ENGINEERING
TOMORROW

Design Guide

iC7-Automation Air-cooled Enclosed Drives

206/385–1710 A

drives.danfoss.com | iC7

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1 Introduction

1.1 Purpose of this Design Guide

This design guide is intended for qualified personnel, such as:

- Project and systems engineers.
- Design consultants.
- Application and product specialists.

The design guide provides technical information to understand the capabilities of the iC7 drives for integration into motor control and monitoring systems. Its purpose is to provide design considerations and planning data for integration of the drive into a system. It caters for selection of drives and options for a diversity of applications and installations. Reviewing the detailed product information in the design stage enables developing a well-conceived system with optimal functionality and efficiency.

This guide is targeted at a worldwide audience. Therefore, wherever occurring, both SI and imperial units are shown.

1.2 Additional Resources

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

- Safety guides, which provide important safety information related to installing iC7 drives.
- Installation guides, which cover the mechanical and electrical installation of drives, or functional extension options.
- Operating guides, which include instructions for control options, and other components for the drive.
- Application guides, which provide instructions on setting up the drive for a specific end use. Application guides for application software packages also provide an overview of the parameters and value ranges for operating the drives, configuration examples with recommended parameter settings, and troubleshooting steps.
- *Facts Worth Knowing about AC Drives*, available for download on www.danfoss.com.
- Other supplemental publications, drawings, and guides are available at www.danfoss.com.

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

1.3 Planning and Design Support Materials

1.3.1 Overview

Danfoss provides access to comprehensive product information that supports throughout the product lifecycle.

All iC7 series design guides, installation guides, safety guides, operating guides, and application guides are available for download at https://www.danfoss.com. It is also possible to order printed guides.

For each iC7 drive or power converter, 2D and 3D drawings, and wiring diagrams are available in standard file formats. EPLAN files with macros, technical data, and 3D models are also provided to support in the system design.

Configuration files for drives or power converters are also available. MyDrive® Suite provides tools that support the entire lifecycle of the product, from system design to service. MyDrive® Suite is available at https://suite.mydrive.danfoss.com/.

The product configurator helps in the product selection, and when the process has been completed, the tool provides a list of relevant documentation and accessories.

Detailed product information can also be accessed by reading the 2D code on the product label.

1.3.2 Locating Support Information

Additional information is available on the company website.

1. Go to https://www.danfoss.com.
2. Select *Products*.
3. Select *Drives*.
4. Select the product series, for example *Low-voltage drives* or *System modules*.
5. Select the product series (for example, iC7).

The browser opens the product page, which provides links to documents, drawings, and software of the product.

1.4 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	Design guide created based on the previous operating guide 139Z8096.

1.5 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
LHD	Low-harmonic
I	Current
IEC	International Electrotechnical Commission
INU	Inverter

Table 2: Abbreviations, Acronyms, and Symbols (continued)

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

1.6 Recommended Disposal

When the product reaches the end of its service life, its primary components can be recycled.

Before the materials can be removed, the product must be disassembled. Product parts and materials can be dismantled and separated. Generally, all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, and cardboard can be used in energy recovery. Printed circuit boards and large electrolytic capacitors with a diameter of under 2.5 cm (1 in) need further treatment according to IEC 62635 guidelines. To ease recycling, plastic parts are marked with an appropriate identification code.

Contact your local Danfoss office for further information on environmental aspects and recycling instructions for professional recyclers. End-of-life treatment must follow international and local regulations.

All products are designed and manufactured in accordance with Danfoss company guidelines on prohibited and restricted substances. A list of these substances is available at https://www.danfoss.com.

This symbol on the product indicates that it must not be disposed of as household waste. Do not dispose of equipment containing electrical components together with domestic waste.
It must be handed over to the applicable take-back scheme for the recycling of electrical and electronic equipment.

- Dispose of the product through channels provided for this purpose.
- Comply with all local and currently applicable laws and regulations.

2 Safety

2.1 Safety

When designing AC drives, some residual dangers cannot be avoided. One example is the discharge time, which must be observed to avoid potential death or serious injury. The discharge time is shown on the danger label on the drive.

For further information on safety precautions related to the installation, operation, or maintenance of products, refer to the product-specific installation, safety, and operating guides.

2.2 Safety Symbols

The following symbols are used in Danfoss documentation.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

The guide also includes ISO warning symbols related to hot surfaces and burn hazard, high voltage and electrical shock, and referring to the instructions.

	ISO warning symbol for hot surfaces and burn hazard
	ISO warning symbol for high voltage and electrical shock
	ISO action symbol for referring to the instructions

2.3 General Safety Considerations

⚠ WARNING

LACK OF SAFETY AWARENESS

This guide provides important information on preventing injury and damage to the equipment or the system. Ignoring this information can lead to death, serious injury, or severe damage to the equipment.

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

DANGER

DISCHARGE TIME (5 OR 20 MINUTES)

The drive contains 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 system.
- Disconnect all inputs and outputs that can supply energy to the drive.
- Wait for the capacitors to discharge fully before performing any service on the equipment. The exact discharge time is also shown on the front cover of the drive. If the device is broken or fuses have tripped, the discharge time is longer.

  Discharge time

  AE10, AE11, IE10, IE11: 5 minutes

  FE9, FE10: 20 minutes
- Measure the voltage level to verify full discharge.

WARNING

ELECTRIC SHOCK

Drives contain hazardous voltage when a power source is connected to AC or DC terminals. Failure to disconnect all power sources can result in death or serious injury.

- Before performing any electrical work on the drive, disconnect, lock out, and tag out all power sources to the drive.
- There is more than 1 live circuit. See the relevant wiring diagram in the product guide.

WARNING

UNINTENDED START

When the drive is connected to a power source, the system may start at any time, causing risk of death, serious injury, and equipment or property damage.

- Stop the drive and motor before configuring parameters.
- Make sure that the drive cannot be started by an external switch, a fieldbus command, an input reference signal from the control panel, or after a cleared fault condition.
- Disconnect the drive from the power source whenever safety considerations make it necessary to avoid unintended start.
- Check that the drive, motor, and any driven equipment are in operational readiness.

2.4 Target Group and Necessary Qualifications

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the products. 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 other relevant guides. Non-qualified electricians are not allowed to perform any 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.

3 Danfoss iC7 Series

3.1 Overview of iC7 Series

The Danfoss iC7 series comprises 3 products that combine hardware and software.

Table 3: The iC7 Series

Product	Product category	Product type	Application software
iC7-Automation	Air-cooled system modules	Active front-end	AFE application
		Inverter	Industry application
	Enclosed drives	Active front-end	AFE application
		Inverter	Industry application
	Frequency converters	Frequency converter	Industry application, Motion application
iC7-Marine	Liquid-cooled system modules	Active front-end	AFE application
		Inverter	Propulsion & Machinery application
iC7-Hybrid	Liquid-cooled system modules	Grid converter	Grid converter application
		DC/DC converter	DC/DC converter application

Additional application software can be purchased and some application software are only available for a specific hardware variant and product.

There are application guides available for all the application software packages.

4 Product Overview

4.1 The Air-cooled Enclosed Drives

The enclosed drives come in 6-pulse, low-harmonic, and regenerative variants. The control compartment on the cabinet door gives easy access to 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.

4.2 Interior Views of the Products

4.2.1 Interior View of the Cabinet, FE9

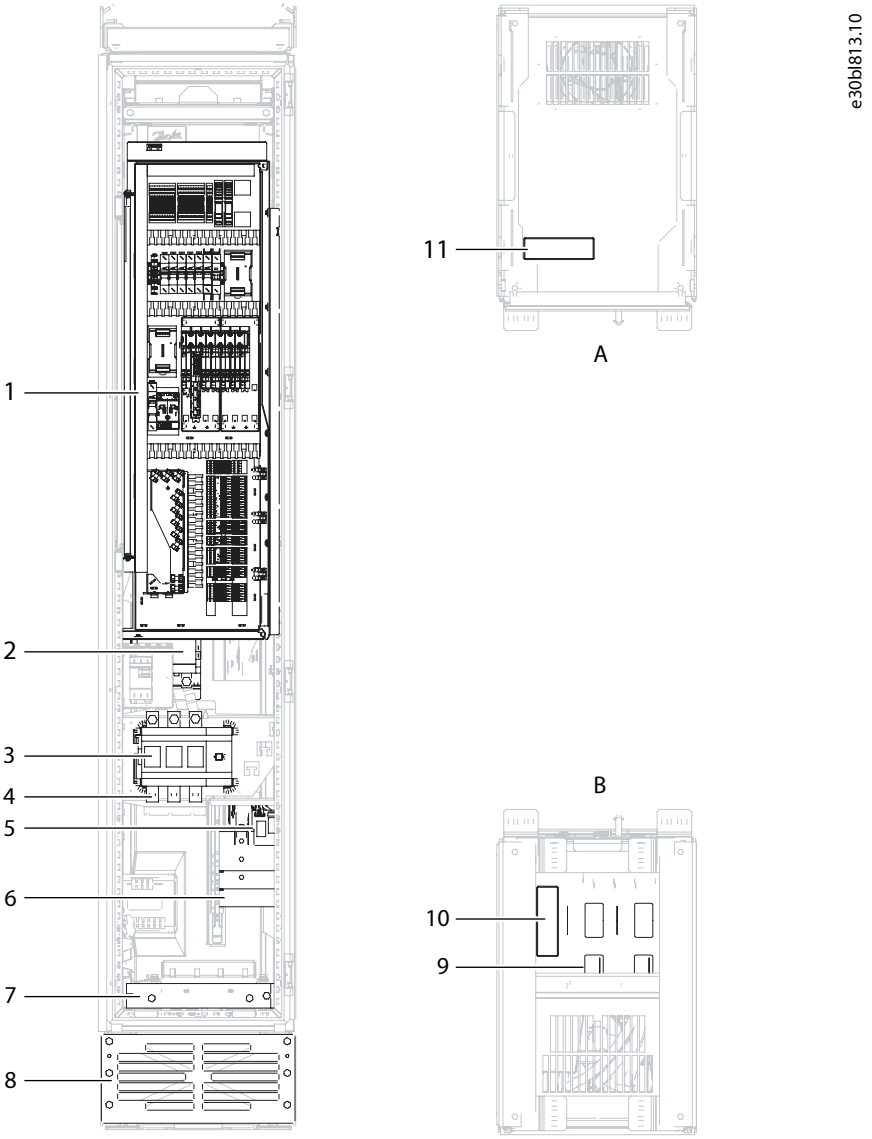


Figure 1: Interior View of FE9

1	Control compartment	**2**	Contactor
3	Main switch (optional)	**4**	Mains terminals

5	dU/dt Filter	**6**	Motor terminals
7	PE busbar	**8**	Inlet air grill
9	IP54 grommet for mains and motor cables (IEC)	**10**	Control cable grommet, bottom
11	Control cable grommet, top	**A**	View from the top
B	View from the bottom		

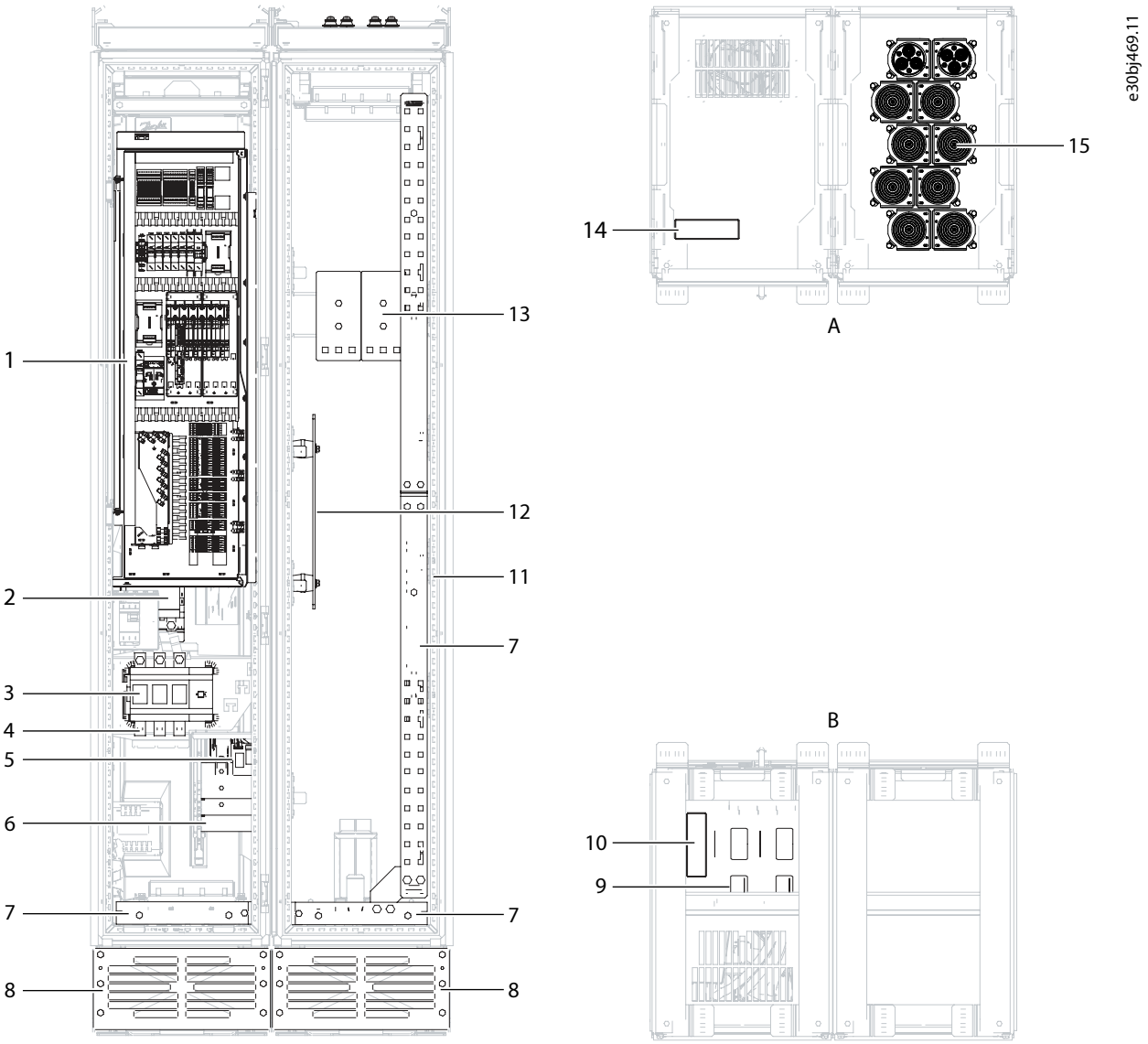


Figure 2: Interior View of FE9 with Top-entry Option

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

11	Motor terminals (behind PE busbar, Top-entry option)	**12**	Mains terminals (Top-entry option)
13	Brake terminals (Top-entry option)	**14**	Control cable grommet, top
15	IP54 grommet for mains and motor cables (Top-entry option)	**A**	View from the top
B	View from the bottom		

4.2.2 Interior View of the Cabinet, FE10

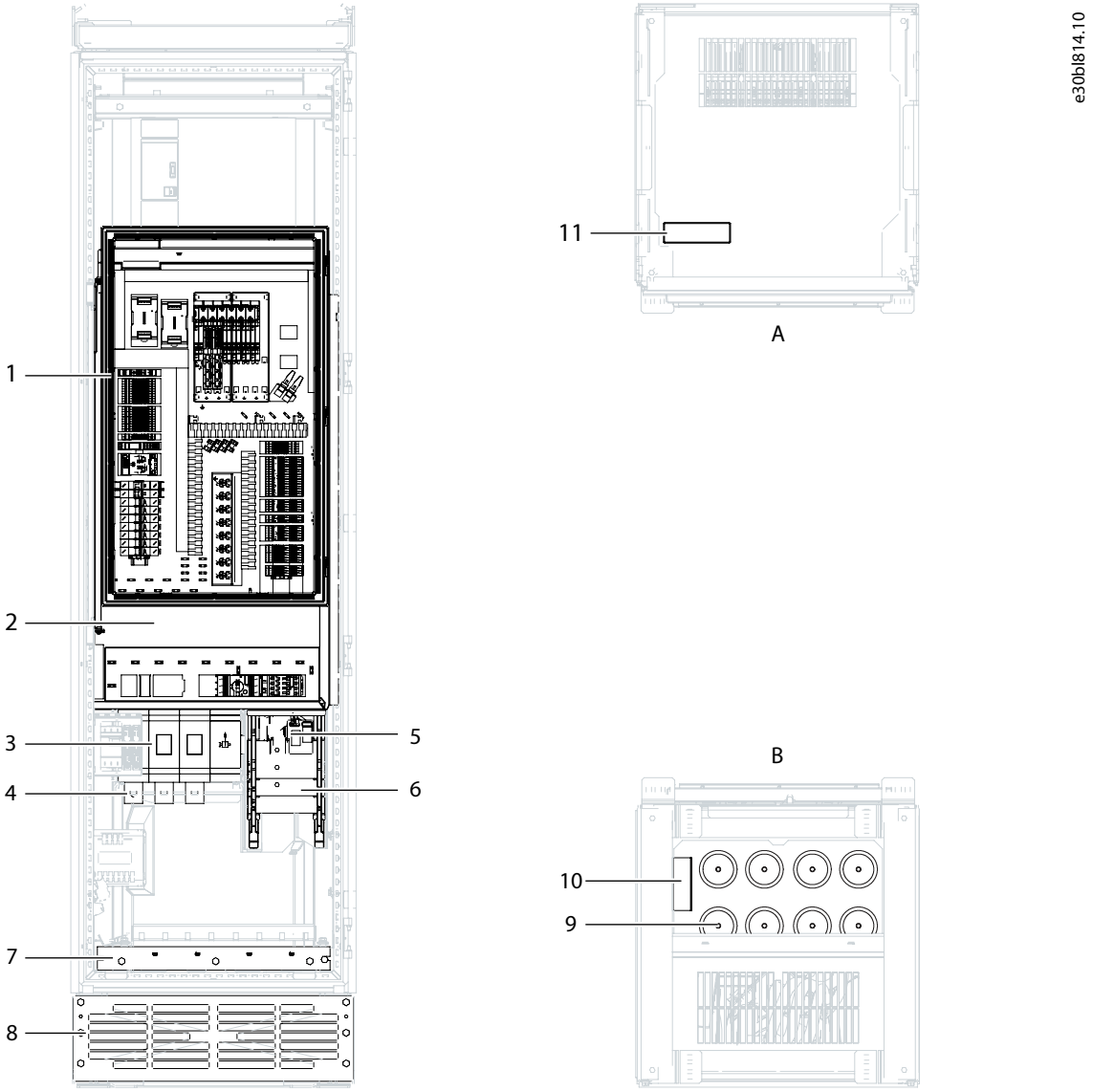


Figure 3: Interior View of FE10

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

11	Control cable grommet, top	**A**	View from the top
B	View from the bottom		

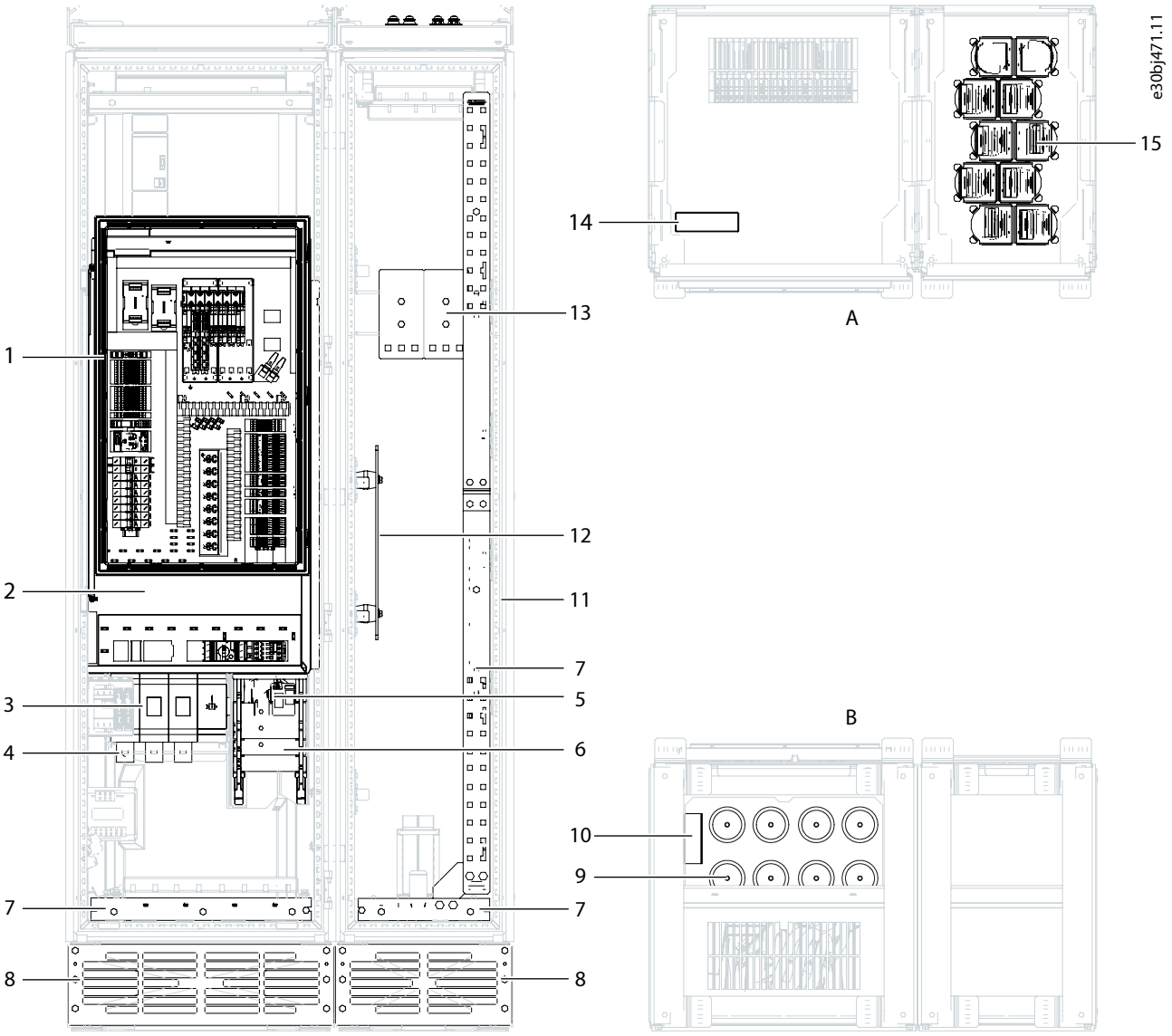


Figure 4: Interior View of FE10 with Top-entry Option

1	Control compartment	**2**	Contactor (behind control compartment)
3	Main switch (optional)	**4**	Mains terminals
5	dU/dt Filter	**6**	Motor terminals
7	PE busbar	**8**	Inlet air grill
9	IP54 grommet for mains and motor cables (IEC)	**10**	Control cable grommet, bottom
11	Motor terminals (behind PE busbar, Top-entry option)	**12**	Mains terminals (Top-entry option)
13	Brake terminals (Top-entry option)	**14**	Control cable grommet, top

15	IP54 grommet for mains and motor cables (Top-entry option)	**A**	View from the top
B	View from the bottom		

4.2.3 Interior View of the Cabinet, AE10 + IE10

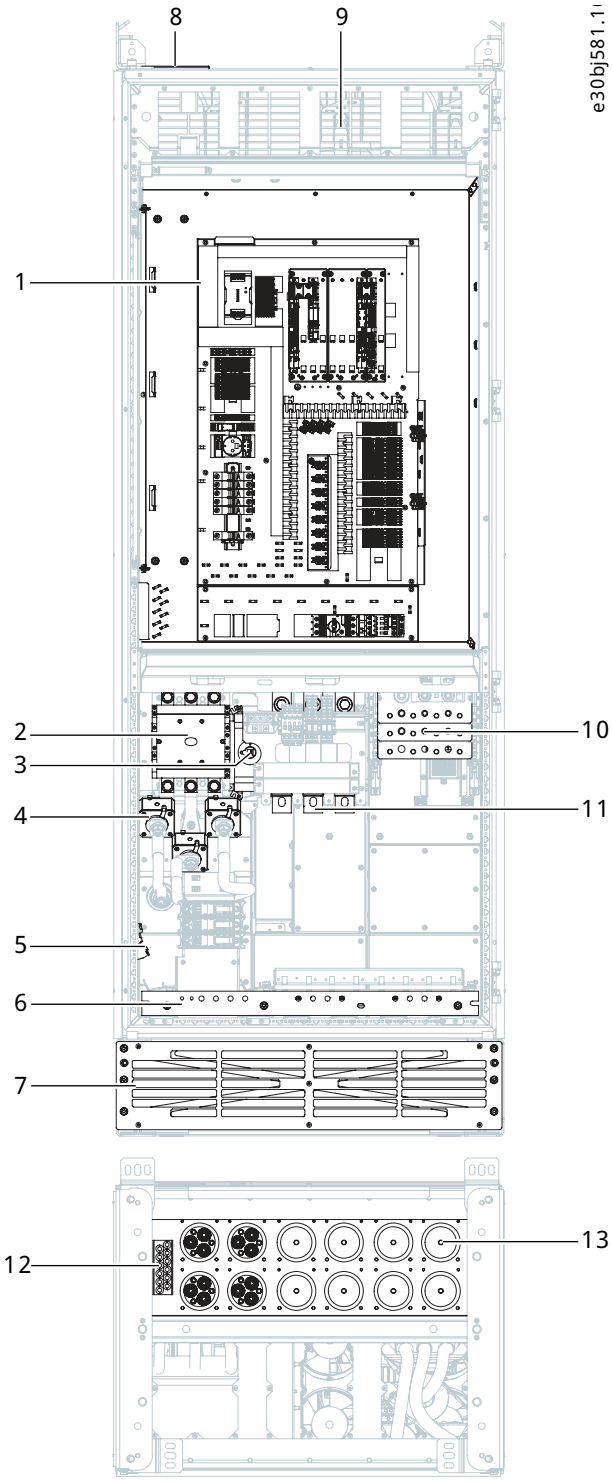


Figure 5: Interior View of the Cabinet, AE10 + IE10

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

4.2.4 **Interior View of the Cabinet, 2 x AE10 + 2 x IE10**

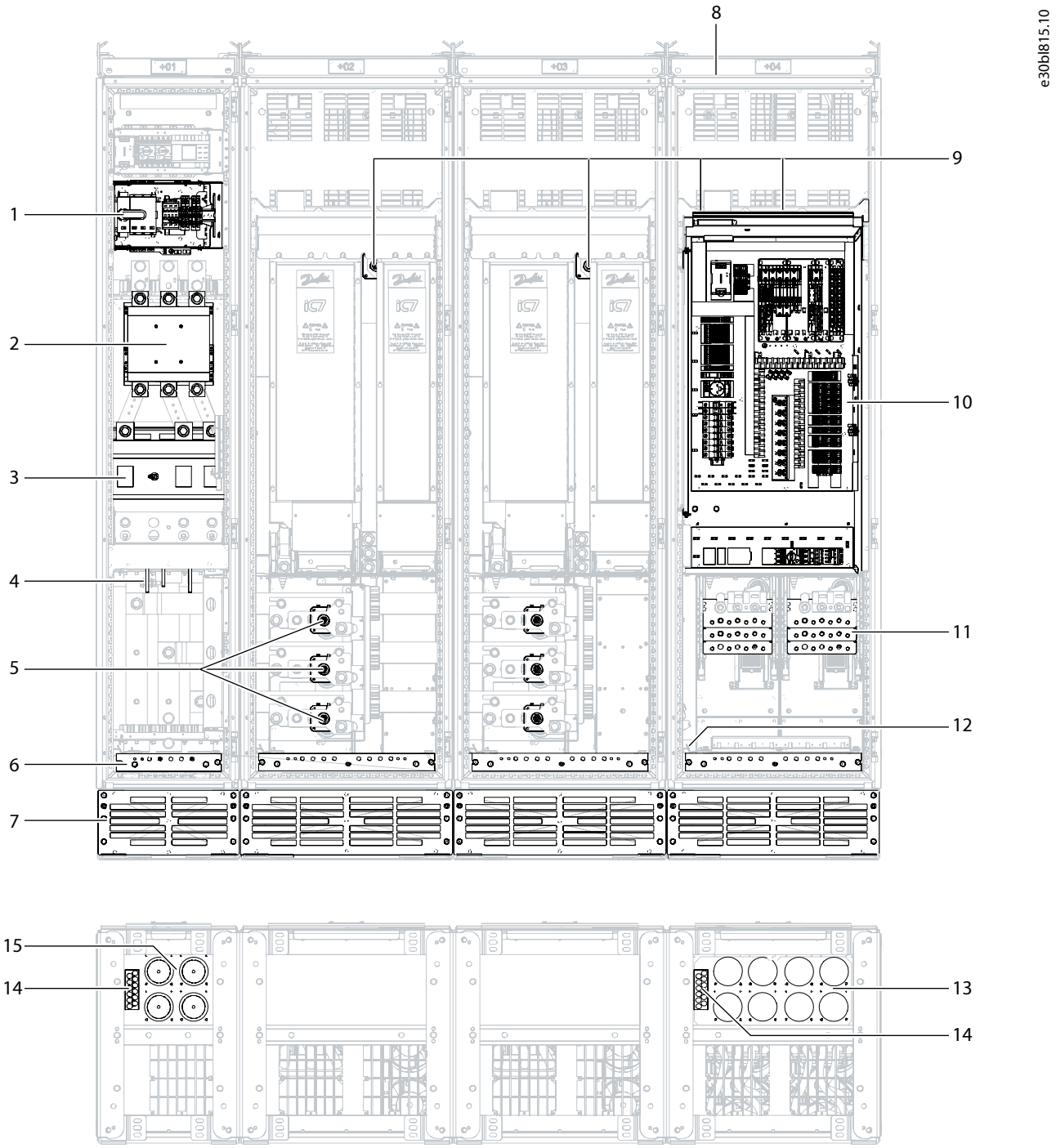


Figure 6: Interior View of the Cabinet, 2 x AE10 + 2 x IE10

1	Pre-charging circuit	**2**	Contactor
3	Main switch	**4**	Mains terminals
5	AC fuses	**6**	PE busbar
7	Inlet air grill	**8**	Control cable grommet, top
9	DC fuses	**10**	Control compartment

11	Motor terminals	**12**	Motor fan control/supply terminals (+ICFI1-4), Auxiliary AC supply terminals (+IHAS), behind PE busbar
13	IP54 grommet for motor cables (IEC)	**14**	Control cable grommet, bottom
15	IP54 grommet for mains cables (IEC)		

4.2.5 Interior View of the Cabinet, AE11 + IE11

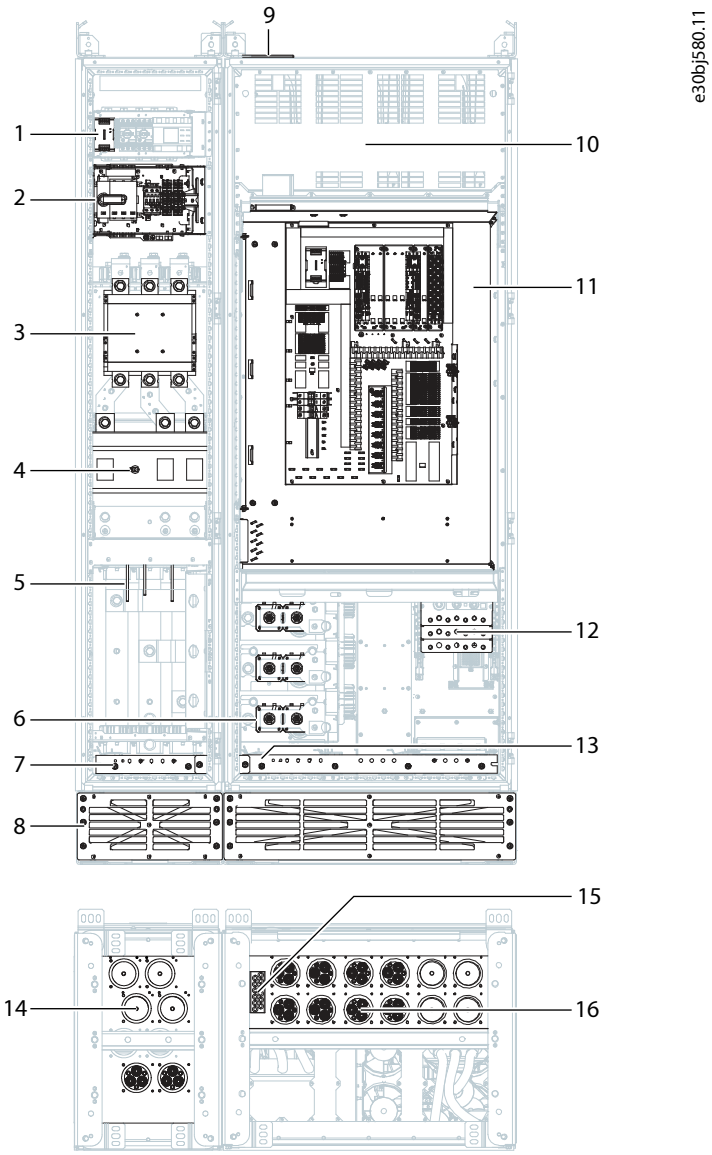


Figure 7: Interior View of the Cabinet, AE11 + IE11

1	Auxiliary AC voltage transformer (+IHAT)	**2**	Pre-charging circuit
3	Contactor	**4**	Main switch
5	Mains terminals	**6**	AC fuses
7	PE busbar	**8**	Inlet air grill
9	Control cable grommet, top	**10**	DC fuses, behind the touch protection plate

11	Control compartment	**12**	Motor terminals
13	Motor fan control/supply terminals (+ICF1-4), Auxiliary AC supply terminals (+IHAS), motor heater supply (+IAMH), behind the PE busbar	**14**	IP54 grommet for mains cable (IEC)
15	Control cable grommet, bottom	**16**	IP54 grommet for motor cable (IEC)

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

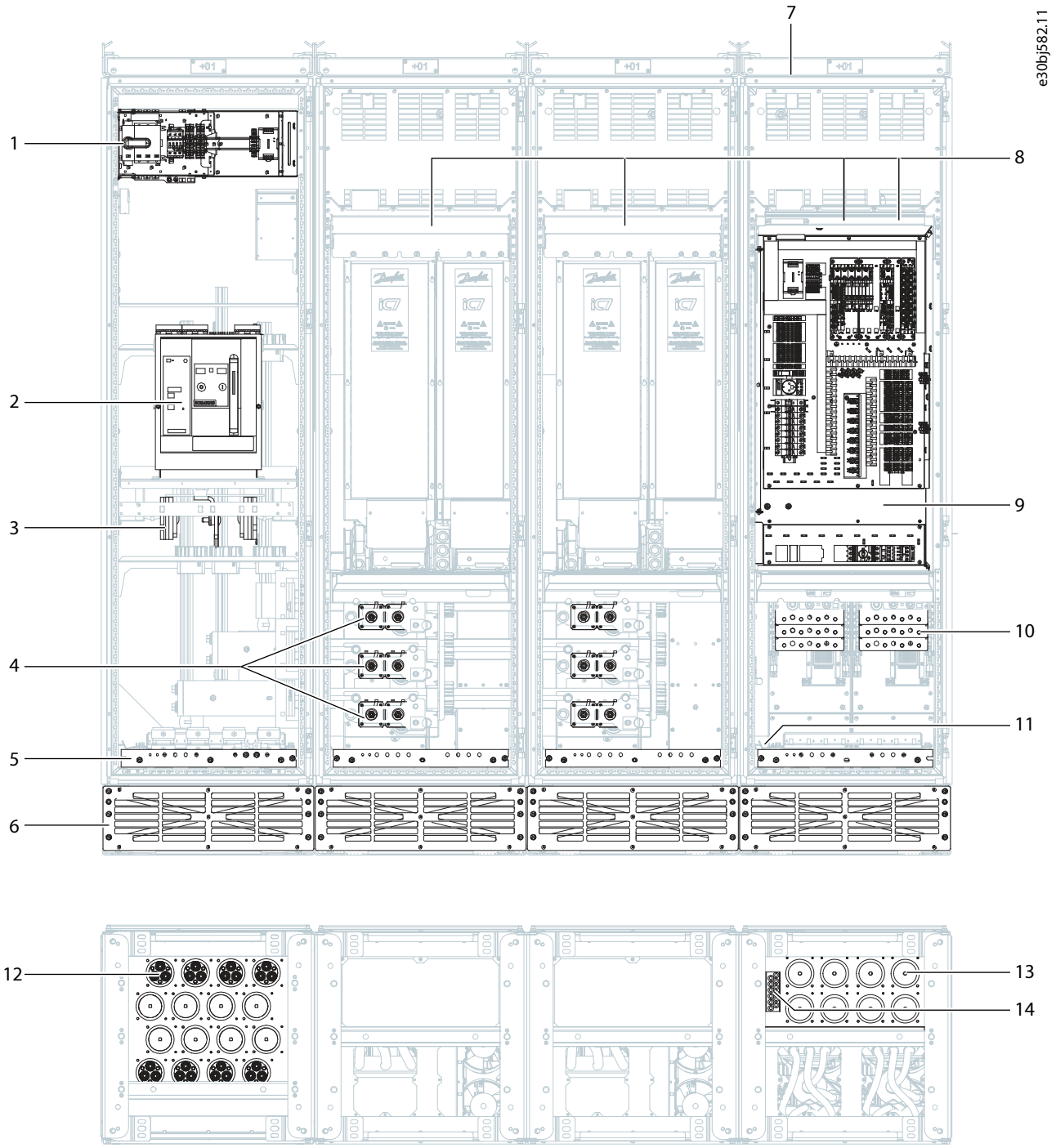


Figure 8: Interior View of the Cabinet, 2 x AE11 + 2 x IE11

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

4.3 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 4: 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

4.4 Weights

Table 5: Weights of the Enclosed Drives (Drive + Cabinet)

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

4.5 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 the order.

Example

The model code can have this format, for example:

iC7-60EA3A05-880AE21F3+XXXX

Table 6: Description of the Model Code

Code	Description
iC7-60	**Product group**
EA	**Product category** EA = air-cooled enclosed drive
3A	**Product type** 3N = 3-phase 6-pulse 3A = 3-phase AFE (regenerative) 3H = 3-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.

4.6 Product Label

The product label gives information about the product.

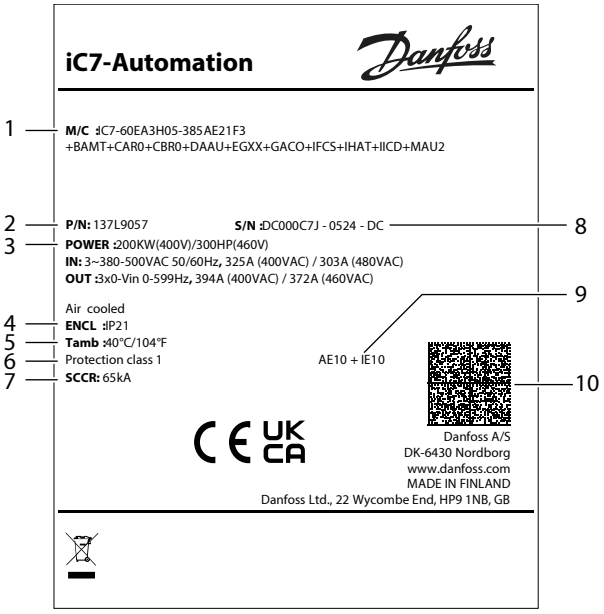


Figure 9: Product Label for iC7-Automation Enclosed Drives

1	Model code of the product	**2**	Product number
3	Power, input, and output ratings	**4**	Protection rating
5	Temperature rating for ambient air	**6**	Protective class
7	Short-circuit current rating	**8**	Serial number
9	Frame designation	**10**	2D code accessible with a Datamatrix ECC 200 compatible barcode reader

4.7 Labels on the Power Units

The power units in the enclosed drive have individual labels on the front. The labels include technical specifications and data for identifying the power unit.

For descriptions of the labels, see:

- FE9, FE10: *iC7-Automation Frequency Converters Design Guide*
- IE10, AE10, IE11, AE11: *iC7 Series Air-cooled System Modules Design Guide*

4.8 Lifting the Enclosed Drive

The AC drive is delivered on a wooden pallet. A delivery containing 1 cabinet is delivered horizontally, but a delivery containing many cabinets is delivered vertically.

⚠ WARNING

LIFTING HEAVY LOAD

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

- Follow local safety regulations on lifting.
- Use a lifting device that is in proper working condition and appropriate for the weight of the load.
- Test lift the load to verify the proper center of gravity. Reposition the lifting point if not level.
- Do not walk under, or place any part of your body under a suspended load.

⚠ WARNING

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.

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.

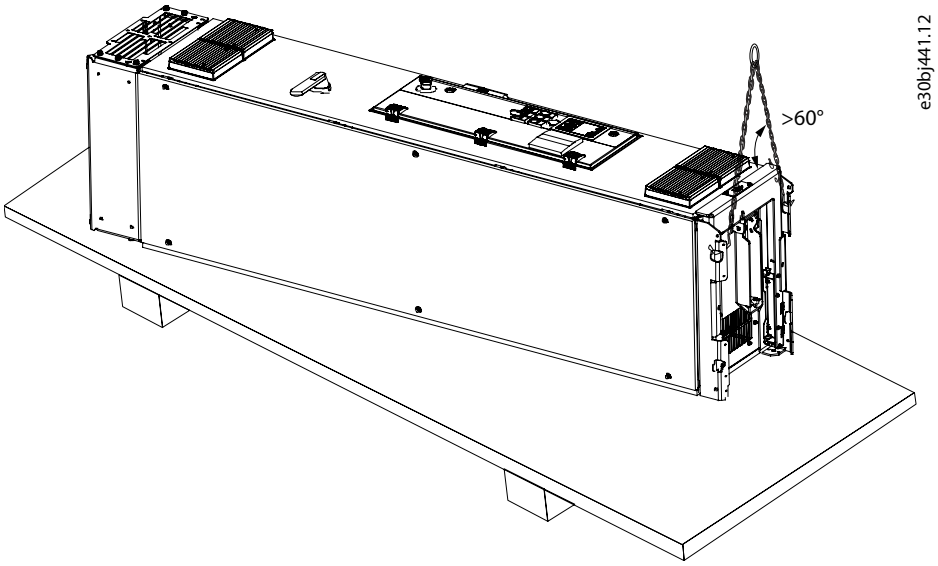


Figure 10: Lifting the Enclosed Drive to an Upright Position

3. Put the lifting hooks in the 4 lifting loops on the top of the cabinet.

   The minimum lifting angle is 60°.

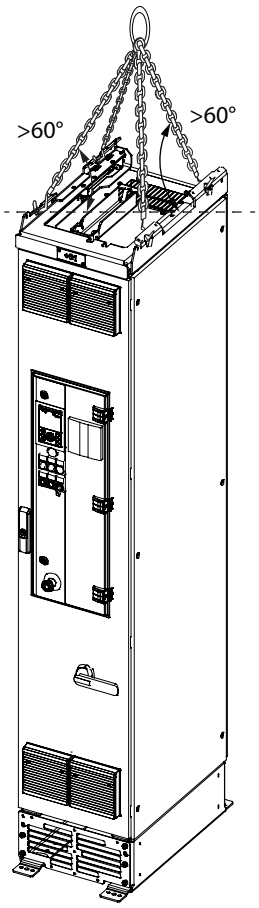


Figure 11: Lifting the Enclosed Drive

4. Lift the drive to the required position.

5 Mechanical Installation

5.1 Storing the Enclosed Drive

5.1.1 Storage Requirements

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

5.1.2 Storage of 2–12 Months

If the package is kept in storage for more than 2 months, keep it in controlled conditions.

1. Make sure that the temperature variation is small.
2. Make sure that the humidity is less than 50%.

5.1.3 Storage of over 12 Months (FE9 and FE10)

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.

1. Connect power to the drive.
2. Keep the power on for a minimum of 2 hours.
3. Disconnect the power.
4. Wait for the correct discharge time before removing the drive and storing it again.

5.1.4 Storage of Several Years

If the package is kept in storage for several years, reform the capacitors every 12 months to prevent damage to the capacitors.

1. Connect a DC supply with adjustable current limit to the DC+ and DC- terminals.
2. Set the current limit (250 mA). In case of parallel power units, multiply the value with the number of power units.
3. Set DC voltage (1.35 x U_n AC), where U_n is the drive nominal voltage.
4. Keep the power on for a minimum of 1 hour.
5. Disconnect the DC supply from the DC+ and DC- terminals.

5.2 Installation Requirements

- Make sure that the ambient conditions at the installation location comply with the specifications in 9.8.3 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 4.4 Weights.
- Make sure that the mounting surface is non-combustible.

5.3 Installing the Enclosed Drive

1. Secure the enclosed drive to the floor and to the wall using all 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.

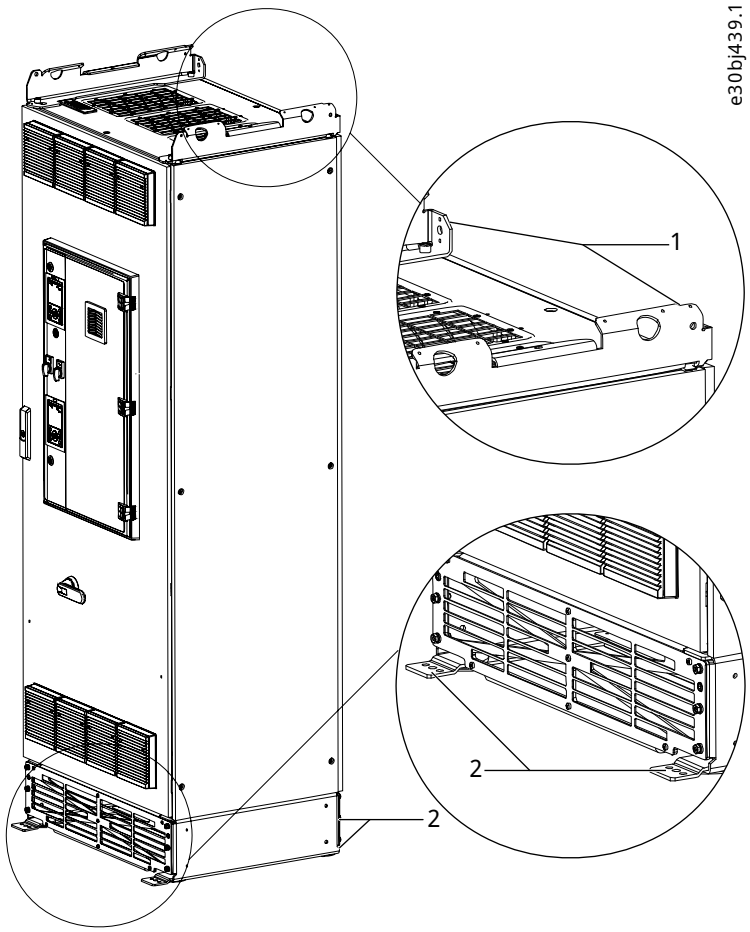


Figure 12: Installing the Enclosed Drive, FE9, FE10

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

5.4 Installing the Enclosed Drives Back to Back

The enclosed drives can be installed back to back with other enclosed drives.

1. When installing enclosed drives back to back, leave a minimum of 100 mm (3.94 in) space between them.

Use a spacer between the enclosed drives, for example a steel tube.

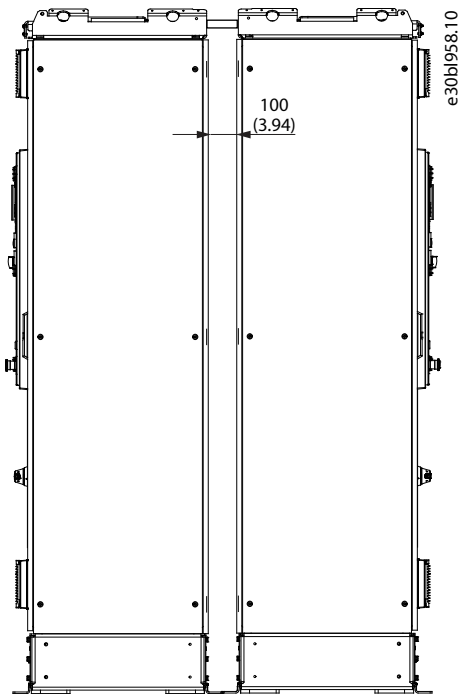


Figure 13: Installation of Cabinets Back to Back, mm (in)

2. Secure the enclosed drive to the floor and to the wall using all 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.

5.5 Installing the IP21 Top Cover

The IP21 top cover is included in the IP21 configuration of the product. The IP21 top cover protects the enclosed drive from dripping water. Install the IP21 top cover on top of the cabinet.

1. Attach the 2 top cover brackets to the lifting bars on top of the cabinet.

   Use 4 size M5x10 thread-forming screws.

2. Attach the top cover to the top cover brackets.

   Use 4 size M5x10 thread-forming screws.

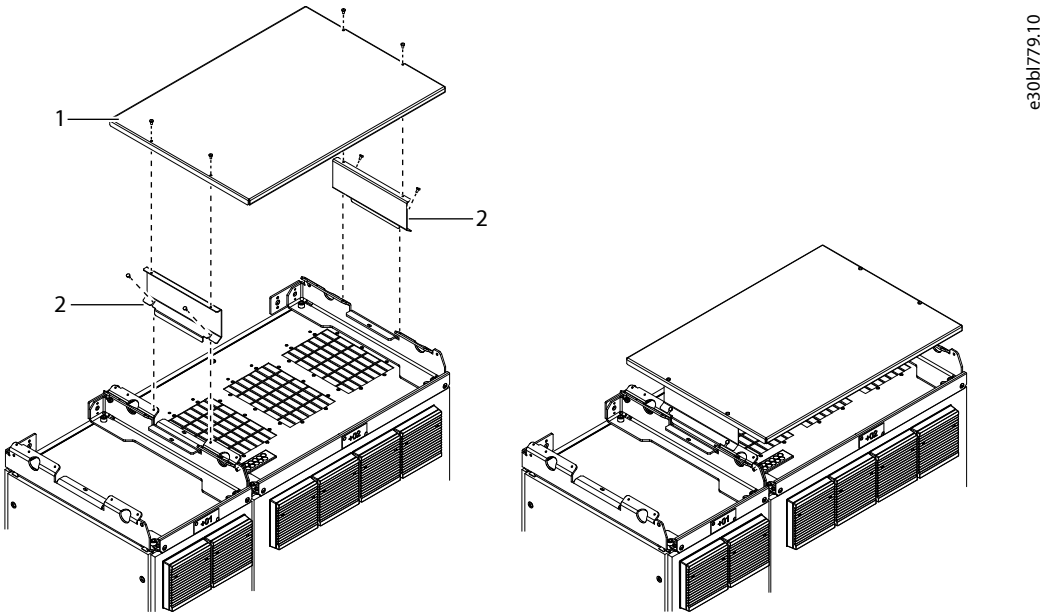


Figure 14: Installing the IP21 Top Cover

1	Top cover	**2**	Top cover brackets

5.6 Cooling Requirements

5.6.1 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 7: 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)

Table 7: Air Flow of Different Fans of the Cabinet (continued)

Cabinet	Main cooling channel [m^3/hr (cfm)]	Auxiliary cooling channel [m^3/hr (cfm)]
2 x AE10, 2 x IE10	5520 (3246)	2530 (1489)
2 x AE11, 2 x IE11	5520 (3246)	2745 (1615)

5.6.2 Default Cooling

Airflow in the default cooling of the enclosed drives is intake in the front, output at the top. Make sure that there is sufficient free space above the cabinet. The minimum space includes the lifting bars on top of the cabinet. Also make sure that there are no obstacles that can stop the airflow.

Table 8: 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)

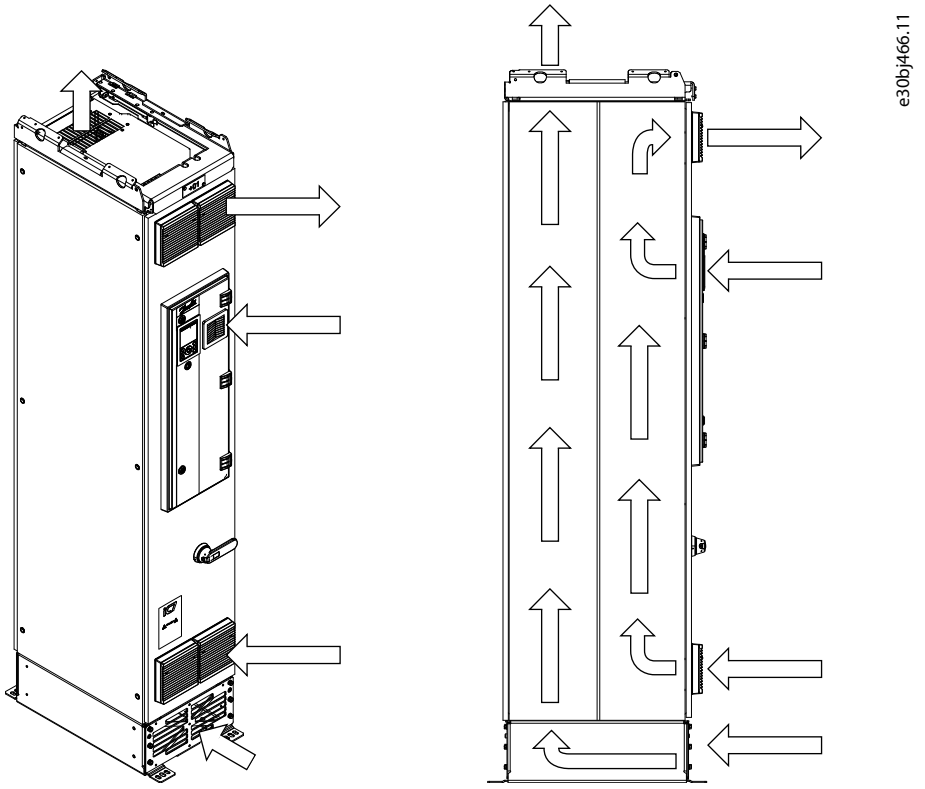


Figure 15: Airflow in Default Cooling of the Enclosed Drives

See the dimensions of the default cooling:

- 9.2.4 Dimensions for Default Cooling, FE9
- 9.2.5 Dimensions for Default Cooling, FE10
- 9.2.6 Dimensions for Default Cooling, AE10, AE11, IE10, IE11

5.6.3 **Cooling Options**

The enclosed drives have two cooling options, the back-channel cooling (+OABC) and the cooling air output flange (+OAOF). In the cooling air output flange, the front and rear plates of the plinth are interchangeable, so the air intake can be in the front or at the back.

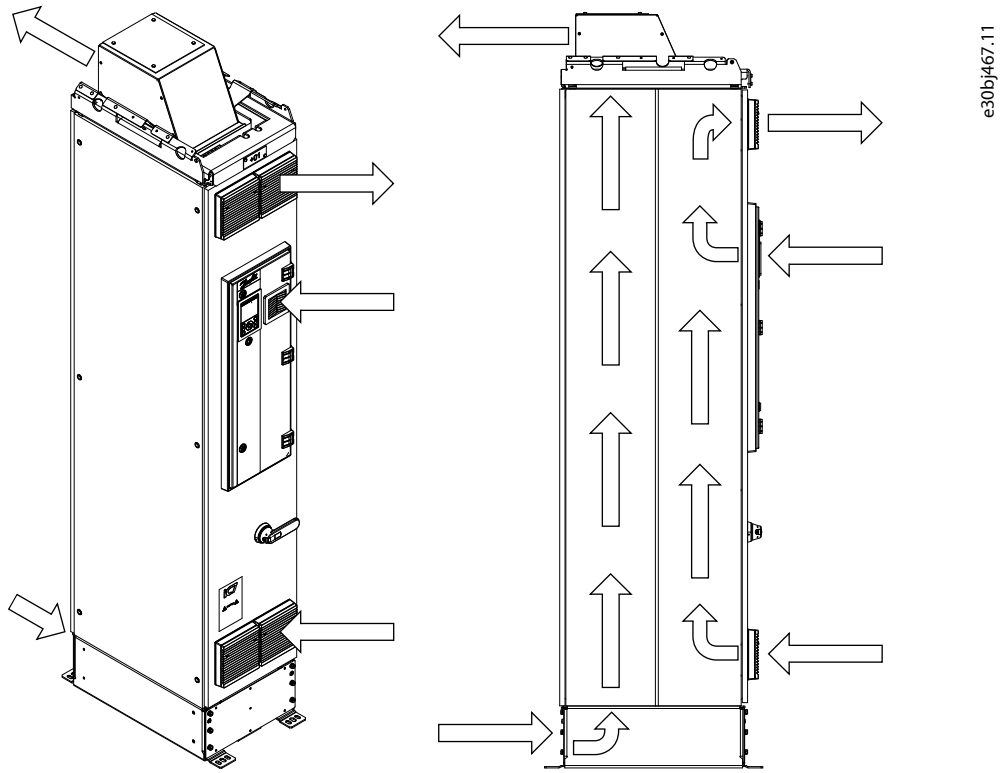


Figure 16: Back-channel Cooling (+OABC), Intake Back, Output Back

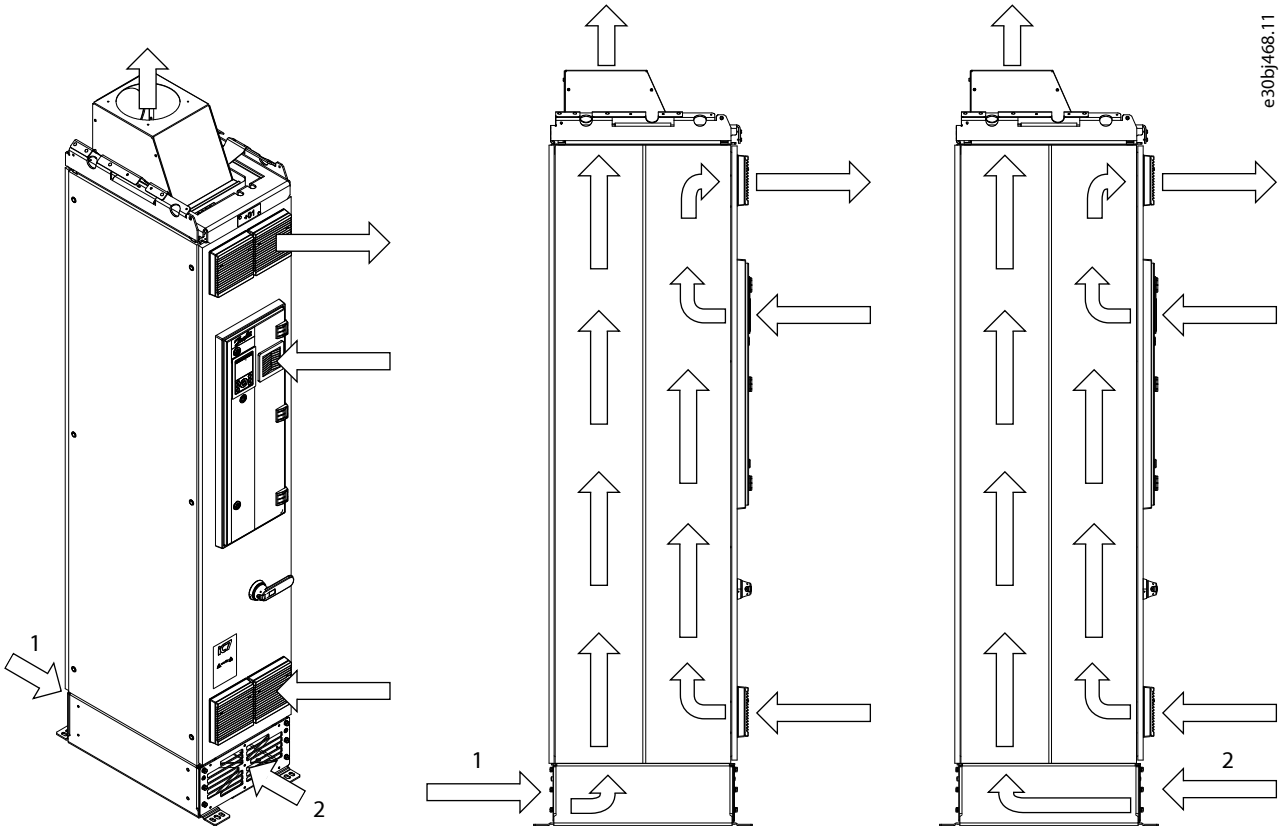


Figure 17: Cooling Air Output Flange (+OAOF), Intake Front or Back, Output Top

1	Air intake at the back	**2**	Air intake in the front

Table 9: Number of Air Output Holes in the Cooling Air Output Flange

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

See the dimensions of the cooling options:

- 9.2.7 Dimensions for Back-channel Cooling Option, FE9
- 9.2.8 Dimensions for Back-channel Cooling Option, FE10
- 9.2.9 Dimensions for Back-channel Cooling Option, AE10, AE11, IE10, IE11
- 9.2.10 Dimensions for the Cooling Air Output Flange Option, FE9
- 9.2.11 Dimensions for the Cooling Air Output Flange Option, FE10
- 9.2.12 Dimensions for the Cooling Air Output Flange Option, AE10, AE11, IE10, IE11

5.7 Installing the Back-channel Cooling Option

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

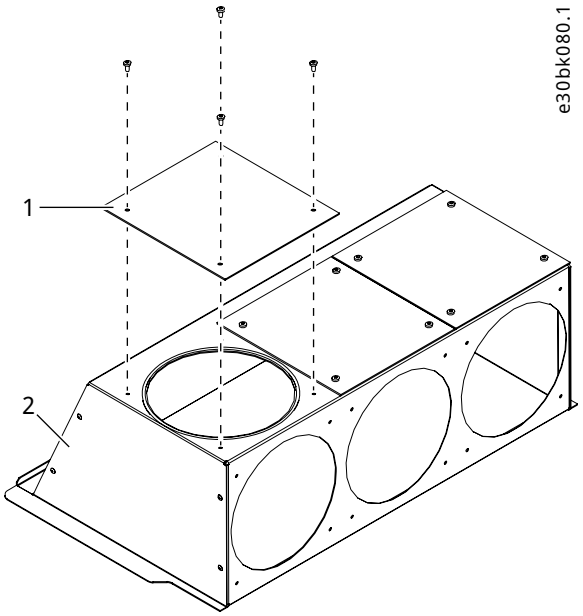


Figure 18: Installing the Back-channel Cooling Option Cover Plate

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, each with 6 mounting holes.

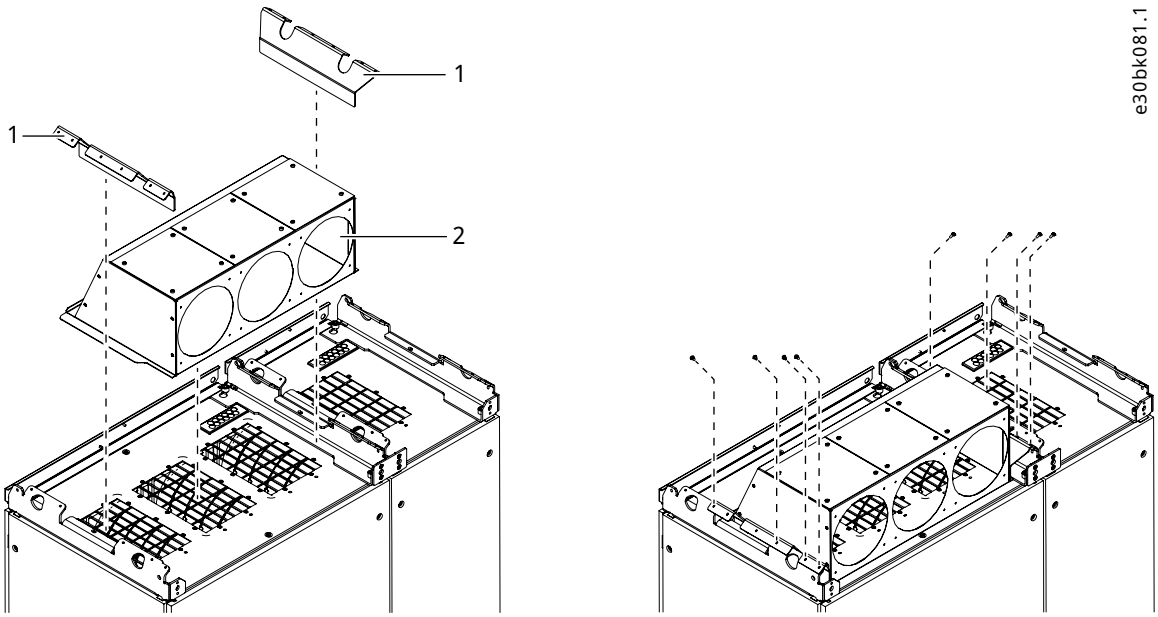


Figure 19: Installing the Back-channel Cooling Option Brackets

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.

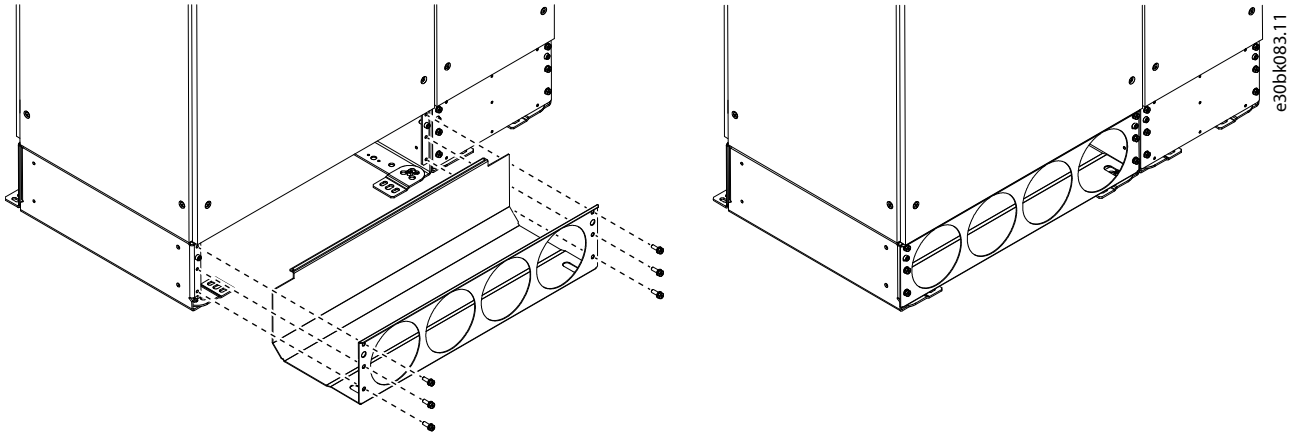


Figure 20: Back-channel Cooling Option Air Guide at the Bottom

6 Electrical Installation

6.1 Fuse Guidelines

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

See the fuse tables: 9.6.1 Fuse Size Tables.

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

DC fuses are preinstalled for parallel units in frames AE10, AE11, IE10, and IE11. Do not replace the DC fuses with any other types.

6.2 Grounding Principles

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

According to IEC 60364-5-54; 543.1, 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 (AWG 2).

The connection must be fixed.

⚠ WARNING

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) (mechanically protected) or 4 mm^2 (12 AWG) (not mechanically 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.

6.3 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 power cabling with power units connected in parallel. 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 9.5.1 General Cable Size Information.

Only use symmetrical and shielded 3-phase motor cables. See Figure 21. 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 Figure 22.

To reach C3 EMC performance, use shielded motor and mains cables.

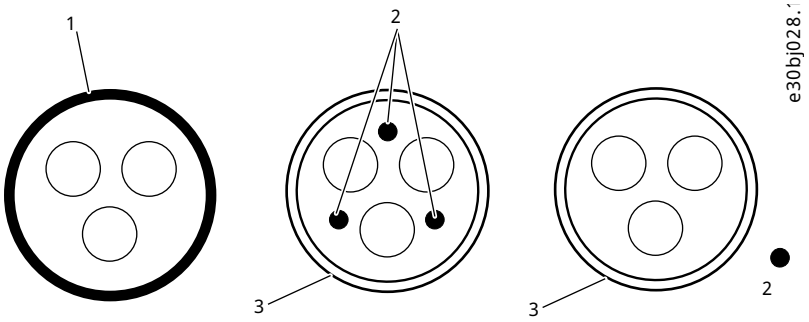


Figure 21: Recommended Cable Types for Mains and Motor Cabling

1	PE conductor and shield	**2**	PE conductor
3	Shield		

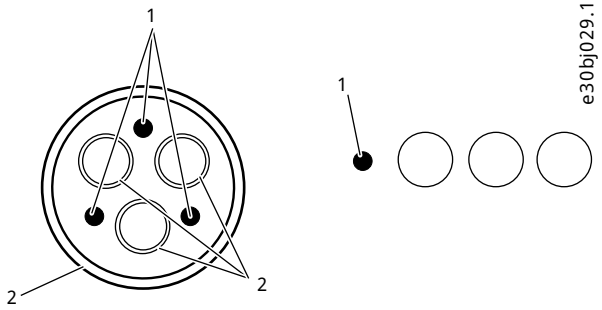


Figure 22: Not Recommended Motor Cable Types

1	PE conductor	**2**	Shield

6.4 Brake Cable Requirements

The maximum brake cable length is 10 m/33 ft.

Table 10: Brake Cable Requirements

Frame	Cable
FE9	Single-core shielded cable
FE10	3-phase shielded multicore cable. 1st core for BR+, 2nd core for BR-, 3rd core not used.

6.5 Prerequisites for Cable Installation

- Before starting, make sure that none of the components of the AC drive are live. Read all safety precautions in this guide and other documents available for this product.
- 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 possible, do not route 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 11).
- 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.
- Check the insulation resistance of cables if necessary.

Table 11: Minimum Distances from Motor Cables to Other Cables

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

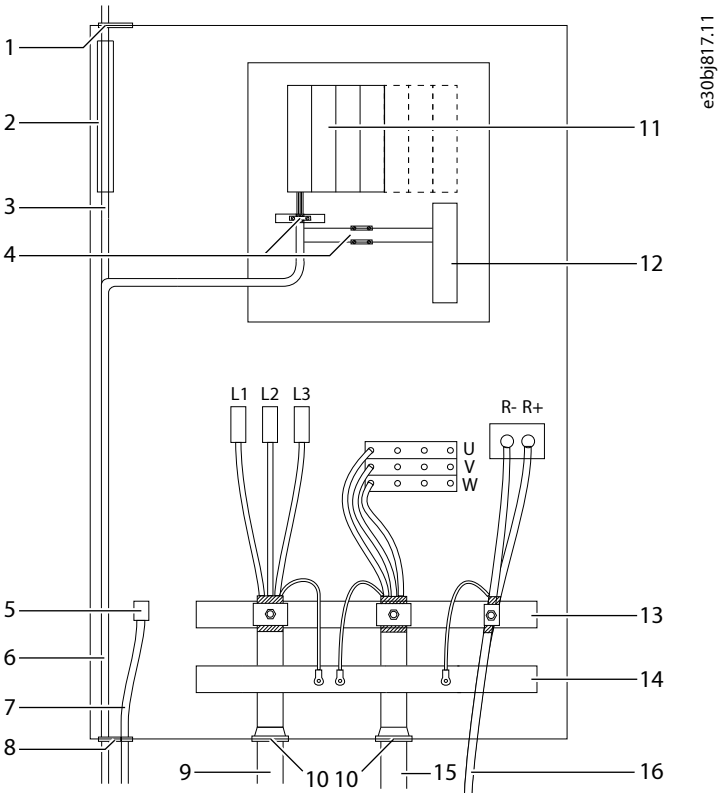


Figure 23: Cabling Principle

1	Control cable grommet	**2**	Cable installation tubes, 2 pcs, diameter 32 mm (1.3 in)
3	Control cables from the top	**4**	Strain relief and cable grounding
5	Auxiliary power terminals	**6**	Control cables from the bottom

7	Auxiliary power cable	**8**	Control cable grommet
9	Mains cable	**10**	Grommets
11	Control board and option boards	**12**	Terminal blocks
13	Strain relief and 360° grounding	**14**	PE busbar
15	Motor cable	**16**	Brake cable

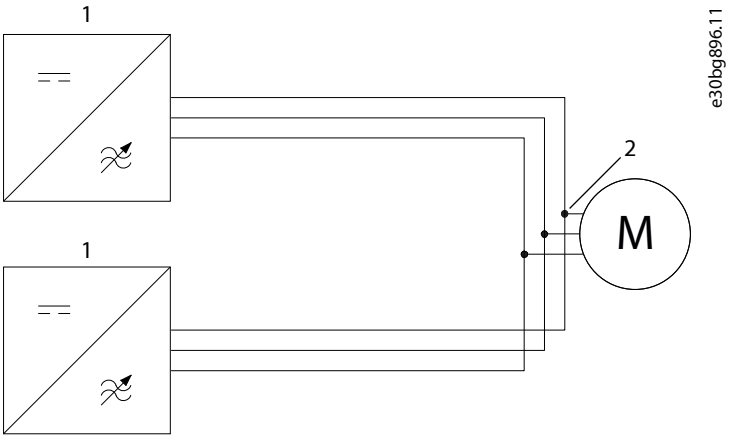


Figure 24: Recommended Installation

1	Inverter 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 Power Cables

6.6.1 Installing the Power Cables through the Bottom

DANGER

ELECTRIC SHOCK

There are live components behind the touch protections. Lack of touch protections can cause death or serious injury.

- After power cabling, reinstall all touch protections at their original places.

1. Lift the service table all the way up until it is locked.
2. Strip the mains and motor cables.
3. In an IP54 installation, make openings for the cables in the grommets on the bottom of the cabinet.

   This instruction applies for IEC installations.

   The grommets must be suited to the output diameter of the cable. The cable diameter is 25–65 mm (1–2.6 in).
4. Lead the power cables through the grommet holders.
5. Peel the cable shield and attach the end to the PE busbar.
6. Use cable clamps to fix the cables.

7. To make a 360° connection, expose the shield of the cables. Use a cable tie to attach the knitted metal mesh tube.

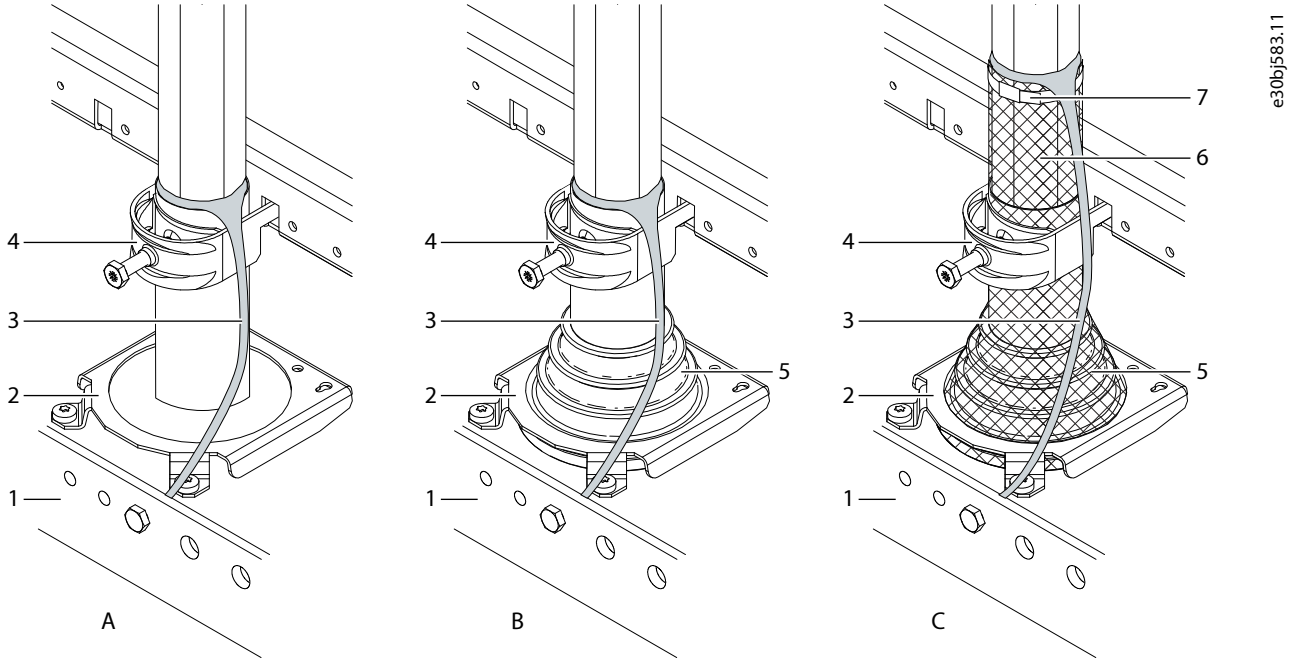


Figure 25: Cabling Methods (IEC)

1	PE busbar	**2**	Grommet holder
3	Cable shield	**4**	Cable clamp
5	Grommet	**6**	Knitted metal mesh tube
7	Cable tie	**A**	IP21
B	IP54	**C**	EMC 360° (IP54 and knitted metal mesh tube)

8. 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 9.1 Tightening Torques.

9. Connect the grounding conductors to the PE busbar.

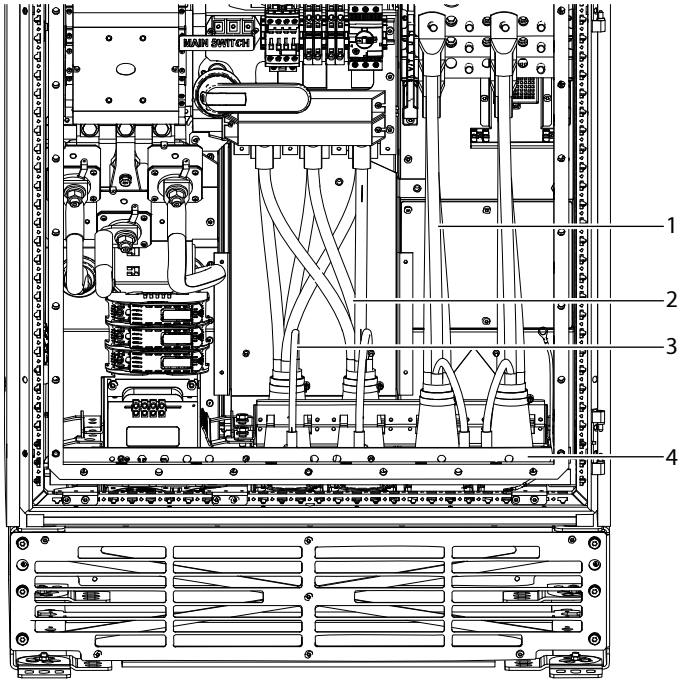


Figure 26: Cabling of the Enclosed Drive

1	Motor cables	**2**	Mains cables
3	Grounding conductor	**4**	PE busbar

10. Release and lower the service table.

6.6.2 Installing the Power Cables through the Top (+KCIT or +KDOT)

Use these instructions with the options Top-entry +KCIT and +KDOT.

⚠ DANGER

ELECTRIC SHOCK

There are live components behind the touch protections. Lack of touch protections can cause death or serious injury.

- After power cabling, reinstall all touch protections at their original places.

1. Strip the mains and motor cables.

2. Make openings for the cables in the grommets at the top of the cabinet.

This applies for IEC installations.

The grommets must be suited to the output diameter of the cable. The cable diameter is 25–65 mm (1–2.6 in).

3. Lead the power cables through the grommet holders.

4. Peel the cable shield and attach the end to the PE busbar.

5. Use cable clamps to fix the cables.

6. To make a 360° connection, expose the shield of the cables. Use a cable tie to attach the knitted metal mesh tube.

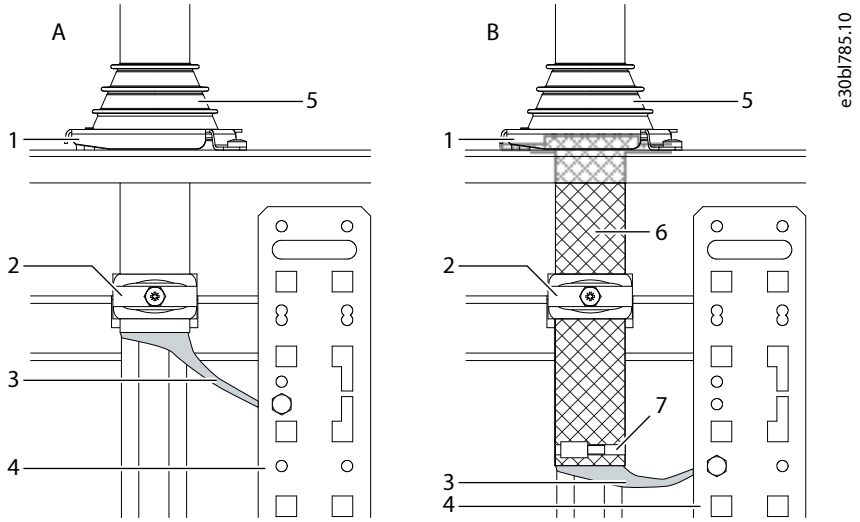


Figure 27: Cabling Methods (IEC)

1	Grommet holder	**2**	Cable clamp
3	Cable shield	**4**	PE busbar
5	Grommet	**6**	Knitted metal mesh tube
7	Cable tie	**A**	IP54
B	EMC 360° (IP54 and knitted metal mesh tube)		

7. 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 9.1 Tightening Torques.

8. Connect the grounding conductors to the PE busbar.

6.7 Installing the Brake Cables, FE9, FE10

1. Strip the brake cables.
2. To make a 360° connection, expose the shield of the cables.
3. Peel the cable shield and attach the end to the PE busbar.
4. Use cable clamps to fix the cables.
5. Find the brake terminals in the system module inside the cabinet. Connect the brake cables to the brake terminals.

   Use M10 bolts.

   Use the tightening torque 19 Nm (168 in-lb).

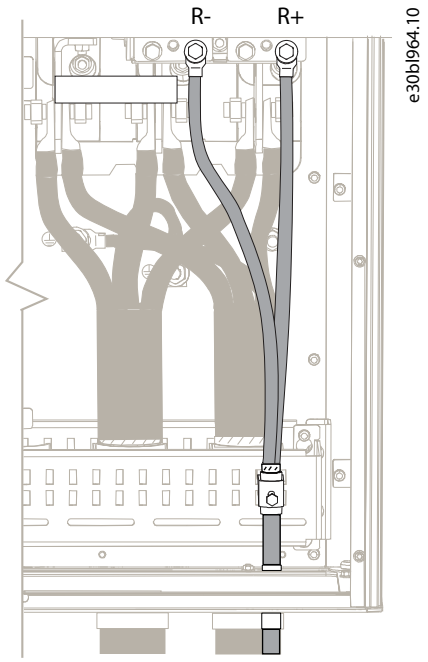


Figure 28: Installing the Brake Cables in the Enclosed Drive, FE9, FE10

6.8 Power Cabling Floor Components, UL

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

Some grounding wires are connected to the PE busbar. Reconnect these grounding wires after installation.

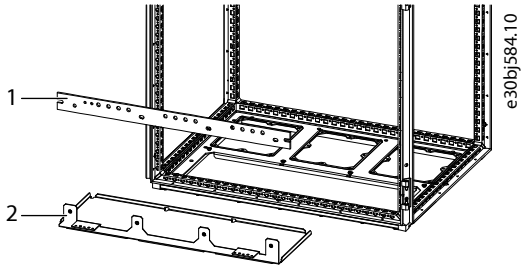


Figure 29: UL Floor Components

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

6.9 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.

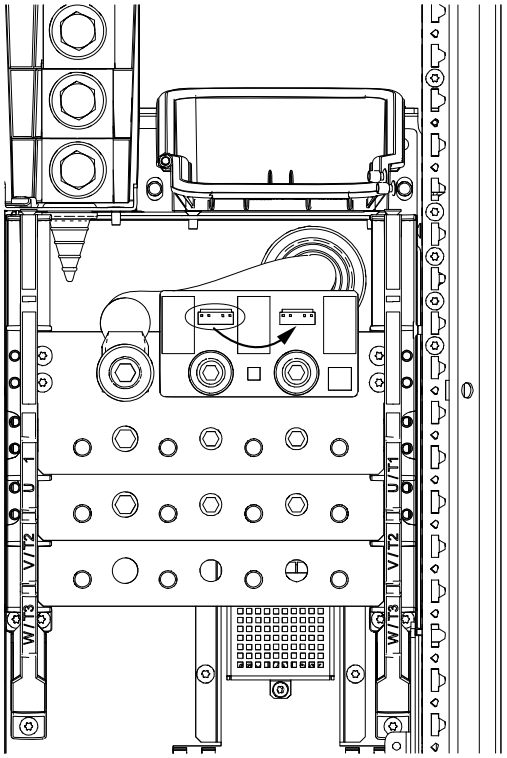
6.10 Disconnecting the dU/dt Filter Capacitors

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.

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. This prevents tight bends in the cables between the control compartment and the frame of the drive and ensures that the control compartment can be fully opened during module maintenance.

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

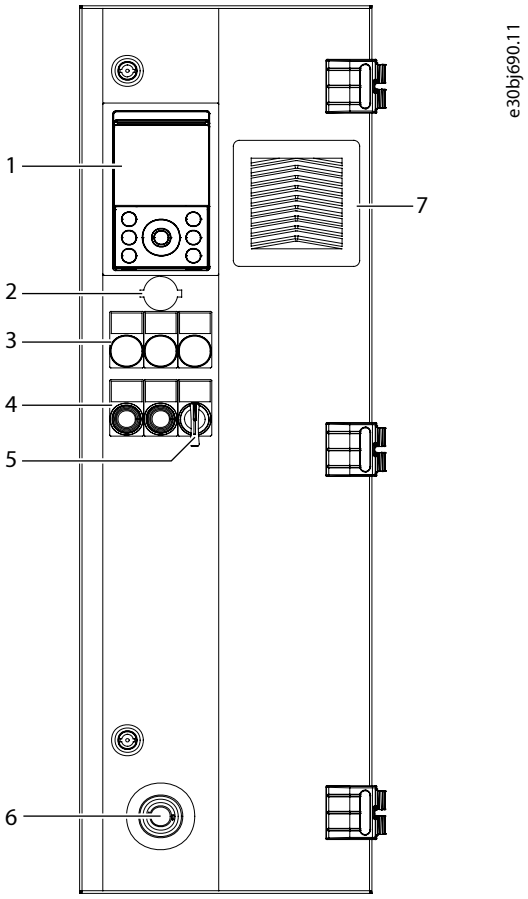


Figure 30: Control Compartment Door Elements, FE9, FE10

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

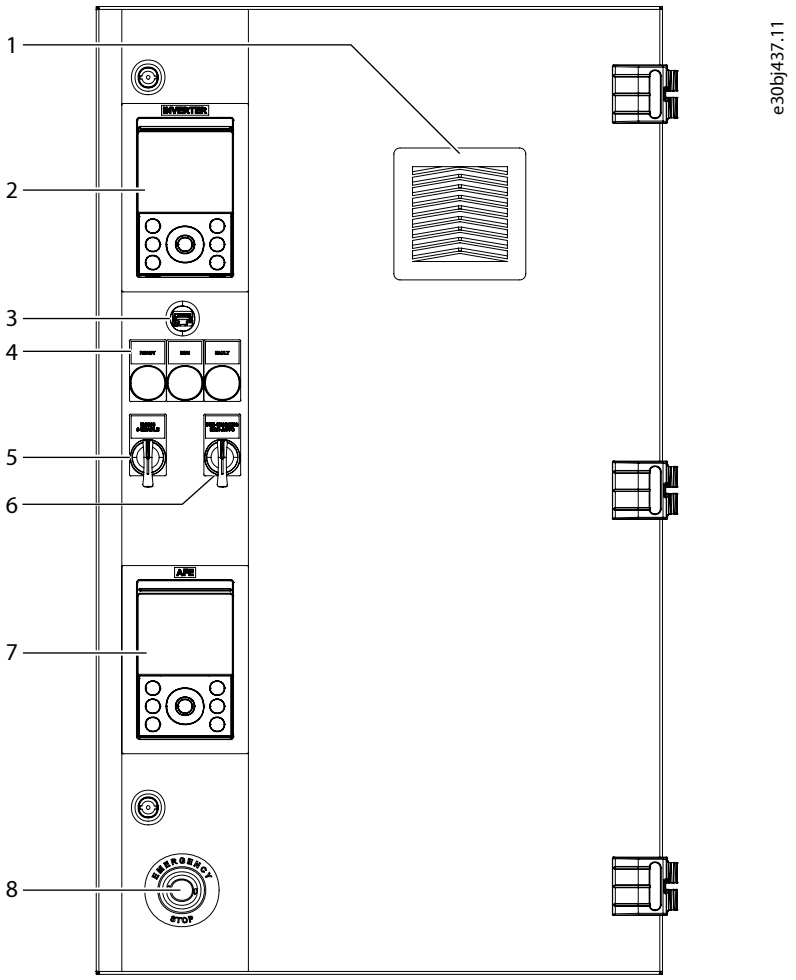


Figure 31: Control Compartment Door Elements, AE10/11, IE10/11

1	Filter cover and optional IP54 filter (+IP54)	**2**	Control panel (for the inverter module), -PGA
3	Ethernet port (for the inverter module), RJ45	**4**	Run, ready, and fault lights (+IICD), -PF3, -PF4, -PF5
5	Mains 0–enable switch, -SF11	**6**	Pre-charging MAN–AUTO switch, -SF12
7	Control panel (for the AFE module), -PGA2	**8**	Emergency stop button (+ILSS), -SFG

7.3 Control Compartment Internal Elements

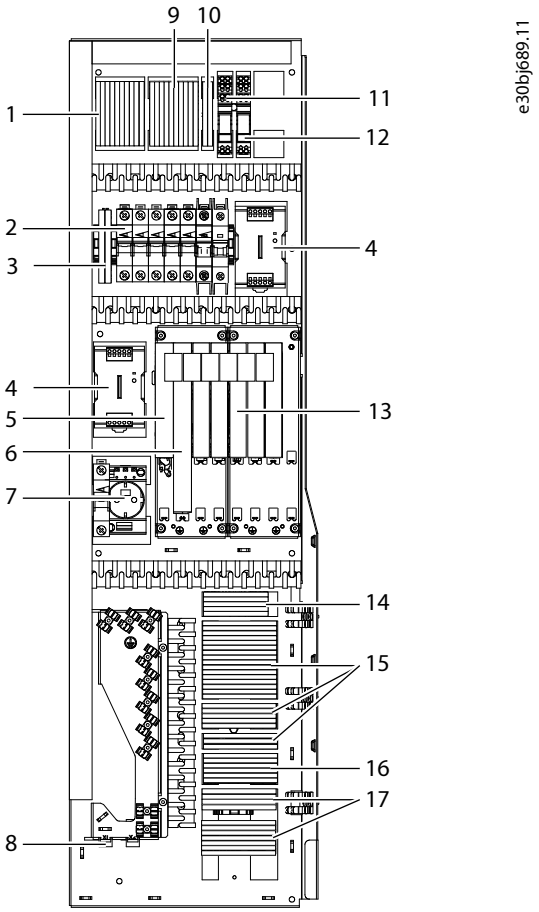


Figure 32: Elements inside the Control Compartment, FE9

1	Mains contactor terminals (+GAC0) -XD0	**2**	Circuit breakers
3	Grounding terminals, -PE	**4**	24 V DC power supply (TB7, TB7.1)
5	Option Extender OC7F2	**6**	I/O and Relay Option OC7C1
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**	Ethernet ports for fieldbus X1 and X2
9	Auxiliary AC supply terminals (+IHAS), or auxiliary AC voltage transformer terminals (+IHAT), -XD1	**10**	Cabinet heater terminals (+IBCH), -XD4
11	Auxiliary relay (+IBCH, +IAMH), -QAM	**12**	Auxiliary relay for door fan- QAB
13	Option slots	**14**	24 V DC terminals, -XD3
15	Spring-type terminals, -XD2.1, -XD2.2, -XD2.3	**16**	Door device terminals, -XDJ
17	Terminals for I/O and relay options		

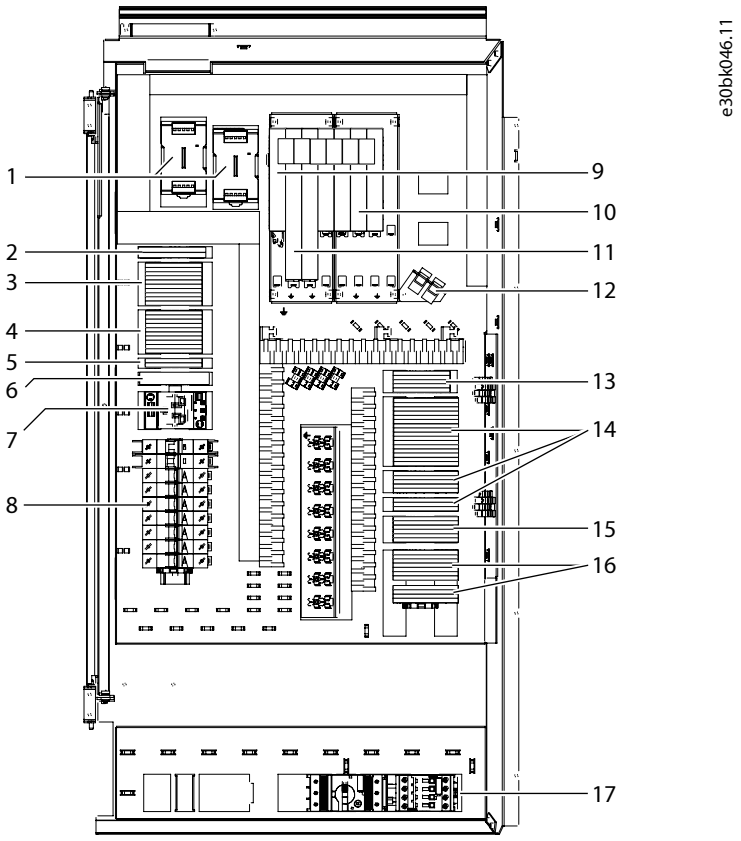


Figure 33: Elements inside the Control Compartment, FE10

1	24 V DC power supply (TB7, TB7.1)	**2**	Grounding terminals, -PE
3	Mains contactor terminals (+GACO), -XD0	**4**	Auxiliary AC supply terminals (+IHAS), or auxiliary AC voltage transformer terminals (+IHAT), -XD1
5	Terminals for the cabinet heater option (+IBCH), -XD4	**6**	Auxiliary relay (+IBCH, +IAMH), -QAM
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**	Circuit breakers
9	Option Extender OC7F2	**10**	Option slots
11	I/O and Relay Option OC7C1	**12**	Ethernet ports for fieldbus X1 and X2
13	24 V DC terminals, -XD3	**14**	Spring-type terminals, -XD2.1, -XD2.2, -XD2.3
15	Door device terminals, -XDJ	**16**	Terminals for I/O and relay options
17	Motor fan supply or control supply (+ICF1...+ICF4), -FCK, -QA9		

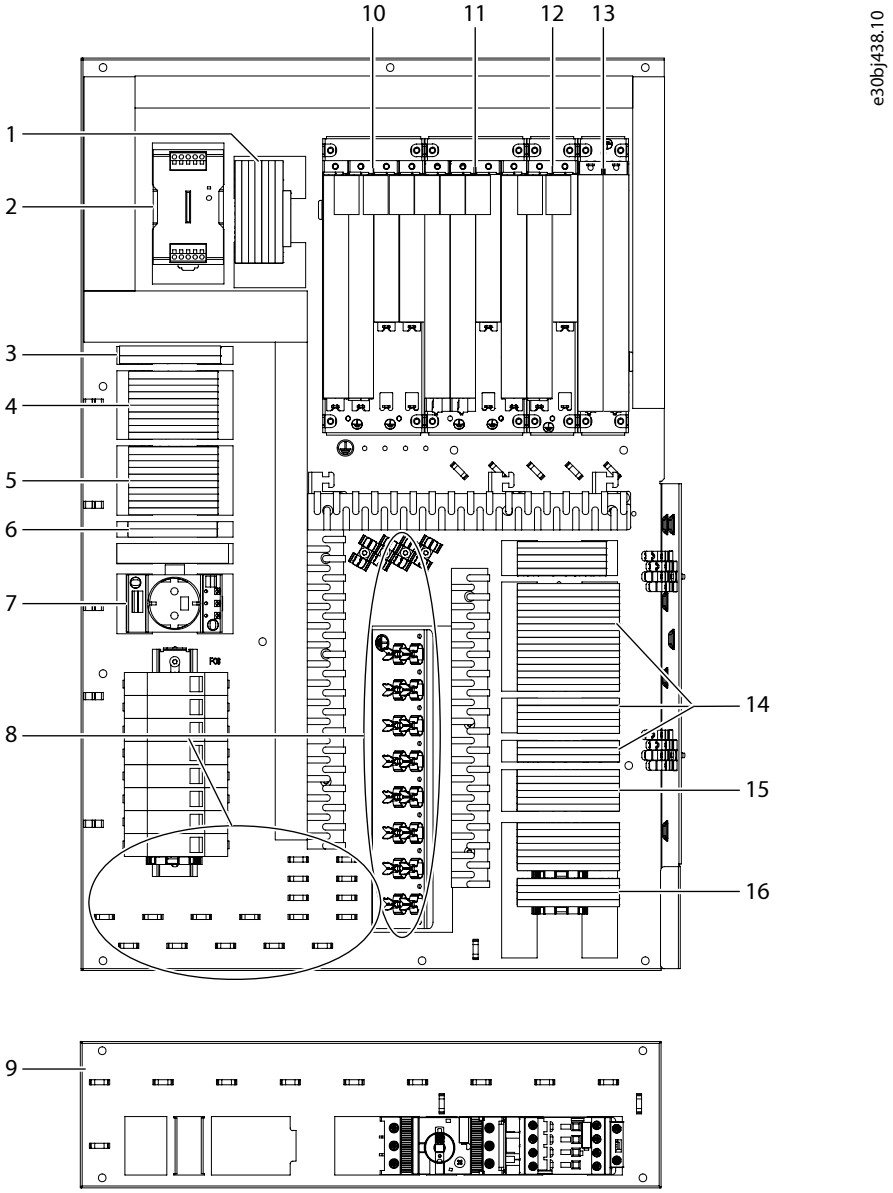


Figure 34: Elements inside the Control Compartment, AE10/11, IE10/11

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 OC7C1, 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 OC7C1.	**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**	Reserved for option terminals, for example, option slot AA3 terminals or insulation monitoring terminals (+IMIF)

7.4 Control Compartment Connections

Table 12: 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 terminal	1 x 10 spring force connector 0.2–1.5 mm^2
OptionBus	OptionBus (internal connection)	Custom
X80	Fiber optic link to power unit or star coupler board	LC-duplex
X9	Control panel terminal	iX Industrial
RTC battery	RTC battery	BR1632 (battery type)

Table 13: STO Terminal Signals (X33, XD2.2)

Terminal on the control board	Function	Terminal block	Description
41A[(1)]	24 V	-XD2.2:41	+ 24 V DC Output
41B[(1)]	24 V	-XD2.2:41	+ 24 V DC Output
42	S.INA+	-XD2.2:42	+ Safe Input Channel A
43	S.INB+	-XD2.2:43	+ Safe Input Channel B
44	S.FB+	-XD2.2:44	+ STO Feedback
45A[(1)]	GND	-XD2.2:45	0 V/GND
45B[(1)]	GND	-XD2.2:45	0 V/GND
46	S.INA-	-XD2.2:46	- Safe Input Channel A
47	S.INB-	-XD2.2:47	- Safe Input Channel B
48	S.FB-	-XD2.2:48	- STO Feedback

1) Terminals 41A, 41B, 45A, and 45B have double pins to make connections easier.

For more information on the STO safety function, see *the iC7 Series Functional Safety Operating Guide, Air-cooled and Liquid-cooled System Modules* (AE10, AE11, IE10, and IE11) or *the iC7-Automation Functional Safety Operating Guide, Frequency Converters* (FE9 and FE10).

Table 14: 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 Star Coupler Board

Enclosed drives consist of multiple power units that are connected via a star coupler board to 1 control unit.

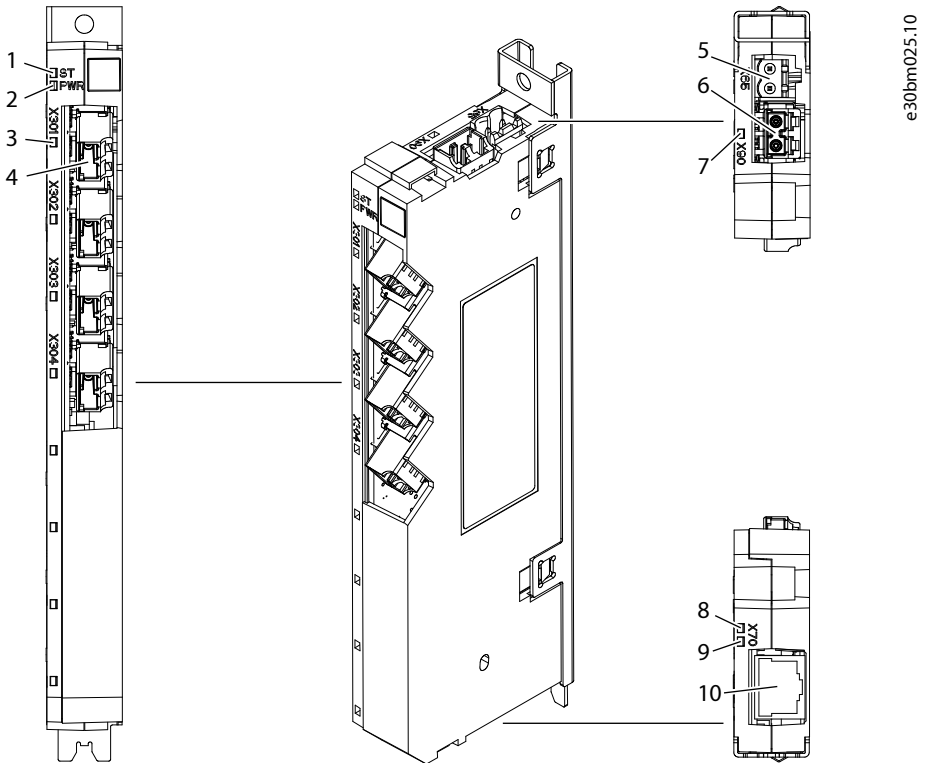


Figure 35: Terminal and Indicator Light Locations on the 4-port Star Coupler Board

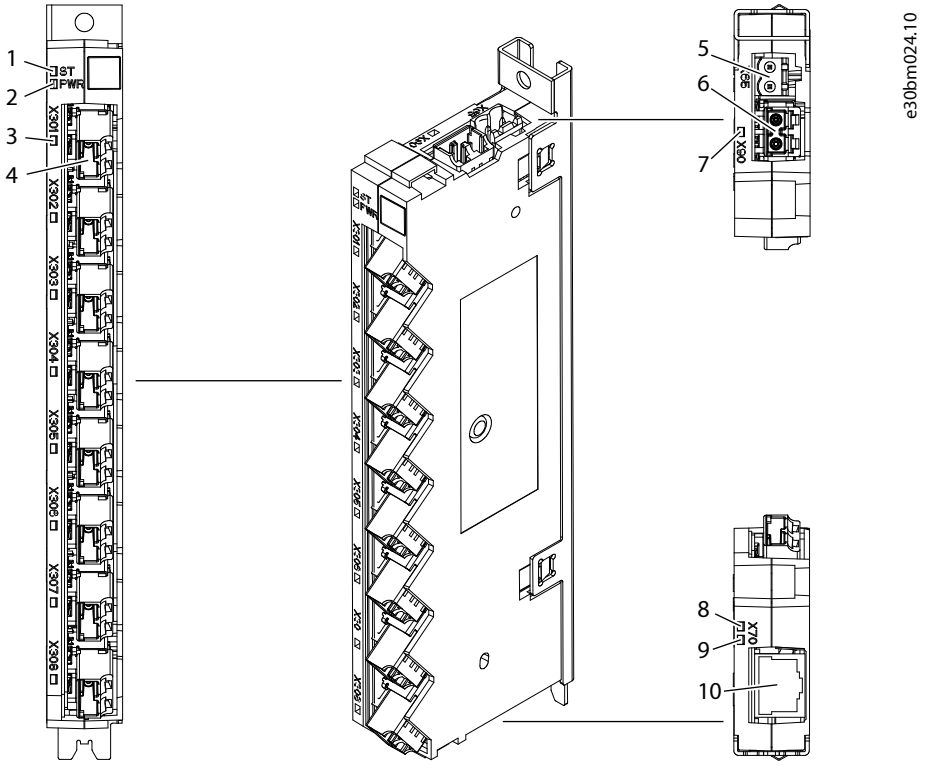


Figure 36: Terminal and Indicator Light Locations on the 8-port Star Coupler Board

1	Board configuration status indicator	**2**	+24 V power status indicator
3	Power unit connection status indicators	**4**	Fiber connection to the power unit (X301–X316)
5	+24 V power supply (X65)	**6**	Fiber connection to the control board (X90)

7	Control link status indicator	**8**	Ethernet speed indicator
9	Ethernet link activity indicator	**10**	Ethernet port (X7)

7.6 I/O and Relay Option Connections

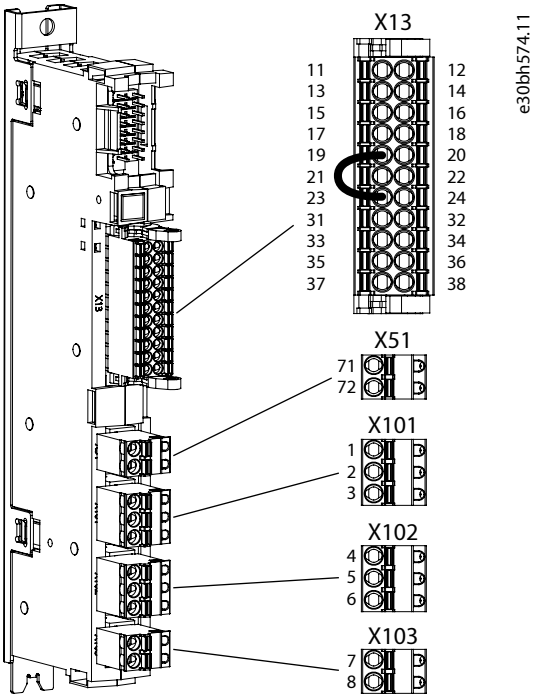


Figure 37: I/O and Relay Option Terminal Block and Terminal Numbering

Table 15: 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 16: I/O Terminal Signals (X13)

Terminal	Function	Terminal block	Description
11	+24 V_{out}	XD2.1:11	Control voltage output. 24 V DC (-15...+20%) Maximum current 200 mA Short-circuit protected
12	+24 V_{out}	XD2.1:12	

Table 16: I/O Terminal Signals (X13) (continued)

Terminal	Function	Terminal block	Description
13	DI 1	XD2.1:13	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	XD2.1:14	
15	DI 3	XD2.1:15	
16	DI 4	XD2.1:16	
17	DI 5	XD2.1:17	
18	DI 6	XD2.1:18	
19	DGND	XD2.1:19	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	XD2.1:20	
21	DO 1	XD2.1:21	Configurable digital output.(1) Push-pull 24 V/50 mA Open collector (NPN/PNP) 48 V/50 mA Short-circuit protected
22	DO 2	XD2.1:22	
23	GND	XD2.1:23	I/O ground. Ground for digital outputs, +10 V Ref, +24 V_{out}, analog inputs, and analog outputs.
24	GND	XD2.1:24	
31	AO 1	XD2.1:31	Configurable analog output. Voltage mode: • 0...10 V • R_L ≥ 1 kΩ • accuracy ≤ ± 0.5% of full scale • short-circuit protected Current mode: • 0...20 mA • R_L ≤ 600 Ω • accuracy ≤ ± 0.5% of full scale • short-circuit protected
32	+10 V ref.	XD2.1:32	10 V (0...+3%), maximum current 10 mA

Table 16: I/O Terminal Signals (X13) (continued)

Terminal	Function	Terminal block	Description
33	AI 1	XD2.1:33	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	XD2.1:34	
35	GND	XD2.1:35	I/O ground. Ground for digital outputs, +10 V Ref, +24 V_{out}, analog inputs, and analog outputs.
36	GND	XD2.1:36	
37	GND	XD2.1:37	
38	GND	XD2.1:38	

1) Digital outputs are not recommended for main circuit breaker control, use relay outputs instead.

Table 17: Thermistor Input Signals (X51)

Terminal	Function	Terminal block	Description
71	TI+	XD2.1:71	Thermistor input, galvanically isolated. R_{trip} = 4 kΩ
72	TI-	XD2.1:72	

Table 18: Relay 1 Signals (X101)

Terminal	Function	Terminal block	Description
1	COM	XD2.1:1	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	XD2.1:2	
3	NC	XD2.1:3	

Table 19: Relay 2 Signals (X102)

Terminal	Function	Terminal block	Description
4	COM	XD2.1:4	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	XD2.1:5	
6	NC	XD2.1:6	

Table 20: Relay 3 Signals (X103)

Terminal	Function	Terminal block	Description
7	COM	XD2.1:7	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	XD2.1:8	

7.7 I/O and Relay Option Interface

7.7.1 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 21: Analog Input Types, Values, and Tolerances

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

7.7.2 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 22: 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

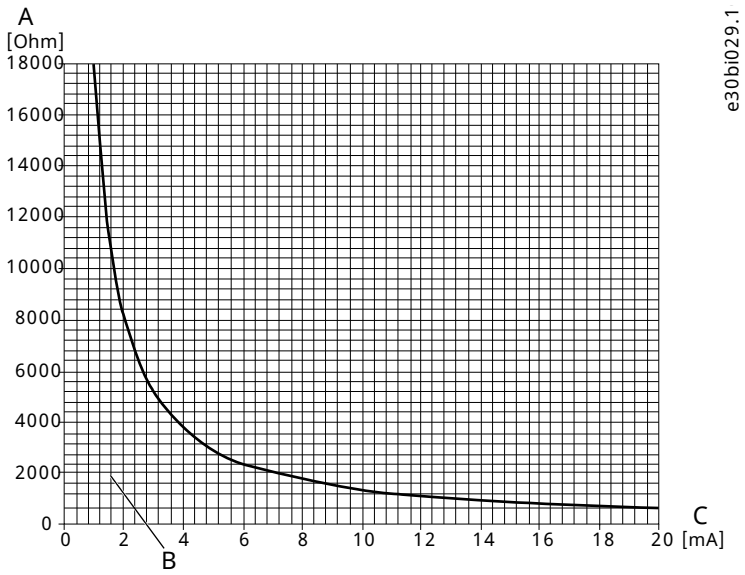


Figure 38: Allowed Load Resistance of Analog Output in Current Mode

A	Load resistance	**B**	Allowed load resistance
C	Output current		

7.7.3 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 23: 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} ≤ 5 V 1 = V_{TH} ≥ 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

7.7.4 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 24: Digital Output Voltage and Current

Parameter	Value
Output Voltage	0 = max 2 V 1 = min 20 V
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

7.7.5 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 25: Relay Output Values

Parameter	Value
Rated Voltage	250 V AC
Max. Switching Voltage	400 V AC
Rated Current	8 A
Breaking Capacity Max	2000 VA

Table 25: Relay Output Values (continued)

Parameter	Value
Operate Time Max.	9 ms
Release Time Max.	5 ms
DC Breaking Capacity	See Figure 39.

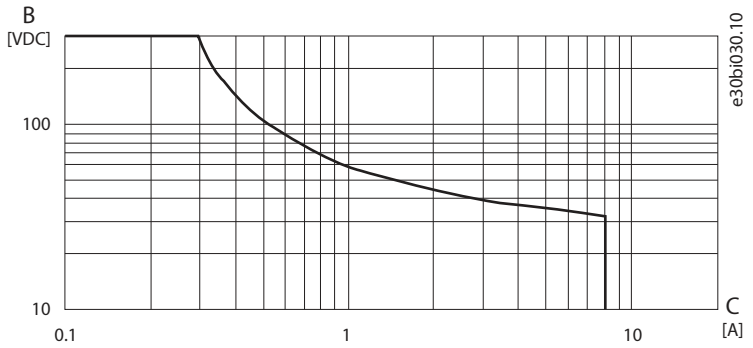


Figure 39: Maximum DC Load Breaking Capacity

B	DC voltage	**C**	DC current

7.7.6 Analog Reference Voltage Output

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

Table 26: 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

7.7.7 24 V DC Voltage Output

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

Table 27: 24 V DC Voltage Output

Parameter	Value
Nominal Voltage	24 V
Accuracy	-15...+20%
Maximum Output Current	200 mA

Table 27: 24 V DC Voltage Output (continued)

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

7.7.8 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 28: Thermistor Input

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

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.

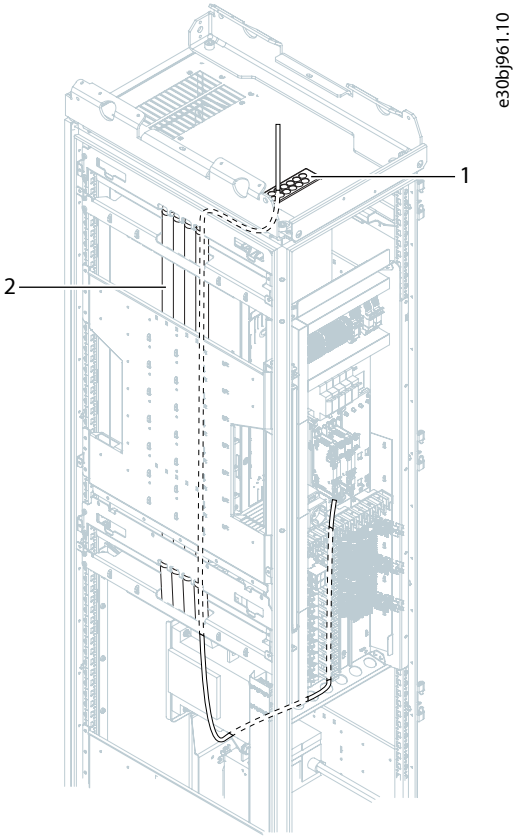


Figure 40: Routing of Control Cables from the Top, FE9, FE10

1	Control cable grommets	**2**	Tubes

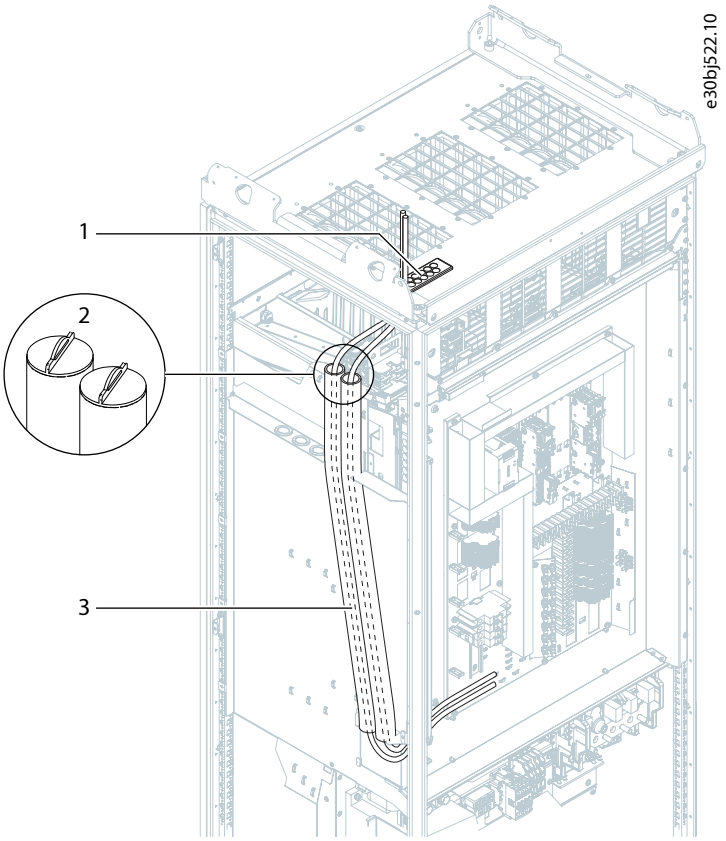


Figure 41: Routing of Control Cables from the Top, AE10/11, IE10/11

1	Control cable grommets	**2**	Two corks, to be removed when routing control cables from the top
3	Tubes, internal diameter 32 mm (1.3 in)		

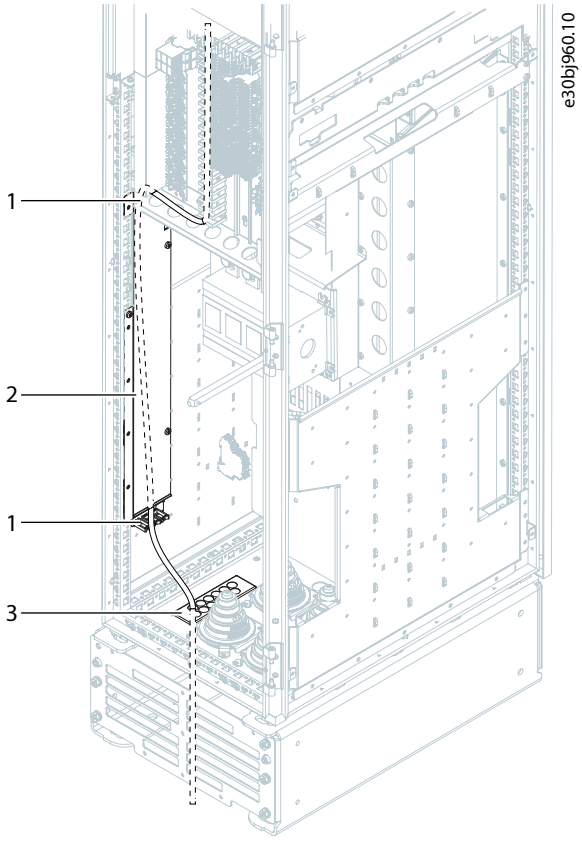


Figure 42: Routing of Control Cables from the Bottom, FE9, FE10

1	Cable clamps	**2**	Protection plate
3	Control cable grommets		

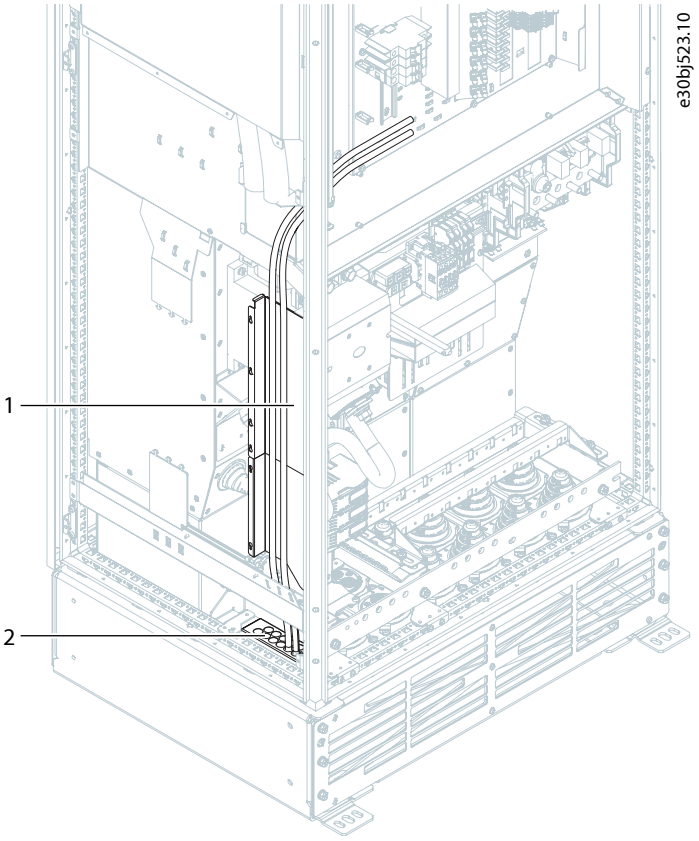


Figure 43: Routing of Control Cables from the Bottom, AE10/11, IE10/11

1	Protection plate	**2**	Control cable grommets

7.9 Installing Boards to the Modular Control Unit

Use these instructions to install a board, for example an option board, to the mounting plate of the modular control unit.

NOTICE

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.

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.

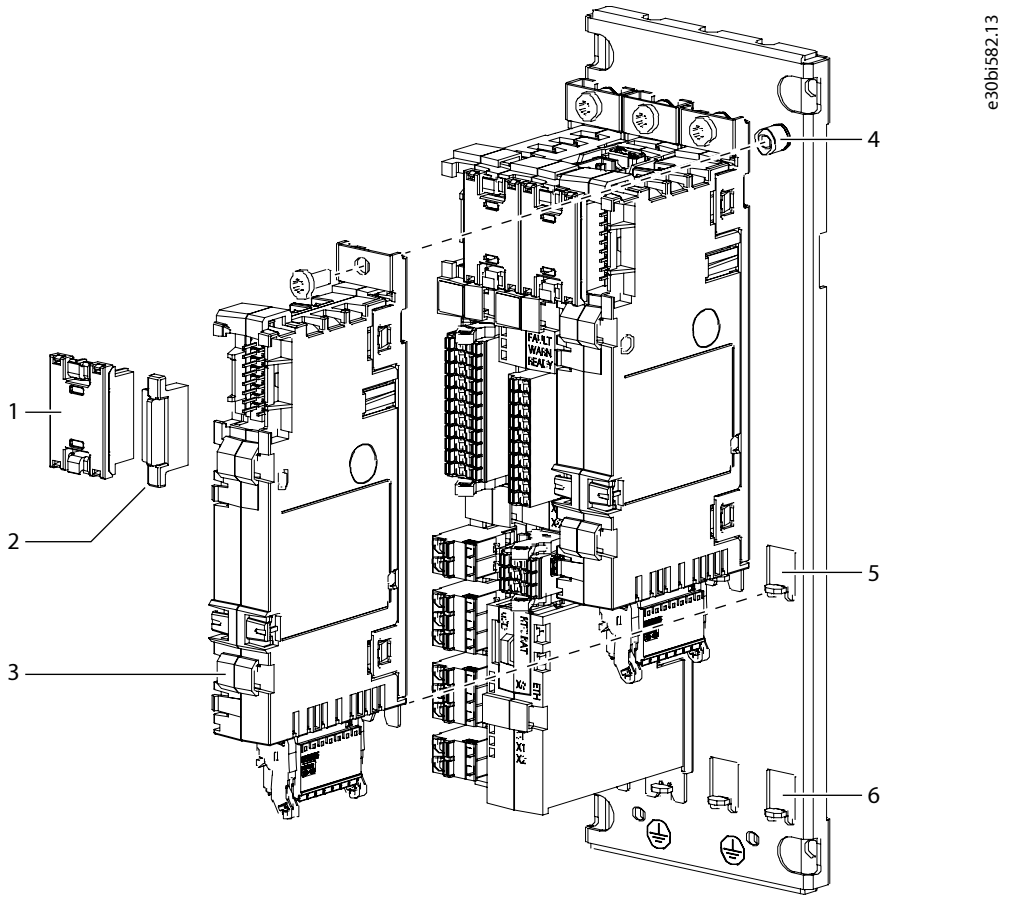


Figure 44: Installing a Board to the Modular Control Unit Mounting Plate

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

7.10.1 Requirements for the Control Cables

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)

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. Use a flexible cable with fine-stranded wires meant for mobile installation.

7.10.2 Installing the Control Cables

1. Install the control cables into the option board or the terminal block.

See the pin numbering of the I/O and Relay Option in 7.6 I/O and Relay Option Connections and the pin numbering of the terminal blocks in 7.4 Control Compartment Connections.

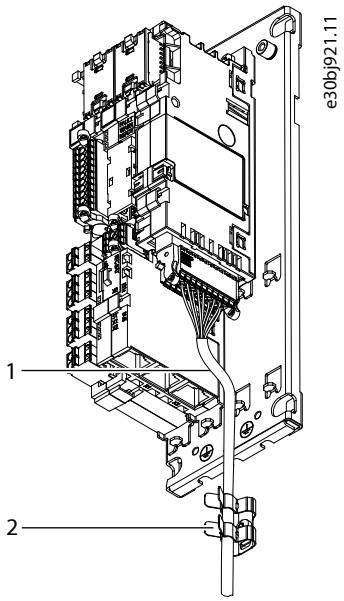


Figure 45: Example of Installing the Control Cables on the Option Board

1	Control cable	**2**	Cable clamp

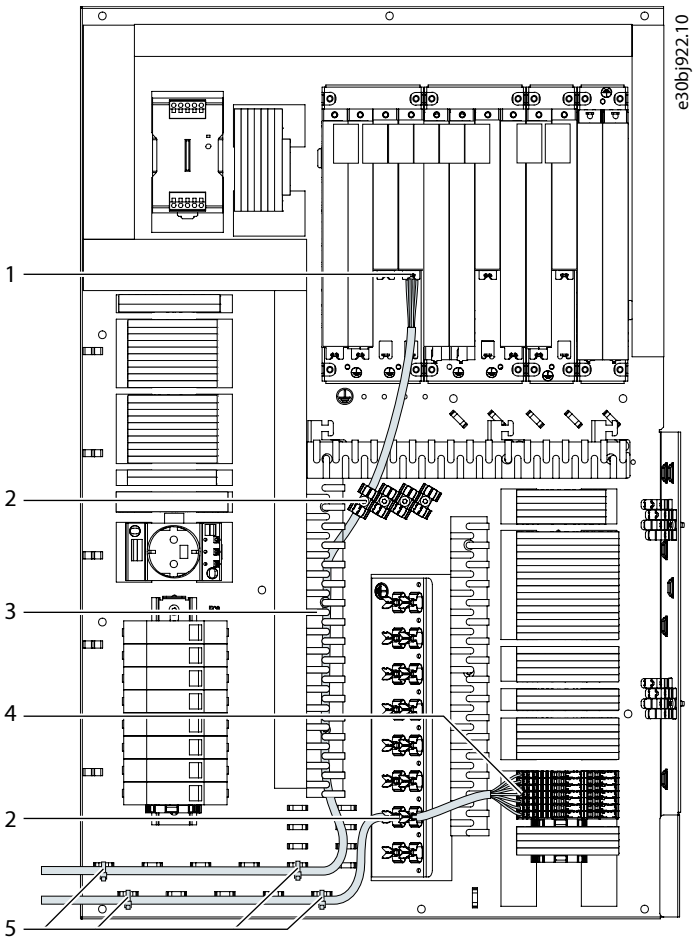


Figure 46: Example of Installing the Control Cables on Terminals Blocks

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

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

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.

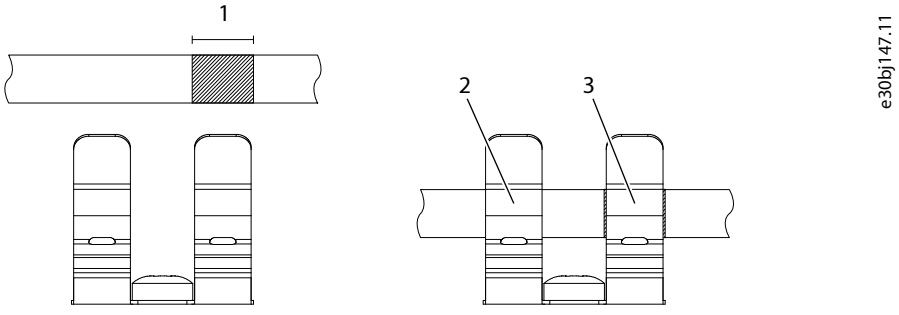


Figure 47: Stripping the Cable and Using the Grounding Plates

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

8 Maintenance

8.1 Preventive Maintenance Recommendations

Generally, all technical equipment, including Danfoss AC drives, need a minimum level of preventive maintenance. To ensure trouble-free operation and long life of the drive, regular maintenance is recommended. 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 drives/systems.

NOTICE

The service schedule for part replacements can vary depending on operating conditions. Under specific conditions, the combination of stressful operation and environmental 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 29: Maintenance Schedule for Air-cooled Drives

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
Installation			
Visual 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 must be performed by trained service personnel.
EMC consideration	1 year	–	Inspect the 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. Avoid parallel routing. 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. Terminate the connections correctly with solid crimped ends. The use of shielded cables and grounded EMC plate, or a twisted pair is recommended.
Clearances	1 year	–	Check that the external clearances for proper airflow for cooling follow the requirements for the frame and product type. For clearances, refer to the local design regulations.
Sealing	1 year	–	Check that the sealing of the enclosure, the covers, and the cabinet doors are in good condition.

Table 29: Maintenance Schedule for Air-cooled Drives (continued)

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
Corrosive environments	1 year	–	Conductive dust and aggressive gases, such as sulphide, chloride, and salt mist, can damage the electrical and mechanical components. Air filters do not remove airborne corrosive chemicals. Act based on the findings.
Drive			
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 are allowed to 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. If necessary, 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 depends on the loading profile of the application and the ambient temperature. For applications with heavy loads in demanding environments or high ripple currents, replace electrolytic capacitors every 8 years and plastic foil capacitors every 12 years. If within the specifications of the drive type, replace every 10–15+ years. Only trained service personnel are allowed to perform this action.
Cleaning and filters	1 year	–	Clean the interior of the enclosure annually, and more frequently if necessary. The amount 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	3–10 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 must 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. If applicable, braided straps are recommended.
PCB	1 year	10–12 years	Visually inspect the printed circuit boards for signs of damage or degrading due to aging, corrosive environments, dust, or environments with high temperatures. Only trained service personnel are allowed to 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 can 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.

Table 29: Maintenance Schedule for Air-cooled Drives (continued)

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
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 are allowed to perform this action.
Batteries	1 year	7–10 years	Replace the batteries according to the manufacturer recommendation. Replace the real-time clock 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 must be performed by trained service personnel.
Exchange units and units stored for long periods before commissioning	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 must be performed by trained service personnel.

1) Defined as the time after the commissioning/startup or the time from the previous inspection.

2) Defined as the time after the commissioning/startup or the time from the previous service schedule actions.

8.2 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.

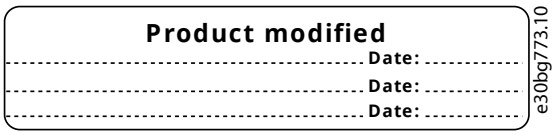


Figure 48: The Product Modified Label

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.

8.3 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.

⚠ CAUTION

RISK OF FIRE AND EXPLOSION

- Replace the battery with a 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.

⚠ CAUTION

RISK OF FIRE OR EXPLOSION

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

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.

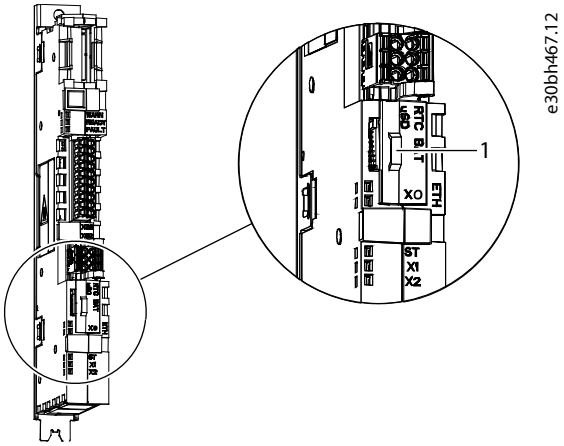


Figure 49: Location of the RTC Battery

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.

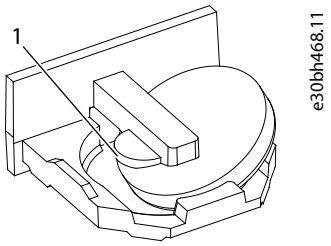


Figure 50: Replacing the Battery

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.

8.4 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.

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.

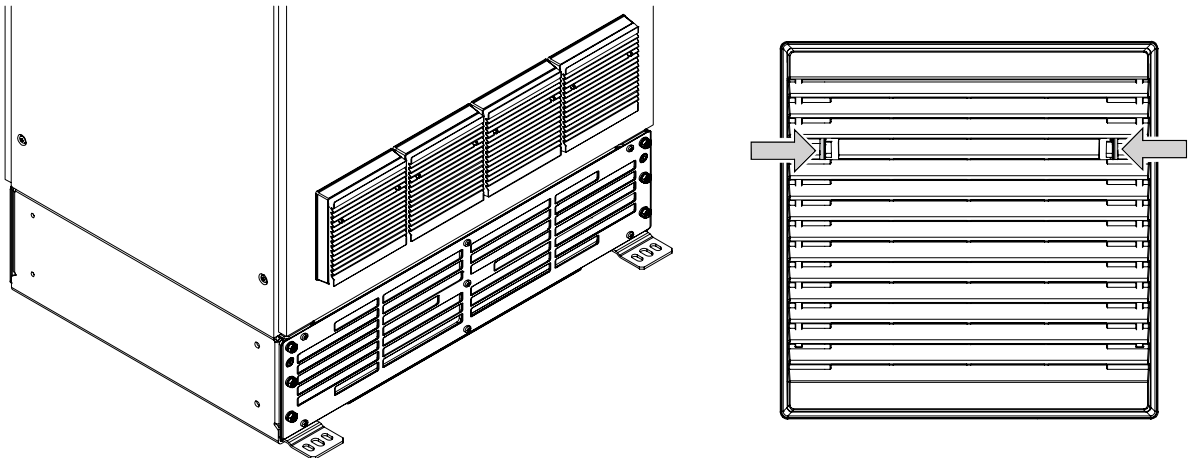


Figure 51: Removing the Fan Grill

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.

9 Specifications

9.1 Tightening Torques

Table 30: Tightening Torques

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

9.2 Dimension Illustrations

9.2.1 Dimensions of the Enclosed Drive, FE9

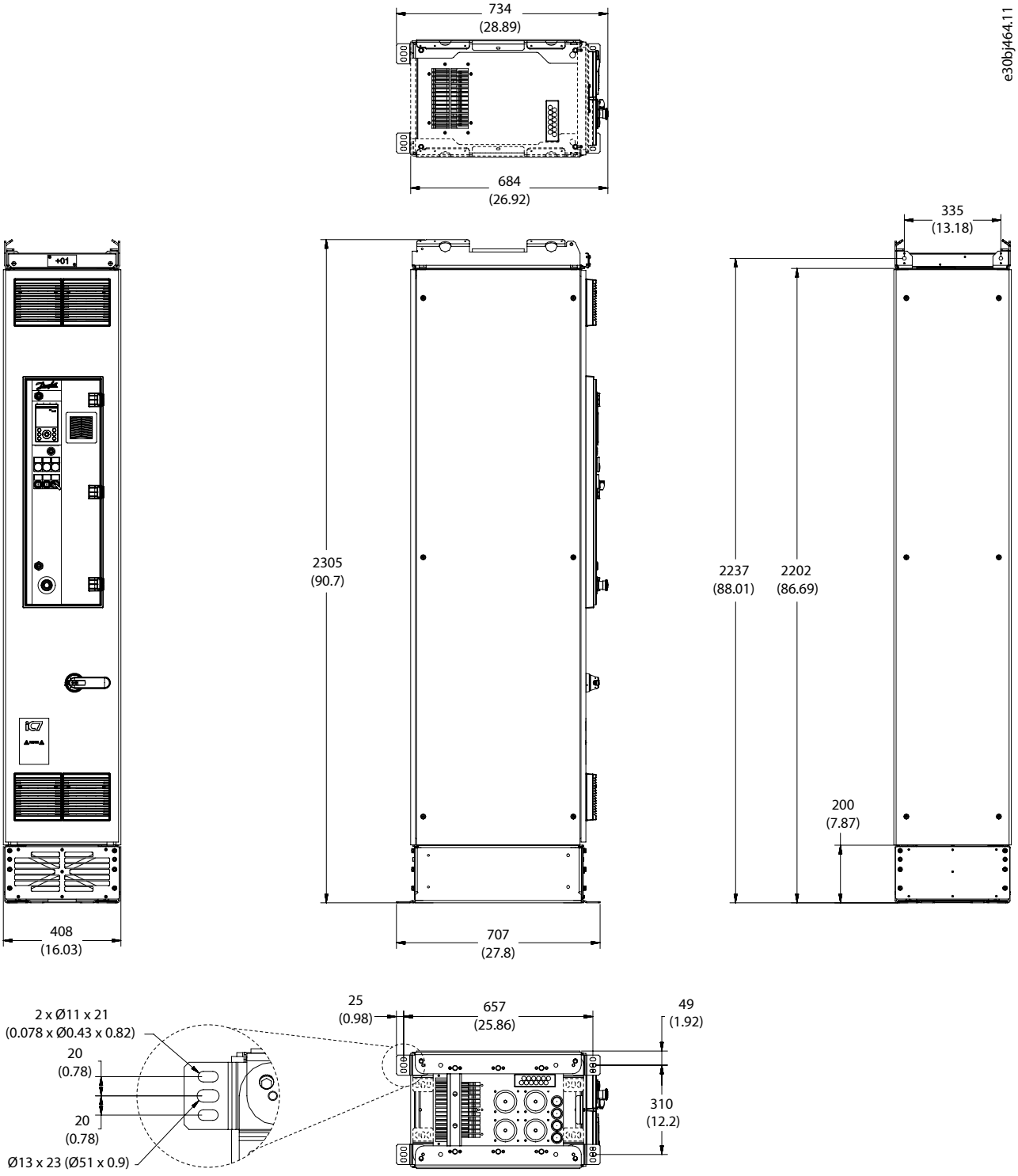


Figure 52: Dimensions of the Enclosed Drive, FE9, in mm (in)

9.2.2 **Dimensions of the Enclosed Drive, FE10**

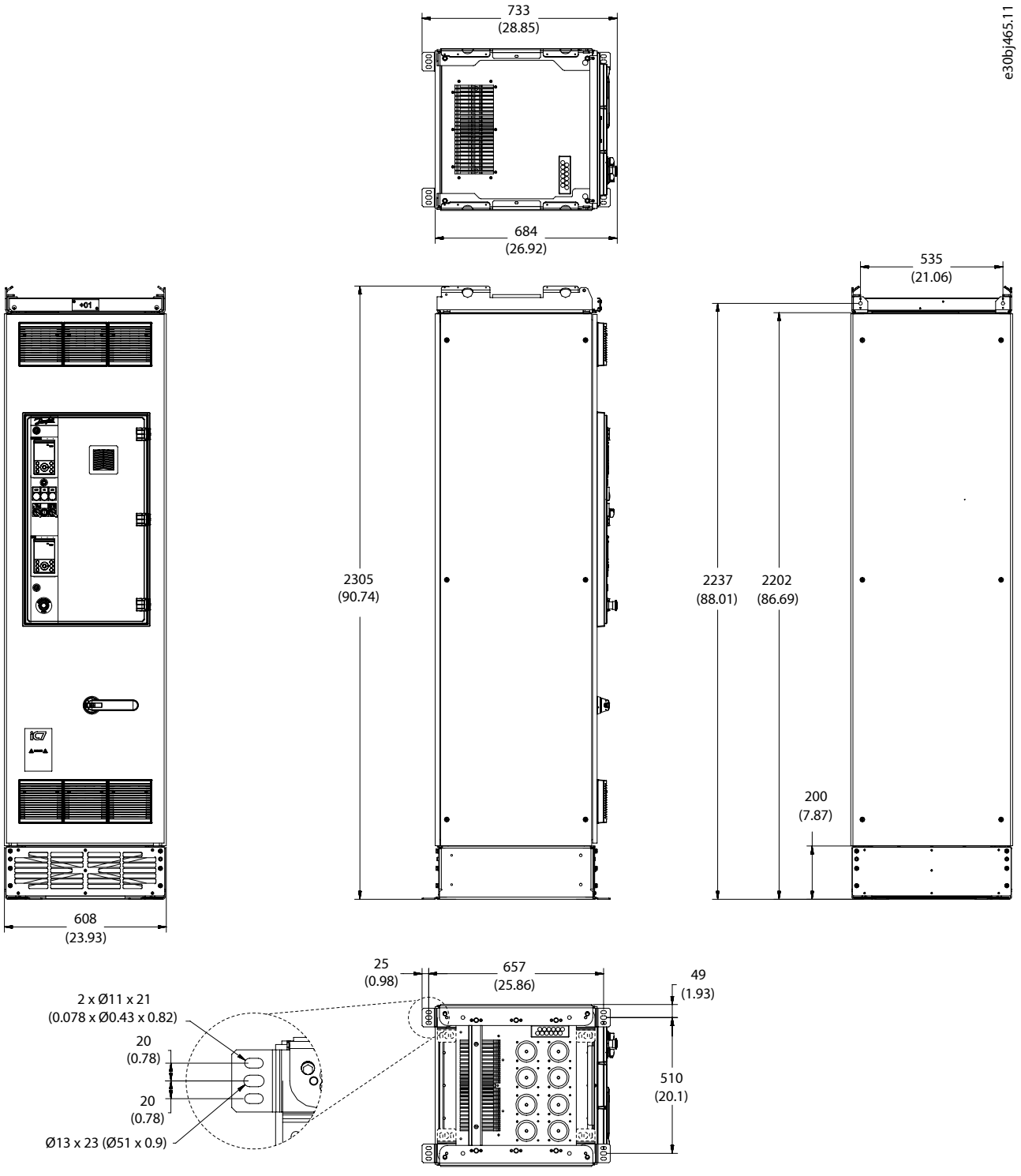


Figure 53: Dimensions of the Enclosed Drive, FE10, in mm (in)

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

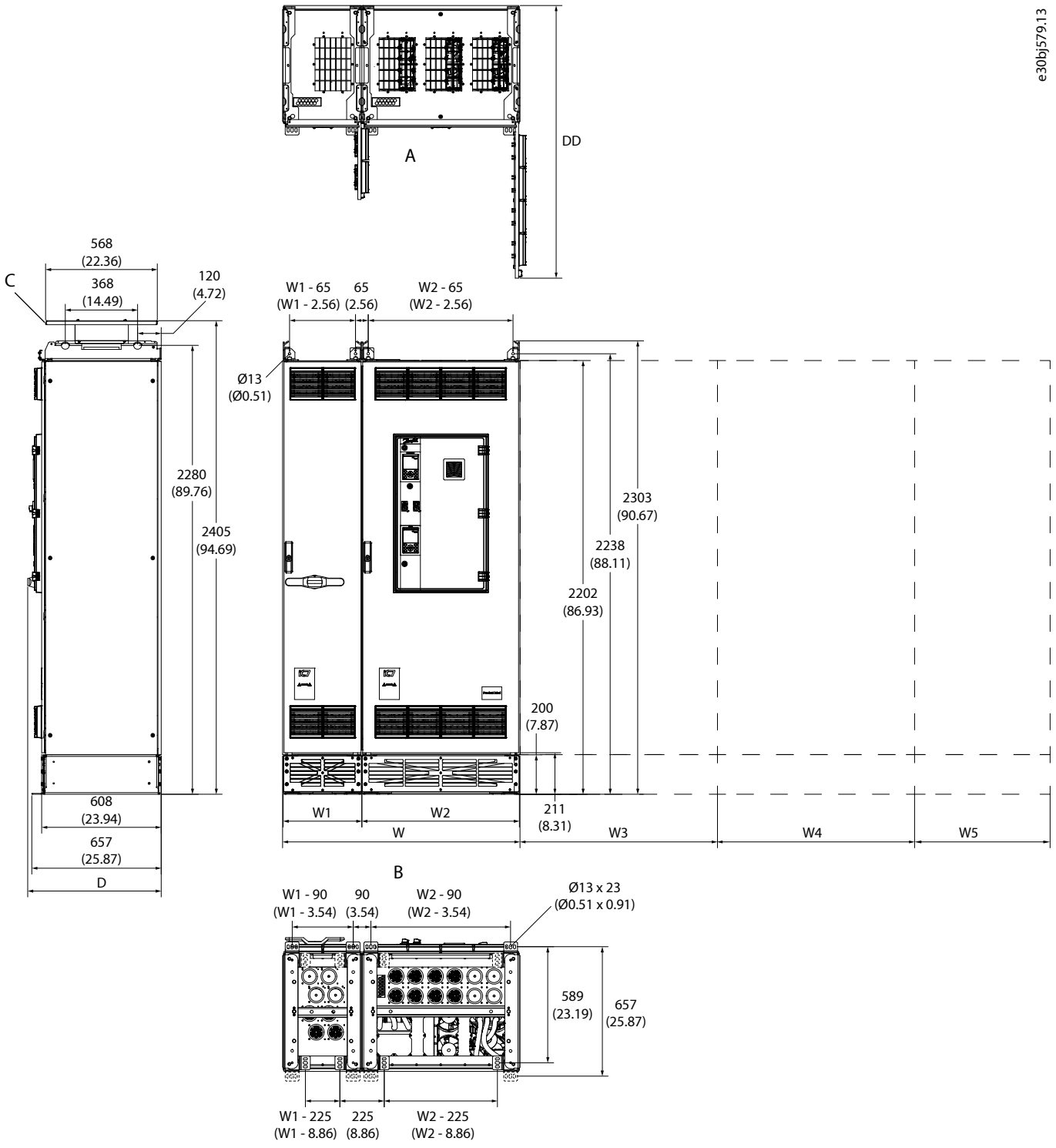


Figure 54: Dimensions of the Enclosed Drive, AE10, AE11, IE10, and IE11, in mm (in)

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

Table 31: Dimensions in mm (in)

Product	D	DD	W	W1	W2	W3	W4	W5
iC7-60EA3A05-385...590 A	671 (26.4)	1385 (54.5)	800 (31.5)	800 (31.5)	–	–	–	400 (15.7)
iC7-60EA3A05-658...880 A	679 (26.7)	1385 (54.5)	1200 (47.2)	400 (15.7)	800 (31.5)	–	–	400 (15.7)
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)	400 (15.7)
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)	400 (15.7)

9.2.4 Dimensions for Default Cooling, FE9

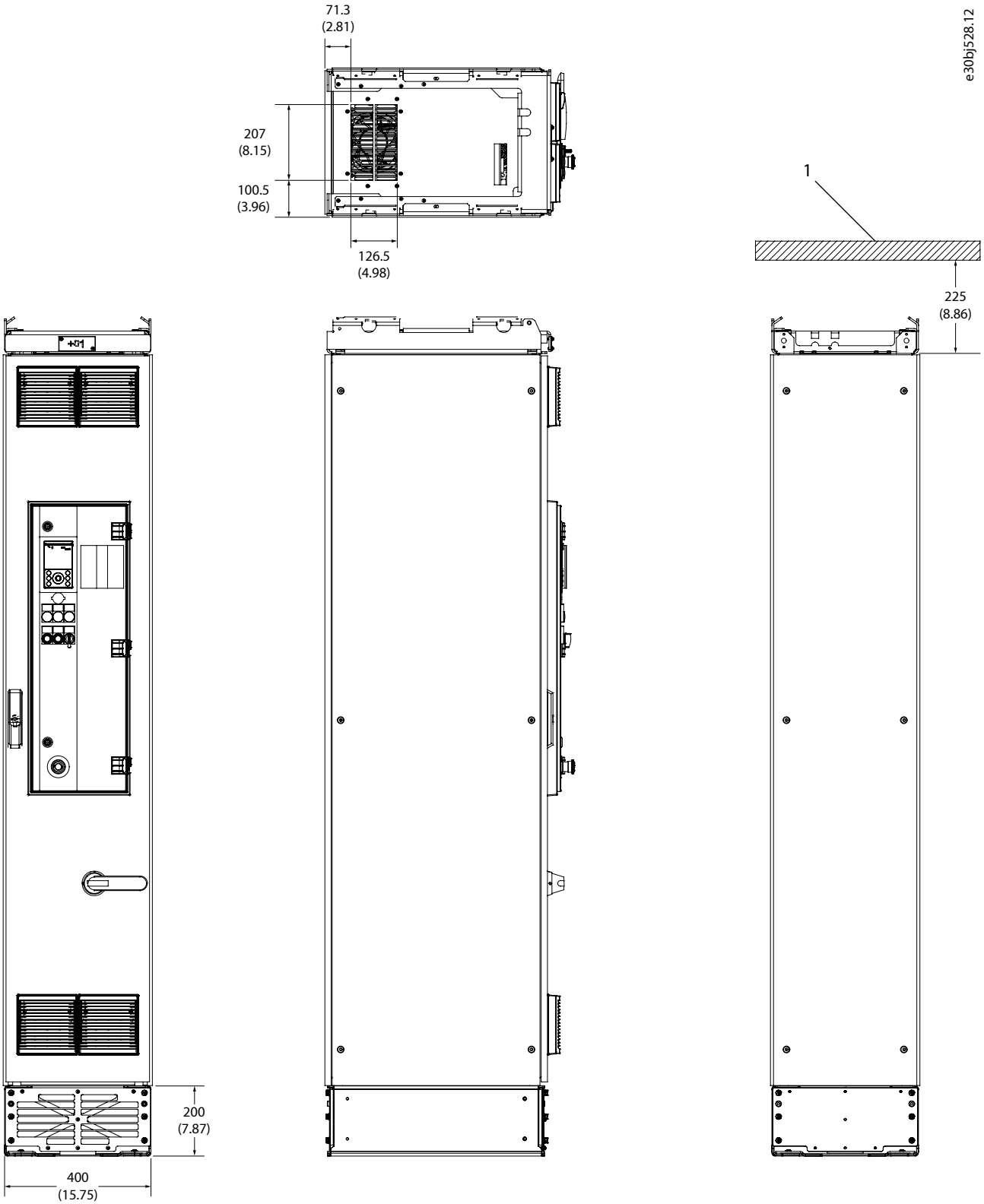


Figure 55: Dimensions for Default Cooling, FE9, in mm (in)

1	Roof

9.2.5 **Dimensions for Default Cooling, FE10**

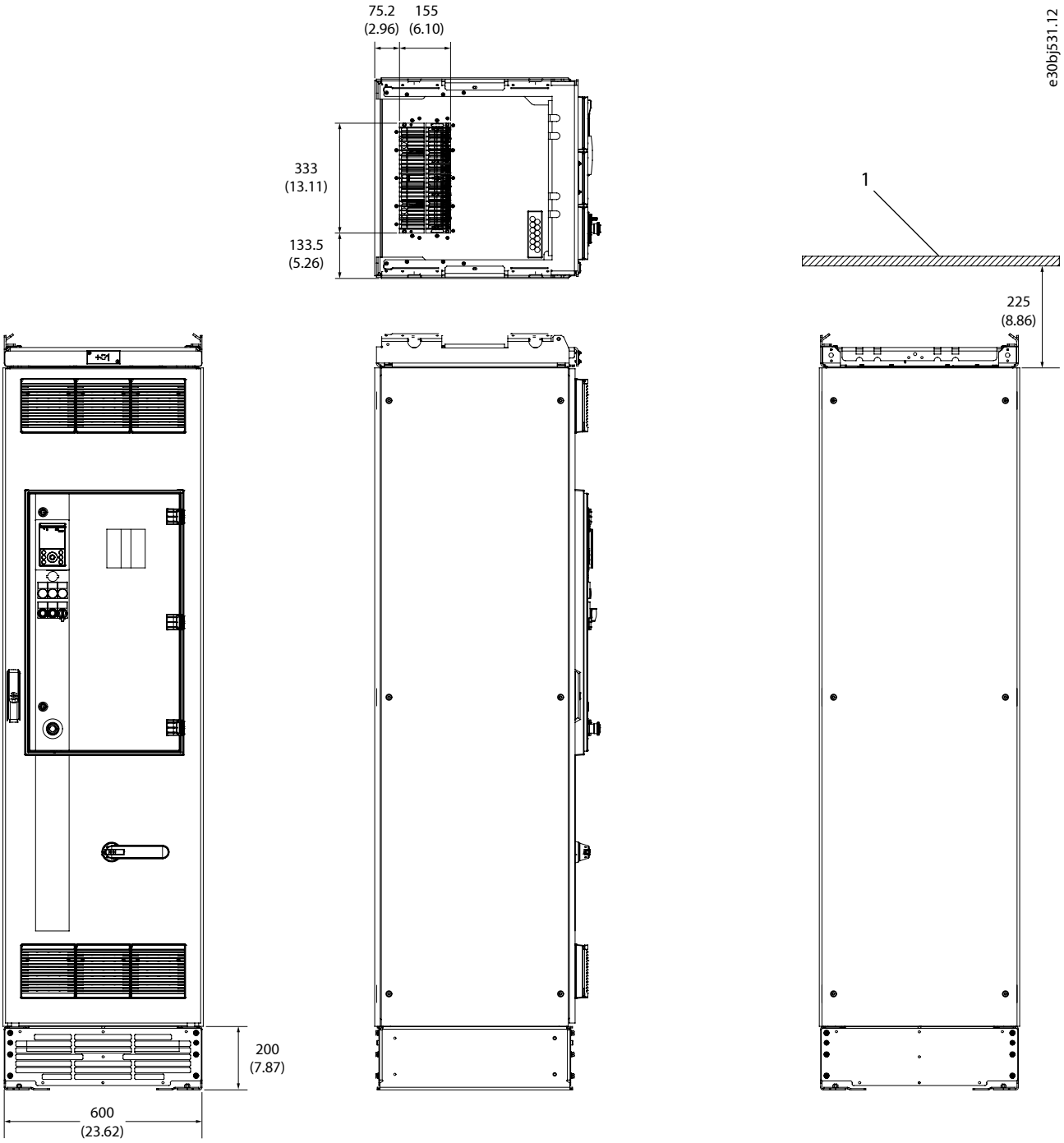


Figure 56: Dimensions for Default Cooling, FE10, in mm (in)

1	Roof

9.2.6 Dimensions for Default Cooling, AE10, AE11, IE10, IE11

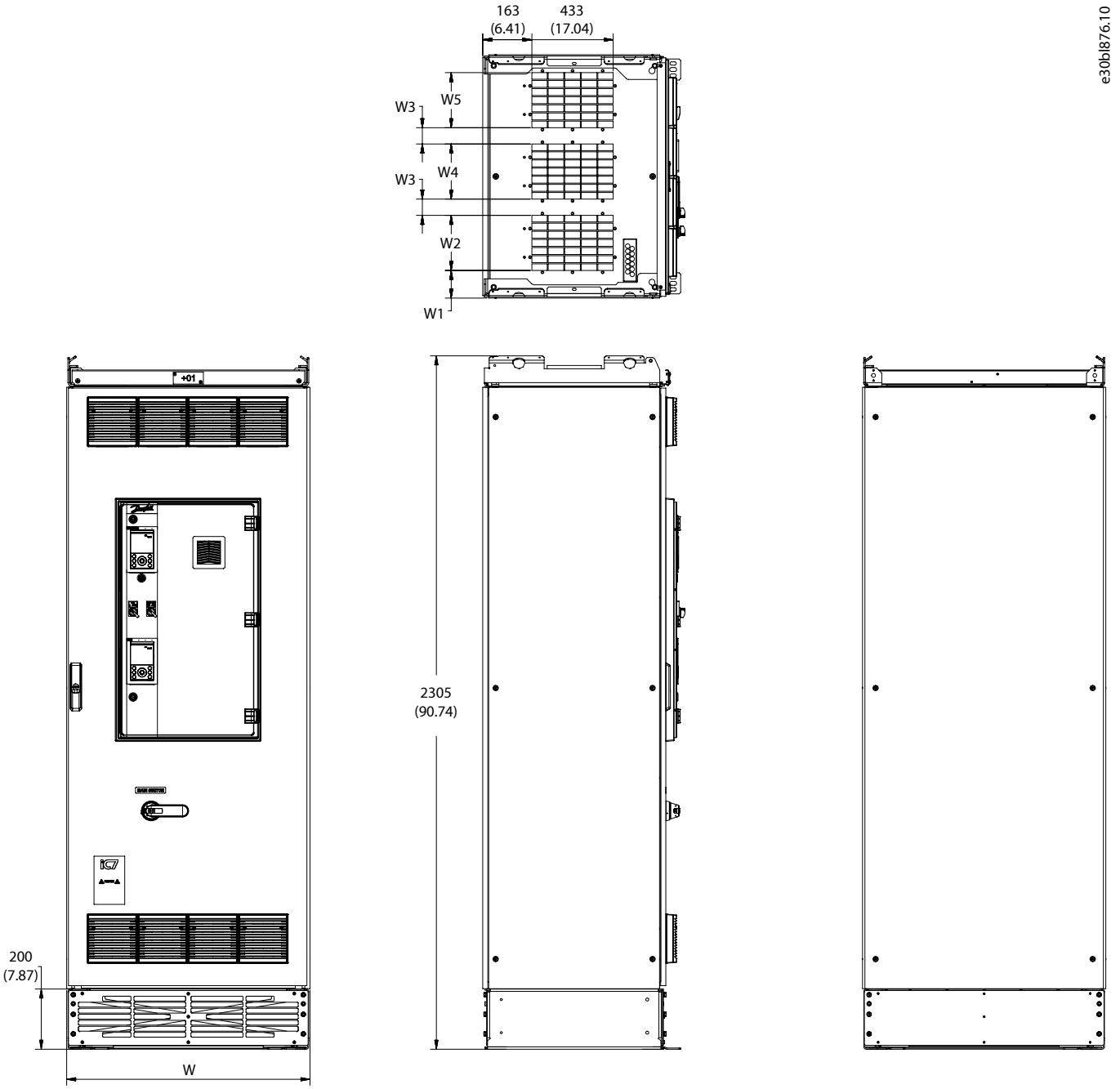


Figure 57: Dimensions for Default Cooling, AE10, AE11, IE10, IE11, in mm (in)

Table 32: Dimensions in mm (in)

W	W1	W2	W3	W4	W5
408 (16.1)	166 (6.5)	183 (7.2)	–	–	–
608 (23.9)	129 (5.1)	183 (7.2)	54 (2.1)	183 (7.2)	–
808 (31.8)	92 (3.6)	183 (7.2)	54 (2.1)	183 (7.2)	183 (7.2)

9.2.7 Dimensions for Back-channel Cooling Option, FE9

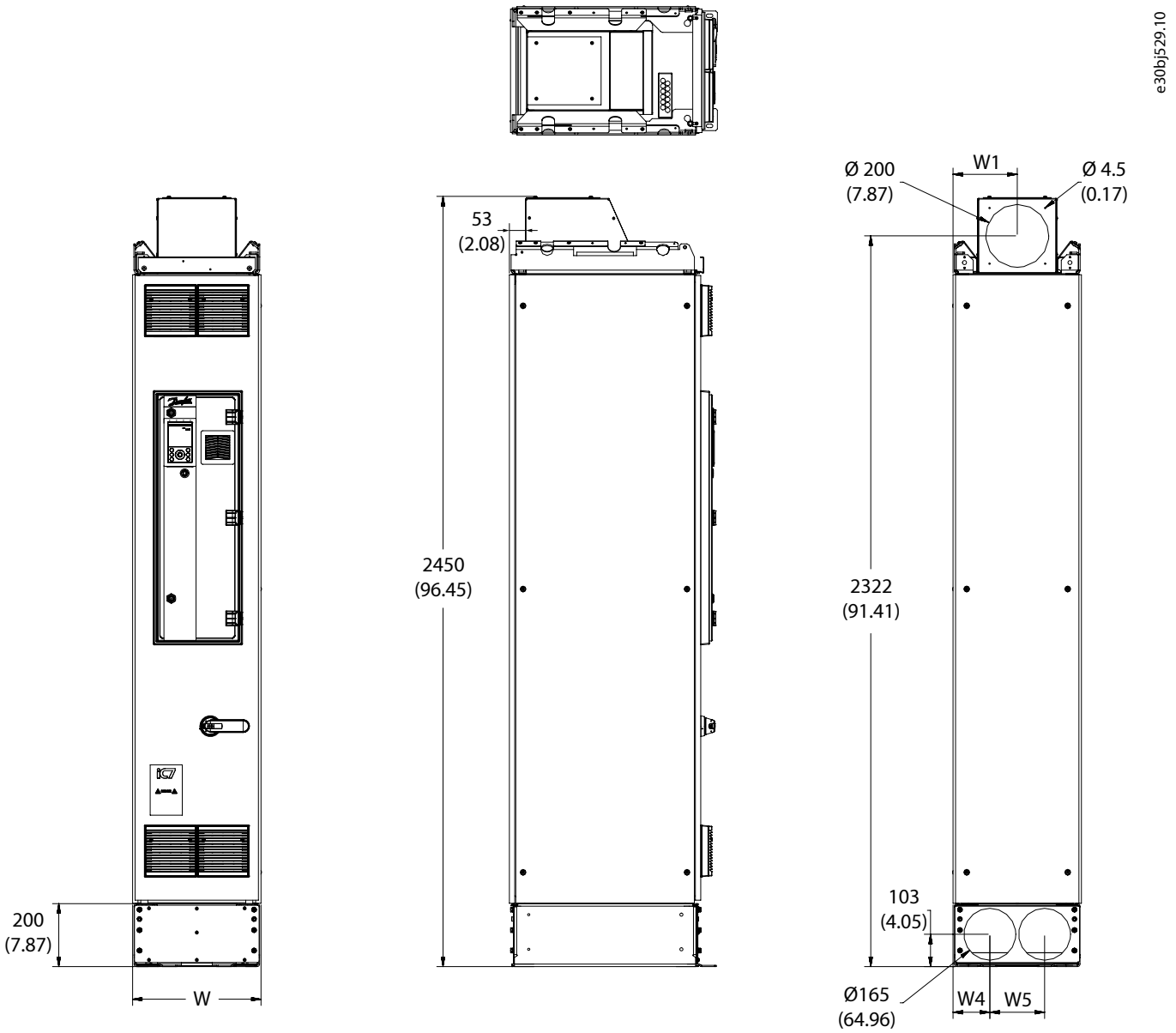


Figure 58: Dimensions for Back-channel Cooling (+OABC), FE9, in mm (in)

Table 33: Dimensions in mm (in)

W	W1	W2	W3	W4	W5	W6	W7
408 (16.1)	204 (8.0)	–	–	117 (4.6)	174 (6.9)	–	–

9.2.8 Dimensions for Back-channel Cooling Option, FE10

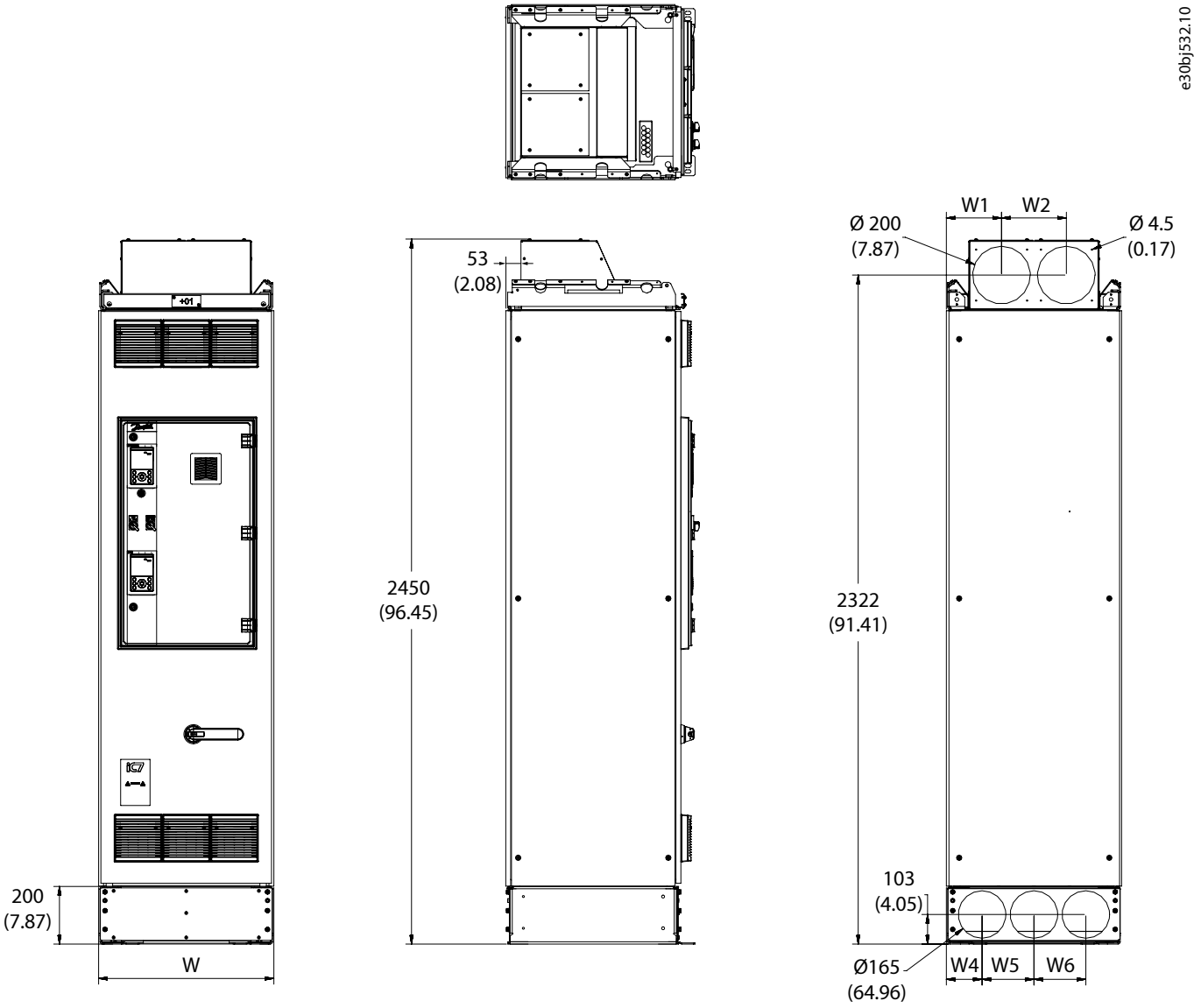


Figure 59: Dimensions for Back-channel Cooling (+OABC), FE10, in mm (in)

Table 34: Dimensions in mm (in)

W	W1	W2	W3	W4	W5	W6	W7
608 (23.9)	192 (7.6)	225 (8.9)	–	123 (4.8)	180 (7.1)	180 (7.1)	–

9.2.9 Dimensions for Back-channel Cooling Option, AE10, AE11, IE10, IE11

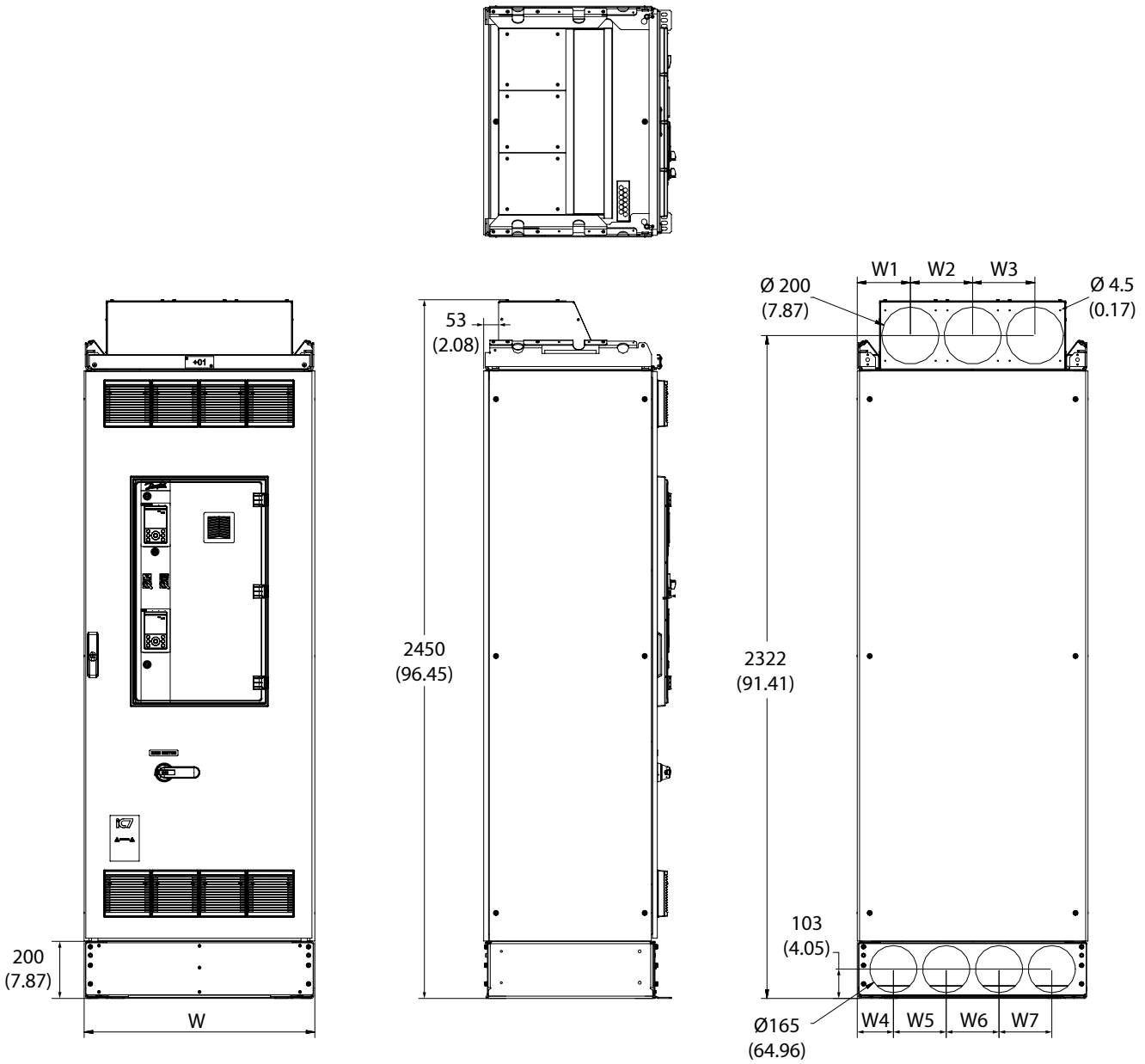


Figure 60: Dimensions for Back-channel Cooling (+OABC), AE10, AE11, IE10, and IE11, in mm (in)

Table 35: Dimensions in mm (in)

W	W1	W2	W3	W4	W5	W6	W7
408 (16.1)	204 (8.0)	–	–	117 (4.6)	174 (6.9)	–	–
608 (23.9)	192 (7.6)	225 (8.9)	–	123 (4.8)	180 (7.1)	180 (7.1)	–
808 (31.8)	186 (7.3)	218 (8.6)	218 (8.6)	126 (5.0)	185 (7.3)	185 (7.3)	185 (7.3)

9.2.10 Dimensions for the Cooling Air Output Flange Option, FE9

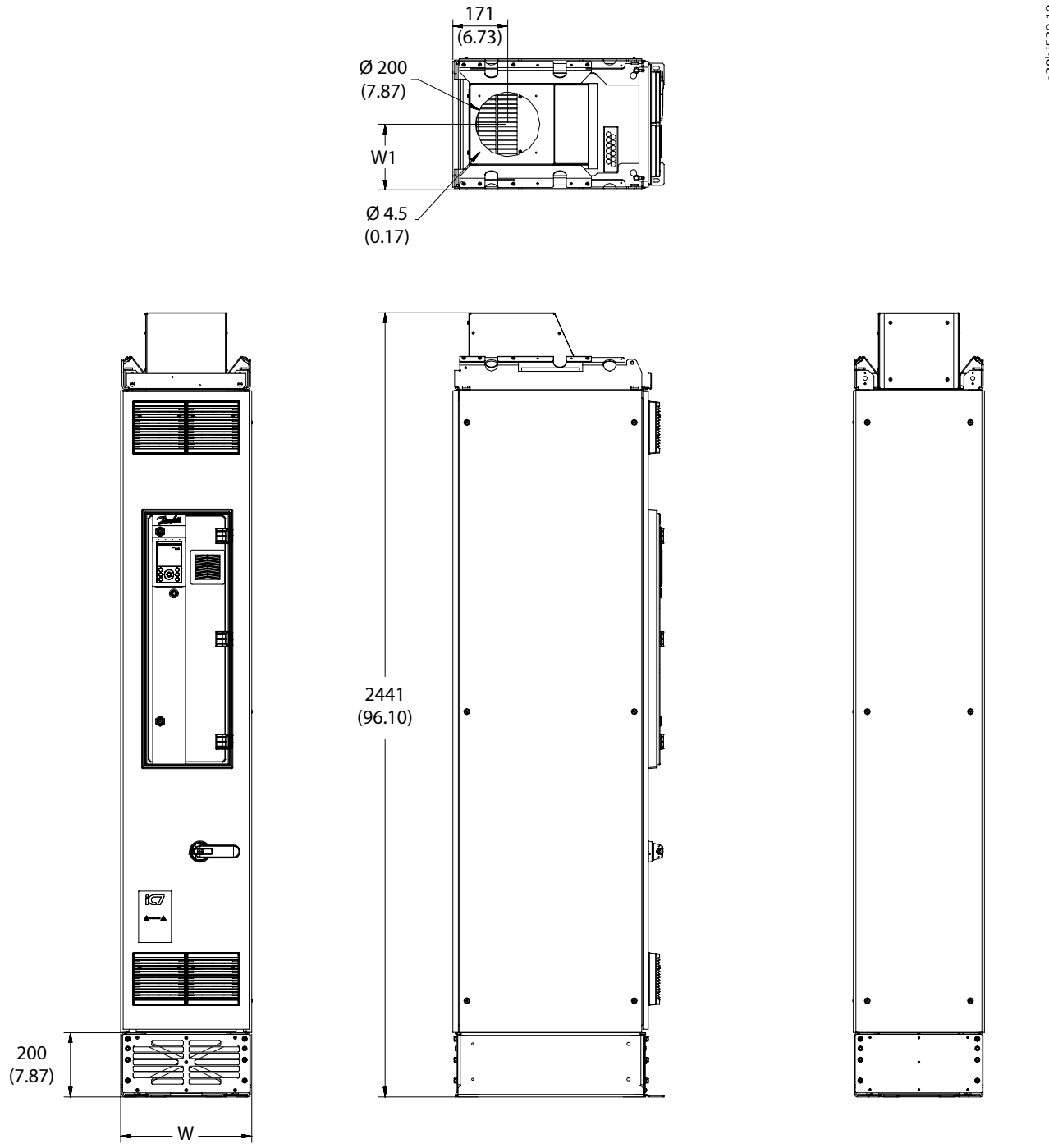


Figure 61: Dimensions for the Cooling Air Output Flange (+OAOF), FE9, in mm (in)

Table 36: Dimensions in mm (in)

W	W1	W2	W3
408 (16.1)	204 (8.0)	–	–

9.2.11 Dimensions for the Cooling Air Output Flange Option, FE10

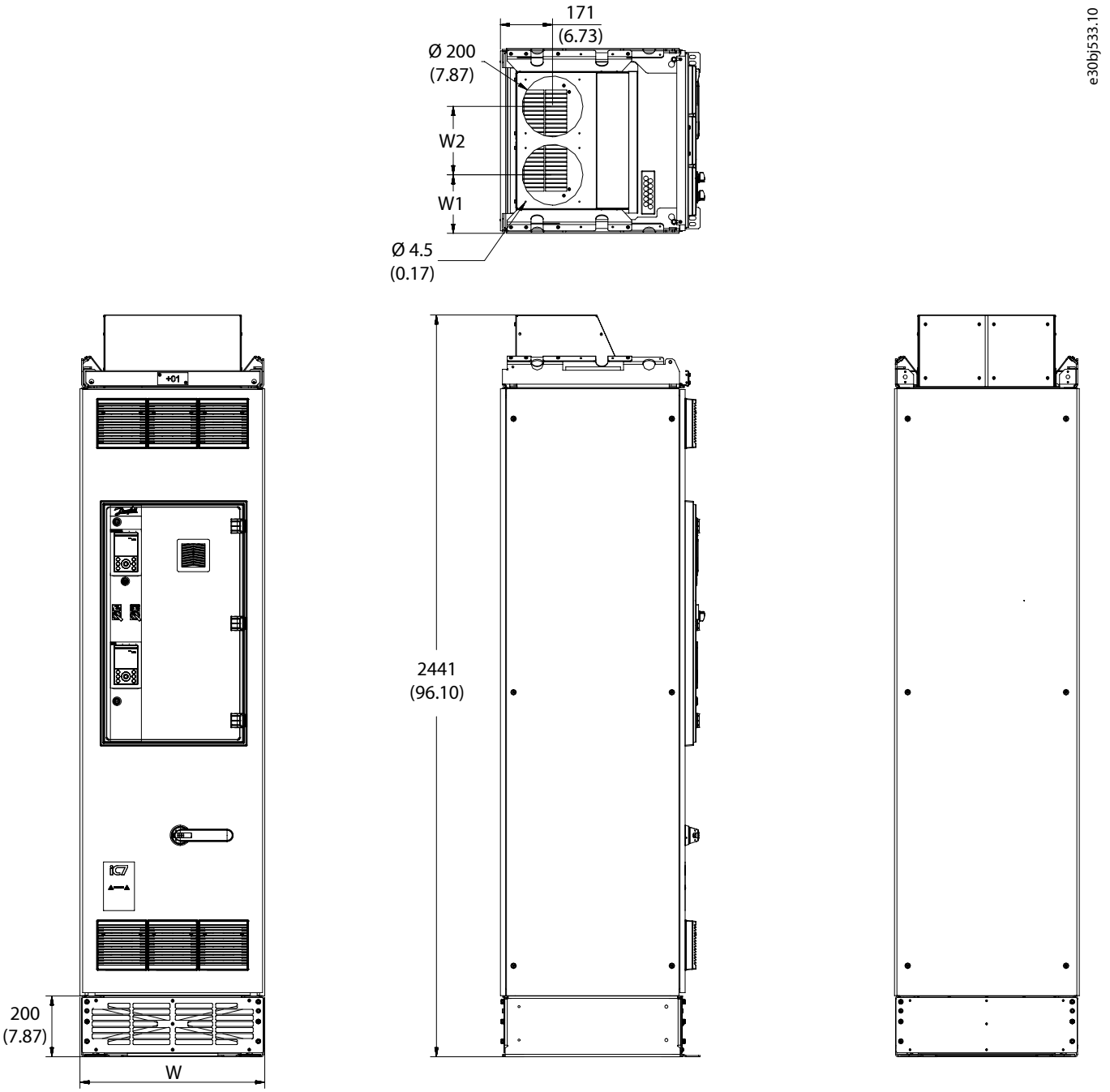


Figure 62: Dimensions for the Cooling Air Output Flange (+OAOF), FE10, in mm (in)

Table 37: Dimensions in mm (in)

W	W1	W2	W3
608 (23.9)	192 (7.6)	225 (8.9)	–

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

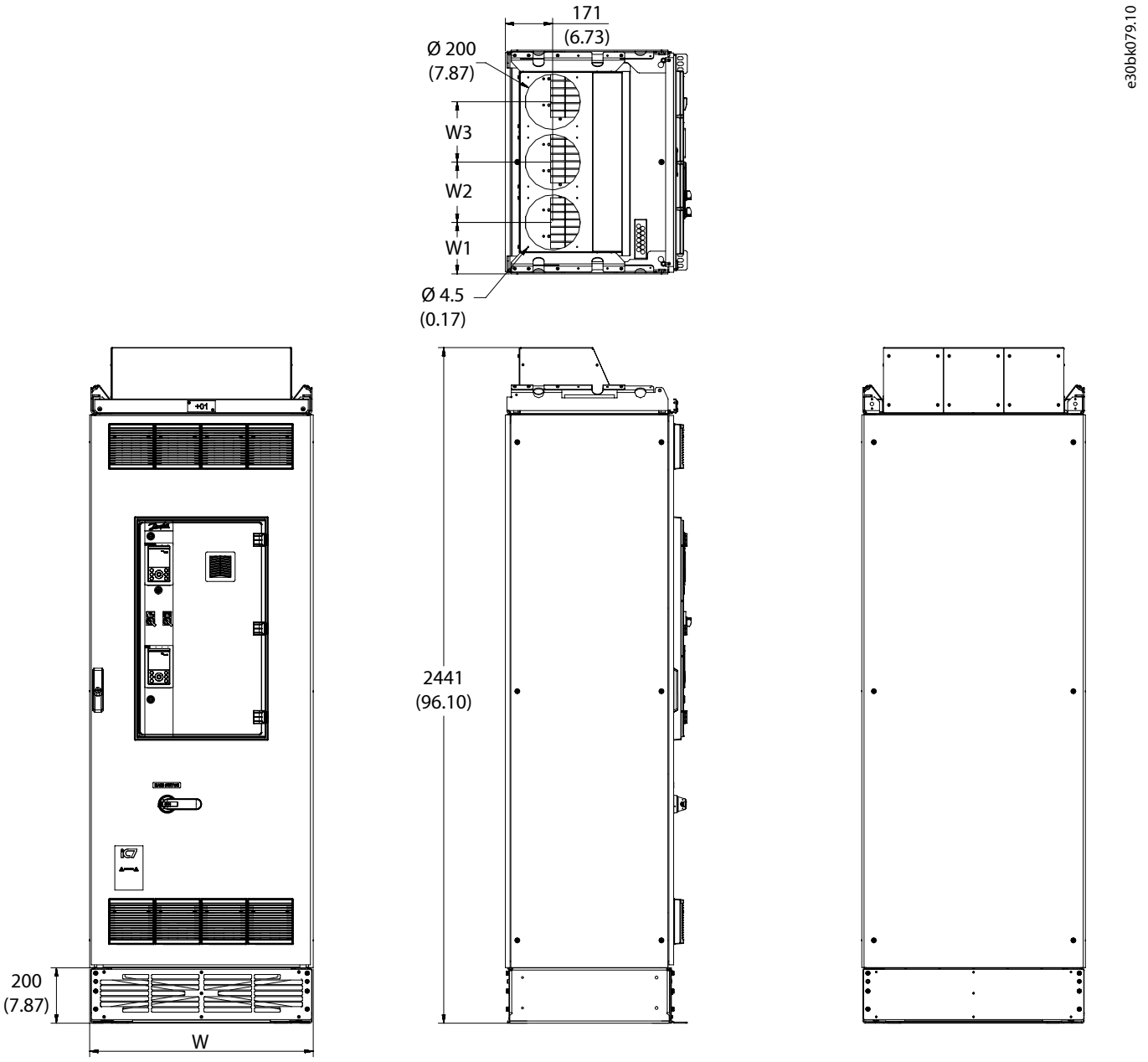


Figure 63: Dimensions for the Cooling Air Output Flange Option (+OAOF), AE10, AE11, IE10, and IE11, in mm (in)

Table 38: Dimensions in mm (in)

W	W1	W2	W3
408 (16.1)	204 (8.0)	–	–
608 (23.9)	192 (7.6)	225 (8.9)	–
808 (31.8)	186 (7.3)	218 (8.6)	218 (8.6)

9.2.13 Dimensions of the Control Board

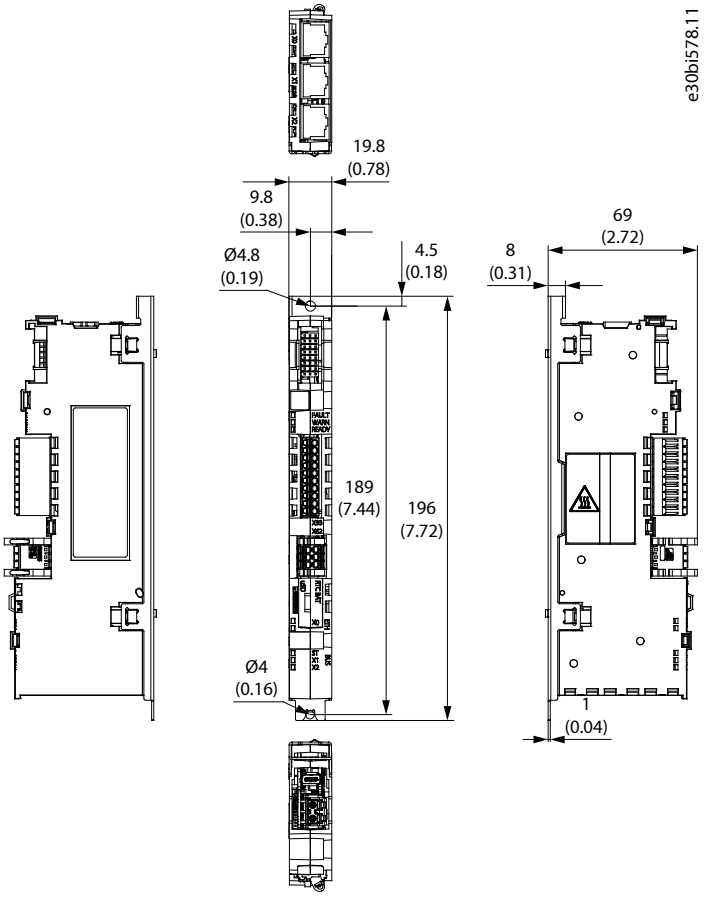


Figure 64: Dimensions of the Control Board in mm (in)

9.2.14 Dimensions of the I/O and Relay Option

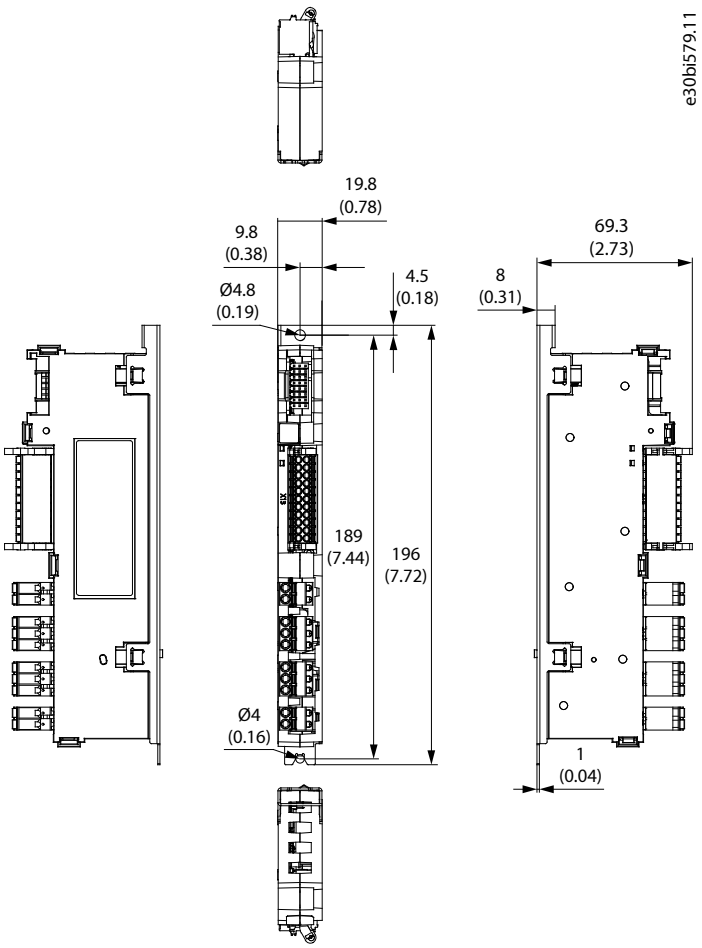


Figure 65: Dimensions of the I/O and Relay Option in mm (in)

9.2.15 Dimensions of an Option Board

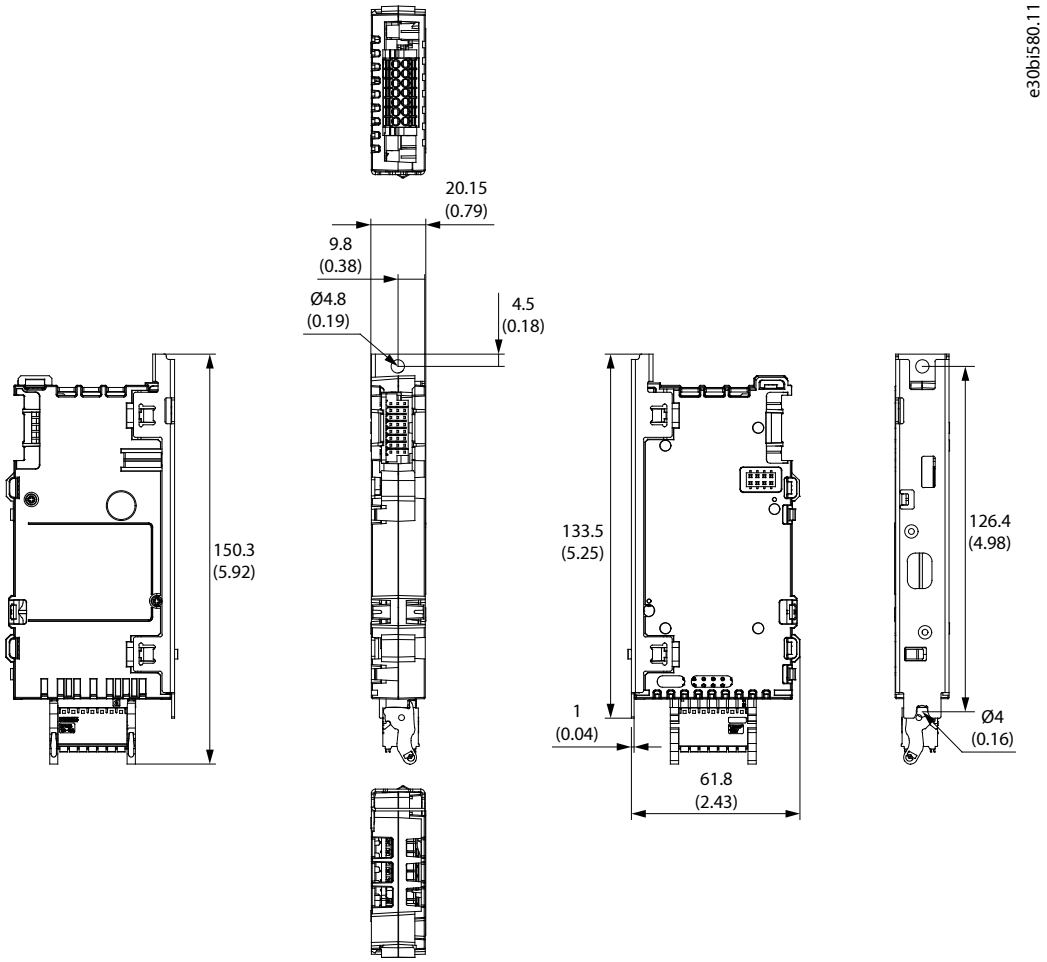


Figure 66: Dimensions of an Option Board in mm (in)

9.2.16 Dimensions of the 4-port Star Coupler Board

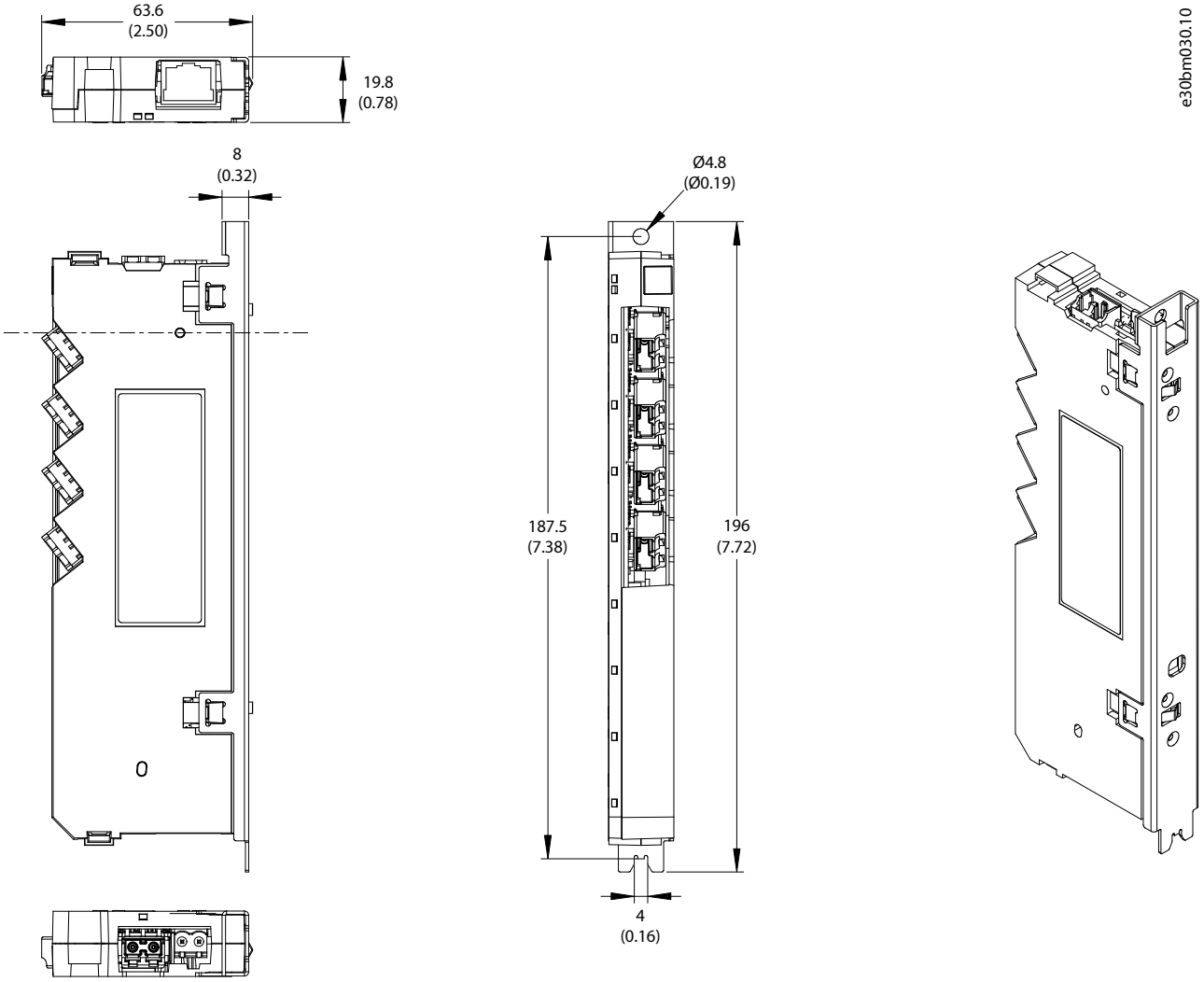


Figure 67: Dimensions of the 4-port Star Coupler Board in mm (in)

9.2.17 **Dimensions of the 8-port Star Coupler Board**

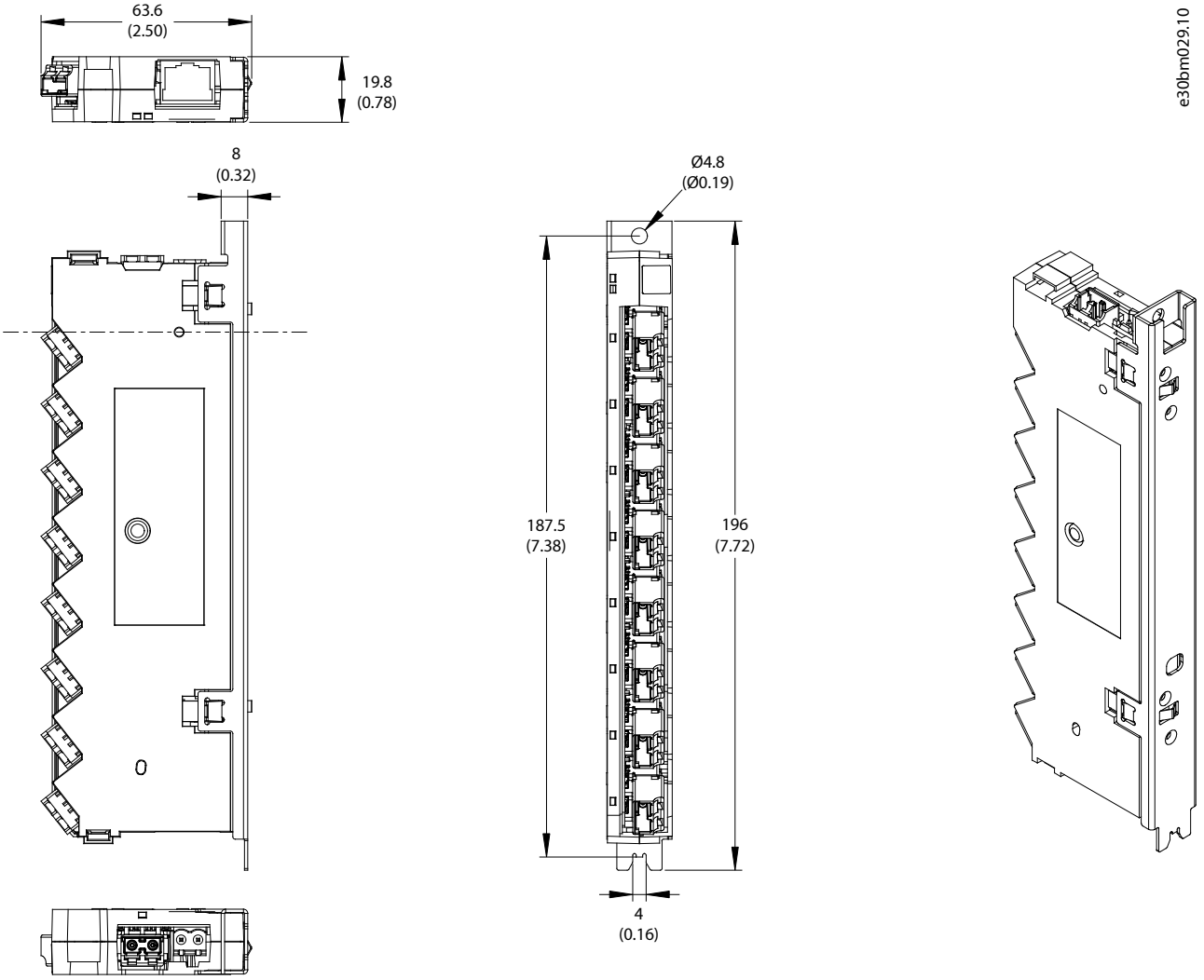


Figure 68: Dimensions of the 8-port Star Coupler Board in mm (in)

9.2.18 Dimensions of the 16-port Star Coupler Board

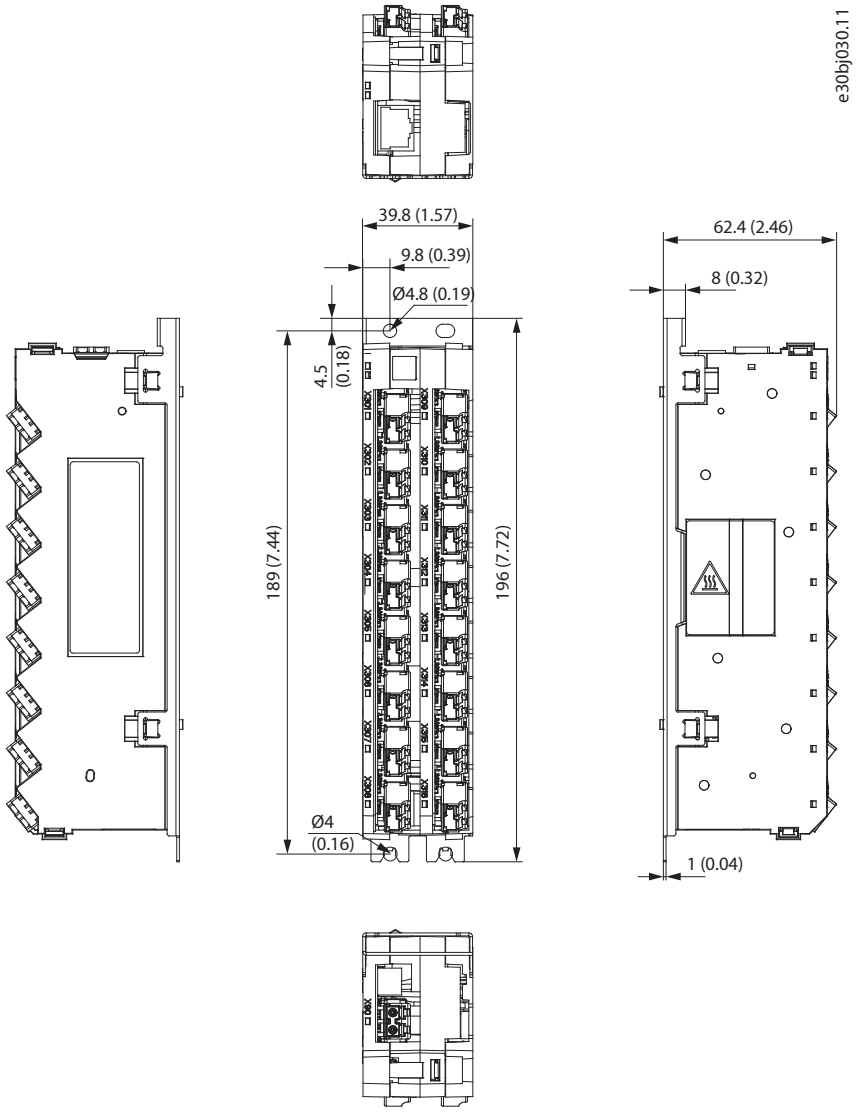


Figure 69: Dimensions of the 16-port Star Coupler Board in mm (in)

9.3 Wiring Diagrams

9.3.1 Wiring Diagram, FE9, FE10

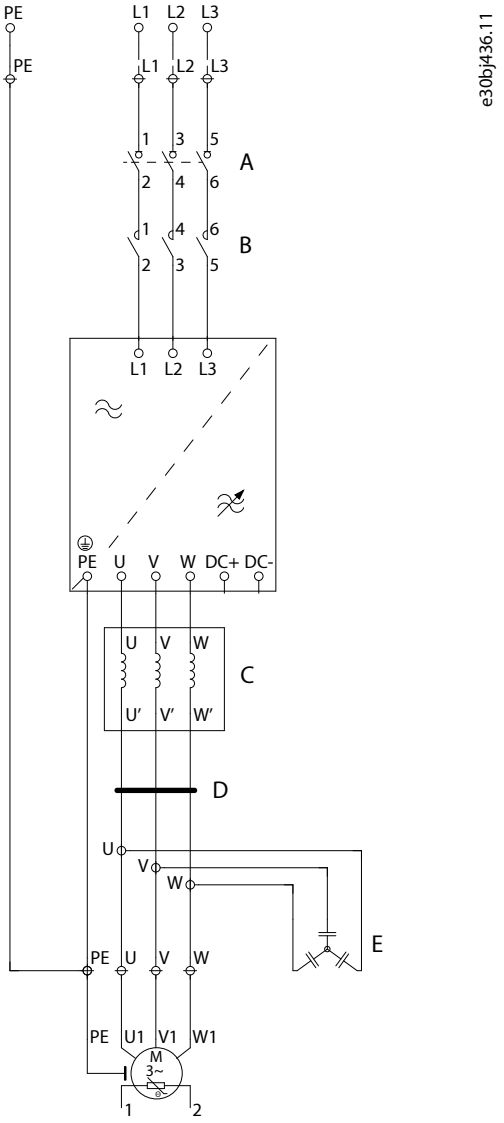


Figure 70: Wiring Diagram, FE9, FE10

A	Switch disconnector +GAMS	**B**	Contactor +GACO
C	dU/dt Filter choke +MADU	**D**	Common-mode Filter +MACM
E	dU/dt Filter capacitor +MADU		

9.3.2 **Wiring Diagram, AE10+IE10, 385–590 A**

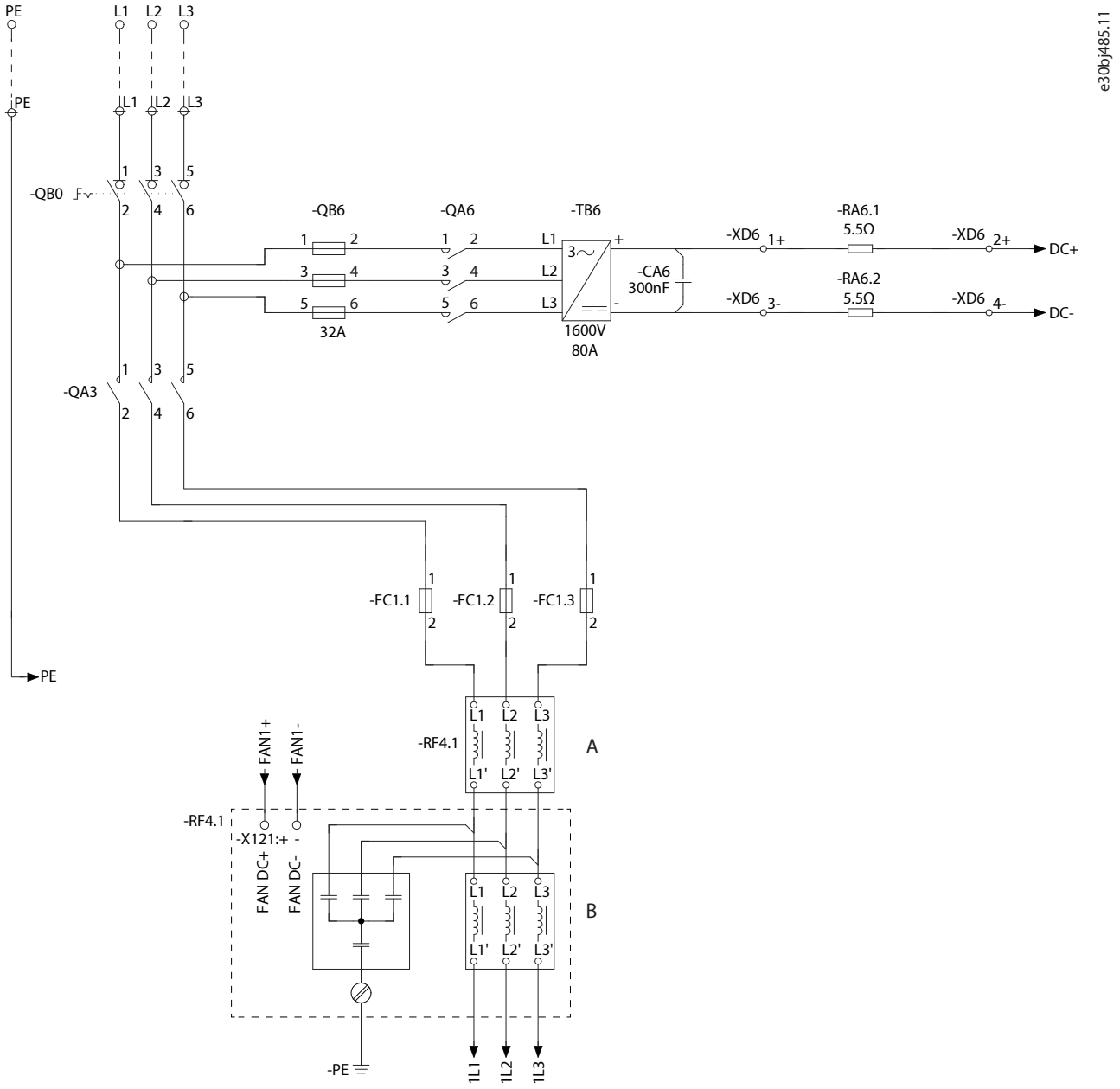


Figure 71: Wiring Diagram, AE10+IE10, 385–590 A

A	L Filter	**B**	LC Filter

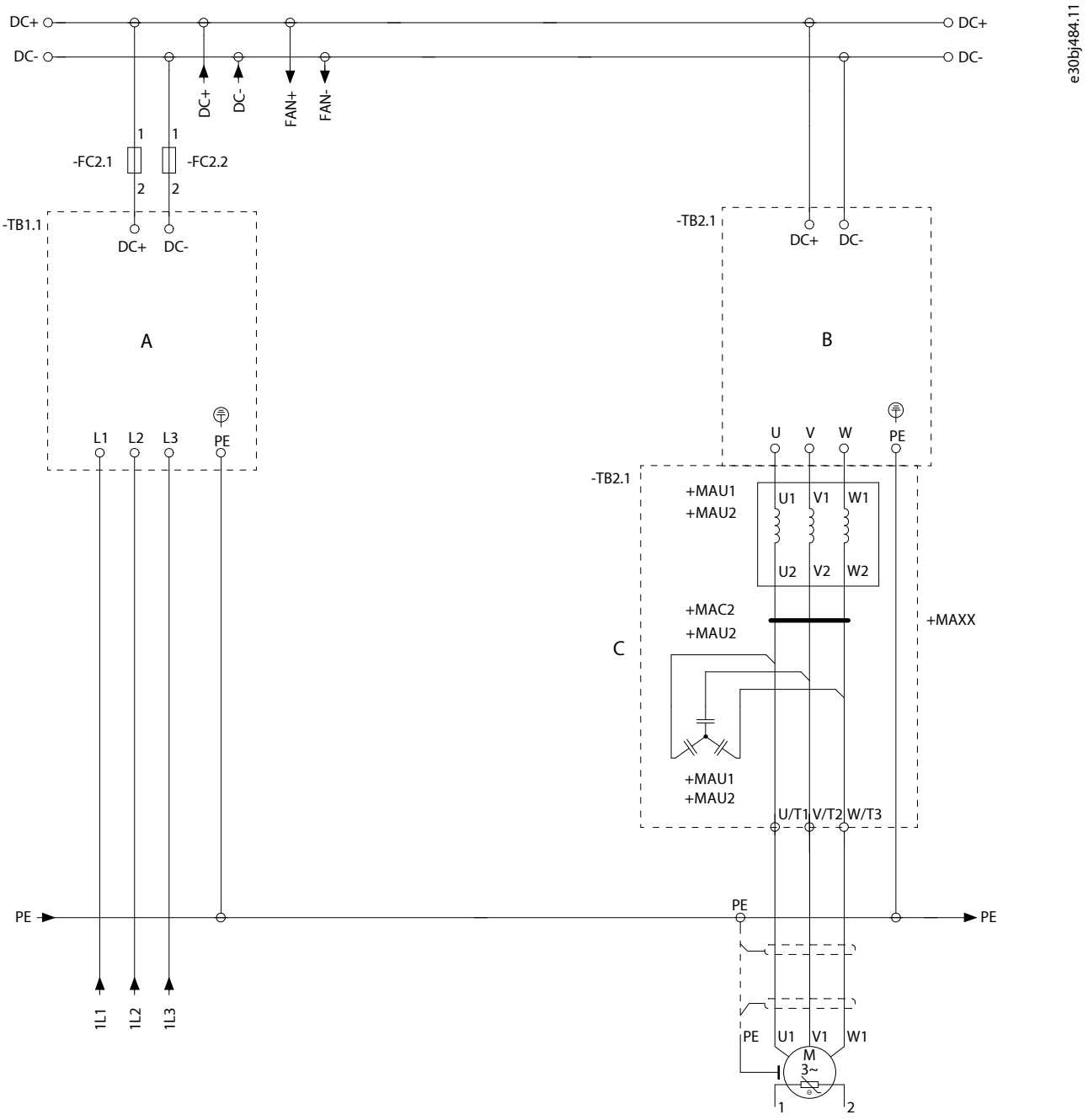


Figure 72: Wiring Diagram, AE10+IE10, 385–590 A (continued)

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

9.3.3 **Wiring Diagram, AE11+IE11, 658–880 A**

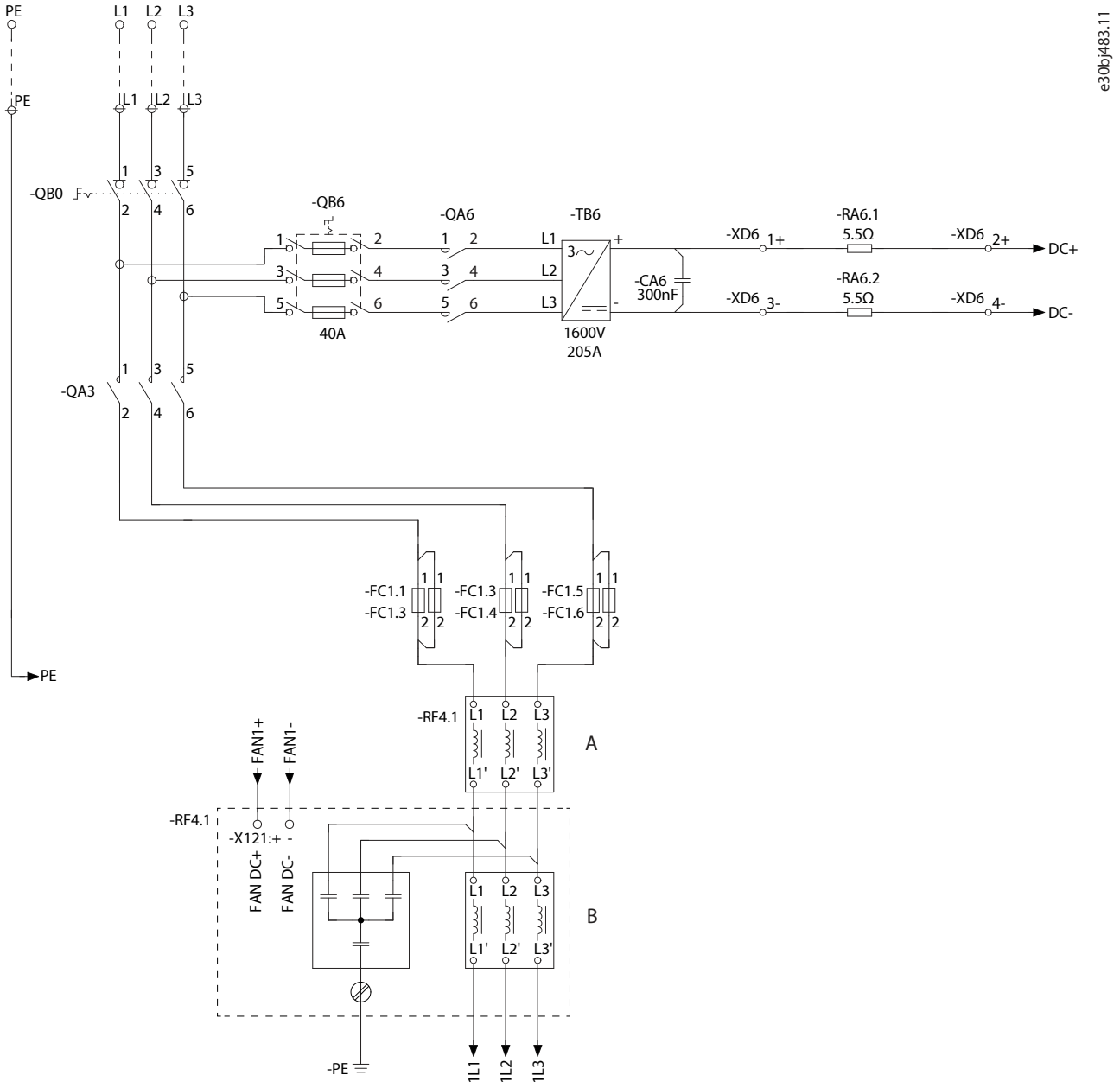


Figure 73: Wiring Diagram, AE11+IE11, 658–880 A

A	L Filter	**B**	LC Filter

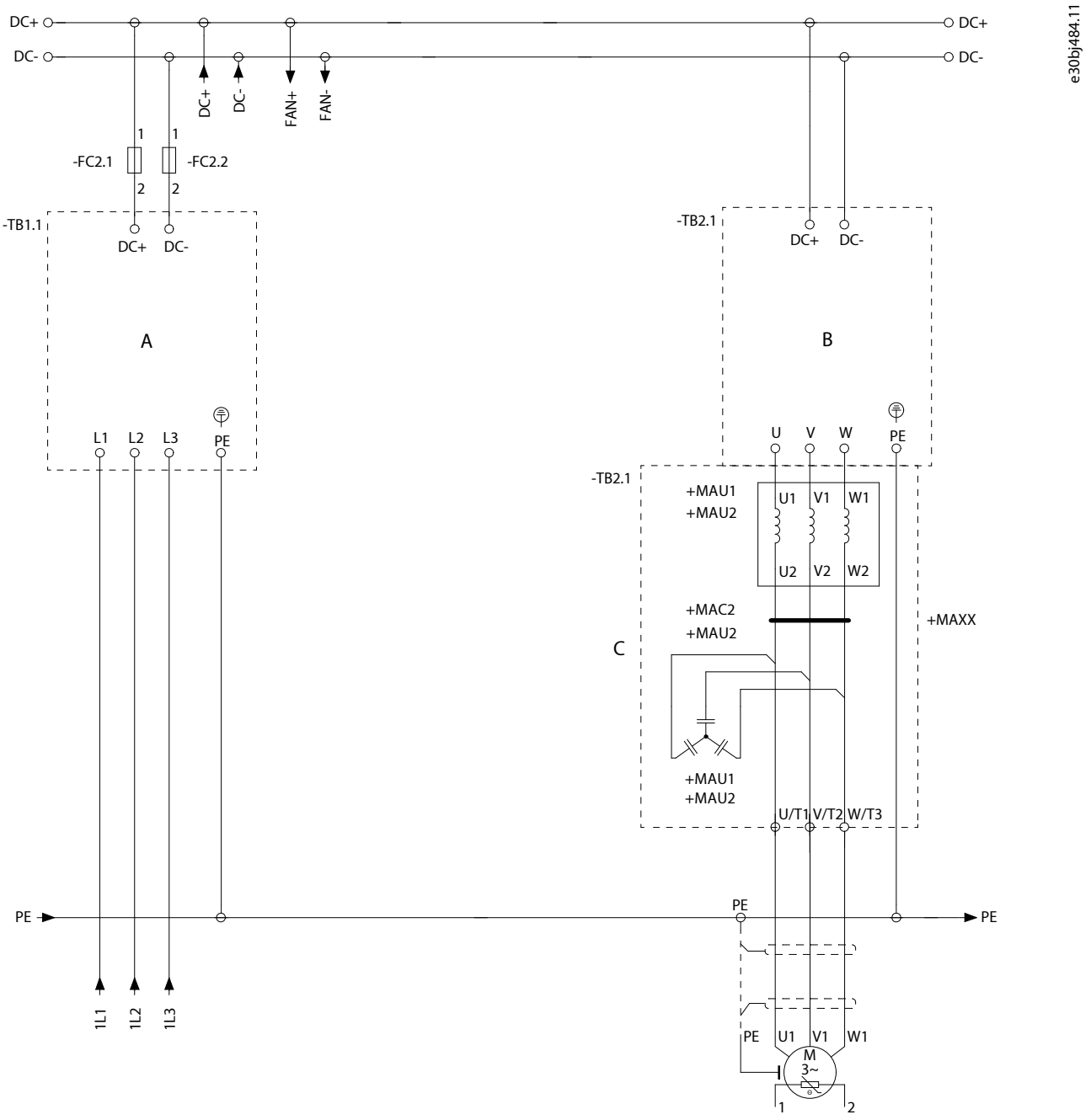


Figure 74: Wiring Diagram, AE11+IE11, 658–880 A (continued)

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

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

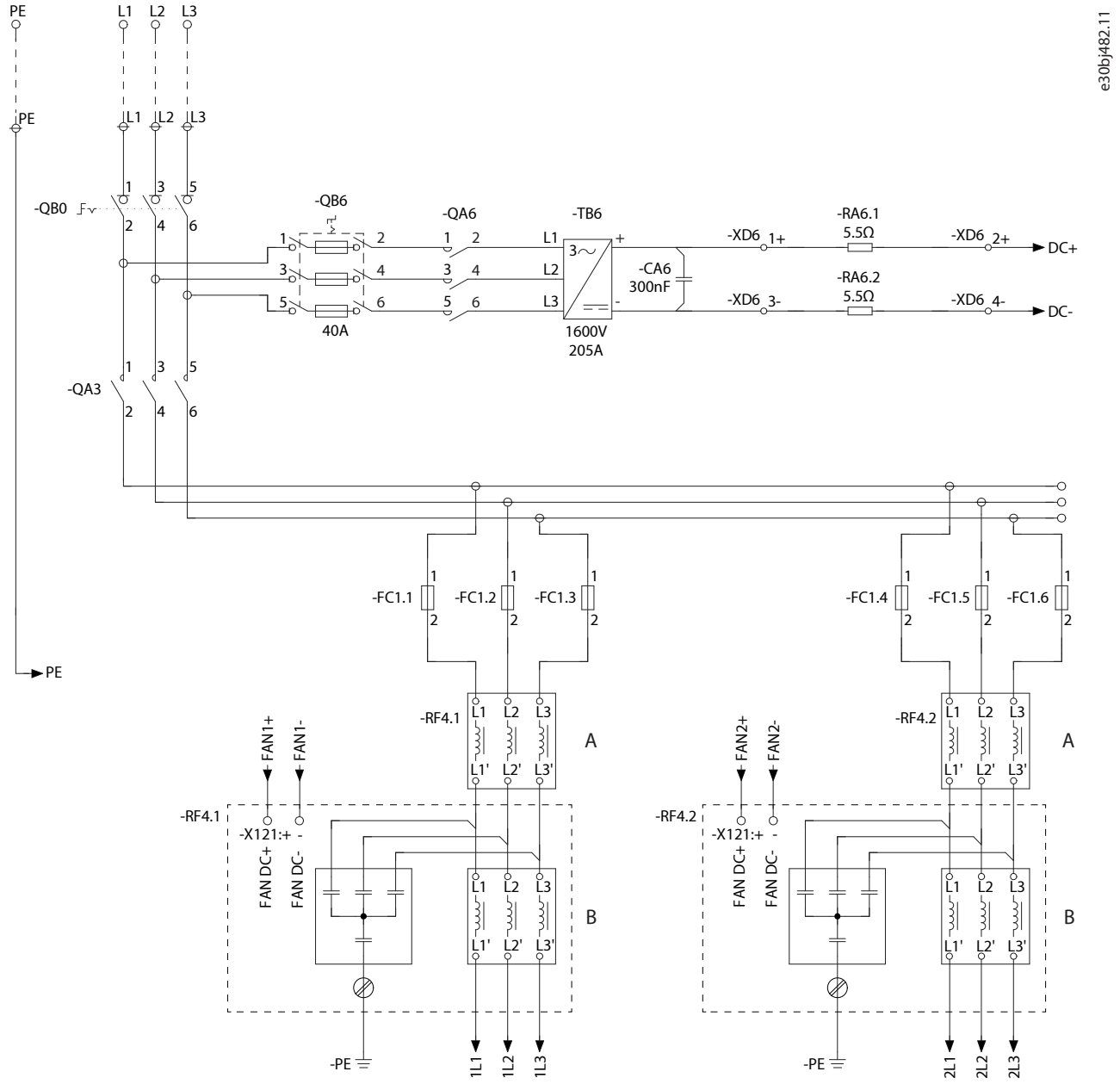


Figure 75: Wiring Diagram, 2 x AE10+2 x IE10, 1000–1100 A

A	L Filter	**B**	LC Filter

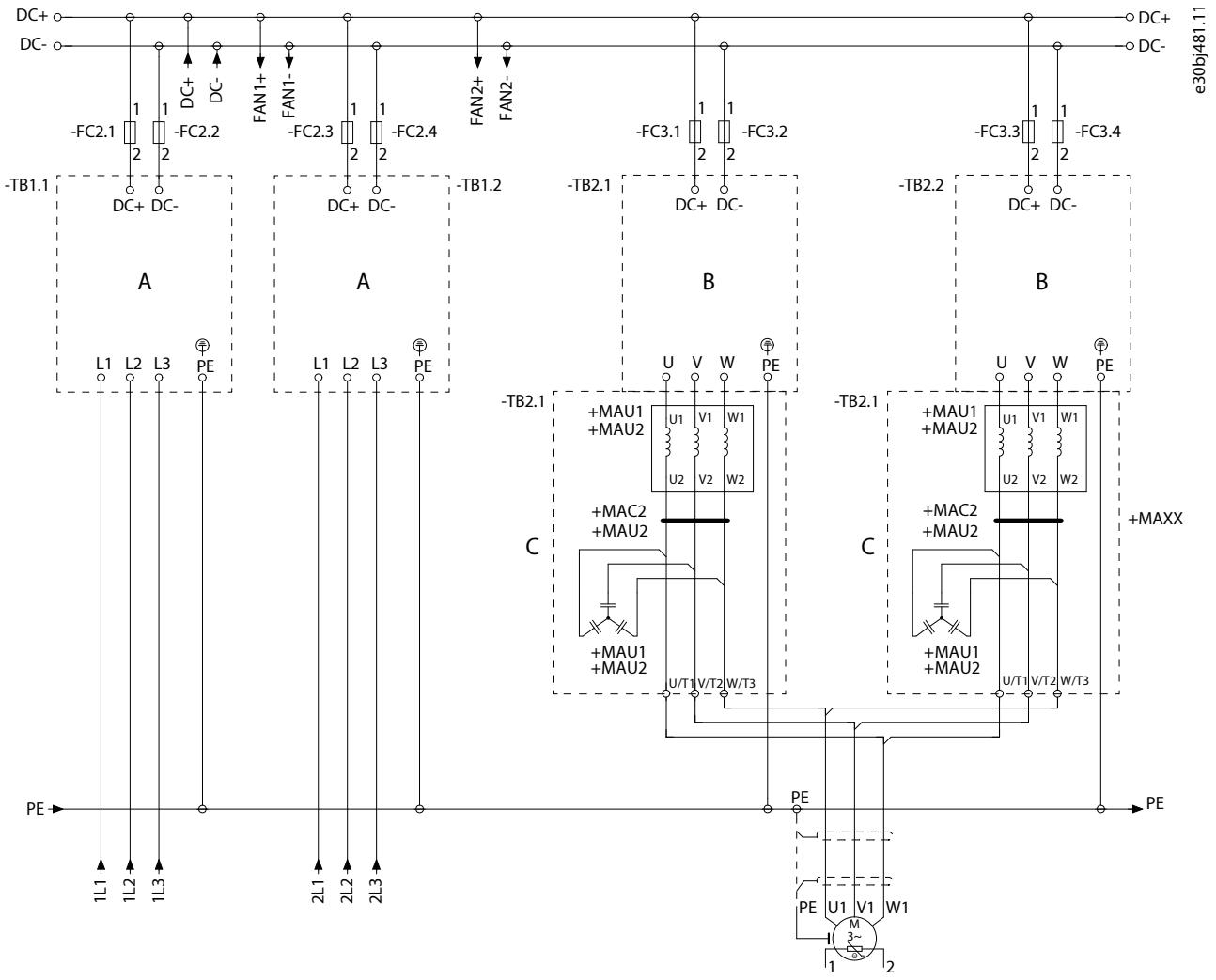


Figure 76: Wiring Diagram, 2 x AE10+2 x IE10, 1000–1100 A (continued)

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

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

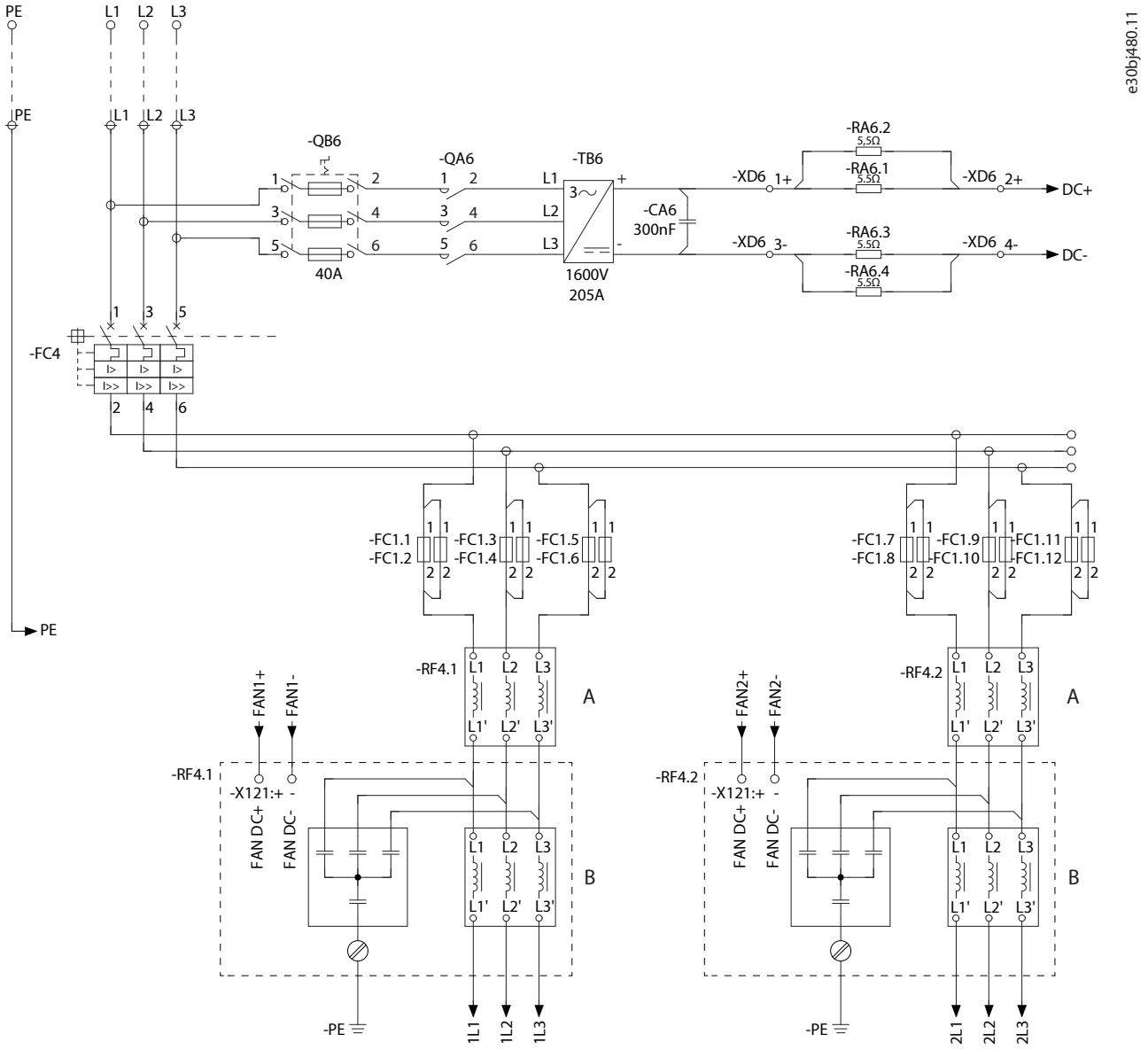


Figure 77: Wiring Diagram, 2 x AE11+2 x IE11, 1260–1710 A

A	L Filter	**B**	LC Filter

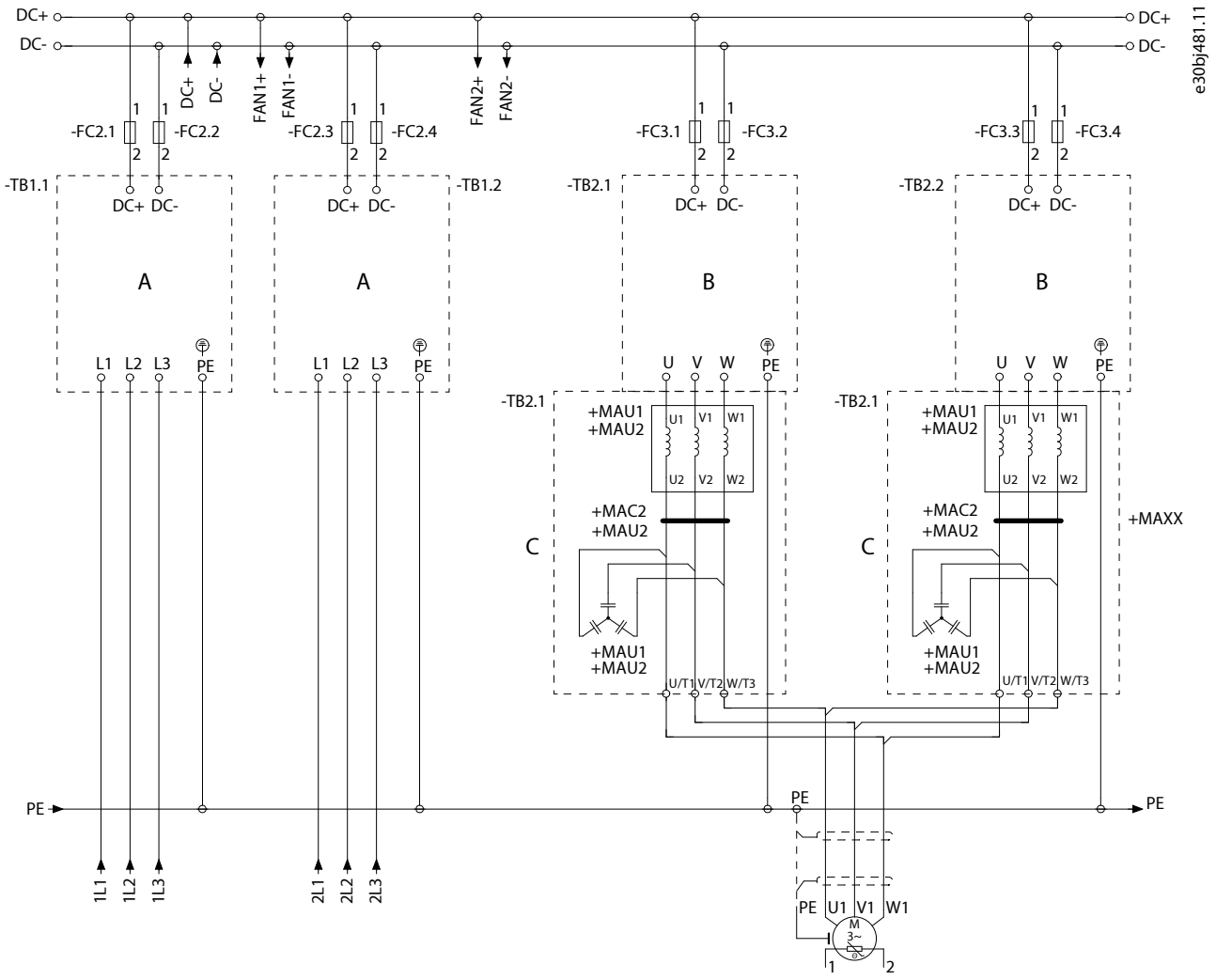


Figure 78: Wiring Diagram, 2 x AE11+2 x IE11, 1260–1710 A (continued)

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

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

NOTICE

This is a generic presentation of the system. Refer primarily to the wiring diagrams delivered with the product.

NOTICE

The products with frame designations FE9 and FE10 do not have a pre-charging control circuit.

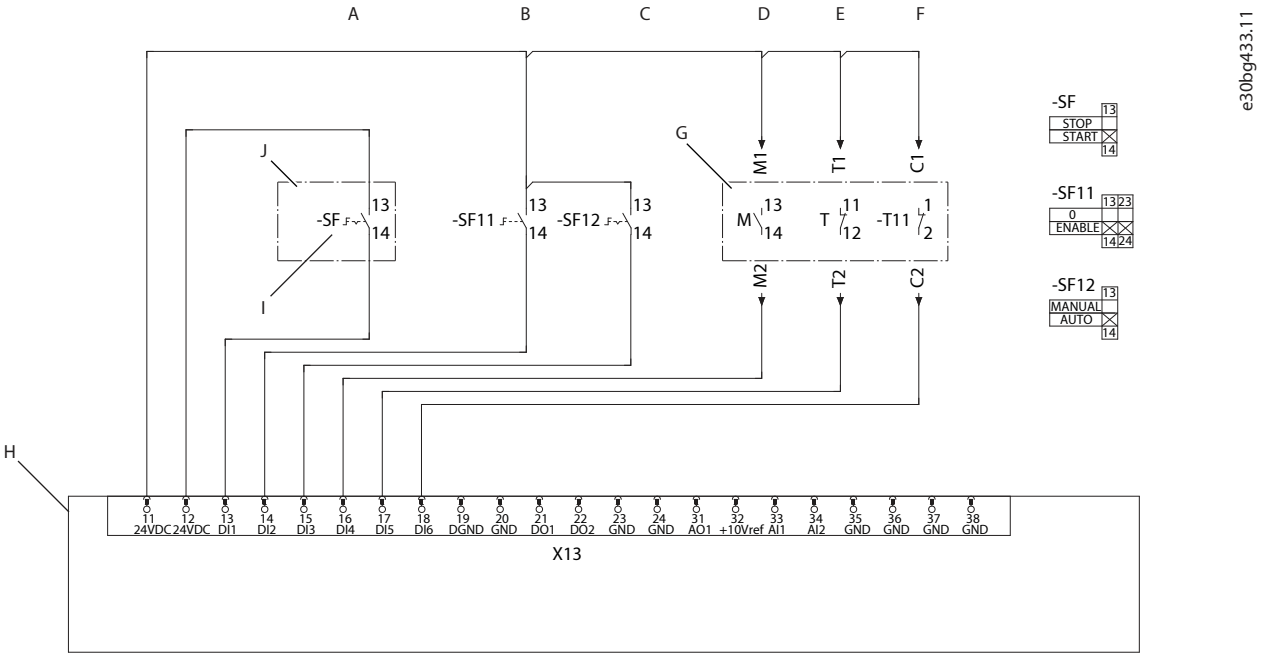


Figure 79: Pre-charging Control Wiring Diagram, AE10, AE11, IE10, IE11

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

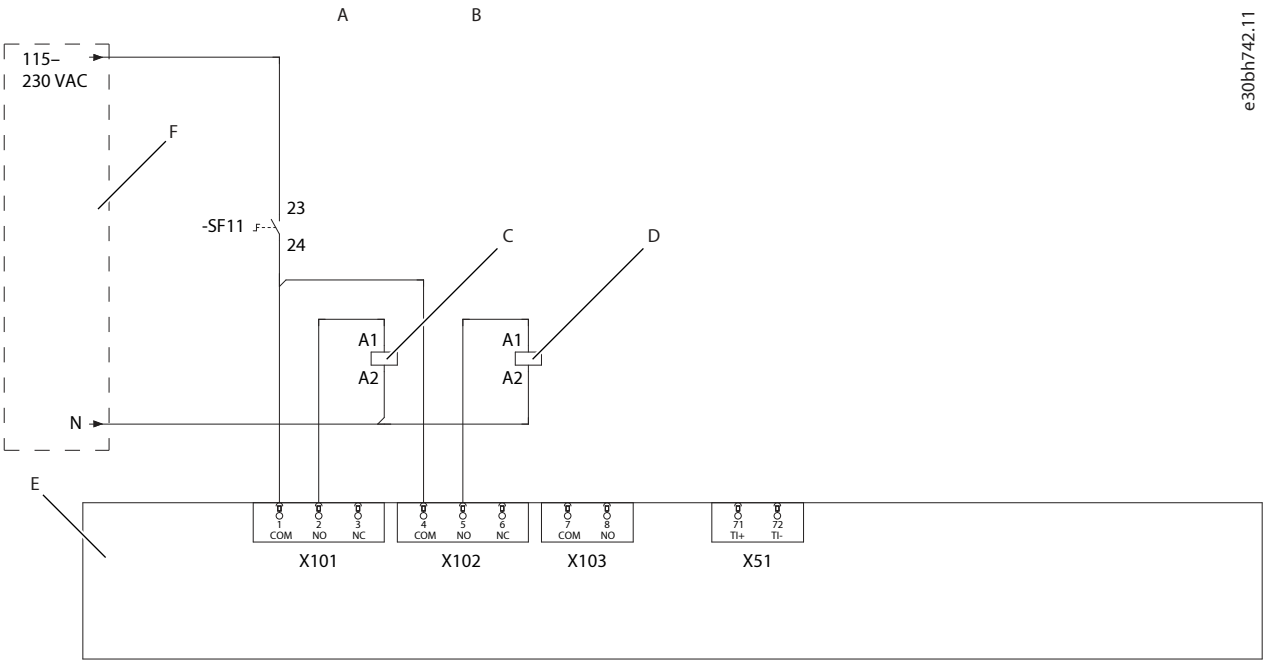


Figure 80: Pre-charging Control Wiring Diagram, AE10, AE11, IE10, IE11

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

9.3.7 The Pre-charging Function

To avoid high inrush current to drive capacitors, pre-charge the drive before switching on main power.

The pre-charging function uses AFE control unit I/Os and relays. Pre-charging can be operated either locally (manually or automatically) or remotely (manually). The pre-charging circuit is protected by fuses installed in the fuse base (AE10, E10) or the fuse switch (AE11, IE11). Check that the mains 0-enable switch is in the 0 position. With 590 A drives and larger, close the pre-charging fuse switch (-QB6). After that, if the drive has a main switch (-QB0), close it. Check that all miniature circuit breakers are closed.

Manual operation

Turn the pre-charging MAN-AUTO switch (-SF12) to the manual position. Turn the mains 0-enable switch (-SF11) to the enable position. Pre-charging starts by pressing the *Run* button on the control panel of the AFE module. The pre-charging contactor closes. When pre-charging is done, the main input device closes and the pre-charging contactor opens. Perform pre-charging again after a power outage.

Automatic operation

Pre-charging starts automatically when pre-charging is enabled with mains 0-enable switch and pre-charging MAN-AUTO switch is in the auto position. The pre-charging contactor closes. When pre-charging is done, the main input device closes and the pre-charging contactor opens. Pre-charging is performed automatically after a power outage.

Remote operation

Turn the pre-charging MAN-AUTO switch to the manual position. Turn the mains 0-enable switch to the enable position. Pre-charging starts by activating Digital Input 1. The AFE starts and the pre-charging contactor closes. When pre-charging is done, the main input device closes and the pre-charging contactor opens. Perform pre-charging again after a power outage.

9.4 Options

9.4.1 Available Options for the Enclosed Drives

Table 39: 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

Table 39: Options for the Enclosed Drives (continued)

Option group	Plus code	Description
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
Cabinet options power supply	+IHAT	Auxiliary AC voltage transformer
	+IHAS	Auxiliary AC supply terminals
Door signal lights	+IICD	Run, ready, fault
Emergency stop	+ILSS	STO/SS1 push button on door
Mains cabling direction	+KCIB	Bottom-entry
	+KCIT	Top-entry
Motor cabling direction	+KDOB	Bottom-entry
	+KDOT	Top-entry
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

9.4.2 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 V DC 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 for AE10, AE11, IE10, and IE11 in the *iC7 Series Functional Safety Operating Guide, Air-cooled and Liquid-cooled System Modules* or for FE9 and FE10 in the *iC7-Automation Functional Safety Operating Guide, Frequency Converters*.

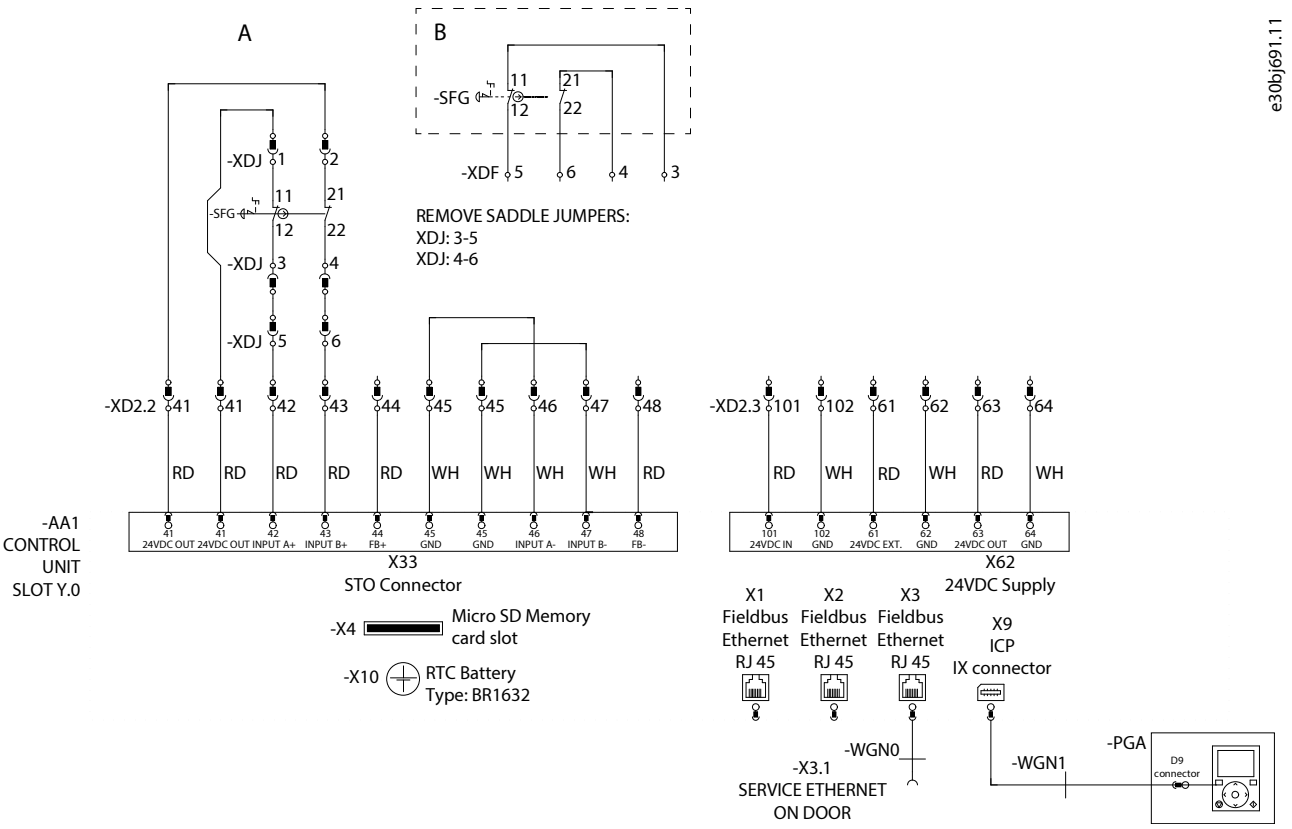


Figure 81: Circuit Diagram of STO/SS1 Push Button on Door (+ILSS)

A	Emergency stop	**B**	Field connection

9.4.3 Auxiliary AC supply (+IHAS)

The Auxiliary AC supply (+IHAS) cable must be short-circuit and overload protected with a 16-A two-pole C-curve miniature circuit breaker.

In UL installations, the Auxiliary AC supply cable must be protected with a UL 489 16-A branch-circuit 2-pole miniature circuit breaker.

The power requirement for the Auxiliary AC supply is a maximum of 1700 W.

9.5 Cable Sizes

9.5.1 General Cable Size Information

The IEC cable sizing is based on these conditions:

- Ambient temperature of 40 °C (104 °F).
- Cables laid side by side on cable ladders.
- Maximum 9 cables per ladder.
- 3 ladders on top of each other.
- XLPE insulated cables, with a maximum conductor temperature of 90 °C (194 °F).

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 these conditions:

- Ambient temperature of 40 °C (104 °F).
- 75 °C (167 °F) rated copper cables.

- Multicore cables installed in cable ducts.
  - If cable ducts are not used, keep sufficient spacing between the cables.
  - Do not stack or bundle the cables without proper spacing for longer than 600 mm (24 in).

In other conditions, refer to the local safety regulations, the input voltage, and the load current of the drive.

It is possible to use M12 cable lugs for the mains cables.

NOTICE

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 enclosed drives can be found with these links.

- 9.5.2 Mains Cable Size Recommendations, 380–500 V
- 9.5.3 Motor Cable Size Recommendations, 380–500 V
- 9.5.4 Mains Cable Size Recommendations, UL 480 V
- 9.5.5 Motor Cable Size Recommendations, UL 480 V
- 9.5.6 Brake Cable Size Recommendations
- 9.5.7 Brake Cable Size Recommendations, UL

9.5.2 Mains Cable Size Recommendations, 380–500 V

Table 40: Mains Cable Size Recommendations, 380–500 V

Model code	Frame	I_N [A]	Cable [mm^2]	Maximum cable size [mm^2]	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]
iC7-60EA3N 05-206A	FE9(2)	206	Cu 1 x (3x70+35) Al 1 x (3x120+41 Cu)	95 Cu/Al	2	Ø10.5	2	Ø10.5
iC7-60EA3N 05-245A		245	Cu 1 x (3x95+50) Al 1 x (3x150+41 Cu)	95 Cu/Al	2	Ø10.5	2	Ø10.5
iC7-60EA3N 05-302A		302	Cu 1 x (3x120+70) Al 2 x (3x95+29 Cu)	95 Cu/Al	2	Ø10.5	2	Ø10.5
iC7-60EA3N 05-385A		385	Cu 2 x (3x95+50) Al 2 x (3x120+41 Cu)	95 Cu/Al	2	Ø10.5	2	Ø10.5
iC7-60EA3N 05-480A	FE10(2)	480	Cu 2 x (3x120+70) Al 2 x (2x185+57 Cu)	150 Cu/120 Al	3	Ø13.5	4	Ø10.5
iC7-60EA3N 05-588A		588	Cu 2 x (3x150+70) Al 2 x (3x240+41 Cu)	150 Cu/120 Al	3	Ø13.5	4	Ø10.5

Table 40: Mains Cable Size Recommendations, 380–500 V (continued)

Model code	Frame	I_N [A]	Cable [mm^2]	Maximum cable size [mm^2]	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]
iC7-60EA3A05-385A	AE10 + IE10(3)	325	Cu 1 x (3x150+70) Al 2 x (3x95+29 Cu)	240 Cu/Al	2(4)	Ø13.5(5)	4	Ø10.5
iC7-60EA3A05-480A		403	Cu 2 x (3x95+ 50) Al 2 x (3x120+41 Cu)	240 Cu/Al	2(4)	Ø13.5(5)	4	Ø10.5
iC7-60EA3A05-590A		508	Cu 2 x (3x120+70) Al 2 x (3x150+41 Cu)	240 Cu/Al	2(4)	Ø13.5(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	Ø13	5	Ø10.5
iC7-60EA3A05-730A		647	Cu 3 x (3x120+70) Al 3 x (3x150+70 Cu)	240 Cu/Al	4	Ø13	5	Ø10.5
iC7-60EA3A05-820A		728	Cu 3 x (3x120+70) Al 4 x (3x120+41 Cu)	240 Cu/Al	4	Ø13	5	Ø10.5
iC7-60EA3A05-880A		809	Cu 3 x (3x150+70) Al 4 x (3x120+41 Cu)	240 Cu/Al	4	Ø13	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	6	Ø13	5	Ø10.5
iC7-60EA3A05-1100		1018	Cu 4 x (3x150+70) Al 4 x (3x185+57 Cu)	240 Cu/Al	6	Ø13	5	Ø10.5
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	Ø13	8	Ø10.5
iC7-60EA3A05-1450		1293	Cu 6 x (3x120+70) Al 6 x (3x150+70 Cu)	240 Cu/Al	8	Ø13	8	Ø10.5
iC7-60EA3A05-1710		1453	Cu 6 x (3x150+70) Al 6 x (3x185+57 Cu)	240 Cu/Al	8	Ø13	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.

4) If the option Top-entry +KCIT is used, the maximum number of mains cables is 4.

5) If the option Top-entry +KCIT is used, the hole size is 13 mm.

9.5.3 Motor Cable Size Recommendations, 380–500 V

Table 41: Motor Cable Size Recommendations, 380–500 V

Model code	Frame	I_N [A]	Cable [mm^2]	Maximum cable size [mm^2](1)	Maximum number of motor cables	Bolt size(2)	Number of grounding holes on PE busbar	Hole size of the grounding terminal [mm]
iC7-60EA3N 05-206A	FE9	206	Cu 1 x (3x70+35) Al 1 x (3x120+41 Cu)	95 Cu/Al(3)	2(4)	M10	2	Ø10.5
iC7-60EA3N 05-245A		245	Cu 1 x (3x95+50) Al 1 x (3x150+41 Cu)	95 Cu/Al(3)	2(4)	M10	2	Ø10.5
iC7-60EA3N 05-302A		302	Cu 1 x (3x120+70) Al 2 x (3x95+29 Cu)	95 Cu/Al(3)	2(4)	M10	2	Ø10.5
iC7-60EA3N 05-385A		385	Cu 2 x (3x95+50) Al 2 x (3x120+41 Cu)	95 Cu/Al(3)	2(4)	M10	2	Ø10.5
iC7-60EA3N 05-480A	FE10	480	Cu 2 x (3x120+70) Al 2 x (2x185+57 Cu)	150 Cu/120 Al(3)	3(4)	M10	4	Ø10.5
iC7-60EA3N 05-588A		588	Cu 2 x (3x150+70) Al 2 x (3x240+41 Cu)	150 Cu/120 Al(3)	3(4)	M10	4	Ø10.5
iC7-60EA3A 05-385A	AE10 + IE10	394	Cu 1 x (3x185+95) Al 2 x (3x120+41 Cu)	240 Cu/Al(3)	4(4)	M10	4	Ø10.5
iC7-60EA3A 05-480A		490	Cu 2 x (3x120+70) Al 2 x (3x150+70 Cu)	240 Cu/Al(3)	4(4)	M10	4	Ø10.5
iC7-60EA3A 05-590A		601	Cu 2 x (3x150+70) Al 2 x (3x185+57 Cu)	240 Cu/Al(3)	4(4)	M10	4	Ø10.5

Table 41: Motor Cable Size Recommendations, 380–500 V (continued)

Model code	Frame	I_N [A]	Cable [mm^2]	Maximum cable size [mm^2](1)	Maximum number of motor cables	Bolt size(2)	Number of grounding holes on PE busbar	Hole size of the grounding terminal [mm]
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 Ø10.5 mm

2) If the option Top-entry +KDOT is used, the bolt size is M13.

3) If the option Top-entry +KDOT is used, the maximum cable size is 240 mm^2.

4) If the option Top-entry +KDOT is used, the maximum number of motor cables is 4.

9.5.4 Mains Cable Size Recommendations, UL 480 V

Table 42: Mains Cable Size Recommendations, UL 480 V

Model code	Frame	I_N [A]	Mains cable [AWG]	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 1/0	LCAX1/0-12-X	300 MCM	2 (Ø10.5)	2 (Ø10.5)
iC7-60EA3N05-245A		245	2 x 2/0	LCAX2/0-12-X	300 MCM	2 (Ø10.5)	2 (Ø10.5)
iC7-60EA3N05-302A		302	2 x 4/0	LCAX4/0-12-X	300 MCM	2 (Ø10.5)	2 (Ø10.5)
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 4/0	LCAX4/0-12-X	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	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)
iC7-60EA3A05-590A		451	3 x 4/0	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)

Table 42: Mains Cable Size Recommendations, UL 480 V (continued)

Model code	Frame	I_N [A]	Mains cable [AWG]	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])
iC7-60EA3A05-1260	2xAE11 + 2xIE11	955	6 x 4/0	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

9.5.5 Motor Cable Size Recommendations, UL 480 V

Table 43: Motor Cable Size Recommendations, UL 480 V

Model code	Frame	I_N [A]	Motor cable [AWG]	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	2 x 1/0	LCAX300-12-6	300 MCM	2 (M10)	2 (Ø10.5)
iC7-60EA3N05-245A		245	2 x 2/0	LCAX300-12-6	300 MCM	2 (M10)	2 (Ø10.5)
iC7-60EA3N05-302A		302	2 x 4/0	LCAX300-12-6	300 MCM	2 (M10)	2 (Ø10.5)
iC7-60EA3N05-385A		385	2 x 300 MCM	LCAX300-12-6	300 MCM	2 (M10)	2 (Ø10.5)
iC7-60EA3N05-480A	FE10	480	3 x 4/0	LCAX300-12-6	300 MCM	3 (M10)	4 (Ø10.5)
iC7-60EA3N05-588A		588	3 x 300 MCM	LCAX300-12-6	300 MCM	3 (M10)	4 (Ø10.5)
iC7-60EA3A05-385A	AE10 + IE10	372	2 x 300 MCM	LCAX300-12-6	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-480A		466	3 x 4/0	LCAX4/0-12-X	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-590A		531	3 x 250 MCM	LCAX250-12-X	500 MCM	4 (M10)	4 (Ø10.5)

Table 43: Motor Cable Size Recommendations, UL 480 V (continued)

Model code	Frame	I_N [A]	Motor cable [AWG]	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]
iC7-60EA3A05-658A	AE11 + IE11	603	3 x 350 MCM	LCAX350-12-6	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-730A		672	4 x 250 MCM	LCAX250-12-X	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-820A		746	4 x 300 MCM	LCAX300-12-6	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-880A		838	4 x 350 MCM	LCAX350-12-6	500 MCM	4 (M10)	4 (Ø10.5)
iC7-60EA3A05-1000	2xAE10 + 2xIE10	940	6 x 4/0	LCAX4/0-12-X	500 MCM	8 (M10)	8 (Ø10.5)
iC7-60EA3A05-1100		1052	6 x 250 MCM	LCAX250-12-X	500 MCM	8 (M10)	8 (Ø10.5)
iC7-60EA3A05-1260	2xAE11 + 2xIE11	1174	6 x 300 MCM	LCAX300-12-6	500 MCM	8 (M10)	8 (Ø10.5)
iC7-60EA3A05-1450		1328	8 x 250 MCM	LCAX250-12-X	500 MCM	8 (M10)	8 (Ø10.5)
iC7-60EA3A05-1710		1603	8 x 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 Ø10.5 mm

9.5.6 Brake Cable Size Recommendations

Table 44: Brake Cable Size Recommendations, 380–500 V

Model code	Frame	I_N [A]	Cable [mm^2]	Maximum cable size [mm^2]	Maximum number of brake cables	Bolt size
iC7-60EA3N05-206A	FE9	206	Cu 70 Al 120	120	2 per polarity	M10
iC7-60EA3N05-245A		245	Cu 95 Al 150	120	2 per polarity	M10
iC7-60EA3N05-302A		302	Cu 120 Al 2 x 95	120	2 per polarity	M10
iC7-60EA3N05-385A		385	Cu 2 x 95 Al 2 x 120	120	2 per polarity	M10

Table 44: Brake Cable Size Recommendations, 380–500 V (continued)

Model code	Frame	I_N [A]	Cable [mm^2]	Maximum cable size [mm^2]	Maximum number of brake cables	Bolt size
iC7-60EA3N05-480A	FE10	480	Cu 2 x (3x120+70) Al 2 x (2x185+57 Cu)	240	2	M10
iC7-60EA3N05-588A		588	Cu 2 x (3x150+70) Al 2 x (3x240+41 Cu)	240	2	M10

9.5.7 Brake Cable Size Recommendations, UL

Model code	Frame	I_N [A]	Cable AWG	Maximum cable size [mm^2]	Maximum number of brake cables	Bolt size
iC7-60EA3N05-206A	FE9	206	2 x 4/0	4/0	2 per polarity	M10
iC7-60EA3N05-245A		245	2 x 4/0	4/0	2 per polarity	M10
iC7-60EA3N05-302A		302	2 x 4/0	4/0	2 per polarity	M10
iC7-60EA3N05-385A		385	2 x 4/0	4/0	2 per polarity	M10
iC7-60EA3N05-480A	FE10	480	2 x 400 MCM	400 MCM	2	M10
iC7-60EA3N05-588A		588	2 x 400 MCM	400 MCM	2	M10

9.6 Fuses

9.6.1 Fuse Size Tables

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

- 9.6.2 AC Fuses, 380–500 V AC
- 9.6.3 DC Fuses, 465–800 V DC
- 9.6.4 External Fuses on External Supply for Input Devices

9.6.2 AC Fuses, 380–500 V AC

Table 45: 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	2000
iC7-60EA3N05-245A		245	3	00	170M2620(2)	700	350	2400
iC7-60EA3N05-302A		302	3	00	170M2621(2)	700	400	2800
iC7-60EA3N05-385A		385	3	00	170M9007(2)	550	475	3700
iC7-60EA3N05-480A	FE10	480	3	1	170M4016(2)	700	630	4500
iC7-60EA3N05-588A		588	3	1	170M4017(2)	700	700	5400
iC7-60EA3A05-385A	AE10 + IE10	385	3	33	PC33UD69V550 TF(3)	690	550	3288
iC7-60EA3A05-480A		480	3	33	PC33UD69V700 TF(3)	690	700	4822
iC7-60EA3A05-590A		590	3	33	PC33UD69V700 TF(3)	690	700	4822
iC7-60EA3A05-658A	AE11 + IE11	658	6(4)	33	PC33UD69V550 TF(3)	690	550	6576
iC7-60EA3A05-730A		730	6(4)	33	PC33UD69V550 TF(3)	690	550	6576
iC7-60EA3A05-820A		820	6(4)	33	PC33UD69V550 TF(3)	690	550	6576
iC7-60EA3A05-880A		880	6(4)	33	PC33UD69V550 TF(3)	690	550	6576
iC7-60EA3A05-1000	2xAE10 + 2xIE10	1000	6	33	PC33UD69V700 TF(3)	690	700	–
iC7-60EA3A05-1100		1100	6	33	PC33UD69V700 TF(3)	690	700	–
iC7-60EA3A05-1260	2xAE11 + 2xIE11	1260	12(4)	33	PC33UD69V550 TF(3)	690	550	–
iC7-60EA3A05-1450		1450	12(4)	33	PC33UD69V550 TF(3)	690	550	–
iC7-60EA3A05-1710		1707	12(4)	33	PC33UD69V550 TF(3)	690	550	–

1) Current, prospective, minimum rating

2) Bussmann

3) Mersen

4) Double fuse per phase

9.6.3 DC Fuses, 465–800 V DC

Table 46: 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		480	2	73	PC73UD13C800TF	1250	800
iC7-60EA3A05-590A		590	2	73	PC73UD10C1000TF	1000	1000
iC7-60EA3A05-658A	AE11 + IE11	658	2	73	PC73UD90V13CTF	900	1250
iC7-60EA3A05-730A		730	2	73	PC73UD90V13CTF	900	1250
iC7-60EA3A05-820A		820	2	73	PC73UD85V14CTF	850	1400
iC7-60EA3A05-880A		880	2	73	PC73UD85V14CTF	850	1400
iC7-60EA3A05-1000	2xAE10 + 2xIE10	1000	8	73	PC73UD13C800TF	1250	800
iC7-60EA3A05-1100		1100	8	73	PC73UD10C1000TF	1000	1000
iC7-60EA3A05-1260	2xAE11 + 2xIE11	1260	8	73	PC73UD90V13CTF	900	1250
iC7-60EA3A05-1450		1450	8	73	PC73UD90V13CTF	900	1250
iC7-60EA3A05-1710		1707	8	73	PC73UD85V14CTF	850	1400

9.6.4 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 47: External Fuses of the Enclosed Drives

Model code	Frame	IEC fuse	Maximum UL fuse
iC7-60EA3N05-206A	FE9, FE10	gG 315 A[(1)] or gG 355 A	Class J, 500 A
iC7-60EA3N05-245A		gG 315 A	Class J, 500 A
iC7-60EA3N05-302A		gG 400 A	Class J, 500 A
iC7-60EA3N05-385A		gG 500 A	Class J, 500 A
iC7-60EA3N05-480A		gG 630 A	Class J, 600 A
iC7-60EA3N05-588A			Class J, 600 A
iC7-60EA3A05-385A	AE10 + IE10	gG 630 A	–
iC7-60EA3A05-480A			
iC7-60EA3A05-590A			–

Table 47: External Fuses of the Enclosed Drives (continued)

Model code	Frame	IEC fuse	Maximum UL fuse
iC7-60EA3A05-658A	AE11 + IE11	gG 1000 A	–
iC7-60EA3A05-730A			
iC7-60EA3A05-820A			
iC7-60EA3A05-880A			
iC7-60EA3A05-1000	2xAE10 + 2xIE10	gG 1250 A	–
iC7-60EA3A05-1100			–

1) with the mains contactor option

9.7 Current Ratings

9.7.1 General Current Rating Information

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.

- 9.7.2 Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, 400 V AC
- 9.7.3 Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, UL, 460 V AC
- 9.7.4 Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, 500 V AC
- 9.7.5 Current Ratings for Regenerative AFE, 400 V AC
- 9.7.6 Current Ratings for Regenerative AFE, UL, 460 V AC
- 9.7.7 Current Ratings for Regenerative AFE, 500 V AC
- 9.7.8 Current Ratings for Low-harmonic AFE, 400 V AC
- 9.7.9 Current Ratings for Low-harmonic AFE, UL, 460 V AC
- 9.7.10 Current Ratings for Low-harmonic AFE, 500 V AC

Table 48: 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.
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

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

Table 49: 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

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

Table 50: 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

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

Table 51: 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

Table 51: Current Ratings for 6-pulse Enclosed Drives, FE9 and FE10, 500 V AC (continued)

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]
iC7-60EA3N05-385A	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

9.7.5 Current Ratings for Regenerative AFE, 400 V AC

Table 52: 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

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

Table 53: 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
iC7-60EA3A05-590A	AE10+IE10	451	531	776	441	520	344	456	450	350
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

9.7.7 Current Ratings for Regenerative AFE, 500 V AC

Table 54: Current Ratings for Regenerative AFE, 500 V AC

Model code	Frame	Nominal ratings			Low overload		High overload		Typical motor power, 500 V AC	
		$I_{N\text{-}in}$ [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	322	372	510	315	364	254	300	250	200
iC7-60EA3A05-480A	AE10+IE10	406	466	619	397	456	315	364	315	250
iC7-60EA3A05-590A	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

Table 54: Current Ratings for Regenerative AFE, 500 V AC (continued)

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]
iC7-60EA3A05-880A	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

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

Table 55: 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
iC7-60EA3H05-590A	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

Table 55: Current Ratings for Low-harmonic AFE, 400 V AC (continued)

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]
iC7-60EA3H05-1450	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

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

Table 56: 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
iC7-60EA3H05-590A	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

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

Table 57: 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
iC7-60EA3H05-590A	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

9.8 Technical Data

9.8.1 Mains Connections

Table 58: 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	The maximum short circuit current $I_{cc} \leq 65$ kA
True power factor (λ)	≥ 0.9 nominal at rated load

Table 58: Mains Connections (continued)

Item	Technical data
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

9.8.2 Motor Connections

Table 59: 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

9.8.3 Ambient Conditions

Table 60: 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)
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

Table 60: Ambient Conditions (continued)

Item	Technical data
Shock (IEC60068-2-27)	max 4 G, 11 ms (in package)
Sound pressure level	–

1) On board level on coated boards.

9.8.4 EMC (IEC 61800-3)

Table 61: 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.

9.8.5 Protections

Table 62: 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.

9.8.6 Product Compliance

Table 63: 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	STO with option +BEF1 (FE9 and FE10). See the *iC7-Automation Functional Safety Operating Guide, Frequency Converters*. STO/SS1-t with option +BEF2. See the *iC7 Series Functional Safety Operating Guide, Air-cooled and Liquid-cooled System Modules*.
Marine type approvals	–

9.8.7 Efficiency

Table 64: 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

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