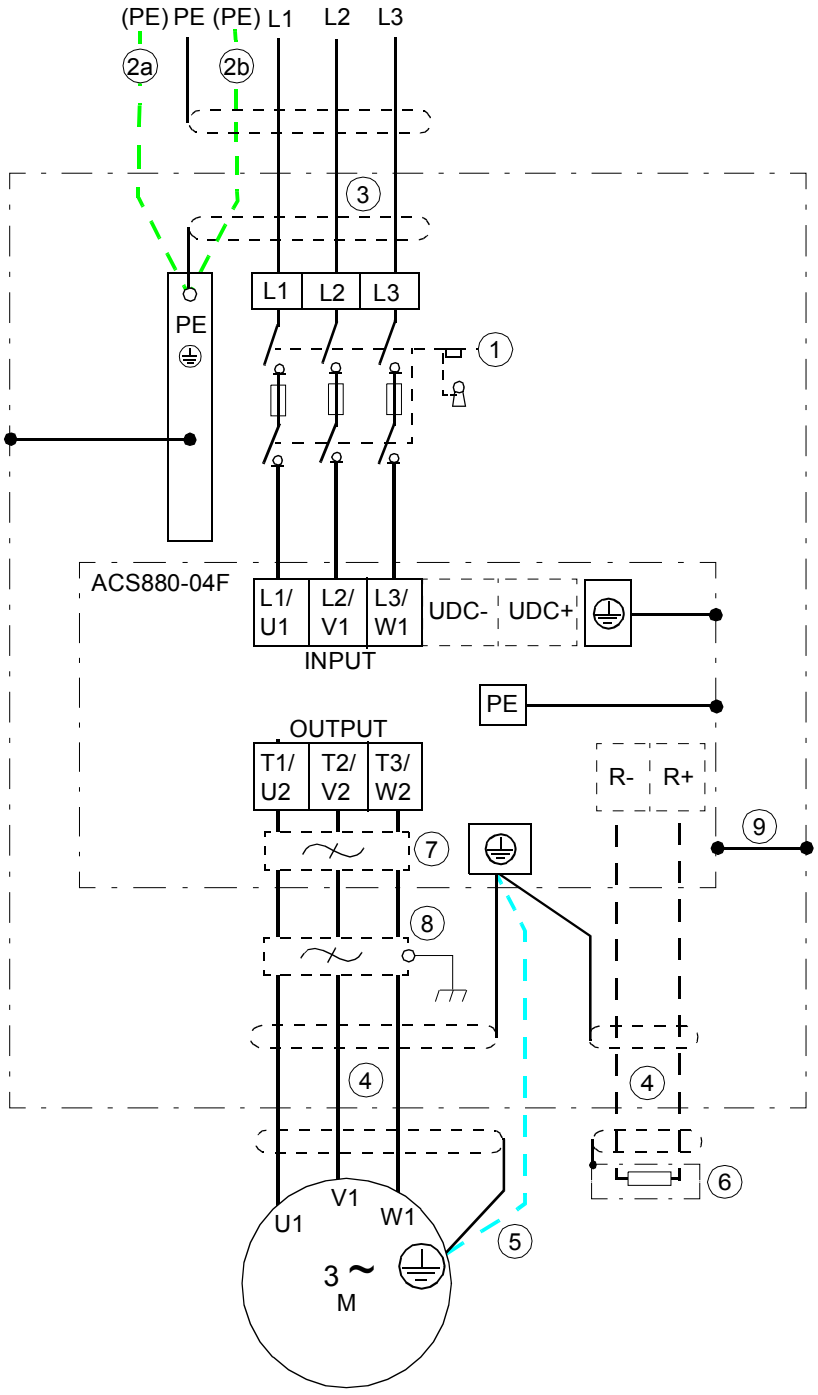
Ground the drive module from its top back grounding hole to the cabinet frame or from the module PE terminal to the cabinet PE busbar.



Connecting the power cables

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

Power cable connection diagram



1	For alternatives, see section *Selecting the supply disconnecting device* on page *58*. In the installing example of this chapter, the disconnecting device is not in the same cubicle with the drive module.
2	If a shielded cable is used (not required but recommended) and the conductivity of the shield is < 50% of the conductivity of the phase conductor, use a separate PE cable (2a) or a cable with a grounding conductor (2b).
3	We recommend 360-degree grounding at the cabinet entry if a shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
4	We recommend 360-degree grounding at the cabinet entry, see page *42*.
5	Use a separate grounding cable if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor and there is no symmetrically constructed grounding conductor in the cable (see page *63*).

6	External brake resistor (optional, see page *165*)
7	Common mode filter (optional, see page *59*)
8	du/dt filter (optional, see page *171*)
9	The drive module frame must be connected to the cabinet frame. See section *Arranging the grounding inside the cabinet* on page *40*.

Note:

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

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

Power cable connection procedure

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

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

For the standard drive module configuration:

- See the step-by-step installation drawings in *ACS880-04F quick installation guide* (3AXD50000044913 [multilingual])
- Connect the full-size output cable connection terminals to the drive module.

For optional input power cable connection terminals and ground busbar assembly (+H370):

- Install the metallic shroud with ground bar as shown in section *Attaching the metallic shroud (standard and with ground bar [option +H370])* on page *54*
- Connect the full-size input power cable connection terminals in a similar way as the motor cable connection terminals, see *ACS880-04F quick installation guide* (3AXD50000044913 [multilingual]).

For drive modules without full-size output cable connection terminals (option +0H371) and IP20 shrouds (option +0B051), Connect the power cables directly to the drive module input and output terminals with cable lugs or by busbars. Protect the power cable terminals and electrical parts against contact and ground the drive module correctly.

Cabinet installation:

1. Run the motor cables from the motor to the cabinet. Ground the cable shields 360° at the lead-through plate.
2. Twist the cable shields of the motor cables into bundles and connect them and any separate ground conductors or cables to the ground terminal of the drive module or to the cabinet ground bar.
3. Connect the phase conductors of the motor cables to terminals T1/U2, T2/V2 and T3/W2 of the drive module. For the tightening torques, see page *127*.
4. Drive modules with option +D150: Run the power cables from the brake resistor to the cabinet. Ground the cable shield (if present) 360° at the lead-through plate. Connect the conductors to the R+ and R- terminals. For the tightening torques, see page *127*.

5. Make sure that all power is disconnected and reconnection is not possible. Use proper safe disconnect procedures according to local codes.
6. Run the input cables from the supply source to the cabinet. Ground the cable shields 360° at the lead-through plate.
7. Twist the cable shields of the input cables into bundles and connect them and any separate ground conductors or cables to the drive module ground terminal or to the cabinet PE busbar.
8. Connect the phase conductors of the input cables to terminals L1/U1, L2/V1 and L3/W1 of the drive module. For the tightening torques, see page *127*.

DC connection

The UDC+ and UDC– terminals are intended for common DC configurations of a number of drives, allowing regenerative energy from one drive to be utilized by the other drives in the motoring mode. See *ACS880-01 drives and ACS880-04 drive modules common DC systems application guide* (3AUA0000127818 [English]).

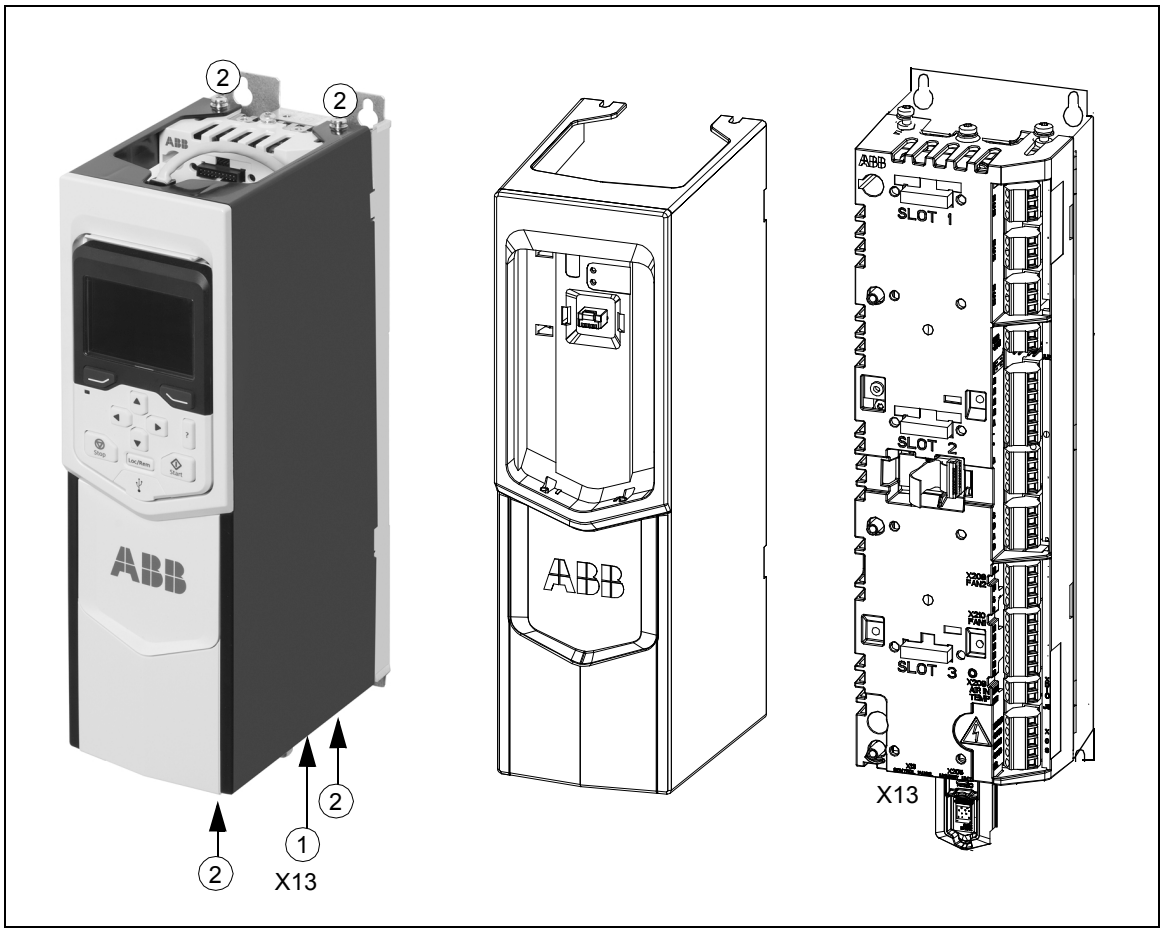
Overview of control cable connection process

This table lists the main steps of the control cable connecting process.

Step	Section	Page
1	*Removing the control panel holder from the external control unit*	*84*
2	*Attaching the control cable clamp plate*	*85*
3	*Connecting the external control unit to the drive module*	*86*
4	*Connecting the control cables to the terminals of the control unit*	*88*

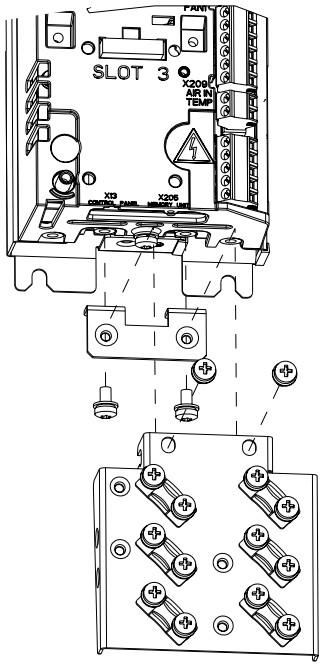
Removing the control panel holder from the external control unit

1. Disconnect the control panel cable from connector X13 on the control unit.
2. Loosen the mounting screws of the control panel holder and take the holder off.



Attaching the control cable clamp plate

Attach the control cable clamp plate either to the top or base of the control unit with four screws as shown below.



0.7 N·m
(6.2 lbf·in)

Connecting the external control unit to the drive module

WARNING! Handle the fiber optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt.

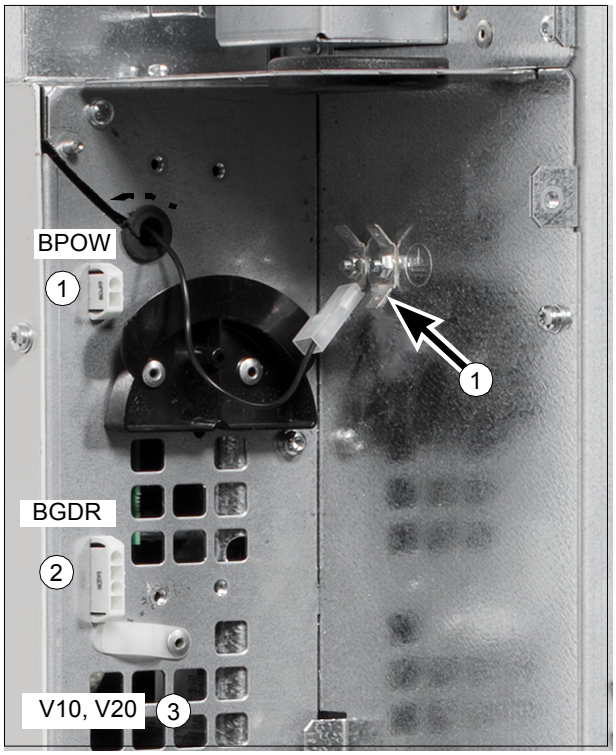
Routing the control unit cables into the drive module

Route the control unit connection cables to the drive module through the slot in the middle front cover at the front or left side or from below or above. When routing through the middle front cover, remove the plate which covers the slot. Then, install the rubber grommet into the slot from the accessories box (no. 6 in the package drawing on page *49*).

Connections to the drive module

1. Connect power supply cable of the control unit to the BPOW connector and the ground wire of the cable to the ground terminal.
2. Connect the BGDR cable to the BGDR connector.
3. Connect the fiber optic cables to the V:20 and V10 connectors.

Secure the cables at the clamps.



Connections to the control unit

Connect the fiber optic, power supply and BGDR cables to the external control unit as follows:

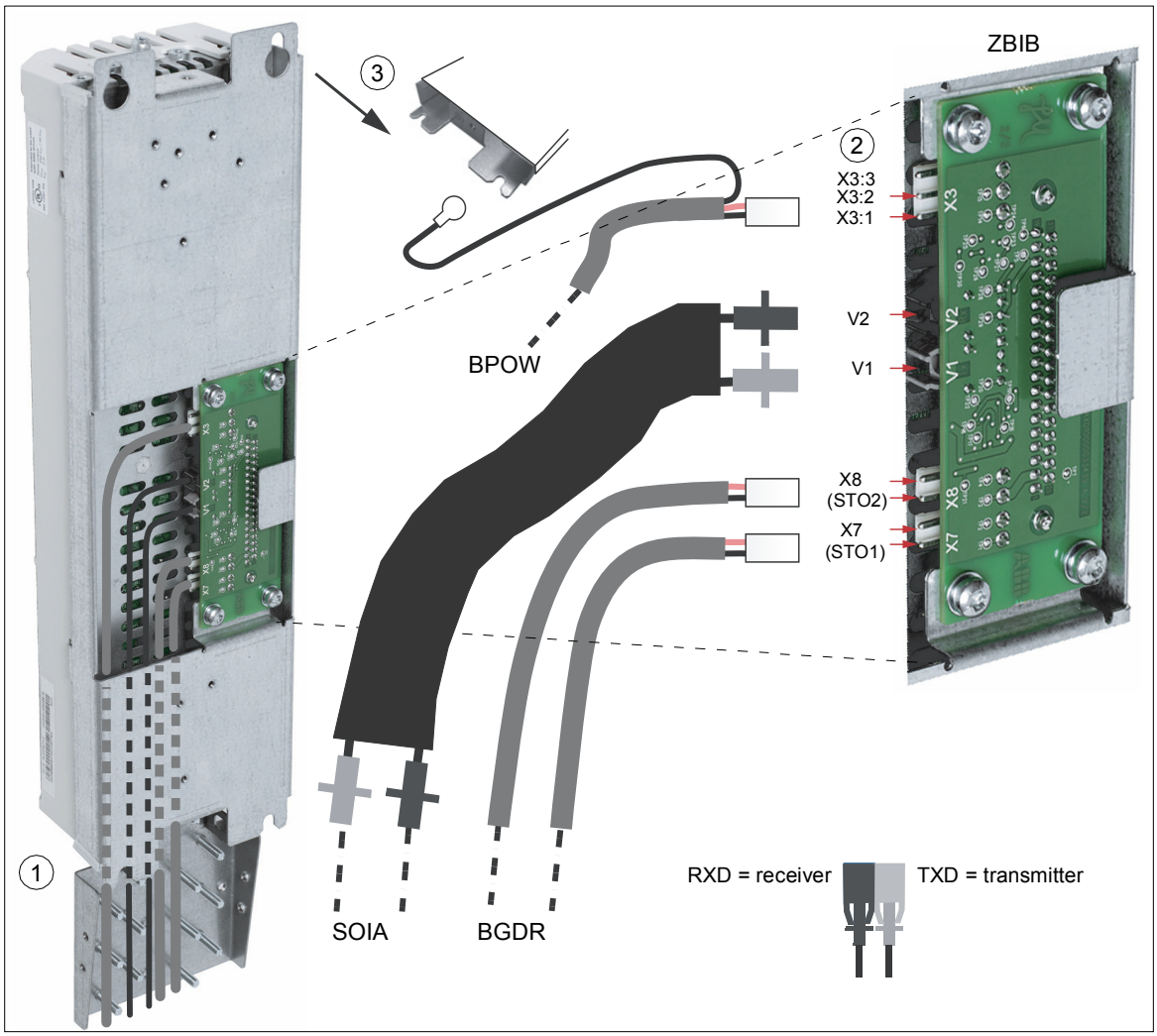
1. Thread the cables inside the back frame of the control unit.
2. Connect the cables to the ZBIB board terminals.

BPOW	ZBIB
X3: 1	X3: 1
X3: 2	X3: 2
X3: 3 (not used)	X3: 3 (not used)

SOIA	ZBIB
V10	V1
V20	V2

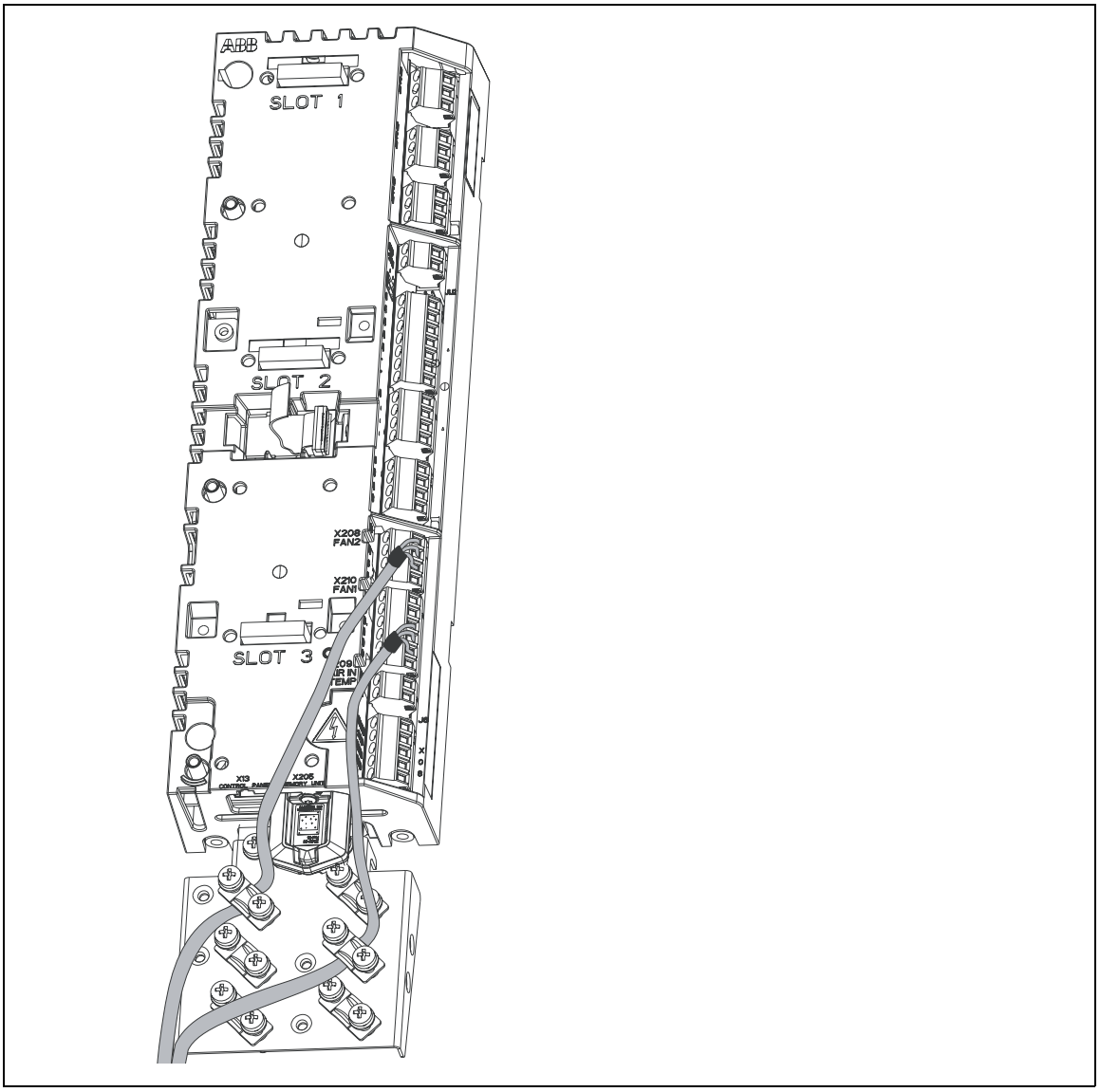
BGDR	ZBIB
X7 (STO1)	X7 (STO1)
X8 (STO2)	X8 (STO2)

3. Connect the BPOW cable grounding wire to the grounding terminal at the back top or bottom of the control unit.



Connecting the control cables to the terminals of the control unit

1. Route the cables to the control unit as shown below.

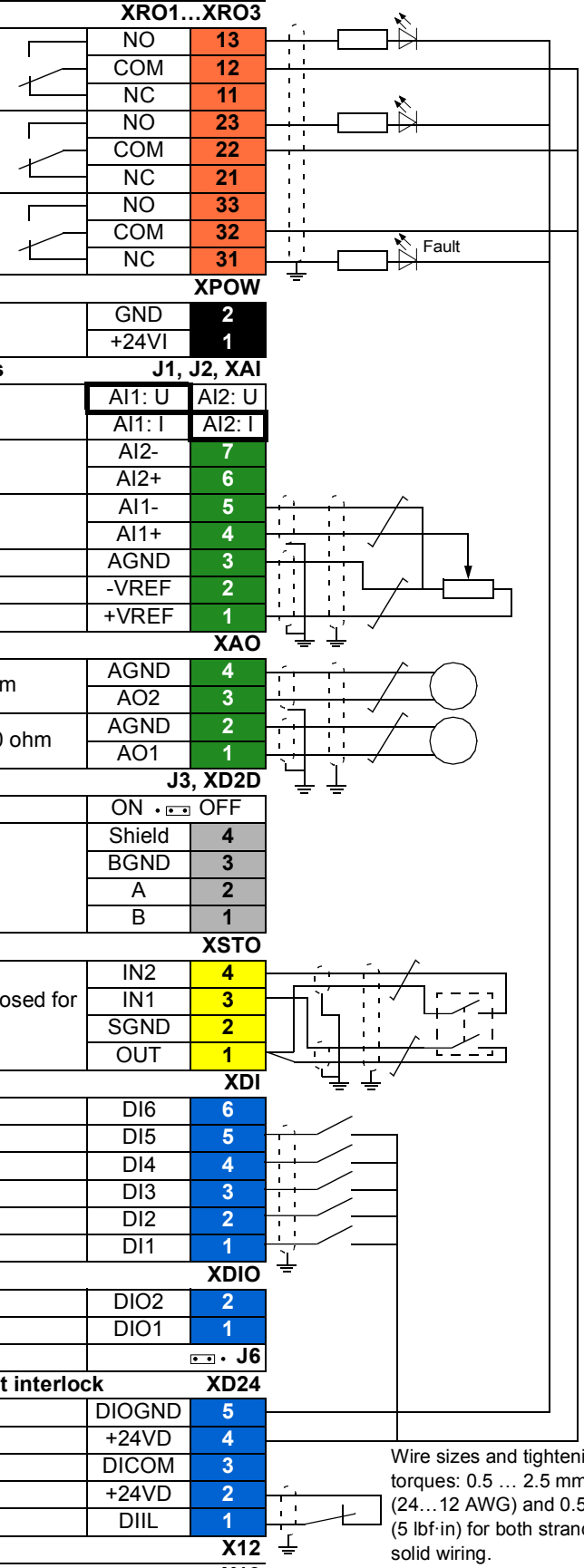


2. Ground the shields of the control cables at the clamp plate. The shields should be continuous as close to the terminals of the control unit as possible. Only remove the outer jacket of the cable at the cable clamp so that the clamp presses on the bare shield. The shield (especially in case of multiple shields) can also be terminated with a lug and fastened with a screw at the clamp plate. Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor, eg, 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are *in the same ground line* with no significant voltage drop between the end points.Tighten the screws to secure the connection.
3. Connect the conductors to the appropriate detachable terminals of the control unit, see page *89.* Use shrink tubing or insulating tape to contain any stray strands.

Note: Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

Default I/O connection diagram

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	GND	2
	+24VI	1
Reference voltage and analog inputs		**J1, J2, XAI**
AI1/AI2 current/voltage selection	AI1: U	AI2: U
	AI1: I	AI2: I
By default not in use. 0(4)…20 mA, R_{in} = 100 ohm [2]	AI2-	7
	AI2+	6
Speed reference 0(2)…10 V, R_{in} > 200 kohm [1]	AI1-	5
	AI1+	4
Ground	AGND	3
-10 V DC, R_L 1…10 kohm	-VREF	2
10 V DC, R_L 1…10 kohm	+VREF	1
Analog outputs		**XAO**
Motor current 0…20 mA, R_L < 500 ohm	AGND	4
	AO2	3
Motor speed rpm 0…20 mA, R_L < 500 ohm	AGND	2
	AO1	1
Drive-to-drive link		**J3, XD2D**
Drive-to-drive link termination [6]	ON • ▭ OFF	
Drive-to-drive link	Shield	4
	BGND	3
	A	2
	B	1
Safe torque off		**XSTO**
Safe torque off. Both circuits must be closed for the drive to start.	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 [4]	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 input interlock		**XD24**
Digital input/output ground	DIOGND	5
+24 V DC 200 mA [3]	+24VD	4
Digital input ground	DICOM	3
+24 V DC 200 mA [3]	+24VD	2
Run enable [8]	DIIL	1
Safety functions module connection		**X12**
Control panel connection		**X13**
Memory unit connection		**X205**



Wire sizes and tightening torques: 0.5 … 2.5 mm^2 (24…12 AWG) and 0.5 N·m (5 lbf·in) for both stranded and solid wiring.
See page 90 for notes.

Notes:

1) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected by jumper J1. Change of setting requires reboot of control unit.
2) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected by jumper J2. Change of setting requires reboot of control unit.
3) Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.
4) 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.
5) Constant speed 1 is defined by parameter 22.26.
6) Must be set to ON when the drive is the last unit on the drive-to-drive (XD2D) link.
7) Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats). See also *Ground isolation diagram)* on page *131*.
   ⊡• DICOM connected to DIOGND. •⊡ DICOM and DIOGND separate.
8) See section *DIIL input (XD24:1)* on page *92*.

External power supply for the control unit

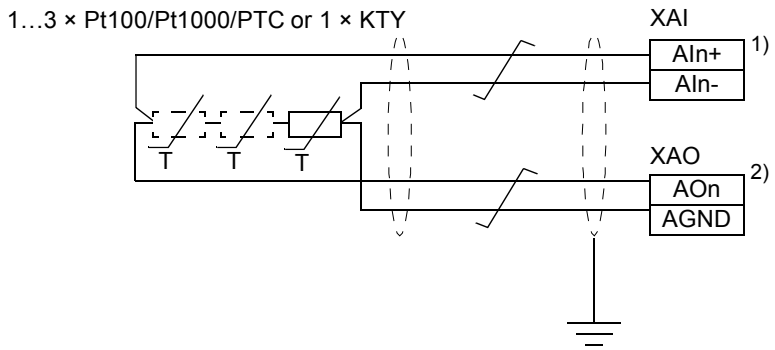
External +24 V (2 A) power supply for the control unit can be connected to terminal block XPOW. Using an external supply is recommended if

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

See also the firmware manual, parameter **95.04**.

AI1 and AI2 as Pt100, Pt1000, PTC and KTY84 sensor inputs (XAI, XAO)

Three Pt100, Pt1000 or PTC sensors or one KTY84 sensor for motor temperature measurement can be connected between an analog input and output as shown below. Do not connect both ends of the cable shields directly to ground. If a high-frequency capacitor of a few nanofarads (eg, 3.3 nF / 630 V) cannot be used at one end, leave that end of the shield unconnected.

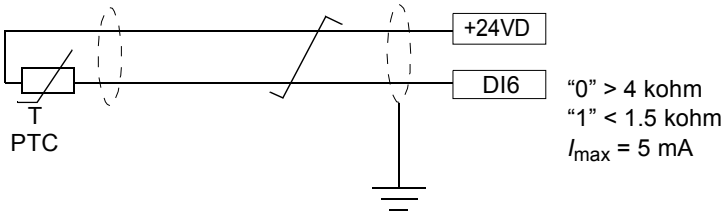


1. Set the input type to voltage with switch J1 for analog input AI1or with J2 for analog input AI2. Set the appropriate analog input unit to V (volt) in parameter group **12 Standard AI**.
2. Select the excitation mode in parameter group **13 Standard AO**.

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.

DI6 (XDI:6) as PTC sensor input

One PTC sensor can be connected to this input for motor temperature measurement as follows. The sum of the sensor resistances must not exceed the threshold resistance of the digital input at the motor normal operating temperature. Do not connect both ends of the cable shield directly to ground. If a high-frequency capacitor of a few nanofarads (eg, 3.3 nF / 630 V) cannot be used at one end, leave that end of the shield unconnected. See the firmware manual for the 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, 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 (XD24:1)

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

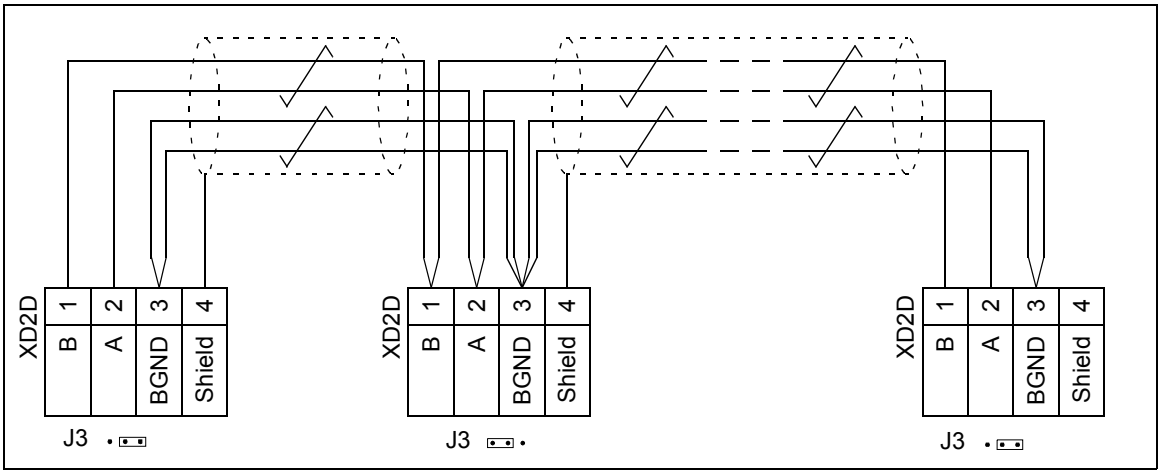
Drive-to-drive link (XD2D)

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

Set termination activation jumper J3 next to this terminal block to the ON position on the drives at the ends of the drive-to-drive link. On intermediate drives, set the jumper to the OFF position.

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 100 meters (328 ft). Avoid unnecessary loops and running the cable near power cables (such as motor cables).

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



Safe torque off (XSTO)

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

See also chapter *Safe torque off function* on page *153*.

Safety functions (X12)

See section *Installing the FSO safety functions module (options +Q972 and +Q973)* on page *95* and *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]).

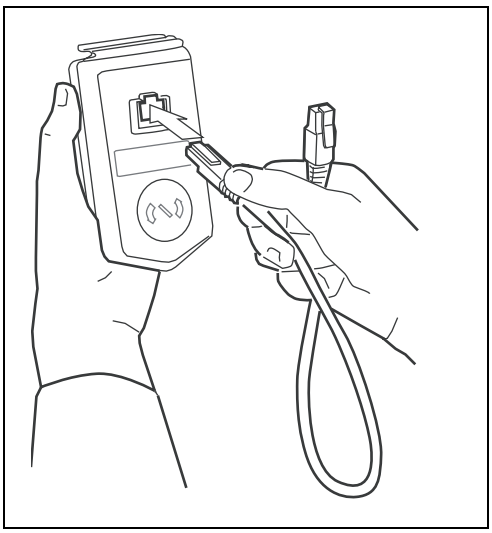
Installing the control panel holder back onto the external control unit

Install the control panel holder back onto the external control unit in reverse order to removing it, see section *Removing the control panel holder from the external control unit* on page *84*.

Connecting a control panel

With door mounting kit (option +J410)), connect the control panel to the control unit as follows:

1. Connect an Ethernet cable to the RJ-45 connector of the control panel.
2. Connect the other end of the cable to the X13 connector of the control unit.



Controlling several drives from one control panel through panel bus

One control panel (or PC) can be used to control several drives by constructing a panel bus. An FDPI-02 module is required. For further information, see *FDPI-02 diagnostics and panel interface user's manual* (3AUA0000113618 [English]). An FDPI-02 module is required. For further information, see *FDPI-02 diagnostics and panel interface user's manual* (3AUA0000113618 [English]).

1. Connect the panel to one drive using an Ethernet (eg. CAT5E) cable.
   - Use **Menu** – **Settings** – **Edit texts** – **Drive** to give a descriptive name to the drive.
   - Use parameter **49.01** to assign the drive with a unique node ID number.
   - Set other parameters in group **49** if necessary.
   - Use parameter **49.06** to validate any changes.

   Repeat the above for each drive.
2. With the panel connected to one drive, link the drives together using Ethernet cables. (Each panel platform has two connectors.)
3. In the last drive, switch bus termination on by moving the terminating switch into the outer position.Termination should be off on all other drives.
4. On the control panel, switch on the panel bus functionality (**Options** – **Select drive** – **Panel bus**). The drive to be controlled can now be selected from the list under **Options** – **Select drive**.

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

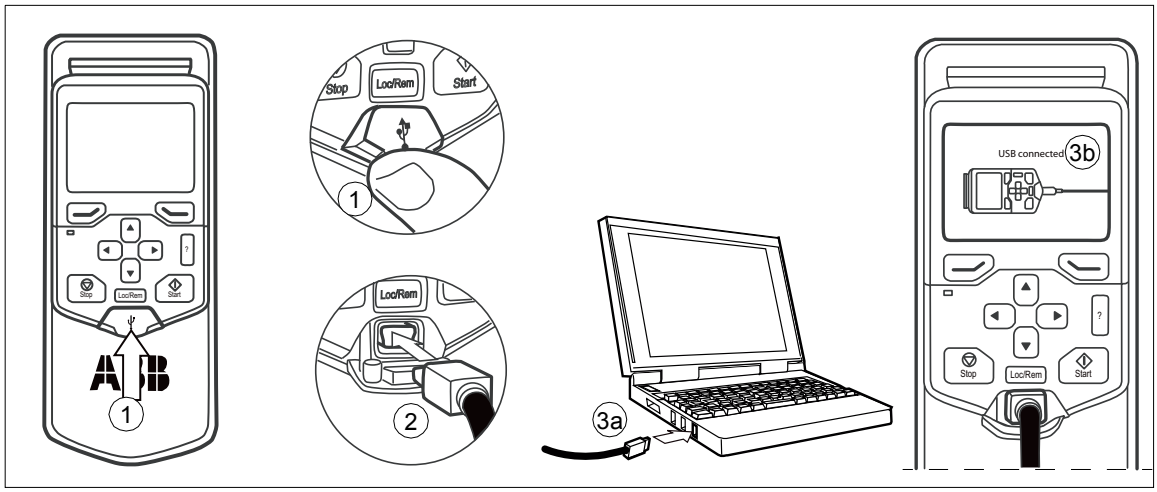
Connecting a PC

You need a control panel to connect a PC to the drive module. Connect the control panel to the drive control unit as described in section *Connecting a control panel* on page *94*.

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

To connect a PC to the control panel with a USB data cable (USB Type A <-> USB Type Mini-B):

1. Lift the USB connector cover on the control panel from bottom upwards.
2. Insert the USB cable Mini-B plug in the control panel USB connector.
3. Insert the USB cable A-plug in the USB connector of the PC (a). -> The panel displays: USB connected (b).



Note 1: When a PC is connected to the control panel, the control panel keypad is disabled. In this case, the control panel acts as a USB-RS485 adapter.

Installing optional modules

Installing the FSO safety functions module (options +Q972 and +Q973)

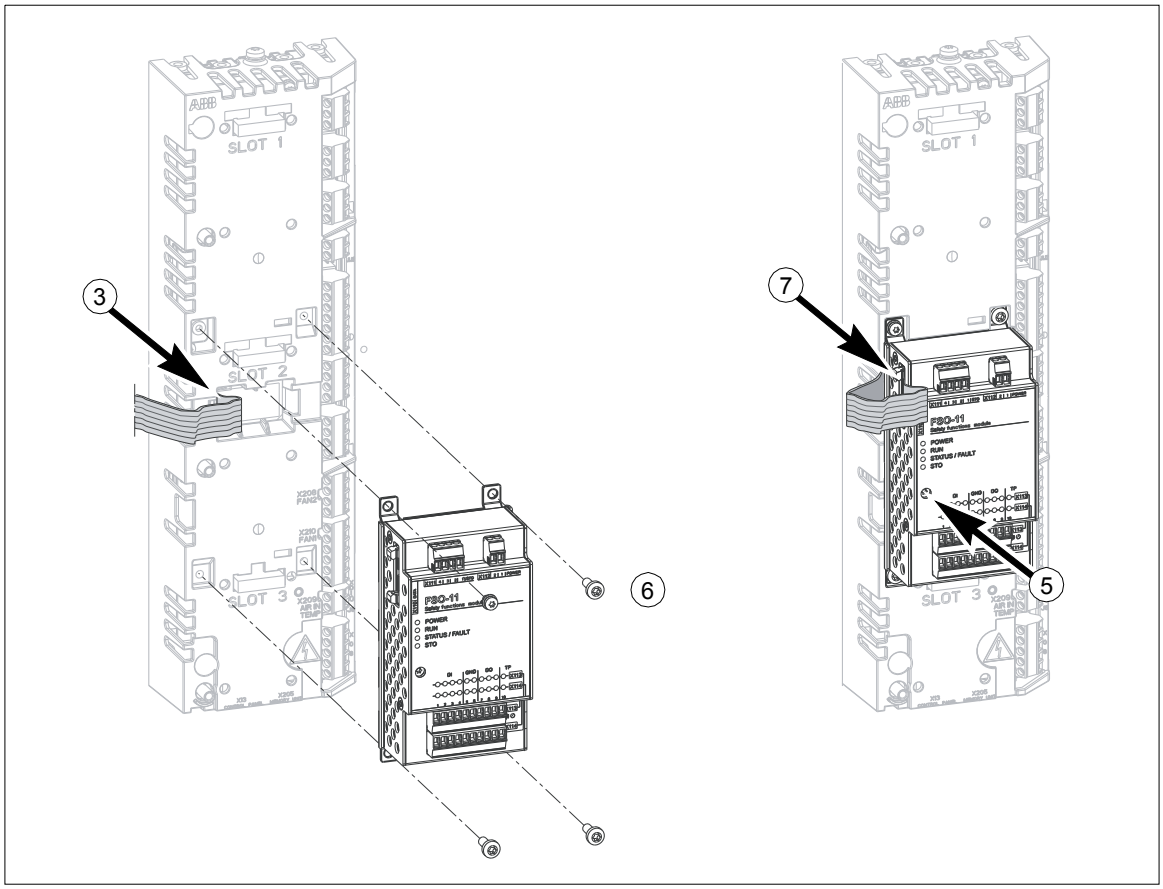
Install the FSO safety functions module in Slot 2 of the control unit

Note: Install the FSO safety functions module before you install any other optional modules on the control unit.

For information on the wiring and configuration of the FSO module, see *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]) [English]).

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start work.
2. If the bottom plate of the FSO module looks different from that in the drawing below, remove the bottom plate and attach the alternative bottom plate from the FSO package to module.
3. Connect the FSO data cable to connector X12 on the control unit.
4. Put the FSO module into its position.
5. Tighten the FSO module electronics grounding screw to 0.8 N·m. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.
6. Fasten the module with four screws.
7. Connect the FSO data cable to FSO connector X110.

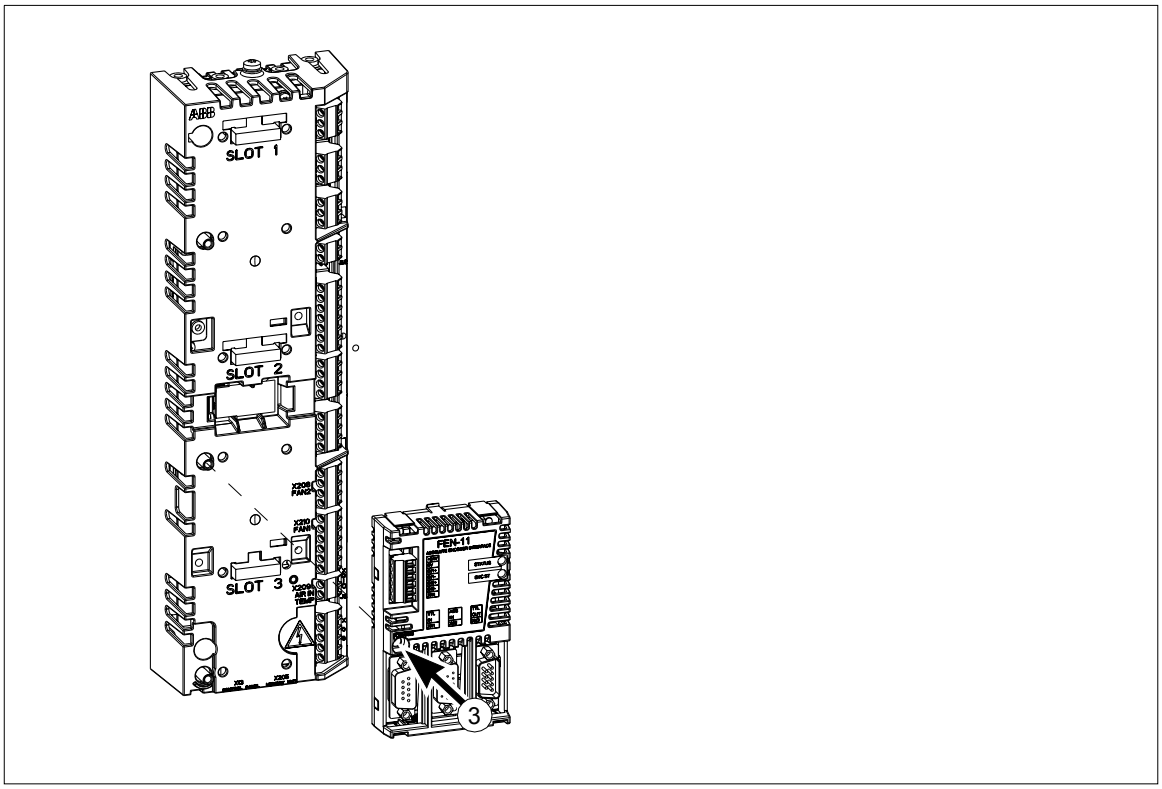


Installing I/O extension, fieldbus adapter and pulse encoder interface modules

See page *31* for the available slots for each module.

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start work.
2. Insert the module carefully into its position on the control unit.
3. Tighten the grounding screw torque of 0.8 N·m. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.



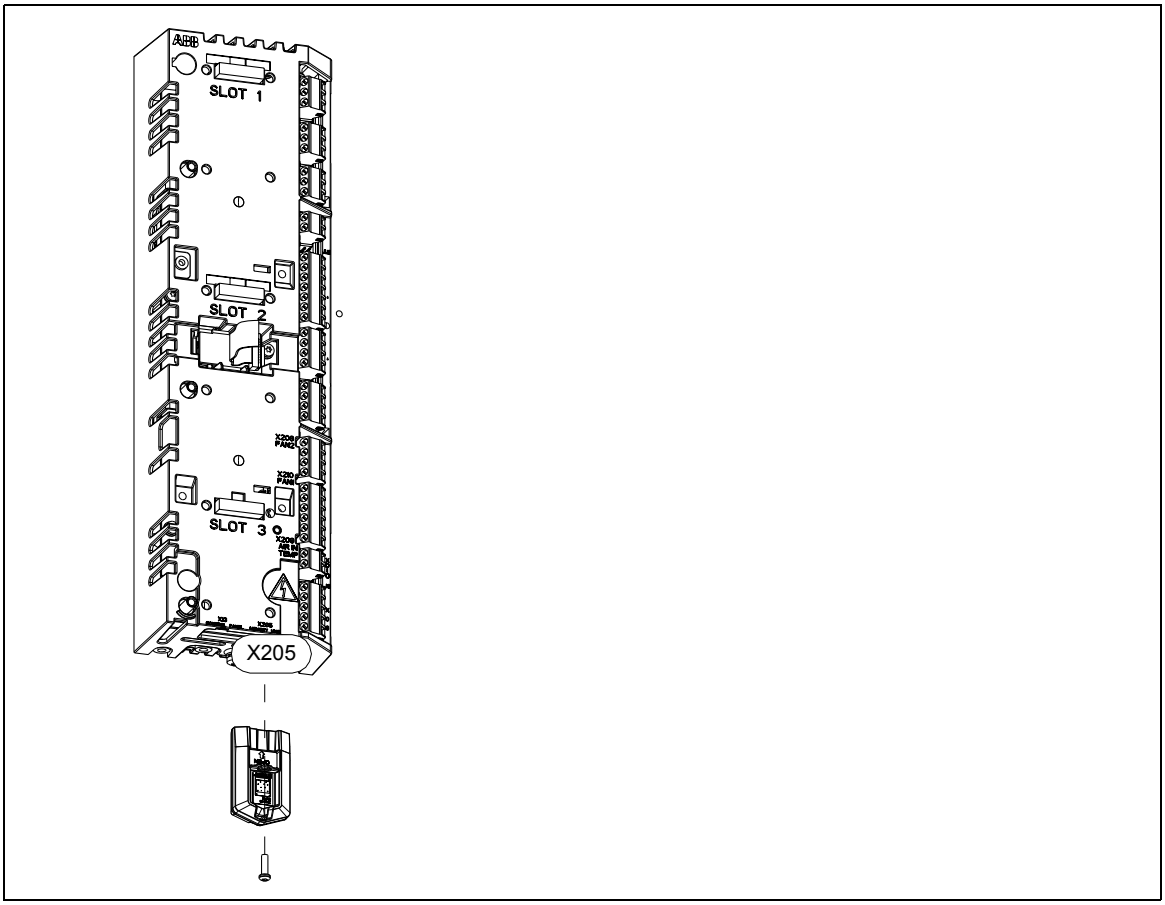
Wiring the optional modules

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

Connecting the memory unit

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start work.
2. Insert the memory unit to the X205 terminal on the control unit.
3. Fasten the memory unit with one screw.



8

Installation checklist

Contents of this chapter

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

Installation checklist

Go through the checklist below together with another person.

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

Check that …	☑
Cabinet construction	
The drive module is fastened properly to the cabinet. (See chapters *Guidelines for planning the mechanical installation*)	☐
Mechanical joints are tightened and not broken.	☐
Parts are clean and painted surfaces not scratched. The cabinet frame and parts which are in metal to metal contact with the frame (for example seams, component fixing points on assembly plates, back of control unit mounting plate) are **not** finished with non-conducting paint or material.	☐
Degree of protection (IPxx)	☐

Check that …	☑
Drive option modules and other components	
Type and number of option modules and other equipment is correct. Option modules and other equipment are not damaged.	☐
Optional modules and terminals are labelled correctly.	☐
The placement of optional modules and other equipment inside the cabinet and on the cabinet door is correct.	☐
The mounting of optional modules and other equipment is correct.	☐
Internal cabling of the cabinet assembly	
Main circuit: • AC supply input cabling is ok. • AC output cabling is ok. • Supply for brake resistor (if used) is ok.	☐
Cable types, cross-sections, colours and optional markings are correct.	☐
Cabling is not susceptible to interference. Check the twisting of cables and cable routes.	☐
Connection of cables to devices, terminal blocks and drive module circuit boards: • Cables are connected to terminals tight enough by pulling the cable. • Cable termination on terminals chaining is done correctly. • Bare conductors are not too far outside the terminal causing an insufficient clearance or loss of shielding against contact. • The control unit is wired properly to the drive module. • The control panel cable is connected properly.	☐
Cables are not lying against sharp edges or bare live parts. Bending radius of fiber optic cables is at least 3.5 cm (1.38 in.).	☐
The type, markings, insulation plates and cross connections of terminal blocks are correct.	☐
Grounding and protection	
The grounding colors, cross-section and grounding points of modules and other equipment match the circuit diagrams. No long routes for pigtails.	☐
Connections of PE cables and busbars are tight enough. Pull the cable to test that it does not loosen. No long routes for pigtails.	☐
Doors equipped with electrical equipment are grounded. No long grounding routes. From EMC standpoint best result is achieved with a flat copper braid.	☐
Fans that can be touched are shrouded.	☐
Live parts inside the doors are protected against direct contact to at least IP2x.	☐
Labels	
The type designation labels and warning and instruction stickers are made according to the local regulations and placed correctly.	☐
Switches and doors	
Mechanical switches, main disconnecting switch and cabinet doors function properly.	☐

Check that …	☑
Installation of the cabinet	
The drive cabinet has been attached to floor and also from top to the wall or roof.	☐
The ambient operating conditions agree with the specifications given in chapter *Technical data*.	☐
The cooling air will flow freely in and out of the drive cabinet, and air recirculation inside the cabinet will not be possible (air baffle plates are on place).	☐
If the drive module has been stored over one year: The electrolytic DC capacitors in the DC link of the drive have been reformed. See page *114*.	☐
There is an adequately sized protective ground conductor between the drive and the switchboard.	☐
There is an adequately sized protective ground conductor between the motor and the drive.	☐
All protective ground conductors have been connected to the appropriate terminals and the terminals have been tightened. (Pull the conductors to check.)	☐
The enclosures of the equipment in the cabinet have proper galvanic connection to the cabinet protective earth (ground) busbar; The connection surfaces at the fastening points are bare (unpainted) and the connections are tight, or separate grounding conductors have been installed.	☐
The supply voltage matches the nominal input voltage of the drive. Check the type designation label.	☐
The input power cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.)	☐
Appropriate AC fuses and a main disconnector have been installed.	☐
The motor cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.)	☐
The brake resistor (if present) has been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.)	☐
The motor cable (and brake resistor cable, if present) has been routed away from other cables.	☐
No power factor compensation capacitors have been connected to the motor cable.	☐
The control cables (if any) have been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.)	☐
If a drive bypass connection is used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked, ie, cannot be closed simultaneously.	☐
There are no tools, foreign objects or dust from drilling inside the drive module.	☐
All shrouds and cover of the motor connection box are in place. Cabinet doors have been closed.	☐
The motor and the driven equipment are ready for start.	☐

9

Start-up

Contents of this chapter

This chapter describes the start-up procedure of the drive.

Start-up procedure

1. Only qualified electricians are allowed to start-up the drive.
2. Make sure that the installation of the drive module has been checked according to the checklist in chapter *Installation checklist,* and 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 the power on, setup the drive control program, and perform the first start of the drive and motor. See the appropriate start-up guide or firmware manual. If you need more information on the use of the control panel, see *ACS-AP-x Assistant control panels user's manual* (3AUA0000085685 [English]).
   - For drives with resistor braking (option +D151), see also section *Start-up* on page *168*.
   - For option +N7502, see also *ACS880 drives with SynRM motors (option +N7502) supplement* (3AUA0000145506 [English]).
   - For drives with ABB du/dt filter, check that bit 13 of parameter **95.20 HW options word 1** is switched on.
   - For drives with ABB sine filter, check that parameter **95.15 Special HW settings** is set to **ABB sine filter**. For other sine filters, see *Sine filter hardware manual* (3AXD50000016814 [English]).
5. For drives with ABB motors in explosive atmospheres, see also *ACS880 drives with ABB motors in explosive atmospheres* (3AXD50000019585 [English]).

6. For drive modules in which the Safe torque off function is in use: Test and validate the operation of the Safe torque off function. See section *Start-up including acceptance test* on page *159*.
7. For drive modules with an FSO-xx safety functions module (option +Q972 and +Q973): Test and validate the operation of the safety functions. See the delivery-specific circuit diagrams and *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]) or *FSO-21 safety functions module user's manual* (3AXD50000015614 [English]) [English]).

10

Fault tracing

Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

LEDs with options +J410

Where	LED	Color	When the LED is lit
Control panel mounting platform	POWER	Green	Control unit is powered and +15 V is supplied to the control panel.
	FAULT	Red	Drive in fault state.

Warning and fault messages

See the firmware manual for the descriptions, causes and remedies of the control program warning and fault messages.

11

Maintenance

Contents of this chapter

This chapter contains maintenance instructions of the drive modules.

Maintenance intervals

If installed in an appropriate environment, the drive requires very little maintenance. Maintenance and component replacement intervals are based on the assumption that the equipment is operated within the specified ratings and ambient conditions. ABB recommends annual drive inspections to ensure the highest reliability and optimum performance.

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

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

Descriptions of symbols

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

Recommended annual maintenance actions by the user

ABB recommends these annual inspections to ensure the highest reliability and optimum performance.

Action	Target
I	IP22 and IP42 air inlet and outlet meshes on the cabinet doors
R	IP54 air filters on the cabinet doors
P	Quality of supply voltage
I	Spare parts
P	DC circuit capacitors reforming, spare modules and spare capacitors
I	Tightness of terminals
I	Dustiness, corrosion and temperature
I	Heat sink cleaning

Recommended maintenance intervals after start-up

Component	Years from start-up						
	3	6	9	12	15	18	21
Cooling							
Main cooling fan of drive module			R			R	
Circuit board compartment cooling fans of drive module		R		R		R	
NSIN filter cooling fan		R		R		R	
Aging							
ZCU control unit battery (real-time clock)		R		R		R	
Control panel battery (real-time clock)			R			R	

4FPS10000239703

Cabinet

Cleaning the interior of the cabinet

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

WARNING! Use a vacuum cleaner with antistatic hose and nozzle. Using a normal vacuum cleaner creates static discharges which can damage circuit boards.

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start the work.
2. When necessary, clean the interior of the cabinet with a soft brush and a vacuum cleaner.

Heatsink

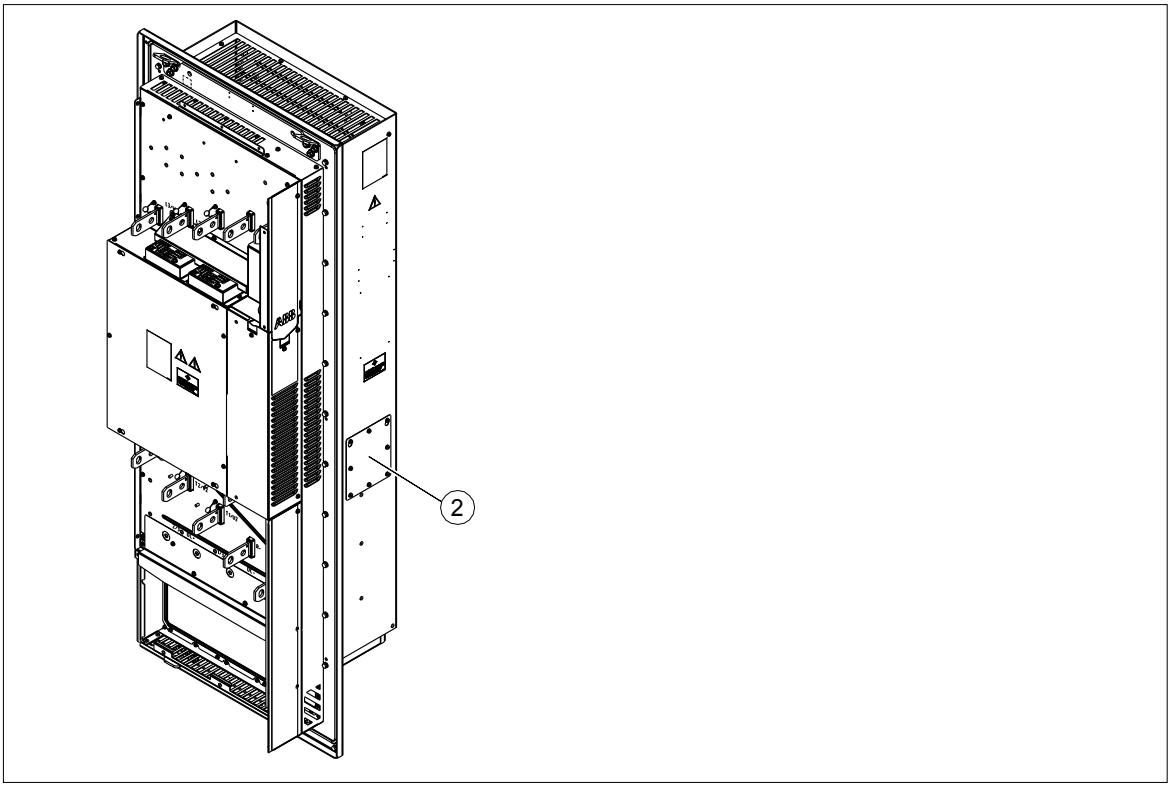
The module heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean.

Cleaning the interior of the heatsink

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

WARNING! Use a vacuum cleaner with antistatic hose and nozzle. Using a normal vacuum cleaner creates static discharges which can damage circuit boards.

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start the work.
2. Undo the attaching screws of the cover plate on the service opening.
3. Remove the plate.
4. Blow clean compressed air (not humid or oily) upwards from the opening and, at the same time, vacuum from the top of the drive module.
5. Reinstall the cover plate.



Fans

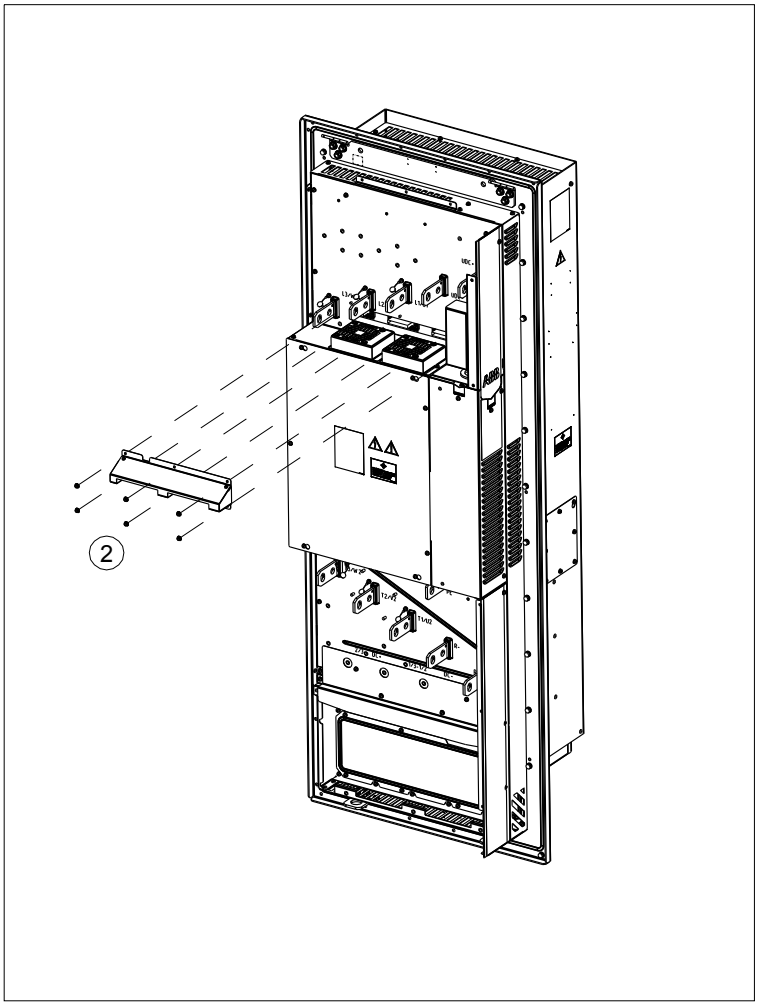
The actual lifespan depends on the running time of the fan, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. For resetting the running time signal after a fan replacement, please contact ABB.

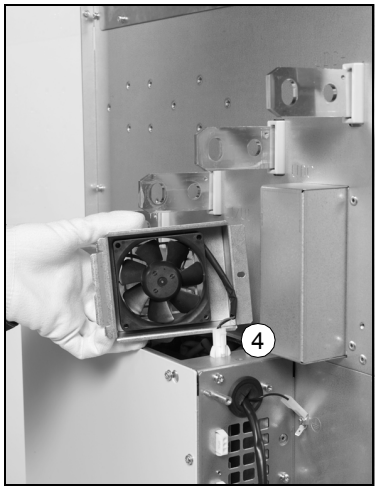
Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

Replacing the circuit board compartment cooling fans

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start the work.
2. Remove the cover.
3. Undo the fastening screw of the fan enclosure.
4. Unplug the power supply cable of the fan.
5. Install the new fan in reverse order to the above.
6. Reset the counter (if used) in group 5 in the primary control program.





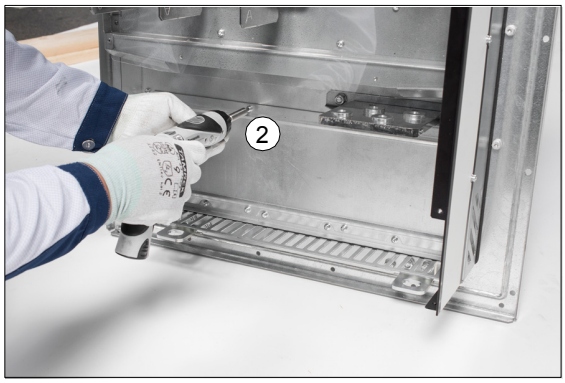
Replacing the main cooling fans

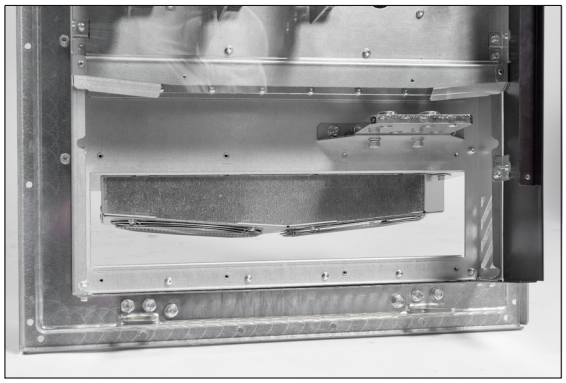
The main cooling fans can be replaced from the front side and the back side.

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

To replace the main cooling fans from the front side:

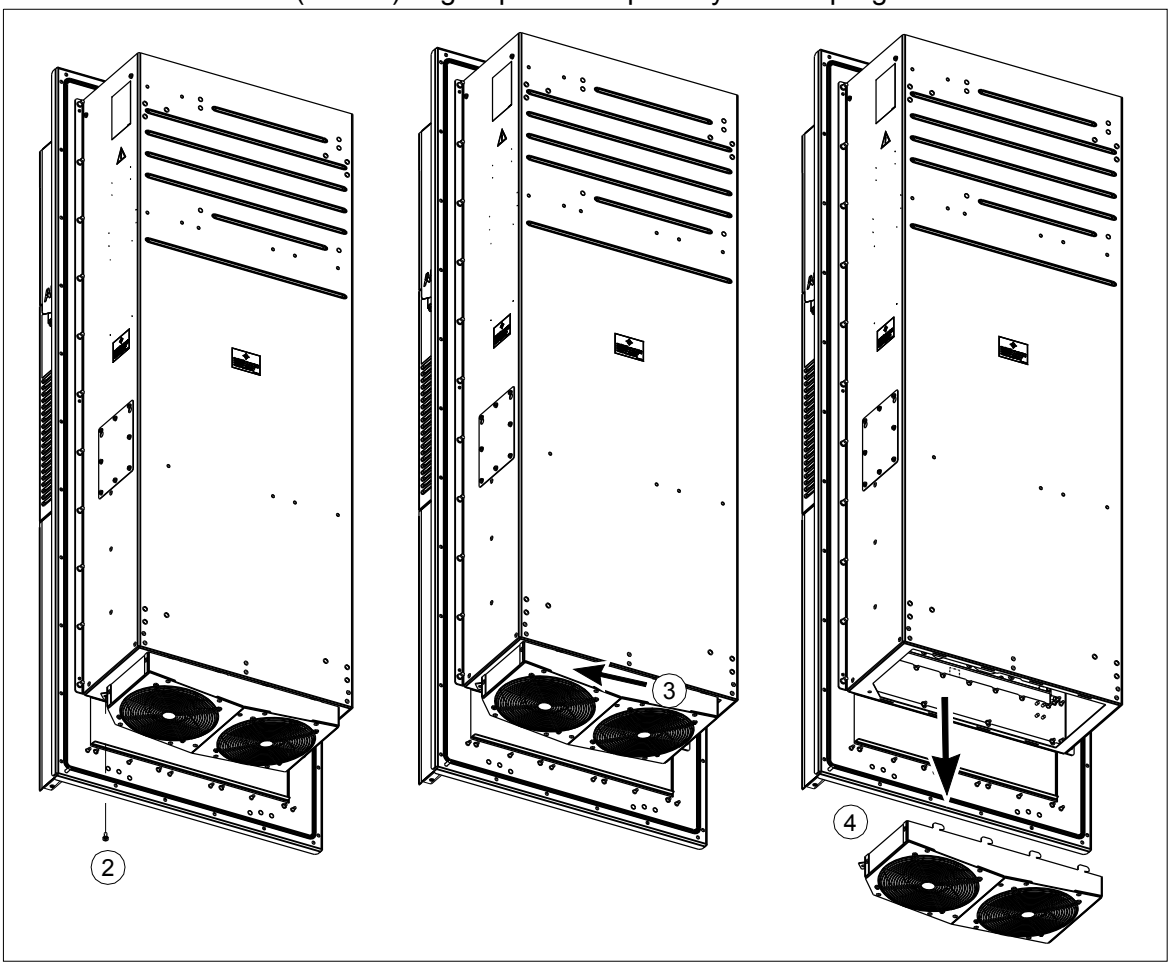
1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start the work.
2. If motor cables are connected to the output terminals, disconnect them.
3. Undo the mounting screws of the fan cassette cover and remove the cover.
4. Disconnect the power supply wires of the fans.
5. Pull the fan cassette out.
6. Install the new fan cassette in reverse order to the above.
7. Reset the counter (if used) in group 5 in the primary control program.





To replace the main cooling fans from the back side:

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start the work.
2. Undo the locking screw.
3. Push the fan cassette to the left.
4. Take the cassette down.
5. Disconnect the power supply wires of the fans, see the previous page.
6. Install the new fan cassette in reverse order to the above.
7. Reset the counter (if used) in group 5 in the primary control program.



Replacing the standard drive module

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

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start the work.
2. Remove the clear plastic shrouds on the power cables and parts in front of the drive module (if present).
3. Disconnect the power cables.
4. Disconnect the power supply, BGDR and fiber optic cables from the drive module.
5. To prevent the drive module from falling, attach its top lifting lugs with chains to the cabinet frame.
6. Remove the screws that attach the drive module to the cabinet.
7. Lift the drive module carefully out of the cabinet with a lifting device preferably with help from another person.
8. Install the new module in reverse order to the above.

Capacitors

The drive intermediate circuit employs several electrolytic capacitors. Their lifespan depends on the operating time of the drive, loading and ambient temperature. The lifespan of the capacitor can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. The capacitor failure is usually followed by damage to the unit and an input cable fuse failure, or a fault trip. Contact ABB if a capacitor failure is suspected. Replacements are available from ABB. Do not use other than ABB specified spare parts.

Reforming the capacitors

If the drive module has been stored for a year or more, reform the capacitors. See page *34* for information on finding out the manufacturing date. For the reforming instructions, see *Converter modules with electrolytic DC capacitors in the DC link, capacitor reforming instructions* (3BFE64059629 [English]).

Replacing the control panel battery

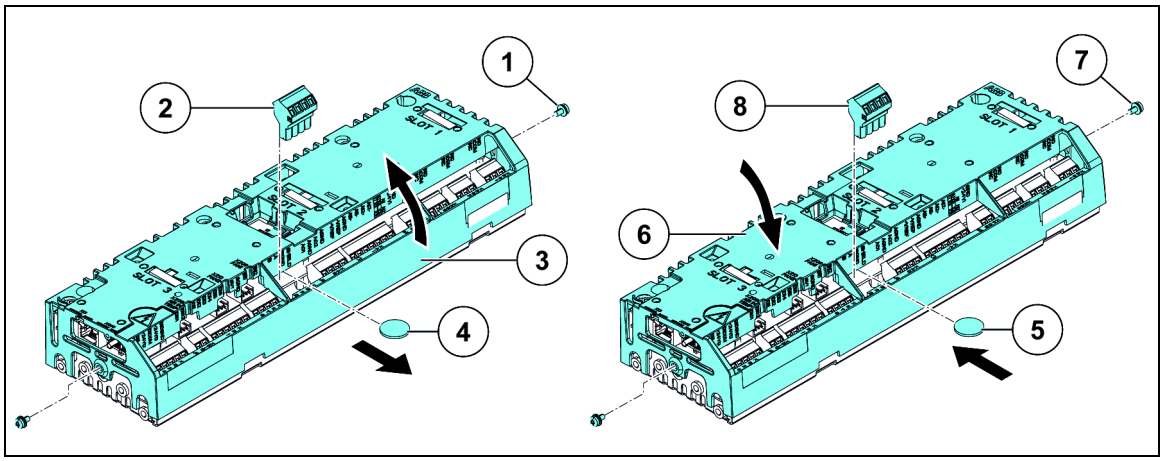
The battery is housed on the rear of the control panel. Replace it with a new CR 2032 battery. Dispose the old battery according to local disposal rules or applicable laws.

Replacing the control unit battery

Stop the drive and do the steps in section *Precautions before electrical work* on page *15* before you start the work.

To replace the control unit battery:

1. Remove the M4x8 (T20) screws at the ends of the control unit.
2. To see the battery, remove the XD2D terminal block.
3. Carefully lift the edge of the control unit cover on the side with the I/O terminal blocks.
4. Carefully pull the battery out of the battery holder.
5. Carefully put a new CR2032 battery into the battery holder.
6. Close the control unit cover.
7. Tighten the M4×8 (T20) screws.
8. Install the XD2D terminal block.



Memory unit

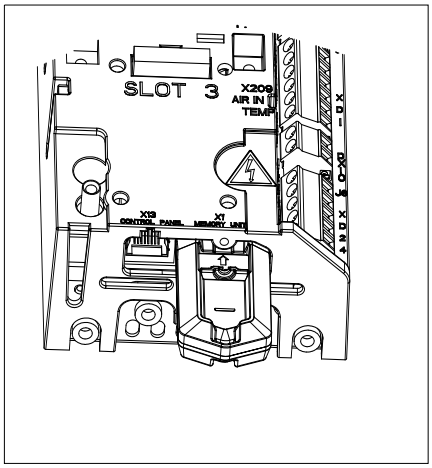
When a drive module is replaced, the parameter settings can be retained by transferring the memory unit from the defective drive module to the new module. The memory unit is located in the control unit, see page *31*.

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

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 can take several minutes.

To remove the memory unit:

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



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Ordering information

Contents of this chapter

This chapter gives ordering information on additional components available from ABB for the drive module installation.

Notes:

- This chapter only lists the installation accessories available from ABB. All other parts must be sourced from a third party by the system integrator. For a listing, refer to the kit-specific installation instructions available at https://www151.abb.com/spaces/lvacdrivesengineeringsupport/content. For access, contact your local ABB representative.

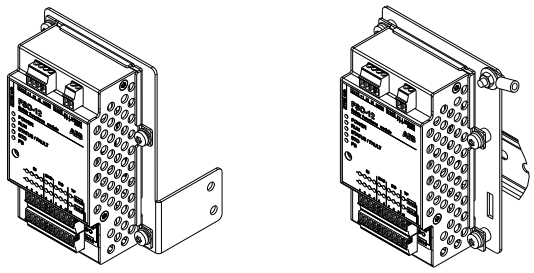
Output (du/dt) filters

See section *du/dt filters* on page *171*.

Sine filters

See section *Sine filters* on page *172*.

FSO accessories kit

Kit code	Ordering code	Illustration
A-X-X-279	3AXD50000025495	 Instruction code: 3AXD50000025583

Retrofit accessory kits

Kit	Option code	Ordering code
Common mode filter kit	E208	3AXD50000026145
Full size cable connection terminals for input power cables	H370	3AXD50000019542
Full size cable connection terminals for output power cables	*	3AXD50000019544
IP20 shrouds for covering the input and motor cabling area	**	3AXD50000019538

* The drive module is delivered with full size cable connection terminals for output power cables as standard. They can be excluded with option +0H371.

** The drive module is delivered with IP20 shrouds for covering the input and motor cabling area as standard. The shrouds can be excluded with option +0B051.

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Technical data

Contents of this chapter

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

Ratings

The ratings of the drive modules with 50 Hz and 60 Hz supply are given below.

IEC RATINGS											
Drive type ACS880-04F-	**Frame size**	**Input current**	**Output ratings**								
			Nominal use					**Light-duty use**		**Heavy-duty use**	
		I_1	I_{max}	I_{max_start}	I_2	P_N	S_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	**A**	**A**	**A**	**kW**	**kVA**	**A**	**kW**	**A**	**kW**
U_N = 400 V											
504A-3	R11	504	560	671	504	250	349	485	250	361	200
584A-3	R11	584	730	828	584	315	405	575	315	429	250
649A-3	R11	649	730	954	649	355	450	634	355	477	250
725A-3	R11	725	1020	1100	725	400	502	715	400	566	315
820A-3	R11	820	1020	1100	820	450	568	810	450	625	355
880A-3	R11	880	1100	1100	880	500	610	865	500	725*	400
U_N = 500 V											
459A-5	R11	459	560	671	459	315	398	450	315	330	200
502A-5	R11	502	560	671	502	355	435	483	315	361	250
582A-5	R11	582	730	828	582	400	504	573	400	414	250
634A-5	R11	634	730	954	634	450	549	623	450	477	315
715A-5	R11	715	850	1100	715	500	619	705	500	566	400
820A-5	R11	820	1020	1100	820	560	710	807	560	625	450

IEC RATINGS											
Drive type ACS880-04F-	Frame size	Input current	Output ratings								
			Nominal use						Light-duty use		Heavy-duty use
		I_1	I_{max}	I_{max_start}	I_2	P_N	S_N		I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	A	A	kW	kVA		A	kW	A	kW
880A-5	R11	880	1100	1100	880	630	762		857	560	697**	500

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NEMA RATINGS											
Drive type ACS880-04F-	Frame size	Input current	Maximum current		Output ratings						
					App. power	Light-duty use			Heavy-duty use		
		I_1	I_{max}	I_{max_start}	S_N	I_{Ld}	P_{Ld}		I_{Hd}	P_{Hd}	
		A	A	A	kVA	A	kW	hp	A	kW	hp
U_N = 460 V											
502A-5	R11	502	560	671	435	483	315	400	361	250	300
582A-5	R11	582	730	828	504	573	400	450	414	250	350
634A-5	R11	634	730	954	549	623	450	500	477	315	400
715A-5	R11	715	850	1100	619	705	500	600	566	400	450
820A-5	R11	820	1020	1100	710	807	560	700	625	450	500
880A-5	R11	880	1100	1100	762	857	560	700	697**	500	600

Definitions

U_N	Nominal voltage of the drive
I_1	Nominal input current (rms) at 40 °C (104 °F)
S_N	Apparent power (no overload)
I_{max}	Maximum output current. Available for 10 seconds at start, otherwise as long as allowed by drive temperature. 140% … 200% of I_{Hd}, depending on power rating.
I_{max_start}	Maximum output current at start. Available for two seconds only at start every five seconds if start current limit is activated by parameter **30.15 Maximum start current.**
I_2	Continuous rms output current. No overload capability at 40 °C (104 °F)
P_N	Typical motor power in no-overload use.
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-overload use.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
*	Continuous rms output current allowing 40% overload for 1 minute every 5 minutes
**	Continuous rms output current allowing 45% overload 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 power ratings apply to most IEC 34 motors at the nominal voltage of the drive.

We recommend to select the drive, motor and gear combination for the required motion profile with the DriveSize dimensioning tool available from ABB.

When is derating needed

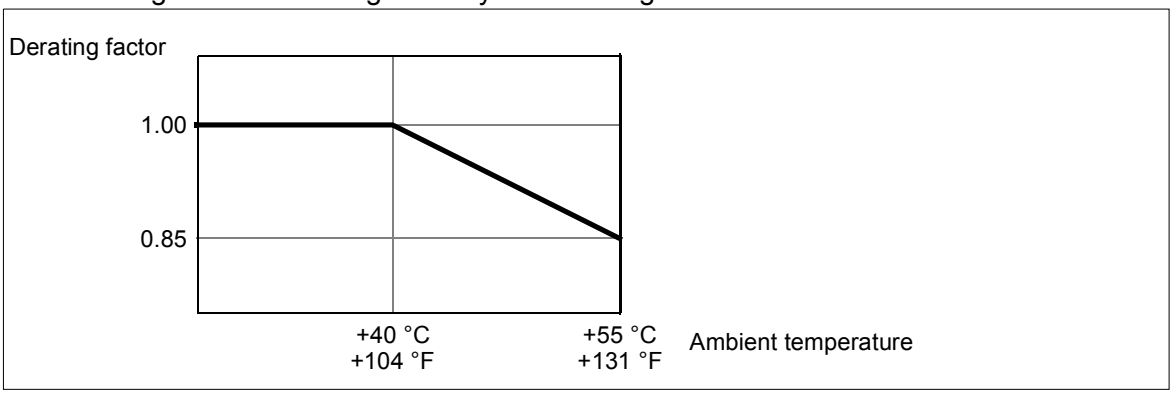
Derate the continuous output current of the drive if

- ambient temperature exceeds +40 °C (+104 °F) or
- drive is installed higher than 1000 m (3280 ft) above sea level
- switching frequency is other than default.

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

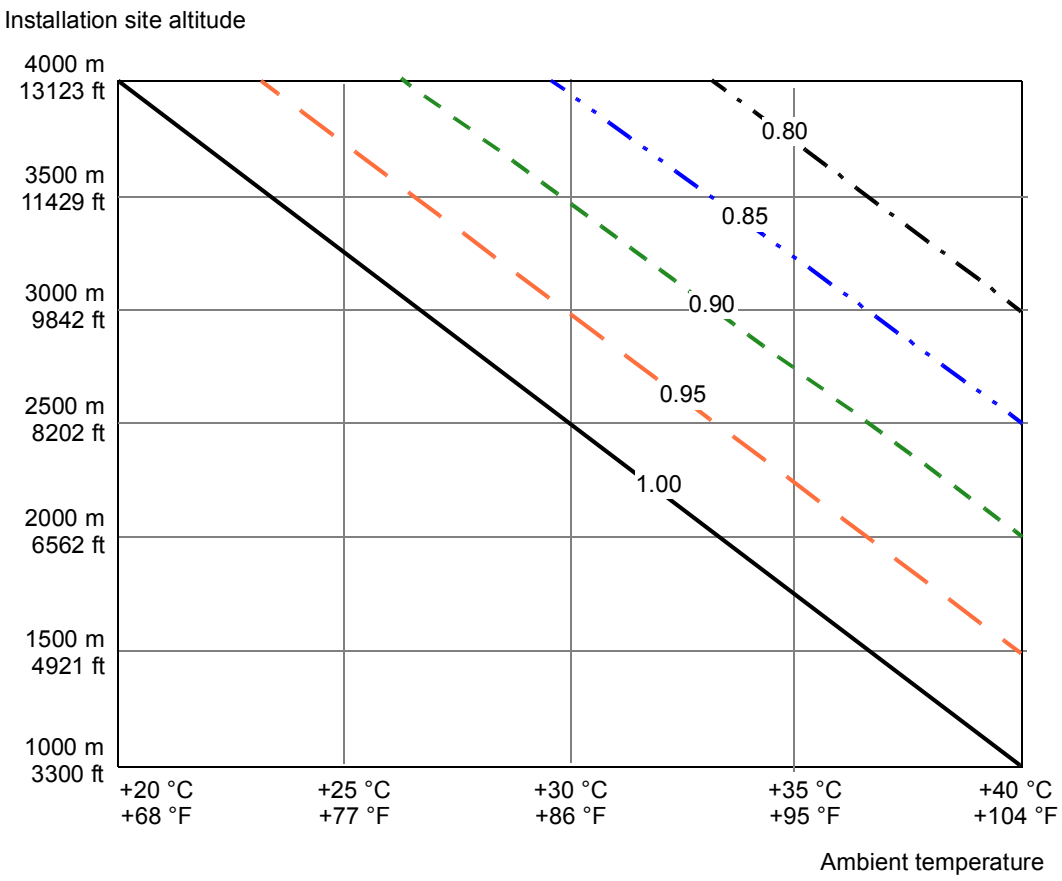
Ambient temperature derating

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. Calculate the output current by multiplying the current given in the rating table by the derating factor.



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). If ambient temperature is below +40 °C (+104 .°F), the derating can be reduced by 1.5% for every 1 °C reduction in temperature. For a more accurate derating, use the DriveSize PC tool. A few altitude derating curves are shown below.



	Derating factor 1.00
	Derating factor 0.95
	Derating factor 0.9
	Derating factor 0.85
	Derating factor 0.80

Deratings for special settings in the drive control program

Enabling special settings in the drive control program can require output current derating.

Ex motor, sine filter, low noise

Table below gives the deratings for these cases:

- drive is used with an ABB motor for explosive atmospheres (Ex) and **EX motor** in Parameter **95.15 Special HW settings** is enabled
- sine filter given in the selection table on page *172* is used and **ABB sine filter** in **Parameter 95.15 Special HW settings** is enabled
- **Low noise optimization** is selected in **Parameter 97.09 Switching freq mode**.

With other than recommended sine filters (see section *Sine filters* on page *172*) and non-ABB Ex motors, contact ABB.

Drive module type ACS880-04F-	Output ratings for special settings											
	Ex motor (ABB Ex motor)				ABB sine filter				Low noise mode			
	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use	Nominal use		Light-duty use	Heavy-duty use
	I_N	P_N	I_{Ld}	I_{Hd}	I_N	P_N	I_{Ld}	I_{Hd}	I_N	P_N	I_{Ld}	I_{Hd}
	A	kW	A	A	A	kW	A	A	A	kW	A	A
U_N = 400 V												
504A-3	479	250	459	345	470	250	450	340	390	200	370	290
584A-3	551	250	389	287	540	250	518	383	437	250	419	311
649A-3	612	315	432	319	600	315	576	425	485	250	466	346
725A-3	667	355	471	351	647	355	628	468	519	250	496	390
820A-3	753	400	534	388	731	400	712	517	587	315	562	431
880A-3	809	450	570	450	785	450	760	600	630	355	600	500*
U_N= 500 V												
459A-5	437	250	427	316	430	250	419	311	357	250	345	265
502A-5	478	315	458	345	470	315	450	340	390	250	370	290
582A-5	531	355	509	364	514	355	487	347	400	250	380	298
634A-5	579	400	553	419	560	400	530	400	410	250	392	298
715A-5	657	450	641	522	637	450	620	507	462	315	428	362
820A-5	753	500	734	576	730	500	710	560	530	355	490	400
880A-5	768	500	747	594	730	500	710	560	550	400	510	410

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U_N	Nominal voltage of the drive
I_N	Continuous rms output current. No overload capability at 40 °C (104 °F)
P_N	Typical motor power in no-overload use.
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-overload use.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes * Continuous rms output current allowing 40% overload for 1 minute every 5 minutes

High speed mode

Selection **High speed mode** of parameter **95.15 Special HW settings** improves control performance at high output frequencies. We recommend it to be selected with output frequency of 120 Hz and above.

This table gives the drive module ratings for 120 Hz output frequency and the maximum output frequency for the drive ratings when **High speed mode** in parameter **95.15 Special HW settings** is enabled: With output frequencies smaller than this recommended maximum output frequency, the current derating is less than the values given in the table. Contact ABB for operation above the recommended maximum output frequency or for the output current derating with output frequencies above 120 Hz and below the maximum output frequency.

Drive module type ACS880-04F-	Deratings with selection High speed mode of parameter 95.15 Special HW settings									
	120 Hz output frequency					Maximum output frequency				
		Nominal use		Light-duty use	Heavy-duty use		Nominal use		Light-duty use	Heavy-duty use
	f	I_N	P_N	I_{Ld}	I_{Hd}	f_{max}	I_N	P_N	I_{Ld}	I_{Hd}
	Hz	A	kW	A	A	Hz	A	kW	A	A
U_N = 400 V										
504A-3	120	504	250	485	361	500	390	200	370	290
584A-3	120	584	315	575	429	500	437	250	419	311
649A-3	120	649	355	634	477	500	485	250	466	346
725A-3	120	725	400	715	566	500	519	250	496	390
820A-3	120	820	450	810	625	500	587	315	562	431
880A-3	120	880	500	865	725*	500	630	355	600	500*
U_N= 500 V										
459A-5	120	459	315	450	330	500	357	250	345	265
502A-5	120	502	355	483	361	500	390	250	370	290
582A-5	120	582	400	573	414	500	400	250	380	298
634A-5	120	634	450	623	477	500	410	250	392	298
715A-5	120	715	500	705	566	500	462	315	428	362
820A-5	120	820	560	807	625	500	530	355	490	400
880A-5	120	880	630	857	697***	500	550	400	510	410

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f	Output frequency
f_{max}	Maximum output frequency with High speed mode
U_N	Nominal voltage of the drive
I_N	Continuous rms output current. No overload capability at 40 °C (104 °F)
P_N	Typical motor power in no-overload use.
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power for light-overload use.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes * Continuous rms output current allowing 40% overload for 1 minute every 5 minutes *** Continuous rms output current allowing 45% overload for 1 minute every 5 minutes

Fuses (IEC)

aR fuses for protection against short-circuit in the input power cable or drive are listed below.

Ultrarapid (aR) fuses							
Drive type ACS880-04F-	**Input current (A)**	**Fuse**					
		A	**A^2s**	**V**	**Manufacturer**	**Type DIN 43620** 	**Size**
U_N = 400 V							
504A-3	505	800	490000	690	Bussmann	170M6812D	3
584A-3	585	1000	985000	690	Bussmann	170M6814D	3
649A-3	650	1000	985000	690	Bussmann	170M6814D	3
725A-3	725	1250	2150000	690	Bussmann	170M8554D	3
820A-3	820	1600	4150000	690	Bussmann	170M8557D	3
880A-3	880	1600	4150000	690	Bussmann	170M8557D	3
U_N = 500 V							
459A-5	460	630	490000	690	Bussmann	170M6810D	3
502A-5	503	800	490000	690	Bussmann	170M6812D	3
582A-5	583	1000	985000	690	Bussmann	170M6814D	3
634A-5	635	1000	985000	690	Bussmann	170M6814D	3
715A-5	715	1250	2150000	690	Bussmann	170M8554D	3
820A-5	820	1600	4150000	690	Bussmann	170M8557D	3
880A-5	880	1600	4150000	690	Bussmann	170M8557D	3

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Note 1: See also *Implementing thermal overload and short-circuit protection* on page 67.

Note 2: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 3: Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.

Note 4: Fuses from other manufacturers can be used if they agree with the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

Fuses (UL)

UL fuses for branch circuit protection per NEC are listed below. **Check that the operating time of the fuse is below 0.1 seconds.** The operating time depends on the fuse type, supply network impedance and the cross-sectional area, material and length of the supply cable. The fuses must be of the “non-time delay” type. Obey local regulations.

Drive type ACS880-04F-	**Input current (A)**	**Fuse**				
		A	**V**	**Manufacturer**	**UL class**	**Type**
U_N = 400 V						
504A-3	505	600	600	Bussmann	T	JJS-600
584A-3	585	800	600	Ferraz	L	A4BY800
649A-3	650	800	600	Ferraz	L	A4BY800
725A-3	725	800	600	Ferraz	L	A4BY800
820A-3	820	900	600	Ferraz	L	A4BY900
880A-3	880	1000	600	Ferraz	L	A4BY1000
U_N = 480 V						
459A-5	460	600	500	Bussmann	T	JJS-500
502A-5	503	600	600	Bussmann	T	JJS-600
582A-5	583	800	600	Ferraz	L	A4BY800
634A-5	635	800	600	Ferraz	L	A4BY800

Drive type ACS880-04F-	Input current (A)	Fuse				
		A	V	Manufacturer	UL class	Type
715A-5	715	800	600	Ferraz	L	A4BY800
820A-5	820	900	600	Ferraz	L	A4BY900
880A-5	880	1000	600	Ferraz	L	A4BY1000

Note 1: See also *Implementing thermal overload and short-circuit protection* on page *67*.

Note 2: In multicable installations, install only one fuse per phase (not one fuse per conductor).

Note 3: Fuses with higher current rating than the recommended ones must not be used. Fuses with lower current rating can be used.

Note 4: Fuses from other manufacturers can be used if they agree with the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

Dimensions, weights and free space requirements

Standard drive module configuration (including flange and shrouds)								
Frame size	Height[1)]		Width		Depth[2)]		Weight	
	mm	in	mm	in	mm	in	kg	lb
R11	1733	68.23	620	24.41	477	18.78	224	494

Optional selection +0B051+0H371 (without shrouds, full-size output power cable connection terminals but with flange)								
Frame size	Height[3)]		Width		Depth[4)]		Weight	
	mm	in	mm	in	mm	in	kg	lb
R11	1647	64.84	620	24.41	405	15.94	219	483
Optional selection +0B051+0H371 (without shrouds, full-size output power cable connection terminals and flange)								
Frame size	Height[5)]		Width		Depth[4)]		Weight	
	mm	in	mm	in	mm	in	kg	lb
R11	1525	60.05	535	21.06	405	15.94	219	483
Optional selection +0B051+E208+0H371+C217 (without shrouds, full-size output power cable connection terminals and with wall mounting kit instead of flange)								
Frame size	Height[3)]		Width		Depth[4)]		Weight	
	mm	in	mm	in	mm	in	kg	lb
R11	1647	64.84	620	24.41	405	15.94	222	489

1 Height of standard drive module with hood: 1930 mm (75.98 in)

2 Depth of standard drive module with hood: 556 mm (21.89 in)

3 Height with optional selection +0B051+0H371, flange (or wall mounting kit) and hood: 1877 mm (73.90 in).

4 Depth with optional selection +0B051+0H371 and hood: 479 mm (18.87 in)

5 Height with optional selection +0B051+0H371 and hood, but without flange: 1755 mm (69.09 in). The height is the same with the wall mounting kit instead of flange.

Weight of optional selections												
Frame size	+E208		+D150		+H356		+0H371		+H370		+0B051	
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
R11	3	7	9	20	2	4	-2.9	-6	2.9	6	-1.5	-3

For requirements of free space around the drive module, see page *45*.

Losses, cooling data and noise

Drive type	Frame size	Air flow		Heat dissipation		Noise
		Heatsink	Front	Heatsink	Front	
		m^3/h	m^3/h	W	W	dB(A)
U_N = 400 V						
ACS880-04F-504A-3	R11	1400	120	5100	550	75
ACS880-04F-584A-3	R11	1400	120	5800	650	75
ACS880-04F-649A-3	R11	1400	120	7400	750	75
ACS880-04F-725A-3	R11	1400	120	7950	850	75
ACS880-04F-820A-3	R11	1400	120	8950	950	75
ACS880-04F-880A-3	R11	1400	120	9600	1000	75
U_N = 500 V						
ACS880-04F-459A-5	R11	1400	120	3900	550	75
ACS880-04F-502A-5	R11	1400	120	5050	600	75
ACS880-04F-582A-5	R11	1400	120	5750	700	75
ACS880-04F-634A-5	R11	1400	120	7350	800	75
ACS880-04F-715A-5	R11	1400	120	7900	900	75
ACS880-04F-820A-5	R11	1400	120	8900	1000	75
ACS880-04F-880A-5	R11	1400	120	10050	1050	75

The cooling air temperature rises 30 degrees Celsius (86 °F) when it goes through the drive module if the temperature of the input cooling air is 40 degrees Celsius (104 °F).

Terminal and lead-through data for the power cables

The maximum accepted cable size is 4 × (3 × 240) mm^2 or 4 × (3 × 500 AWG). Screw size for connecting busbars to the drive module input and output busbars: M12, tightening torque 50...75 N·m.

Units without full-size output cable connection terminals (+0H371) and with a common mode filter (+E208)

It is possible to use the maximum cable size (4 × [3 × 240] mm^2 or 4 ×[(3 × 500 AWG]) only with special cable lugs and additional insulation. For more information, contact your local ABB representative.

Terminal data for the control cables

See page 89.

Electrical power network specification

Voltage (U_1)	ACS880-04F-xxxx-3 drive modules: 380…415 V AC phase +10%/-15%. This is indicated in the type designation label as typical input voltage level 3 ~ 400 V AC. ACS880-04F-xxx-5 drive modules: 380...500 V AC 3-phase +10%/-15%. This is indicated in the type designation label as typical input voltage levels 3 ~ 400/480/500 V AC.
Network type	TN (grounded) and IT (ungrounded) systems
Short-circuit withstand strength (IEC 61439-1)	Maximum allowable prospective short-circuit current is 65 kA when by the fuses given in the fuse table. For the maximum allowable prospective short-circuit current with circuit breakers, see section *Protecting the drive and input power cable in short-circuits* on page 67.

Short-circuit current protection (UL 508A)	The drive is suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes at 600 V maximum when by the fuses given in the fuse table.
Short-circuit current protection (CSA C22.2 No. 14-05)	The drive is suitable for use on a circuit capable of delivering not more than 100 kA rms symmetrical amperes at 600 V maximum when by the fuses given in the fuse table.
Frequency (f_1)	50/60 Hz. Variation ±5% of the nominal frequency.
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Fundamental power factor (cos phi$_1$)	0.98 (at nominal load)

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet motors, AC induction servomotors and ABB synchronous reluctance motors (SynRM motors)
Voltage (U_2)	0 to U_1, 3-phase symmetrical, U_{max} at the field weakening point
Frequency (f_2)	0…500 Hz For drives with du/dt filter: 200 Hz For drives with sine filter: 120 Hz
Frequency resolution	0.01 Hz
Current	See section *Ratings*.
Switching frequency	3 kHz (typically)
Maximum recommended motor cable length	See table below.

DTC control	Scalar control
500 m (1640 ft)	500 m (1640 ft)

Note: Motor cable longer than 100 m (328 ft) is allowed but then the EMC Directive requirements of Category C3 may not be fulfilled.

Brake resistor connection data

See page 169.

DC connection data

Drive type	I_{DC} (A)	Capacitance (mF)
U_N = 400 V		
ACS880-04F-504A-3	640	14
ACS880-04F-584A-3	714	14
ACS880-04F-649A-3	870	14
ACS880-04F-725A-3	909	21
ACS880-04F-820A-3	1033	21
ACS880-04F-880A-3	1120	21
U_N = 500 V		
ACS880-04F-459A-5	487	14
ACS880-04F-502A-5	640	14
ACS880-04F-582A-5	714	14
ACS880-04F-634A-5	870	14
ACS880-04F-715A-5	909	21
ACS880-04F-820A-5	1033	21
ACS880-04F-880A-5	1120	21

Control unit connection data (ZCU-14)

Power supply (XPOW)

24 V (±10%) DC, 2 A

External power supply in. With some drive module sizes, not used as the control unit is supplied from the drive module.

Connector pitch 5 mm, wire size 2.5 mm^2

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 1…3 PTC thermistors.
“0” > 4 kohm, “1” < 1.5 kohm
I_{max}: 15 mA (for DI6 5 mA)

Start interlock input DIL (XD24:1)

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)

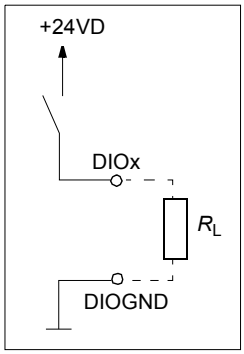
Input/output mode selection by parameters.

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 mm^2

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

As outputs:
Total output current from +24VDis limited to 200 mA



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

Connector pitch 5 mm, wire size 2.5 mm^2
10 V ±1% and –10 V ±1%, R_{load} 1…10 kohm

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

Current/voltage input mode selection by jumpers.

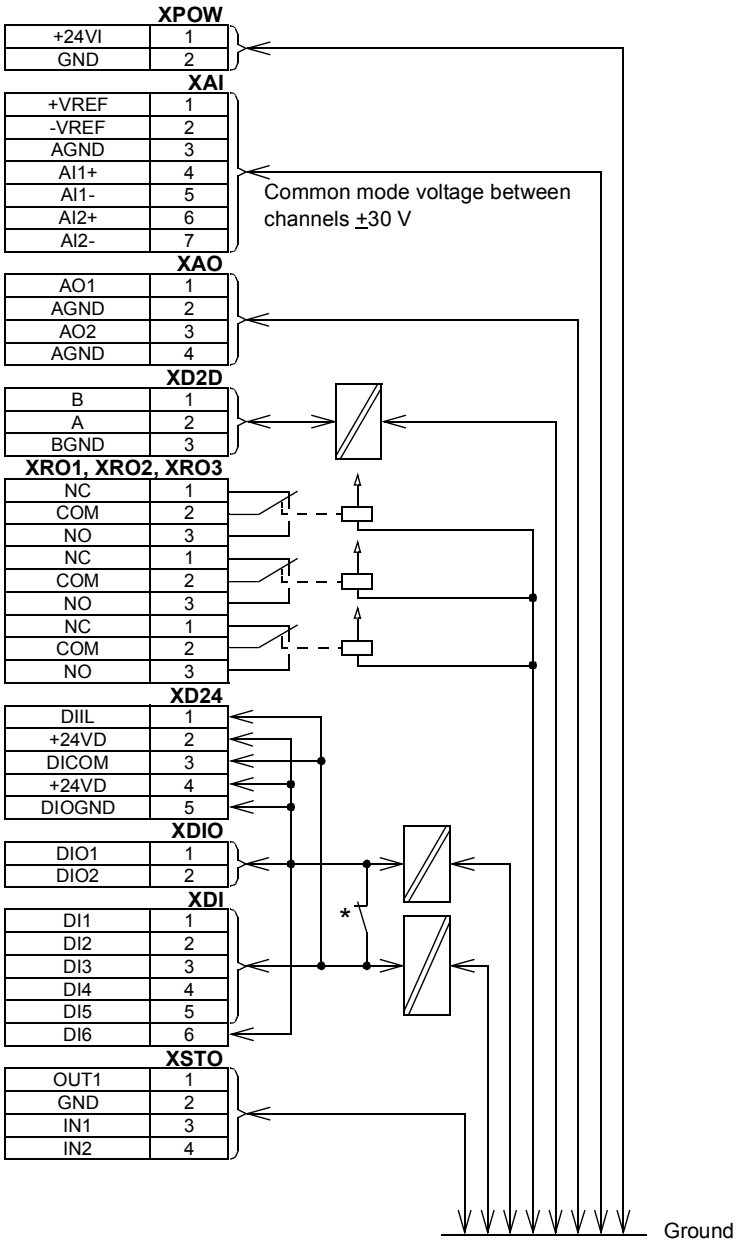
Connector pitch 5 mm, wire size 2.5 mm^2
Current input: –20…20 mA, R_{in}: 100 ohm
Voltage input: –10…10 V, R_{in}: > 200 kohm
Differential inputs, common mode range ±30 V
Sampling interval per channel: 0.25 ms
Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms
Resolution: 11 bit + sign bit
Inaccuracy: 1% of full scale range.
Inaccuracy for Pt100 sensors: 10 °C (50 °F)

Analog outputs AO1 and AO2 (XAO)

Connector pitch 5 mm, wire size 2.5 mm^2
0…20 mA, R_{load} < 500 ohm
Frequency range: 0…300 Hz
Resolution: 11 bit + sign bit
Inaccuracy: 2% of full scale range

Drive-to-drive link (XD2D)	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485 Termination by jumper
Safe torque off connection (XSTO)	Connector pitch 5 mm (0.2 in), wire size 2.5 mm2 (14 AWG) Input voltage range: -3…30 V DC Logic levels: “0” < 5 V, “1” > 19 V For the drive to start, both connections must be closed (OUT1 to IN1 and IN2). Current consumption: 50 mA (+24 V DC, continuous) per STO channel EMC (immunity) according to IEC 61326-3-1
Control panel / PC connection (X13)	Connector: RJ-45 Cable length < 3 m

Ground isolation diagram)



*** Ground selector (J6) settings**

• (ZCU-14) All digital inputs share a common ground (DICOM connected to DIOGND). This is the default setting.
• (ZCU-14) Ground of digital inputs DI1…DI5 and DIIL (DICOM) is isolated from DIO signal ground (DIOGND). Isolation voltage 50 V.

Control panel type

ACS-AP-W assistant control panel

Efficiency

Approximately 98% at nominal power level

Protection classes

Degree of protection (IEC/EN 60529)	Front: IP20 Front with option +0B051: IP00 Heatsink: IP55
Enclosure type (UL 508C)	Front: UL Open Type Front with option +0B051: UL Open Type Heatsink: NEMA Type 12
Overvoltage category (IEC 60664-1)	III

Ambient conditions

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

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	For TN and TT neutral-grounded network systems and IT non-corner grounded network systems: 0 to 4000 m (13123 ft) above sea level For TN, TT and IT corner-grounded network systems: 0 to 2000 m (6561 ft) above sea level Above 1000 m [3281 ft]), see page *120*.	-	-
Air temperature	-15 to +55 °C (5 to 131 °F). No frost allowed. See page *120*.	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	5 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels	IEC/EN 60721-3-3:2002: Classification of environmental conditions- Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations	IEC 60721-3-1:1997	IEC 60721-3-2:1997
Chemical gases	Class 3C2	Class 1C2	Class 2C2
Solid particles	Class 3S2. No conductive dust allowed.	Class 1S3. (packing must support this, otherwise 1S2)	Class 2S2
Pollution degree	2		
Atmospheric pressure	70 to 106 kPa 0.7 to 1.05 atmospheres	70 to 106 kPa 0.7 to 1.05 atmospheres	60 to 106 kPa 0.6 to 1.05 atmospheres

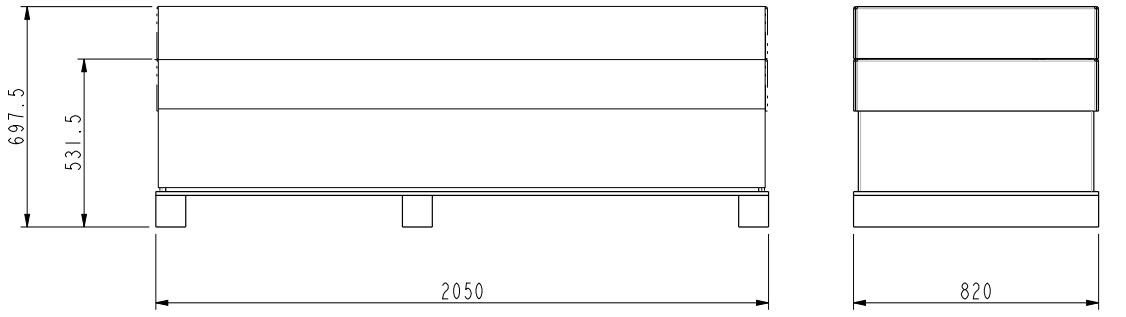
Vibration IEC 60068-2-6:2007, EN 60068-2-6:2008 *Environmental testing Part 2: Tests –Test Fc: Vibration (sinusoidal)*	Max. 0.1 mm (0.004 in.) (10 to 57 Hz), max. 10 m/s^2 (33 ft/s^2) (57 to 150 Hz) sinusoidal	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s^2 (49 ft/s^2) (9 to 200 Hz) sinusoidal
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009 *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock*	Not allowed	With packing max. 100 m/s^2 (330 ft./s^2), 11 ms	With packing max. 100 m/s^2 (330 ft./s^2), 11 ms
Free fall	Not allowed	100 mm (4 in.) for weight over 100 kg (220 lb)	100 mm (4 in.) for weight over 100 kg (220 lb)

Materials

Drive enclosure

- PC/ABS 2.5 mm (0.098 in.), color NCS 1502-Y (RAL 9002 / PMS 420 C)
- hot-dip zinc coated steel sheet 1.5 to 2.5 mm (0.059 to 0.098 in.), thickness of coating 100 micrometers, color NCS 1502-Y

Package Plywood and cardboard, bands PP.



3AXD50000040437_assy

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.

EN 61800-5-1:2007 *Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy*

EN 60204-1:2006 + A1:2010 *Safety of machinery. Electrical equipment of machines. Part 1: General requirements*. Provisions for compliance: The final assembler of the machine is responsible for installing
- emergency-stop device
- supply disconnecting device
- IP00 drive module into a cabinet.

IEC/EN 60529:1991 + A2:2013 *Degrees of protection provided by enclosures (IP code)*

EN 61800-3:2004 +A1:2012	*Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods*
UL 508C (3rd edition)	*UL Standard for Safety, Power Conversion Equipment, third edition*
CSA-C22.2 No. 0-10	*General Requirements - Canadian Electrical Code, Part II*
CSA C22.2 No. 14-13	*Industrial Control Equipment*
CSA C22.2 No. 274-13	*Adjustable speed drives*

CE marking

A CE mark is attached to the drive to verify that the unit 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 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. The declaration of conformity is shown below.

Declaration of Conformity

Power and productivity
for a better world™

EU Declaration of Conformity

Machinery Directive 2006/42/EC

We

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

declare under our sole responsibility that the following products:

Frequency converters

ACS880-01

ACS880-04/-04F

ACS880-M04

ACS880-14/-34

with regard to the built-in safety function:

Safe torque off;

and with regard to the following optional safety functions with FSO-12 module (option code +Q973, encoderless):

Safe stop 1; Safe stop emergency; Safely-limited speed; Safe maximum speed; Safe brake control; Prevention of Unexpected Start-up;

and with regard to the following optional safety functions (option codes +Q972 and +L521, encoder supported):

Safe stop 1; **Safe stop emergency**; **Safely-limited speed**; **Safe maximum speed; Safe brake control**; **Safe speed monitor; Safe direction; Prevention of Unexpected Start-up;**

and with regard to the following optional safety function with FPTC-01 thermistor protection module (option code +L536):

Safe Motor Temperature;

are in conformity with all the relevant safety component requirements of EU Machinery Directive 2006/42/EC, when the listed safety functions are used for safety component functionality.

Power and productivity
for a better world™

EU Declaration of Conformity

Machinery Directive 2006/42/EC

The following harmonized standards have been applied:

EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional*
EN 62061:2005 + AC:2010 + A1:2013 + A2:2015	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1:2015	*Safety of machinery – Safety-related parts of control systems. Part 1: General requirements*
EN ISO 13849-2:2012	*Safety of machinery – Safety-related parts of the control systems. Part 2: Validation*
EN 60204-1: 2006 + A1:2009 + AC:2010	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

The following other standards have been applied:

IEC 61508:2010	Functional safety of electrical / electronic / programmable electronic safety-related systems

The products referred in this Declaration of conformity fulfil the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AXD10000497831.

Person authorized to compile the technical file:

Name and address: Juha Martinmaa, Hiomotie 13, 00380 Helsinki, Finland.

Helsinki, 22 Nov 2016

Manufacturer representative:

Tuomo Hoysniemi
Vice President, ABB Oy

Compliance with EN 61800-3:2004

Definitions

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

First environment includes 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 and 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 C3

The drive complies with the standard with the following provisions:

1. The drive is equipped with EMC filter +E200 or +E201.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 100 meters.

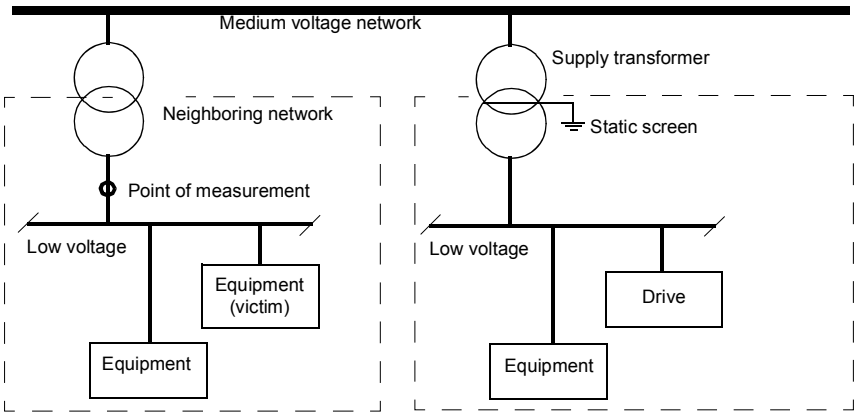
WARNING! A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

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 the hardware manual.
4. The drive is installed according to the instructions given in the hardware 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

cULus Listing is pending for the drive modules.

UL checklist

- The drive module is to be used in a heated, indoor controlled environment. The drive module must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust. See page *132*.
- The maximum ambient air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 50 °C (104 to 122 °F).
- The drive module is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 V maximum when the input cable is protected with class T fuses. The ampere rating is based on tests done according to UL 508C.
- The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
- The input cable must be protected with fuses. Circuit breakers must not be used without fuses in the USA. For suitable circuit breakers, contact your local ABB representative. Suitable IEC (class aR) fuses for drive protection are listed on page *125* and UL fuses on page *125*.
- For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, use the UL classified fuses.

- For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfill this requirement, use the UL classified fuses.
- The drive module provides overload protection in accordance with the National Electrical Code (NEC).

CSA marking

CSA marking is pending for the drive modules.

EAC (Eurasian Conformity) marking

The drive has EAC certification. EAC marking is required in Russia, Belarus and Kazakhstan.

EIP (Electronic Information Products) marking

An EIP mark is attached to the drive to verify that the drive complies with the regulations of the Chinese Administrative Measure on the Control of Pollution Caused by Electronic Information Products.

Disclaimers

Cybersecurity disclaimer

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

Disclaimer

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

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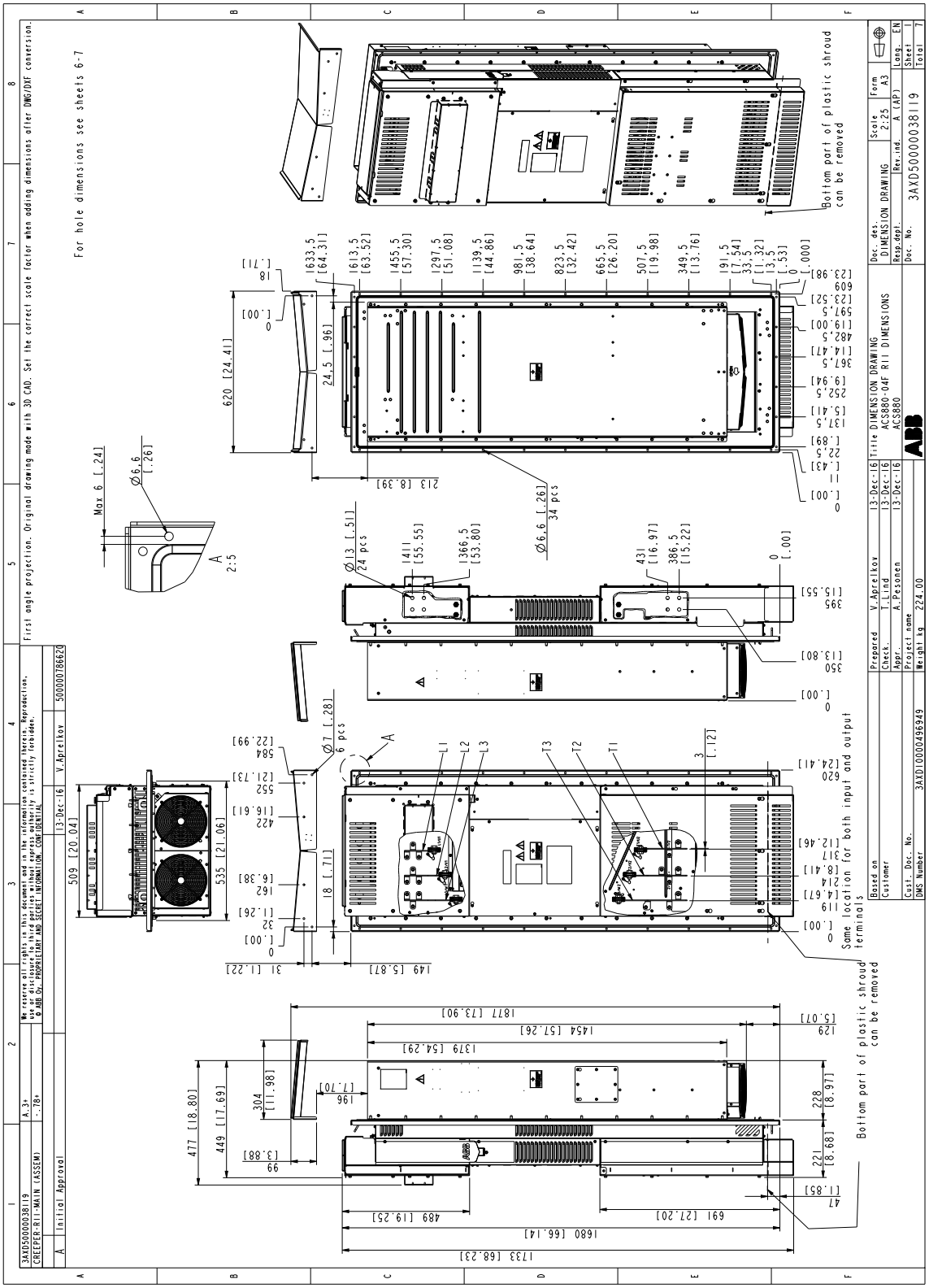
Dimension drawings

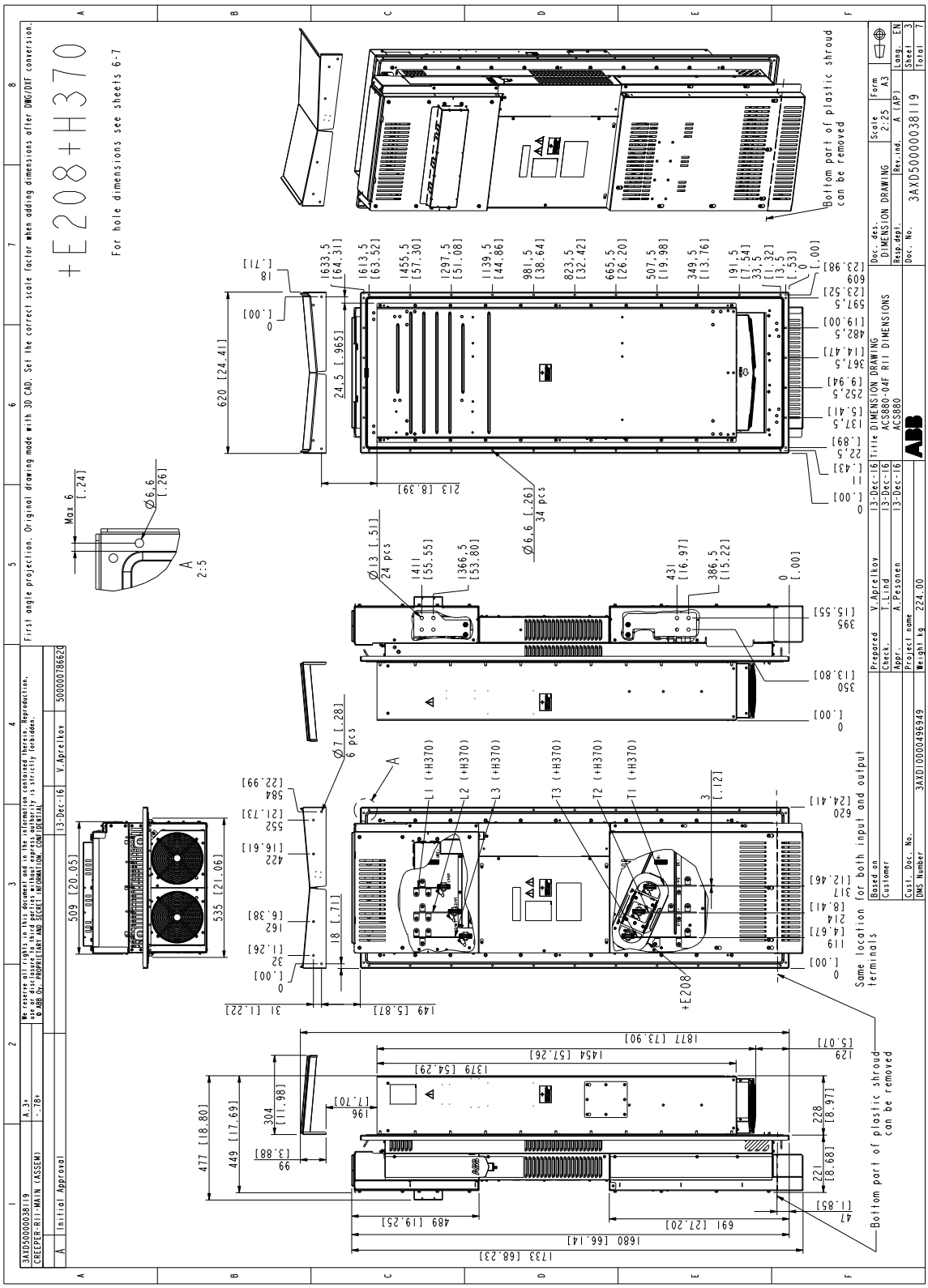
Contents of this chapter

This chapter contains dimension drawings of the drive modules.

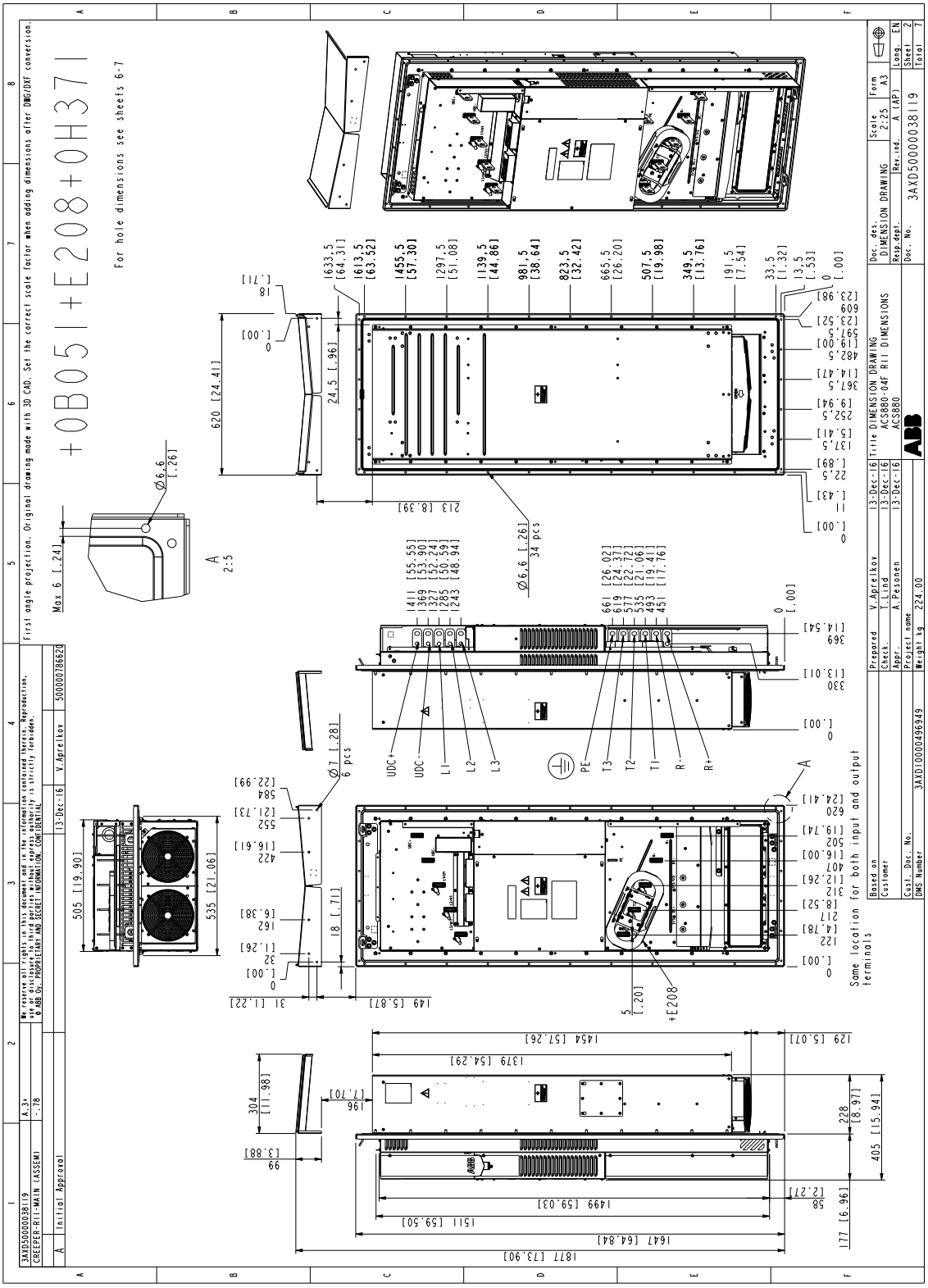
Standard configuration – IP20 (UL Open Type)



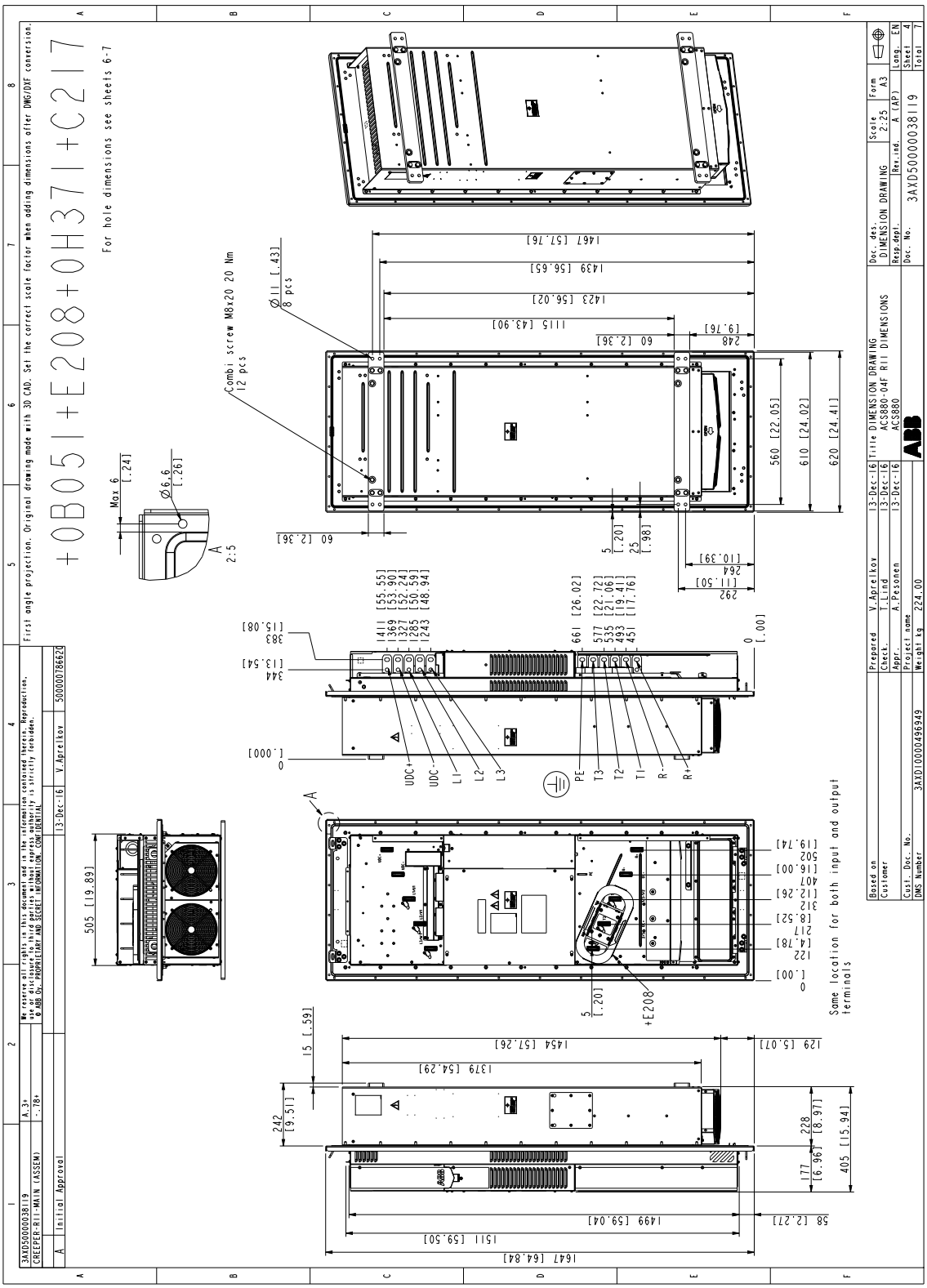
Drive module with options +E208 and +H370 – IP20 (UL Open Type)



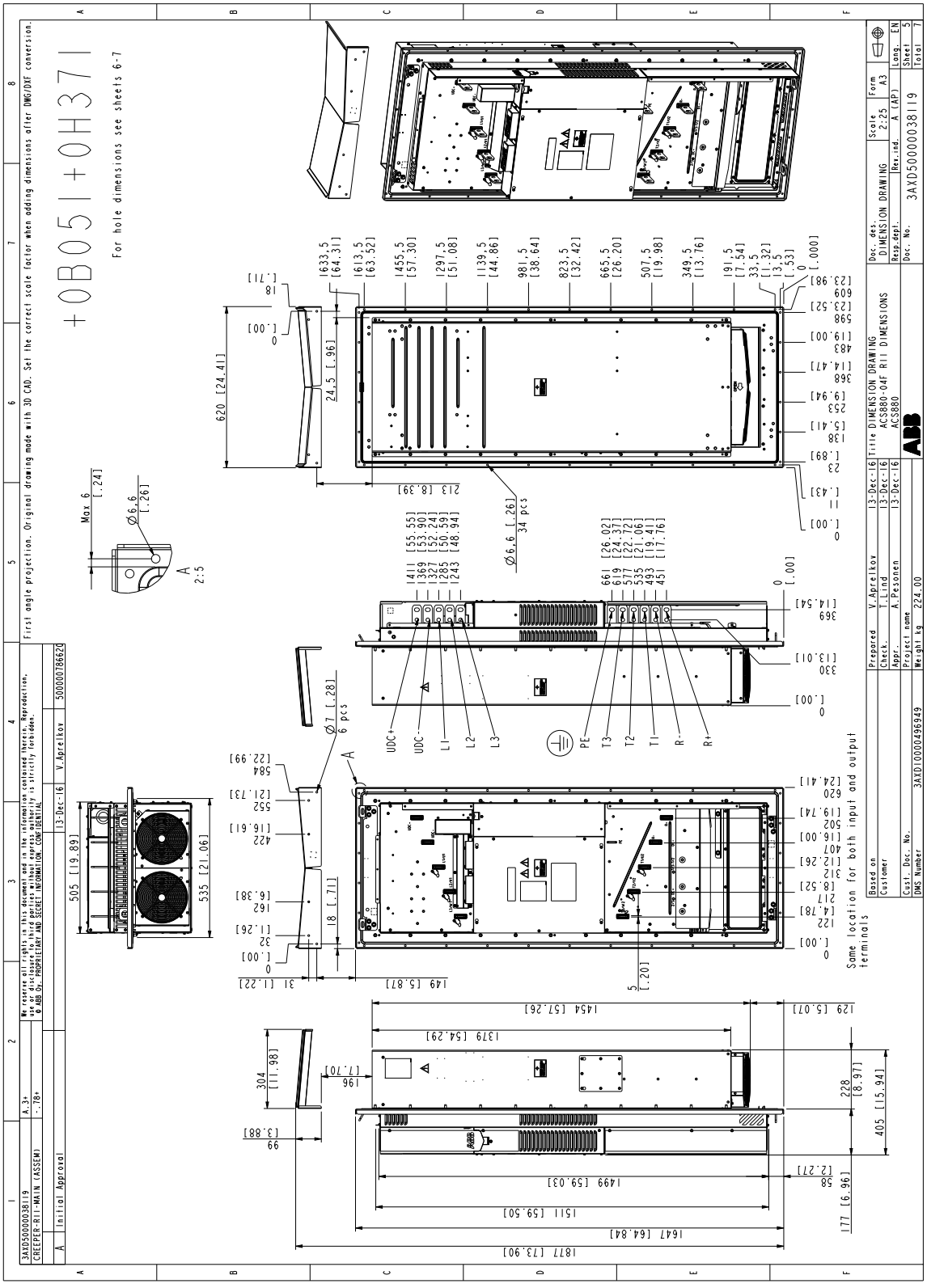
Drive module with options +0B051+E208+0H371 – IP00 (UL Open Type)



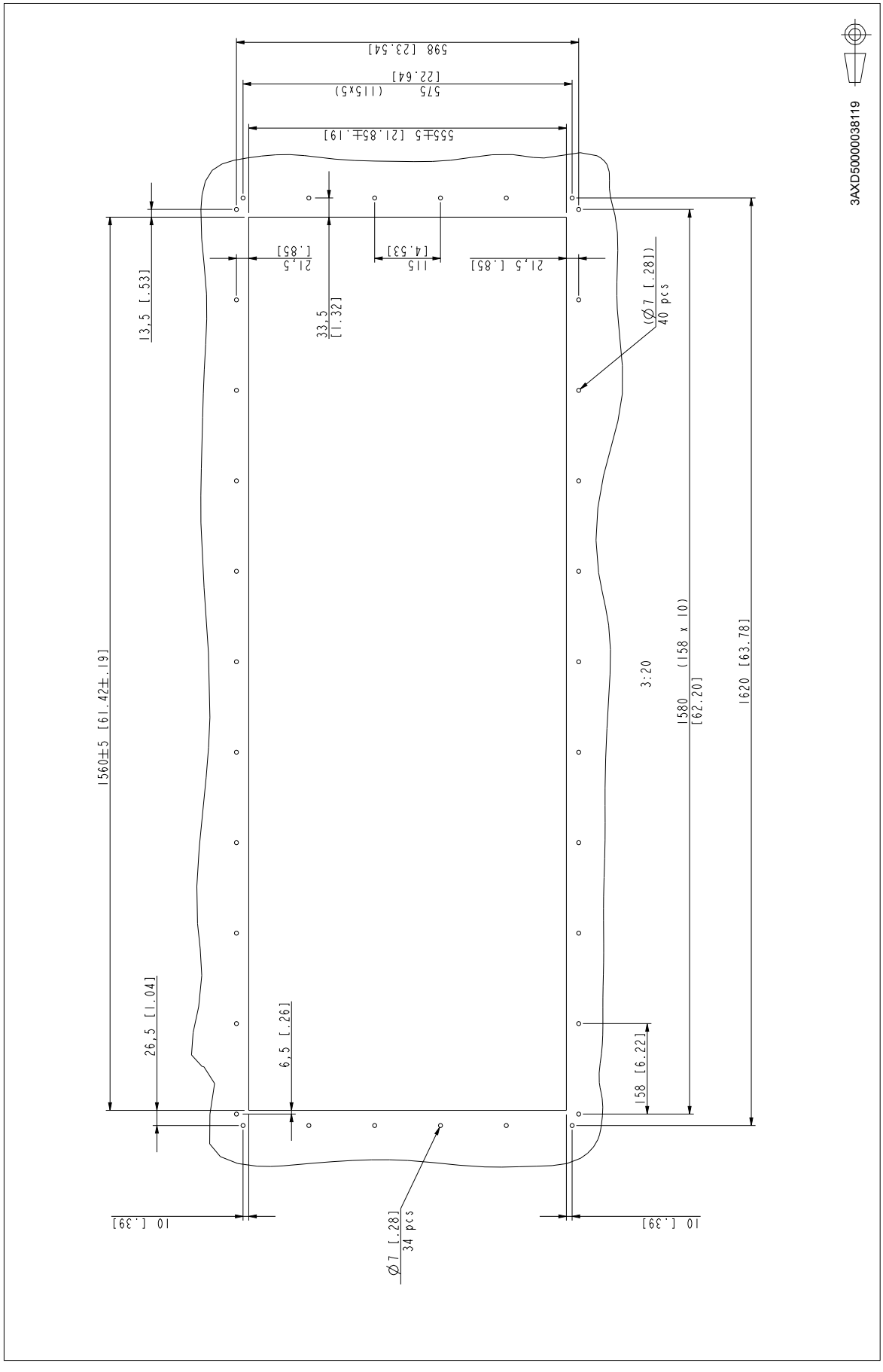
Drive module with options +0B051+E208+0H371+C217 – IP00 (UL Open Type)

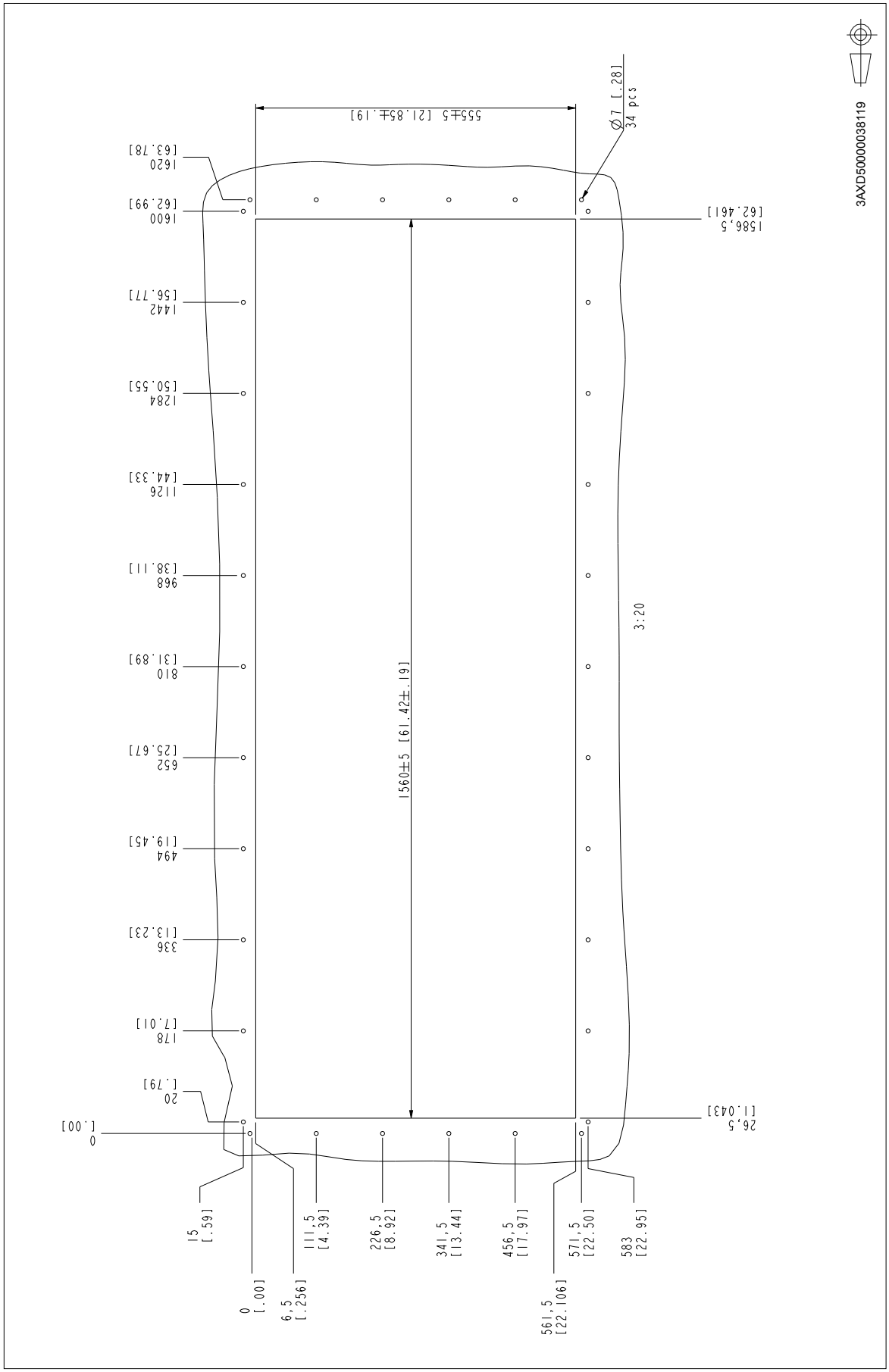


Drive module with options +0B051+0H371 – IP00 (UL Open Type)



Mounting plate




3AXD50000038119
555±5 [21.85±.19]
Ø 7 [.28]
34 pcs
1620
[63.78]
1600
[62.99]
1586,5
[62.461]
1442
[56.77]
1284
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1126
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1560±5 [61.42±.19]
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0
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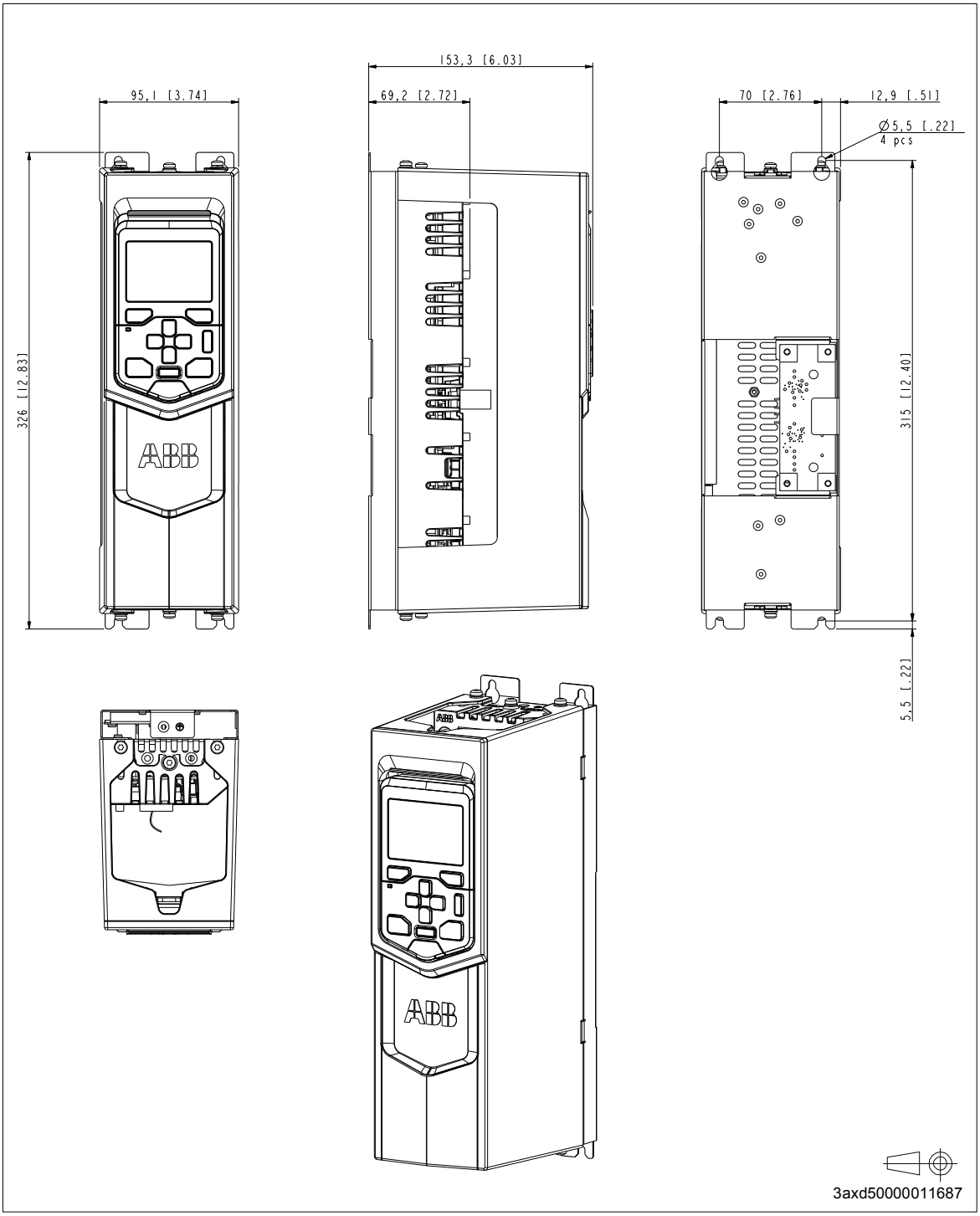
583
[22.95]

External control unit



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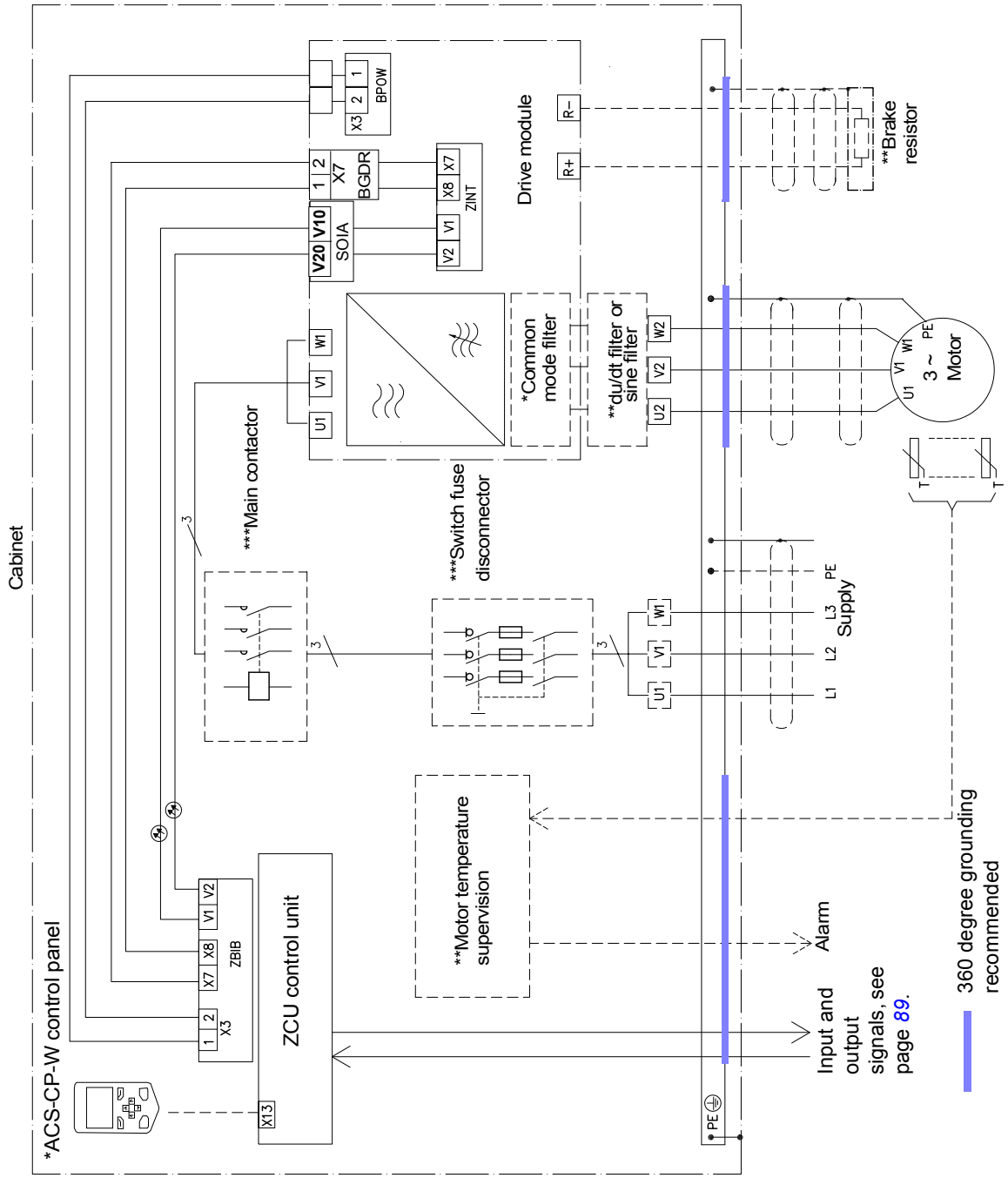
Example circuit diagram

Contents of this chapter

This chapter shows an example circuit diagram for a cabinet-installed drive module.

Example circuit diagram

This diagram is an example for the main wiring of a drive cabinet. Note that the diagram includes components which are not included in a basic delivery (* plus code options, ** other options, *** to be acquired by the customer).



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Safe torque off function

Contents of this chapter

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

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.

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*

Standard	Name
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 61511:2016	*Functional safety – Safety instrumented systems for the process industry sector*
IEC/EN 61800-5-2:2016	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
IEC 62061:2015 EN 62061:2005 +AC:2010+A1:2013+A2:2015	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1:2015	*Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*
EN ISO 13849-2:2012	*Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

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

Compliance with the European Machinery Directive

See section *Compliance with the European Machinery Directive* on page *134*.

Wiring

The following diagrams present examples of Safe torque off wiring for

- a single drive (page *155*)
- multiple drives (page *157*)
- multiple drives when an external 24V DC power supply is used (page *158*)

For information on the specifications of the STO input, see section *Default I/O connection diagram* on page *89*.

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.

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

Cable types and lengths

We recommend double-shielded twisted-pair cable (see page *65*).

Maximum cable lengths:

- 300 m (984 ft) between activation switch [K] and drive control unit
- 60 m (200 ft) between multiple drives
- 60 m (200 ft) between external power supply and first drive.

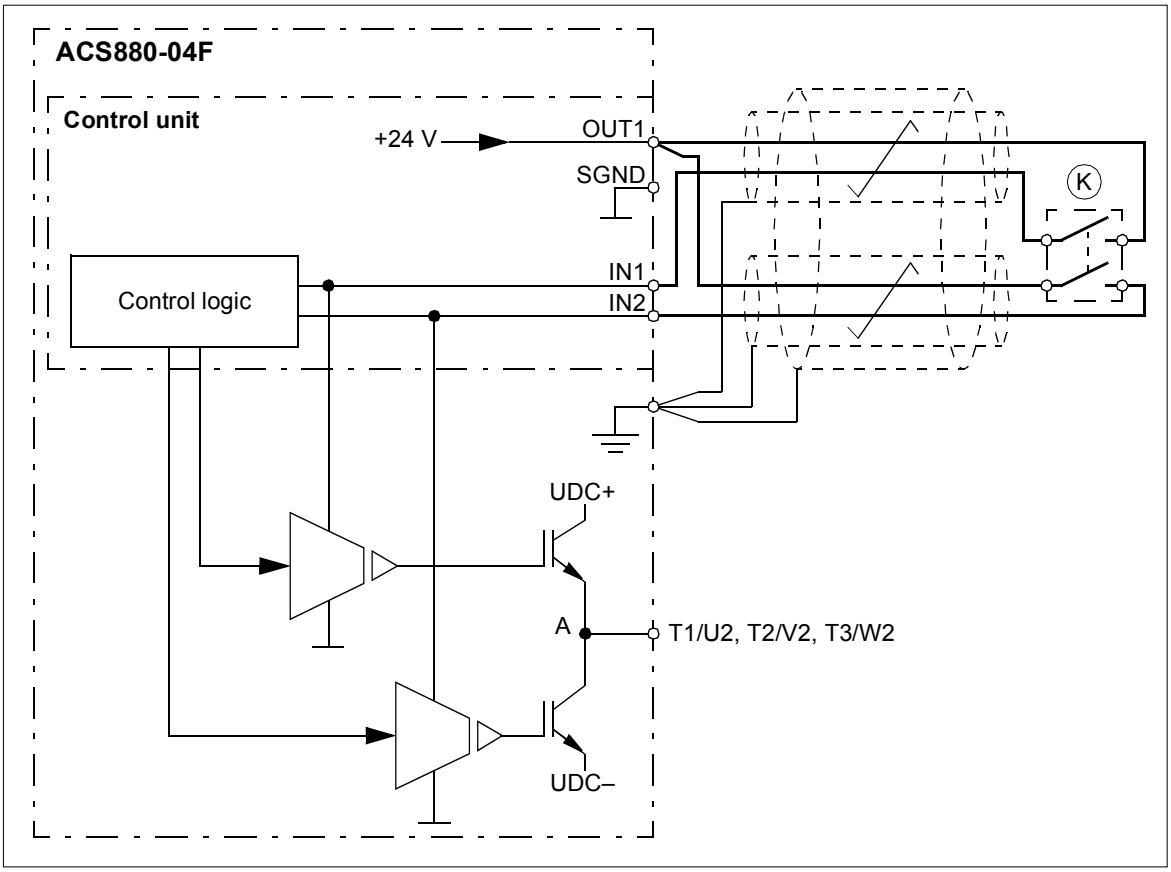
Note: The voltage at the INx terminals of the control unit must be at least 17 V DC to be interpreted as “1”.

Grounding of protective shields

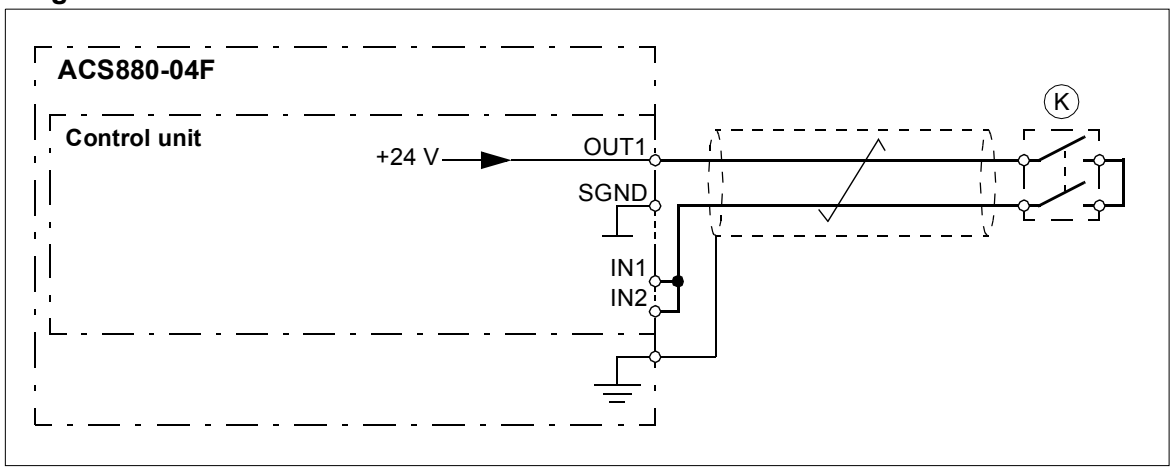
- Ground the shield in the cabling between the activation switch and the control unit at the control unit.
- Ground the shield in the cabling between two control units at one control unit only.

Single drive (internal power supply)

Dual-channel connection



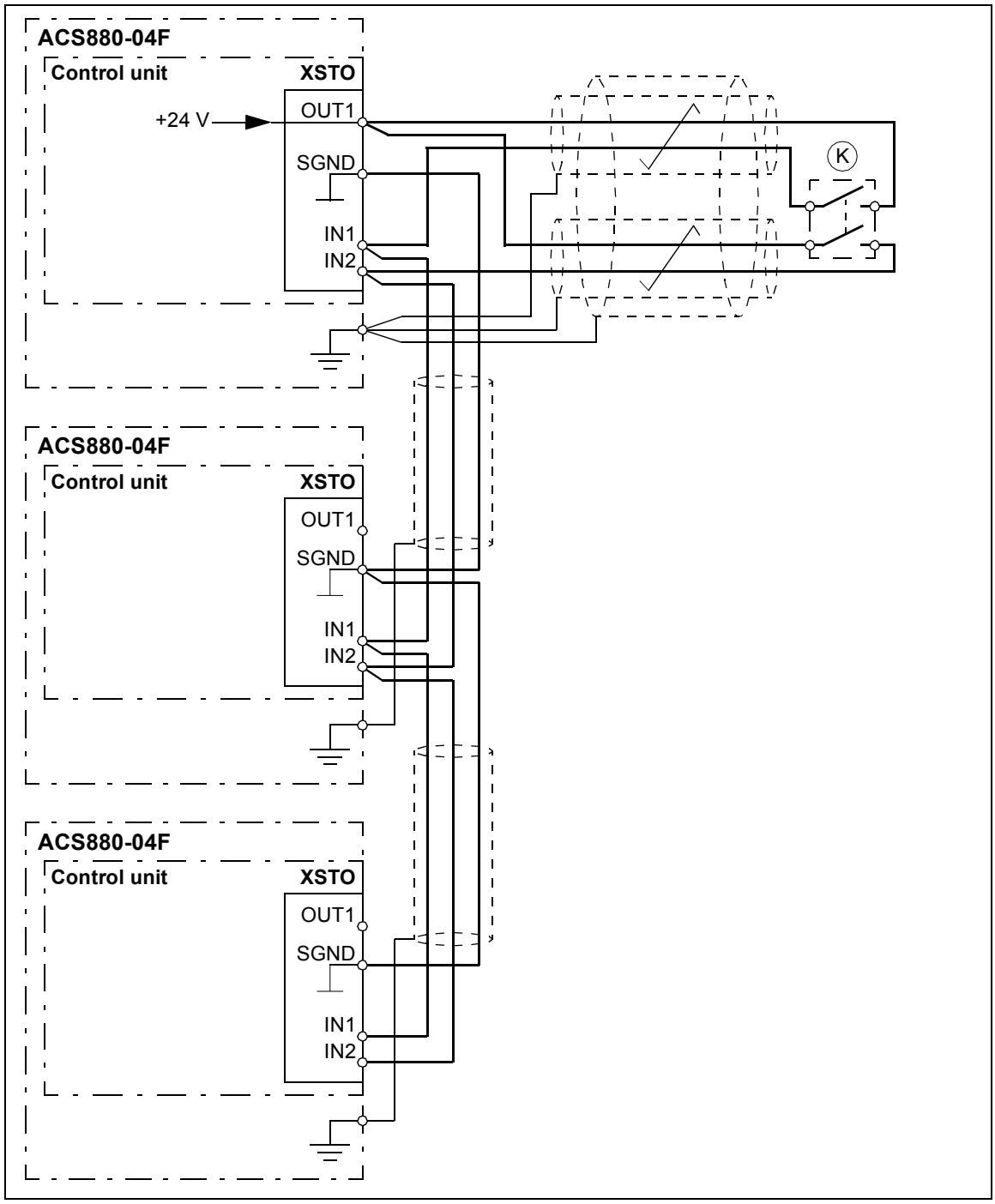
Single-channel connection



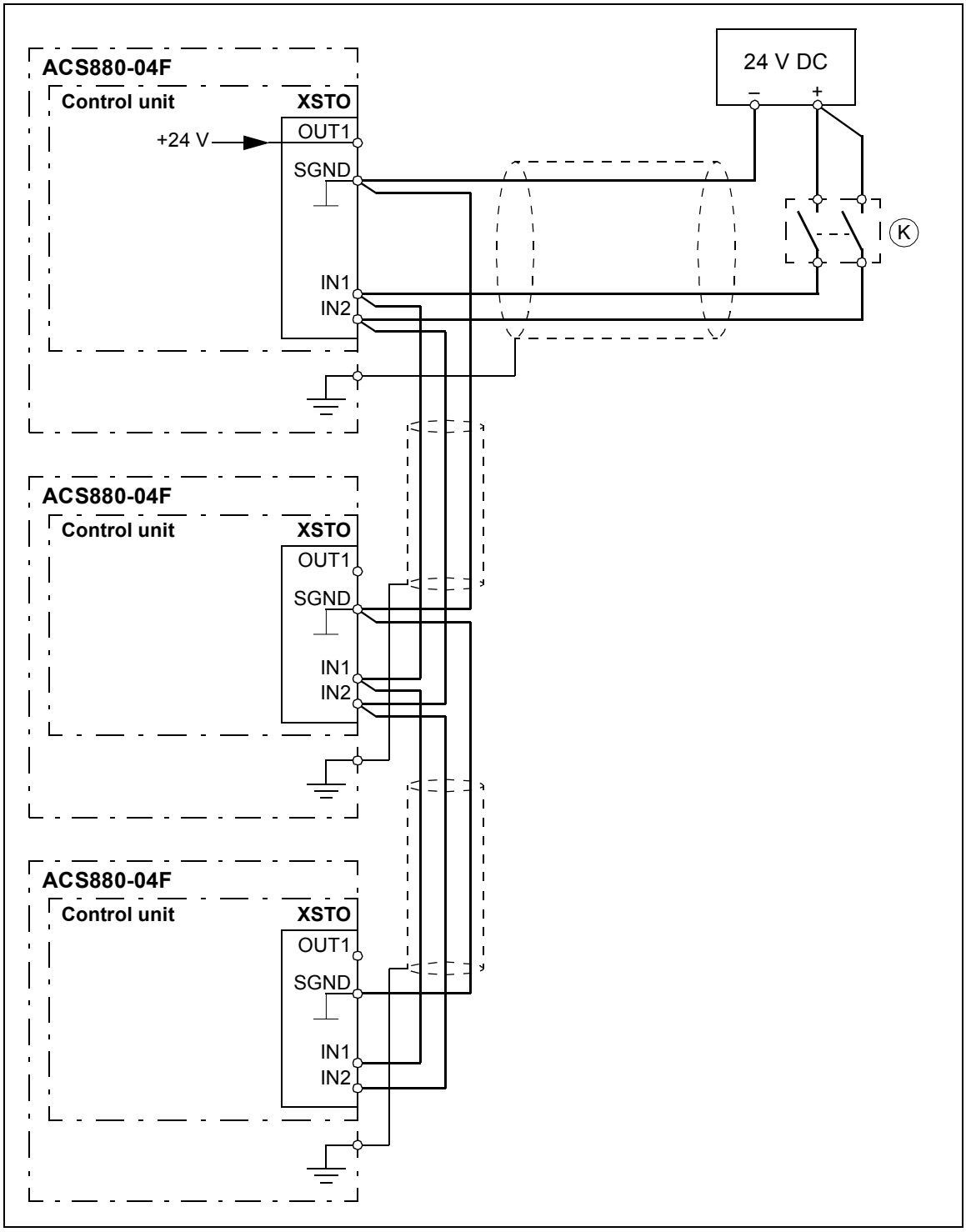
Notes:

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

Multiple drives (internal power supply)



Multiple drives (external power supply)



Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. 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 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.

Start-up including acceptance test

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

- 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.

Competence

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.

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.

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	☑
WARNING! Obey the safety instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.	☐
Ensure that the drive can be run and stopped freely during start-up.	☐
Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.	☐
Check the Safe torque off circuit connections against the wiring diagram.	☐
Close the disconnector and switch the power on.	☐

Action	☑
Test the operation of the STO function when the motor is stopped. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Ensure that the drive operates as follows: • Open the STO circuit. The drive generates an indication if one is defined for ‘stopped’ state in parameter 31.22 (see the firmware manual). • Give a start command to verify that the STO function blocks the operation of the drive. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the STO function when the motor is running. • Start the drive and ensure the motor is running. • Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for ‘running’ state in parameter 31.22 (see the firmware manual). • Reset any active faults and try to start the drive. • Ensure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the failure detection of the inverter. The motor can be stopped or running. • Open the 1st channel of the STO circuit (wire coming to IN1). If the motor was running, it should coast to a stop. The drive generates a *FA81 Safe Torque Off 1 loss* fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the drive’s operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally. • Open the 2nd channel of the STO circuit (wire coming to IN2). If the motor was running, it should coast to a stop. The drive generates a *FA82 Safe Torque Off 2 loss* fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the drive’s operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.	☐

Use

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

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

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

Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 5 or 2 years. see section *Safety data* (page *162*). It is assumed that all dangerous failures of the STO circuit are detected by the proof test. To perform the proof test, do the *Acceptance test procedure* (page *159*).

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

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

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

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

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

If any wiring or component change is needed after start-up, or the parameters are restored, follow the test given in section *Acceptance test procedure* on page *159*.

Use only ABB approved spare parts.

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

Competence

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

Fault tracing

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

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an “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.

Safety data

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

Frame	SIL/ SILCL	SC	PL	SFF (%)	PFH (T_1 = 20 a) (1/h)	PFD_{avg} (T_1 = 2 a)	PFD_{avg} (T_1 = 5 a)	$MTTF_d$ (a)	DC* (%)	Cat.	HFT	CCF (%)	Lifetime (a)
R11	3	3	e	99.63	3.91E-09	3.43.E-05	8.56E-05	18774	$\geq$ 90	3	1	80	20

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* According to Table E1 EN/ISO 13849-1

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with $\triangle T$ = 71.66 °C
  - 1340 on/off cycles per year with $\triangle T$ = 61.66 °C
  - 30 on/off cycles per year with $\triangle T$ = 10.0 °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time
- The STO is a type A safety component as defined in IEC 61508-2.
- Relevant failure modes:
  - The STO trips spuriously (safe failure)
  - The STO does not activate when requested

  A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- STO reaction time (shortest detectable break): 1 ms
- STO response time: 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

Abbreviations

Abbr.	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_{avg}	IEC 61508	Average probability of failure on demand
PFH	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 *Maintenance* on page *161*.

17

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.

Operation principle and hardware description

The dive can be equipped with optional built-in brake chopper (+D150). Brake resistors are available as add-on kits.

The brake chopper handles the energy generated by a decelerating motor. The chopper connects the brake resistor to the intermediate DC circuit whenever the voltage in the circuit exceeds the limit defined by the control program. Energy consumption by the resistor losses lowers the voltage until the resistor can be disconnected.

Planning the braking system

Selecting the default brake circuit components

1. Calculate the maximum power generated by the motor during braking (P_{max}).
2. Select a suitable drive, brake chopper and brake resistor combination for the application from the rating table on page *119*. The braking power of the chopper must be greater or equal than the maximum power generated by the motor during the braking.
3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the resistor heat dissipation capacity E_R.
   Note: If the E_R value is not sufficient, it is possible to use a four-resistor assembly in

which two standard resistors are connected in parallel, two in series. The E_R value of the four-resistor assembly is four times the value specified for the standard resistor.

Selecting a custom resistor

If you use a resistor other than the default resistor, make sure that:

1. The resistance of the custom resistor is greater or equal than the resistance of the default resistor in the rating table on page *169*:

$$R \geq R_{min}$$

where

R Resistance of the custom resistor.

WARNING! Never use a brake resistor with a resistance smaller than R_{min}. The drive and the chopper are not able to handle the overcurrent caused by the low resistance.

R_{min} Resistance of the default resistor

2. The load capacity of the custom resistor is higher than the instantaneous maximum power consumption of the resistor when it is connected to the drive DC link voltage by the chopper:

$$P_r > \frac{U_{DC}^2}{R}$$

where

P_r Load capacity of the custom resistor

U_{DC} Drive DC link voltage.
1.35 · 1.25 · 415 V DC (when supply voltage is 380 to 415 V AC)
1.35 · 1.25 · 500 V DC (when supply voltage is 440 to 500 V AC)

R Resistance of the custom resistor

Selecting and routing the external brake resistor cables

Use the same cable type for the resistor cabling as for the drive input cabling to ensure that the input fuses also protect the resistor cable. Alternatively, a two conductor shielded cable with the same cross-sectional area can be used.

Minimizing electromagnetic interference

Obey these rules in order to minimize electromagnetic interference caused by the rapid current changes in the resistor cables:

- Shield the braking power line completely, either by using shielded cable or a metallic enclosure. Unshielded single-core cable can only be used if it is routed inside a cabinet that efficiently suppresses the radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance should be 0.3 meters (0.98 ft).
- Cross the other cables at right angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on chopper IGBTs. The longer the cable the higher the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

Maximum cable length

The maximum length of the resistor cable(s) is 10 m (33 ft).

EMC compliance of the complete installation

Note: ABB has not verified that the EMC requirements are fulfilled with external user-defined brake resistors and cabling. The EMC compliance of the complete installation must be considered by the customer.

Placing the brake resistors

Install the resistors outside the drive module in a place where they will cool.

Arrange the cooling of the resistor in a way that:

- no danger of overheating is caused to the resistor or nearby materials
- the temperature of the room the resistor is located in does not exceed the allowed maximum.

Supply the resistor with cooling air/water according to the resistor manufacturer's instructions.

WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, ensure that the material withstands high temperatures. Protect the resistor against contact.

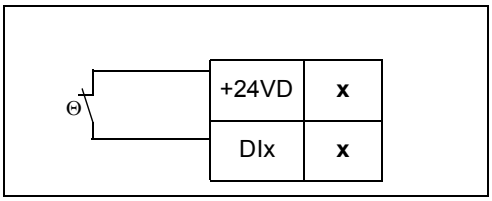
Protecting the system against thermal overload

The brake chopper protects itself and the resistor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. The drive control program includes a resistor and resistor cable thermal protection function which can be tuned by the user. See the firmware manual.

A main contactor is not required for protecting against resistor overheating when the resistor is dimensioned according to the instructions and the internal brake chopper is in use. The drive will disable power flow through the input bridge if the chopper remains conductive in a fault situation but the charging resistor may fail.

Note: If an external brake chopper (outside the drive module) is used, a main contactor is always required.

A thermal switch (standard in ABB resistors) is required for safety reasons. The thermal switch cable must be shielded and may not be longer than the resistor cable. Wire the switch to a digital input on the drive control unit as shown in the figure below.



Protecting the resistor cable against short-circuits

The input fuses will also protect the resistor cable when it is identical with the input cable.

Mechanical installation of external brake resistors

All brake resistors must be installed outside the drive. Obey the resistor manufacturer's instructions.

Electrical installation

Checking the insulation of the assembly

Obey the instructions given in section *Brake resistor and resistor cable* on page *78*.

Connection diagram

See section *Power cable connection diagram* on page *81*.

Connection procedure

- Connect the resistor cables to the R+ and R- terminals in the same way as the other power cables. If a shielded three-conductor cable is used, cut the third conductor and ground the twisted shield of the cable (protective earth conductor of the resistor assembly) at both ends.
- Connect the thermal switch of the brake resistor as described in section *Protecting the system against thermal overload* on page *167*.

Start-up

Set the following parameters (ACS880 primary control program):

- Disable the overvoltage control of the drive by parameter **30.30 Overvoltage control**.
- Set parameter **31.01 External event 1 source** to point to the digital input where the thermal switch of the brake resistor is wired.
- Set parameter **31.02 External event 1 type** to **Fault**.
- Enable the brake chopper by parameter **43.06 Brake chopper enable**. If **Enabled with thermal model** is selected, set also the brake resistor overload protection parameters **43.08** and **43.09** according to the application.
- Check the resistance value of parameter **43.10 Brake resistance**.

With these parameter settings, the drive stops by coasting at brake resistor overtemperature. For settings of other control programs, see the appropriate firmware manual.

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.

Technical data

Ratings

Drive type	Internal brake chopper		Example brake resistor(s)			
	P_{brcont}	R_{min}	Type	R	E_R	P_{Rcont}
	kW	ohm		ohm	kJ	kW
U_N = 400 V						
ACS880-04F-504A-3	250	2.0	2xSAFUR125F500	2.00	7200	18
ACS880-04F-584A-3	315	1.3	2xSAFUR200F500	1.35	10800	27
ACS880-04F-649A-3	315	1.3	2xSAFUR200F500	1.35	10800	27
ACS880-04F-725A-3	400	0.7	3xSAFUR200F500	0.90	16200	40
ACS880-04F-820A-3	400	0.7	3xSAFUR200F500	0.90	16200	40
ACS880-04F-880A-3	400	0.7	3xSAFUR200F500	0.90	16200	40
U_N = 500 V						
ACS880-04F-459A-5	250	2.0	2xSAFUR125F500	2.00	7200	18
ACS880-04F-502A-5	250	2.0	2xSAFUR125F500	2.00	7200	18
ACS880-04F-582A-5	315	1.3	2xSAFUR200F500	1.35	10800	27
ACS880-04F-634A-5	315	1.3	2xSAFUR200F500	1.35	10800	27
ACS880-04F-715A-5	400	0.7	3xSAFUR200F500	0.90	16200	40
ACS880-04F-820A-5	400	0.7	3xSAFUR200F500	0.90	16200	40
ACS880-04F-880A-5	400	0.7	3xSAFUR200F500	0.90	16200	40

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P_{brcont} Maximum continuous braking power. The braking is considered continuous if the braking time exceeds 30 seconds.

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

R Resistance value for the listed resistor assembly

E_R Short energy pulse that the resistor assembly withstands every 400 seconds

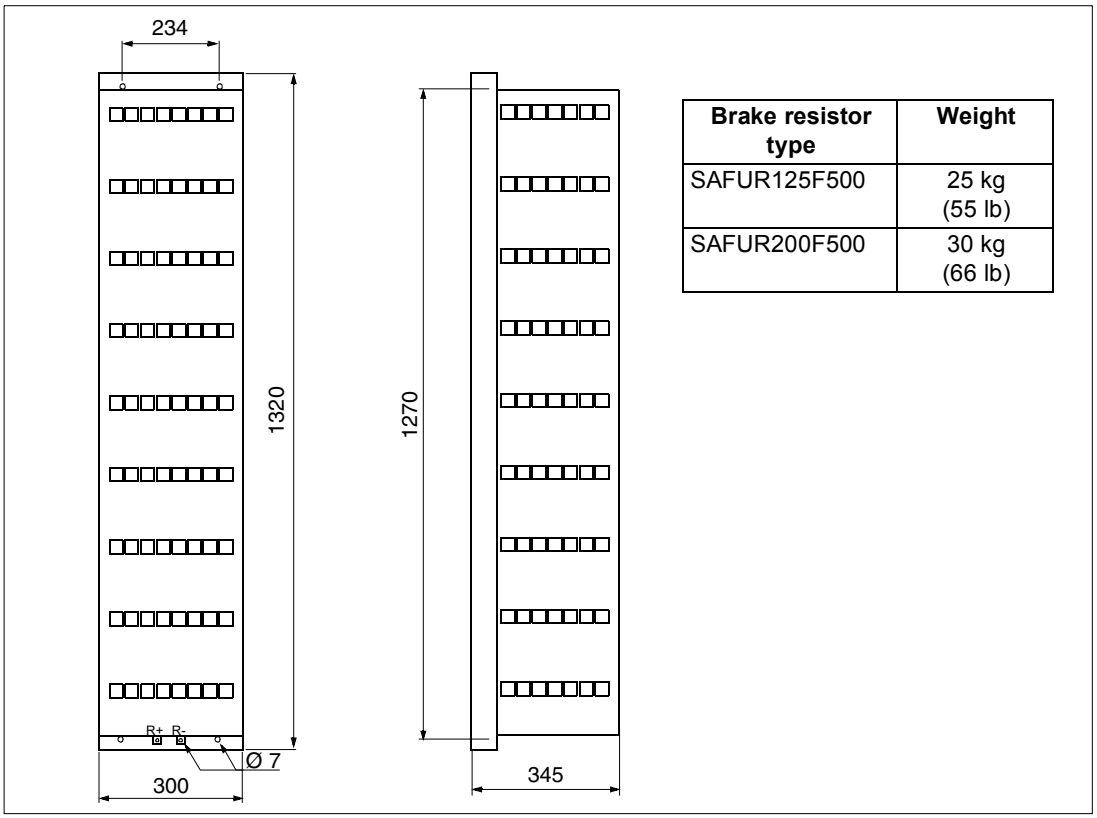
P_{Rcont} Continuous power (heat) dissipation of the resistor when placed correctly

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

SAFUR resistors

The degree of protection of SAFUR resistors is IP00. The resistors are not UL listed. The thermal time constant of the resistors is 555 seconds.

Dimensions and weights



Brake resistor type	Weight
SAFUR125F500	25 kg (55 lb)
SAFUR200F500	30 kg (66 lb)

Ordering codes

Brake resistor type	ABB ordering code
SAFUR125F500	68759285
SAFUR200F500	68759340

Terminals and cable lead-through data

See section *Terminal and lead-through data for the power cables* on page *127*.

18

d*u*/d*t* and sine filters

Contents of this chapter

This chapter describes how to select d*u*/d*t* and sine filters for the drive.

d*u*/d*t* filters

When is a d*u*/d*t* filter needed?

See section *Examining the compatibility of the motor and drive*, page *58*.

Selection table

d*u*/d*t* filter types for the drive modules are given below.

Drive module type ACS880-04F-	d*u*/d*t* filter type	Drive module type ACS880-04F-	d*u*/d*t* filter type
U_N = 400 V		U_N = 500 V	
504A-3	FOCH0610-70	459A-5	FOCH0610-70
584A-3	FOCH0610-70	502A-5	FOCH0610-70
649A-3	FOCH0610-70	582A-5	FOCH0610-70
725A-3	FOCH0875-70	634A-5	FOCH0610-70
820A-3	FOCH0875-70	715A-5	FOCH0875-70
880A-3	FOCH0875-70	820A-5	FOCH0875-70
-	-	880A-5	FOCH0875-70

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Ordering codes

Filter type	ABB ordering code
FOCH-0610-70	68550483
FOCH-0875-70	3AUA0000125245

Description, installation and technical data of the FOCH filters

See *FOCH du/dt filters hardware manual* (3AFE68577519 [English]).

Sine filters

When is a sine filter needed?

See section *Examining the compatibility of the motor and drive*, page *58*.

Selection table

Sine filter types for the drive modules are given below.

Basic drive module type ACS880-04F-	Sine filter type	Drive module type ACS880-04F-	Sine filter type
U_N = 400 V		U_N = 500 V	
725A-3	NSIN900-6	715A-5	NSIN900-6
820A-3	NSIN900-6	820A-5	NSIN900-6
880A-3	NSIN900-6	880A-5	NSIN900-6

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Ordering codes

Filter type	ABB ordering code
NSIN485-6	64254936
NSIN900-6	64254961

Derating

See section *Deratings for special settings in the drive control program* on page *128*.

Description, installation and technical data of the sine filters

See *Sine filters hardware manual* (3AXD50000016814 [English]). For more information, contact ABB.

Further information

Product and service inquiries

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

Product training

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

Providing feedback on ABB Drives manuals

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

Document library on the Internet

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

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