# **PFC-10** Digital Power Factor Controller



# We Keep You Right On Target





## **PFC-10 Features**

The PFC-10 is used to continuously control the capacitor bank, thereby improving the Power Factor of operating facilities. It monitors mains Voltage, Current and Active/Reactive Power.

When the inductive current is higher than the pre-adjusted setting, the controller will initiate an "Add Capacitor" demand to connect the appropriate capacitor steps. Similarly, when the inductive current is below a calculated level, a "Reduce Capacitor" demand for disconnection will be initiated. The PFC-10 also provides nine alarm indications such as, power-factor deviation from the target setting and Total Harmonic Distortion (THD) when exceeding the preset valve.

### Advantages at a Glance

- Second generation digital design and technology
- True RMS voltage and current measurement
- Real Power Factor (Cos) through active/reactive power measurement
- Built to sustain high harmonic ratio
- Simple adjustment (four parameters) for standard operation
- Automatic c/k adjustment
- Unique display of historical power factor average
- Measures and displays THD with alarm capability
- Full RS485 communication with Modbus RTU protocol (Optional)
- Choice of operating voltage range in the same unit (115/230/400V)
- Automatic frequency adjustment 50/60Hz
- Minimum measured current at 0.5%

### Control

- One or Four programmable quadrant controls
- One quadrant operation includes automatic identification of current direction
- Four quadrant operation includes automatic measurement for regenerative power
- Automatic count-down algorithm for reduced time between steps
- To increase capacitor MTBF, a 20 sec. delay is applied to switched out capacitor steps (in auto mode)
- Automatic measurement allows fast step switching for immediate Power Factor improvement
- Immediate disconnection upon mains loss automatically reconnects the same steps upon mains restoration.
- Measured Parameters assist in fault detection (1PH instead of 3 PH etc.) P, Q,V, I.

### Alarms

- Low PF for more than 10 min.
- Negative PF for more than 10 sec.
- Over-current for more than 30 sec.
- THD alarm (Adjustable level)
- Continuous Internal Testing (alarm upon failed test)
- Capacitor steps will trip upon :
  - a. Voltage outage for over 2 sec.
  - b. Current below threshold level for more than 2 sec.

## Faults

- Continues to operate in alarm mode
- Automatic C/T polarity detection in one quadrant operation
- Four quadrant operation, phase sequence can be reversed instead of C/T polarity
- All faults (except Internal Trip) include auto reset upon fault removal





## Front & Rear Panels

## Front Panel



## User Friendly 4 key combination Keypad LED and Seven Segment Displays

The LED indentifies the parameter shown on the seven segment display. Pressing the SELECT key scrolls between parameters. The front panel incorporates twelve additional LEDs displaying the PFC-10 status.

LED Symbol	LED illuminates when:
Auto	Controller operates in normal mode
Man	Controller operates in manual mode
Fault	Alarm is initiated for a fault (see fault list)
Prog	Controller is in Programming mode
PF & HPF	Power Factor is displayed and flashes when Historical PF is displayed
v	Mains Voltage (V) is displayed
I	Mains Current (I) is displayed
Р	Active Power (KW or MW) is displayed
Q	Reactive Power (KVAR or MVAR) is displayed
THD	THD is displayed (%)
(+) Add	Indicates a demand to add capacitor steps to meet the preset power factor target
(-) Reduce	Indicates a demand to reduce capacitor steps to meet the preset power factor target
1-12	When capacitor steps 1-12 are connected

**Rear Panel** 



## **Connector Description**

- Plug A Voltage & Current measurement inputs
- Plug B Supply Voltage (115, 230 or 400V)
- Plug C Output Relays, capacitor steps1-6 & alarm
- Plug D Output Relays, capacitor steps 7-12
- Plug E RS485 communication with Modbus RTU protocol

## Alarm Relay

The alarm relay is a C/O contact using fail safe logic. When the PFC-10 is energized the relay energizes closing (AL0 - AL1). When fault or supply loss occurs, the contact closes (AL0 - AL2).

## Communication (optional)

Serial RS485 communication with Modbus RTU protocol allowing up to 32 PFC's to be connected on a twisted shielded pair, with speeds of 2400-9600 baud.



## Parameters

Nineteen parameters may be modified to suit every application:

1

2

3

1

2 0

0 0

1 2

1

#### 1. Capacitor Value

can be programmed to any value between 1 - 999 KVAR.

#### 2. Current Transformer Ratio Enter the ratio of the current transformer

eg:500/5 =100

3. Number of Contactors Used

There are two types of controllers:

PFC-10-6, for 1-6 capacitor steps	3	0	6
PFC-10-12, for 1-12			

capacitor steps

#### 4. Switching Program

1111 1111(FIFO) 1222 1122 1233 1244 1236 1248

Ч	1	1	

#### 5. Connection Mode

There are two methods for PFC-10 voltage measurement: Phase to neutral -S 1. Р Ы Display shows:

Phase to Phase (3ph) -Display shows:

#### 6. Target Power Factor

Adjust the value to the desired power factor Display shows:



0

0

٦

S [3, ]

Ρ Ⴙ

#### 7. Alarm Power Factor

Operates the alarm fail-safe relay if the desired power factor is not reached within 10 min. Display shows: 0. 9



The time delay before the first capacitor step is switched "On". 8

Display shows:

#### 9. Time Delay Between Steps

The time delay between steps, after the first step has already been switched "On". 9 1 0 Display shows:

#### 10. Center Line Origin

Location of the center line in the parallel shifting Display shows:



#### 11. Limitation of Hysteresis

Threshold to prevent switching back and forth (Hunting) Display shows:

#### 1. 0 1.

0

#### 12. Capacitor Rated Voltage

The rated voltage on the capacitor name-plate (assists the accuracy of the PFC when the current is known) Display shows: 2. Ч| 0

#### 13. Potential Transformer Ratio

Enter the ratio of the Voltage transformer, eg: 3300/110 = 30 Display shows: 3.

#### 14.THD operation, On - Off

Switching the THD alarm On or Off through software programming. THD measures harmonics in the basic RMS wave, directly up to the 9th harmonic with a slightly reduced accuracy up to the 25th harmonic. Display shows:



F

F

1. 0

#### 15. Fast Capacitor Step Switching

Enables/disables fast switching and time saving for large loads where capacitor switching takes valuable time. S. D Display shows:

#### 16. Quadrant Selection

Using One Quadrant mode permits connection of current transformer disregarding its polarity. When using Four Quadrants, a regenerating system may be involved, therefore, the polarity becomes crucial for connection. Display shows:



#### **17.Communication Link Number**

Enter the number you wish to numerate your link in the range of 1-247. Display shows:

#### 2 Ч 8 ٦

#### 18.Baud Rate (bit per second)

The communication link Baud Rate using the range between 1200 - 9600. Display shows: 8. 9 6

#### **19. Statistical Reset**

Available for access only through communication. Allows statistical data reset (historical PF) via comm.





### General

The PFC-10 is designed for connection to three phase systems, with or without neutral wire with several connecting configurations.

## Phase to Neutral Connection (4 wire system)

Supply Voltage & Voltage/Current Measurements are measured on the same phase



## Phase to Phase Connection (3 wire system)

Voltage Supply & Voltage Measurement are connected between two phases. Current is measured on the third phase.



## Phase to Neutral & Phase to Phase Connection (4 wire system)

Phase to Neutral Supply Voltage, Phase to Phase Voltage Measurement, current is measured on the third phase.



## Communication

## Hardware & Software

The PFC-10 incorporates RS485 with Modbus Protocol, operating at baud rates of 2400 to 9600 bits/sec.

## System Integration

## RS-232

For programming and supervision of single units via IBM-PC or compatible.

An optional basic communication package is available. The package includes:

- 1. Windows based package
- 2. Communication cable with RS232-485 converter
- 3. Communication Manual

### RS-485

Serial link allows connection of up to 32 PFC's to the host computer. For detailed information see the Communication Manual.

When introduced into larger systems, a Data Highway may be used to enable multiple PFC-10 connections.

Up to 32 PFC-10's can be connected on a "twisted pair" numbering from 1 - 247.



## Mounting & Dimention





## **Technical Specifications**

## System

Mains Voltage Measurement: Control Supply: Frequency: Voltage Consumption: Current Measurement: Mode of Operation: No-Volt Protection: Voltage Inputs: Current Inputs: Output Relays: Alarm Relay: Relay Contacts: Maximum Voltage:

## Accuracy

Total Harmonic Distortion:

Current : Voltage: Active/Reactive Power:

## Settings

Target Power Factor: Center Line: Threshold: Time Delay Between Steps: Initial (Add) Time Delay: Wrong Power Factor Alarm: Switching Program:

## Displays

Seven-Segment Display:

LEDs:

## Communication

RS-485:

### Enclosure

Material: Connections: Weight: Operating Amb. Temp: Direct connection 115, 230, 400v +10% -15%: 115, 230V single or three phase 50/60 Hz 10 / 15 VA or 6 / 12 step controller: From Current Transformer 5A Automatic or Manual Trips all connected steps upon voltage outage True RMS with a power consumption Voltage path : 0.2VA True RMS with a power consumption Current path : 0.5VA 6 steps + 1 Alarm, or 12 steps + 1 Alarm Fail-Safe logic 8A/250VAC,1800VA. 48Vdc/0.25A-inductive/1A-resistive 250VAC. 125Vdc, 0.15A 125Vdc, 0.4A

Up to 9th harmonic with accuracy of 5% of the reading and up to 20% for the 25th harmonic 1.0%, for 0.9 \* CT Primary amps setting 1.0% of full scale For(2% +0.01 \* CT Primary/ FLC.) of Full Scale

0.80 Inductive to 0.95 Capacitive For optimal power factor correction Prevents over-correction at light loads (Hunting) 10 - 240 sec. 0 - 240 sec. Off, 0.8 Inductive - to 1 1.1.1.1.1... 1.1.1.1... (FIFO) 1.2.2.2.2... 1.1.2.2.2... 1.2.3.3.3... 1.2.4.4.4... 1.2.3.6.6... 1.2.4.8.8...

Power Factor, Voltage, Current, Active and Reactive Power, Total Harmonic Distortion, Parameter Settings and Faults.

6 LEDs correspond to Seven-Segment display
6 LEDs indicate Add / Reduce demand, Fault and operating modes
6 / 12 Additional LEDs for PFC-10 with 6 / 12 steps

RS-485 communication port with Modbus RTU protoco

Synthetic, IP40, flame resistant Plug-in connections IP20 0.8 Kg (PFC-10-6), 1.0 Kg (PFC-10-12) 0-50°C



## Additional Products

Additional catalogues available from Solcon's product range







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