



**ABSORPTION HYBRID FILTER  
FAR-Q TYPE**

**USER MANUAL**

**Code M98206701-03-07A**

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## 1.- BASIC INSTRUCTIONS

This manual is designed to familiarise the user with operating the **FAR-Q** power factor correction and filtering equipment in order to get the best from its features.

**FAR-Q** hybrid filters are specifically developed for power factor correction on systems with medium harmonic distortion. The aim is to improve power factor and at the same time, to attenuate harmonics. The operating principle consists in correcting power factor and at the same time absorbing the 5th and 7th harmonics generated by certain loads so that they do not get into the system or go towards other nearby loads.

**Please read this manual carefully before connecting and switching on the instrument** in order to avoid irreversible damage caused by improper use.

**NOTE:** So that absorption is effective the hybrid bank must be separate from the other loads (other lines or users) by a shock reactor or transformer

### 1.1.- Checking the contents of your package

Please check the following points on receipt of the instrument:

- a) The equipment delivered matches your order specifications.
- b) Check that the voltage and frequency match the installation's.
- c) After unpacking, check that the equipment has not been damaged during delivery.
- d) Check that it is equipped with the following standard items:
  - Instruction manual of bank
  - Instruction manual of regulator
  - Current transformer (not included)

### 1.2.- Model range of FAR-Q

The range of **standard FAR-Q** equipment is shown in the following tables.

*Table 1.- Standard FAR-Q filters for 50 Hz systems*

CODE	TYPE (*)	VOLTAGE (V)	STEPS	Q STEPS x (kvar)	Irms (A)	5 <sup>th</sup> (A)	7 <sup>th</sup> (A)	CABINET
R7C101	FAR5-Q6-112.5-400	400	3	3 x 37.5	176	60	30	FR6
R7C102	FAR5-Q6-150-400	400	4	4 x 37.5	234	80	40	FR6
R7C103	FAR5-Q6-187.5-400	400	5	5 x 37.5	293	100	50	FR6
R7C104	FAR5-Q6-225-400	400	6	6 x 37.5	351	120	60	FR6
R7C105	FAR5-Q6-262.5-400	400	4	37.5 + (3 x 37.5)	410	140	70	FR6
R7C106	FAR5-Q6-300-400	400	4	4 x 75	469	160	80	FR6
R7C107	FAR5-Q6-337.5-400	400	5	37.5 + (4 x 75)	527	180	90	FR6
R7C108	FAR5-Q6-375-400	400	5	5 x 75	586	200	100	FR6
R7C109	FAR5-Q8-412.5-400	400	6	37.5 + (5 x 75)	644	220	110	FR8
R7C110	FAR5-Q8-450-400	400	6	6 x 75	703	240	120	FR8
R7C111	FAR5-Q8-487.5-400	400	7	37.5 + (6 x 75)	761	260	130	FR8

R7C112	FAR5-Q8-525-400	400	8	7 x 75	820	280	140	FR8
R7C113	FAR5-Q12-562.5-400	400	8	37.5 + (7 x 75)	878	300	150	FR12
R7C114	FAR5-Q12-600-400	400	8	8 x 75	937	320	160	FR12
R7C115	FAR5-Q12-637.5-400	400	9	37.5 + (8 x 75)	996	340	170	FR12
R7C116	FAR5-Q12-675-400	400	9	9 x 75	1054	360	180	FR12
R7C117	FAR5-Q12-712.5-400	400	10	37.5 + (9 x 75)	1113	380	190	FR12
R7C118	FAR5-Q12-750-400	400	10	10 x 75	1171	400	200	FR12

Table 2.- Standard filters for 60 Hz systems

CODE	TYPE (*)	VOLTAGE (V)	STEPS	Q STEPS x (kvar)	I <sub>rms</sub> (A)	5 <sup>th</sup> (A)	7 <sup>th</sup> (A)	CABINET
R7C401	FAR5-Q6-105-400	480	3	3 x 35	166	60	30	FR6
R7C402	FAR5-Q6-140-400	480	4	4 x 35	221	80	40	FR6
R7C403	FAR5-Q6-175-400	480	5	5 x 35	276	100	50	FR6
R7C404	FAR5-Q6-210-400	480	6	6 x 35	331	120	60	FR6
R7C405	FAR5-Q6-245-400	480	4	35 + (3 x 35)	387	140	70	FR6
R7C406	FAR5-Q6-280-400	480	4	4 x 70	442	160	80	FR6
R7C407	FAR5-Q6-315-400	480	5	35 + (4 x 70)	497	180	90	FR6
R7C408	FAR5-Q6-350-400	480	5	5 x 70	552	200	100	FR6
R7C409	FAR5-Q8-385-400	480	6	35 + (5 x 70)	608	220	110	FR8
R7C410	FAR5-Q8-420-400	480	6	6 x 70	663	240	120	FR8
R7C411	FAR5-Q8-455-400	480	7	35 + (6 x 70)	718	260	130	FR8
R7C412	FAR5-Q8-490-400	480	8	7 x 70	773	280	140	FR8
R7C413	FAR5-Q12-525-400	480	8	35 + (7 x 70)	829	300	150	FR12
R7C414	FAR5-Q12560-400	480	8	8 x 70	884	320	160	FR12
R7C415	FAR5-Q12-595-400	480	9	35 + (8 x 70)	939	340	170	FR12
R7C416	FAR5-Q12-630-400	480	9	9 x 70	994	360	180	FR12
R7C417	FAR5-Q12-665-400	480	10	35 + (9 x 70)	1050	380	190	FR12
R7C418	FAR5-Q12-700-400	480	10	10 x 70	1105	400	200	FR12

### 1.3.- Safety warnings



This manual contains information and warnings about the **FAR-Q** hybrid bank which must be followed to guarantee the proper operation of all instrument functions and to maintain it in a safe condition.

**If the instrument is not installed in accordance with manufacturer's specifications, the instrument's protection may be damaged.**

Check that the protection devices are operating correctly.

### 2.- MAIN FEATURES

A **FAR-Q** hybrid filter is formed by various groups of inductances plus a capacitor in series, located in an appropriate cabinet. Each step is characterised by three parameters:

- 1) Power factor to be corrected at 50 or 60 Hz.
- 2) Harmonic to be filtered, generally 5<sup>th</sup> and 7<sup>th</sup>.

3) Harmonic current capable of absorbing.

Each step is formed by 2 reactors and a 6 terminal capacitor which contains 2 three-phase, 3 terminal capacitors each electrically insulated. The operating principle of this design is that each reactor is connected to each of the three capacitor terminals forming an LC set tuned to a frequency close to the 5th harmonic and another set tuned near to the 7th harmonic. The following diagram shows how the step is formed:

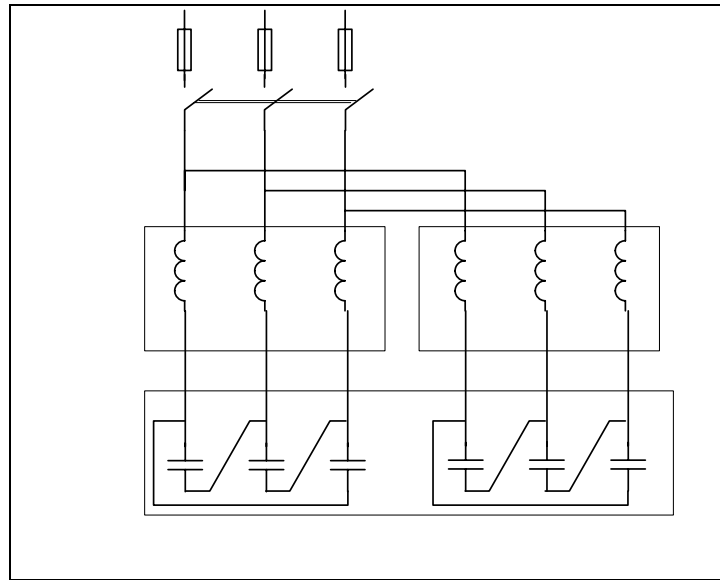


Fig. 1 – Standard type at 400V 50Hz, triangle connection **AF1**

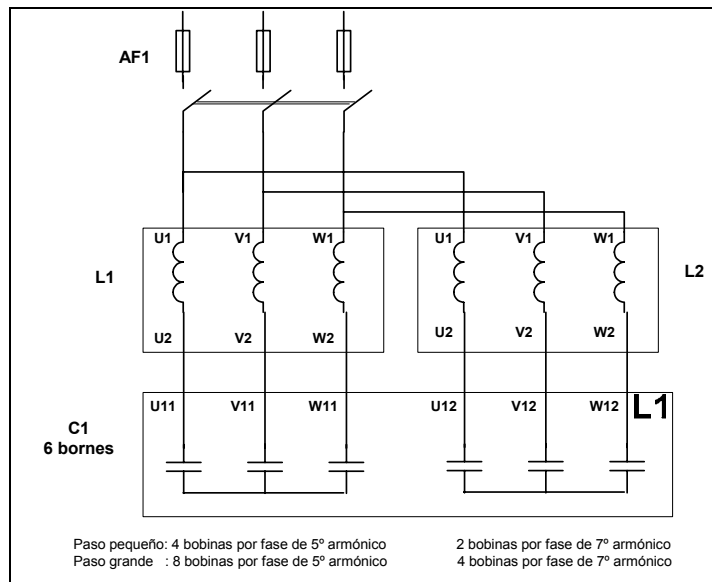


Fig. 2 – Standard type at 480V 60Hz, star connection

U1            V1            W1  
 U2            V2            W2  
 U11          V11          W11

**C1**  
**6 bornes**

**Filter regulation**

Filter regulation is via a conventional power factor regulator as with any other standard capacitor bank. (See regulator manual)

Paso pequeño: 4 bobinas por fase de 5º ar  
 Paso grande : 8 bobinas por fase de 5º ar

### 3.- TYPES ACCORDING TO FILTER COMPOSITION

The types of filters depend on three main parameters:

- Voltage and basic frequency of system
- Step number of filter

### 3.- TECHNICAL FEATURES

The technical features stated in this manual are for the FAR-Q hybrid banks. However there may be variations depending on the operating and protection systems.

#### 3.1.- Main Technical Features

Table 3.- Technical features

Standard voltage .....	400V and 480 V (1)
Frequency.....	50 Hz or 60 Hz
Ambient temperature.....	-10°C to +45°C
General filter switch	See table 4
Protection devices (each step)	Fuses. Thermostat on L (overload disconnection)
Filter cabinet: Cabinet protection devices Filter cabinet	Painted Fe sheet IP22 Grille: IP21
Standards	IEC-61642, EN-60439, IEC-664, EN-60831, EN-60289
<b>(1) Other voltages on request</b>	
Cabinets	(See figures 3, 4 and 5)
Operation cabinet	Sheet metallic, epoxy paint, IP 31
L and C cabinet	Ventilation grille, epoxy paint, IP 21
Types and weight	(See catalogue)
Dimensions	(See figures 3, 4 and 5)
FA5 Type	One cabinet: L =980 mm, W= 520 mm, H= 2000 mm
2 x FA5 Type	Two cabinets: L =980 mm, W= 520 mm, H= 2000 mm
FR6 Type	One cabinet: L =1100 mm, W= 800 mm, H= 1850 mm
2 x FR6 Type	Two cabinets: L =1100 mm, W= 800 mm, H= 1850 mm

### 3.2.- Technical features of LC filters

*Table 5.- Filtering groups features*

	Tuning frequency	$1.1 f_n$
<b>Inductance</b>		
	Core / Wound	Directed grain cover / Aluminium strip
	Insulating voltage	2kV
	L value tolerance	<3%
	Saturation $\Delta L=5\%$	$1.6 I_{nominal}$
	Maximum ambient temperature	50°C
	Internal temperature at $I_{nom}$	<110°C
	Protecting thermostat	95 °C
	Max. overload $\Sigma(n.I_n)^2$	
	Permanent	20%
	Short-time (1 min.)	2 $I_n$
<b>Capacitor</b>		
	Dielectric	Self-healing polypropylene
	Operating rated voltage	1.15 $U_{nom}$ system
	Short-time overload (10s)	1000 V
	Insulating voltage to earth	3 kV
	Ambient temperature	max. 40°C
	Losses	0.5W/Kva

### 3.3.- Dimensions

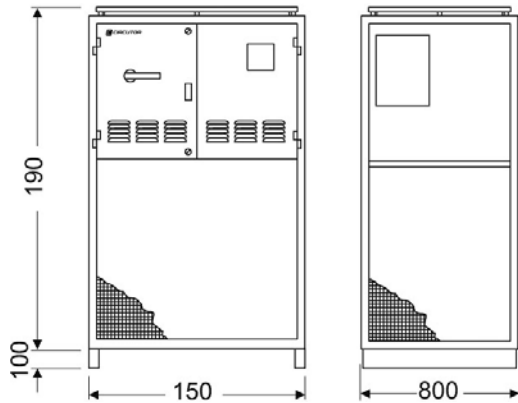


Fig. 3.- Cabinet for FAR-Q6 filters

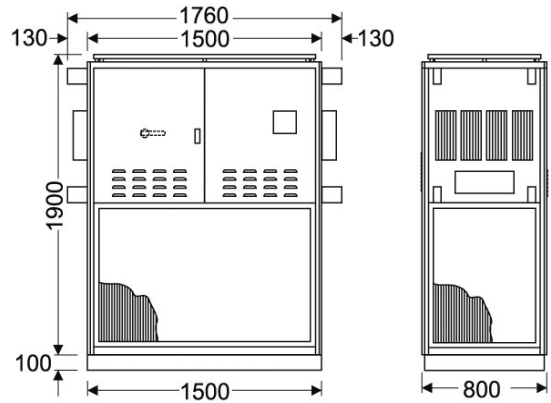


Fig. 4.- Cabinet for FAR-Q8 type filters

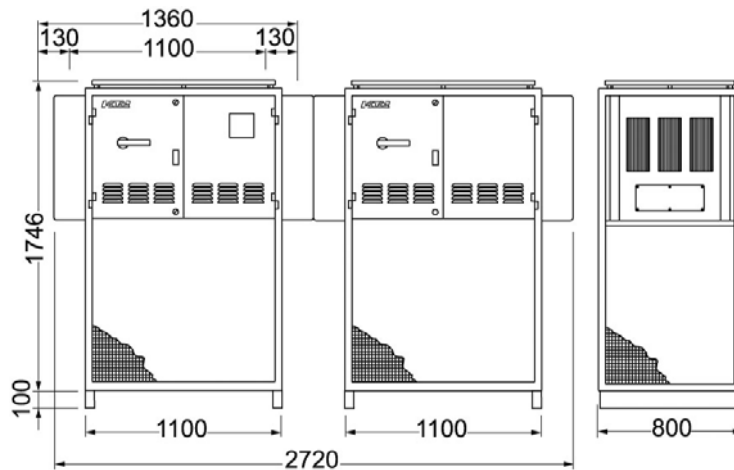


Fig. 5.- Cabinet for FAR-Q12 type filters

## 4.- INSTRUCTIONS FOR INSTALLING THE FAR-Q FILTERS

### 4.1.- Initial checks (before applying voltage)

For the **FAR-Q** hybrid filters to operate properly the following general installation conditions must be followed:

- The equipment's **ventilation** conditions must be examined leaving minimum distances between the sides and bottom of the cabinet and walls ensuring that air can circulate properly.
- FAR-Q equipment must not be mounted near to heat sources. The maximum ambient temperature must not exceed 40 °C. Assemble ventilation over 35 °C. In particular FAR equipment must not be installed in direct sunlight.
- FAR-Q equipment must not be mounted in the same line as any other active filter.
- Check that the equipment's rated voltage stated on the technical features board matches the rated voltage between phases in the system to which it will be connected.
- Check that the equipment setting (step and currents) match the installation's requirements.

### 4.2.- Revision of external connections (before applying voltage)



All external connections must be via the terminal boards and the input strip on the FAR-Q cabinet.

- It is necessary to install a current transformer in order to start (normally **In / 5 A**) in **accordance with the total current of the installed receivers**. The current transformer secondary line must have the appropriate diameter in terms of its distance from the regulator (minimum 2.5 mm<sup>2</sup>).
- The power supply voltage for the regulator is **between phases** (except when it is a special single-phase regulator). **Voltage must be taken from the two phases where there is no current transformer**. The phase where the current transformer is installed **does not coincide** with any of the phases from which voltage is being taken to supply the regulator.
- The current transformer is installed at a point where all of the load currents to be corrected plus the capacitor current are passing.

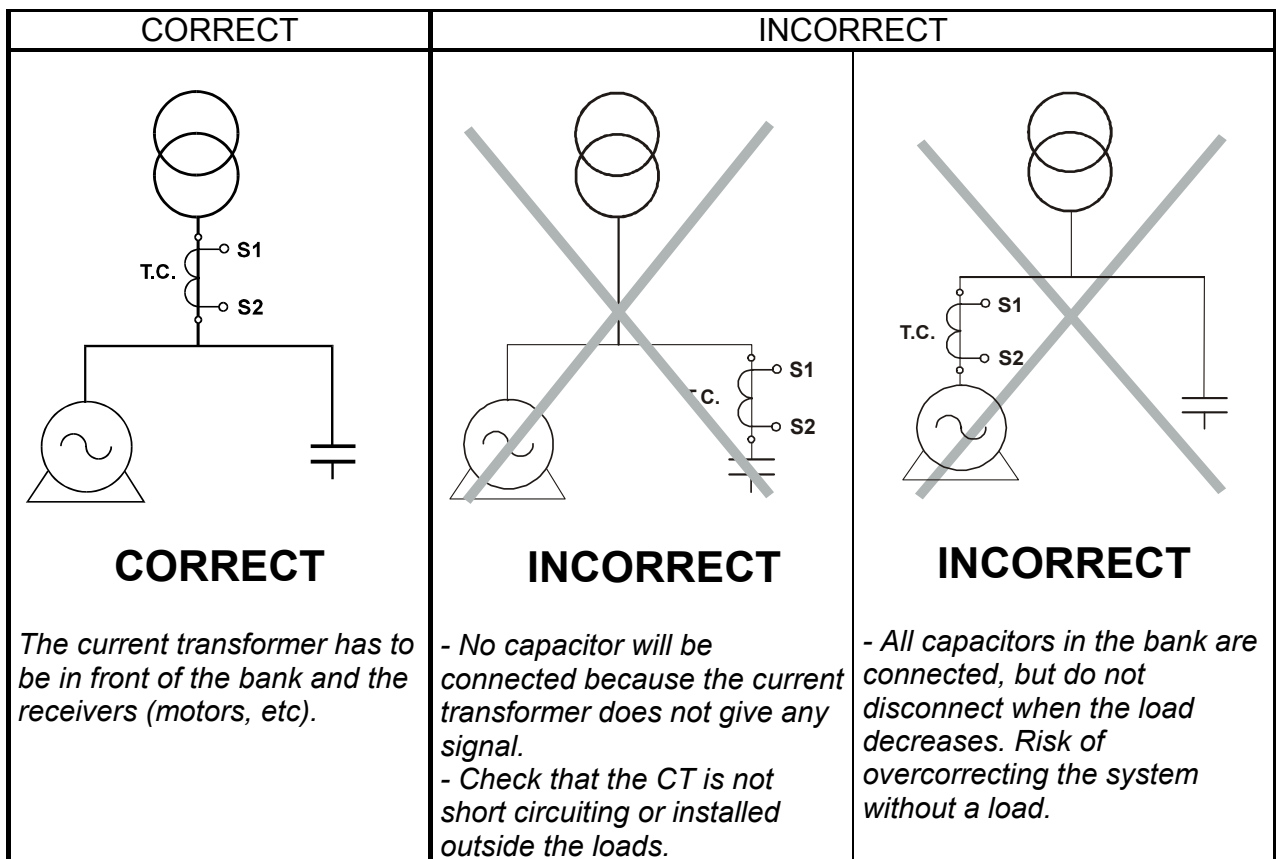


Fig. 6.- Attaching the current transformer (CT)

Connect the current transformer secondary (S1-S2) onto the terminals marked S1-S2 (1 and 2). If a  $\cos \varphi$  value appears on the display which does not match, it means that the phase progress is wrong: invert the connection of the voltage phases on the regulator (or invert S1-S2 on the current transformer secondary). (See regulator manual)

## **5.- STARTING-UP OF FAR-Q EQUIPMENT**

**Follow the steps stated below to start hybrid filter equipment:**

1. Check the tightness of the bank's connections.
2. Check if the voltage and frequency levels are correct in the installation.
3. Check that the current transformer is connected on the correct line and that its polarity, both physical and wiring, are also correct.
4. Check the operation of the regulator without power.
5. Program the regulator in accordance with the instructions in the regulator's manual.
6. Connect power.
7. Check the capacitor burden.

## **6.- TROUBLESHOOTING**

If this equipment does not work properly when applying voltage, check the following points:

- If a step does not enter, check the contactor coil and the selector or control relay.
- Check that the step current does not exceed the rated current under normal operating conditions. A true effective value instrument must be used.
- In the event of a fault, which cannot be resolved using the above paragraphs, please contact the CIRCUTOR technical service.

### **IMPORTANT!**

- It is recommended that the temperatures of the capacitor walls and the reactor iron are checked after one hour's operation. The former must not exceed 60°C and the latter 85°C. If not, check the ventilation.

## **7.- MAINTENANCE**

**Annual inspection:**

- Inspect the bank by eye. No insulation faults or overheating parts should be detected.
- Check Ia temperature of the capacitors and reactors (limits stated in paragraph 6).
- Check that the contactor contacts are not showing signs of wear.
- Check that all steps work properly. If not, check voltage supply fuses.
- Check the current in each step. Excess current may be a sign of more harmonics than the filter can absorb and that it may be necessary to expand the filter.
- Check that there are no power terminals with loose connections which may cause the cables to overheat.

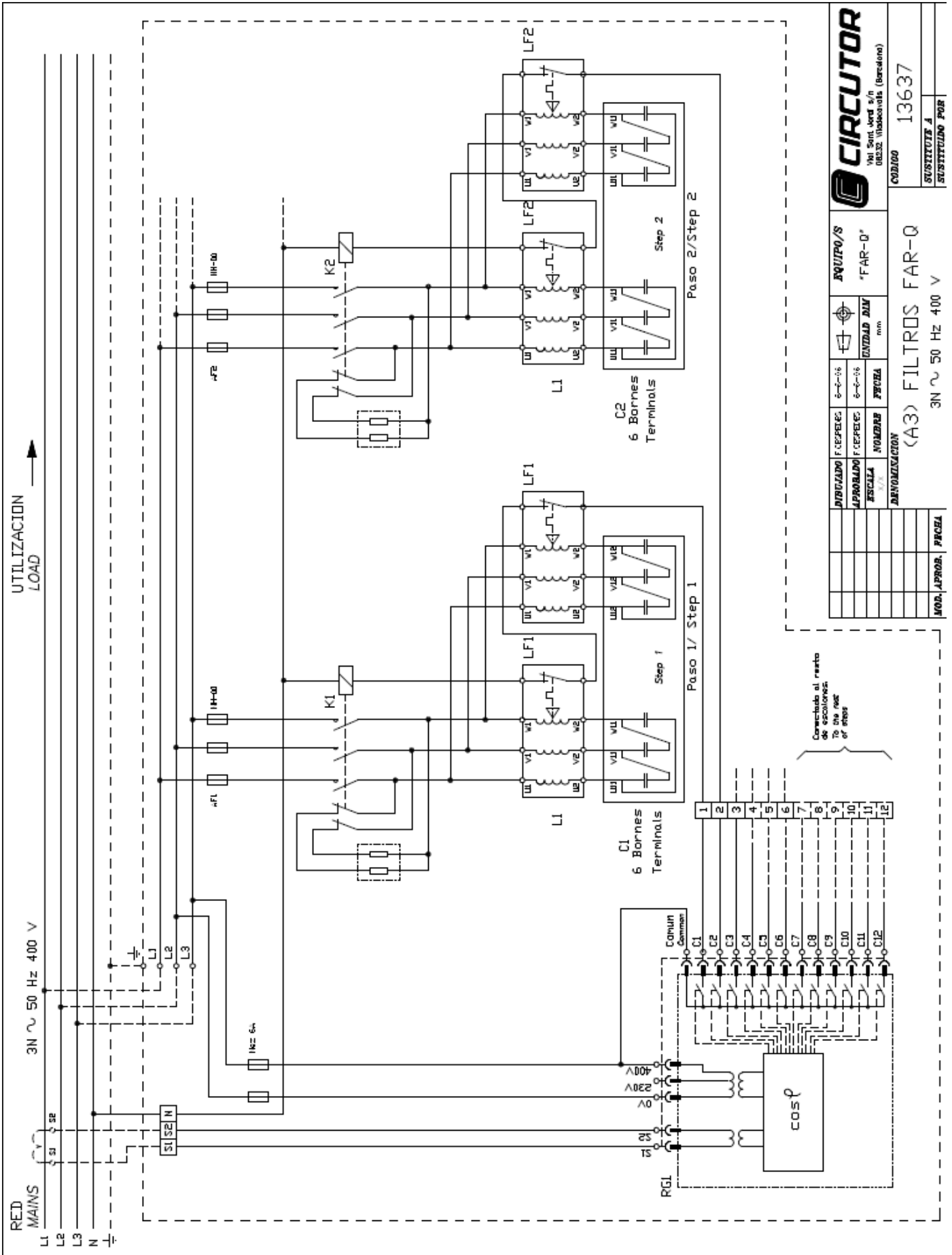
## **8.- TECHNICAL SERVICE AND WARRANTY**

CIRCUTOR guarantees its products against any manufacturing fault for a period of one year from the date of delivery. The warranty does not cover protection devices (fuses) or operating parts subject to normal wear and tear.

This warranty shall be nullified in the event of improper handling or if the installation conditions are not followed.

CIRCUTOR has its CONSULTANCY AND TECHNICAL ASSISTANCE services available for any advice.

**NOTE:** The intended settings, number of steps, harmonics and the means of grouping them either fixed or by remote control are configurable and therefore may change according to order specifications. See setting sheet.



APROBADO	F. CEPELEC	6-8-06	UNIDAD	MM	EQUIPO/S	 Vial Sorri, Verdú & Iñigo 08232 Masquefales (Barcelona)	CODIGO	13637	
APROBADO	F. CEPELEC	6-8-06	UNIDAD	MM	"FAR-O"		SUSTITUIR A		
ESCALA	NOMBRE		PRECIA				SUSTITUCION POR		
DESIGNACION									
(A3) FILTROS FAR-O 3N ~ 50 Hz 400 V							MOD.	APROB.	PRECIA

Conectado al resto de escobillas.  
To the rest of brushes