

iC7 Series Liquid-cooled DC Filter OF7D1

1 Overview

1.1 DC Filter

A DC/DC converter requires a DC filter between the DC source and the converter for current control and the ability to boost voltage. The filter also smoothens the current and voltage waveform, making them suitable for most DC sources or loads.

There are 2 electrical sizes of the filter: DC10L (570 A) and DC12L (1200 A).

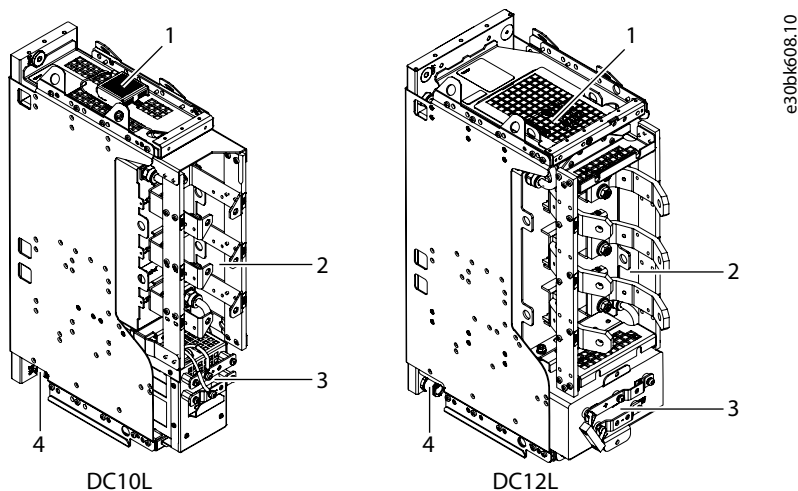


Illustration 1: Liquid-cooled DC Filters

1	AuxBus temperature measurement board	3	Capacitor terminals
2	Inductor terminals	4	Cooling connectors

1.2 Contents of the Delivery

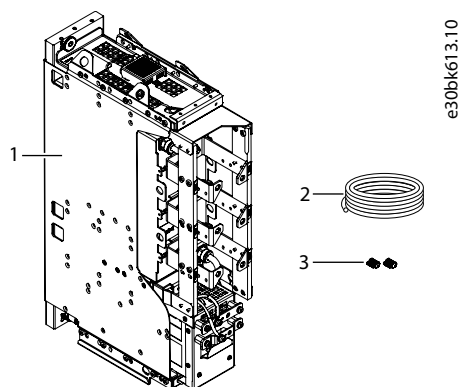


Illustration 2: Items Included in the Delivery

1	DC Filter, DC10L or DC12L	3	AuxBus terminals, 2 pcs
2	AuxBus cable, 3 m (9.8 ft)		

Available options:

- +ANN1 = Push-in cooling connectors
- +AO20 = 2.0 m (6.6 ft) cooling hose

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 operating guide for the iC7 Series System Modules.

2.2 Installation Requirements

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

The cabinet must also be sufficiently strong for the weight of the system modules and other devices.

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

2.3 Installing the Filter into a Cabinet

Procedure

1. Install the filter into the cabinet in a vertical or horizontal position.

See [2.4 Dimensions of the DC Filter](#).

2. Attach the filter from the mounting holes on the frame to the cabinet.

For aluminum parts, use M6 grade 8.8 screws with a thread depth of 6–14 mm (0.24–0.55 in), and a tightening torque of 6–8 Nm (53–71 in-lb).

For sheet metal parts, use M5 (DIN 7500) screws with a maximum thread depth of 20 mm (0.79 in), and a tightening torque of 3–4 Nm (27–35 in-lb).

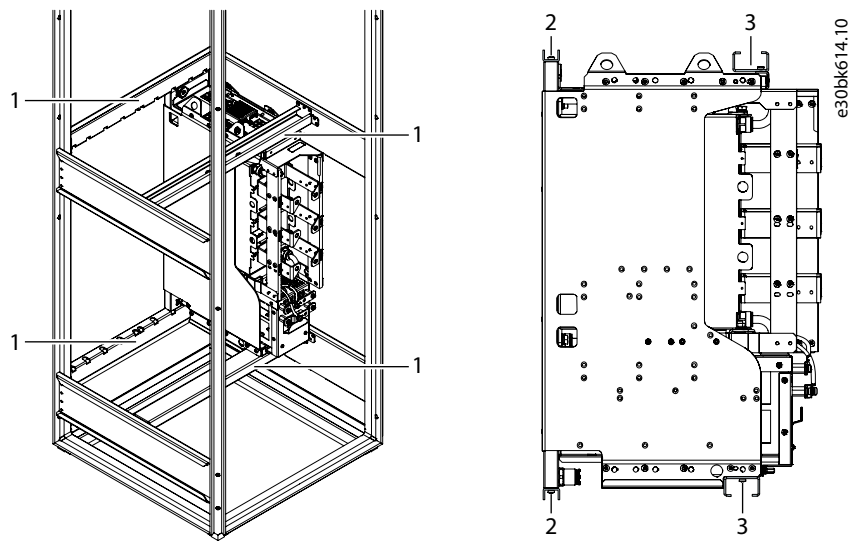


Illustration 3: Example of Mounting the DC Filter in the Cabinet Vertically

1	Mounting brackets	3	Mounting holes in sheet metal parts
2	Mounting holes in aluminum parts		

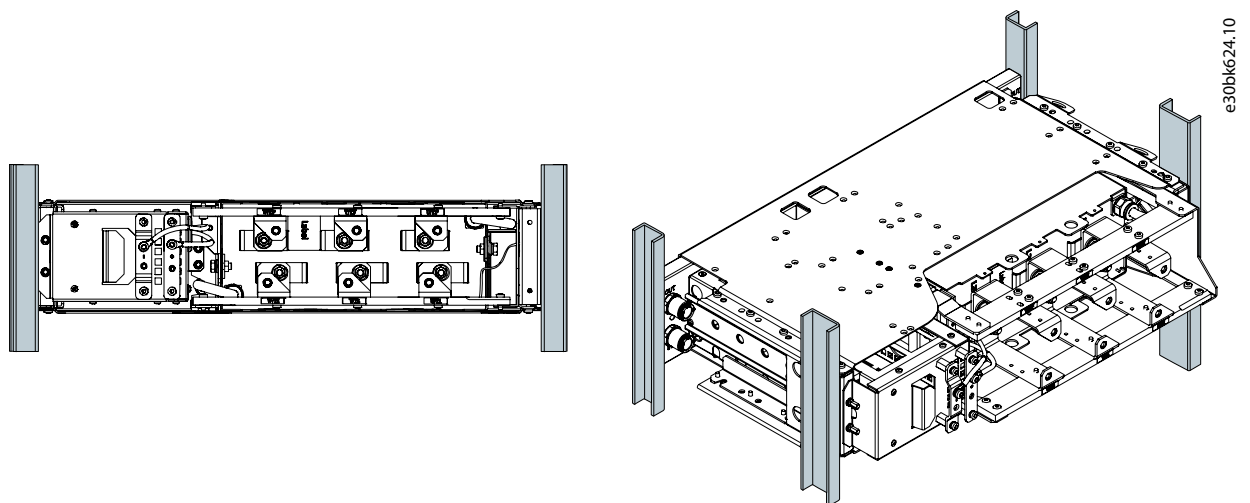


Illustration 4: Example of Mounting the DC Filter Horizontally

2.4 Dimensions of the DC Filter

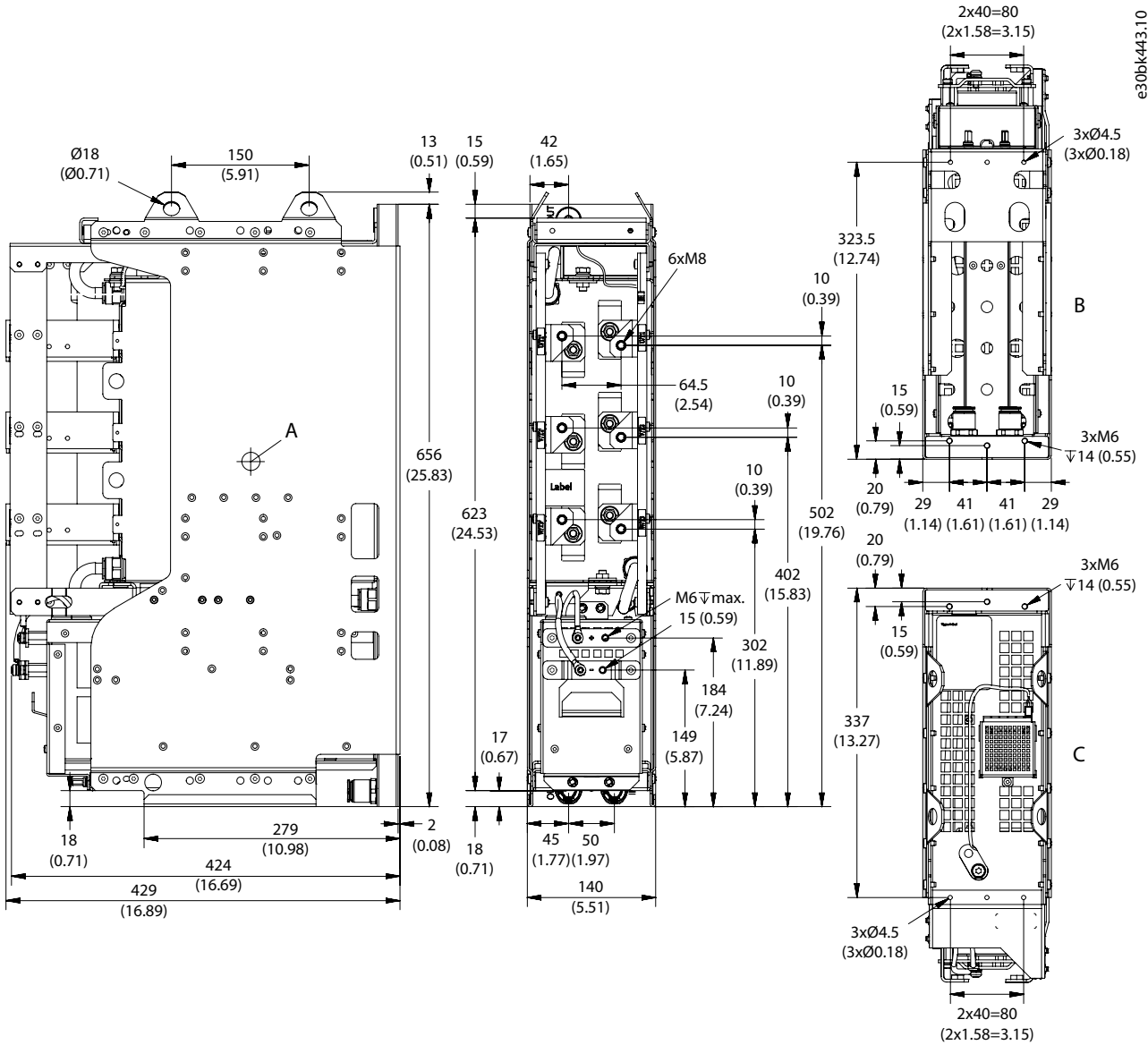
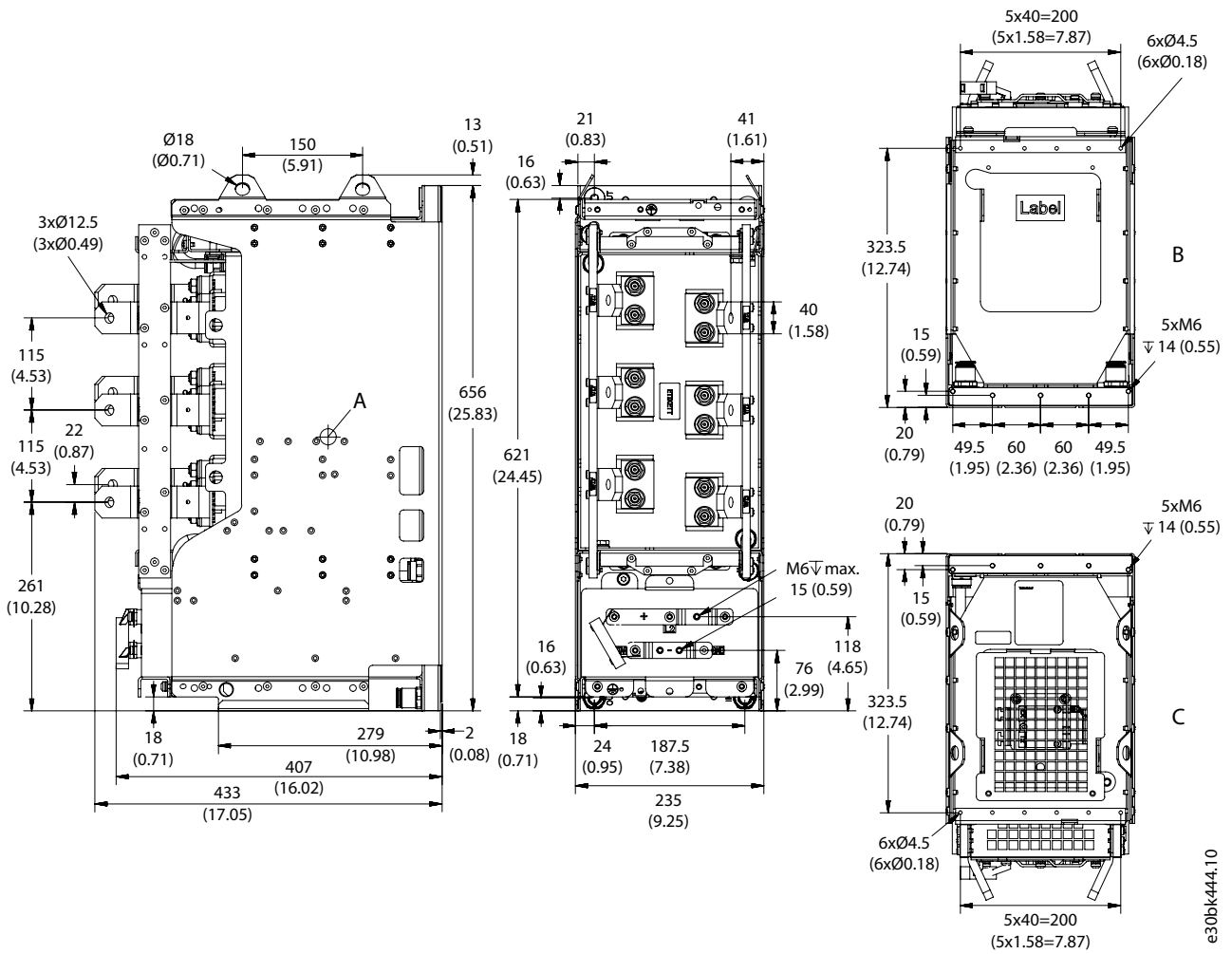


Illustration 5: Dimensions of DC Filter DC10L in mm (in)

A	Center of gravity	C	View from the top
B	View from the bottom		



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Illustration 6: Dimensions of DC Filter DC12L in mm (in)

A	Center of gravity	C	View from the top
B	View from the bottom		

3 Cooling Requirements

3.1 Safety in Liquid-cooling

⚠ WARNING ⚠

POISONOUS COOLANTS

Glycols and inhibitors can be 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.

N O T I C E

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.

N O T I C E

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

N O T I C E

For more detailed information about the requirements for liquid-cooling, see the iC7 Series Liquid-cooled System Modules Operating 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, 95% 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:

- 6.7 l/min (1.77 gal/min) with water
- 8.7 l/min (2.30 gal/min) with 30% glycol
- 10.1 l/min (2.67 gal/min) with 50% glycol

The liquid volume per element:

- DC10L: 0.70 l (0.185 gal)
- DC12L: 1.25 l (0.330 gal)

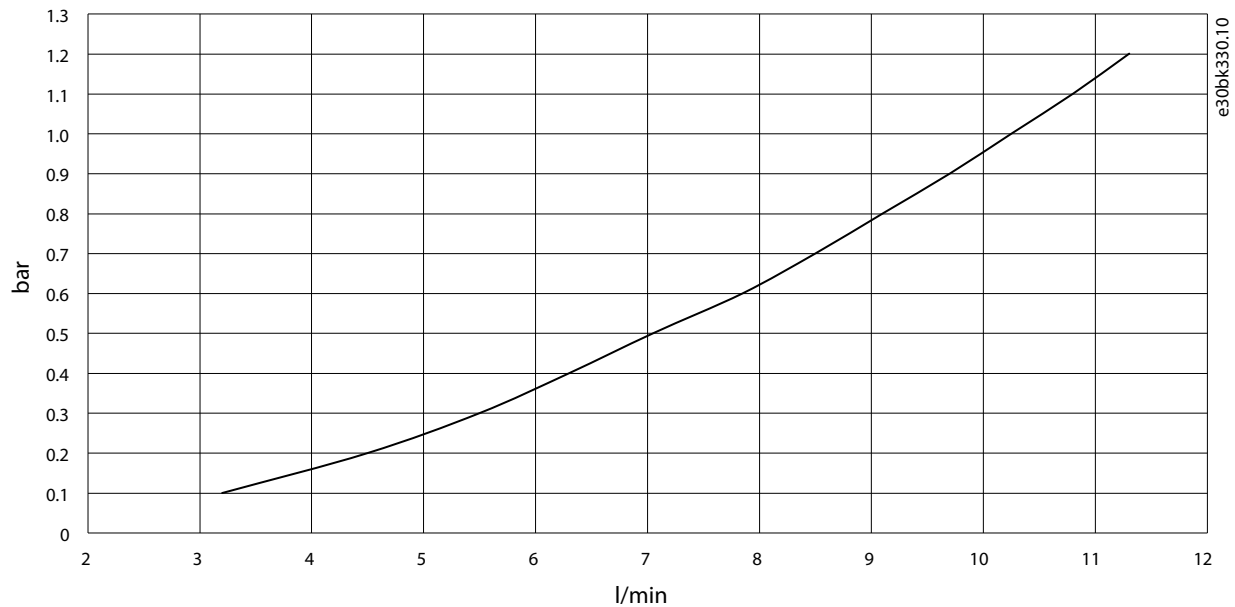


Illustration 7: Pressure Drop with Water, DC10L

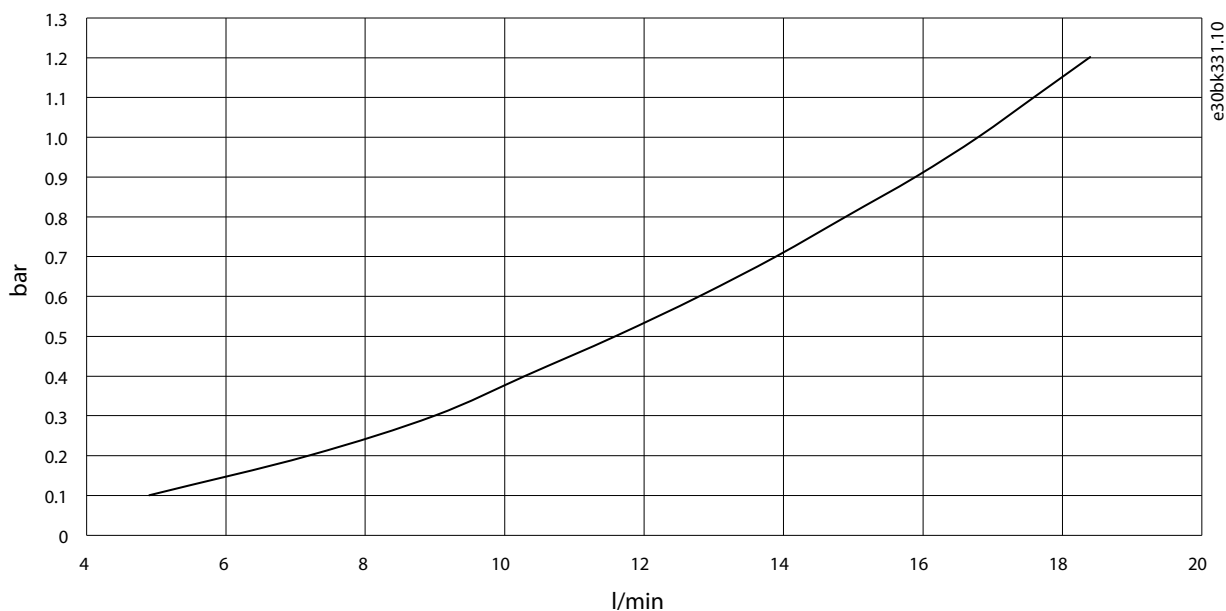


Illustration 8: Pressure Drop with Water, DC12L

3.3 Cooling Circuit Connectors

The DC filter has cooling circuit connectors in the manifold plate. 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.

The inlet and outlet connectors are at the bottom of the filter. An alternative outlet connector is available at the top of the filter. If the optional outlet connector at the top is used, the outlet connector at the bottom must be closed with a plug.

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

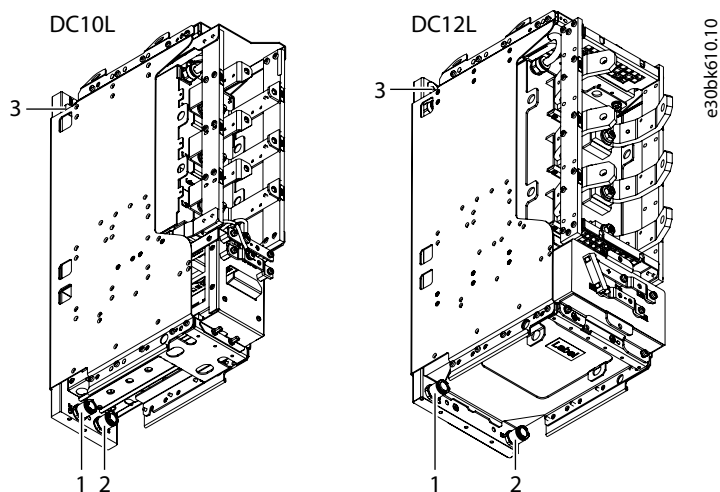


Illustration 9: Location of the Cooling Circuit Connectors

1	Outlet connector	3	Alternative outlet connector
2	Inlet connector		

4 Electrical Installation

4.1 Electrical Installation Safety

⚠ W A R N I N G ⚠

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 DC Filter

Install the DC filter between the DC/DC converter and the DC source. See [4.9 Wiring Diagrams](#).

4.3 Cable Requirements

It is recommended to use symmetrical cables with an even number of conductors for DC+ and DC-.

- 3-core cable: Use 2 conductors for DC+ and DC-, and the 3rd conductor for PE.
- 4-core cable: Use 2 conductors for DC+ and 2 conductors for DC-.

It is recommended to use cables with common shielding. Connect the cable shield to ground at both ends.

If single-core shielded cables are used, ground the cable shield only from 1 end.

Use single-core unshielded cables only if EMI protection is not necessary, or it is ensured by other means.

Cable insulation must be rated for minimum 90 °C (194 °F).

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

4.3.1 Cable Sizes for the Connections to DC Source

Table 2: Cable Sizes for the Connections from the DC-filter Inductors to the DC Source

Filter size	Current (I _L) [A]	1-core cable Cu [mm ²]	3-core cable Cu [mm ²] ⁽¹⁾	4-core cable Cu [mm ²] ⁽²⁾
DC10L	300	3x(1x95)	2x(3x70)	1x(4x70)
	360	3x(1x95)	2x(3x70)	1x(4x70)
	420	4x(1x95)	2x(3x95)	1x(4x95)
	480	4x(1x95)	2x(3x95)	1x(4x95)
	570	4x(1x120)	2x(3x120)	1x(4x120)
DC12L	720	5x(1x95)	3x(3x95)	2x(4x70)
	840	6x(1x95)	3x(3x95)	2x(4x70)
	960	7x(1x95)	3x(3x120)	2x(4x95)
	1080	7x(1x95)	3x(3x120)	2x(4x95)
	1200	8x(1x95)	4x(3x120)	2x(4x120)

¹ 3-core cables: Use 2 conductors for 'plus' and 'minus', and 3rd conductor for PE.

² 4-core cables: Use 2 conductors for 'plus' and 2 conductors for 'minus'.

4.3.2 Cable Sizes for the Connections to DC/DC Converter

The cables must be as short as possible and the length for each phase as equal as possible.

Table 3: Cable Sizes for the Connections from the DC-filter Inductors to the DC/DC Converter

Filter size	Current (I_L) [A]	1-core cable Cu [mm ²]/phase
DC10L	300	95
	360	95
	420	120
	480	120
	570	150
DC12L	720	2x95
	840	2x120
	960	2x120
	1080	2x120
	1200	2x150

4.3.3 Cable Sizes for the DC-filter Capacitor Connections

For connecting the minus terminal of the DC-filter capacitor to the DC bus, use copper cable or single wire with at least 1100 V DC voltage, and 90 °C (194 °F) temperature rating.

To optimize the performance of the DC-filter capacitor, make sure that the wire between the capacitor and the DC bus is as short as possible.

Minimum cable sizes

- DC10L: 16 mm² (AWG 6)
- DC12L: 35 mm² (AWG 2)

4.3.4 Grounding

Ground the DC 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 mm² (AWG 2) according to IEC 60364-5-54; 543.1.

The connection must be fixed.

4.4 Source DC+ Fuses

To protect the equipment, install fuses between the DC Filter and the source DC+.

Table 4: Recommended Source DC+ Fuses

Filter size	Rated current (I_L) [A] ⁽¹⁾	Number of fuses	Fuse size	Part number (Mersen)	Fuse U_n [V]	Fuse I_n [A]	$I_{cp, mr}$ [A] ⁽²⁾
DC10L	300	3	72	D72SG120V250QF	1200	250	1600
	360	3					
	420	3					
	480	3	72	D72SG120V315QF	1200	315	2200
	570	3					
DC12L	720	3	272	D272SG120V500QF	1200	500	3100

Filter size	Rated current (I _L) [A] ⁽¹⁾	Number of fuses	Fuse size	Part number (Mersen)	Fuse U _n [V]	Fuse I _n [A]	I _{cp, mr} [A] ⁽²⁾
	840	3	272	D272SG120V630QF	1200	630	4400
	960	3					
	1080	3					
	1200	3					

¹ Nominal current of the DC/DC converter with low overload (110%). Allows a +10% load variation for 1 minute every 5 minutes.

² Minimum required prospective short-circuit current at 5 ms pre-arcing time. If there is a short-circuit fault in the common DC bus, a multiplied I_{cp, mr} value is required.

4.5 Installing the Cables

Procedure

1. Connect the DC cables to the inductor terminals U, V, W, and U', V', W'.

DC10L: Use M8 screws and tightening torque 17–20 Nm (150–177 in-lb).
 DC12L: Use M10 screws and tightening torque 35–40 Nm (310–354 in-lb) or M12 screws and tightening torque 65–70 Nm (575–620 in-lb).

2. Connect the DC cables to the capacitor terminals + and -.

Use M6 screws and tightening torque 6–9 Nm (53–80 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

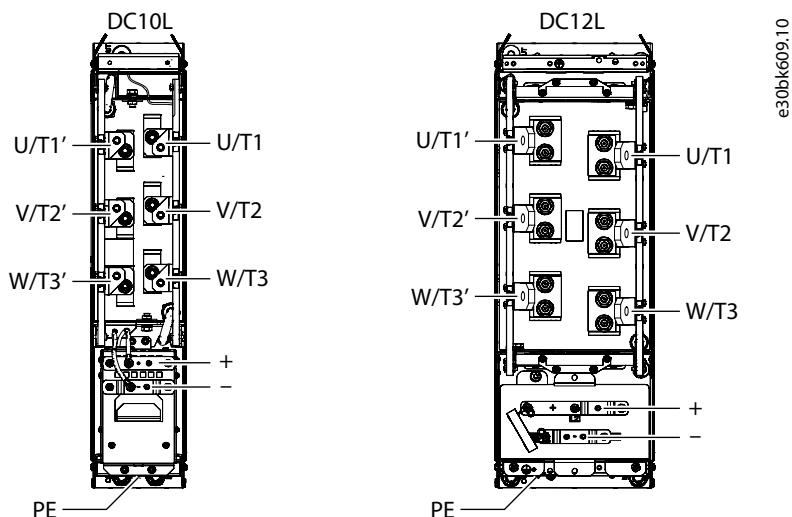


Illustration 10: Terminals of the DC Filter

Table 5: DC Filter Terminal Descriptions

Terminal	Description
U/T1 V/T2 W/T3	DC+ connection point for DC source to filter inductor
U/T1'	DC connection point for DC/DC converter to filter inductor

Terminal	Description
V/T2' W/T3'	
+	DC+ connection point for DC source to filter capacitor
-	DC- connection point for DC source to filter capacitor
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 insulation of the cable.
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 6: 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

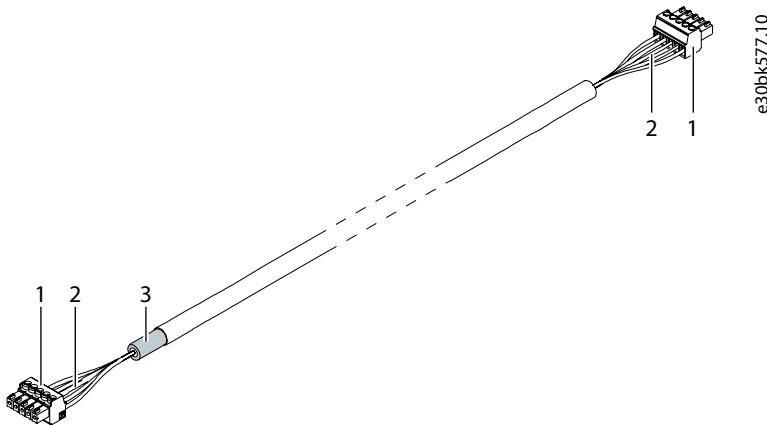


Illustration 11: The Ready AuxBus Cable

1	Terminals	3	Shield removed
2	Wires		

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 System Module operating guides.

Procedure

1. To access the AuxBus temperature measurement board, remove the cover.

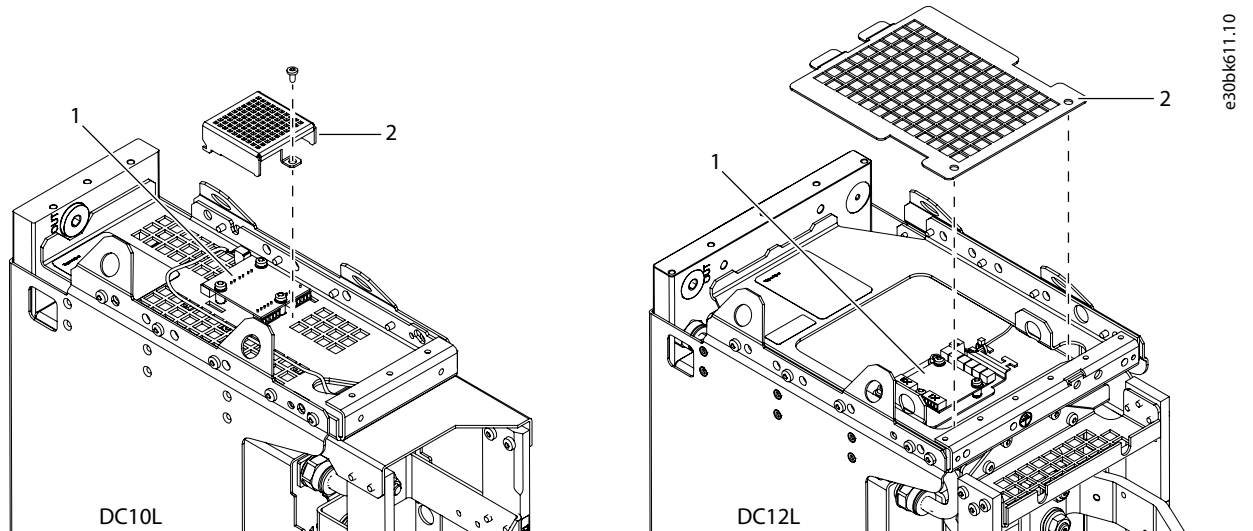


Illustration 12: Accessing the AuxBus Temperature Measurement Board

1	AuxBus temperature measurement board
2	Cover

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 X79 on the power unit.
 - b. Connect the other end of the AuxBus cable to terminal X86 on the AuxBus temperature measurement board.

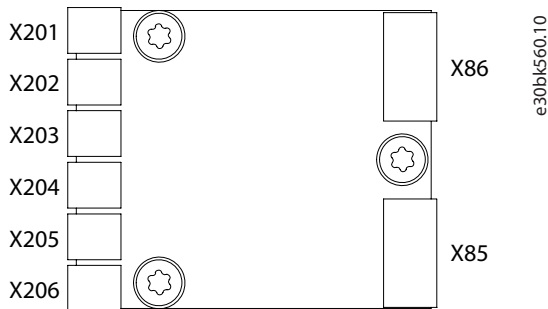


Illustration 13: Terminals on the AuxBus Temperature Measurement Board

X206	Temperature measurement input	X86	AuxBus out
X85	AuxBus in		

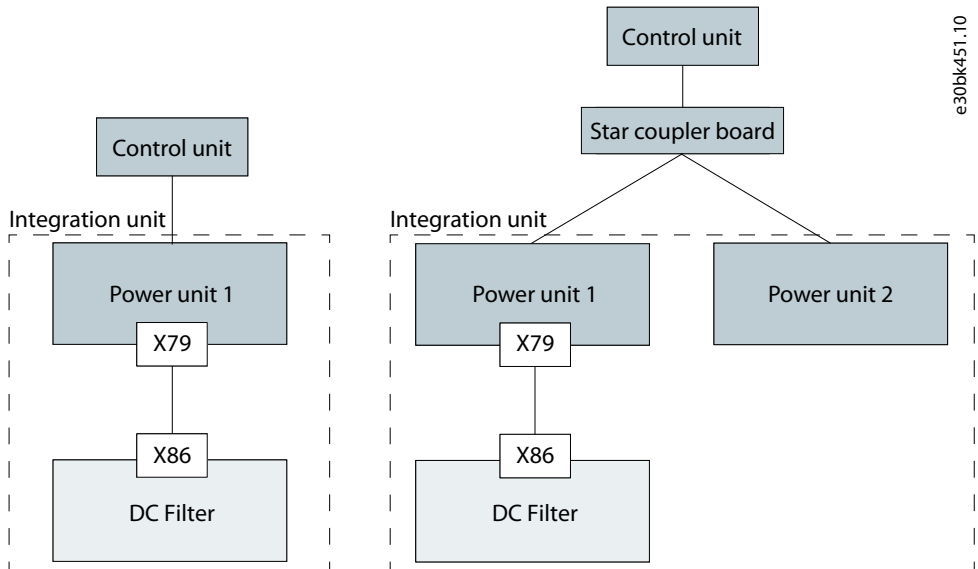


Illustration 14: AuxBus Topology

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 X79 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.

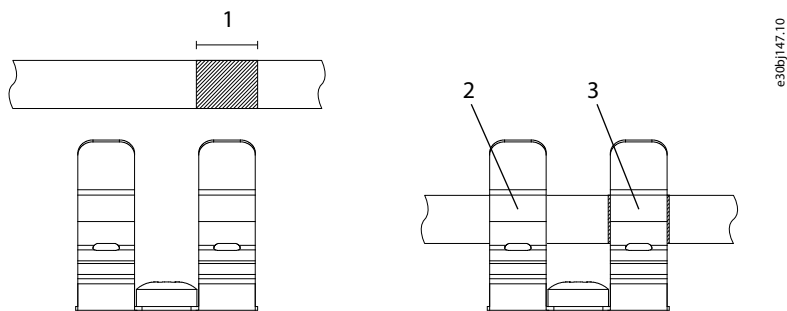


Illustration 15: Using the Cable Clamps

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

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

4.9 Wiring Diagrams

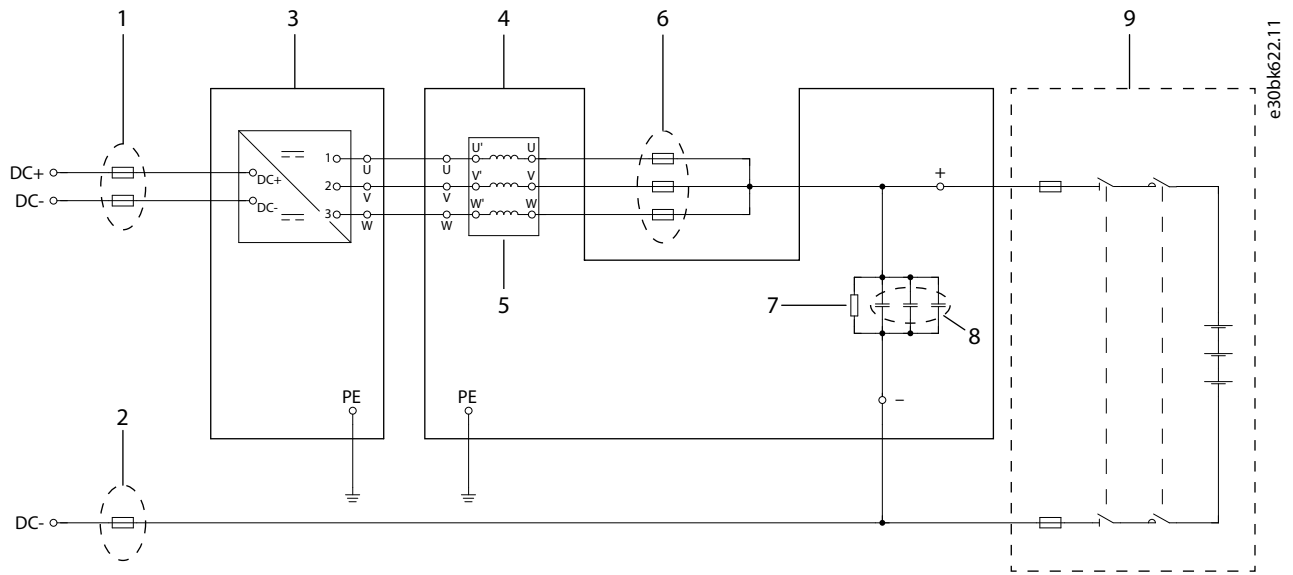


Illustration 16: Wiring Diagram, DC10L

1	DC-bus fuses, option	6	Source fuses, option
2	Source DC- fuses, option	7	Discharging resistor
3	DC/DC converter module DM10L	8	Capacitors
4	DC Filter DC10L	9	DC source/load
5	DC-filter inductor		

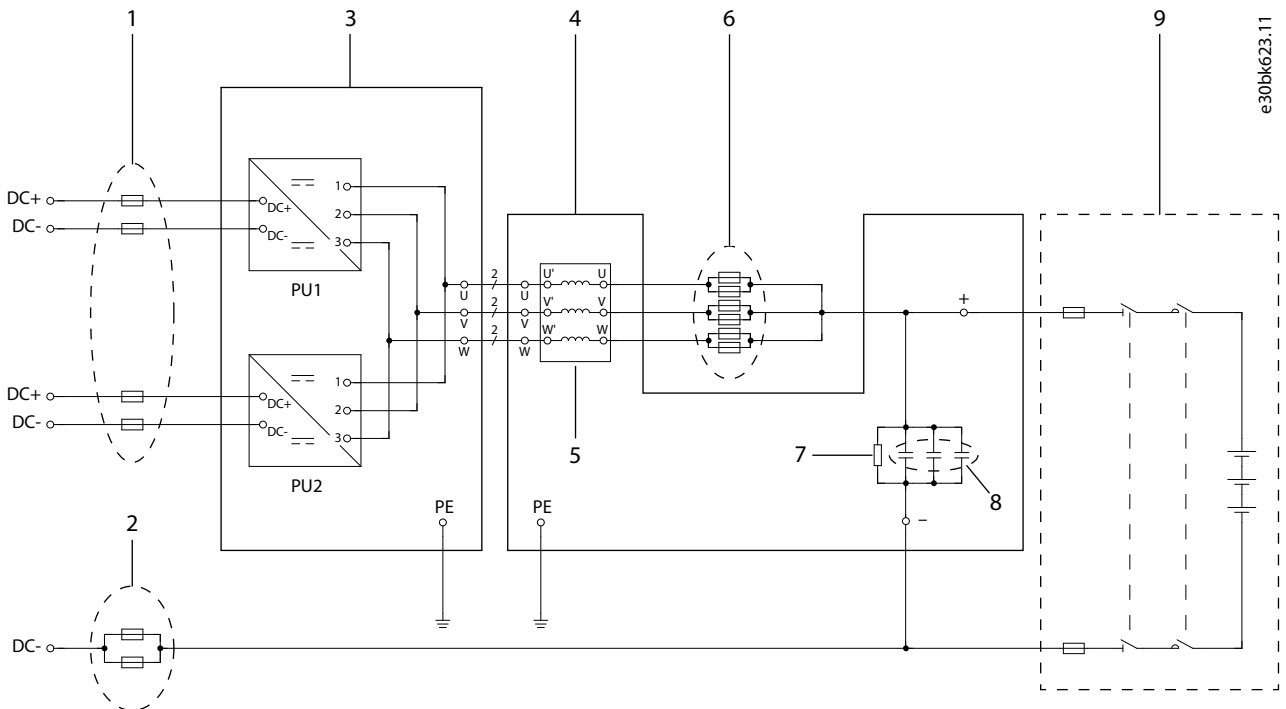


Illustration 17: Wiring Diagram, DC12L

1	DC-bus fuses, option	6	Source fuses, option
2	Source DC- fuses, option	7	Discharging resistor
3	DC/DC converter module DM12L	8	Capacitors
4	DC Filter DC12L	9	DC source/load
5	DC-filter inductor		

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