AUTOMATIC POWER FACTOR CORRECTION RELAY (APFCR)

USER'S MANUAL

TRINITY
MAKING ENERGY MATTER

USER'S MANUAL

AUTOMATIC POWER FACTOR CORRECTION RELAY (APFCR)

This document contains the latest technical information about Automatic Power Factor Correction Relay (APFCR) which is a micro-controller based KVAR controller. The unit is tested against latest "MTE" Standard Model PRS400.3 having basic accuracy of 0.02%, traceable upto International Standards derived using appropriate ratio techniques.

The product, APFCR is sophisticated electronic equipment and, the user is advised to read this User's Manual carefully before attempting to install or operate the equipment.

Published on: 12.05.2017
Document Version: 1.8

Warranty Statement

Trinity warrants to the original retail purchaser of the Trinity product enclosed with this limited warranty statement that the product, if purchased new and used in the India conforms to the manufacturer's specifications and will be free from defects in workmanship and materials for a period of one year from the date of original purchase, unless expressly stated otherwise by Trinity, in a written format.

Should your Trinity product prove defective during the warranty period, please bring the product securely packaged in its original container or an equivalent, along with proof of the date of original purchase, to our Trinity Dealer or Factory. You are responsible for all costs (shipping, insurance, travel time) in getting the product to the service location. Trinity will, at its option, repair or replace on an exchange basis the defective unit, without charge for parts or labor. When warranty service involves the exchange of the product or of a part, the item replaced becomes Trinity property. The replacement unit may be new or refurbished to the Trinity standard of quality, and at Trinity's option, the replacement may be another model of like kind and quality. Trinity's liability for replacement of the covered product will not exceed the original retail selling price of the covered product. Exchange or replacement products or parts assume the remaining warranty period of the product covered by this limited warranty.

What This Warranty Does Not Cover:

This warranty does not apply to refurbished or reconditioned products. This warranty covers only normal use in India. This warranty does not cover damage to

the Trinity product caused by parts or supplies not manufactured, distributed or certified by Trinity. This warranty is not transferable. This warranty does not cover third party parts, components or peripheral devices added to the Trinity product after its shipment from Trinity. Trinity is not responsible for warranty service should the Trinity label or logo or the rating label or serial number be removed or should the product fail to be properly maintained or fail to function properly as a result of misuse, abuse, improper installation, neglect, improper shipping, damage caused by disasters such as fire, flood, and lightning, improper electrical current, interaction with non-Trinity products or service other than by an Trinity Authorized Service.

The warranty and remedy provided above are exclusive and in lieu of all other express or implied warranties including, but not limited to, the implied warranties of merchantability or fitness for a particular purpose. In the event, the remedies above fail, Trinity's entire liability shall be limited to a refund of the price paid for the Trinity product covered by this limited warranty. Except as provided in this written warranty, neither Trinity Energy Systems Pvt. Ltd. nor its affiliates shall be liable for any loss, inconvenience, or damage, including direct, special, incidental, or consequential damages, resulting from the use or inability to use the Trinity product, whether resulting from breach of warranty or any other legal theory.

Introduction

The relay is meant for flush mounting in a panel for connection to the electrical system.

The relay is the 'intelligence' which controls the automatic system for correction of the power factor. It senses the power factor by taking the ratio of the KW and the true rms KVA of the system, for any one phase of the three phase electrical system. This means that the phase and neutral are connected to the meter as voltage inputs and the current of the same phase as current input. For correct operation of the relay, however there are some minimum system requirements to be met. Unless the various points in the system which are mentioned below are correctly setup, proper operation of the relay cannot be expected.

System Consideration

1. If there is an imbalance in the three phase currents, the current transformer (CT) must be mounted on the phase which has maximum load. All the load current and the capacitor current must pass through the bus on which the main CT is mounted. Ensure that this condition is achieved for proper operation of relay.
2. The actual load current at the time of operation should be more then 5% of the CT Primary current rating. If this is not true, the relay will not operate.
3. The relay assumes a uniform loading of the three phase system. If all capacitor banks are off and the relay indicates LEAD power factor, then the Main CT S1 and S2 must be interchanged so as to correct the polarity error.
4. The relay senses the power factor and switches ON or OFF the capacitor banks (through contactors in a panel), to bring power factor closest to the set value. For this the voltage must be within plus/minus 20% of the rated voltage of the relay. The voltage is to be sensed between any phase and neutral.
5. If need is felt for an external auto/manual control, there is no harm in having one,

provided it is implemented properly. An improperly implemented scheme might cause the mal-operation of the panel. Make sure this is not the case before putting the blame on the relay.

6. Check all these points carefully in the system. If found ok, installation and commissioning of the relay is easy.

Main Features

+ 16 x 1 backlit LCD.
+ Automatic power factor control through system PF.
+ Programmable target PF setting (from 0.800 -1.000 LAG or LEAD).
+ Programmable Time Delay for step switching (Normal: 40-120 sec, Fast: 1-10 sec).
+ Stage wise LED indication.
+ Auto / Manual mode selection through external wiring scheme.
+ Test mode for checking proper wiring and relay connection in panel.
+ Normal/Fast switching control action is site programmable.
+ LCD backlight ON or OFF is site programmable.

Technical Specifications

Parameters		
Type	**Name**	**Statistics**
INPUT	Supply	One Phase and Neutral of a 3P4W system
	Voltage	Direct Voltage Input : Up to 300V L-N Burden : 0.5VA
	Current	Secondary Current Input : 5A or 1A (To be specified at the time of Ordering) CT Ratio : Site Selectable Range of Reading : 0 - 8000A Burden : < 1.0VA Overload : 5A CT = 6A RMS Continuous 1A CT = 1.2A RMS Continuous
	Power Supply	Self Powered from mains. Wide operating Voltage SMPS: 80 VAC - 480 VAC, 50-60 Hz.
OUTPUT	Relay	*Switching Voltage : Max. 230 VAC* *Switching Power : Max. 1000W* *Expected Mechanical Life : >10 x 10^6 switching operations.* *Expected Electrical Life : >4 x 10^6 switching operations. @(Load = 200VA, Cos Ø = 0.5)*

MEASUREMENT	True RMS basic parameters	Capacitor Current	CT Ratio Range of Reading Accuracy	: Site Selectable : 0 - 5000A : 1.0% of Reading
		Power Factor	Accuracy Range of Reading	: 1.0% of Reading (IPFI≥0.5) : 0.05 to 1.00 Lag/Lead
MISCELLANEOUS	Dimensions	Bazel	144 X 144 mm	
		Panel Cutout	138 X 138 mm	
		Depth of Installation	55 mm	
	Operation Temp		10°C to 50°C	
	Weight		0.560 Kg. (Approx)	
	Min. Operation Current		5% of CT Primary in FIFO/SFIFO mode	

Installation and Commissioning

In case of imbalanced load, the phase which has maximum load should have the main CT mounted on it. The phase itself must also be connected for self power supply. Ensure that the capacitor CT must also be mounted on its same phase for autosense of each capacitor banks. In case of manual mode, 230 VAC must be supplied to the terminals marked; K1 and K2 (see details in the next section).

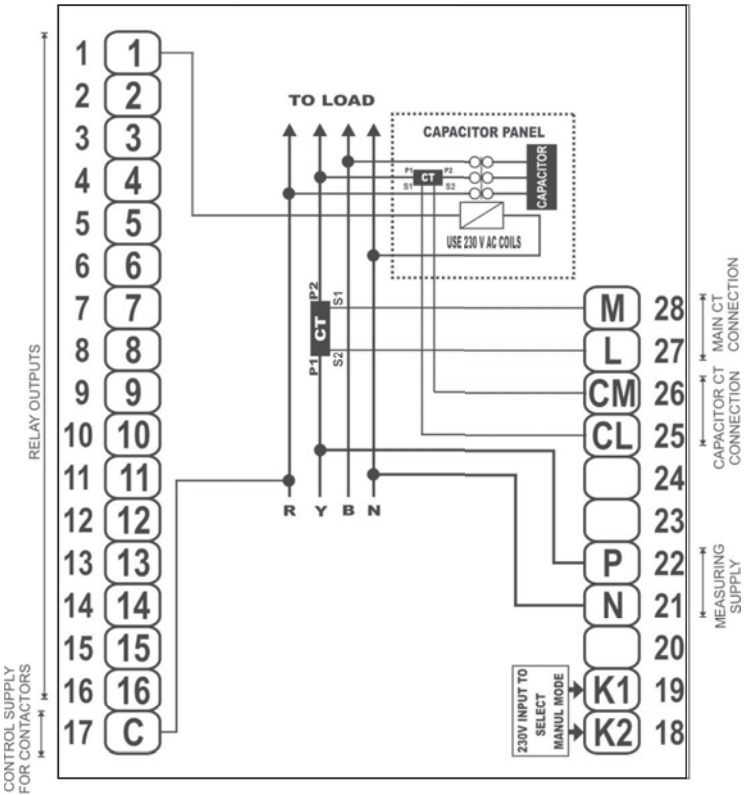
To install and commission the unit, proceed as follows:

1. Push the unit into the Panel and mount it by using the clamps provided.
2. Connect the two wires from the main CT to the terminals marked M and L such that S1 from CT goes to M and S2 from CT goes to L on the unit. Make sure that the phase coming to the unit comes through control fuse of 1.0 amp rating. This will protect the electronics inside from damage due to severe over voltages or phase faults in the system.
3. Connect the two wires from the capacitor CT to terminals marked CM and CL on the unit. (The capacitor CT is needed for operation in VAR mode only. In FIFO and Straight FIFO(SFIFO) mode, the capacitor CT is not needed).
4. Connect the phase and neutral wires to the terminals marked P and N for self power supply of the unit.

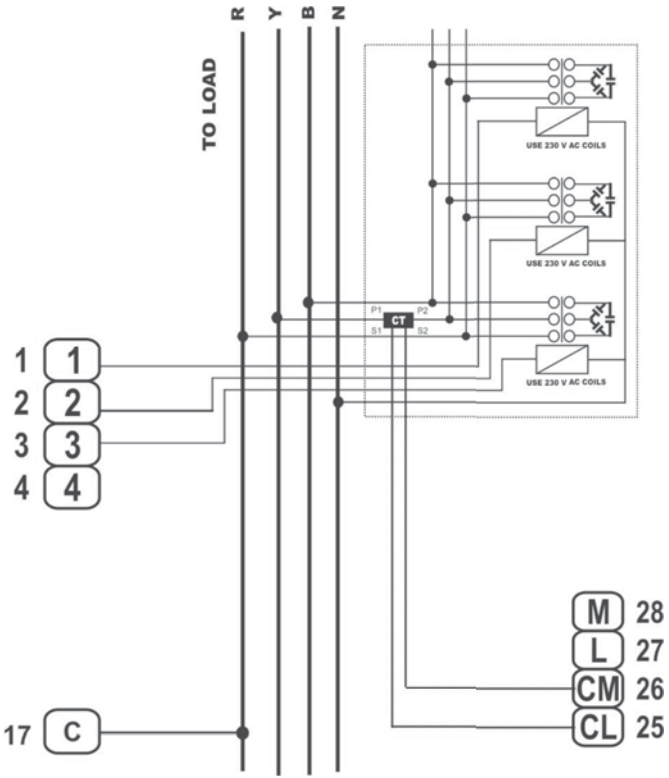
   [Ensure that the phase used for voltage connection is same as the phase on which the Main CT is mounted.]

5. Switch on the three phases supply. The Unit will display some information for few seconds.
6. First of all, user should program the parameters of the unit such as Main CT Ratio, Control Action (FIFO, SFIFO or VAR), PF, Time Delay, ON Delay, OFF Delay, Damp, Scroll Mode, Stages, Capacitor CT Ratio, AUTOSENSE, Backlight ON/OFF and switching Normal/Fast. Refer Operational Details in the next section. The proper operation of the relay can commence only after these parameters are defined.

   In case of AUTOSENSE, the unit switches one bank on at a time and also, displays the bank size of every stage. After AUTOSENSING is completed, the unit will restart and enter into run mode.
7. Now, the unit is ready for operation.



CONNECTION SCHEME



CAPACITOR PANEL

Operational Details

The KVAR based controller APFCR is a versatile unit, with all the features needed to implement a robust PF maintenance system.

There are basically two modes of operation in APFCR:

1. Programming Mode
2. Run Mode

After supplying power (80 VAC - 480 VAC), the unit displays the power on message, TRINITY ESPL on LCD screen, display some useful information for few seconds, then by default, the display comes into Run Mode as shown below.

PF=1.000	LD

The unit can now be operated by using the following keys for both the Programming Mode and Run Mode:

Programming Mode

To make the unit suitable for most field conditions and different types of loads, a lot of parameters have been made programmable. The following parameters can be programmed by the user :

1. CT Ratio for load current.
2. Mode of control action FIFO, SFIFO or VAR
3. Desired PF setting
4. Time Delay - delay between two successive switching operations of the relay
5. On Delay for lagging PF.
6. Off Delay for leading PF.
7. Damp Factor for sensitivity of the control action.
8. Scroll display in Run Mode.
9. Capacitor Bank stages.
10. CT-Ratio for capacitor current.
11. Control action sensitivity in percentage - (75% or 100%).
12. Autosense of capacitor Bank sizes.
13. LCD Backlight
14. Switching

1. Setting the Main CT-Ratio

In order to give actual current values in your system, the Main CT Ratio between the primary and secondary current should be set. The CT Ratio can be set from 5 A to 8000 A.

To set the Main CT Ratio, proceed as follows :

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS∧.
2. Press ▲ key to enter into the programming mode. The display will now prompt:

   CTR_M=500

3. Press ENTR key. Immediately, 'P' starts blinking which shows that the parameter can now be changed. Set the MAIN CTR by pressing ▲ and ▼ keys until the desired value is achieved and then, press ENTR key again to confirm the setting.
4. If other parameters need to be changed, do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

2. Setting the Mode of Control Action

For PF correction, there are three types of Control Action such as VAR, SFIFO and FIFO which are selectable at site. In case the control action is selected to VAR, Minimum Bank, Capacitor CT and AUTOSENSING become relevant as programmable parameters. However, these parameters are not applicable in case of FIFO or SFIFO mode control action.

To select the Control action, proceed as follows:

1. In the Run Mode display, press PROG/RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS ∴.
2. Press ▲ key to enter into the programming mode. Press ▲ again till the prompt shows:

   CONTROL=VAR

3. Press ENTR key. Immediately, 'P' starts blinking which shows that the parameter can now be changed. Select the CONTROL Mode to VAR or PF by pressing ▲ and ▼ keys and then, press ENTR key to confirm the setting.
4. If other parameters need to be changed, do so using similar method. Else, press PROG/RUN key for about four seconds continuously. The unit will restart and enter into run mode.

3. Setting the Desired PF

The desired PF can be set to either LEAD or LAG according to user's requirement. For FIFO or SFIFO mode of control action, the PF can be set from 0.800 LAG to 1.000 LAG. For VAR mode of control action, the PF can be set to either LEAD or LAG. In case of LAG, the PF could be set from 0.800 to 1.000. In case of LEAD, the PF could

be setting from 1.800 to 1.999. e.g., the PF to be set for 0.998 LEAD should be set as 1.998.

To set the desired PF, proceed as follows

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS
2. Press ▲ key to enter into programming mode. Press ▲ again till the prompt shows :

   SET_PF=1.999

3. Press ENTR key. Immediately, 'P' starts blinking which shows that the parameter can now be changed. Set the PF according to your desire by pressing ▲ and ▼ keys until the desired value is achieved and then, press ENTR key to confirm the setting.
4. If other parameters need to be changed, do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

4. Setting the Time Delay in between stages

The Time Delay is freely programmable. In fast switching mode Value can be set from 1 to 10. In normal switching mode value can be set from 40 to 120. For the user defined time delay, the relay will not switch on or off for any capacitor bank. i.e. Unit will not take control action for PF correction. This is one type of a digital dead band.

To set the Time Delay, proceed as follows:

1. In the Run Mode display, press PROG/RUN key for about four seconds continuously. The display will prompt PROG MODE.PRESS ∴.
2. Press ▲ key to enter into the programming mode. Press ▲ continuously till the prompt shows:

   TIME_D=60

3. Press ENTR key. Immediately, 'P' starts blinking which also indicates that the parameter can now be changed. Set the Time Delay by pressing ▲ and ▼ keys until the desired value is achieved and then, press ENTR key so as to confirm the value. The unit enters into next programmable parameter, On Delay.
4. If other parameters needs to be changed, do so using similar method. Else, press PROG/RUN key for about four seconds continuously. The unit will restart and enter into run mode.

5. Setting On Delay with Lagging PF

In case of FIFO or SFIFO control action, On Delay is freely programmable. In fast switching mode Value can be set from 1 to 10. In normal switching mode value can be set from 10 to 20. If the system PF falls below the target PF on the lagging side, the unit waits for the situation to persist for the programmed On Delay seconds. If the situation remains the same, the relay will switch ON the next capacitor bank. However, during the On Delay period if the target PF gets achieved or overshot, the On Delay is reset and the monitoring of PF value for sake of control action begins afresh.

In other words, if the PF keeps lagging below the set target PF value continuously for On Delay seconds, then only the next capacitor bank will Switch ON.

This ON delay will apply only in the FIFO or SFIFO control action mode. In case the control action has been selected as VAR only time delay parameter will apply.

To set the On Delay, proceed as follows:

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS ⋰.
2. Press ▲ key to enter into the programming mode. Press ▲ continuously till the prompt shows:

ON_DELAY=15

3. Press ENTR key. Immediately, 'P' starts blinking which indicates that the parameter can now be changed. Set the On Delay by pressing ▲ and ▼ keys until the desired value is achieved and then, press ENTR key to confirm the value. The unit will enter into the next programmable parameter, Off Delay.
4. If Other parameters needs to be changed, do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

6. Setting OFF Delay with Leading PF

Off Delay is freely programmable. In fast switching mode Value can be set from 1 to 10. In normal switching mode value can be set from 10 to 20. If the system PF falls below the target PF setting on the lead side and capacitor banks have to be switched off, the relay will ensure that the situation prevails continuously for off delay seconds, and only then takes the control action.

This parameter will not apply if the control action selected is VAR.

To set the Off Delay, proceed as follows:

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS ∴.
2. Press ▲ key to enter into programming mode. Press ▲ continuously till the prompt shows:

   OFF_DELAY=15

3. Press ENTR key. Immediately, 'P' starts blinking which indicates that the parameter can now be changed. Set the Off Delay by pressing ▲ and ▼ keys until the desired value is achieved and then, press ENTR key to confirm the value. The unit enters into the next programmable parameter, Damp.
4. If Other parameters needs to be changed do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

7. Setting Damp Factor for Sensitivity of Control Action

The damp is freely programmable. In fast switching mode Value can be set from 1 to 10. In normal switching mode value can be set from 5 to 20 so as to slow down the response of the control algorithm. Setting a higher value of DAMP will slow down the response of the relay to transient jumps into system KVAR values. This parameter is applicable in VAR mode only.

To set the Damp Factor, proceed as follows:

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS .
2. Press ▲ key to enter into programming mode. Press ▲ continuously till the prompt shows:

   DAMP=20

3. Press ENTR key. 'P' starts blinking which indicates that the parameter can now be changed. Set the Damp by pressing ▲ and ▼ keys until the desired value is achieved and then, press ENTR key so as to confirm the value and proceed into the next programmable parameter, Scroll.
4. If Other parameters needs to be changed, do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

8. Setting Scroll Display in Run Mode

The Run Mode displays will always autoscroll by default. The scroll time is freely programmable from 5 to 12 seconds to each parameter on a cyclic basis. If the SCROLL is set to 0, the display will be frozen.

To set the Scroll value, proceed as follows:

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS .
2. Press ▲ key to enter into programming mode. Press ▲ continuously till the prompt shows:

   SCROLL=10

3. Press ENTR key. Immediately, 'P' starts blinking which indicates that the parameter can now be changed. Set the Scroll value by pressing ▲ and ▼ keys until the desired value is achieved and then, press key to confirm the value. The unit will proceed into next programmable parameter, Bank Stages.
4. If Other parameters needs to be changed, do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

9. Selecting Capacitor Bank Stages

APFCR supports upto 16 capacitor bank stages. For user's system requirement, the number of active stages can be selected from 2 to 16. This is helpful in cases where the relay has been purchased for higher number of stages but presently, fewer stages have been actually connected.

To select the Stages, proceed as follows:

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS
2. Press ▲ key to enter into programming mode. Press ▲ continuously till the prompt shows:

   STAGE=8

3. Press ENTR key. Immediately, 'P' starts blinking which indicates that the parameter can now be changed. Select the stages by pressing and keys ▲ and ▼ then, press ENTR key to confirm the value.
4. If other parameters need to be changed, do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

NOTE: It is recommended to do autosensing if stages value is changed

10. Setting the Capacitor CT Ratio

For the VAR mode control action, the capacitor CT primary can be set from 5 A to 5000 A.

To set Capacitor CT Ratio, proceed as follows:

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS ∴.
2. Press ▲ key to enter into the programming mode. Press ▲ continuously till the prompt shows:

   CTR_C =500

3. Press ENTR key. Immediately, 'P' starts blinking which indicates that the parameter can now be changed. Set the capacitor CT Ratio by pressing ▲ and ▼ keys until the desired value is achieved and then, press ENTR key to confirm the setting.
4. If other parameters need to be changed, do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

11. Selecting Minimum Bank Value (VAR mode only)

If the Minimum Bank value is set to 100%, the unit will take control action when the need KVAR (system KVAR value which calls for some control action) is greater than or equal to the minimum capacitor bank connected. E.g. if the need KVAR value is 6 KVAR and the smallest capacitor bank connected is 5 KVAR, then it will be switched ON. Alternatively, if the smallest bank is 10 KVAR, no control action will happen.

Similarly, if the Minimum bank value is set at 75%, the relay will take control action even if the need KVAR value is greater than 75% of the smallest capacitor bank connected.

To set the Minimum Bank Value, proceed as follows:

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS .
2. Press ▲ key to enter into the programming mode. Press ▲ continuously till the prompt shows:

   MIN. BANK=75%

3. Press ENTR key. Immediately, 'P' starts blinking which indicates that the parameter can now be changed. Select the Minimum Bank to either 100% or 75% by pressing ▲ and ▼ keys and then, press ENTR key to confirm the value. The unit will restart and enter into Run Mode.
4. If other parameters need to be changed, do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

12. Performing Autosense of Capacitor Bank Sizes (VAR mode only)

When the Autosense is set to YES, the unit switches on all relays one by one. The bank sizes will also display as capacitor banks get sensed one by one and the user therefore must be patient and wait for about 4 to 5 minutes while the autosense is in progress. This process is vital for the smooth operation of the relay. Once all capacitor banks are sensed, the relay will restart and take control action as per fast/normal switching is selected.

To get the relay to Autosense, proceed as follows:

1. In the Run Mode display, press PROG RUN for about four seconds continuously. The display will prompt PROG MODE.PRESS ⋰.
2. Press ▲ key to enter into the programming mode. Press ▲ continuously till the prompt shows:

   AUTO_SENSE=YES

3. Press ENTR key. Immediately, 'P' starts blinking which indicates that the parameter can now be changed. Select the AUTOSENSE to YES by pressing ▲ and ▼ keys and then, press ENTR key to confirm the setting.
4. The unit starts autosensing the capacitor stages one by one. After completing the AUTOSENSING upto the number of stages specified before, the unit will restart and enter into Run Mode.

13. LCD Backlight

If Cont. backlight is set to ON, backlight will be always ON with full brightness and if it set to OFF, backlight will be dimmed after 5 minutes. On any key press event LCD will have full brightness.

14. Switching

Normal (Contactor) OR Fast (Thyristor) is Site selectable. If other parameters need to be changed, do so using similar method. Else, press PROG RUN key for about four seconds continuously. The unit will restart and enter into run mode.

Run Mode

In the run mode, the various parameters calculated by the APFCR are displayed sequentially on a 16 x 1 backlit LC Display.

Screen Displays :

Displays	Descriptions
PF=0.999	The first display shows system PF.
VOLTS=242.3	The second display shows system voltage.
AMPS=373.9	The third display shows system current.
NEEDKVAR=2.42	The fourth display shows the KVAR needed to achieve the target PF. This parameter displays in VAR mode only.
SYSKVAR=34.3	The fifth display shows the system KVAR. The system KVAR will show –ve sign, if it is leading.

Manual/Auto Mode

APFCR has in-built Auto Mode and Manual Mode of operation. The default mode of operation is Auto Mode in which all relays take control action according to the nature of load in the system. In case the relay's automatic control action needs to be overridden and the user desires to operate the capacitor stages manually, the relay can be taken in the manual mode as follows. Supply 230V AC to the terminals marked K1 and K2. A blinking 'N' on the rightmost position of the LCD will indicate that the unit is in manual mode.

On taking the relay from Auto to Manual mode, it will switch off all the capacitor banks and will not take only control action.

OPTIONS:

There is another 1 optional feature, which have to be specified at the time of ordering.

Dual Source

Dual Source:

In this option, one programmable parameter has been added which is "SET PF2". When 230V is applied on K1-K2 terminals, system will do PF Correction according to "SET PF2". This feature is useful to maintain PF even while on DG.

Control Outputs

The relays are internally protected against fast voltage transients which occur when inductive loads are switched off and therefore, the following points should be taken care when using these relay contacts:

- Use 230V AC coils only in the contactors. DO NOT use 440V AC coils.
- DO NOT switch very small loads like electronic Hooters, small relays with 230V AC coils etc., directly from the relay contact of APFCR. Instead use these relay contacts to switch an Auxiliary contactor and put the load on the contactor contacts.

For correct operation, various points in the system need attention and unless these are correctly set up, proper operation cannot be expected.

(A) Trouble Shooting

The APFCR is robust electronic equipment and must be handled with all the care merited by it. It is quite rugged and will withstand a few hard knocks, but this cannot make up for the deficiency in system design.

Repairs at site are not recommended because at most this can only be a patch work, and sustained reliability is difficult to achieve with a site repaired Relay. This section on Troubleshooting therefore deals with fault finding in the system and to establish whether the Relay is defective or whether it is a system problem. If the fault is seen to

lie entirely with the Relay, it will have to be sent to factory for repairs.

System faults can be classified into three categories:

- Those related to the basic configuration of the system.
- Those related to the errors and mistakes in the implementation of the system design.
- Those related to the faults in the actual equipment.

The most common faults are:

External Manual Control not implemented properly

Here many designers provide a 'Starter-relay' configuration for the manual control, and just bring the connection from the relay contact to the contactor.

There are two problems with this:

I. Timing function is not provided from Manual control.

ii. The scheme does not work in Auto mode. The remedy is to examine the drawings and make changes at site. The temporary remedy is to change the relay mode to Manual, and use the panel manually. The better alternative is to change the control wiring to incorporate suitable isolating contacts, timers etc. to make a proper system.

CT of the Capacitor Panel itself connected to the Relay

In this case obviously the Relay does not read the power factor of the system. There is no current through the Relay when capacitors are off. If you force one of the capacitors on, it may cause an indication of full Lead (if the current taken by the capacitor is sufficiently high). If the Relay is in Auto mode, it will switch off the capacitor immediately, and nothing further will happen.

b. Faults Related to the actual site conditions:

These faults occur when the actual site conditions are different from those assumed by the designer of the system. These faults relate to the location of the load feeders on the busbar, buscouplers, and connections from transformers etc. The locations of the CTs are the most important factor as far as the Relay is concerned.

Another problem frequently encountered is that of insufficient load on the power system. This might occur because the Plant has not been commissioned fully, or because the system allows for future expansion. In either case the actual current through the CT is very low compared to the rating of the CT.

In such conditions, the relay, (specially, if there are no small banks in the capacitor panel) will not take any control action at all. However, the transformer losses will cause the monthly average PF to show up as very poor. The remedy is to connect a small bank directly (independent of the automatic control scheme) for compensating transformer losses.

These relate to the defects in the connected equipments. Again an exhaustive list is beyond the scope of this document. A few are listed below:

Blown fuses, shorted CT, shorted voltage connections, switches that do not make contact, open connections etc. Check everything - before, during and after commissioning and you will be rewarded with a finely tuned system which will give you years of trouble-free service.

(B) Trouble Shooting Guide

1. Relay is dead. Check that the specified voltages are available at the voltage terminals of the Relay. Do not check with a neon tester. Use a multi-meter and check physically the voltages available. If the voltage is available and the Relay is dead, the Relay in all probability is defective. Please send it back for repairs.
2. Relay does not indicate expected power factor. Your wiring is wrong. Either the wrong phase is coming to the Relay or the location of the main CT is not correct. It may be on the wrong phase or mounted such that the total load current and the capacitor current is not flowing through it.
3. Relay switches the capacitors on, but the power factor does not improve

   The source of this fault could be:

a. The CT is located only on the Load bus, and capacitor current is not passing through the CT. Change the location of the CT to the true main Incomer.

b. The capacitors are all defective. This seemingly unlikely fault has occurred at many sites. Measure the current in each lead of each capacitor as it switches on, to check. This would also reveal if all the fuses of all the capacitors have blown.

4. Relay switches on all the capacitors, the power factor improves, but does not reach the set value. At the extreme is the possibility that the total installed KVAR is too low. In this case, the Relay switches on all the capacitors but the power factor does not improve to the set value. Check if the capacitors are healthy. Remedy is to add capacitors and add stages. This may need total reconfiguration of the panel wiring.

5. Relay switches on the contactors but does not switch them off, though indication on the Relay is correct. The External Manual control is not configured correctly. The contactors are latching up through their holding contacts. Extensive rewiring is required to remedy this fault. This is also possible if 440 VAC coils have been used.

6. Relay is on but PF meter indicates 1.0 always. The current through the Relay is inadequate.

P.O No. : .....

Customer : .....

Sr. No. : .....

Routine and function tests conducted to relevant standards and our Specifications/Literature/O & M Manual.

Traceability: tested against "MTE" Standard Model PRS400.3 having basic accuracy of 0.02%, traceable upto International Standards derived using appropriate ratio techniques.

Result of Test : .....

Remarks : .....

Test engineer : .....

Date : .....

TRINITY ENERGY SYSTEMS PVT. LTD.

386, Savli GIDC Estate, Savli-Vadodara Highway,
MANJUSAR - 391 775, Dist. Vadodara, Gujarat, India.
Tel.: +91-9228004452 / 53 / 54
email : info@trinityenergy.co.in

web : www.trinityenergy.co.in

CE

NIMBUS ISO 9001 ASCB(E) Accrediting Certifying Bodies

TRINITY
Making Energy Matter