



Low voltage capacitor banks with detuned filters and static operation by semiconductors.

OPTIM FRES/FRE Series



INSTRUCTION MANUAL

(M099B01-03-19A)



SAFETY PRECAUTIONS

Follow the warnings described in this manual with the symbols shown below.

	DANGER Warns of a risk, which could result in personal injury or material damage.
	ATTENTION Indicates that special attention should be paid to a specific point.

If you must handle the unit for its installation, start-up or maintenance, the following should be taken into consideration:

	Incorrect handling or installation of the unit may result in injury to personnel as well as damage to the unit. In particular, handling with voltages applied may result in electric shock, which may cause death or serious injury to personnel. Defective installation or maintenance may also lead to the risk of fire. Read the manual carefully prior to connecting the unit. Follow all installation and maintenance instructions throughout the unit's working life. Pay special attention to the installation standards of the National Electrical Code. The installation, operation and maintenance of LV units must only be carried out by authorised installers. LV regulations (Art. 22) specifically define the requirements that authorised installers must meet. If in order to install the unit, you must work in areas that have high-voltage (HV) units installed, take into account that the personnel handling units in this area must be authorised to work in HV installations. See National Electric Code 55/2004 dated 18-06-2004, which regulates the requirements and the operation of high-voltage installation and maintenance companies.
	Refer to the instruction manual before using the unit In this manual, if the instructions marked with this symbol are not respected or carried out correctly, it can result in injury or damage to the unit and /or installations.

CIRCUTOR, SA reserves the right to modify features or the product manual without prior notification.

DISCLAIMER

CIRCUTOR, SA reserves the right to make modifications to the device or the unit specifications set out in this instruction manual without prior notice.

CIRCUTOR, SA on its web site, supplies its customers with the latest versions of the device specifications and the most updated manuals.

www.circutor.com



	CIRCUTOR , recommends using the original cables and accessories that are supplied with the device.
---	---

CONTENTS

SAFETY PRECAUTIONS	3
DISCLAIMER	3
CONTENTS.....	4
REVISION LOG.....	5
1.- VERIFICATION UPON RECEPTION	6
1.1.- RECEPTION PROTOCOL	6
1.2.- TRANSPORT AND HANDLING	6
1.3.- STORAGE.....	7
2.- PRODUCT DESCRIPTION	8
2.1.- FAST REGULATOR.....	8
2.2.- CPC4 PANEL: STEP-BY-STEP CONNECTION CONTROL.....	8
2.3.- POWER BLOCK.....	9
3.- INSTALLATION	10
3.1.- PRELIMINARY RECOMMENDATIONS	10
3.2.- PREPARATION.....	11
3.3.- PLACE OF INSTALLATION	12
3.4.- CONNECTION OF THE CAPACITOR BANK TO THE GRID	12
3.5.-POWER CIRCUIT	13
3.6.- EXTERNAL CIRCUIT BREAKER AND PROTECTION ELEMENTS.....	14
3.7.- AUXILIARY CONTROL VOLTAGE.....	14
3.8.- EARTH CABLE CONNECTION	14
3.9.- CURRENT TRANSFORMER (CT) CONNECTION	14
4.- CAPACITOR BANK START-UP	16
4.1.- BEFORE START-UP.....	16
4.2.- START-UP.....	17
4.3.- CHECKS ONCE THE CAPACITOR BANK HAS BEEN CONNECTED AND THE REGULATOR	18
5.- MAINTENANCE.....	19
5.1.- SAFETY REGULATIONS	19
5.2.- MAINTENANCE WITH THE CAPACITOR BANK DISCONNECTED	19
5.2.1. BASIC MAINTENANCE PROTOCOL	19
5.2.2. KEY POINTS FOR INSPECTING THE SEMICONDUCTORS	20
5.2.3. KEY POINTS FOR INSPECTING CAPACITORS.....	20
5.2.4. KEY POINTS FOR INSPECTING THE REGULATOR	20
5.2.5. CLEANING THE CABINET	20
5.3.- MAINTENANCE WITH THE CAPACITOR BANK CONNECTED	21
5.3.1. REGULATOR CHECKS.....	22
5.4.- ENVIRONMENTAL CONDITIONS.....	22
6.- TECHNICAL FEATURES	23
7.- STANDARD ELECTRICAL DIAGRAMS	24
8.- MAINTENANCE AND TECHNICAL SERVICE.....	29
9.- GUARANTEE.....	29
10.- CE CERTIFICATE.....	30

REVISION LOG

Table 1: Revision log.

Date	Revision	Description
09/16	M099B01-03-15A	Initial Version
11/19	M099B01-03-19A	Changes in the following sections: 3.2. - 4.2. - 10.

Note: The images of the devices are for illustrative purposes only and may differ from the original device.

1.- VERIFICATION UPON RECEPTION

1.1.- RECEPTION PROTOCOL

Check the following points when you receive the device:

- a) The device meets the specifications described in your order.
- b) The device has not suffered any damage during transport.
- c) Perform an external visual inspection of the device prior to switching it on.
- d) Check that it has been delivered with the following:
 - The device manual
 - The installed regulator manual.



If any problem is noticed upon reception, immediately contact the transport company and/or **CIRCUTOR's** after-sales service.

1.2.- TRANSPORT AND HANDLING



The transport, loading and unloading and handling of the device must be carried out with proper precautions and using the proper manual and mechanical tools so as not to damage it.

If the device is not to be immediately installed, it must be stored at a location with a firm and level floor, and the storage conditions listed in the technical features section must be observed. In this case, it is recommended that the device be stored with its original protective packaging.

To move the device a short distance, the device's floor support profiles facilitate handling with a pallet jack or forklift. (**Figure 1**)

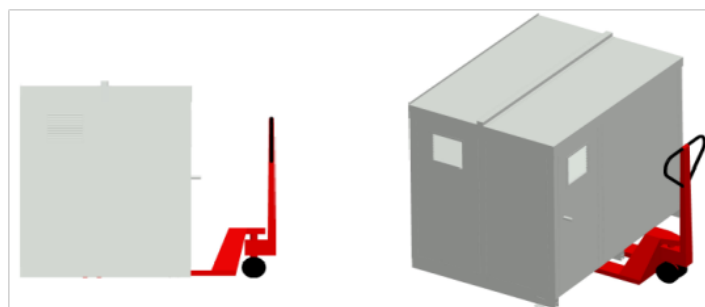


Figure 1: Transport with pallet jack.



The centre of gravity of some devices may be found at a considerable height. Therefore, when handling with a forklift, it is recommended that the device be securely fastened and that no abrupt manoeuvres be made. The device should not be lifted more than 20 cm off the ground.

When unloading and moving the device, use a forklift with forks long enough to support the entire length of the base. Otherwise, the forks should be long enough to support at least $\frac{3}{4}$ of said

depth. The forks must be flat and supported firmly by the base. Raise the cabinet by placing the forks underneath the profile that supports the device. (Figure 2).



There might be an offset in the centre of gravity from the centre of the cabinet, as a result of the uneven distribution of loads inside the device. The necessary precautions must be taken to prevent the device from tipping over during abrupt operations.

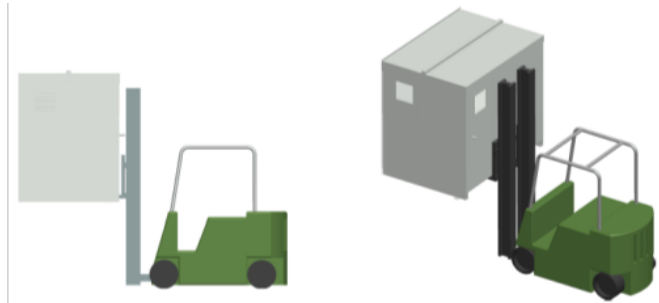


Figure 2: Unloading with a forklift.

1.3.- STORAGE

The following storage recommendations must be followed for the hybrid capacitor banks:

- ✓ Avoid placing them on uneven surfaces.
- ✓ Do not store them in outdoor areas, humid areas or areas exposed to splashing water.
- ✓ Avoid hot spots (maximum ambient temperature: 40 °C)
- ✓ Avoid salty and corrosive environments.
- ✓ Avoid storing the devices in areas where a lot of dust is generated or where the risk of chemical or other types of contamination is present.
- ✓ Do not place any weight on top of the device cabinets.

2.- PRODUCT DESCRIPTION

The purpose of this manual is to assist during the installation, start-up and maintenance of **OPTIM FRES/FRE** series low voltage (LV) capacitor banks with detuned filters and operation by semiconductors. Carefully read the manual to achieve the best performance from those devices.

From the electrical standpoint, the device is made up of the following blocks:

2.1.- FAST REGULATOR

The static capacitor banks are equipped with **computer Max 6f V12dc** fast regulators. The outputs of these regulators are static, i.e. instead of an output via relay contact, these regulators have a semiconductor-based switch, which enables them to perform operations in fast succession and in practically every network cycle.

These outputs provide a 12 Vdc activation signal to the + and - inputs of the connection controller boards, as opposed to the **CPC4** type zero voltage.

Fast regulators enable regulation with minimum delay, generally between 20 and 100 ms (See the manual or quick guide of the specific regulator being used)

2.2.- CPC4 PANEL: STEP-BY-STEP CONNECTION CONTROL

The static capacitor banks come equipped with **CPC4** boards.

The role of the **CPC** panels is to control the zero-crossing step connection of the semiconductor-diode modules, and so avoid connection current transients.

The standard connection diagram of a step can be seen in **Figure 3** and with more detail in the single-line diagrams in section **7.- STANDARD ELECTRICAL DIAGRAMS**.

The **CPC** panels are activated via a 12 Vdc signal supplied by the **6f V12dc Computer Max** regulator outputs. The standard **CPC4** is ready for U_{max} mains : 440 V.

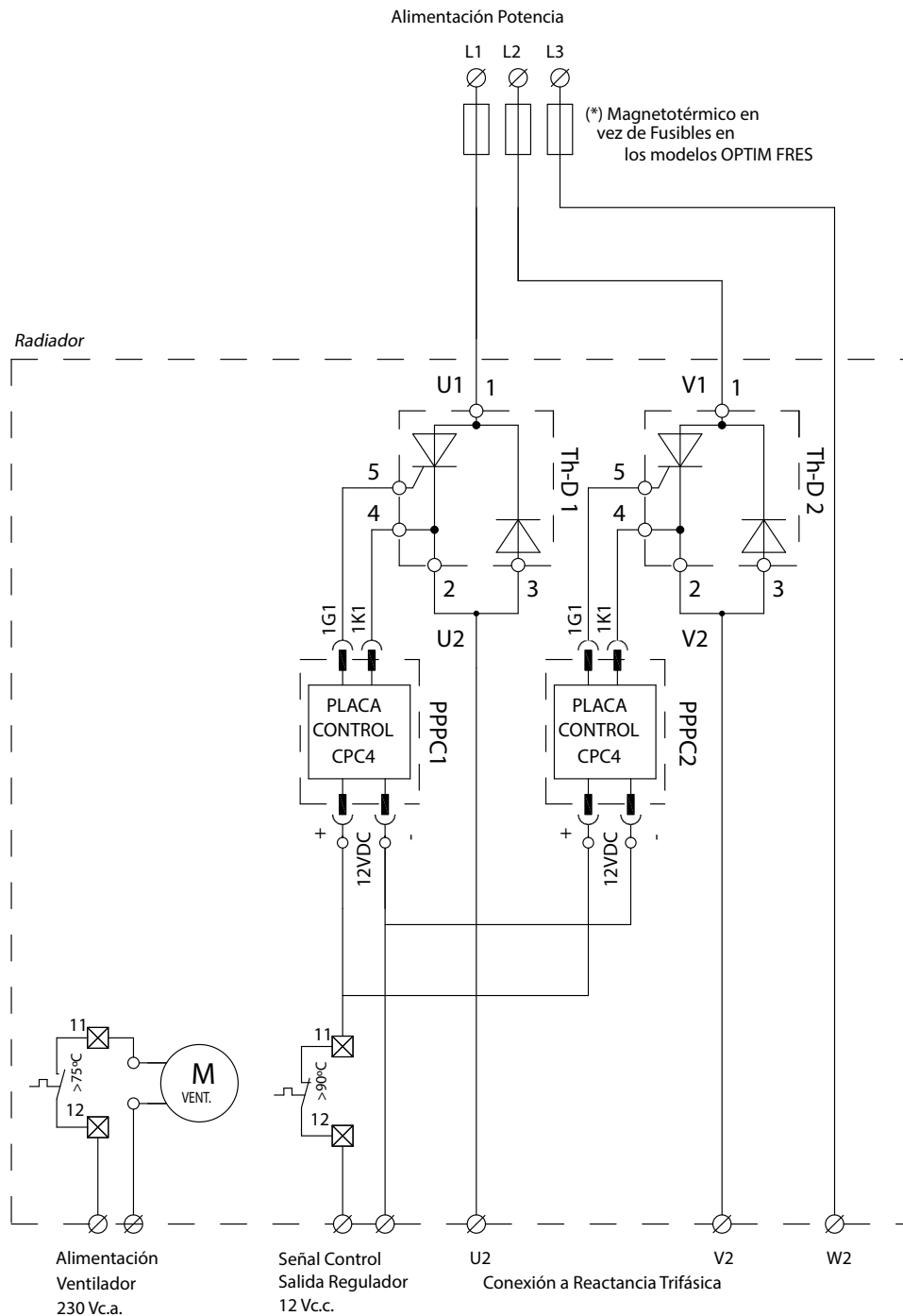


Figure 3: Basic connection diagram of the CPC4 to the power block.

2.3.- POWER BLOCK

The power block of an **OPTIM FRES/FRE** device consists of step protection (three-pole circuit breaker for **OPTIM FRES** models, and a NH-00 fuse in each phase for **OPTIM FRE**) models, two semiconductor-diode semiconductors, controlled by a **CPC4** panel and mounted on a heat-sink, also equipped with a fan, a three-phase filter reactor and one or more cylindrical three-phase capacitors, depending on the power and voltage of the stage.

You can find a more detailed description in the single-line diagrams in section **7.- STANDARD ELECTRICAL DIAGRAMS**.

3.- INSTALLATION

3.1.- PRELIMINARY RECOMMENDATIONS

	In order to use the device safely, it is critical that individuals who handle it follow the safety measures set out in the standards of the country where it is being used, use the personal protective equipment necessary, and pay attention to the various warnings indicated in this instruction manual.
	Installation or maintenance personnel should read and understand this manual before operating the device. A copy of this manual should always be available to maintenance personnel for reference purposes
	Connecting the device to the public mains must be carried out in compliance with the EN-IEC60204-1 standard, regarding the safety of LV electrical installations.
	It is recommended that several personnel are present when handling the device for installation or maintenance. If damage or faults are detected during device operation, or in circumstances that compromise safety, immediately stop work in that area and disconnect the device in order to check it without voltage.

The manufacturer of the device is not responsible for any damage resulting from failure by the user or installer to heed the warnings and/or recommendations set out in this manual, nor for damage resulting from the use of products or accessories that did not come with the device or that were made by other manufacturers.

If an anomaly or malfunction is detected in the device, do not use it to perform any operation.

	Modifying, upgrading or rebuilding the device without written authorisation from the manufacturer is prohibited.
	The installation, operation and maintenance of low voltage (LV) devices must only be carried out by authorised installers. LV regulations (Art. 22) specifically define the requirements that authorised installers must meet.
	Do not access the active elements of a capacitor bank with static operation that has been powered and might have voltages present. Wait at least 5 minutes after the power supply has been disconnected.
	Do not touch the terminals or active parts of the device until you have verified that voltage is not present. If you have to handle or touch the terminals or other control panel components, use adequately insulated personal protection equipment and tools.
	After any maintenance and before re-connecting the power supply to the device, check that its enclosure is properly closed and that no items or tools were left inside that could cause a short-circuit.



Do not disconnect the current transformer secondary without short-circuiting it first. The operation of a current transformer with an open secondary will cause an overvoltage that could damage it and electrocute the person handling it.

3.2.- PREPARATION

The **CIRCUTOR OPTIM FRES/FRE** static capacitor banks come ready for easy installation and start-up.

Remove the packaging of the device and verify that its electrical features are suitable for connection to the available mains. To do so, check the features label located inside the cabinet next to the regulator, see **Figure 4**.

Key data to be checked:

- ✓ Mains frequency and voltage, U_n / f_n .
- ✓ Nominal power of the capacitor bank, Q_n (kvar) and composition.
- ✓ Type of filter, identified by the factor p%.
- ✓ Current consumption, I_n . This current must be considered to select the proper size of the power supply cable of the device and ultimately the circuit breakers and protection elements to be connected in front of it.
- ✓ Auxiliary control voltage, U_{aux} . (See "**3.7.- AUXILIARY CONTROL VOLTAGE**")
- ✓ Environmental conditions. (See "**6.- TECHNICAL FEATURES**")

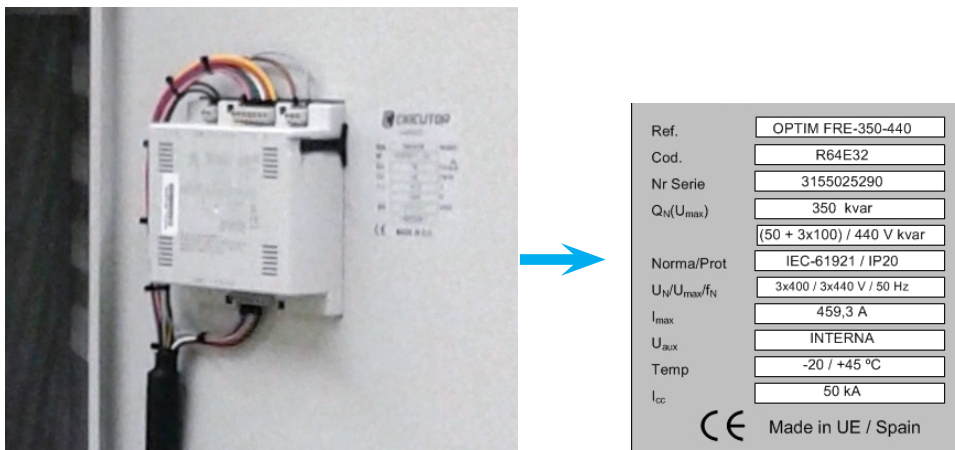


Figure 4: Features label.

3.3.- PLACE OF INSTALLATION

It is important to maintain a minimum distance around the device to facilitate cooling.

In self-supporting cabinets, the back and front sides of the cabinet must be kept at least **50 cm** away from walls of other devices and structures to allow for ventilation.

In terms of the side walls, it is recommended that a separation of **10 cm** be maintained between adjacent cabinets.

On wall-mounted cabinets, it is recommended that at least **20 cm** of separation be maintained between the sides of adjacent cabinets.

Make sure the device can be accessed easily.

The environmental conditions of the place where the device is installed must not exceed the limits set forth in the technical features (See "**6.- TECHNICAL FEATURES**")

To ensure proper ventilation, the device must be installed in a vertical position.

In accordance with LVR, once the device is installed, it must be protected against direct and indirect contacts; therefore, a circuit breaker and earth leakage protection for the capacitor bank power supply line should be installed.

3.4.-CONNECTION OF THE CAPACITOR BANK TO THE GRID



Check that the rated voltage of the capacitor bank coincides with the voltage between phases of the grid where it is being connected.
Also check the operating circuit voltage (semiconductors).
(See "**3.7.- AUXILIARY CONTROL VOLTAGE**")



For feeding cables into the capacitor bank cabinet, always and only use the cable entry points available for this purpose.
All models have a cable entry point on the bottom (base of the cabinet) as well as a cable entry point on the side.

Figure 5 shows the cable entry points of the **OPTIM FRES** models.

Figure 6 shows the cable entry points of the **OPTIM FRE** models.

If another part of the cabinet is cut out to be used for cable entry, the CIR-CUTOR manufacturer's guarantee shall be rendered void.



Do not cut holes in other parts of the cabinet for feeding cables through or for installing support brackets.

It may produce trimmings that can cause short-circuits.



Figure 5: Cable entry points of the OPTIM FRES models.



Figure 6: Cable entry points of the OPTIM FRE models.

3.5.-POWER CIRCUIT

Connect input terminals L1, L2 and L3 (power circuit) to the mains using a cable with a suitable cross-section, in accordance with the LVR, ITC-BT-19.

Generally, the cables of the phases are according to the following colour code: L1 (black), L2 (brown), L3 (grey).

In order to determine the size of the phase cables, consider the nominal current I_n indicated on the device label which should be able to withstand transient overloads of 1.5 times I_n .

3.6.- EXTERNAL CIRCUIT BREAKER AND PROTECTION ELEMENTS

If the capacitor bank does not have an internal switch or isolation switch, it must be connected to a line that has an external switch or isolation switch.



The protection elements, isolation switches and/or switches that are added externally to the capacitor bank must be of a minimum size to withstand a current 1.5 times greater than what is indicated on the label (LVR, ICT-BT-48)

If an earth leakage protection for the capacitor bank is installed, its sensitivity and trip delay must be adjustable.

When the capacitor bank is connected to the mains, it is recommended that the current transformer (CT) is placed on the phase going to L1 (black cable).

Outputs S1 and S2 of the CT must be connected to the terminals with the same name.

3.7.- AUXILIARY CONTROL VOLTAGE

Control circuits are defined as those related to the regulator's output relays and the capacitor's operating semiconductors, and to the forced ventilation systems (heatsink fans).

The control circuit of the zero-crossing control boards (operation of the semiconductors), is powered at 12 Vdc directly from the output of the reactive regulator.

In terms of the fans, these are usually powered with a 230 V~ auxiliary voltage (most common).

For the standard models from the **OPTIM FRES** and **OPTIM FRE** range, the **auxiliary voltage is supplied from an internal AUTOTRANSFORMER**: Does not require connection of the external neutral. The label indicates U_{aux}/f ... internal

3.8.- EARTH CABLE CONNECTION

Connect the earth cable to the capacitor bank's earth terminal located on the operating panel of the device.

The cross-section of the earth cable must be selected in accordance with the admissible current limits established in the LVR (ITC-BT-19 – Internal or receiver installations) for each type of cable and location.

3.9.- CURRENT TRANSFORMER (CT) CONNECTION

	A current transformer (CT) that is external to the capacitor bank must be installed to measure the total load current plus that of the capacitor bank (Figure 7).
	The standard transformer must have a nominal output of 5 A at the secondary. We recommend connecting the CT to phase L1 in the direction of the current flow from P1 to P2 (see Figure 7) and connecting the secondary (terminals S1, S2) to the terminals with the same name on the capacitor bank (see Figure 7)
	Avoid current flow through the CT primary winding prior to connecting it to terminals S1 S2 of the bank. If the CT must be installed while the installation is under load, short-circuit S1 and S2 while they are not connected to the capacitor bank.

The current value of the CT primary winding must be equal to or slightly greater than the size of the mains switch of the installation. Therefore, the CT must be able to measure the maximum current expected to be consumed by all the loads being compensated.

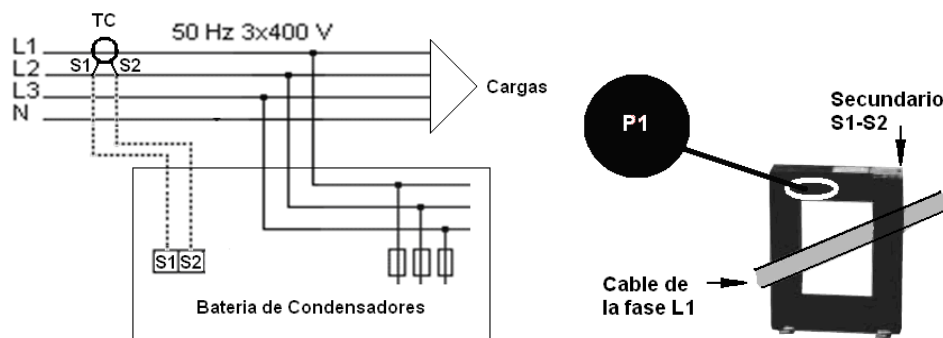


Figure 7: Installation of the external current transformer (CT).

The connection point of the CT for a capacitor bank that compensates an entire installation is after the mains switch of the installation.

To prevent excessive attenuation of the signal, it is recommended that the minimum cross-section of the secondary section winding cable (terminals S1, S2) is at least **2.5 mm²**.

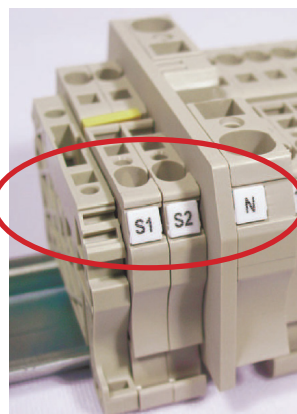


Figure 8: Current transformer (CT) connection terminals.

Once the cables are installed, disconnect the jumper connecting the S1 and S2 terminals or the yellow jumper, according to the terminals of the capacitor bank (**Figure 9**)

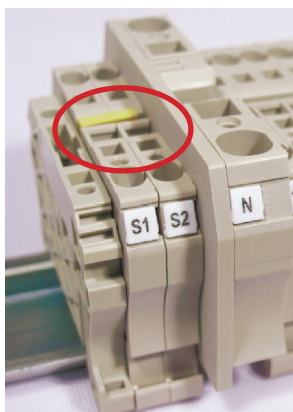


Figure 9: Jumper for short-circuiting the secondary winding of the current transformer (CT).



Any time you wish to change or disconnect a current transformer that is already installed, it is important to install the jumper connecting S1 and S2.

4.- CAPACITOR BANK START-UP

4.1.- BEFORE START-UP

The automatic capacitor banks include a power factor regulator.

	The operation of said regulator must be known prior to start-up; for this reason, all the capacitor banks include a specific manual for the regulator used. Ensure you have this manual available for the start-up process.
	In order to adjust the regulator incorporated to the capacitor bank and for optimum start-up, the installation's state of charge must be at least 30% or 40% of the nominal load for which the capacitor bank has been dimensioned. If all the stages are not included, they can be manually connected to check them all.
	During low load periods, the entire capacitor bank should not be connected manually, as in some cases resonance with the power transformer of the installation could occur.
	The capacitors are connected in manual mode, first allow enough time for the capacitors to discharge (as indicated in the capacitor bank's features label) before reconnecting them to the network. Otherwise, they could start-up out of phase with a voltage of up to $2xU_n$ causing the destruction of the capacitor.

4.2.- START-UP

	Before operating the devices, follow the safety regulations indicated in section “3.- INSTALLATION ” of this manual. The National Electric Code of the country where the capacitor bank is installed or operated should be strictly followed.
---	--

1.- Make sure that the internal circuit breaker that protects the regulator (two-pole or three-pole depending on the regulator) is connected (| position).

2.- Apply power supply to the panel and check that the regulator display illuminates immediately. Otherwise, stop and check the previous step.

3.- Check the regulator's **cos φ** indication.

If the indication is out of range **0.5** to **1**, it may be possible that the current transformer and/or the power supply to the regulator are not properly connected.

Most of the regulators use only one current transformer. In this case, connect according to **Figure 11** (place the current transformer on phase L1 and take the power supply voltage from phases L2 and L3).



Figure 10: 12 Vdc Computer Max Fast Regulator (Photo for illustrative purposes, the model used in your device may differ).

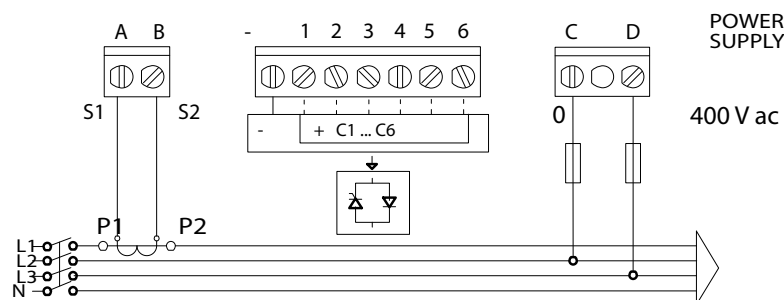


Figure 11: Connection of a regulator with only one CT. (If using 12 Vdc Computer SMART III, 3 CT are used. Check the specific manual.)

4.- After ensuring that the regulator is properly connected, adjust the regulator parameters for the installation you are attempting to compensate. For this, follow the regulator's instructions manual included with the battery.

4.3.- CHECKS ONCE THE CAPACITOR BANK HAS BEEN CONNECTED AND THE REGULATOR

1.- After start-up, make sure that the device is operating correctly. A sign of proper operation is when the display indicates a $\cos \varphi$ close to 1 and the reactive energy meter stops (if it is electromechanical) or the blinking rate of the kvar.h/pulse ratio indicator LED slows down.

2.- Check that the power supply voltage does not exceed the nominal value +10% (IEC 60831-1).

3.- Check the current absorbed by each capacitor.

Under normal conditions, it must be close to the nominal value indicated on its dataplate and never exceed 1.3 times this value constantly.

Continuous consumption over the nominal value may be caused by the presence of harmonics in the network or an excessively high power supply voltage. Both circumstances are harmful for capacitors.

4.- In accordance with the IEC 60831-1 Standard, the capacitor is prepared to operate at the permanent voltage assigned to it and with an overvoltage of up to 10% for 8 out of every 24 hours.

NOTE: For capacitor banks with filters, the capacitor's voltage exceeds the network voltage by a % that is approximately equal to the overvoltage factor of the filter (p%). In fact, the capacitor's real overvoltage is:

$$\frac{\Delta V_C}{V_{RED}} \% = \frac{100 \cdot p\%}{(100 - p\%)}$$

5.- To check the correct tuning of the filter, make sure that the voltage on the terminals of each winding of the reactor is:

$$V_L = V_{RED} \cdot \frac{100 \cdot p\%}{(100 - p\%)}$$



Check the working temperature of the capacitors and reactors after they have been operating for 24 hours.

The capacitor capsule must be under 40°C.

The housing of reactors can reach temperatures of about 70 °C

5.- MAINTENANCE

5.1.- SAFETY REGULATIONS



Before operating the devices, follow the safety regulations indicated in section **“3.1.- PRELIMINARY RECOMMENDATIONS”**

The National Electric Code of the country where the capacitor bank is installed or operated should be strictly followed.

5.2.- MAINTENANCE WITH THE CAPACITOR BANK DISCONNECTED

5.2.1. BASIC MAINTENANCE PROTOCOL

Monthly:

- ✓ Visually inspect the capacitors.
- ✓ Check the protection fuse.
- ✓ Control the ambient temperature (average of 35 °C. In accordance with IEC 60831).
- ✓ Control the service voltage (especially during moments of low load, when it must not exceed the nominal +10%).

Biannually:

- ✓ Keep the capacitor and reactor terminals clean.
- ✓ Force the disconnection of all of the capacitors (refer to the regulator's instruction manual to perform this operation). Once all disconnected, verify that the current consumed by the three phases is practically zero. If there is a current in any of the phases, this indicates that a semiconductor is short-circuited.
- ✓ Check that the capacitor current is not lower than 25% nor greater than 120% of the nominal value by phase and that there is no phase unbalance greater than 15%.

Annually:

- ✓ Perform a dielectric rigidity test by applying **2.5 kV** for **1** second between the terminals of the capacitor and earth.

Note: *The thyristors must be short-circuited to perform the insulation test on static capacitor banks.*

- ✓ Check the capacity of the capacitors at the different steps.
One indirect check may be to check that the consumption is nominal.
- ✓ Check the tightening torque of all terminal connections on the different power elements.
- ✓ Inspect the fuses and/or circuit breakers (depending on model).
- **Power Circuit:** NH fuses. Check continuity and temperature.
- **Power Circuit:** Check the continuity and temperature of the three-pole circuit breaker.
- **Control Circuit:** Check the continuity and temperature of the two-pole or three-pole circuit breaker, depending on the regulator.

5.2.2. KEY POINTS FOR INSPECTING THE SEMICONDUCTORS

- ✓ Check that the plastic parts are not blackened and do not show signs of burning or hardening.
- ✓ The terminals must be clean.

✓ **Cleaning the semiconductors:** In dirty environments (dust, sawdust, rust particles, etc.) vacuum the contactor periodically.

There is no estimated time frame for cleaning, it depends on the amount of dirt that is inside the capacitor bank.

5.2.3. KEY POINTS FOR INSPECTING CAPACITORS

- ✓ Inspect the cables and terminals. They should not be overheated or blackened.
- ✓ The terminals must be clean.
- ✓ The slow discharge resistors must be in good condition. They must not be open or show signs of burning.
- ✓ Check the tightness of the capacitor terminals, as shown in **Table 2**.

Table 2: Torques of the cables to the capacitor terminals.

Cylindrical capacitor	Power terminal torque (Nm)
CLZ-FP	2

5.2.4. KEY POINTS FOR INSPECTING THE REGULATOR

- ✓ Check that the regulator does not show signs of deterioration and the display is lit as normal.
- ✓ Inspect the cables and terminals. They should be clean and should not be hardened or overheated.
- ✓ Inspect the connections and the insertion of removable power strips:
 - The power strips must be well fastened on removable regulators.
 - Check that the terminals are tightened properly. The recommended torque is **0.6 Nm**.

5.2.5. CLEANING THE CABINET

- ✓ Remove possible metallic and non-metallic particles.
- ✓ Clean the inside of the cabinet.
- ✓ Clean ventilation grilles.

5.3.- MAINTENANCE WITH THE CAPACITOR BANK CONNECTED

- ✓ Check that the main switch turns on and off without having to force the mechanism.
- ✓ If there is individual earth leakage protection for the capacitor bank, check its proper operation by pressing the test button.

- ✓ Check that the auxiliary control voltage is within the tolerance limits.

If the capacitor bank has an autotransformer, check that it is in good condition and shows no signs of deterioration.

- ✓ Force the connection and disconnection of the capacitors in manual mode. (refer to the regulator's manual before carrying out these actions) and perform the following checks:

- Check that the semiconductors connect and disconnect properly.

Check that there is no consumption in any phase when a step is disconnected. If there is consumption this means that one of the thyristors is defective (is short-circuited).

- Check the consumption of the capacitors in each of the phases.

The nominal values are shown in **Table 3**.

- Check the voltage on all of the reactor's windings (input - output of the same winding, not between phases). The voltage depends on the p% factor of the filter (see p% value label on the device), in accordance with the following formula:

$$V_L = V_{RED(fase-fase)} \frac{0.577 p\%}{(100 - p\%)}$$

Example: For the 400 V grid and p%=7, $V_L=17.38$ V. For the 400 V grid and p%=14, $V_L=37.57$ V. The value is proportional to the voltage for other voltages.

Table 3: Nominal consumption of the capacitor paths, by power.

Power	In, Current	
	3 x 230 V ~	3 x 400V~
2.5 kvar	6.28 A	3.6 A
5 kvar	12.56 A	7.2 A
7.5 kvar	18.85 A	10.8 A
10 kvar	25.12 A	14.4 A
12.5 kvar	31.41 A	18 A
15 kvar	37.7 A	21.6 A
20 kvar	50.24 A	28.8 A
25 kvar	62.82 A	36 A
30 kvar	75.4 A	43.2 A
40 kvar	100.48 A	57.6 A
50 kvar	-	72 A
60 kvar	-	86.4 A
80 kvar	-	115 A

Note: If consumption is $\pm 25\%$ less than that indicated in **Table 3** and the voltage is within the tolerance limits, this is usually a sign of degradation of the capacitors. If this is detected in any capacitor, it should be replaced with another capacitor.

Note: When the consumption of the steps is 10% more than the values stated in Table 3 this may be caused by the presence of resonances. If this is detected, measure the voltage THD of the grid (it must be under 5%) or check the tuning frequency of the filter.

Note: If the voltage drop in a reactor deviates from the values stated in this section, check the reactor. This phenomenon can be caused by the presence of a resonance.

5.3.1. REGULATOR CHECKS



Refer to the manual of the specific regulator used in the capacitor bank.
This manual is always supplied with the capacitor bank

- ✓ Check that there are no faulty segments on the display.
- ✓ Check that the keypad is working properly:
 - Enter Setup and check the adjusted values
 - Force the manual connection and disconnection of a step.

5.4.- ENVIRONMENTAL CONDITIONS

- ✓ Check that the maximum environmental conditions listed in section “6.- TECHNICAL FEATURES”

6.- TECHNICAL FEATURES

Electrical features	
Usage voltage and nominal frequency	Un / fn, listed on the label
Design voltage	Un+ 10% (440 V for 400 V devices)
Nominal power and distribution of steps	Qn and composition, (see label)
Total losses	< 0.5 W / kvar
Residual discharge voltage	75 V after 3 minutes
Overload capacity	1.3 In in all the elements
Operation voltage semiconductor connection controller boards	12 V  ⁽¹⁾
Current Transformer	Secondary winding 5 A, (Transformer In/5 A) NOTE: Minimum cable section of 2.5 mm ² .

⁽¹⁾ All models include an autotransformer for the auxiliary power supply, so an external auxiliary power supply is not required.

Capacitor features	
Capacity tolerance	- 5% / + 10%
Insulation level from earth	3 kV / 50 Hz
Impulse test	15 kV, ray-type wave 1.2/50 μ s
Protections	Internal fuses and over-pressure system
In accordance with Standards	UNE EN 60831

Reactor features	
Inductance tolerance	$\pm$ 5%
Rated working voltage	Standard 500 V (RMS value)
Saturation current	Standard at 1.8 In, Δ L: 5%
Insulation level	4 kV / 50 Hz; 15 kV shockwave 1.2/50 μ s
Maximum overload $\Sigma(n I_n)^2$	Permanent: 1.17 In Transient (1 minute): 2 In
Temperature category	Class H (150 °C)

Protections	
OPTIM FRES	Three-pole circuit breaker by stages
OPTIM FRE	Fuses by phase of each stage. Type gL/gG, calibre NH
Reactor thermostat:	90 °C $\pm$ 5%
Insulation	3 kV / 50 Hz
Cut off power	10 A / 250 V ~, resistive load

Environmental features			
Maximum temperature of capacitors	Category D in accordance with EN 60831-1		
	Maximum during 1 h.	24 h average	Annual mean
	55 °C	45 °C	35 °C
Cabinet ventilation	For outdoor Tamb > 30 °C forced ventilation should be provided in the cabinet		
Maximum relative humidity	80%		
Maximum altitude	1000 m (For higher altitude, forced ventilation should always be provided)		
Protection degree	Marked on the label		

Mechanical features			
Model	OPTIM FRES	OPTIM FRE4	OPTIM FRE6
Dimensions (Width x Height x Depth)	800 x 1200 x 500mm	900 x 1900 x 650mm	1200 x 1900 x 650mm
Weight	128 Kg	460 Kg	685 Kg
Model	OPTIM FRE8	OPTIM FRE10	OPTIM FRE12
Dimensions (Width x Height x Depth)	1500 x 1900 x 650mm	2100 x 1900 x 650mm	2400 x 1900 x 650mm
Weight	1000 Kg	1100 Kg	1390 Kg
Paint	Epoxy type, oven-dried		
Standard colours	RAL 7035 Grey; RAL 3005 Maroon		

Standards	
Power capacitors. Low voltage power factor compensation capacitor banks.	UNE-EN 61921:2004
Low voltage switchgear sets. Part 1: General rules.	UNE-EN 61439-1: 2012

7.- STANDARD ELECTRICAL DIAGRAMS

The electrical diagrams indicated in this manual are for the standard models in each range, and do not include the various additional accessories which these may equip, such as those listed below:

- ✓ Forced ventilation system.
- ✓ General manual load cut off switch.
- ✓ Circuit breaker for general protection.
- ✓ Earth leakage protection device.
- ✓ Automatic regulator not for the 12 Vdc Computer Max Fast range

And they are exclusively for the standard 3 x 440 V / 50 Hz rated voltage range, for use in three-phase networks with a rated voltage of 3 x 400 V / 50 Hz.



Figure 12: Standard electrical diagram of OPTIM FRES model capacitor banks.



* (Numeración bornes de Tiristor-Diodo (Th-D) correspondiente a modelo MCMA de IXYS)

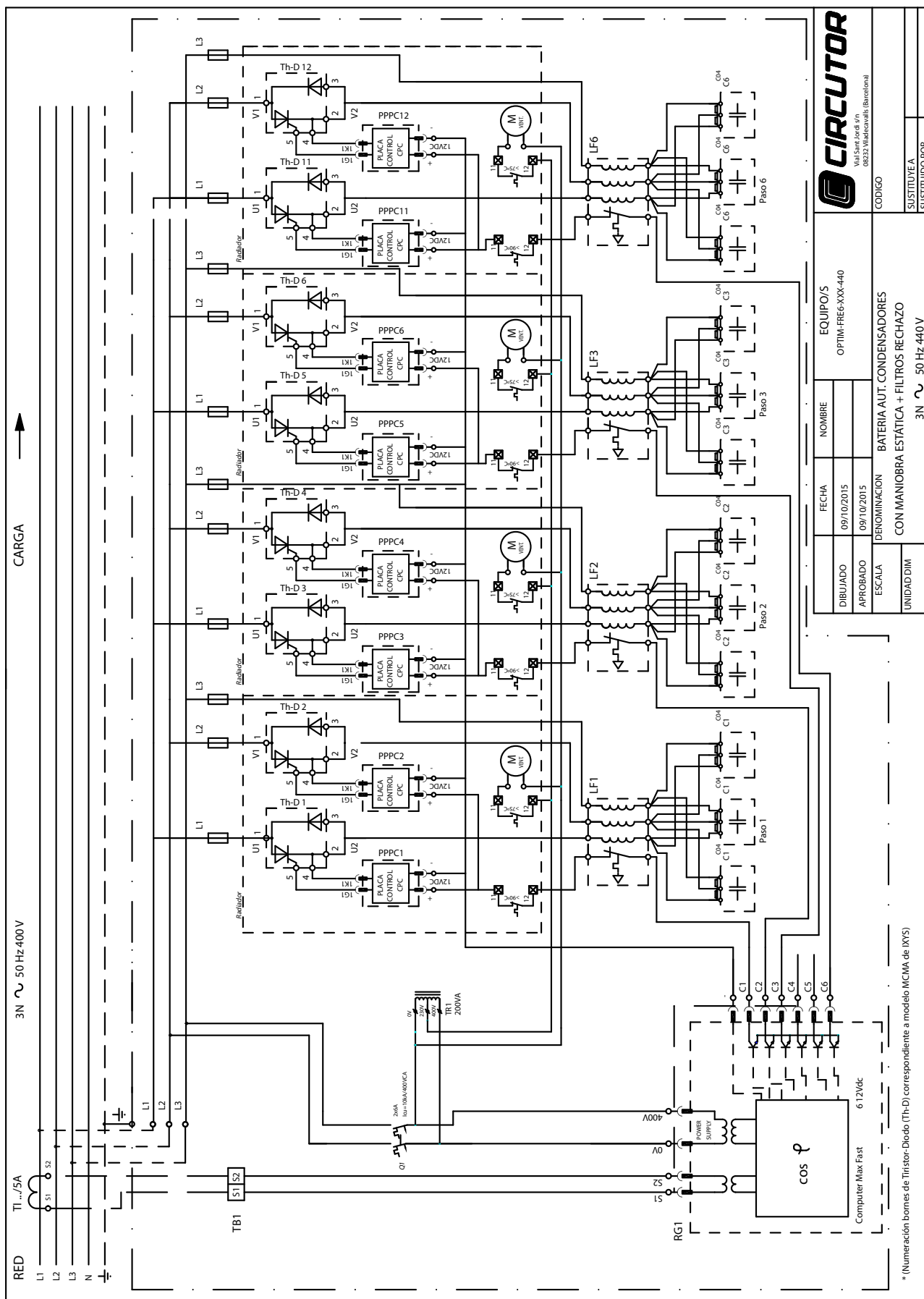


Figure 14: Standard electrical diagram of OPTIM FRE6 model automatic capacitor banks.

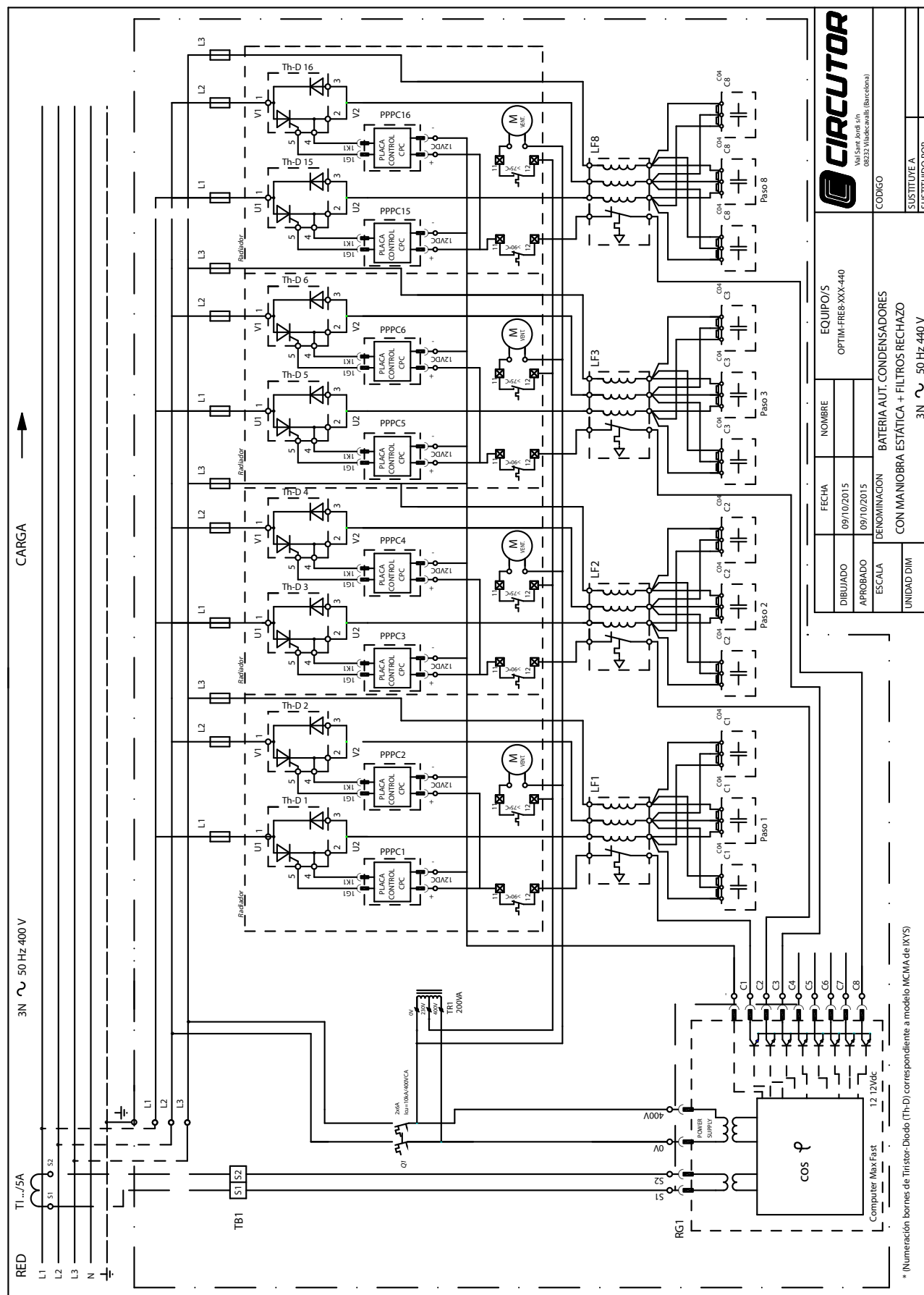


Figure 15: Standard electrical diagram of OPTIM FRE8 model automatic capacitor banks.

8.- MAINTENANCE AND TECHNICAL SERVICE

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

Technical Assistance Service

Vial Sant Jordi, s/n, 08232 - Viladecavalls (Barcelona)

Tel: 902 449 459 (España) / +34 937 452 919 (outside of Spain)

email: sat@circutor.com

9.- GUARANTEE

CIRCUTOR guarantees its products against any manufacturing defect for two years after the delivery of the equipment.

CIRCUTOR will repair or replace any defective factory product returned during the guarantee period.



No returns will be accepted and no device will be repaired or replaced if it is not accompanied by a report indicating the defect detected or the reason for the return.

The guarantee will be void if the equipment has been improperly used or the storage, installation and maintenance instructions listed in this manual have not been followed. "Improper usage" is defined as any operating or storage condition contrary to LV Regulations or that surpasses the limits indicated in the technical and environmental features of this manual.

In particular, capacitor devices are very sensitive to adverse environmental conditions, to temperatures above the established limits and overloads produced by the absorption of harmonic currents. Therefore, special care must be taken to not surpass these usage conditions.

CIRCUTOR accepts no liability due to the possible damage to equipment or other parts of the installation, nor will it cover any possible sanctions derived from a possible failure, improper installation or "improper usage" of the equipment. Consequently, this guarantee does not apply to failures occurring in the following cases:

- Overvoltages and/or electrical disturbances in the supply.
- Water, if the product does not have the appropriate IP classification.
- Poor ventilation and/or excessive temperatures.
- Improper installation and/or lack of maintenance.
- If another part of the cabinet is cut out to enable the insertion of cables. And if it has been cut out without taking the appropriate measures to prevent metal shavings from entering the capacitor bank, with the risk of causing the short circuits and insulation faults that this may entail.
- Buyer repairs or modifications without the manufacturer's authorisation.

10.- CE CERTIFICATE



CIRCUTOR, SA – Vial Sant Jordi, s/n
08232 Viladecavalls (Barcelona) Spain
(+34) 937 452 900 – info@circutor.com



DECLARACIÓN UE DE CONFORMIDAD

La presente declaración de conformidad se expide bajo la exclusiva responsabilidad de CIRCUTOR con dirección en Vial Sant Jordi, s/n – 08232 Viladecavalls (Barcelona) España

Producto:

Baterías automáticas con filtros, Maniobra por contactores estáticos

Serie:

OPTIM FRES, OPTIM FRE4, OPTIM FRE6, OPTIM FRE8, OPTIM FRE10, OPTIM FRE12, OPTIM FRE14

Marca:

CIRCUTOR

EL objeto de la declaración es conforme con la legislación de armonización pertinente en la UE, siempre que sea instalado, mantenido y usado en la aplicación para la que ha sido fabricado, de acuerdo con las normas de instalación aplicables y las instrucciones del fabricante

2014/35/UE: Low Voltage Directive 2014/30/UE: Electromagnetic Compatibility Directive
2011/65/UE: RoHS2 Directive

Está en conformidad con la(s) siguiente(s) norma(s) u otro(s) documento(s) normativos(s):

IEC 61921-1:2017 IEC 61000-6-2:2016 Ed 3.0
IEC 61010-1:2010+AMD1:2016 CSV Ed 3.0 IEC 60831-1:2014 Ed 3.0
IEC 61000-6-4:2006+AMD1:2010 CSV Ed 2.1 IEC 61642:1997 Ed 1.0

Año de marcado "CE":

1996



EU DECLARATION OF CONFORMITY

This declaration of conformity is issued under the sole responsibility of CIRCUTOR with registered address at Vial Sant Jordi, s/n – 08232 Viladecavalls (Barcelona) Spain

Product:

Automatic capacitor banks with rejection filters (static contactor)

Series:

OPTIM FRES, OPTIM FRE4, OPTIM FRE6, OPTIM FRE8, OPTIM FRE10, OPTIM FRE12, OPTIM FRE14

Brand:

CIRCUTOR

The object of the declaration is in conformity with the relevant EU harmonisation legislation, provided that it is installed, maintained and used for the application for which it was manufactured, in accordance with the applicable installation standards and the manufacturer's instructions

2014/35/UE: Low Voltage Directive 2014/30/UE: Electromagnetic Compatibility Directive
2011/65/UE: RoHS2 Directive

It is in conformity with the following standard(s) or other regulatory document(s):

IEC 61921-1:2017 IEC 61000-6-2:2016 Ed 3.0
IEC 61010-1:2010+AMD1:2016 CSV Ed 3.0 IEC 60831-1:2014 Ed 3.0
IEC 61000-6-4:2006+AMD1:2010 CSV Ed 2.1 IEC 61642:1997 Ed 1.0

Year of CE mark:

1996



DECLARATION UE DE CONFORMITÉ

La présente déclaration de conformité est délivrée sous la responsabilité exclusive de CIRCUTOR dont l'adresse postale est Vial Sant Jordi, s/n – 08232 Viladecavalls (Barcelone) Espagne

Produit:

Batteries automatiques de condensateurs avec filtres de rejection (manoeuvre par contacteurs statiques)

Série:

OPTIM FRES, OPTIM FRE4, OPTIM FRE6, OPTIM FRE8, OPTIM FRE10, OPTIM FRE12, OPTIM FRE14

Marque:

CIRCUTOR

L'objet de la déclaration est conforme à la législation d'harmonisation pertinente dans l'UE, à condition d'avoir été installé, entretenu et utilisé dans l'application pour laquelle il a été fabriqué, conformément aux normes d'installation applicables et aux instructions du fabricant

2014/35/UE: Low Voltage Directive 2014/30/UE: Electromagnetic Compatibility Directive
2011/65/UE: RoHS2 Directive

Il est en conformité avec la(les) suivante (s) norme(s) ou autre(s) document(s) réglementaire (s):

IEC 61921-1:2017 IEC 61000-6-2:2016 Ed 3.0
IEC 61010-1:2010+AMD1:2016 CSV Ed 3.0 IEC 60831-1:2014 Ed 3.0
IEC 61000-6-4:2006+AMD1:2010 CSV Ed 2.1 IEC 61642:1997 Ed 1.0

Année de marquage « CE »:

1996

Viladecavalls (Spain), 15/03/2018
General Manager: Ferran Gil Torné



CIRCUTOR, SA – Vial Sant Jordi, s/n
08232 Viladecavalls (Barcelona) Spain
(+34) 937 452 900 – info@circutor.com



KONFORMITÄTSERKLÄRUNG UE

Vorliegende Konformitätserklärung wird unter alleiniger Verantwortung von CIRCUTOR mit der Anschrift, Vial Sant Jordi, s/n – 08232 Viladecavalls (Barcelona) Spanien, ausgestellt

Produkt:

Automatische Kompensationsanlagen verdrosselt,
Thyristorschalter

Serie:

OPTIM FRES, OPTIM FRE4, OPTIM FRE6, OPTIM FRE8, OPTIM
FRE10, OPTIM FRE12, OPTIM FRE14

Marke:

CIRCUTOR

Der Gegenstand der Konformitätserklärung ist konform mit der geltenden Gesetzgebung zur Harmonisierung der EU, sofern die Installation, Wartung und Verwendung der Anwendung seinem Verwendungszweck entsprechend gemäß den geltenden Installationsstandards und der Vorgaben des Herstellers erfolgt.

2014/35/UE: Low Voltage Directive 2014/30/UE: Electromagnetic Compatibility Directive
2011/65/UE: RoHS2 Directive

Es besteht Konformität mit der/den folgender/folgenden Norm/Normen oder sonstigem/sonstiger Regelwerk/Regelwerken

IEC 61921-1:2017	IEC 61000-6-2:2016 Ed 3.0
IEC 61010-1:2010+AMD1:2016 CSV Ed 3.0	IEC 60831-1:2014 Ed 3.0
IEC 61000-6-4:2006+AMD1:2010 CSV Ed 2.1	IEC 61642:1997 Ed 1.0

Jahr der CE-Kennzeichnung:

1996



DECLARAÇÃO DA UE DE CONFORMIDADE

A presente declaração de conformidade é expedida sob a exclusiva responsabilidade da CIRCUTOR com morada em Vial Sant Jordi, s/n – 08232 Viladecavalls (Barcelona) Espanha

Produto:

baterias automáticas de condensadores com filtros de rejeição, comando por contactores estáticos

Série:

OPTIM FRES, OPTIM FRE4, OPTIM FRE6, OPTIM FRE8, OPTIM
FRE10, OPTIM FRE12, OPTIM FRE14

Marca:

CIRCUTOR

O objeto da declaração está conforme a legislação de harmonização pertinente na UE, sempre que seja instalado, mantido e utilizado na aplicação para a qual foi fabricado, de acordo com as normas de instalação aplicáveis e as instruções do fabricante.

2014/35/UE: Low Voltage Directive 2014/30/UE: Electromagnetic Compatibility Directive
2011/65/UE: RoHS2 Directive

Está em conformidade com a(s) seguinte(s) norma(s) ou outro(s) documento(s) normativo(s):

IEC 61921-1:2017	IEC 61000-6-2:2016 Ed 3.0
IEC 61010-1:2010+AMD1:2016 CSV Ed 3.0	IEC 60831-1:2014 Ed 3.0
IEC 61000-6-4:2006+AMD1:2010 CSV Ed 2.1	IEC 61642:1997 Ed 1.0

Ano de marcação "CE":

1996



DICHIARAZIONE DI CONFORMITÀ UE

La presente dichiarazione di conformità viene rilasciata sotto la responsabilità esclusiva di CIRCUTOR, con sede in Vial Sant Jordi, s/n – 08232 Viladecavalls (Barcelona) Spagna

prodotto:

Batterie automatiche con filtri, manovra mediante contattori statici

Serie:

OPTIM FRES, OPTIM FRE4, OPTIM FRE6, OPTIM FRE8, OPTIM
FRE10, OPTIM FRE12, OPTIM FRE14

MARCHIO:

CIRCUTOR

L'oggetto della dichiarazione è conforme alla pertinente normativa di armonizzazione dell'Unione Europea, a condizione che venga installato, mantenuto e utilizzato nell'ambito dell'applicazione per cui è stato prodotto, secondo le norme di installazione applicabili e le istruzioni del produttore.

2014/35/UE: Low Voltage Directive 2014/30/UE: Electromagnetic Compatibility Directive
2011/65/UE: RoHS2 Directive

È conforme alle seguenti normative o altri documenti normativi:

IEC 61921-1:2017	IEC 61000-6-2:2016 Ed 3.0
IEC 61010-1:2010+AMD1:2016 CSV Ed 3.0	IEC 60831-1:2014 Ed 3.0
IEC 61000-6-4:2006+AMD1:2010 CSV Ed 2.1	IEC 61642:1997 Ed 1.0

Anno di marcatura "CE":

1996

CIRCUTOR, S.A.

NIF: A-08513178
Vial Sant Jordi, s/n,
08232 VILADECAVALLS
(Barcelona) Spain
Tel. (+34) 93 745 29 00



Viladecavalls (Spain), 15/03/2018
General Manager: Ferran Gil Torné



CIRCUTOR, SA – Vial Sant Jordi, s/n
08232 Viladecavalls (Barcelona) Spain
(+34) 937 452 900 – info@circutor.com



DEKLARACJA ZGODNOŚCI UE

Niniejsza deklaracja zgodności zostaje wydana na wyłączną odpowiedzialność firmy CIRCUTOR z siedzibą pod adresem: Vial Sant Jordi, s/n – 08232 Viladecavalls (Barcelona) Hiszpania

produkt:

Automatyczne baterie z filtrami odstrojonymi, z tyrystorami

Seria:

OPTIM FRES, OPTIM FRE4, OPTIM FRE6, OPTIM FRE8, OPTIM
FRE10, OPTIM FRE12, OPTIM FRE14

marka:

CIRCUTOR

Przedmiot deklaracji jest zgodny z odpowiednimi wymaganiami prawodawstwa harmonizacyjnego w Unii Europejskiej pod warunkiem, że będzie instalowany, konserwowany i użytkowany zgodnie z przeznaczeniem, dla którego został wyprodukowany, zgodnie z mającymi zastosowanie normami dotyczącymi instalacji oraz instrukcjami producenta

2014/35/UE: Low Voltage Directive 2014/30/UE: Electromagnetic Compatibility Directive
2011/65/UE: RoHS2 Directive

Jest zgodny z następującą(y) normą(ami) lub innym(i) dokumentem(ami) normatywnym(i):

IEC 61921:2017	IEC 61000-6-2:2016 Ed 3.0
IEC 61010-1:2010+AMD1:2016 CSV Ed 3.0	IEC 61000-6-4:2006+AMD1:2010 CSV Ed 2.1
IEC 61439-1:2011 Ed 2.0	IEC 61642:1997 Ed 1.0

Rok oznakowania "CE":

1996

Viladecavalls (Spain), 15/03/2018
General Manager: Ferran Gil Torné



CIRCUTOR, SA

Vial Sant Jordi, s/n

08232 - Viladecavalls (Barcelona)

Tel: (+34) 93 745 29 00 - Fax: (+34) 93 745 29 14

www.circutor.es central@circutor.com