Installation Guide

iC7 Series Air-cooled LCL Filter OF7Z3 and LC Filter OF7Z1

1 Overview

1.1 LCL Filter and LC Filter

The iC7 Series Air-cooled LCL Filter OF7Z3 and LC Filter OF7Z1 are designed to be used with iC7 Series Air-cooled System Modules. For more details, see the *iC7 Series Air-cooled System Modules Design Guide*.

The LCL filter and LC filter are used as input filters with AFE or grid converter modules in applications where regenerative or low-harmonic functionality is required. The filters reduce switching noise, and ensure correct power quality and minimal interruption to the grid.

The filter complies with the standard IEC 61800-5-1 and must be used accordingly. The loadability of the filter must be equal to or higher than the rated operating current.

Table 1: The Available LCL Filters and LC Filters

Filter	Voltage rating	Current rating	Frame designation
LCL Filter OF7Z3	380–500 V AC	514 A	LCL10
LCL Filter OF7Z3	380–500 V AC	816 A	LCL11
LCL Filter OF7Z3	380–500 V AC	820 A	LCL11W
LCL Filter OF7Z3	525–690 V AC	380 A	LCL10
LCL Filter OF7Z3	525–690 V AC	530 A	LCL11
LC Filter OF7Z1	380–500 V AC	820 A	LC11W

The filters are available with protection ratings IP00 and IP54.

1.2 Contents of the Delivery

The LCL filter and LC filter consist of 2 parts. The top and bottom parts are delivered on separate wooden pallets.

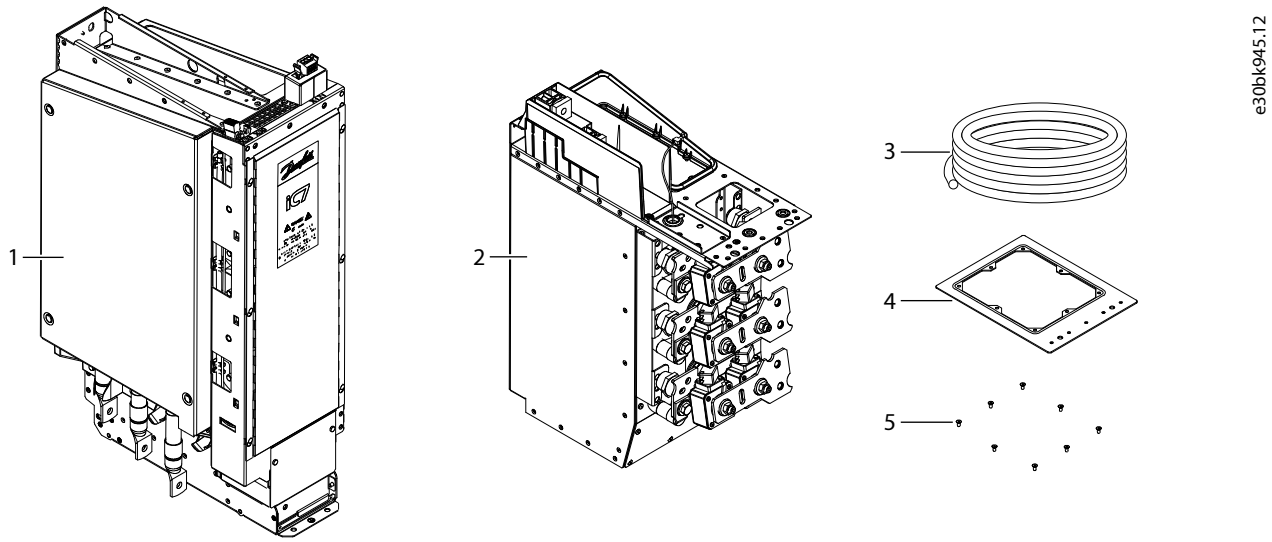

Figure 1: Items Included in the Delivery

1	Top part of the filter	**2**	Bottom part of the filter
3	AuxBus cable, 3 m (9.8 ft)	**4**	Bottom mounting bracket
5	M5x10 screws, 8 pcs		

2 Mechanical Installation

2.1 Safety Information

⚠ WARNING

SHOCK HAZARD FROM THE COMPONENTS

The components of the drive are live when the drive is connected to mains.

- Do not make changes in the AC drive when it is connected to mains.

⚠ CAUTION

BURN HAZARD

The filter is hot during operation.

- Do not install the filter on a combustible surface.
- Do not touch the filter when hot.

Only qualified personnel are allowed to perform the installation described in this guide.

Follow the instructions in this guide and relevant local regulations.

Also read the instructions and safety information in the *iC7 Series Air-cooled and Liquid-cooled System Modules and Air-cooled Enclosed Drives Installation Safety Guide*.

2.2 Installation Requirements

The products described in this guide have the protection rating IP00/UL Open Type. Install the products in an enclosure that has a correct level of protection against the ambient conditions in the installation area. Make sure that the enclosure gives protection against water, humidity, dust, and other contaminations.

The enclosure must also be sufficiently strong for the weight of the filter components and other devices.

The protection rating of the enclosure must be at least IP21/UL Type 1. When preparing the installation, obey the local regulations.

2.3 Installing the LCL Filter or LC Filter into the Cabinet

This is the recommended installation procedure for iC7 Series Air-cooled LCL Filters or LC Filters and AFE modules with an integration unit.

The wider variant LCL11W can be installed with the AFE module in a 600 mm wide cabinet. It is not possible to install LCL11W with the INU and AFE modules in an 800 mm wide cabinet.

See the installation dimensions in 2.5 Dimensions of the LCL Filter and LC Filter.

1. Install mounting brackets to the cabinet.

   Mounting brackets are not included in the delivery.

2. Install the bottom part of the filter into the cabinet.
   a. Mount the bottom part of the filter to the back wall of the cabinet.
   b. Mount the front of the filter to a mounting bracket.
   c. Optionally, the bottom part of the filter can also be mounted from the bottom with the bottom mounting bracket.

      The bottom mounting bracket and mounting screws for it are included in the delivery.

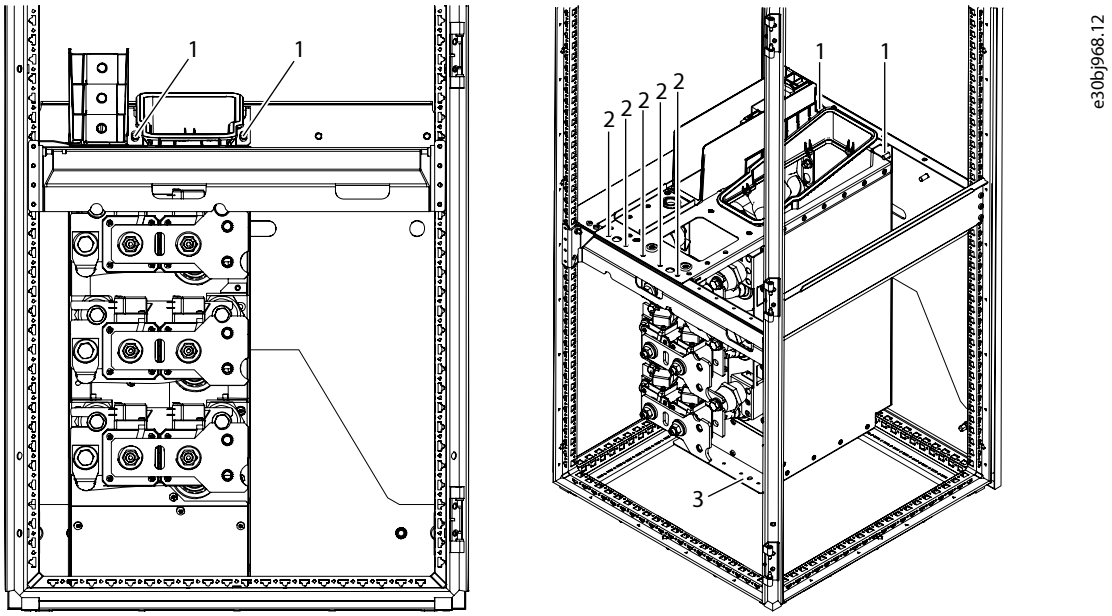

Figure 2: Installing the Bottom Part of the Filter

1	The mounting holes at the back	**2**	The mounting holes in the front
3	Bottom mounting bracket		

3. Install the integration unit of the AFE module into the cabinet.

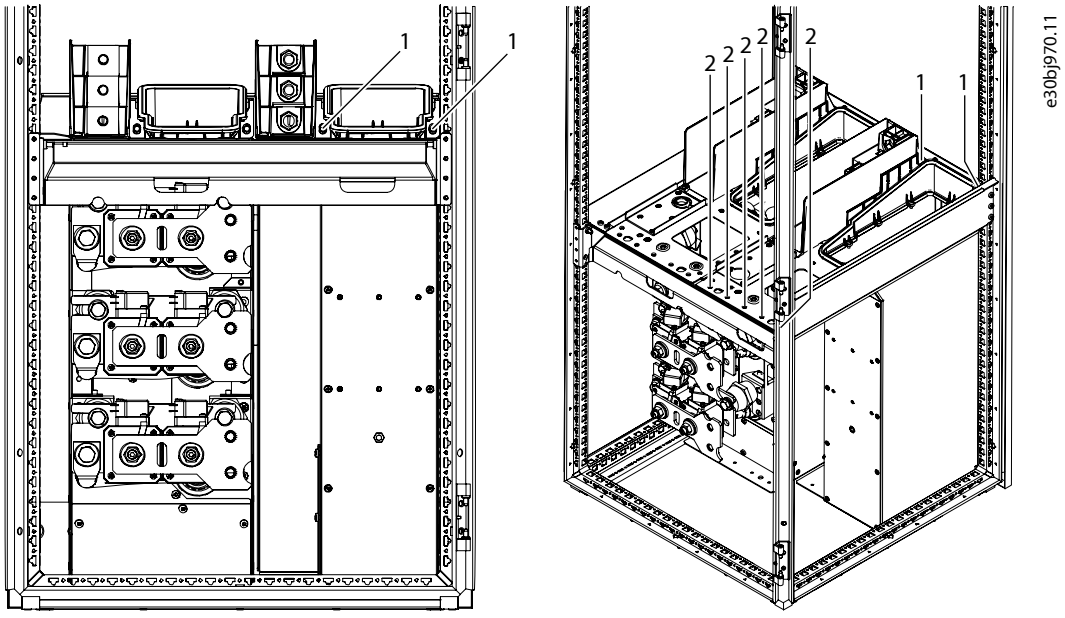

Figure 3: Installing the Integration Unit of the AFE Module

1	The mounting holes at the back	**2**	The mounting holes in the front

4. Push and slide the top part of the filter into the cabinet, on top of the bottom part.

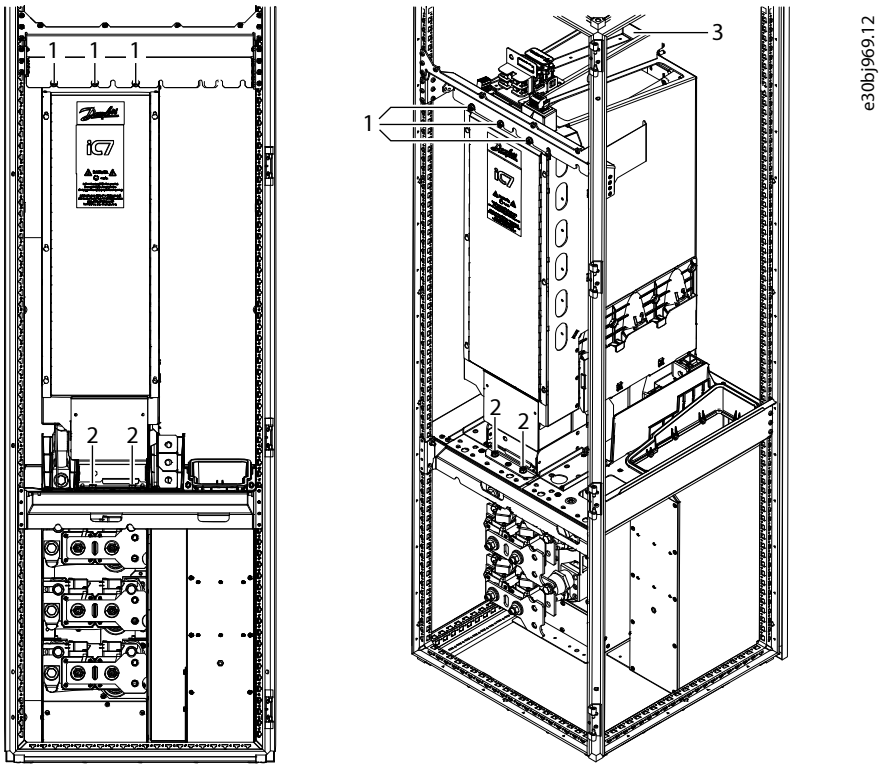

Figure 4: Installing the Top Part of the Filter

1	The upper mounting holes in the front	**2**	The lower mounting holes in the front
3	The upper mounting holes at the back		

5. Push and slide the AFE module into the cabinet.

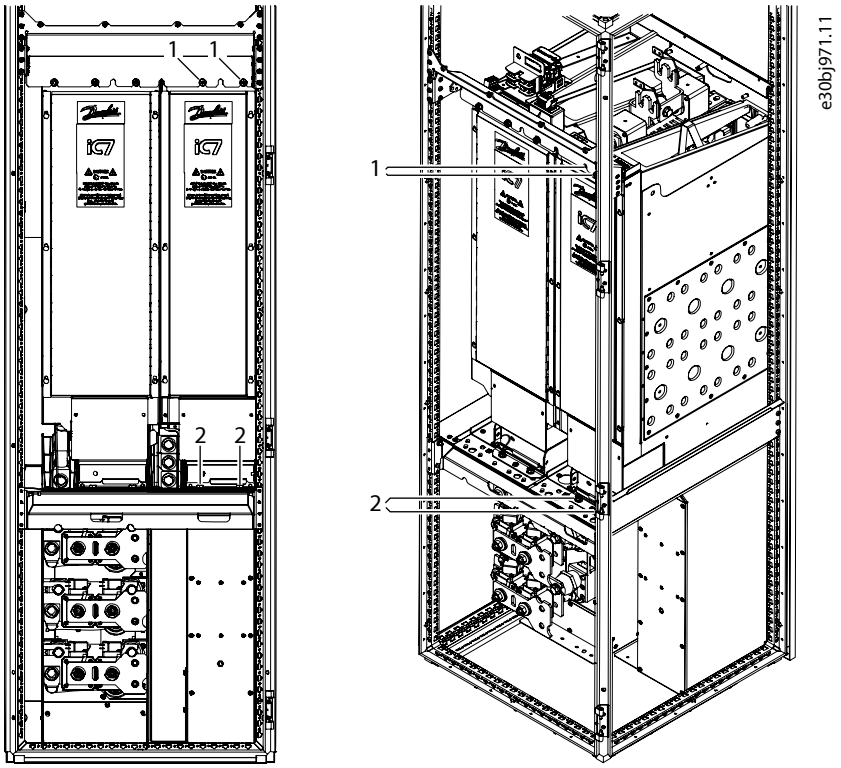

Figure 5: Installing the AFE Module

1	The upper mounting holes in the front	**2**	The lower mounting holes in the front

6. Mount the top front bracket.
7. Attach the filter and AFE module to the front brackets at the top and bottom.

2.4 Cooling Requirements

The maximum ambient operating temperature of the LCL/LC filter is 40 °C (104 °F), with derating up to 55 °C (131 °F).

The product requires forced air cooling. Make sure that the cooling airflow through the filter is sufficient. The minimum airflow is 3 m/s (10 ft/s).

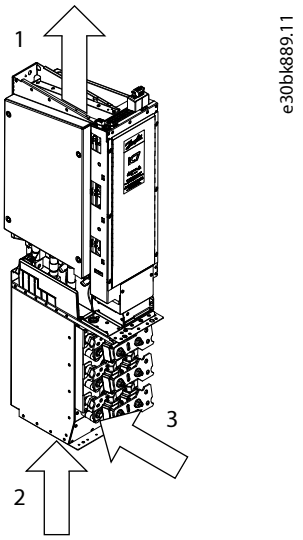

Figure 6: Airflow Through the LCL Filter or LC Filter

1	Air outlet from the top	**2**	Air inlet from the bottom
3	Optional air inlet from the front (available if the plate below the terminals is removed)		

2.5 Dimensions of the LCL Filter and LC Filter

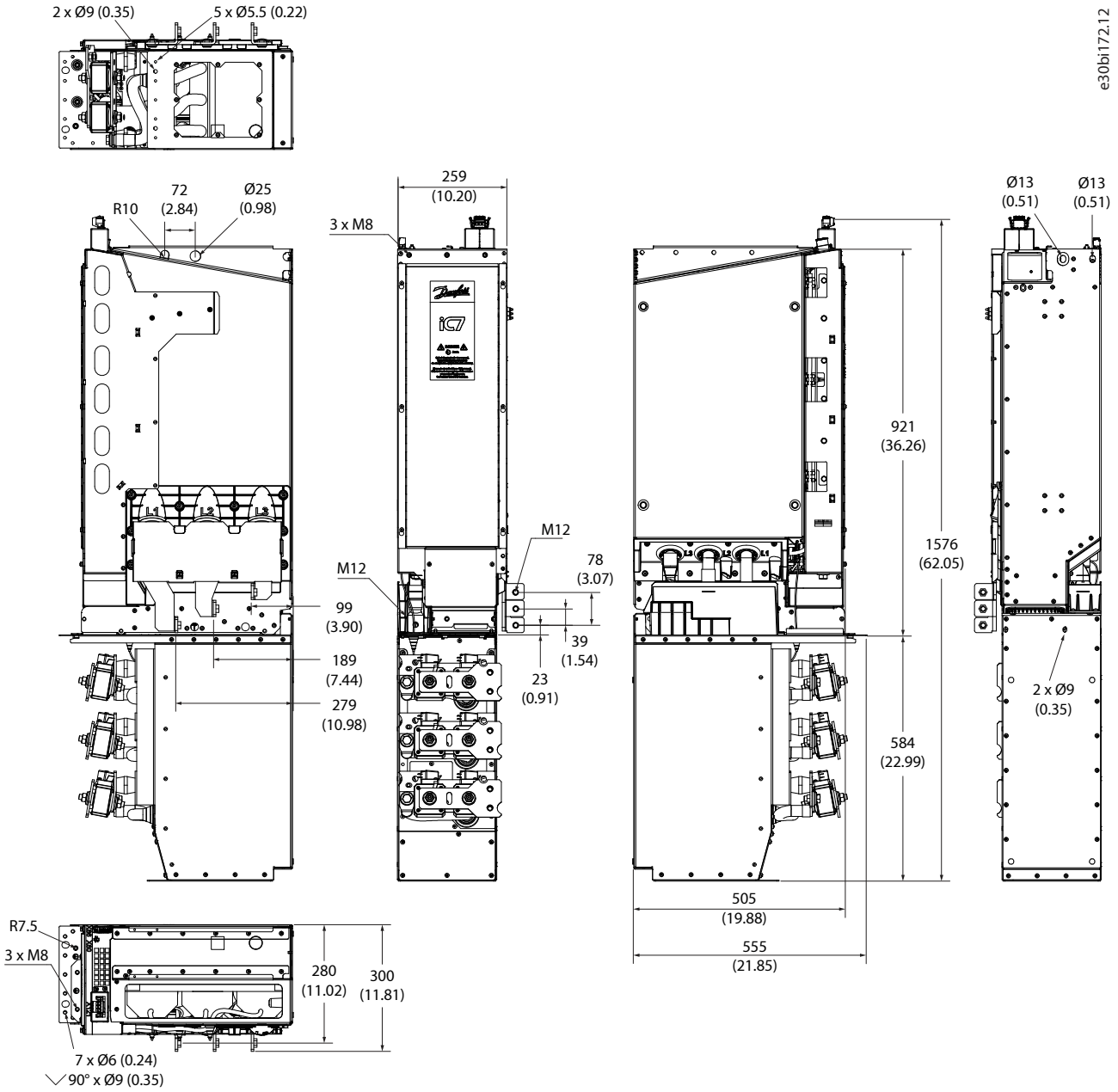

Figure 7: Dimensions of LCL10, LC10, LCL11, and LC11 in mm (in)

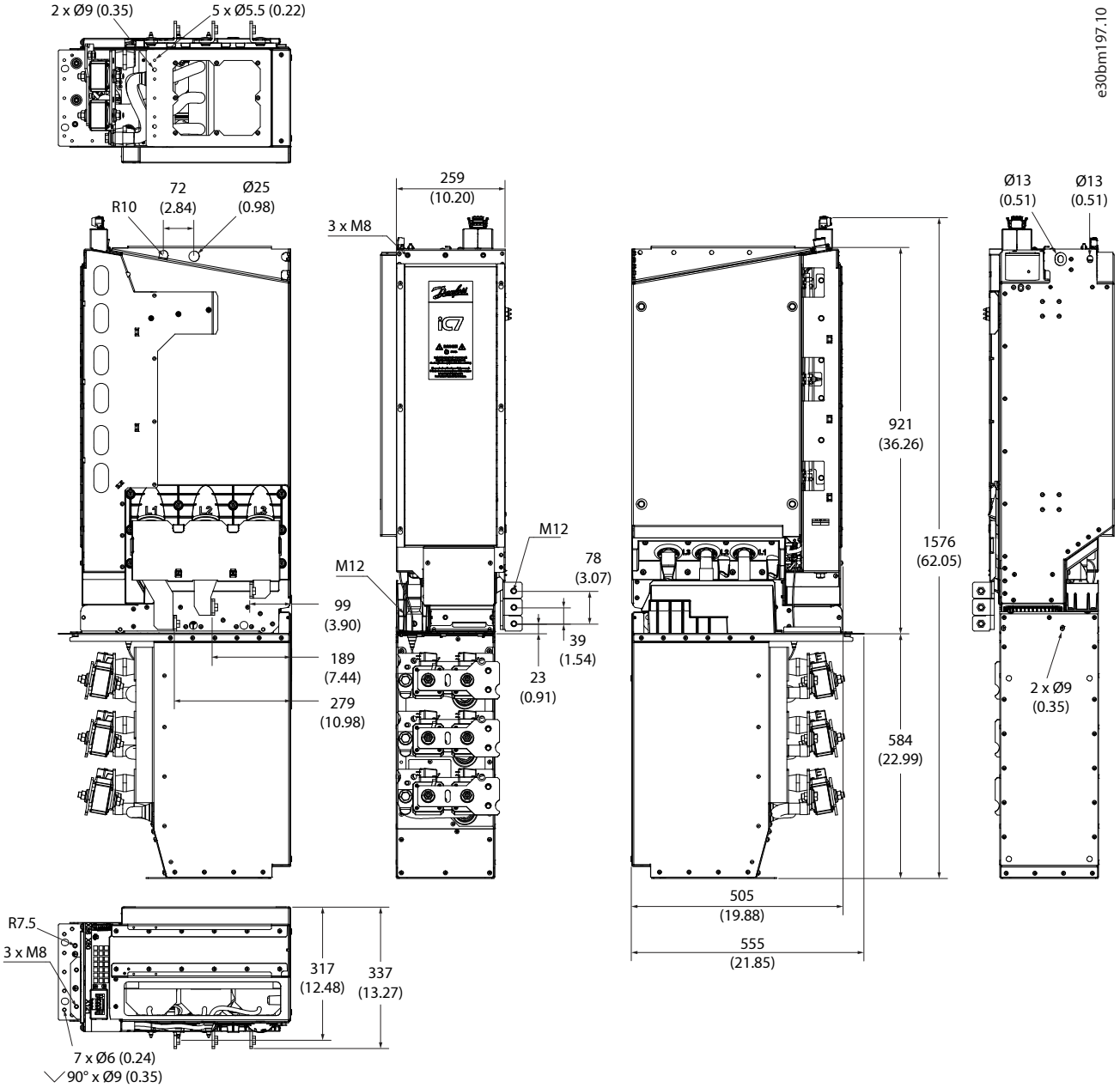

Figure 8: Dimensions of LCL11W and LC11W in mm (in)

3 Electrical Installation

3.1 Electrical Installation Safety

⚠ WARNING

OVERHEATED CABLES

Overheated cables are a fire hazard.

- Because of several possible cable installations and environmental conditions, it is important to consider local regulations and IEC/EN standards.

Route the wires away from sharp edges, screw threads, burrs, fins, moving parts, drawers, and similar parts, which can abrade the wire insulation.

For the main circuit, use double insulated wires or protect the wires with, for example, a protective sleeve or wrap to minimize the risk of short circuit. Maintain separation between the main and control circuit wires.

3.2 Power Cabling

Install the LCL filter or LC filter at the input of the active front-end. If the AFE has parallel power units, install a separate LCL filter or LC filter at the input of each power unit. See 3.11 Wiring Diagrams.

The LC filter can be installed in a system where an input transformer is needed. The inductance of the primary windings of the transformer can be used as a grid-side inductor. The short-circuit impedance of the transformer must be >4%.

In a parallel connected system, each separate LC filter must be connected in a dedicated transformer winding.

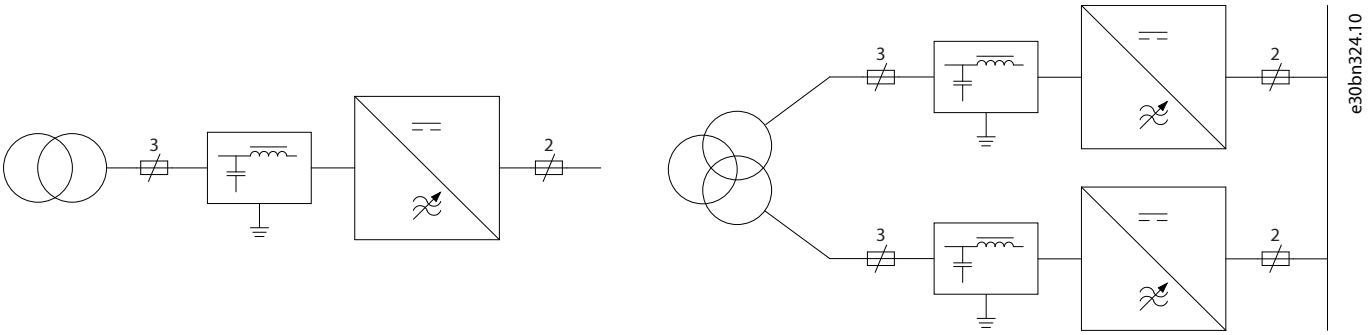

Figure 9: Installation of the LC Filter

3.3 Cable Requirements

For information about recommended cable types and required cable sizes, see the *iC7 Series Air-cooled System Modules Design Guide*.

3.4 Grounding

Ground the filter in accordance with applicable standards and directives.

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

The connection must be fixed.

3.5 AC Fuses

The front-end modules in the drive system must be equipped with fast-acting AC fuses to limit the damage of the drive system. Install AC fuses at the input terminals of the LCL filter or LC filter.

The AC fuses are not included in the delivery of the LCL filter or LC filter. For the recommended fuse types and required fuse sizes, see the *iC7 Series Air-cooled System Modules Design Guide*.

3.6 Installing the Cables

1. Connect the input cables from the top part of the filter to the output terminals in the bottom part of the filter.

   Use M12 bolts and tightening torque 70 Nm (620 in-lb).

2. Connect the mains cables to the mains terminals of the LCL filter or LC filter with internal cables or busbars.

   The terminals are not designed for installing the mains cabling directly. Install additional terminals for the recommended mains AC cabling. Use internal cabling or busbars between the AC terminals of the LCL filter or LC filter and the actual mains terminals. Define the size of the internal cables or busbars according to the nominal current and according to local regulations.

   Use M12 bolts and tightening torque 70 Nm (620 in-lb).

3. Connect the output terminals of the LCL filter or LC filter to the input terminals of the power unit.

Use M12 bolts and tightening torque 70 Nm (620 in-lb).

4. Connect the grounding cable to the PE terminal.

Use M8 screws and tightening torque 20 Nm (177 in-lb).

3.7 Terminals

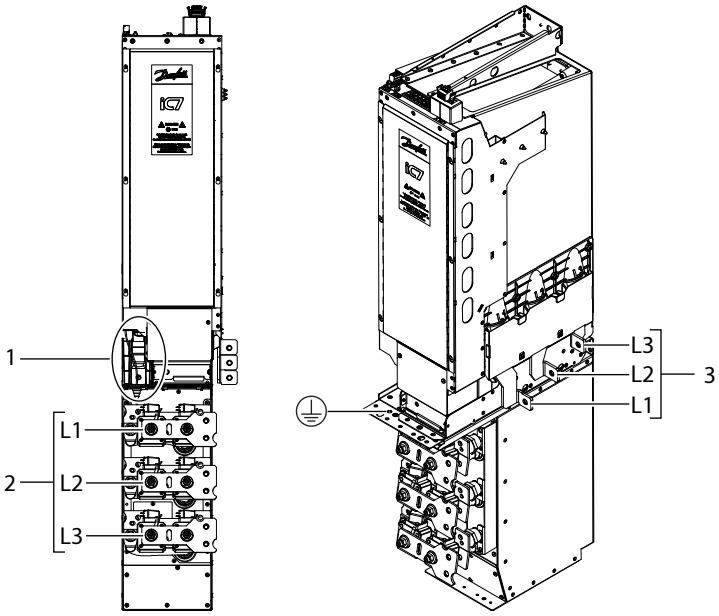

Figure 10: Terminals of the LCL Filter and LC Filter

1	Terminals between the top and bottom parts of the filter	**2**	Mains input terminals L1, L2, L3
3	Output terminals to the power unit L1, L2, L3		

3.8 Connecting the Filter Fan Supply

⚠ WARNING

SHOCK HAZARD FROM THE COMPONENTS

The components of the drive are live when the drive is connected to mains.

- Do not make changes in the AC drive when it is connected to mains.

NOTICE

The filter fan supply is protected with internal fuses. Use external fuses if the local safety regulations or installation conditions require fuse protection.

Table 2: DC-link Voltage Supply

Item	Value
Maximum load current	2 A
Maximum voltage	800 V DC

Table 3: Connector X121

Item	Value
Connector	Wago, 831-3103/037-000
Maximum wire insulation diameter	7 mm (0.3 in)
Wire stripping length	14 mm (0.6 in)
Conductor size	maximum 10 mm^2/AWG8
Fine-stranded conductor	ferrule maximum 6 mm^2

Table 4: Cable Requirements

Area	Requirements	Example wire
IEC	Minimum 800 V DC voltage Minimum 2 A current	Leoni BETAtrans® 4 GKW-ENX R 1800 V M, 1x2.5 mm^2, order number 312474
UL	Minimum 600 V Minimum size AWG14 Minimum rated for 80 °C (176 °F)	UL AWM style 10269, AWG14

To enable the functioning of the fan of the LCL filter or LC filter, do these steps.

1. Consider ambient temperature and other installation conditions.
2. Refer to the local safety regulations.
3. Protect the installation against mechanical and environmental damage and use strain relief when necessary.
4. Connect the DC-link voltage supply from the DC link to connector X121 on the filter.

Pay attention to the correct polarity.
Do not connect the supply between the AFE module and the DC fuses. The supply connection point is after the AFE module fuses.

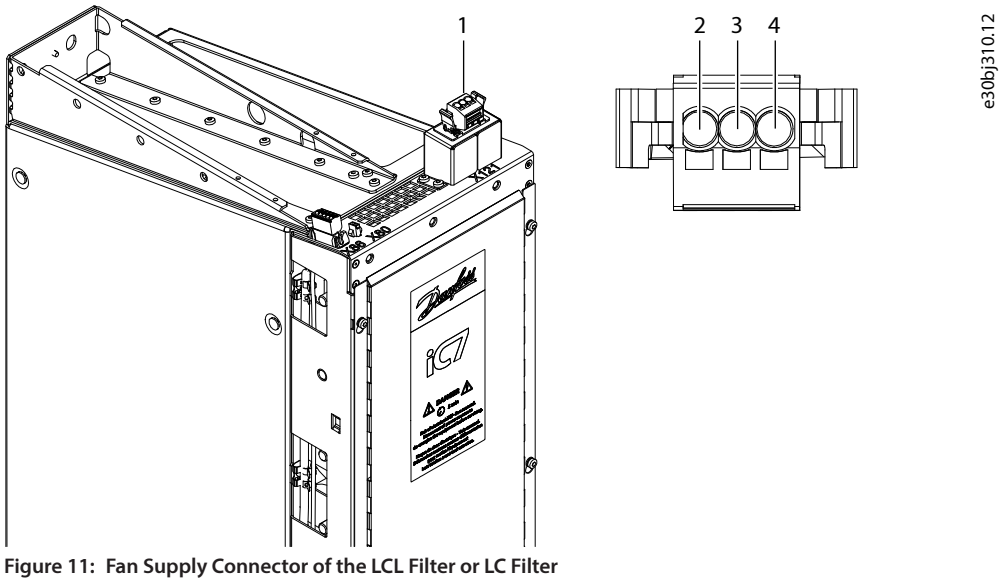

Figure 11: Fan Supply Connector of the LCL Filter or LC Filter

1	Fan supply (X121)	**2**	465–800 V DC (+)
3	Empty	**4**	0 V DC (-)

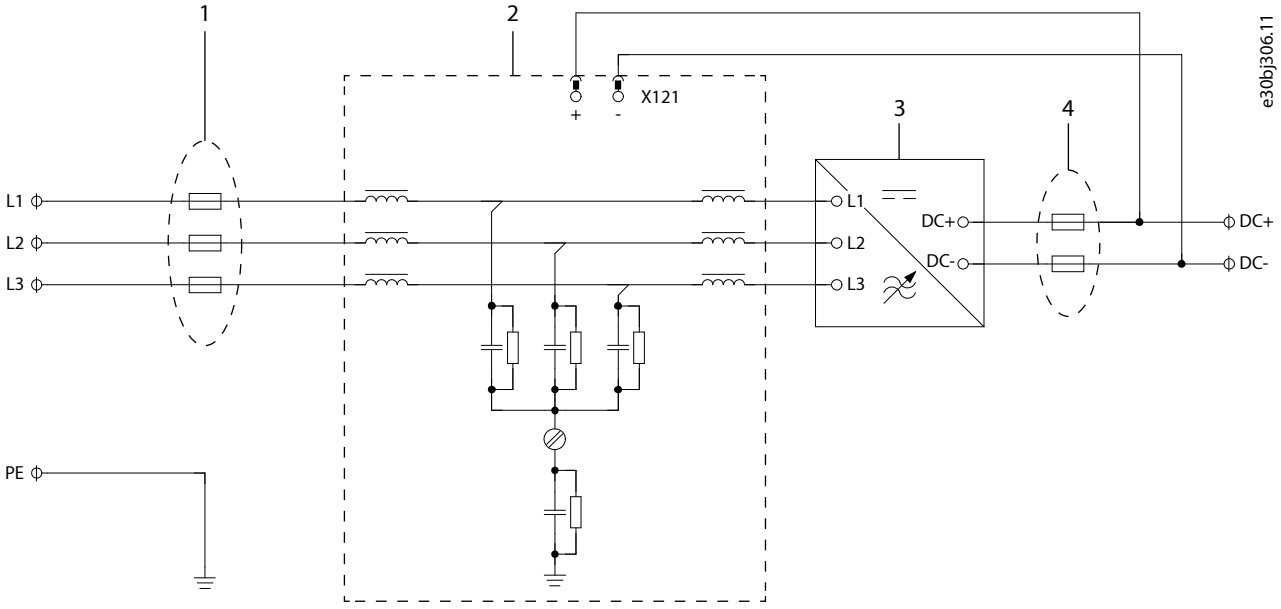

Figure 12: Diagram of the Fan Supply of the LCL Filter or LC Filter

1	AC fuses	**2**	LCL filter or LC filter
3	AFE module	**4**	DC fuses

3.9 Preparing the AuxBus Cable

1. Cut the cable to the required length.
2. To reveal the wires, strip the cable at both ends.
3. At 1 end of the cable, remove approximately 15 mm (0.59 in) of the cable insulation.
4. Strip the wires 7 mm (0.28 in).
5. Connect the wires to the terminals included in the delivery. Use the tightening torque 0.22–0.25 Nm (1.9–2.2 in-lb).

Table 5: Wiring of the AuxBus Terminals

Pin	Wire color	Signal
1	White	+24 V
2	Brown	GND
3	Green	CAN_H
4	Yellow	CAN_L
5	Grey	+24 V

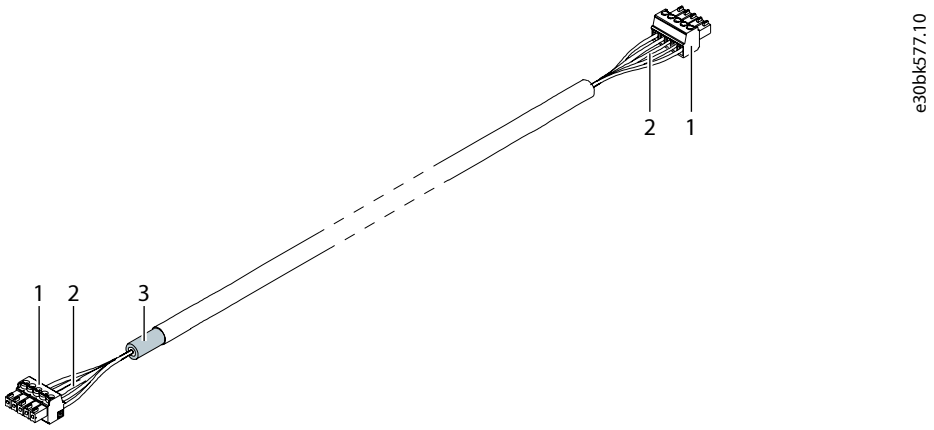

Figure 13: The Ready AuxBus Cable

1	Terminals	**2**	Wires
3	Shield removed		

3.10 AuxBus Connections

NOTICE

For the drive to be able to protect the filters, AuxBus must be connected.

For more information about AuxBus, see the *iC7 Series Air-cooled System Modules Design Guide*.

1. In LCL filters, connect the thermocouple wire from the bottom part of the filter to terminal X205 on the AuxBus temperature measurement board.

   The thermocouple wire of the LC Filter is connected to terminal X206.

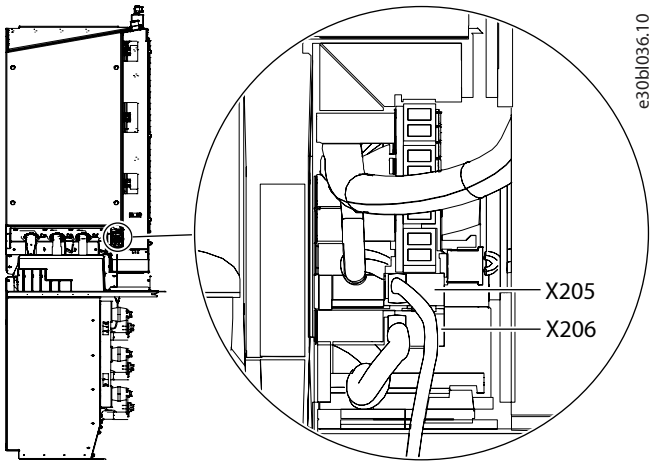

Figure 14: Thermocouple Wiring in the LCL Filter

2. Connect the AuxBus cable between the filter and the power unit. If there are several power units and filters, connect each filter to the power units individually.
   - **a.** Connect the end of the AuxBus cable where the insulation was removed to terminal X25 on the power unit.
   - **b.** Connect the other end of the AuxBus cable to terminal X86 on the filter.

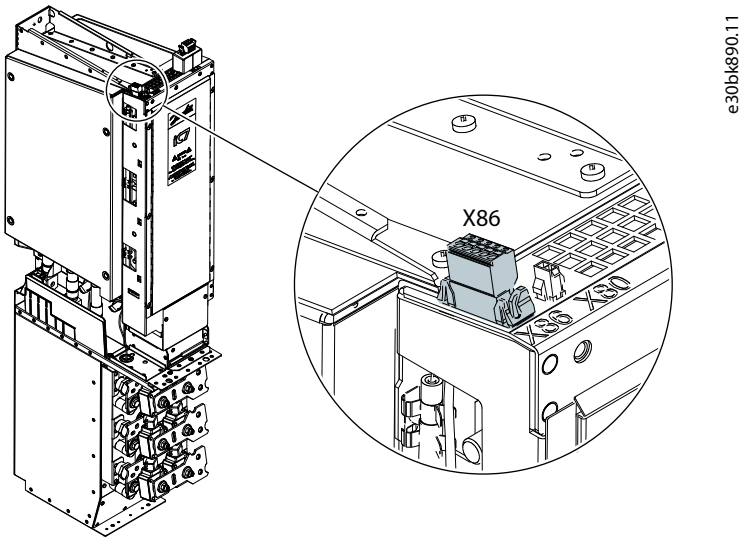

Figure 15: Location of the X86 Terminal on the LCL Filter or LC Filter

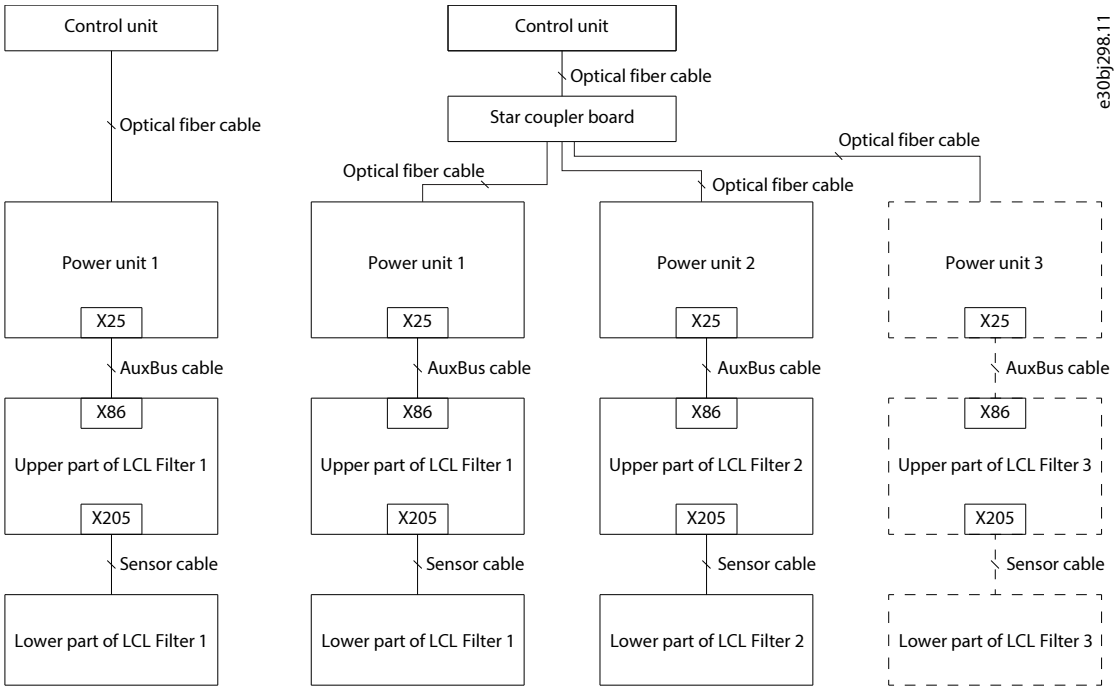

Figure 16: AuxBus Topology

3. Route the cable so that there is no risk of getting in touch with bare busbars or terminals.
4. Ground each AuxBus cable at 1 end, at the X25 terminal. To make the grounding connection, attach the shield of the cable to the frame with a cable clamp.

   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.

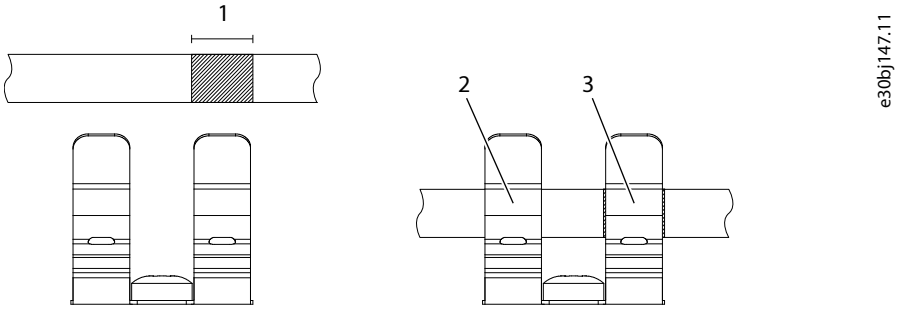

Figure 17: Using the Cable Clamps

1	Stripping length, 15 mm (0.59 in)	**2**	Strain relief
3	Grounding		

5. At the terminal X86 end of the cable, place the cable in a cable clamp for strain relief.

3.11 Wiring Diagrams

The following wiring diagrams show installations with AFE modules and LCL or LC filters. The LCL filter includes the LC filter and L filter.

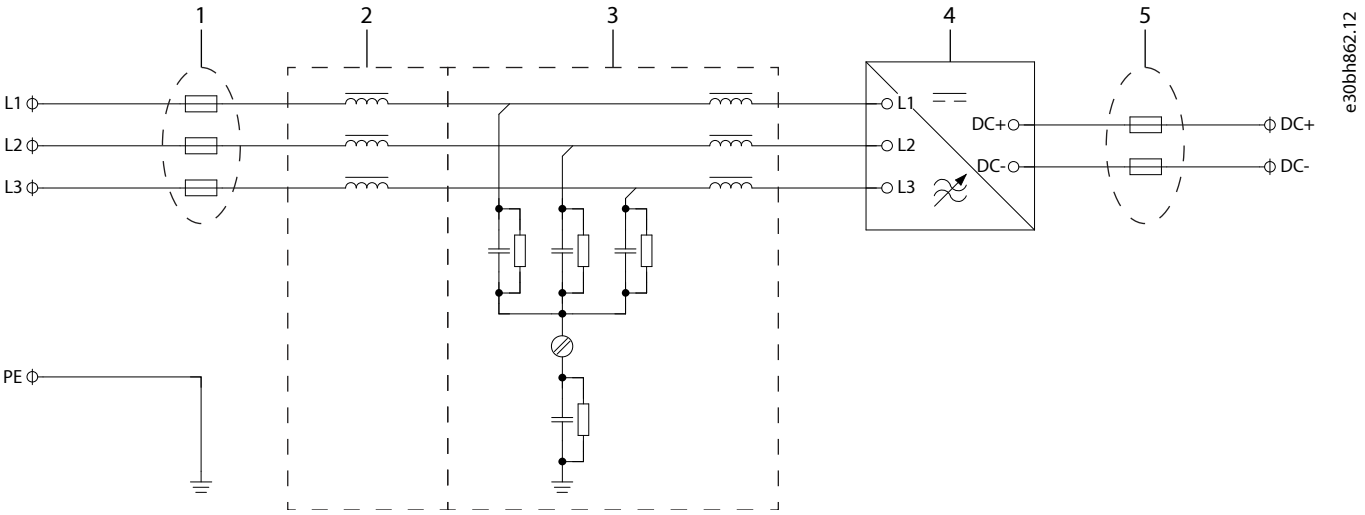

Figure 18: Wiring Diagram, AFE Module and LCL/LC Filter

1	AC fuses (option)	**2**	L filter (only included in LCL Filter OF7Z3)
3	LC filter	**4**	AFE module
5	DC fuses (option)		

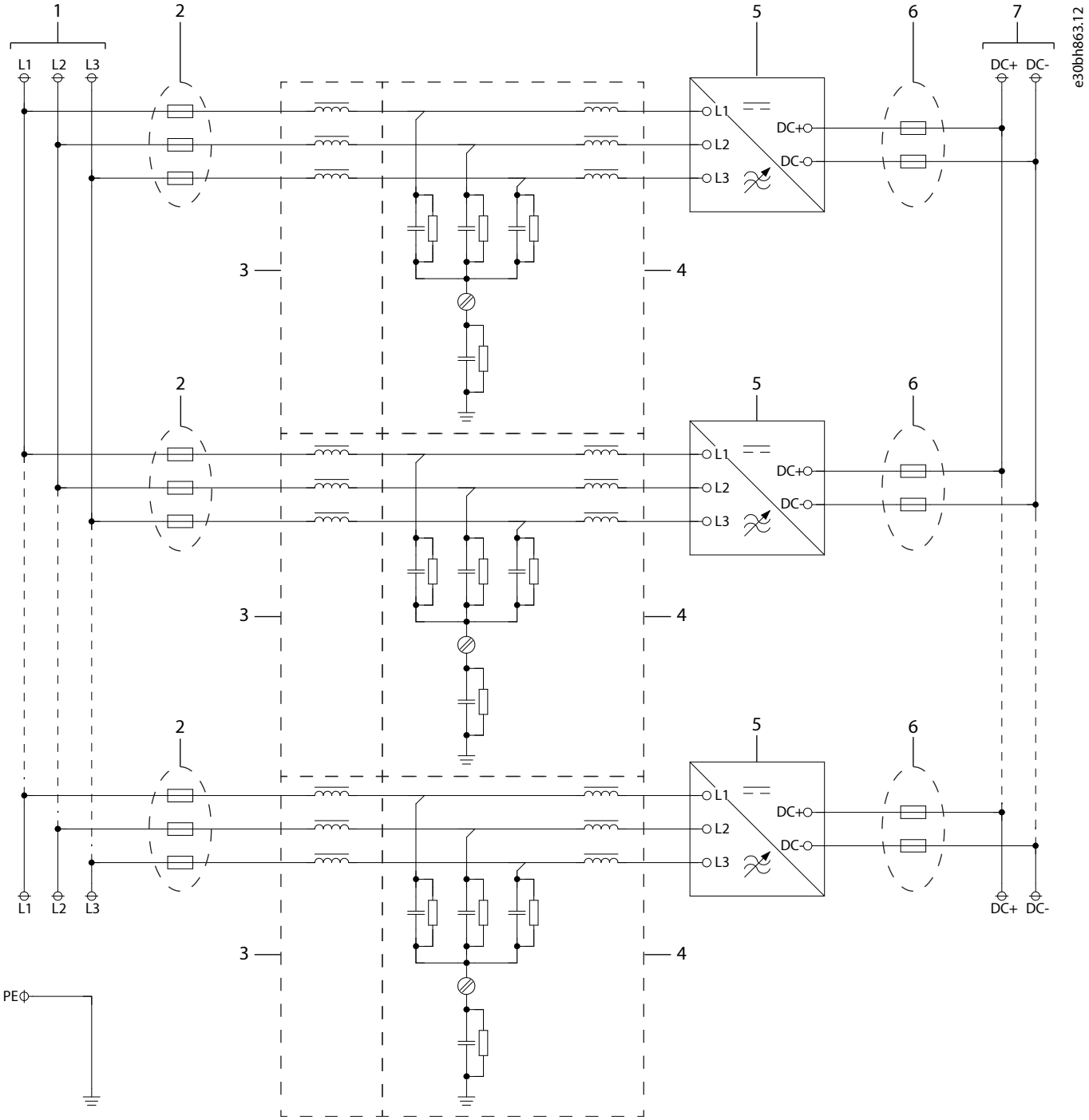

Figure 19: Wiring Diagram, AFE Modules with Parallel Power Units and LCL/LC Filters

1	Common AC bus	**2**	AC fuses (option)
3	L filter (only included in LCL Filter OF7Z3) *	**4**	LC filter
5	AFE modules	**6**	DC fuses (option)
7	Common DC bus		

* If the L filter is not installed, an input transformer is required. See 3.2 Power Cabling.

4 Maintenance

4.1 Preventive Maintenance Recommendations

Generally, all technical equipment needs a minimum level of preventive maintenance. Regular maintenance is recommended to ensure trouble-free operation and long life of the product. 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 the product.

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 your application and operating conditions.

Table 6: Maintenance Schedule for Air-cooled Filters

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.
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.
Power cabling	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.
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.
EMC consideration	1 year	–	Inspect the installation wiring regarding the electromagnetic capability and the separation distance between control wiring and power cables.
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.
Proper clearances	1 year	–	Check that the required external clearances for proper airflow for cooling are followed according to the type of the drive. For clearances, refer to the local design regulations.

Table 6: Maintenance Schedule for Air-cooled Filters - (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 findings.
Filter components			
Capacitors	1 year	12–15 years	The expected life time of the capacitor is determined based on load and the temperature of the environment. Replace parts according to the service schedule. For applications with heavy loads or demanding environments, replace the capacitors every 12 years. In a typical environment, within the specifications of the filter, replace every 15 years. Only trained service personnel are allowed to perform this action.
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.
Insulators	1 year	10–15 years	Inspect the insulators for signs of degradation due to high temperature and aging. Replacement is based on findings. Only trained service personnel are allowed to perform this action.
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.

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.

4.2 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 over 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 the 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 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.

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