ENGINEERING TOMORROW

Operating Guide

iC7-Automation Air-cooled Enclosed Drives

206/385–1710 A

drives.danfoss.com | iC7

Contents

1 Introduction

1.1 Purpose of this Operating Guide

This operating guide provides information for safe installation and commissioning of the product. It is intended for use by qualified personnel. Read and follow the instructions to use the drive safely and professionally. Pay particular attention to the safety instructions and general warnings. Always keep this operating guide available with the drive.

1.2 Additional Resources

Additional resources are available to help understand the features, and safely install and operate the iC7 products:

- The safety guide, which provides important safety information related to installing iC7 drives.
- The installation guides, which cover the mechanical and electrical installation of drives, functional extension options, or other extra components.
- The application guides, which provide instructions on setting up the drive for a specific end-use.

Latest versions of Danfoss product documentation are available for download at https://www.danfoss.com/en/service-and-support/documentation/.

1.3 Version History

This guide is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this guide is English.

Table 1: Version History

Version	Remarks
A	First version
B	Minor updates

1.4 Abbreviations

Table 2: Abbreviations, Acronyms, and Symbols

Term	Definition
AC	Alternating current
AFE	Active front end
AI	Analog input
AO	Analog output
AWG	American wire gauge
DC	Direct current
DI	Digital input
DO	Digital output
EMC	Electromagnetic compatibility
EN	European standards
GND	Ground
I	Current
IEC	International Electrotechnical Commission
INU	Inverter

Term	Definition
I/O	Input/output
IP	Ingress protection
LC	Inductor-capacitor
NC	Normally closed
NO	Normally open
PCB	Printed circuit board
PE	Protective earth
RTC	Real-time clock
SS1	Safe stop 1
STO	Safe torque off
U	Voltage
UL	Underwriters Laboratories

1.5 Disposal

Do not dispose of equipment containing electrical components together with domestic waste. Collect it separately in accordance with local and currently valid legislation.

2 Safety

2.1 Safety Symbols

The following symbols are used in this guide:

⚠ D A N G E R ⚠

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ W A R N I N G ⚠

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ C A U T I O N ⚠

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

N O T I C E

Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

2.2 General Safety Considerations

⚠ W A R N I N G ⚠

LACK OF SAFETY AWARENESS

This document gives important information on how to prevent injury and damage to the equipment or your system. Ignoring them can lead to death, serious injury, or severe damage to the equipment.

- Make sure to fully understand the dangers and safety measures incurred in your application.

⚠ W A R N I N G ⚠

DISCHARGE TIME (5 OR 20 MINUTES)

The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off.

Failure to wait for the given discharge time after power has been removed before performing service or repair work can result in death or serious injury.

- Stop the motor.
- Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery back-ups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully before performing any service or repair work. The exact discharge time is also shown on the front cover of the drive.

Frame	Minimum waiting time (minutes)
AE10, AE11, IE10, IE11	5
FE9, FE10	20

- Measure the voltage level to verify full discharge.

For US and Canadian markets:

NOTE! Download the English and French product guides with applicable safety, warning and caution information from https://www.danfoss.com/en/service-and-support/.

REMARQUE Vous pouvez télécharger les versions anglaise et française des guides produit contenant l'ensemble des informations de sécurité, avertissements et mises en garde applicables sur le site https://www.danfoss.com/en/service-and-support/.

To install and operate this product safely:

1. Check that the content of the delivery is correct and complete.
2. Never install or start up damaged units. File a complaint immediately to the shipping company, if you receive a damaged unit.
3. Follow the instructions in this document and the specific product manuals.
4. Make sure that all personnel working on or with the product have read and understood this manual and the additional product-specific manuals. Do not hesitate to contact Danfoss, if you are unclear of the given information, or if you are missing information.
5. There can be sharp edges in the drive that can cause cuts. Be careful to avoid injuries and wear the appropriate safety equipment when you do mounting, cabling, or maintenance operations.

2.3 Target Group and Necessary Qualifications

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of AC drives. Only **qualified personnel** are allowed to perform all related activities for these tasks. Qualified personnel are defined as properly trained staff, who are familiar with and authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the qualified personnel must be familiar with the instructions and safety measures described in this guide and the other product-specific guides. Non-qualified electricians are not allowed to do electrical installation or troubleshooting activities.

Only **Danfoss authorized**, qualified personnel are allowed to repair this equipment. Specialized training is required to perform the activities related to repair.

2.4 Designated Use

Installing and operating a Danfoss drive not following the following preconditions is regarded as non-designated use. Danfoss does not take any liability for non-designated use.

Danfoss drives are units intended for installation in electrical systems. They comply with the requirements of various directives and certifications. To see all valid certifications for your product, check the product label of your product.

When the drive is installed in machinery or system, these have to comply with relevant national regulations.

In any case, the drive and its components have to be operated in accordance with all national Occupational Safety & Health regulations and directives.

Operation of Danfoss drives is only allowed under observance of the respective EMC regulations.

Operation of Danfoss drives is only allowed under observance of the specifications and requirements given on the product label and in the product-specific documentation.

Danfoss drives provide dedicated functions to support the functional safety concept for your application. Nevertheless, the drive alone is not a sufficient safety device. Perform a risk analysis for your application and add all needed safety devices.

Only use spare parts approved and provided by Danfoss. Using other spare parts can damage the drive.

2.5 Safe Operation

The drive is not suitable as the only safety device in the system. Make sure that all needed extra monitoring and protection devices on drives, motors, and accessories are installed according to the regional safety guidelines and accident prevention regulations.

Before activating any automatic fault reset functions or changing limit values, make sure that no dangerous situations can occur after restart. If the autoreset function is activated, the device connected to the drive output starts automatically after an automatic fault reset.

Keep all doors and covers closed and terminal boxes screwed on during operation of the drive and when AC or DC supply is connected.

Drive components and accessories can still be live and connected to AC or DC supply, even after the operation indicators are no longer illuminated.

3 Product Overview

3.1 Overview of the Products

The enclosed drives come in 6-pulse, low-harmonic, and regenerative variants. The control compartment on the cabinet door makes it easy to access the control. The air-cooled enclosed drives have high power density because of efficient cooling solutions. The integrated service table is used for maintenance.

The protection rating of the products is IP21 or IP54. The enclosed drives can withstand a wide range of ambient temperatures and altitudes.

3.2 Description of the Frame Designation

A frame designation is used to refer to different types of iC7 series drives. The frame designation describes the function, mechanical variant, and size of the drive.

Example

The frame designation can have this format, for example:

AE11

Table 3: Description of the Frame Designation

Code	Description
A	**Function** F = 6-pulse frequency converter A = Active front end I = Inverter
E	**Mechanical variant** E = enclosed drive
11	**Size** 9, 10 or 11

3.3 Weights

Table 4: Weights

Product	Weight [kg]	Weight [lb]
FE9	305	672
FE10	420	926
AE10 + IE10	690	1520
AE11 + IE11	980	2160
2 x AE10 + 2 x IE10	1580	3480
2 x AE11 + 2 x IE11	1920	4230

3.4 Description of the Model Code

The model code is made of standard codes and plus codes. Each part of the model code agrees to the data in your order.

Example

The model code can have this format, for example:

iC7-60EA3A05-880AE21F3+XXXX

Table 5: Description of the Model Code

Code	Description
iC7-60	**Product group**
EA	**Product category** EA = air-cooled enclosed drive
3A	**Product type** 3N = three-phase 6-pulse 3A = three-phase AFE (regenerative) 3H = three-phase LHD (low-harmonic)
05	**Voltage rating** 05 = 380–500 V AC
-880A	**Current rating ($I_{L(1/5)}$)** -880A = 880 A -1260 = 1260 A
E21	**Protection rating** E21 = IP21/UL type 1 E54 = IP54/UL type 12
F3	**EMC level** F3 = C3 industry compliance F4 = C4 system component
+XXXX	**Options** See separate list.

3.5 Interior View of the Cabinet, FE9

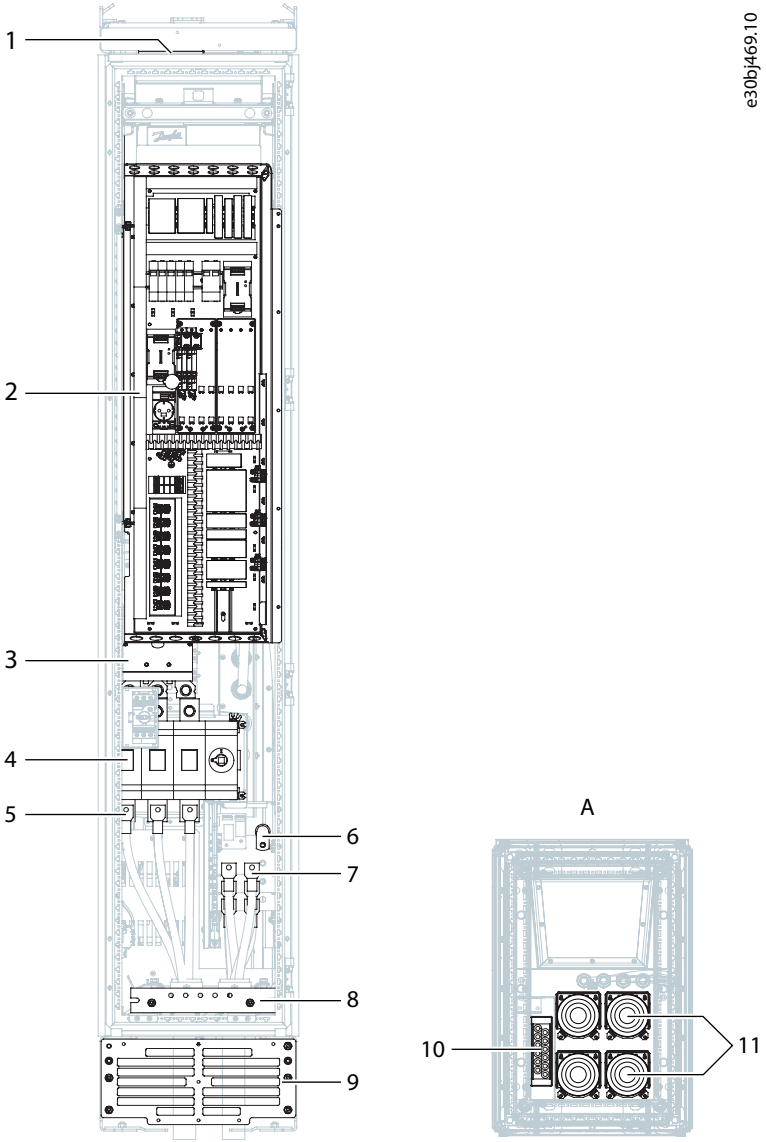


Illustration 1: Interior View, FE9

1	Control cable grommet, top	7	Motor terminals
2	Control compartment	8	PE bar
3	Contactor	9	Inlet air grill
4	Main switch (optional)	10	Control cable grommet, bottom
5	Mains terminals	11	IP54 grommet for mains and motor cables (IEC)
6	dU/dt Filter	A	View from the bottom

3.6 Interior View of the Cabinet, FE10

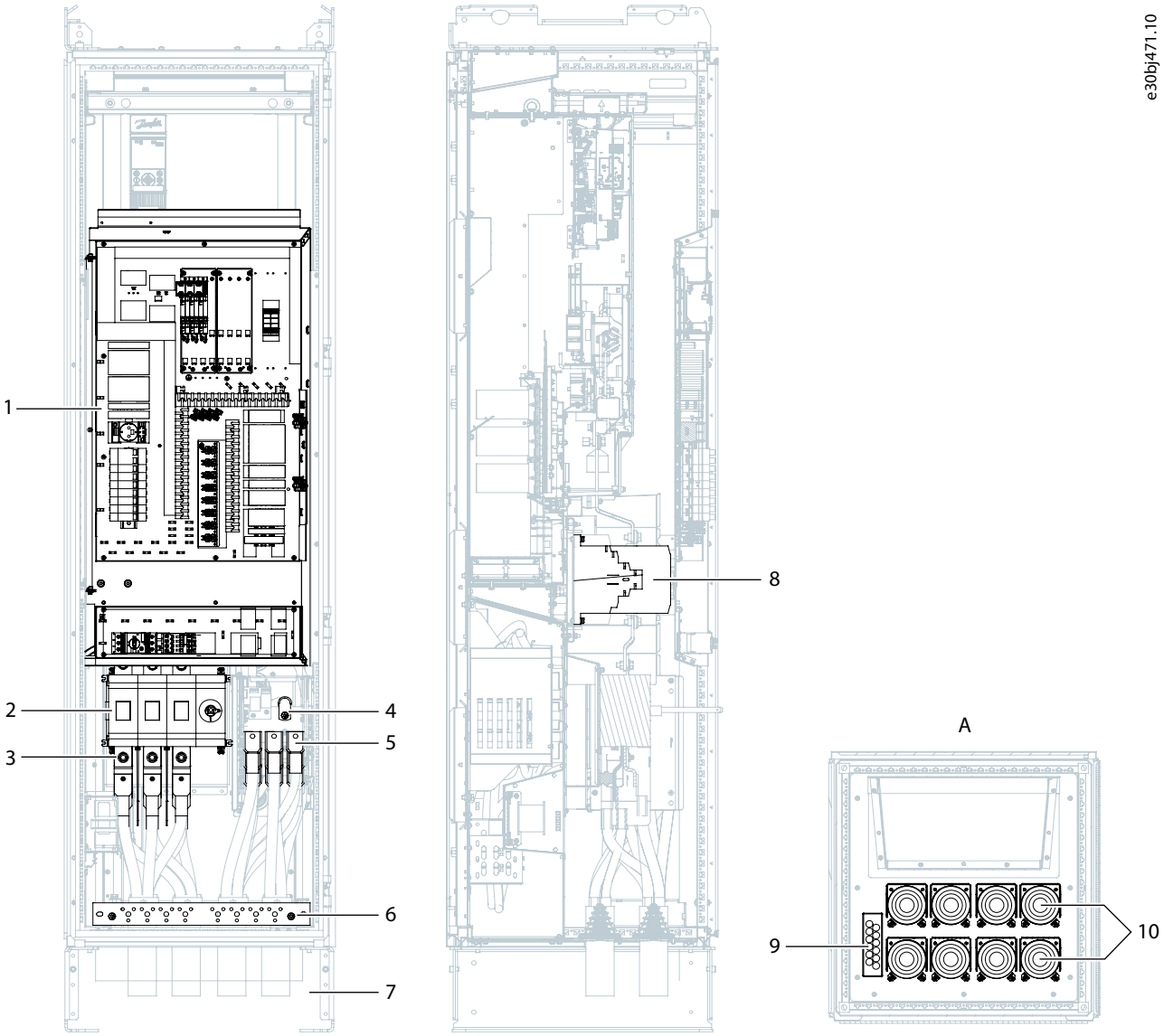


Illustration 2: Interior View, FE10

1	Control compartment	7	Inlet air grill
2	Main switch (optional)	8	Contactor
3	Mains terminals	9	Control cable grommet, bottom
4	dU/dt Filter	10	IP54 grommet for mains and motor cables (IEC)
5	Motor terminals	A	View from the bottom
6	PE bar		

3.7 Interior View of the Cabinet, AE10 + IE10

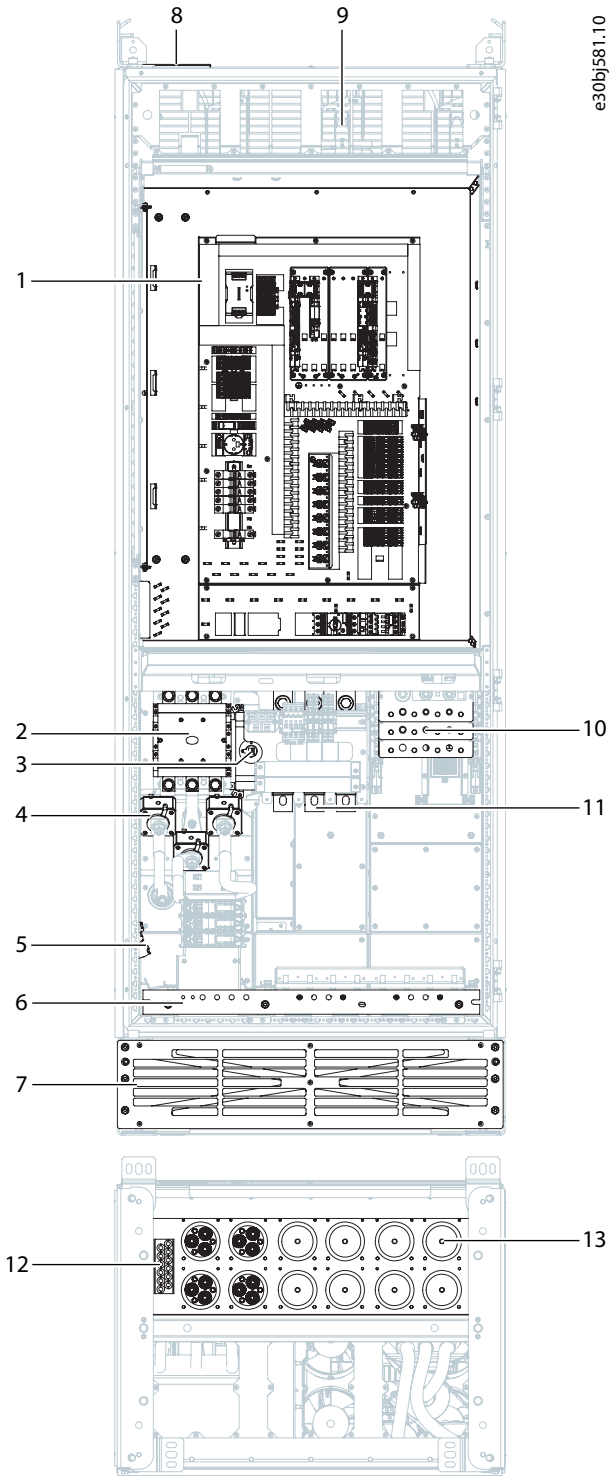


Illustration 3: Interior View of the Cabinet, AE10 + IE10

1	Control compartment	8	Control cable grommet, top
2	Contactor	9	DC fuses, 2 pcs, behind the touch protection plate
3	Main switch	10	Motor terminals
4	AC fuses, 3 pcs	11	Mains terminals
5	Motor fan control/supply terminals (+ICFI1-4), AUX AC supply terminals (+IHAS)	12	Control cable grommet, bottom
6	PE busbar	13	IP54 grommet for mains and motor cables (IEC)
7	Inlet air grill		

3.8 Interior View of the Cabinet, AE11 + IE11

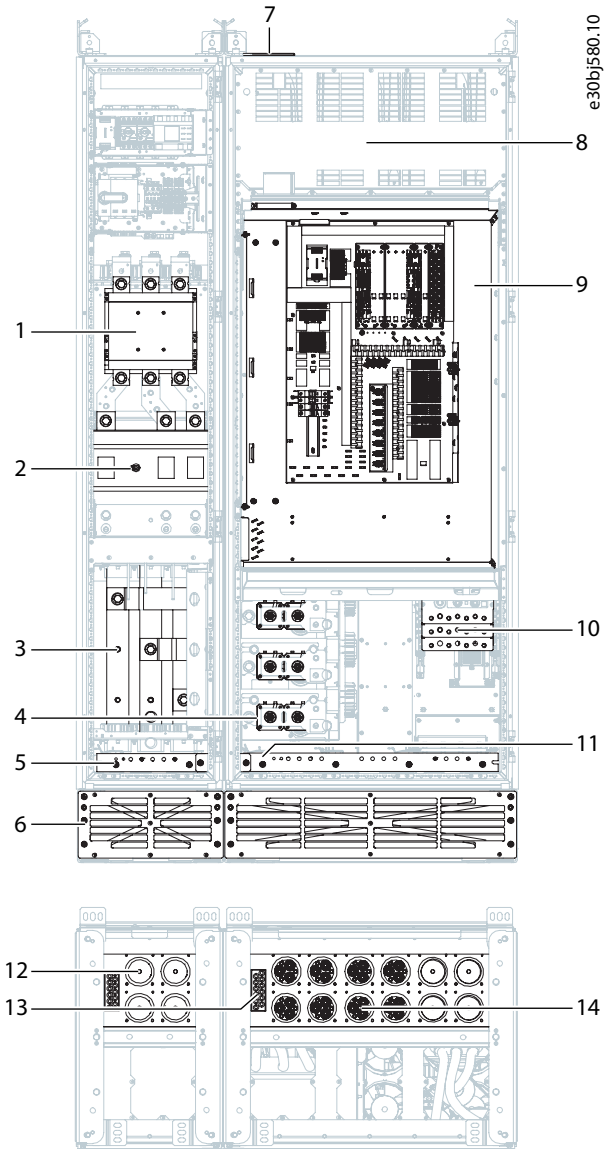


Illustration 4: Interior View of the Cabinet, AE11 + IE11

1	Contactor	8	DC fuses, 2 pcs, behind the touch protection plate
2	Main switch	9	Control compartment
3	Mains terminals	10	Motor terminals
4	AC fuses, 3 pcs	11	Motor fan control/supply terminals (+ICF1-4), AUX AC supply terminals (+IHAS), behind the PE busbar
5	PE busbar	12	IP54 grommet for mains cable (IEC)
6	Inlet air grill	13	Control cable grommet, bottom
7	Control cable grommet, top	14	IP54 grommet for motor cable (IEC)

3.9 Interior View of the Cabinet, 2 x AE11 + 2 x IE11

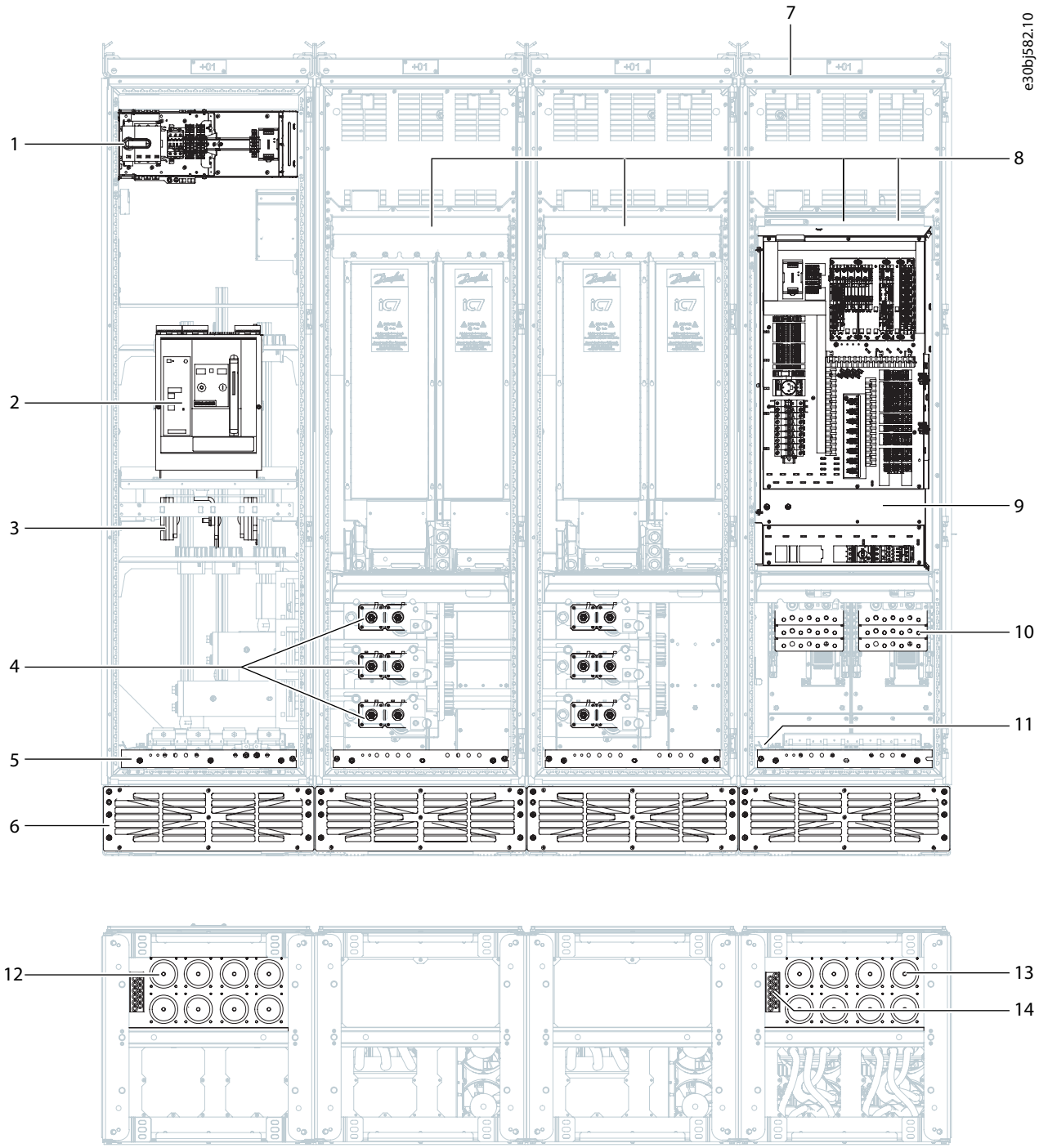


Illustration 5: Interior View of the Cabinet, 2 x AE11 + 2 x IE11

1	Charging circuit	8	DC fuses, behind the touch protection plate
2	Air circuit breaker	9	Control compartment
3	Mains terminals	10	Motor terminals
4	AC fuses	11	Motor fan control/supply terminals (+ICFI1-4), AUX AC supply terminals (+IHAS), behind PE busbar
5	PE busbar	12	IP54 grommet for mains cables (IEC)
6	Inlet air grill	13	IP54 grommet for motor cables (IEC)
7	Control cable grommet, top	14	Control cable grommet, bottom

4 Receiving the Drive

4.1 Checking the Shipment

Procedure

1. Examine the packaging and the drive for transport damage.
   - **a.** If the drive was damaged during transport, contact the cargo insurance company or the carrier.
2. Make sure that the items supplied and the information on the product label correspond to the order confirmation.
   - **a.** If the shipment does not match the order, contact the vendor immediately.

4.2 Storing the Enclosed Drive

If it is necessary to store the product before installing it, follow these instructions.

Keep the product in the original packaging. Make sure that the ambient storage conditions correspond to these requirements:

- Temperature: -40...+70 °C (-40...+158 °F)
- Humidity: 0...95%, no condensation

Procedure for storage of 2–12 months

1. If the package is kept in storage for more than 2 months, keep it in controlled conditions.
   - **a.** Make sure that the temperature variation is small.
   - **b.** Make sure that the humidity is less than 50%.

Procedure for storage of over 12 months (FE9 and FE10)

1. If the package is kept in storage for more than 12 months, do these steps every 12 months, to reform the capacitors to prevent damage to the capacitors.
   - **a.** Connect power to the drive.
   - **b.** Keep the power on for a minimum of 2 hours.
   - **c.** Disconnect the power.
   - **d.** Wait for the correct discharge time before removing the drive and storing it again.

Procedure for storage of several years

1. If the package is kept in storage for several years, reform the capacitors every 12 months to prevent damage to the capacitors.
   - **a.** Connect a DC supply with adjustable current limit to the DC+ and DC- terminals.
   - **b.** Set the current limit (250 mA). In case of parallel power units, multiply the value with the number of power units.
   - **c.** Set DC voltage (1.35 * U_n AC), where U_n is the drive nominal voltage.
   - **d.** Keep the power on for a minimum of 1 hour.
   - **e.** Disconnect the DC supply from the DC+ and DC- terminals.

4.3 Lifting the Enclosed Drive

⚠ W A R N I N G ⚠

LIFTING HEAVY LOAD

Not following the safe lifting instructions can result in death or serious injury and damage to the equipment.

- Do not walk under, or place any part of your body under suspended loads.
- Use lifting devices that are appropriate for the weight of the unit.
- Use the recommended lifting method.
- Before lifting the product, check its center of gravity.

⚠ W A R N I N G ⚠

SWINGING HAZARD DURING LIFTING

The swing effect can cause serious injury and damage to the equipment. It occurs when lifting the product into a vertical position, just before the product reaches vertical position, when the center of gravity of the product surpasses the floor support point.

- Make sure that the lifting ropes are properly attached.
- Secure the lifting area.
- Lift the product slowly and carefully.

The AC drive is delivered on a wooden pallet. A delivery containing one cabinet is delivered horizontally, but a delivery containing many cabinets is delivered vertically.

Use a lifting device that is sufficiently strong for the weight of the drive.

Lifting the Drive

1. Remove the package from the drive.
2. If the drive is delivered horizontally, lift it to an upright position.
   - **a.** Put the lifting hooks in the 2 front lifting loops on the top of the cabinet.

     The minimum lifting angle is 60°.
   - **b.** Lift the drive to an upright position.

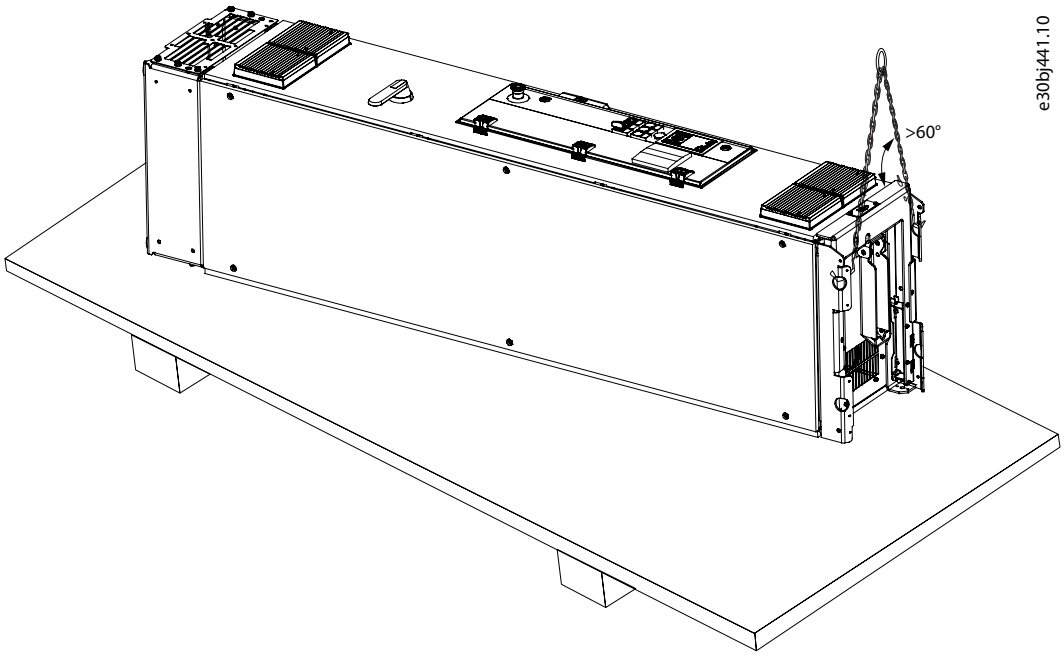


Illustration 6: Lifting the Enclosed Drive to an Upright Position

3. Put the lifting hooks in the four lifting loops on the top of the cabinet.

   The minimum lifting angle is 60°.

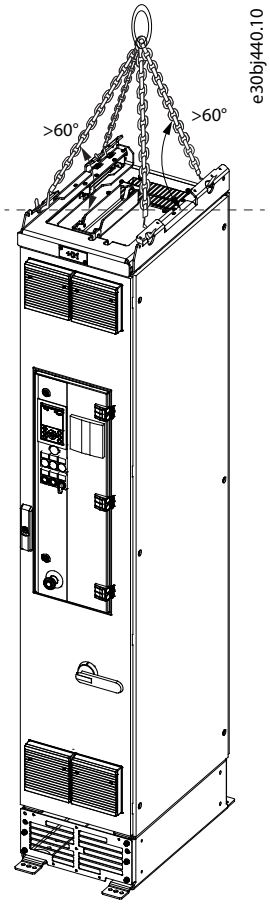


Illustration 7: Lifting the Enclosed Drive

4. Lift the drive to the required position.

5 Mechanical Installation

5.1 Installation Requirements

- Make sure that the ambient conditions at the installation location comply with the specifications in 10.8.3 Ambient Conditions.
- Install the drive on a solid and level surface.
- Make sure that the mounting surface can support the weight of the drive. See 3.3 Weights.
- Make sure that the mounting surface is non-combustible.

5.2 Installing the Enclosed Drive

Procedure

1. Attach the enclosed drive to the floor and to the wall using the mounting holes.

   There are 2 mounting holes at the rear top, 6 mounting holes at the front bottom, and 6 mounting holes at the rear bottom.

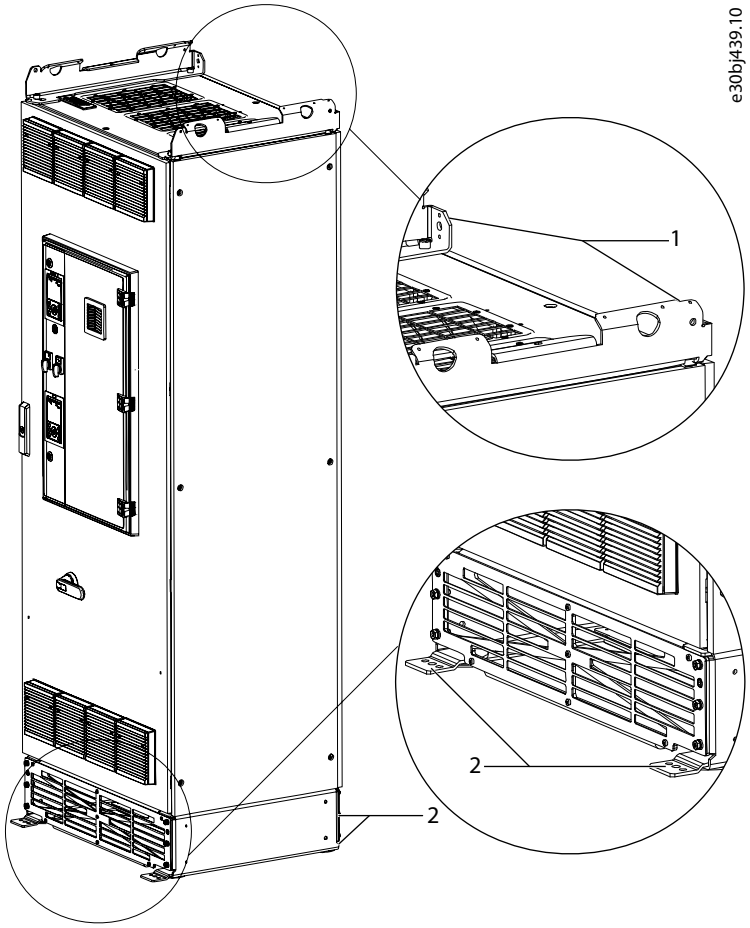


Illustration 8: Installing the Enclosed Drive, FE9, FE10

1	Mounting holes at the top
2	Mounting holes at the bottom

5.3 Cooling Requirements

5.3.1 General Cooling Requirements

The power units produce heat in operation. The fans circulate air and decrease the temperature of the drive. Make sure that there is sufficiently free space around the drive.

Some free space in front of the drive is also necessary for maintenance. It must be possible to open the cabinet door. 2 or more drives can be installed side by side.

All the product variants have a segregated cooling channel. The air flow enters the segregated cooling channel through the front grill or the back grill of the plinth. There is an auxiliary cooling channel for the control compartment. There are 3 cooling methods available:

- Default cooling
- Cooling air output flange option
- Back-channel cooling option

The air must move freely and efficiently through the cabinet and the drive. Make sure that the hot air goes out of the cabinet and does not come back into the cabinet.

Make sure that the temperature of the cooling air does not become higher than the maximum ambient operating temperature or lower than the minimum ambient operating temperature of the drive.

Table 6: Air Flow of Different Fans of the Cabinet

Cabinet	Main cooling channel [m^3/hr (cfm)]	Auxiliary cooling channel [m^3/hr (cfm)]
FE9	340 (200)	102 + 2 x 265 (60 + 2 x 156)
FE10	340 (200)	204 + 3 x 185 (120 + 3 x 109)
AE10, IE10	2706 (1623)	1050 (618)
AE11, IE11	2706 (1623)	1480 (871)
2 x AE10, 2 x IE10	5520 (3246)	2530 (1489)
2 x AE11, 2 x IE11	5520 (3246)	2745 (1615)

5.3.2 Default Cooling

Make sure that there is sufficiently free space above the cabinet. The minimum distance includes the lifting bars on top of the cabinet. Also make sure that there are no obstacles that can stop the airflow.

Table 7: Minimum Space above the Cabinet

Drive	Minimum space above the cabinet	
	mm	in
FE9, FE10	225	8.9
AE10, AE11, IE10, IE11	200	7.9

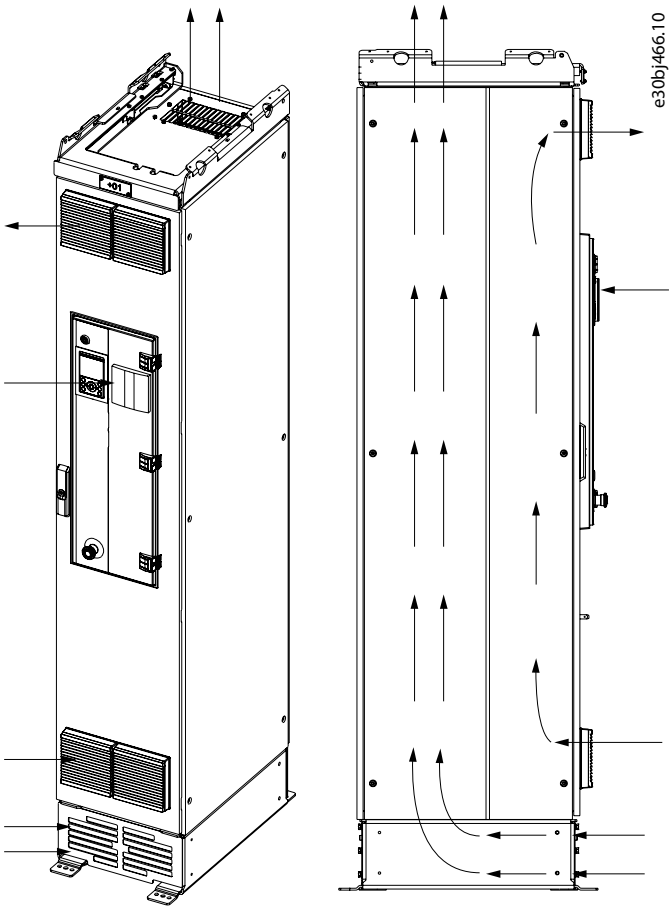


Illustration 9: Air Flow in Default Cooling of the Enclosed Drives

See 10.2.4 Dimensions for Default Cooling, FE9 and 10.2.5 Dimensions for Default Cooling, FE10.

5.3.3 Cooling Options

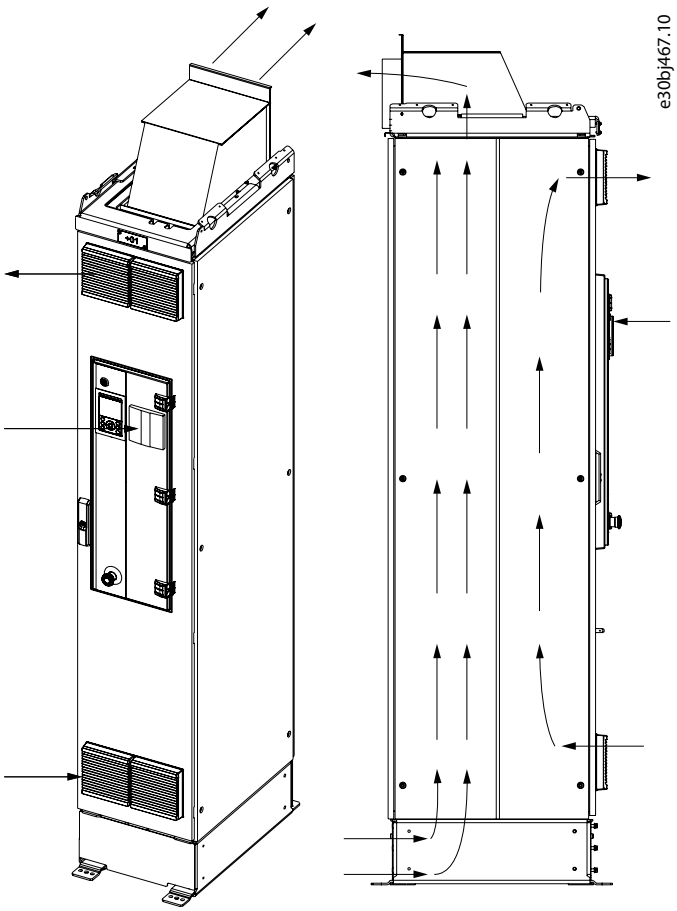


Illustration 10: Back-channel Cooling (+OABC), Intake Back, Output Back

See 10.2.6 Dimensions for Back-channel Cooling, FE9 and 10.2.7 Dimensions for Back-channel Cooling, FE10.

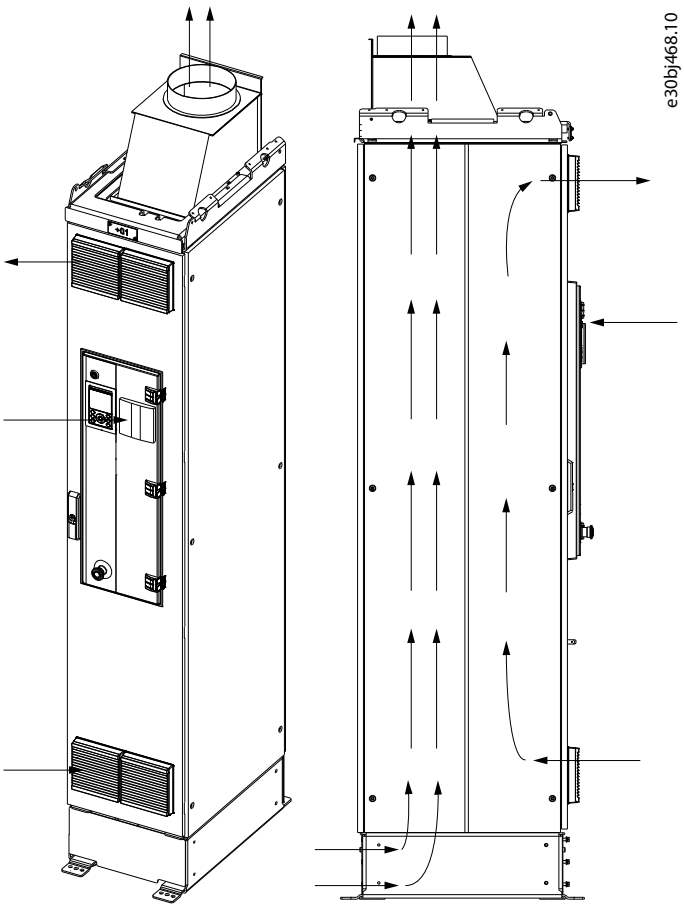


Illustration 11: Cooling Air Output Flange (+OAOF), Intake Front or Back, Output Top

The front and rear plates of the plinth are interchangeable, so the air intake can be in the front or at the back.

Table 8: Number of Air Output Holes in the Cooling Air Output Flange

Width of the cabinet in mm (in)	Number of holes at the top
400 (15.7)	1
600 (23.6)	2
800 (31.5)	3

See 10.2.9 Dimensions for the Cooling Air Output Flange Option, FE9 and 10.2.10 Dimensions for the Cooling Air Output Flange Option, FE10.

5.4 Installing the Back-channel Cooling Option

Procedure

1. Attach the cover plate of the top hood with 4 screws.

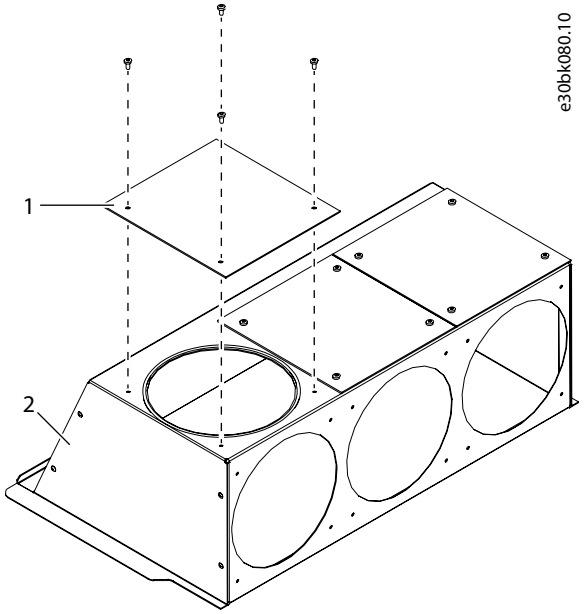


Illustration 12: Installing the Back-channel Cooling Option Cover Plate

1	The cover plate
2	The top hood

2. Place the top hood on top of the cabinet.
3. Place the brackets so that they press the sides of the top hood down.
   - **a.** Attach each bracket with 4 screws.

The brackets are identical, that is why each has 6 mounting holes.

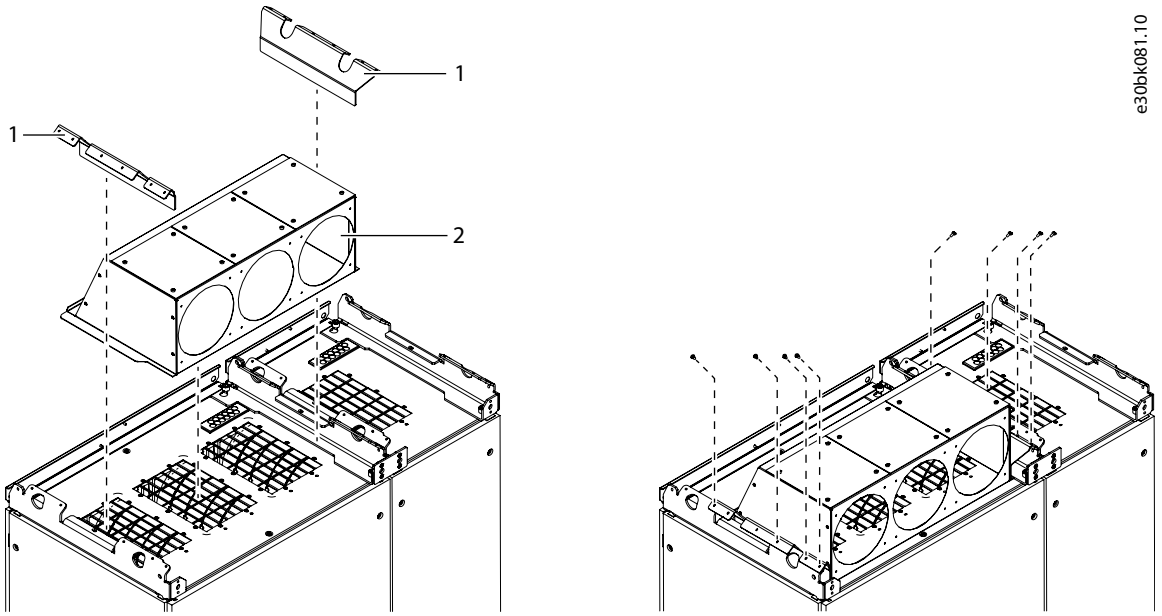


Illustration 13: Installing the Back-channel Cooling Option Brackets

1	The brackets

2	The top hood

4. Attach a duct against the top hood to direct the airflow.
5. Adjust the air guide at the bottom.

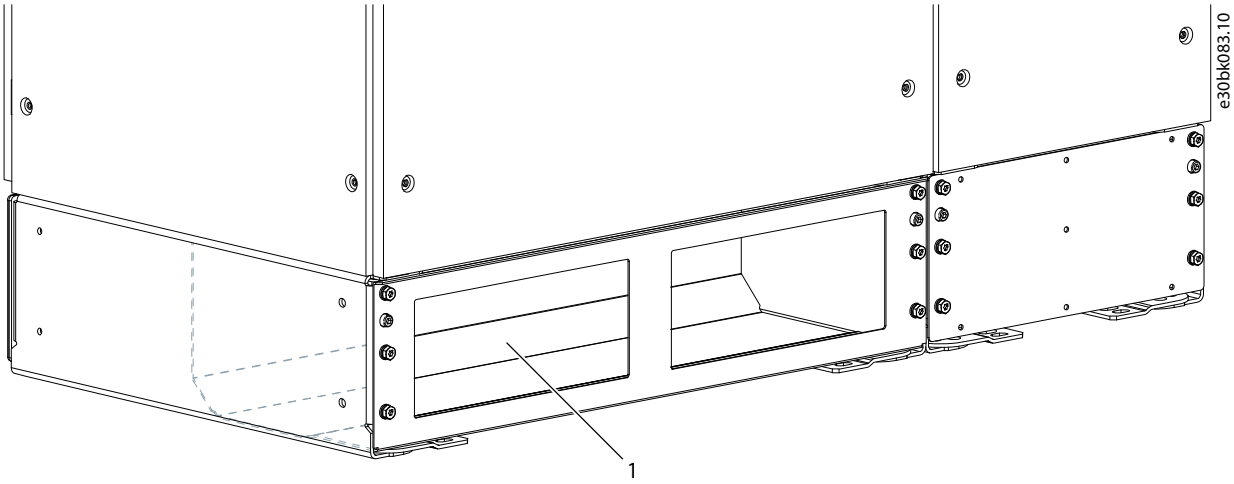


Illustration 14: Back-channel Cooling Option Air Guide at the Bottom

6 Electrical Installation

6.1 Electrical Installation Safety

⚠ WARNING ⚠

OVERHEATED CABLES

Overheated cables are a fire hazard.

- Because of several possible cable installations and environmental conditions, it is important to consider local regulations and IEC/EN standards.
- Also follow Danfoss recommendations for minimum cables.

⚠ WARNING ⚠

BRANCH CIRCUIT HAZARD

Unprotected branch circuits can cause an electrical or a fire hazard.

- Internal short-circuit protection does not provide branch-circuit protection. To protect the installation, all branch circuits in an installation, switchgear, and machines must be protected against short circuits and overcurrent according to national or international regulations.

⚠ WARNING ⚠

OVERCURRENT HAZARD

Overheated cables are a fire hazard.

- To avoid fire hazards due to overheating of cables in the installation, use overload protection. The drive system is equipped with an internal overcurrent protection that can be used for upstream overload protection. Moreover, fuses or circuit breakers can be used to provide the overcurrent protection in the installation. Parallel cabling must be done in a way that minimizes the risk of cable overheating due to unequal current sharing between parallel conductors. Always perform overcurrent protection according to local regulations.

⚠ WARNING ⚠

SHORT-CIRCUIT HAZARD

Unprotected drive system can cause an electrical or a fire hazard.

- Protect the drive system against short circuits. To protect the unit, use the fuses that are required by the manufacturer. The drive system provides full short-circuit protection against a short circuit on the motor output.

6.2 Fuse Guidelines

The drive system is equipped with fast-acting AC fuses to limit the damages of the drive system.

See the fuse tables: 10.6.1 List of Fuse Size Information.

To ensure fuse performance, make sure that available supply short-circuit current is sufficient. Check the minimum required values (I_{SC}) at the fuse location.

Frame Designations AE10, AE11, IE10, and IE11

DC fuses are preinstalled for parallel units to limit the damages of the drive system. Do not replace the DC fuses with any other types.

6.3 Grounding

Ground the AC drive in accordance with applicable standards and directives.

Unless local wiring regulations state otherwise, the cross-sectional area of the protective grounding conductor must be at least ½ times of the phase conductor and made of the same material when the phase conductor cross-section is above 35 mm^2 according to IEC 60364-5-54; 543.1.

The connection must be fixed.

⚠ W A R N I N G ⚠

ELECTRICAL SHOCK HAZARD - LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to connect the drive properly to protective earth (PE) can result in death or serious injury.

- Ensure reinforced protective earthing conductor according to IEC 60364-5-54 cl. 543.7 or according to local safety regulations for high touch current equipment. The reinforced protective earthing of the drive can be done with:
- a PE conductor with a cross-section of at least 10 mm^2 (8 AWG) Cu or 16 mm^2 (6 AWG) Al.
- an extra PE conductor of the same cross-sectional area as the original PE conductor as specified by IEC 60364-5-54 with a minimum cross-sectional area of 2.5 mm^2 (14 AWG) (mechanical protected) or 4 mm^2 (12 AWG) (not mechanical protected).
- a PE conductor completely enclosed with an enclosure or otherwise protected throughout its length against mechanical damage.
- a PE conductor part of a multi-conductor power cable with a minimum PE conductor cross-section of 2.5 mm^2 (14 AWG) (permanently connected or pluggable by an industrial connector. The multi-conductor power cable shall be installed with an appropriate strain relief).
- NOTE: In IEC/EN 60364-5-54 cl. 543.7 and some application standards (for example IEC/EN 60204-1), the limit for requiring reinforced protective earthing conductor is 10 mA leakage current.

6.4 Cable Requirements

Follow these requirements for the mains and motor cables used in the drive system.

- Select and install mains cables and motor cables according to the local safety regulations, the input voltage, and the load current of the drive.
- Use motor cables rated for +90 °C for IEC, +75 °C (167 °F) for UL. Consider the operating temperature of the mains terminals, and make sure that the mains cables do not overheat near the mains terminals.
- Use symmetrical cabling with parallel power units. Each power unit must have the same number of cables with an equal cross-section and equal length.

Maximum number of power unit cables and bolts sizes can be found in 10.5.1 General Cable Size Information.

Only use symmetrical and shielded 3-phase mains and motor cables. See Illustration 15. Do not use symmetrical and shielded 3-phase cable with individual shield for each phase conductor or single-core phase conductors and PE with or without shield, see Illustration 16.

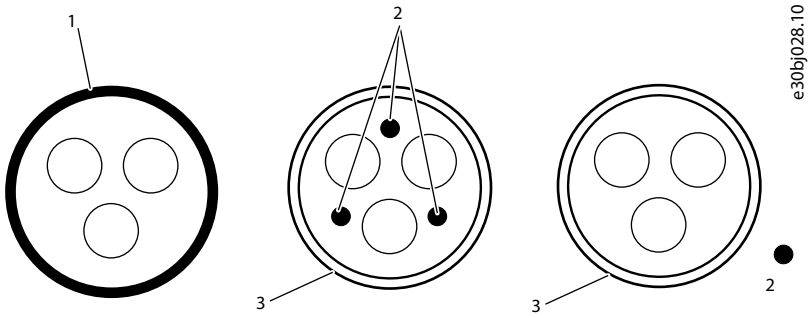


Illustration 15: Recommended Cable Types for Mains and Motor Cabling

1	PE conductor and shield	3	Shield
2	PE conductor		

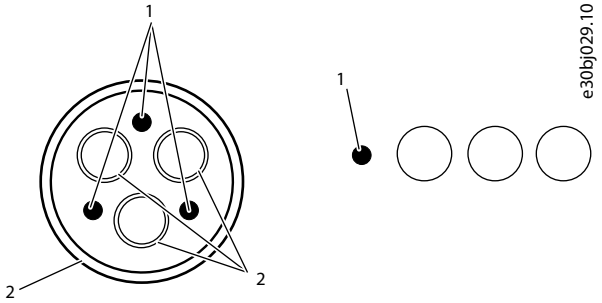


Illustration 16: Not Recommended Cable Types

1	PE conductor
2	Shield

6.5 Additional Instructions for Cable Installation

- Before starting the cable installation, make sure that none of the components of the AC drive is live. Read carefully the warnings in Safety section.
- Make sure that the motor cables are sufficiently far from other cables.
- The motor cables must across other cables at an angle of 90°.
- If it is possible, do not put the motor cables in long parallel lines with other cables.
- If the motor cables are in parallel with other cables, obey the minimum distances (see Table 9).
- The distances are also valid between the motor cables and the signal cables of other systems.
- The maximum length of shielded motor cables is 150 m (492 ft). If the used motor cables are longer, contact the vendor for more information.
- Check the maximum cable length of the filters.
- Only use symmetrical and shielded motor cables.
- If the cable insulation checks are necessary, see 8.3 Measuring the Cable and Motor Insulation.

Table 9: Minimum Distances from Motor Cables to Other Cables

Distance to other cables [m]	Length of the shielded cable [m]	Distance to other cables [ft]	Length of the shielded cable [ft]
0.3	≤ 50	1.0	≤ 164
1.0	≤ 150	3.3	≤ 492

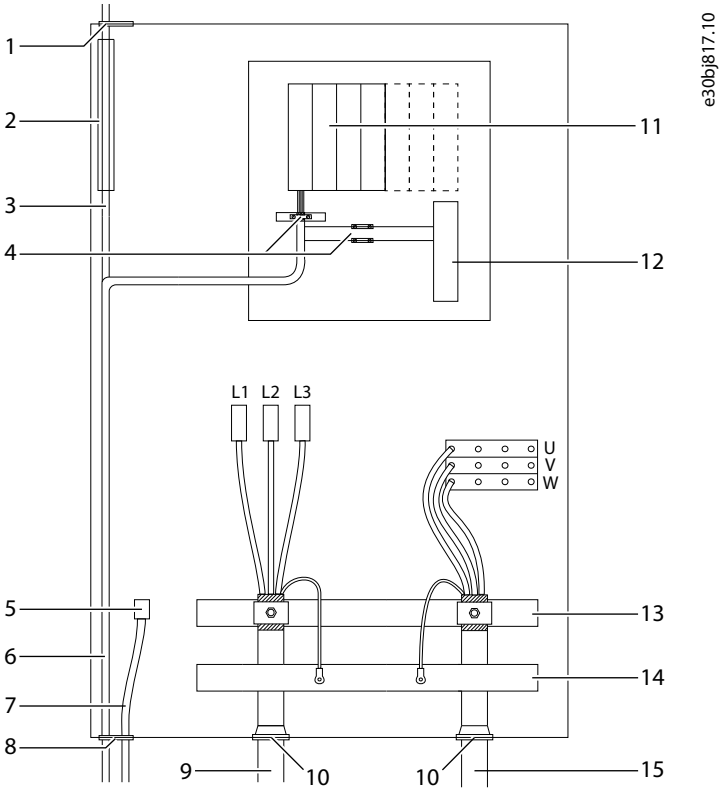


Illustration 17: Cabling Principle

1	Control cable grommet	9	Mains cable
2	Cable installation tubes, 2 pcs, diameter 32 mm	10	Grommets
3	Control cables from the top	11	Control board and option boards
4	Strain relief and cable grounding	12	Terminal blocks
5	Auxiliary power terminals	13	Strain relief and 360° grounding
6	Control cables from the bottom	14	PE busbar
7	Auxiliary power cable	15	Motor cable
8	Control cable grommet		

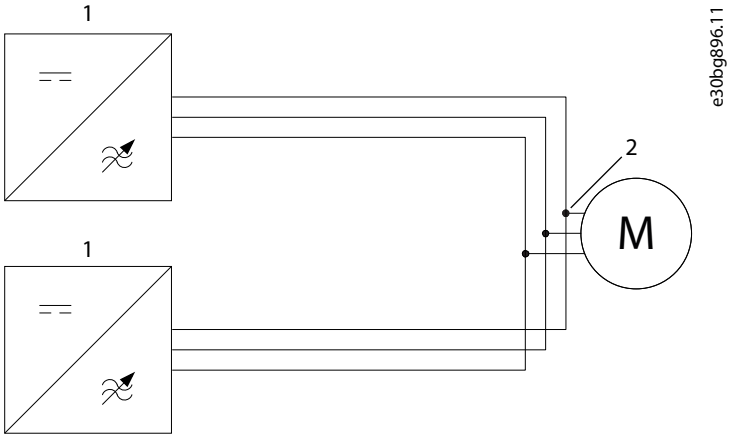


Illustration 18: Recommended Installation

1	INU module

2	Common coupling point at the motor terminals

If the drives are connected in parallel without output filters or only with a Common-mode Filter, the recommended common coupling point of motor cables is at the motor terminals.

6.6 Installing the Power Cables

Procedure

1. Strip the mains and motor cables.
2. Make openings for the cables in the grommets on the bottom of the cabinet and lead the cables through them.

   This applies for IEC installations.
   The grommets must be suited to the output diameter of the cable.
   The cable diameter is 25–65 mm.
3. Use cable clamps to fix the cables. OR
4. To make a 360° connection with the grounding mesh, expose the shield of the motor cables.

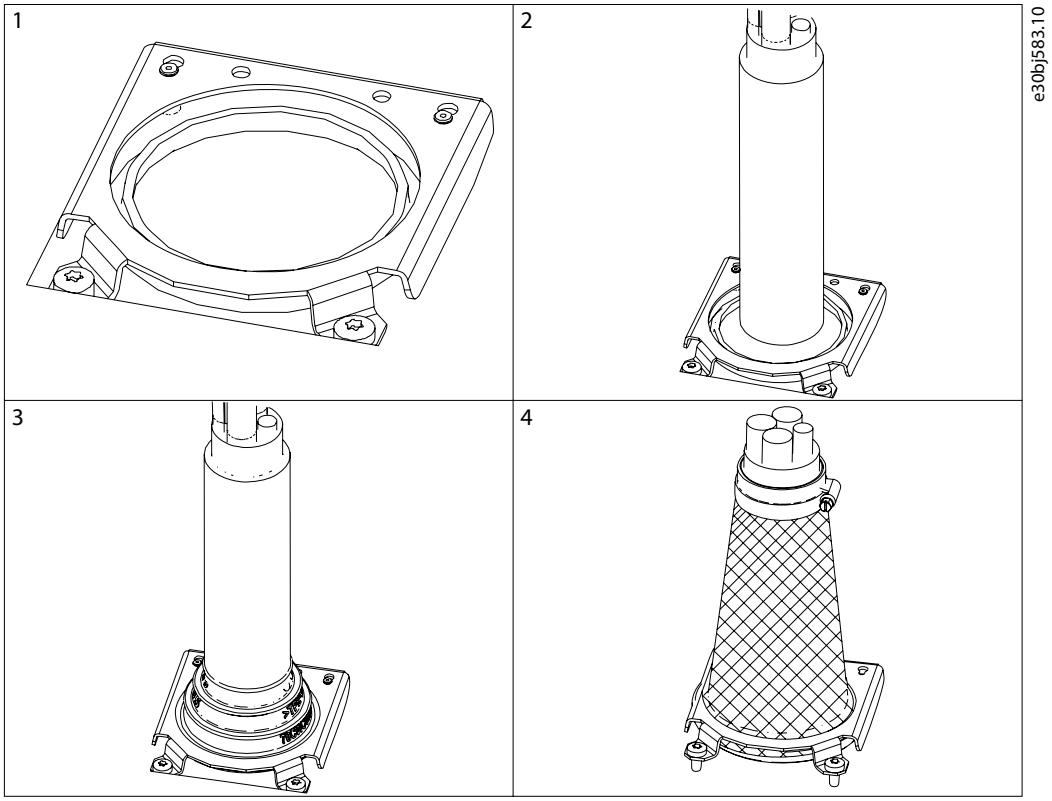


Illustration 19: Cabling Methods (IEC)

1	No cable	3	IP54
2	IP21	4	EMC 360° (IP54 and knitted metal mesh tube)

5. Connect the mains cables to the terminals L1, L2, and L3, and the motor cables to the terminals U, V, and W.

   See the correct tightening torques in 10.1 Tightening Torques.

6. Connect the grounding conductors to the grounding bar.

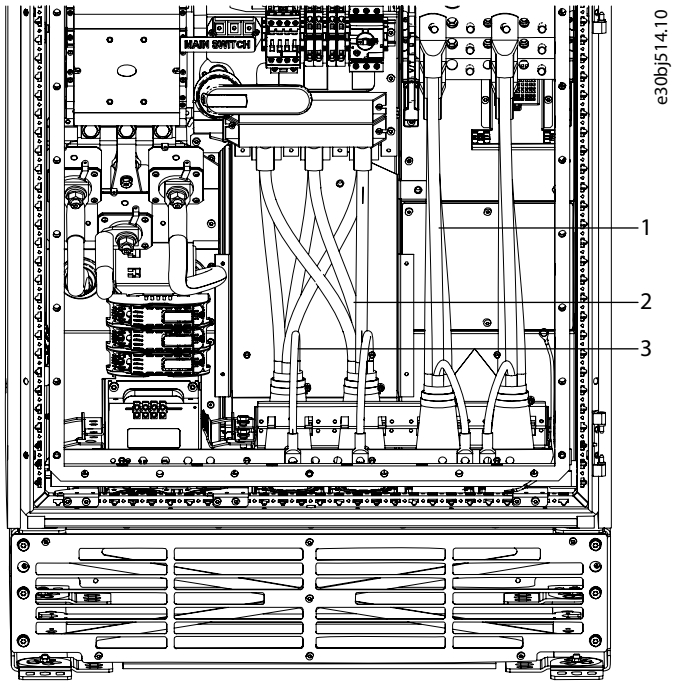


Illustration 20: Cabling of the Enclosed Drive

1	Motor cables	3	Grounding conductor
2	Mains cables		

6.7 UL Cabling

The UL variant of the enclosed drive includes a sealed bottom plate for free cutting of the cable entry holes.

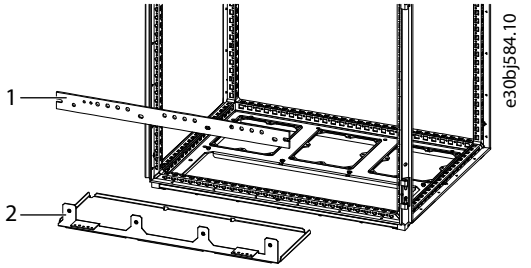


Illustration 21: UL Floor Components

1	PE busbar
2	Plate for cutting of the cable entry holes

6.8 Parameter Settings for IT Mains

If the drive is supplied from an isolated mains (IT mains, floating delta, or grounded delta) or TT/TN-S mains with grounded leg, it is recommended to check the parameter settings of the grid type and RFI. The filter capacitors between the chassis and the DC link should be cut off via the parameters to avoid damage to the DC link and to reduce the ground capacity currents.

See more information in the iC7 Series Industry Application Guide.

Keep the filter capacitors between the chassis and the DC link in these cases:

- When optimal EMC performance is needed
- When parallel motors are used
- When the motor cable is longer than 25 m (82 ft)

It is important to use isolation monitors that are rated for use together with power electronics.

6.9 Disconnecting the dU/dt Filter Capacitors

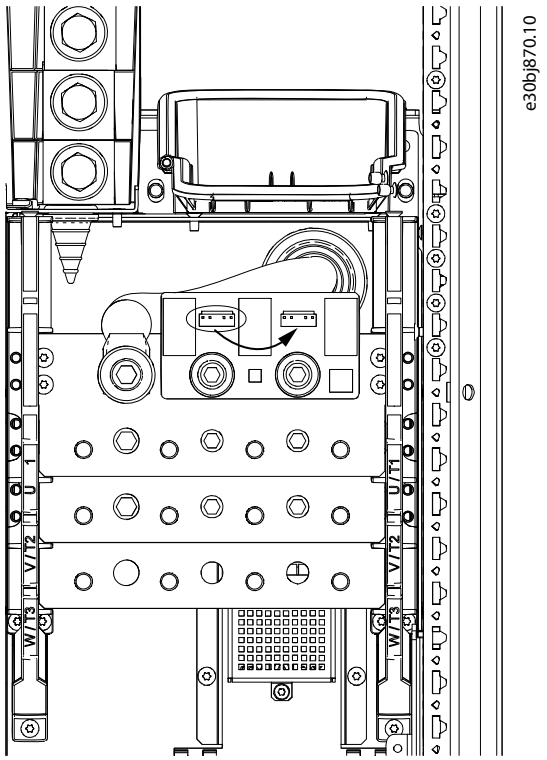
To measure the insulation resistance of the motor cable, disconnect the dU/dt Filter capacitors of AE10, AE11, IE10, and IE11 from the main circuit.

Procedure

1. Move the terminal including its wires from the left side to the right side.

   The terminal is on the U phase.

The dU/dt Filter capacitors are now disconnected from the main circuit.



7 Control and Option Installation

7.1 General Information of the Control Compartment

The enclosed drive has a door-mounted control compartment for the control terminals, separated from the cabinet section. The control compartment is accessed through a separate door on the cabinet door.

Make sure that the control cables are long enough to prevent tight bends in the cables between the control compartment and the frame of the drive.

The 2 first I/O option boards are wired into the terminal blocks on the control compartment, and the next ones directly into the option board terminals. The wiring of the boards:

- I/O and Relay Option OC7C1 as standard I/O: on the terminal block on the control compartment
- Relay Option OC7R0: on the terminal block on the control compartment
- General Purpose I/O OC7C0: on the terminal block on the control compartment
- I/O and Relay Option OC7C1 as an option: on the option board

7.2 Control Compartment Door Elements

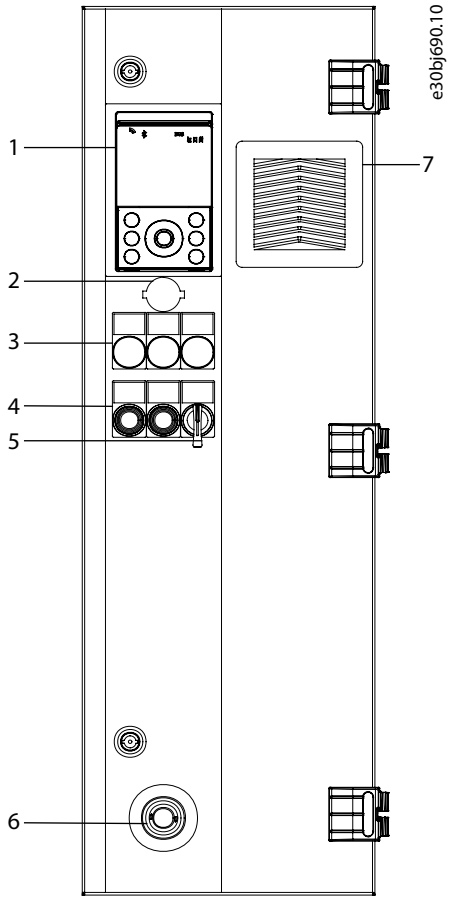


Illustration 22: Control Compartment Door Elements, FE9, FE10

1	Control panel, -PGA	5	Mains contactor Local/Remote switch, -SFB
2	Ethernet port, RJ45	6	Emergency stop button (+ILSS), -SFG
3	Run, ready, and fault lights (+IICD), -PF3, -PF4, -PF5	7	Fan and filter cover and optional IP54 filter (+IP54)
4	Mains contactor push button Open/Close, -SF7.1, -SF7.2		

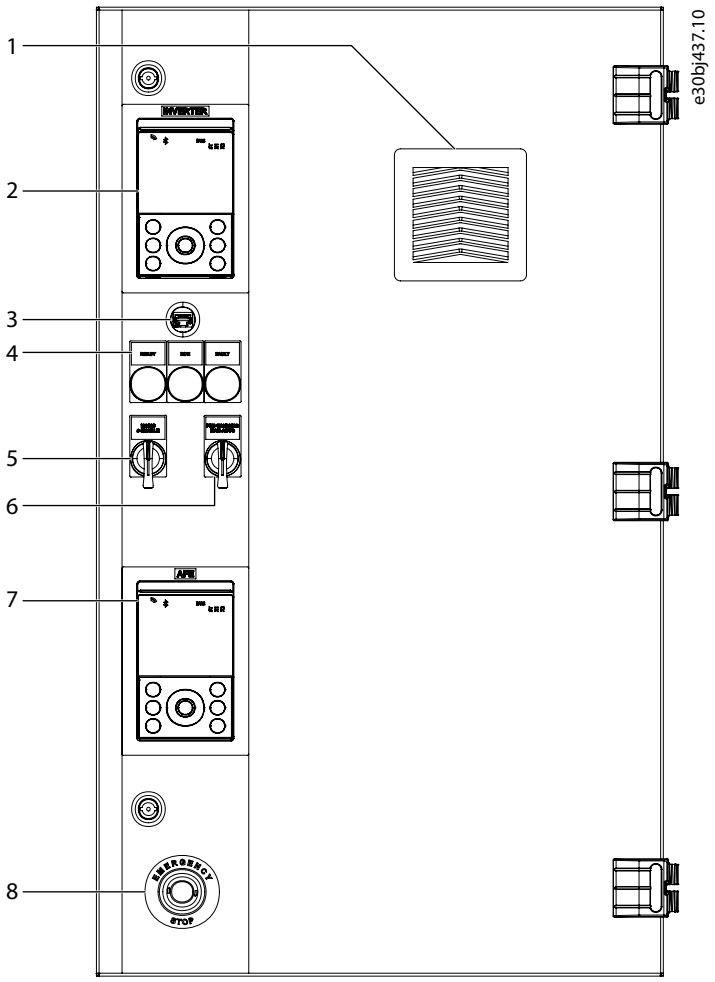


Illustration 23: Control Compartment Door Elements, AE10/11, IE10/11

1	Filter cover and optional IP54 filter (+IP54)	5	Main switch, SF11
2	Control panel (for the INU module), -PGA	6	Pre-charging switch, SF12
3	Ethernet port (for the inverter module), RJ45	7	Control panel (for the AFE module), -PGA2
4	Run, ready, and fault lights (+IICD), -PF3, -PF4, -PF5	8	Emergency stop button (+ILSS), -SFG

7.3 Control Compartment Internal Elements

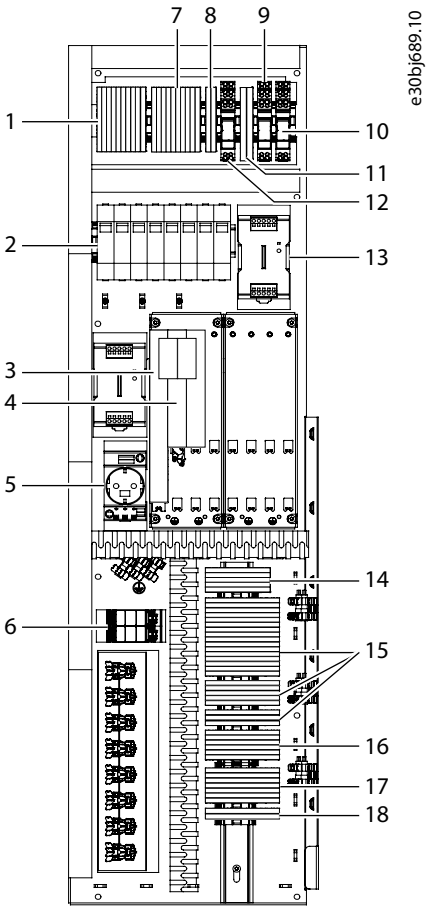


Illustration 24: Elements inside the Control Compartment, FE9

1	Mains contactor terminals (+GAC0) -XD0
2	Circuit breakers
3	Control board
4	Option slots for the the option extender and the I/O and Relay Option
5	230 V AC socket (CEE 7/3, +IGS0), or 115 V AC socket (US, +IGS1), or 230 V AC socket (UK, +IGS2), -XD1
6	Ethernet port for fieldbus X1 and X2
7	Auxiliary AC supply terminals (+IHAS), or auxiliary AC voltage transformer terminals (+IHAT), -XD1
8	Cabinet heater terminals (+IBCH)
9	Auxiliary relay for door fan
10	Auxiliary relay for the thermal protection of the Common-mode Filter
11	Earthing terminals, -PE
12	Auxiliary relay (+IBCH, +IAMH)
13	24 V DC power supply for door fan, -TB7.1
14	24 V DC terminals, -XD3
15	Spring-type terminals, -XD2.1, -XD2.2, -XD2.3
16	Door device terminal, -XDJ
17	Option slot AA3 terminals
18	Door fan terminals, -XD7

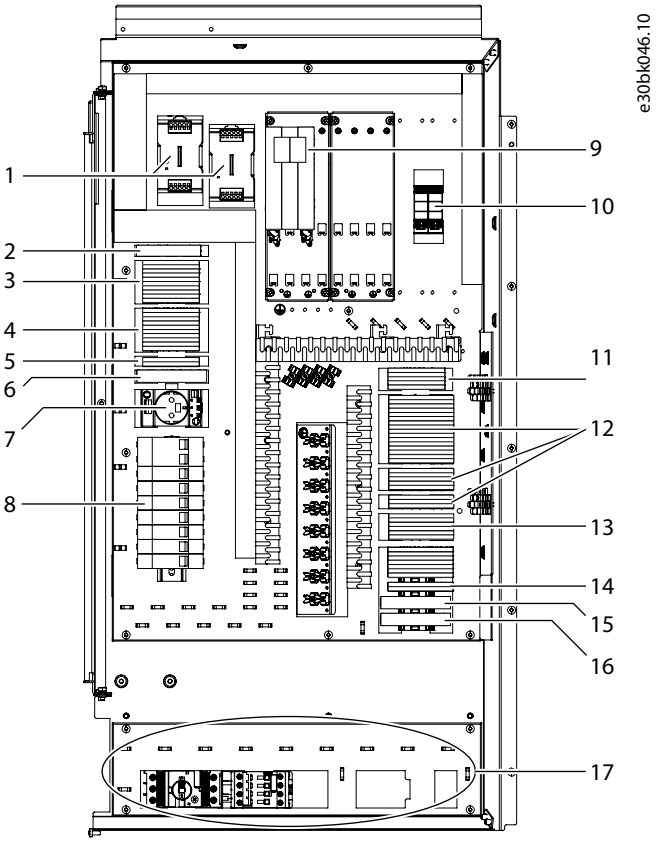


Illustration 25: Elements inside the Control Compartment, FE10

1	24 V DC power supply (TB7, TB7.1)	10	Ethernet port for fieldbus X1 and X2
2	Grounding terminals, -PE	11	24 V DC terminals, -XD3
3	Mains contactor terminals (+GACO), -XD0	12	Spring-type terminals, -XD2.1, -XD2.2, -XD2.3
4	Auxiliary AC voltage transformer terminals (+IHAT), -XD1	13	Door device terminals, -XDJ
5	Terminals for the cabinet heater option (+IBCH), -XD4	14	Door fan terminals, -XD7
6	Motor heater control auxiliary relay (+IBCH, +IAMH)	15	Door fan auxiliary relay, -QAB
7	230 V AC socket, -XD10	16	CM filter auxiliary relay, -KFJ
8	Circuit breakers	17	Motor fan supply or control supply (+ICF1…… +ICF4), -FCK,-QA9.
9	Option slots for option extender and I/O and Relay Option		

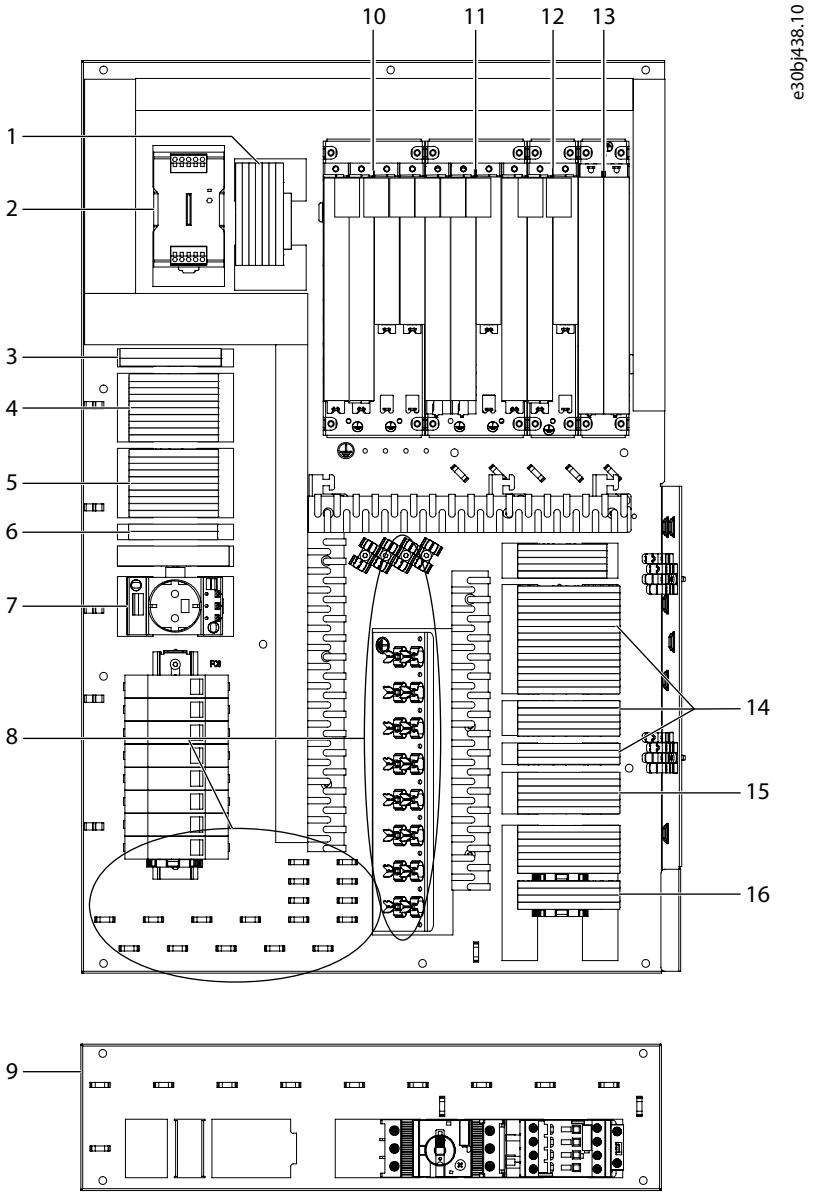


Illustration 26: Elements inside the Control Compartment, AE10/11, IE10/11

1	AFE terminals, -XD12.1.
2	24 V DC power supply (+IFCS), -TB7.
3	Grounding terminals, -PE
4	Fixed air circuit breaker terminals (+GACB), or withdrawable air circuit breaker terminals (+GACW), or mains contactor terminals (+GAC0) -XD0.
5	Auxiliary AC supply terminals (+IHAS), or auxiliary AC voltage transformer terminals (+IHAT), -XD1
6	Terminals for the cabinet heater option, -XD4
7	230 V AC socket (CEE 7/3, +IGS0), or 115 V AC socket (US, +IGS1), or 230 V AC socket (UK, +IGS2), -XD10
8	Strain relief and EMC grounding
9	Motor fan supply or control supply (+ICF1...+ICF4), -FCK, -QA9
10	Option slots for the inverter module. AA1 = I/O and Relay Option, AA2 = control board, AA3 + AA4 = option boards.
11	Option slots for the inverter module. AA5, AA6, AA7 = option boards. Option slot for the AFE module. AB1 = I/O and Relay Option.
12	Options slots for the AFE module. AB2 =control board, AB3 = option board.
13	Options slot AB4 = star coupler board for AFE, AA8 = star coupler board for inverter.
14	Spring-type terminals, -XD2.1, -XD2.2, -XD2.3
15	Door device terminals, -XDJ
16	Option slot AA3 terminals or insulation monitoring terminals (+IMIF)

7.4 Control Compartment Connections

Table 10: Control Compartment Connections

Terminal	Function	Connector type
X1	Ethernet port	RJ45
X2	Ethernet port	RJ45
X0	Ethernet port (used for the PC tool)	RJ45 (Cabled to the door -XD3.1 ethernet terminal)
Micro SD	microSD card	Micro SD
X62	24 V DC supply	2 x 3 spring force connector 0.2–1.5 mm^2
X33	STO connector	1 x 10 spring force connector 0.2–1.5 mm^2
Option bus	Option bus (internal connection)	Custom
X80	Fiber optic link to power unit or star coupler board	LC-duplex
X9	Control panel connector	iX Industrial
RTC battery	RTC battery	BR1632 (battery type)

Table 11: STO Connector Signals (X33, XD2.2)

Terminal on the control board	Function	Terminal block	Description
41	+24 V_{out}	-XD2.2:41	Not yet available
41	+24 V_{out}	-XD2.2:41	
42	Safe input A+	-XD2.2:42	

Terminal on the control board	Function	Terminal block	Description
43	Safe input B+	-XD2.2:43	
44	Safe feedback +	-XD2.2:44	
45	GND	-XD2.2:45	
45	GND	-XD2.2:45	
46	Safe input A-	-XD2.2:46	
47	Safe input B-	-XD2.2:47	
48	Safe feedback -	-XD2.2:48	

For more information on the STO safety function, see the iC7 Series Functional Safety Operating Guide.

Table 12: 24 V DC Supply Signals (X62, XD2.3)

Terminal on the control board	Function	Terminal block	Description
101	+24 V input	-XD2.3:101	Internal +24 V DC, 60 W control supply
102	GND	-XD2.3:102	Power supply ground
61	+24 V external input	-XD2.3:61	External +24 V DC control supply, maximum 10 A. Must be fuse-protected. Possible to daisy chain for multiple controllers.
62	GND	-XD2.3:62	Power supply ground
63	+24 V output	-XD2.3:63	+24 V DC output for daisy chain, only available when the +24 V DC external input control supply is used.
64	GND	-XD2.3:64	Power supply ground

7.5 I/O and Relay Option Connections

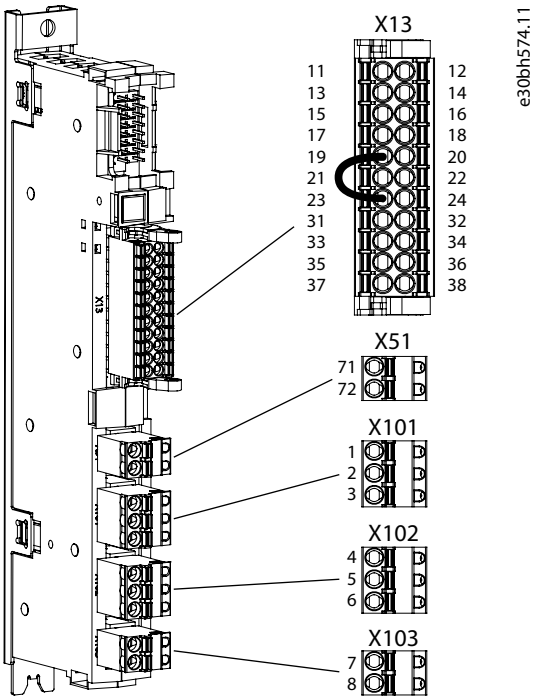


Illustration 27: I/O and Relay Option Terminal Block and Terminal Numbering

Table 13: I/O and Relay Option Signals

Terminal	Function	Connector type
X13	I/O terminal	2 x 11 spring force connector 0.2–1.5 mm^2
X51	Thermistor input	1 x 2 spring force connector 0.25–2.5 mm^2
X101	Relay 1	1 x 3 spring force connector 0.25–2.5 mm^2
X102	Relay 2	1 x 3 spring force connector 0.25–2.5 mm^2
X103	Relay 3	1 x 2 spring force connector 0.25–2.5 mm^2

Table 14: I/O Terminal Signals (X13)

Terminal	Function	Description
11	+24 V_{out}	Control voltage output. 24 V DC (-15...+20%) Maximum current 200 mA Short-circuit protected
12	+24 V_{out}	
13	DI 1	Configurable digital input, galvanically isolated. 24 V DC, 0 < 5 V, 1 > 15 V. Input load 7.5 mA constant current + 10 kΩ resistive load, maximum pulse frequency 100 kHz.
14	DI 2	
15	DI 3	
16	DI 4	
17	DI 5	
18	DI 6	

Terminal	Function	Description
19	DGND	Digital input ground, not isolated by default. When using the internal +24 V_{out} supply, connect the external jump wire between DGND and GND. When using the external +24 V DC supply, remove the external jump wire between DGND and GND.
20	DGND	
21	DO 1	Configurable digital output. Push-pull 24 V/50 mA Open collector (NPN/PNP) 48 V/50 mA Short-circuit protected
22	DO 2	
23	GND	I/O ground. Ground for digital outputs, +10 V Ref, +24 V_{out}, analog inputs, and analog outputs.
24	GND	
31	AO 1	Configurable analog output. Voltage mode: • 0...10 V • $R_L \geq 1$ kΩ • accuracy ≤ ± 0.5% of full scale • short-circuit protected Current mode: • 0...20 mA • $R_L \leq 600$ Ω • accuracy ≤ ± 0.5% of full scale • short-circuit protected
32	+10 V ref.	10 V (0...+3%), maximum current 10 mA
33	AI 1	Configurable analog input. Voltage mode: • 0 ± 10 V • single-ended • R_i ~ 10 kΩ • accuracy ± 0.5% of full scale Current mode: • 0 ± 20 mA • differential • R_i ~ 200 Ω • accuracy ± 0.5% of full scale
34	AI 2	
35	GND	I/O ground. Ground for digital outputs, +10 V Ref, +24 V_{out}, analog inputs, and analog outputs.
36	GND	
37	GND	
38	GND	

Table 15: Thermistor Input Signals (X51)

Terminal	Function	Description
71	TI+	Thermistor input, galvanically isolated. R_{trip} = 4 kΩ
72	TI-	

Table 16: Relay 1 Signals (X101)

Terminal	Function	Description
1	COM	Configurable relay output. Switching capacity: • 24 V DC/8 A • 250 V AC/8 A • 125 V DC/0.4 A Minimum switching load: 5 V/10 mA
2	NO	
3	NC	

Table 17: Relay 2 Signals (X102)

Terminal	Function	Description
4	COM	Configurable relay output. Switching capacity: • 24 V DC/8 A • 250 V AC/8 A • 125 V DC/0.4 A Minimum switching load: 5 V/10 mA
5	NO	
6	NC	

Table 18: Relay 3 Signals (X103)

Terminal	Function	Description
7	COM	Configurable relay output. Switching capacity: • 24 V DC/8 A • 250 V AC/8 A • 125 V DC/0.4 A Minimum switching load: 5 V/10 mA
8	NO	

7.6 I/O and Relay Option Interface

7.6.1 Analog Inputs

The I/O and Relay Option has 2 analog inputs that can be configured with the software to voltage input or current input. The table shows the specification for the analog inputs.

The analog inputs are protected in overvoltage conditions.

Table 19: Analog Input Types, Values, and Tolerances

Parameter	Value
Measuring range: voltage mode	-10...+10 V
Measuring range: current mode	-20...+20 mA

Parameter	Value
Input impedance	Voltage mode ≈ 10 kΩ
	Current mode ≈ 200 Ω
Accuracy	0.5% of full scale
Reaction time	0...90% step: < 1 ms
Number of inputs	2
Overvoltage limit	+15/-15 V
Overcurrent limit	+32/-32 mA
Electrical fast transient (EFT)	2 kV

7.6.2 Analog Outputs

The I/O and Relay Option has 1 analog output that can be configured with the software to voltage output or current output. The table shows the specification for the analog output.

The analog output is protected in overvoltage conditions.

Table 20: Analog Output Types and Values

Parameter	Value
Output Voltage Range	0...10 V
Output Current Range	0...20 mA
Accuracy	0.5% of full scale
Reaction time	0...90% step: <1 ms
Electrical fast transient (EFT)	2 kV

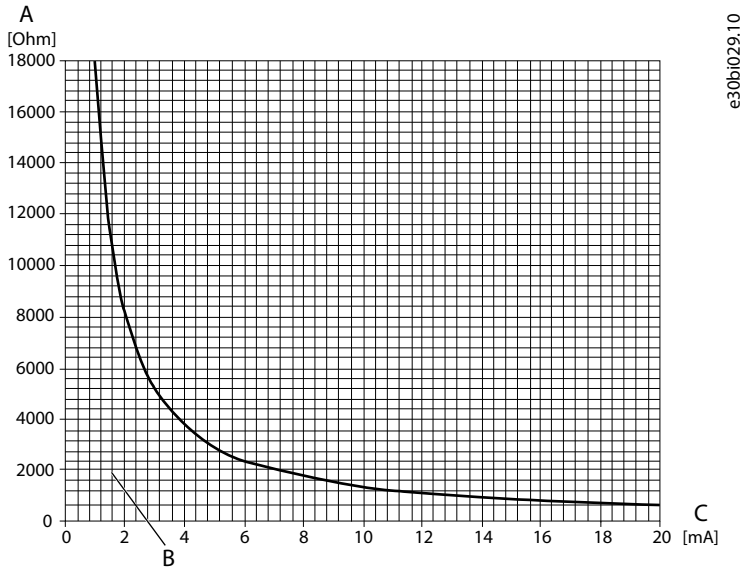


Illustration 28: Allowed Load Resistance of Analog Output in Current Mode

A	Load resistance	C	Output current
B	Allowed load resistance		

7.6.3 Digital Inputs

The I/O and Relay Option has 6 digital inputs. By default, the digital inputs are not isolated, because there is an external wire between the connector pins 19 (D_{GND}) and 23 (GND). The digital inputs can be functionally isolated from the PCB ground of the I/O and Relay Option by removing the wire. The digital inputs are polarity free.

Digital inputs are overvoltage protected.

Table 21: Digital Inputs Logic Levels and Other Requirements

Parameter	Value
Recommended Operation Voltage	0...24 V +20%/-10%
Overvoltage Limit	33 V
Logic Level	0 = $V_{TL} \leq 5$ V 1 = $V_{TH} \geq 15$ V
Input Load	7.5 mA constant current and 10 kΩ resistive load
Reaction Time	< 5 µs
Maximum Frequency	100 kHz
Electrical fast transient (EFT)	2 kV

7.6.4 Digital Outputs

The I/O and Relay Option has 2 digital outputs. The digital outputs are the push-pull type. The digital outputs can also be used as the open collector type.

The digital outputs are short-circuit protected.

Table 22: Digital Output Voltage and Current

Parameter	Value
Output Voltage	0 = max 2 V 1 = min 20 V (1)
Rated Current	±50 mA
Overcurrent Limit	±80 mA
Maximum voltage when used as open collector output	48 V
Maximum Frequency	100 kHz
Electrical fast transient (EFT)	2 kV

[1] Control unit power supply 24 V +20%/-10% and I_{load} max 50 mA

7.6.5 Relay Outputs

The I/O and Relay Option has 3 relay outputs. Relay 1 and Relay 2 have NO and NC contacts [1 form C (CO)]. Relay 3 has only an NO contact [1 form A (NO)]. The relay output interface is reinforced for system voltages ≤ 300 V. The lifetime for relays is 100.000 cycles.

Table 23: Relay Output Values

Parameter	Value
Rated Voltage	250 V AC
Max. Switching Voltage	400 V AC

Parameter	Value
Rated Current	8 A
Breaking Capacity Max	2000 VA
Operate Time Max.	9 ms
Release Time Max.	5 ms
DC Breaking Capacity	See Illustration 29.

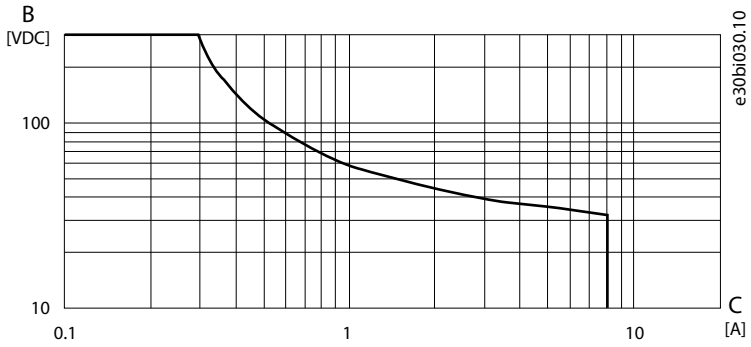


Illustration 29: Maximum DC Load Breaking Capacity

B	DC voltage
C	DC current

7.6.6 Analog Reference Voltage Output

The I/O and Relay Option contains 1 analog reference voltage output.

Table 24: Analog Reference Voltage Output Values

Parameter	Value
Nominal Voltage	10 V
Accuracy	-3...+3% of nominal voltage
Maximum Output Current	10 mA
Short Circuit Current	13 mA
Electrical fast transient (EFT)	2 kV

7.6.7 24 V DC Voltage Output

The I/O and Relay Option contains 1 voltage output of 24 V DC.

Table 25: 24 V DC Voltage Output

Parameter	Value
Nominal Voltage	24 V
Accuracy	-15...+20%

Parameter	Value
Maximum Output Current	200 mA
Short Circuit Current	250 mA
Electrical fast transient (EFT)	2 kV

7.6.8 Thermistor Input

The I/O and Relay Option contains 1 thermistor input. Thermistor input has basic isolation for system voltages ≤ 600 V and reinforced isolation for system voltages ≤ 300 V (OVC III 3000 m). For system voltage of 600 V, supplementary insulation is necessary at the motor end.

Table 26: Thermistor Input

Parameter	Value
Electrical fast transient (EFT)	2 kV
Sensor	R_{trip} 4.0 kΩ (PTC)

7.7 Cable Connection of the Option Extender

The option extender provides an interface from the control compartment of the cabinet to the drive module. The option extender is available as option for AE10, AE11, IE10, IE11, but is default for FE9 and FE10.

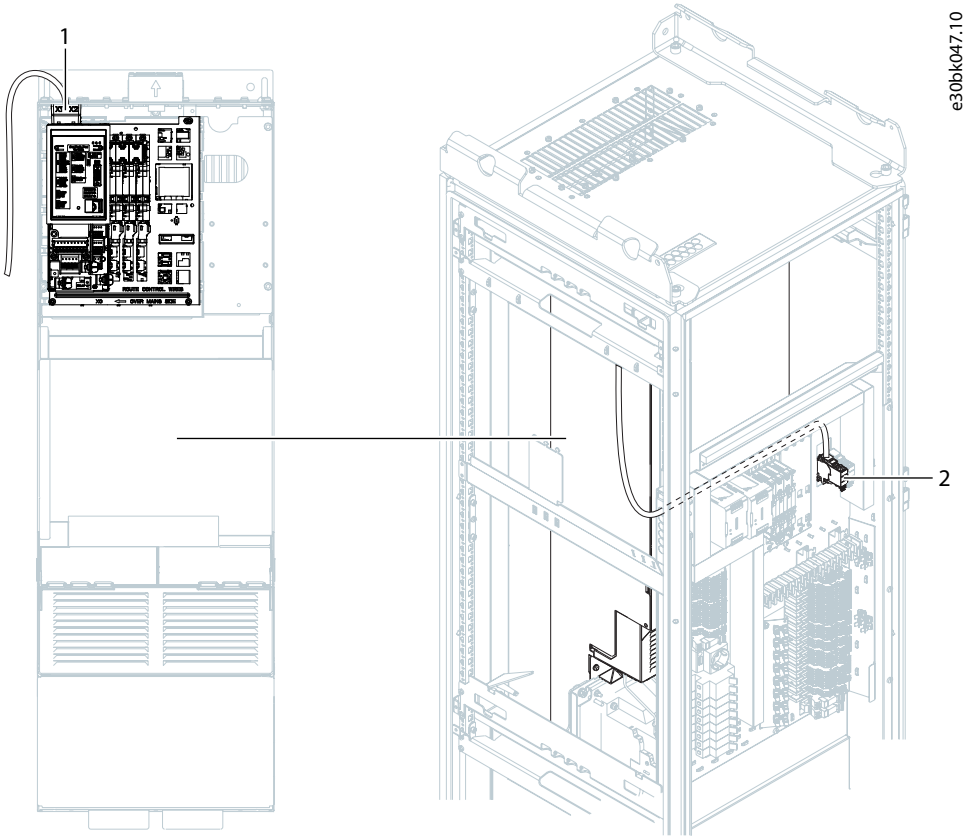


Illustration 30: Ethernet Cable Connection of the Option Extender from the Top

1	Ethernet port of the control of the module
2	RJ45 extender of the control compartment

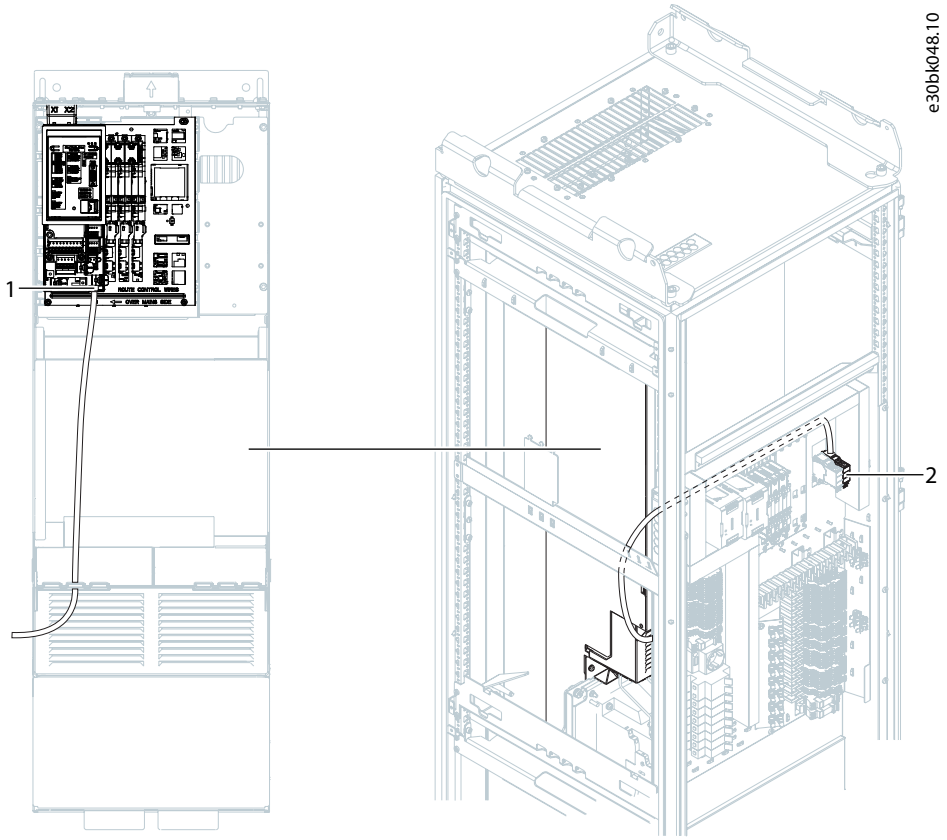


Illustration 31: Ethernet Cable Connection of the Option Extender from the Bottom

1	Ethernet port of the control of the module
2	RJ45 extender of the control compartment

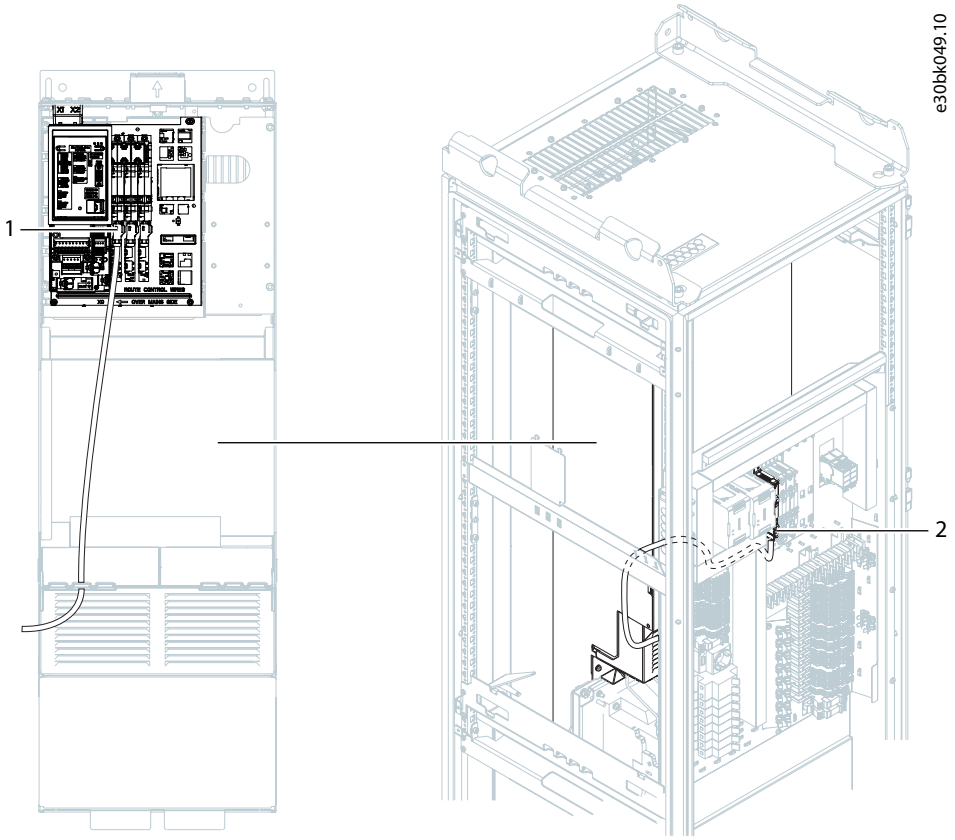


Illustration 32: Fiber Cable Connection from the Control of the Module to the Control Board of the Control Compartment

1	Control board of the module
2	Control board of the control compartment

7.8 Control Cable Routing

Use the control cable grommets and tubes to route the control cables into the control compartment. There are control cable grommets at the top and at the bottom of the cabinet.

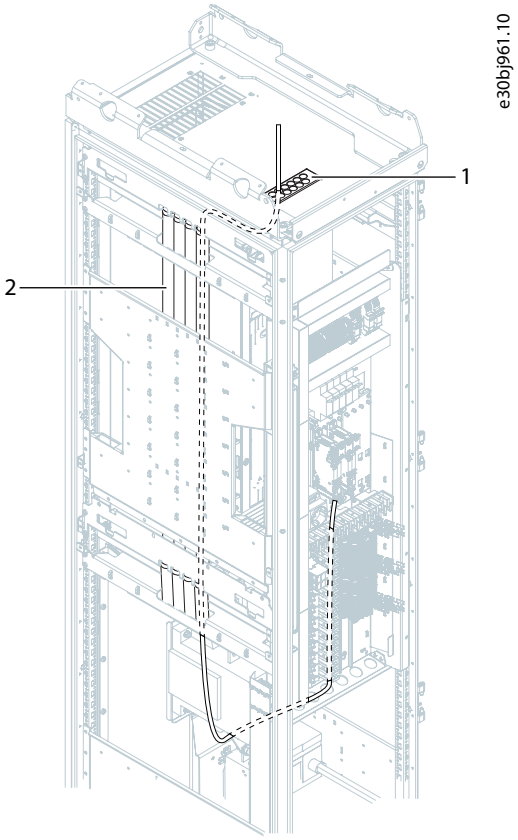


Illustration 33: Routing of Control Cables from the Top, FE9, FE10

1	Control cable grommets
2	Tubes

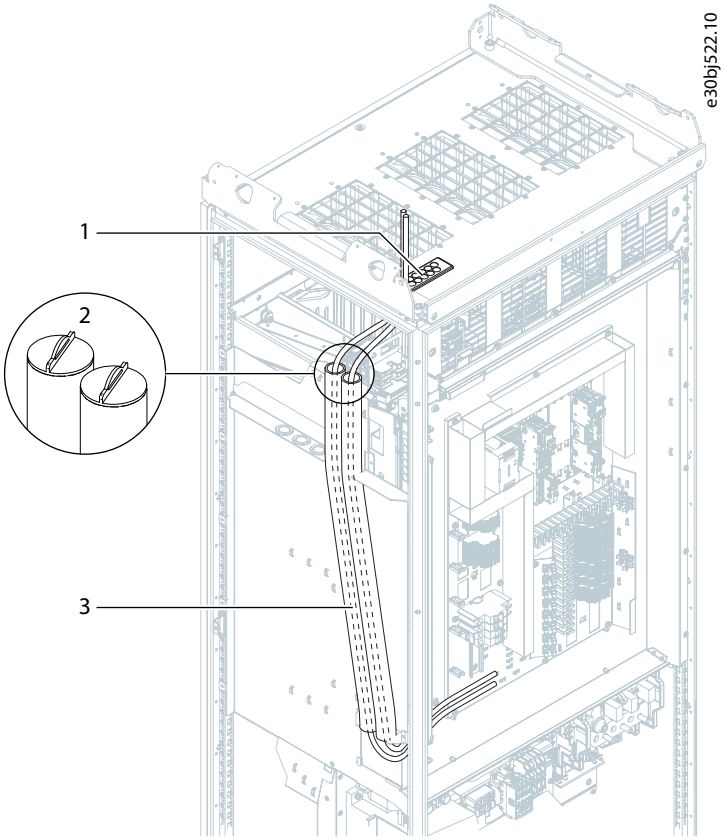


Illustration 34: Routing of Control Cables from the Top, AE10/11, IE10/11

1	Control cable grommets	3	Tubes, internal diameter 32 mm
2	Two corks, to be removed when routing control cables from the top		

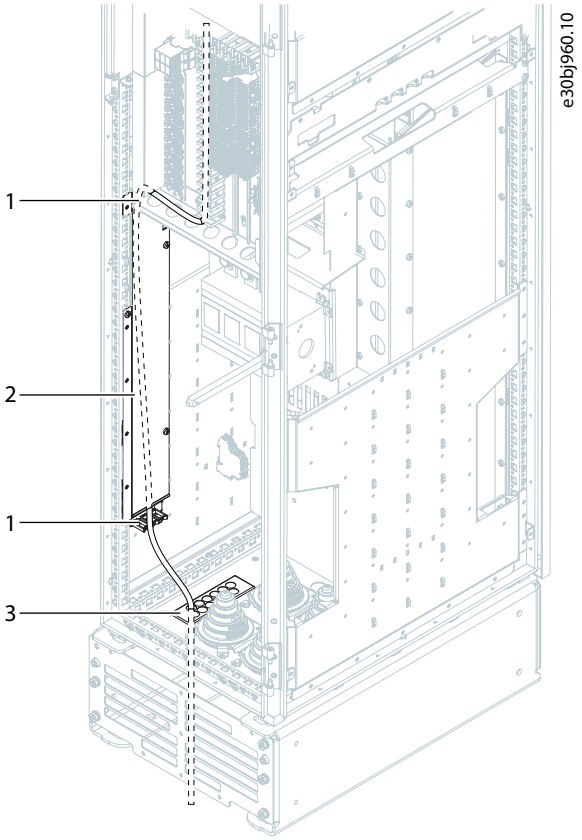


Illustration 35: Routing of Control Cables from the Bottom, FE9, FE10

1	Cable clamps	3	Control cable grommets
2	Protection plate		

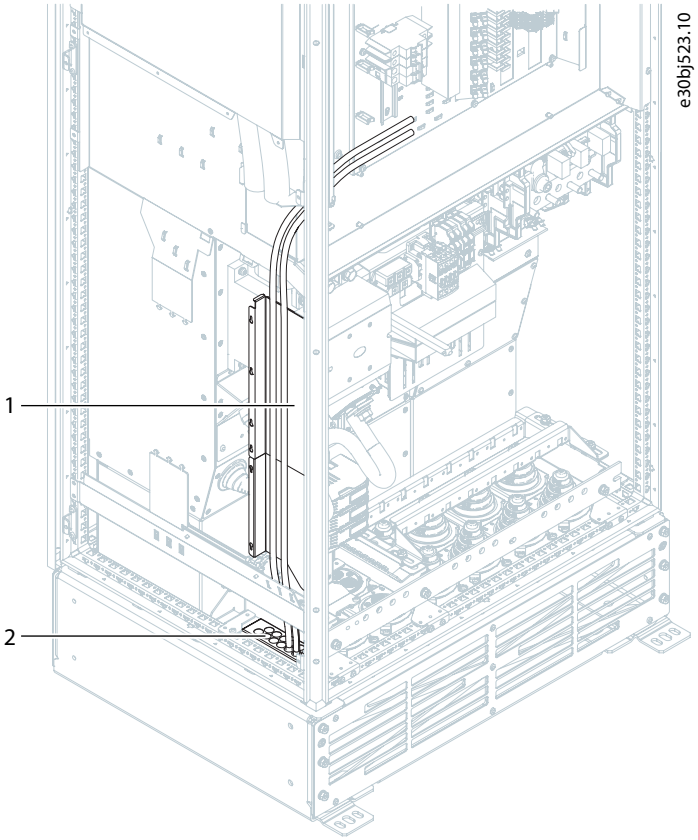


Illustration 36: Routing of Control Cables from the Bottom, AE10/11, IE10/11

1	Protection plate
2	Control cable grommets

7.9 Installing Boards to the Control Compartment

Use these instructions to install a board, for example an option board, to the mounting plate on the control compartment.

⚠ C A U T I O N ⚠

DAMAGE TO OPTION BOARDS

Do not install, remove, or replace option boards on the drive when the power is on. Doing this can cause damage to the boards.

- Switch off the AC drive before installing, removing, or replacing option boards on the drive.

Procedure

1. Remove the screw that is pre-attached to the fixing point at the top of the mounting plate and keep it.

2. Slide the lower edge of the board to the mounting plate fixing point.

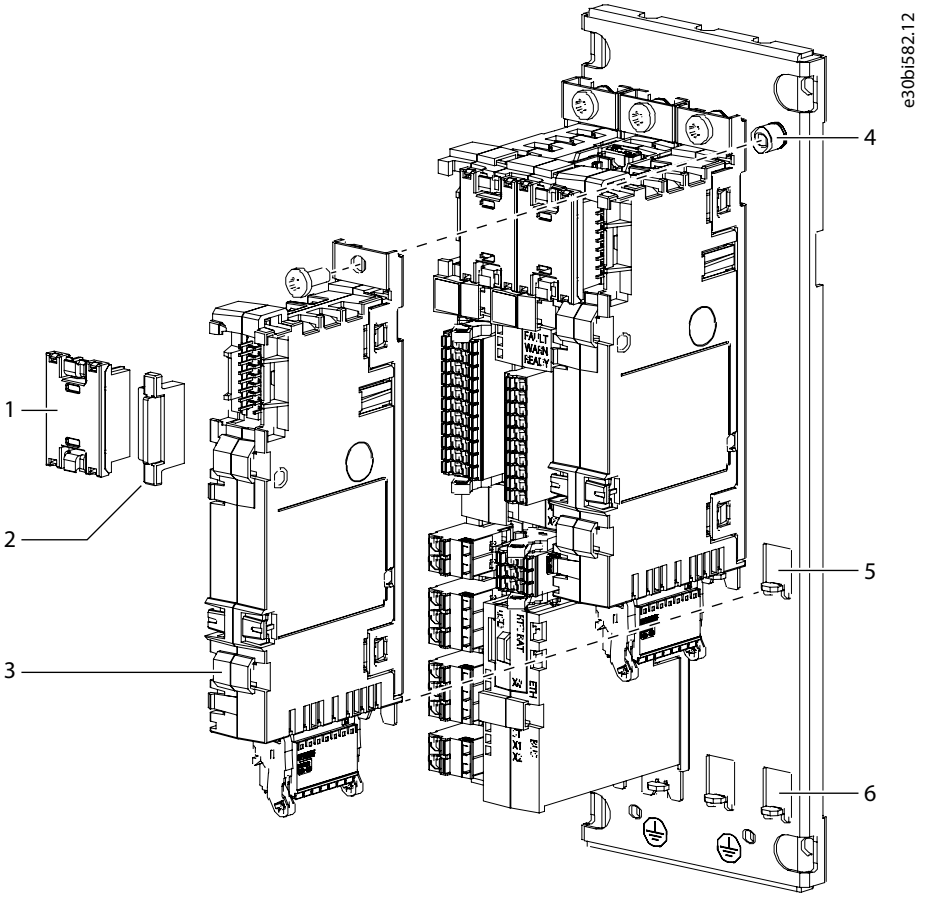


Illustration 37: Installing a Board to the Control Compartment Mounting Plate

1	Option connector	4	Fixing point at the top
2	Option terminal cover	5	Fixing point at the middle
3	Option board	6	Fixing point at the bottom

3. Use the screw to attach the board to the fixing point at the top.
4. Attach an option connector to the newly installed board and the board next to it.
5. Attach option terminal covers to the empty terminals.

7.10 Installing the Control Cables into the Control Terminals

See 7.1 General Information of the Control Compartment.

Requirements for the control cables:

- Wire size: 0.25–4 mm^2 (22–12 AWG)
- Wire size with end ferrule: 0.25–2.5 mm^2 (22–14 AWG)
- Wire stripping length: 10–12 mm (0.4–0.5 in)

Installing the control cables on the option board

1. Install the control cables into the control terminals.

   See the pin numbering of the I/O and Relay Option in Illustration 27.

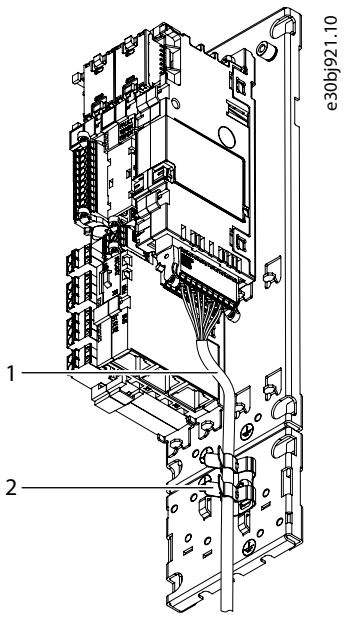


Illustration 38: Example of Installing the Control Cables on the Option Board

1	Control cable
2	Cable clamp

2. Strip the control cables. Attach the control cables to the cable clamps on the grounding plate.

The lower part of the cable clamp fixes the cable to the plate and provides strain relief. The upper part provides ~360° grounding for the cable shield.

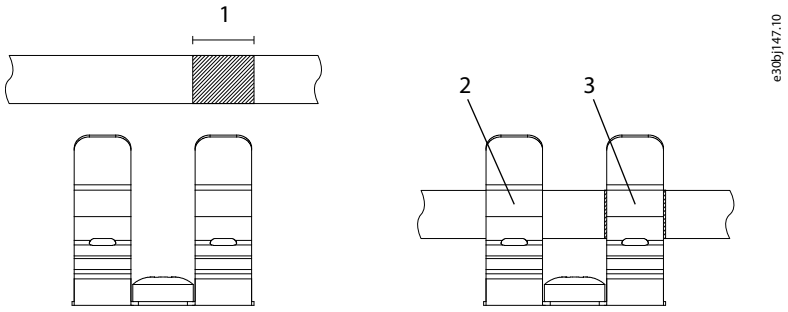


Illustration 39: Stripping the Cable and Using the Grounding Plates

1	Stripping length, 10 mm (0.4 in)	3	Grounding
2	Strain relief		

Installing the control cables on terminals blocks

1. Install the control cables into the terminals in the terminal block.

See the pin numbering of the terminal blocks in 7.4 Control Compartment Connections.

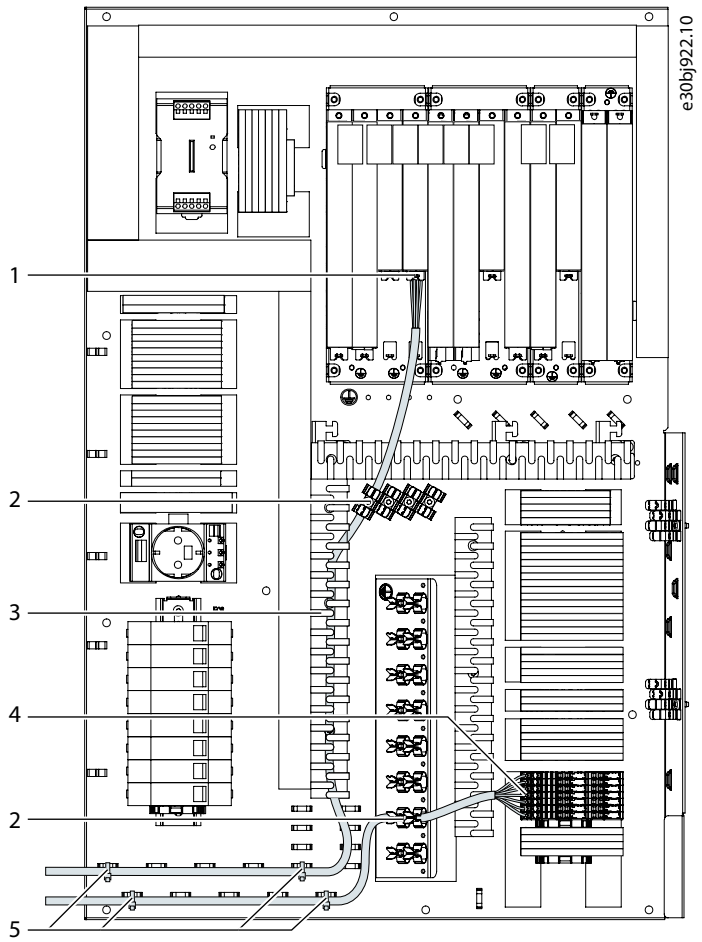


Illustration 40: Example of Installing the Control Cables on Terminals Blocks

1	Option board	4	Terminal block
2	Cable clamp	5	Guidance for the control cable
3	Cable duct		

2. Strip the control cables. Attach the control cables to the cable clamps on the control compartment.

7.11 Installing the microSD Card

Supported microSD card types:

- SD
- SDHC
- SDXC

The microSC card must be formatted for the file system FAT32. It is recommended to use SDHC type cards as they are preformatted to FAT32.

Procedure

1. Locate the microSD card hole on the control board of the control unit.

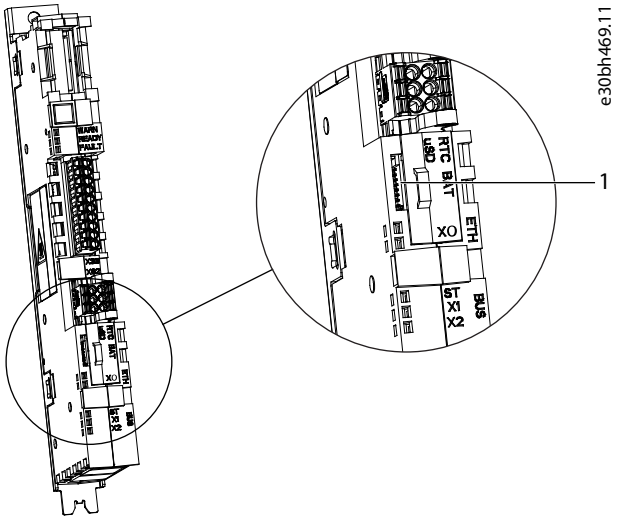


Illustration 41: Location of the microSD Card

1	The microSD card

2. Push the new microSD card into the hole.

The contact area must face the text *µSD* on the right.

To remove the microSD card, push it. The microSD card pops out.

7.12 Preparing for a PC Connection

Use these instructions to connect the drive or several drives to a PC with an RJ45 cable.

Procedure

1. Connect an RJ45 cable to the PC.

To connect several drives at the same time, use an Ethernet switch between the PC and the control unit.

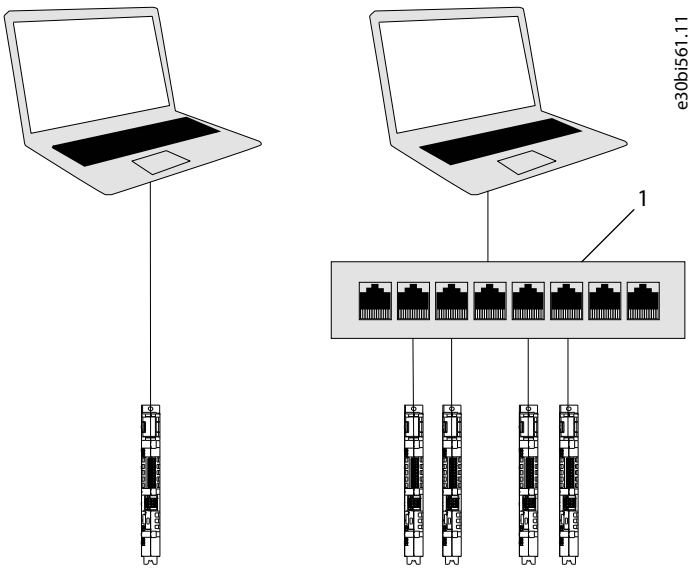


Illustration 42: Connecting the Drive to a PC

1	Ethernet switch

2. Connect the cable coming from the PC or from the Ethernet switch to the Ethernet port X0 on the control unit of the drive.

7.13 Installing MyDrive® Insight

Procedure

1. To install the tool, go to suite.mydrive.danfoss.com/content/tools.
2. Install MyDrive® Insight.

   See more information on how to use the tool in its help menu.

3. Use MyDrive® Insight to connect the drive to a PC.

8 Starting the Drive

8.1 Commissioning the AC Drive

Follow these instructions to commission the AC drive.

Read the safety instructions in 2.2 General Safety Considerations and 6.1 Electrical Installation Safety and obey them.

Procedure

1. Make sure that the motor is installed correctly.
2. Make sure that the motor is not connected to mains.
3. Make sure that the AC drive and the motor are grounded.
4. Make sure to select the mains cable and the motor cable correctly.

   For information on cable selections, see 10.5.1 General Cable Size Information.
5. Make sure that the control cables are as far as possible from the power cables.
6. Make sure that the shields of the shielded cables are connected to a grounding terminal that is identified with the grounding symbol.
7. Check the tightening torques of all the terminals.
8. Make sure that the cables do not touch the electrical components of the drive.
9. Make sure that the common input +24 V is connected to an external power source and the ground of the digital input is connected to ground of the control terminal.
10. Check the quantity of cooling air.
11. Make sure that there is no condensation on the surfaces of the AC drive.
12. Make sure that there are no unwanted objects in the installation space.
13. Before connecting the drive to mains, check the installation and the condition of all the fuses and other protective devices.

    For information on fuse selections, see 10.6.1 List of Fuse Size Information.
14. Check that all Start/Stop switches connected to the I/O terminals are in the Stop position.
15. Perform the cable and motor insulation checks, see 8.3 Measuring the Cable and Motor Insulation.
16. For information on setting the parameters, see the relevant application guide.

8.2 Pre-charging the Drive

N O T I C E

Before starting the drive, the drive must be pre-charged.

Procedure

1. Check that the pre-charging main switch (-QB6) is closed. It is located inside the cabinet.
2. Select automatic or manual pre-charging with the switch -SF12.
3. Enable mains with the switch -SF11.
4. Connect the power supply.
5. For frames 2 x EA10 + 2 x EI10 and smaller, close the drive main switch -QB0.

   In the automatic mode, the drive starts pre-charging immediately when the power is connected.
6. In the manual mode, start the pre-charging by pushing the Run button on the AFE control panel or by giving a start command from remote PLC or fieldbus.

   When the pre-charging is complete, the drive automatically closes the main contactor or circuit breaker.

8.3 Measuring the Cable and Motor Insulation

Do these checks if necessary.

NOTE! AC drive is already measured at the factory.

- The insulation checks of the motor cable, see 8.3.1 Insulation Checks of the Motor Cable
- The insulation checks of the mains cable, see 8.3.2 Insulation Checks of the Mains Cable
- The insulation checks of the motor, see 8.3.3 Insulation Checks of the Motor

8.3.1 Insulation Checks of the Motor Cable

Use these instructions to check the insulation of the motor cable.

Procedure

1. Disconnect the motor cable from the terminals U, V, and W and from the motor.
2. Measure the insulation resistance of the motor cable between phase conductors 1 and 2, between phase conductors 1 and 3, and between phase conductors 2 and 3.
3. Measure the insulation resistance between each phase conductor and the grounding conductor.
4. The insulation resistance must be >1 MΩ at the ambient temperature of 20 °C (68 °F).

8.3.2 Insulation Checks of the Mains Cable

Use these instructions to check the insulation of the mains cable.

Procedure

1. Disconnect the mains cable from the terminals L1, L2, and L3 and from mains.
2. Measure the insulation resistance of the mains cable between phase conductors 1 and 2, between phase conductors 1 and 3, and between phase conductors 2 and 3.
3. Measure the insulation resistance between each phase conductor and the grounding conductor.
4. The insulation resistance must be >1 MΩ at the ambient temperature of 20 °C (68 °F).

8.3.3 Insulation Checks of the Motor

Use these instructions to check the insulation of the motor.

NOTICE

Obey the instructions of the motor manufacturer.

Procedure

1. Disconnect the motor cable from the motor.
2. Open the bridging connections in the motor connection box.
3. Measure the insulation resistance of each motor winding. The voltage must be the same or higher than the motor nominal voltage, but at least 1000 V.
4. The insulation resistance must be >1 MΩ at the ambient temperature of 20 °C (68 °F).
5. Connect the motor cables to the motor.
6. Do the final insulation check on the drive side. Put all phases together and measure to the ground.
7. Connect the motor cables to the drive.

9 Maintenance

9.1 Preventive Maintenance Recommendations

Generally, all technical equipment, including Danfoss AC drives need a minimum level of preventive maintenance. Regular maintenance is recommended to ensure trouble-free operation and long life of the drive. It is also recommended, as a good service practice to record a maintenance log with counter values, date, and time describing the maintenance and service actions.

Danfoss recommends the following inspections and service intervals for air-cooled drive/system.

N O T I C E

The service schedule for part replacements can vary depending on operation conditions. Under specific conditions, the combination of stressful operating and environment conditions work together to reduce the lifetime of the components significantly. These conditions can include, for example, extreme temperature, dust, high humidity, hours of use, corrosive environment, and loading.

For operation in stressful conditions, Danfoss offers the DrivePro® Preventive Maintenance service. DrivePro® services extend the lifetime and increase the performance of the product with scheduled maintenance including customized part replacements. DrivePro® services are tailored to the specific application and operating conditions.

Table 27: Maintenance Schedule for Air-cooled Drives

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
Installation			
Visual drive inspection	1 year	–	Check for the unusual, for example, for signs of overheating, aging, corrosion, and for dusty and damaged components.
Auxiliary equipment	1 year	According to manufacturer recommendations	Inspect equipment, switchgear, relays, disconnects or fuses/circuit breakers. Examine the operation and condition for possible causes of operational faults or defects. The continuity check on fuses is performed by trained service personnel.
EMC consideration	1 year	–	Inspect the installation wiring regarding the electromagnetic capability and the separation distance between control wiring and power cables.
Cable routing	1 year	–	Check for parallel routing of motor cables, mains wiring, and signal wiring. Parallel routing must be avoided. Avoid routing cables through free air without support. Check for aging and wearing of the cable insulation.
Control wiring	1 year	–	Check for tightness, damaged or crimped wires or ribbon wires. The connections should be terminated correctly with solid crimped ends. The use of shielded cables and grounded EMC plate, or a twisted pair is recommended.
Proper clearances	1 year	–	Check that the required external clearances for proper airflow for cooling are followed according to the frame designation and drive type of the drive. For clearances, refer to the local design regulations.
Seals condition	1 year	–	Check that the seals of the enclosure, the covers, and the cabinet doors are in good condition.
Corrosive environments	1 year	–	Conductive dust and aggressive gases, such as sulphide, chloride, salt mist, and so on, can damage the electrical and mechanical components. Air filters will not remove airborne corrosive chemicals. Act based on findings.
Drive			

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
Programming	1 year	–	Check that the AC drive parameter settings are correct according to the motor, drive application, and I/O configuration. Only trained service personnel may perform this action.
Control panel	1 year	–	Check that the display pixels are intact. Check the event log for warnings and faults. Repetitive events are a sign of potential issues. Contact a local service center.
Drive Cooling capacity	1 year	–	Check for blockages or constrictions in the air passages of the cooling channel. The heat sinks must be free of dust and condensation.
Capacitors, DC link	1 year	8–15+ years	The expected lifetime of the capacitors is dependent on the loading profile of the application and the environmental temperature. For applications with heavy loads in demanding environments or high ripple current, replace electrolytic capacitors every 8 years and plastic foil capacitors every 12 years. If within specification of the drive type, replace every 10–15+ years. Only trained service personnel may perform this action.
Cleaning and Filters	1 year	–	The interior of the enclosure should be cleaned annually, and more frequently if necessary. The level of dust in the filter or inside the enclosure is an indicator for when the next cleaning or filter replacement is required.
Fans	1 year	5–10 years	Inspect the condition and operational status of all cooling fans. With the power off, the fan axis should feel tight, and spinning the fan with a finger, the rotation should be almost silent and not have abnormal rotation resistance. When in RUN mode, fan vibration, excessive or strange noise is a sign of the bearings wearing, and the fan should be replaced.
Grounding	1 year	–	The drive system requires a dedicated ground wire connecting the drive, the output filter, and the motor to the building ground. Check that the ground connections are tight and free of paint or oxidation. Daisy-chain connections are not allowed. Braided straps are recommended if applicable.
PCB	1 year	10–12 years	Visually inspect the PCBs for signs of damage or degrading due to aging, corrosive environments, dust, or environments with high temperatures. Only trained service personnel may perform the inspection and service action.
Power cables and wiring	1 year	–	Check for loose connections, aging, insulation condition, and proper torque to the drive connections. Check for proper rating of fuses and continuity check. Observe if there are any signs of operation in a demanding environment. For example, discoloration of the fuse housing may be a sign of condensation or high temperatures.
Vibration	1 year	–	Check for abnormal vibration or noise coming from the drive to ensure that the environment is stable for electronic components.
Insulator gaskets	1 year	10–15 years	Inspect the insulators for signs of degradation due to high temperature and aging. Replacement is based on findings or done at the same time as DC capacitor replacement. Only trained service personnel may perform this action.
Batteries	1 year	7–10 years	Batteries should be replaced according to manufacturer recommendation. Replace the RTC battery in the control unit every 7–10 years.
Spare parts			
Spare parts	1 year	2 years	Stock spares in their original boxes in a dry and clean environment. Avoid hot storage areas. Electrolytic capacitors require reforming as stated in the service schedule. The reforming is performed by trained service personnel.
Exchange units and units stored for long pe-	1 year	2 years	Visually inspect for signs of damage, water, high humidity, corrosion, and dust within the visual field of view without disassembly. The exchange units with mounted electrolytic capacitors require reforming as stated in the service schedule. The reforming is performed by trained service personnel.

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
riods before commissioning			

[1] Defined as the time after the commissioning/start-up or the time from the previous inspection.

[2] Defined as the time after the commissioning/start-up or the time from the previous service schedule actions.

9.2 Replacing the RTC Battery

The real-time clock (RTC) battery can be used to provide a reliable power source for the RTC. If power is lost in the control unit, the RTC battery keeps the internal real time. The time is used for scheduled activities and timestamping occurrences based on application needs. The RTC battery is optional and comes preinstalled if the option is selected.

⚠ C A U T I O N ⚠

RISK OF FIRE OR EXPLOSION

- Replace the battery with Panasonic BR1632A (3 V, 125 °C) coin-cell battery only. Using another battery may present a risk of fire or explosion.
- Only qualified personnel can exchange the battery.
- For detailed safety information, refer to the documentation provided with the battery.

⚠ C A U T I O N ⚠

RISK OF FIRE OR EXPLOSION

- Do not recharge, disassemble, or dispose of in fire.

Procedure

1. Locate the RTC battery holder on the control board of the control unit.
2. Pull from the handle next to the text *RTC BAT*.

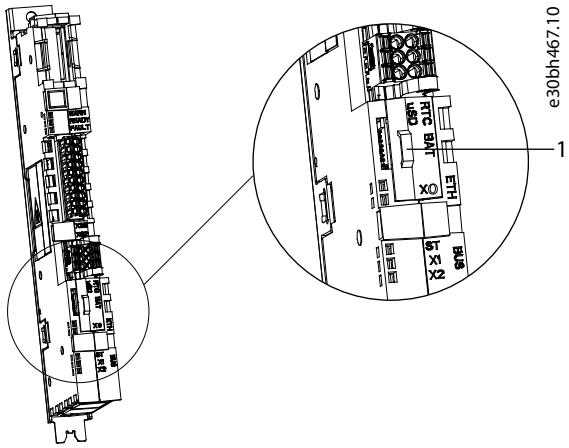


Illustration 43: Location of the RTC Battery

1	The handle

➔ The battery holder slides out.

3. To remove the battery, push it on the tooth side and slide it out of the plastic holder.

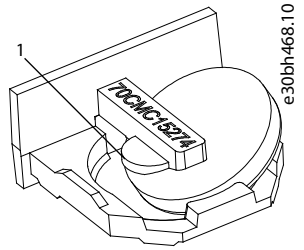


Illustration 44: Replacing the Battery

1	The tooth

4. To put a new battery in place, start from the opposite side and slide it into the slot in the holder, the plus side towards the tooth.

The correct battery type is a coin type lithium battery BR1632.

5. Push the holder back into the control board.

9.3 Using the Product Modified Label

In the accessories bag, there is also a "product modified" label. The function of the label is to tell the service personnel about the changes that are made in the AC drive.

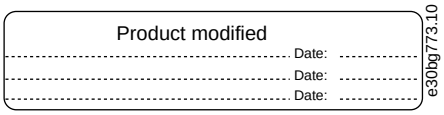


Illustration 45: The Product Modified Label

Procedure

1. Attach the label on the side of the AC drive, in a place where it is easy to find.
   - **a.** Attach the label, for example, next to the other labels on the power unit.
2. If changes are made to the AC drive, write the change and date on the label.

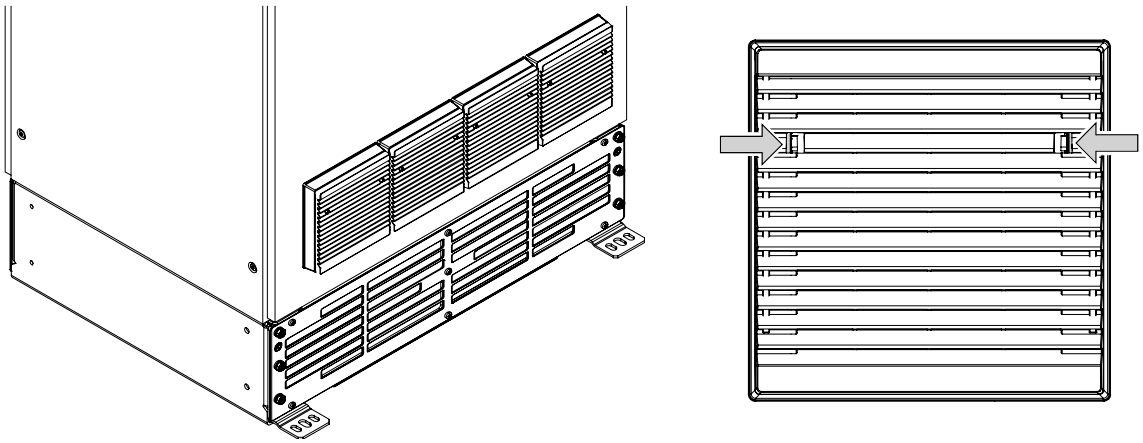
9.4 Cleaning or Replacing the Door Filters

Clean filters are important to ensure a good air flow into the cabinet. The filters are only included in drives with protection rating IP54.

Procedure

1. Locate the door filters on the outside of the cabinet door.

2. Pinch together the release tabs on the fan grill and remove the grill from the filter frame.



e30bj609.12

Illustration 46: Removing the Fan Grill

3. Remove and clean or replace the filter.
4. Put the cleaned or new filter into the filter frame on the outside of the door.
5. Reposition the fan grill over the filter and press to snap into place.

10 Specifications

10.1 Tightening Torques

Table 28: Tightening Torques

Frame	Bolt	Tightening torque	
		Nm	In-lb
FE9, FE10	M4	1.8	16
FE9, FE10	M5	2.7	24
FE9, FE10	M6	6	53
FE9, FE10, AE10, AE11, IE10, IE11	M8	20	180
FE9, FE10	M10	30–44	270–390
AE10, AE11, IE10, IE11	M10	40	350
FE9, FE10, AE10, AE11, IE10, IE11	M12	70	620
FE9, FE10, AE10, AE11, IE10, IE11	Grounding bolt (M8)	13.5	120

10.2 Dimension Illustrations

10.2.1 Dimensions of the Enclosed Drive, FE9

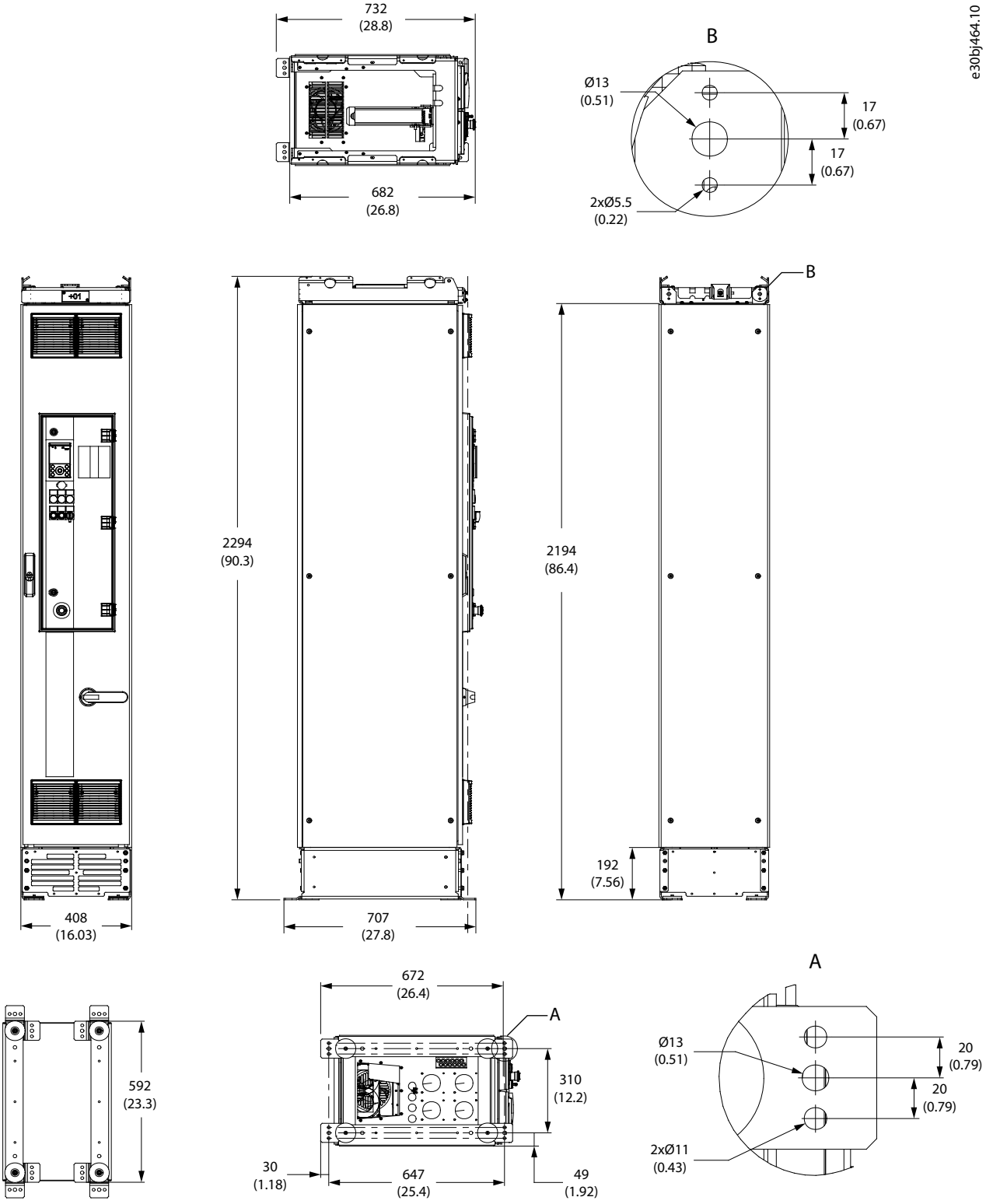


Illustration 47: Dimensions of the Enclosed Drive, FE9, in mm (in)

A	Mounting holes at the bottom
B	Mounting holes at the top

10.2.2 Dimensions of the Enclosed Drive, FE10

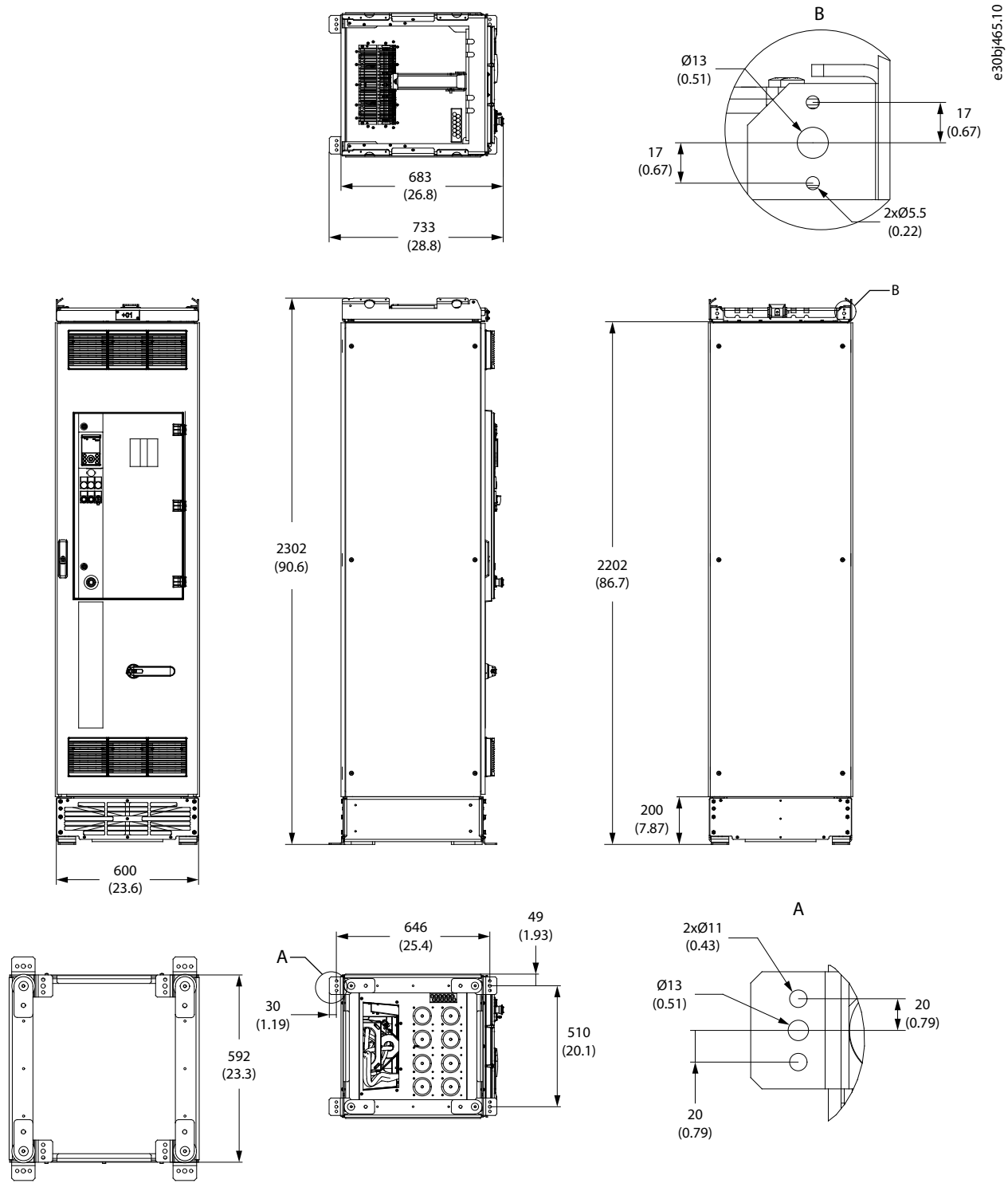


Illustration 48: Dimensions of the Enclosed Drive, FE10, in mm (in)

A	Mounting holes at the bottom
B	Mounting holes at the top

10.2.3 Dimensions of the Enclosed Drive, AE10, AE11, IE10, IE11

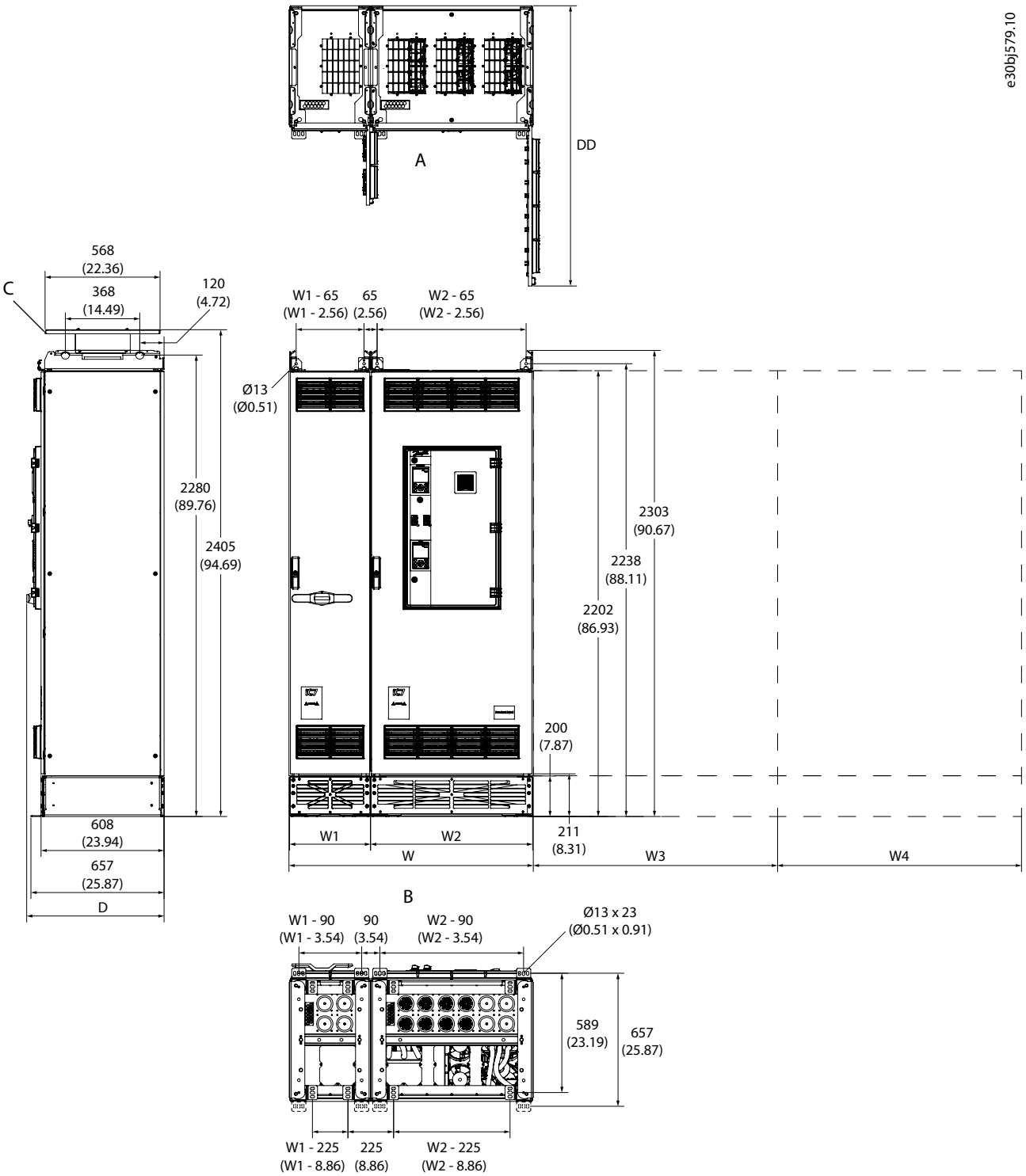


Illustration 49: Dimensions of the Enclosed Drive, AE10, AE11, IE10, and IE11, in mm (in)

A	View from the top	C	IP54 hood
B	View from the bottom		

Table 29: Dimensions in mm (in)

Product	D	DD	W	W1	W2	W3	W4
iC7-60EA3A05-385...590A	671 (26.4)	1385 (54.5)	800 (31.5)	800 (31.5)	–	–	–
iC7-60EA3A05-658...880A	679 (26.7)	1385 (54.5)	1200 (47.2)	400 (15.7)	800 (31.5)	–	–
iC7-60EA3A05-1000...1100	679 (26.7)	1185 (46.7)	2200 (86.6)	400 (15.7)	600 (23.6)	600 (23.6)	600 (23.6)
iC7-60EA3A05-1260...1710	671 (26.4)	1185 (46.7)	2400 (94.5)	600 (23.6)	600 (23.6)	600 (23.6)	600 (23.6)

10.2.4 Dimensions for Default Cooling, FE9

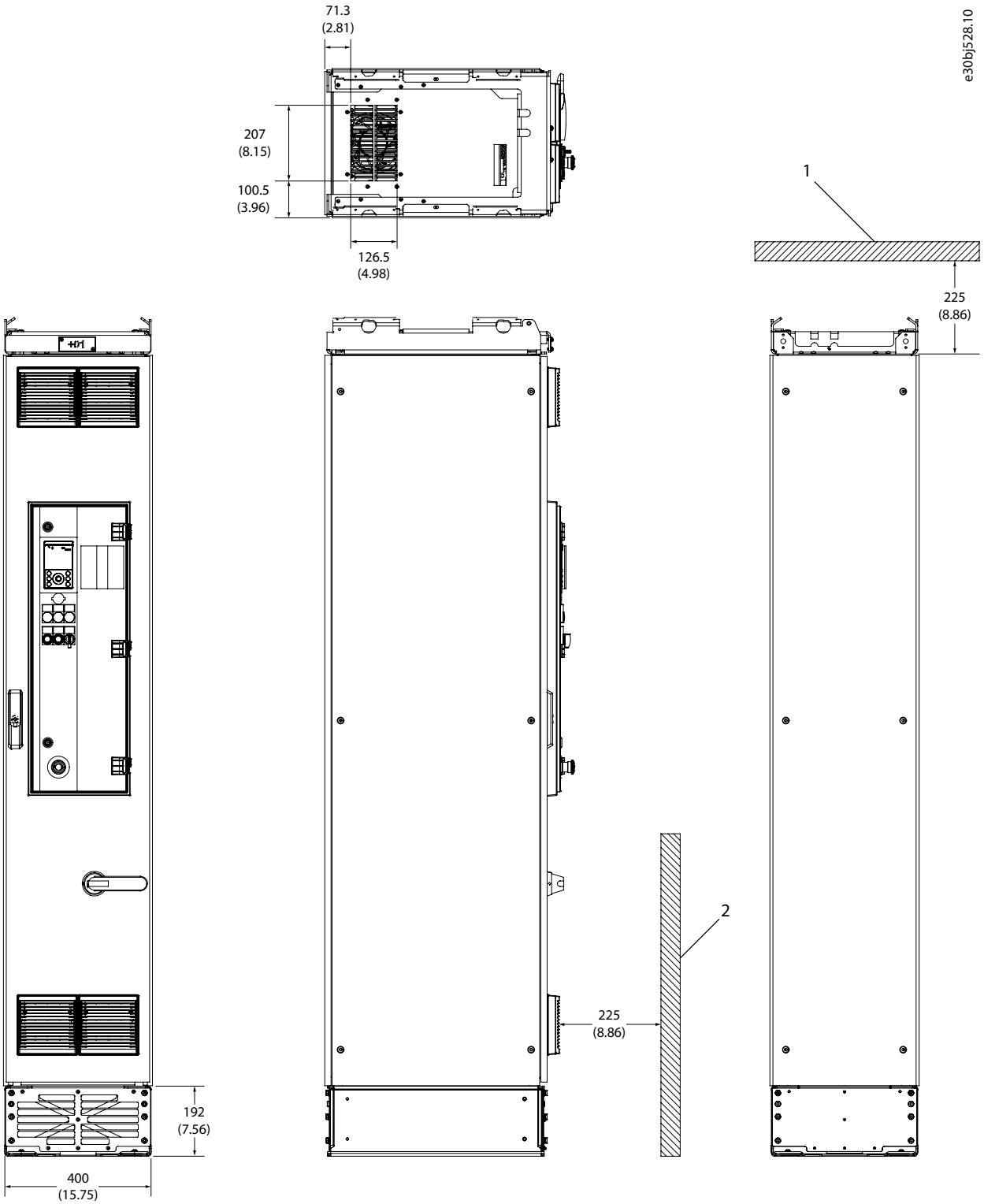


Illustration 50: Dimensions for Default Cooling, FE9, in mm (in)

1	Roof
2	Wall

10.2.5 Dimensions for Default Cooling, FE10

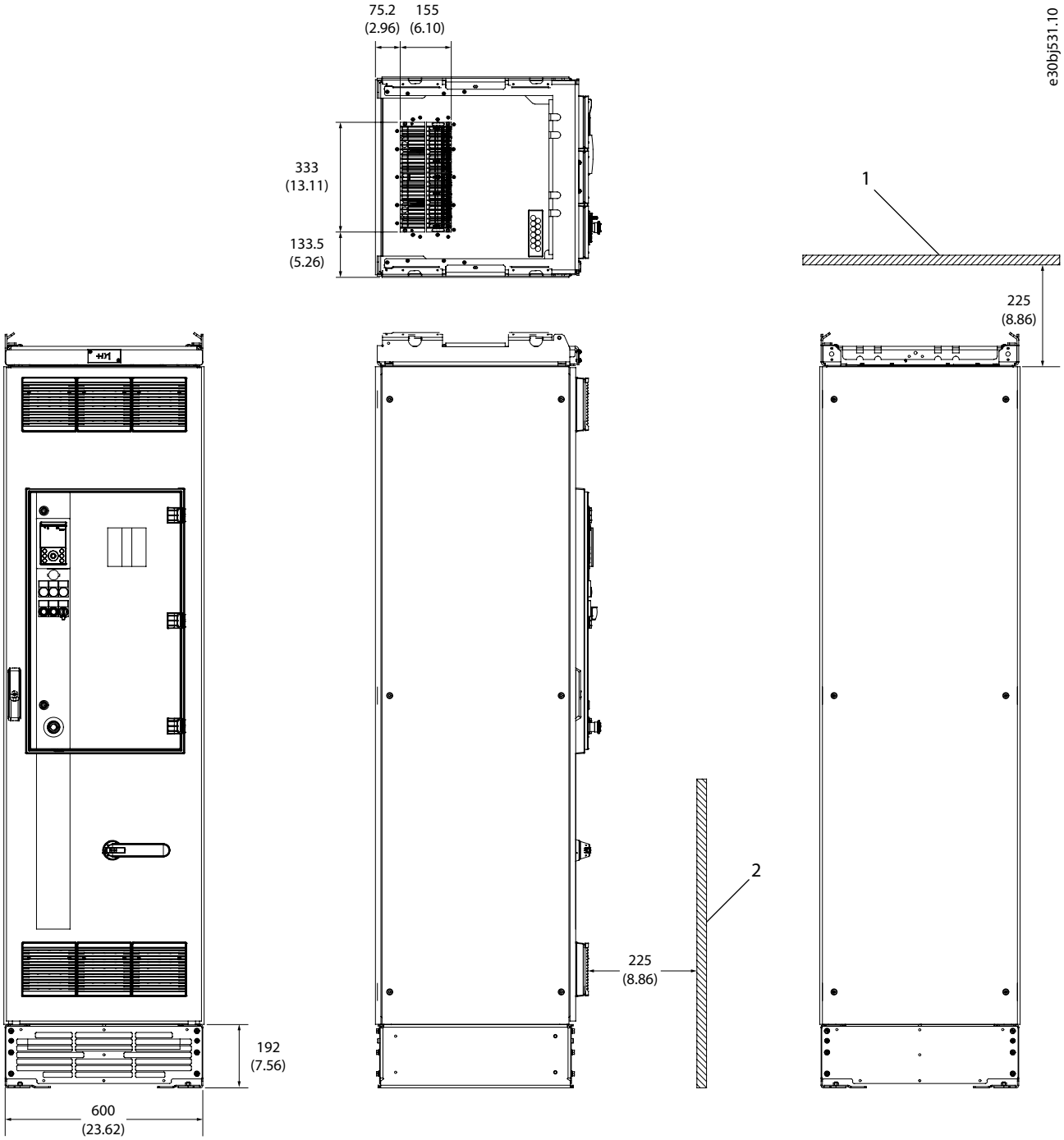


Illustration 51: Dimensions for Default Cooling, FE10, in mm (in)

1	Roof
2	Wall

10.2.6 Dimensions for Back-channel Cooling, FE9

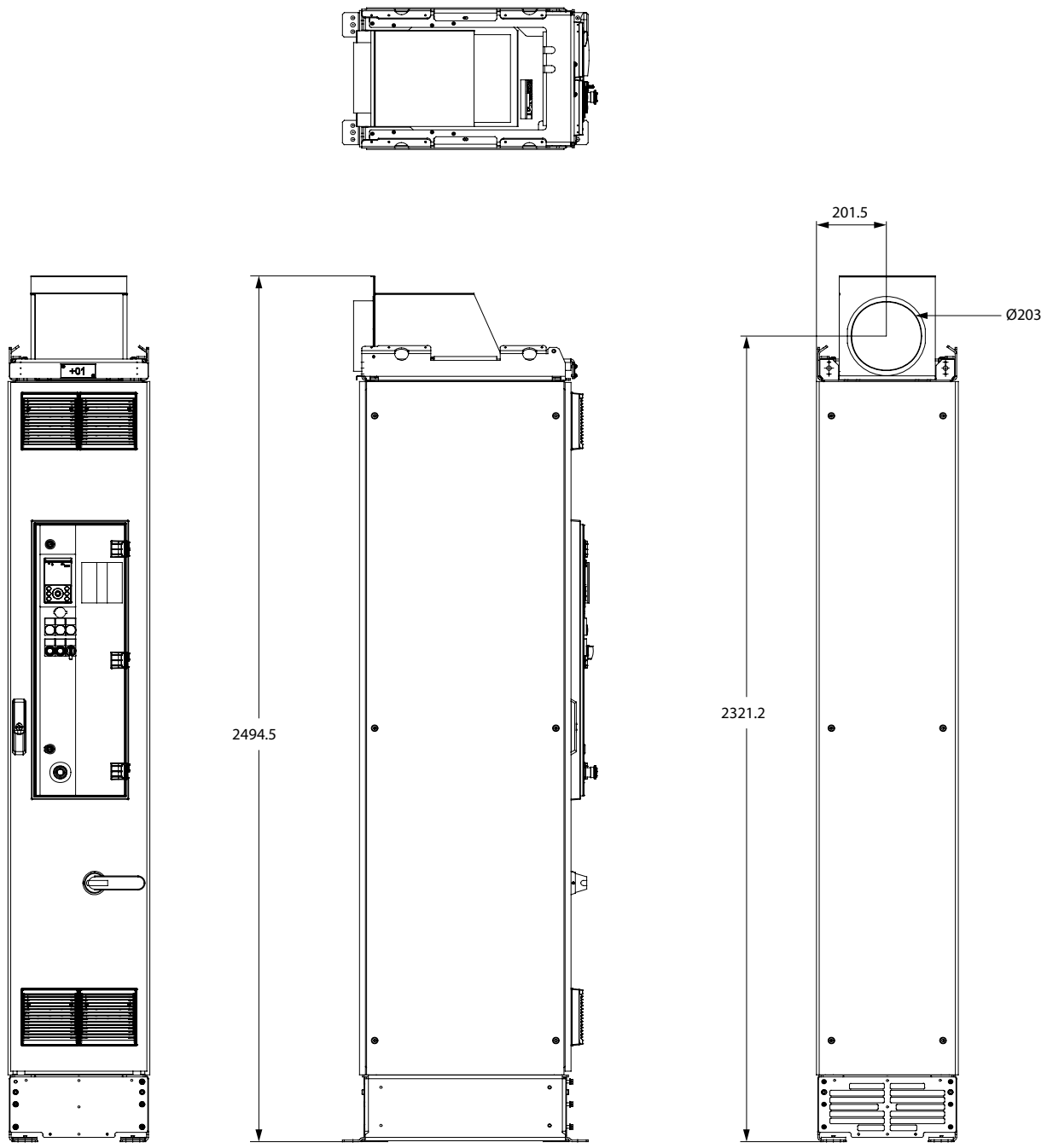


Illustration 52: Dimensions for Back-channel Cooling (+OABC), FE9, in mm (in)

10.2.7 Dimensions for Back-channel Cooling, FE10

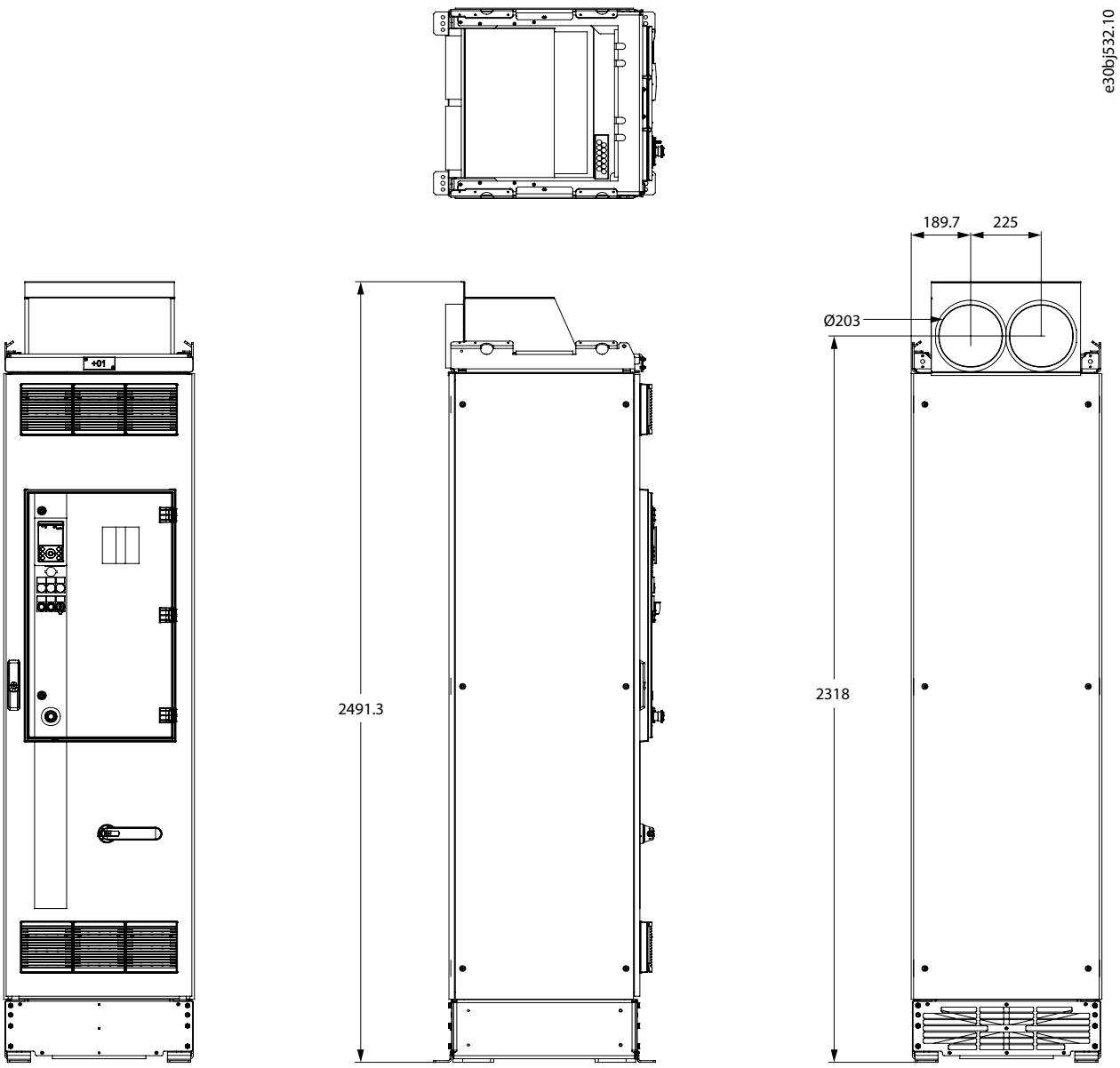


Illustration 53: Dimensions for Back-channel Cooling (+OABC), FE10, in mm (in)

10.2.8 Dimensions for Back-channel Cooling, AE10, AE11, IE10, IE11

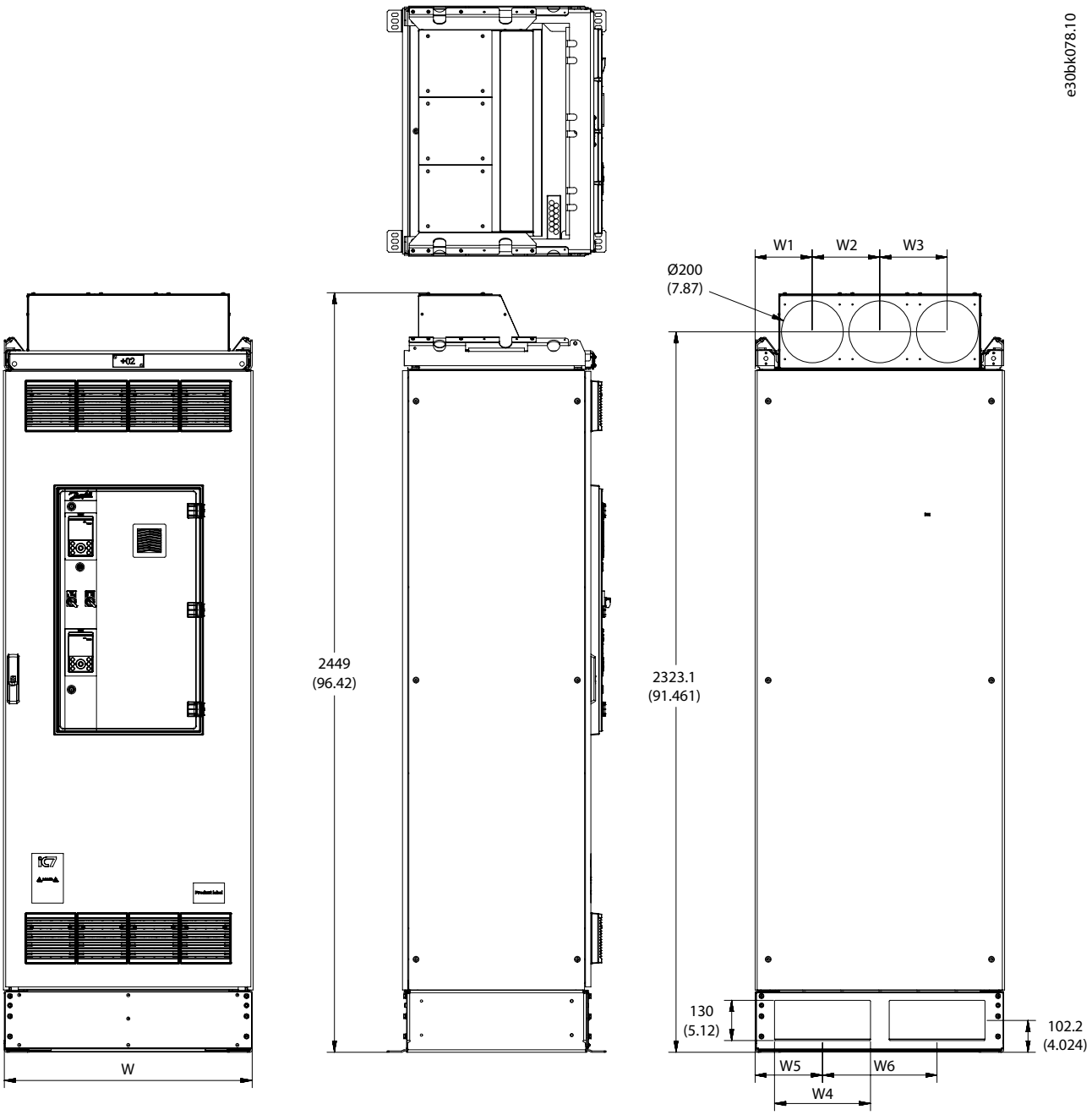


Illustration 54: Dimensions for Back-channel Cooling (+OABC), AE10, AE11, IE10, and IE11, in mm (in)

Table 30: Dimensions in mm (in)

W	W1	W2	W3	W4	W5	W6
400 (15.7)	203 (8.0)	–	–	280 (11.0)	203 (8.0)	–
600 (23.6)	190 (7.5)	225 (8.9)	–	220 (8.7)	173 (6.8)	260 (10.2)
800 (31.5)	185 (7.3)	218 (8.6)	218 (8.6)	310 (12.2)	218 (8.6)	370 (14.6)

10.2.9 Dimensions for the Cooling Air Output Flange Option, FE9

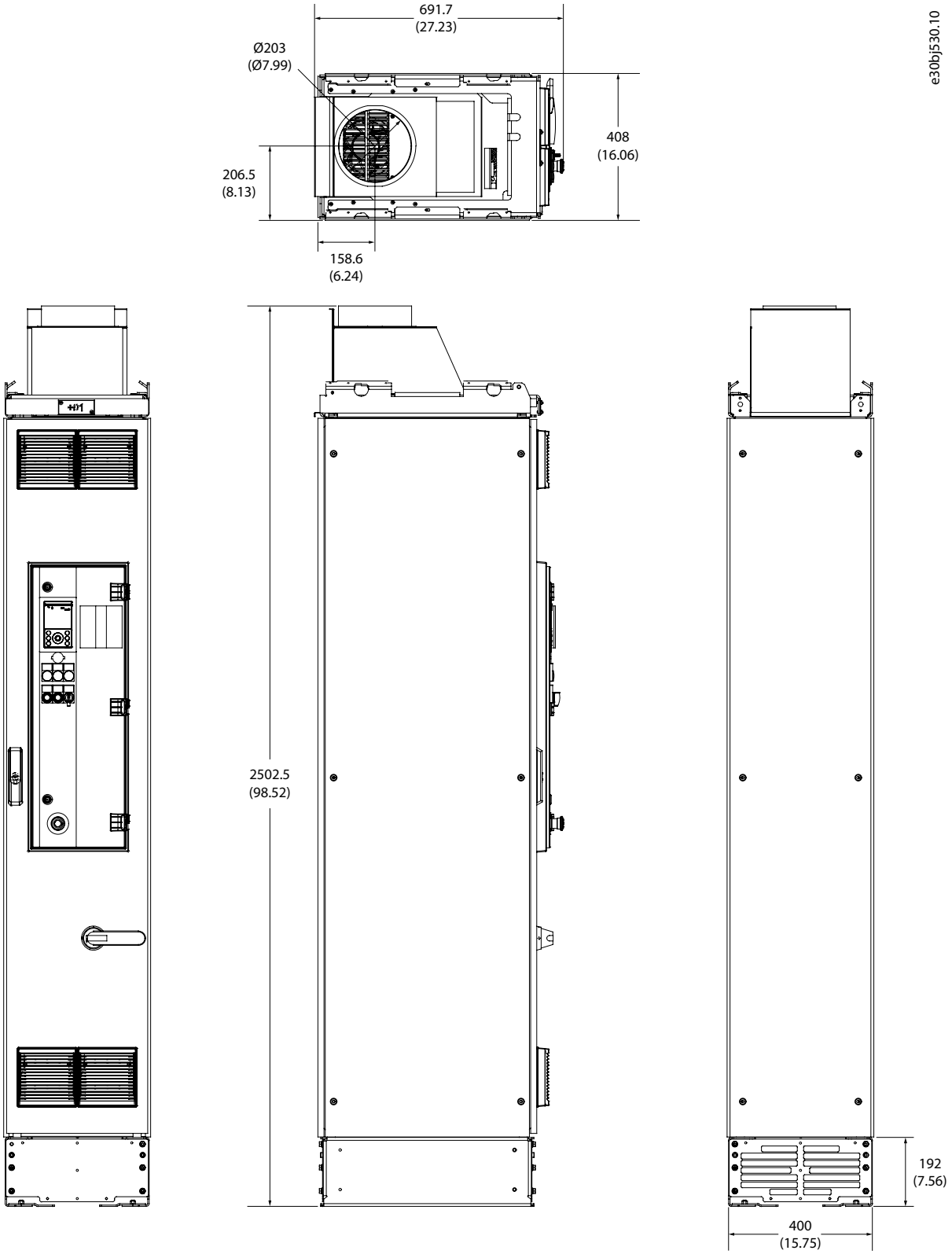


Illustration 55: Dimensions for the Cooling Air Output Flange (+OAOF), FE9, in mm (in)

10.2.10 Dimensions for the Cooling Air Output Flange Option, FE10

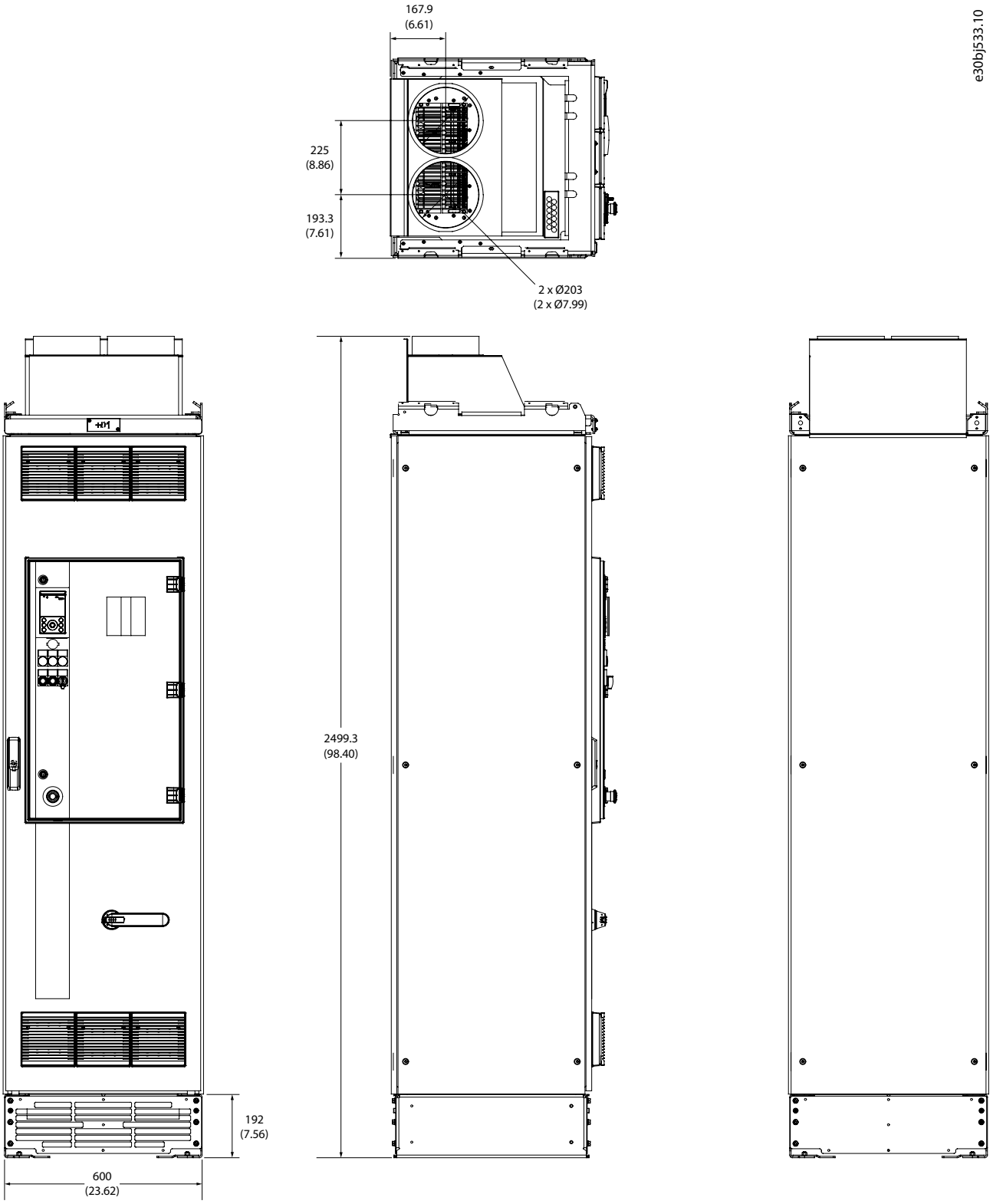


Illustration 56: Dimensions for the Cooling Air Output Flange (+OAOF), FE10, in mm (in)

10.2.11 Dimensions for the Cooling Air Output Flange Option, AE10, AE11, IE10, IE11

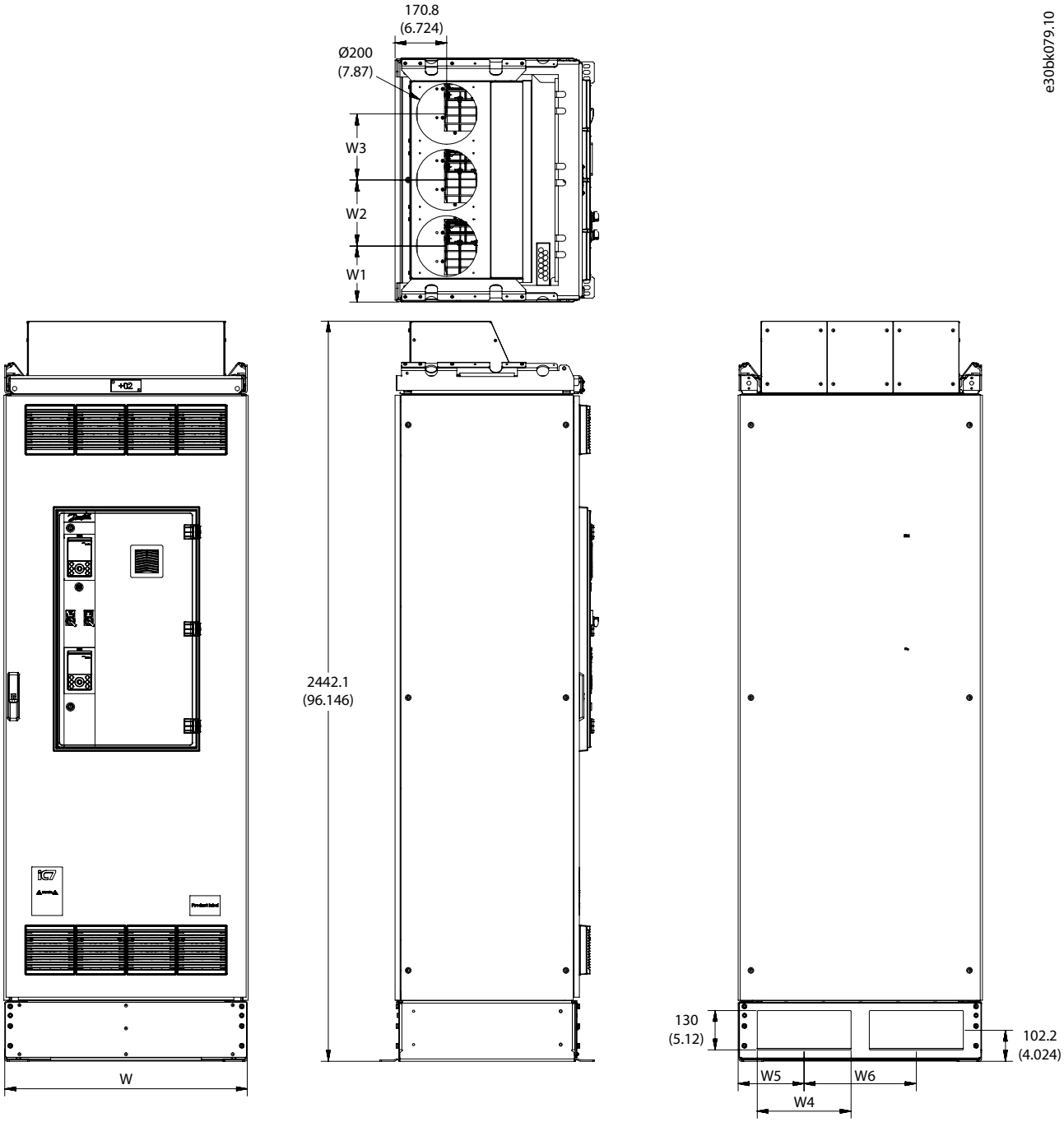


Illustration 57: Dimensions for the Cooling Air Output Flange Option (+OAOF), AE10, AE11, IE10, and IE11, in mm (in)

Table 31: Dimensions in mm (in)

W	W1	W2	W3	W4	W5	W6
400 (15.7)	203 (8.0)	–	–	280 (11.0)	203 (8.0)	–
600 (23.6)	190 (7.5)	225 (8.9)	–	220 (8.7)	173 (6.8)	260 (10.2)
800 (31.5)	185 (7.3)	218 (8.6)	218 (8.6)	310 (12.2)	218 (8.6)	370 (14.6)

10.3 Wiring Diagrams

10.3.1 Wiring Diagram, FE9, FE10

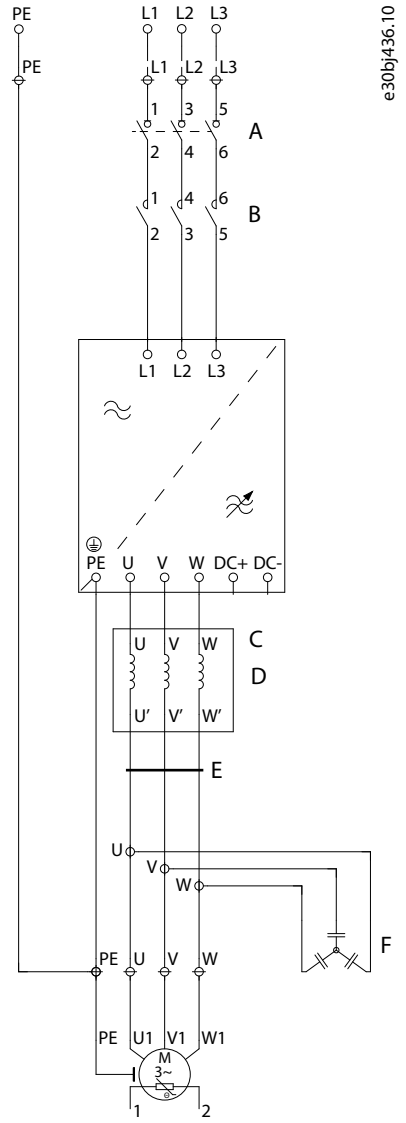


Illustration 58: Wiring Diagram, FE9, FE10

A	+GAMS	D	+MADU
B	+GACO	E	Common-mode Filter +MACM
C	dU/dt Filter choke	F	dU/dt Filter capacitor

10.3.2 Wiring Diagram, AE10+IE10, 385–588 A

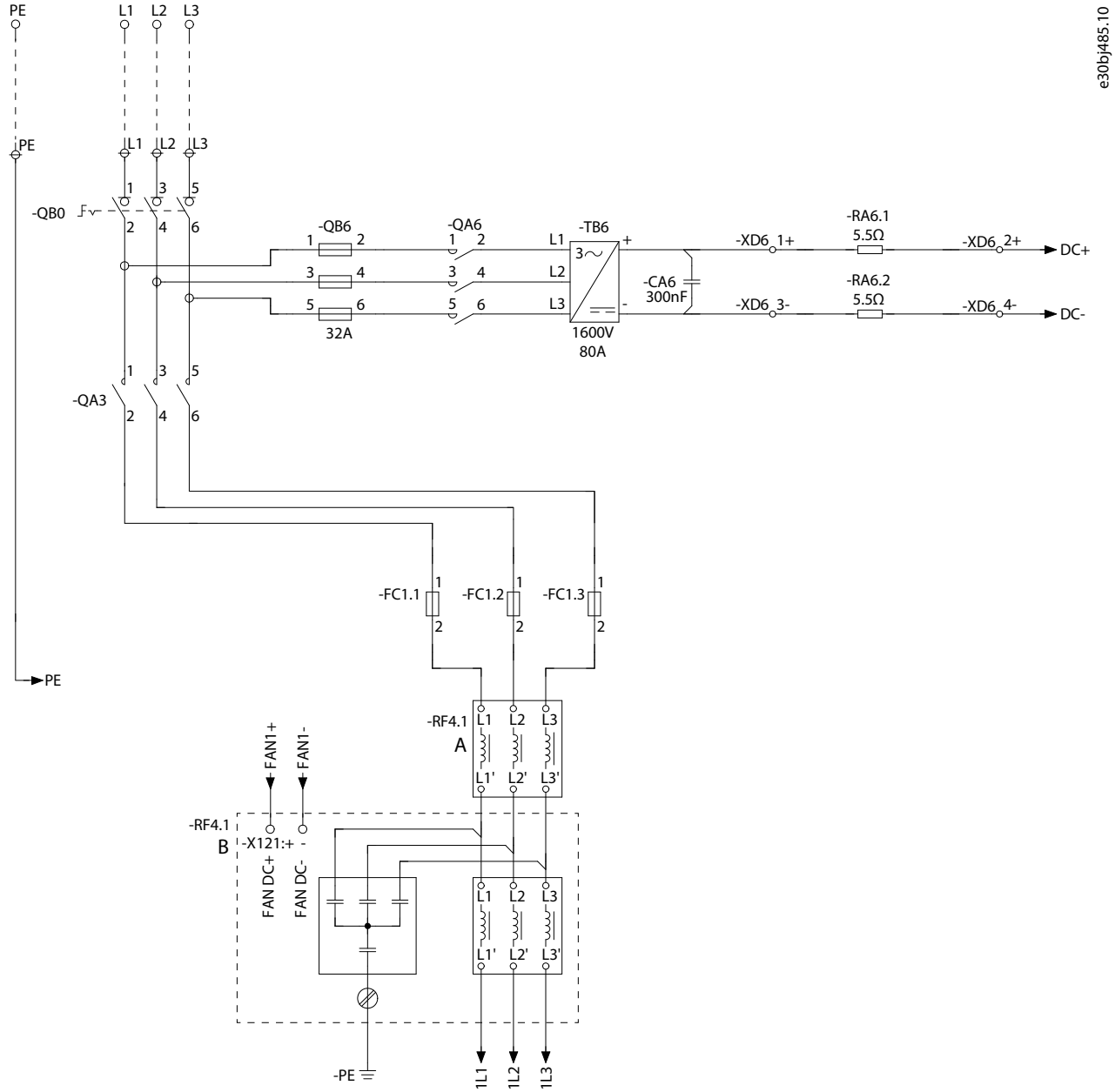


Illustration 59: Wiring Diagram, AE10+IE10, 385–588 A

A	L Filter
B	LC Filter

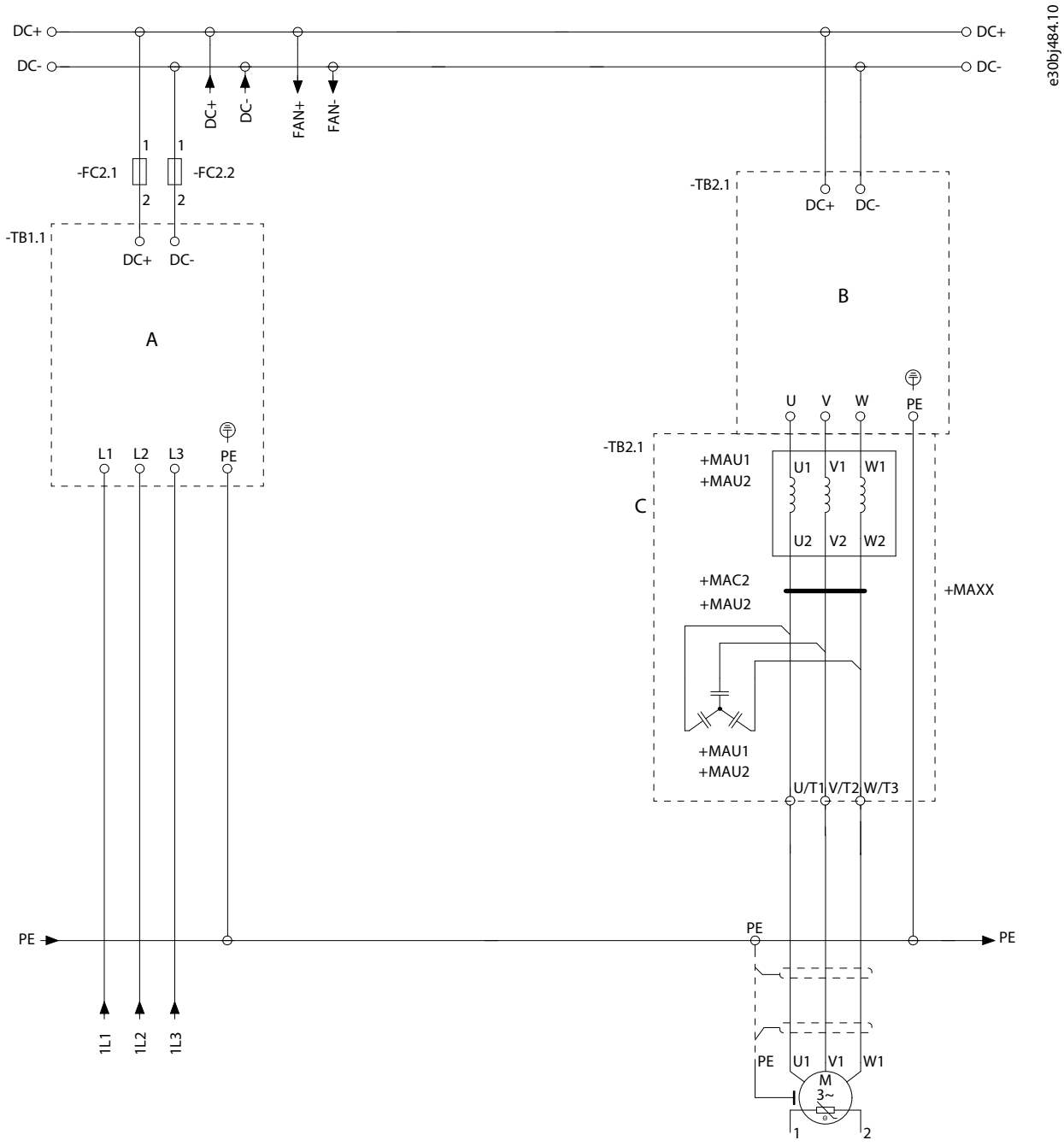


Illustration 60: Wiring Diagram, AE10+IE10, 385–588 A (continued)

A	Power unit of the AFE module	C	Integration unit
B	Power unit of the inverter module		

10.3.3 Wiring Diagram, AE11+IE11, 658–880 A

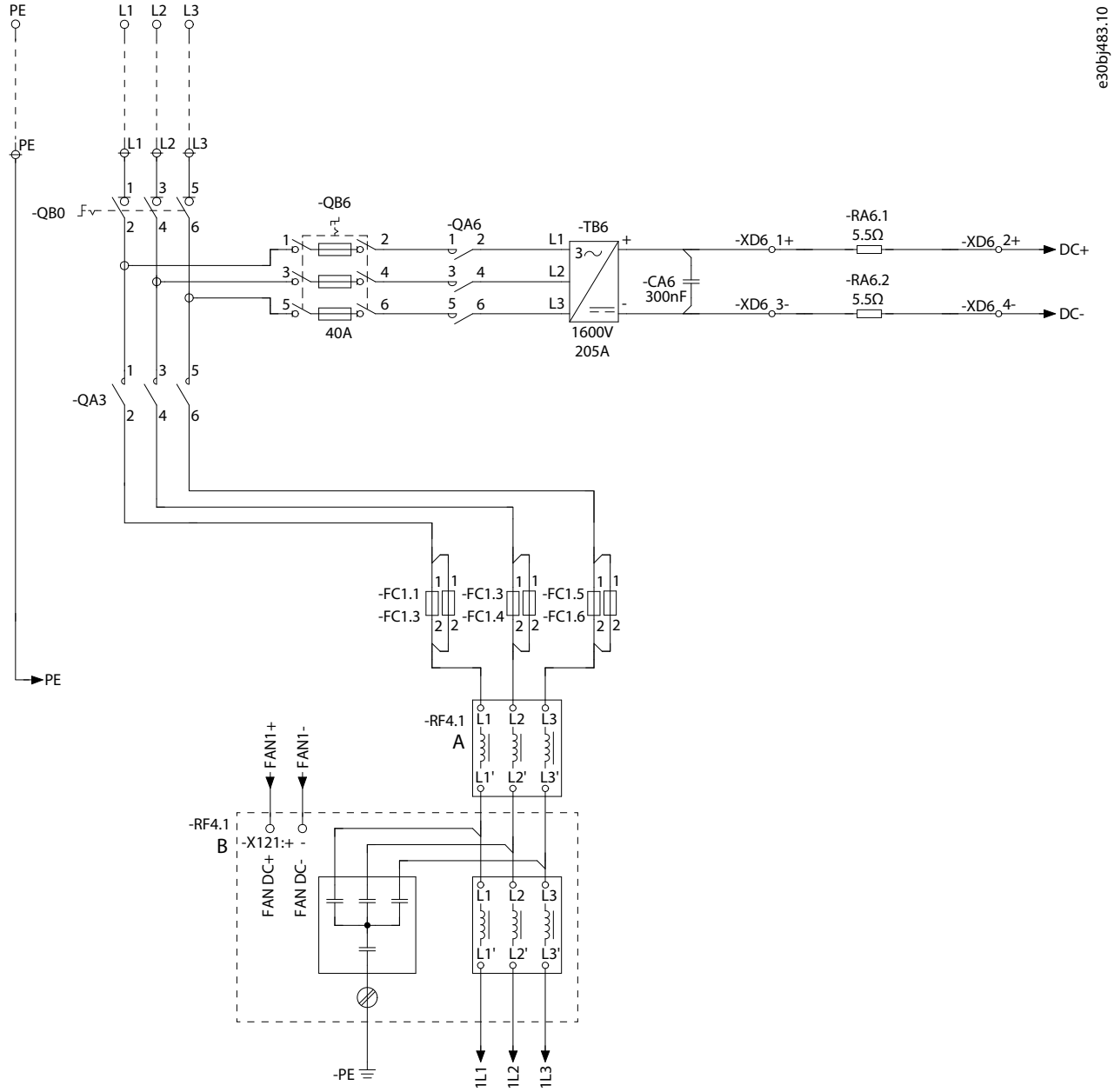


Illustration 61: Wiring Diagram, AE11+IE11, 658–880 A

A	L Filter
B	LC Filter

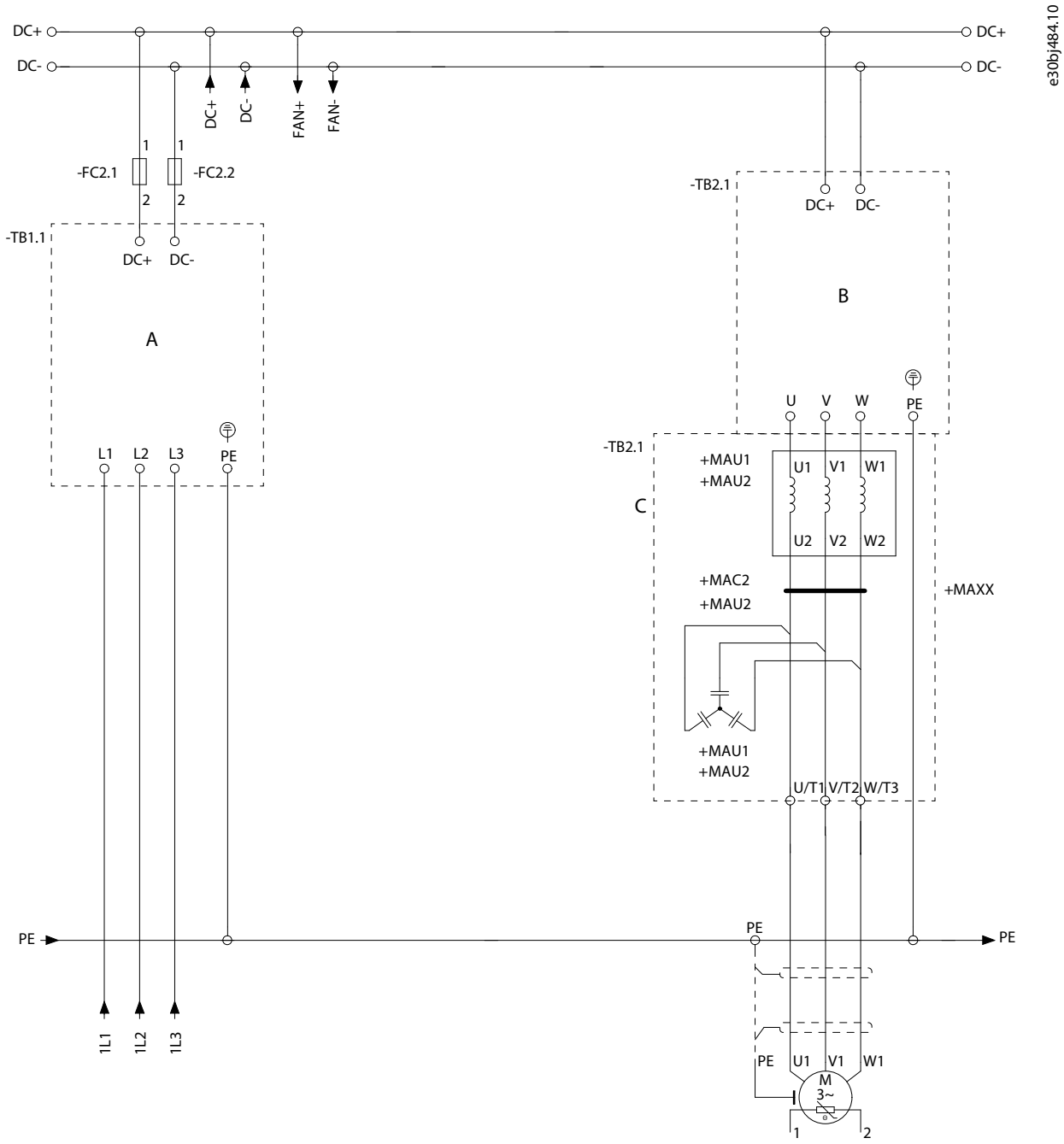


Illustration 62: Wiring Diagram, AE11+IE11, 658–880 A (continued)

A	Power unit of the AFE module	C	Integration unit
B	Power unit of the inverter module		

10.3.4 Wiring Diagram, 2 x AE10+2 x IE10, 1000–1100 A

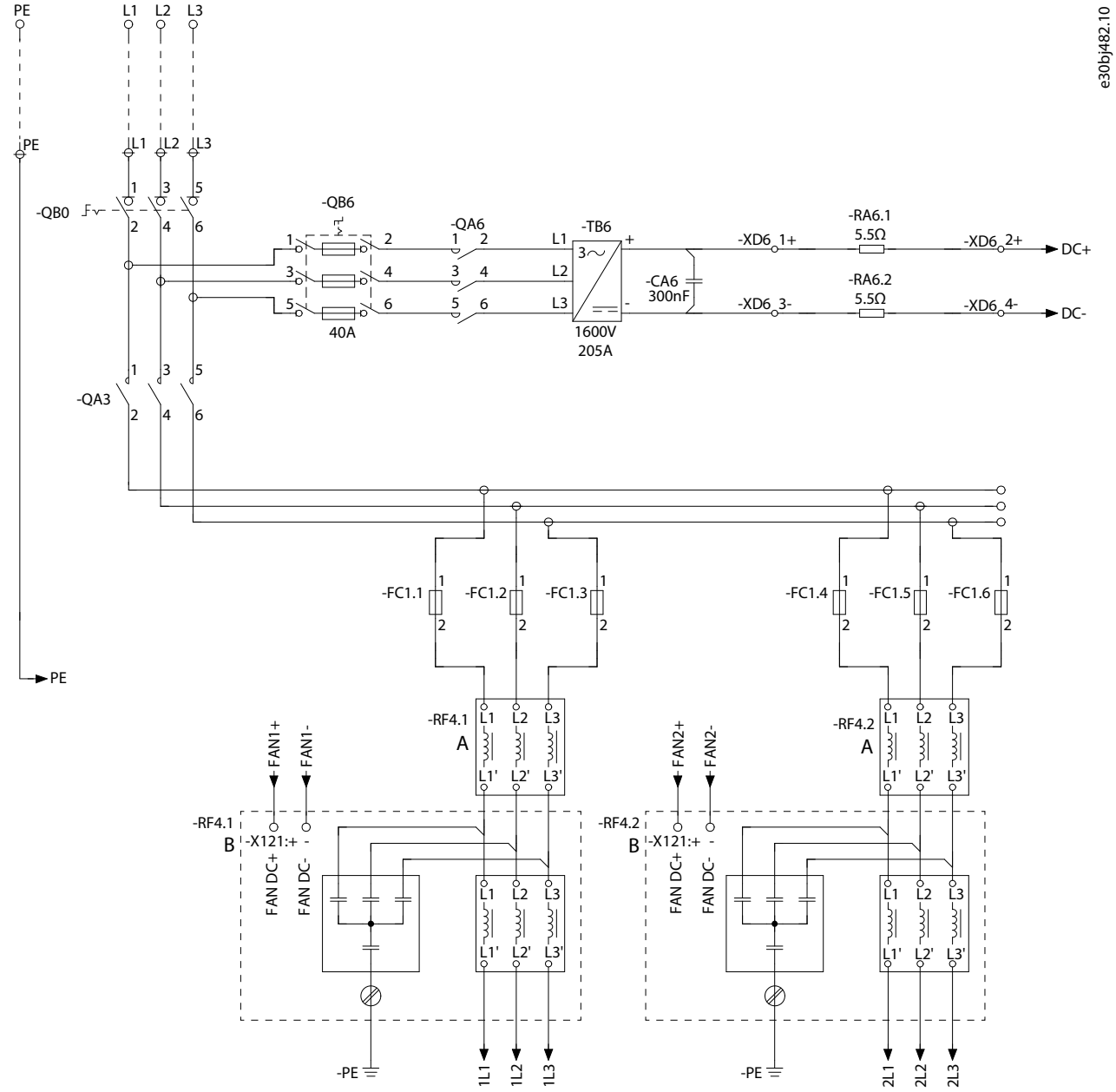


Illustration 63: Wiring Diagram, 2 x AE10+2 x IE10, 1000–1100 A

A	L Filter
B	LC Filter

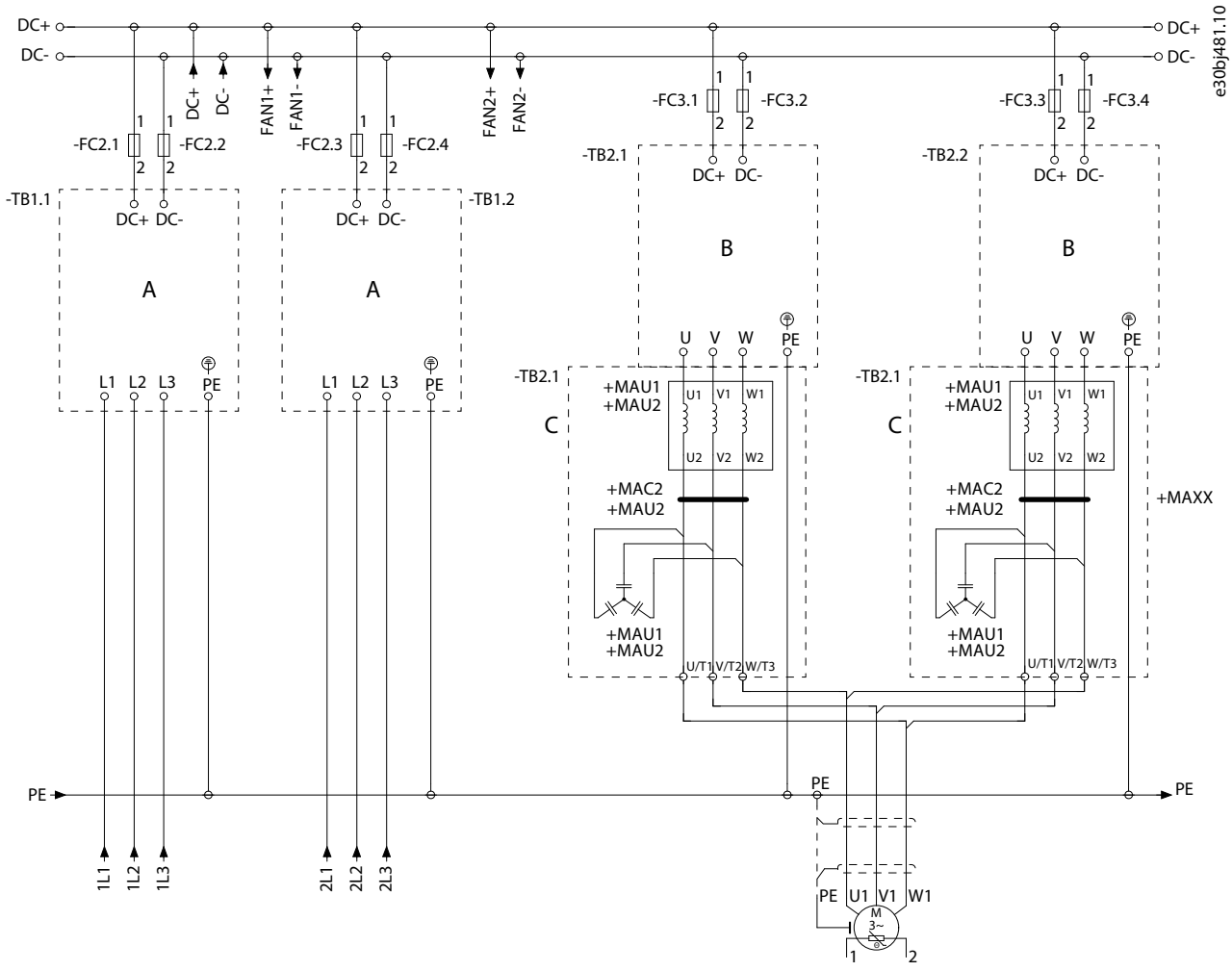


Illustration 64: Wiring Diagram, 2 x AE10+2 x IE10, 1000–1100 A (continued)

A	Power unit of the AFE module	C	Integration unit
B	Power unit of the inverter module		

10.3.5 Wiring Diagram, 2 x AE11+2 x IE11, 1260–1710 A

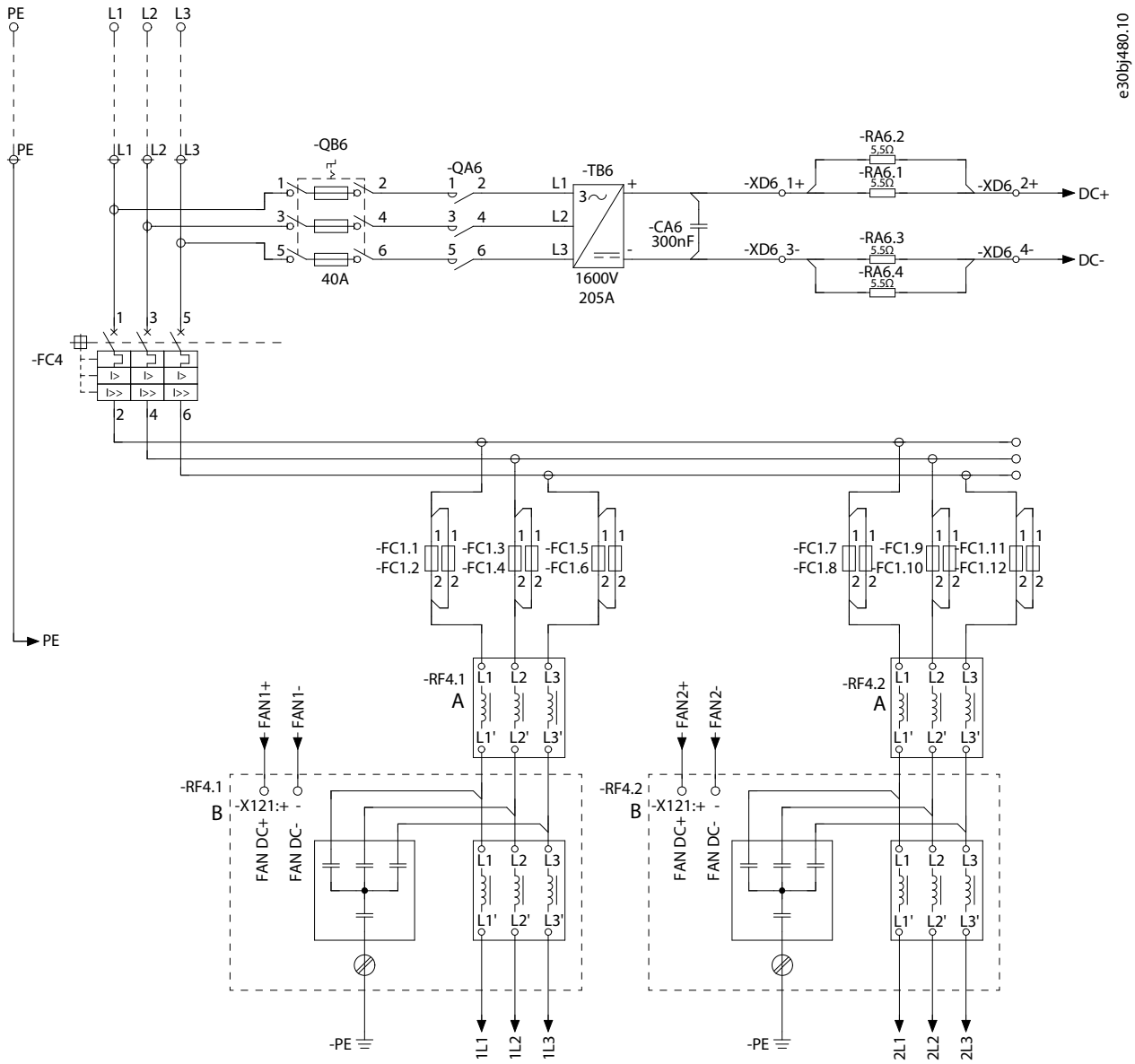


Illustration 65: Wiring Diagram, 2 x AE11+2 x IE11, 1260–1710 A

A	L Filter
B	LC Filter

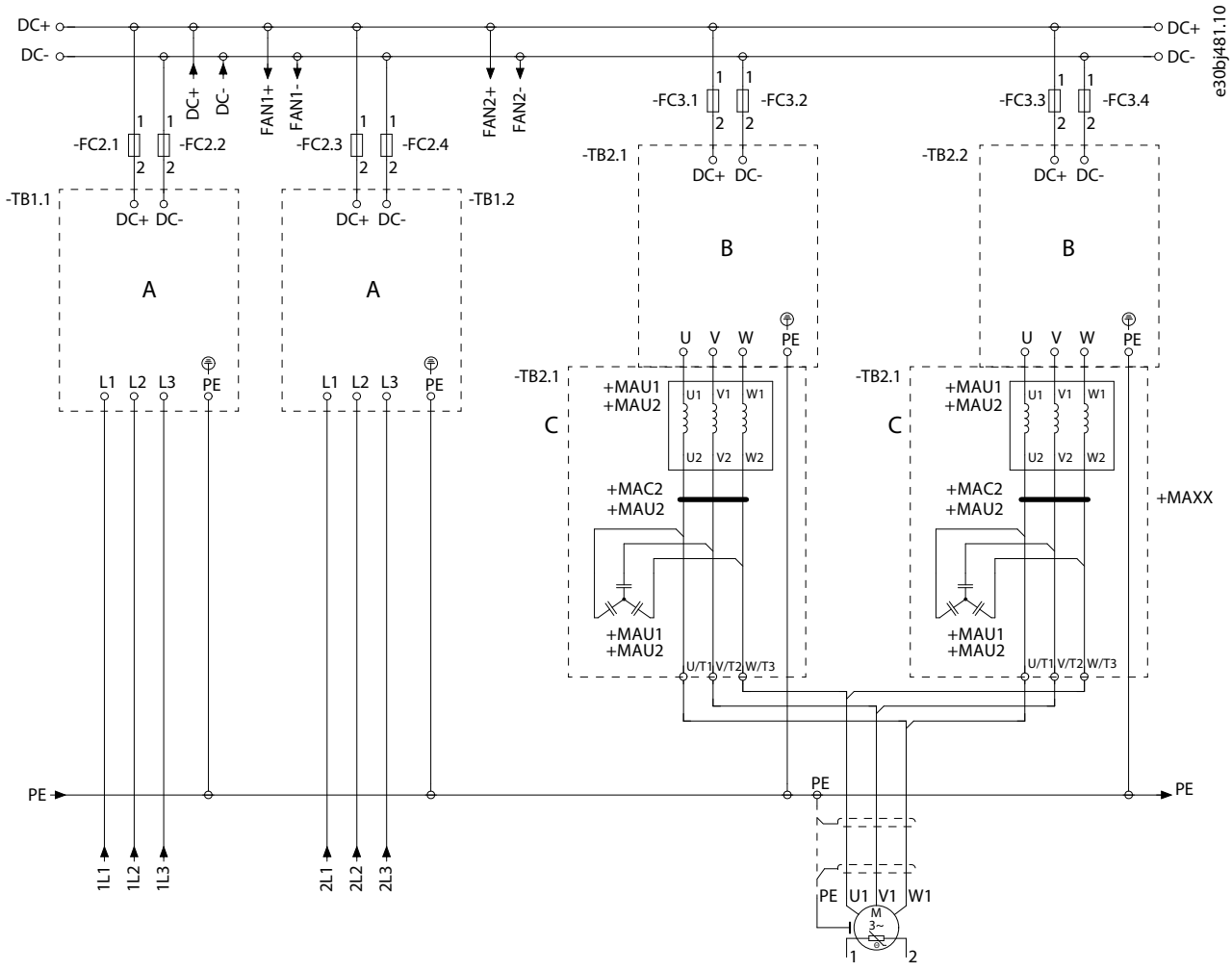


Illustration 66: Wiring Diagram, 2 x AE11+2 x IE11, 1260–1710 A (continued)

A	Power unit of the AFE module	C	Integration unit
B	Power unit of the inverter module		

10.3.6 Pre-charging Control Wiring Diagram, AE10, AE11, IE10, IE11

N O T I C E

The products with frame designations FE9 and FE10 do not have precharging control circuit.

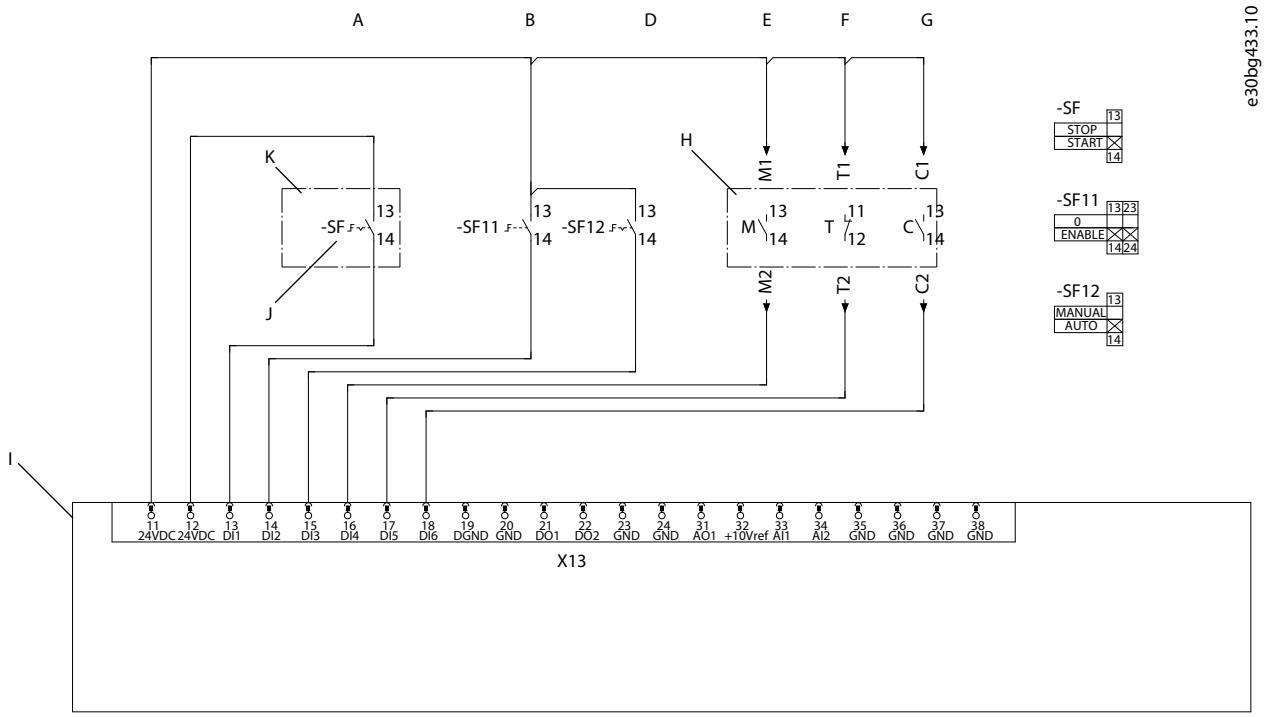


Illustration 67: Pre-charging Control Wiring Diagram, AE10, AE11, IE10, IE11

A	AFE remote control start/stop	G	Cooling supervision
B	Mains 0-enable	H	Status/supervision
D	Pre-charging man-auto	I	I/O and Relay Option
E	Main input device status	J	AFE start/stop
F	Main input device tripped (circuit breaker)	K	Field connection

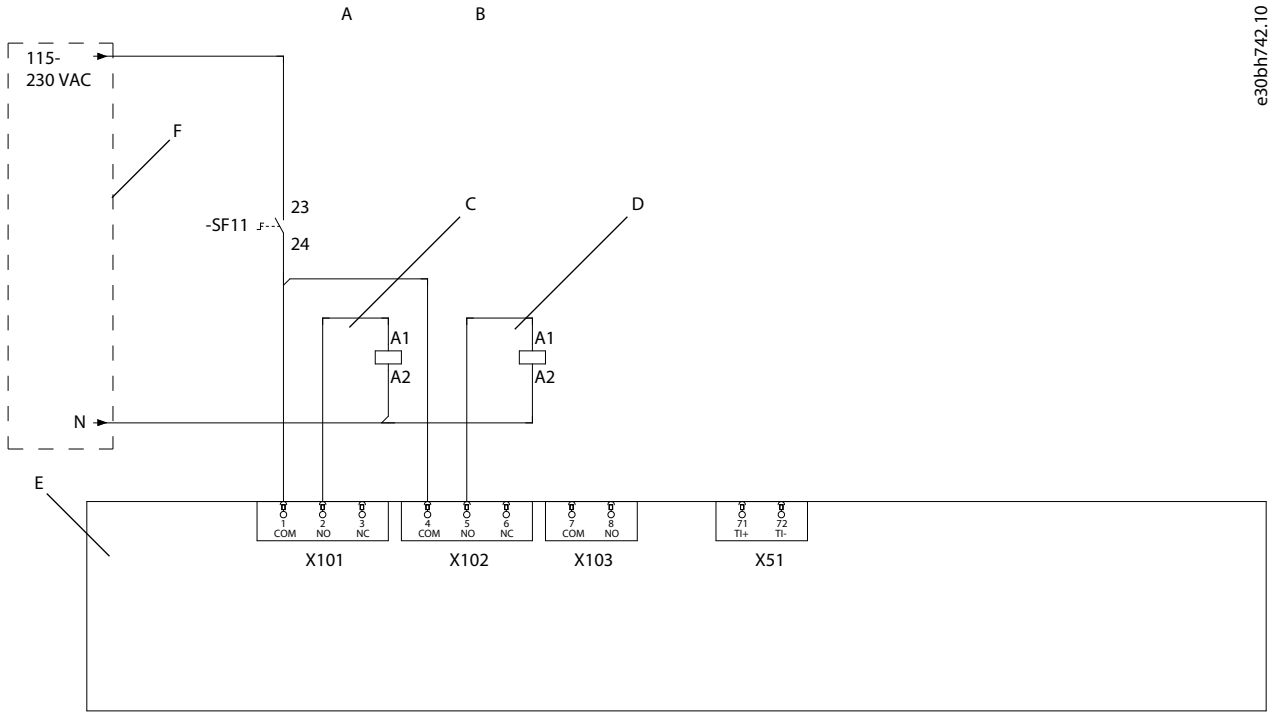


Illustration 68: Pre-charging Control Wiring Diagram, AE10, AE11, IE10, IE11

A	Pre-charging contactor control	D	-QA3, Mains contactor coil
B	Main input device control	E	I/O and Relay Option
C	-QA6, Pre-charging contactor coil	F	Short-circuit protected supply

10.3.7 The Pre-charging Function

The drive must be pre-charged before switching main power on to avoid high inrush current to drive capacitors.

The pre-charging function utilizes AFE control unit I/Os and relays. The pre-charging function requires auxiliary voltage for the control unit and the pre-charging circuit. Pre-charging can be operated either locally (manually or automatically) or remotely (manually). Pre-charging is enabled by activating Digital Input 2. Select the MANUAL or AUTO mode by activating/deactivating Digital Input 3 (activated = AUTO). Select remote operation by activating Digital Input 1. Connect the input device, the contactor, or the circuit breaker, the auxiliary contacts to the control unit as described in 10.3.6 Pre-charging Control Wiring Diagram, AE10, AE11, IE10, IE11. Connect also the cooling supervision signal from the cooling module if possible. The charging circuit is protected by fuses installed in the fuse-switch disconnector. Turn the switch ON.

Manual operation

Enable pre-charging and switch it to MANUAL mode. Pre-charging starts by pressing the Run button on the control panel of the AFE module. The pre-charging contactor closes. When charging is done, the main input device closes and the pre-charging contactor opens. Charging must be performed again after power outage.

Auto operation

Enable pre-charging and switch it to AUTO mode. Pre-charging starts immediately. The pre-charging contactor closes. When charging is done, the main input device closes and the pre-charging contactor opens. Charging is performed automatically after power outage.

Remote operation

Enable pre-charging and set it to MANUAL mode. Pre-charging starts by activating Digital Input 1. The AFE module starts and the pre-charging contactor closes. When charging is done, the main input device closes and the pre-charging contactor opens. Charging must be performed again after power outage.

10.4 Options

Table 32: Options for the Enclosed Drives

Option group	Plus code	Description
Input options	+GACO	Mains contactor
	+GAMS	Main switch
	+GACB	Air circuit breaker fixed
Grounding device	+GCEP	Provision for grounding device
Motor heater control	+IAMH	Motor heater control
Cabinet heater	+IBCH	Cabinet heater
Motor fan control	+ICFC	Motor fan control
	+ICF1	Motor fan ctrl/supply 2.5–4 A
	+ICF2	Motor fan ctrl/supply 4–6.3 A
	+ICF3	Motor fan ctrl/supply 6.3–10 A
	+ICF4	Motor fan ctrl/supply 10–16 A
Motor brake control	+IDBC	Motor brake control
24 V DC power supply	+IFCS	24 V DC power supply
Service socket	+IGS0	230 V AC socket CEE 7/3

Option group	Plus code	Description
Cabinet options power supply	+IHAT	Aux AC voltage transformer
	+IHAS	Aux AC supply terminals
Door signal lights	+IICD	Run, ready, fault
Emergency stop	+ILSS	STO/SS1 push button on door
Mains cabling direction	+KCIB	Mains cabling from bottom
	+KCIT	Mains cabling from top
Motor cabling direction	+KDOB	Motor cabling from bottom
	+KDOT	Motor cabling from top
Cable entry plate	+KFCP	Plate with no holes
Output filter	+MAC2	Common-mode Filter
	+MAU1	dU/dt Filter
	+MAU2	dU/dt Filter w/ CM filter
Cooling options	+OABC	Back-channel cooling
	+OAOF	Cooling air output flange
Power unit lifting	+QALS	Lifting support for power unit
Marine Construction	+AFMC	Marine Construction

10.4.1 STO/SS1 Push Button on Door (+ILSS)

The STO inputs are wired to the (-SFG) emergency stop push button on the control compartment door. External emergency stop push buttons can be connected to the same circuit. Remove the saddle jumpers XDJ:3-XDJ:5 and XDJ:4-XDJ:6 and connect the external emergency stop push button to these terminals according to the circuit diagram.

If option +ILSS is not selected, inputs A+ and B+ are connected to 24 VDC on -XD2.2 terminal block with saddle jumpers. Without option +ILSS or an external emergency stop push button, the STO inputs can be used for the STO safety function. See details in the iC7 Series Functional Safety Operating Guide.

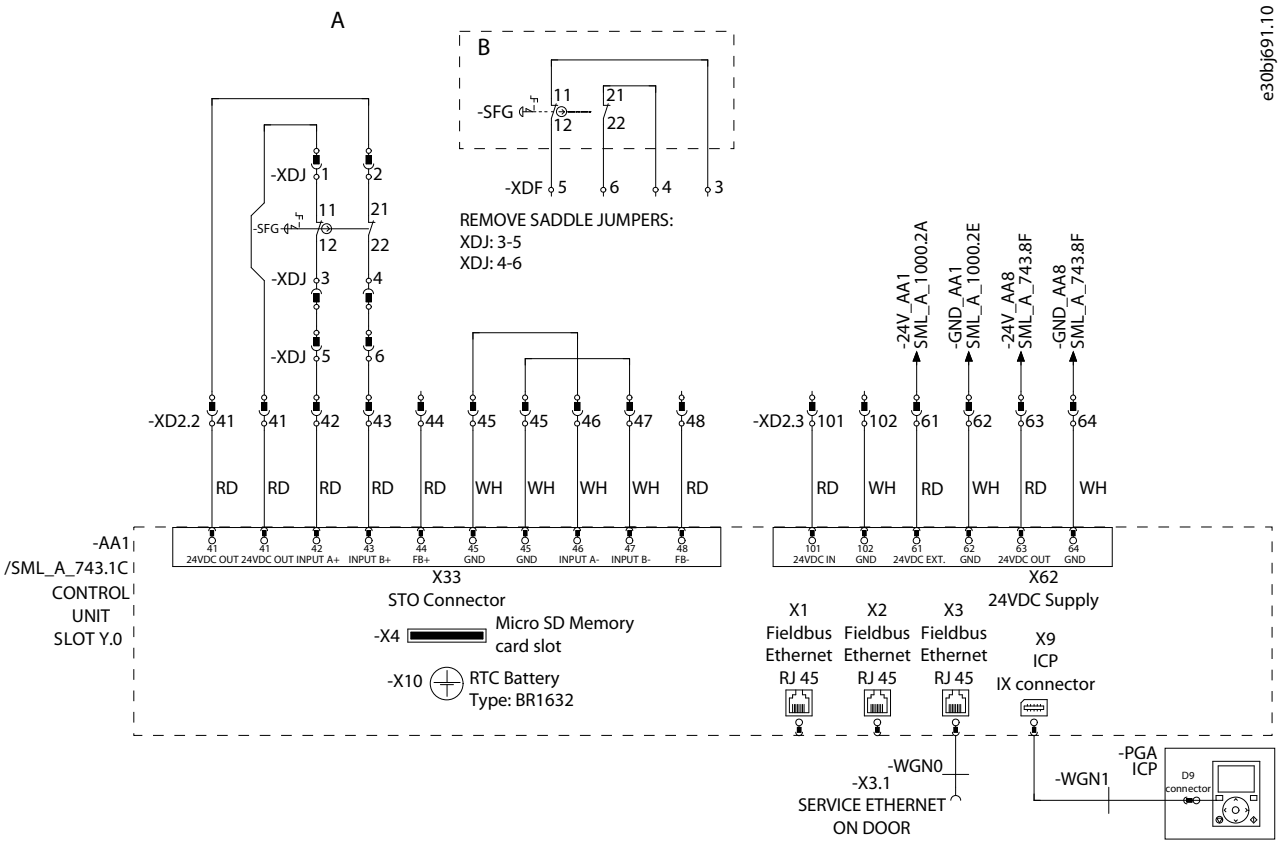


Illustration 69: Circuit Diagram of STO/SS1 Push Button on Door (+ILSS)

A	Emergency stop
B	Field connection

10.5 Cable Sizes

10.5.1 General Cable Size Information

The IEC cable sizing is based on the ambient temperature of 40 °C, cables laid side by side on cable ladders, maximum 9 cables per ladder, and 3 ladders on top of each other. Use cable insulation that can withstand a temperature of at least 90 °C. Cables are XLPE insulated, maximum conductor temperature 90 °C. In other conditions, refer to the local safety regulations, the input voltage, and the load current of the drive.

The UL cable sizing is based on the ambient temperature of 40 °C (104 °F), 75 °C (167 °F) or 90 °C (194 °F) rated copper cables, and multicore cables installed raceways or not stacked or bundled longer than 600 mm (24 in) without maintaining spacing. In other conditions, refer to the local safety regulations, the input voltage, and the load current of the drive.

N O T I C E

Use symmetrical cabling with system modules connected in parallel. Each module must have the same number of cables with an equal cross-section.

The cable size tables for the air-cooled enclosed drives can be found with these links.

- 10.5.2 Mains Cable Size Recommendation, 380–500 V
- 10.5.3 Motor Cable Size Recommendation, 380–500 V
- 10.5.4 Mains Cable Size Recommendation, UL 480 V
- 10.5.5 Motor Cable Size Recommendation, UL 480 V

10.5.2 Mains Cable Size Recommendation, 380–500 V

Table 33: Mains Cable Size Recommendation, 380–500 V

Model code	Frame	I_N [A]	Cable [mm²]	Maximum cable size [mm²]	Maximum number of mains cables(1)	Hole size of the mains terminal [mm]	Number of grounding holes on PE busbar	Hole size of the grounding terminal [mm]
iC7-60EA3N05-206A	FE9(2)	198	Cu 2 x (3x95+50) Al 2 x (3x95+29 Cu)	95 Cu/Al	2	Ø10.5	2	Ø10.5
iC7-60EA3N05-245A		236	Cu 2 x (3x95+50) Al 2 x (3x95+29 Cu)	95 Cu/Al	2	Ø10.5	2	Ø10.5
iC7-60EA3N05-302A		291	Cu 2 x (3x95+50) Al 2 x (3x95+29 Cu)	95 Cu/Al	2	Ø10.5	2	Ø10.5
iC7-60EA3N05-385A		371	Cu 2 x (3x95+50) Al 2x(3x95+29 Cu)	95 Cu/Al	2	Ø10.5	2	Ø10.5
iC7-60EA3N05-480A	FE10(2)	462	Cu 2 x (3x150+70) Al 3 x (3x120+41 Cu)	150 Cu/120 Al	3	Ø13.5	4	Ø10.5
iC7-60EA3N05-588A		566	Cu 2 x (3x150+70) Al 3 x (3x120+41 Cu)	150 Cu/120 Al	3	Ø13.5	4	Ø10.5
iC7-60EA3A05-385A	AE10 + IE10(3)	325	Cu 1 x (3x150+70) Al 2 x (3x95+29 Cu)	240 Cu/Al	2	Ø13.5	4	Ø10.5
iC7-60EA3A05-480A		403	Cu 2 x (3x95+ 50) Al 2 x (3x120+41 Cu)	240 Cu/Al	2	Ø13.5	4	Ø10.5
iC7-60EA3A05-588A		508	Cu 2 x (3x120+70) Al 2 x (3x150+41 Cu)	240 Cu/Al	2	Ø13.5	4	Ø10.5
iC7-60EA3A05-658A	AE11 + IE11	571	Cu 2 x (3x150+70) Al 3 x (3x120+41 Cu)	240 Cu/Al	4	Ø10.5	5	Ø10.5
iC7-60EA3A05-730A		647	Cu 3 x (3x120+70) Al 3 x (3x150+70 Cu)	240 Cu/Al	4	Ø10.5	5	Ø10.5
iC7-60EA3A05-820A		728	Cu 3 x (3x120+70) Al 4 x (3x120+41 Cu)	240 Cu/Al	4	Ø10.5	5	Ø10.5
iC7-60EA3A05-880A		809	Cu 3 x (3x150+70) Al 4 x (3x120+41 Cu)	240 Cu/Al	4	Ø10.5	5	Ø10.5
iC7-60EA3A05-1000	2 x AE10 + 2 x IE10	905	Cu 4 x (3x120+70) Al 4 x (3x150+70 Cu)	240 Cu/Al	4	Ø10.5	5	Ø10.5
iC7-60EA3A05-1100		1018	Cu 4 x (3x150+70) Al 4 x (3x185+57 Cu)	240 Cu/Al	4	Ø10.5	5	Ø10.5

Model code	Frame	I_N [A]	Cable [mm²]	Maximum cable size [mm²]	Maximum number of mains cables(1)	Hole size of the mains terminal [mm]	Number of grounding holes on PE busbar	Hole size of the grounding terminal [mm]
iC7-60EA3A05-1260	2 x AE11 + 2 x IE11	1148	Cu 6 x (3x95+50) Al 6 x (3x120+41 Cu)	240 Cu/Al	8	Ø10.5	8	Ø10.5
iC7-60EA3A05-1450		1293	Cu 6 x (3x120+70) Al 6 x (3x150+70 Cu)	240 Cu/Al	8	Ø10.5	8	Ø10.5
iC7-60EA3A05-1710		1453	Cu 6 x (3x150+70) Al 6 x (3x185+57 Cu)	240 Cu/Al	8	Ø10.5	8	Ø10.5

[1] Cable lugs installed on both sides of the fixing hole

[2] With copper cables, use copper lugs. With aluminum cables, use bimetallic lugs.

[3] Use bimetallic lugs. No direct aluminum contact to the mains terminals.

10.5.3 Motor Cable Size Recommendation, 380–500 V

Table 34: Motor Cable Size Recommendation, 380–500 V

Model code	Frame	I_N [A]	Cable [mm²]	Maximum cable size [mm²](1)	Maximum number of motor cables	Bolt size	Number of grounding holes on PE busbar	Hole size of the grounding terminal [mm]
iC7-60EA3N05-206A	FE9	206	Cu 2 x (3x95+50) Al 2 x (3x95+29 Cu)	95 Cu/Al	2	M10	2	Ø10.5
iC7-60EA3N05-245A		245	Cu 2 x (3x95+50) Al 2 x (3x95+29 Cu)	95 Cu/Al	2	M10	2	Ø10.5
iC7-60EA3N05-302A		302	Cu 2 x (3x95+50) Al 2 x (3x95+29 Cu)	95 Cu/Al	2	M10	2	Ø10.5
iC7-60EA3N05-385A		385	Cu 2 x (3x95+50) Al 2 x (3x95+29 Cu)	95 Cu/Al	2	M10	2	Ø10.5
iC7-60EA3N05-480A	FE10	480	Cu 2 x (3x150+70) Al 3 x (3x120+41 Cu)	150 Cu/120 Al	3	M10	4	Ø10.5
iC7-60EA3N05-588A		588	Cu 2 x (3x150+70) Al 3 x (3x120+41 Cu)	150 Cu/120 Al	3	M10	4	Ø10.5
iC7-60EA3A05-385A	AE10 + IE10	394	Cu 1 x (3x185+95) Al 2 x (3x120+41 Cu)	240 Cu/Al	4	M10	4	Ø10.5
iC7-60EA3A05-480A		490	Cu 2 x (3x120+70) Al 2 x (3x150+70 Cu)	240 Cu/Al	4	M10	4	Ø10.5

Model code	Frame	I_N [A]	Cable [mm^2]	Maximum cable size [mm^2][(1)]	Maximum number of motor cables	Bolt size	Number of grounding holes on PE busbar	Hole size of the grounding terminal [mm]
iC7-60EA3A05-588A		601	Cu 2 x (3x150+70) Al 2 x (3x185+57 Cu)	240 Cu/Al	4	M10	4	Ø10.5
iC7-60EA3A05-658A	AE11 + IE11	672	Cu 2 x (3x185+95) Al 3 x (3x150+70 Cu)	240 Cu/Al	4	M10	4	Ø10.5
iC7-60EA3A05-730A		746	Cu 3 x (3x150+70) Al 4 x (3x120+41 Cu)	240 Cu/Al	4	M10	4	Ø10.5
iC7-60EA3A05-820A		838	Cu 3 x (3x150+70) Al 4 x (3x150+70 Cu)	240 Cu/Al	4	M10	4	Ø10.5
iC7-60EA3A05-880A		899	Cu 4 x (3x120+70) Al 4 x (3x150+70 Cu)	240 Cu/Al	4	M10	4	Ø10.5
iC7-60EA3A05-1000	2 x AE10 + 2 x IE10	1021	Cu 4 x (3x150+70) 6 x (3x95+29 Cu)	240 Cu/Al	8	M10	8	Ø10.5
iC7-60EA3A05-1100		1123	Cu 4 x (3x185+95) Al 6 x (3x120+41 Cu)	240 Cu/Al	8	M10	8	Ø10.5
iC7-60EA3A05-1260	2 x AE11 + 2 x IE11	1287	Cu 6 x (3x120+70) Al 6 x (3x150+70 Cu)	240 Cu/Al	8	M10	8	Ø10.5
iC7-60EA3A05-1450		1481	Cu 6 x (3x150+70) Al 6 x (3x185+57 Cu)	240 Cu/Al	8	M10	8	Ø10.5
iC7-60EA3A05-1710		1746	Cu 6 x (3x185+95) Al 8 x (3x150+70 Cu)	240 Cu/Al	8	M10	8	Ø10.5

[1] With the vertical PE busbar extension installed: 20 x Ø6.5 mm or 16 x Ø6.5 mm + 4 x Ø10.5mm

10.5.4 Mains Cable Size Recommendation, UL 480 V

Table 35: Mains Cable Size Recommendation, UL 480 V

Model code	Frame	I_N [A]	Mains cable Cu	Cable termination, Panduit terminal part number	Maximum cable size	Maximum number of mains cables[(1)] (hole size of the mains terminal [mm])	Number of grounding holes on PE busbar (hole size [mm])
iC7-60EA3N05-206A	FE9	206	2 x 300 MCM	LCAX300-12-6	300 MCM	2 (Ø10.5)	2 (Ø10.5)
iC7-60EA3N05-245A		245	2 x 300 MCM	LCAX300-12-6	300 MCM	2 (Ø10.5)	2 (Ø10.5)
iC7-60EA3N05-302A		302	2 x 300 MCM	LCAX300-12-6	300 MCM	2 (Ø10.5)	2 (Ø10.5)

Model code	Frame	I_N [A]	Mains cable Cu	Cable termination, Panduit terminal part number	Maximum cable size	Maximum number of mains cables[1] (hole size of the mains terminal [mm])	Number of grounding holes on PE busbar (hole size [mm])
iC7-60EA3N05-385A		385	2 x 300 MCM	LCAX300-12-6	300 MCM	2 (Ø10.5)	2 (Ø10.5)
iC7-60EA3N05-480A	FE10	480	3 x 300 MCM	LCAX300-12-6	300 MCM	3 (Ø13.5)	4 (Ø10.5)
iC7-60EA3N05-588A		588	3 x 300 MCM	LCAX300-12-6	300 MCM	3 (Ø13.5)	4 (Ø10.5)
iC7-60EA3A05-385A	AE10 + IE10	303	2 x 4/0 AWG	LCAX4/0-12-X	500 MCM	- (Ø13.5)	4 (Ø10.5)
iC7-60EA3A05-480A		352	2 x 250 MCM	LCAX250-12-X	500 MCM	- (Ø13.5)	4 (Ø10.5)
iC7-60EA3A05-588A		451	3 x 4/0 AWG	LCAX4/0-12-X	500 MCM	- (Ø13.5)	4 (Ø10.5)
iC7-60EA3A05-658A	AE11 + IE11	500	3 x 250 MCM	LCAX250-12-X	500 MCM	4 (Ø10.5)	5 (Ø10.5)
iC7-60EA3A05-730A		554	3 x 300 MCM	LCAX300-12-6	500 MCM	4 (Ø10.5)	5 (Ø10.5)
iC7-60EA3A05-820A		604	3 x 350 MCM	LCAX350-12-6	500 MCM	4 (Ø10.5)	5 (Ø10.5)
iC7-60EA3A05-880A		704	4 x 250 MCM	LCAX250-12-X	500 MCM	4 (Ø10.5)	5 (Ø10.5)
iC7-60EA3A05-1000	2xAE10 + 2xIE10	755	4 x 300 MCM	LCAX300-12-6	500 MCM	4 (Ø10.5)	5 (Ø10.5)
iC7-60EA3A05-1100		855	4 x 350 MCM	LCAX350-12-6	500 MCM	4 (Ø10.5)	5 (Ø10.5)
iC7-60EA3A05-1260	2xAE11 + 2xIE11	955	6 x 4/0 AWG	LCAX4/0-12-X	500 MCM	8 (Ø10.5)	8 (Ø10.5)
iC7-60EA3A05-1450		1106	6 x 300 MCM	LCAX300-12-6	500 MCM	8 (Ø10.5)	8 (Ø10.5)
iC7-60EA3A05-1710		1306	6 x 350 MCM	LCAX350-12-6	500 MCM	8 (Ø10.5)	8 (Ø10.5)

[1] Cable lugs installed on both sides of the fixing hole

10.5.5 Motor Cable Size Recommendation, UL 480 V

Table 36: Motor Cable Size Recommendation, UL 480 V

Model code	Frame	I_N [A]	Motor cable, Cu	Cable termination, Panduit terminal part number	Maximum cable size	Maximum number of motor cables (bolt size)	Number of grounding holes on PE busbar (hole size [mm])[1]
iC7-60EA3N05-206A	FE9	206	2x300 MCM	LCAX300-12-6	300 MCM	2 (M10)	2 (Ø10.5)
iC7-60EA3N05-245A		245	2x300 MCM	LCAX300-12-6	300 MCM	2 (M10)	2 (Ø10.5)
iC7-60EA3N05-302A		302	2x300 MCM	LCAX300-12-6	300 MCM	2 (M10)	2 (Ø10.5)
iC7-60EA3N05-385A		385	2x300 MCM	LCAX300-12-6	300 MCM	2 (M10)	2 (Ø10.5)
iC7-60EA3N05-480A	FE10	480	3x300 MCM	LCAX300-12-6	300 MCM	3 (M10)	4 (Ø10.5)
iC7-60EA3N05-588A		588	3x300 MCM	LCAX300-12-6	300 MCM	3 (M10)	4 (Ø10.5)
iC7-60EA3A05-385A	AE10 + IE10	372	2x 300 MCM	LCAX300-12-6	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-480A		466	3x 4/0 AWG	LCAX4/0-12-X	500 MCM	4 (M10)	4 (Ø10.5)

Model code	Frame	I_N [A]	Motor cable, Cu	Cable termination, Panduit terminal part number	Maximum cable size	Maximum number of motor cables (bolt size)	Number of grounding holes on PE busbar (hole size [mm])(1)
iC7-60EA3A05-588A		531	3x 250 MCM	LCAX250-12-X	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-658A	AE11 + IE11	603	3x 350 MCM	LCAX350-12-6	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-730A		672	4x 250 MCM	LCAX250-12-X	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-820A		746	4x 300 MCM	LCAX300-12-6	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-880A		838	4x 350 MCM	LCAX350-12-6	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-1000	2xAE10 + 2xIE10	940	6x 4/0 AWG	LCAX4/0-12-X	500 MCM	8 (M10)	8 (Ø10.5)
iC7-60EA3A05-1100		1052	6x 250 MCM	LCAX250-12-X	500 MCM	8 (M10)	8 (Ø10.5)
iC7-60EA3A05-1260	2xAE11 + 2xIE11	1174	6x 300 MCM	LCAX300-12-6	500 MCM	8 (M10)	8 (Ø10.5)
iC7-60EA3A05-1450		1328	8x 250 MCM	LCAX250-12-X	500 MCM	8 (M10)	8 (Ø10.5)
iC7-60EA3A05-1710		1603	8x 300 MCM	LCAX300-12-6	500 MCM	8 (M10)	8 (Ø10.5)

[1] With the vertical PE busbar extension installed: 20 x Ø6.5 mm or 16 x Ø6.5 mm + 4 x Ø10.5mm

10.6 Fuses

10.6.1 List of Fuse Size Information

The fuse size tables for the air-cooled enclosed drives can be found with these links.

- 10.6.2 AC Fuses, 380–500 V AC
- 10.6.3 DC Fuses, 465–800 V DC
- 10.6.4 External Fuses on External Supply for input devices

10.6.2 AC Fuses, 380–500 V AC

Table 37: AC Fuses, 380–500 V AC

Model code	Frame	Rated current I_L [A]	Number of fuses	Fuse size	Part number	Fuse U_n [V]	Fuse I_n [A]	$I_{cp,mr}$ [A] (1)
iC7-60EA3N05-206A	FE9	206	3	00	170M2619(2)	700	315	–
iC7-60EA3N05-245A		245	3	00	170M2620(2)	700	350	–
iC7-60EA3N05-302A		302	3	00	170M2621(2)	700	400	–
iC7-60EA3N05-385A		385	3	00	170M9007(2)	550	475	–
iC7-60EA3N05-480A	FE10	480	3	1	170M4016(2)	700	630	–
iC7-60EA3N05-588A		588	3	1	170M4017(2)	700	800	–
iC7-60EA3A05-385A	AE10 + IE10	385	3	33	PC33UD69V550TF(3)	690	550	3288
iC7-60EA3A05-480A		480	3	33	PC33UD69V700TF(3)	690	700	4822
iC7-60EA3A05-588A		588	3	33	PC33UD69V700TF(3)	690	700	4822

Model code	Frame	Rated current I_L [A]	Number of fuses	Fuse size	Part number	Fuse U_n [V]	Fuse I_n [A]	$I_{cp,mr}$ [A] (1)
iC7-60EA3A05-658A	AE11 + IE11	658	6(4)	33	PC33UD69V550TF(3)	690	550	6576
iC7-60EA3A05-730A		730	6(4)	33	PC33UD69V550TF(3)	690	550	6576
iC7-60EA3A05-820A		820	6(4)	33	PC33UD69V550TF(3)	690	550	6576
iC7-60EA3A05-880A		880	6(4)	33	PC33UD69V550TF(3)	690	550	6576
iC7-60EA3A05-1000	2xAE10 + 2xIE10	1000	6	33	PC33UD69V700TF(3)	690	700	–
iC7-60EA3A05-1100		1100	6	33	PC33UD69V700TF(3)	690	700	–
iC7-60EA3A05-1260	2xAE11 + 2xIE11	1260	12(4)	33	PC33UD69V550TF(3)	690	550	–
iC7-60EA3A05-1450		1450	12(4)	33	PC33UD69V550TF(3)	690	550	–
iC7-60EA3A05-1710		1707	12(4)	33	PC33UD69V550TF(3)	690	550	–

[1] current, prospective, minimum rating

[2] Bussmann

[3] Mersen

[4] Double fuse per phase

10.6.3 DC Fuses, 465–800 V DC

Table 38: DC Fuses, 465–800 V DC

Model code	Frame	Rated current I_L [A]	Number of fuses	Fuse size	Part number	Fuse U_n [V]	Fuse I_n [A]
iC7-60EA3A05-385A	AE10 + IE10	385	2	73	PC73UD13C630TF	1250	630
iC7-60EA3A05-480A	AE10 + IE10	480	2	73	PC73UD13C800TF	1250	800
iC7-60EA3A05-588A	AE10 + IE10	588	2	73	PC73UD10C1000TF	1000	1000
iC7-60EA3A05-658A	AE11 + IE11	658	2	73	PC73UD90V13CTF	900	1250
iC7-60EA3A05-730A	AE11 + IE11	730	2	73	PC73UD90V13CTF	900	1250
iC7-60EA3A05-820A	AE11 + IE11	820	2	73	PC73UD85V14CTF	850	1400
iC7-60EA3A05-880A	AE11 + IE11	880	2	73	PC73UD85V14CTF	850	1400
iC7-60EA3A05-1000	2xAE10 + 2xIE10	1000	8	73	PC73UD13C800TF	1250	800
iC7-60EA3A05-1100	2xAE10 + 2xIE10	1100	8	73	PC73UD10C1000TF	1000	1000
iC7-60EA3A05-1260	2xAE11 + 2xIE11	1260	8	73	PC73UD90V13CTF	900	1250
iC7-60EA3A05-1450	2xAE11 + 2xIE11	1450	8	73	PC73UD90V13CTF	900	1250
iC7-60EA3A05-1710	2xAE11 + 2xIE11	1707	8	73	PC73UD85V14CTF	850	1400

10.6.4 External Fuses on External Supply for input devices

The enclosed drives with a mains contactor or a main switch must be protected with external fuses. The fuses in the table meet the IEC type 1 coordination for contactor short circuit current performance and are required for main switch protection.

Table 39: External Fuses of the Enclosed Drives

Model code	Frame	IEC fuse	UL fuse
iC7-60EA3N05-206A	FE9, FE10	gG 315 A[1] or gG 355 A	–
iC7-60EA3N05-245A	FE9, FE10	gG 315 A	–
iC7-60EA3N05-302A	FE9, FE10	gG 400 A	–
iC7-60EA3N05-385A	FE9, FE10	gG 500 A	–
iC7-60EA3N05-480A	FE9, FE10	gG 630 A	–
iC7-60EA3N05-588A	FE9, FE10		–
iC7-60EA3A05-385A	AE10 + IE10	gG 630 A	Class J, 600 A
iC7-60EA3A05-480A	AE10 + IE10		
iC7-60EA3A05-588A	AE10 + IE10		Class J/L, 800 A
iC7-60EA3A05-658A	AE11 + IE11	gG 1000 A	Class L, 1200 A
iC7-60EA3A05-730A	AE11 + IE11		
iC7-60EA3A05-820A	AE11 + IE11		
iC7-60EA3A05-880A	AE11 + IE11		
iC7-60EA3A05-1000	2xAE10 + 2xIE10	gG 1250 A	–
iC7-60EA3A05-1100	2xAE10 + 2xIE10		–

[1] with the mains contactor option

10.7 Current Ratings

10.7.1 Current Rating Table List

The current rating tables show the ratings of the enclosed drives at relevant voltage ratings. The current rating tables for the different products can be found with these links.

- 10.7.2 Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, 400 V AC
- 10.7.3 Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, UL, 460 V AC
- 10.7.4 Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, 500 V AC
- 10.7.5 Current Ratings for Regenerative AFE, 400 V AC
- 10.7.6 Current Ratings for Regenerative AFE, UL, 460 V AC
- 10.7.7 Current Ratings for Regenerative AFE, 500 V AC
- 10.7.8 Current Ratings for Low-harmonic AFE, 400 V AC
- 10.7.9 Current Ratings for Low-harmonic AFE, UL, 460 V AC
- 10.7.10 Current Ratings for Low-harmonic AFE, 500 V AC

Table 40: Abbreviations Used in the Rating Tables

Abbreviation	Description
I_N	Nominal current. If the process does not require any overloadability or the process does not include any load variation or margin for overloadability, the dimensioning can be done according to this current.
I_L	Nominal current with low overload (110%). Allows a +10% load variation for 1 minute every 5 minutes.

Abbreviation	Description
I_H	Nominal current with high overload (150%). Allows a +50% load variation for 1 minute every 5 minutes.
I_{peak}	Start current. Available for 3 s at start, then as long as the enclosed drive temperature allows. Relevant for inverter modules.
P_L	Output power at low overload
P_H	Output power at high overload

10.7.2 Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, 400 V AC

Current ratings

Table 41: Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, 400 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 400 V AC	
		$I_{N\text{-}in}$ [A]	I_N [A]	I_{peak} [A]	$I_{L\text{-}in}$ [A]	I_L [A]	$I_{H\text{-}in}$ [A]	I_H [A]	P_L [kW]	P_H [kW]
iC7-60EA3N05-206A	FE9	203	211	289	199	206	164	170	110	90
iC7-60EA3N05-245A	FE9	241	251	351	236	245	199	206	132	110
iC7-60EA3N05-302A	FE9	297	309	417	291	302	236	245	160	132
iC7-60EA3N05-385A	FE9	379	394	514	371	385	291	302	200	160
iC7-60EA3N05-480A	FE10	472	490	655	463	480	371	385	250	200
iC7-60EA3N05-588A	FE10	578	601	816	567	588	463	480	315	250

10.7.3 Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, UL, 460 V AC

Table 42: Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, UL, 460 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 480 V AC	
		$I_{N\text{-}in}$ [A]	I_N [A]	I_{peak} [A]	$I_{L\text{-}in}$ [A]	I_L [A]	$I_{H\text{-}in}$ [A]	I_H [A]	P_L [Hp]	P_H [Hp]
iC7-60EA3N05-206A	FE9	185	201	283	196	206	154	166	150	125
iC7-60EA3N05-245A	FE9	227	245	334	240	245	181	196	200	150
iC7-60EA3N05-302A	FE9	285	309	408	302	302	222	240	250	200
iC7-60EA3N05-385A	FE9	343	372	514	364	385	279	302	300	250
iC7-60EA3N05-480A	FE10	430	466	619	456	480	336	364	350	300
iC7-60EA3N05-588A	FE10	490	531	776	520	588	421	456	450	350

10.7.4 Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, 500 V AC

Table 43: Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, 500 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 500 V AC	
		$I_{N\text{-}in}$ [A]	I_N [A]	I_{peak} [A]	$I_{L\text{-}in}$ [A]	I_L [A]	$I_{H\text{-}in}$ [A]	I_H [A]	P_L [kW]	P_H [kW]
iC7-60EA3N05-206A	FE9	193	201	283	189	196	160	166	132	110
iC7-60EA3N05-245A	FE9	236	245	334	232	240	189	196	160	132
iC7-60EA3N05-302A	FE9	297	309	408	291	302	232	240	200	160
iC7-60EA3N05-385A	FE9	358	372	514	351	364	291	302	250	200
iC7-60EA3N05-480A	FE10	449	466	619	440	456	351	364	315	250
iC7-60EA3N05-588A	FE10	512	531	776	501	520	440	456	355	315

10.7.5 Current Ratings for Regenerative AFE, 400 V AC

Table 44: Current Ratings for Regenerative AFE, 400 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 400 V AC	
		$I_{N\text{-}in}$ [A]	I_N [A]	I_{peak} [A]	$I_{L\text{-}in}$ [A]	I_L [A]	$I_{H\text{-}in}$ [A]	I_H [A]	P_L [kW]	P_H [kW]
iC7-60EA3A05-385A	AE10+IE10	325	394	510	317	385	254	300	200	160
iC7-60EA3A05-480A	AE10+IE10	403	490	655	394	480	317	385	250	200
iC7-60EA3A05-590A	AE10+IE10	508	601	816	497	588	394	480	315	250
iC7-60EA3A05-658A	AE11+IE11	571	672	930	559	658	394	547	355	250
iC7-60EA3A05-730A	AE11+IE11	647	746	1031	633	730	499	606	400	315
iC7-60EA3A05-820A	AE11+IE11	728	838	1158	712	820	562	681	450	355
iC7-60EA3A05-880A	AE11+IE11	809	899	1243	791	880	633	731	500	400
iC7-60EA3A05-1000	2 x AE10+2 x IE10	905	1021	1411	886	1000	712	830	560	450
iC7-60EA3A05-1100	2 x AE10+2 x IE10	1018	1123	1553	997	1100	791	913	630	500
iC7-60EA3A05-1260	2 x AE11+2 x IE11	1148	1287	1785	1123	1260	886	1050	710	560
iC7-60EA3A05-1450	2 x AE11+2 x IE11	1293	1481	2057	1265	1450	997	1210	800	630
iC7-60EA3A05-1710	2 x AE11+2 x IE11	1453	1746	2414	1423	1710	1123	1420	900	710

10.7.6 Current Ratings for Regenerative AFE, UL, 460 V AC

Table 45: Current Ratings for Regenerative AFE, UL, 460 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 480 V AC	
		$I_{N\text{-}in}$ [A]	I_N [A]	I_{peak} [A]	$I_{L\text{-}in}$ [A]	I_L [A]	$I_{H\text{-}in}$ [A]	I_H [A]	P_L [Hp]	P_H [Hp]
iC7-60EA3A05-385A	AE10+IE10	303	372	510	296	364	247	300	300	250
iC7-60EA3A05-480A	AE10+IE10	352	466	619	344	456	296	364	350	300
iC7-60EA3A05-588A	AE10+IE10	451	531	776	441	520	344	456	450	350

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 480 V AC	
		I_{N-in} [A]	I_N [A]	I_{peak} [A]	I_{L-in} [A]	I_L [A]	I_{H-in} [A]	I_H [A]	P_L [Hp]	P_H [Hp]
iC7-60EA3A05-658A	AE11+IE11	500	603	833	489	590	344	490	500	350
iC7-60EA3A05-730A	AE11+IE11	554	672	930	542	658	443	547	550	450
iC7-60EA3A05-820A	AE11+IE11	604	746	1031	591	730	492	606	600	500
iC7-60EA3A05-880A	AE11+IE11	704	838	1158	688	820	542	681	700	550
iC7-60EA3A05-1000	2 x AE10+2 x IE10	755	940	1299	738	920	591	764	750	600
iC7-60EA3A05-1100	2 x AE10+2 x IE10	855	1052	1454	837	1030	640	855	850	650
iC7-60EA3A05-1260	2 x AE11+2 x IE11	955	1174	1632	935	1150	738	960	950	750
iC7-60EA3A05-1450	2 x AE11+2 x IE11	1106	1328	1836	1082	1300	837	1080	1100	850
iC7-60EA3A05-1710	2 x AE11+2 x IE11	1306	1603	2227	1279	1570	1082	1310	1300	1100

10.7.7 Current Ratings for Regenerative AFE, 500 V AC

Table 46: Current Ratings for Regenerative AFE, 500 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 500 V AC	
		I_{N-in} [A]	I_N [A]	I_{peak} [A]	I_{L-in} [A]	I_L [A]	I_{H-in} [A]	I_H [A]	P_L [kW]	P_H [kW]
iC7-60EA3A05-385A	AE10+IE10	322	372	510	315	364	254	300	250	200
iC7-60EA3A05-480A	AE10+IE10	406	466	619	397	456	315	364	315	250
iC7-60EA3A05-588A	AE10+IE10	457	531	776	447	520	397	456	355	315
iC7-60EA3A05-658A	AE11+IE11	518	603	833	506	590	399	490	400	315
iC7-60EA3A05-730A	AE11+IE11	583	672	930	570	658	450	547	450	355
iC7-60EA3A05-820A	AE11+IE11	647	746	1031	633	730	506	606	500	400
iC7-60EA3A05-880A	AE11+IE11	725	838	1158	709	820	570	681	560	450
iC7-60EA3A05-1000	2 x AE10+2 x IE10	815	940	1299	797	920	633	764	630	500
iC7-60EA3A05-1100	2 x AE10+2 x IE10	919	1052	1454	899	1030	709	855	710	560
iC7-60EA3A05-1260	2 x AE11+2 x IE11	1034	1174	1632	1012	1150	797	960	800	630
iC7-60EA3A05-1450	2 x AE11+2 x IE11	1164	1328	1836	1139	1300	899	1080	900	710
iC7-60EA3A05-1710	2 x AE11+2 x IE11	1422	1603	2227	1392	1570	1012	1310	1100	800

10.7.8 Current Ratings for Low-harmonic AFE, 400 V AC

Table 47: Current Ratings for Low-harmonic AFE, 400 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 400 V AC	
		$I_{N\text{-}in}$ [A]	I_N [A]	I_{peak} [A]	$I_{L\text{-}in}$ [A]	I_L [A]	$I_{H\text{-}in}$ [A]	I_H [A]	P_L [kW]	P_H [kW]
iC7-60EA3H05-385A	AE10+IE10	325	394	510	317	385	254	300	200	160
iC7-60EA3H05-480A	AE10+IE10	403	490	655	394	480	317	385	250	200
iC7-60EA3H05-588A	AE10+IE10	508	601	816	497	588	394	480	315	250
iC7-60EA3H05-658A	AE11+IE11	571	672	930	559	658	394	547	355	250
iC7-60EA3H05-730A	AE11+IE11	647	746	1031	633	730	499	606	400	315
iC7-60EA3H05-820A	AE11+IE11	728	838	1158	712	820	562	681	450	355
iC7-60EA3H05-880A	AE11+IE11	809	899	1243	791	880	633	731	500	400
iC7-60EA3H05-1000	2 x AE10+2 x IE10	905	1021	1411	886	1000	712	830	560	450
iC7-60EA3H05-1100	2 x AE10+2 x IE10	1018	1123	1553	997	1100	791	913	630	500
iC7-60EA3H05-1260	2 x AE11+2 x IE11	1148	1287	1785	1123	1260	886	1050	710	560
iC7-60EA3H05-1450	2 x AE11+2 x IE11	1293	1481	2057	1265	1450	997	1210	800	630
iC7-60EA3H05-1710	2 x AE11+2 x IE11	1453	1746	2414	1423	1710	1123	1420	900	710

10.7.9 Current Ratings for Low-harmonic AFE, UL, 460 V AC

Table 48: Current Ratings for Low-harmonic AFE, UL, 460 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 480 V AC	
		$I_{N\text{-}in}$ [A]	I_N [A]	I_{peak} [A]	$I_{L\text{-}in}$ [A]	I_L [A]	$I_{H\text{-}in}$ [A]	I_H [A]	P_L [Hp]	P_H [Hp]
iC7-60EA3H05-385A	AE10+IE10	303	372	510	296	364	247	300	300	250
iC7-60EA3H05-480A	AE10+IE10	352	466	619	344	456	296	364	350	300
iC7-60EA3H05-588A	AE10+IE10	451	531	776	441	520	344	456	450	350
iC7-60EA3H05-658A	AE11+IE11	500	603	833	489	590	344	490	500	350
iC7-60EA3H05-730A	AE11+IE11	554	672	930	542	658	443	547	550	450
iC7-60EA3H05-820A	AE11+IE11	604	746	1031	591	730	492	606	600	500
iC7-60EA3H05-880A	AE11+IE11	704	838	1158	688	820	542	681	700	550
iC7-60EA3H05-1000	2 x AE10+2 x IE10	755	940	1299	738	920	591	764	750	600
iC7-60EA3H05-1100	2 x AE10+2 x IE10	855	1052	1454	837	1030	640	855	850	650
iC7-60EA3H05-1260	2 x AE11+2 x IE11	955	1174	1632	935	1150	738	960	950	750
iC7-60EA3H05-1450	2 x AE11+2 x IE11	1106	1328	1836	1082	1300	837	1080	1100	850
iC7-60EA3H05-1710	2 x AE11+2 x IE11	1306	1603	2227	1279	1570	1082	1310	1300	1100

10.7.10 Current Ratings for Low-harmonic AFE, 500 V AC

Table 49: Current Ratings for Low-harmonic AFE, 500 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 500 V AC	
		$I_{N\text{-}in}$ [A]	I_N [A]	I_{peak} [A]	$I_{L\text{-}in}$ [A]	I_L [A]	$I_{H\text{-}in}$ [A]	I_H [A]	P_L [kW]	P_H [kW]
iC7-60EA3H05-385A	AE10+IE10	322	372	510	315	364	254	300	250	200
iC7-60EA3H05-480A	AE10+IE10	406	466	619	397	456	315	364	315	250
iC7-60EA3H05-588A	AE10+IE10	457	531	776	447	520	397	456	355	315
iC7-60EA3H05-658A	AE11+IE11	518	603	833	506	590	399	490	400	315
iC7-60EA3H05-730A	AE11+IE11	583	672	930	570	658	450	547	450	355
iC7-60EA3H05-820A	AE11+IE11	647	746	1031	633	730	506	606	500	400
iC7-60EA3H05-880A	AE11+IE11	725	838	1158	709	820	570	681	560	450
iC7-60EA3H05-1000	2 x AE10+2 x IE10	815	940	1299	797	920	633	764	630	500
iC7-60EA3H05-1100	2 x AE10+2 x IE10	919	1052	1454	899	1030	709	855	710	560
iC7-60EA3H05-1260	2 x AE11+2 x IE11	1034	1174	1632	1012	1150	797	960	800	630
iC7-60EA3H05-1450	2 x AE11+2 x IE11	1164	1328	1836	1139	1300	899	1080	900	710
iC7-60EA3H05-1710	2 x AE11+2 x IE11	1422	1603	2227	1392	1570	1012	1310	1100	800

10.8 Technical Data

10.8.1 Mains Connections

Table 50: Mains Connections

Item	Technical data
Nominal AC voltage	Voltage class 5: 3 x 380...500 V AC ±10%, -15% at reduced power
Mains network	TN-S, TN-C, IT and TT. (Supply voltage limited to 500 V AC for corner-grounded networks.)
Mains frequency	45...66 Hz
Voltage imbalance	3% of rated voltage
Short-circuit current rating, with the specified fuses or circuit-breakers	The maximum short circuit current $I_{cc} \leq 65$ kA
True power factor (λ)	≥ 0.9 nominal at rated load
Displacement power factor (DPF)	AFE: 1 6-pulse: 0.97
Switching on input supply from a discharged drive	FE09–FE10: Maximum 1 time/2 minutes
Overvoltage category	Category III

10.8.2 Motor Connections

Table 51: Motor Connections

Item	Technical data
Output voltage	0–100% of supply voltage
Output frequency	0...599 Hz [1]
Switching frequency	1.5…8 kHz, default 3 kHz
Field weakening point	1...600 Hz
Motor control principles	U/f control VVC+ (Vector Voltage Control) FVC+ (Flux Vector Control)
Motor and generator types supported	Induction/asynchronous motor Non-Salient Permanent Magnet Motor
Torque control, torque step rise time	Open loop: <5 ms with nominal torque and <1 ms with nominal torque with AFE supply Closed loop: <5 ms with nominal torque and <1 ms with nominal torque with AFE supply
Torque control, static accuracy	Open loop: <2% of motor nominal torque up to nominal speed and <4% of motor nominal torque in the field weakening area Closed loop: <2% of motor nominal torque up to nominal speed and <4% of motor nominal torque in the field weakening area
Speed control, static accuracy	Open loop: 5% of motor nominal slip up to motor nominal motor frequency and 10% of motor nominal slip in the field weakening area Closed loop: 0.01% static error of nominal speed with encoder PPR of 1024 or better
Speed control, dynamic accuracy (response)	Open loop: 0.2...0.4% s with nominal torque step Closed loop: 0.1...0.2% s with nominal torque step
Motor control resolution	Reference setpoint resolution 31 bit + sign
Cable length	up to 150 m (492 ft) shielded motor cable up to 300 m (984 ft) unshielded motor cable

[1] Dependent on voltage, current, and control mode

10.8.3 Ambient Conditions

Table 52: Ambient Conditions

Item	Technical data
Protection rating	IP21/UL Type 1 IP54/UL Type 12
Ambient operating temperature	-15 °C...0 °C (5 °F...32 °F) (no frost). The highest current rating of AE11 and IE11 must be derated 20% in freezing conditions. 0 °C...+40 °C (32 °F...104 °F) (at I_N) with derating up to +55 °C (131 °F).
Installation temperature	–10 °C...+70 °C (14 °F...158 °F)

Item	Technical data
Storage/transportation temperature	–40 °C...+70 °C (-40 °F...158 °F)
Relative humidity	5...95% RH, no condensation, no dripping water
Environmental conditions storage	(IEC 60721-3-1) Climatic conditions: Class 1K5 Chemically active substances: Class 1C2 Biological conditions: Class 1B1 Mechanical conditions: Class 1M3 Mechanically active substances: Class 1S3
Environmental conditions transportation	(IEC 60721-3-2) Climatic conditions: Class 2K4 Chemically active substances: Class 2C2 Biological conditions: Class 2B1 Mechanical conditions: Class 2M2 Mechanically active substances: Class 2S2
Environmental conditions operation	(IEC 60721-3-3) Climatic conditions: Class 3K5 Chemically active substances: IEC 60721-3-3 Edition 3.0/ISO 3223 Second Edition, class C4 [1] Biological conditions: Class 3B1 Mechanical conditions: Class 3M3 Mechanically active substances: Class 3S3 Special climatic conditions (heat radiation): Class 3Z1
Pollution degree	PD2
Altitude	0...4000 m (0...13100 ft) above sea level: in case network is not corner-grounded (Voltage class 5) Above 1000 m (3300 ft): derating of maximum ambient operating temperature by 1 °C per each 100 m is required.
Vibration (IEC60068-2-6)	Displacement amplitude 0.5 mm (peak) at 5...22 Hz) Maximum acceleration amplitude 1 G at 22...150 Hz
Shock (IEC60068-2-27)	max 4 G, 11 ms (in package)
Sound pressure level	–

[1] On board level on coated boards.

10.8.4 EMC (IEC 61800-3)

Table 53: EMC Data

Item	Technical data
Immunity	Fulfills EN 61800-3, 1st and 2nd environment
Emissions	380–500 V AC: EN 61800-3 (2004), category C3, if the drive is installed according to instructions. All: The drive can be changed to C4 for IT type mains.

10.8.5 Protections

Table 54: Protections

Item	Technical data
Overvoltage trip limit	Mains voltage 500 V AC: 911 V DC
Undervoltage trip limit	Depends on mains voltage (0.8775 x mains voltage) Mains voltage 400 V AC: trip limit 334 V DC Mains voltage 500 V AC: trip limit 447 V DC
Ground fault protection	Yes
Mains supervision	Yes
Motor phase supervision	Yes
Overcurrent protection	Yes
Unit overtemperature protection	Yes
Motor overload protection	Yes [1]
Motor stall protection	Yes
Motor underload protection	Yes

[1] The motor overload protection activates at 110% of the full load current.

10.8.6 Product Compliance

Table 55: Product Compliance

Item	Technical data
Conformity	CE, RCM, KC, EAC, UA, UKCA. See the product label of the drive for more approvals.
Safety standards	IEC/EN 61800-5-1 + A1 IEC/EN 62477-1 + A1
Functional safety	–
Marine type approvals	–

10.8.7 Efficiency

Table 56: Efficiency

Item	Technical data
Efficiency	Inverter module >99%, AFE module + LCL filter 97.5%, FE module 97.1% at 500 V AC, 1.5 kHz

Index

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