



**LV CAPACITOR BANKS WITH DETUNED
FILTERS OPERATED BY CONTACTORS**

FR SERIES



INSTRUCTION MANUAL

M98121401-20-11A

CIRCUTOR, SA

SYMBOLS AND WARNINGS

Pay attention to the warnings in this manual, which are shown with the following symbols.



DANGER: Warns of a risk, which could result in personal injury or material damage.



WARNING: Indicates that special attention should be paid to a specific point.

If you must handle the equipment 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 equipment. In particular, handling with power 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.

Carefully read the manual prior to connecting the equipment. Follow all the installation and maintenance instructions for the equipment throughout its working life. In particular, follow the installation standards indicated in the CENELEC Low Voltage Directive (LVD 2006/95/EC) and the technical instructions of the Electrical National Code in each country .

The installation, operation and maintenance of LV equipment must only be carried out by authorised installers. LV local regulations specifically define the requirements that authorised installers must meet.

If in order to install the equipment, you must work in areas that have high-voltage (HV) equipment installed, then the personnel handling equipment in this area must be authorised to work in HV installations. Refer to CENELEC Low Voltage Directive (LVD 2006/95/EC) and to the National Code technical instructions for HV installations in each country.

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1 INTRODUCTION


The purpose of this manual is to assist during the installation, start-up and maintenance of low voltage (LV) capacitor banks with FR series detuned filters operated by means of contactors. Carefully read the manual to achieve the best equipment performance.

2 SAFETY HAZARDS AND WARNINGS


2.1 Hazards encountered during the installation and start-up of electrical equipment.

| | |
|---|---|
|  | <p>The installation, operation and maintenance of low voltage (LV) equipment must only be carried out by authorised installers. See CENELEC Low Voltage Directive (LVD 2006/95/EC) and the technical instructions of the Electrical National Code in each country to find the requirements that authorised installers must meet.</p> <p>Do not access the active elements of a filter bank that has been powered, since residual voltages might be present because of capacitors charge. Wait at least 5 minutes after the power supply has been disconnected.</p> <p>Do not touch the terminals or active parts of the unit 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 gloves, equipment and tools.</p> <p>After maintenance and before re-applying power to the unit, check that its enclosure is properly closed and that no items or tools were left inside that could cause a short-circuit.</p> <p>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 can damage it and electrocute the person handling it.</p> |
|---|---|

2.2 Safety warnings

| | |
|---|--|
|  | <p>Apart from the general standards listed above, the standards and applicable regulations of the country where the filter bank is installed or operated should be strictly followed.</p> <p>Installation or maintenance personnel should read and understand this manual before operating the equipment.</p> <p>A copy of this manual should always be available to maintenance personnel for reference purposes.</p> <p>Connecting the equipment to the public grid must be carried out in compliance with standard EN-IEC60204-1, on the safety of LV electrical installations.</p> <p>It is recommended that several personnel are present when handling the equipment for either installation or maintenance.</p> <p>If damage or faults are detected during equipment operation, or in circumstances that compromise safety, immediately stop work in that area and disconnect the equipment in order to check it while it is de-energized.</p> <p>Modifying, upgrading or rebuilding the equipment without written authorization from the manufacturer is prohibited.</p> |
|---|--|

2.3 Application warnings

| | |
|---|--|
|  | <p>Capacitor banks with detuned filters can attenuate the remote control signals transmitted through the network which are used in some countries. When remote control frequencies close to the tuning frequency of FR filters are used, blocking filters must be placed in front or the tuning frequency of the FR filters must be changed.</p> |
|---|--|

3 RECEPTION, TRANSPORT, HANDLING AND STORAGE

3.1 Reception protocol

- Make sure that the equipment has not been damaged during transport.
- Check that the equipment received matches the order and that its electrical characteristics are suitable for the grid where it is to be connected.
- Check the shipping documentation. The dispatch note number must coincide with the number marked on the outer part of the unit packaging.
- Unload and transport the equipment in accordance with the instructions in section 3.2
- Perform an external and internal visual inspection of the equipment prior to connecting it.
- Check that all items on the packing list are present.



If any discrepancy is noticed upon reception, immediately contact the transport company or CIRCUTOR's after-sales services.

3.2 Transport, loading and unloading, handling and storage

The transport, loading and unloading and handling of the equipment must be carried out with proper precautions and using the proper manual or mechanical tools to prevent damaging the equipment.



If the equipment 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 equipment be stored with its original protective packaging.

To move the equipment a short distance, the unit's floor support profiles facilitate handling with a pallet jack or forklift.



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

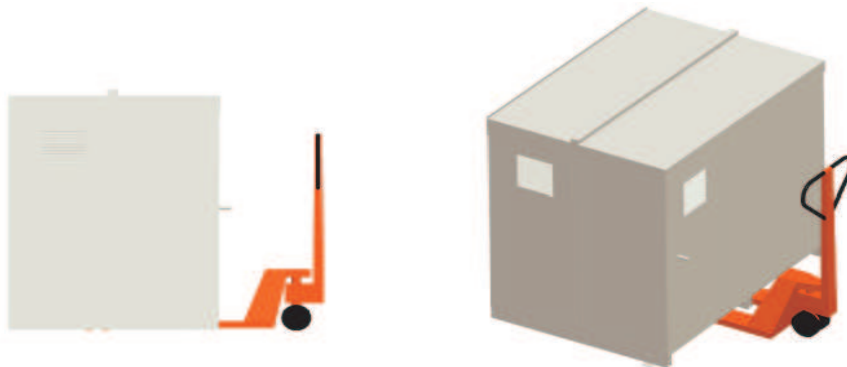


Fig. 3-1 .-Transport with pallet jack

When unloading and moving the equipment, use a forklift with forks long enough to support the entire length of the base. Otherwise, the forks should be long enough to support the total depth. The forks must be flat and laid firmly on the base. The cabinet must be raised by placing the forks underneath the profile that supports the equipment. (Fig. 3-2).



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 in equipment. The necessary precautions must be taken to prevent the equipment from tipping over during abrupt operations.

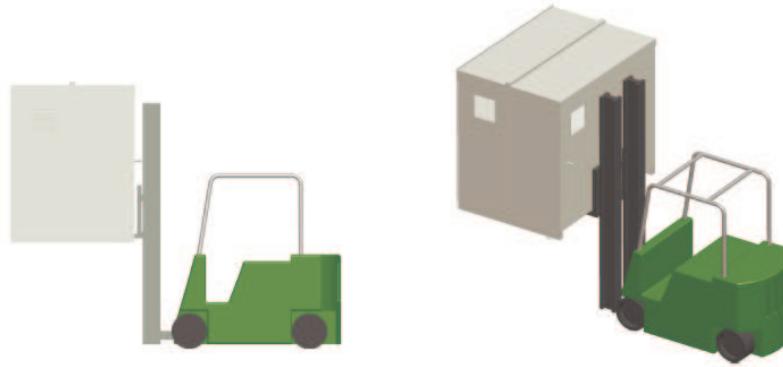


Fig. 3-2 .-Unloading with a Forklift

3.3 Storage

The following storage recommendations should be followed for capacitor banks with detuned filters:

- Avoid placing it on uneven surfaces.
- Do not store in outdoor areas, humid areas or areas exposed to the splashing of water.
- Avoid hot spots (maximum environmental temperature: 45 °C)
- Avoid saline and corrosive environments.
- Avoid storing the equipment 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 equipment cabinets.

4 TECHNICAL FEATURES

4.1 Label with the equipment's features

The label with the equipment's features is located inside it, generally next to the PF regulator (refer to Fig. 4-1). The filter bank includes the p% information, which states the filter's tuning factor. This information is important to establish the filter's resonance frequency.

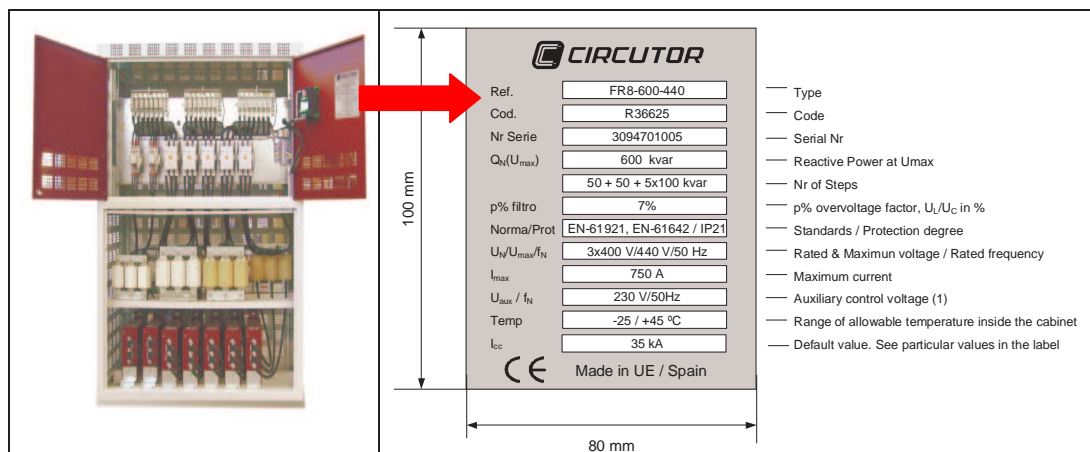


Fig. 4-1.- Label showing the main characteristics

4.2 Electrical features

- Operating voltage and nominal frequency: U_n / f , listed on the label
- Design voltage: $U_n + 10\%$ (440 V for 400V equipment)
- Nominal power and distribution of steps: Q_n and composition, (see label)
- Overvoltage factor, p%
Standard 7% ,
Others 14%, 8.2% and 5.67% (see label)
- Total loss:
Standard 3.5 to 4 W/kvar
- Residual discharge voltage:
75 V after 3 minutes
- Overload capacity:
 $1,3 \cdot I_n$ in all items
- Auxiliary control voltage:
 U_{aux} , listed on the label.

NOTE: In general, use a 1.5 mm² cable to supply external power.
If "Internal" , is marked, the equipment does not require external power.

- Current Transformer Input: 5 A , (Transformer $I_n/5A$)
NOTE: Minimum cable section 2.5mm².
UNE EN 61921 and EN-61642
- Compliance with Standards
- Protection elements:
 - Power Fuses: Type gL, NH gauge (minimum 1,5× $I_{nominal}$)
 - Reactor thermostat: 90°C ±5°C
 - Insulation: 3 kV /50 Hz
 - Breaking capacity: 10A / 250 V CA, resistive load
- Capacitor characteristics:
 - Capacity tolerance: ± 5%
 - Insulation level to earth: 3 kV /50 Hz
 - Impulse test: 15 kV , 1,2/50 µs standard wave
 - Protection elements: Internal fuses and over-pressure system
 - Compliance with Standards: UNE EN 60831
- Reactor characteristics:
 - Inductor tolerance: ± 5%
 - Nominal working voltage: standard 500 V (RMS value)
 - Saturation current: standard at 1.4 I_n , ΔL=5% (Others in RBX)
 - Level of insulation between: 3kV /50Hz; 15kV ; 1,2/50 µs standard wave
 - phases and to earth
 - Max. overload $\Sigma(n.I_n)^2$: 20% permanent; Transient (1 min.) 2 I_n

4.3 Environmental Characteristics

- Capacitor max. temperature: Category C in accordance with EN 60831-1
 - Maximum for 1h: 50°C
 - 24h average: 40°C
 - Annual average: 30°C
- Max. temperature of reactors: In accordance with IEC 60076-6
 - Maximum environmental temperature: 60°C
 - Indoor temperature at I_n : <110°C
 - Protection thermostat: 90 °C
- Cabinet ventilation: For outdoor $t_{amb} > 30^\circ\text{C}$, forced ventilation must be used for the cabinet
- Maximum relative humidity: 80%
- Altitude: 1000 m (For higher altitudes, always maintain forced ventilation)

4.4 Mechanical features

- Protection degree: Marked on the label:
- Paint: Oven dried epoxy type
- Standard colours: RAL 7035 Grey ; RAL 3005 Maroon

4.5 External dimensions and weights.



Fig. 4-2.- Dimensions

| Model | Dimensions (mm) | | | Max weight (kg) |
|-------|-----------------|------------|-------|-----------------|
| | Width | Height (*) | Depth | |
| FRS | 700 | 1000 | 380 | 215 |
| FR4 | 800 | 1900 | 650 | 460 |
| FR6 | 1100 | 1900 | 650 | 685 |
| FR8 | 1500 | 1900 | 650 | 1000 |
| FR12 | 2200 | 1900 | 650 | 1389 |

(*) Maximum dimensions

4.6 Filter bank components

Fig. 4-3 shows the different models of filter banks and their essential components. Some protection elements are optional.

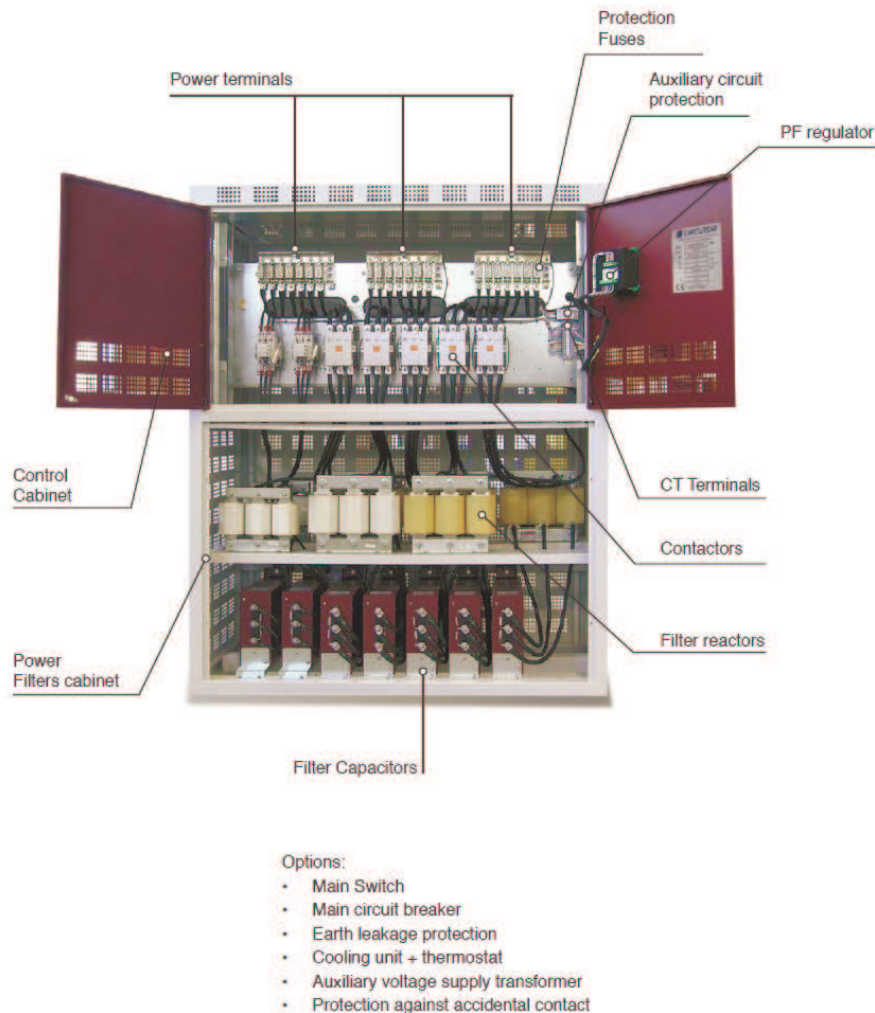


Fig. 4-3 .- FR Filter bank components

5 INSTALLATION

5.1 Preparation

CIRCUTOR's FR filter banks are prepared for an easy installation and start-up.

Remove the equipment's packaging and verify that the unit's electrical characteristics are suitable for connection to the available grid. For this, check the characteristics at the label located inside the cabinet, next to the regulator, refer to Fig. 4-1 as an example.

Key data to be checked:

- Grid voltage and frequency, U_N / f .
- Nominal power of the filter bank, Q_N (kvar) and composition
- Type of filter, identified by the p% factor (7%, 14%, ..., etc.)
- Current consumption, I_{max} (See label) . This current must be considered to select the proper size of the supply cable circuit breakers and other protection devices to be connected upstream the supply terminals.
- Auxiliary control voltage, U_{aux} (See section 4.2)
- Environmental conditions. (See section 4.3)

5.2 Installation location

It is important to maintain a minimum distance around the equipment to facilitate cooling. In self-supporting cabinets, the back and front sides of the cabinet must be placed at least 50 cm away from other walls and equipment. Regarding the side faces of the cabinet, it is recommended to keep a gap of 10 cm with adjacent equipment. On wall mounted cabinets, it is recommended to keep a gap of at least 20 cm between the side faces of adjacent equipment.

Make sure that the equipment can be accessed easily.

The environmental conditions of the location where the equipment is installed must not surpass the limits established in the technical characteristics (See section 4.3)

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

In accordance with the EEC LV Directive, once the unit is installed, it must be protected against direct and indirect contacts. Therefore, an earth leakage or insulation surveillance device must be installed for the protection of the power supply line and the filter bank.

5.3 Connection of the filter bank to the grid



Check that the nominal voltage of the FR filter bank matches the phase to phase voltage of the grid where it is being connected. Also check the auxiliary control voltage (contactors supply). For this, refer to section 5.3.3

For the feeding cables of the filter bank cabinet, use always the entry windows available for this purpose.

Do not drill holes into the cabinet for feeding cables through them or for installing support brackets. Drilling produces metal shavings that may enter the contactors or other switching or protection devices and cause short-circuits.

5.3.1 Power circuit.

- Connect input terminals L1, L2 and L3 (power circuit) to the grid using proper sized cable in accordance with the the EEC LV Directive. Generally, the cables of the phases follow the following colour code: L1 (black), L2 (brown), L3 (grey). If auxiliary voltage is required, the neutral cable will be connected to N (blue colour)
- To determine the size of the phase cables, the maximum nominal current I_{max} shown on the equipment's label and a transient overload of up to 1.5 times I_{max} must be taken into account. The neutral cable must be at least 1.5 mm².

5.3.2 External insulation and protection elements

- In case the filter bank does not have an internal switch or circuit breaker, it must be connected to a line with an external switch or circuit breaker.



The protection elements, insulation switches and/or switches that are added externally to the filter bank must be of a minimum size to withstand a current 1.5 times greater than what is indicated on the label

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

- For filter banks with equipped with a standard regulator measuring the current in a single phase, we advise installing the current transformer (TC) in the phase connected to L1 (black cable). The CT terminals S1 and S2 must be connected to the terminals with the same name at the filter bank. For more details about the connection of the CT, see 5.3.5

5.3.3 Auxiliary control voltage.

- Control circuits are defined as those related with the regulator's output relays and contactors switching the filter's LC steps. These circuits are usually powered with an auxiliary voltage of 230VAC (the most common case) or in special cases can be powered with 110VAC (the later is frequently used for 500V or 690V filter banks). There are two possible ways of feeding the control circuitry.

- **FR filter bank with an auxiliary voltage obtained from an internal AUTOTRANSFORMER**

This configuration does not require the connection of the external neutral. The label box $U_{aux/f}$ in such equipment indicates "interna"

- **FR filter bank with auxiliary voltage obtained between PHASE and NEUTRAL**

Requires the connection of the external neutral to terminal N (see Fig. 5-2 and Fig. 5-4. The label box $U_{aux/f}$ in such equipment indicates the value of control voltage (usually 230V)

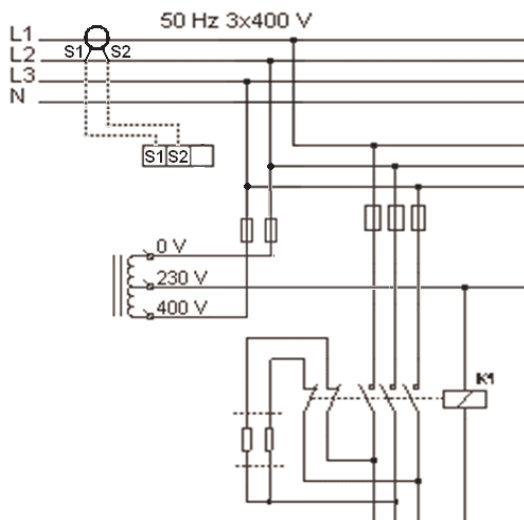


Fig. 5-1 .- Auxiliary power supply with autotransformer

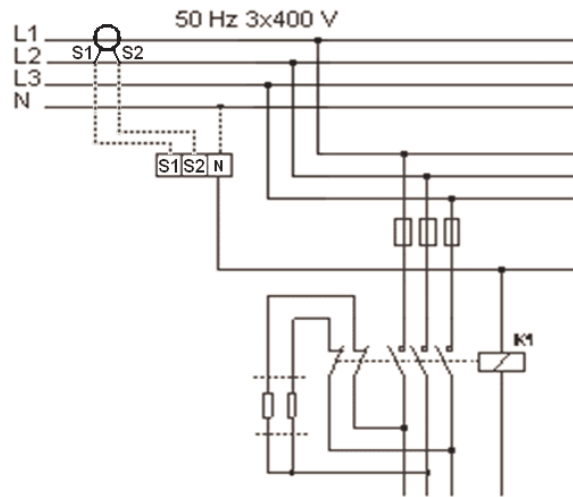



Fig. 5-2 .- Auxiliary power supply with neutral

5.3.4 Earth cable connection

- Connect the earth terminal of the filter bank located inside the equipment control cabinet (see Fig. 4-3) to the exterior earth connection. The earth cable section will be selected in accordance with the admissible current limits established in the REBT (ITC-BT-19 – Indoor or receiver installations).

5.3.5 Connecting the current transformer (CT)

| | |
|---|--|
|  | <p>A current transformer (TC) that is external to the filter bank must be installed to measure the total load current plus that of the filter bank (see Fig. 5-3).</p> <p>The standard transformer must have a nominal output of 5A at the secondary. We recommend connecting the TC to phase L1 in the direction of the current flow from P1 to P2 (see Fig. 5-3) and connecting the secondary (terminals S1, S2) to the terminals with the same name on the filter bank (see Fig. 5-3). Avoid the flow of current through the TC's primary before connecting the secondary to the filter bank's S1 and S2 terminals. If the TC must be installed while the installation is under load, short-circuit S1 and S2 while they are not connected to the filter bank.</p> |
|---|--|

- The current value of the TC primary winding must be equal to or slightly greater than the size of the installation's mains switch. Therefore, the TC must be able to measure the maximum forecast current consumption that will be consumed by all the loads being compensated.

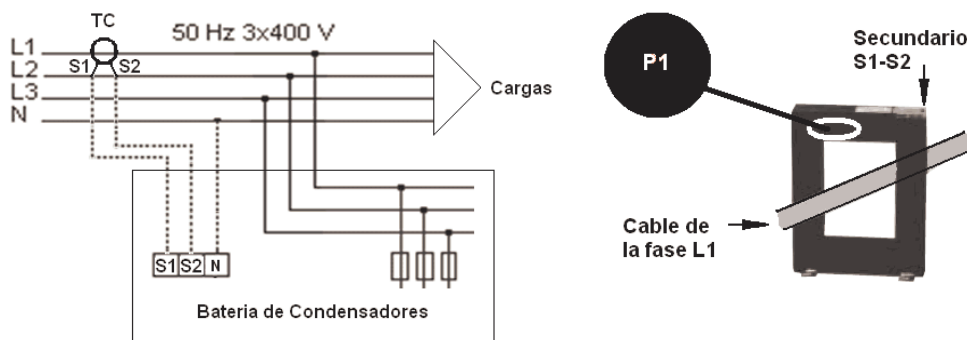


Fig. 5-3 .- Installation of the current transformer (TC) (external)

- The connection point of the TC for a filter bank that compensates an entire installation is after the installation's mains switch.
- To prevent excessive attenuation of the signal, the minimum secondary cable section (terminals S1, S2) should be at least 2.5 mm².

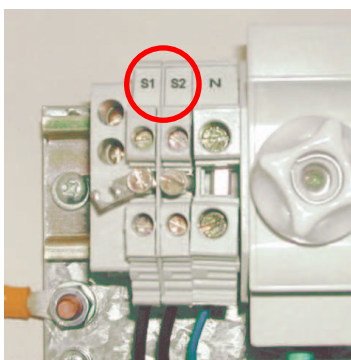


Fig. 5-4 .- TC and neutral connection terminals if required

- Once the cables are installed, disconnect the jumper connecting terminals S1 and S2 on the filter bank (see Fig. 5-5)



Fig. 5-5 .- Jumper for short-circuiting the secondary winding of the current transformer (TC).



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.

6 START-UP OF A CAPACITOR BANK WITH DETUNED FILTERS

6.1 Before start-up

Automatic capacitor banks with FR filters have a built-in power factor regulator. Prior to start-up, the operation of said regulator must be known; for this reason, all filter banks **come with the specific manual of the regulator used. Ensure you have this manual available for the start-up process.**



The adjustment of the built-in regulator of filter banks with and its optimum start-up requires the installation to have at least a 30 to 40% nominal load for which the filter bank was dimensioned. If all the stages are not included, they can be manually connected to check them all.

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

For manual connections of the LC steps, remember that you must wait until the capacitors have been discharged before they can be connected to the grid, otherwise, the system could start up having a transient voltage of up to $2xU_n$, causing current peaks in the capacitors.

6.2 Start-up



SAFETY

Apply the safety regulations listed in section 2 of this manual before operating the equipment.

The standards and applicable national regulations of the country where the filter bank is installed or operated should be strictly followed.

- Ensure that the inner circuit breaker supplying the regulator (shown as the operating protection in fig. 4.3) is connected
- Apply power to the panel and check that the regulator display illuminates immediately. If not, stop and check the previous step.
- Check the regulator's $\cos\phi$ indication. If the indication is out of range 0.5 to 1, the current transformer and / or the power supply to the regulator may be improperly connected. Most of the regulators use only one current transformer. In this case, connect as per fig. 6-2 (place the current transformer in phase L1 and take the power voltage from phases L2 and L3)



Fig. 6-1 .- Computer Max Regulator
(Picture provided as an example. It may not coincide with the model used on your unit).

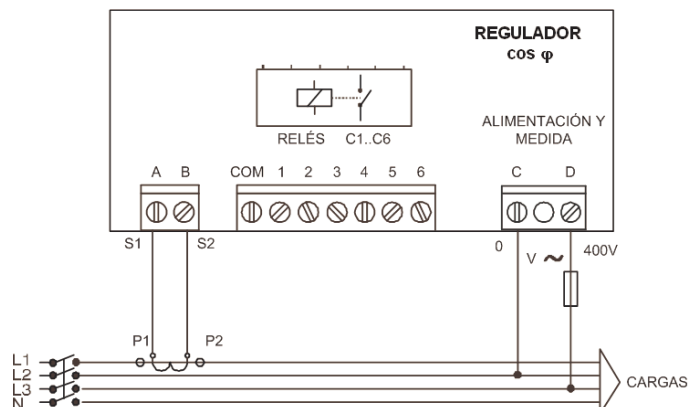


Fig. 6-2 .- Standard connection of a regulator with a single TC (3 current transformers will be used when Computer + is used. See the specific manual of the Computer + regulator)

- Once ensured 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.

6.3 Checkings once the filter bank is connected and the regulator has been adjusted

- After start-up, make sure that the equipment is operating correctly. A sign of proper operation after the regulator's reaction time has passed is a $\cos\phi$ near to 1. In addition, the reactive meter must stop.
- Check that the power supply voltage does not exceed the nominal value +10% (IEC 60831-1)
- Check the current absorbed by each LC group of the filter. Under normal working conditions, it must be close to the nominal values (see Table 7.5) and never more than 1.3 times this value continuously. Continuous consumption over the nominal value may be caused by the presence of harmonics in the grid or an excessively high power supply voltage. Both circumstances are harmful for capacitors and the filter's reactors.
- In accordance with the IEC 60831-1 Standard, the capacitor is prepared to operate at the permanent voltage assigned and with an overvoltage of up to 10% during 8 hours every 24 hours.
- NOTE: For filter banks, the capacitor's voltage exceeds the grid voltage by a % that is approximately equal to the filter's overvoltage factor (p%). In fact, the capacitor's real overvoltage is
$$\frac{\Delta V_C}{V_{RED}} \% = \frac{100 \cdot p\%}{(100 - p\%)}$$
- To check the filter's correct tuning, 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 60°C

7 MAINTENANCE

7.1 Safety regulation



SAFETY

Apply the safety regulations listed in section 2 of this manual before operating the equipment.
The standards and applicable national regulations of the country where the filter bank is installed or operated should be strictly followed.

7.2 Maintenance with the filter bank disconnected

7.2.1 Basic maintenance protocol

Monthly

- Visually inspect the capacitors
- Check the protection fuses
- Control the environmental temperature (average of 30 °C. In accordance with IEC 60831).
- Control the service voltage (especially during moments of low charge, it must not exceed the nominal +10%).

Six-monthly

- Keep the capacitor terminals and reactors clean.
- Verify the state of the contactors of operating elements.
- Check that the capacitor current is not less than 25% or greater than 120% of the nominal value by phase and that there is no phase unbalance greater than 15%.

Annually

- Perform dielectric rigidity tests on the different elements of the power circuit, applying 2.5 kV during 1s between the capacitor and earth terminals.
- Check the capacity of the different steps. An indirect verification can be performed by checking that the consumption matches the value stated in Table 7.5, with a maximum deviation of $\pm 10\%$.
- Check the tightness of all terminal connections on the different power elements.
- Inspection of the fuses.
 - Power circuit: NH fuses. Check continuity and temperature.
 - Control Circuit protection: Neozed fuses or circuit breaker. Check continuity and temperature.

7.2.2 Tightening the electrical connections.

- The connections must be tight. The following tightening torques for the fuse bases and contactors are listed in tables 7-1 and 7-2

Table 7-1.- Tightening torques of the cables to the fuse bases

| FUSE BASE | TORQUE (Nm) |
|-------------|-------------|
| NEOZED 63 A | 3.6 |
| NH-00 | 15.2 |

Table 7-2.- Tightening torques of the cables to contact terminals

| MODEL | Auxiliary (Nm) | POWER (Nm) |
|---------|----------------|------------|
| GMC-12 | 1.3 | 1.6 |
| GMC-18 | 1.3 | 2.2 |
| GMC-32 | 1.3 | 2.9 |
| GMC-40 | 1.3 | 2.9 |
| GMC-50 | 1.3 | 4.5 |
| GMC-65 | 1.3 | 4.5 |
| GMC-75 | 1.3 | 4.5 |
| GMC-85 | 1.3 | 4.5 |
| GMC-150 | 1.3 | 9 |

Table 7-3.- Tightening torques of the cables to reactor terminals.

| Reactor | Connection | Terminal (Nm) |
|-----------|------------|---------------|
| R-5-400 | Terminal | 1.83 |
| R-10-400 | Terminal | 1.83 |
| R-15-400 | Terminal | 1.83 |
| RB-20-400 | Flat strip | 6.2 |
| RB-25-400 | Flat strip | 6.2 |
| RB-30-400 | Flat strip | 15.2 |
| RB-40-400 | Flat strip | 15.2 |
| RB-50-400 | Flat strip | 30 |
| RB-60-400 | Flat strip | 30 |
| RB-80-400 | Flat strip | 30 |

7.2.3 Key points for inspecting contactors.

- Check that the plastic parts are not blackened and do not show signs of burning or hardening.
- Check that the head is properly inserted
- Check the tightness of cables and terminals, as shown in table 7-2
- The terminals must be clean.
- If the filter bank includes RD discharge resistances, check they are in good condition (that they are not open or show signs of burning).

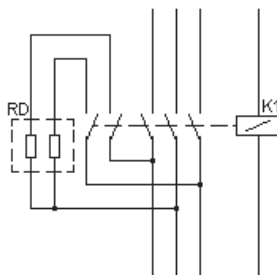


Fig. 7-1 .- Connection of the discharge resistances

- Cleaning the contactors: In dirty environments (dust, sawdust, metal trimmings, etc). Periodically vacuum the dust and solid remains. There is no estimated time frame for cleaning, it depends on the amount of dirt that penetrates the filter bank's cabinet.

7.2.4 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 resistances must be in good condition (they should not be open or show signs of burns)
- Check the tightness of capacitor terminals, as shown in Table 7-4

Table 7-4.- Tightening torques of the cables on the filter bank terminals

| Capacitor | Power terminal (Nm) | Earth terminal (Nm) |
|-----------|---------------------|---------------------|
| CV | 4.49 | 6.2 |
| CF, CS | 21 | 6.2 |

| CLZ CAPACITORS | | |
|----------------|---------------------|---------------------|
| Diameter (mm) | Power terminal (Nm) | Earth terminal (Nm) |
| 2.5 | 0.33 | 0.463 |
| 3 | 0.57 | 0.8 |
| 4 | 1.3 | 1.83 |
| 5 | 2.59 | 3.62 |
| 6 | 4.49 | 6.2 |
| 8 | 10.9 | 15.2 |
| 10 | 21 | 30 |
| 12 | 37 | 50 |

7.2.5 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 must be clean, not hardened or overheated.
- Check the connections and the insertion of removable terminal strips, if used:
 - The terminal strips must be well fastened on removable regulators.
 - Check that the terminals are tightened properly. The recommended torque is 0.6 Nm.

7.2.8 Cleaning the cabinet.

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

7.3 Maintenance with the battery connected.

- Check that the mains switch connects and disconnects, without having to force the mechanism
- If there is an individual earth leakage protection for the filter bank, check its proper operation by pressing the test button.
- Check that the auxiliary control voltage is within the tolerance limits. If the filter bank has an autotransformer, check it is in good condition and does not show 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 checkings:
 - Check that the contactors connect and disconnect properly.
 - Check that the contact, once connected, does not rattle or vibrate.
 - Check the consumption of the different LC steps, in each phase. The normal values are shown in Table 7-5, in accordance with the power of each step.

Table 7-5.- Nominal consumption of the LC steps of an FR filter, depending on its power

| POWER | CURRENT | |
|------------------|----------|---------|
| | 230V | 400V |
| | In | In |
| 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 | 125.64 A | 72 A |
| 60 kvar | 150.8 A | 86.4 A |
| 70 kvar | 175.92 A | 101.1 A |
| 80 kvar | 200.96 A | 115 A |

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

$$V_L = V_{Mains(\text{phase_to_phase})} \frac{0,577 \cdot p\%}{(100 - p\%)}$$

For example, in the case of the 400V grid and $p\%=7$, $V_L=17.38V$. For the 400V grid and $p\%=14$, $V_L=37.57V$. The value is proportional to the voltage for other voltages.

NOTES:

- When the consumption of the steps is 25% less than that stated in Table 7-5 and the voltage is within the tolerance limits, this is a sign of degradation of the capacitors. These must be replaced with a suitable spare part if these symptoms are detected in a step.
- When the consumption of the steps is 10% more than the values stated in Table 7-5, this can be caused by the presence of resonances. If this is detected, measure the grid's voltage THD (it must be under 5%) or check the filter's tuning frequency.
- 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.

7.3.3 PF Regulator Checkings.



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

- Make sure that there are no damaged segments on the display (abnormal brightness).
- Make sure that regulator's keyboard is working properly:
 - Enter Setup and check the adjusted values
 - Force the manual connection and disconnection of a step.

7.4 Environmental Conditions:

- Check that the maximum environmental conditions listed in section 4.3 are observed

8 GUARANTEE,

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

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



No returns will be accepted and no unit 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 units 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 for possible damage to equipment or other parts of the installation, nor will it cover any possible penalties resulting from possible failure, improper installation or "improper usage" of the equipment.

Consequently, this guarantee does not apply to failures occurring in the following cases:

1. Overvoltages and/or electrical disturbances in the supply;
2. Water, if the product does not have the appropriate IP classification;
3. Poor ventilation and/or excessive temperatures;
4. Improper installation and/or lack of maintenance;
5. Buyer repairs or modifications without the manufacturer's authorisation.

9 TECHNICAL ASSISTANCE AND DECLARATION OF CONFORMITY

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

CIRCUTOR, SA

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9.1 Declaration of conformity

| | | |
|---|--|---|
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|---|--|---|

DECLARACION DE CONFORMIDAD CE
CE DECLARATION OF CONFORMITY
DECLARATION DE CONFORMITE CE

Por la presente
We hereby
Par le présent

CIRCUTOR, S.A.

Con dirección en:
With address in:
Avec adresse à:

Vial Sant Jordi, s/n
08232 VILADECÀVALLS (Barcelona)
ESPAÑA

Declaramos bajo nuestra responsabilidad que el producto:
We declare under our responsibility that the product:
Nous déclarons sous notre responsabilité que le produit:

Baterías automáticas de condensadores
con filtros de rechazo
Automatic capacitor bank with detened filters

Serie: FRS, FR4, FR6, FR8, FR12

Marca CIRCUTOR

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,
Provided that it is installed, maintained and used in application for which it was made, in accordance with relevant installation standards and manufacturer's instructions.
Toujours qu'il soit installé, maintenu et utilisé pour l'application par laquelle il a été fabriqué, d'accord avec les normes d'installation applicables et suivant les instructions du fabricant,

Cumple con las prescripciones de la(s) Directiva(s):
Complies with the provisions of Directive(s):
Accompli avec les prescriptions de la (les) Directive(s):

2006/95/CE
2004/108/CE
2006/42/CE

Está en conformidad con la(s) siguiente(s) norma(s) u otro(s) documento(s) normativo(s) :
It is in conformity with the following standard(s) or other normative document(s) :
Il est en conformité avec la (les) norme(s) suivante(s) ou autre(s) document(s) normatif (ves) :

IEC 61439-1 :2009
IEC 60831-1 :2002
IEC 61000-6-2 :2005
IEC 61000-6-4 :2006

Año de colocación del marcado "CE": 1996
Year of affixing "CE" marking:
An de mise en application du marquage "CE":

Revisado en Viladecavalls
Fecha: 02/03/2010

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Nom et signature


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