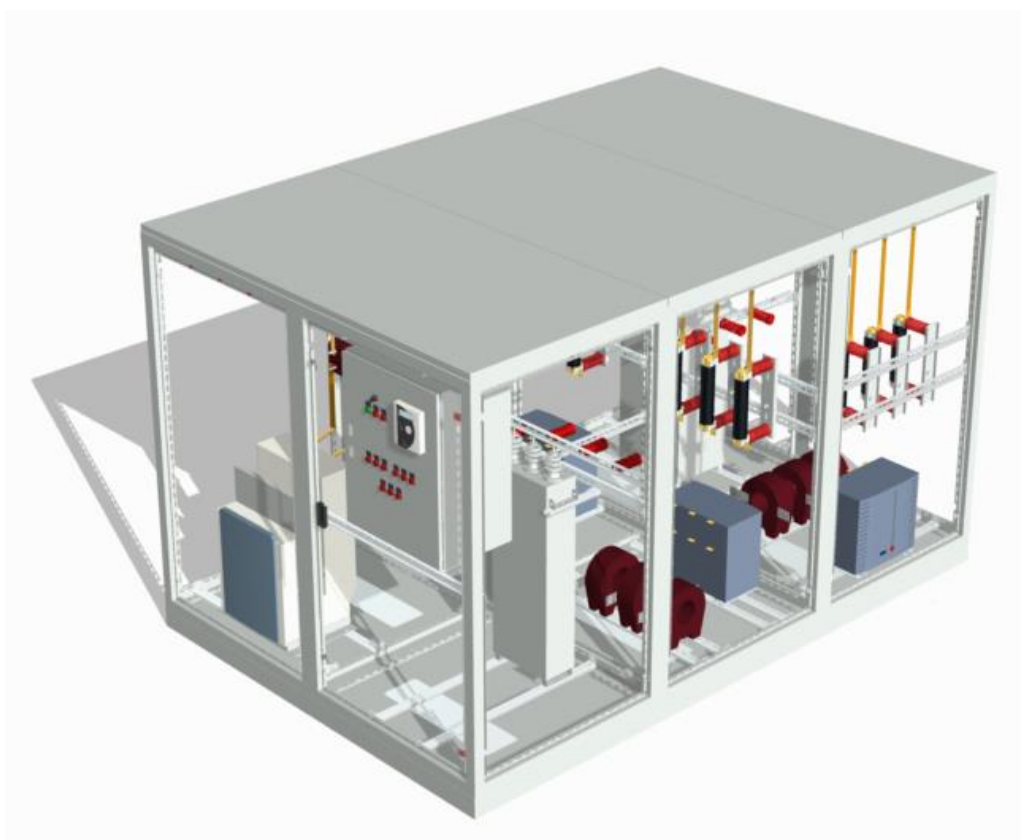


**Lifasa**  
REACTIVE POWER SOLUTIONS



## **HIGH-VOLTAGE NETWORK CAPACITOR BANKS**



**INSTALLATION AND MAINTENANCE MANUAL**



**ADVERTENCIAS / SÍMBOLOS**

<p><b>PELIGRO</b></p>	<p>Una conexión incorrecta del equipo puede producir la muerte, lesiones graves y riesgo de incendio. Lea y entienda el manual antes de conectar el equipo. Observe todas las instrucciones de instalación y operación durante el uso de este instrumento.</p> <p>La instalación, operación y mantenimiento de este instrumento debe ser efectuado por personal cualificado solamente. El Código Eléctrico Nacional define a una persona cualificada como "una que esté familiarizada con la construcción y operación del equipo y con los riesgos involucrados".</p>
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<p><b>ATENCIÓN</b></p>	<p><b>Consultar el manual de instrucciones antes de utilizar el equipo</b></p> <p>En el presente manual, si las instrucciones precedidas por este símbolo no se respetan o realizan correctamente, pueden ocasionar daños personales o dañar el equipo y /o las instalaciones.</p>
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LIFASA se reserva el derecho de modificar las características o el manual del producto, sin previo aviso.



**WARNINGS / SYMBOLS**

<p><b>DANGER</b></p>	<p>Death, serious injury, or fire hazard could result from improper connection of this instrument. Read and understand this manual before connecting this instrument. Follow all installation and operating instructions while using this instrument.</p> <p>Installation, operation, and maintenance of this instrument must be performed by qualified personnel only. The National Electrical Code defines a qualified person as "one who has the skills and knowledge related to the construction and operation of the electrical equipment and installations, and who has received safety training on the hazards involved."</p>
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<p><b>WARNING</b></p>	<p><b>Consult the instruction manual before using the equipment.</b></p> <p>In this manual, if the instructions preceded by this symbol are not met or done correctly, can cause personal injury or equipment damage and / or facilities.</p>
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**WARNHINWEISE / SYMBOLE**


<p><b>DANGER</b></p>	<p>Un branchement incorrect de l'appareil peut entraîner la mort ou des lésions graves et peut provoquer un incendie. Avant de brancher votre appareil, lisez attentivement le manuel et assurez-vous de bien avoir compris toutes les explications données. Respectez toutes les instructions concernant le mode d'installation de l'appareil et son fonctionnement.</p> <p>L'installation, le fonctionnement et la maintenance de cet appareil doivent être réalisés uniquement par du personnel qualifié. Le code électrique national définit en tant que personne qualifiée toute personne connaissant le montage et le fonctionnement de l'appareil ainsi que les risques que ceux-ci comportent »</p>
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<p><b>ATTENTION</b></p>	<p><b>Consulter le manuel d'instructions avant d'utiliser l'appareil</b></p> <p>Si les instructions suivantes, précédées dans le manuel d'un symbole, ne sont pas respectées ou sont réalisées incorrectement, elles pourront provoquer des dommages personnels ou abîmer l'appareil et/ou les installations.</p>
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**WARNHINWEISE / SYMBOLE**


<p><b>GEFAHR</b></p> 	<p>Durch einen nicht sachgemäßen Anschluss der Anlage können Tod, schwere Verletzungen und Brandrisiko hervorgerufen werden. Bevor Sie die Anlage anschließen, lesen Sie bitte das Handbuch durch und machen Sie sich dessen Inhalt klar. Beachten Sie bei Einsatz dieses Instrumentes sämtliche Installations- und Betriebshinweise.</p> <p>Installation, Betrieb und Wartung dieses Instrumentes müssen ausschließlich von entsprechend qualifiziertem Personal vorgenommen werden. Von dem nationalen Elektrocode wird eine qualifizierte Person als jemand definiert, "der mit der Konstruktion und dem Betrieb einer Anlage und der damit verbundenen Risiken vertraut ist".</p>
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<p><b>ACHTUNG</b></p> 	<p><b>Vor Inbetriebnahme der Anlage ist das Handbuch zu lesen.</b></p> <p>Werden die in dem vorliegenden Handbuch mit diesem Symbol versehenen Hinweise nicht beachtet oder falsch verstanden, können Personenschäden und Schäden an der Anlage und/oder den Installationen verursacht werden.</p>
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**ADVERTÊNCIAS / SÍMBOLOS**


<p><b>PERIGO</b></p> 	<p>Uma ligação incorrecta do equipamento pode provocar a morte, lesões graves e risco de incêndio. Leia e compreenda o manual antes de ligar o equipamento. Observe todas as instruções de instalação e operação durante o uso deste aparelho.</p> <p>A instalação, operação e manutenção deste aparelho devem ser levadas a cabo exclusivamente por pessoal qualificado. O Código Eléctrico Nacional define uma pessoa qualificada como "uma pessoa que se encontre familiarizada com a construção e operação do equipamento assim como com os riscos inerentes".</p>
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<p><b>ATENÇÃO</b></p> 	<p><b>Consultar o manual de instruções antes de utilizar o equipamento</b></p> <p>No presente manual, se as instruções que precedem este símbolo não forem respeitadas ou realizadas de forma correcta, podem ocorrer ferimentos pessoais ou danos no equipamento e/ou nas instalações.</p>
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A empresa LIFASA reserva-se ao direito de modificar as características ou o manual do produto, sem aviso prévio .



**AVVERTENZE / SIMBOLI**

<p><b>PERICOLO</b></p> 	<p>Un collegamento errato del dispositivo può provocare morte, lesioni gravi nonché rischio di incendio. Prima di collegare il dispositivo leggere attentamente il manuale. Osservare tutte le istruzioni relative all'installazione e all'operatività durante l'uso di questo strumento.</p> <p>L'installazione, operatività e manutenzione di questo strumento devono essere realizzate solamente da personale qualificato. Il Codice Elettrico Nazionale definisce una persona qualificata come "colui che ha familiarità con la costruzione e operatività del dispositivo e con i rischi che ne possano derivare".</p>
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<p><b>ATTENZIONE</b></p> 	<p><b>Consultare il manuale di istruzioni prima di utilizzare il dispositivo</b></p> <p>Qualora le istruzioni riportate nel presente manuale precedute da questo simbolo non vengano osservate o realizzate correttamente, possono provocare danni personali o danneggiare il dispositivo e/o gli impianti.</p>
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LIFASA si riserva il diritto di modificare, senza alcun preavviso, le caratteristiche o il manuale del prodotto

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## 1.-INTRODUCTION

The purpose of this manual is to help in the installation, start-up and maintenance of high-voltage capacitor banks, in order to obtain optimum performance from them.

### 1.1.- Manual contents

This manual comprises the following chapters

- Chapter 2 "*Safety information*" sets out warnings and alerts the user should bear in mind during handling and use of the equipment.
- Chapter 3 "*Packaging, receiving and handling*" contains equipment packaging description, receiving instructions and proper handling.
- Chapter 4 "*General information*" provides an overview of the main issues related to the equipment and protections for installation and start-up.
- Chapter 5 "*Equipment installation*" contains instructions for installing the equipment and connecting the various power circuits.
- Chapter 6 "*Checking external circuits*" contains instructions for ensuring that measurement circuits are properly connected to the equipment regulation and protection system.
- Chapter 7 "*Start-up*" contains instructions for starting up the equipment
- Chapter 8 "*Maintenance*" contains instructions and recommended timelines for equipment maintenance
- Chapter 9 "*Waste treatment*" outlines disposal procedures for worn, deteriorated or unserviceable units.
- Chapter 10 "*Guarantee, technical assistance and statement of conformity*" contains the EC declaration of conformity and the equipment guarantee conditions.

### 1.2.- Intended use

This user manual is intended for use by personnel in charge of installation, start-up and maintenance of LIFASA high-voltage capacitor banks.

The personnel in charge of installation, start-up and maintenance must be familiar with high-voltage electricity and its corresponding occupational risks.

### 1.3.- Disclaimer


LIFASA disclaims any responsibility for the eventual consequences of aggressive weather conditions (moisture, contamination, etc.) and/or power supply modifications, for which the equipment has not been adapted prior to client acceptance.


LIFASA disclaims any responsibility for personal injury or equipment/material damage caused by improper use or use beyond the specifications of this manual.

## 2.- SAFETY INFORMATION


### 2.1.- Safety symbols


Follow the warnings contained in this manual by the symbols shown below.


	<b>DANGER:</b> Warns of electrical risk.
---	--


	<b>WARNING:</b> Indicates message or warning requiring special attention.
---	---


### 2.2.- Risks

	Personnel working with high-voltage equipment should be expert in this field in order to prevent personal injury or equipment/material damage.
--	--









	Do not handle parts of the bank having active power until the discharge time shown on the equipment specifications tag has lapsed; ensure absence of voltage and connection to ground.
---	--

	Try not to touch the control panel terminals without first checking for absence of voltage. If you have to handle or touch the terminals or other control panel components, use personal protection equipment and adequately insulated tools.
---	---

	Before powering up the equipment, check that the enclosure or housing is properly closed and there are no elements or tools inside that could cause a short circuit in the power supply and control circuits.
---	---

	Shunt the current transformer secondary before disconnecting it. Operation of a transformer with the secondary open will cause accumulation of high voltage that could damage it and/or cause serious human injury.
---	---

## 2.3.- Warnings

- |   |  |
|---|--|
|    | The standards and applicable laws of the country where the capacitor bank is installed or operated should be strictly followed.  |
|    | Personnel should read and understand this manual before operating the equipment.   |
|    | A copy of this manual should be always be on hand for reference.   |
|    | Electrical connections should be made per IEC 60204-1 and IEC 60204-11 standards regarding equipment safety.   |
|    | Use safety lockouts on distribution cells and protection equipment to prevent its energization while being worked on.  |
|  | Compensation personnel should always be present when the equipment is being worked on. Never work on the equipment alone.  |
|  | If damage or faults are detected during equipment operation, or in circumstances that may compromise safety, immediately stop work in that area and disconnect the equipment in order to check it. |
|  | Modifying, upgrading, or rebuilding the equipment without written authorization from the manufacturer is prohibited.   |

## 3.-PACKAGING, RECEIVING AND HANDLING

### 3.1.- Packaging

Depending on the destination and means of transport, the equipment will be packaged as follows:

- Basic cardboard and plastic packaging, to prevent minor damage and scratches, is provided by default.



Fig.1- Basic packaging

- If maritime shipment is required, or is requested by the client when placing the order, the items will be packaged in a wooden crate suitable for such.



Fig. 2.- Maritime packaging


- Other packaging may be used when agreed upon in advance.


### 3.2.- Receiving

- Verify the proper condition of items shipped.
- Ensure the number on the shipping documentation matches that affixed to the exterior of the package.
- Equipment unloading and transportation (see section 3.3).




- Perform an external and internal visual inspection of the equipment.
- Check that all items on the packing list are present.

 In the event of any problem, contact the carrier and **LIFASA** immediately.

 If the capacitor bank will not be installed immediately, it should be placed on solid, level ground, in an area that will remain dry and free of corrosive gases or mud. Do not remove the original protection packaging.

### 3.3.- Unloading, transporting and handling

 It is essential that equipment handling be performed by specialized personnel using the appropriate tools.

The equipment base supports will accommodate forklifts or pallet jacks for movement over short distances. Due to the great weight of the equipment, a maximum of height of 20 cm above ground level during transport is recommended.

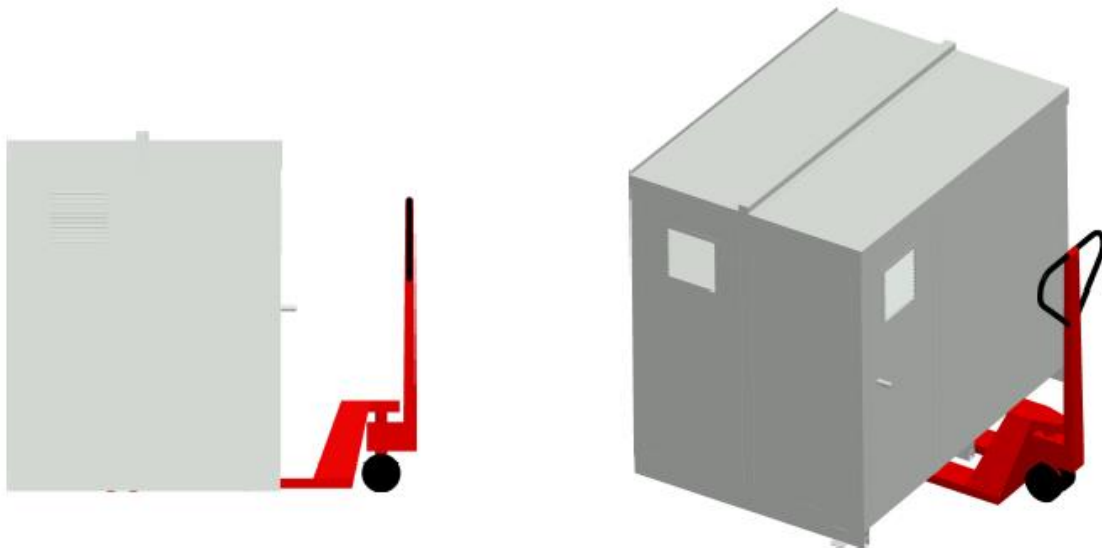


Fig. 3.-Transport with pallet jack.

For unloading the equipment more safely, use a forklift with forks long enough to support the entire length of the base. Shorter forks may be used, provided they span greater than half the length of the base, and that their use will not dent or damage the equipment or its internal elements. (Fig. 3). Due to load distribution within the equipment, its center of gravity may be not be at its actual center.

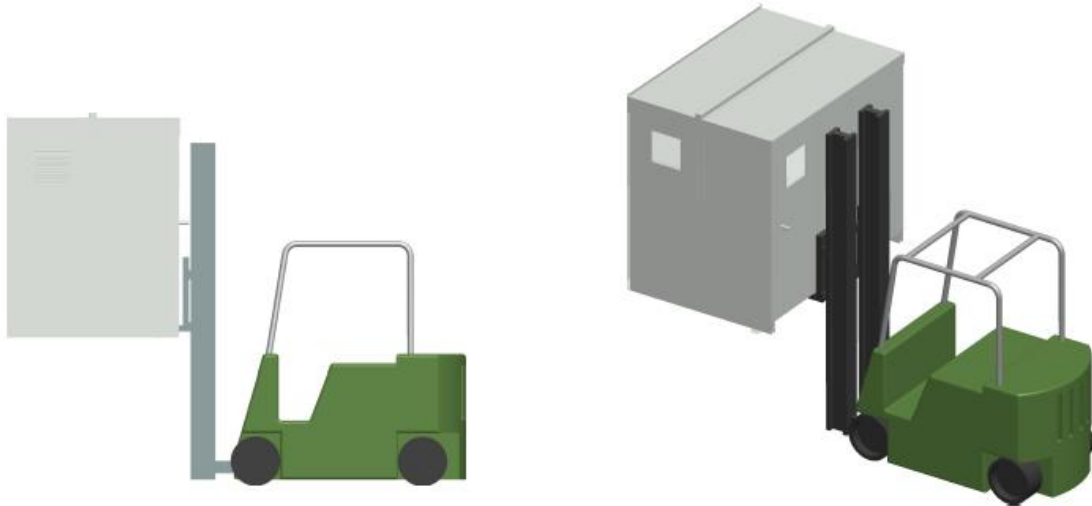


Fig. 4.-Unloading with forklift

To facilitate lifting, graphics attached to the packaging indicate the center of gravity location (Fig.5). This should not prohibit personnel from positioning the fork for even better stability based upon their own criteria.

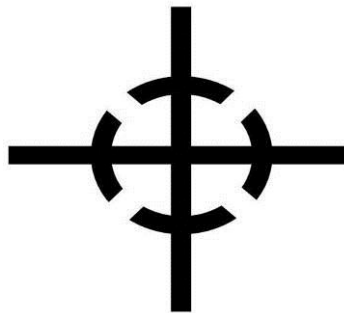


Fig. 5.- Center of gravity

## 4.- GENERAL INFORMATION

These are the primary considerations with respect to operation and protection during installation of the reactive compensation equipment.



The equipment may be ordered without operation and/or protection elements, in which case its owner must guarantee, at minimum, one protection exclusive to the capacitor bank.

### 4.1.- Operation equipment

The capacitor operation and protection equipment must guarantee capacitive loads will be cut.

For correct operation, and per IEC 60871-1 norms, the equipment must be capable of handling 1.43 times the capacitor nominal current.

### 4.2.- Protections

#### **4.2.1.- General bank protection**

Use of a main circuit breaker is recommended for general protection, whether it be installed within the equipment or in the installation upstream.

Overload and short-circuit protection are required at minimum. The following protections regulations is recommended:

- Short-circuit protection at 4-6  $I_n$  with 0.1 second reaction time.
- Overload Reverse time curve timing  $\approx$  4 seconds at 1.3  $I_n$  (depending on the neutral installation system)

#### **4.2.2.- Step protection**

Each step has its own protection via a set of high rupture capacity (HRC) fuses, which include a micro-fuse wired to the control panel to indicate fuse faults.

#### **4.2.3.- Built-in capacitor protection**

The capacitors have internal fuses to protect the individual units (sized according to capacitor power and voltage).

These ensure continued operation of the bank in the event an individual unit fails. This protection prevents internal gas generation, thus avoiding high pressure within the enclosure. The capacitors may also be equipped with a pressure regulator as a preventive maintenance measure.

## 5.-EQUIPMENT INSTALLATION

LIFASA capacitor banks are prepared for easy installation and start-up.

Use this document and the plans provided for all stages of assembly and connection.

For installation of LIFASA capacitor banks, please follow the steps below in order:

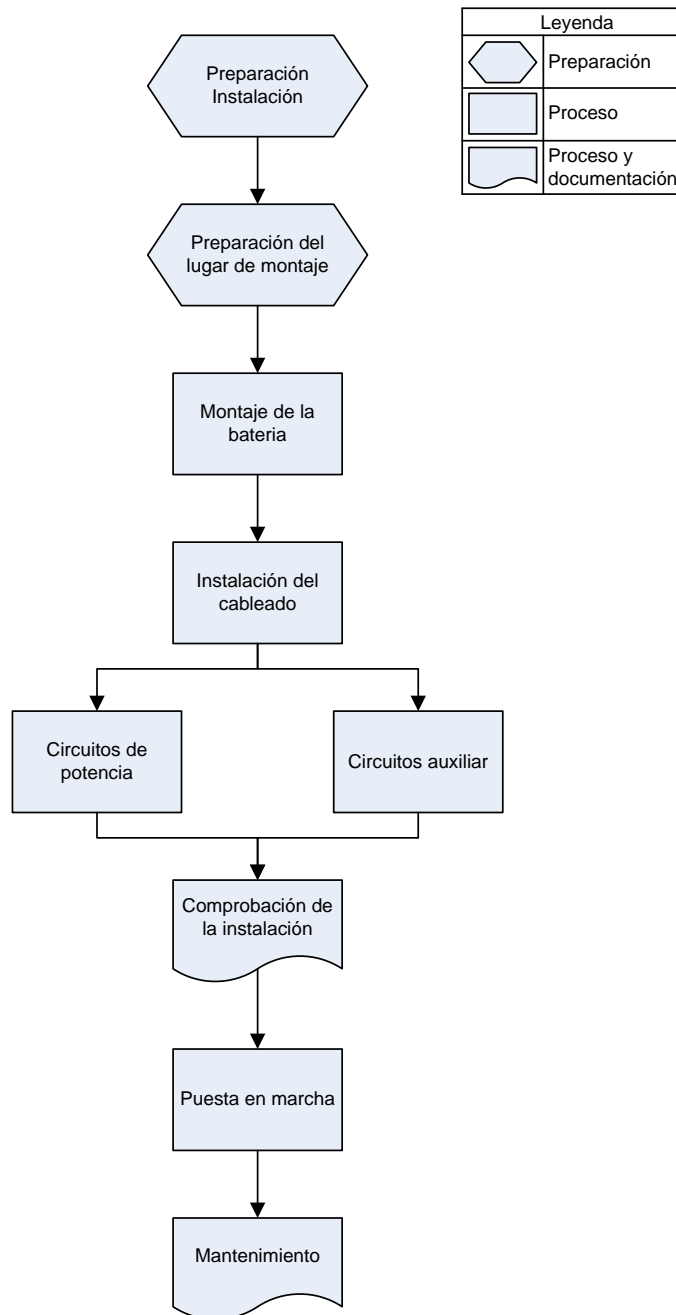


Fig. 6.- Capacitor bank installation flow chart

## 5.1.- Installation Preparation

Ensure the bank data match the buyer's requirements and the electrical features of the installation. The bank comes with a set of plans including a description of all elements, which may be compared with the specifications tag on the equipment enclosure.


 INTERNATIONAL CAPACITORS, S.A. Cod. R9191100110XX	
Ref.	ABATE0660578
Nº	3102191653/001
Q <sub>N</sub>	578 Kvar
U <sub>N</sub>	6600 V 50 Hz
	1x578 Kvar
	Δ
U <sub>N</sub>	20/60 kV
I <sub>N</sub>	50,6 A
L <sub>f</sub>	450 uH
Tiempo mínimo entre desconexión y reconexión 10 minutos MADE IN E.U.	

Fig. 7.- Specifications tag

## 5.2.- Preparation of the assembly site

The assembly site should meet the following criteria:

- It should have a flat and solid surface on which to mount the capacitor bank.
- There should be enough space to allow a perimeter of at least 50 cm around the enclosure to facilitate cooling and access.
- It is recommended that the standard operating temperature does not exceed 35 ° C nor drop below -25° C.
- For assemblies without an enclosure (IP00), the site should be surrounded by a perimeter fence/barrier with restricted access.



Whether installed indoors or outdoors the site should be well away from any heat source (transformers, motors, furnaces, etc.). If this is not possible it should be installed in an air conditioned room.

### 5.3.- Capacitor bank assembly

- Place the bank on the designated site.
- If there is more than one module, connect them using the screws provided.
- If anchors were requested prior to acceptance of the order, we recommend using M16 hex-head screws with stainless steel anchors. If the equipment will be attached from the inside, threaded rods embedded in the mounting surface should be used, but it is critical that these do not penetrate the equipment by more than 5 cm.



Fig. 8.- External anchor holes

#### Considerations for equipment to be installed outdoors

- The mounting surface should be completely level, in order to ensure proper rainwater runoff from the top of the enclosure.
- Adhesive gaskets will be provided for installation of multiple modules requiring protection degree IP23 or greater between them.



Fig. 9.- Self-adhesive gasket

- When multiple module are joined, a cover piece must be placed over the joints between enclosure covers. This part is supplied with the set and should be fixed in place by a rivet or sheet metal screw.



Fig. 10.- Module with exposed joint



Fig. 11.- Module with covered joint

## 5.4.- Wiring installation



Try not to touch the control panel terminals without first checking for absence of voltage. If you must handle or touch the terminals or other components of the control panel, use adequately insulated personal protection equipment and tools.



Secure the work area and lockout the circuit breaker to prevent energization of the circuits during wiring installation. Multiple safety lockouts are recommended.

### 5.4.1.- Power circuits

- Connect the bank to the facility ground using its terminal, and the grounding circuit of each module to the others using the conductors provided.

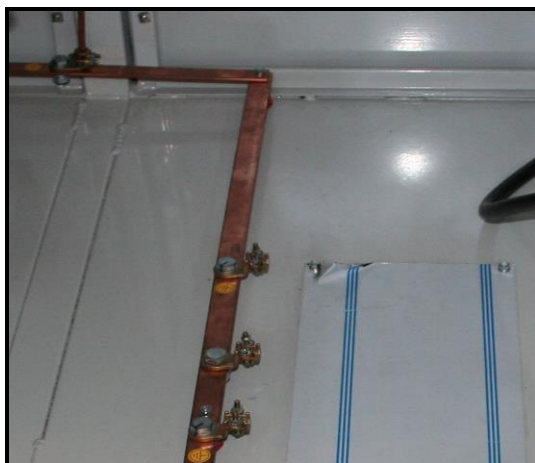


Fig. 12.- Main ground connection



Fig. 13.- Ground connection between modules

- Power cable connection. Connect the power terminals (L1, L2 and L3) using three cables of sufficient diameter to accommodate the bank nominal power. Nominal current

is indicated on the equipment specifications tag. As shown in the plans, these cables will be connected directly to their intended terminals from the service entrance.

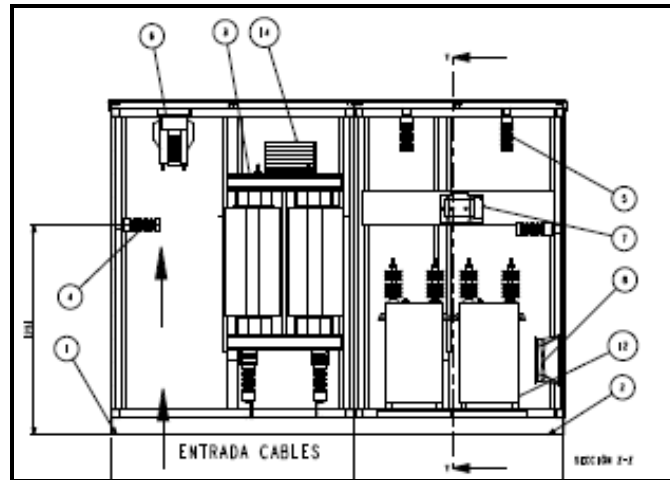


Fig. 14.- Service entrance shown in plans

- If the equipment comprises several modules, the copper busbars of each should be electrically joined to each other by a smaller one, which may be folded out from it. Unfold the connector busbars and line up their machined holes with those of the adjoining bars. Secure them with an M12 screw adjusted to a torque of 25 Nm.



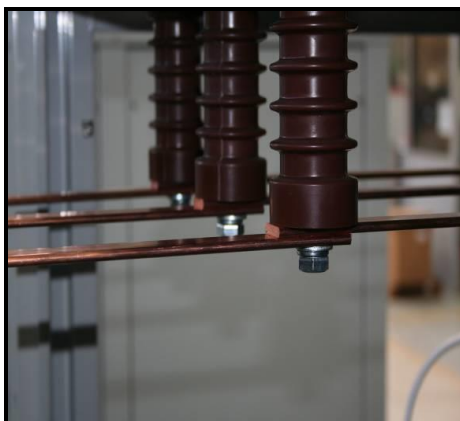
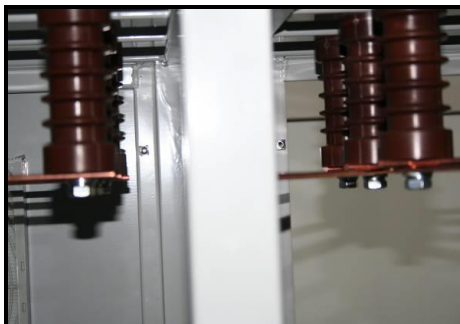


Fig. 15.- Busbar connection between modules



Do not exceed the recommended torque. Excessive tightening may break the attachment or its support.

#### 5.4.2.- Auxiliary circuits

- The low-voltage power supply and auxiliary measurement signal connections, which are required for control circuit function, are made inside the control panel, using the terminals provided, and are indicated in the equipment wiring diagram. To facilitate connecting the mains, stuffing boxes for wiring conduit are pre-installed.



Fig. 16.- Stuffing boxes for control cables

- If the bank comprises several modules, the control cable conduit should be connected to the control panel using Harting type multi-polar connectors, as shown.

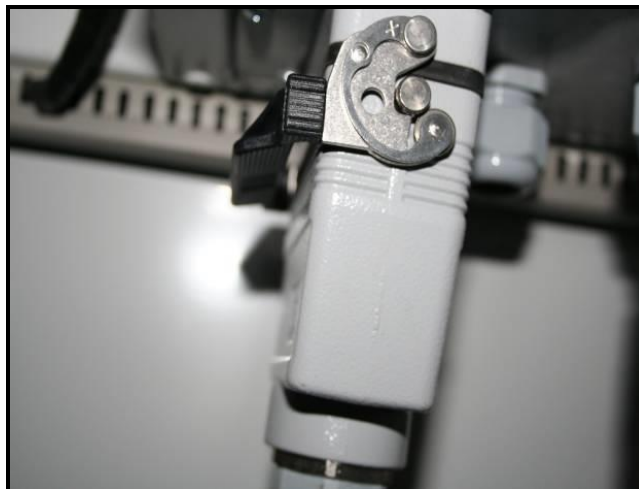


Fig. 17.- Inter-module signal connector

## 6.-EXTERNAL CIRCUIT TESTING

Check that bank external circuit terminals are properly connected to cos phi regulators, protection devices, or other functions that may be required by the user.

The terminals will be indicated in the plans provided with the equipment.

This process is outlined under “*checklist*” in the Annex.



This check should be done with all power off. If this is not possible, follow appropriate safety measures.



Check that auxiliary circuits wiring is done per the wiring diagrams and manuals provided with the equipment.

### 6.1.- Measurement circuit current and voltage testing

Perform the following current and voltage tests and checks in the measurement circuits:

- Current and voltage measuring transformer transformation ratio. Generally 110 volts and 5 amps.
- Proper placement of current transformer(s)
- Transformer polarity
- Current and voltage transformer phase sequence.



Improper measurement circuit connection may cause the equipment to malfunction or result in damage to it.



Do not disconnect the current transformer secondary without first shunting it. Operation of a transformer with the secondary open will cause accumulation of high voltage that could damage it and/or cause serious human injury.

### 6.2.- Checking auxiliary power supply

Use the wiring diagrams provided to verify the power supply voltage required for the various auxiliary circuits, including:

- Reactive regulator power supply
- Protection relay power supply
- Power contactor
- Circuit breaker
- Interior lighting
- Heating elements
- Fans
- Others

## 7.- START-UP

### 7.1.- Before starting up

Check the following:

- The equipment has been assembled according to the documentation provided.
- Torque specifications.(Remember that maximum capacitor torque is 8 Nm.)
- Isolation distances between power cable terminals and the structure.

Degree of isolation	Minimum distance [mm]
20/60	90
28/75	120
38/95	160
50/125	220
70/170	320

*Minimum distances required per IEC 60071-2 standard*

- Capacitor capacity>Contact the manufacturer in the event of deviations.
- Check that capacitors have not lost any oil during assembly.
- Check network voltage.This should not exceed the equipment nominal voltage by more than 5%.
- Operating environment conditions.IEC 60871 standard maximum operating temperatures are shown in the following table.

	TEMPERATURE	AIR TEMPERATURE	AMBIENT TEMPERATURE
Symbol	Maximum Temperature	Highest average during any 24-hour period	In a period of one year
A	40	30	20
B	45	35	25
C (*)	50	40	30
D	55	45	35

(\*) Temperature class of the material supplied

## 7.2.- Automatic capacitor bank

An automatic capacitor bank has one or more steps that may be operated manually or by a power factor regulator.



For optimum start-up, the line load status must be appropriate for the particular capacitor bank. This will enable the equipment to cycle through all its steps so that proper operation can be verified.

If the equipment comes with a power factor regulator the following must be considered:

- The operation of this regulator must be known prior to start-up, a specific manual is enclosed for this. This is required because the regulator parameters must be programmed to correctly read  $\cos \phi$  values at start-up. The regulator will then connect or disconnect operation elements that act upon the capacitors as appropriate.
- It is essential that the bank main circuit breaker be connected before powering the regulator. This will enable a stepped operation of the bank, avoiding a connection surge that could damage the equipment.
- Ensure that all operation protection circuit breakers are in normal position.
- The equipment includes a two-position switch in the control panel to start the regulator. If the regulator does not show any activity, check for adequate power supply and proper condition of fuses.



Fig. 16.- Power factor regulator.



After start-up, check for proper equipment operation, and for operating temperature after 24 hours of operation.


## 7.3.- Warnings and notes


- The current absorbed by the bank capacitors can exceed the nominal due to the presence of harmonics in the supply or a voltage higher than the nominal. Both circumstances are harmful for capacitors.

The current absorbed by each capacitor, measured at the corresponding contactor output, should be the nominal indicated in the specification tag, and never exceed 1.3 times that figure.

To prevent measurement errors, only meters that measure true rms should be used.

- Per IEC 60871-1 standards, the capacitor is prepared to operate continuously at up to 10% overvoltage for up to 12 hours out of each 24 hour day.

	During periods of low load, manually connecting the entire bank is not recommended, as in some cases resonance with the installation power transformer could occur.
---	---

	<b>If manual connection is necessary, first allow the capacitors to discharge (as indicated in the specifications tag) before reconnecting them to the supply. Otherwise, they could start-up out of phase with a voltage of up to <math>2xU_n</math> causing destruction of the capacitor.</b>
---	---

## 8.- MAINTENANCE

### 8.1.- Safety regulation



Apply safety regulations before operating the equipment.



The standards and applicable laws of the country where the capacitor bank is installed or operated should be strictly followed.

- Disconnect the bank Disconnect bank main breaker, as well as the isolator switch (if included), so that the disconnection may be observed visually.
- Allow capacitors to discharge (10 minutes).
- If the equipment includes a grounding isolator switch, move it to the closed position (shunt to ground), indicated by "C" on the specifications tag.
- Access the equipment using its doors or, in their absence, by removing the necessary panels.
- Check for the absence of voltage at the various phases and points of the circuit: service entrance, input-output contactors, isolator switches and circuit breakers
- Shunt the capacitor phases and ground with a grounding set.
- Post signs designating the work area.
- Working on the bank
- Proceed in reverse to reconnect.

## 8.2.- Maintenance operations

### 8.2.1.- General maintenance operations

Bi-annual maintenance checklist:

- Visually inspect capacitors.
- Examine condition of fuses.
- Check supply voltage and absorbed current, especially under low load.

Annual maintenance checklist:

- Physical inspection of capacitors  
Measurement of capacities  
Any capacitor with a capacity change of 5% must be replaced.
- Verify torque of all connections.  
Recommended torque for capacitor porcelain insulator connector screws is 10 Nm.  
Adjust all other connections to 25 Nm.
- Check temperature.
- Check voltage and current in equipment terminals.
- Keep the capacitor terminals and insulators clean.



Do not use terminals to manipulate capacitors. Doing so may break the welds, causing oil and insulation loss.

### 8.2.2.- Regulator replacement

- Note configuration parameters.
- Identify each conductor.
- Check for absence of voltage.  
Disconnect both the power supply and the regulator supply.
- Shunt the S1-S2 current transformer secondary.  
If this cannot be done at the bank, it may be done at the transformer supply cable terminals.
- Replace the regulator.
- Connect according to the diagram on the back of the regulator.
- Remove the current transformer shunt.
- Power up the regulator.
- Program the regulator (see manual).
- Verify proper operation of regulator.

### 8.2.3.- Replacing the fuses

- Disconnect equipment and allow capacitors to discharge (10 minutes).



- Check for the absence of voltage.
- Shunt the capacitor phases and ground with a grounding set.
- Check for absence of voltage.
- Examine condition of fuses.
- Replace the fuses.
- Check that they are well seated and installed.
- Remove the phase and ground shunt.
- Connect equipment power supply.

#### **8.2.4.- Replacing an operation contactor/switch**

- Disconnect equipment and allow capacitors to discharge (10 minutes).
- Check for absence of voltage.
- Shunt the capacitor phases and ground with a grounding set.
- Check for absence of voltage.
- Identify the order of phases and control cables. Remove the contactor.
- Install the new contactor, following the order of phases and of control.
- Connect equipment power supply.
- Check proper operation of contactor.

### **8.2.5.- Replacing the capacitors**

- Disconnect equipment and allow capacitors to discharge (10 minutes).
- Check for absence of voltage.
- Shunt the capacitor phases and ground with a grounding set.
- Check for absence of voltage.
- Remove capacitor connectors and terminals.
- Remove the capacitor using the fins on its sides (never handle the capacitor by its terminals).
- Check that the features of the capacitor to be installed match those of the one removed.
- Install and reconnect the capacitor. Verify terminal connector torque.
- Connect equipment power supply.
- Check correct operation of capacitor.

### **8.3.- Procedures in case of anomaly**

If a critical situation occurs (overpressure, short-circuit, etc.), proceed as follows:

- Disconnecting the bank. Shut off the capacitor main breaker and secure it with the built-in safety lockouts. Do not try to use the bank ground isolator switch.
- Put up a safety perimeter at a radius of at least 20 meters from the bank.
- Immediately contact LIFASA technical assistance service.

## 9.- WASTE DISPOSAL

To dispose of an unserviceable capacitor, proceed as follows:

- Disconnect the capacitor and allow it to discharge for 10 minutes prior to disassembly, check for the absence of voltage, and shunt phases and ground. Anything that remains connected should be disconnected.
- Using safety footwear, class 3 insulating gloves and goggles, shunt both capacitor terminals with a conductor cable to remove any residual charge that may remain.
- Obtain a 15-20 liter capacity container with a wide opening. Use safety gear such as goggles, rubber gloves and safety footwear, to protect from possible projectiles, and break the ceramic insulators with a hammer. Tip the capacitor and pour its oil into the container, allowing it to drain completely. This oil does not contain PCBs or any other toxic agent requiring special treatment. So it may be disposed of at any plant or recycling site that accepts common oils.
- The rest of the capacitor comprises the housing (stainless steel) and the capacitive elements (aluminium, film and paper). To separate these two components for recycling, after emptying use a metal cutting tool to make a perimetral cut, preferably along its transverse axis. Separate the halves and remove the capacitive components. The housing may be disposed of with metals and the capacitive elements along with general waste.

## 10.- GUARANTEE

LIFASA guarantees its products against any manufacturing defect for two years after equipment delivery.

LIFASA will repair or replace any defective factory product returned during the guarantee term, accompanied by a certified letter specifying the reasons for the return. No product or element will be accepted without this certified letter.

Failure to follow the installation and maintenance instructions or improper use of the equipment will void this guarantee.

## 11.- TECHNICAL ASSISTANCE

LIFASA provides advice and technical assistance services throughout Spain for the planning and installation of capacitors, automatic power factor correction equipment and harmonics filters.

### LIFASA

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## 12.- ANNEX – CHECKLIST

Model	
Serial no.	
Verification date	

**OK** – Verified correct  
**OBS** – Any notes or observation should be recorded in the following chapter: "Notes/Observations"  
**NA** – Not applicable.

<b>VISUAL INSPECTION</b>	
1. Check nominal voltage, composition, current, frequency and serial no.	
2. Site conditions (temperature, moisture, cleanliness)	
3. Site	
4. Housing (check surface and cleanliness)	
5. Internal structure (verify screw and nut torques, loose connections, damage to internal elements)	
6. Check structural connectors.	
7. Condition of capacitors	
8. Condition of other components	

<b>WIRING INSPECTION</b>	
1. Nominal voltage of all control components consistent with their supply voltage.	
2. Review power cable connections (according to diagram provided)	
3. Review connection of current and voltage measurement cables (according to diagram provided and polarity)	
4. Review connection of auxiliary power supply cables (according to diagram supplied).	
5. Check that all components with metal parts are connected to a functioning ground.	

<b>INSPECTION, OPERATION AND PROTECTION</b>	
1. Check regulator programming and measurement (installation minimum load condition).	
2. Check protection relay programming.	
3. Check reclosing system safety delay (according to bank documentation).	
3. Check required operation behavior (perform without the power part connected)	
4. Check required operation behavior (performed with the power part connected)	

Name and signature

