

ABB machinery drives

Hardware manual

ACS850-04 drive modules (160 to 560 kW, 200 to 700 hp)



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List of related manuals

Drive hardware manuals and guides

Code (English)

| | |
|---|--------------------------------|
| <i>ACS850-04 drive modules (160 to 560 kW, 200 to 700 hp) hardware manual</i> | 3AUA0000081249 |
| <i>Safe torque off function for ACSM1, ACS850 and ACQ810 drives application guide</i> | 3AFE68929814 |

Drive firmware manuals and guides

| | |
|--|--------------------------------|
| <i>ACS850 standard control program quick start-up guide</i> | 3AUA0000045498 |
| <i>ACS850 standard control program firmware manual</i> | 3AUA0000045497 |
| <i>ACS850 crane control program supplement (to std ctrl prg)</i> | 3AUA0000081708 |
| <i>ACS850-04 drives with SynRM motors (option +N7502) supplement</i> | 3AUA0000123521 |

Option manuals and guides

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| <i>ACS-CP-U Control Panel IP54 Mounting Platform Kit (+J410) Installation Guide</i> | 3AUA0000049072 |
| <i>ACS850 Common DC configuration for ACS850-04 drives application guide</i> | 3AUA0000073108 |
| <i>ATEX-certified Safe disconnection function for ACS850 drives (+Q971) application guide</i> | 3AUA0000074343 |
| <i>Application programming for ACS850 and ACQ810 drives application guide</i> | 3AUA0000078664 |
| <i>Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.</i> | |

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[ACS850-04 manuals](#)

ACS850-04 drive modules
160 to 560 kW (200 to 700 hp)

Hardware manual

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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, motor or driven equipment. Read the safety instructions before you work on the unit.

Use of warnings

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment and advise on how to avoid the danger. The following warning symbols are 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.

Safety in installation and maintenance

Electrical safety

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, motor cable or motor when main power is applied. After disconnecting the input power, always wait for 5 min to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.

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

1. voltage between drive input phases U1, V1 and W1 and the frame is close to 0 V.
 2. voltage between terminals UDC+ and UDC- and the frame is close to 0 V.
- 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 cause dangerous voltages inside the drive even when the main power on the drive is switched off.
 - Do not make any insulation or voltage withstand tests on the drive or drive modules.

Note:

- The motor cable terminals on the drive are at a dangerously high voltage when the input power is on, regardless of whether the motor is running or not.
- The brake control terminals (UDC+, UDC-, R+ and R- terminals) carry a dangerous DC voltage (over 500 V).
- Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the terminals of relay outputs (X2) or Safe torque off (X6).
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits.

Grounding

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



WARNING! Ignoring the following instructions can cause physical injury, death, increased electromagnetic interference and equipment malfunction:

- Ground the drive, motor and adjoining equipment to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and interference.
- Make sure that grounding conductors are adequately sized as required by safety regulations.
- In a multiple-drive installation, connect each drive separately to protective earth (PE).
- Where EMC emissions must be minimized, make a 360° high frequency grounding of cable entries at the cabinet lead-through in order to suppress electromagnetic disturbances. In addition, connect the cable shields to protective earth (PE) in order to meet safety regulations.

Note:

- Power cable shields are suitable for equipment grounding conductors only when adequately sized to meet safety regulations.
 - As the normal leakage current of the drive is higher than 3.5 mA AC or 10 mA DC, a fixed protective earth connection is required by EN 61800-5-1, 4.3.5.5.2.
-

Permanent magnet motor drives

These are additional warnings concerning permanent magnet motor drives.



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

- Do not work on the drive when the permanent magnet motor is rotating. Also, when the supply power is switched off and the drive is stopped, a rotating permanent magnet motor feeds power to the intermediate circuit of the drive and the supply connections become live.

Before installation and maintenance work on the drive:

- Stop the motor.
 - Ensure that there is no voltage on the drive power terminals according to step 1 or 2, or if possible, according to the both steps.
1. Disconnect the motor from the drive with a safety switch or by other means. Measure that there is no voltage present on the drive input, output or DC terminals (U1, V1, W1, U2, V2, W2, UDC+, UDC-).
 2. Ensure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, is able to rotate the motor directly or through any mechanical connection like felt, nip, rope, etc. Measure that there is no voltage present on the drive input, output or DC terminals (U1, V1, W1, U2, V2, W2, UDC+, UDC-). Ground the drive output terminals temporarily by connecting them together as well as to the PE.
-

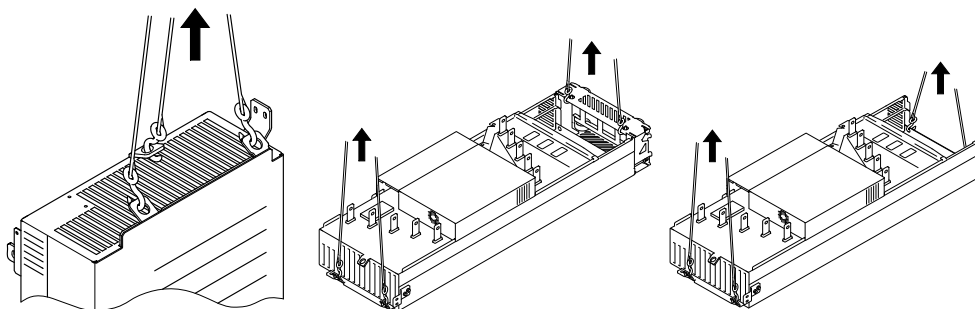
General safety

These instructions are intended for all who install and service the drive.

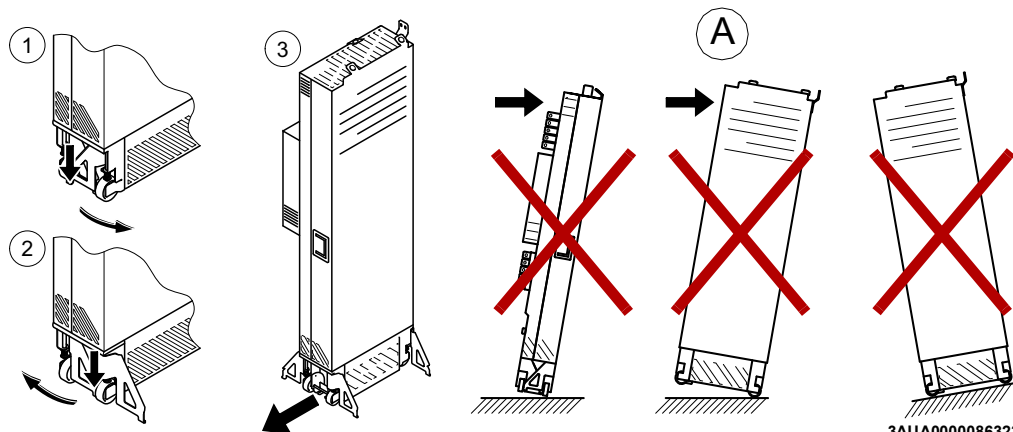


WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Lift the drive module using the lifting lugs attached to the top and base of the unit.

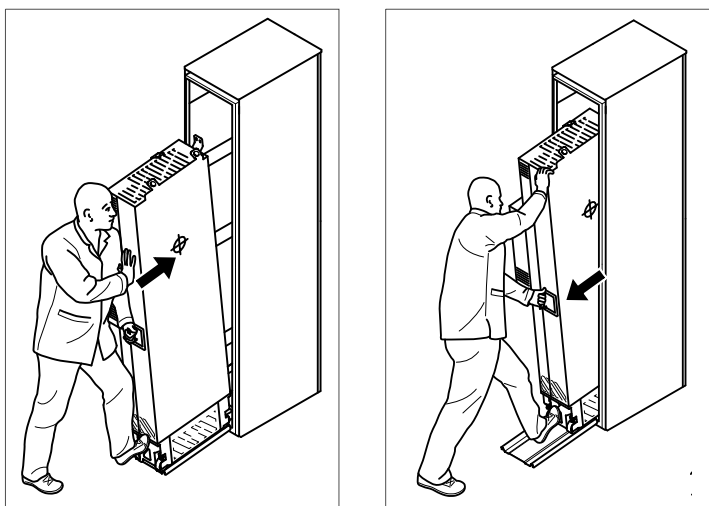


- Handle the drive module carefully. Make sure that the module does not fall down when moving it on the floor and during installation and maintenance work: Open the support legs by pressing each leg a little down (1, 2) and turning it aside. When ever possible secure the module also with chains.
- Do not tilt the drive module (A). It is **heavy** (over 160 kg [350 lb]) and its **center of gravity is high**. The module will overturn from a sideways tilt of 5 degrees. Do not leave the module unattended on a sloping floor.



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- Push the drive module into the cabinet and pull it from the cabinet carefully preferably with help from another person as shown below. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back. Use safety shoes with metal toe cap to avoid foot injury. Do not use the ramp with plinth heights which exceed the maximum height marked on the ramp next to the fastening screw. (The maximum plinth height is 50 mm when the telescopic ramp is shortest and 150 mm when the ramp is longest.) Tighten the two fastening bolts of the ramp carefully.



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- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Make sure that dust from borings and grindings does not enter the drive when installing. Electrically conductive dust inside the unit may cause damage or malfunctioning.
- Ensure sufficient cooling.
- Do not fasten the drive by riveting or welding.

Fiber optic cables



WARNING! Ignoring the following instructions can cause equipment malfunction and damage to the fiber optic cables:

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

Printed circuit boards



WARNING! Ignoring the following instructions can cause damage to the printed circuit boards:

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



Safe start-up and operation

General safety

These warnings are intended for all who plan the operation of the drive 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 any automatic fault reset functions of the drive control program 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; instead, use the control panel keys  and , or commands via the I/O board of the drive. The maximum allowed number of charging cycles of the DC capacitors, ie, power-ups by applying power, is five in ten minutes.

Note:

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

Permanent magnet motor drives



WARNING! Do not run the motor over the rated speed. Motor overspeed leads to overvoltage which may damage or explode the capacitors in the intermediate circuit of the drive.

Introduction to the manual

What this chapter contains

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

Target audience

This manual is intended for persons who

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

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

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

Contents of the manual

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

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

Introduction to the manual introduces the manual.

Operation principle and hardware description describes the drive module.

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

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

Installation describes how to install the drive module into a cabinet and connect the cables to the drive.

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

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

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

Maintenance contains preventive maintenance instructions.

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

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

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

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

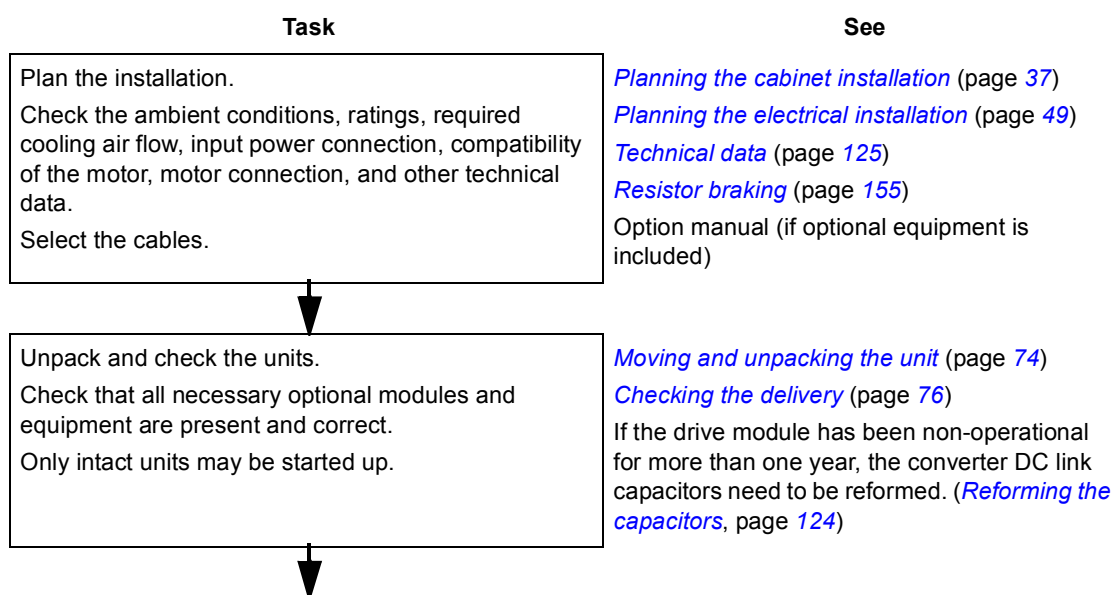
du/dt filters describes how to select du/dt filters for the drive.

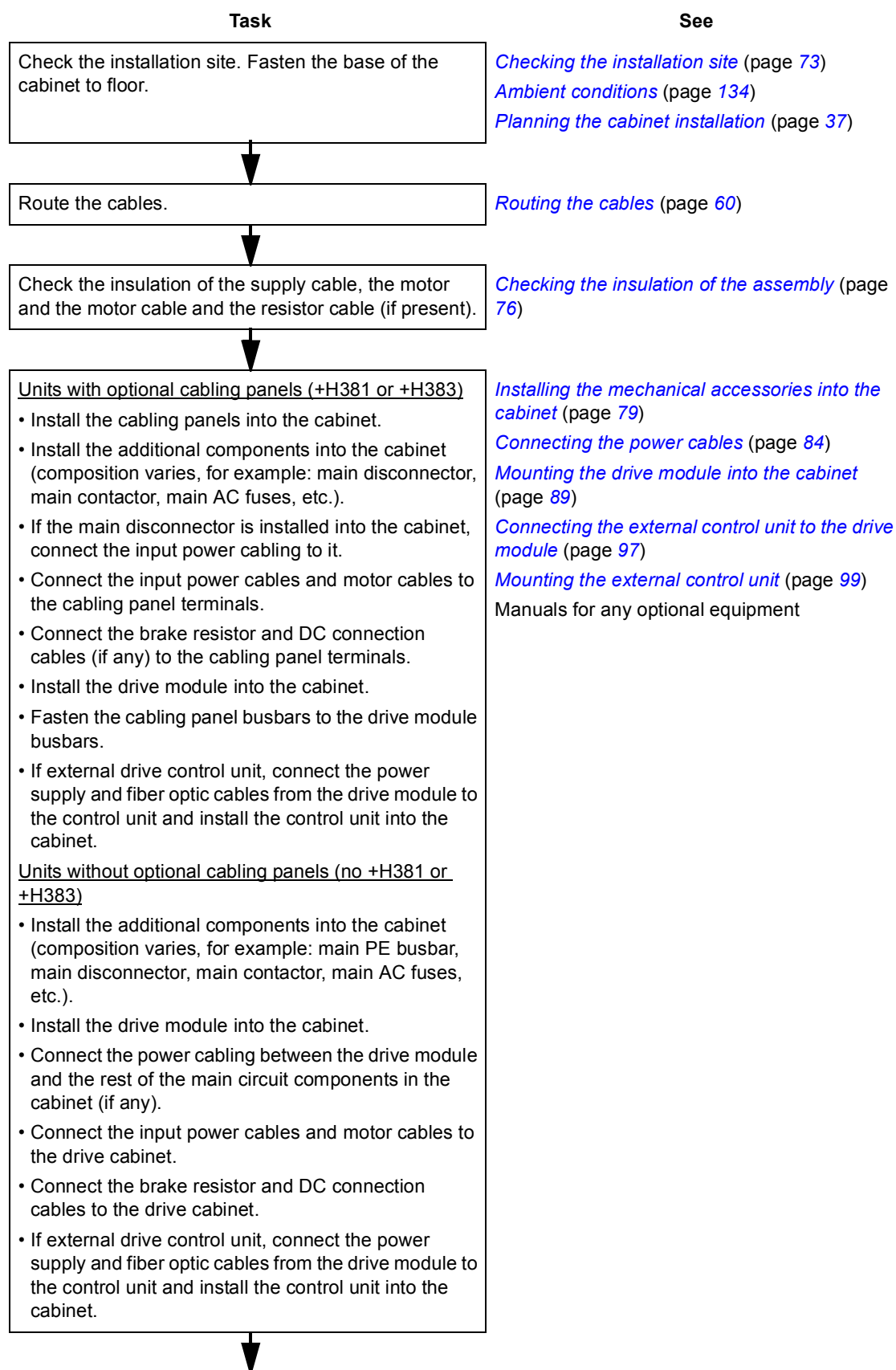
Categorization by frame size and option code

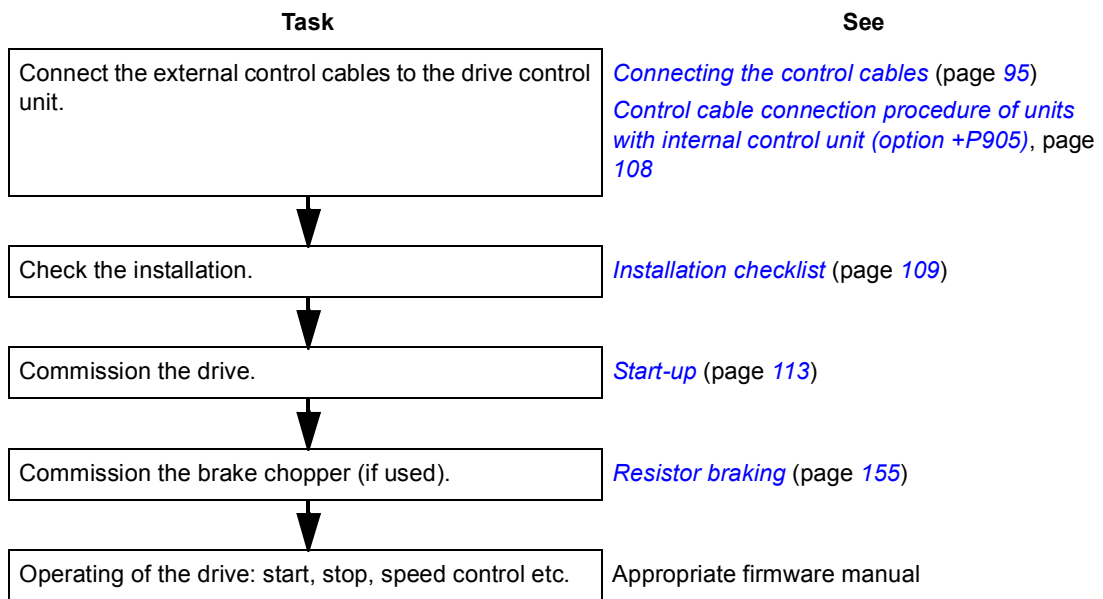
The instructions, technical data and dimension drawings which concern only certain drive frame sizes are marked with the symbol of the frame size (G1 or G2). The frame size is marked on the type designation label.

The instructions and technical data which concern only certain optional selections are marked with option codes, eg, +H381. The options included in the drive can be identified from the option codes visible on the type designation label. The option selections are listed in section *Type designation key* on page 35.

Quick installation, commissioning and operating flowchart







Terms and abbreviations

| Term/Abbreviation | Explanation |
|-------------------|---|
| AIBP | Input bridge protection board |
| APOW | Power supply board |
| BFPS | Power supply board |
| EMC | Electromagnetic compatibility |
| EMI | Electromagnetic interference |
| FCAN-01 | Optional CANopen adapter module |
| FDNA-01 | Optional DeviceNet™ adapter module |
| FECA-01 | Optional EtherCAT® adapter module |
| FEN-01 | Optional TTL encoder interface module |
| FEN-11 | Optional absolute encoder interface module |
| FEN-21 | Optional resolver interface module |
| FEN-31 | Optional HTL encoder interface |
| FENA-11 | Optional Ethernet/IP™, Modbus/TCP and PROFINET IO fieldbus adapter module |
| FIO-01 | Optional digital I/O extension module |
| FIO-11 | Optional analog I/O extension module |
| FIO-21 | Optional analog and digital I/O extension module |
| FLON-01 | Optional LonWorks® adapter module |
| FPBA-01 | Optional PROFIBUS DP adapter module |

| | |
|--------------|--|
| Frame (size) | Size of the drive module. The drive modules described in this manual are of frame size G1 and G2. |
| FSCA-01 | Optional Modbus adapter |
| HTL | High-threshold logic |
| IGBT | Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in converters due to their easy controllability and high switching frequency. |
| I/O | Input/Output |
| JCU | The control unit of the drive module. The external I/O control signals are connected to the JCU, or to optional I/O extension modules mounted on it. |
| JGDR | Gate driver board |
| JINT | Main circuit board |
| JMU-xx | The memory unit attached to the control unit (JCU) |
| JRIB | Adapter board connected to the control board in the control unit (JCU) |
| STO | Safe torque off |
| SynRM | Synchronous reluctance motor |
| RFI | Radio-frequency interference |
| TTL | Transistor-transistor logic |

Operation principle and hardware description

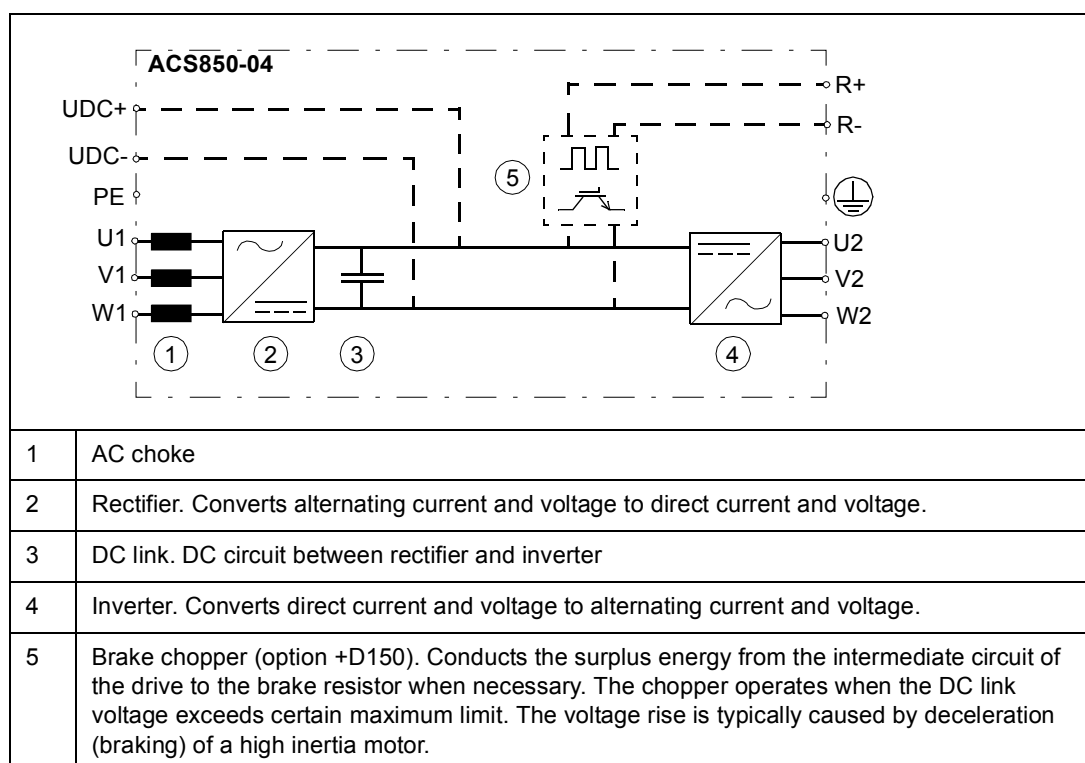
What this chapter contains

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

Product overview

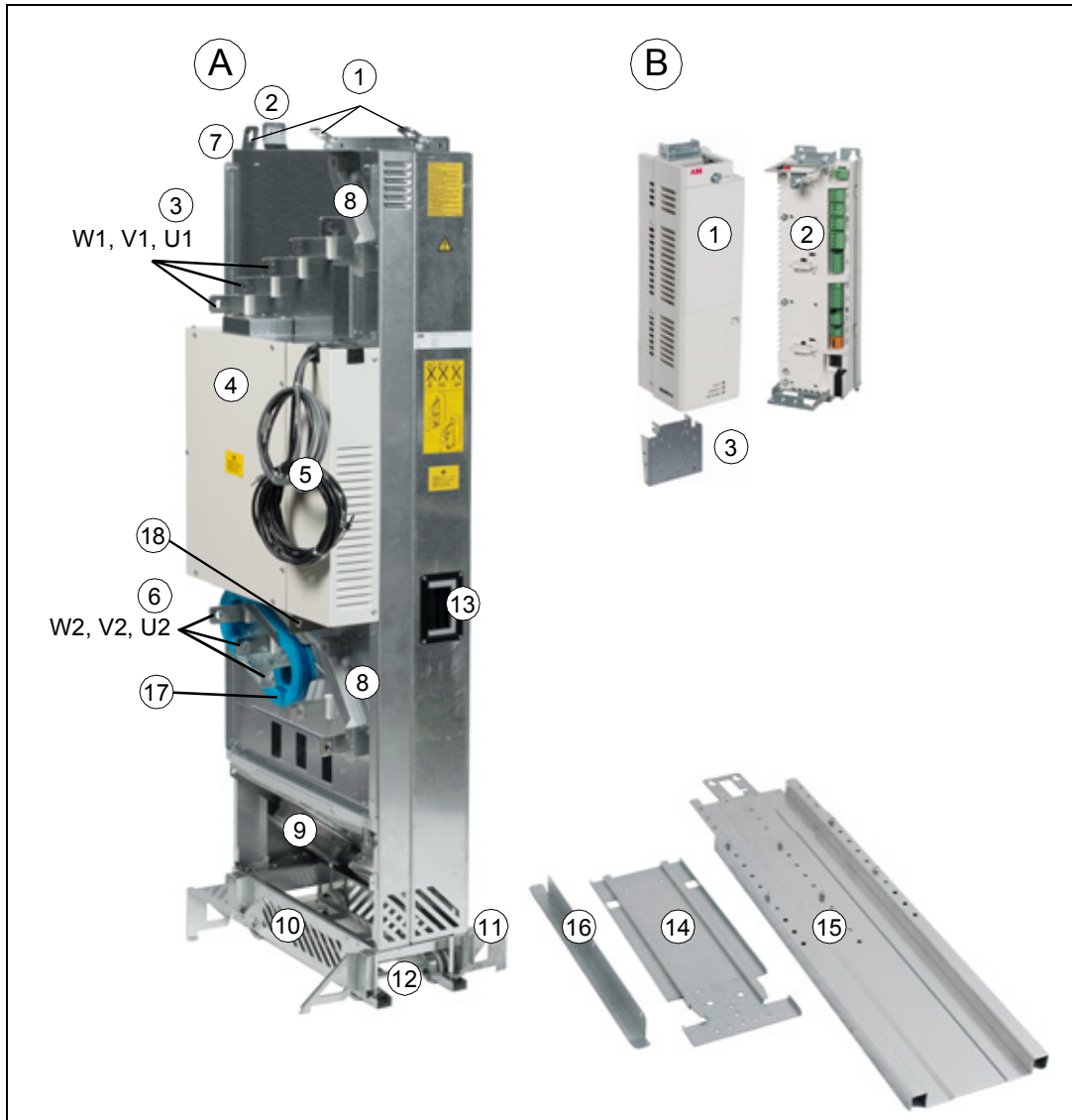
The ACS850-04 is a drive module for controlling asynchronous AC induction motors, permanent magnet motors and ABB synchronous reluctance motors (SynRM motors).

The main circuit of the drive module is shown below.



Layout

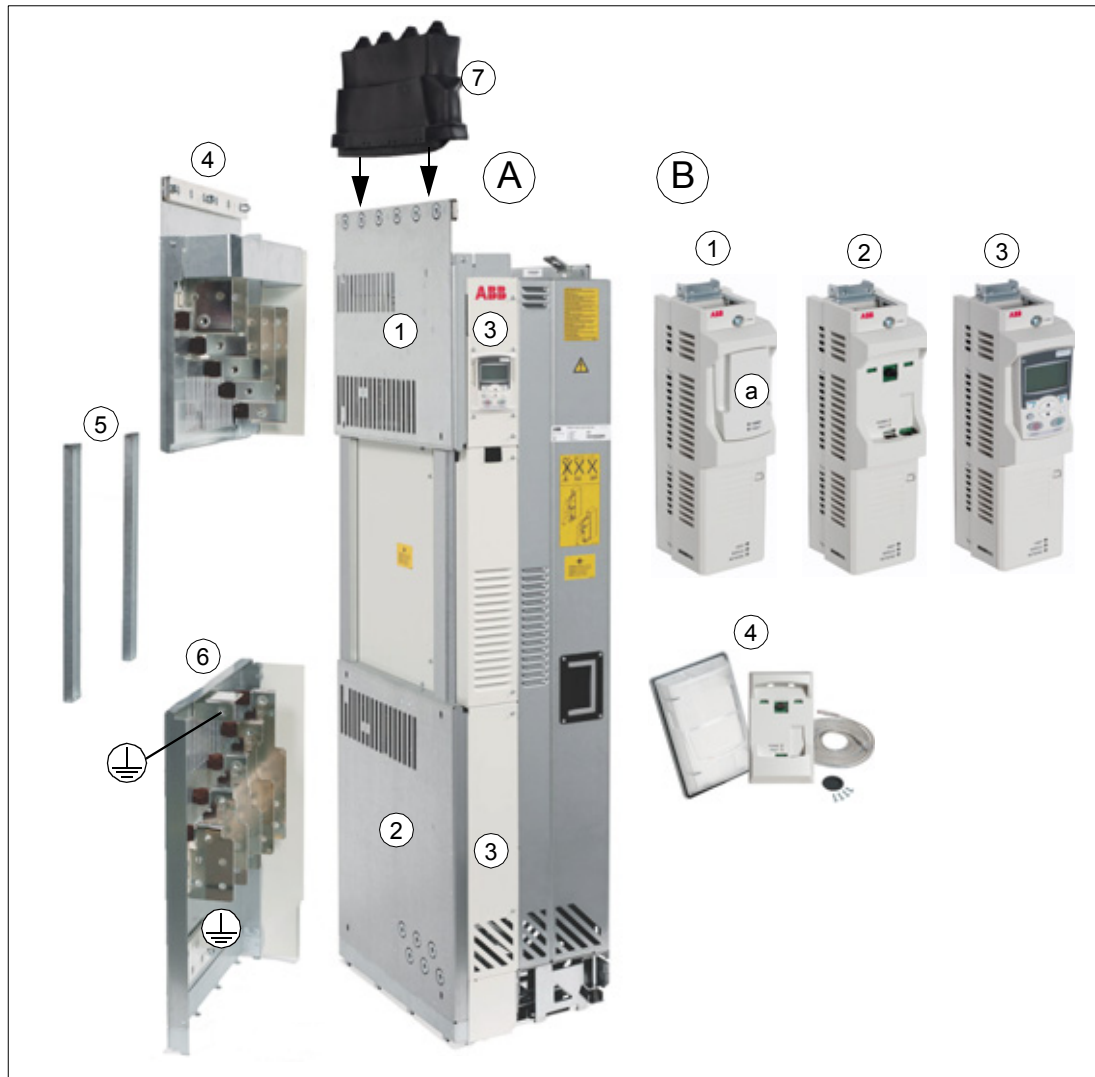
The components of the standard unit are shown below.



| Item | Description |
|----------|--|
| A | Drive module |
| 1 | Lifting lugs |
| 2 | Fastening bracket |
| 3 | Input cable connection busbars and optional DC+ and DC- busbars (+H356) |
| 4 | Circuit board compartment |
| 5 | Power supply and fiber optic cables to be connected to the external control unit |
| 6 | Output cable connection busbars and optional brake resistor connection busbars (+D150) |
| 7 | PE terminal |
| 8 | Control cable duct |
| 9 | Main cooling fans |
| 10 | Pedestal |
| 11 | Retractable support legs |

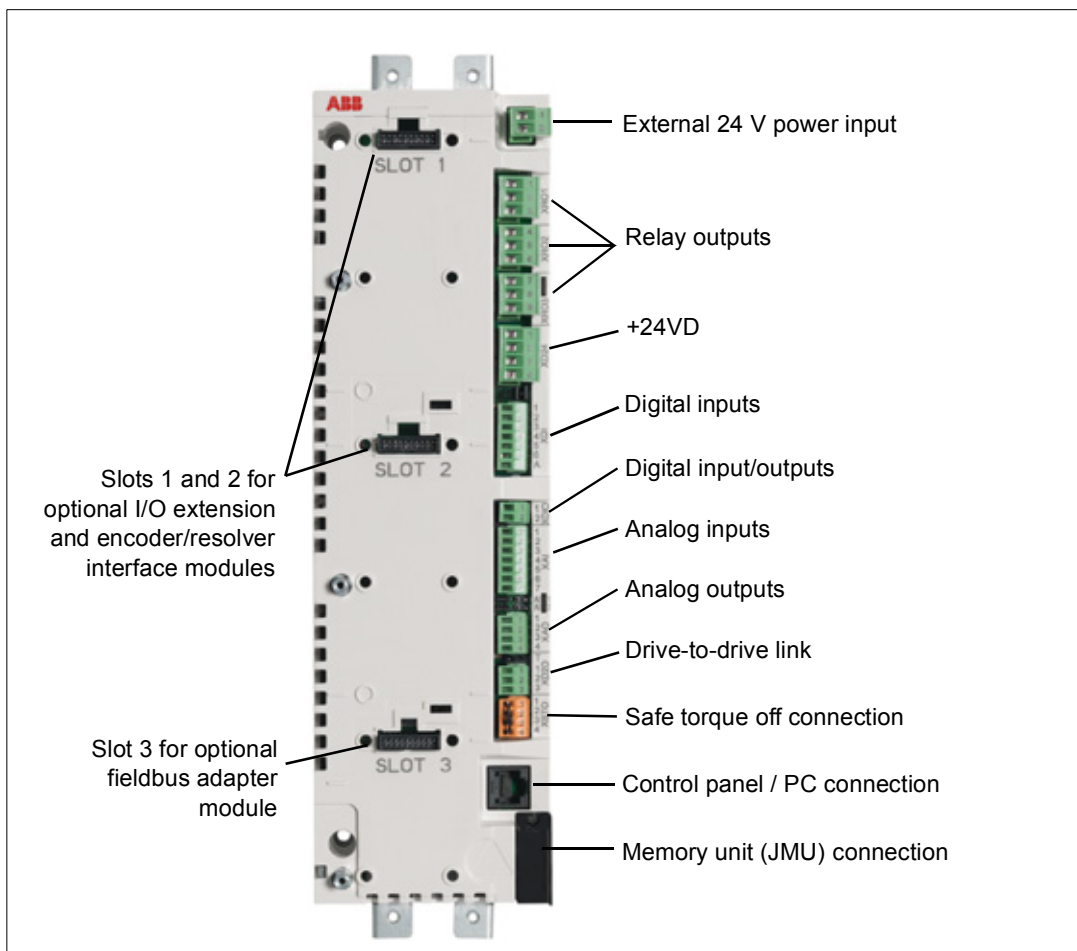
| Item | Description |
|-------------|--|
| 12 | Base fastening screws |
| 13 | Handle for pulling the drive module out of the cabinet |
| 14 | Pedestal guide plate |
| 15 | Telescopic extraction and insertion ramp |
| 16 | Top guide plate |
| 17 | Optional common mode filter (+E208) |
| 18 | Grounding busbar |
| B | Control unit (JCU) |
| 1 | Control unit with front cover |
| 2 | Control unit with front cover removed |
| 3 | Control cable clamp plate |

The drive module and optional selections are shown below: control unit and control panel variations and cabling panels.



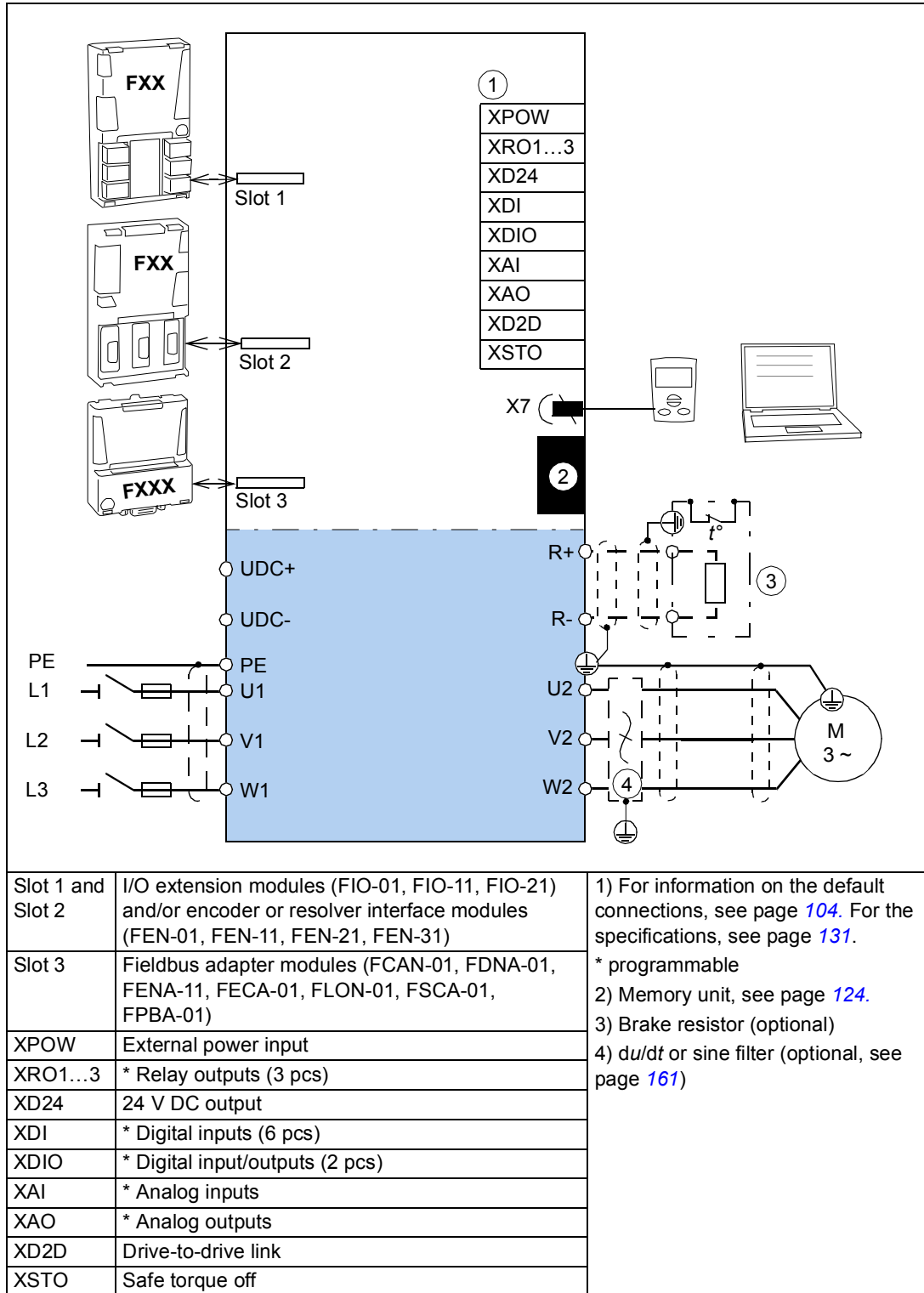
| Item | Description |
|----------|--|
| A | Drive module |
| 1 | Input power cabling panel to be fastened to the cabinet (+H381 or +H383) |
| 2 | Output power cabling panel to be fastened to the cabinet (+H381 or +H383) |
| 3 | Front cover. With option +P905, the control panel is placed on this cover. |
| 4 | Input power cabling panel (+H381 or +H383) |
| 5 | Side guides (+H381 or +H383) |
| 6 | Output power cabling panel (+H381 or +H383) |
| 7 | Rubber grommet (+H381) |
| B | Control unit variants |
| 1 | Control unit with control panel holder (+J414) |
| 2 | Control unit with control panel holder (+J414) when cover (a) is removed |
| 3 | Control unit with control panel (+J400) |
| 4 | Control panel door mounting kit (+J410) |

The control unit layout is shown below (cover assembly and protective coverings of the slots removed).



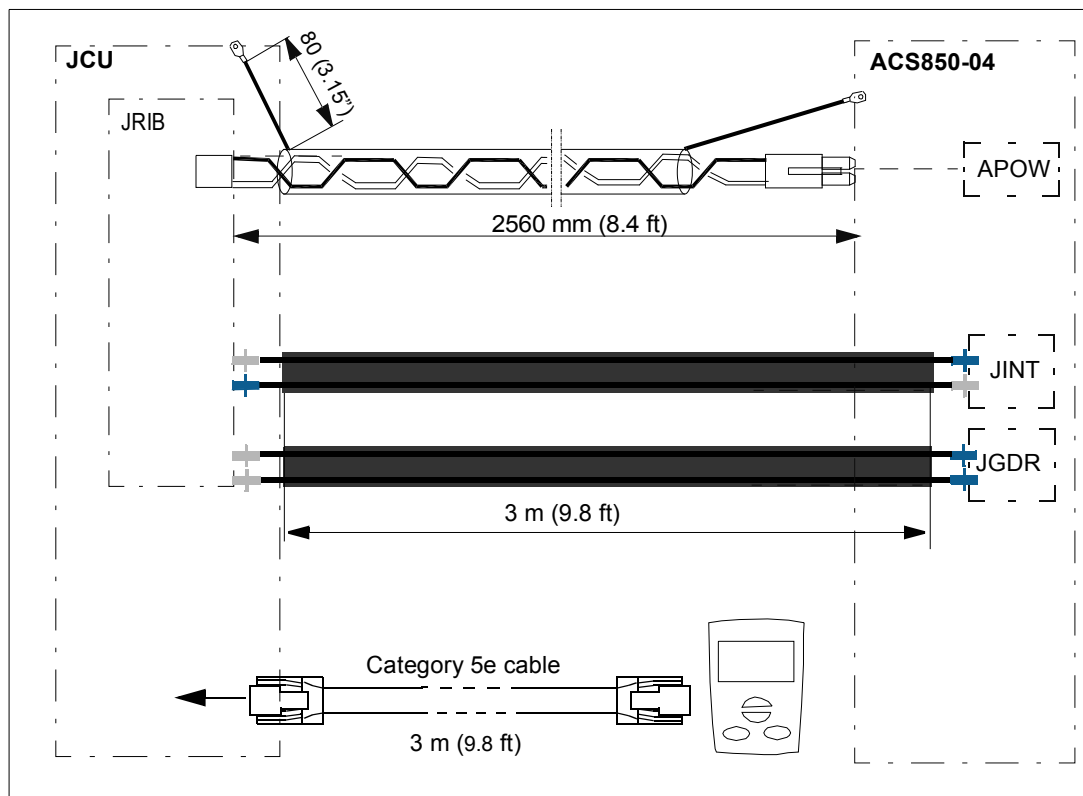
Power connections and control interfaces

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



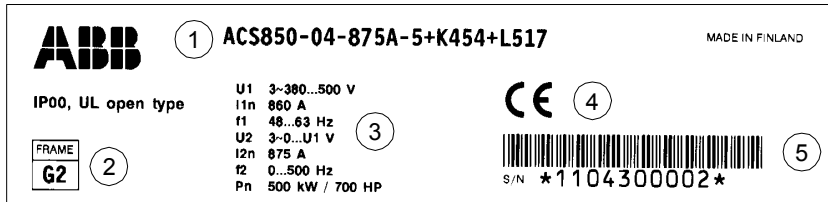
External control unit connection cables

The cables for connecting the drive module and control panel to the control unit are shown below. See sections [Connecting the external control unit to the drive module](#) (page 97) and [Connecting a PC](#) (page 108) for the actual connections.



Type designation label

The type designation label includes an IEC and NEMA rating, CE and cULus, and CSA markings, a type designation and a serial number, which allow individual recognition of each unit. The type designation label is located on the front cover. An example label is shown below.



| No. | Description |
|-----|---|
| 1 | Type designation, see section Type designation key on page 35. |
| 2 | Frame size |
| 3 | Ratings |
| 4 | Valid markings |
| 5 | Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number. |

Type designation key

The type designation contains information on the specifications and configuration of the drive module. The first digits from left express the basic configuration. The optional selections are given thereafter, separated by plus signs, eg, +E208. The main selections are described below. Not all selections are available for all types. For more information, refer to *ACS850-04 Ordering Information* (3AXD00000579470), available on request.

| Code | Description |
|---|---|
| Basic code, eg, ACS850-04-710A-5 | |
| Product series | |
| ACS850 | ACS850 product series |
| Type | |
| 04 | Air-cooled drive module. When no options are selected: IP00 (UL type open), top entry and bottom exit for cables (terminals at the side of the module), external JCU control unit with a front cover but no control panel, Standard Control Program, AC choke, coated boards, Safe torque off function, pedestal guide plate, extraction and insertion ramp, module fastening bracket and screws, hardware manual, multilingual quick start-up guide and CD containing all manuals. |
| Size | |
| xxxA | Refer to the rating tables, page 125 . |
| Voltage range | |
| 5 | 380...500 V AC |
| Option codes (plus codes) | |
| Resistor braking | |
| D150 | Brake chopper and brake resistor connection busbars, and R+ and R- terminals in the power cabling panel (+H381 or +H383) if the power cabling panels are ordered |
| Filters | |
| E208 | Common mode filter. Includes three extension busbars to the drive module output busbars with units without option +H381 or +H383. |
| Cabling panels | |
| H381 | Power cabling panels (U1, V1, W1, U2, V2, W2 terminals) to be installed in the cabinet, rubber grommet that gives the unit an IP20 protection class. |
| H383 | Power cabling panels (U1, V1, W1, U2, V2, W2 terminals) to be installed in the cabinet, degree of protection: IP00. |
| DC busbars | |
| H356 | DC output busbars, and DC+ and DC- terminals in the power cabling panel (+H381 or +H383) if the power cabling panels are ordered |
| Pedestal | |
| 0H354 | No pedestal |
| Control panel and control unit | |
| J400 | Control panel inserted onto the JCU control unit. Includes control panel mounting platform and internal cable. |
| J410 | Control panel with a door mounting kit. Includes control panel mounting platform, IP54 cover and a 3-meter panel connection cable. |
| J414 | Control panel holder with cover and internal cable but no control panel. Not to be used with +J400. |
| 0C168 | Without front cover for the JCU control unit |
| P905 | JCU control unit inside the circuit board compartment of drive module. |

| Code | Description |
|--|---|
| Fieldbus adapter modules | |
| K451 | FDNA-01 DeviceNet™ fieldbus adapter module |
| K452 | FLON-01 LonWorks® fieldbus adapter module |
| K454 | FPBA-01 PROFIBUS DP fieldbus adapter module |
| K457 | FCAN-01 CANopen fieldbus adapter module |
| K458 | FSCA-01 Modbus fieldbus adapter module |
| K469 | FECA-01 EtherCAT® fieldbus adapter module |
| K473 | FENA-11 Ethernet/IP™, Modbus/TCP and PROFINET IO fieldbus adapter module |
| I/O extension and feedback interface modules | |
| L500 | FIO-11 analog I/O extension module |
| L501 | FIO-01 digital I/O extension module |
| L502 | FEN-31 HTL incremental encoder interface module |
| L516 | FEN-21 resolver interface module |
| L517 | FEN-01 TTL incremental encoder interface module |
| L518 | FEN-11 TTL absolute encoder interface module |
| L519 | FIO-21 analog and digital I/O extension module |
| Control programs | |
| N2007 | Standard control program version UIF12110 (frame G2 only) |
| N2008 | Standard control program version UIF12200 (frame G2 only) |
| N2009 | Standard control program version UIF12210 (frame G2 only) |
| N2010 | Standard control program version UIF12300 (frame G2 only) |
| N3050 | Crane technology library |
| N5050 | Crane control program. Requires option +N3050. |
| N7502 | SynRM control program |
| Warranty | |
| P904 | Extended warranty |
| ATEX-certified function | |
| Q971 | ATEX-certified Safe motor disconnection function using the drive Safe torque off function |
| Paper manuals. Note: The delivered manual set may include manuals in English if the translation is not available. | |
| R700 | English |
| R701 | German |
| R702 | Italian |
| R703 | Dutch |
| R704 | Danish |
| R705 | Swedish |
| R706 | Finnish |
| R707 | French |
| R708 | Spanish |
| R709 | Portuguese |
| R710 | Portuguese spoken in Brazil |
| R711 | Russian |
| R714 | Turkish |

Planning the cabinet installation

What this chapter contains

This chapter guides in planning drive cabinets and installing the drive module into a user-defined cabinet so that the front of the module faces the cabinet door. The chapter gives cabinet layout examples and free space requirements around the module for cooling. The issues discussed are essential for the safe and trouble-free use of the drive system.

Limitation of liability

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

Basic requirements for the cabinet

Use a cabinet which:

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

Planning the layout of the cabinet

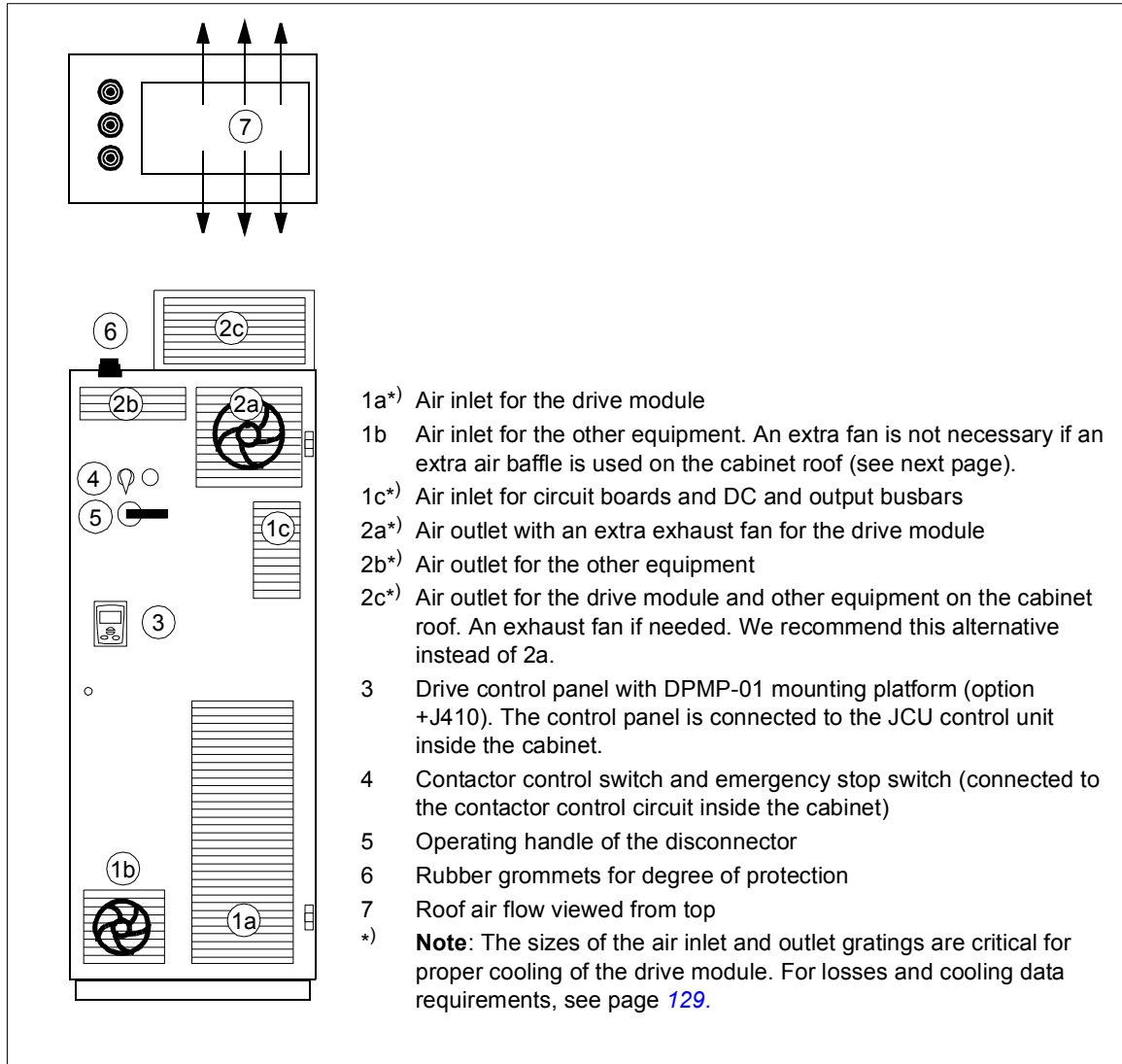
Design a spacious layout to ensure easy installation and maintenance. Sufficient cooling air flow, obligatory clearances, cables and cable support structures all require space.

Place the control board(s) away from:

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

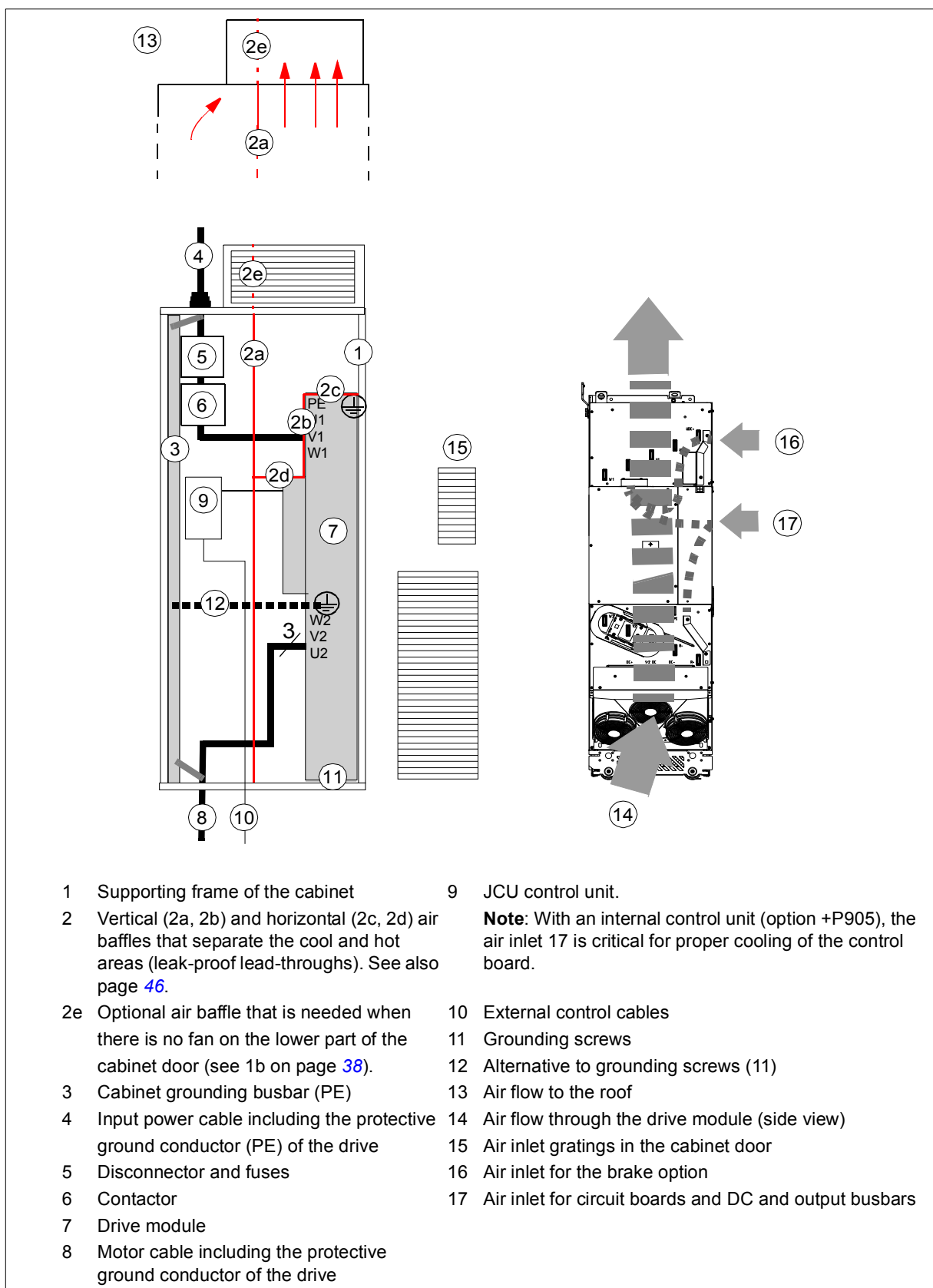
Layout examples, door closed

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



Layout example, door open

This diagram shows a layout example when optional cabling panels are not used.



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

Note 2: See also section [Required free space](#), page 47.

Arranging the grounding inside the cabinet

Arrange the grounding of the drive module by leaving the contact surfaces of the fastening points unpainted (bare metal-to-metal contact). The module frame will be grounded to the PE busbar of the cabinet via the fastening surfaces, screws and the cabinet frame. Alternatively, use a separate grounding conductor between the PE terminal of the drive module and the PE busbar of the cabinet.

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

Selecting the busbar material and preparation of the joints

If planning the use of busbars, note the following:

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

Tightening torques

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

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

Planning the fastening of the cabinet

Note the following when planning the fastening of the cabinet:

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

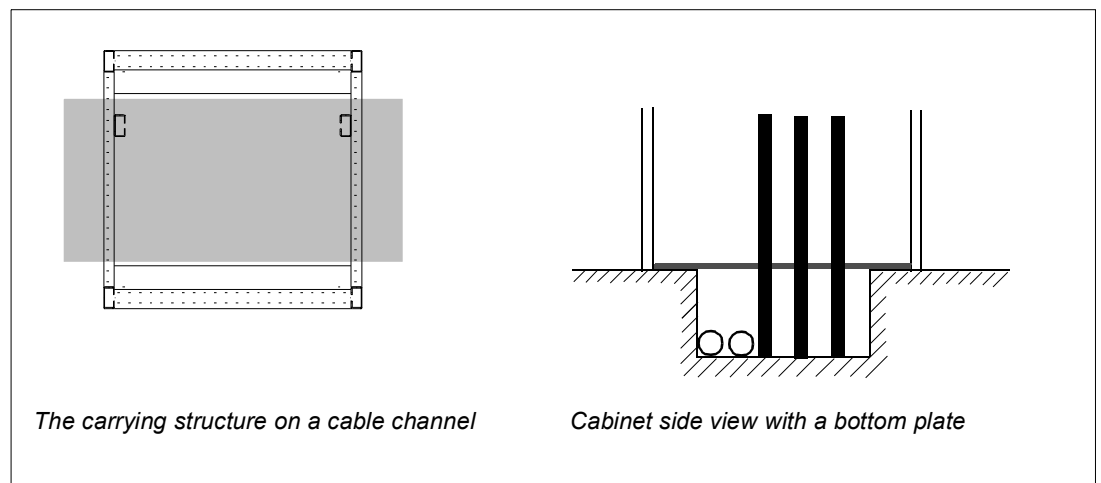


WARNING! Do not fasten the cabinet by electric welding. ABB does not assume any liability for damages caused by electric welding as the welding circuit may damage electronic circuits in the cabinet.

Planning the cabinet placement on a cable channel

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

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

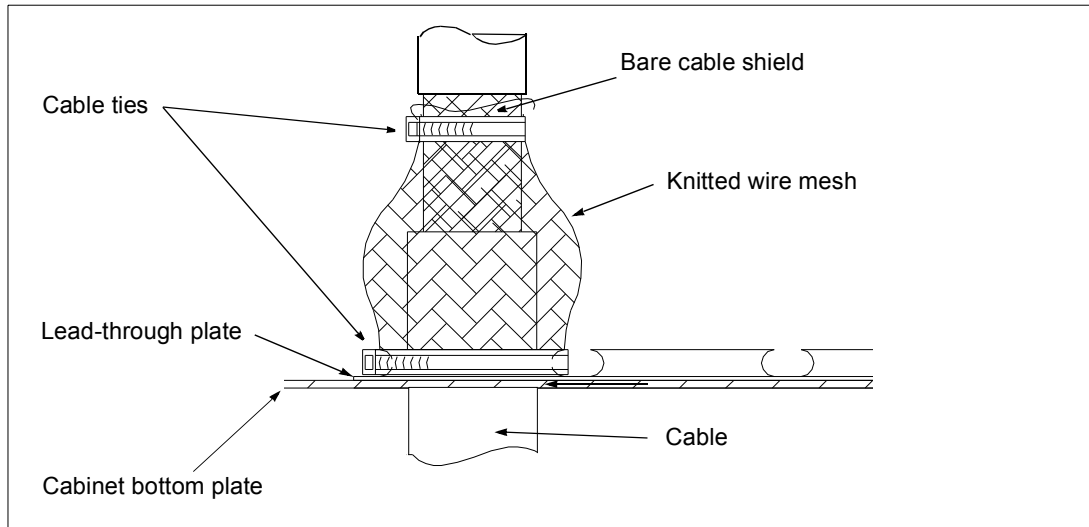


Planning the electromagnetic compatibility (EMC) of the cabinet

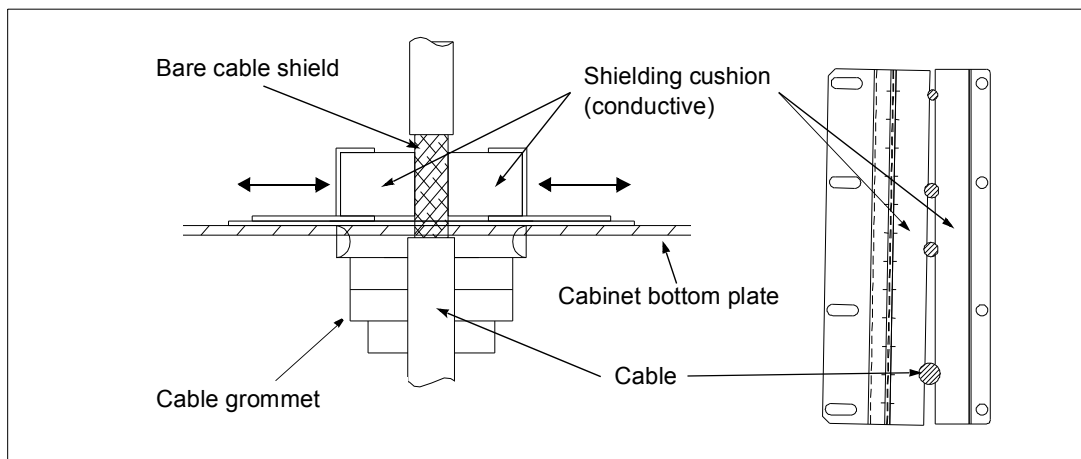
Note following when planning the electromagnetic compatibility of the cabinet:

- Generally, the fewer and smaller the holes in the cabinet, the better the interference attenuation. The maximum recommended diameter of a hole in galvanic metal contact in the covering cabinet structure is 100 mm. Pay special attention to the cooling air inlet and outlet gratings.
- The best galvanic connection between the steel panels is achieved by welding them together as no holes are necessary. If welding is not possible, 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.
- Construct sufficient high-frequency grounding network in the cabinet to avoid voltage differences and forming of high-impedance radiator structures. A good high-frequency grounding is made with short flat copper braids for low inductance. One-point high-frequency grounding cannot be used due to the long distances inside the cabinet.

- 360° high frequency grounding of the cable shields at the cable lead-throughs improves the EMC shielding of the cabinet.
- 360° high frequency grounding of the motor cable shields at their entries is recommended. The grounding can be implemented by a knitted wire mesh screening as shown below.

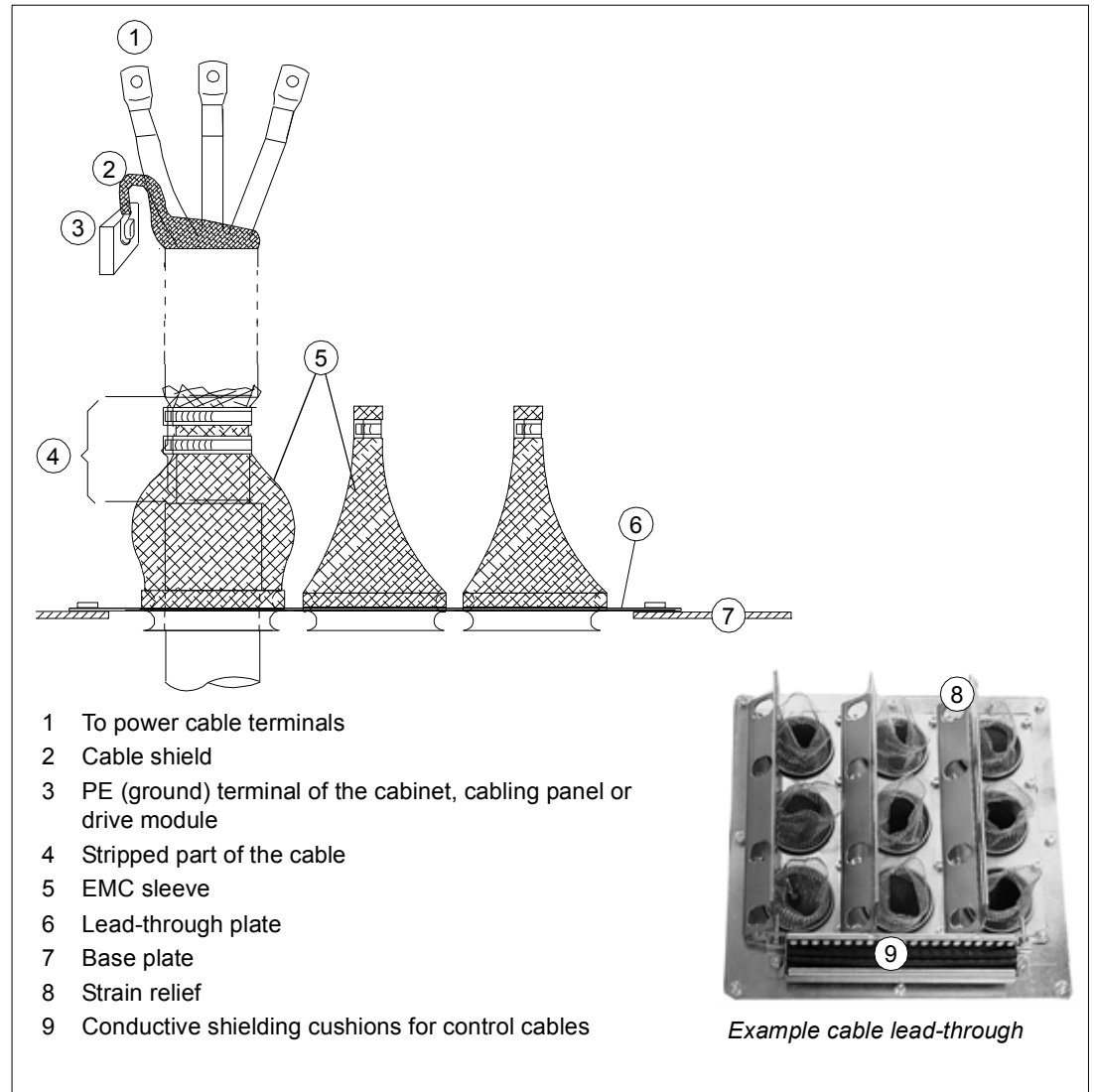


- 360° high frequency grounding of the control cable shields is recommended at their entries. The shields can be grounded by means of conductive shielding cushions pressed against the cable shield from both directions:



Planning the grounding of the cable shields at the cabinet lead-through

Follow the principle shown below when planning the grounding of the cable shields at the cabinet lead-through.

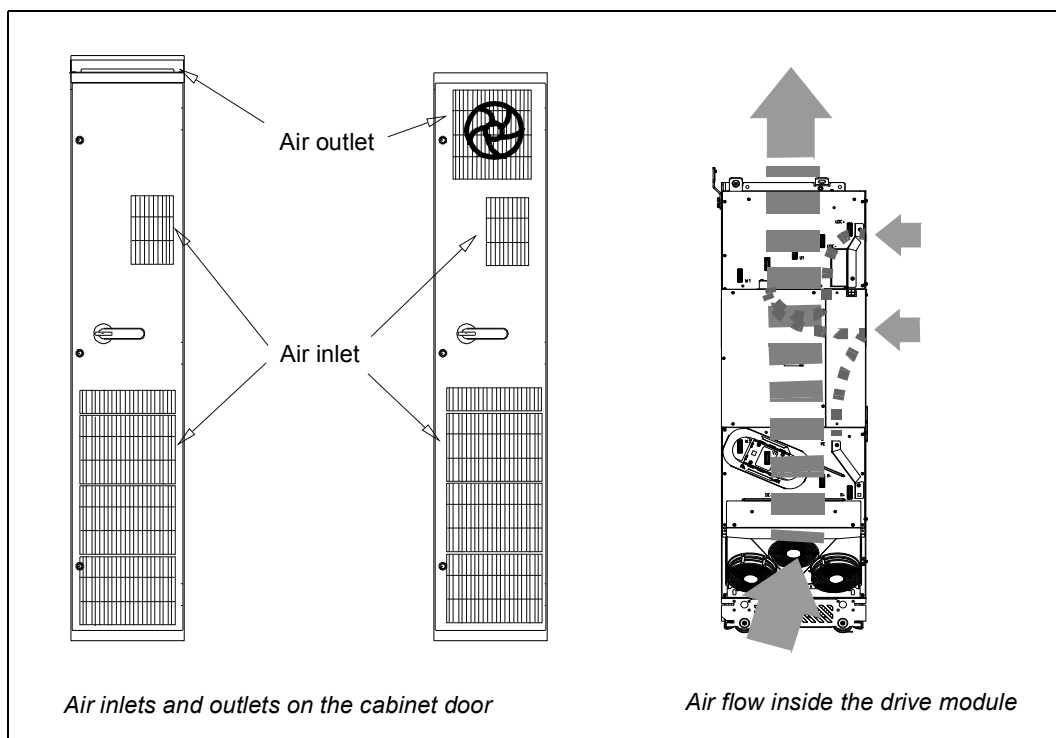


Planning the cooling

Note following guidelines when planning the cooling of the cabinet:

- Ventilate the installation site sufficiently so that the cooling air flow and ambient temperature requirements of the drive module are met, see pages [129](#) and [134](#). The internal cooling fan of the drive module rotates at a constant speed thus blowing constant air flow through the module. Whether the same amount of air must be replaced all the time in the facility depends on how much heat must be removed.

- Leave enough free space around the components to ensure sufficient cooling. Observe the minimum clearances given for each component. For the required free space around the drive module, see page 47.
- Also ventilate the heat dissipated by cables and other additional equipment.
- **Make sure that the air inlets and outlets are large enough to allow sufficient air flow in and out of the cabinet.** This is critical for proper cooling of the drive module.
- Equip the air inlets and outlets with gratings that:
 - guide the air flow
 - protect against contact
 - prevent water splashes from entering the cabinet.
- The drawing below shows two typical cabinet cooling solutions. The air inlet is at the bottom of the cabinet, while the outlet is at the top, either on the upper part of the door or on the roof. We recommend that the air outlet is on the cabinet roof. Use an extra exhaust fan if the air outlet is on the cabinet door.



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

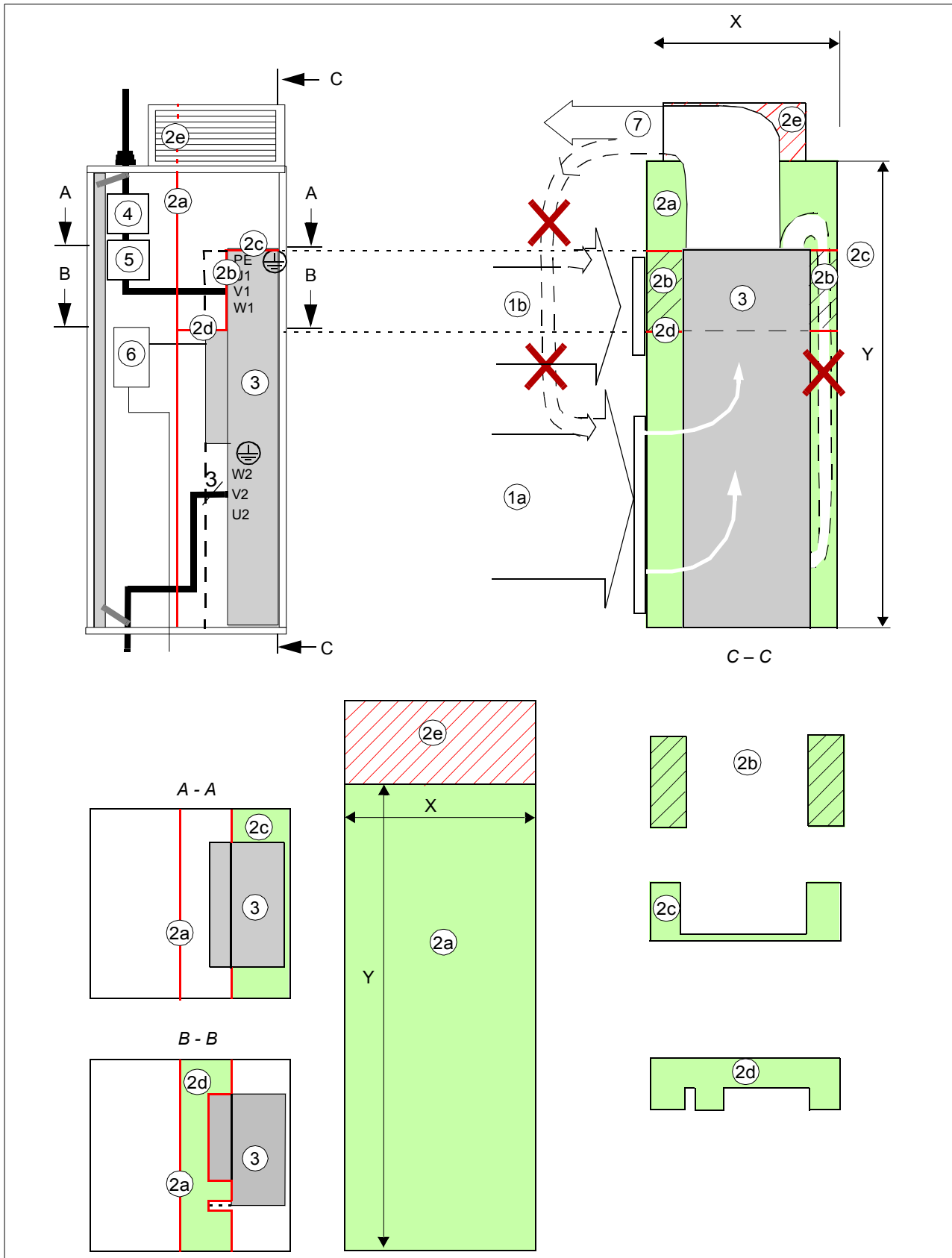
Preventing the recirculation of hot air

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

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

Prevent hot air circulation inside the cabinet with, for example, leak-proof air baffles at the positions shown in the diagram below. No gaskets are usually required.

| | | | |
|----|--|---|------------------------|
| 1a | Air flow to the drive module, max. 40 °C (104 °F) | 3 | Drive module |
| 1b | Air inlet to the drive circuit boards and DC and output busbars | 4 | Disconnecter and fuses |
| 2a | Vertical air baffle that separates the cool and hot areas in the cabinet | 5 | Contactator |
| 2b | Vertical air baffle | 6 | JCU control unit |
| 2c | Upper horizontal air baffle | 7 | Air flow out |
| 2d | Lower horizontal air baffle | | |
| 2e | Optional air baffle that is needed when there is no fan on the lower part of the cabinet door (see 1b on page 38). | | |

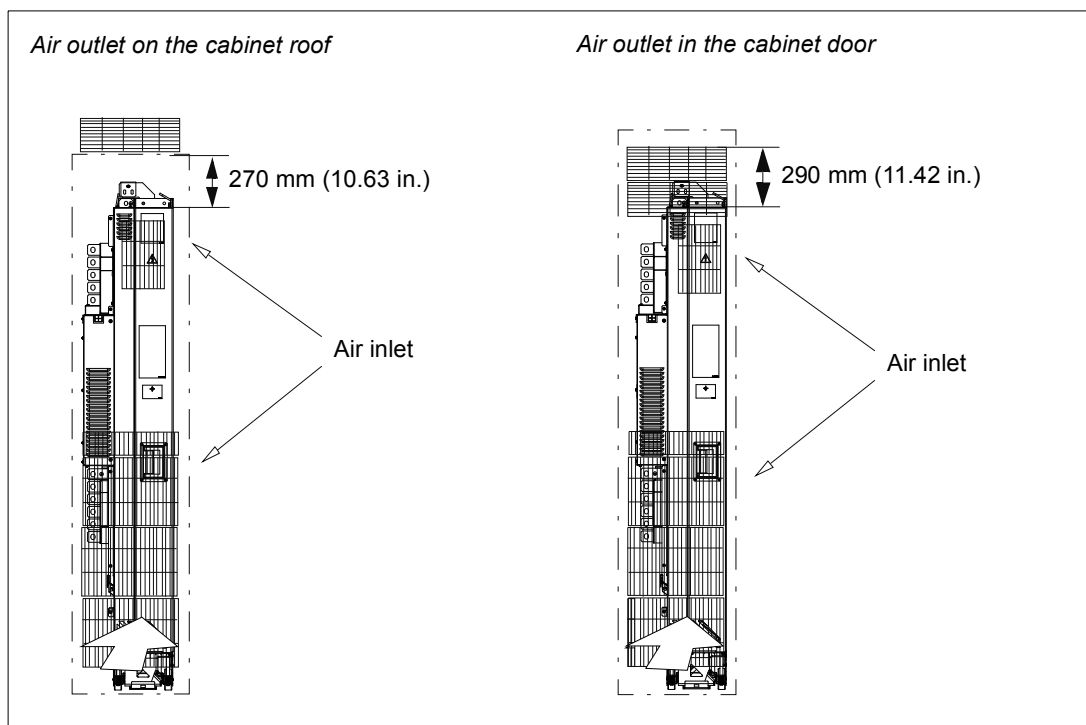


Required free space

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

Free space at the top of the drive module

The required free space at the top of the module is shown below when a) the air outlet is on the cabinet roof or b) on the upper part of the cabinet door. The air inlets on the cabinet door are also shown.



Free space around the drive module

20 mm (0.79 in.) free space around the drive module is required from the cabinet back panel and front door. No free space for cooling is required on the left- and right-hand sides of the module.

The module is designed to be installed in a cabinet with the following measurements: width 400 mm (15.75 in.), depth 600 mm (23.62 in.) and height 2000 mm (78.74 in.).

Other installation positions

Contact your local ABB representative.

Planning the placement of the control panel

Note the following alternatives when planning the placement of the control panel:

- The control panel can be snapped on the control unit of the drive. See page [30](#).
- The control panel can be mounted onto the cabinet door using the control panel mounting kit (+J410). For the installation instructions, refer to *ACS-CP-U Control Panel IP54 Mounting Platform Kit (+J410) Installation Guide (3AUA0000049072 [English])*.

Planning the use of the cubicle heaters

Use a cubicle heater if there is a risk of condensation in the cabinet. Although the primary function of the heater is to keep the air dry, it may also be required for heating at low temperatures.

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 system.

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

Selecting the supply disconnecting device

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

European Union

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

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

Other regions

The disconnecting device must conform to the applicable safety regulations.

Selecting and dimensioning the main contactor

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

Protecting the motor insulation and bearings

The drive employs modern IGBT inverter technology. Regardless of frequency, the drive output comprises pulses of approximately the drive DC bus voltage with a very short rise time. The pulse voltage can almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This 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.

Optional du/dt filters protect motor insulation system and reduce bearing currents. Common mode filters mainly reduce bearing currents. Insulated N-end (non-drive) bearings protect the motor bearings. See section [Checking the compatibility of the motor and drive](#) below for the required filters and N-end bearings to be used with the drive. Select and install the cables according to the instructions given in the hardware manual.

Checking the compatibility of the motor and drive

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

Select the motor and drive according to the rating tables in chapter [Technical data](#). Use the DriveSize PC tool if the default load cycles are not applicable.

1. Check that the motor ratings lie within the allowed ranges of the drive control program:
 - motor nominal voltage is in the range of $1/2 \dots 2 \cdot U_N$
 - motor nominal current is $1/6 \dots 2 \cdot I_{Hd}$ of the drive in DTC control and $0 \dots 2 \cdot I_{Hd}$ in scalar control. The control mode is selected by a control program parameter.
2. Check that the motor voltage rating meets the application requirements:

| When | ... the motor voltage rating should be ... |
|---|--|
| No resistor braking is in use | U_N |
| Frequent or long term brake cycles will be used | $1.21 \cdot U_N$ |

$U_N \hat{=}$ Input voltage of the drive

See section [Additional requirements for the braking applications](#) on page 53.

3. Consult the motor manufacturer before using a motor in a drive system where the motor nominal voltage differs from the AC power source voltage.
4. Ensure that the motor insulation system withstands the maximum peak voltage in the motor terminals. See the [Requirements table](#) below for the required motor insulation system and drive filtering.

Example 1: When the supply voltage is 440 V and the drive is operating in the motor mode only, the maximum peak voltage in the motor terminals can be approximated as follows: $440 \text{ V} \cdot 1.35 \cdot 2 = 1190 \text{ V}$. Check that the motor insulation system withstands this voltage.

Requirements table

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

| Manufacturer | Motor type | Nominal mains voltage (AC line voltage) | Motor insulation system | Requirement for | | |
|---------------------------------|--|--|--|--|--|---|
| | | | | ABB du/dt filter, insulated N-end bearing and ABB common mode filter | | |
| | | | | $P_N < 100 \text{ kW}$ and frame size $< \text{IEC 315}$ | $100 \text{ kW} \leq P_N < 350 \text{ kW}$ or frame size $\geq \text{IEC 315}$ | $P_N \geq 350 \text{ kW}$ or frame size $\geq \text{IEC 400}$ |
| | | | | | | |
| A B B | Random-wound M2_, M3_ and M4_ | $U_N \leq 500 \text{ V}$ | Standard | - | + N | + N + CMF |
| | | $500 \text{ V} < U_N \leq 600 \text{ V}$ | Standard | + du/dt | + du/dt + N | + du/dt + N + CMF |
| | | | or | Reinforced | - | + N |
| | | $600 \text{ V} < U_N \leq 690 \text{ V}$ (cable length $\leq 150 \text{ m}$) | Reinforced | + du/dt | + du/dt + N | + du/dt + N + CMF |
| | | $600 \text{ V} < U_N \leq 690 \text{ V}$ (cable length $> 150 \text{ m}$) | Reinforced | - | + N | + N + CMF |
| | Form-wound HX_ and AM_ | $380 \text{ V} < U_N \leq 690 \text{ V}$ | Standard | n.a. | + N + CMF | $P_N < 500 \text{ kW}$: + N + CMF $P_N \geq 500 \text{ kW}$: + N + CMF + du/dt |
| Old* form-wound HX_ and modular | $380 \text{ V} < U_N \leq 690 \text{ V}$ | Check with the motor manufacturer. | + du/dt with voltages over 500 V + N + CMF | | | |
| Random-wound HX_ and AM_** | $0 \text{ V} < U_N \leq 500 \text{ V}$ | Enamelled wire with fibre glass taping | + N + CMF | | | |
| | $500 \text{ V} < U_N \leq 690 \text{ V}$ | | + du/dt + N + CMF | | | |
| HDP | Consult the motor manufacturer. | | | | | |

| Manufacturer | Motor type | Nominal mains voltage (AC line voltage) | Requirement for | | | | |
|--|---|--|---|--|--|--|--|
| | | | Motor insulation system | ABB du/dt filter, insulated N-end bearing and ABB common mode filter | | | |
| | | | | $P_N < 100 \text{ kW}$ and frame size < IEC 315 | $100 \text{ kW} \leq P_N < 350 \text{ kW}$ or frame size \geq IEC 315 | $P_N \geq 350 \text{ kW}$ or frame size \geq IEC 400 | |
| | | | | $P_N < 134 \text{ hp}$ and frame size < NEMA 500 | $134 \text{ hp} \leq P_N < 469 \text{ hp}$ or frame size \geq NEMA 500 | $P_N \geq 469 \text{ hp}$ or frame size > NEMA 580 | |
| NON-ABB | Random-wound and form-wound | $U_N \leq 420 \text{ V}$ | Standard: $\hat{U}_{LL} = 1300 \text{ V}$ | - | + N or CMF | + N + CMF | |
| | | $420 \text{ V} < U_N \leq 500 \text{ V}$ | Standard: $\hat{U}_{LL} = 1300 \text{ V}$ | + du/dt | + du/dt + N | + du/dt + N + CMF | |
| | | | | or | | | |
| | | | | + du/dt + CMF | | | |
| | | or | | | | | |
| | | $500 \text{ V} < U_N \leq 600 \text{ V}$ | Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$, 0.2 microsecond rise time | - | + N or CMF | + N + CMF | |
| | | | | + du/dt | + du/dt + N | | |
| | | | | or | | | |
| | | | | + du/dt + CMF | | | |
| | | or | | | | | |
| $600 \text{ V} < U_N \leq 690 \text{ V}$ | Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$ | - | + N or CMF | + N + CMF | | | |
| | | + du/dt | + du/dt + N | | | | |
| | | - | N + CMF | | N + CMF | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

* manufactured before 1.1.1998

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

*** If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

The abbreviations are defined below.

| Abbreviation | Definition |
|----------------|---|
| U_N | Nominal voltage of the supply network |
| \hat{U}_{LL} | Peak line-to-line voltage at motor terminals which the motor insulation must withstand |
| P_N | Motor nominal power |
| du/dt | du/dt filter at the output of the drive |
| CMF | Common mode filter +E208 |
| N | N-end bearing: insulated motor non-drive end bearing |
| n.a. | Motors of this power range are not available as standard units. Consult the motor manufacturer. |

Additional requirements for explosion-safe (EX) motors

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

Additional requirements for HXR and AMA motors

All AMA machines (manufactured in Helsinki) for drive systems have form-wound windings. All HXR machines manufactured in Helsinki starting 1.1.1998 have form-wound windings.

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

Use the selection criteria given for non-ABB motors.

Additional requirements for the braking applications

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

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

Additional requirements for ABB high-output motors and IP23 motors

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

| Nominal AC supply voltage | Motor insulation system | Requirement for | | |
|--|-------------------------|---|--|---------------------------|
| | | ABB du/dt and common mode filters, insulated N-end motor bearings | | |
| | | $P_N < 100 \text{ kW}$ | $100 \text{ kW} \leq P_N < 200 \text{ kW}$ | $P_N \geq 200 \text{ kW}$ |
| | | $P_N < 140 \text{ hp}$ | $140 \text{ hp} \leq P_N < 268 \text{ hp}$ | $P_N \geq 268 \text{ hp}$ |
| $U_N \leq 500 \text{ V}$ | Standard | - | + N | + N + CMF |
| $500 \text{ V} < U_N \leq 600 \text{ V}$ | Standard | + du/dt | + N + du/dt | + N + du/dt + CMF |
| | or Reinforced | - | + N | + N + CMF |
| $600 \text{ V} < U_N \leq 690 \text{ V}$ | Reinforced | + du/dt | + N + du/dt | + N + du/dt + CMF |

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

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347:2001. The table below shows the requirements for random-wound and form-wound non-ABB motors with nominal power smaller than 350 kW. For bigger motors, consult the motor manufacturer.

| Nominal AC supply voltage | Motor insulation system | Requirement for | |
|--|---|--|---|
| | | ABB du/dt filter, insulated N-end bearing and ABB common mode filter | |
| | | $P_N < 100 \text{ kW}$ or frame size $< \text{IEC 315}$ | $100 \text{ kW} \leq P_N < 350 \text{ kW}$ or $\text{IEC 315} \leq \text{frame size} < \text{IEC 400}$ |
| | | $P_N < 134 \text{ hp}$ or frame size $< \text{NEMA 500}$ | $134 \text{ hp} \leq P_N < 469 \text{ hp}$ or $\text{NEMA 500} \leq \text{frame size} \leq \text{NEMA 580}$ |
| $U_N \leq 420 \text{ V}$ | Standard: $\hat{U}_{LL} = 1300 \text{ V}$ | + N or CMF | + N + CMF |
| $420 \text{ V} < U_N \leq 500 \text{ V}$ | Standard: $\hat{U}_{LL} = 1300 \text{ V}$ | + du/dt + (N or CMF) | + N + du/dt + CMF |
| | or Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$, 0.2 microsecond rise time | + N or CMF | + N + CMF |
| $500 \text{ V} < U_N \leq 600 \text{ V}$ | Reinforced: $\hat{U}_{LL} = 1600 \text{ V}$ | + du/dt + (N or CMF) | + du/dt + N + CMF |
| | or Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$ | + N or CMF | + N + CMF |
| $600 \text{ V} < U_N \leq 690 \text{ V}$ | Reinforced: $\hat{U}_{LL} = 1800 \text{ V}$ | + N + du/dt | + N + du/dt + CMF |
| | Reinforced: $\hat{U}_{LL} = 2000 \text{ V}$, 0.3 microsecond rise time *** | N + CMF | N + CMF |

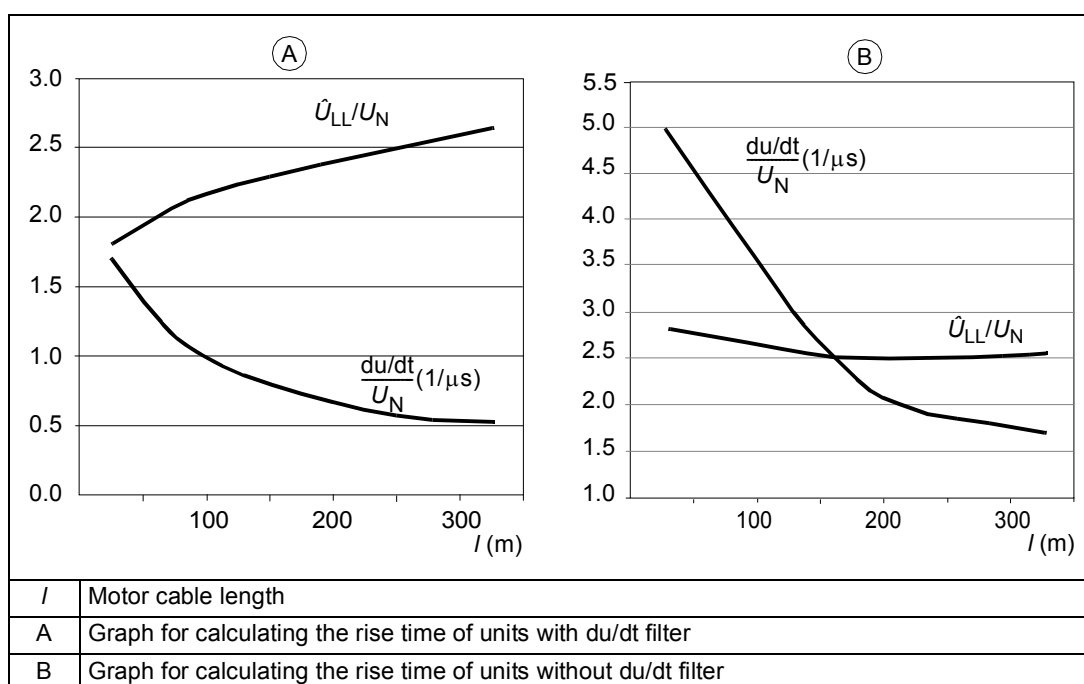
*** If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

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

The peak line-to-line voltage at the motor terminals generated by the drive as well as the voltage rise time depend on the cable length. The requirements for the motor insulation system given in the table are “worst case” requirements covering installations with 30 meter and longer cables.

If you need to calculate the actual peak voltage and voltage rise time considering the actual cable length, proceed as follows:

- Peak line-to line voltage: Read the relative \hat{U}_{LL}/U_N value from the appropriate diagram below and multiply it by the nominal supply voltage (U_N).
- Voltage rise time: Read the relative values \hat{U}_{LL}/U_N and $(du/dt)/U_N$ from the appropriate diagram below. Multiply the values by the nominal supply voltage (U_N) and substitute into equation $t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.



Additional note for sine filters

Sine filters protect the motor insulation system. A factory-installed sine filter is available for the cabinet-installed units. The peak phase-to-phase voltage with the sine filter is approximately $1.5 \times U_N$.

Additional note common mode filters

Common mode filter is available as a plus code option (+E208).

Selecting the power cables

General rules

Dimension the input power and motor cables **according to local regulations**:

- Dimension the cable to carry the drive load current. See chapter [Technical data](#) for the rated currents.
- Select a cable rated for at least 70 °C (158 °F) maximum permissible temperature of conductor in continuous use. For US, see [Additional US requirements](#), page 59.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- 600 V AC cable is accepted for up to 500 V AC.

Use symmetrical shielded motor cable, see page 58.

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

A four-conductor system is allowed for input cabling, but shielded symmetrical cable is recommended. To operate as a protective conductor, the shield conductivity requirements according to IEC 60439-1 are shown below when the protective conductor is made of the same metal as the phase conductors:

| Cross-sectional area of the phase conductors S (mm²) | Minimum cross-sectional area of the corresponding protective conductor S_p (mm²) |
|---|---|
| $S \leq 16$ | S |
| $16 < S \leq 35$ | 16 |
| $35 < S$ | S/2 |

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

Keep the motor cable and its PE pigtail (twisted shield) as short as possible to reduce high-frequency electromagnetic emissions.

Typical power cable sizes

The table below gives copper and aluminium cable types with concentric copper shield for the drives with nominal current. See also [Terminal and lead-through data for the power cables](#) on page 129.

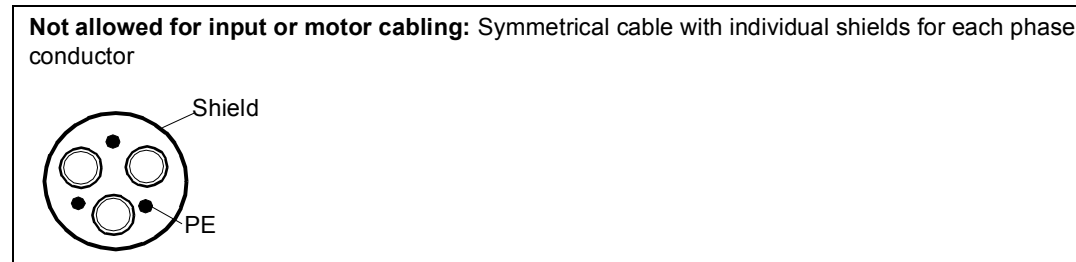
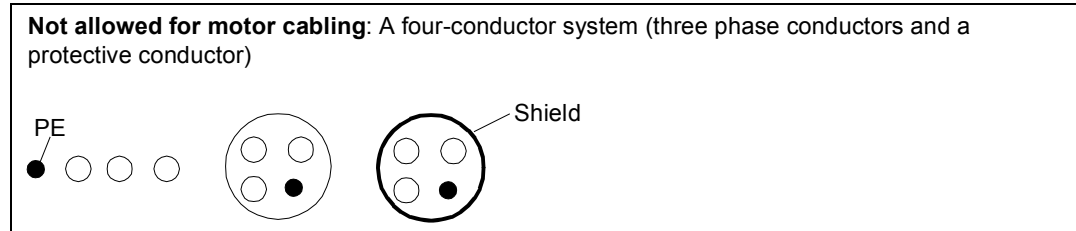
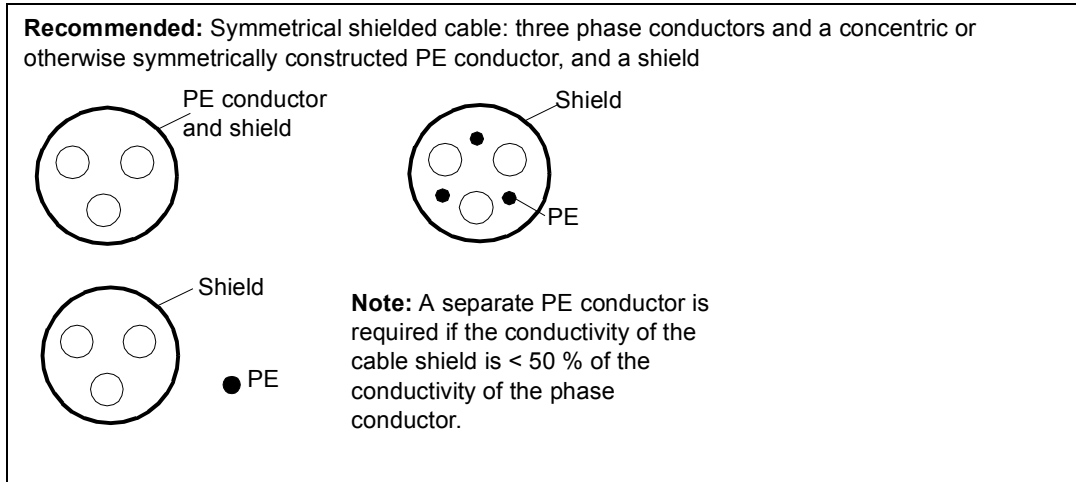
| Drive type ACS850-04 | IEC ¹⁾ | | US ²⁾ | |
|-------------------------|-------------------|-----------------|----------------------------|----------------------------|
| | Cu cable type | Al cable type | Cu cable type | Al cable type |
| | mm ² | mm ² | AWG/kcmil | AWG/kcmil |
| -387A-5 | 2 × (3×120) | 3 × (3×120) | 2 × 250 MCM | 2 × 350 MCM |
| -500A-5 | 3 × (3×95) | 3 × (3×150) | 2 × 500 MCM or 3 × 250 MCM | 2 × 600 MCM or 3 × 300 MCM |
| -580A-5 | 3 × (3×120) | 3 × (3×185) | 2 × 500 MCM or 3 × 250 MCM | 2 × 700 MCM or 3 × 350 MCM |
| -650A-5 | 3 × (3×150) | 3 × (3×240) | 2 × 600 MCM or 3 × 300 MCM | 3 × 400 MCM or 4 × 250 MCM |
| -710A-5 | 3 × (3×185) | 4 × (3×185) | 2 × 700 MCM or 3 × 350 MCM | 3 × 500 MCM or 4 × 300 MCM |
| -807A-5 | 3 × (3×240) | 4 × (3×240) | 3 × 500 MCM or 4 × 300 MCM | 3 × 600 MCM or 4 × 400 MCM |
| -875A-5 | 3 × (3×240) | 4 × (3×240) | 3 × 500 MCM or 4 × 300 MCM | 3 × 700 MCM or 4 × 500 MCM |

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- 1) The cable sizing is based on max. 9 cables laid on a cable ladder side by side, three ladder type trays one on top of the other, ambient temperature 30 °C (86 °F), PVC insulation, surface temperature 70 °C (158 °F) (EN 60204-1 and IEC 60364-5-52). For other conditions, dimension the cables according to local safety regulations, appropriate input voltage and the load current of the drive.
- 2) The cable sizing is based on NEC Table 310-16 for copper wires, 75 °C (167 °F) wire insulation at 40 °C (104 °F) ambient temperature. Not more than three current-carrying conductors in raceway or cable or earth (directly buried). For other conditions, dimension the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

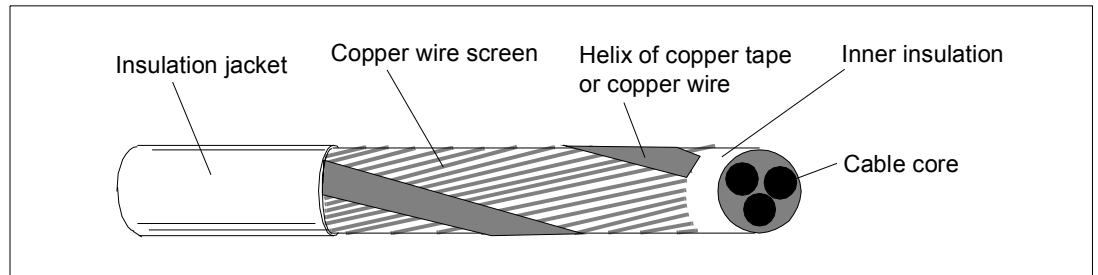
Alternative power cable types

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



Motor cable shield

If the motor cable shield is used as the sole protective earth conductor of the motor, ensure that the conductivity of the shield is sufficient. See subsection [General rules](#) above, or IEC 60439-1. 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 or copper wire. The better and tighter the shield, the lower the emission level and bearing currents.



Additional US requirements

Use type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable for the motor cables if metallic conduit is not used. For the North American market, 600 V AC cable is accepted for up to 500 V AC. For drives rated over 100 amperes, the power cables must be rated for 75 °C (167 °F).

Conduit

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

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

Armored cable / shielded power cable

Six conductor (3 phases and 3 ground) type MC continuous corrugated aluminum armor cable with symmetrical grounds is available from the following suppliers (trade names in parentheses):

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

Shielded power cables are available from Belden, LAPPKABEL (ÖLFLEX) and Pirelli.

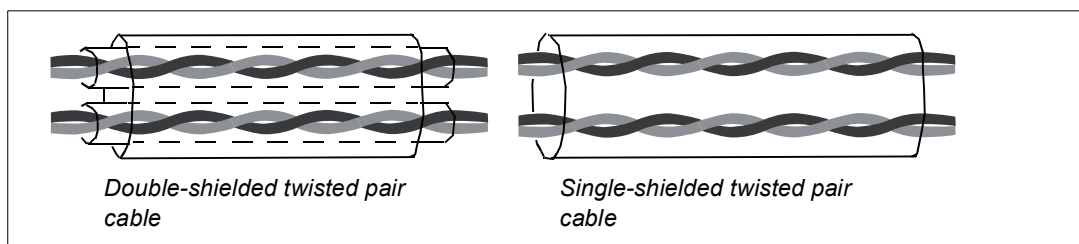
Selecting the control cables

Shielding

All control cables must be shielded.

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

A double-shielded cable is the best alternative for low-voltage digital signals but single-shielded twisted pair cable is also usable.



Signals in separate cables

Run analog and digital signals in separate, shielded cables.

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

Signals allowed to be run in the same cable

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

Relay cable type

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

Control panel cable length and type

In remote use, the cable connecting the control panel to the drive must not exceed 3 meters (10 ft). The cable type tested and approved by ABB is used in control panel option kits.

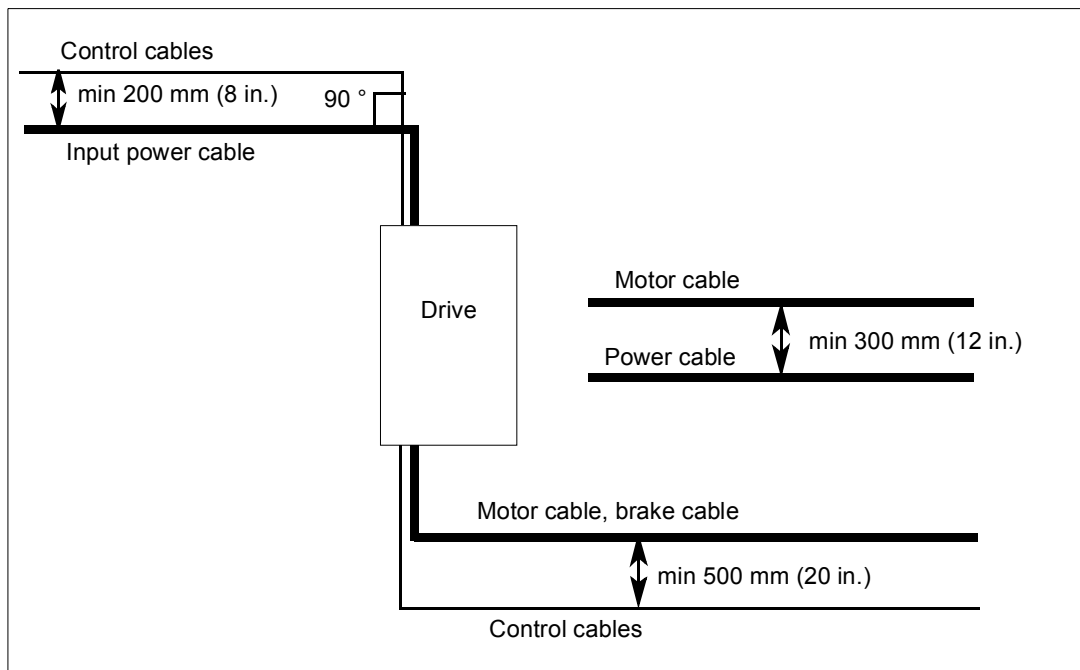
Routing the cables

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.

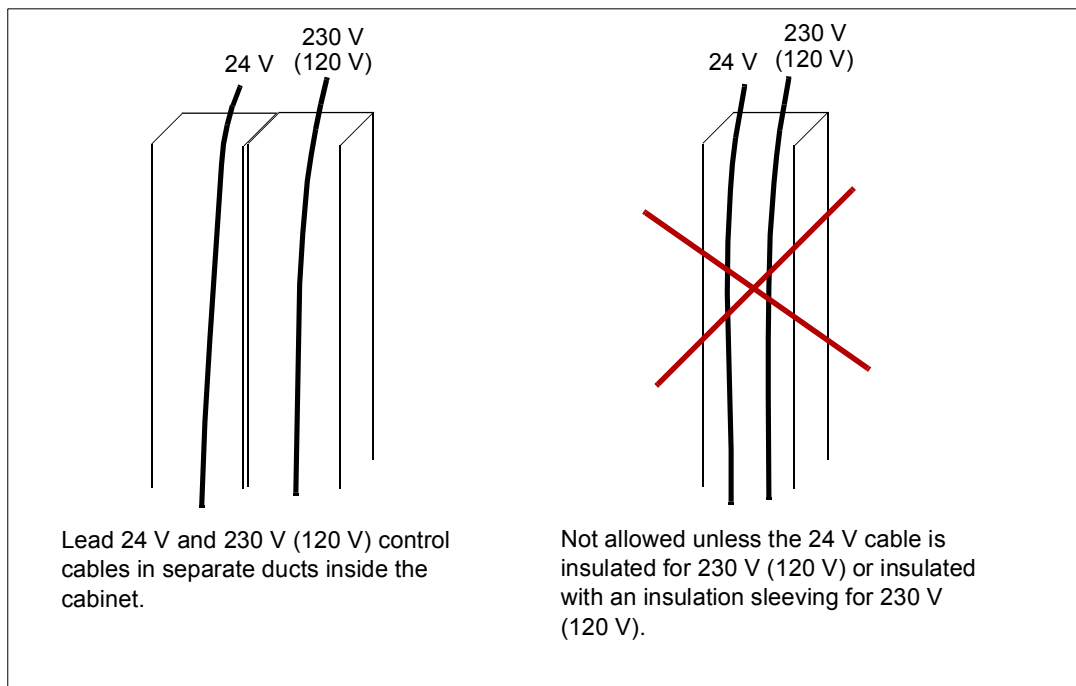
Where control cables must cross power cables ensure that they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the drive.

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 shown below.



Separate control cable ducts



Continuous motor cable shield or enclosure for equipment in the motor cable

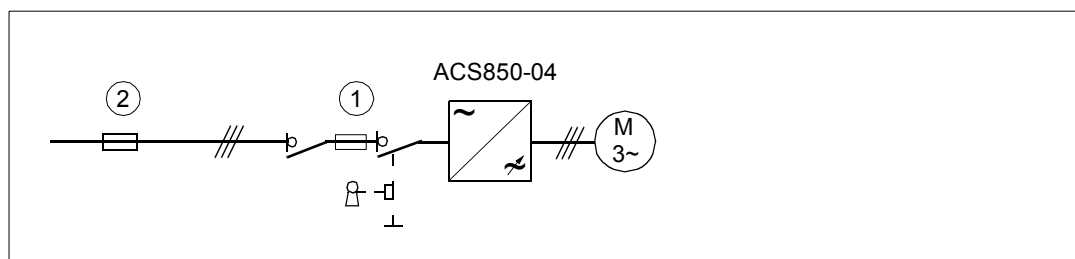
To ensure safety and minimize the emission level when safety switches, contactors, connection boxes or similar equipment are installed in the motor cable between the drive and the motor:

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

Implementing thermal overload and short-circuit protection

Protecting the drive and input power cable in short-circuits

Protect the drive with fuses (1) and the input cable with fuses (2) as shown below:



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

Note 1: If the fuses for the drive protection are placed at the distribution board and the input cable is dimensioned according to the nominal input current of the drive given in the rating table on page [125](#), the fuses will protect also the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive. No separate fuses for the input cable protection are needed.

Note 2: Circuit breakers must not be used without fuses. For more information, contact ABB.

Protecting the motor and motor cable in short-circuits

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

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

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



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

Protecting the motor against thermal overload

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

The most common temperature sensors are:

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

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

Protecting the drive against ground faults

The drive is equipped with an internal ground fault protective function to protect the unit against ground faults in the motor and 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 firmware manual.

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


Residual current device compatibility

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

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

Implementing the Emergency stop function

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

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

Implementing the Safe torque off function

The drive includes the Safe torque off function. For more information, see *Safe torque off function for ACSM1, ACS850 and ACQ810 drives application guide* (3AFE68929814 [English]).

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

With option +Q971, the drive provides ATEX-certified safe motor disconnection without contactor using the drive Safe torque off function. For more information, see *ATEX-certified Safe disconnection function for ACS850 drives (+Q971) application guide* (3AUA0000074343 [English]).

Implementing the Power loss ride-through function

Implement the power loss ride-through function as follows:

1. Activate the power loss ride-through function of the drive (parameter **47.02 Undervolt ctrl** in the Standard Control Program).
2. If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.



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

Using power factor compensation capacitors with the drive

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



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

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

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

Implementing a safety switch between the drive and motor

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

Using a contactor between the drive and the motor

Arrange the control of the output contactor by applying one of the alternatives described below.

Alternative 1: When you have selected to use the default motor control mode (DTC) and motor coast stop in the drive, open the contactor as follows:

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

Alternative 2: When you have selected to use the default motor control mode (DTC) and motor ramp stop in the drive, open the contactor as follows:

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

Alternative 3: When you have selected to use the scalar motor control mode in the drive, open the contactor as follows:

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



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

Implementing a bypass connection

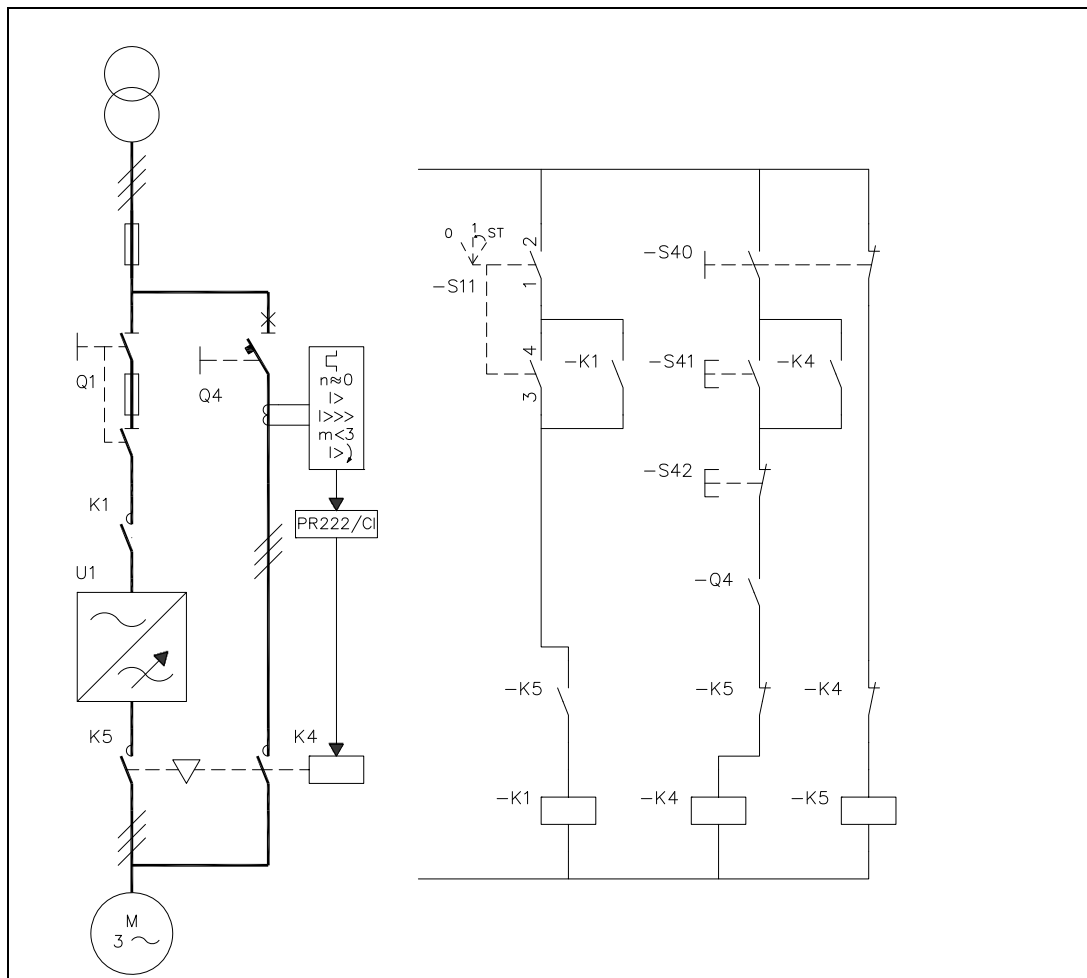
If bypassing is required, employ mechanically or electrically interlocked contactors between the motor and the drive and between the motor and the power line. Ensure with interlocking that the contactors cannot be closed simultaneously.



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

Example bypass connection

An example bypass connection is shown below.



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

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

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

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

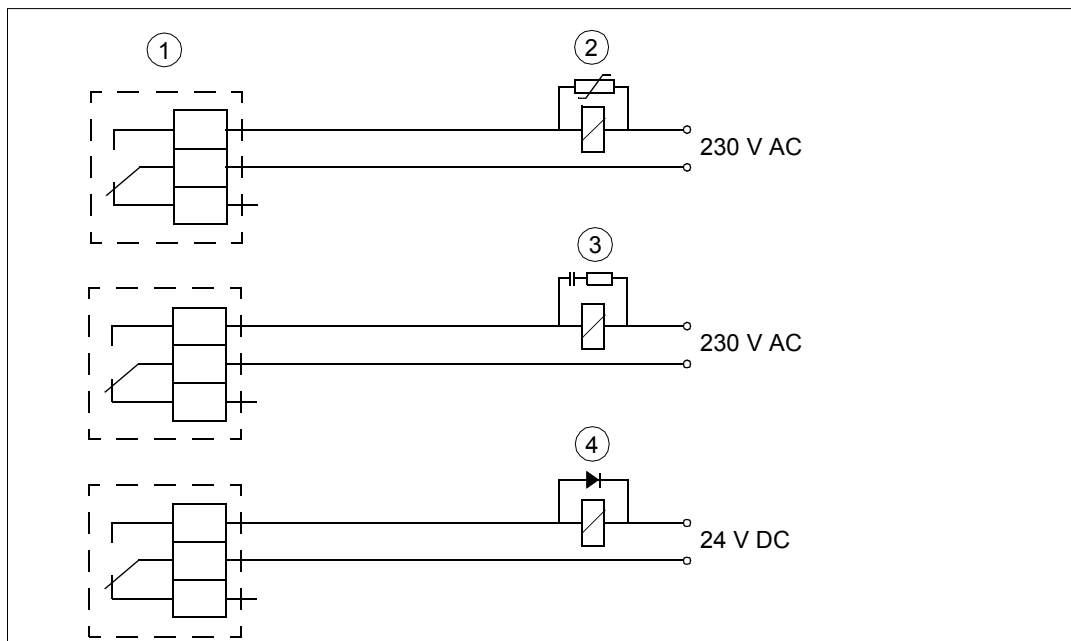
1. Stop the motor with S42.
2. Switch the motor power supply from direct-on-line to the drive with S40.
3. Close the main contactor of the drive with switch S11 (-> turn to position ST for two seconds and leave to position 1).
4. Start the drive and the motor with the drive control panel (drive in the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

Protecting the contacts of relay outputs

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

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

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



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

Connecting a motor temperature sensor to the drive I/O



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

To fulfil this requirement, the connection of a thermistor (and other similar components) to the digital inputs of the drive can be implemented in three alternate ways:

1. There is double or reinforced insulation between the thermistor and live parts of the motor.
2. Circuits connected to all digital and analog inputs of the drive are protected against contact and insulated with basic insulation (the same voltage level as the drive main circuit) from other low voltage circuits.
3. An external thermistor relay is used. The insulation of the relay must be rated for the same voltage level as the main circuit of the drive. For connection, see the firmware manual.

Example circuit diagram

See page [154](#).

Installation

What this chapter contains

In this chapter, the drive module is installed in a 400 mm wide Rittal TS 8 cabinet in a bookshelf way of mounting: The module is placed in an upright position on the cabinet bottom with its front facing the cabinet door. The following Rittal parts and drive module options are used in the installation examples:

| Drive module standard parts | | |
|--|-----------|---|
| <ul style="list-style-type: none"> • Drive module • Top guide plate • Fastening bracket • Grounding busbar • Pedestal guide plate • Telescopic extraction and insertion ramp • Fastening screws in a plastic bag • External control unit | | |
| Drive module options | | |
| Option code | Qty (pcs) | Description |
| +H381 | 1 | Power cabling panels and a rubber grommet |
| +H383 | | Power cabling panels |
| +P905 | 1 | Internal control unit |
| Rittal parts | | |
| Rittal part code | Qty (pcs) | Description |
| TS 8406.510 | 1 | Enclosure without mounting plate. Includes frame, door, side and back panels. |
| TS 8612.160 | 5 | Punched section with mounting flange, outer mounting level for 600 mm horizontal |
| TS 8612.140 | 3 | Punched section with mounting flange, outer mounting level for 400 mm horizontal |
| SK 3243.200 | 2 | Air filter 323 mm × 323 mm |
| TS 4396.500 | 3 | Support rails (alternative to a customer-made bottom plate) |
| Customer-made parts (not ABB or Rittal products) | | |
| Air baffles | 6 | See section Frames G1 and G2 – Air baffles on page 151 for the dimension drawings of the air baffles required in the cabinet. |
| Cabinet bottom plate (alternative to Rittal support rails) | 1 | See Frames G1 and G2 – Bottom plate on page 150 for the dimension drawing of a customer-made bottom plate. |

Always follow the general rules given in this chapter and local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches local laws and/or other regulations.

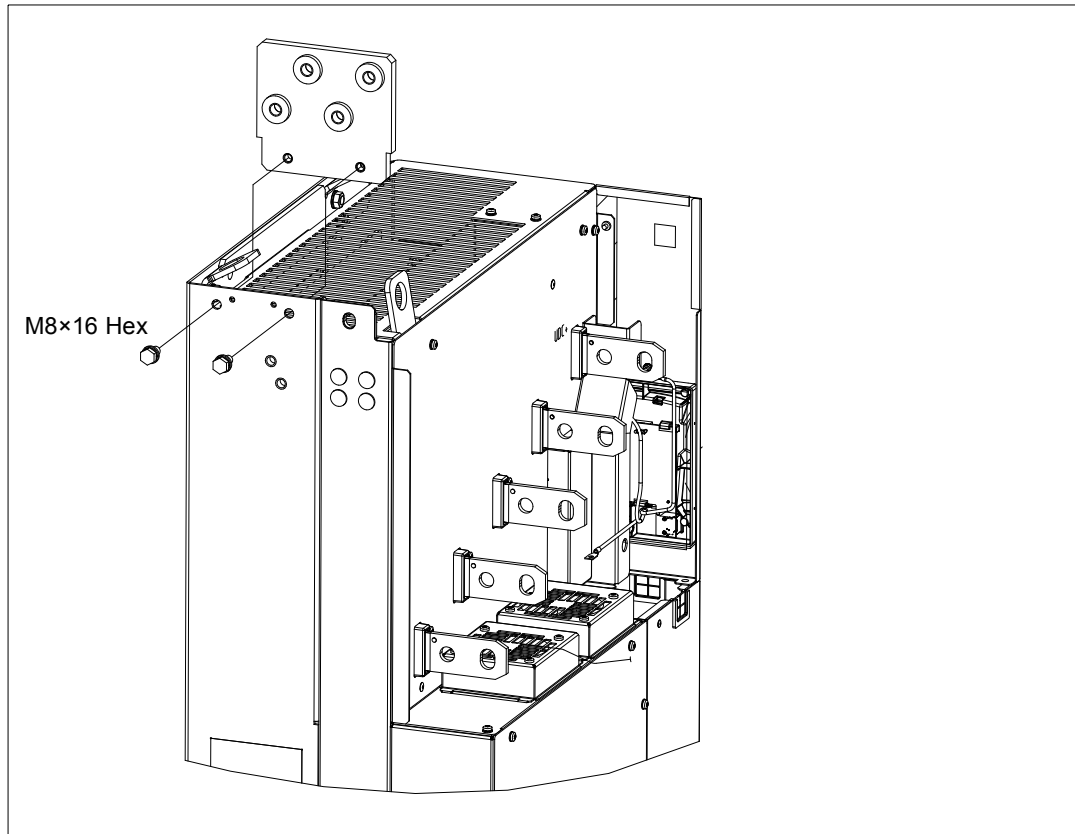
Note 1: The drive module can also be installed in other than Rittal TS 8 cabinets.

Note 2: Installations with input and motor cables of size $4 \times 240 \text{ mm}^2$ per phase

If resistor cables are to be connected, the lower side plate of the output cabling panel must be removed and the resistor cables lead from side to the terminals of the output cabling panel.

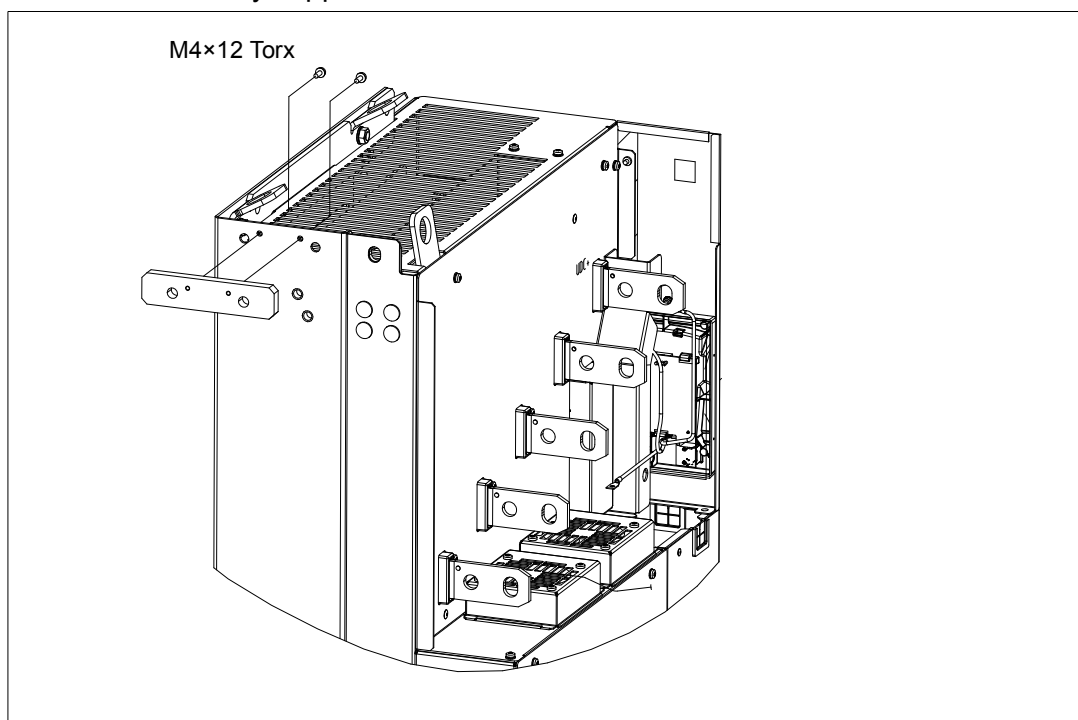
Note 3: Installations without the optional cabling panels (no +H381 or +H383)

Install the PE terminal as shown below.



Note 4: Mounting the drive module to an assembly panel

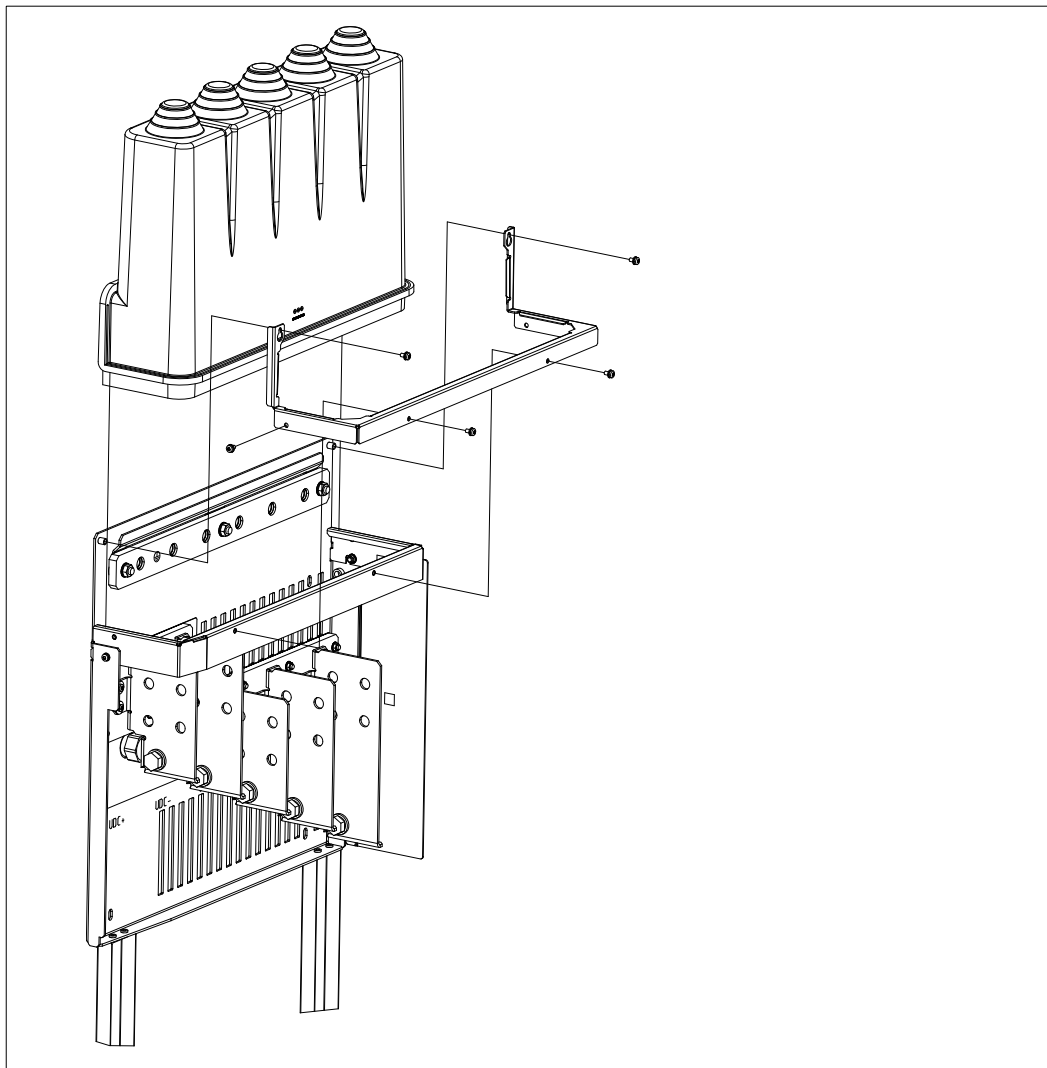
Mount the assembly support as shown below.



Note 5: Mounting the rubber grommet of units with optional cabling panels (+H381)

Installing the input power cables through the rubber grommet of the optional cabling panels provides the degree of protection of IP20 for the unit. Mount the grommet as follows:

1. Cut adequate holes into the grommet for the input power cables.
2. Lead the cables through the grommet.
3. Mount the grommet to the input cabling panel with five M4x8 Torx T20 screws as shown below.



Note 6: Alternative installation means

In addition to the installation examples presented in this chapter, there are a few alternative installation means, such as:

- The power cables can be connected directly to the drive module input and output terminals with cable lugs or by busbars. The drive module can also be installed self standing to the floor in an electrical equipment room when the power cable terminals and electrical parts are protected against contact and the unit is grounded properly.
- The drive module without pedestal (option +0H354) can be mounted on wall or cabinet with four screws through the fastening holes at the top and bottom of the right-hand side of the module.

Safety



WARNING! Only qualified electricians are allowed to carry out the electrical installation work described in this chapter. Follow the [Safety instructions](#) on the first pages of this manual. Ignoring the safety instructions can cause injury or death.

Checking the installation site

The material below the drive must be non-flammable and strong enough to carry the weight of the drive.

See section [Ambient conditions](#) on page 134 for the allowed ambient conditions and section [Losses, cooling data and noise](#) on page 129 for the required cooling air.

Required tools

- Set of screw drivers (Torx and Pozidrive)
- Torque wrench with a 500 mm (20 in.) or 2 × 250 mm (2 × 10 in.) long extension bar
- 17 mm (11/16 in.) magnetic-end socket for mounting the drive module busbars to the optional cabling panels (+H381 or +H383)
- 10 mm magnetic-end socket or a torx screw driver for mounting the drive module top fastening bracket to the cabinet back and for mounting the optional cabling panels (+H381 or +H383) to the cabinet side panels
- 13 mm socket for mounting the drive module to the cabinet bottom plate or floor
- 22 mm magnetic-end socket for mounting the cable lugs to the terminals (M12 bolt).

Moving and unpacking the unit

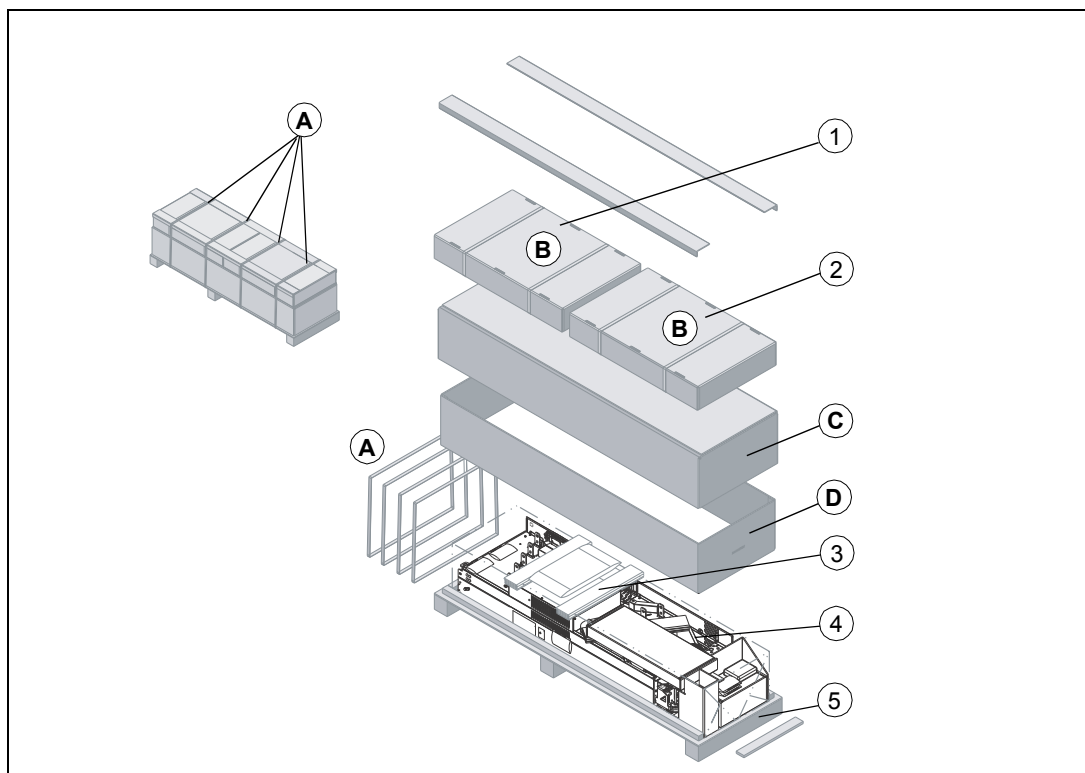


WARNING! Follow the safety instructions, page 14. Ignoring the instructions can cause physical injury or death, or damage to the equipment

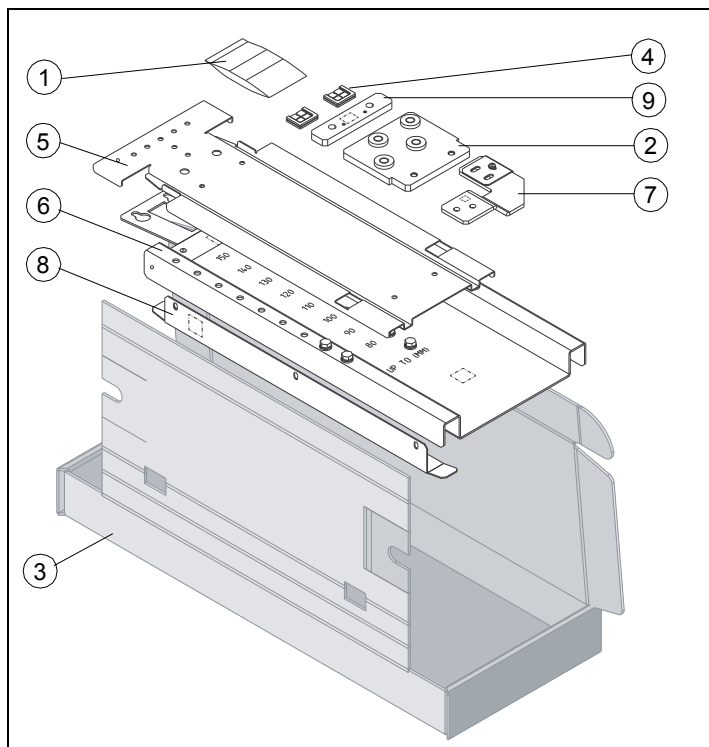
Move the transport package by pallet truck to the installation site.

Unpack the package as follows:

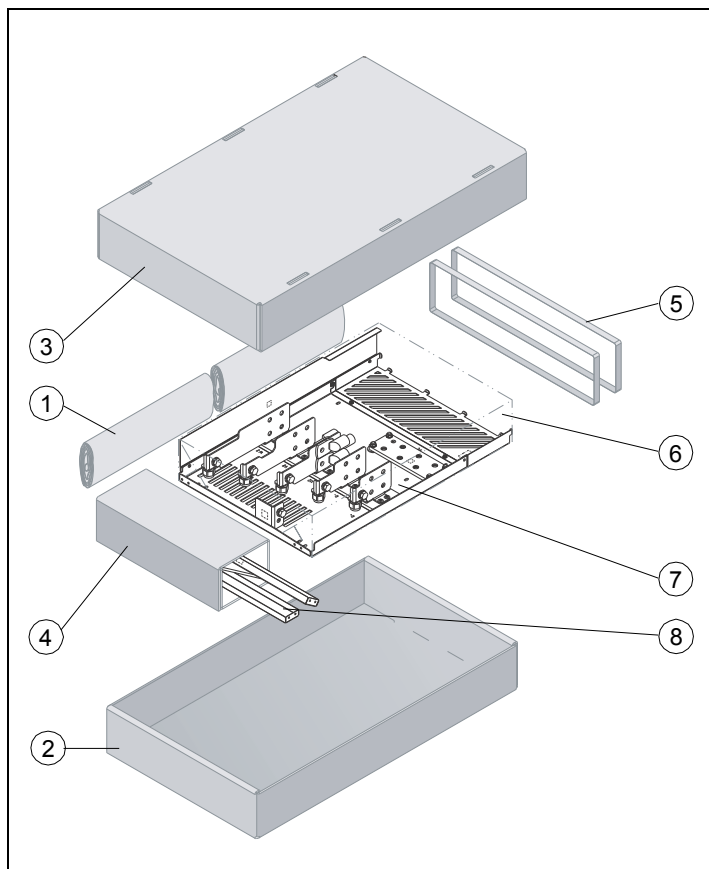
- Cut the bands (A).
- Unpack the additional boxes (B).
- Remove the outer sheathing by lifting it (C).
- Remove the sheathing by lifting it (D).
- Insert lifting hooks to the drive module lifting eyes and lift the module to the installation place.



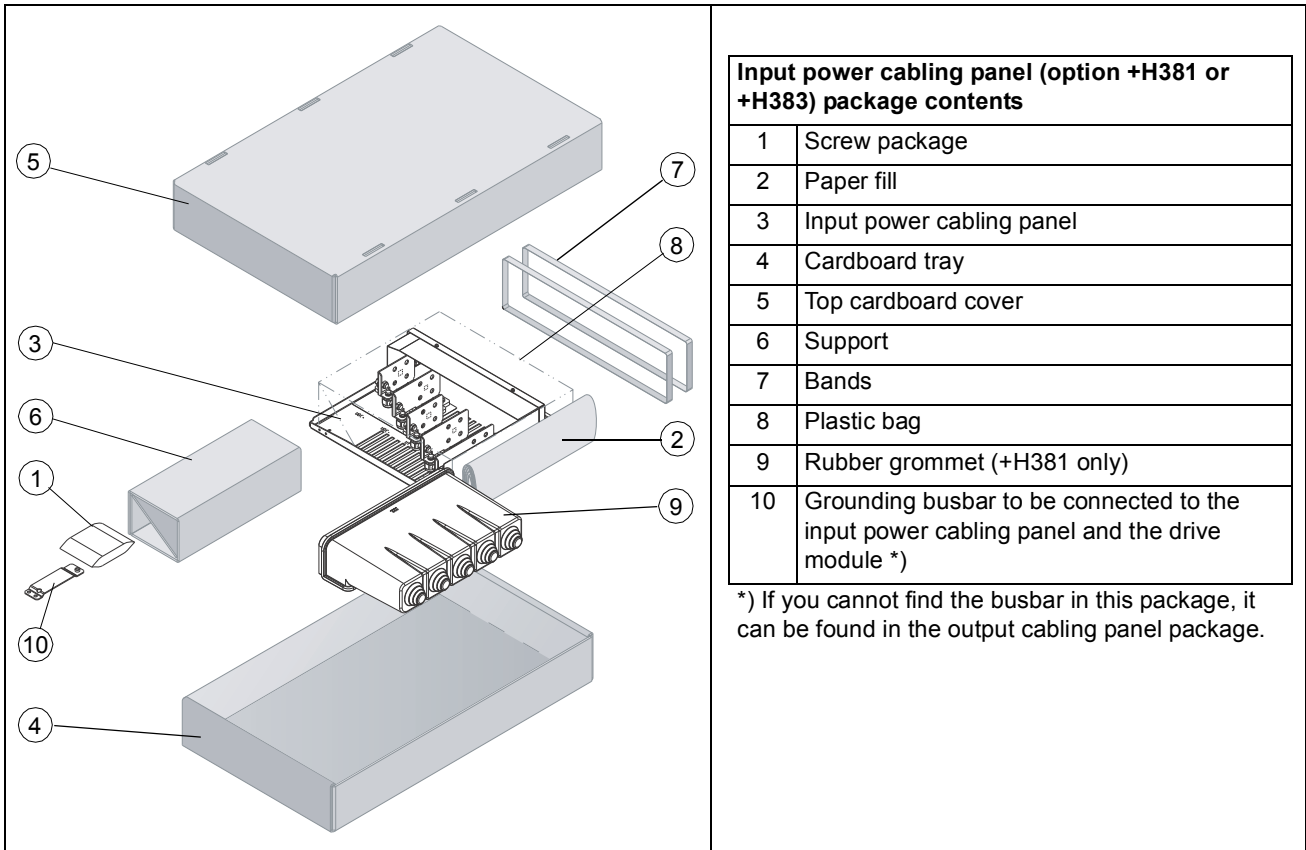
| Description of the package contents | |
|-------------------------------------|---|
| 1 | Input cabling panel (option +H381 or +H383), see contents below. |
| 2 | Output cabling panel (option +H381 or +H383), see contents below. |
| 3 | Plywood support |
| 4 | Drive module with factory installed options and multilingual residual voltage warning sticker, top guide plate, pedestal guide plate, telescopic ramp package, fastening screws in a plastic bag, external control unit with control cable clamp plate and factory installed optional modules, control panel with door mounting kit (option +J410), delivery documents, printed hardware manual and multilingual quick start-up guide and manuals CD. Other printed manuals with options +R700 to +R714 |
| 5 | Pallet |



| Ramp package contents | |
|------------------------------|--|
| 1 | Screw package |
| 2 | PE terminal |
| 3 | Cardboard box |
| 4 | Feed through |
| 5 | Pedestal guide plate |
| 6 | Telescopic extraction and insertion ramp |
| 7 | Fastening bracket |
| 8 | Top guide plate |
| 9 | Support |



| Output power cabling panel (option +H381 or +H383) package contents | |
|--|---|
| 1 | Paper fill |
| 2 | Cardboard tray |
| 3 | Top cardboard cover |
| 4 | Support |
| 5 | Bands |
| 6 | Plastic bag |
| 7 | Output power cabling panel |
| 8 | Side guides for Rittal cabinet assembly |



Checking the delivery

Check that all items listed under section [Moving and unpacking the unit](#) are present.

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

Checking the insulation of the assembly

Drive

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

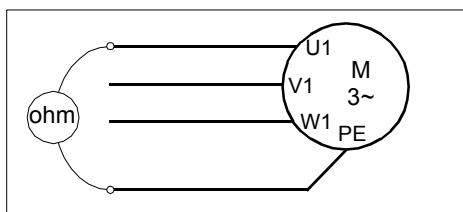
Input cable

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

Motor and motor cable

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

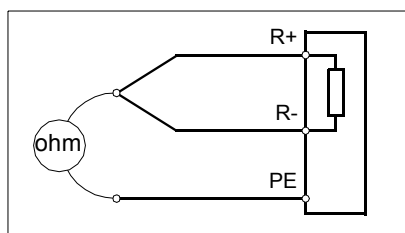
1. Check that the motor cable is disconnected from the drive output terminals U2, V2 and W2.
2. Measure the insulation resistance between each phase conductor and the Protective Earth conductor using a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, please consult the manufacturer's instructions. **Note:** Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.



Brake resistor and resistor cable

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

1. 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 conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



Overall flowchart of the installation process

This flowchart describes the installation process of the units listed under *What this chapter contains* on page 69.

| Step | Task | For instructions, see |
|------|---|---|
| 1 | Install the Rittal parts, cabinet bottom plate, drive bottom guide plate and top guide and loose drive options (cabling panels, option +H381 or +H383) in the drive module cubicle. | <i>Installing the mechanical accessories into the cabinet</i> , page 79 |
| 2 | Install the auxiliary components (such as mounting plates, air baffles, switches, busbars etc.). | The component manufacturer's instructions <i>Layout example, door open</i> , page 38 |
| 3 | Connect the power cables to the cabling panels. | <i>Connecting the power cables</i> , page 84 |
| 4 | Mount the drive module into the cabinet. | <i>Mounting the drive module into the cabinet</i> , page 89 |
| 5 | <u>Drive modules with an external control unit:</u> Mount the external control unit. | <i>Mounting the external control unit</i> , page 99 |
| 6 | Connect the control cables. | <i>Connecting the power cables</i> , page 95 |
| 7 | Install the remaining parts, for example, cabinet doors, side plates, etc. | The component manufacturer's instructions |

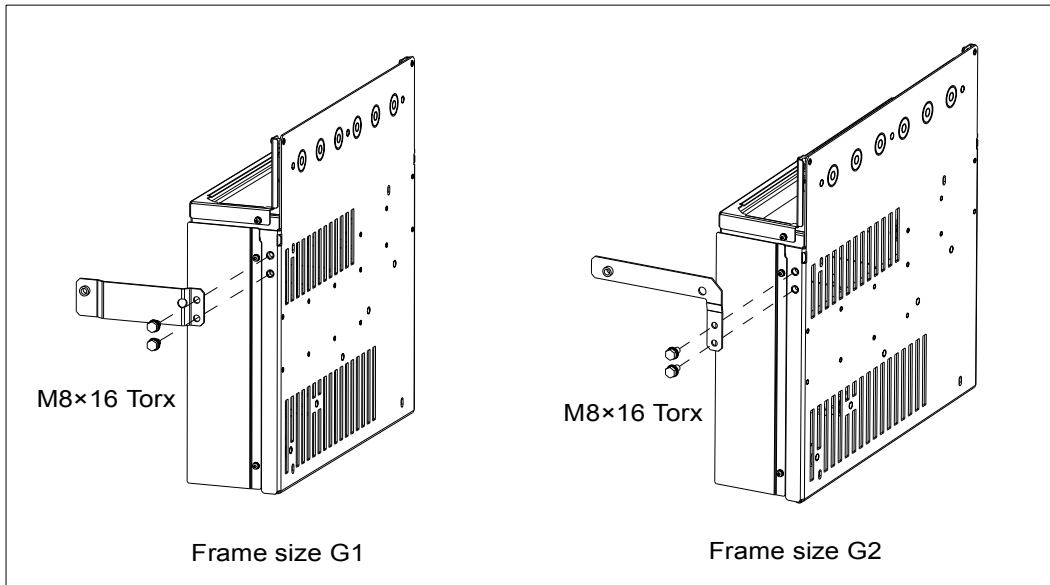
Installing the mechanical accessories into the cabinet

For frame G1, see the assembly drawing on page [81](#). For frame G2, see the assembly drawing on page [82](#). Install the mechanical accessories into the cabinet as follows:

1. If you use a bottom plate, make the bottom plate according to the dimension drawing on page [150](#)) and install the bottom plate on the bottom of the cabinet.
Note: If the thickness of the bottom plate is not 2.5 mm (0.1 in.), adjust the dimensions accordingly.
2. If you use Rittal support rails (TS 4396.500), install three support rails on the bottom of the cabinet, see also the dimension drawing on page [145](#) (frame G1) or page [149](#) (frame G2).
3. Install the pedestal guide onto the bottom plate (or support rails).
4. Install the Rittal punched sections TS 8612.610 (5 pcs) and TS8612.140 (3 pcs).
5. Install the air baffles (see page [83](#)).
6. Install the top guide plate.
7. Install the output cabling panel. **Note:** After you have installed the output cabling panel, you can remove the support rail that is under the panel if there is not enough space for cables.
8. Install the side guides to the output cabling panel (2 screws for each side guide).



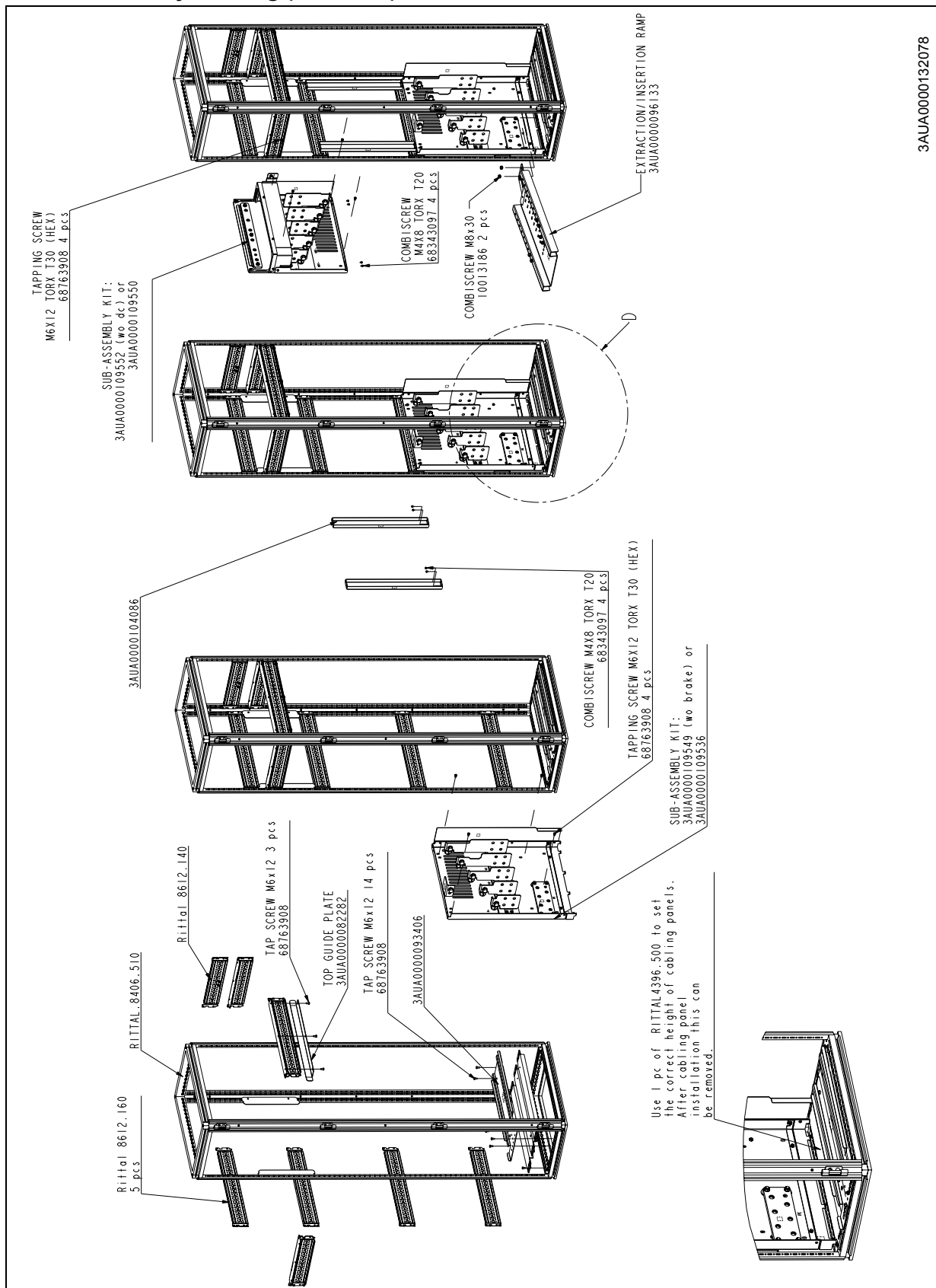
9. Mount the grounding busbar to the input cabling panel (option +H381 or +H383). Back view is shown below.



10. Mount the side guides to the input cabling panel (2 screws for each side guide) and mount the input cabling panel to the punched section.

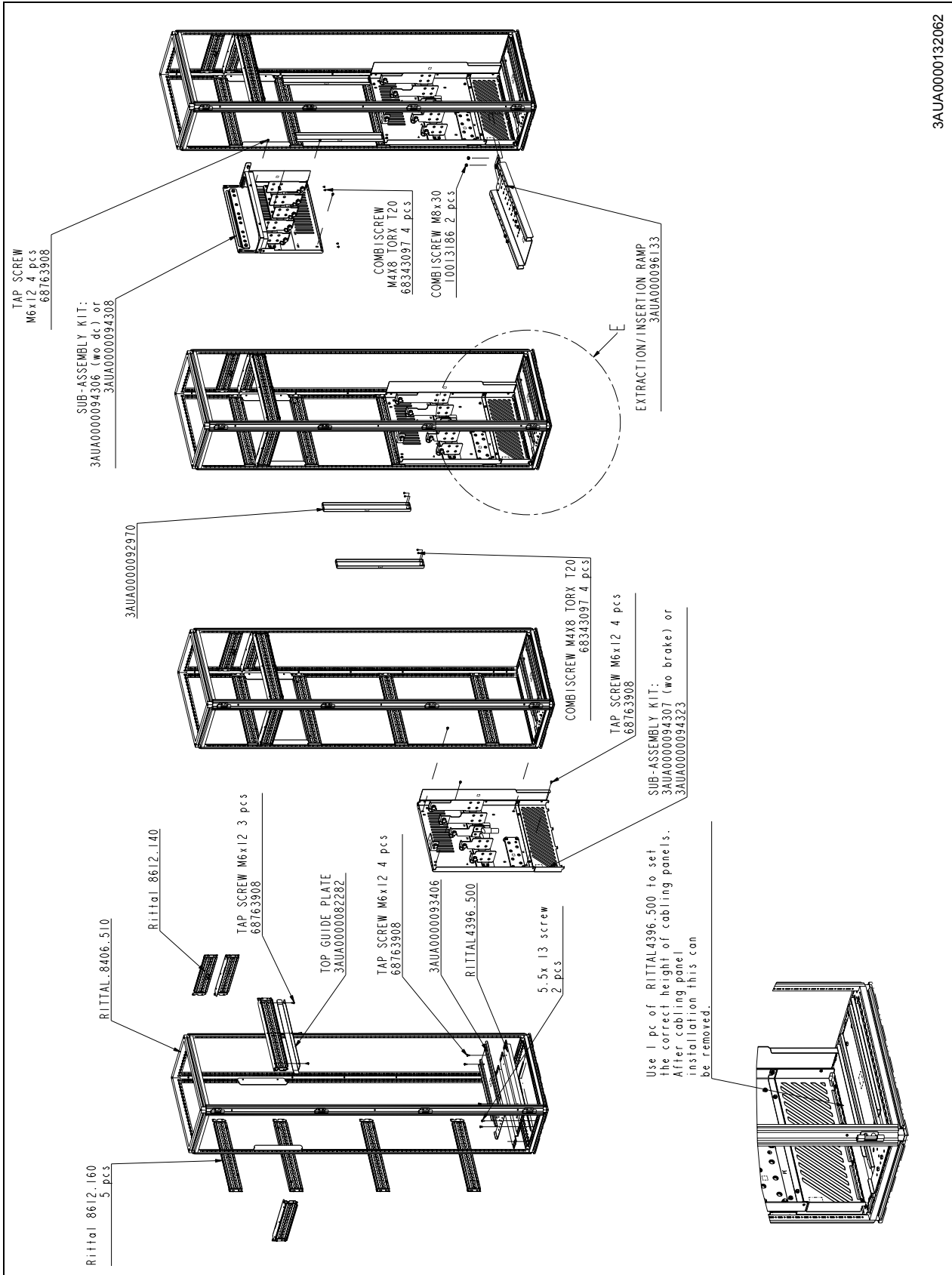


Assembly drawing (frame G1)



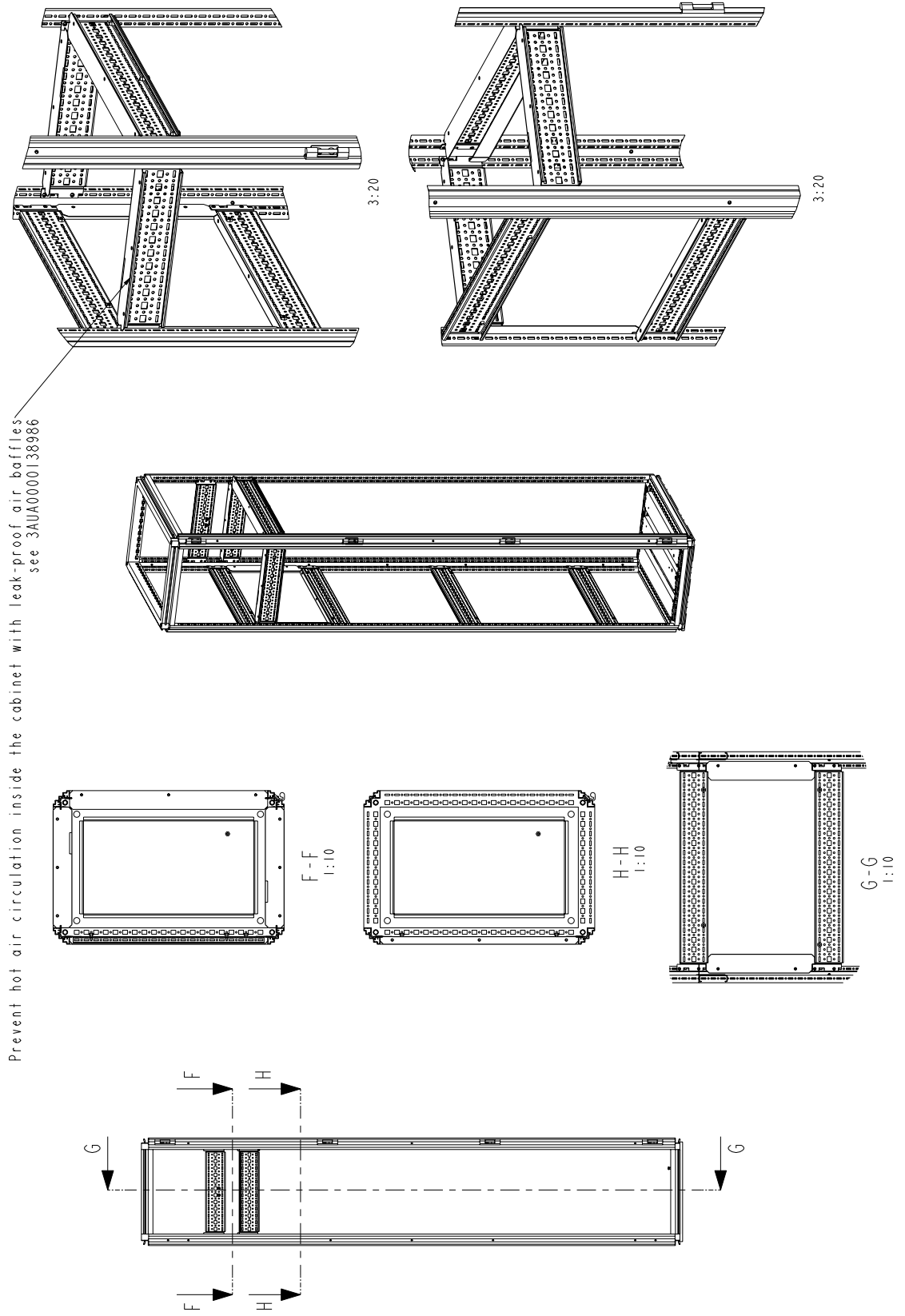
3AUA0000132078

Assembly drawing (frame G2)



3AUA0000132062

Assembly drawing (air baffles)



Prevent hot air circulation inside the cabinet with leak-proof air baffles
see 3AUA0000138986

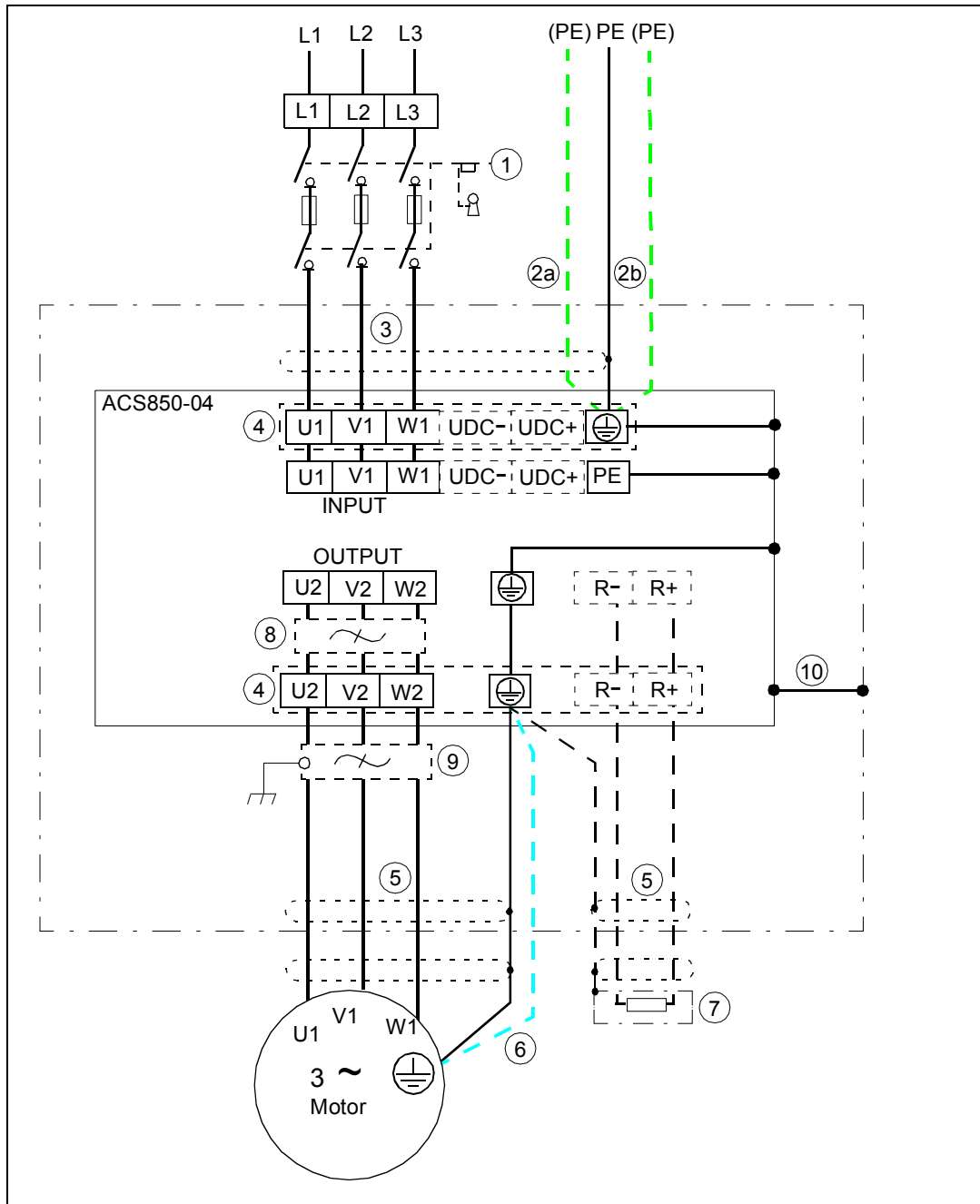
3AUA0000132062

Connecting the power cables



WARNING! Follow the safety instructions, page 14. Ignoring the instructions can cause physical injury or death, or damage to the equipment

Connection diagram



| | |
|--|---|
| 1 | For alternatives, see section Selecting the supply disconnecting device on page 49. In the mounting example of this chapter, the disconnecting device is not in the same cubicle with the drive module. |
| 2 | If a shielded cable is used (not required but recommended) and the conductivity of the shield is < 50% of the conductivity of the phase conductor, use a separate PE cable (2a) or a cable with a grounding conductor (2b). |
| 3 | 360-degree grounding is recommended at the cabinet entry if a shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board. |
| 4 | Input and output power cabling panels (option +H381 or +H383). |
| 5 | 360-degree grounding at the cabinet entry is recommended, see page 41. |
| 6 | Use a separate grounding cable if the conductivity of the cable shield is < 50% of the conductivity of the phase conductor and there is no symmetrically constructed grounding conductor in the cable (see page 58). |
| 7 | External brake resistor, see page 155. |
| 8 | Common mode filter (option +E208), see page 51. |
| 9 | du/dt filter (optional, see page 161). |
| 10 | The drive module frame must be connected to the cabinet frame. See section Arranging the grounding inside the cabinet on page 40. |
| <p>Note:</p> <p>If there is a symmetrically constructed grounding conductor in the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.</p> <p>Do not use an asymmetrically constructed motor cable. Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.</p> | |

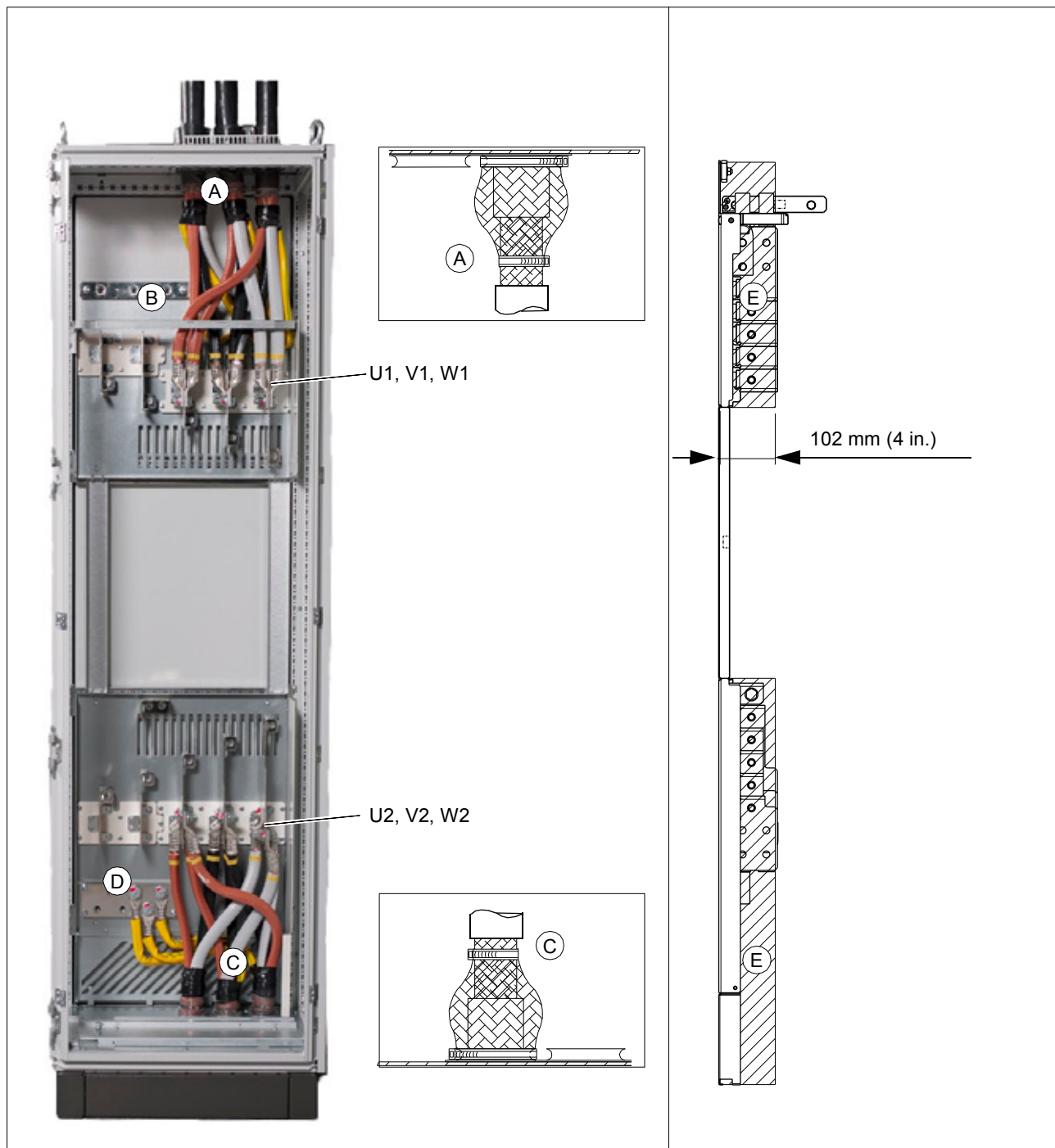
Power cable connection procedure



WARNING! Follow the instructions in chapter [Safety instructions](#). Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Lead the input cables into the inside of the cabinet. Ground the cable shield 360° at the lead-through plate.
2. Twist the cable shields of the input cables into bundles and connect them and any separate ground conductors or cables to the PE (ground) terminal of the input power cabling panel.
3. Connect the phase conductors of the input cables to terminals U1, V1 and W1 of the input cabling panel. For the tightening torques, see page [129](#).
4. Lead the motor cables into the inside of the cabinet. Ground the cable shield 360° at the lead-through plate.
5. Twist the cable shields of the motor cables into bundles and connect them and any separate ground conductors or cables to the PE (ground) terminal of the output power cabling panel.
6. Connect the phase conductors of the motor cables to terminals U2, V2, W2 of the output cabling panel. For the tightening torques, see page [129](#).

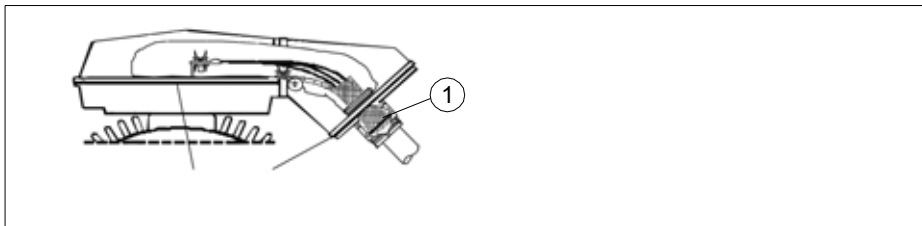
Note: The input and output power cables must fit inside the area marked with diagonal lines in the image below to avoid chafing of the cables when the drive module is inserted into the cabinet.



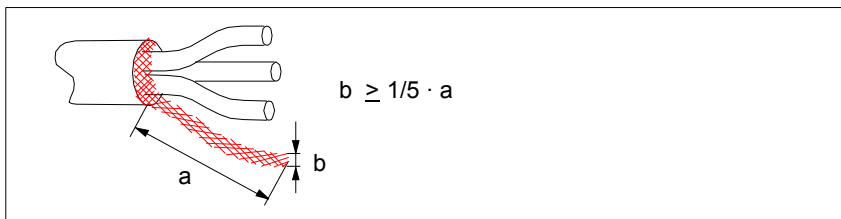
View without cabinet side plate in place. A) 360-degree grounding at the lead-through plate for the input power cables; B) Grounding busbar of the input power cabling panel; C) 360-degree grounding at the lead-through plate for the output power cables; D) Grounding busbar of the output power cabling panel; E) Allowed space for power cables

Ground the motor cable shield at the motor end as follows:

- 360 degrees at the lead-through of the motor terminal box (1)



- or by twisting the shield as follows: flattened width $\geq 1/5 \cdot$ length.



DC connection

The UDC+ and UDC– terminals are intended for common DC configurations of a number of drives, allowing regenerative energy from one drive to be utilised by the other drives in the motoring mode. For more information, see *Common DC configuration application guide for ACS850-04 drive modules* (3AUA0000073108 [English]).

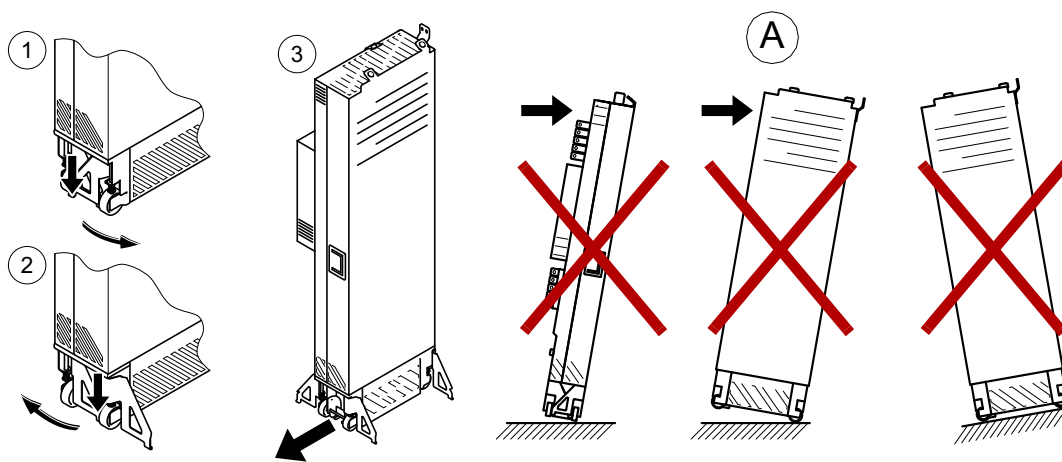
Mounting the drive module into the cabinet



WARNING! Follow the safety instructions, page 14. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

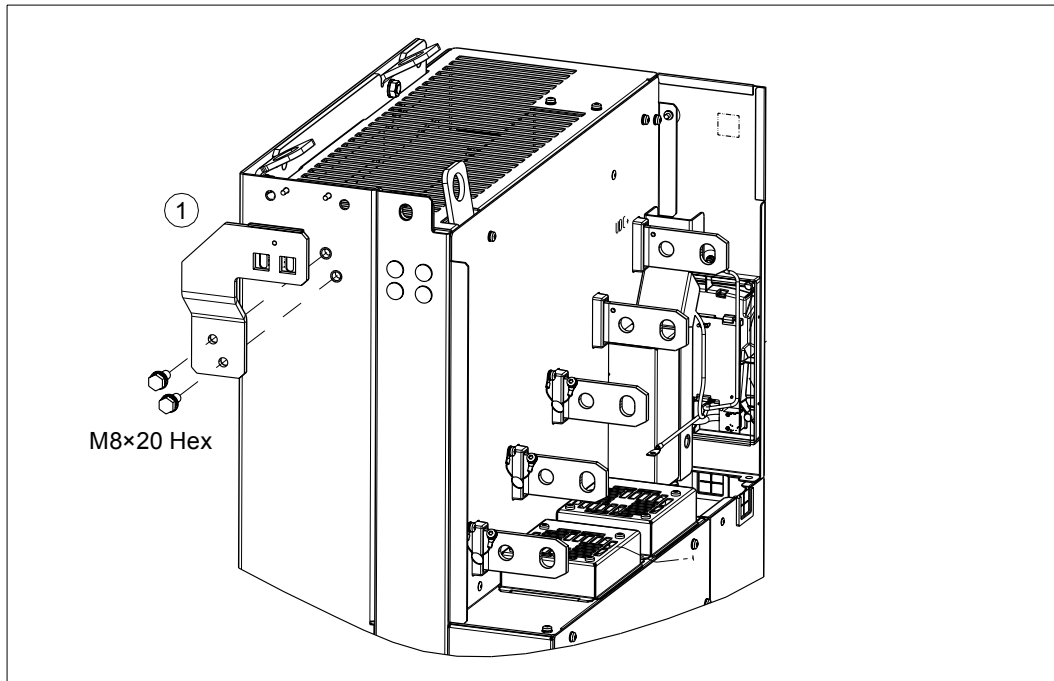
Handle the drive module carefully. Make sure that the module does not fall down when moving it on the floor and during installation and maintenance work: Open the support legs by pressing each leg a little down and turning it aside (1, 2). When ever possible secure the module also with chains from top.

Do not tilt the drive module (A). It is **heavy** (over 160 kg [350 lb]) and its **center of gravity is high**. The module will overturn from a sideways tilt of 5 degrees. Do not leave the module unattended on a sloping floor.

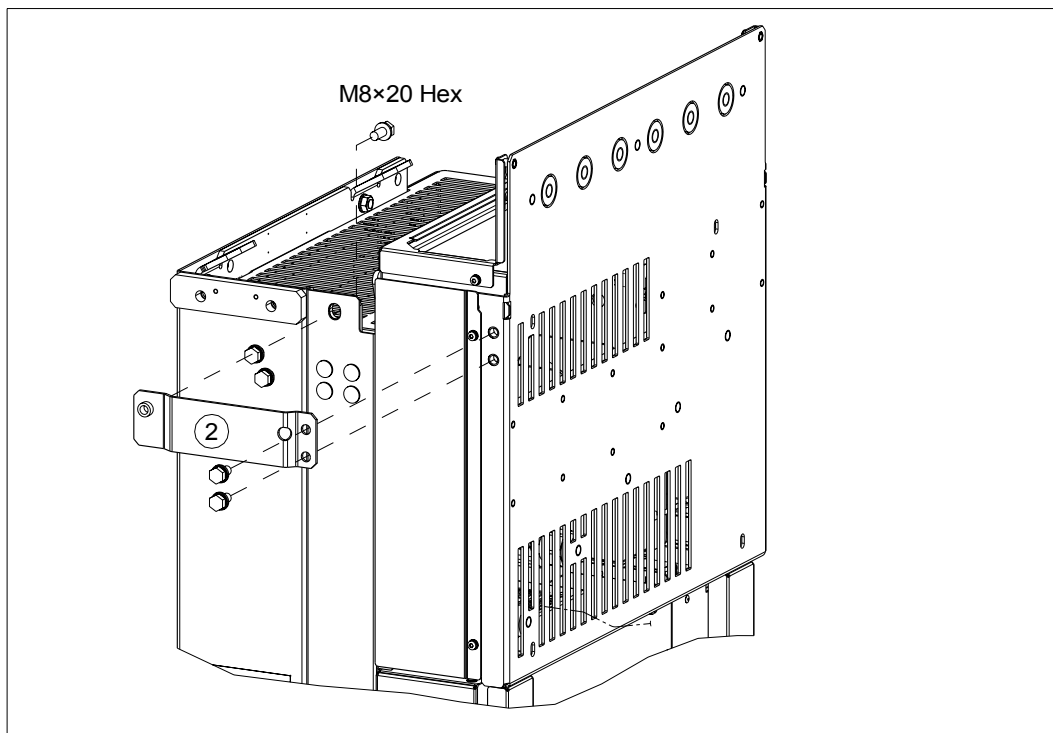


Mounting procedure

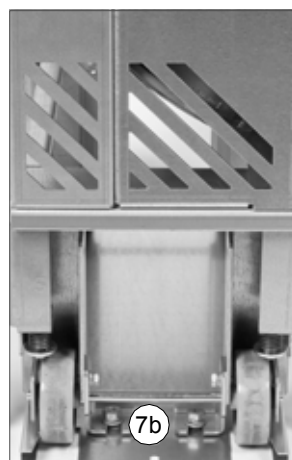
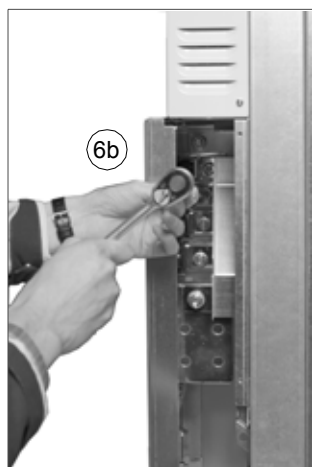
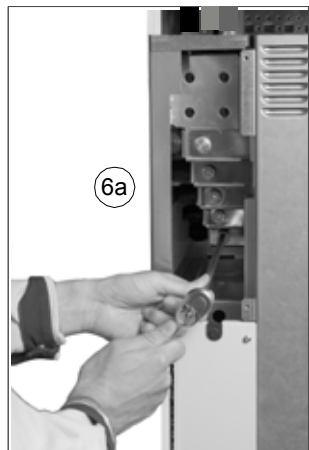
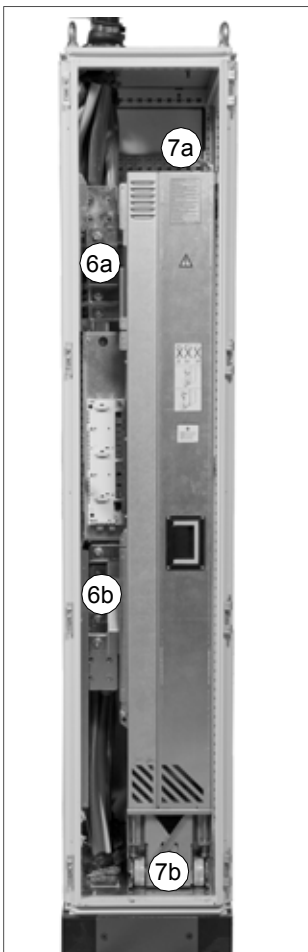
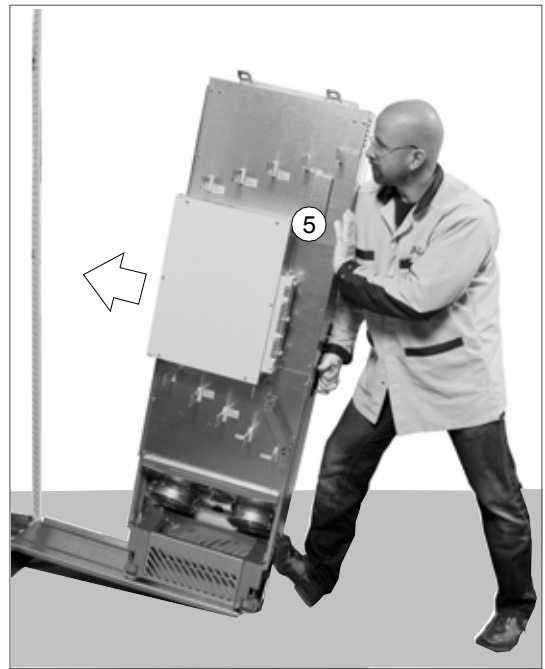
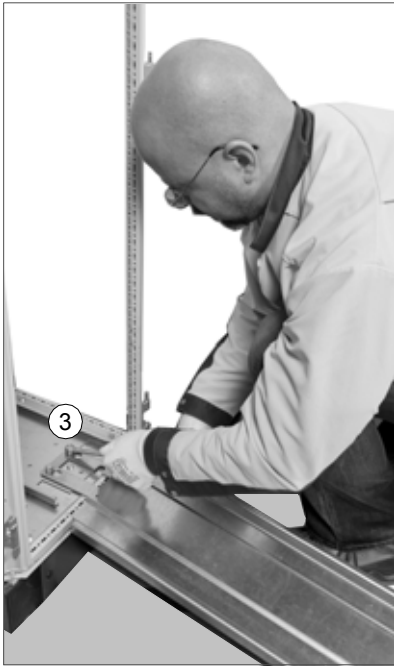
1. Mount the fastening bracket to the drive module.



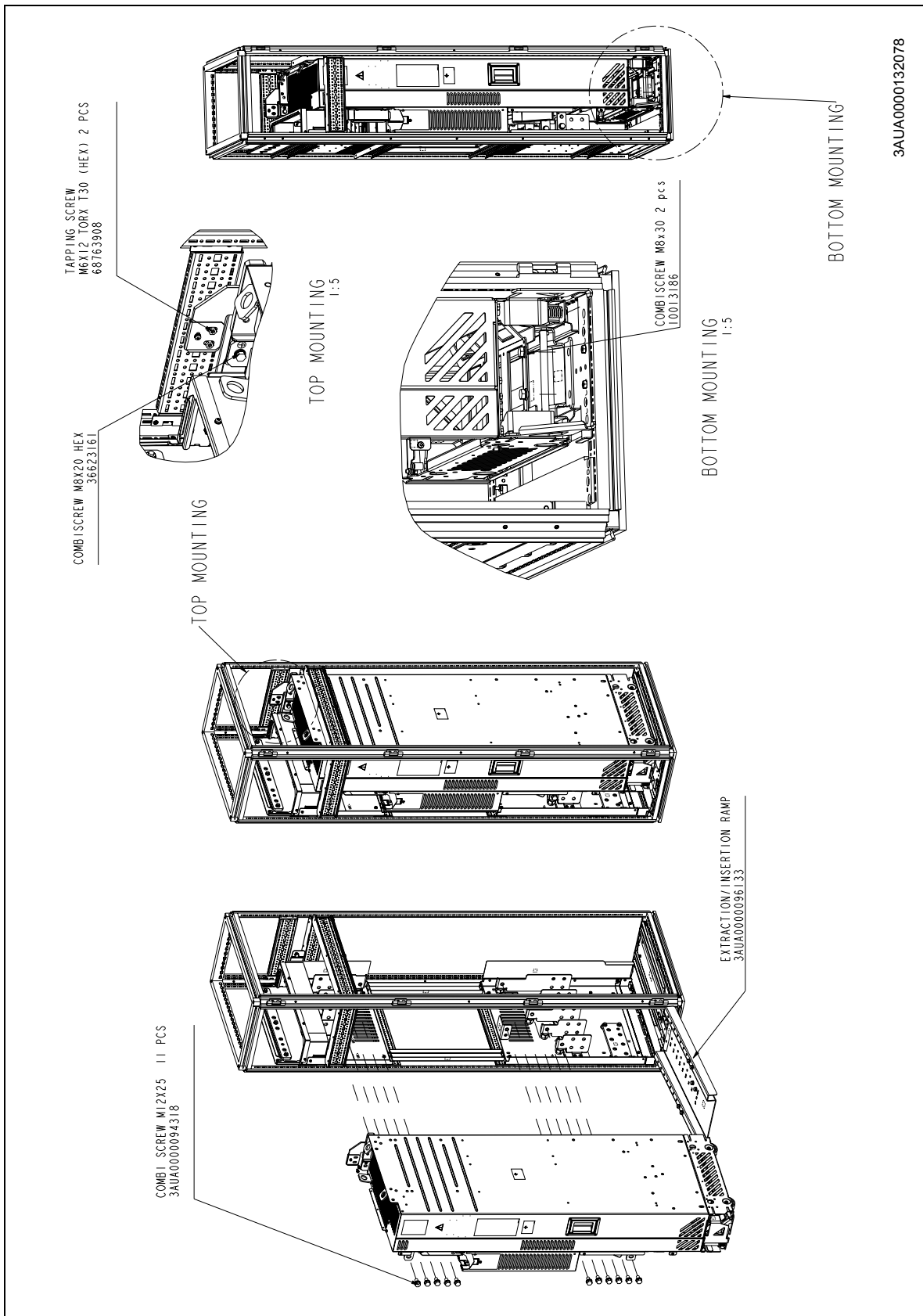
2. Mount the grounding busbar that has been previously mounted to the input cabling panel to the drive module. **Note:** The design of the grounding busbar can differ from what is shown in the figure.



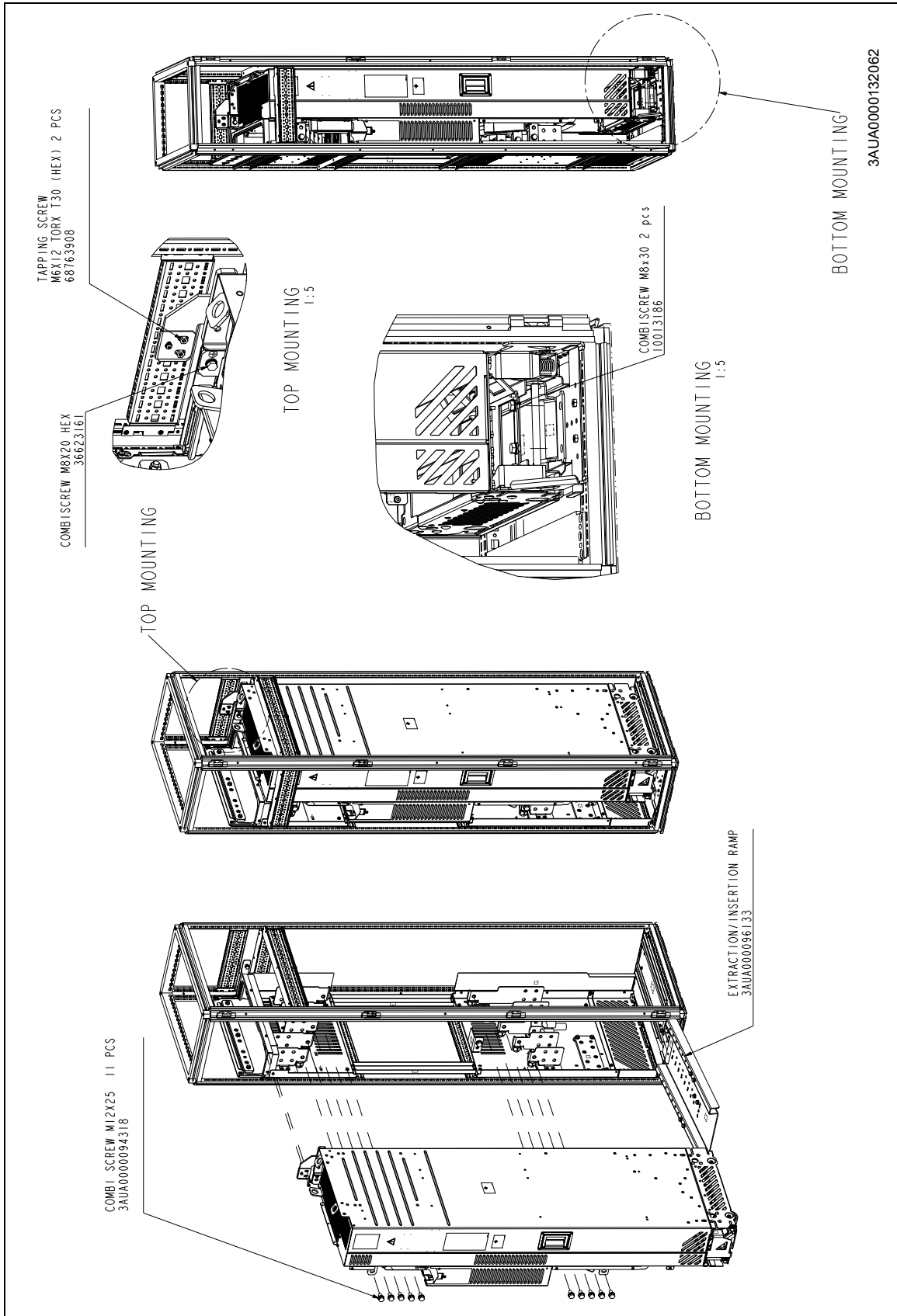
3. Install the extraction and insertion ramp to the cabinet base with two screws.
4. Remove the upper and lower left-side front covers of the drive module. M4×8 combi screws, 2 N·m.
5. Push the drive module carefully into to the cabinet preferably with help from another person.
6. Connect the busbars of the drive module to the busbars of the cabling panels. combi screw M12, 70 N·m (52 lbf·ft).
7. Mount the drive module to the cabinet from top and bottom as shown below and in the assembly drawing on page 93 (frame G1) or page 94 (frame G2). **Note:** The screws ground the module to the cabinet frame.
8. Units with an external control unit: Put back the removed front covers of the drive module on the power cable sections.
Units with an internal control unit (option +P905): Put back the removed front covers of the drive module on the power cable sections after connecting the control cables to the control unit.



Assembly drawing of installing the drive module to the cabinet (frame G1)



Assembly drawing of installing the drive module to the cabinet (frame G2)



Removing the protective covering from the module air outlet



WARNING! Remove the protective covering from the top of the drive module after the installation. If the covering is not removed, the cooling air cannot flow freely through the module and the drive will run to overtemperature.



Connecting the control cables

Flowchart of the control cable installation process (external control unit)

| Step | Task | For instructions, see section |
|------|--|--|
| 1 | Remove the cover assembly of the control unit. | <i>Removing the cover assembly of the external control unit</i> , page 96 |
| 2 | Fasten the control cable clamp plate to the control unit. | <i>Fastening the control cable clamp plate</i> , page 97 |
| 3 | Install the optional modules to the control unit (if not mounted yet). | <i>Installing optional modules</i> , page 101 |
| 4 | Connect the power supply and fiber optic cables between the control unit and the drive module. | <i>Connecting the external control unit to the drive module</i> , page 97 |
| 5 | Mount the control unit to the wall or DIN rail. | <i>Mounting the external control unit</i> , page 99 |
| 6 | Connect the external control cables to the control unit and the optional modules. | <i>Connecting the control cables to the terminals of the control unit</i> , page 102 |
| 7 | Refit the control unit cover assembly | <i>Removing the cover assembly of the external control unit</i> , page 96 |

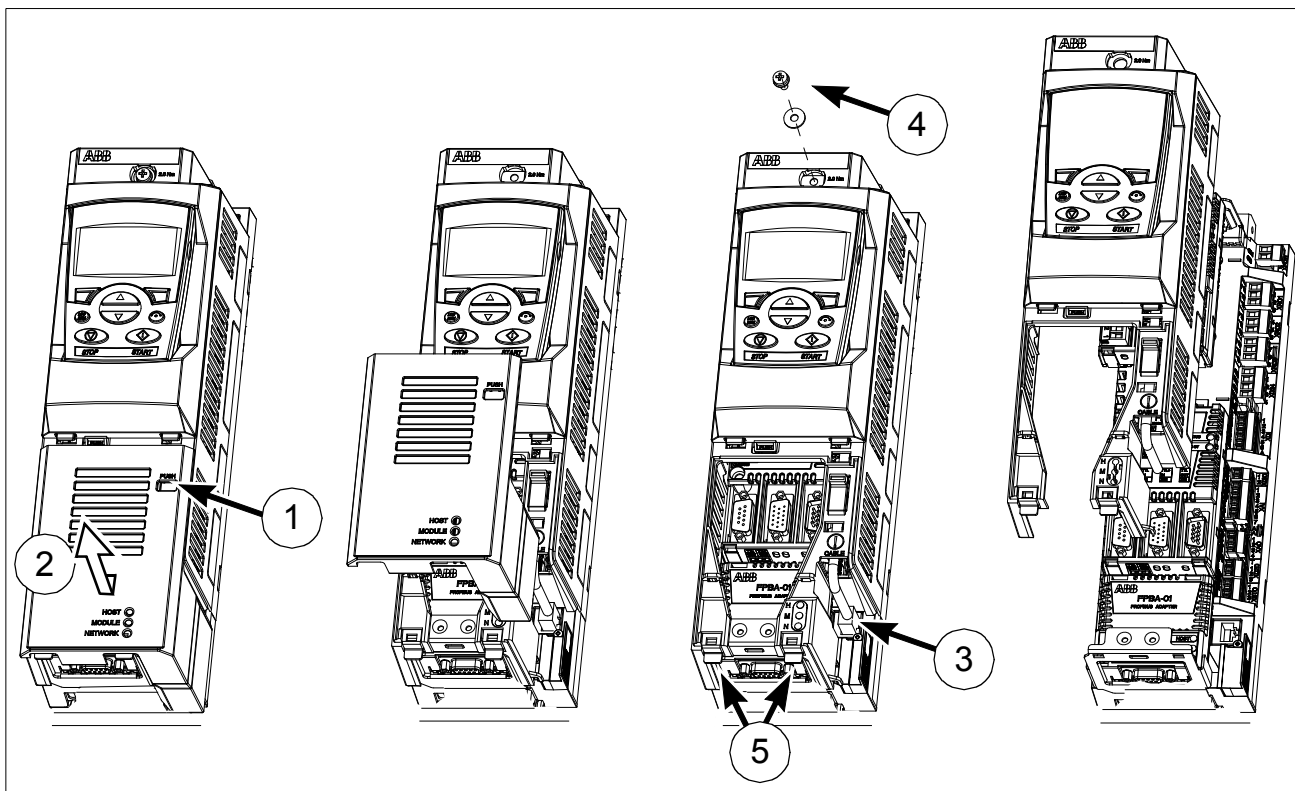
Flowchart of the control cable installation process (internal control unit, option +P905)

| Step | Task | For instructions, see section |
|------|---|---|
| 1 | Route the control cables inside the cabinet and connect them. | <i>Control cable connection procedure of units with internal control unit (option +P905)</i> , page 108 |

Removing the cover assembly of the external control unit

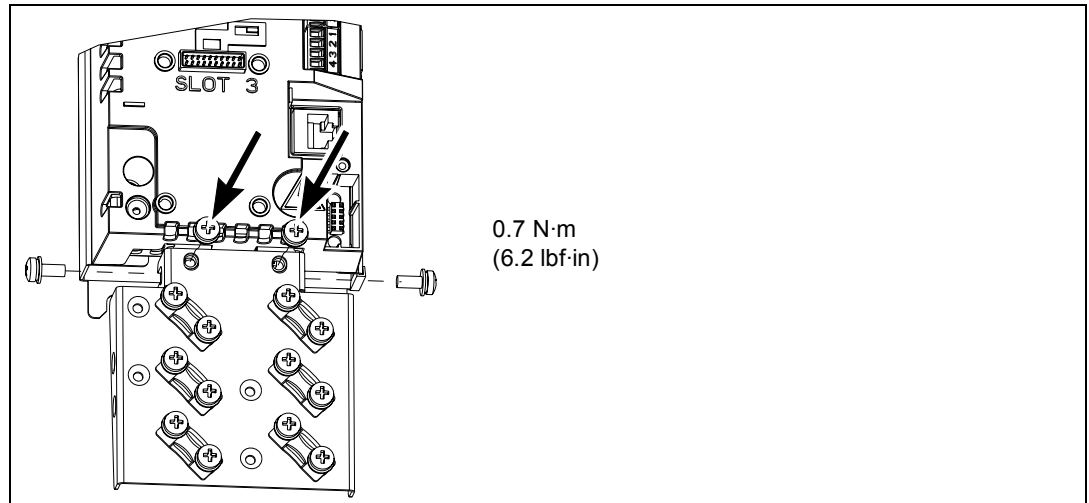
The cover assembly needs to be removed before the installation of optional modules and the connection of control cabling. Follow this procedure to remove the cover assembly. The numbers refer to the illustrations below.

1. Press the tab slightly with a screwdriver.
2. Slide the lower cover plate slightly downwards and pull it out.
3. Disconnect the panel cable if present.
4. Remove the fastening screw at the top of the cover assembly.
5. Carefully pull the lower part of the base outwards by the two tabs.
6. Refit the cover in reverse order to the above when the control cables have been connected.



Fastening the control cable clamp plate

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



Connecting the external control unit to the drive module



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

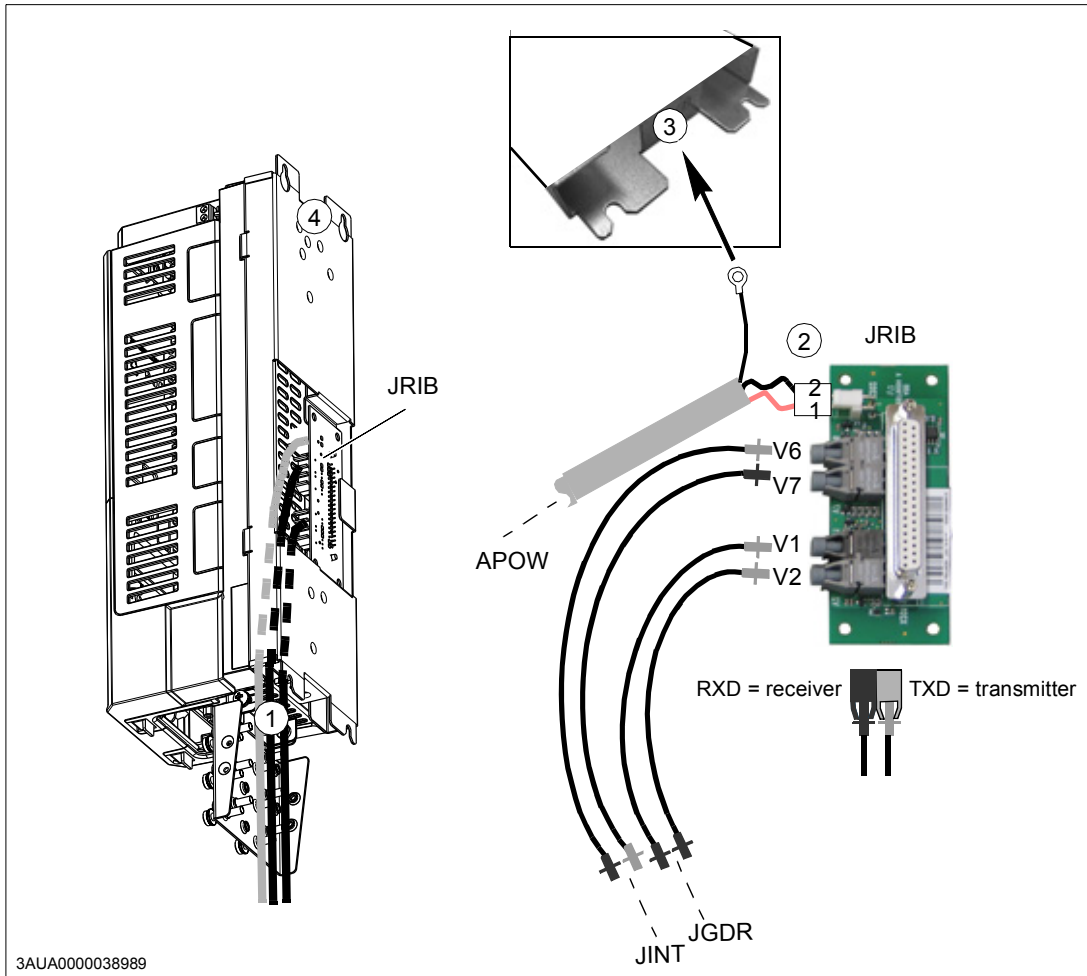
Note: The power rating of the drive is defined in the JRIB board that is inside the JCU control unit. Do not interchange JCU control units between drives with different power ratings. This can cause damage to the equipment.

Connect the fiber optic cables and power supply cable coming from the drive module through the U-hole in the circuit board compartment cover to the external control unit as follows:

1. Thread the cables inside the back frame of the control unit as shown below.
2. Connect the cables to the JRIB board terminals.

| Connection table | |
|------------------|---------|
| APOW | JRIB |
| X3: 1 | X202: 1 |
| X3: 2 | X202: 2 |
| JINT | JRIB |
| V1 | V1 |
| V2 | V2 |
| JGDR | JRIB |
| V6 | V6 |
| V7 | V7 |

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

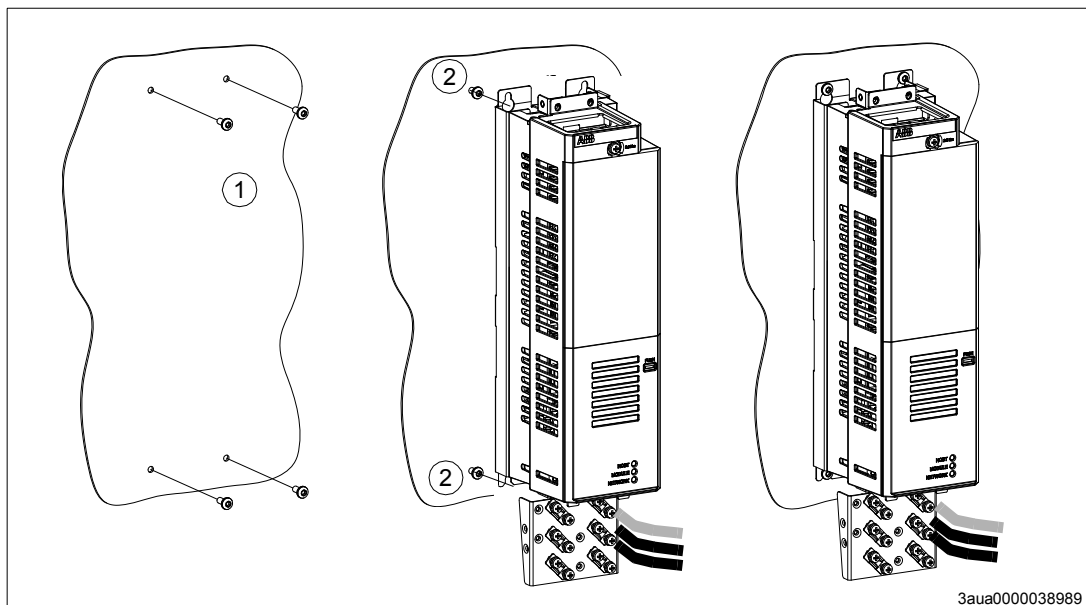


Mounting the external control unit

The drive control unit can be fastened on a mounting plate through the fastening holes in its back or by using a DIN rail.

Mounting the external control unit to wall

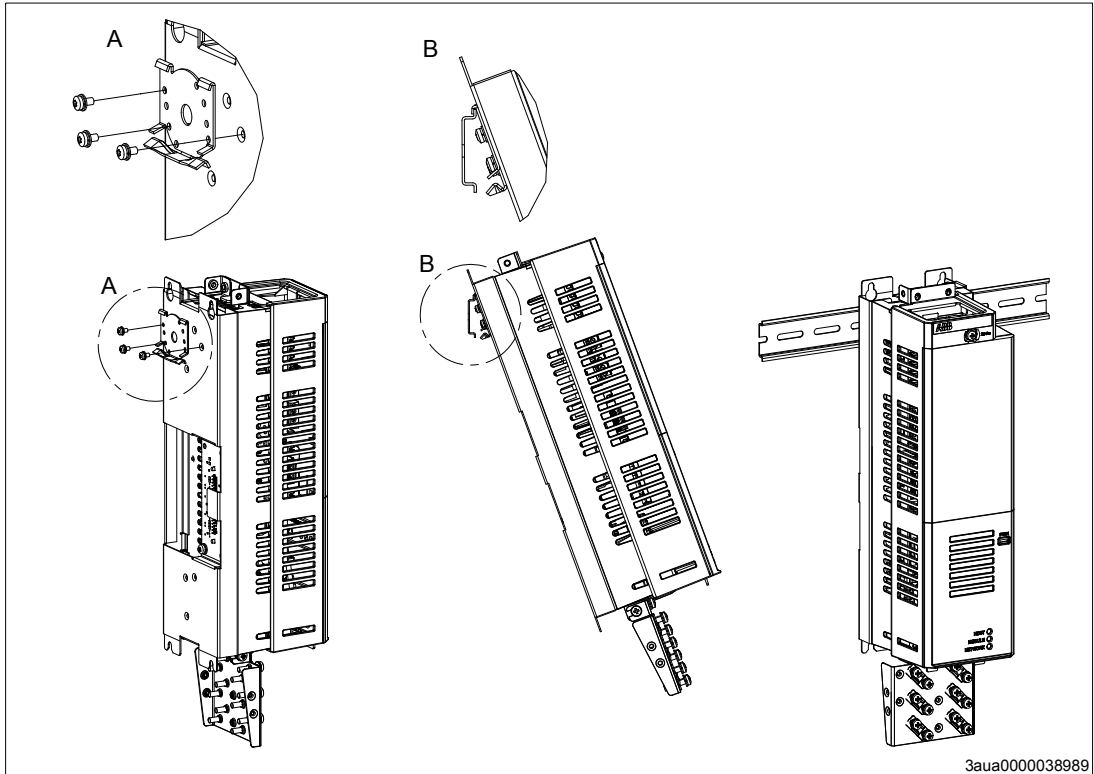
1. Fasten the fastening screws in the wall.
2. Lift the unit onto the screws and tighten the screws.



3aua0000038989

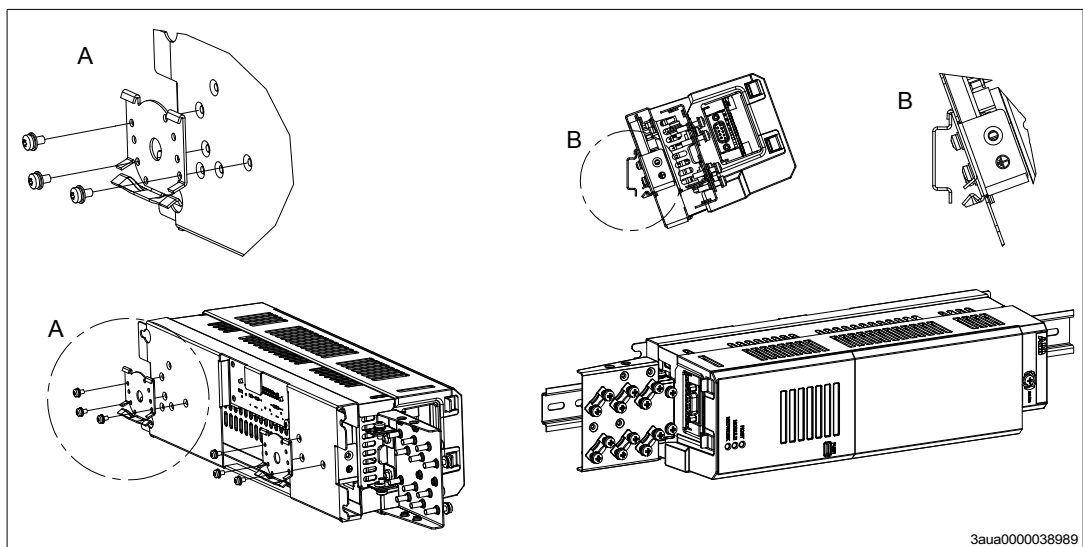
Mounting the external control unit vertically on a DIN rail

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



Mounting the control unit horizontally on a DIN rail

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



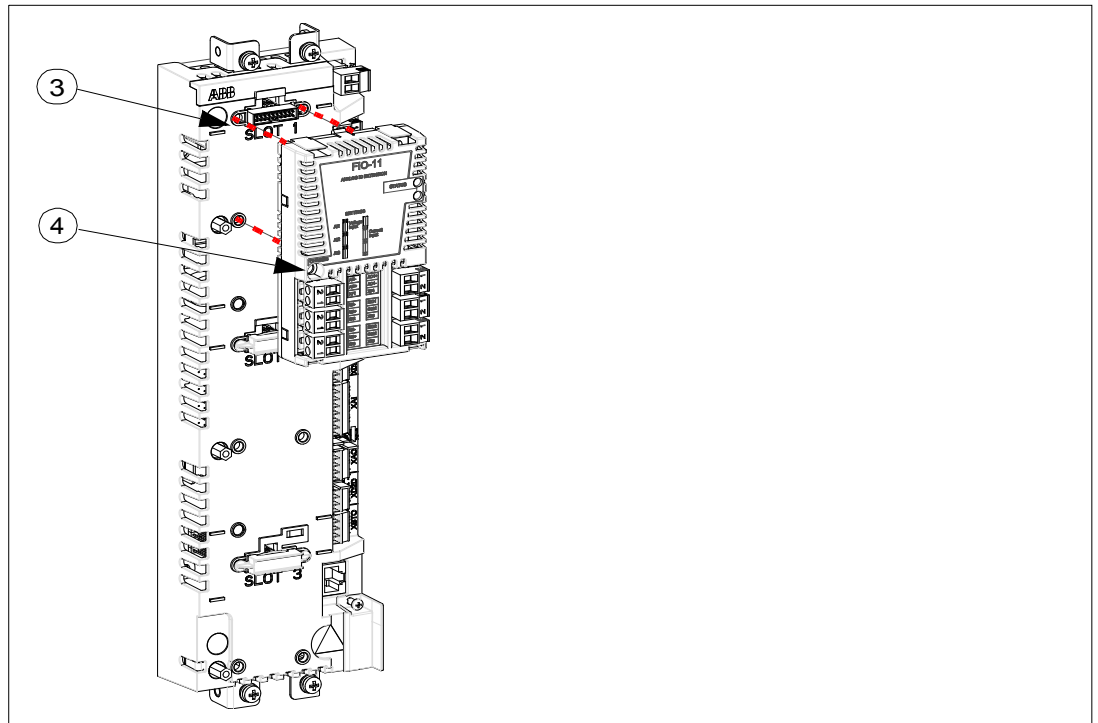
Installing optional modules

Mechanical installation

Optional modules such as a fieldbus adapters, an I/O extensions and the pulse encoder interfaces are inserted in the optional module slot on the control unit. See page 32 for the available slots.

1. Remove the control unit cover.
2. Remove the protective cover (if present) from the connector of the slot.
3. Insert the module carefully into its position on the control unit.
4. Fasten the screw.

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

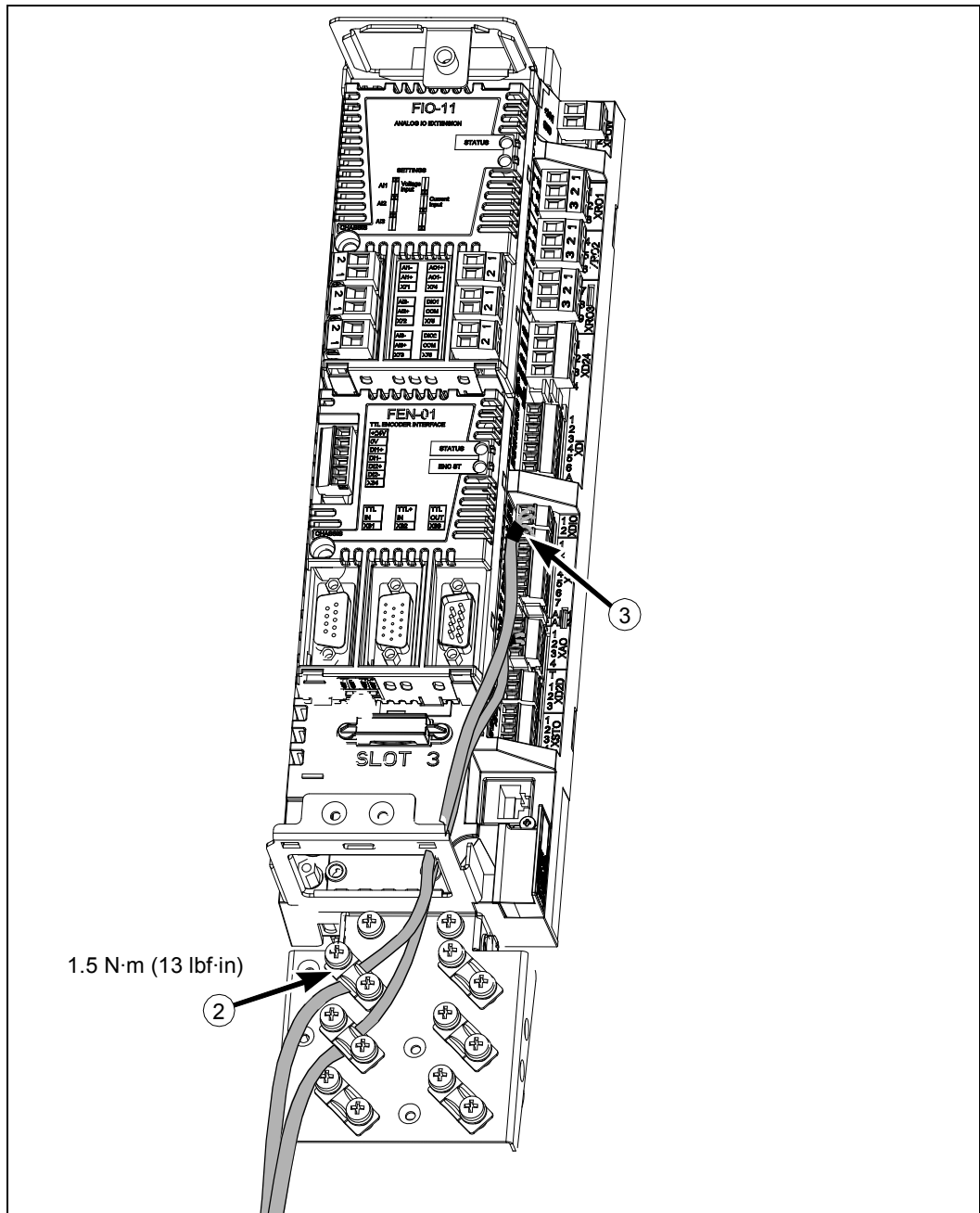


Wiring the modules

See the appropriate optional module manual for specific installation and wiring instructions. See page 102 for routing the cables.

Connecting the control cables to the terminals of the control unit

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



2. Ground the shields of the control cables at the clamp plate. The shields should be continuous as close to the terminals of the control unit as possible. Only remove the outer jacket of the cable at the cable clamp so that the clamp presses on the bare shield. The shield (especially in case of multiple shields) can also be terminated with a lug and fastened with a screw at the clamp plate. Leave the other end of the shield unconnected or ground it indirectly via a few nanofarads high-frequency capacitor eg, 3.3 nF / 630 V.

The shield can also be grounded directly at both ends if they are *in the same ground line* with no significant voltage drop between the end points. Tighten the screws to secure the connection.

3. Connect the conductors to the appropriate detachable terminals of the control unit. See section [Default I/O connection diagram](#), page 104. Use shrink tubing or insulating tape to contain any stray strands.

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

Default I/O connection diagram

Notes:

[...] denotes default setting with ACS850 Standard Control Program (Factory macro). See the firmware manual for other macros.

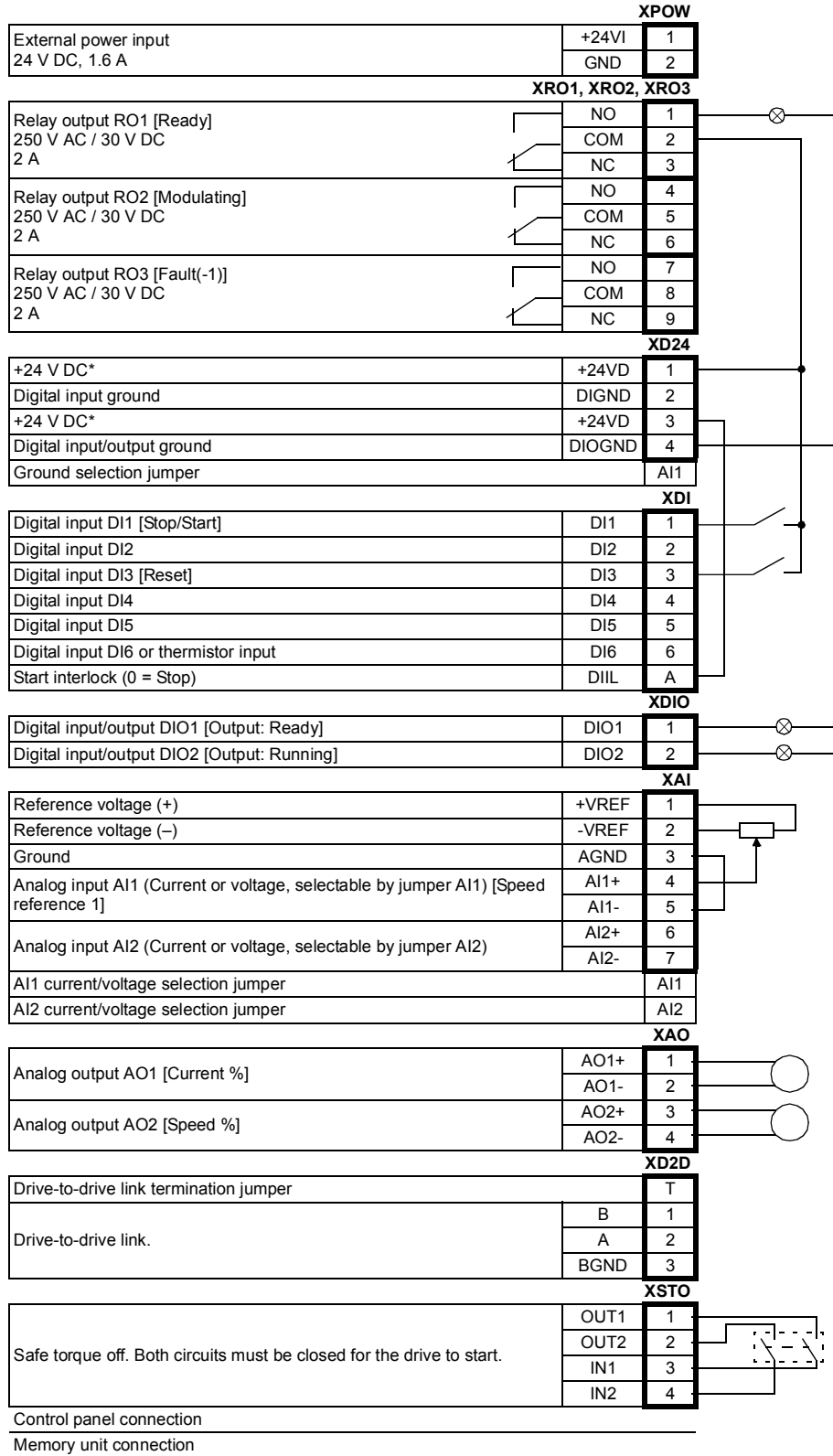
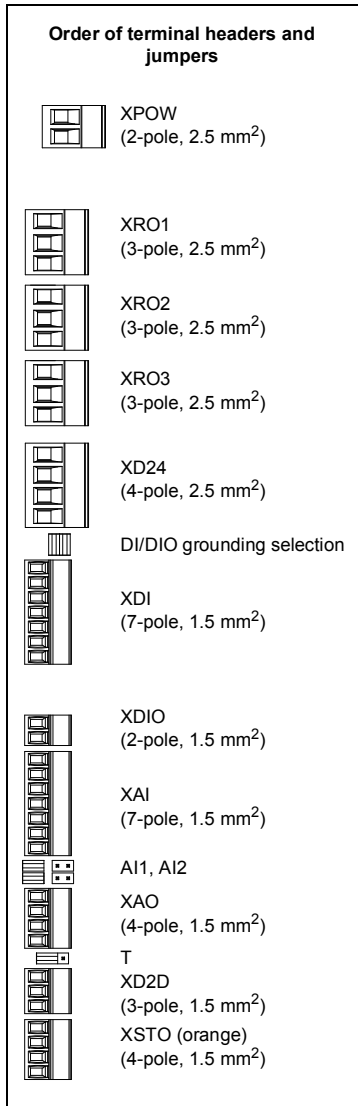
*Total maximum current: 200 mA

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

Wire sizes and tightening torques:

XPOW, XRO1, XRO2, XRO3, XD24:
0.5 ... 2.5 mm² (24...12 AWG). Torque: 0.5 N·m (5 lbf·in)

XDI, XDIO, XAI, XAO, XD2D, XSTO:
0.5 ... 1.5 mm² (28...14 AWG). Torque: 0.3 N·m (3 lbf·in)

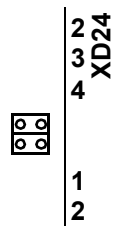


Jumpers

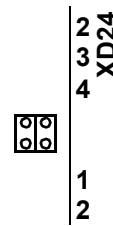
DI/DIO grounding selector (located between XD24 and XDI) – Determines whether the DIGND (ground for digital inputs DI1...DI5) floats, or if it is connected to DIOGND (ground for DI6, DIO1 and DIO2). See the JCU isolation and grounding diagram on page 133.

If DIGND floats, the common of digital inputs DI1...DI5 should be connected to XD24:2. The common can be either GND or V_{cc} as DI1...DI5 are of the NPN/PNP type.

DIGND floats

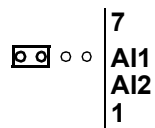


DIGND tied to DIOGND

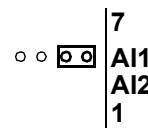


AI1 – Determines whether analog input AI1 is used as a current or voltage input.

Current

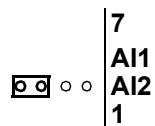


Voltage

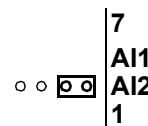


AI2 – Determines whether analog input AI2 is used as a current or voltage input.

Current

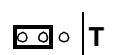


Voltage



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

Termination ON



Termination OFF



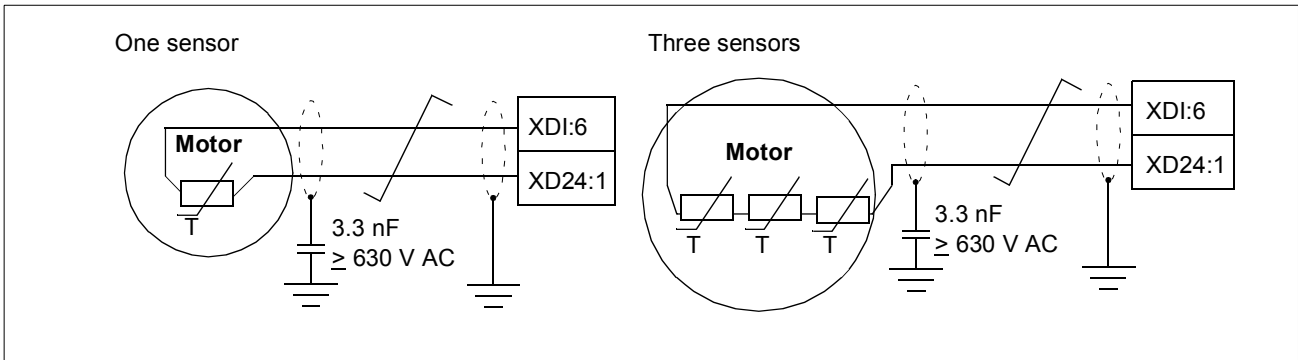
External power supply for the JCU control unit (XPOW)

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

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

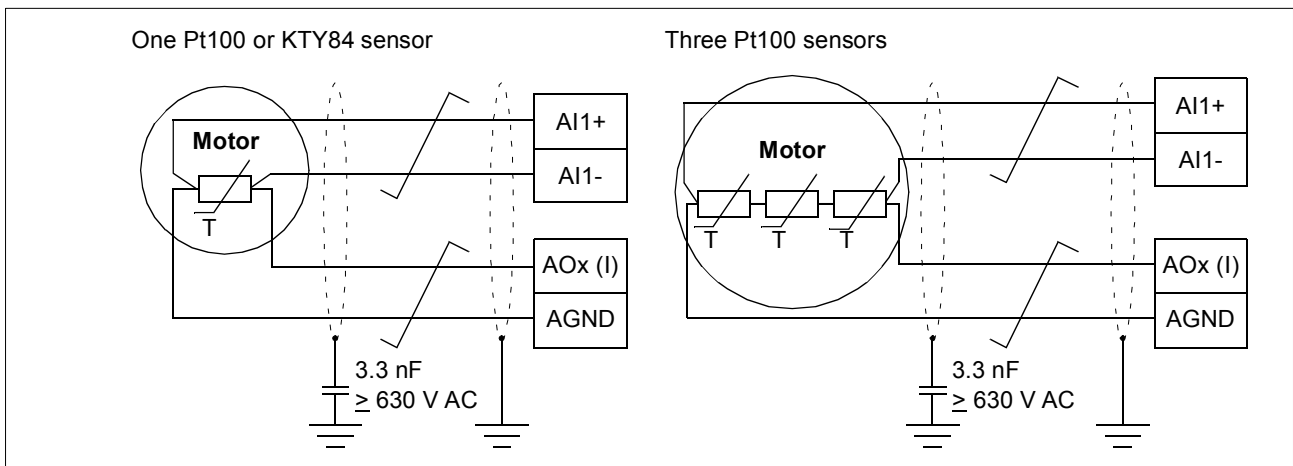
DI6 (XDI:6) as a thermistor input

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



Notes:

- Do not connect both ends of the cable shields directly to ground. If a capacitor cannot be used at one end, leave that end of the shield unconnected.
- The connection of temperature sensors involves parameter adjustment. See the firmware manual of the drive.
- PTC (as well as KTY84) sensors can alternatively be connected to a FEN-xx encoder interface. See the user's manual of the interface for wiring information.
- Pt100 and KTY84 sensors are not to be connected to the thermistor input. Instead, an analog input and an analog current output (located either on the JCU or on an I/O extension module) are used as shown below. The analog input must be set to voltage.





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

- 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.

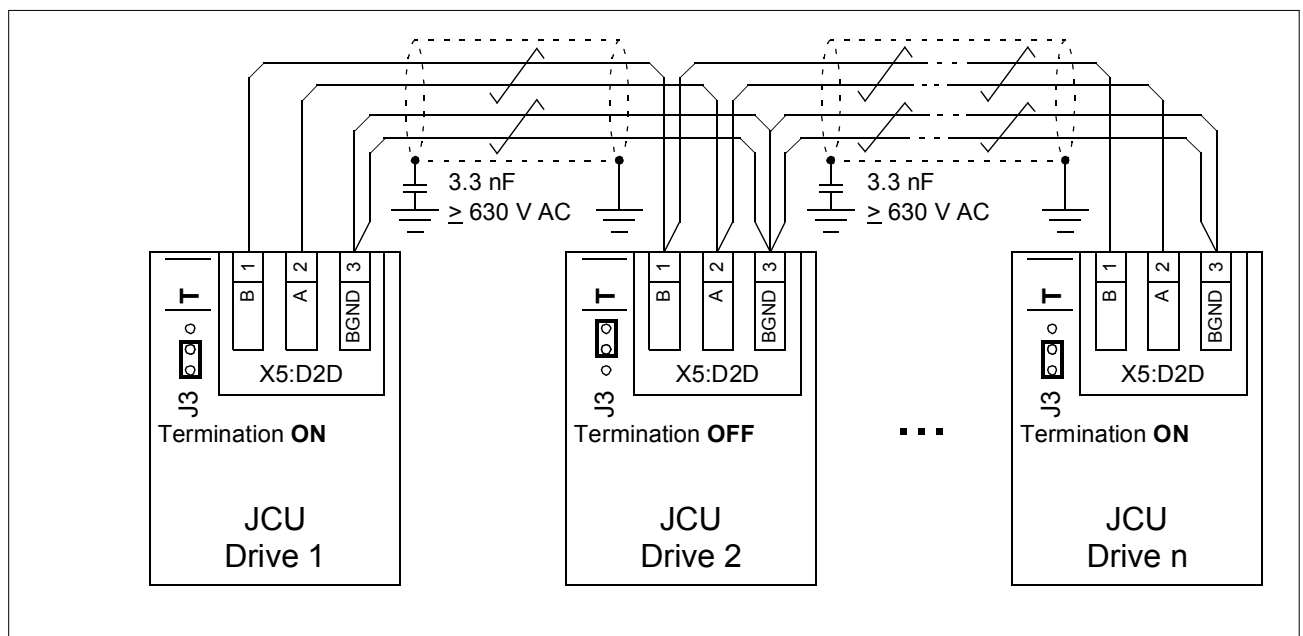
Drive-to-drive link (XD2D)

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

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

Shielded twisted-pair cable (~100 ohm, for example 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 100 meters (328 ft). Unnecessary loops and running the cable near power cables (such as motor cables) must be avoided. The cable shields must to be grounded to the control cable clamp plate on the drive as shown on page [102](#).

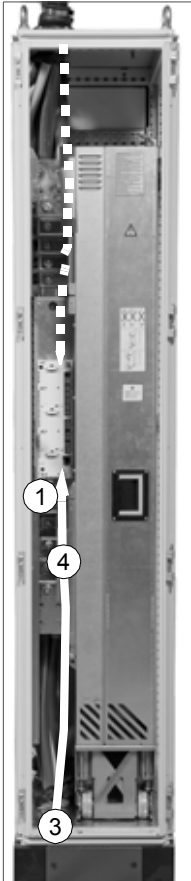
The following diagram shows the wiring of the drive-to-drive link.



Safe torque off (XSTO)

For the drive to start, both connections (OUT1 to IN1, and OUT2 to IN2) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting an external Safe torque off circuitry to the drive. See page 64.

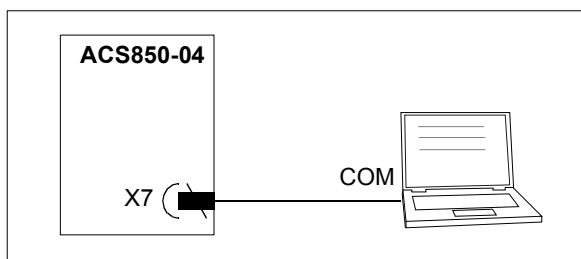
Control cable connection procedure of units with internal control unit (option +P905)



1. Fasten the clamp plate to the control unit with two screws from front, see [Fastening the control cable clamp plate](#) on page 97.
2. Fasten the optional modules if not fastened already.
3. Lead the control cables inside the drive cabinet.
4. Route the control cables along the control cable duct from bottom or top to the control unit.
5. Ground the outer control cable shields 360 degrees at the cabinet lead-through plate (recommendation).
6. Ground the control cables at the clamp plate as described in bullet 2 under [Connecting the control cables to the terminals of the control unit](#) on page 104.
7. Connect the conductors to the appropriate detachable terminals of the control unit (see page 104). Use shrink tubing or insulating tape to contain any stray strands. Tighten the screws to secure the connection.
Note: Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

Connecting a PC

Connect the PC to the drive control unit as follows:



Installation checklist

What this chapter contains

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

Installation checklist

Go through the checklist below together with another person.



WARNING! Follow the safety instructions, page 14. Ignoring the instructions can cause physical injury or death, or damage to the equipment

| | |
|--|---|
| <input checked="" type="checkbox"/> | Check that ... |
| Cabinet construction | |
| <input type="checkbox"/> | The drive module is fastened properly to the cabinet. (See chapters Planning the cabinet installation and Installation .) |
| <input type="checkbox"/> | Mechanical joints are tightened and not broken. |
| <input type="checkbox"/> | Parts are clean and painted surfaces not scratched. The cabinet frame and parts which are in metal to metal contact with the frame (for example seams, component fixing points on assembly plates, back of control unit mounting plate) are not finished with non-conducting paint or material. |
| <input type="checkbox"/> | Degree of protection (IPxx) |
| Drive option modules and other components | |
| <input type="checkbox"/> | Type and number of option modules and other equipment is correct. Option modules and other equipment are not damaged. |
| <input type="checkbox"/> | Option modules and terminals are labelled correctly. |
| <input type="checkbox"/> | The placement of option modules and other equipment inside the cabinet and on the cabinet door is correct. |
| <input type="checkbox"/> | The mounting of option modules and other equipment is correct. |
| Internal cabling of the cabinet assembly | |
| <input type="checkbox"/> | Main circuit: <ul style="list-style-type: none"> • AC supply input cabling is ok. • AC output cabling is ok. • Supply for brake resistor (if used) is ok. |
| <input type="checkbox"/> | Cable types, cross-sections, colours and optional markings are correct. |
| <input type="checkbox"/> | Cabling is not susceptible to interference. Check the twisting of cables and cable routes. |

| | |
|-------------------------------------|--|
| <input checked="" type="checkbox"/> | Check that ... |
| <input type="checkbox"/> | <p>Connection of cables to devices, terminal blocks and drive module circuit boards:</p> <ul style="list-style-type: none"> • Cables are connected to terminals tight enough by pulling the cable. • Cable termination on terminals chaining is done correctly. • Bare conductors are not too far outside the terminal causing an insufficient clearance or loss of shielding against contact. • JCU control unit is wired properly to the drive module. • Control panel cable is connected properly. |
| <input type="checkbox"/> | Cables are not lying against sharp edges or bare live parts. Bending radius of fiber optic cables at least 3.5 cm (1.38 in.). |
| <input type="checkbox"/> | The type, markings, insulation plates and cross connections of terminal blocks are correct. |
| Grounding and protection | |
| <input type="checkbox"/> | The grounding colors, cross-section and grounding points of modules and other equipment match the circuit diagrams. No long routes for pigtails. |
| <input type="checkbox"/> | Connections of PE cables and busbars are tight enough. Pull the cable to test that it does not loosen. No long routes for pigtails. |
| <input type="checkbox"/> | Doors equipped with electrical equipment are grounded. No long grounding routes. From EMC standpoint best result is achieved with a flat copper braid. |
| <input type="checkbox"/> | Fans that can be touched are shrouded. |
| <input type="checkbox"/> | Live parts inside the doors are protected against direct contact to at least IP2x. |
| Labels | |
| <input type="checkbox"/> | The type designation labels and warning and instruction stickers are made according to the local regulations and placed correctly. |
| Switches and doors | |
| <input type="checkbox"/> | Mechanical switches, main disconnecting switch and cabinet doors function properly. |
| Installation of the cabinet | |
| <input type="checkbox"/> | The drive cabinet has been fixed to floor and also from top to the wall or roof. |
| <input type="checkbox"/> | The ambient operating conditions meet the specifications given in chapter Technical data . |
| <input type="checkbox"/> | The cooling air will flow freely in and out of the drive cabinet, and air recirculation inside the cabinet will not be possible (air baffle plates are on place). |
| <input type="checkbox"/> | <u>If the drive has been stored over one year:</u> The electrolytic DC capacitors in the DC link of the drive have been reformed. See page 124 . |
| <input type="checkbox"/> | There is an adequately sized protective ground conductor between the drive and the switchboard. |
| <input type="checkbox"/> | There is an adequately sized protective ground conductor between the motor and the drive. |
| <input type="checkbox"/> | All protective ground conductors have been connected to the appropriate terminals and the terminals have been tightened. (Pull the conductors to check.) |
| <input type="checkbox"/> | The enclosures of the equipment in the cabinet have proper galvanic connection to the cabinet protective earth (ground) busbar; The connection surfaces at the fastening points are bare (unpainted) and the connections are tight, or separate grounding conductors have been installed. |

| | |
|-------------------------------------|--|
| <input checked="" type="checkbox"/> | Check that ... |
| <input type="checkbox"/> | The supply voltage matches the nominal input voltage of the drive. Check the type designation label. |
| <input type="checkbox"/> | The input power cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.) |
| <input type="checkbox"/> | Appropriate AC fuses and main disconnectors have been installed. |
| <input type="checkbox"/> | The motor cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.) |
| <input type="checkbox"/> | The brake resistor (if present) has been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.) |
| <input type="checkbox"/> | The motor cable (and brake resistor cable, if present) has been routed away from other cables. |
| <input type="checkbox"/> | The brake resistor cable has been routed away from other cables. |
| <input type="checkbox"/> | No power factor compensation capacitors have been connected to the motor cable. |
| <input type="checkbox"/> | The control cables (if any) have been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.) |
| <input type="checkbox"/> | <u>If a drive bypass connection will be used:</u> The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked, ie, cannot be closed simultaneously. |
| <input type="checkbox"/> | There are no tools, foreign objects or dust from drilling inside the drive. |
| <input type="checkbox"/> | All shrouds and cover of the motor connection box are in place. Cabinet doors have been closed. |
| <input type="checkbox"/> | The motor and the driven equipment are ready for start. |

Start-up

What this chapter contains

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

Start-up procedure

1. Ensure that the installation of the drive has been checked according to the checklist in chapter [Installation checklist](#), and that the motor and driven equipment are ready for start.
2. Perform the start-up tasks instructed by the cabinet-installer of the drive module.
3. Switch the power on and set-up the drive control program according to the start-up instructions given in the drive firmware manual.
4. Validate the Safe torque off function, see *Safe torque off function for ACSM1, ACS850 and ACQ810 drives application guide* (3AFE68929814 [English]).

Fault tracing

What this chapter contains

This chapter describes the fault tracing possibilities of the drive.

LEDs

This table describes LEDs of the drive module.

| Where | LED | When the LED is lit |
|------------|--------------|--|
| JINT board | V204 (green) | +5 V voltage of the board is OK. |
| | V309 (red) | Not in use. |
| | V310 (green) | IGBT control signal transmission to the gate driver control boards is enabled. |
| BFPS board | V79 (green) | +5 V voltage of the board is OK. |

Warning and fault messages

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

Maintenance

What this chapter contains

This chapter contains maintenance instructions of the drive module.

Applicability

The drive module replacement described in this chapter applies to the Rittal TS 8 example installation of chapter [Installation](#). The other maintenance instructions are general.

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 |
|---|--|--|
| Every year | Check the main cooling fan and circuit board cooling fan, tightness of terminals, dustiness, corrosion, temperature and quality of supply voltage. | Maintenance if needed. See sections Cabinet and Heatsink on page 119 . |
| Every year when stored | Reform the capacitors. | See Reforming the capacitors . |
| Every 3 years | Check the condition of fiber optic cables. | See the fault logger. If PPCC LINK faults have recurred, change the fiber optic cables. |
| Every 6 years Every 3 years if the ambient temperature is over 40 °C (104 °F) or cyclic heavy load or continuous nominal load. | Replace the circuit board compartment cooling fan. | See Fans . |
| | Replace the DC circuit electrolytic capacitors and discharging resistors. | Contact ABB. |
| Every 9 years Every 6 years if the ambient temperature in continuous operation is over 40 °C (104 °F). | Replace the main cooling fan. | See Fans . |
| Every 9 years | Replace the JINT board and flat cable, the BFPS, BGAD and JGDR boards. | Contact ABB. |
| | Replace the control panel battery. | The battery is housed on the rear of the control panel. Replace with a new CR 2032 battery. |

Note: Perform the maintenance tasks of the cabinet (for example, clean the air inlet and outlet filters) when necessary and according to the cabinet manufacturer's instructions.

Consult your local ABB Service representative for more details on the maintenance. On the Internet, go to <http://www.abb.com/drivesservices>.

Cabinet

Cleaning the interior of the cabinet



WARNING! Follow the safety instructions, page 14. Ignoring the instructions can cause physical injury or death, or damage to the equipment.



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

1. Ensure that the drive is disconnected from the power line and all other precautions described under *Safety in installation and maintenance* on page 14 have been taken into consideration.
2. When necessary, clean the interior of the cabinet with a soft brush and a vacuum cleaner.

Heatsink

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

Cleaning the interior of the heatsink



WARNING! Follow the safety instructions, page 14. Ignoring the instructions can cause physical injury or death, or damage to the equipment.



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

1. Ensure that the drive is disconnected from the power line and all other precautions described under *Safety in installation and maintenance* on page 14 have been taken into consideration.
2. Undo the fastening screws of the handle plate of the drive module.
3. Remove the handle plate.
4. Vacuum the interior of the heatsink from the opening.
5. Blow compressed air upwards from the opening and, at the same time, vacuum from the top of the drive module.



Fans

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

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

Replacing the circuit board compartment cooling fan



WARNING! Follow the safety instructions, page [14](#). Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Remove the drive module out of the cabinet as described in section [Replacing the drive module](#) on page [122](#).
2. Undo the fastening screw of the fan enclosure.
3. Unplug the power supply cable of the fan.
4. Install the new fan in reverse order to the above.

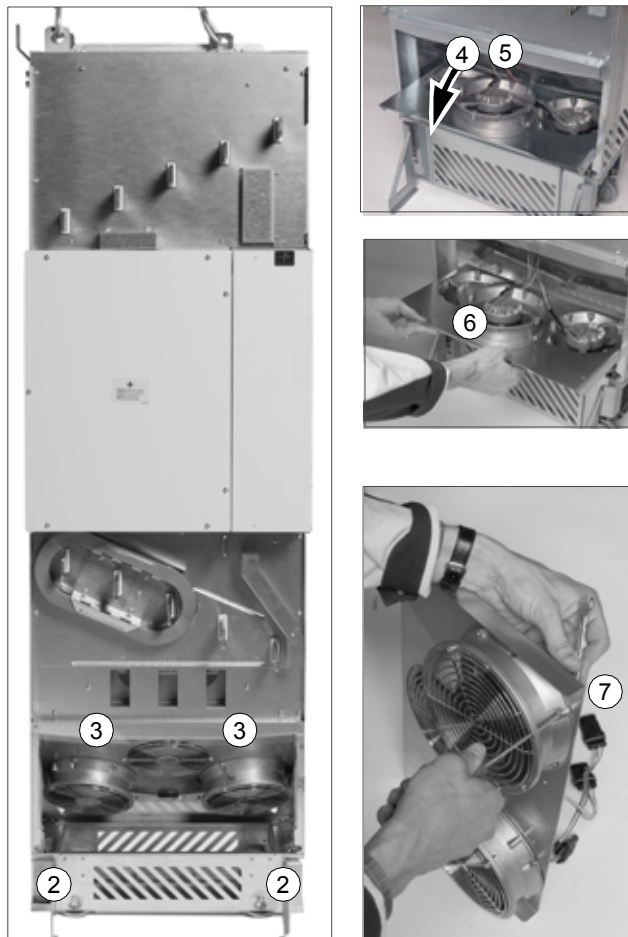


Replacing the main cooling fans



WARNING! Follow the safety instructions, page 14. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Remove the drive module out of the cabinet as described in section *Replacing the drive module* on page 122.
2. Open the support legs of the pedestal.
3. Undo the two screws that fasten the fan assembly plate.
4. Tilt the fan assembly plate down.
5. Disconnect the power supply wires of the fans.
6. Remove the fan assembly from the drive module.
7. Undo the fastening screws of the fan(s) and remove the fan(s) from the assembly plate.
8. Install the new fan(s) in reverse order to the above.



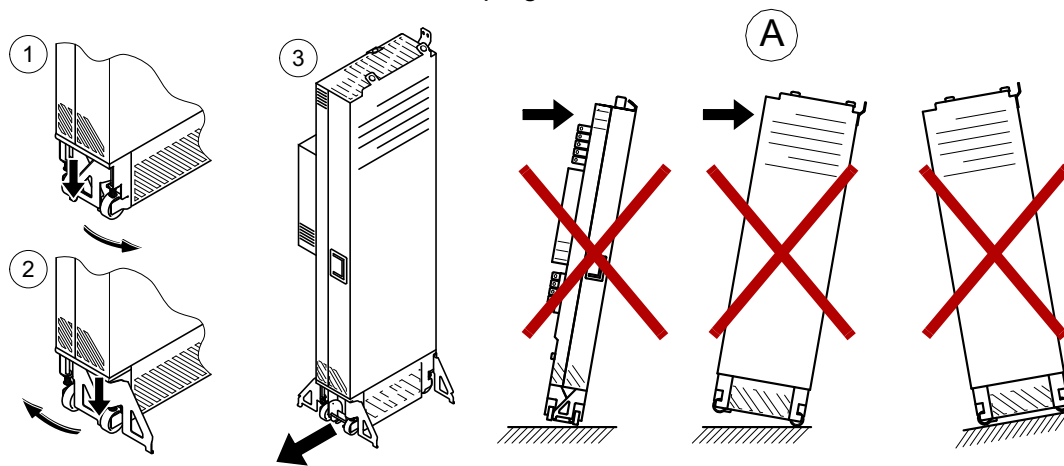
Replacing the drive module



WARNING! Follow the safety instructions, page 14. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

Handle the drive module carefully. Make sure that the module does not fall down when moving it on the floor and during installation and maintenance work: Open the support legs by pressing each leg a little down and turning it aside (1, 2). When ever possible secure the module also with chains.

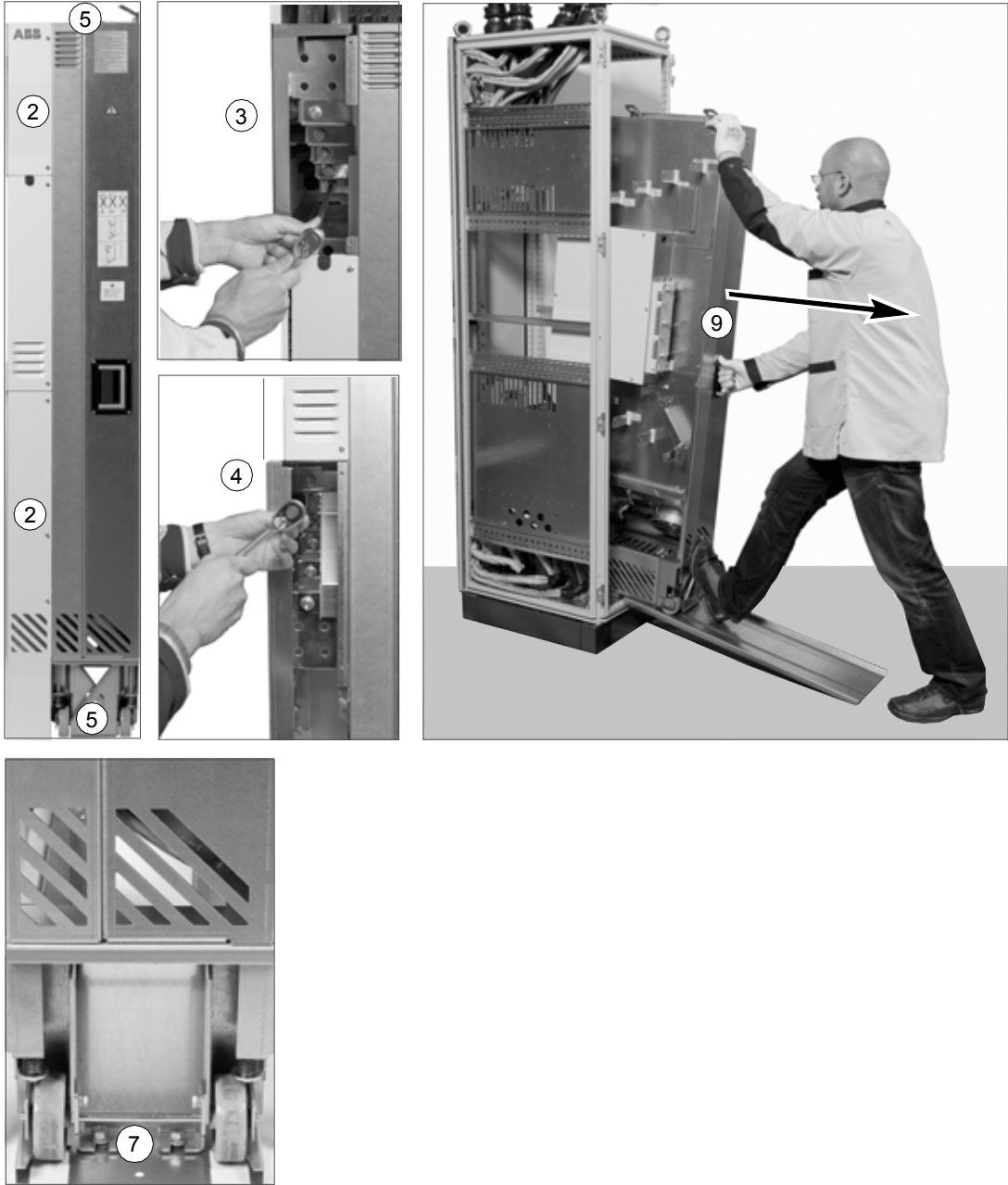
Do not tilt the drive module (A). It is **heavy** (over 160 kg [350 lb]) and its **center of gravity is high**. The module will overturn from a sideways tilt of 5 degrees. Do not leave the module unattended on a sloping floor.



1. Ensure that the drive is disconnected from the power line and all other precautions described under *Safety in installation and maintenance* on page 14 have been taken into consideration.
2. Remove the left-hand side upper and lower front covers of the drive module by undoing the fastening screws. M4×8 combi screws, 2 N·m.
3. Disconnect the drive module busbars from the input cabling panel. Combi screw M12, 70 N·m (52 lbf·ft).
4. Disconnect the drive module busbars from the output cabling panel. Combi screw M12, 70 N·m (52 lbf·ft).
5. Undo the screws that fasten the drive module to the cabinet at the top and behind the front support legs.
6. Remove the front air baffle.
7. Fasten the extraction ramp to the cabinet base with two screws.
8. Disconnect the power supply cable and the fibre optic cables from the external control unit and coil them on the top of the drive module. If you have an internal control unit (+P905), detach the control unit from the drive module by undoing the fastening screws below the optional modules and turn the control unit and the cables aside. (Alternatively remove the clamp plate, and disconnect the cables from the control unit.)

9. Pull the drive module carefully out of the cabinet preferably with help from another person.

10. Install the new module in reverse order to the above.



Capacitors

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

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

Reforming the capacitors

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

Memory unit

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



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 several minutes.

Technical data

What this chapter contains

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

Ratings

The ratings of the drive modules with 400 V, 460 V and 500 V (50 Hz and 60 Hz) supply are given below.

| Drive type ACS850-04 | Frame size | Input rating | Output ratings | | | | | | | | | | |
|-------------------------|---------------|-----------------|----------------|-----------|----------|-------|-----|--------------------|----------|-----|----------------|----------|----|
| | | | Nominal use | | | | | Light-overload use | | | Heavy-duty use | | |
| | | | I_{1N} | I_{max} | I_{2N} | P_N | | I_{Ld} | P_{Ld} | | I_{Hd} | P_{Hd} | |
| | | | A | A | A | kW | hp | A | kW | hp | A | kW | hp |
| $U_N = 400\text{ V}$ | | | | | | | | | | | | | |
| -387A-5 | G1 | 380 | 470 | 387 | 200 | - | 377 | 200 | - | 300 | 160 | - | |
| -500A-5 | G1 | 490 | 560 | 500 | 250 | - | 480 | 250 | - | 355 | 200 | - | |
| -580A-5 | G1 | 570 | 680 | 580 | 315 | - | 570 | 315 | - | 414 | 200 | - | |
| -650A-5 | G1 | 640 | 730 | 650 | 355 | - | 634 | 355 | - | 477 | 250 | - | |
| -710A-5 | G2 | 690 | 850 | 710 | 400 | - | 700 | 400 | - | 566 | 315 | - | |
| -807A-5 | G2 | 790 | 1020 | 807 | 450 | - | 785 | 450 | - | 625 | 355 | - | |
| -875A-5 | G2 | 860 | 1100 | 875 | 500 | - | 857 | 450 | - | 680 | 400 | - | |
| $U_N = 500\text{ V}$ | | | | | | | | | | | | | |
| -387A-5 | G1 | 380 | 470 | 387 | 200 | - | 377 | 250 | - | 300 | 160 | - | |
| -500A-5 | G1 | 490 | 560 | 500 | 250 | - | 480 | 250 | - | 355 | 250 | - | |
| -580A-5 | G1 | 570 | 680 | 580 | 355 | - | 570 | 355 | - | 414 | 250 | - | |
| -650A-5 | G1 | 640 | 730 | 650 | 400 | - | 634 | 400 | - | 477 | 315 | - | |
| -710A-5 | G2 | 690 | 850 | 710 | 500 | - | 700 | 500 | - | 566 | 400 | - | |
| -807A-5 | G2 | 790 | 1020 | 807 | 560 | - | 785 | 560 | - | 625 | 450 | - | |
| -875A-5 | G2 | 860 | 1100 | 875 | 560 | - | 857 | 560 | - | 680 | 450 | - | |
| $U_N = 460\text{ V}$ | | | | | | | | | | | | | |
| -387A-5 | G1 | 380 | 470 | 387 | - | 300 | 377 | - | 300 | 300 | - | 200 | |
| -500A-5 | G1 | 490 | 560 | 500 | - | 350 | 480 | - | 350 | 355 | - | 250 | |
| -580A-5 | G1 | 570 | 680 | 580 | - | 450 | 570 | - | 450 | 414 | - | 350 | |
| -650A-5 | G1 | 640 | 730 | 650 | - | 500 | 634 | - | 500 | 477 | - | 400 | |
| -710A-5 | G2 | 690 | 850 | 710 | - | 600 | 700 | - | 600 | 566 | - | 450 | |
| -807A-5 | G2 | 790 | 1020 | 807 | - | 700 | 785 | - | 600 | 625 | - | 500 | |
| -875A-5 | G2 | 860 | 1100 | 875 | - | 700 | 857 | - | 700 | 680 | - | 600 | |

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| | |
|-----------|---|
| I_{1N} | Nominal input current (rms) at 40 °C (104 °F) |
| I_{max} | Maximum output current. Available for 10 seconds at start, otherwise as long as allowed by drive temperature. |
| I_{2N} | Continuous rms output current. No overload capability at 40 °C (104 °F) |

| | |
|----------|--|
| P_N | Typical motor power in no-overload use. |
| I_{Ld} | Continuous rms output current. 10% overload is allowed for 1 minute every 5 minutes. |
| P_{Ld} | Typical motor power for light-overload use. |
| I_{Hd} | Continuous rms output current. 50% overload is allowed for 1 minute every 5 minutes. |
| P_{Hd} | Typical motor power for heavy-duty use. |

Note: To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. The power ratings apply to most IEC 34 motors at the nominal voltage of 400 V or 500 V.

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

Derating

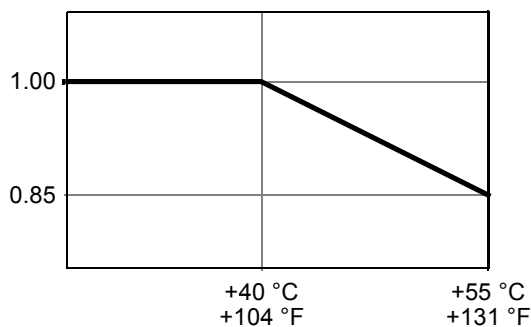
The continuous output currents stated above must be derated if any of the following conditions apply:

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

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

Ambient temperature derating



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



Altitude derating

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

Fuses (IEC)

| <i>Ultrarapid (aR) fuses</i> | | | | | | | |
|--|---------------------------|------|------------------|-----|--------------|---|------|
| Drive type ACS850-04 | Input current A | Fuse | | | | | |
| | | A | A ² s | V | Manufacturer | Type DIN 43620  | Size |
| -387A-5 | 380 | 630 | 220000 | 690 | Bussmann | 170M6810D | DIN3 |
| -500A-5 | 490 | 800 | 490000 | 690 | Bussmann | 170M6812D | DIN3 |
| -580A-5 | 570 | 1000 | 985000 | 690 | Bussmann | 170M6814D | DIN3 |
| -650A-5 | 640 | 1000 | 985000 | 690 | Bussmann | 170M6814D | DIN3 |
| -710A-5 | 690 | 1250 | 2150000 | 690 | Bussmann | 170M8554D | DIN3 |
| -807A-5 | 790 | 1600 | 4150000 | 690 | Bussmann | 170M8557D | DIN3 |
| -875A-5 | 860 | 1600 | 4150000 | 690 | Bussmann | 170M8557D | DIN3 |
| <i>aR fuses with flush end contact</i> | | | | | | | |
| Drive type ACS850-04 | Input current A | Fuse | | | | | |
| | | A | A ² s | V | Manufacturer |  | Size |
| -710A-5 | 690 | 1400 | 1400000 | 690 | Bussmann | 170M7060 *) | DIN4 |
| -807A-5 | 790 | 1400 | 1400000 | 690 | Bussmann | 170M7060 *) | DIN4 |
| -875A-5 | 860 | 1400 | 1400000 | 690 | Bussmann | 170M7060 *) | DIN4 |

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*) or equivalent Bussmann type: 170M7080, 170M7100, 170M7120

Fuses (UL)

| <i>UL recognised Class T / Class L fuses</i> | | | | | | |
|--|-----------------------|------|-----|--------------|----------|--------------------------|
| Drive type ACS850-04 | Input current A | Fuse | | | | |
| | | A | V | Manufacturer | UL Class | Bussmann/ Ferraz type |
| -387A-5 | 380 | 500 | 600 | Bussmann | T | JJS-500 |
| -500A-5 | 490 | 600 | 600 | Bussmann | T | JJS-600 |
| -580A-5 | 570 | 800 | 600 | Ferraz | L | A4BY800 |
| -650A-5 | 640 | 800 | 600 | Ferraz | L | A4BY800 |
| -710A-5 | 690 | 800 | 600 | Ferraz | L | A4BY800 |
| -807A-5 | 790 | 900 | 600 | Ferraz | L | A4BY900 |
| -875A-5 | 860 | 1000 | 600 | Ferraz | L | A4BY1000 |

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Note 1: See also [Implementing thermal overload and short-circuit protection](#) on page 62.

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

Note 3: Larger fuses than the recommended ones must not be used.

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

Dimensions, weights and free space requirements

| Drive type ACS850-04 | Frame size | H1 mm | H2 mm | W1 mm | W2 mm | D1 mm | D2 mm | Weight 1 kg |
|-------------------------|---------------|----------|----------|----------|----------|----------|----------|----------------|
| -387A-5 | G1 | 1462 | 1590 | 305 | 329 | 505 | 515 | 161 |
| -500A-5 | G1 | 1462 | 1590 | 305 | 329 | 505 | 515 | 161 |
| -580A-5 | G1 | 1462 | 1590 | 305 | 329 | 505 | 515 | 161 |
| -650A-5 | G1 | 1462 | 1590 | 305 | 329 | 505 | 515 | 161 |
| -710A-5 | G2 | 1662 | 1740 | 305 | 329 | 505 | 515 | 199 |
| -807A-5 | G2 | 1662 | 1740 | 305 | 329 | 505 | 515 | 199 |
| -875A-5 | G2 | 1662 | 1740 | 305 | 329 | 505 | 515 | 199 |

| Drive type ACS850-04 | Frame size | H1 in. | H2 in. | W1 in. | W2 in. | D1 in. | D2 in. | Weight 1 lb |
|-------------------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| -387A-5 | G1 | 57.56 | 62.60 | 12.01 | 12.95 | 19.88 | 20.28 | 355 |
| -500A-5 | G1 | 57.56 | 62.60 | 12.01 | 12.95 | 19.88 | 20.28 | 355 |
| -580A-5 | G1 | 57.56 | 62.60 | 12.01 | 12.95 | 19.88 | 20.28 | 355 |
| -650A-5 | G1 | 57.56 | 62.60 | 12.01 | 12.95 | 19.88 | 20.28 | 355 |
| -710A-5 | G2 | 65.43 | 68.50 | 12.01 | 12.95 | 19.88 | 20.28 | 439 |
| -807A-5 | G2 | 65.43 | 68.50 | 12.01 | 12.95 | 19.88 | 20.28 | 439 |
| -875A-5 | G2 | 65.43 | 68.50 | 12.01 | 12.95 | 19.88 | 20.28 | 439 |

H1 Height of the module with pedestal

H2 Height of the module with pedestal and with optional cabling panels (+H383)

Note: The no pedestal option (+0H354) reduces the height of the module by 125 mm [4.92 in].

W1 Width of the module

W2 Width of the module with optional cabling panels (+H383)

D1 Depth of the module without the fastening bracket on the backside of the module

D2 Depth of the module with optional cabling panels (+H383), without the fastening bracket on the backside of the module

Weight Weight of the module with pedestal, internal control unit and control panel. The weights of additional options are shown below in the table. The weights of options +D150, +H356 and +H381/+H383 vary depending on what other options are installed.

| 0H354 | E208 | D150 | H356 | H381 H383 | Weight (G1) | | Weight (G2) | |
|-------|------|------|------|--------------|-------------|-----|-------------|-----|
| | | | | | kg | lb | kg | lb |
| x | | | | | -7 | -15 | -7 | -15 |
| | x | | | | +3 | +7 | +3 | +7 |
| | | x | | | +10 | +22 | +9 | +20 |
| | | | x | | +2 | +4 | +2 | +4 |
| | | | | x | +28 | +62 | +28 | +62 |

For requirements of free space around the drive module, see page [47](#).

Losses, cooling data and noise

| Drive type ACS850-04 | Frame size | Air flow | | Heat dissipation W | Noise dB(A) |
|-------------------------|------------|-------------------|----------------------|-----------------------|----------------|
| | | m ³ /h | ft ³ /min | | |
| -387A-5 | G1 | 1200 | 707 | 4403 | 72 |
| -500A-5 | G1 | 1200 | 707 | 5602 | 72 |
| -580A-5 | G1 | 1200 | 707 | 6409 | 72 |
| -650A-5 | G1 | 1200 | 707 | 8122 | 72 |
| -710A-5 | G2 | 1200 | 707 | 8764 | 72 |
| -807A-5 | G2 | 1200 | 707 | 9862 | 72 |
| -875A-5 | G2 | 1420 | 848 | 10578 | 71 |

Terminal and lead-through data for the power cables

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

Units with optional common mode filter (+E208)

The additional busbars are included in the delivery of units with optional common mode filter (+E208). The output busbars of the drive module can be enhanced with the additional busbars in units without optional cabling panels (no +H381 or +H383). Then, the maximum accepted cable size is $4 \times (3 \times 240) \text{ mm}^2$ or $4 \times (3 \times 500 \text{ AWG})$.
Screw size for connecting busbars to the drive module input and output busbars:
M12, tightening torque 50...75 N·m.

Units with optional cabling panels (+H381 or +H383)

The maximum accepted cable size is $4 \times (3 \times 240) \text{ mm}^2$ or $4 \times (3 \times 500 \text{ AWG})$. The cabling panels are connected to the drive module busbars with M12 serpress nuts, tightening torque 30 N·m (20 lbf·ft).

Input, motor and brake resistor cable terminal sizes and tightening torques are given below.

| U1, V1, W1, U2, V2, W2, UDC+, UDC-, R+, R- | | Grounding busbar | |
|--|--------------------------|------------------|--------------------------|
| Screw | Tightening torque N-m | Screw | Tightening torque N-m |
| M12 | 50...75 | M10 | 30...44 |

| U1, V1, W1, U2, V2, W2, UDC+, UDC-, R+, R- | | Grounding busbar | |
|--|-----------------------------|------------------|-----------------------------|
| Screw | Tightening torque lbf·ft | Screw | Tightening torque lbf·ft |
| 1/2 | 37...55 | 3/8 | 22...32 |

Two-hole 1/2 inch diameter cable lugs can be used.

Units without optional cabling panels (no +H381 or +H383)

In units without optional cabling panels (option +H381/+H383 not selected), it is possible to use the maximum cable size (4 × (3 × 240) mm² or 4 × [3 × 500 AWG]) only with special cable lugs and additional insulation. For more information, contact your local ABB representative.

Terminal data for the control cables

See page [104](#).

Electrical power network specification

| | |
|--|--|
| Voltage (U_1) | 380...500 VAC 3-phase ± 10% |
| Rated conditional short-circuit current (IEC 60439-1) | 65 kA when protected by fuses given in the fuse tables |
| Frequency | 48 to 63 Hz, maximum rate of change 17%/s |
| Imbalance | Max. ± 3% of nominal phase to phase input voltage |
| Fundamental power factor (cos ϕ_1) | 0.98 (at nominal load) |

Motor connection data

| | |
|-----------------------------------|---|
| Motor types | asynchronous AC induction motors, permanent magnet motors, ABB synchronous reluctance motors (SynRM motors) |
| Voltage (U_2) | 0 to U_1 , 3-phase symmetrical, U_{max} at the field weakening point |
| Frequency | DTC mode: 0 to $3.2 \cdot f_f$. Maximum frequency 500 Hz (120 Hz with du/dt or sine filter). Low motor noise mode is recommended with high frequencies (see also firmware manual). |

$$f_f = \frac{U_N}{U_m} \cdot f_m$$

f_f : frequency at field weakening point; U_N : electrical power system voltage; U_m : nominal motor voltage; f_m : nominal motor frequency

| | |
|---|---------------------------------------|
| Frequency resolution | 0.01 Hz |
| Current | See section Ratings . |
| Nominal motor frequency | 0...500 Hz |
| Switching frequency | 3 kHz (typically) |
| Maximum recommended motor cable length | |

| DTC control | Scalar control |
|----------------|----------------|
| 300 m (984 ft) | 300 m (984 ft) |

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

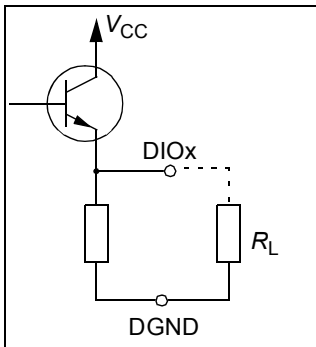
Brake resistor connection data

See page [159](#).

DC connection data

| Drive module type | I_{DC} (A) | Capacitance (mF) |
|-------------------|--------------|------------------|
| ACS850-04-387A-5 | 487 | 14 |
| ACS850-04-500A-5 | 640 | 14 |
| ACS850-04-580A-5 | 714 | 14 |
| ACS850-04-650A-5 | 870 | 14 |
| ACS850-04-710A-5 | 909 | 21 |
| ACS850-04-807A-5 | 1033 | 21 |
| ACS850-04-875A-5 | 1120 | 21 |

Control unit (JCU-11) connection data

| | |
|---|---|
| Power supply | 24 V ($\pm 10\%$) DC, 1.6 A Supplied from the power unit of the drive, or from an external power supply through connector XPOW (pitch 5 mm, wire size 2.5 mm ²). |
| Relay outputs RO1...RO3 (XRO1 ... XRO3) | Connector pitch 5 mm, wire size 2.5 mm ² 250 V AC / 30 V DC, 2 A Protected by varistors |
| +24 V output (XD24) | Connector pitch 5 mm, wire size 2.5 mm ² |
| Digital inputs DI1...DI6 (XDI:1 ... XDI:6) | 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: 0.25 ms min. DI6 (XDI:6) can alternatively be used as an input for 1...3 PTC thermistors. Note: The input has no safety insulation (see page 107). I_{max} : 15 mA |
| Start interlock input DIIL (XDI:A) | Wire size 1.5 mm ² 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in} : 2.0 kohm |
| Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2) | Connector pitch 3.5 mm, wire size 1.5 mm ² <u>As inputs:</u> 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in} : 2.0 kohm Filtering: 0.25 ms min. <u>As outputs:</u> Total output current limited by auxiliary voltage outputs to 200 mA Output type: Open emitter |
| Input/output mode selection by parameters. DIO1 can be configured as a frequency input (0...16 kHz) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See firmware manual, parameter group 12. | |
| |  |
| Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2) | Connector pitch 3.5 mm, wire size 1.5 mm ² 10 V $\pm 1\%$ and -10 V $\pm 1\%$, $R_{load} > 1$ kohm |

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

Current/voltage input mode selection by jumpers. See page 105.

Connector pitch 3.5 mm, wire size 1.5 mm²
 Current input: -20...20 mA, R_{in} : 100 ohm
 Voltage input: -10...10 V, R_{in} : 200 kohm
 Differential inputs, common mode ± 20 V
 Sampling interval per channel: 0.25 ms
 Filtering: 0.25 ms min.
 Resolution: 11 bit + sign bit
 Inaccuracy: 1% of full scale range

Analog outputs AO1 and AO2 (XAO)

Connector pitch 3.5 mm, wire size 1.5 mm²
 0...20 mA, $R_{load} < 500$ ohm
 Frequency range: 0...800 Hz
 Resolution: 11 bit + sign bit
 Inaccuracy: 2% of full scale range

Drive to drive link (XD2D)

Connector pitch 3.5 mm, wire size 1.5 mm²
 Physical layer: RS-485
 Termination by jumper

Safe torque off connection (XSTO)

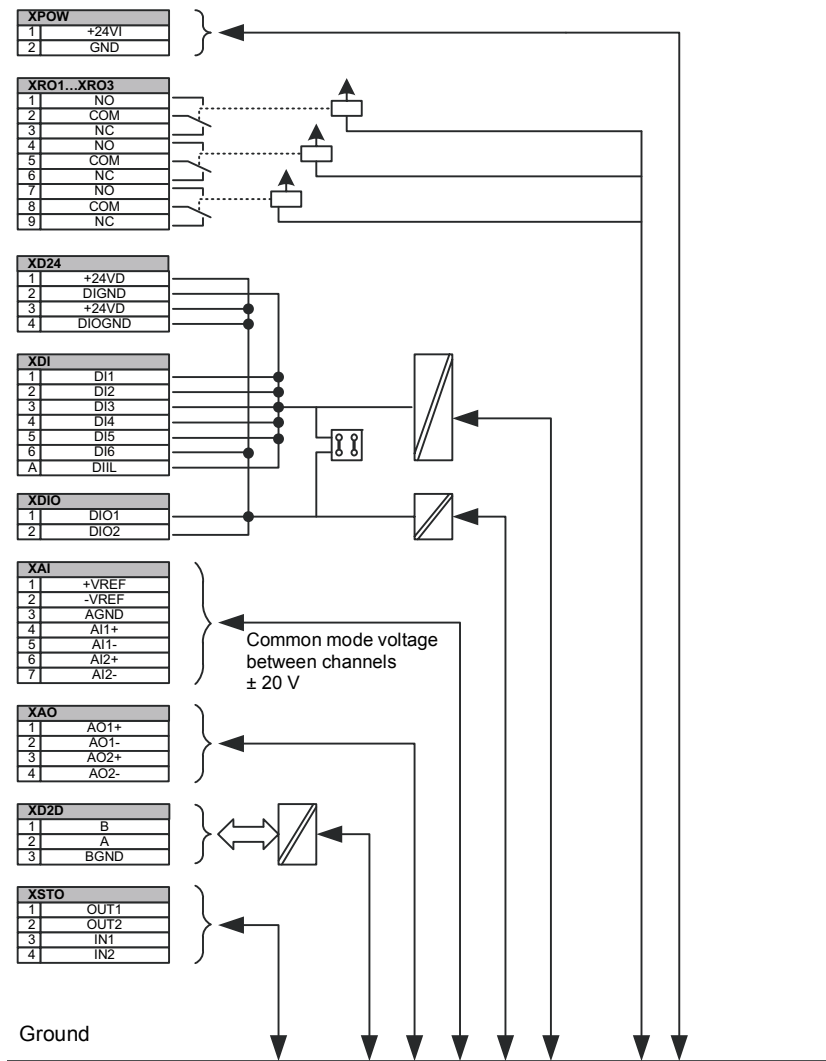
Connector pitch 3.5 mm, wire size 1.5 mm²
 For the drive to start, both connections (OUT1 to IN1, and OUT2 to IN2) must be closed

Control panel / PC connection

Connector: RJ-45
 Cable length < 3 m

Note: The terminals on the board fulfil the Protective Extra Low Voltage (PELV) requirements. The relay outputs of the drive do not fulfil the Protective Extra Low Voltage (PELV) requirements at installation sites above 4000 meters (13123 feet) if used with a voltage greater than 48 V. At installation sites between 2000 meters (6562 feet) and 4000 meters (13123 feet), PELV requirements are not fulfilled if one or two relay outputs are used with a voltage greater than 48 V and the remaining relay output(s) are used with a voltage lower than 48 V.

Isolation and grounding diagram



Efficiency

Approximately 98% at nominal power level

Degree of protection

IP00 (UL type open). With option +H381: IP20 (UL type open).

Note: The degree of protection of IP20 requires that the input power cables are installed through the rubber grommet mounted on top of the module (+H381).

Ambient conditions

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

| | Operation installed for stationary use | Storage in the protective package | Transportation in the protective package |
|--|---|---|--|
| Installation site altitude | <u>Non-corner grounded TN and TT systems</u> : 0 to 4000 m (13123 ft) above sea level. <u>Other systems</u> : 0 to 2000 m (6561 ft) above sea level. Above 1000 m (3281 ft), see section Derating . | - | - |
| Air temperature | -15 to +55 °C (5 to 131 °F). No frost allowed. See section Derating . | -40 to +70 °C (-40 to +158 °F) | -40 to +70 °C (-40 to +158 °F) |
| Relative humidity | 5 to 95% | Max. 95% | Max. 95% |
| | No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases. | | |
| Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1) | No conductive dust allowed. | | |
| | Chemical gases: Class 3C2 Solid particles: Class 3S2 | Chemical gases: Class 1C2 Solid particles: Class 1S3 | Chemical gases: Class 2C2 Solid particles: Class 2S2 |
| Atmospheric pressure | 70 to 106 kPa 0.7 to 1.05 atmospheres | 70 to 106 kPa 0.7 to 1.05 atmospheres | 60 to 106 kPa 0.6 to 1.05 atmospheres |
| Vibration (IEC 60068-2-6. Test Fc) | Max. 0.1 mm (0.004 in.) (10 to 57 Hz), max. 10 m/s ² (33 ft/s ²) (57 to 150 Hz) sinusoidal | Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s ² (23 ft/s ²) (13.2 to 100 Hz) sinusoidal | Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s ² (49 ft/s ²) (9 to 200 Hz) sinusoidal |
| Shock (IEC 60068-2-27) | Not allowed | Max. 100 m/s ² (330 ft./s ²), 11 ms | Max. 100 m/s ² (330 ft./s ²), 11 ms |
| Free fall | Not allowed | 100 mm (4 in.) for weight over 100 kg (220 lb) | 100 mm (4 in.) for weight over 100 kg (220 lb) |

Materials

| | |
|------------------------|---|
| Drive enclosure | <ul style="list-style-type: none"> • PC/ABS 2.5 mm, color NCS 1502-Y (RAL 9002 / PMS 420 C) • hot-dip zinc coated steel sheet 1.5 to 2.5 mm, thickness of coating 100 micrometers, color NCS 1502-Y |
| Package | Plywood and cardboard, bands PP. |
| Disposal | <p>The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated.</p> <p>Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and DC capacitors (C1-1 to C1-x) need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code.</p> <p>Please contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.</p> |

Applicable standards

| | |
|----------------------------------|---|
| | The drive complies with the following standards. |
| EN 61800-5-1:2007 | <i>Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy</i> |
| EN 60204-1:2006 | <p><i>Safety of machinery. Electrical equipment of machines. Part 1: General requirements.</i></p> <p>Provisions for compliance: The final assembler of the machine is responsible for installing</p> <ul style="list-style-type: none"> - emergency-stop device - supply disconnecting device - IP00 drive module into a cabinet. |
| EN 60529:1992 (IEC 60529) | <i>Degrees of protection provided by enclosures (IP code)</i> |
| IEC 60664-1:2007 | <i>Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.</i> |
| EN 61800-3:2004 | <i>Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods</i> |
| EN 61800-5-2:2007 | <i>Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional</i> |
| UL 508C (2002) | <i>UL Standard for Safety, Power Conversion Equipment, third edition</i> |
| CSA C22.2 No. 14-10 | <i>Industrial control equipment</i> |
| GOST R 51321-1:2007 | <i>Low-voltage switchgear and control gear assemblies. Part 1 – Requirements for type-tested and partially type-tested assemblies – General technical requirements and methods of tests</i> |

CE marking

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

Compliance with the European Low Voltage Directive

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

Compliance with the European EMC Directive

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

Compliance with the European Machinery Directive

The drive is an electronic product which is covered by the European Low Voltage Directive. However, the drive includes the Safe torque off function and can be equipped with other safety functions for machinery which, as safety components, are in the scope of the Machinery Directive. These functions of the drive comply with European harmonized standards such as EN 61800-5-2. The declaration of conformity for the Safe torque off function is in the appropriate function-specific manual, *Safe torque off function for ACSM1, ACS850 and ACQ810 drives application guide* (3AFE68929814 [English]).

Compliance with EN 61800-3:2004

Definitions

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

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not supplying domestic premises.

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

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

Category C3

The drive complies with the standard with the following provisions:

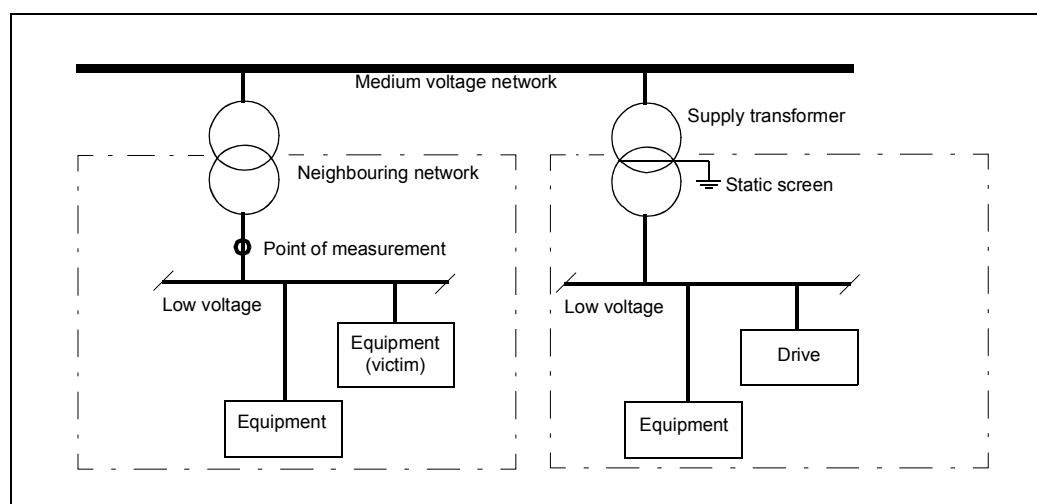
1. The motor and control cables are selected as specified in the hardware manual.
2. The drive is installed according to the instructions given in the hardware manual.
3. Maximum cable length is 100 metres.

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

Category C4

If the provisions under [Category C3](#) cannot be met, the requirements of the standard can be met as follows:

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



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

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

UL marking

The drive is cULus listed.

UL checklist

- The drive is to be used in a heated, indoor controlled environment. 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. See page [134](#).
- The maximum ambient air temperature is 40 °C (104 °F) at rated current. The current is derated for +40...55 °C (+104...131 °F).
- The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 500 V maximum when the input cable is protected with T-class fuses. The ampere rating is based on tests done according to UL 508A.
- The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
- The input cable must be protected with fuses. Circuit breakers must not be used without fuses in the USA. For suitable circuit breakers, contact your local ABB representative. Suitable IEC (class aR) fuses and UL (class J) fuses for drive protection are listed on page [127](#).
- 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.
- 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.
- The drive provides overload protection in accordance with the National Electrical Code (NEC).

CSA marking

CSA marking is pending for the drive.

“C-tick” marking

A “C-tick” mark is attached to each drive in order to verify compliance with the EMC product standard (EN 61800-3:2004), required under the Trans-Tasman Electromagnetic Compatibility Scheme for levels 1, 2 and 3 in Australia and New Zealand.

For fulfilling the requirements of the standard, see section [Compliance with EN 61800-3:2004](#).

GOST R certificate of conformity

The drive has been given a GOST R certificate of conformity. Available on request.

Disclaimer

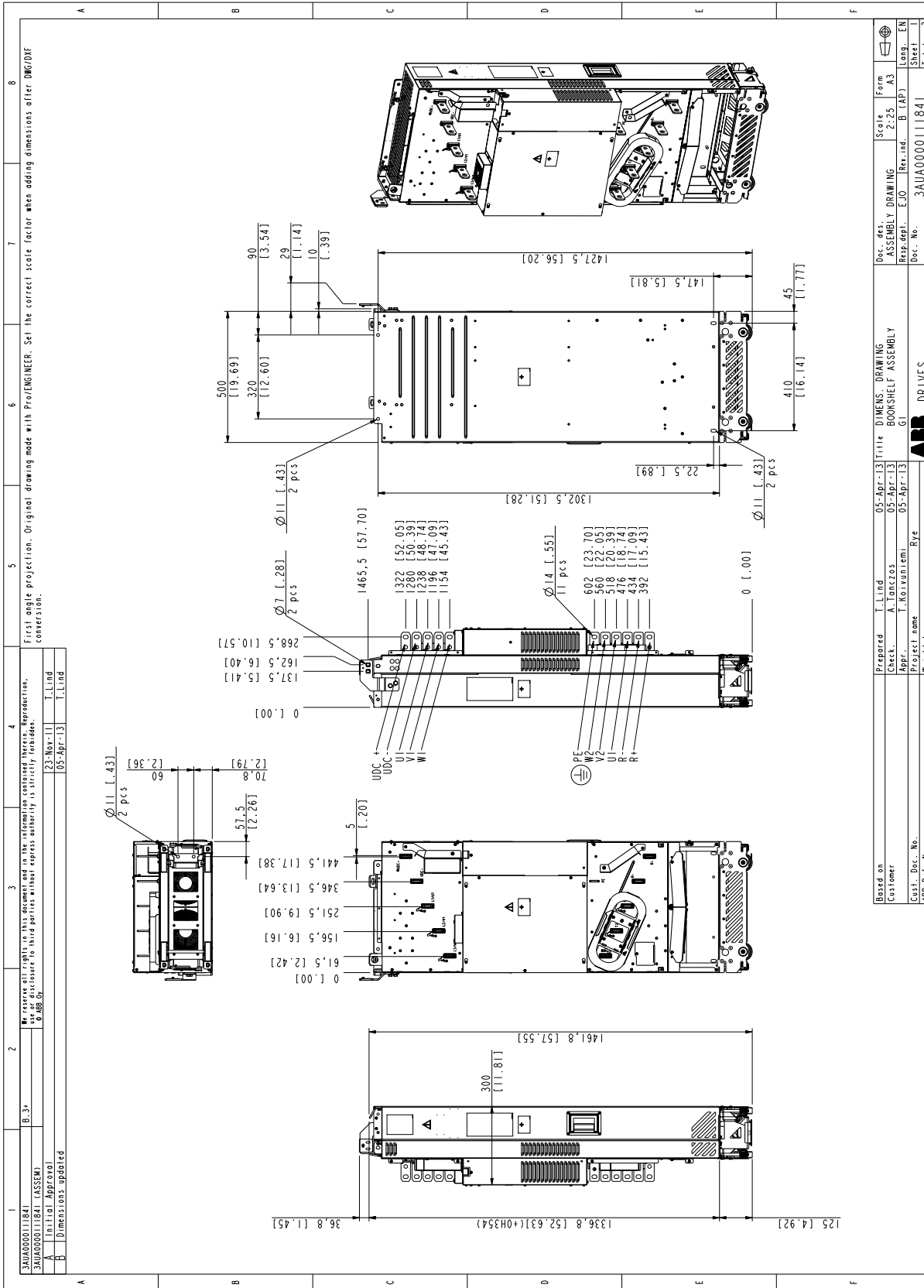
The manufacturer shall have no obligation with respect to any product which (i) has been improperly repaired or altered; (ii) has been subjected to misuse, negligence or accident; (iii) has been used in a manner contrary to the manufacturer's instructions; or (iv) has failed as a result of ordinary wear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

Dimension drawings

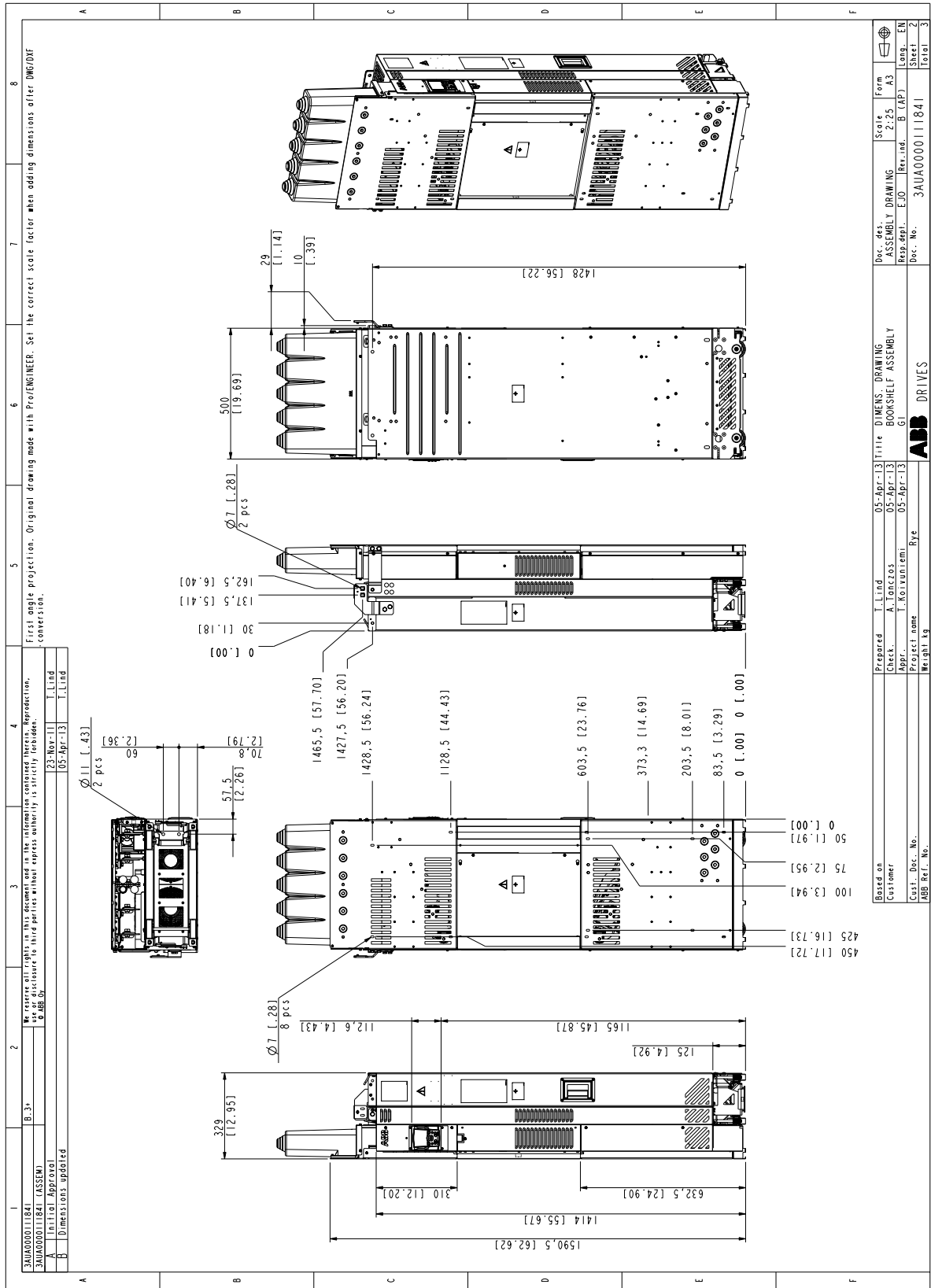
What this chapter contains

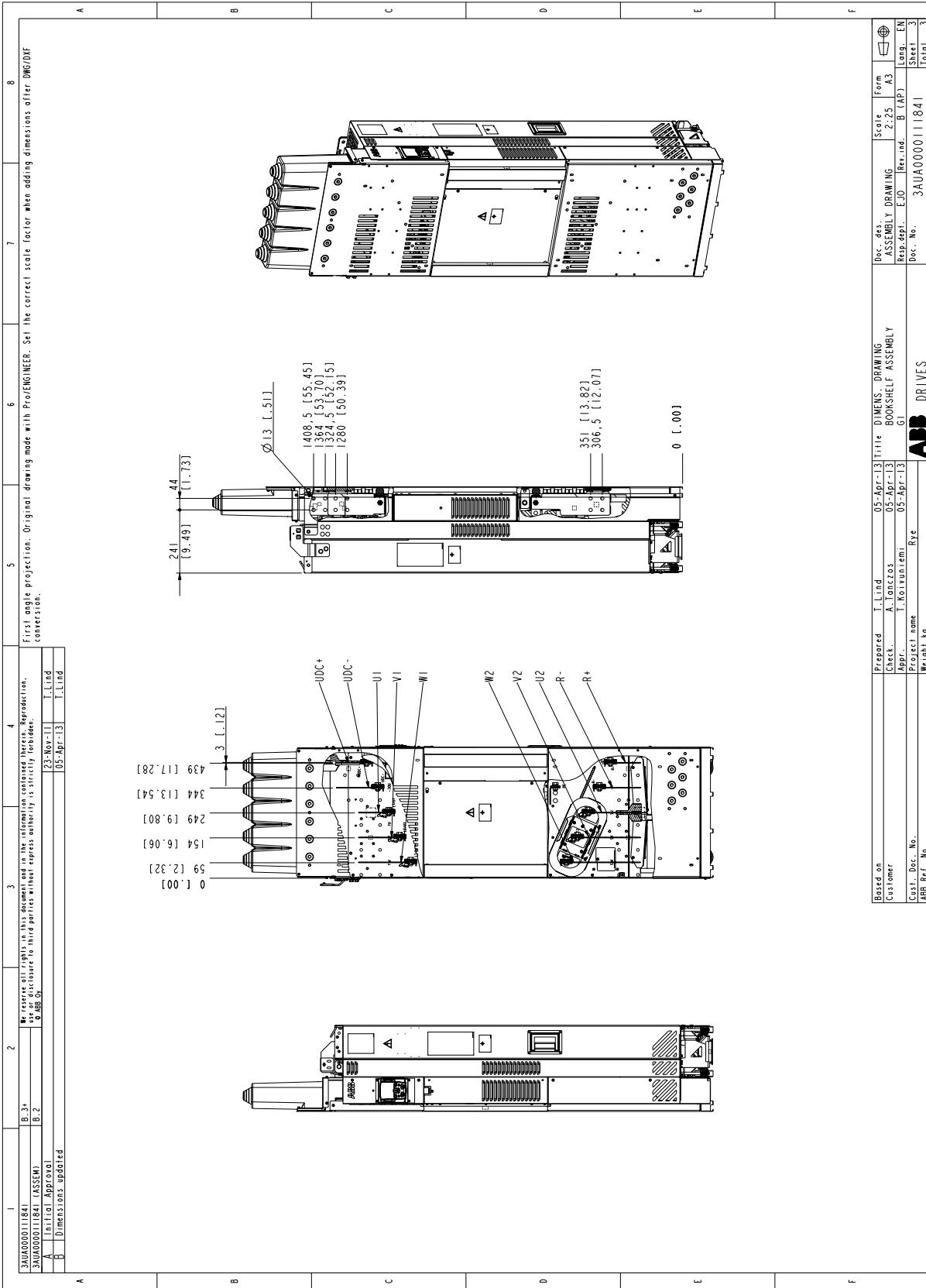
This chapter contains dimension drawings of the drive modules with optional parts for Rittal TS 8 cabinet assembly.

Frame G1 – Drive module dimensions

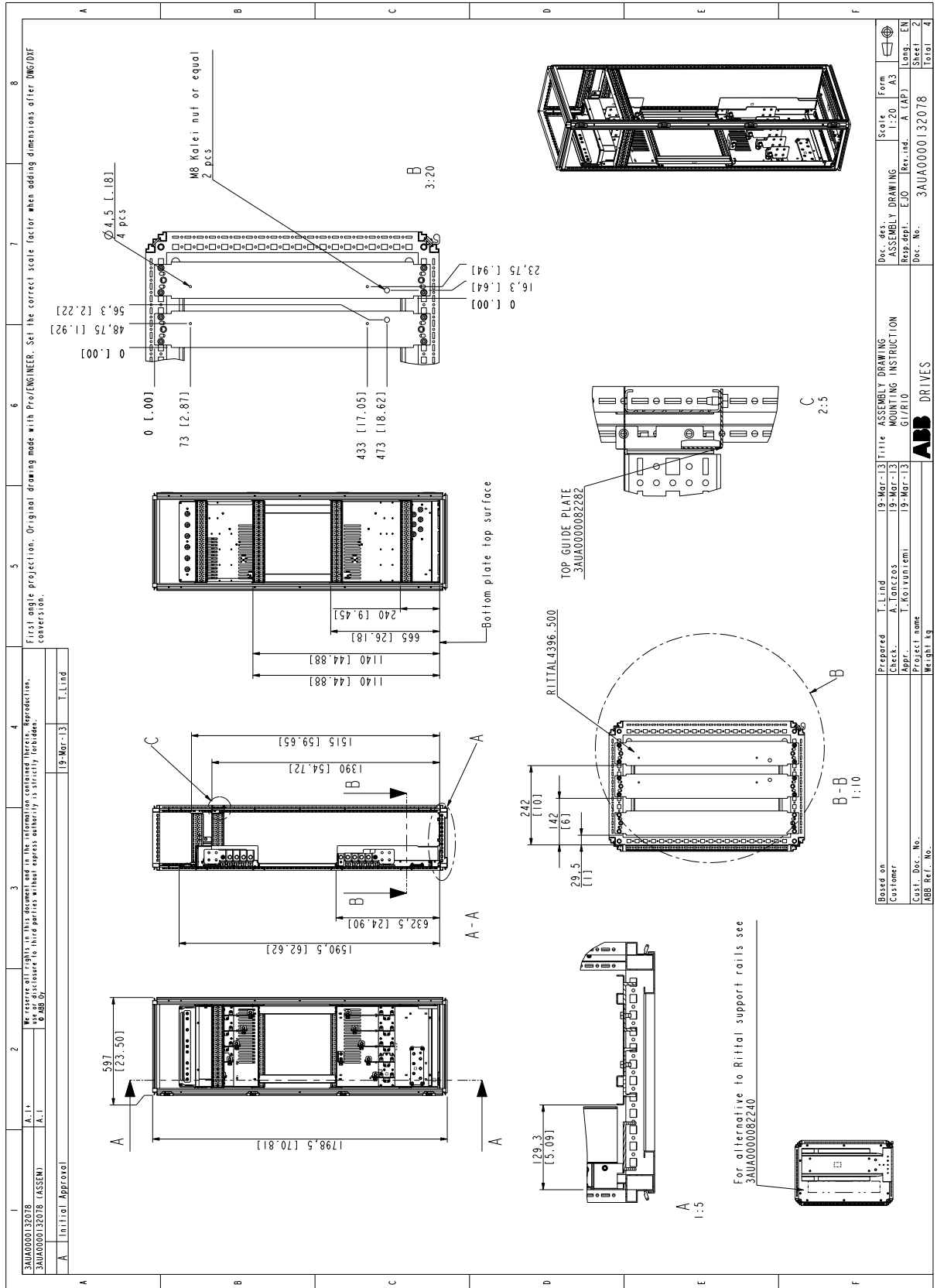


Frame G1 – Drive module dimensions with optional cabling panels (+H381)

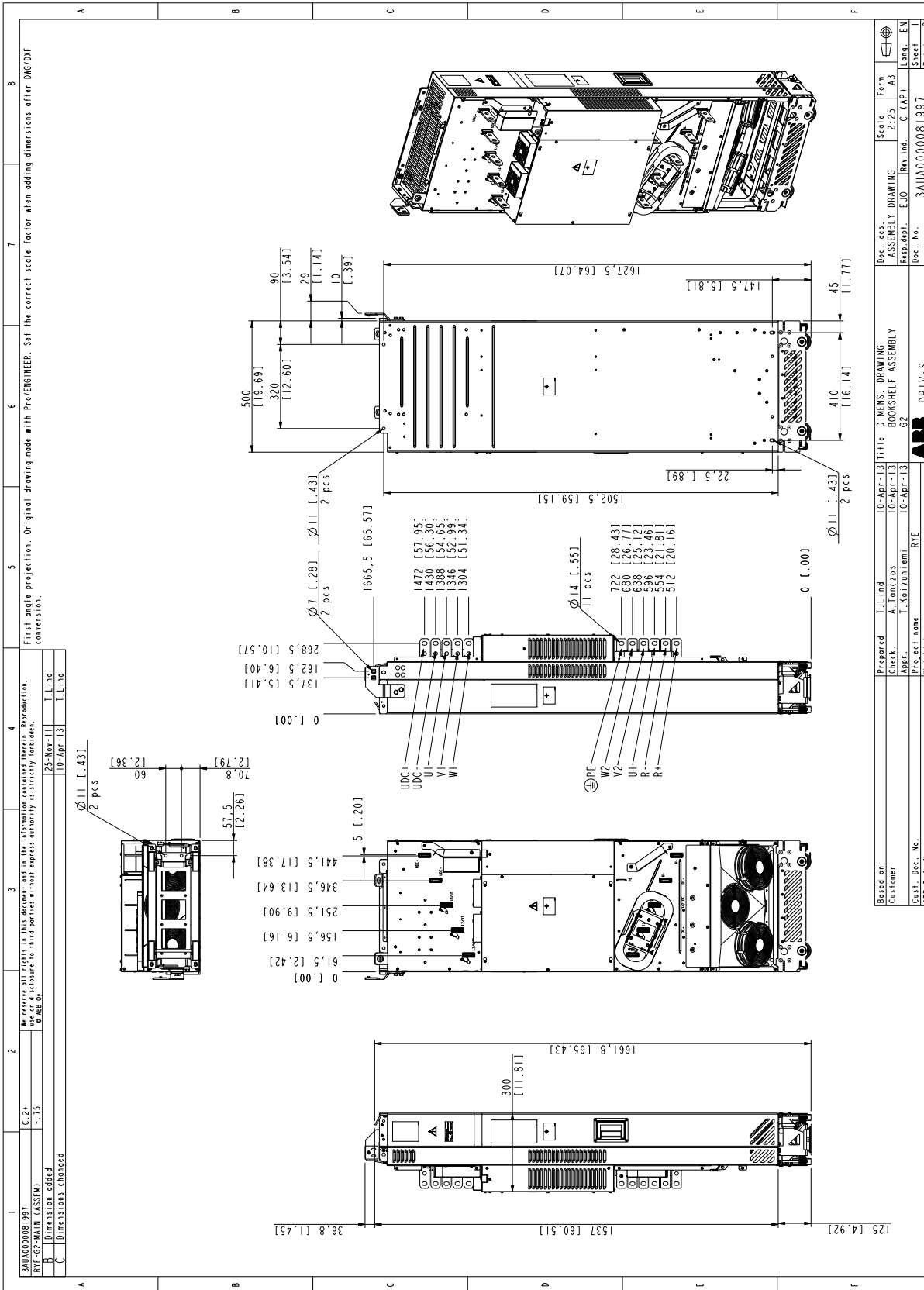




Frame G1 – Cabling panels (+H383) installed into a Rittal TS 8 cabinet

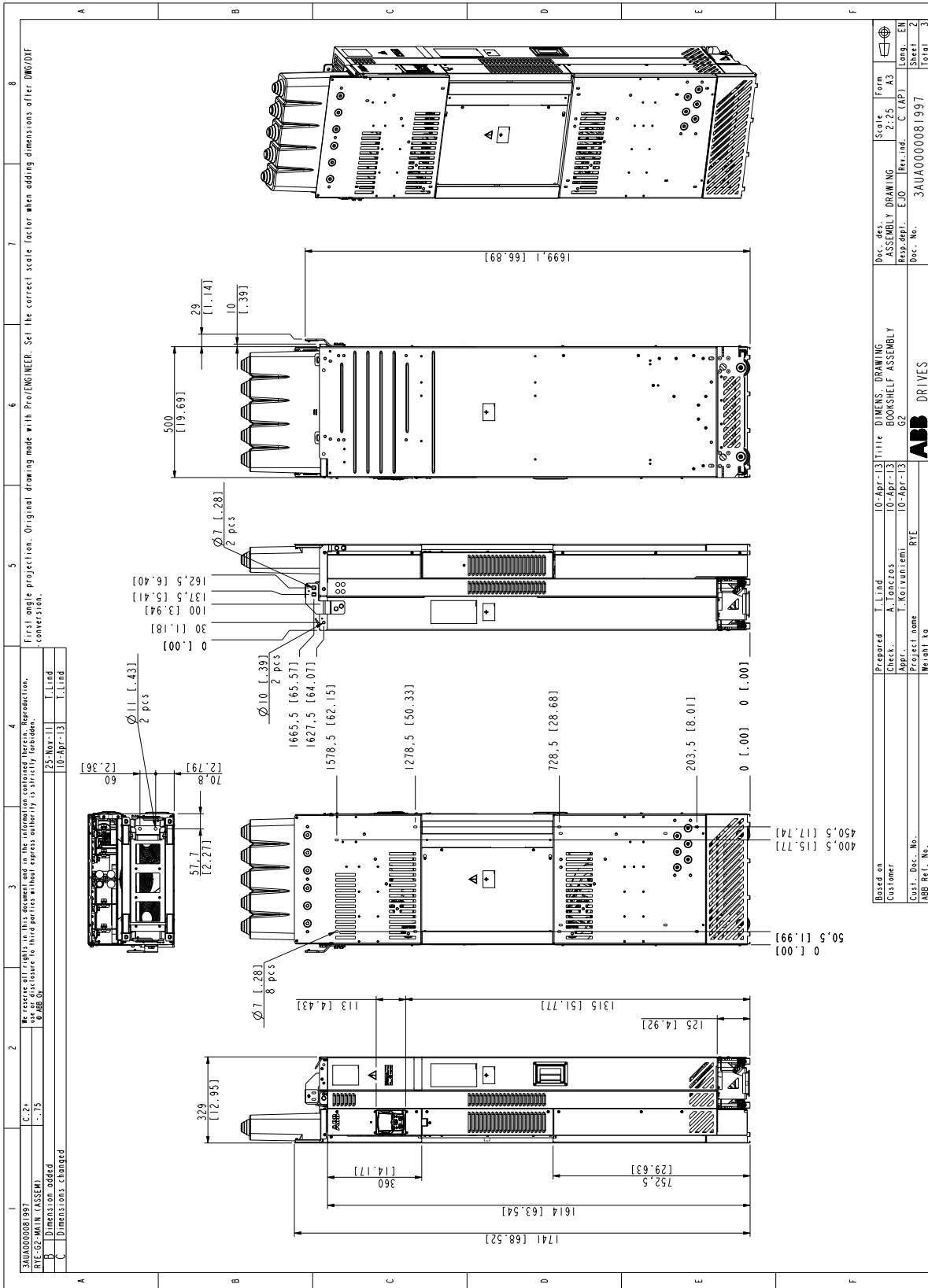


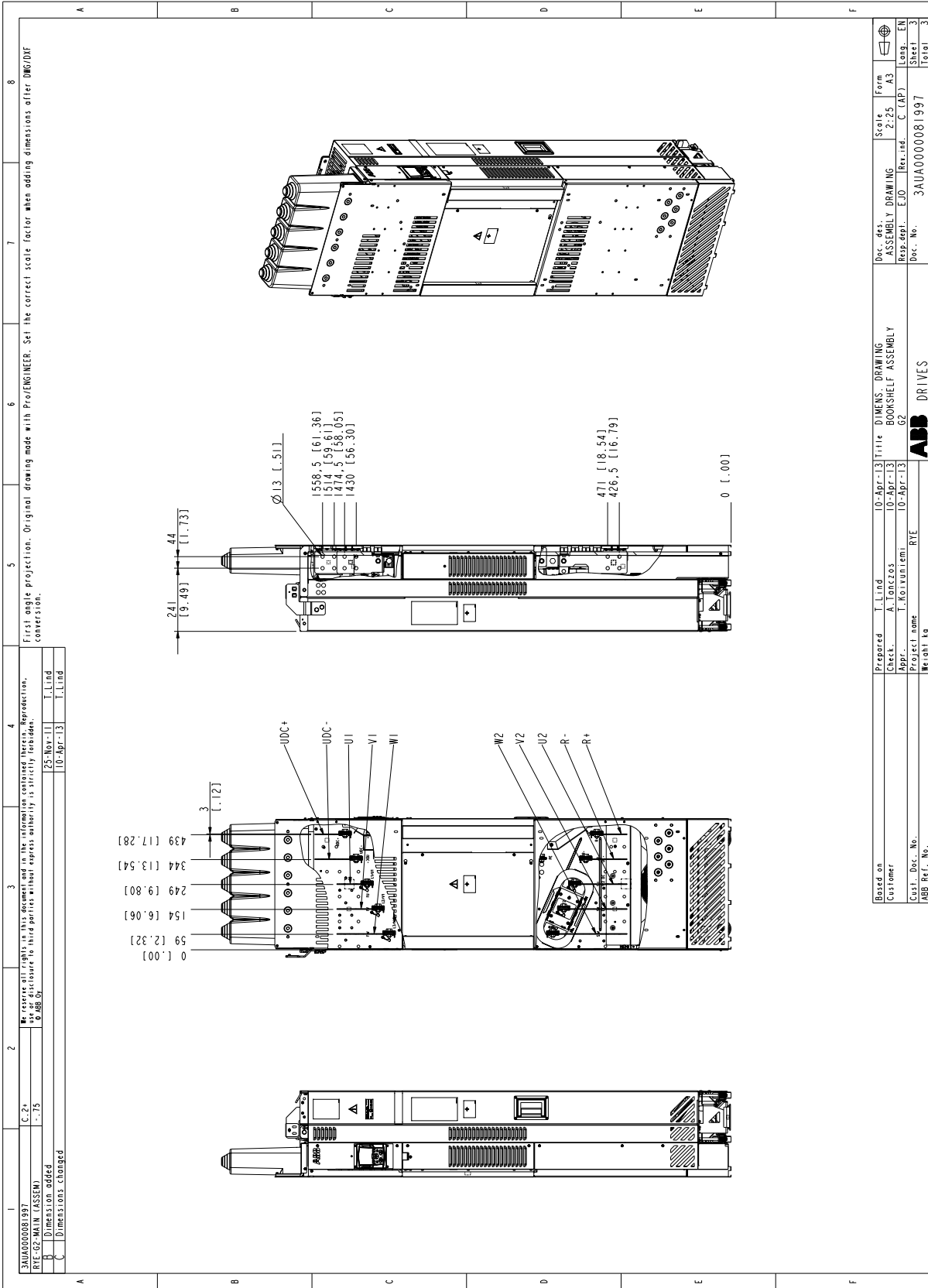
Frame G2 – Drive module dimensions



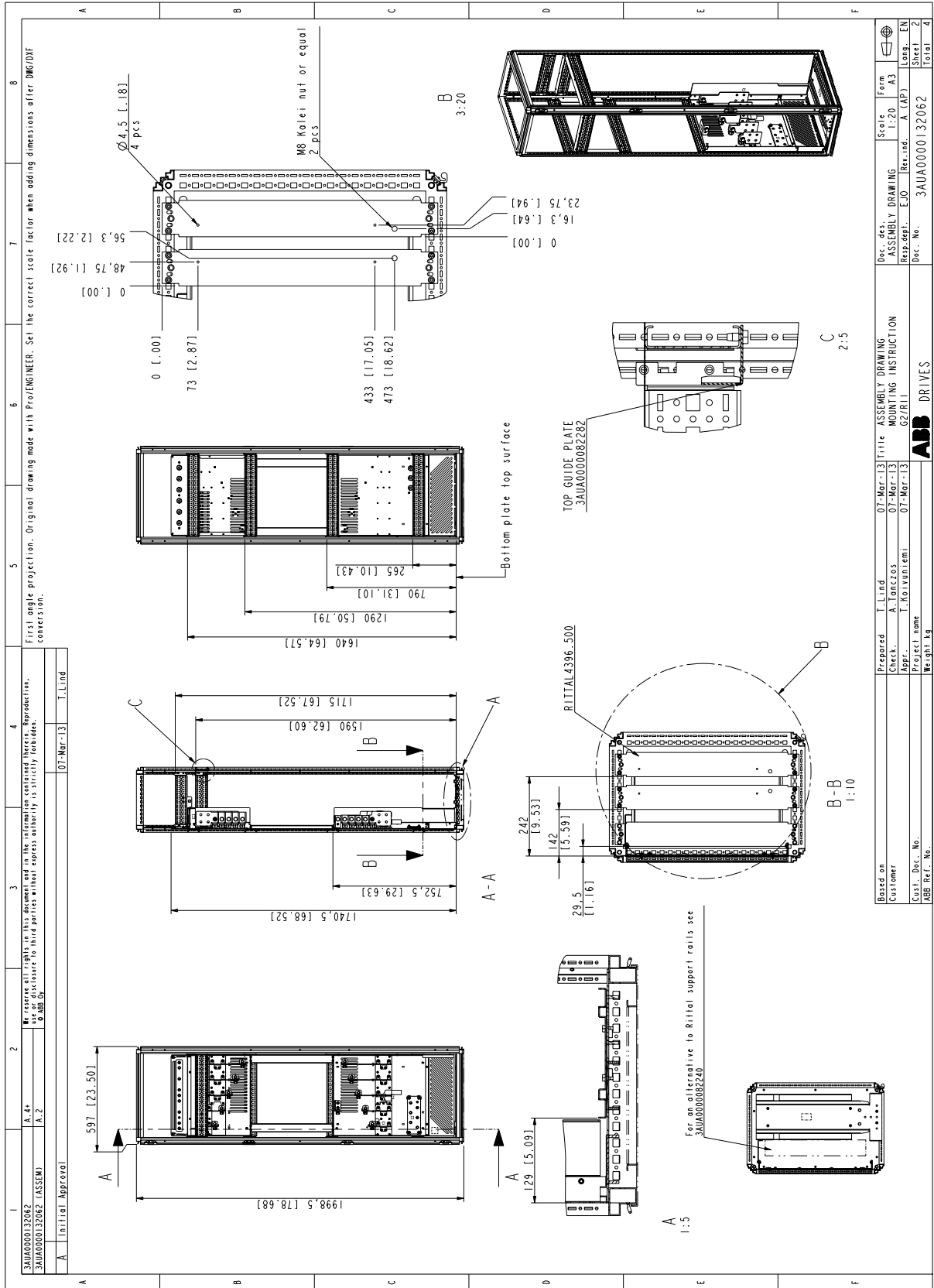
| | |
|-------------------|------------------|
| Doc. No. | 3AUA0000081997 |
| Rev. Ind. | C. (AP) |
| Rev. No. | 27:25 |
| Scale | 4:3 |
| Form | 43 |
| Doc. Desc. | ASSEMBLY DRAWING |
| Project name | ABB DRIVES |
| Project No. | |
| Customer | |
| Customer Ref. No. | |
| Weight | kg |
| Prepared | T. Lind |
| Checked | A. Yonczos |
| Approved | T. Kojima (cm) |
| Project name | ABB DRIVES |
| Project No. | |
| Customer | |
| Customer Ref. No. | |
| Weight | kg |
| Prepared | T. Lind |
| Checked | A. Yonczos |
| Approved | T. Kojima (cm) |
| Project name | ABB DRIVES |
| Project No. | |
| Customer | |
| Customer Ref. No. | |
| Weight | kg |

Frame G2 – Drive module dimensions with optional cabling panels (+H381)

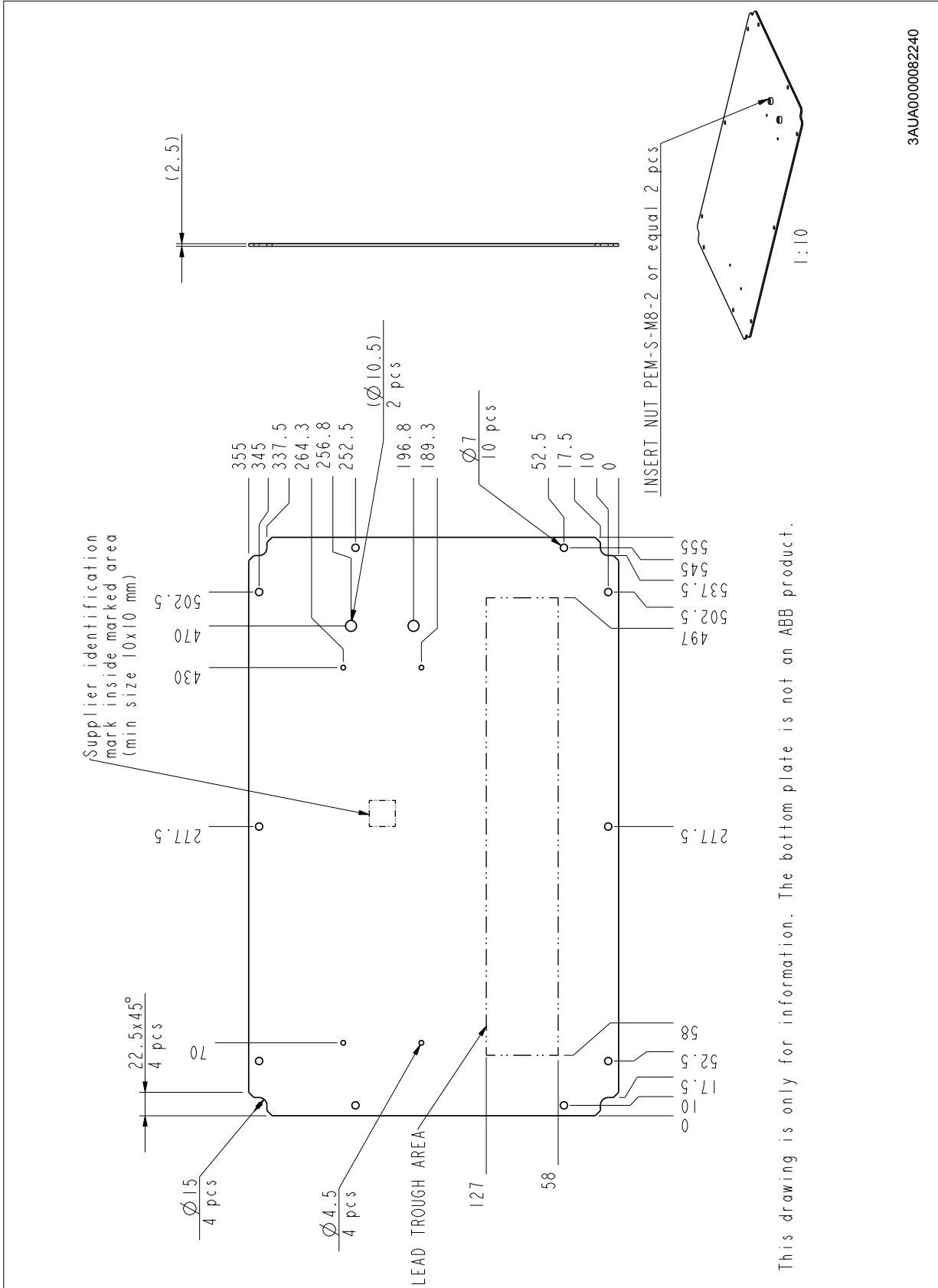




Frame G2 – Cabling panels (+H383) installed into a Rittal TS 8 cabinet



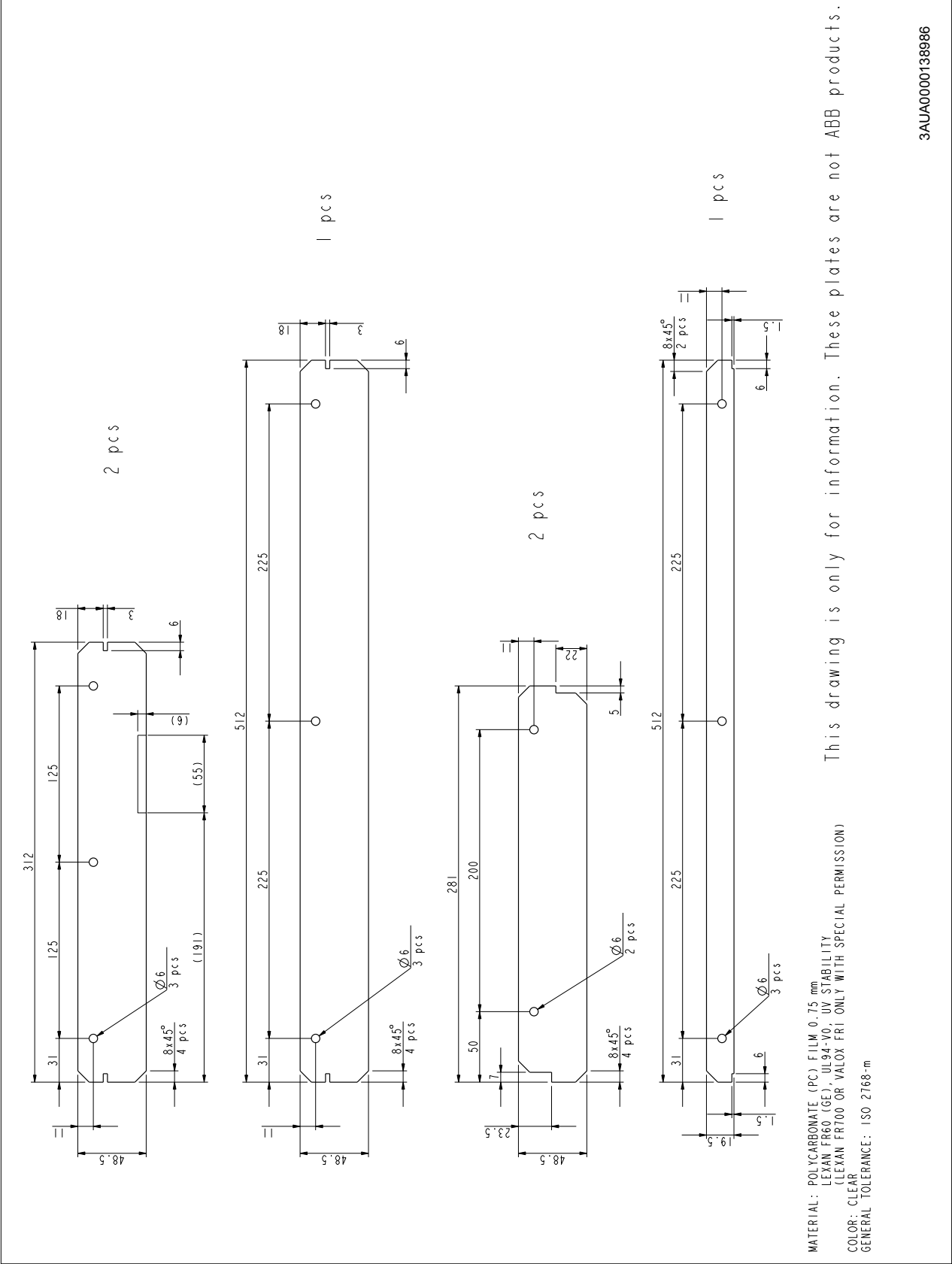
Frames G1 and G2 – Bottom plate



This drawing is only for information. The bottom plate is not an ABB product.

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Frames G1 and G2 – Air baffles



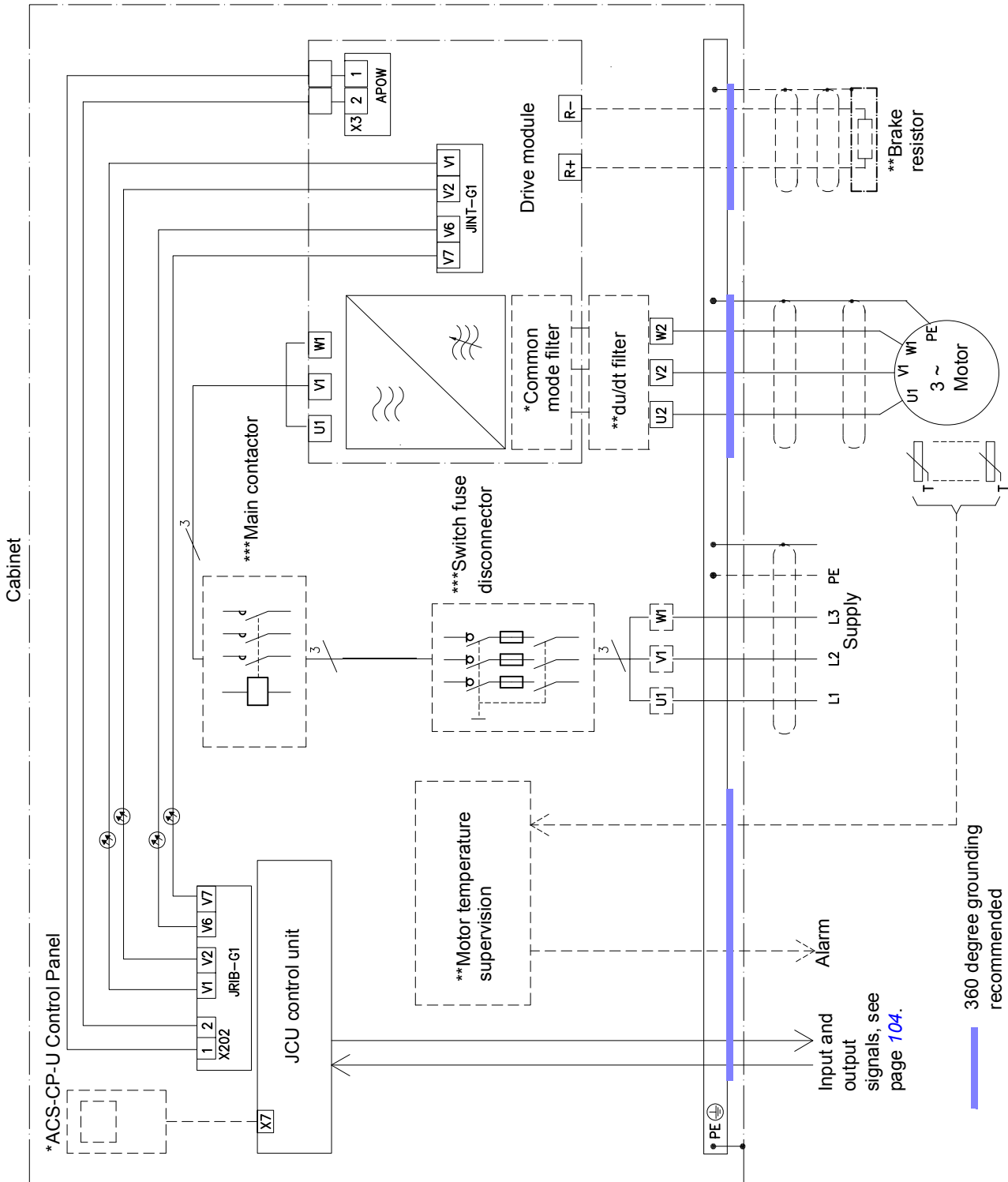
Example circuit diagram

What this chapter contains

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

Example circuit diagram

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



Resistor braking

What this chapter contains

This chapter describes how to select, protect and wire brake resistors.

Availability of brake choppers and resistors

Brake choppers are optionally available as built-in units, indicated in the type description by +D150. External resistors are available on request from ABB.

When is resistor braking needed

Typically, a drive system is equipped with brake choppers and resistors if:

- high capacity braking is needed and the drive cannot be equipped with a regenerative supply unit
- a backup for the regenerative supply unit is needed.

Operation principle

The energy generated by the motor during a fast deceleration of the drive typically causes the voltage to rise in the drive module intermediate DC circuit. The chopper connects the brake resistor to the intermediate DC circuit whenever the voltage in the circuit exceeds its maximum limit. Energy consumption by the resistor losses lowers the voltage until the resistor can be disconnected.

Planning the braking system

Selecting the brake circuit components

1. Calculate the maximum power (P_{\max}) generated by the motor during braking.
2. Select a suitable drive and brake resistor combination for the application according to the rating table on page 159. Take also account of other factors in the drive selection. The braking power must be greater than or equal to the maximum power generated by the motor during braking:

$$P_{\text{br}} \geq P_{\max}$$

3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the resistor heat dissipation capacity E_R .

Note: If the E_R value is not sufficient, it is possible to use a four-resistor assembly in which two standard resistors are connected in parallel, two in series. The E_R value of the four-resistor assembly is four times the value specified for the standard resistor.

A resistor other than the standard resistor can be used provided that:

- its resistance is not lower than the resistance of the standard resistor



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

- the resistance does not restrict the braking capacity needed, ie,

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

where

| | |
|-----------------|---|
| P_{\max} | Maximum power generated by the motor during braking |
| U_{DC} | Voltage over the resistor during braking, eg, 1.35 · 1.2 · 415 V DC when supply voltage is 380 to 415 VAC 1.35 · 1.2 · 500 V DC when supply voltage is 440 to 500 VAC |
| R | Resistor resistance (ohm) |

- the heat dissipation capacity (E_R) is sufficient for the application, see step 3 above.

Placing the brake resistors

All resistors must be installed outside the drive module in a place where they will cool and the maximum allowed cable length (10 m [33 ft]) is not exceeded.

Arrange the cooling of the resistor in a way that:

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

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



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

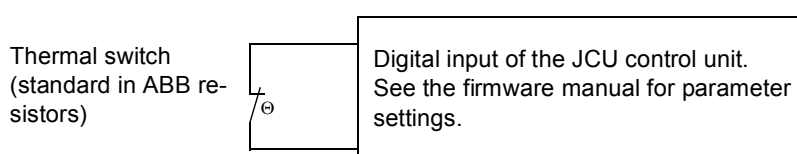
Protecting the system in fault situations

Thermal overload protection

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

A main contactor is not required for protecting against resistor overheating when the resistor is dimensioned according to the instructions and the internal brake chopper is in use. The drive will disable power flow through the input bridge if the chopper remains conductive in a fault situation but the charging resistor may fail. **Note:** If an external brake chopper (outside the drive module) is used, a main contactor is always required.

A thermal switch (standard in ABB resistors) is required for safety reasons. The cable must be shielded and not longer than the resistor cable.



Short-circuit protection

The input fuses will also protect the resistor cable when it is dimensioned according to the input cable.

Selecting and routing the brake circuit cables

Use the cable type used for drive input cabling (see page 57) to ensure that the input fuses will also protect the resistor cable. Alternatively, two-conductor shielded cable with the same cross-sectional area can be used.

Minimizing electromagnetic interference

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

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

Maximum cable length

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

EMC compliance of the complete installation

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

Mechanical installation

See the resistor manufacturer's instructions.

Electrical installation

Connection diagram

See the power cable connection diagram of the drive, page [84](#).

Connection procedure

- Connect the resistor cables to the R+ and R- terminals in the same way as the other power cables. If a shielded three-conductor cable is used, cut the third conductor and ground the twisted shield of the cable (protective earth conductor of the resistor assembly) at both ends.
- Connect the thermal switch of the brake resistor as described in section [Thermal overload protection](#) on page [157](#).

Brake circuit commissioning

- Enable the brake chopper function. Please note that a brake 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.

For more information, see the firmware manual.



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

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

Technical data

Ratings

The ratings for selecting the brake system components are given below at an ambient temperature of 40 °C (104 °F). **Check that the braking energy transmitted to the specified resistor(s) in 400 seconds does not exceed E_R .** See page [155](#).

| Drive module type | Internal brake chopper | | Example brake resistors | | | |
|-------------------|------------------------|--------------------|-------------------------|--------------|---------------|---------------------|
| | P_{brcont} (kW) | R_{min} (ohm) | Type * | R (ohm) | E_R (kJ) | P_{Rcont} (kW) |
| 380...500 V | | | | | | |
| ACS850-04-387A-5 | 250 | 2.0 | 2 × SAFUR125F500 | 2 | 7200 | 18 |
| ACS850-04-500A-5 | 250 | 2.0 | 2 × SAFUR125F500 | 2 | 7200 | 18 |
| ACS850-04-580A-5 | 315 | 1.3 | 2 × SAFUR200F500 | 1.35 | 10800 | 27 |
| ACS850-04-650A-5 | 315 | 1.3 | 2 × SAFUR200F500 | 1.35 | 10800 | 27 |
| ACS850-04-710A-5 | 400 | 0.7 | 3 × SAFUR200F500 | 0.90 | 16200 | 40 |
| ACS850-04-807A-5 | 400 | 0.7 | 3 × SAFUR200F500 | 0.90 | 16200 | 40 |
| ACS850-04-875A-5 | 400 | 0.7 | 3 × SAFUR200F500 | 0.90 | 16200 | 40 |

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

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

R Resistance value for the resistor assembly.

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

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

* The resistors are connected in parallel.

Brake resistor connection data

Voltage over the resistor during braking is $1.35 \cdot 1.2 \cdot 415$ V DC when the supply voltage is 380 to 415 VAC and $1.35 \cdot 1.2 \cdot 500$ V DC when the supply voltage is 440 to 500 VAC.

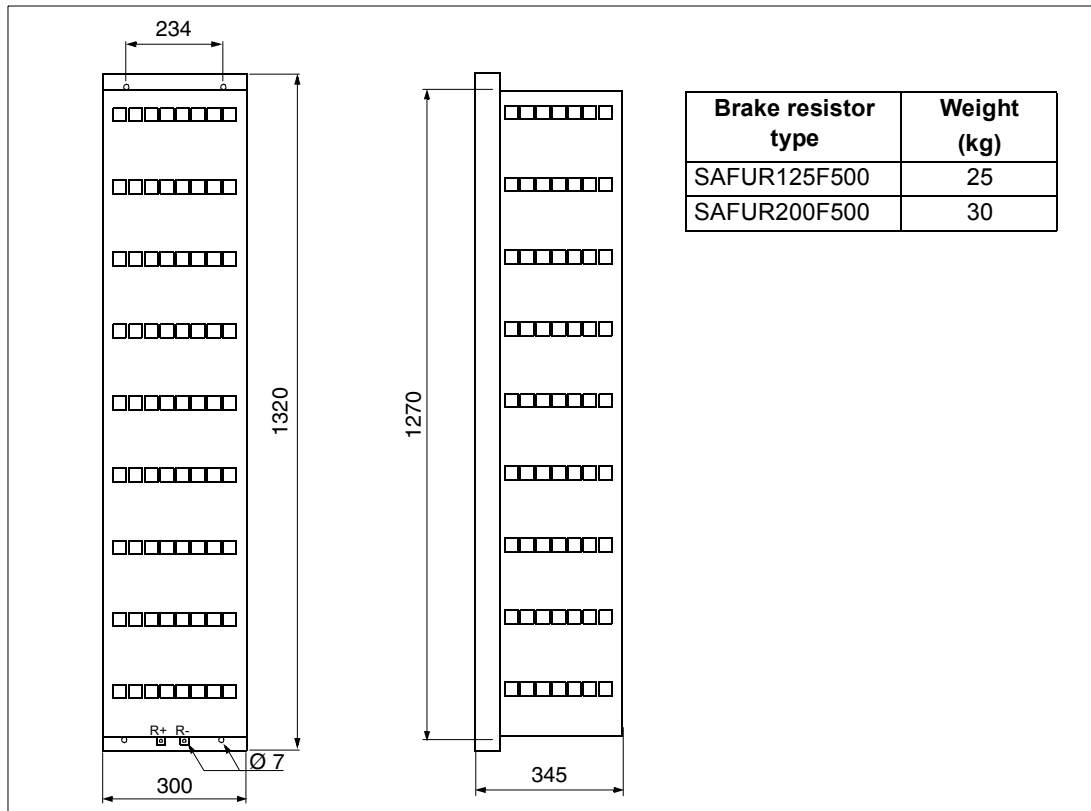
SAFUR resistors

Degree of protection: IP00. The resistors are not UL listed.

Maximum resistor cable length

10 m (33 ft)

Dimensions and weights



du/dt filters

What this chapter contains

This chapter describes how to select *du/dt* filters for the drive.

du/dt filters

When is *du/dt* filter needed?

See section [Checking the compatibility of the motor and drive](#), page 50.

Selection table

du/dt filter types for the drive module types are given below.

| Drive module type | <i>du/dt</i> filter type |
|-------------------|--------------------------|
| ACS850-04-387A-5 | FOCH0610-70 |
| ACS850-04-500A-5 | FOCH0610-70 |
| ACS850-04-580A-5 | FOCH0610-70 |
| ACS850-04-650A-5 | FOCH0610-70 |
| ACS850-04-710A-5 | FOCH0610-70 |
| ACS850-04-807A-5 | FOCH0875-70 |
| ACS850-04-875A-5 | FOCH0875-70 |

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Description, installation and technical data of the FOCH filters

See *FOCH du/dt Filters Hardware Manual* (3AFE68577519 [English]).

Further information

Product and service inquiries

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

Product training

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

Providing feedback on ABB Drives manuals

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

Document library on the Internet

You can find manuals and other product documents in PDF format on the Internet. Go to www.abb.com/drives and select *Document Library*. You can browse the library or enter selection criteria, for example a document code, in the search field.

Contact us

www.abb.com/drives

www.abb.com/drivespartners

3AJUA0000081249 Rev C (EN) 2013-04-11