



POWER FACTOR REGULATOR

Computer-8d -96

Computer-8d -144

INSTRUCTION MANUAL

(M 981 601 / 98A)

POWER FACTOR REGULATOR COMPUTER- 8 d

1.- POWER FACTOR REGULATORS COMPUTER-8d-96 & COMPUTER-8d-144

Power factor regulator **Computer- 8d** series shows the system $\cos \varphi$, on a digital display and controls the automatic connection and disconnection of capacitors in response to this $\cos \varphi$.

With an in built microprocessor and based on the FCP system (FAST Computerized Program), the power factor regulator is an intelligent instrument, able to accurately display the status of the power system, and to make complex decisions that require a high volume of calculations. This series is a result of PDL's long experience with power factor regulators, improving their previous features by the application of the latest technology.

Main features:

- **True r.m.s. measurements:** The regulator measures the reactive power in the system, and will connect or disconnect available capacitors according to setup data.
- Regulator from 3 to 8 output relays, with the possibility of an additional alarm relay.
- Led Display with THREE seven segment digits.
- 4 quadrant, three-phase regulator (single-phase mode user-selectable through internal jumper)
- Settings via front keyboard (4 keys).
- Alarms for current harmonic distortion and improper power factor correction.
- Two sizes as per DIN 43 700 :
 - **COMPUTER-8d-144** : 144 x 144 mm
 - **COMPUTER-8d-96** : 96 x 96 mm

1.2.- Connection instructions

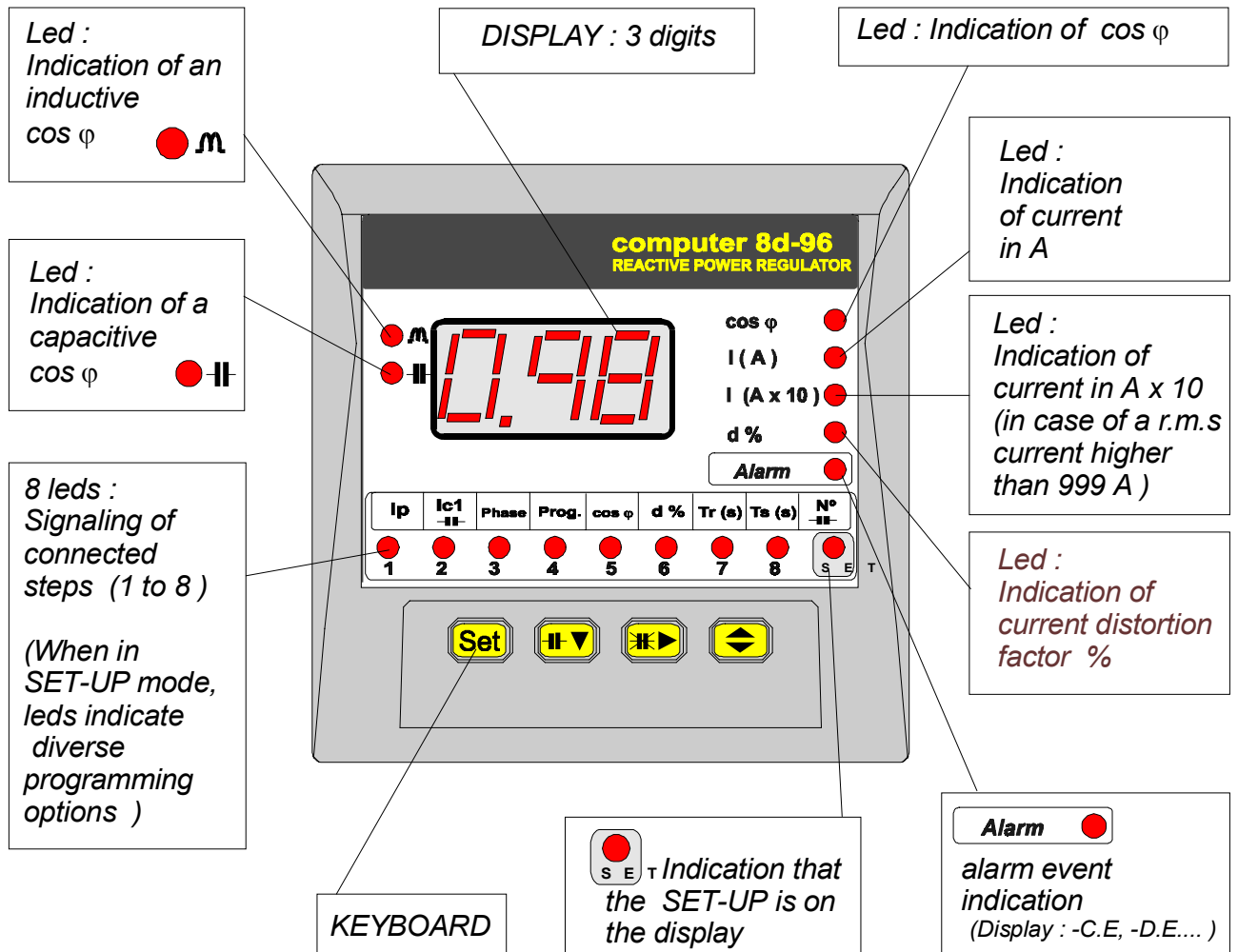


This manual contains information and warnings about the **Computer 8d** that the user should follow in order to guarantee the correct operation of all the instrument functions and safety requirements.

2.- GENERAL DESCRIPTION

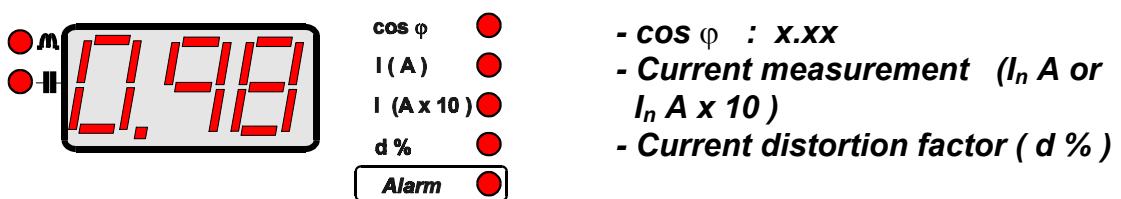
2.1.- DISPLAY OF PARAMETERS :

The regulator provides following displays on the front panel:



Computer-8d display :

Parameters displayed are:




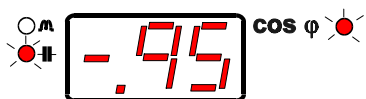


Parameter on display can be selected by pressing the key . 4 leds on the right indicate the parameter shown on display.

When the last parameter is reached, whether this key is pressed again, the "SCAN" mode is accessed, which provides an automatic and sequential display of all parameters (3 s cadence). Pressing it again, the regulator turns back to "normal" mode.

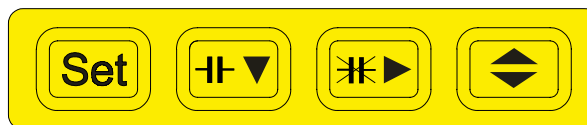
ALARM messages are also displayed

Note : The regulator works in **four quadrant measuring mode**. A negative sign is shown at the first digits of the display, to indicate the power system is regenerative. Check connection of phases and setup if the indication is not correct. (**SET-UP - phase**) .










	$\cos \varphi > 0$ - system consuming energy ex.: 0.96 L inductive (+ kW & kvarL)
	$\cos \varphi > 0$ - system consuming energy ex.: 0.95 C capacitive (+ kW & kvarC)
	$\cos \varphi < 0$ - system generating energy ex.: - .85 L inductive (- kW & kvarL)
	$\cos \varphi < 0$ - system generating energy ex.: - .95 C capacitive (- kW & kvarC)

2.2.- KEYBOARD

The regulator is equipped with following keys on the **front panel**:



Diverse functions are assigned to each key according to the operation mode.

	<ul style="list-style-type: none"> - Pressing the key (SET) the regulator configuration can be displayed, but this cannot be modified (see setup procedure section). Led "SET" is on.  The key  permits to access diverse configuration sections.  Press the key (SET) again to exit. (when no key is press for more than 3 minutes, setup display is automatically exited). <p><i>Note: during this display mode, the regulator continues measuring and controlling the power system.</i></p>
 	<ul style="list-style-type: none"> - These keys permit a MANUAL CONNECTION  / DISCONNECTION  of capacitors. When a key is kept pressed, all capacitors will be sequentially connected/ disconnected according to the defined delay times (Tr (s) & Ts (s)). 20 s after the key is released, the regulator returns to automatic operation mode. - <i>Within the SET-UP mode, diverse available configuration options can be selected by repeatedly pressing these keys.</i>
	<ul style="list-style-type: none"> - This key selects the parameter displayed on: cos φ, Current measurement (In A or in A x 10) & Current distortion (d %). - <i>Within the SET-UP mode, use this key to VALIDATE configuration choices.</i>

2.3.- USER-PROGRAMMABLE PARAMETERS (SET-UP menu)

Ip	Ic1 - -	Phase	Prog.	cos φ	d %	Tr (s)	Ts (s)	N° - -
● 1	● 2	● 3	● 4	● 5	● 6	● 7	● 8	● SET

1.- Current transformer setting: choice of standard values	
2.- Rated current of first capacitor (Ic1)	
3.- Choice of voltage phase	
4.- Operation program	: 5 programs
5.- Cos φ: setting	: 0.80 L to - 0.95 C
6.- Distortion factor setting	: 0 999 %
7.- Connection time	: 4 999 s
8.- Safety time	: 20....999 s
9.- Number of output relays	: 1.....8

Set-up Options Description

(1) PRIMARY OF CURRENT TRANSFORMER:

- Select here the current transformer primary (from 5 A to 9990 A) .
- Secondary is fixed (standard ...5 A a.c.)

(2) RATED CURRENT OF FIRST CAPACITOR:

- Sets the rated current of the first capacitor in the bank.
- From this current and the C.T. ratio, the regulator automatically calculated the C/K value.

(3) CONNECTION PHASE SELECTION:

The user can select the configuration of the regulator installation to perform the power factor measurement. The regulator reads the current of one phase (generally through a .../5 A C.T.) and the power system voltage (generally between two phases).

(4) SELECTION OF OPERATION PROGRAM

Available operation programs are:

- program 1 ----> 1.1.1.1.1
- program 2 ----> 1.2.2.2.2
- program 3 ----> 1.2.4.4.4
- program 4 ----> 1.2.4.8.8
- program 5 ----> 1.1.2.2.2

(5) Cos φ : setting: Programmable from **0.80** Inductive to **0.95** capacitive

(6) DISTORTION FACTOR SETTING d % : 1 999 %

(7) (8) TIMES

- Connection time : from 4 s to 999 s
- Discharge time (safety time) : from 20 s to 999 s



When the regulator is powered up, delay time for the connection of the first capacitor is the safety time Ts.

(9) NUMBER OF CAPACITORS: When selecting this option, the number of capacitors selected is shown up on display, as well as related leds are on.

Other points to consider:

- When no current is measured (indication 0.00 on display), any relay which is closed, will be automatically opened by the regulator .
- If a very high capacitive cos φ is measured, all steps are automatically disconnected.



4.- INSTALLATION AND START-UP

This manual contains information and warnings about the **Computer 8d** that the user should follow in order to guarantee the correct operation of all the instrument functions and safety requirements.

The regulator must not be used until it is assembled inside the switchboard.

When the instrument is not used as the manufacturer specifies, the instrument may be damaged.

When any failure is suspected (for example, it presents external visible damages), the instrument must be immediately turned off. In this case contact a qualified serviceman.

.1.- INSTALLING THE REGULATOR

Before powering the regulator up, check following points:

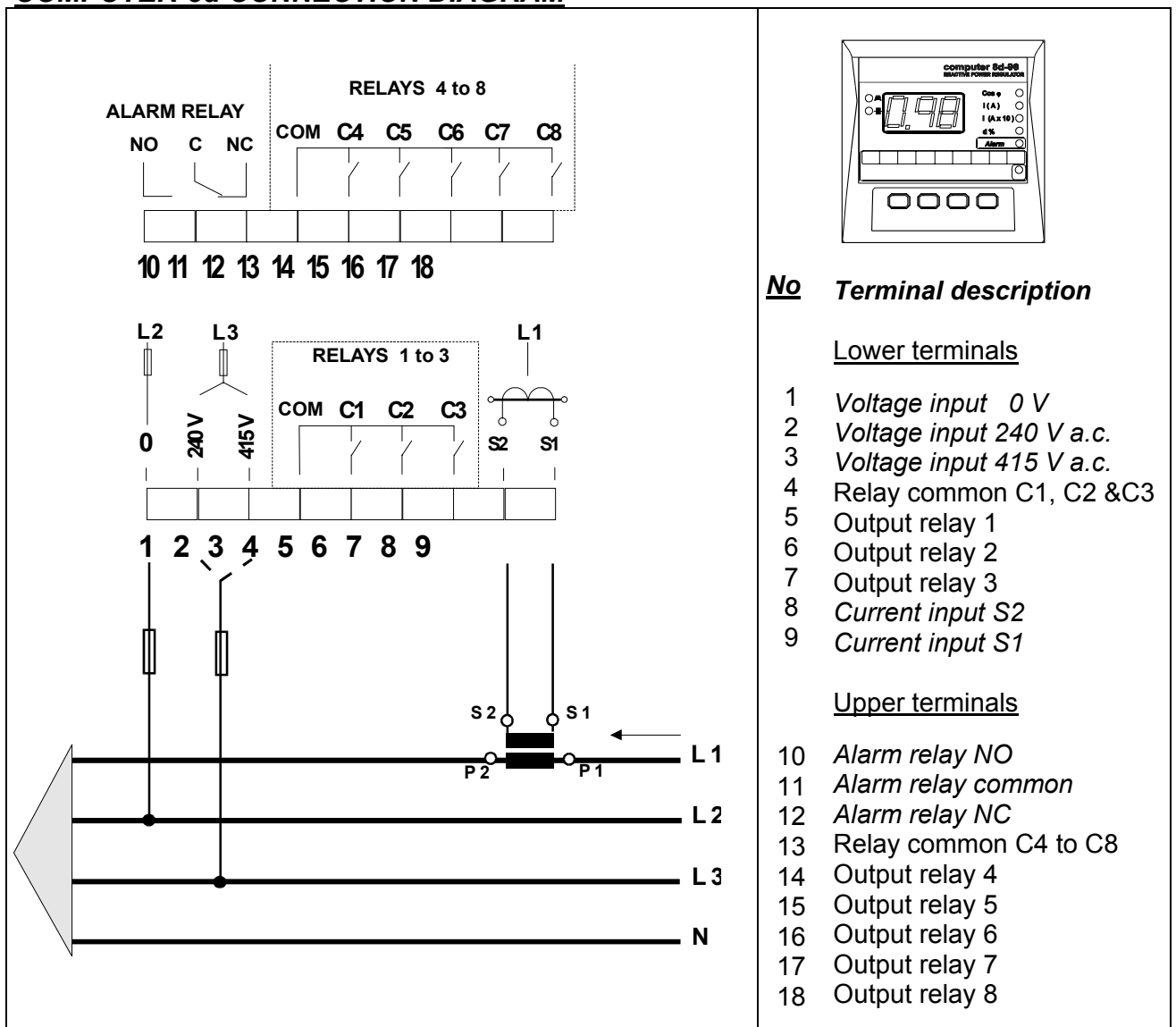
- a.- **Supply voltage** : see rear of your Computer-8d
- b.- Current measurement:
 - $I_N/5$ A a.c. Current transformer
 - Connection terminals 8 & 9 .
- c.- Working conditions :
 - Working temperature : -10° to +50°C
 - Working humidity : 25 to 80 % RH
- d. The regulator is to be mounted on panel (cut out as per DIN 43 700) .
 - *Computer-8d-96* : cut out $92^{+0.8} \times 92^{+0.8}$ mm.
 - *Computer-8d-144* : cut out $138^{+1} \times 138^{+1}$ mm.

4.2.- CONNECTIONS

Note that with the instrument powered up, all terminals could be live and dangerous to touch. The removal of covers or elements may allow access to dangerous parts. Therefore, the instrument must not be used until it is completely installed.

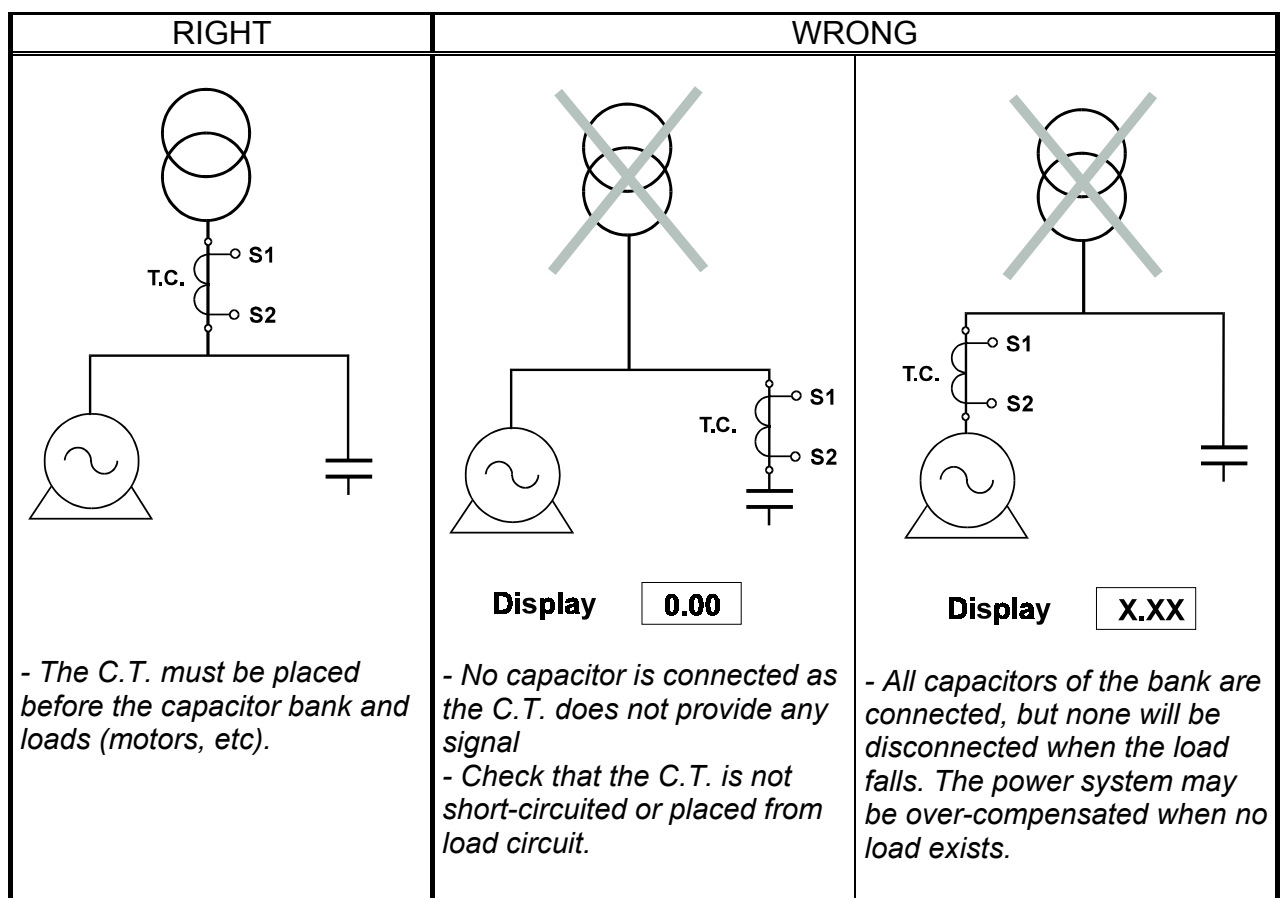
The regulator must be powered from a power source protected with gl type (IEC 269) or M type fuses rated between 0.5 and 2 A. This circuit should be provided with an automatic switch (I/O) or any equivalent element to connect (ON) or disconnect (OFF) the instrument from the power supply network. Power supply circuit as well as connections to different relays will be wired with cables of a minimum cross-section of 2.5 mm². The circuit from the current transformer secondary also wired with a cable which a has a minimum cross-section of 2,5 mm².

COMPUTER-8d CONNECTION DIAGRAM



Connect the regulator according to the connection drawing attached at the rear part of the regulator. Take following points into account:

- To start-up the regulator it is necessary to install a current transformer (normally $I_N / 5 A$) suitable for **the full load current of the installation**. The cabling from the C.T. secondary must be of a cross-section adequate to the distance between the C.T. and the regulator.
- The regulator is powered between **two phases** (except for a single-phase model). **The phase in which the C.T. is placed, may or may not be any of the phases the regulator is powered from. This parameter is configurable, see " PHASE RELATION SETTING"**
- The C.T. must be placed at a point of the power system where the whole current of the whole load, including current of capacitors, can be measured.



- Connect the C.T. secondary (S1-S2) to the terminals marked as S1-S2 (9 & 8). When the display shows an incoherent value for the $\cos \varphi$, a discrepancy with the set phase relation may exist: access set-up, and then the option "Phase" (see related section) .

- Whether the display shows "**0.00**", insufficient current signal is available to the regulator, and therefore cannot measure the $\cos \varphi$. In case when the loads are in operation, check the circuit coming from the C.T. secondary (this could be open or in short-circuit at any point).

5.- SETTING UP THE REGULATOR






To access the **Regulator Setup Menu** proceed as follows:

- If the regulator is powered on and keys  &  are simultaneously pressed within first five seconds, SET-UP options are accessed and configuration parameters may be modified.





If the process is correctly done, the word "SET" is shown on display for some seconds, and the led "Set" is on.

Here you can access different programming options:

- a.- Use the key  to select the parameter to be programmed.
- b.- Use the key  to confirm the selected parameter.
- c.- Use keys  &  to modify the value shown on display.
- d.- Once modification is finished, press  to exit and validate modifications. General SET-UP menu is again accessed.

Proceed similarly for all programming sections.



When more than 5 seconds has elapsed from when the regulator was powered up, no action occurs if keys  &  are pressed.



When pressing the key (**SET**) at any moment, the regulator configuration can be visualized by display, but this cannot be modified. The led "Set" is also on for this action.



5.1.- C.T. PRIMARY SETTING:

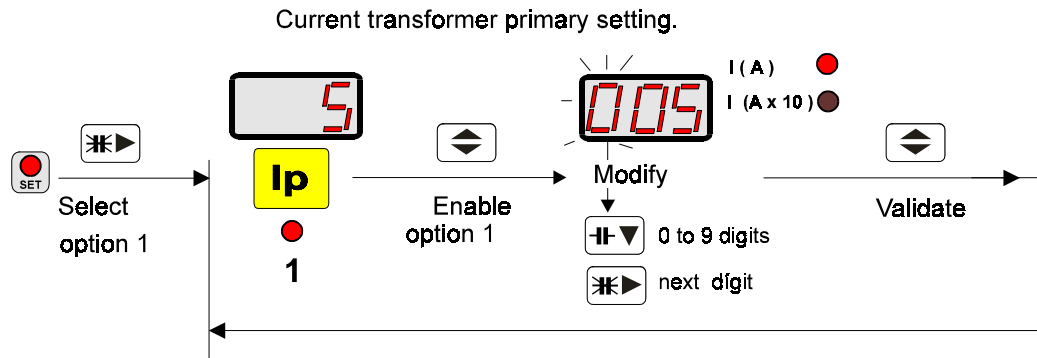
Set the value of the current transformer primary (from 5 A to 9990 A).

For a value fixed between 5 to 999 A, current readout is direct, and from 1000 A, the readout will be the total current divided by ten, and the led I(A x 10) will be on (real value = readout x 10).

The secondary value is fixed (standard ...5 A a.c.).

Once in setup mode (the led "set", red coloured, is always on) :

- a.- Use the key  to place at position 1: the led "1" is on
- b.- Use the key  to enable **current transformer primary setting**.



The value of the previously set primary is shown on display, and the first digit blinks.

c.- Use keys & to modify the value on display:

- Repeatedly pressing the key the value of the blinking digit is increased.
- Press the key to pass to next digit. When last digit is reached, when the key is again pressed, the led "I(A)" or "I(A x 10)" starts to blink, then pressing the key the scale can be switched: x 1 (value up to 999 A) or x 10 (value up to 9990 A).

Note :if the scale "I(Ax 10) is chosen, the value programmed on the screen must be divided by 10

Example: the value 1000 is set as 100 and the led "I(A x 10)" must be on.
(Real value = value on display x 10).

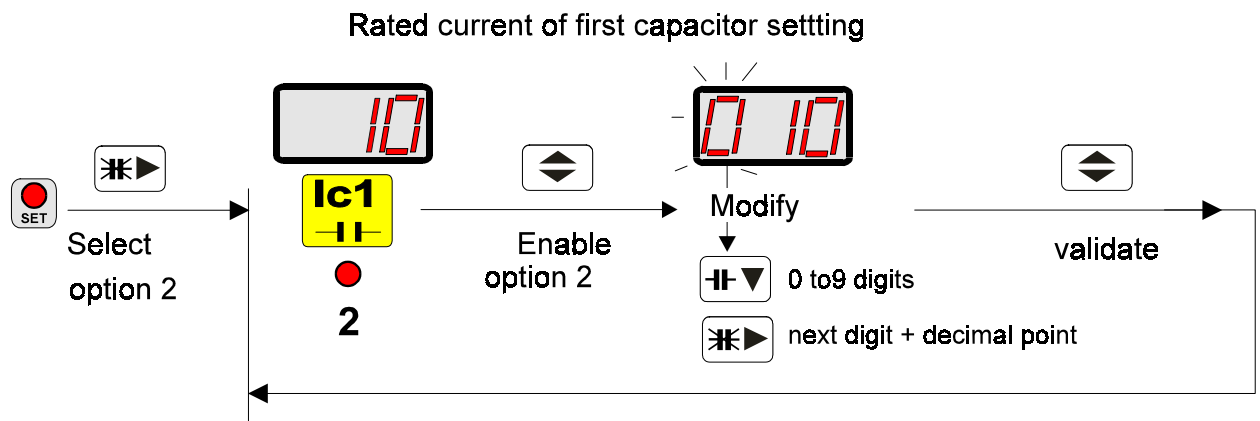
d.- Press to exit this menu option and to validate modifications General SET-UP menu is again accessed.

5.2.- RATED CURRENT OF FIRST CAPACITOR:

Set the value of the rated current of the first capacitor in the power factor correction bank (value programmable from 0.01 A to 999 A).



Once in setup mode (the led "set", red coloured, is always on) :





- a.- Use the key to place at position 2: the led "2" is on
- b.- Use the key to enable **rated current of first capacitor setting**.




Note : From this current (2) and the C.T. ratio (1), the regulator automatically calculates the C/K value.

The value of the previously set primary is shown on display, and the first digit blinks.

c.- Use keys  &  to modify the value on display:

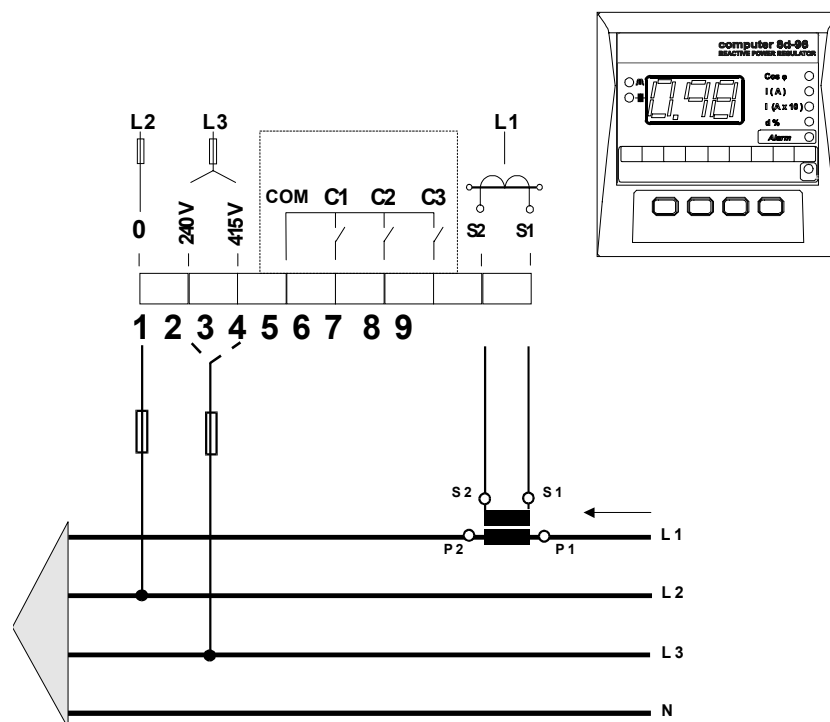
- Repeatedly pressing the key  the value of the blinking digit is increased.
- Press the key  to pass to next digit. When last digit is reached, whether the key  is again pressed, the decimal point starts to blink. Pressing the key  the position of this decimal point can be moved: (x .xx → xx .x → xxx . → x .xx)

d.- Press  to exit this menu option and to validate modifications General SET-UP menu is again accessed.



5.3.- CHOICE OF CONNECTION PHASE:

Select the installation configuration: **the current transformer is placed at one phase and the voltage input is taken between two phases.**

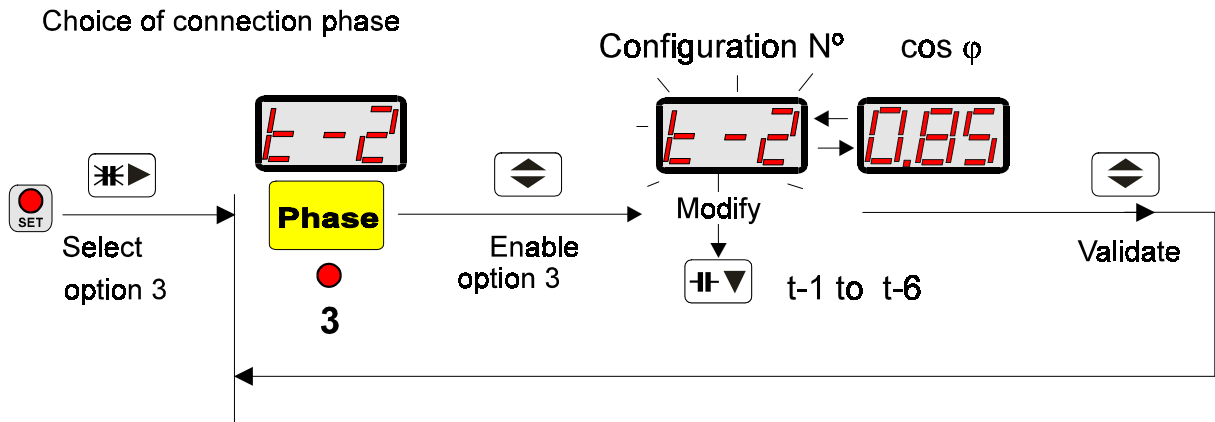
Default configuration is that placing the C.T. at one phase and taking the voltage input between other two phases (t-2), but other configuration can be set.



Once in setup mode (the led "set", red coloured, is always on) :

- a.- Use the key  to place at position 3: the led "3" is on
- b.- Use the key  to enable **phase relation setting**.

The previously set choice is shown on display (t-x), and the **cos φ** readout in the installation according to the selected connection mode is also automatically shown up.



c.- Use keys & to modify the option on display:

- Repeatedly pressing the key the connection mode choice is modified. Some seconds later the **cos φ** is shown. In case that this value is not a reasonable value press again the key

t-1	t-2	t-3	t-4	t-5	t-6
CT = L3 VM = L2-L3	CT = L1 VM = L2-L3	CT = L2 VM = L2-L3	CT = L3 VM = L3-L2	CT = L1 VM = L3-L2	CT = L2 VM = L3-L2

d.- Press to exit this menu option and to validate modifications General SET-UP menu is again accessed.

Three-phase connection (L1 -L2 -L3): Current signal from one phase and voltage measurement between two phases.

Connection mode	V- I shift angle with $\cos \varphi = 1$	Phase connection	Connection drawing
Direct C.T. t-1	30°	Current = L3 Voltage = L2-L3	
Inverted C.T. t-4	210°	Phase of current coincides with one phase of voltage	

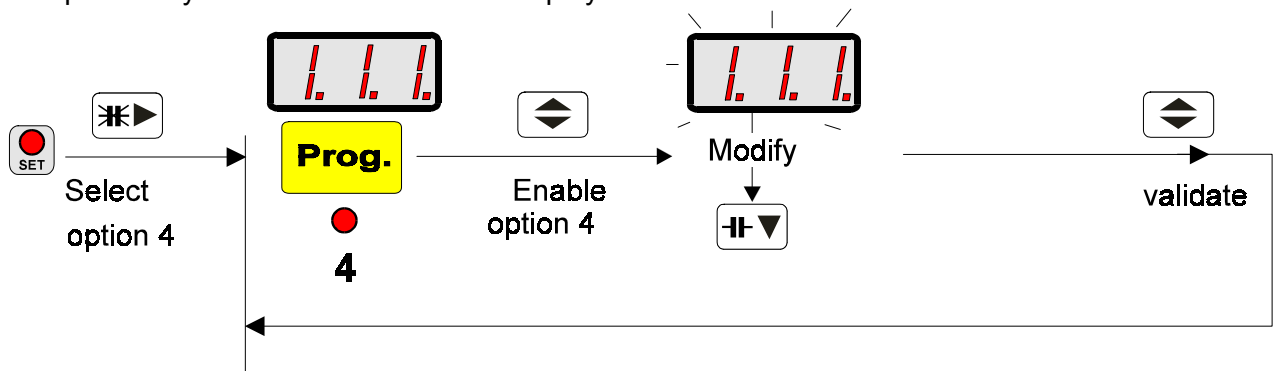
Direct C.T. t-2	90°	Current = L1 Voltage = L2-L3	
Inverted C.T. t-5	270°	Phase of current is not a voltage phase	
Direct C.T. t-3	150°	Current = L2 Voltage = L2-L3	
Inverted C.T. t-6	330°	Phase of current coincides with one phase of voltage	

5.4.- CHOICE OF THE OPERATION PROGRAM

Select here the operation program for the capacitor connection.
Once in setup mode (the led "set", red coloured, is always on) :


- a.- Use the key to place at position 4: the led "4" is on
- b.- Use the key to enable **operation mode setting** (relation between capacitors in the automatic bank).

The previously set choice is shown on display:



- c.- Use keys & to modify the operation program on display:
 - Repeatedly pressing the key the operation mode choice is modified.


- program 1.1.1.1.1 → **1.1.1**
- program 1.2.2.2.2 → **1.2.2**
- program 1.2.4.4.4 → **1.2.4**
- program 1.2.4.8.8 → **2.4.8**
- program 1.1.2.2.2 → **1.1.2**


d.- Press  to exit this menu option and to validate modifications General SET-UP menu is again accessed.

5.5.- cos φ SETTING:

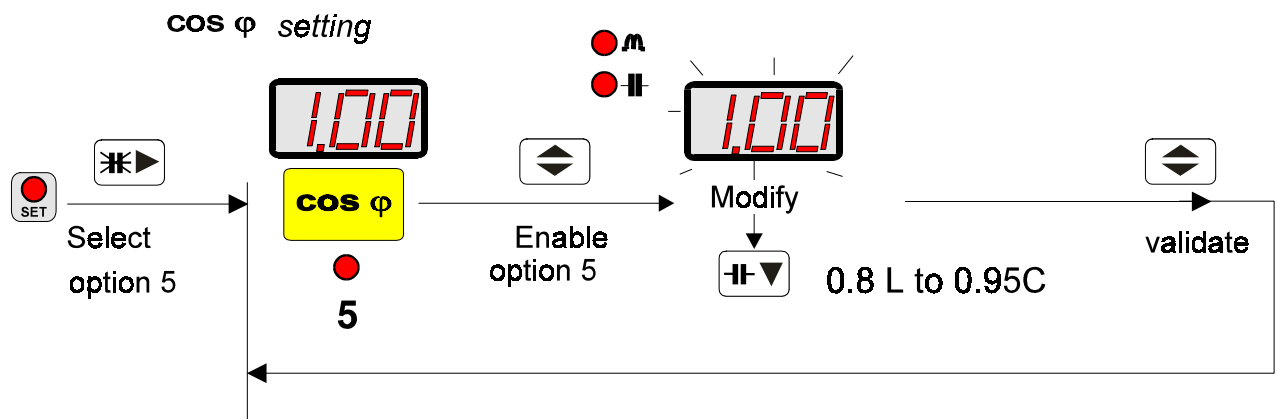
Use this option to set the **cos φ** value to be reached at the installation. This is a user-programmable value from **0.80** Inductive to **0.95** capacitive.



Once in setup mode (the led "set", red coloured, is always on) :


a.- Use the key  to place at position 5: the led "5" is on


b.- Use the key  to enable **cos φ setting**

The previously set choice is shown on display:



c.- Use keys  &  to modify the operation program on display:


- Repeatedly pressing the key  the cos φ value will vary from 0.85 Inductive to 0.95 capacitive.


d.- Press  to exit this menu option and to validate modifications General SET-UP menu is again accessed.

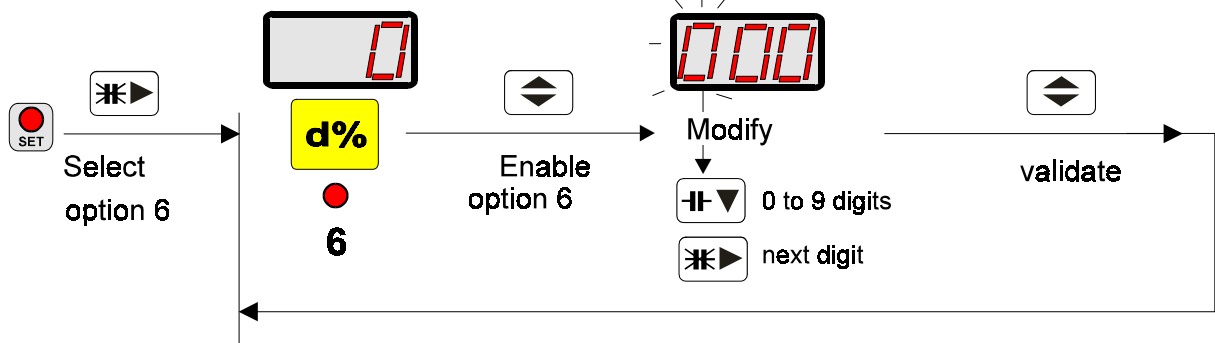
5.6.- DISTORTION FACTOR d % SETTING





Use this option to set the value for the distortion alarm of the installation. This is a user-programmable value from **1 to 999 %**


Once in setup mode (the led "set", red coloured, is always on) :

a.- Use the key  to place at position 6: the led "6" is on

- b.- Use the key  to enable **factor d % setting**
 The value of the previously set choice is shown on display and the first digit blinks.





- c.- Use keys  &  to modify the value on display:
 - Repeatedly pressing the key  the value of the blinking digit is increased.
 - Press the key  to pass to next digit.

- d.- Press  to exit this menu option and to validate modifications General SET-UP menu is again accessed.

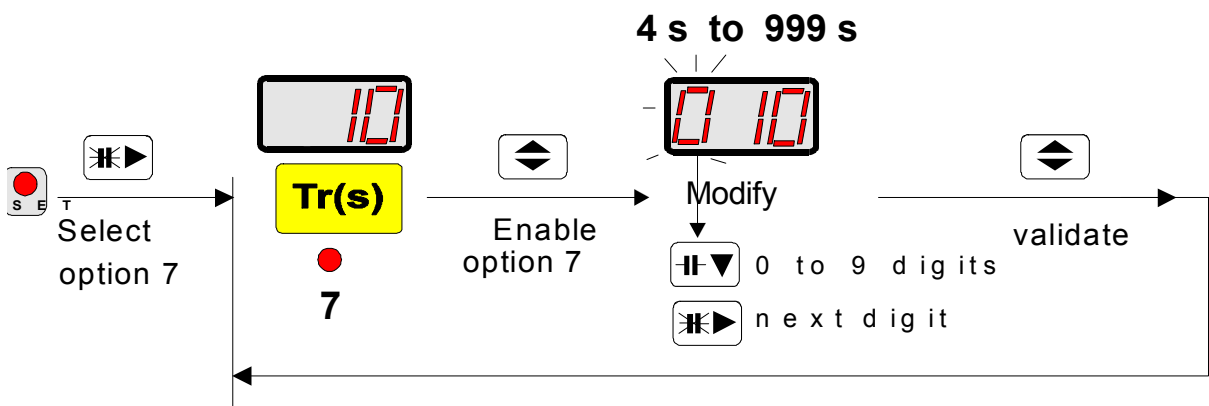
5.7.- CONNECTION TIME





Set here the delay time between the connection of automatic bank steps. This is a user-programmable value from **4 s to 999 s**


Once in setup mode (the led "set", red coloured, is always on) :

- a.- Use the key  to place at position 7: the led "7" is on
 b.- Use the key  to enable **connection time in seconds setting**

The value of the previously set choice is shown on display, and the first digit blinks.




- c.- Use keys  &  to modify the value on display:
 - Repeatedly pressing the key  the value of the blinking digit is increased.
 - Press the key  to pass to next digit.

d.- Press  to exit this menu option and to validate modifications General SET-UP menu is again accessed.

5.8.- RECONNECTION – SAFETY TIME

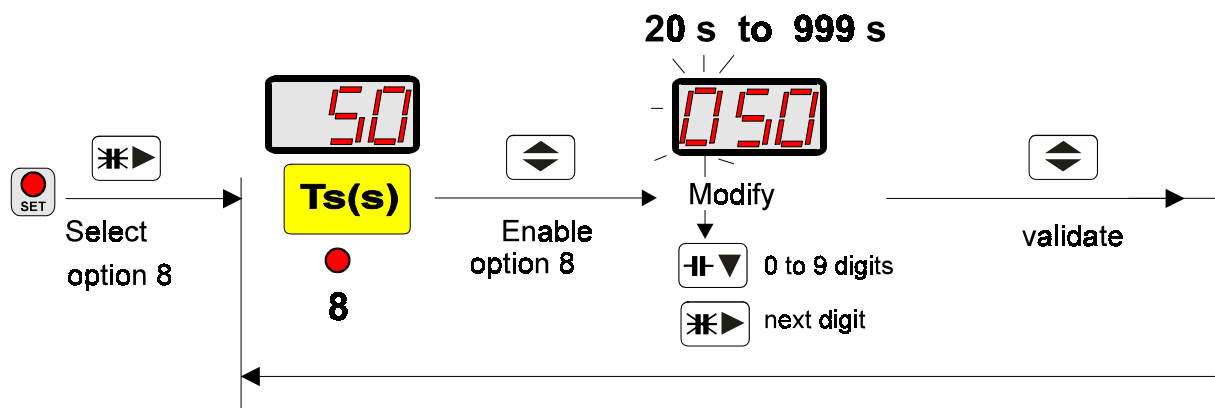
Set here the delay time for the reconnection of a same capacitor in the automatic bank (safety time). This is a user-programmable value from **20 s to 999 s**.



Once in setup mode (the led "set", red coloured, is always on) :


a.- Use the key  to place at position 8: the led "8" is on.

b.- Use the key  to enable **safety time in seconds setting**


The value of the previously set choice is shown on display, and the first digit blinks.



c.- Use keys  &  to modify the value on display:

- Repeatedly pressing the key  the value of the blinking digit is increased.

- Press the key  to pass to next digit.

d.- Press  to exit this menu option and to validate modifications General SET-UP menu is again accessed.

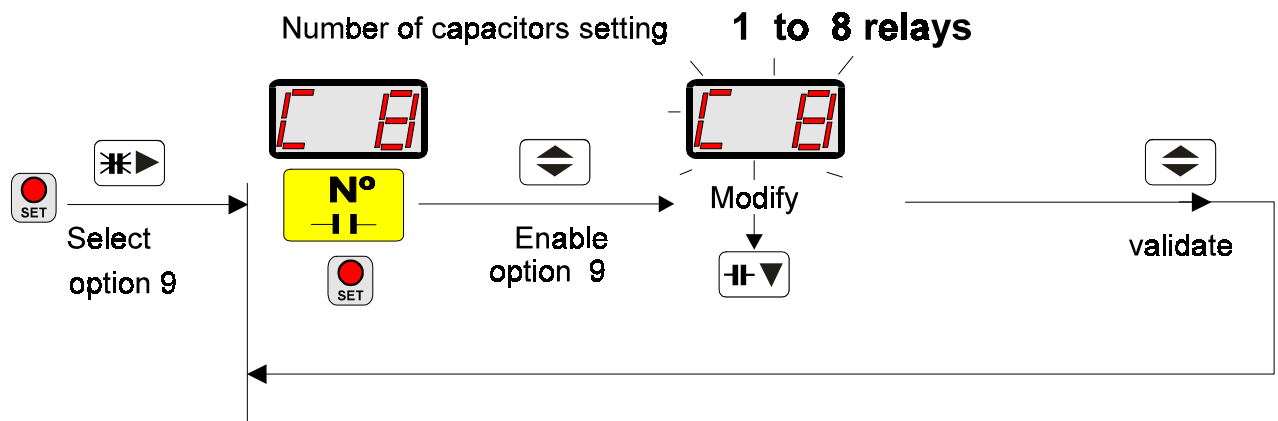
5.9.- NUMBER OF CAPACITORS SETTING:

When entering this set-up option, the number of capacitor is shown on display, as well as related leds are on.

Use this option to set the number of output relays used in the regulator. This is a user-programmable value from **1 to 8 relays**.

a.- Use the key  to place at position **No**: only the led "set" is on.

The value of the previously set choice is shown on display:



c.- Use keys & to modify the value on display:

- Repeatedly pressing the key the number of relays changes along C-1 C-8, and related leds are on.

d.- Press to exit this menu option and to validate modifications General SET-UP menu is again accessed.

6.- ALARMS

The regulator is equipped with diverse alarms that trip when following conditions are met:

Alarm type	Indication on display	Alarm description
Ineffective power factor correction	"- C.E" (Correction Error)	- Alarm condition is met when a reactive power twice the set unit power is being measured for more than 100 seconds. The alarm led (H) is then on and the displays shows the message "- C.E". - Time considered for this alarm starts when all programmed relays are on and a higher demand is detected, or when all relays are off and capacitive power is still in excess.
Distortion alarm d %	"- d.E " (Distortion Error)	- This alarm trips when user-defined alarm condition occurs for at least 10 seconds. When this alarm is activated, the regulator successively switches off steps until alarm conditions are satisfied. - For a set value of 0, this alarm is disable.
Overcurrent alarm	"- A.E" (A error)	- This alarm trips when an overload higher than 5.8 A is detected at the current input during at least 10 seconds.
Overvoltage alarm	"- U.E" (Voltage error)	- This alarm instantaneously trips when an overvoltage is detected at the regulator power supply.

In all above cases, the **alarm led (H)** is on, and the related message is shown on display to indicate the alarm type.

Whether the regulator is also provided with an alarm relay (according to the model), this relay is independent and a change-over type (terminals 10, 11 & 12).. When the regulator is powered and no alarm condition is met, the contact position is (10-11 closed and 11-12 open).

NOTE: *pressing any key will cancel the alarm message on display. If alarm conditions are present, the message will reappear within 2 minutes.*

7.- INTERNAL PERFORMANCE OF THE FCP SYSTEM

With external data received from the circuit (voltage and current), the regulator calculates the phase angle and the capacitor value necessary to reach the pre-set target $\cos \phi$. Once this value has been obtained, the FCP system takes the decision to switch on appropriate steps.

In case that, for instance, the operation program is 1.2.2, the regulator will decide, according to the reactive demand, whether to connect the first step, or directly switch on a double unit. This system avoids unnecessary switching operations of the first step, thus increasing the life span of the whole power factor correction unit.

Further more, in order to achieve a uniform wear of the automatic bank, the FCP system keeps in memory the time each capacitor remains switched off. When a capacitor is required to be connected, the capacitor connected will be the one switched off for the longest time.

A safety system prevents a capacitor to be re-connected if the user-defined safety time (Ts) has not elapsed.

Example: Required switching operation for a 100 % demand from zero for a regulator set at 6 steps.

S T A N D A R D S Y S T E M

Steps	1	2	2	2
1				
2				
3	x			
4		x		
5	x	x		
6		x	x	
7	x	x	x	
8		x	x	x
9	x	x	x	x
10		x	x	x
11	x	x	x	x


Total number of operations = 16

FCP SYSTEM

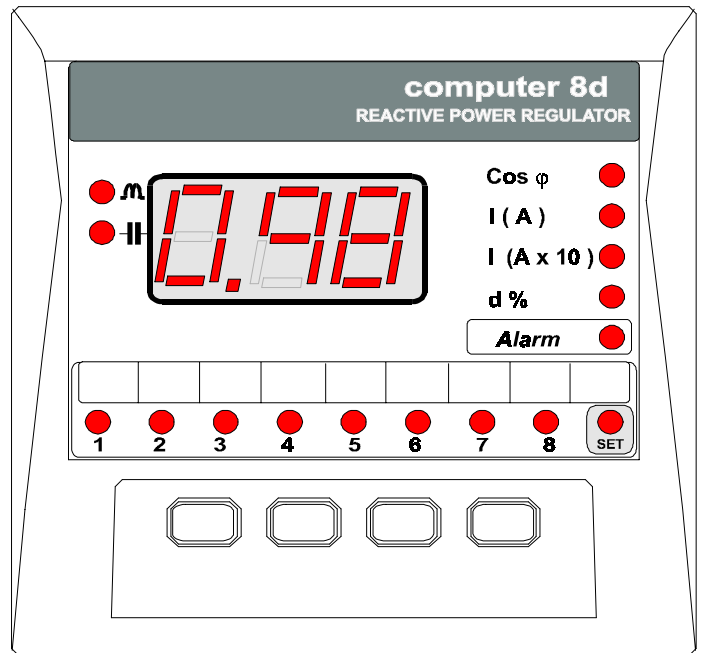
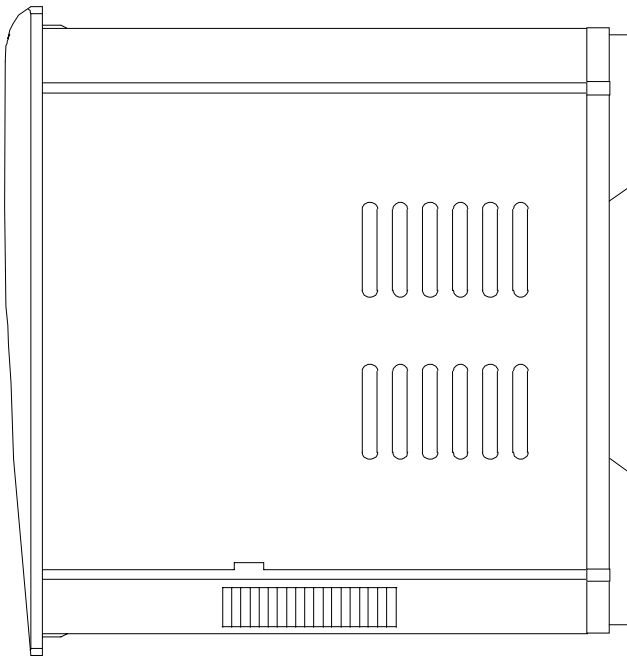
Steps	1	2	2	2
1				
2		x		
3		x	x	
4		x	x	x
5		x	x	x
6	x	x	x	x

Total number of operations = 6

8.- TECHNICAL SPECIFICATION

Supply voltage :	240 / 415 V a.c.  other voltages on request
Voltage circuit : Tolerance Burden Frequency	+ 15 % / - 15 % 5 VA 45 ... 65 Hz
Current circuit : Rated current Permanent overload Short-time overload Burden	Isolated In / 5 A a.c. 2 x In (alarm signal due to overcurrent at 5.8 A) 5 x In during 10 s 0,5 VA
Control system	FCP
Cos φ setting	0,80 ind 0,95 Cap.
Cos φ display	By display - 3 digits
Operation programs	1:1:1:1 / 1:2:2:2 / 1:2:4:4 / 1:2:4:8 / 1:1:2:2
Output relays	According to the model : 8 relays + alarm relay
Connection time Tr	4 to 999 s (user-programmable)
Safety time Ts	20 to 999 s (user-programmable)
Output relay : Maximum voltage Ui Thermal current Ith AC11 Ie / Ue DC11 Ie / Ue Mechanic endurance Electric endurance	400 V a.c. / 250 V d.c. 10 A 4 A / 250 V a.c. 1 A / 110 V c.c. 3 · 10 ⁷ operations 2 · 10 ⁵ operations (full load)
Safety	Installation class III, as per EN 61010. Protection against electric shock by double isolation system (class II equipment)
Environmental conditions Working temperature Maximum relative humidity	-10° to +50 °C 95 % no-condensation
Mechanic characteristics : Connection Case material Protection class External dimensions Net weight	Spade plug-in connection terminals Self-extinguishing, V0, plastic Assembled instrument (frontal) : IP 54 Not-assembled instrument (side and rear plates): IP 31 COMPUTER-8d-144 : 144 x 144 mm - depth - 100 mm COMPUTER-8d-96 : 96 x 96 mm depth - 100 mm 0.520 kg
Standards :	IEC 605, EN 61010, IEC 414, EN 50 081, EN 50 082 IEC 348, IEC 255, UL 94, UNE 20 607, UNE 20 608, UNE 21 349, UNE 20 553, UNE 21 136, VDE 0110
Codes :	code 1 11 ***

Computer-8 d (96 x 96 mm) :



9.- SAFETY WARNINGS

The user should take into account all installation instructions referred in sections related with INSTALLATION AND STARTUP, CONNECTION INSTRUCTIONS and TECHNICAL FEATURES of the regulator.

Note that with the instrument powered on, the terminals could be dangerous to touching, and cover opening or elements removal actions may allow accessing dangerous parts. The regulator is factory-shipped in proper conditions.

10.- MAINTENANCE

The **Computer 8d** does not require any special maintenance. No adjustment, maintenance or repairing actions should be done over the instrument open and, should those are essential, high-qualified operators must perform them.

Before any adjustment, replacement, maintenance or repairing operation is carried out, the instrument must be disconnected from any power supply source. When any protection failure is suspected to exist, the instrument must be immediately put out of service. The own instrument design permits a quick replacement in case of damage.

11.- TECHNICAL SERVICE

For any inquiry about the instrument operation mode or in case of malfunction, you can contact PDL technical service.

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