ABB industrial drives

Hardware manual
ACS880-07 drives (560 to 2800 kW)

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Hardware manual

ACS880-07 drives (560 to 2800 kW)

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1

Safety instructions

Contents of this chapter

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

Use of warnings and notes

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

The manual uses these warning symbols:

WARNING!

Electricity warning tells about hazards from electricity which can cause injury or death, or damage to the equipment.

WARNING!

General warning tells about conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.

WARNING!

Electrostatic sensitive devices warning tells you about the risk of electrostatic discharge which can cause damage to the equipment.

General safety in installation, start-up and maintenance

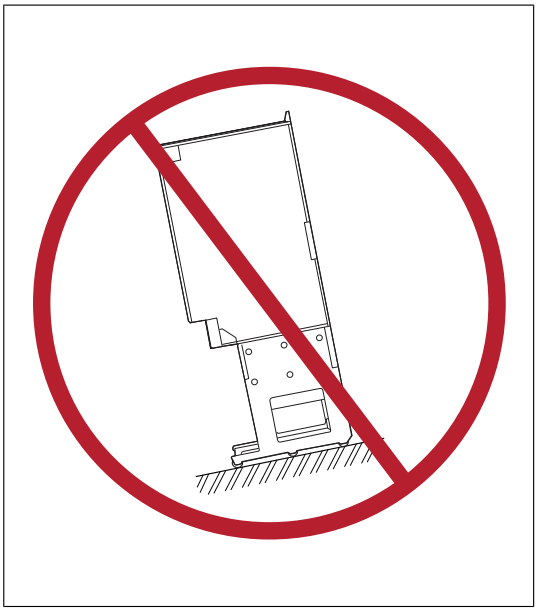
These instructions are for all personnel that install and commission the drive, and do maintenance work on it.

WARNING!

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

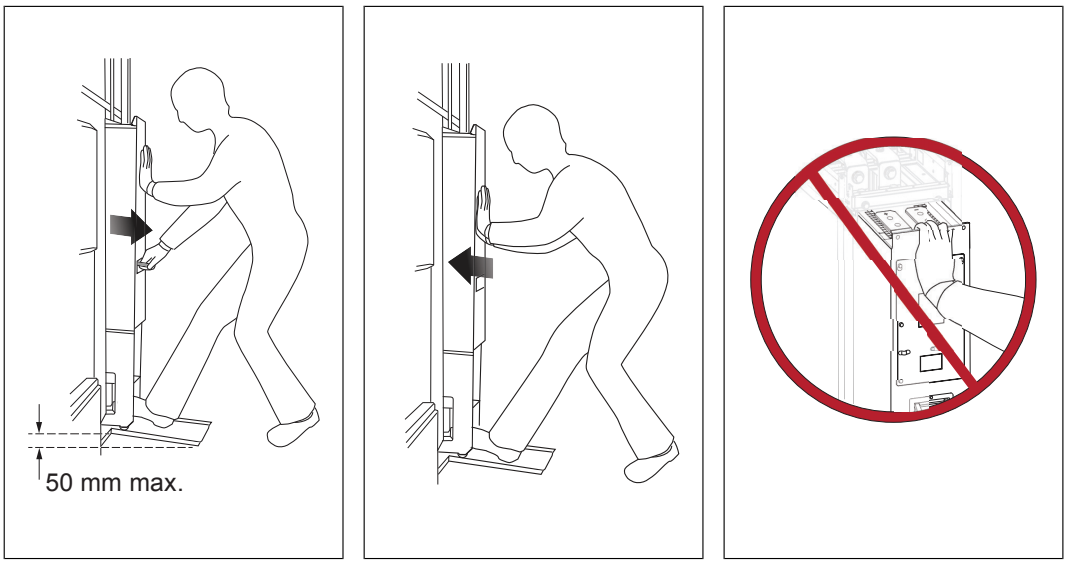
- Keep the drive in its package until you install it. After unpacking, protect the drive from dust, debris and moisture.
- Use the required personal protection equipment: safety shoes with metal toe cap, protective gloves, etc.
- Lift the drive with an lifting device. Use the designated lifting points. See the dimension drawings.
- Secure the drive cabinet to the floor to prevent it from toppling over. The cabinet has a high center of gravity. When you pull out heavy components or power modules, there is a risk of overturning. Secure the cabinet also to the wall when necessary.

- Be careful when handling a tall module. The module overturns easily because it is heavy and has a high center of gravity. Whenever possible, secure the module with chains. Do not leave an unsupported module unattended especially on a sloping floor.



- Modules running on wheels:
  - Do not use the module installation ramp with plinth heights which exceed 50 mm [1.97 in].

- Secure the module extraction/installation ramp carefully.
- Push the module into the cabinet and pull it from the cabinet carefully preferably with help from another person. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back. Keep your fingers away from the edges of the front flange of the module.



- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, and brake resistors, remain hot for a while after disconnection of the electrical supply.
- Beware of hot air exiting from the air outlets.
- Vacuum clean the area around the drive before the start-up to prevent the drive cooling fan from drawing the dust inside the drive.
- Make sure that there is sufficient cooling. See the technical data.
- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists. If you cannot avoid working on a powered drive, obey the local laws and regulations on live working (including – but not limited to – electric shock and arc protection).
- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
- Before you activate the automatic fault reset or automatic restart functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault or supply break. If these functions are activated, the installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".
- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.
- Validate any safety circuits (for example, Safe torque off or emergency stop) in start-up. See separate instructions for the safety circuits.
- Do not cover the air inlet or outlet when the drive is running.

Note:

- If you select an external source for the start command and it is on, the drive will start immediately after fault reset unless you configure the drive for pulse start. See the firmware manual.

- When the control location is set to Remote in the control panel, the stop key on the control panel will not stop the drive.
- Only authorized persons are allowed to repair a malfunctioning drive.

Electrical safety in installation, start-up and maintenance

Electrical safety precautions

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

WARNING!

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

1. Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.
2. Clearly identify the work location.
3. Disconnect all possible voltage sources.
   - Open the main switch-disconnector (Q1.1) (or rack out the main breaker, Q1) of the drive.
   - Open the disconnector of the supply transformer. The main switch-disconnector or breaker of the drive does not remove the voltage from the input busbars of the drive.
   - If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
   - Make sure that re-connection is not possible. Lock the disconnectors to open position and attach a warning notice to them.
   - Disconnect any external power sources from the control circuits before you do work on the control cables.
   - After you disconnect the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
4. Protect any other energized parts in the work location against contact.
5. Take special precautions when close to bare conductors.
6. Measure that the installation is de-energized. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).
   - Use a multimeter with an impedance of at least 1 Mohm.
   - Make sure that the voltage between the drive input power terminals and the grounding (PE) busbar is close to 0 V.
   - Make sure that the voltage between the drive DC busbars (+ and -) and the grounding (PE) busbar is close to 0 V.
7. Install temporary grounding as required by the local regulations. Close the grounding switch or switches (option +F259, Q9) if present.
8. Ask the person in control of the electrical installation work for a permit to work.

Additional instructions and notes

WARNING!

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

- If you are not a qualified electrician, do not do electrical installation or maintenance work.
- Do not install the drive if the electrical power network, motor/generator, or environmental conditions do not agree with the drive data.
- Do not install a drive with EMC filter (option +E200 or +E202) on an ungrounded power system or a high resistance-grounded (over 30 ohms) power system.
- We do not recommend that you secure the cabinet by arc welding. If you have to, obey the separate welding instructions in the drive manuals.
- Do not do insulation or voltage withstand tests on the drive.

Note:

- The motor cable terminals of the drive are at a dangerous voltage when the input power is on, regardless of whether the motor is running or not.
- When the input power is on, the drive DC bus is at a dangerous voltage. If brake chopper and resistor are in use, they are also at a dangerous voltage. (Option +D150)
- External wiring can supply dangerous voltages to the relay outputs of the control units of the drive.
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.

WARNING!

Obey these instructions. If you ignore them, damage to the equipment can occur.

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

WARNING!

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

Grounding

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

WARNING!

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

- If you are not a qualified electrician, do not do grounding work.
- Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- Make sure that the conductivity of the grounding conductors is sufficient. See electrical planning instructions. Obey the local regulations.

- Connect the power cable shields to protective earth (PE) of the drive to make sure of personnel safety.
- Make a 360° grounding of the power and control cable shields at the cable entries to suppress electromagnetic disturbances.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) busbar of the switch board or the transformer.

Note:

- You can use power cable shields as grounding conductors only when their conductivity is sufficient.
- As the normal touch current of the drive is higher than 3.5 mA AC or 10 mA DC, you must use a fixed protective earth connection. See standard IEC/EN 61800-5-1, 4.3.5.5.2.

Additional instructions for permanent magnet motor drives

Safety in installation, start-up, maintenance

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

WARNING!

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

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

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

- Stop the drive and do the steps in section *Electrical safety precautions (page 19)*.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
- Install temporary grounding to the drive output terminals (U2, V2, W2). Connect the output terminals together as well as to the PE.

During the start up:

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

Safety in operation

WARNING!

Do not run the motor over the rated speed. Motor overspeed causes overvoltage which can damage the capacitors in the intermediate circuit of the drive.

2

Introduction to the manual

Contents of this chapter

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

Target audience

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

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 configuration. The chapters of the manual are briefly described below.

Safety instructions gives safety instructions for the installation, start-up, operation and maintenance of the drive.

Introduction to the manual gives an introduction to this manual.

Operation principle and hardware description describes the operation principle and construction of the drive.

Mechanical installation describes how to install the drive mechanically.

Guidelines for planning the electrical installation contains instructions for the motor and cable selection, protections and cable routing.

Electrical installation gives instructions on wiring the drive.

Control units of the drive contains the default I/O connection diagrams, descriptions of the terminals and technical data for the control units of both the supply and inverter units.

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

Start-up describes the start-up procedure of the drive.

Fault tracing describes the fault tracing possibilities of the drive.

Maintenance contains preventive maintenance instructions.

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

Dimensions contains example dimension drawings of the drive.

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

Categorization by frame size and option code

Some instructions, technical data and dimension drawings which concern only certain frame sizes are marked with the symbol of the frame size. The frame size indicates the number of power modules that form the supply and inverter units respectively.

For example, the marking “2×D8T + 3×R8i” refers to a drive that has a supply unit consisting of two frame D8T supply modules and an inverter unit consisting of three frame R8i inverter modules. The frame size is marked on the type designation label, and can also be determined from the type code.

The instructions, technical data and dimension drawings which only concern certain optional selections are marked with option codes (such as +E205). 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 (page 54)*.

Quick installation, commissioning and operation flowchart

Task	See
Plan the electrical installation and acquire the accessories needed (cables, fuses, etc.). Check the ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.	*Guidelines for planning the electrical installation (page 75)* *Technical data (page 177)*
⬇	
Check the installation site.	*Ambient conditions (page 193)*
⬇	
Unpack and check the drive (only intact units may be started up). Make sure that all necessary optional modules and equipment are present and correct. Install the drive mechanically.	*Mechanical installation (page 59)*
⬇	
Route the cables.	*Routing the cables (page 86)*
⬇	
Check the insulation of the supply cable, the motor and the motor cable.	*Checking the insulation of the assembly (page 95)*
⬇	
If the drive is about to be connected to an IT (ungrounded) system, check that the drive is not equipped with EMC filter +E202.	*Checking the compatibility with IT (ungrounded) systems (page 96)*
⬇	
Connect the power cables. Connect the control cables.	*Electrical installation (page 95)*
⬇	
Check the installation.	*Installation checklist (page 141)* If the drive has been non-operational for more than one year, reform the DC link capacitors. See *Converter module capacitor reforming instructions* (3BFE64059629 [English].
⬇	
Start the drive up.	*Start-up (page 143)*
⬇	
Operate the drive: start, stop, speed control etc.	ACS880 quick start-up guide, firmware manual

Terms and abbreviations

Term/ Abbreviation	Description
BCU	Type of control unit
Drive	Frequency converter for controlling AC motors. The drive consists of a rectifier and an inverter connected together by the DC link. In drives up to approximately 500 kW, these are integrated into a single module (drive module). Larger drives typically consist of separate supply and inverter units. This manual uses the term drive to refer converters and inverter as well.
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
FEN-01	Optional TTL incremental encoder interface module
FEN-11	Optional TTL absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL incremental encoder interface module
FIO-11	Optional analog I/O extension module
FPTC-01	Optional thermistor protection module
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres
Frame	Physical size of the drive or power module
FSO-12, FSO-21	Optional functional safety modules
I/O	Input/Output
IGBT	Insulated gate bipolar transistor
Inverter unit	Inverter module(s) under control of one control board, and related components. One inverter unit typically controls one motor.
Power module	Common term for drive module, inverter module, supply module, brake chopper module etc.
RFI	Radio-frequency interference
STO	Safe torque off
Supply unit	Supply module(s) under control of one control board, and related components.

Related manuals

Drive hardware manuals and guides	**Code (English)**	
ACS880-07 (560 to 2800 kW) hardware manual	3AUA0000143261	
ACX-AP-x assistant control panels user’s manual	3AUA0000085685	
Drive firmware manuals and guides		
ACS880 primary control program firmware manual	3AUA0000085967	
Quick start-up guide for ACS880 drives with primary control program	3AUA0000098062	
ACS880 diode supply control program firmware manual	3AUA0000103295	
Option manuals and guides		
Drive composer start-up and maintenance PC tool user’s manual	3AUA0000094606	
FSO-12 safety functions module user’s manual	3AXD50000015612	
FSO-21 safety functions module user’s manual	3AXD50000015614	
User’s manual for Prevention of unexpected start-up (+Q950) for ACS880-07/17/37 drives	3AUA0000145922	
User’s manual for Emergency stop, stop category 0 (+Q951) for ACS880-07/17/37 drives	3AUA0000119895	
User’s manual for Emergency stop, stop category 1 (+Q952) for ACS880-07/17/37 drives	3AUA0000119896	

User’s manual for Prevention of unexpected start-up (+Q957) for ACS880-07/17/37 drives	3AUA0000119910	
User’s manual for Emergency stop, stop category 0 (+Q963) for ACS880-07/17/37 drives	3AUA0000119908	
User’s manual for Emergency stop, stop category 1 (+Q964) for ACS880-07/17/37 drives	3AUA0000119909	
User's manual for Safely-limited speed with the encoder interface (+Q965) for ACS880-07/17/37 drives	3AXD50000019727	
User's manual for ATEX-certified motor thermal protection functions (+L513+Q971 and +L514+Q971) for cabinet-built ACS880 drives	3AXD50000014979	
User’s manual for Emergency stop, configurable stop category 0 or 1 (+Q978) for ACS880-07/17/37 drives	3AUA0000145920	
User’s manual for Emergency stop, configurable stop category 0 or 1 (+Q979) for ACS880-07/17/37 drives	3AUA0000145921	
Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.		

ACS880-07 (560 to 2800 kW) manuals

See www.abb.com/drives/documents for all manuals on the Internet.

3

Operation principle and hardware description

Contents of this chapter

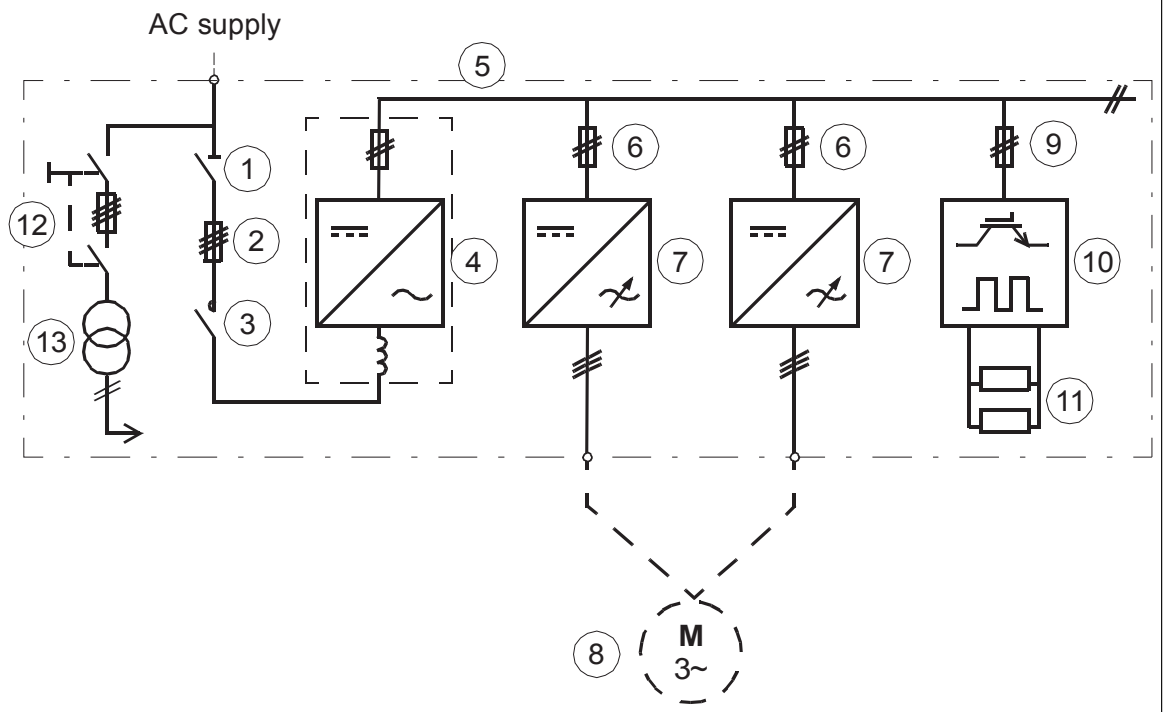
This chapter briefly describes the operation principle and construction of the drive.

Operation principle

The ACS880-07 is an air-cooled cabinet-installed drive for controlling asynchronous AC induction motors, permanent magnet synchronous motors and AC induction servomotors.

The drive consists of several cubicles that contain the supply and motor terminals, 1 to 4 diode supply module(s), 2 to 5 inverter modules, and optional equipment. The actual arrangement of the cubicles vary from type to type and the selected options.

Overview circuit diagram of the drive



1	*Main switch-disconnector (Q1.1)
2	*AC fuses. Frames 1×D8T + 2×R8i (6-pulse), 2×D7T + 2×R8i (12-pulse), 2×D8T + n×R8i(12-pulse) have AC fuses installed in the incoming cubicle (ICU) only. Frames 2×D8T + 2×R8i and above (6-pulse) and 4×D8T + n×R8i (12-pulse) have AC fuses installed for each supply module in the supply module cubicle(s). Additional common AC fuses are installed in the incoming cubicle (ICU) if optional main contactor (+F250) is present.
3	*Main contactor (Q2.1). Optional (+F250) with frames 2×D7T + 2×R8i, 2×D8T + 2×R8i and 2×D8T + 3×R8i. 12-pulse units have two contactors (Q2.1 and Q2.2).
*With larger units, an air circuit breaker is either optional (+F255) or standard, replacing items 1…3. Each supply module has dedicated AC fuses installed in the supply module cubicle(s).	
4	Supply module. Converts alternating current and voltage to direct current and voltage. The ACS880-07 has 1…4 supply modules connected in parallel. 12-pulse units have either one or two supply modules per each 6-pulse supply line.
5	DC bus
6	Inverter DC fuses
7	Inverter module. Converts direct current and voltage to alternating current and voltage. The ACS880-07 has 2…5 inverter modules connected in parallel.
8	Motor
9	**Brake chopper DC fuses
10	**Brake chopper. Conducts surplus energy from the intermediate DC circuit of the drive to the brake resistor when necessary. The chopper operates when the DC voltage exceeds a certain maximum limit.The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
11	**Brake resistors
**Brake chopper (+D150) and resistors (+D151) are optionally available for frame sizes 1×D8T + 2×R8i and up. See chapter *Resistor braking (page 265)*.	
12	Auxiliary voltage switch (Q21) with fuses

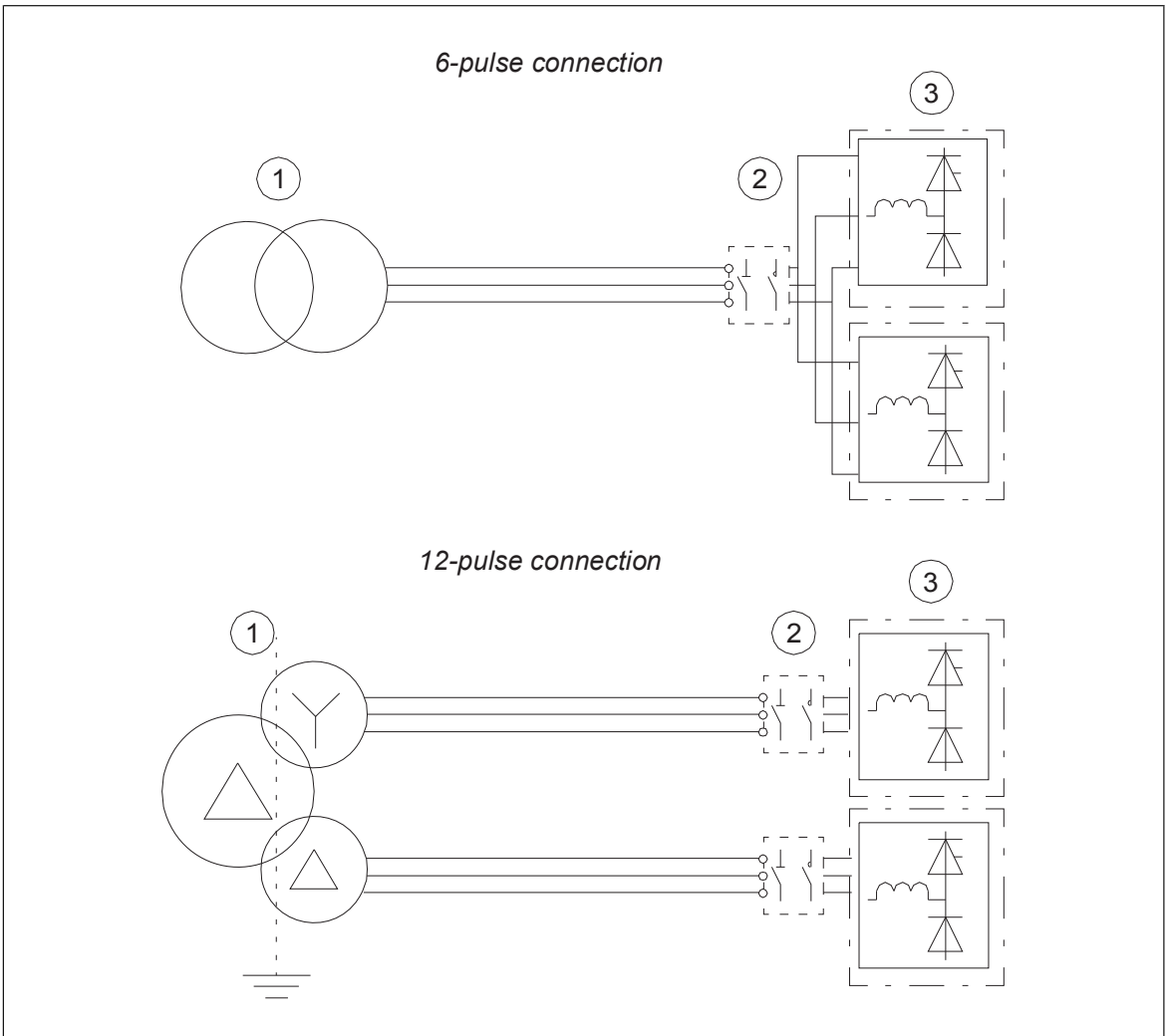
13	Auxiliary voltage transformers (T21, T101, T111). T21 is standard; T101 and T111 are added whenever required by the options ordered.

12-pulse connection (option +A004)

The figure below illustrates the difference between 6-pulse and 12-pulse AC supply connections. 6-pulse connection is standard. If the drive has an even number of supply modules, you can order it as a 12-pulse version (option +A004).

12-pulse supply connection eliminates the fifth and seventh harmonics, which remarkably reduces the harmonic distortion of the line current and the conducted emissions.

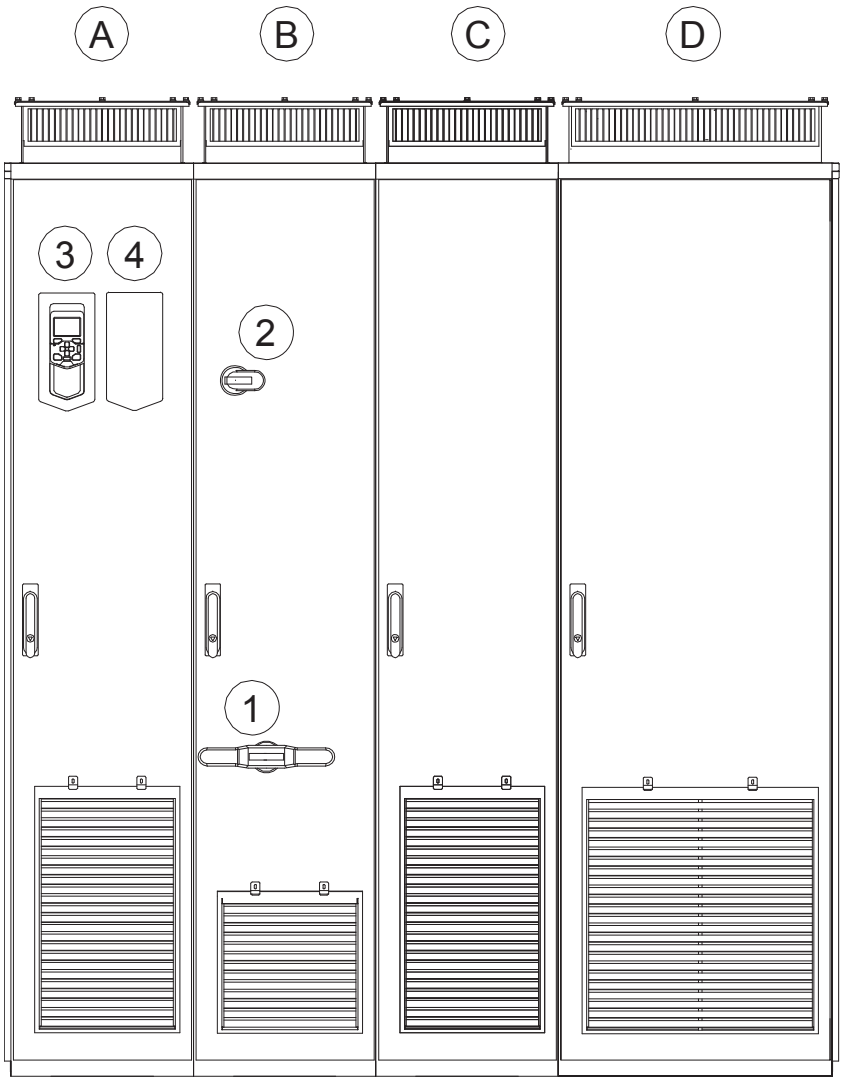
12-pulse connection requires a three-winding transformer, or two separate transformers. There is a 30-degree phase shift between the two 6-pulse supply lines, which are connected to different supply modules through electrically separate switching equipment.



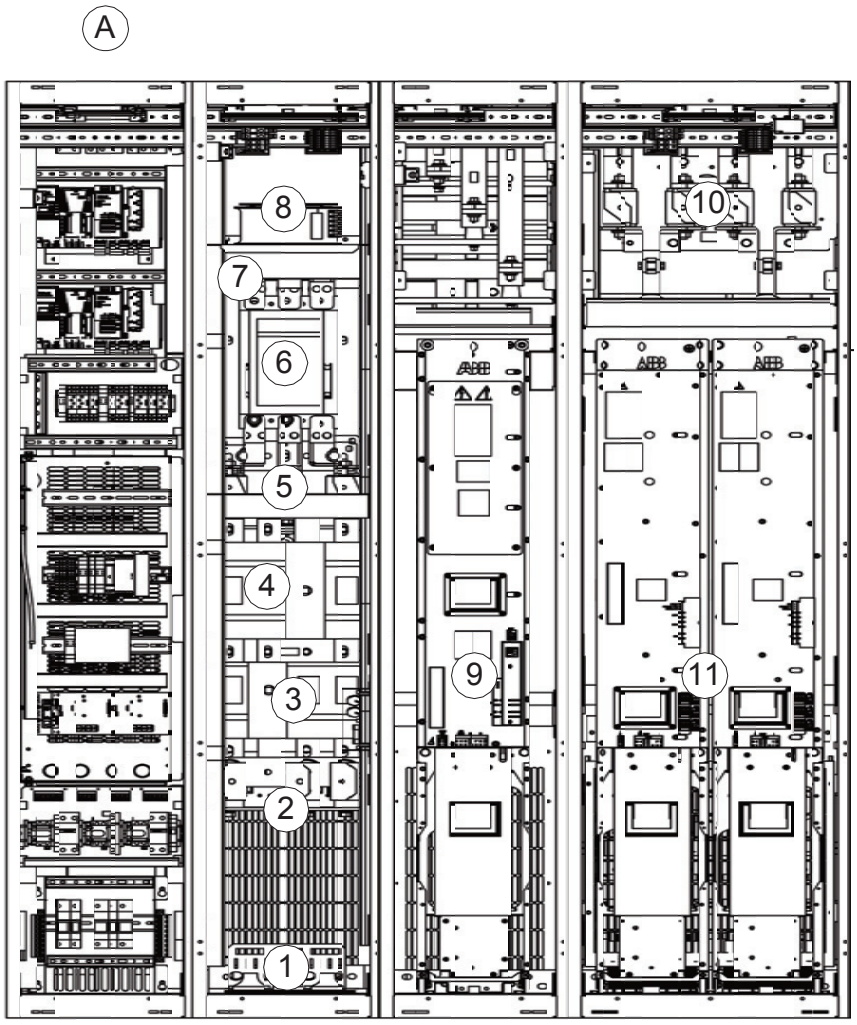
No.	Description
1.	Supply transformer
2.	Switching equipment
3.	Diode supply modules

Cabinet line-up and layout examples

Frame 1×D8T + 2×R8i

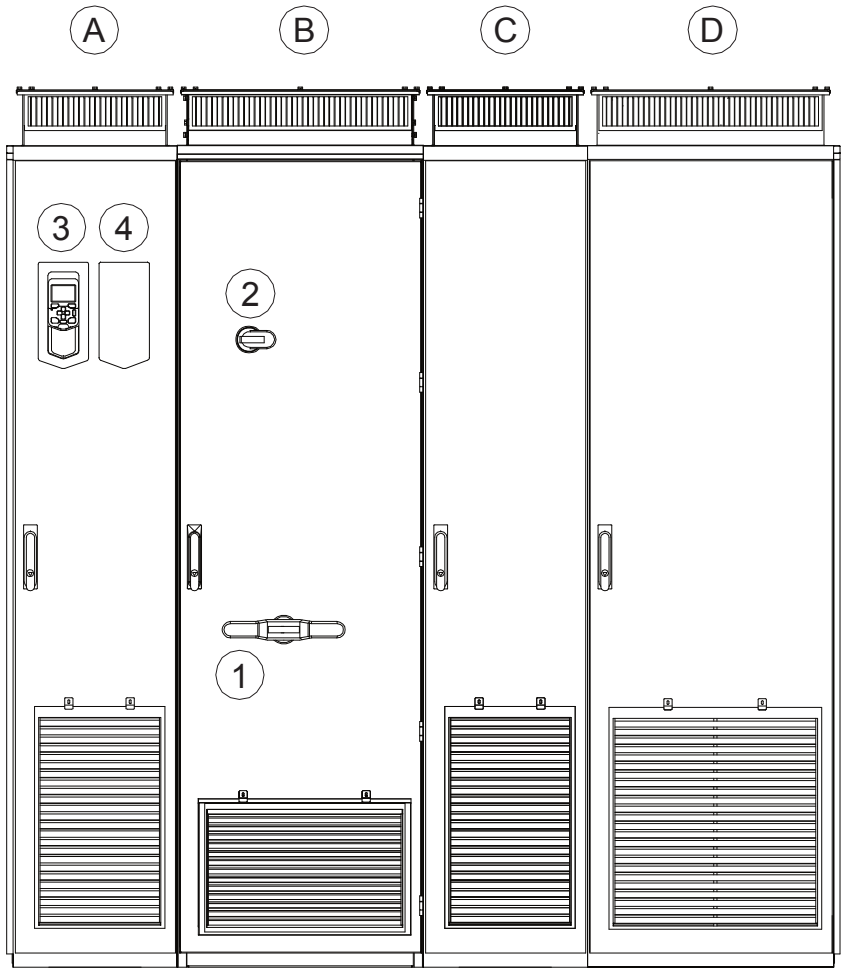


Cabinet line-up example	
A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section *Auxiliary control cubicle (ACU) layout (page 40)*.
B	Incoming cubicle (ICU). Contains the power input cable terminals and switchgear.
C	Supply module cubicle. Contains the D8T supply module.
D	Inverter module cubicle. Contains two R8i inverter modules. As standard, the motor cables are run from each inverter module to the motor unless the drive is equipped with option +H359 (common motor terminal cubicle), +H366 (common output terminals) or +E206 (sine filters).
1	Main switch-disconnector (Q1.1)
2	Auxiliary voltage switch (Q21)
3	Drive control panel. See section *Control panel (page 44)*.
4	Door switches and lights. See section *Door switches and lights (page 43)*.

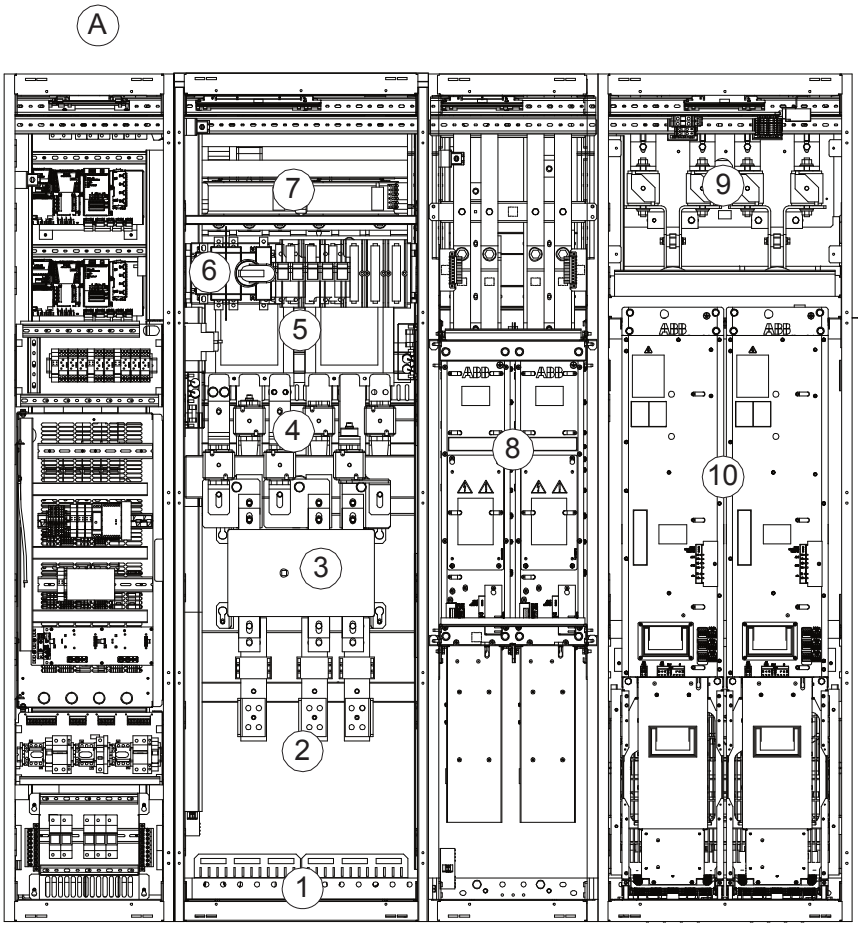


Cabinet layout example	
A	Auxiliary control cubicle (ACU). See section *Auxiliary control cubicle (ACU) layout (page 40)*.
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Main switch-disconnector (Q1.1)
4	Grounding (earthing) switch (Q9.1) (optional)
5	AC fuses
6	Main contactor (Q2.1) (optional)
7	Auxiliary voltage switch (Q21) with fuses
8	Incoming cubicle cooling fan
9	Supply module
10	Inverter DC fuses
11	Inverter modules. The output terminals are located behind each module. Each module must be individually connected to the motor using separate cables unless the drive is equipped with option +H359 (common motor terminal cubicle), +H366 (common output terminals) or +E206 (sine filters).

Frame 2×D7T + 2×R8i (12-pulse connection, option +A004)

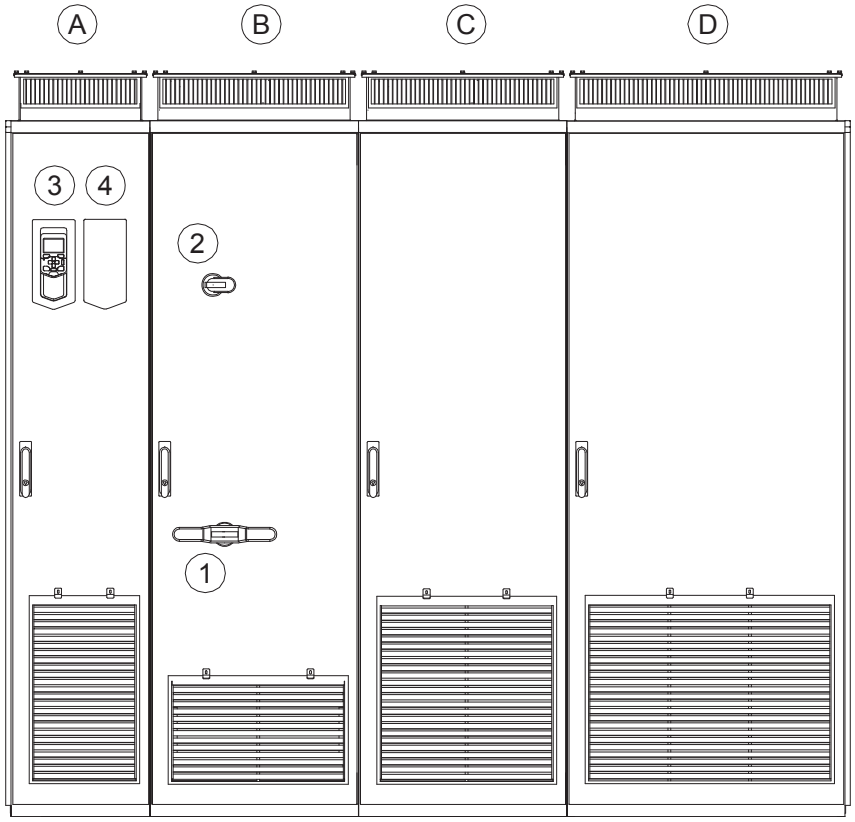


Cabinet line-up example	
A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section *Auxiliary control cubicle (ACU) layout (page 40)*.
B	Incoming cubicle (ICU). Contains the power input cable terminals and switchgear. With option +F259 (grounding switch), there are two incoming cubicles, one for each 6-pulse supply line.
C	Supply module cubicle. Contains two D7T supply modules, each connected to a different 6-pulse supply line.
D	Inverter module cubicle. Contains two R8i inverter modules. As standard, the motor cables are run from each inverter module to the motor unless the drive is equipped with option +H359 (common motor terminal cubicle), +H366 (common output terminals) or +E206 (sine filters).
1	Main switch-disconnector (Q1.1)
2	Auxiliary voltage switch (Q21)
3	Drive control panel. See section *Control panel (page 44)*.
4	Door switches and lights. See section *Door switches and lights (page 43)*.

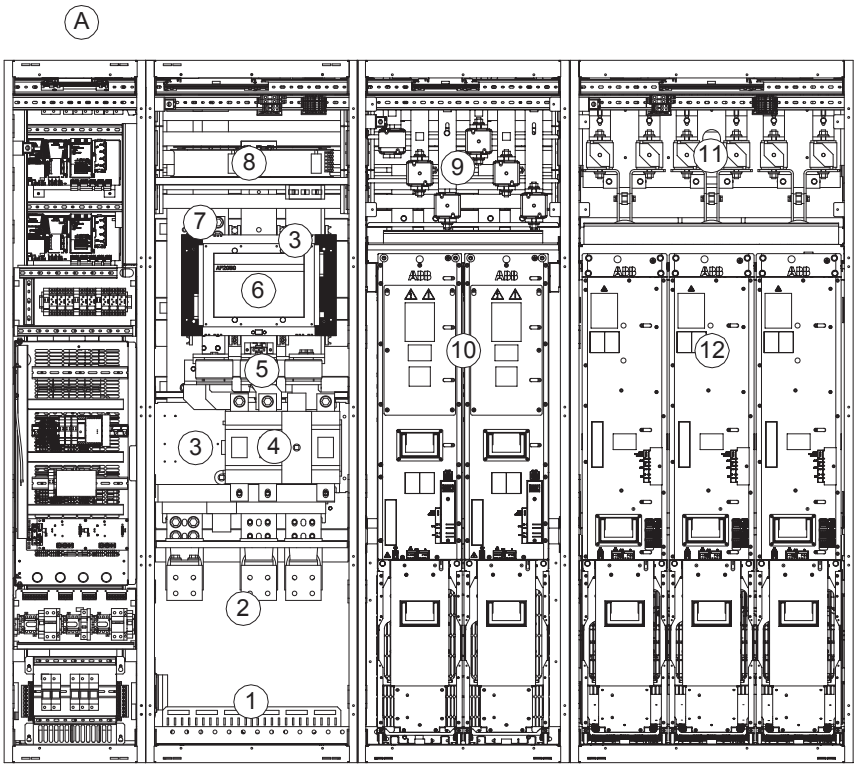


Cabinet layout example	
A	Auxiliary control cubicle (ACU). See section *Auxiliary control cubicle (ACU) layout (page 40)*.
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Main switch-disconnector (Q1.1)
4	AC fuses
5	Main contactors (Q2.1 and Q2.2) (optional)
6	Auxiliary voltage switch (Q21) with fuses
7	Incoming cubicle cooling fans
8	Supply modules. Each module is connected to a different 6-pulse supply line.
9	Inverter DC fuses
10	Inverter modules. The output terminals are located behind each module. Each module must be individually connected to the motor using separate cables unless the drive is equipped with option +H359 (common motor terminal cubicle), +H366 (common output terminals) or +E206 (sine filters).

Frame 2×D8T + 3×R8i

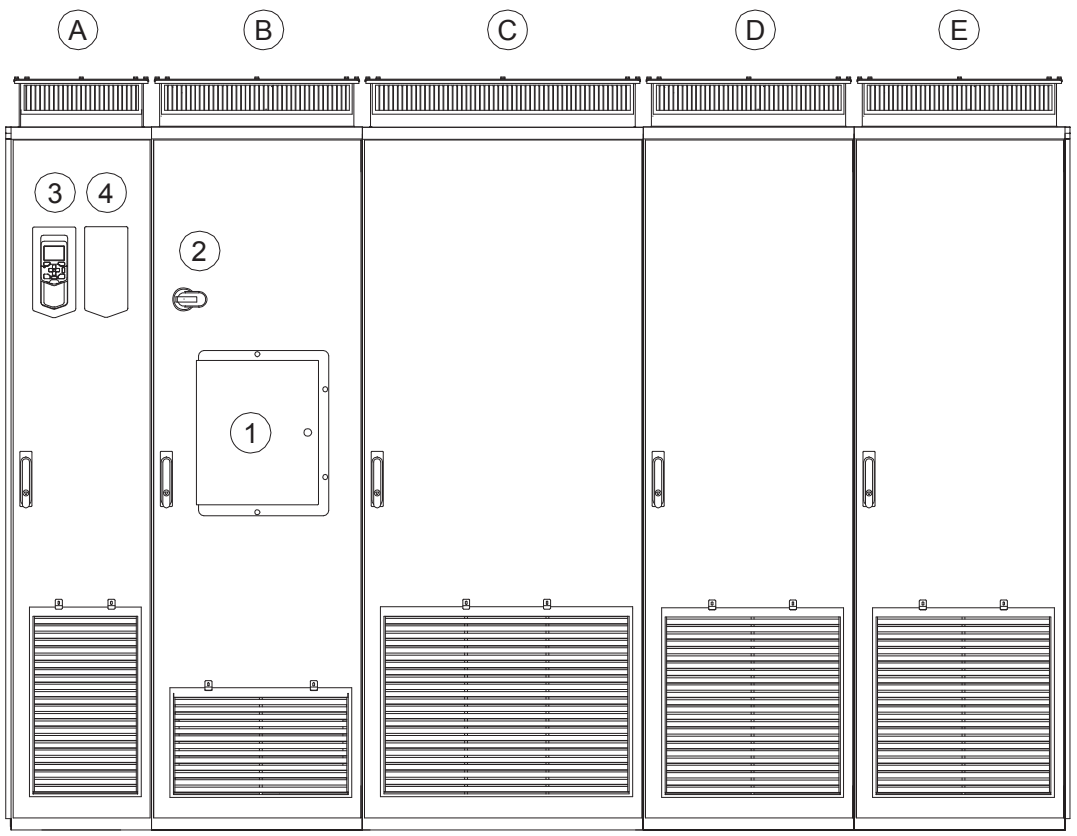


Cabinet line-up example	
A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section *Auxiliary control cubicle (ACU) layout (page 40)*.
B	Incoming cubicle (ICU). Contains the power input cable terminals and switchgear.
C	Supply module cubicle. Contains two D8T supply modules.
D	Inverter module cubicle. Contains three R8i inverter modules. As standard, the motor cables are run from each inverter module to the motor unless the drive is equipped with option +H359 (common motor terminal cubicle) or +H366 (common output terminals).
1	Main switch-disconnector (Q1.1)
2	Auxiliary voltage switch (Q21)
3	Drive control panel. See section *Control panel (page 44)*.
4	Door switches and lights. See section *Door switches and lights (page 43)*.

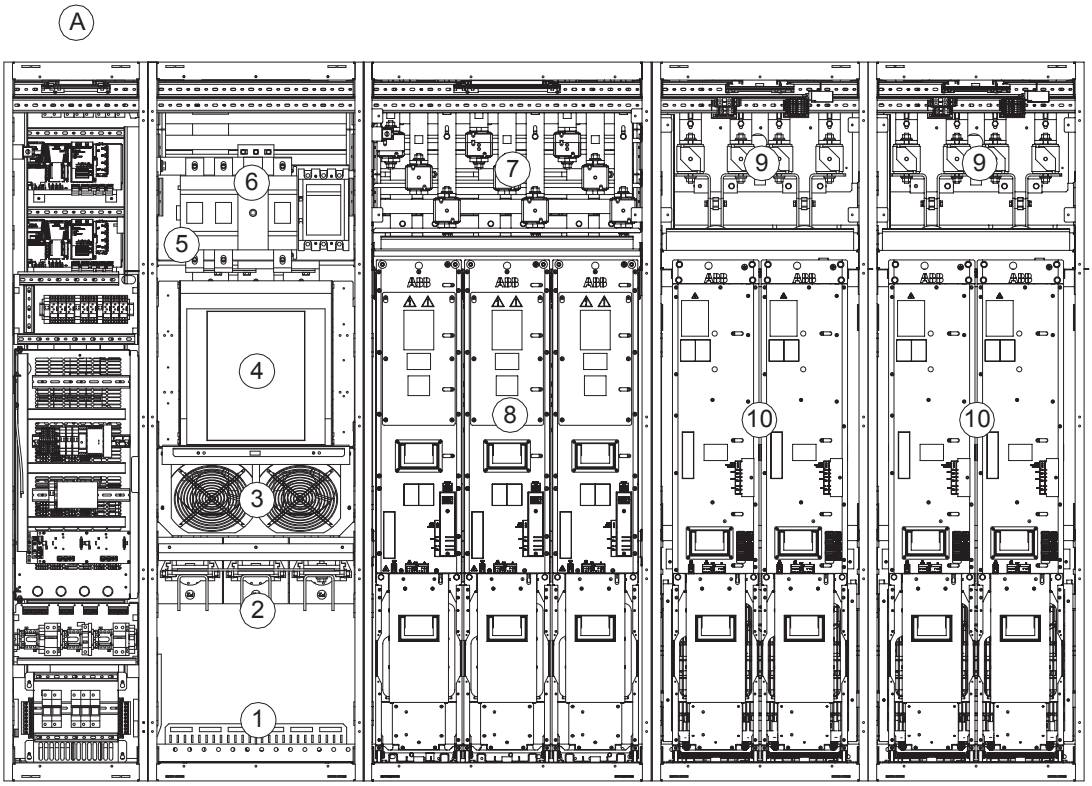


Cabinet layout example	
A	Auxiliary control cubicle (ACU). See section *Auxiliary control cubicle (ACU) layout (page 40)*.
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Main switch-disconnector (Q1.1)
4	Grounding (earthing) switch (Q9.1) (optional)
5	Common AC fuses (installed with optional main contactor)
6	Main contactor (Q2.1) (optional)
7	Auxiliary voltage switch (Q21) with fuses
8	Incoming cubicle cooling fans
9	Supply module AC fuses
10	Supply modules
11	Inverter DC fuses
12	Inverter modules. The output terminals are located behind each module. Each module must be individually connected to the motor using separate cables unless the drive is equipped with option +H359 (common motor terminal cubicle) or +H366 (common output terminals).

Frame 3×D8T + 4×R8i (with main breaker, option +F255)



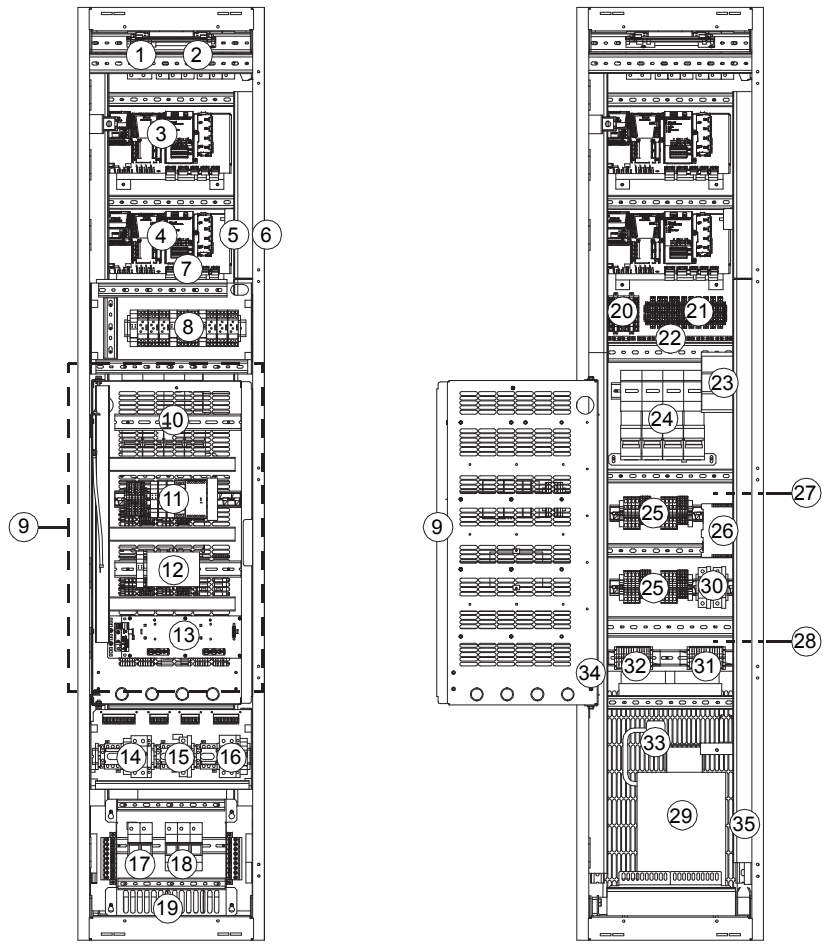
Cabinet line-up example	
A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See section *Auxiliary control cubicle (ACU) layout (page 40)*.
B	Incoming cubicle (ICU). Contains the power input cable terminals and switchgear.
C	Supply module cubicle. Contains three D8T supply modules.
D, E	Inverter module cubicles 1 and 2. Each cubicle contains two R8i inverter modules. As standard, the motor cables are run from each inverter module to the motor unless the drive is equipped with option +H359 (common motor terminal cubicle) or +H366 (common output terminals).
1	Main breaker (Q1) (option +F255)
2	Auxiliary voltage switch (Q21)
3	Drive control panel. See section *Control panel (page 44)*.
4	Door switches and lights. See section *Door switches and lights (page 43)*.



Cabinet layout example	
A	Auxiliary control cubicle (ACU). See section *Auxiliary control cubicle (ACU) layout (page 40)*.
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Incoming cubicle cooling fans
4	Main breaker (Q1) (option +F255)
5	Auxiliary voltage switch (Q21) with fuses
6	Grounding (earthing) switch (Q9.1) (optional)
7	Supply module AC fuses
8	Supply modules
9	Inverter DC fuses
10	Inverter modules. The output terminals are located behind each module. Each module must be individually connected to the motor using separate cables unless the drive is equipped with option +H359 (common motor terminal cubicle) or +H366 (common output terminals).

Auxiliary control cubicle (ACU) layout

A layout example of the auxiliary control cubicle (ACU) is shown below. On the left: Swing-out frame closed, detachable mounting plates in place. On the right: Swing-out frame open, without detachable mounting plates.

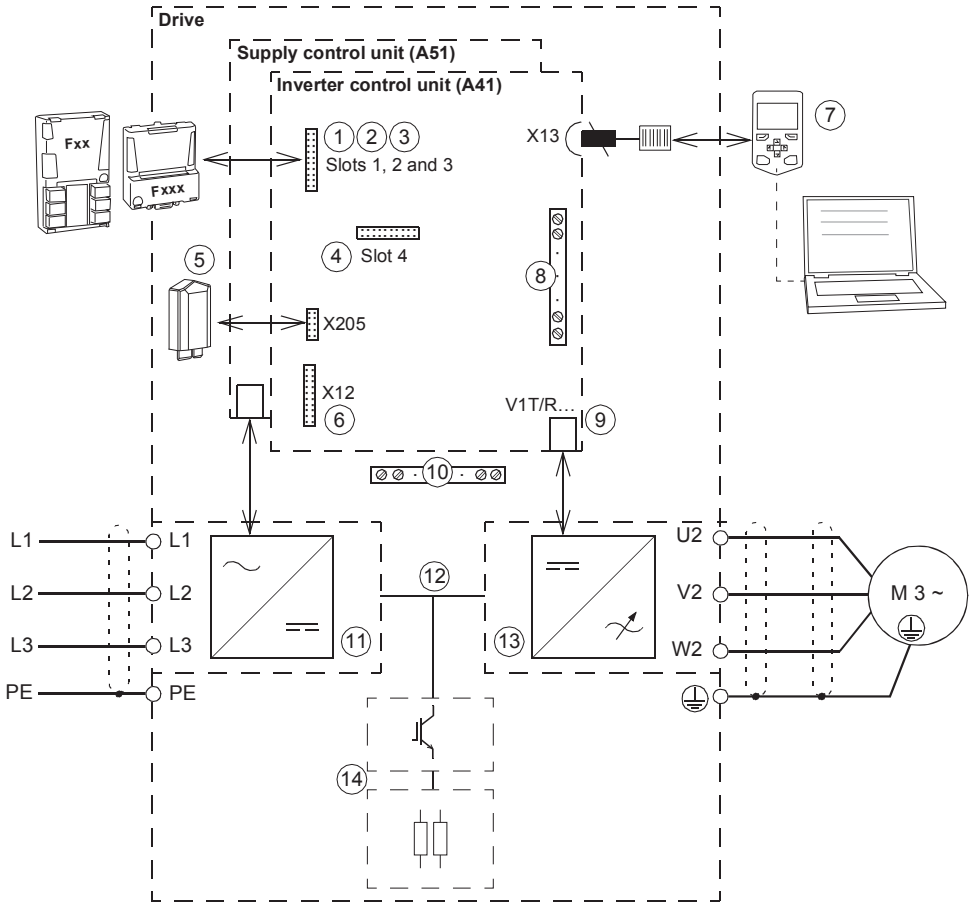


1	Fuse-disconnectors F101. On the primary of transformer T101 (item 27).		19	Lead-through for control cables
2	Fuse-disconnectors (F27) for motor cooling fan outputs (options +M602…610)		20	Terminal block (X68) for FSO-xx safety functions module (option +Q973)
3	Supply control unit (A51). See chapter *Control units of the drive (page 129)*.		21	I/O terminal block (option +L504). The I/O of the inverter control unit is wired to this block.
4	Inverter control unit (A41). Three optional I/O extension, encoder interface, or fieldbus adapter modules can be installed on the unit. Additional modules are installed on item 13. See chapter *Control units of the drive (page 129)*		22	Grounding/clamping point for control cables
5	Auxiliary voltage circuit breaker F112. On the secondary of transformer T111 (item 29). Mounted on the right-hand inside wall.		23	24 V DC power supply and buffer module
6	Switch (F90) for ground fault monitoring (item 12)		24	Motor fan starters and contactors (options +M602…610)
7	FSO-xx safety functions module (option +Q973 and other options requiring FSO-xx)		25	Terminal blocks (X601) for motor fan connections (options +M602…610)

8	Temperature monitoring relays (options +L505 and +L506). The terminals (X506) are located on the back of the detachable mounting plate.		26	24 V DC power supply for cabinet lighting (option +G301)
9	Swing-out frame		27	Auxiliary voltage transformer T101 (at the back of the cubicle, not visible). Supplies IP54, brake chopper and brake resistor cabinet cooling fans (options +B055, +D150 and +D151).
10	Mounting rail for additional equipment		28	Auxiliary voltage transformer T21 (at the back of the cubicle, not visible). Supplies the control circuitry and the cooling fans in both the incoming unit (ICU) and the auxiliary control unit (ACU).
11	Safety options (emergency stop, safe torque off)		29	Auxiliary voltage transformer T111. (Customized equipment only.)
12	Ground fault monitoring equipment for ungrounded systems (option +Q954)		30	Auxiliary voltage circuit breakers F22 and F102. On the secondary of transformers T21 (item 28) and T101 (item 27) respectively.
13	FEA-03 extension adapter (option +L515).		31	Input voltage setting for auxiliary voltage transformer T101 (item 27)
14	Switch and circuit breaker for externally-supplied motor space heater (option +G313). The terminals (X313) are located on the back of the detachable mounting plate.		32	Input voltage setting for auxiliary voltage transformer T21 (item 28)
15	Switch and circuit breaker for externally-supplied control voltage (option +G307), eg. UPS. The terminals (X307) are located on the back of the detachable mounting plate.		33	Input voltage setting for auxiliary voltage transformer T111 (item 29)
16	Switch and circuit breaker for externally-supplied cabinet lighting and heating (options +G300 and +G301). The terminals (X300) are located on the back of the detachable mounting plate.		34	Terminal blocks X250: indication of main switch-disconnector and contactor status X951: connection of external emergency stop button X954: ground fault alarm indication X957: for connection of Prevention of unexpected start-up switch. Mounted on the left-hand side wall.
17	Fuse-disconnectors F21. On the primary of transformer T21 (item 28). Mounted on a detachable plate.		35	Cubicle heater element (option +G300). Mounted on the right-hand side wall.
18	Fuse-disconnectors F111. On the primary of transformer T111 (item 29). Mounted on a detachable plate.			

Overview of power and control connections

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



1 2 3 4	Option modules can be inserted into slots 1, 2, 3 and 4 as follows: **Module type** — **Slots** Analog and digital I/O extension modules — 1, 2, 3 Feedback interface modules — 1, 2, 3 Fieldbus communication modules — 1, 2, 3 RDCO-xx DDCS communication option module (standard equipment). As standard, a fiber optic link connects the supply and inverter control units. — 4 Additional modules can be installed on an optional FEA-03 extension adapter connected to the RDCO module on slot 4.
5	Memory unit
6	Connection for FSO-xx safety functions module
7	Control panel and PC connection
8	Terminal blocks on the inverter control unit. These terminals are optionally wired to terminal block X504 in the auxiliary control cabinet of the drive.
9	Fiber optic link to each inverter module. Similarly, each supply module is connected to the supply control unit by fiber optic cables.

10	Terminal blocks for customer connections installed in the drive cabinet. For the locations, see section *Auxiliary control cubicle (ACU) layout (page 40)*.
11	Supply unit (consisting of one or more supply modules)
12	DC intermediate link
13	Inverter unit (consisting of two or more inverter modules)
14	Optional brake chopper (+D150) and resistors (+D151)

Door switches and lights

	Label in English	Label in local language	Description
1	READY	-	Ready light (option +G327)
2	RUN	-	Run light (option+G328)
3	FAULT	-	Fault light (option +G329)
4	RUN/ENBL OFF 	-	Run enable signal switch for the supply unit OFF: Run enable signal off (starting the supply unit not allowed) ON: Run enable signal on (starting the supply unit allowed). Close the main contactor if present.
5	E-STOP RESET	-	Emergency stop reset push button (with emergency stop options only)
6	EARTH FAULT	-	Ground (earth) fault light with option +Q954
7	-	-	Reserved for application-engineered equipment
8	EMERGENCY STOP	-	Emergency stop push button (with emergency stop options only)

The layout depends on the options selected.

Main disconnecting device (Q1.1)

Depending on the configuration of the drive, the main disconnecting device of the drive is either a switch-disconnector or a main circuit breaker. Units with a switch-disconnector also have a main contactor.

The main disconnecting device switches the main supply to the drive on and off. To disconnect the main supply, turn the switch-disconnector to the 0 (OFF) position, or rack out the main breaker (whichever device is installed).

WARNING!

The main disconnecting device does not isolate the input power terminals, AC voltage meters, or the auxiliary voltage circuit from the power line. To isolate the auxiliary voltage circuit, open the auxiliary voltage switch (Q21). To isolate the input power terminals and AC voltage meters, open the main breaker of the supply transformer.

To close the main disconnecting device, auxiliary voltage must be switched on, and the grounding switch (if present) must be open.

Auxiliary voltage switch (Q21)

The auxiliary voltage switch controls the supply to the auxiliary voltage transformers. The transformer feeds the control circuits inside the drive such as cooling fans, relays and measuring equipment. The switch is fitted with fuses.

Grounding (earthing) switch (Q9.x), optional

The grounding switch (Q9.1, option +F259) connects the main AC power bus to the PE busbar. Units with 12-pulse connection (option +A004) have two switches (Q9.1 and Q9.2), one for each 6-pulse supply line.

To close the grounding switch, auxiliary voltage must be switched on, and the main disconnecting device must be open.

WARNING!

The grounding switch does not ground the input power terminals of the drive or the auxiliary (control) voltage circuits.

Other devices on the door

- Voltmeter (option +G334); comes with a phase selector switch.

  Note:

  The voltage is measured on the supply side of the main switch or breaker.

- AC current meter (option +G335) on one phase.

Control panel

The ACS-AP-W is the user interface of the drive. It provides the essential controls such as Start/Stop/Direction/Reset/Reference, and the parameter settings for the inverter control program.

The control panel can be removed by pulling it forward by the top edge and reinstalled in reverse order. For the use of the control panel, see *ACX-AP-x assistant control panel user's manual* (3AUA0000085685 [English]) and the firmware manual.

Control by PC tools

There is a USB connector on the front of the panel that can be used to connect a PC to the drive. When a PC is connected to the control panel, the control panel keypad is disabled.

Descriptions of options

Note:

All options are not available for all drive types, do not coexist with certain other options, or may require additional engineering. Check actual availability with ABB.

Degree of protection

Definitions

According to IEC/EN 60529, the degree of protection is indicated by an IP code where the first numeral means protection against ingress of solid foreign objects, and the second numeral protection against ingress of water. The IP codes of the standard cabinet and options covered in this manual are defined below.

IP code	The equipment is protected …	
	First numeral	Second numeral
IP22	against ingress of solid foreign objects > 12.5 mm diameter *	against dripping (15° tilting) water
IP42	against ingress of solid foreign objects > 1 mm	against dripping (15° tilting) water
IP54	dust-protected	against splashing water

* meaning for protection of persons: against access to hazardous parts with finger

IP22 (standard)

The degree of protection of the standard drive cabinet is IP22 (UL type 1). The air outlets at the top of the cabinet and the air inlet gratings are covered with metallic gratings. With doors open, the degree of protection of the standard cabinet and all cabinet options is IP20. The live parts inside the cabinet are protected against contact with clear plastic shrouds or metallic gratings.

IP42 (option +B054)

This option provides the degree of protection of IP42 (UL type 1). The air inlet gratings are covered with a metallic mesh between the inner and outer metallic gratings.

IP54 (option +B055)

This option provides the degree of protection of IP54 (UL type 12). It provides the cabinet air inlets with filter housings containing folded board air filter mats between the inner and outer metallic gratings. An additional fan and filtered outlets on the cabinet roof are also included.

Cooling air intake through bottom of cabinet (option +C128)

See section *Air inlet through the bottom of cabinet (option +C128) (page 72)*.

Channeled air outlet (option +C130)

This option provides a collar for connection to an air outlet duct. The collar is located on the cabinet roof. Depending on the equipment installed in each cubicle, the channeled air outlet either replaces, or adds to, the standard roof arrangement.

The option also provides the cabinet air inlets with filter housings containing folded board air filter mats between the inner and outer metallic gratings.

See also section *Air outlet duct on the cabinet roof (option +C130) (page 73)*.

Marine construction (option +C121)

The option includes the following accessories and features:

- reinforced mechanics
- grab railings
- door flush bolt which allows the door to open 90 degrees and prevents it from slamming close
- self-extinctive materials
- flat bars at base of the cabinet for fastening
- fastening braces at the top of the cabinet.

Additional wire markings (see *Additional wire markings (options +G340 and +G342)*) may be required for classification.

UL Listed (option +C129)

The cabinet is built according to UL 508C and contains the following accessories and features:

- top entry and exit with US cable conduit entries (plain plate without ready-made holes)
- all components UL Listed/Recognized
- maximum supply voltage 600 V
- main (air circuit) breaker whenever available for the particular drive type.

CSA Approved (option +C134)

The option includes the following accessories and features:

- bottom entry and exit of cables with US cable conduit entry (plain plate without ready-made holes)
- all components UL/CSA listed/recognized
- maximum supply voltage 600 V

- main (air circuit) breaker when available for the particular drive type.

Plinth height (options +C164 and +C179)

The standard height of the cabinet plinth is 50 mm. These options specify a plinth height of 100 mm (+C164) or 200 mm (+C179).

Seismic design (option +C180)

The option involves seismic capability according to International building code 2012, test procedure ICC-ES AC-156. The installation level must not exceed 25% of the height of the building, and S_{DS} (installation site specific spectral acceleration response) must not exceed 2.0 *g*.

The option adds the following accessories and features:

- reinforced plinth
- flat bars at base of the cabinet for fastening.

Empty cubicles (options +C199…C201)

The option adds an empty 400, 600 or 800 mm wide cubicle to the left end of the line-up. The cubicle is equipped with blank power cable lead-throughs both at the top and the bottom. See *Dimensions of empty cubicles (options +C199, +C200, +C201) (page 237)*.

Resistor braking (options +D150 and +D151)

See chapter *Resistor braking (page 265)*.

EMC filters (option + E202)

EMC filter for first environment TN (grounded) system, category C2. More information: *Technical Guide No. 3 – EMC Compliant Installation and Configuration for a Power Drive System* (3AFE61348280 [English])

Sine filter (option +E206)

A sine filter provides true sinusoidal voltage waveform at the drive output by suppressing the high-frequency voltage components of the output. These high-frequency components cause stress to motor insulation as well as output transformer saturation (if present).

The sine filter option consists of three single-phase reactors and delta-connected capacitors at the output of the drive. The filter is fitted in a separate cubicle and has a dedicated cooling fan.

Cabinet heater with external supply (option +G300)

The option contains:

- heating elements in the cubicles or supply/inverter modules
- load switch for providing electrical isolation during service
- miniature circuit breaker for overcurrent protection
- terminal block for external power supply.

The heater prevents humidity condensation inside the cabinet when the drive is not running. The power output of the semiconductor-type heating elements depends on the environmental temperature. The customer must switch the heating off when it is not needed by cutting the supply voltage off.

The customer must supply the heater from an external 110…240 V AC power source.

See also

- section *Powering the heating and lighting equipment (options +G300, +G301 and +G313) (page 107)*
- circuit diagrams delivered with drive for the actual wiring.

Cabinet lighting (option +G301)

This option contains LED lighting fixtures in each cubicle (except joining and brake resistor cubicles) and a 24 V DC power supply. The lighting is powered from the same external 110…240 V AC power source as the cabinet heater (option +G300).

Terminals for external control voltage (option +G307)

The option provides terminals for connecting external uninterruptible control voltage to the control unit and control devices when the drive is not powered.

See also sections:

- *Supplying power for the auxiliary circuits (page 91)*
- *Connecting a 230/115 V AC auxiliary voltage supply (UPS, option +G307) (page 104)*
- circuit diagrams delivered with drive for the actual wiring.

Output for motor space heater (option +G313)

The option contains:

- load switch for providing electrical isolation during service
- miniature circuit breaker for overcurrent protection
- terminal block for external supply and heating element(s) connection

The heater is off when the drive is running. The customer controls the heating elements in the motor windings on and off with the external supply. The power and voltage of the motor heater depend on the motor.

See also sections:

- *Supplying power for the auxiliary circuits (page 91)*
- *Powering the heating and lighting equipment (options +G300, +G301 and +G313) (page 107)*
- circuit diagrams delivered with drive for the actual wiring.

Supply connection by busbars (option +G317)

This option provides input (supply) terminals and a busbar entry that enable direct connection to busbar trunking systems.

Ready/Run/Fault lights (options +G327…G329)

These options provide "ready" (+G327, white), "run" (+G328, green) and "fault" (+G329, red) lights installed on the cabinet door.

Halogen-free wiring and materials (option +G330)

The option provides halogen-free cable ducts, control wires and wire sleeves, thus reducing toxic fire gases.

V-meter with selector switch (option +G334)

The option contains a voltmeter and a selector switch on the cabinet door. The switch selects the two input phases across which the voltage is measured.

A-meter in one phase (option +G335)

The option contains an ammeter that reads the current flowing through one input phase.

Additional wire markings (options +G340 and +G342)

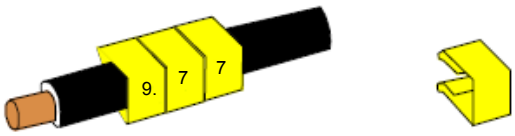
Standard wire markings

As standard, wires and terminals are marked as follows:

- Plug-in connectors of wire sets: Connectors labeled with designation (eg. "X1"). Both the connector and the individual wires are marked with pin numbers.
- Wires without a connector: Connector designation and pin number printed on wire (eg. "X1:7").
- Fiber optic pairs: Component and connector designation printed on marker tape.
- Main input, output and PE terminals: Connector identifier (eg. "U1", "PE") printed on sticker on terminal, or on insulating material close to the terminal. PE cables marked with yellow/green tape.

Additional wire markings

The following additional wire markings are available.

Option	Additional markings
+G340	Equipment pin numbers are marked with snap-on markers on wires between modules and on wires connected to equipment, terminal blocks and detachable screw terminals. Plug-in connector identifications are marked on labels near the connectors. The label holders are attached around conductor bundles. Main circuit conductors are marked with white tape or printing. 
+G342	Equipment identifications and terminal block pin numbers and remote addresses are marked with tubing or rings on wires between modules, and on wires connected to equipment, terminal blocks and detachable screw terminals. Plug-in connector identifications are marked on labels attached around the conductor bundles near the connectors. Main circuit conductors are marked with white tape or printing. **Note:** Even wires with equipment and pin identifiers ready printed on the wire insulation are marked with rings or tubing. Remote end addresses **are not** marked on wire ends that are connected to plug-in connectors. Short and obvious connections are marked with printing only. 

Bottom cable entry/exit (options +H350 and +H352)

For UL Listed (+C129) units, the default input and output cabling direction is through the roof of the cabinet. The bottom entry (+H350) and bottom exit (+H352) options provide

power and control cable entries at the floor of the cabinet. The entries are equipped with grommets and 360° grounding hardware.

For non-UL Listed units, bottom entry/exit is the default cabling arrangement.

Top cable entry/exit (options +H351 and +H353)

For non-UL Listed units, the default input and output cabling direction is through the bottom of the cabinet. The top entry (+H351) and top exit (+H353) options provide power and control cable entries at the roof of the cabinet. The entries are equipped with grommets and 360° grounding hardware.

For UL Listed (+C129) units, top entry/exit is the default cabling arrangement.

Cable conduit entry (option +H358)

The option provides US/UK conduit plates (plain 3 mm thick steel plates without any ready-made holes). US/UK conduit plates are provided as standard with options +C129 and +C134 instead of the normal cable entries.

Common motor terminal cubicle (option +H359)

As standard, each inverter module must be individually cabled to the motor. This option provides an additional cubicle containing a single set of terminals for the motor cables.

The width of the cubicle and the size of the terminals within depend on the power rating of the drive.

Note that this option is not available with option +E206 (sine filters), In this case, the motor cables are connected to the sine filter cubicle.

Common output terminal (option +H366)

As standard, each inverter module must be individually cabled to the motor. This option adds bridging that connects the outputs of multiple (in practice, two or three) inverter modules mounted in the same cubicle. The bridging balances the motor current between the modules, which allows more cabling options. For example, it is possible to use a number of cables that could not otherwise be evenly distributed between the inverter modules.

WARNING!

The bridging can carry the nominal output of one inverter module. In case of three parallel modules, ensure that the load capacity of the bridging is not exceeded. For example, if the cabling connects to the output busbars at one module only, use the module in the middle.

Note:

The +H366 option only interconnects the outputs of inverter modules within the same cubicle, not modules installed in different cubicles. Therefore, when the drive has more than three inverter modules, make sure that the load is distributed evenly between the modules:

- In case of two inverter cubicles of two modules, connect the same number of cables to each cubicle.
- In case of one inverter cubicle with three modules and another with two, each cubicle requires a number of cables proportional to the number of modules within. For example, connect three out of five (or six out of ten, etc.) cables to the cubicle with three modules, the remaining two out of five (four out of ten) cables to the cubicle with two modules.

Additional terminal block X504 (option +L504)

The standard terminal blocks of the drive control unit are wired to the additional terminal block at the factory for customer control wiring. The terminals are spring loaded.

Cables accepted by the terminals:

- solid wire 0.08 to 4 mm2
- stranded wire with ferrule 0.14 to 2.5 mm2
- stranded wire without ferrule 0.08 to 2.5 mm2 (28 to 12 AWG).

Stripping length: 10 mm.

Note:

The optional modules inserted in the slots of the control unit (or optional FEA-03 extension adapter) are not wired to the additional terminal block. The customer must connect the optional module control wires directly to the modules.

Thermal protection with PTC relays (options +L505, +2L505, +L513, +2L513, +L536, +L537)

PTC thermistor relay options are used for overtemperature supervision of motors equipped with PTC sensors. When the motor temperature rises to the thermistor wake-up level, the resistance of the sensor increases sharply. The relay detects the change and indicates motor overtemperature through its contacts.

+L505, +2L505, +L513, +2L513

Option +L505 provides a thermistor relay and a terminal block. The terminal block has connections for the measuring circuit (one to three PTC sensors in series), the output indication of the relay, and an optional external reset button. The relay can be reset either locally or externally, or the reset circuit can be jumpered for automatic reset.

The output indication of the relay can be wired by the customer for example to

- the main contactor or breaker control circuit of the drive, to open it in case of motor overtemperature,
- the appropriate digital input of the drive, to trip the drive and generate a fault message in case of motor overtemperature, or
- an external monitoring circuit.

Option +L513 is an ATEX-certified thermal protection function that has the same external connectivity as +L505. In addition, +L513 comes with +Q971 (ATEX-certified safe disconnection function) as standard and is wired at the factory to activate the Safe torque off function of the drive in an overtemperature situation. A manual reset for the protection function is required by Ex/ATEX regulations. For more information, see *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).

Options +2L505 and +2L513 duplicate options +L505 and +L513 respectively, containing the relays and connections for two separate measurement circuits.

+L536, +L537

An alternative to a thermistor relay option is the FPTC-01 (option +L536) or FPTC-02 (+L537, also requires +Q971) thermistor protection module. The module mounts onto the inverter control unit, and has reinforced insulation to keep the control unit PELV-compatible. The connectivity of the FPTC-01 and the FPTC-02 is the same; FPTC-02 is Type Examined as a protective device within the scope of the European ATEX Product Directive.

For protection purposes, the FPTC has a "fault" input for the PTC sensor. An overtemperature situation executes the SIL/PL-capable SMT (Safe motor temperature) safety function by activating the Safe torque off function of the drive.

The FPTC also has a "warning" input for the sensor. When the module detects overtemperature through this input, it sends a warning indication to the drive.

For more information and wiring examples, see the module manuals and the circuit diagrams delivered with the drive.

See also

- firmware manual for parameter settings
- *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English])
- *FPTC-01 thermistor protection module (option +L536) for ACS880 drives user's manual* (3AXD50000027750 [English])
- *FPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual* (3AXD50000027782 [English])
- *Wiring the PTC thermistor relay(s) (options +L505, +2L505, +L513 and +2L513) (page 105)*
- circuit diagrams delivered with the drive for the actual wiring.

Thermal protection with Pt100 relays (options +nL506)

Pt100 temperature monitoring relays are used for overtemperature supervision of motors equipped with Pt100 sensors. For example, there can be three sensors to measure the temperature of the motor windings and two sensors for the bearings.

The standard Pt100 relay options include two (+2L506), three (+3L506), five (+5L506) or eight (+8L506) relays. The monitoring relays are connected to one to three auxiliary relays whose outputs are wired at the factory to a terminal block. The sensors are to be connected by the customer to the same terminal block.

As the temperature rises, the sensor resistance increases linearly. At an adjustable wake-up level, the monitoring relay de-energizes its output which then trips one of the auxiliary relays.

The output indication of the auxiliary relays can be wired by the customer for example to

- the main contactor or breaker control circuit of the drive, to open it in case of motor overtemperature,
- the appropriate digital input of the drive, to trip the drive and generate a fault message in case of motor overtemperature, or
- an external monitoring circuit.

Options +3L514 (3 relays), +5L514 (5 relays) and +8L514 (8 relays) are ATEX-certified thermal protection functions that have the same external connectivity as +nL506. In addition, each monitoring relay has a 0/4…20 mA output that is available on the terminal block. Option +nL514 comes with +Q971 (ATEX-certified safe disconnection function) as standard and is wired at the factory to activate the Safe torque off function of the drive in an overtemperature situation. As the monitoring relay does not have a reset functionality, the

manual reset required by Ex/ATEX regulations must be implemented using drive parameters. For more information, see *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).

See also

- firmware manual for parameter settings
- *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English])
- *Wiring the Pt100 relays (option +nL506) (page 106)* or *Wiring the Pt100 relays (option +nL514) (page 106)*
- Pt100 relay alarm and trip limit setting instructions in the start-up instructions
- circuit diagrams delivered with the drive for the actual wiring.

Starter for auxiliary motor fan (options +M602…M610)

What the option contains

The option provides switched and protected connections for 3-phase auxiliary motor fans. Each fan connection is equipped with

- fuses
- a manual motor starter switch with an adjustable current limit
- a contactor controlled by the drive, and
- terminal block X601 for customer connections.

The number of connections must be specified when ordering. The maximum number of connections available depends on the current requirement. The lower current ratings allow up to four fan connections (eg. option +4M602), while the highest current rating only allows one (eg. +M610). For more information, refer to *ACS-880-X7 single drives ordering information* (3AXD10000052815, available on request).

Description

The output for the auxiliary fan is wired from the 3-phase supply voltage to terminal block X601 through a motor starter switch and a contactor. The contactor is operated by the drive. The 230 V AC control circuit is wired through a jumper on the terminal block; the jumper can be replaced by an external control circuit.

The starter switch has an adjustable trip current limit, and can be opened to permanently switch the fan off.

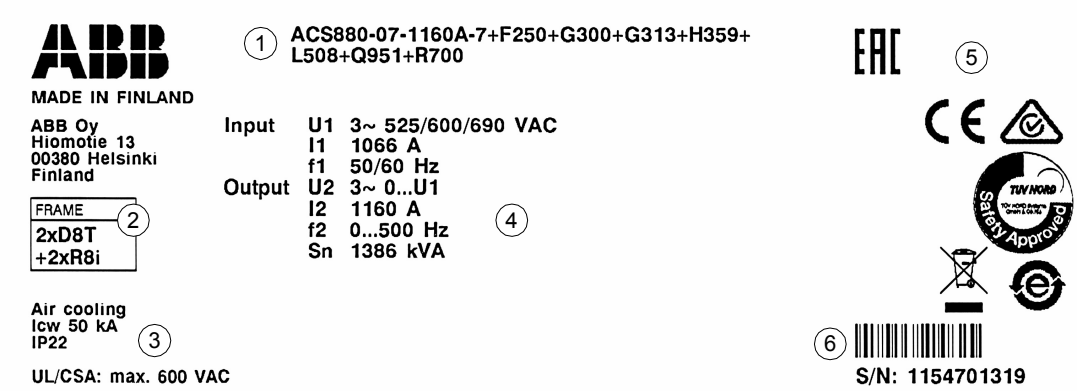
The statuses of both the starter switch and the fan contactor are wired to the terminal block.

See the circuit diagrams delivered with the drive for the actual wiring.

Type designation label

The type designation label includes ratings, appropriate markings, a type designation and a serial number, which allow the identification of each unit. A sample label is shown below.

Quote the complete type designation and serial number when contacting technical support.



1	Type designation (see section *Type designation key (page 54)*).
2	Frame size
3	Short-time withstand current rating (see chapter *Technical data (page 177)*); degree of protection; UL/CSA specifications
4	Ratings. See also chapter *Technical data (page 177)*.
5	Valid markings
6	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. The first digits from left express the basic configuration (eg, ACS880-07-1580A-5). The optional selections are given thereafter, separated by plus signs, eg, +E202. The main selections are described below. Not all selections are available for all types. For more information, refer to *ACS880-X7 single drives ordering information* (3AXD10000052815, available on request).

CODE	DESCRIPTION
Basic codes	
ACS880	Product series
ACS880-07	When no options are selected: cabinet-installed drive, IP22 (UL Type 1), main switch-disconnector (and contactor) or breaker, aR fuses, ACS-AP-W assistant control panel, EMC filter (category 3, 2nd Environment), du/dt filters, common mode filtering, ACS880 primary control program, Safe torque off function, coated circuit boards, bottom entry and exit of cables with lead-through-type entries, multilingual door device label sticker, USB memory stick containing circuit diagrams, dimension drawings and manuals.
Size	
xxxxx	Refer to the rating tables
Voltage range	

CODE	DESCRIPTION
3	380…415 V AC. This is indicated in the type designation label as typical input voltage level (3~ 400 V AC)
5	380…500 V AC. This is indicated in the type designation label as typical input voltage levels (3~ 400/480/500 V AC)
7	525…690 V AC. This is indicated in the type designation label as typical input voltage levels (3~ 525/600/690 V AC)
Option codes (plus codes)	
Supply connection	
A004	12-pulse supply connection
Degree of protection	
B054	IP42 (UL Type 1)
B055	IP54 (UL Type 12)
Construction	
C121	Marine construction. See section *Descriptions of options (page 45)*.
C128	Air inlet through bottom of cabinet. See section *Descriptions of options (page 45)*.
C129	UL Listed. See section *Descriptions of options (page 45)*.
C130	Channeled air outlet. See section *Descriptions of options (page 45)*.
C134	CSA approved. See section *Descriptions of options (page 45)*.
C164	Plinth height 100 mm. See section *Descriptions of options (page 45)*.
C179	Plinth height 200 mm. See section *Descriptions of options (page 45)*.
C180	Seismic design. See section *Descriptions of options (page 45)*.
C199	Empty 400 mm wide cubicle on left. See section *Descriptions of options (page 45)*.
C200	Empty 600 mm wide cubicle on left. See section *Descriptions of options (page 45)*.
C201	Empty 800 mm wide cubicle on left. See section *Descriptions of options (page 45)*.
Resistor braking	
D150	Brake choppers
D151	Brake resistors
Filters	
E202	EMC filter for first environment TN (grounded) system, category C2
E206	Sine output filter
Line options	
F250	Main (line) contactor
F255	Main (air) circuit breaker
F259	Grounding (earthing) switch
Cabinet equipment	
G300	Cabinet and module heating elements (external supply). See section *Descriptions of options (page 45)*.
G301	Cabinet lighting. See section *Descriptions of options (page 45)*.
G307	Terminals for connecting external control voltage (230 V AC or 115 V AC, eg. UPS). See section *Descriptions of options (page 45)*.
G313	Output for motor space heater (external supply)
G317	Supply connection by busbars

CODE	DESCRIPTION
G327	Ready light on door, white
G328	Run light on door, green
G329	Fault light on door, red
G330	Halogen-free wiring and materials
G334	V-meter with selector switch
G335	A-meter in one phase
G340	Additional wire markings. See section *Descriptions of options (page 45)*.
G342	
Cabling	
H350	Bottom entry. See section *Descriptions of options (page 45)*.
H351	Top entry. See section *Descriptions of options (page 45)*.
H352	Bottom exit. See section *Descriptions of options (page 45)*.
H353	Top exit. See section *Descriptions of options (page 45)*.
H358	Cable conduit entry (US/UK). See section *Descriptions of options (page 45)*.
H359	Common motor terminal cubicle. See section *Descriptions of options (page 45)*.
H366	Common output terminals (for inverter modules mounted in the same cubicle). See section *Descriptions of options (page 45)*.
Fieldbus adapters	
K451	FDNA-01 DeviceNet™ adapter module
K454	FPBA-01 PROFIBUS DP adapter module
K457	FCAN-01 CANopen adapter module
K458	FSCA-01 RS-485 (Modbus/RTU) adapter module
K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCat adapter module
K470	FEPL-02 EtherPOWERLINK adapter module
K473	FENA-11 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols
K475	FENA-21 Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
I/O extensions and feedback interfaces	
L500	FIO-11 analog I/O extension module
L501	FIO-01 digital I/O extension module
L502	FEN-31 HTL incremental encoder interface module
L503	FDCO-01 optical DDCS communication adapter module
L504	Additional I/O terminal block. See section *Descriptions of options (page 45)*.
L505	Thermal protection with PTC relays (1 or 2 pcs). See section *Descriptions of options (page 45)*.
L506	Thermal protection with Pt100 relays (2, 3, 5 or 8 pcs). See section *Descriptions of options (page 45)*.
L508	FDCO-02 optical DDCS communication adapter module
L513	ATEX-certified thermal protection with PTC relays (1 or 2 pcs)
L514	ATEX-certified thermal protection with Pt100 relays (3, 5 or 8 pcs)
L515	FEA-03 I/O extension adapter
L516	FEN-21 resolver interface module
L517	FEN-01 TTL incremental encoder interface module

CODE	DESCRIPTION
L518	FEN-11 TTL absolute encoder interface module
L521	FSE-31 pulse encoder interface module
L525	FAIO-01 analog I/O extension module
L526	FDIO-01 digital I/O extension module
L536	FPTC-01 thermistor protection module
L537	FPTC-02 ATEX-certified thermistor protection module
Starter for auxiliary motor fan (see section *Descriptions of options (page 45)*)	
M602	Trip limit setting range: 2.5 … 4 A
M603	Trip limit setting range: 4 … 6.3 A
M604	Trip limit setting range: 6.3 … 10 A
M605	Trip limit setting range: 10…16 A
M606	Trip limit setting range: 16…20 A
M610	Trip limit setting range: 20…25 A
Control program	
N5000	Winder control program
N5050	Crane control program
N5100	Winch control program
N5200	PCP/ESP control program
N5300	Test bench control program
N5450	Override control program
N8010	IEC 61131-3 application programmability
Specialties	
P902	Customized
P904	Extended warranty
P912	Seaworthy packaging
P913	Special color
P929	Container packaging
Safety functions	
Q950	Prevention of unexpected start-up with FSO-xx safety functions module, by activating the Safe torque off function
Q951	Emergency stop (category 0) with safety relays, by opening the main breaker/contactor
Q952	Emergency stop (category 1) with safety relays, by opening the main breaker/contactor
Q954	Ground fault monitoring for IT (ungrounded) systems
Q957	Prevention of unexpected start-up with safety relays, by activating the Safe torque off function
Q963	Emergency stop (category 0) with safety relays, by activating the Safe torque off function
Q964	Emergency stop (category 1) with safety relays, by activating the Safe torque off function
Q965	Safely-limited speed with FSO-21 and encoder
Q966	Safely-limited speed without encoder
Q971	ATEX-certified safe disconnection function
Q972	FSO-21 safety functions module
Q973	FSO-12 safety functions module
Q978	Emergency stop (configurable for category 0 or 1) with FSO-xx safety functions module, by opening the main breaker/contactor

CODE	DESCRIPTION
Q979	Emergency stop (configurable for category 0 or 1) with FSO-xx safety functions module, by activating the Safe torque off function
Q982	PROFIsafe with FSO-xx safety functions module and FENA-21 Ethernet adapter module
Full set of printed manuals in the selected language **Note:** The delivery may include manuals in English if the requested language is not available.	
R700	English
R701	German
R702	Italian
R703	Dutch
R704	Danish
R705	Swedish
R706	Finnish
R707	French
R708	Spanish
R709	Portuguese
R711	Russian

4

Mechanical installation

Contents of this chapter

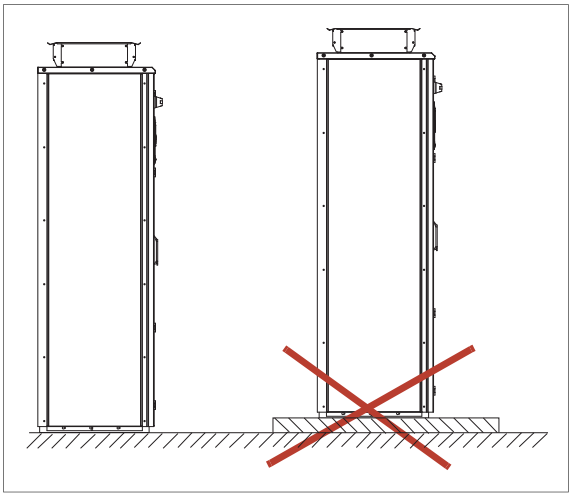
This chapter describes the mechanical installation procedure of the drive.

Examining the installation site

Examine the installation site:

- The installation site is sufficiently ventilated or cooled to transfer away the drive losses. See the technical data.
- The ambient conditions of the drive meet the specifications. See the technical data.
- The wall behind the unit is of non-flammable material.
- There is enough free space above the drive to enable cooling air flow, service and maintenance, and opening of the pressure relief lid.
- The floor that the unit is installed on is of non-flammable material, as smooth as possible, and strong enough to support the weight of the unit. Check the floor flatness with a spirit level. The maximum allowed deviation from the surface level is 5 mm in every 3 meters. Level the installation site, if necessary, as the cabinet is not equipped with adjustable feet.

Do not install the drive on an elevated platform or a recess. The module extraction/installation ramp included with the drive is only suitable for a height difference of 50 mm maximum (ie. the standard plinth height of the drive).



Necessary tools

The tools required for moving the unit to its final position, fastening it to the floor and wall and tightening the connections are listed below:

- crane, fork-lift or pallet truck (check load capacity!), slate/spud bar, jack and rollers
- Pozidriv and Torx screwdrivers
- torque wrench
- set of wrenches or sockets.

Checking the delivery

The drive delivery contains:

- drive cabinet line-up
- optional modules (if ordered) installed onto the control unit(s) at the factory
- appropriate drive and optional module manuals
- delivery documents.

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

Moving and unpacking the drive

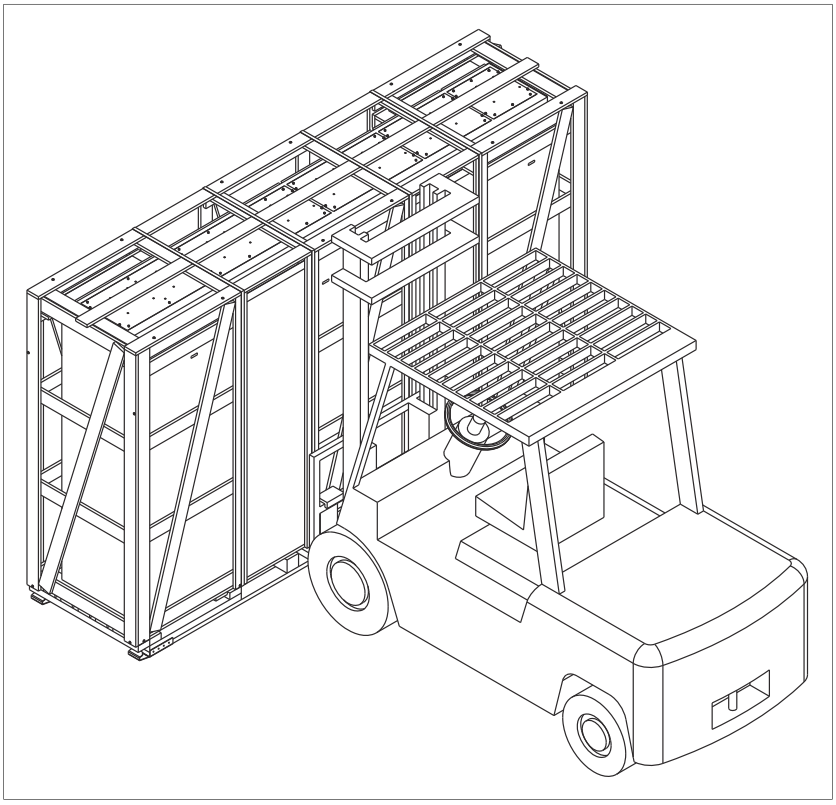
Move the drive in its original packaging to the installation site as shown below to avoid damaging the cabinet surfaces and door devices. When you are using a pallet truck, check its load capacity before you move the drive.

The drive cabinet is to be moved in the upright position.

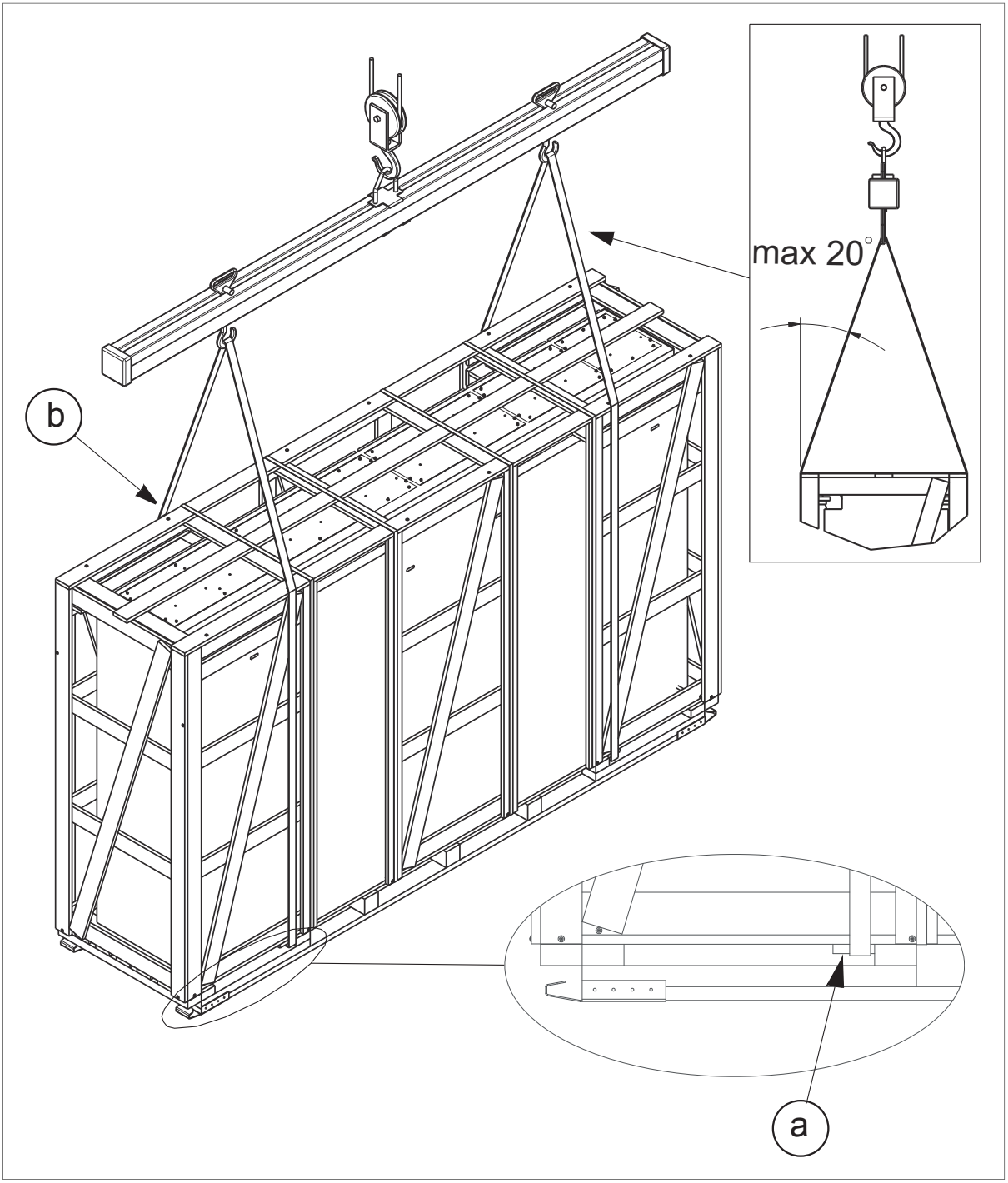
The center of gravity of the cabinet is high. Be therefore careful when moving the unit. Avoid tilting.

Moving the drive in its packaging

Lifting the crate with a forklift



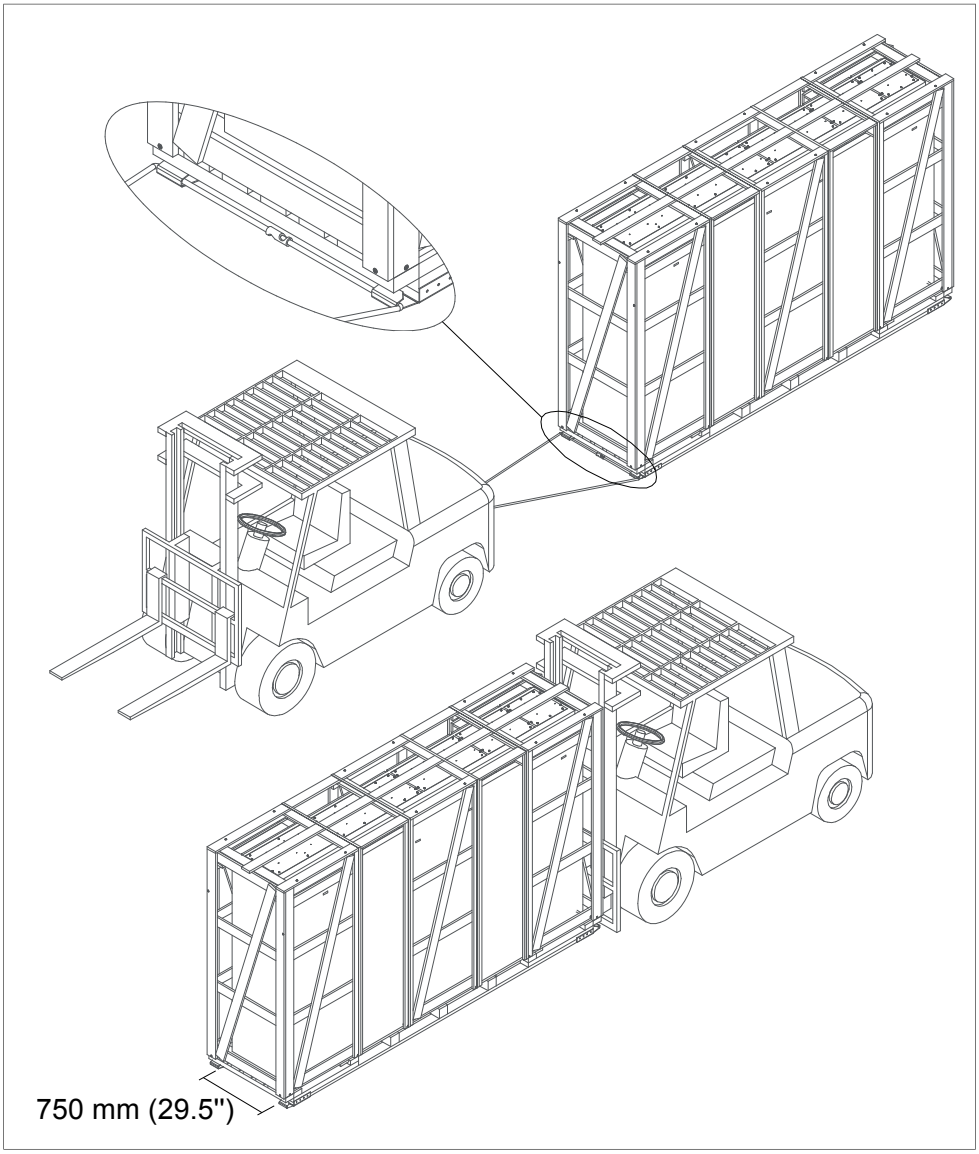
Lifting the crate with a crane



a Lifting point

b Optimal position for the lifting sling: as close to the traverse board as possible

Moving the crate with a forklift



Removing the transport package

Remove the transport package as follows:

1. Undo the screws that attach the wooden parts of the transport crate to each other.
2. Remove the wooden parts.
3. Remove the clamps with which the drive cabinet is mounted onto the transport pallet by undoing the fastening screws.
4. Remove the plastic wrapping.

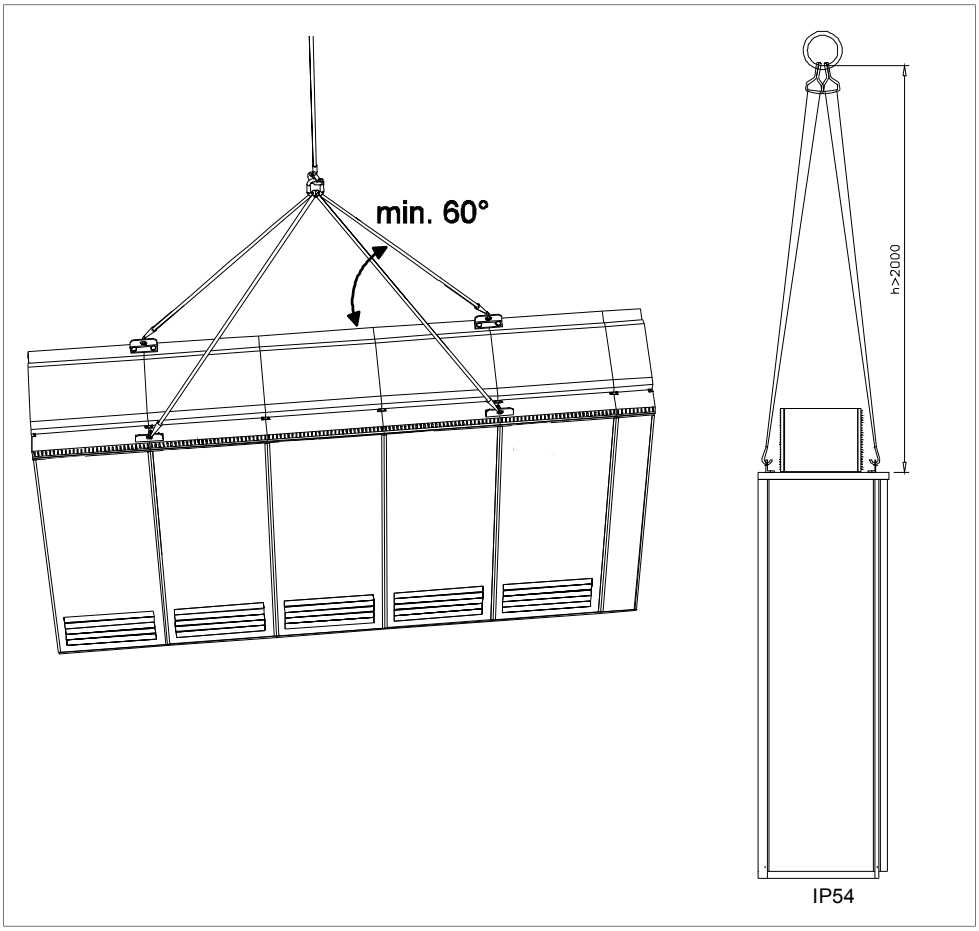
Moving the unpacked drive cabinet

Lifting the cabinet with a crane

Lift the drive cabinet using its lifting eyes. The lifting eyes can be removed after the cabinet is in its final position, but their mounting holes must be blocked to retain the degree of protection.

Note:

The minimum allowed height of the lifting slings with IP54 units is 2 meters (6’7”).

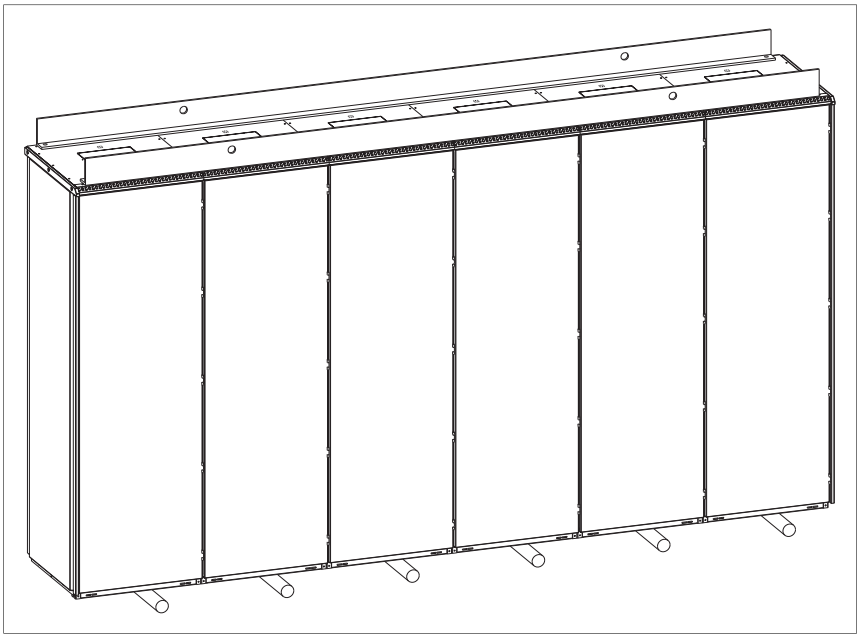


Moving the cabinet on rollers

WARNING!

Do not move marine versions (option +C121) on rollers.

Lay the cabinet on the rollers and move it carefully until close to its final location. Remove the rollers by lifting the unit with a crane, forklift, pallet truck or jack.

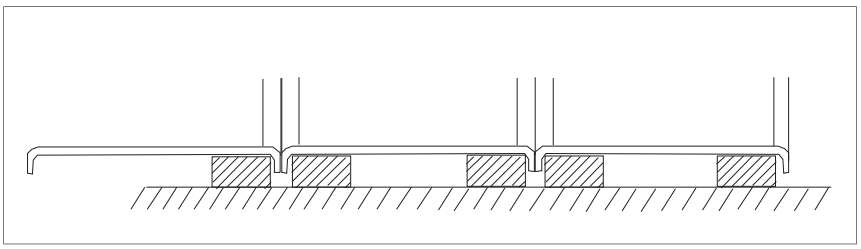


Moving the cabinet on its back

WARNING!

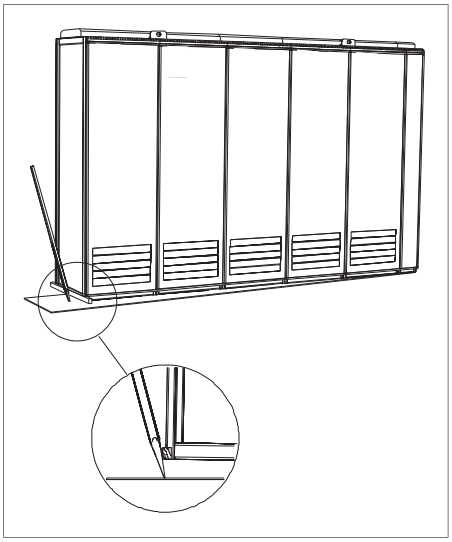
Do not transport the drive with a sine filter (option +E206) on its back. It will damage the filter.

Support the cabinet from below alongside the cubicle seams.



Final placement of the cabinet

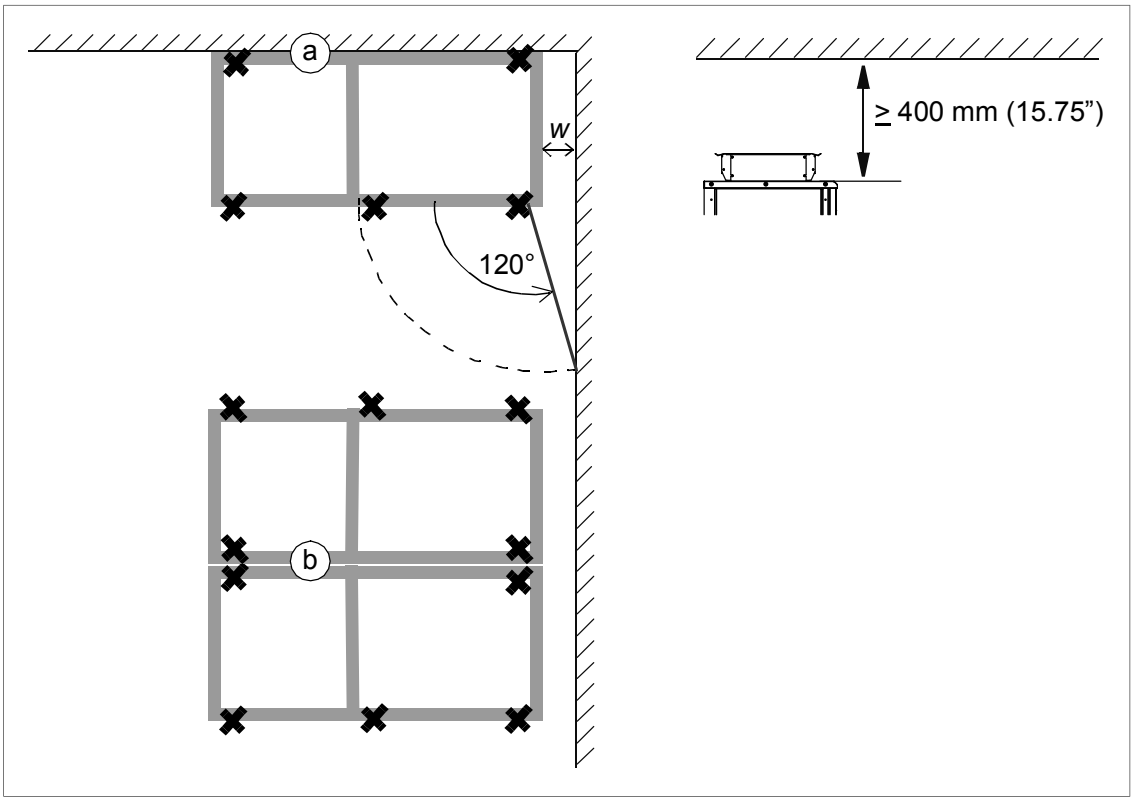
Move the cabinet into its final position with a slate bar (spud bar). Place a piece of wood between the edge of the cabinet and the bar to protect the cabinet frame.



Fastening the cabinet to the floor and wall or roof (non-marine units)

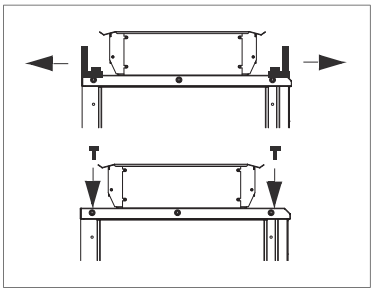
General rules

- The drive must be installed in an upright vertical position.
- The cabinet can be installed with its back against a wall (a), or back-to-back with another unit (b).
- Leave 400 mm (15.75”) of free space above the basic roof level of the cabinet for cooling.
- Leave some space (*w*) at the side where the cabinet outmost hinges are to allow the doors to open sufficiently. The doors must open 120° to allow supply or inverter module replacement.



Note 1: Any height adjustment must be done before fastening the units or shipping splits together. Height adjustment can be done by using metal shims between the cabinet bottom and floor.

Note 2: If the lifting eyes are removed, refasten the bolts to retain the degree of protection of the cabinet.



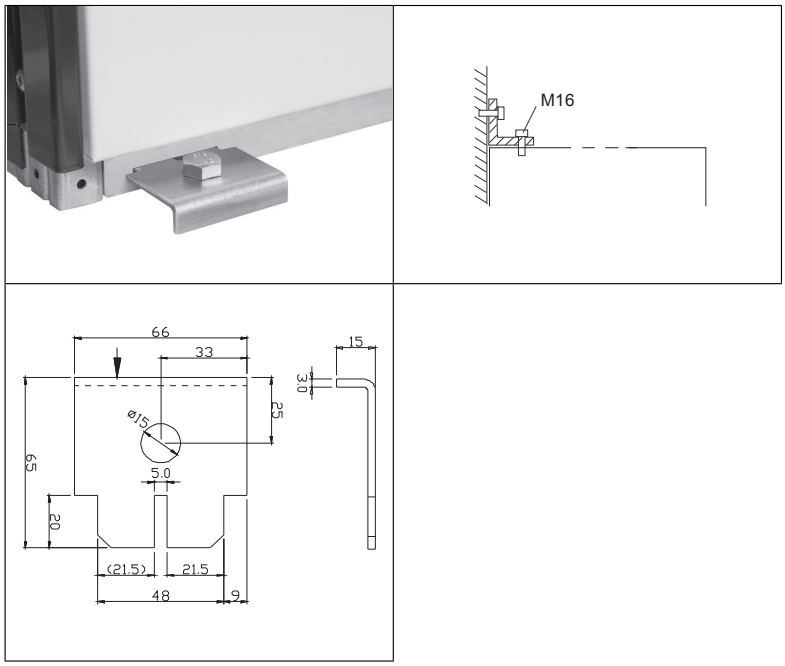
Fastening methods

Fasten the cabinet to the floor by using the clamps included along the edge of the cabinet bottom, or by bolting the cabinet to the floor through the holes inside (if they are accessible).

Alternative 1 – Clamping

1. Insert the clamps into the twin slots along the front and rear edges of the cabinet frame body and fasten them to the floor with a bolt. The recommended maximum distance between the clamps in the front edge is 800 mm (31.5”).
2. If floor mounting at the back is not possible, fasten the top of the cabinet to the wall with L-brackets (not included in the delivery) bolted to the lifting bar fastening holes.

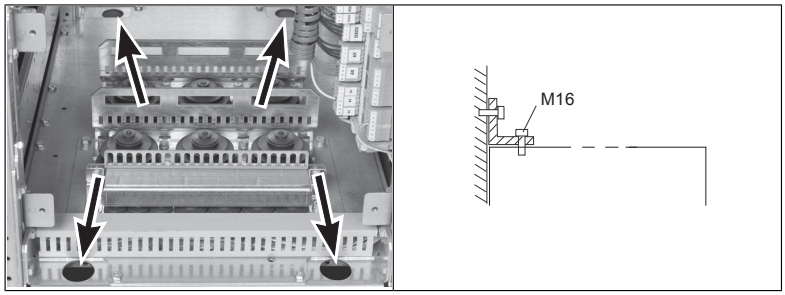
Clamping bottom to floor *Fastening top to wall*



Alternative 2 – Using the holes inside the cabinet

1. Fasten the cabinet to the floor through the bottom fastening holes with M10 to M12 (3/8” to 1/2”) bolts. The recommended maximum distance between the front edge fastening points is 800 mm (31.5”).
2. If the back fastening holes are not accessible, fasten the cabinet at the top to wall with L-brackets (not included in the delivery) using the lifting bar fastening holes.

Fastening bottom to floor *Fastening top to wall*



Fastening the cabinet to the floor and roof/wall (marine units)

Obey the general cabinet installation rules also in the installation of the marine variant. See section *General rules (page 66)*.

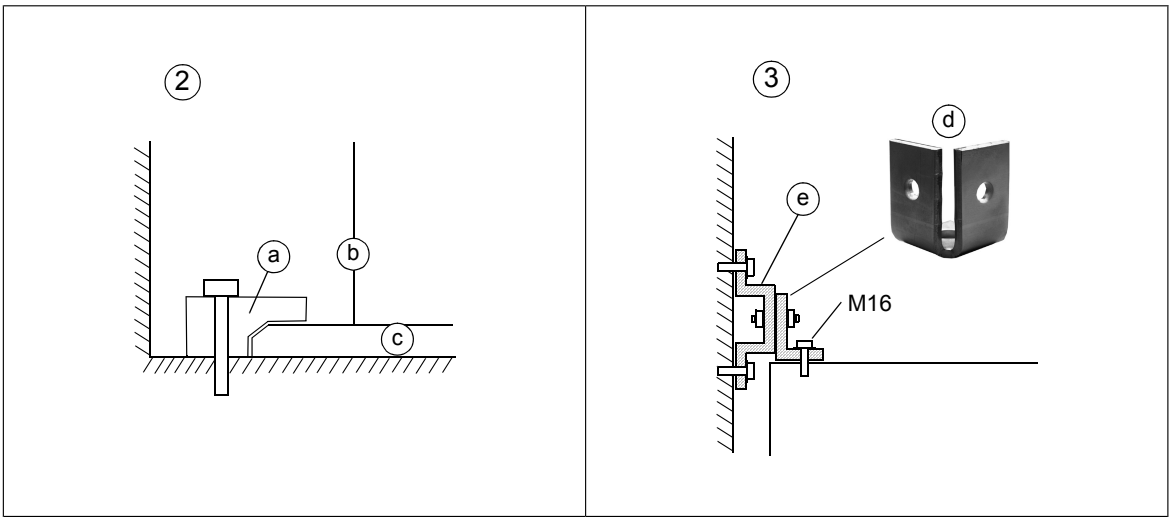
See the dimension drawing delivered with the drive for details of the fastening points.

Fasten the cabinet to the floor and roof (wall) as follows:

1. Bolt the unit to the floor through the flat bars at the base of the cabinet using M10 or M12 screws.
2. If there is not enough room behind the cabinet for installation, clamp (a) the rear edges of the flat bars (c) to the floor. See the figure below.

3. Remove the lifting lugs and bolt the corner brackets (d) to the lifting lug holes. Fasten the corner brackets to the rear wall and/or roof with suitable hardware such as U-brackets (e).

Fastening to floor with a clamp *Fastening to wall*



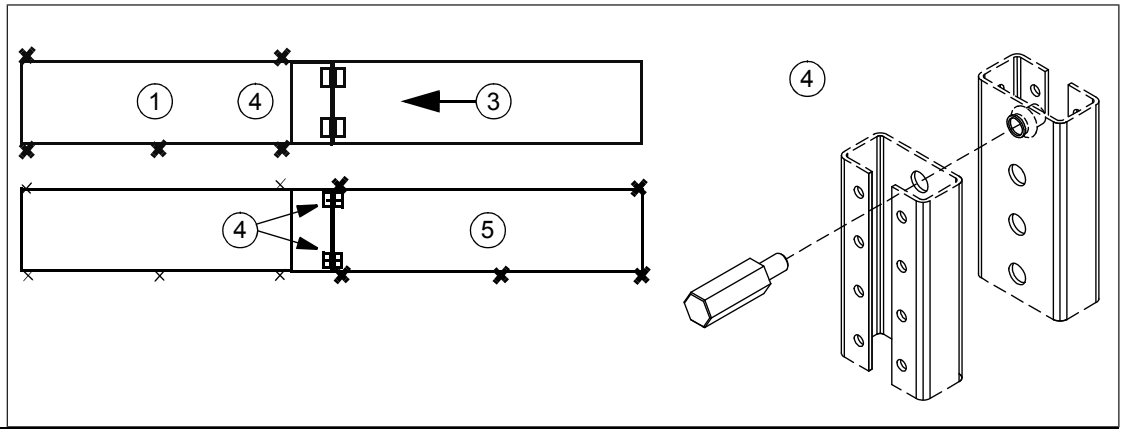
2. Clamping the cabinet to the floor at the back **3. Fastening the cabinet at the top**

a - Clamp (not included)	d - Corner bracket (included)
b - Back panel of cabinet	e - U-bracket (not included)
c - Flat bars at base of cabinet	

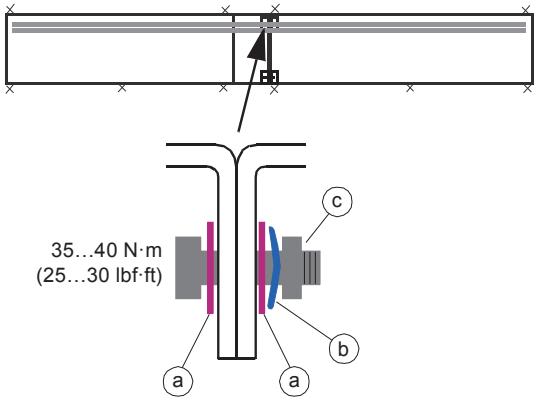
Joining shipping splits together

Wide cabinet line-ups are delivered in multiple parts called “shipping splits”. The connection is made using a 200 mm wide joining cubicle at the end of one shipping split (a common motor terminal cubicle can also act as a joining cubicle). The screws required for the joining are enclosed in a plastic bag inside the cabinet. The threaded bushings are already mounted on the cabinet posts.

1. Fasten the first shipping split to the floor.
2. Remove any plates covering the rear post of the joining cubicle.
3. Align the two shipping splits.
4. Fasten the front and rear posts of the joining cubicle to the posts of the other shipping split with 14 screws (7 per post). Tighten the screws to 5 N·m (3.7 lbf·ft).
5. Fasten the second shipping split to the floor.

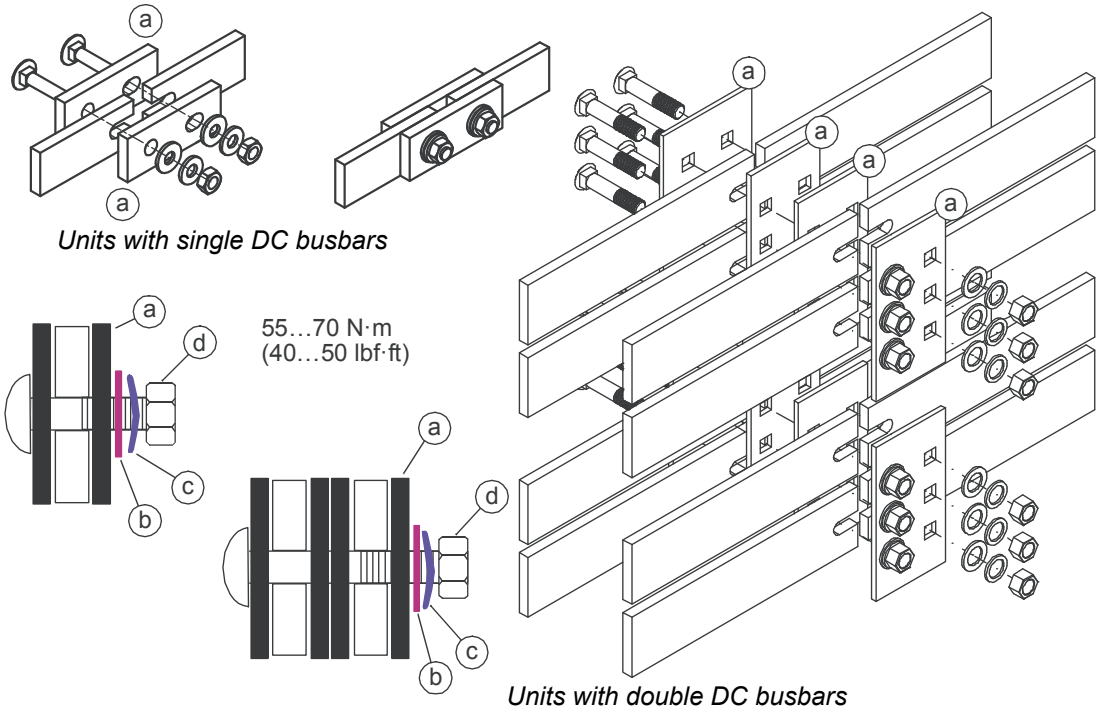


6. Connect the PE busbars using the M10 bolts and nuts included. Tighten to 35…40 N·m (25…30 lbf·ft).



a Plain washer
b Spring washer
c Bolt and nut

7. Remove the shroud covering the DC busbars in the joining cubicle.
8. Use the joint pieces to connect the DC busbars. Tighten the bolts to 55…70 N·m (40…50 lbf·ft).



a Joint piece
b Plain washer with electroplated zinc coating and blue chromate passivation
c Spring washer with mechanically sprayed zinc coating
d Nut

WARNING!

Make sure you install the washers in the correct order as shown. For example, placing an unpassivated zinc-coated spring washer directly against the joint piece will cause corrosion.

WARNING!

Do not use any joining parts other than those delivered with the unit. The parts are carefully selected to match the material of the busbars. Other parts or materials can form a galvanic couple and cause corrosion.

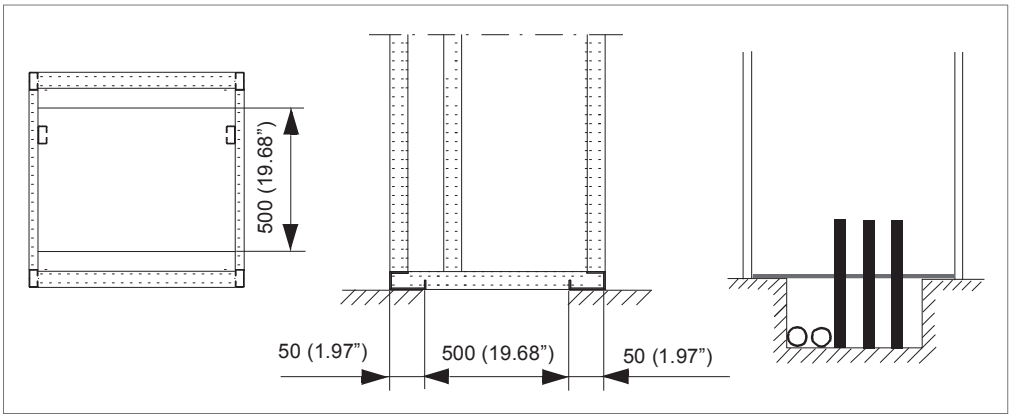
9. Reinstall any covering plates removed earlier.
10. Repeat steps 2 to 9 for any further shipping splits.

Miscellaneous

Cable duct in the floor below the cabinet

A cable duct can be constructed below the 500 mm wide middle part of the cabinet. The cabinet weight lies on the two 50 mm wide transverse sections which the floor must carry.

Prevent the cooling air flow from the cable duct to the cabinet by bottom plates. To ensure the degree of protection for the cabinet, use the original bottom plates delivered with the unit. With user-defined cable entries, take care of the degree of protection, fire protection and EMC compliance.



Arc welding

Fastening the cabinet by arc welding is not recommended. However, if arc welding is the only mounting option, connect the return conductor of the welding equipment to the cabinet frame at the bottom within 0.5 meters (1'6") of the welding point.

Note:

The thickness of the zinc plating of the cabinet frame is 100 to 200 micrometers (4 to 8 mil).

WARNING!

Make sure that the return wire is connected correctly. Welding current must not return via any component or cabling of the drive. If the welding return wire is connected improperly, the welding circuit can damage electronic circuits in the cabinet.

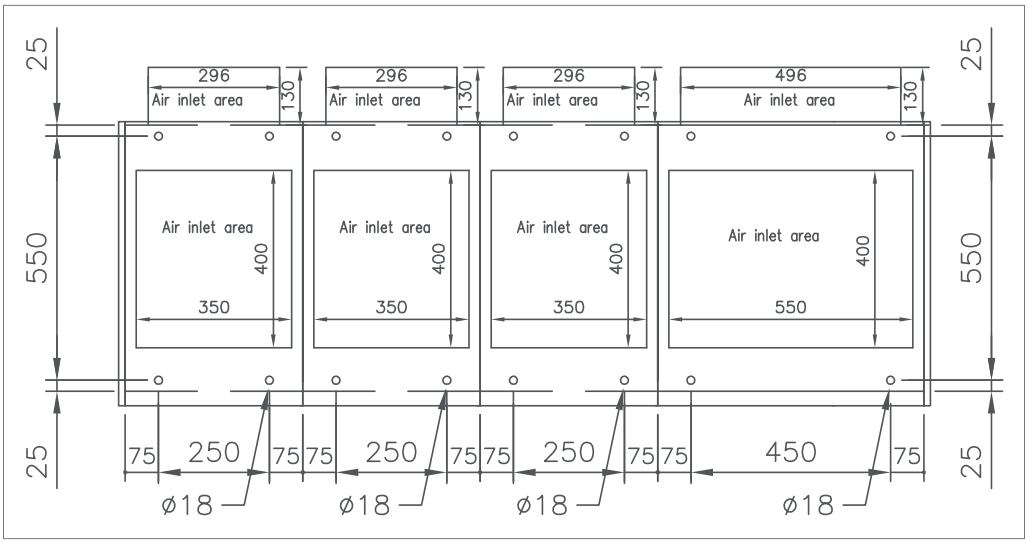
WARNING!

Do not inhale the welding fumes.

Air inlet through the bottom of cabinet (option +C128)

Drives with air intake through the bottom of the cabinet (option +C128) are intended for installation on an air duct in the floor. Each cubicle (except top entry adapter and joining cubicles) have an inlet through the bottom plate. The option also adds a 130 mm deep inlet area at the back of the cubicle.

An example of the air inlets in the cabinet bottom plate is shown below. Refer also to the dimension drawings delivered with the drive.



Support the plinth of the cabinet all round.

The air duct must be able to supply a sufficient volume of cooling air. See technical data for the minimum air flow values.

Top cable entry adapter and joining cubicles have no air inlet.

WARNING!

Make sure that the incoming air is sufficiently clean. If not, dust goes into the cabinet. The outlet filter on the cabinet roof prevents dust from going out. The collected dust can cause drive malfunction and danger of fire.

Air outlet duct on the cabinet roof (option +C130)

The ventilation system must keep the static pressure in the air outlet duct sufficiently below the pressure of the room where the drive is located in order that the cabinet fans can produce the required air flow through the cabinet. Make sure that no dirty or moist air is able to flow backward to the drive in any case, even during off-time or while servicing the drive or the ventilation system.

Calculating the required static pressure difference

The required static pressure difference between the exit air duct and the drive installation room can be calculated as follows:

$\Delta p_s = (1.5…2) \cdot p_d$

where

$p_d = 0.5 \cdot \rho \cdot v_m$

$v_m = q / A_c$

p_d	Dynamic pressure
ρ	Air density (kg/m^3)
v_m	Average air velocity in the exit duct(s) (m/s)
q	Rated air flow of the drive (m^3/s)
A_c	Cross-sectional area of the exit duct(s) (m^2)

Example

The cabinet has 3 exit openings of 315 mm diameter. The rated air flow of the cabinet is 4650 m^3/h =1.3 m^3/s.

$A_c = 3 \cdot 0.315^2 \cdot \pi = 0.234$ m^2

$v_m = 1.3/0.234 = 5.5$ m/s

$p_d = 0.5 \cdot \rho \cdot v_m^2 = 0.5 \cdot 1.1 \cdot 5.5^2 = 17$ Pa

The required pressure in the exit air duct is then, 1.5…2 · 17 Pa = 26…34 Pa, below the pressure in the room.

5

Guidelines for planning the electrical installation

Contents of this chapter

This chapter contains instructions for planning the electrical installation of the drive. Some instructions are mandatory to follow in every installation, others provide useful information that only concerns certain applications.

Limitation of liability

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

Selecting the supply disconnecting device

The drive is equipped with the main disconnecting device as standard. Depending on the size of the drive, and the selected options, the disconnecting device is a switch-disconnector or an air circuit breaker.

Selecting the main contactor or breaker

Depending on the drive size, you can order it either with a main contactor (option +F250) or a main breaker (option +F250).

Examining the compatibility of the motor and drive

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

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

Make sure that the motor withstands the maximum peak voltage in the motor terminals. See section *Requirements table (page 76)*. For basics of protecting the motor insulation and bearings in drive systems, see section *Protecting the motor insulation and bearings (page 76)*.

Note:

- Consult the motor manufacturer before using a motor whose nominal voltage differs from the AC line voltage connected to the drive input.
- The voltage peaks at the motor terminals are relative to the supply voltage of the drive, not the drive output voltage.
- If the motor and drive are not of the same size, consider the operation limits of the drive control program for the motor nominal voltage and current. See the appropriate parameters in the firmware manual.

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. This can gradually erode the bearing races and rolling elements.

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

Requirements table

These tables show how to select the motor insulation system and when a drive d*u*/d*t* and common mode filters and insulated N-end (non-drive end) motor bearings are required. Ignoring the requirements or improper installation may shorten motor life or damage the motor bearings and voids the warranty.

This table shows the requirements when an ABB motor is in use.

Motor type	**Nominal AC supply voltage**	**Requirement for**			
		Motor insulation system	**ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings**		
			P_N < 100 kW and frame size < IEC 315	**100 kW ≤ P_N < 350 kW or IEC 315 ≤ frame size < IEC 400**	**P_N ≥ 350 kW or frame size ≥ IEC 400**
			P_N < 134 hp and frame size < NEMA 500	**134 hp ≤ P_N < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580**	**P_N ≥ 469 hp or frame size > NEMA 580**
Random-wound M2_, M3_ and M4_	U_N ≤ 500 V	Standard	-	+ N	+ N + CMF
	500 V < U_N ≤ 600 V	Standard	+ d*u*/d*t*	+ N + d*u*/d*t*	+ N + d*u*/d*t* + CMF
		or			
		Reinforced	-	+ N	+ N + CMF
	600 V < U_N ≤ 690 V (cable length ≤ 150 m)	Reinforced	+ d*u*/d*t*	+ N + d*u*/d*t*	+ N + d*u*/d*t* + CMF
	600 V < U_N ≤ 690 V (cable length > 150 m)	Reinforced	-	+ N	+ N + CMF
Form-wound HX_ and AM_	380 V < U_N ≤ 690 V	Standard	n.a.	+ N + CMF	P_N < 500 kW: +N + CMF
					P_N ≥ 500 kW +N + d*u*/d*t* + CMF
Old [1] form-wound HX_ and modular	380 V < U_N ≤ 690 V	Check with the motor manufacturer.	+ N + d*u*/d*t* with voltages over 500 V + CMF		
Random-wound HX_ and AM_ [2]	0 V < U_N ≤ 500 V	Enamelled wire with fiber glass taping	+ N + CMF		
	500 V < U_N ≤ 690 V		+ N + d*u*/d*t* + CMF		
HDP	Consult the motor manufacturer.				

1) manufactured before 1.1.1998

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

This table shows the requirements when a non-ABB motor is in use.

Motor type	Nominal AC supply voltage	Requirement for			
		Motor insulation system	ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings		
			P_N < 100 kW and frame size < IEC 315	100 kW ≤ P_N < 350 kW or IEC 315 ≤ frame size < IEC 400	P_N ≥ 350 kW or frame size ≥ IEC 400
			P_N < 134 hp and frame size < NEMA 500	134 hp ≤ P_N < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580	P_N ≥ 469 hp or frame size > NEMA 580
Random-wound and form-wound	U_N ≤ 420 V	Standard: $\hat{U}_{LL}$ = 1300 V	-	+ N or CMF	+ N + CMF
	420 V < U_N ≤ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ d*u*/d*t*	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
		or			
		Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 micro-second rise time	-	+ N or CMF	+ N + CMF
	500 V < U_N ≤ 600 V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ d*u*/d*t*	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
		or			
		Reinforced: $\hat{U}_{LL}$ = 1800 V	-	+ N or CMF	+ N + CMF
	600 V < U_N ≤ 690 V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ d*u*/d*t*	+ d*u*/d*t* + N	+ N + d*u*/d*t* + CMF
		Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 micro-second rise time [1)]	-	+ N + CMF	+ N + CMF

1) If the intermediate DC circuit voltage of the drive is increased from the nominal level due to long term resistor braking cycles, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

The abbreviations used in the tables are defined below.

Abbr.	Definition
U_N	Nominal AC line voltage
$\hat{U}_{LL}$	Peak line-to-line voltage at motor terminals which the motor insulation must withstand
P_N	Motor nominal power
d*u*/d*t*	d*u*/d*t* filter at the output of the drive
CMF	Common mode filter
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.

Availability of du/dt filter and common mode filter by drive type

Product type	Availability of du/dt filter	Availability of common mode filter (CMF)
ACS880-07	Standard	Standard

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

Use the selection criteria given for non-ABB motors.

Additional requirements for 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 AC line voltage application must be selected as if the drive were supplied with 480 V.

Additional requirements for ABB high-output and IP23 motors

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347 (2001).

This table shows the requirements for protecting the motor insulation and bearings in drive systems for ABB random-wound motor series (for example, M3AA, M3AP and M3BP).

Nominal AC supply voltage	Requirement for			
	Motor insulation system	ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings		
		P_N < 100 kW	100 kW ≤ P_N < 200 kW	P_N ≥ 200 kW
		P_N < 140 hp	140 hp ≤ P_N < 268 hp	P_N ≥ 268 hp
U_N ≤ 500 V	Standard	-	+ N	+ N + CMF
500 V < U_N ≤ 600 V	Standard	+ d*u*/d*t*	+ d*u*/d*t* + N	+ d*u*/d*t* + N + CMF
	or			
	Reinforced	-	+ N	+ N + CMF
600 V < U_N ≤ 690 V	Reinforced	+ d*u*/d*t*	+ d*u*/d*t* + N	+ d*u*/d*t* + N + CMF

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

The rated output power of high-output motors is higher than what is stated for the particular frame size in EN 50347 (2001).

If you plan to use a non-ABB high-output motor or an IP23 motor, consider these additional requirements for protecting the motor insulation and bearings in drive systems:

- If motor power is below 350 kW: Equip the drive and/or motor with the filters and/or bearings according to the table below.
- If motor power is above 350 kW: Consult the motor manufacturer.

Nominal AC supply voltage	**Requirement for**		
	Motor insulation system	**ABB d*u*/d*t* and common mode filters, insulated N-end motor bearings**	
		P_N < 100 kW or frame size < IEC 315	**100 kW < P_N < 350 kW or IEC 315 < frame size < IEC 400**
		P_N < 134 hp or frame size < NEMA 500	**134 hp < P_N < 469 hp or NEMA 500 < frame size < NEMA 580**
$U_N \leq 500$ V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N or CMF	+ N or CMF
420 V < U_N < 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
	or		
	Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	+ N or CMF	+ N or CMF
500 V < $U_N \leq$ 600 V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ d*u*/d*t* + (N or CMF)	+ N + d*u*/d*t* + CMF
	or		
	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ N or CMF	+ N + CMF
600 V < $U_N \leq$ 690 V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ N + du/dt	+ N + d*u*/d*t* + CMF
	Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 microsecond rise time [1)]	+ N + CMF	+ N + CMF

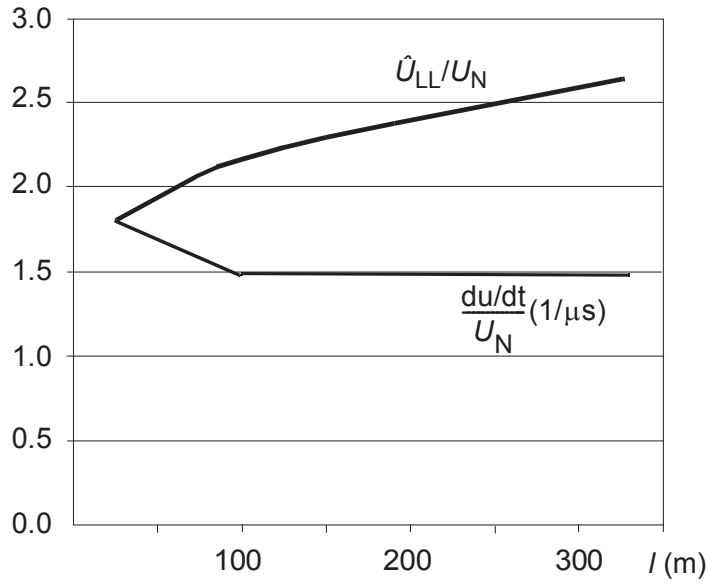
1) If the intermediate DC circuit voltage of the drive is increased from the nominal level due to long term resistor braking cycles, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

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

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 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 diagram below. Multiply the values by the nominal supply voltage (U_N) and substitute into equation $t = 0.8 \cdot \hat{U}_{LL}/(\mathrm{d}u/\mathrm{d}t)$.

The peak voltage and voltage change rate are shown below.



l	Motor cable length
$\hat{U}_{LL}/U_N$	Relative peak line-to-line voltage
(du/dt)/U_N	Relative du/dt value

Note:
$\hat{U}_{LL}$ and du/dt values are approximately 20% higher during the resistor braking.

Additional note for sine filters

A sine filter also protects the motor insulation system. The peak phase-to-phase voltage with a sine filter is approximately $1.5 \cdot U_N$.

Sine filter is available as an option (+E206).

Selecting the power cables

General rules

Select the input power and motor cables according to local regulations. Obey these rules:

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

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

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

We recommend symmetrical shielded cable for the input cabling, but a four-conductor system is also possible.

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.

The protective conductor must always have an adequate conductivity. Unless local wiring regulations state otherwise, the cross-sectional area of the protective conductor must agree with the conditions that require automatic disconnection of the supply required in 411.3.2. of IEC 60364-4-41:2005 and be capable of withstanding the prospective fault current during the disconnection time of the protective device. The cross-sectional area of the protective conductor can either be selected from the table below or calculated according to 543.1 of IEC 60364-5-54.

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

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

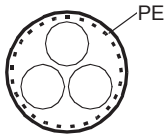
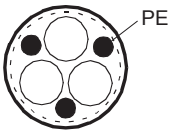
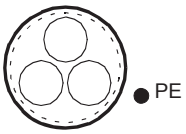
Typical power cable sizes

See the technical data in the appropriate hardware manual for the typical power cable sizes for each drive or unit type.

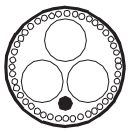
Alternative power cable types

Recommended power cable types

This section presents the recommended cable types. Check with local / state / country electrical codes for allowance.

Cable type	Use as input power cabling	Use as motor cabling
 Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield.	Yes.	Yes.
 Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield.	Yes.	Yes.
 Symmetrical shielded cable with three phase conductors and a shield, and a separate PE conductor/cable	Yes. A separate PE conductor is required if the shield does not agree with the PE conductor requirements. **Note:** If the shield size is smaller than 10 mm^2 Cu (or 16 mm^2 Al), you need two PE conductors typically, for example, the shield and a separate conductor/cable. This is due to the safety regulations related to the leakage current. See IEC/EN 61800-5-1, or the drive safety instructions for more information.	Yes. A separate PE conductor is required if the shield does not agree with the PE conductor requirements.

Power cable types for limited use

Cable type	Use as input power cabling	Use as motor cabling
 A four-conductor system: three phase conductors and a PE conductor on a cable tray	Yes	No
 Corrugated cable with three phase conductors and a PE conductor, or cable in EMT conduit	Yes	Only with phase conductor cross section less than 10 mm² (8 AWG) or motors < 30 kW (40 hp).
 A well-shielded (Al/Cu shield) four-conductor system (three phase conductors and a PE conductor or four conductors)	Yes	Only with motors up to 100 kW if there is potential equalization between the frames of motor and driven equipment.

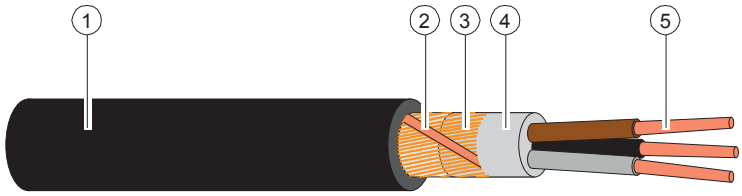
Not allowed power cable types

Cable type	Use as input power cabling	Use as motor cabling
 Symmetrical shielded cable with individual shields for each phase conductor	No	No

Power cable shield

If the cable shield is used as the sole PE conductor, make sure that the conductivity agree with the PE conductor requirements.

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



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

Additional US requirements

Use type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable for the motor cables if metallic conduit is not used. For the North American market, 600 V AC cable is accepted for up to 500 V AC. 1000 V AC cable is required above 500 V AC (below 600 V AC). For drives rated over 100 amperes, the power cables must be rated for 75 °C (167 °F).

Conduit

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

Note:

Do not 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.

Planning the resistor braking system

See chapter Resistor braking.

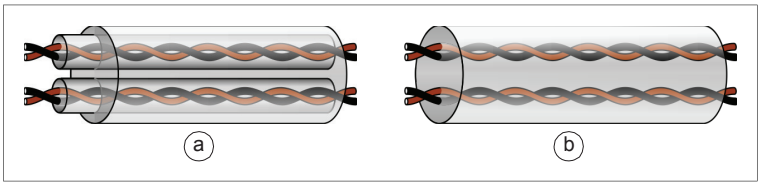
Selecting the control cables

Shielding

All control cables must be shielded.

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



Signals in separate cables

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

Signals allowed to be run in the same cable

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

Relay cable type

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

Control panel cable length and type

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

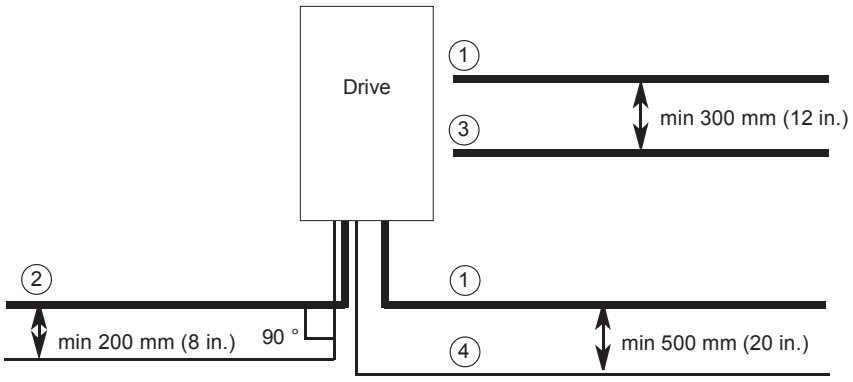
Routing the cables

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

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

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

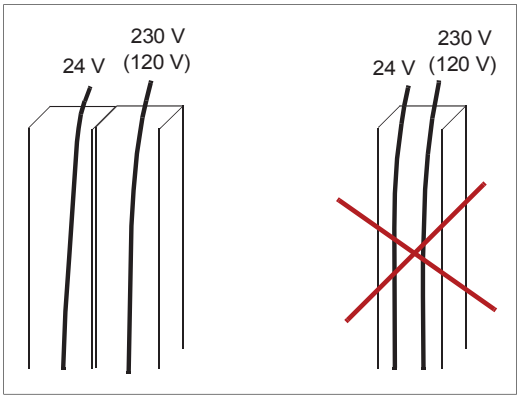
A diagram of the cable routing is shown below.



1	Motor cable
2	Input power cable
3	Power cable
4	Control cable

Separate control cable ducts

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



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

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

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

Implementing thermal overload and short-circuit protection

Protecting a drive and input power cable in short-circuits

The drive is equipped with internal AC fuses as standard. Protect the input cable with fuses or a suitable circuit breaker.

The fuses will protect the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Protecting the motor and motor cable in short-circuits

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

Protecting the drive and the power cables against thermal overload

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

WARNING!

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

Protecting the motor against thermal overload

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

The most common temperature sensors are:

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

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 in TN (grounded) networks. This is not a personnel safety or a fire protection feature. The ground fault protective function can be disabled with a parameter, refer to the firmware manual.

An optional ground fault monitoring device (+Q954) is available for IT (ungrounded) systems. The option includes a ground fault indicator on the drive cabinet door.

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

You can order the drive with a category 0 or category 1 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, or turning the operating switch of the drive from position “1” to “0” does not generate an emergency stop of the motor or separate the drive from dangerous potential.

See the appropriate emergency stop user’s manual for the wiring, start-up and operation instructions.

Option code	User’s manual	Manual code (English)
+Q951	Emergency stop, stop category 0 (using main contactor/breaker)	3AUA0000119895
+Q952	Emergency stop, stop category 1 (using main contactor/breaker)	3AUA0000119896
+Q963	Emergency stop, stop category 0 (using Safe torque off)	3AUA0000119908
+Q964	Emergency stop, stop category 1 (using Safe torque off)	3AUA0000119909
+Q978	Emergency stop, stop category 0 or 1 (using main contactor/breaker and Safe torque off)	3AUA0000145920
+Q979	Emergency stop, stop category 0 or 1 (using Safe torque off)	3AUA0000145921

Implementing the Safe torque off function

See chapter Safe torque off function.

Implementing the Prevention of unexpected start-up function

The drive can be equipped with a Prevention of unexpected start-up (POUS) function.

The POUS function enables short-time maintenance work (like cleaning) on the non-electrical parts of the machinery without switching off and disconnecting the drive.

See the appropriate user’s manual for the wiring, start-up and operation instructions.

Option code	User’s manual	Manual code (English)
+Q950	Prevention of unexpected start-up, with FSO-xx safety functions module	3AUA0000145922
+Q957	Prevention of unexpected start-up, with safety relay	3AUA0000119910

Implementing the functions provided by the FSO-xx safety functions module (option +Q972 or +Q973)

The drive can be equipped with an FSO-xx safety functions module (option +Q972 or +Q973) which enables the implementation of functions such as Safe brake control (SBC), Safe stop 1 (SS1), Safe stop emergency (SSE), Safely limited speed (SLS) and Safe maximum speed (SMS).

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

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

For wiring instructions, safety data and more information on the functions provided by the FSO-xx, refer to its manual. See *FSO-12 safety functions module user's manual* (3AXD50000015612 [English]).

Implementing the Power-loss ride-through

Implement the power-loss ride-through function as follows:

- Check that the power-loss ride-through function of the inverter unit is enabled with parameter *30.31 Undervoltage control* in the ACS880 primary control program.
- Make sure that the control of the main contactor/breaker either keeps the contactor closed over the short power break, or closes it after the break automatically.

WARNING!

Make sure that the automatic re-connection of the input power does not cause any danger. If you are in doubt, do not implement the Power-loss ride-through function.

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.

Units with main contactor (option +F250)

The main contactor of the drive opens in a power-loss situation. When the power returns, the contactor closes. However, if the power-loss situation lasts so long that the drive trips on undervoltage, it must be reset and started again to continue operation. If the power-loss situation lasts so long that the auxiliary power buffer module runs out, the main contactor remains open and the drive operates only after reset and a new start.

With external uninterruptible control voltage (option +G307), the main contactor remains closed in power-loss situations. If the power-loss situation lasts so long that the drive trips on undervoltage, it must be reset and started again to continue operation.

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. Make sure with interlocking that the contactors cannot be closed simultaneously. The installation must be clearly marked as defined in IEC/EN 61800-5-1, subclause 6.5.3, for example, "THIS MACHINE STARTS AUTOMATICALLY".

Bypass connection is available as a factory-installed option for certain cabinet-built drive types. Consult ABB for more information.

WARNING!

Never connect the drive output to the power line. The connection may damage the drive.

Supplying power for the auxiliary circuits

The drive is equipped with an auxiliary control voltage transformer which supplies control voltage, for example, for the control devices and cabinet fan(s).

The following options are to be supplied from external power sources:

- +G300/+G301: Cabinet heaters and/or lighting (230 or 115 V AC; external fuse: 16 A gG)
- +G307: Connection for an external uninterruptible power supply (230 or 115 V AC; external fuse 16 A gG) to the control unit and control devices when the drive is not powered
- +G313: Power supply connection (230 V AC; external fuse 16 A gG) for a motor space heater output.

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, make sure that the connection steps are low enough not to cause voltage transients that would trip the drive.
3. Check that the power factor compensation unit is suitable for use in systems with AC drives, ie, harmonic generating loads. In such systems, the compensation unit should typically be equipped with a blocking reactor or harmonic filter.

Implementing a safety switch between the drive and the motor

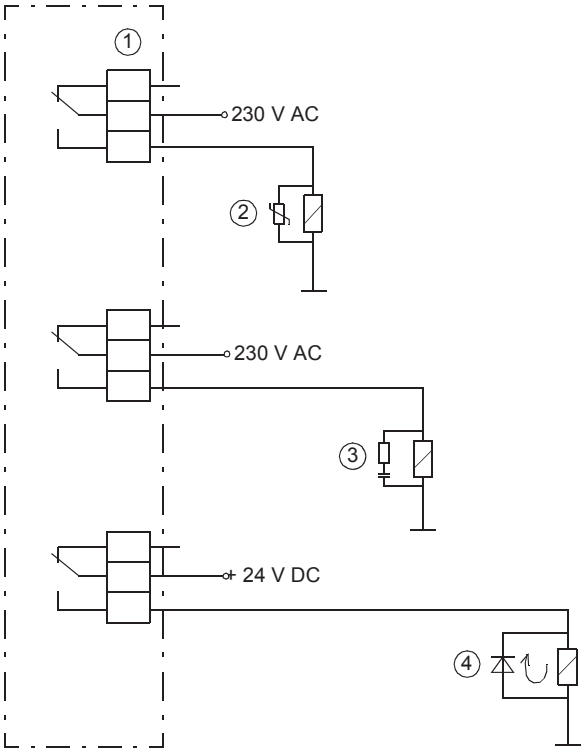
We recommend to install a safety switch between the permanent magnet synchronous motor and the drive output. The switch is needed to isolate the motor during any maintenance work on the drive.

Protecting the contacts of relay outputs

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

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

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



1	Relay outputs
2	Varistor
3	RC filter
4	diode

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

1. You can connect the sensor directly to the inputs of the drive if there is double or reinforced insulation between the sensor and the live parts of the motor.
2. If there is no double or reinforced insulation between the sensor and the live parts of the motor, you can connect the sensor to the inputs of the drive only if all circuits

connected to the drive's digital and analog inputs (typically low-voltage circuits) are protected against contact and insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit.

3. You can connect the sensor to an extension module with basic insulation (eg. FAIO-01) or reinforced insulation (eg. FPTC-xx) between the sensor connector and the other connectors of the module. See the table below for the sensor insulation requirement. For sensor connection to the extension module, see its manual.
4. You can connect a sensor to an external thermistor relay the insulation of which is rated for the same voltage level as the main circuit of the drive.

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

See

- section *AI1 or AI2 as a Pt100, Pt1000, PTC or KTY84 sensor input (page 134)*
- section *DI6 as a PTC sensor input (page 134)*
- *FPTC-01 thermistor protection module (option +L536) for ACS880 drives user's manual* (3AXD50000027750 [English])
- *FPTC-02 ATEX-certified thermistor protection module Ex II (2) GD (option +L537+Q971) for ACS880 drives user's manual* (3AXD50000027782 [English]).

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

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

Note:

The inaccuracy of the drive analog inputs for Pt100 sensors is 10 °C (18 °F). If a better accuracy is needed, use the FAIO-01 analog I/O extension module (option +L525).

6

Electrical installation

Contents of this chapter

This chapter gives instructions on the wiring of the drive.

Warnings

WARNING!

Only qualified electricians are allowed to carry out the 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 insulation of the assembly

Drive

Do not make any voltage withstand 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.

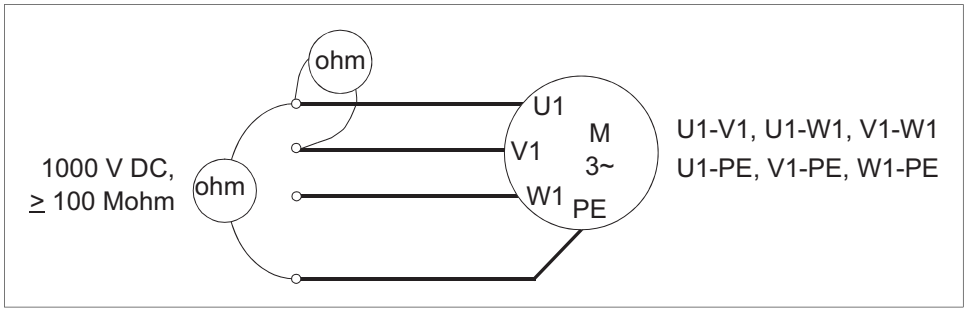
Motor and motor cable

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, 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.



Custom brake resistor assembly

See section *Electrical installation of custom brake resistors (page 270)*.

Checking the compatibility with IT (ungrounded) systems

EMC filter +E202 is not suitable for use in an IT (ungrounded) system. If the drive is equipped with filter +E202, disconnect the filter before connecting the drive to the supply network. For instructions on how to do this, contact your local ABB representative.

WARNING!

If a drive with EMC filter +E202 is installed on an IT system (an ungrounded power system or a high resistance-grounded [over 30 ohm] power system), the system will be connected to earth potential through the EMC filter capacitors of the drive. This may cause danger, or damage the unit.

Attaching the device stickers to the cabinet door

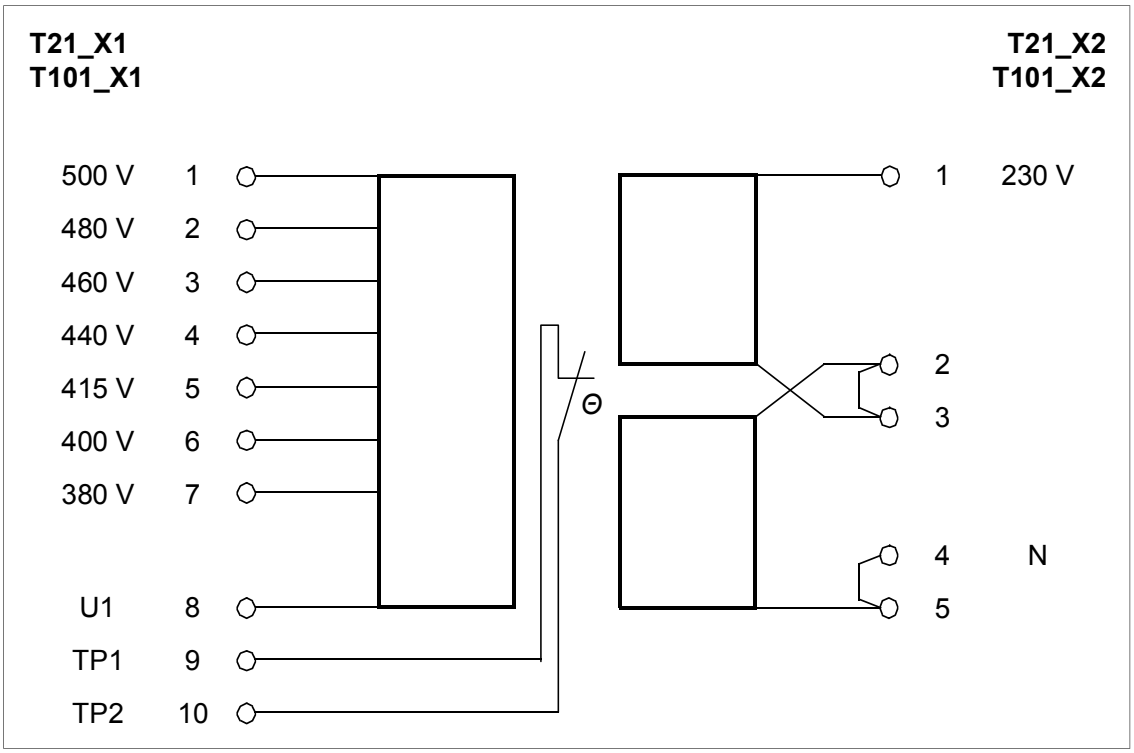
A multilingual device label sticker is delivered with the drive. Attach the stickers in the appropriate language on the English texts; see section *Door switches and lights (page 43)*.

Checking the settings of transformers T21, T101 and T111

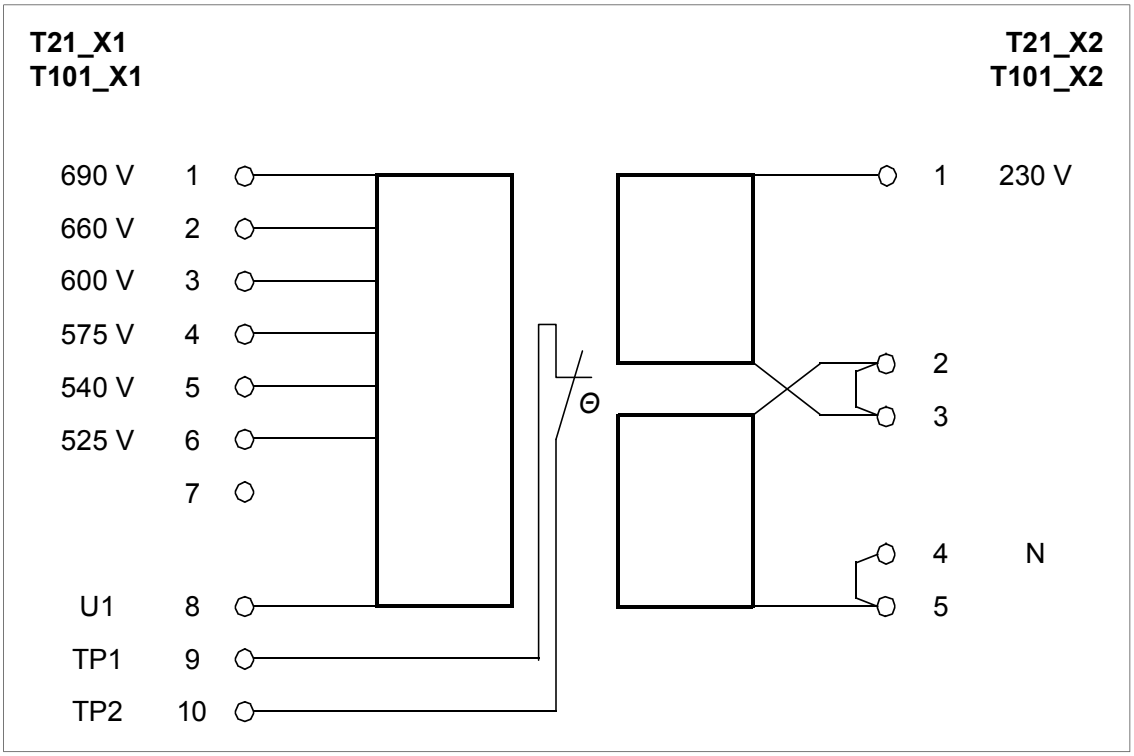
Check the tap settings of all auxiliary voltage transformers. Transformer T21 is standard equipment; T101 and T111 are present depending on drive configuration.

The voltage settings of transformers T21 and T101 are made at terminal blocks T21_X1/X2 and T101_X1/X2 respectively. The settings of transformer T111 are made on the transformer itself. The locations of the transformers and the terminal blocks are shown in section *Operation principle and hardware description (page 29)*.

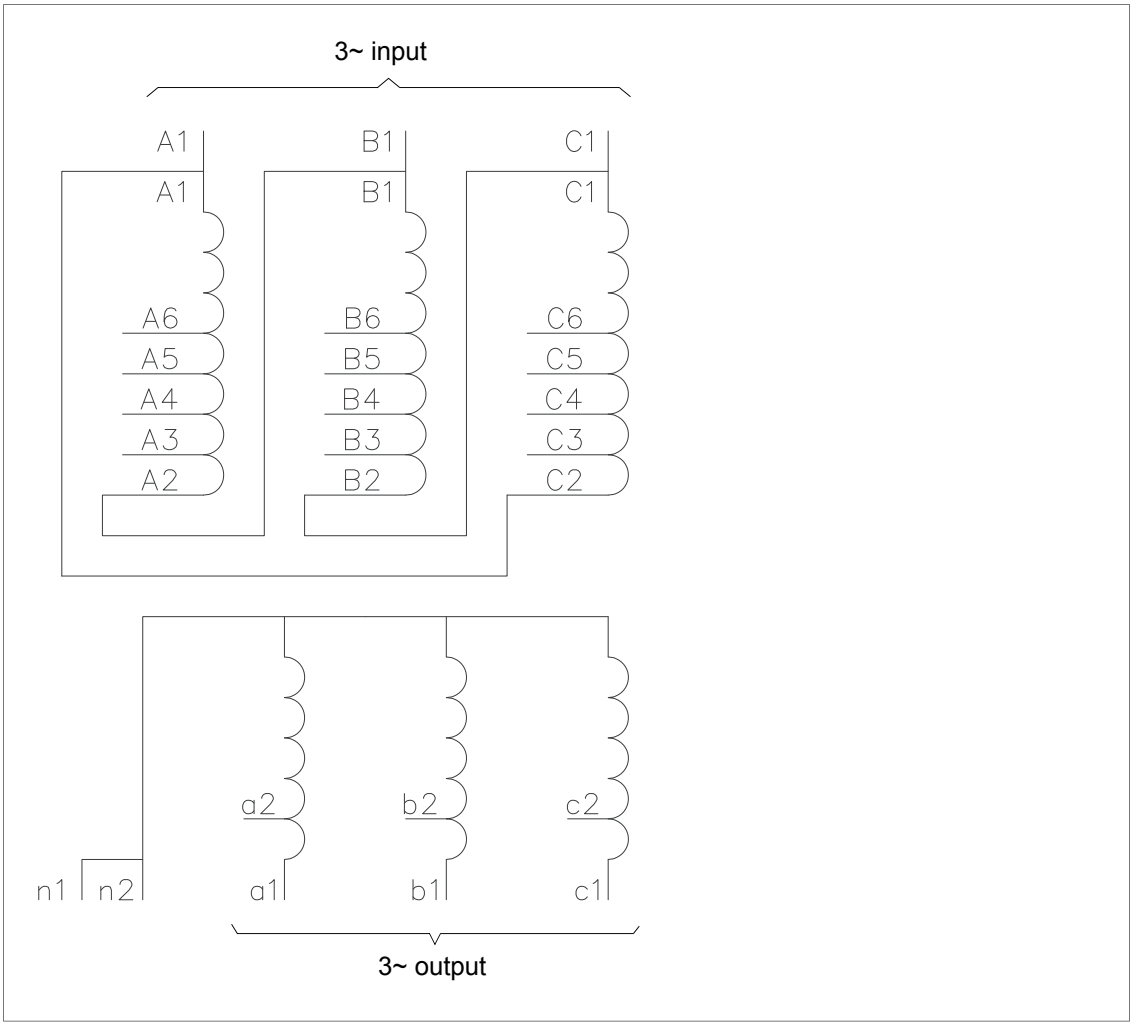
T21 and T101 tap settings (400…500 V units)



T21 and T101 tap settings (690 V units)



T111 tap settings



	3~ input				3~ output	
Supply voltage	Terminals	Tap settings			Terminals	
		A1–	B1–	C1–	400 V (50 Hz)	320/340 V (60 Hz)
690 V	A1, B1, C1	C2	A2	B2	a1, b1, c1	a2, b2, c2
660 V	A1, B1, C1	C2	A2	B2	a1, b1, c1	a2, b2, c2
600 V	A1, B1, C1	C3	A3	B3	a1, b1, c1	a2, b2, c2
575 V	A1, B1, C1	C3	A3	B3	a1, b1, c1	a2, b2, c2
540 V	A1, B1, C1	C4	A4	B4	a1, b1, c1	a2, b2, c2
525 V	A1, B1, C1	C4	A4	B4	a1, b1, c1	a2, b2, c2
500 V	A1, B1, C1	C4	A4	B4	a1, b1, c1	a2, b2, c2
480 V	A1, B1, C1	C5	A5	B5	a1, b1, c1	a2, b2, c2
460 V	A1, B1, C1	C5	A5	B5	a1, b1, c1	a2, b2, c2
440 V	A1, B1, C1	C5	A5	B5	a1, b1, c1	a2, b2, c2
415 V	A1, B1, C1	C6	A6	B6	a1, b1, c1	a2, b2, c2
400 V	A1, B1, C1	C6	A6	B6	a1, b1, c1	a2, b2, c2
380 V	A1, B1, C1	C6	A6	B6	a1, b1, c1	a2, b2, c2

Connecting the control cables

See chapter *Control units of the drive (page 129)* for the default I/O connections of the inverter unit (with the ACS880 primary control program). The default I/O connections can be different with some hardware options, see the circuit diagrams delivered with the drive for the actual wiring. For other control programs, see their firmware manuals.

Control cable connection procedure

WARNING!

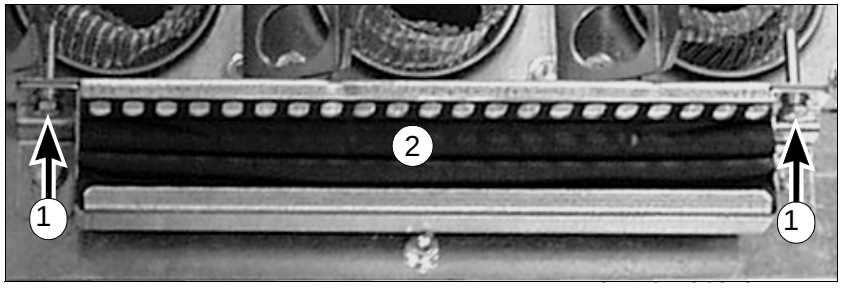
Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

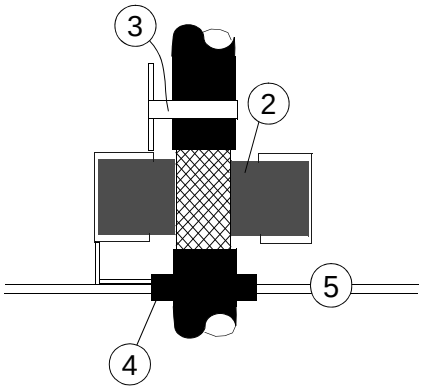
1. Stop the drive (if running) and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Run the control cables into the auxiliary control cubicle (ACU) as described in section *Grounding the outer shields of the control cables at the cabinet lead-through* below.
3. Route the control cables as described in section *Routing the control cables inside the cabinet (page 102)*.
4. Connect the control cables as described in section *Connecting to the inverter control unit (A41) (page 103)*.

Grounding the outer shields of the control cables at the cabinet lead-through

Ground the outer shields of all control cables 360 degrees at the EMI conductive cushions as follows:

1. Loosen the tightening screws of the EMI conductive cushions and pull the cushions apart.
2. Cut adequate holes to the rubber grommets in the lead-through plate and lead the cables through the grommets and the cushions into the cabinet.
3. Strip off the cable plastic sheath above the lead-through plate just enough to ensure proper connection of the bare shield and the EMI conductive cushions.
4. Tighten the two tightening screws so that the EMI conductive cushions press tightly round the bare shield.



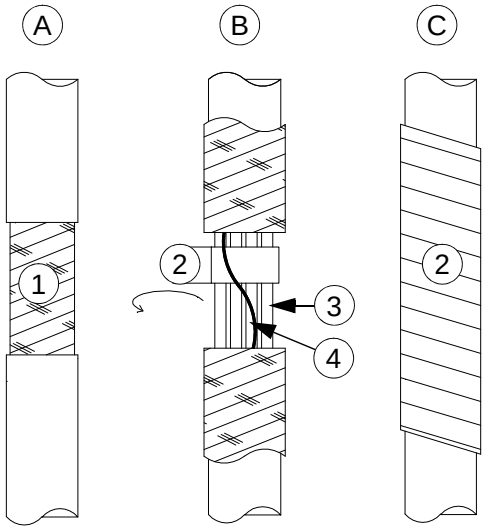


1	Tightening screw
2	EMI conductive cushion
3	Strain relief
4	Grommet
5	Lead-through plate

Note 1: Keep the shields continuous as close to the connection terminals as possible. Secure the cables mechanically at the lead-through strain relief.

Note 2: If the outer surface of the shield is non-conductive:

- Cut the shield at the midpoint of the bare part. Be careful not to cut the conductors or the grounding wire (if present).
- Turn the shield inside out to expose its conductive surface.
- Cover the turned shield and the stripped cable with copper foil to keep the shielding continuous.



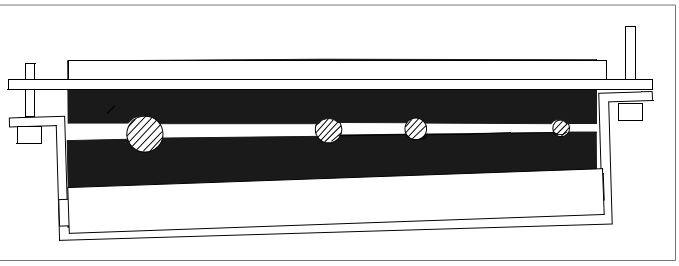
A	Stripped cable
B	Conductive surface of the shield exposed
C	Stripped part covered with copper foil
1	Cable shield
2	Copper foil
3	Shielded twisted pair
4	Grounding wire

Note for top entry of cables: When each cable has its own rubber grommet, sufficient IP and EMC protection can be achieved. However, if very many control cables come to one cabinet, plan the installation beforehand as follows:

1. Make a list of the cables coming to the cabinet.
2. Sort the cables going to the left into one group and the cables going to the right into another group to avoid unnecessary crossing of cables inside the cabinet.
3. Sort the cables in each group according to size.
4. Group the cables for each grommet as follows ensuring that each cable has a proper contact to the cushions on both sides.

Cable diameter in mm	Max. number of cables per grommet
≤ 13	4
≤ 17	3
< 25	2
≥ 25	1

5. Arrange the bunches according to size from thickest to the thinnest between the EMI conductive cushions.



6. If more than one cable go through a grommet, seal the grommet by applying Loctite 5221 (catalogue number 25551) inside the grommet.

Routing the control cables inside the cabinet

Use the existing trunking in the cabinet wherever possible. Use sleeving if cables are laid against sharp edges. When running cables to or from the swing-out frame, leave enough slack at the hinge to allow the frame to open fully.

Connecting to the inverter control unit (A41)

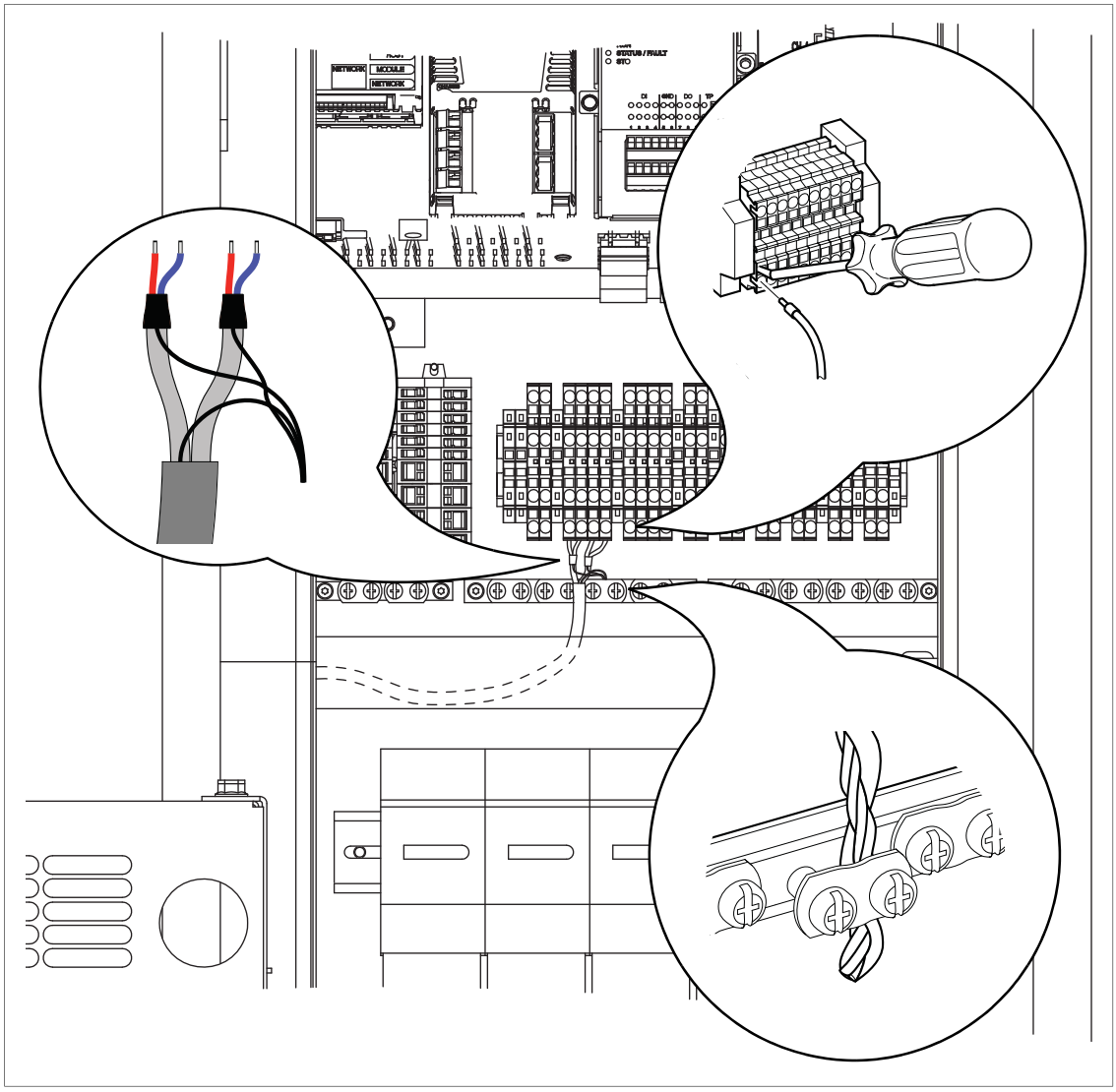
Connect the conductors to the appropriate terminals of the control unit or terminal block X504 (option +L504).

Connect the inner twisted pair shields and all separate grounding wires to the grounding clamps below the control unit.

The drawing below represents a drive with additional I/O terminal block (option +L504). Without the block, the grounding is made the same way.

Notes:

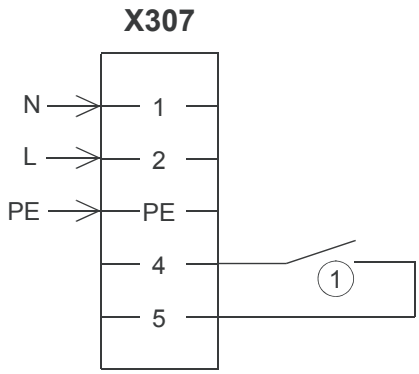
- Do not ground the outer shield of the cable here since it is grounded at the lead-through.
- Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.



At the other end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, 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.

Connecting a 230/115 V AC auxiliary voltage supply (UPS, option +G307)

Wire the external control voltage to terminal block X307 at the back side of the mounting plate as shown below.



1 Internal wiring of UPS supervision: circuit breaker or fuse off/fault = contact open.

Connecting the emergency stop push buttons (options +Q951, +Q952, +Q963, +Q964, +Q978,+Q979)

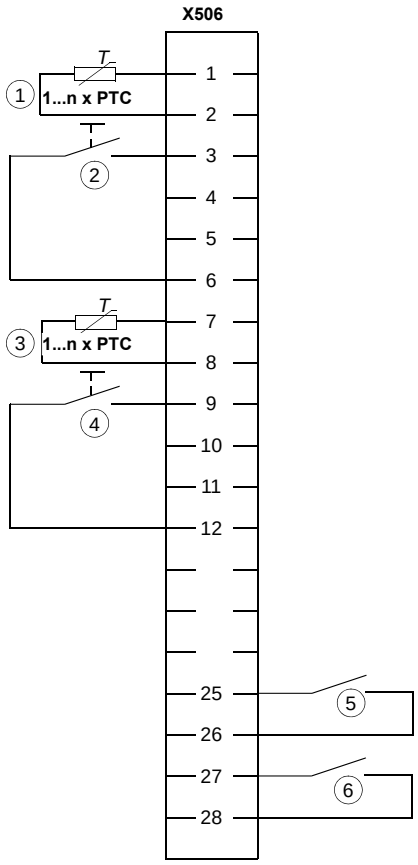
Connect external emergency stop push buttons according to the circuit diagrams delivered with the drive.

Wiring the starter for auxiliary motor fan (options +M602…+M610)

Connect the power supply wires for the auxiliary motor fan to terminal blocks X601…X605 according to the circuit diagrams delivered with the drive.

Wiring the PTC thermistor relay(s) (options +L505, +2L505, +L513 and +2L513)

The external wiring of option +2L505 and +2L513 (two thermistor relays) is shown below. For example, one relay can be used to monitor the motor windings, the other to monitor the bearings. The maximum contact load capacity is 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive. For instructions on commissioning options +L513 and +2L513, see *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).



1 PTC sensors monitored by relay K74.
$R_G = R_1 + R_2 + R_N < 1.5$ kohm.

2 External reset for relay K74.

Note:

With +L505 and +2L505, the terminals can be bridged for automatic reset. However, this is not allowed by ATEX regulations.

3 PTC sensors monitored by relay K75.
$R_G = R_1 + R_2 + R_N < 1.5$ kohm.

4 External reset for relay K75.

Note:

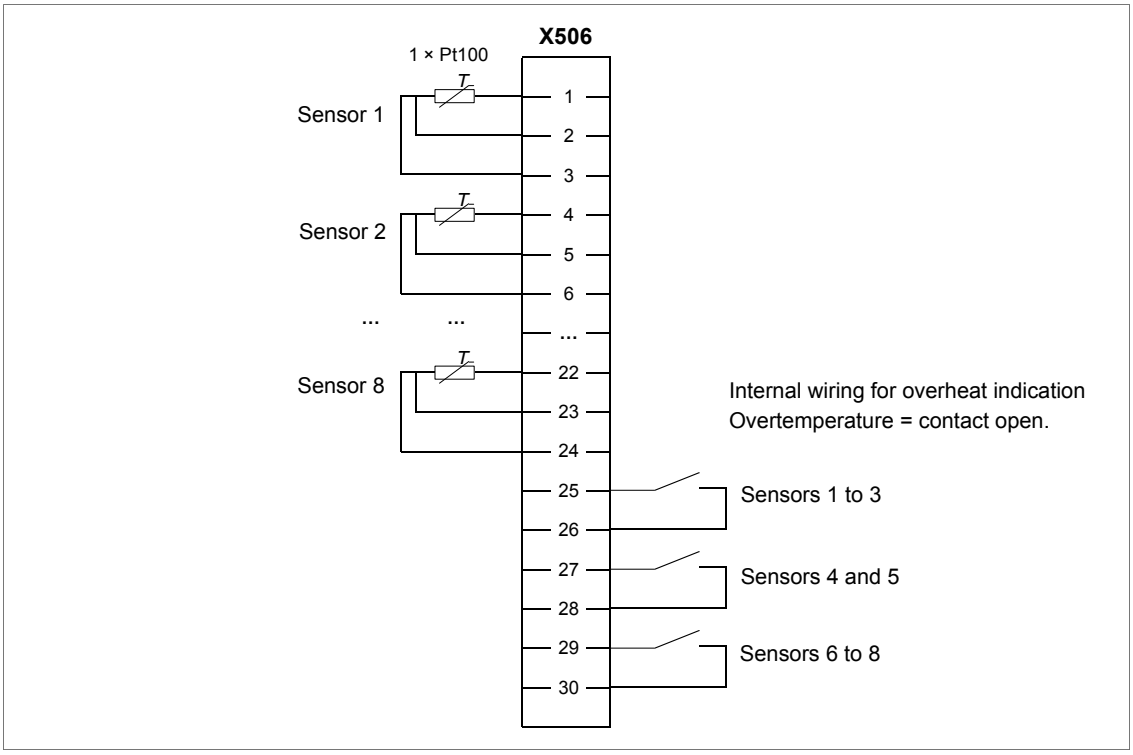
With +L505 and +2L505, the terminals can be bridged for automatic reset. However, this is not allowed by ATEX regulations.

5 Overheat indication from relay K74: overtemperature = contact open.

6 Overheat indication from relay K75: overtemperature = contact open.

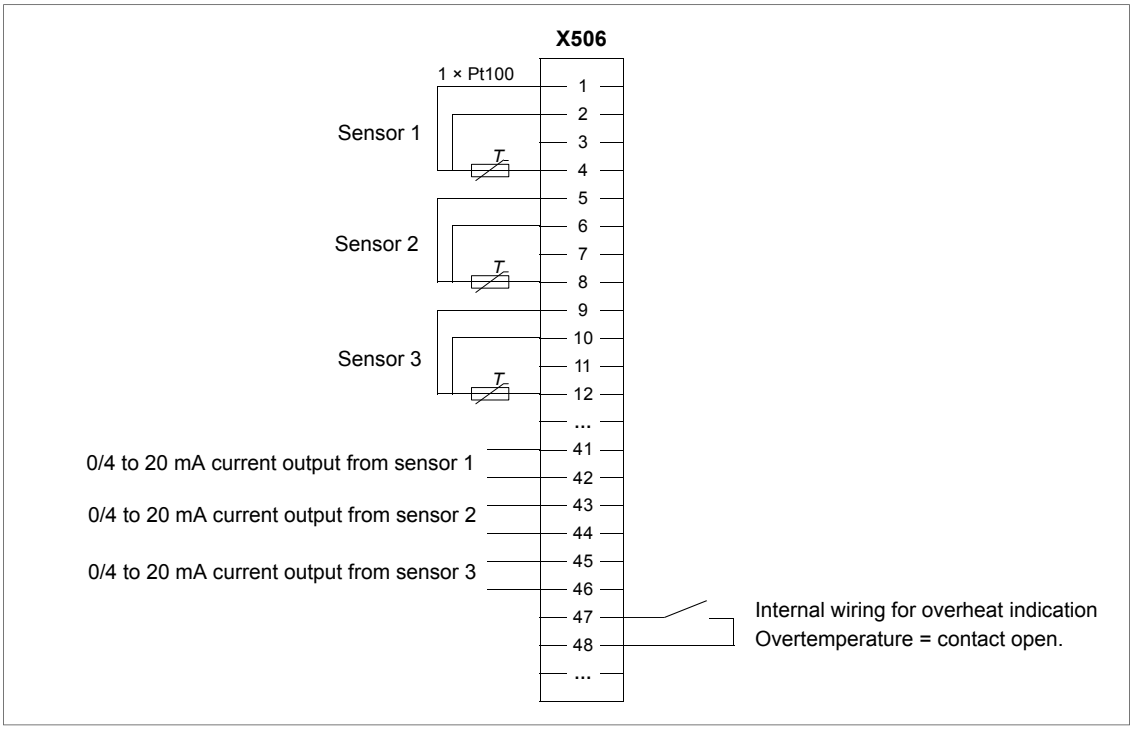
Wiring the Pt100 relays (option +nL506)

External wiring of eight Pt100 sensor modules is shown below. Contact load capacity 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive.



Wiring the Pt100 relays (option +nL514)

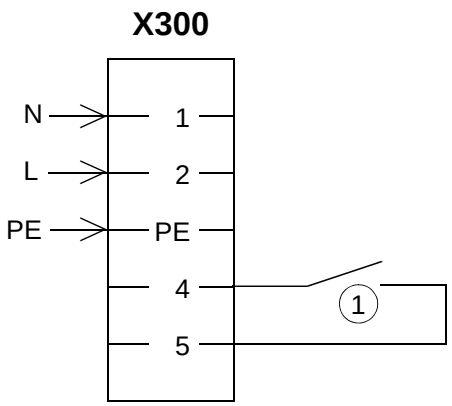
External wiring of three Pt100 sensor modules is shown below. Contact load capacity 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive. For instructions on commissioning option +nL514, see *ATEX-certified motor thermal protection functions for cabinet-built ACS880 drives (options +L513+Q971 and +L514+Q971) user's manual* (3AXD50000014979 [English]).



Powering the heating and lighting equipment (options +G300, +G301 and +G313)

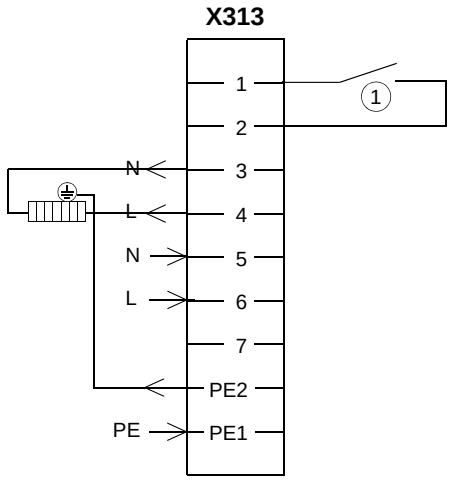
See the circuit diagrams delivered with drive.

Connect the external power supply wires for the cabinet heater and lighting to terminal block X300 at the back of the mounting plate.



1 Internal wiring of the cabinet heater: heater off/fault = contact open.

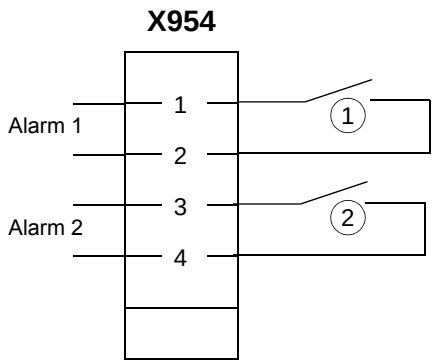
Connect the motor heater wiring to terminal block X313 as shown below. Maximum external power supply 16 A.



1 Internal wiring of the motor space heater supervision: heater off/fault = contact open.

Wiring ground fault monitoring for IT ungrounded systems (option +Q954)

We recommend to connect Alarm 1 for drive tripping and Alarm 2 for alarm signals in order to avoid unnecessary trippings due to the ground fault monitor self testing with Alarm 2.



1 Internal wiring: Ground fault alarm 1. No ground fault = contact closed. Contact load capacity 250 V AC 2 A.

2 Internal wiring: Ground fault alarm 2: No ground fault = contact closed. Contact load capacity 250 V AC 8 A.

Connecting the motor cables (units without common motor terminal cubicle or sine output filter)

On units without a common motor terminal cubicle or a sine output filter, the motor cables connect to busbars located behind the inverter module(s). The location and dimensions of the busbars are visible in the dimension drawings delivered with the drive, as well as the example drawings presented in this manual in chapter *Dimensions*.

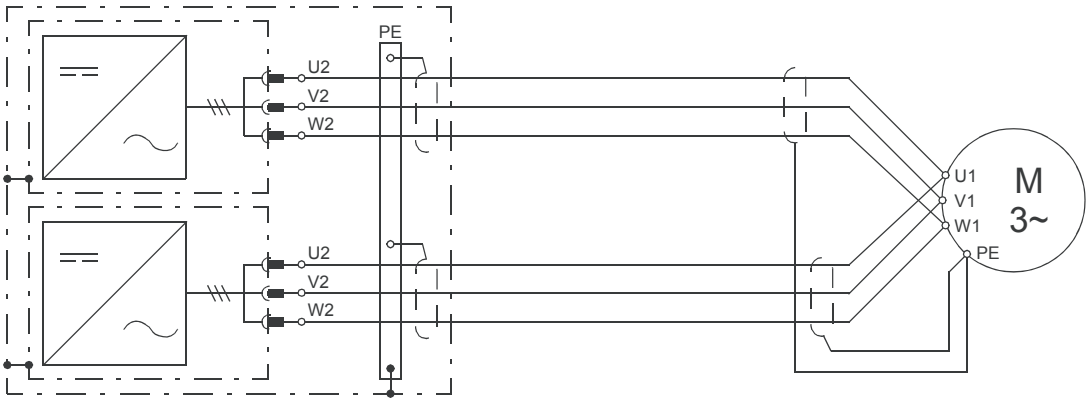
To allow the most room for the work, the modules can be removed completely from the cabinet. For instructions, see section *Removing the inverter module(s) (page 111)*.

Especially in the case of multiple inverter modules in the same cubicle, you can consider only removing the fan carriage of each module. This is faster than removing the entire module, but allows less room for the connecting work. For instructions, see section *Removing and reinstalling the fan carriage of an inverter module (page 115)*

If the drive is equipped with a common motor terminal cubicle (option +H359) or a sine output filter (option +E206), follow the instructions in section*Connecting the motor cables (units with common motor terminal cubicle or sine output filter) (page 119)*.

Motor connection diagram (without option +H366)

All parallel-connected inverter modules are to be cabled separately to the motor. 360° earthing is to be used at cable lead-throughs.

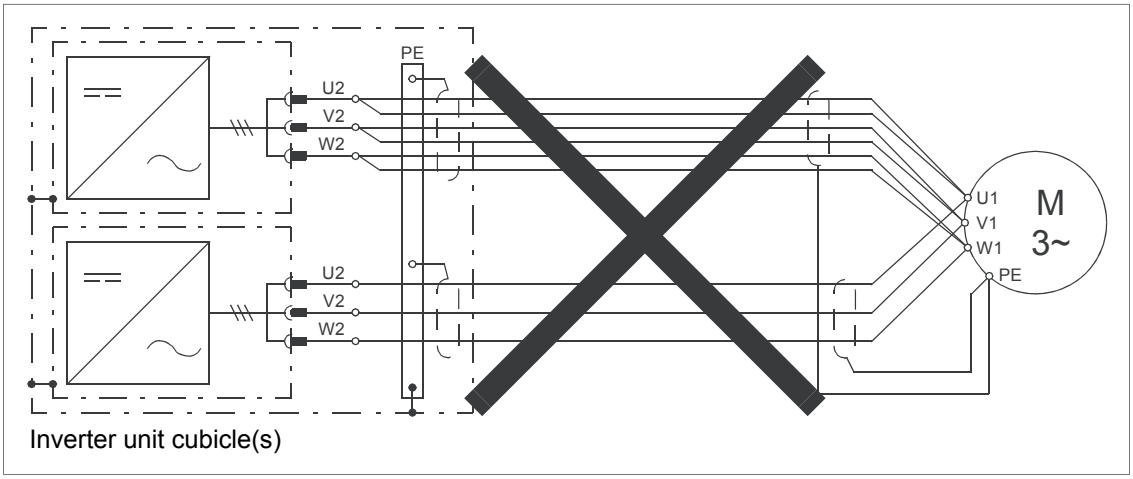


Inverter unit cubicle(s)

The recommended cable types are given in chapter *Output cable sizes*.

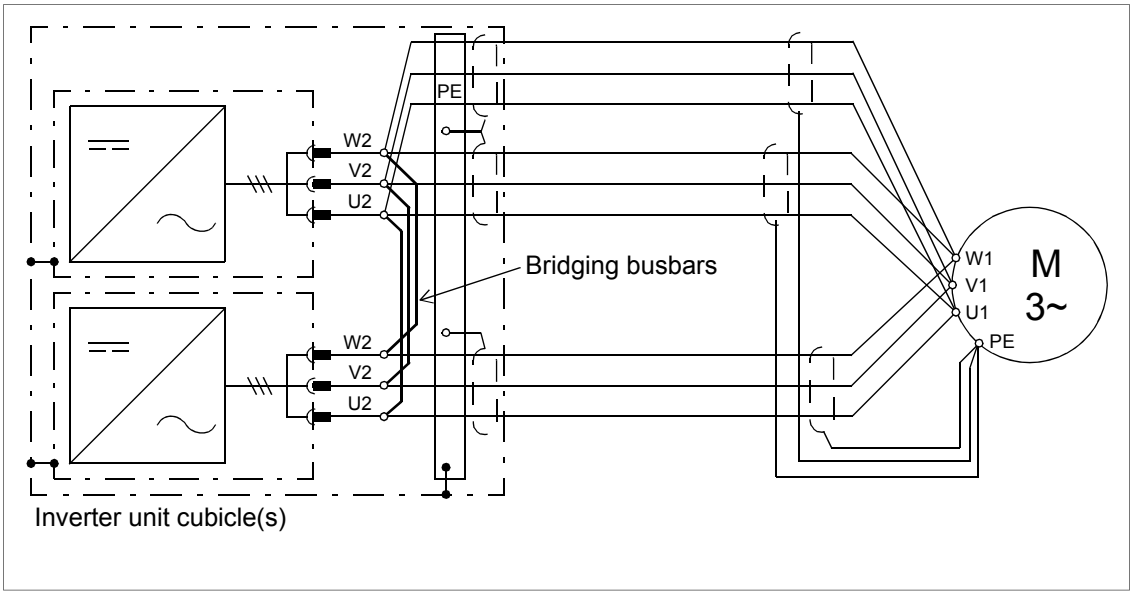
WARNING!

The cabling from all inverter modules to the motor must be physically identical considering cable type, cross-sectional area, and length.



Motor connection diagram (with option +H366)

With option +H366, the output busbars of the inverter modules **within the same cubicle** are connected by bridging busbars. The bridging balances the motor current between the modules, which allows more cabling options. For example, it is possible to use a number of cables that could not otherwise be evenly distributed between the inverter modules.



The recommended cable types are given in chapter *Technical data*, section *Output cable sizes*.

WARNING!

The bridging can carry the nominal output of one inverter module. In case of three parallel modules, ensure that the load capacity of the bridging is not exceeded. For example, if the cabling connects to the output busbars at one module only, use the module in the middle.

Note:

The +H366 option only interconnects the outputs of inverter modules within the same cubicle, not modules installed in different cubicles. Therefore, when the drive has multiple inverter cubicles (ie. two cubicles of two modules each), make sure that the motor cabling is identical for both cubicles.

Procedure

Removing the inverter module(s)

To allow more room for cabling work, the inverter modules can be removed completely instead of only the fan carriages.

Refer to the drawings below.

WARNING!

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

1. Do the steps in section *Electrical safety precautions (page 19)*before you start the work.
2. Open the inverter module cubicle door.
3. Remove the shroud at the top of the cubicle.
4. Detach the terminal block [X50] at the top of the module.
5. Detach the DC busbars from the module. Make note of the order and position of the screws and washers.
6. Detach the wiring connected to the terminals on the front of the module (including fiber optic cabling). Move the disconnected wiring aside.
7. Attach the module extraction/installation ramp (included) to the base of the cabinet so that the tabs on the mounting bracket enter the slots on the ramp.

   WARNING!

   Do not use the ramp included in the drive delivery with plinth heights over 50 mm.

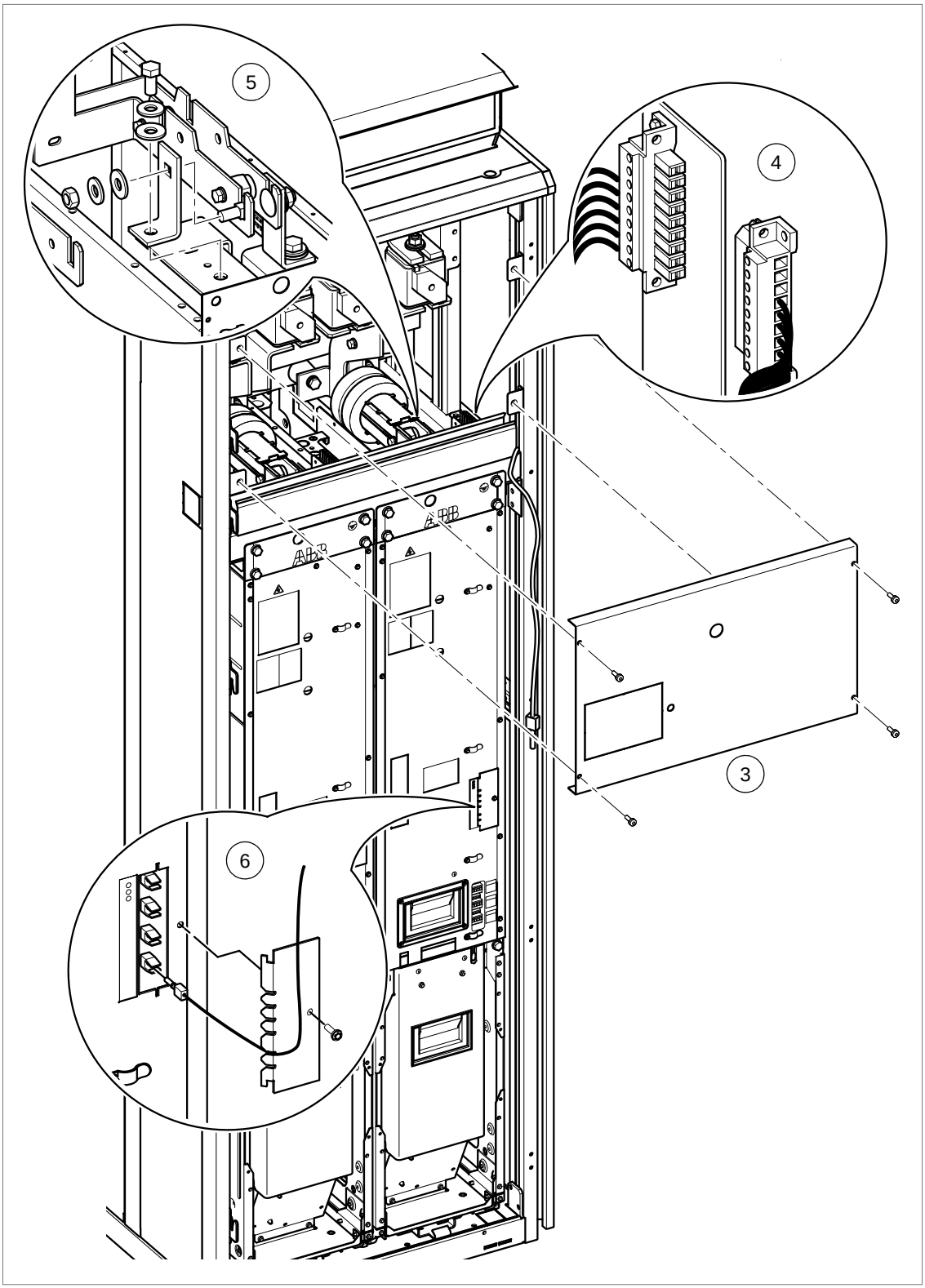
8. Remove the two screws at the bottom front of the module.

   WARNING!

   Before you proceed, make sure the cabinet is level, or chock the wheels of the module.

9. Remove the two screws at the top front of the module.
10. Pull the module carefully out along the ramp. While pulling on the handle with your right hand, keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
11. Move the module into a safe location outside the immediate work area and make sure it cannot topple over. Chock the wheels of the module if the floor is not completely level.
12. Repeat the procedure for the other inverter modules.

Proceed to *Connecting the motor cables (page 117)*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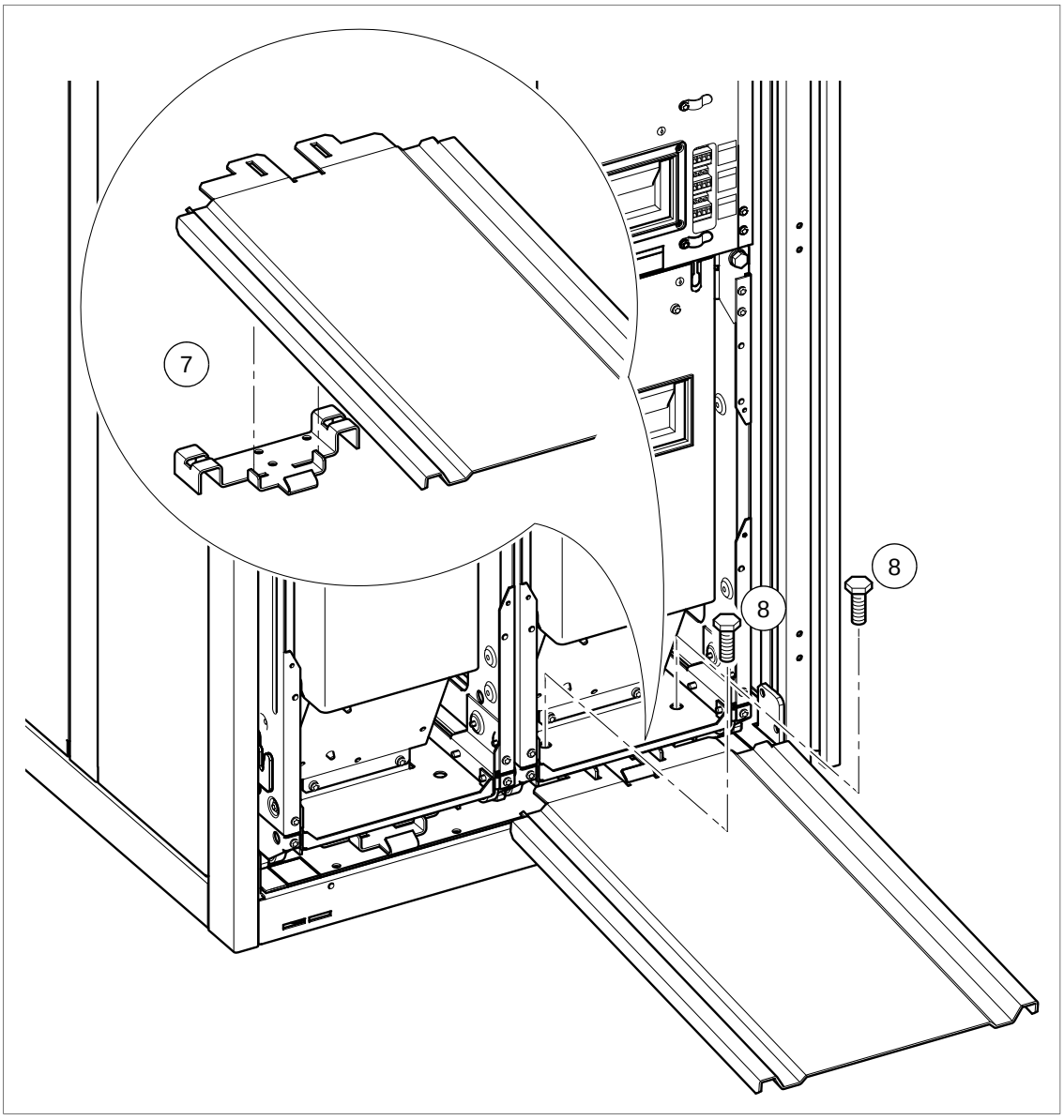
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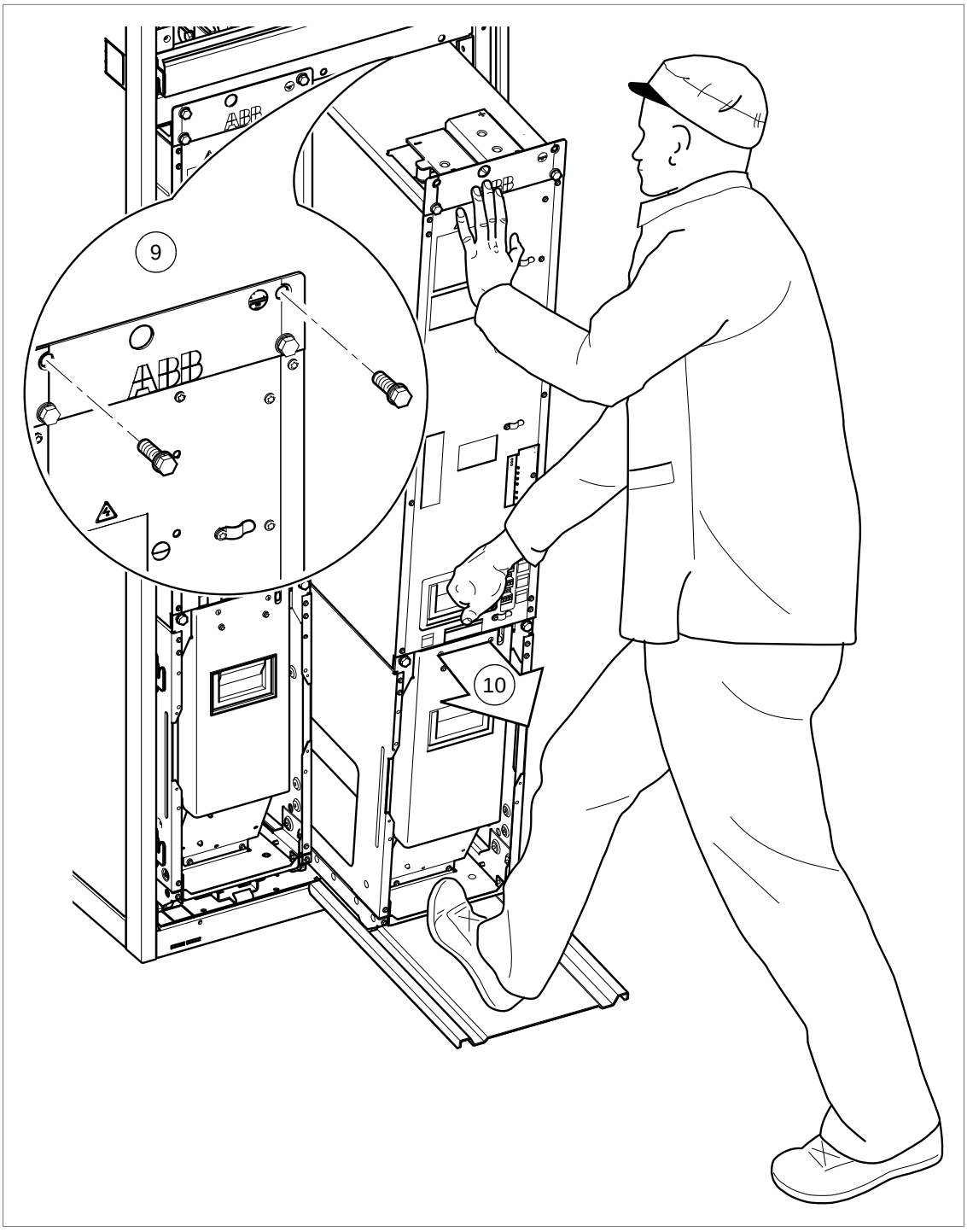

9
10

Removing and reinstalling the fan carriage of an inverter module

Refer to the drawings below.

WARNING!

Obey the instructions in chapter *Safety instructions (page 15)*. If you ignore them, injury or death, or damage to the equipment can occur.

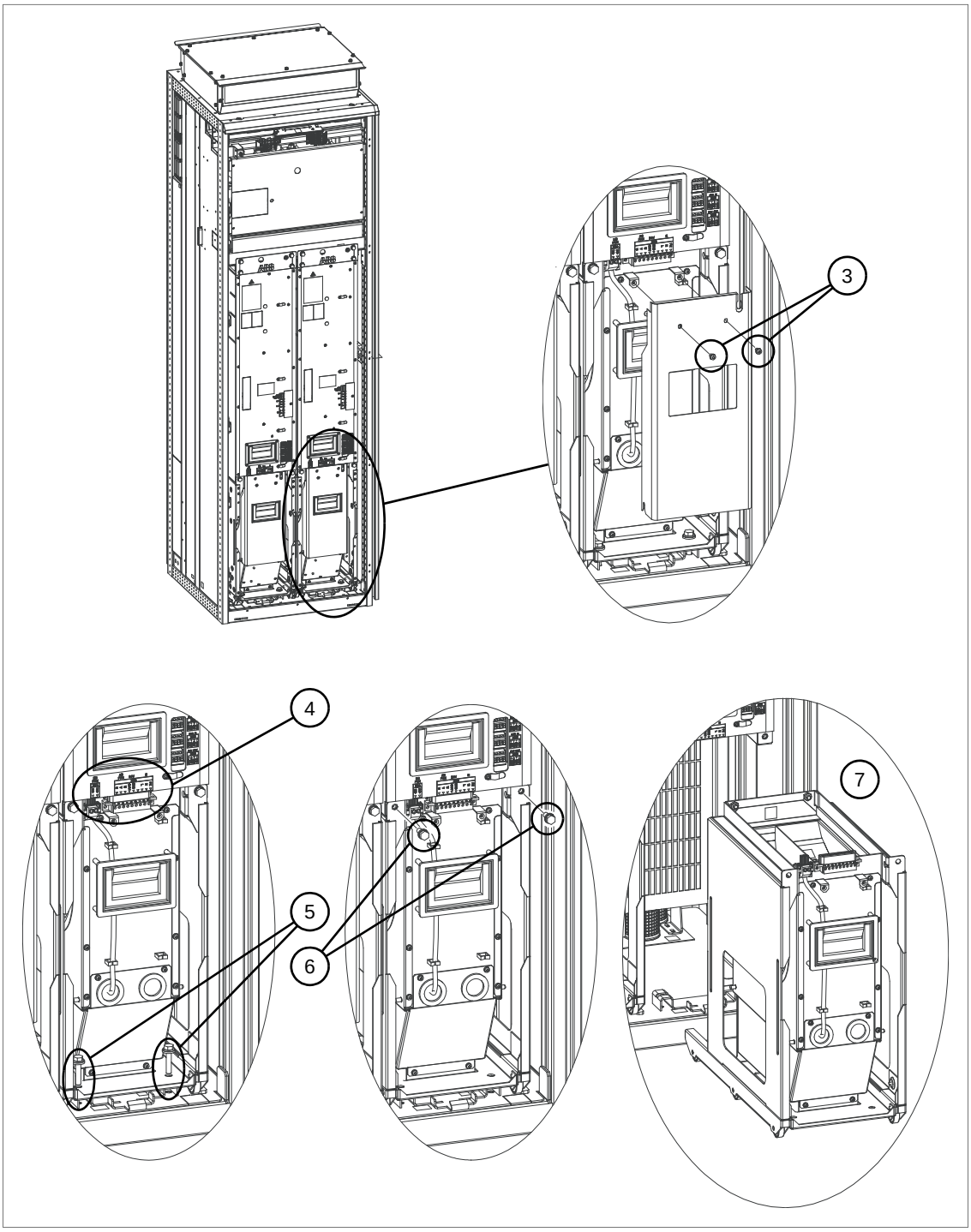
1. Do the steps in section *Electrical safety precautions (page 19)*before you start the work.
2. Open the inverter module cubicle door.
3. Remove the screws holding the front cover plate. Lift the cover plate somewhat to release it.
4. Disconnect the wiring at the top of the fan carriage.
5. Remove the two screws at the bottom of the fan carriage.

WARNING!

Before you proceed, make sure the two screws holding the top of the inverter module are in place.

6. Remove the two screws at the top of the fan carriage.
7. Pull the fan carriage out.
8. Repeat the procedure for other fan carriages in the same cubicle.

Proceed to *Connecting the motor cables (page 117)*.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7

Connecting the motor cables

Refer to the drawings below.

WARNING!

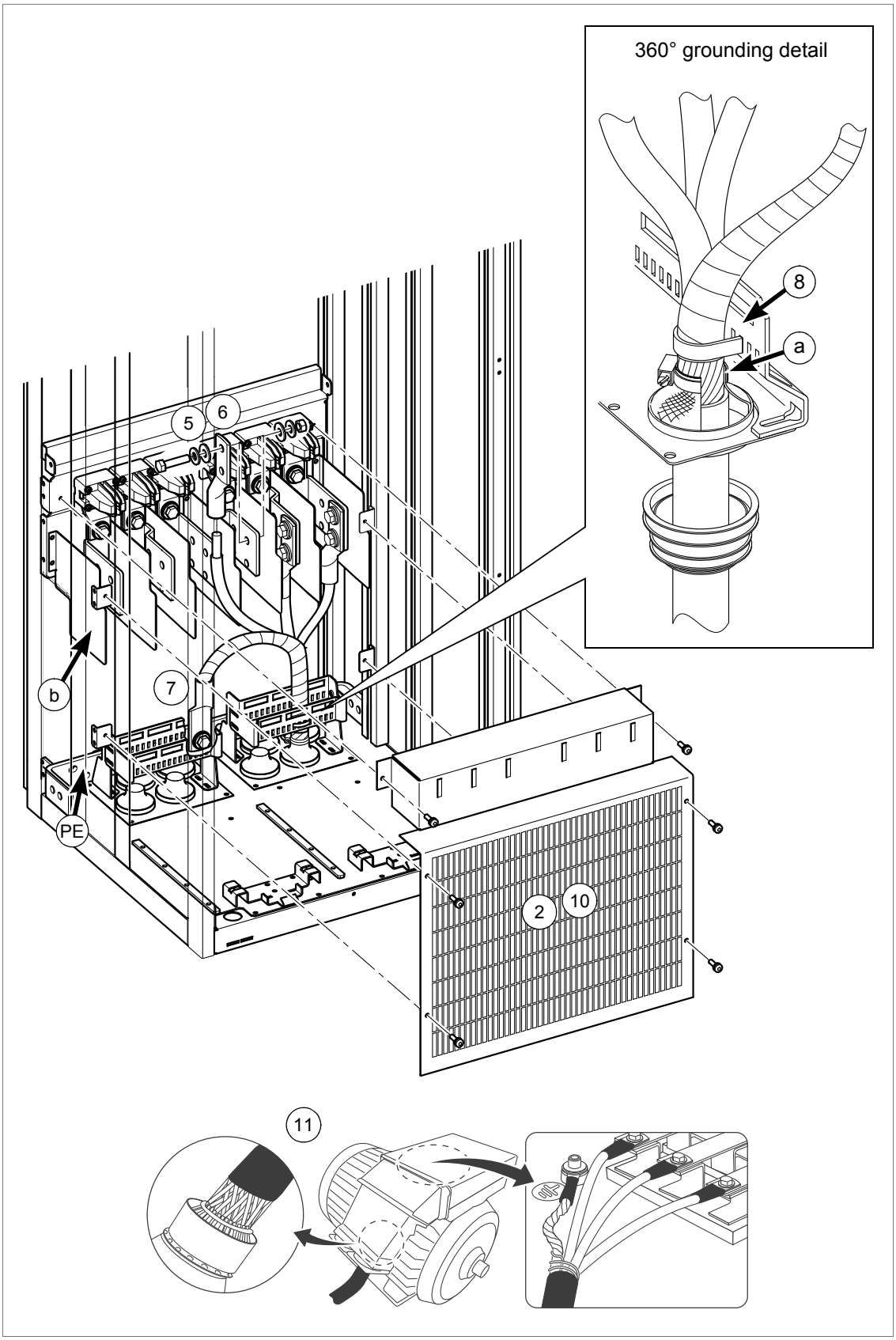
Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

1. Do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Remove the shroud in front of the output busbars.
3. For 360° grounding of the shield at the cable entry, remove the outer jacket of each cable where they pass through the cable entry (a).
4. Cut the cable to suitable length and strip the ends of the individual conductors. Twist the shield strands together to form a separate conductor and wrap it with tape.
5. Crimp suitable lug terminals onto the phase conductors and the ground conductor. The dimensions of the output busbars are shown in chapter *Technical data*.
6. Connect the phase conductors of the motor cable to the U2, V2 and W2 terminals. You can temporarily remove the plastic insulators (b) between the busbars to make the connecting work easier.

WARNING!

The plastic insulators (b) between the busbars must be in place when the inverter is powered.

7. Connect the shield (and any grounding conductors) of the cable to the PE busbar close to the cable entries.
8. Secure the cable mechanically.
9. Repeat the procedure for each motor cable.
10. Refit the shroud removed earlier.
11. At the motor, connect the cables according to instructions from the motor manufacturer. Pay special attention to the phase order. For minimum radio-frequency interference, ground the cable shield 360 degrees at the cable entry of the motor terminal box, or ground the cable by twisting the shield so that the flattened shield is wider than 1/5 of its length.


360° grounding detail
8
a
5
6
b
7
PE
2
10
11

Re-installing the fan carriage of an inverter module

(If the inverter module was removed completely instead of only the fan carriage, proceed to section *Re-inserting the inverter module into the cubicle* below).

The re-installation of the fan carriage is the removal procedure in reverse. See section *Removing and reinstalling the fan carriage of an inverter module (page 115)*.

Re-inserting the inverter module into the cubicle

WARNING!

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

1. Make sure there are no tools, debris or any other foreign objects in the cubicle.
2. If not already in place, attach the module extraction/installation ramp (included) to the base of the cabinet so that the tabs on the mounting bracket enter the slots on the ramp.
3. Push the module up the ramp and back into the cubicle.
   - **Keep your fingers away from the edge of the module front plate to avoid pinching.**
   - **Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.**
4. Secure the top front of the module with two screws. Tighten to 22 N·m (16 lbf·ft).
5. Secure the bottom front of the module with two screws. Tighten to 22 N·m (16 lbf·ft).
6. Remove the ramp.
7. Attach the DC busbars to the module. Tighten to 70 N·m (52 lbf·ft).
8. Reconnect terminal block [X50] at the top of the module.
9. Reconnect the wiring and fiber optic cables to the terminals on the front of the module.
10. Repeat the procedure for the other inverter modules.
11. Reinstall the shroud near the top of the cubicle.

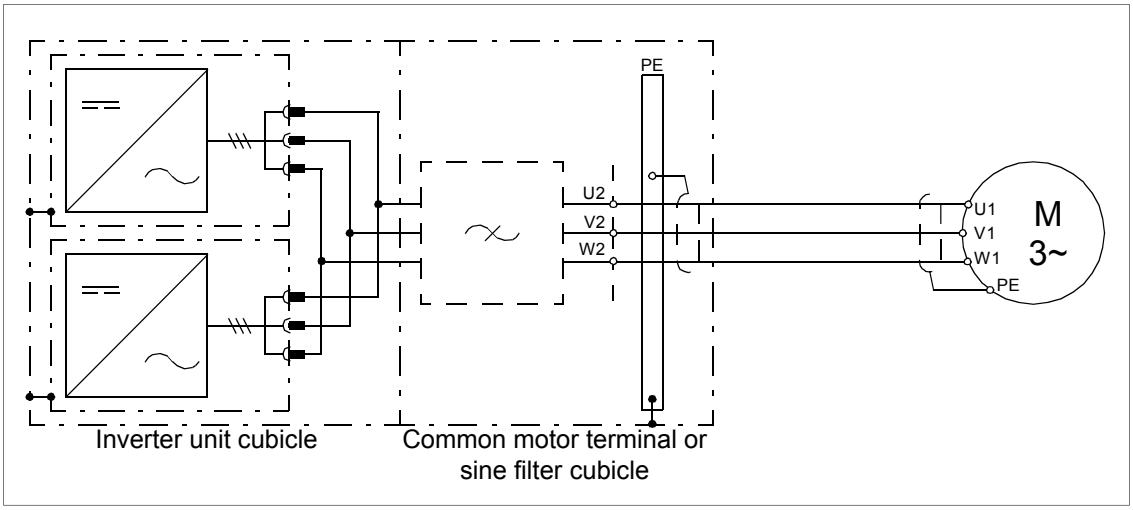
Connecting the motor cables (units with common motor terminal cubicle or sine output filter)

Output busbars

If the drive is equipped with option +H359, the motor cables connect to a common motor terminal cubicle. Similarly, if the drive is equipped with option +E206 (sine output filter), the motor cables connect to the output busbars in the sine filter cubicle.

The location and dimensions of the busbars for either case are visible in the dimensional drawings delivered with the drive, as well as the example dimension drawings in the manual.

Connection diagram



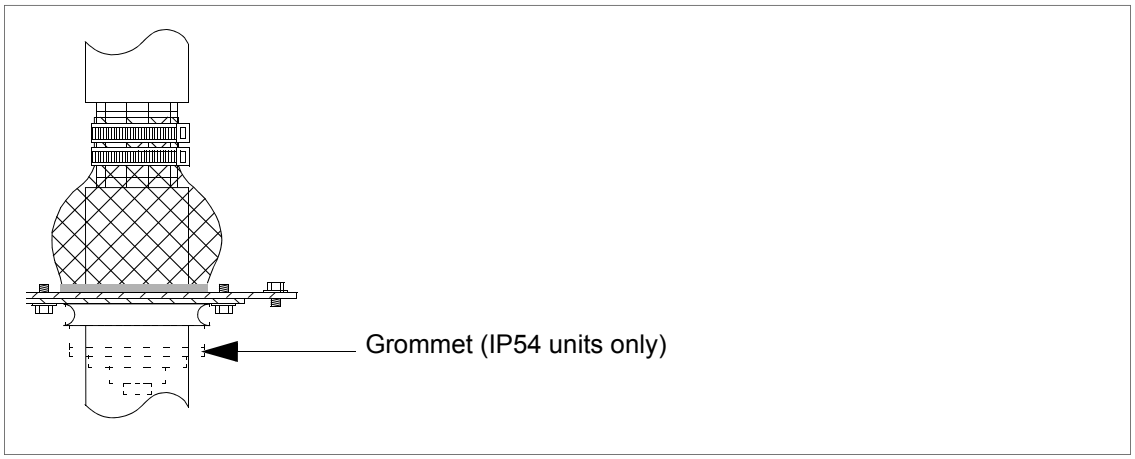
The recommended cable types are given in chapter *Technical data*.

Procedure

WARNING!

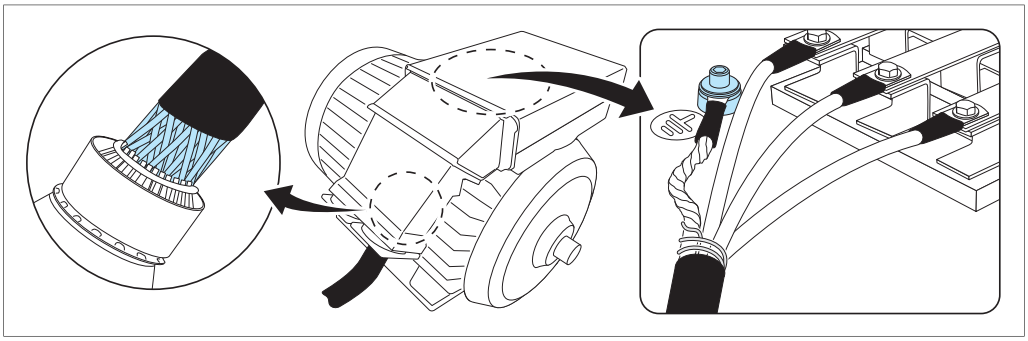
Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

1. Do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the door of the common motor terminal or sine filter cubicle and remove the shrouding.
3. Lead the cables into the cubicle. Make the 360° earthing arrangement at the cable entry as shown.



4. Cut the cables to suitable length. Strip the cables and conductors.
5. Twist the cable screens into bundles and connect the bundles to the PE busbar in the cubicle.
6. Connect any separate ground conductors/cables to the PE busbar in the cubicle.
7. Connect the phase conductors to the output terminals. Use the torques specified under *Tightening torques (page 202)*.
8. Refit any shrouding removed earlier and close the cubicle doors.

9. At the motor, connect the cables according to instructions from the motor manufacturer. Pay special attention to the phase order. For minimum radio-frequency interference, ground the cable shield 360 degrees at the lead-through of the motor terminal box, or ground the cable by twisting the shield so that the flattened shield is wider than 1/5 of its length.



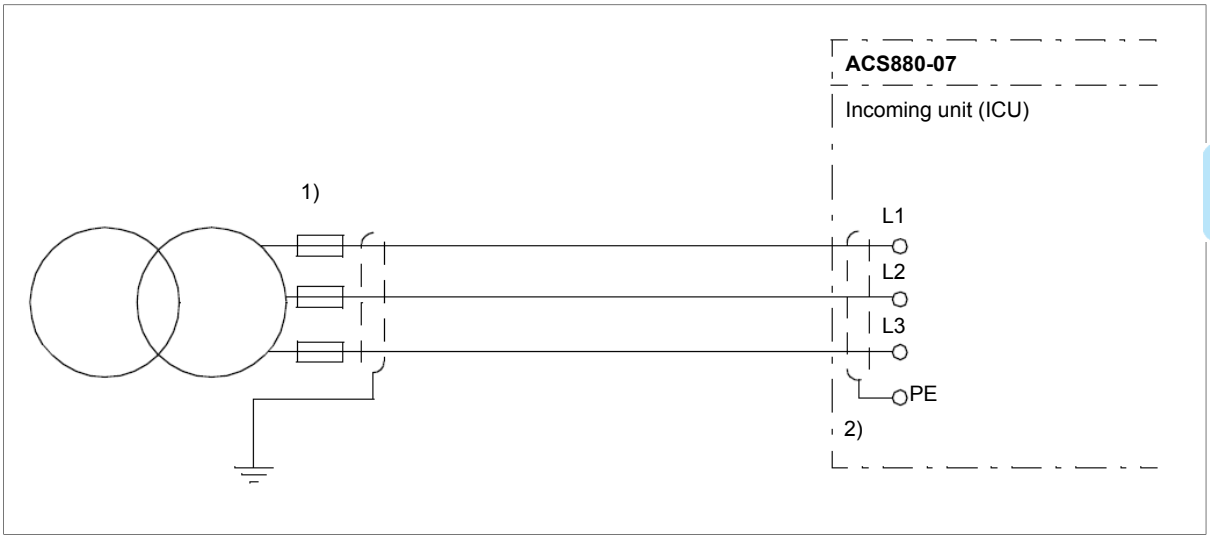
Connecting an external brake resistor assembly

See section *Electrical installation of custom brake resistors (page 270)*.

For the location of the terminals, refer to the dimension drawings delivered with the unit or the dimension drawing examples in chapter *Dimensions*.

Connecting the input power cables

Connection diagram, 6-pulse units



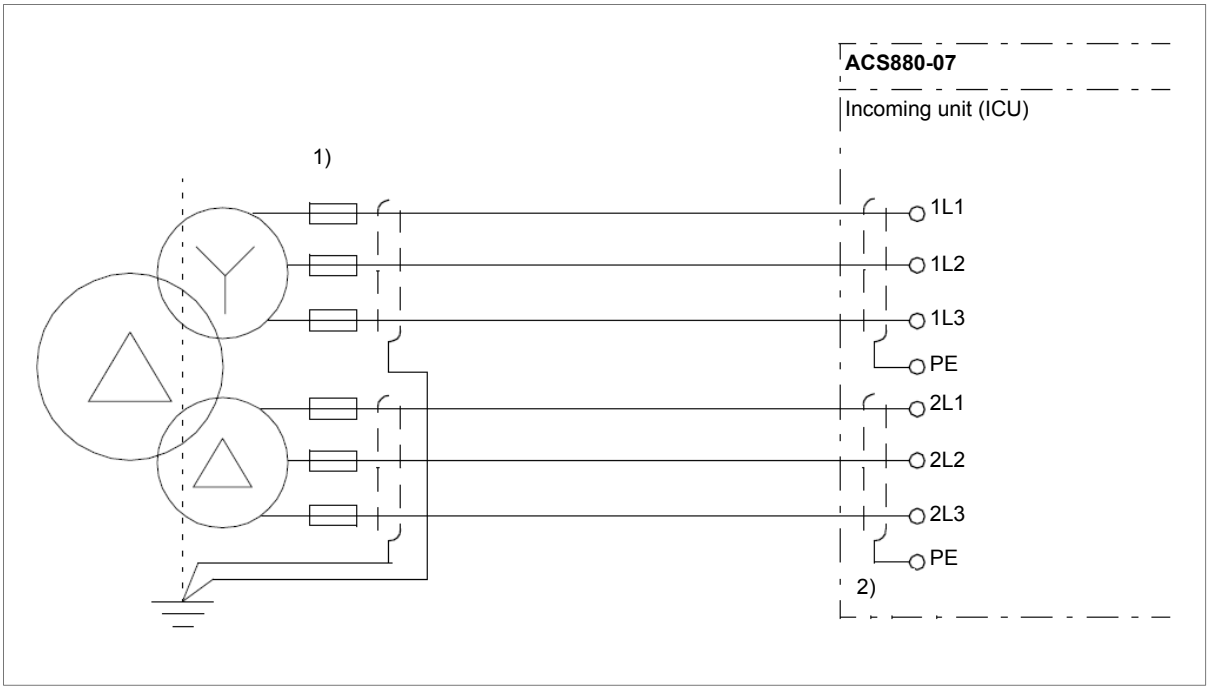
1) Fuses or other protection means.

2) 360-degree grounding is recommended if shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.

Note:

Use a separate grounding PE cable (1a) or a cable with a separate PE conductor (1b) if the conductivity of the shield does not meet the requirements for the PE conductor.

Connection diagram, 12-pulse units



1) Fuses or other protection means.

2) 360-degree grounding is recommended if shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.

Note:

Use a separate grounding PE cable (1a) or a cable with a separate PE conductor (1b) if the conductivity of the shield does not meet the requirements for the PE conductor.

Layout of the input cable connection terminals and lead-throughs

The location and dimensions of the busbars are visible in the dimensional drawings delivered with the drive. Alternatively, see the example dimension drawings in the manual.

Connection procedure

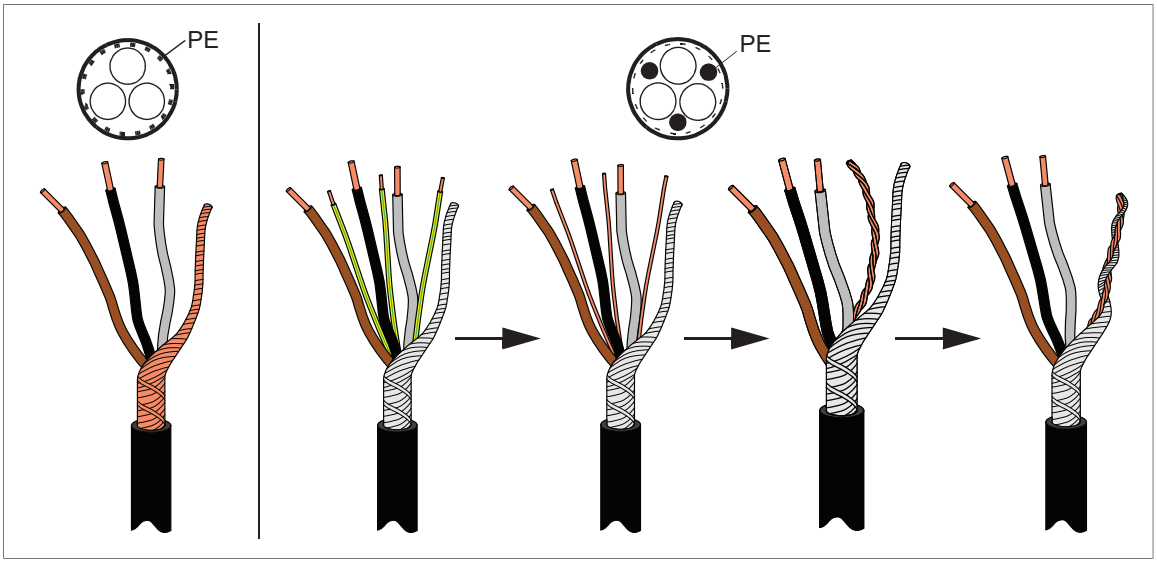
WARNING!

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

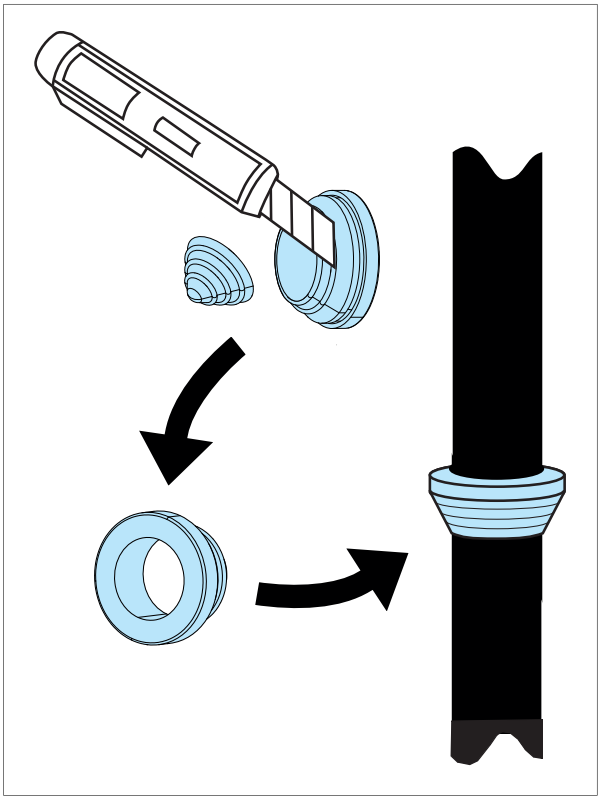
1. Do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the door of the incoming cubicle. open the door of the supply and inverter module cubicle.
3. Remove the shrouding covering the input terminals.
4. Peel off 3 to 5 cm of the outer insulation of the cables above the lead-through plate for 360° high-frequency grounding.
5. Prepare the ends of the cables.

WARNING! Aluminum-aluminum contact

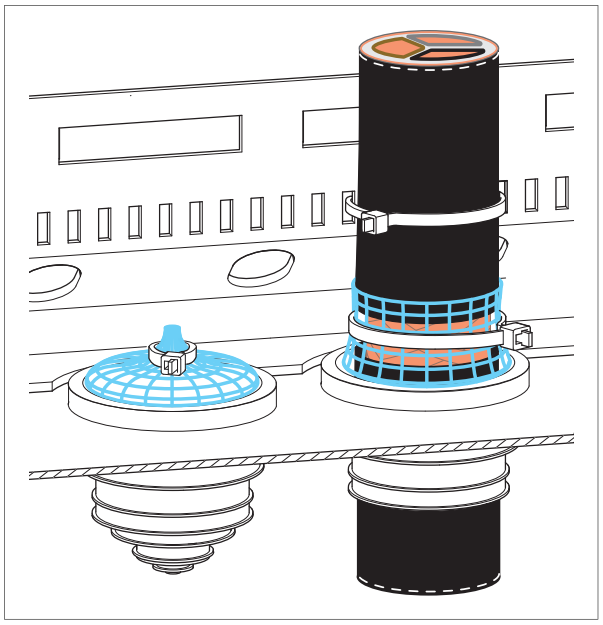
Apply grease to stripped aluminum conductors before attaching them to non-coated aluminum cable lugs. Obey the grease manufacturer's instructions. Aluminum-aluminum contact can cause oxidation in the contact surfaces.



6. If fire insulation is used, make an opening in the mineral wool sheet according to the diameter of the cable.
7. Remove rubber grommets from the cable entries for the cables to be connected. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Slide the cables into the cubicle through the conductive sleeves and attach the grommets to the holes.



8. Attach the conductive sleeves to the cable shields with cable ties. Tie up the unused conductive sleeves with cable ties.



9. Seal the slot between the cable and mineral wool sheet (if used) with sealing compound (eg. CSD-F, ABB brand name DXXT-11, code 35080082).
10. Connect the twisted shields of the cables to the PE busbar of the cabinet.
11. Connect the phase conductors of the input cable to the L1, L2 and L3 terminals. (With 12-pulse connection, the terminals are 1L1, 1L2 and 1L3 for one 6-pulse supply line, 2L1, 2L2 and 2L3 for the other.) Tighten the screws to the torque given under *Tightening torques (page 202)*.
12. Reinstall the shrouding removed earlier.
13. Close the cubicle door.

Connecting a PC

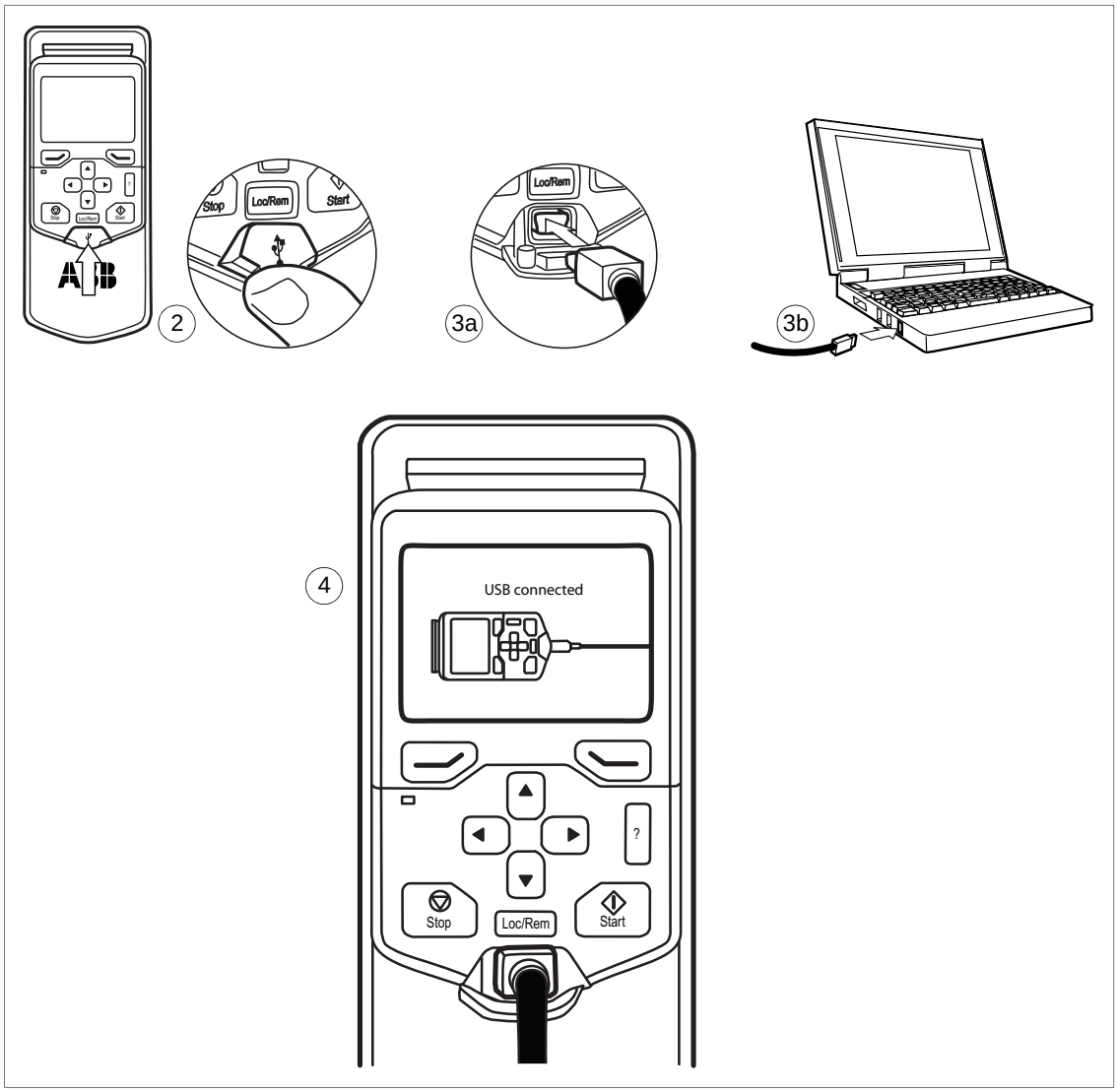
A PC (with eg. the Drive composer PC tool) can be connected to the inverter unit as follows:

1. Connect an ACS-AP-I control panel to the inverter control unit either by using an Ethernet (eg. CAT5E) networking cable, or by inserting the panel into the panel holder (if present).

WARNING!

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

2. Remove the USB connector cover on the front of the control panel.
3. Connect an USB cable (Type A to Type Mini-B) between the USB connector on the control panel (3a) and a free USB port on the PC (3b).
4. The panel will display an indication whenever the connection is active.



5. See the documentation of the PC tool for setup instructions.

Panel bus (Control of several units from one control panel)

One control panel (or PC) can be used to control several drives by constructing a panel bus. This is done by daisy-chaining the panel connections of the drives. Some drives have the necessary panel connectors in the control panel holder.. Others, including the ACS880-07, require the installation of an FDPI-02 module (available separately). For further information, see *FDPI-02 diagnostics and panel interface user's manual* (3AUA0000113618 [English]).

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

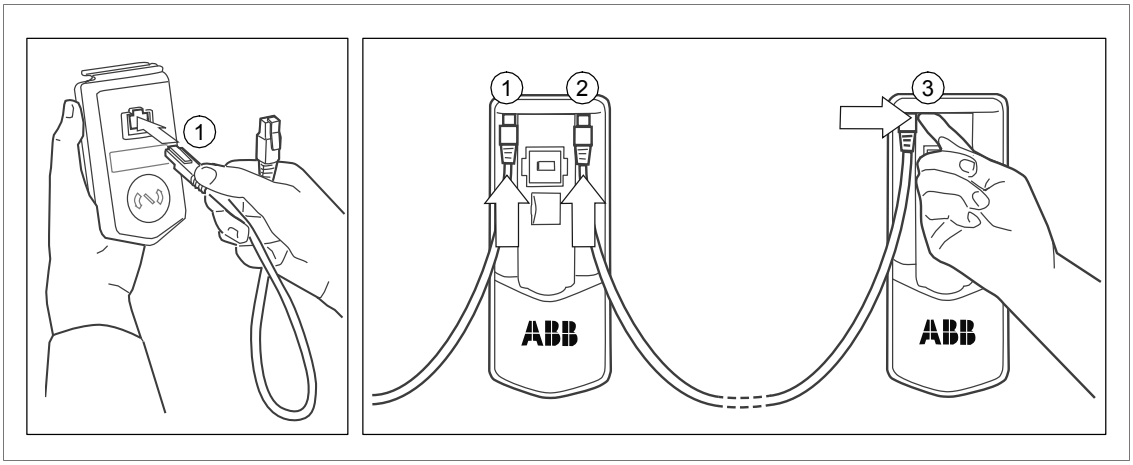
   Repeat the above for each drive.
2. Chain the panel and the drives together using Ethernet cables.
3. Switch on the bus termination on the drive that is farthest from the control panel in the chain.
   - With drives that have the panel mounted on the front cover, move the terminating switch into the outer position.

- With an FDPI-02 module, move termination switch S2 into the TERMINATED position.

Make sure that bus termination is off on all other drives.

4. On the control panel, switch on the panel bus functionality (Options - Select drive - Panel bus). The drive to be controlled can now be selected from the list under Options - Select drive.

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



Installing option modules

Mechanical installation of I/O extension, fieldbus adapter and pulse encoder interface modules

See hardware description for the available slots for each module. Install the option modules as follows:

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the door of the auxiliary control cubicle (ACU).
3. Remove the shrouding at the top of the cubicle.
4. Locate the inverter control unit (A41).
5. Insert the module carefully into its position on the control unit.
6. Fasten the mounting screw.

Note:

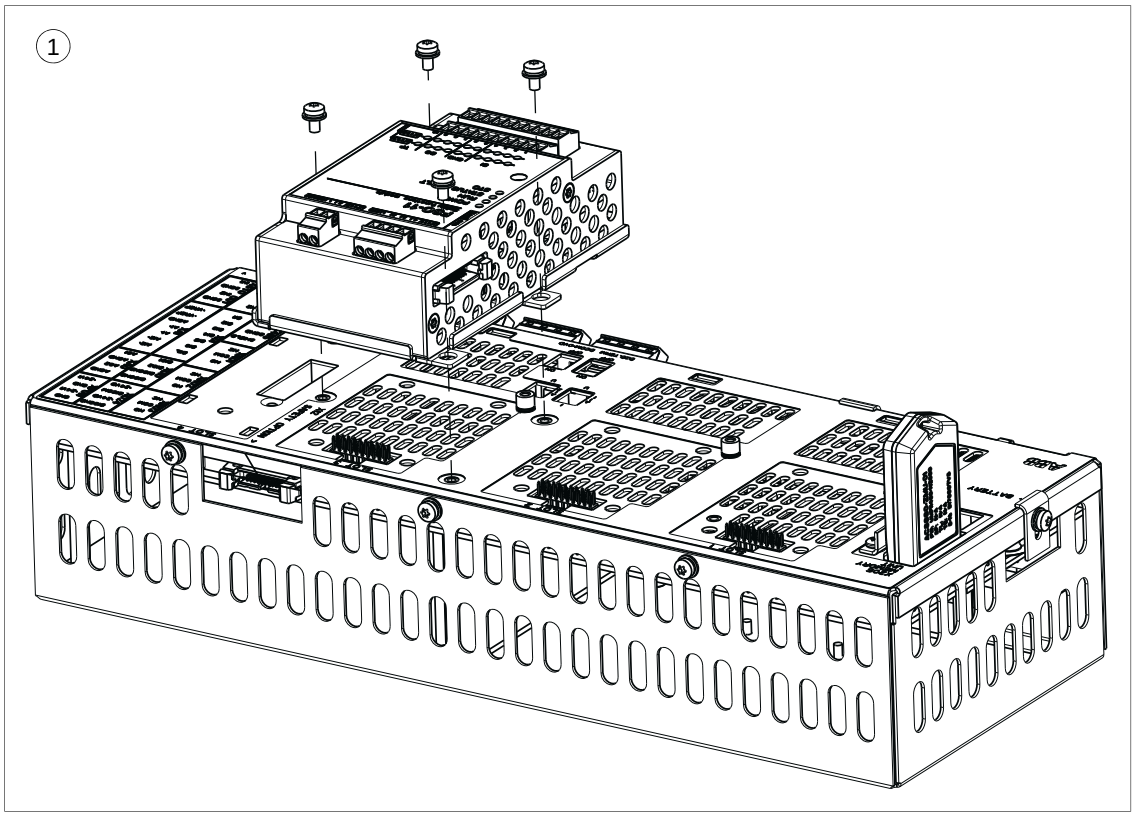
The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.

Mechanical installation of an FSO-xx safety functions module

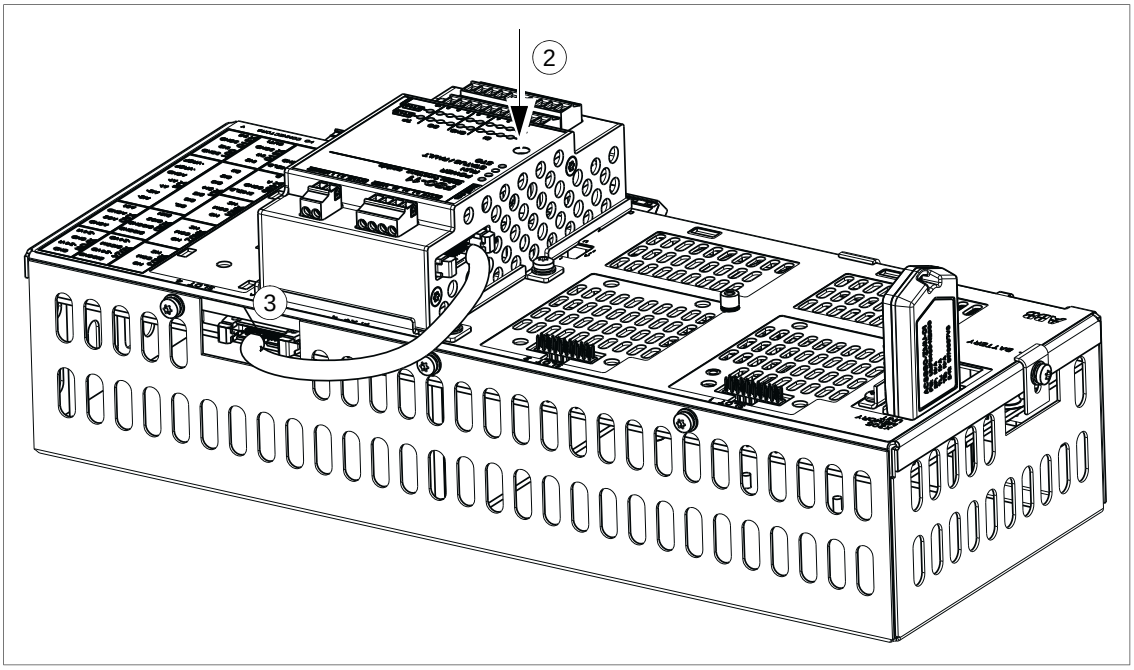
This procedure describes the mechanical installation of an FSO-xx safety functions module onto the inverter control unit. (The FSO-xx can alternatively be installed beside the control

unit, which is the standard with factory-installed FSO-xx modules. For instructions, see the FSO-xx manual.)

1. Fasten the module onto slot 3 of the inverter control unit (A41) with four screws.



2. Tighten the FSO-xx electronics grounding screw.
3. Connect the FSO-xx data cable between FSO-xx connector X110 and to BCU-x2 connector X12.



Wiring of optional modules

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

7

Control units of the drive

What this chapter contains

This chapter

- describes the connections of the control units used in the drive,
- contains the specifications of the inputs and outputs of the control units.

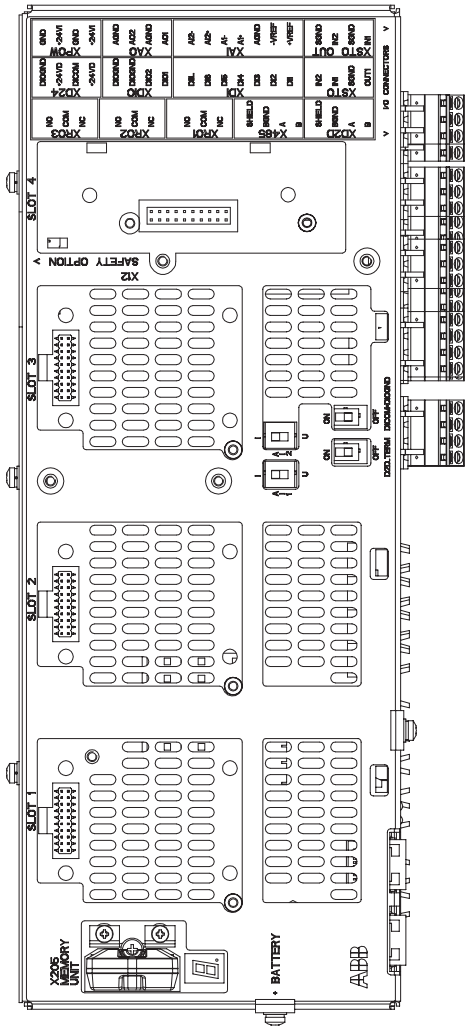
General

The ACS880 drive utilizes BCU-x2 control units. The BCU-x2 consists of a BCON-12 control board (and a BIOC-01 I/O connector board and power supply board) built in a metal housing.

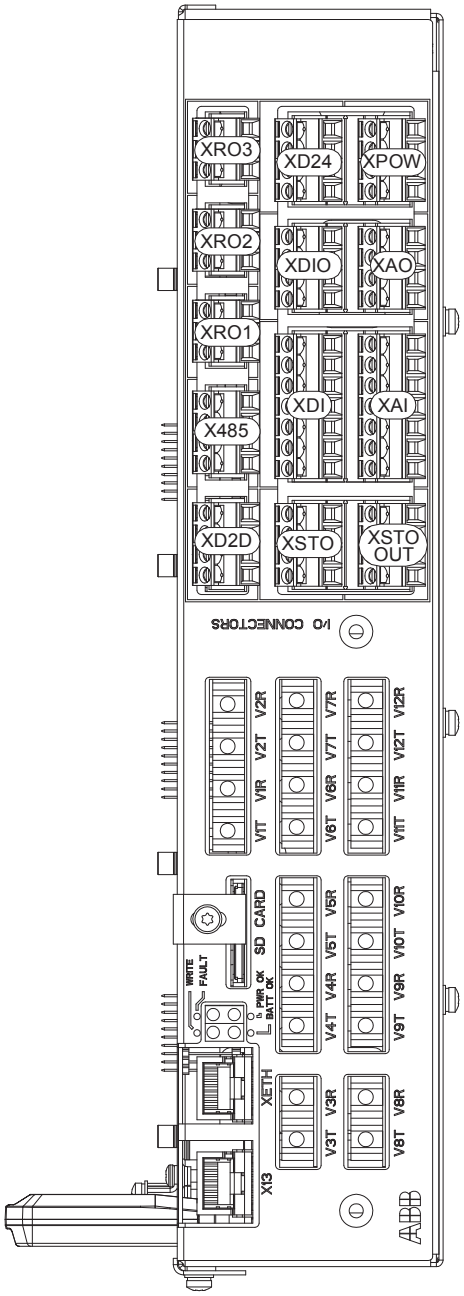
The supply and inverter units of the drive are each controlled by a dedicated BCU-x2 control unit. The designation of the supply control unit is A51; the inverter control unit is A41. Both are located in the ACU cubicle, and connected to the power modules (ie. supply and inverter modules respectively) by fiber optic cables.

In this manual, the name “BCU-x2” represents the control unit types BCU-02 and BCU-12. These have a different number of power module connections (2 and 7 respectively) but are otherwise similar.

Control unit layout and connections



	Description
I/O	I/O terminals (see following diagram)
SLOT 1	I/O extension, encoder interface or fieldbus adapter module connection. (This is the sole location for an FDPI-02 diagnostics and panel interface.)
SLOT 2	I/O extension, encoder interface or fieldbus adapter module connection
SLOT 3	I/O extension, encoder interface, fieldbus adapter or FSO-xx safety functions module connection
SLOT 4	RDCO-0x DDCS communication option module connection
X205	Memory unit connection
BATTERY	Holder for real-time clock battery (BR2032)
AI1	Mode selector for analog input AI1 (I = current, U = voltage)
AI2	Mode selector for analog input AI2 (I = current, U = voltage)
D2D TERM	Termination switch for drive-to-drive link (D2D)
DICOM= DIOGND	Ground selection. Determines whether DICOM is separated from DIOGND (ie. the common reference for the digital inputs floats). See the ground isolation diagram.
7-segment display Multicharacter indications are displayed as repeated sequences of characters	
o	(“U” is indicated briefly before “o”.)
U	Control program startup in progress
L	(Flashing) Firmware cannot be started. Memory unit missing or corrupted
1	Firmware download from PC to control unit in progress
2	At power-up, the display may show short indications of eg. “1”, “2”, “b” or “U”. These are normal indications immediately after power-up. If the display ends up showing any other value than those described, it indicates a hardware failure.



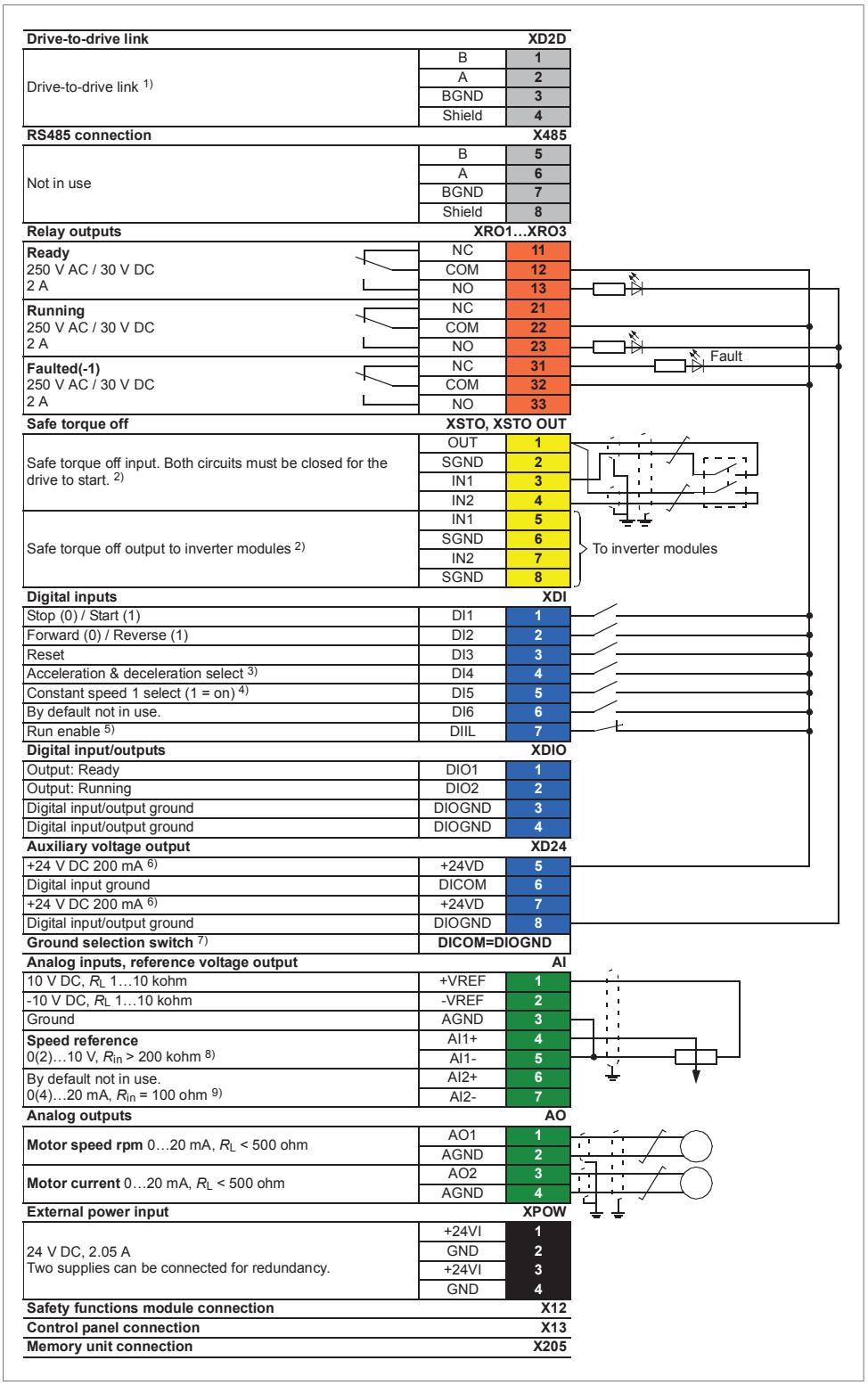
	Description
XAI	Analog inputs
XAO	Analog outputs
XDI	Digital inputs, Digital input interlock (DIIL)
XDIO	Digital input/outputs
XD2D	Drive-to-drive link
XD24	+24 V output (for digital inputs)
XETH	Ethernet port (eg. for PC communication)
XPOW	External power input
XRO1	Relay output RO1
XRO2	Relay output RO2
XRO3	Relay output RO3
XSTO	Safe torque off connection (input signals)
XSTO OUT	Safe torque off connection (to inverter modules)
X12	(On the opposite side) Connection for FSO-xx safety functions module (optional)
X13	Control panel / PC connection
X485	Not in use
V1T/V1R, V2T/V2R	Fiber optic connection to modules 1 and 2 (VxT = transmitter, VxR = receiver)
V3T/V3R … V7T/V7R	Fiber optic connection to modules 3…7 (BCU-12/22 only) (VxT = transmitter, VxR = receiver)
V8T/V8R … V12T/V12R	Fiber optic connection to modules 8…12 (BCU-22 only) (VxT = transmitter, VxR = receiver)
SD CARD	Data logger memory card for inverter module communication
BATT OK	Real-time clock battery voltage is higher than 2.8 V. If the LED is off when the control unit is powered, replace the battery.
FAULT	The control program has generated a fault. See the firmware manual of the supply/inverter unit.
PWR OK	Internal voltage supply is OK
WRITE	Writing to memory card in progress. Do not remove the memory card.

Default I/O diagram of the supply control unit (A51)

The diagram below shows the default I/O connections on the supply control unit (A51), and describes the use of the signals/connections in the supply unit. Under normal circumstances, the factory-made wiring should not be changed.

Relay outputs		**XRO1…XRO3**
XRO1: **Running** (energized = running) 250 V AC / 30 V DC 2 A	NO	3
	COM	2
	NC	1
XRO2: **Fault (-1)** (energized = no fault) 250 V AC / 30 V DC 2 A	NO	3
	COM	2
	NC	1
XRO3: **MCB ctrl** (energized = main contactor/breaker closed) 250 V AC / 30 V DC 2 A	NO	3
	COM	2
	NC	1
Reference voltage and analog inputs		**XAI**
10 V DC, R_L 1…10 kohm	+VREF	1
-10 V DC, R_L 1…10 kohm	-VREF	2
Ground	AGND	3
Not in use 0(2)…10 V, R_{in} > 200 kohm	AI1+	4
	AI1-	5
Not in use 0(4)…20 mA, R_{in} = 100 ohm	AI2+	6
	AI2-	7
Analog outputs		**XAO**
Not in use	AO1	1
	AGND	2
Not in use	AO2	3
	AGND	4
Drive-to-drive link		**XD2D**
Not in use	Shield	4
	BGND	3
	A	2
	B	1
Safe torque off		**XSTO**
Safe torque off. Both circuits must be closed for the supply unit to start. (IN1 and IN2 must be connected to OUT.)	IN2	4
	IN1	3
	SGND	2
	OUT	1
Digital inputs		**XDI**
Temperature fault (0 = overtemperature)	DI1	1
Run / enable (1 = run enable)	DI2	2
MCB feedback (1 = main contactor/breaker closed)	DI3	3
Circuit breaker fault (0 = auxiliary circuit breaker or switch open)	DI4	4
Ground (earth) fault (with optional ground fault monitoring)	DI5	5
Reset (0 ⟶ 1 = fault reset)	DI6	6
Emergency stop (0 = emergency stop activated) (units with em. stop option only)	DIIL	7
Digital input/outputs		**XDIO**
Not in use	DIO1	1
Not in use	DIO2	2

Default I/O diagram of the inverter control unit (A41)



Notes:

The wire size accepted by all screw terminals (for both stranded and solid wire) is 0.5 … 2.5 mm^2 (24…12 AWG). The torque is 0.5 N·m (5 lbf·in).

1) See section *Drive-to-drive link (XD2D) (page 135)*.

2) See chapter *The Safe torque off function (page 253)*.

[3] 0 = Acceleration/deceleration ramps defined by parameters 23.12/23.13 in use. 1 = Acceleration/deceleration ramps defined by parameters 23.14/23.15 in use.

[4] Constant speed 1 is defined by parameter 22.26.

[5] See section *DIIL input (page 135)*.

[6] Total load capacity of these outputs is 4.8 W (200 mA at 24 V) minus the power taken by DIO1 and DIO2.

[7] Determines whether DICOM is separated from DIOGND (ie. common reference for digital inputs floats; in practice, selects whether the digital inputs are used in current sinking or sourcing mode). See also *Ground isolation diagram (page 139)*. DICOM=DIOGND ON: DICOM connected to DIOGND. OFF: DICOM and DIOGND separate.

[8] Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected by switch AI1. Change of setting requires reboot of control unit.

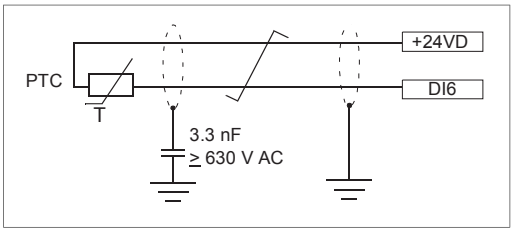
[9] Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected by switch AI2. Change of setting requires reboot of control unit.

External power supply for the control unit (XPOW)

The BCU-x2 is powered from a 24 V DC, 2 A supply through terminal block XPOW. A second supply can be connected to the same terminal block for redundancy.

DI6 as a PTC sensor input

A PTC sensor can be connected to this input for motor temperature measurement as follows. The sensor can alternatively be connected to FEN-xx encoder interface module. At the sensor end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, 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. See the firmware manual for parameter settings.



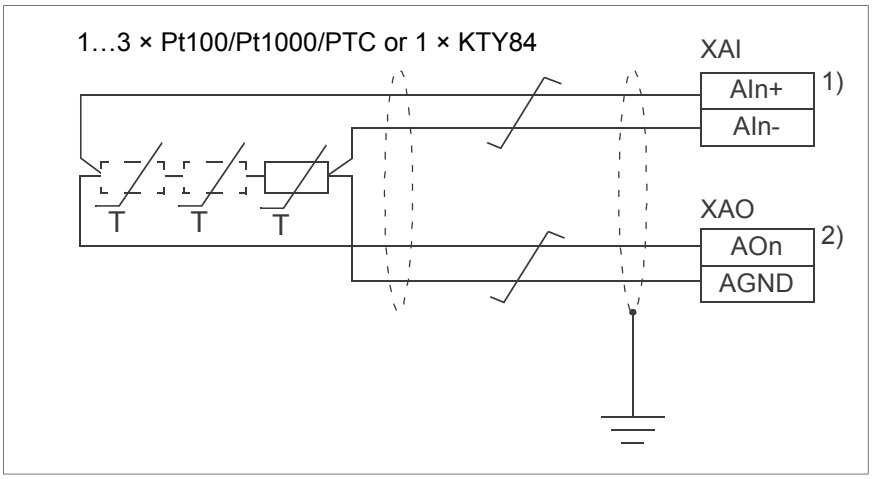
WARNING!

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

AI1 or AI2 as a Pt100, Pt1000, PTC or KTY84 sensor input

Three Pt100/Pt1000 sensors or one KTY84 sensor for motor temperature measurement can be connected between an analog input and output as shown below. (Alternatively, you can connect the KTY to an FIO-11 or FAIO-01 analog I/O extension module or FEN-xx encoder interface module.) At the sensor end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, 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.



1) Set the input type to voltage with the appropriate switch or jumper on the control unit. Make the corresponding setting in the control program in parameter group **12 Standard AI**.

2) Select the excitation mode in parameter group **13 Standard AO**.

WARNING!

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

DIIL input

The DIIL input is used for the connection of safety circuits. The input is parametrized to stop the unit when the input signal is lost.

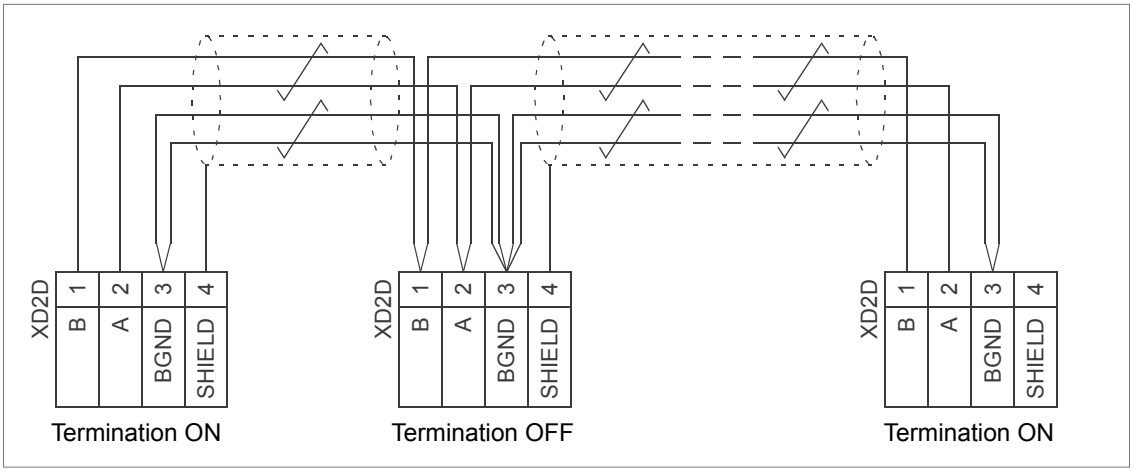
Drive-to-drive link (XD2D)

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

Enable bus termination on the inverters at the ends of the drive-to-drive link by setting switch D2D TERM on the control unit to ON. On intermediate inverters, disable bus termination.

Use shielded twisted-pair cable (~100 ohm, for example, PROFIBUS-compatible cable) for the wiring. For best immunity, high quality cable is recommended. Keep the cable as short as possible; the maximum length of the link is 50 meters (164 ft). Avoid unnecessary loops and running the cable near power cables (such as motor cables). Ground the cable shields.

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



Safe torque off (XSTO, XSTO OUT)

On the inverter control unit (A41), the XSTO input can be used to implement a safe torque off (STO) function. For the drive to start, both connections (OUT1 to IN1 and IN2) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting an external Safe torque off circuit to the drive. For information on the implementation of a Safe torque off function, see chapter *The Safe torque off function (page 253)*.

Note:

The XSTO input only acts as a true Safe torque off input on the inverter control unit [A41]. De-energizing the IN1 and/or IN2 terminals on the supply control unit [A51] will stop the supply unit but not constitute a true safety function.

The XSTO OUT connector is wired to the STO IN connector of one inverter module. In case the inverter unit consists of multiple modules, the STO OUT connector of one module is wired to the STO IN connector of the next module etc. so that all modules are part of the chain.

FSO-xx safety functions module connection (X12)

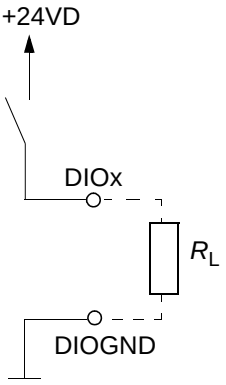
See the user manual of the FSO-xx module.

SDHC memory card slot

The BCU-x2 has an on-board data logger that collects real-time data from the power modules to help fault tracing and analysis. The data is stored onto the SDHC memory card inserted into the SD CARD slot and can be analyzed by ABB service personnel.

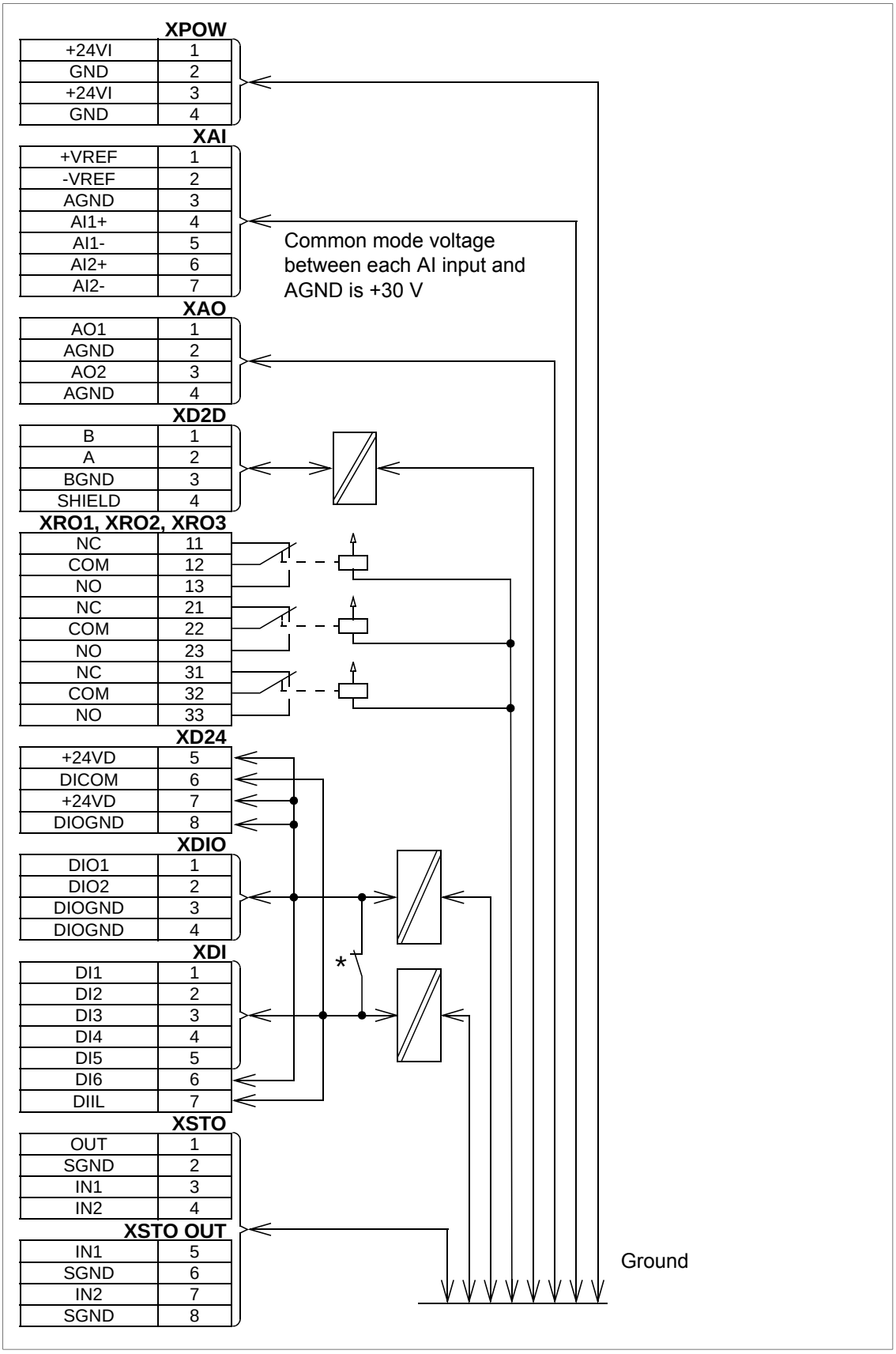
Connector data

Power supply (XPOW)	Connector pitch 5 mm, wire size 2.5 mm^2 24 V (±10%) DC, 2 A External power input. Two supplies can be connected for redundancy.
Relay outputs RO1…RO3 (XRO1…XRO3)	Connector pitch 5 mm, wire size 2.5 mm^2 250 V AC / 30 V DC, 2 A Protected by varistors
+24 V output (XD24:2 and XD24:4)	Connector pitch 5 mm, wire size 2.5 mm^2 Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.

Digital inputs DI1…DI6 (XDI:1…XDI:6)	Connector pitch 5 mm, wire size 2.5 mm^2 24 V logic levels: “0” < 5 V, “1” > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP (DI1…DI5), NPN (DI6) Hardware filtering: 0.04 ms, digital filtering up to 8 ms DI6 (XDI:6) can alternatively be used as an input for a PTC sensor. “0” > 4 kohm, “1” < 1.5 kohm. I_{max}: 15 mA (DI1…DI5), 5 mA (DI6)
Start interlock input DIIL (XDI:7)	Connector pitch 5 mm, wire size 2.5 mm^2 24 V logic levels: “0” < 5 V, “1” > 15 V R_{in}: 2.0 kohm Input type: NPN/PNP Hardware filtering: 0.04 ms, digital filtering up to 8 ms
Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2) Input/output mode selection by parameters. DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual of the supply/inverter unit, parameter group 111/11.	Connector pitch 5 mm, wire size 2.5 mm^2 As inputs: 24 V logic levels: “0” < 5 V, “1” > 15 V. R_{in}: 2.0 kohm. Filtering: 1 ms. As outputs: Total output current from +24VD is limited to 200 mA 
Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)	Connector pitch 5 mm, wire size 2.5 mm^2 10 V ±1% and –10 V ±1%, R_{load} 1…10 kohm Maximum output current: 10 mA
Analog inputs AI1 and AI2 (XAI:4 … XAI:7). Current/voltage input mode selection by switches.	Connector pitch 5 mm, wire size 2.5 mm^2 Current input: –20…20 mA, R_{in} = 100 ohm Voltage input: –10…10 V, R_{in} > 200 kohm Differential inputs, common mode range ±30 V Sampling interval per channel: 0.25 ms Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range
Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm, wire size 2.5 mm^2 0…20 mA, R_{load} < 500 ohm Frequency range: 0…500 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
Drive-to-drive link (XD2D)	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485 Termination by jumper or switch
RS-485 connection (X485)	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485

Safe torque off connection (XSTO)	Connector pitch 5 mm, wire size 2.5 mm^2 Input voltage range: -3…30 V DC Logic levels: “0” < 5 V, “1” > 17 V. For the unit to start, both connections must be “1”. Current consumption: 66 mA (continuous) per STO channel per R8i inverter module EMC (immunity) according to IEC 61326-3-1
Safe torque off output (XSTO OUT)	Connector pitch 5 mm, wire size 2.5 mm^2 To STO connector of inverter module.
Control panel connection (X13)	Connector: RJ-45 Cable length < 3 m
Ethernet connection (XETH)	Connector: RJ-45
SDHC memory card slot (SD CARD)	Memory card type: SDHC Maximum memory size: 4 GB
The terminals of the control unit fulfill the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if a voltage higher than 48 V is connected to the relay output.	

Ground isolation diagram



***Ground selector (DICOM=DIOGND) settings**

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

8

Installation checklist

Contents of this chapter

This chapter contains an installation checklist which you must complete before you start up the drive.

Warnings

WARNING!

Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur. Do the steps in section *Electrical safety precautions (page 19)* before you start the work. Go through the checklist together with another person.

Checklist

Check that …	☑
The ambient operating conditions meet the specifications. See the technical data.	☐
The drive cabinet has been fixed to floor, and if necessary due to vibration etc, also from top to the wall or roof.	☐
The cooling air will flow freely in and out of the drive.	☐
If the drive will be connected to an IT (ungrounded) or a corner grounded TN network: The optional EMC filter (+E200, +E202) of the drive (if any) has been disconnected. See the electrical installation instructions.	☐
There is an adequately sized protective earth (ground) conductor between the drive and the switchboard, and the conductor has been connected to appropriate terminal, and the terminal have been tightened. (Pull the conductor to check.) Proper grounding has also been measured according to the regulations.	☐
The input power cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull on the conductors to check.)	☐

Check that …	☑
There is an adequately sized protective earth (ground) conductor between the motor and the drive, and the conductor has been connected to appropriate terminal, and the terminal have been tightened. (Pull on the conductors to check.). Proper grounding has also been measured according to the regulations.	☐
The motor cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull on the conductors to check.)	☐
The motor cable has been routed away from other cables.	☐
No power factor compensation capacitors have been connected to the motor cable.	☐
If an external brake resistor has been connected to the drive: There is an adequately sized protective earth (ground) conductor between the brake resistor and the drive, and the conductor has been connected to appropriate terminal. Proper grounding has also been measured according to the regulations.	☐
If an external brake resistor has been connected to the drive: The brake resistor has been connected to the appropriate terminals, and the terminals have been tightened. (Pull on the conductors to check.)	☐
If an external brake resistor has been connected to the drive: The brake resistor cable has been routed away from other cables.	☐
The control cables have been connected to the appropriate terminals, and the terminals have been tightened. (Pull on the conductors to check.)	☐
The supply voltage matches the nominal input voltage of the drive. Check the type designation label.	☐
The voltage setting of the auxiliary voltage transformers (if any) is correct. See the electrical installation instructions.	☐
If a drive bypass connection will be used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked, ie, cannot be closed simultaneously.	☐
There are no tools, foreign objects or dust from drilling inside the drive.	☐
The area in front of the drive is clean: the drive cooling fan cannot draw any dust or dirt inside.	☐
All shrouds and cover of the motor connection box are in place. Cabinet doors have been closed.	☐
The motor and the driven equipment are ready for start.	☐

9

Start-up

Contents of this chapter

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

Start-up procedure

The tasks which are needed in certain cases only are marked with underlining, and option codes are given in brackets. Default device designations (if any) are given in brackets after the name, for example “main switch-disconnector [Q1]”. The same device designations are also used in the circuit diagrams.

These instructions cannot and do not cover all possible start-up tasks of a customized drive. Always refer to the delivery-specific circuit diagrams when proceeding with the start-up.

WARNING!

Only qualified electricians are allowed to do the work described in this chapter.

Note:

For certain options (such as functional safety options +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q978, +Q979), additional start-up instructions are given in their separate manuals.

Action	☑
Safety	
WARNING! Obey the safety instructions during the start-up procedure. See chapter *The Safe torque off function (page 253)*.	☐
Checks/Settings with no voltage connected	
Ensure that the disconnector of the supply transformer is locked to the off (0) position, ie. no voltage is, and cannot be connected to the drive inadvertently.	☐

Action	☑
Check that the main switch-disconnector (Q1.1) is switched off, or main breaker (Q1) racked out. **Note:** Some 12-pulse units are equipped with two switch-disconnectors or breakers – check that both are open before you proceed.	☐
Check that the grounding switch (Q9.1) (option +F259) is switched on. 12-pulse units have two switches, Q9.1 and Q9.2.	☐
Check the mechanical and electrical installation of the drive. See *Installation checklist (page 141)*.	☐
Check the settings of breakers/switches in the auxiliary circuits. See the circuit diagrams delivered with the drive.	☐
Check the tap settings of transformers T21, T101 (if present) and T111 (if present). See section *Checking the settings of transformers T21, T101 and T111 (page 96)*.	☐
Disconnect any unfinished or uninspected auxiliary voltage (115/230 V AC) cables that lead from the terminal blocks to the outside of the equipment.	☐
Check that both channels of the Safe torque off circuit connected to the STO inputs of both the supply control unit [A51] and the inverter control unit [A41] are closed. Refer to the wiring diagrams delivered with the drive.	☐
If the Safe torque off functionality is used, check that the STO OUT output on the inverter control unit (A41) is chained to the STO inputs of all inverter modules. If the Safe torque off functionality is not used, check that the STO input on all inverter modules is correctly wired to +24 V and ground.	☐
Drives with ground fault monitoring for IT (ungrounded) systems (option +Q954): Adjust the settings of the ground fault monitor to suit the installation. See the circuit diagrams of the delivery and *IRDH275B Ground Fault Monitor Operating Manual* by Bender (code: TGH1386en).	☐
Drives with Pt100 relays (option +(n)L506): • Check the connections against the circuit diagrams of the delivery. • Set the alarm and trip levels of the Pt100 relays. Set the alarm and trip levels of the Pt100 relay as low as possible based on the operating temperature and test results of the machine. The trip level can be set, for example, 10 °C higher than what the temperature of the machine is at maximal load in the maximum environmental temperature. We recommend to set the operating temperatures of the relay, typically for example, as follows: • 120…140 °C when only tripping is in use • alarm 120…140 °C and trip 130…150 °C when both alarm and tripping are used.	☐
Powering up the auxiliary circuit of the drive	
Make sure that it is safe to connect voltage. Ensure that • nobody is working on the drive or circuits that have been wired from outside into the drive cabinet • the cover of the motor terminal box is in place.	☐
Drives with a voltmeter (option +G334): Make sure that the circuit breaker of the measuring circuit (F5.1) is closed.	☐
Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits.	☐
Close the cabinet doors.	☐
Close the main breaker of the supply transformer.	☐
Switch on the auxiliary voltage (Q21).	☐
Setting up the supply unit parameters	
Check the voltage range setting in parameter *195.01 Supply voltage*. For more information on setting up the supply control program, see the *ACS880 diode supply control program firmware manual* (3AUA0000103295 [English]). If you need more information on the use of the control panel, see the *ACX-AP-x Assistant control panels user's manual* (3AUA0000085685 [English]).	☐

Action	☑
Setting up the inverter unit parameters, and performing the first start	
Set up the inverter control program. See the appropriate start-up guide and/or firmware manual. There is a separate start-up guide only for some control programs.	☐
Check that parameter *95.09 Fuse switch control* is disabled.	☐
Drives with a brake chopper (option +D150): See chapter *Resistor braking (page 265)*.	☐
Drives with a sine output filter (option +E206): Check that bit 1 of parameter *95.15 Special HW settings* is activated.	☐
Drives with an fieldbus adapter module (optional): Set the fieldbus parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the fieldbus adapter module, and the drive firmware manual. Check that the communication works between the drive and the PLC.	☐
Drives with an encoder interface module (optional): Set the encoder parameters. Activate the appropriate assistant (if present) in the control program, or see the user's manual of the encoder interface module, and the drive firmware manual.	☐
Powering up the main circuit of the drive	
Switch the grounding switch (Q9.1) (option +F259) off. 12-pulse units have two grounding switches, Q9.1 and Q9.2.	☐
Close the main switch-disconnector (Q1.1) or main breaker (Q1). **Note:** Do not use excessive force. The main switch-disconnector (or main breaker) can only be closed when • the main input terminals (L1, L2, L3) are powered, and • auxiliary voltage is switched on (Q21), and • grounding switch is off (Q9.1, Q9.2) (option +F259).	☐
Turn the operating switch (S21) to the ON (1) position to activate the run enable signal. Depending on control source settings, this may also close the main contactor (if present). If a main contactor is present and does not close, refer to the circuit diagrams delivered by the drive as well as the appropriate firmware manuals.	☐
On-load checks	
Start the motor to perform the ID run.	☐
Check that the cooling fans rotate freely in the right direction, and the air flows upwards.	☐
Check that the motor starts. stops and follows the speed reference in the correct direction when controlled with the control panel.	☐
Check that the motor starts. stops and follows the speed reference in the correct direction when controlled through the customer-specific I/O or fieldbus.	☐
Drives in which the Safe torque off control circuit is in use: Test and validate the operation of the Safe torque off function. See section *Start-up including acceptance test (page 258)*.	☐
Drives with an emergency stop circuit (options +Q951, +Q952, +Q963, +Q964, +Q978, +Q979): Test and validate the operation of the emergency-stop circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.	☐
Drives with the Prevention of unexpected start-up with safety relay (option +Q957): Test and validate the operation of the Prevention of unexpected start-up circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.	☐
Test and validate the operation of Prevention of unexpected start with FSO-xx (option +Q950): Test and validate the operation of the Prevention of unexpected start-up circuit. See the delivery specific circuit diagrams and wiring, start-up and operating instructions of the option.	☐

10

Fault tracing

Contents of this chapter

This chapter describes the fault tracing possibilities of the drive.

LEDs

This table shows the LEDs visible on the control panel mounting platform on cabinet door (when panel has been removed), and on the BCU-xx control unit inside the cabinet.

Where	LED	Color	Indication
Control panel mounting platform	POWER	Green	Control unit is powered and +15 V is supplied to the control panel.
	FAULT	Red	Drive in fault state.
Control unit	BATT OK	Green	Battery voltage of the real-time clock is OK (higher than 2.8 V). When the LED is not lit, • battery voltage is below 2.8 V, • the battery is missing, or • the control unit is not powered.
	PWR OK	Green	Internal voltage OK
	FAULT	Red	The control program indicates that the equipment is faulty. See the appropriate firmware manual.
	WRITE	Yellow	Writing to SD card in progress.

Warning and fault messages

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

11

Maintenance

Contents of this chapter

This chapter contains maintenance instructions.

Maintenance intervals

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

Component	Years from start-up												
	1	2	3	4	5	6	7	8	9	10	11	12	…
Cooling													
Supply and inverter module main cooling fans									R				
Sine filter (option +E206) cooling fan			R			R			R			R	
Supply and inverter modules: circuit board compartment fan						R						R	
Internal cabinet cooling fans (internal, door and IP54)						R						R	
Batteries													
Control panel battery						R						R	
Control unit battery						R						R	
Connections and environment													
Air inlet and outlet meshes (IP22/IP42)	I	I	I	I	I	I	I	I	I	I	I	I	I
Cabinet door filters (IP54)	R	R	R	R	R	R	R	R	R	R	R	R	R
Tightness of terminals	I	I	I	I	I	I	I	I	I	I	I	I	I
Ambient conditions (dustiness, moisture, corrosion, temperature)	I	I	I	I	I	I	I	I	I	I	I	I	I
Cleaning of heatsinks	I	I	I	I	I	I	I	I	I	I	I	I	I
Quality of supply voltage	O	O	O	O	O	O	O	O	O	O	O	O	O
Air circuit breaker maintenance (if present)	I	I	I	I	I	I	I	I	I	I	I	I	I
Spare parts													
Spare part stock	I	I	I	I	I	I	I	I	I	I	I	I	I
Reforming DC circuit capacitors (spare modules and spare capacitors)	O	O	O	O	O	O	O	O	O	O	O	O	O

Symbols

I Inspection, maintenance action if needed

(I) Inspection in harsh conditions [1)], maintenance action if needed

R Replacement

(R) Replacement in harsh conditions [1)]

O Other work (commissioning, tests, measurements,etc.)

1) Ambient temperature constantly over 40 °C (104 °F), especially dusty or humid ambient conditions, cyclic heavy load, or continuous nominal (full) load.

Maintenance and component replacement intervals are based on the assumption that the equipment is operated within the specified ratings and ambient conditions. ABB recommends annual drive inspections to ensure the highest reliability and optimum performance.

Note:

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

Cabinet

Cleaning the interior of the cabinet

WARNING!

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

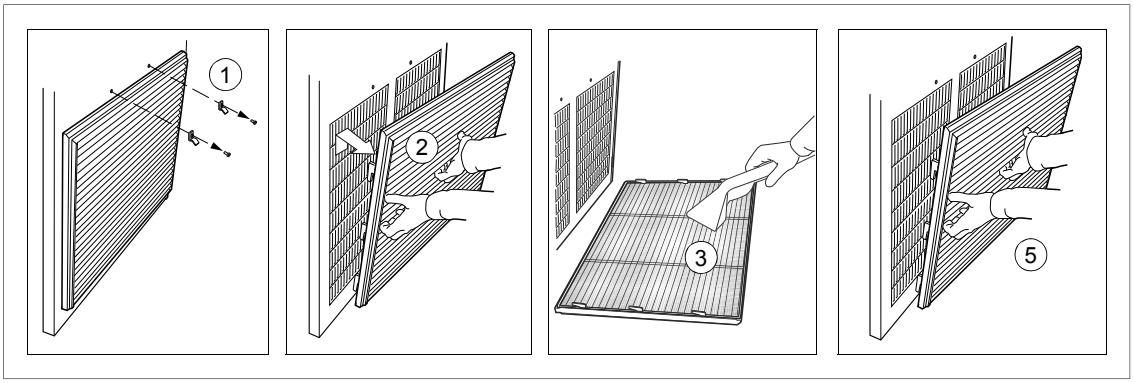
WARNING!

Use a vacuum cleaner with an antistatic hose and nozzle, and wear a grounding wristband. Otherwise an electrostatic charge might build up and damage the circuit boards.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the cabinet doors.
3. Clean the interior of the cabinet. Use a vacuum cleaner and a soft brush.
4. Clean the air inlets of the fans and air outlets of the modules (top).
5. Clean the air inlet gratings on the doors (see below).
6. Close the doors.

Cleaning the door air inlets (IP22 and IP42)

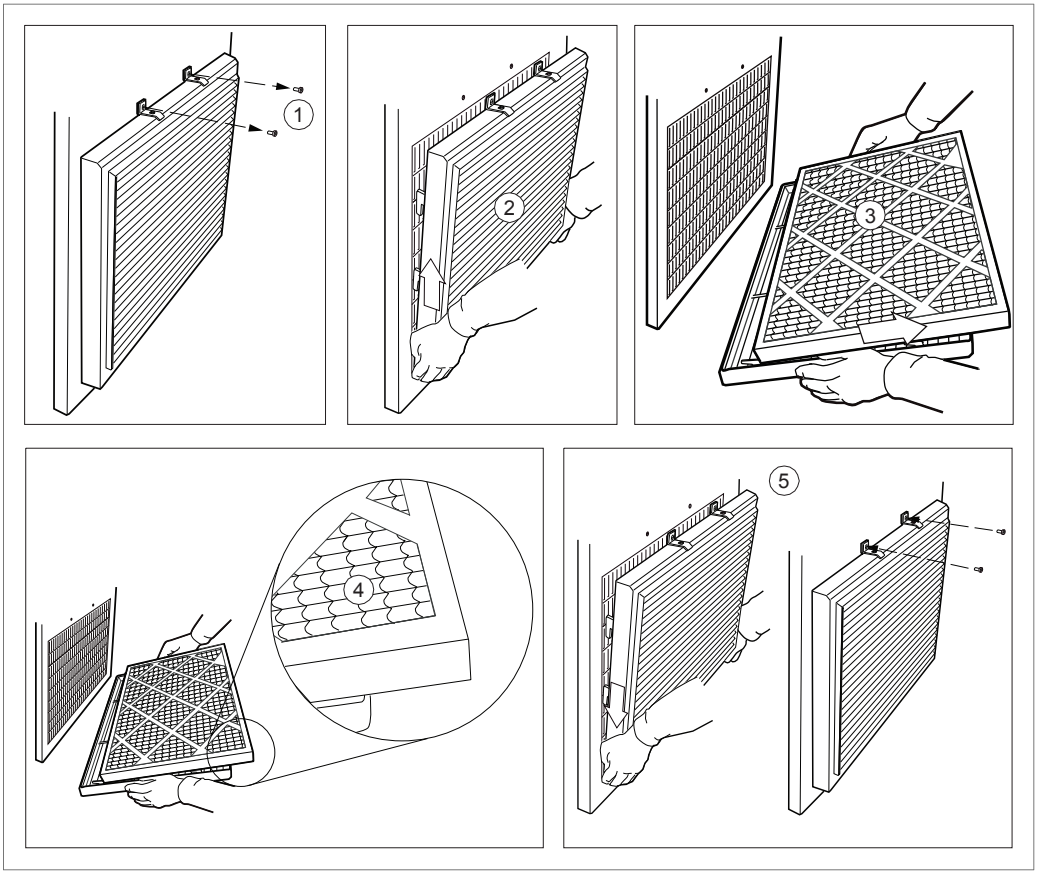
1. Remove the fasteners at the top of the grating.
2. Lift the grating and pull it away from the door.
3. Vacuum clean or wash the grating on both sides.
4. Reinstall the grating in reverse order.



Cleaning the door air inlets (IP54)

1. Remove the fasteners at the top of the grating.
2. Lift the grating and pull it away from the door.
3. Remove the air filter mat.
4. Place the new filter mat in the grating the metal wire side facing the door.

5. Reinstall the grating in reverse order.



Cleaning the outlet (roof) filters (IP54)

The outlet (roof) filters in IP54 units can be accessed by pulling the gratings upwards.

Replacing the outlet (roof) filters (IP54)

1. Remove the front and back gratings of the fan cubicle by lifting them upwards.
2. Remove the air filter mat.
3. Place the new filter mat in the grating.
4. Reinstall the gratings in reverse order.

Power connections and quick connectors

Retightening the power connections

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Check the tightness of the cable connections. Use the tightening torques given in chapter Technical data.

Fans

The lifespan of the cooling fans of the drive depends on the running time, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. Reset the running time signal after fan replacement.

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

Replacing the cooling fan in the auxiliary control cubicle

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Remove the shrouding from in front of the fan.
3. Unplug the power supply cable of the fan.
4. Remove the fastening screws of the fan.
5. Install the new fan in reverse order.

Replacing the cooling fan(s) in the incoming cubicle

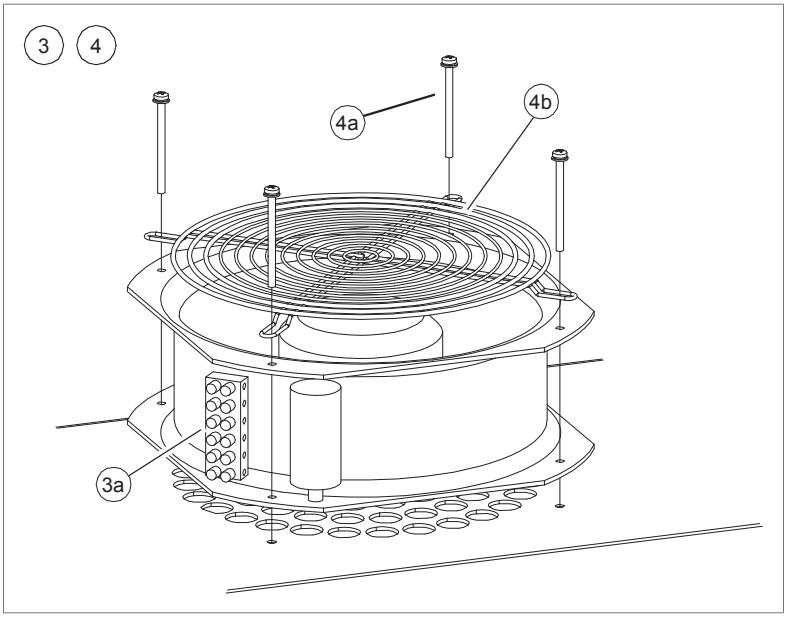
One or two cooling fans are installed in the incoming cubicle(s) (ICU).

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Remove the shrouding (if any) in front of the fan.
3. Disconnect the fan wiring (a).
4. Remove the fastening screws (a) and finger guard (b) of the fan.

5. Install the new fan in reverse order.



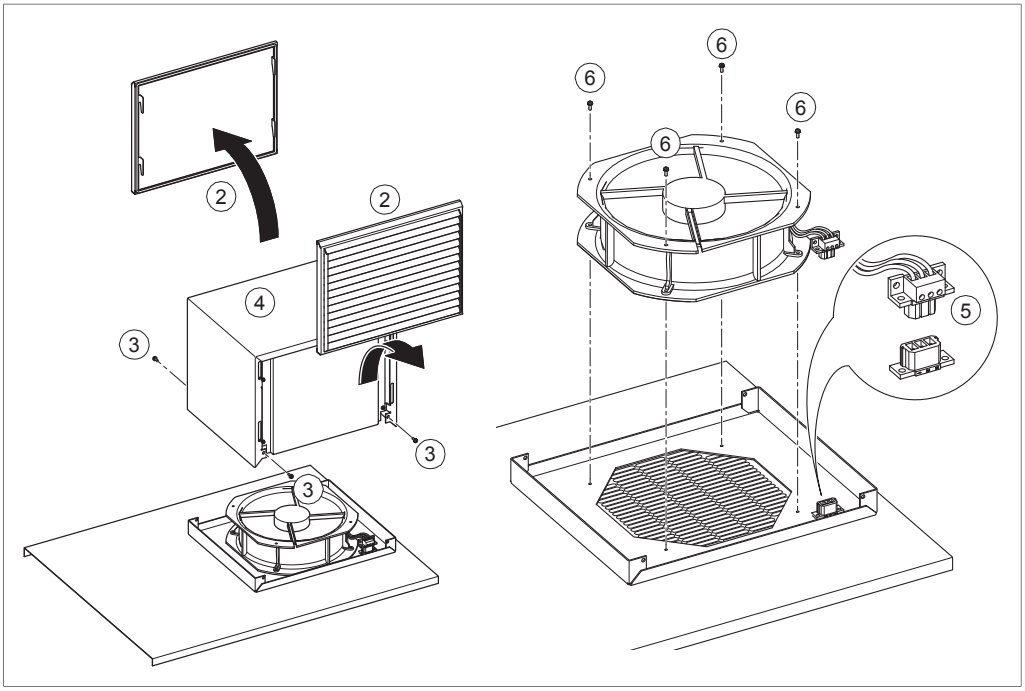
Replacing a roof fan (IP54/UL type 12)

WARNING!

bey the instructions in chapter Safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Lift the front and back gratings upwards and remove them.
3. Loosen the mounting screws of the fan cover.
4. Lift the cover off.
5. Disconnect the fan supply wires.
6. Loosen the mounting screws of the fan.
7. Lift the fan off.

8. Install the new fan in reverse order.



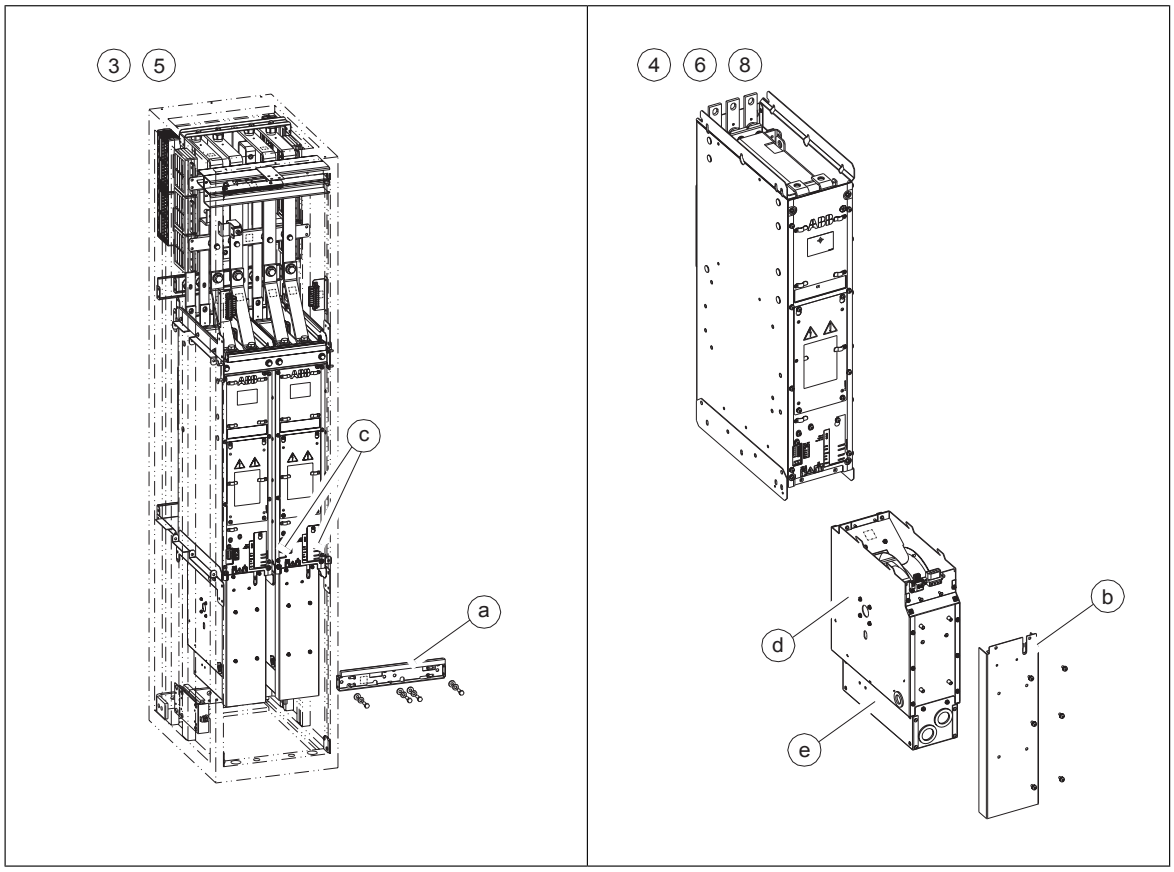
Replacing a supply module (D7T) cooling fan

WARNING!

Only qualified electricians are allowed to do this work. Read the complete safety instructions of the drive. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the cubicle door.
3. Remove the lower support bracket (a) of the module.
4. Remove the front cover of the fan holder (b).
5. Disconnect the fan wiring from the module: power supply plug and fibre optic cables (c).
6. Support the fan holder (d) from below and pull it to release it from the module.
7. Pull out the fan holder.
8. Transfer the fan control box (e) from the old fan holder to the new fan holder.

9. Install the fan holder in reverse order to the above.



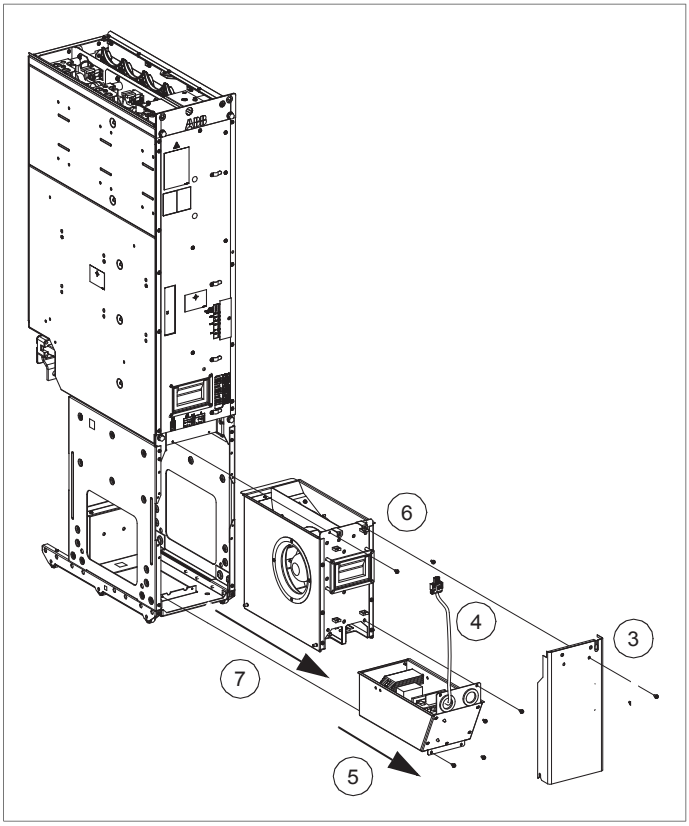
Replacing a supply module (D8T) or inverter module (R8i) cooling fan

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the cubicle door.
3. Remove the screws holding the front cover plate. Lift the cover plate somewhat to release it.
4. Disconnect the fan wiring.
5. Remove the unit below the fan.
6. Remove the screws of the fan unit.
7. Pull out the fan unit.

8. Install new fan in reverse order.



Replacing the circuit board compartment fan

Frame D8D supply and frame R8i inverter modules are equipped with a fan blowing air through the circuit board compartment.

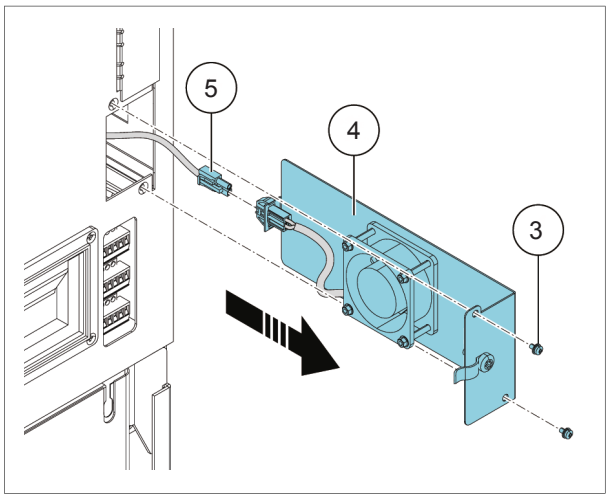
The fan is accessible from the front of the module.

WARNING!

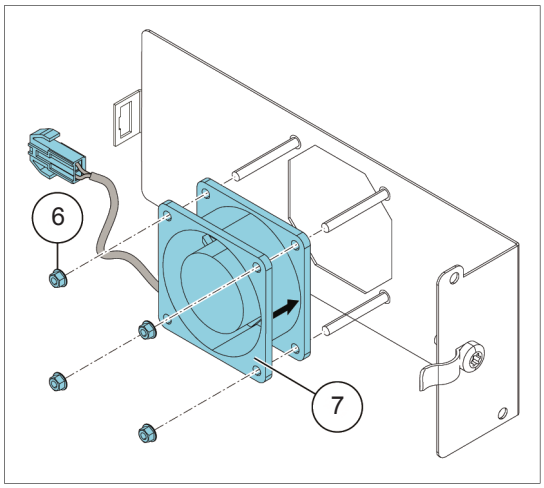
Obey the instructions in chapter Safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the door of the module cubicle.
3. Remove the two M4×12 (T20) screws which lock the fan holder.
4. Pull the fan holder out of the module.

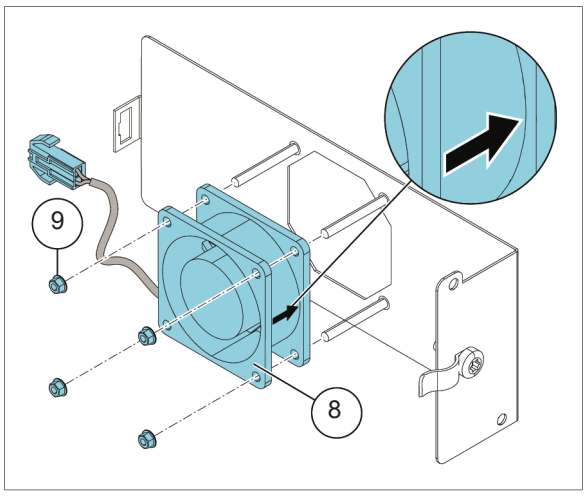
5. Disconnect the fan cable.



6. Remove the four M3 (5.5 mm) nuts which hold the fan.
7. Remove the fan from the fan holder.

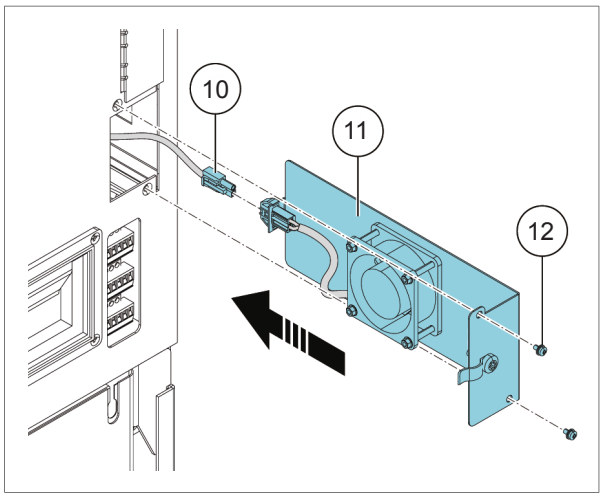


8. Put the fan onto the threaded studs on the fan holder with the airflow direction arrow pointing towards the fan holder.
9. Install and tighten the four nuts removed earlier.



10. Connect the fan cable.
11. Align and push the fan holder into the module.

12. Install and tighten the two M4×12 (T20) screws.



Supply and inverter modules

Replacing a frame D7T supply module

WARNING!

Only qualified electricians are allowed to do this work. Read the complete safety instructions of the drive. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

WARNING!

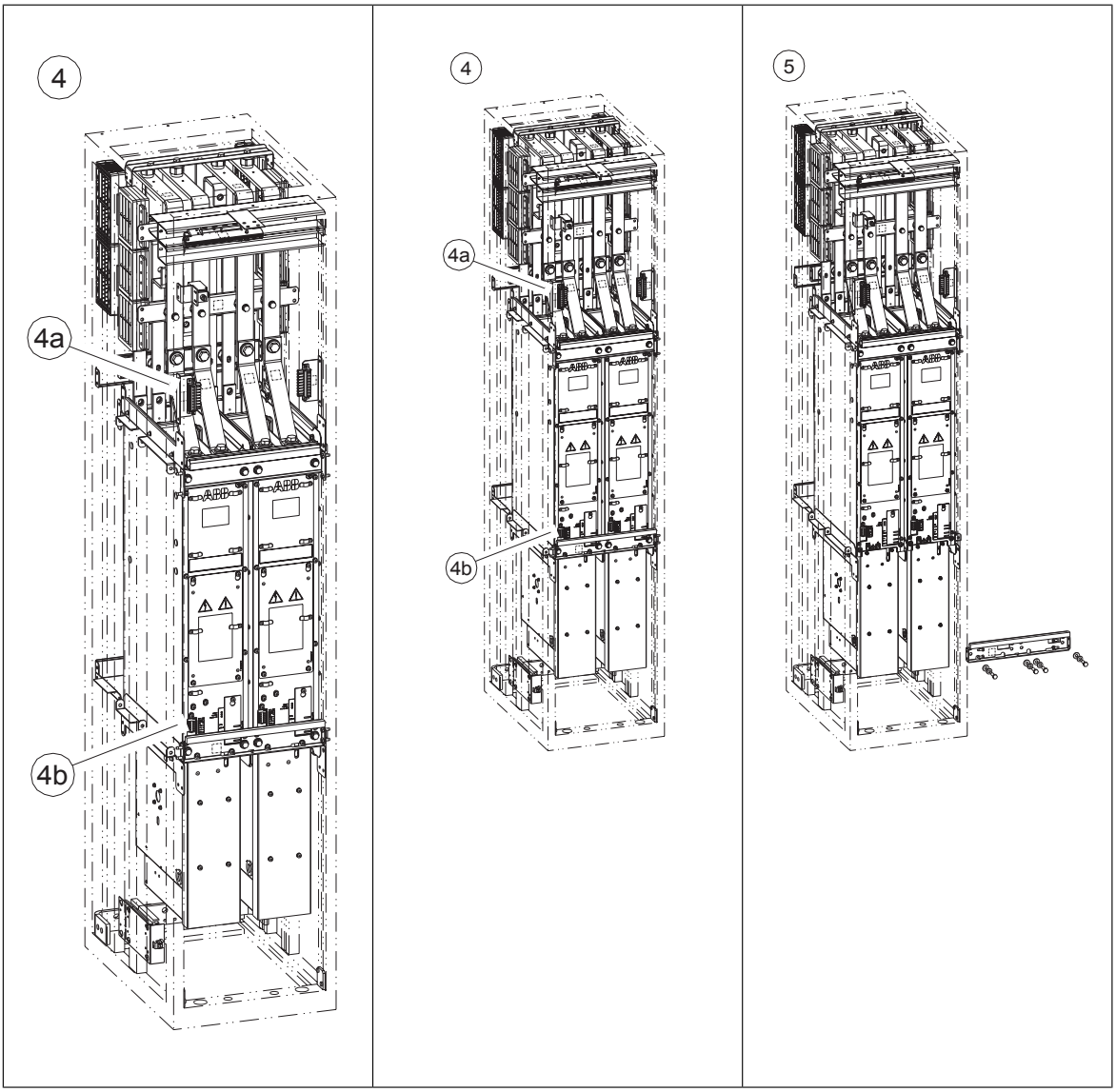
Use extreme caution when maneuvering the supply module. It is heavy and have a high center of gravity. Ignoring the following instructions can cause physical injury, or damage to the equipment.

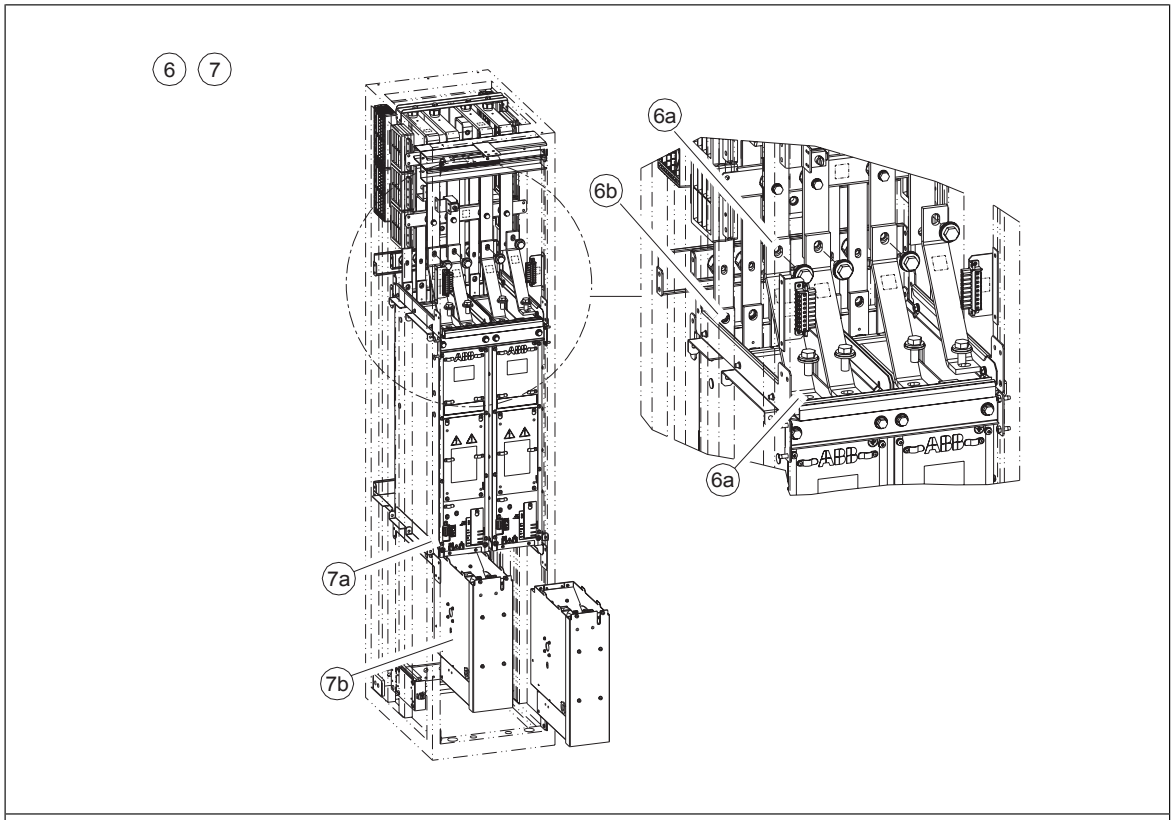
- Wear appropriate safety equipment.
- Be careful when removing bolts and washers on top of the module not to drop anything inside the module.
- Use a lifting device:
  - Attach the lifting device securely to the module lifting eyes before removing the module fastening bolts. Keep the lifting device attached to the module until you have lifted the module onto a pallet and made sure that the module is supported and cannot topple over.
  - Lift a replacement module only with a lifting device. Keep the lifting device attached to the module during the work until you are tighten the module fastening bolts.
- Do not tilt the module. Do not leave the module unattended on a floor.
- When you push the replacement module into the cabinet, keep your fingers away from the edge of the module edges to avoid pinching them between the module and the cabinet.

Obey these instructions for replacing the module. Refer to the drawings below.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the cubicle door.
3. Remove the shroud.
4. Unplug the plug connector on top of the module (a), and the plug connector and fiber optic connector in front of the module (b).
5. Remove the lower support bracket of the module.
6. Remove the fastening bolts of the DC busbars (a) and the DC busbars carefully. Do not drop anything inside the module. Remove the fastening bolts of the AC busbars (b).
7. Remove the cooling fan plug connector (a) and the cooling fan (b). See also section about the cooling fan replacement.
8. Remove the side fastening screws of the module on the top (a) and bottom (b).
9. Attach a lifting device to the lifting eyes of the module (a).
10. Remove the upper support brackets of the module (a).
11. Pull the module out of the cabinet carefully. Keep the weight on the lifting device constantly.
12. Lift the module down onto a pallet.
13. Keep the lifting chain attached to the module and attach the module safely to the pallet.

14. Remove the lifting chain from the old module and move the module away.
15. Install a new module in reverse order.
16. Close the cubicle door.

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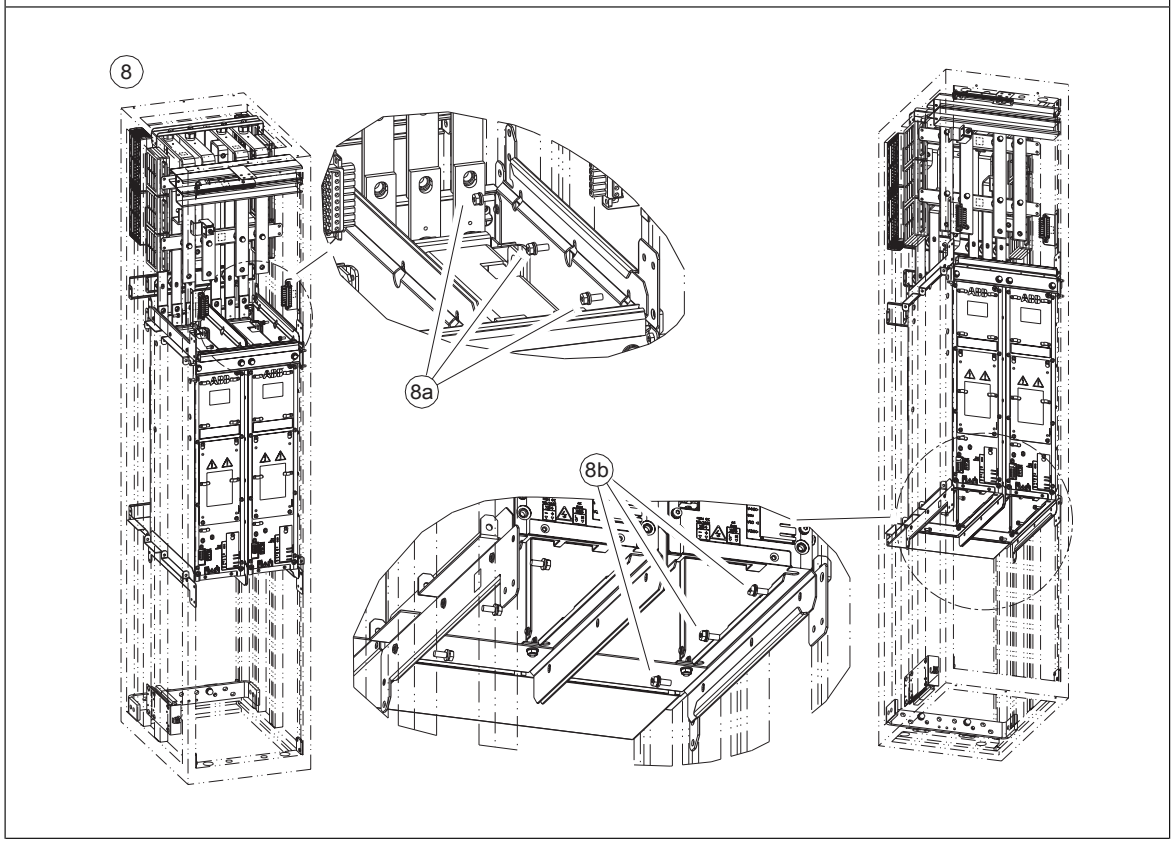
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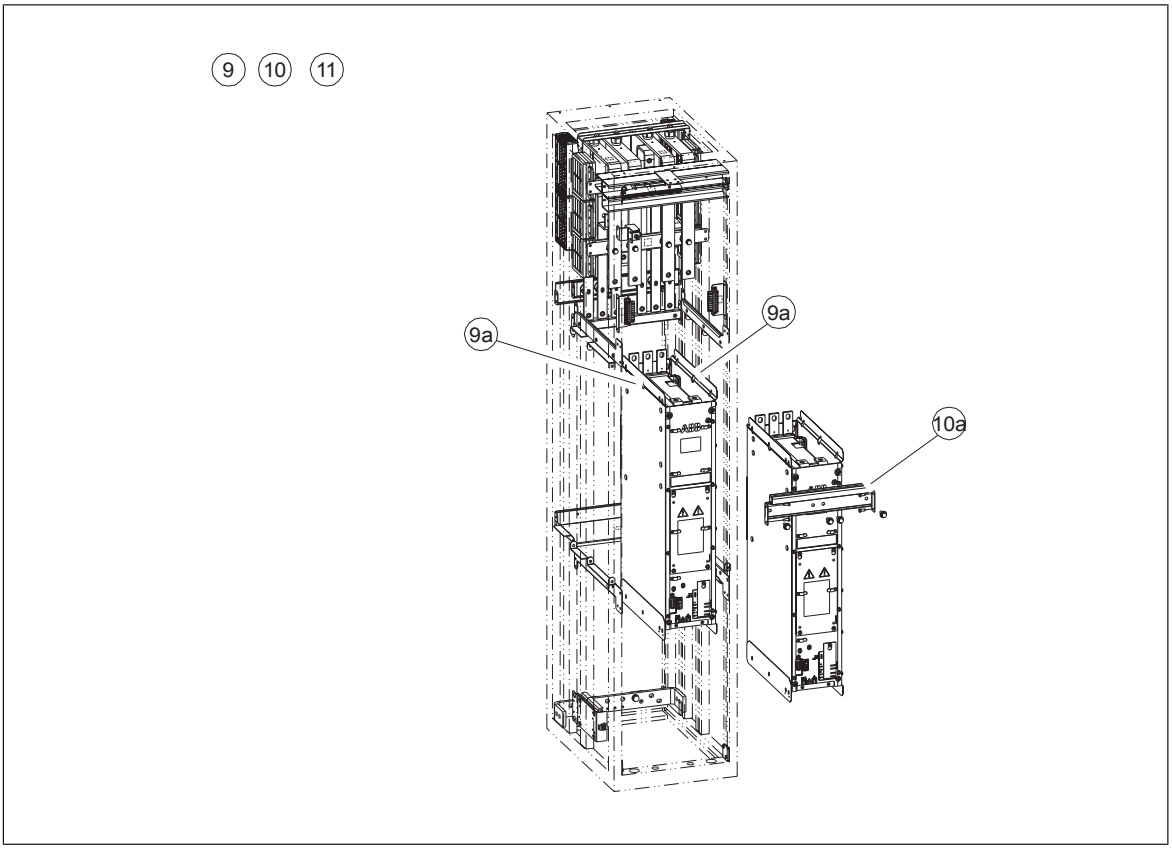


Replacing a frame D8T supply module

WARNING!

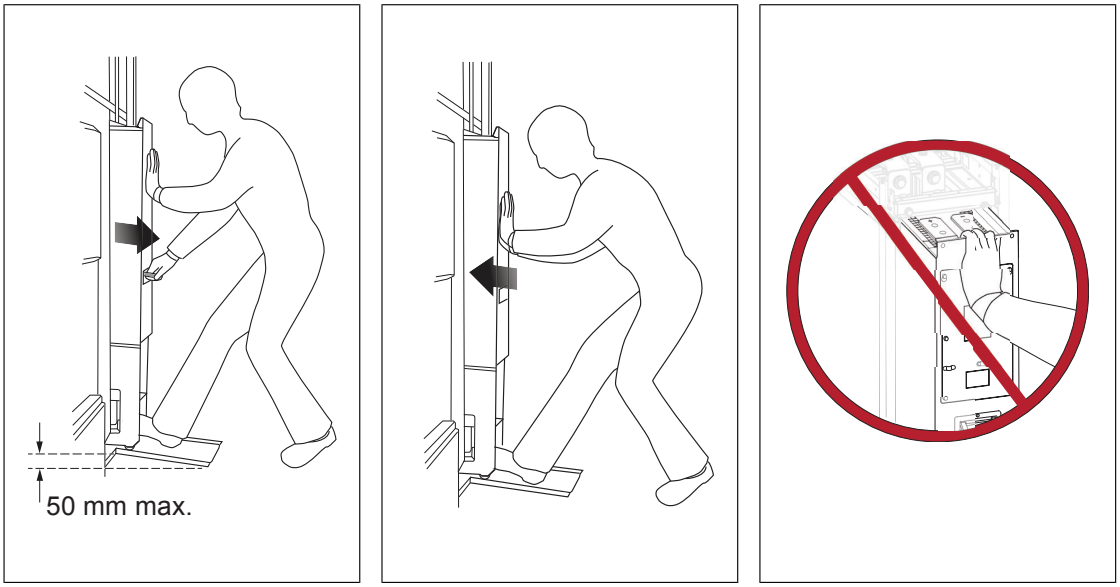
Only qualified electricians are allowed to do this work. Read and obey the complete safety instructions of the drive. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

WARNING!

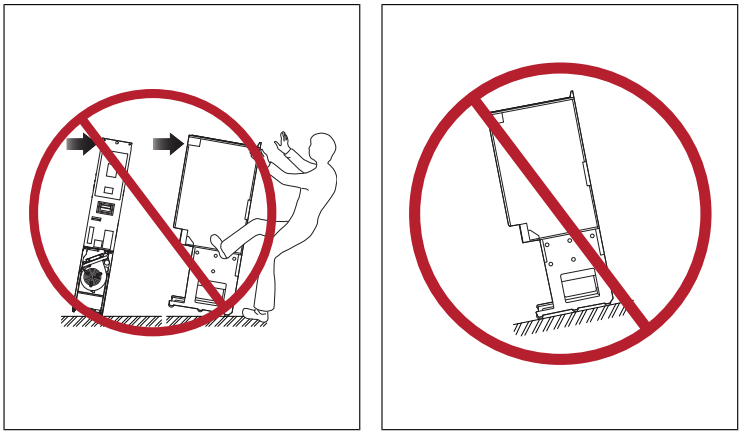
Use extreme caution when maneuvering the supply module. It is heavy and have a high center of gravity. Ignoring the following instructions can cause physical injury, or damage to the equipment.

- Use the required personal protection equipment: safety shoes with metal toe cap, protective gloves, etc.
- Lift the drive with an lifting device. Use the designated lifting points. See the dimension drawings.
- Do not use the module installation ramp with plinth heights which exceed 50 mm [1.97 in].
- Secure the module extraction/installation ramp carefully.
- Push the module into the cabinet and pull it from the cabinet carefully preferably with help from another person. Keep a constant pressure with one foot on the base of the

module to prevent the module from falling on its back. Keep your fingers away from the edges of the front flange of the module.



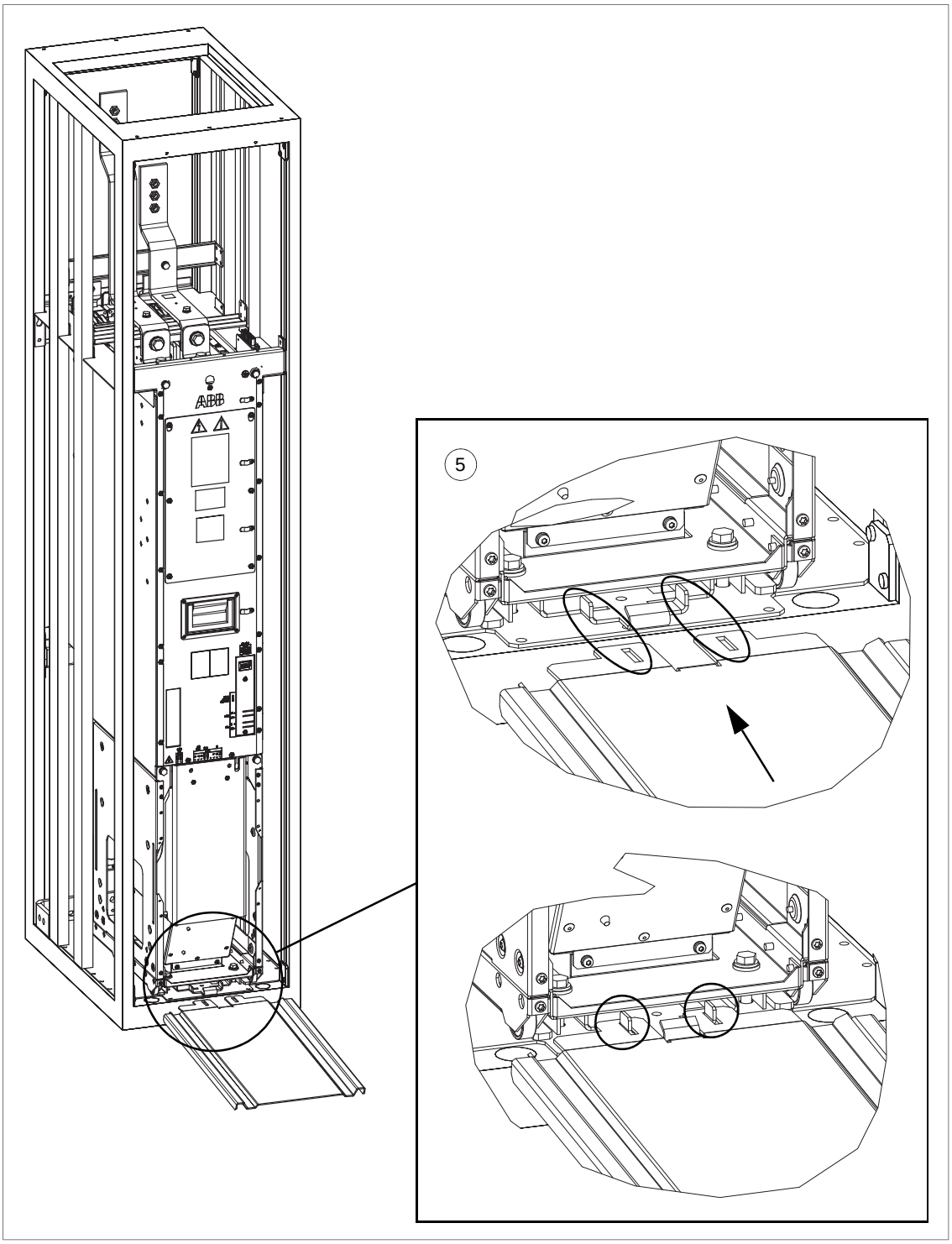
- Do not tilt the module. It will overturn very easily because it is heavy and its center of gravity is high. Make sure that the module does not topple over when you move it on the floor. Whenever possible secure the module with chains. Do not leave the module unattended on a sloping floor.

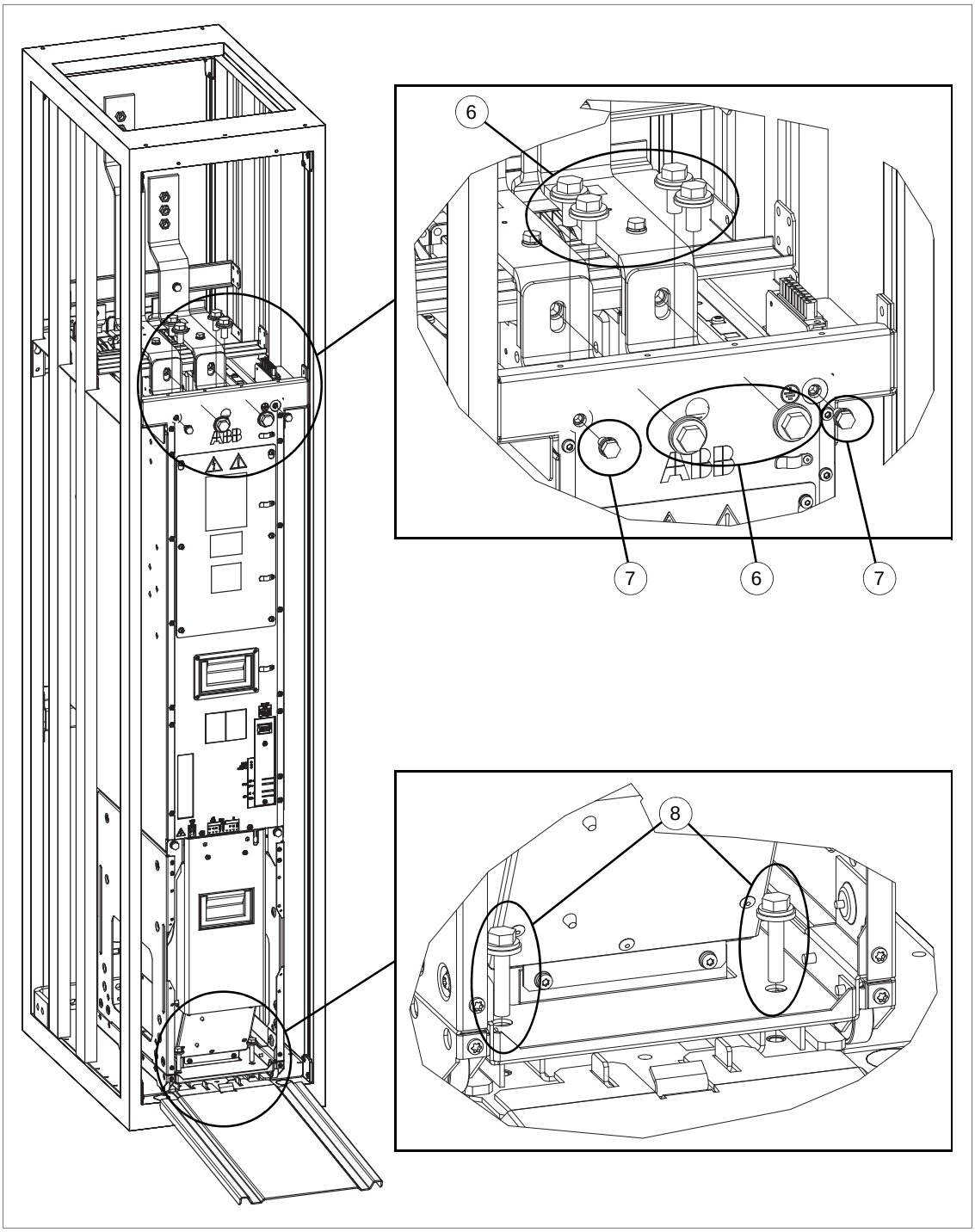


Obey these instructions for replacing the module. Refer to the drawings below.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the door of the supply module cubicle.
3. Undo the screws of the shroud in the upper part of the cubicle. Lift and remove the shroud.
4. Unplug the wires and optic cables from the module, and move them aside.
5. Attach the module extraction/installation ramp (included) to the base of the cabinet so that the tabs on the mounting bracket enter the slots on the ramp.
6. Remove the bolts holding the DC busbars.
7. Remove the module fastening screws at the top of the module.
8. Remove the module fastening screws at the bottom of the module.
9. Pull the module carefully out of the cabinet along the ramp.

10. To reinsert the module into the cubicle:
    - Push the module back in and fasten. Tighten the fastening screws of the module to 22 N·m (16.2 lbf·ft) and the fastening bolts of the DC output busbars to 70 N·m (52 lbf·ft).
    - Reconnect the wires and fiber optic cables to the module.
    - Reinstall the shrouding.
    - Remove the module extraction/installation ramp and close the cubicle door.

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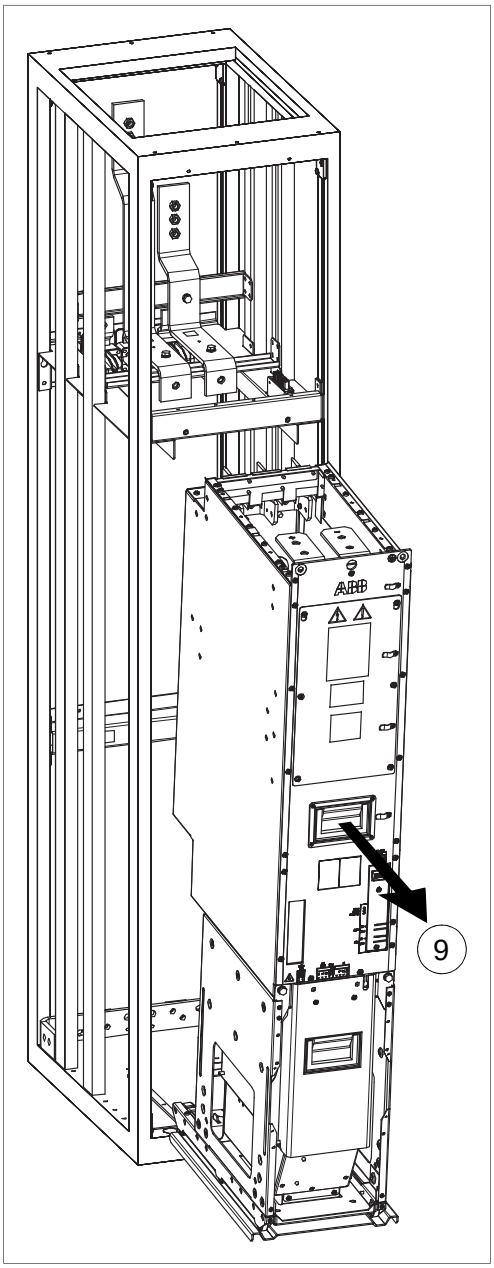


Cleaning the heatsink

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

WARNING!

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

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.

2. Remove the drive module from the cabinet.
3. Remove the module cooling fan(s). See the separate instructions.
4. Blow dry, clean compressed air from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.

   Note:

   If there is a risk of dust entering adjoining equipment, perform the cleaning in another room.

5. Reinstall the cooling fan.

Activating the reduced run of the inverter unit

Note:

A “reduced run” function is available for inverter units consisting of parallel-connected inverter modules. The function makes it possible to continue operation with limited current even if one (or more) module is out of service, for example, because of maintenance work. In principle, reduced run is possible with only one module, but the physical requirements of operating the motor still apply; for example, the modules remaining in use must be able to provide the motor with enough magnetizing current.

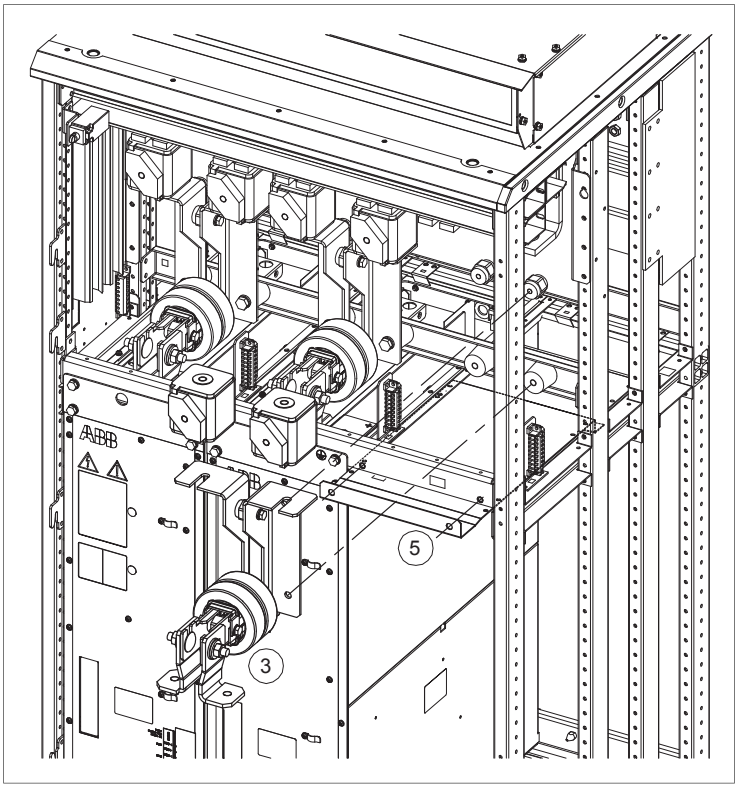
WARNING!

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

Refer to the drawing below.

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Remove the shrouding above the module bay (in front of the DC fuses).
3. Remove the DC fuses and the busbar assembly connecting the fuses to the inverter module. Store these parts – they are to be reinstalled only with the inverter module. Make note of the order of washers.
4. Remove the faulty module from its bay. See the module replacement instructions.
5. Install the air baffle (included) to the underside of the top module guide:
   - Fasten the front edge of the baffle to the module mounting holes using the module mounting screws (2 × M8). Tighten to 9 N·m (6.6 lbf·ft).

- Fasten the left/right sides of the baffle if wherever possible using M4 screws. (This depends on the location of the module in the cubicle.) Tighten to 1…2 N·m (0.7 … 1.5 lbf·ft).



6. If the inverter control unit (A41) is powered from the faulty module, connect the power supply wiring using the extension wire set included to another module.
7. If the Safe torque off (STO) function is in use, install the jumper wire set included in the STO wiring in place of the missing module. (This is not needed if the module was the last on the STO wire chain.)
8. Reinstall all shrouding removed earlier.

   Note:

   Do not reinstall the DC fuses or busbars but store them elsewhere until the module can be reinstalled.

9. Switch on the power to the drive.
10. Enter the number of inverter modules present into parameter *95.13 Reduced run mode*.
11. Reset all faults and start the drive.
12. If the Safe torque off (STO) function is in use, perform an acceptance test. See the STO instructions.

The maximum current is now automatically limited according to the new inverter configuration. A mismatch between the number of detected modules and the value set in *95.13* will generate a fault.

Returning the module

1. Install the module in reverse order. Use the following tightening torques:
   - DC busbar assembly to upper insulators (2 × M8): 9 N·m (6.6 lbf·ft)
   - DC busbar assembly to lower insulators (2 × M10): 18 N·m (13.3 lbf·ft)
   - Fuses to DC busbars: 50 N·m (37 lbf·ft) (Bussmann), 46 N·m (34 lbf·ft) (Mersen/Ferraz-Shawmut)
   - Module to cabinet frame (4 × M8): 22 N·m (16 lbf·ft)
   - DC busbar assembly to module DC input (2 × M12): 70 N·m (52 lbf·ft)
2. Restore the original wiring (STO and control unit power supply whenever needed).
3. Set parameter *95.13* to 0 to disable the reduced run function.
4. If the Safe torque off (STO) function is in use, perform an acceptance test. See the STO instructions.

Capacitors

The DC circuit of the power modules of the drive contain several electrolytic capacitors. Their lifespan depends on the operating time of the drive, loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

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

Reforming the capacitors

The capacitors must be reformed if the drive has been stored for a year or more. The manufacturing date is on the type designation label. For information on reforming the capacitors, see *Converter module capacitor reforming instructions* (3BFE64059629 [English]).

Fuses

Replacing the AC and DC fuses in cabinet

This procedure instructs how to replace the drive AC and DC fuses inside the cabinet. The location of the fuses vary depending on the drive type and options. Locate the fuses to be replaced using the delivery-specific layout drawings and circuit diagrams.

Note: ACS880-07 AC fuse locationsACS880-07 AC fuse locations

The drive can have several sets of AC fuses in different locations.

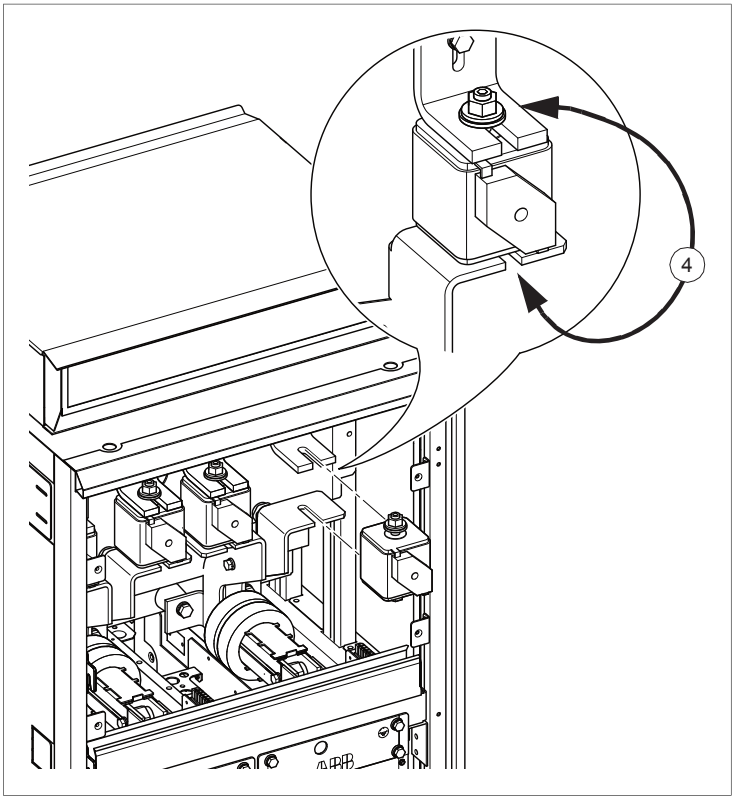
Frame size	Location of AC fuses
6-pulse connection	
1×D8T + 2×R8i	Incoming cubicle (ICU)
2×D8T + 2×R8i 2×D8T + 3×R8i	Supply module cubicle. Also incoming cubicle (ICU) when equipped with main contactor.
3×D8T + 3×R8i	Supply module cubicle.
12-pulse connection (option +A004)	
2×D7T + 2×R8i 2×D8T + 2×R8i 2×D8T + 3×R8i	Incoming cubicle (ICU)
4×D8T + 3×R8i 4×D8T + 4×R8i 4×D8T + 5×R8i	Supply module cubicles. Also incoming cubicles (ICU) when equipped with main contactor.

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the door of the cubicle in which the fuses are.
3. Remove the shrouding from in front of the fuses.
4. Slacken the nuts of the headless screws of the fuses so that you can slide out the fuse blocks. Make note of the order of the washers on the screws.
5. Remove the screws, nuts and washers from the old fuses and attach them to the new fuses. Make sure to keep the washers in the original order.
6. Insert the new fuses into their slots in the cubicle. Pre-tighten the nuts first by hand or by applying a torque of no more than 5 N·m (3.7 lbf·ft).
7. Tighten the nuts to torque as follows:
   - Cooper-Bussmann fuses: 50 N·m (37 lbf·ft)
   - Mersen (Ferraz-Shawmut): 46 N·m (34 lbf·ft)
   - Other: Refer to the fuse manufacturer’s instructions.

8. Reinstall the shroud and close the door.



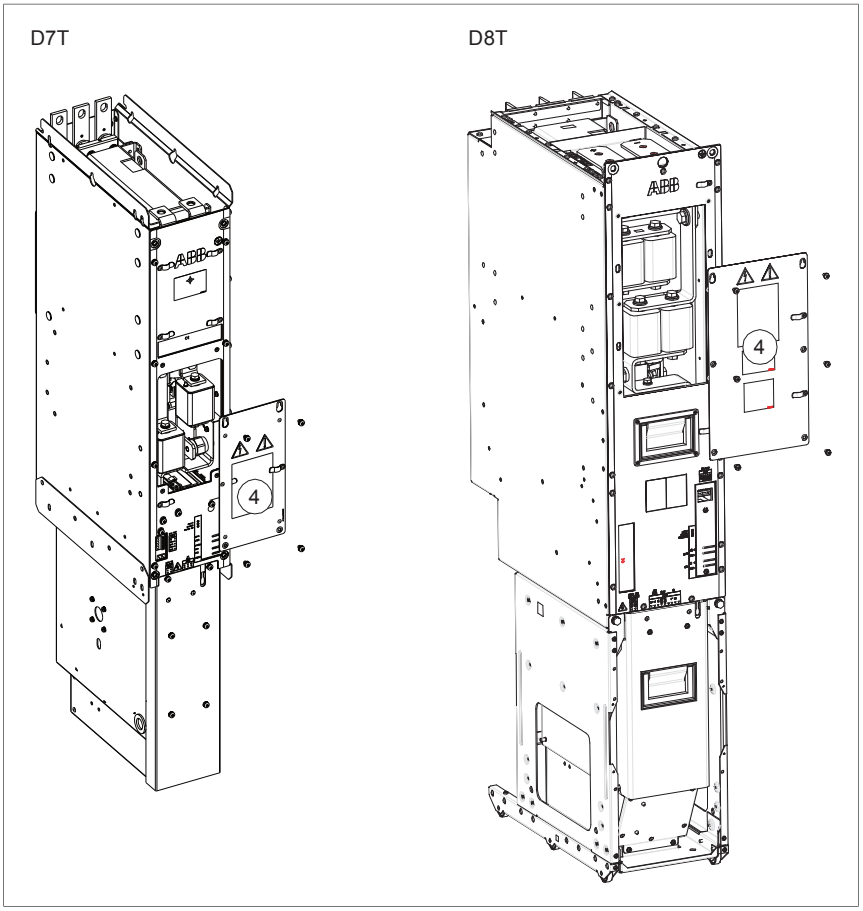
Replacing the supply module DC fuses (D7T and D8T)

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Open the door of the supply module cubicle..
3. Move aside any wiring run across the fuse compartment cover.
4. Slacken the two top screws of the fuse compartment cover. Remove the remaining screws. Lift the cover somewhat so you can remove it.
5. Check the condition of the fuses and replace if necessary. Use the tightening torque specified by the fuse manufacturer.

6. Reinstall the cover removed earlier and close the cubicle door.



Control panel

Replacing the control panel battery

1. Turn the lid on the back of the panel counter-clockwise until the lid opens.
2. Replace the battery with a new CR2032 battery.
3. Put the lid back and tighten it by turning it clockwise.
4. Dispose of the old battery according to local disposal rules or applicable laws.

Cleaning

See *ACX-AP-x assistant control panels user's manual* [3AUA0000085685 (English)].

Control units

BCU control unit types

There are three variants of the BCU control unit used in ACS880 drives: BCU-02, BCU-12 and BCU-22. These have a different number of converter module connections (2, 7 and 12 respectively) but are otherwise identical. The three BCU types are interchangeable as long as the number of connections is sufficient. For example, the BCU-22 can be used as a direct replacement for both BCU-02 and BCU-12.

Replacing the memory unit

After replacing a control unit, you can retain the existing parameter settings by transferring the memory unit from the defective control unit to the new control unit.

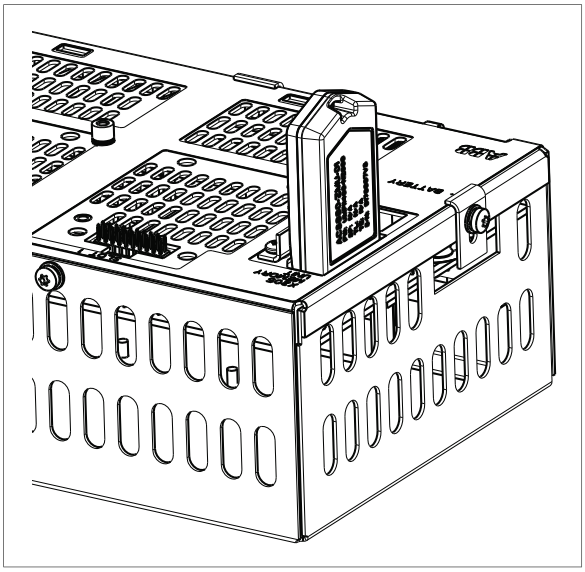
WARNING!

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

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Make sure that the control unit is not powered.
3. Undo the fastening screw and pull the memory unit out.
4. Install a memory unit in reverse order.



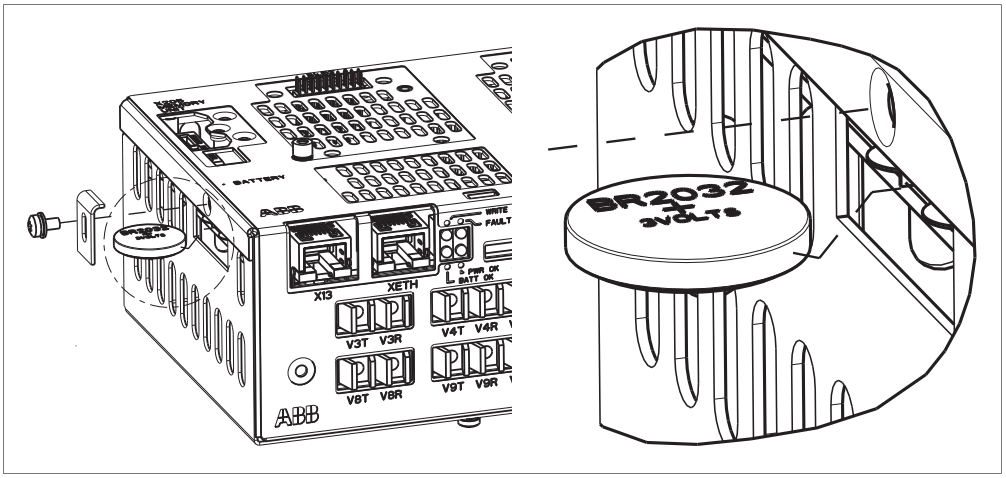
Replacing the BCU control unit battery

Replace the real-time clock battery if the BATT OK LED is not illuminated when the control unit is powered.

WARNING!

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

1. Stop the drive and do the steps in section *Electrical safety precautions (page 19)* before you start the work.
2. Undo the fastening screw and remove the battery
3. Replace the battery with a new BR2032 battery.
4. Dispose of the old battery according to local disposal rules or applicable laws.
5. Set the real-time clock.



12

Technical data

Contents of this chapter

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

Ratings

The nominal ratings for the drives with 50 Hz and 60 Hz supply are given below. The symbols are described below the table.

ACS880-07-…	Input rating	Output ratings										
		No-overload use					Light-overload use			Heavy-duty use		
	I_1	I_N	I_{max}	P_N		S_N	I_{Ld}	P_{Ld}		I_{Hd}	P_{Hd}	
	A	A	A	kW	hp	kVA	A	kW	hp	A	kW	hp
U_N = 400 V, 6-pulse connection												
1140A-3	1047	1140	1482	630	–	790	1072	560	–	787	400	–
1250A-3	1148	1250	1630	710	–	866	1200	630	–	935	500	–
1480A-3	1359	1480	1930	800	–	1025	1421	800	–	1107	630	–
1760A-3	1617	1760	2120	1000	–	1219	1690	900	–	1316	710	–
2210A-3	2030	2210	2880	1200	–	1531	2122	1200	–	1653	900	–
2610A-3	2397	2610	3140	1400	–	1808	2506	1400	–	1952	1000	–
U_N = 400 V, 12-pulse connection												
0990A-3+A004	909	990	1287	560	–	686	950	500	–	741	400	–
1140A-3+A004	1047	1140	1482	630	–	790	1094	560	–	853	450	–
1250A-3+A004	1148	1250	1630	710	–	866	1200	630	–	935	500	–
1480A-3+A004	1359	1480	1930	800	–	1025	1421	800	–	1107	630	–
1760A-3+A004	1617	1760	2120	1000	–	1219	1690	900	–	1316	710	–
2210A-3+A004	2030	2210	2880	1200	–	1531	2122	1200	–	1653	900	–
2610A-3+A004	2397	2610	3140	1400	–	1808	2506	1400	–	1952	1000	–

ACS880-07-…	Input rating	Output ratings										
		No-overload use					Light-overload use			Heavy-duty use		
	I_1	I_N	I_{max}	P_N		S_N	I_{Ld}	P_{Ld}		I_{Hd}	P_{Hd}	
	A	A	A	kW	hp	kVA	A	kW	hp	A	kW	hp
U_N = 500 V, 6-pulse connection												
1070A-5	983	1070	1391	710	900	927	1027	710	900	800	560	700
1320A-5	1212	1320	1716	900	1000	1143	1267	900	1000	987	710	900
1450A-5	1332	1450	1890	1000	1250	1256	1392	900	1200	1085	710	900
1580A-5	1451	1580	2060	1100	1400	1368	1517	1000	1250	1182	800	1000
1800A-5	1653	1800	2340	1250	1600	1559	1728	1200	1500	1346	900	1100
1980A-5	1819	1980	2574	1400	1750	1715	1901	1300	1500	1481	1000	1250
U_N = 500 V, 12-pulse connection												
0990A-5+A004	909	990	1287	710	900	857	950	630	800	741	500	600
1320A-5+A004	1212	1320	1716	900	1000	1143	1267	900	1000	987	710	900
1450A-5+A004	1332	1450	1890	1000	1250	1256	1392	900	1200	1085	710	900
1580A-5+A004	1451	1580	2060	1100	1400	1368	1517	1000	1250	1182	800	1000
1800A-5+A004	1653	1800	2340	1250	1600	1559	1728	1200	1500	1346	900	1100
1980A-5+A004	1819	1980	2574	1400	1750	1715	1901	1300	1500	1481	1000	1250
U_N = 690 V, 6-pulse connection												
0800A-7	735	800	1200	800	900	956	768	710	800	598	560	600
0900A-7	827	900	1350	900	1000	1076	864	800	900	673	630	700
1160A-7	1066	1160	1740	1100	1250	1386	1114	1100	1250	868	800	900
1450A-7	1332	1450	2175	1400	1600	1733	1392	1250	1500	1085	1000	1100
1650A-7	1516	1650	2475	1600	1750	1972	1584	1500	1750	1234	1200	1250
1950A-7	1791	1950	2925	1900	2000	2330	1872	1800	2000	1459	1400	1500
2300A-7	2113	2300	3450	2200	2500	2749	2208	2000	2250	1720	1600	1750
2600A-7	2388	2600	3900	2500	2800	3107	2496	2400	2700	1945	1900	2000
2860A-7	2627	2860	4290	2800	3100	3418	2746	2600	2900	2139	2000	2250
U_N = 690 V, 12-pulse connection												
0800A-7+A004	735	800	1200	800	900	956	768	710	800	598	560	600
0950A-7+A004	873	950	1425	900	1000	1135	912	800	900	711	630	700
1160A-7+A004	1066	1160	1740	1100	1250	1386	1114	1100	1250	868	800	900
1450A-7+A004	1332	1450	2175	1400	1600	1733	1392	1250	1500	1085	1000	1100
1650A-7+A004	1516	1650	2475	1600	1750	1972	1584	1500	1750	1234	1200	1250
1950A-7+A004	1791	1950	2925	1900	2000	2330	1872	1800	2000	1459	1400	1500
2300A-7+A004	2113	2300	3450	2200	2500	2749	2208	2000	2250	1720	1600	1750
2600A-7+A004	2388	2600	3900	2500	2800	3107	2496	2400	2700	1945	1900	2000
2860A-7+A004	2627	2860	4290	2800	3100	3418	2746	2400	2900	2139	2000	2250
												3AXD00000601909

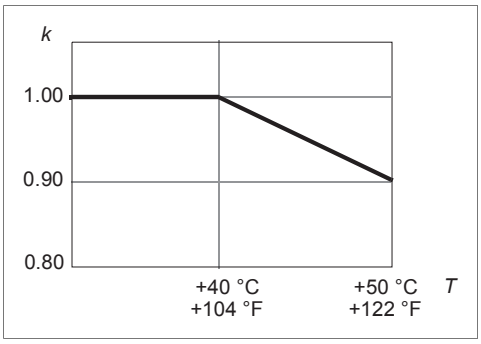
Definitions

U_N	Supply voltage range
I_1	Nominal rms input current
I_N	Nominal output current (available continuously with no over-loading)
I_{max}	Maximum output current. Available for 10 seconds at start, then as long as allowed by drive temperature.
P_N	Typical motor power in no-overload use. The horsepower ratings are typical NEMA motor sizes at 460 V (ACS880-07-xxxxA-5) and 575 V (ACS880-07-xxxxA-7) respectively.
S_N	Apparent power in no-overload use
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power in light-overload use
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes
P_{Hd}	Typical motor power in heavy-duty use
Note 1: The ratings apply at an ambient temperature of 40 °C (104 °F). **Note 2:** To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.	

Derating

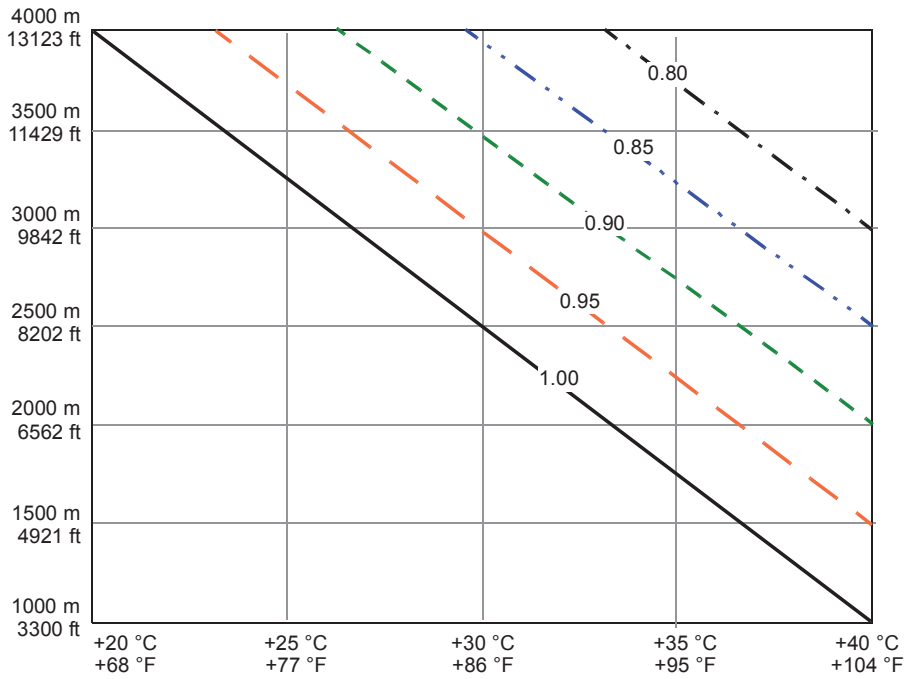
Ambient temperature derating

In the temperature range +40…50 °C (+104…122 °F), the rated output current is derated by 1 pp for every added 1 °C (1.8 °F). The output current can be calculated by multiplying the current given in the rating table by the derating factor *(k)*:



Altitude derating

At altitudes from 1000 to 4000 m (3300 to 13123 ft) above sea level, the output current derating is 1 pp for every 100 m (328 ft). If ambient temperature is below +40 °C (+104 °F), the derating can be reduced by 1.5 pp for every 1 °C (1.8 °F) reduction in temperature. For a more accurate derating, use the DriveSize PC tool. A few altitude derating curves are shown below.



	Derating factor 1.00
	Derating factor 0.95
	Derating factor 0.90
	Derating factor 0.85
	Derating factor 0.80

Switching frequency derating

Switching frequencies other than default can require output current derating. Contact ABB for more information.

Output frequency derating

Motor operation above 150 Hz can require type-specific output current derating. Contact ABB for more information.

Frame sizes and power module types

ACS880-07-…	Frame size	Supply module(s) used		Inverter modules used	
		Qty	Type	Qty	Type
U_N = 400 V, 6-pulse connection					
1140A-3	1×D8T + 2×R8i	1	ACS880-304-0980A-3+A018	2	ACS880-104-0640A-3
1250A-3	2×D8T + 2×R8i	2	ACS880-304-0650A-3+A018	2	ACS880-104-0640A-3
1480A-3	2×D8T + 2×R8i	2	ACS880-304-0980A-3+A018	2	ACS880-104-0760A-3
1760A-3	2×D8T + 2×R8i	2	ACS880-304-0980A-3+A018	2	ACS880-104-0900A-3
2210A-3	3×D8T + 3×R8i	3	ACS880-304-0980A-3+A018	3	ACS880-104-0760A-3
2610A-3	3×D8T + 3×R8i	3	ACS880-304-0980A-3+A018	3	ACS880-104-0900A-3
U_N = 400 V, 12-pulse connection					
0990A-3+A004	2×D7T + 2×R8i	2	ACS880-304-0490A-3+A018	2	ACS880-104-0640A-3
1140A-3+A004	2×D8T + 2×R8i	2	ACS880-304-0650A-3+A018	2	ACS880-104-0640A-3
1250A-3+A004	2×D8T + 2×R8i	2	ACS880-304-0650A-3+A018	2	ACS880-104-0640A-3
1480A-3+A004	2×D8T + 2×R8i	2	ACS880-304-0980A-3+A018	2	ACS880-104-0760A-3
1760A-3+A004	2×D8T + 2×R8i	2	ACS880-304-0980A-3+A018	2	ACS880-104-0900A-3
2210A-3+A004	4×D8T + 3×R8i	4	ACS880-304-0650A-3+A018	3	ACS880-104-0760A-3
2610A-3+A004	4×D8T + 3×R8i	4	ACS880-304-0650A-3+A018	3	ACS880-104-0900A-3
U_N = 500 V, 6-pulse connection					
1070A-5	1×D8T + 2×R8i	1	ACS880-304-0980A-5+A018	2	ACS880-104-0590A-5
1320A-5	2×D8T + 2×R8i	2	ACS880-304-0650A-5+A018	2	ACS880-104-0740A-5
1450A-5	2×D8T + 2×R8i	2	ACS880-304-0980A-5+A018	2	ACS880-104-0740A-5
1580A-5	2×D8T + 2×R8i	2	ACS880-304-0980A-5+A018	2	ACS880-104-0810A-5
1800A-5	2×D8T + 3×R8i	2	ACS880-304-0980A-5+A018	3	ACS880-104-0740A-5
1980A-5	2×D8T + 3×R8i	2	ACS880-304-0980A-5+A018	3	ACS880-104-0810A-5
U_N = 500 V, 12-pulse connection					
0990A-5+A004	2×D7T + 2×R8i	2	ACS880-304-0490A-5+A018	2	ACS880-104-0590A-5
1320A-5+A004	2×D8T + 2×R8i	2	ACS880-304-0650A-5+A018	2	ACS880-104-0740A-5
1450A-5+A004	2×D8T + 2×R8i	2	ACS880-304-0980A-5+A018	2	ACS880-104-0740A-5
1580A-5+A004	2×D8T + 2×R8i	2	ACS880-304-0980A-5+A018	2	ACS880-104-0810A-5
1800A-5+A004	2×D8T + 3×R8i	2	ACS880-304-0980A-5+A018	3	ACS880-104-0740A-5
1980A-5+A004	2×D8T + 3×R8i	2	ACS880-304-0980A-5+A018	3	ACS880-104-0810A-5
U_N = 690 V, 6-pulse connection					
0800A-7	1×D8T + 2×R8i	1	ACS880-304-0820A-7+A018	2	ACS880-104-0410A-7
0900A-7	1×D8T + 2×R8i	1	ACS880-304-0820A-7+A018	2	ACS880-104-0530A-7
1160A-7	2×D8T + 2×R8i	2	ACS880-304-0570A-7+A018	2	ACS880-104-0600A-7
1450A-7	2×D8T + 3×R8i	2	ACS880-304-0820A-7+A018	3	ACS880-104-0530A-7
1650A-7	2×D8T + 3×R8i	2	ACS880-304-0820A-7+A018	3	ACS880-104-0600A-7
1950A-7	3×D8T + 4×R8i	3	ACS880-304-0820A-7+A018	4	ACS880-104-0600A-7
2300A-7	3×D8T + 4×R8i	3	ACS880-304-0820A-7+A018	4	ACS880-104-0600A-7
2600A-7	4×D8T + 5×R8i	4	ACS880-304-0820A-7+A018	5	ACS880-104-0600A-7
2860A-7	4×D8T + 5×R8i	4	ACS880-304-0820A-7+A018	5	ACS880-104-0600A-7
U_N = 690 V, 12-pulse connection					
0800A-7+A004	2×D7T + 2×R8i	2	ACS880-304-0410A-7+A018	2	ACS880-104-0410A-7
0950A-7+A004	2×D8T + 2×R8i	2	ACS880-304-0570A-7+A018	2	ACS880-104-0530A-7
1160A-7+A004	2×D8T + 2×R8i	2	ACS880-304-0570A-7+A018	2	ACS880-104-0600A-7
1450A-7+A004	2×D8T + 3×R8i	2	ACS880-304-0820A-7+A018	3	ACS880-104-0530A-7
1650A-7+A004	2×D8T + 3×R8i	2	ACS880-304-0820A-7+A018	3	ACS880-104-0600A-7
1950A-7+A004	4×D8T + 4×R8i	4	ACS880-304-0570A-7+A018	4	ACS880-104-0600A-7

ACS880-07-…	Frame size	Supply module(s) used		Inverter modules used	
		Qty	Type	Qty	Type
2300A-7+A004	4×D8T + 4×R8i	4	ACS880-304-0570A-7+A018	4	ACS880-104-0600A-7
2600A-7+A004	4×D8T + 5×R8i	4	ACS880-304-0820A-7+A018	5	ACS880-104-0600A-7
2860A-7+A004	4×D8T + 5×R8i	4	ACS880-304-0820A-7+A018	5	ACS880-104-0600A-7
3AXD00000601909					

Fuses

AC fuses

Notes:

- Fuses with higher current rating than the recommended ones must not be used.
- 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.

ACS880-07-…	Input current (A)	Ultrarapid (aR) fuses at supply module input					
		Qty	A	A^2s at 660 V	V	Manufacturer	Type
U_N = 400 V, 6-pulse connection							
1140A-3	1140	3	1600	3900000	690	Bussmann	170M6419
1250A-3	1250	6	1100	1300000	690	Bussmann	170M6415
1480A-3	1480	6	1600	3900000	690	Bussmann	170M6419
1760A-3	1760	6	1600	3900000	690	Bussmann	170M6419
2210A-3	2210	9	1600	3900000	690	Bussmann	170M6419
2610A-3	2610	9	1600	3900000	690	Bussmann	170M6419
U_N = 400 V, 12-pulse connection							
0990A-3+A004	990	6	800	465000	690	Bussmann	170M6412
1140A-3+A004	1140	6	1100	1300000	690	Bussmann	170M6415
1250A-3+A004	1250	6	1100	1300000	690	Bussmann	170M6415
1480A-3+A004	1480	6	1600	3900000	690	Bussmann	170M6419
1760A-3+A004	1760	6	1600	3900000	690	Bussmann	170M6419
2210A-3+A004	2210	12	1100	1300000	690	Bussmann	170M6415
2610A-3+A004	2610	12	1100	1300000	690	Bussmann	170M6415
U_N = 500 V, 6-pulse connection							
1070A-5	1070	3	1600	3900000	690	Bussmann	170M6419
1320A-5	1320	6	1600	3900000	690	Bussmann	170M6419
1450A-5	1450	6	1600	3900000	690	Bussmann	170M6419
1580A-5	1580	6	1600	3900000	690	Bussmann	170M6419
1800A-5	1800	6	1600	3900000	690	Bussmann	170M6419
1980A-5	1980	6	1600	3900000	690	Bussmann	170M6419
U_N = 500 V, 12-pulse connection							
0990A-5+A004	990	6	800	465000	690	Bussmann	170M6412
1320A-5+A004	1320	6	1600	3900000	690	Bussmann	170M6419
1450A-5+A004	1450	6	1600	3900000	690	Bussmann	170M6419
1580A-5+A004	1580	6	1600	3900000	690	Bussmann	170M6419
1800A-5+A004	1800	6	1600	3900000	690	Bussmann	170M6419
1980A-5+A004	1980	6	1600	3900000	690	Bussmann	170M6419
U_N = 690 V, 6-pulse connection							
0800A-7	800	3	1400	2450000	690	Bussmann	170M6417
0900A-7	900	3	1400	2450000	690	Bussmann	170M6417
1160A-7	1160	6	1000	945000	690	Bussmann	170M6414
1450A-7	1450	6	1400	2450000	690	Bussmann	170M6417
1650A-7	1650	6	1400	2450000	690	Bussmann	170M6417
1950A-7	1950	9	1400	2450000	690	Bussmann	170M6417
2300A-7	2300	9	1400	2450000	690	Bussmann	170M6417
2600A-7	2600	12	1400	2450000	690	Bussmann	170M6417
2860A-7	2860	12	1400	2450000	690	Bussmann	170M6417

ACS880-07-…	Input current (A)	Ultrarapid (aR) fuses at supply module input					
		Qty	A	A^2s at 660 V	V	Manufacturer	Type
U_N = 690 V, 12-pulse connection							
0800A-7+A004	800	6	700	300000	690	Bussmann	170M6411
0950A-7+A004	950	6	1000	945000	690	Bussmann	170M6414
1160A-7+A004	1160	6	1000	945000	690	Bussmann	170M6414
1450A-7+A004	1450	6	1400	2450000	690	Bussmann	170M6417
1650A-7+A004	1650	6	1400	2450000	690	Bussmann	170M6417
1950A-7+A004	1950	12	1000	945000	690	Bussmann	170M6414
2300A-7+A004	2300	12	1000	945000	690	Bussmann	170M6414
2600A-7+A004	2600	12	1400	2450000	690	Bussmann	170M6417
2860A-7+A004	2860	12	1400	2450000	690	Bussmann	170M6417

DC fuses

The drive has DC fuses at the input of each inverter module.

Notes:

- Fuses with higher current rating than the recommended ones must not be used.
- 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.

ACS880-07-…	DC fuses at inverter module input					
	Qty	A	A^2s	V	Manufacturer	Type
U_N = 400 V, 6-pulse connection						
1140A-3	4	1250	[1] 1950000	690	Bussmann	170M6416
1250A-3	4	1250	[1] 1950000	690	Bussmann	170M6416
1480A-3	4	1400	[1] 2450000	690	Bussmann	170M6417
1760A-3	4	1600	[1] 3900000	690	Bussmann	170M6419
2210A-3	6	1400	[1] 1950000	690	Bussmann	170M6417
2610A-3	6	1600	[1] 3900000	690	Bussmann	170M6419
U_N = 400 V, 12-pulse connection						
0990A-3+A004	4	1250	[1] 1950000	690	Bussmann	170M6416
1140A-3+A004	4	1250	[1] 1950000	690	Bussmann	170M6416
1250A-3+A004	4	1250	[1] 1950000	690	Bussmann	170M6416
1480A-3+A004	4	1400	[1] 1950000	690	Bussmann	170M6417
1760A-3+A004	4	1600	[1] 3900000	690	Bussmann	170M6419
2210A-3+A004	6	1400	[1] 1950000	690	Bussmann	170M6417
2610A-3+A004	6	1600	[1] 3900000	690	Bussmann	170M6419
U_N = 500 V, 6-pulse connection						
1070A-5	4	1100	[1] 1300000	690	Bussmann	170M6415
1320A-5	4	1400	[1] 2450000	690	Bussmann	170M6417
1450A-5	4	1400	[1] 2450000	690	Bussmann	170M6417
1580A-5	4	1400	[1] 2450000	690	Bussmann	170M6417
1800A-5	6	1400	[1] 2450000	690	Bussmann	170M6417
1980A-5	6	1400	[1] 2450000	690	Bussmann	170M6417
U_N = 500 V, 12-pulse connection						
0990A-5+A004	4	1100	[1] 1300000	690	Bussmann	170M6415

ACS880-07-…	DC fuses at inverter module input					
	Qty	A	A^2s	V	Manufacturer	Type
1320A-5+A004	4	1400	1) 2450000	690	Bussmann	170M6417
1450A-5+A004	4	1400	1) 2450000	690	Bussmann	170M6417
1580A-5+A004	4	1400	1) 2450000	690	Bussmann	170M6417
1800A-5+A004	6	1400	1) 2450000	690	Bussmann	170M6417
1980A-5+A004	6	1400	1) 2450000	690	Bussmann	170M6417
U_N = 690 V, 6-pulse connection						
0800A-7	4	800	2) 995000	1250	Bussmann	170M6546
0900A-7	4	1000	2) 2150000	1250	Bussmann	170M6548
1160A-7	4	1100	2) 2800000	1250	Bussmann	170M6549
1450A-7	6	1000	2) 2150000	1250	Bussmann	170M6548
1650A-7	6	1100	2) 2800000	1250	Bussmann	170M6549
1950A-7	8	1100	2) 2800000	1250	Bussmann	170M6549
2300A-7	8	1100	2) 2800000	1250	Bussmann	170M6549
2600A-7	10	1100	2) 2800000	1250	Bussmann	170M6549
2860A-7	10	1100	2) 2800000	1250	Bussmann	170M6549
U_N = 690 V, 12-pulse connection						
0800A-7+A004	4	800	2) 995000	1250	Bussmann	170M6546
0950A-7+A004	4	1000	2) 2150000	1250	Bussmann	170M6548
1160A-7+A004	4	1100	2) 2800000	1250	Bussmann	170M6549
1450A-7+A004	6	1000	2) 2150000	1250	Bussmann	170M6548
1650A-7+A004	6	1100	2) 2800000	1250	Bussmann	170M6549
1950A-7+A004	8	1100	2) 2800000	1250	Bussmann	170M6549
2300A-7+A004	8	1100	2) 2800000	1250	Bussmann	170M6549
2600A-7+A004	10	1100	2) 2800000	1250	Bussmann	170M6549
2860A-7+A004	10	1100	2) 2800000	1250	Bussmann	170M6549

1) Clearing at 660 V
2) Clearing at 1000 V

Supply module internal DC fuses

Each supply module has internal DC fuses.

Notes:

- Fuses with higher current rating than the recommended ones must not be used.
- 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.

Supply module frame size	DC fuses in each supply module					
	Qty	A	A^2s	V	Manufacturer	Type
D7T	2	700	755000	1000	Bussmann	170M4908
D8T	4	900	1) 1750000	1100	Bussmann	170M5499

1) Clearing at 1000 V

Brake chopper DC fuses

Optional (+D150) brake choppers have two DC fuses each. The fuse type is Bussmann 170M8635 (630 A 1000 V).

Dimensions and weights

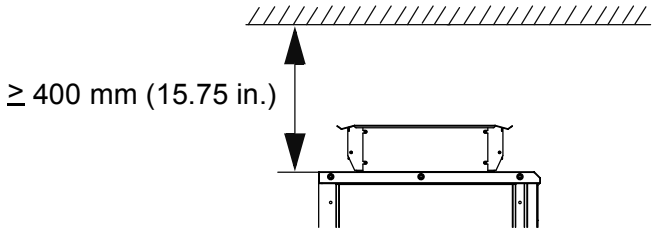
See chapter *Dimensions (page 205)*

Free space requirements

The values are as required by cooling. Also obey the general installation rules given under *Fastening the cabinet to the floor and wall or roof (non-marine units) (page 66)*.

Front		Sides		Above [1]	
mm	in.	mm	in.	mm	in.
150	5.91	0	0	400	15.75

1) Measured from the base plate of the cabinet top.



Cooling data and noise

ACS880-07-…	Air flow		Heat dissipation	Noise
	m³/h	ft³/min	kW	dB(A)
U_N = 400 V, 6-pulse connection				
1140A-3	4290	2525	18	73
1250A-3	5720	3367	21	74
1480A-3	5720	3367	25	74
1760A-3	5720	3367	29	74
2210A-3	8580	5050	37	76
2610A-3	8580	5050	44	76
U_N = 400 V, 12-pulse connection				
0990A-3+A004	5720	3367	15	73
1140A-3+A004	5720	3367	19	74
1250A-3+A004	5720	3367	21	74
1480A-3+A004	5720	3367	25	74
1760A-3+A004	5720	3367	29	74
2210A-3+A004	10010	5892	35	76
2610A-3+A004	10010	5892	44	76
U_N = 500 V, 6-pulse connection				
1070A-5	4290	2525	18	73
1320A-5	5720	3367	22	74
1450A-5	5720	3367	25	74

ACS880-07-…	Air flow		Heat dissipation	Noise
	m^3/h	ft^3/min	kW	dB(A)
1580A-5	5720	3367	27	74
1800A-5	7150	4208	32	75
1980A-5	7150	4208	36	75
U_N = 500 V, 12-pulse connection				
0990A-5+A004	5720	3367	16	73
1320A-5+A004	5720	3367	22	74
1450A-5+A004	5720	3367	25	74
1580A-5+A004	5720	3367	27	74
1800A-5+A004	7150	4208	32	75
1980A-5+A004	7150	4208	36	75
U_N = 690 V, 6-pulse connection				
0800A-7	4290	2525	16	73
0900A-7	4290	2525	20	74
1160A-7	5720	3367	26	74
1450A-7	7150	4208	32	75
1650A-7	7150	4208	36.5	75
1950A-7	10010	5892	44	76
2300A-7	10010	5892	52	76
2600A-7	12870	7575	58	78
2860A-7	12870	7575	65	78
U_N = 690 V, 12-pulse connection				
0800A-7+A004	5720	3367	16	73
0950A-7+A004	5720	3367	20	74
1160A-7+A004	5720	3367	26	74
1450A-7+A004	7150	4208	32	75
1650A-7+A004	7150	4208	36.5	75
1950A-7+A004	11440	6733	44	77
2300A-7+A004	11440	6733	52	77
2600A-7+A004	12870	7575	58	78
2860A-7+A004	12870	7575	65	78
				3AXD00000601909

Sine output filter data

Sine output filters are available as option +E206. The table below shows the types and technical data of the filters and filter cubicles used in drives. The standard filters listed require no current derating.

For availability of sine output filters for other types, contact your local ABB representative.

ACS880-07-…	Sine filter(s) used		Cooling data		Dimensions	
	Qty	Type	Heat dissipation	Air flow	Width	Weight
			kW	m^3/h (ft^3/min)	mm	kg (lbs)
U_N = 400 V						
0990A-3+A004	1	NSIN-1380-6	7	2000 (1180)	1000	750 (1650)
1140A-3	1	NSIN-1380-6	7	2000 (1180)	1000	750 (1650)
1140A-3+A004	1	NSIN-1380-6	7	2000 (1180)	1000	750 (1650)
U_N = 500 V						
0990A-5+A004	1	NSIN-1380-6	7	2000 (1180)	1000	750 (1650)
1070A-5	1	NSIN-1380-6	7	2000 (1180)	1000	750 (1650)
U_N = 690 V						
0800A-7	1	NSIN-0900-6	7	2000 (1180)	1000	550 (1210)
0800A-7+A004	1	NSIN-0900-6	7	2000 (1180)	1000	550 (1210)
0900A-7	1	NSIN-1380-6	7	2000 (1180)	1000	750 (1650)
0950A-7+A004	1	NSIN-1380-6	7	2000 (1180)	1000	750 (1650)
1160A-7	1	NSIN-1380-6	7	2000 (1180)	1000	750 (1650)
1160A-7+A004	1	NSIN-1380-6	7	2000 (1180)	1000	750 (1650)

Input cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for nominal current.

ACS880-07-…	IEC [1]		US [2]	
	Al cable size	Cu cable size	Cu cable size	Ground wire size
	mm²	mm²	AWG/kcmil	AWG/kcmil
U_N = 400 V				
0990A-3+A004	6 × (3 × 150 + 41 Cu)	4 × (3 × 240 + 120)	3 × 250	1/0
1140A-3	5 × (3 × 240 + 72 Cu)	4 × (3 × 240 + 120)	5 × 400	4/0
1140A-3+A004	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 + 120)	3 × 300	3/0
1250A-3	6 × (3 × 240 + 72 Cu)	5 × (3 × 185 + 95)	6 × 350	3/0
1250A-3+A004	6 × (3 × 240 + 72 Cu)	6 × (3 × 150 + 70)	4 × 4/0	3/0
1480A-3	7 × (3 × 240 + 72 Cu)	5 × (3 × 240 + 120)	7 × 350	4/0
1480A-3+A004	8 × (3 × 185 + 57 Cu)	6 × (3 × 185 + 95)	4 × 300	4/0
1760A-3	8 × (3 × 240 + 72 Cu)	8 × (3 × 150 + 70)	7 × 500	4/0
1760A-3+A004	8 × (3 × 240 + 72 Cu)	8 × (3 × 150 + 70)	5 × 250	4/0
2210A-3	10 × (3 × 240 + 72 Cu)	9 × (3 × 185 + 95)	11 × 300	4/0
2210A-3+A004	10 × (3 × 240 + 72 Cu)	10 × (3 × 150 + 70)	7 × 4/0	3/0
2610A-3	12 × (3 × 240 + 72 Cu)	9 × (3 × 240 + 120)	12 × 350	4/0
2610A-3+A004	12 × (3 × 240 + 72 Cu)	12 × (3 × 150 + 70)	6 × 350	3/0
U_N = 500 V				
0990A-5+A004	6 × (3 × 150 + 41 Cu)	4 × (3 × 240 + 120)	3 × 250	1/0
1070A-5	5 × (3 × 240 + 72 Cu)	4 × (3 × 240 + 120)	6 × 250	4/0
1320A-5	6 × (3 × 240 + 72 Cu)	6 × (3 × 150 + 70)	6 × 350	4/0
1320A-5+A004	6 × (3 × 240 + 72 Cu)	6 × (3 × 150 + 70)	4 × 250	4/0
1450A-5	8 × (3 × 185 + 57 Cu)	5 × (3 × 240 + 120)	7 × 350	4/0
1450A-5+A004	8 × (3 × 185 + 57 Cu)	6 × (3 × 185 + 95)	4 × 250	4/0
1580A-5	7 × (3 × 240 + 72 Cu)	10 × (3 × 95 + 50)	8 × 300	4/0
1580A-5+A004	10 × (3 × 150 + 41 Cu)	8 × (3 × 150 + 70)	5 × 4/0	4/0
1800A-5	8 × (3 × 240 + 72 Cu)	6 × (3 × 240 + 120)	8 × 400	4/0
1800A-5+A004	8 × (3 × 240 + 72 Cu)	8 × (3 × 185 + 95)	6 × 4/0	4/0
1980A-5	9 × (3 × 240 + 72 Cu)	8 × (3 × 185 + 95)	10 × 300	4/0
1980A-5+A004	12 × (3 × 150 + 41 Cu)	8 × (3 × 185 + 95)	5 × 300	4/0
U_N = 690 V				
0800A-7	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	4 × 300	4/0
0800A-7+A004	4 × (3 × 240 + 72 Cu)	4 × (3 × 150 + 70)	2 × 300	1/0
0900A-7	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	4 × 400	4/0
0950A-7+A004	6 × (3 × 150 + 41 Cu)	4 × (3 × 185 + 95)	3 × 4/0	2/0
1160A-7	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 + 120)	6 × 300	2/0
1160A-7+A004	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 + 120)	3 × 300	2/0
1450A-7	8 × (3 × 185 + 57 Cu)	5 × (3 × 240 + 120)	7 × 350	4/0
1450A-7+A004	8 × (3 × 185 + 57 Cu)	6 × (3 × 185 + 95)	4 × 250	4/0
1650A-7	9 × (3 × 185 + 57 Cu)	7 × (3 × 185 + 95)	7 × 400	4/0
1650A-7+A004	10 × (3 × 150 + 41 Cu)	8 × (3 × 150 + 70)	4 × 350	4/0
1950A-7	9 × (3 × 240 + 72 Cu)	8 × (3 × 185 + 95)	9 × 350	4/0
1950A-7+A004	10 × (3 × 185 + 57 Cu)	8 × (3 × 185 + 95)	6 × 4/0	2/0
2300A-7	12 × (3 × 185 + 57 Cu)	8 × (3 × 240 + 120)	10 × 400	4/0

ACS880-07-…	IEC [1]		US [2]	
	Al cable size	Cu cable size	Cu cable size	Ground wire size
	mm²	mm²	AWG/kcmil	AWG/kcmil
2300A-7+A004	12 × (3 × 185 + 57 Cu)	8 × (3 × 240 + 120)	6 × 300	2/0
2600A-7	14 × (3 × 185 + 57 Cu)	9 × (3 × 240 + 120)	11 × 400	4/0
2600A-7+A004	12 × (3 × 240 + 72 Cu)	12 × (3 × 150 + 70)	8 × 4/0	4/0
2860A-7	15 × (3 × 185 + 57 Cu)	15 × (3 × 120 + 70)	11 × 500	4/0
2860A-7+A004	12 × (3 × 300 + 88 Cu)	10 × (3 × 240 + 120)	8 × 250	4/0
+A004 = 12-pulse supply connection				

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, PVC insulation, surface temperature 70 °C (IEC/EN 60204-1 and IEC 60364-5-52/2001). For other conditions, size 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 310-15(B)(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, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

Output cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for nominal current.

Note:

If the drive is not equipped with option Common motor terminal cubicle (option +H359) or Common output terminal (option +H366), each inverter module of the drive is to be individually cabled to the motor.

ACS880-07-…	IEC [1]		US [2]
	Al cable size	Cu cable size	Cu cable size
	mm²	mm²	AWG/kcmil
U_N = 400 V			
0990A-3+A004	6 × (3 × 150 + 70 Cu)	4 × (3 × 185 + 95)	5 × 300
1140A-3 1140A-3+A004	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 × 120)	5 × 400
1250A-3 1250A-3+A004	6 × (3 × 240 + 72 Cu)	6 × (3 × 150 × 70)	6 × 350
1480A-3 1480A-3+A004	8 × (3 × 185 + 57 Cu)	6 × (3 × 185 × 95)	7 × 350
1760A-3 1760A-3+A004	8 × (3 × 240 + 72 Cu)	8 × (3 × 150 × 70)	7 × 500
2210A-3 2210A-3+A004	12 × (3 × 185 + 57 Cu)	9 × (3 × 185 × 95)	11 × 300
2610A-3 2610A-3+A004	12 × (3 × 240 + 72 Cu)	12 × (3 × 150 × 70)	12 × 350
U_N = 500 V			
0990A-5+A004	6 × (3 × 150 + 70 Cu)	4 × (3 × 185 × 95)	5 × 300
1070A-5	6 × (3 × 150 + 70 Cu)	4 × (3 × 185 × 95)	5 × 350
1320A-5	6 × (3 × 240 + 72 Cu)	6 × (3 × 150 × 70)	6 × 350
1320A-5+A004	8 × (3 × 185 + 57 Cu)	6 × (3 × 150 × 70)	6 × 350
1450A-5 1450-5+A004	8 × (3 × 185 + 57 Cu)	6 × (3 × 185 × 95)	7 × 350
1580A-5 1580A-5+A004	8 × (3 × 185 + 57 Cu)	8 × (3 × 150 × 70)	6 × 500
1800A-5 1800A-5+A004	9 × (3 × 240 + 72 Cu)	9 × (3 × 150 × 70)	8 × 400
1980A-5 1980A-5+A004	9 × (3 × 240 + 72 Cu)	9 × (3 × 150 × 70)	10 × 300
U_N = 690 V			
0800A-7 0800A-7+A004	6 × (3 × 120 + 41 Cu)	4 × (3 × 150 + 70)	4 × 300
0900A-7 0950A-7+A004	6 × (3 × 150 + 41 Cu)	4 × (3 × 185 + 95)	4 × 400
1160A-7 1160A-7+A004	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 × 120)	6 × 300
1450A-7 1450A-7+A004	9 × (3 × 150 + 41 Cu)	6 × (3 × 185 + 95)	7 × 350
1650A-7 1650A-7+A004	9 × (3 × 185 + 57 Cu)	9 × (3 × 120 × 70)	7 × 400
1950A-7 1950A-7+A004	12 × (3 × 150 + 41 Cu)	8 × (3 × 185 + 95)	9 × 350
2300A-7	10 × (3 × 240 + 72 Cu)	10 × (3 × 185 × 95)	10 × 400

ACS880-07-…	IEC [1]		US [2]
	Al cable size	Cu cable size	Cu cable size
	mm²	mm²	AWG/kcmil
2300A-7+A004	12 × (3 × 185 + 57 Cu)	8 × (3 × 240 × 120)	10 × 400
2600A-7 2600A-7+A004	15 × (3 × 150 + 41 Cu)	15 × (3 × 120 × 70)	11 × 400
2860A-7 2860A-7+A004	15 × (3 × 185 + 57 Cu)	15 × (3 × 120 × 70)	11 × 500
+A004 = 12-pulse supply connection			

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, PVC insulation, surface temperature 70 °C (IEC/EN 60204-1 and IEC 60364-5-52/2001). For other conditions, size 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 310-15(B)(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, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

Terminal and lead-through data for the power cables

The locations and sizes of lead-throughs are shown by the dimension drawings delivered with the drive, and the dimension drawing examples in this manual.

The location and size of power cable terminals are shown in the dimension drawing examples in this manual.

Terminal data for the supply and inverter control units

See chapter *Control units of the drive (page 129)*.

Electrical power network specification

Voltage (U_1)	400 V units: 380…415 V AC 3-phase ± 10%. This is indicated in the type designation label as typical input voltage level (3~ 400 V AC). 500 V units: 380…500 V AC 3-phase ± 10%. This is indicated in the type designation label as typical input voltage levels (3~ 400/480/500 V AC). 690 V units: 525…690 V AC 3-phase ± 10% (525…600 V AC ± 10% in corner-grounded TN systems). This is indicated in the type designation label as typical input voltage levels (3~ 525/600/690 V AC).
Network type	TN (grounded) and IT (ungrounded) systems
Frequency	50/60 Hz, variation ± 5% of nominal frequency
Imbalance	Max. ± 3% of nominal phase-to-phase input voltage
Short-circuit withstand strength (IEC/EN 61439-1)	ACS880-07-2610A-3, ACS880-07-2300A-7 and ACS880-07-2860A-7 without grounding/earthing switch (ie. without option +F259): Rated peak withstand current (I_{pk}): 143 kA Rated short-time withstand current (I_{cw}): 65 kA/1 s All other configurations: Rated peak withstand current (I_{pk}): 105 kA Rated short-time withstand current (I_{cw}): 50 kA/1 s
Short-circuit current protection (UL 08A, CSA C22.2 No. 14-13)	The drive is suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes at 600 V maximum when the input cable is protected with class T fuses.
Fundamental power factor (cos phi_1)	0.98 (at nominal load)

Transformer specification for 12-pulse supply (IEC 60076-1:2011)	Connection: Dy 11 d0 or Dyn 11 d0 Phase shift between secondaries: 30° electrical Voltage difference between secondaries: < 0.5% Short-circuit impedance of secondaries: > 5% Short-circuit impedance difference between secondaries: ≤ 10% of the percentage impedance No grounding of the secondaries allowed. Static shield recommended.

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet synchronous motors and AC induction servomotors, ABB synchronous reluctance (SynRM) motors
Voltage (U_2)	0 to U_1, 3-phase symmetrical, U_{max} at the field weakening point
Frequency	0…500 Hz (0…120 Hz with sine output filters (option +E206)) • For higher operational output frequencies, please contact your local ABB representative. • Operation above 150 Hz may require type-specific derating. For more information, contact your local ABB representative.
Current	See the rating tables.
Switching frequency	3 kHz (typical). The switching frequency can vary per frame and voltage. For exact values, please contact your local ABB representative.
Maximum recommended motor cable length	500 m (1640 ft). **Note:** With motor cables longer than 150 m (492 ft) the EMC Directive requirements may not be fulfilled.

Control unit connection data

See chapter *Control units of the drive (page 129)*.

Efficiency

Efficiency	97.2 … 98.0% at nominal power level depending on drive type

Protection classes

Degrees of protection (IEC/EN 60529)	IP22 (standard), IP42 (optional), IP54 (optional)
Enclosure types (UL50)	UL Type 1 (standard), UL Type 1 (option +B054), UL Type 12 (option +B055). For indoor use only.
Overvoltage category (IEC/EN 60664-1)	III
Protective class (IEC/EN 61800-5-1)	I

Ambient conditions

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

	Operation installed for stationary use	**Storage in the protective package**	**Transportation in the protective package**
Installation site altitude	0…2000 m (0…6562 ft) above sea level. For altitudes over 2000 m, contact ABB. Output derated above 1000 m (3281 ft).	-	-
Air temperature	0 … +40 °C (+32 … +104 °F). No condensation allowed. Output derated in the range +40 … +50 °C (+104 … +122 °F).	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	Max. 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination	IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations Chemical gases: Class 3C2 Solid particles: Class 3S2. No conductive dust allowed.	IEC 60721-3-1:1997 Chemical gases: Class 1C2 Solid particles: Class 1S3 (packing must support this, otherwise 1S2)	IEC 60721-3-2:1997 Chemical gases: Class 2C2 Solid particles: Class 2S2
Vibration IEC/EN 61800-5-1 IEC 60068-2-6:2007, EN 60068-2-6:2008 Environmental testing Part 2: Tests –Test Fc: Vibration (sinusoidal)	IEC/EN 60721-3-3:2002 10…57 Hz: max. 0.075 mm amplitude 57…150 Hz: 1 *g* Units with marine construction (option +C121): Max. 1 mm (0.04 in.) (5 … 13.2 Hz), max. 0.7 *g* (13.2 … 100 Hz) sinusoidal	IEC/EN 60721-3-1:1997 10…57 Hz: max. 0.075 mm amplitude 57…150 Hz: 1 *g*	IEC/EN 60721-3-2:1997 2…9 Hz: max. 3.5 mm amplitude 9…200 Hz: 10 m/s^2 (32.8 ft/s^2)
Shock IEC 60068-2-27:2008, EN 60068-2-27:2009 Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	Not allowed	With packing max. 100 m/s^2 (328 ft/s^2) 11 ms	With packing max. 100 m/s^2 (328 ft/s^2) 11 ms

Materials

Cabinet	Hot-dip zinc coated 1.5 mm thick steel sheet (thickness of coating approximately 20 micrometers). Polyester thermosetting powder coating (thickness approximately 80 micrometers) on visible surfaces, color RAL 7035 and RAL 9017.
Busbars	Tin-plated copper
Fire safety of materials (IEC 60332-1)	Insulating materials and non-metallic items mostly self-extinctive

Package	Standard package: • timber, polyethylene sheet (thickness 0.15 mm), stretch film (thickness 0.023 mm), PP tape, PET strap, sheet metal (steel) • for land and air transport when planned storage time is less than 2 months or when storage can be arranged in clean and dry conditions less than 6 months • can be used when products will not be exposed to corrosive atmosphere during transport or storage Container package: • timber, VCI sheet film (PE, thickness 0.10 mm), VCI stretch film (PE, thickness 0.04 mm), VCI emitter bags, PP tape, PET strap, sheet metal (steel) • for sea transport in containers • recommended for land and air transport when storage time prior to installation exceeds 6 months or storage is arranged in partially weather-protected conditions Seaworthy package: • timber, plywood, VCI sheet film (PE, thickness 0.10 mm), VCI stretch film (PE, thickness 0.04 mm), VCI emitter bags, PP tape, PET strap, sheet metal (steel) • for sea transport with or without containerization • for long storage periods in environments where roofed and humidity-controlled storage cannot be arranged Cabinets are fastened to the pallet with screws and braced from the top end to the package walls to prevent swaying inside the package. Package elements are attached to each other with screws.
Disposal	The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated. Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and DC capacitors (C1-1 to C1-x) need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code. Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.

Applicable standards

Standard	**Information**
European electrical safety requirements product standards	
IEC/EN 61800-5-1:2007	Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy
IEC 60146-1-1:2009 EN 60146-1-1:2010	Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements
IEC/EN 60664-1:2007	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests
IEC 60529:1989 EN 60529:1991	Degrees of protection provided by enclosures (IP code).
IEC 60204-1:2005 + A1:2008 EN 60204-1:2006 + AC:2010	Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
IEC/EN 61439-1:2009	Low-voltage switchgear and controlgear assemblies -- Part 1: General rules
EMC performance	
IEC/EN 61800-3:2004	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
Product requirements in North America	
UL 508A 1st edition:2001	Industrial Control Panels

Standard	Information
UL 50 12th edition:2007	Enclosures for Electrical Equipment, Non-Environmental Considerations
CSA C22.2 No. 14-13:2013	Industrial control equipment
CSA C22.2 No. 274-13:2013	Adjustable speed drives

CE marking

A CE marking is attached to the product to signify that it conforms to all applicable European Union legislation.

Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to appropriate European harmonized standards.

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 *Compliance with EN 61800-3:2004 (page 200)*.

Compliance with the European Machinery Directive

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.

Declaration of Conformity (According to Machinery Directive)

Power and productivity
for a better world™

EU Declaration of Conformity

Machinery Directive 2006/42/EC

We

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Phone: +358 10 22 11

declare under our sole responsibility that the following products:

Frequency converters and **frequency converter components**

ACS880-04, -14, -34 (frames nxR8i)

ACS880-04XT (frames 2xR10 and 2xR11)

ACS880-07

ACS880-17, -37 (frames nxR8i 380V – 690V; frame R11 380V – 525V)

ACS880-104, -107

ACS880 multidrives

ACS880-104LC (frames nxR8i)

identified with serial numbers beginning with 1 or 8

with regard to the safety functions

Safe torque off

Safe motor temperature with FPTC-01 module (option code +L536)

Safe stop 1, Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Prevention of unexpected start-up, with FSO-12 module (option code +Q973)

Safe stop 1, Safe stop emergency, Safely-limited speed, Safe maximum speed, Safe brake control, Safe Speed monitor, Safe direction, Prevention of unexpected start-up, with FSO-21 and FSE-31 modules (option codes +Q972 and +L521)

ACS880-07, -17, -37 and ACS880 multidrives: Prevention of unexpected start-up (option codes +Q950; +Q957), **Emergency stop** (option codes +Q951; +Q952; +Q963; +Q964; +Q978; +Q979), **Safely-limited speed** (option codes +Q965; Q966)

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

The following harmonized standards have been applied:

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

The following other standards have been applied:

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

The products referred in this Declaration of conformity fulfil the relevant provisions of other European Union Directives which are notified in Single EU Declaration of conformity 3AXD10000497305.

Person authorized to compile the technical file:

Name and address: Vesa Tiihonen, Hiomotie 13, 00380 Helsinki, Finland.

Helsinki, 25 Apr 2017

Manufacturer representative:

Peter Lindgren
Vice President, ABB Oy

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 C2: drive of rated voltage less than 1000 V and intended to be installed and started up only by a professional when used in the first environment. **Note:** A professional is a person or organization having necessary skills in installing and/or starting up power drive systems, including their EMC aspects.

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

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

Category C2

The drive complies with the standard with the following provisions:

1. The drive is equipped with EMC filter (option +E202).
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 100 meters (328 ft).

WARNING!

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

WARNING!

Do not install a drive equipped with EMC filter +E202 on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage the unit.

Category C3

The drive complies with the standard with the following provisions:

1. The input power cables, motor cables and control cables are selected as specified in the appropriate drive manual(s).
2. The drive is installed according to the instructions given in the appropriate drive manual(s).
3. Maximum motor cable length is 100 meters (328 ft).

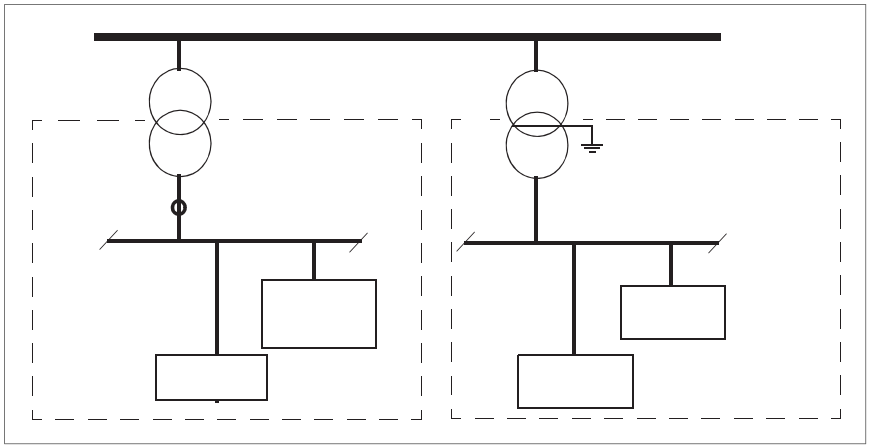
WARNING!

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

Category C4

If the provisions under Category 3 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 natural 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 input power cables, motor cables and control cables are selected as specified in the appropriate drive manual(s).
4. The drive is installed according to the instructions given in the appropriate drive manual(s).

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 and CSA markings

The drive is C-UL-US Listed (with option +C129) and CSA certified (with option +C134). The approvals are valid with rated voltages up to 600 V. The appropriate marking is attached to the drive when either option is selected.

UL and CSA checklist

- Use the drive in a heated, indoor controlled environment.
- Install the drive in clean air according to enclosure classification. The cooling air must be clean, and free from corrosive materials and electrically conductive dust.
- The maximum ambient air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 50 °C (104 to 122 °F).
- The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 V maximum when the input cable is protected with UL classified fuses given. 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 in UL-compliant installations.
- Protect the input cable with fuses. Suitable IEC fuses and UL fuses for drive protection are listed in chapter Technical data. Circuit breakers must not be used without fuses in the USA. For suitable circuit breakers, contact your local ABB representative.
- For installation in the United States, provide branch circuit protection in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, the drive must have option +C129.
- For installation in Canada, provide branch circuit protection in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfill this requirement, the drive must have option +C129 or +C134.
- The drive provides overload protection in accordance with the National Electrical Code (NEC).

RCM marking

RCM marking is required in Australia and New Zealand. An RCM mark is attached to each drive in order to verify compliance with the relevant standard (IEC 61800-3:2004), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

For fulfilling the requirements of the standard, see *Compliance with EN 61800-3:2004 (page 200)*.

EAC (Eurasian Conformity) marking

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

Tightening torques

Unless a tightening torque is specified in the text, the following torques can be used.

Electrical connections

Size	Torque	Note
M3	0.5 N·m (4.4 lbf·in)	Strength class 4.6...8.8
M4	1 N·m (9 lbf·in)	Strength class 4.6...8.8

Size	Torque	Note
M5	4 N·m (35 lbf·in)	Strength class 8.8
M6	9 N·m (6.6 lbf·ft)	Strength class 8.8
M8	22 N·m (16 lbf·ft)	Strength class 8.8
M10	42 N·m (31 lbf·ft)	Strength class 8.8
M12	70 N·m (52 lbf·ft)	Strength class 8.8
M16	120 N·m (90 lbf·ft)	Strength class 8.8

Mechanical connections

Size	Max. torque	Note
M5	6 N·m (53 lbf·in)	Strength class 8.8
M6	10 N·m (7.4 lbf·ft)	Strength class 8.8
M8	24 N·m (17.7 lbf·ft)	Strength class 8.8

Insulation supports

Size	Max. torque	Note
M6	5 N·m (44 lbf·in)	Strength class 8.8
M8	9 N·m (6.6 lbf·ft)	Strength class 8.8
M10	18 N·m (13.3 lbf·ft)	Strength class 8.8
M12	31 N·m (23 lbf·ft)	Strength class 8.8

Cable lugs

Size	Max. torque	Note
M8	15 N·m (11 lbf·ft)	Strength class 8.8
M10	32 N·m (23.5 lbf·ft)	Strength class 8.8
M12	50 N·m (37 lbf·ft)	Strength class 8.8

Disclaimers

Generic 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.

Cybersecurity disclaimer

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

13

Dimensions

Cabinet line-up dimensions

The drive consists of cubicles built into a cabinet line-up. The tables below show the composition of cabinet line-ups for each frame size and the standard combinations of options. The dimensions are in millimeters (for inches, divide by 25.4).

Notes:

- The side panels at the left and right ends of the line-up increase the total line-up width by 30 millimeters (1.2”).
- The standard depth of the cabinet line-up is 644 mm (25.35”) excluding equipment such as handles and air inlet gratings. This is increased by 200 mm (7.87”) with top cable exit units, or by 130 mm with option +C128 (cooling air intake through bottom of cabinet).
- UL Listed (+C129) units are top cable entry/exit by default.
- Not all possible configurations are presented. For information on unlisted configurations, contact ABB.
- The data given is preliminary. ABB reserves the right to modify the design at any time without notice. Consult ABB for up-to-date, drive-specific information.

The tables are followed by selected dimension drawing examples.

Dimension tables

1×D8T + 2×R8i – 6-pulse connection															
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	EMC/RFI filter cubicle	Supply module cubicle	Inverter module cubicle	Common motor terminal cubicle	Sine filter cubicle	Joining cubicle	Brake chopper 1 1)	Brake resistor 1 1)	Brake chopper 2 1)	Brake resistor 2 1)	Brake chopper 3 1)	Brake resistor 3 1)	Shipping split widths	Line-up width
400	400		400	600										1800	1800
400	400	300	400	600										2100	2100
400	400		400	600	300									2100	2100
400	400	300	400	600	300									2400	2400
400	400		400	600		1000								2800	2800
400	400	300	400	600		1000								3100	3100
400	400		400	600				400		400				2600	2600
400	400	300	400	600				400		400				2900	2900
400	400		400	600	300			400		400				2900	2900
400	400	300	400	600	300			400		400				3200	3200
400	400		400	600		1000		400		400				3600	3600
400	400	300	400	600		1000		400		400				3900	3900
400	400		400	600				400	800	400	800			4200	4200
400	400	300	400	600			200	400	800	400	800			2300 + 2400	4700
400	400		400	600	300			400	800	400	800			2100 + 2400	4500
400	400	300	400	600	300			400	800	400	800			2400 + 2400	4800
400	400		400	600		1000	200	400	800	400	800			3000 + 2400	5400
400	400	300	400	600		1000	200	400	800	400	800			3300 + 2400	5700
400	400		400	600				400		400		400		3000	3000
400	400	300	400	600				400		400		400		3300	3300
400	400		400	600	300			400		400		400		3300	3300
400	400	300	400	600	300			400		400		400		3600	3600
400	400		400	600		1000		400		400		400		4000	4000
400	400	300	400	600		1000	200	400		400		400		3300 + 1200	4500
400	400		400	600			200	400	800	400	800	400	800	2000 + 3600	5600
400	400	300	400	600			200	400	800	400	800	400	800	2300 + 3600	5900
400	400		400	600	300			400	800	400	800	400	800	2100 + 3600	5700
400	400	300	400	600	300			400	800	400	800	400	800	2400 + 3600	6000
400	400		400	600		1000	200	400	800	400	800	400	800	3000 + 3600	6600
400	400	300	400	600		1000	200	400	800	400	800	400	800	3300 + 3600	6900

1) The number of brake choppers depends on required braking power. See chapter *Resistor braking (page 265)*.

2×D7T + 2×R8i – 12-pulse connection (option +A004), without grounding switch (no option +F259)															
Auxiliary control cubicle (ACU)	**Incoming cubicle (ICU)**	**Adapter for top cable entry**	**Supply module cubicle**	**Inverter module cubicle**	**Common motor terminal cubicle**	**Sine filter cubicle**	**Joining cubicle**	**Brake chopper 1 1)**	**Brake resistor 1 1)**	**Brake chopper 2 1)**	**Brake resistor 2 1)**	**1)Brake chopper 3**	**Brake resistor 3 1)**	**Shipping split widths**	**Line-up width**
400	600		400	600										2000	2000
400	600	200	400	600										2200	2200
400	600		400	600	300									2300	2300
400	600	200	400	600	300									2500	2500
400	600		400	600		1000								3000	3000
400	600	200	400	600		1000								3200	3200
400	600		400	600				400		400				2800	2800
400	600	200	400	600				400		400				3000	3000
400	600		400	600	300			400		400				3100	3100
400	600	200	400	600	300			400		400				3300	3300
400	600		400	600		1000		400		400				3800	3800
400	600	200	400	600		1000		400		400				4000	4000
400	600		400	600			200	400	800	400	800			2200 + 2400	4600
400	600	200	400	600			200	400	800	400	800			2400 + 2400	4800
400	600		400	600	300			400	800	400	800			2300 + 2400	4700
400	600	200	400	600	300			400	800	400	800			2500 + 2400	4900
400	600		400	600		1000	200	400	800	400	800			3200 + 2400	5600
400	600	200	400	600		1000	200	400	800	400	800			3400 + 2400	5800
400	600		400	600				400		400		400		3200	3200
400	600	200	400	600				400		400		400		3400	3400
400	600		400	600	300			400		400		400		3500	3500
400	600	200	400	600	300			400		400		400		3700	3700
400	600		400	600		1000		400		400		400		4200	4200
400	600	200	400	600		1000	200	400		400		400		3400 + 1200	4600
400	600		400	600			200	400	800	400	800	400	800	2200 + 3600	5800
400	600	200	400	600			200	400	800	400	800	400	800	2400 + 3600	6000
400	600		400	600	300			400	800	400	800	400	800	2300 + 3600	5900
400	600	200	400	600	300			400	800	400	800	400	800	2500 + 3600	6100
400	600		400	600		1000	200	400	800	400	800	400	800	3200 + 3600	6800
400	600	200	400	600		1000	200	400	800	400	800	400	800	3400 + 3600	7000

1) The number of brake choppers depends on required braking power. See chapter *Resistor braking (page 265)*.

2×D7T + 2×R8i – 12-pulse connection (option +A004), with grounding switch (option +F259)															
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU) 1	Supply module cubicle	Incoming cubicle (ICU) 2	Inverter module cubicle	Common motor terminal cubicle	Sine filter cubicle	Joining cubicle	Brake chopper 1 1)	Brake resistor 1 1)	Brake chopper 2 1)	Brake resistor 2 1)	Brake chopper 3 1)	Brake resistor 3 1)	Shipping split widths	Line-up width
400	400	400	400	600										2200	2200
400	400	400	400	600	300									2500	2500
400	400	400	400	600		1000								3200	3200
400	400	400	400	600				400		400				3000	3000
400	400	400	400	600	300			400		400				3300	3300
400	400	400	400	600		1000		400		400				4000	4000
400	400	400	400	600			200	400	800	400	800			2400 + 2400	4800
400	400	400	400	600	300			400	800	400	800			2500 + 2400	4900
400	400	400	400	600		1000	200	400	800	400	800			3400 + 2400	5800
400	400	400	400	600				400		400		400		3400	3400
400	400	400	400	600	300			400		400		400		3700	3700
400	400	400	400	600		1000	200	400		400		400		3400 + 1200	4600
400	400	400	400	600			200	400	800	400	800	400	800	2400 + 3600	6000
400	400	400	400	600	300			400	800	400	800	400	800	2500 + 3600	6100
400	400	400	400	600		1000	200	400	800	400	800	400	800	3400 + 3600	7000

1) The number of brake choppers depends on required braking power. See chapter *Resistor braking (page 265)*.

2×D8T + 2×R8i – 6-pulse connection, 400/500 V															
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top cable entry	Supply module cubicle	Inverter module cubicle	Joining cubicle	Common motor terminal cubicle	Sine filter cubicle	Joining cubicle	Brake chopper 1 1)	Brake resistor 1 1)	Brake chopper 2 1)	Brake resistor 2 1)	Brake chopper 3 1)	Brake resistor 3 1)	Shipping split widths	Line-up width
400	600		600	600											2200	2200
400	600	200	600	600											2400	2400
400	600		600	600		300									2500	2500
400	600	200	600	600		300									2700	2700
400	600		600	600			1000								3200	3200
400	600	200	600	600			1000								3400	3400
400	600		600	600					400		400		400		3400	3400
400	600	200	600	600					400		400		400		3600	3600
400	600		600	600	200				400	800	400	800	400	800	2400 + 3600	6000
400	600	200	600	600	200				400	800	400	800	400	800	2600 + 3600	6200
400	600		600	600		300			400		400		400		3700	3700
400	600	200	600	600		300			400		400		400		3900	3900
400	600		600	600		300			400	800	400	800	400	800	2500 + 3600	6100
400	600	200	600	600		300			400	800	400	800	400	800	2700 + 3600	6300
400	600		600	600	200		1000		400		400		400		2400 + 2200	4600
400	600	200	600	600	200		1000		400		400		400		2600 + 2200	4800
400	600		600	600			1000	200	400	800	400	800	400	800	3400 + 3600	7000
400	600	200	600	600			1000	200	400	800	400	800	400	800	3600 + 3600	7200

1) The number of brake choppers depends on required braking power. See chapter *Resistor braking (page 265)*.

2×D8T + 2×R8i – 6-pulse connection, 690 V															
Auxiliary control cubicle (ACU)	**Incoming cubicle (ICU)**	**Supply module cubicle**	**Inverter module cubicle**	**Joining cubicle**	**Common motor terminal cubicle**	**Sine filter cubicle**	**Joining cubicle**	**Brake chopper 1 1)**	**Brake resistor 1 1)**	**Brake chopper 2 1)**	**Brake resistor 2 1)**	**Brake chopper 3 1)**	**Brake resistor 3 1)**	**Shipping split widths**	**Line-up width**
400	400	600	600											2000	2000
400	400	600	600		300									2300	2300
400	400	600	600			1000								3000	3000
400	400	600	600					400		400		400		3200	3200
400	400	600	600	200				400	800	400	800	400	800	2200 + 3600	5800
400	400	600	600		300			400		400		400		3500	3500
400	400	600	600		300			400	800	400	800	400	800	2300 + 3600	5900
400	400	600	600			1000		400		400		400		4200	4200
400	400	600	600			1000	200	400	800	400	800	400	800	3200 + 3600	6800

1) The number of brake choppers depends on required braking power. See chapter *Resistor braking (page 265)*.

2×D8T + 2×R8i – 12-pulse connection (option +A004), without grounding switch (no option +F259)														
Auxiliary control cubicle (ACU)	**Incoming cubicle (ICU)**	**Adapter for top cable entry**	**Supply module cubicle**	**Inverter module cubicle**	**Common motor terminal cubicle**	**Joining cubicle**	**Brake chopper 1 1)**	**Brake resistor 1 1)**	**Brake chopper 2 1)**	**Brake resistor 2 1)**	**Brake chopper 3 1)**	**Brake resistor 3 1)**	**Shipping split widths**	**Line-up width**
400	600		600	600									2200	2200
400	600	200	600	600									2400	2400
400	600		600	600	300								2500	2500
400	600	200	600	600	300								2800	2800
400	600		600	600			400		400		400		3400	3400
400	600	200	600	600			400		400		400		3600	3600
400	600		600	600		200	400	800	400	800	400	800	2400 + 3600	6000
400	600	200	600	600		200	400	800	400	800	400	800	2600 + 3600	6200
400	600		600	600	300		400		400		400		3700	3700
400	600	200	600	600	300		400		400		400		3900	3900
400	600		600	600	300		400	800	400	800	400	800	2500 + 3600	6100
400	600	200	600	600	300		400	800	400	800	400	800	2700 + 3600	6300

1) The number of brake choppers depends on required braking power. See chapter *Resistor braking (page 265)*.

2×D8T + 2×R8i – 12-pulse connection (option +A004), with grounding switch (option +F259)														
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU) 1	Supply module cubicle	Incoming cubicle (ICU) 2	Inverter module cubicle	Common motor terminal cubicle	Joining cubicle	Brake chopper 1 1)	Brake resistor 1 1)	Brake chopper 2 1)	Brake resistor 2 1)	Brake chopper 3 1)	Brake resistor 3 1)	Shipping split widths	Line-up width
400	400	600	400	600									2400	2400
400	400	600	400	600	300								2700	2700
400	400	600	400	600			400		400		400		3600	3600
400	400	600	400	600		200	400	800	400	800	400	800	2600 + 3600	6200
400	400	600	400	600	300		400		400		400		3900	3900
400	400	600	400	600	300		400	800	400	800	400	800	2700 + 3600	6300

1) The number of brake choppers depends on required braking power. See chapter *Resistor braking (page 265)*.

2×D8T + 3×R8i – 6-pulse connection; 12-pulse connection (option +A004) without grounding switch (no option +F259)							
Supply voltage range (V)	Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top cable entry	Supply module cubicle	Inverter module cubicle	Common motor terminal cubicle	Line-up width
500/690	400	600		600	800		2400
500/690	400	600	200	600	800		2600
500	400	600		600	800	400	2800
690	400	600		600	800	300	2700
500	400	600	200	600	800	400	3000
690	400	600	200	600	800	300	2900

2×D8T + 3×R8i – 12-pulse connection (option +A004), with grounding switch (option +F259)							
Supply voltage range (V)	Auxiliary control cubicle (ACU)	Incoming cubicle (ICU) 1	Supply module cubicle	Incoming cubicle (ICU) 2	Inverter module cubicle	Common motor terminal cubicle	Line-up width
500/690	400	400	600	400	800		2400
500	400	400	600	400	800	400	3000
690	400	400	600	400	800	300	2900

3×D8T + 3×R8i						
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top cable entry	Supply module cubicle	Inverter module cubicle	Common motor terminal cubicle 1)	Line-up width
400	600		800	800		2600
400	600	200	800	800		2800
400	600		800	800	400	3000
400	600	200	800	800	400	3200
400	600	200	800	800	600	3400

1) 600 mm with ACS880-07-2610-3 with top cable exit, otherwise 400 mm.

3×D8T + 4×R8i							
Auxiliary control cubicle (ACU)	**Incoming cubicle (ICU)**	**Adapter for top cable entry**	**Supply module cubicle**	**Inverter module cubicle 1**	**Common motor terminal cubicle**	**Inverter module cubicle 2**	**Line-up width**
400	600		800	600		600	3000
400	600	200	800	600		600	3200
400	600		800	600	400	600	3400
400	600	200	800	600	600	600	3800

4×D8T + 3×R8i											
Auxiliary control cubicle (ACU)	**Incoming cubicle (ICU) 1**	**Adapter for top cable entry 1**	**Supply module cubicle 1**	**Supply module cubicle 2**	**Adapter for top cable entry 2 [1]**	**Incoming cubicle (ICU) 2 [1]**	**Joining cubicle**	**Inverter module cubicle**	**Common motor terminal cubicle [2]**	**Shipping split widths**	**Line-up width**
400	600		600	600				800		3000	3000
400	600	200	600	600				800		3200	3200
400	600		600	600				800	400	3400	3400
400	600	200	600	600				800	600	3800	3800
400	600		600	600		600		800		3600	3600
400	600	200	600	600	200	600		800		4000	4000
400	600		600	600		600		800	400	4000	4000
400	600	200	600	600	200	600	200	800	600	3400 + 1400	4800

1) Units with option +F259 (grounding switch) only.
2) 600 mm with ACS880-07-2610-3+A004 with top cable exit, otherwise 400 mm.

4×D8T + 4×R8i											
Auxiliary control cubicle (ACU)	**Incoming cubicle (ICU) 1**	**Adapter for top cable entry 1**	**Supply module cubicle 1**	**Supply module cubicle 2**	**Adapter for top cable entry 2 [1]**	**Incoming cubicle (ICU) 2 [1]**	**Joining cubicle**	**Inverter module cubicle 1**	**Common motor terminal cubicle [2]**	**Inverter module cubicle 2**	**Shipping split widths**	**Line-up width**
400	600		600	600				600		600	3400	3400
400	600	200	600	600				600		600	3600	3600
400	600		600	600				600	400	600	3800	3800
400	600	200	600	600				600	400	600	4200	4200
400	600	200	600	600				600	600	600	4000	4000
400	600		600	600		600		600		600	4000	4000
400	600	200	600	600	200	600	200	600		600	3400 + 1200	4600
400	600		600	600		600		600	400	600	3800 + 600	4400
400	600	200	600	600	200	600	200	600	600	600	3400 + 1800	5200

1) Units with option +F259 (grounding switch) only.
2) 600 mm with ACS880-07-2300A-7+A004 with top cable exit, otherwise 400 mm.

4×D8T + 5×R8i												
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU) 1 [1]	Adapter for top cable entry 1	Supply module cubicle 1	Supply module cubicle 2	Adapter for top cable entry 2 [2]	Incoming cubicle (ICU) 2 [2]	Joining cubicle	Inverter module cubicle 1	Common motor terminal cubicle	Inverter module cubicle 1	Shipping split widths	Line-up width
400	600		600	600				800		600	3600	3600
400	600	200	600	600				800		600	3800	3800
400	600		600	600				800	600	600	4200	4200
400	600	200	600	600				800	600	600	3800 + 600	4400
400	1000		600	600				800		600	4000	4000
400	1000	200	600	600				800		600	4200	4200
400	1000		600	600				800	600	600	4000 + 600	4600
400	1000	200	600	600				800	600	600	4200 + 600	4800
400	600		600	600		600		800		600	4200	4200
400	600	200	600	600	200	600	200	800		600	3400 + 1400	4800
400	600		600	600		600		800	400	600	4000 + 600	4600
400	600	200	600	600	200	600	200	800	600	600	3400 + 2000	5400

1) 1000 mm with 6-pulse UL Listed (+C129) and CSA Approved (+C134) units, otherwise 600 mm.
2) 12-pulse units with option +F259 (grounding switch) only.

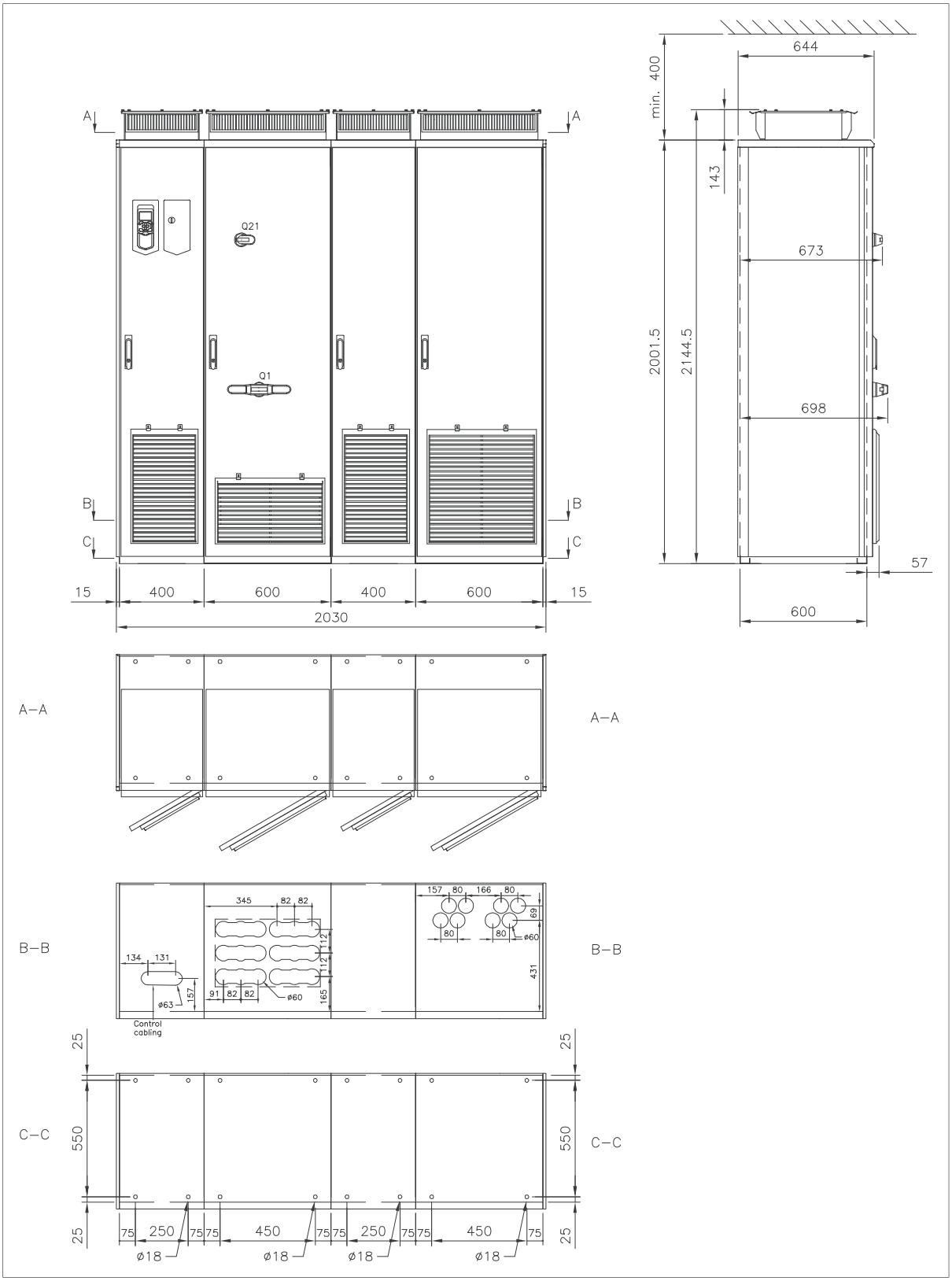
Weights

The table below lists the approximate basic weights.

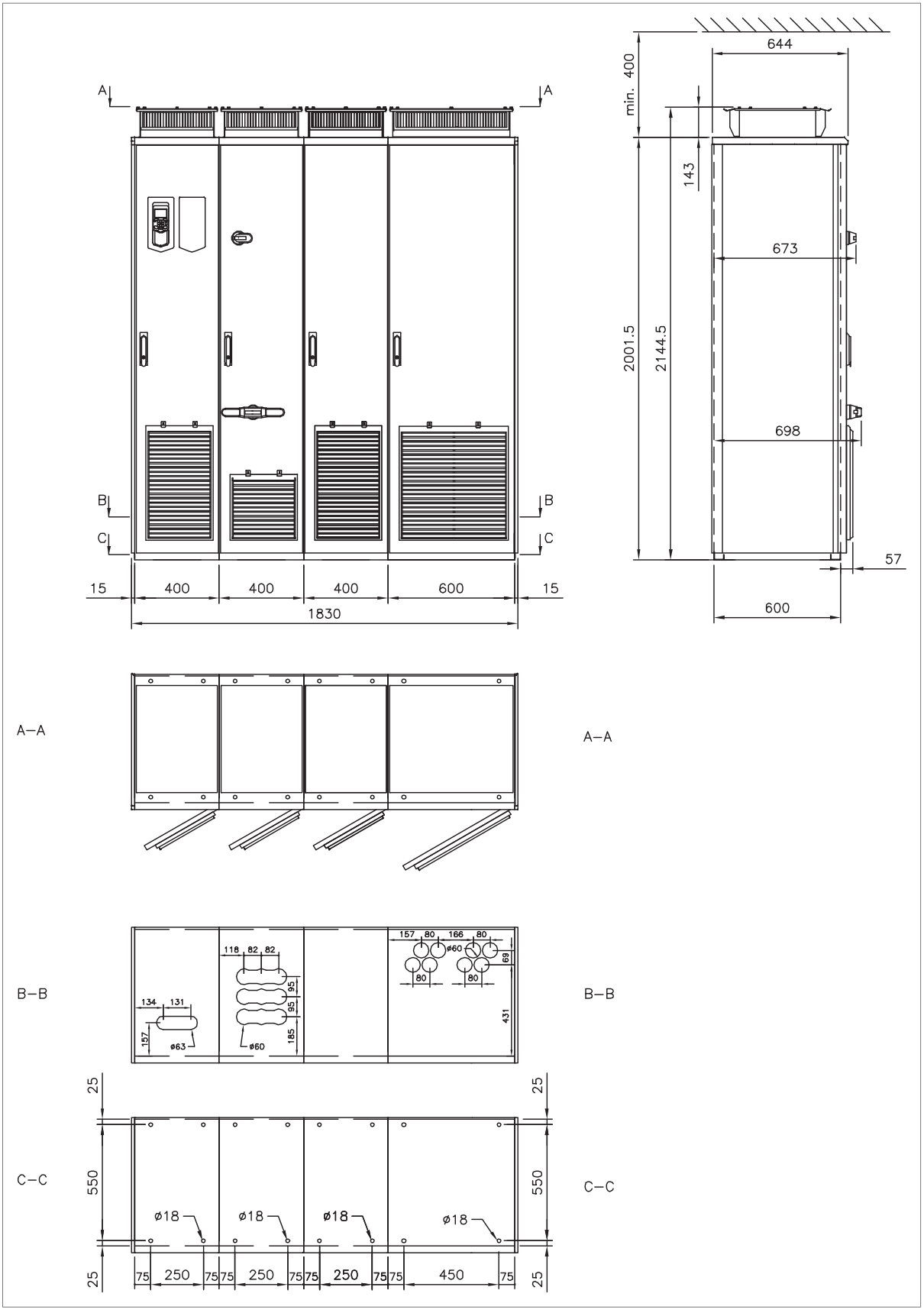
Frame size	Weight	
	kg	lbs
1×D8T + 2×R8i	1470	3240
2×D7T + 2×R8i	1710	3770
2×D8T + 2×R8i (6-pulse)	1770	3900
2×D8T + 2×R8i (12-pulse)	1870	4120
2×D8T + 3×R8i (6-pulse)	1920	4230
2×D8T + 3×R8i (12-pulse)	2020	4450
3×D8T + 3×R8i	2230	4920
3×D8T + 4×R8i	2590	5710
4×D8T + 3×R8i	2600	5730
4×D8T + 4×R8i	2960	6530
4×D8T + 5×R8i	3110	6860

Dimension drawing examples

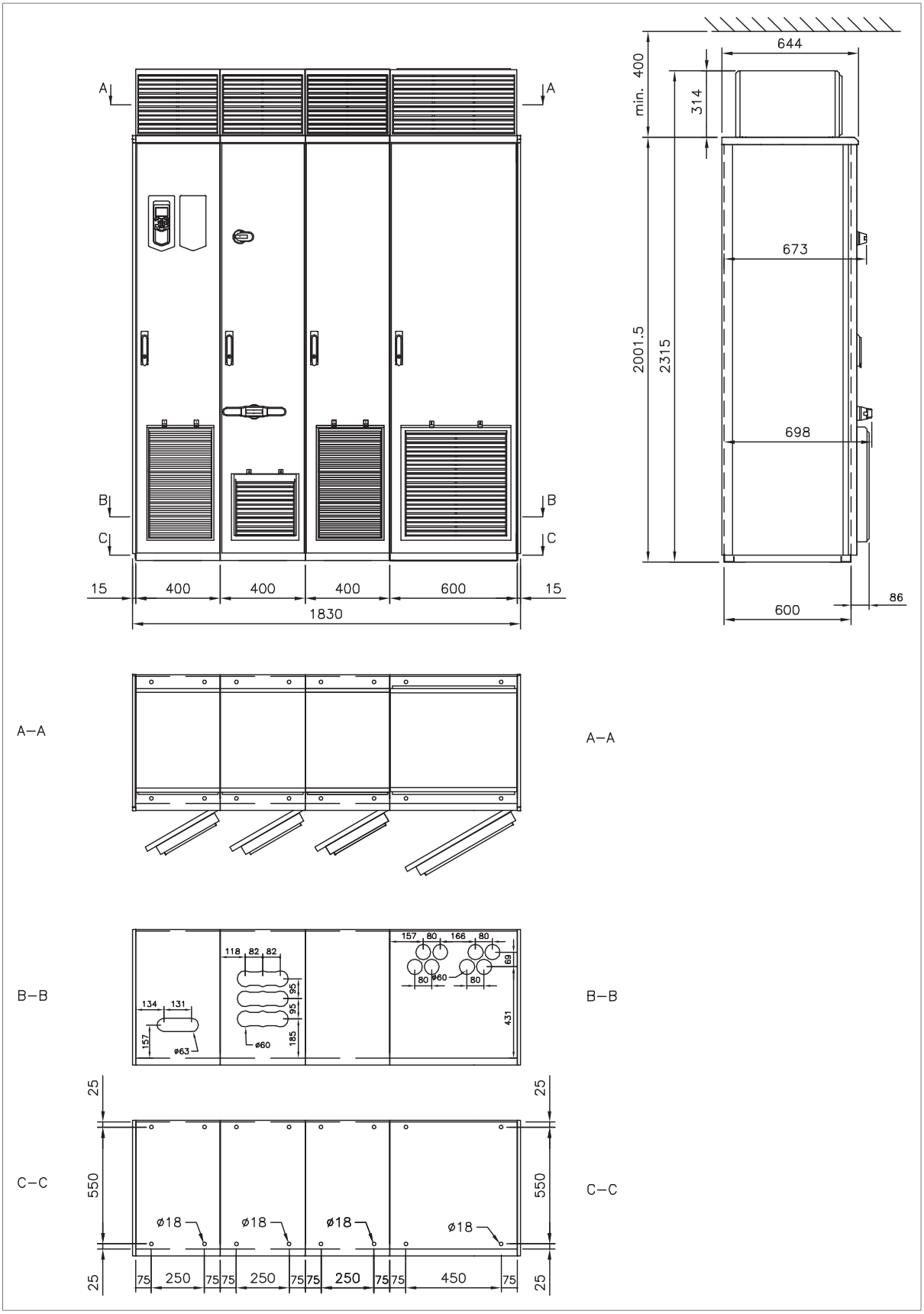
Frame 2×D7T + 2×R8i, 12-pulse (+A004)



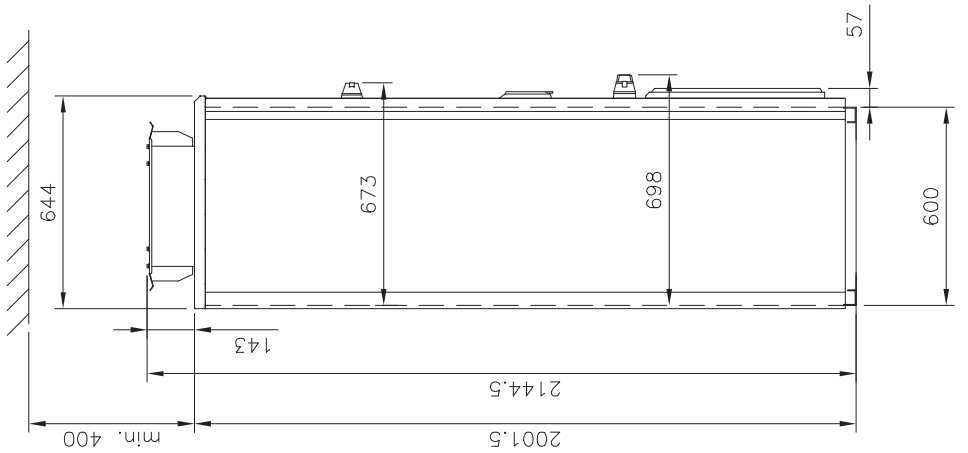
Frame 1×D8T + 2×R8i (IP22)

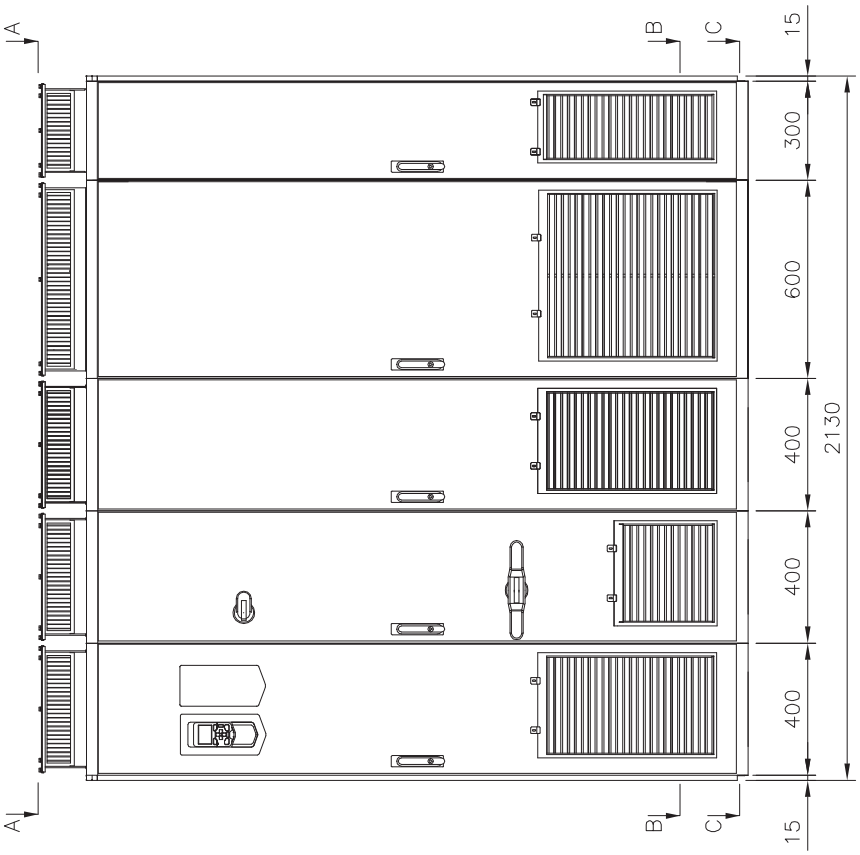


Frame 1×D8T + 2×R8i, IP54 (+B055)

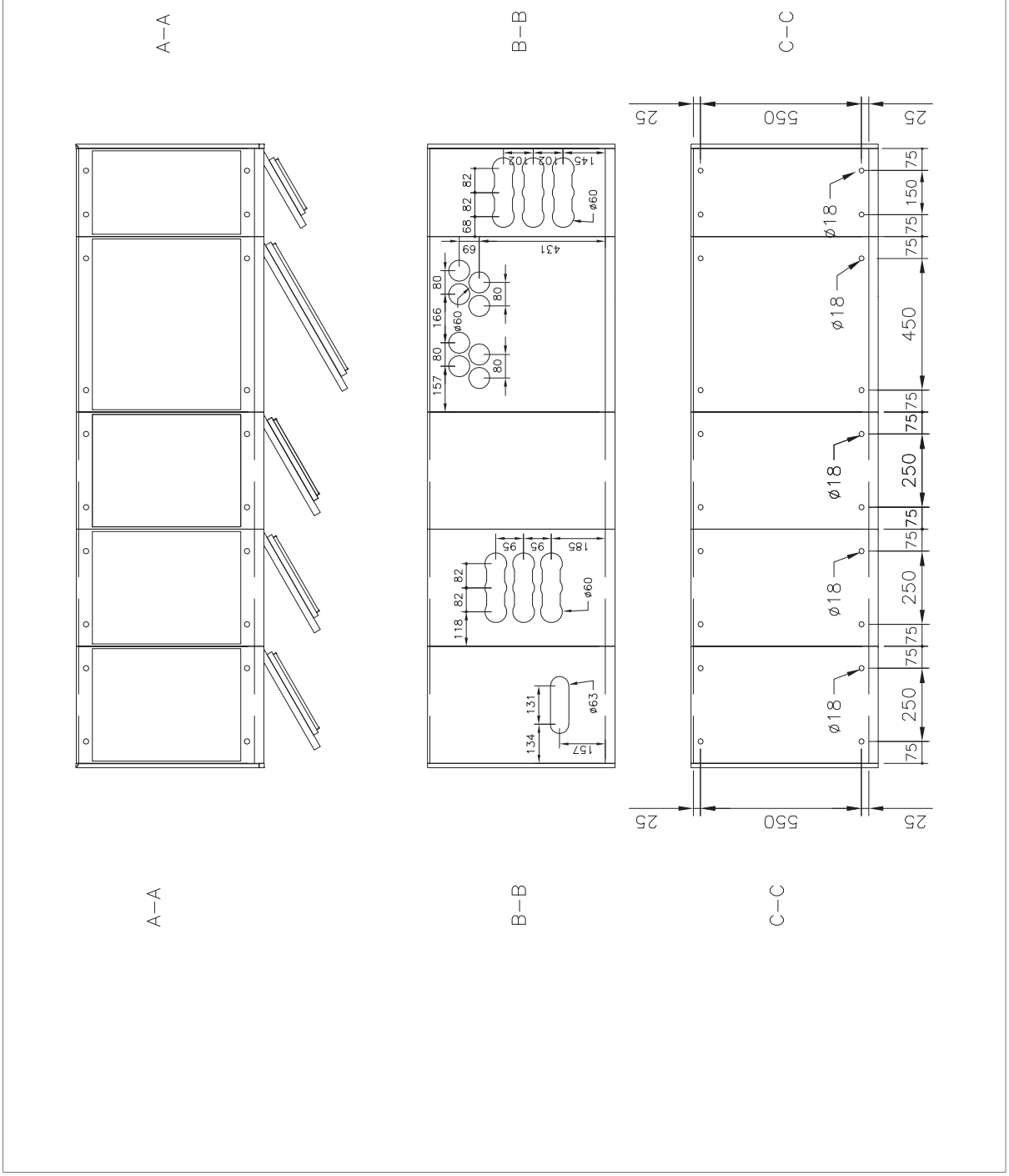


Frame 1×D8T + 2×R8i with common motor terminal cubicle (+H359), 1/2

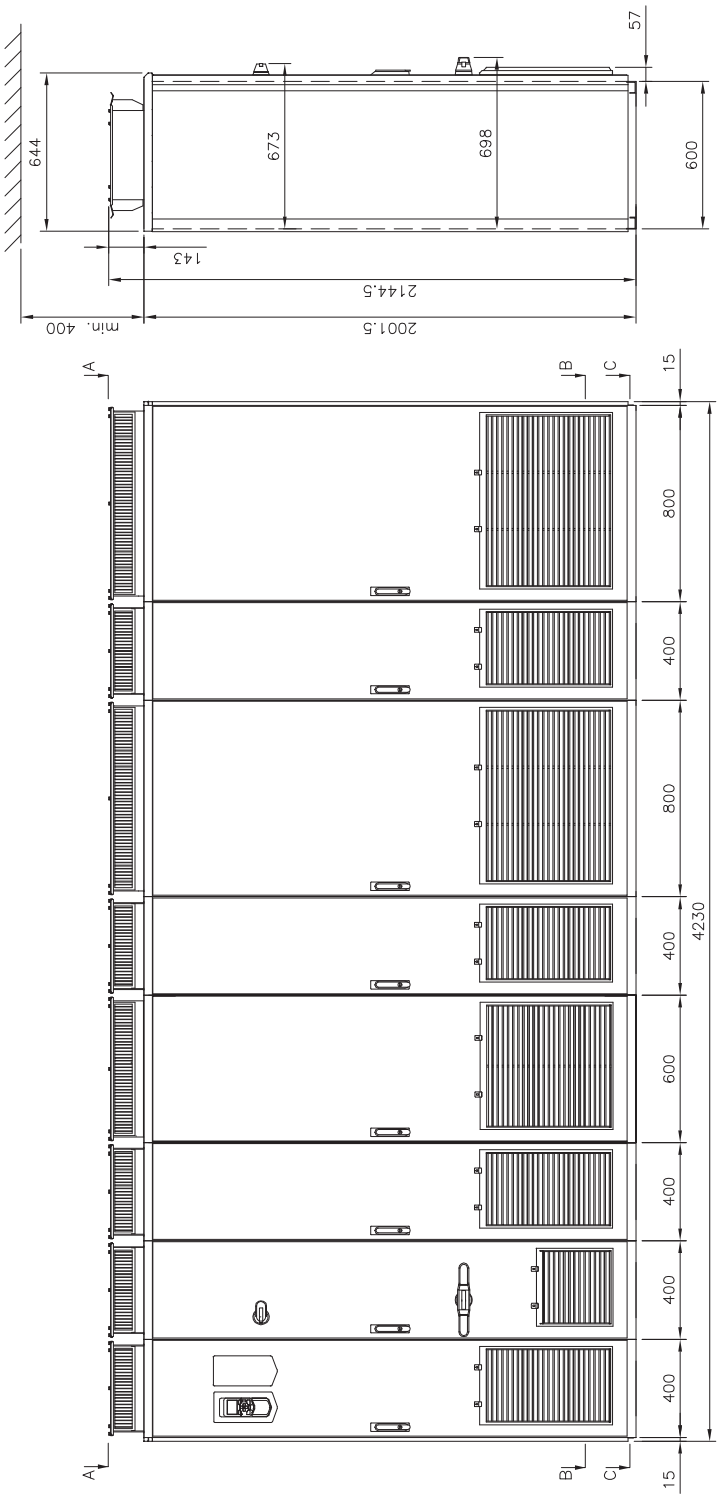




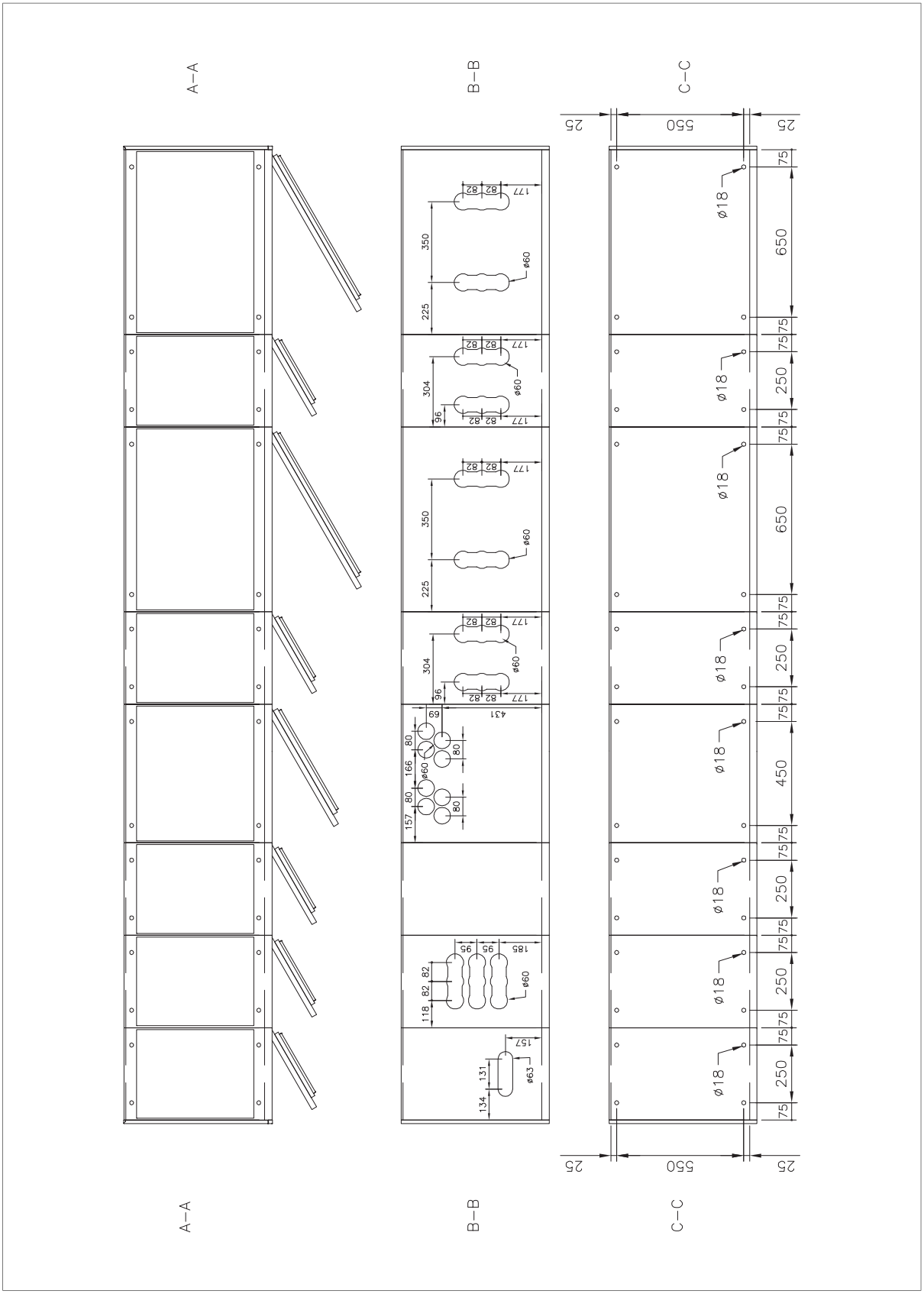
Frame 1×D8T + 2×R8i with common motor terminal cubicle (+H359), 2/2



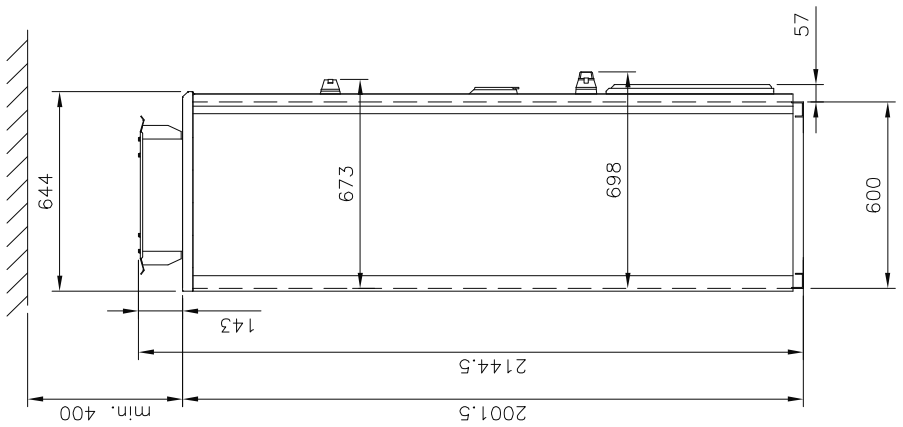
Frame 1×D8T + 2×R8i with brake choppers and resistors (+D150 +D151), 1/2

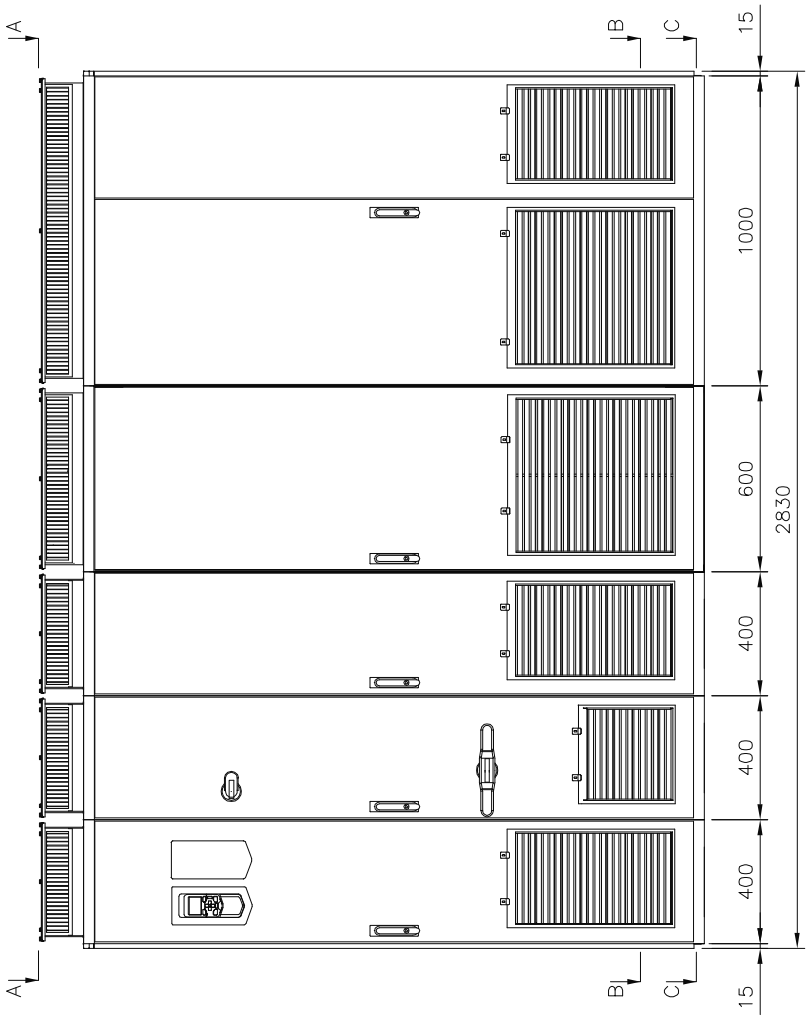


Frame 1×D8T + 2×R8i with brake choppers and resistors (+D150 +D151), 2/2

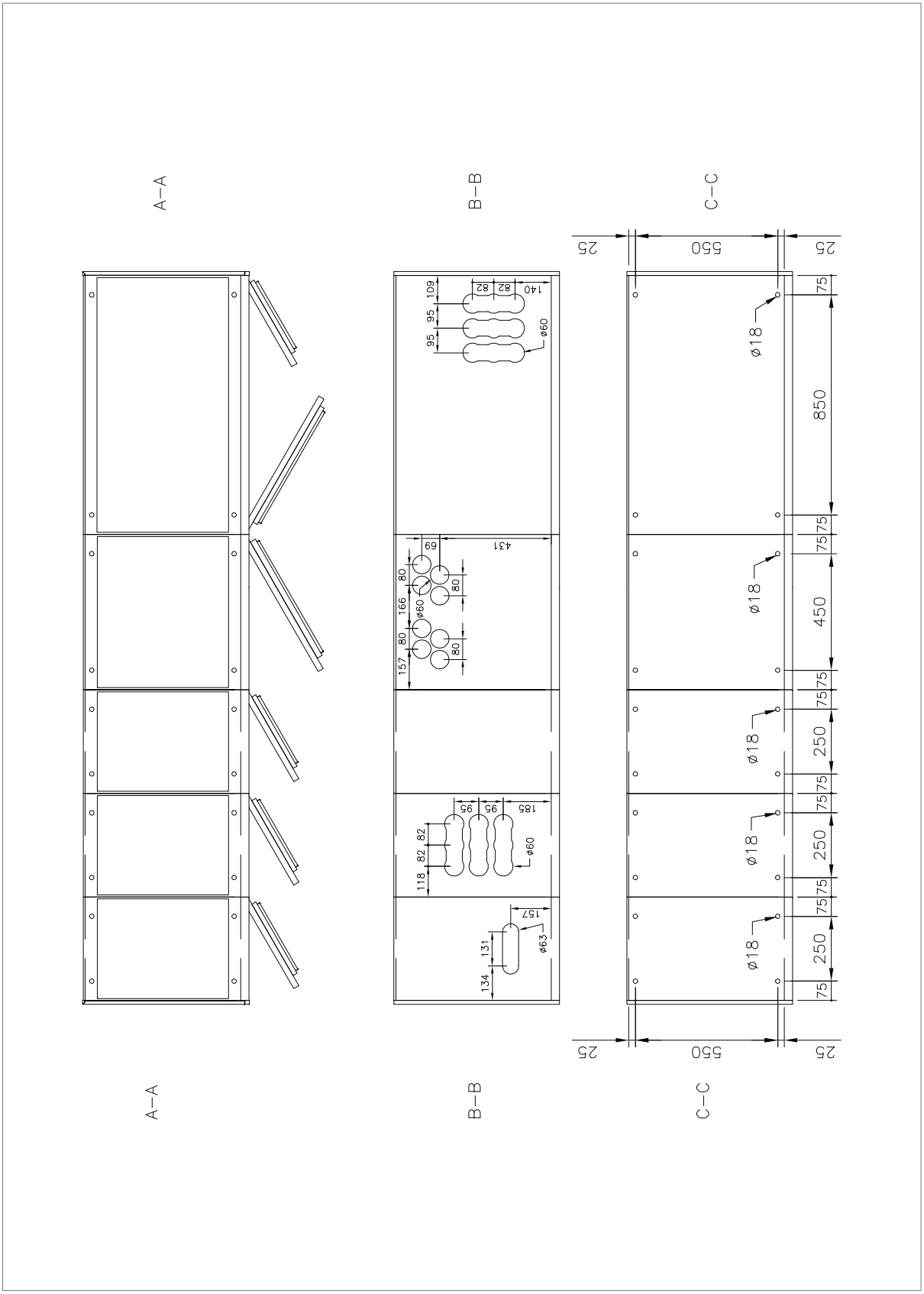


Frame 1×D8T + 2×R8i with sine output filter (+E206), 1/2

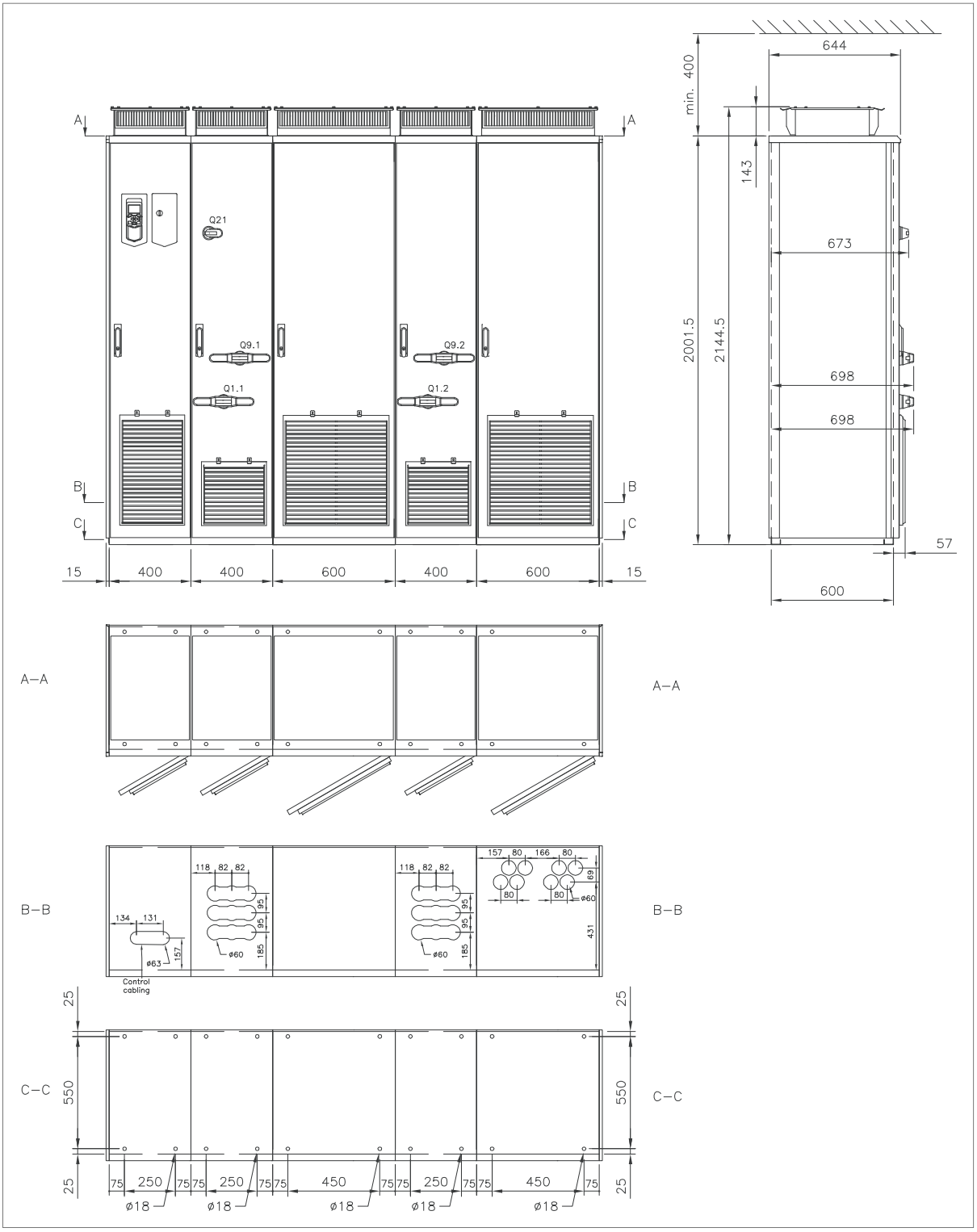




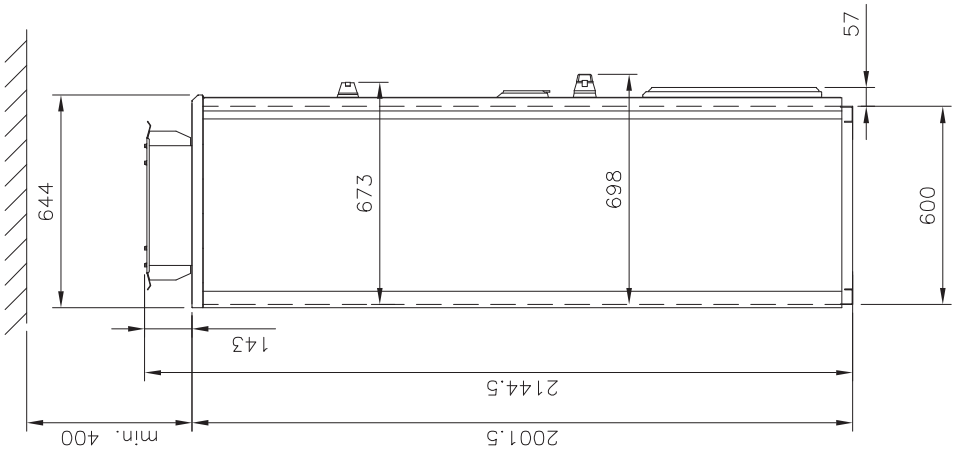
Frame 1×D8T + 2×R8i with sine output filter (+E206), 2/2

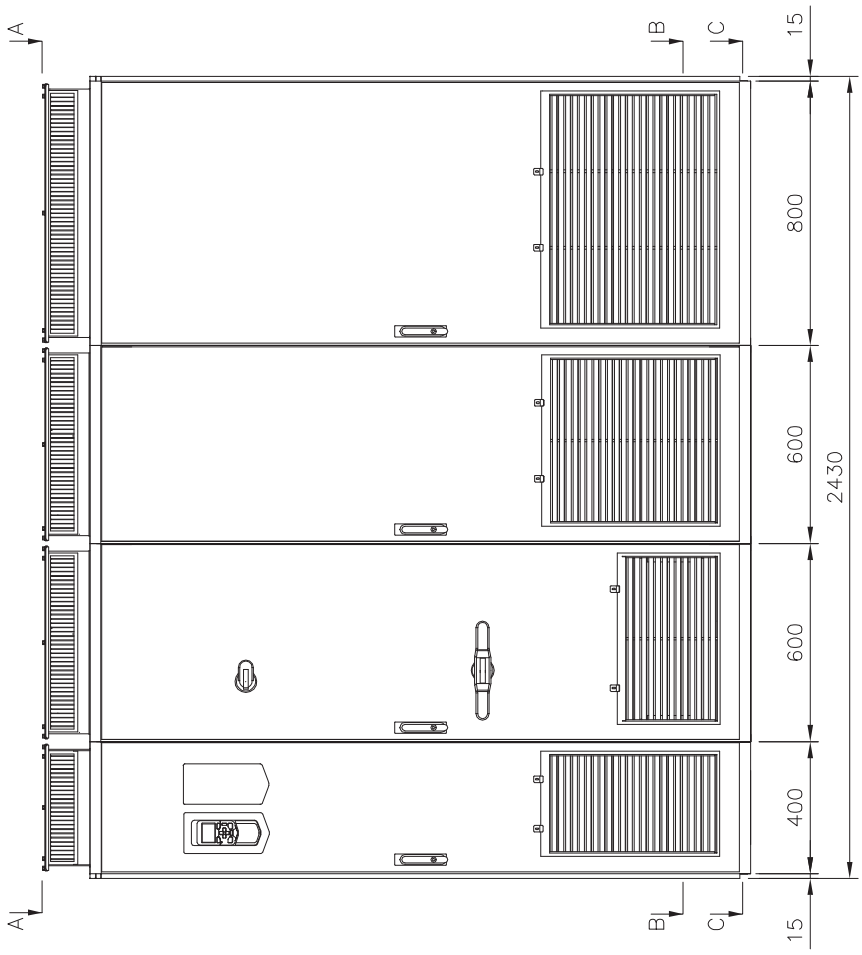


Frame 2×D8T + 2×R8i, 12-pulse (+A004) with grounding switch (+F259)

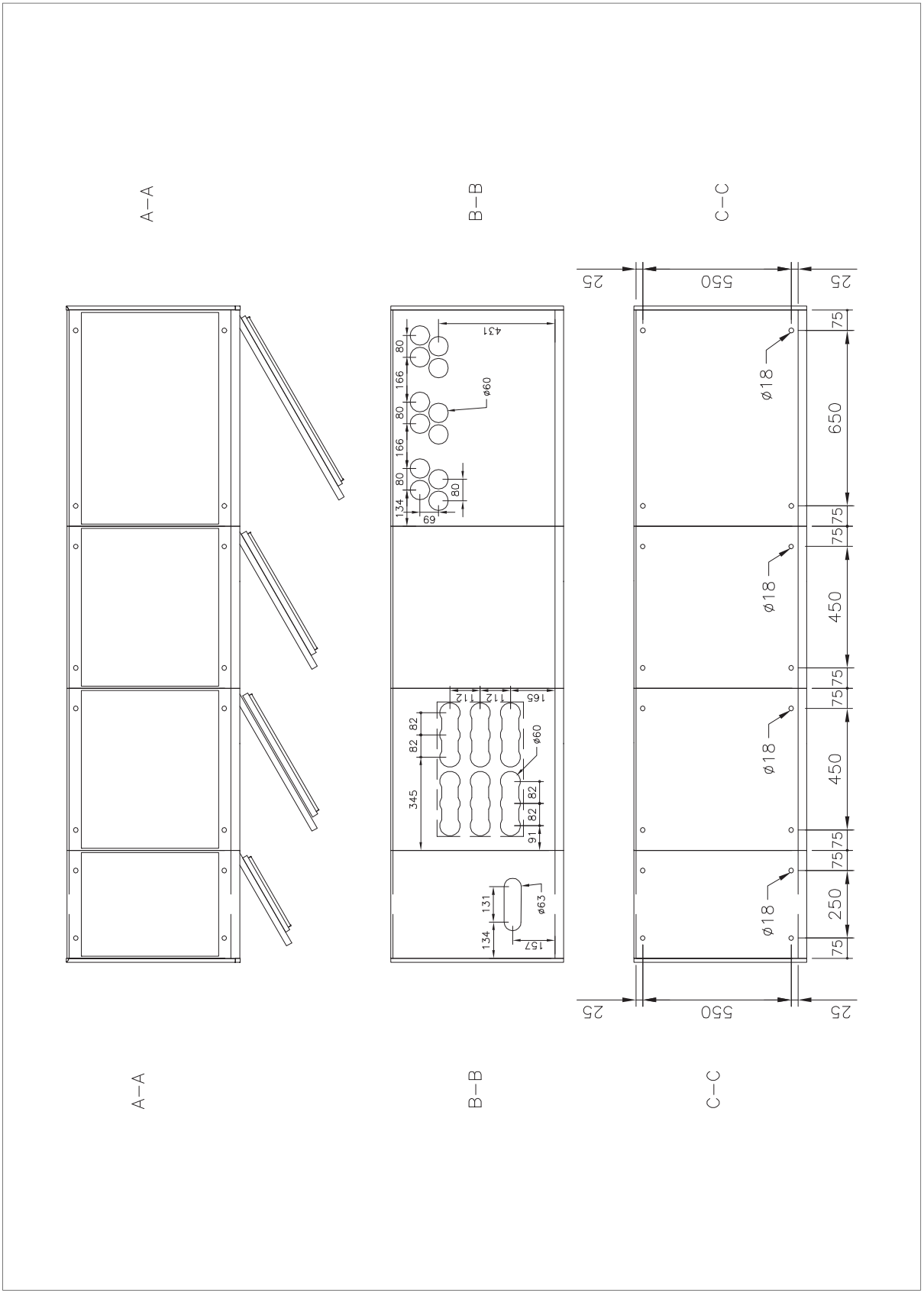


Frame 2×D8T + 3×R8i, 1/2

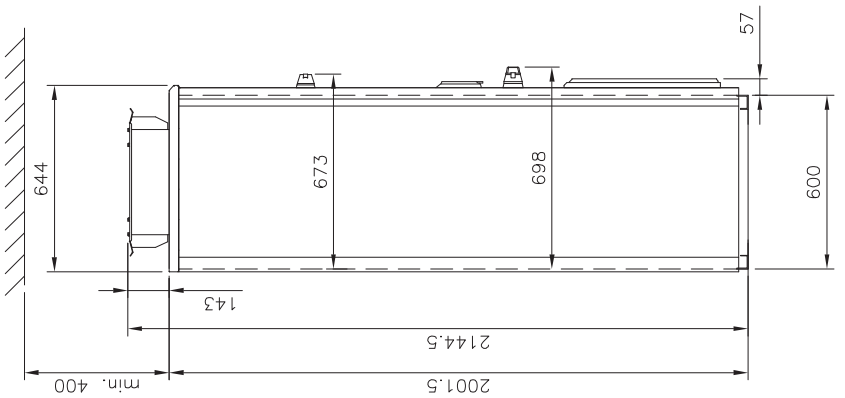


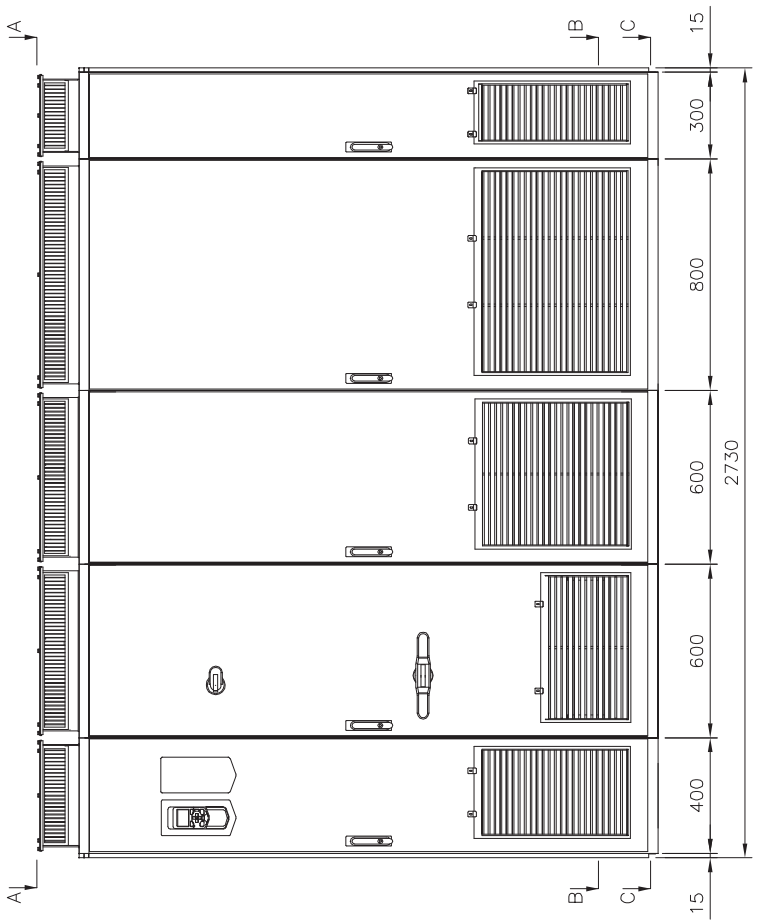


Frame 2×D8T + 3×R8i, 2/2

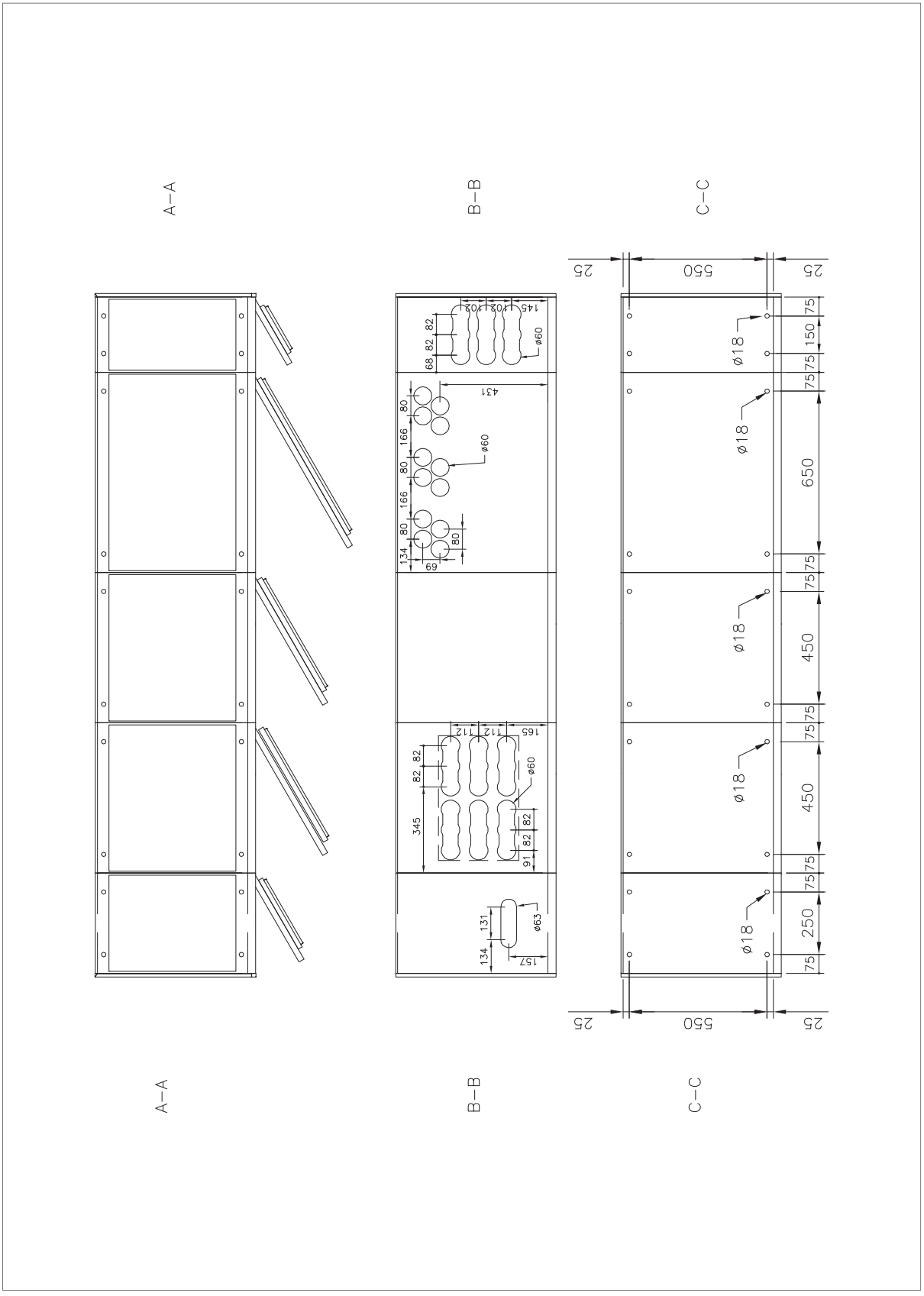


Frame 2×D8T + 3×R8i with common motor terminal cubicle (+H359), 1/2

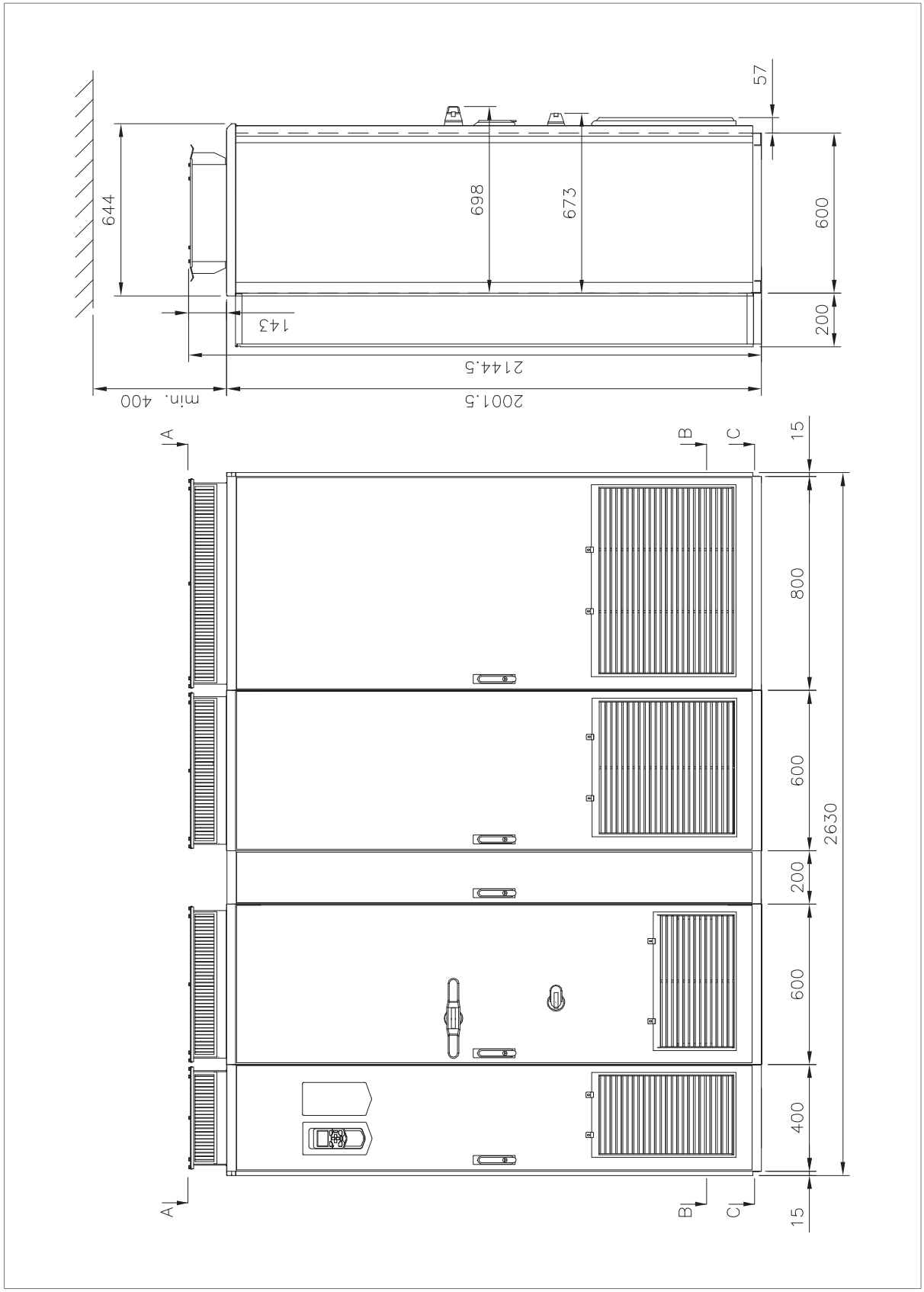




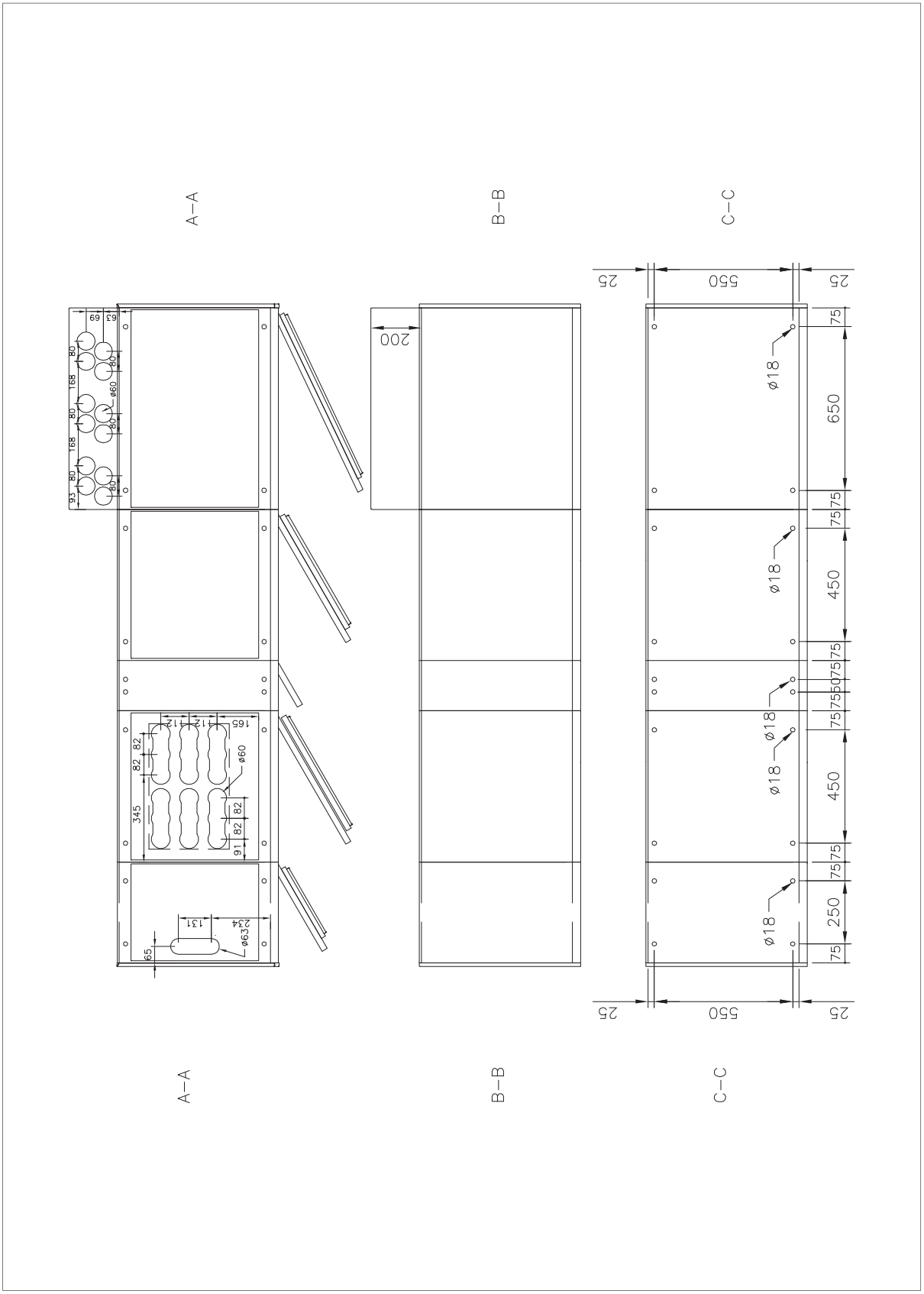
Frame 2×D8T + 3×R8i with common motor terminal cubicle (+H359), 2/2



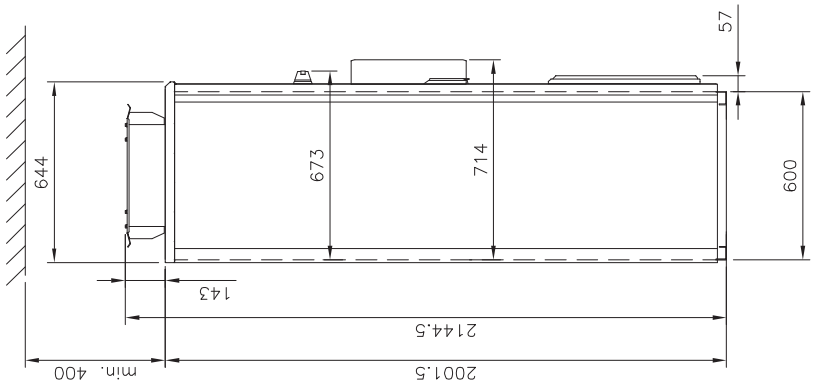
Frame 2×D8T + 3×R8i with top entry / top exit (+H351/+H353), 1/2

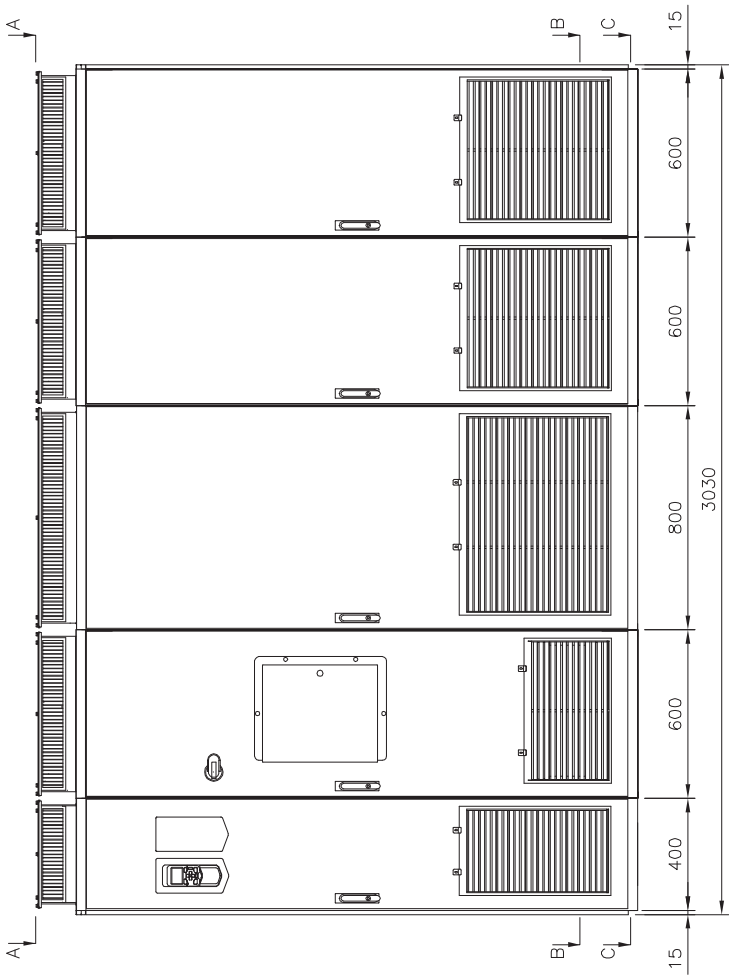


Frame 2×D8T + 3×R8i with top entry/top exit, 2/2

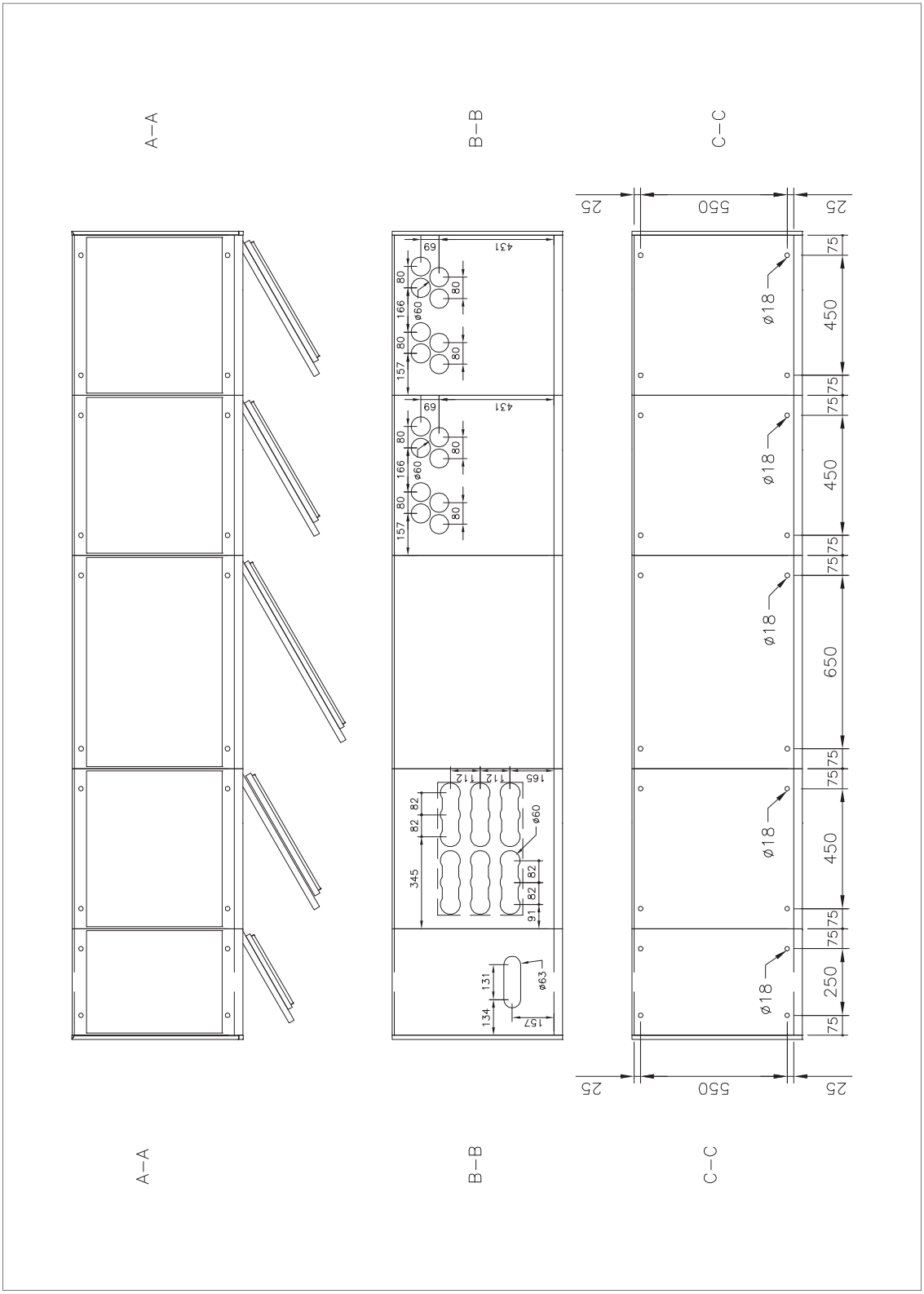


Frame 3×D8T + 4×R8i, 1/2

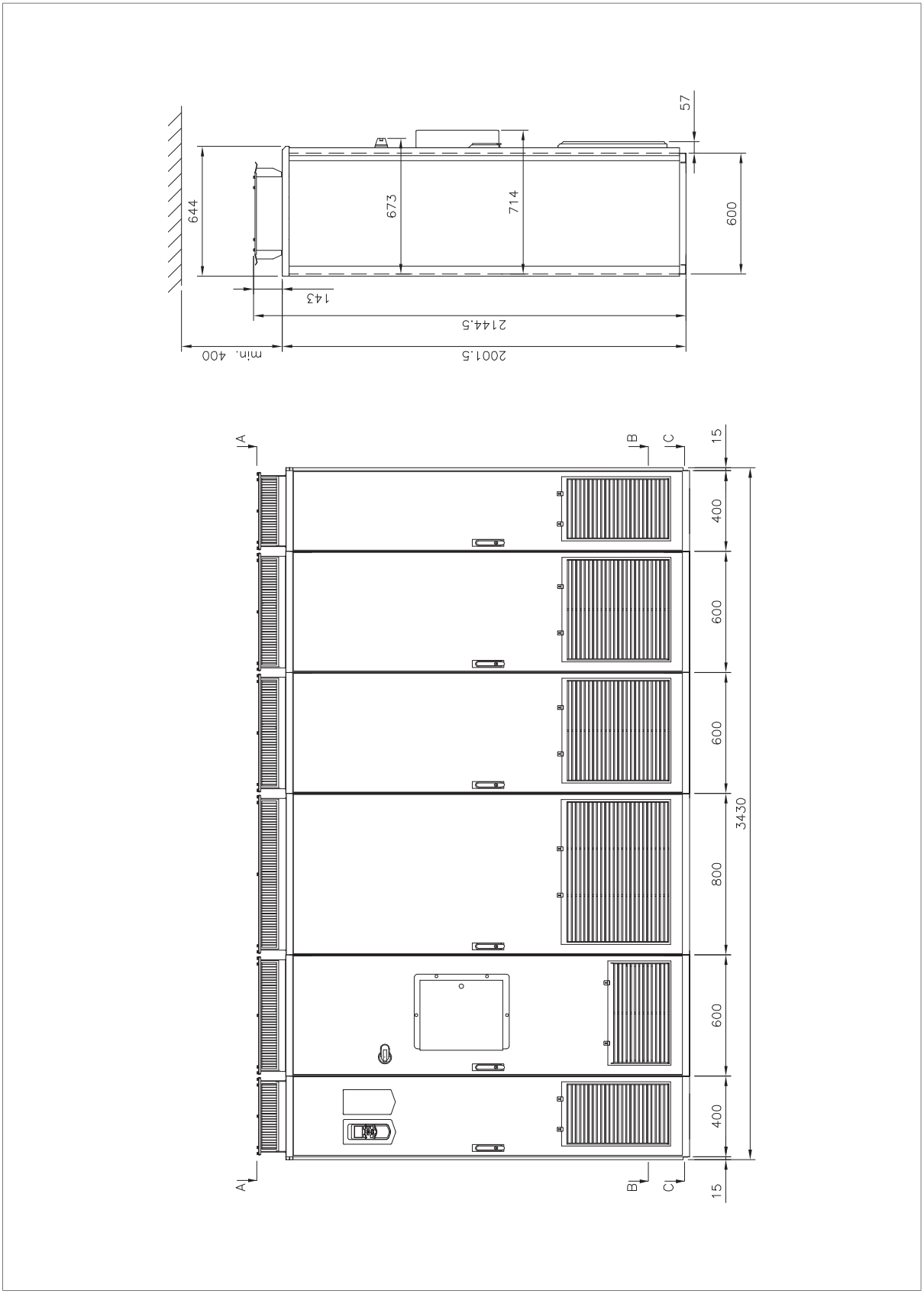




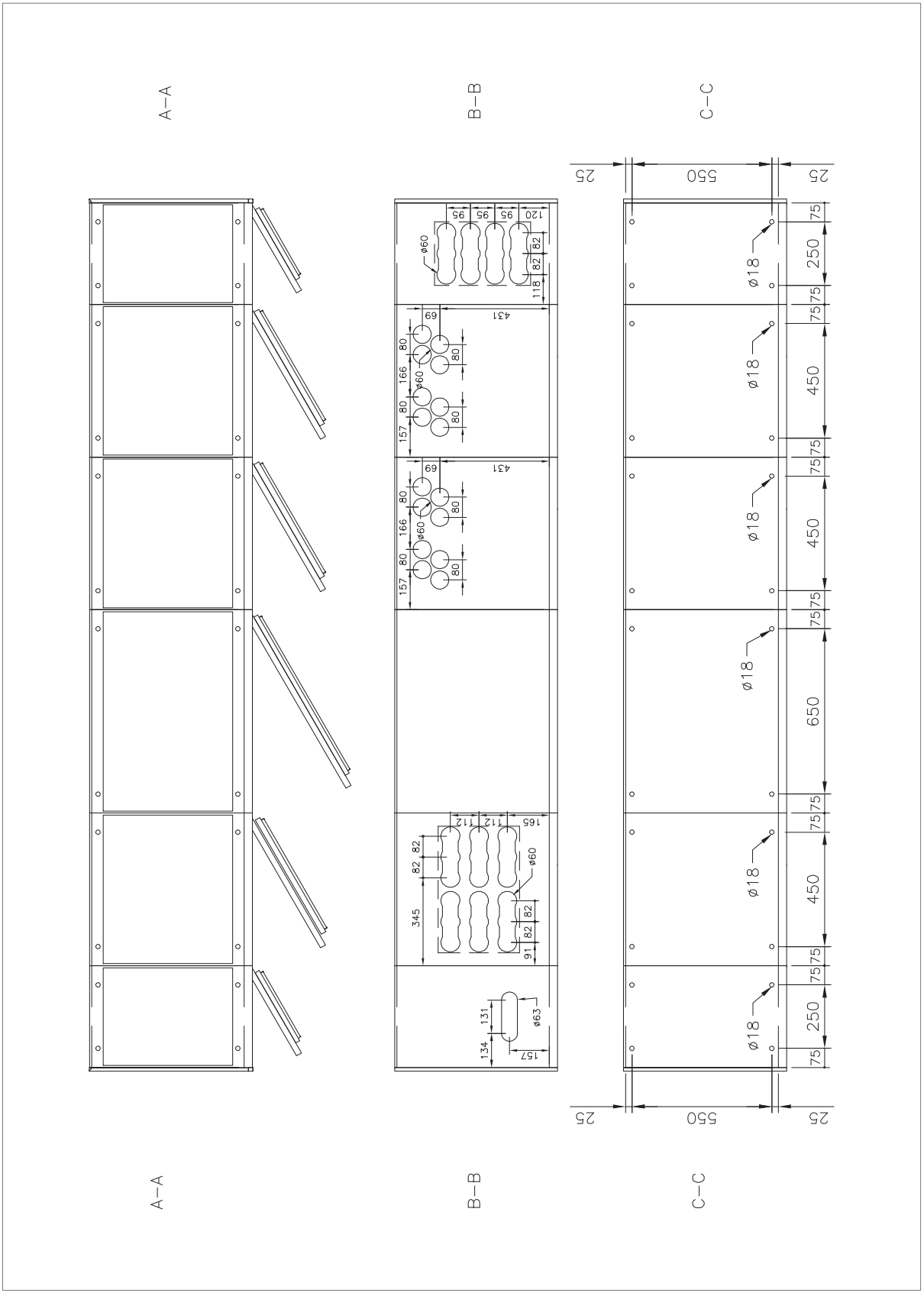
Frame 3×D8T + 4×R8i, 2/2



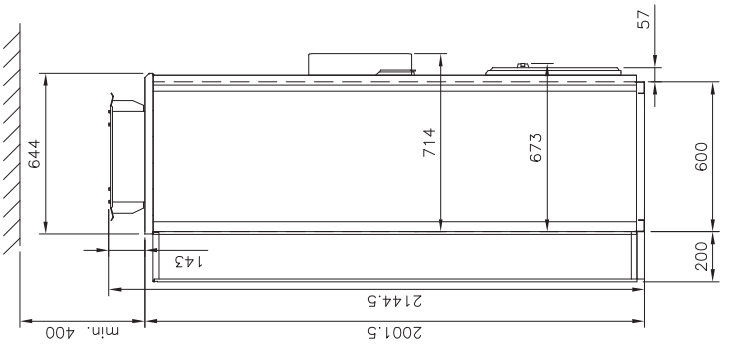
Frame 3×D8T + 4×R8i with common motor terminal cubicle (+H359), 1/2

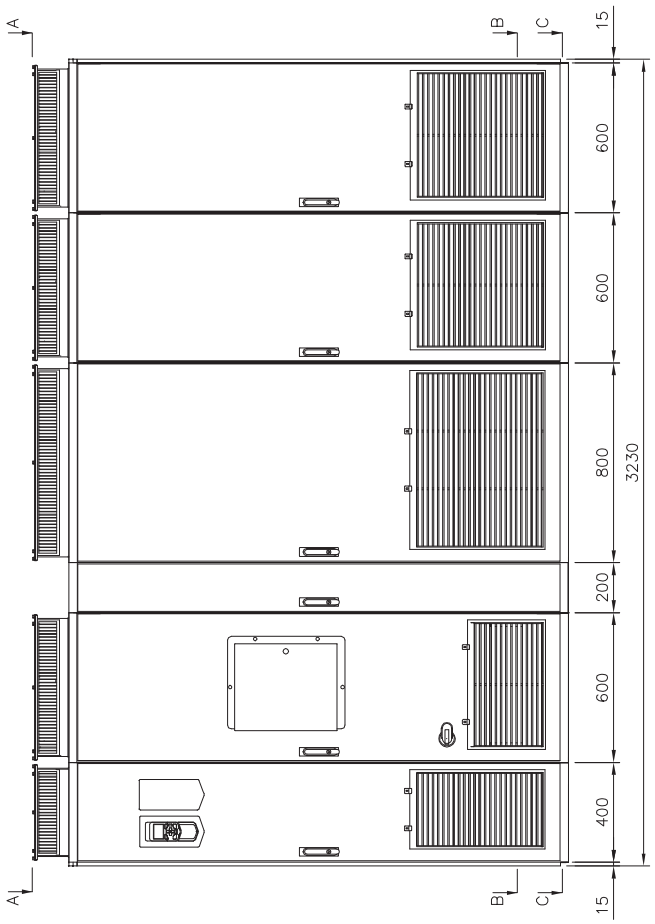


Frame 3×D8T + 4×R8i with common motor terminal cubicle (+H359), 2/2

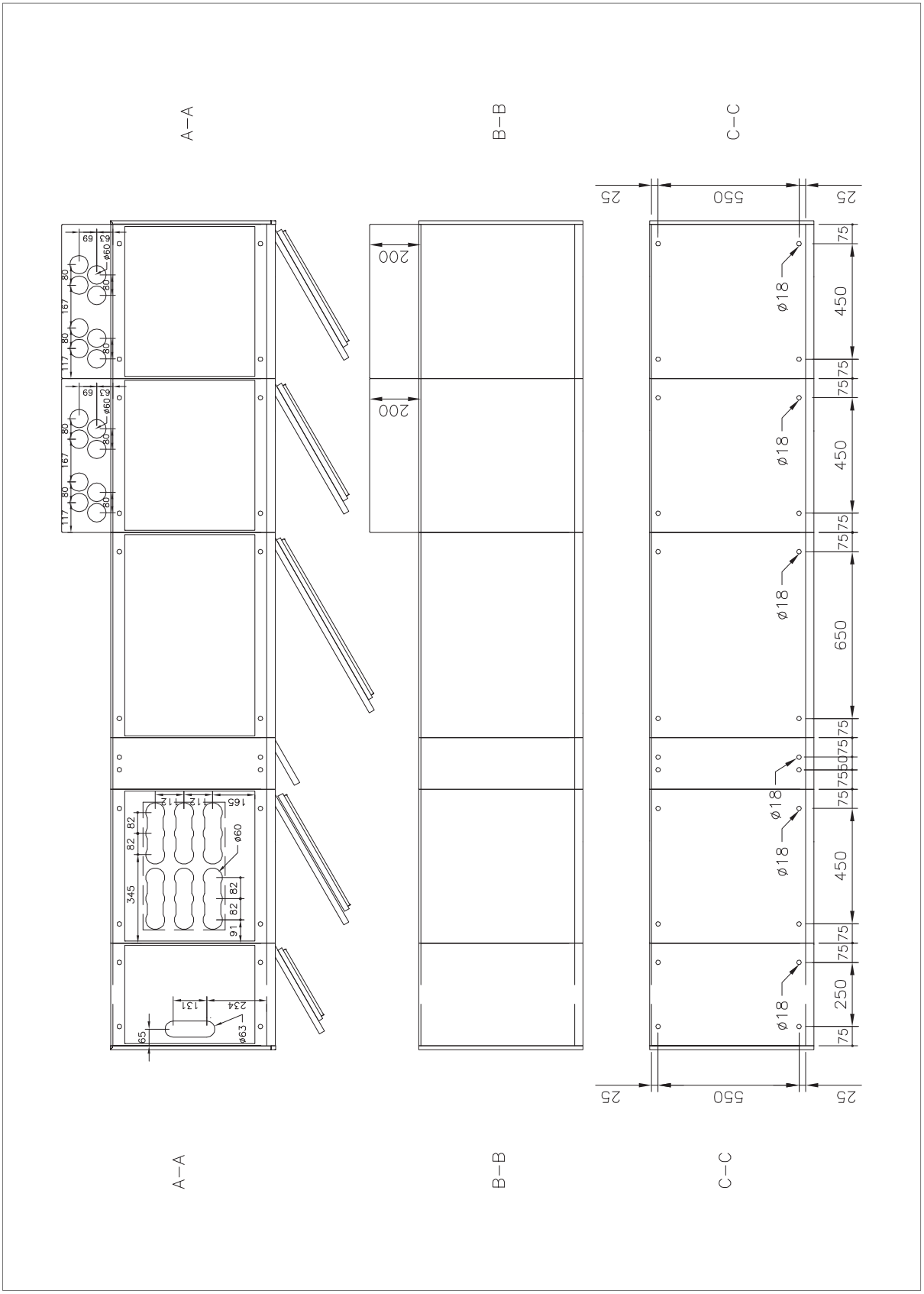


Frame 3×D8T + 4×R8i with top entry / top exit (+H351/+H353), 1/2

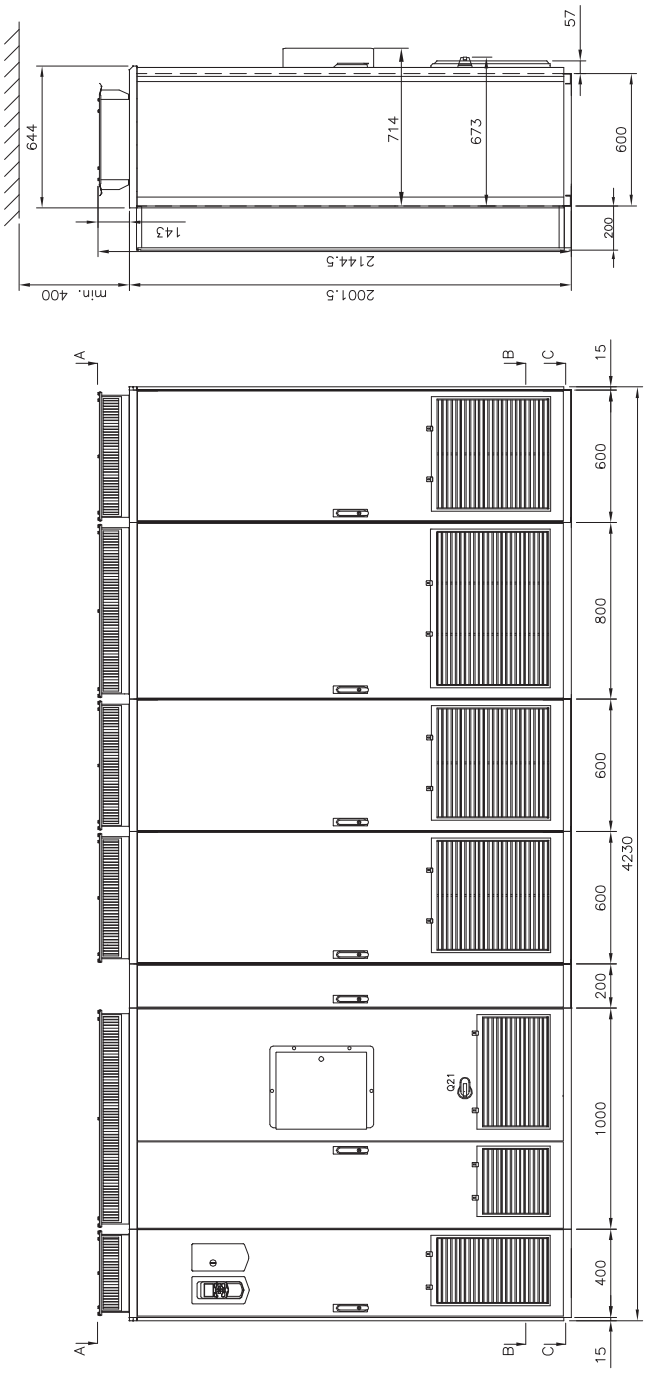




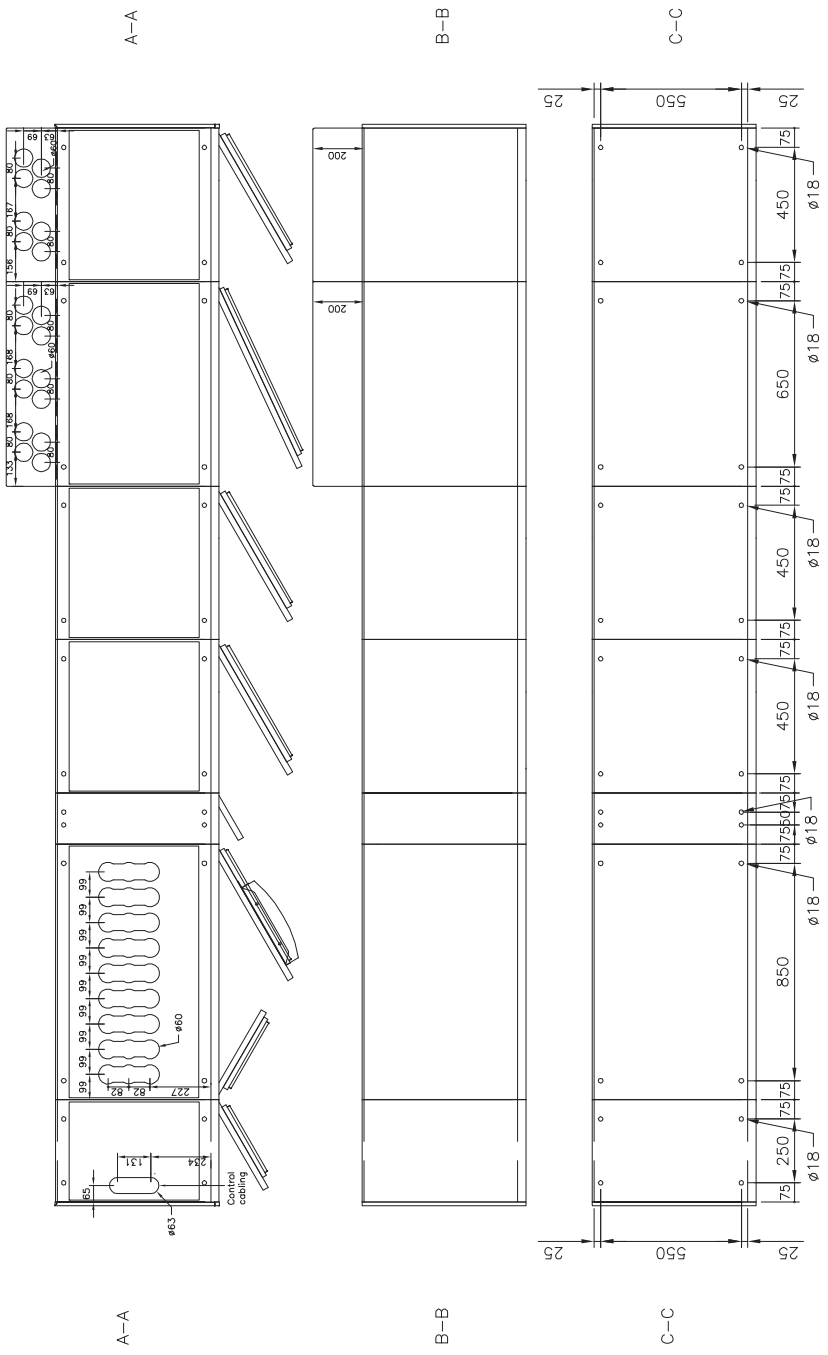
Frame 3×D8T + 4×R8i with top entry / top exit (+H351/+H353), 2/2



Frame 4×D8T + 5×R8i (6-pulse) with top entry/exit, UL Listed (+C129), 1/2

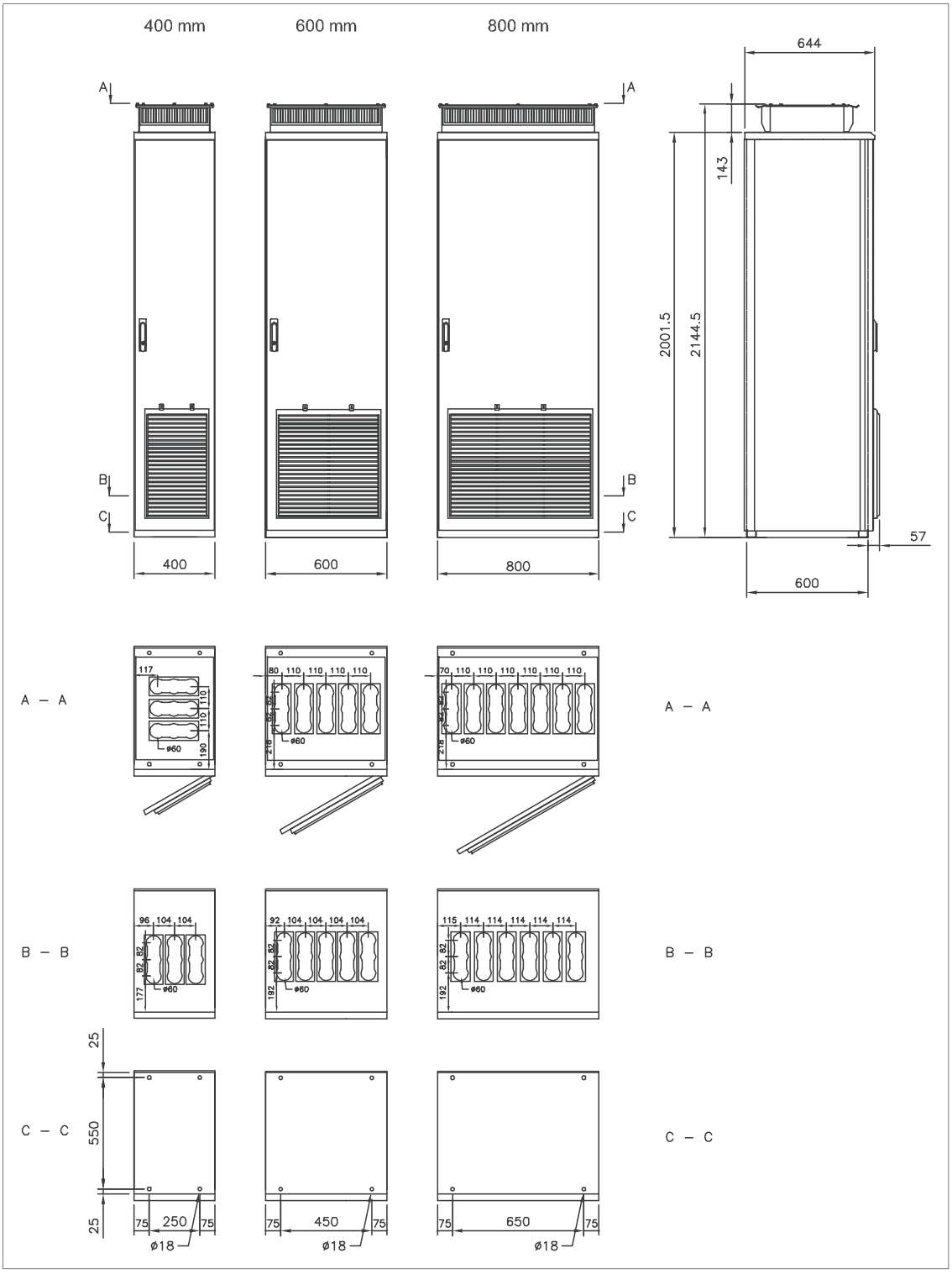


Frame 4×D8T + 5×R8i (6-pulse) with top entry/exit, UL Listed (+C129), 2/2

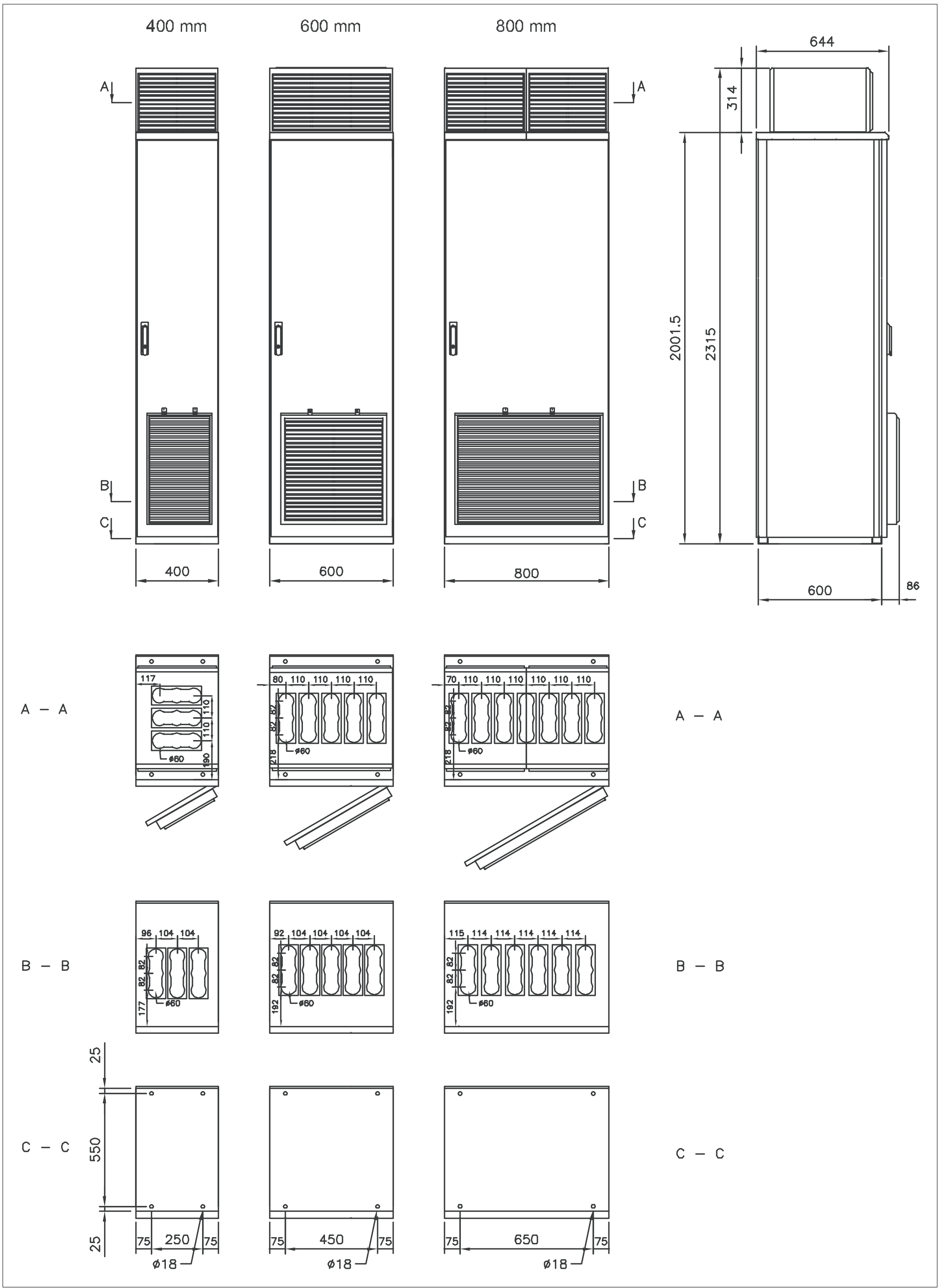


Dimensions of empty cubicles (options +C199, +C200, +C201)

IP22/IP42



IP54

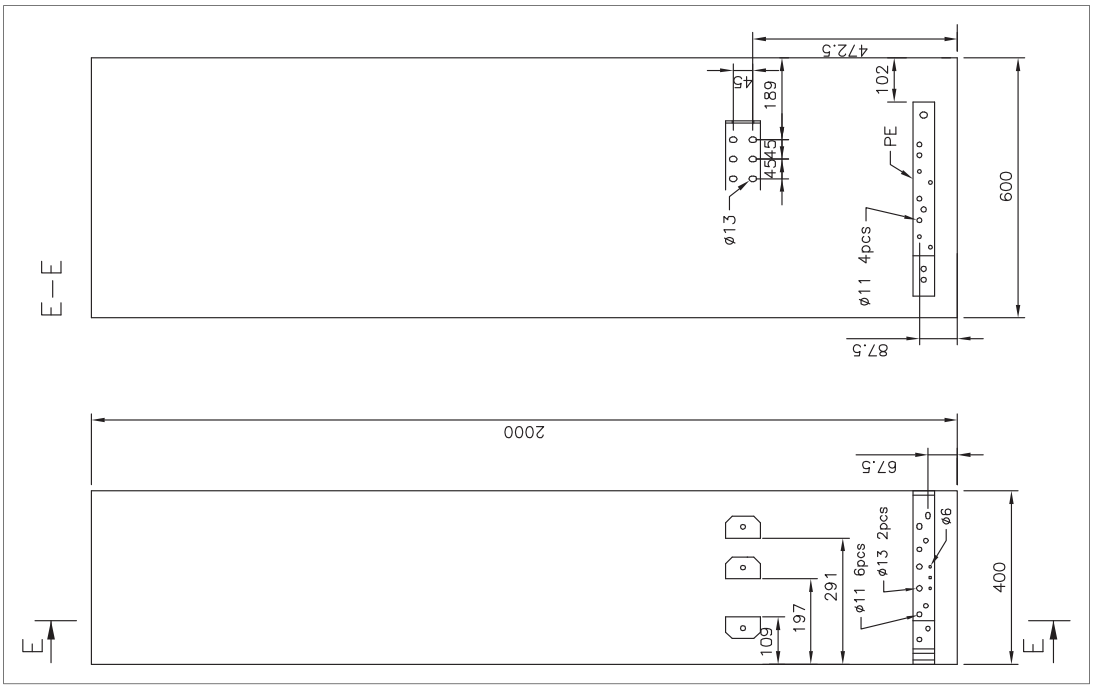

400 mm
600 mm
800 mm
644
314
2001.5
2315
A
B
C
400
600
800
600
86
A – A
117
110
110
190
ø60
80
110
110
110
110
82
82
218
70
B – B
96
104
177
92
192
115
114
C – C
25
550
75
250
450
650
ø18

Location and size of input terminals

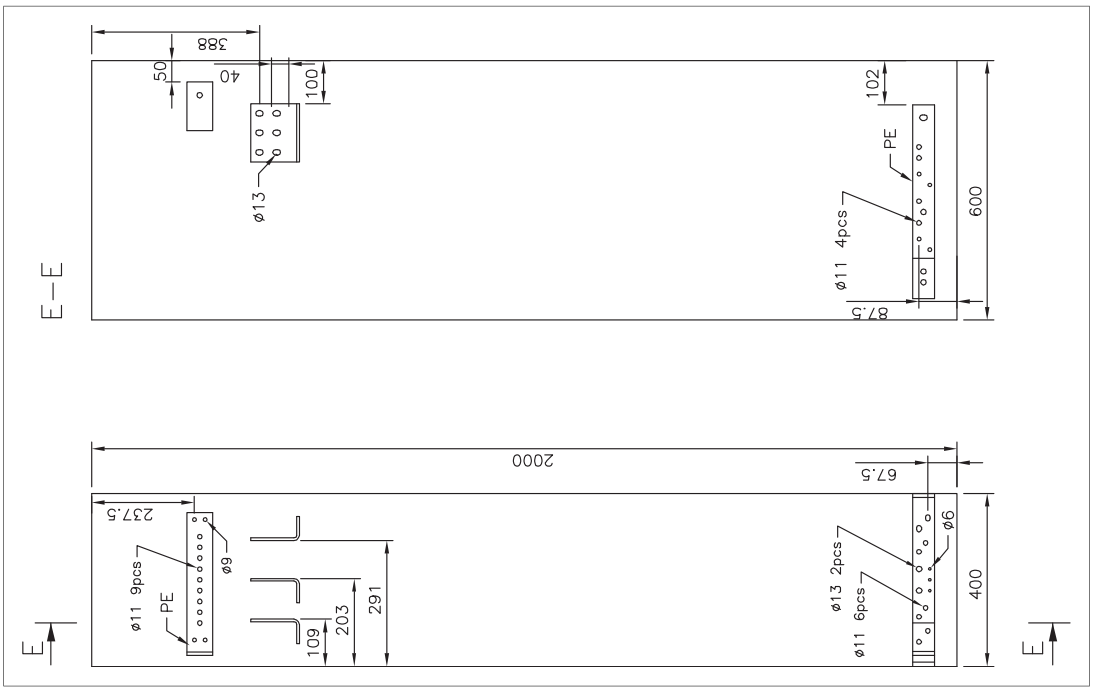
Note:

See the dimension tables as to which incoming cubicles are used with which drive type and options.

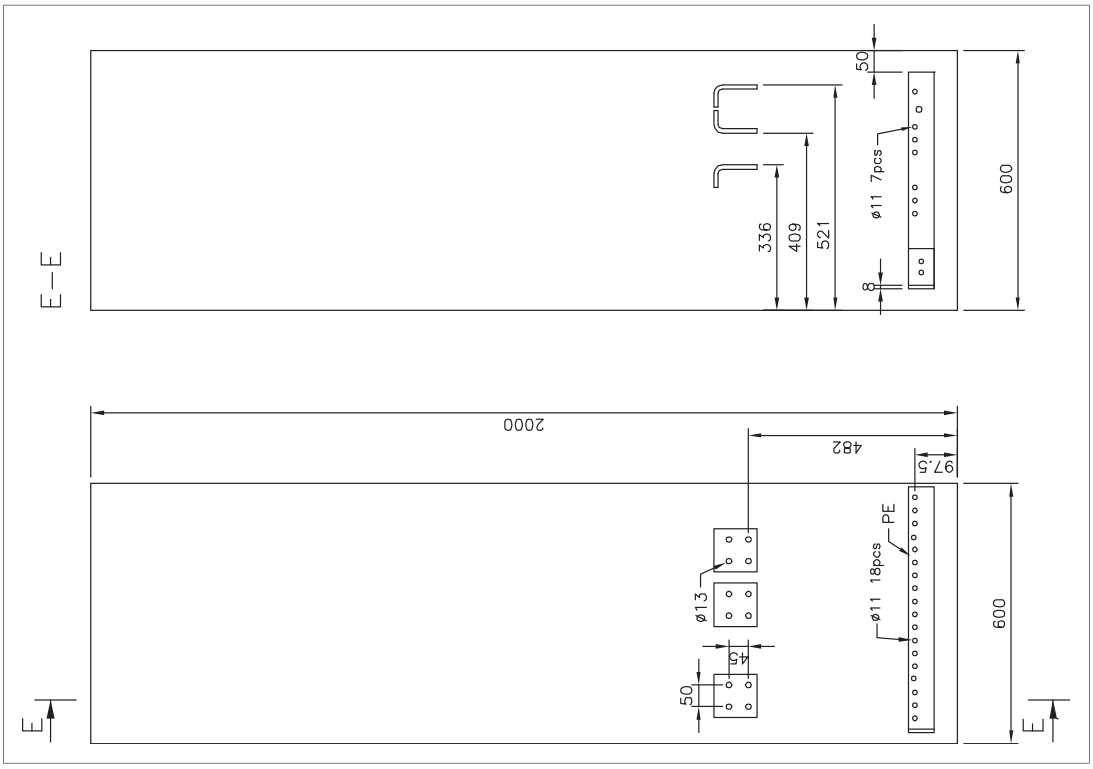
400 mm, bottom cable entry



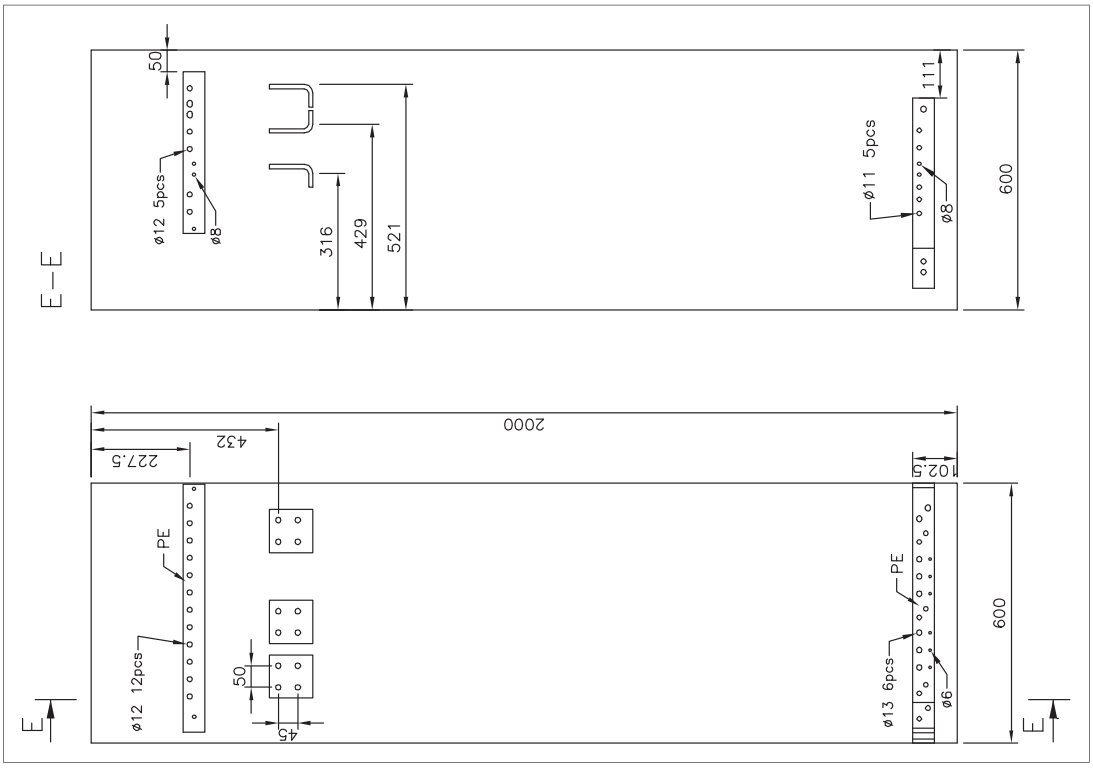
400 mm, top cable entry



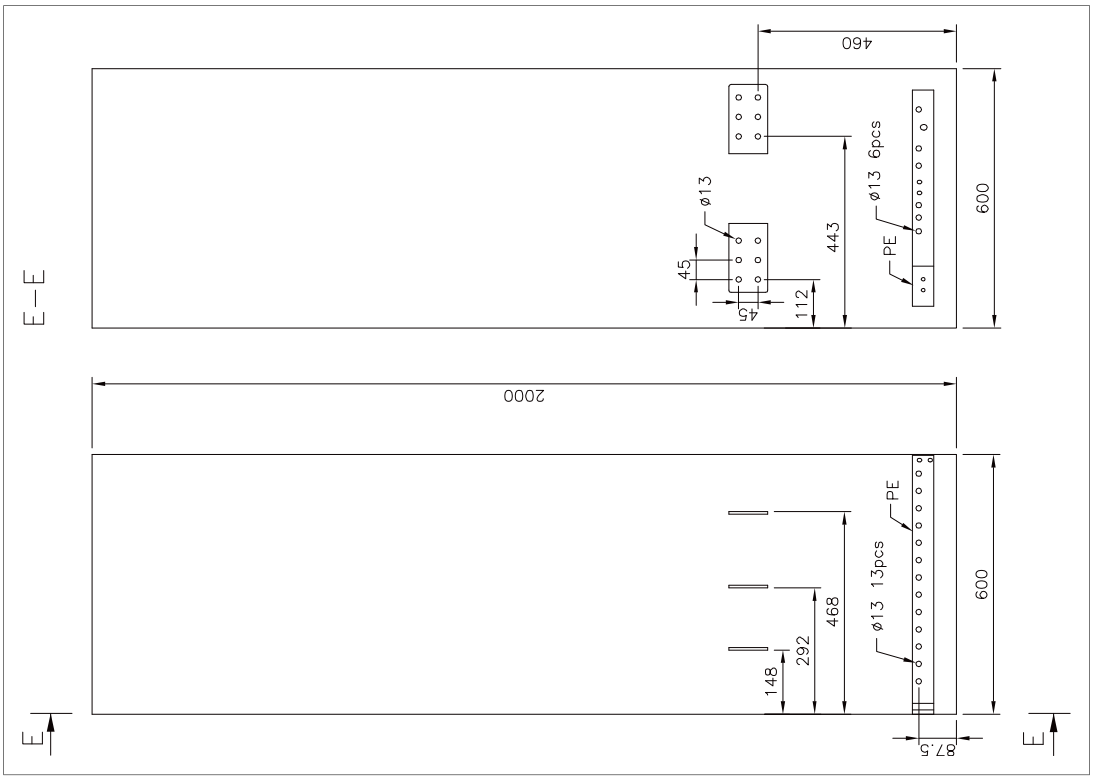
600 mm, without main breaker, bottom cable entry (including 12-pulse units with grounding switch)



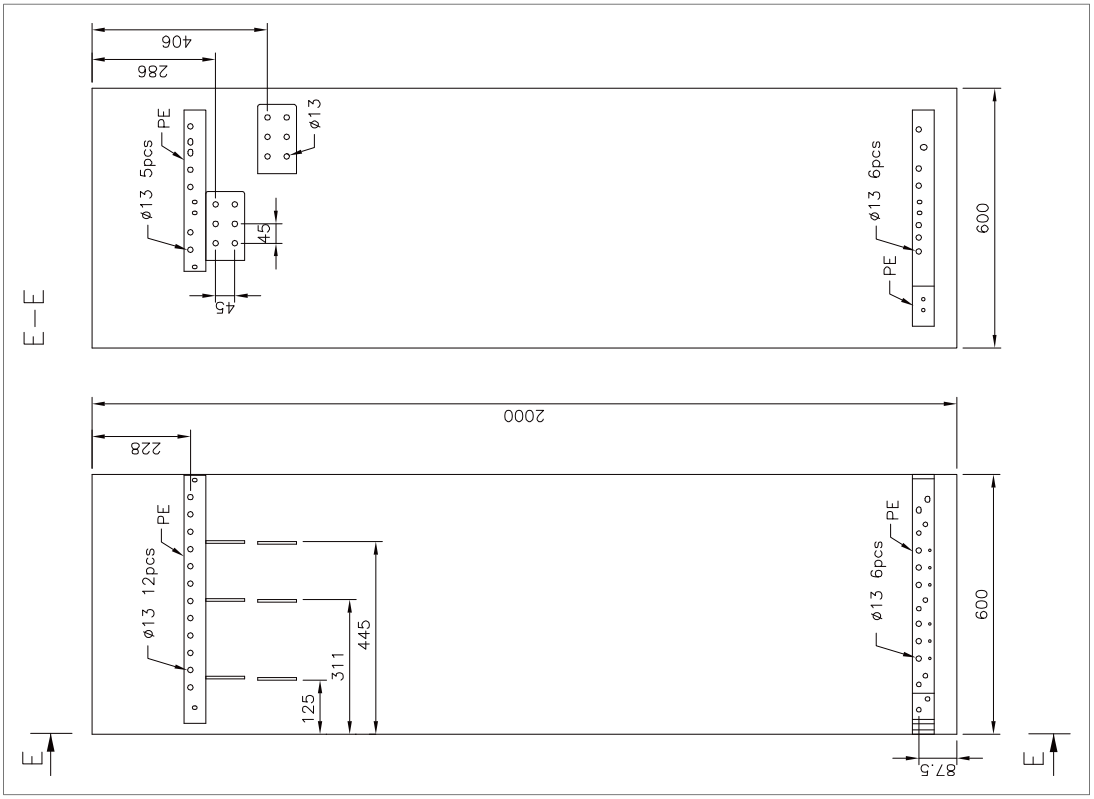
600 mm, without main breaker, top cable entry (including 12-pulse units with grounding switch)



600 mm, 12-pulse units without grounding switch, bottom cable entry

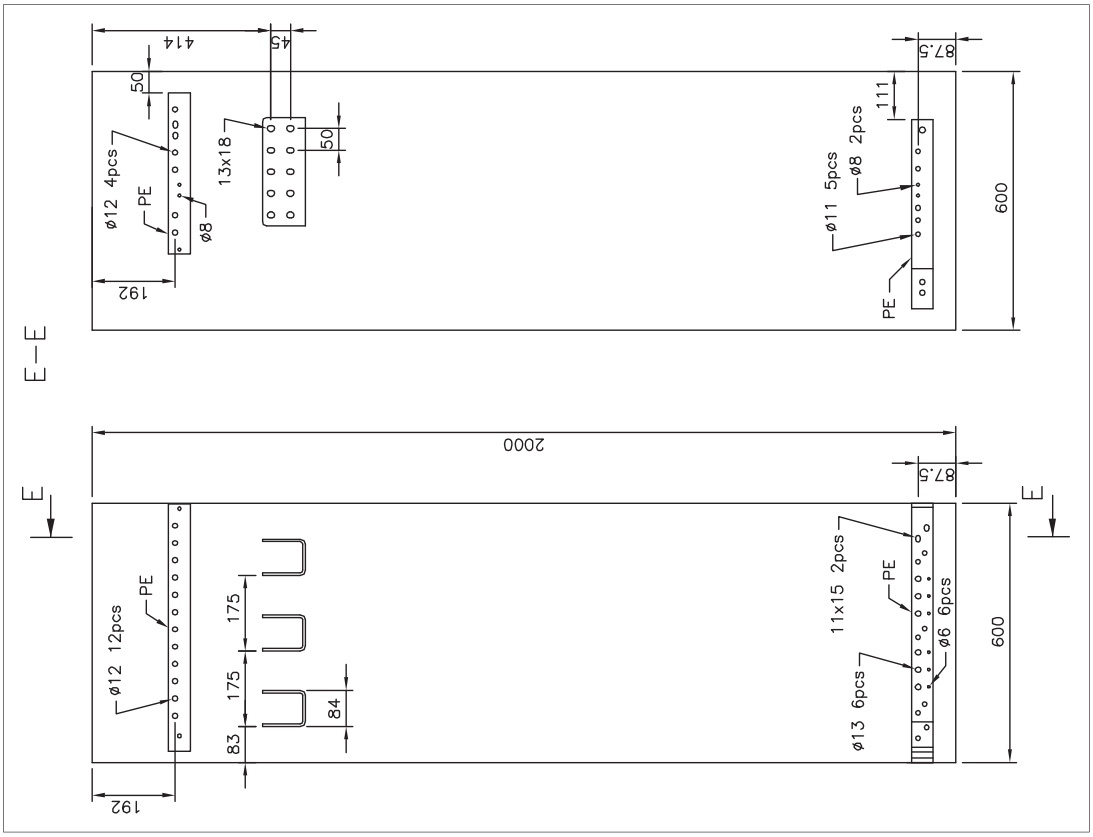


600 mm, 12-pulse units without grounding switch, top cable entry

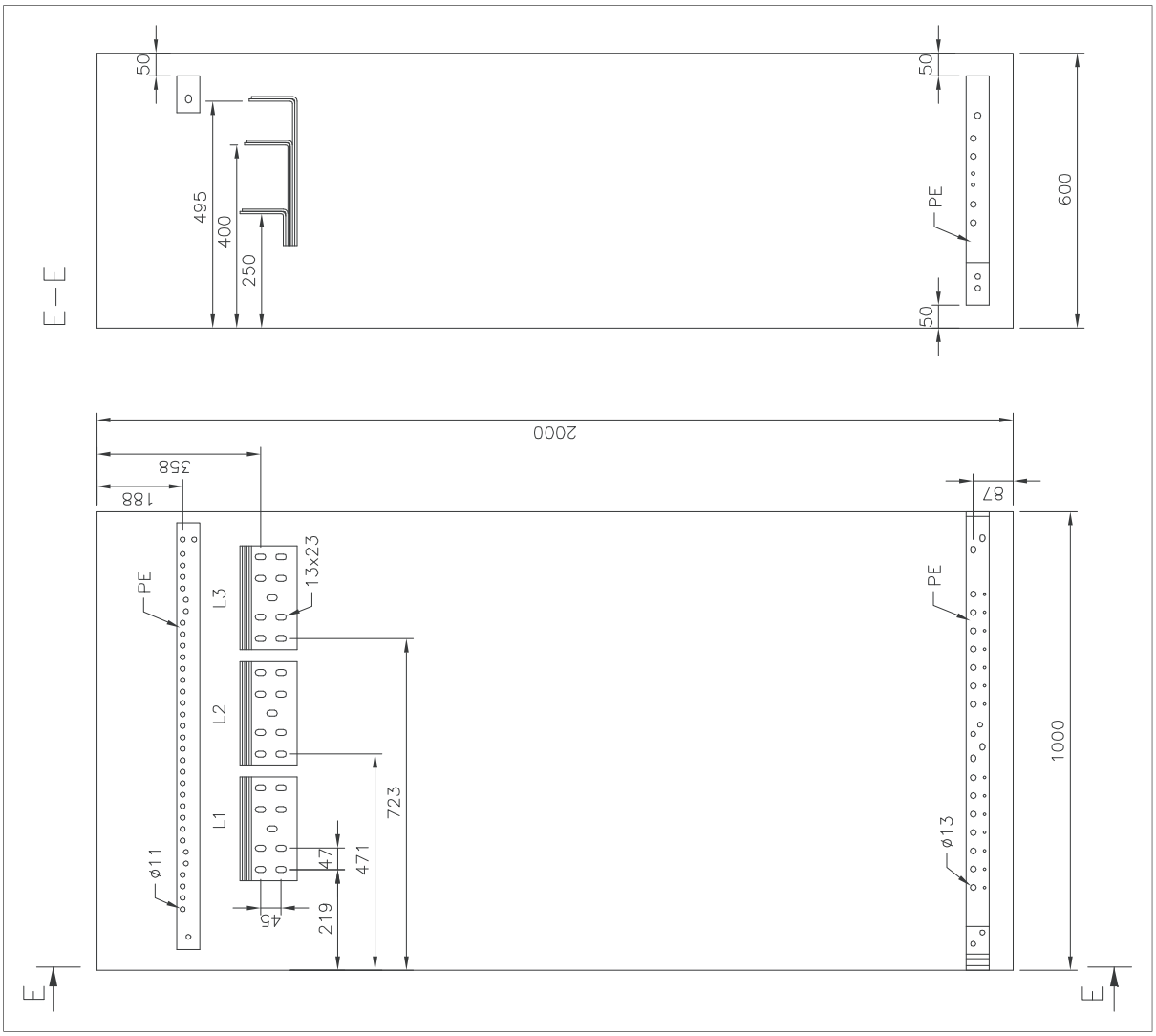


600 mm, with main breaker, bottom cable entry

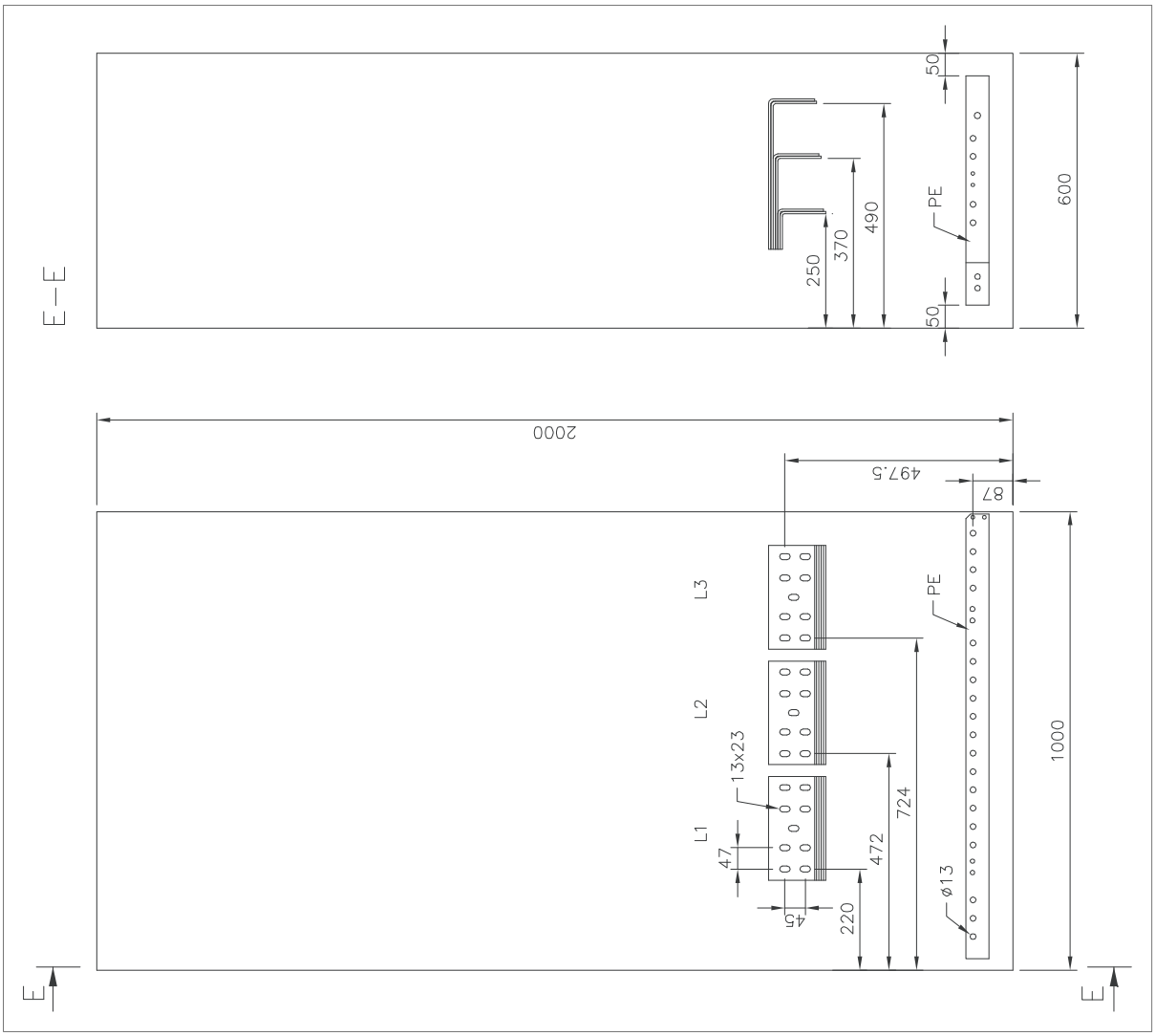
600 mm, with main breaker, top cable entry



1000 mm (UL/CSA), top cable entry



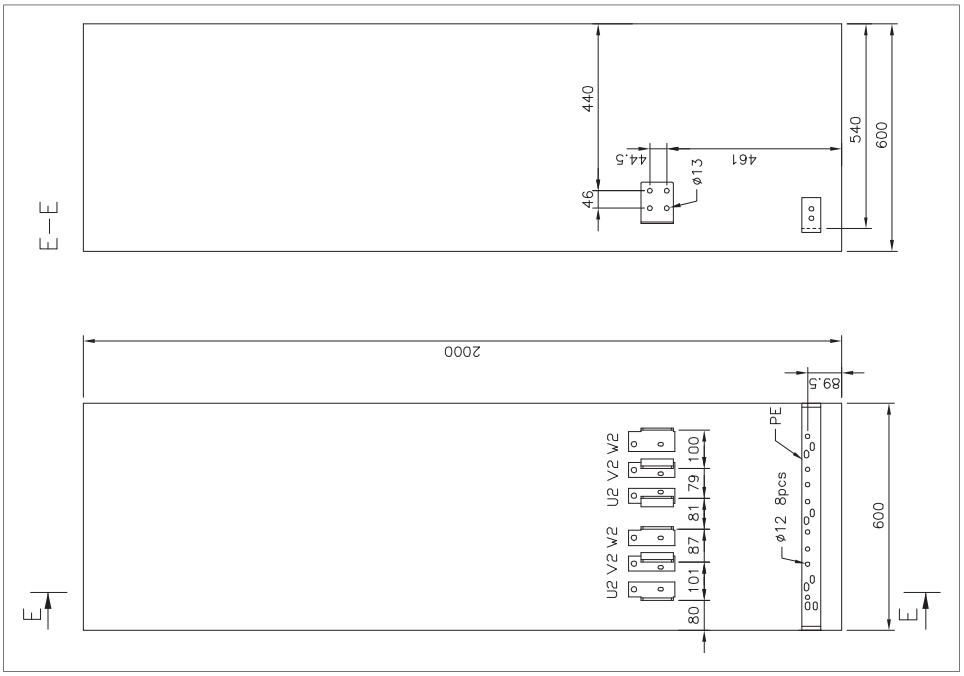
1000 mm (UL/CSA), bottom cable entry



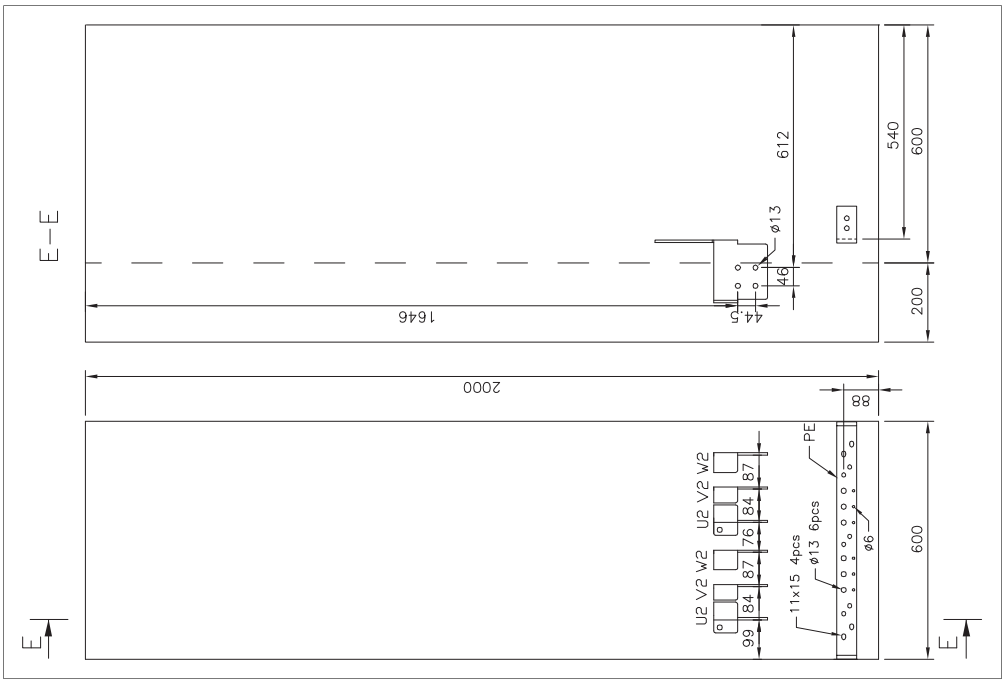
Location and size of output terminals

Units without common motor terminal cubicle (no option +H359)

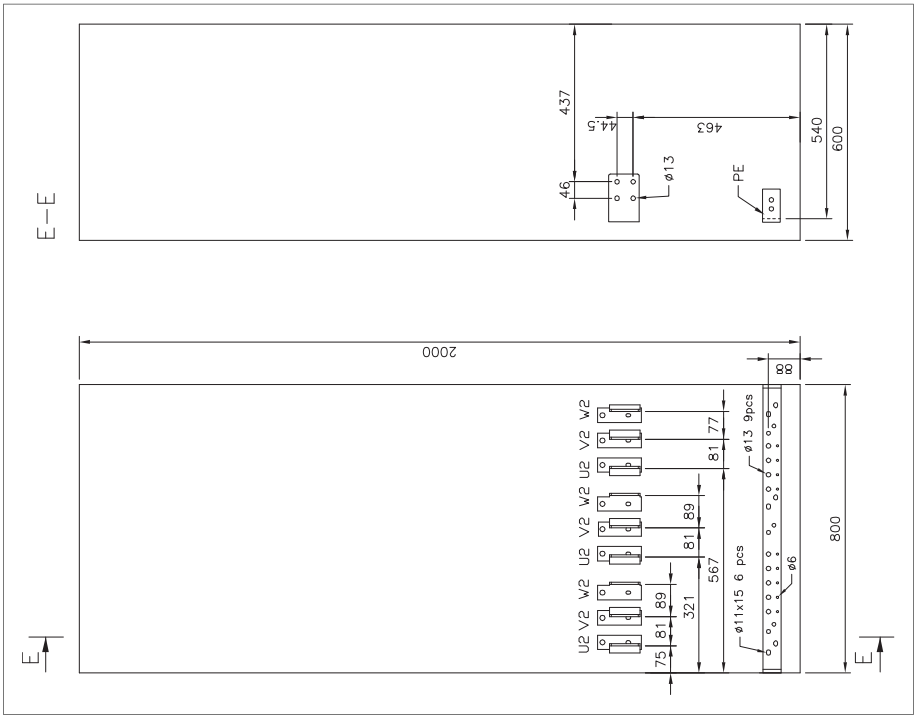
Inverter module cubicle with two R8i modules, bottom cable exit (no +H353)



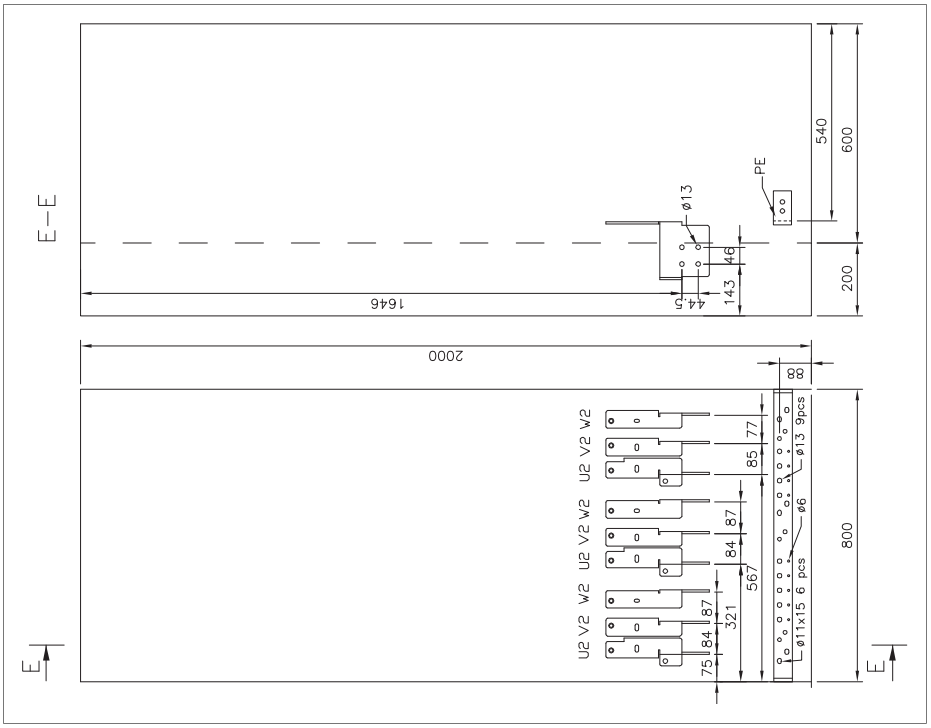
Inverter module cubicle with two R8i modules, top cable exit (+H353)



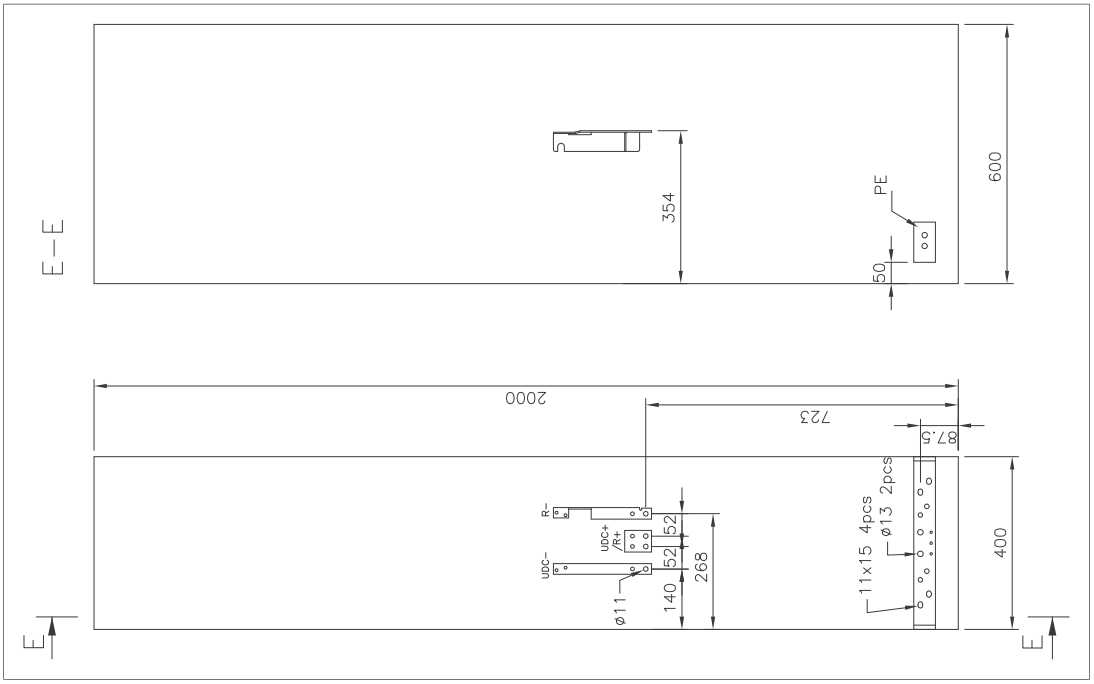
Inverter module cubicle with three R8i modules, bottom cable exit (no +H353)



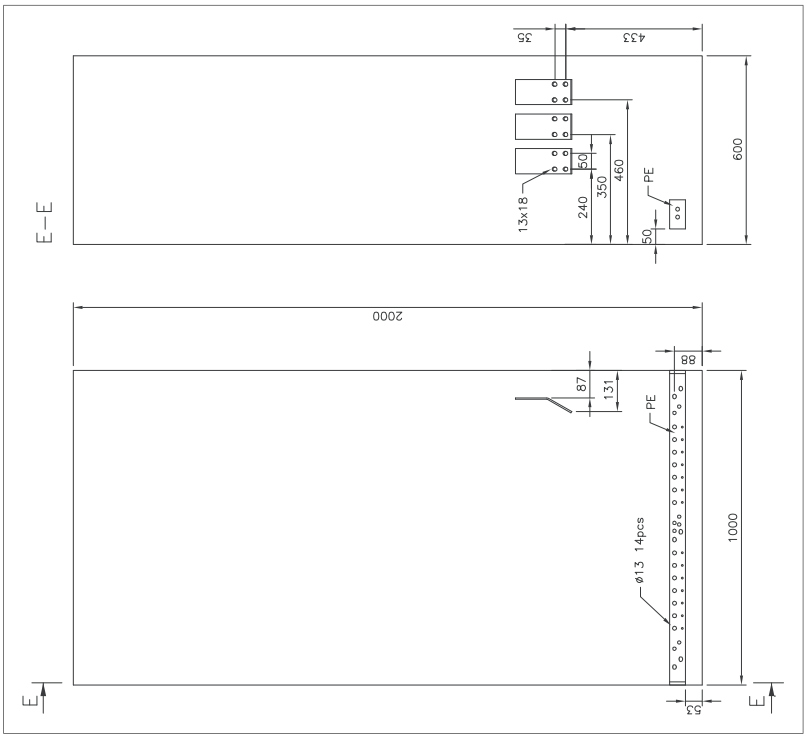
Inverter module cubicle with three R8i modules, top cable exit (+H353)



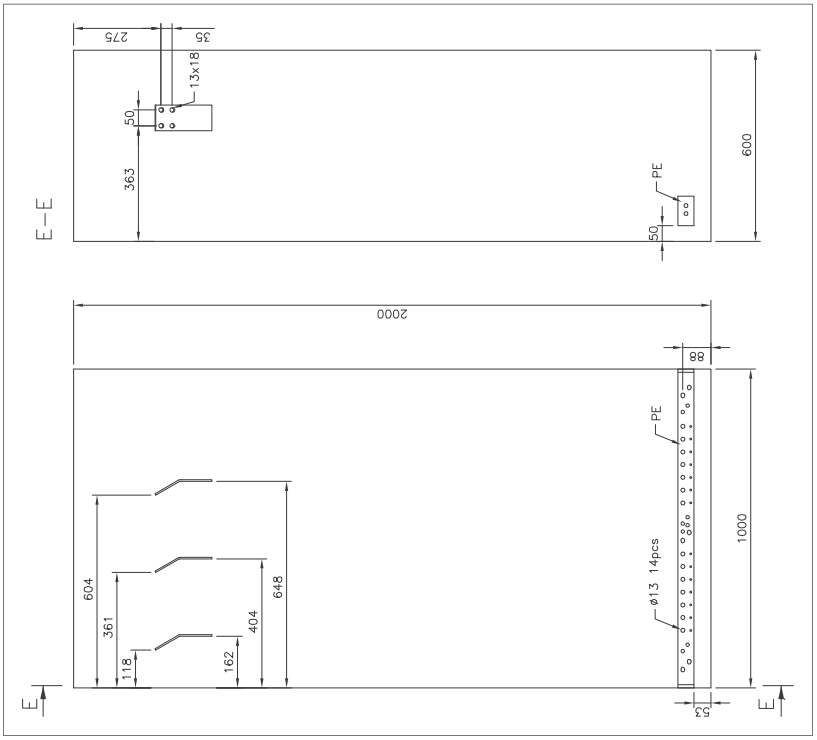
Brake chopper cubicle



Sine filter (+E206) cubicle, 1000 mm, bottom cable exit (no +H353)



Sine filter (+E206) cubicle, 1000 mm, top cable exit (+H353)

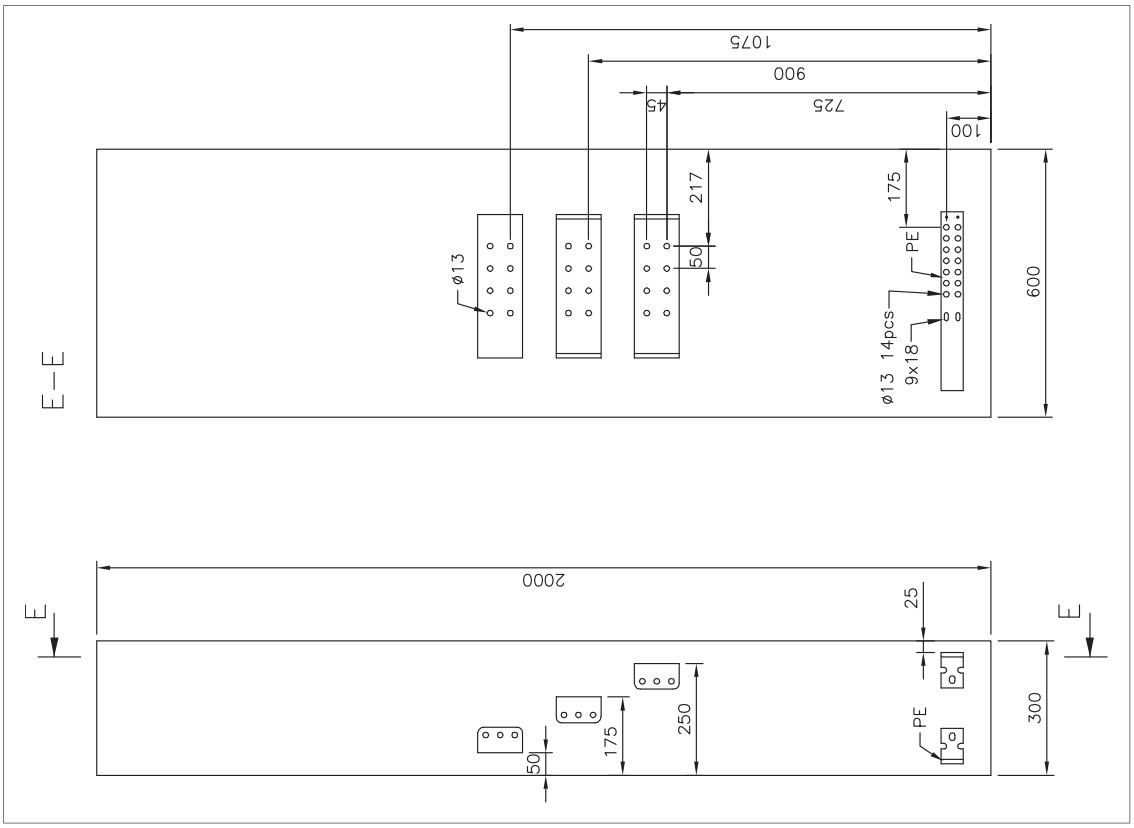


Units with common motor terminal cubicle (option +H359)

Note:

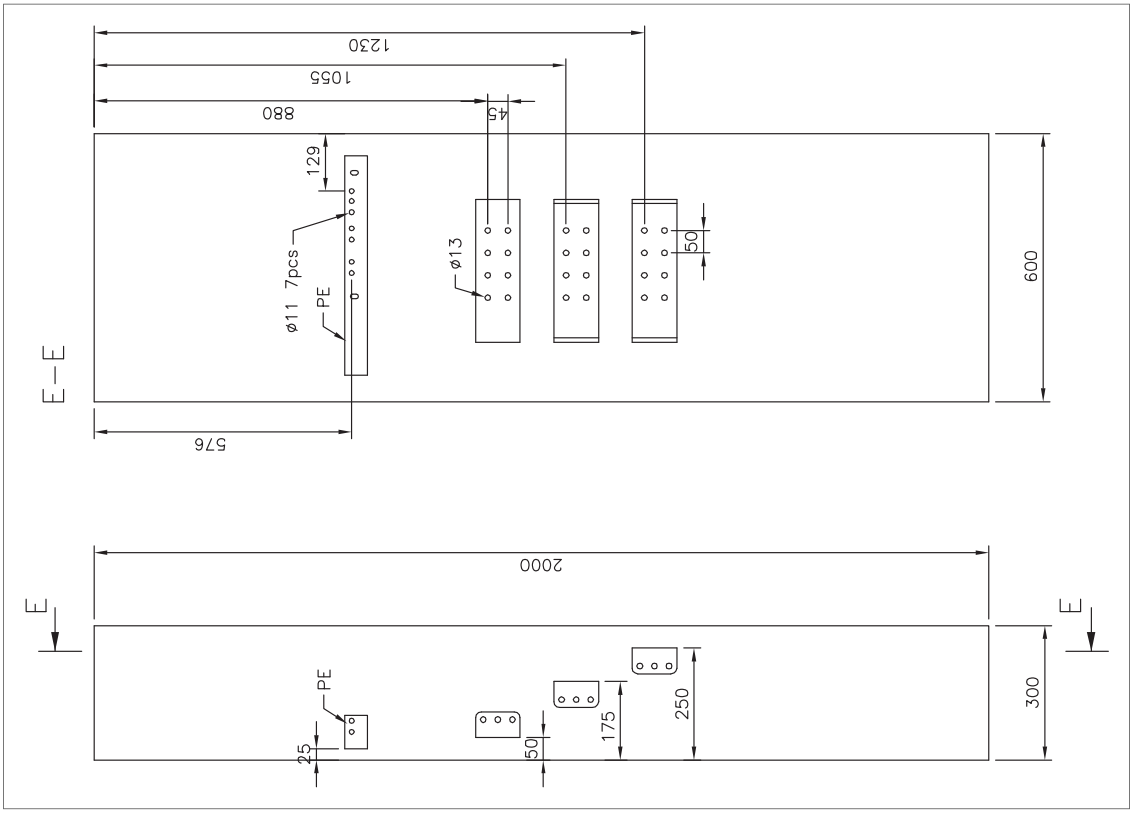
See the dimension tables to which common motor terminal cubicle width is used with which drive type.

Cubicle width 300 mm, bottom cable exit

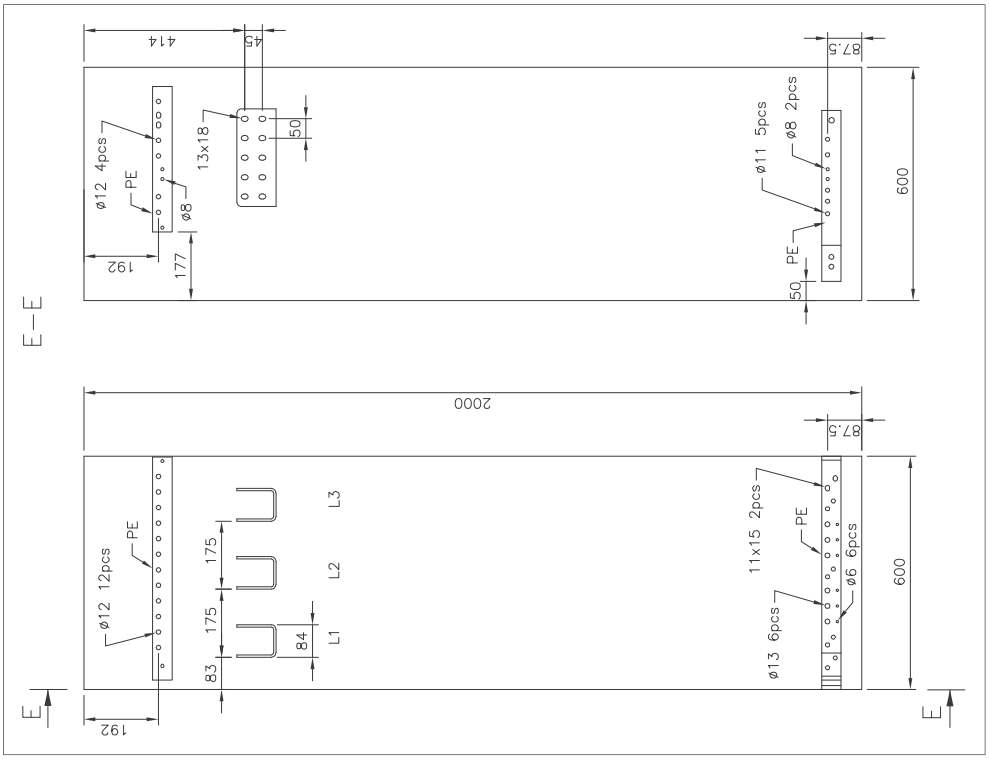


Cubicle width 300 mm (double-busbar version), bottom cable exit

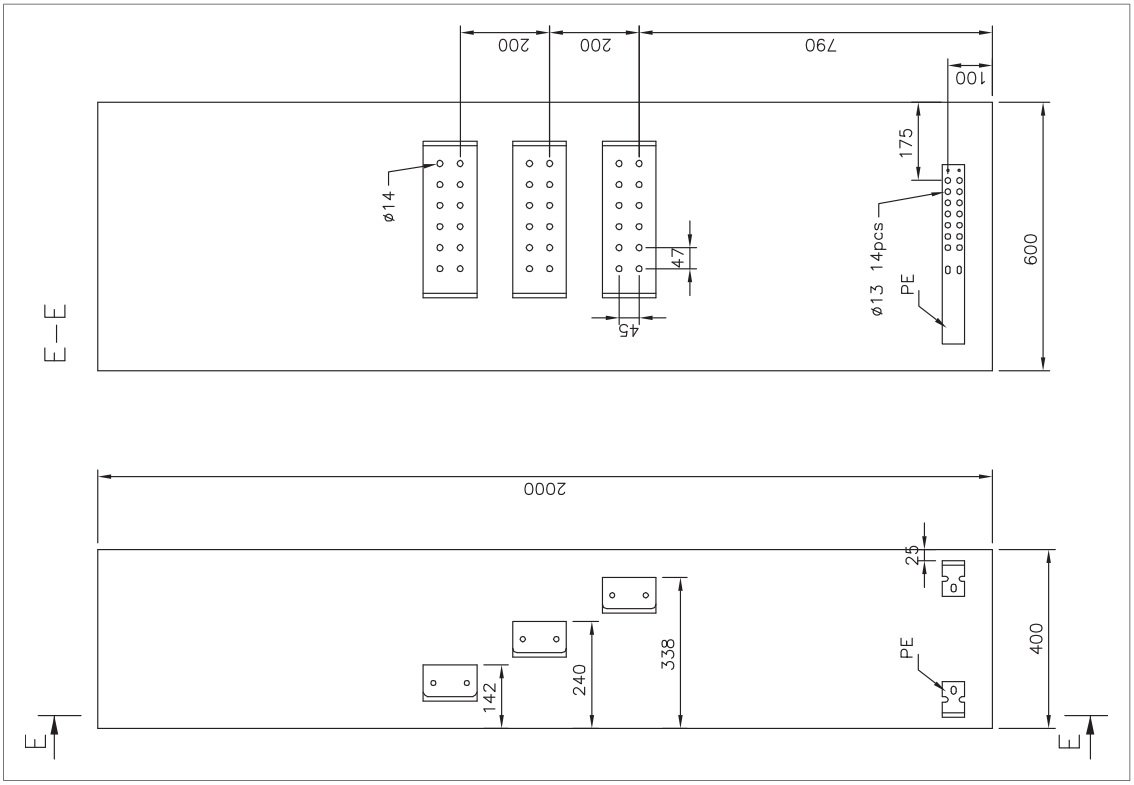
Cubicle width 300 mm, top cable exit



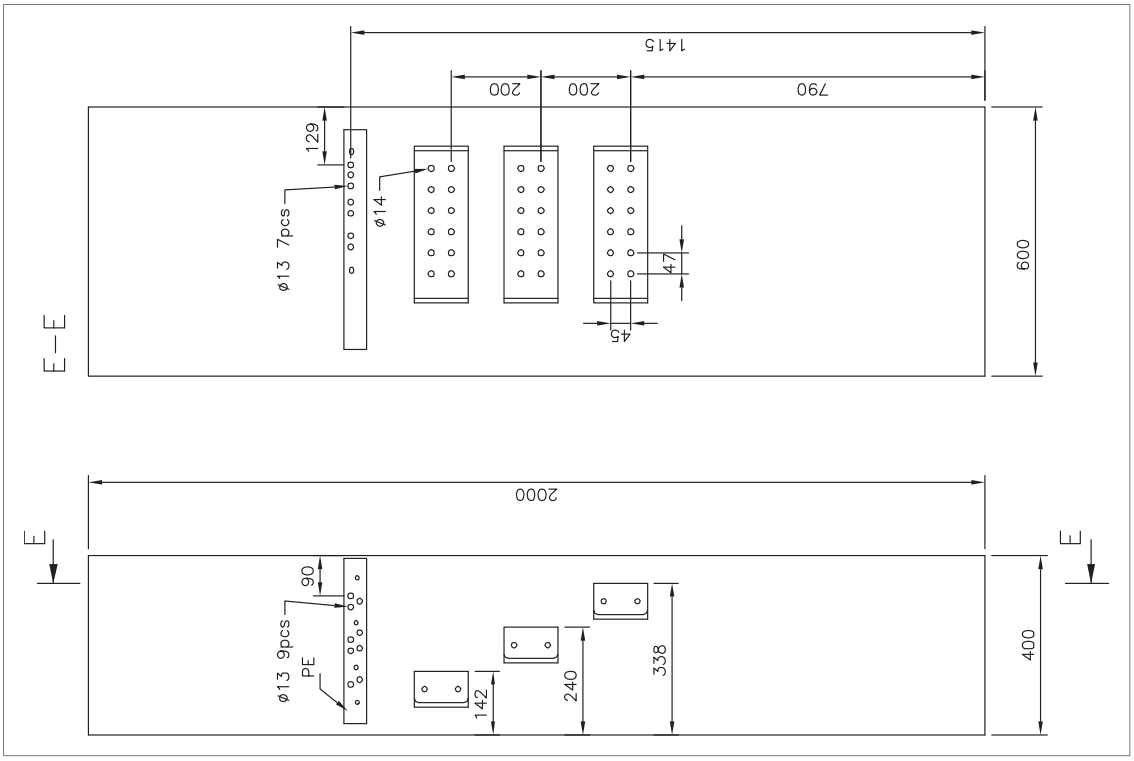
Cubicle width 300 mm (double-busbar version), top cable exit



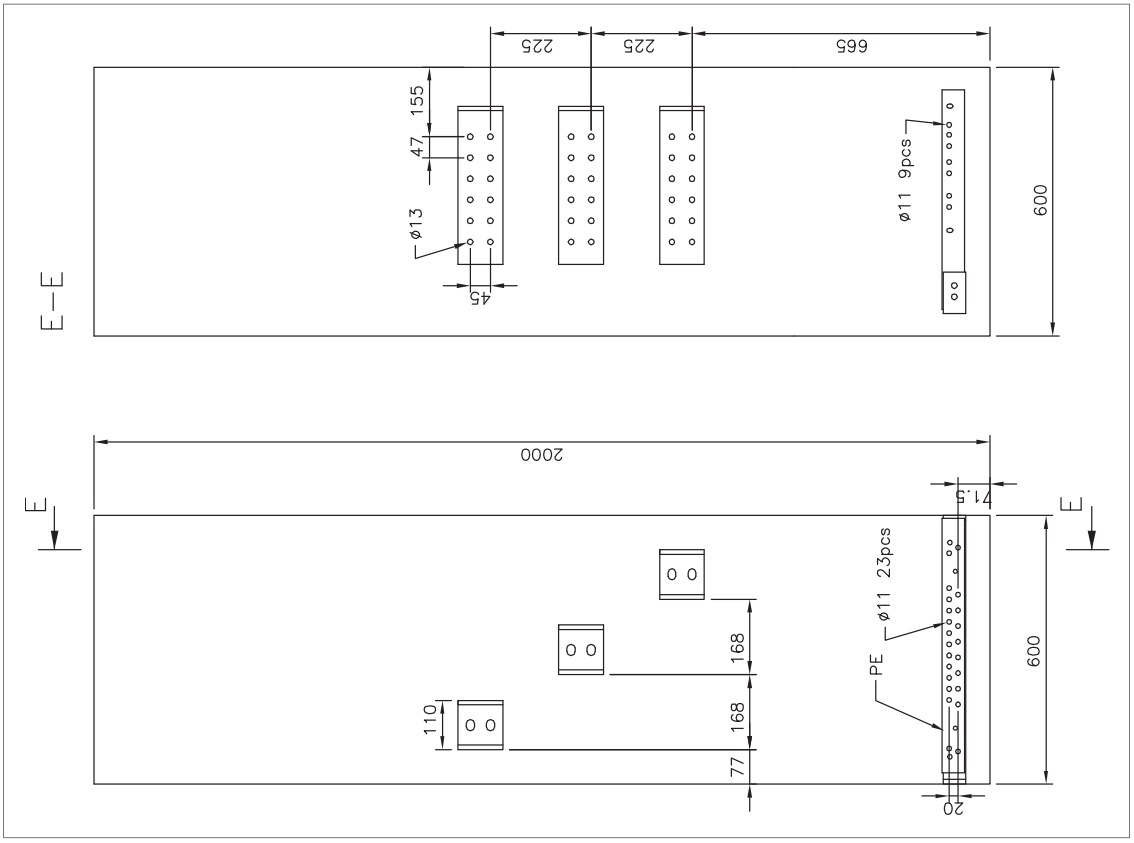
Cubicle width 400 mm, bottom cable exit



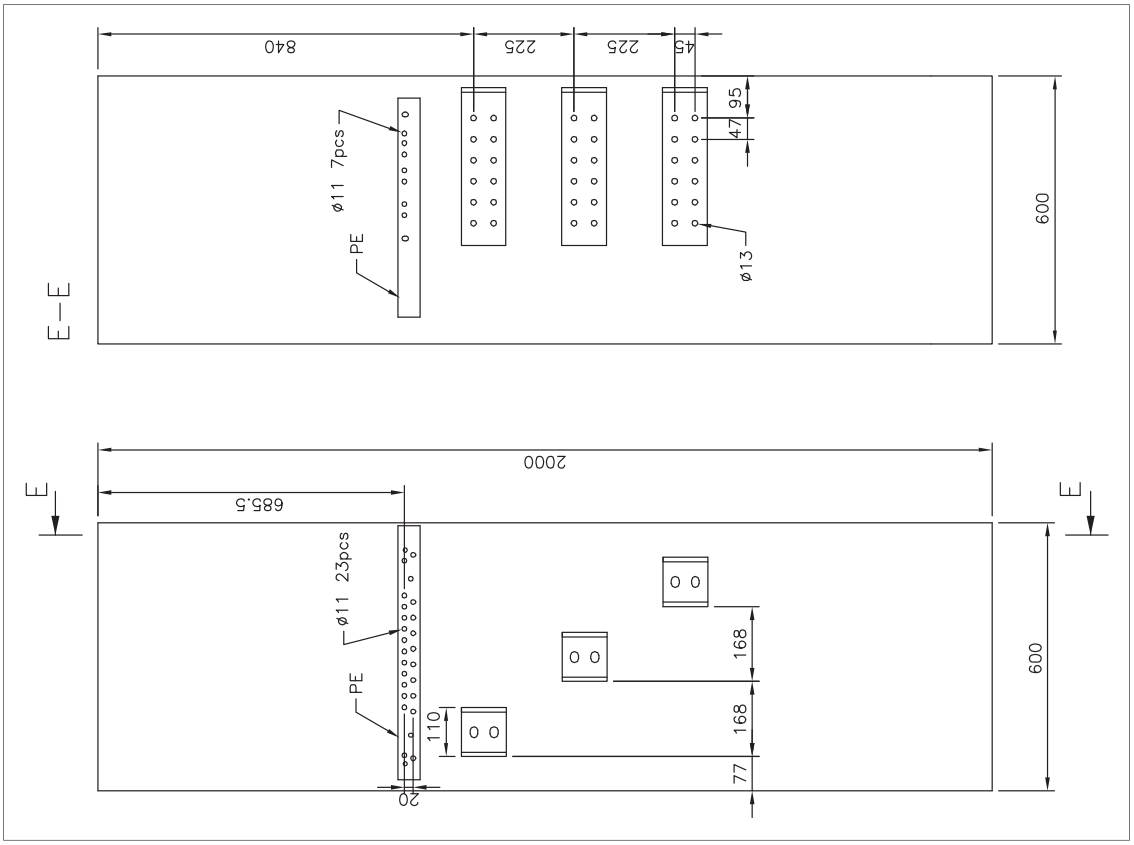
Cubicle width 400 mm, top cable exit



Cubicle width 600 mm, bottom cable exit



Cubicle width 600 mm, top cable exit



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The Safe torque off function

Contents of this chapter

This chapter describes the Safe torque off (STO) function of the inverter unit of the ACS880-07 and gives instructions for its use.

Description

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

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

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

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

Standard	Name
EN 60204-1:2016	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*
IEC 61326-3-1:2008	*Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*

Standard	Name
IEC 61508-1:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*
IEC 61508-2:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*
IEC 61511-1:2016	*Functional safety – Safety instrumented systems for the process industry sector*
IEC 61800-5-2:2016 EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
IEC 62061:2015 EN 62061:2005 +AC:2010+A1:2013+A2:2015	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1:2015	*Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*
EN ISO 13849-2:2012	*Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

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

Compliance with the European Machinery Directive

Compliance with the European Machinery Directive (page 197)

Wiring

The following diagrams present examples of Safe torque off wiring for

- a frame n×R8i inverter unit (page *255*)
- multiple inverter units (page *256*)
- multiple inverter units when an external 24 V DC power supply is used (page *257*).

For the specification of the STO input, see the control unit description.

Activation switch

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

- In case a manually operated activation switch is used, the switch must be of a type that can be locked out to the open position.
- The contacts of the switch or relay must open/close within 200 ms of each other.
- An FSO-xx safety functions module or and FPTC-0x thermistor protection module can also be used. For more information, see the module documentation.

Cable types and lengths

- Double-shielded twisted-pair cable is recommended.
- Maximum cable lengths:
  - 300 m (1000 ft) between activation switch [K] and inverter control unit

- 60 m (200 ft) between multiple inverter units
- 60 m (200 ft) between external power supply and first inverter unit
- 30 m (100 ft) between BCU control unit and last inverter module in the chain.

Note:

The voltage at the INx terminals of each inverter control unit (or frame R8i inverter module) must be at least 17 V DC to be interpreted as “1”.

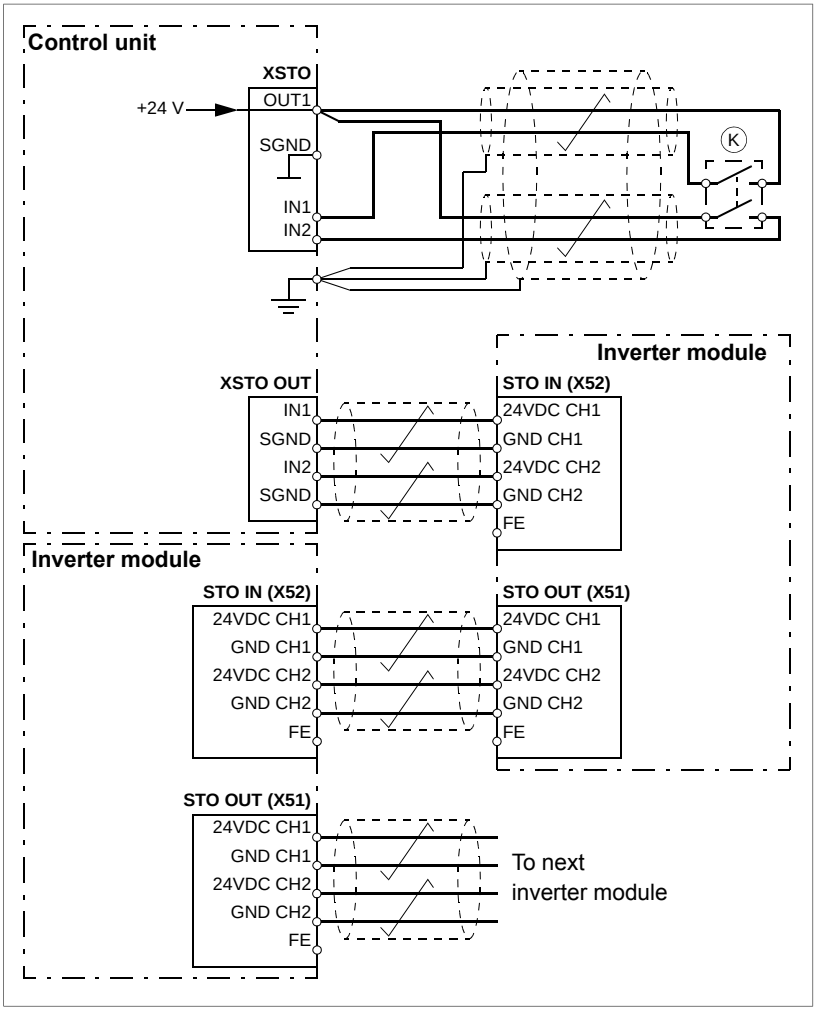
Grounding of protective shields

- Ground the shield in the cabling between the activation switch and the control unit at the control unit.
- Ground the shield in the cabling between two control units at one control unit only.
- Do not ground the shield in the cabling between BCU and R8i module, or between R8i modules.

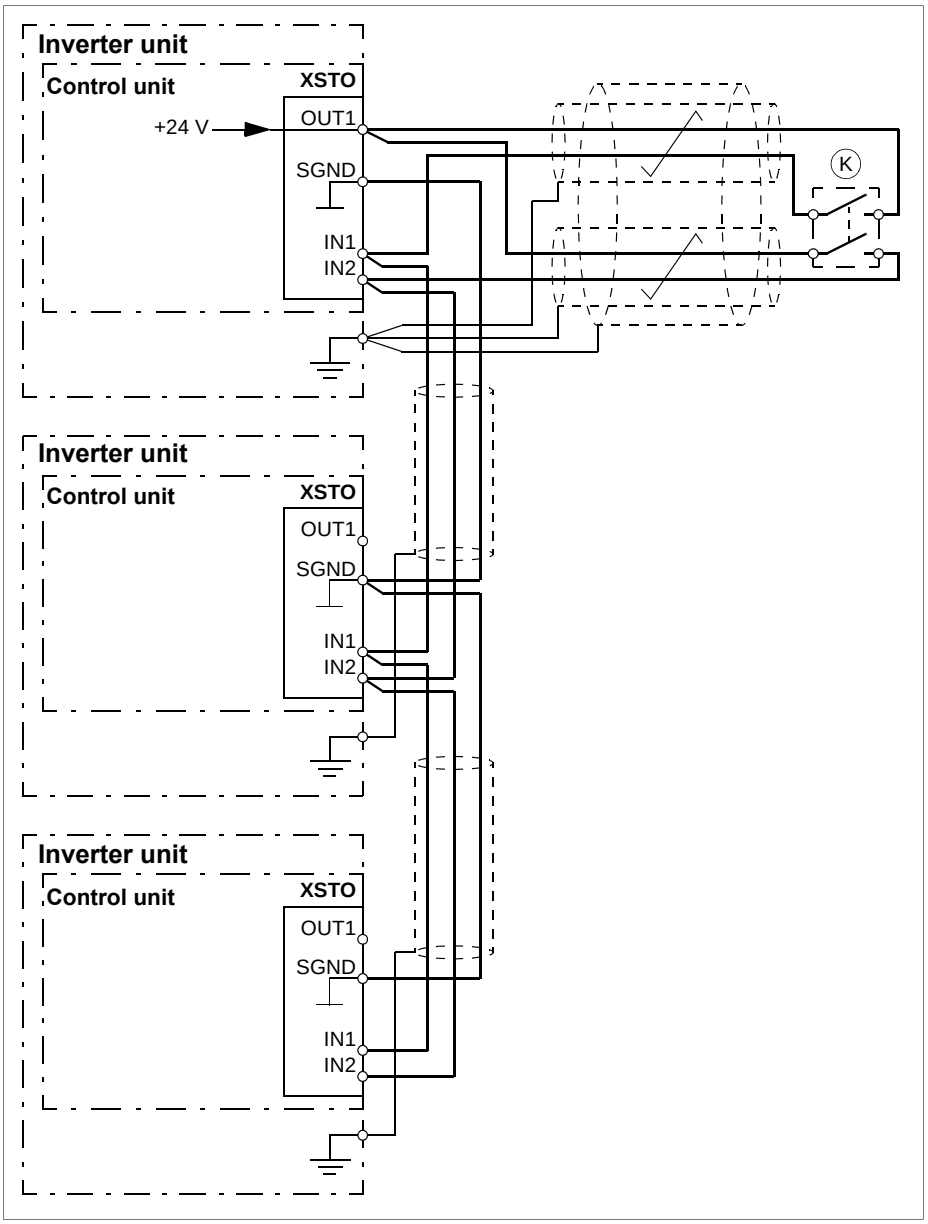
Frame n×R8i inverter unit (internal power supply)

WARNING!

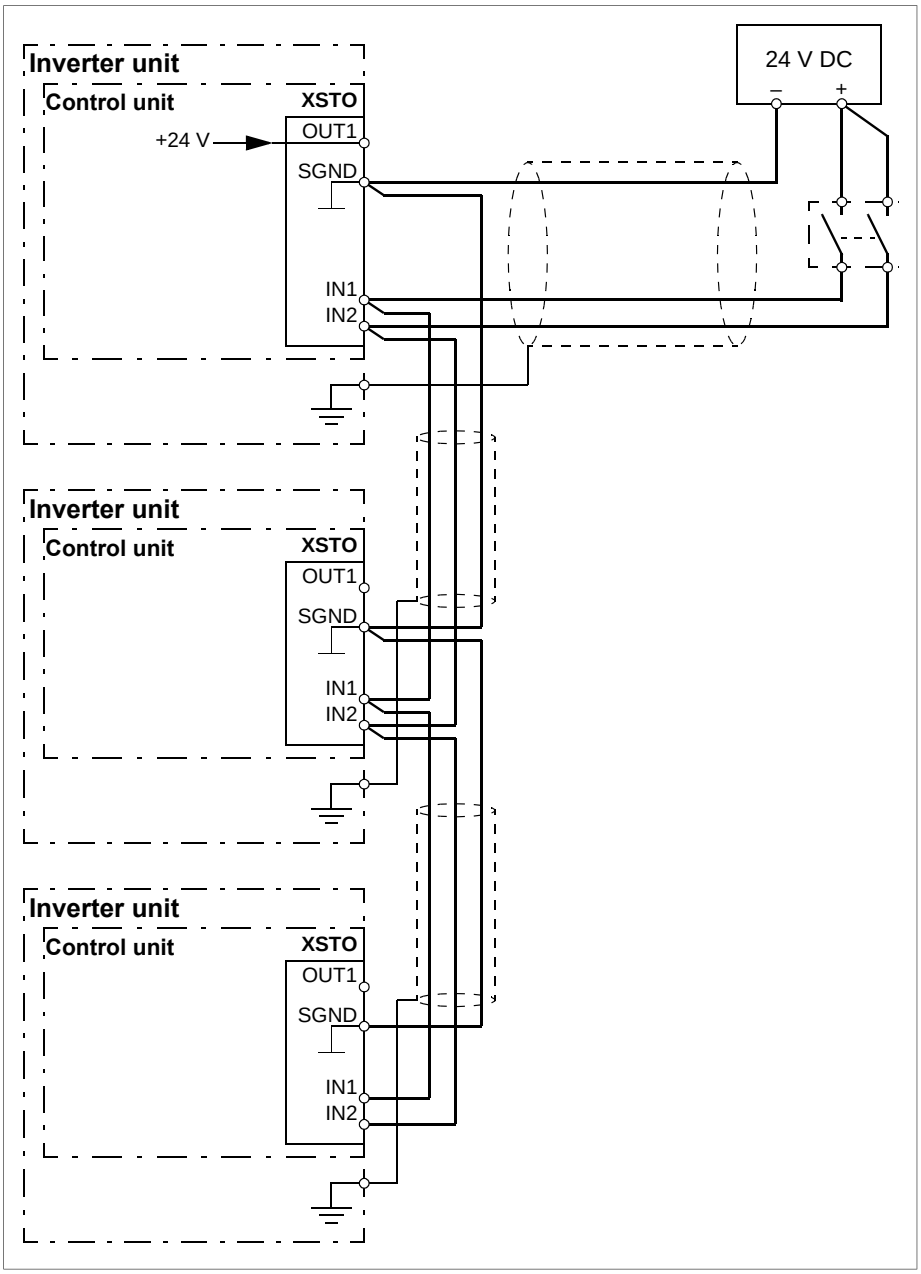
Frame R8i inverter modules are as standard delivered with a jumper wire set that supplies 24 V from connector X53 to X52. The jumper wire set must be removed before wiring the Safe torque off circuit.



Multiple inverter units (internal power supply)



Multiple inverter units (external power supply)



Operation principle

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

Start-up including acceptance test

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

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

Competence

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

Acceptance test reports

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

Acceptance test procedure

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

Note:

If the drive is equipped with safety option +Q950, +Q951, +Q952, +Q957, +Q963, +Q964, +Q978 or +Q979, do the procedure shown in the documentation of the option.

Note:

If the drive is equipped with safety option +Q972 or +Q973, do the procedure shown in the FSO module documentation.

Note:

All inverter modules of the inverter unit must be powered and connected to the STO circuit during the acceptance test.

Action	☑
WARNING! Follow the safety instructions given in *Safety instructions*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.	☐
Ensure that the drive can be run and stopped freely during start-up.	☐
Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.	☐
Check the Safe torque off circuit connections against the wiring diagram.	☐

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

Use

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

WARNING!

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

WARNING!

The Safe torque off functionality is only achieved through the XSTO connector of the inverter control unit (A41). True Safe torque off functionality is not achieved through the XSTO connectors of other control units (such as the supply control unit or the brake control unit).

The Safe torque off function is supported by the ACS880 inverter control program. It is not supported by supply or brake firmware.

WARNING!

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

Notes:

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

Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 5 or 2 years; see section *Safety data (page 261)*. It is assumed that all dangerous failures of the STO circuit are detected by the proof test. To perform the proof test, do the *Acceptance test procedure (page 258)*.

Note:

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

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

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

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

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

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

If any wiring or component change is needed after start up, or the parameters are restored, follow the test given in section *Acceptance test procedure (page 258)*.

Use only ABB approved spare parts.

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

Competence

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

Fault tracing

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

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

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

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

Safety data

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

Note:

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

Frame size	SIL/SIL-CL	SC	PL	SFF (%)	PFH$\diamond$ (T_1 = 20 a) (1/h)	PFD_{avg} (T_1 = 2 a)	PFD_{avg} (T_1 = 5 a)	$MTTF_D$ (a)	DC (%)	Cat.	HFT	CCF	Life-time (a)
2×R8i	3	3	e	>99	6.2E-11	5.5E-07	1.3E-06	16330	≥90	3	1	80	20
3×R8i	3	3	e	>99	7.3E-11	6.5E-07	1.6E-06	12390	≥90	3	1	80	20
4×R8i	3	3	e	>99	8.4E-11	7.6E-07	1.9E-06	9980	≥90	3	1	80	20
5×R8i	3	3	e	>99	9.5E-11	8.6E-07	2.1E-06	8360	≥90	3	1	80	20

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with ΔT = 71.66 °C
  - 1340 on/off cycles per year with ΔT = 61.66 °C
  - 30 on/off cycles per year with ΔT = 10.0 °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time.
- The STO is a type B safety component as defined in IEC 61508-2.
- Relevant failure modes:
  - The STO trips spuriously (safe failure)
  - The STO does not activate when requested
  - A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- STO reaction time (shortest detectable break): 1 ms
- STO response time: 2 ms (typical), 25 ms (maximum)
- Fault detection time: Channels in different states for longer than 200 ms
- Fault reaction time: Fault detection time + 10 ms
- STO fault indication (parameter *31.22*) delay: < 500 ms
- STO warning indication (parameter *31.22*) delay: < 1000 ms

Abbreviations

Abbr.	Reference	Description
Cat.	EN ISO 13849-1	Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability. The categories are: B, 1, 2, 3 and 4.
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage
FIT	IEC 61508	Failure in time: 1E-9 hours
HFT	IEC 61508	Hardware fault tolerance
$MTTF_D$	EN ISO 13849-1	Mean time to dangerous failure: (The total number of life units) / (the number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD_{avg}	IEC 61508	Average probability of dangerous failure on demand
PFH	IEC 61508	Average frequency of Probability of dangerous failures per hour
PL	EN ISO 13849-1	Performance level. Levels a…e correspond to SIL
SC	IEC 61508	Systematic capability
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1…3)
SILCL	IEC/EN 62061	Maximum SIL (level 1…3) that can be claimed for a safety function or subsystem
SS1	IEC/EN 61800-5-2	Safe stop 1
STO	IEC/EN 61800-5-2	Safe torque off

Abbr.	Reference	Description
T1	IEC 61508-6	Proof test interval. T1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of T1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. Note that any T1 values given cannot be regarded as a guarantee or warranty.

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Resistor braking

Contents of this chapter

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

Operating principle

The brake chopper handles the energy generated by a decelerating motor. During the deceleration, motor generates energy back to the drive and the voltage in the drive intermediate DC link starts to rise. The chopper connects the brake resistor to the intermediate DC circuit whenever the voltage in the circuit exceeds the limit defined by the control program. Energy consumption by the resistor losses lowers the voltage until the resistor can be disconnected.

Factory-installed brake choppers and resistors

The following brake choppers (option +D150) and resistors (+D151) are available for the drive as factory-installed. It is also possible to use option +D150 with a custom resistor assembly.

U_N	ACS880-07 type	Brake chopper type (+D150)	Brake resistor type (+D151)
400 V	ACS880-07-0990A-3	2 × NBRA-659	2 × (2 × SAFUR180F460)
	ACS880-07-1140A-3		
	ACS880-07-1250A-3	3 × NBRA-659	3 × (2 × SAFUR180F460)
	ACS880-07-1480A-3		
	ACS880-07-1760A-3		
500 V	ACS880-07-0990A-5	2 × NBRA-659	2 × (2 × SAFUR200F500)
	ACS880-07-1070A-5		
	ACS880-07-1320A-5	3 × NBRA-659	3 × (2 × SAFUR200F500)
	ACS880-07-1450A-5		
	ACS880-07-1580A-5		
690 V	ACS880-07-0800A-7	3 × NBRA-669	3 × (2 × SAFUR200F500)
	ACS880-07-0900A-7		
	ACS880-07-0950A-7		
	ACS880-07-1160A-7		

Technical data

Ratings of chopper/resistor combinations

U_N	Chopper(s)	Resistors	R (ohm)	P_{brmax} (kW)	P_{brcont} (kW)	I_{max} (A)	Duty Cycle (10/60 s)		Duty Cycle (1/5 min)	
							P_{br} (kW)	I_{rms} (A)	P_{br} (kW)	I_{rms} (A)
400 V	2 × NBRA-659	2 × (2 × SAFUR180F460)	1.2	706	108	1090	575	888	333	514
400 V	3 × NBRA-659	3 × (2 × SAFUR180F460)	1.2	1058	162	1635	862	1332	500	771
500 V	2 × NBRA-659	2 × (2 × SAFUR200F500)	1.35	806	108	1210	575	710	333	412
500 V	3 × NBRA-659	3 × (2 × SAFUR200F500)	1.35	1208	162	1815	862	1065	500	618
690 V	2 × NBRA-669	2 × (2 × SAFUR200F500)	1.35	807	108	1670	575	514	333	298
690 V	3 × NBRA-669	3 × (2 × SAFUR200F500)	1.35	1211	162	2505	862	771	500	447

U_N Nominal voltage

R — Resistance of specified resistors (per chopper). This is also the minimum allowed resistance for the resistor assembly.

P_{brmax} — Maximum short-term (1 min every 10 mins) braking power

P_{brcont} — Maximum continuous power rating

I_{max} — Maximum peak current

P_{br} — Maximum braking power for the specified duty cycle

I_{rms} — Rms current for the specified duty cycle

SAFUR resistor data

Type	U_N (V)	R (ohm)	E_R (kJ)	P_{Rcont} (kW)	IPxx
SAFUR125F500	500	4.0	3600	9.0	IP00
SAFUR210F575	575	3.4	4200	10.5	IP00
SAFUR200F500	500	2.7	5400	13.5	IP00
SAFUR180F460	460	2.4	6000	15.0	IP00

U_N — Nominal voltage

R — Resistance

E_R — Short energy pulse that the resistor assembly will withstand each 400 seconds

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

IPxx — Degree of protection

Terminals and cable lead-through data of factory-installed chopper/resistor cubicles

See the dimension drawings delivered with the unit.

Planning the braking system

Verifying the load capacity of the braking equipment

1. Calculate the maximum power generated by the motor during braking (P_{max}).
2. Ensure that the maximum power rating of the braking equipment is equal to or greater than P_{max}.
   The P_{brmax} values specified in the ratings table are for the reference braking cycle (1 minute of braking, 9 minutes of rest). If the actual duty cycle does not correspond to the reference cycle, either use the power rating given for the other two reference cycles (P_{br}), or calculate the maximum braking power for a custom braking cycle. See below for instructions on calculating P_{br} for other braking cycles.
3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the heat dissipation capacity of the resistor (E_R). If you use custom resistor(s), see also the separate instructions below.
   If the E_R value of the resistor is not sufficient, it is possible to use a four-resistor assembly in which two resistors are connected in parallel, two in series. The E_R value of the four-resistor assembly is four times that of a single resistor.

Custom resistor

Resistors other than those available as option +D151 can be used provided that

- the resistance is not lower than the value given in the ratings table

---

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 would not able to handle the overcurrent caused by the low resistance.

- the resistance of the custom resistor does not restrict the braking capacity needed, ie. $P_{max} < U_{DC}^2/R$
  where

P_{max}	Maximum power generated by the motor during braking
U_{DC}	Voltage over the resistor during braking. UDC equals 1.35 · 1.25 · 415 V DC (when supply voltage is 380 to 415 V AC) 1.35 · 1.25 · 500 V DC (when supply voltage is 440 to 500 V AC) or 1.35 · 1.25 · 690 V DC (when supply voltage is 525 to 690 V AC)
R	Resistor resistance (ohm)

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

Calculating the maximum braking power for a custom duty cycle

These rules must be met during any braking cycle:

1. Braking energy transferred during any ten minute period must be less than or equal to the energy transferred during the reference braking cycle (1/9 min).
2. The maximum braking power for a custom braking cycle (P_{br}) must not exceed the rated maximum value P_{brmax}.

The rules as equations:

1. $n \times P_{br} \times t_{br} \leq P_{brmax} \times 60\ s \Rightarrow P_{br} \leq (P_{brmax} \times 60\ s)/(n \times t_{br})$
2. $P_{br} \leq P_{brmax}$

n	Number of braking pulses during a 10-minute period
P_{br}	Maximum braking power (kW) for a custom braking cycle
t_{br}	Braking time (s)
P_{brmax}	Maximum braking power for a reference braking cycle (1 minute of braking, 9 minutes of rest)

Example 1

The duration of a braking cycle is 30 minutes. The braking time is 15 minutes.

Result: If the braking time exceeds 10 minutes, the braking is considered continuous. The allowed continuous braking power is 10% of maximum braking power (P_{brmax}).

Example 2

The duration of a braking cycle (T) is three minutes. The braking time (t_{br}) is 40 seconds.

1. $n \times P_{br} \times t_{br} \leq P_{brmax} \times 60\ s \Rightarrow P_{br} \leq (P_{brmax} \times 60\ s) / (4 \times 40\ s) = 0.375 \times P_{brmax}$
2. $P_{br} \leq P_{brmax} \Leftrightarrow 0.375 \times P_{brmax} \leq P_{brmax}$ **OK**

Result: The maximum braking power for the custom braking cycle is 37% of the rated value given for the reference cycle.

Selecting and routing the cables of a custom resistor

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

Minimizing electromagnetic interference

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

- Shield the braking power line completely, either by using shielded cable or a metallic enclosure. Unshielded single-core cable can only be used if it is routed inside a cabinet that efficiently suppresses the radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance should be 0.3 meters (1 ft).
- Cross any other cables at right angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on chopper IGBTs. The longer the cable the higher the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

Note:

ABB has not verified that the EMC requirements are fulfilled with custom brake resistors and cabling. The customer must consider the EMC compliance of the complete installation.

Maximum cable length

The maximum length of the resistor cable(s) is 50 m (164 ft).

Placing custom brake resistors

Install the resistors outside the drive in a place where they are able to cool effectively.

Arrange the cooling of the resistor in a way that

- no danger of overheating is caused to the resistor or nearby materials, and
- 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. The temperature of the air flowing from the resistor is hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, ensure that the materials withstand high temperatures. Protect the resistor against contact.

Protecting the brake system against thermal overload

The brake chopper protects itself and the resistor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. By default, a brake chopper fault is wired to stop the supply unit of the drive.

Thermal protection of the resistors

The standard resistors available as option +D151 are equipped with a thermal switch. The switches of the resistors are wired in series and connected to the Enable input of the brake chopper. The relay output of the chopper is wired to the supply control unit so that a chopper fault condition stops the supply unit.

With custom resistors, user must implement a similar protection. Use cable rated as follows:

- twisted pair, shielding recommended
- rated operating voltage between a conductor and ground (U_0) > 750 V
- insulation test voltage > 2.5 kV.

Keep the cable as short as possible.

Protecting the resistor cable against short-circuits

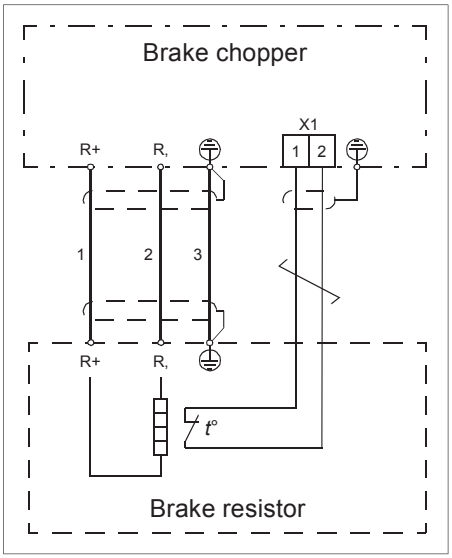
The input fuses of the drive will also protect the resistor cable provided that the resistor cable is of the same type as the input cable.

Mechanical installation of custom brake resistors

Obey the resistor manufacturer's instructions.

Electrical installation of custom brake resistors

Connection diagram



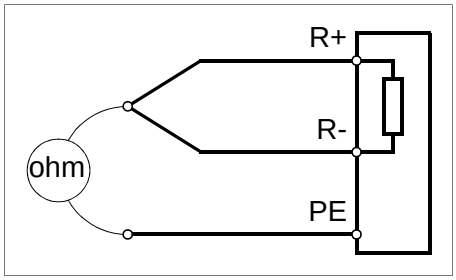
Connection procedure

WARNING!

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

- Do the steps in section Electrical safety precautions in chapter Safety instructions before you start the work.
- Connect the resistor cable at the resistor end only. If a shielded three-conductor cable is used, cut off the third conductor. Ground the twisted shield of the cable as well as any separate PE conductor (if present).

- At the chopper end of the cable, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



- Connect the resistor cable to the R+ and R- terminals of the chopper. If a shielded three-conductor cable is used, cut off the third conductor. Ground the twisted shield of the cable as well as any separate PE conductor (if present).
- Connect the thermal switch of the brake resistor to the enable input (X1) on the brake chopper control board. Use cable specified under *Thermal protection of the resistors (page 270)*. If there are multiple thermal switches, connect them in series.

WARNING!

The ENABLE input terminal block of the brake chopper is at intermediate circuit potential when the supply unit of the drive is running. This voltage is extremely dangerous and can cause serious damage or injury if the isolation level and protection conditions for the thermal switches are not sufficient. The thermal switches must always be properly insulated (over 2.5 kV) and shrouded against contact.

Brake system start up

Check the settings of the following inverter control program parameters (ACS880 primary control program):

- *30.30 Overvoltage control*: Overvoltage control disabled.

For settings of other control programs, see the appropriate firmware manual.

Note:

New brake resistors may be coated with storage grease. As the brake chopper operates for the first time, the grease burns off and may produce some smoke. Make sure there is proper ventilation.

Further information

Product and service inquiries

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

Product training

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

Providing feedback on ABB manuals

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

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