
OPTIONS FOR ABB DRIVES

AOCH and NOCH filters

Hardware manual



AOCH and NOCH filters

Hardware manual

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4. Installation



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Introduction to the manual

Contents of this chapter

This chapter describes the contents of the manual and gives some general information.

Applicability

This manual applies to the following du/dt filter types:

- NOCH0016-6x
- NOCH0030-6x
- NOCH0070-6x
- NOCH0120-6x
- NOCH0260-60¹⁾
- NOCH0400-60¹⁾
- NOCH0760-60¹⁾
- AOCH0260-70¹⁾
- AOCH0400-70¹⁾.

¹⁾ Not an active product, can be ordered through ABB Service.

Target audience

This manual is intended for people who select, plan the installation, install, commission and use the *du/dt* filter.

Read the manual before working on the filter. You are expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

Safety

Only qualified specialists are allowed to install, commission and maintain the du/dt filter.

The complete safety instructions for the drive are given in the drive hardware manual. Read and follow the complete safety instructions before working on the drive.

The following instructions are intended for all who install and service the du/dt filter. Ignoring the following instructions can cause physical injury or death, or damage to the equipment.



WARNING!

- The filter is heavy. Lift the filter by the lifting holes only.
 - Ground the filter properly:
 - Fasten the filter with the four fastening screws to a metallic installation base.
 - Ensure that there is a proper galvanic connection in between the base and the PE busbar of the cabinet.
 - Beware of hot surfaces. The surface temperature of the du/dt filter can be higher than 150 °C (302 °F) during operation. After the operation, let the filter cool off for two hours before working on it.
Ensure sufficient cooling, see chapter Installation.
-



Operation principle

Contents of this chapter

This chapter describes the operation principle of the du/dt filter.

Operation principle

The drive employs modern IGBT inverter technology. Regardless of frequency, the drive output comprises pulses of approximately the drive DC bus voltage with a very short rise time. The pulse voltage can almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This can cause additional stress on the motor and motor cable insulation.

Modern variable speed drives with their fast rising voltage pulses and high switching frequencies can generate current pulses that flow through the motor bearings, which can gradually erode the bearing races and rolling elements.

There are optional common mode filters and du/dt filters available for the ABB drives. The common mode filters mainly reduce bearing currents. The du/dt filters also protect the motor insulation system.

To avoid damage to motor bearings and insulation system:

- Select and install the cables according to the instructions given in the drive hardware manual.
- Check if the installation needs to be equipped with additional protection equipment, such as insulated N-end bearings in the motor, or the drive output filters. The requirements are specified in the drive hardware manual. See chapter Planning the electrical installation.

■ Graphs illustrating the effect of the du/dt filter

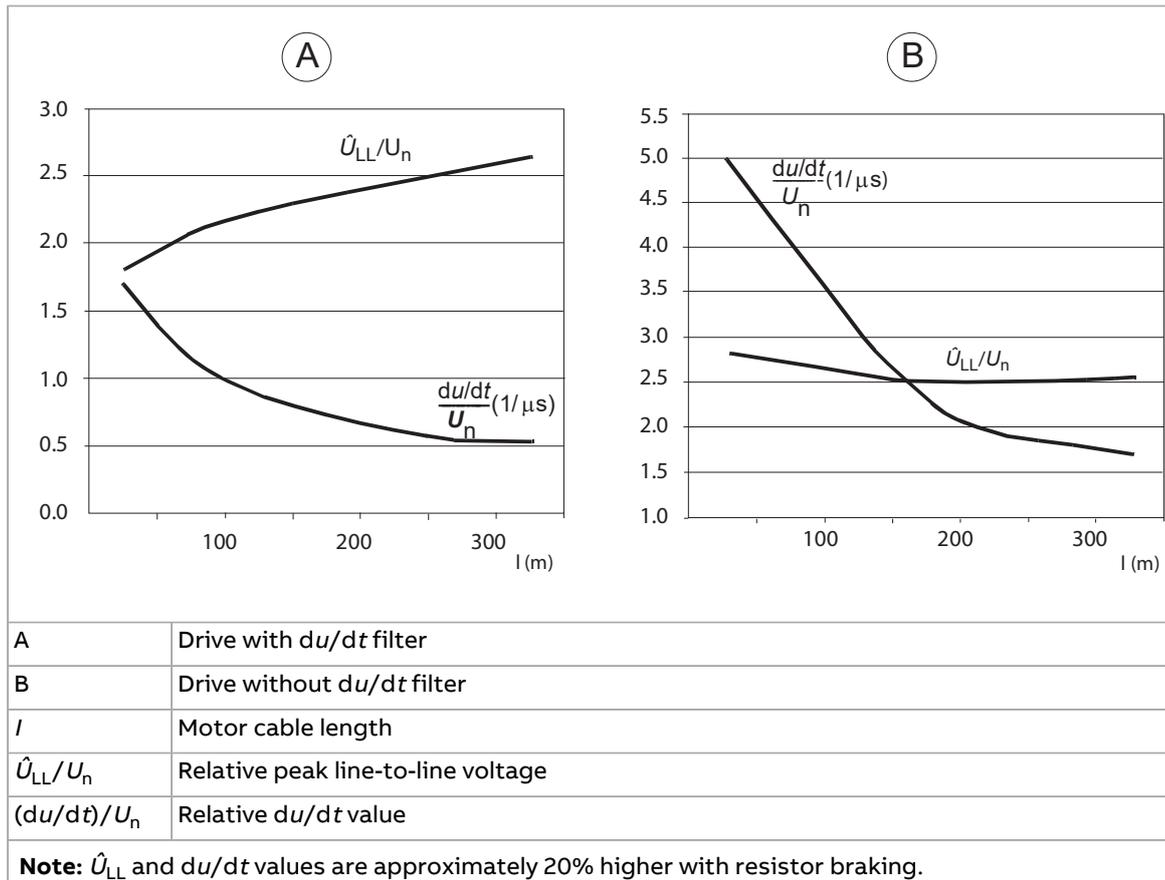
The graphs show the peak line-to-line voltage (\hat{U}_{LL}) and voltage change (du/dt) at the motor terminals as a function of the motor cable length. \hat{U}_{LL} and du/dt are scaled to

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the nominal line-to-line voltage (U_n). To calculate the actual peak voltage value in volts and du/dt value in volts per microsecond, multiply the values of the graph by the supply voltage (U_n).

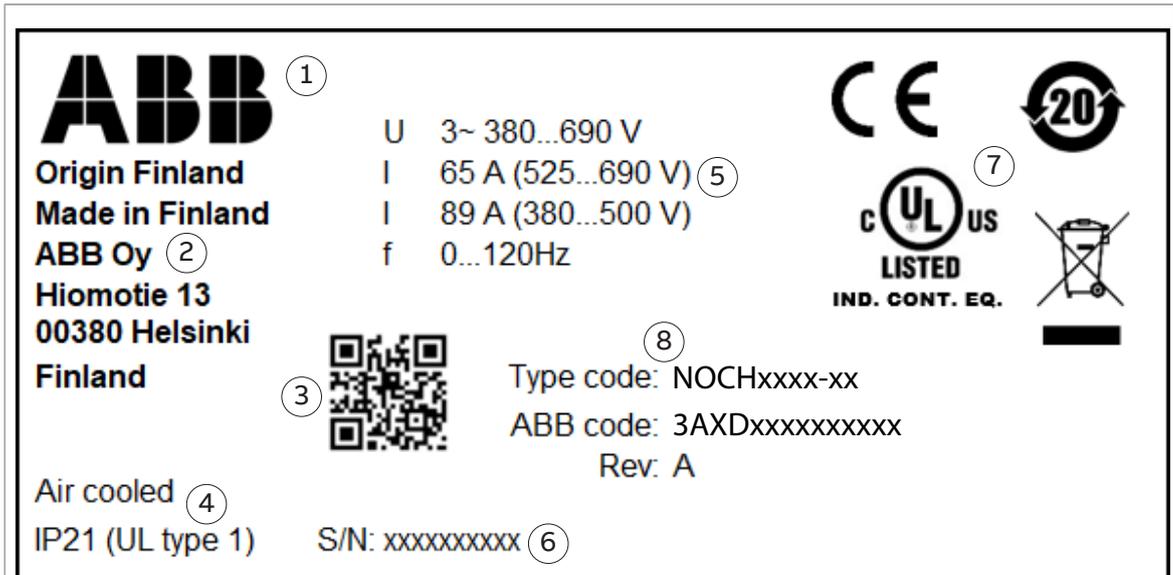
The values in the first graph are measured with an ABB du/dt filter while the second graph without any output filtering. The values in the second graph are only representative. The actual unfiltered du/dt values depend on the drive type, and are usually in the range of 1 to 5 kV/microsecond.

The voltage rise time can be calculated as follows: $t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.



Type designation label

The type designation label includes IEC and UL (NEC) ratings, appropriate markings and the type designation and serial number, which allow identification of each filter. An example label is shown below.



No.	Description
1	ABB logo
2	Country of origin and contact address
3	Link to the product data sheet
4	Degree of protection
5	Technical data
6	S/N: Serial number of format MYYWWXXXXX, where M: Manufacturing plant YY: 16, 17, 18, ... for 2016, 2017, 2018, ... WW: 01, 02, 03, ... for week 1, week 2, week 3, ... XXXXX: Digits making the serial number unique
7	Valid markings
8	Type code, ABB material code, revision letter



Selecting the du/dt filter

Contents of this chapter

The chapter instructs in selecting a du/dt filter for your drive.

Filter selection procedure

Step	What to do	More information
1	Check whether a du/dt filter is needed in the installation.	The requirements are specified in the drive hardware manual. See chapter Planning the electrical installation. ¹⁾
2	Pre-select a filter according to the drive type.	Filter selection tables are in the drive hardware manual. ¹⁾
3	Check that the pre-selected filter is suitable for your application.	See section Applicability checks of the pre-selected filter. If the checks are passed, use the pre-selected filter. If any of the conditions is not met, choose a bigger filter, use two filters in series or change the motor cabling.

¹⁾ For the ACS880 drives, the data can be found either from the appropriate Technical catalog or Hardware manual. The PDF files are available at www.abb.com/drives.

Applicability checks of the pre-selected filter

Long or several parallel motor cables, or special cable types may cause additional temperature rise in the filter. Therefore, check that the filter selected on the basis of the filter selection table fulfils the application requirements:

- The motor cable is not longer than the maximum allowed motor cable length given in the drive hardware manual. For some filter types the length is still restricted
-

14 Selecting the du/dt filter

independent on the drive type. See the maximum values in section [General notes and restrictions \(page 15\)](#).

- The energy loss in the du/dt filter is not higher than the maximum allowed value (E_{\max}) given in subsection Maximum current and heat dissipation of the filter. The energy loss is calculated as follows:

$$E = \frac{1}{2} \cdot C \cdot (U_{dc})^2$$

where

E = energy loss in the du/dt filter

C = total capacitance of the motor cable(s), ie, the product of the capacitance/length value given in the cable catalogue and the length of the motor cable. In case of several motor cables, the total capacitance is the sum of the individual cable capacitance.

U_{dc} = average intermediate circuit DC voltage of the drive = approximately $1.35 \cdot U_n$

U_n = drive supply voltage.

- The current flow through the filter is not higher than the maximum allowed value given in subsection Maximum current and heat dissipation of the filter.

■ Maximum current and heat dissipation of the filter

This table gives maximum allowed current (I_{th}) and heat dissipation (E_{\max}) values for the du/dt filters.

du/dt filter type	400 V	500 V	690 V	E_{\max} (mJ)	P_{loss} (W)
	I_{th} (A) _{rms}	I_{th} (A) _{rms}	I_{th} (A) _{rms}		
NOCH0016-60/2	19	19	15	24	110
NOCH0016-65	19	19	15	8	58
NOCH0030-60/2	34	34	28	28	167
NOCH0030-65	34	34	28	9	95
NOCH0070-60/2	89	89	65	35	210
NOCH0070-65	89	89	65	12	150
NOCH0120-60	178	164	113	94	240 ¹⁾
NOCH0120-62	166	157	113	47	210 ¹⁾
NOCH0120-65	166	157	113	15	180 ¹⁾
NOCH0260-60	375	345	230	134	441
NOCH0400-60	521	495	351	252	750
AOCH0260-70 ²⁾	261	258	177	94	309
AOCH0400-70 ²⁾	445	440	280	176	525
AOCH0260-70 ³⁾	375	345	230	134	441
AOCH0400-70 ³⁾	521	495	351	252	750

¹⁾ Value is for a kit, which includes three filters.

²⁾ Filters installed on top of each other.

³⁾ Filters installed side by side.

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Installation

Contents of this chapter

This chapter contains mechanical and electrical installation instructions.

General notes and restrictions

**WARNING!**

Do not attempt any work on a powered drive. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before working on the frequency converter, the motor or the motor cable. Measure that the installation is de-energized. Use a quality voltage tester.

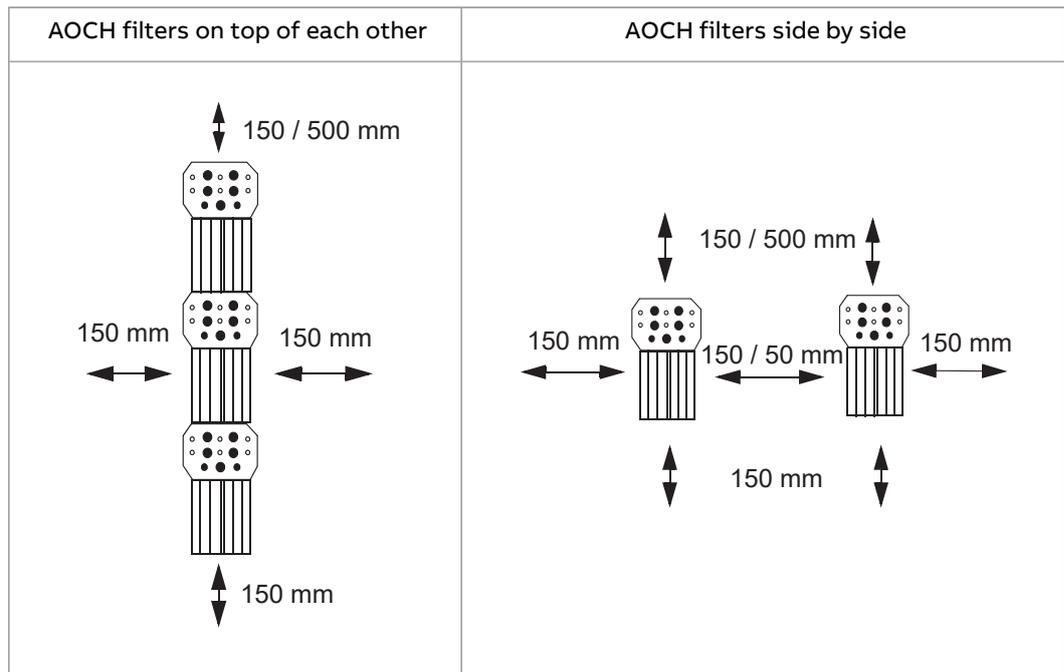
- Encase the non-enclosed (IP00) filters to meet the safety requirements (for cabinet installation solely).
 - Beware of hot surfaces. The surface of the IP22/IP54 filter housing can reach a temperature up to 40 °C higher than the ambient temperature.
 - Use shielded cable between enclosures.
 - Mount the filter on a mounting structure that is of non-flammable material and strong enough to carry the weight of the filter.
 - Ground the filter to the protective earth (PE) terminal of the cabinet. No separate grounding conductor is needed if there is proper galvanic connection through the filter fixing screws and the mounting plate.
 - Maximum allowed drive output frequency: 120 Hz
 - Maximum allowed average switching frequency:
-

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- 3 kHz (converter units with supply voltage < 500 V) or
- 2 kHz (converter units with supply voltage > 500 V)
- Change the switching frequency with a drive parameter. If there is no such parameter in the drive software, apply the settings to be used with long motor cables.
- Maximum cable length between the drive output and the filter: 3 m
- Maximum motor cable length for AOCH0xxx-70 filters: 300 m (cumulative for several parallel-connected motors)
- Maximum motor cable length for NOCH0xxx-6x filters: 300 m (cumulative for several parallel-connected motors):

NOCH0016-60/62 NOCH0030-60/62 NOCH0070-60/62 NOCH0120-62	150 m (can be increased to 300 m by connecting two filters in series)
NOCH0016-65 NOCH0030-65 NOCH0070-65 NOCH0120-65	50 m (can be increased to 100 m by connecting two filters in series)
NOCH0120-60 NOCH0260-60 NOCH0400-60 NOCH0760-60	300 m

- The filters cool by natural convection. The airspace above the filter is hot (up to 70 °C (158 °F) depending on the installation and operating conditions). Take this into account in the cabinet design.
- The following free space requirements apply for the AOCH0xxx-70 filters:
 - 150 mm free space on each free side. Exception: 500 mm above the filter if installed below the drive. Exception: 50 mm between the single phase filters which are connected to the same drive.
 - If filters are mounted on top of each other with single drive types 0320-5, 0610-5 and 0610-7, the filters need a minimum of 700 m³/h of forced cooling. Maximum of three filters can be mounted on top of each other.



- NOCH0xxx-6x filters cool by natural convection, thus the following free space requirements apply:
 - Enclosed (IP22 and IP54) filter units:
300 mm on each free side. Exception: 500 mm above the filter if installed below the drive.
 - Non-enclosed (IP00) filter units:
300 mm on each free side. Exception: 50 mm between single phase filters connected to the same drive. Exception: 500 mm above the filter if installed below the drive.
- Busbar and enclosure clearance distances from the input and output terminals and coil surfaces must be at least 15 mm (0.59 in.). Pay attention to the local regulations.

Note: Due to high temperature of the coil surfaces during operation, route the motor cables at least 50 mm (1.97 in.) away from the coil surfaces and secure them appropriately.

Mechanical installation and tightening torques

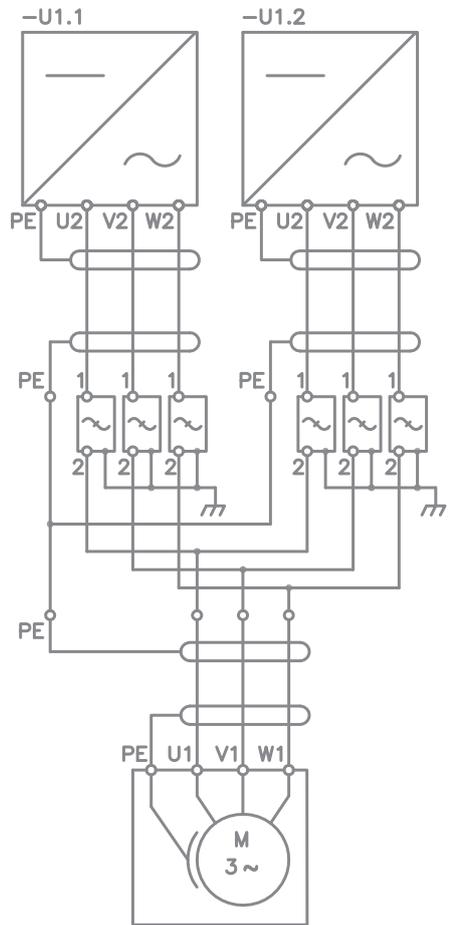
1. Lift the filter by the lifting holes to the installation position.
 2. Fasten the filter with four screws at the fastening points in the mounting legs.
- See chapter [Dimension drawings \(page 31\)](#) for the dimensions.

■ Tightening torques

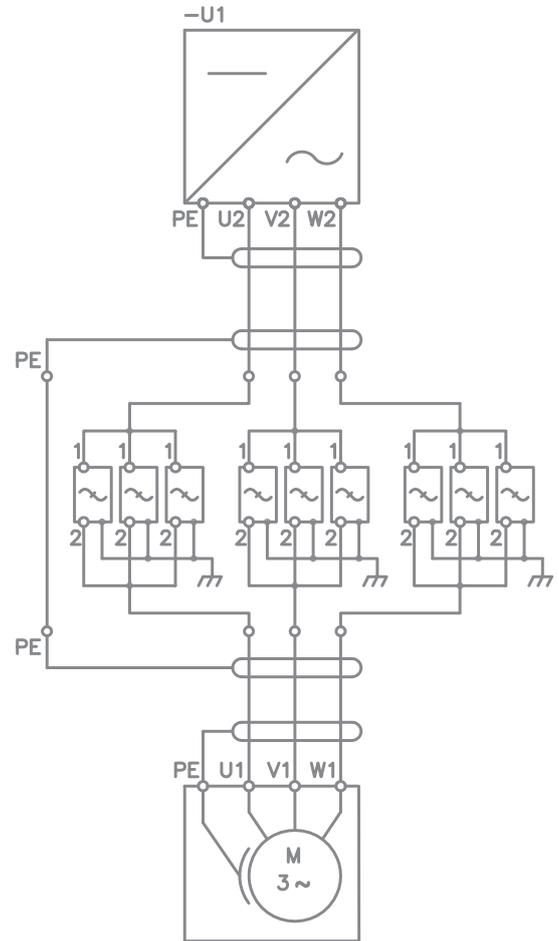
This table applies to grade 8.8 screws with or without joint compound.

Screw	Torque	
	N·m	lbf·ft
M5	3.5	2.6
M6	9	6.6
M8	20	14.8
M10	40	29.5
M12	70	51.6
M16	180	132.8

Power connection diagrams

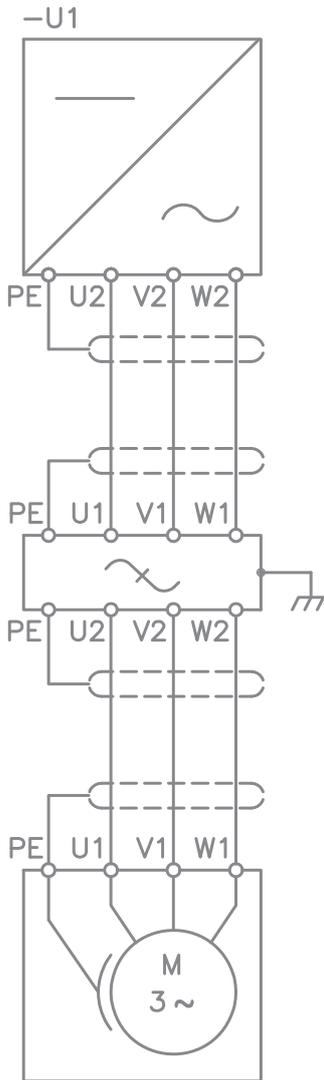


NOCH0260-60
 NOCH0400-60
 NOCH0760-60

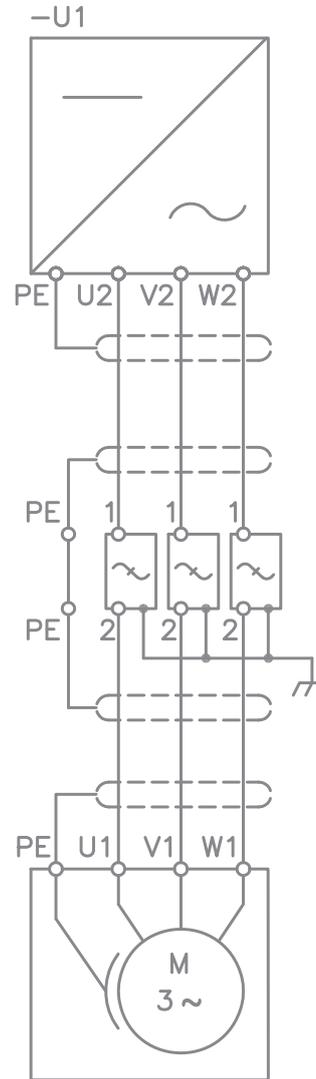


NOCH0400-60

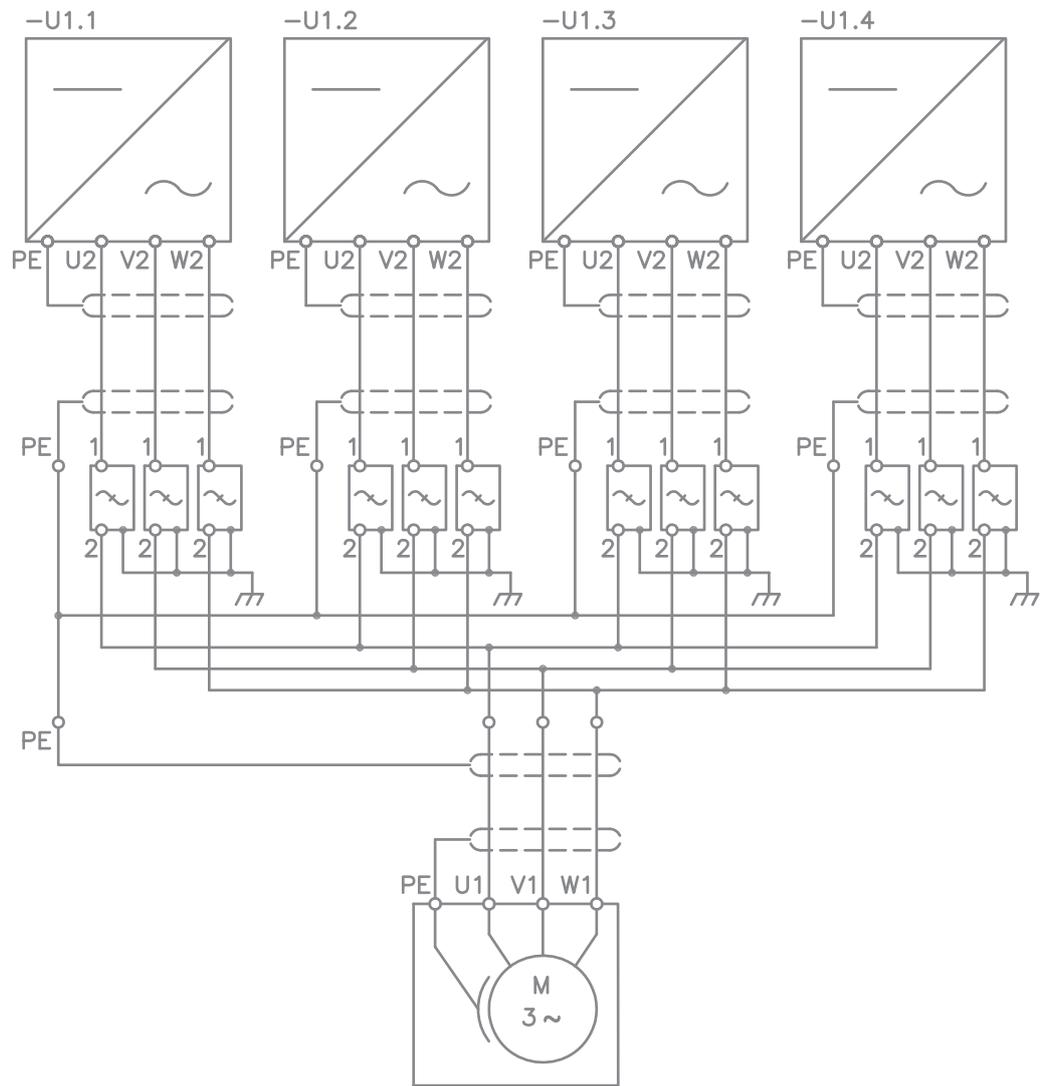
20 Installation



NOCH0016-6x
 NOCH0030-6x
 NOCH0070-6x

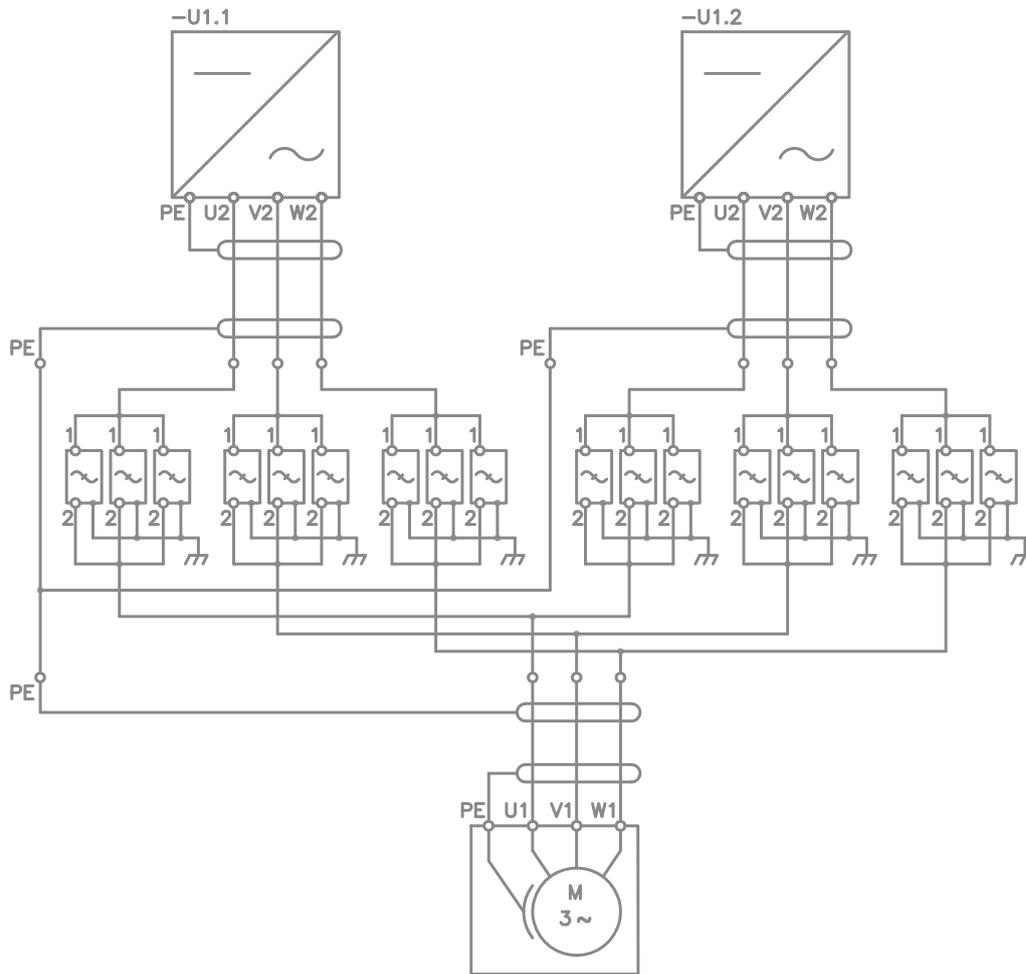


NOCH0120-6x
 NOCH0260-60
 NOCH0400-60
 NOCH0760-60
 AOCH0260-70
 AOCH0400-70

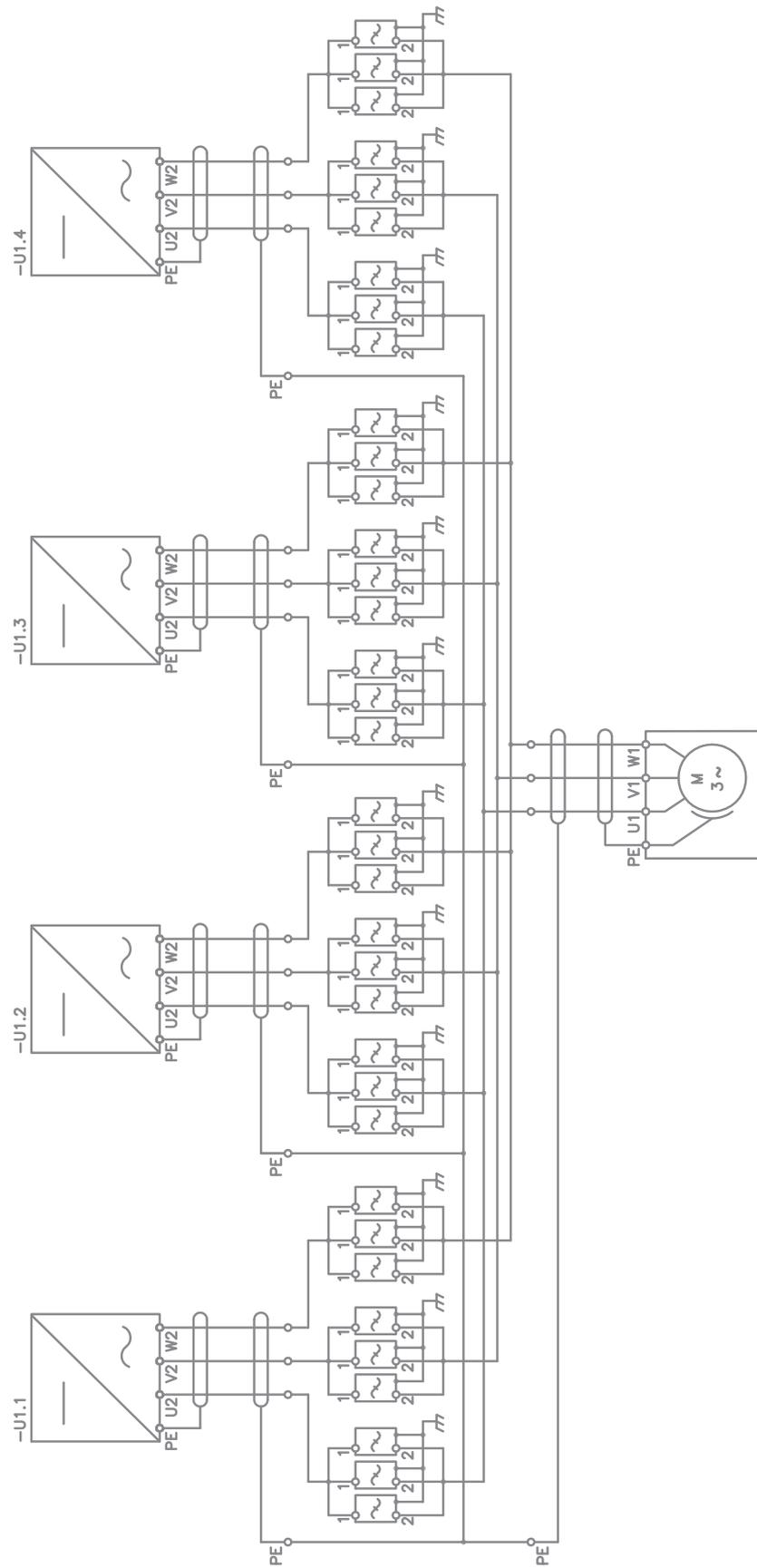


NOCH0760-60

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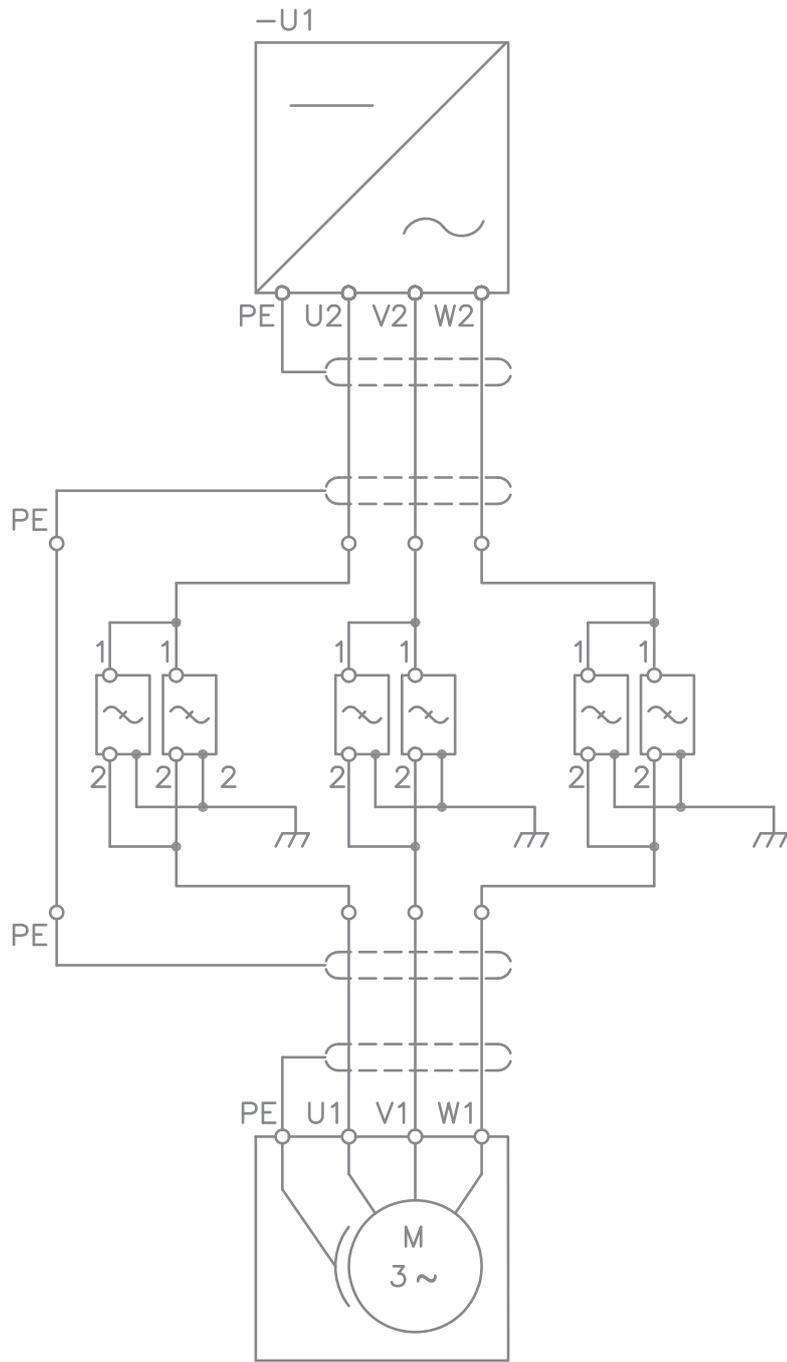


NOCH0400-60



NOCH0400-60

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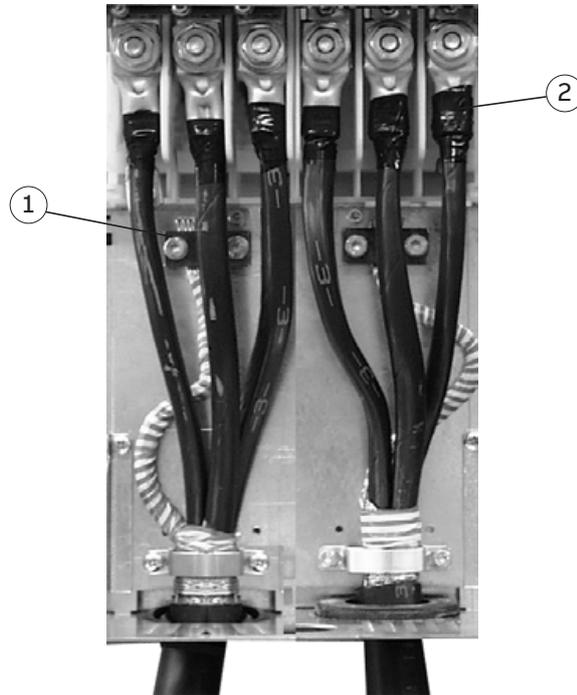


AOCH0400-70

AOCH0260-70

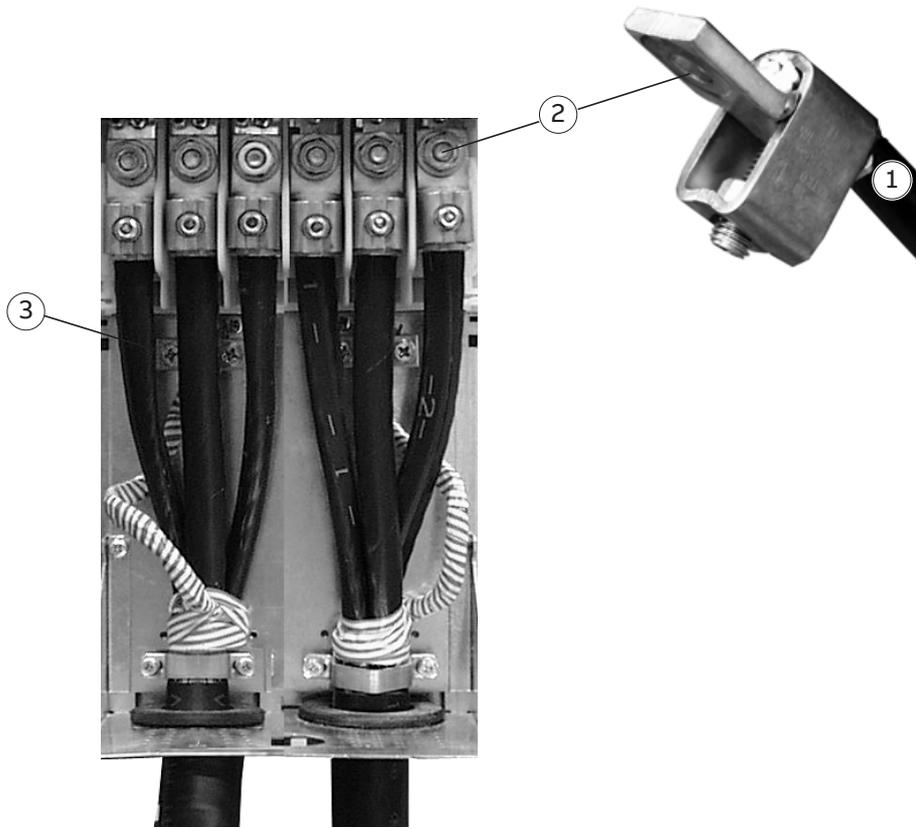
■ Detail photos of the NOCH0120-6 connection

NOCH0120-6x: Cable lug installation [16 to 70 mm² (6 to 2/0 AWG) cables]



1	PE
2	Isolate the ends of the cable lugs with insulating tape or shrink tubing.

NOCH0120-6x: Cable lug installation [95 to 185 mm² (3/0 to 350 AWG) cables]



- | | |
|---|------------------------------------|
| 1 | Connect the cable to the terminal. |
| 2 | Connect the terminal to the drive. |
| 3 | PE |



WARNING!

If the wire size is less than 95 mm² (3/0 AWG), a cable lug must be used. A cable of wire size less than 95 mm² (3/0 AWG) connected to this terminal will loosen and may damage the drive.



Technical data

Nominal voltage: 380 ... 690 V \pm 10%.

Rated short-time withstand current: 50 kA 1 s.

Applicable standards: EN 60204-1, EN 60529, EN 61800-5-1, EN 50178.

Ambient conditions, operation

Air temperature: -15 to +50 °C. At temperatures from +40 °C to +50 °C, the rated output current is decreased by 1% for every additional 1 °C. The output current is calculated by multiplying the current given in the rating table by the derating factor.

Relative humidity: 5% to 95%, no condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.

Installation site altitude: 0 to 4000 m. At altitudes from 1000 to 4000 m above the sea level, the rated output current is decreased by 1% for every 100 m.

Vibration:

AOCH0xxx-70: Max 1 mm (5 to 13.2 Hz), max 7 m/s² (13.2 to 100 Hz) sinusoidal (IEC 60068-2)

NOCH0xxx-6x: Max 0.3 mm (2 to 9 Hz), max 1 m/s² (9 to 200 Hz) sinusoidal (IEC60068-2)

Shock: Max 70 m/s², 22 ms (IEC 60068-2-27)

Ambient conditions, storage

Temperature: -40 to +70 °C.

Relative humidity: Less than 95%, no condensation allowed

Atmospheric pressure: 70 to 106 kPa

Vibration:

AOCH0xxx-70: Max 1 mm (5 to 13.2 Hz), max 7 m/s² (13.2 to 100 Hz) sinusoidal (IEC 60068-2)

NOCH0xxx-6x: Max 0.3 mm (2 to 9 Hz), max 1 m/s² (9 to 200 Hz) sinusoidal (IEC 60068-2)

Shock: Max 100 m/s², 11 ms (IEC 60068-2-27)

Ambient conditions, transportation

Ambient transportation conditions refer to the conditions du/dt filters are subjected to during transportation in the protective package.

Temperature: -40 to +70 °C

Relative humidity: Less than 95%, no condensation allowed.

Atmospheric pressure: 60 to 106 kPa

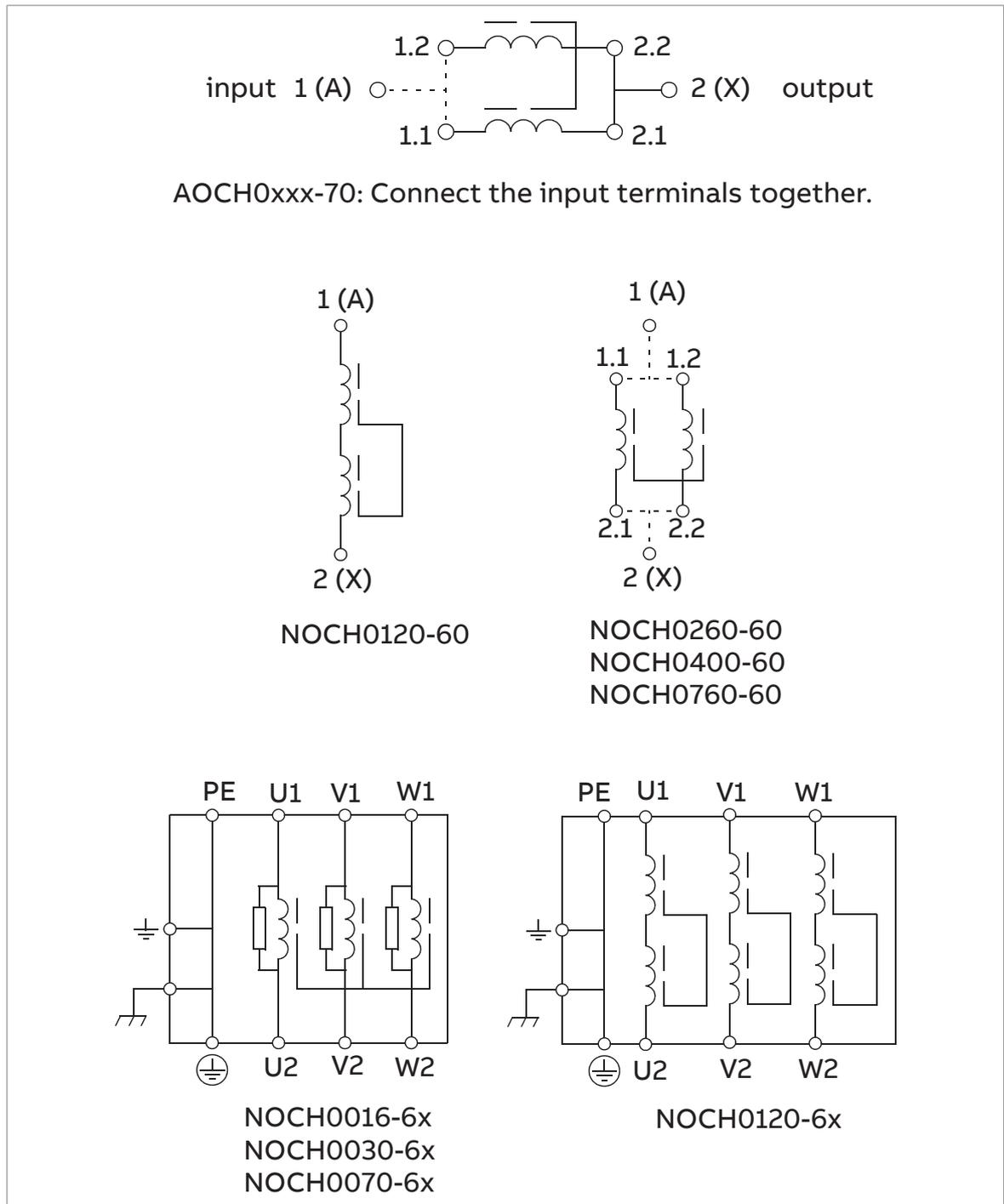
Vibration: Max 3.5 mm (2 to 9 Hz), max 15 m/s² (9 to 200 Hz) sinusoidal (IEC 60068-2)

Shock: Max 100 m/s², 11 ms (IEC 60068-2-27)

Bump: Max 300 m/s², 6 ms (IEC 60068-2-29)

Free fall: 250 mm

Internal circuit diagrams



Disposal

The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should 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, cardboard and other packaging material can be used in energy recovery.

Printed circuit boards and DC capacitors need selective treatment according to IEC 62635 guidelines.

To aid recycling, most plastic parts are marked with an appropriate identification code. In addition, components containing substances of very high concern (SVHCs) are listed in European Chemicals Agency's SCIP database. SCIP is the database for information on Substances of Concern In articles as such or in complex objects (Products) established under the Waste Framework Directive (2008/98/EC). For further information, contact your local ABB distributor or consult European Chemicals Agency's SCIP database to find out which SVHCs are used in the drive, and to find out where those components are located.

Contact your local ABB distributor for further information on environmental aspects. End of life treatment must follow international and national regulations.

For more information on ABB end of life services, refer to new.abb.com/service/end-of-life-services.

Markings

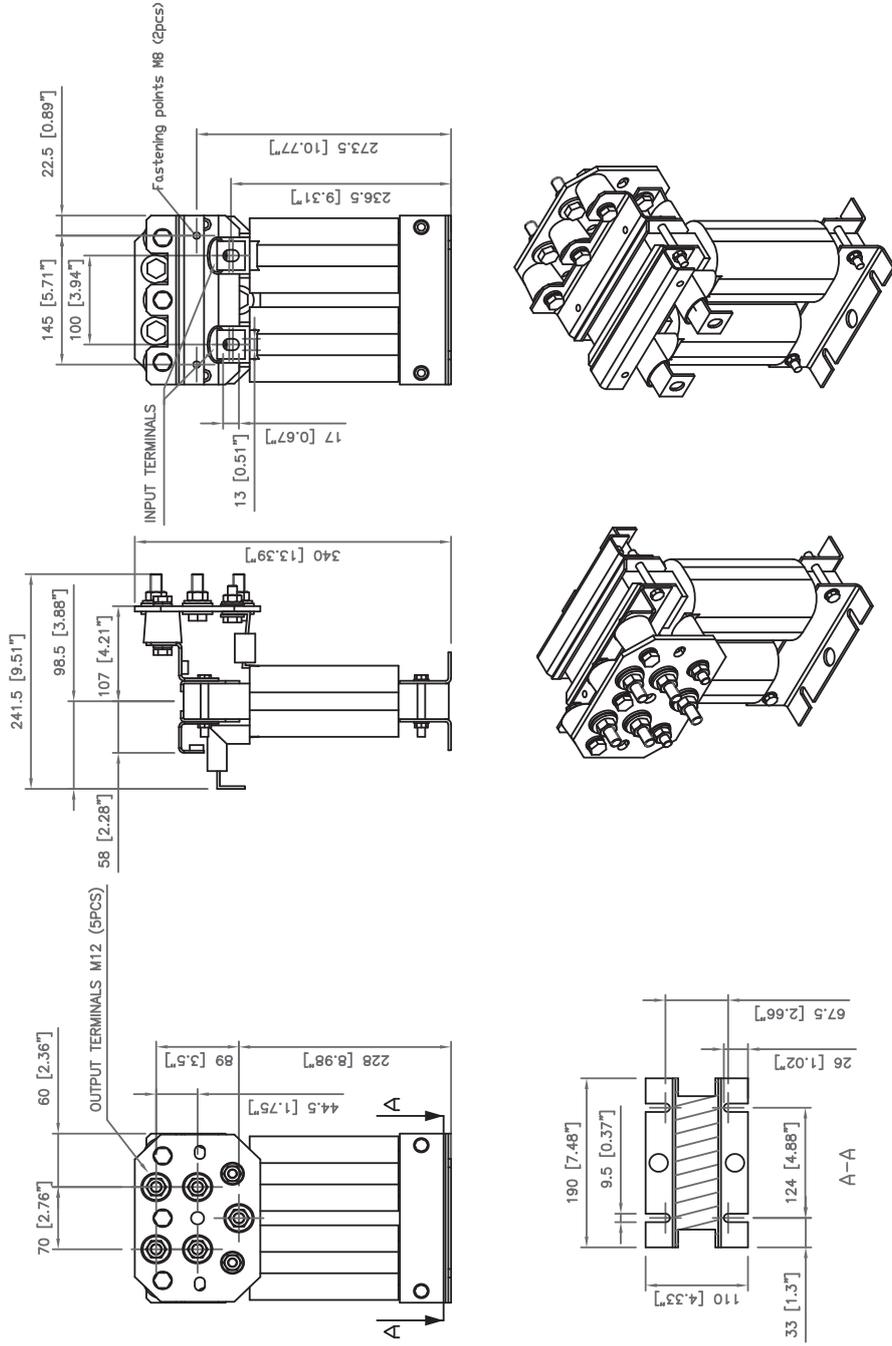
These markings are attached to the drive:

	<p>CE mark Product complies with the applicable European Union legislation. For fulfilling the EMC requirements, see the additional information concerning the drive EMC compliance (IEC/EN 61800-3).</p>
	<p>UL Listed mark for USA and Canada Product has been tested and evaluated against the relevant North American standards by the Underwriters Laboratories. Valid with rated voltages up to 600 V.</p>
	<p>Electronic Information Products (EIP) symbol including an Environment Friendly Use Period (EFUP). Product is compliant with the People's Republic of China Electronic Industry Standard (SJ/T 11364-2014) about hazardous substances. The EFUP is 20 years. China RoHS II Declaration of Conformity is available from https://library.abb.com.</p>
	<p>WEEE mark At the end of life the product should enter the recycling system at an appropriate collection point and not placed in the normal waste stream.</p>



Dimension drawings

AOCH0260-70, single phase filter
du/dt filter kit includes 3 pieces of single phase filters.



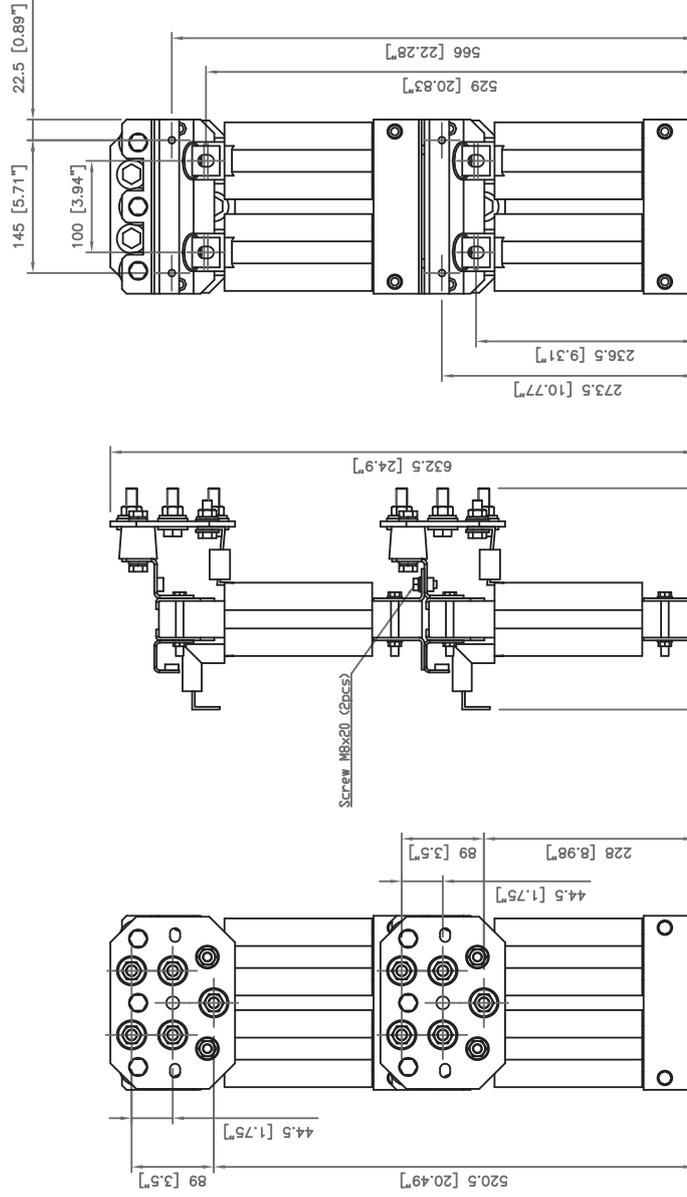
AOCH0260-70

du/dt filter kit includes 3 pieces of single phase filters.

Cable size: 3x(3x185) Weight: 15.9 kg (35.1 lbs)

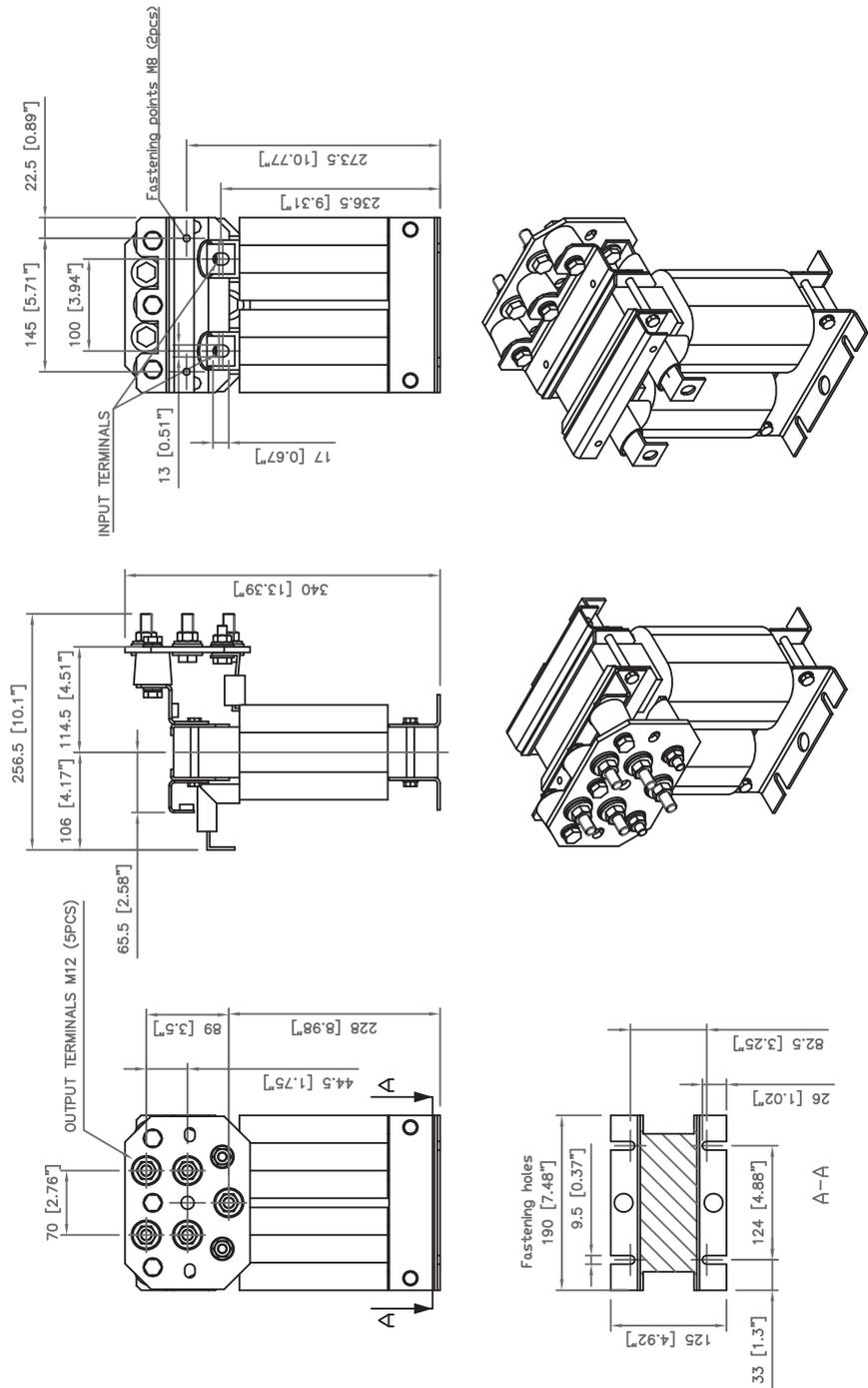
Screw size: M12 I_{TH} 227 A_{rms}

Power loss: 147 W L 74 μH



Alternative assembly

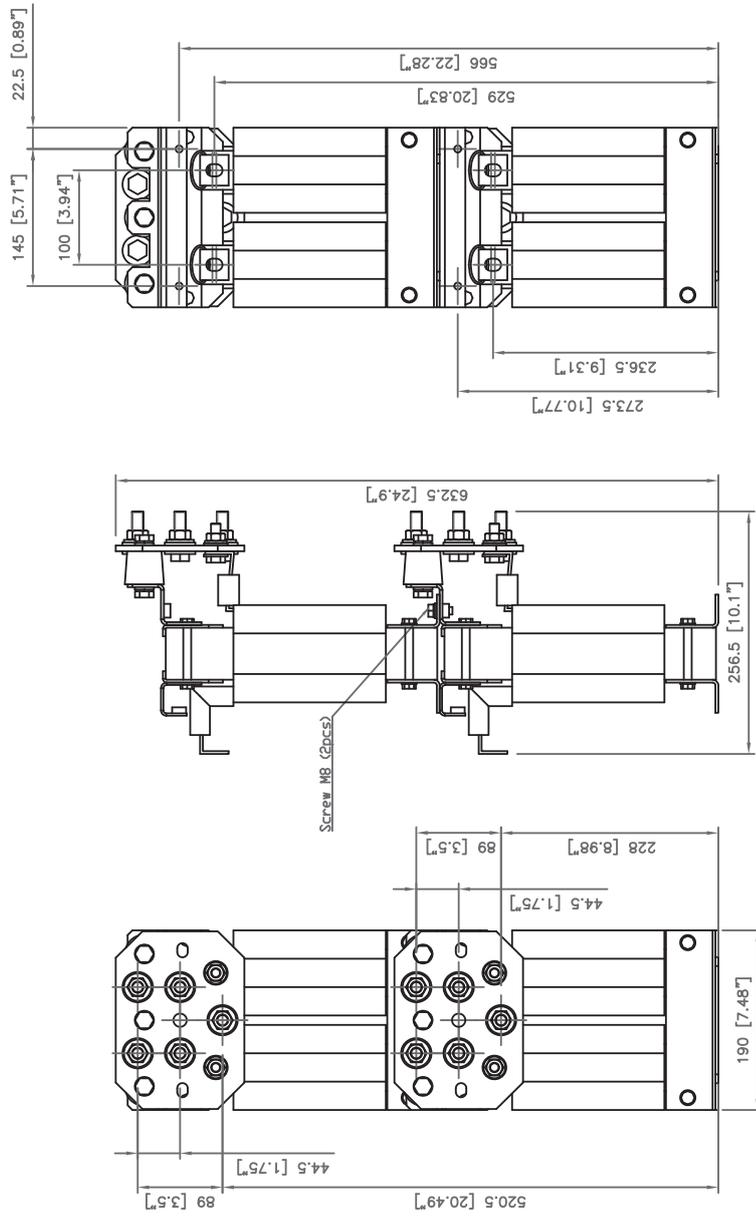
AOCH0400-70, single phase filter
 du/dt kit includes 3 pieces of single phase filters.



AOCH0400-70

du/dt filter kit includes 3 pieces of single phase filters.

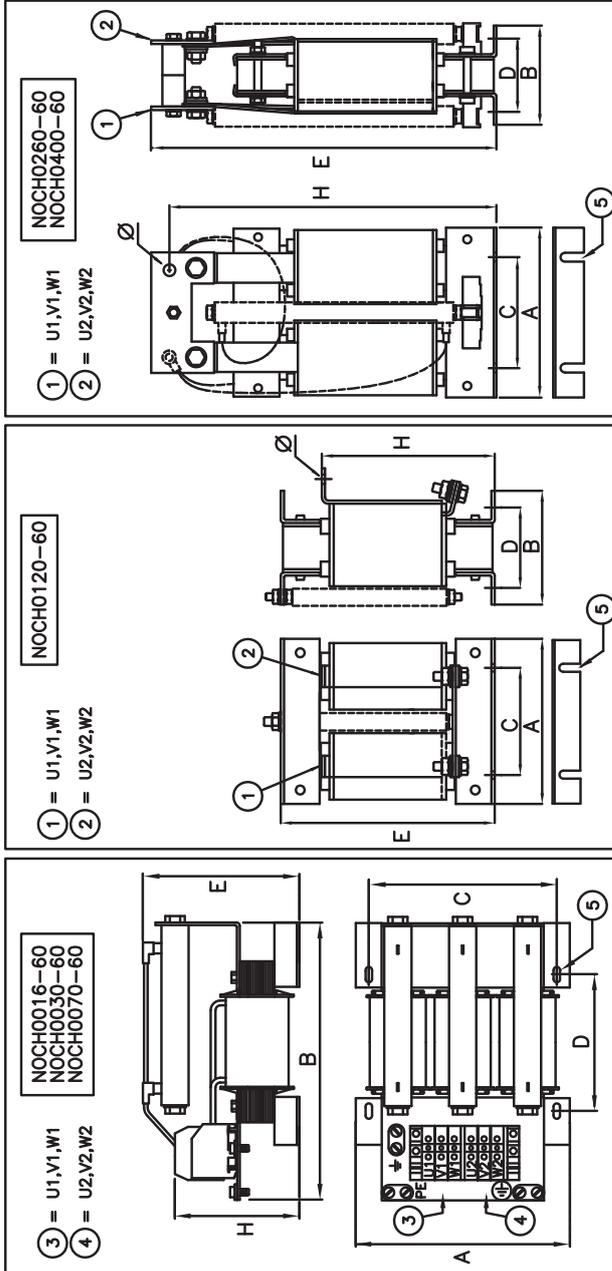
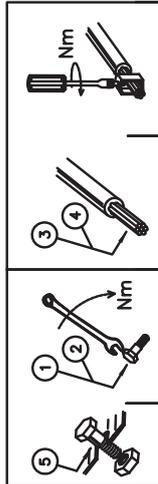
Cable size:	3x(3x185)	Weight:	20.7 kg (45.6 lbs)
Screw size:	M12	I_{TH}	355 A _{rms}
Power loss:	250 W	L	52 μH



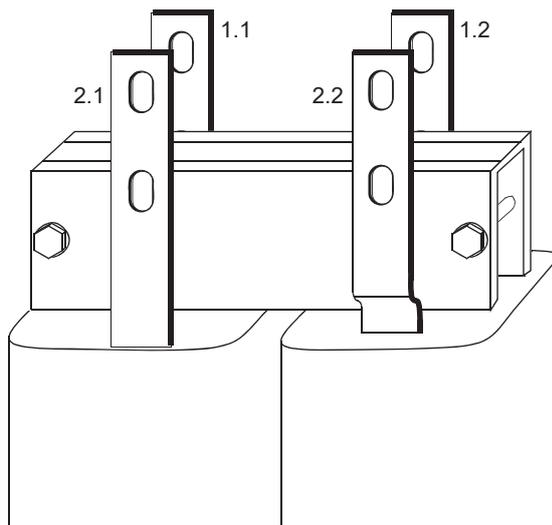
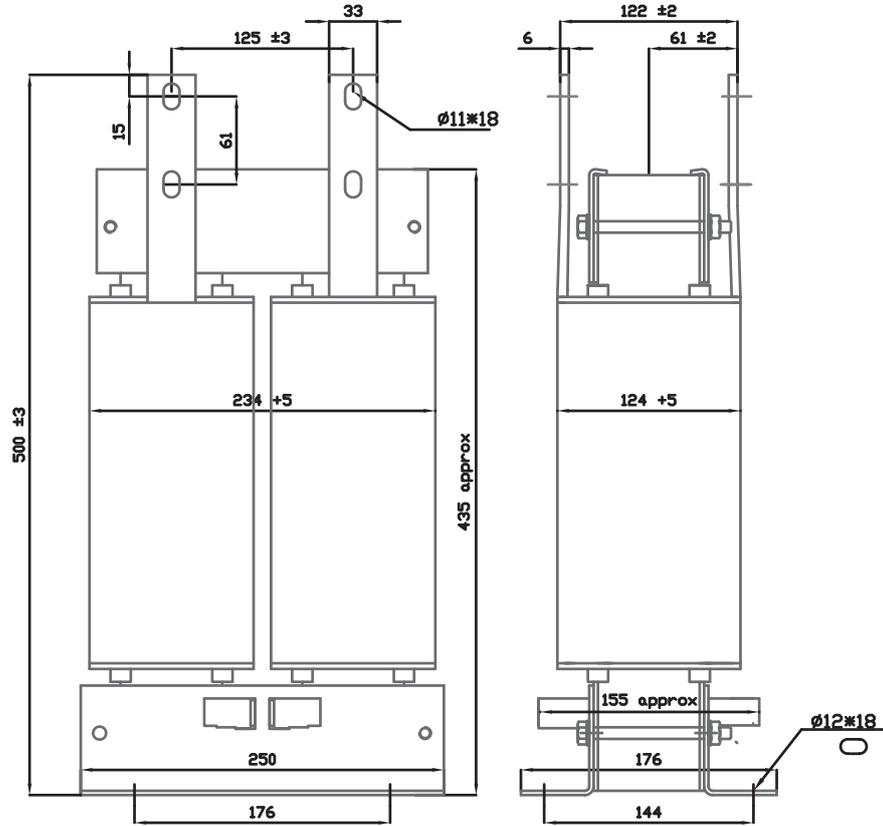
Alternative assembly

NOCH0120-60, NOCH0260-60 and NOCH0400-60 du/dt kits include 3 filters.

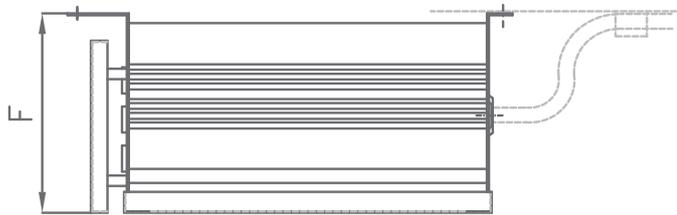
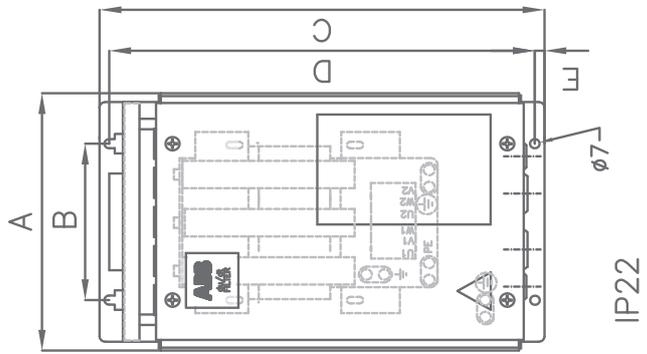
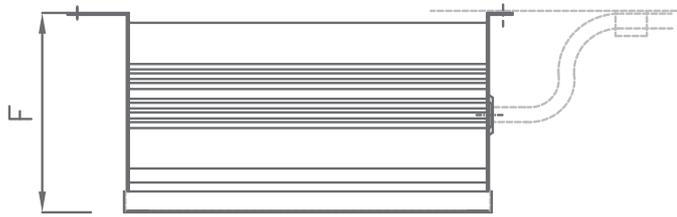
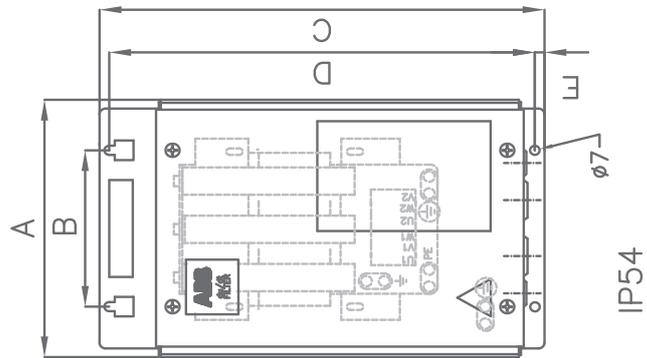
L2	mm							kg	Ø	Nm	mm ²	Nm
	A	B	C	D	E	H						
NOCH0016-60	140	195	120	85	115	83	2.4	M5	4	0.2...10	1.5	
NOCH0030-60	165	215	145	108	130	95	4.7	M5	4	0.5...16	1.5	
NOCH0070-60	180	261	170	125	150	120	9.5	M6	6	10...35	2.5	
NOCH0120-60	154	106	100	75	200	160	7	M8	20	-	-	
NOCH0260-60	185	111	124	82	383	368	13	M10	30	-	-	
NOCH0400-60	185	126	124	97	383	368	13	M10	30	-	-	



NOCH0760-60 Weight: 43 kg (95 lbs)
 du/dt filter kit includes 3 filters.

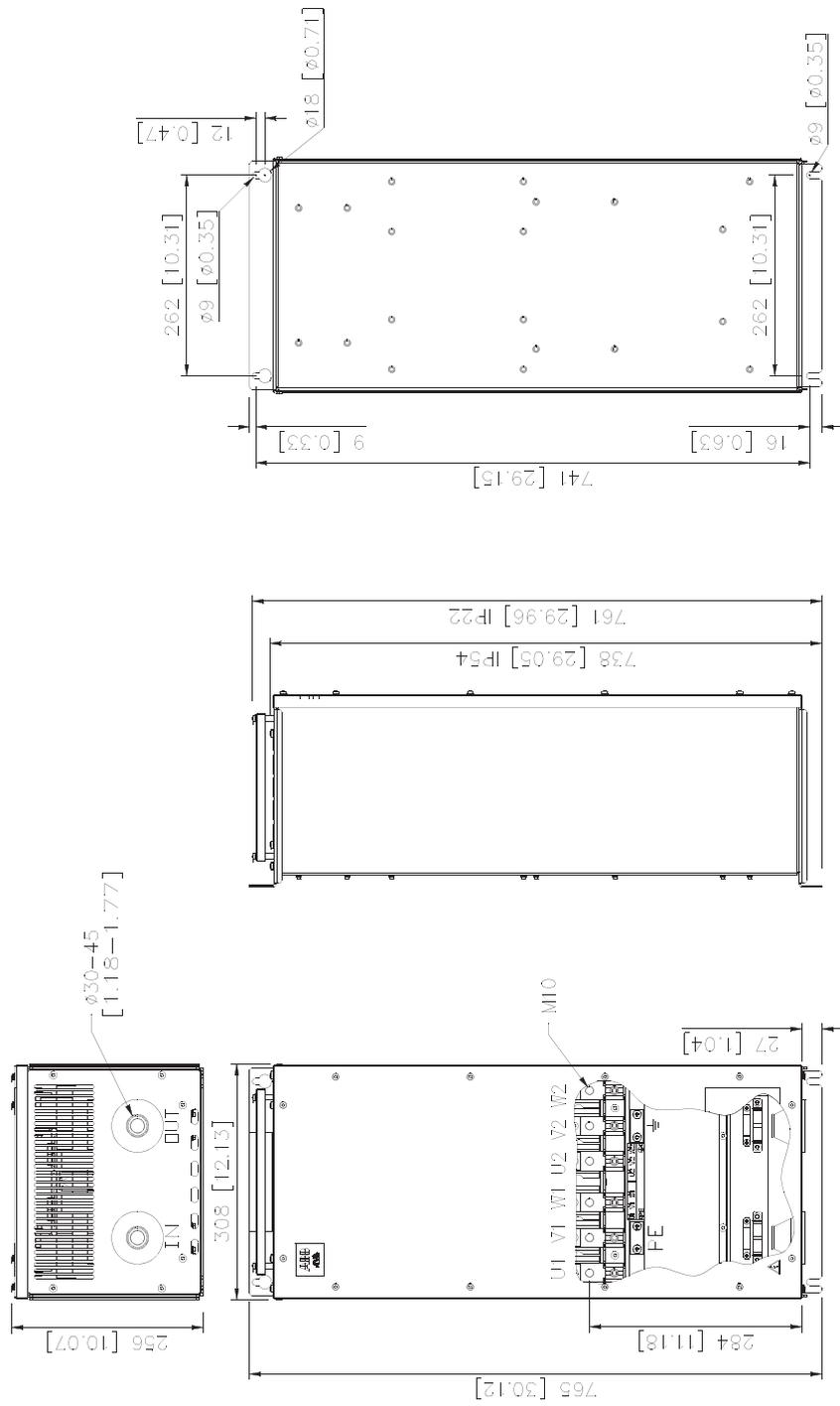


38 Dimension drawings



		A	B	C	D	E	F	 1
IP22	NOCH0016-62	199	120	323	309	7	154	6
	NOCH0030-62	249	160	348	334	7	172	9
	NOCH0070-62	279	180	433	419	7	202	15.5
IP54	NOCH0016-65	199	120	323	309	7	154	6
	NOCH0030-65	249	160	348	334	7	172	9
	NOCH0070-65	279	180	433	419	7	202	15.5

NOCH0120-62, NOCH0120-65 Weight 45 kg (99 lbs)
du/dt filter kit includes 3 filters.



Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/contact-centers.

Product training

For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB manuals

Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

Document library on the Internet

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