ACSM1

Hardware Manual
ACSM1-04Lx Liquid-cooled Drive Modules (55 to 160 kW)

ACSM1 Drive Manuals

DRIVE HARDWARE MANUAL*

ACSM1-04Lx Liquid-cooled Drive Modules (55 to 160 kW) Hardware Manual
3AUA0000022083 (English)

ACSM1-04 Drive Modules (0.75 to 45 kW) Hardware Manual
3AFE68797543 (English)

ACSM1-04 Drive Modules (55 to 110 kW) Hardware Manual
3AFE68912130 (English)

DRIVE FIRMWARE MANUALS

ACSM1 Speed and Torque Control Program Firmware Manual
3AFE68848261 (English). *For drives of type ACSM1-04xS…*

ACSM1 Motion Control Program Firmware Manual
3AFE68848270 (English). *For drives of type ACSM1-04xM…*

DRIVE PC TOOLS MANUALS

DriveStudio User Manual
3AFE68749026 (English)

Solution Program Composer User Manual
3AFE68836590 (English)

APPLICATION GUIDES

Safe Torque Off Function (STO) Application Guide
3AFE68929814 (English)

OPTION MANUALS*

FIO-01 Digital I/O Extension User’s Manual
3AFE68784921 (English)

FIO-11 Analog I/O Extension User’s Manual
3AFE68784930 (English)

FEN-01 TTL Encoder Interface User’s Manual
3AFE68784603 (English)

FEN-11 Absolute Encoder Interface User’s Manual
3AFE68784841 (English)

FEN-21 Resolver Interface User’s Manual
3AFE68784859 (English)

FEN-31 HTL Encoder Interface User’s Manual
3AUA0000031044 (English)

ACSM1 Control Panel User’s Guide
3AUA0000020131 (English)

*A multilingual quick installation guide is included with the delivery.

ACSM1-04Lx Liquid Cooled Drive Modules
55 to 160 kW

Hardware Manual

3AUA0000022083 REV A EN
EFFECTIVE: 1.9.2008

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Safety instructions

What this chapter contains

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

Use of warnings and notes

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

Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.

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

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

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

Installation and maintenance work

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

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

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

- Never work on the drive, the motor cable or the motor when input power is applied. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, the motor or the motor cable.

  Always ensure by measuring with a multimeter (impedance at least 1 Mohm) that:

  1. There is no voltage between the drive input phases U1, V1 and W1 and the ground.
  2. There is no voltage between terminals UDC+ and UDC– and the ground.
  3. There is no voltage between terminals R+ and R– and the ground.

- Drives controlling a permanent magnet motor: A rotating permanent magnet motor feeds power to the drive causing the drive to become live even when it is stopped and the supply power switched off. Before maintenance work on the drive,
  – disconnect the motor from the drive by using a safety switch
  – prevent the start-up of any other motors in the same mechanical system
  – lock the motor shaft
  – measure that the motor is in fact de-energised, then connect the U2, V2 and W2 terminals of the drive to each other and to the PE.

- Do not work on the control cables when power is applied to the drive or to the external control circuits. Externally supplied control circuits may carry dangerous voltages even when the input power of the drive is switched off.

- Do not make any insulation or voltage withstand tests on the drive.

- Disconnect the internal EMC filter of the drive (for directions, see page 57) if the drive is to be installed on an IT power system (an ungrounded power system or a high resistance grounded [over 30 ohms] power system) or a corner-grounded power system.

Notes:

- Even when the motor is stopped, dangerous voltages are present at the power circuit terminals U1, V1, W1 and U2, V2, W2, and UDC+, UDC–, R+, R–.

- Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the terminals of the relay output(s) of the drive.

- The drive supports the “Safe Torque Off” function. See page 49.

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

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

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

Start-up and operation

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

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

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

Notes:

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

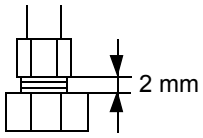
WARNING! The surfaces of drive system components (such as the braking resistor, if present) may become hot when the system is in use.

Work on the liquid cooling system

These instructions are intended for all who are responsible for installation and maintenance work of the liquid cooling system of the drive. Ignoring these instructions can cause physical injury or damage to the equipment.

WARNING!

- Beware of hot liquid. Do not work on the liquid cooling system until the pressure is lowered down by stopping the pumps. High-pressure warm coolant (max. 10 bar, 55 °C) is present in the internal cooling circuit when it is in operation.
- Before power switch-on, make sure that the internal cooling circuit is filled up with coolant. Running the pump dry will damage it. Also the drive will not cool down.
- Avoid skin contact with any coolant, especially antifreeze. Do not syphon them by mouth. If such substance is swallowed or gets into the eyes, seek medical advice.
- Do not use the liquid piping or any of its parts for grounding electrical equipment
- Do not use weld connectors. Voltage spikes caused by welding may damage electronical components of the drive and shorten the lifespan of the drive. Disconnect the piping of the drive from the external cooling system when welding external pipes.
- Do not overtighten the outer union of the nuts of the liquid hoses - leave 2 to 3 mm of thread visible. Overtightening may break the hose.



- Drain the unit before storing in temperatures below 0°C. Drying the pipes with compressed air is recommended. Freezing of the liquid cooling system is not allowed.

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Mechanical installation

Planning the electrical installation

Electrical installation

Installation checklist

Maintenance

The internal cooling circuit

Technical data

Resistor braking

Dimension drawings

About this manual

What this chapter contains

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

Compatibility

The manual is compatible with ACSM1-04Lx (frame size E).

Intended audience

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

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

Categorization according to the + code

The instructions, technical data and dimensional drawings which concern only certain optional selections are marked with + codes, e.g. +L500. The options included in the drive can be identified from the + codes visible on the type designation label of the drive. The + code selections are listed in chapter *The ACSM1-04Lx* on page *25*.

Product and service inquiries

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

Product training

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

Providing feedback on ABB Drives manuals

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

Contents

The chapters of this manual are briefly described below.

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

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

The ACSM1-04Lx describes the drive module.

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

Mechanical installation instructs how to place and mount the drive.

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

Electrical installation instructs on how to wire the drive.

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

Maintenance lists periodic maintenance actions along with work instructions.

The internal cooling circuit contains information on the drive internal cooling system.

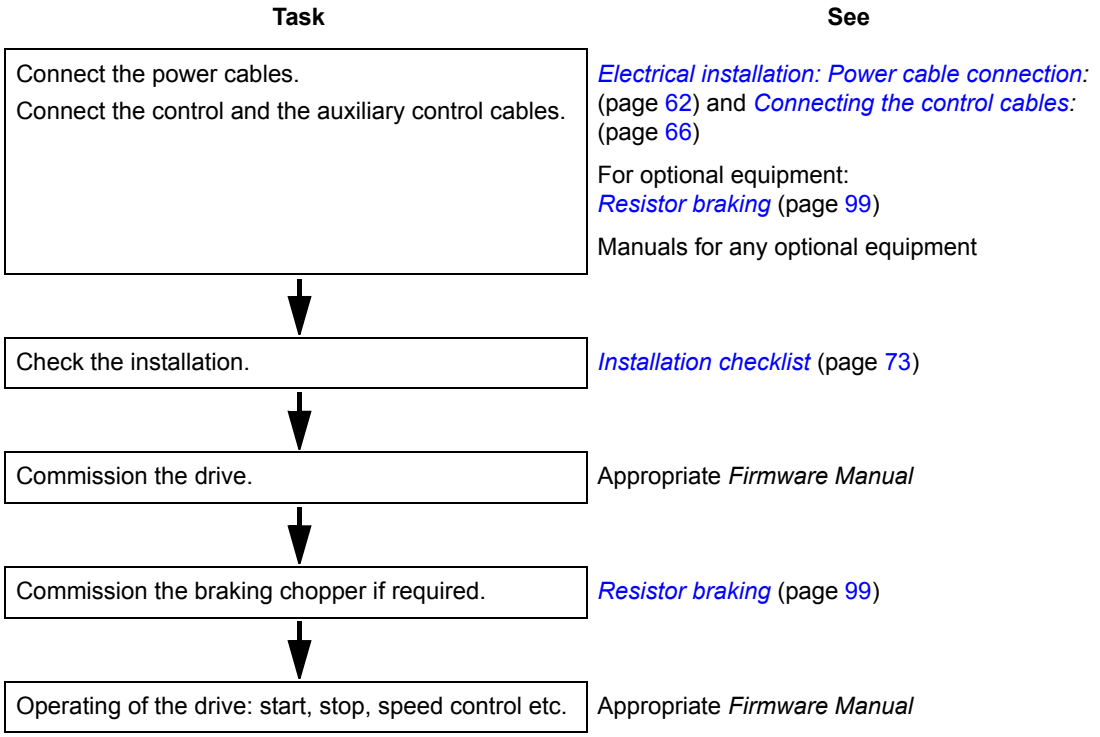
Technical data contains the technical specifications of the drive, e.g. the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings and warranty policy.

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

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

Installation and commissioning flowchart

Task	See
Plan the installation. Check the ambient conditions, ratings, required cooling, external cooling circuit arrangements, input power connection, compatibility of the motor, motor connection, and other technical data. Select the cables.	*Planning the cabinet assembly* (page 27) *Technical data* (page 83) *Planning the electrical installation* (page 45)
Unpack and check the units. Check that all necessary optional modules and equipment are present and correct. Only intact units may be started up.	*Mechanical installation*: *Contents of the package* (page 35) If the converter has been non-operational for more than one year, the converter DC link capacitors need to be reformed. (see *ACS800 Capacitor Reforming Guide* [64059629, English]))
Check the installation site.	*Mechanical installation: Before installation* (page 36) *Technical data* (page 83)
If the drive is about to be connected to an IT (ungrounded) or corner-grounded system, check that the internal EMC filtering of the drive has been disconnected.	*Connection to an IT (ungrounded) power system: Installation and maintenance work* (page 57)
Install the drive and the equipment related to the cooling system in a cabinet. Attach the cooling pipes to the drive.	*Mechanical installation*: *Installation procedure* (page 36) *Cooling arrangements* (page *29*)
Route the cables.	*Planning the electrical installation: Routing the cables* (page 53)
Check the insulation of the supply cable, the motor and the motor cable, and the resistor cable (if present).	*Electrical installation: Checking the insulation of the assembly* (page 56)


Task
See
Connect the power cables.
Connect the control and the auxiliary control cables.
Electrical installation: Power cable connection: (page 62) and Connecting the control cables: (page 66)
For optional equipment: Resistor braking (page 99)
Manuals for any optional equipment
Check the installation.
Installation checklist (page 73)
Commission the drive.
Appropriate Firmware Manual
Commission the braking chopper if required.
Resistor braking (page 99)
Operating of the drive: start, stop, speed control etc.
Appropriate Firmware Manual

Terms and abbreviations

Term/Abbreviation	Explanation
EMC	Electromagnetic Compatibility.
FIO-01	Optional digital I/O extension for the ACSM1.
FIO-11	Optional analogue I/O extension for the ACSM1.
FEN-01	Optional TTL encoder interface for the ACSM1.
FEN-11	Optional absolute encoder interface for the ACSM1.
FEN-21	Optional resolver interface for the ACSM1.
FCAN-0x	Optional CANopen adapter for the ACSM1.
FDNA-0x	Optional DeviceNet adapter for the ACSM1.
FENA-0x	Optional Ethernet/IP adapter for the ACSM1.
FPBA-0x	Optional PROFIBUS DP adapter for the ACSM1.
Frame (size)	Size of the drive module. This manual applies to ACSM1-04Lx frame size E.
IGBT	Insulated Gate Bipolar Transistor; a voltage-controlled semiconductor type widely used in inverters due to their easy controllability and high switching frequency.
I/O	Input/Output.
JBR-xx	Series of optional braking resistors for the ACSM1.
JCU	The control unit of the drive module. The JCU is installed on top of the power module. The external I/O control signals are connected to the JCU, or optional I/O extensions mounted on it.
JMU-xx	The memory unit attached to the control unit of the drive.
JPU	The power unit.
RFI	Radio-frequency interference.

The ACSM1-04Lx

What this chapter contains

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

The ACSM1-04Lx

The ACSM1-04Lx is a liquid-cooled IP20 drive module for controlling AC motors. It is to be installed into a cabinet by the customer.

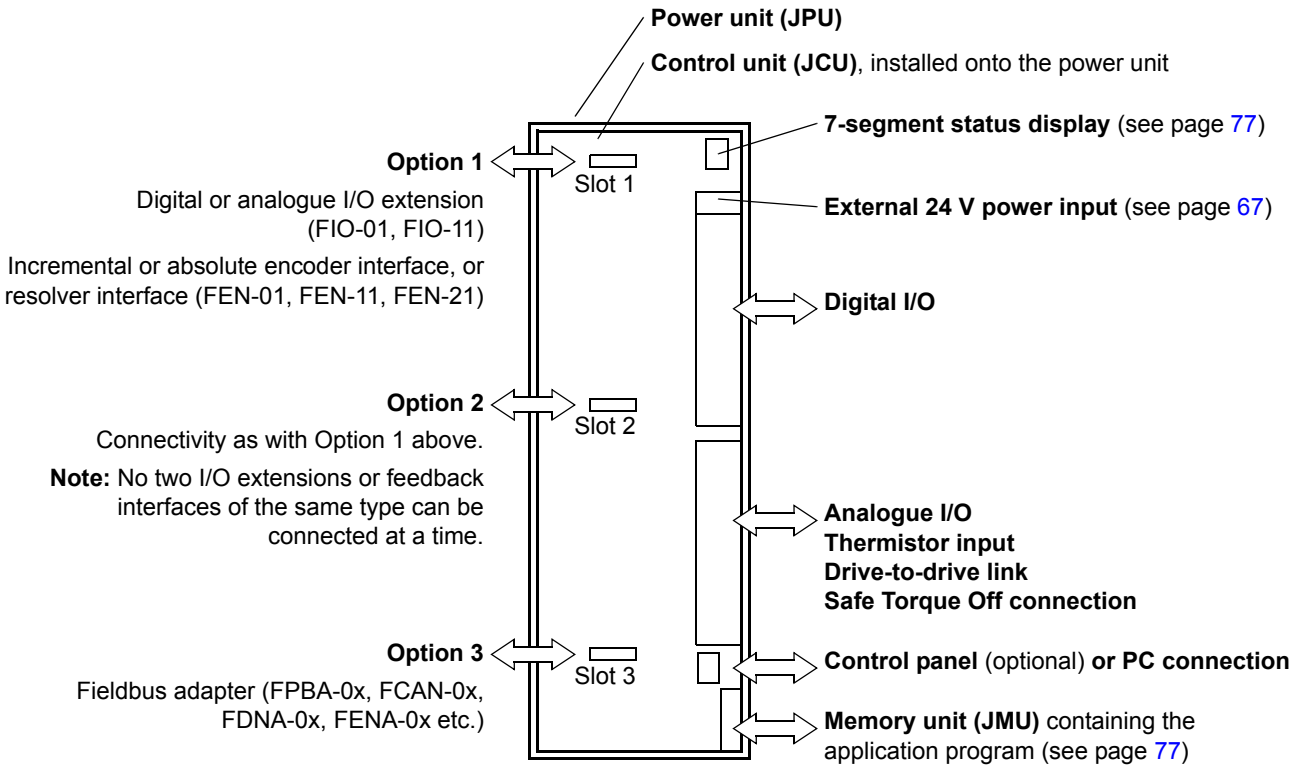
The ACSM1-04Lx is only available in frame size E.

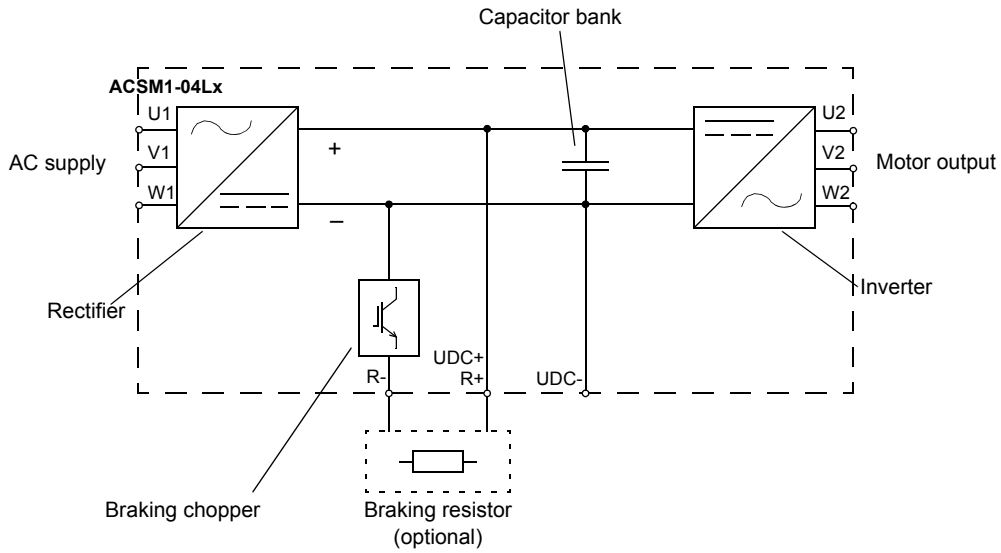
Layout

JCU Control Unit

Main circuit and control interfaces

The diagram below shows the control interfaces and the main circuit of the drive. For further information on the JCU Control Unit, see the chapter *Electrical installation*.





Operation

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

Component	Description
Braking chopper	Conducts the energy generated by a decelerating motor from the DC bus to a braking resistor. The braking chopper is built in the ACSM1-04Lx; braking resistors are external options.
Braking resistor	Dissipates the regenerative energy by converting it into heat.
Capacitor bank	Energy storage which stabilizes the intermediate circuit DC voltage.
Inverter	Converts the DC voltage to AC voltage and vice versa. The motor is controlled by switching the IGBTs of the inverter.
Rectifier	Converts the three-phase AC voltage to DC voltage.

Type code

The type code contains information on the specifications and configuration of the drive. The first digits from left express the basic configuration (e.g. ACSM1-04LS-175A-4). The optional selections are given thereafter, preceded by + signs (e.g. +L501). The main selections are described below. Not all selections are necessarily available for all types; refer to *ACSM1 Ordering Information*, available on request.

See also section *Delivery check and drive module identification* on page 35.

Selection	Alternatives	
Product series	ACSM1 product series	
Type (1)	04	Drive module. When no options are selected: IP20, no control panel, internal EMC filter, internal mains choke, braking chopper, coated boards, Safe Torque Off, Quick Guide (multilingual), latest firmware version, Drive SP programming
Type (2)	L	Liquid-cooled module
Type (3)	S	Speed and torque control firmware
	M	Motion control firmware
Size	Refer to *Technical data: Ratings.*	
Voltage range	4	380 V, **400 V** (nominal rating), 415 V, 440 V, 460 V or 480 V AC
+ options		
Fieldbus	K...	+K451: FDNA-01 DeviceNet adapter +K454: FPBA-01 PROFIBUS DP adapter +K457: FCAN-01 CANopen adapter +K466: FENA-02 Ethernet/IP adapter
I/O extensions and feedback interfaces	L...	+L500: FIO-11 analogue I/O extension +L501: FIO-01 digital I/O extension +L502: FEN-31 HTL encoder interface +L516: FEN-21 resolver interface +L517: FEN-01 TTL encoder interface +L518: FEN-11 absolute encoder interface
Memory unit configuration	N...	Solution functions and programs

Planning the cabinet assembly

What this chapter contains

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

Note: The installation examples in this manual are provided only to help the installer in designing the installation. **Note that the installation must, however, always be designed and made according to applicable local laws and regulations.** ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations.

Cabinet construction

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

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

Disposition of the devices

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

For layout examples, see section *Cooling arrangements* below.

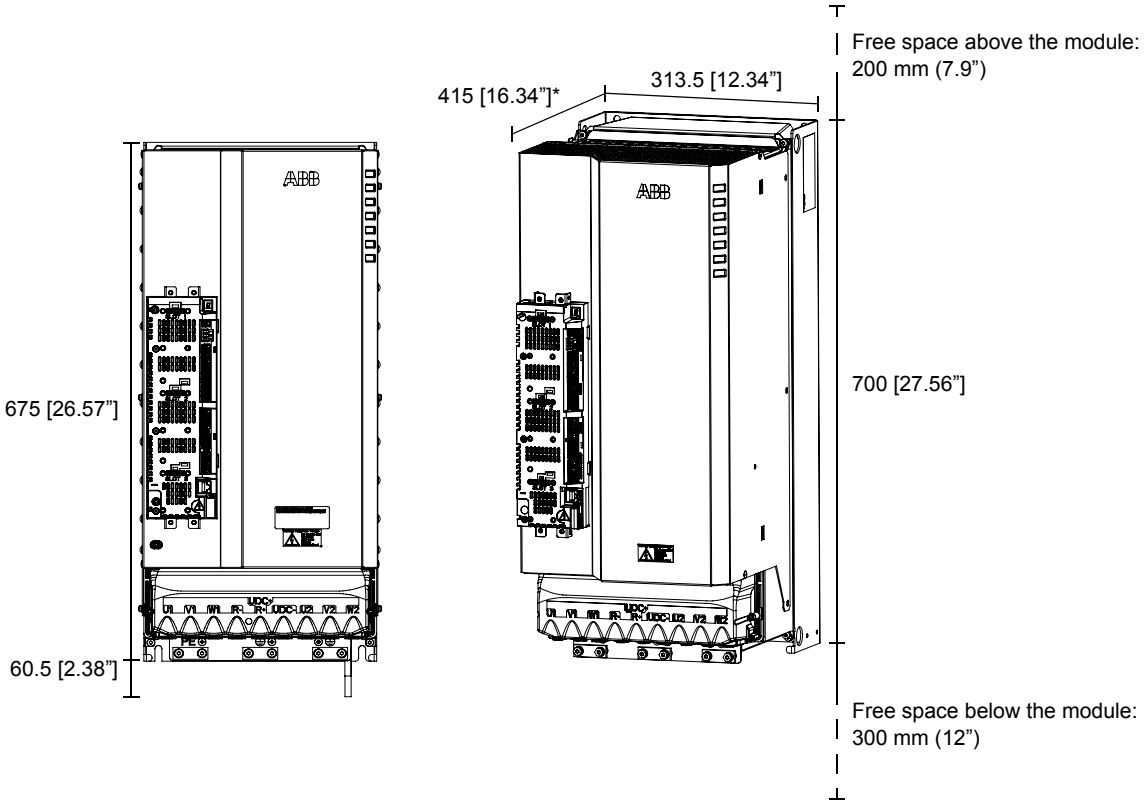
Grounding of mounting structures

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

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

Main dimensions and free space requirements

The modules can be installed side by side. The main dimensions of the drive modules as well as free space requirements are shown below. For more details, refer to the chapter *Dimension drawings*.



*Including options installed on the JCU Control Unit. Note that the wiring to some fieldbus adapters requires approximately 50 mm (2”) of additional depth.

Cooling arrangements

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

70–80% of the heat is absorbed by the liquid-cooled heatsink and 20–30% by air. See chapter *The internal cooling circuit* for information on cooling arrangements of the liquid cooling system. Two methods of arranging air cooling are described in this chapter: open cabinet and closed circulation cabinet equipped with a heat exchanger.

Ensure that coolant flow is adequate in the internal cooling circuit and the coolant inlet temperature is within allowed limits and the coolant meets the specifications given in *Internal cooling circuit specifications*.

Cooling and degrees of protection

The air inlets and outlets must be equipped with gratings that

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

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

- cooling air flow
- allowed ambient temperature.

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

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

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

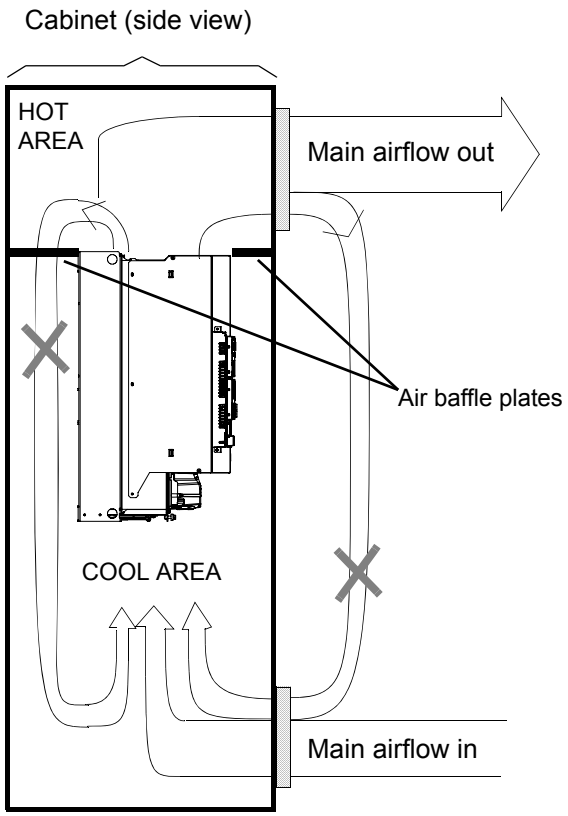
The installation site must be sufficiently ventilated.

Open cabinet

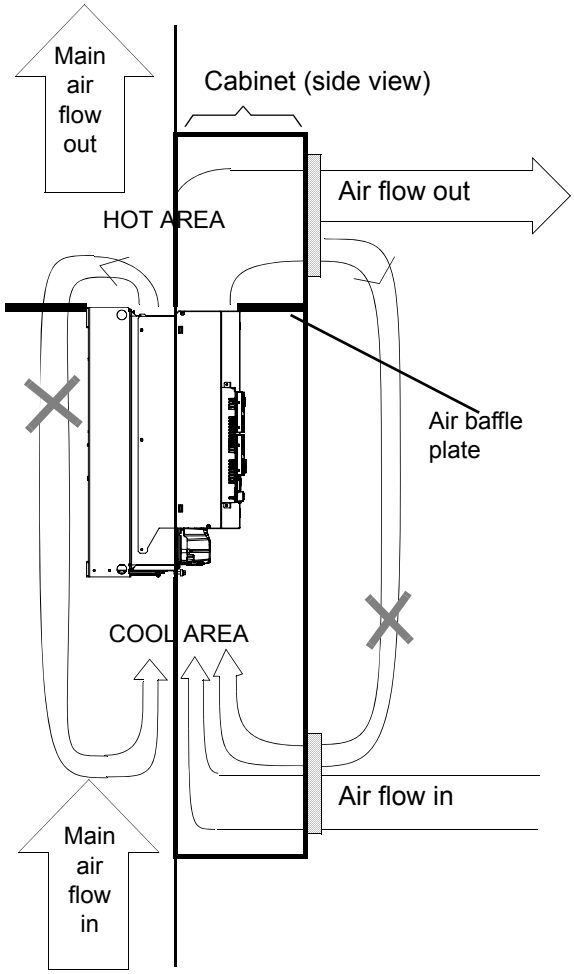
Air enters through the lower part of the cabinet and is then fanned out of the cabinet at the top. With an open cabinet, it is important to prevent the recirculation of hot air.

Preventing the recirculation of hot air

Typical vertical mounting



Push-through mounting



Outside the cabinet

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

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

Inside the cabinet

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

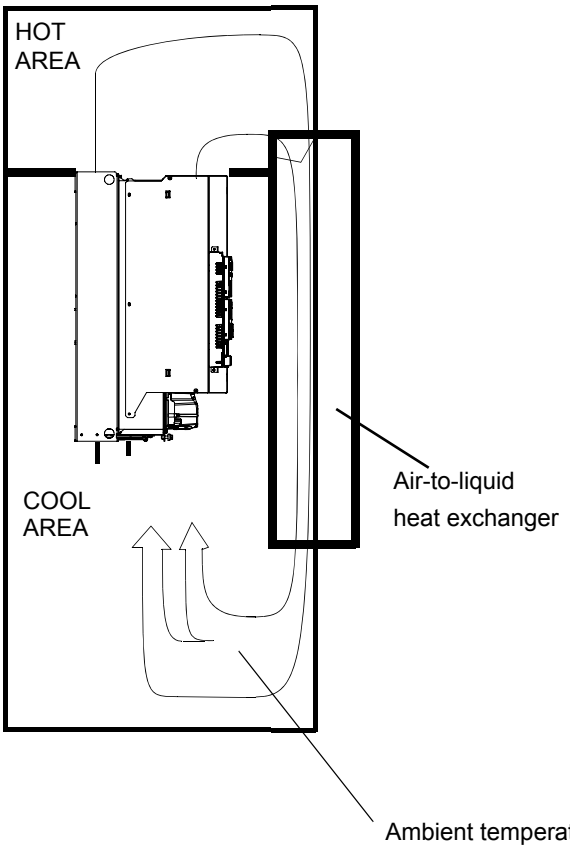
Heat exchanger, closed circulation cabinet

The ACSM1-04Lx drive module is installed in a closed cabinet without air vents. As some parts of the drive module are not directly liquid-cooled, module cooling fans circulate air inside the cabinet through an air-to-liquid or air-to-air heat exchanger. For purposes of selecting the heat exchanger and temperature limits (see *Ambient conditions*) in a closed cabinet, ambient temperature is effectively the temperature of the air after it exits the heat exchanger.

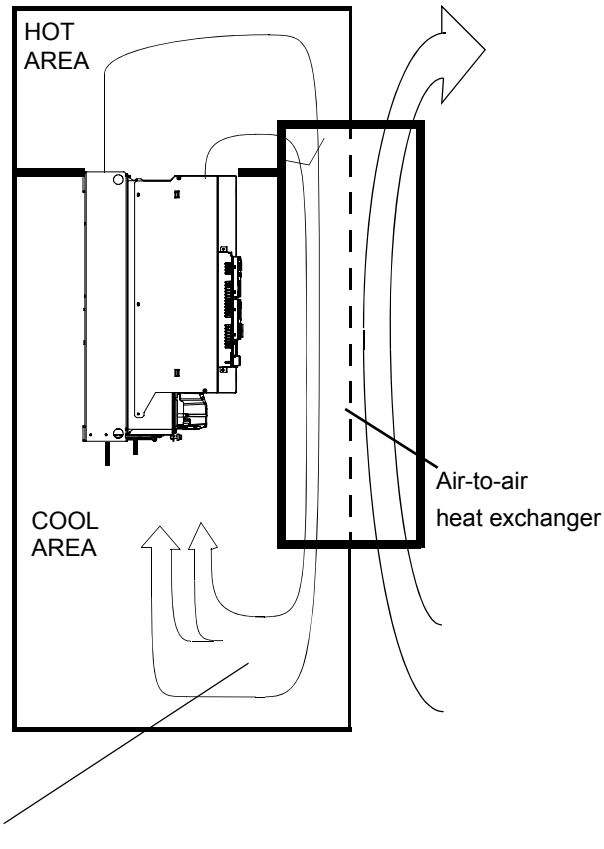
With an air-to liquid heat exchanger, the liquid circulation is first connected to the heat exchanger and then to the drive module. The coolant inlet and outlet are usually at the bottom of the heat exchanger and outside the cabinet. The coolant temperature increases approximately 1–2 °C. Ensure that the coolant is within allowed limits when entering the drive module; see *Derating* and *Temperature limits*).

In a cabinet with an air-to-air heat exchanger, the heat is transfered into cool air from outside the cabinet that is fanned through the heat exchanger and then blown out.

Air-to-liquid heat exchanger



Air-to-air heat exchanger



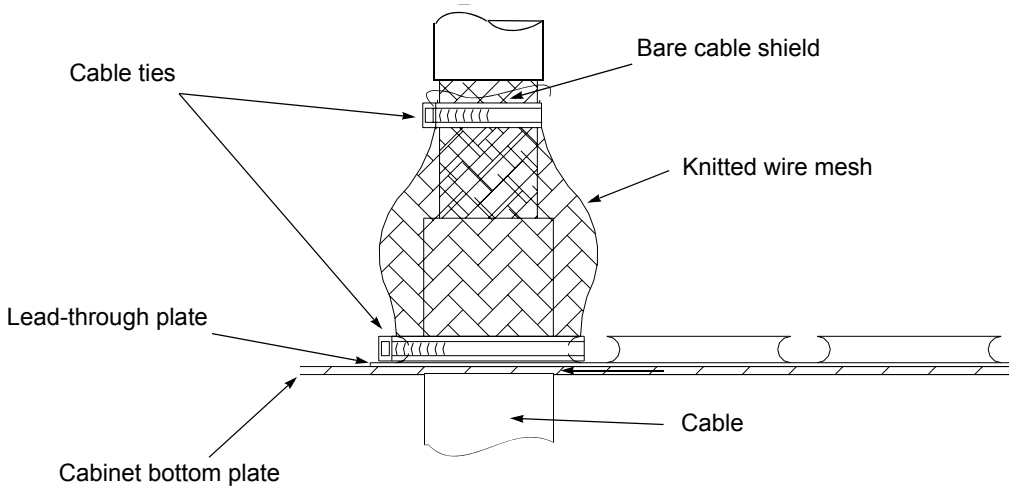
EMC requirements

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

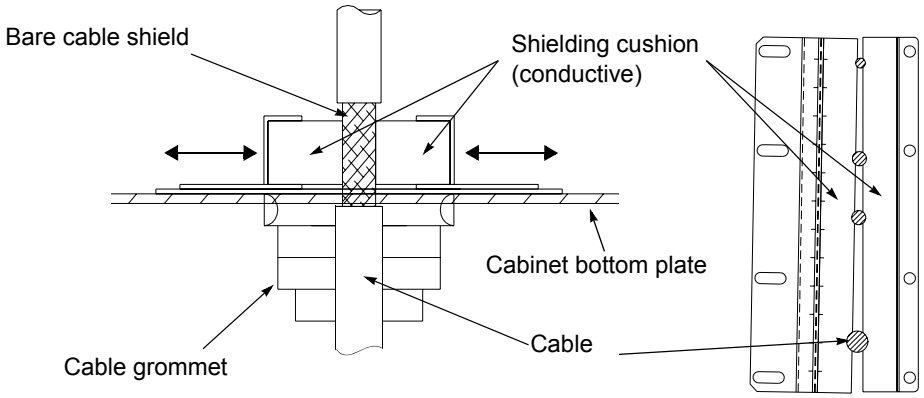
The best galvanic connection between the steel panels is achieved by welding them together as no holes are necessary. If welding is not possible, the seams between the panels **are recommended to be left unpainted** and equipped with special conductive EMC strips to provide adequate galvanic connection.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

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

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



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



Cabinet heaters

Use a cabinet heater if there is a risk of condensation in the cabinet. Use a cabinet heater only when the drive is in use.

Although the primary function of the heater is to keep the air dry, it may also be required for heating at low ambient temperatures. When placing the heater, follow the instructions provided by its manufacturer. See also *Internal cooling circuit specifications* for information on minimum coolant inlet temperature.

However, using a cabinet heater may also cause condensation if the ambient air temperature rises above the coolant temperature. Therefore, it is recommended that coolant circulation be stopped when the drive is not in use.

Mechanical installation

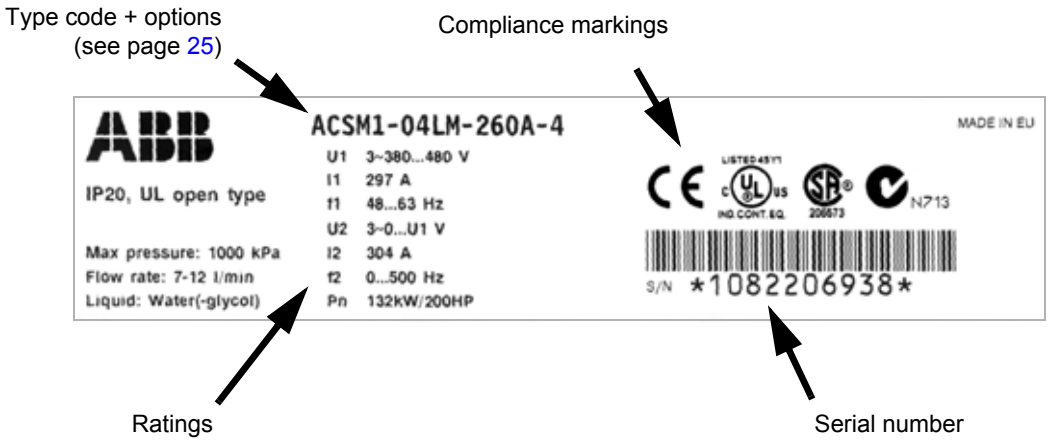
Contents of the package

The drive is delivered in a plywood box. The box contains:

- ACSM1-04Lx drive module, with factory-installed options
- one cable clamp plate for control cabling with screws
- screw-type terminal blocks to be attached to the headers on the JCU Control Unit
- two pipe connectors
- Quick Installation Guide.

Delivery check and drive module identification

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



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

Before installation

Check the installation site according to the requirements below. Refer to *Dimension drawings* for frame details.

Requirements for the installation site

See *Technical data* for the allowed operation conditions of the drive.

The mounting plate the drive is to be mounted on must be of non-flammable material and strong enough to carry the weight of the drive. The material below the drive must be non-flammable.

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

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

See page 57 for directions.

Installation procedure

Mounting onto a solid mounting plate

1. Mark the locations for the four holes. The mounting points are shown in *Dimension drawings*.
2. Fix the screws or bolts to the marked locations.
3. Position the drive onto the screws on the wall.

Note: Only lift the drive by its lifting holes.

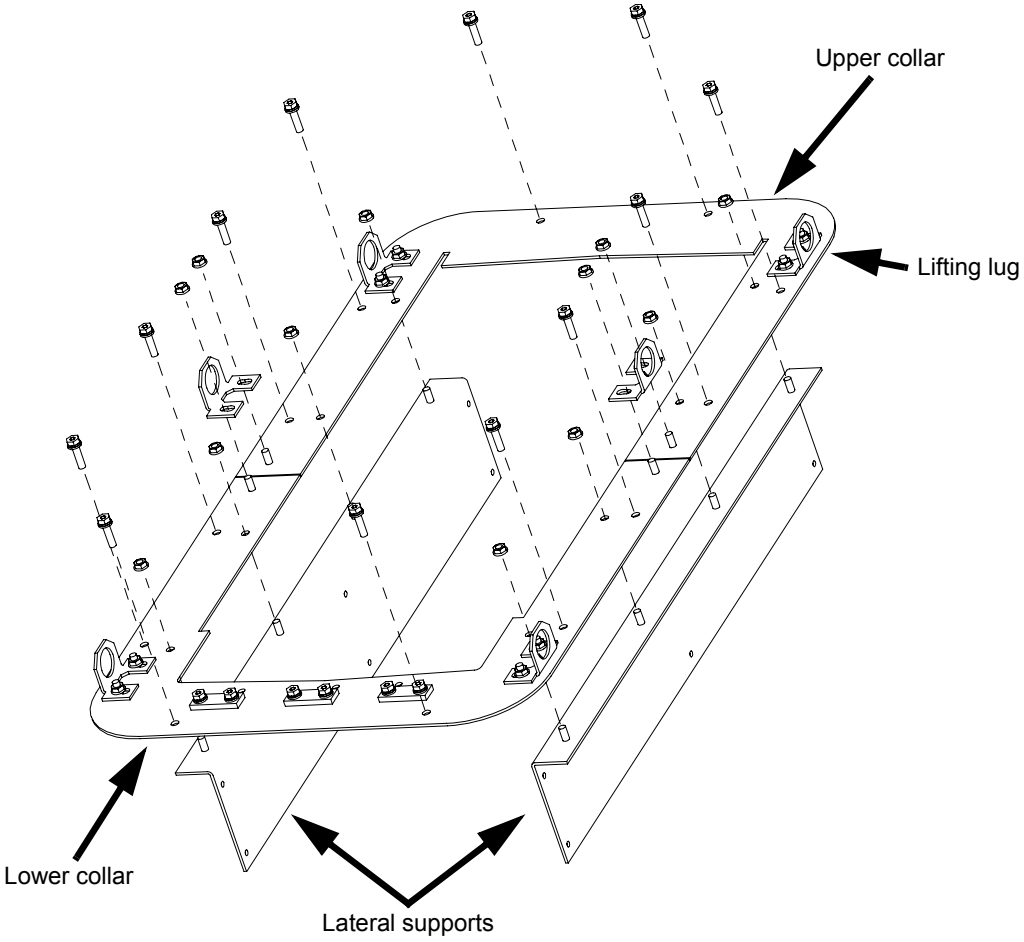
---

4. Tighten the screws.

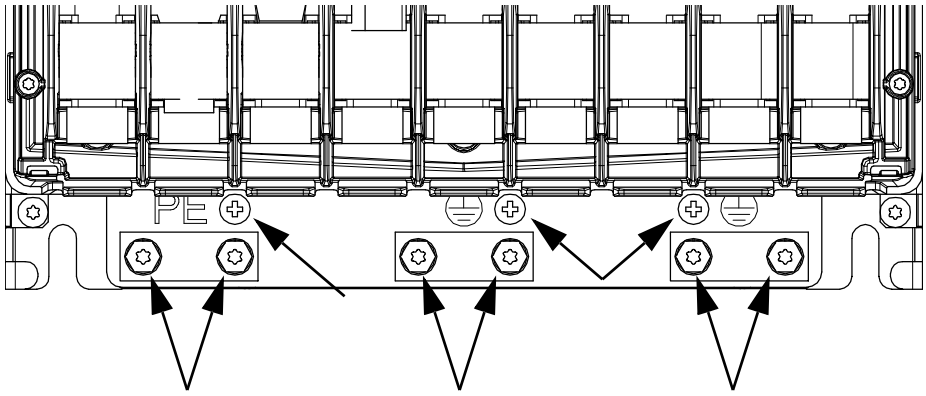
Push-through mounting

An installation kit is available for push-through mounting. The kit enables the installation of the drive module in the wall of a cooling air duct so that part of the module protrudes into the duct.

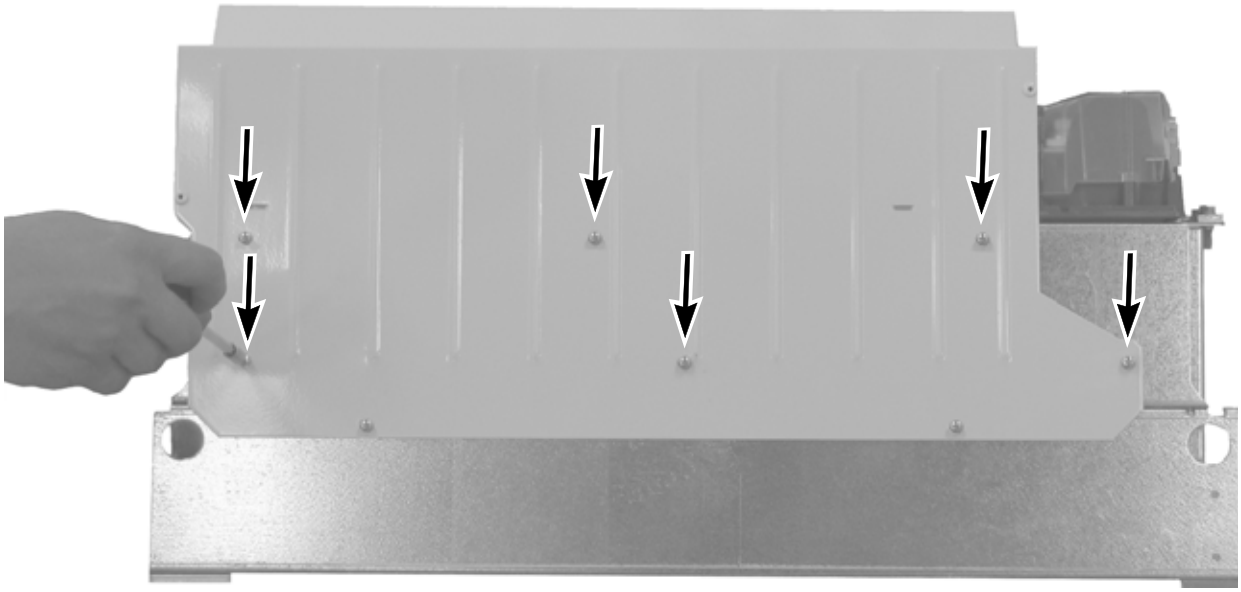
Keep the screws removed during the procedure – they will later be used to fasten the push-through mounting parts.



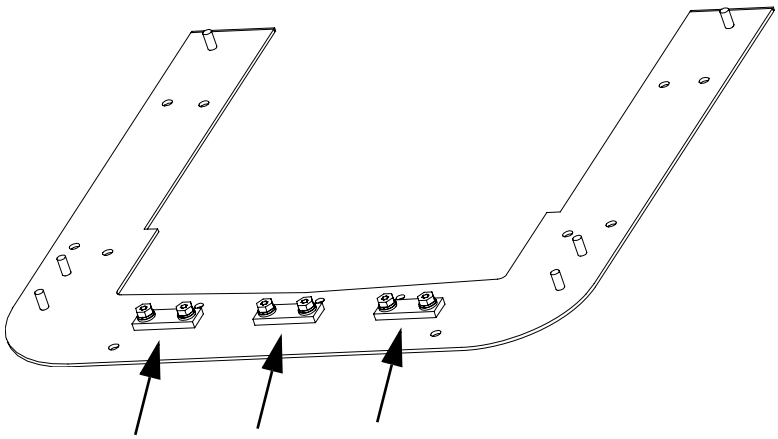
1. Place the drive module on its back on a level surface.
2. Remove the grounding terminals (3 × 2 screws) as well as the three screws nearby.



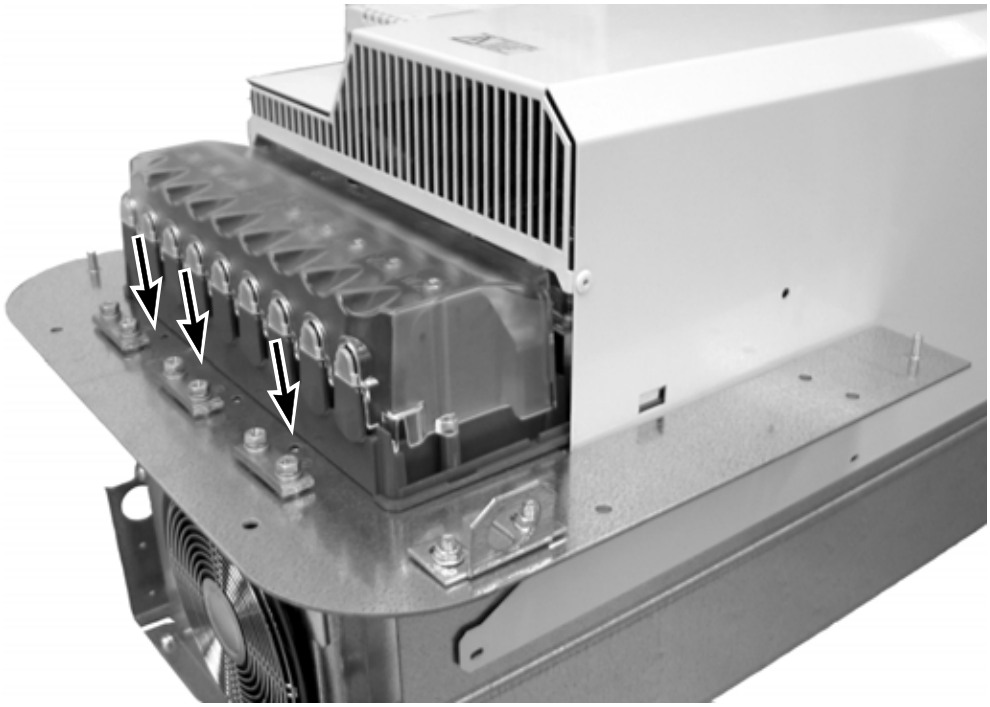
3. Remove the arrowed screws on each side of the module cover. (The middle row of screws is used later to attach the lateral supports of the mounting kit.)



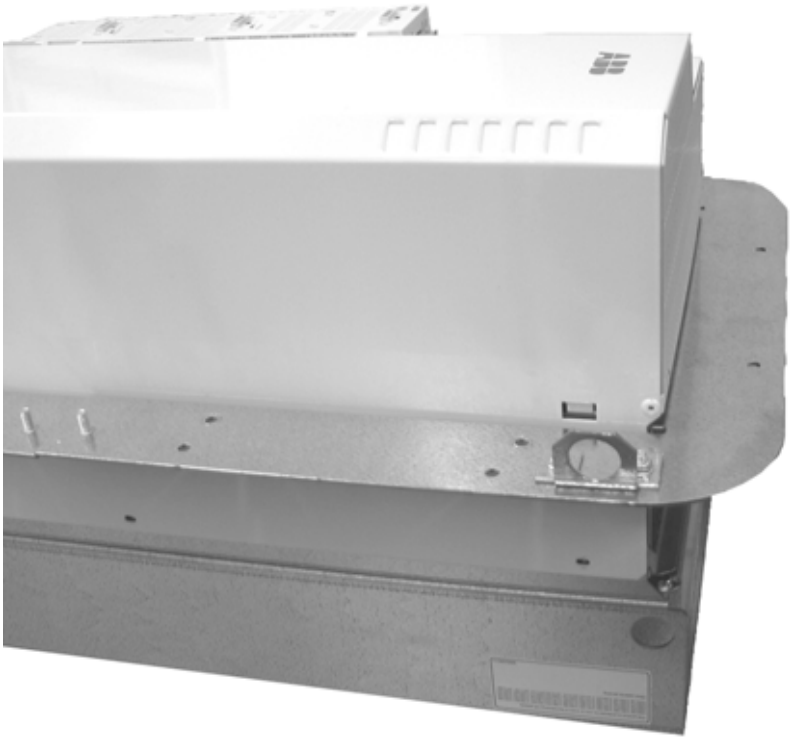
4. Attach the grounding terminals to the lower collar.



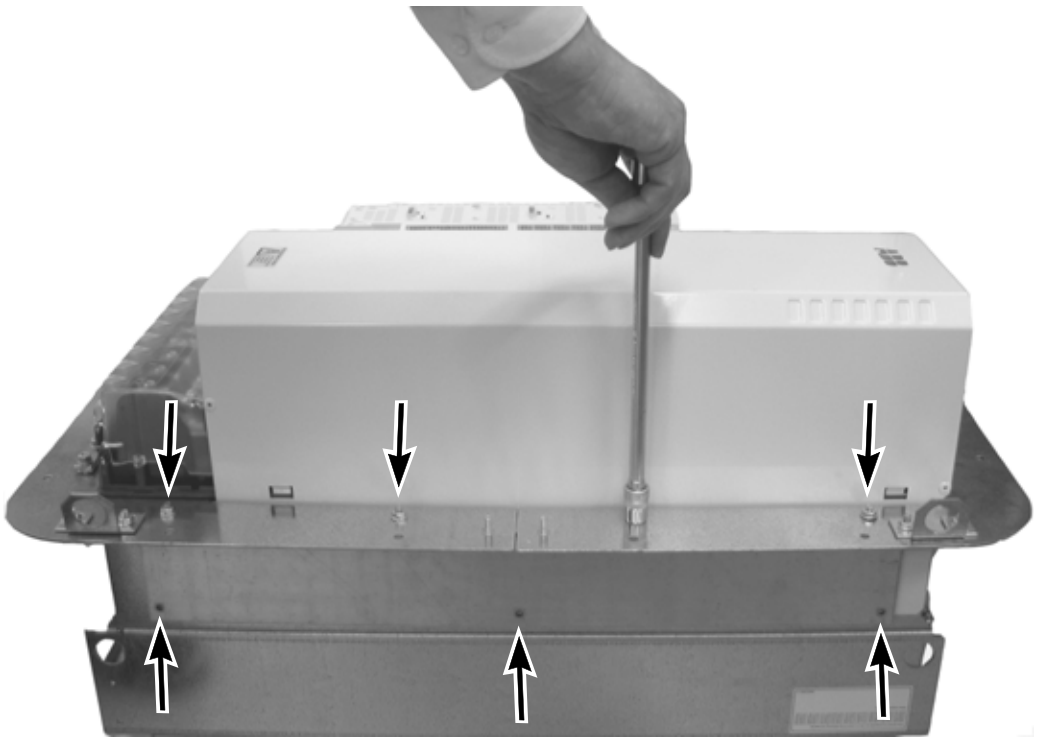
5. Slide the lower collar onto the drive module into the position shown. Fasten through the holes (arrowed) using the three screws removed at step 2.



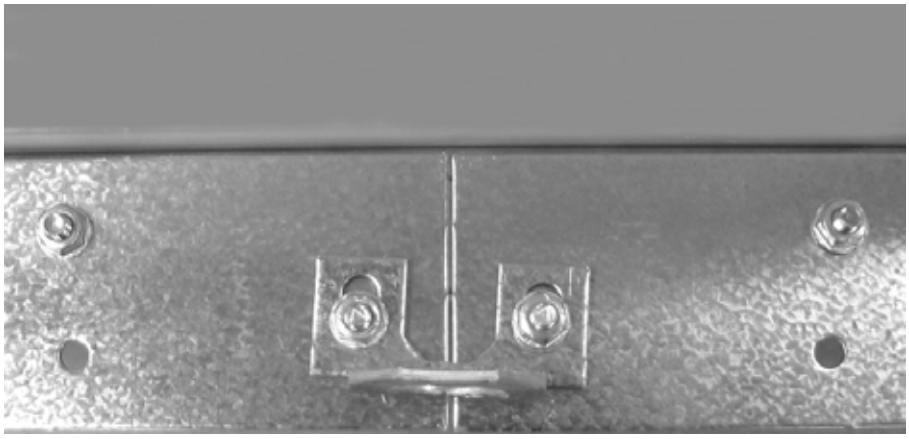
6. Slide the upper collar onto the drive module into the position shown.



7. Attach the lateral supports to the drive module and the collars. Each support is fastened to the collars by four nuts, and to the drive module by three (out of six) screws removed at step 3.



8. Join the collars by attaching lifting lugs on both sides. Attach further lifting lugs as needed.

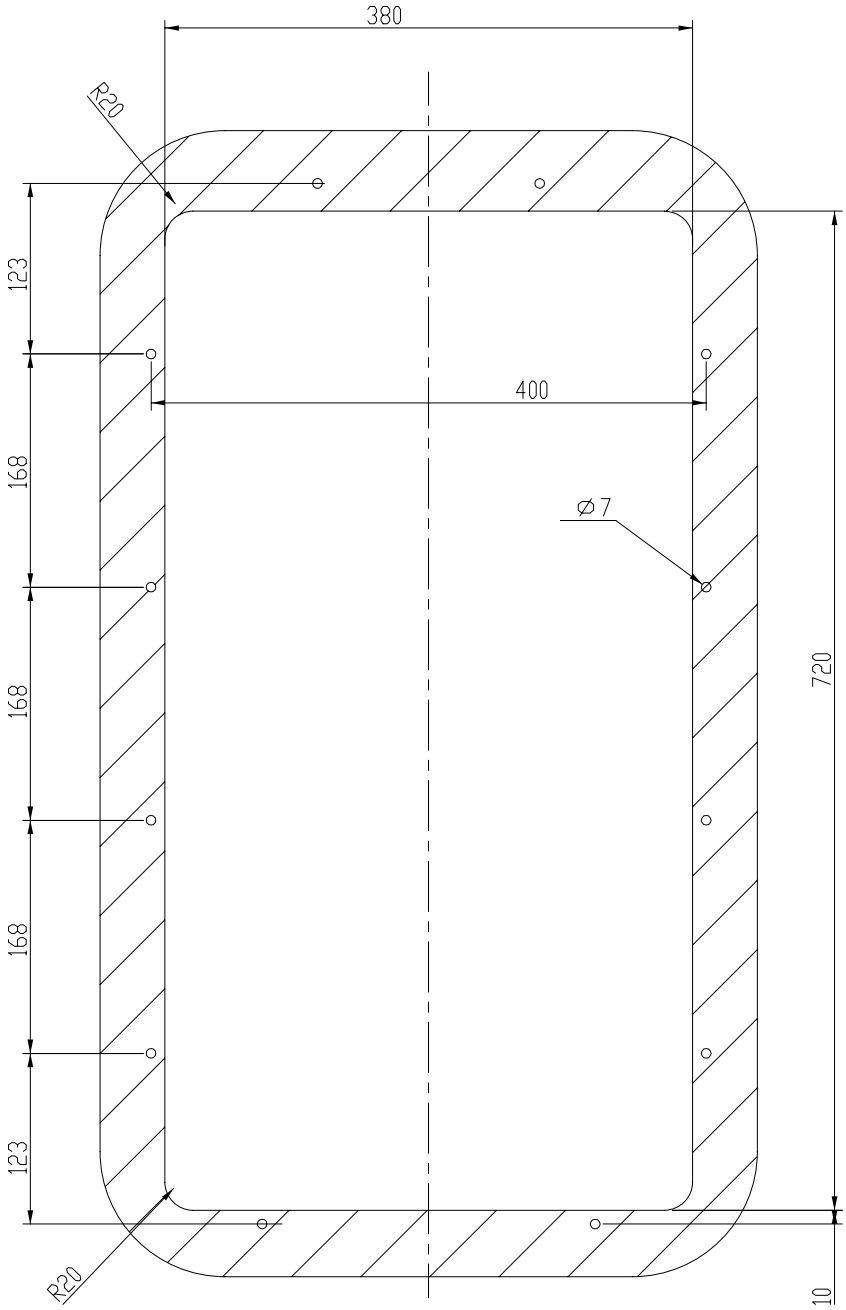


9. Use the measurements in the drawing below to cut the hole in the duct. Fasten the module to the edges using screws.

WARNING: With the kit attached to the drive module, do not lift the module by one lifting lug only. Always use at least two lifting lugs.

Note: The maximum allowed vibration for the drive has not been tested with push-through mounting. If the drive is exposed to vibration, it is recommended to fasten it also by the standard mounting holes.

Hole dimensions for push-through mounting

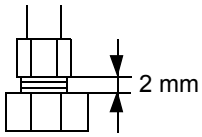


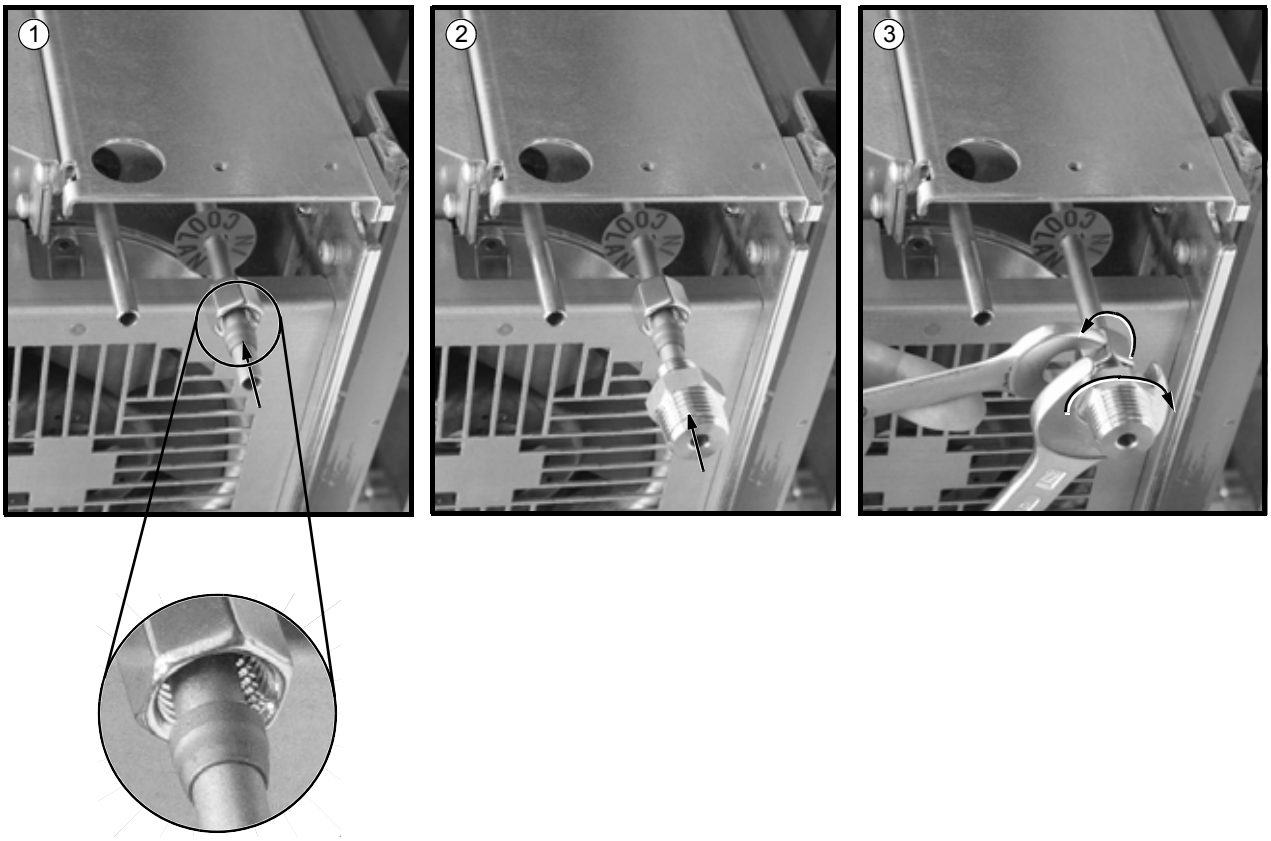
Braking resistor installation

See the chapter *Resistor braking* on page 99.

Installing pipe connectors

1. Slide the nut and the cutting ring onto the liquid inlet pipe marked as *coolant in*. Ensure that the ring's thicker end is towards the nut.
2. Place the union body of the connector to the end of the pipe.
3. Tighten the connection but leave 2 to 3 mm of thread visible. Overtightening may cause leaks.
4. Repeat the steps for the outlet pipe.





Planning the electrical installation

What this chapter contains

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

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

Motor selection and compatibility

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

Protecting the motor insulation and bearings

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

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

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

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

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

Permanent magnet synchronous motors

Only one permanent magnet synchronous motor can be connected to the inverter output. It is recommended to install a safety switch between the permanent magnet motor and the drive output in order to isolate the motor from the drive during maintenance work on the drive.

Supply connection

Use a fixed connection to the AC power line.

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

Supply disconnecting device

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

Europe

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

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

Other regions

The disconnecting means must conform to the applicable safety regulations.

Thermal overload and short circuit protection

Thermal overload protection

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

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

Protection against short circuit in motor cable

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

Protection against short circuit in the supply cable or the drive

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

Operating time of the fuses and circuit breakers

Check that the operating time of the fuse is below 0.1 seconds. The operating time depends on the type, the supply network impedance, and the cross-sectional area, material and length of the supply cable. US fuses must be of the “non-time delay” type.

Circuit breakers

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

Motor thermal protection

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

The ACSM1-04 has a dedicated connection for PTC or KTY84 sensors. See page 67 in this manual, and the appropriate *Firmware Manual* for the parameter settings concerning motor thermal protection.

Ground fault protection

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

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

Emergency stop devices

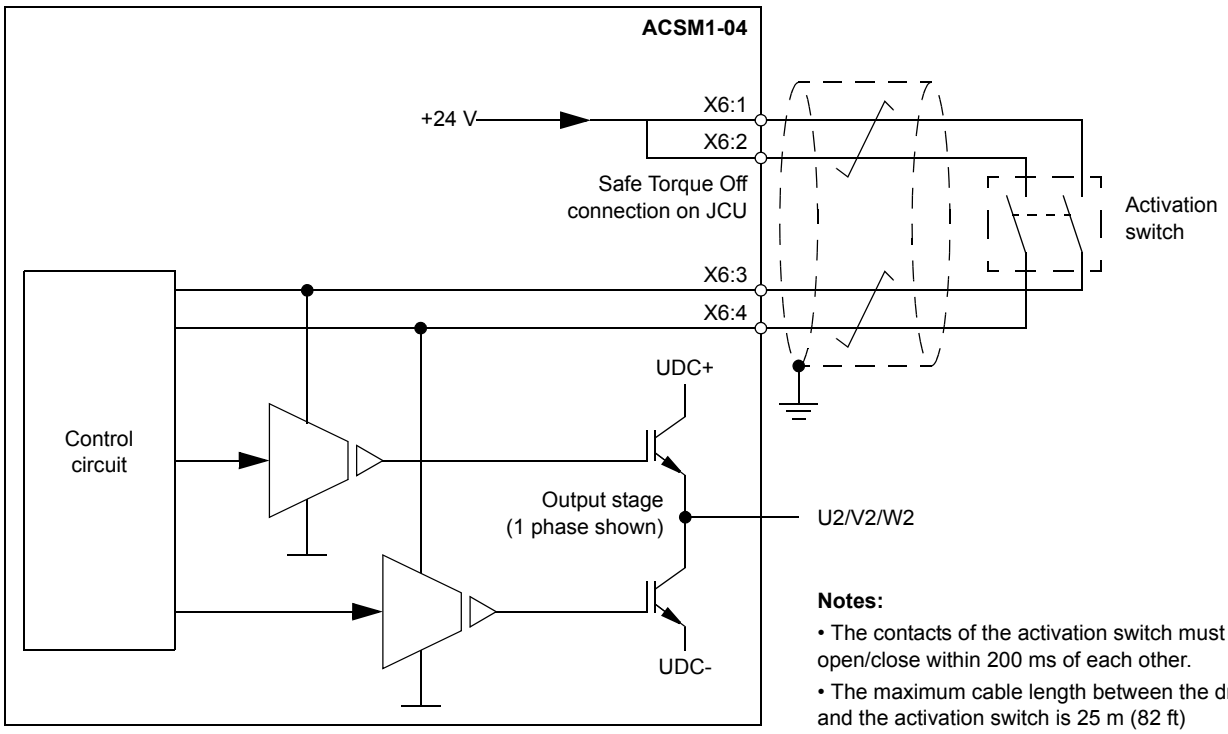
For safety reasons, install the emergency stop devices at each operator control station and at other operating stations where emergency stop may be needed.

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

Safe Torque Off

The drive supports the Safe Torque Off (STO) function according to standards EN 61800-5-2; EN 954-1: 1997; EN/ISO 13849-1: 2006, IEC/EN 60204-1: 1997; EN 61508: 2002, EN 1037: 1996, and IEC 62061:2005. The function also corresponds to an uncontrolled stop in accordance with category 0 of IEC 60204-1.

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



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

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

For further information on the function, refer to *Safe Torque Off Function, Application Guide* (3AFE68929814 [English]).

Selecting the power cables

General rules

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

- The cable must be able to carry the drive load current. See the chapter *Technical data* for the rated currents.
- The cable must be rated for at least 70 °C (US: 75 °C [167 °F]) maximum permissible temperature of conductor in continuous use.
- The conductivity of the PE conductor must be equal to that of a phase conductor (ie. same cross-sectional area).
- 600 V AC cable is accepted for up to 500 V AC.
- Refer to the chapter *Technical data* for EMC requirements.

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

A four-conductor system is allowed for input cabling, but shielded symmetrical cable is recommended. Compared to a four-conductor system, the use of symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as motor bearing currents and wear.

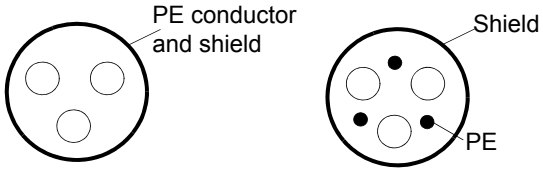
The motor cable and its PE pigtail (twisted shield) should be kept as short as possible in order to reduce electromagnetic emission.

Alternative power cable types

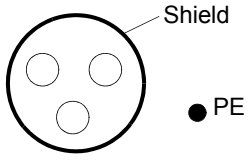
Power cable types that can be used with the drive are represented below.

Motor cable
(also recommended for supply cabling)

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

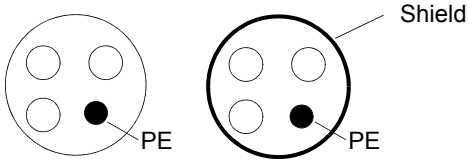


Note: A separate PE conductor is required if the conductivity of the cable shield is not sufficient for the purpose.



Allowed for supply cabling

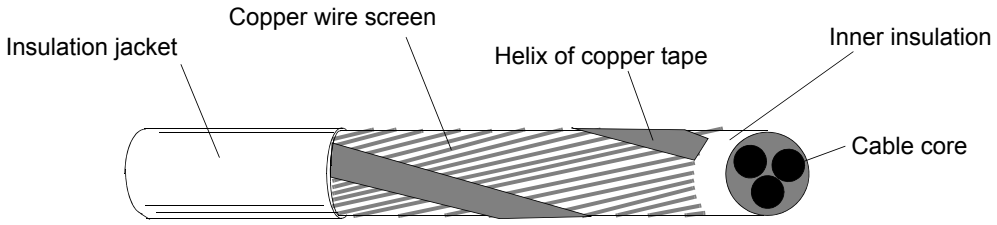
A four-conductor system: three phase conductors and a protective conductor.



Motor cable shield

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

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

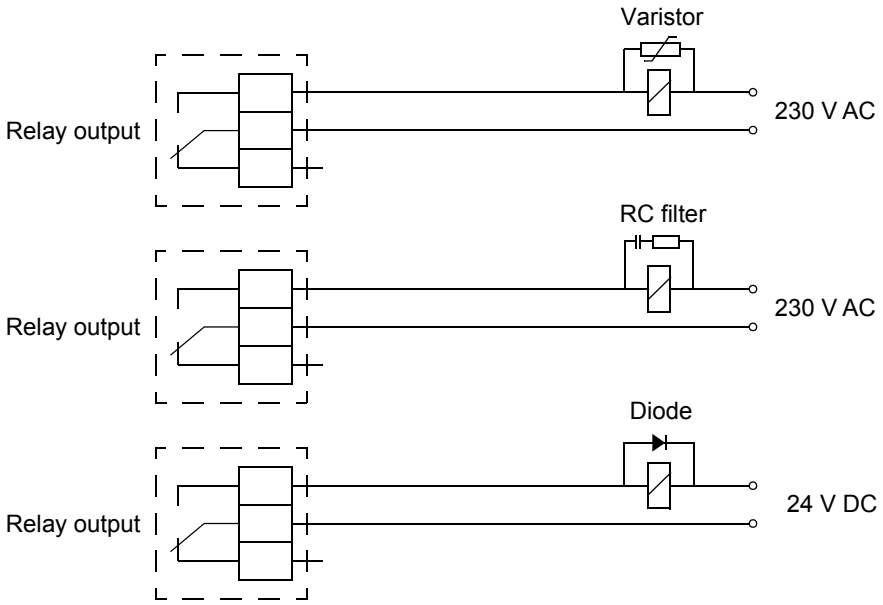


Protecting the relay output contacts and attenuating disturbances in case of inductive loads

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

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

Install the protective component as close to the inductive load as possible, not at the relay output.



Residual current device (RCD) compatibility

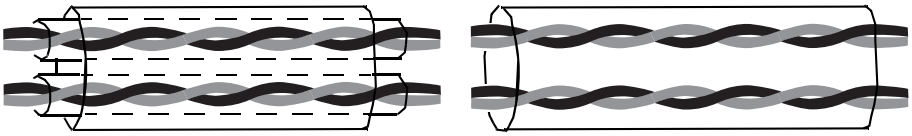
ACSM1-04 drives are suitable to be used with residual current devices of Type B. Other measures for protection in case of direct or indirect contact, such as separation from the environment by double or reinforced insulation or isolation from the supply system by a transformer, can also be applied.

Selecting the control cables

It is recommended that all control cables be shielded.

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

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



a
Double-shielded twisted pair cable

b
Single-shielded twisted multipair cable

Run analogue and digital signals in separate cables.

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

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

Relay cable

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

Control panel cable

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

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

See Thermistor input (X4:8…9) on page 67.

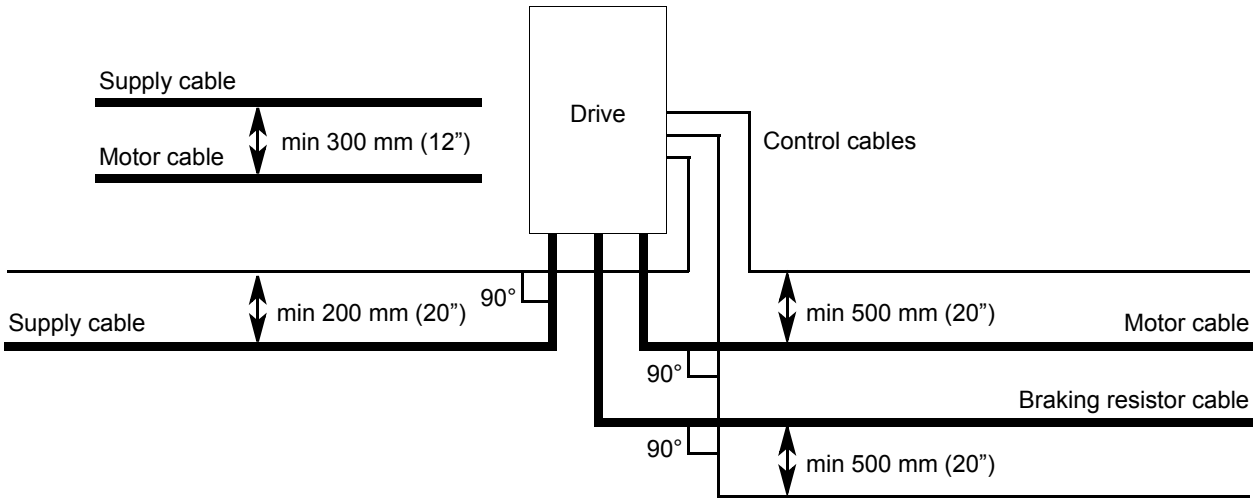
Routing the cables

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

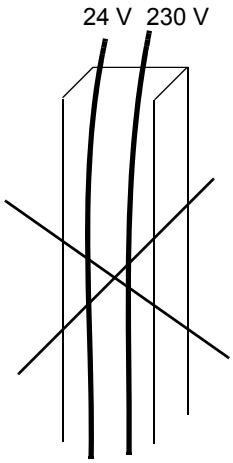
Where control cables must cross power cables make sure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the drive.

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

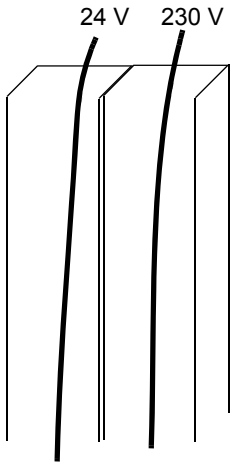
A diagram of the cable routing is below.



Control cable ducts



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



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

Electrical installation

What this chapter contains

This chapter describes the electrical installation procedure of the drive.

WARNING! The work described in this chapter may only be carried out by a qualified electrician. Follow the *Safety instructions* on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

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

Checking the insulation of the assembly

Drive

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

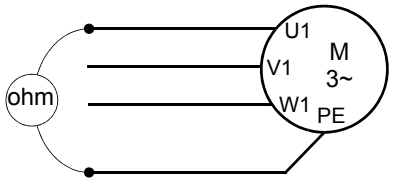
Supply cable

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

Motor and motor cable

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

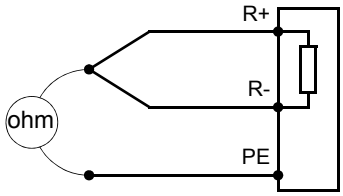
1. Check that the motor cable is connected to the motor, and disconnected from the drive output terminals U2, V2 and W2.
2. Measure the insulation resistance between each phase conductor and the Protective Earth conductor using a measuring voltage of 500 V DC. The insulation resistance of an ABB motor must exceed 10 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, please consult the manufacturer's instructions. **Note:** Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.



Braking resistor assembly

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

1. Check that the resistor cable is connected to the resistor, and disconnected from the drive output terminals R+ and R-.
2. At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



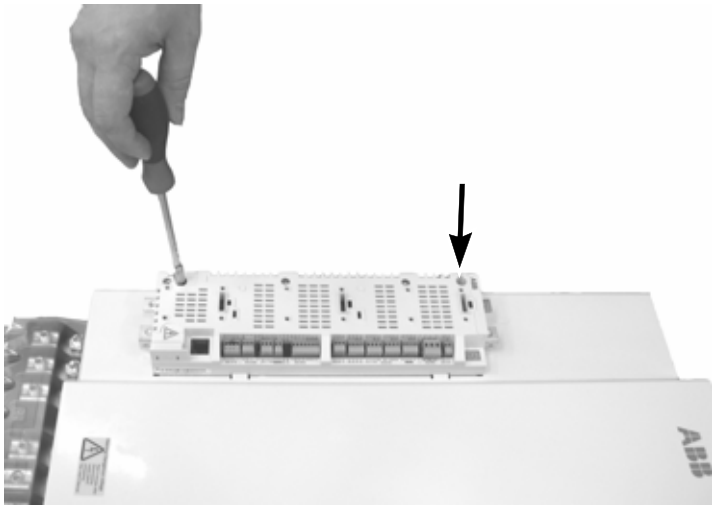
Connection to an IT (ungrounded) power system

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

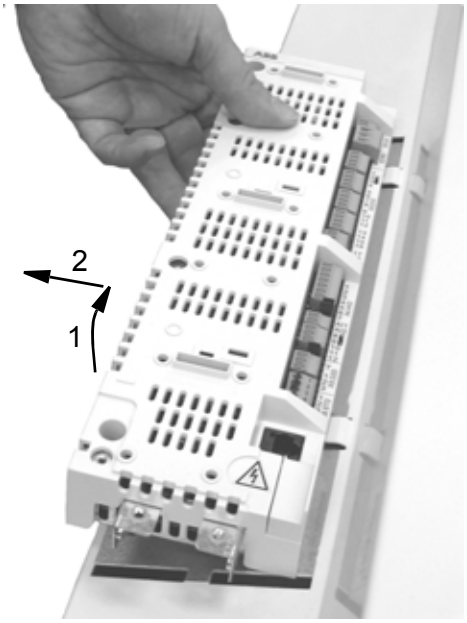
If a drive with its internal EMC filtering connected is installed on an IT system or a corner-grounded system, the drive system will be connected to earth potential through the EMC filter capacitors of the drive. This may cause danger or damage the unit.

Disconnection of internal EMC filtering

1. Place the drive module on its back on a level surface.
2. Release the two screws holding the JCU control unit.

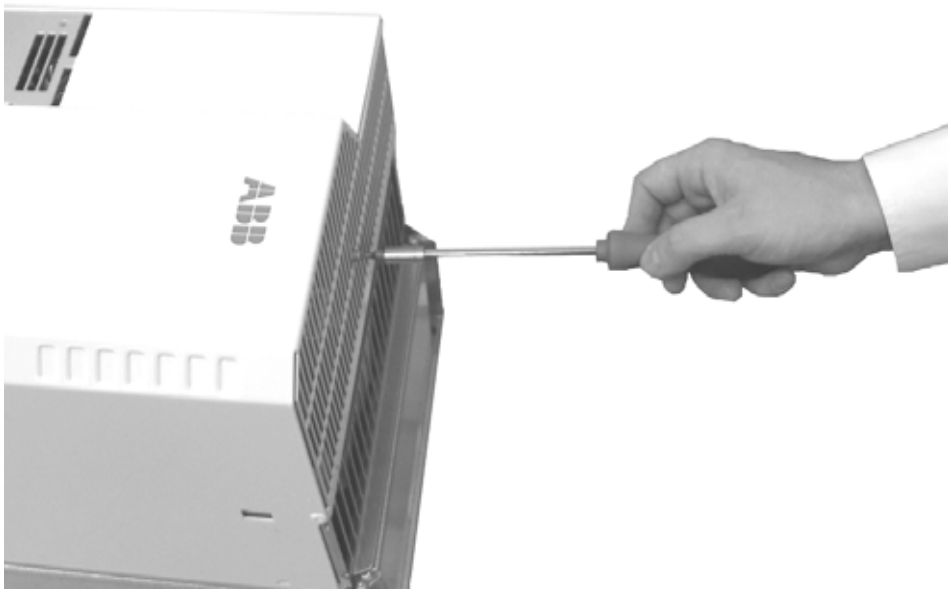


3. Lift the left-hand edge of the JCU control unit until the connector beneath disengages, then move JCU to the left to remove it.

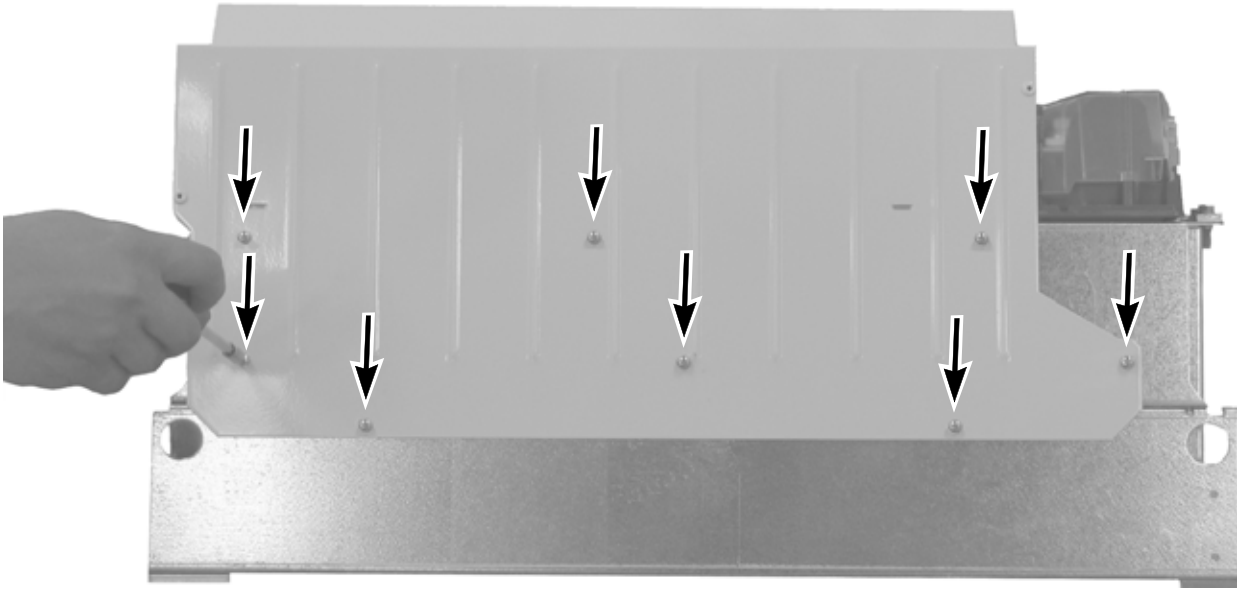


4. Disconnect the two cables coming to the mounting base of the JCU.

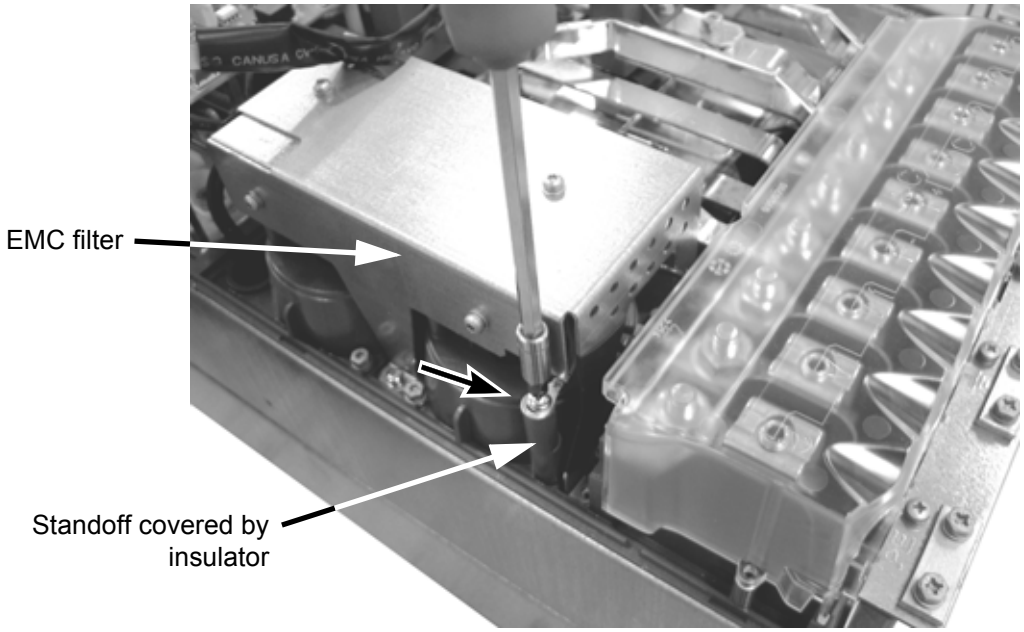
5. Remove the screw in the middle of the air outlet grating.



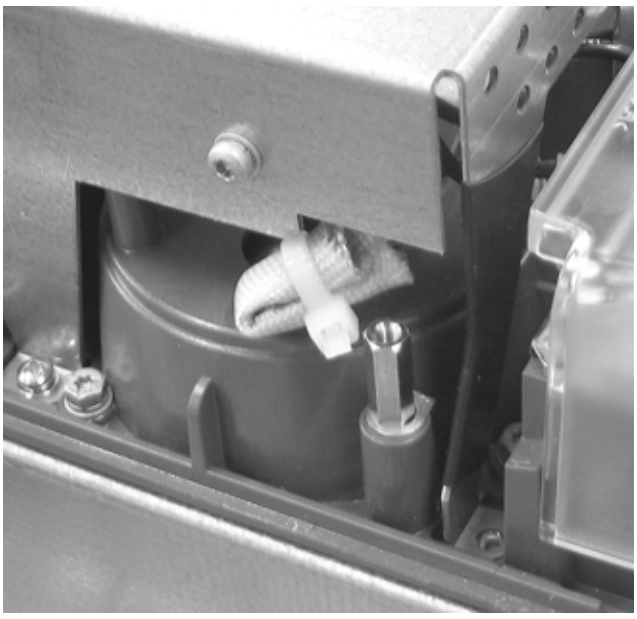
6. Remove the screws holding the drive module cover (8 on each side). Lift off the cover, bottom edge first.



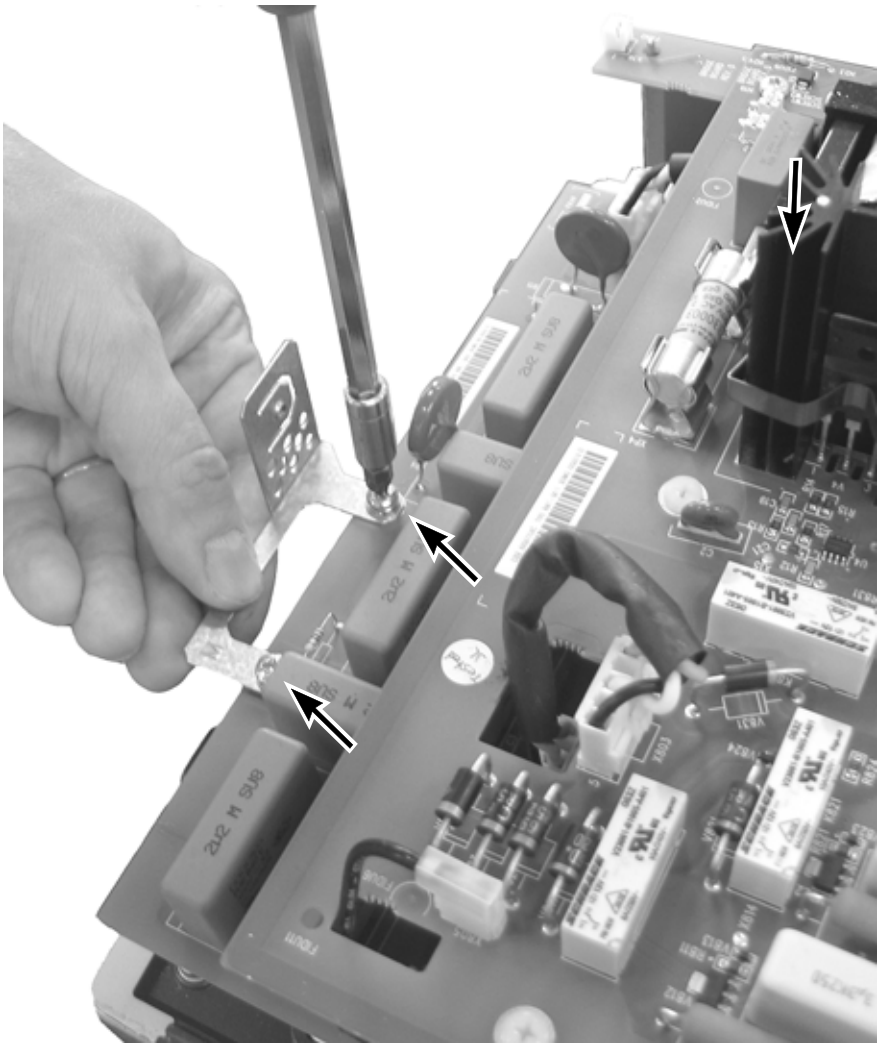
7. Undo the screw connecting the grounding wire to a standoff right next to the EMC filter. Cut off the lug. Discard the screw and the tubular insulator.



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



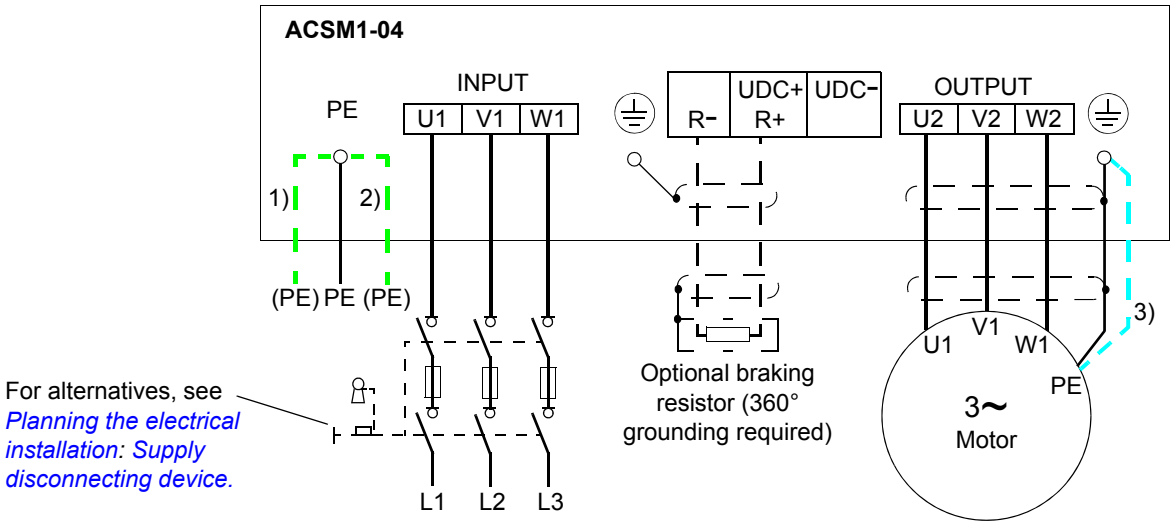
9. Near the top of the module, remove the grounding clip (held by two screws) that connects the varistor board to the module cover.



10. Refit the module cover (top edge first) and fasten using the screws removed at step 6. (The screw in the middle of the air outlet grating that was removed at step 5 is no longer needed.)
11. Reconnect the cables that were disconnected at step 4.
12. Refit the JCU control unit.

Power cable connection

Power cable connection diagram



Notes:

– If shielded supply (input) cable is used, and the conductivity of the shield is less than 50% of the conductivity of a phase conductor, use a cable with a ground conductor (1) or a separate PE cable (2). With shielded cable, 360° grounding at cable entry is recommended.

– For motor cabling, use a separate ground cable (3) if the conductivity of the cable shield is less than 50% of the conductivity of a phase conductor and the cable has no symmetrical ground conductors. See also section *Selecting the power cables* on page 50.
If there is a symmetrically-constructed ground conductor in the motor cable in addition to the conductive shield, connect it to the ground connectors at both the drive and motor ends. Do not use an asymmetrically-constructed motor cable.

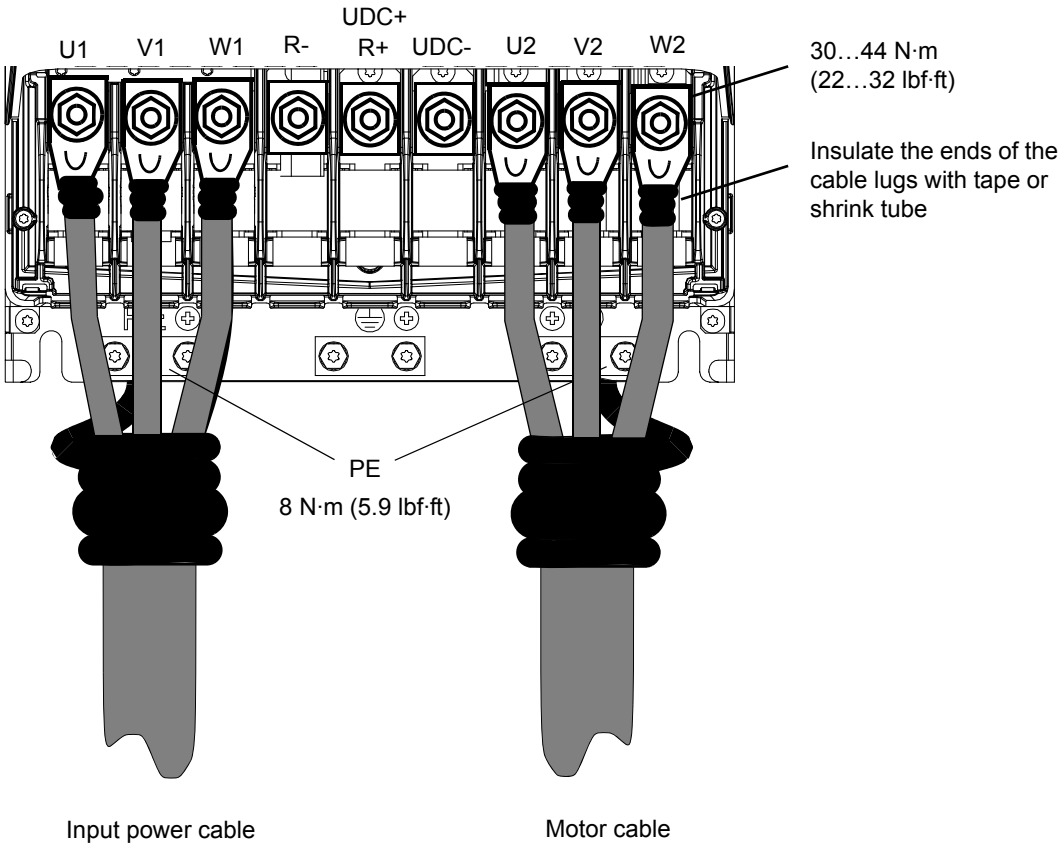
Procedure

Follow the procedure below to connect the cables. See the following pages for drawings detailing the installation and the correct tightening torques.

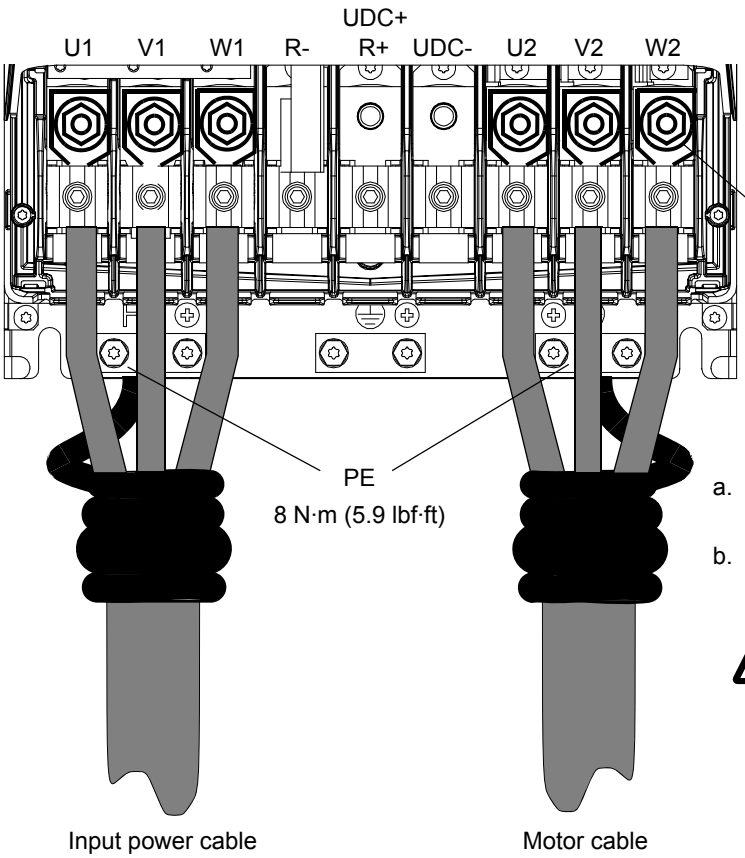
1. Remove the plastic shroud covering the main terminals. Remove the two screws at the sides, then release the two clips on the front edge as shown.

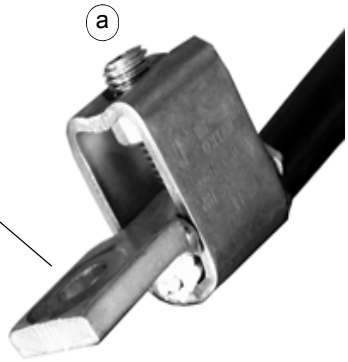
2. Connect the twisted shields of the power cables to the grounding terminals of the drive module.
3. Connect the phase conductors of the supply cable to the U1, V1 and W1 terminals, and the phase conductors of the motor cable to the U2, V2 and W2 terminals. The recommended stripping length is 28 mm (1.1”).
4. Secure the cables mechanically outside the drive module.
5. Cut suitable slots on the edge of the plastic shroud to accommodate the power cables. Refit the shroud.
6. Ground the other end of the supply cable shield or PE conductor at the distribution board.

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



Screw terminal installation (95 to 240 mm^2 [AWG3/0 to AWGG500] cables)





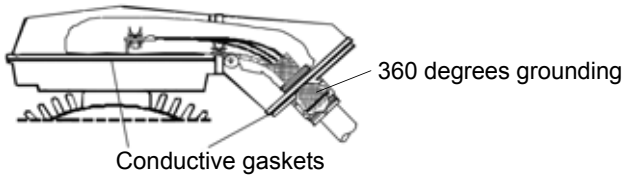
a. Connect the cable to the terminal. Tighten the Allen screw to 20…40 N·m (15…30 lbf·ft).

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

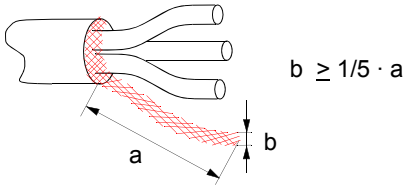
WARNING! If the wire size is less than 95 mm^2 (3/0 AWG), a crimp lug must be used. A cable of wire size less than 95 mm^2 (3/0 AWG) connected to this terminal will loosen and may damage the drive.

Grounding the motor cable shield at the motor end

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



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



Connecting the control cables

Control connections to the JCU Control Unit

Notes:

[Default setting]

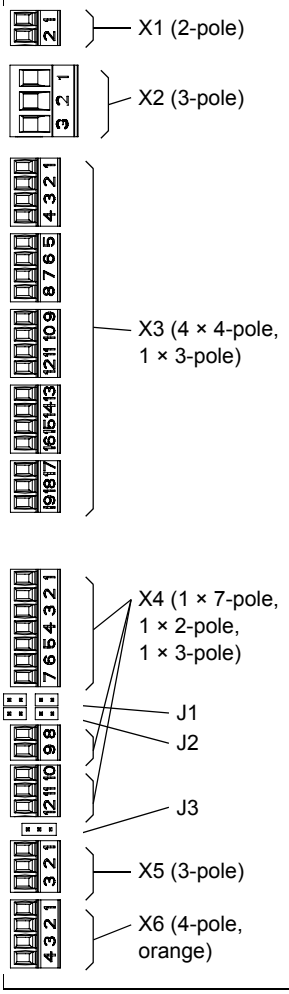
*Total maximum current: 200 mA
**Default assignment with ACSM1 Motion Control Program

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

Wire sizes and tightening torques:

X2: 0.5 … 2.5 mm^2 (24…12 AWG).
Torque: 0.5 N·m (5 lbf·in)
X3, X4, X5, X6:
0.5 … 1.5 mm^2 (28…14 AWG).
Torque: 0.3 N·m (3 lbf·in)

Order of terminal headers and jumpers

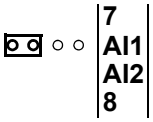


		X1
External power input 24 V DC, 1.6 A	+24VI	1
	GND	2
		X2
Relay output 250 V AC / 30 V DC 2 A	NO	1
	COM	2
	NC	3
		X3
+24 V DC*	+24VD	1
Digital I/O ground	DGND	2
Digital input 1 [Stop/Start]	DI1	3
Digital input 2 [EXT1/EXT2]	DI2	4
+24 V DC*	+24VD	5
Digital I/O ground	DGND	6
Digital input 3 [Fault reset]	DI3	7
Digital input 4 [Positioning start]**	DI4	8
+24 V DC*	+24VD	9
Digital I/O ground	DGND	10
Digital input 5 [Position ref. set 1/2]**	DI5	11
Digital input 6 [Homing start]**	DI6	12
+24 V DC*	+24VD	13
Digital I/O ground	DGND	14
Digital input/output 1 [Ready]	DIO1	15
Digital input/output 2 [Running]	DIO2	16
+24 V DC*	+24VD	17
Digital I/O ground	DGND	18
Digital input/output 3 [Fault]	DIO3	19
		X4
Reference voltage (+)	+VREF	1
Reference voltage (–)	-VREF	2
Ground	AGND	3
Analogue input 1 (Current or voltage, selectable by jumper J1) [Speed reference]	AI1+	4
	AI1-	5
Analogue input 2 (Current or voltage, selectable by jumper J2) [Torque reference]	AI2+	6
	AI2-	7
AI1 current/voltage selection		J1
AI2 current/voltage selection		J2
Thermistor input	TH	8
Ground	AGND	9
Analogue output 1 (current) [Output current]	AO1 (I)	10
Analogue output 2 (voltage) [Actual speed]	AO2 (U)	11
Ground	AGND	12
		X5
Drive-to-drive link termination		J3
Drive-to-drive link.	B	1
	A	2
	BGND	3
		X6
Safe Torque Off. Both circuits must be closed for the drive to start.	OUT1	1
	OUT2	2
	IN1	3
	IN2	4
Control panel connection		**X7**
Memory unit connection		**X205**

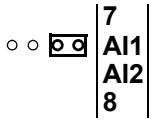
Jumpers

J1 – Determines whether Analogue input AI1 is used as a current or voltage input.

Current

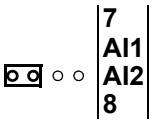


Voltage

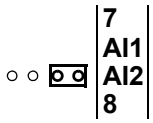


J2 – Determines whether Analogue input AI2 is used as a current or voltage input.

Current

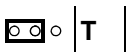


Voltage



J3 – Drive-to-drive link termination. Must be set to the ON position when the drive is the last unit on the link.

Termination ON



Termination OFF

External power supply for the JCU Control Unit (X1)

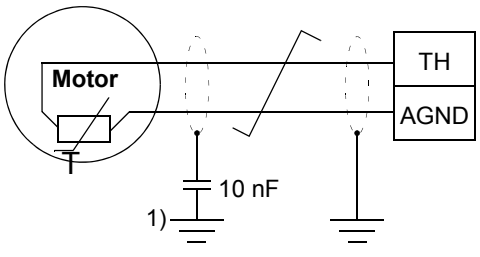
External +24 V (minimum 1.6 A) power supply for the JCU Control Unit can be connected to terminal block X1. Using an external supply is recommended if

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

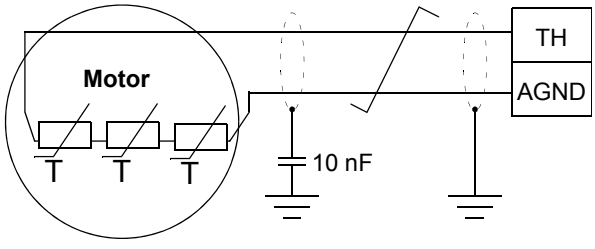
Thermistor input (X4:8…9)

Motor temperature can be measured using PTC or KTY84 sensors connected to the thermistor input.

One PTC or KTY84 sensor



Three PTC sensors



1) Use capacitor or leave unconnected.

WARNING! As the thermistor input on the JCU Control Unit is not insulated according to IEC 60664, the connection of the motor temperature sensor requires

double or reinforced insulation between motor live parts and the sensor. If the assembly does not fulfil the requirement,

- 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.

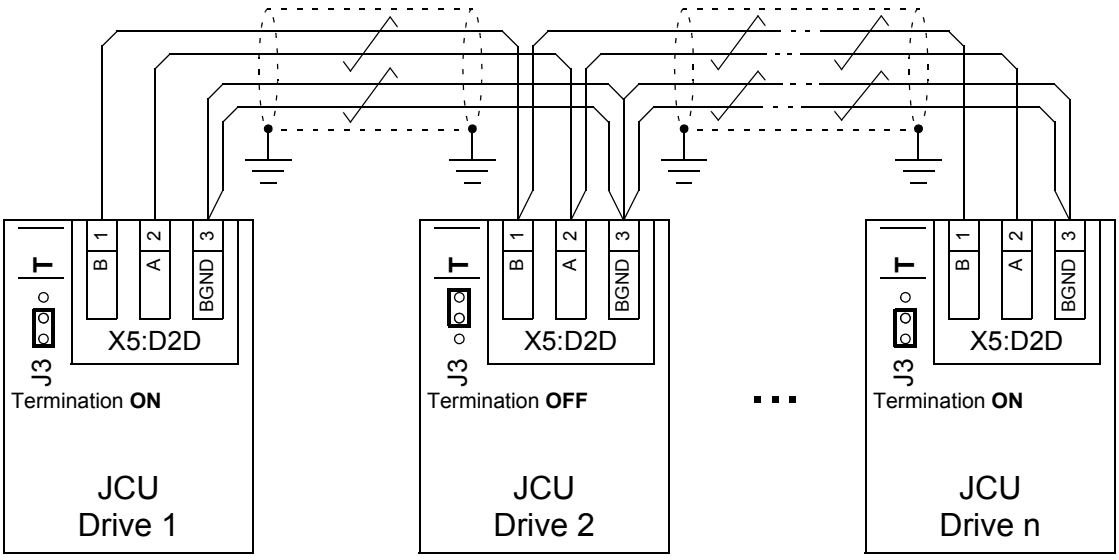
Drive-to-drive link (X5)

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

Termination activation jumper J3 (see section *Jumpers* above) next to this terminal block must be set to the ON position on the drives at the ends of the drive-to-drive link. On intermediate drives, the jumper must be set to the OFF position.

Shielded twisted-pair cable (~100 ohm, e.g. PROFIBUS-compatible cable) must be used for the wiring. For best immunity, high quality cable is recommended. The cable should be kept as short as possible; the maximum length of the link is 50 metres (164 ft). Unnecessary loops and running the cable near power cables (such as motor cables) must be avoided. The cable shields are to be grounded to the control cable clamp plate on the drive as shown on page 70.

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



Safe Torque Off (X6)

For the drive to start, both connections (OUT1 to IN1, and OUT2 to IN2) must be closed. This is implemented by means of a safety switch and related wiring. See page 49.

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.

More information is available in the *Safe Torque Off Function (STO) Application Guide* (3AFE68929814 [English]). For related parameter settings, see the appropriate *Firmware Manual*.

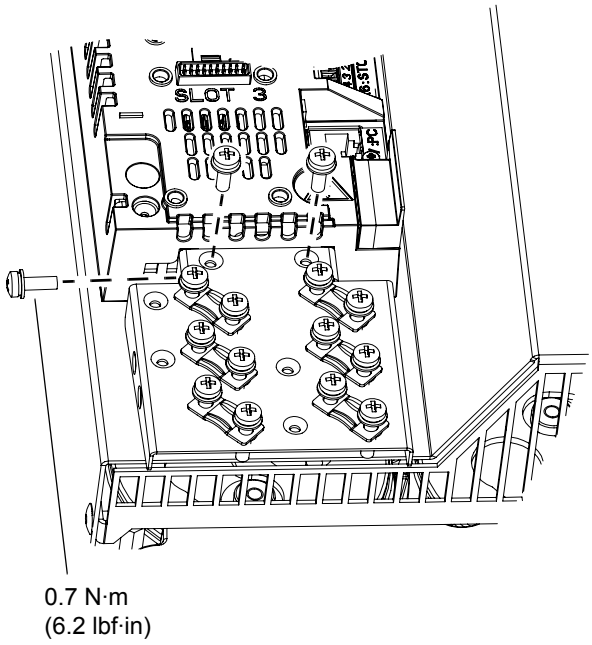
Control cable grounding

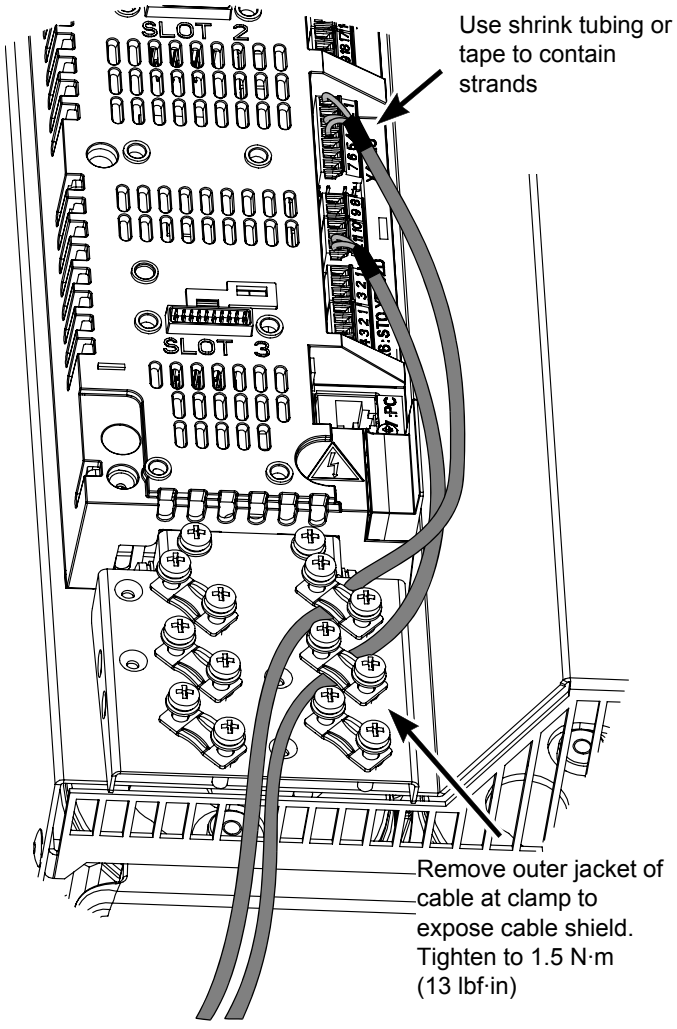
The shields of all control cables connected to the JCU Control Unit must be grounded at the control cable clamp plate. Use three M4 screws to fasten the plate as shown below left. The plate can be fitted either at the top or bottom of the JCU.

The shields should be continuous as close to the terminals of the JCU as possible. Only remove the outer jacket of the cable at the cable clamp so that the clamp presses on the bare shield. At the terminal block, use shrink tubing or insulating tape to contain any stray strands. The shield (especially in case of multiple shields) can also be terminated with a lug and fastened with a screw at the clamp plate. Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor (e.g. 3.3 nF / 630 V). The shield can also be grounded directly at both ends if they are *in the same ground line* with no significant voltage drop between the end points.

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

Mounting the clamp plate





Installation of options

Options such as fieldbus adapters, I/O extensions and encoder interfaces are inserted into slots on the JCU Control Unit. See page 24 for the available slots; see the appropriate option manual for specific installation and wiring instructions.

Installation checklist

Checklist

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

	Check
MECHANICAL INSTALLATION	
☐	The ambient operating conditions are within the allowed limits. (See *Mechanical installation, Technical data: Ratings, Ambient conditions*.)
☐	The unit is fastened properly to the cabinet. (See *Planning the cabinet assembly* and *Mechanical installation.*)
☐	The motor and the driven equipment are ready for start. (See *Planning the electrical installation, Technical data: Motor connection*.)
ELECTRICAL INSTALLATION (See *Planning the electrical installation, Electrical installation.*)	
☐	The internal EMC filter is disconnected if the drive is connected to an IT (ungrounded) or corner-grounded supply network.
☐	The capacitors are reformed if stored over one year (see *ACS800 Capacitor Reforming Guide* [64059629, English])).
☐	The drive is grounded properly.
☐	The supply (input power) voltage matches the drive nominal input voltage.
☐	The supply (input power) is connected to U1/V1/W1 (UDC+/UDC- in case of a DC supply) and the terminals are tightened to specified torque.
☐	Appropriate supply (input power) fuses and disconnector are installed.
☐	The motor is connected to U2/V2/W2, and the terminals are tightened to specified torque.
☐	The braking resistor (if present) is connected to R+/R-, and the terminals are tightened to specified torque.
☐	The motor cable (and braking resistor cable, if present) is routed away from other cables.
☐	There are no power factor compensation capacitors in the motor cable.
☐	The external control connections to the JCU Control Unit are OK.
☐	There are no tools, foreign objects or dust from drilling inside the drive, and no discarded installation material has been left in the cabinet.

	Check
☐	The supply (input power) voltage cannot be applied to the output of the drive through a bypass connection.
☐	Motor connection box and other covers are in place.
COOLING CIRCUIT (See *The internal cooling circuit*)	
☐	The cooling circuit joints are tight.
☐	Bleed and drain valves (if any) in the cooling circuit are closed.
☐	The inlet and outlet valves (if any) to each power module are open.
☐	The internal cooling circuit is filled up.
☐	The coolant is able to flow freely through the drive system.
☐	Coolant temperature, flow rate and pressure are within allowed limits. See also *Internal cooling circuit specifications*.

Maintenance

What this chapter contains

This chapter contains preventive maintenance instructions.

Safety

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

Maintenance intervals

If installed in an appropriate environment, the drive requires very little maintenance. This table lists the routine maintenance intervals recommended by ABB.

Interval	Maintenance	Instruction
Regularly	Inspect and purify the pipeline or change the coolant in the internal cooling circuit	See manufacturer's instructions on the cooling unit.
Every year of storage	Capacitor reforming	See *Capacitors* on page *76.*
Every 6 years if the ambient temperature does not exceed 40 °C (104 °F). **Every 3 years** if the ambient temperature is higher than 40 °C (104 °F).	Cooling fan change	See *Cooling fan* on page *76.*
Every 10 years	Capacitor change	See *Capacitors* on page *76.*

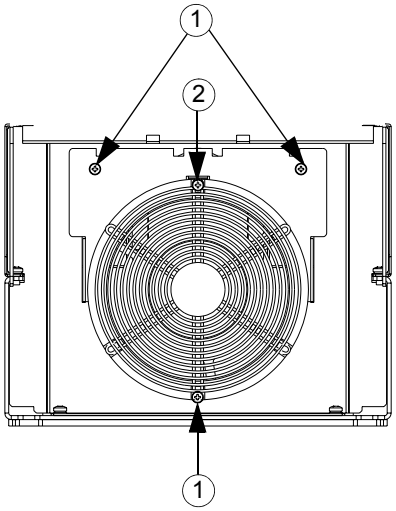
Note: The coolant and external piping may require routine maintenance such as adding inhibitor.

Cooling fan

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

Fan replacement

To remove the fan, undo the fixing screws. Disconnect the cable. Install the new fan in reverse order.



Bottom view

Capacitors

Reforming

The capacitors must be reformed if the drive has been stored for a year or more. See page 35 for information on finding out the manufacturing date. For information on reforming the capacitors, (see *ACS800 Capacitor Reforming Guide* [64059629, English])).

Changing

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

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

Other maintenance actions

Transferring the memory unit to a new drive module

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

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

After power-up, the drive will scan the memory unit. If a different application program or different parameter settings are detected, they are copied to the drive. This may take a few moments; the LED display will read “L” while copying is in progress.

The 7-segment display on the JCU Control Unit

The following table describes the indications given by the 7-segment display on the JCU Control Unit. Multi-character indications are displayed as repeated sequences of characters.

Display	Meaning
L	Loading application program or data from the memory unit. This is the normal display immediately after powering up the drive.
□	Normal operation – drive stopped.
	(Rotating display) Normal operation – drive running.
“E” followed by four-digit error code	System error. 9001, 9002 = Control unit hardware failure. 9003 = No memory unit connected. 9004 = Memory unit failure. 9007, 9008 = Loading of firmware from memory unit failed. 9009…9018 = Internal error. 9019 = Contents of memory unit corrupted. 9020 = Internal error. 9021 = Program versions of memory unit and drive incompatible. 9102…9108 = Internal error.
“A” followed by four-digit error code	Alarm generated by the application program. For error codes, see the Firmware Manual.
“F” followed by four-digit error code	Fault generated by the application program. For error codes, see the Firmware Manual.

The internal cooling circuit

General

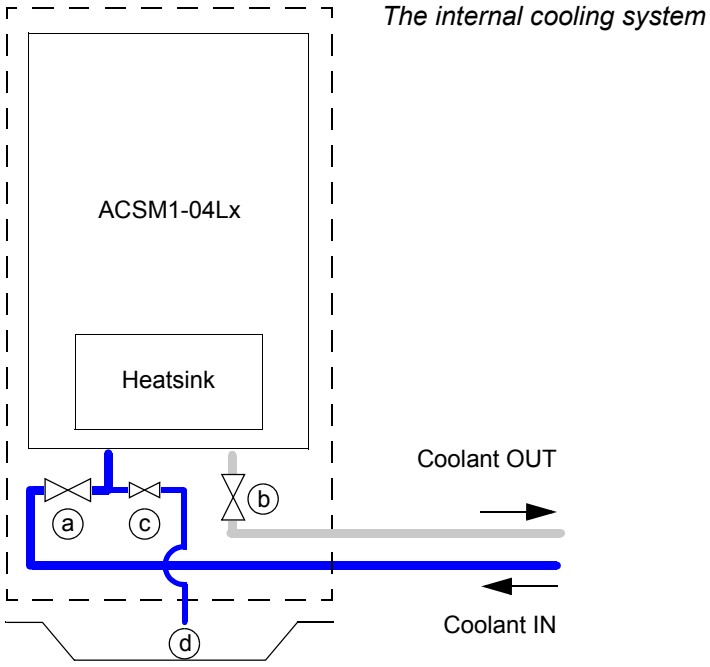
This chapter describes the internal cooling circuit of the ACSM1-04Lx drive module (frame E) and gives examples of arranging heat transfer out of the system. Use the information in this chapter as guidelines for building a liquid cooling system.

While the liquid cooling system deals with a majority of the heat generated, some components are air-cooled. For more information on cooling arrangements as a whole, see *Cooling arrangements* on page *29*.

Note: The cooling systems described below are examples. It is possible to equip the system with a different kind of cooling unit.

Internal cooling system diagram

The internal cooling system



Each drive module can be isolated from the main cooling circuit by closing the inlet (a) and outlet valves (b). Each drive module is also equipped with a drain valve (c) that can be used to drain the drive module. It is recommended to install a leak detector (d) under the drive cabinet.

The coolant enters and exits the module through the bottom. Inside the module, the coolant runs through the heatsink.

Connection to a cooling unit

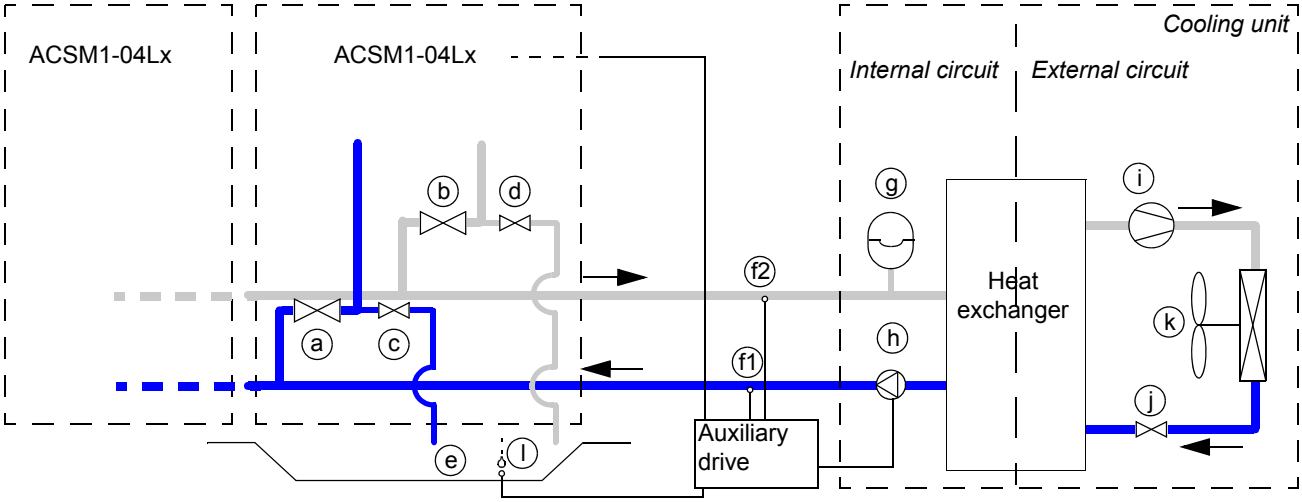
General recommendations

- Equip the system with an expansion tank to damp pressure rise due to volume changes when the coolant temperature varies. In pressurized systems, keep the pressure within the limits specified in *Pressure limits* on page 88. Install a pressure regulator to ensure that the maximum permissible operating pressure is not exceeded.
- Install a bleed valve at the highest point of the cooling circuit.
- Use pipes of at least 1 1/2” in diameter for the main pipes in a system with several ACSM1 drives connected in parallel.
- Install a leak detector under the drive or drive cabinet to detect leaks and condensation.

Coolant temperature control

The temperature of the coolant in the internal cooling circuit must be kept within the limits specified in *Temperature limits* on page 88. Note that the minimum coolant temperature is dependent on ambient temperature and relative humidity.

The following diagram shows an example of coolant temperature control in a system with a chiller cooling unit. In this example an auxiliary drive controls the pump (h) and receives information from the sensors (f and l). The auxiliary drive may be an ACSM1 or any other drive with sufficient capacity for controlling the pump and handling sensor information.



a. Inlet valve
b. Outlet valve
c. Drain valve
d. Bleed valve
e. Sewer system or drain collector
f. Temperature sensors
g. Expansion tank
h. Circulation pump
i. Compressor
j. Expansion valve
k. Condenser and fan
l. Leak detector

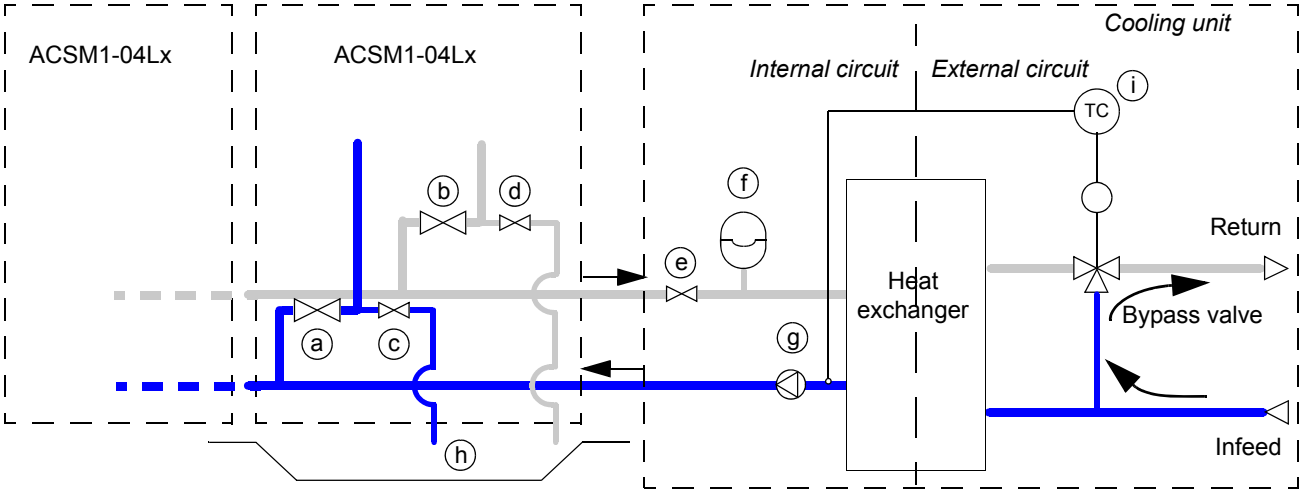
The auxiliary drive sets the pump motor speed to a preprogrammed value to achieve an ideal flow rate.

The purpose of the temperature sensor f1 is to measure if the coolant temperature is within the limits given in *Temperature limits* before the coolant enters the drives, so that no condensation forms inside the cabinet when the drives are not running.

The primary function of the temperature sensor f2 is to ensure an adequate flow rate. A rise in the coolant temperature above a set limit indicates that there is an obstruction in the pipes. The limit depends on how much losses the system has and what the flow rate is. The obstruction can be temporarily compensated for by increasing pump motor speed (and thus flow rate) but only up to the maximum given in *Flow rate*. The sensor f2 can be replaced or supplemented with pressure sensors or flow sensors.

The auxiliary drive is connected to the ACSM1 drives. If the drives are shut down for a certain period of time, the circulation pump stops running. If the coolant temperature is above the maximum at f2 or below the minimum at f1, the auxiliary drive gives a fault indication, and if necessary, system power is reduced or the system shuts down. Also, if the leak detector detects moisture, the system shuts down.

The following diagram shows an example of coolant temperature control using the three-way valve in the external cooling circuit. Part of the infeed coolant flow is directed into the return pipe through a three-way valve without letting it circulate in heat exchanger if the coolant in the internal circuit is too cold.



a. Inlet valve
b. Outlet valve
c. Drain valve
d. Bleed valve
e. Throttle valve
f. Expansion tank
g. Circulation pump
h. Sewer system or drain collector
i. Temperature control

Technical data

What this chapter contains

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

Ratings

The nominal ratings for the ACSM1-04 with 50 Hz and 60 Hz supplies are given below.

Drive type ACSM1-04Lx…	Frame size	Input ratings	Output ratings					
		I_{1N}	I_{2N}	$I_{2cont4k}$	$I_{2cont8k}$	I_{2max}	P_N	
		A	A	A	A	A	kW	HP
-110A-4	E	107	110	110	75	165	55	75
-135A-4	E	131	135	135	90	202	75	100
-175A-4	E	171	175	175	115	282	90	125
-210A-4	E	205	210	210	135	326	110	150
-260A-4	E	254	260*	260*	165	351	160	200

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I_{1N}	Nominal input current (rms) at 40 °C (104 °F).
I_{2N}	Nominal continuous output current at 40 °C (104 °F).
$I_{2contxk}$	Continuous output current at a switching frequency of 4 or 8 kHz at 40 °C (104 °F).
P_N	Typical motor power.
I_{2max}	Maximum short-time output current. See section *Cyclic loads* below.
*	$I_{2cont2K}$ and $I_{2cont3k}$ for type ACSM1-04Lx-260A are 304 A.

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

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

Power loss and cooling characteristics

Drive type ACSM1-04Lx…	Frame size	Power loss		Air flow
		liquid	air	m^3/h
		W	W	
-110A-4	E	825	235	270
-135A-4	E	1240	350	
-175A-4	E	1540	510	
-210A-4	E	1925	645	
-260A-4	E	2450	865	

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Derating

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

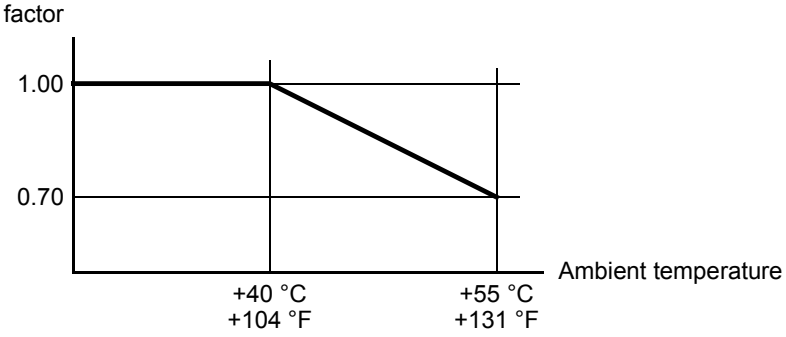
- the ambient temperature exceeds +40 °C (+104°F)
- the coolant temperature exceeds +42 °C (+108°F)
- a mixture of water and glycol is used as the coolant
- the AC supply voltage is higher than 400 V
- the drive is installed higher than 1000 m above sea level.

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

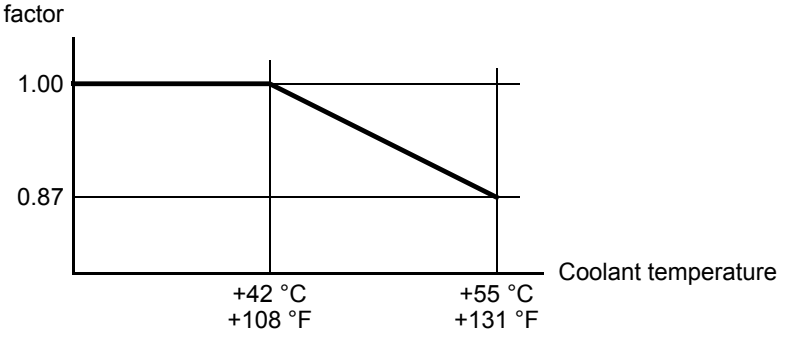
Temperature derating

Ambient temperature derating and coolant temperature derating are not cumulative. Only the worse derating value of the two applies. For example, if both the ambient and coolant temperature are +50 °C, the derating factors are approximately 0.85 and 0.92, respectively. Since only the worse derating value applies, the temperature derating factor is 0.85 in this case.

If the ambient temperature is +40…55 °C (+104…131 °F), the output current is derated linearly as follows:

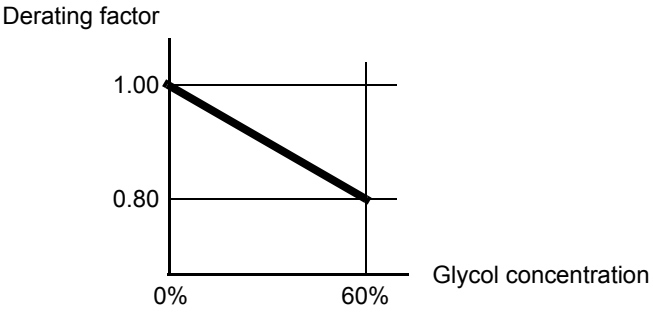


If the coolant temperature is +42…55 °C (+108…131 °F), the output current is derated linearly as follows:



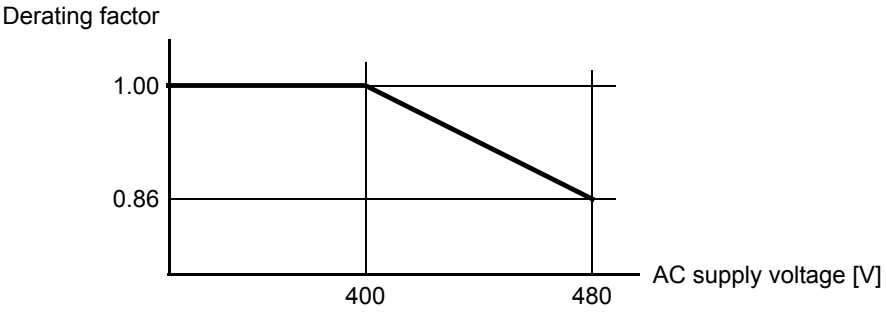
Glycol concentration derating

For every three percent of glycol in the coolant, the output current is derated by 1%.



AC supply voltage derating

With AC supply voltages above 400 V AC, the output current is derated linearly as follows:



Altitude derating

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

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

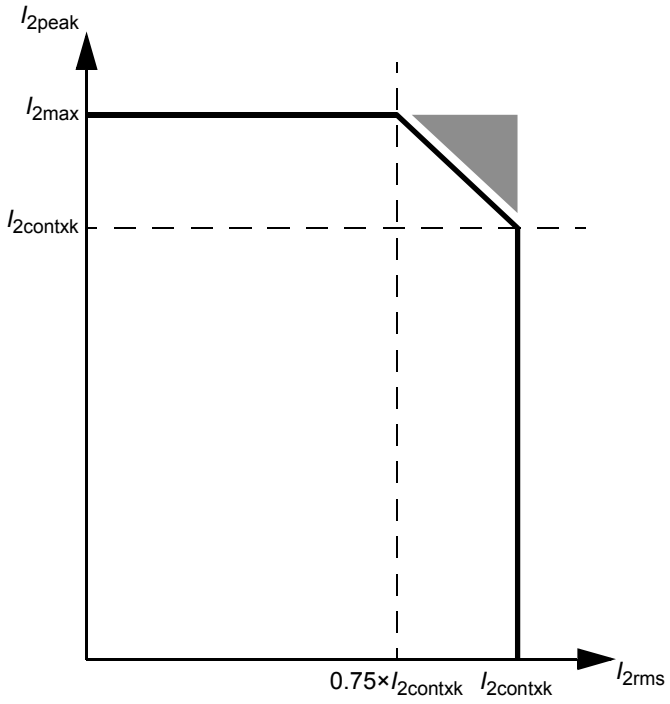
Cyclic loads

If the load cycle is shorter than 10 seconds, the thermal time constant of the heatsink (approximately 30 seconds) can be ignored, and the following simple procedure can be applied to find out whether the drive can handle the cycle.

1. Determine the rms value (I_{2rms}) of the output current over the whole load cycle.
2. Determine the maximum instantaneous rms value (I_{2peak}) of the output current during the load cycle.
3. Determine the point (I_{2rms}, I_{2peak}) on the graph below.

If the point falls within the region bordered by a solid line, the load cycle is safe. For $I_{2contxk}$ and I_{2max}, use the ratings stated for the drive type and switching frequency used.

If the point falls within the shaded area, a more detailed study is required.



The above procedure can also be applied to longer load cycles by dividing the cycle into subcycles no longer than 10 seconds. If any of the subcycles fail the test, a more detailed study is required.

The DriveSize dimensioning tool available from ABB is recommended for more detailed dimensioning.

Dimensions, weights, noise

See also the chapter *Dimension drawings*.

Frame size	Height mm (in.)	Width mm (in.)	Depth (without options installed on JCU) mm (in.)	Depth (with options installed on JCU) mm (in.)	Weight kg (lbs)	Noise dB
E	700 (27.56)	313.5 (12.34)	398 (15.67)	415 (16.34)	67 (148)	65

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Note: Some of the I/O options require some 50 mm (2”) of additional depth for wiring.

Supply cable fuses

Fuses for short circuit protection of the supply cable are listed below. The fuses also protect the adjoining equipment of the drive in case of a short circuit. **Check that the operating time of the fuse is below 0.1 seconds**. The operating time depends on the supply network impedance and the cross-sectional area and length of the supply cable. If the operating time of 0.1 seconds is exceeded, use a fuse of the aR type instead. See also chapter *Planning the electrical installation*.

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

Drive type ACSM1-04xx…	Input current (A)	IEC fuse (gG)			IEC fuse (aR)			Cross-sectional area of cable	
		Rated current (A)	Voltage (V)	Class	Rated current (A)	Voltage (V)	UL Class	mm^2	AWG/MCM
-110A-4	107	160	500	gG	200	690	aR	95…240	3/0 AWG…500 MCM
-135A-4	131	200	500	gG	315	690	aR		
-175A-4	171	200	500	gG	400	690	aR		
-210A-4	205	250	500	gG	400	690	aR		
-260A-4	254	315	500	gG	550	690	aR		

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Drive type ACSM1-04xx…	Input current (A)	UL fuse			DC fuse		Cross-sectional area of cable	
		Rated current (A)	Voltage (V)	UL Class	Rated current (A)	Class	mm^2	AWG/MCM
-110A-4	107	150	600	T	200	aR	95…240	3/0 AWG…500 MCM
-135A-4	131	200	600	T	315	aR		
-175A-4	171	225	600	T	315	aR		
-210A-4	205	300	600	T	400	aR		
-260A-4	254	350	600	T	550	aR		

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Internal cooling circuit specifications

Temperature limits

Ambient temperature: See *Ambient conditions*.

Minimum coolant inlet temperature: Condensation is not allowed. The minimum coolant temperature to avoid condensation (at an atmospheric pressure of 1 bar) is shown below as a function of the relative humidity (ϕ) and the ambient temperature (T_{air}).

T_{air} (°C)	Min. $T_{coolant}$ (°C)				
	ϕ = 95%	ϕ = 80%	ϕ = 65%	ϕ = 50%	ϕ = 40%
5	4.3	1.9	-0.9	-4.5	-7.4
10	9.2	6.7	3.7	-0.1	-3.0
15	14.2	11.5	8.4	4.6	1.5
20	19.2	16.5	13.2	9.4	6.0
25	24.1	21.4	17.9	13.8	10.5
30	29.1	26.2	22.7	18.4	15.0
35	34.1	31.1	27.4	23.0	19.4
40	39.0	35.9	32.2	27.6	23.8
45	44.0	40.8	36.8	32.1	28.2
50	49.0	45.6	41.6	36.7	32.8
55	53.9	50.4	46.3	42.2	37.1

= Not allowed as standard but the coolant temperature must be 5 °C or above. Consult an ABB representative if operation below coolant temperature 5 °C is required.

Example: At an ambient temperature of 45 °C and relative humidity of 65% the coolant temperature may not be below +36.8 °C

Maximum coolant inlet temperature

- 42 °C when the drive output capacity is not derated
- 42 °C …55 °C when the drive output capacity is derated. See *Derating*.

Pressure limits

- 0…1000 kPa
- If operation above 1000 kPa is required, consult ABB.

Flow rate

The flow rate must be 7…12 l/min. Exceeding the maximum flow rate of 12 l/min may cause erosion corrosion.

Pressure loss: Shown below as a function of flow rate and glycol concentration in the coolant.

Glycol% (weight)	Δp (kPa)					
	7 l/min	8 l/min	9 l/min	10 l/min	11 l/min	12 l/min
0%	103	134	170	210	254	302
10%	109	142	180	222	269	321
20%	115	151	191	235	285	339
30%	121	159	201	248	300	357
40%	128	167	211	260	315	375
50%	134	175	221	273	330	393
60%	140	183	231	286	346	411

Coolant quality

Cooling has been tested with water and a water-propylene glycol (CAS Number: 57-55-6) solution. If you use another coolant, contact ABB.

Note: Do not use sea water for cooling.

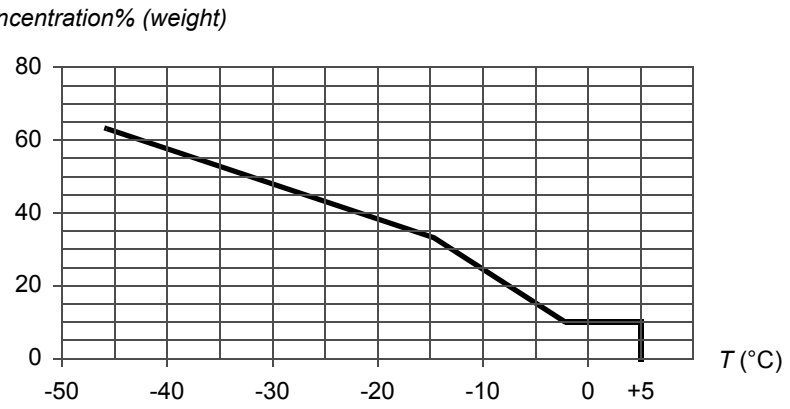
Industrial water that fulfills the following requirements may be used.	
pH value	5…9.5
Chloride	< 250 mg/l
Sulphate	< 200 mg/l
Total dissolved solids	< 200 mg/l, no deposits are allowed at the temperature of +57 °C
Total hardness Ca^{2+} + Mg^{2+}	< 2.5 mmol/l
Conductivity	< 2500 µS/cm
Maximum solid particle size	2 mm

Deposits in the pipes should be avoided. Deposits may be caused by organic impurities (bacteria and algae) and other impurities in the coolant. This should be taken into account when designing the system. If necessary, arrange a method for cleaning the pipes.

Glycol concentration

The maximum glycol concentration in the coolant is 60%.

The graph below shows the required glycol concentration in weight percentage according to ambient/storage temperature *T*.



Note: A water-ethylene glycol solution may also be used. Ethylene glycol is not appropriate for drain disposal.

Materials

The internal cooling circuit is made of stainless steel (DIN 1.4401 (AISI 316) / DIN 1.4404 (AISI 316L)).

Corrosion

Stainless steel is an inert material and thus appropriate for different kinds of cooling systems. Other materials have to be chosen depending on the liquids used to avoid corrosion.

AC input (supply) connection

Voltage (U_1)	380…480 V AC +10%/-15%, 3-phase
Frequency	50…60 Hz ±5%
Network type	Grounded (TN, TT) or ungrounded (IT). **Note:** Connection to an ungrounded (IT) or corner-grounded delta network is not allowed at altitudes of 2000 m (6600 ft) or higher.
Imbalance	Max. ±3% of nominal phase to phase input voltage
Fundamental power factor (cos phi$_1$)	0.98 (at nominal load)
Terminals	With cable sizes from 16 to 70 mm^2 (AWG6 to AWG2/0): Posts for crimp lugs (lugs not included). With cable sizes from 95 to 240 mm^2 (AWG3/0 to AWG500): Screw lugs (included). Grounding clamps.

DC connection

Voltage 436 … 712 V DC

Ratings

Drive type ACSM1-04Lx…	I_{dcN} (A)	C (µF)
-110A-4	122	3300
-135A-4	149	3300
-175A-4	194	4700
-210A-4	232	4700
-260A-4	287	7050

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

Motor connection

Motor types	Asynchronous induction motors, asynchronous servo motors, synchronous permanent magnet motors
Frequency	0…500 Hz
Current	See section *Ratings.*
Switching frequency	Selectable between 1…8 kHz. Default: 4 kHz, above which output current derated
Maximum motor cable length	50 m (164 ft) with screened cable 75 m (246 ft) with unscreened cable
Terminals	With cable sizes from 16 to 70 mm^2 (AWG6 to AWG2/0): Posts for crimp lugs (lugs not included). With cable sizes from 95 to 240 mm^2 (AWG3/0 to AWG500): Screw lugs (included). Grounding clamps.

JCU Control Unit

Power supply
24 V (±10%) DC, 1.6 A
Supplied from the power unit of the drive, or from external power supply through connector X1 (pitch 3.5 mm, wire size 1.5 mm^2).

Relay output (X2)
Connector pitch 5 mm, wire size 2.5 mm^2
250 V AC / 30 V DC, 2 A
Protected by varistors

Digital inputs DI1…DI6 (X3)
Connector pitch 3.5 mm, wire size 1.5 mm^2
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Filtering: Adjustable, 0.25 ms min. (see also *Firmware Manual)*

Digital inputs/outputs DIO1…DIO3 (X3).

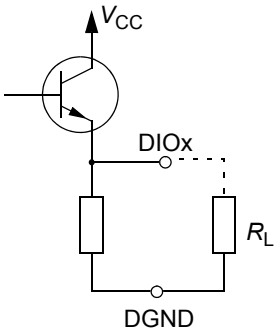
Input/output mode selection by parameters.

DIO2 can be configured as a frequency input (3…32 kHz) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO3 can be configured as a 24 V level square wave frequency output. See *Firmware Manual,* parameter group 12.

Connector pitch 3.5 mm, wire size 1.5 mm^2

As inputs:
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Filtering: Adjustable, 0.25 ms min. (see also *Firmware Manual)*

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



Analogue inputs AI1 and AI2 (X4).

Current/voltage input mode selection by jumpers. See page 67.

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

Thermistor input (X4)
Connector pitch 3.5 mm, wire size 1.5 mm^2
Input devices: PTC or KTY84 thermistor
Up to three PTCs can be connected in series
KTY84 thermistor: Inaccuracy 5 °C
No safety insulation (see page 67)

Analogue outputs AO1 and AO2 (X4)
Connector pitch 3.5 mm, wire size 1.5 mm^2
AO1 (current): 0…20 mA, R_{load} < 500 ohm
AO2 (voltage): –10…10 V, R_{load} > 1 kohm
Frequency range: 0…800 Hz
Resolution: 11 bit + sign bit
Inaccuracy: 2% of full scale range

Reference voltage (VREF) for analogue inputs
Connector pitch 3.5 mm, wire size 1.5 mm^2
10 V ±1% and –10 V ±1%, R_{load} > 1 kohm

Drive to drive link (X5)	Connector pitch 3.5 mm, wire size 1.5 mm^2 Physical layer: RS-485 Termination by jumper
Safe Torque Off connection (X6)	Connector pitch 3.5 mm, wire size 1.5 mm^2 For the drive to start, both connections (OUT1 to IN1, and OUT2 to IN2) must be closed
Control panel / PC connection (X7)	Connector: RJ-45 Cable length < 3 m

Efficiency

Approximately 98% at nominal power level

Cooling

Method	Liquid cooling and internal fan, flow direction from bottom to top.
Free space around the unit	See chapter *Planning the cabinet assembly*.

Degree of protection

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

Ambient conditions

Environmental limits for the drive are given below. The drive is to be used in a heated, indoor, controlled environment. Drain the unit before storing or transporting it.

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	0 to 4000 m (13123 ft) above sea level. [See also section *Altitude derating* on page 85.]	-	-
Air temperature	-10 to +55°C (14 to 131°F). No frost allowed. See section *Derating* on page 84.	-40 to +70°C (-40 to +158°F)	-40 to +70°C (-40 to +158°F)
Relative humidity	0 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	According to IEC 60721-3-3: Chemical gases: Class 3C2 Solid particles: Class 3S2 The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust.	According to IEC 60721-3-1: Chemical cases: Class 1C2 Solid particles: Class 1S2	According to IEC 60721-3-2: Chemical cases: Class 2C2 Solid particles: Class 2S2
Sinusoidal vibration (IEC 60721-3-3)	Tested according to IEC 60721-3-3, mechanical conditions: Class 3M4 2…9 Hz: 3.0 mm (0.12”) 9…200 Hz: 10 m/s^2 (33 ft/s^2)	–	–
Shock (IEC 60068-2-27, ISTA 1B)	–	According to ISTA 1B. Max. 100 m/s^2 (330 ft/s^2), 11 ms	According to ISTA 1B. Max. 100 m/s^2 (330 ft/s^2), 11 ms
Free fall	Not allowed	25 cm (10”)	25 cm (10”)

Materials

Drive enclosure

- JCU Control Unit housing: PC/ABS, colour NCS 1502-Y (RAL 9002 / PMS 420 C)
- Sheet metal parts: Hot-dip zinc-coated steel. Front cover painted on the outside, colour NCS 1502-Y (RAL 9002 / PMS 420 C)
- Heatsink: Cast aluminium AlSi.
- Internal cooling circuit: DIN 1.4401 (AISI 316) and DIN 1.4404 (AISI 316L).

Packaging Plywood, PE-LD wrapping, PP or steel banding.

Pipe connectors Male stud connector, thread Whitworth ISO7/1, R1/2”K (12.7 mm), stainless steel (DIN 1.4401 (AISI 316) and DIN 1.4404 (AISI 316L))

Disposal

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

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

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

Applicable standards

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

• EN 50178 (1997)	Electronic equipment for use in power installations
• IEC 60204-1 (2005), modified	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. *Provisions for compliance:* The final assembler of the machine is responsible for installing - an emergency-stop device - a supply disconnecting device - the ACSM1-04 into a cabinet.
• EN 60529: 1991 (IEC 60529)	Degrees of protection provided by enclosures (IP code)
• IEC 60664-1 (2007), Edition 2.0	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.
• IEC 61800-3 (2004)	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.
• EN 61800-5-1 (2003)	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements. Electrical, thermal and energy *Provisions for compliance:* The final assembler of the machine is responsible for installing the ACSM1-04 in a cabinet that is protected to IP2X (IP3X for top surfaces for vertical access).
• prEN 61800-5-2	Adjustable speed electrical power drive systems. Part 5-2: Safety requirements. Functional
• UL 508C (2002), Third Edition	UL Standard for Safety, Power Conversion Equipment
• NEMA 250 (2003)	Enclosures for Electrical Equipment (1000 Volts Maximum)
• CSA C22.2 No. 14-05 (2005)	Industrial Control Equipment

CE marking

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage and EMC Directives (Directive 73/23/EEC, as amended by 93/68/EEC, and Directive 89/336/EEC, as amended by 2004/108EC).

Compliance with the European Low Voltage Directive

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

Compliance with the European EMC Directive

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

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

Definitions

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

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

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

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

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

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

Compliance with EN 61800-3 (2004), category C2

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

1. The motor and control cables are selected as specified in the chapter *Planning the electrical installation*.
2. The drive is installed according to the instructions given in this manual.
3. Motor cable length does not exceed 50 metres (164 ft).

Note: The internal EMC filter must be disconnected on IT (ungrounded) systems. Otherwise the supply network becomes connected to ground potential through the filter capacitors which may cause danger or damage the drive.

Note: The internal EMC filter must be disconnected on a corner-grounded TN system. Otherwise the drive will be damaged.

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

Compliance with EN 61800-3 (2004), category C3

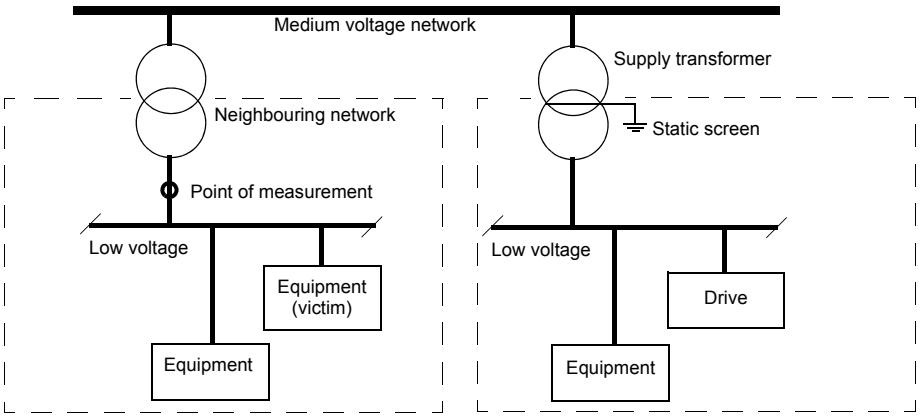
The drive meets the requirements of the EMC Directive with the following provisions:

1. The motor and control cables are selected as specified in the chapter *Planning the electrical installation*.
2. The drive is installed according to the instructions given in this manual.
3. Motor cable length does not exceed 50 metres (164 ft).

Compliance with EN 61800-3 (2004), category C4

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

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



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 chapter *Planning the electrical installation*.
4. The drive is installed according to the instructions given in this manual.

Compliance with the Machinery Directive

The drive is intended to be incorporated into machinery to constitute machinery covered by Machinery Directive (98/37/EC) and does therefore not in every respect comply with the provisions of the directive. For more information, see the Declaration of Incorporation by ABB Drives (code 64652770).

C-Tick marking

Compliance with IEC 61800-3 (2004)

See section *Compliance with the European EMC Directive* on page 96.

UL marking

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

UL checklist

Input power connection – See section *AC input (supply) connection* on page 91.

Disconnecting device (Disconnecting means) – See section *Supply disconnecting device* on page 46.

Ambient conditions – The drive is to be used in a heated indoor controlled environment. See section *Ambient conditions* on page 94 for specific limits.

Input cable fuses – For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, use the UL classified fuses given in section *Supply cable fuses* on page 87.

For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfil this requirement, use the UL classified fuses given in section *Supply cable fuses* on page 87.

Power cable selection – See section *Selecting the power cables* on page 50.

Power cable connections – For the connection diagram and tightening torques, see section *Power cable connection* on page 62.

Control connections – For the connection diagram and tightening torques, see section *Connecting the control cables* on page 66.

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

Braking – The ACSM1-04 has an internal braking chopper. When applied with appropriately sized braking resistors, the braking chopper will allow the drive to dissipate regenerative energy (normally associated with quickly decelerating a motor). Braking resistor selection is discussed in the chapter *Resistor braking* on page 99.

UL standards – See section *Applicable standards* on page 95.

Liquid cooling circuit – Connected to a system in which pressure, flow rate, coolant temperature and material requirements are fulfilled. See *Internal cooling circuit specifications*.

Coolant type – See *Coolant quality*.

Product protection in the US

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

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

Other patents pending.

Resistor braking

What this chapter contains

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

Note: All braking resistors available from ABB are air-cooled.

Braking choppers and resistors with the ACSM1-04Lx

Braking choppers

ACSM1-04Lx drives have a built-in braking chopper as standard equipment to handle the energy generated by a decelerating motor.

When the braking chopper is enabled and a resistor connected, the chopper will start conducting when the DC link voltage of the drive reaches 780 V. The maximum braking power is achieved at 840 V.

Braking resistor selection

To select a braking resistor:

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

Pre-selected resistors are available from ABB as shown in the table below. If the listed resistor is not sufficient for the application, a custom resistor can be selected within the limits imposed by the internal braking chopper of the ACSM1-04Lx. The following rules apply:

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

$$P_{max} < \frac{U_{DC}^2}{R}$$

where UDC equals 840 V.

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

- The maximum braking power must not exceed P_{brmax} at any point
- The average braking power must not exceed P_{brcont}
- The braking energy must not exceed the energy dissipation capacity of the selected resistor
- It is highly recommended that the resistor be protected from thermal overload; see the section *Contactor protection of drive* below.

Chopper data / Resistor selection table

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

Drive type ACSM1-04Lx…	*Internal braking chopper*			*Example braking resistor*			
	P_{brcont} (kW)	P_{brmax} (kW)	R_{min} (ohm)	Type	R (ohm)	P_n (W)	E_{pulse} (kJ)
-110A-4	40	75	4	JBR-09 (Danotherm CBT-H 560 GHT 415 4R0)	4	2200	540
-135A-4	55	100					
-175A-4	65	120					
-210A-4	80	150					
-260A-4	110	180		*			

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P_{brcont} The internal chopper will withstand this continuous braking power. The braking is considered continuous if the braking time exceeds 30 seconds.

P_{brmax} Maximum braking power of the chopper. The chopper will withstand this braking power for 1 second within every 10 seconds. **Note:** The listed resistors will withstand this braking power for 1 second within every 120 seconds.

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

R Resistance of the listed resistor.

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

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

* Listed resistor braking power is 150 kW for 1 second within every 120 seconds.

Refer to page 106 for a dimension drawing of the resistor.

Resistor installation and wiring

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

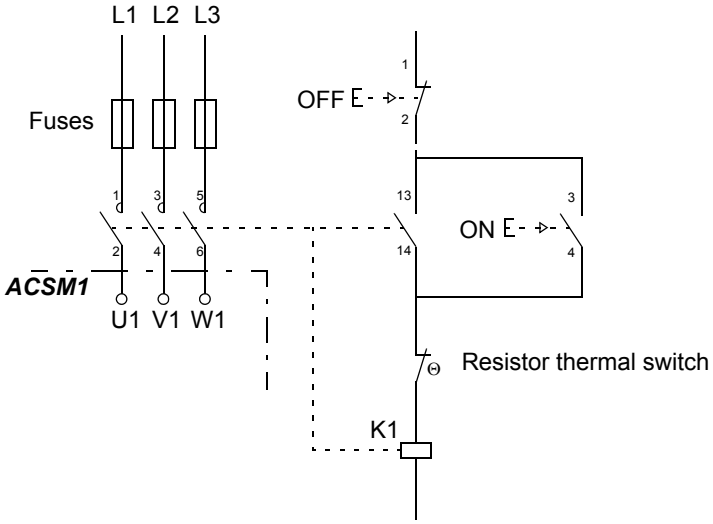
WARNING! The materials near the braking resistor must be non-flammable. The surface temperature of the resistor may rise above 200 °C (400 °F), and the temperature of the air flowing from the resistor is hundreds of degrees Celsius. Protect the resistor against contact.

The maximum length of the resistor cable(s) is 20 m (65 ft). For the connections, see section *Power cable connection* on page 62.

Contactor protection of drive

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

Below is a simple example wiring diagram.



Braking circuit commissioning

For more information, see the appropriate *Firmware Manual*.

- Enable the braking chopper function. Please note that a braking resistor must be connected when the chopper is enabled
- Switch off the overvoltage control of the drive
- Adjust any other relevant parameters in group 48.

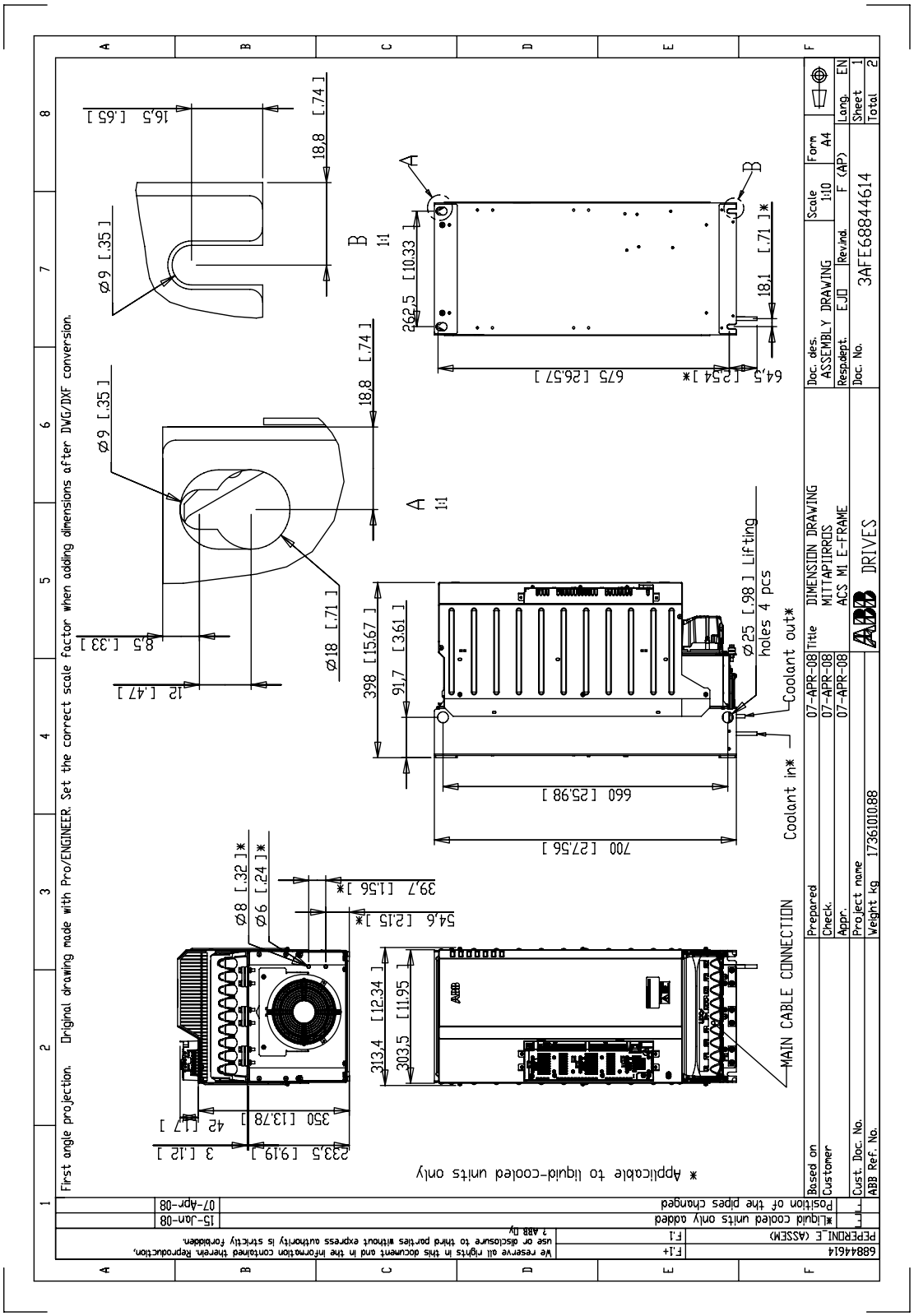
WARNING! If the drive is equipped with a braking chopper but the chopper is not enabled by parameter setting, the braking resistor must be disconnected because the protection against resistor overheating is then not in use.

Dimension drawings

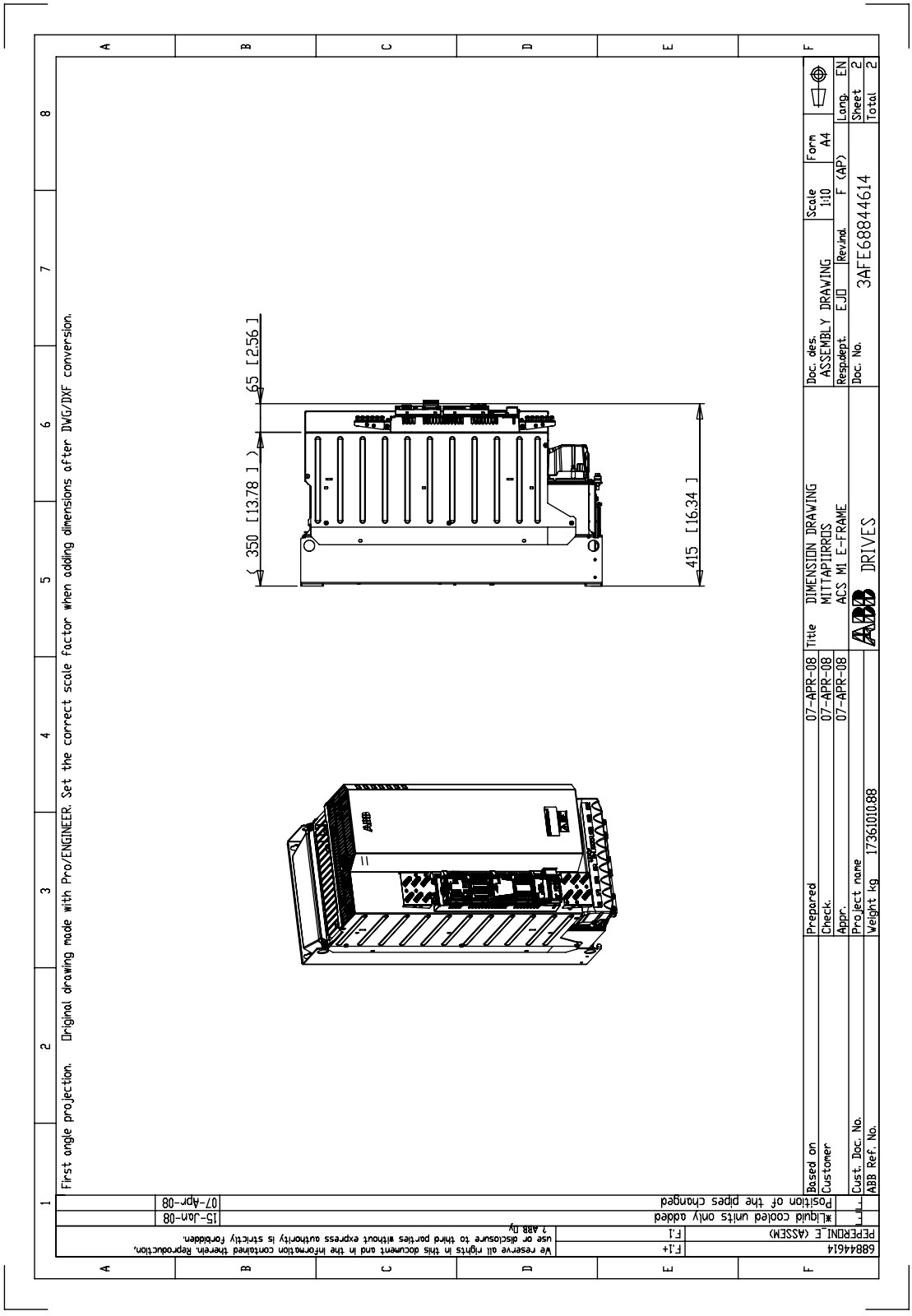
What this chapter contains

Dimension drawings of the ACSM1-04Lx (frame size E) and related accessories are shown below.

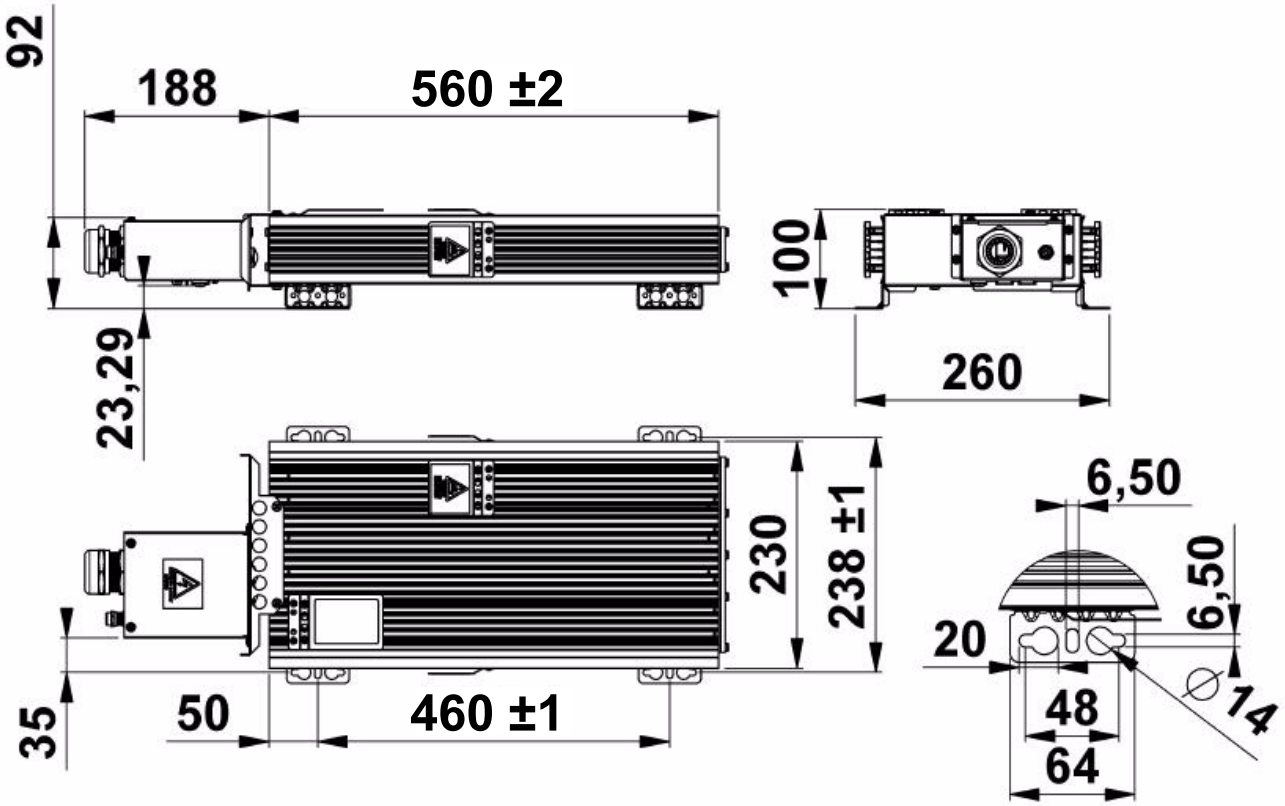
Drive module



Drive module (continued from previous page)



Braking resistor (JBR-09, air-cooled)



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