



Installation manual

Filters

Pólux®

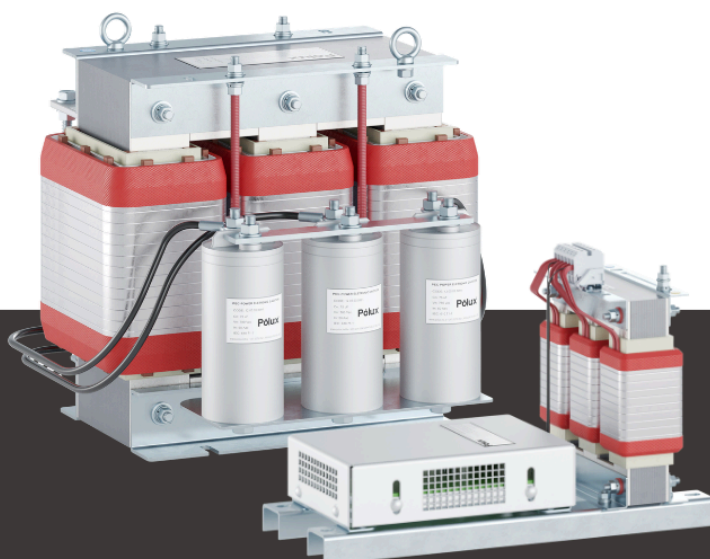
Congratulations!

You have purchased a filter developed and manufactured by Pólux Indústria Eletromecânica LTDA.

To ensure optimal performance and equipment lifespan, carefully read the instructions in this manual. Following the guidelines presented here contributes to the safe operation of the filter and helps prevent wear or damage resulting from improper installation, operation, or maintenance.

It is also recommended to consult the standards and requirements for electrical installations established by local utility companies.

This manual aims to provide all the necessary information for the installation, operation, preservation, and maintenance of Pólux filters. Each piece of equipment is designed and manufactured to meet the specific application needs of our customers, guaranteeing quality, safety, and reliability. If you have any questions or require technical support, please contact our team. We will be happy to assist you!



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1. Safety warning

- Do not lift or move the filter without proper equipment and experienced personnel;
- Do not unload the filter until a complete inspection has been completed;
- Do not adjust or remove any accessories or covers while the filter is powered on;
- The filter must be de-energized and all terminals grounded before any maintenance;
- Make sure all connections are complete and tight before powering on the filter;
- Do not change the connections when the filter is powered on.

2. Introduction

This manual aims to provide necessary instructions for users handling, transporting, storing, installing, and maintaining Pólux filters. Following these instructions will ensure optimal filter performance, as well as the electrical characteristics for which it was designed and specified by the customer.

The manual covers dV/dt , passive harmonic, and sinusoidal filters for inverters, establishing the critical parameters necessary to ensure efficient and safe filter performance, as well as detailing inspection procedures, proper installation, and preventive maintenance.

Pólux filters are designed and manufactured in strict accordance with the standards in effect at the time of their construction. For further clarification, it is recommended to read the following standards:

- IEC/EN 61000-3-2 – Limits for harmonic current emissions (equipment input current <16 A per phase);
- IEC/EN 61000-3-12 – Limits for harmonic currents produced by equipment connect to public low-voltage systems with input current >16 A and <75 A per phase;
- IEC/EN 61000-3-4 – Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A;
- IEC 61000-2-4 – Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances;
- IEEE 519 – Standard for Harmonic Control in Electric Power Systems.

To ensure the correct installation and operation of the transformer, it is essential that the procedures described in this manual and in the aforementioned standards be carried out by a qualified professional with knowledge of the applicable technical and safety standards, ensuring a proper and safe installation.

3. DV/DT filter

A dV/dt filter is a device used in electrical systems to attenuate or limit the rate of change of voltage (represented by dV/dt , where "dV" is the voltage change and "dt" is the time change). These filters are commonly used in the outputs of frequency inverters, especially in applications with electric motors, to protect the insulation of the motor windings and reduce electromagnetic interference (EMI).

Frequency inverters are used to control the speed of electric motors by converting direct current voltage into alternating current voltage of variable

frequency. During this process, inverters can generate voltage pulses with a high rate of change (high dV/dt).

High dV/dt ratio can cause several problems, such as:

- **Damage to motor insulation:** High voltage can stress the insulation of the motor windings, causing premature failures;
- **High dV/dt rates** can also generate electromagnetic interference, affecting other nearby electronic equipment;
- **Wave reflection:** In long cables, wave reflection can occur, increasing the voltage at the motor terminals, which can lead to malfunctions.

The function of the dV/dt filter, when installed at the inverter output, is to smooth voltage transitions, reducing the rate of change of the voltage applied to the motor. This is done through components such as inductors and resistors that delay rapid voltage changes, protecting the system from potential damage and operational problems.

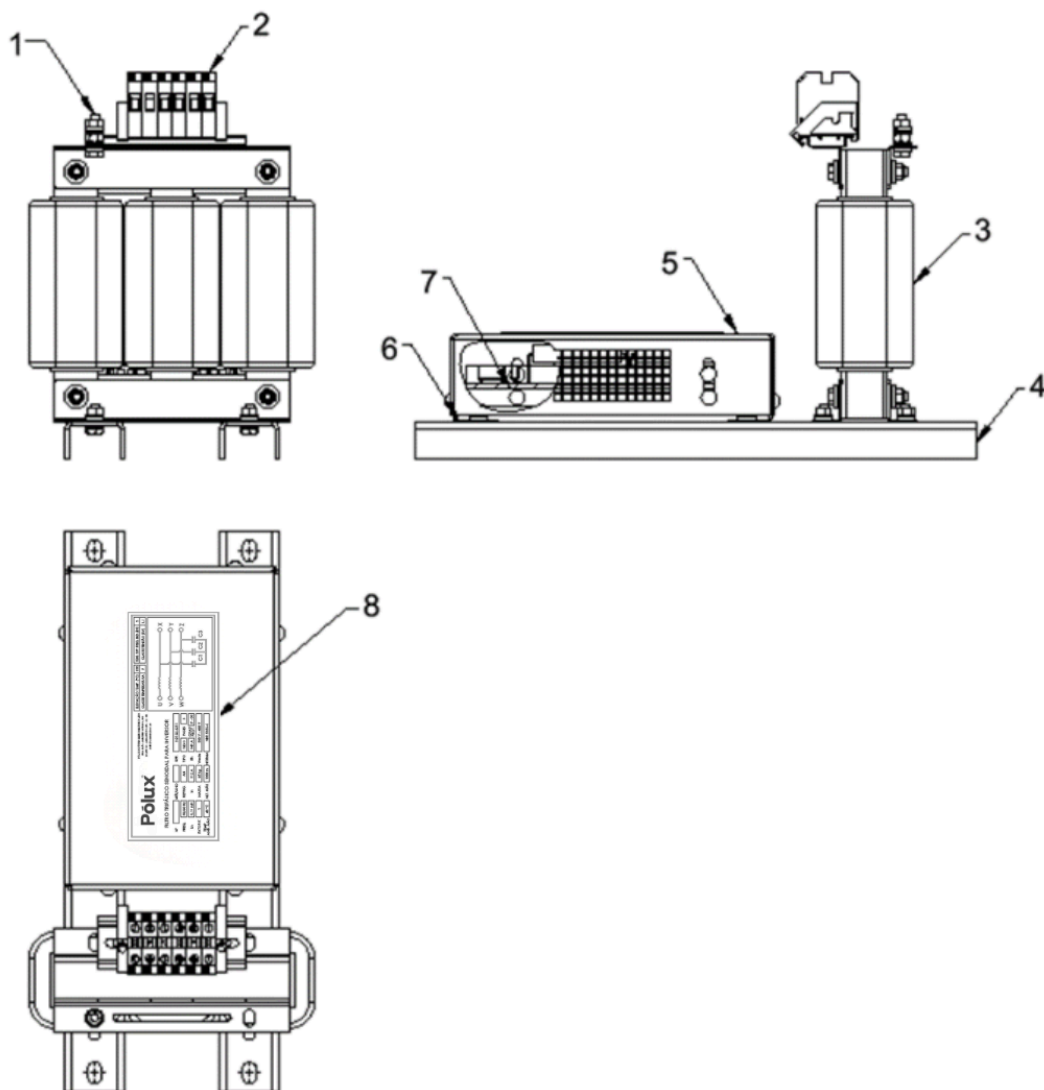
The benefits of using this equipment are:

- **Motor protection:** The output voltage of the frequency converter is a series of trapezoidal pulses with a variable width (pulse width modulation) characterized by a pulse rise time. When a transistor in the inverter switches, the voltage across the motor terminal increases by a ratio dV/dt that depends on the motor cable and the high-frequency surge impedance of the motor. Due to impedance mismatch between the characteristic impedance of the cable and the surge impedance of the motor, wave reflection occurs, causing a touch voltage overshoot at the motor terminals. These filters are essential in industrial applications where motors and frequency inverters are used in critical environments or where equipment reliability and longevity are paramount.

- **Reducing motor acoustic noise:** When a motor is powered by a frequency converter, the pulse-width modulated (PWM) voltage applied to the motor causes additional magnetic noise at the switching frequency and harmonics of the switching frequency (primarily twice the switching frequency). In some applications, this is unacceptable. To eliminate this additional switching noise, a sine wave filter should be used. This will filter the pulse-shaped voltage from the frequency converter and provide a sinusoidal phase-to-phase voltage at the motor terminals.
- **Reducing electromagnetic interference:** The use of frequency inverters to control the speed of electric motors involves the use of PWM modulation, which involves the generation of high-frequency pulses with rapid transitions, which can generate EMI. The use of dV/dt filters reduces EMI, protecting equipment from interference and potential damage, and also ensuring regulatory compliance.
- **More reliable operation:** Improves the reliability of the drive system by mitigating problems associated with high dV/dt rates; this is crucial in industrial environments where signal integrity and stable equipment operation are essential for continuous and safe production.

3.1. Construction features

Figure 1 – General identification of the dV/dt filter.



Source: Pólux Indústria Eletromecânica Ltda

Caption:

1. Grounding screw;
2. Terminal block for connection;
3. Reactance;
4. Mounting shoe;
5. Aluminum heat sink;
6. Corner bracket for heat sink;

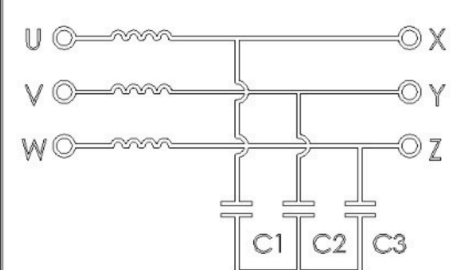
7. PCB components;
8. Data plate.

3.2. Identification

The dV/dt filters produced by Pólux have a label showing the nominal values.

Figure 2 – Example of an anodized aluminum nameplate.

				PÓLUX INDÚSTRIA ELETROMECÂNICA LTDA RUA JOÃO JANUÁRIO AYRES, 900 89.253-100 - JARAGUÁ DO SUL - SC - BR CNPJ 79.303899/0001-29				ELEVAÇÃO TEMP. (°C)		TENS. SUP. FREQ. IND. (kV)	
				CLASSE TEMPERATURA		CLASSE TENSÃO (kV)					
FILTRO DV/DT PARA INVERSOR											
Nº	MÊS/ANO		REF.								
FREQ.	REFRIG.		TIPO		FASES						
Ln	In		Ith		GRAU PROT.						
FATOR K	MASSA		Vrede								
TEMP. AMB. MÁX	ALT. MÁX		NORMA								



Source: Pólux Indústria Eletromecânica Ltda

Caption:

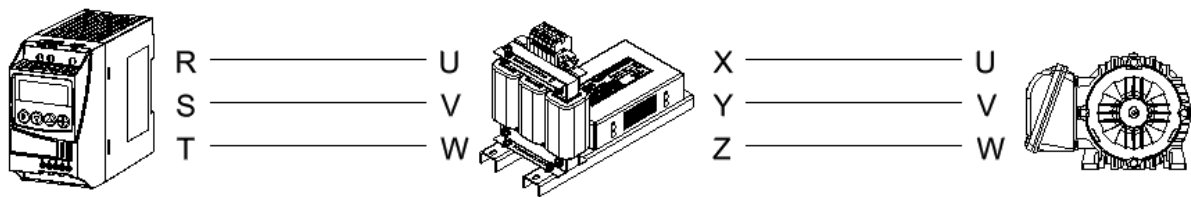
- FREQ.: frequency;
- Ln: nominal inductance;
- TEMP. AMB. MÁX: maximum ambient temperature;
- REF.: reference code;
- In: nominal current;
- ALT. MÁX: maximum altitude;
- Ith: thermal current;
- GRAU PROT.: degree of protection;
- Vrede: grid voltage;
- ELEVAÇÃO TEMP. (°C): temperature rise;

- TENS. SUP. FREQ. IND. (kV): surface voltage inductive frequency.

3.3. Application

Below is an illustration of how the dV/dt filter should be connected. In the example, the dV/dt filter is used at the inverter output and at the motor input.

Figure 3 – Example of a dV/dt filter connection.



Source: Pólux Indústria Eletromecânica Ltda

4. Passive harmonic filter

A passive harmonic filter is a device for mitigating the effects of unwanted harmonics in the electrical network. It is composed of passive electrical components, such as resistors (R), inductors (L), and capacitors (C), which are configured in specific arrangements to attenuate certain harmonics while allowing the passage of the fundamental frequency. The operating principle is based on resonance and selective impedance, where the filter is designed to present low impedance with respect to the specific harmonic frequencies that one wishes to mitigate.

- Inductor: offers high impedance for high frequencies, which allows it to block unwanted harmonic frequencies.
- Capacitor: offers low impedance for high frequencies, ensuring that they pass through and are filtered or dissipated.
- Resistor: can be used to dissipate energy and adjust the filter response.

These components are configured in specific topologies depending on the harmonic that one wishes to filter.

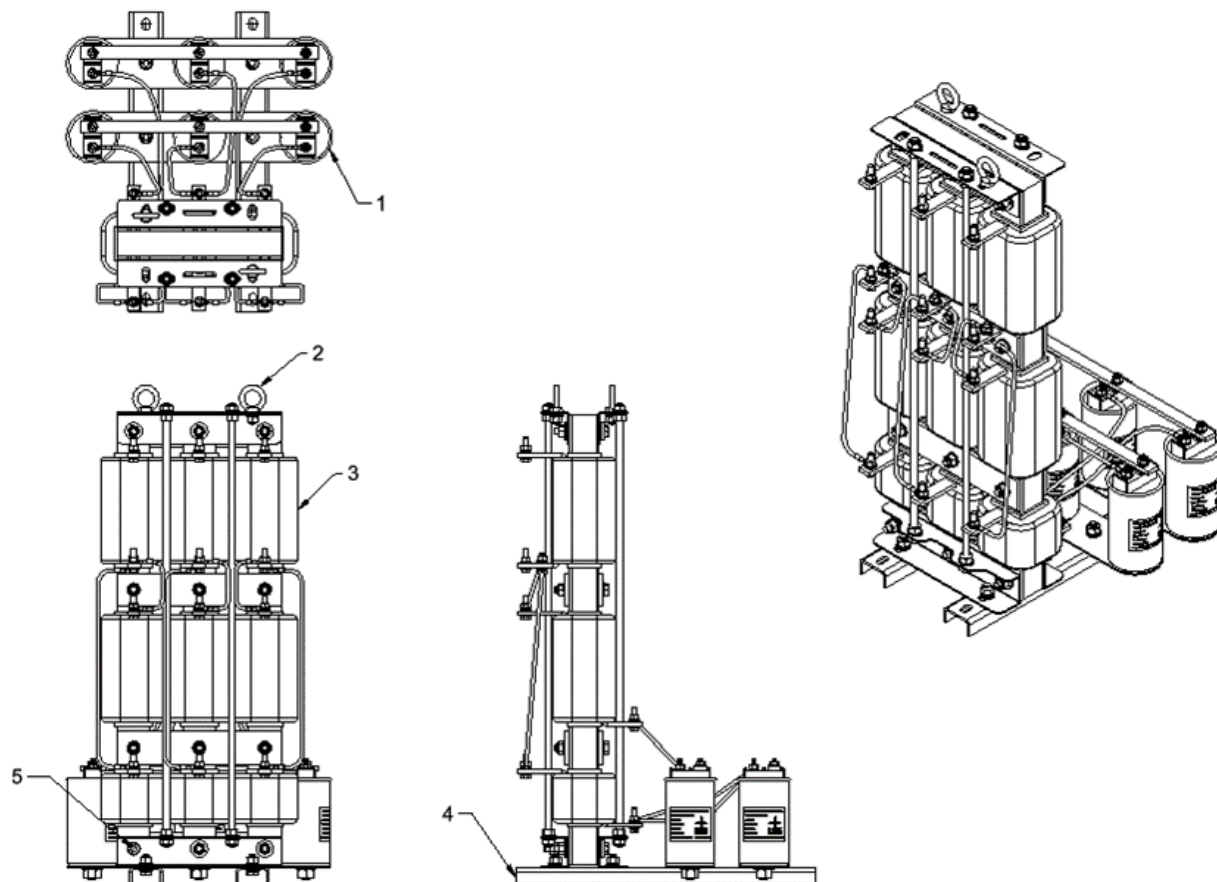
The objectives of a passive harmonic filter are:

- **Reducing Total Harmonic Distortion of the Current (THDi):** The main objective of a passive harmonic filter is to reduce THDi, which is a measure of how much the current waveform has been distorted due to the presence of harmonics. Therefore, reducing this parameter contributes to improving the quality of the supplied power.
- **Protecting equipment:** Harmonics can cause overheating and wear in motors, transformers, and other electrical equipment. Reducing harmonics provides greater protection for this equipment and extends its lifespan.
- **Meeting regulatory requirements:** In many industries, there are regulatory requirements that establish maximum levels of harmonics allowed in the electrical grid. The use of passive filters helps ensure compliance with these standards, avoiding fines and penalties.

Compared to an active harmonic filter, a passive filter has some advantages, such as lower cost and simplicity during installation and maintenance, since it does not have complex electronic components. However, passive filters are tuned to specific frequencies, and even though they can reduce harmonics of other orders, they are not intended to reduce all orders of harmonics.

4.1. Construction features

Figure 4 – General identification of a passive harmonic filter.



Source: Pólux Indústria Eletromecânica Ltda

Caption:

1. Capacitor bank;
2. Lifting lug;
3. Reactor;
4. Mounting shoe;
5. Grounding screw.

4.2. Identification

Figure 5 – Example of an anodized aluminum plate.

Pólux® PÓLUX INDÚSTRIA ELETROMECÂNICA LTDA RUA JOÃO JÂNIO, 470/200, 300 87.350-100 - JABOTICABATUBA, SP - 08 CNPJ 77.380.697/0001-23		CLASSE TEMPERATURA		TENS. APLICADA (kV)	
		ELEVAÇÃO TEMP. (°C)		CLASSE TENSÃO (kV)	
FILTRO TRIFÁSICO DE HARMÔNICAS PARA INVERSOR					
Nº					
MÊS/ANO					
REF.					
FREQ.					
REFRIG.					
TIPO	FASES				
Ln					
In					
GRAU.PROT.	Ith				
ALT. MÁX	MASSA				
TEMP. MÁX					
Vrede	THDi				
NORMA	NBR 5356-6 / IEEE 119				

Source: Pólux Indústria Eletromecânica Ltda

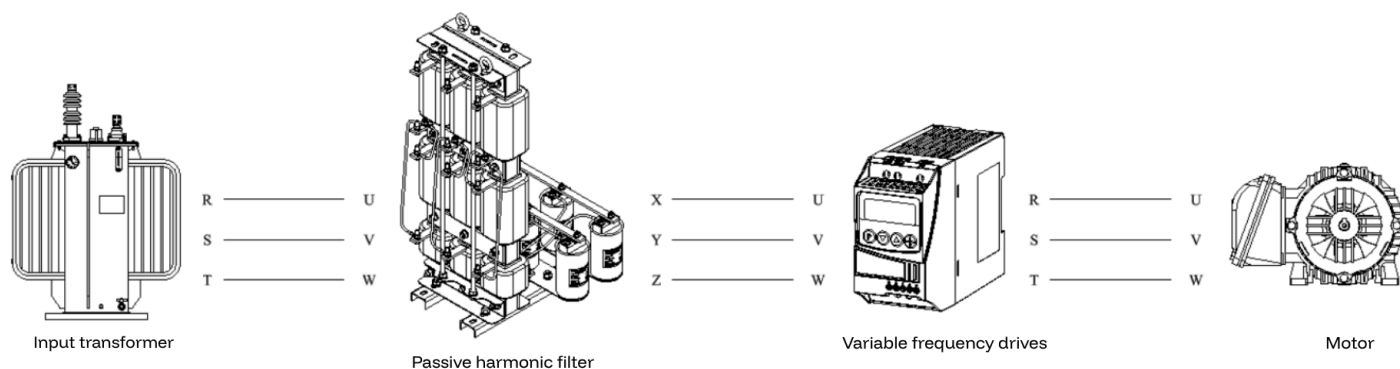
Caption:

- THDi: Total Harmonic Distortion of the Current.

4.3. Application example

Figure 6 shows an illustration of how the passive harmonic filter should be connected. In the example, the filter is used at the inverter input.

Figure 6 – Example of a passive harmonic filter connection.



source: Pólux Indústria Eletromecânica Ltda

5. Sinusoidal filter for inverter

A sinusoidal filter for an inverter is a device used in power conversion systems, such as frequency inverters, to smooth the output waveforms and improve the quality of the electrical signal supplied to sensitive loads. The inverter converts direct current (DC) to alternating current (AC), but the resulting waveform usually contains unwanted harmonics, which cause distortion.

The inverter typically produces a stepped waveform or an approximation of a sine wave, called a PWM (pulse width modulation) wave. The sine wave filter acts after the inverter, filtering out harmonics and other distortions present in the inverter output, smoothing the waveform so that it approximates a pure sine wave. The result is an output voltage with low harmonic distortion, suitable for powering electric motors, transformers, or other sensitive loads that require a pure sine wave.

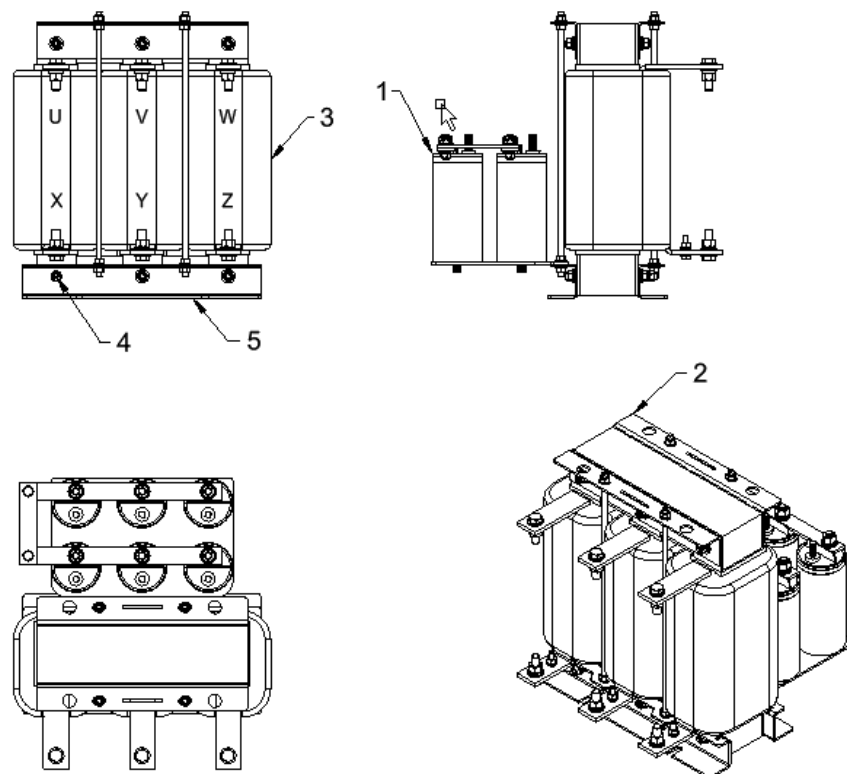
The benefits are:

- **Low harmonic distortion:** the result is an output voltage with low harmonic distortion, suitable for powering electric motors, transformers, or other sensitive loads that require a pure sine wave;
- **Equipment protection:** by providing a pure sine wave, the filter protects sensitive equipment against overheating, noise, and malfunctions that could occur due to harmonic distortion;
- **Greater efficiency:** In motor applications, the use of a sinusoidal filter can reduce motor losses and improve its efficiency.

The use of a sinusoidal filter is essential in applications where power quality is critical to the performance and longevity of connected equipment.

5.1. Construction features

Figure 7 – General identification of a sinusoidal filter for an inverter.



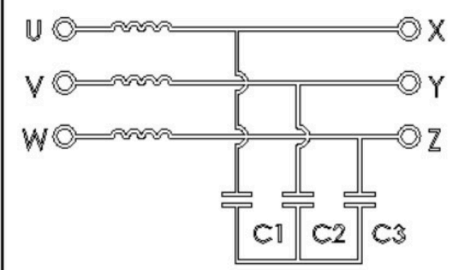
Source: Pólux Indústria Eletromecânica Ltda

Caption:

1. Capacitor bank;
2. Angle bracket with lifting lugs;
3. Reactor;
4. Grounding screw;
5. "U" profile for fixing.

5.2. Identification

Figure 8 – Example of an anodized aluminum plate.

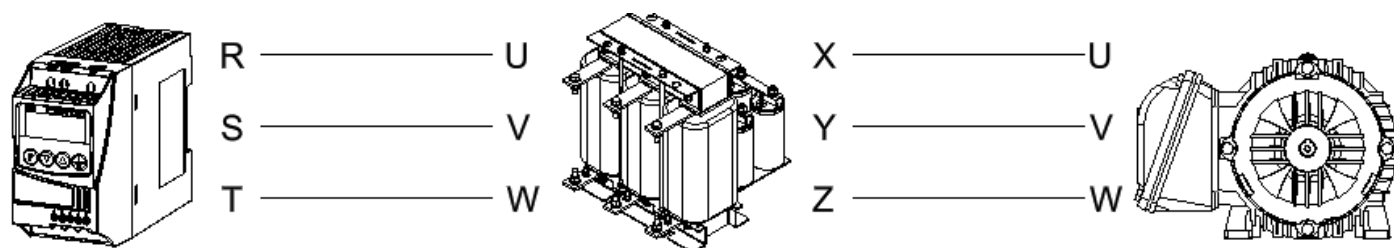
		PÓLUX INDÚSTRIA ELETROMECÂNICA LTDA	
		RUA JOÃO JANIÚNO AYRES, 300 89.253-100 - JARAGUÁ DO SUL - SC - BR CNPJ 77.385899/0001-29	
FILTRO TRIFÁSICO SENOIDAL PARA INVERSOR		ELEVAÇÃO TEMP. (°C) 100	
		TENS. SUP. FREQ. IND. (kV) 3	
		CLASSE TEMPERATURA F	
		CLASSE TENSÃO (kV) 1,1	
			
Nº	MÊS/ANO	REF. 9.01.02.6211	
FREQ. 50/60 Hz	REFRIG. AN	TIPO FSENO	FASES 3
Ln 0,15 mH	In 312 A	Ith 343 A	GRAU IP-00
FATOR K 1	MASSA 85 kg	Vrede 380 V - 480 V	
TEMP. AMB. MÁX 40 °C	ALT. MÁX 1000 m	NORMA NBR 5356-6	

Source: Pólux Indústria Eletromecânica Ltda

5.3. Application

Below is an illustration of how the inverter sine wave filter should be connected. In the example, the filter is used at the inverter output and at the motor input.

Figure 9 – Example of a sinusoidal filter connection

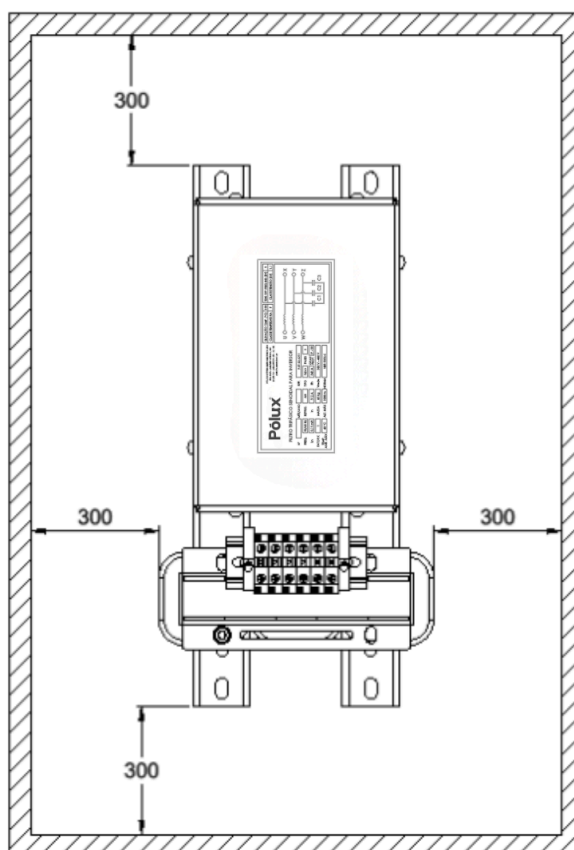


Source: Pólux Indústria Eletromecânica Ltda

6. Distance for energization

For all filters, maintain a minimum distance of 0,3 meters between walls, buildings, and other equipment (if any) to allow for air circulation.

Figure 10 – Minimum distance between filter and other structure.



Source: Pólux Indústria Eletromecânica Ltda

If air conditioning is installed in the electrical room where the filter is located, do not point the air conditioning equipment directly at the filter to avoid condensation. This contact with water can cause serious problems and lead to the equipment burning out.

The cable between the frequency inverter and the filter needs to be as short as possible and not exceed 10 meters in length. Using a cable longer than 10 meters is possible, but Pólux strongly recommends against it, as there is a risk of increasing electromagnetic interference and voltage spikes at the filter terminals.

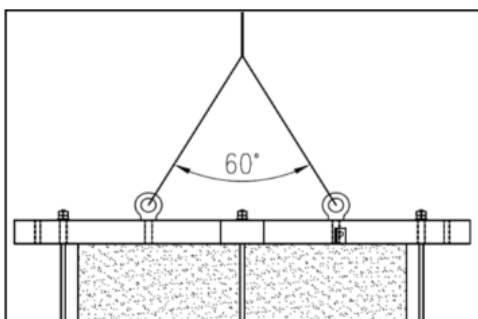
7. Receipt

Upon receiving the filters, it is essential to perform a visual inspection to identify any damage that may have occurred during transport. If any problems or damage are detected, immediately notify the transport company and Pólux before authorizing the unloading of the material. The packaging is properly designed for transport to prevent any accidents with the product.

For moving products that exceed the weight supported by a human being, the equipment can be supplied with lifting lugs. To avoid excessive stress on any device, it is recommended to use all available lugs on the filter during lifting.

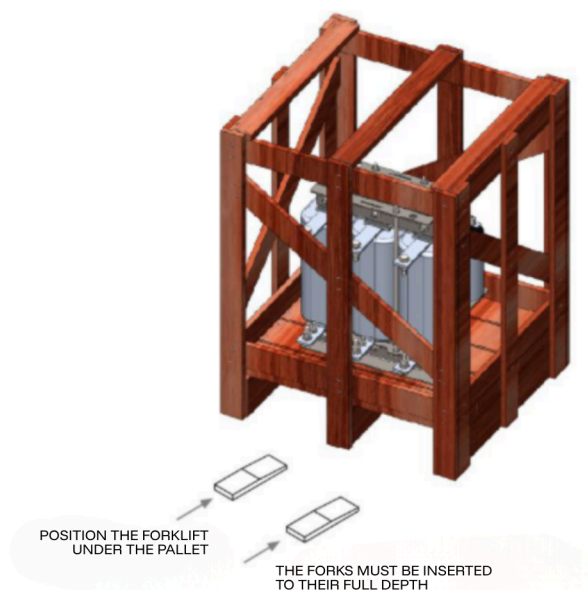
Filters should never be moved by their active parts or connection terminals, as excessive stress in inappropriate locations can cause irreversible damage to the equipment. Lifting should only be carried out with a forklift, pallet on the underside of the housing (when applicable), or by overhead crane, using the internal lifting lugs fixed to the upper structure of the core and coil assembly, ensuring uniform load distribution.

Filters can be quite heavy and have a relatively high center of gravity, so they need to be handled carefully and moved slowly to avoid dropping them.



- Use all available lifting lugs;
- Do not allow the angle between the lifting cables to exceed 60°.
- Handle the filter only in an upright position;
- Be very careful when lifting and moving the filter to avoid tipping it over.

Figure 11 – Positioning of the forklift forks for moving the filter.



Source: Pólux Indústria Eletromecânica Ltda

7.1. Place of receipt

It is advisable to unload the filter at its final installation location to avoid impacts or even displacement of the active part, which could cause highly critical accidents.

7.2. Receiving inspection

Upon receipt, it is important to verify that the physical product matches the product listed on the invoice. A visual inspection should also be carried out to check the external condition of the filter, its accessories, and any possible damage caused during transport. The inspection should be done before unloading it from the truck, and if there is any obvious damage or any indication of rough handling, a complaint should be filed immediately with the carrier and Pólux notified.

A visual inspection should be performed to locate any possible damage or displacement of parts, loose or broken connections, dirt or foreign material, and the presence of water or moisture. Also verify that the information on the identification plate installed on the equipment matches the job specifications to ensure proper filter installation.

If the filter has been stored prior to installation, this inspection should be repeated before putting it into service.

7.3. Storage

If storage is necessary, the filter should be placed in a clean, dry room where a uniform temperature is maintained. Air circulation through the filter housing should be allowed. The relative humidity to which the insulating materials will be exposed should be kept as low as possible. The floor where the equipment will be stored should not allow moisture to enter from the air, and precautions should be taken to protect against water ingress from any source, such as roofs, leaks, water or steam lines, windows, etc.

If storage is prolonged, periodic inspections are recommended to ensure that environmental conditions do not cause damage to the equipment. In cases where the relative humidity during storage is high or unknown, electric resistance heaters should be used inside the enclosure.

Never store the filter with its base directly on the ground. Suitable wedges, appropriate to the environment and the base material (aluminum or stainless steel), should ensure a distance of 10 cm between the ground and the equipment.



If the equipment will be stored, the packaging supplied with the reactor should not be removed.

7.4. Installation

During filter installation, strictly follow the instructions in the manual and connection diagrams provided. Ensure all electrical connections are secure and proper, as specified. The installation location must be clean and free of obstructions, with sufficient space for adequate ventilation and future maintenance. Additionally, verify that the filter is properly grounded, in accordance with applicable safety standards.

7.5. Security

To ensure the safety of everyone involved in handling and operating the filters, it is essential that only authorized and trained professionals perform these activities. All workers must be aware of safety practices, including the use of Personal Protective Equipment, energy source lockout procedures, and the proper use of tools and testing equipment.

Accident prevention is a shared responsibility, and therefore, the presence of fire-fighting equipment and first aid notices in visible and accessible locations is crucial. Safety must be a priority at every stage of the process, from receiving to the ongoing operation of the filters.

7.6. Maintenance

Filter maintenance must be performed according to a strict schedule, following the manufacturer's recommendations. Regular inspections are necessary to identify signs of wear or damage that could compromise equipment performance. Any intervention must be carried out with the equipment de-energized and all connections grounded, ensuring the safety of the person responsible for maintenance.

Recording all maintenance activities is essential for monitoring equipment history and proactively planning future interventions. Adherence to

these practices will ensure the longevity and efficient operation of the filters, preventing unscheduled downtime and increasing system reliability.

8. Installation and assembly

8.1. General considerations

Pólux filters are designed and manufactured to operate at a maximum ambient temperature of 40 °C and a maximum altitude of 1,000 meters. If the client has special application requirements, these must be communicated in advance during the technical/commercial proposal process so that the conditions can be evaluated by engineering. The installation environment must provide adequate ventilation for the correct operation of the equipment, as its power may be reduced at temperatures exceeding the design limit. Therefore, it is important that the air inlets are located at the bottom and the outlets at the top of the opposite wall, with sufficient openings for minimum circulation according to Equation 1:

$$F = 2,5 \times Ps \text{ (1)}$$

Given that:

Ps = filter loss in kW;

F = Airflow in m³/hour.

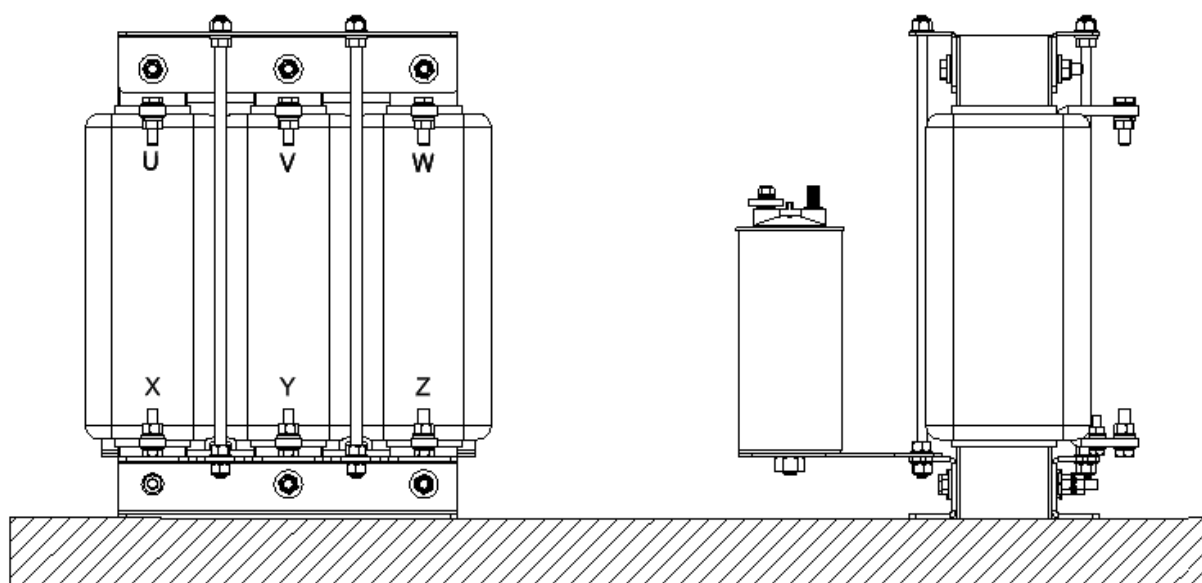
Before installing the filter, the availability of appropriate tools and equipment, as well as qualified professionals to perform the procedure in accordance with NR 10 - Safety in Electrical Installations and Services, must be verified.

The following factors should be carefully considered when installing filters:

- Avoid installation on rainy days;
- Perform a visual inspection of the assembly, especially the terminals, connectors, and accessories, to identify any damage resulting from handling and transport of the equipment;
- Verify that the data on the identification plate is consistent with the system in which the filter will be installed;
- All Pólux filters should only be powered on after the mains power has stabilized and while the unit is unloaded;
- When lifting is required, the cables used must be attached to the lifting lugs provided for this purpose.

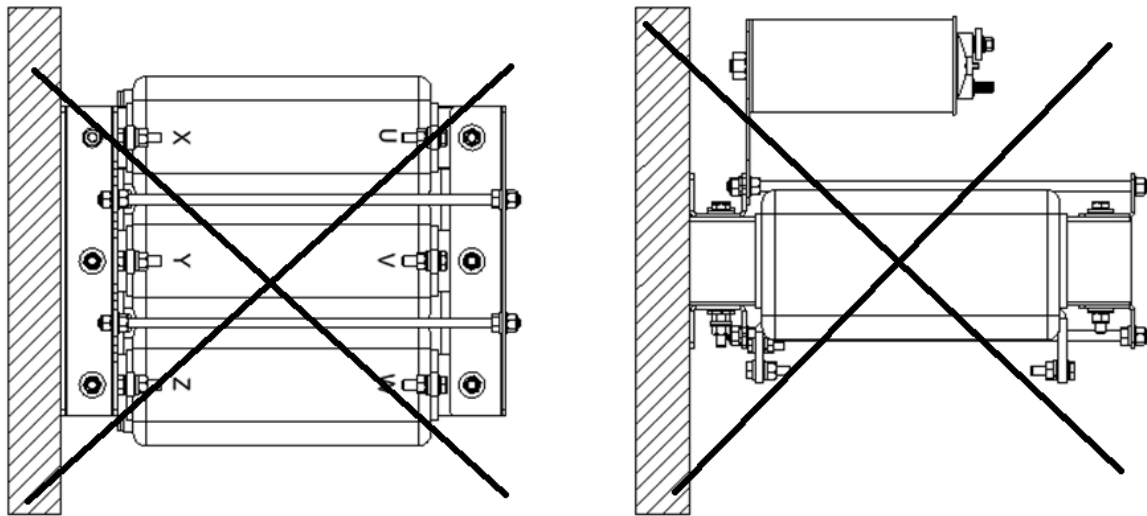
The filter should be mounted vertically to allow for proper heat dispersion.

Figure 12 – Recommended mounting position.



Source: Pólux Indústria Eletromecânica Ltda

Figure 13 – Prohibited mounting position.



Source: Pólux Indústria Eletromecânica Ltda

Proper filter installation is crucial for its proper functioning and the safety of the system. Failure to follow installation instructions, including choosing the correct location, can result in problems such as overheating, reduced lifespan, and even equipment failure. Pólux will not be held responsible for any damage caused by improper filter installation.

8.2. Special considerations

Special operating, transport, or installation conditions include those that may require special construction, revision of nominal values, or special care during the transport, installation, or operation of the equipment.

Examples of these special conditions are:

- Installation at altitudes above 1,000 meters above sea level and temperatures above 40 °C;
- Exposure to excessive moisture, saline atmosphere, gases or smoke that are harmful to the equipment;
- Exposure to harmful dust such as iron ore dust, sulfur, etc.;

- Exposure to explosive materials in the form of gases or dust;
- Insulation requirements differ from those specified for the equipment;
- Limited installation space;
- Transportation, installation and storage under precarious conditions;
- Risk of abnormal vibrations, seismic tremors and occasional shocks.

These factors should always be checked in order to obtain optimal performance and as a preventative measure against accidents or damage to the equipment. Exposure to these factors will cause a loss of filter efficiency, such as the temperature class of the material, the dielectric strength of the insulators, among others.

8.2.1. Filter operating altitude

Pólux filters are designed and manufactured according to applicable standards for installations up to 1,000 meters above sea level. At higher altitudes, the filter's operating capacity will be reduced due to a decrease in the dielectric strength of the air. Therefore, a correction factor, as shown in Table 1, must be used.

Table 1 – Correction of air dielectric strength by altitude.

Altitude (m)	Correction factor
1000	1.0
1200	0.98
1500	0.95
1800	0.92
2100	0.89
2400	0.86
2700	0.83
3000	0.80
3600	0.75
4200	0.70
4500	0.67

Source: NBR

8.2.2. Connection

It is necessary to check the current and inductance information shown on the nameplate before installation.

The input and output terminals of the Pólux filters are made of copper, aluminum, or brass screws and are located at the ends of the coils. Before connecting the filter terminals to your circuits, the following procedures must be followed:

- All terminations must be flexible in order to avoid mechanical stress. These terminations can support considerable conductor weights, but long distances without supports should be avoided;
- The cables or bars must be correctly sized and the connections properly tightened in order to avoid overheating.

All Pólux filters have terminal identification in accordance with applicable standards. Before connecting the filter terminals to their respective circuits, the following procedures must be followed to prepare their surfaces:

- Protect the filter so that cleaning residue does not settle on the coils and other parts;
- Apply industrial petroleum jelly or a zinc-rich antioxidant compound to the conductive parts immediately after surface cleaning. Cleaning tin-plated copper connectors should follow the same procedure, taking care not to remove the finishing material.
- In aluminum-copper connections, a copper-aluminum alloy plate (bimetallic element) may be used, not supplied with the filter unless requested. All connection accessories such as screws, nuts, flat, spring or conical washers must be made of steel and protected against corrosion (galvanized, cadmium plated, etc.);
- To transmit the correct screw pressure to the contact surface, conical washers should be used that do not deform and can accommodate volume variations due to temperature fluctuations;
- The bolts should preferably be tightened using a dynamometer or torque limiting wrench, ensuring even pressure distribution and proper electrical contact.



After the first 24 hours of operation under load, it is recommended to inspect all connections to detect any overheating resulting from loose connections or poorly crimped terminals on the connecting cable. Repeat inspection every 12 months.

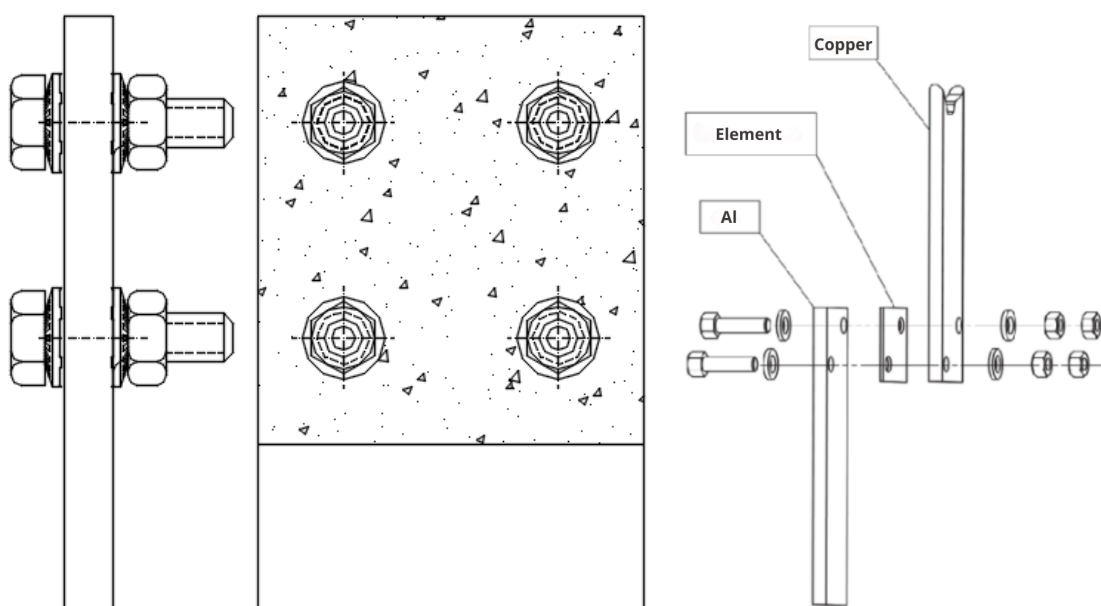
The recommended torques are shown in Table 2, for both bolted and compression electrical connections:

Table 2 – Nominal Tightening Torques.

Type of electrical connections	Torque - Nominal Tightening [N.m]				
	M6	M8	M10	M12	M16
Hex Head Bolts (Class 8.8)	8	22	43	75	183
Brass Screws	8	22	35	50	120
304 Stainless Steel Screws	6,2	15	30	52	130

Source: NBR

Figure 14 - Type of terminals available for connecting the reactor terminals with a bimetallic element.



Source: Pólux Indústria Eletromecânica Ltda



To even out any potential settling, Pólux recommends retightening the screws a few weeks after installation. When retightening, the torque applied should not exceed the torque applied during assembly.

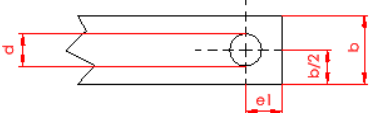
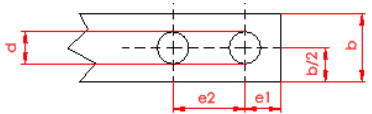
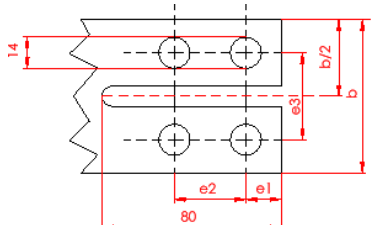
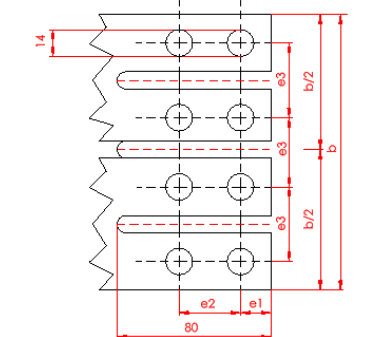
Unless otherwise specified in the electrical design, the measurements from the ends of the bars to the base or ceiling should be followed according to Table 3.

Table 3 – Distances between connection point and ceiling/base.

Gauge	1 cable per phase (mm)	2 cables per phase (mm)	3 cables per phase (mm)	4 cables per phase (mm)	5 cables per phase (mm)	6 or 8 cables per phase (mm)
6	100	100	100	-	-	-
10	100	100	100	-	-	-
16	150	150	150	-	-	-
25	150	150	150	-	-	-
35	150	150	150	-	-	-
50	150	150	150	-	-	-
70	150	170	200	-	-	-
95	180	180	215	-	-	-
120	215	215	230	260	-	-
150	255	255	280	305	-	-
185	305	305	330	360	400	450
240	360	360	380	400	450	500
300	380	405	460	480	530	580
400	460	510	560	600	600	600
500	485	560	600	600	600	600

Source: Pólux Indústria Eletromecânica Ltda

Table 4 – Connection layout.

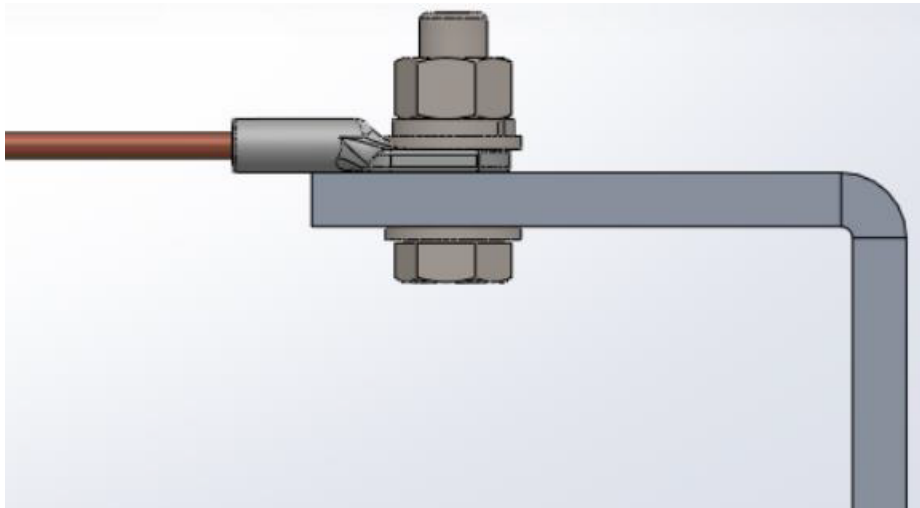
F o r m a	Dimensional figure	b (mm)	d (mm)		Screw	e1 (mm)	e2 (mm)	e3 (mm)
			Through hole	Thread				
1		12	5.5	M5	M5	6	-	-
		15	6.6	M6	M6	7.5		
		20	9.0	M8	M8	10		
		25	11	M10	M10	12.5		
		30	11	M10	M10	15		
		40	14	M12	M12	20		
		50	14	M12	M12	25		
2		25	11	M10	M10	12.5	30	-
		30	11	M10	M10	15	30	-
		40	14	M12	M12	20	40	-
		50	14	M12	M12	20	40	-
		60	14	M12	M12	20	40	-
3		80	14	M12	M12	20	40	40
		100				20	40	50
		120				20	40	60
4		160	14	M12	M12	20	40	40
		200						50

Source: Pólux Indústria Eletromecânica Ltda

The filter connection can be made using cables, and for this, it is necessary to check if the busbar is clean and free of corrosion or oxidation (if necessary, clean the contact areas with a wire brush or a non-abrasive cloth). Ensure that the connection points on the busbar are accessible and prepared to receive the tubular terminal.

Use the torque wrench to tighten the mounting screws, following the torque specified in this manual for each gauge. Figure 15 below shows how the connection between the busbar and the connecting cable should be.

Figure 15 – Demonstration of the filter busbar connection with the cable.



Source: Pólux Indústria Eletromecânica Ltda

For installation after long periods of storage, the contact surfaces should be polished with a fine steel brush or fine sandpaper, along with non-acidic lubricating petroleum jelly, which will also help prevent corrosion of the aluminum.

8.2.3. Protection and switching components

Filters can be protected by devices such as fuse switches, circuit breakers, disconnectors, and surge arresters, among others, in order to prevent

short circuits, overloads, and atmospheric surges. These protective devices must be correctly sized, supplied, and installed by the customer.

8.2.4. Filters installed in metal cubicles

Filters installed in enclosed substations (masonry rooms) or metal cubicles must follow these procedures:

- Air inlets should be considered in the upper and lower thirds of the side and front walls of the cubicle;
- The minimum internal dimensions of the cubicle must comply with the measurements indicated in the dimensional drawing of the filter and/or specific technical documentation;
- To prevent the formation of tight loops in the cubicle walls, it is recommended to electrically insulate the joints between the sheets with insulating material and insulating anchors on the screws of the joints.

9. Tools

Below are the general tools for handling, installation, and maintenance:

- 75 N.m torque wrench;
- Bushing ratchet;
- Bushing of 13 and 17;
- Clamp for spinal alignment;
- Rubber mallet;
- Hydraulic jack, which can operate in a horizontal position;
- Axle wrench;
- Extra-thin latch adapter;
- Extra-fine socket, 13 and 17 mm.

10. Energization

Energizing Pólux filters is an extremely important procedure and must be performed by a qualified professional, respecting all applicable technical and regulatory standards. Before energizing the filter, in addition to verifying the installation according to safety standards, the following points must be observed:

- **Connections and fastening:** Check that all connections have been made correctly and that cables, busbars or any connecting elements are fixed and properly supported, avoiding mechanical stress on the terminals;
- **Screw torque:** Check the connections and torque of the contact screws according to Table 2 of this manual;
- **Foreign objects:** Ensure that there are no foreign objects (nuts, bolts, washers, tools, etc.) trapped between the coils, between the coils and the core, or between the capacitor bank;
- **Grounding connection:** Confirm that the filter is securely connected to the grounding circuit via the connector installed on its base.

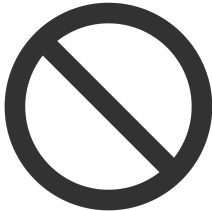


To prevent the formation and circulation of currents in the grounding grid, only one point should be connected to the ground.

After verifying all the points above, the energizing of the Pólux filters should follow these procedures:

- a. Energize the filter without load;
- b. Always maintain a safe distance from the energized filter;
- c. **The filter contains capacitors, so after any power outage, wait at least 5 minutes before touching any part of the filter.**

Strictly following these procedures will ensure the safety and proper performance of the filter during operation.



NEVER TOUCH THE ENERGIZED FILTER

Life-threatening danger!

11. Maintenance

Filters manufactured by Pólux are designed to require little or no maintenance. However, to ensure optimal performance and extend their lifespan, we recommend conducting periodic visual inspections every twenty-four months.

11.1. Maintenance items

- **Visual inspection of the site:** Perform a thorough visual inspection of the environment where the filter is installed. Check for signs of deterioration, dust buildup, or other contaminants that could affect its proper functioning;
- **Inspection of torque seals:** Visually check the torque seals on the connecting bolts. Ensure that all bolts are securely tightened and that there are no signs of loosening or corrosion;
- **Cleaning the ventilation channels:** Regularly clean the ventilation channels between the coils. Obstruction of these channels can lead to overheating and compromise the equipment's performance;
- **Verification of connection terminals:** Use a thermal imaging camera to inspect the temperature at the connection terminals. Early detection of

hot spots can prevent catastrophic failures. Check that the terminals are free of oxidation and properly connected;

- **Thermal protection assembly operation:** Test the thermal protection assembly, when applicable, to ensure it is operating correctly. Any anomaly should be corrected immediately;
- **Electrical connections:** Ensure all electrical connections are secure and free from corrosion. Inspect cables and busbars for signs of wear or damage;
- **Mechanical components:** Check all mechanical components, such as supports and fasteners, to ensure they are secure and show no signs of excessive wear;
- **Maintenance documentation:** Keep a detailed record of all inspections and maintenance performed. This includes date, time, points checked, actions taken, and observations. This history is crucial for tracking filter performance over time and planning future preventive maintenance.

Following these recommendations will help ensure that Pólux filters continue to operate efficiently and safely. If you have any questions or require technical assistance, please contact Pólux technical support for expert guidance.

11.2. Main Abnormalities and Solutions

Table 5 – Operational abnormalities.

Item	Defect	Probable cause	Corrective action
1	Overheating at the HV and LV terminals, connection points, and switch panel	Bad connection	- Clean contact areas; - Retighten nuts and screws.
2	Overheating	Supply voltage higher than expected	- Check the voltage.
		Overload exceeding expectations	- Reduce the load; - Increase the refrigeration airflow.
		Insufficient cooling air circulation	- Clean the cooling air ducts.
		Cooling air temperature above the expected temperature	- Reduce the load; - Increase the refrigeration airflow.
3	The capacitor's current phase is out of balance by more than 10%	One or more capacitors have failed	- Use a multimeter to locate the faulty capacitor. If you cannot find it, call Pólux customer service.
4	Excessive noise	One or more loose screws	Tighten all screws.

Source: Pólux Indústria Eletromecânica Ltda

If the abnormalities persist after applying the suggested corrective actions, or if other abnormalities not described in Table 5 are observed, contact Pólux's after-sales service immediately.

11.3. Paint touch-ups

If touch-ups are needed on the paintwork, the following procedures should be followed:

1. Using adhesive tape, mark off the area of the filter surface that will be touched up;
2. Using fine sandpaper, remove the paint from the outlined area;
3. To remove the RTV, use a plastic brush;
4. Clean the area with solvent or alcohol;
5. Dry the area to be touched up;
6. Apply a coat of finishing paint, as specified by Pólux, using a brush or air gun;

7. Silicone paint repair (RTV):

- a. Using a paintbrush or roller, apply a coat of RTV paint, duly approved by Pólux;
- a. If the equipment is outdoors, cover it with plastic to protect it from sun or rain for a minimum of 72 hours to ensure the paint dries properly.

Note: The drying times indicated above assume an ambient temperature of 20 °C and use materials recommended by Pólux. For paints from other brands, consult the supplier's technical data sheet.

12. Safety and environment

A Pólux is committed to protecting the environment, using the most suitable materials in the manufacture of our reactors, transformers, and filters. When a filter reaches the end of its useful life or when any of its components need to be replaced, it is essential that disposal is carried out in accordance with current safety procedures and environmental regulations. Similarly, the packaging that protects the filter during transport must be disposed of appropriately.

If you have any questions about proper disposal, please consult our quality engineering department for detailed guidance.

Pólux believes that we should all share the commitment to preserving the environment. It is crucial to prevent contaminating materials and used components from being improperly disposed of, as many of these materials can be recycled, preventing the contamination of natural water and soil sources and protecting public health.

Furthermore, we emphasize the importance of adopting sustainable practices throughout the entire equipment lifecycle. This includes reducing

resource waste during manufacturing, optimizing energy use, and implementing environmental management systems that ensure compliance with environmental legislation and industry best practices.

Pólux encourages its customers and partners to actively engage in sustainability initiatives, promoting the reuse of materials and recycling whenever possible.

Furthermore, it is recommended to conduct regular training sessions on environmental and safety practices for all employees involved in the handling, installation, and maintenance of filters, ensuring they are aware of the best practices and procedures to follow.

By adopting these measures, we are not only fulfilling our legal and ethical responsibilities, but also contributing to a more sustainable and healthy future for generations to come. Together, we can make a difference in preserving our planet.

13. Performance

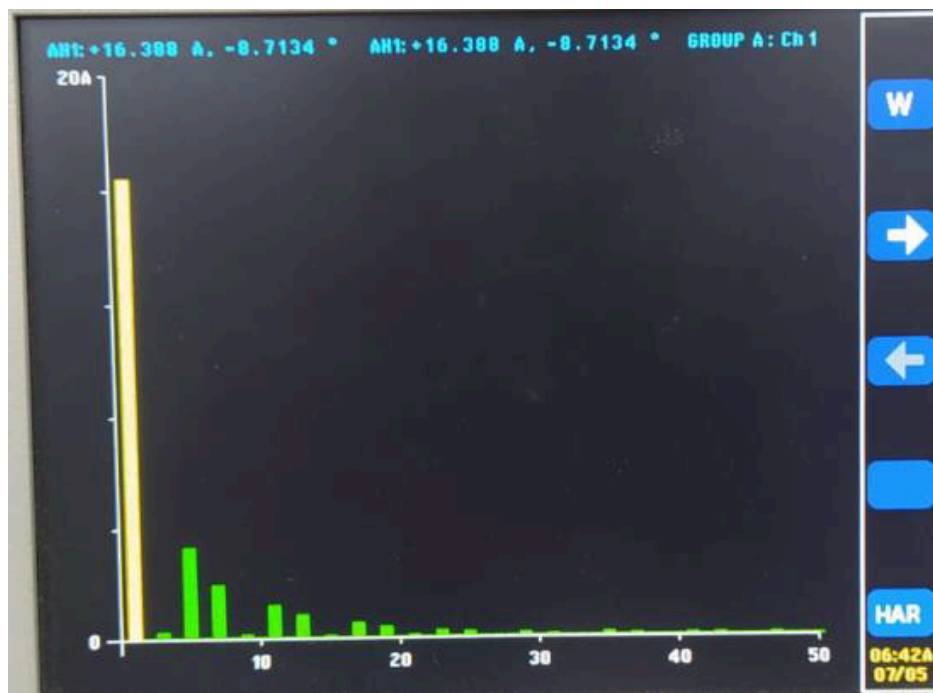
This chapter will present images showing the effect on the system when using a Pollux filter.

Figure 16 – Demonstration of the waveform without the filter.



Source: Pólux Indústria Eletromecânica Ltda

Figure 17 – Demonstration of the frequency spectrum without the filter.



Source: Pólux Indústria Eletromecânica Ltda

Figure 18 – Demonstration of total THDi without the filter.

GROUP A Ch1	GROUP B Ch2	GROUP C Ch3	GROUP D Ch4
Vrms 216.68	V Vrms 218.85	V Vrms 216.89	V Vdc
Arms 16.625	A Arms 16.674	A Arms 16.714	A Adc
Watt 3.4476	kW Watt 3.4863	kW Watt 3.4733	kW Watt 21.741
Adf 25.237	% Adf 24.960	% Adf 23.919	%
A1m 16.131	A A1m 16.185	A A1m 16.267	A
A1p -8.6019	° A1p -8.9452	° A1p -8.6509	°
A2m 12.428	mA A2m 13.476	mA A2m 25.236	mA
A2p 93.358	° A2p -95.573	° A2p 174.56	°
A3m 227.81	mA A3m 164.99	mA A3m 66.615	mA

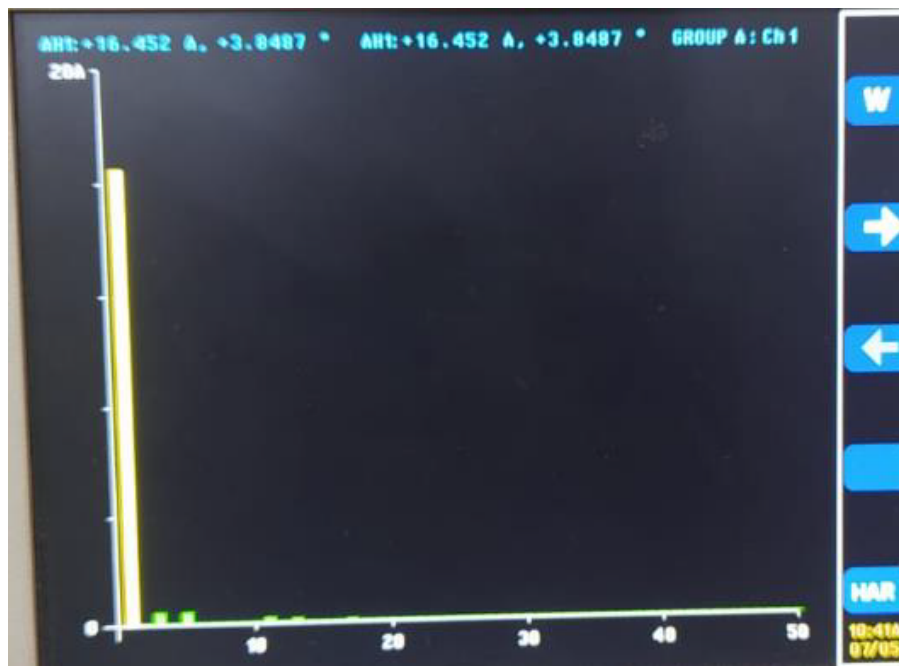
Source: Pólux Indústria Eletromecânica Ltda

Figure 19 – Demonstration of waveform with the filter.



Source: Pólux Indústria Eletromecânica Ltda

Figure 20 – Demonstration of the frequency spectrum with the filter.



Source: Pólux Indústria Eletromecânica Ltda

Figure 21 – Demonstration of total THDi with the filter.

GROUP A Ch1	GROUP B Ch2	GROUP C Ch3	GROUP D Ch4
Vrms 216.63	Vrms 218.63	Vrms 216.02	Vdc 21.925 mV
Arms 16.472	Arms 16.566	Arms 16.434	Adc -6.2459 kA
Watt 3.5589 kW	Watt 3.6149 kW	Watt 3.5427 kW	Watt -137.49 mW
Adf 4.3769 %	Adf 3.7228 %	Adf 4.1568 %	
A1m 16.456	A1m 16.555	A1m 16.420	A
A1p 3.8289 °	A1p 3.4237 °	A1p 3.6290 °	
A2m 6.9626 mA	A2m 6.0043 mA	A2m 3.7133 mA	
A2p 34.335 °	A2p -9.9587 °	A2p 49.788 °	
A3m 409.38 mA	A3m 277.27 mA	A3m 181.81 mA	
A3p -92.134 °	A3p 110.44 °	A3p 54.097 °	
A4m 13.021 mA	A4m 4.4919 mA	A4m 12.771 mA	
A4p 132.20 °	A4p -87.830 °	A4p 47.851 °	

Source: Pólux Indústria Eletromecânica Ltda

14. Warranty terms

Before putting this equipment into operation, commissioning must be carried out, observing the information contained in the project and/or nameplate, in order to check its condition after transport and installation, retightening all connections and fully reading this warranty document. We are not responsible for damages caused by failure to observe this warning.

- The warranty period for Pólux products will be 12 (twelve) months, starting from the delivery of the product when this is the responsibility of the manufacturer, or starting from the collection of the product at Pólux's premises when it is the responsibility of the customer;
- Any and all repairs should only be carried out at the Pólux factory in Jaraguá do Sul – SC or by a qualified technician if previously authorized by the factory;
- All repairs and parts replacements during the warranty period will be performed free of charge by Pólux if a manufacturing defect is proven, with the customer responsible for delivering and collecting the equipment at the factory. Transportation costs or personnel travel expenses in the field are not covered by the warranty and are the customer's responsibility;
- In the event of an anomaly, the equipment must be available for the minimum period necessary to identify the causes and carry out repairs.

14.1. The following equipment will not be covered by the warranty

- That have suffered damage during transport, when this is the customer's responsibility;
- That have been stored or handled improperly or in an unsuitable location;
- Those that are improperly installed, failing to comply with the technical standards applicable to the installation of electrical equipment;

- Whose power supply network conditions are outside the specified limits;
- That they have been assisted by a person who is not qualified and not authorized by Pólux;
- That have undergone some modification by third parties;
- That have suffered overload, short circuit, overvoltage, overcurrent or atmospheric discharges or any other anomaly arising from transport or application;
- That are being misused;
- Whose connection terminals are loose, rusty, or have poor contact;
- That are subject to environmental conditions and aggressive agents not foreseen in the client's specifications;
- That have not undergone periodic preventive maintenance.

The assessment of these requirements will be the responsibility of Pólux's technical team, based on information obtained from the client and after analysis of the damaged equipment. The client may be responsible for charging for the costs involved in the service provided by Pólux.

The warranty expires after the aforementioned period, with all transportation expenses and risks being the responsibility of the customer.

This warranty is limited to the equipment supplied, and Pólux is not liable for damages to persons, third parties, other equipment or installations, lost profits, or any incidental or consequential damages.

This warranty does not cover parts or components subject to normal wear and tear, such as: fuses, lamps, thyristors, power transistors and diodes, varistors, contacts and similar items, as well as components whose lifespan under normal use is shorter than the warranty period.

Special care should be taken with power factor correction equipment. Measurements are recommended for the correct sizing of this equipment, as

well as to verify the presence or absence of network disturbances (harmonics). The warranty will only be granted for installations where the measurement characteristics remain the same as those existing at the time the equipment was sized.

We emphasize that, when this equipment is not sized by Pólux, our responsibility is limited to manufacturing it according to the specifications in the customer's requirements, commercial proposal, contract, purchase order, and/or order.

Pólux disclaims responsibility for any damage caused to the client's plant, whether it occurs before or after the installation of equipment manufactured by Pólux.



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