POWER FACTOR CONTROLLER
PFC5 PFC7 PFC8 PFC12

I	**Istruzioni per l'uso**	*I*
GB	**Operating instructions**	*GB*
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ITALFARAD

CE

English

PRELIMINARY OPERATIONS

For safety concerning personnel and product, please read the contents of these operating instructions carefully before connecting.

CAUTION

If the controller is mounted in an ITALFARAD power factor correction panel, during the first installation, the only parameter to be preset is the value of the CT primary. Hence when powering up the controller for the first time, follow the instructions given in Chapter 1.10 "RAPID C.T. SETUP".
If the power factor correction panel has already been switched on or else if it is necessary to modify the C.T. value, proceed to adjust parameter P.01 of the basic set-up.
Unauthorized tampering of the other parameters could cause faulty operation of the power factor correction panel or damage to it; in such case the warranty clauses and the manufacturer's liability would cease automatically.

The default values given in the tables on pages 33 and 38 refer to controllers purchased individually and not mounted in an ITALFARAD power factor correction panel. Otherwise such values are those regarding the specific controller and they depend on the type of capacitors used.

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1.00 CONTROLLER MANUAL

1.01 GENERAL CHARACTERISTICS

- Digital microprocessor power factor controller
- TTL-RS232 serial interface for set-up and automatic testing via PC (Personal Computer)
- Internal temperature sensor
- Advanced functions for capacitor current overload measurement, average weekly power factor, maximum value logging
- 2 relays programmable as alarm and/or fan control

1.02 FRONT PANEL

3 digit 7-segment LED display

LED indication of operation selected

LED indicating type of load detected

LED indication of alarms (if preset)

LED indication of measurement on the display

LED indication of steps enabled

4-membrane key keypad access the controller functions
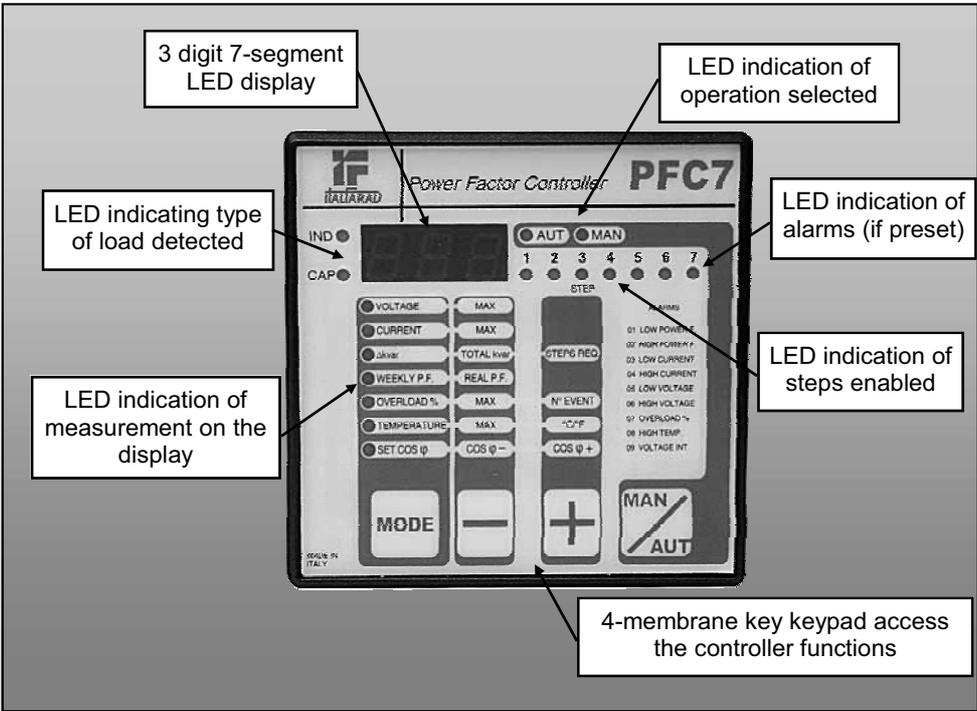
1.03 INSTALLATION

Install the controller according to wiring diagrams given on page 31.

The CT (Current Transformer) must be connected to the free phase, i.e. **not** on phases used to supply the unit, as indicated in the wiring diagrams.

The controller automatically recognizes the CT current flow. In case of co-generation systems, disable this function (refer to "Advanced menu" section 1.18 "ADVANCED MENU SETTINGS") and connect the CT correctly.

The CT secondary must be earthed/grounded.

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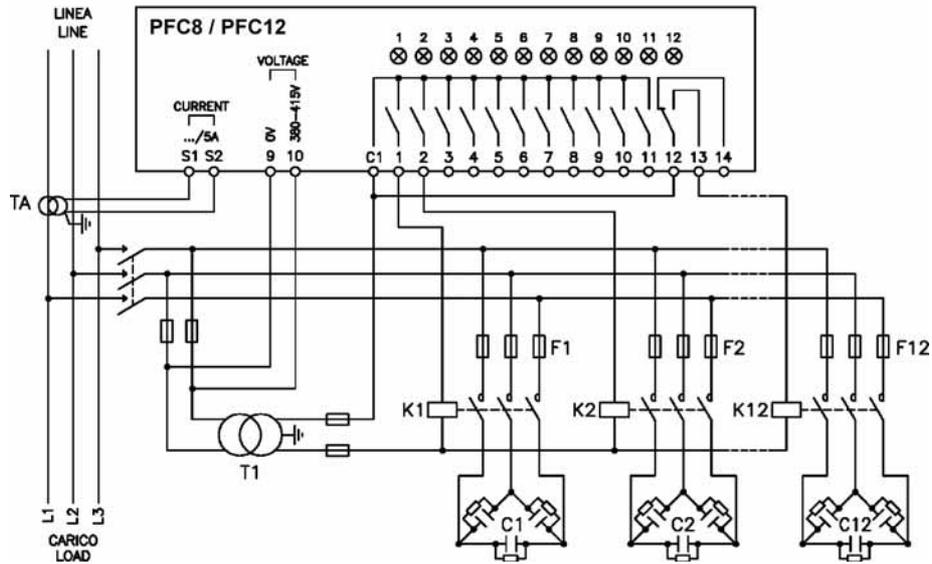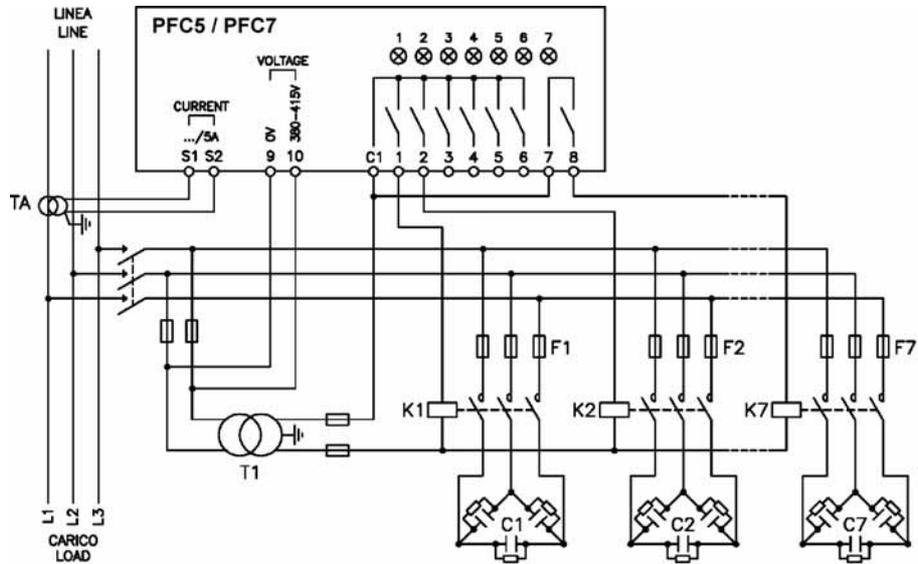
IMPORTANT!
- For three-phase connection, the voltage input must be connected phase to phase; the current transformer must be connected on the remaining phase.
- The polarity of the current/voltage input is indifferent.

WARNING! Disconnect the line and the supply when operating on terminals.

1.04 POWER UP

At the first power up, the display shows **---** which means no parameter has been programmed yet.
Under these conditions, a manual test of the steps can be conducted to check the connections.
Press the **+** or **–** key to connect or disconnect the steps.
WARNING! During this phase, the step control is totally manual and the unit does not control the reconnection time to allow the capacitors to discharge.

1.05 PARAMETER SET-UP

There are various methods of setting parameters and commissioning the controller to operate properly, namely:
* Section 1.06   MANUAL KEYPAD SET-UP
* Section 1.09   QUICK SET-UP VIA PC
* Section 1.11 AUTOMATIC SET-UP

1.06 MANUAL KEYPAD SET-UP

* Place the unit in manual mode and press the **MODE** key for 5 consecutive seconds.

5 sec

* The wording *SEt* appears on the display to confirm access to the basic menu parameters.

* Press the **MAN/AUT** key to enter the next parameter.
* Press the **MODE** key to return to the previous parameter.
* Press the **+** and **-** keys to view and change the setting of the selected parameter. If no key is pressed for a few seconds, the selected parameter is displayed once again.
* Exit from set-up is automatic once the last parameter is exceeded.

display and modify parameter

previous parameter
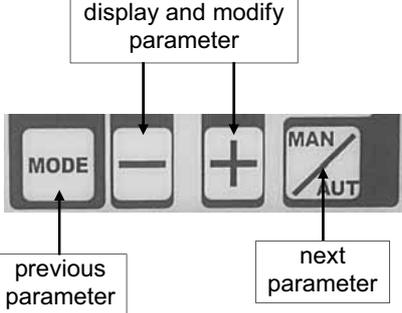
next parameter

1.07 TABLE OF BASIC MENU PARAMETERS

PARAMETER 1	DESCRIPTION	RANGE	DEFAULT
P.01 **(a)**	CT primary current	OFF… 10.000	OFF
P.02	Smallest step kvar (lowest common multiple)	0.10… 300	1.00
P.03	Rated capacitor voltage (V)	80… 750V	400
P.04	Reconnection time (sec)	5… 240sec	60
P.05	Sensitivity (sec)	5… 600sec	60
P.06 (LED 1)	Step 1 coefficient	0… 16	0
P.06 (LED 2)	Step 2 coefficient	0… 16	0
P.06 (LED n-1) **(a)**	Follow the same programming for the remaining steps as above for the first two steps except for the last two. Penultimate step coefficent.	0… 16 *noA (c)* *ncA (c)* *FAn (c)*	0
P.06 (LED n) **(b)**	Follow the same programming for the remaining steps as above for the first two steps except for the last two. Last step coefficient.	0… 16 *noA (c)* *ncA (c)* *FAn (c)*	0
Setting of required cosφ value (Ind). **(d)**		0.80Ind… 0.80Cap	0.95

a	**CAUTION!** If you have purchased a finished panel, this is the only parameter to be preset.
b	n = Number of controller steps.
c	*noA* = Normally open contact under no alarm conditions. *ncA* = Normally closed contact under no alarm conditions. *FAn* = Fan control.
d	See Measurement and cosφ setting section on page 36.

1.08 DESCRIPTION OF BASIC MENU PARAMETERS

P.01 - CT primary current
For values higher than 1000, a flashing dot indicates "thousands".
P.02 - Smallest step kvar
Rated power in kvar of the smallest installed capacitor bank.
Example: For 10 kvar, set 10.0
P.03 - Rated capacitor voltage
Rated voltage (nameplate) of the capacitors.
Example: For 460V, set *460*
P.04 - Reconnection time of the same step in seconds
Minimum time needed for the capacitor to discharge and be ready to be used again.
Example: For 60 seconds, set *060*
P.05 - Sensitivity
The sensitivity is a coefficient, which allows adjusting the controller operating speed. A low sensitivity provides faster adjustments but with a greater number of switchings. With high sensitivity, the regulation is slower but with fewer switchings.
The sensitivity value corresponds to the time the controller waits before responding to a

reactive power demand which is equal to the smallest step (kvar). For higher power demands, the time will be quicker according to the criteria of inverse proportion.

Example: For 60 s/step, set *060*

In this case with the smallest bank of 10kvar (P.02 = 10.0) and a system demanding 20kvar to achieve the set cosφ (Δkvar = 20), the controller will wait for 60/2 = 30 seconds before beginning the capacitor connection procedure (indicated by the flashing AUT LED).

P.06 LED 1...n Step coefficients

The coefficients of the steps represent the power rating of each step in relation to the smallest capacitor bank, whose value is programmed at *P.02*. If a step has the same power rating of the smallest step, then its coefficient will be 1, while if it is double it will be 2 and so on up to a maximum of 16. By setting 0, the step will be disabled and will never be considered or used by the controller. The last two steps can be programmed to operate as normal steps or as alarm relay or again as fan control. If the penultimate step is linked to a function then the last step cannot be used as a normal step.

To select these functions, press **-** until the following codes are viewed:

noA = Normally open alarm (contact open in absence of alarm)

ncA = Normally closed alarm (contact closed in absence of alarm)

FAn = Fan control

N.B. For the alarms, see table on page 41. For fan control, refer to pages 36 and 38.

Example: With a PFC7 installed in a control panel with 6 capacitor banks, 5, 10, 20, 20, 20, 20 kvar respectively at rated 460V and the last step is to be used as alarm, the parameters must be programmed as follows:

P.02 = 5.00 (Smallest step = 5kvar)

P.03 = 460 (Rated voltage 460V)

P.06 LED 1 = 001 (5 kvar = 1 times P.02)

P.06 LED 2 = 002 (10 kvar = 2 times P.02)

P.06 LED 3 = 004 (20 kvar = 4 times P.02)

P.06 LED 4 = 004 (20 kvar = 4 times P.02)

P.06 LED 5 = 004 (20 kvar = 4 times P.02)

P.06 LED 6 = 004 (20 kvar = 4 times P.02)

P.06 LED 7 = *noA* (Normally open alarm)

1.09 QUICK SET-UP VIA PC

For quick set-up via PC, it is necessary to use the relative automatic test and remote control software that includes the PC software and the connection cable. For this reason, all the controller models are provided with a communication port at the rear. All parameters are displayed on the PC monitor. The settings can be transmitted and stored with a few simple clicks of the mouse.

If a number of controllers must be programmed with the same settings, the set-up can be downloaded on a file and reused later by programming all the parameters with maximum ease and security.

1.10 RAPID CT SET-UP

When the CT to be used at the moment of the installation is not known, the parameter

P.01 for CT primary current can remain set to *OFF* while all the others can be programmed.

In this case during the system installation and once the controller is powered up, the display will view a flashing *Ct* (Current Transformer). The CT primary can be set directly by pressing **+** and **-**.

Once programmed, press **MAN/AUT** to confirm. The unit will store the setting and directly restart in automatic mode.

1.11 AUTOMATIC SET-UP

CAUTION!
Never use if a complete panel has been purchased.
The setting is useful if it is not possible to access the C.T. or else when the characteristics of the capacitor banks are not known.

The automatic set-up of parameters allows the unit to be placed in service without having to program any parameter.

To activate the automatic set-up when the unit is in MAN or **---** mode, simultaneously press **MODE** and **MAN/AUT** keys for 5 seconds.

The wording *ASE* (Automatic Set-up) flashes indicating that the automatic set-up of the parameters is in progress.

The procedure will last a few minutes during which the controller measures the power rating of the connected steps. This measurement will then be continuously updated during the normal operation.

If the load of the system varies frequently, the same step may have to be measured several times. In this case, the procedure may last longer.

At the end of the automatic set-up, the controller is ready for automatic operation.

IMPORTANT!

It is recommended to avoid substantial current variations as much as possible during the automatic set-up. During this automatic set-up, the controller is not able to monitor certain data such as CT primary current, rated capacitor voltage.

Therefore we shall have as follows:

- The current cannot be viewed in Amperes but only as a percentage.
- The Δkvar and Σkvar measurements are not available.
- The measurement and protection for capacitor overload are not accessible.
- All of the relays are considered as normal capacitors banks. So no alarm relay or fan control configuration is possible.
- The capacitors installed must be with a power rating which is a multiple of 1, 2, 4, 8 or 16 times the smallest capacitor step.
- The unused steps must be placed at the higher step numbers.

Note: After termination of the automatic set-up, if access is gained in manual mode to setting the parameters, the controller will consider all the parameters present as valid. Therefore, all of the measurements and functions will be available once again.

1.12 DISPLAY OF MEASUREMENTS AND REQUIRED COSφ SETTING

Normally, the display shows the cosφ of the system together with the IND and CAP LED's. The flashing decimal point indicates the negative sign (inverse energy flow).

By pressing the **MODE** key, the V, A, Δkvar, etc. LEDs are switched on one after another and the relative measurement of each is shown.

An optional function is available for each LED and indicated on the front panel, which can be displayed by pressing the **+** and **-** keys (the LED flashes quickly thereafter).

When the SET COSφ LED lights up, the set-point of the required cosφ can be pro-grammed; the **+** and **-** keys increase or decrease the value respectively. The set cosφ can be adjusted between 0.8 IND and 0.8 CAP.

The following table summarises all the available measurements.

LED	FUNCTION	BY PRESSING	BY PRESSING +
VOLTAGE	RMS voltage	MAX voltage value	
CURRENT	RMS current	MAX current value	
Δkvar	kvar required to reach set-point	Σkvar (system kvar)	Steps (kvar) required to reach set-point
WEEKLY P.F.	Average weekly power factor **(a)**	Real power factor	
OVERLOAD %	Thd I % capacitors **(b)**	MAX overload value	Overload event counter
TEMP.	Electric panel Temperature **(c)**	MAX temperature value	Unit of meaure °C or °F
SET COSφ	Required COSφ	Decrease SET COSφ value	Increase SET COSφ value

a	This PF (Power Factor) value is determined by active and reactive energy meters of the last 7 days. It is referred to positive energy quadrants only.
b	Overload current (Thd I %) caused by harmonic voltage at the capacitor terminals.
c	Caution! The temperature measurement is considered valid after a period of 20-30 minutes after power up.

1.13 MAXIMUM VALUE CLEARING

The maximum values of Voltage, Current, Overload and Temperature along with average weekly power factor can be cleared by simultaneously pressing the **+** and **-** keys for 3 seconds. Once clearing is complete, the display views *CLr*.

1.14 OPERATING MODE

The AUT and MAN LED's indicate the automatic or manual operating mode.

To change mode, press the **MAN/AUT** key for at least 1 second.

When the SET COS φ LED is lit up, no mode change is possible.

The operating mode remains stored even if power is removed.

1.15 MANUAL OPERATION

When the controller is in manual mode, one of the steps can be selected and manually connected or disconnected. If a measurement other than cosφ is viewed, press **MODE** until all the LEDs of the measurements go out.

To select one of the steps, use the **+** and **-** keys. The LED of the selected step starts flashing quickly. Press **MODE** to connect or disconnect the selected step. If the reconnection time of the selected step has not elapsed, the MAN LED flashes to indicate the operation has been confirmed and will be conducted in due time.

The manual configuration of the steps is maintained even when voltage is removed. When power returns, the original state of the steps is restored.

1.16 AUTOMATIC OPERATION

In automatic mode, the controller calculates the optimum configuration to achieve the set cosφ value.

The selection criteria take into consideration many variables such as: power rating of each step, the number of operations, the total time of usage, reconnection time, etc.

The controller displays the imminent connection or disconnection of the step by the AU LED flashing. The LED flashing can last in cases when the connection of a step is not possible because of the reconnection time (i.e. capacitor discharge time).

1.17 KEYPAD LOCK

It is possible to enable a function to exclude any modification to the operating parameters, however viewing of the measurements is still provided.

To lock and unlock the keypad, press and hold down the **MODE** key. Next press the **+** key three times and the **-** key twice, then release **MODE**. The display will show *LOC* when the keypad is locked and *UnL* when unlocked.

When the lock is enabled, it is not possible to make the following operations:

- Change from automatic and manual mode
- Access set-up menus
- Change the cosφ set-point
- Clearing of MAX values.

When attempting to perform the above operations, the display will show *LOC* to indicate the locked keypad state.

1.18 ADVANCED MENU SETTINGS

With the controller in MAN mode, press the **MODE** key for at least 5 seconds.

The wording *SEt* will appear to indicate access to basic menu parameters.

At this point, simultaneously press the **+** and **-** keys for 5 seconds until *AdS* appears on the display to indicate access to advanced menu parameters.

1.19 ADVANCED MENU TABLE OF PARAMETERS

PARAM.	FUNCTION	RANGE	DEFAULT
P.11	Type of connection	*3PH* Three phase *1PH* Single phase	*3PH*
P.12	CT connection recognition	*Aut* Automatic *dir* Direct *rEU* Inverse	*Aut*
P.13	Frequency recognition	*Aut* Automatic *50H* 50Hz *60H* 60Hz	*Aut*
P.14	Step power adjustment	*On* Enabled *OFF* Disabled	*OFF*
P.15	Regulation mode	*Std* Standard *Bnd* Band	*Std*
P.16	Step connection mode	*Std* Standard *Lin* Linear	*Std*
P.17	Co-generation cosφ set-point	*OFF* *0.80* Ind … *0.80* Cap	*OFF*
P.18	Disconnection sensitivity	*OFF* *1 … 600*sec	*OFF*
P.19	Step disconnection at change to MANU mode	*OFF* Disabled *On* Enabled	*OFF*
P.20	Capacitor overload alarm threshold (%)	*OFF* *0 … 250* %	*125*
P.21	Overload threshold for immediate step disconnection (%)	*OFF* *0 … 250* %	*150*
P.22	Overload event counter clearing time (h)	*1 … 240*h	*24*
P.23	Overload alarm reset time (min)	*1 … 30*min	*5*
P.24	Unit of measure for temperature	*°C* Celsius *°F* Fahrenheit	*°C*
P.25	Fan start temperature (°C)	*0 … 100* °C *32 … 212* °F	*55*
P.26	Fan stop temperature (°C)	*0 … 100* °C *32 … 212* °F	*50*
P.27	Temperature alarm threshold (°C)	*50 … 100* °C *122 … 212* °F	*60*

1.20 DESCRIPTION OF ADVANCED MENU PARAMETERS

P.11 - Type of connection
Programs either single-phase or three-phase connection.

P.12 - CT connection recognition
When set to Automatic, the controller operates in 2quadrants and at power on, it recognizes direction of current flow in the C.T.
When set to Direct, the controller operates in 4 quadrants and can be used both in normal or co-generation systems. It is however necessary to check the correct CT connection by making sure the decimal point of the cosφ measurement is not flashing with energy import

conditions. If not, the CT connections (S1 and S2 terminals) must be inverted or more simply set Inverse.

WARNING! Before disconnecting the S1 and S2 terminals, check that the CT secondary terminals are shorted.

P.13 - Mains frequency recognition

Automatic selection, fixed 60 Hz or fixed 50 Hz

P.14 - Step power adjustment

When this function is enabled and during normal operation, the unit allows automatic measurement of the power rating of the steps and modification of the operating parameters in case the steps are worn (i.e. by making many operations).

Note:
- When this function is used, the time between the connection of one bank and the next is 40 seconds.
- If the automatic set-up is used, the function is automatically enabled.

P.15 - Standard or Band regulation mode

In Standard mode, the controller adjusts the system cos φ to the set value. In Band mode, the capacitors are connected when the system cosφ is lower than the set value and are disconnected when in capacitive conditions. The Band mode is used to further reduce the number of capacitor connections and disconnections.

Note: The Band mode configuration does not allow programming of capacitive cosφ.

P.16 - Standard or Linear connection mode

In Standard mode, the controller freely selects the steps according to the logic described in the Automatic operation section above. In Linear mode, the steps are connected only by progression from left to right following the step number and according to the LIFO (Last In First Out) logic. The controller will not connect a step when the system steps are of different power ratings and by connecting the next step, the set-point value would be exceeded.

P.17 - Co-generation cos φ set-point

This parameter is programmed when a 4-quadrant operation is required, i.e. when the system is in the condition of consuming or producing energy. When the parameter is set to *OFF*, the cosφ set-point is the only one and corresponds to the value programmed with SET COSφ (see page 36). On the other hand, when it is set to a numeric value then the set-points are two: under normal conditions (system consumes mains energy, positive cos φ), the set-point value is considered as programmed by SET COSφ.

Under co-generation conditions (system produces energy, negative cos φ), it is used as programmed to *P.17*.

P.18 - Disconnection sensitivity

With this parameter at *OFF*, the sensitivity value set to *P.05* (see basic menu) adjusts the reactive speed during both the connection and disconnection phases. However, if *P.18* is set to a different value, the programmed value of *P.05* is considered for the connection while the value *P.18* is used for the disconnection of the steps.

P.19 - Step disconnection at change to MAN mode

When this parameter is enabled, the connected steps are disconnected in sequence when changing from AUT to MAN mode. At the end of the disconnection, the normal manual mode function is restored.

P.20 - Capacitor overload alarm threshold

By using this parameter, it is possible to adjust the tripping threshold of alarm Capacitor Overload. The percentage of current flowing in the capacitors (calculated by the waveform of the phase voltage) is compared with this threshold. If the threshold value is exceeded, after the delay, the alarm is generated and the steps disconnected.

P.21 - Overload threshold for immediate step disconnection
When the measured overload exceeds the value set at *P.21* , the capacitors are immediately disconnected and the capacitor overload alarm *A07* is generated.
Note: The delay time of Capacitor overload alarm *A07* operates inversely proportional to the overload entity, compared to the programmed thresholds of *P.20* and *P.21*. When the overload is lower than the *P.20* threshold, the alarm will not be generated. When the overload is equal to *P.20*, the delay time is equal to the one set for the alarm (3 minutes by default but can be changed via the PC). As the overload increases, the delay time becomes proportionally less until it attains zero once the value set to *P.21* is reached. With *P.20* at *OFF*, there is no tripping until the value *P.21* is exceeded and the immediate disconnection of the steps takes place.
With *P.21* at *OFF*, the delay TIME is also constant. With *P.20* and *P.21* both at *OFF*, the capacitor overload measurement is disabled as well as the alarm *A07*. In these conditions, the display indicates **---** instead of the overload measurement. Whenever the capacitor banks are equipped with inductances to prevent harmonic overload, *P.20* and *P.21* must be at *OFF* .

P.22 - Overload event counter clear time
Each time an *A07* Capacitor overload alarm is generated, the event is registered by an internal counter, which can be consulted by pressing the **+** key when the OVERLOAD % LED is lit up. The counter indicates the number of capacitor overload events that have taken place over the time period defined by *P.22*. This parameter also defines the number of hours during which the events remain stored. If no event has taken place during the set time period, the counter is cleared.

P.23 - Overload alarm reset time
Time period during which the *A07* Capacitor overload alarm remains active even though the overload value has decreased below the alarm thresholds.

P.24 - Unit of measure for temperature
This defines the unit of measurement, in degrees Celsius or Fahrenheit, for displaying the temperature and the threshold settings related to it.

P.25 -Fan start temperature
Sets the temperature above which the fan relay is activated (if programmed in one of the last two steps).

P.26 -Fan stop temperature
Sets the temperature below which the fan relay is disactivated (if programmed in one of the last two steps).

P.27 - Temperature alarm threshold
Sets the temperature above which the Temperature too high alarm *A08* is activated.

1.21 ALARMS

When the controller detects an abnormal situation in the system, a flashing alarm code is displayed. By pressing any key, display of the alarm will be momentarily ignored to allow the user to check all the measurements. If no key is pressed for 30 seconds and the alarm conditions persist, the alarm code will be displayed once again.
Each alarm can cause diverse results such as the alarm relay tripping, the delayed or immediate step disconnection, etc., according to the programmed property. The property of each alarm can be changed (e.g. disabled, change the delay time or effect), by using a PC and the relative software, used for the quick parameter set-up.
The following table indicates the alarm codes and the relative meaning of each along with the default setting.

ALARM CODE	DESCRIPTION	ENABLING	ALARM RELAY	DISCONECTION	TRIPPING DELAY
A01	Under compensation				15min
A02	Over compensation	●			120sec
A03	Low current	●		●	5sec
A04	High current	●	●		60sec
A05	Low voltage	●			5sec
A06	High voltage	●		●	15min
A07	Capacitor overload	●	●	●	180sec
A08	Overtemperature	●	●	●	5min
A09	No-voltage release	●		●	0sec

Note:
None of the above-indicated alarms are non-volatile.
In MAN mode the steps disconnection takes place only for the No voltage release (micro-breaking) alarm A09 - No-voltage release.

A01 - Under compensation
Capacitors are all connected and $\cos\varphi$ is lower than the set-point value.
A02 - Over compensation
All capacitors are disconnected and $\cos\varphi$ is higher than the set-point value.
A03 - Low current
Current value is lower than 2.5% full scale value. In automatic, the capacitors are disconnected after 2 minutes of the alarm activation.
A04 - High current
Current value is 120% higher than full scale value.
A05 -Low voltage
Voltage value is -15% lower than lower rated voltage.
A06 - High voltage
Voltage value is +10% higher than higher rated voltage.
A07 - Capacitor overload
Current value flowing in the capacitors is higher than the set threshold (refer to *P.20* and *P.21* of advanced menu).
A08 - Overtemperature
Internal temperature value is higher than the set threshold (refer to *P.27* of advanced menu).
A09 - No-voltage release
Voltage failure duration is more than 8ms.

1.22 TECHNICAL CHARACTERISTICS

Auxiliary supply	PFC5	PFC7	PFC8	PFC12
Rated voltage Ue	380… 415VAC (other values on request)			
Operating limit	-15%… +10% Ue			
Rated frequency	50 o 60Hz ±1% (self configurable)			
Maximum consumption	6.2VA		5VA	
Maximum dissipation	2.7W		3W	
Maximum power dissipated by output contacts	0.5W with 5A			
Immunity time for micro-breaking	≤30ms			
No-voltage release	≥8ms			

Current input	
Rated current Ie	5A (1A on request)
Operating limit	0.125… 6A
Constant overload	+20%
Type of measurement	True RMS
Short time withstand current	10Ie for 1s
Dynamic limit	20Ie for 10ms
Input power	0.65W

Output relay	PFC5	PFC7	PFC8	PFC12
Number of outputs (1 output contact is galvanically isolated)	5	7	8	12
Type of output	4+1 N/O	6+1 N/O	7 N/O + 1 C/O	11 N/O + 1 C/O
Maximum current at contact common	12A			
Rated capacity Ith	5A			
Rated operating voltage	250VAC			
Maximum switching voltage	400VAC			
Designation according to IEC/EN 60947-5-1 AC-DC	C/250, B/400			
Electrical life at 0.33A, 250VAC and AC11 load conditions	5×10^6 ops			
Electrical life at 2A, 250VAC and AC11 load conditions	4×10^5 ops			
Electrical life at 2A, 400VAC and AC11 load conditions	2×10^5 ops			

Control range	
Power factor setting	0.80ind… 0.80cap
Reconnection time of the same step	5… 240s
Sensitivity	5… 600s/step

Connections	
Type of terminal	Removable / Plug-in
Cable cross section (min-max)	0.2÷2.5mm² (24÷12 AWG)
Tightening torque	0.8 Nm (7LBin)

Operating ambient conditions	
Operating temperature	-20… +60°C
Storage temperature	-30… +80°C
Relative humidity	<90%

Enclosure	PFC5	PFC7	PFC8	PFC12
Version	Flush mount			
Material	Thermoplastic NORYL SE1 GNF2		Thermoplastic LEXAN 3412R	
Dimensions wxhxd	96x96x65mm		144x144x62mm	
Panel cutout dimension	91x91mm		138.5x138.5mm	
Degree of protection	IP54		IP41 (IP51 with protection cover)	
Weight	440g	460g	740g	770g

Reference standards
IEC/EN 61010-1; IEC/EN 61000-6-2; ENV 50204; CISPR 11/EN 55011; 61000-3-3; IEC/EN 60068-2-61; IEC/EN60068-2-27; IEC/EN60068-2-6; UL508; CSA C22.2 No14-95

Certification
cULus pending

1.23 TERMINAL BLOCK CONNECTIONS

PFC 5 - PFC7

PFC8 - PFC12
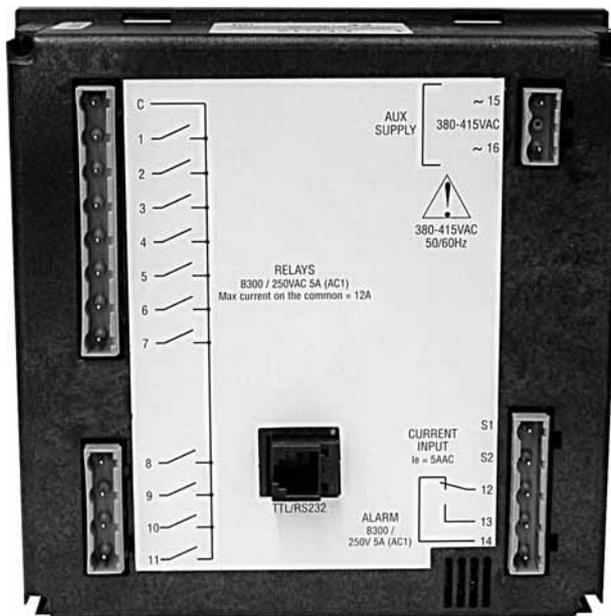
1.24 EXTERNAL DIMENSIONS AND PANEL CUT-OUT

PFC5 - PFC7
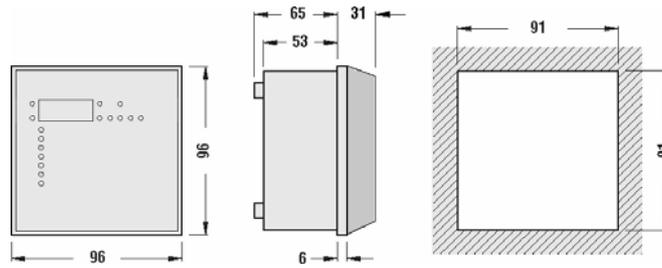
PFC8 - PFC12
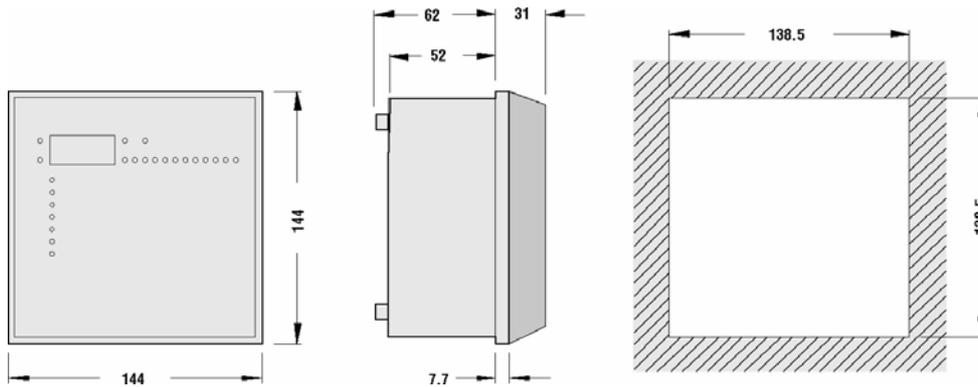
2. PROGRAMMING SOFTWARE MANUAL

2.01 FOREWORD

The programming software allows connection of a controller to a PC via a serial port RS232.

Thanks to this software the tasks of presetting set-up parameters and functional check of the power factor correction panel are quicker and easier. The software is also very useful in trouble shooting as all the measurements and dimensions can be easily monitored by the operator.

Above all, the following functions are available:

- Graphic display of all the measurements supplied by the unit with numeric indication and bar-graphs.
- For each step:
  - Display of the status (ON/OFF)
  - Display of the function (step/alarm/fan)
  - Display of the preset power
  - Display of the number of operations
  - Display of the total step operating time
  - Commands for manual closing/opening
- Access to the Basic Setup and Advanced Setup menus
- Access to the alarm properties
- Possibility of saving/loading/printing the setup settings
- Display via virtual front panel with provision for actuating the buttons
- Switching from manual/automatic modes
- Keypad lock function

2.02   MINIMUM CONFIGURATION REQUIREMENTS

- Operating system Windows® 95/98/2000/XP
- Graphic card with resolution 1024x768 or higher
- One standard free serial interface Rs232 (COM:)
- 64Mb of RAM
- Processor, class Pentium® or higher
- CD-ROM drive for the installation

2.03 INSTALLATION

Before proceeding to installation, it is necessary to have the personal computer with the operating system already installed and functioning as well as the CD for the program setup. It is also necessary to have a minimum acquaintance with the personal computer and the commands of the Windows® operating system.

The software is supplied on a CD with two different installation procedures. The standard installation procedure used with Windows 95 or 98 operating systems is to be found under the *Setup1* directory.

Under *Setup2* directory, there is a new installation procedure, suitable for Windows 98 SE, 2000 and XP operating systems.

Setup1:
- Close all applications if open
- Insert the CD in the drive
- Under the Setup1 directory, run the *setup.exe* program
- Press the button with the icon of a PC to start the installation procedure.
- A window appears with a request to specify the directory where to install the program. If the directory is to be changed, specify the new name in the appropriate box.
- Follow the instructions given. If the presence is signalled on the PC of files more recent than the ones which are about to be installed, keep the files already present (reply YES or "keep" to the request to retain the files).

Setup2:
- Close all applications if open
- Insert the CD in the drive
- Under the Setup2 directory, run *setup.exe*
- A window appears with a request to specify the directory where to install the program. If the directory is to be changed, specify the new name in the appropriate box.
- If a request to reboot the system is given at the end of the installation, carry out such procedure.

2.04 PC-CONTROLLER CONNECTION

The practical use of this software assumes connection of the PC to a controller via serial cable. This cable (supplied as standard with the software) includes an RS232/TTL converter for conversion of the TTL signals present on the rear connector of the control units into an isolated RS232 signal connectable to the PC.
Connect the end with the telephone jack RJ6 to the controller and the end with the DB9 connector to the serial port of PC. When running the software it is possible to check immediately whether the connection has been made properly.
If the software fails to activate the communication (ONLINE mode), check the number of the serial port used on the PC with the one selected in the *Configuration-Options* menu.

converter
RS232/TTL
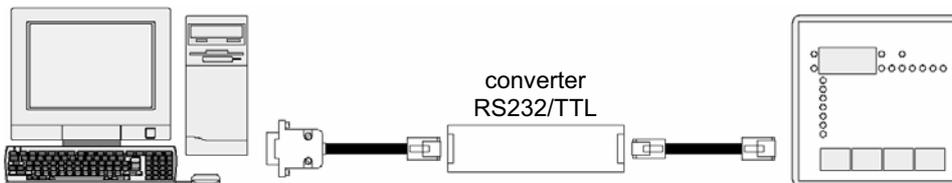
N.B.: This type of connection has been designed to be used in the setup, testing or diagnostics phases.
For a permanent serial connection it is preferable to use the controllers of the PFCS series provided with serial output RS485.

2.05 MAIN WINDOW

The main window displays simultaneously all the various measurements coming from the controller, thus allowing an overall vision of the status of the power factor correction panel.

All functions are accessible via pull-down menus, while the more frequently used functions can be accessed on the toolbar.

Certain of these functions are locked and can only be made available after entering the password, which can be modified by the user (at the first setup, the default password is *"ITALFARAD"*).

The main window shows the following:

- Three 7-segment display units indicating the current $\cos\varphi$, the preset $\cos\varphi$ and the average weekly power factor respectively.
- A graphic representation of the current phase angle on the four quadrants.
- Panels with voltage, current, Δ-kvar, capacitor overload and temperature, each one with numeric indication, bargraph and, where available, readout of the MAX value recorded. If the control unit has been programmed with the Auto-Setup procedure, certain of these measurements will not be available.

A series of panels, one for each step, with the following information:

- An icon representing the status (activated-disactivated) and function of the relay (capacitor bank, fan control or overall alarm).
- A box indicating the power in kvar of the step. Such box indicates the preset power rating (programmed in the setup). If the control unit has been programmed with the Auto-Setup procedure, the power rating of the step will not be available.
- A box indicating the total number of operations of the step. Counting is held even when the unit is switched off.
  N.B.: The controller distributes the number of operations equally <u>between the steps of equal power</u>. Hence it is normal that steps of different power have a different number of operations.
- A box indicating the total ON time of the step in hours-minutes. The ON time is held even when the unit is switched off.

Lastly, the following is indicated on the *status bar* close to the bottom edge of the main window, from left to right:

- Model and revision of the controller connector
- Status of the serial communication (ONLINE = connection active, OFFLINE = connection not active)
- Mode of operation of the controller (MANUAL / AUTOMATIC)
- Alarm status
- Page updating time (rate of refresh)
- Method of setup of the controller (None / Standard / Autosetup)

Marker and numeric value of max. peak recorded

Bargraph Delta-kvar
IN= kvar to be enabled
OUT= kvar to be disabled

Real-time measurements with numeric value and bargraph

Phase angle
Blue Marker= current angle
White Marker = set-point

Keypad lock/unlock

Display of front panel

Setup and alarms

AUT mode

MAN mode

Communication OFF

Communication ON

Current cosφ

Set-point cosφ

Average weekly P.F.

Power rating of the steps

Counter number of operations

Buttons for manual command of the step

Total time of use of the step

Icon with status and function of the steps

PFC7 Control Panel

ITALFARAD S.p.A.

PFC7 CONTROL PANEL
View Passwords Configuration Mode Communication Parameters Tools Help

PHASE ANGLE DISPLACEMENT

IND+   CAP+

16°

IND-   CAP-

ACTUAL COS-PHI

SETPOINT COS-PHI

WEEK AVG P.F.

VOLTAGE 377 V
-600 -500 -400 -300 -200 -100 0

CURRENT 629.6 A
-120% -100% -75% -50% 25% 0%

DELTA-kVar 037
IN   0   OUT

CAP OVRL 000 %
-250% -200% -150% -100% -50% -0%

TEMP 021°C
100 75 50 25 0 -25

STEP 01 Kvar 12.5 OpCnt 00007 Time 00:16 IN OUT
STEP 02 12.5 00007 00:14 IN OUT
STEP 03 25.0 00007 00:11 IN OUT
STEP 04 25.0 00006 00:11 IN OUT
STEP 05 25.0 00007 00:08 IN OUT
STEP 06 0.0 00000 00:00 IN OUT
ALARM 00000 00:00 IN OUT
STEP 08 IN OUT
STEP 09 IN OUT
STEP 10 IN OUT
STEP 11 IN OUT
STEP 12 IN OUT

ONLINE MAN MODE STANDARD
PFC7 Rev. 1.2 24

2.06 ACCESS TO SET-UP MENUS

The unit settings are entered through the setup parameters. They can be displayed and modified by using the appropriate *Parameters* menu or else directly from the toolbar, by clicking on the corresponding icon. Unless the password has been entered previously, it will be possible only to display the current settings, while transmission of modifications to the unit will not be possible.

This mode of access to the settings of the controller is easier and more immediate compared to direct access via the front keypad as the following items are displayed when using the PC:

- Code of the parameter
- Description in relative language
- Preset value
- Bargraph or pull-down box with the possible options

The parameters have been grouped in two menus reflecting the organization described in the User Manual:

- Basic Setup (basic settings such as CT primary, number and power ratings of the steps etc.)
- Advanced Setup (special modes of operation and other advanced functions)

Besides the two previous menus, there is also a third window giving the properties of the alarms, where the user can modify the behaviour of the unit after an alarm occurs.

The complete group of settings of a controller can be stored in an ASCII text file on the PC disk, so that it can be easily and quickly readily reloaded with the same settings in another unit. Such function is very useful when having to program a series of controllers with the same settings or when it is wished to keep an archive of the original settings of a system.

To save the parameters on disk, select the *Parameters-Save file* menu and enter the required name.

The following items are stored in each file:

- Type (number of steps) and internal revision of the unit.
- Set-point of $\cos\varphi$
- Parameters of the basic setup
- Parameters of the advanced setup
- Alarm properties

The extension associated with this type of file is *.par*. To perform the inverse operation,   i.e. transfer a file from the PC to the controller, use the *Parameters-Load file* menu.

Obviously such operation is only possible between units of the same type, i.e. with the same number of steps and with the same internal revision.

Furthermore, it is possible to obtain a print-out of the settings, which could be useful to file together with the documentation of the system by using the *Parameters-Print* menu.

2.07 ALARM PROPERTIES

Thanks to this window it is possible to customize the behaviour of the unit after a certain alarm has occurred.

The user can preset the following properties for each alarm:

- *Enabled:* Allows determining whether an alarm should be enabled or not. If an alarm is disabled, it is no longer generated (the unit behaves as though the alarm does not exist)
- *Relay:* Defines whether, following the occurrence of the alarm in question, the contact of the overall alarm should be activated or not.
- *Disconnect:* Defines whether, when the alarm is given, the control unit should disconnect the steps or not. Disconnection of the steps is performed gradually, with two seconds of distance between one step and the next.
- *Delay:* This property presets the delay between occurring of the conditions which generates the alarm and the activation of such alarm. The two options min and sec allow deciding whether to express the delay in minutes or seconds. Max. presettable delay is 240 minutes.

Certain alarm properties are not accessible (modifiable) by the user as they must have a definite behaviour owing to their very nature (i.e. presetting a delay in micro-breaking would have no sense).

N.B.:
Unlike the parameters, the alarm properties cannot be preset from the unit front panel. Hence the programming software is the only means possible to display / preset these properties.

<div align="center">

CAUTION!
Set value in selection cell "A07 Opening" shall not be modified,
it might lead to damage or bad working of panel.

</div>

2.08 FRONT PANEL

Through the programming software it is possible to have a "virtual" representation of the front panel of the controller on the PC monitor. Such facility is useful, for example, when wishing to make a demonstration of the operation by projecting the image of the PC monitor.
When this window is called with the *View-Front Panel* menu the front panel of the unit connected will be displayed, with real-time viewing of the displays and LED's in their current status.
By clicking on the buttons with the mouse, it is possible to select between the measurements and functions in the same way in which they are performed on the real unit. However it will no be possible to access those functions (such as programming of parameters, reset max. peaks, etc.) which require simultaneous and/or prolonged pressing of the buttons.
There are four types of front panels, representing models PFC5, PFC7, PFC8 and PFC12 respectively. The display will be adapted automatically to the model currently connected.

N.B.:
Quality of the graphic representation of the front panel could vary according to the graphic resolution of the PC and/or the monitor settings used.

3. CONNECTING CABLE

3.01 DESCRIPTION

The cable includes a RS232/TTL converter, which allows converting the TTL signals, incoming and outgoing via the rear connector of the controllers, into an isolated RS232 signal, connectable to a PC. It is designed so that the set-up and the customising of functions of such devices can be achieved, via the appropriate software, on controllers provided with relative communication port connector.

3.02 GENERAL CHARACTERISTICS

- RS232/TTL isolated interface
- Interface supply derived from the controller
- Connection to PC by SUB-D 9-pin female connector.

3.03 OPERATION

Connect the RJ6/6 phone jack to the controller and the SUB-D 9-pole connector to the PC serial port.
By installing and opening the programming software, check if the connection is working correctly.

3.04 TECHNICAL CHARACTERISTICS

Maximum communication speed	19200 baud
Insulation between RS232/TTI	2.5kVAC for 1min
Operating temperature	-10… +50°C
Storage temperature	-30… +80°C
Degree of protection	IP00
Connector to PC	9-pin SUB-D female
Connector to controller	RJ 6/6
Total cable length	<3m
Converter dimensions WxHxD	18x18x70mm
Reference standards	IEC/EN 60950 (2001) EN 55022 (1998)+A1 EN 61000-4-3 (1995)+A1 EN 61000-4-2(1998)+A1/A2 EN 61000-4-6 (1996)+A1 EN 61000-4-4 (1995)+A1 EN 61000-4-8 (1994)+A1 EN 61000-4-5 (1995)+A1