User's Manual for
The StacoVAR, StacoVAR PA, PH and PM

AUTOMATIC POWER FACTOR CORRECTION SYSTEM WITH FILTERS

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CAUTION!

THE FOLLOWING OPERATIONS MUST BE PERFORMED BEFORE ACCESSING THE INSIDE OF THE EQUIPMENT:

1. DISCONNECT THE POWER SUPPLY.

2. WAIT AT LEAST FIVE (5) MINUTES FOR DISCHARGING CAPACITORS. CONFIRM BY USE OF A VOLTMETER FOR BOTH AC AND DC.

3. THEN SHORT CIRCUIT AND EARTH ALL OF THE CAPACITORS.

CONTENTS

DEFINITIONS

CAPACITOR BANK: Assembly composed of capacitors and their corresponding connection and protection devices; the bank, as a whole, is managed by one of the output relays of the Automatic Reactive Power Controller. There are two families of Power Factor Correction Products - Power Factor Correction (only) [PFC] and Power Factor Correction with harmonic mitigation [HFC].

STEP: The number of units into which the total power of the equipment is divided, as governed by the controller; a single step may be formed by one or more banks.

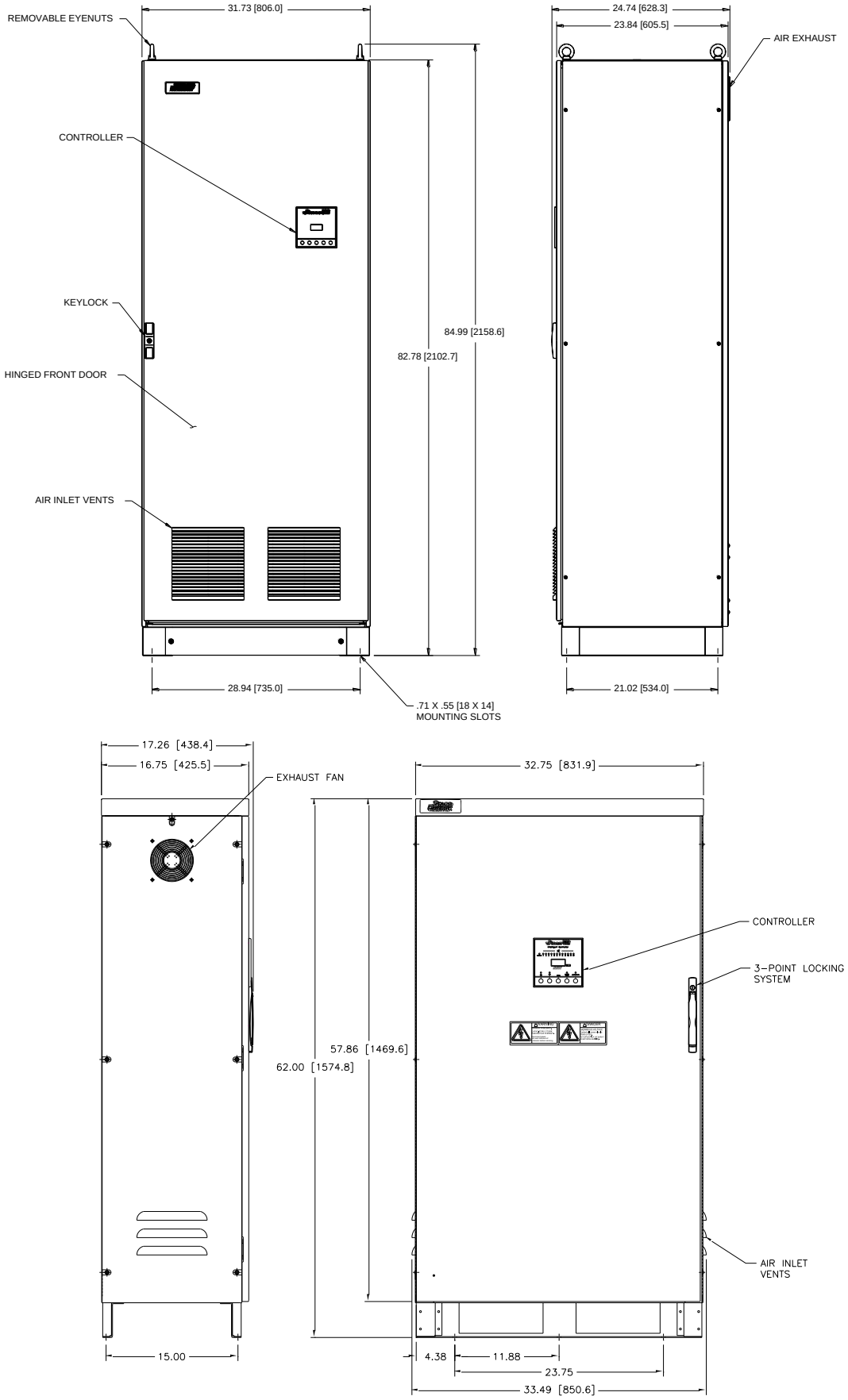
The symbols used in this manual are as follows:

Components:

A	Automatic Reactive Power Controller
C	Capacitors
CB	Circuit Breaker (optional)
CT	Current Transformer
F	Fuses and protective devices
K	Contactors, PTCs, control relays
L	Reactors
R	Discharge resistors
T	Transformers
TB	Terminal boards
T*	Temperature switch

DESCRIPTION

The System is designed to be used in low voltage (208-600vac), 3-phase, 60 Hz networks; and is a complete system, which is capable of automatically connecting and disconnecting the capacitor banks by means of switching devices (electro-mechanical or thyristor) under the supervision of the controller.


REMOVABLE EYENUTS
31.73 [806.0]
24.74 [628.3]
23.84 [605.5]
AIR EXHAUST
CONTROLLER
KEYLOCK
84.99 [2158.6]
82.78 [2102.7]
HINGED FRONT DOOR
AIR INLET VENTS
28.94 [735.0]
.71 X .55 [18 X 14]
MOUNTING SLOTS
21.02 [534.0]
17.26 [438.4]
16.75 [425.5]
EXHAUST FAN
32.75 [831.9]
CONTROLLER
3-POINT LOCKING
SYSTEM
57.86 [1469.6]
62.00 [1574.8]
AIR INLET
VENTS
15.00
4.38
11.88
23.75
33.49 [850.6]

COMPONENTS

MODULE ASSEMBLY (ENCLOSURE)

Steel modular trays are located inside the enclosure. Each module will contain components such as power capacitors, switching devices, reactors (HFC models only), fusing and electrical bus bars. Modules will be installed in a vertical fashion, as required, to accommodate total kvar requirements.

Capacitors

Individual modules will contain three-phase power capacitors (internally connected in either delta or wye arrangement), with finger proof terminal protection and equipped with fixed external discharge resistors. Capacitors are rated for the proper kVAR, voltage and frequency, may have individual switched steps, or be fixed, and when combined, meet the total kVAR requirements.

Reactors (Applications for Filtering Harmonics)

To protect capacitors from harmonic currents, each capacitor bank (in HFC models only) is fitted with a three-phase iron-core reactor. A fan package is provided for additional forced air ventilation, controlled by the automatic reactive power controller.

Switching Devices/Fuses/Blown Fuse Indication

The operation of the capacitors is carried out by means of either contactors or thyristor switches (high-speed applications), which are suitable for the connection of capacitors.

Protection against short-circuits are assured by the use of a set of three NH-00 or NH-000, gRL, 200kaic fuses (one per phase) for each capacitor step in the PA and PH models. The PM model is protected by RK5, dual element, time-delayed fuses with blown fuse indicator.

Disconnection (Optional)

Rated current: Reference component nameplate
Type: Molded Case Circuit Breaker

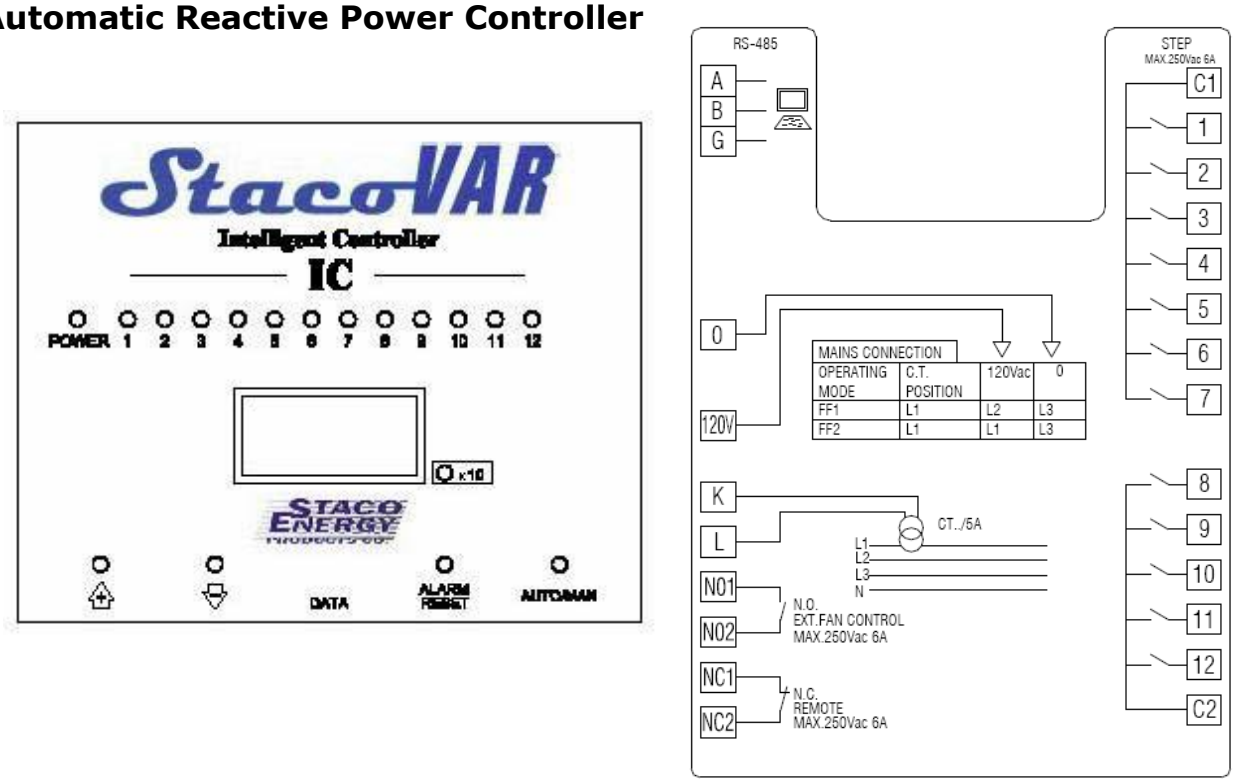


Fig.1 – Front and rear panel view

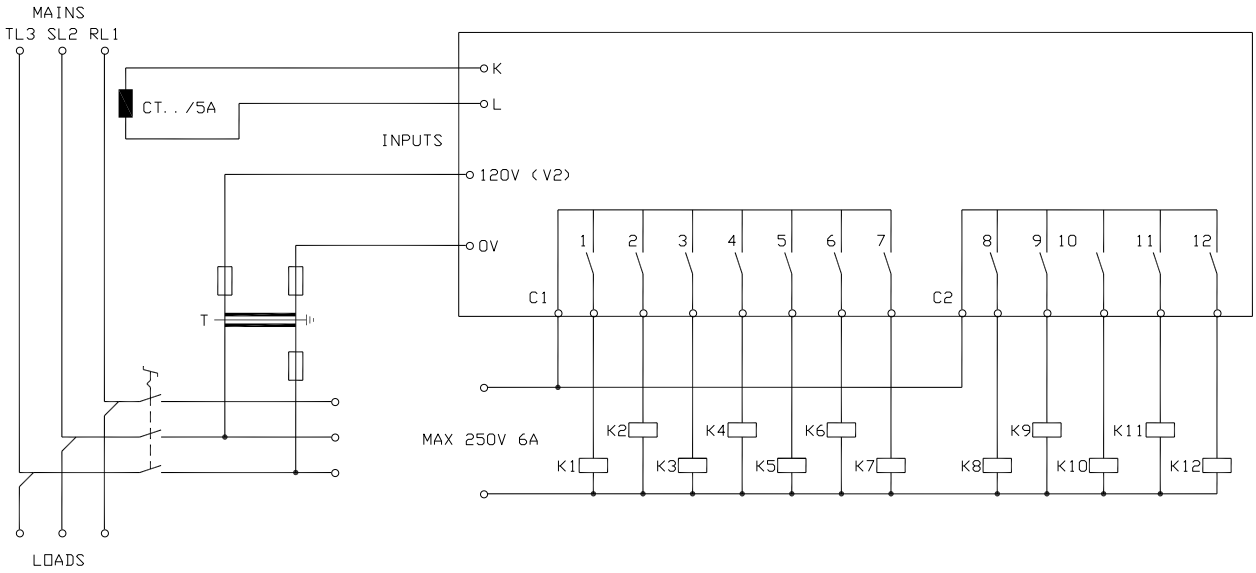


Fig.2 – Electrical Connections

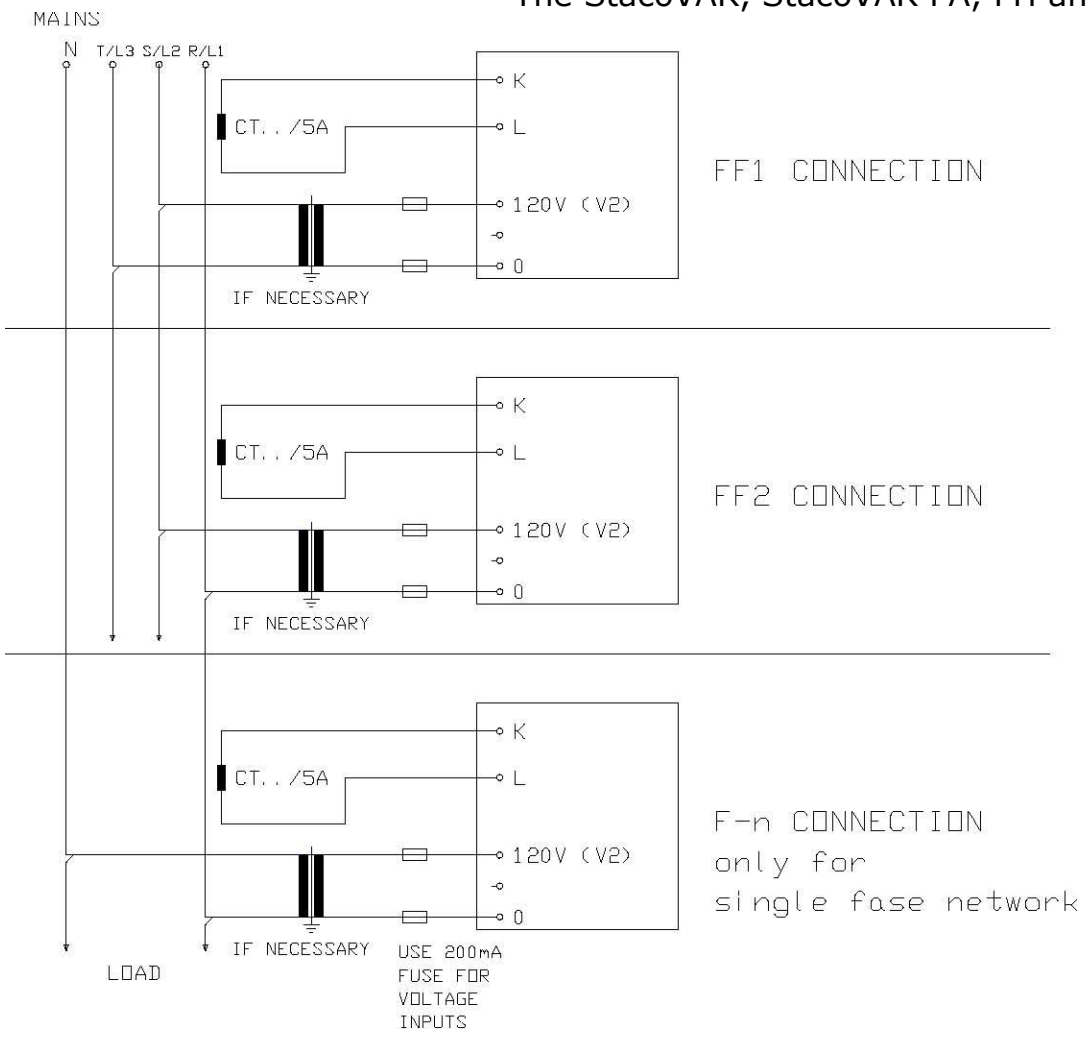
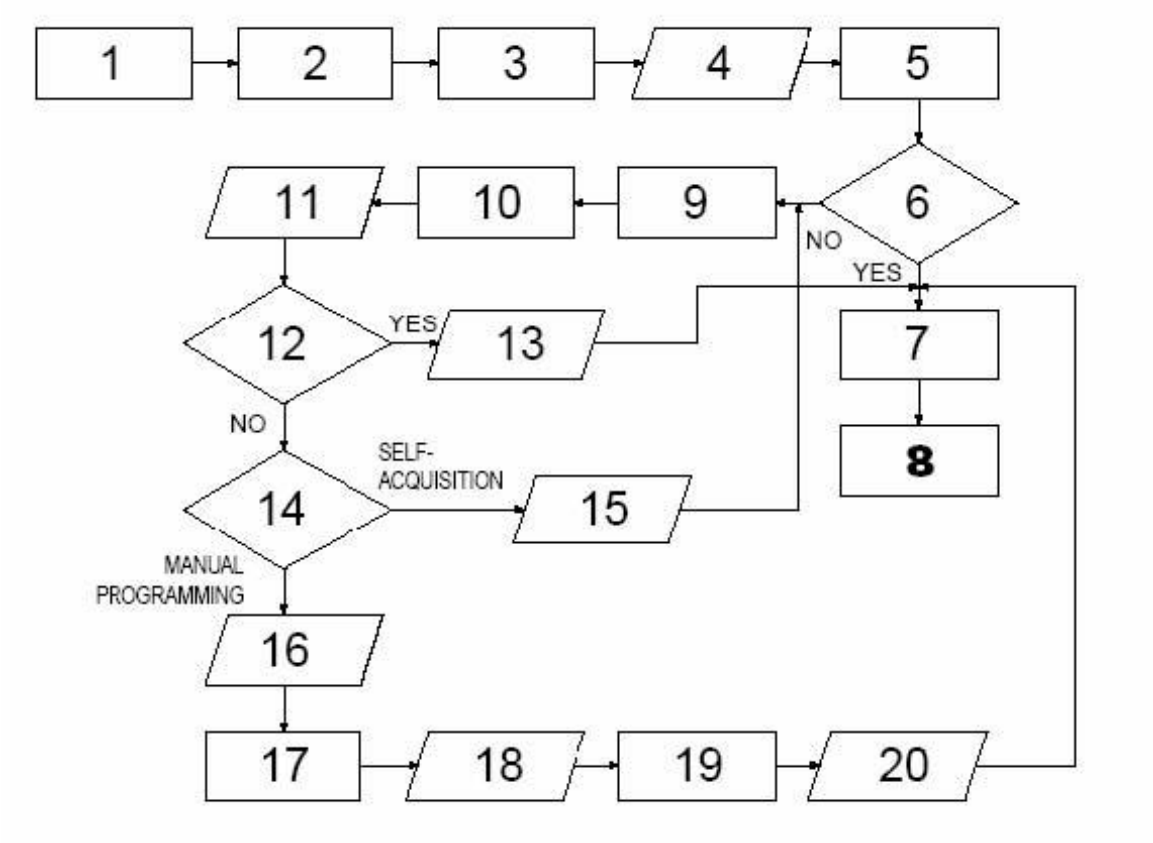


Fig.3 – Mains connection CONTENTS

1. SIMPLIFIED DIAGRAM RELATIVE TO FIRST POWERING UP



1 POWER THE CONTROLLER
2 DISPLAY ALTERNATELY SHOWS **"IL"** AND **"- - -"**
3 ENTER "IL" PARAMETER MAINS C.T. RATIO (e.g. w/ C.T. 200/5 enter 40)
4 **"+"** AND **"-"** TO CHANGE THE PARAMETER AND **"DATA"** KEY TO CONFIRM
5 **"FAS"** DISPLAYED IN TURN WITH **"0"** OR **"1"**
6 IS THE CONTROLLER INSTALLED ON A DUCATI ENERGIA POWER FACTOR CORRECTION SYSTEM?
7 DISPLAY ALTERNATELY SHOWS "**COS**" AND THE SYSTEM POWER FACTOR
8 STEPS SWITCHED IN AND OUT OF SERVICE TO ACHIEVE DESIRED POWER FACTOR
9 STEPS SWITCHED IN AND OUT THREE TIMES (AUTO-ACQUISITION)
10 DISPLAY ALTERNATELY SHOWS **"C1"** AND THE VALUE MEASURED FOR THE FIRST BANK
11 PRESS **"DATA"** KEY TO DISPLAY VALUE OF SUBSEQUENT BANKS
12 ARE THE MEASURED POWERS CORRECT?
13 PRESS THE **"DATA"** KEY THREE TIMES TO EXIT
14 START A NEW SELF-ACQUISITION OR CARRY OUT A MANUAL PROGRAMMING
15 TO LAUNCH A NEW AUTO-ACQUISITION PROCEDURE PRESS "**ALARM/RESET**" + **"+"**
16 FOR MANUAL PROGRAMMING PRESS "**ALARM/RESET**" + **"-"**
17 DISPLAY SHOWS **"Pro"** PRESS **"+"** OR **"-"** TO SET THE DESIRED PROGRAM (SEE TABLE 1 – Page 18)
18 PRESS THE **"DATA"** KEY
19 DISPLAY SHOWS "**PPC**" PRESS **"+"** OR **"-"** TO SET THE VALUE OF THE FIRST BANK
20 PRESS THE "**DATA**" KEY

2. SAFETY

This automatic power factor correction controller was manufactured and tested in conformity with current standards and left the factory in perfect conditions of technical safety.

In order to maintain these conditions and ensure safe operation, the user must abide by the instructions provided herein.

WARNING

This device must be installed by qualified personnel in accordance with the equipment regulations currently in force in order to prevent injury or damage to persons or property. Maintenance or repair work must be managed solely by authorized personnel.

Before undergoing any maintenance or repairs, the device must be disconnected from all power sources.

The constructor disclaims all liability for any injury or damage caused to persons or property as a result of improper use of its products.

In view of the continuous evolution of our technology, we reserve the right to change the specifications contained herein without notice. The catalogue descriptions and data shall thus have no contractual validity.

Allow capacitors to discharge for at least five (5) minutes before performing maintenance.

3. GENERAL DESCRIPTION

The StacoVAR reactive power controller is designed to control and regulate capacitor banks. It operates on the basis of microprocessor technology, which provides accurate, reliable power factor measurements. The power factor is controlled by switching capacitor banks according to the reactive power requirements of the load: if more than one step is needed in order to reach the cosϕ required, STACOVAR activates all the steps necessary with a delay between one and the other equal to the set time "T2". The number of switching operations is thereby reduced and where the capacitor banks have an equal value, they will be used in a homogeneous manner.

The controller features both automatic and manual operating modes. In addition, the powers associated with the steps can be automatically acquired thanks to the "AutoAcquisition" function. At the end of this procedure, moreover, the controller also automatically selects the most appropriate switching sequence. Alternatively a user program, chosen among the numerous available options, can be manually set. Thanks to this function the controller will be able to intervene and correct the system PF more quickly: in fact, on the basis of real-time power measurements and the known powers associated with individual steps, it can calculate how much reactive power is needed to bring the cosϕ to the desired value and switch on all the necessary steps together (with just a settable delay "T2" between one and the next), as noted previously.

The model also features an Rs485 serial interface with standard "DUCATI" communication protocol which enables the user to connect the device to a network of instruments and read the measured data remotely from a connected PC.

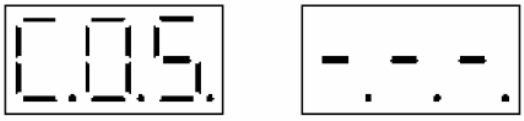
STACOVAR also offers other useful functions, such as panelboard temperature measurements for controlling an external cooling fan, a series of protections and associated alarms to safeguard the capacitor banks and guarantee efficient system performance, the possibility of counting the number of switching operations of a certain step to prevent possible downtimes due to failures and thereby increase the system's reliability, and other functions as well.

NOTE: The front panel of STACOVAR features a series of keys for accessing functions and programming; some functions are activated by pressing a **combination of 2 keys**: in this manual, when mention is made of a two-key combination (e.g. **AUTO/MAN** + ▲), it means that the user must press the first key and, **without releasing it**, then press the second one. (In fact the combination **AUTO/MAN** + ▲ activates a different function from the combination ▲ + **AUTO/MAN**

4. HOW IT WORKS The measured current from the mains C.T. is filtered and compared with the required power factor and the insensitivity zone: if the conditions set by the user thus require, the ▲ (or ▼) LED will light up and all the banks necessary in order to reach the set power factor will be switched into service in as little time as possible (compatibly with the capacitor discharge time T1).

The controller automatically adjusts to the direction of circulation of the current drawn from the C.T.

If the current to the C.T. secondary winding falls below 200mA, the controller will disconnect all the banks and the display will show "COS" in turn with flashing "-.-.-.".



It will go into standby until a current exceeding that value is restored.

5. MAINS CONNECTION

The STACOVAR reactive power controller may be connected to the mains according to two different configurations (see diagram in **Fig. 3**).

"**FF1**" In this configuration (default) the C.T./5A is positioned on phase R(L1) and the reference voltage is drawn from the line voltage between phases S(L2) and T(L3). This is the classic varmetric connection. "**FF2**" In this configuration the C.T./5A is on phase R(L1) whereas the reference voltage is the line voltage between phase R(L1) itself and phase S(L2).

Warning: if the cyclical direction of the power supply phases is not known, configuration FF2 may give rise to an error in the power factor measurement.

"**F-n**" In this configuration the C.T./5A is on phase R(L1) whereas the reference voltage is the phase-neutral between phase R(L1) itself and the neutral N. Use this configuration **only for single-phase networks.**

6. INSTRUCTIONS FOR INSTALLING THE C.T.

The C.T. must have a value:

- at the primary winding: equal to or relatively higher than the maximum current absorbed by the load downstream from the C.T. itself.
- at the secondary winding: 5A.

VERY IMPORTANT:

- The C.T. must be connected both upstream from the power factor correction system and upstream from the load (See Fig.4 positions a and b).
- The C.T. must never be directly connected on the load power supply line (See Fig.4 position c) or directly on the power factor correction line (See Fig.4 position d).
- In the FF1 connection configuration the C.T. must be connected to the phase not used for the voltmetric supply to the controller.

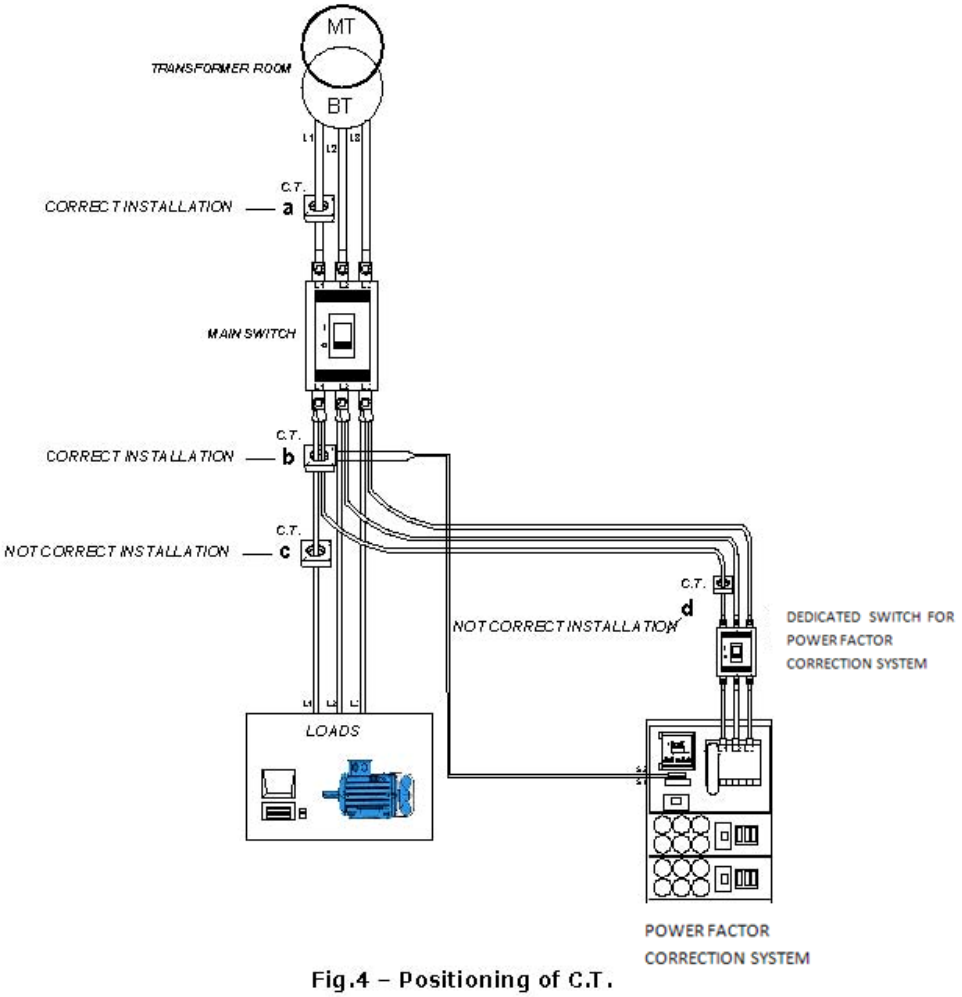
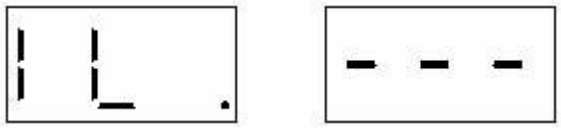


Fig.4 – Positioning of C.T.

7. POWERING UP FOR THE FIRST TIME

The STACOVAR regulator behaves differently the first time it is started up since it will need the **IL** parameter (mains C.T. ratio) to be set in order to work; the regulator **cannot be started up** without setting this parameter. On subsequent occasions it will utilize the previously programmed parameter, unless the user wishes to change it. As soon as the controller is switched on, **8.8.8.** will appear on the display for a few seconds and all the LEDs will light up to enable their efficiency to be checked.

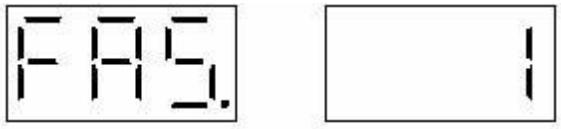
The first time the controller is powered the display will show "**IL**" in turn with flashing "**---**" and remain in this situation until the mains CT ratio is set.



Press the ▲ (or ▼) key to change the parameter and the **DATA** key to confirm.

SETTING THE IL PARAMETER: for example, if the user has a C.T. with a ratio of 200/5, the parameter to set must be IL= 40 (mains CT ratio);
Other examples: CT 300/5 IL=60; CT 350/5 IL=70; CT 400/5 IL=80.

Subsequently the controller will alternately display "**FAS**" and "**0**" or "**1**";



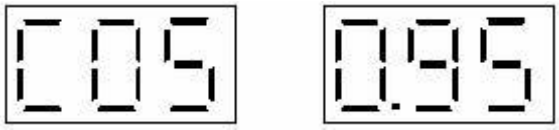
at this stage the system will read and display the direction of the incoming current from the C.T. (0 = direct / 1= inverted). It is only an indication.

*NOTE***:** if the incoming current is insufficient (less than 200mA), STACOVAR cannot determine its direction and will **stand by** in this status until current is supplied.

After displaying the "**FAS**" parameter it will automatically launch the automatic procedure for acquiring the powers of the single capacitor steps. The capacitor steps will be switched on and measured in sequence a total of three times each. At the end of this procedure the controller will alternately display "**C1**" and the measured power value of the first step; the power of the next step can be displayed by pressing the **DATA** key. Ex.

If the power measurements are incorrect, from the same menu the user can press:
- **– ALARM/RESET** + ▲ to launch a new auto acquisition procedure
- **– ALARM/RESET** + ▼ to enter the manual programming mode (see chap.10)

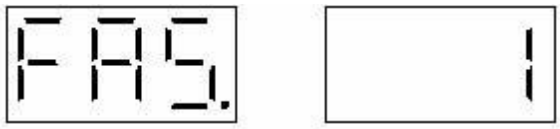
If the power measurements are correct**, the user can press the** DATA **key for three seconds to exit this menu and the controller will start to work automatically**, **displaying the letters "**COS**" in turn with the system power factor**.
Ex.



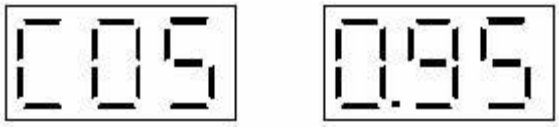
NOTE: The STACOVAR regulator needs a power supply of 120Vac 50/60Hz, but it's set by the factory to a main voltage of 400Vac 50/60Hz ("**UFF**" parameter). If the mains voltage is different the step's power displayed is incorrect. You should manually change the "**UFF**" parameter and start a new procedure for acquiring the powers of the single capacitor steps (see chapter 10) FOR A CORRECT WORKING OF THE CONTROLLER, CHECK THAT POWERS MEASURED BY THE CONTROLLER ARE CORRECT.

8. SUBSEQUENT STARTUPS

As soon as the controller is switched on, **8.8.8.** will appear on the display for a few seconds and all the LEDs will light up to enable their efficiency to be checked.
Subsequently the controller will alternately display "**FAS**" and "**0**" or "**1**";
Ex.



At this stage the system will read and display the direction of the incoming current from the C.T. (0 = direct / 1= inverted). It is only an indication.
NOTE: if the incoming current is insufficient (less than 200mA), STACOVAR cannot determine its direction and will **stand by** in this status until current is supplied.
At this point, the controller no longer requires any type of setting and will be ready for perfect operation: it will alternately display "**COS**" and the system power factor.
Ex.



9. TESTING CONTROLLER PERFORMANCE

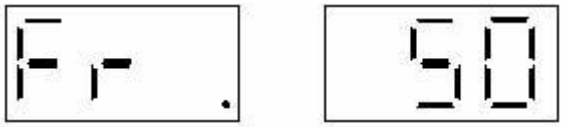
To immediately check whether the controller is working efficiently, the user should keep in mind that:

- When the load is started, the controller should turn on the ▲ LED and switch the capacitor steps into service.
- If the load is reduced or removed, the controller should turn on the ▼ LED and disconnect capacitor steps accordingly.
- When the ▲ and ▼ LEDs are off, the controller should display a cosϕ close to the one set
- As the inductive cosϕ increases up to 1, the current circulating upstream from the power factor correction decreases, whereas it increases with the capacitive cosϕ.

10. SETUP PARAMETERS

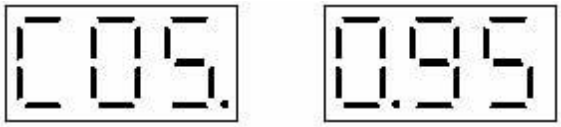
To enter the setup menu press ▲ + ▼. The display will show the following parameters:

"**Fr**" = Mains frequency. The "**Fr**" parameter is displayed in turn with the measured value. It is only an indication.



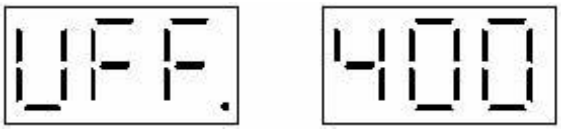
Press **DATA** to go on to the next parameter

"**COS**" = Power factor desired in the system.
The "**COS**" parameter is displayed in turn with the default value "**0.95**".
The value can be changed using the ▲ or ▼ key.



Press **DATA** to go on to the next parameter

"**UFF**" = Mains voltage
The "**UFF**" parameter is displayed in turn with the default value "**400**".
The value can be changed using the using the ▲ or ▼ key
(preset values are 400 or 230).

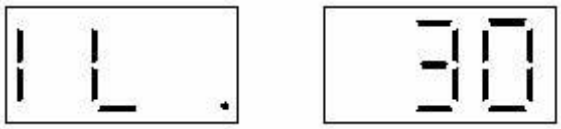


N.B.: If the controller is powered by an auxiliary transformer, the UFF parameter should be set at the rated primary voltage of the auxiliary transformer (range 100..700). To change this parameter, press:

ALARM/RESET + ▲ to increase the value.
ALARM/RESET + ▼ to decrease the value.

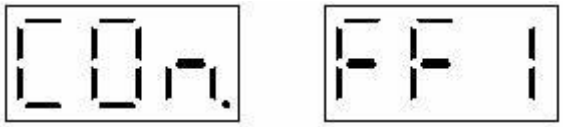
Press **DATA** to go on to the next parameter

"**IL**" = Mains C.T. ratio.
The "**IL**" parameter is displayed in turn with the value previously set by the user.
The value can be changed using the ▲ or ▼ key.
Setting examples:
C.T. 300/5 IL=60; C.T. 350/5 IL=70; C.T. 400/5 IL=80
Ex.



Press **DATA** to go on to the next parameter

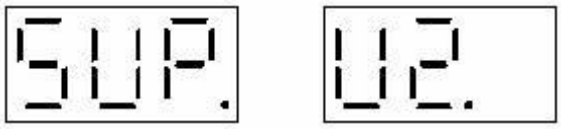
"**COn**" = Type of connection of controller to mains. "**COn**" is displayed in turn with the default value "FF1".



The user can change this parameter using the ▲ or ▼ key (possible settings: FF1, FF2, F-n).

Press **DATA** to go on to the next parameter

"**SUP**" = Setting of terminal used to power the controller. "**SUP**" is displayed in turn with the default value "**U2**".

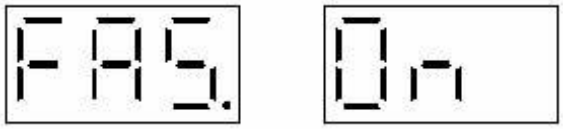


In this version of the controller the only right setting is U2

Press **DATA** to go on to the next parameter

"**FAS**" = Activation or deactivation of automatic adjustment of mains C.T. direction.

"**FAS**" is displayed in turn with the default value "**0n**" (auto-adjustment enabled).

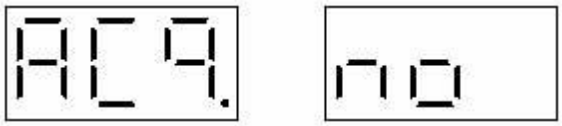


The parameter can be changed using the ▲ or ▼ key
(possible settings: **On**/auto-adjustment, **blo**/C.T. direction fixed).

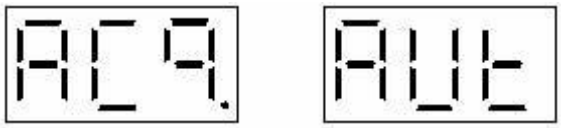
Press **DATA** to go on to the next parameter

"**ACq**" = Menu for launching the procedure for acquiring the power of single steps and setting their switching logic.
"**ACq**" is displayed in turn with the default value "**no**".
The parameter can be changed using the ▲ or ▼ key and confirmed by pressing **DATA**; the possible settings are:

no = no acquisition procedure will be carried out.



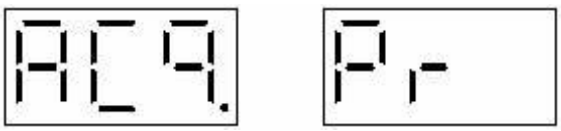
AUt = a new automatic acquisition procedure will be carried out.



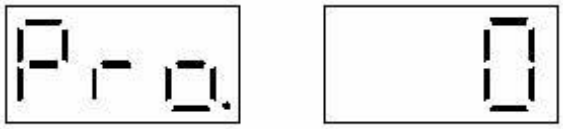
The capacitor steps will be switched on and measured in sequence a total of three times each. At the end of this procedure the controller will alternately display "**C1**" and the measured power value of the first step; the power of the next step can be displayed by pressing the **DATA** key.

Press **DATA** for three seconds to go on to the next parameter.

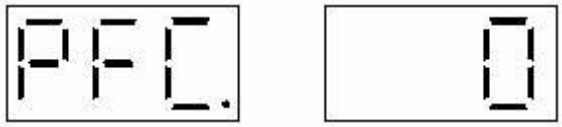
Pr = the switching logic and power of the single steps is manually set.



When the letters "**Pro**" appear, select the desired program (see **Table 1 – Page 18**) using the ▲ or ▼ key and press **DATA** to confirm.



Thereafter, when the letters "**PFC**" appear, set the value in kVAr of the first power factor correction capacitor bank (always connected to output terminal "**1**"), again using the ▲ or ▼ key;



Example: if you have an automatic 100kVAr system with power steps of 10-10-20-20-40 the parameters should be set as follows:
Pro = 26 (see Table 1)
PFC = 10.

Press **DATA** to confirm and go on to the next parameter.

11. SWITCHING LOGICS

The controller can adopt one of three logics to switch the capacitor banks in and out of service in order to achieve and maintain the set cosϕ, i.e.:

LINEAR LOGIC
This logic is identified by the code 1:1:1 and presupposes the condition that all capacitor banks have equal powers. Given a situation such as the one illustrated in the table,

Bank No.	1	2	3	4	5	6
Status	OFF	ON	ON	ON	OFF	OFF

the controller will switch on bank no. 5 if a bank needs to be switched into service and switchs off bank no. 2 if one needs to be switched off.
This will ensure that all the banks will work and as a result component wear will be evenly distributed among them.

GEOMETRIC LOGIC
It is identified by the code 1:2:4 and presupposes the condition that each bank has a power equal to or at most double the power of the one that precedes it. Assuming that the banks have powers as shown in the table,

Bank No.	1	2	3	4	5	6
Power	10	20	40	40	40	80

and that the load requires 50 kVAr, the controller will switch on the 1st, 2nd and then 3rd banks, thereby reaching 70 kVAr. At this point it will switch off the 1st and then the 2nd, which will bring it to 40 kVAr, and finally it will switch the 1st back on to reach 50 kVAr.

As may be observed, this logic makes it possible to obtain a large number of steps with a limited number of banks. However, the number of switching operations is not evenly distributed among the banks, resulting in greater wear on the first ones.

SEMI-GEOMETRIC LOGIC
It is identified by the code 1:2:2 and the power of the first bank must be half that of the others, which must all be equal. The first bank is managed according to a geometric logic whereas all the others, which have equal powers, are managed according to a linear logic.

IMPORTANT: the first output relay must always be connected to the capacitor bank with the least power. If the powers of the steps are all equal, only make sure that the first step is not left without controlled capacitors. Moreover, in the event that a specific user program is configured (as in Table 1), the value of the **first** bank must be set.

> "**s:s:s:**" = Display of set logic. At the end of an automatic acquisition or manual setting procedure, the controller will display a switching sequence and will start to work automatically. If the controller cannot identify an optimal sequence, it will set the 1:1:1 logic.

Press **DATA** to go back to the first parameter in the menu.
To exit the setup menu, keep the DATA key pressed down for three seconds

PROGRAM n°	SEQUENCE	N° OF BANKS	DESCRIPTION
Pr0	Automatica	**12**	Settino of n° of steps and power of bank connected to the first output relay
Pr1	**1:1:1**	**2**	"
Pr2	1:1:1	**3**	"
Pr3	1:1:1	**4**	"
Pr4	1:1:1	**5**	"
Pr5	1:1:1	**6**	"
Pr6	1:1:1	**7**	"
Pr7	1:1:1	**8**	"
Pr8	1:1:1	**9**	"
Pr9	1:1:1	**10**	"
Pr10	1:1:1	**11**	"
Pr11	1:1:1	**12**	"
Pr12	**1:2:2**	**2**	"
Pr13	1:2:2	**3**	"
Pr14	1:2:2	**4**	"
Pr15	1:2:2	**5**	"
Pr16	1:2:2	**6**	"
Pr17	1:2:2	**7**	"
Pr18	1:2:2	**8**	"
Pr19	1:2:2	**9**	"
Pr20	1:2:2	**10**	"
Pr21	1:2:2	**11**	"
Pr22	1:2:2	**12**	"
Pr23	**1:2:4**	**2**	"
Pr24	1:2:4	**3**	"
Pr25	1:2:4	**4**	"
Pr26	1:2:4	**5**	"
Pr27	1:2:4	**6**	"
Pr28	1:2:4	**7**	"
Pr29	1:2:4	**8**	"
Pr30	1:2:4	**9**	"
Pr31	1:2:4	**10**	"
Pr32	1:2:4	**11**	"
Pr33	1:2:4	**12**	"

Table 1: user program selection

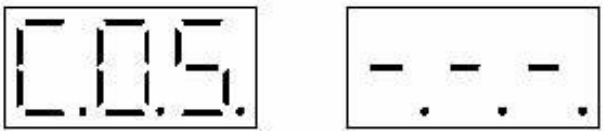
12. PARAMETER DESCRIPTION RANGE DEFAULT

PARAMETER	DESCRIPTION	RANGE	DEFAULT
Fr	Measured mains frequency. Only an indication	50 or 60 Hz	-/-
COS	Power factor to be achieved within the system.	0.8IND÷0.8CAP	**0,95**
UFF	Voltage rating of controller.	230 o 400	**400**
IL	Mains C.T. ratio. Example: with CT 100/5 set 20 Example: with CT 200/5 set 40	1…3000	-
Con	Type of connection of controller to mains.	FF1 FF2 F-n	**FF1**
SUP	Setting of terminal used to power the controller.	U1 (not allowed) U2 (120V)	**U2**
FAS	Auto-adjustment of mains C.T. direction: On=auto-adjustment blo= fixed direction	On blo	**On**
ACq	Acquisition of step powers: no = no acquisition procedure AUt = automatic acquisition Pr = manual setting	no AUt Pr	**No**
(**s:s:s:**	Display of set logic	1:1:1 1:2:2 1:2:4	-/-

Table 2: Setup parameters

13. DISPLAY OF MEASUREMENTS

Normally the display shows the system cosϕ.
A minus sign indicates a capacitive power factor.
N.B.: In the event of a power cut, the controller will not be able to calculate the cosϕ and will alternately display " C.O.S. " and "-.-.-.".



Press the **DATA** key to display the measurement readings: every time you press, the next parameter will be displayed.

The parameters are displayed in the following sequence:

- "**COS**" (system power factor)
- "**UFF**" (effective measured line voltage)
- "**IL"** (line current measured at the primary winding of the CT)
- "**PA**" (equivalent active power absorbed by load, in kW)
- "**PL**" (equivalent reactive power absorbed by load, in kVAr)
- "**thd**" (crest factor normalized to 1: values less or greater than 1 if harmonic distortion is present)
- "**°C**" (temperature inside panel board enclosure at the point where the controller is installed; the value shown may be considered reliable after about 1 hour of operation)

14. ADDITIONAL FUNCTIONS

14.1 MANUAL OPERATING MODE

Press the **AUTO/MAN** key for about two seconds until the corresponding LED lights up: the controller is now ready to be programmed in the manual mode.
The user must indicate the desired status for every output relay: at the end of the programming procedure, the controller will set all the capacitor steps in the status requested. Operatively, STACOVAR indicates "r1" in turn with the status (which can be "**On**" or "**OFF**");
Ex.

press the ▲ or ▼ key to choose the status of the relay you want to set in the manual operating mode; press the **DATA** key to display the status of the subsequent relay. After viewing the status of the last relay, press the **DATA** key to exit this function.

14.2 DISPLAYING THE POWERS OF SINGLE STEPS

Press **DATA** + ▲ to access the relevant menu ("**CP**" will appear on the display and ▲ will flash); when the ▲ key is pressed, STACOVAR will alternately display "**C1**" and the value in kVAr associated with the first step.
Ex.

Every time you press the **DATA** key, the controller will show the powers of the individual steps in sequence; after viewing the last step press the **DATA** key to exit this function.

14.3 PROCEDURE FOR CHECKING THE EFFICIENCY OF THE SINGLE STEPS

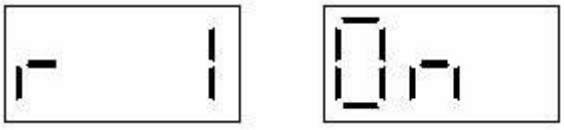
Press **DATA** + ▼ to access the menu pertaining to the procedure for checking the powers of the capacitor steps (the display will show "**ChP**" and ▼ will flash).

Pressing the ▼ key will cause STACOVAR to switch off all the banks and start the procedure for measuring the power of all the steps (the cycle will be launched three times to provide a better measurement). If STACOVAR detects differences of more than 25% in the power that was associated with the step during the previous auto-acquisition procedure, the corresponding LED will flash. At the same time the letters "**rSt**" will appear on the display and the user must disable the step by pressing **ALARM/RESET**; if this key is not pressed within a few seconds, the operation will be terminated without any effect taking place. Once the check is completed, STACOVAR will function as before, with the exclusion of any steps detected to be faulty, whose LEDs will continue flashing to signal their status of unavailability.

14.4 PROCEDURE FOR ENABLING/DISABLING OUTPUT RELAYS IN THE AUTOMATIC OPERATING MODE

The user can decide which relays the controller must not use in the automatic mode.
Press ▲ + **AUTO/MAN** to access the menu for enabling/disabling the output relays (the display will show "**Abi**" and ▲ will flash).

When you press the ▲ key, the ▲ and ▼ LEDs will flash and the display will start showing the status of the first relay: "**r1**" will be displayed in turn with its status ("**On**" or "**OFF**").
Ex.



At this point you can choose the status of the relay, pressing the ▲ key to switch it "**On**" or the ▼ key to switch it "**OFF**". Press the **DATA** key to display the status of the next relay; after viewing the status of the last relay, press the **DATA** key to exit this function.

14.5 DISPLAYING THE COUNTER OF TOTAL OPERATIONS PERFORMED BY EACH RELAY

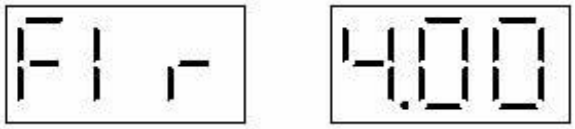
The user can display the number of switching operations performed by each relay controlling
the capacitor banks.
Press ▼ + **AUTO/MAN** to access the relevant menu (the display will show "**Cnt"** and ▼ will flash).

When you press the ▼ key, the ▲ and ▼ LEDs will flash and the display will show the operation performed by the first output relay. "**C1**" will appear, followed by the number of switching operations. A "**.**" is used to separate thousands.
Ex.

Press the **DATA** key to display the number of switching operations of the next relay; after viewing the data of the last relay, press the **DATA** key to exit the function.
Important: when an output relay counter totals over 100,000 switching operations, the LED
corresponding to the step will flash to warn of the need to overhaul/replace the contactors. The output will not be disabled, only a warning will be signaled.

14.6 DISPLAYING THE SOFTWARE RELEASE

To display the software release number of the controller, press **ALARM/RESET + DATA**: the display will alternately show "**Flr**" and the firmware version "x.xx".

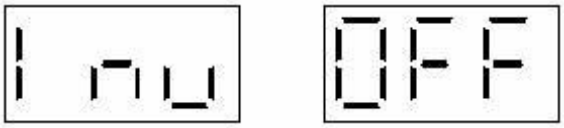


14.7 PROCEDURE FOR TESTING CONNECTIONS TO CAPACITOR STEPS

An automatic procedure is provided to make it easier to check the efficiency of connections to the capacitor steps, independently of the mains network status and the presence of current on terminals "**K**" and "**L**". This procedure can be launched by pressing **DATA + AUTO/MAN**, regardless of the current controller situation ("**tSt**" will appear on the display and the **AUTO/MAN** LED will flash); if the procedure is launched during normal operation, it will be necessary to press the **AUTO/MAN** key for about another 2 seconds to confirm the launching of the test. The procedure consists of switching on the individual steps in sequence at two-second intervals. The closing time of an individual step is five seconds.

14.8 GENERATOR POWER FACTOR CORRECTION MODE

To correct the power factor of the generators, the user must set this operating mode, which involves inhibiting the automatic mains CT direction adjustment function and configuring the signals accordingly. This operation must be carried out with the mains powered by the generator. Press **AUTO/MAN** + ▼ to access the menu for fixing the C.T. direction. When you press the keys, the ▼ LED will flash and you must press the corresponding key. At this point the ▲ and ▼ LEDs will flash and the controller will simultaneously display "**Inu**" (INV) in turn with "**On**" or "**OFF**".

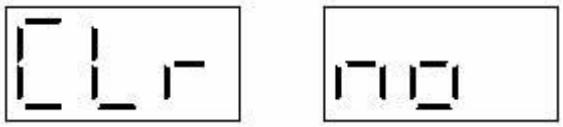


To set the appropriate operating mode for correcting the power factor of generators, press the ▲ key: the word "**On**" will appear. If, on the contrary, you wish to enable the C.T. direction auto-adjustment function (in the case of traditional power factor correction of loads) press the ▼ key: the word "**OFF**" will appear to confirm the selection.

14.9 TOTAL RESETTING OF SETUP PARAMETERS

This command reinstates all the default parameters and returns the controller to the initial starting up condition; after this operation, reset the controller by following the directions in chapter 7 for **POWERING UP FOR THE FIRST TIME** (after setting the **IL** parameter, the controller always starts the procedure for acquiring banks).

Press ▲ + ▼ to access the setup menu and press the **DATA** key repeatedly until the set logic (1:1:1, 1:2:2, 1:2:4) is displayed; to reset the controller, keep **ALARM/RESET** pressed for 5 seconds. The letters "**CLr**" will be displayed in turn with the default setting "**no**".



The parameter can be changed using the ▲ or ▼ key and confirming with the **DATA** key. The possible choices are:

no = no reset will be carried out.

yes = the parameters will be reset; during this phase the controller will switch off all the steps and the digits **8.8.8.** will appear for a few seconds with all LEDs illuminated

15. SIGNALS AND ALARMS

The STACOVAR controller features a device for signaling overvoltage and power factor correction failures as well as alarms which are activated when an overtemperature protection trips or in the event of excessive harmonic distortion and voltage drops or mains dips. When a protection trips, the **ALARM** LED will light up and the NC contact will close to remotely signal the alarm status. With the exception of the device for signaling power factor correction failures and overvoltage, the protections will cause the capacitor banks to be switched off.

15.1 SIGNALING OF POWER FACTOR CORRECTION FAILURE

This signal is activated when the system power factor remains below the set value for more than two consecutive hours (reentries of up to 1 minute are allowed) with all the capacitor banks switched on. This signaling function is not active in the manual mode. When a power factor correction failure is signaled:

- the initials "A.L.A." will be displayed in turn with "C.O.S. " and the last value measured (these digits will also be separated by ...) Ex.

- the **ALARM** LED situated on the front panel of the controller will light up.
- the alarm relay contact connected to the controller terminal block will open.

After 30 minutes all these actions will be cleared and the controller will automatically resume
operation (auto-reset status **A.r.**), though the incident will continue to be signaled via the display, which will show "**A.L.A.**" in turn with "**C.O.S.**" and the last value measured.
To clear the display press **ALARM/RESET**.

15.2 OVERVOLTAGE SIGNAL

This signal is activated when the controller measures a supply voltage exceeding the maximum allowed by the transformer (120+19%) for longer than 30 seconds.
This protection is active even if no capacitor bank is currently switched on. When this alarm is triggered:

- the initials **"A.L.A."** will be displayed in turn with **"U.F.F."** and the last value measured
- (these digits will also be separated by ...)
  Ex.

- the **ALARM** LED situated on the front panel of the controller will light up.
- the alarm relay contact connected to the controller terminal block will open.
- the number shown by the **UFF** alarm counter will increase by one.

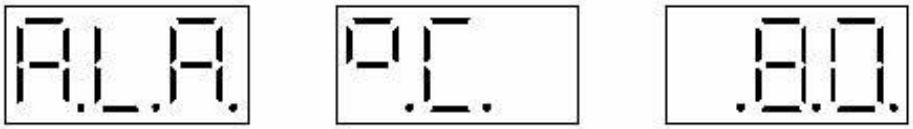
After 30 minutes all these actions will be cleared and the controller will automatically resume
operation (auto-reset status **A.r**.), though the incident will continue to be signaled via the display, which will show "**A.L.A.**" in turn with "**U.F.F.**" and the last value measured.
To clear the display press **ALARM/RESET**.

15.3 OVERTEMPERATURE PROTECTION

This protection will trip if the temperature around the controller exceeds 70°C for at least 15 seconds.
When this alarm is triggered:

- the initials "**A.L.A.**" will be displayed in turn with "**°.C..** " and the last temperature read (these digits will also be separated by **...**).

Ex.



- the **ALARM** LED situated on the front panel of the controller will light up.
- the alarm relay contact connected to the controller terminal block will open.
- the controller will activate the procedure for **rapid disconnection** of all steps and go into a standby status (in this status the controller will not work).

After 30 minutes all these actions will be cleared and the controller will automatically resume operation (auto-reset status **A.r.**), though the incident will continue to be signaled via the display, which will show "**A.L.A.**" in turn with "**°.C**.. " and the last value measured.
To clear the display press **ALARM/RESET**.
This protection is also active in the manual mode and even if no capacitors are switched on.

15.4 PROTECTION AGAINST EXCESSIVE HARMONIC DISTORTION

This protection will trip when the rate of current harmonic distortion may pose a hazard to the power factor correction capacitors.
When this alarm is triggered:

- the initials "**A.L.A.**" will be displayed in turn with "**t.h.d.** " and the measured Crest Factor (these digits will also be separated by**...**).

  Ex.

- the **ALARM** LED situated on the front panel of the controller will light up.
- the alarm relay contact connected to the controller terminal block will open.
- the number shown by the **t.h.d.** alarm counter will increase by one.
- the controller will activate the procedure for **rapid disconnection** of all steps and go into a standby status (in this status the controller will not work).

After 30 minutes all these actions will be cleared and the controller will automatically resume operation (auto-reset status **A.r**.), though the incident will continue to be signaled

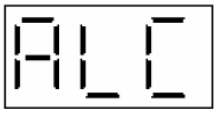
via the display, which will show "**A.L.A.**" in turn with "**t.h.d.**" and the measured Crest Factor.
To clear the display press **ALARM/RESET**. [This protection is also active in the manual mode.]

15.5 PROTECTION AGAINST MAINS VOLTAGE DIPS AND DROPS

This protection trips in the presence of mains voltage dips lasting more than two periods (40mS at 50Hz, 33mS at 60Hz). In such cases, also in the manual mode, the controller will instantly **de-energize** all the output relays in order to protect the capacitors. It will then resume its normal control functions, switching steps into service as necessary after the time T1 has elapsed. If the voltage dip lasts longer than two cycles, or the voltage drops below the minimum required to power the device correctly, the "power-fail" cycle will be activated: STACOVAR will instantly de-energize all the output relays until the voltage returns to normal levels or disappears completely to prevent undesired operations on the capacitor banks.

15.6 DISPLAY OF ALARM COUNTERS

The user can see how many times the controller has gone into an alarm status due to overvoltage and excessive harmonic distortion. To view the counters, press ▲ + **DATA**. The letters "**ALC**" will appear and the ▲ LED will
flash.
Ex.



Press the corresponding ▲ key to access the settings. The ▲ and ▼ LEDs will flash and the first alarm (**t.h.d.**) will be displayed in turn with the number of activations; to view the next alarm (**UFF**) press the **DATA** key. Press the **DATA** key again to exit the function. These counters cannot be cleared.

15.7 CHANGING THE ALARM ACTIVATION MODES

The user can change the activation modes of the controller alarms. In particular, in regards to the signals and protections for power factor correction failures, overvoltage, over-temperature and excessive harmonic distortion, it is possible to set:

- **ON** status: this has the functions described previously, except that the auto-reset (**A.r.**) function will not be active and the controller will remain in a standby status until you press the **ALARM/RESET** key on the front panel. Pressing this key will enable the controller to resume normal operation.
- **OFF** status: the protection and alarm or signaling function and all their consequent actions are completely inhibited. The user should be fully aware of the risks of choosing the **OFF** status; as a rule it is an unadvisable choice, since it may give rise to potentially hazardous situations.
- **A.r**. status (auto-reset-default status): it has the functions described previously. When the controller is turned on for the first time, the default status of all alarms is **A.r**.
- To access the menu, press **AUTO/MAN** + ▲; the letters "**ALP**" will appear and the ▲ LED will flash.

Press the corresponding key to access the settings. The ▲ and ▼ LEDs will flash and the first alarm/signal will be displayed; to change the alarm status press the ▲ or ▼ key and to go on to the next alarm press the **DATA** key (**°C, UFF, thd, COS**); after the last parameter has been displayed, press the **DATA** key again to exit the function.

16. HIDDEN MENU

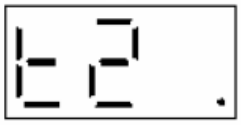
Some STACOVAR parameters are present in the hidden menu. These settings may be accessed by the user only when setting the C.T. ratio. To access the menu, press ▲ + ▼ and while the "**IL**" parameter is shown on the display, keep the **ALARM/RESET + DATA** keys pressed down until the display shows:

- "**t1**" in the case of five-step versions of STACOVAR
- "**FAn**" in the case of seven- and twelve-step versions of STACOVAR at this point you have entered the hidden menu. All the parameters of this submenu can be changed using the ▲ and ▼ keys. To go on to the next parameter, press the **DATA** key. The parameter sequence is as follows:

-("**FAn**") **Temperature threshold** for closing the N/O relay that controls the external fan (this parameter is available only for seven-and twelve-step versions of STACOVAR, it is suggested not to modify).

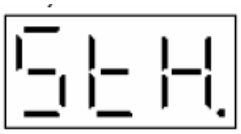
-("**t1**") Display of **T1, the time for which steps are unavailable for re-activation** (you are advised not to change this parameter).

-("**t2**") Display of **T2, the delay** between the closing of two relays controlling consecutive steps (you are advised not to change this parameter).



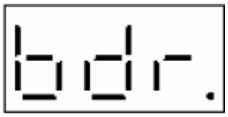
-("**HU**") Setting of the **Voltage Transformation Ratio**. If the controller is powered via a VT (refer to chapter 10.3 -"UFF" parameter), it is recommended to adjust the "UFF" parameter rather than changing HU.

-("**StH**") Setting of **trip time of the harmonic distortion alarm t.h.d.** The possible settings are 1,2,3. If you set 1, the trip time will be proportional to the level of harmonic distortion; setting 2 will double this time; setting 3 will quadruplicate the time (you are advised not to change this parameter).



-("**Adr**") **Instrument address** for Rs485 network connection to other instruments and a PC (this parameter is available only for seven- and twelve-step versions of STACOVAR).

-("**bdr**") **Speed of data transmission** (Baud Rate) on the Rs485 port. The speed is expressed without the last zero (e.g. 9600bps is shown as "960"; this parameter is available only for seven- and twelve-step versions of STACOVAR).



Press **DATA** for three seconds to exit the menu.

PARAMETER	DESCRIPTION	RANGE	DEFAULT
Fan REGO7-12	Temperature threshold (°C) for tripping fan activation.	5...50	**25**
t1	Time (in seconds) of unavailability of a step for re-activation. Always wait for capacitors to discharge before switching them back on.	5...255	**30**
t2	Delay time (in units: each unit corresponds to 500mS) between the activation of one step and the next.	1...600	**2**(=1S)
HU	Mains VT transformation ratio.	1...1000	**1**
StH	Setting of trip time of t.h.d. harmonic distortion alarm.	1.2.3	**-/-**
Adr	Address of the instrument in the Rs485 serial connection with external units.	1...99	**1**
bdr	Speed of data transmission through the Rs485 port (Baud rate).	1200...9600	**9600**

Table 3: Hidden menu parameters

17. LIST OF MAIN KEYS AND ASSOCIATED FUNCTIONS

KEYS	FUNCTION	CHAPTER/SECTION
▲ OR ▼	CHANGE THE DISPLAYED PARAMETERS	
DATA	SCAN THROUGH MEASUREMENTS AND CONFIRM PARAMETER SETTINGS	
▲ + ▼	ACCESS THE SETUP MENU	10
ALARM/RESET	RESET NAFTER ALARM CONDITIONING	15
AUTO/MAN	MANUAL OPERATING MODE	14.1
DATA + ▲	DISPLAY THE POWERS OF SINGLE STEPS	14.2
DATA + ▼	PROCEDURE FOR CHECKING THE EFFICIENCY OF SINGLE STEPS	14.3
▲+ AUTO/MAN	PROCEDURE FOR ENABLING/DISABLING OUTPUT RELAYS IN AUTOMATIC MODE	14.4
▼ + AUTOMAN	DISPLAY COUNTER FOR TRACKING OF OPERATIONS PERFORMED BY EACH OUTPUT RELAY	14.5
ALARM/RESET+DATA	DISPLAY SOFTWARE RELEASE	14.6
DATA+AUTO/MAN	TEST PROCEDURE FOR CONTACTOR CONNECTIONS	14.7
AUTO/MAN + ▼	GENERATOR POWER FACTOR CORRECTION MODE	14.8
▲ + DATA	DISPLAY ALARMS COUNTER	15.6
AUTO/MAN + ▼	CHANGE ALARM ACTIVATION MODE	15.7

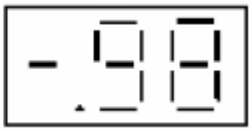
TABLE 4: LIST OF MAIN COMMANDS

18. TROUBLESHOOTING

Should the controller show any of these faults

- When powered, the controller remains stuck on "FAS"

- When no bank is switched on, the controller displays a capacitive cosϕ (negative cosϕ)



- The controller displays a cosϕ that does not correspond to the system's.
- The controller alternately displays " C.O.S. " and "-.-.-.".

- The controller displays a cosϕ below the one set and fails to switch on any banks.
- The controller switches on all the banks even in the absence of loads and fails to switch them off.

We recommend performing the following checks:

- ✓ Check the positioning and connection of the C.T. (See chap. 6) INSTRUCTIONS FOR C.T. INSTALLATION)
- ✓ Check that a current greater than 200mA is circulating on the secondary winding of the C.T. (the power factor correction function requires a working load).
- ✓ Check that the setup parameters have been correctly configured (See chap.10 - Page 13 – SETUP PARAMETERS). In particular:
- ✓ the **IL** parameter (C.T. ratio – e.g.: with a C.T. 200/5, IL=40)
- ✓ the **FAS** parameter must be "**On**"

N.B.:if you wish to reinstate all the default parameter settings recommended by the factory, reset the controller as directed in chap.14.9 – TOTAL RESETTING OF SETUP PARAMETERS) and start all over again from the first powering up procedure (See chap. 7).

- ✓ Check that the generator power factor correction mode (Inu) is Off (See

chap.14.8 - GENERATOR POWER FACTOR CORRECTION MODE).

- ✓ Make sure that the controller has correctly acquired the powers of the capacitor banks (See chap.14.2– DISPLAYING THE POWERS OF SINGLE STEPS).

- ✓ Check that the output relays are not disabled (See chap.14.4 - PROCEDURE FOR ENABLING/DISABLING OUTPUT RELAYS IN THE AUTOMATIC MODE).

Due to problems of step swing (continuous connection and disconnection of banks), we suggest to:

- ✓ either increase or decrease the "COS" parameter (see chap. 10 -Page 13 – Power factor desired in the system) until reaching a balance condition.
- ✓ Increase the "t2" parameter (see chap. 16), thus delaying the connection of banks.

INSTALLATION

IMPORTANT!
Please read entire Installation section before installing.

Correct installation is required for proper performance and function of the equipment. Physical inspection of equipment for damage is recommended, prior to any installation. Indoor storage for indoor and outdoor rated equipment should be in a clean, dry environment. Outdoor storage of outdoor equipment shall require installation of any materials shipped for site assembly, such as fans and bus ducts and the mating of equipment at shipping splits. Where recommended, packaging materials may be required to be removed.

Equipment includes removable lifting lugs, for transport and site installation handling (except for the PM models). As a cautionary note, placement of the assembly shall be at a level and solid location, for correct operation. The equipment is designed for floor mounted installations generally with the entrance for the cables from the bottom or rear (top or side for the PM models). Equipment should be placed in a well-ventilated environment and air must be able to circulate freely. **It is important to keep this equipment away from walls or other equipment.** A gap of at least 4 inches [10cm] minimum must be maintained at the rear (sides for the PM models)of the unit to ensure adequate ventilation.

National Electrical Code (NEC), electric utility company, local area or service provider codes shall be adhered to during the installation. Electrical connections shall also be in compliance with required codes.

The StacoVAR, StacoVAR PA, PH and PM Installer/Contractor shall inspect and verify proper alignment, anchorage and grounding, proper connections and tightness of connections, prior to any start-up functions.

Appropriate personnel shall start-up and operate equipment upon installation approval.

CONNECTION TO THE MAINS

Power Connections: L1, L2, L3 and PE

Connect L1, L2 and L3 terminals of the main lugs or circuit breaker provided inside the enclosure to the network using 75°C minimum copper leads of the proper gauge. If the unit does not have the optional circuit breaker, a disconnect device (switch or circuit breaker) must be installed between the StacoVAR and the power system per NEC requirements. Rated current values for protection device should be more than 1.25-1.5 times nominal current. Connect the earth ground lug provided inside the enclosure to the PE earth lead.

CT Connection

WARNING!

When working with CTs, the secondary (terminals on the unit or wires from the unit) must either be shorted together or properly connected to the intended load (e.g. controller). An open circuit CT secondary may develop lethal voltage (this precaution is not required if the bus or cable through the CT is not energized).

Connect the secondary of the CT of the network to terminals – TB1-8, TB1-9 (terminals connected to K and L on the PM models) using a two-conductor copper cable (refer to 3.1.6 above).

IMPORTANT!

The reactive power controller must be connected so that it can sample the current of one phase and the voltage between the other two phases.

The monitored voltage is derived inside the unit between phase L2 and L3 (the central pole and the one to the right of the main bus-bars); the CT, therefore, must be inserted in the phase connected to the pole L1 (the left pole) of the main bus-bars.

An erroneous connection does not permit a correct interpretation of the measurement signals by the reactive power controller thereby compromising the efficiency of the power factor correction system.

ADJUSTMENTS AND INSPECTIONS

Before starting the equipment it is necessary to carry out the following adjustments and inspections:

Please read the StacoVAR Controller manual.

It is necessary to make sure that:

- There are no loose connections or blown fuses.
- The mains current transformer (CT) is connected upstream of all the loads and the power factor correction system.
- Any fixed capacitor for power factor correction of the system power supply transformer must be upstream of the CT.
- The CT is mounted on the phase connected to pole L1 (the left pole) and there must be no interruptions or short-circuit bridges in the secondary circuit.

START-UP

When the controller is energized for the first time, a set of parameters must be initialized per an automatic start-up procedure. These include setting the CT ratio and an automatic acquisition of the power of each individual

capacitor step. For all information, please read controller manual, section 10 (Setup Parameters).

MAINTENANCE

CONTACTORS

Inspection for any wear of the principal contacts and of the integrity of the damping resistors (damping resistors not supplied when reactors are utilized), as well as their replacement (or the replacement of the entire contactor) should be carried out in reasonable periods of time taking into account that the number of operations strongly depends on the fluctuation of the load that undergoes power factor correction by the equipment.

Inspection of the contactors every 10,000 operations.

CAUTION!

It is very important to carry out the inspections indicated in order to avoid a situation in which the excessive wear of the contacts can result in dangerous operating conditions which may cause the destruction of the contactors and the capacitors.

An evaluation of the number of operations that the contactors may carry out during the operation of the power factor correction equipment can be made at the moment of installation by observing, in a given period of time, the number of times the contactors of the various capacitor banks are activated to follow the load. If it is observed, for example, that in correspondence to fluctuations in the load the contactor of a capacitor bank is activated six times in an hour, and if we consider a working period of 8 hours a day, the state of wear of the contacts should be checked after about one year:

6 operations/hour x 8 hours/day x 220 days @ 10,000 operations

The controller logs the number of operations of each step. Please read the instruction manual for more information.

THYRISTOR SWITCHES (Not implemented at this time)

Capacitors switched with power electronic, thryristor switches are performed at a zero-crossing, to avoid inrush currents. Thyristor switches can be

The StacoVAR, StacoVAR PA, PH and PM operated many times per second, and due to its design require minimal maintenance. REFER TO THE THYRISTOR SWITCH INSTRUCTION MANUAL.

CAUTION

Caution should be taken during inspection of thyristor switch devices. Voltage may be present on the thyristor and printed circuit board.

MAINTENANCE PROGRAM

Every Six (6) Months

√ Manually step on/off all capacitors-contactors to verify proper operation. Return to automatic mode program as was previously set, confirm displayed information such as operations logged (contactors), power factor etc., verify controller display and function operate properly.

√ Verify that the bus bar current has not changed outside of the CT setting by checking the current from the CT (current transformer), confirm amperes are within limits. If out of limit range, CT connections may need to be changed.

√ Examine outside of enclosure for damage, objects obstructing access and/or ventilation flow.

√ Verify enclosure door locks properly.

√ Open/close circuit breaker (if equipped) to verify operation. Disconnect circuit breaker (or switch) from external feeder, or circuit breaker located within the StacoVAR unit, prior to entry.

√ Visually inspect power factor correction capacitors and resistors. Broken or burned resistors need replacement. Check capacitors for any swelling.

√ Where equipped, inspect iron-core reactors for any "hot-spots", discoloration.

√ Contactors, inspection for any wear of the main contacts and of the integrity of the damping resistors (where equipped); Thyristor switches - due to design require minimal maintenance, inspect wire connections.

√ Visually inspect fuses to see if blown, replace as necessary, note operation of lights.

√ Where equipped, inspect lights, operation counter and condition of TVSS.

√ Inspect all connections, tighten as required.

√ Clean inside area of any dirt and debris.

√ Where equipped, inspect air flow filters, clean as necessary.

√ Where equipped with fans, verify "running" operation.

Every Twelve (12) Months

√ As above.

√ Replace all air flow filters in equipment and dispose.

√ Review of power factor and correction requirements, verify values meet present requirements.

Additional Considerations for all StacoVAR Apparatus

√ Clean and prepare for paint: existing roof, doors, exterior panels, base, interior panels.

√ Repair /refurbish damage to side panels, door, roof, base/frame.

√ Note any conduit, cables etc. to be repaired/replaced.

√ Install new sub-assemblies, components.

√ Special testing, site surveys, engineering required.

√ Spare parts required.

√ Maintenance should be performed on StacoVAR equipment, along with panelboard, switchboard, switchgear, motor control centers and other electrical power distribution equipment for optimum and efficient operation.

Bills-Of-Materials

Reference the system schematic to determine the components and other material information. For a specific unit, Contact Staco Energy Products for replacement and renewal parts, start-up, and servicing of equipment. Phone number 1.937.253.1191 or our toll free number 1.866.261.1191, fax 1.937.253.1723, email sales@stacoenergy.com.

Component	Symbol	Part Number	PM Model Only
Controller	A1	273-0395	273-0395
Fan	B1	319-0220	319-0222
Capacitor - 3 x 106 MFD	C101-C108	194-0396	194-0396
Capacitor - 3 x 133 MFD (HFC units)	C101-C108	194-0397	N/A
Fuse, 3.2A	F3	307-0077	307-0077
Fuse, 1.5A	F1, F2	307-0266	307-0266
Fuse, 3A	F1, F2	307-0271	307-0271
Fuse, 6.25A	F3	307-0272	N/A
Fuse, 100A	F101-F112	307-0273	307-0318
Fuse, 50A	F101-F112	307-0274	307-0352
Contactor, 25 kVAR (480V) (HFC units)	K101-K104	249-0137	N/A
Contactor, 25 kVAR (480V)	K101-K104	249-0138	249-0138
Contactor, 50 kVAR (480V) (HFC units)	K101-K104	249-0139	N/A
Contactor, 50 kVAR (480V)	K101-K104	249-0140	249-0140
Auxiliary Contact Block (on contactors)	K101-K104	249-0142	N/A
PTC Thermistor Relay	K2, K3	558-0176	N/A
Relay, 2 Form C	K1	558-0177	N/A
Reactor, 25 kVAR (480V) (HFC units)	L101-L104	712-1429	N/A
Reactor, 50 kVAR (480) (HFC units)	L101-L104	712-1430	N/A
Resistor, 150kOhm, 3W (HFC units)	R101-R116	546-0893	N/A

TECHNICAL SPECIFICATION - CONTROLLER

STACOVAR 5/7/12 step power circuit

Supply Voltage	120±10%
Rated frequency	50 or 60Hz (measured and autonomously set by the controller)
Input Power	15VA max. (STACOVAR 7/12) Internal fuse 250mA T curve.
Protection	To protect the instrument from permanent overvoltage, the user should install an external fuse (we recommend 200mA)

Current input

Rated Current	5A
Operating Range	0.2...5A
Overload	3 In for 10s
Consumption	1.5VA max.

Measurement and control data

Type of voltage and current measurement	true effective value *(true RMS)*
Power factor control	0.80 inductive ÷ 0.80 capacitive
Step re-connection time lag	5…255s

Relay outputs

Number of outputs	12
Contact status	N/O
Nominal contact capacity	5A-250V
Voltage rating	250Vac
Alarm relay	1 N/C contact (3A-250V) When controller is off, the contact is N/O
Nominal insulation voltage	3kV/1 minute
Max. relay switching power	2200W or 1500W - cosϕ.5 250V

Measuring precision	±2%
Power factor	±2%
Active voltage (UFF)	±2% value read for I>200mA
Line Current	(CT secondary winding)

PC Interface

Serial Line	1 RS485 line
Polarity	terminal A = non-inverting (+) terminal B = inverting (-)
Protocol Type	“Ducati” protocol (character based)

Ambient Operating Conditions

Operating Tempertaure	0...+60°C
Storage Temperature	–20...+70°C

Connections spring terminal

Terminal Type	2.5mm2 max.
Wire Size	

Enclosure

Construction	Recess mounted with panel
Dimension LxHx	144x144x65mm
Hole Dimension	138x138mm
Protection Rating	IP40 on front panel, IP20 on terminal block
Fixing	With four pressure plates
Weight	800g