

iC7 Series Liquid-cooled L Filter OF7Z5

1 Overview

1.1 L Filter

The L Filter is used together with an LC Filter to create an LCL input filter for AFE or grid converter modules in applications where regenerative or low-harmonic functionality is required.

There are 3 electrical sizes of the filter: 400 A, 1000 A, and 1640 A.

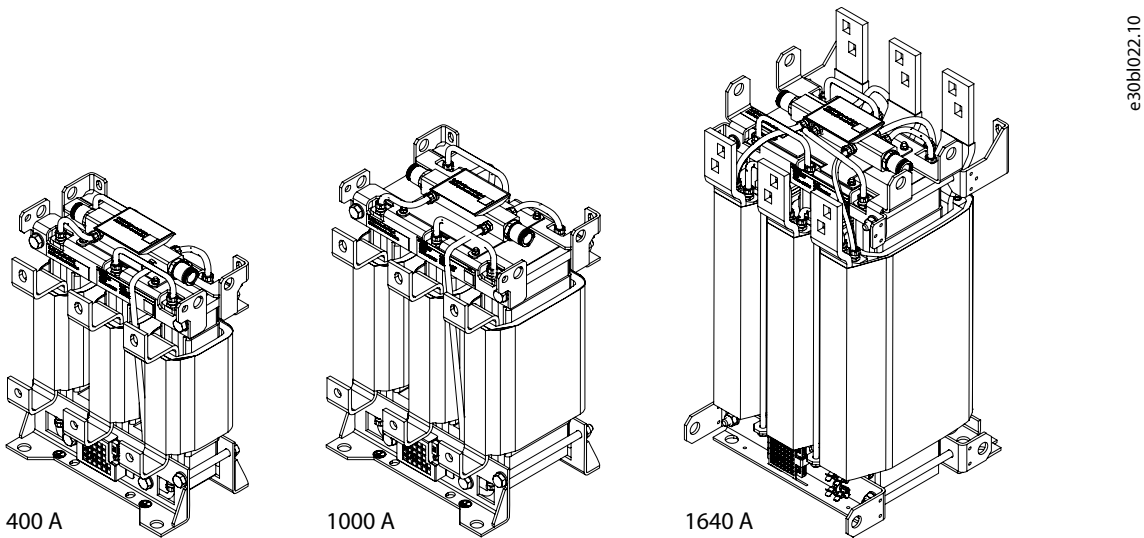


Figure 1: Liquid-cooled L Filters

1.2 Contents of the Delivery

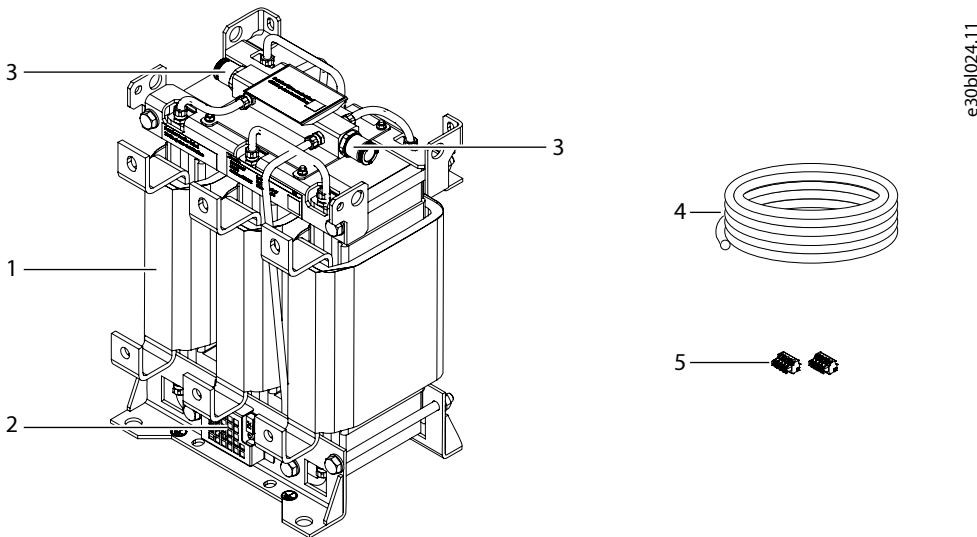


Figure 2: Items Included in the Delivery

1	L Filter, 400 A, 1000 A, or 1640 A	2	AuxBus temperature measurement board (installed)
3	Push-in cooling connectors, 2 pcs (available as option +ANN1)	4	AuxBus cable, 3 m (9.8 ft)
5	AuxBus terminals, 2 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 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 L Filter into a Cabinet, 400 A, 1000 A

1. Install the filter into the cabinet in a vertical position.
2. Align the filter so that the pins of the filter fit into the square holes at the back wall of the cabinet.

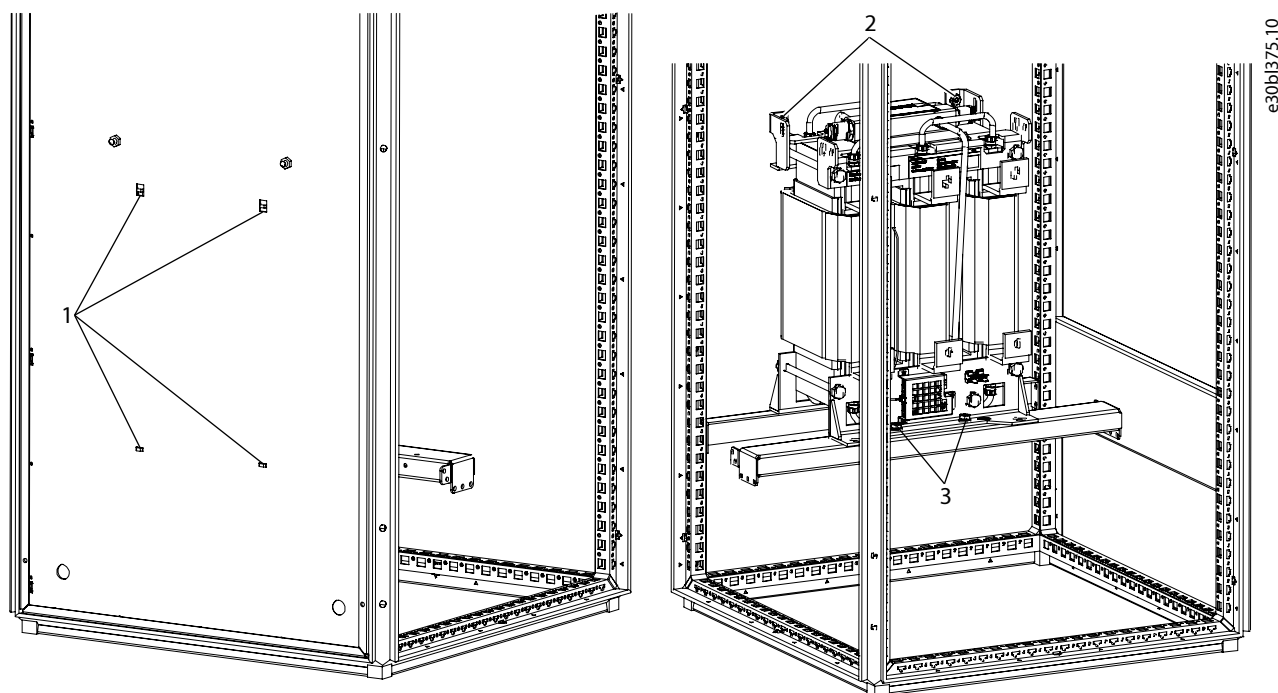


Figure 3: Installing the L Filter into a Cabinet (400 A, 1000 A)

- | | | | |
|---|----------------------------------|---|-------------------------------|
| 1 | Square mounting holes | 2 | The mounting holes at the top |
| 3 | The mounting holes at the bottom | | |

3. Use the mounting holes to attach the filter.
 - a. Attach the filter from all these corners: top back, bottom front, and bottom back.

The mounting brackets are not included in the delivery.

2.4 Installing L Filter into a Cabinet, 1640 A

1. Install the filter into the cabinet in a vertical position.
2. Use the mounting holes to attach the filter.
 - a. Attach the filter from all the corners: top front, top back, bottom front, and bottom back.

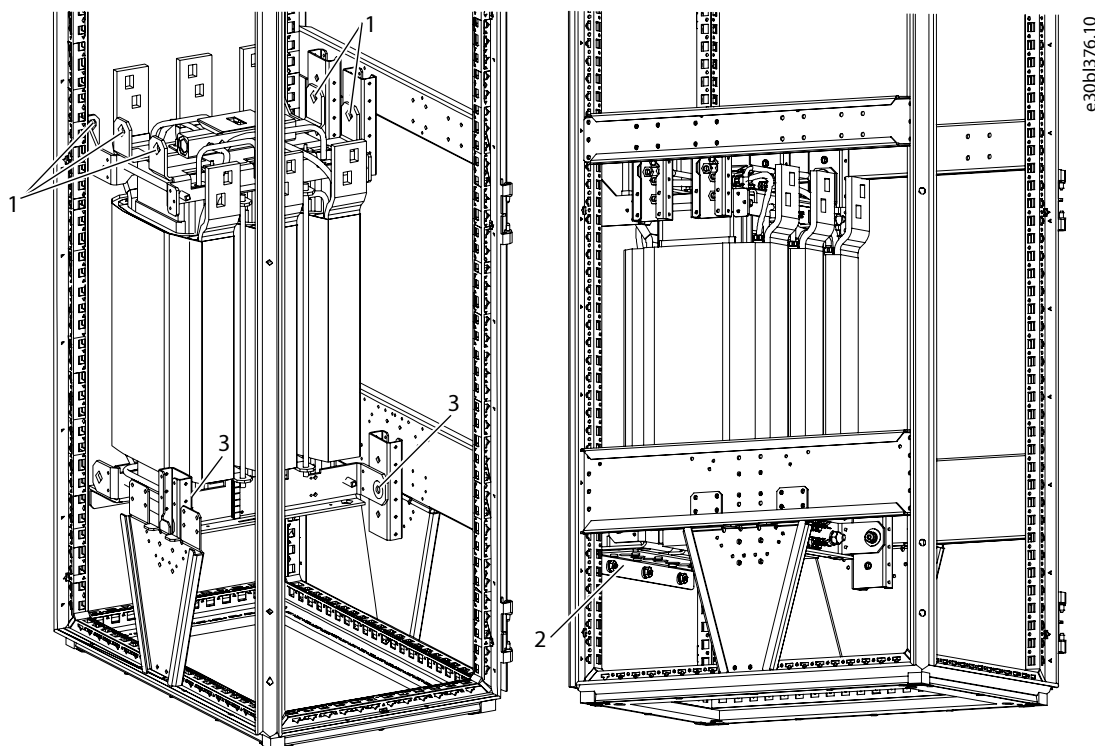


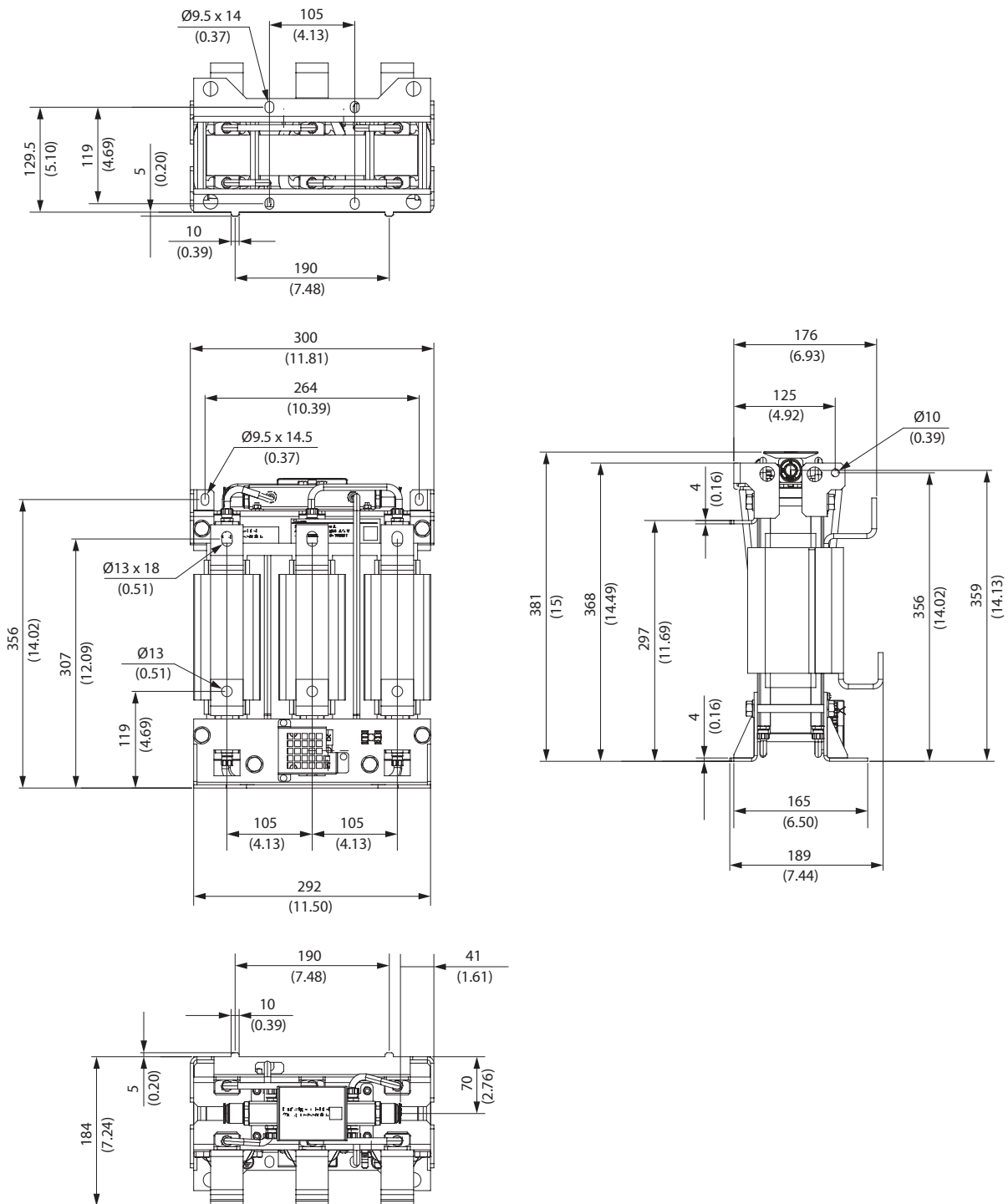
Figure 4: Installing the L Filter into a Cabinet (1640 A)

- | | |
|--|----------------------|
| <p>1 The mounting holes at the top</p> <p>3 The mounting holes at the bottom</p> | <p>2 The bracket</p> |
|--|----------------------|

3. Use the bracket to attach the filter from below.

The mounting brackets are not included in the delivery.

2.5 Dimensions of the L Filter



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Figure 5: Dimensions of the L Filter, 400 A

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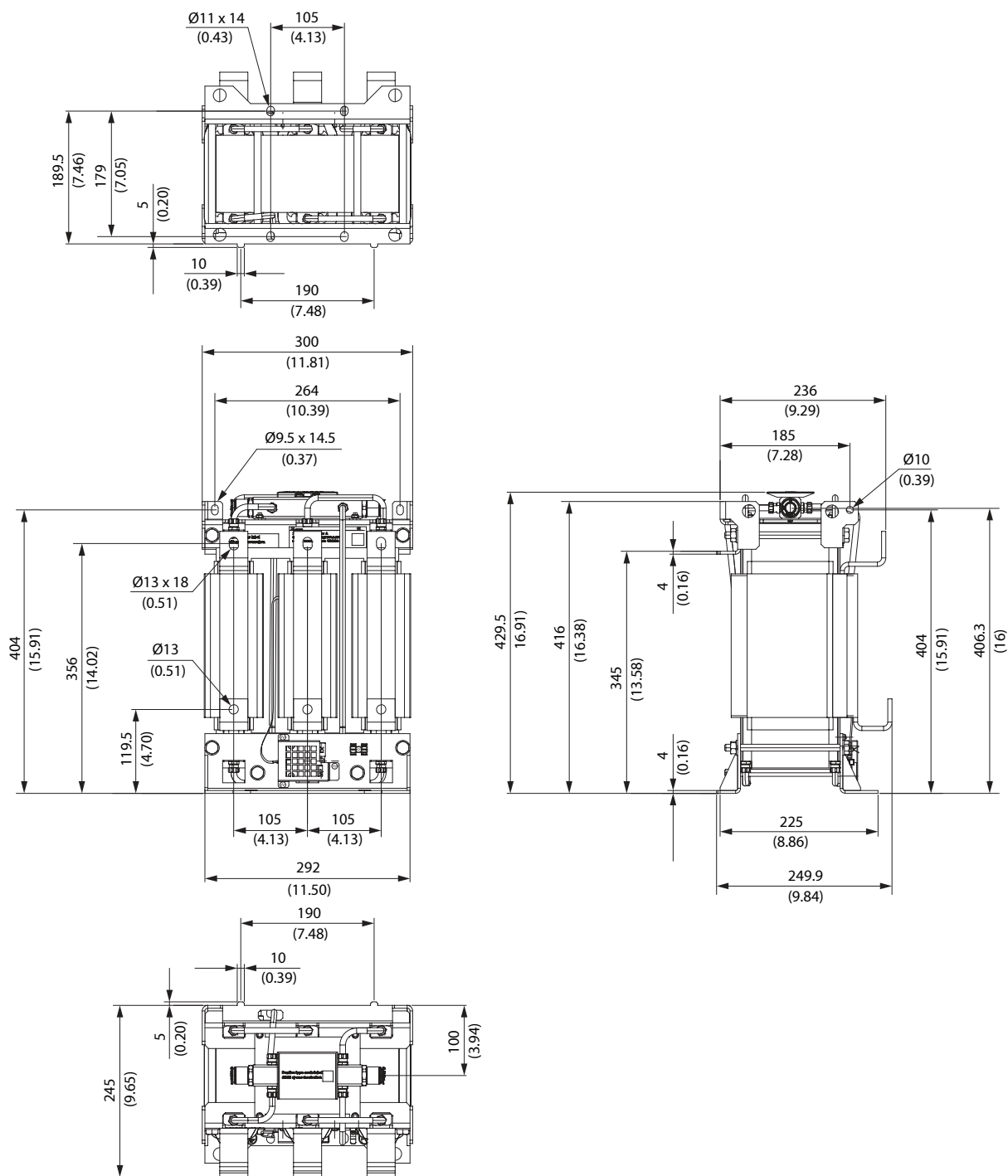
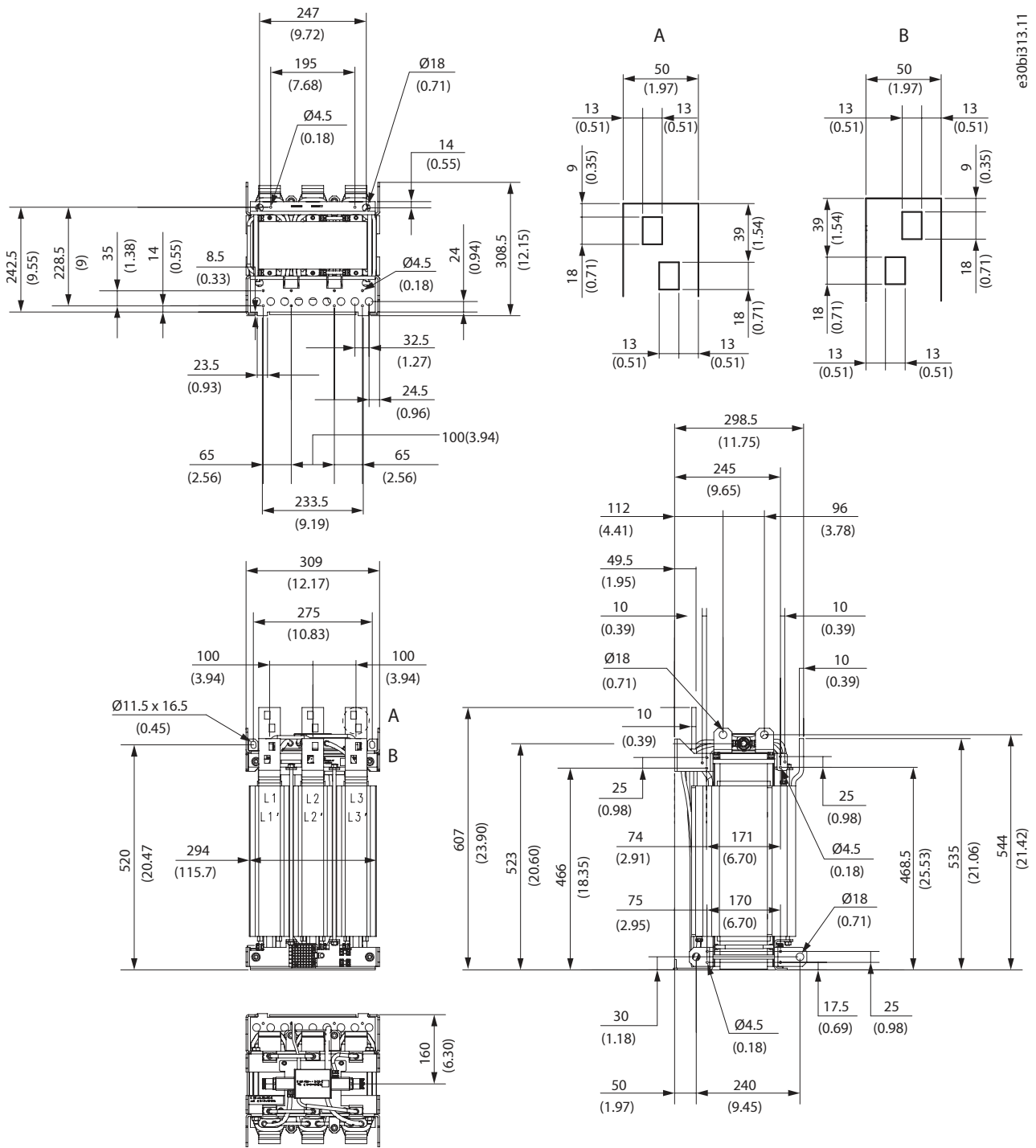


Figure 6: Dimensions of the L Filter, 1000 A



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Figure 7: Dimensions of the L Filter, 1640 A

A	B
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3 Cooling Requirements

3.1 Safety in Liquid-cooling

WARNING

POISONOUS COOLANTS

Glycols and inhibitors are poisonous. If touched or consumed, they can cause injury.

- Prevent the coolant from getting into the eyes. Do not drink the coolant.

CAUTION



HOT COOLANT

Hot coolant can cause burns.

- Avoid contact with the hot coolant.

CAUTION

PRESSURIZED COOLING SYSTEM

Sudden release of pressure from the cooling system can cause injury.

- Be careful when operating the cooling system.

NOTICE

INSUFFICIENT COOLING CAPACITY

Insufficient cooling can cause the product to become too hot and thus become damaged.

- To make sure that the cooling capacity of the cooling system stays sufficient, make sure that the cooling system is vented and that the coolant circulates properly.

NOTICE

DAMAGE TO COOLING SYSTEM

If the coolant circulation is stopped too soon, high-temperature components can cause rapid local increase in the coolant temperature, which can damage the cooling system.

- Do not stop the cooling system when stopping the drive. Keep the coolant circulation flowing for 2 minutes after the drive has been stopped.

3.2 General Information on Cooling

NOTICE

For more detailed information about the requirements for liquid-cooling, see the *iC7 Series Liquid-cooled System Modules Design Guide*.

The product is cooled with liquid. The liquid circulation of the drive is usually connected to a heat exchanger (liquid-to-liquid or liquid-to-air) that cools down the liquid circulating in the cooling elements. The cooling elements are made of aluminum.

If there is no risk of freezing, purified water can be used as coolant. Freezing water permanently damages the cooling system. Purified water is demineralized, deionized, or distilled water.

The allowed antifreeze coolants are the following ethylene glycols and propylene glycols.

- **Ethylene glycols:** DOWCAL 100 or Clariant Antifrogen N
- **Propylene glycols:** DOWCAL 200 or Clariant Antifrogen L

These glycols already include corrosion inhibitors. Do not add any other inhibitor. Do not mix different glycol qualities because there can be harmful chemical interactions.

The glycol concentration of the coolant must be 25–55% by volume, according to the specified ambient temperature. Higher concentration reduces cooling capacity. Lower concentration results in biological growth and inadequate amount of corrosion inhibitors. Antifreeze must be mixed with purified water.

To gain full performance of the product, the temperature of the coolant entering the system module must be a maximum of 45 °C (113 °F). Typically, 60–70% of the power losses are dissipated in the coolant. It is recommended to equip the cooling circulation with temperature supervision.

The minimum nominal flow rate of the coolant:

- 7.5 l/min (1.98 gal/min) with water
- 9.8 l/min (2.59 gal/min) with 30% glycol
- 11.3 l/min (2.99 gal/min) with 50% glycol

The liquid volume per element:

- 400/1000 A: 0.20 l (0.053 gal)
- 1640 A: 0.60 l (0.159 gal)

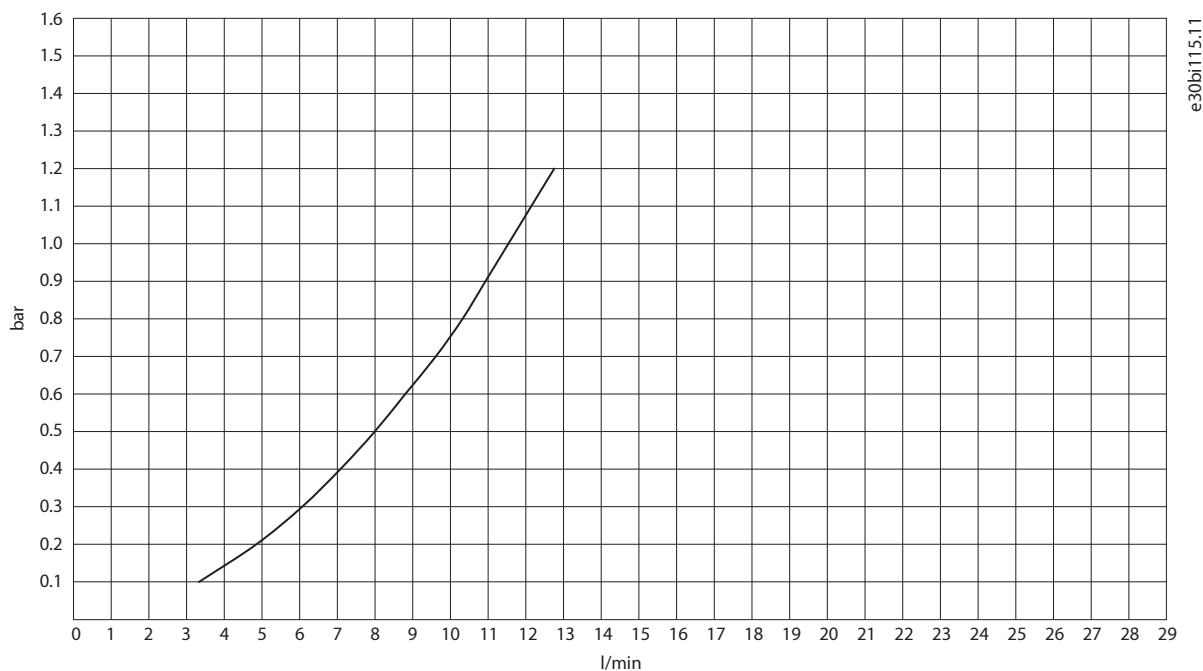


Figure 8: Pressure Drop, L Filter OF7Z5, 690 V/400 A

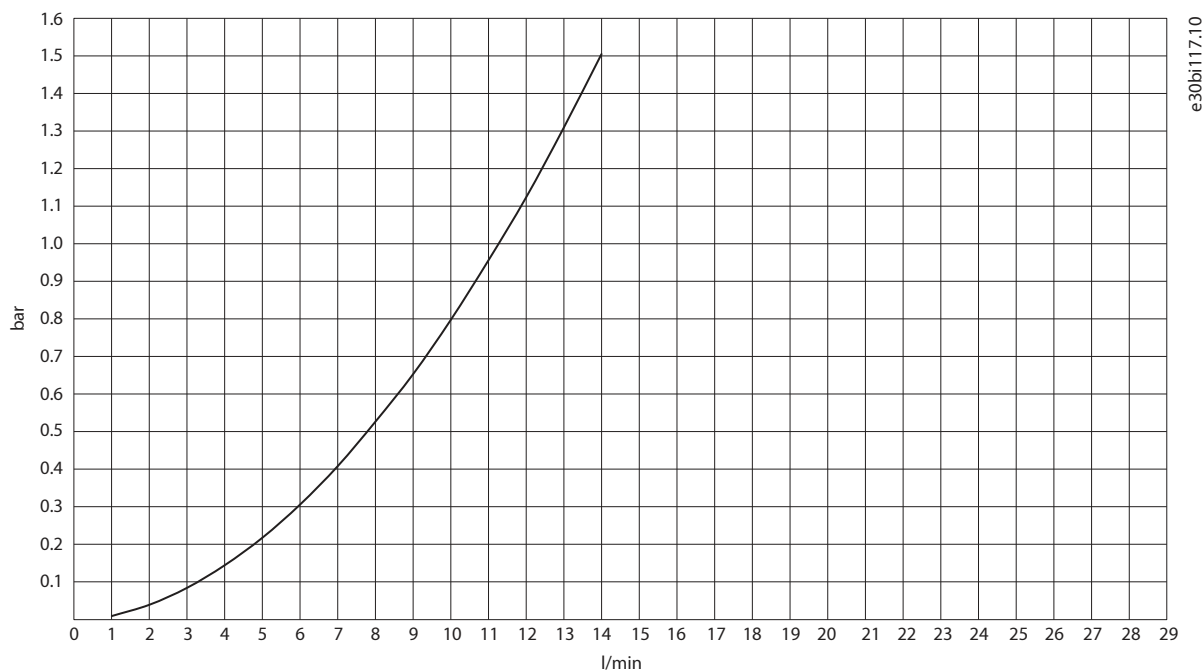


Figure 9: Pressure Drop, L Filter OF7Z5, 690 V/1000 A

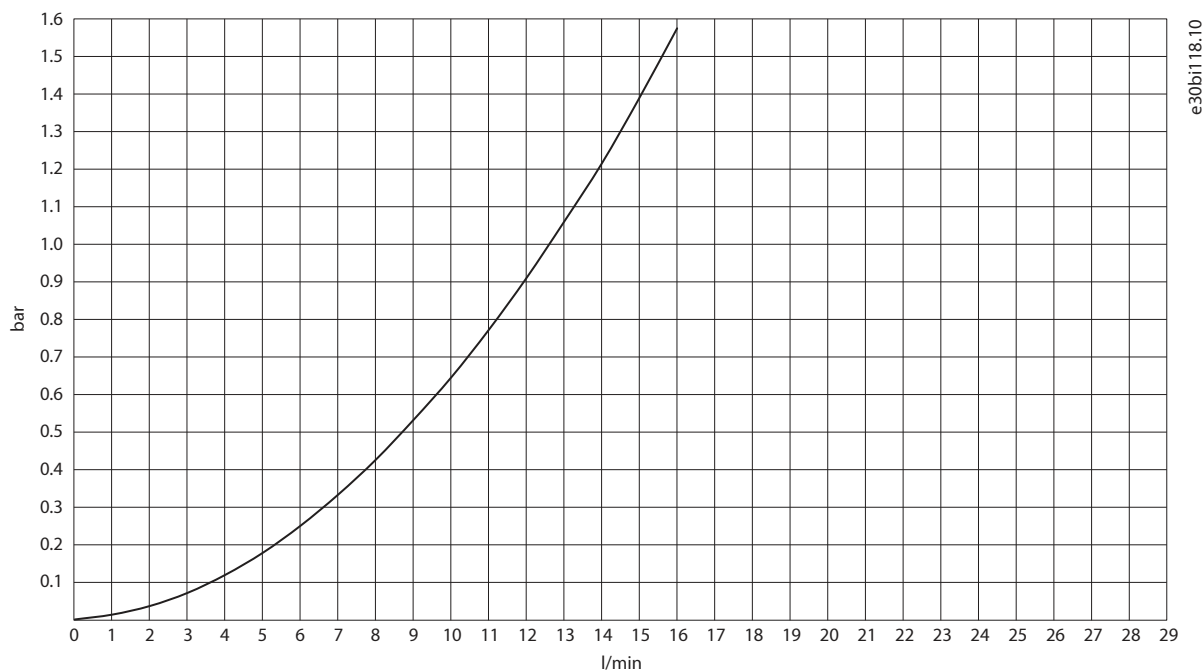


Figure 10: Pressure Drop, L Filter OF7Z5, 690 V/1640 A

3.3 Cooling Circuit Connectors

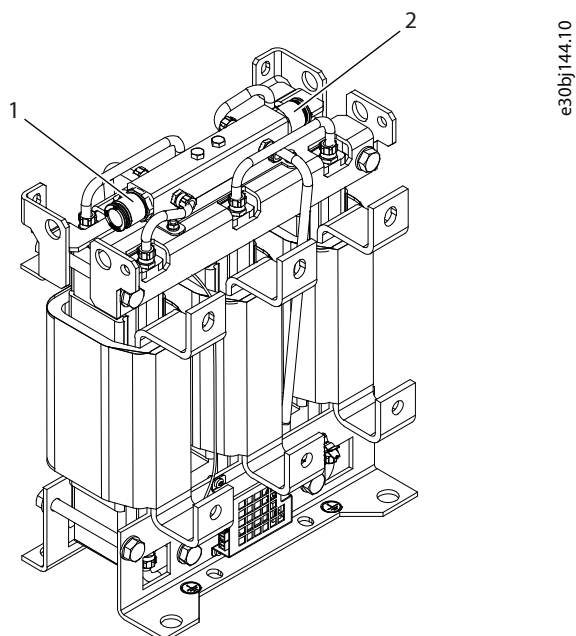
The L Filter has cooling circuit connectors at the top of the filter. The internal thread size is G1/2. The depth of the threads is 13 mm (0.51 in). The maximum tightening torque is 30 Nm (265 in-lb). Push-in connectors are available as option +ANN1.

Each connector can be used for coolant input or output.

Do not connect filters in series. Connecting in series requires high flow rates and high pressure because of the temperature rise of the coolant in the filters.

Table 1: Recommended Connectors

Connector	Tightening torque	Pipe	Pipe ferrule
Parker 69111621 MALE STUD 1/2"BSPP SS STEEL 31 6L D16 EPDM SEAL	20–30 Nm (177–265 in-lb)	PA 16/13 pipe	Parker 1827-16-13



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Figure 11: Inlet and Outlet Connectors of the L Filter

1	Inlet/outlet connector	2	Inlet/outlet connector
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4 Electrical Installation

4.1 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.

4.2 Installing the L Filter

Install the L Filter between the LC Filter and the AC grid. If the AFE has parallel power units, install a separate L Filter for each of them. See [4.9 Wiring Diagrams](#).

4.3 Cable Requirements

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

4.4 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 50% of the cross-sectional area of the phase conductor and made of the same material when the phase conductor cross-section is above 35 mm² (AWG 2) according to IEC 60364-5-54; 543.1.

The connection must be fixed.

4.5 Installing the Cables

Procedure

1. Connect the mains AC cables to terminals L1, L2, and L3.

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 AC terminals of the L 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 M10 screws and tightening torque 35–40 Nm (310–354 in-lb).

2. Connect the AC cables from the AFE to terminals L1', L2', and L3'.

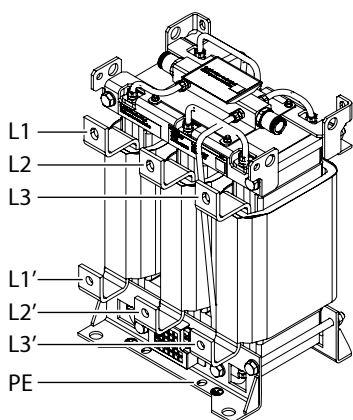
Use M10 screws and tightening torque 35–40 Nm (310–354 in-lb).

3. Connect the grounding cable to the PE terminal.

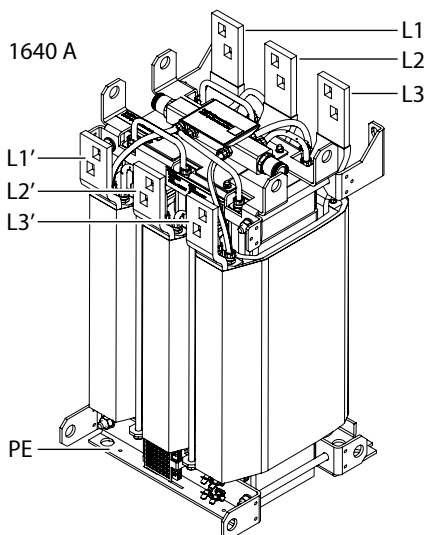
Use M8 screws and tightening torque 17–20 Nm (150–177 in-lb).

4.6 Terminals

400/1000 A



1640 A



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Figure 12: Terminals of the L Filter

Table 2: L Filter Terminal Descriptions

Terminal	Description
L1, L2, L3	AC connection point for mains input
L1', L2', L3'	AC connection point for output to AFE
PE	Grounding terminal for filter frame

4.7 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 3: 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

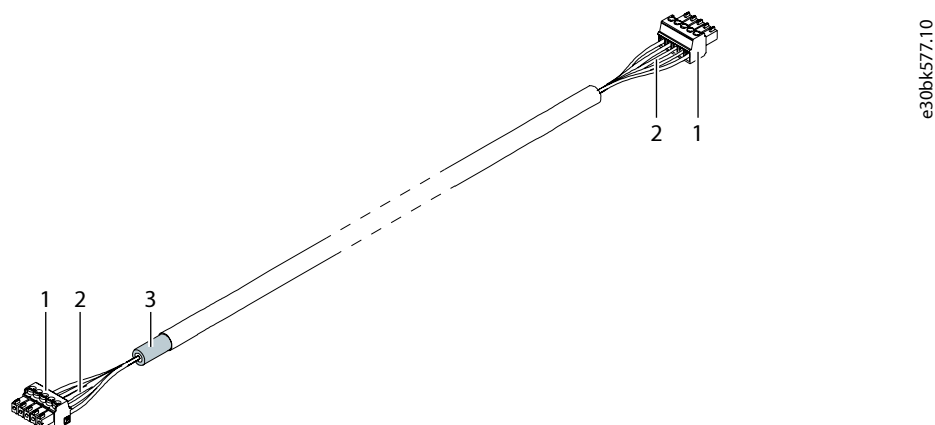


Figure 13: The Ready AuxBus Cable

1	Terminals	2	Wires
3	Shield removed		

4.8 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 Liquid-cooled System Modules Design Guide*.

Procedure

1. Connect the AuxBus cable between the L Filter and the LC Filter. If there are several parallel filters, connect each L Filter to the LC Filters individually.
 - a. Connect the end of the AuxBus cable where the insulation was removed to terminal X85 on the LC Filter.
 - b. Connect the other end of the AuxBus cable to terminal X86 on the AuxBus temperature measurement board.

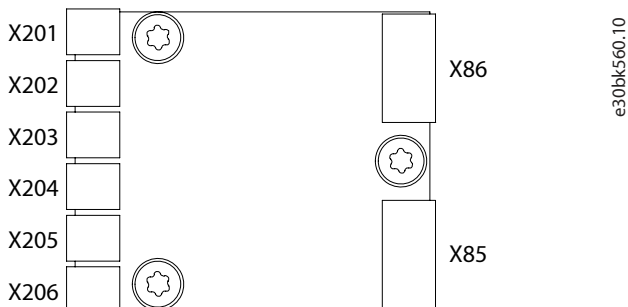


Figure 14: Terminals on the AuxBus Temperature Measurement Board

X206	Temperature measurement input	X85	AuxBus in
X86	AuxBus out		

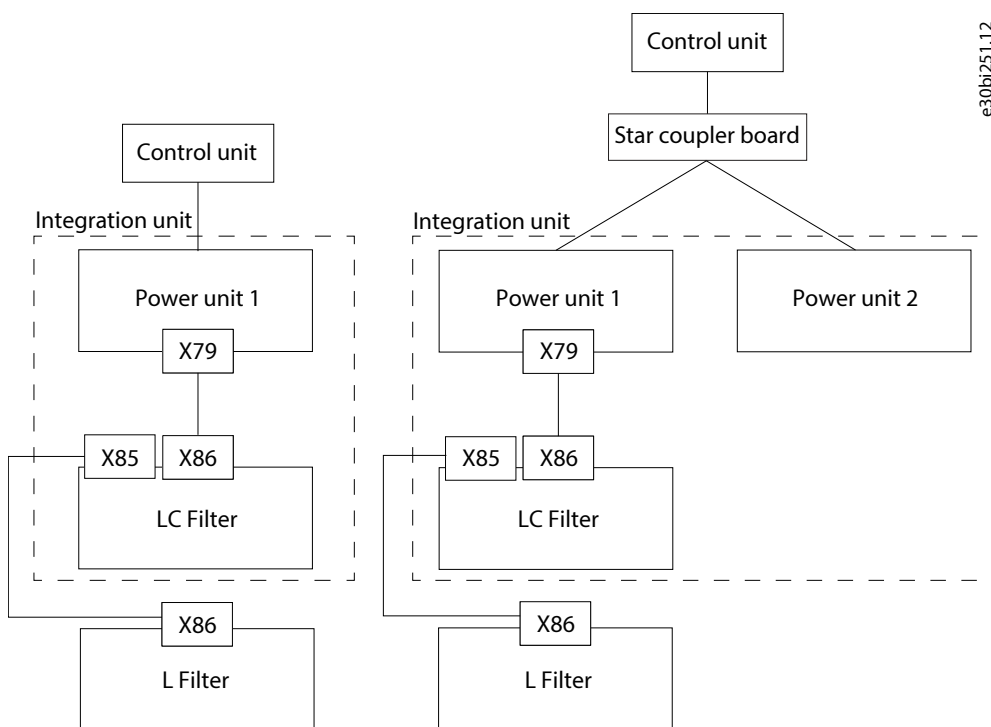
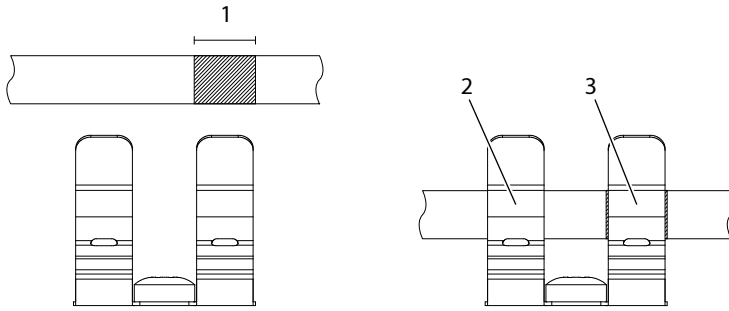


Figure 15: AuxBus Topology for AFE and Grid Converter Modules AR10L and AR12L

2. Route the cable so that there is no risk of getting in touch with bare busbars or terminals.
3. Ground each AuxBus cable at 1 end at the X85 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.



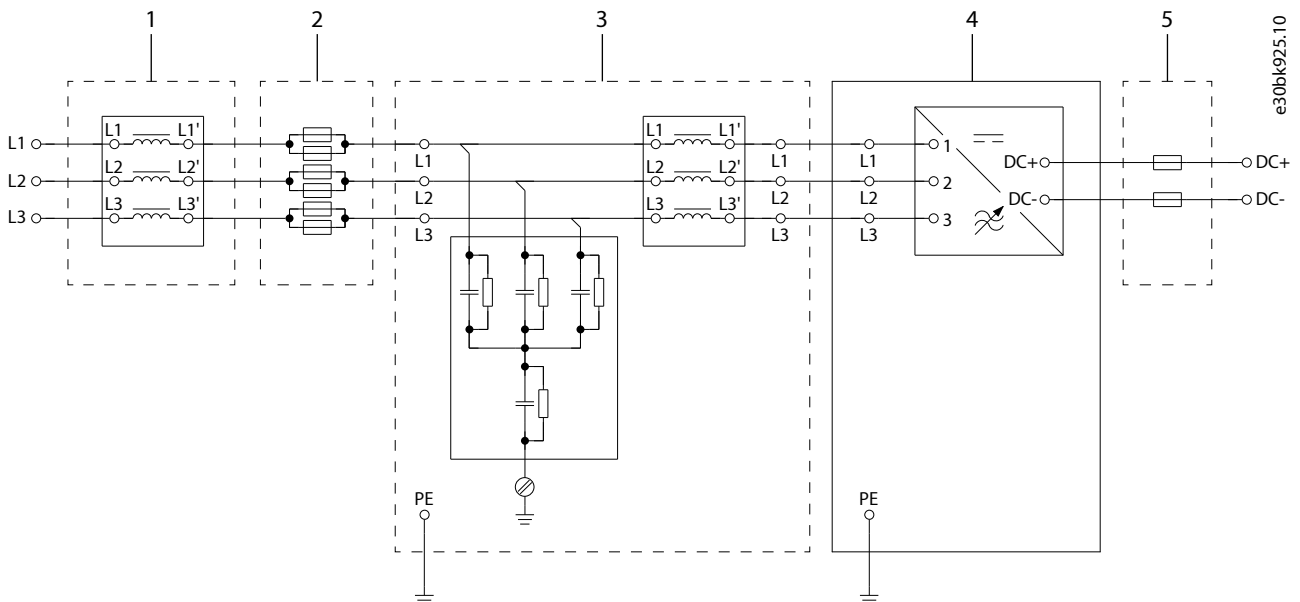
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Figure 16: Using the Cable Clamps

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

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

4.9 Wiring Diagrams



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Figure 17: Wiring Diagram, L Filter and Single Power Unit

1	L Filter	2	AC fuses, loose option
3	LC Filter, loose option	4	AFE module AM10L
5	DC fuses, loose option		

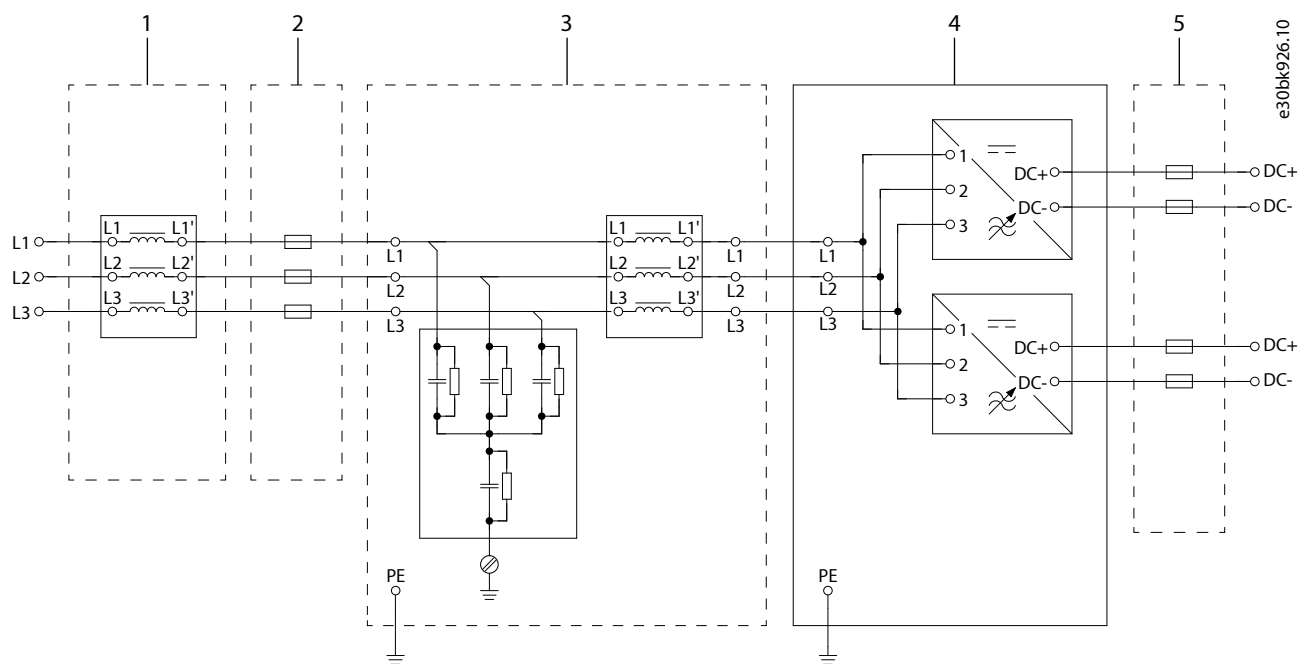


Figure 18: Wiring Diagram, L Filter and Parallel Power Units

1	L Filter, loose option	2	AC fuses, loose option
3	LC Filter, loose option	4	AFE module AM10L
5	DC fuses, loose option		

5 Maintenance

5.1 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 4: Maintenance Schedule for Liquid-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.

Table 4: Maintenance Schedule for Liquid-cooled Filters (continued)

Component	Inspection interval ⁽¹⁾	Service schedule ⁽²⁾	Preventive maintenance actions
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.
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.

Table 4: Maintenance Schedule for Liquid-cooled Filters (continued)

Component	Inspection interval ⁽¹⁾	Service schedule ⁽²⁾	Preventive maintenance actions
Coolant			
Log	Commissioning/startup, or at time of replacing liquid coolant	–	Record the water quality specification values to create a baseline for future reference before and after adding inhibitor and glycol. Also record the system pressure, coolant flow rate, temperature range, and create a baseline for future reference.
Glycols	1 year	Based on findings	Measure and record the level of glycol in the cooling system. The minimum concentration level is always 75/25% demineralized water/glycol.
Corrosive inhibitors	1 year	Based on findings	Measure and record the level of corrosive inhibitor (Cortec-VpCI-649) in the liquid coolant (see specification). Measure the level of the inhibitor every year. If the inhibitor level is below the recommended level of 1%, add more inhibitor. Before adding more inhibitor, practice caution not to exceed the level of electrical conductivity. Use the corrosive inhibitor recommended by Danfoss.
Pre-mixed glycol and inhibitor coolant	1 year	Based on findings	The pre-mixed coolants contain specific percentages of glycol and inhibitor for antifreeze and corrosion protection. The advantage of using a pre-mixed coolant is that the chemical composition is within Danfoss specifications, and there is no need for analyzing the coolant.
Demineralized water	1 year	Based on findings	Only use demineralized or deionized water in the coolant solution. Record and compare the chemical composition values when replacing or adding coolant.
Liquid cooling system			
Pipes, hoses, and connections	1 year	1 year	Check for external signs of moisture, corrosion, and coolant leaks. Check the tightness of the cooling pipe connections. Check the heat sinks and host pipes in the cooling system.
Leak detector	1 year	10 years	Test the functioning of the leak detector.
Power unit heat sinks	1 year	6 years	Check that the heat sink temperature across all cooling circuits or power phases is balanced. Imbalanced temperature of the cooling circuits is a possible sign of a restriction. Under normal conditions, clean or acid-wash the heat sinks every 6 years with cleaning products recommended by Danfoss. Refill the coolant system and log the new coolant specification values.
Auxiliary equipment	1 year	According to manufacturer recommendations	Check that the sensors, gauges, and indicators are functioning correctly. Act based on findings.
System cooling capacity	1 year	Based on findings	Test the cooling capacity and the thermal transfer of the system. Record the coolant system flow, pressure, and input and output temperature, and compare to the previous measurements. Act based on findings.

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.

5.2 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 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 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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