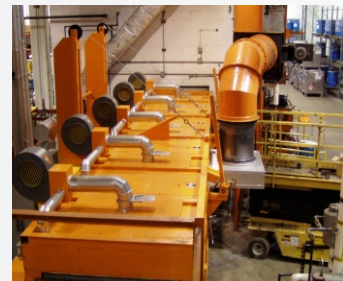


Automatic Power Factor Controller



APFC148



Training Manual

www.selec.com

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Product Overview

Selec Power Factor Controller APFC148 designed to automatically turn power factor correction capacitors on or off to maintain a desired target power factor under varying load conditions on the low voltage distribution systems of industrial, institutional, and commercial facilities.

Automatic Power Factor Control Panels are fitted with MCB, contactor and fuse. They all jointly work to maintain power at required level.

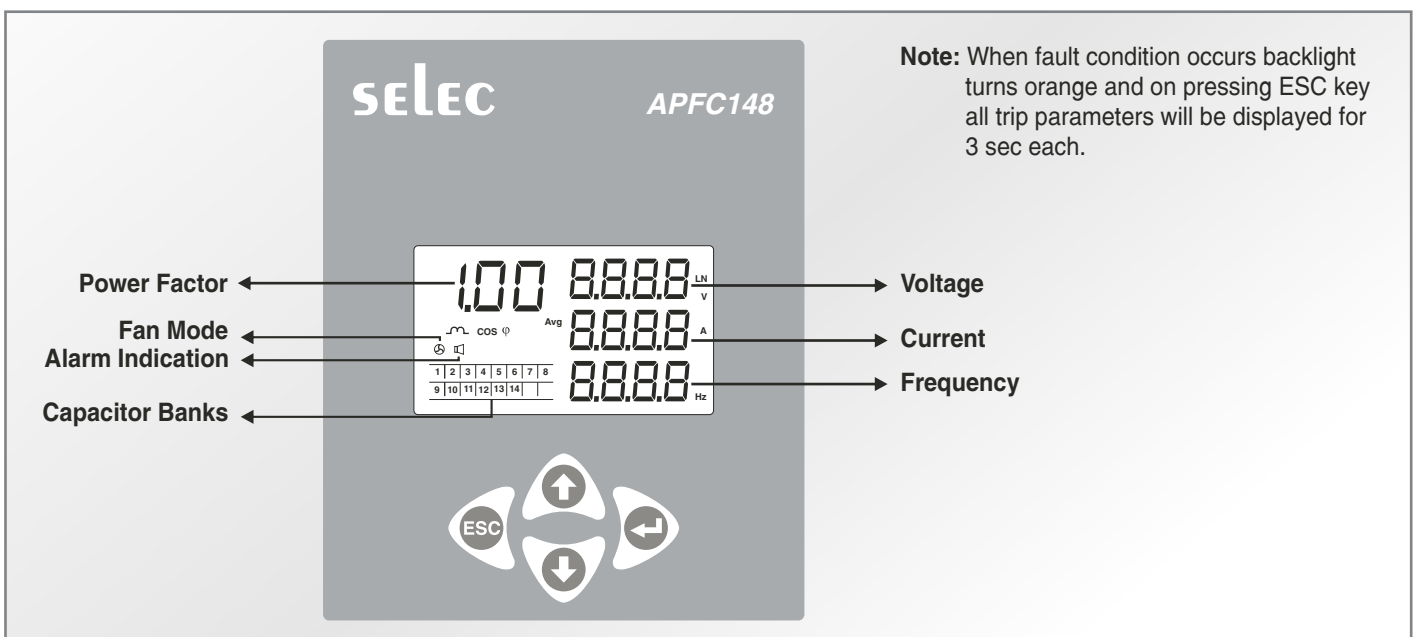
Selec Power Factor Controller APFC148 also provides flexibility in configuring (or disabling) different alarms. The alarms can be linked to a dedicated signal contact to alert the users of potential issues such as under compensation thus avoiding penalty charges from the utilities.

The regulator supports the Modbus-RTU protocol.

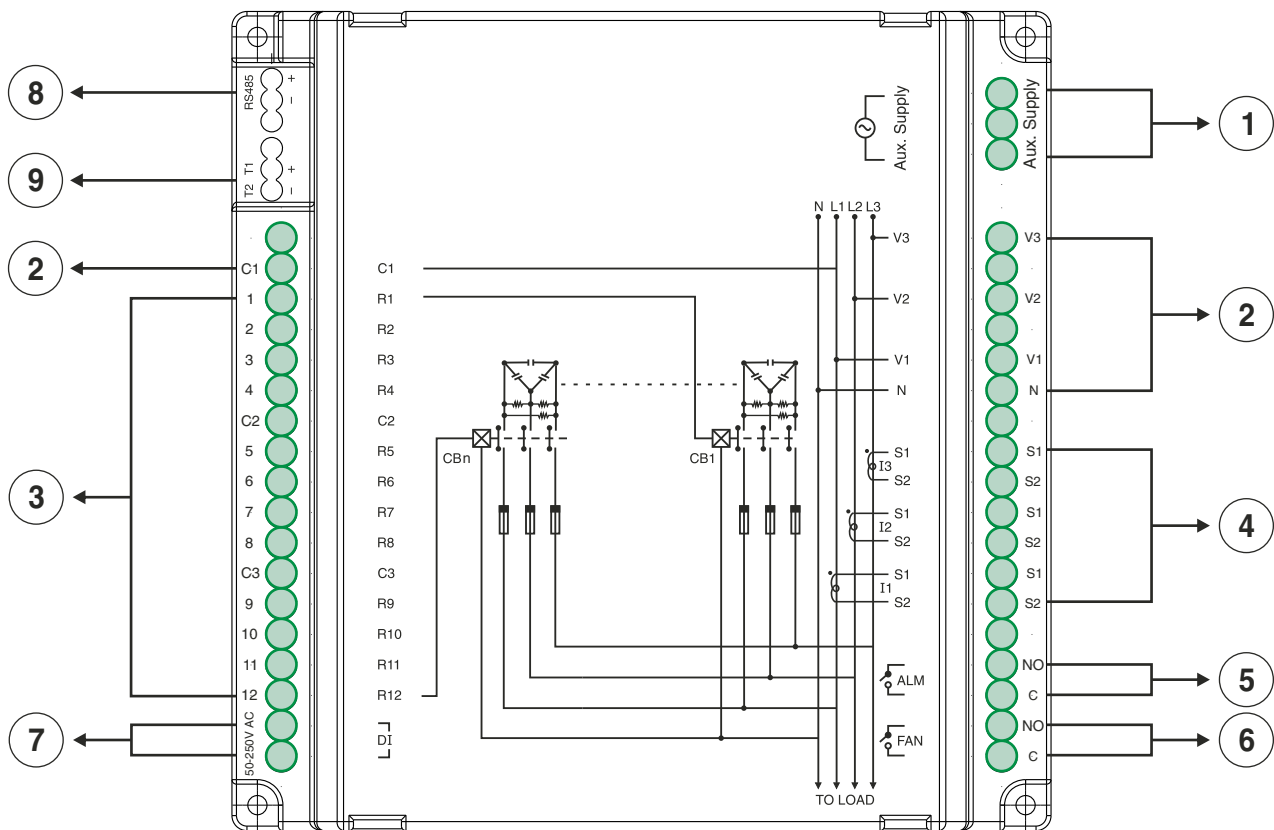
Features:

- 4 digits single row LCD with dual backlight.
- 3 CT Sensing
- 8/12/14 steps output
- 3 different switching programs
 1. Automatic
 2. Rotational
 3. Linear
- Configurable Power factor
- Configurable settings for
 1. Over voltage
 2. Under voltage
 3. Over current
 4. Under current
 5. Over compensation
 6. Under compensation
 7. Step Error
 8. Over Temperature
- CT polarity Error detection
- MODBUS RTU Communication (Only for 12 Relay option)
- Password protected
- Size: 144mm (H) x 144mm (W) x 50mm (D)

Main Display:



Wiring Diagram:



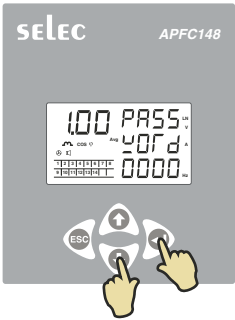
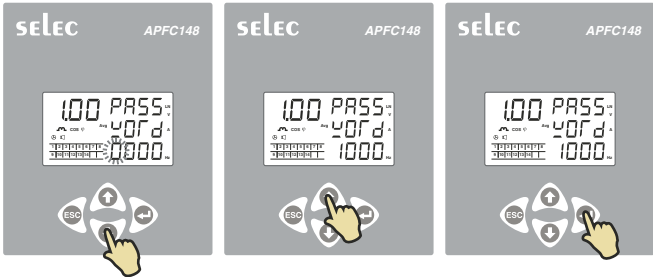
BEFORE STARTING INSTALLATION PLEASE SWITCH OFF THE SUPPLY TO APFC PANEL TO AVOID ELECTRICAL SHOCK.

1. Connect L & N i.e Auxiliary supply to Power ON the APFC
2. Connect any Phase to C1, C2 & C3 (Common terminal of relays), L2 Phase to V2 & L3 Phase to V3 and Neutral to Neutral of load.
3. R1 to R8 / R12 are terminals for the Capacitor Banks.
4. S1 & S2 are terminals for Current transformers of R, Y & B phases.
5. C & NO is 230V /5A relay for Alarm purpose.
6. Connect fan. Fan output will turn ON when the temperature exceed user set value.
7. User can connect any digital input to turn ON every capacitor bank manually.
 - Note:** 13 & 14 relay will be used for control switching only when customer selects 14 relay in configuration else it will be used as FAN & ALM respectively.
8. Communication port (Valid only for APFC148-312)
9. Thermistor input

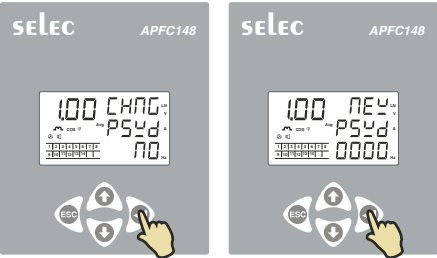

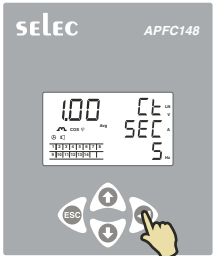
Note 1: In case the connections are not done as mentioned above then to match the phase internally & get accurate Power Factor, One needs to change the phase compensation angle by entering into the Settings.

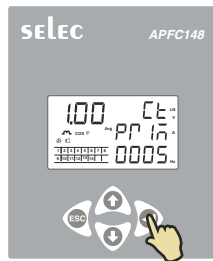
Note 2: For APFC148-312 there are 12 relays R1 to R12 and for APFC148-308 there are 8 relays R1 to R8.

Programming:

	<p>Step 1 : Press + for 3sec. to enter or exit configuration menu.</p>
	<p>Step 2 : Password will be displayed. Press & then to enter the Password 1. for level 1 (installation level), the password is 1000 2. For Level 2 (Technical Level), the Password is 2000 Press key for 1 sec, to change the level.</p>

Level 1 Settings:

	<p>Step 1 : Press Key. To change the Password, press & then key. If user wants to change the Password, select as YES & enter the new password & press key to save.</p>
	<p>Step 2 : Network selection will be displayed. select 3Ø 4 wire / 3Ø 3 wire / 1Ø 2 wire / 2Ø 2 wire as per wiring done. Press & then key to change wiring selection.</p>
	<p>Step 3 : Press key CT secondary will be displayed. Press & then key to change the value as 1A or 5A.</p>

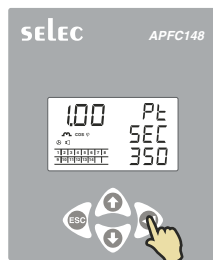
**Step 4 :**

Press key

CT primary will be displayed.

Press & then key to change the value

The range is 1A/5A to 9999A.

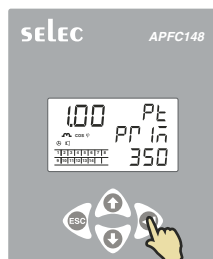
**Step 5 :**

Press Key

PT secondary will be displayed.

Press & then key to change the value

The range is 100V to 500V.

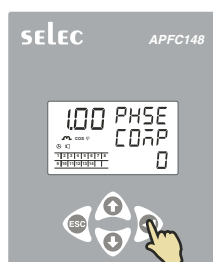
**Step 6 :**

Press Key

PT Primary will be displayed.

Press & then key to change the value

the range is 100V to 500kV.

**Step 7 :**

Press Key

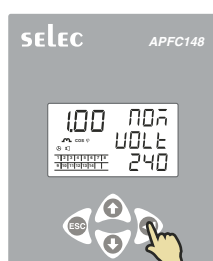
Phase Compensation will be displayed

Select phase compensation as per wiring done

The values are 0°, 90°, 120°, 210°, 240°, 330°.

(Only valid for 1Ø 2 wire & 2Ø 3 wire).

Press & then to select phase compensation angle.

**Step 8 :**

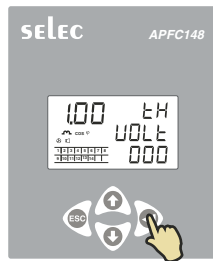
Press Key.

Nominal Voltage will be displayed.

The range is 50V to 550V.

For 1Ø 2 wire / 3Ø 4 wire, 240V is the default value

For 3Ø 3 wire / 2Ø 2 wire, 415 is the default value.

**Step 9 :**

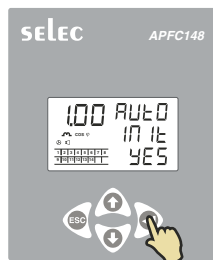
Press Key.

Threshold voltage will be displayed.

The range are 0 to 100%

Press & then to set value.

If VTH value is set to 0, It will stop Auto Initialization for any change in voltage.

**Step 10 :**

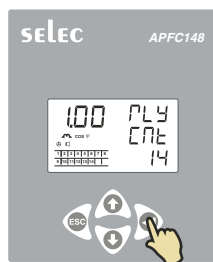
Press Key.

Auto Initialization will be displayed.

Press & then Key to select Yes or No option.

If Yes is selected, Unit will go into auto initialization mode to check the values of capacitor banks incase voltage fluctuates above or below threshold limit, else initialization will happen each time on power ON.

Auto initialization works best, under stable load conditions.

**Step 11 :**

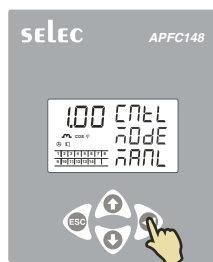
Press Key

Relay count will be displayed.

Select 1 to 8/12/14 relay count as per capacitor banks are connected to the APFC

Press & then Key to select no of relays.

The default value is 8 for APFC148-308 & 12 for APFC148-312

**Step 12 :**

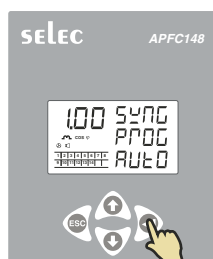
Press Key.

Control mode will be displayed.

Press & then key to select Automatic mode or manual mode

When automatic mode is selected capacitor banks will be automatically ON

When manual mode is selected user can manually switch ON the capacitor banks from level 3.

**Step 13 :**

Press Key.

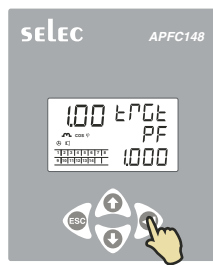
Switching program will be displayed.

Press & then key to select Automatic / Linear / Rotational.

Automatic : Intelligent switching sequence (Switching sequence is not fixed)

Linear : Last in first out sequence

Rotational : First in first out sequence.

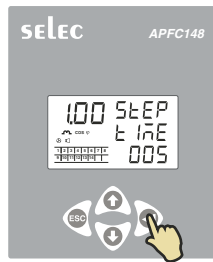
**Step 14 :**

Press Key.

Target PF will be displayed.

The range is 0.800 to -0.800

Press & then Key to set target power factor.

**Step 15 :**

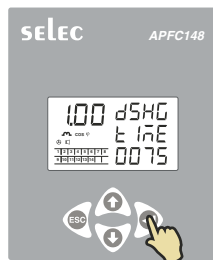
Press Key.

Step time will be displayed.

The range is 1 to 999sec

Press & then Key to select step time.

It is the time taken to Switch ON the capacitor bank.

**Step 16 :**

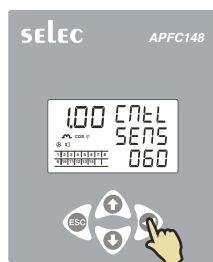
Press Key.

Discharge time (Reconnection time) will be displayed.

The range is 5 to 9999 sec

Press & then Key to select discharge time.

It is the time taken to reconnect the discharged capacitor.

**Step 17 :**

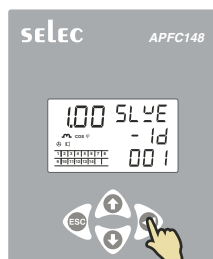
Press Key.

Control sensitivity setting will be displayed.

The range is 55% to 100%

Default value is 60%

It is 60% of lowest kVAr of capacitor.




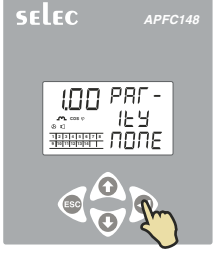



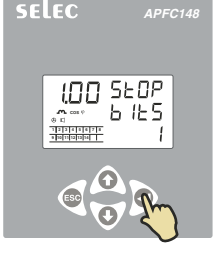


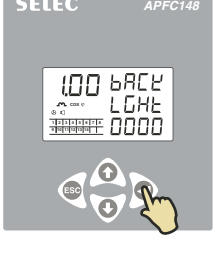



***Step 18 :**

Press key.

Slave ID will be displayed.

The range is 001 to 255.



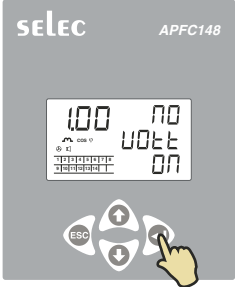




Press & then Key to change slave ID.

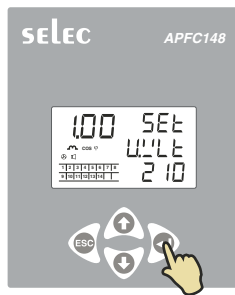
	<p>*Step 19 : Press  key Baud rate will be displayed. User can select 300 / 600 / 1200 / 2400 / 4800 / 9600 / 19200. Press  & then  Key to change baud rate.</p>
	<p>*Step 20 : Press  key Parity will be displayed. Press  & then  key to select None / Odd / Even.</p>
	<p>*Step 21 : Press  key. Stop bits will be displayed. Press  & then  key to select 1 or 2.</p>
	<p>Step 22 : Press  key. Back light will be displayed. The range is 0 to 7200 sec. Press  & then  Key to change backlight time. The default value is 0 (Contiguously ON)</p>

*Note: These parameters are valid only for APFC148-312

To enter into the level 2, enter the password 2000

Level 2 Settings:

	<p>Step 1 : Press  key Trip time will be displayed. Press  & then  Key to ON / OFF trip time.</p>
	<p>Step 2 : Press  key NO volt will be displayed. Press  & then  key to change the settings. If it ON, APFC will disconnect all the steps, when any phase is missing.</p>
	<p>Step 3: Press  key Over voltage will be displayed. Press  & then  key to switch it On or OFF</p>
	<p>Step 4 : Press  key Over voltage setting will be displayed. only if over volt is ON As per the network selection, the range is 250 - 290V (L-N) & 490 -520 (L-L) Press  & then  Key to set over voltage.</p>
	<p>Step 5 : Press  key Under voltage will be displayed. Press  & then  key to make it ON or OFF</p>

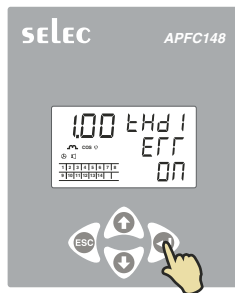
**Step 6 :**

Press key

Under voltage setting will be displayed, only if under volt is ON.

As per the network selection, the range is 195 - 210V (L-N) & 400 - 415 (L-L)

Press & then Key to set under voltage.

**Step 7 :**

Press key

Total harmonic distortion error setting will be displayed.

Press & then key to switch it On or OFF

**Step 8 :**

Press key

THDI range will be displayed only if Total Harmonic Distortion is ON

The range is 20 to 100%

Press & then key to set range.

**Step 9 :**

Press key

Over compensation will be displayed.

Press & then key to switch it ON or OFF

**Step 10 :**

Press key

Under compensation will be displayed.

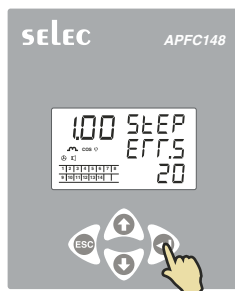
Press & then key to switch it ON or OFF

**Step 11 :**

Press key

Step error will be displayed.

Press & then key to switch it On or OFF

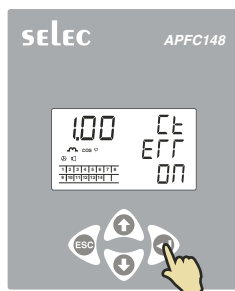
**Step 12 :**

Press key

Step error settings will be displayed. only if step error is ON

The range is 20 to 80%

Press & then key to set range.

**Step 13 :**

Press key

CT polarity error will be displayed.

Press & then key to switch it ON or OFF

**Step 14 :**

Press key

Over temperature will be displayed.

Press & then key to switch it ON or OFF

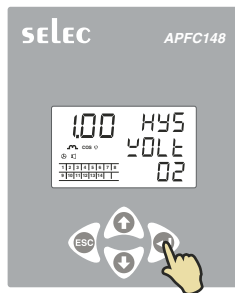
**Step 15 :**

Press key

Over temperature setting will be displayed, only if over temperature is ON

The range is 0 to 100°C

Press & then key to set over temperature.

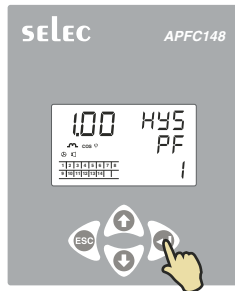
**Step 16 :**

Press key

Hysteresis voltage will be displayed.

The range is 1 to 10%

Press & then key to set range.

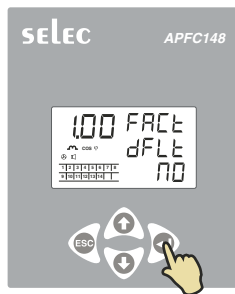
**Step 17 :**

Press key

Hysteresis PF will be displayed.

the range is 1 to 5%

Press & then key to set range.

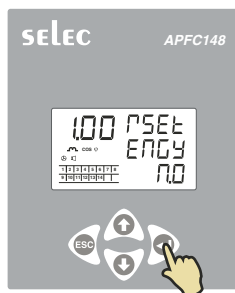
**Step 18 :**

Press key

Factory default will be displayed.

Press & then key to make it YES or NO

If value is YES then all parameters will be reseted to factory values.

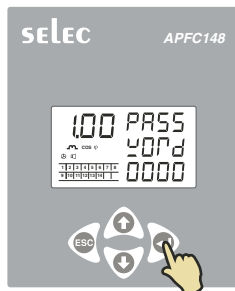
**Step 19 :**

Press key

Reset energy will be displayed.

Press & then key to make it YES or NO

If value is Yes, password will be prompted.

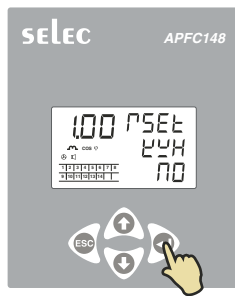
**Step 20 :**

Press key

Password will be displayed.

To reset the energy, Password is 2001.

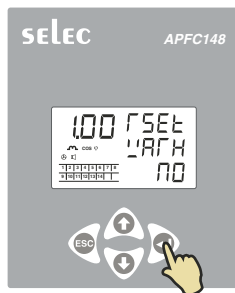
Press & then key to enter password.

**Step 21 :**

Press key

Reset kWh will be displayed.

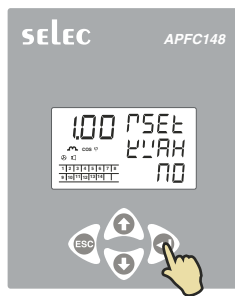
Press & then key to make it YES or NO
if value is Yes, kWh value will reset to 0.

**Step 22 :**

Press key

Reset kVArh will be displayed.

Press & then key to switch it YES or NO
if value is yes, kVArh value will reset to 0.

**Step 23 :**

Press key

Reset kVAh will be displayed.

Press & then key to switch it YES or NO
if value is yes, kVAh value will reset to 0.

FAQ's

A Basic terms:

1. What is Power factor ?

Ans. Power factor is the ratio between the kW (Kilo-Watts) and the kVA (Kilo-Volt Amperes) drawn by an electrical load where the kW is the actual load power and the kVA is the apparent load power. It is a measure of how effectively the current is being converted into useful work output and more particularly is a good indicator of the effect of the load current on the efficiency of the supply system.

A load with a power factor of 1.0 results in the most efficient loading of the supply.

2. What are the causes of low power factor ($\cos \phi$) ?

Ans. Low $\cos \phi$ results in

- Higher energy consumption and Costs
- Less power distributed via the Network
- Power loss in the network
- Higher transformer losses
- Increased voltage drop in power distribution networks.

3. Why automatic power factor controllers are used ?

Ans. APFC is designed to optimize the control of reactive power compensation. Reactive power compensation is achieved by measuring continuously the reactive power of the system and then compensated by the switching of capacitor banks.

B Control Parameters:

1. What is Targeted Power Factor ?

Ans. The user will be able to set the target power factor value from 1.00 capacitive to 1.00 inductive. The regulator will switch the capacitor banks on and off, attempting to achieve this set value.

2. What is Discharge Time (Reconnection Time) ?

Ans. This is the safety lockout time which is used to prohibit the reconnection of the same capacitor step before it is fully discharged. This parameter is usually set larger than the discharge time of the largest capacitor size in used.

3. What is CT Polarity ?

Ans. The automatic CT polarity correction automatically corrects the reversed connection of the current transformer in terms of measured parameters and compensation calculation.

4. What is Switching program ?

Ans. This setting allows the user to configure the regulator to operate in one of the following switching algorithms:

- **Manual Switching (MANL)**

1) when this switching program is registered, the capacitor steps are controlled manually by the user

2) **DI:** When user selects manual switching through, Auto/manual switch on the panel. then all the relays that are 'ON' through APFC are turned 'OFF' by user for respective banks. In this case APFC has no more control & it switches OFF all banks that it was earlier controlling

- **Automatic**

The regulator selects the most appropriate step to switch in order to achieve the target power factor in the shortest reaction time within the minimum number of steps. For equal aging of capacitor and contactor the program will select the least used step to switch in or the most used step to switch out, if there are 2 or more equally rated steps.

- **Linear**

In this mode, the regulator switches the regulator in a first-in-last-out (FILO) switching sequence to achieve the target power factor.

- **Rotational**

In this mode, the regulator switches the regulator in a first-in-first-out (FIFO) basis to achieve the target power factor.

5. Reset To Factory Default Setting

Ans. To reset all programmable parameters to factory default, go to level 2 in programming menu, set default value (DFT) to yes, APFC is restored to factory default setting.

6. What is Auto Initialization ?

Ans. Selec APFC has feature of detecting value of capacitor bank connected to it. The process of detecting the value of capacitor bank is known as auto initialization. This happens if the auto initialization setting is kept "ON" in the product. To get the proper value of capacitor bank the load connected to APFC should be stable.

7. When does Auto Initialization happen ?

Ans. Auto Initialization happens each time the APFC is powered ON (A.IN setting should be ON) and each time the voltage fluctuates above or below threshold (Voltage threshold setting should be greater than 0%)

8. Why is Auto Initialization required ?

Ans. The value of capacitor changes with fluctuation in voltage & frequency. The change of value is generally mentioned on capacitor, thus to have exact value of capacitor auto initialization is required.

9. What will happen if Auto Initialization does not happen under fluctuating voltage condition?

Ans. The value of capacitor changes with fluctuation in voltage & frequency. The change of value is generally mentioned on capacitor, In case voltage fluctuates the value of capacitor may change leading to under or over compensation of power factor.

10. Are level 3 settings always accessible ?

Ans. No, they are only accessible if the password is set to access level 3 and manual mode of operation is selected.

11. What are the check point if display is showing negative power factor even through all capacitor Banks are OFF ?

Ans. Check points are

- 1) Check the wiring whether it is as per the drawing or not, Whether phase angle compensation setting is right are not
- 2) Is there any capacitor Bank connected separately ?

Note: 1) Always compare Power factor of APFC with Electric Board meter.

2) In case, there are 2 separate PF controllers then average of power factor will be displayed on Electric Board meter.

3) In case, electrical wiring diagram is not available then check with 900VPR-2 for phase sequence error.

12. What are the backlight indications ?

Ans. In normal condition, the backlight will be white in color.

When fault condition occurred, backlight will turned to orange color, press ESC key to display trip parameter

Backlight turns to white again when user will press ESC key in fault condition.

Trip parameters will be displayed for 3 sec.

13. How to check serial number ?

Ans. Press ESC key for 10 sec to change & digit serial number at and & 2nd line of display

When fault condition occurred, backlight will turned to orange color, press ESC key to display

14. How to change online page mode ?

Ans. Press enter key for 3 sec, to change page maode.

15. What are the diffrent fan settings ?

Ans. Fan settings are as follows

Setting	Description
None	Fan output permanently OFF.
Fixed ON	Fan output permanently ON.
Temperature ON / OFF (Setting range = 0°C - 100°C)	Fan output will turn ON when the temperature exceeds user set value

16. In which product, communication parameters are available ?

Ans. Communication parameters are available only in APFC148-312-90/550V.

Applications

- Factories, windmills, Textile Machinery
- Printing Industry
- Pharmaceutical Industry
- CNC Machine
- Hospitals
- Film Industry
- Food Processing industry
- Resorts / Hostels / farm house Engineering Plant
- Automobile Industry
- Molding Industry