

ABB industrial drives

Hardware manual

ACS880-37 drives (160 to 3200 kW)



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List of related manuals

Drive hardware manuals and guides

	Code (English)
<i>ACS880-37 drives hardware manual</i>	3AXD50000020437
<i>ACX-AP-x assistant control panels user's manual</i>	3AUA0000085685

Drive firmware manuals and guides

<i>ACS880 primary control program firmware manual</i>	3AUA0000085967
<i>Quick start-up guide for ACS880 drives with primary control program</i>	3AUA0000098062
<i>ACS880 IGBT supply control program firmware manual</i>	3AUA0000131562

Option manuals and guides

<i>Drive composer start-up and maintenance PC tool user's manual</i>	3AUA0000094606
<i>FSO-12 safety functions module user's manual</i>	3AXD50000015612
<i>FSO-21 safety functions module user's manual</i>	3AXD50000015614
<i>User's manual for Prevention of unexpected start-up (+Q950) for ACS880-07/17/37 drives</i>	3AUA0000145922
<i>User's manual for Emergency stop, stop category 0 (+Q951) for ACS880-07/17/37 drives</i>	3AUA0000119895
<i>User's manual for Emergency stop, stop category 1 (+Q952) for ACS880-07/17/37 drives</i>	3AUA0000119896
<i>User's manual for Prevention of unexpected start-up (+Q957) for ACS880-07/17/37 drives</i>	3AUA0000119910
<i>User's manual for Emergency stop, stop category 0 (+Q963) for ACS880-07/17/37 drives</i>	3AUA0000119908
<i>User's manual for Emergency stop, stop category 1 (+Q964) for ACS880-07/17/37 drives</i>	3AUA0000119909
<i>User's manual for Safely-limited speed with the encoder interface (+Q965) for ACS880-07/17/37 drives</i>	3AXD50000019727
<i>User's manual for ATEX-certified motor thermal protection functions (+L513+Q971 and +L514+Q971) for cabinet-built ACS880 drives</i>	3AXD50000014979
<i>User's manual for Emergency stop, configurable stop category 0 or 1 (+Q978) for ACS880-07/17/37 drives</i>	3AUA0000145920
<i>User's manual for Emergency stop, configurable stop category 0 or 1 (+Q979) for ACS880-07/17/37 drives</i>	3AUA0000145921
<i>Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.</i>	

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[ACS880-37 \(160 to 3200 kW\) manuals](#)

Hardware manual

ACS880-37 drives (160 to 3200 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:



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



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



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

General safety in installation, start-up and maintenance


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

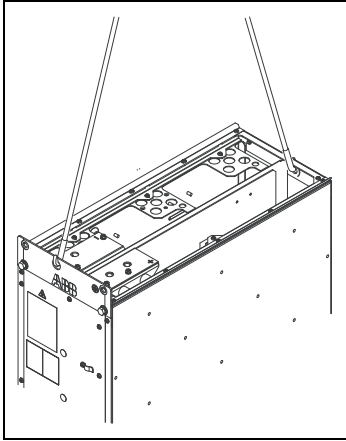
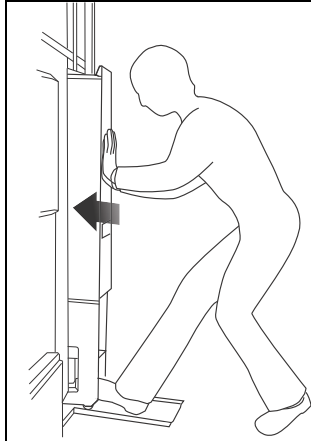


WARNING! Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- Secure the cabinet to the floor to prevent it from toppling over when you pull out power (inverter/supply/filter) modules. The power modules are heavy and have a high center of gravity.



- 
- Wear protective gloves and long sleeves. Some parts have sharp edges.
 - Handle the inverter, supply and filter modules carefully:
 - Use safety shoes with a metal toe cap to avoid foot injury.
 - Lift the module with a lifting device only. Use the designated lifting points shown in the drawing below.
 - 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.
 - Do not use the module extraction/installation ramp with plinth heights over 50 mm (2"). The ramp supplied with the drive system is designed for a plinth height of 50 mm (2") (the standard plinth height of ABB cabinets).
 - 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.
-

<p>Support the top and bottom of the module when extracting it from the cubicle!</p>	<p>Do not tilt!</p>	<p>Do not leave the module unattended on a sloping floor!</p>
 <p>50 mm (2") max.</p>		
<p>Lift the module by the upper part only using the lifting eyes at the top!</p>	<p>Mind your fingers! Keep fingers away from the edges of the front flange of the module!</p>	<p>Support the top and bottom of the module when reinserting it into the cubicle!</p>
		



- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Beware of hot air exiting from the air outlets.
- Keep the drive in its package or protect it otherwise from dust and burr from drilling and grinding until you install it. Protect also the installed drive against dust and burr. Electrically conductive debris inside the drive can cause damage or malfunction.
- Vacuum clean the area around the drive before the start-up to prevent the drive cooling fan from drawing the dust inside the drive.
- Do not cover the air inlet or outlet when the drive is running.
- Make sure that there is sufficient cooling. See section [Examining the installation site](#) (page 59).

- 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.
- Make sure that any safety circuits (for example, emergency stop and Safe torque off) are validated at start-up. See chapter [The Safe torque off function](#) (page 237). For other safety functions, see their separate instructions.

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 not set to Local, 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 warnings 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 breaker [Q1] of the drive.
 - Open the disconnector of the supply transformer as the main switch-disconnector or breaker of the drive does not remove the voltage from the input busbars of the drive or from the voltmeter (option +G334).
 - Make sure that reconnection is not possible. Lock the disconnectors to open position and attach a warning notice to them.
 - Disconnect any external power sources (eg. UPS, motor fan supply, or cubicle heater supply) from the control circuits before you do work on the control cables.
 - After you disconnect the drive, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you continue.
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.
 - 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.



WARNING! 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).

7. Install temporary grounding as required by the local regulations. Close the grounding switch (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 a drive with EMC filter option +E202 on an ungrounded power system or a high resistance-grounded (over 30 ohms) power system.
- Do not connect the drive to a voltage higher than what is specified on the type designation label. If you do, the brake chopper (if present) starts to operate which causes the overheating of the brake resistor. Overvoltage can also cause the motor to rush to its maximum speed.
- We do not recommend that you secure the cabinet by arc welding. If you have to, obey the instructions on page [74](#).
- Do not do insulation or voltage withstand tests on the drive or its modules.

Note:

- The motor cable terminals of the drive are at a dangerous voltage when the input power is on, regardless of whether the motor is running or not.
- The DC bus, brake chopper and brake resistors (if any) are at a dangerous voltage.
- 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! Use a grounding wrist band when you handle the printed circuit boards. Do not touch the boards unnecessarily. The boards contain components sensitive to electrostatic discharge.



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

- Handle 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").
-

■ Grounding

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



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

- If you are not a qualified electrician, do not do grounding work.
- Always ground the drive, the motor and adjoining equipment. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- Make sure that the conductivity of the grounding conductors is sufficient. See section [Selecting the power cables](#) (page 81). 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 and maintenance

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



WARNING! Obey these instructions. If you ignore them, injury or death and 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 motor.
 - Disconnect the motor from the drive with a safety switch or by other means.
 - If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
 - Measure that the installation is de-energized.
 - Use a multimeter with an impedance of at least 1 Mohm.
 - Make sure that the voltage between the drive output terminals (U2, V2, W2) and the grounding (PE) busbar is close to 0 V.
 - Make sure that the voltage between the drive input power terminals (1L1, 1L2, 1L3) and the grounding (PE) busbar is close to 0 V.
 - Make sure that the voltage between the plus and minus busbars of the drive DC link and the grounding (PE) busbar is close to 0 V.
 - Install temporary grounding to the drive output terminals (U2, V2, W2). Connect the output terminals together as well as to the PE.
 - Make sure that the operator cannot run the motor over the rated speed. Motor overspeed causes overvoltage which can damage the capacitors in the intermediate circuit of the drive.
-





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.

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

Related documents

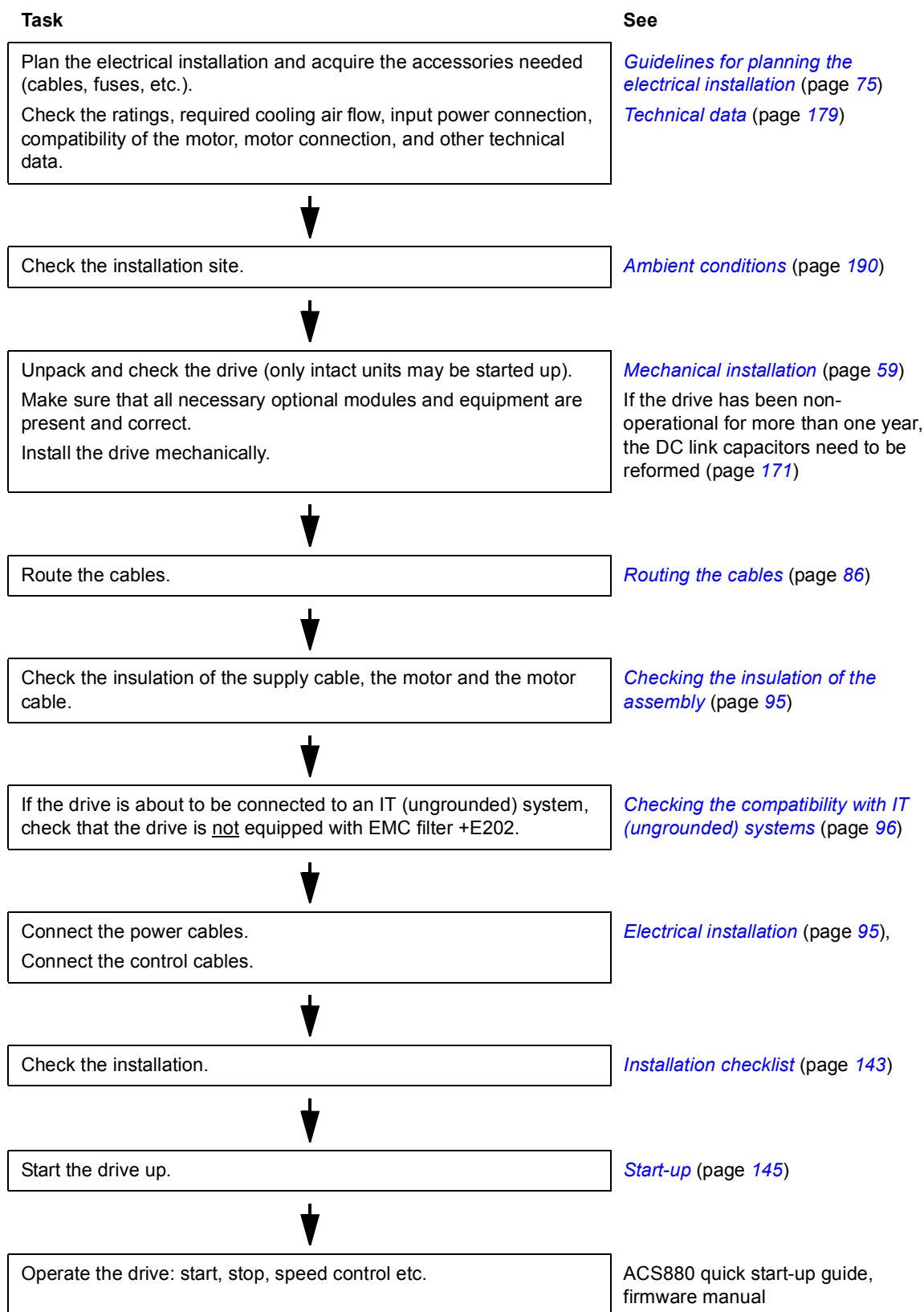
See *List of related manuals* on the inside of the front cover.

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×R8i + 2×R8i” refers to a drive that has a supply unit consisting of two frame R8i IGBT supply modules and an inverter unit consisting of two frame R8i inverter modules. The frame size is marked on the type designation label (see page 54), and can also be determined from the type code (see table under *Frame sizes and power module types*, page 183).

The instructions, technical data and dimension drawings which only concern certain optional selections are marked with option codes (such as +B054). The options included in the drive can be identified from the option codes visible on the type designation label (see page 54). The option selections are listed in section *Type designation key* (page 55).

Quick installation, commissioning and operation flowchart



Terms and abbreviations

Term/ Abbreviation	Explanation
BCU	Drive control unit. The drive contains two BCU control units. One controls the supply unit, the other controls the inverter unit. As standard, the external I/O control signals are connected to the control unit, or optional I/O extensions mounted on it.
Drive	Frequency converter for controlling AC motors. The drive consists of the <i>supply unit</i> (aka line-side converter) and the <i>inverter unit</i> (aka motor-side converter) connected together by the DC link. In this manual, the term refers to the ACS880-37 as a whole.
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EMT	Electrical metallic tubing
FAIO-01	Optional analog I/O extension module
FCAN-01	Optional CANopen adapter module
FCNA-01	Optional ControlNet™ adapter module
FDCO-01	Optional DDCS communication module with two pairs of 10 Mbit/s DDCS channels
FDIO-01	Optional digital I/O extension module
FDNA-01	Optional DeviceNet™ adapter module
FEA-03	Optional I/O extension adapter
FECA-01	Optional EtherCAT adapter module
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
FENA-11	Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols
FENA-21	Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
FEPL-02	Optional Ethernet POWERLINK adapter module
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FLON-01	Optional LonWorks® adapter module
FPBA-01	Optional PROFIBUS DP adapter module
FPTC-01	Optional thermistor protection module
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres
Frame (size)	Relates to the construction type of the component in question. For example, several drive types with different power ratings may have the same basic construction, and a frame size is used in reference to all those drive types. The frame size marking of the drive indicates the quantity and frame size of the supply modules, plus the quantity and frame size of the inverter modules, eg. “2×R8i + 2×R8i”. To determine the frame size of a drive type, see the rating tables in chapter Technical data .
FSCA-01	Optional RS-485 (Modbus/RTU) adapter
FSO-xx	Optional safety functions modules
IGBT	Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in drives due to their easy controllability and high switching frequency.

Term/ Abbreviation	Explanation
Inverter unit	The part of the <i>drive</i> that converts DC to AC for the motor. Consists of one or more inverter modules and their auxiliary components. The inverter unit is also capable of feeding energy from a decelerating motor into the DC link.
I/O	Input/Output
Power module	Supply module or inverter module. See also <i>Frame (size)</i> .
RDCO-0x	DDCS communication module
RFI	Radio-frequency interference
SAR	Safe acceleration range
SBC	Safe brake control
SLS	Safely-limited speed without encoder
SS1	Safe stop 1
SSE	Safe stop emergency
SSM	Safe speed monitor without encoder
STO	Safe torque off. See chapter <i>The Safe torque off function</i> (page 237).
Supply unit	The part of the <i>drive</i> that converts AC to DC. Consists of one or more supply modules and their auxiliary components such as the LCL filter.

■ Safety data (SIL, PL)

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 dangerous failures per hour
PL	EN ISO 13849-1	Performance level. Levels a...e correspond to SIL
SC	IEC 61508	Systematic capability
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1...3)
SILCL	IEC/EN 62061	Maximum SIL (level 1...3) that can be claimed for a safety function or subsystem
SS1	IEC/EN 61800-5-2	Safe stop 1
STO	IEC/EN 61800-5-2	Safe torque off
T1	IEC 61508	Proof test interval. T1 is a parameter used to define the probabilistic failure rate (PFH or PFD) for the safety function or subsystem. Performing a proof test at a maximum interval of T1 is required to keep the SIL capability valid. The same interval must be followed to keep the PL capability (EN ISO 13849) valid. Note that any T1 values given cannot be regarded as a guarantee or warranty. See also section <i>Maintenance</i> (page 246).

3

Operation principle and hardware description

Contents of this chapter

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

Operation principle

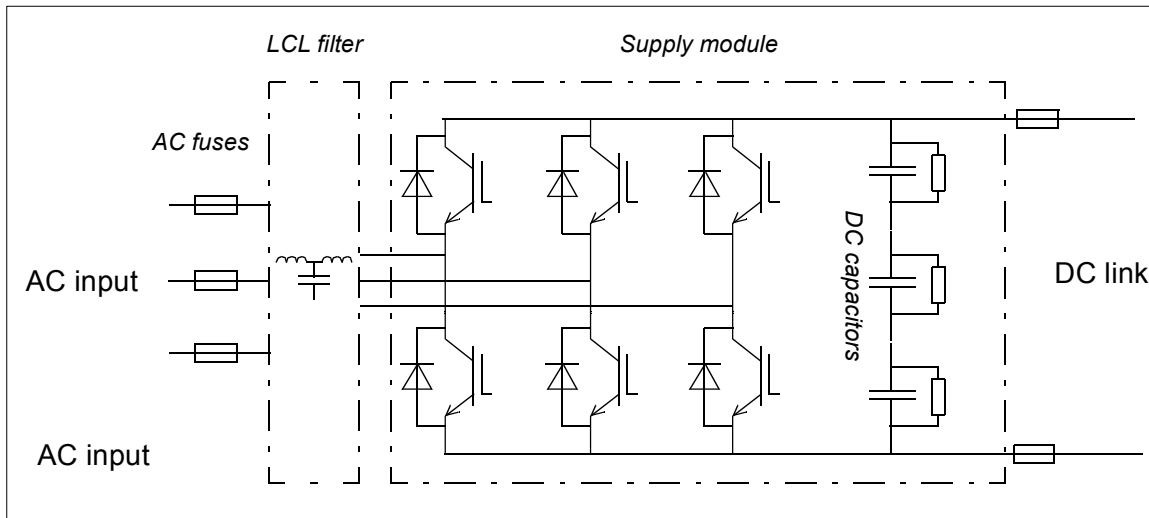
The ACS880-37 is a low-harmonic, air-cooled, cabinet-installed drive for controlling asynchronous AC induction motors, permanent magnet synchronous motors, AC induction servomotors and ABB synchronous reluctance (SynRM) motors.

The drive consists of several cubicles that contain the supply and motor terminals, 1 to 6 IGBT supply module(s) forming the supply unit (line-side converter), 1 to 6 inverter modules forming the inverter unit (motor-side converter), and optional equipment. The actual arrangement of the cubicles varies from type to type and the selected options. Some optional equipment require additional cubicles. See chapter [Dimensions](#) for examples of cabinet line-ups.

■ Supply unit

The supply unit rectifies three-phase AC current to direct current for the intermediate DC link of the drive.

The following figure shows the simplified main circuit diagram of the supply unit. Larger drives have supply units that consist of multiple supply modules connected in parallel. The supply unit is controlled by a type BCU control unit [A51].



AC voltage and current waveforms

The AC current is sinusoidal at a unity power factor. The LCL filter suppresses the AC voltage distortion and current harmonics. The high AC inductance smooths the line voltage waveform distorted by the high-frequency switching of the converter. The capacitive component of the filter effectively filters the high-frequency (over 1 kHz) harmonics.

Charging

Charging is needed to power up the DC link capacitors smoothly. Discharged capacitors cannot be connected to the full supply voltage. The voltage must be increased gradually until the capacitors are charged and ready for normal use. The drive contains a resistive charging circuit consisting of fuses, contactor and charging resistors. The charging circuit is in use after start-up until the DC voltage has risen to a predefined level.

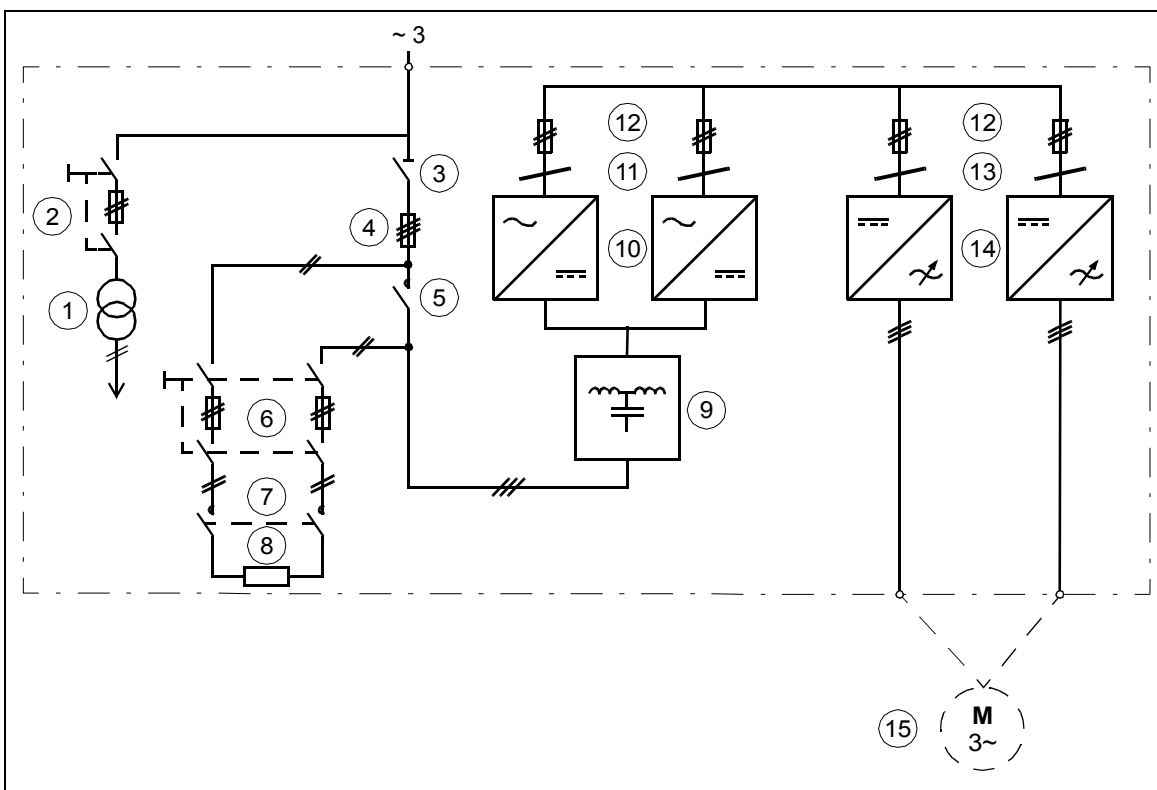
Licensing

Each supply module has a hardware license (+N8201) which allows the module to be used as an ACS880-37 supply module only. For example, a module with +N8201 cannot be used as an inverter module. On the other hand, it is possible to use a module without +N8201 as a spare part for an ACS880-37 supply module as long as the types of the modules are otherwise the same.

■ Inverter unit

The inverter unit converts the DC back to AC that rotates the motor. It is also able to feed the braking energy from a rotating motor back into the DC link. The inverter unit is controlled by a type BCU control unit [A41].

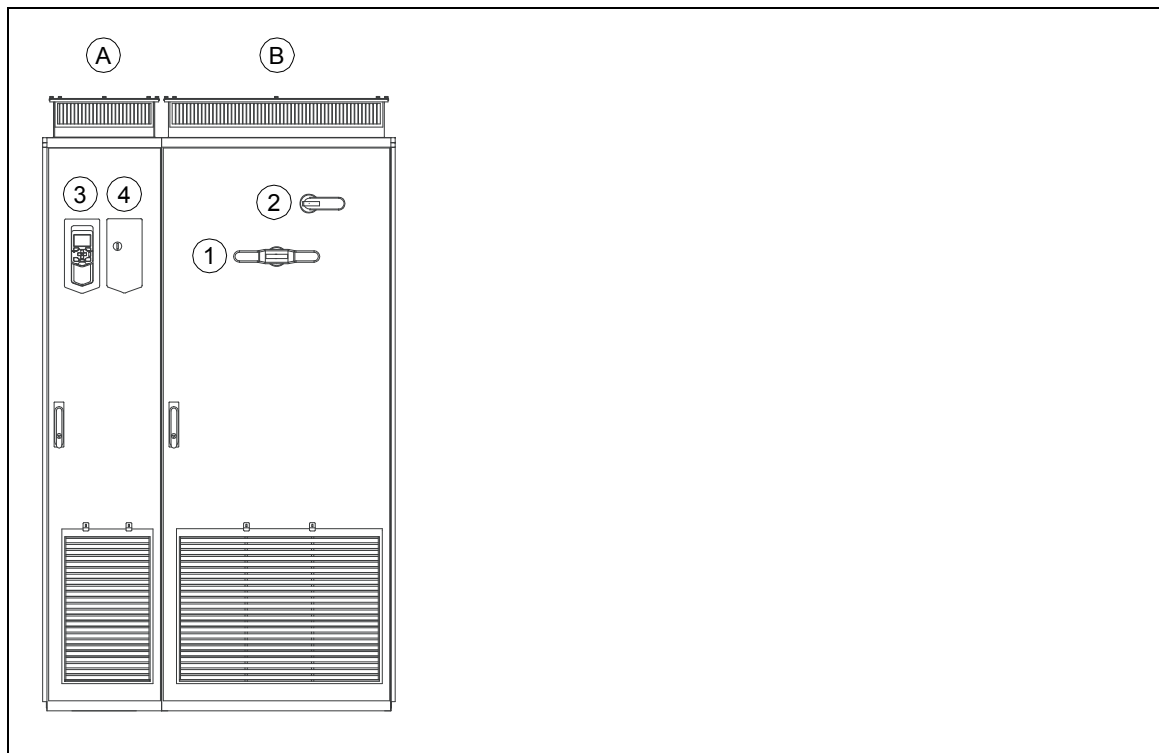
■ Overview circuit diagram of the drive



1	Auxiliary voltage transformer(s)
2	Auxiliary voltage switch [Q21]. Frame 1×R8i + 1×R8i has fuse disconnectors [F20.x] in place of an auxiliary voltage switch. The auxiliary voltage is switched by the main switch/disconnector.
3	*Main switch/disconnector [Q1.1]
4	*AC fuses [F1.x]. If the drive has multiple LCL filters, there are additional AC fuses at the input of each filter.
5	*Main contactor [Q2]
*With drive types ACS880-37-1210A-3, -1430A-3, -1530A-5, -1450-7 and -1680-7, these items can be replaced by an air circuit breaker [Q1] by selecting option +F255. Larger drive types have an air circuit breaker as standard equipment. Drives with an air circuit breaker have AC fuses only at the input of each LCL filter.	
6	Charging switch fuse [Q3]
7	Charging contactor [Q4]
8	Charging resistors [R4.x]
9	LCL filter [R3.x]
10	Supply module [T1.x]
11	Common mode filters [R1.x] at the output of each supply module
12	DC fuses at the output of each supply module [F2.x], and at the input of each inverter module [F11.x]. Frame 1×R8i + 1×R8i drives do not have DC fuses.
13	Common mode filters [R11.x] at the input of each inverter module (except frame 1×R8i + 1×R8i)
14	Inverter unit consisting of one or several inverter modules [T11.x]
15	Motor

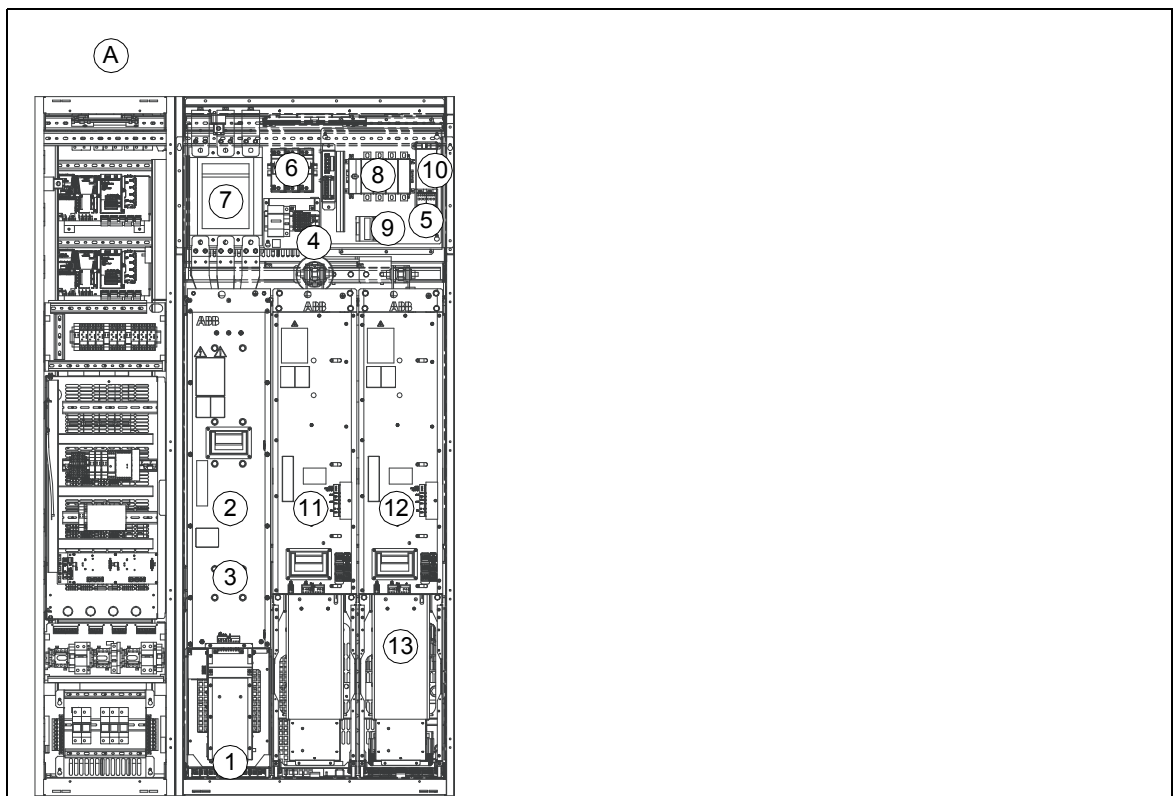
Cabinet line-up and layout examples

■ Frame 1×R8i + 1×R8i



Cabinet line-up example

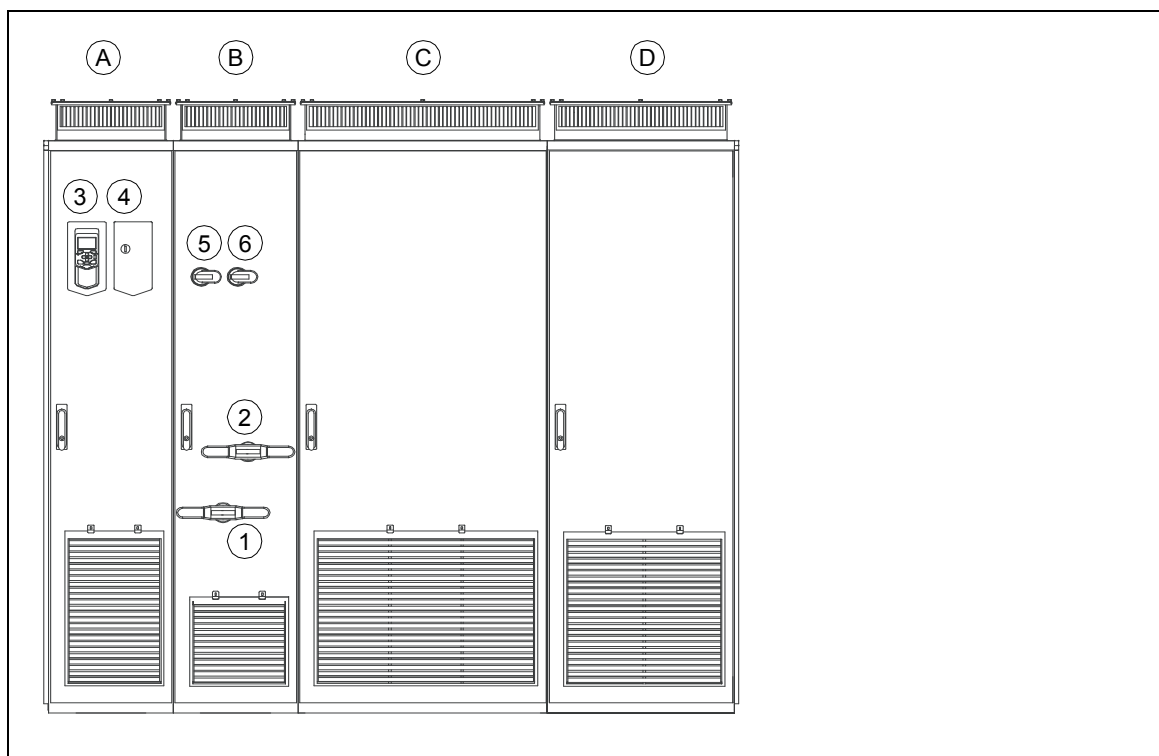
A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See page 38.
B	Supply and inverter module cubicle. Contains the supply module, LCL filter, inverter module and switchgear, as well as the power cable terminals.
1	Main switch-disconnector [Q1.1].
2	Charging switch [Q3]
3	Drive control panel (see page 44)
4	Door switches and lights (see page 42)



Cabinet layout example

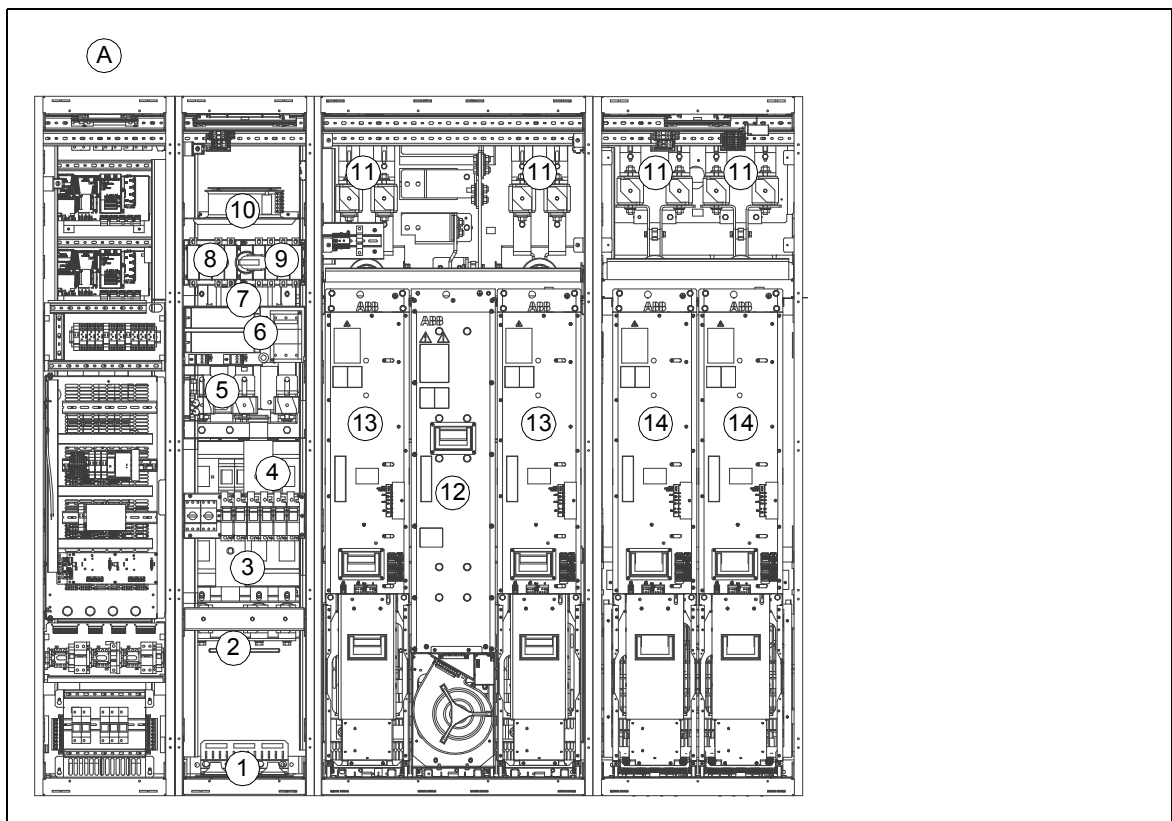
A	Auxiliary control cubicle (ACU). See page 38.
1	Input cable lead-throughs, PE busbar
2	LCL filter module
3	Input terminals (behind LCL filter module)
4	Main switch/disconnector [Q1.1] (behind mounting plate)
5	AC fuses (behind mounting plate)
6	Fuse disconnectors for auxiliary voltage [F20.x]
7	Main contactor [Q2.1]
8	Charging fuse switch [Q3]
9	Charging contactor
10	Charging resistors
11	Supply module
12	Inverter module
13	Output terminals (behind inverter module)

■ Frame 2×R8i + 2×R8i



Cabinet line-up example

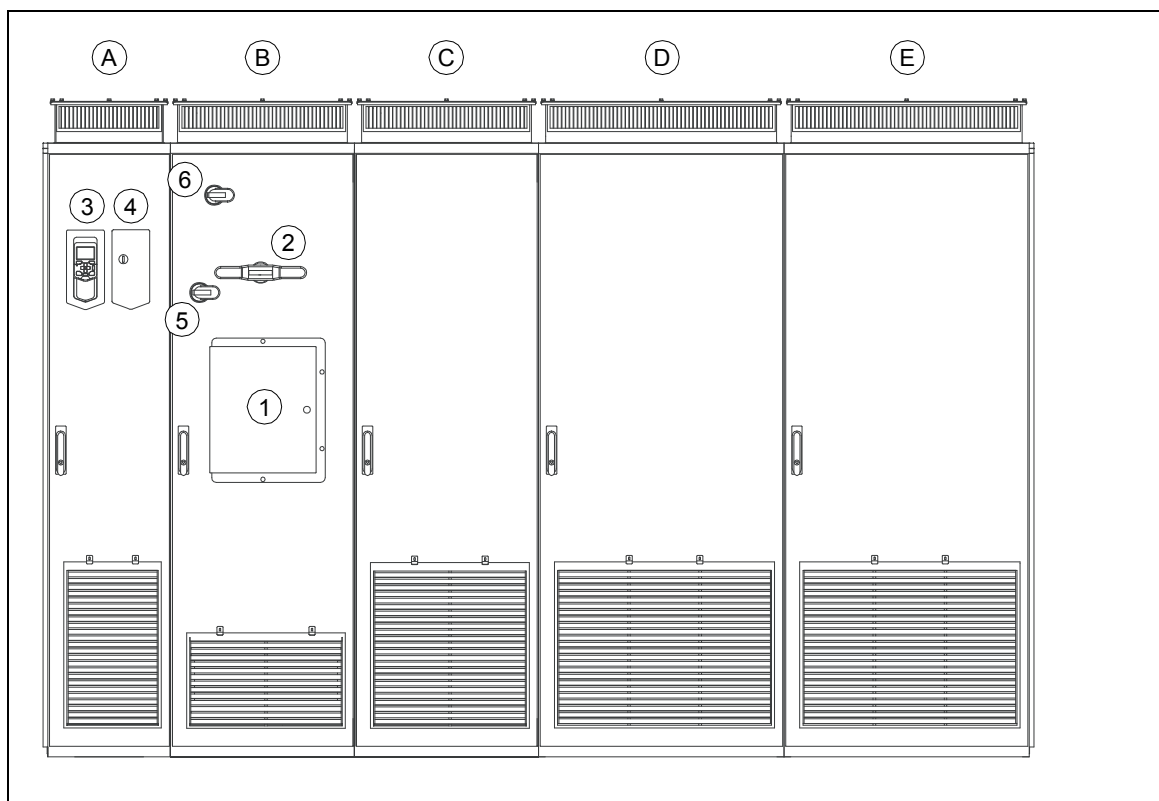
A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See page 38.
B	Incoming cubicle. Contains the input terminals, switchgear and charging equipment.
C	Supply module cubicle. Contains two R8i supply modules together with an LCL filter module.
D	Inverter module 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	Grounding/earthing switch [Q9.1] (option +F259)
3	Drive control panel (see page 44)
4	Door switches and lights (see page 42)
5	Auxiliary voltage switch [Q21]
6	Charging switch [Q3]



Cabinet layout example

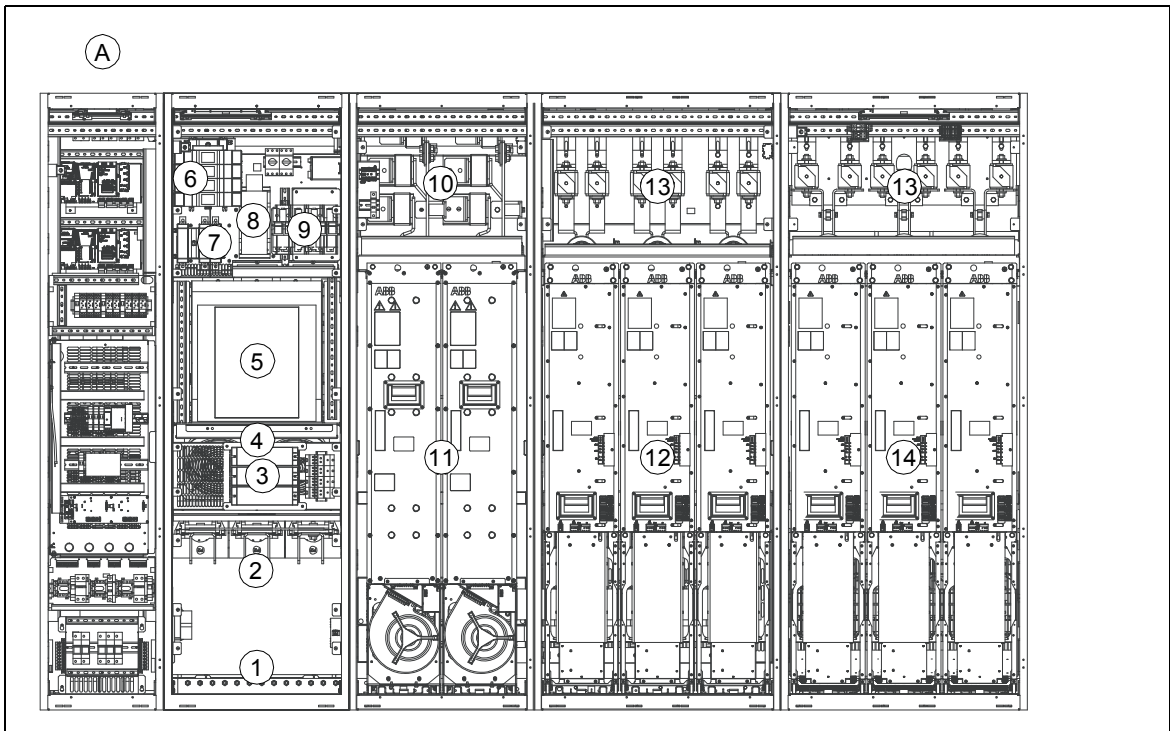
A	Auxiliary control cubicle (ACU). See page 38.
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Main switch-disconnector [Q1.1]
4	Grounding/earthing switch [Q9.1] (option +F259)
5	AC fuses
6	Charging resistors and contactor
7	Main contactor (behind charging equipment)
8	Auxiliary voltage switch [Q21]
9	Charging switch [Q3]
10	Incoming cubicle cooling fan
11	DC fuses (at the output of each supply module and at the input of each inverter module)
12	LCL filter module
13	Supply modules
14	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 3×R8i + 3×R8i (with main breaker)



Cabinet line-up example

A	Auxiliary control cubicle (ACU). Contains control electronics and customer I/O connections. See page 38.
B	Incoming cubicle. Contains the input terminals, switchgear and charging equipment.
C	Supply module cubicle (1). Contains two LCL filter modules.
D	Supply module cubicle (2). Contains three R8i supply modules.
E	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), +H366 (common output terminals) or +E206 (sine filters).
1	Main circuit breaker [Q1]
2	Grounding/earthing switch [Q9.1] (option +F259)
3	Drive control panel (see page 44)
4	Door switches and lights (see page 42)
5	Auxiliary voltage switch [Q21]
6	Charging switch [Q3]

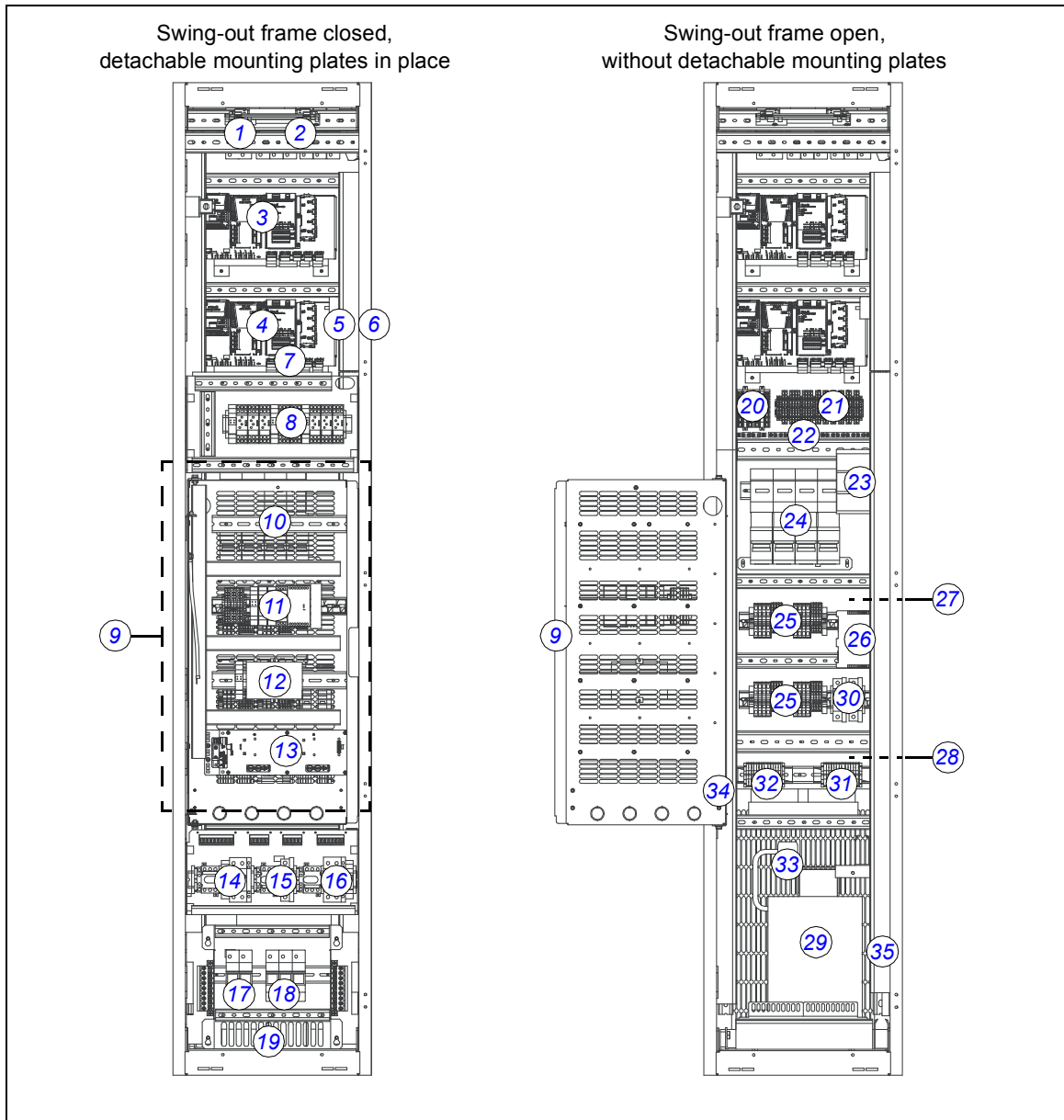


Cabinet layout example

A	Auxiliary control cubicle (ACU). See page 38.
1	Input cable lead-throughs, PE busbar
2	Input terminals
3	Charging resistors
4	Incoming cubicle cooling fans (behind the charging resistor mounting plate)
5	Main breaker [Q1]
6	Charging switch [Q3]
7	Auxiliary voltage switch [Q21]
8	Grounding/earthing switch [Q9.1] (option +F259)
9	Charging contactor (behind auxiliary equipment)
10	AC fuses
11	LCL filter modules
12	Supply modules
13	DC fuses (at the output of each supply module and at the input of each inverter module)
14	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).

Auxiliary control cubicle (ACU) layout

A layout example of the auxiliary control cubicle (ACU) is shown below.

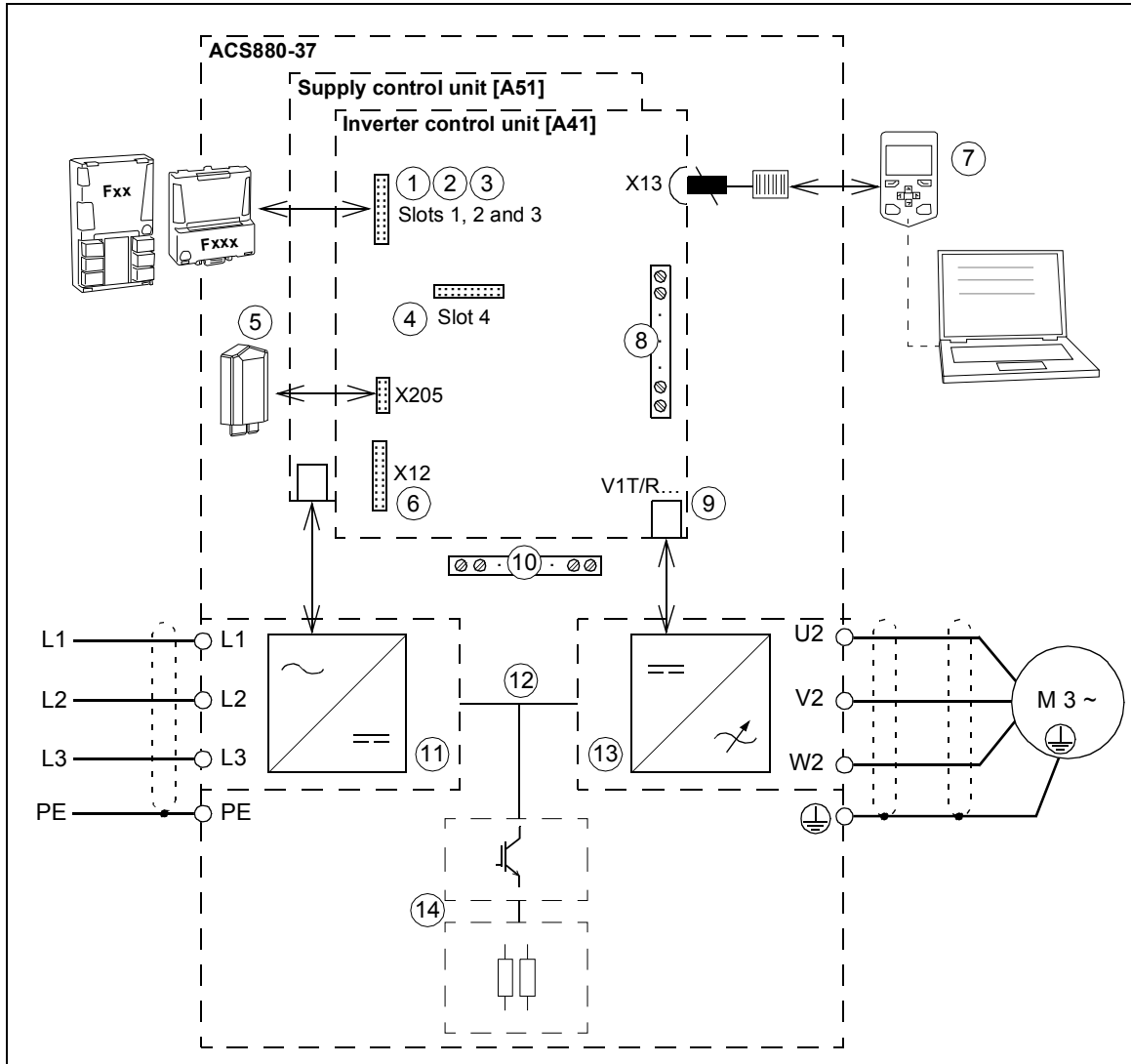


1	Fuse-disconnectors F101. On the primary of transformer T101 (item 27).	19	Lead-through for control cables
2	Fuse-disconnectors F27 for motor cooling fan outputs (options +M602...610)	20	Terminal block X68 for FSO-xx safety functions module (option +Q973)
3	Supply control unit [A51]. See chapter Control units of the drive (page 131)	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 131)	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	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	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). Also supplies the cooling fan of type BLCL-1x-x LCL filter modules.
11	Safety options (emergency stop, safe torque off)	29	Transformer T111. Supplies the cooling fans of LCL filter (BLCL-2x-x).
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). See item 4.	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 <ul style="list-style-type: none"> • 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	Option modules can be inserted into slots 1, 2, 3 and 4 as follows:	
2	Module type	Slots
3	Analog and digital I/O extension modules	1, 2, 3
4	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
	See section Type designation key , page 55	
	Additional modules can be installed on an optional FEA-03 extension adapter connected to the RDCO module on slot 4.	
5	Memory unit (see page 177)	
6	Connection for FSO-xx safety functions module	
7	See section Control panel (page 44)	
8	Terminal blocks on the inverter control unit. See page 101, and Control units of the drive (page 131). 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 Auxiliary control cubicle (ACU) layout (page 38). Wiring details are given starting on page 103.
11	Supply unit (consisting of one or more supply modules and LCL filters)
12	DC link
13	Inverter unit (consisting of one 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 <table border="1" style="width: 100%;"> <tr> <td>OFF</td> <td>Run enable signal off (starting the supply unit not allowed)</td> </tr> <tr> <td>ON</td> <td>Run enable signal on (starting the supply unit allowed). Close the main contactor/breaker.</td> </tr> </table>	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/breaker.
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/breaker.						
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.

*With frame 1×R8i + 1×R8i units, the main switch-disconnector [Q1.1] also switches the auxiliary voltage on and off.

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.

Note: Frame 1×R8i + 1×R8i units are not fitted with an auxiliary voltage switch. The auxiliary voltage is switched on and off by the main disconnecting device [Q1], and protected by fuse disconnectors F20.1...F20.3.

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

The grounding switch [Q9.1] (option +F259) connects the main AC power bus to the PE busbar.

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.

Charging switch [Q3]

The DC capacitors of the drive must be charged smoothly before the drive can be started. A charging circuit is provided to limit the charging current with resistors until the capacitors are charged and main contactor/breaker can be closed.

Charging is enabled using the charging switch [Q3] – the charging itself is controlled by the supply control unit. The switch must be kept closed during operation.

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 \geq 12.5 mm diameter *	against dripping (15° tilting) water
IP42	against ingress of solid foreign objects \geq 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 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 [Air outlet duct on the cabinet roof \(option +C130\)](#) on 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 page [48](#)) 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 whenever 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, +C200, +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 the dimension drawings on page [221](#).

■ Resistor braking (options +D150 and +D151)

See chapter [Resistor braking](#) on page 249.

■ EMC filters (option + E202)

See section [Type designation key](#) on page 55 and sections [Compliance with the European EMC Directive](#) on page 193 and [Compliance with EN 61800-3:2004](#) on page 196.

More information: *Technical Guide No. 3 – EMC Compliant Installation and Configuration for a Power Drive System* (3AFE61348280 [English])

■ Sine output 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

- [Powering the heating and lighting equipment \(options +G300, +G301 and +G313\)](#)
- 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

- [Supplying power for the auxiliary circuits](#) (page 90)
 - [Connecting a 230/115 V AC auxiliary voltage supply \(UPS, option +G307\)](#) (page 103)
 - 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

- [Supplying power for the auxiliary circuits](#) (page 90)
- [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)

The 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 (L1) input phase.

■ Additional wire markings (options +G340 and +G342)

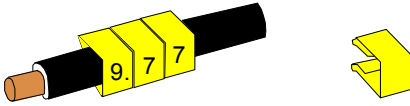

Standard wire markings

As standard, wires and terminals are marked as follows:

- Plug-in connectors of wire sets: Connector 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	<p>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.</p> 
+G342	<p>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.</p> <p>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.</p> 

■ 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 [0.12"] 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. See chapter [Dimensions](#) (page 201).

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 (0.4").

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) 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\(s\) \(options +L505, +2L505, +L513, +2L513\)](#) (page 104)
 - circuit diagrams delivered with the drive for the actual wiring.
-

■ Thermal protection with Pt100 relays (options +nL506 and +nL514)

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 105) or [Wiring the Pt100 relays \(option +nL514\)](#) (page 106)
 - Pt100 relay alarm and trip limit setting instructions (page 146)
 - 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 *ACS880-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.

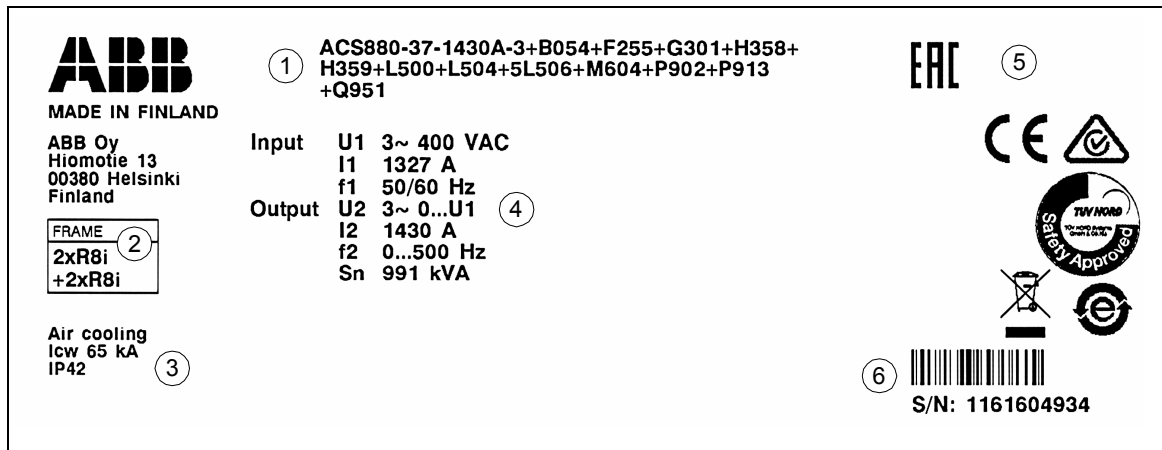
The statuses of both the starter switch and the fan contactor are wired to the terminal block.

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.



No.	Description
1	Type designation (see section Type designation key below)
2	Frame size
3	Short-time withstand current rating (see page 189); degree of protection; UL/CSA specifications
4	Ratings. See also sections Ratings (page 179) and Electrical power network specification (page 189).
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, ACS880-37-1210A-3). 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
37	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 (page 179)
Input voltage range	
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)	
Degree of protection	
B054	IP42 (UL Type 1)
B055	IP54 (UL Type 12)
Construction	
C121	Marine construction (page 46)
C128	Air inlet through bottom of cabinet (page 45)
C129	UL Listed (page 46)
C130	Channeled air outlet (page 45)
C134	CSA approved (page 46)
C164	Plinth height 100 mm (page 46)
C179	Plinth height 200 mm (page 46)
C180	Seismic design (page 46)
C199	Empty 400 mm wide cubicle on left
C200	Empty 600 mm wide cubicle on left
C201	Empty 800 mm wide cubicle on left
Resistor braking	
D150	Brake choppers (page 47)
D151	Brake resistors (page 47)
Filters	
E202	EMC filter for first environment TN (grounded) system, category C2 (page 47)
E206	Sine output filter (page 47)

CODE	DESCRIPTION
Line options	
F255	Main (air circuit) breaker (instead of line contactor)
F259	Grounding (earthing) switch
Cabinet equipment	
G300	Cabinet and module heating elements (external supply) (page 47)
G301	Cabinet lighting (page 47)
G307	Terminals for connecting external control voltage (230 V AC or 115 V AC, eg. UPS) (page 47)
G313	Output for motor space heater (external supply) (page 48)
G317	Supply connection by busbars (page 48)
G327	Ready light on door, white (page 48)
G328	Run light on door, green (page 48)
G329	Fault light on door, red (page 48)
G330	Halogen-free wiring and materials (page 48)
G334	V-meter with selector switch (page 48)
G335	A-meter in one phase (page 48)
G340	Additional wire markings (page 48)
G342	
Cabling	
H350	Bottom entry (page 49)
H351	Top entry (page 49)
H352	Bottom exit (page 49)
H353	Top exit (page 49)
H358	Cable conduit entry (US/UK) (page 49)
H359	Common motor terminal cubicle (page 49)
H366	Common output terminals (for inverter modules mounted in the same cubicle) (page 50)
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 (page 50)
L505	Thermal protection with PTC relays (1 or 2 pcs) (page 50)
L506	Thermal protection with Pt100 relays (2, 3, 5 or 8 pcs) (page 52)
L508	FDCO-02 optical DDCS communication adapter module
L513	ATEX-certified thermal protection with PTC relays (1 or 2 pcs) (page 50)

CODE	DESCRIPTION
L514	ATEX-certified thermal protection with Pt100 relays (3, 5 or 8 pcs) (page 52)
L515	FEA-03 I/O extension adapter
L516	FEN-21 resolver interface module
L517	FEN-01 TTL incremental encoder interface module
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 (page 50)
L537	FPTC-02 ATEX-certified thermistor protection module (page 50)
Starter for auxiliary motor fan (page 53)	
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
N7502	Control program for synchronous reluctance motors (SynRM)
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/contactors
Q952	Emergency stop (category 1) with safety relays, by opening the main breaker/contactors
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
Q971	ATEX-certified safe disconnection function
Q972	FSO-21 safety functions module
Q973	FSO-12 safety functions module

58 Operation principle and hardware description

CODE	DESCRIPTION
Q978	Emergency stop (configurable for category 0 or 1) with FSO-xx safety functions module, by opening the main breaker/contactactor
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. ¹⁾
- The ambient conditions of the drive meet the specifications. ¹⁾
- 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.
- 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.

¹⁾ The heat losses and ambient conditions are specified in chapter [Technical data](#).

Note: 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 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. See section [Type designation key](#) on page 55.



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.

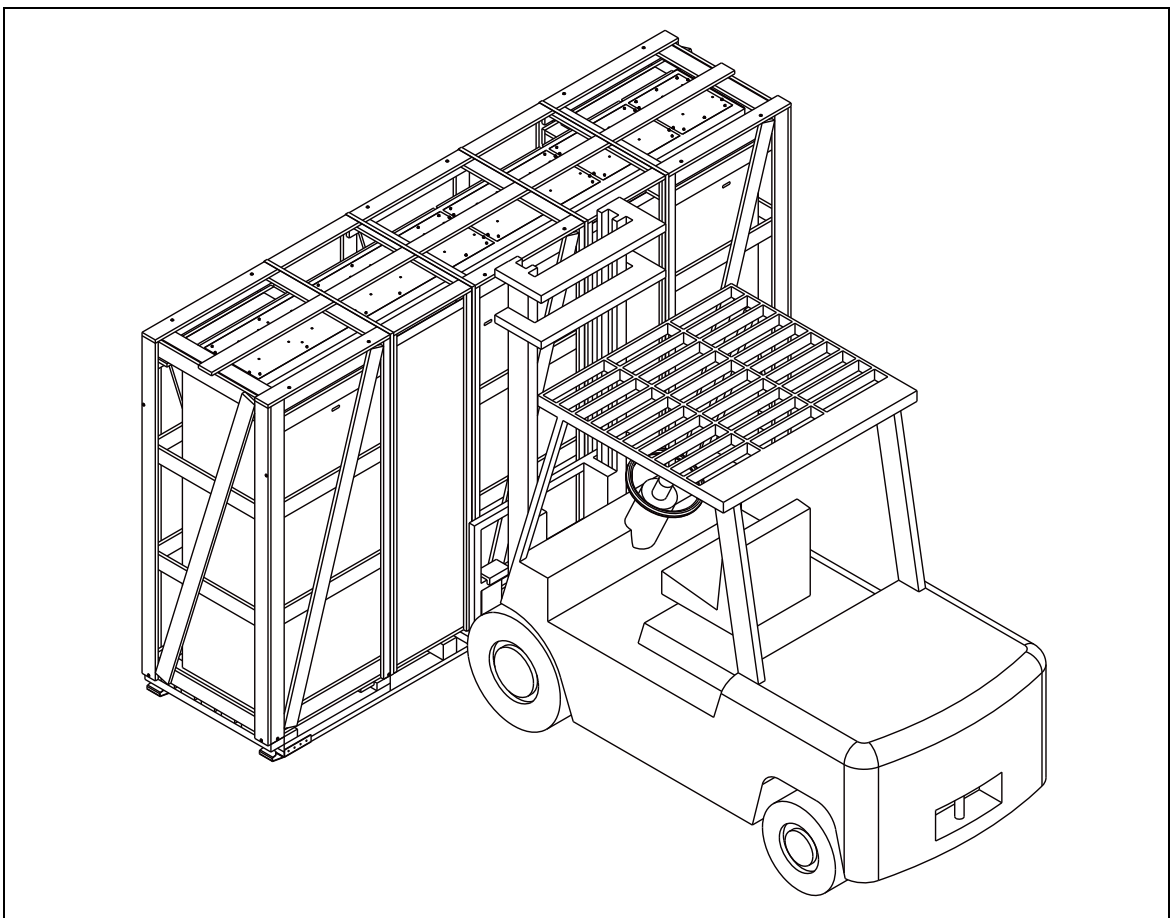
The drive cabinet is to be moved in the upright position.



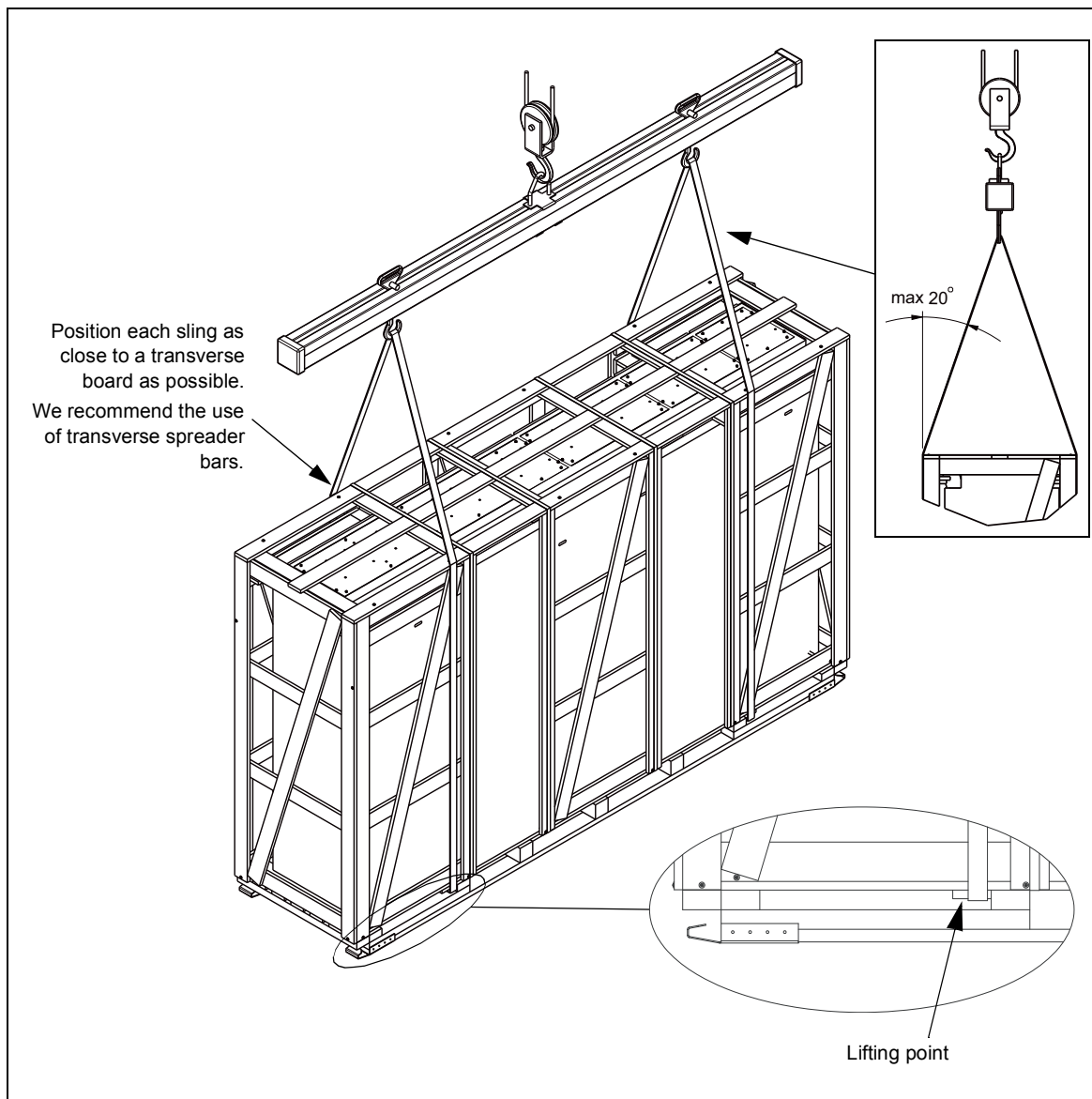
WARNING! Be careful when moving the cabinet. Avoid tilting the cabinet as its center of gravity is high.

■ Moving the drive in its packaging

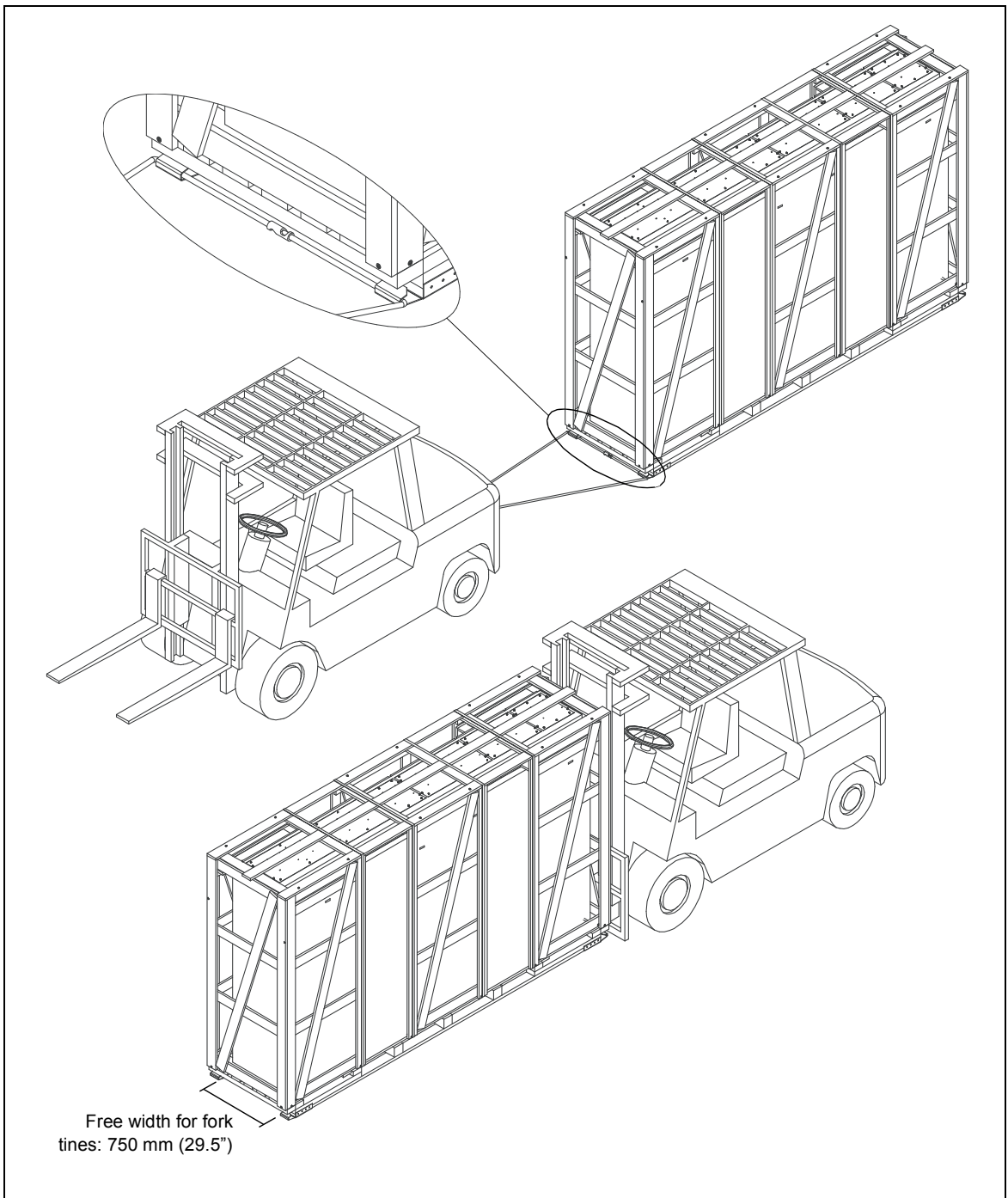
Lifting the crate with a forklift



Lifting the crate with a crane



Moving the crate with a forklift



■ Removing the transport package

Remove the transport package as follows:

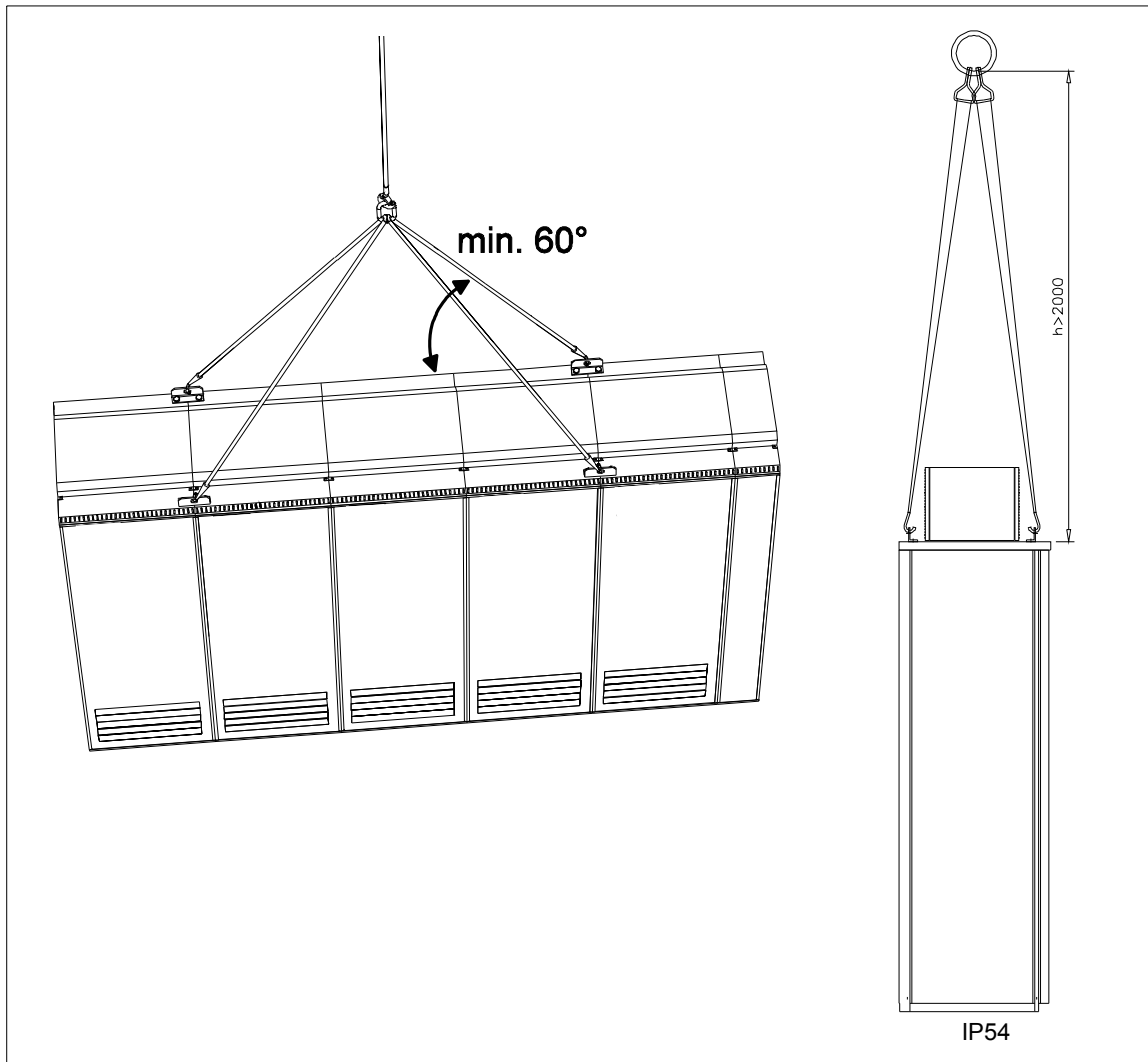
1. Undo the screws that attach the wooden parts of the transport crate together.
2. Remove the wooden parts.
3. Remove the clamps with which the drive cabinet is mounted onto the transport pallet by undoing the fastening screws.
4. Remove the plastic wrapping.

■ 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").

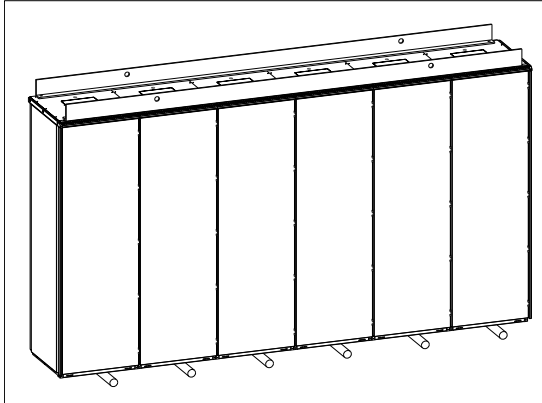


Moving the cabinet on rollers



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.

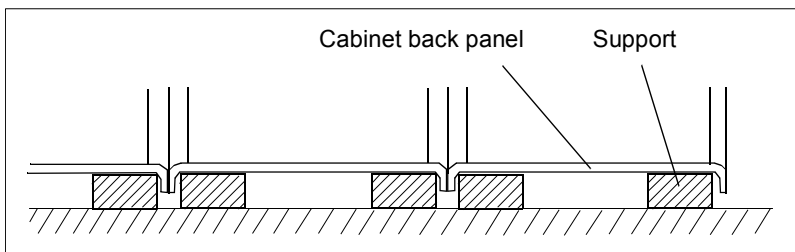


Moving the cabinet on its back



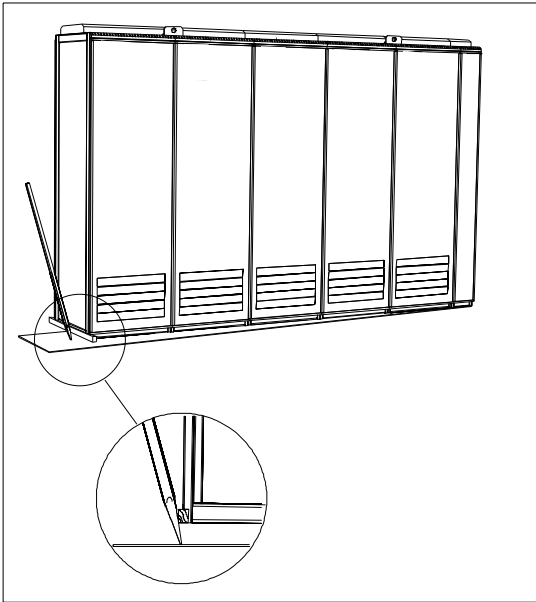
WARNING: Transportation of the cabinet on its back is only allowed with the BLCL (LCL filter) modules and sine filters (option +E206) removed from the cabinet.

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.

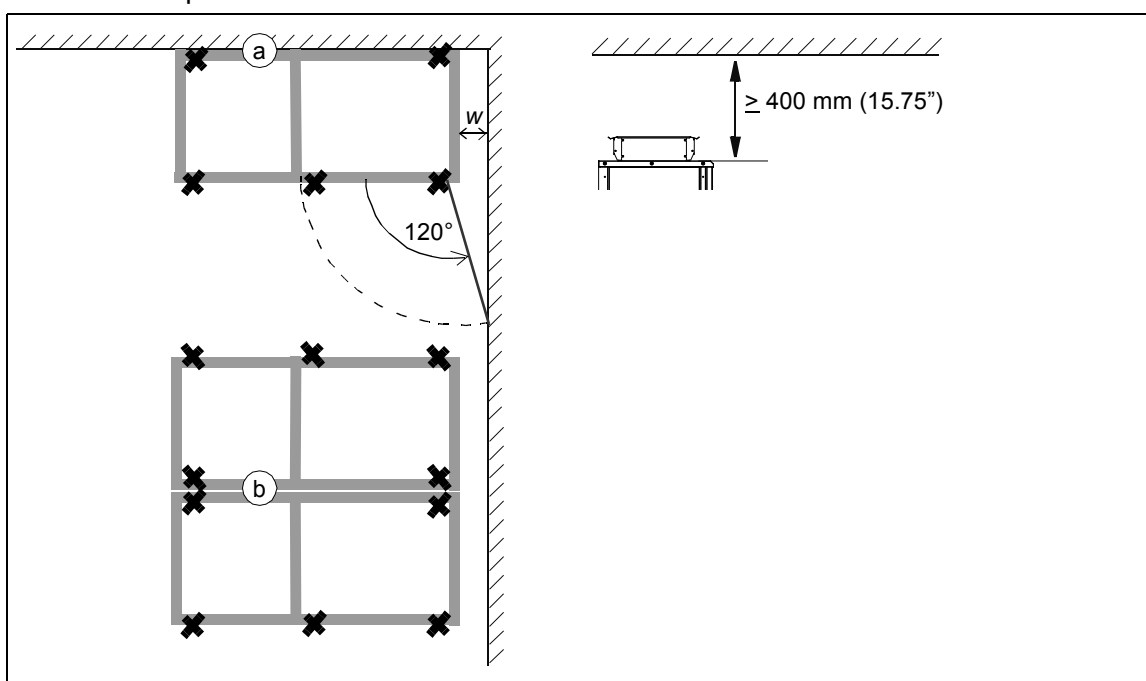


Fastening the cabinet to the floor and wall or roof

(non-marine units)

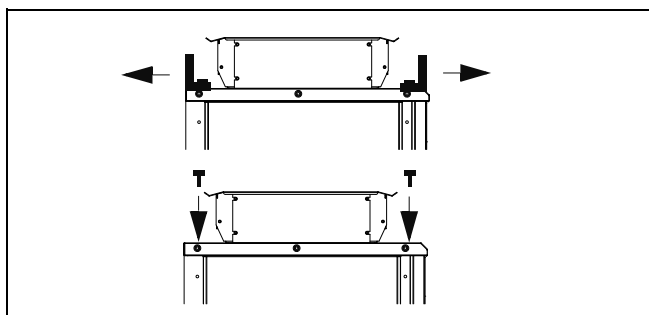
■ General rules

- 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.

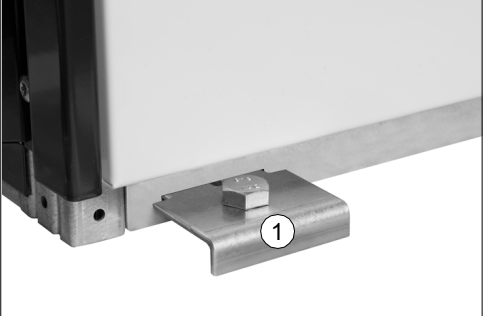
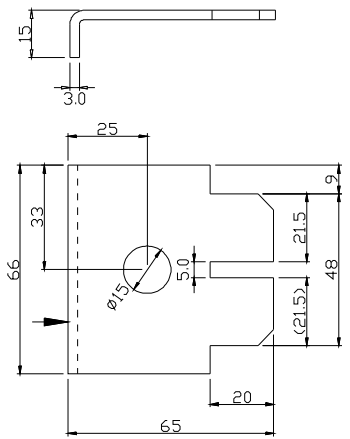
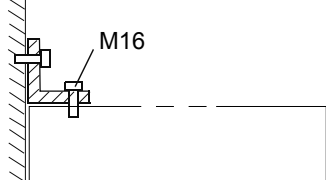
Note 2: If the lifting eyes are removed, refasten the bolts to retain the degree of protection of the cabinet.



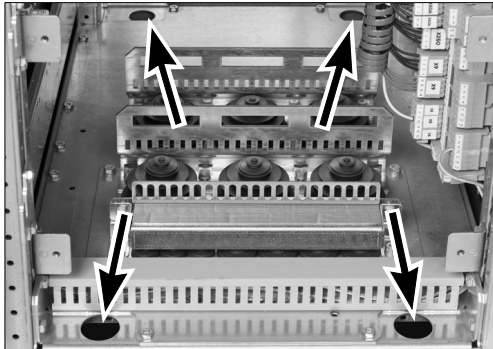
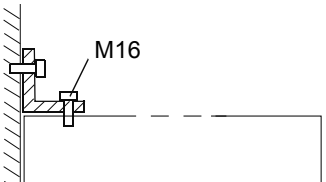
Fastening methods

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

  <p style="text-align: center;">Clamp dimensions</p>	<ol style="list-style-type: none"> 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. 
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Alternative 2 – Using the holes inside the cabinet

	<ol style="list-style-type: none"> 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. 
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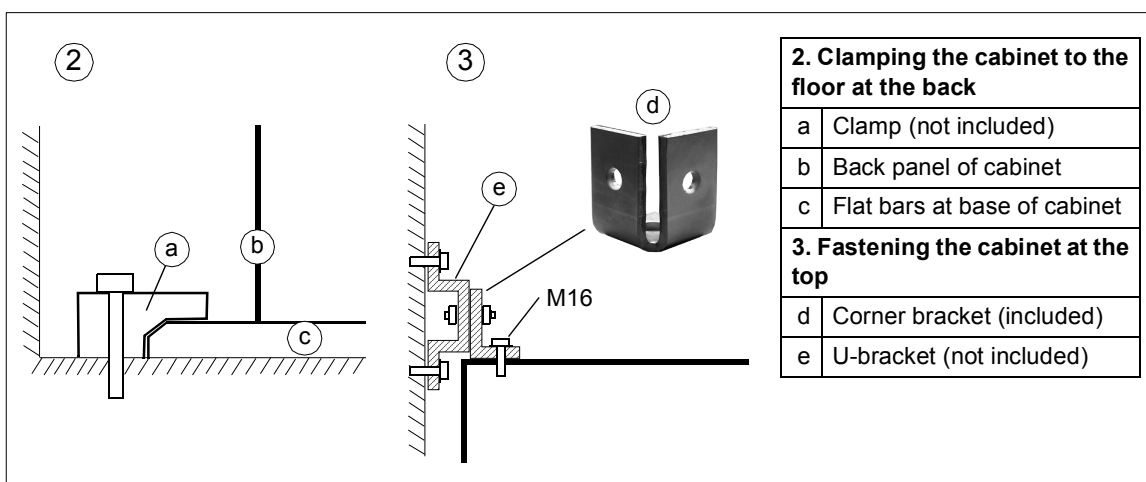
Fastening the cabinet to the floor and roof/wall (marine units, +C121)

Follow the general rules given in section [General rules](#) on page 67.

See the dimension drawing delivered with the drive for the locations of the fastening holes in the flat bars below the cabinet and for fastening points at the top of the cabinet.

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

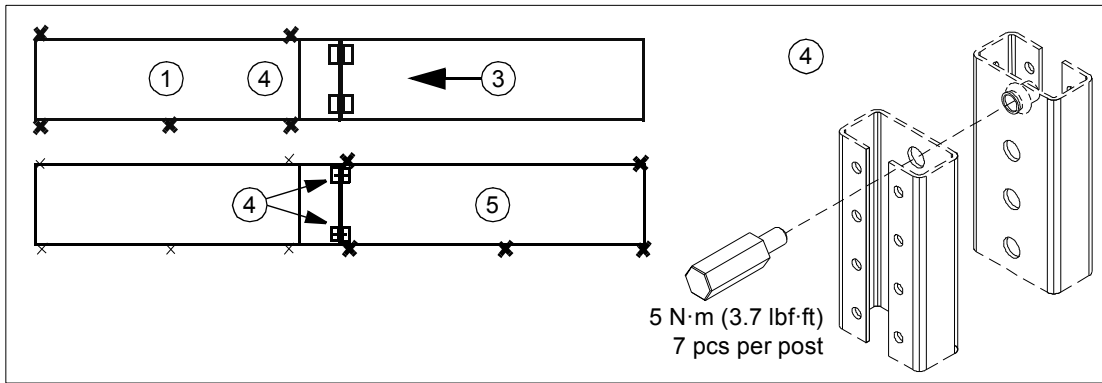
1. Bolt the unit to the floor through the flat bars at the base of the cabinet using M10 or M12 screws.
2. If there is not enough room behind the cabinet for installation, clamp (a) the rear edges of the flat bars (c) to the floor.
3. Remove the lifting lugs and bolt the corner brackets (d) to the lifting lug holes. Fasten the corner brackets to the rear wall and/or roof with suitable hardware such as U-brackets (e).



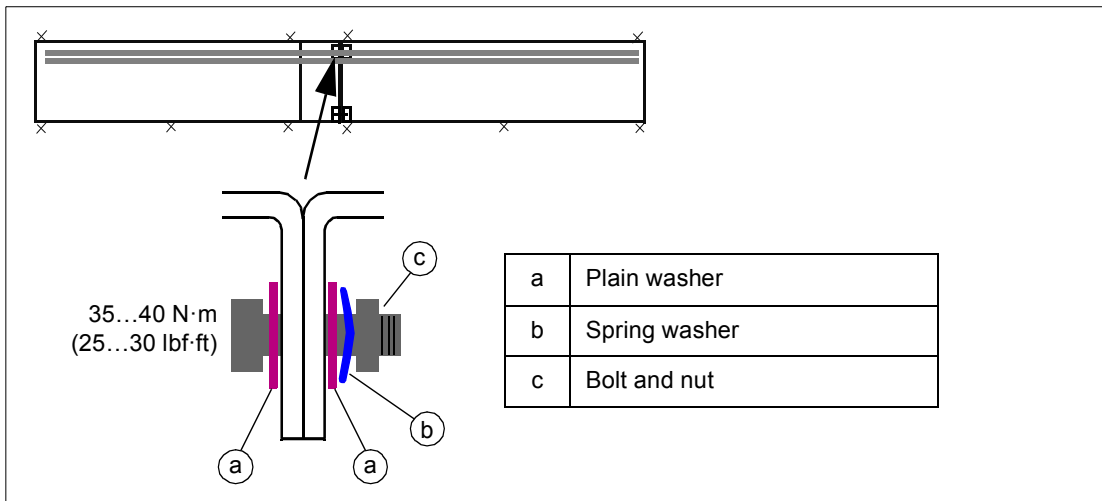
Joining shipping splits together

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.

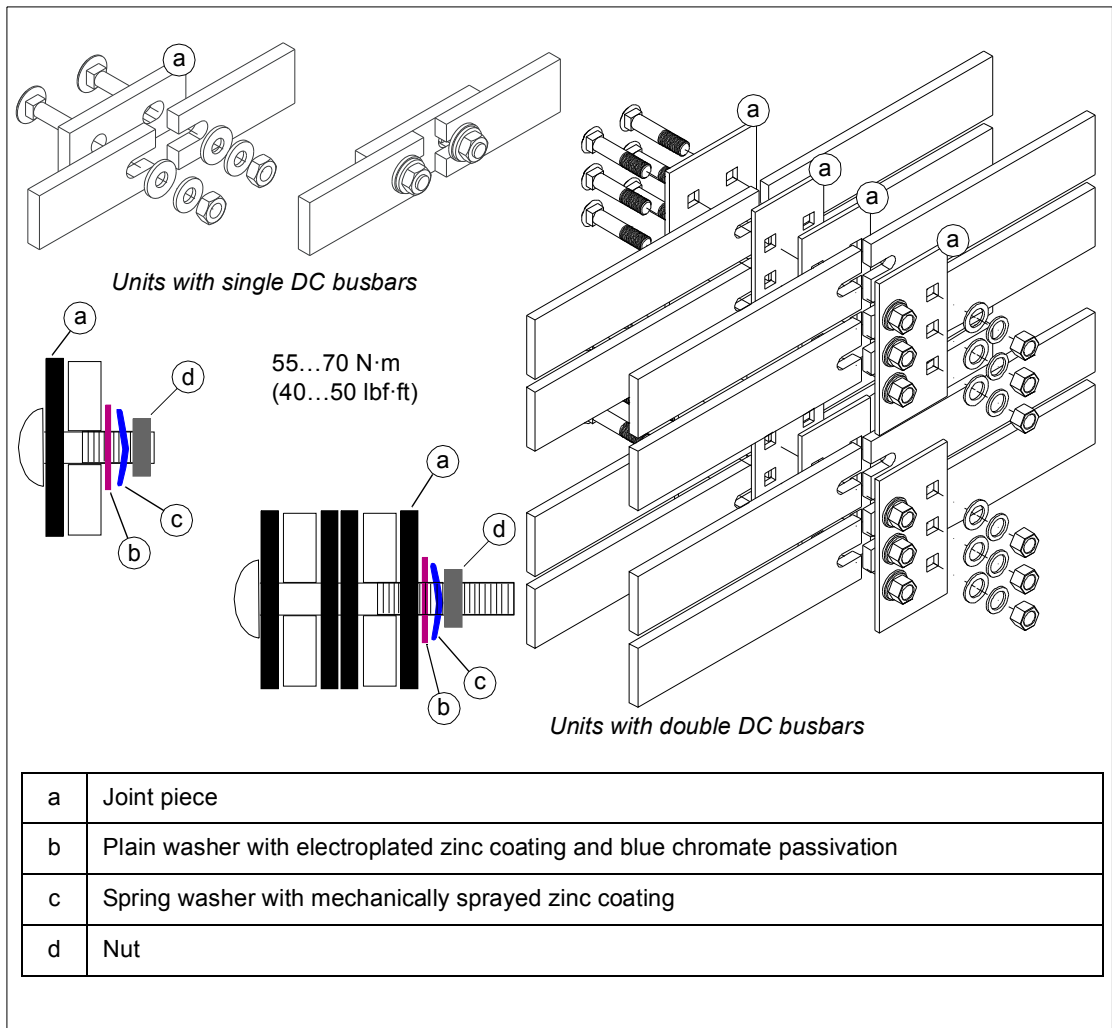
1. Fasten the first shipping split to the floor.
2. Remove any plates covering the rear post of the joining cubicle.
3. Align the two shipping splits.
4. Fasten the front and rear posts of the joining cubicle to the posts of the other shipping split with 14 screws (7 per post). Tighten the screws to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



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).



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.

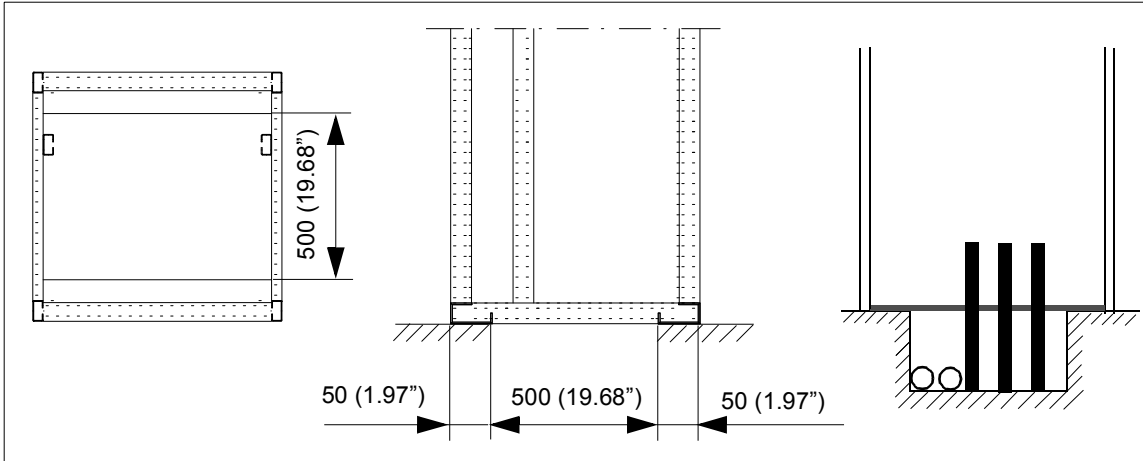


Miscellaneous

■ 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.

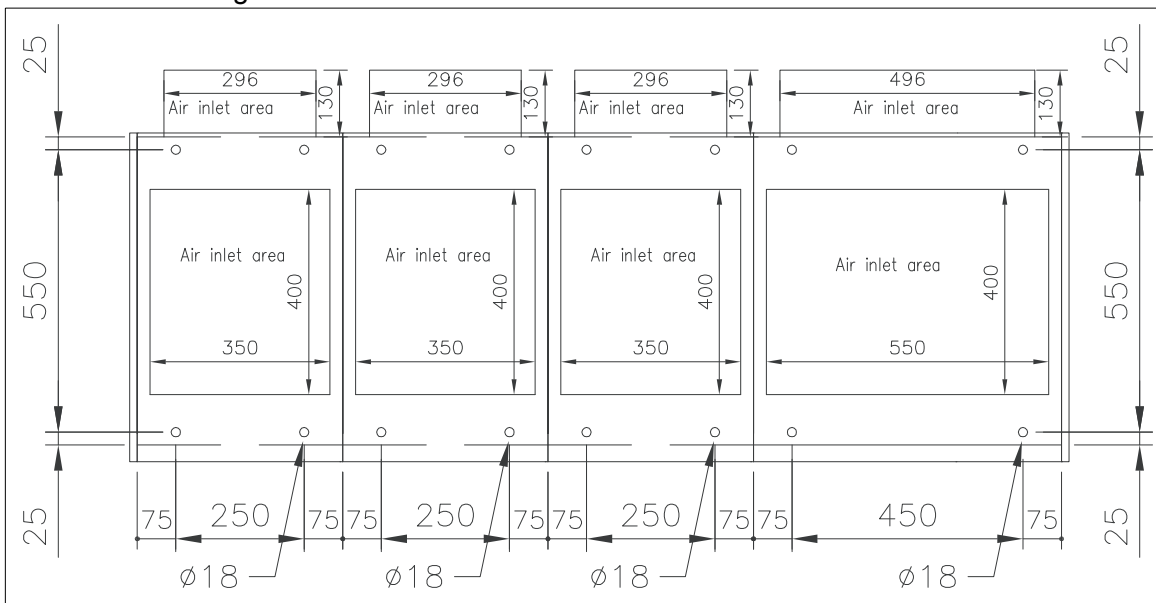
Prevent the cooling air flow from the cable duct to the cabinet by bottom plates. To ensure the degree of protection for the cabinet, use the original bottom plates delivered with the unit. With user-defined cable entries, take care of the degree of protection, fire protection and EMC compliance.



■ Air inlet through the bottom (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. The minimum air flow values are given in section [Cooling data, noise](#) (page 187).

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:

$$\Delta p_s = (1.5 \dots 2) \cdot p_d$$

where

$$p_d = 0.5 \cdot \rho \cdot v_m^2$$

$$v_m = q / A_c$$

p_d $\hat{=}$ Dynamic pressure

ρ $\hat{=}$ Air density (kg/m³)

v_m $\hat{=}$ Average air velocity in the exit duct(s) (m/s)

q $\hat{=}$ Rated air flow of the drive (m³/s)

A_c $\hat{=}$ Cross-sectional area of the exit duct(s) (m²)

Example

The cabinet has 3 exit openings of 315 mm diameter. The rated air flow of the cabinet is 4650 m³/h = 1.3 m³/s.

$$A_c = 3 \cdot 0.315^2 \cdot \pi / 4 = 0.234 \text{ m}^2$$

$$v_m = q / A_c = 1.3 / 0.234 = 5.5 \text{ m/s}$$

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

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

For more information: Contact ABB.



■ 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 coating 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.



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 a main disconnecting device. Depending on the size of the drive, the disconnecting device is a switch-disconnector or an air circuit breaker. The disconnecting device can be locked to the open position for installation and maintenance work.

Selecting the main contactor

Some drive types can be equipped with a line contactor. See [Overview circuit diagram of the drive](#) (page 31).

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 in chapter [Technical data](#) on basis of the AC line voltage and motor load. Use the DriveSize PC tool if you need to tune the selection more in detail.

Make sure that the motor withstands the maximum peak voltage in the motor terminals. See the [Requirements table](#) on page 77. For basics of protecting the motor insulation and bearings in drive systems, refer to section [Protecting the motor insulation and bearings](#) below.

Note:

- Consult the motor manufacturer before 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 following operation limits of the drive control program:
 - motor nominal voltage range $1/6 \dots 2 \cdot U_N$
 - motor nominal current range $1/6 \dots 2 \cdot I_N$ of the drive in DTC control and $0 \dots 2 \cdot I_N$ in scalar control. The control mode is selected by a drive parameter.

■ 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.

du/dt filters protect motor insulation system and reduce bearing currents. Common mode filters mainly reduce bearing currents. Insulated N-end (non-drive end) bearings protect the motor bearings.

■ Requirements table

The following table shows how to select the motor insulation system and when a du/dt filter, 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.

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

* manufactured before 1.1.1998

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

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

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

The abbreviations used in the table are defined below.

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

Additional requirements for explosion-safe (EX) motors

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

Additional requirements for 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 ABB random-wound motor series (for example, M3AA, M3AP and M3BP).

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

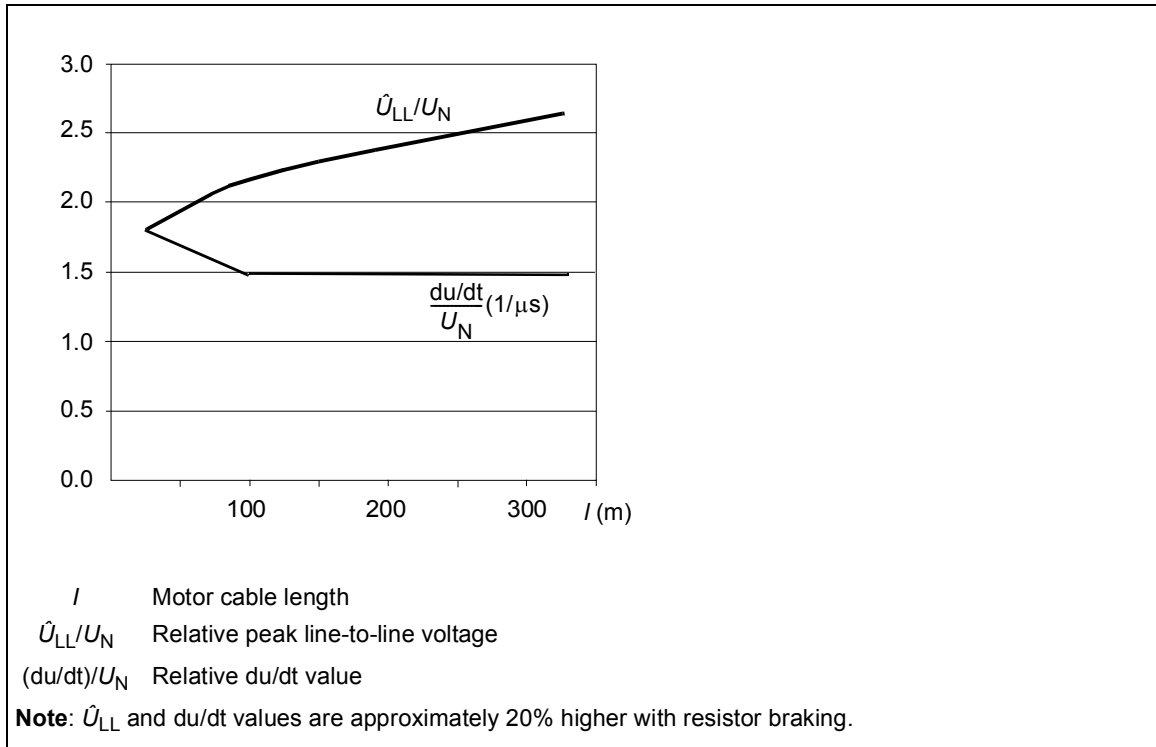
Additional requirements for non-ABB high-output and IP23 motors

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, consult the motor manufacturer.

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 $t = 0.8 \times \hat{U}_{LL}/(du/dt)$.



Additional note for sine filters

A sine filter (option +E206) also protects the motor insulation system. The peak phase-to-phase voltage with a sine filter is approximately $1.5 \times U_N$.

Selecting the power cables

■ General rules

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

- Select a cable capable of carrying the drive nominal current. See section [Ratings](#) (page 179) for the rated currents, and section [Typical cable sizes](#) (page 82).
- Select a cable rated for at least 70 °C maximum permissible temperature of conductor in continuous use. For US, see [Additional US requirements](#), page 85.
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. For 690 V AC rated equipment, the rated voltage between the conductors of the cable should be at least 1 kV.

Use symmetrical shielded motor cable (see page 84). Ground motor cable shields 360° at both ends. Keep the motor cable and its PE pigtail (twisted shield) as short as possible to reduce high-frequency electromagnetic emissions.

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

A four-conductor system is allowed for input cabling with restrictions, but shielded symmetrical cable is recommended (see page 84).

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. The table below 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.

Cross-sectional area of the phase conductors S (mm ²)	Minimum cross-sectional area of the corresponding protective conductor S_p (mm ²)
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S \leq 400$	$S/2$

Typical cable sizes

Input (supply) cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for nominal current. For drawings of the terminals, see chapter *Dimensions* (page 201).

Drive type ACS880-37-...	IEC ¹⁾		US ²⁾	
	Al cable size	Cu cable size	Cu cable size	Ground cable size
	mm ²	mm ²	AWG/kcmil	AWG/kcmil
U_N = 400 V				
0450A-3	2 × (3 × 240 + 72 Cu)	2 × (3 × 150 + 70)	2 × 400	1/0
0620A-3	3 × (3 × 185 + 57 Cu)	2 × (3 × 240 + 120)	3 × 350	2/0
0870A-3	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	4 × 350	4/0
1110A-3	4 × (3 × 300 + 88 Cu)	3 × (3 × 300 + 150)	5 × 400	4/0
1210A-3	5 × (3 × 240 + 72 Cu)	4 × (3 × 240 + 120)	6 × 300	250
1430A-3	6 × (3 × 240 + 72 Cu)	4 × (3 × 300 + 150)	5 × 600	350
1700A-3	7 × (3 × 240 + 72 Cu)	6 × (3 × 240 + 120)	8 × 350	350
2060A-3	9 × (3 × 240 + 72 Cu)	7 × (3 × 240 + 120)	9 × 400	250
2530A-3	9 × (3 × 300 + 88 Cu)	8 × (3 × 240 + 120)	9 × 600	250
U_N = 500 V				
0420A-5	2 × (3 × 185 + 57 Cu)	2 × (3 × 150 + 70)	2 × 350	1/0
0570A-5	3 × (3 × 185 + 57 Cu)	3 × (3 × 120 + 70)	3 × 300	2/0
0780A-5	4 × (3 × 185 + 57 Cu)	3 × (3 × 185 + 95)	3 × 500	4/0
1010A-5	5 × (3 × 185 + 57 Cu)	4 × (3 × 185 + 95)	4 × 500	4/0
1110A-5	4 × (3 × 300 + 88 Cu)	3 × (3 × 300 + 150)	5 × 400	4/0
1530A-5	7 × (3 × 240 + 72 Cu)	5 × (3 × 240 + 120)	6 × 500	350
1980A-5	8 × (3 × 240 + 72 Cu)	6 × (3 × 300 + 150)	10 × 300	250
2270A-5	8 × (3 × 300 + 88 Cu)	7 × (3 × 240 + 120)	10 × 400	250
U_N = 690 V				
0320A-7	2 × (3 × 150 + 41 Cu)	2 × (3 × 95 + 50)	2 × 4/0	2
0390A-7	2 × (3 × 185 + 57 Cu)	2 × (3 × 120 + 70)	2 × 300	1/0
0580A-7	3 × (3 × 185 + 57 Cu)	3 × (3 × 120 + 70)	3 × 300	2/0
0660A-7	3 × (3 × 240 + 72 Cu)	3 × (3 × 150 + 70)	3 × 350	2/0
0770A-7	4 × (3 × 185 + 57 Cu)	3 × (3 × 185 + 95)	3 × 500	4/0
0950A-7	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	5 × 300	4/0
1130A-7	4 × (3 × 300 + 88 Cu)	5 × (3 × 150 + 70)	5 × 400	4/0
1450A-7	6 × (3 × 240 + 72 Cu)	5 × (3 × 240 + 120)	5 × 600	350 / 4/0
1680A-7	7 × (3 × 240 + 72 Cu)	6 × (3 × 240 + 120)	8 × 350	350 / 4/0
1950A-7	8 × (3 × 240 + 72 Cu)	8 × (3 × 185 + 95)	9 × 350	250
2230A-7	9 × (3 × 240 + 72 Cu)	7 × (3 × 240 + 120)	10 × 400	250
2770A-7	10 × (3 × 300 + 88 Cu)	9 × (3 × 240 + 120)	10 × 600	250
3310A-7	12 × (3 × 300 + 88 Cu)	9 × (3 × 300 + 150)	12 × 600	250

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 (motor) cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for nominal current. For drawings of the terminals, see chapter *Dimensions* (page 201).

Note: With no options selected, each inverter module of the drive is to be individually cabled to the motor. See also sections *Common motor terminal cubicle (option +H359)* (page 49) and *Common output terminal (option +H366)* (page 50).

Drive type ACS880-37-...	IEC ¹⁾		US ²⁾
	Al cable size	Cu cable size	Cu cable size
	mm ²	mm ²	AWG/kcmil
$U_N = 400\text{ V}$			
0450A-3	2 × (3 × 240 + 72 Cu)	2 × (3 × 185 + 95)	2 × 400
0620A-3	4 × (3 × 150 + 41 Cu)	3 × (3 × 150 + 70)	3 × 350
0870A-3	4 × (3 × 240 + 72 Cu)	3 × (3 × 240 + 120)	4 × 350
1110A-3	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 + 120)	4 × 600
1210A-3	6 × (3 × 240 + 72 Cu)	6 × (3 × 150 + 70)	6 × 300
1430A-3	8 × (3 × 185 + 57 Cu)	6 × (3 × 185 + 95)	8 × 250
1700A-3	8 × (3 × 240 + 72 Cu)	6 × (3 × 240 + 120)	8 × 350
2060A-3	9 × (3 × 240 + 72 Cu)	6 × (3 × 300 + 150)	9 × 400
2530A-3	12 × (3 × 240 + 72 Cu)	9 × (3 × 240 + 120)	9 × 600
$U_N = 500\text{ V}$			
0420A-5	2 × (3 × 240 + 72 Cu)	2 × (3 × 150 + 70)	2 × 350
0570A-5	3 × (3 × 185 + 57 Cu)	2 × (3 × 240 + 120)	3 × 300
0780A-5	4 × (3 × 185 + 57 Cu)	3 × (3 × 150 + 70)	3 × 500
1010A-5	6 × (3 × 150 + 41 Cu)	4 × (3 × 185 + 95)	4 × 500
1110A-5	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 + 120)	6 × 300
1530A-5	8 × (3 × 185 + 57 Cu)	6 × (3 × 185 + 95)	6 × 500
1980A-5	9 × (3 × 240 + 72 Cu)	6 × (3 × 300 + 150)	9 × 400
2270A-5	12 × (3 × 185 + 57 Cu)	9 × (3 × 185 + 95)	9 × 500
$U_N = 690\text{ V}$			
0320A-7	2 × (3 × 150 + 41 Cu)	2 × (3 × 95 + 50)	2 × 4/0
0390A-7	2 × (3 × 185 + 57 Cu)	2 × (3 × 150 + 70)	2 × 300
0580A-7	3 × (3 × 185 + 57 Cu)	2 × (3 × 240 + 120)	3 × 300
0660A-7	4 × (3 × 150 + 41 Cu)	4 × (3 × 120 + 70)	2 × 700
0770A-7	4 × (3 × 185 + 57 Cu)	4 × (3 × 120 + 70)	4 × 300
0950A-7	6 × (3 × 150 + 41 Cu)	4 × (3 × 185 + 95)	4 × 400
1130A-7	6 × (3 × 185 + 57 Cu)	4 × (3 × 240 + 120)	4 × 600
1450A-7	9 × (3 × 150 + 41 Cu)	6 × (3 × 185 + 95)	6 × 500
1680A-7	9 × (3 × 185 + 57 Cu)	6 × (3 × 240 + 120)	6 × 600
1950A-7	9 × (3 × 240 + 72 Cu)	6 × (3 × 300 + 150)	8 × 500
2230A-7	12 × (3 × 185 + 57 Cu)	9 × (3 × 185 + 95)	8 × 600
2770A-7	12 × (3 × 240 + 72 Cu)	12 × (3 × 185 + 95)	10 × 600
3310A-7	12 × (3 × 300 + 88 Cu) XLPE insulated only	12 × (3 × 240 + 120)	12 × 600

1. The cable sizing is based on max. 9 cables laid on a cable ladder side by side, three ladder type trays one

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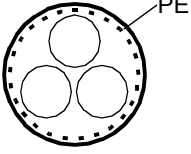
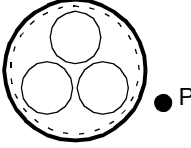
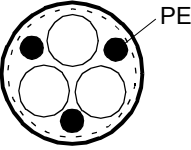
on top of the other, ambient temperature 30 °C, PVC insulation, surface temperature 70 °C (IEC/EN 60204-1 and IEC 60364-5-52/2001). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive.

- 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.

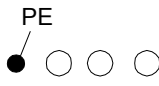

Alternative power cable types

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


Recommended power cable types

	<p>Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. The shield must meet the requirements of IEC 61800-5-1, see page 81. Check with local / state / country electrical codes for allowance.</p>
	<p>Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. A separate PE conductor is required if the shield does not meet the requirements of IEC 61800-5-1, see page 81.</p>
	<p>Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must meet the requirements of IEC 61800-5-1.</p>

Power cable types for limited use

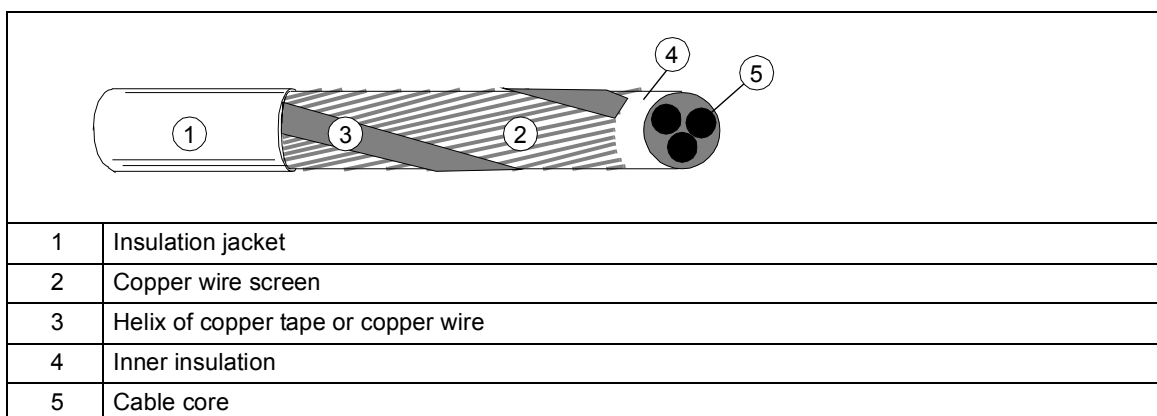
	<p>A four-conductor system consisting of unshielded single-core phase conductors and a protective conductor on a cable tray) is not allowed for input cabling on IT (ungrounded) networks.</p> <p> WARNING! Do not use unshielded single-core cables with drives on IT (ungrounded) networks. A dangerous voltage can become present on the non-conductive outer sheath of the cable. This can cause injury or death.</p> <p>A four-conductor system consisting of separate phase conductors (regardless of the presence of shielding) and a protective conductor on a cable tray is not allowed for motor cabling.</p>
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Not allowed power cable types

	<p>Symmetrical shielded cable with individual shields for each phase conductor is not allowed in any cable size for input and motor cabling.</p>
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■ Motor cable shield

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



■ 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 braking system

See chapter [Resistor braking](#).

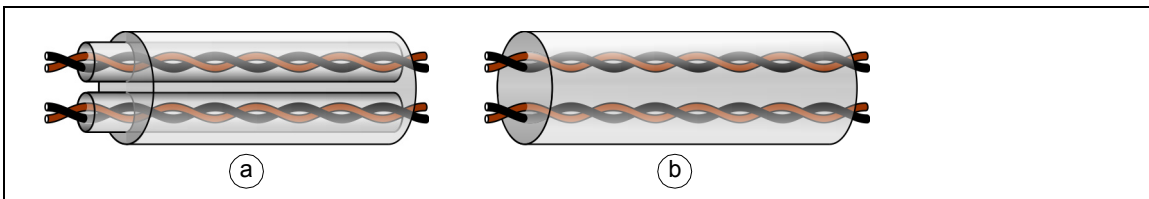
Selecting the control cables

■ 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.

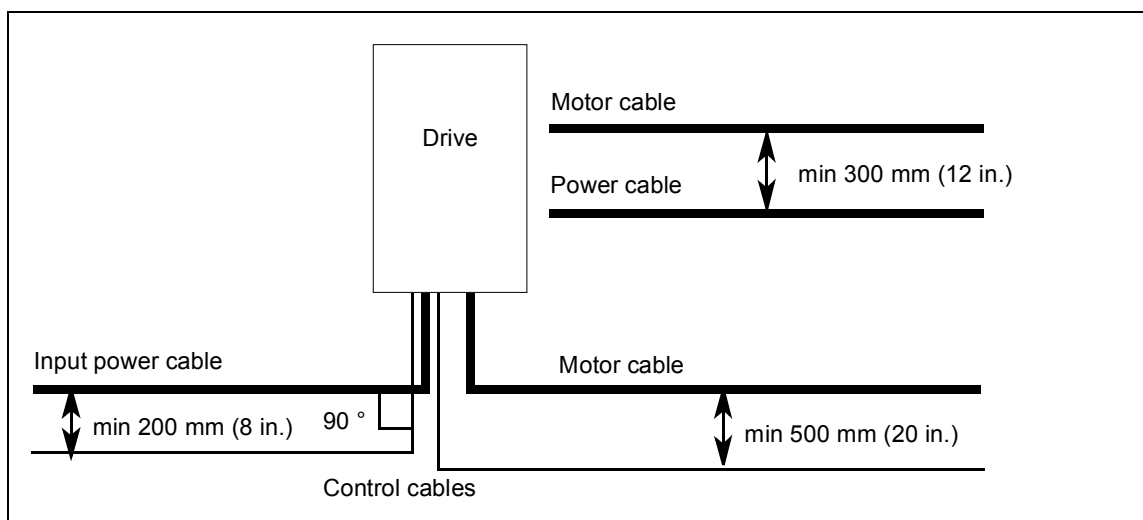
Routing the cables

Route the motor cable away from other cable routes. Motor cables of several drives 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.

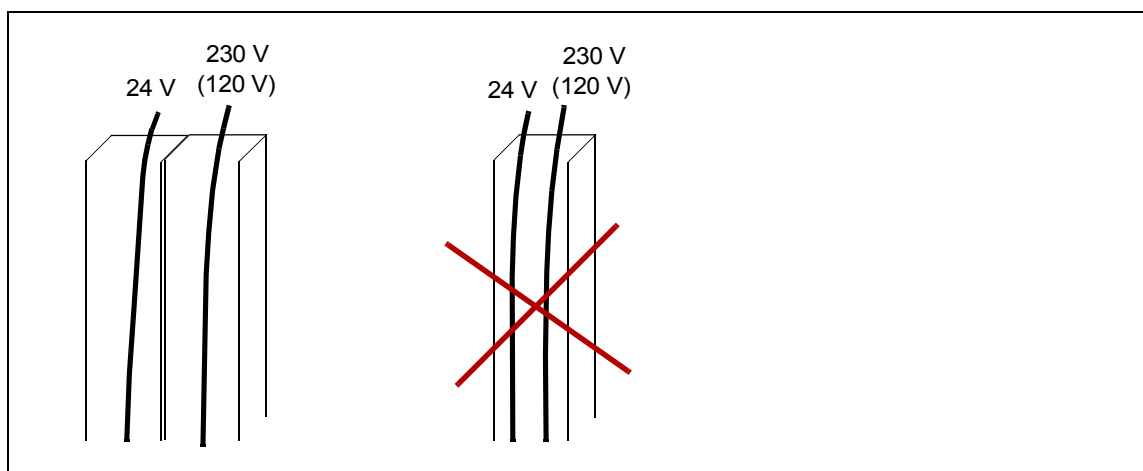
The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

A diagram of the cable routing is shown below.



■ **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 the 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. Size the input cable fuses according to the instructions given in chapter [Technical data](#). 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

The drive can be equipped 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 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 [The Safe torque off function](#) (page 237).

Implementing the Prevention of unexpected start-up function

The drive can be equipped with a Prevention of unexpected start-up (POUS) function either with an FSO-xx safety functions module (option +Q950) or with a safety relay (option +Q957). 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 connectors of the module are pre-wired to terminal block X68. 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.

■ Declaration of Conformity

See page [194](#).

Implementing the Power-loss ride-through function

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.



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.

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 buffer module (see page [38](#)) 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.

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)
 - +G307: Connection for an external uninterruptible power supply (230 or 115 V AC; external fuse: 16 A) to the control unit and control devices when the drive is not powered
 - +G313: Power supply connection (230 V AC; external fuse 16 A) 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

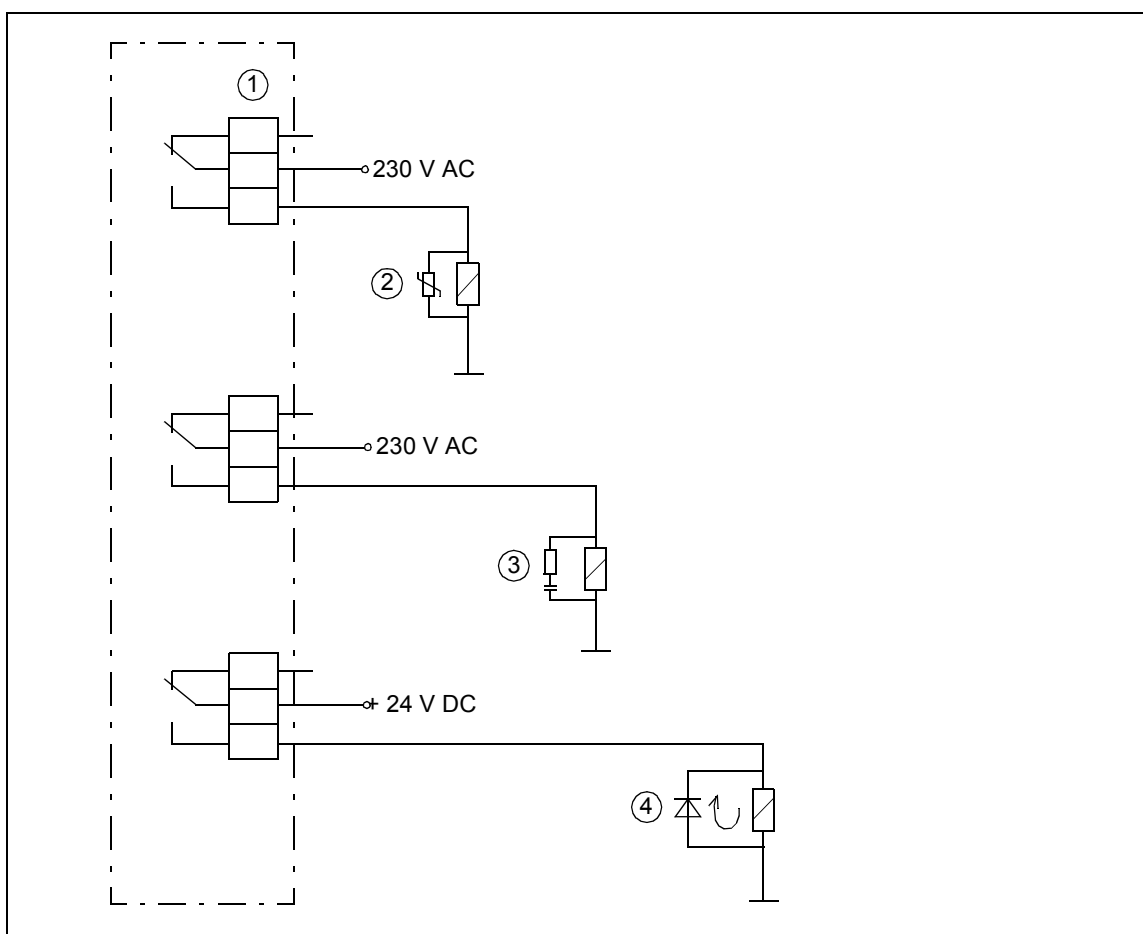
We recommend to install a safety switch between the permanent magnet synchronous motor and the drive output. The switch is needed to isolate the motor during any maintenance work on the drive.

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 137)
- section *DI6 as a PTC sensor input* (page 136)
- *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	-	-	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

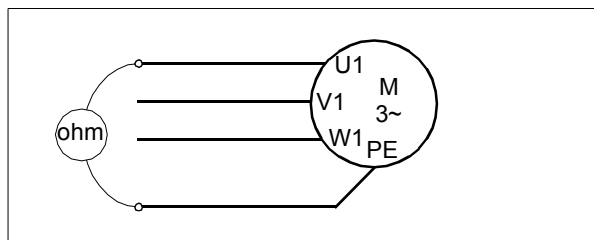
Do not make any voltage tolerance or insulation resistance tests on any part of the drive as testing can damage the drive. Every drive has been tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the drive which cut down the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

■ Input cable

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

■ Motor and motor cable

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 [Connection procedure](#) (page 256).

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

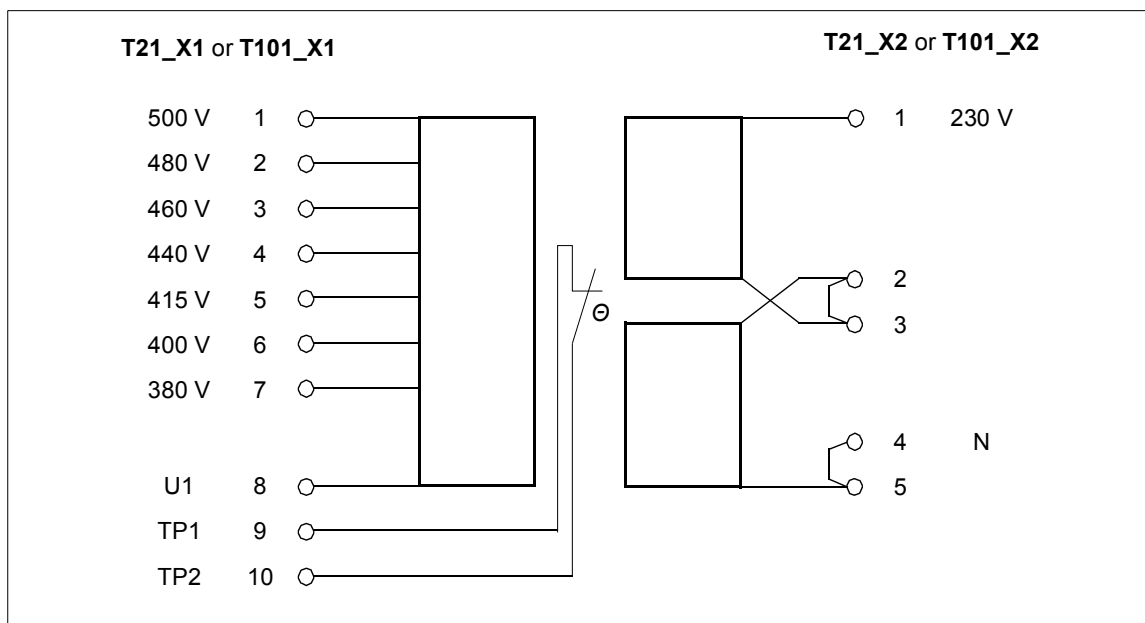
A multilingual device label sticker is delivered with the drive. Attach the stickers in the appropriate language on the English texts; see section [Door switches and lights](#) (page 42).

Checking the settings of transformers T21, T101 and T111

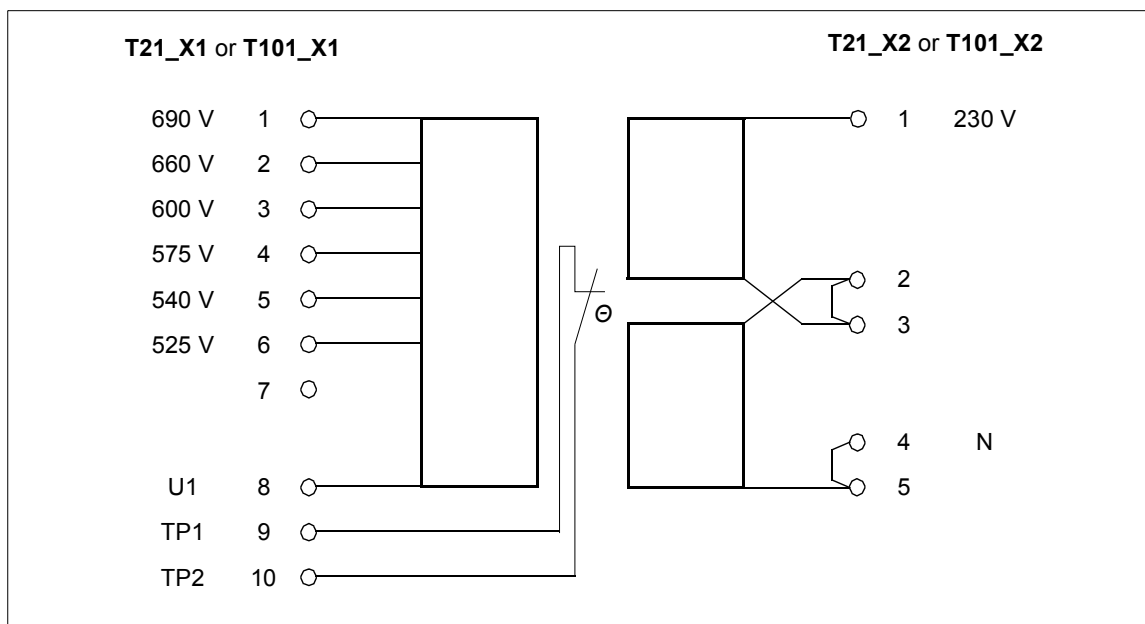
Check the tap settings of all auxiliary voltage transformers. Transformer T21 is standard equipment; T101 and T111 are present depending on drive configuration.

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 [Auxiliary control cubicle \(ACU\) layout](#) (page 38).

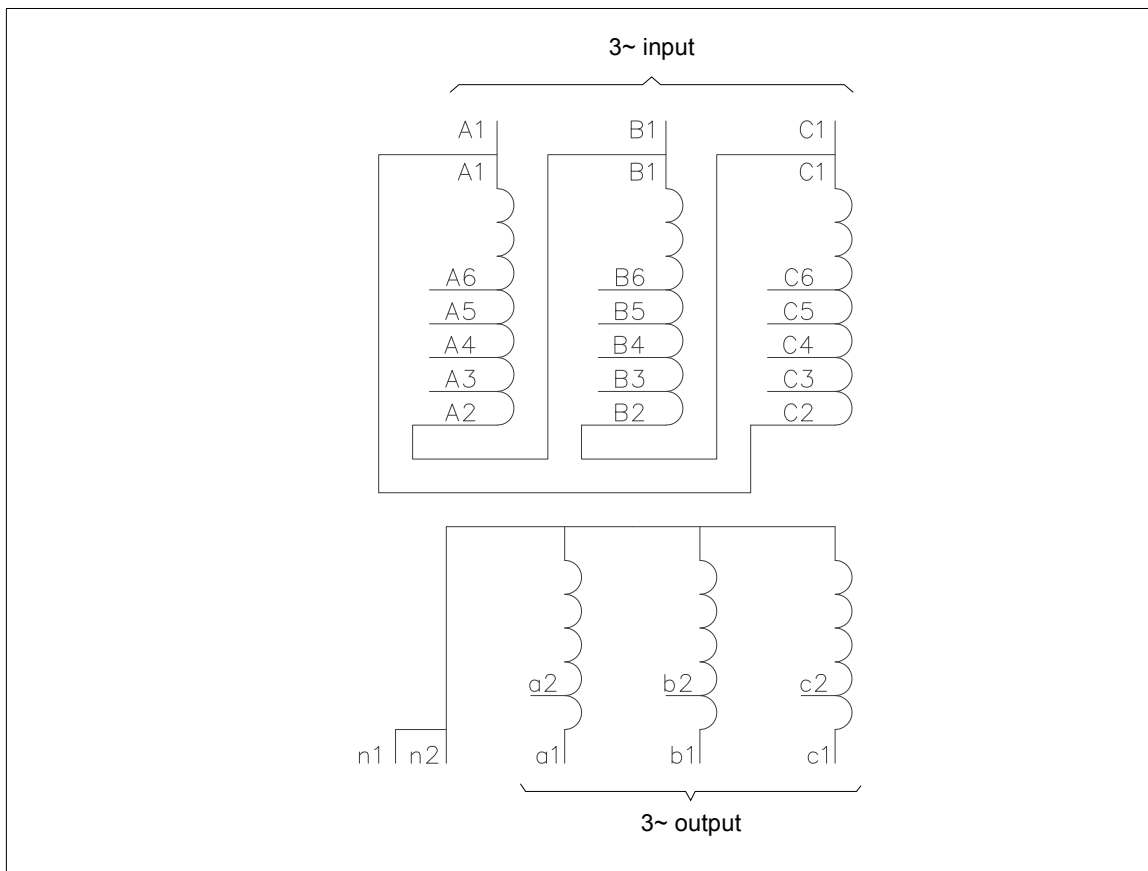
■ **T21 and T101 tap settings (400...500 V units)**



■ **T21 and T101 tap settings (690 V units)**



T111 tap settings



Supply voltage	3~ input			3~ output		
	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 131) 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



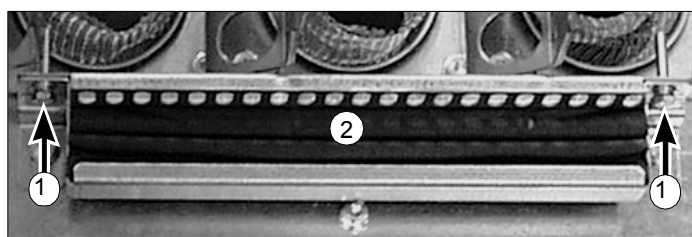
WARNING! Obey the instructions in chapter *Safety instructions*. If you ignore them, injury or death, or damage to the equipment can occur.

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 101).
4. Connect the control cables as described starting on page 101.

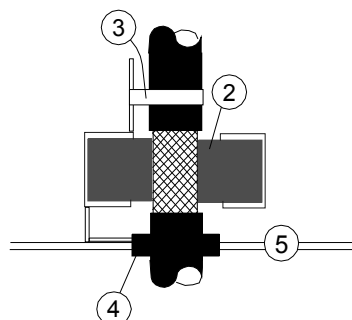
Grounding the outer shields of the control cables at the cabinet lead-through

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.



View from above



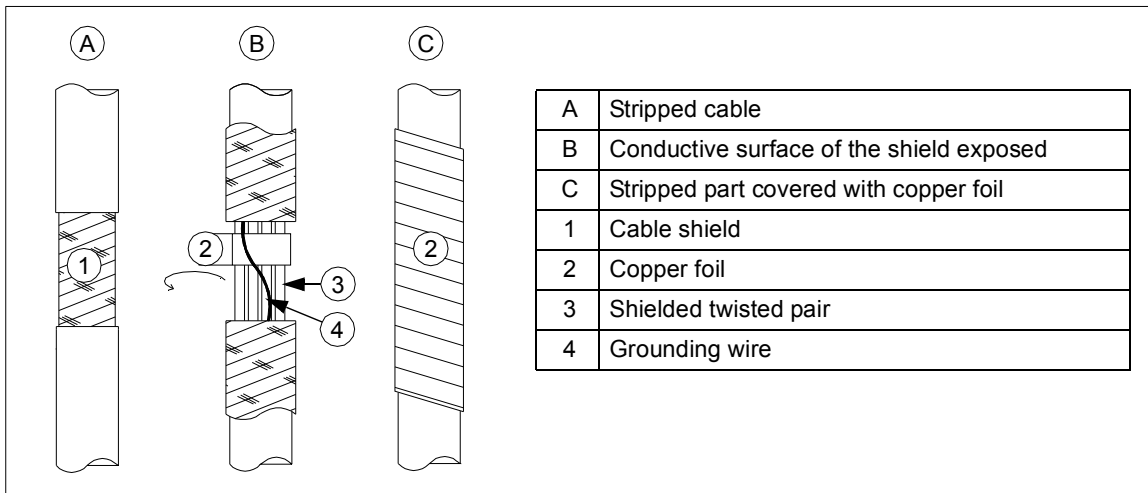
1	Tightening screw
2	EMI conductive cushion
3	Strain relief
4	Grommet
5	Lead-through plate



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.



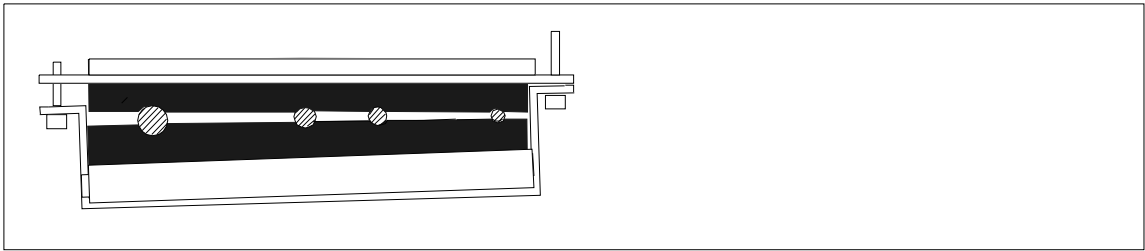
Note for top entry of cables: When each cable has its own rubber grommet, sufficient IP and EMC protection can be achieved. However, if very many control cables come to one cabinet, plan the installation beforehand as follows:

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 (see page [131](#)) of the control unit or terminal block X504 (option +L504).

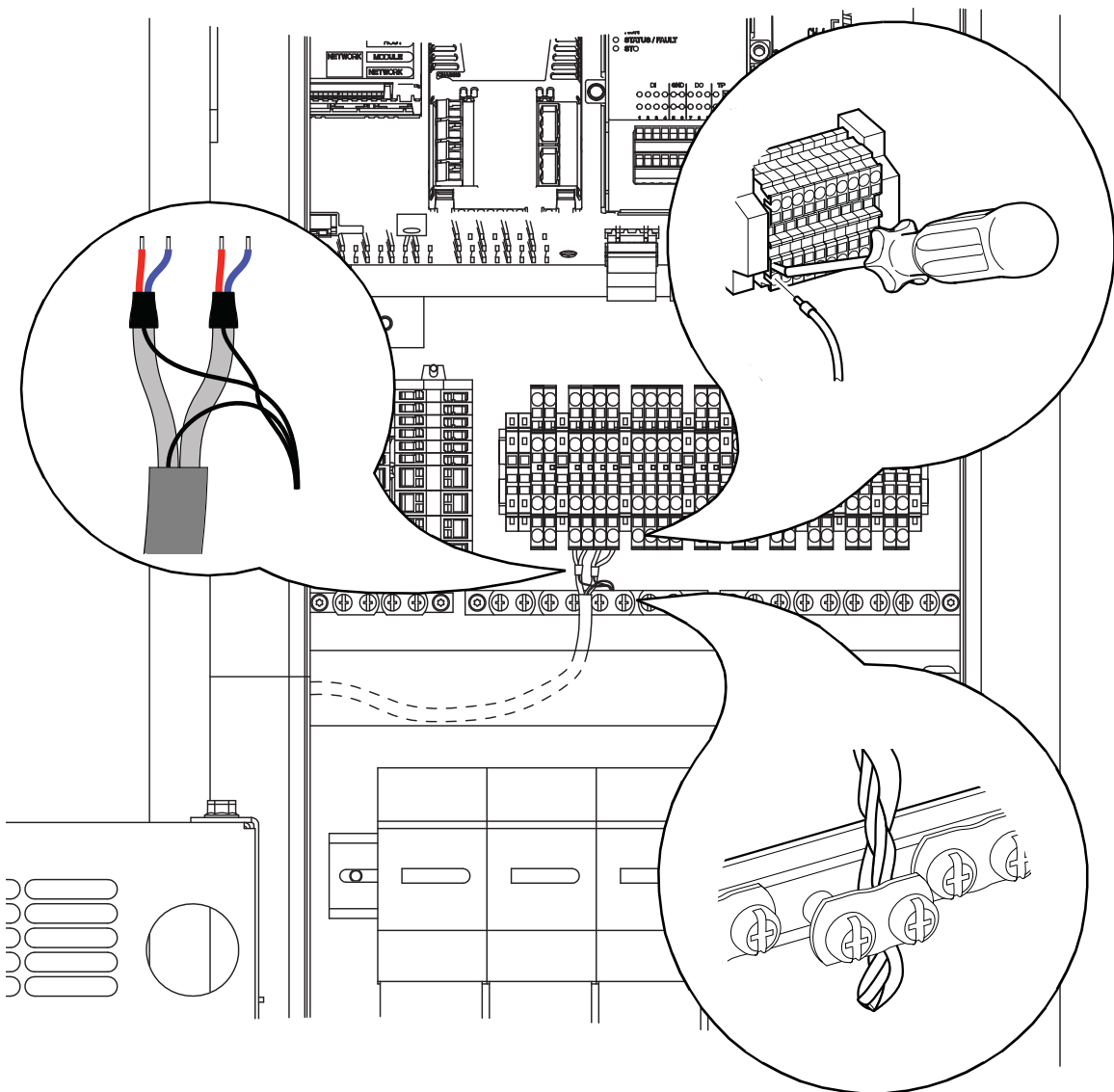
Connect the inner twisted pair shields and all separate grounding wires to the grounding clamps below the control unit.

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.

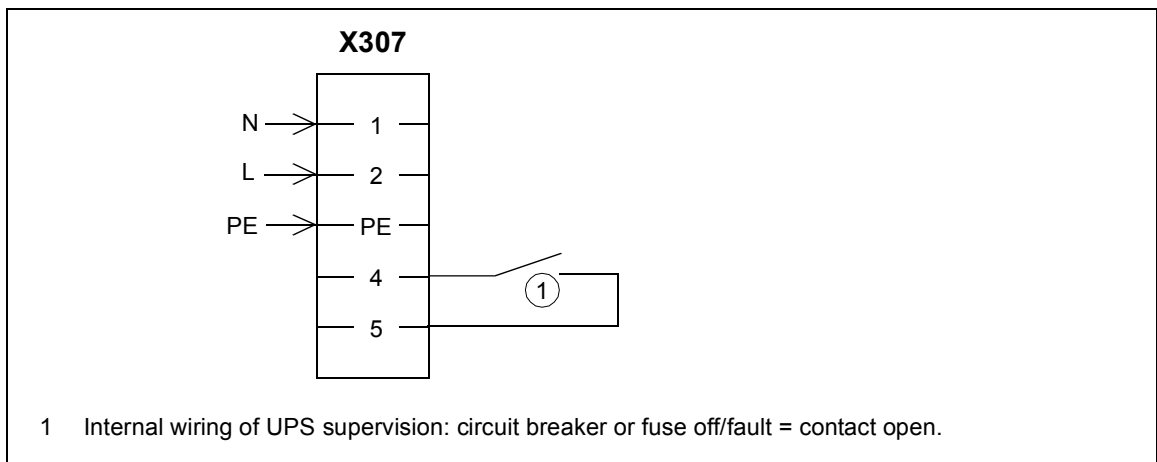




At the other end of the cable, leave the shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, eg. 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are in the same ground line with no significant voltage drop between the end points.

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.

**Connecting 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.

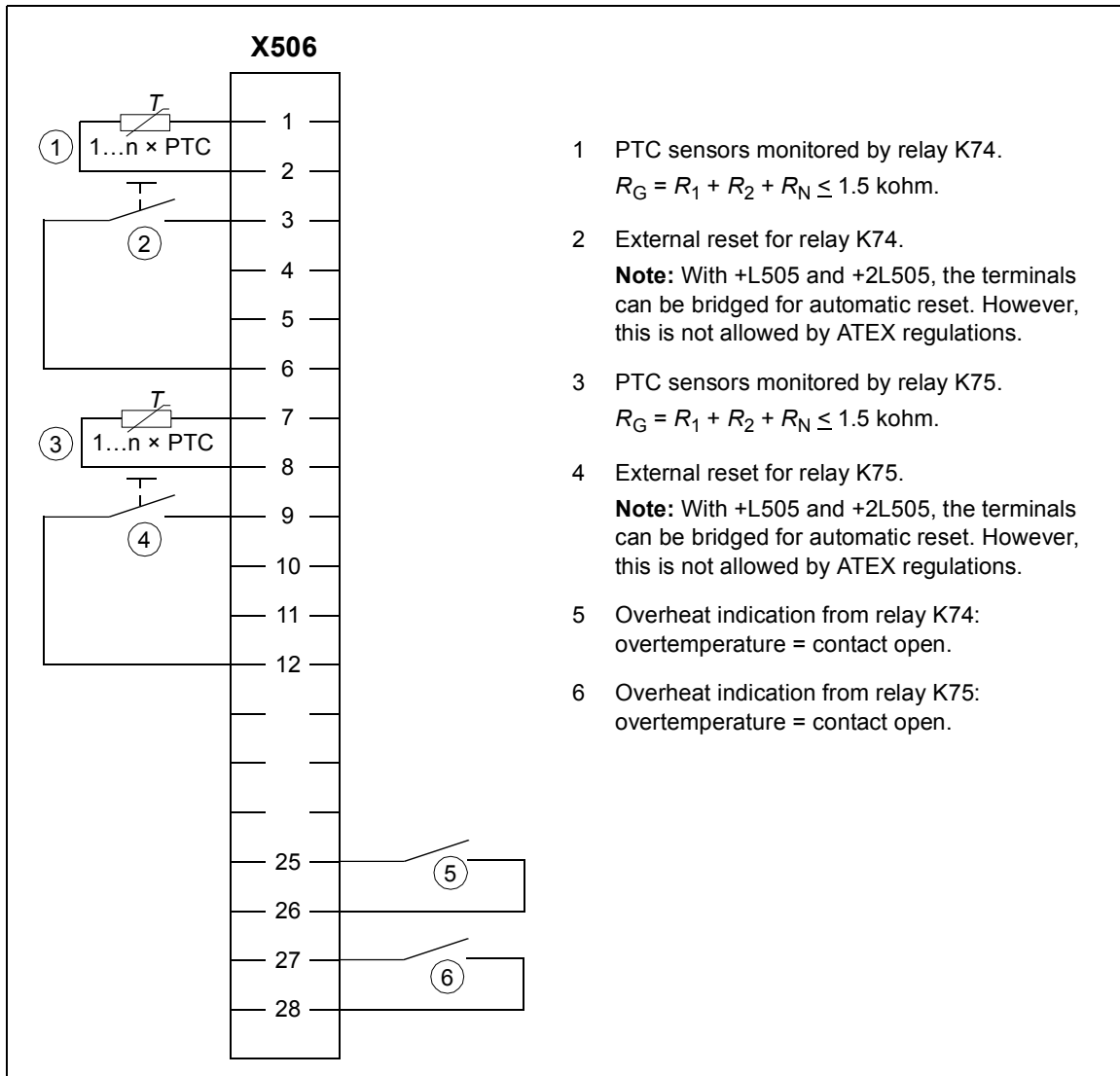
Wiring the starter for auxiliary motor fan (options +M602...+M610)

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



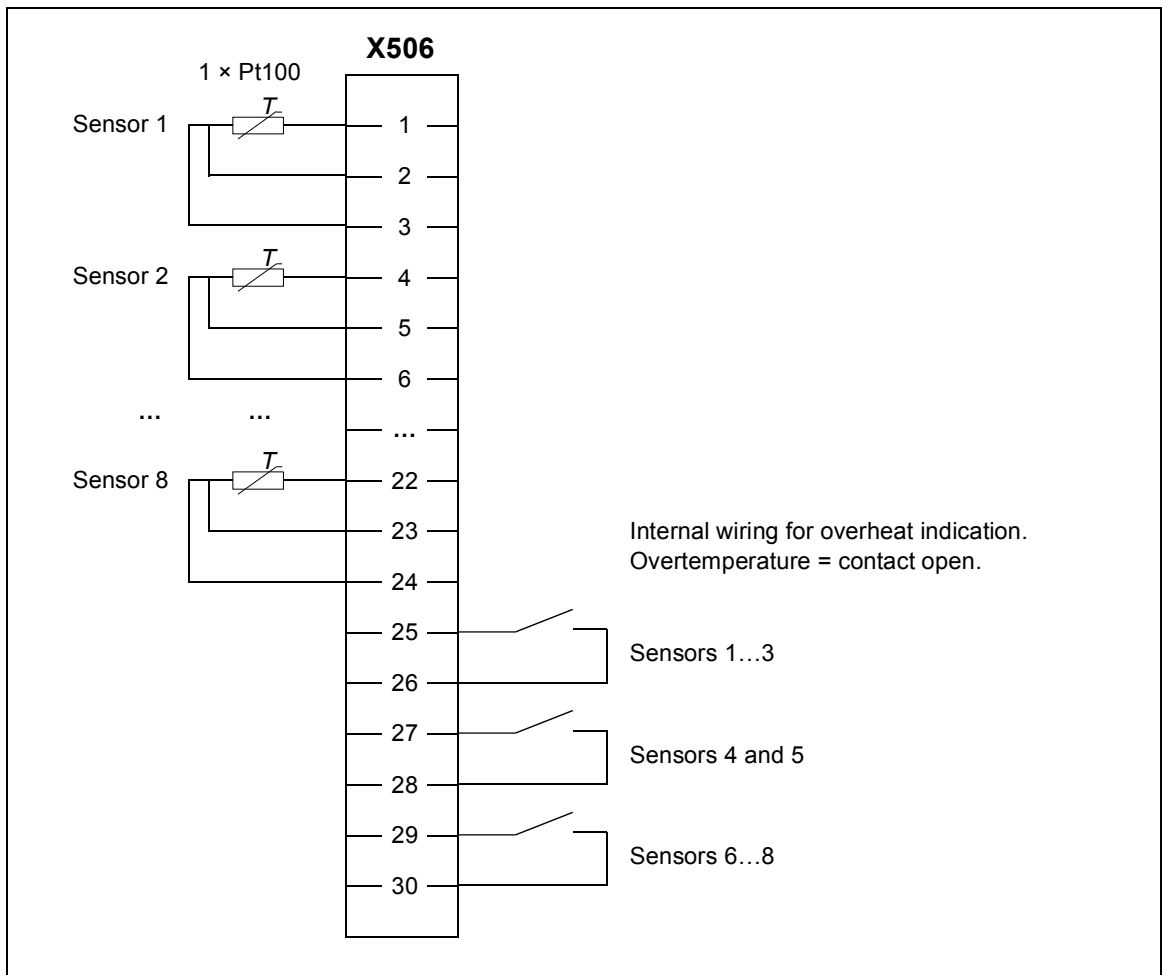
Wiring the PTC thermistor relay(s) (options +L505, +2L505, +L513, +2L513)

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]).



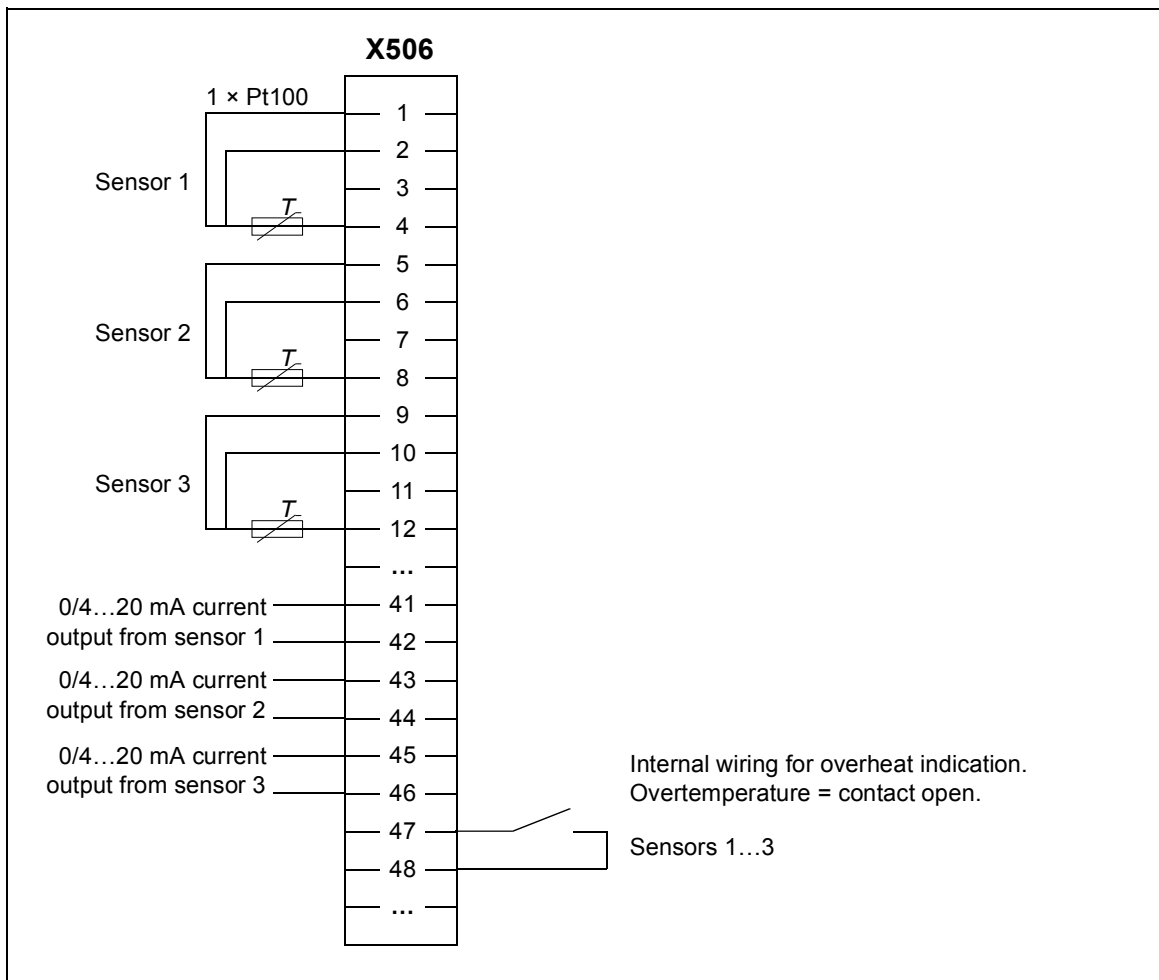
Wiring the Pt100 relays (option +nL506)

External wiring of eight Pt100 sensors is shown below. The maximum contact load capacity is 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive.



Wiring the Pt100 relays (option +nL514)

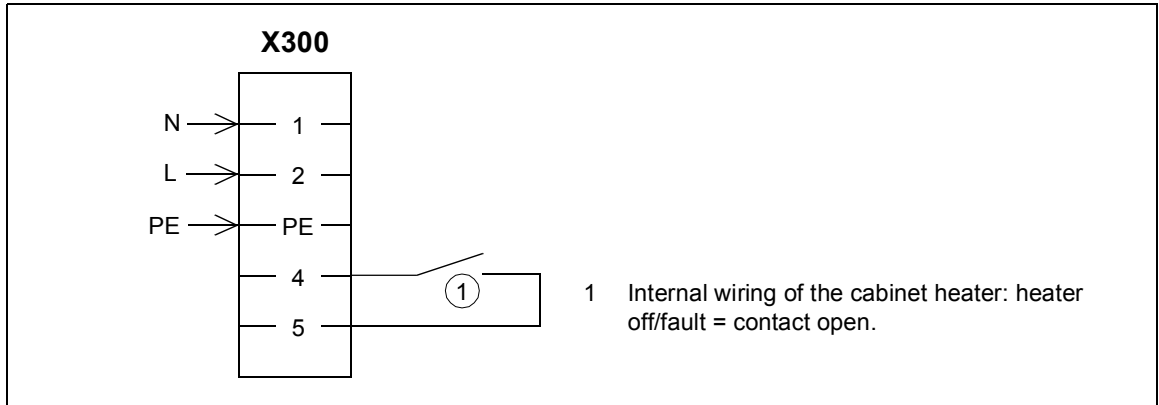
External wiring of three Pt100 sensors is shown below. The maximum contact load capacity is 250 V AC 10 A. For the actual wiring, see the circuit diagram delivered with the drive. For instructions on commissioning option +nL514, see *ATEX-certified motor thermal protection functions for cabinet-built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



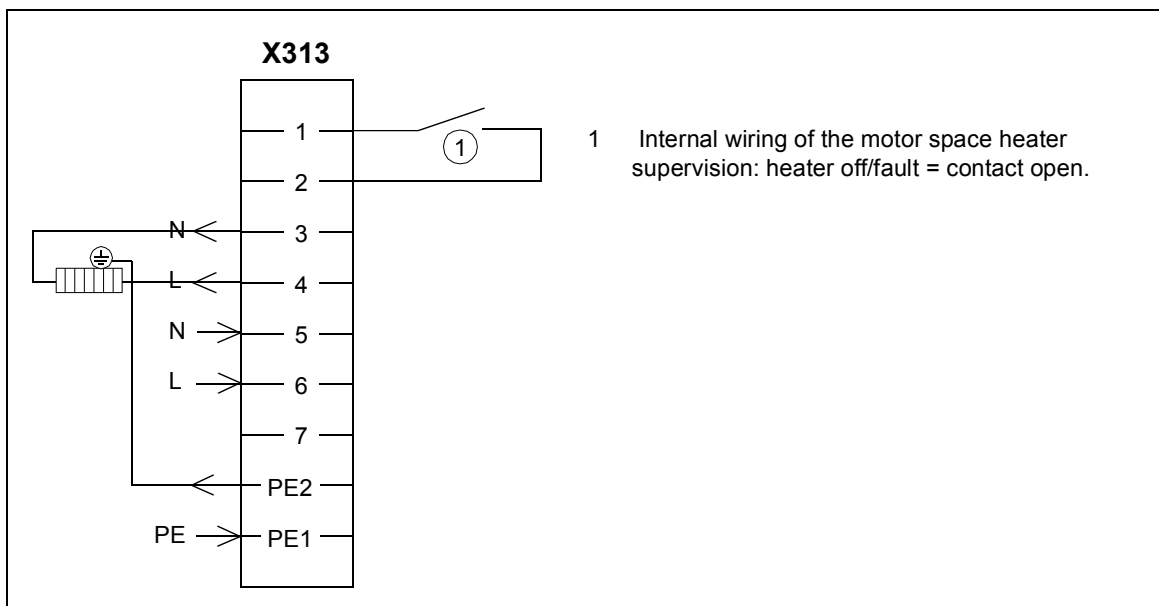
Powering the heating and lighting equipment (options +G300, +G301 and +G313)

See the circuit diagrams delivered with drive.

Connect the external power supply wires for the cabinet heater and lighting to terminal block X300.

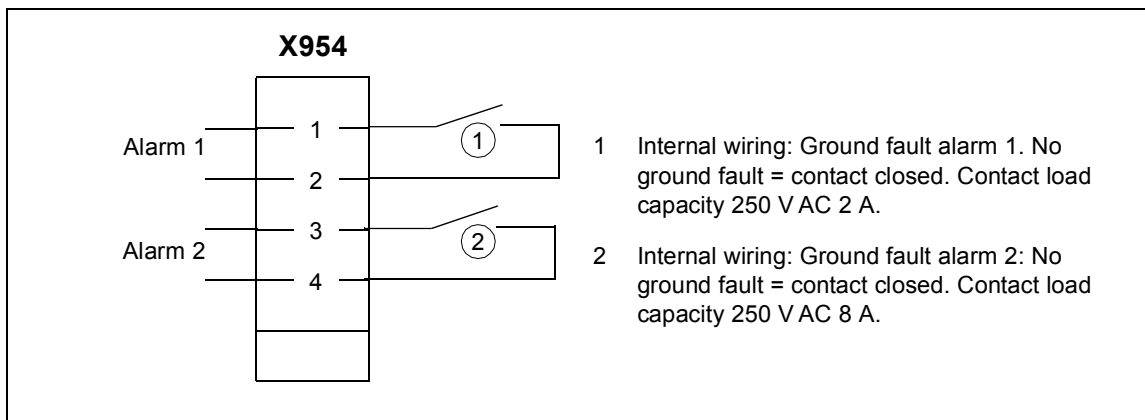


Connect the motor heater wiring to terminal block X313 as shown below. Maximum external power supply 16 A.



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.



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 (starting on page 227).

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

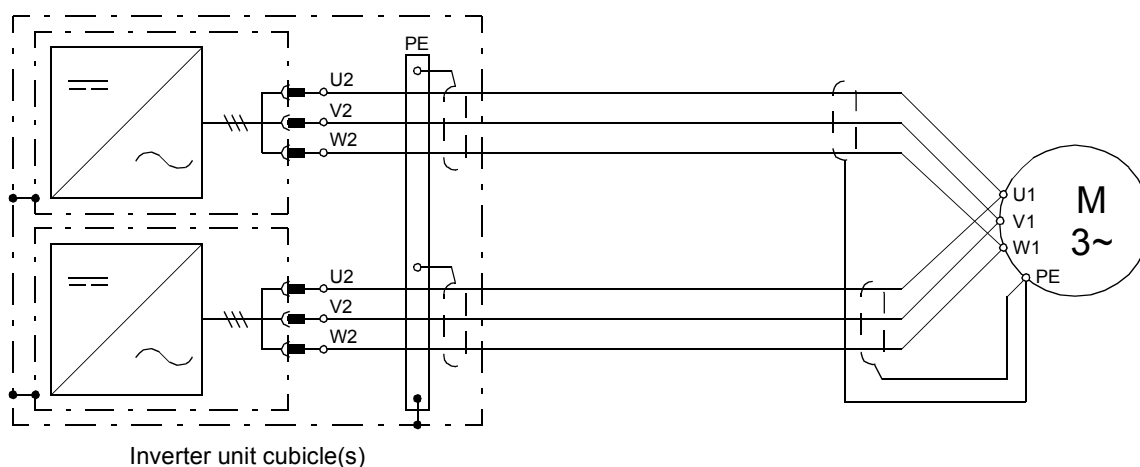
Especially in the case of multiple inverter modules in the same cubicle, you can consider only removing the fan carriage of each module. This is faster than removing the entire module, but allows less room for the connecting work. For instructions, see section [Removing and reinstalling the fan carriage 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 procedure starting on page 120.

Note for frame 1×R8i + 1×R8i: It is practical to remove all three modules (LCL filter, supply, inverter) before making the motor and input power cable connections.

■ Connection diagram (without option +H366)

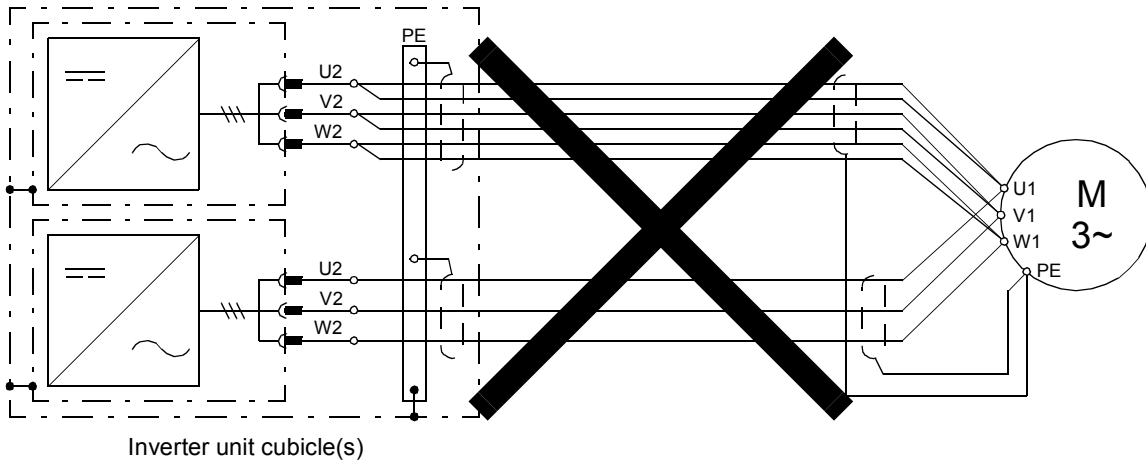
All parallel-connected inverter modules are to be cabled separately to the motor. 360° earthing is to be used at cable lead-throughs.



The recommended cable types are given in chapter [Guidelines for planning the electrical installation](#).

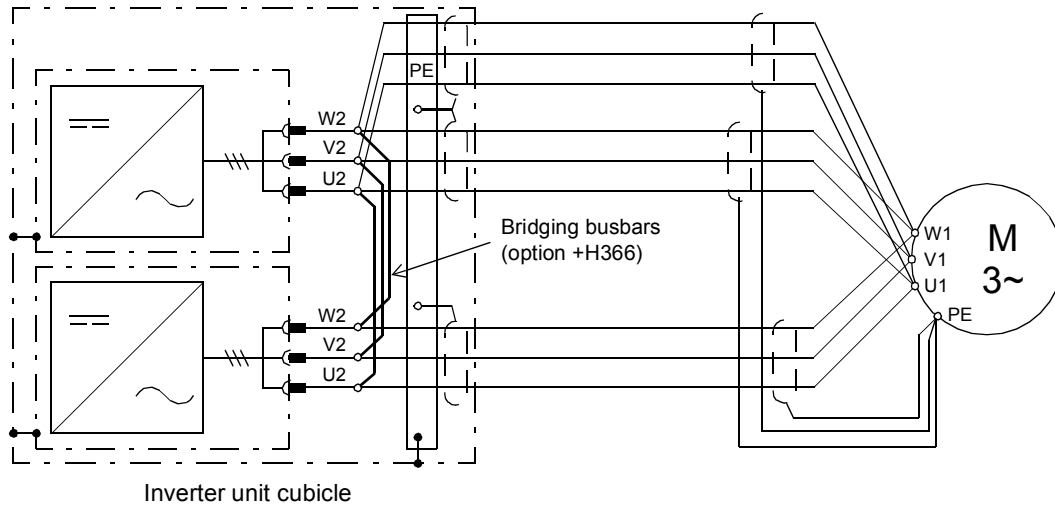


WARNING! The cabling from all inverter modules to the motor must be physically identical considering cable type, cross-sectional area, and length.



■ 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 [Guidelines for planning the electrical installation](#).



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 module can be removed completely instead of only the fan carriage.

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 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 module extraction/installation ramp with plinth heights over 50 mm.

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

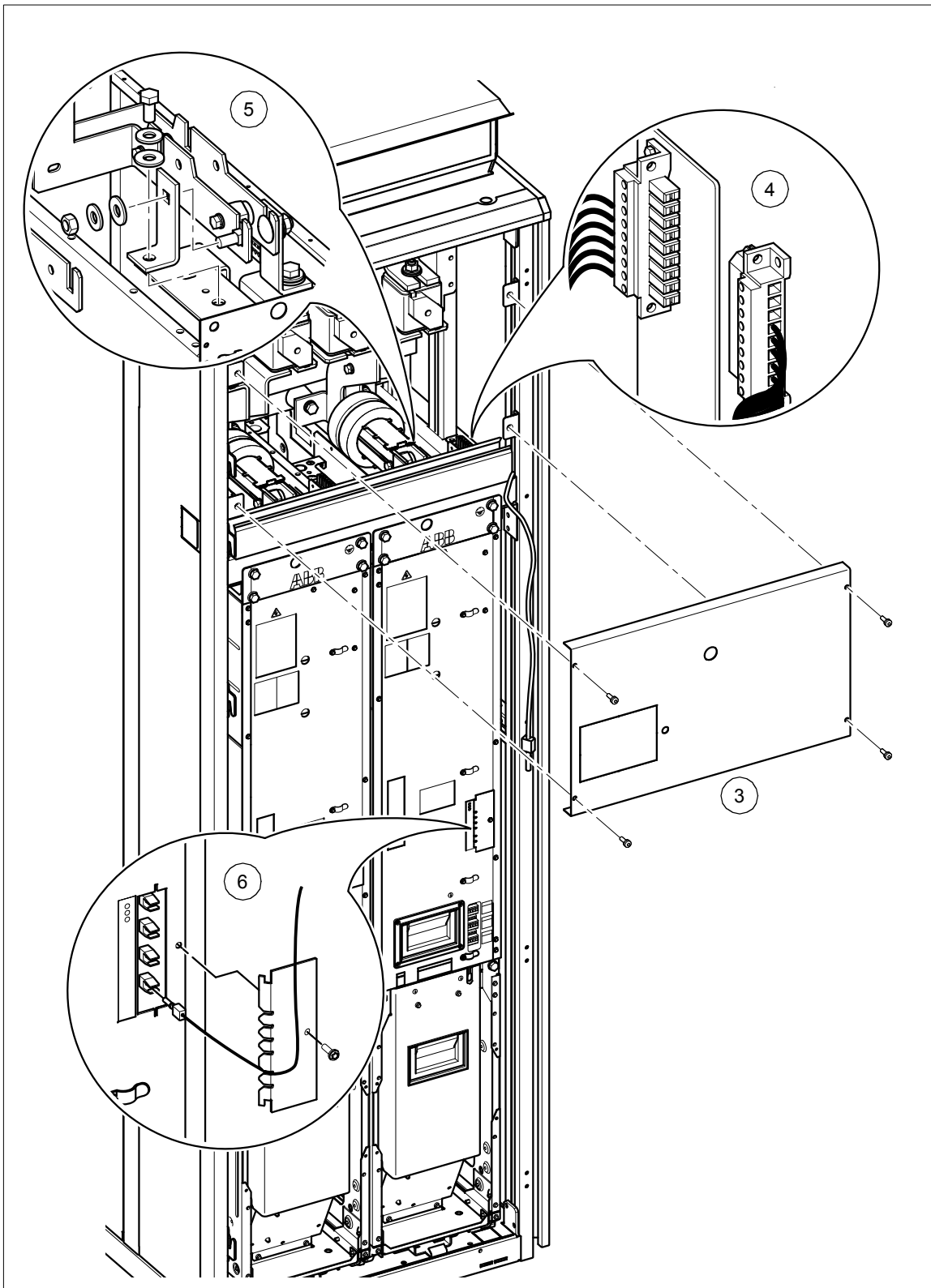


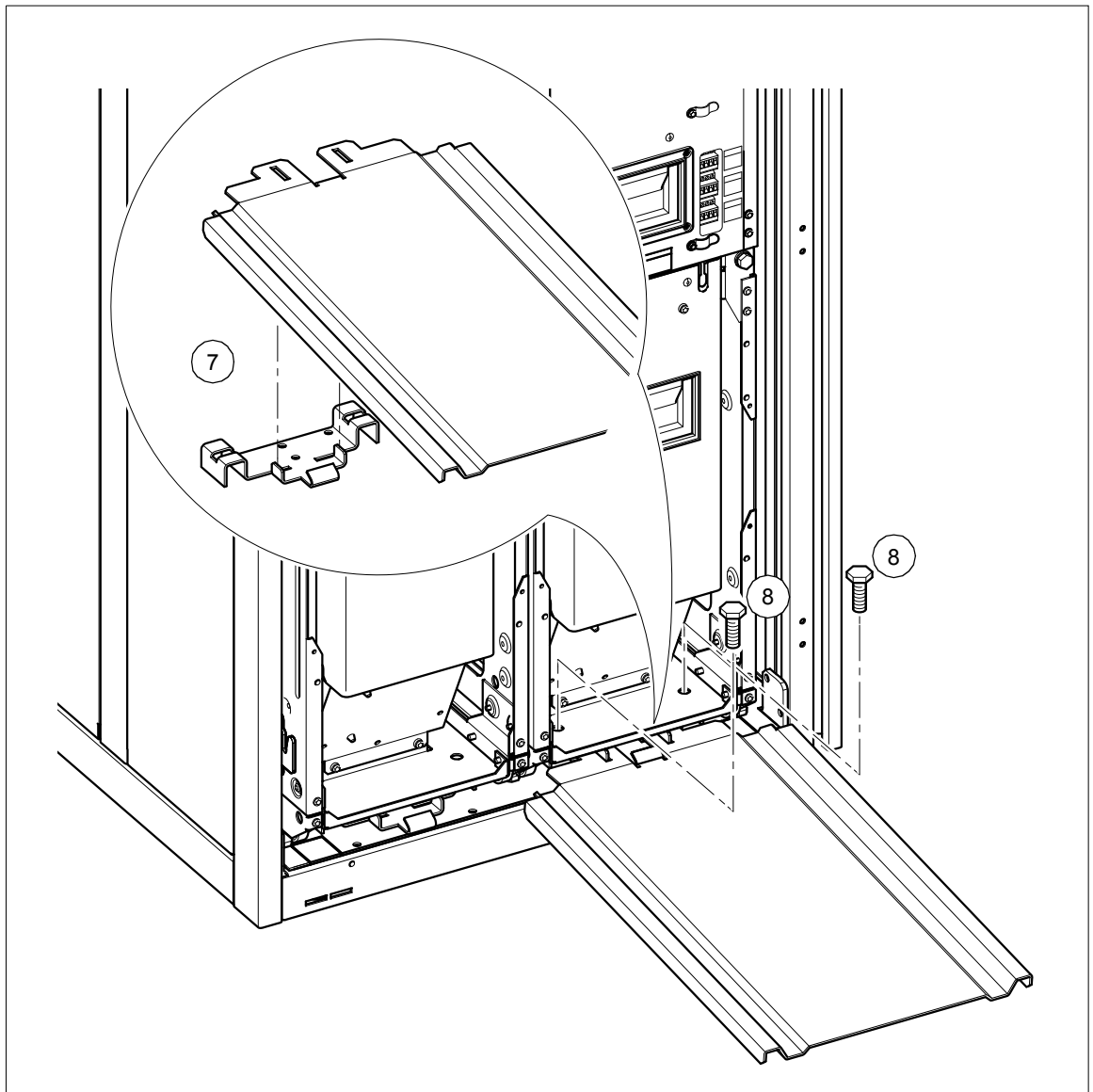
WARNING! Before you proceed, make sure the cabinet is level, or chock the wheels of the module.

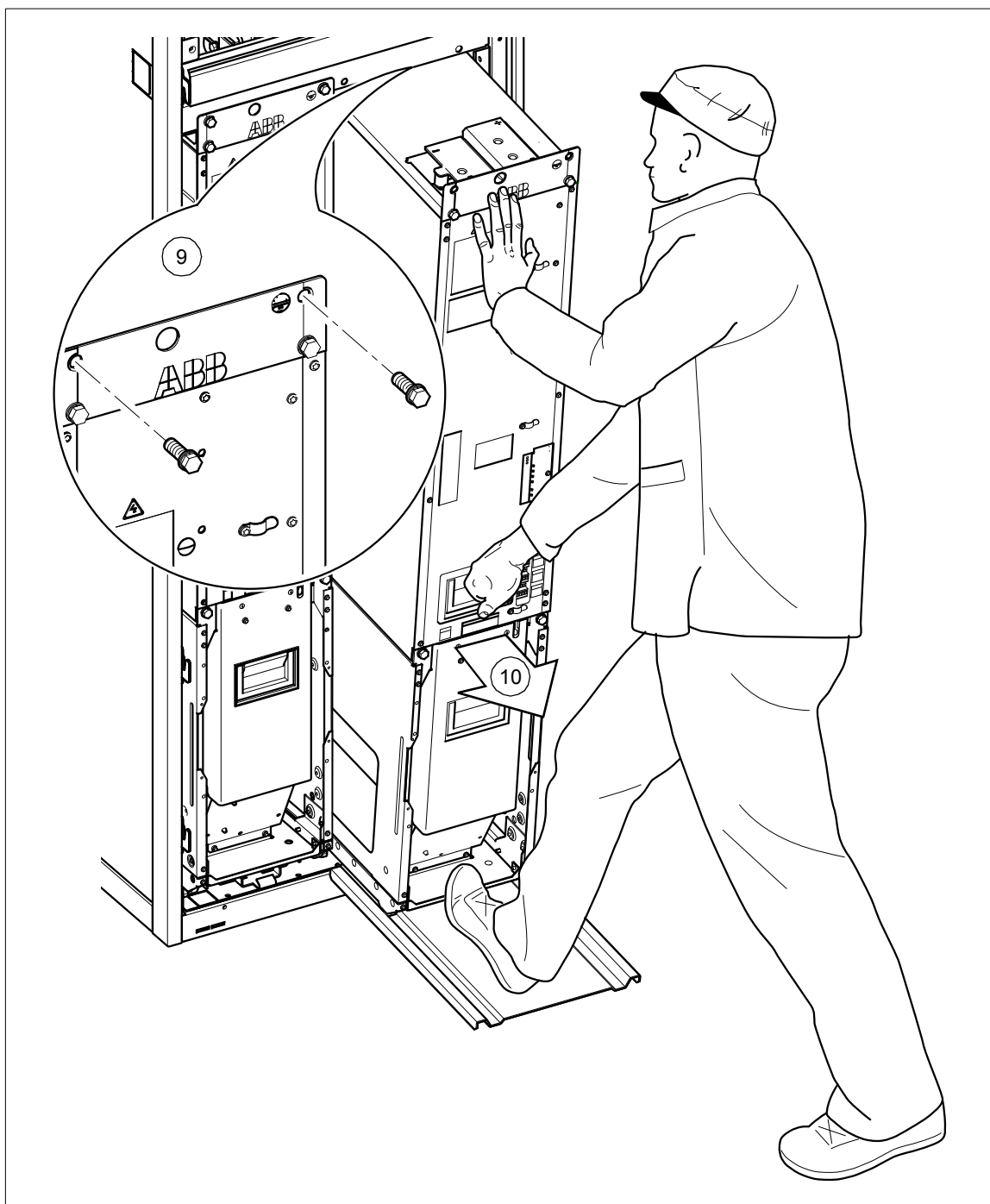
9. Remove the two screws at the top front of the module.
10. Pull the module carefully out along the ramp. While pulling on the handle with your right hand, keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
11. Move the module into a safe 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 (if any).
13. Frame 1×R8i + 1×R8i only: Repeat the procedure for the supply module.
14. Frame 1×R8i + 1×R8i only: Remove the LCL filter module as described on page 168.

Proceed to [Connecting the motor cables](#) (page 117).









Removing and reinstalling the fan carriage of an inverter module

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 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.
-

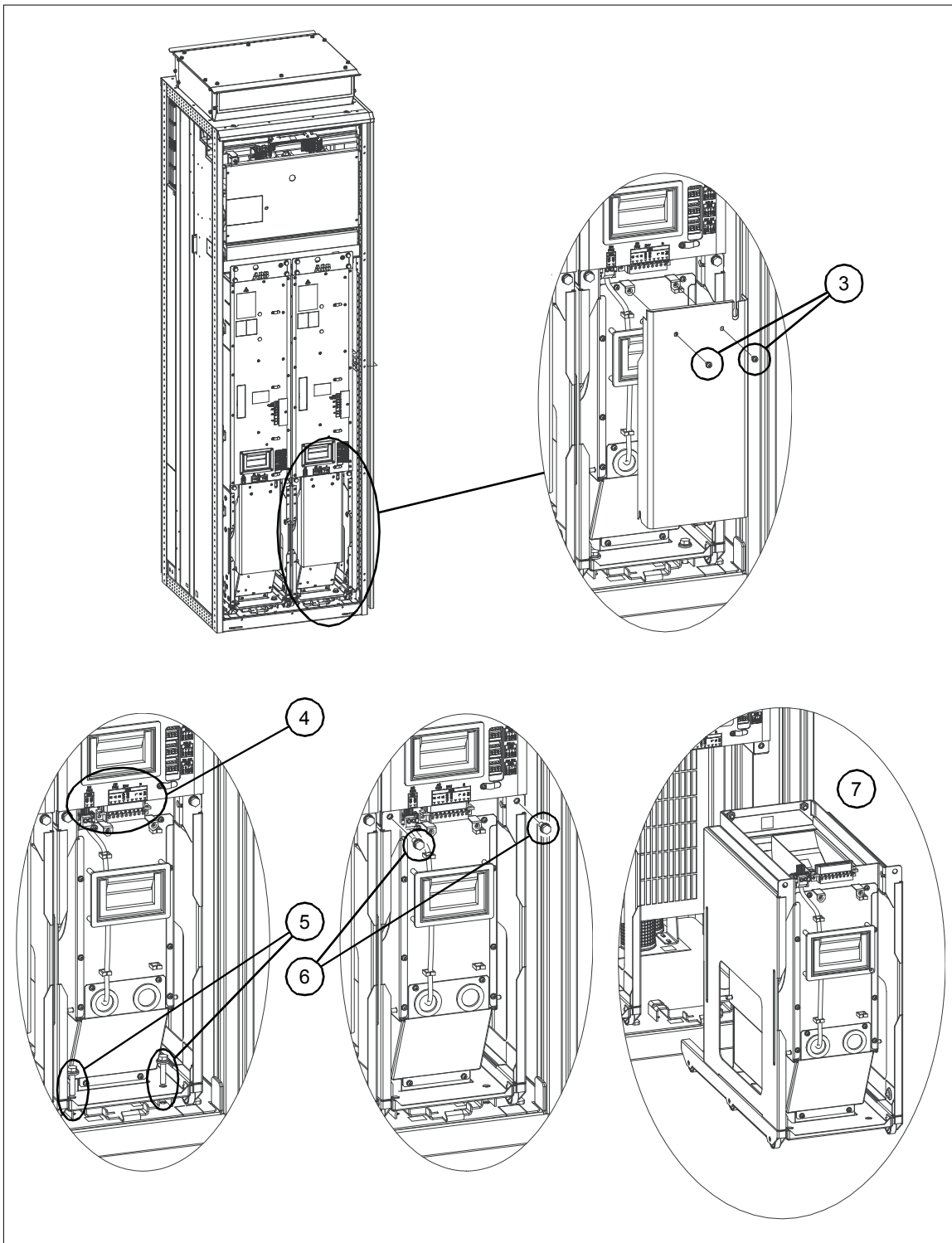


WARNING! Before you proceed, make sure the two screws holding the top of the inverter module are in place.

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).





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.

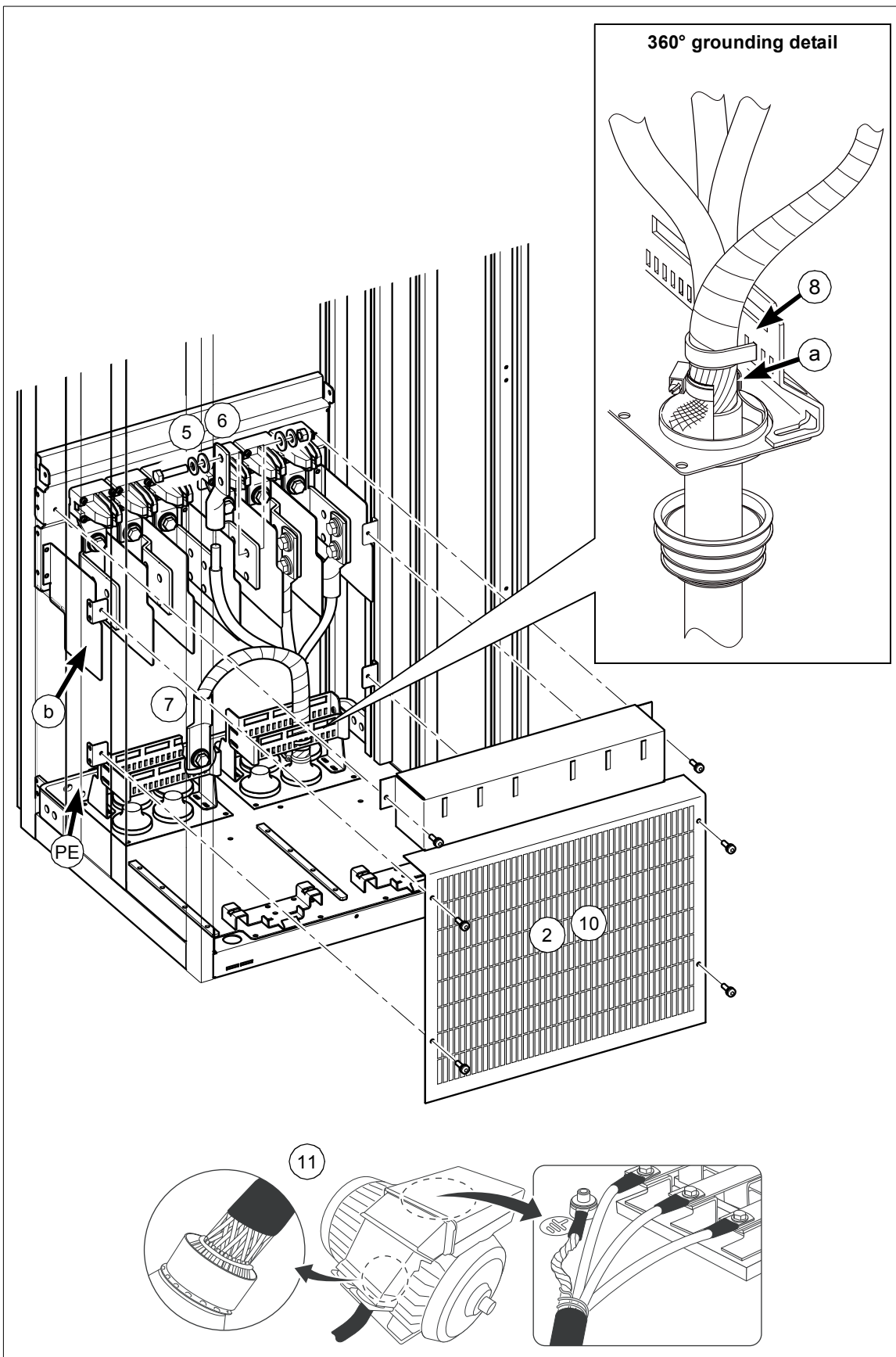
1. Do the steps in section [Electrical safety precautions](#) (page 19) before you start the work.
 2. Remove the shroud in front of the output busbars.
 3. For 360° grounding of the shield at the cable entry, remove the outer jacket of each cable where they pass through the cable entry (a).
 4. Cut 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.
-





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

Frame 1×R8i + 1×R8i only: This procedure applies to both the supply and inverter modules. However, do not insert the modules before connecting also the input power cables. See page 122.



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 (or, in the case of frame 1×R8i + 1×R8i, the supply module).
11. Reinstall the shroud near the top of the cubicle.



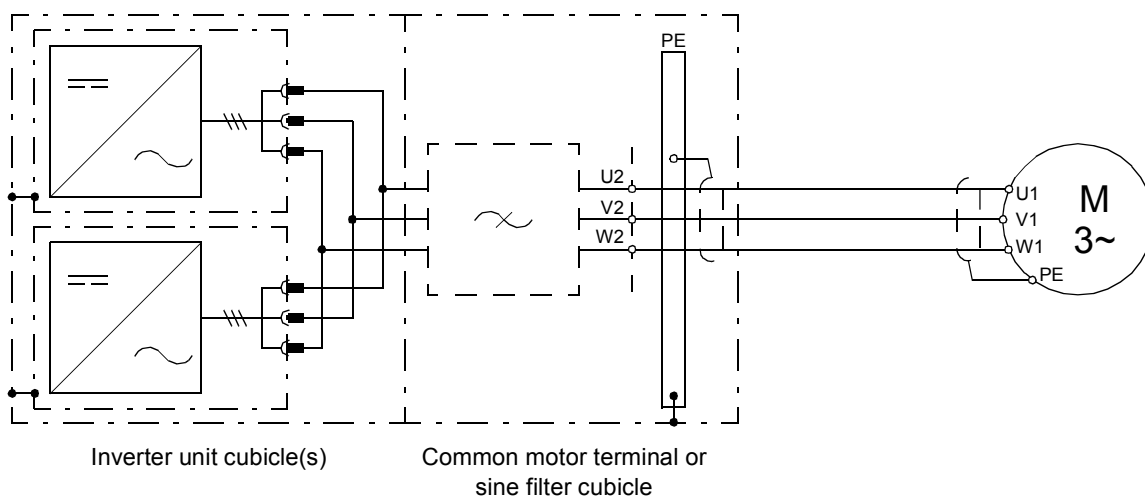
Connecting the motor cables (units with common motor terminal cubicle or sine filter)

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 drawings starting on page 231.

Connection diagram



The recommended cable types are given in chapter [Guidelines for planning the electrical installation](#).

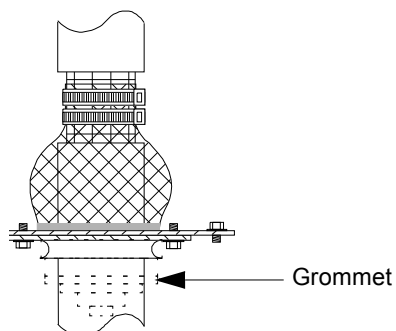
Procedure



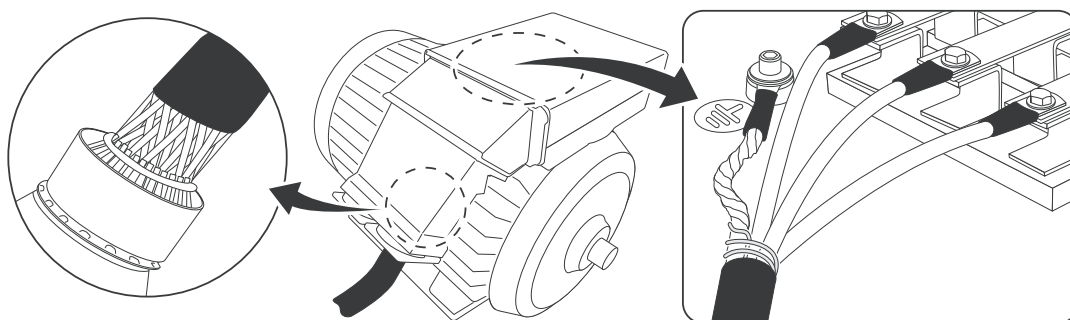
WARNING! Obey the instructions in chapter [Safety instructions](#). If you ignore them, injury or death, or damage to the equipment can occur.

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 198).
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.



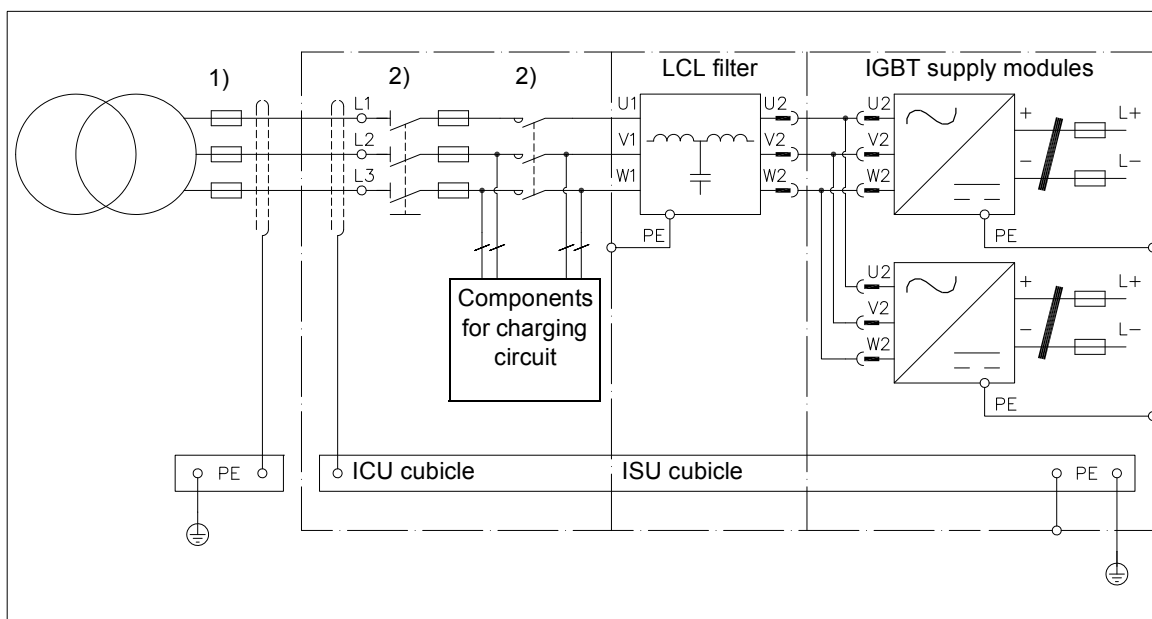
Connecting an external brake resistor assembly

See section [Electrical installation of custom brake resistors](#) (page 255).

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



Notes:

1) Fuses or other protection means.

Use a separate PE conductor in addition if the conductivity of the shield does not meet the requirement for the PE conductor. See section [Selecting the power cables](#) (page 81).

■ 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, as well as the drawings starting on page 223.

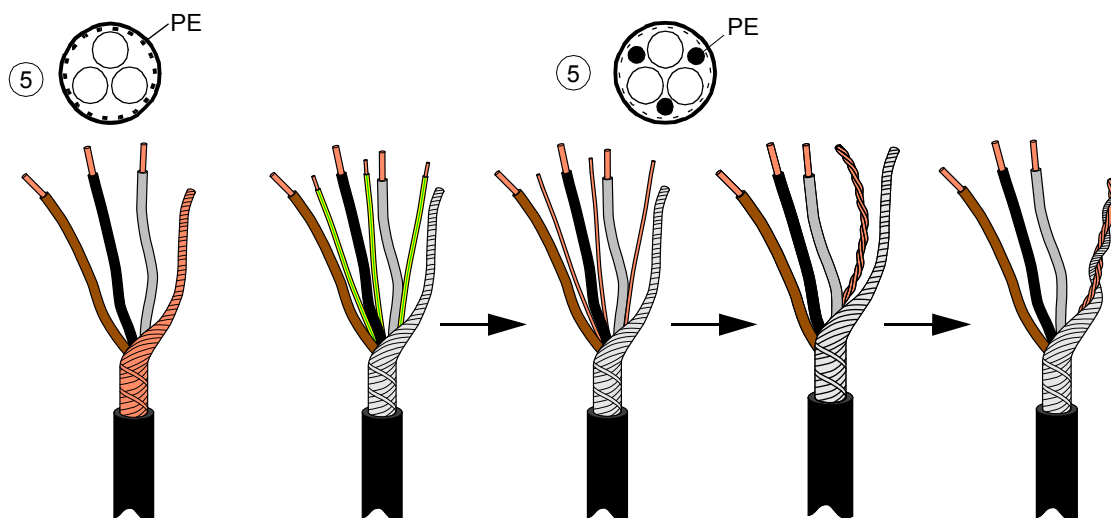
■ Connection procedure



WARNING! Obey the instructions in chapter [Safety instructions](#). If you ignore them, injury or death, or damage to the equipment can occur.

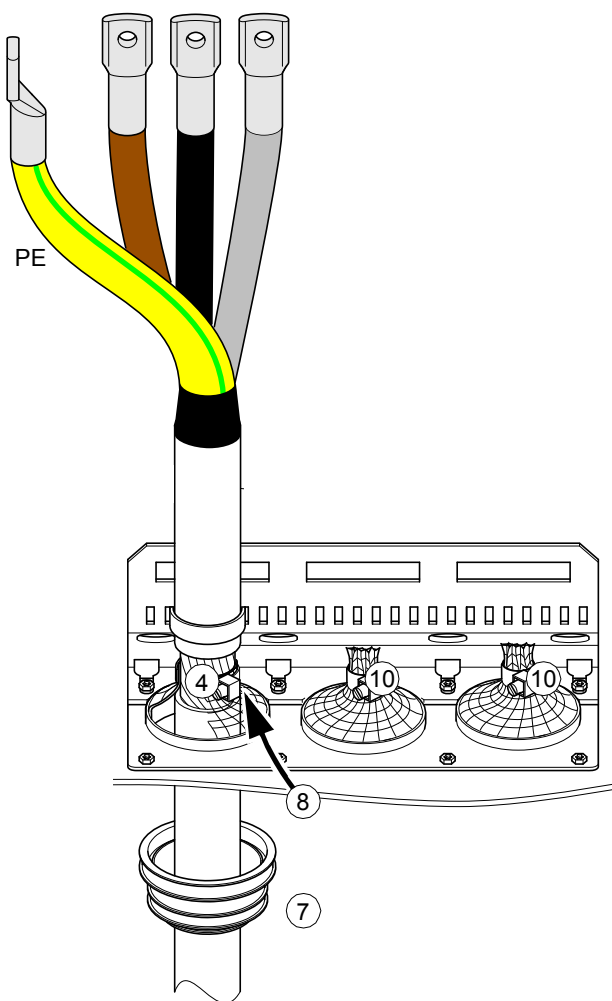
1. Do the steps in section [Electrical safety precautions](#) (page 19) before you start the work.
2. Open the door of the incoming cubicle (or, in the case of frame 1×R8i + 1×R8i, the door of the supply and inverter module cubicle).
3. Remove the shrouding covering the input terminals.
4. Peel off 3 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.



6. If fire insulation is used, make an opening in the mineral wool sheet according to the diameter of the cable.
7. Remove the rubber grommets from the lead-through plate for the cables to be connected. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Slide the cables through the lead-throughs with the conductive sleeves and attach the grommets to the holes.
8. Fasten the conductive sleeves to the cable shields 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. Tie up the unused conductive sleeves with cable ties.
11. Connect the twisted shields of the cables to the PE busbar of the cabinet.
12. Connect the phase conductors of the input cable to the L1, L2 and L3 terminals. Tighten the screws to the torque given under [Tightening torques](#) (page 198).
13. Reinstall the shrouding removed earlier.
14. Frame 1×R8i + 1×R8i only: Reinstall the LCL filter module as described on page 168.
15. Frame 1×R8i + 1×R8i only: Re-insert the supply and inverter modules as described on page 119.
16. Close the cubicle door.





Connecting a PC

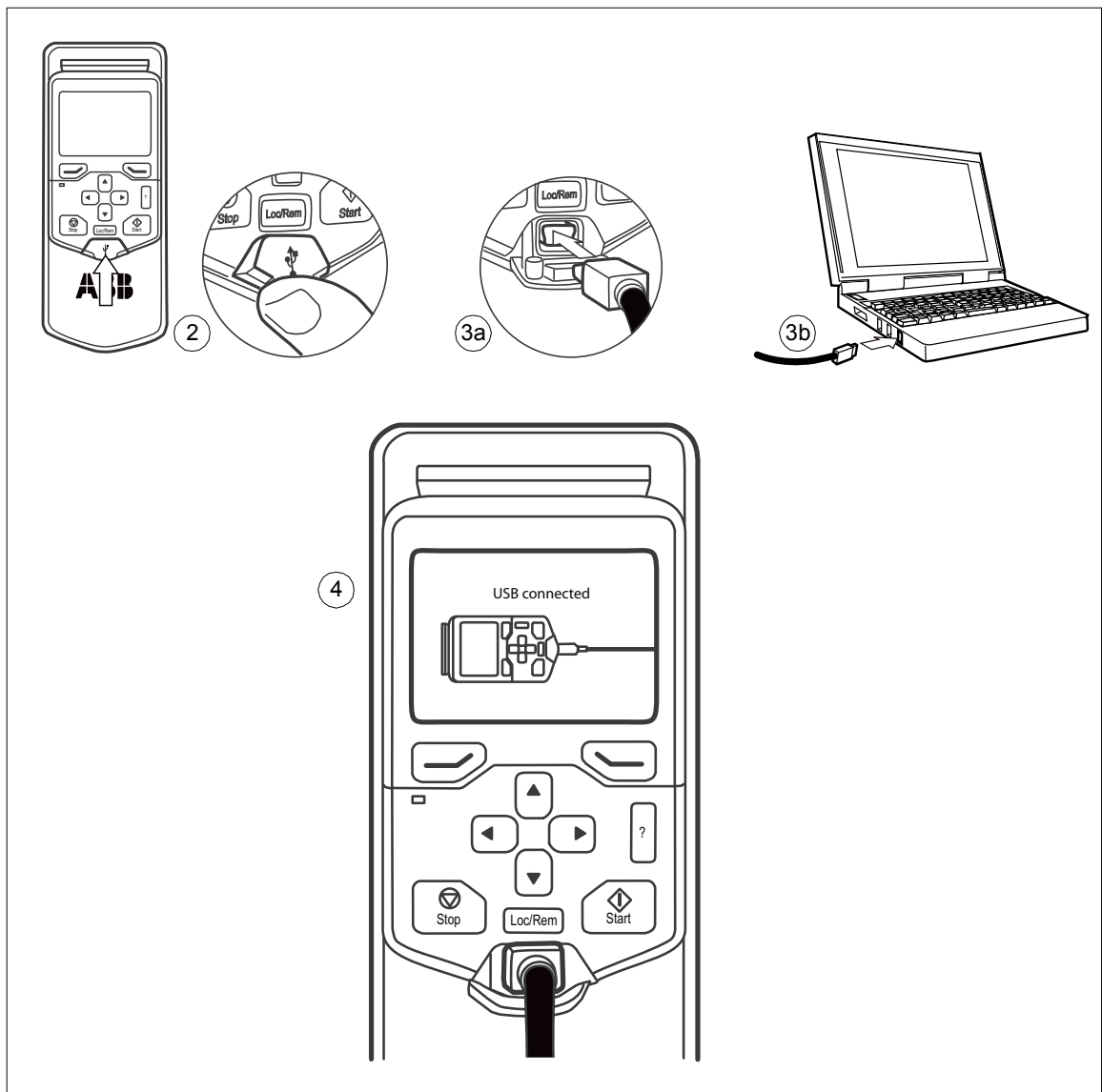
A PC (with eg. the Drive composer PC tool) can be connected to the inverter unit as follows:

1. Connect an ACS-AP-x 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.



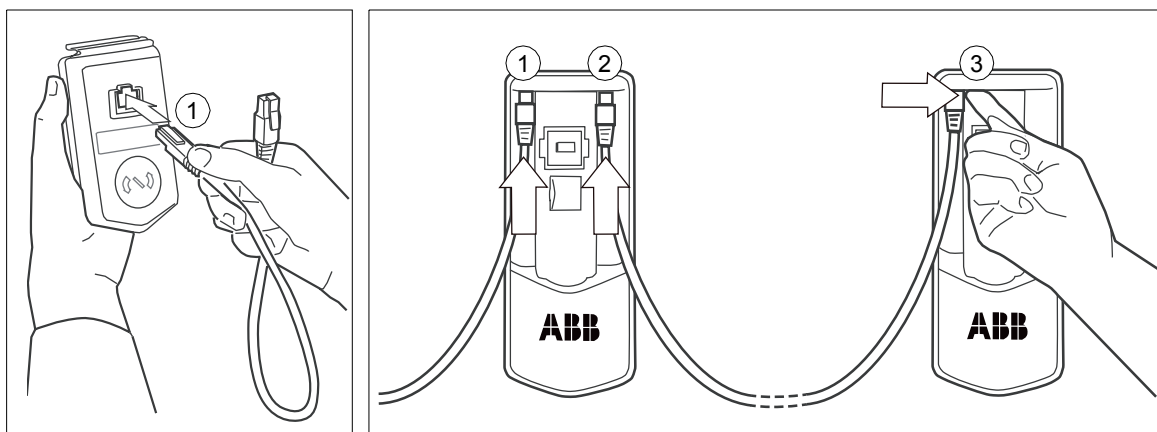
5. See the documentation of the PC tool for setup instructions.



Panel bus (Control of several drives 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 ACS880-37, 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.
5. 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 page 40 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.

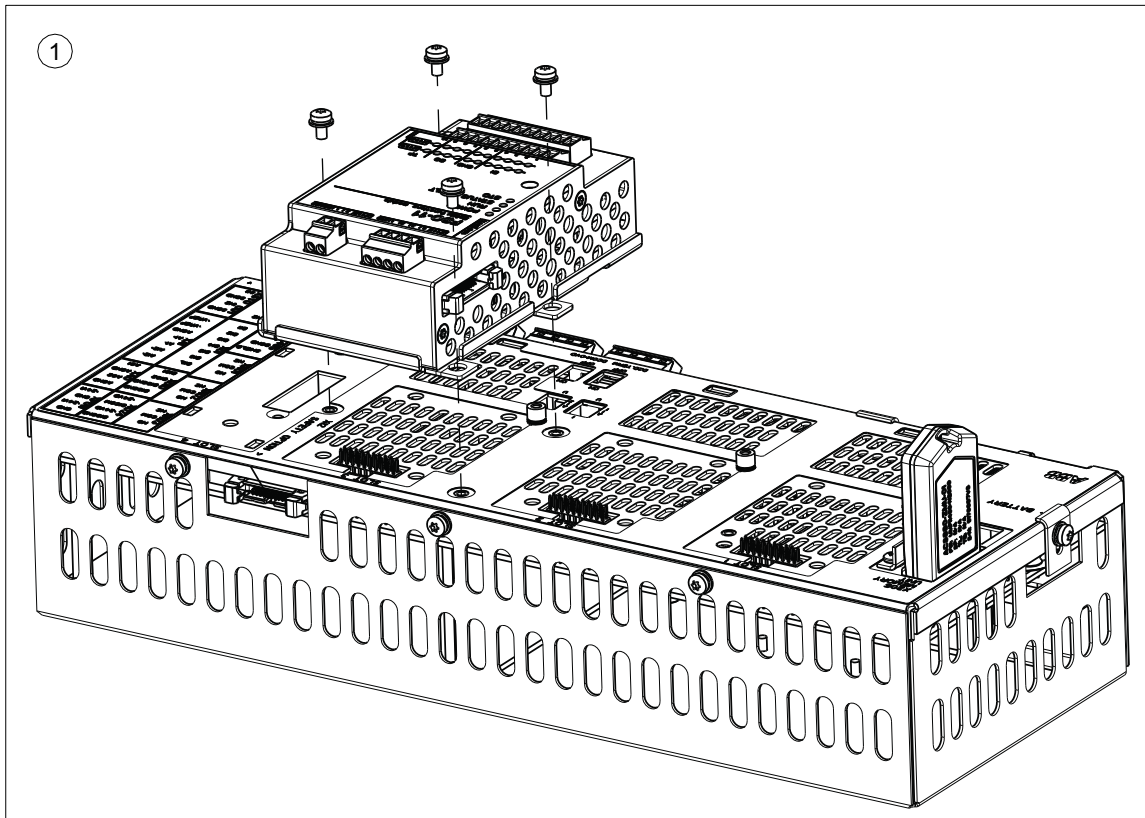
1. Stop the drive and do the steps in section *Electrical safety precautions* (page 19) before you start the work.
2. Open the door of the auxiliary control cubicle (ACU).
3. Remove the shrouding at the top of the cubicle.
4. Locate the inverter control unit [A41].
5. Insert the module carefully into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



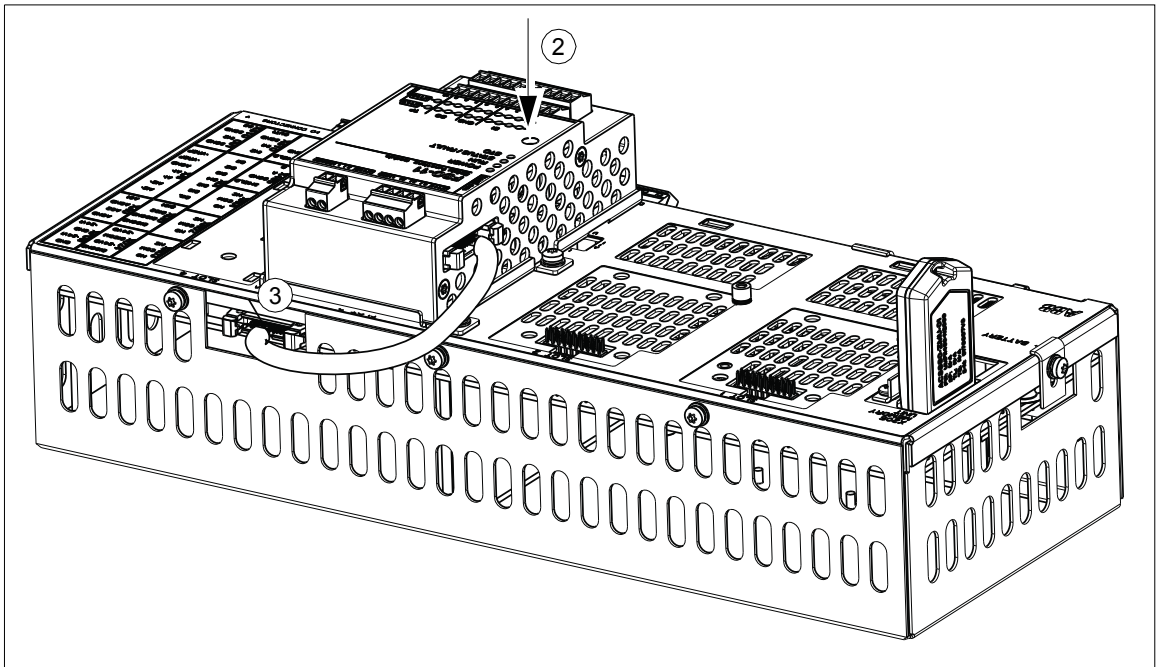
■ Mechanical installation of an FSO-xx safety functions module

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 option modules

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







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.

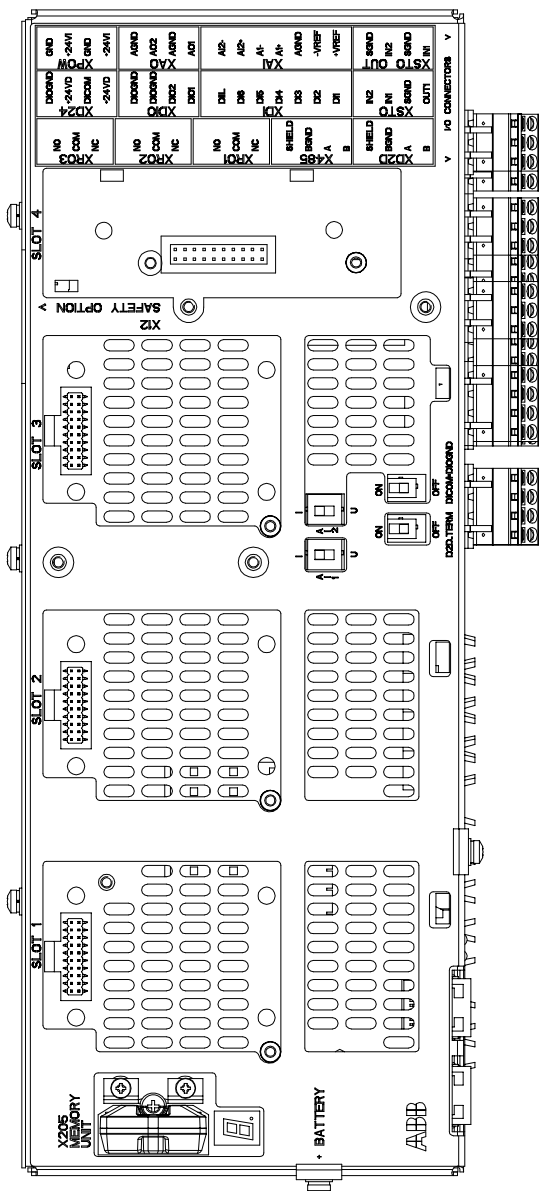
General

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.

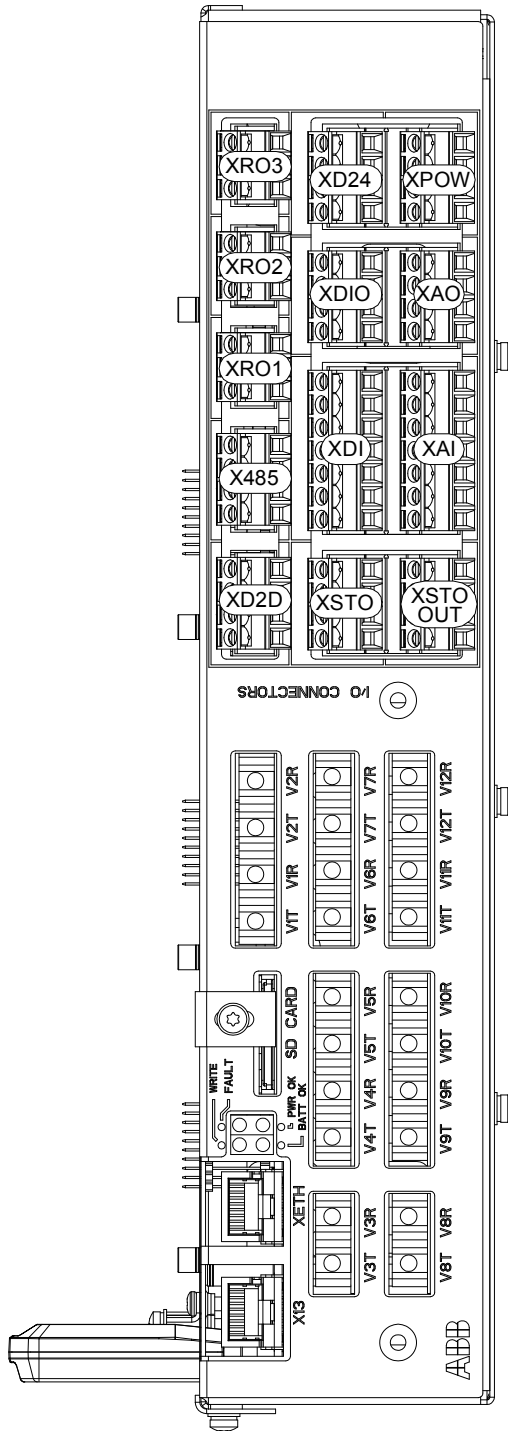
The supply and inverter units of the ACS880-37 are each controlled by a dedicated BCU-x2 control unit. The designation of the supply control unit is A51; the inverter control unit is A41. Both are located in the ACU cubicle (see the drawings in chapter [Operation principle and hardware description](#)), and connect 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 (page 141).
7-segment display Multicharacter indications are displayed as repeated sequences of characters	
	("U" is indicated briefly before "o".) Control program startup in progress
	(Flashing) Firmware cannot be started. Memory unit missing or corrupted
	Firmware download from PC to control unit in progress
	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.



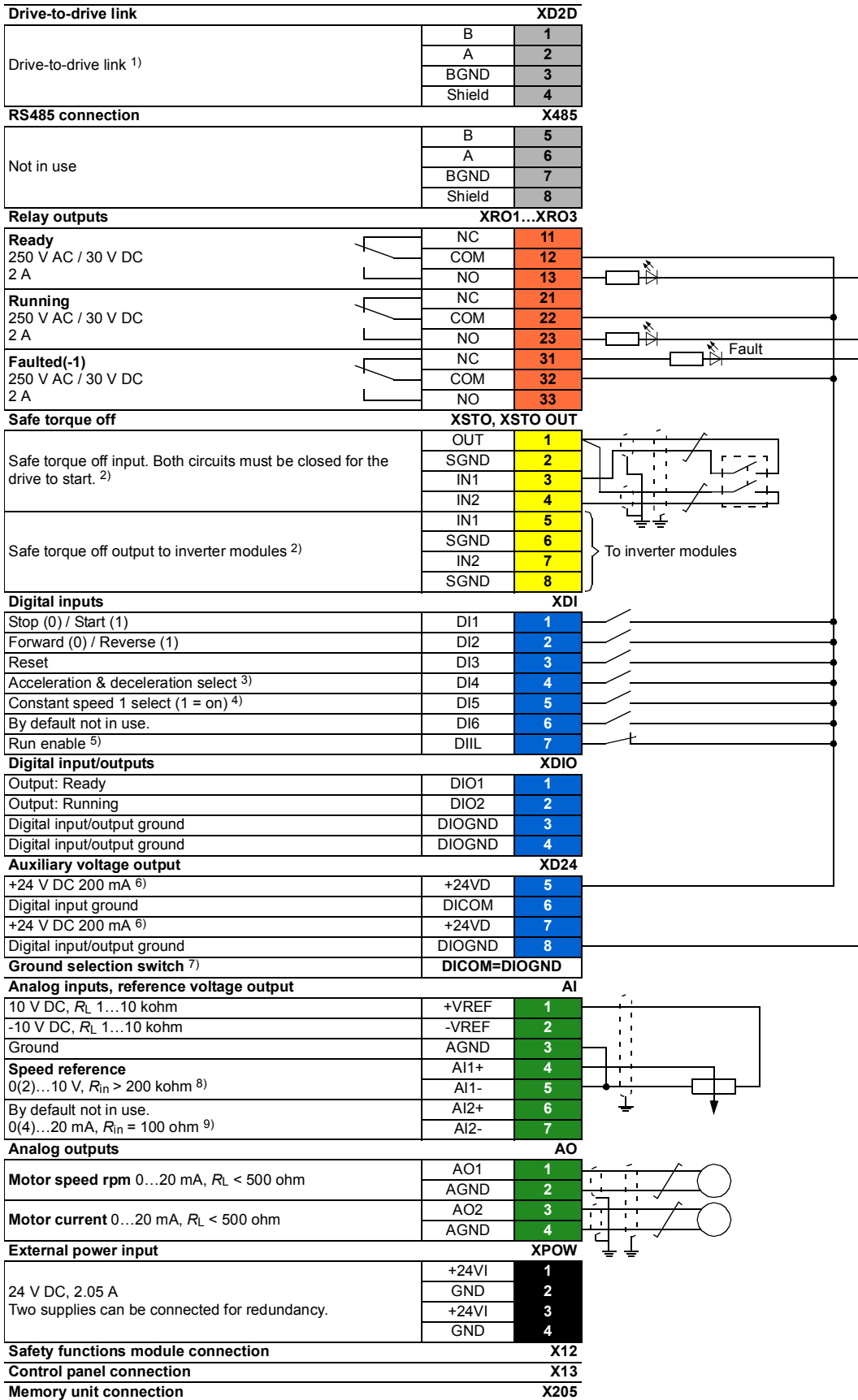
	Description
XAI	Analog inputs
XAO	Analog outputs
XDI	Digital inputs, Digital input interlock (DIIL)
XDIO	Digital input/outputs
XD2D	Drive-to-drive link
XD24	+24 V output (for digital inputs)
XETH	Ethernet port (eg. for PC communication)
XPOW	External power input
XRO1	Relay output RO1
XRO2	Relay output 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: Charging (energized = charging contactor closed) 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		AI1+	4
0(2)...10 V, $R_{in} > 200$ kohm		AI1-	5
Not in use		AI2+	6
0(4)...20 mA, $R_{in} = 100$ ohm		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 mm² (24...12 AWG). The torque is 0.5 N·m (5 lbf·in).

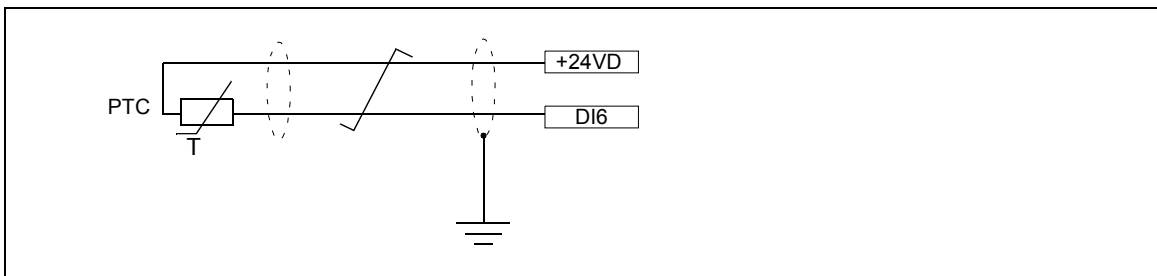
- 1) See section [Drive-to-drive link \(XD2D\)](#) (page 137).
- 2) See chapter [The Safe torque off function](#) (page 237).
- 3) 0 = Acceleration/deceleration ramps defined by parameters 23.12/23.13 in use.
1 = Acceleration/deceleration ramps defined by parameters 23.14/23.15 in use.
- 4) Constant speed 1 is defined by parameter 22.26.
- 5) See section [DIIL input](#) (page 137).
- 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](#) on page 141.
DICOM=DIOGND ON: DICOM connected to DIOGND. **OFF:** DICOM and DIOGND separate.
- 8) Current [0(4)...20 mA, $R_{in} = 100 \text{ ohm}$] or voltage [0(2)...10 V, $R_{in} > 200 \text{ kohm}$] input selected by switch **AI1**. Change of setting requires reboot of control unit.
- 9) Current [0(4)...20 mA, $R_{in} = 100 \text{ ohm}$] or voltage [0(2)...10 V, $R_{in} > 200 \text{ kohm}$] 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.

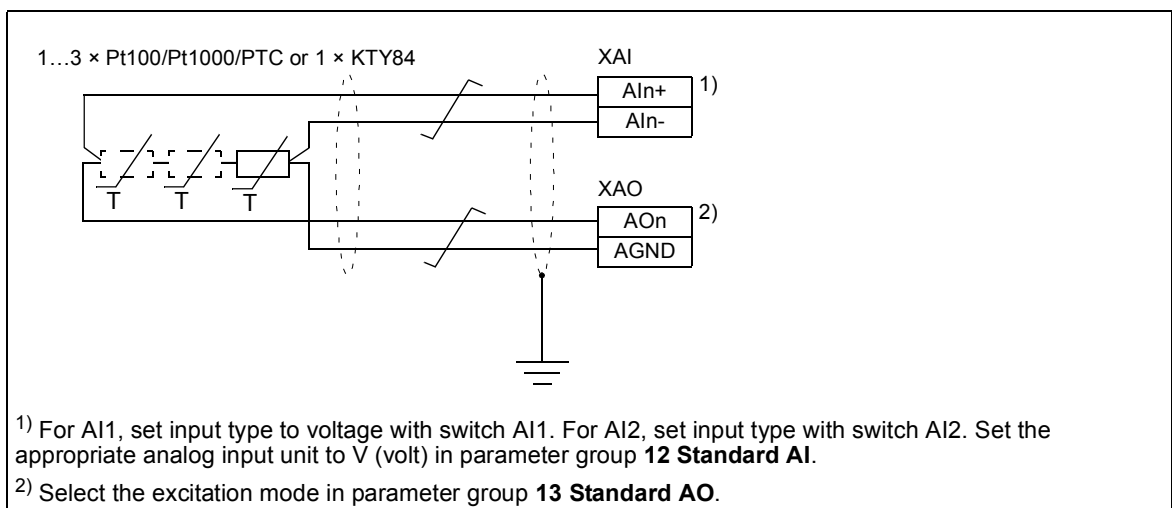




WARNING! As the inputs pictured above are not insulated according to IEC 60664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor. If the assembly does not fulfill the requirement, the I/O board terminals must be protected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



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

■ DIIL input

On both the supply and inverter units, 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.

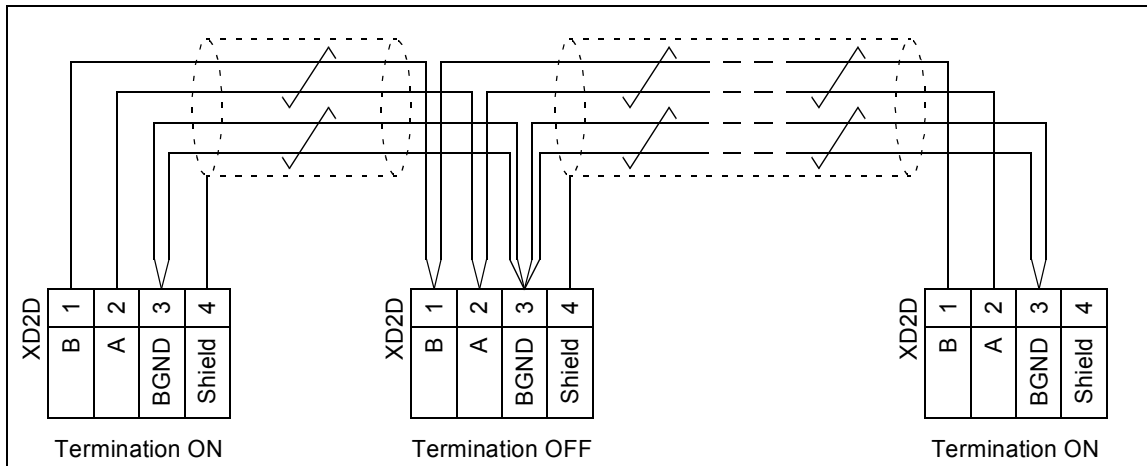
■ Drive-to-drive link (XD2D)

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 as described in section [Connecting the control cables](#) (page 99).

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 237).

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.

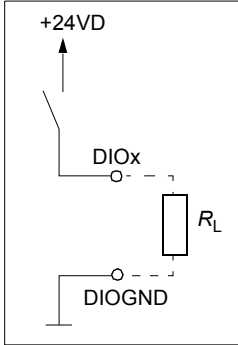
■ FSO-xx safety functions module connection (X12)

See section [Implementing the functions provided by the FSO-xx safety functions module \(option +Q972 or +Q973\)](#) (page 90), and 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.

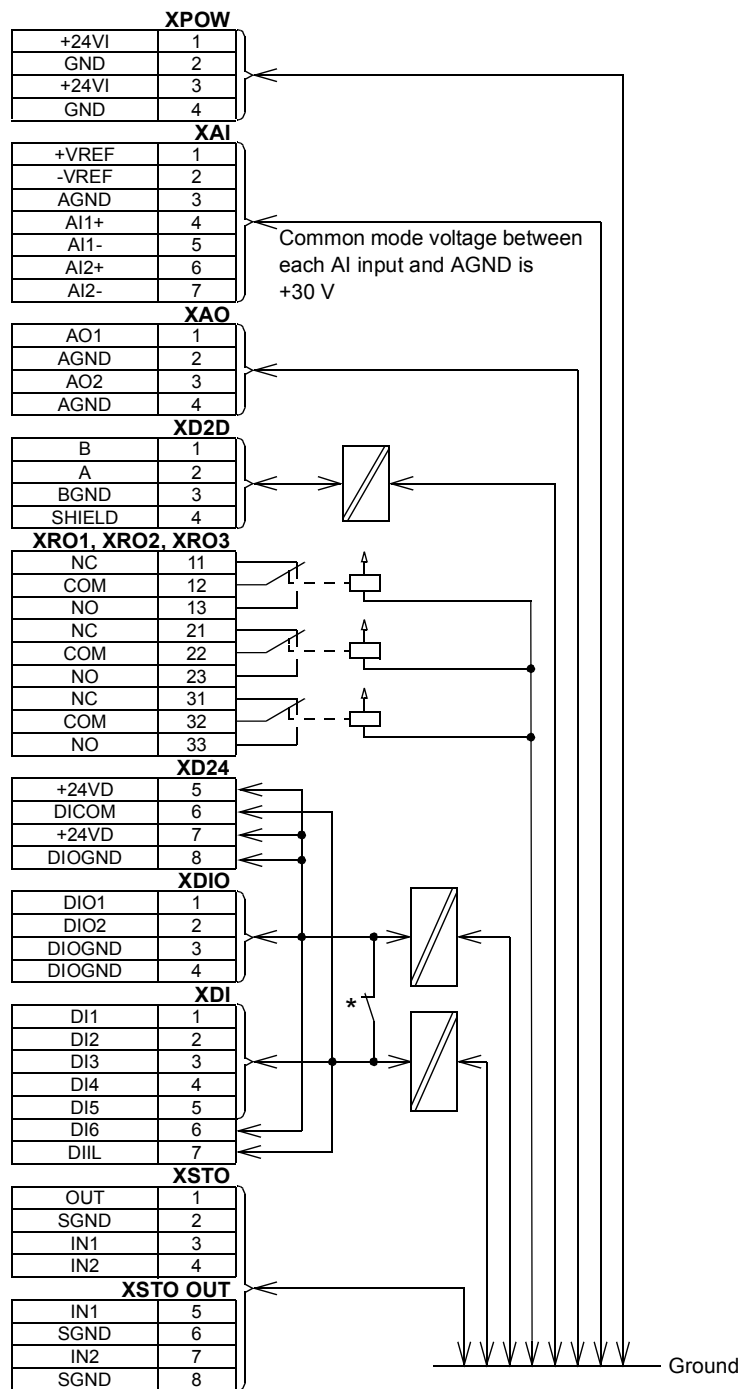
Control unit connector data

Power supply (XPOW)	<p>Connector pitch 5 mm, wire size 2.5 mm² 24 V ($\pm 10\%$) DC, 2 A External power input. Two supplies can be connected for redundancy.</p>
Relay outputs RO1...RO3 (XRO1...XRO3)	<p>Connector pitch 5 mm, wire size 2.5 mm² 250 V AC / 30 V DC, 2 A Protected by varistors</p>
+24 V output (XD24:2 and XD24:4)	<p>Connector pitch 5 mm, wire size 2.5 mm² Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.</p>
Digital inputs DI1...DI6 (XDI:1...XDI:6)	<p>Connector pitch 5 mm, wire size 2.5 mm² 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)</p>
Start interlock input DIIL (XDI:7)	<p>Connector pitch 5 mm, wire size 2.5 mm² 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</p>
Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2)	<p>Connector pitch 5 mm, wire size 2.5 mm²</p>
<p>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.</p>	<p><u>As inputs:</u> 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in}: 2.0 kohm Filtering: 1 ms <u>As outputs:</u> Total output current from +24VD is limited to 200 mA</p>
	
Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)	<p>Connector pitch 5 mm, wire size 2.5 mm² 10 V $\pm 1\%$ and -10 V $\pm 1\%$, R_{load} 1...10 kohm Maximum output current: 10 mA</p>
Analog inputs AI1 and AI2 (XAI:4 ... XAI:7).	<p>Connector pitch 5 mm, wire size 2.5 mm² Current input: -20...20 mA, R_{in} = 100 ohm Voltage input: -10...10 V, R_{in} > 200 kohm Differential inputs, common mode range ± 30 V Sampling interval per channel: 0.25 ms Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range</p>
Current/voltage input mode selection by switches.	

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 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 IN connector of inverter module. See chapter The Safe torque off function (page 237).
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



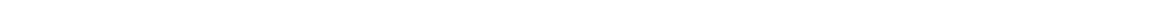
***Ground selector (DICOM=DIOGND) settings**

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 instructions in chapter [Safety instructions](#). If you ignore them, injury or death, or damage to the equipment can occur.

Checklist

Do the steps in section [Electrical safety precautions](#) (page 19) before you start the work. Go through the checklist together with another person.

Check that ...	<input checked="" type="checkbox"/>
The ambient operating conditions meet the specifications given in chapter Technical data .	<input type="checkbox"/>
The drive cabinet has been fixed to floor, and if necessary due to vibration etc, also from top to the wall or roof.	<input type="checkbox"/>
The cooling air will flow freely in and out of the drive cabinet,	<input type="checkbox"/>
<u>If the drive will be connected to an IT (ungrounded) or a corner grounded TN network:</u> The optional EMC filter (+E202) of the drive (if any) has been disconnected. See page 96.	<input type="checkbox"/>
<u>If the drive has been stored over one year:</u> The electrolytic DC capacitors in the DC link of the drive have been reformed. See Converter module capacitor reforming instructions (3BFE64059629 [English]).	<input type="checkbox"/>

Check that ...	<input checked="" type="checkbox"/>
There is an adequately sized protective earth (ground) conductor between the drive and the switchboard, and the conductor has been connected to appropriate terminal. Proper grounding has also been measured according to the regulations.	<input type="checkbox"/>
There is an adequately sized protective earth (ground) conductor between the motor and the drive, and the conductor has been connected to appropriate terminal. Proper grounding has also been measured according to the regulations.	<input type="checkbox"/>
<u>Only for drives with option +D150:</u> There is an adequately sized protective earth (ground) conductor between the user-installed brake resistor and the drive, and the conductor has been connected to appropriate terminal. Proper grounding has also been measured according to the regulations.	<input type="checkbox"/>
The supply voltage matches the nominal input voltage of the drive. Check the type designation label.	<input type="checkbox"/>
The voltage setting of the auxiliary voltage transformers T21 (standard), T101 (option-specific) and T111 (option-specific) is correct. See page 96.	<input type="checkbox"/>
The input power cable has been connected to the appropriate terminals, the phase order is correct, and the terminals have been tightened. (Pull on the conductors to check.)	<input type="checkbox"/>
The motor cable has been connected to the appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull the conductors to check.)	<input type="checkbox"/>
The motor cable (and brake resistor cable, if present) has been routed away from other cables.	<input type="checkbox"/>
No power factor compensation capacitors have been connected to the motor cable.	<input type="checkbox"/>
<u>If a drive bypass connection will be used:</u> The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked, ie, cannot be closed simultaneously.	<input type="checkbox"/>
The external brake resistor (if present) has been connected to the appropriate terminals, and the terminals have been tightened. (Pull on the conductors to check.)	<input type="checkbox"/>
The brake resistor cable has been routed away from other cables.	<input type="checkbox"/>
The control cables have been connected to the appropriate terminals, and the terminals have been tightened. (Pull the conductors to check.)	<input type="checkbox"/>
There are no tools, foreign objects or dust from drilling inside the drive.	<input type="checkbox"/>
All shrouds and cover of the motor connection box are in place. Cabinet doors have been closed.	<input type="checkbox"/>
The motor and the driven equipment are ready for start.	<input type="checkbox"/>

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 typically 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. See the listing of manuals inside the front cover.



Action	<input checked="" type="checkbox"/>
Safety	
 WARNING! Obey the safety instructions during the start-up procedure. See chapter Safety instructions on page 15.	<input type="checkbox"/>
Checks/Settings with no voltage connected	
Ensure that the disconnecter of the supply transformer is locked to the off (0) position, ie. no voltage is, and cannot be connected to the drive inadvertently.	<input type="checkbox"/>
Check that the main switch-disconnector [Q1.1] is switched off, or main breaker [Q1] racked out.	<input type="checkbox"/>
Check that the grounding switch [Q9.1] (option +F259) is switched on.	<input type="checkbox"/>
Check the mechanical and electrical installation of the drive. See Installation checklist (page 143).	<input type="checkbox"/>
Check the settings of breakers/switches in the auxiliary circuits. See the circuit diagrams delivered with the drive.	<input type="checkbox"/>
Check the tap settings of transformers T21, T101 (if present) and T111 (if present). See Checking the settings of transformers T21, T101 and T111 (page 96).	<input type="checkbox"/>
Disconnect any unfinished or uninspected auxiliary voltage (115/230 V AC) cables that lead from the terminal blocks to the outside of the equipment.	<input type="checkbox"/>
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.	<input type="checkbox"/>
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.	<input type="checkbox"/>
<u>Drives with ground fault monitoring for IT (ungrounded) systems (option +Q954):</u> Adjust the settings of the ground fault monitor to suit the installation. See the circuit diagrams of the delivery and <i>IRDH275B Ground Fault Monitor Operating Manual</i> by Bender (code: TGH1386en).	<input type="checkbox"/>
<u>Drives with Pt100 relays (options +nL506 and +nL514+Q971):</u> <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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. 	<input type="checkbox"/>
Powering up the auxiliary circuit of the drive	
Make sure that it is safe to connect voltage. Ensure that <ul style="list-style-type: none"> • 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. 	<input type="checkbox"/>
<u>Drives with a voltmeter (option +G334):</u> Make sure that the circuit breaker of the measuring circuit [F5.1] is closed.	<input type="checkbox"/>
Close the circuit breakers and/or fuse disconnectors supplying the auxiliary voltage circuits.	<input type="checkbox"/>
Close the cabinet doors.	<input type="checkbox"/>
Close the main breaker of the supply transformer.	<input type="checkbox"/>



Action	<input checked="" type="checkbox"/>
Switch on the auxiliary voltage [Q21]. <u>Drives of frame size 1×R8i + 1×R8i</u> : Close the main switch-disconnector [Q1.1]. This will power up the main circuit of the drive as well as the auxiliary voltage circuit.	<input type="checkbox"/>
Setting up the supply unit parameters	
Check the voltage range setting in parameter <i>195.01 Supply voltage</i> . For more information on setting up the supply control program, see the <i>ACS880 IGBT supply control program firmware manual</i> (3AUA0000131562 [English]). If you need more information on the use of the control panel, see <i>ACX-AP-x Assistant control panels user's manual</i> (3AUA0000085685 [English]).	<input type="checkbox"/>
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.	<input type="checkbox"/>
Check that parameter <i>95.09 Fuse switch control</i> is disabled.	<input type="checkbox"/>
<u>Drives with a brake chopper (option +D150)</u> : Refer also to chapter <i>Resistor braking</i> , section <i>Start-up</i> (page 256).	<input type="checkbox"/>
<u>Drives with a sine output filter (option +E206)</u> : Check that bit 1 of parameter <i>95.15 Special HW settings</i> is activated.	<input type="checkbox"/>
<u>Drives with a fieldbus adapter module (optional)</u> : 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.	<input type="checkbox"/>
<u>Drives with an encoder interface module (optional)</u> : 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.	<input type="checkbox"/>
Powering up the main circuit of the drive	
Switch off the grounding switch [Q9.1] (option +F259).	<input type="checkbox"/>
Close the main switch-disconnector [Q1.1] or main breaker [Q1]. (With frame size 1×R8i + 1×R8i, this has already been done to power up the auxiliary circuit.) Note: Do not use excessive force. The main switch-disconnector (or main breaker) can only be closed when <ul style="list-style-type: none"> the main input terminals (L1, L2, L3) are powered, and auxiliary voltage is switched on [Q21], and grounding switch is off [Q9.1] (option +F259). 	<input type="checkbox"/>
Close the charging switch [Q3]. This will enable the pre-charging of the DC capacitors of the drive. The charging itself is controlled by the supply control unit [A51].	<input type="checkbox"/>
Turn the operating switch [S21] to the ON (1) position to activate the run enable signal for the supply unit. 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.	<input type="checkbox"/>
On-load checks	
Start the motor to perform the ID run.	<input type="checkbox"/>
Check that the cooling fans rotate freely in the right direction, and the air flows upwards.	<input type="checkbox"/>
Check that the motor starts, stops and follows the speed reference in the correct direction when controlled with the control panel.	<input type="checkbox"/>



Action	<input checked="" type="checkbox"/>
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.	<input type="checkbox"/>
<u>Drives in which the Safe torque off control circuit is in use:</u> Test and validate the operation of the Safe torque off function. See Start-up including acceptance test (page 243).	<input type="checkbox"/>
<u>Drives with an emergency stop circuit (options +Q951, +Q952, +Q963, +Q964, +Q978, +Q979):</u> 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 (see page 89).	<input type="checkbox"/>
<u>Drives with the Prevention of unexpected start-up with safety relay (option +Q957):</u> 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 (see page 89).	<input type="checkbox"/>
<u>Test and validate the operation of Prevention of unexpected start-up with FSO-xx (option +Q950)</u>	<input type="checkbox"/>





Fault tracing

Contents of this chapter

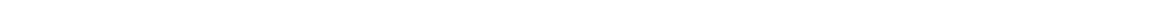
This chapter describes the fault tracing possibilities of the drive.


LEDs

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.
Supply or inverter control unit (A51 or A41)	BATT OK	Green	Battery voltage of the real-time clock is OK (higher than 2.8 V). When the LED is not lit, <ul style="list-style-type: none"> • 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 preventive 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).

Legend

I Inspection (visual inspection and maintenance action if needed)

R Replacement

P Performance of on/off-site work (commissioning, tests, measurements or other work)

Recommended annual actions by the user	
Air inlet and outlet meshes (IP22/IP42)	I
Cabinet door filters (IP54)	R
Ambient conditions (dustiness, moisture, corrosion, temperature)	I
Cleaning of heatsinks	I
Tightness of terminals	I
Quality of supply voltage	P
Air circuit breaker maintenance (if present)	I
Reforming DC circuit capacitors (spare modules and spare capacitors)	O
Spare parts	I

Cooling	Years from start-up						
	3	6	9	12	15	18	21
Supply and inverter module main cooling fans			R			R	
LCL filter module cooling fans		R		R		R	
Sine filter (option +E206) cooling fan		R		R		R	
Supply and inverter modules: circuit board compartment fan		R		R		R	
Internal cabinet cooling fans (internal, door and IP54)		R		R		R	
Batteries							
Control panel battery			R			R	
Control unit battery		R		R		R	

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.

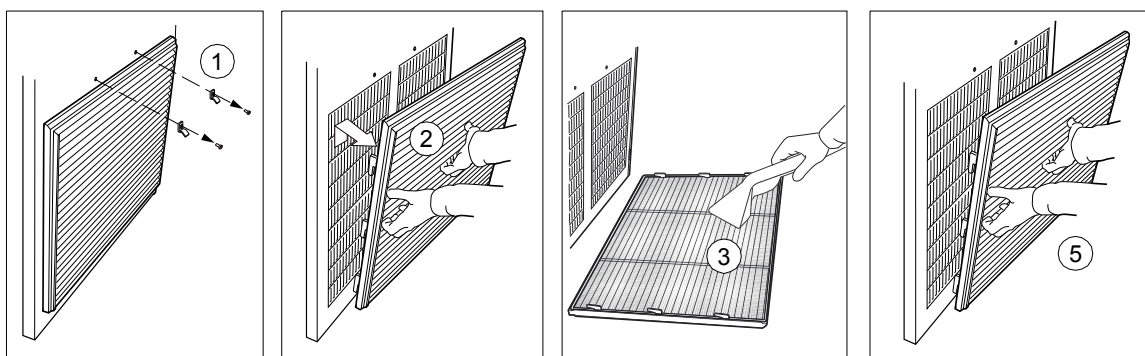


WARNING! Use a vacuum cleaner with an antistatic hose and nozzle, and wear a grounding wristband. Otherwise an electrostatic charge might build up and damage the circuit boards.

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.

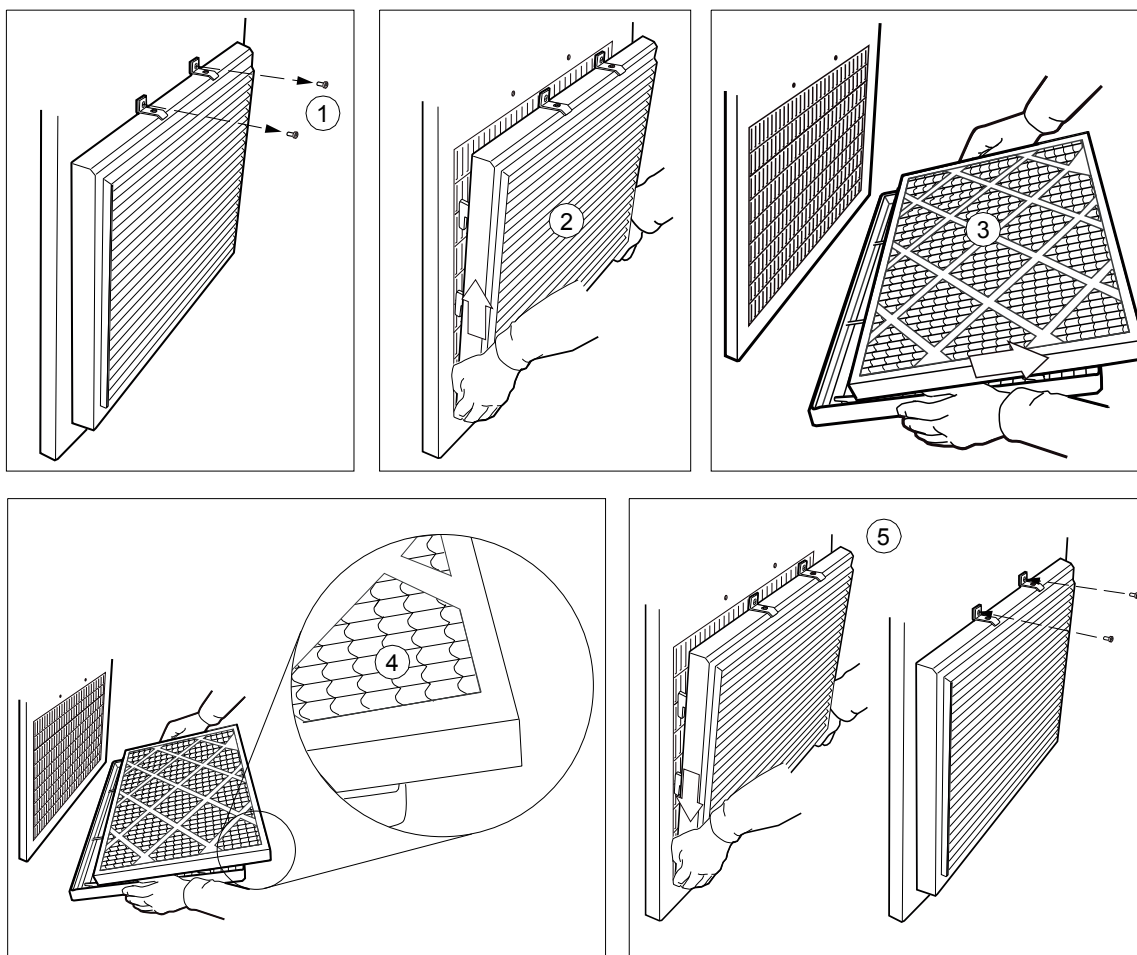
■ Cleaning the door air inlets (IP22 and IP42)

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.



■ Replacing the outlet (roof) filters (IP54)

1. Remove the front and back gratings of the fan compartment 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.

Module heatsinks

The module heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean. 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 module from the cabinet.
3. Remove the module cooling fan(s). See section [Fans](#) below.
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.

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 (if running) 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.

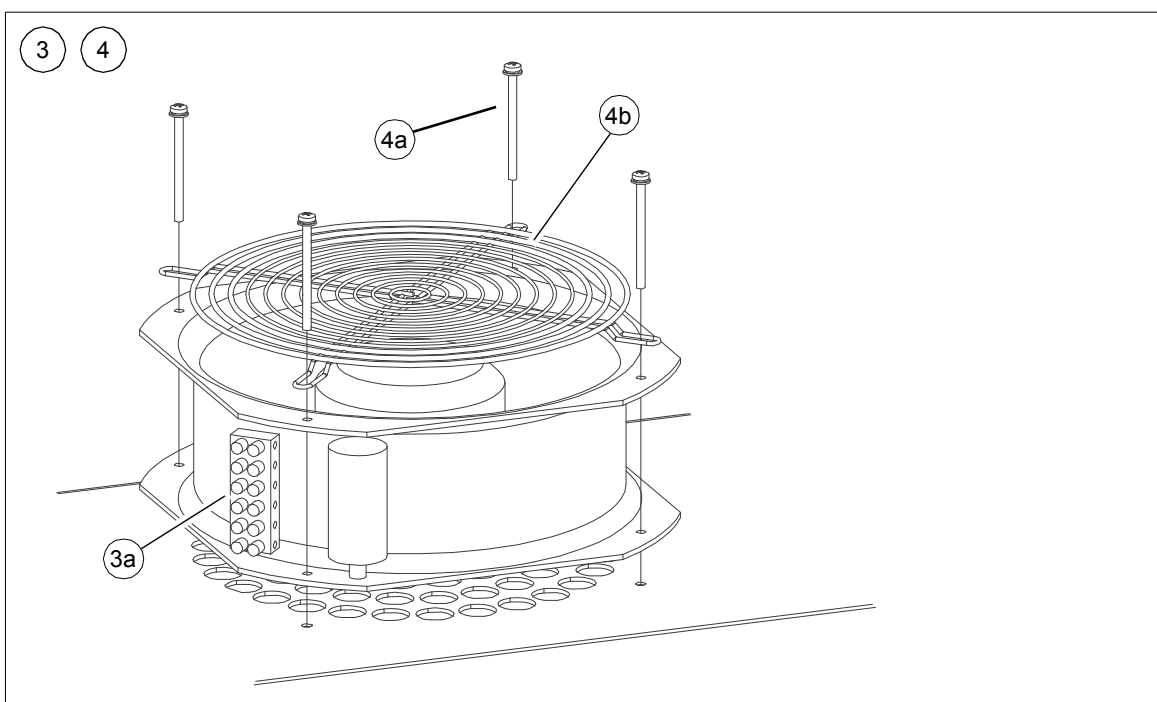
1. Stop the drive and do the steps in section [Electrical safety precautions](#) (page 19) before you start the work.
 2. Remove the shrouding from in front of the fan.
 3. Unplug the power supply cable of the fan.
 4. Remove the fastening screws of the fan.
 5. Install the new fan in reverse order.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

■ Replacing the fan(s) in the incoming 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 (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.

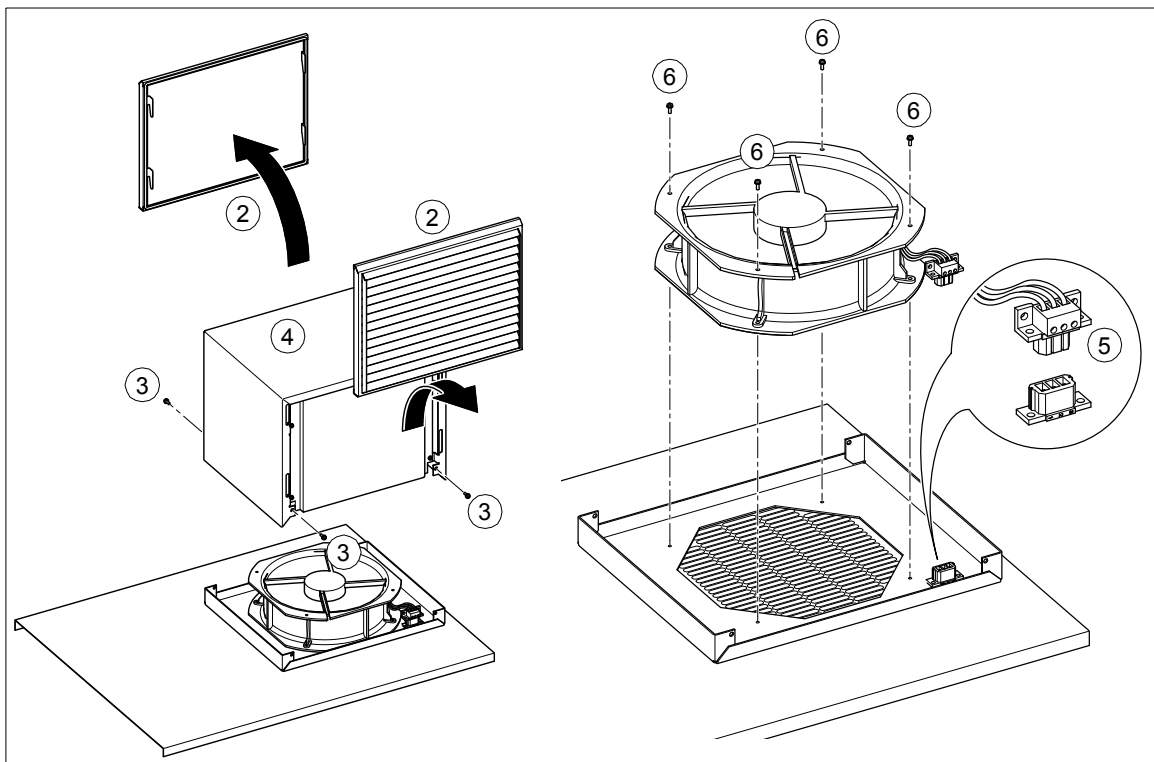


■ Replacing a roof fan (IP54/UL type 12)



WARNING! 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. 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.

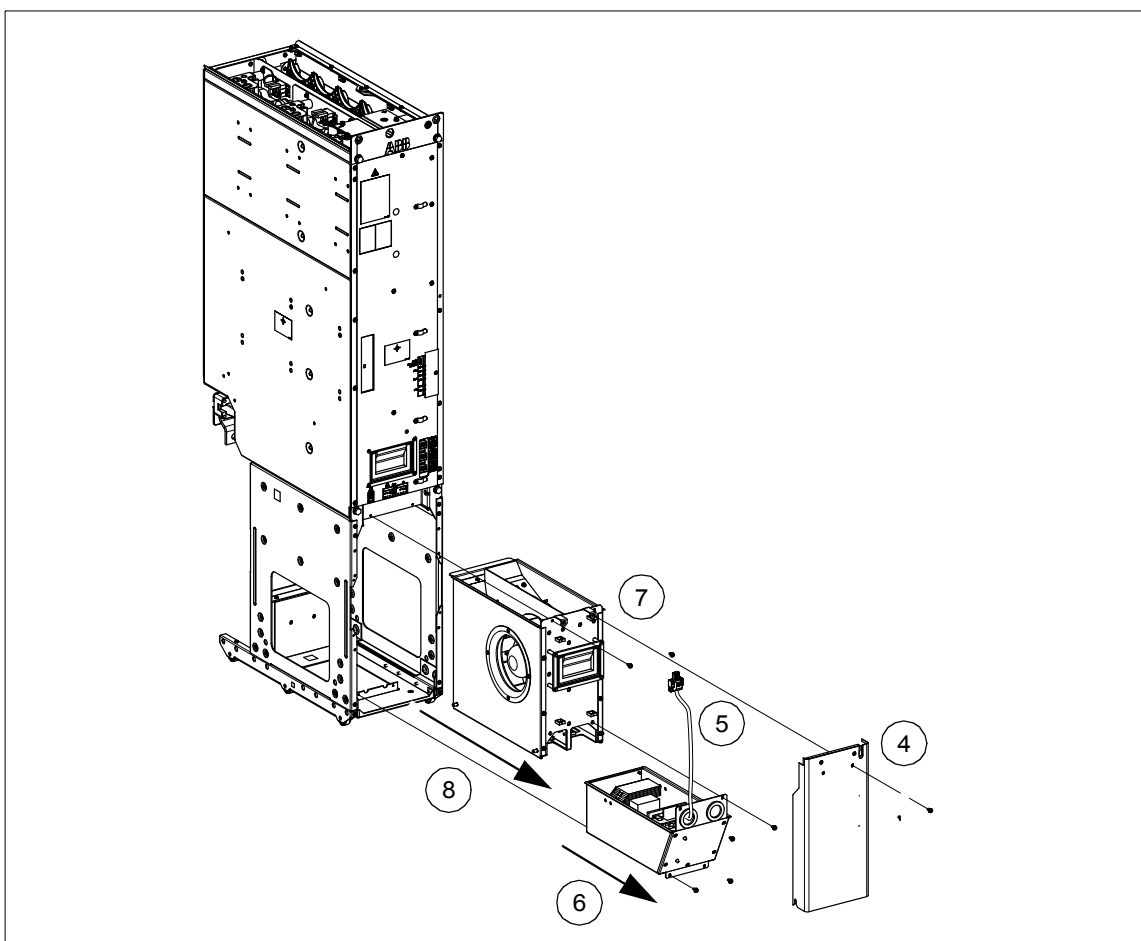


■ Replacing a supply or inverter module cooling fan



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 shroud in front of the fan.
4. Remove the cover panel in front of the fan.
5. Unplug the wiring of the fan.
6. Remove the fan control box.
7. Undo the screws of the fan unit.
8. Pull the fan unit out.
9. Install the new fan in reverse order.



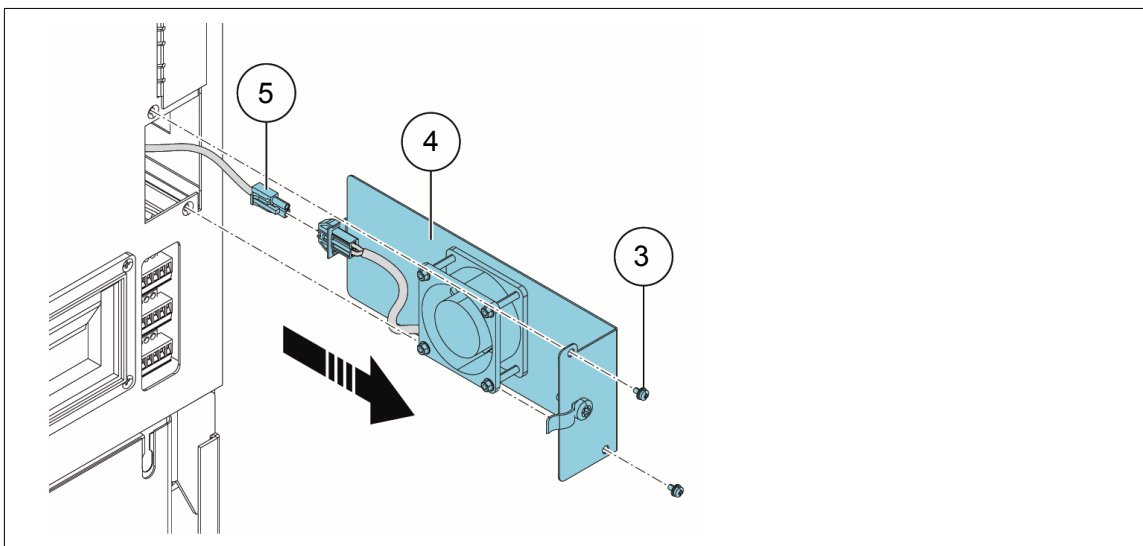
■ Replacing the circuit board compartment fan (frame R8i)

The R8i module is equipped with a fan blowing air through the circuit board compartment. The fan is accessible from the front of the module.

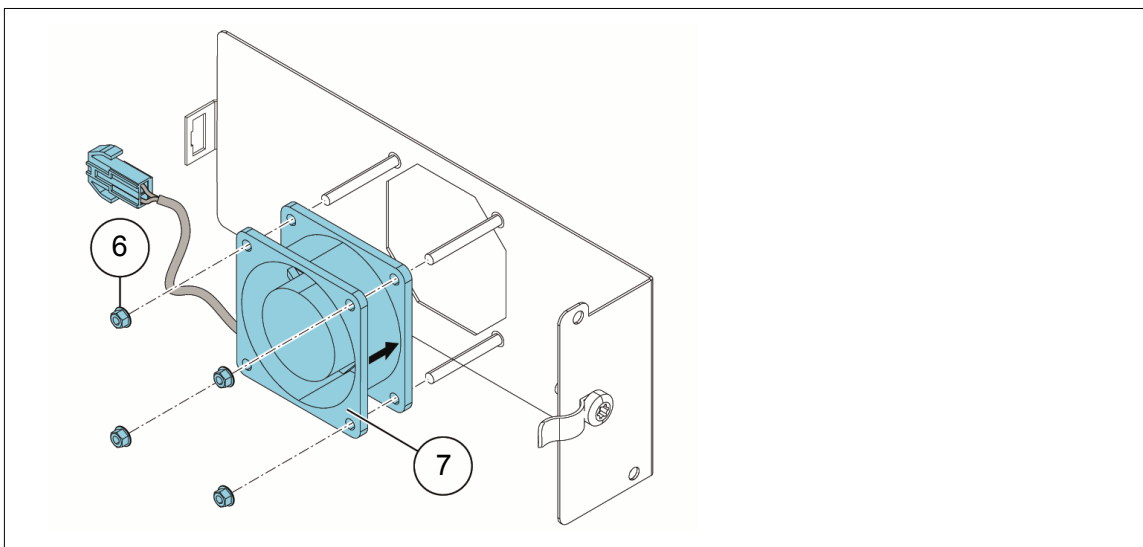


WARNING! Obey the instructions in chapter [Safety instructions](#). If you ignore them, injury or death, or damage to the equipment can occur.

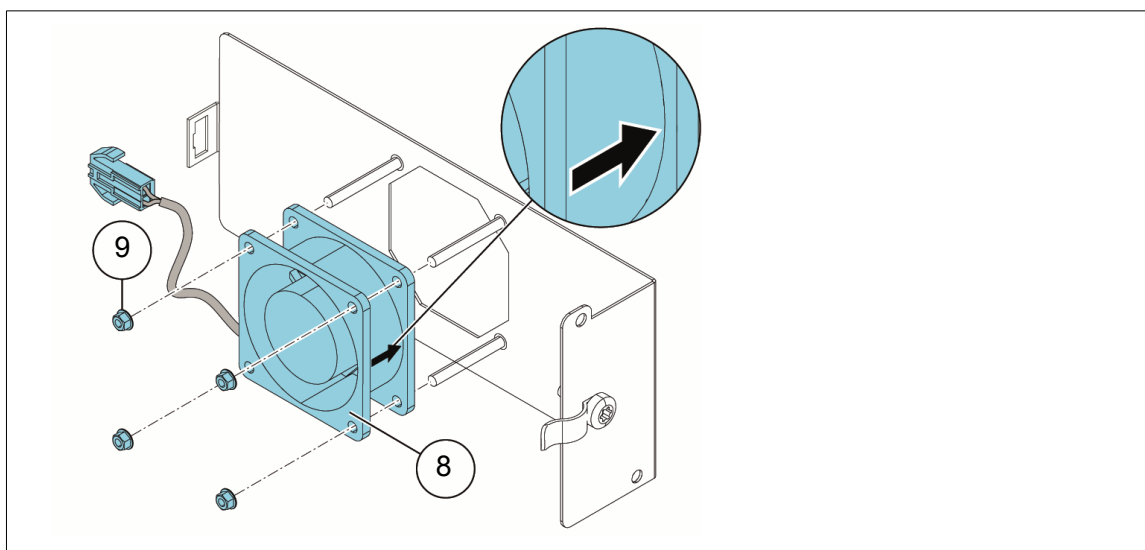
1. Stop the drive (if running) and do the steps in section [Electrical safety precautions](#) (page 19) before you start the work.
2. Open the door of the module cubicle.
3. Remove the two M4×12 (T20) screws which lock the fan holder.
4. Pull the fan holder out of the module.
5. Disconnect the fan cable.



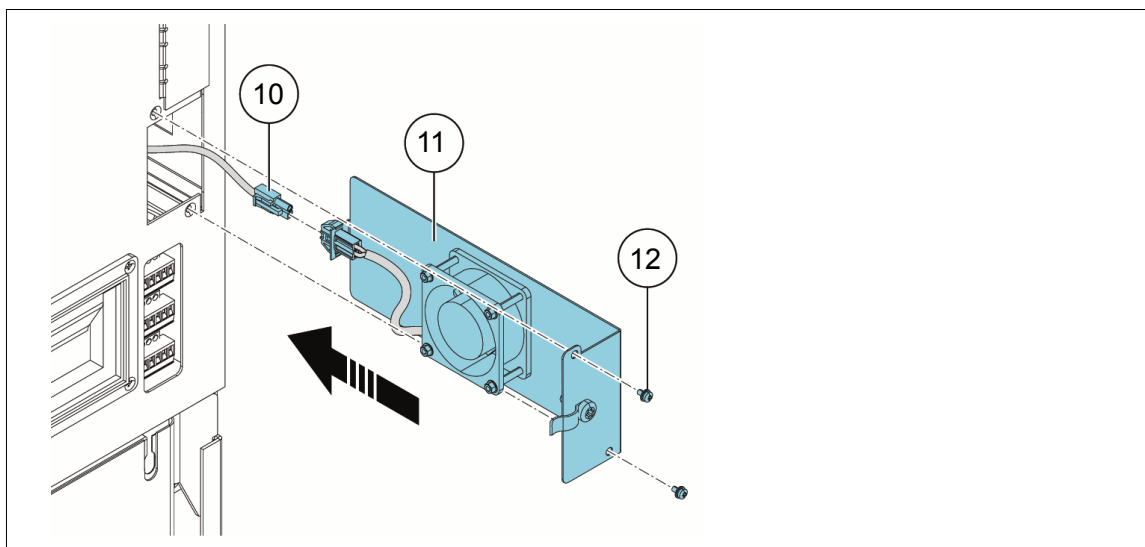
6. Remove the four M3 (5.5 mm) nuts which hold the fan.
7. Remove the fan from the fan holder.



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.

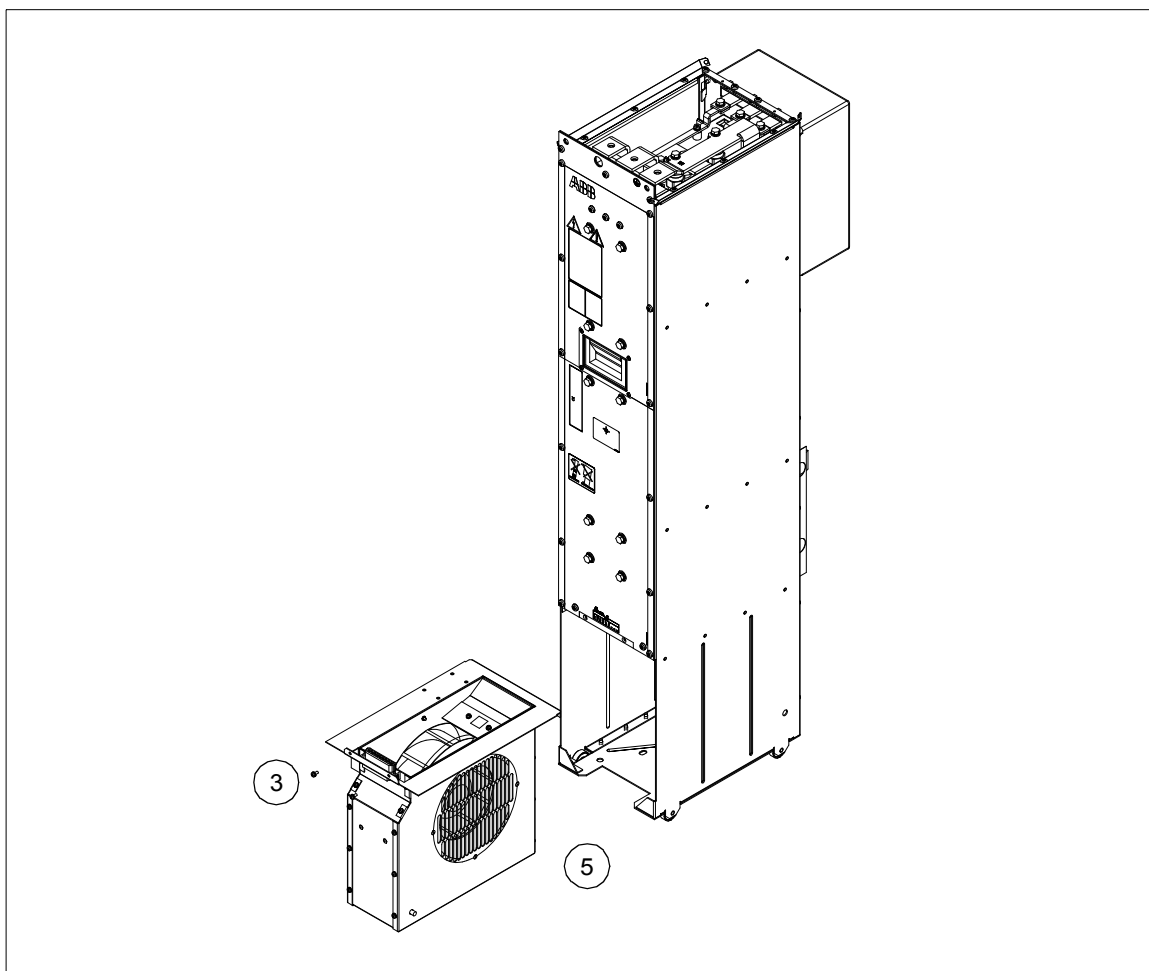


■ Replacing the fan of the LCL filter (BLCL-1x-x)



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. Open the door.
3. Remove the screw in front of the fan unit.
4. Unplug the fan power supply cable.
5. Pull the fan unit out.
6. Install a new fan in reverse order.

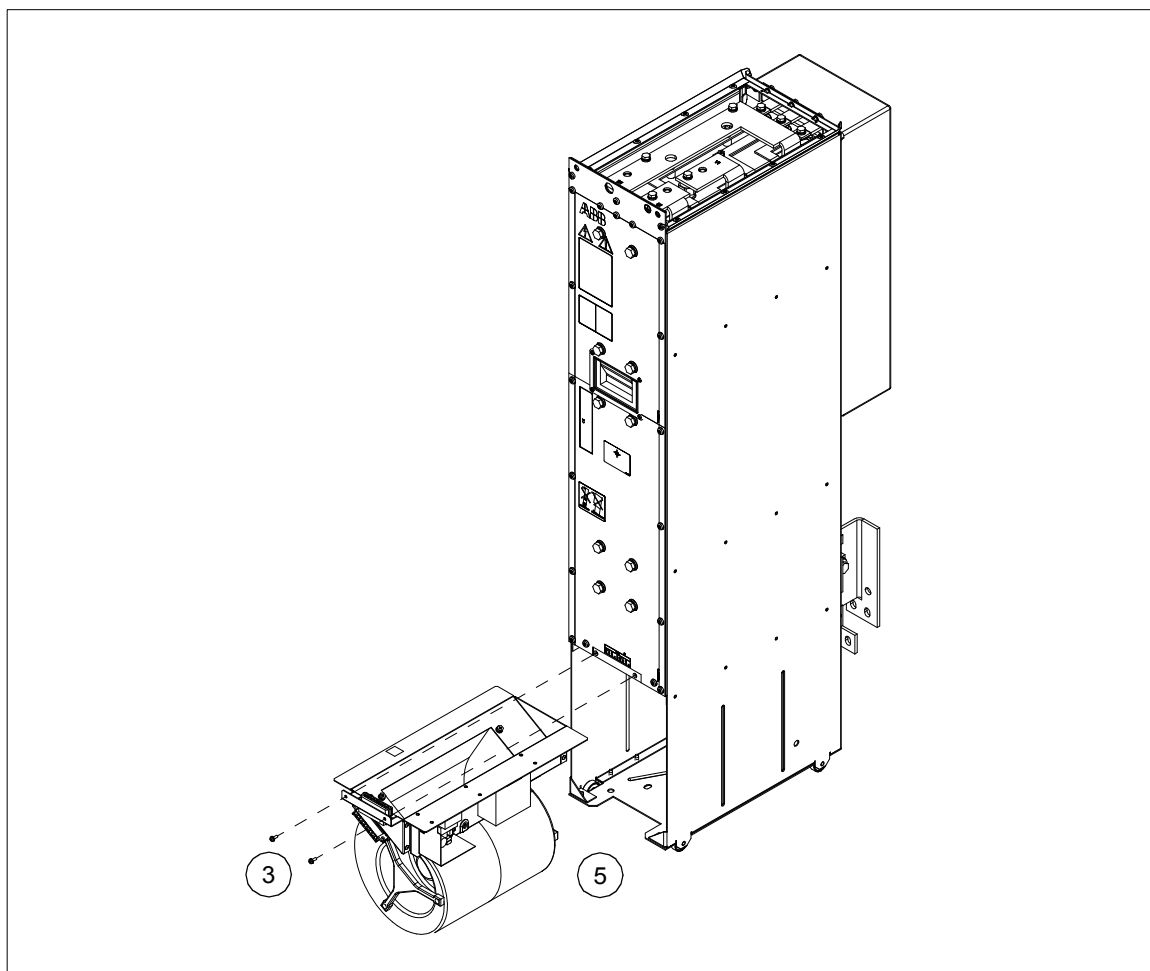


■ Replacing the fan of the LCL filter (BLCL-2x-x)



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. Open the door.
3. Remove the two screws in front of the fan unit.
4. Unplug the fan power supply cable.
5. Pull the fan unit out.
6. Install a new fan in reverse order.



Supply and inverter modules

■ Cleaning

The module heatsink fins pick up dust from the cooling air. The module runs into overtemperature warnings and faults if the heatsink is not clean. In a “normal” environment (neither especially dusty nor clean), the heatsink should be checked annually, in a dusty environment more often.



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. Remove the cooling fan of the supply module as described under [Fans](#) elsewhere in this chapter.
3. Blow clean, dry and oilfree compressed air through the module from bottom to top, simultaneously using a vacuum cleaner at the air outlet to trap the dust. **Note:** Prevent the dust from entering adjoining equipment.
4. Refit the cooling fan.

■ Replacing a supply or inverter module



WARNING! Make sure the replacement module has exactly the same type code as the old module. See also section [Licensing](#) (page 30).

Follow the module extraction and insertion procedures under [Connecting the motor cables \(units without common motor terminal cubicle or sine output filter\)](#) (page 109).

■ Reduced run

A “reduced run” function is available for supply and inverter units consisting of parallel-connected 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 drive still apply; for example, the inverter modules remaining in use must be able to provide the motor with enough magnetizing current.

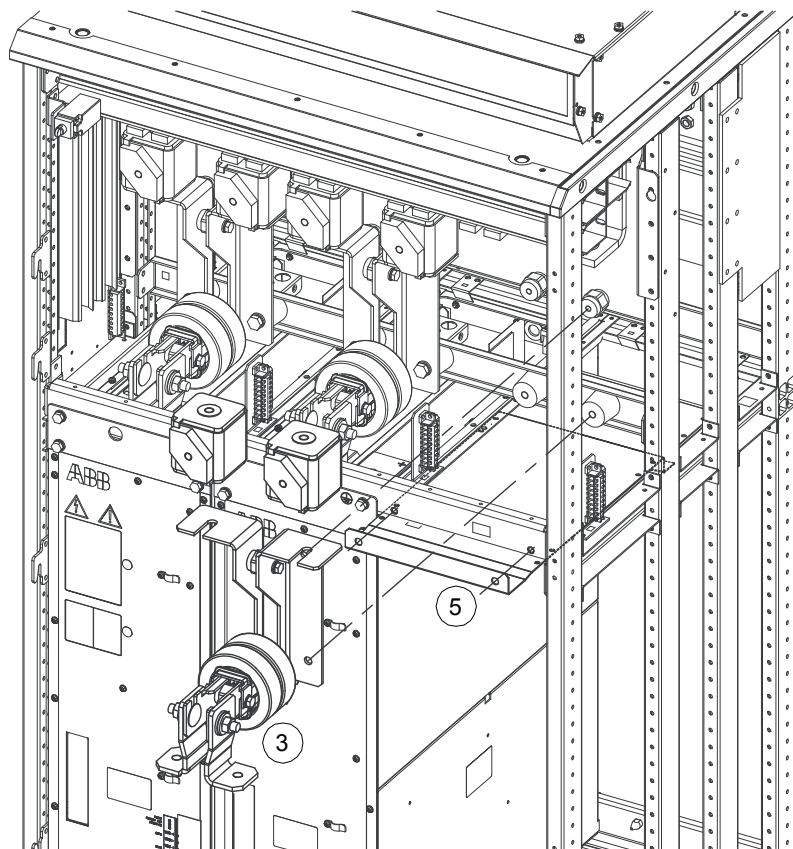
Activation of the reduced run function



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. The drawing represents the inverter unit, but the procedure is similar for the supply unit.

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.
 3. Remove the DC busbar assembly (along with fuses) above the module. Store these parts – they are to be reinstalled only with the module. Make note of the order of washers.
 4. Remove the faulty module from its bay according to section [Removing the inverter module\(s\)](#) (page 111).
 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 control unit (A41 or A51) 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 supply/inverter modules present into parameter *195.13/95.13 Reduced run mode*.
11. Reset all faults and start the drive.
12. If the module removed was an inverter module and the Safe torque off function is in use, perform an acceptance test as described under *Start-up including acceptance test* (page 243).

The maximum current is now automatically limited according to the new configuration. A mismatch between the number of detected modules and the value set in *195.13/95.13* will generate a fault.

Returning the module

1. Remove the air baffle and 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 *195.13/95.13* to 0 to disable the reduced run function.
 4. If the module reinstalled was an inverter module and the Safe torque off function is in use, perform an acceptance test as described under [Start-up including acceptance test](#) (page 243).
-

LCL filter

■ Replacing the LCL filter



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

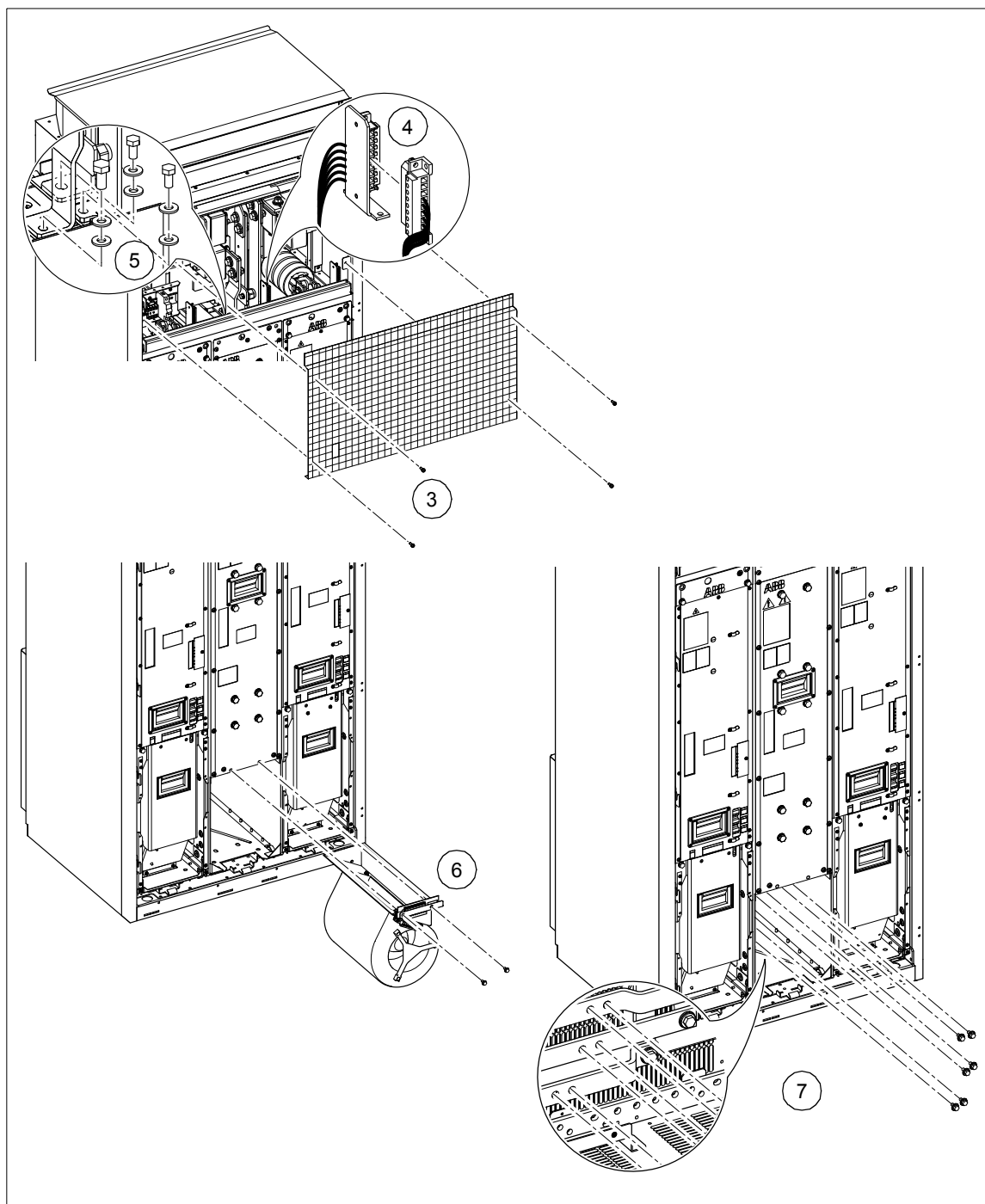
- Use extreme caution when maneuvering modules that run on wheels. The modules are heavy and have a high center of gravity. They topple over easily if handled carelessly.
- When removing a module on wheels, pull the module carefully out of the cubicle along the extraction/installation ramp. While pulling on the handle, keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
- When reinserting the module, keep your fingers away from the edge of the module front plate to avoid pinching them between the module and the cubicle. Also, keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
- Do not tilt the module. Do not leave the module unattended on a sloping floor.
- Do not use the module extraction/installation ramp with plinth heights over 50 mm. The ramp supplied with the drive system is designed for a plinth height of 50 mm (the standard plinth height of ABB cabinets).

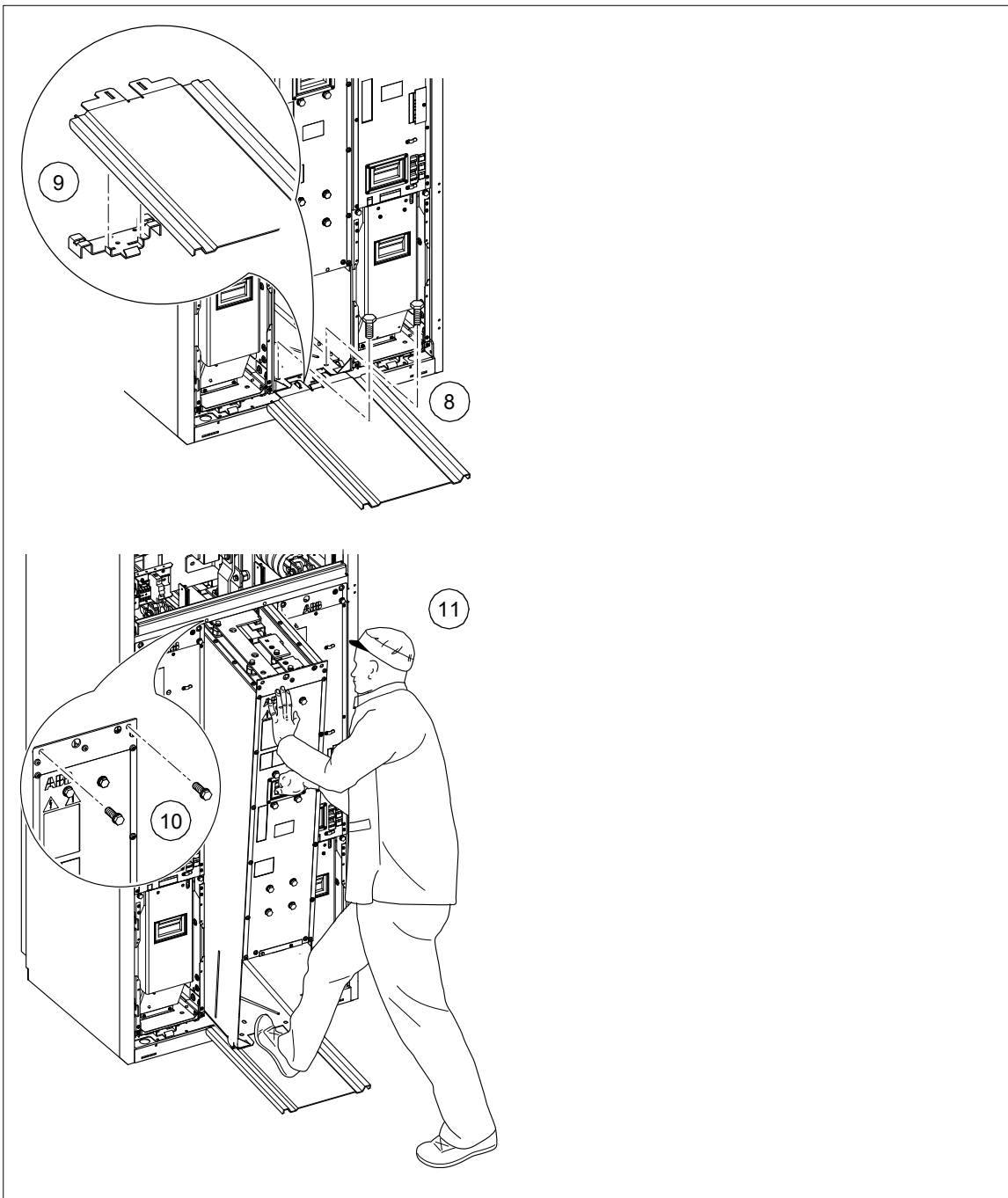


WARNING! Obey the instructions in chapter [Safety instructions](#). If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive (if running) and do the steps in section [Electrical safety precautions](#) (page 19) before you start the work.
2. Open the cubicle door.
3. Undo the four screws of the shroud in the upper part of the cubicle. Remove the shroud.
4. Unplug the signal connector cable on top of the module.
5. Remove the screws in the busbars on top of the LCL filter module. Be careful not to drop the screws inside the module!
6. Remove the fan of the LCL filter module. Unplug the signal connector cable and remove the screws in front of the fan.
7. Remove the fastening screws in the busbar behind the module.
8. Remove the two screws that fasten the bottom of the module to the base of the cabinet.
9. Install the module extraction/installation ramp: lift the ramp against the cabinet base so that the hooks of the base go into the ramp's holes.
10. Remove the two fastening screws that fasten the top of the module to the cabinet frame.
11. Pull the module carefully out of the cabinet along the ramp. While pulling on the handle, keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.

12. Replace the module: install the module in reverse order. Mind your fingers. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back. **Note:** Be careful not to break the fastening screws: tighten the fastening screws of the module to 22 N·m (16.2 lbf.ft) and fastening bolts of the DC output busbars to 70 N·m (51.6 lbf.ft).
 - Plug the module signal wire set to the module signal connector.
 - Fasten the shrouds.
13. Remove the module extraction/installation ramp and close the cabinet doors.





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. See page [55](#) for information on finding out the manufacturing date. For information on reforming the capacitors, see *Converter module capacitor reforming instructions* (3BFE64059629 [English]).

Fuses

■ Replacing the AC fuses in the incoming cubicle

Units without a main breaker have AC fuses in the incoming cubicle (or, in the case of frame 1×R8i + 1×R8i, in the combined supply and inverter module cubicle).



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 cubicle door.
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) fuses: 46 N·m (34 lbf·ft)
 - Other: Refer to the fuse manufacturer's instructions.
8. Reinstall the shroud and close the door.

■ Replacing the AC fuses in the LCL filter module or supply module cubicle (frame 3×R8i + 3×R8i and up)

Frames 3×R8i + 3×R8i and up have AC fuses located above each LCL filter module. To replace, use the procedure [Replacing the DC fuses in the supply module cubicle \(frame 2×R8i + 2×R8i and up\)](#) below.

■ Replacing the DC fuses in the supply module cubicle (frame 2×R8i + 2×R8i and up)

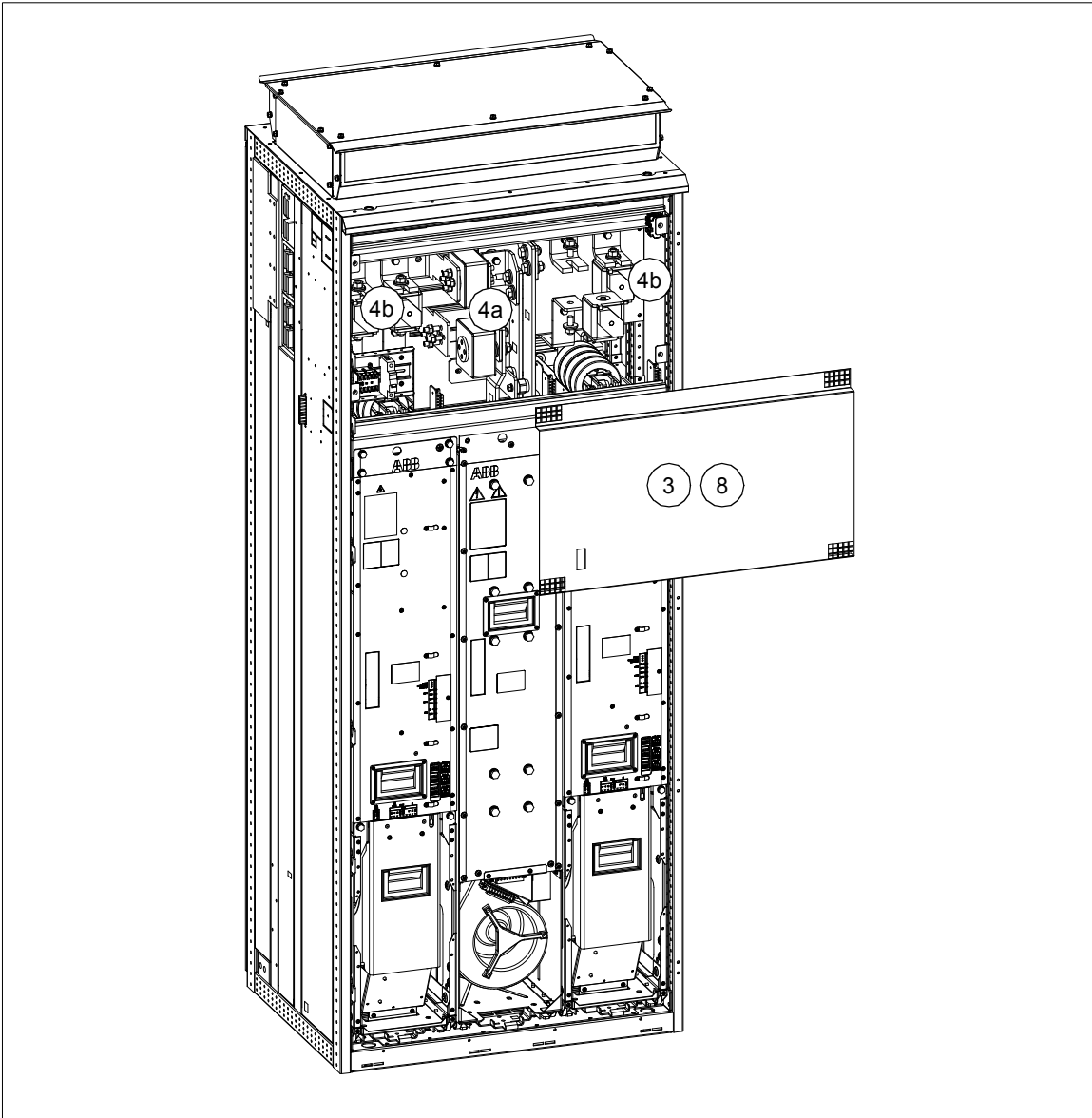
There are DC fuses at the output of each supply module (labeled 4b in the drawing below). Note that there are also DC fuses at the input of each inverter module; see page 175.

This procedure can also be used to replace the AC fuses located above the LCL filter modules (4a).



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 supply module cubicle.
 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.
-



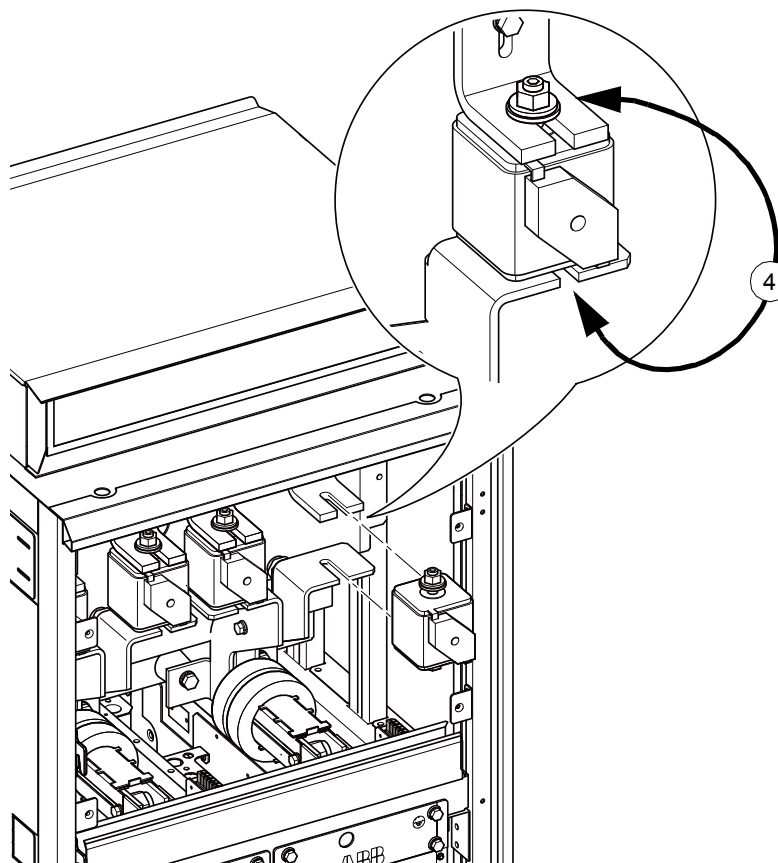
■ Replacing the DC fuses in the inverter module cubicle (frame 2×R8i + 2×R8i and up)

Parallel-connected inverter modules have DC fuses fitted above each module.



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](#) on page 19 before you start the work.
2. Open the door of the inverter module cubicle.
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.
7. Tighten the nuts to torque as follows:
 - 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 shrouding removed earlier and close the cubicle door.



Control panel

■ Replacing the 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.

■ Memory unit

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



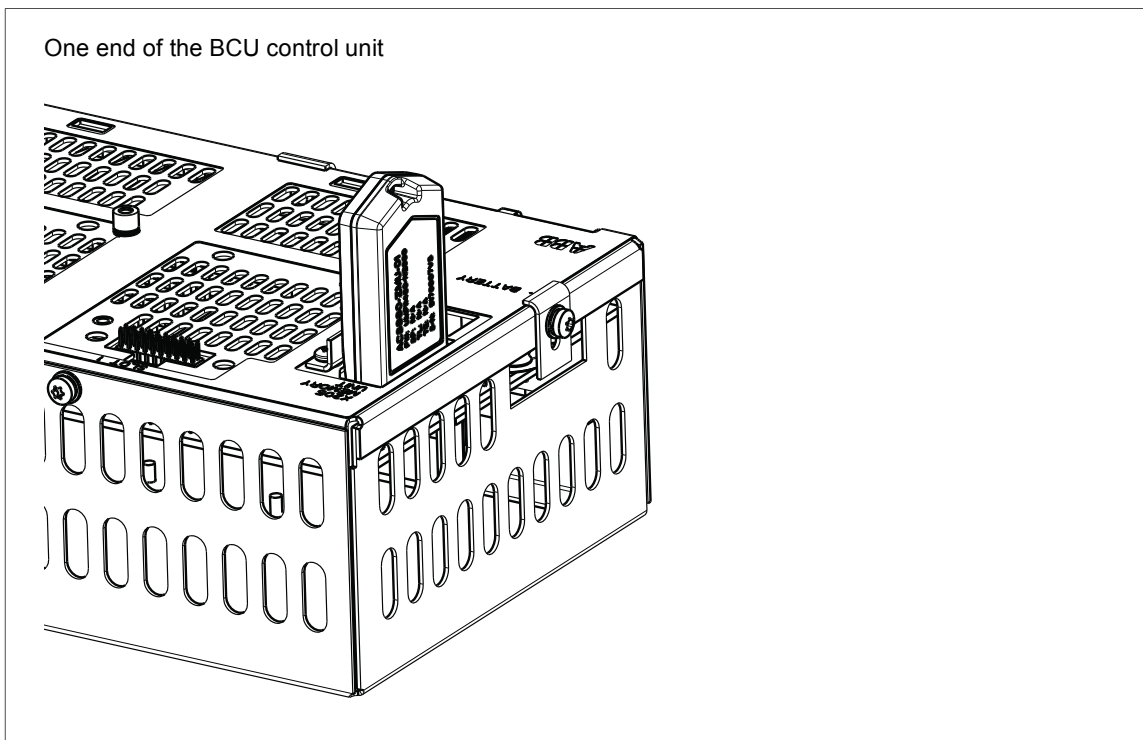
WARNING! Do not remove or insert the memory unit when the control unit is powered.



WARNING! Obey the instructions in chapter [Safety instructions](#). If you ignore them, injury or death, or damage to the equipment can occur.

1. 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.

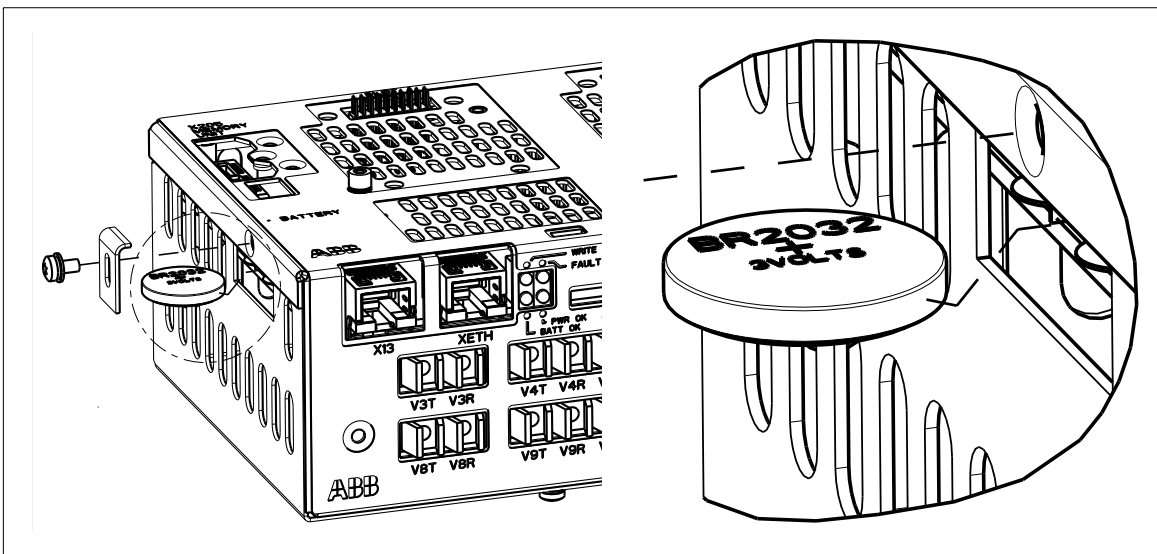
One end of the BCU control unit



■ Control unit battery

Replace the real-time clock battery if the BATT OK LED is not illuminated when the control unit is powered. For information on the LED, see [Control unit layout and connections](#) on page 132.

1. 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.

Drive type ACS880-37- ...	Input ratings	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	
$U_N = 400\text{ V}$												
0450A-3	418	450	590	250	–	312	432	200	–	337	160	–
0620A-3	575	620	810	355	–	430	595	315	–	464	250	–
0870A-3	807	870	1140	500	–	603	835	450	–	651	355	–
1110A-3	1030	1110	1450	630	–	769	1066	560	–	830	450	–
1210A-3	1123	1210	1580	710	–	838	1162	630	–	905	500	–
1430A-3	1327	1430	1860	800	–	991	1373	710	–	1070	560	–
1700A-3	1577	1700	2210	1000	–	1178	1632	900	–	1272	710	–
2060A-3	1911	2060	2680	1200	–	1427	1978	1100	–	1541	800	–
2530A-3	2347	2530	3290	1400	–	1753	2429	1200	–	1892	1000	–

Drive type ACS880-37- ...	Input ratings	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	
$U_N = 500\text{ V}$												
0420A-5	390	420	550	250	350	364	403	250	300	314	200	250
0570A-5	529	570	750	400	500	494	547	355	450	426	250	350
0780A-5	724	780	1020	560	700	675.5	749	500	600	583	400	500
1010A-5	937	1010	1320	710	900	875	970	630	800	755	500	600
1110A-5	1030	1110	1450	800	1000	961	1066	710	900	830	560	700
1530A-5	1420	1530	1990	1100	1400	1325	1469	1000	1250	1144	800	1000
1980A-5	1837	1980	2580	1400	1750	1715	1901	1300	1500	1481	1000	1250
2270A-5	2106	2270	2960	1600	2000	1966	2179	1500	1900	1698	1200	1500
$U_N = 690\text{ V}$												
0320A-7	297	320	480	315	350	382	307	250	300	239	200	250
0390A-7	362	390	590	355	400	466	374	355	350	292	250	300
0580A-7	538	580	870	560	600	693	557	500	600	434	400	450
0660A-7	612	660	990	630	700	789	634	560	600	494	450	500
0770A-7	714	770	1160	710	800	920	739	710	700	576	560	600
0950A-7	881	950	1430	900	1000	1135	912	800	1000	711	710	700
1130A-7	1048	1130	1700	1100	1250	1350	1085	1000	1100	845	800	1000
1450A-7	1345	1450	2180	1400	1500	1733	1392	1300	1500	1085	1000	1100
1680A-7	1559	1680	2520	1600	1750	2008	1613	1500	1750	1257	1200	1250
1950A-7	1809	1950	2930	1900	2000	2330	1872	1800	2000	1459	1400	1500
2230A-7	2069	2230	3350	2200	2500	2665	2141	2000	2250	1668	1600	1750
2770A-7	2570	2770	4160	2700	3100	3310	2659	2600	2900	2072	2000	2250
3310A-7	3071	3310	4970	3200	–	3956	3178	3000	–	2476	2400	2700

Definitions

U_N	Supply voltage range. See also section Electrical power network specification (page 189).
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 (ACS880-37-xxxxA-5) and 575 V (ACS880-37-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).

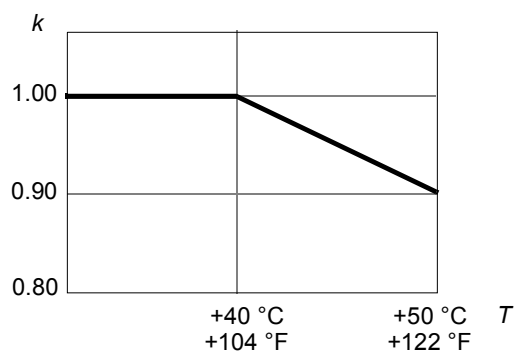
Note 2: To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.

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

■ Derating

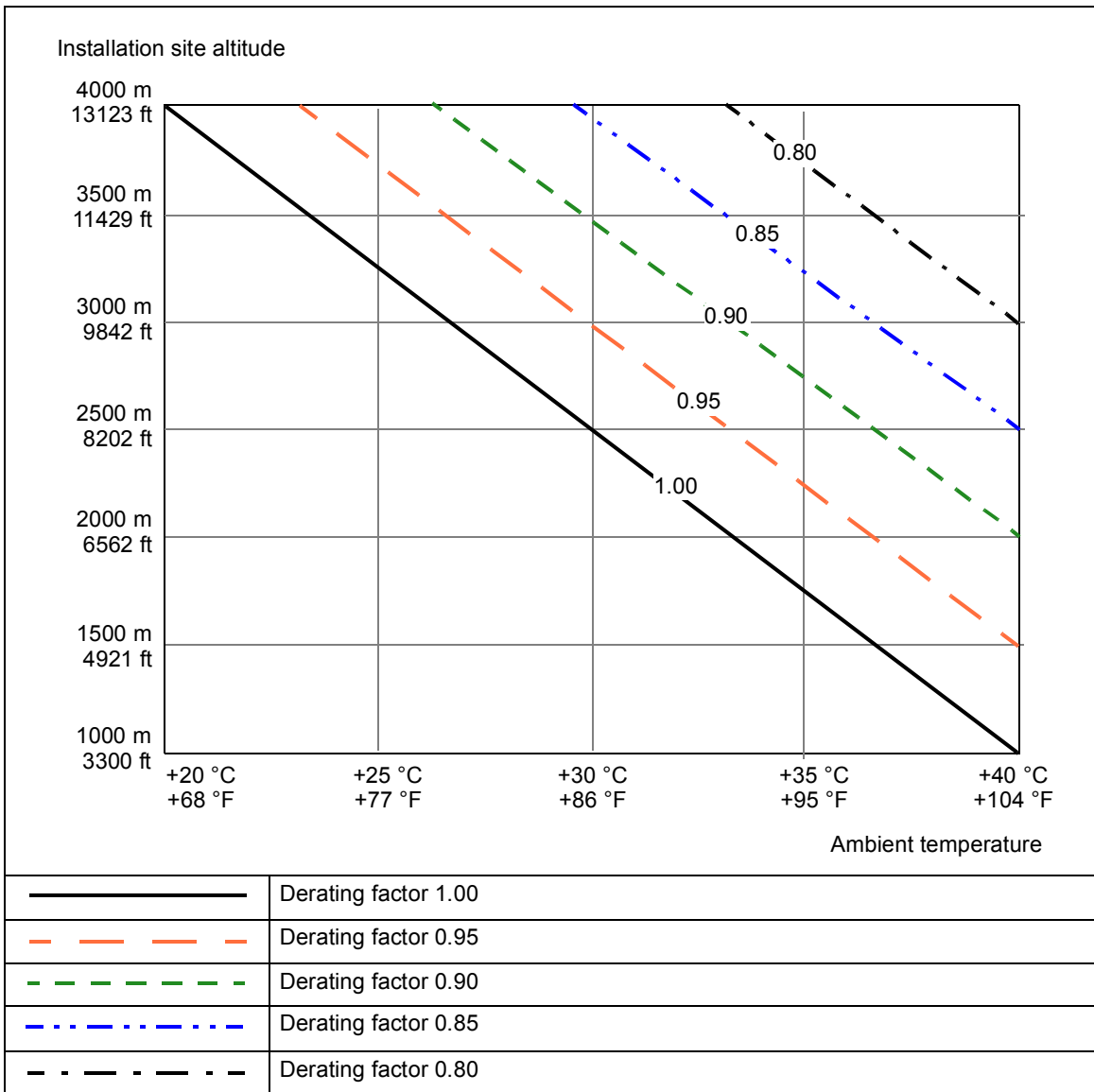
Ambient temperature derating

In the temperature range +40...50 °C (+104...122 °F), the rated output current is derated by 1% 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% for every 100 m (328 ft). If ambient temperature is below +40 °C (+104 °F), the derating can be reduced by 1.5% for every 1 °C reduction in temperature. For a more accurate derating, use the DriveSize PC tool. A few altitude derating curves are shown below.



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

Drive type ACS880-37-...	Frame size	Supply module(s) used		LCL filter(s) used		Inverter modules used	
		Qty	Type ACS880-104-...	Qty	Type	Qty	Type ACS880-104-...
$U_N = 400\text{ V}$							
0450A-3	1×R8i + 1×R8i	1	0470A-3+E205+N8201	1	BLCL-13-5	1	0470A-3+E205
0620A-3	1×R8i + 1×R8i	1	0640A-3+E205+N8201	1	BLCL-13-5	1	0640A-3+E205
0870A-3	1×R8i + 1×R8i	1	0900A-3+E205+N8201	1	BLCL-15-5	1	0900A-3+E205
1110A-3	2×R8i + 2×R8i	2	0640A-3+E205+N8201	1	BLCL-24-5	2	0640A-3+E205
1210A-3	2×R8i + 2×R8i	2	0640A-3+E205+N8201	1	BLCL-24-5	2	0640A-3+E205
1430A-3	2×R8i + 2×R8i	2	0760A-3+E205+N8201	1	BLCL-24-5	2	0760A-3+E205
1700A-3	2×R8i + 2×R8i	2	0900A-3+E205+N8201	1	BLCL-25-5	2	0900A-3+E205
2060A-3	3×R8i + 3×R8i	3	0900A-3+E205+N8201	2	BLCL-24-5	3	0760A-3+E205
2530A-3	3×R8i + 3×R8i	3	0900A-3+E205+N8201	2	BLCL-24-5	3	0900A-3+E205
$U_N = 500\text{ V}$							
0420A-5	1×R8i + 1×R8i	1	0440A-5+E205+N8201	1	BLCL-13-5	1	0440A-5+E205
0570A-5	1×R8i + 1×R8i	1	0590A-5+E205+N8201	1	BLCL-13-5	1	0590A-5+E205
0780A-5	1×R8i + 1×R8i	1	0810A-5+E205+N8201	1	BLCL-15-5	1	0810A-5+E205
1010A-5	2×R8i + 2×R8i	2	0590A-5+E205+N8201	1	BLCL-24-5	2	0590A-5+E205
1110A-5	2×R8i + 2×R8i	2	0590A-5+E205+N8201	1	BLCL-24-5	2	0590A-5+E205
1530A-5	2×R8i + 2×R8i	2	0810A-5+E205+N8201	1	BLCL-25-5	2	0810A-5+E205
1980A-5	3×R8i + 3×R8i	3	0810A-5+E205+N8201	2	BLCL-24-5	3	0740A-5+E205
2270A-5	3×R8i + 3×R8i	3	0810A-5+E205+N8201	2	BLCL-24-5	3	0810A-5+E205
$U_N = 690\text{ V}$							
0320A-7	1×R8i + 1×R8i	1	0340A-7+E205+N8201	1	BLCL-13-7	1	0340A-7+E205
0390A-7	1×R8i + 1×R8i	1	0410A-7+E205+N8201	1	BLCL-13-7	1	0410A-7+E205
0580A-7	1×R8i + 1×R8i	1	0600A-7+E205+N8201	1	BLCL-15-7	1	0600A-7+E205
0660A-7	2×R8i + 2×R8i	2	0410A-7+E205+N8201	1	BLCL-24-7	2	0410A-7+E205
0770A-7	2×R8i + 2×R8i	2	0410A-7+E205+N8201	1	BLCL-24-7	2	0410A-7+E205
0950A-7	2×R8i + 2×R8i	2	0600A-7+E205+N8201	1	BLCL-25-7	2	0530A-7+E205
1130A-7	2×R8i + 2×R8i	2	0600A-7+E205+N8201	1	BLCL-25-7	2	0600A-7+E205
1450A-7	3×R8i + 3×R8i	3	0600A-7+E205+N8201	2	BLCL-24-7	3	0530A-7+E205
1680A-7	3×R8i + 3×R8i	3	0600A-7+E205+N8201	2	BLCL-24-7	3	0600A-7+E205
1950A-7	4×R8i + 4×R8i	4	0600A-7+E205+N8201	2	BLCL-25-7	4	0600A-7+E205
2230A-7	4×R8i + 4×R8i	4	0600A-7+E205+N8201	2	BLCL-25-7	4	0600A-7+E205
2770A-7	6×R8i + 5×R8i	6	0600A-7+E205+N8201	3	BLCL-25-7	5	0600A-7+E205
3310A-7	6×R8i + 6×R8i	6	0600A-7+E205+N8201	3	BLCL-25-7	6	0600A-7+E205

Fuses

AC fuses

Notes:

- See also [Implementing thermal overload and short-circuit protection](#) (page 88) and [Electrical power network specification](#) (page 189).
- 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.

Drive type ACS880-37-...	Ultraprapid (aR) AC fuses					
	Qty	A	A ² s at 660 V	V	Manufacturer	Type
U_N = 400 V						
0450A-3	3	700	300000	690	Bussmann	170M6411
0620A-3	3	900	670000	690	Bussmann	170M6413
0870A-3	3	1250	1950000	690	Bussmann	170M6416
1110A-3	3	1600	3900000	690	Bussmann	170M6419
1210A-3	3	2000	3950000	690	Bussmann	170M7062
1430A-3	3	2500	7800000	690	Bussmann	170M7063
1700A-3	3	2500	7800000	690	Bussmann	170M7063
2060A-3	6	2000	3950000	690	Bussmann	170M7062
2530A-3	6	2000	3950000	690	Bussmann	170M7062
U_N = 500 V						
0420A-5	3	700	300000	690	Bussmann	170M6411
0570A-5	3	900	670000	690	Bussmann	170M6413
0780A-5	3	1250	1950000	690	Bussmann	170M6416
1010A-5	3	1600	3900000	690	Bussmann	170M6419
1110A-5	3	1600	3900000	690	Bussmann	170M6419
1530A-5	3	2500	7800000	690	Bussmann	170M7063
1980A-5	6	2000	3950000	690	Bussmann	170M7062
2270A-5	6	2000	3950000	690	Bussmann	170M7062
U_N = 690 V						
0320A-7	3	500	95000	690	Bussmann	170M6408
0390A-7	3	630	210000	690	Bussmann	170M6410
0580A-7	3	900	670000	690	Bussmann	170M6413
0660A-7	3	1000	945000	690	Bussmann	170M6414
0770A-7	3	1250	1950000	690	Bussmann	170M6416
0950A-7	3	1400	2450000	690	Bussmann	170M6417
1130A-7	3	1600	3900000	690	Bussmann	170M6419
1450A-7	3*	2500	7800000	690	Bussmann	170M7063
	6**	1250	965000	690	Bussmann	170M7059
1680A-7	3*	2500	7800000	690	Bussmann	170M7063
	6**	1250	965000	690	Bussmann	170M7059
1950A-7	6	2000	3950000	690	Bussmann	170M7062
2230A-7	6	2000	3950000	690	Bussmann	170M7062
2770A-7	9	2000	3950000	690	Bussmann	170M7062
3310A-7	9	2000	3950000	690	Bussmann	170M7062

*Units with line contactor only, **All units

■ DC fuses

Drives with parallel-connected supply and inverter modules (ie. frames 2×R8i + 2×R8i and above) have DC fuses at the output of each supply module and 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.

Drive type ACS880-37-...	DC fuses at supply module output and inverter module input					
	Qty	A	A ² s	V	Manufacturer	Type
U_N = 400 V						
1110A-3	8	1250	1950000 ³⁾	690	Bussmann	170M6416
1210A-3	8	1250	1950000 ³⁾	690	Bussmann	170M6416
1430A-3	8	1400	2450000 ³⁾	690	Bussmann	170M6417
1700A-3	8	1600	3900000 ³⁾	690	Bussmann	170M6419
2060A-3	6 ¹⁾	1400	2450000 ³⁾	690	Bussmann	170M6417
	6 ²⁾	1600	3900000 ³⁾	690	Bussmann	170M6419
2530A-3	12	1600	3900000 ³⁾	690	Bussmann	170M6419
U_N = 500 V						
1010A-5	8	1100	1300000 ³⁾	690	Bussmann	170M6415
1110A-5	8	1250	1950000 ³⁾	690	Bussmann	170M6416
1530A-5	8	1400	2450000 ³⁾	690	Bussmann	170M6417
1980A-5	12	1400	2450000 ³⁾	690	Bussmann	170M6417
2270A-5	12	1400	2450000 ³⁾	690	Bussmann	170M6417
U_N = 690 V						
0660A-7	4 ¹⁾	800	995000 ⁴⁾	1250	Bussmann	170M6546
	4 ²⁾	800	1090000 ⁴⁾	1100	Mersen (Ferraz Shawmut)	PC73UD13C800TF
0770A-7	4 ¹⁾	800	995000 ⁴⁾	1250	Bussmann	170M6546
	4 ²⁾	800	1090000 ⁴⁾	1100	Mersen (Ferraz Shawmut)	PC73UD13C800TF
0950A-7	8	1000	2150000 ⁴⁾	1100	Bussmann	170M6548
1130A-7	8	1100	2800000 ⁴⁾	1000	Bussmann	170M6549
1450A-7	12	1000	2150000 ⁴⁾	1100	Bussmann	170M6548
1680A-7	12	1100	2800000 ⁴⁾	1000	Bussmann	170M6549
1950A-7	16	1100	2800000 ⁴⁾	1000	Bussmann	170M6549
2230A-7	16	1100	2800000 ⁴⁾	1000	Bussmann	170M6549
2770A-7	22	1100	2800000 ⁴⁾	1000	Bussmann	170M6549
3310A-7	24	1100	2800000 ⁴⁾	1000	Bussmann	170M6549

¹⁾ At outputs of supply modules, ²⁾ At inputs of inverter modules, ³⁾ Clearing at 660 V, ⁴⁾ Clearing at 1000 V

Fuses on CVAR varistor board

The CVAR board is used in units for UL and CSA installations.
 The fuse type is Ferraz A070GRB10T13/G330010 (10 A 700 V AC).

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

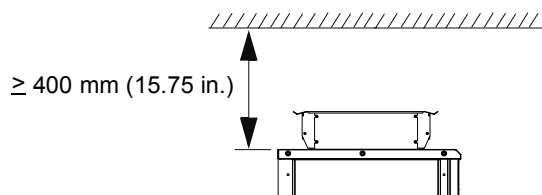
See chapter *Dimensions* (page 201).

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 67).

Front		Sides		Above*	
mm	in.	mm	in.	mm	in.
150	5.91	0	0	400	15.75

*Measured from the base plate of the cabinet top.



Cooling data, noise

Drive type	Air flow		Heat dissipation	Noise
	m ³ /h	ft ³ /min	kW	dB(A)
U_N = 400 V				
ACS880-37-0450A-3	3760	2215	14	75
ACS880-37-0620A-3	3760	2215	18	75
ACS880-37-0870A-3	3760	2215	27	75
ACS880-37-1110A-3	7220	4250	31	77
ACS880-37-1210A-3	7220	4250	34	77
ACS880-37-1430A-3	7220	4250	38	77
ACS880-37-1700A-3	7220	4250	51	77
ACS880-37-2060A-3	11580	6815	61	78
ACS880-37-2530A-3	11580	6815	76	78
U_N = 500 V				
ACS880-37-0420A-5	3760	2215	13	75
ACS880-37-0570A-5	3760	2215	17	75
ACS880-37-0780A-5	3760	2215	25	75
ACS880-37-1010A-5	7220	4250	31	77
ACS880-37-1110A-5	7220	4250	32	77
ACS880-37-1530A-5	7220	4250	46	77
ACS880-37-1980A-5	11580	6815	59	78
ACS880-37-2270A-5	11580	6815	69	78
U_N = 690 V				
ACS880-37-0320A-7	3760	2215	16	75
ACS880-37-0390A-7	3760	2215	19	75
ACS880-37-0580A-7	3760	2215	26	75
ACS880-37-0660A-7	7220	4250	30	77
ACS880-37-0770A-7	7220	4250	34	77
ACS880-37-0950A-7	7220	4250	40	77
ACS880-37-1130A-7	7220	4250	48	77
ACS880-37-1450A-7	11580	6815	63	78
ACS880-37-1680A-7	11580	6815	74	78
ACS880-37-1950A-7	14440	8500	84	79
ACS880-37-2230A-7	14440	8500	95	79
ACS880-37-2770A-7	18800	11065	119	79
ACS880-37-3310A-7	21660	12750	142	79

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 ACS880-37 drives. The standard filters listed require no current derating.

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

Drive type ACS880-37-...	Sine filter(s) used		Nominal current A	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							
0450A-3	1	NSIN-0485-6	447	2	700 (410)	400	350 (770)
0620A-3	1	NSIN-0900-6	783	5	2000 (1180)	1000	550 (1210)
0870A-3	1	NSIN-1380-6	1201	7	2000 (1180)	1000	750 (1650)
1110A-3	1	NSIN-1380-6	1201	7	2000 (1180)	1000	750 (1650)
1210A-3	1	NSIN-1380-6	1201	7	2000 (1180)	1000	750 (1650)
U_N = 500 V							
0420A-5	1	NSIN-0485-6	447	2.5	700 (410)	400	350 (770)
0570A-5	1	NSIN-0900-6	783	6	2000 (1180)	1000	550 (1210)
0780A-5	1	NSIN-0900-6	783	6	2000 (1180)	1000	550 (1210)
1010A-5	1	NSIN-1380-6	1201	8	2000 (1180)	1000	750 (1650)
1110A-5	1	NSIN-1380-6	1201	8	2000 (1180)	1000	750 (1650)
U_N = 690 V							
0320A-7	1	NSIN-0485-6	447	3	700 (410)	400	350 (770)
0390A-7	1	NSIN-0485-6	447	3	700 (410)	400	350 (770)
0580A-7	1	NSIN-0900-6	783	7	2000 (1180)	1000	550 (1210)
0660A-7	1	NSIN-0900-6	783	7	2000 (1180)	1000	550 (1210)
0770A-7	1	NSIN-0900-6	783	7	2000 (1180)	1000	550 (1210)
0950A-7	1	NSIN-1380-6	1201	9	2000 (1180)	1000	750 (1650)
1130A-7	1	NSIN-1380-6	1201	9	2000 (1180)	1000	750 (1650)

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 starting on page [207](#).

The location and size of power cable terminals are shown in the drawings starting on page [223](#).

Terminal data for the supply and inverter control units

See chapter [Control units of the drive](#) (page [131](#)).

Electrical power network specification

Voltage (U_1)	ACS880-37-xxxx-3: 380...415 V AC 3-phase \pm 10%. This is indicated in the type designation label as typical input voltage level (3~ 400 V AC). ACS880-37-xxxx-5: 380...500 V AC 3-phase \pm 10%. This is indicated in the type designation label as typical input voltage levels (3~ 400/480/500 V AC). ACS880-37-xxxx-7: *525...690 V AC 3-phase \pm 10%. This is indicated in the type designation label as typical input voltage levels (3~ 525/600/690 V AC). *525...600 V AC in corner-grounded TN systems
Network type	TN (grounded) and IT (ungrounded) systems
Frequency	50/60 Hz, variation \pm 5% of nominal frequency
Imbalance	Max. \pm 3% of nominal phase-to-phase voltage
Short-circuit withstand strength (IEC 61439-1)	IEC/EN 61439-1:2009 Frame 1×R8i + 1×R8i: Maximum allowable prospective shortcircuit current (I_{CC}): 65 kA. The input cable must be equipped with fuses as follows: • maximum 1250 A gG* *) Type gG according to IEC 60269 Maximum allowed operating time is <0.1 s for fuses mentioned above. Frame 2×R8i + 2×R8i and above: Rated peak withstand current (I_{pk}): 105 kA (143 kA for units with air circuit breaker and no grounding/earthing switch) Rated short-time withstand current (I_{cw}): 50 kA/1 s (65 kA/1 s for units with air circuit breaker and no grounding/earthing switch)
Short-circuit current protection (UL 508A, 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.
Power factor	$\cos\phi_1 = 1$, $\cos\phi$ (total) = 0.99
Harmonic distortion	Harmonics are below the limits defined in IEEE519.

R_{sc}	THD Voltage [%]	THD Current [%]
20	3	2.5*
100	0.8	2.5*

$$\sqrt{\sum_{n=2}^{50} \left(\frac{I_n}{I_N}\right)^2}$$

I_n nth harmonic component

I_N nominal current

THD = Total Harmonic Distortion (THD). The voltage THD depends on the short-circuit ratio (R_{sc}). The spectrum of the distortion also contains interharmonics.

$$R_{sc} = I_{sc}/I_N$$

I_{sc} = short-circuit current at point of common coupling (PCC)

I_N = IGBT supply unit nominal current

*Other loads may influence the THD value.

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet synchronous motors, 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...±598 Hz (0...±120 Hz with sine output filters [option +E206]) <ul style="list-style-type: none"> • 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 section Ratings .
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 131).

Efficiency

97.2 ... 98.0% at nominal power level depending on drive type

Protection classes

Degrees of protection (IEC/EN 60529)	IP22 (standard), IP42 (option +B054), IP54 (option +B055)
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 system 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). See section Derating .	-	-
Air temperature	0 ... +40 °C (+32 ... +104 °F). No condensation allowed. Output derated in the range +40 ... +50 °C (+104 ... +122 °F). See section Derating .	-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 Chemical gases Solid particles	IEC/EN 60721-3-3:2002: Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use of weather protected locations	IEC 60721-3-1:1997	IEC 60721-3-2:1997
	Class 3C2	Class 1C2	Class 2C2
	Class 3S2. No conductive dust allowed.	Class 1S3 (packing must support this, otherwise 1S2)	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 (330 ft./s ²) 11 ms	With packing max. 100 m/s ² (330 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. For handling the packages, see section [Moving and unpacking the drive](#) on page 61.

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

■ Compliance with the European Low Voltage Directive

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

■ Compliance with the European EMC Directive

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

■ Compliance with the European Machinery Directive

The drive is an electronic product which is covered by the European Low Voltage Directive. However, the drive includes the Safe torque off function and can be equipped with other safety functions for machinery which, as safety components, are in the scope of

the Machinery Directive. These functions of the drive comply with European harmonized standards such as EN 61800-5-2. The related declarations of conformity are shown below.

Declaration of Conformity

Power and productivity
for a better world™



EU Declaration of Conformity

Machinery Directive 2006/42/EC

We

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

declare under our sole responsibility that the following products:

Frequency converters and frequency converter components

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

ACS880-04XT

ACS880-07

ACS880-17, -37 (frames nxR8i)

ACS880-104, -107

ACS880 multidrives

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

The following other standards have been applied:

IEC 61508:2010	<i>Functional safety of electrical / electronic / programmable electronic safety-related systems</i>
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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, 28 Jun 2016

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.

Note: 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:

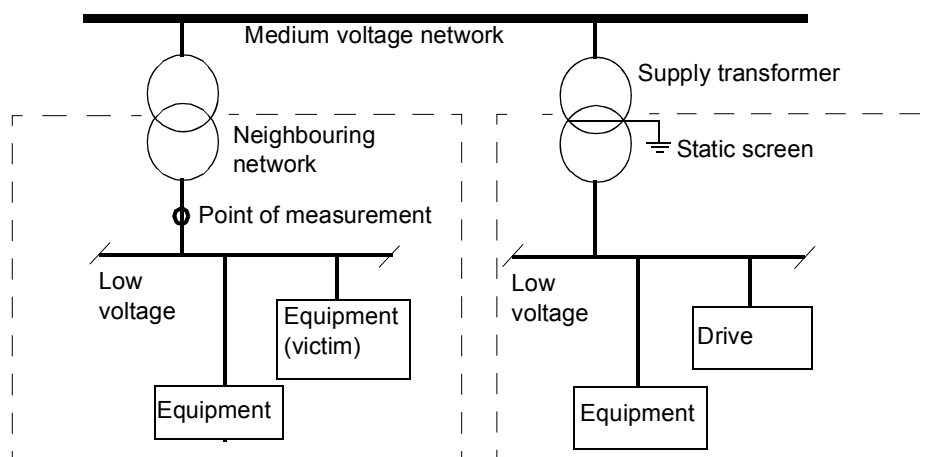
1. The motor and control cables are selected as specified in the hardware manual.
2. The drive is installed according to the instructions given in the hardware manual.
3. Maximum motor cable length is 100 meters (328 ft).

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 C3](#) cannot be met, the requirements of the standard can be met as follows:

1. It is ensured that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the 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 motor and control cables are selected as specified in the hardware manual.
4. The drive is installed according to the instructions given in the hardware manual.

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

UL 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 (class aR) fuses and UL fuses are listed starting on page 184. 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 RMC 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 section [Compliance with EN 61800-3:2004](#).

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
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

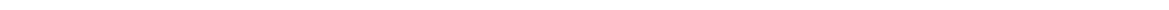
Disclaimers

■ 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

What this chapter contains

This chapter contains the following dimension data:

- Composition of cabinet line-ups in tabular form for each frame size with options (page [202](#))
 - Approximate weights of basic line-ups (page [206](#))
 - Dimension drawing examples of selected line-ups (page [207](#))
 - Dimensions of empty cubicles (options +C199, +C200, +C201) (page [221](#))
 - Location and size of input terminals (page [223](#))
 - Location and size of output terminals for drives without common motor terminal cubicle (page [227](#))
 - Location and size of output terminals for drives with common motor terminal cubicle (+H359) (page [231](#)).
-

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 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×R8i + 1×R8i										
Auxiliary control cubicle (ACU)	Supply and inverter module cubicle	Common motor terminal cubicle	*Sine filter cubicle	Joining cubicle	**Brake chopper 1	**Brake resistor 1	**Brake chopper 2	**Brake resistor 2	Shipping split widths	Line-up width
400	800								1200	1200
400	800	300							1500	1500
400	800		400						1600	1600
400	800		1000						2200	2200
400	800				400				1600	1600
400	800	300			400				1900	1900
400	800		400		400				2000	2000
400	800		1000		400				2600	2600
400	800				400	800			2400	2400
400	800	300			400	800			2700	2700
400	800		400		400	800			2800	2800
400	800		1000		400	800			3400	3400
400	800				400		400		2000	2000
400	800	300			400		400		2300	2300
400	800		1000		400		400		3000	3000
400	800				400	800	400	800	3600	3600
400	800	300			400	800	400	800	3900	3900
400	800		1000	200	400	800	400	800	2400 + 2400	4800

*400 mm with ACS880-37-0450A-3, -0420-5, -0320A-7 and -0390A-7, 1000 mm with other types.

**The number of brake choppers depends on required braking power. See chapter [Resistor braking](#).

ACS880-37-1110A-3, -1010A-5, -1110A-5, -0660A-7, -0770A-7, -0950A-7, -1130A-7															
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	*Brake resistor 1	*Brake chopper 2	*Brake resistor 2	*Brake chopper 3	*Brake resistor 3	Shipping split widths	Line-up width
400	400	800	600											2200	2200
400	400	800	600		300									2500	2500
400	400	800	600			1000								3200	3200
400	400	800	600					400		400				3000	3000
400	400	800	600		300			400		400				3300	3300
400	400	800	600			1000		400		400				4000	4000
400	400	800	600	200				400	800	400	800			2400 + 2400	4800
400	400	800	600		300			400	800	400	800			2500 + 2400	4900
400	400	800	600			1000	200	400	800	400	800			3400 + 2400	5800
400	400	800	600					400		400		400		3400	3400
400	400	800	600		300			400		400		400		3700	3700
400	400	800	600			1000	200	400		400		400		3400 + 1200	4600
400	400	800	600	200				400	800	400	800	400	800	2400 + 3600	6000
400	400	800	600		300			400	800	400	800	400	800	2500 + 3600	6100
400	400	800	600			1000	200	400	800	400	800	400	800	3400 + 3600	7000

*The number of brake choppers depends on required braking power. See chapter [Resistor braking](#).

ACS880-37-1210A-3, -1430A-3, -1700A-3, -1530A-5																
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top entry	Supply module cubicle	Inverter module cubicle	Joining cubicle	*Common motor terminal cubicle	Sine filter cubicle	Joining cubicle	**Brake chopper 1	**Brake resistor 1	**Brake chopper 2	**Brake resistor 2	**Brake chopper 3	**Brake resistor 3	Shipping split widths	Line-up width
400	600		800	600											2400	2400
400	600	200	800	600											2600	2600
400	600		800	600		300									2700	2700
400	600	200	800	600		300									2900	2900
400	600		800	600			1000								3400	3400
400	600	200	800	600			1000								3600	3600
400	600		800	600				400		400					3200	3200
400	600	200	800	600				400		400					3400	3400
400	600		800	600		300		400		400					3500	3500
400	600	200	800	600		300		400		400					3700	3700
400	600		800	600			1000	400		400					4200	4200
400	600	200	800	600			1000	200	400	400					3800 + 800	4600
400	600		800	600	200			400	800	400	800				2600 + 2400	5000
400	600	200	800	600	200			400	800	400	800				2800 + 2400	5200
400	600		800	600		300		400	800	400	800				2700 + 2400	5100
400	600	200	800	600		300		400	800	400	800				2900 + 2400	5300
400	600		800	600			1000	200	400	800	400	800			3600 + 2400	6000
400	600	200	800	600			1000	200	400	800	400	800			3800 + 2400	6200
400	600		800	600				400		400		400			3600	3600
400	600	200	800	600				400		400		400			3800	3800
400	600		800	600		300		400		400		400			3900	3900
400	600	200	800	600		300		400		400		400			4100	4100
400	600		800	600	200			400	800	400	800	400	800		2600 + 3600	6200
400	600	200	800	600	200			400	800	400	800	400	800		2800 + 3600	6400
400	600		800	600		300		400	800	400	800	400	800		2700 + 3600	6300
400	600	200	800	600		300		400	800	400	800	400	800		2900 + 3600	6500

*Double-busbar version with ACS880-37-1430A-3, -1700A-3 and -1530A-5

**The number of brake choppers depends on required braking power. See chapter [Resistor braking](#).

3×R8i + 3×R8i								
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top entry	Supply (LCL filter) cubicle	Supply module cubicle	Inverter module cubicle	*Common motor terminal cubicle	Shipping split widths	Line-up width
400	600		600	800	800		3200	3200
400	600		600	800	800	300	3500	3500
400	600		600	800	800	400	3600	3600
400	600	200	600	800	800		3400	3400
400	600	200	600	800	800	300	3700	3700
400	600	200	600	800	800	400	3800	3800

*300 mm double-busbar version with ACS880-37-1450A-7 and -1680A-7. 600 mm with ACS880-37-2530A-3+H353 (top exit). 400 mm with other types

4×R8i + 4×R8i									
Auxiliary control cubicle (ACU)	Incoming cubicle (ICU)	Adapter for top entry	Supply module cubicle 1	Supply module cubicle 2	Inverter module cubicle 1	Common motor terminal cubicle	Inverter module cubicle 2	Shipping split widths	Line-up width
400	600		800	800	600		600	3800	3800
400	600		800	800	600	400	600	4200	4200
400	600	200	800	800	600		600	4000	4000
400	600	200	800	800	600	400	600	3800 + 600	4400

6×R8i + 5×R8i											
Auxiliary control cubicle (ACU)	*Incoming cubicle (ICU)	Adapter for top entry	Supply module cubicle 1	Supply module cubicle 2	Supply module cubicle 3	Joining cubicle	Inverter module cubicle 1	**Common motor terminal cubicle	Inverter module cubicle 2	Shipping split widths	Line-up width
400	600		800	800	800	200	800		600	3600 + 1400	5000
400	600		800	800	800	200	800	400	600	3600 + 1800	5400
400	600	200	800	800	800	200	800		600	3800 + 1400	5200
400	600	200	800	800	800	200	800	600	600	3800 + 2000	5800
400	1000		800	800	800	200	800		600	4000 + 1400	5400
400	1000		800	800	800	200	800	400	600	4000 + 1800	5800
400	1000	200	800	800	800	200	800		600	4200 + 1400	5600
400	1000	200	800	800	800	200	800	600	600	4200 + 2000	6200

*1000 mm with UL Listed (+C129) and CSA Approved (+C134) units, otherwise 600 mm.

**400 mm with bottom exit, 600 mm with top exit.

6×R8i + 6×R8i											
Auxiliary control cubicle (ACU)	*Incoming cubicle (ICU)	Adapter for top entry	Supply module cubicle 1	Supply module cubicle 2	Supply module cubicle 3	Joining cubicle	Inverter module cubicle 1	Common motor terminal cubicle	Inverter module cubicle 2	Shipping split widths	Line-up width
400	600		800	800	800	200	800		800	3600 + 1600	5200
400	600		800	800	800	200	800	600	800	3600 + 2200	5800
400	600	200	800	800	800	200	800		800	3800 + 1600	5400
400	600	200	800	800	800	200	800	600	800	3800 + 2200	6000
400	1000		800	800	800	200	800		800	4000 + 1600	5600
400	1000		800	800	800	200	800	600	800	4000 + 2200	6200
400	1000	200	800	800	800	200	800		800	4200 + 1600	5800
400	1000	200	800	800	800	200	800	600	800	4200 + 2200	6400

*1000 mm with UL Listed (+C129) and CSA Approved (+C134) units, otherwise 600 mm.

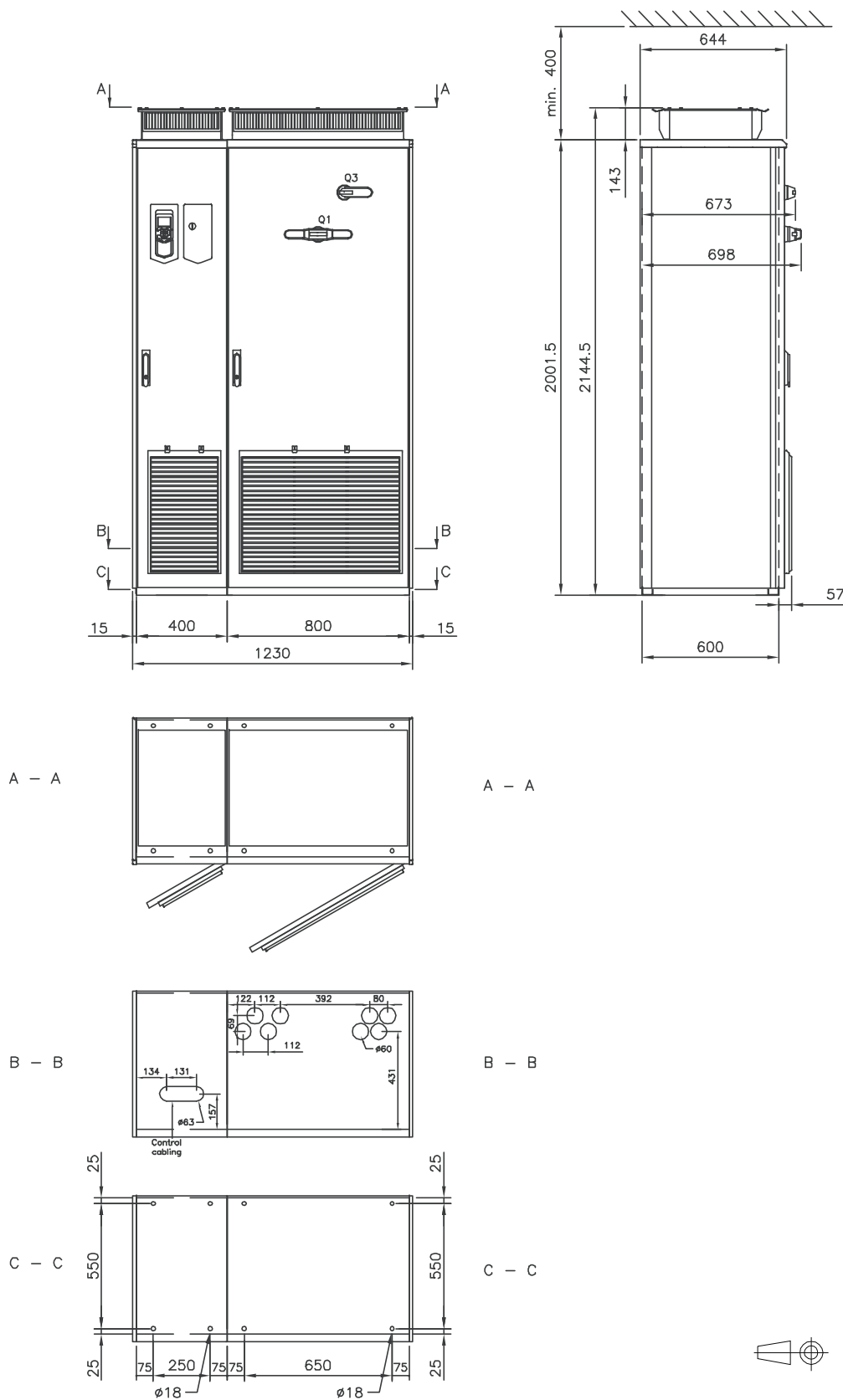
Weights

The table below lists the approximate basic weights of the drive types.

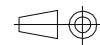
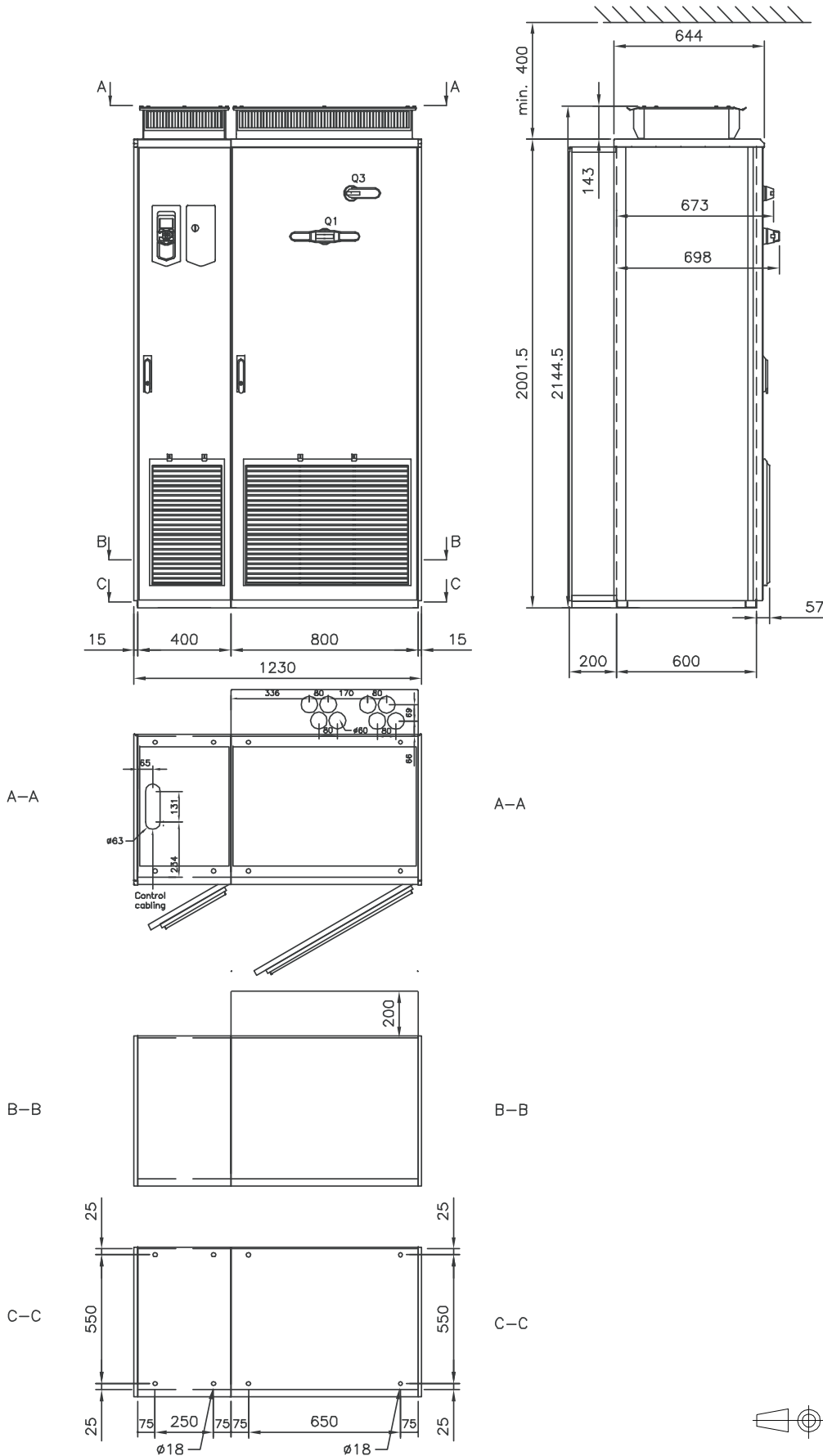
Drive type ACS880-37-...			Weight	
			kg	lbs
0450A-3 0620A-3 0870A-3	0420A-5 0570A-5 0780A-5	0320A-7 0390A-7 0580A-7	1180	2600
1110A-3	1010A-5 1110A-5	0660A-7 0770A-7 0950A-7 1130A-7	1970	4340
1210A-3 1430A-3 1700A-3	1530A-5		2090	4610
2060A-3 2530A-3			2290	5050
		1450A-7 1680A-7	2730	6020
	1980A-5 2270A-5		2930	6460
		1950A-7 2230A-7	3700	8160
		2770A-7	4830	10650
		3310A-7	4980	10980

■ Dimension drawing examples

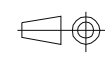
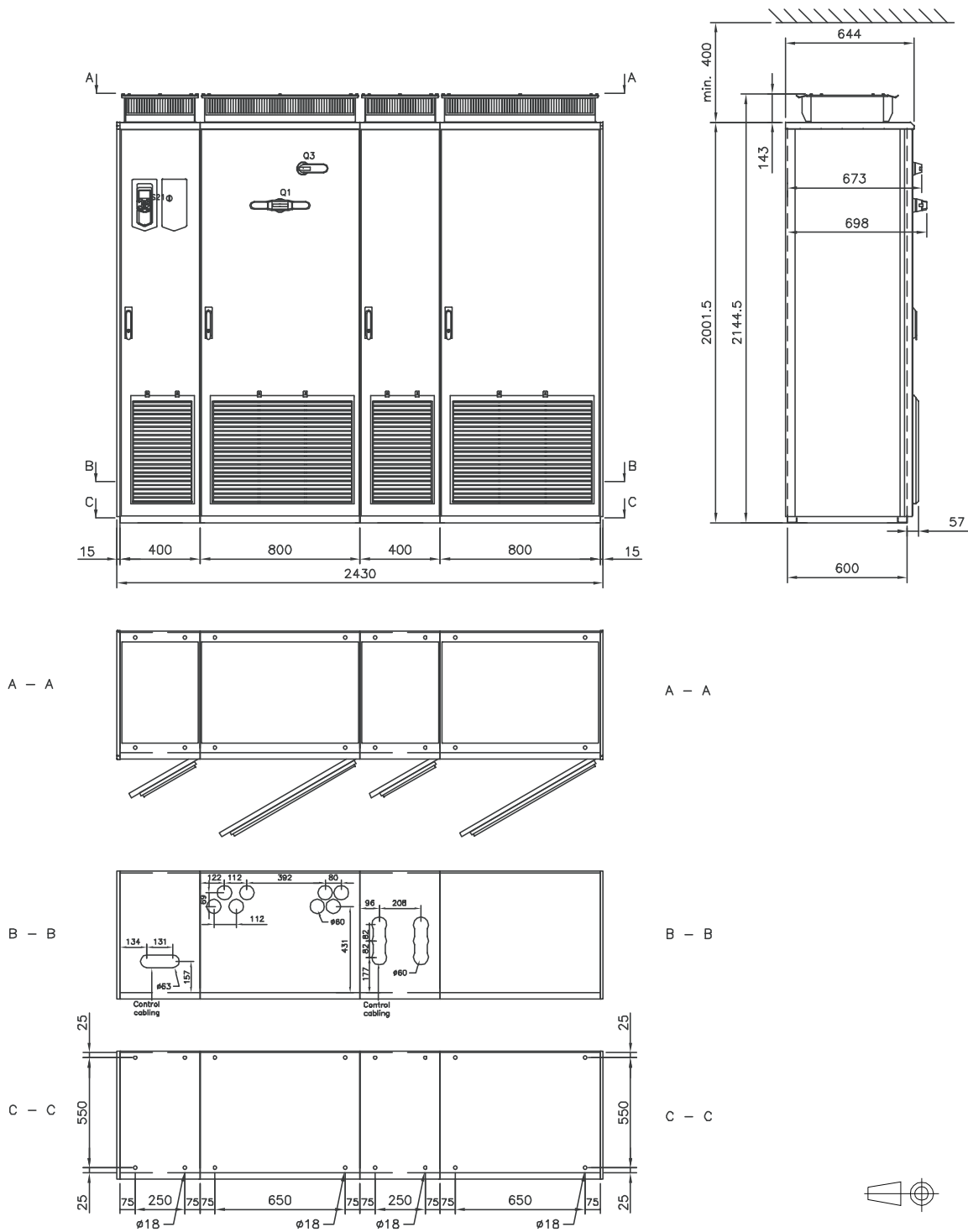
Frame 1×R8i + 1×R8i



Frame 1×R8i + 1×R8i, top cable entry/exit (+H351+H353)

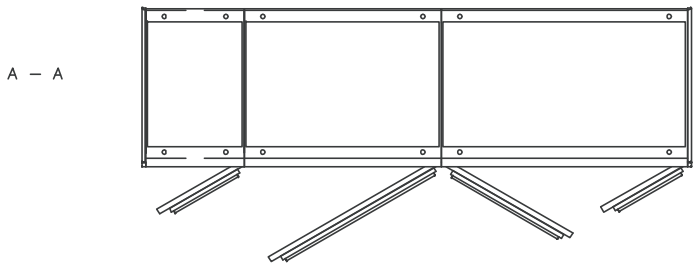
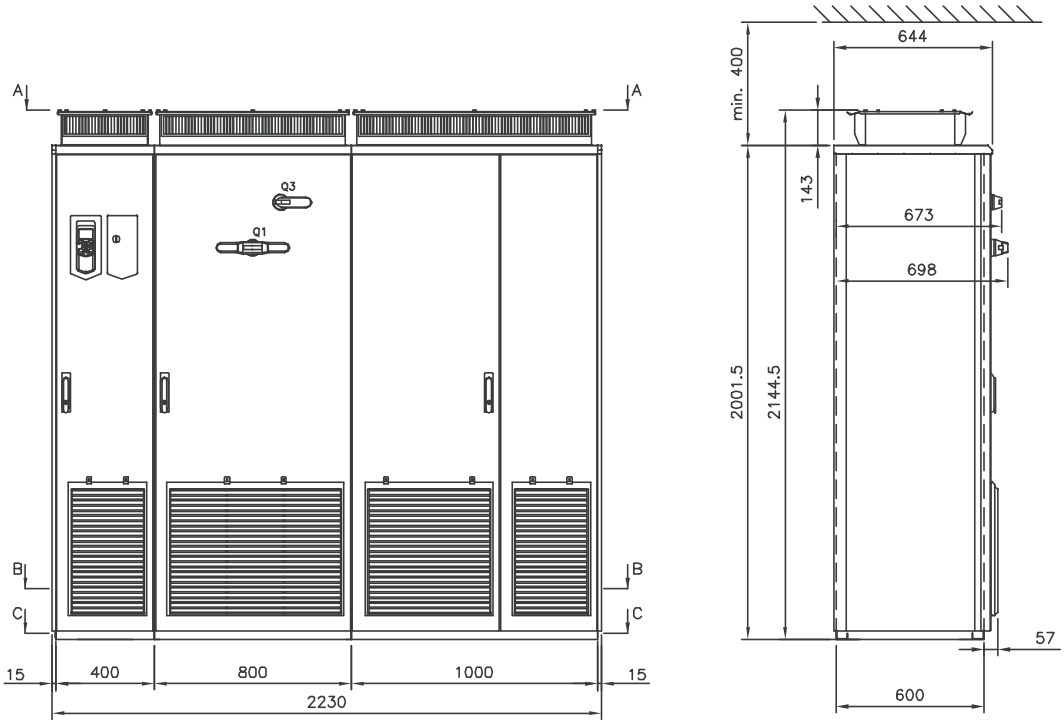


Frame 1×R8i + 1×R8i with brake choppers and resistors (+D150+D151)

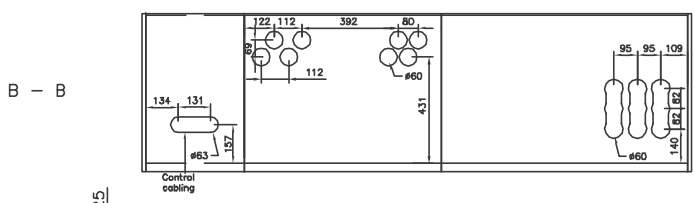


210 Dimensions

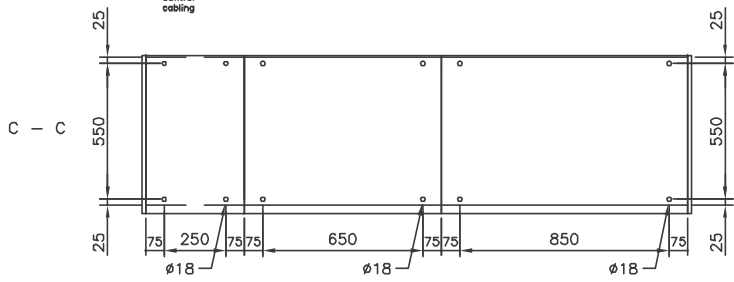
Frame 1×R8i + 1×R8i with sine output filter (+E206)



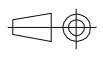
A - A



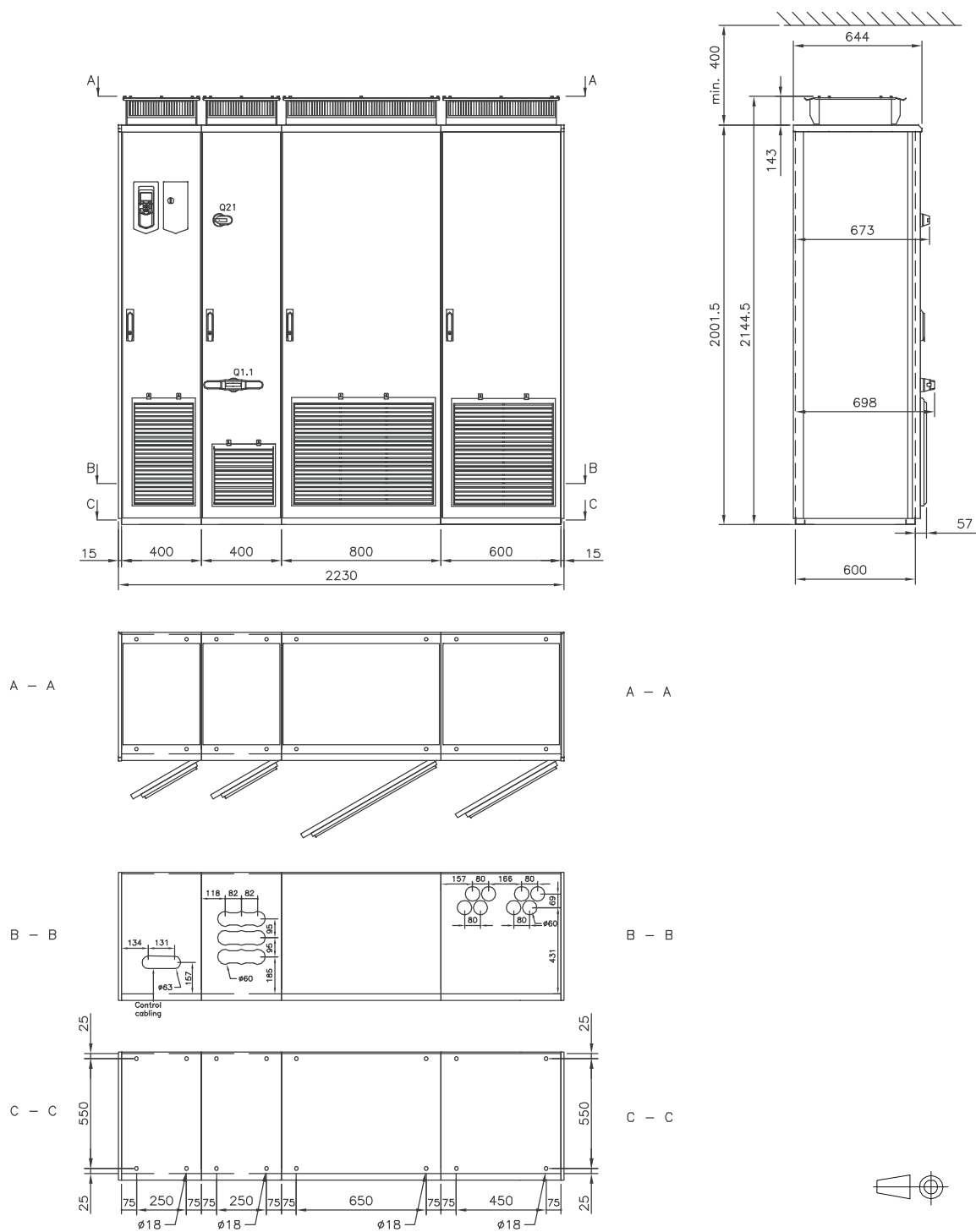
B - B



C - C

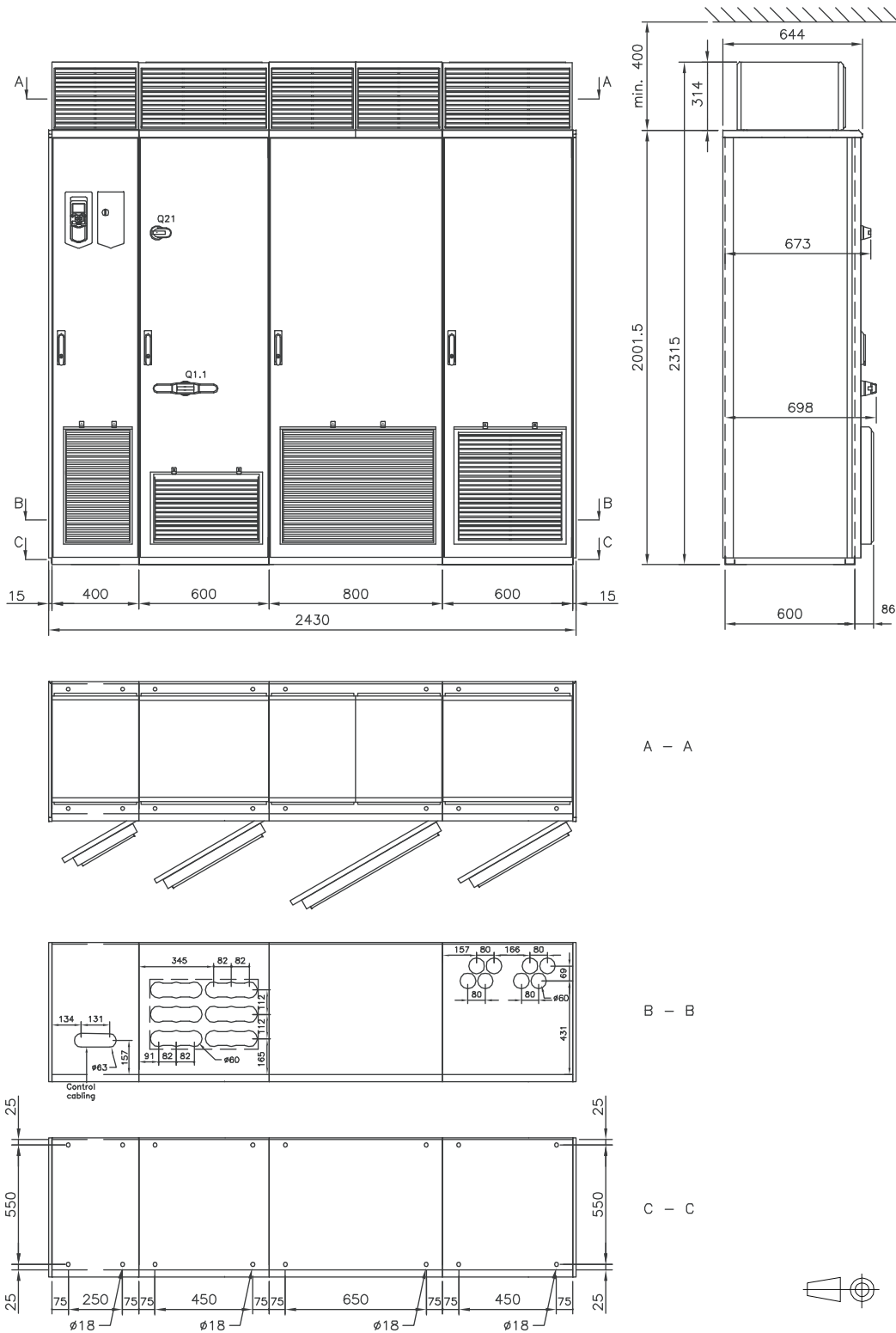


Frame 2×R8i + 2×R8i (eg. ACS880-37-1110A-3), IP22

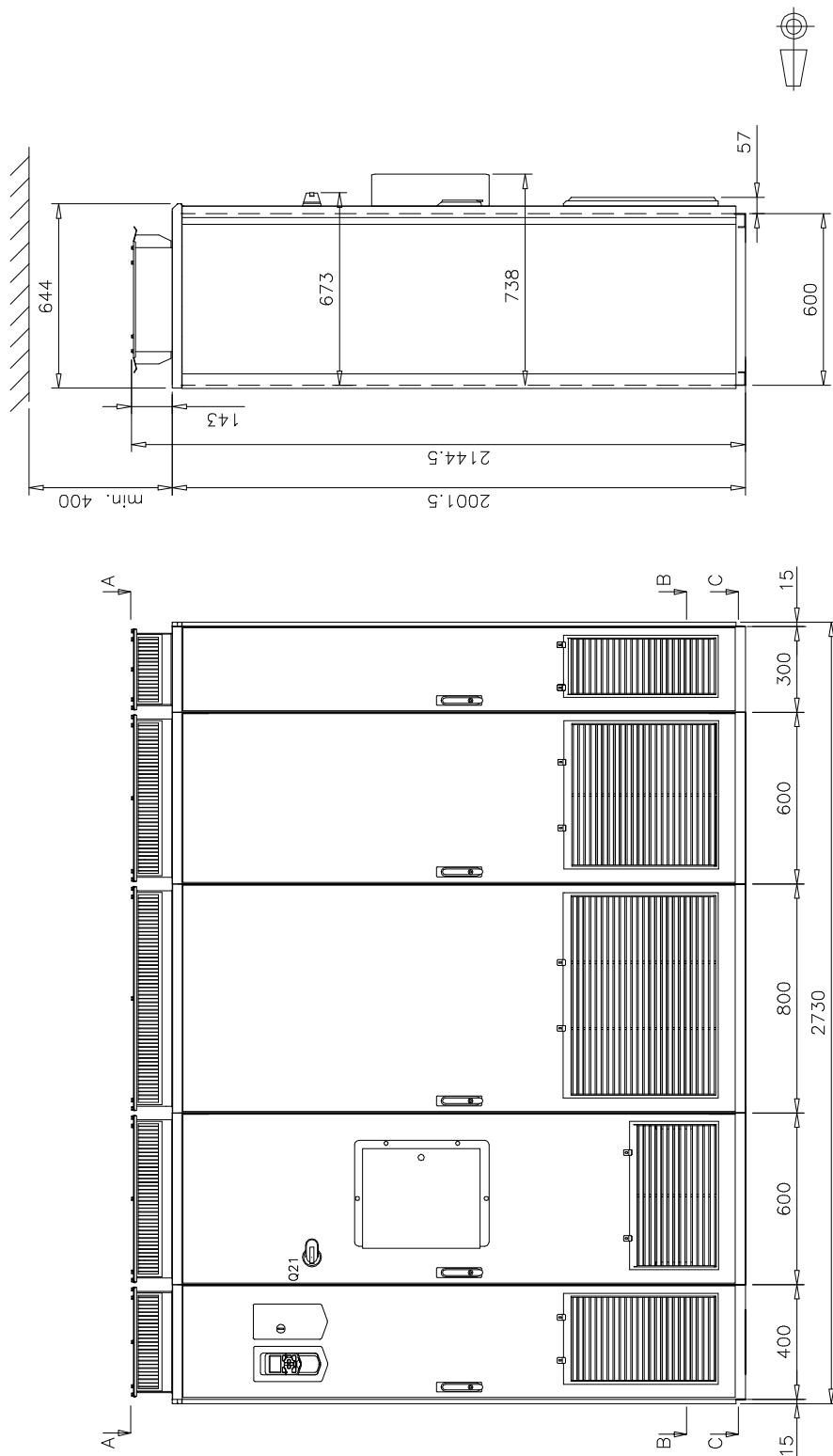


212 Dimensions

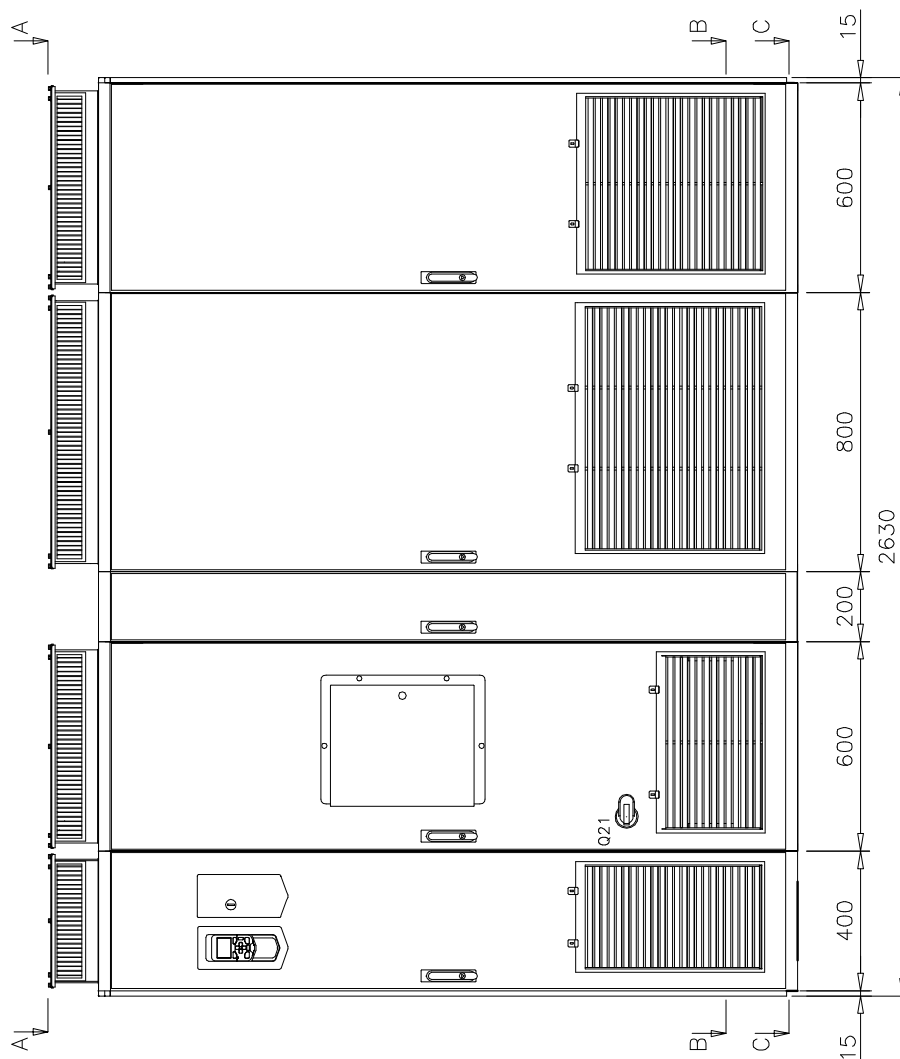
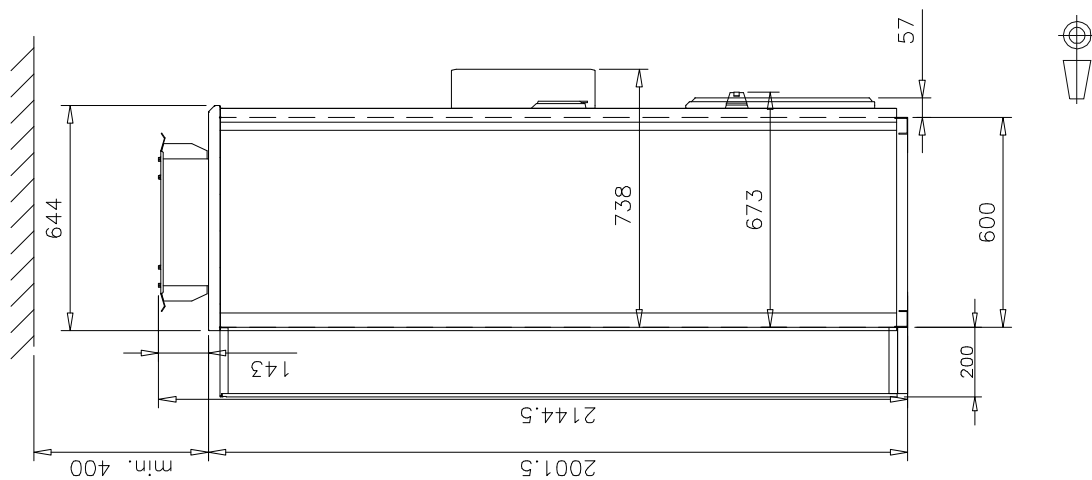
Frame 2xR8i + 2xR8i (eg. ACS880-37-1210A-3), IP54



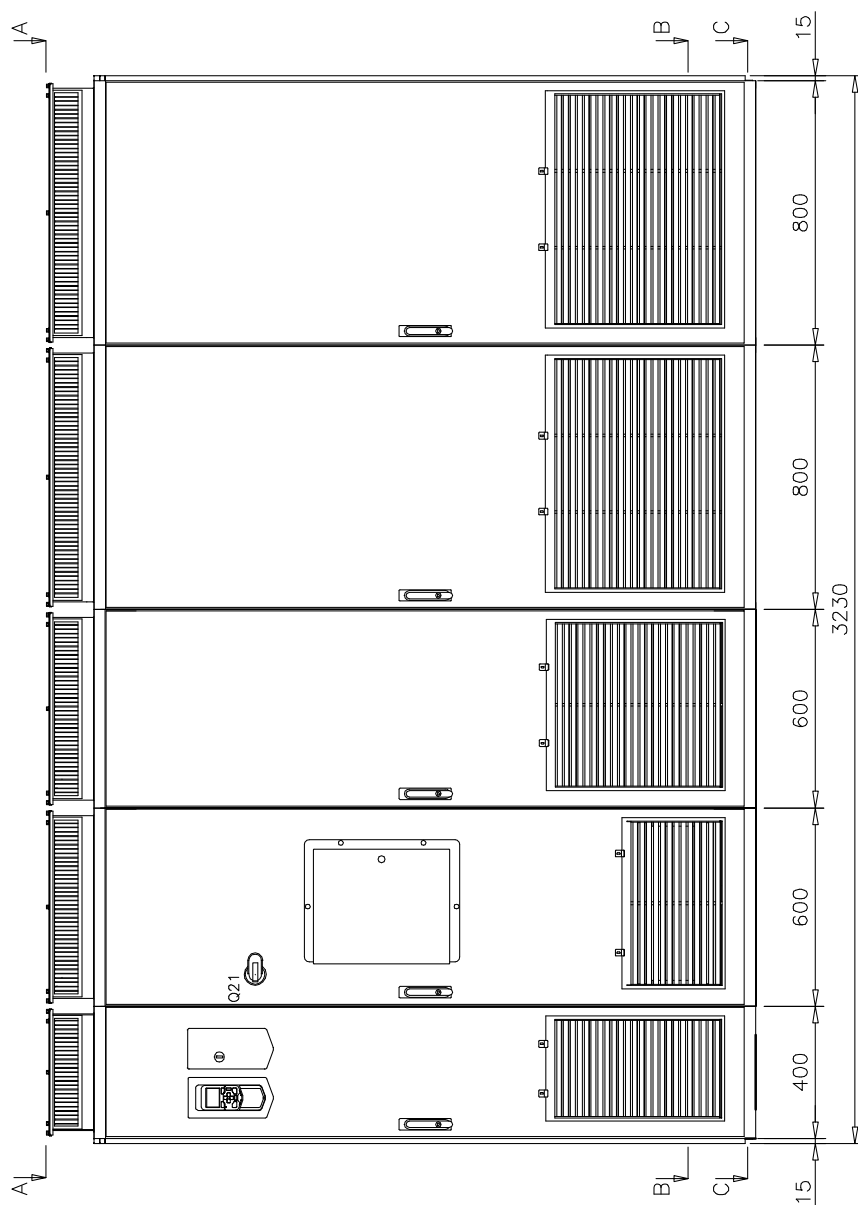
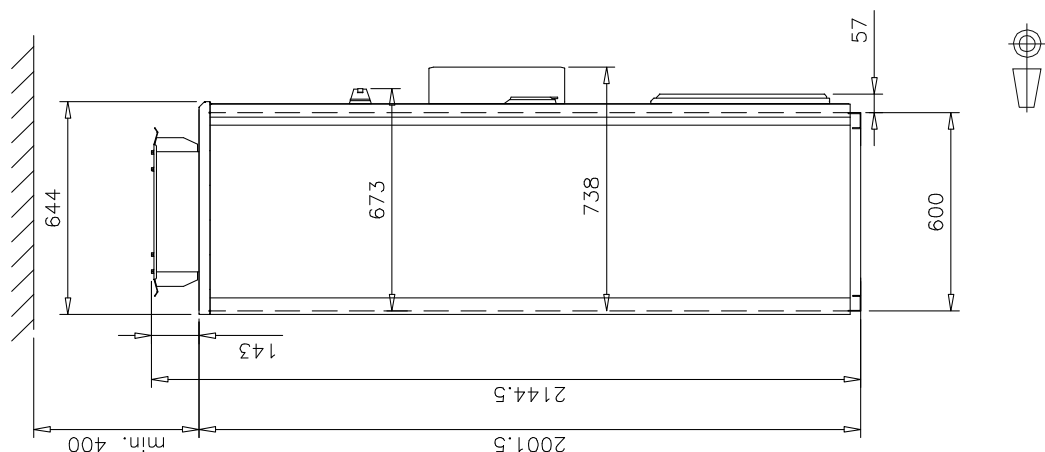
Frame 2×R8i + 2×R8i with main breaker (+F255) and common motor terminal cubicle (+H359), 1/2



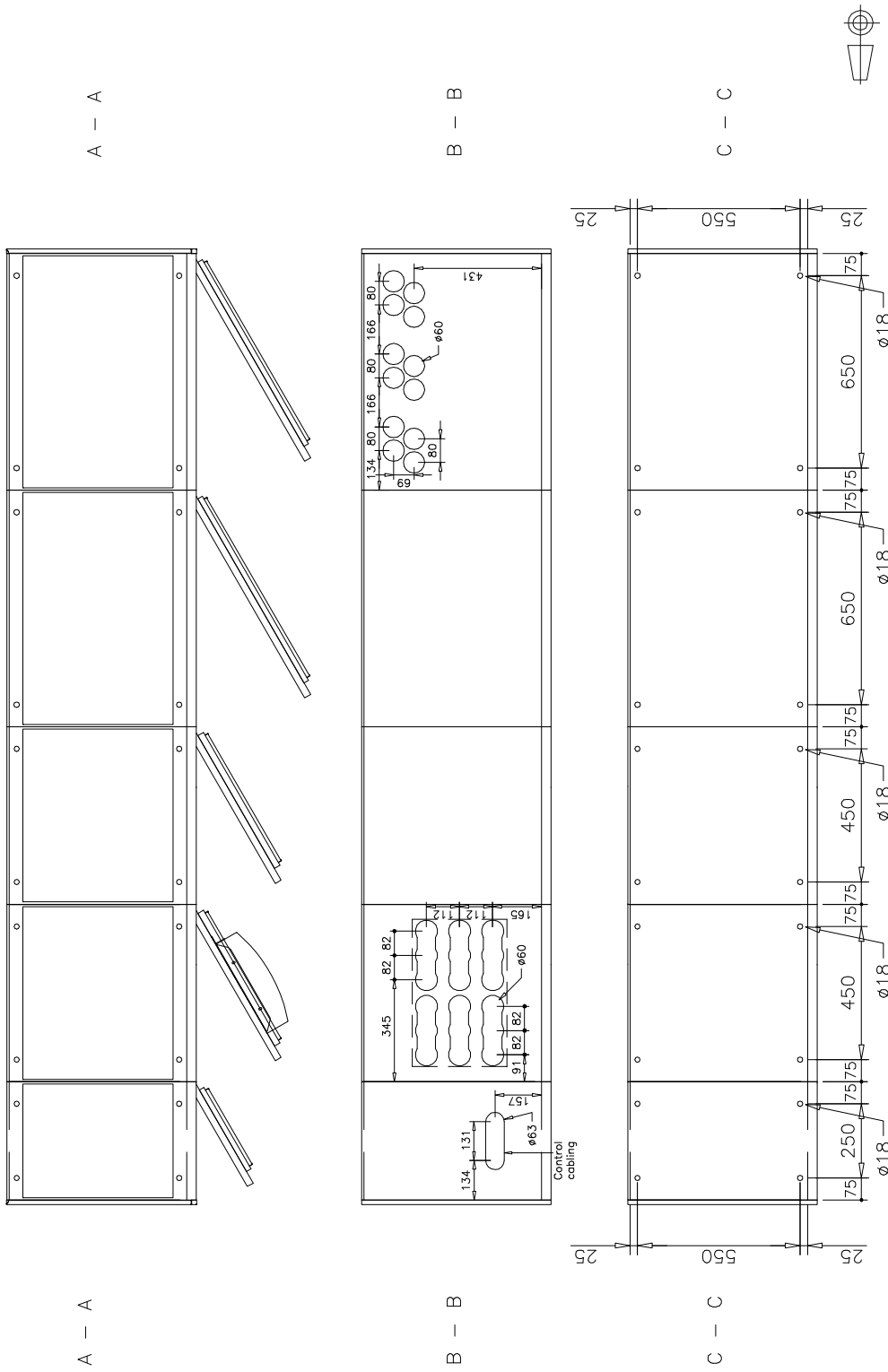
**Frame 2xR8i + 2xR8i with main breaker (+F255) and top entry/top exit (+H351+H353),
1/2**



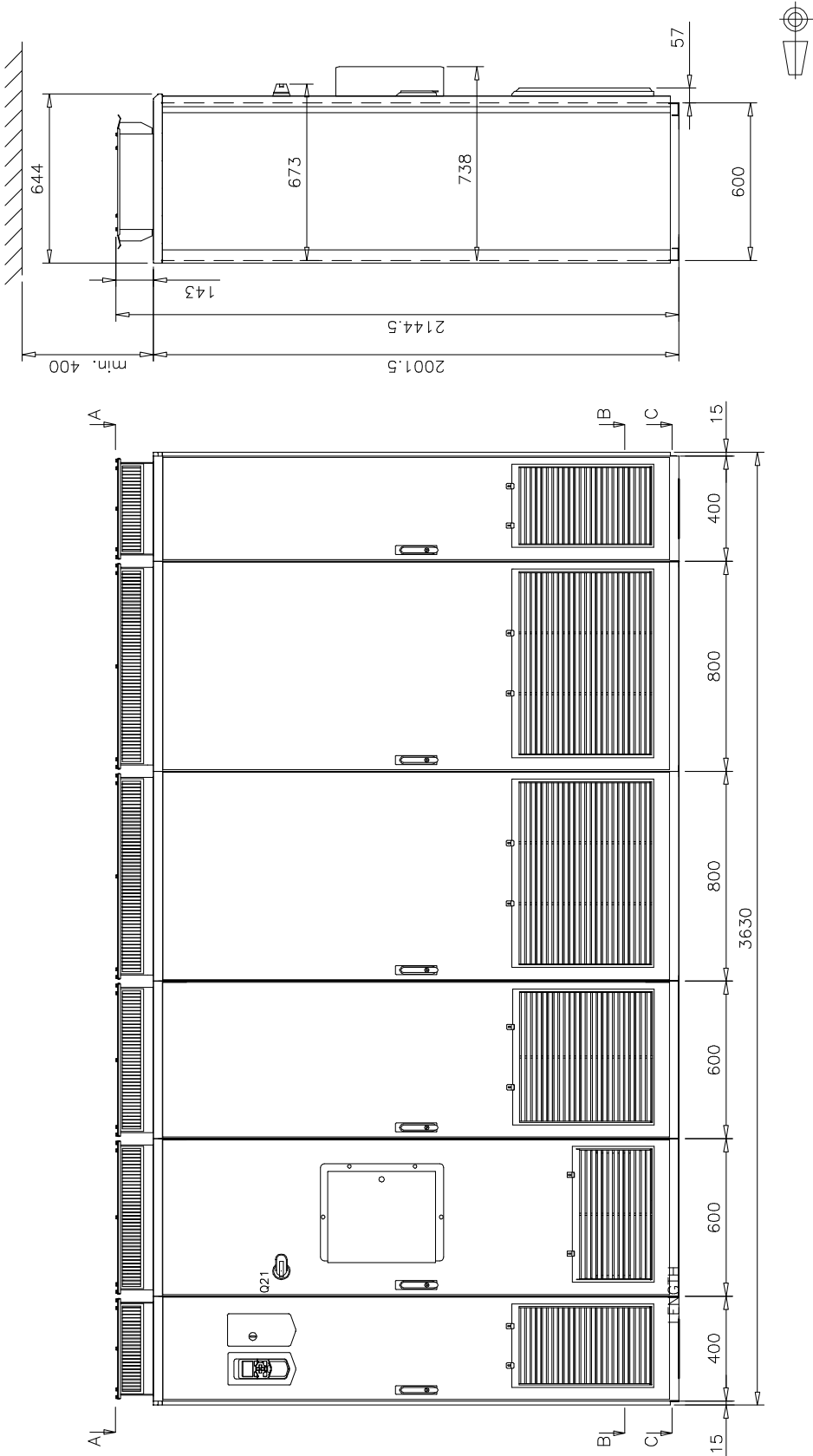
Frame 3×R8i + 3×R8i, 1/2



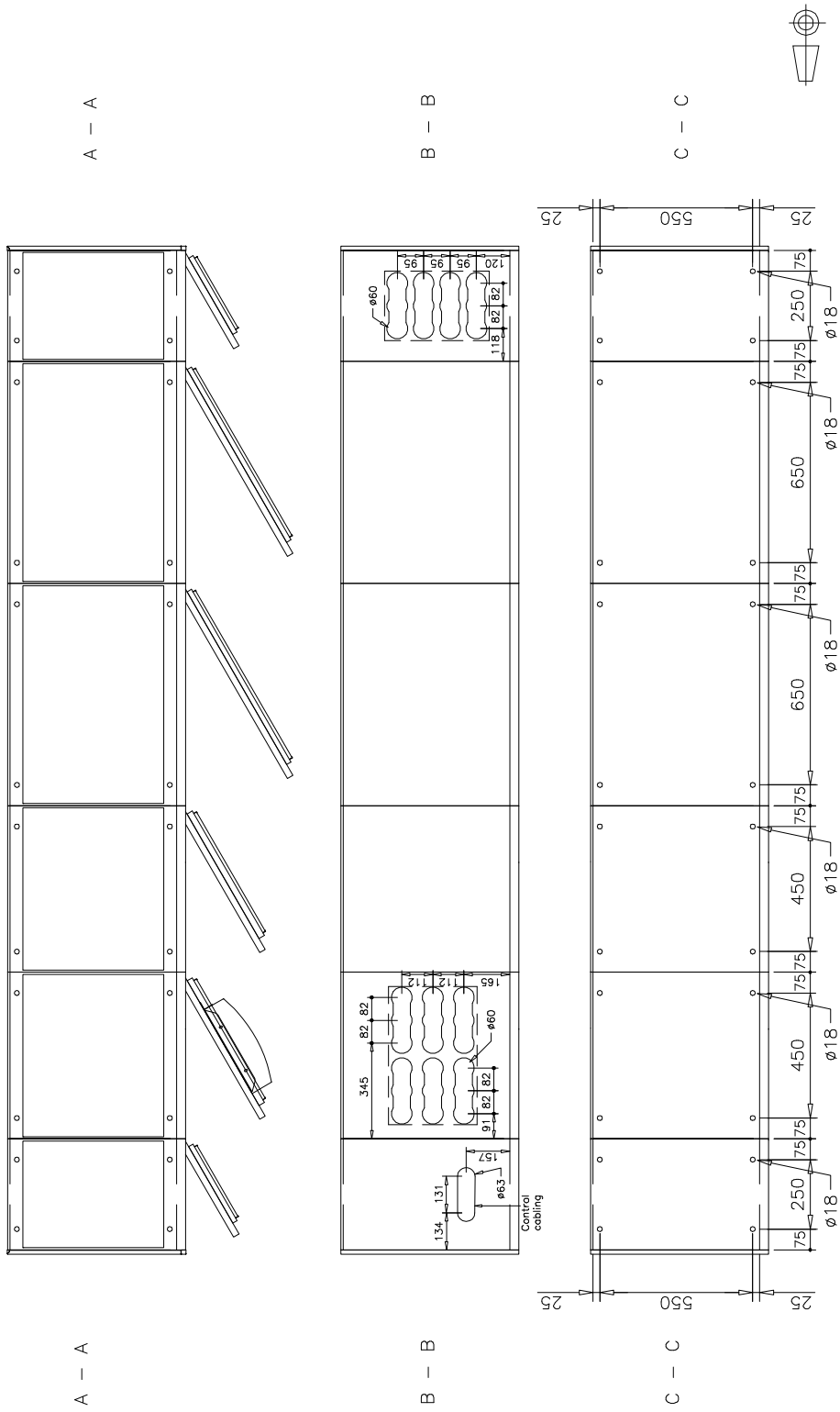
Frame 3×R8i + 3×R8i, 2/2



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

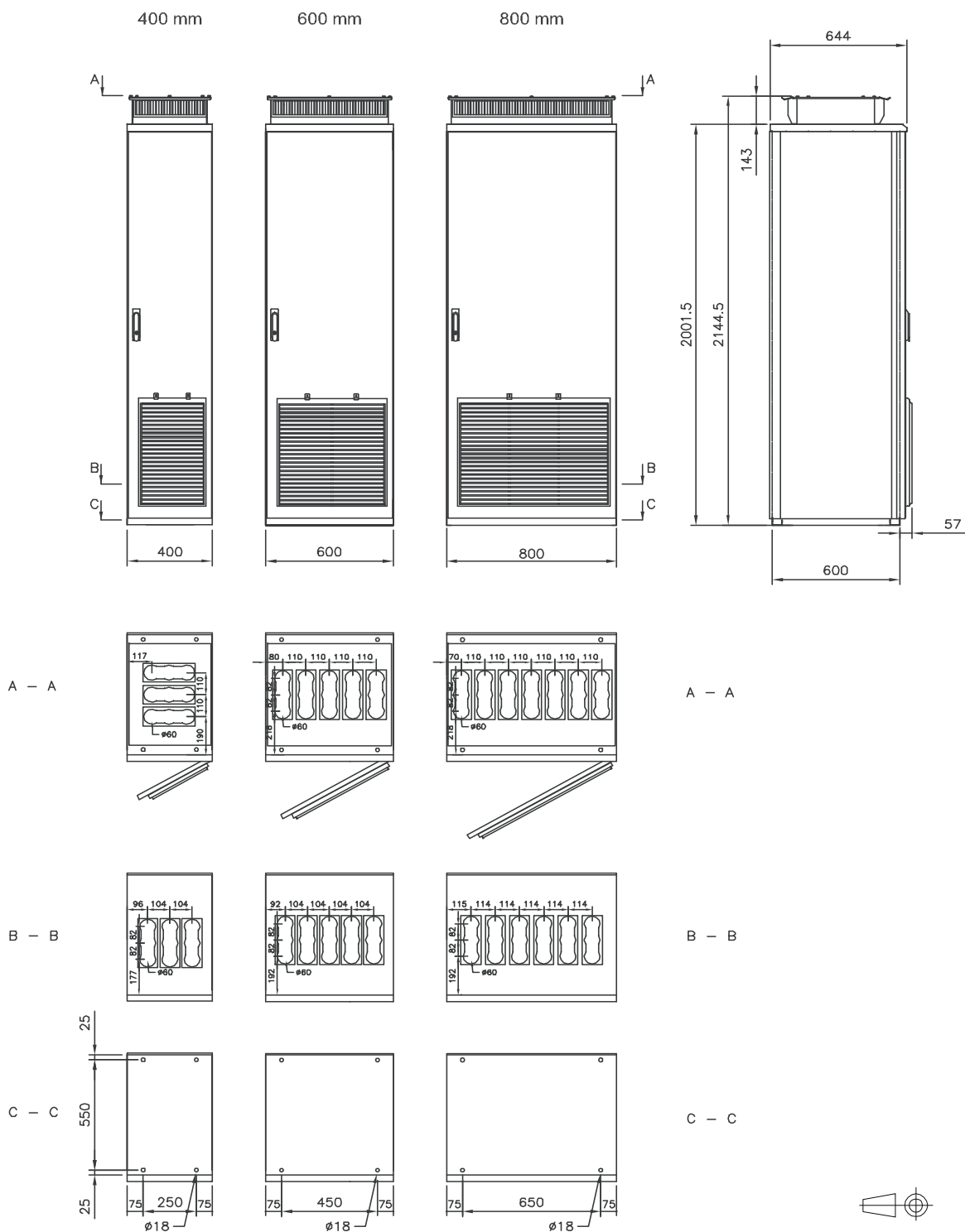


Frame 3×R8i + 3×R8i with common motor terminal cubicle (+H359), 2/2

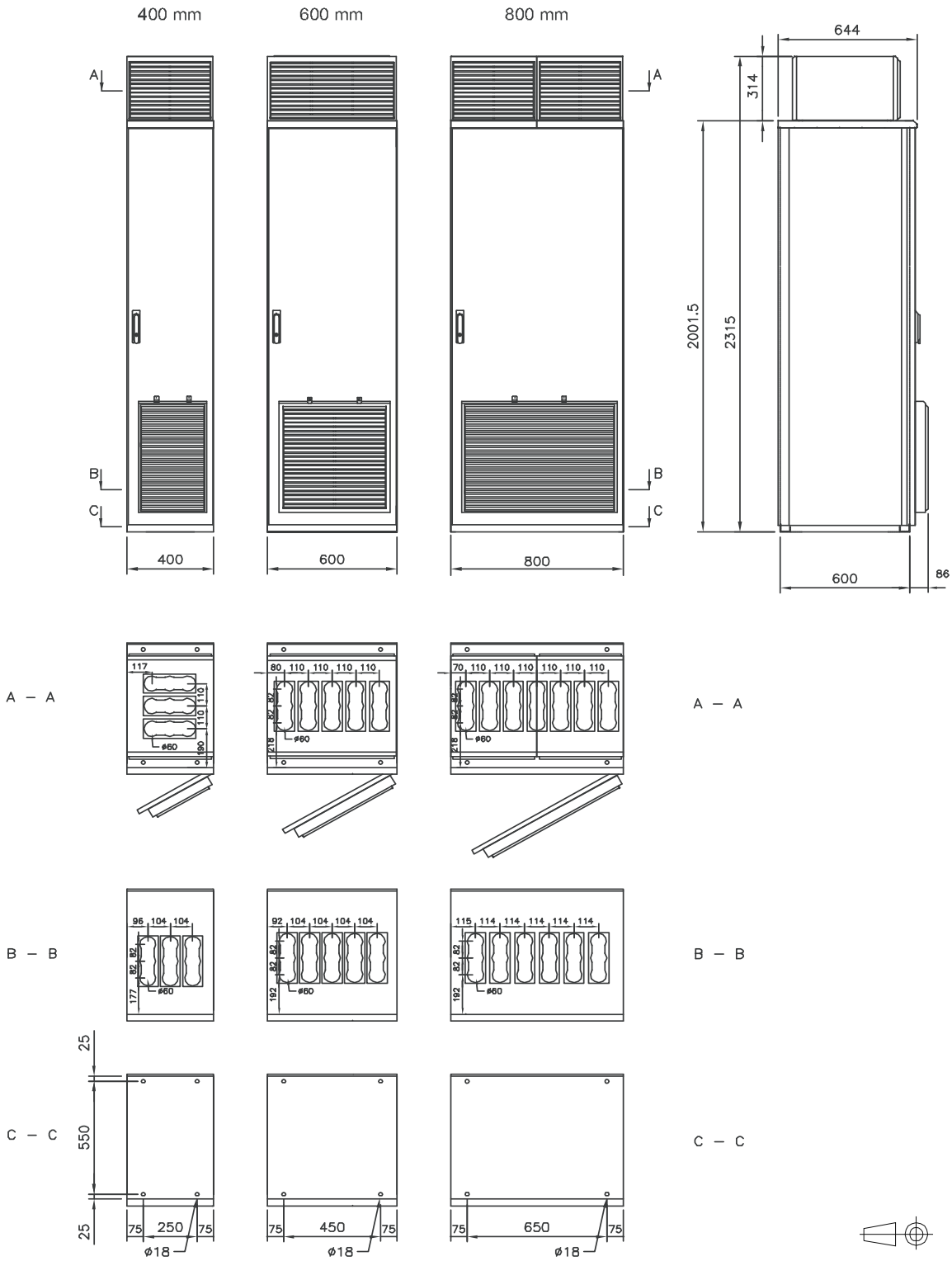


■ Dimensions of empty cubicles (options +C199, +C200, +C201)

IP22/IP42

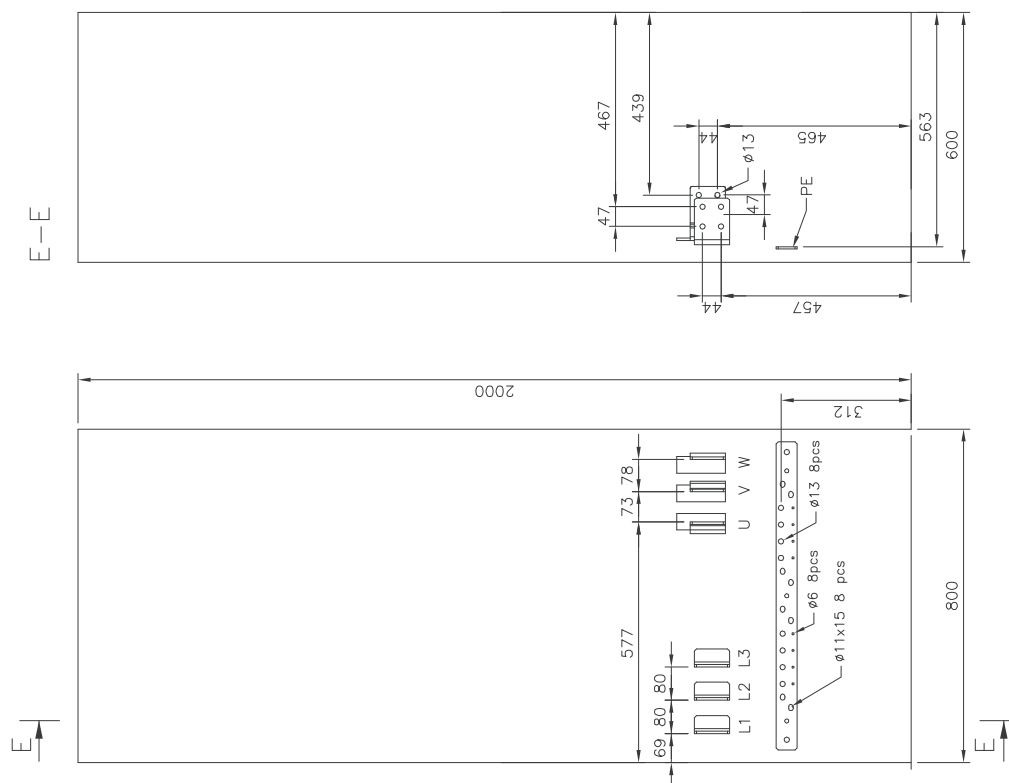


IP54

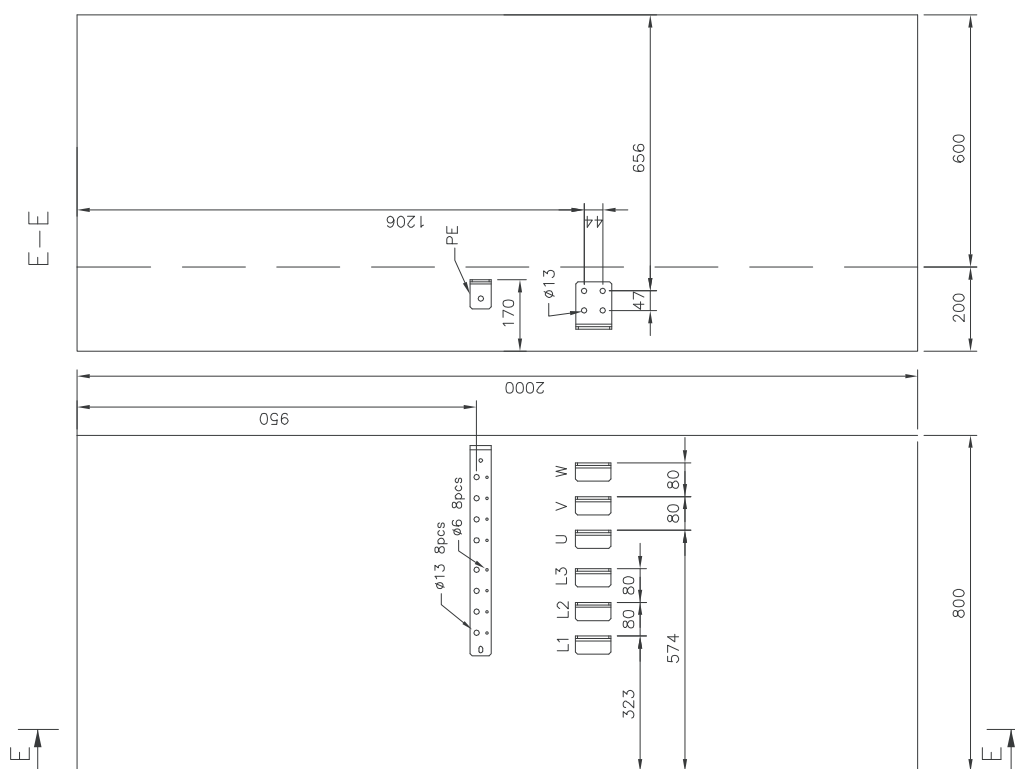


Location and size of input terminals

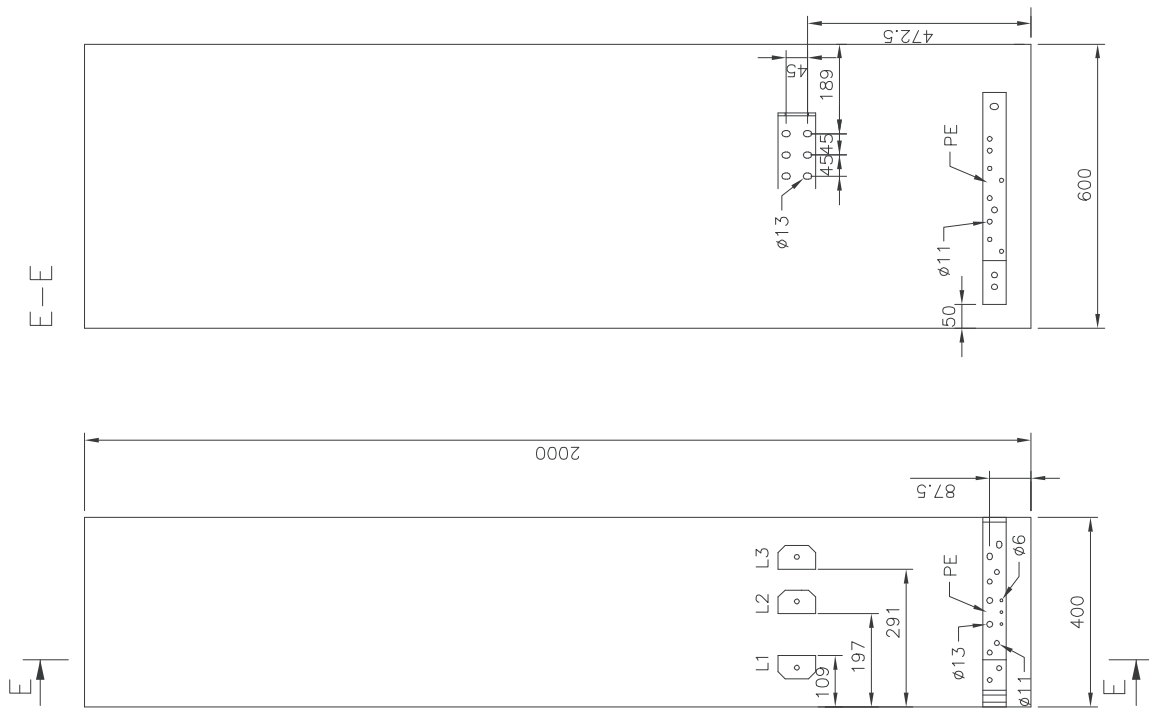
■ Frame 1×R8i + 1×R8i, bottom cable entry



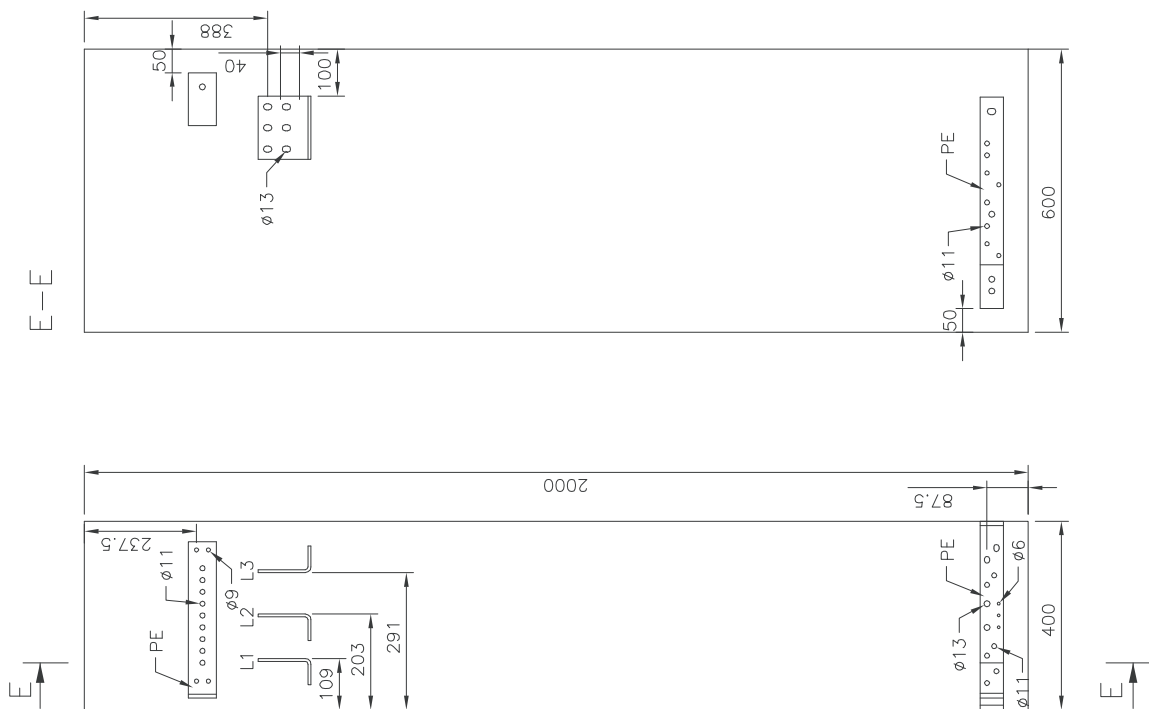
■ Frame 1×R8i + 1×R8i, top cable entry



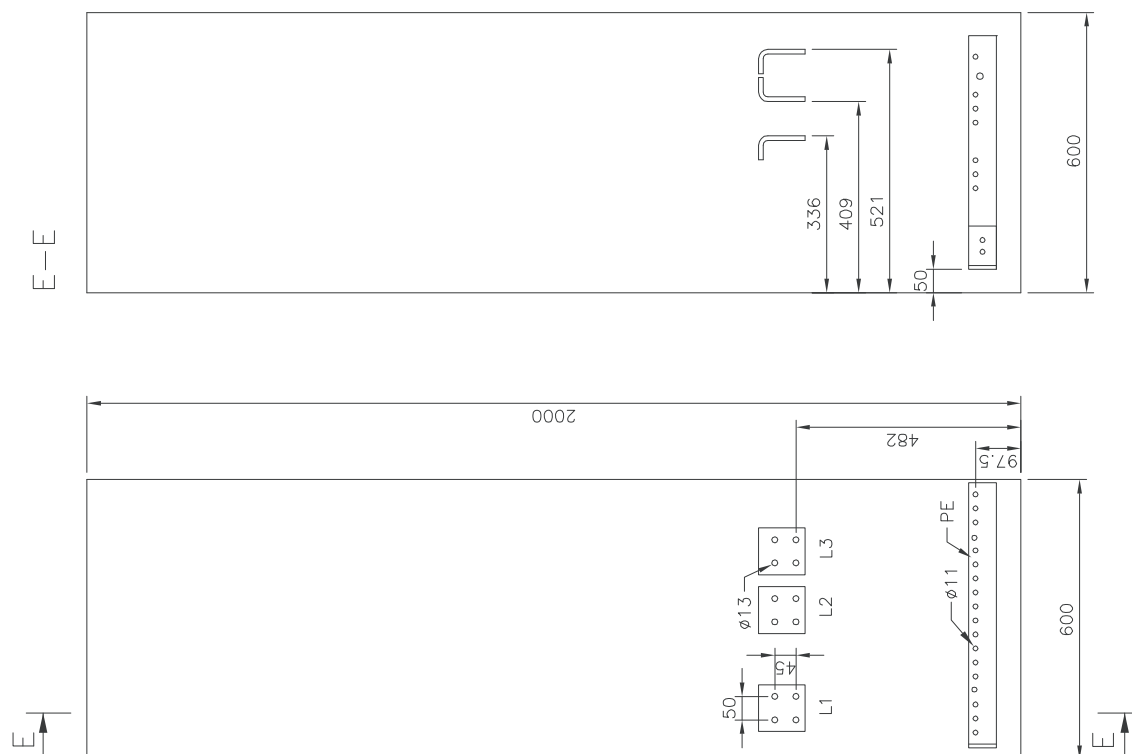
■ **Frame 2×R8i + 2×R8i with main switch/disconnector (400 mm), bottom cable entry**



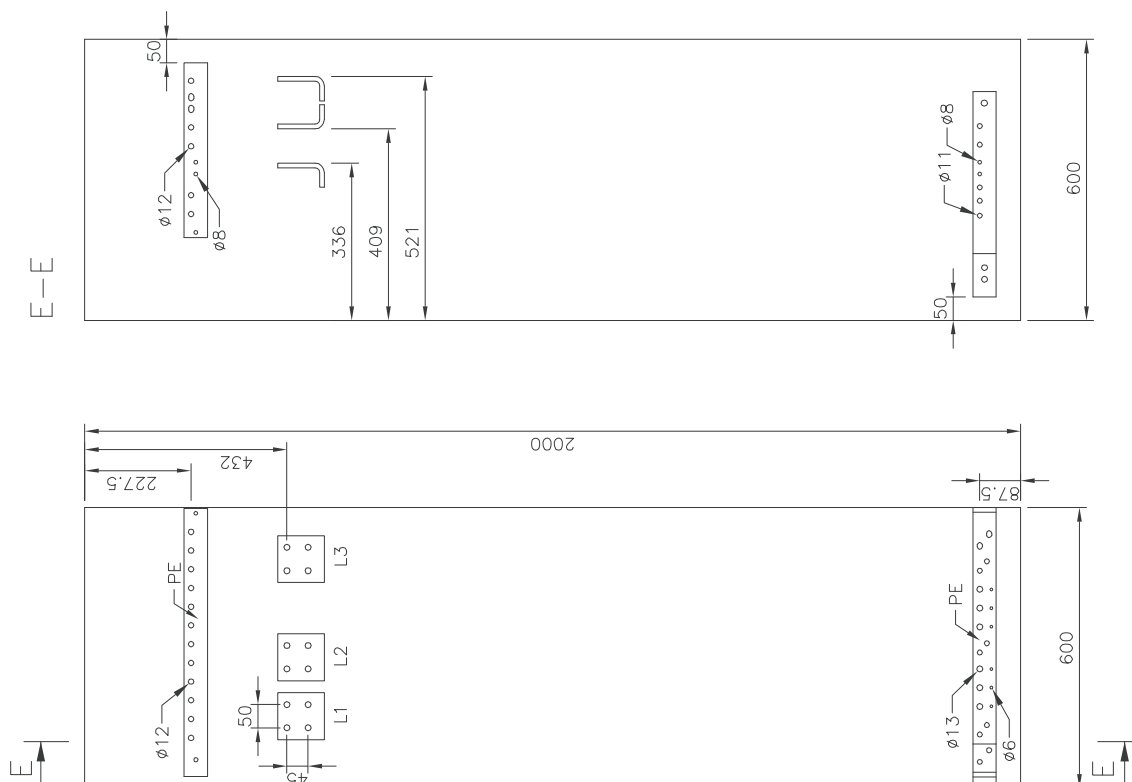
■ **Frame 2×R8i + 2×R8i with main switch/disconnector (400 mm), top cable entry**



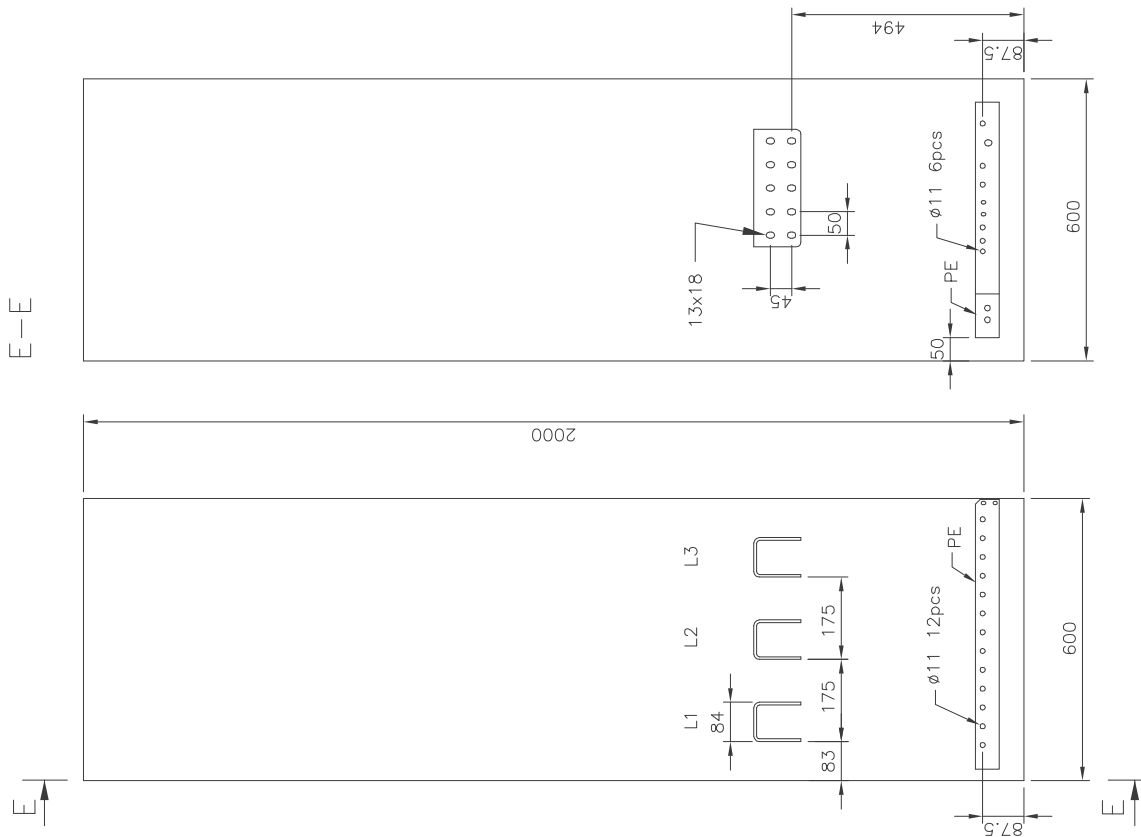
■ **Frame 2×R8i + 2×R8i with main switch/disconnector (600 mm), bottom cable entry**



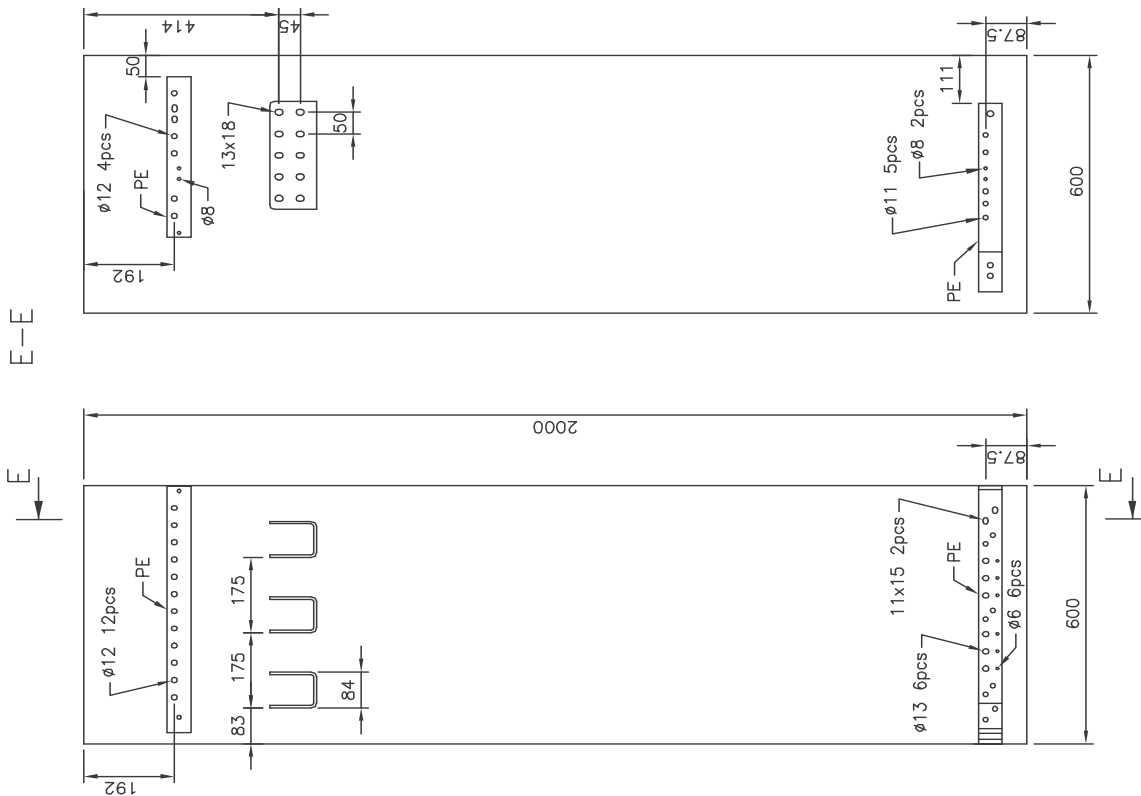
■ **Frame 2×R8i + 2×R8i with main switch/disconnector (600 mm), top cable entry**



■ Units with main breaker (600 mm), bottom cable entry



■ Units with main breaker (600 mm), top cable entry

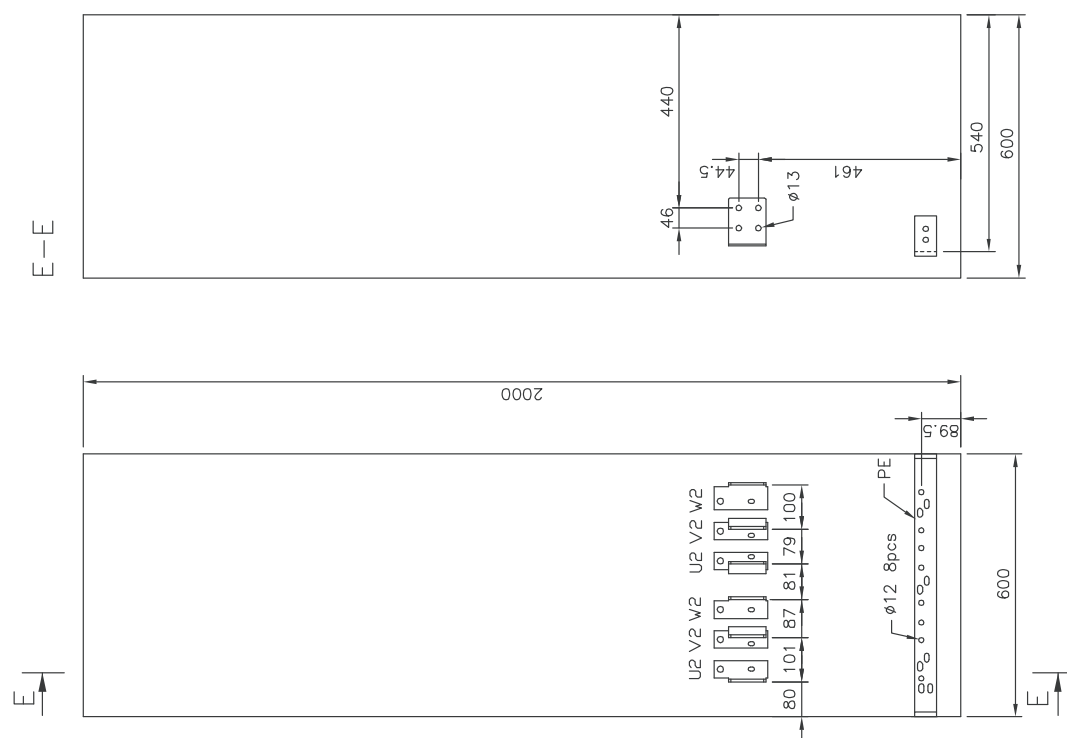


Location and size of output terminals (units without common motor terminal cubicle)

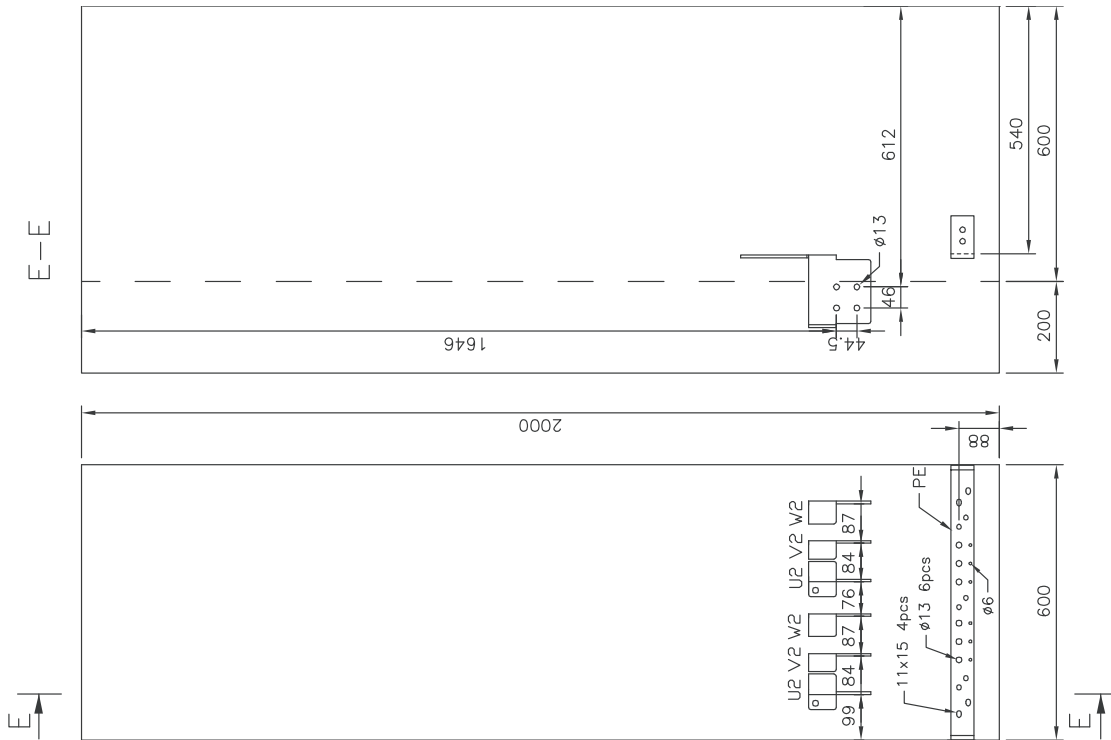
- Frame 1×R8i + 1×R8i (without sine output filter)

See page [223](#).

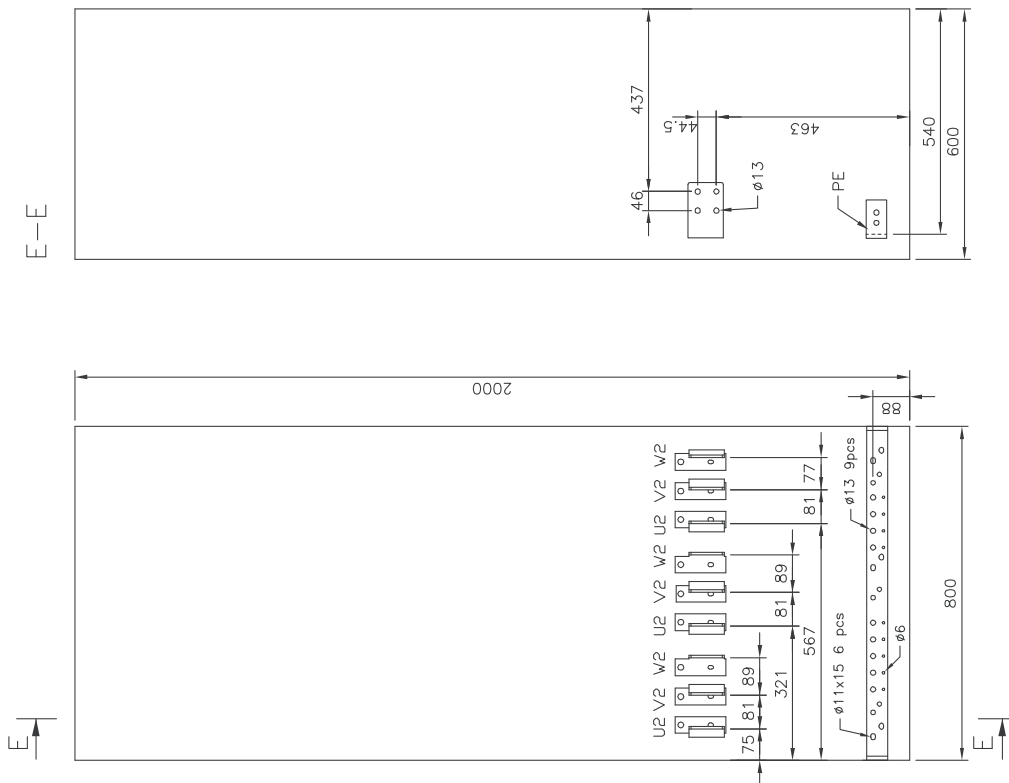
- Inverter module cubicle with two R8i modules, bottom cable exit



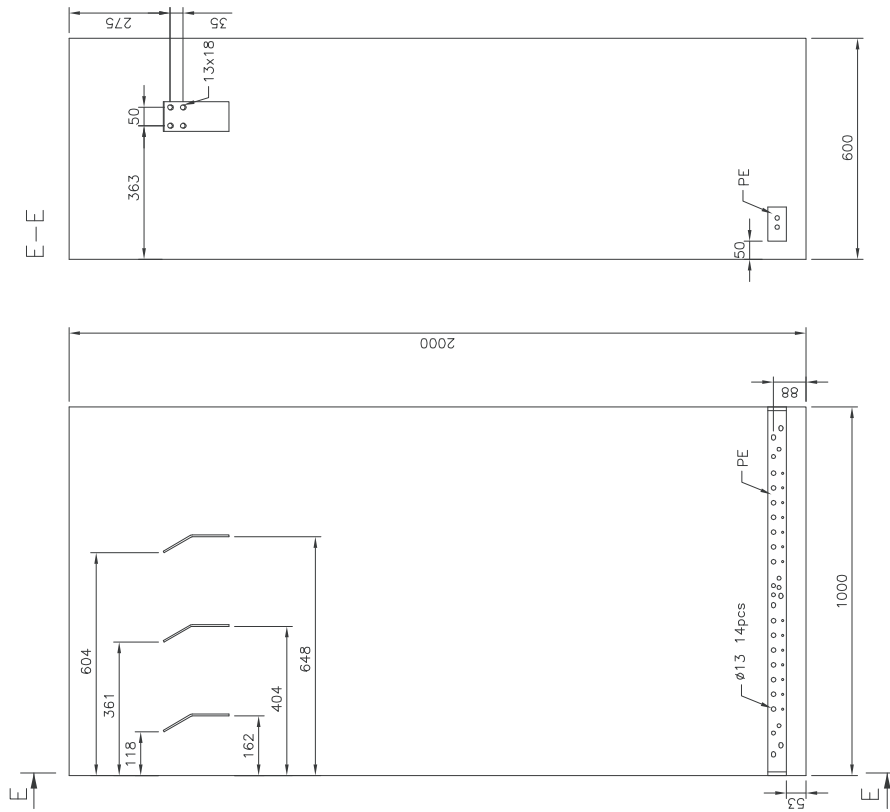
Inverter module cubicle with two R8i modules, top cable exit



Inverter module cubicle with three R8i modules, bottom cable exit



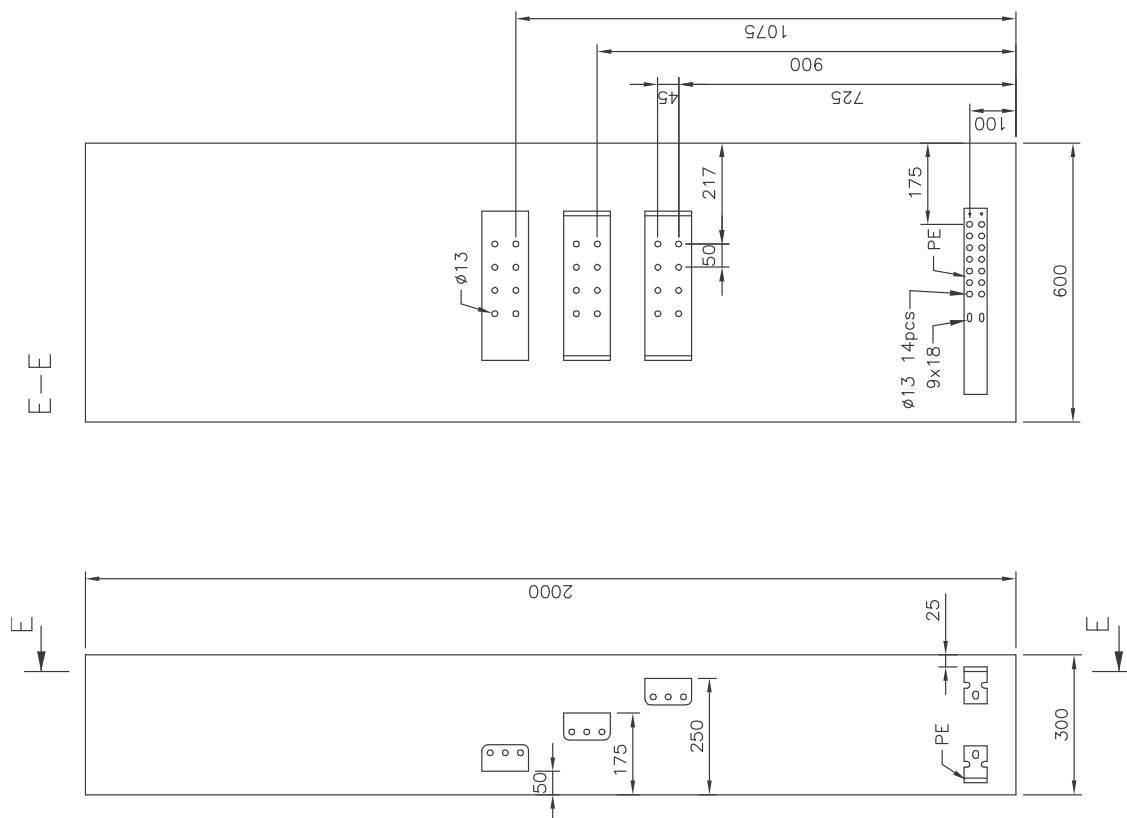
■ Sine filter (+E206) cubicle, 1000 mm, top cable exit



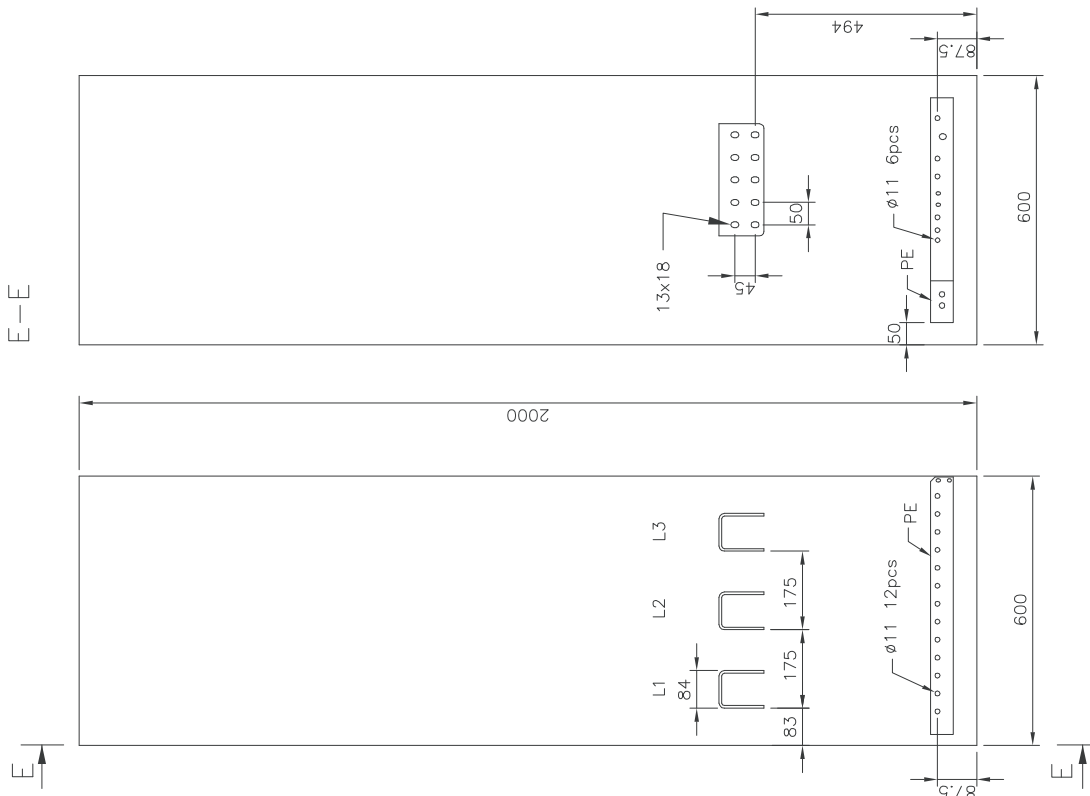
Location and size of output terminals (units with common motor terminal cubicle)

Note: See the dimension tables starting on page 202 as to which common motor terminal cubicle width is used with which drive type.

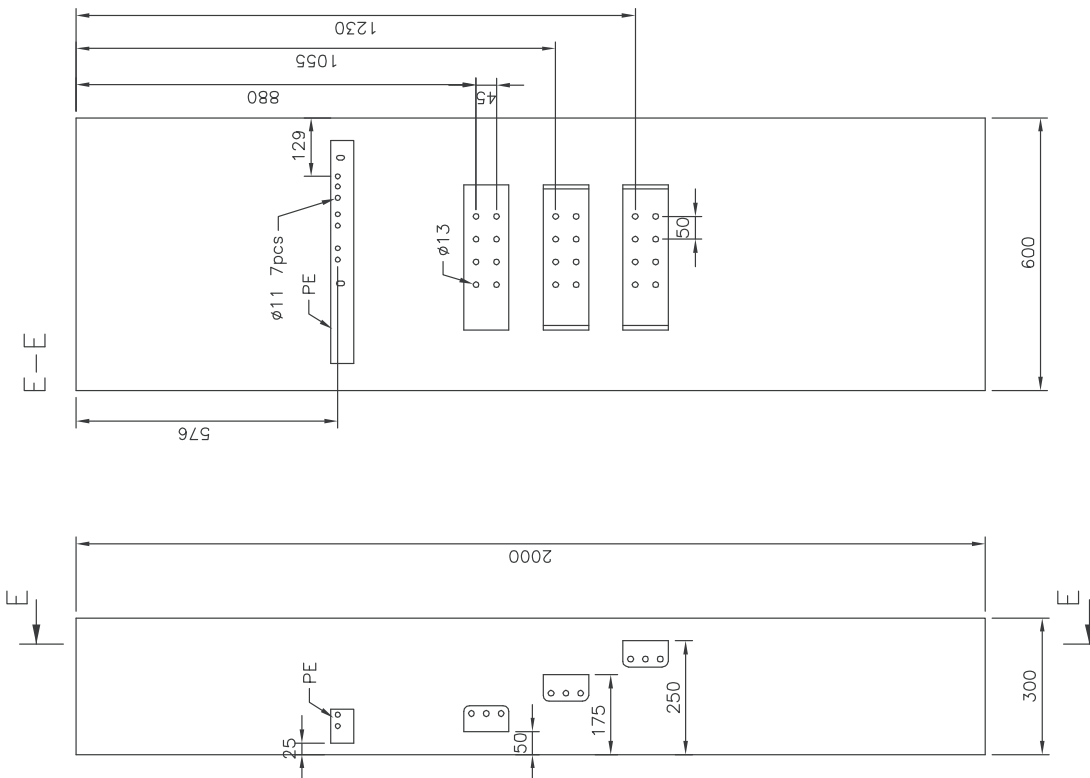
■ **Cubicle width 300 mm, bottom cable exit**



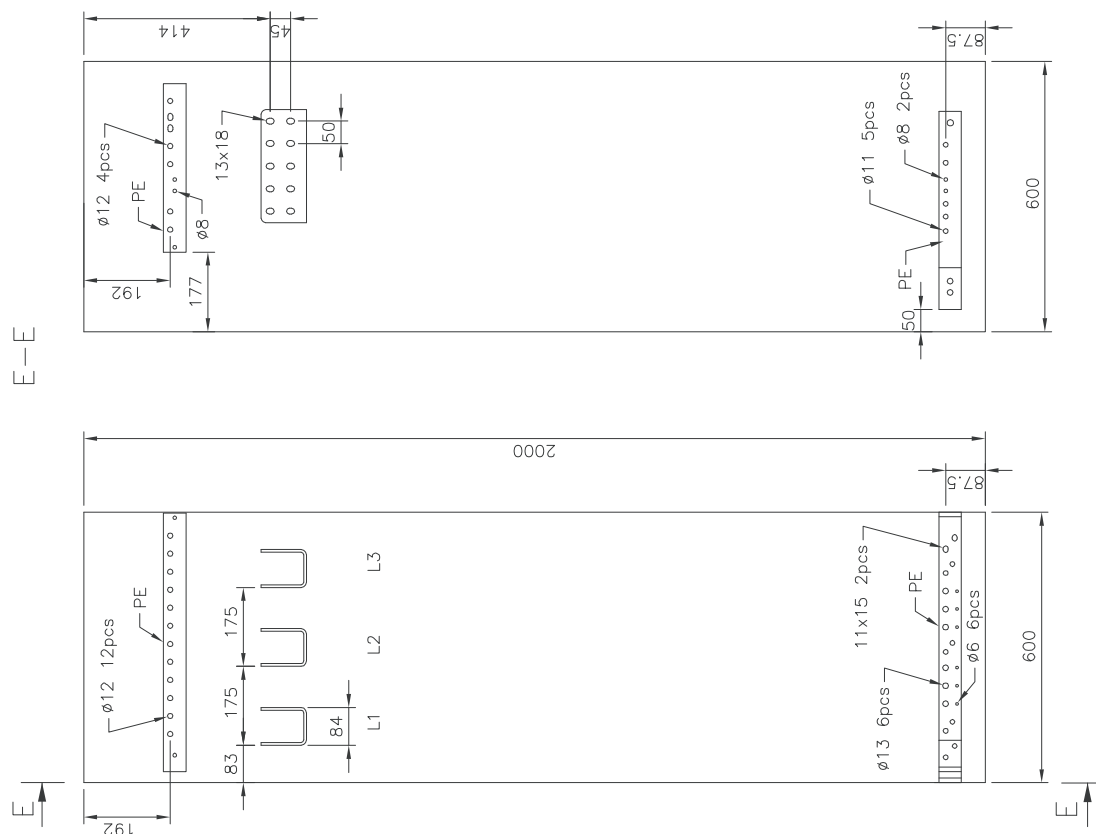
■ Cubicle width 300 mm (double-busbar version), bottom cable exit



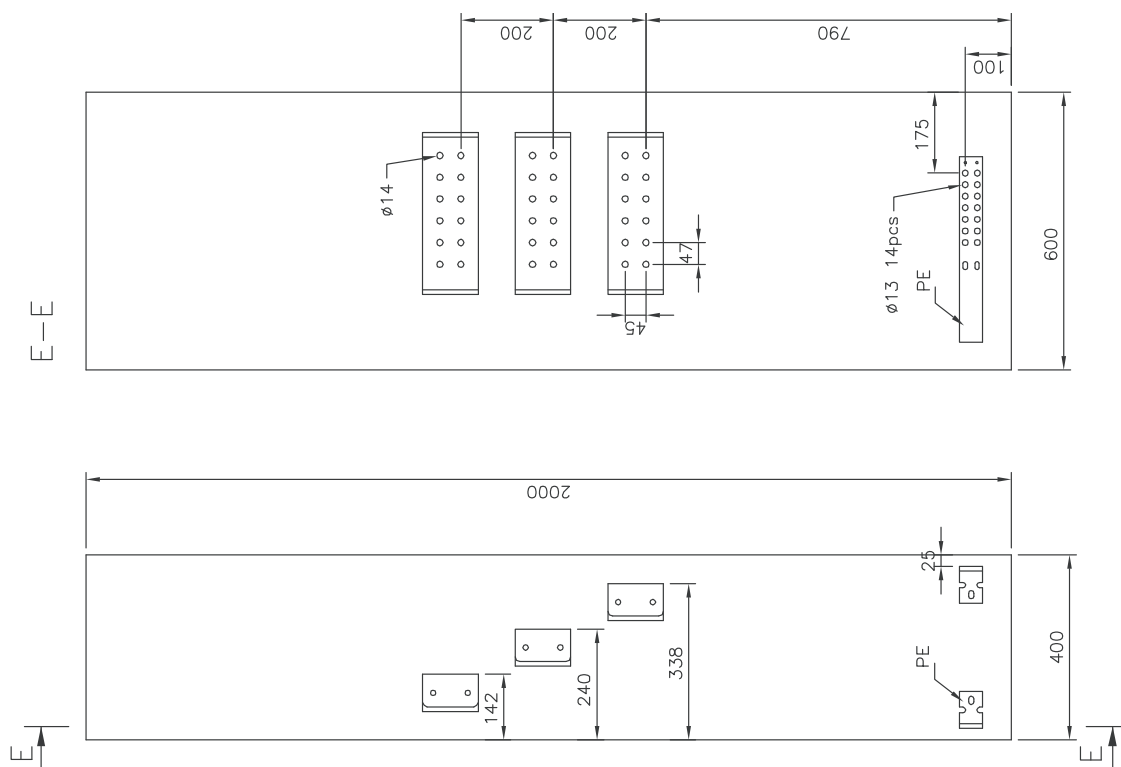
■ Cubicle width 300 mm, top cable exit



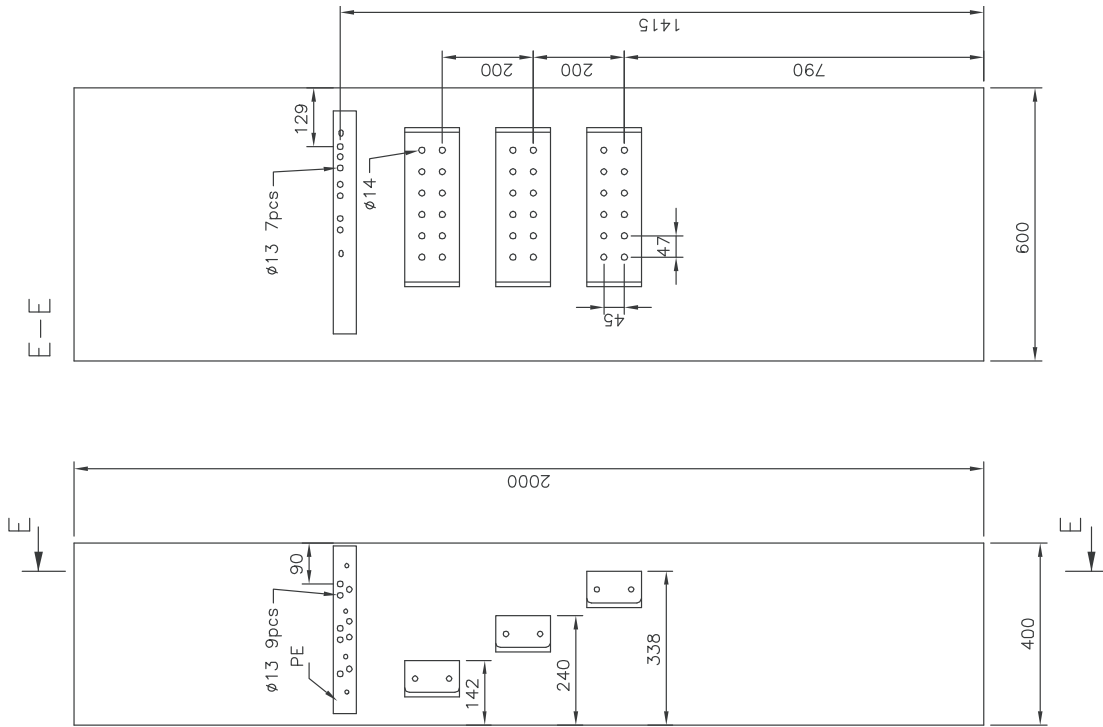
■ Cubicle width 300 mm (double-busbar version), top cable exit



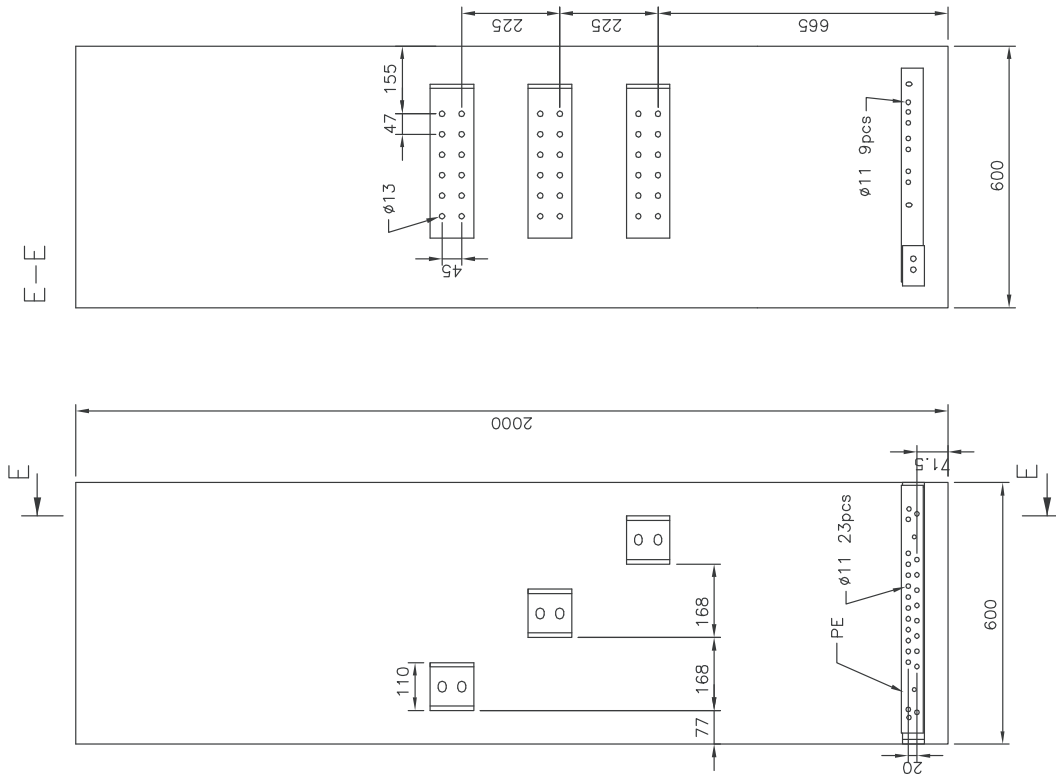
■ Cubicle width 400 mm, bottom cable exit



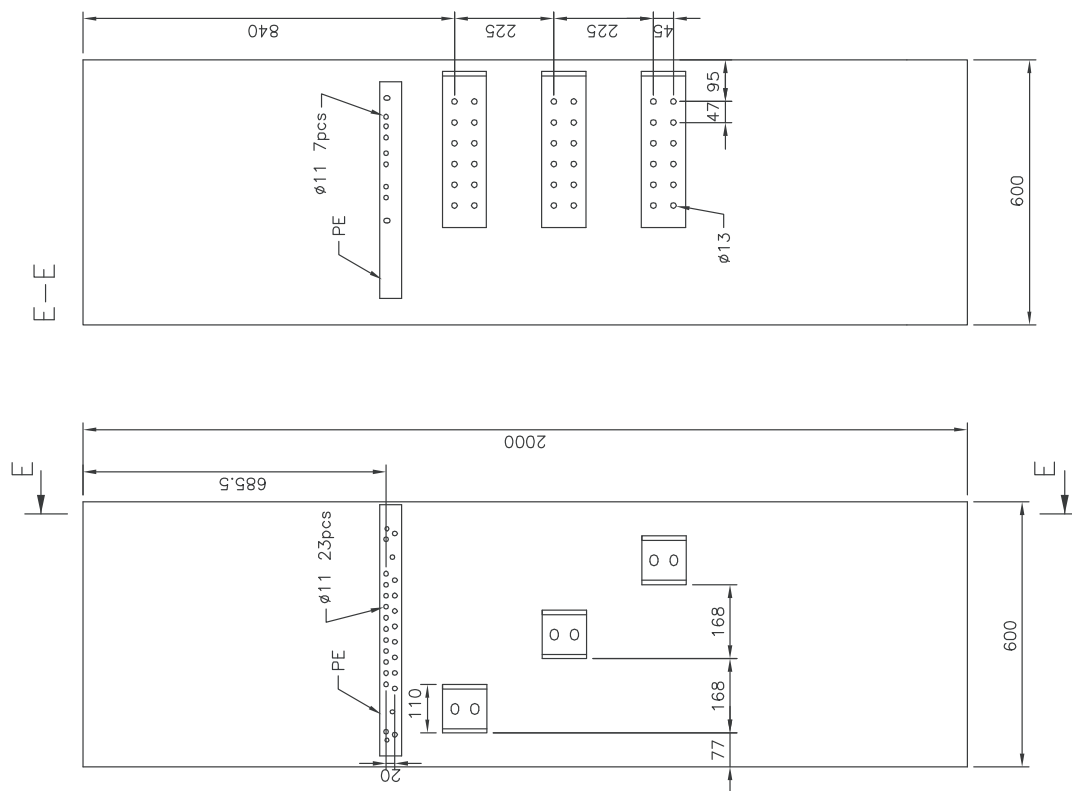
■ Cubicle width 400 mm, top cable exit

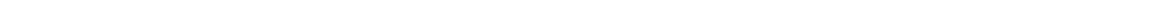


■ Cubicle width 600 mm, bottom cable exit



■ Cubicle width 600 mm, top cable exit





14

The Safe torque off function

Contents of this chapter

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

Description

The Safe torque off function can be used, for example, to construct safety or supervision circuits that stop the 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	<i>Safety of machinery – Electrical equipment of machines – Part 1: General requirements</i>
IEC 61326-3-1:2008	<i>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</i>

Standard	Name
IEC 61508-1:2010	<i>Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements</i>
IEC 61508-2:2010	<i>Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems</i>
IEC 61511-1:2016	<i>Functional safety – Safety instrumented systems for the process industry sector</i>
IEC 61800-5-2:2016 EN 61800-5-2:2007	<i>Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional</i>
IEC 62061:2015 EN 62061:2005 +AC:2010+A1:2013+A2:2015	<i>Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems</i>
EN ISO 13849-1:2015	<i>Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design</i>
EN ISO 13849-2:2012	<i>Safety of machinery – Safety-related parts of control systems – Part 2: Validation</i>

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

See page [193](#).

Wiring

The following diagrams present examples of Safe torque off wiring for

- a frame n×R8i inverter unit (page 240)
- multiple inverter units (page 241)
- multiple inverter units when an external 24 V DC power supply is used (page 242).

For information on the specifications of the STO input, see chapter [Control units of the drive](#) (page 131).

■ 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 an 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
 - With frame n×R8i inverter units: 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”.

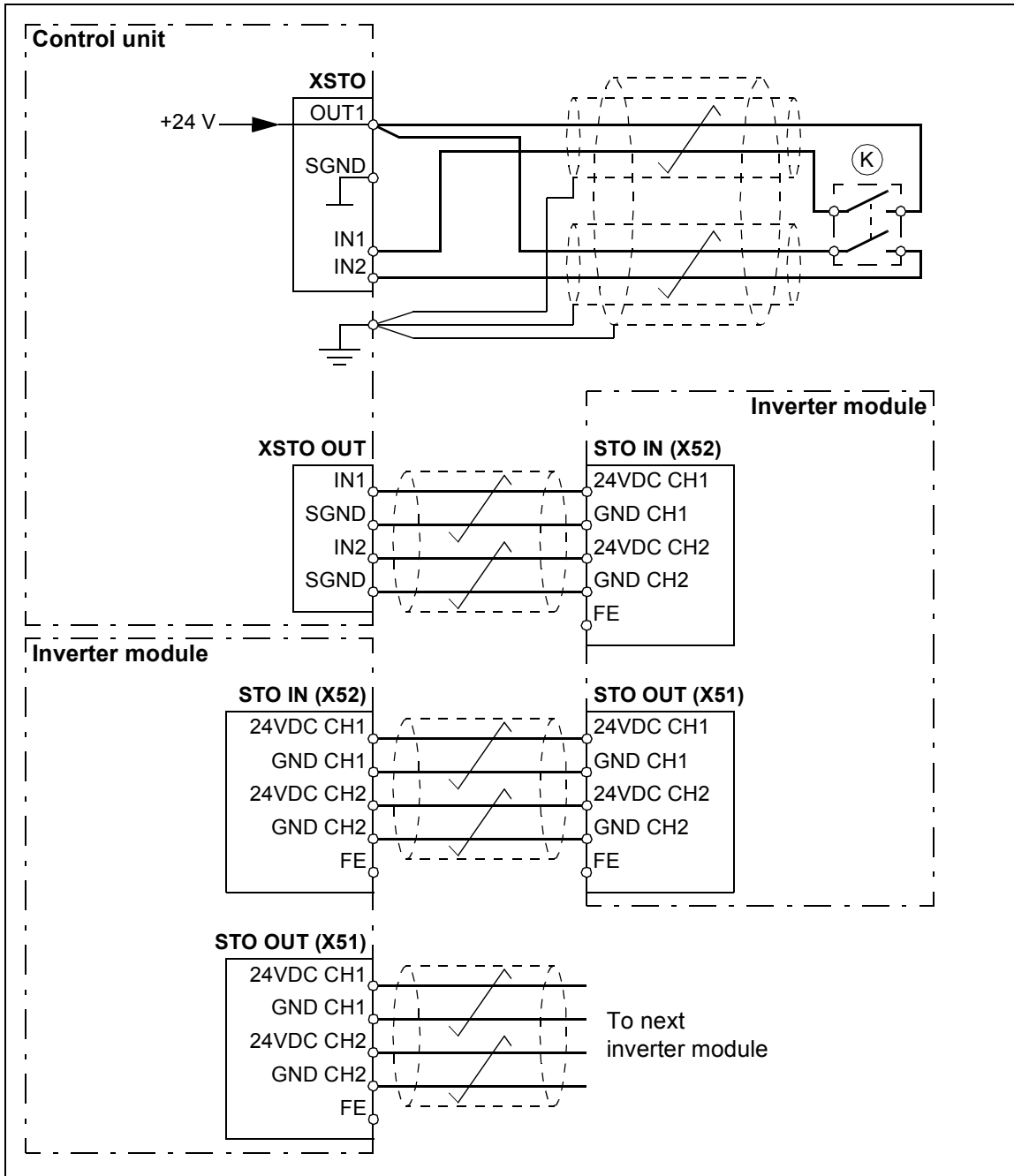
■ Grounding of protective shields

- 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.
-

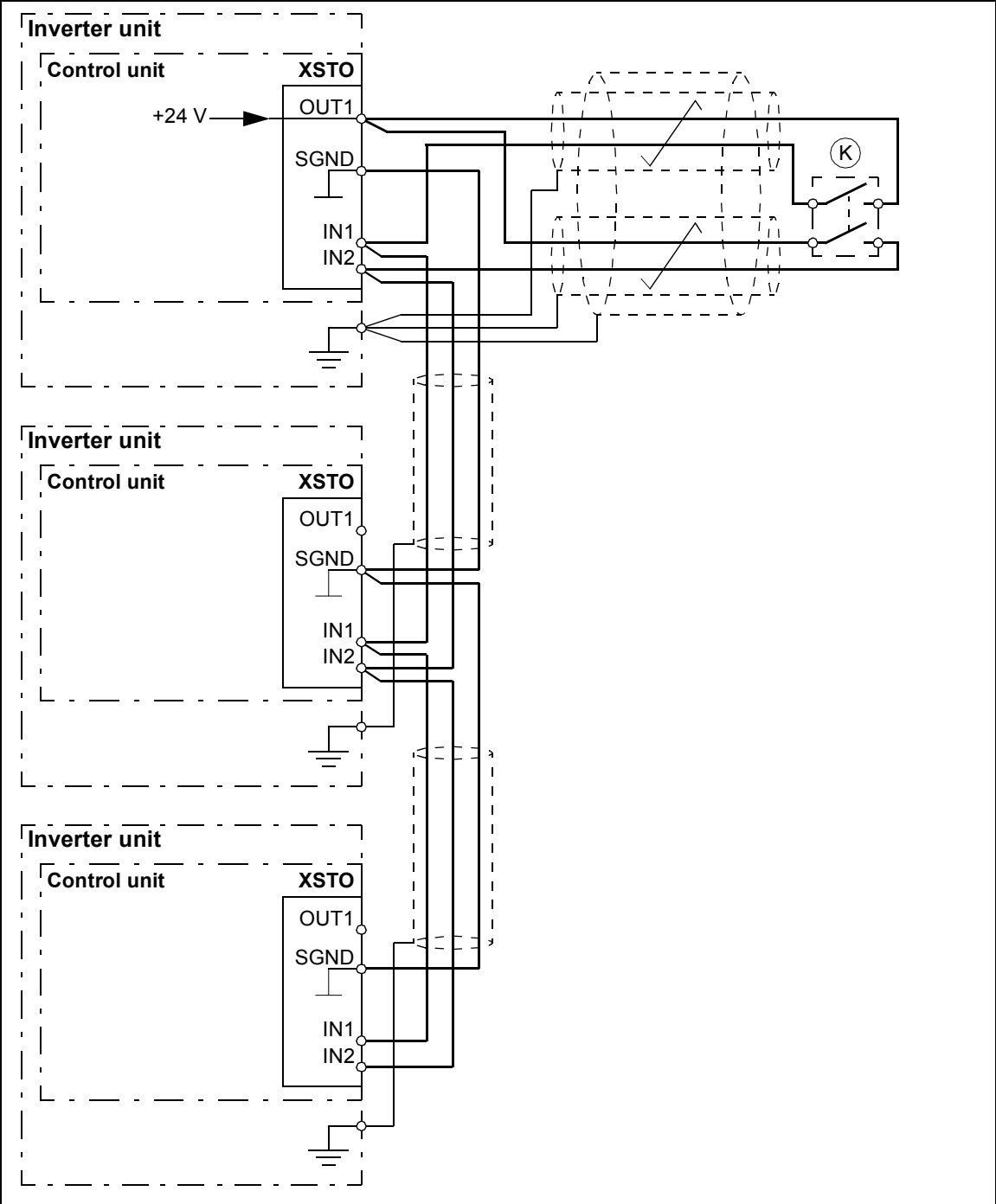
Frame n×R8i inverter unit (internal power supply)



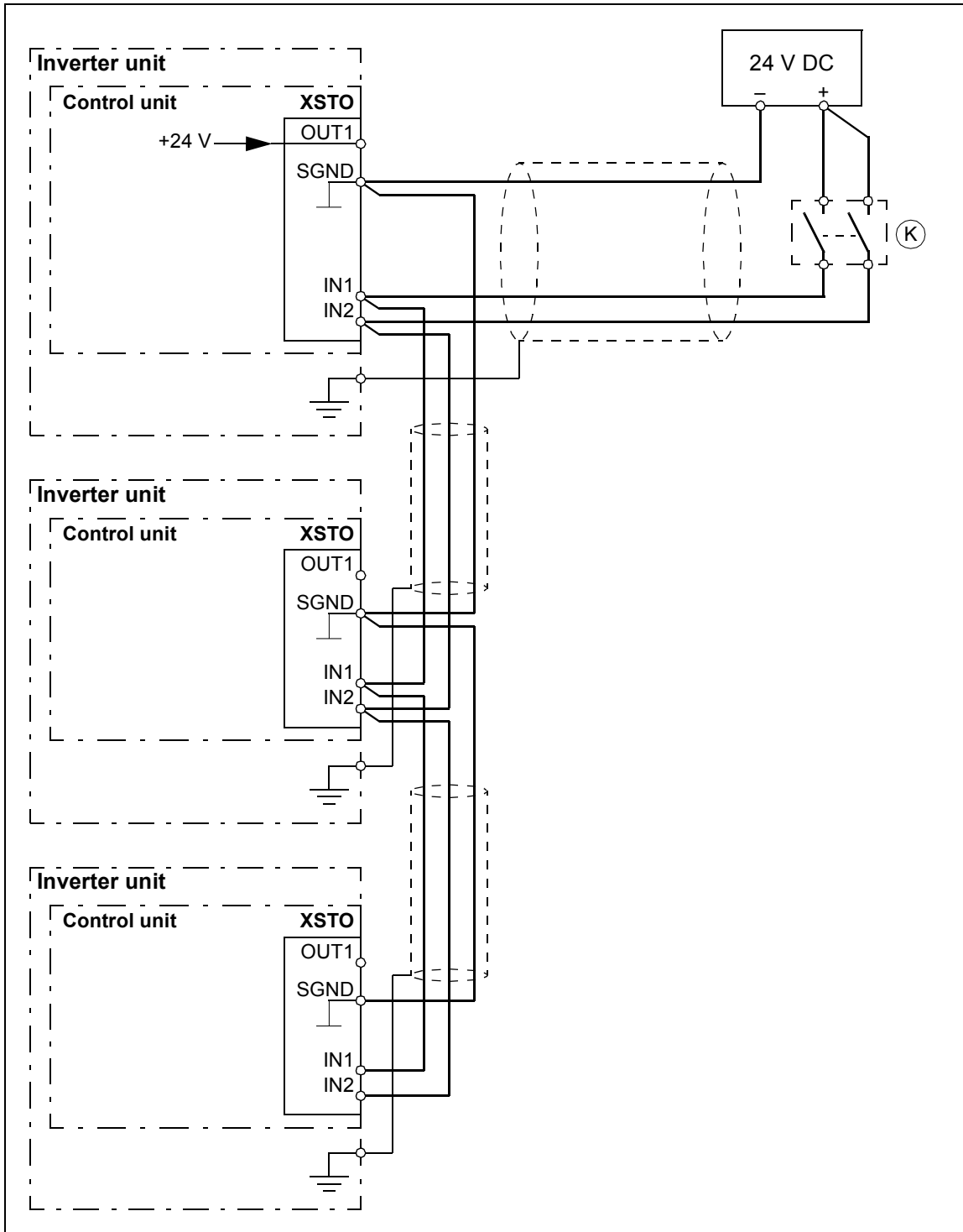
WARNING! Frame R8i inverter modules are as standard delivered with a jumper wire set that supplies 24 V from connector X53 to connector X52. The jumper wire set must be removed before wiring the Safe torque off circuit.



■ 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.

Notes:

- 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. If the drive is equipped with safety option +Q972 or Q973, do the procedure shown in the FSO module documentation.
- All inverter modules must be powered and connected to the STO circuit during the acceptance test.

Action	<input checked="" type="checkbox"/>
 WARNING! Follow the safety instructions given in chapter Safety instructions (page 15). Ignoring the instructions can cause physical injury or death, or damage to the equipment.	<input type="checkbox"/>
Ensure that the inverter can be run and stopped freely during start-up.	<input type="checkbox"/>
Stop the inverter (if running), switch the input power off and isolate the inverter from the power line by a disconnecter.	<input type="checkbox"/>
Check the Safe torque off circuit connections against the wiring diagram.	<input type="checkbox"/>
Close the disconnecter and switch the power on.	<input type="checkbox"/>
Test the operation of the STO function when the motor is stopped. <ul style="list-style-type: none"> • Give a stop command for the inverter (if running) and wait until the motor shaft is at a standstill. Ensure that the inverter operates as follows: <ul style="list-style-type: none"> • Open the STO circuit. The inverter 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 inverter's operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the inverter and check that the motor runs normally. 	<input type="checkbox"/>
Test the operation of the STO function when the motor is running. <ul style="list-style-type: none"> • Start the inverter and ensure the motor is running. • Open the STO circuit. The motor should stop. The inverter 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 inverter. • Ensure that the motor stays at a standstill and the inverter operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the inverter and check that the motor runs normally. 	<input type="checkbox"/>

Action	<input checked="" type="checkbox"/>
<p>Test the operation of the failure detection of the inverter. The motor can be stopped or running.</p> <ul style="list-style-type: none"> • Open the 1st channel of the STO circuit (wire coming to IN1). If the motor was running, it should coast to a stop. The inverter generates a <i>FA81 Safe Torque Off 1 loss</i> fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the inverter's operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the inverter 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 inverter generates a <i>FA82 Safe Torque Off 2 loss</i> fault indication (see the firmware manual). • Give a start command to verify that the STO function blocks the inverter's operation. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the inverter and check that the motor runs normally. 	<input type="checkbox"/>
Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.	<input type="checkbox"/>

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 drive will not restart while the activation switch or safety relay contacts are open.
5. Deactivate the STO by closing the activation switch, or resetting the safety functionality that is wired to the STO connection.
6. Reset any faults before restarting.



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



WARNING! 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 any ACS880 inverter unit firmware. 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 $180/2p$ (with synchronous reluctance [SynRM] motors) degrees regardless of the activation of the Safe torque off function. p denotes the

number of pole pairs.

Notes:

- If a running drive is stopped by using the Safe torque off function, the drive will cut off the motor supply voltage and the motor will coast to a stop. If this causes danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.
- The Safe torque off function overrides all other functions of the 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 247). 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 244).

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 244).

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/SILCL	SC	PL	SFF (%)	PFH ($T_1 = 20$ a) (1/h)	PFD _{avg} ($T_1 = 2$ a)	PFD _{avg} ($T_1 = 5$ a)	MTTF _D (a)	DC (%)	Cat.	HFT	CCF	Lifetime (a)
1×R8i	3	3	e	>99	5.0E-11	4.5E-07	1.1E-06	23970	≥90	3	1	80	20
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
6×R8i	3	3	e	>99	1.1E-10	9.6E-07	2.4E-06	7190	≥90	3	1	80	20

- The following temperature profile is used in safety value calculations:

- 670 on/off cycles per year with $\Delta T = 71.66$ °C
- 1340 on/off cycles per year with $\Delta T = 61.66$ °C
- 30 on/off cycles per year with $\Delta T = 10.0$ °C
- 32 °C board temperature at 2.0% of time
- 60 °C board temperature at 1.5% of time
- 85 °C board temperature at 2.3% of time.

- The STO is a type 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 dangerous failures per hour
PL	EN ISO 13849-1	Performance level. Levels a...e correspond to SIL
SC	IEC 61508	Systematic capability
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1...3)
SILCL	IEC/EN 62061	Maximum SIL (level 1...3) that can be claimed for a safety function or subsystem
SS1	IEC/EN 61800-5-2	Safe stop 1
STO	IEC/EN 61800-5-2	Safe torque off
T1	IEC 61508-6	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. See also section Maintenance (page 246).

■ Declaration of conformity

See section [Compliance with the European Machinery Directive](#) (page 193).

15

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. 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 ACS880-37 as factory-installed. It is also possible to use option +D150 with a custom resistor assembly.

U_N	ACS880-37 type	Brake chopper type (+D150)	Brake resistor type (+D151)
400 V	ACS880-37-0450A-3	NBRA-659	2 × SAFUR180F460
	ACS880-37-0620A-3		
	ACS880-37-0870A-3	2 × NBRA-659	2 × (2 × SAFUR180F460)
	ACS880-37-1110A-3		
	ACS880-37-1210A-3		
	500 V	ACS880-37-1430A-3	3 × NBRA-659
ACS880-37-1700A-3			
ACS880-37-0420A-5		NBRA-659	2 × SAFUR200F500
ACS880-37-0570A-5			
ACS880-37-0780A-5		2 × NBRA-659	2 × (2 × SAFUR200F500)
ACS880-37-1010A-5			
ACS880-37-1110A-5			
690 V	ACS880-37-1530A-5	3 × NBRA-659	3 × (2 × SAFUR200F500)
	ACS880-37-0320A-7	NBRA-669	2 × SAFUR200F500
	ACS880-37-0390A-7		
	ACS880-37-0580A-7	2 × NBRA-669	2 × (2 × SAFUR200F500)
	ACS880-37-0660A-7		
	ACS880-37-0770A-7		
	690 V	ACS880-37-0950A-7	3 × NBRA-669
ACS880-37-1130A-7			

Consult your local ABB representative for availability of brake choppers and resistors for other drive types.

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	NBRA-659	2 × SAFUR180F460	1.2	353	54	545	287	444	167	444
	2 × NBRA-659	2 × (2 × SAFUR180F460)	1.2	706	108	1090	575	888	333	514
	3 × NBRA-659	3 × (2 × SAFUR180F460)	1.2	1058	162	1635	862	1332	500	771
500 V	NBRA-659	2 × SAFUR200F500	1.35	403	54	605	287	355	167	206
	2 × NBRA-659	2 × (2 × SAFUR200F500)	1.35	806	108	1210	575	710	333	412
	3 × NBRA-659	3 × (2 × SAFUR200F500)	1.35	1208	162	1815	862	1065	500	618
690 V	NBRA-669	2 × SAFUR200F500	1.35	404	54	835	287	257	167	149
	2 × NBRA-669	2 × (2 × SAFUR200F500)	1.35	807	108	1670	575	514	333	298
	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 of the resistor assembly.

P_{brmax} = Maximum short-term (1 min every 10 mins) braking power

P_{brcont} = Maximum continuous braking power

I_{max} = Maximum peak current

P_{br} = Braking power for the specified duty cycle

I_{rms} = Corresponding rms current

■ SAFUR resistors

The SAFUR resistors available as factory-installed (option +D151) are also available separately.

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 when placed 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 capacity of the braking equipment

1. Calculate the maximum power generated by the motor during braking (P_{\max}).
2. Ensure that the braking power of the chopper is equal to or greater than P_{\max} .

The P_{brmax} values specified in the ratings table on page 251 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, the maximum allowed braking power (P_{br}) must be used instead. In the ratings table, P_{br} is given for two additional braking cycles. 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 the E_R 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 resistors

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 (page 251)



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 be able to handle the overcurrent caused by the low resistance.

- the resistance of the custom resistor does not restrict the braking capacity needed, ie.

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

where

P_{\max}	Maximum power generated by the motor during braking
U_{DC}	Voltage over the resistor during braking. U_{DC} 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 (P_{br})

- Braking energy transferred during any ten minute period must be less than or equal to the energy transferred during the reference braking cycle.
- The braking power must not exceed the rated maximum value P_{brmax} .

$$1. \quad n \times P_{br} \times t_{br} \leq P_{brmax} \times 60 \text{ s}$$

$$2. \quad P_{br} \leq P_{brmax}$$

n = Number of braking pulses during a 10-minute period

P_{br} = Maximum allowed braking power (kW)

t_{br} = Braking time (s)

P_{brmax} = Maximum braking power for a reference cycle (kW)

Example 1

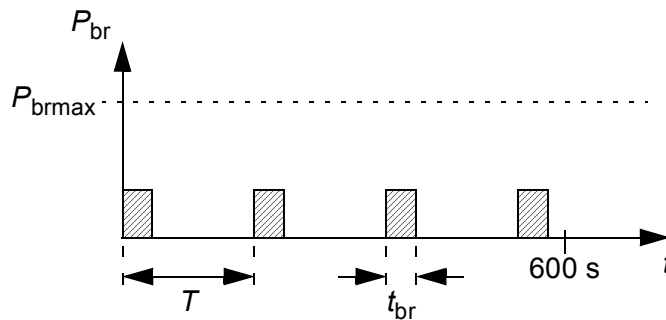
The duration of a braking cycle is 30 minutes. The braking time is 15 minutes.

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.

$$1. \quad P_{br} \leq \frac{P_{brmax} \times 60 \text{ s}}{4 \times 40 \text{ s}} = 0.375 \times P_{brmax}$$



$$2. \quad P_{br} \leq P_{brmax} \quad \text{OK}$$

Result: The maximum allowed braking power for the 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.

Maximum cable length

The maximum length of the resistor cable(s) is 50 m (164 ft).

EMC compliance of the complete installation

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

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 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, a similar protection must be implemented. Use cable rated as follows:

- twisted pair, shielding recommended
- rated operating voltage between a conductor and ground (U_0) \geq 750 V
- insulation test voltage $>$ 2.5 kV.

Keep the cable as short as possible.

■ Protecting the resistor cable against short-circuits

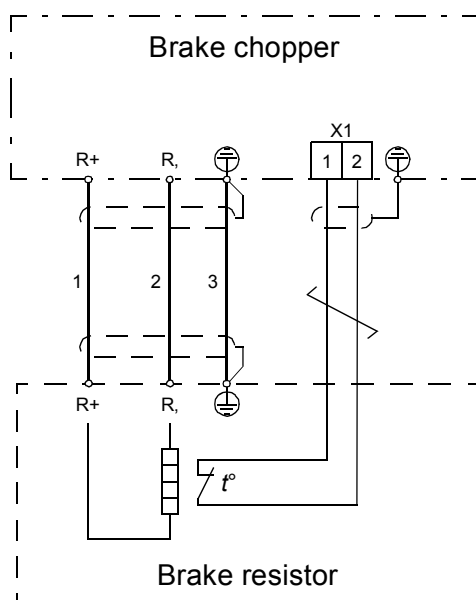
The input fuses of the drive will also protect the resistor cable provided that the resistor cable is of the same type as the input cable.

Mechanical installation of custom brake resistors

Follow the resistor manufacturer's instructions.

Electrical installation of custom brake resistors

■ Connection diagram

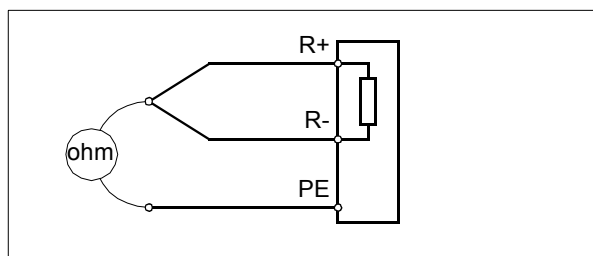


■ Connection procedure



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](#) (page 19) 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 255). 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.

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 Drives manuals

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

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