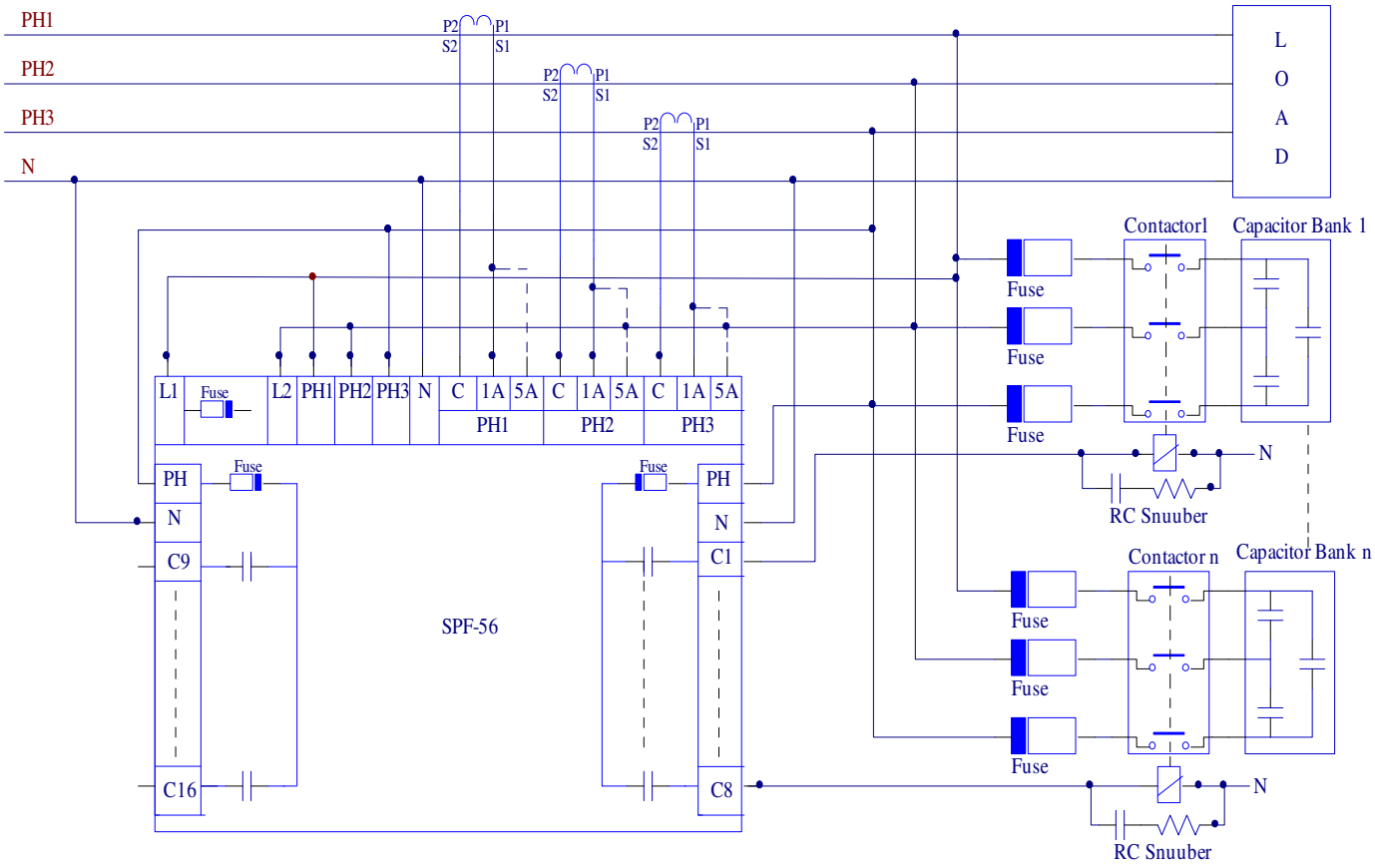
TAS PowerTek
SPF-56 / (04 / 08 / 12 / 16)
Intelligent Automatic Power Factor Controller & Data-Logger
For L.T. Distribution Power Transformers
User Operations Guidelines
(Detailed User Manual can be availed from TAS website)

Key Features:

Micro-Controller based logic for measurements, monitoring, analysis, logging & control.
Application Suitability for L.T. P.F. correction application generally on Distribution Transformers secondary side.
Internal Protection & Functionality for taking care of Supply System abnormalities and various faults. Internal Protection for system controlled components like Capacitor Banks and switching contactors.
RS-232 (Non-Isolated) Port for **Down**-loading of logged data & further viewing it on the P.C.
Fire Retardant ABS grade plastic material body with sufficient ventilation for cooling on back side.
Externally replaceable RTCC Coin Battery slot for maintenance convenience.
LCD Display 16 Char. x 2 Lines, Alpha-Numeric, Dot-Matrix, LED Back-Light & Auto Shut-Off for Back-Light.
Keypad with soft touch **7** Keys, for Scrolling between various displays and various functionalities / settings.
Wide Range of Operating Power supply & measurements for ease of Universal Applications.
Reliable Screw type terminals for fork/ring type lugs with externally replaceable fuse protection for relay outputs.
Capacitor Banks switching logic is programmed for Equal Utilization of same kVAr value Capacitor Banks.
Auto-Synchronization is for Auto Phase correction at Power-Up against any changed V/I phase sequence.
Dimensions: 144 x 144 x 107 mm, Panel Cut-out: 138 mm x 138 mm, matching to DIN Standard.

Typical wiring diagram for P.F. Controller:



1] Delta-Connected Capacitor Banks have in-built Capacitor Discharging Resistors across each individual Capacitor.
2] Suitable Rating & tight tolerance MOVs or R-C Snubber can be utilized across EACH Power Contactor Coil.
3] For DC operated Power Contactor Coils, use Fly-back Diodes of 1000 V, 3 Amp rating, with proper A-K Polarity.
4] The DC Coil Voltage should not be more than 24 V.

Keyboards Keys: Left, Right Cursor Control and Up, Down Keys, Mode Key, Memory / Save Key, Enter Key.

LCD Display Contrast adjusts: Repetitive strikes of "Right" key to increase Contrast. Repetitive strikes of "Left" key to reduce contrast. Press "Save / Memory" Key to save in non-volatile memory new settings, after adjustment.

First line of display indicates P.F. value, inductive / capacitive PF, mode of operation, and fault /OK status:
"PF = 1.000" indicates overall P.F. of the system. "+" or "-" indicates if PF is inductive or capacitive respectively.
"A" or "M" indicates the Auto and Manual mode of operation respectively.
"Up-Arrow" or "Down-Arrow" indicates the "Mains" or "Generator" Mode of operation respectively.
"OK" (blinking) indicates status of the system, healthy or not blinking means faulty.

'I AM OK' Blinking LED indicates APFC is OK. If this LED is continuously ON or OFF, Controller is not functioning properly.

Last two characters represent one of the following statuses:
OK = Controller Status is OK, AS = Auto-Synchronization Pending
ZV = Zero Voltage at measurement terminals, ZC = Zero-Current in any one phase for Supply Current
OV = Over-Voltage at measurement terminals, UV = Under-Voltage at measurements terminals
VH = Voltage Over-Harmonics THD%, IH = Current Over-Harmonics THD%
BF = Battery-Failed of RTCC, Battery-Low!!! For RTCC Coin Battery Low Voltage, – Warning
UF = Under-Frequency of AC Mains Supply, OF = Over-Frequency of AC Mains Supply
UL = Under-Load (kW), OC = Load Side Over-Current – Warning
OB = Out of Banks (Insufficient Total Capacitive kVAr) – Warning
OT = Over-Temperature internal to APFC Unit C1 = Control-Fault-1, Control Phase to Relays 1 to 8 is missing,
C2 = Control-Fault-2, Control Phase to Relays 9 to 16 is missing
C3 = Control-Fault-3, Control Phase to Relays 1 to 16 is missing

Total No. of Banks connected is indicated by "_ "on second line, which also indicates status of each capacitor bank by symbols, such as: Fixed-ON, ON, OFF, Faulty, or Discharging,
A dash (-) symbol = Bank is connected, but is in OFF state. A Capacitor symbol = Bank is connected & it is in ON state.
A BOLD Capacitor symbol = Bank is declared as fixed bank & is ON. A X symbol = Bank is declared faulty and is OFF.
A D symbol = Capacitor Bank has just turned off and it is in discharging state.

Power-on discharge time is given for Capacitors Banks to discharge completely. If User is sure that Capacitors Banks are discharged, press Left Arrow Cursor Key for Controller to come out of "Power-ON discharging time".

Display of various parameters: Values of various parameters can be viewed by scrolling from default PF display screen using UP / DN keys & then pressing ENT key on the respective sub-menu. To exit a sub-menu, press PROGRAM key.

Mode Selection: Three modes of operation as, Manual, Auto, and Edit Parameters (APFC System parameters Data settings). Press MODE key for Mode Selection. Enter password (if enabled) by using Right / Left / Up / Down / Enter keys. Using Up or Down Keys, select the Mode of operation and then Press ENTER to enter the specific mode.
AUTO OPERATION: For functioning in Automatic P. F. correction mode.
MANUAL OPERATION: Primarily for Capacitor Banks Testing under User Observations.
EDIT PARAMETERS: To Edit APFC Settings to match requirements of APFC system.

Manual Mode Operation: Pressing ENTER button, while Manual mode displayed on the LCD screen, will put SPF-56 in Manual mode. If user has switched to Manual Mode, and for 5 Minutes no key on the keypad is pressed, then SPF-56 will automatically switch to "Auto" Mode of Operation. In Manual mode, the user can manually turn ON/OFF Capacitor Banks, but it is not allowable for all the faults. In case of faults: 1] Under-Voltage (UV) 2] Over-Voltage (OV) 3] Under-Frequency (UF) 4] Over-Frequency (OF) 5] Control Fault (CF), turning ON Capacitor Banks in Manual Mode is NOT allowed.

Entering into manual mode shall first turns-off all the Capacitor Banks. It is normally used to perform the operations like: 1] Re-setting of faulty Capacitor Banks to healthy status. 2] Checking the Capacitor Banks by turning them ON / OFF. 3] Declaring specific Capacitor Bank(s) faulty for masking of the Capacitor Banks so that once auto mode is selected, these faulty declared banks would not be used for PF correction.

Declaring Banks faulty: While in Manual Mode default screen, press ENTER key. The cursor above Bank 1 will start blinking. Use Left or Right Arrow key to select the specific bank. Then use Down key to declare it faulty. Press "Enter" Key for the Cursor to stop blinking. Then, press "Save / Memory" Key to save the faulty Capacitor Bank status.

Resetting the faulty bank(s): In Manual Mode, bring the blinking cursor to that particular faulty Capacitor Bank to be reset and use Down key to declare that bank as healthy. Press "Enter" Key for the Cursor to stop blinking. Then, press "Save / Memory" Key to save the faulty Capacitor Bank status.

After any of these operations press ENTER key so that cursor stops blinking. Then, press "Save/Memory" Key to save the setting. After saving settings, Unit will jump back to default mode. By default, the controller is set to operate in AUTO mode.

Testing Capacitor Banks with Manual ON / OFF commands: In manual mode default screen, pressing ENTER key, the cursor will start blinking. Use Left / Right Arrow key to select the specific Capacitor Bank that are healthy and use Up Key to turn ON and use Down Key to turn OFF that particular Capacitor Bank. To exit Manual ON / OFF edit mode, press ENTER key so that cursor stops blinking.

Edit Parameters: Select 'Edit Parameter Mode' on the display & press 'Enter' to select edit parameter mode. Use Up / Down Keys and select the particular menu for which Parameter are to be edited.

The types of parameters that can be edited are: **General and I/O**, for general settings; **System**, for APFC System related settings; **Fault,** for Fault settings; **Step** for Capacitor Bank step settings; **Communication**, for Communication parameters, and **Utilization counter**, for Capacitor Bank operations utilization counters.

After selecting the type, press ENTER to enter the sub-menu of that specific type. Editing of sub-menu settings is done by using the ENTER, Up, Down, Left, and Right Keys. To exit sub-menu, press MODE key once.
To store the edited parameters permanently, press SAVE / MEMORY when, either in the Edit Parameters or any sub-menu area. To exit Edit Parameters Mode without saving the changes, press MODE key again.

GENERAL Input / Output:
Password: Enable or disable password
Change Password: Set new value of password (4-Digit). Factory default password is "0000"
Load Default: Loads factory set default parameters. Yes and No.
THD to Display: Type of THD to be displayed for V and I: R-THD (RMS) and F-THD (fundamental).
Reset Energy Counter: Reset all energy counters to zero.
AUX OP1 FUNCTION: Program Aux. O/P to become N.C. due to any of: None, Trip Fault, Sys Flt, Out Of Bank.
AUX IP1 FUNCTION: Set action through Aux. I/P: None, O/P En Di (o/p enable disable), Mains / Generator, Reset Bank Fault.

SYSTEM:
Rated Supply voltage: Sets rated Supply Voltage of APFC System.
Ext-PT Ratio: In case the external Potential Transformer (P.T.) is used, this ratio can be set.
Current CT Primary: Rated Feedback Supply (Load) Current for Mains / Generator.
D.T. Ratio: Set the Distribution Transformer Primary Voltage to Secondary Voltage Step-down ratio. Default is 1:1.
Power Factor Limits: P.F. limits can be set as inductive or capacitive. Also Target PF band can be set as Upper P.F. and Lower P.F. limit. These limits can be set for Mains or for Generator. Use more relaxed P.F. settings for the D-G Set Operation.
Phase Auto-Synchronization: Auto-Synchronization feature is enabled or disabled. Note that to do Auto-Sync., the Controller has to do extra work of Capacitor Banks Switching & Testing at the Power-On, before Auto Phase Correction success.

FAULTS: For Over-Voltage and Under-Voltage fault, the option available is Fast–OFF Step.
For all the faults, normally two limits are defined. One is Detection Limit and another Resume Limit. Detection Limit if exceeded (above/below) by the parameter would mean the action as defined by parameter in type of fault (as given here-above). Resume Limit defines the parameter value above/below which the fault is de-activated.
Other Options available at appropriate stages are: Enable / Disable / Indicative / Not-Programmable / Fixed Enabled / t Off Step (Only Normal Banks Off).

Over-Voltage: Over-Voltage conditions persisting in any one phase for 3 Seconds.
Under-Voltage: Under-Voltage conditions in any one phase persisting for 3 Seconds.

Under-Load fault: The values here are set as % of maximum rated kW. This is useful in case of banks are put in circuit to take care of no-load compensation.
Over-Current: APFC detects if supply system is overloaded, then, it is for warning indication. Capacitor Banks are not switched-off with this detection because, switching off Capacitor Banks in this situation would increase Supply Current.

Over-Temperature fault: APFC inside Temperature exceeds the set limits. There are two parameters related to this fault, i.e. the temperature upper limit and lower limit. If fault is set, then "Fast Off step" action is undertaken.

Out of Banks Fault: This is only with Disable and Enable options. If enabled, then APFC Unit will indicate the out of bank fault if for two consecutive correction cycles, P.F. is more inductive than Lower P.F. set point and all the healthy capacitor banks are in ON state. In short, the total capacitive kVAr is less that the required, to maintain P.F. within the limits set.

Harmonic Overload: This fault has two options, namely Disable and Fast Off. This is basically to indicate harmonic faults.

V-THD Threshold limit (%): If percentage of voltage THD is above the set limit, then voltage harmonics fault (VH) will be displayed on the default screen. Average THD in any one phase over 3 Minutes period if exceeded, and then this fault is activated. The V-THD limit can be set through V-THD threshold limit screen.
I-THD Threshold limit (%): If percentage of current THD is above the set limit, then current harmonics fault (IH) will be displayed on the default screen. Average THD in any one phase over 3 Minutes period if exceeded, and then this fault is activated. The I-THD limit can be set through I-THD threshold limit screen.

Harmonic Fault Auto-Reset: This fault has two options, namely Enable and Disable. If it is enabled and Harmonics exceeds from the set limits then Controller switch OFF all the Capacitor Bank steps until harmonics come down within set limits. After harmonics comes below the set limits controller clears the fault automatically after a period of 180 Seconds & is ready to switch ON the capacitor bank steps, and if disabled, controller shows the Harmonic fault until User resets the fault manually.
Harmonic Limit Ext Loading: Set the actual load limit in percentage of rated load for which Harmonic fault limit shall be extended by multiplying factor.

Low Range Multiplying Factor for VTHD: By setting this factor, one can extend the V-THD fault limit.
Low Range Multiplying Factor for ITHD: By setting this factor, one can extend the I-THD fault limit.

Control Fault: This fault has two options, namely Disable and Enable. The control fault is used to detect low AC voltage supply to Power Contactor coil, low voltage, or control supply fuse failure fault. It has instantaneous activation for preventing chattering of Power Contactors.

Bank Health Tolerance: In Capacitor Bank health check monitoring, this indicates tolerance between the user set Bank kVAr values and the actual kVAr, as calculated by the Controller. Detoriated kVAr Capacitor Bank is kept off by internally declaring it as a Faulty Bank automatically. This also avoids the chances of series resonance with the series connected current-limiting inductive reactor due to changed value of Capacitor Bank.

Capacitor Banks Steps:
Steps Connected: Defines the number of operational steps, depending on the Capacitor Bank steps of the APFC System. Maximum of up to 16 Capacitor Banks can be connected, depending on the ordered version of the APFC Unit.
Define kVAr Voltage: Capacitor Bank voltage line-to-line value, for the rated kVAr is defined.
Smallest kVAr Safety Factor: It is a multiplier for the smallest Capacitor Bank kVAr. The default value is 1.5. The range is 1.1 to 1.9 (Refer to the Detailed version of the User Manual for better understanding of this feature).
It defines the "No- Action" zone, prohibiting Capacitor Bank On/Off operation to avoid hunting.
P. F. Correction Time: Time in seconds, between two consecutive kVAr compensations i.e., time between change in load kVAr demand & subsequent switching of Capacitor Bank steps. It can be set within the range of 1 to 240 Seconds (4 Minutes).
Capacitor Banks Discharge Time: Set within the range of 1 to 300 Seconds (5 Minutes). It should match or be a higher setting than the actual Capacitor Bank Discharge Time as mentioned for the capacitor under application.
Inter-Leaving Delay: It is switching delay between switching ON of two consecutive capacitor bank steps. It is set as 1Second.
Fixed Bank Setting: Any Capacitor Bank (number of banks depends upon the steps connected) can be set as a fixed Capacitor Bank.
Unequal Bank kVAr [1….16]: The capacitor bank step configuration values are to be set here. These parameters are to be defined for each Capacitor Bank kVAr (at defined Capacitor Bank Voltage). SPF-56 has an in-built intelligent algorithm to select the best possible combination to suit the exact kVAr requirement for compensation.

COMMUNICATIONS:

Panel ID: Value: Defines the 8-Digit Panel ID, used for serial communication on RS-232 Dedicated protocol, and for further analysis of down-loaded data. The panel ID can be changed and a new UNIQUE Panel ID can be saved only if all the logged data is erased from the EPROM. This is to prevent incorrect / false data.
Erase Data for New ID: Yes Or No. It erases all the logged data in the EEPROM. The panel ID can be changed and a new UNIQUE Panel ID can be saved only if all the logged data is erased from the EEPROM.
Baud Rate: Front-Panel Non-Isolated RS-232 Port, Standard Baud Rates selectable are: 4,800 bps, 9,600 bps, 19,200 bps, 57,600 bps. The Baud rate MUST match on both sides, APFC & PC / HHU for communication.
Real Time Clock-Calendar: Defines the Real Time Clock / Calendar setting.
Time: Defines Hours (24 Hours Clock), Minutes and Seconds (HH:MM:SS) format.
Date: Defines the date, month & year setting. (DD:MM:YY) format.
The above mentioned date time setting is applicable only after saying "Yes" to initialize RTCC, by pressing Up key.
Initialize RTCC: Yes Or No. Defining "Yes" initializes RTCC (real time clock-calendar) to the specified set values.
Clear Battery fault: Yes Or No. Defining "Yes" clears Battery fault and / or NV RAM fault in **SPF-56.**
Select LOG Interval Time: 60 MIN, 30 MIN, 15 MIN, or 10 MIN. It defines data-logging interval of 60 or 30 or 15 or 10 Minute. Factory Default value is 60 Minutes for an Hourly Logging of the Data.
EraseData4LOGTime: Yes Or No. Defining "Yes" erase all previously logged data from the EEPROM.
Select LOG Time mentioned above can be changed and new Select LOG Time can be saved only if all the previously logged data is erased from the EEPROM. This is to maintain time synchronization of data.

Over-write INTER LOG: User can enable this option to allow the interval logged data to be overwritten after log data memory is full. If the option is disable data logging will get stop after memory is full.
Over-write EVENT LOG: User can enable this option to allow the Event logged data to be overwritten after log data memory is full. If the option is disable data logging will get stop after memory is full.
Non-Isolated COM-2 Functions: None, MOD-Bus ASCII, MOD-Bus RTU, GSM. Option MOD-Bus ASCII & MOD-Bus RTU is for Non-Isolated RS-485 communication, and Option GSM is for Non-Isolated RS-232 communication for an external GSM / GPRS MODEM. Isolated Voltage Feedback Modules, matching with the feedback voltage level, are available from TAS; else, the User will have to use a Galvanically Isolated RS-485 Port for the MOD-Bus "Master".
Baud Rate: Standard Baud Rates selectable are: 4,800 bps, 9,600 bps, 19,200 bps, 57,600 bps. The Baud rate MUST match on both sides, that is, APFC Side and the MOD-Bus or the GSM / GPRS, for successful communication.
GSM Service Provider: GSM service provider number is to be given. It is a 10-Digit number. The ISD Country Code of India, as "91" is internally pre-fixed in the Controller. For outside India, it has to be as per the specific ISD Code at that location.
SMS Receiver Number: Defines the number to where SMS communication is to be sent. Normally, it's a Master Control Unit Receiver Number. This is a 10-Digit Number. Country-Code of India as "91" is presently internally set.
Utilization Counter, (NOT editable in the field): Utilization counters: Bank nn: This gives the number of ON operations of the "nn"th bank. All Counters are initially set to "0000000000" at the time of factory testing.

Auto-Synchronization: The SPF-56 is an intelligent, Micro-Controller based Automatic Power Factor Controller, for switching on or off external capacitor banks, to maintain the Power Factor (P.F.) as close as possible, to the target P.F. set.

In normal industrial loads, in the absence of any PF improvement, the load P.F. is normally inductive (lagging), the inductive reactive power is compensated by using capacitive reactive power of the right magnitude to bring the P.F. close to Unity.

This scheme is possible only if the three-phase voltages and the respective load current feedback CTs are correctly wired to the P.F. Controller. For example, the current of 'R' Phase must be connected to the 'R' Phase current input channel, with proper polarity, as per the wiring diagrams shown in this User Manual.

However, it is observed that in the field, during initial start-up itself, or later during maintenance, these proper phase-relationships, 3-phase voltages and corresponding 3-phase currents, gets disturbed due to wrong maintenance practices.

In such a situation, a P.F. Controller without Auto-Synchronization, will not be able to do its operation correctly, or rather, its operation will be totally erratic and unpredictable.

SPF-56 has an in-built intelligence, if enabled, to automatically detect the correct voltage phase-sequence as well as corresponding load current input channels, even if the proper connection order is not followed. It is even intelligent enough to detect the 'reversed' polarity of CT connections. But, one has to ensure the correct connections as far as the Phase-Voltages and Phase-Currents Terminals are concerned.

At the time of APFC Unit is powered 'ON', in case, if following Fault occurs while performing Auto-Synch or before performing Auto-Synch, the "Auto-Synch" function is not done and it is kept pending, until all fault conditions are recovered.

1] Under Voltage (UV) 2] Over Voltage (OV) 3] Under Frequency (UF) 4] Over Frequency (OF) 5] Zero Voltage (ZV)
6] V-THD Fault 7] I-THD Fault 8] Control Fault (C1, C2, C3) 9] CT Open or very Low Load Current (ZC)

Under these conditions, APFC LCD will display as "AS" i.e. Auto-Synch pending and the user will be able to access the key-pad. If Auto-Synch kept pending for a long time, then measurement and data-logging are performed based on previously stored successful phase sequences.

For example, if UV Fault occurs during Auto-Synch Process then, the Controller LCD will display the same on screen.

If none of the above faults are present, APFC will proceed for Auto-Synch. First attempt of Auto-Synch is made without switching on any capacitor banks. In this method, if previously stored sequence is matching with present sequence then, "Auto-Synch" is made successful. Otherwise, Auto-Synch is performed by switching ON & OFF the capacitor banks.

For performing Auto-Synch without switching on / off any capacitor banks, there should be load current present which is greater than 10% of rated current otherwise, it will perform Auto-Synch by switching off all capacitor banks.

SPF-56 Controller fault indications and fault actions:

Sr. No.	Status Indications on LCD Display	Status / Fault Description	Programmable Options provided on Fault	Fault description	Action taken by APFC controller	Status appearing in Data Logging
			Enable / Disable / Indicative / Fast OFF		If Enabled	Yes / No
1	OK	Controller status is OK				Yes
2	ZV	Zero Voltage	Not programmable	If voltage absent in any one of the three phases	Fast OFF	Yes
3	OV	Over Voltage	Not programmable (Fixed enable)	If voltage exceeds than defined limit in any one of the 3 P-N values	Fast OFF	Yes
4	UV	Under Voltage	Not programmable (Fixed enable)	If voltage reduces than defined limit in any one of the 3 P-N values	Fast OFF	Yes
5	VH	Voltage over-harmonics THD%	Enable / Disable	If V-THD exceeds than defined limit , in any one of the 3 P-N values	Fast OFF	Yes
6	IH	Current over-harmonics THD%	Enable / Disable	If I-THD exceeds than defined limit, in any one of the 3 P-N values	Fast OFF	Yes
7	BF	Battery for RTCC faulty	Not programmable	Battery checked as un-usable	Stops data logging	Yes
8	ZC	Zero Current	Not programmable	Load Current less than 1.5% in any one of the three phases	Fast OFF	Yes
9	OB	Out of Banks	Enable / Disable	Insufficient bank kVAr	Indicative	Yes
10	OT	Over Temperature	Fast off / Disable	Indicates temperature inside the micro-controller	Fast OFF	Yes
11	UF	Under Frequency	Not programmable	If drops below 47 Hz (limit)	Fast OFF	Yes
12	OF	Over Frequency	Not programmable	If exceeds 53 Hz (limit)	Fast OFF	Yes
13	UL	Under Load (kW)	Enable / Disable	If kW reduces than defined limit, in any one of the 3 P-N values	Fault OFF (only normal banks off)	Yes
14	OC	Over Current	Enable / Disable	Load Current exceeds than defined limit, in any one of the 3 P-N values	Indicative	Yes
15	Battery Low!!!	Low Coin Battery Voltage	Not programmable	Battery Voltage drops below 2.6 V	Indicative	Yes
16	AS	Auto-Synch Pending	Not programmable	Auto-Synch process kept pending, if any of the faults mentioned on the relevant page occurs	Indicative	Yes
17	C1	Control Phase Failure	Enable / Disable	Control Phase to banks 1 to 8 is missing	Indicative	Yes
18	C2	Control Phase Failure	Enable / Disable	Control Phase to banks 9 to 16 is missing	Indicative	Yes
19	C3	Control Phase Failure	Enable / Disable	Both C1 and C2 is present	Indicative	Yes
20	NF	Neutral Fault	Not programmable	Shifting of neutral voltage away from balanced condition	Fast OFF	Yes

Commissioning Instructions:

Before panel is powered-up, for the first time:

1. **Panel Wiring Check:** Ensure that all connections in the panel are tightened properly and there are no loose connections. Also ensure that the wiring is done as per the wiring diagram. Keep wires of high-voltages and low-voltages, such as CT feedbacks, separate from each others, to avoid cross-coupling or induced signals. The Controller Unit should be firmly mounted in the panel using the 4 mounting clips/clamps at the back.

2. **Power Wiring Check:** Ensure that the power cables are connected properly from the Panel I/C to the feeder O/G or the transformer bushings. The connection has to be after the Load Current Feedback CTs, looking from the Transformer side.

Ensure that the Bus-Bars and/or Lugs are clean and free of Dust, Corrosion or Oxidation on the contact sides so that good electrical connection is maintained. The surface area should be flat so as to get maximum contact area.

If required, clean the Bus-Bars and/ or Lugs by rubbing it with Polish Paper to remove the oxidation layer. Provide contact paste in between the contacts surfaces. Not performing this can result in to a weaker source point for Capacitor charging during Step on and this can generate undesirable Noise which can hamper the performance of equipments installed in the capacitor panel.

3. **Supply (Load) Current Feedback CTs connections:** Ensure that the load current feedback CTs connections are done properly. Confirm that correct phase CT is connected with the correct phase input terminals. In case, the CT Connections were improper in terms of Phase Relationship or the CT Polarity, and if "Auto-Sync" option is kept "Enabled", then, the "Auto-Sync" function, when successfully executed, is capable of taking care of wrong CT polarities or CT position interchanging.
So, after "Auto-Sync" Success, the LCD Display, the Phase Current readings will be seen correctly on the respective Per Phase basis.
If Auto-Sync was for some reasons, like a Fault Condition such as "Over-Voltage or "Under-Voltage" was detected, then, the Controller internally sets a Status of "Auto-Sync" Pending. It will retry "Auto-Sync" after the Fault Conditions have disappeared.

CT connections MUST be done carefully, so as to ensure that the wire does not get opened and there are no loose contacts or loose connections.

Loose connection or open CT secondary will result in very high voltages getting developed at the CT Connection Terminals which can damage the CT and also can damage the APFC Unit as well.

After APFC Panel is powered-up:

1. Remove the fuses/switch-off MCBs / MCCBs which are in series with every Capacitor Bank. Connect supply to the APFC Unit. Keep the Supply (load) current feedback CTs in shorted condition.

2. Turn ON the supply to the panel and set Date / Time & various other parameters as per the panel configuration. It is important to understand the meaning of every parameter from the instructions given before and then put the appropriate values in them. Wrong values entered can give the wrong performance of the panel. Keep Auto-Synchronization in Disabled state.

3. Once the parameterization is complete, put the APFC Unit in Manual mode to check every bank command is transmitted to the Contactor. This can be observed by turning ON the contactor coil supply MCB on. The corresponding output should be checked for physical turn ON / OFF of the contactor.

4. Once all the contactors are seen to be getting the correct commands, switch off the supply to the panel and replace all the fuses (or turn on MCBs / MCCBs if they are provided instead of fuses). Turn ON the panel.

5. Put APFC back in Manual mode and turn ON / OFF the individual steps. Use Tong tester (ac current measurement) to check that current in all three phase of the corresponding bank are OK. In case any bank is not showing the desired current, check for capacitor bank healthiness or power circuits.

6. Keep all the Capacitor Banks in off mode. Remove the shorting of Supply (Load) Current feedback CTs. In case kW value is seen as –Ve for any phase, CT is with wrong polarity. Either select "Auto-synchronization" in Enable mode or change respective CT polarity such that the respective Phase kW value is shown +Ve.

7. Switch OFF all the Capacitor Banks manually and put the APFC in Automatic mode. Switch Off the supply to panel and put it ON again. If auto-synchronization is enabled, APFC Unit will first turn ON all the Capacitor Banks, one-by-one, and turn them off. This is one of the routine steps for auto-synchronization during power-up.

In case of message of "Auto-Synchronization Failure", APFC Unit will go in "No compensation". In case of such failures (normally seen with very high fluctuating loads only), manual synchronization is mandatory by physically checking the CT connections and polarity.

Observe the APFC Panel performance carefully, for at least about 2 Hours after commissioning. Note-down the successful settings in the Manual.

Protection and Functionalities:

(A) If **Supply (Load) Current CT** connections are not connected to the **SPF-56** Unit i.e., if no current is detected or the detected current is below 1.5% of rated load current, then, SPF-56 would show the on the LCD Display as "ZC" for Zero-Load-Current, which actually mean Supply (Load) Current is too low to do any P.F. Correction work.

(B) If **Harmonics Overload** fault is enabled, and if the voltage or current THD% exceeds the set limit, then **SPF-56** would show the respective VH or IH display on the LCD Display. Pressing the Enter key would reset the VH / IH fault, even if Voltage / Current THD is above the set limit. The fault indication would continue till the respective THD% is above the set limit.

In case of THD% above set limit, all capacitor banks are switched off to protect these Capacitor Banks. A parameter called Harmonic Fault Auto-Reset, if enabled, then, the controller automatically clears off the harmonic fault after 180 Seconds when the harmonic level (THD %) falls down, below the Set limits.

(C) **Control Fault:** Control Fault can appear instantaneously in cases of A] Failure of the Common fuse giving voltage supply to Power Contactor coils, B] AC Supply Voltage to Power Contactor coil has dropped below 150 Volts AC.
This can cause "Chattering" of the Power Contactors, C] Supply to the Control Phase powering the Power Contactor coil is absent. Pressing the "Enter" key, would reset the control fault.

If the fault is sensed again, the fault will re-appear. In case of Control Fault exists, turning ON the Capacitor Bank is not allowed. Control Fault may appear in three types: C1, C2 and C3.
There are two separate circuits for this fault as there are two separate fuses for AC Supply Common Points, for Banks 1 to 8 and Banks 9 to 16.
C1 appears when Control Phase to Banks 1 to 8 is missing.
C2 appears when Control Phase to Banks 9 to 16 is missing.
C3 appears when C1 and C2 both are present, means Banks 1 to 16, Control Phase(s) is (are) missing.

(D) **Battery Low:** If the internal Lithium coin Battery Voltage of nominal 3 V drops below 2.6 V then the controller will flash "Battery Low!!!" message on the Default screen display (in a blinking state with certain delay) until the battery is replaced by a new healthy battery. Please note that even when the "Battery Low!!!" message is being flashed on the LCD display the user can still operate the keypad.

It is essential to have the battery operational to maintain the "Real Time Clock and Calendar" information. If the Coin Battery Voltage falls below certain limit, the R.T.C.C. will stop functioning. All Data Logging operations are prohibited if the R.T.C.C. is stopped.

(E) **Battery Replacement:** The R.T.C.C. Battery is Maxell Make, CR2032 type. This Coin Battery can be replaced without opening the Controller through the Slot provided on the Top Left-Hand side of the Controller.

The Old Battery should be removed using insulated tip pliers and a new Coin Battery is to be placed using the same insulated tip pliers. Please observe the correct positive and negative polarity of the Battery while replacing.

The positive (+Ve) of the Battery should be towards the viewer (LCD Side) and the negative (-Ve) towards the PCB. It is always recommended to replace this Battery with Auxiliary supply to the Unit in ON condition.

This would prevent re-setting up of R.T.C.C. date, time. Still if one wishes, it can be safely done with unit in Power-down condition too without fear of losing logged-data.

Contact us for Detailed User Manual & Support: The Sales & Marketing Dept. / The Customer Support & Service Dept., **TAS PowerTek Pvt. Ltd.,** W-61, C/o. Pawar Industries, Opp. "Machine House", MIDC Industrial Area, Ambad, **Nasik – 422 010 (via Mumbai),** Maharashtra State, **India.** Phones: +0091-253-6694956 (Sales & Marketing), +0091-253-6694955 (Customer Support), E-mails: sales@taspowertek.com; marketing@taspowertek.com Web: www.taspowertek.com

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