Installation Guide

iC7 Series Air-cooled dU/dt Filter OF7U1

1 Overview

1.1 dU/dt Filter

The iC7 Series Air-cooled dU/dt Filter OF7U1 is 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 dU/dt filter is used to limit the voltage rise time and maximum voltage seen by the motor. This can be necessary to protect motor insulation and guarantee a long lifetime. The motor terminal phase-to-phase voltage remains pulse shaped, but the dU/dt and maximum values are reduced.

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 of the drive. At operating frequencies above 70 Hz, current derating must be considered.

Table 1: The Available dU/dt Filters

Voltage rating	Current rating	Frame designation
380–690 V AC	261 A	DU9
380–690 V AC	416 A	DU10
380–690 V AC	590 A	DU10
380–500 V AC	880 A	DU11

1.2 Contents of the Delivery

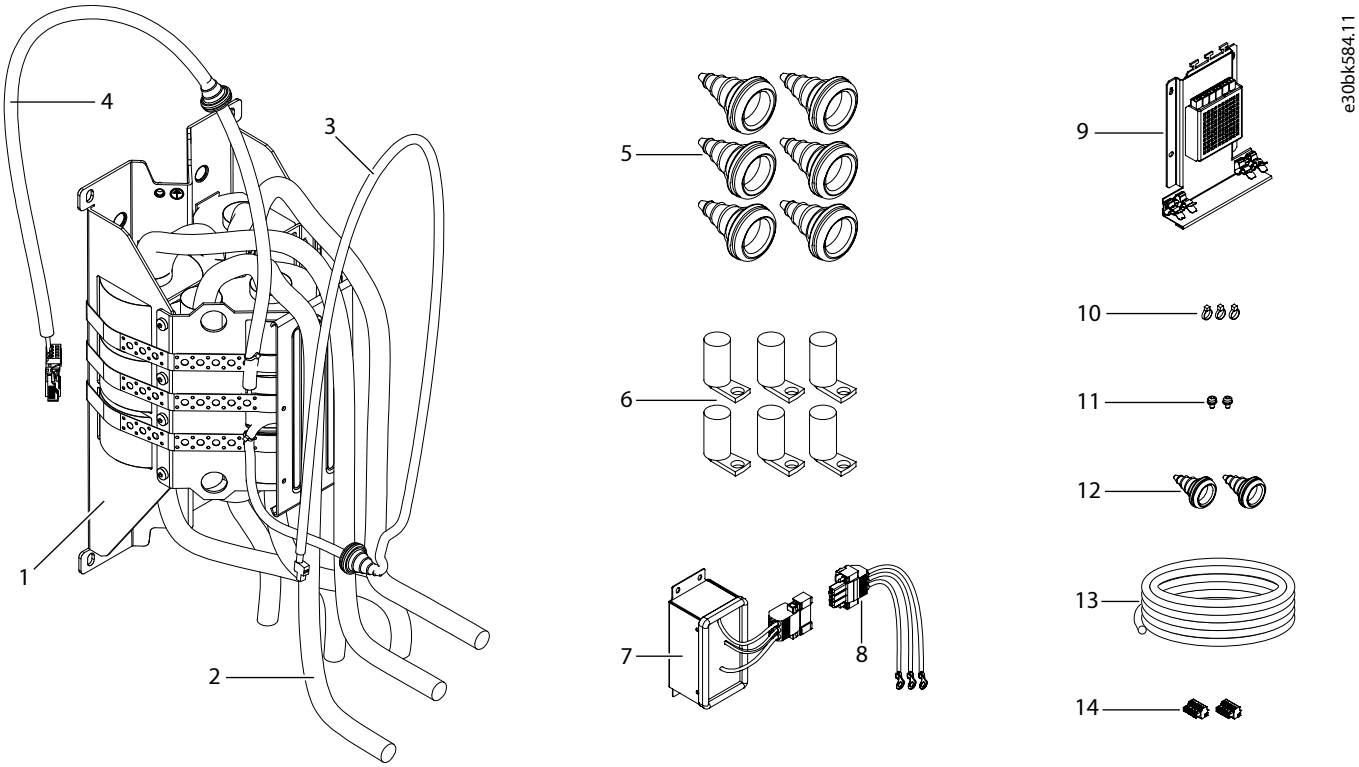

Figure 1: Items Included in the Delivery

1	dU/dt Filter inductor	**2**	Power cables, 1.5 m (4.9 ft) at each side, assembled
3	AuxBus temperature measurement wire, 1.5 m (4.9 ft), assembled	**4**	Thermal relay wire, 1.0 m (3.3 ft), assembled

5	Grommet M50, 6 pcs	**6**	Tubular cable lug 90° angle, 120 or 150 mm^2, 6 pcs
7	dU/dt Filter capacitor assembly	**8**	dU/dt Filter capacitor wire harness
9	AuxBus temperature measurement board assembly	**10**	Cable ties, 3 pcs
11	M5x10 screws, 2 pcs	**12**	Grommet, Ø25.3 mm (Ø1 in), 2 pcs
13	AuxBus cable, 3 m (9.8 ft)	**14**	AuxBus terminals, 2 pcs
15	Heat shrinkable tubing, 32 mm (1.26 in), 1 m (3.3 ft), not shown in illustration		

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 dU/dt Filter into the Cabinet

See the installation dimension in 2.5 Dimensions of the dU/dt Filter.

1. Attach the dU/dt Filter inductor to the cabinet with 4 screws.

   - Mount the inductor vertically, with the temperature measurement sensor at the top (assuming that the direction of the cooling airflow is upwards). See 2.4 Cooling Requirements.
   - In IP54 installations, mount the inductor in the IP54 section.

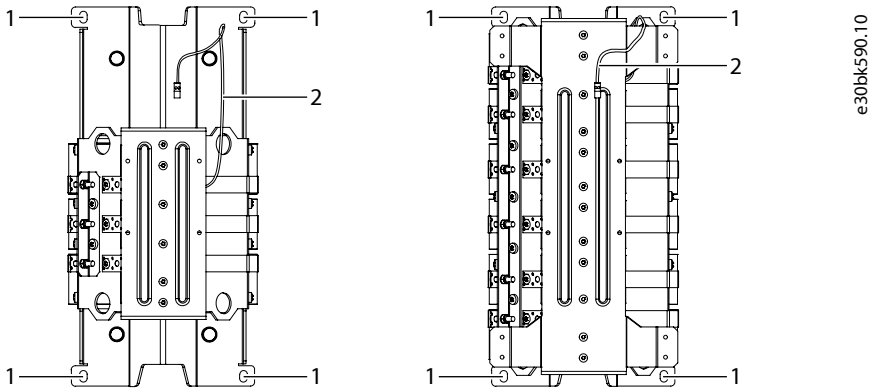

Figure 2: Mounting Holes of the dU/dt Filter Inductor

1	Mounting holes	**2**	Temperature measurement wire

2. Attach the inductor from the mounting holes on the front support plate to an air channel or other cover plate.

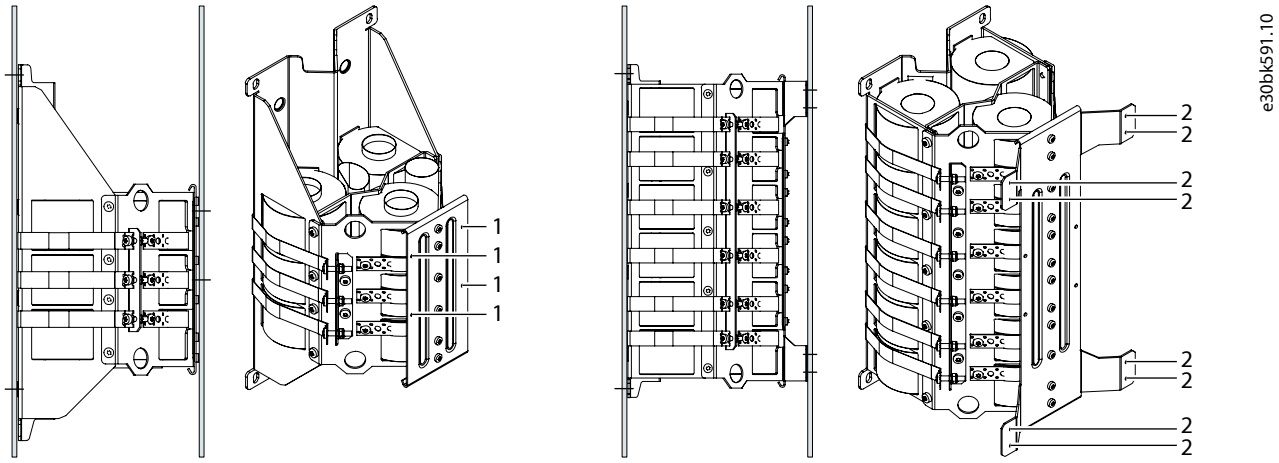

Figure 3: Mounting Holes on the Front Support Plate of the Inductor

1	Mounting holes on 590 A inductor	**2**	Mounting holes on 880 A inductor

3. Mount the dU/dt Filter capacitor assembly to the cabinet with 4 screws.

In IP54 installations, mount the capacitor assembly outside the IP54 section.

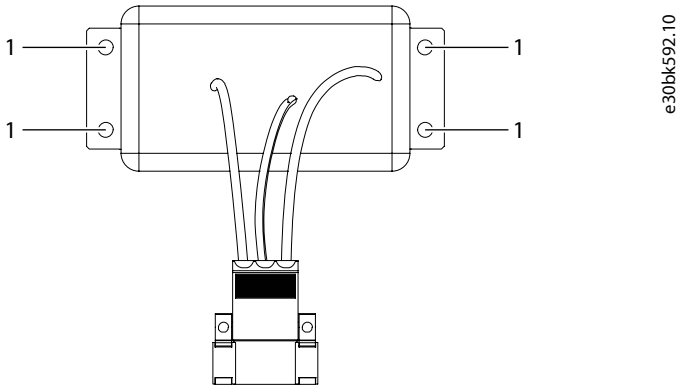

Figure 4: Mounting Holes of the Capacitor Assembly

1	Mounting holes

4. Mount the assembly plate of the AuxBus temperature measurement board to the cabinet with 4 screws.

In IP54 installations, mount the assembly plate outside the IP54 section.

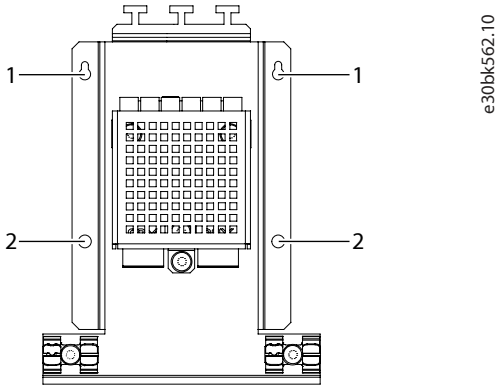

Figure 5: Mounting Holes of the Assembly Plate

1	Mounting holes with keyholes, Ø5/3 mm (Ø0.20/0.12 in)	**2**	Mounting holes, Ø5.5 mm (Ø0.22 in)

2.4 Cooling Requirements

The maximum ambient operating temperature of the dU/dt 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).

The filter cables also require cooling along their whole length. Minimize the length of the cables which are not cooled by the airflow.

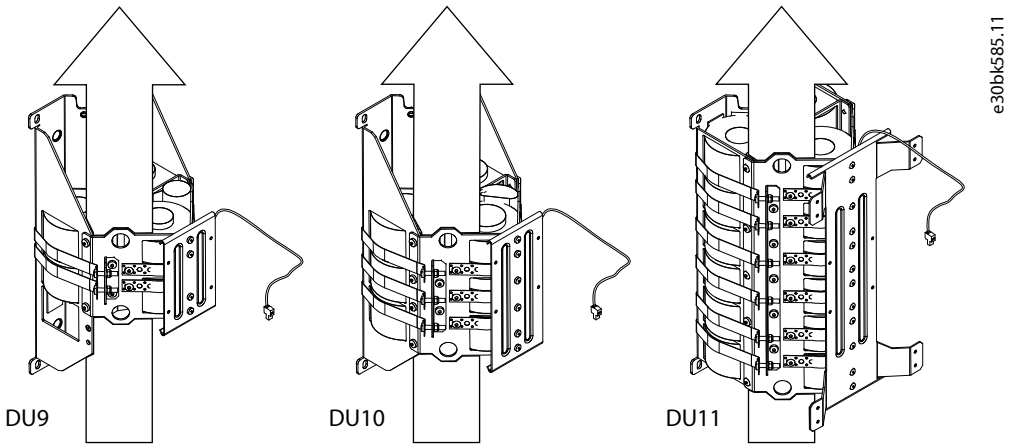

Figure 6: Airflow Through the Filter

2.5 Dimensions of the dU/dt Filter

The dimensional drawings for the dU/dt Filters do not show the pre-installed cables.

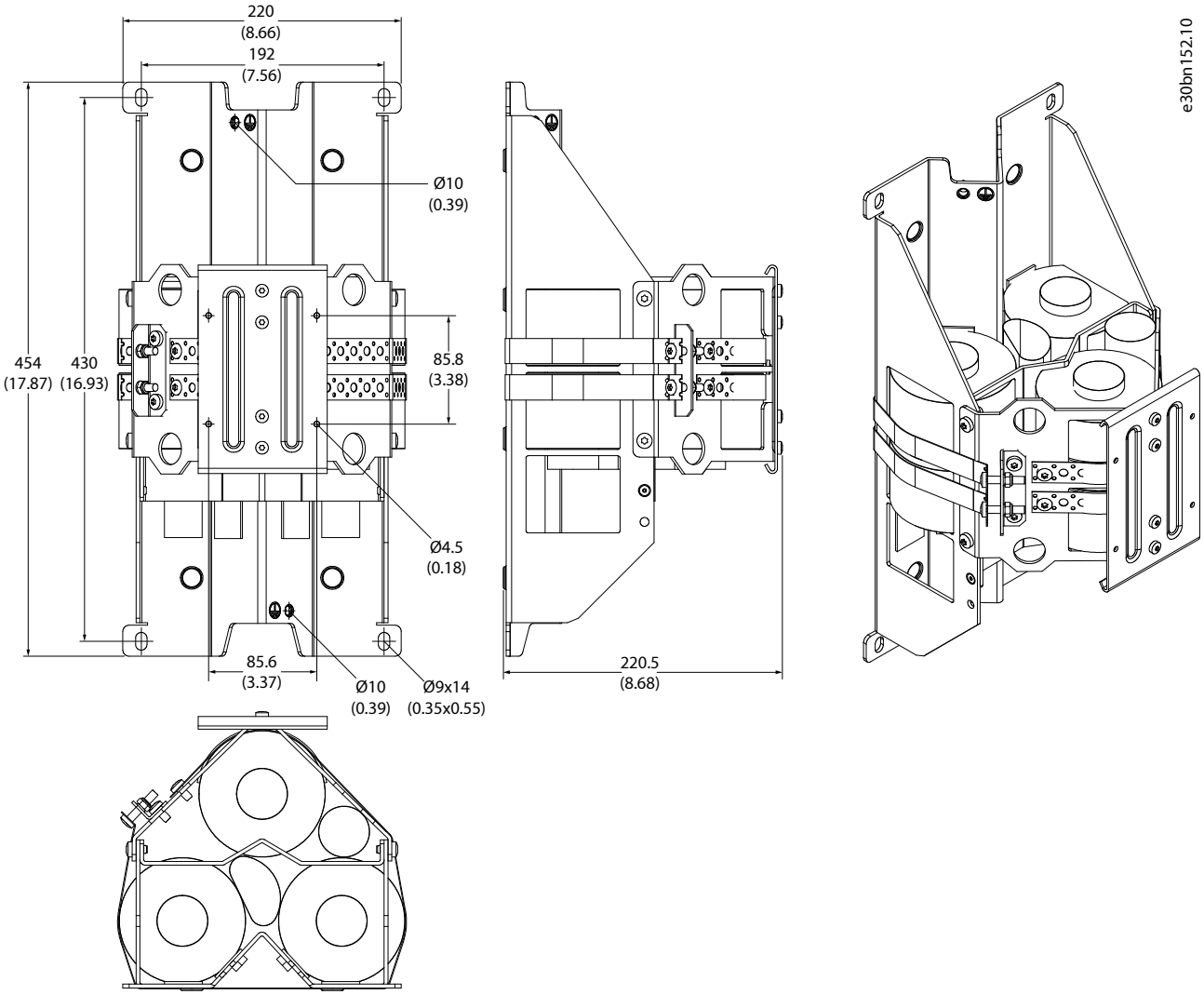

Figure 7: Dimensions of the dU/dt Filter 261 A Inductor in mm (in)

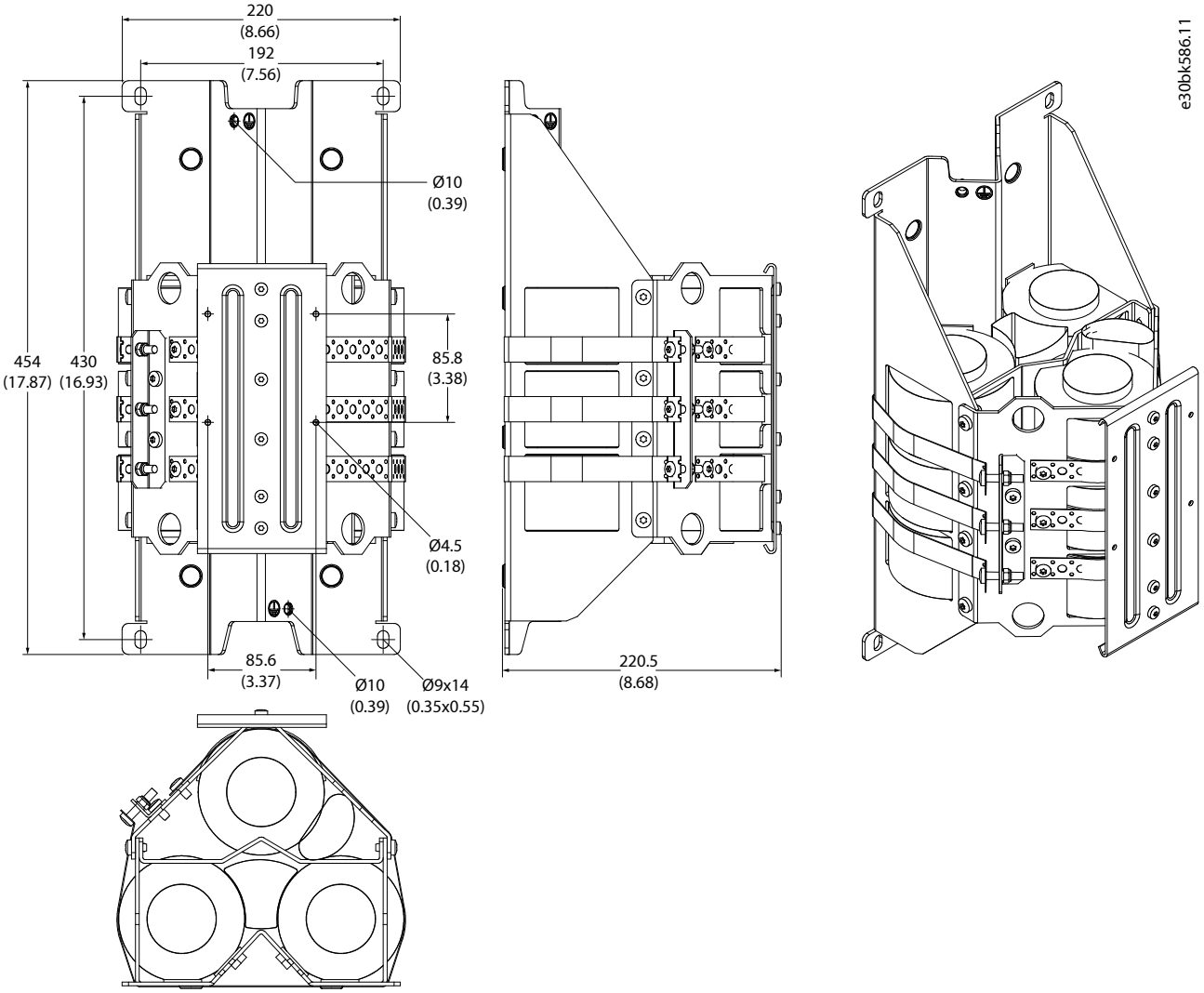

Figure 8: Dimensions of the dU/dt Filter 416/590 A Inductor in mm (in)

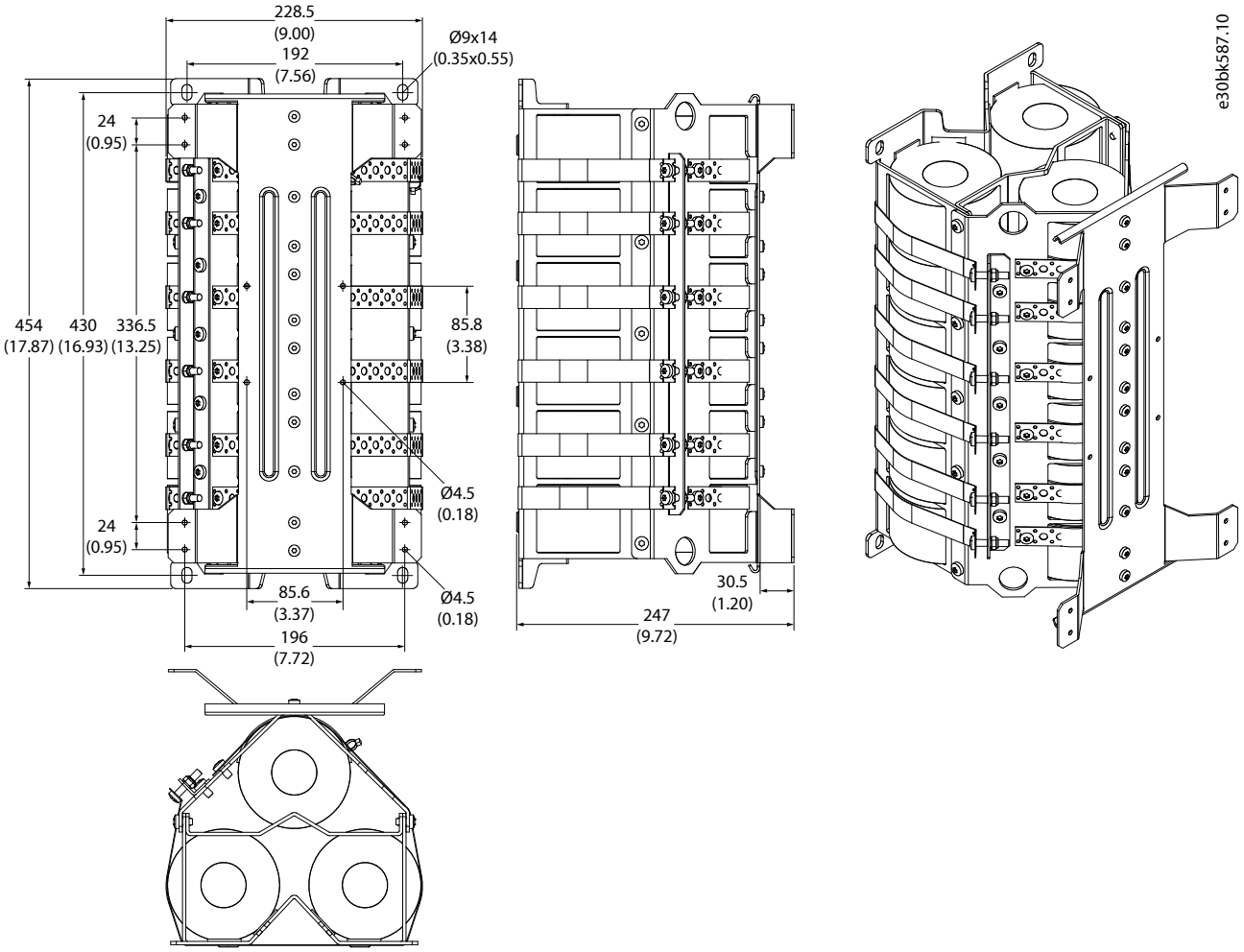

Figure 9: Dimensions of the dU/dt Filter 880 A Inductor in mm (in)

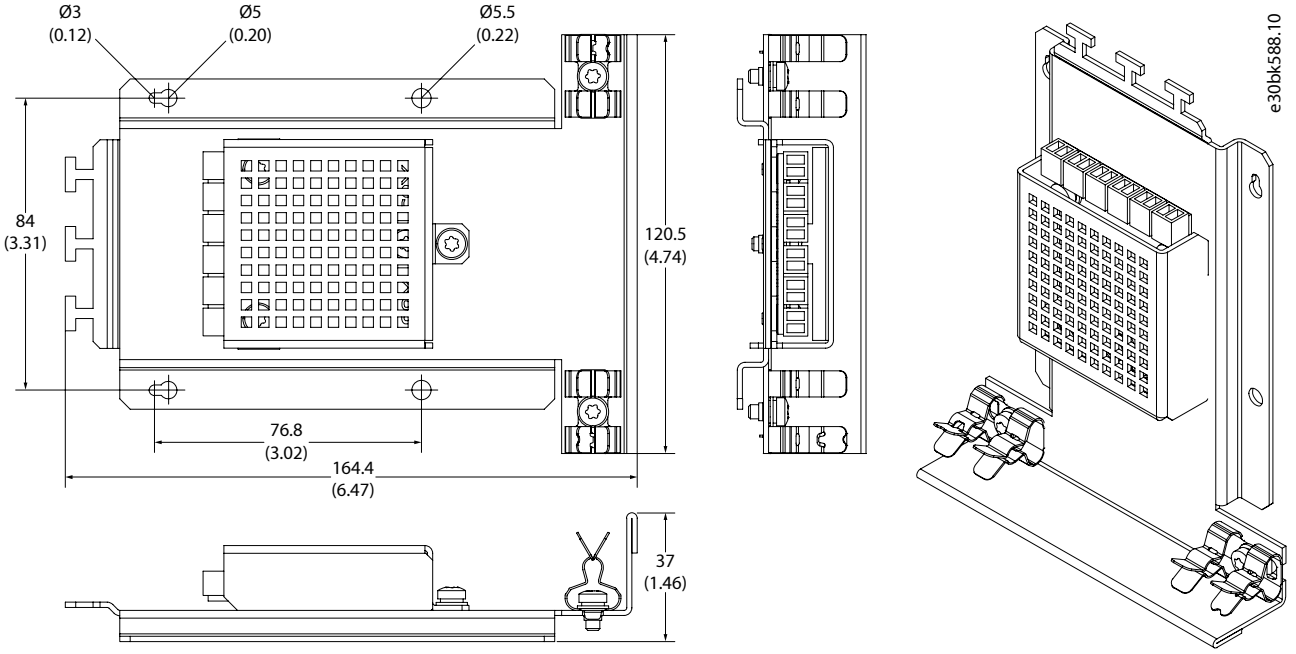

Figure 10: Dimensions of the AuxBus Temperature Measurement Board Assembly in mm (in)

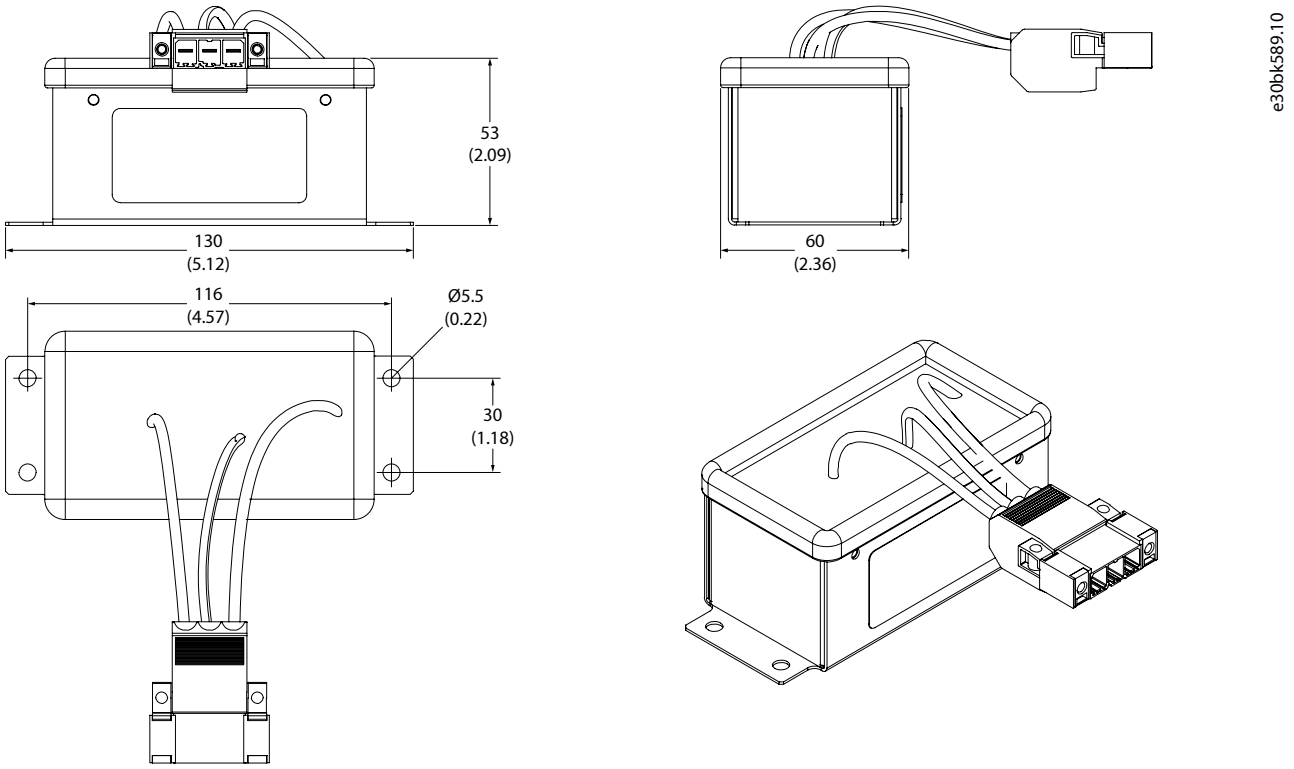

Figure 11: Dimensions of the dU/dt Filter Capacitor Assembly in mm (in)

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 Installing the Filter

Install the dU/dt Filter at the inverter output. If the inverter has parallel power units, install a separate dU/dt Filter at the output of each power unit.

The dU/dt Filter can be installed as the only output filter, or it can be used with a Common-mode Filter. If a Common-mode Filter is installed, install the dU/dt Filter between the inverter output and the Common-mode Filter.

See 3.7 Wiring Diagrams.

3.3 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 mm² according to IEC 60364-5-54; 543.1.

The connection must be fixed.

3.4 Installing the Cables

1. Prepare the power cables of the dU/dt Filter.
   a. If necessary, cut the cables to the correct length. The length of the cables is 1.5 m (4.9 ft) at both sides of the filter.

      Use hot cutting for the mesh type mechanical protection sleeve to avoid fraying.
      The copper cable ends have tapes to keep the strands together. If possible, also use tape around the cutting point to avoid fraying.
      In general, keep the length between the drive output and the filter input as short as possible. The recommended maximum value is 3 m (9.8 ft).

   b. If the filter is installed in a separate IP54 section, route the cables through the M50 grommets included in the delivery.

      Cut the grommets tight to the cable and use the provided heat shrink tube to seal the grommet to the cable.

   c. Attach the provided cable lugs to the ends of the cables.

      Remove the possible tapes from the cable ends.
      Do not place the silicone sleeve and mesh type mechanical protection sleeve on top of the cable lug.
      Use the provided heat shrink tube to seal the connection. The recommended tube length is 70 mm (2.8 in).

2. Connect the power cables from the dU/dt Filter to the busbars. Use M12 bolts with plain washers and spring washers.

   To avoid overheating, do not bunch the power cables together, but route them separately. Leave a minimum 20 mm of free space between the cables. The cables are marked with 2 and 3 in Figure 12.

3. To ground the frame of the dU/dt Filter, connect a grounding cable between one of the grounding points and the ground.
4. Use the provided dU/dt Filter capacitor wire harness to connect the capacitor assembly to the busbars.
   a. Connect the connector on the wire harness to the connector of the capacitor assembly.
   b. Connect the harness wires to the busbars on the motor side of the inductor. Use M4 bolts with plain washers and spring washers.

   Do not extend the capacitor wire harness.

5. Connect the temperature measurement wire from the filter inductor to terminal X206 on the AuxBus temperature measurement board.
   a. If necessary, the wire can be cut shorter. The length of the wire is 1.5 m (4.9 ft).
   b. If the filter inductor is installed in a separate IP54 section, route the wire through the grommet included in the delivery.
   c. Attach the wire to the assembly plate with a cable tie.
6. If AuxBus is not available, connect the thermal relay wire to the I/O terminal of a temperature monitoring device.
   a. If necessary, the wire can be cut shorter. The length of the wire is 1.0 m (3.3 ft).
   b. If the filter inductor is installed in a separate IP54 section, route the wire through the grommet included in the delivery.
7. Bundle up the unused temperature measurement or thermal relay wire and attach it safely close to the inductor.

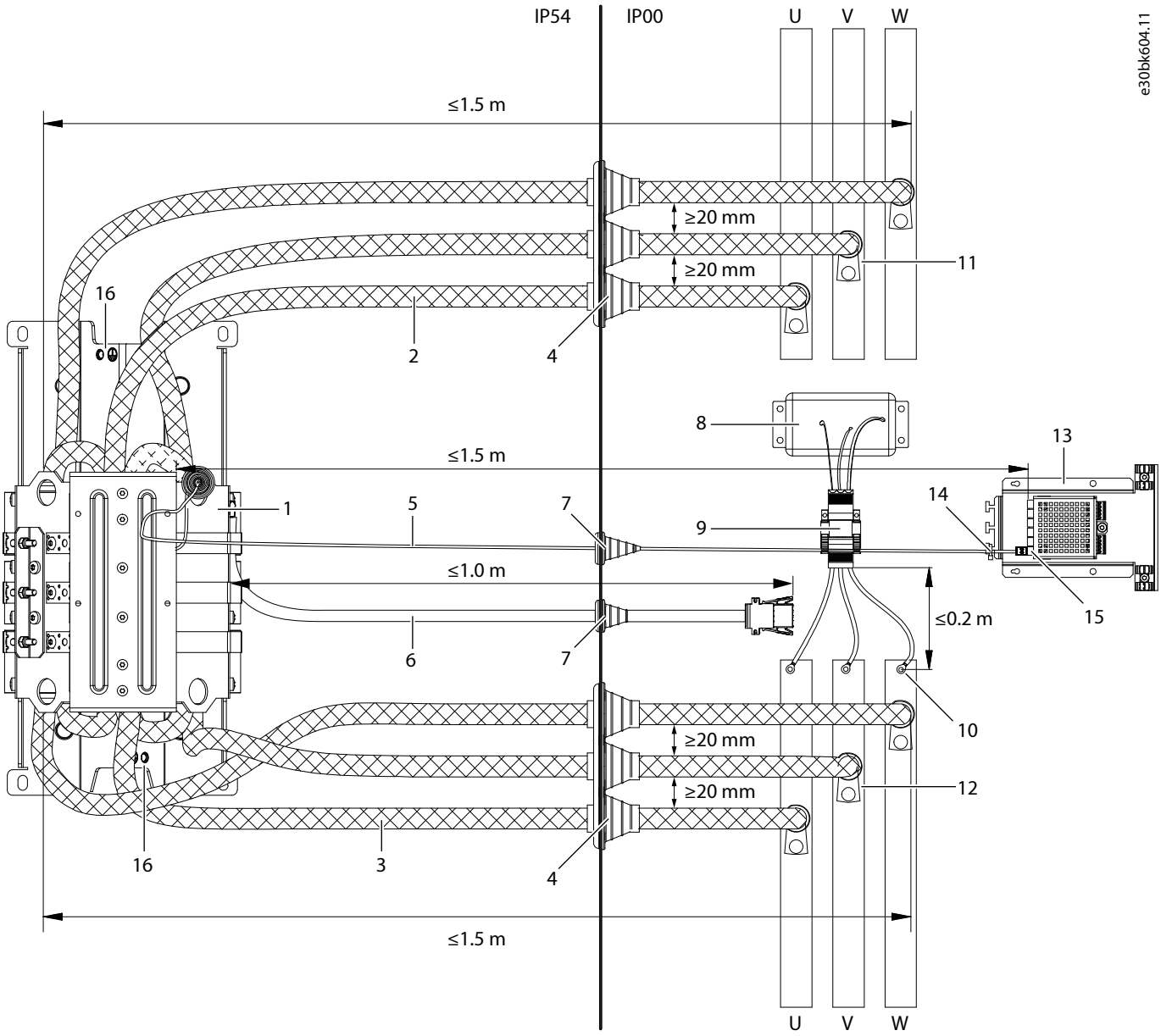

Figure 12: dU/dt Filter Cable Connections

1	Inductor	**2**	Power cables, drive side, 1.5 m (4.9 ft)
3	Power cables, motor side, 1.5 m (4.9 ft)	**4**	M50 grommets, IP54 only
5	AuxBus temperature measurement wire, 1.5 m (4.9 ft)	**6**	Thermal relay wire, 1.0 m (3.3 ft)
7	Grommet, Ø25.3 mm (Ø1 in), IP54 only	**8**	dU/dt Filter capacitor assembly
9	Connector of dU/dt Filter capacitor wire harness	**10**	dU/dt Filter capacitor wire harness connection to busbars, motor side
11	Power cable connections to busbars, drive side	**12**	Power cable connections to busbars, motor side
13	AuxBus temperature measurement assembly	**14**	Cable tie
15	Terminal X206	**16**	Grounding points, Ø10 mm (Ø0.39 in)

3.5 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 2: 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

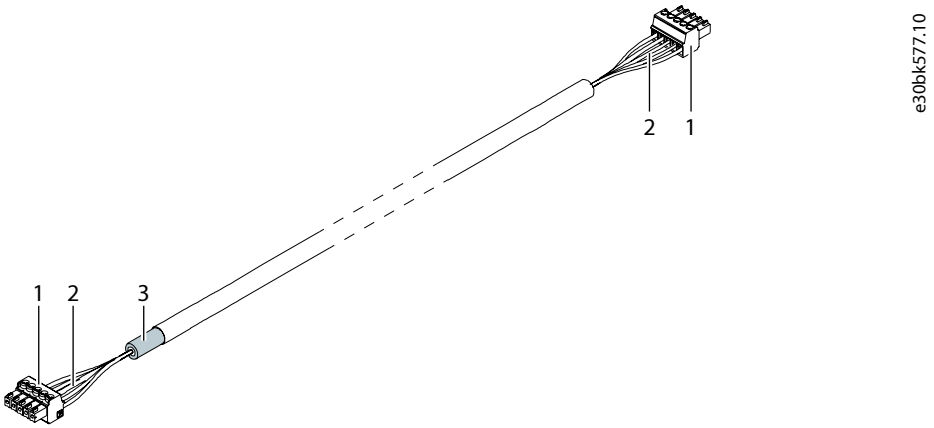

Figure 13: The Ready AuxBus Cable

1	Terminals	**2**	Wires
3	Shield removed		

3.6 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. 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 AuxBus temperature measurement board.

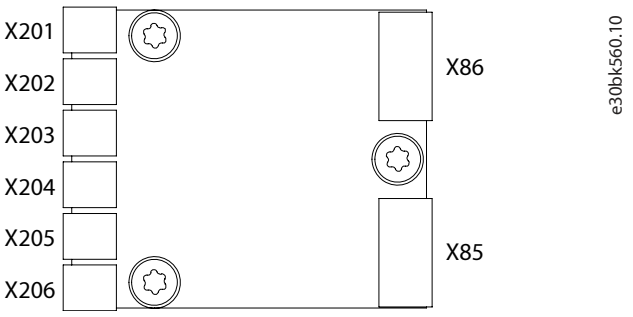

Figure 14: Terminals on the AuxBus Temperature Measurement Board

X20_	Temperature measurement input	**X85**	AuxBus in
X86	AuxBus out		

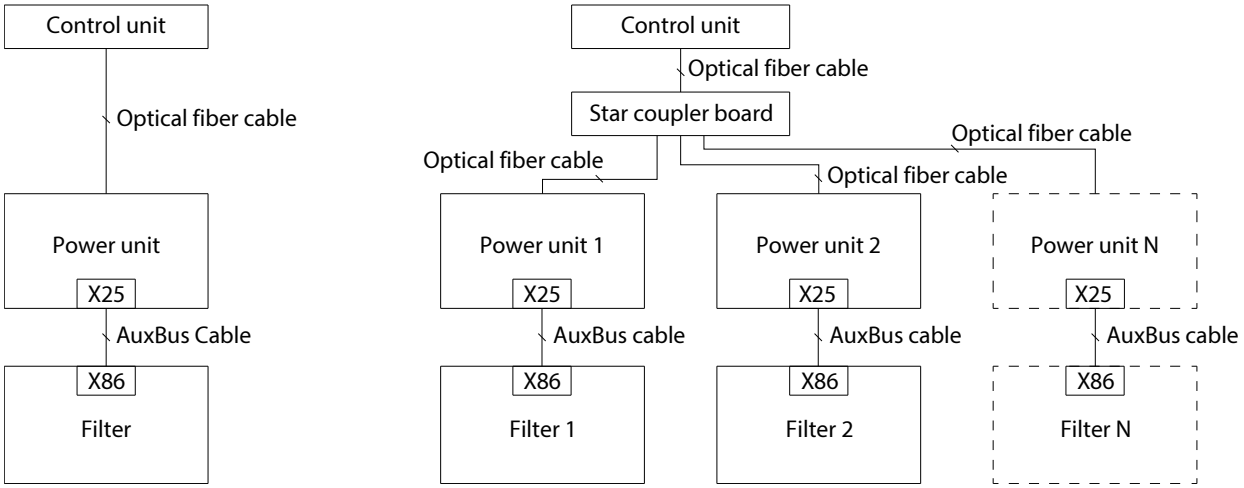

Figure 15: AuxBus Topology

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 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.

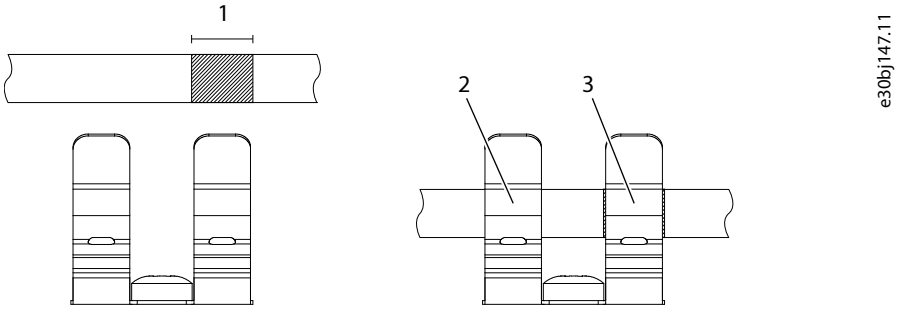

Figure 16: Using the Cable Clamps

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

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

3.7 Wiring Diagrams

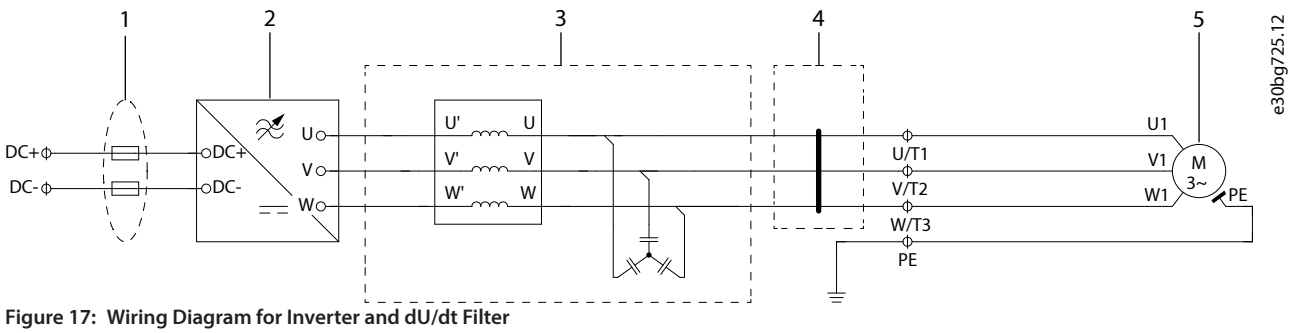

Figure 17: Wiring Diagram for Inverter and dU/dt Filter

1	DC fuses	**2**	Inverter module
3	dU/dt Filter	**4**	Common-mode Filter (optional)
5	Motor		

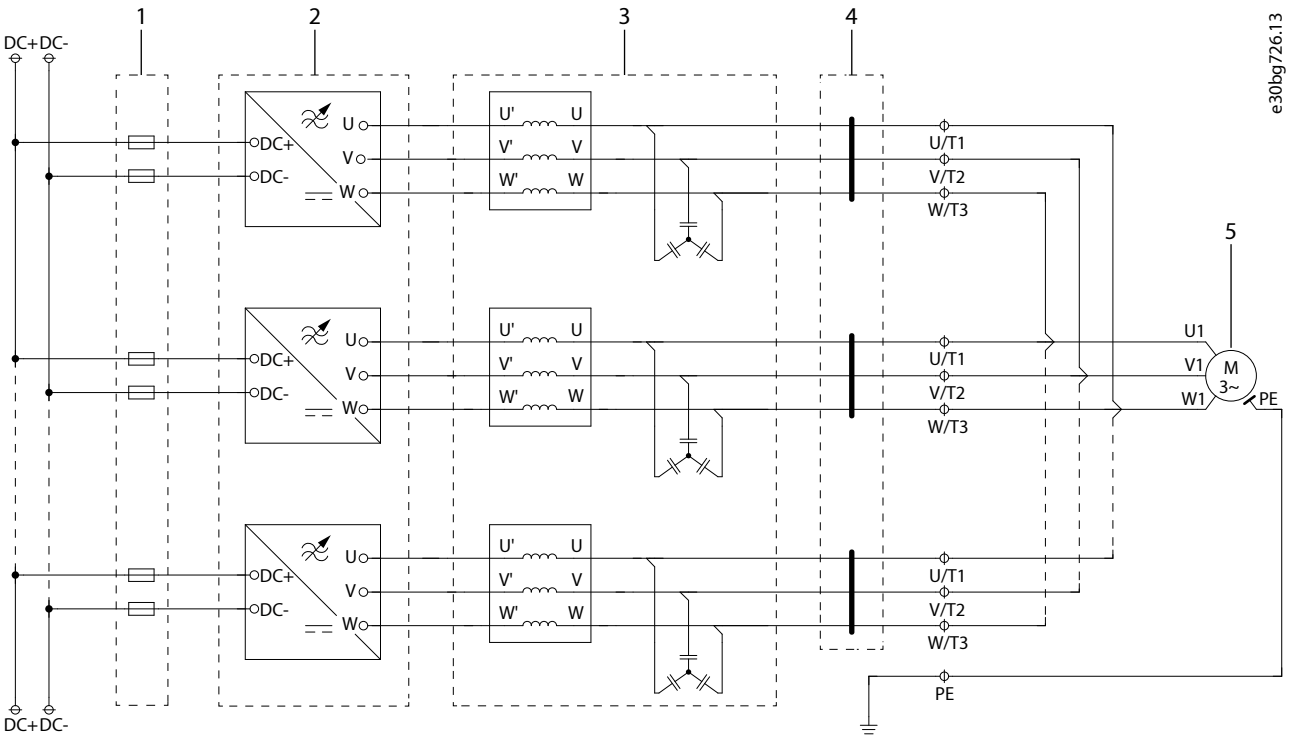

Figure 18: Wiring Diagram for Inverter with Parallel Power Units and dU/dt Filters

1	DC fuses	**2**	Inverter modules
3	dU/dt Filters	**4**	Common-mode Filters (optional)
5	Motor		

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 3: 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.
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.

Table 3: Maintenance Schedule for Air-cooled Filters - (continued)

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