SPF-56

LT Intelligent Automatic Power Factor Controller
& Data Logger
For Distribution Power Transformers

User Manual

Version 1.1.6

Updated on: 29th Nov. 2016.

NOTE

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired or should particular problems arise which are not covered sufficiently for the purchasers purposes, the matter should be referred to our office.

The contents of this instruction Manual shall not become part of or modify any prior or existing agreement or relationship. Any statements contained herein do not create new warranties or modify the existing warranty.

CAUTIONS: 

1. There are High Voltages associated with this Unit. So, take appropriate precautions.

2. To be installed & commissioned by a technically qualified person only.

3. This Automatic Power Factor Controller (APFC), SPF-56, is to be used indoor only.

4. Make sure that the Capacitor Bank Discharge Time set in the PF Controller matches with the actual Capacitor Bank Discharge Time.

5. This User Manual is applicable to SPF-56 APFC Unit with Firmware Version 1.0.7 as on 25th JAN. 2016.

Because of continuous improvements carried out by TAS PowerTek in their Product's Features and Specifications, the Product as well as the Content of the User Manual is likely to get updated without any prior notice.

Therefore, please always refer to the User Manual supplied to customer along with the Product, at the time of product dispatch.

Index

Ordering Information

Product Specific Information Number (PSIN): Three-CT Automatic Power Factor Controller with Data-Logging Facility; with wide voltage range Input **AC** Operating Aux. Input Supply.

SPF-56 / nn

nn: Number of Relay N.O. Contacts Outputs for Capacitor Banks Switching:

Standard Output Options are: 08, 12, or 16.

(Similar APFC Unit is available with Current-Sourcing Transistor Outputs, as TPF-56, for fast, real-time, P. F. Corrections.

The TPF-56 Firmware is compatible for the high-speed P. F. Correction Applications with TAS or similar other make high-speed Capacitor-Duty Thyristor Switches, for Power Capacitor Banks Switching).

TAS also offers higher reliability Capacitor-Duty Thyristor Switches in 25 Amps, 40 Amps and 80 Amps Capacitor Current Ratings, for Power Factor Correction using a **Hybrid Technology** of Thyristor & Relays Combination for extremely low operating power requirements.

This is TAS “THY-CON” Serial of Products, are ideal for replacing lower reliability Three-Phase Capacitor-Duty Power Contactors.

TAS SPF-56/nn can drive the “THY-CON” Command Input at 230 Vac, for low to medium speed P. F. Corrections, offering longer operational life of the APFC Panel.

Please contact TAS PowerTek, Nasik, India, for further details.)

Features:

- Totally Micro-Controller based logic for measurements, monitoring, analysis, logging & control.
- Application Suitability: LT PF correction application for Distribution Transformers secondary side used by Electricity Distribution Companies, Private Industries, Offices, Establishments etc.
- Protection and Functionality to take care of Supply System abnormalities and various faults.
- Protection against internal faults and its controlled components like Capacitor Banks and switching contactors.
- Communication port RS-232 (Non-Isolated) for logged data downloading and for other convenience functionalities.
- Completely Fire Retardant ABS grade plastic material body with sufficient ventilation for cooling on back side.
- Externally replaceable Coin Battery slot for maintenance convenience. This battery is used primarily for RTCC – "Real Time Clock-Calendar" to work during supply power down condition.
- LCD – 16 Char. x 2 Line Yellow-Green Backlight and Black Characters, Display for Display of various parameters, symbols & functionalities requirement. LCD Display with LED Backlight and with Auto Shut-Off.
- Keypads with soft touch 7 Keys for Scrolling between various displays and various functionalities / settings.
- Power supply and measurement range is wide-ranging and highly reliable operation under various supply system P.Q. issues like supply voltage dips / swells, transients, cycle loss etc.
- Reliable Screw type terminals for fork/ring type lugs with externally replaceable fuse protection for relay outputs.
- Capacitor Banks – same value Equal Utilization logic.
- Auto-Synchronization reliable logic at Power-Up against any changed phase sequence or CT phase-wise position or CT polarity change. This is for authentically measuring Power & Energy with such system abnormalities.

Features (Continued)**:**

- Capacitor Banks actual value measurement in terms of kVAr (reactive power) normalized values for rated supply voltage and frequency, for monitoring it's health. This is on-line monitoring with complex algorithm for getting right values under variable loading conditions authentically.

- Measurement and Display of Various Electrical values:
  - ✓ 3-phase Voltages (Line – Neutral Values)
  - ✓ 3-phase Currents and Neutral Current.
  - ✓ Individual Phase PF, Active Power, Reactive Power, Apparent Power values.
  - ✓ AC Mains Supply Line frequency.
  - ✓ Overall Values: Average Voltage & Current, Total Active Power, Total Reactive Power, Total Apparent Power.
  - ✓ Energy Values: Active Energy Consumed, Reactive Energy Inductive (uncompensated), Reactive Energy Capacitive (uncompensated), Apparent Energy.
  - ✓ Harmonics: Per Phase V-THD-F% and I-THD-F% values up to 15th odd harmonics.
  - ✓ Capacitor Bank Values: Normalized for rated supply voltage and frequency and monitored on line.
  - ✓ Temperature of the Unit.
  - ✓ Battery Voltage for RTCC / NV-RAM Battery.

- Data Logging: Unit has sufficient Non-Volatile memory to log hourly, 30 min,15 min,10 min readings and to log last 1024 events. The Parameters are logged for downloading on PC based program "Data View" for viewing and report generation purpose.
  The Logged values for viewing and report generation are:
  - ✓ Unit ID, Sr. No., Date / Time stamp.
  - ✓ 3-phase Voltages (Line – Neutral Values)
  - ✓ 3-phase Currents.
  - ✓ Supply frequency.
  - ✓ Overall Power Values: Total Active Power, total Reactive Power, total Apparent Power.
  - ✓ Energy Values: Active Energy Consumed, Reactive Energy Inductive (uncompensated), Reactive Energy Capacitive (uncompensated), Apparent Energy.
  - ✓ Harmonics: Maximum value of Phase V-THD-F% and I-THD-F% values.

Features (Continued)**:**

- ✓ Capacitor Bank Values: Normalized for rated supply voltage and frequency and monitored on line.
- ✓ All Capacitor Bank Status.
- ✓ Temperature of the APFC Unit.
- ✓ Battery Voltage for RTCC / NV-RAM Battery.

- Data Mobilizer – In future, we will add Hand Held Unit (HHU-01) as a separate unit, that can be procured separately for transfer of data from remote site located SPF-56 Unit that can be further uploaded to PC having "Data View" software. Such Unit even have added facilities like fixed set parameter uploading (5 pre-programmed sets of Parameters to be programmed in SPF-56).

- Manual Mode (Testing) facility available for convenience of checking the Turn-On and Turn-Off of capacitor banks. This feature is additionally useful for Manual Synchronization and for resetting the "faulty" declared capacitor banks.
- GSM (global system for mobile) :

  Enabling GSM send SMS about various parameter :
  - ✓ 3-phase Voltages (Line – Neutral Values)
  - ✓ 3-phase Currents and Neutral Current.
  - ✓ Bank status .
  - ✓ Fault.
- RS-485 communication :

  There are two basic transmission modes found in serial MOD-BUS connections, ASCII and RTU. These transmission modes determine the way in which the MOD-BUS messages are coded.

  One of the main differences between MOD-BUS/ ASCII and MOD-BUS RTU is that ASCII allows gaps between the bytes of a message with a maximum length of 1 second. With MOD-BUS RTU, continuous streams of messages must be sent. Enabling MOD-BUS ASCII or RTU gives values:
  - ✓ 3-phase Voltages (Line – Neutral Values)
  - ✓ 3-phase Currents and Neutral Current.
  - ✓ Individual Phase PF, Active Power, Reactive Power, Apparent Power values.
  - ✓ AC Mains Supply Line frequency.
  - ✓ Overall Values: Average Voltage & Current, Total Active Power, Total Reactive Power, Total Apparent Power.
  - ✓ Energy Values: Active Energy Consumed, Reactive Energy Inductive (uncompensated), Reactive Energy Capacitive (uncompensated), Apparent Energy.
  - ✓ Harmonics: Per Phase V-THD-F% and I-THD-F% values.
  - ✓ Capacitor Bank Values: Normalized for rated supply voltage and frequency and monitored on line.
  - ✓ Temperature of the Unit.

Specifications of SPF-56/xx APFC Unit:

1. Rated supply voltage values:

3 – Phase, 4 – Wire supply system.
Line to Line rated voltage 440 V_{AC} sinusoidal.
Rated Nominal frequency 50 Hz +/- 3 Hz OR 60 Hz +/-3 Hz.

2. Auxiliary Supply:

- Line to Line sinusoidal voltage range 100V_{AC} - 500V_{AC}.
- Supply frequency range 47 Hz to 53 Hz; OR 57 Hz to 63 Hz.
- Supply VA burden – 8 VA maximum. (typical 6 VA)
- Protected by externally replaceable 500mA/500V_{AC} slow-blow ceramic cartridge type standard fuse.

3. Metering (measurement) Input:

Voltage Input:

- Voltage 3-Ph, 4-Wire with Ph-N values range of measurement as 60 V_{AC} to 300 V_{AC}.
- Voltage Measurement burden < 1VA per phase.

Current Input:

- Current measurement through secondary current of 3 Nos of Current transformers with secondary rated current as either 1 Amp or 5 Amp AC.
- Current measurement range: 1.5%$I_{Nomonal}$ to 130%$I_{Nominal}$
  For 1 Amp terminals: 15 mA to 1.3 Amp.
  For 5 Amp terminals: 75 mA to 6.5 Amp.
- Maximum current withstanding capacity: 4x$I_{N0minal}$ for 1 Second.
- Maximum VA burden on CT: < 1VA.

Measurement Values and Accuracy:

- Per phase Voltage, Per phase & neutral Current, Overall Power and Overall Energy values with accuracy class 1.0 as defined in IS-14697 with all Amendments till date. This is for Active & Reactive Power / Energy.

4. Control supply (Contactor coil's supply at "COM" term):

- Typical 254 V_{AC}, 50 Hz, 1-ph. Range 165 V_{AC} to 305 V_{AC}.
- Shut-off protection < 145 V_{AC} to 165 V_{AC}. (contactor coil supply under-voltage causing contactor chattering)

Specifications (continued)**:**

5. Output relay "N.O." contacts:

- Total No. of output relay contacts for capacitor banks switching ON / OFF : 16 Numbers maximum .
- Rating of relay "N.O." contacts: Continuous Inductive + Resistive Load: 0.5Amp / 250V_{AC}.
- Relay coil supply of +5V_{DC} which would be available for entire range of Auxiliary Supply input to maintain contact pressure.
- Number of Electrical Operations (on Ind. + Resistive rated load): Minimum 2,00,000 On + Off operations.
- Galvanic Isolation range – 2.5kV_{AC} / 1Min. / 3 milli-Amp trip current.
- Protected by Glass cartridge fuse – 5 Amp/250 VAC/fast-blow.

6. Connection Terminals (rear side):

- All the connectors are on rear side and suitable for connecting Insulated fork ("U") type copper lugs with 1.5 mm^2 or 2.5 mm^2 wires.
- Maximum applicable torque on Screws of Terminal while tightening is 0.5 Newton-meter. Recommended torque calibrated screw driver adjustment is 0.35 Newton-meter.
- Voltage rating across 2 adjacent terminals – 300V_{AC}.
- Continuous Current rating (RMS value) – 8 Amp.

7. Coin Battery for R.T.C.C. (Real Time Clock-Calendar) & N.V. RAM:

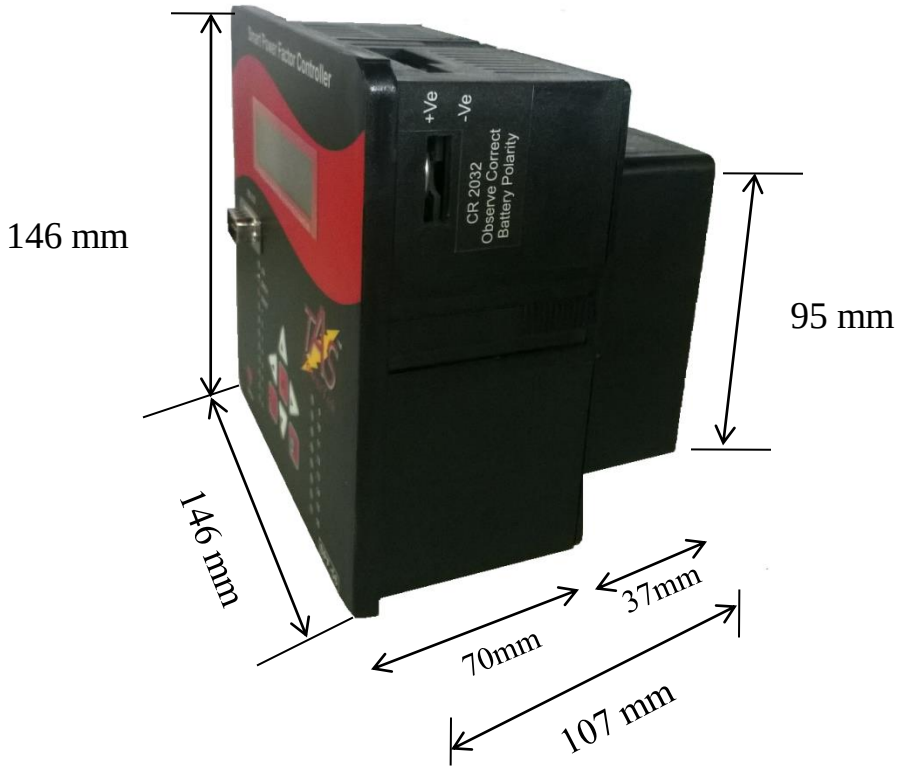
- Coin Battery type to be used : CR-2032. (Maxell make preferred)
- Battery Voltage (New) : 3.1V_{DC} to 3.3V_{DC}.
- Low Battery Alarm : 2.6V_{DC}. (Range 2.65V_{DC} to 2.55V_{DC})
- Battery Fault Indication : < 1.8V_{DC}.
- Expected Battery Life: @ 2½ Years to 3 Years.
- Time frame for Battery replacement after Low Battery Alarm is Maximum 6 months. Recommended period < 3months.

8. Data Log Non-Volatile Memory:

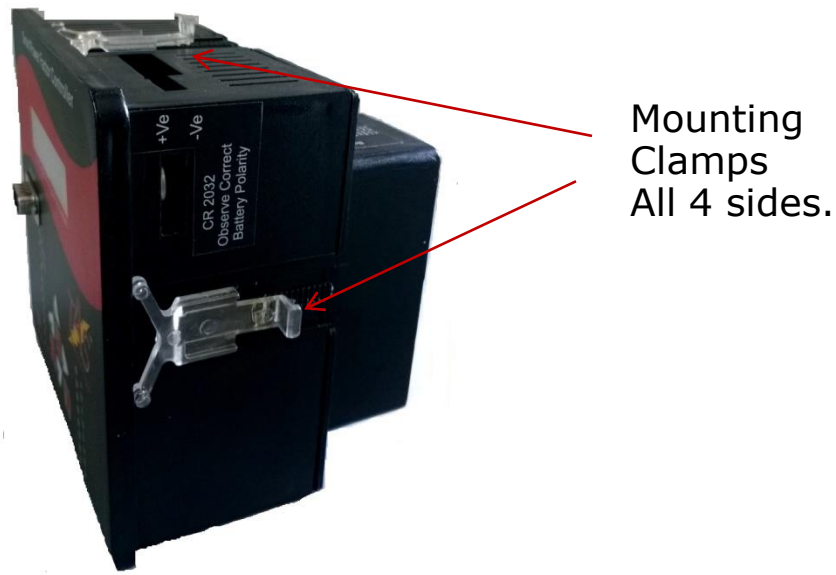
- Used for SPF-56 Program Parameter storage, 1 Hour, 30 min, 15 min, 10 min. interval data log, latest 1024 "Events" data log and Power-down values storage with "Early-Warning-Power-Failed (E.W.P.F.)" sequence.
- 120 Days for Data-Logging is done on an Hourly Basis.
- Proportionately lesser number of days of logged-data for faster logging intervals
- Critical storage even with R.T.C.C. Battery Fail or Replacement for ensuring no data loss or maintain Energy-Counter values.

Specifications (continued)**:**

9. Mechanical Dimensions: Overall: 146 x 146 x 107 mm
Panel Cut-out: DIN Standard: 138 x 138 mm



All Dimensions in mm.



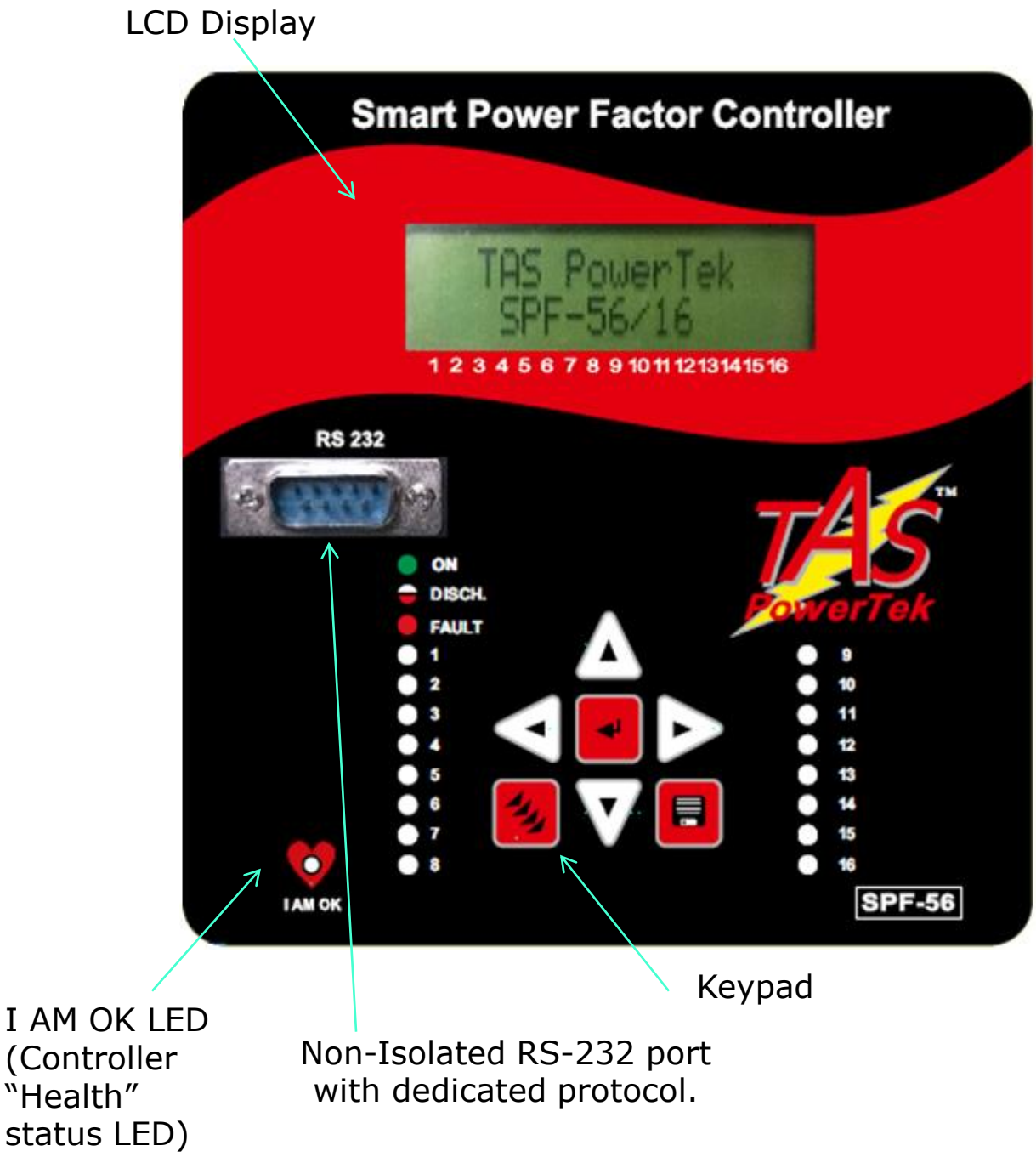
•Un-packed net weight of the Unit: Approx. 940 Grams.

Specifications (continued)**:**

9. Mechanical Dimensions (Continued):

Front fascia

Keyboard, LCD display and communication port



Specifications (continued):

Back side terminals

Note:

Use appropriately rated and type, while replacing the fuse(s) in the field

F3: Fuse for Capacitor Banks 9 to 16(5A,250V Fast-blow, Glass Cartridge).

Measurement voltage (Line To Neutral 300VAC max)

Load current CTs

Output commands to Capacitor-Duty Contactors. 9 to 16 Outputs.

F2: Fuse for Capacitor Banks 1 to 8(5A , 250V Fast-blow, Glass Cartridge).

Output commands to Capacitor-Duty Contactors. 1 to 8 Outputs.

F1: Fuse for Auxiliary Supply (0.8A , 500VAC slow- blow, Ceramic Body).

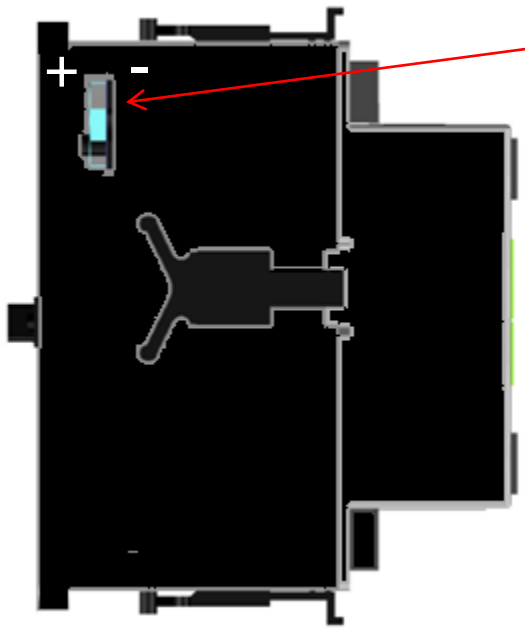
Auxiliary Supply Voltage (100V to 500V AC)

Use Correct Size "U" Type, Insulated Fork Lugs for Field Wires Connections, suitable for 2.5 mm-Square wires. Suggested Make: Chetna Engg., F-57, Ambad MIDC, Nashik-422 010, India. Cat. No.: **CCFM-937**, Serial No.: 835. Or Direct Equivalent.

Specifications (continued)**:**

Other Auxiliary Arrangements:

R.T.C.C. Coin-Battery insertion slot.



Coin Battery Slot for replacement of CR2032, 3 Vdc L-i. Battery.

(Remove "Black" sticker over the slot to see the Coin-Battery inside)

Recommended to change the Coin-Battery with Auxiliary Supply to Unit in ON condition. R.T.C.C. would not be disturbed.

Ensure new battery replacement with **Correct Polarity**. Use insulated tips, thin & long-nose plier to remove old coin-battery & insert the new coin-battery.

In case, the Aux. Supply was OFF and then this R.T.C.C. Battery is replaced, user will have to set R.T.C.C. once again to correct date & time using LCD Menu.

Side-view of SPF-56 for seeing Coin-Battery insertion slot.

The unit after mounting in panel is compatible for enclosure protection class as per DIN 40 050:

Front side: IP-54.
Back side: IP-10.

10. Environmental Requirements:

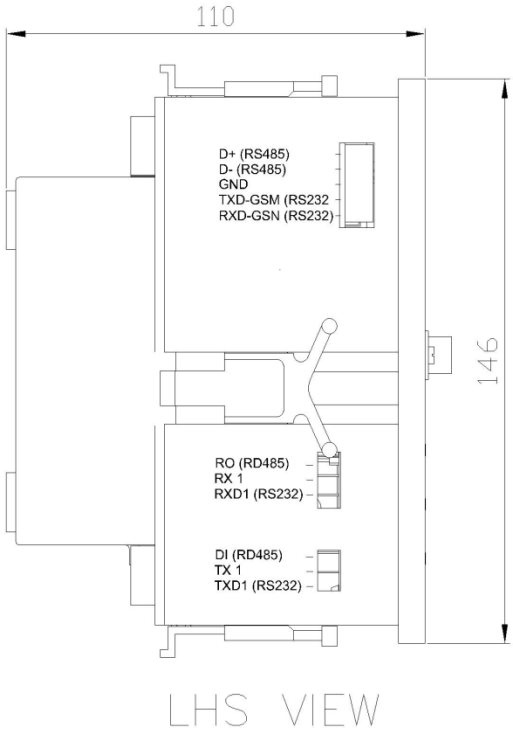
- Operating temperature range: 0°C to +55°C.
- Storage temperature range: 0°C to +65°C.
- Altitude: up to 3500 meters above sea level.
- Relative Humidity range: 10% to 95% (Non-condensing).

11. Standards Compatibility:

Unit is designed to comply with following standards compliance.
Safety Standards: IEC61010-1:2001
EMI Standards: CISPR 11
EMC Standards: IEC61000-4-2:8kV
IEC61000-4-4:4kV
IEC61000-4-11:Class A.
Accuracy Standards: IS14697: Class 1.0

Specifications (continued)**:**

9. Jumper Selection for Non-Isolated RS-485 or GSM comm. (Continued):



Side-View shows connector for RS-232 and RS-485 Communication. RX and TX for RS-232, GSM/GPRS communication and D- and D+ for RS-485, Mod-Bus communication. Note that the "Signal Ground" Terminal is common for both, RS-232 or RS-485. Use only one of these two interfaces, RS-232 or RS-485, at any given time, and configure APFC suitably from the LCD Display Menu, and do wiring accordingly. Note: **Ports are Non-Isolated.**

Jumper Selecting Middle-Pin & Bottom-Pin by shorting jumpers, in both groups, enables RS-232 communication for external GSM Modem.

Jumper Selecting Middle-Pin & Upper-Pin by shorting jumpers, in both groups, enables RS-485 for MOD-Bus ASCII, or MOD-Bus RTU protocol.

Fig: Berg Pins Shorting Jumpers selection for RS-232 or RS-485 Interface.

D+ (RS-485)

D- (RS-485)

SIGNAL GND.

TXD-GSM(RS-232)

RXD-GSM(RS-232)

Contact TAS for RS-232 to RS-485 converter module for RS-485 communication between TAS APFC as a Slave and PC / PLC's (as a Master) RS-232 Port, with Auto-Data-Direction Control.

Please remove the 5-way mating Green Connector of RS-232/RS-485 while installing the Unit in the DIN Standard Cut-out on the Panel Door, and replace it after the installation is done.

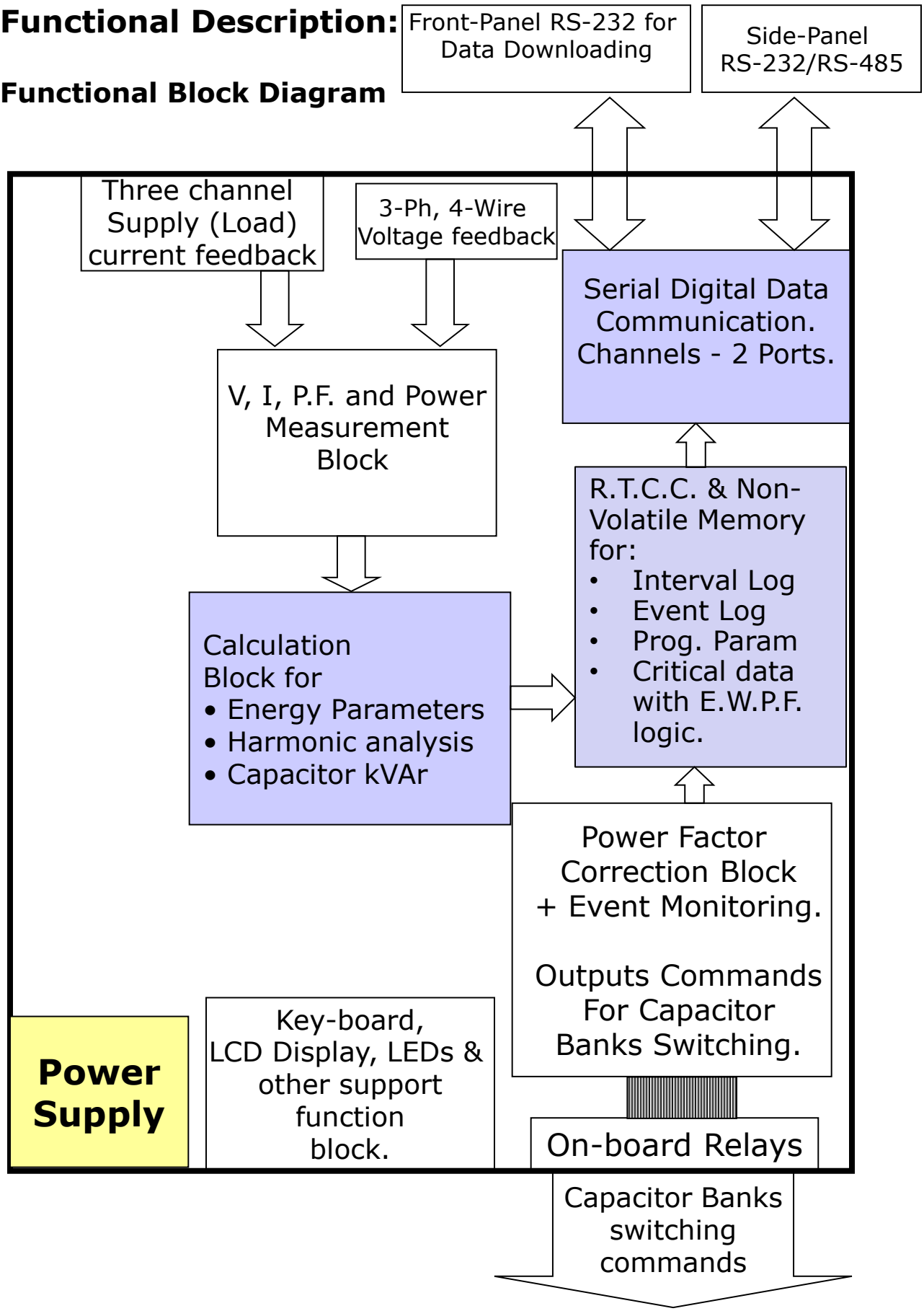
Contact us for Separate Documents for MOD-Bus and GSM Functionality Implementations.

Fig: Connector for RS-232 and RS-485, towards the Top Left-Hand Side of the Cabinet.

NOTE: Use Galvanically Isolated RS-485 Port for the "Master" on the MOD-Bus. Similarly, the RS-232 Port MODEM for GSM can also be "Galvanically Isolated" for better protection to the SPF-56/xx Unit.

Functional Description:

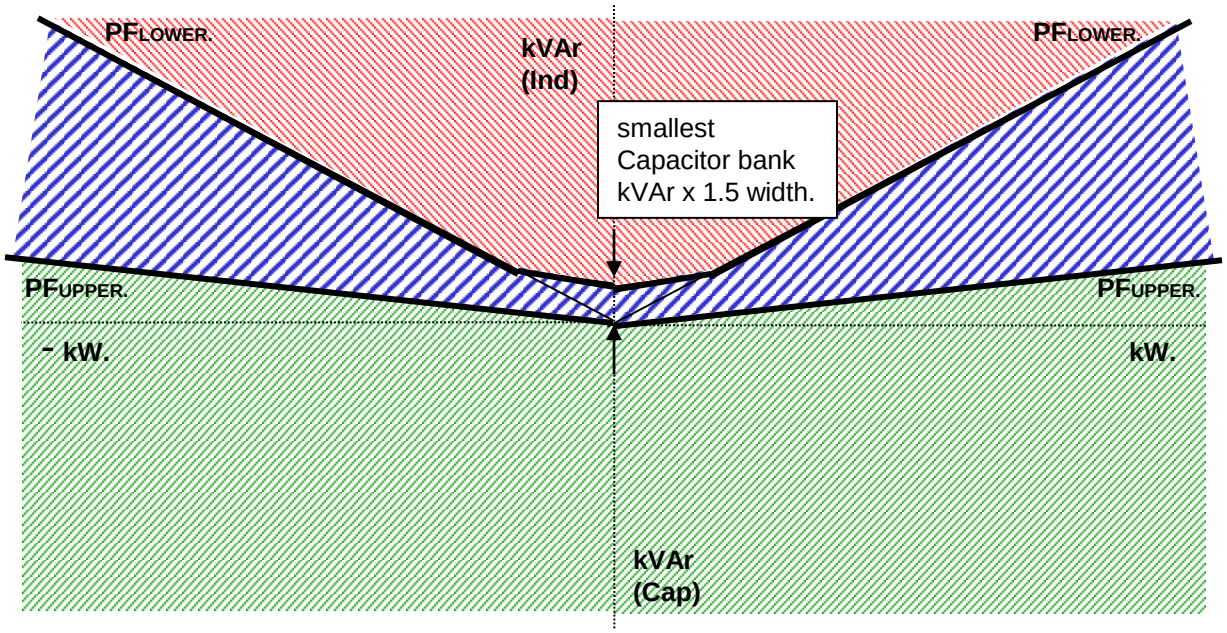
Functional Block Diagram



Functional Description (Continued):

PF correction technique

Case-1: PF-UPPER & PF-LOWER both set as inductive:

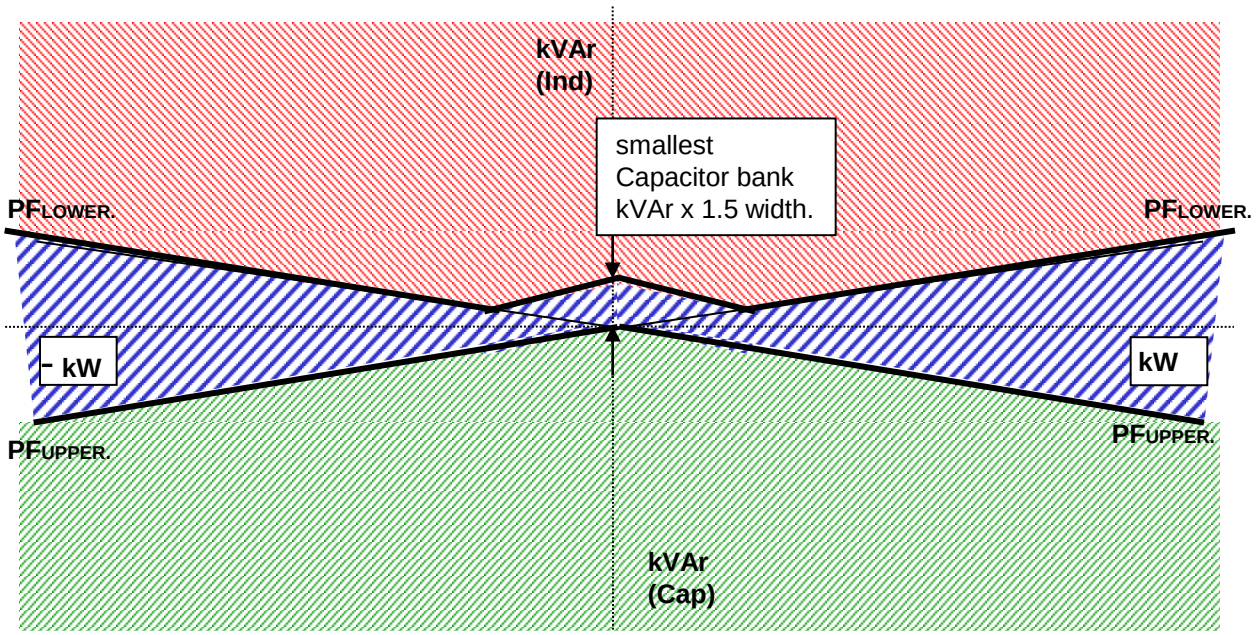


"No-Change" band.

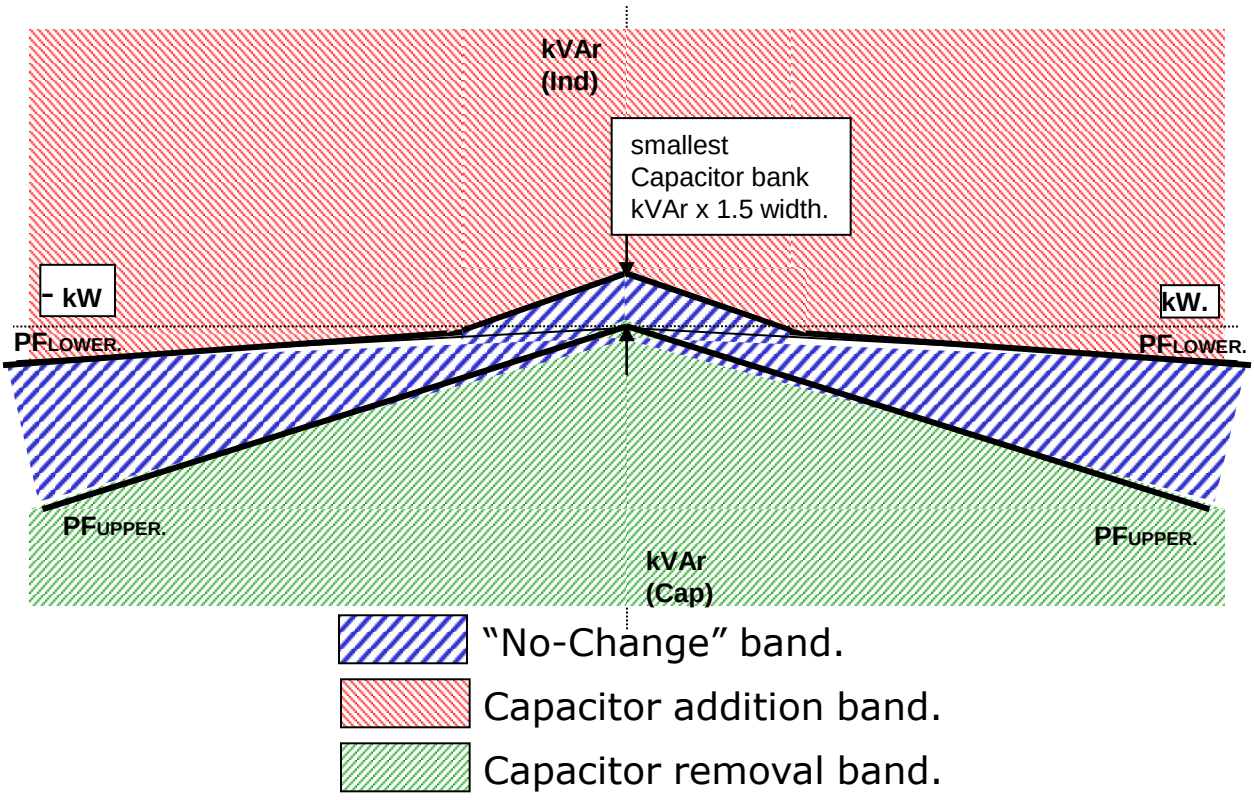
Capacitor addition band.

Capacitor removal band.

Case-2: PF-UPPER as Capacitive & PF-LOWER set as Inductive:



Case-3: PF-UPPER & PF-LOWER both set as Capacitive:



There are two PF set-points to be set in SPF-56/16. The UPPER limit and the LOWER limit. SPF-56 ensures that PF-UPPER is never exceeded. Additionally, "No change band" to minimum kVAr band size equal to smallest bank kVAr x 1.5 (1.5 is the Factory Default Setting) ensures no hunting during the low kW loading.

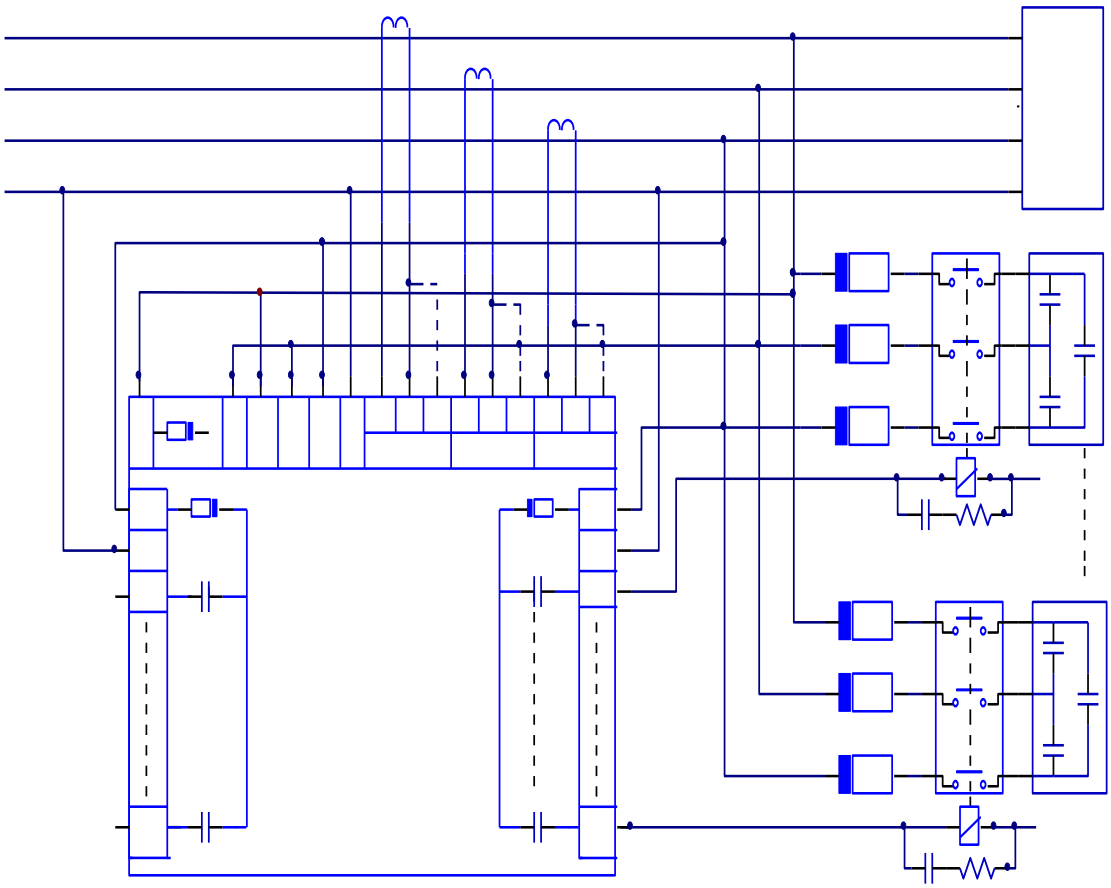
SPF-56 is normally set for PF settings as per first two diagrams shown where PF-LOWER is inductive. This philosophy helps to optimize the system maximum kVAr to be used as well as reduces the number of switching operations during higher loading conditions. This ensures better life expectancies of the switched capacitors as well as the power switching devices.

This methodology of kVAr compensation reduces the complex settings that are used by conventional PF relays. The settings like C/K ratio and kVAr offsets/shifts are eliminated which makes SPF-56 user friendly and thus easy to commission.

For all the three conditions shown in the above diagrams, 4-quadrant operation is achieved. Typical example of 4-quadrant operation is "Co-Generation Plants" and "Wind-Power Generation". But with most conventional consumer applications, only +Ve kW is seen, where the Auto Synchronization feature can be used.

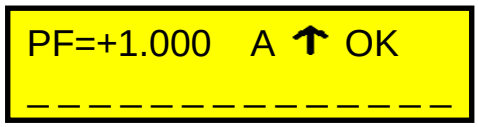
Typical wiring diagram for PF correction:

Notes:
1] The Delta-Connected Capacitor Banks have in-built Capacitor Discharging Resistors across each individual Capacitor.
2] Suitable Rating and tight voltage tolerance MOVs can be utilized across EACH Power Contactor Coil.
3] In case of DC Voltage operated Power Contactor Coils, use Fly-back Diode of suitable Voltage and Current Rating, with proper Anode (A) and Cathode (K) Polarity, directly across EACH Power Contactor Coil. The DC Coil Voltage should not be more than 24 V



Front fascia:

LCD Screen



First line of display indicates the PF value, inductive / capacitive PF, mode of operation and fault /OK status:

"PF = 1.000" indicates the overall PF of the system.
"+" or "-" indicates if this PF is inductive or capacitive respectively.
"A" or "M" indicates the Auto and Manual mode of operation respectively.
"↑" or "↓' indicates the Mains and Generator mode of operation respectively.

"OK" (blinking) indicates status of the system, healthy or faulty.

Last two characters represent one of the following status:

OK	Controller status is OK
ZV	Zero Voltage (Measurements)
OV	Over Voltage (Measurements)
UV	Under-Voltage (Measurements)
VH	Voltage over-harmonics THD%
IH	Current over-harmonics THD%
BF	Battery Fail for Battery or RTCC faulty
ZC	Zero-Current in any one phase
AS	Auto-Synchronization Pending

OB	Out of Banks – warning.
OT	Over Temperature (Internal to APFC Unit)
C1	Control-fault1- If control phase to relays 1 to 8 is missing
C2	Control-fault2- If control phase to relays 9 to 16 is missing
C3	Control-fault3- If C1 and C2 both faults are present
UF	Under -Frequency
OF	Over -Frequency
UL	Under-Load (kW)
BL	Low Battery (Coin Battery) Warning
OC	System Over-Current Warning

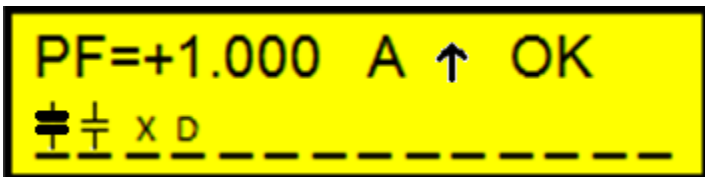
Second line indicates the status of each capacitor bank by symbols.
'I AM OK' Blinking LED indicates the controller's health status, i.e., the controller is working okay. If this LED stays continuously ON or continuously OFF, then, it means the Controller is not functioning properly.

- "I am OK" (Blinking Green colour LED) to indicate the healthy state of Controller

Front fascia:

LCD screen

Example of a typical LCD display screen is show below:



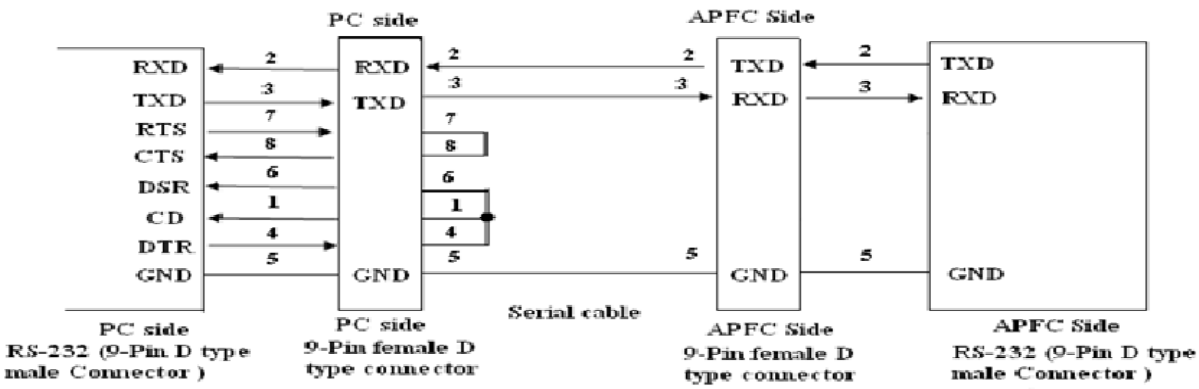
Meaning of this screen contents:
Total no. of banks connected is 16.
Power Factor at Load sensing CT is '+1.000'
'+' indicates Inductive.('-' indicates Capacitive)
Unit is operating in 'A' Auto mode. ('M' defines Manual mode)
"↑" indicates controller is on mains.
"↓" indicates controller is on Generator.
Total number of banks that are operational are 16.
Bank no. 1 is declared as fixed and is in ON condition.
Bank no. 2 is in ON condition.
Bank no. 3 is declared as faulty.
Bank no. 4 is in discharging state.
Bank no. 5 to 16 are in OFF condition.

"I AM OK", flashing Green LED indicates the controller health status.
This LED is located at the extreme, left-hand, bottom side of the front panel, as viewed by the user.
This LED, if continuously ON or continuously OFF, indicates malfunctioning of the controller.

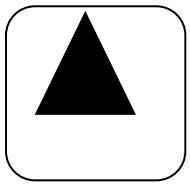
On powering up the unit, there is power-on discharge time given for the capacitors to discharge completely. However, if the user is sure that the capacitors are discharged, then on pressing the **left key** would allow the controller to come out of the discharge time and thus user need not wait for the discharge time to get complete, and thus saves time, during testing.

Front side Non-Isolated RS232 communication port connection:

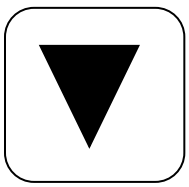
This port is used for down-loading of data already logged in the controller. The interface is Standard, 3-wire, RS232. For further description about the data logging, please refer to further pages of this user manual. Following gives the pin configurations:



Front fascia:
Keypad

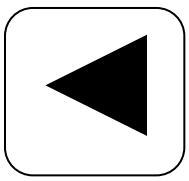


UP key. Used to scroll up the menu screen; increment values when entering numbers. Also used for changing the status of banks.

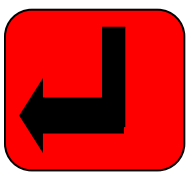


DOWN key. Used to scroll down the menu screen; decrement values when entering numbers. Also use to change status of bank.

RIGHT key. Used to shift the cursor to right; also used to increase the contrast of LCD in default display screen mode.



LEFT key. Used to shift the cursor to left; also used to decrease the contrast of LCD in default display screen mode.



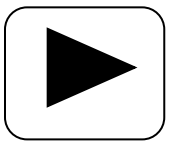
ENTER key. Used for entering a submenu or for setting up values.

MODE key. Used for selecting modes of operation and editing of parameters.

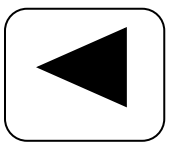
SAVE key. Used to save all the changes made in the Program mode menu.

LCD Display Contrast & Back-light.

The LCD display Contrast is adjustable by front keyboard.



Repetitive strikes of “Right” key would increase the contrast



Repetitive strikes of “Left” key would reduce the contrast of LCD display.

LCD – Background visibility light (Back-light) is turned on during Power Up of SPF-56.

Any key on the Key-pad pressed once, will turn on the Back-light of LCD Display.

Any non-activity on the keyboard for more than 1 Minute, would automatically turn-off the back-light of LCD Display.

Display of various parameters

Values of various parameters can be viewed by using UP / DN keys & then pressing ENT key. To exit a sub-menu press PROGRAM.

PF=+0.980 A ↑ OK ----------	This is factory set default display screen giving information on PF, mode, bank & controller status.
DISPLAY OVERALL VALUES	Overall values gives the average values of system parameters – V, I, kW, kVAr, kVA, C-kVAr, frequency.
DISPLAY MAXIMUM VALUES	Max values gives the maximum values of V, I, kW, kVAr and kVA, detected after the last reset. This also has the facility of resetting the maximum values manually which would be the actual instantaneous values and not zero.
DISPLAY PER-PHASE RMS	Per phase RMS gives the per phase values of voltage, current, and neutral current.
DISPLAY POWER	Displays overall power parameters for per phase like PF, kW, kVAr, kVA.
DISPLAY ENERGY	Displays overall energy parameters like kWH, Inductive & Capacitive kVArH, kVAH.
DISPLAY HARMONICS	Displays THD in terms of "%" for per phase voltage and current up to 15th odd harmonics.
DISPLAY STEP KVAr	Displays the Step kVAr of the number of banks connected.
BATTERY VOLTAGE 3.15 VOLT	Displays the Battery voltage of the Lithium Coin Battery inserted in the Battery Holder.
INT-Temperature 29 Deg C	Displays the internal (cabinet) temperature of the SPF-56 Unit.
TIME: 15:10:14 DATE:25/02/14	Displays current time & date that is from the internal Real Time Clock-Calendar. Time is in HH/MM/SS (24 Hours) &Date is in DD/MM/YY format.
TAS POWERTEK VER. 1.0.5	Displays Name & the version of software. This can change as per the necessary updates from time-to-time.
UNIT SR.NO 4600054100001	Display Sr. No of Controller. It is used for Data down-loading. This should be a Unique Number always.

Sub-menu for Display of parameters:

Overall Values	Max. Values	Per Phase RMS	Display Power	Display Energy	Display Harmonics	Step KVAR
Average Voltage 00000.0 (L-N)	Maximum Voltage 00000.0 V	R-Phase Voltage 00000.0 (L-N)	R-Phase PF 1.000 IND	KWH 000000000.0	Vr-THD -F 000.0 %	Step [01] Kvar 0000.0
Average Current 0000.5 A	Maximum Current 0000.5 A	Y-Phase Voltage 00000.0 (L-N)	Y-Phase PF 1.000 IND	IND KVARH 000000000.0	Vy-THD-F 000.0 %	Step [02] Kvar 0000.0
Active Power 00000.0 KW	Max__KW 00000.0 KW	B-Phase Voltage 00000.0 (L-N)	B-Phase PF 1.000 IND	CAP KVARH 000000000.0	Vb-THD -F 000.0 %	Step [03] Kvar 0000.0
Reactive Power 00000.0 KVAr	Max_ KVAR 00000.0 KVAr	R-Phase Current 00000.0 A	R-Phase KW 00000.0	KVAH 000000000.0	Ir-THD -F 000.0 %	Step [04] Kvar 0000.0-
Apparent Power 00000.0 KVA	Max_KVA 00000.0 KVA	Y-Phase Current 00000.0A	Y-Phase KW 00000.0		Iy-THD -F 000.0 %	Step [05] Kvar 0000.0
C-KVAR 000000.0	RESET MAXIMUM VALUES NO :	B-Phase Current 00000.0A	B-Phase KW 00000.0		Ib-THD -F 000.0 %	Step [06] Kvar 0000.0
Frequency 00.0 Hz		Neutral Current 00000.0A	R-Phase KVAR 00000.0		In-THD -R 000.0 %	--
			Y-Phase KVAR 00000.0			--
			B-Phase KVAR 00000.0			---
			R-Phase KVA 00000.0			---
			Y-Phase KVA 00000.0			Step [nn] Kvar 0000.0
			B-Phase KVA 00000.0			Step [16] Kvar 0000.0

continued..

Harmonic data of various current & voltage parameters can be viewed by pressing ENT on the respective parameter screen of the Harmonics menu. Following are the sub-menus giving the harmonic data of voltage, current & capacitor current for each phase.
continued..

V (Voltage) Harmonics:

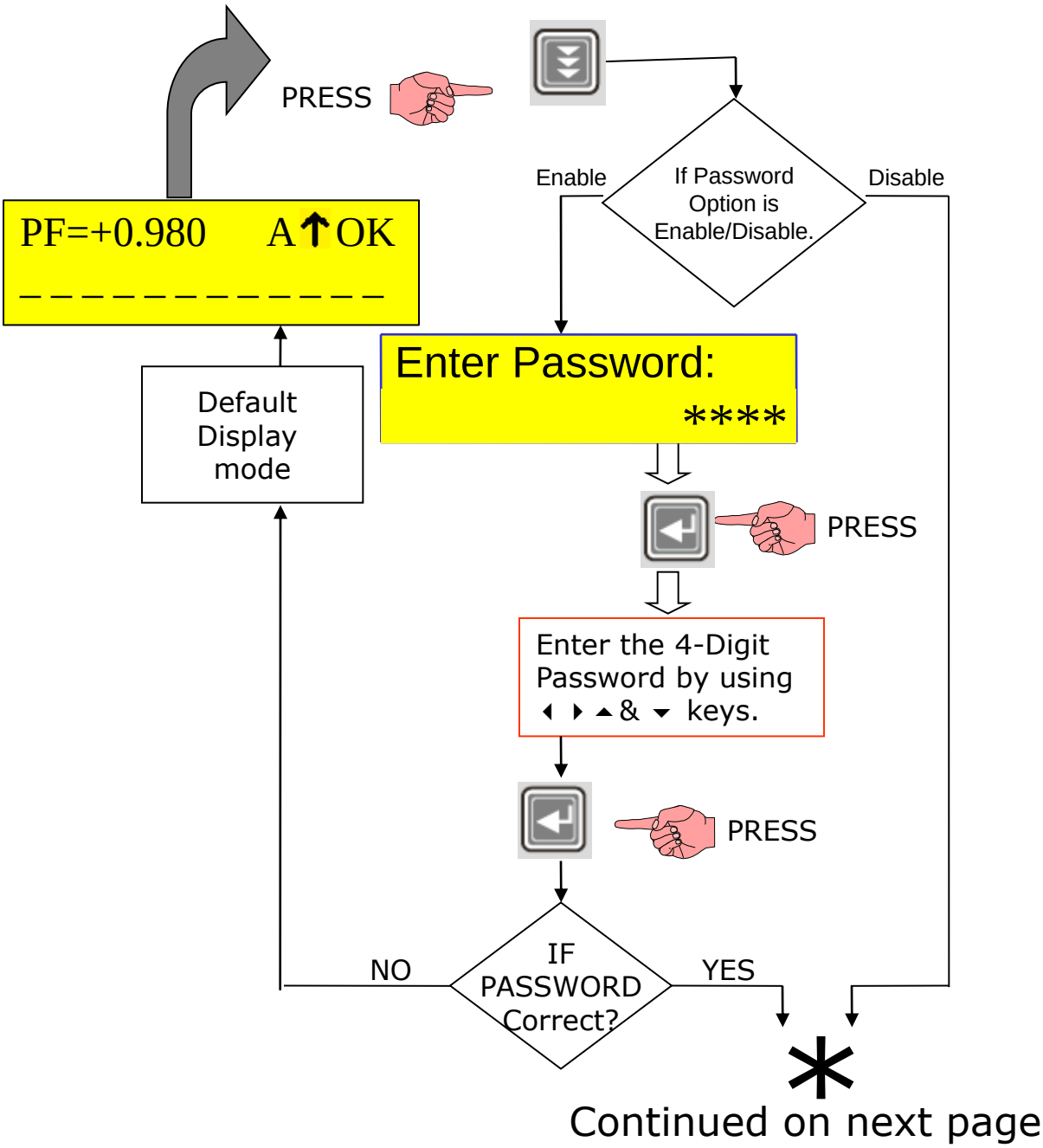
Vr Harmonics 3rd:00.0%	Vy Harmonics 3rd:00.0%	Vb Harmonics 3rd:00.0%
Vr Harmonics 5th:00.0%	Vy Harmonics 5th:00.0%	Vb Harmonics 5th:00.0%
Vr Harmonics 7th:00.0%	Vy Harmonics 7th:00.0%	Vb Harmonics 7th:00.0%
Vr Harmonics 9th:00.0%	Vy Harmonics 9th:00.0%	Vb Harmonics 9th:00.0%
Vr Harmonics 11th:00.0%	Vy Harmonics 11th:00.0%	Vb Harmonics 11th:00.0%
Vr Harmonics 13th:00.0%	Vy Harmonics 13th:00.0%	Vb Harmonics 13th:00.0%
Vr Harmonics 15th:00.0%	Vy Harmonics 15th:00.0%	Vb Harmonics 15th:00.0%

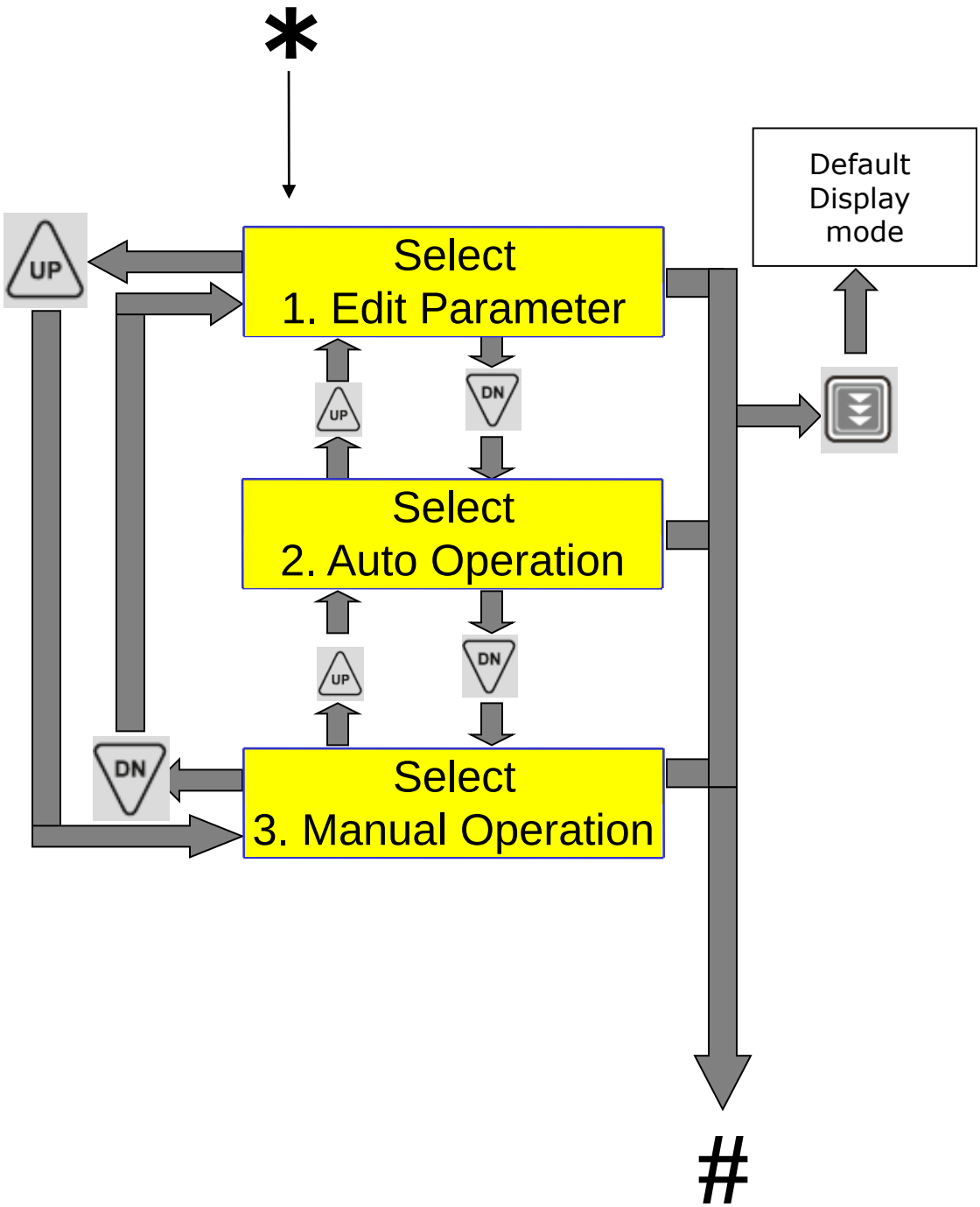
I (Load-Current) Harmonics:

Ir Harmonics 3rd:00.0%	Iy Harmonics 3rd:00.0%	Ib Harmonics 3rd:00.0%	In Harmonics 3rd:00.0%
Ir Harmonics 5th:00.0%	Iy Harmonics 5th:00.0%	Ib Harmonics 5th:00.0%	In Harmonics 5th:00.0%
Ir Harmonics 7th:00.0%	Iy Harmonics 7th:00.0%	Ib Harmonics 7th:00.0%	In Harmonics 7th:00.0%
Ir Harmonics 9th:00.0%	Iy Harmonics 9th:00.0%	Ib Harmonics 9th:00.0%	In Harmonics 9th:00.0%
Ir Harmonics 11th:00.0%	Iy Harmonics 11th:00.0%	Ib Harmonics 11th:00.0%	In Harmonics 11th:00.0%
Ir Harmonics 13th:00.0%	Iy Harmonics 13th:00.0%	Ib Harmonics 13th:00.0%	In Harmonics 13th:00.0%
Ir Harmonics 15th:00.0%	Iy Harmonics 15th:00.0%	Ib Harmonics 15th:00.0%	In Harmonics 15th:00.0%

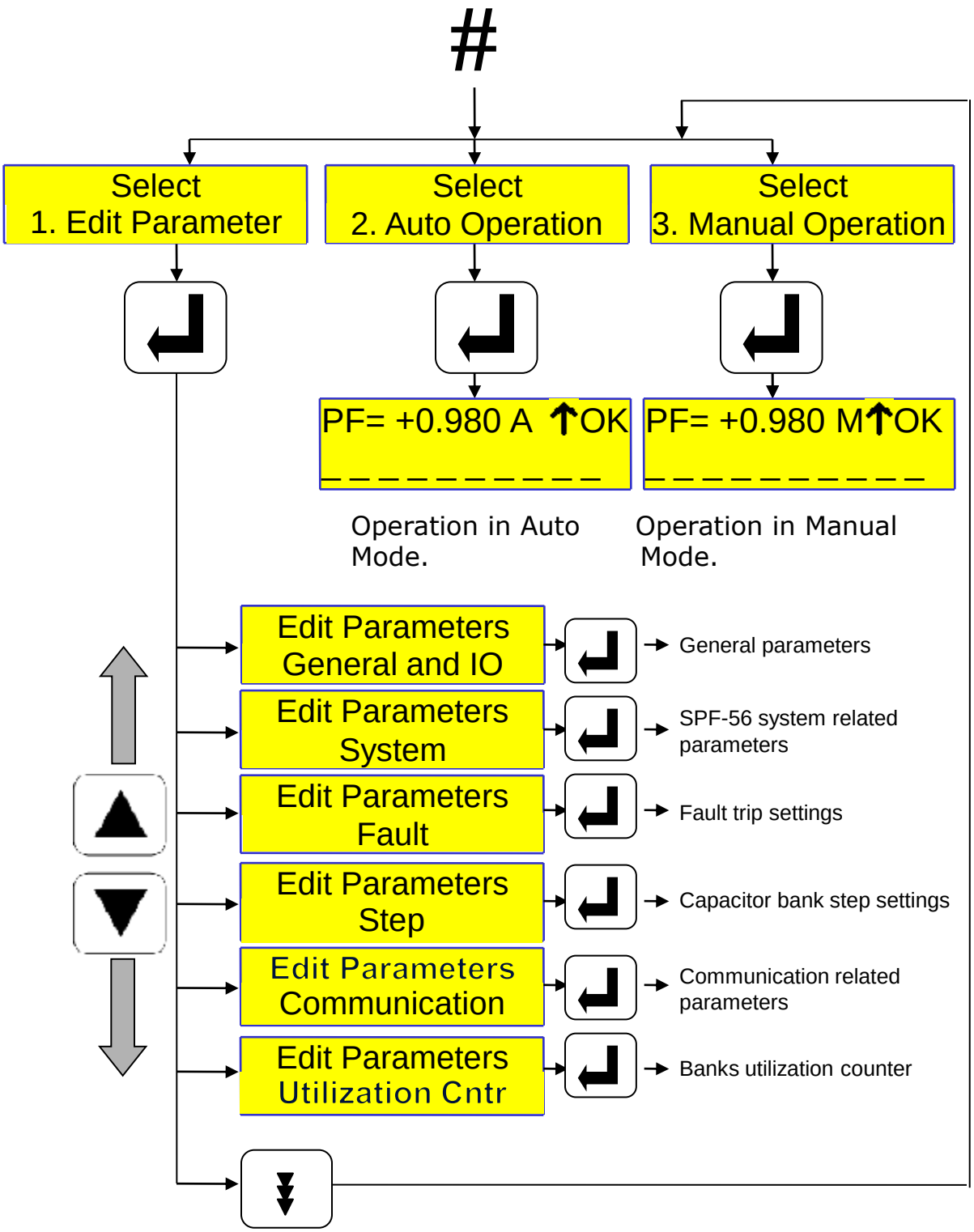
Method for keyboard / display usage

Flow-chart for entering into different modes:





Continued on next page


#
Select
1. Edit Parameter
Select
2. Auto Operation
Select
3. Manual Operation
PF= +0.980 A OK
PF= +0.980 M OK
Operation in Auto Mode.
Operation in Manual Mode.
Edit Parameters General and IO
General parameters
Edit Parameters System
SPF-56 system related parameters
Edit Parameters Fault
Fault trip settings
Edit Parameters Step
Capacitor bank step settings
Edit Parameters Communication
Communication related parameters
Edit Parameters Utilization Cntr
Banks utilization counter

Keyboard / Display operations

Mode Selection

There are two modes of operation (Manual and Auto) and one mode for data entry (Edit Parameters).
Press the PROGRAM key. Enter password (if enabled) by using ◄ ► ▲ ▼ keys. Press ENTER Now using ▲ ▼ keys, select the Mode of operation:

- **AUTO OPERATION**
- **MANUAL OPERATION**
- **EDIT PARAMETERS**

Then press ENTER to enter the specific mode.

Auto Operation:
For functioning in Automatic P. F. correction mode.

Manual Operation:
Pressing ENTER button, while on this 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 the Capacitor Banks. But this is not allowable for all the faults. In case of the following faults, turning ON the Capacitor Banks in Manual Mode is NOT allowed:
1] Under Voltage (UV)
2] Over Voltage (OV)
3] Under Frequency (UF)
4] Over Frequency (OF)
5] Control Fault (CF)

Entry in to Manual Mode of operation first turns-off all the Capacitor Banks.

This mode is normally used to perform the operations like:

- Resetting of faulty banks to healthy status.
- Checking the Capacitor banks by turning them ON/OFF.
- Declaring specific bank/banks faulty. Masking of the banks so that once auto mode is selected, these faulty declared banks would not be used for PF correction.

For Declaring banks faulty or Resetting faulty banks:
While in Manual Mode default screen, press ENTER key.
The cursor above bank 1 will start blinking. Use ◄ ► keys to select the specific bank. Then use ▼ key to declare it faulty.
To reset the faulty bank, bring the blinking cursor to that bank and use ▼ key again to declare that bank as healthy.
After any of these operations press ENTER key so that cursor stops blinking. To save the status on permanent basis (so that even after Power-down, the status is unchanged), press MEMORY key. After saving the settings, the unit will jump back to default mode. By default, the controller is set to operate in AUTO mode.

For Testing Capacitor Banks with Manual ON / OFF commands:

Press ENTER key, the cursor will start blinking. Use ◂ ▸ keys to select the specific bank/s that are healthy and use ▲ key to turn ON and use ▼ key to turn OFF that capacitor banks.
To come out of Manual ON / OFF edit mode, press ENTER key so that cursor stops blinking.

Edit Parameters:
This mode is used to carry out system settings. In this mode, various system settings can be carried out. To do the same, use the ▲ ▼ keys and select the type of parameters to be edited. The types of parameters that can be edited are:

General & I/O : For general settings.
System : For APFC system related settings.
Fault : Fault settings.
Step : Capacitor Bank step settings.
Communication : Communication parameters.
Utilization counter: Capacitor Bank operations utilization counters.

After selecting the type, press ENTER to enter the sub-menu of that specific type.
The details of these sub-menus for every type is given further.
You can edit all these sub-menu settings by using the ENTER, ▲, ▼, ◂, and ▸ keys
To come out of the sub-menu press MODE key once.
To store the edited parameters permanently, press MEMORY when you are either in the Edit Parameters or any sub-menu area.
To come out of Edit Parameters without saving the changes, press MODE key again.

General & I/O

Password Disable :
Change Password : 0000
Load Default No :
THD To Display F-THD :
Reset energy Cnt No :
AUX OP1 FUNCTION None :
AUX IP1 FUNCTION None :

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 the auxiliary output to become NC due to any of the following :None, TripFlt, Sys Flt, Out Of Bank.

AUX IP1 FUNCTION : Set an action through auxiliary input None ,O/P En Di (output enable disable) , Mains/generator, Reset Bnk Flt. When controller is on Mains then on main screen shows ↑(arrow). And if controller is on generator then on main screen shows ↓(arrow).

System

Rated Supply Vtg (L-N) : 0254.0 V
EXT-PT Ratio 0001.0 : 1
CUR CT Primary : 1000
DT Ratio 0001.0 : 1
PF Up Lim: Mains [Cap :] 0.999
PF Up Lim: Mains Cap: [0.999]
PF Low Lim: Mains [Ind :] 0.990
PF Low Lim: Mains Ind : [0.999]
PF Up Lim: Gen [Cap :] 0.820
PF Up Lim: Gen Cap: [0.820]
PF Low Lim: Gen [Ind :] 0.800
PF Low Lim: Gen Ind : [0.800]
Phase Auto Sync Disable :

Rated Supply voltage :user can set rated supply voltage of panel.

Ext-PT ratio: In case the external Potential Transformer (P.T.) is used, this ratio can be set.

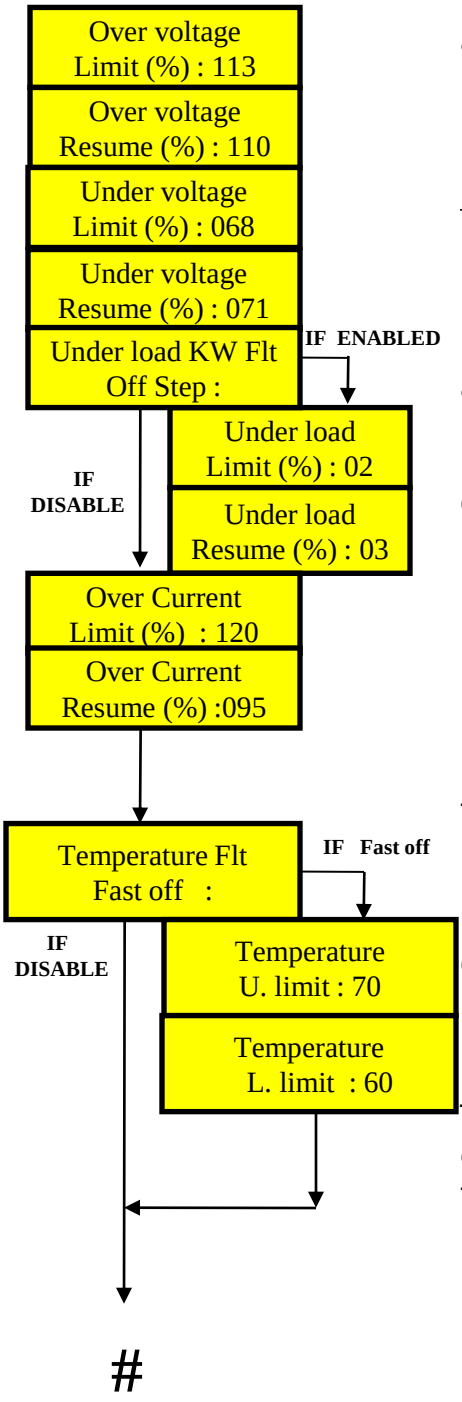
Cur CT Primary: Rated Feedback Load Current for Mains.

DT Ratio: Set the Distribution Transformer ratio. Default 1:1

Power Factor Limits: PF limits can be set as inductive or capacitive. Also Target PF band can be set as Upper PF and Lower PF 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 success.

Fault



For Over-Voltage and Under-Voltage fault, the option available is as here under:

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.

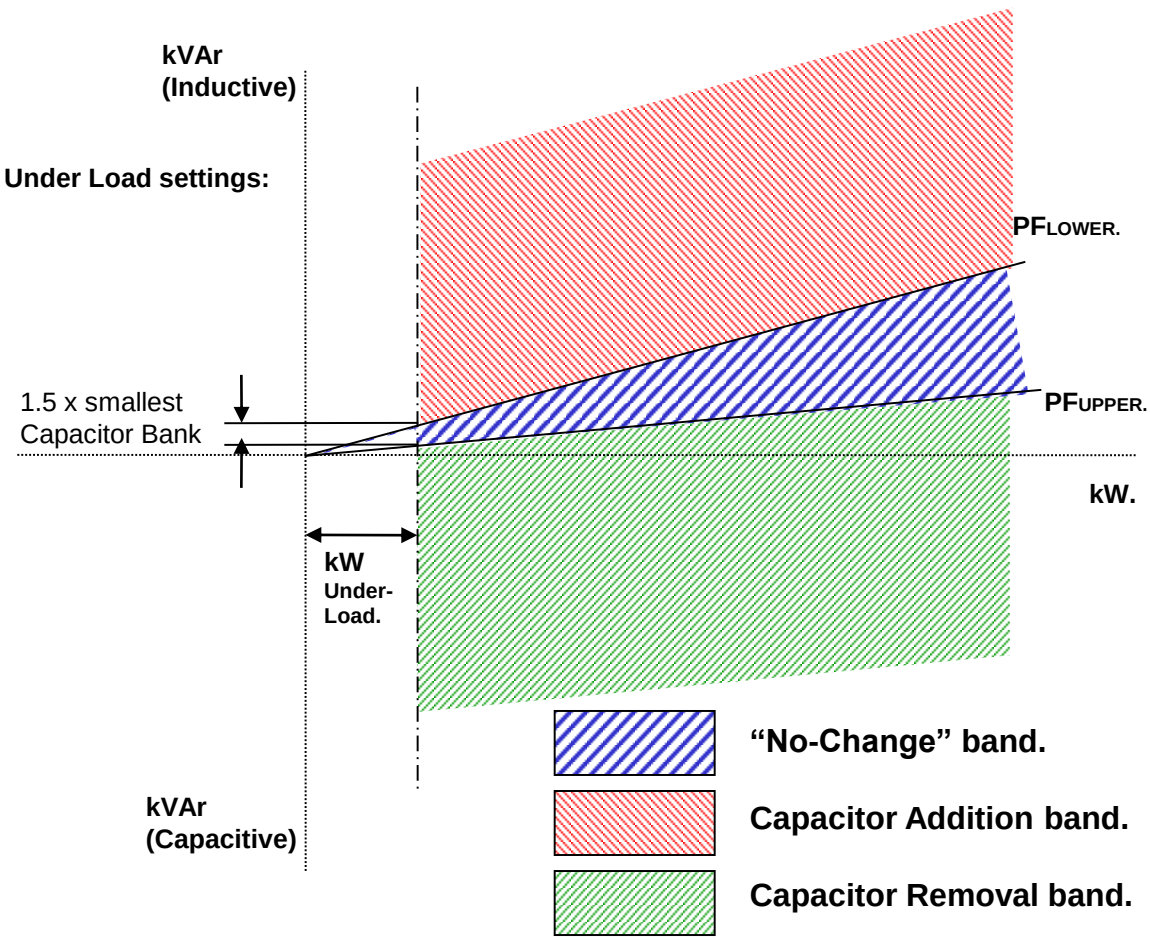
• Over-Voltage: As name suggests, its for Over-Voltage conditions persisting in any one phase for 3 Seconds.

• Under-Voltage: For 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. Value for this Under-Load kW can be calculated as shown in Paragraph/title " Under-Load settings".

•Over-Current: The SPF-56 detects if the supply system is overloaded, then it is for warning indication. Capacitor Banks are not switched-off with this detection.

•Temperature fault: As the name suggests, the "Over Temperature (OT)" fault is indicated, if the 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.



For PF-UPPER Inductive and PF-LOWER Inductive :

$$\textbf{Under-Load kW value setting} = \frac{\textbf{1.5 (Factory Set) x Smallest bank kVAr.}}{\textbf{[tan\{cos}^{-1}\textbf{(PF}_{\textbf{LOWER}}\textbf{)\} – tan\{cos}^{-1}\textbf{(PF}_{\textbf{UPPER}}\textbf{)\}]}}$$

For PFUPPER Capacitive and PFLOWER Inductive :

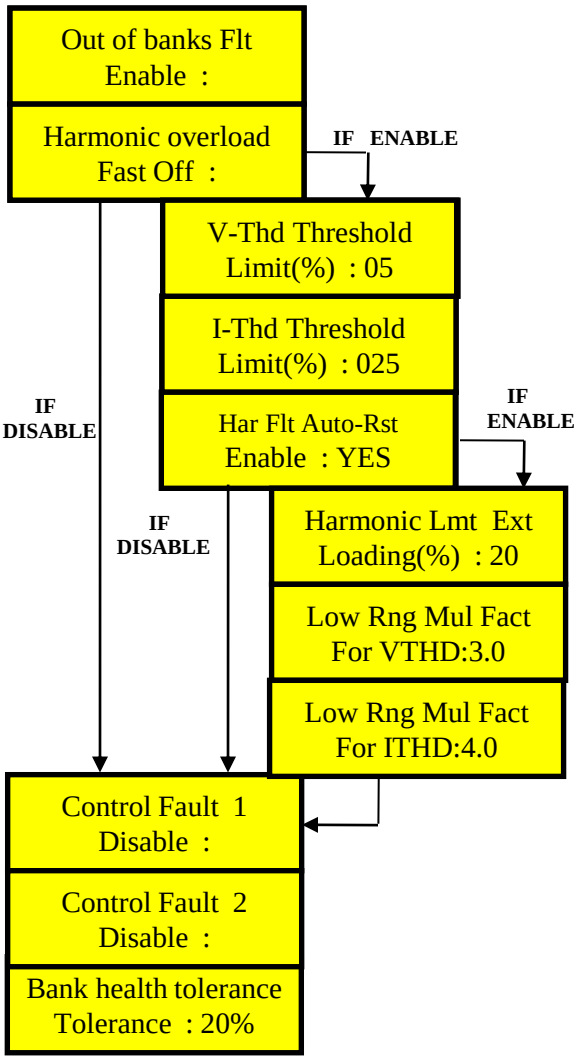
$$\textbf{Under-Load kW value setting} = \frac{\textbf{1.5 (Factory Set) x Smallest bank kVAr.}}{\textbf{[tan\{cos}^{-1}\textbf{(PF}_{\textbf{UPPER}}\textbf{)\} + tan\{cos}^{-1}\textbf{(PF}_{\textbf{LOWER}}\textbf{)\}]}}$$

For PFUPPER Capacitive and PFLOWER Capacitive:

$$\textbf{Under-Load kW value setting} = \frac{\textbf{1.5 (Factory Set) x Smallest bank kVAr.}}{\textbf{[tan\{cos}^{-1}\textbf{(PF}_{\textbf{UPPER}}\textbf{)\} – tan\{cos}^{-1}\textbf{(PF}_{\textbf{LOWER}}\textbf{)\}]}}$$

…continued.

#



•Out of Banks Fault: This is only with Disable and Enable options. If Enabled, then unit will indicate the out of bank fault if for two consecutive correction cycles, PF is more inductive than Lower PF 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 the 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, then this fault is activated.
The VTHD 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, then this fault is activated. The I-THD limit can be set through I-THD threshold limit screen

•Harmonic Flt Auto-Rst: 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 disable controller shows the fault until you reset the fault manually.

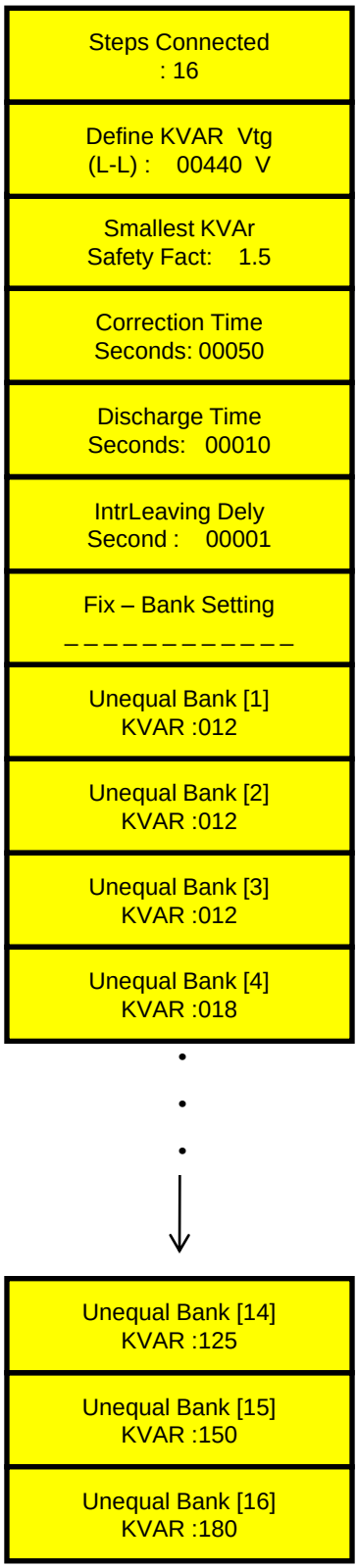
Harmonic Lmt Ext Loading: User can set the actual load limit in percentage of rated load here for which harmonic fault can be detected.

•Low Rng Mul Fact For VTHD: By setting this factor user can extend the VTHD fault limit
•.
•Low Rng Mul Fact For ITHD: By setting this factor user can extend the ITHD fault limit.

•Control Fault: This fault has two options, namely Disable and Enable. The control fault is used to detect low 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 the Capacitor Bank health check monitoring, this indicates the tolerance between the user set bank kVAr values and the actual kVAr as calculated by the controller.

Step



•Steps Connected: Defines the number of operational steps . Depending on the Capacitor Bank steps of the APFC system, this parameter is set. Maximum 16 Capacitor Banks can be connected.

•Define kVAr Voltage: Capacitor Bank voltage line-to-line value is defined here. i.e. it defines the Voltage value at the defined kVAr.

•Smallest kVAr safety Fact: This factor is a multiplier for the smallest Capacitor Bank kVAr. The default value is 1.5. The range is 1.1 to 1.9 It defines the "No- Action" zone, prohibiting the Capacitor Bank On/Off operation to avoid hunting.

• Correction Time: Defined in Seconds. This is the Time between two consecutive kVAr compensations i.e., time between change in load kVAr demand & subsequent switching of Capacitor Bank steps. This can be set within the range of 1 to 240 Seconds (4 Minutes).

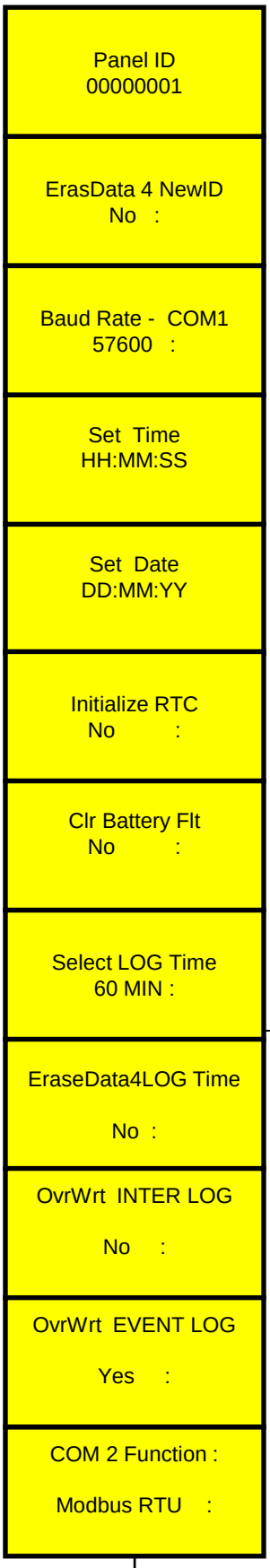
• Discharge Time: Time defined here is the time allowed for discharging of the Capacitor Bank to a voltage level, so that that Bank can be turned ON again. This can be set within the range of 1 to 300 Seconds (5 Minutes). However, it should match or be a higher setting than the actual Capacitor Bank Discharge Time.

•Inter-Leaving Dely: This is the switching delay between switching ON of two consecutive capacitor bank steps. User can set it as instantaneous or 1 Second, as option.

•Fixed Bank setting: In this, 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 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.

Communication



•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 RS-232, Std. Baud Rates selectable are: 4,800 bps, 9,600 bps, 19,200 bps, 57,600 bps. The Baud rate should match on both sides, APFC & PC/HHU for communication.

• Real Time Clock: 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) 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 Time : 60 MIN, 30 MIN, 15 MIN, 10 MIN. By pressing UP key it Define log data at 60 /30/15/10 Minute interval period. Factory Default value is as 60 Minutes.

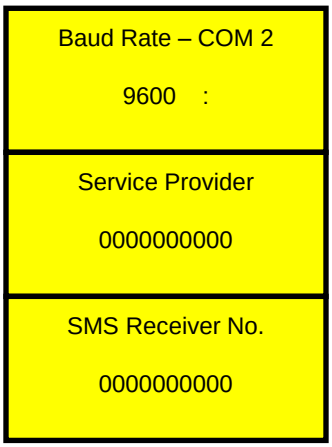
• EraseData4LOGTime : Yes Or No.
Defining "Yes" erase all previously logged data from the EEPROM. Select LOG Time mentioned above can be changed and new Select LOG Time can be saved only if all the previously logged data is erased from the EEPROM. This is to maintain time synchronization of data.

•OvrWrt INTER LOG: User can enable this option to allow the interval logged data to be overwrite after log data memory is full. If the option is disable data logging will get stop after memory is full.

•OvrWrt EVENT LOG: User can enable this option to allow the Event logged data to be overwrite after log data memory is full. If the option is disable data logging will get stop after memory is full.

•COM 2 Function : None, MOD-Bus ASCII , MOD-Bus RTU, GSM. Option MOD-Bus ASCII & MOD-Bus RTU for RS-485 communication and GSM for RS-232 communication for an external GSM/GPRS MODEM, for SMS Communications.

#

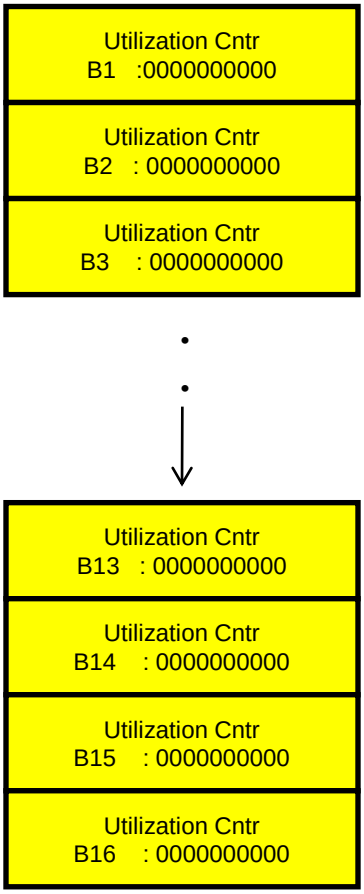


- COM 2 Baud Rate: Std. Baud Rates selectable are: 4,800 bps, 9,600 bps, 19,200 bps, 57,600 bps. The Baud rate should match on both sides, APFC & GSM/GPRS for communication.

- 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: This defines the number to where the 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):

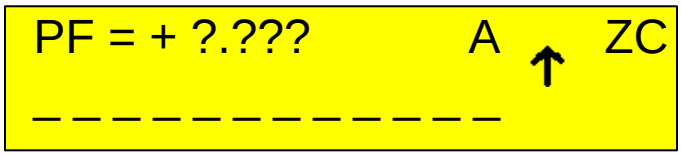


Utilization counters: Bank nn: This gives the number of ON operations of the "nn"th bank.

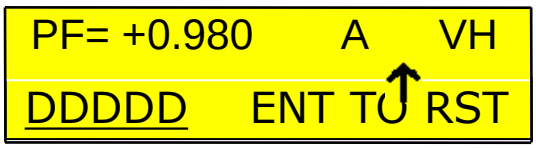
All Counters are initially set to "0000000000" at the time of factory testing.

Notes on Protection and Functionalities:

(1)If 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 following display on the LCD Display as "ZC" for Zero-Load-Current:



(2) If **Harmonics Overload** fault is enabled, and if the voltage or current THD% exceeds the set limit, then *SPF-56* would show the following 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.

(3) Control Fault :

Control Fault can appear instantaneously in following cases:

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 is missing.

(4) Coin Battery Low: If 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.

(5)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 plier and a new Coin Battery is to be placed using the same insulated tip plier.

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 loosing logged-data.

Note: Unit is equipped with E.W.P.F. logic. With Battery Faulty condition or Battery-Low condition, Battery Replacement can be safely done without any data download and without a fear of loosing any logged data or "Energy-Counter" values or Capacitor Bank logged kVAr values. Such battery replacement can be even safely be done with unit in powered-down condition.

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

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 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 PF 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, this 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 it's operation correctly, or rather, it's operation will be totally erratic and unpredictable.

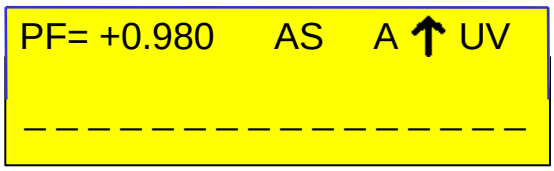
▪SPF-56 has an in-built intelligence, if enabled, to automatically detect the correct voltage phase-sequence as well as corresponding load current input channels, even if the proper connection order is not followed. It is even intelligent enough to detect the 'reversed' polarity of CT connections. But, 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 following 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.

▪ Thus, the facility of "Auto Synchronization" enables SPF 56 controller to tolerate wiring errors in feedback signals, and still perform the P.F. correction work correctly.

Events and interval based data-logging facilities:

▪ The APFC controller has non-volatile memory where internal operational status is monitored and specific change-of-state, called as an "Event", is internally recorded in the non-volatile memory, with R.T.C.C. date & time stamping for the event data.

▪ Up to 1024 latest events are held in the non-volatile memory, which can be off-loaded from the Controller to a PC or to a Hand-Held-Unit (HHU) for further analysis.

▪ This information is useful to the user because the user comes to know when a particular fault occurred and when the Controller resumed from the faulty condition.

▪ The "**Data View**" Application Software for PC, is provided to the users of APFC Unit to download and process the logged-data directly from the APFC using a laptop/PC or downloaded from Hand-Held-Unit (HHU), if the HHU already has the data from APFC. A separate User Manual is available from TAS, for the "Data View" Software.

▪ "Data View" is for not only for data downloading from the APFC Units, but also for presenting the captured information in a User-Friendly manner.

▪ APFC Unit is capable of internally logging various important Electrical Parameters as well as the Capacitor Bank Status, on a fixed Time Interval Basis.

▪ The most common Time Interval provided is that of 1 Hour, therefore the data-logging is on an Hourly basis.
Thus, the Hourly logged records in the APFC Unit are first downloaded by "Data View", and then, analysed and presented to the User in various ways.

▪ "Data View" is capable of generating the reports in visual forms as well as in print form for hard-copy storage.

▪ The Non-Volatile Memory of the SPF-56 Unit is capable of logging the Hourly Data for a maximum duration of 120 days. The "Data View" downloads all logged data of 120 days. Selecting shorter time interval period for logging will correspondingly reduce the number of days for the logged data because the amount (size) of memory for data-logging, is internally fixed in the design.

▪ "Data View" has the ability to show the date of downloading and expected date of next download. Time span between date of downloading and next date of downloading is 90 days.
This facility allows about One Month margin to get the data from the field. This is important so that one actually does not miss any field data.
If the logged-data is not off-loaded from the Controller in time, the old data will be over-written by the Controller to always present the latest data.

▪ For the maintenance purpose, it is possible to generate "faults" related information for a particular date and time. It also possible to see the Status of the Capacitor Banks of SPF-56 Unit, at a specified date and time.

Please refer to the appropriate page of this user manual for the connection diagram between PC and the SPF-56 APFC Unit, on RS-232.

Aux. Power Input AC Power "Early Warning Power-Failed" monitoring (E.W.P.F.):

The APFC has the ability to detect the "Power-failing" condition by way of an internal "Early-Warning" of impending AC Input Aux. Power Failure, and takes preventive measures for the following:

▪ In case of "Power-Failing" Early-Warning condition, the SPF-56 saves all the dynamic parameters in its non-volatile memory (EEPROM) along with R.T.C.C. current date and time. So, the "Power-Down" event is precisely known. Similar Record is created at the time of AC Aux. Input Power-Up. This enables the PC Side Data-View / Data View Software to find the interval for which the APFC did not receive it's Operating AC Power Supply.

▪ After "saving" in to non-volatile memory operation, the LCD back-light which was off at the time of detection of "Power-Failing", it flashes on once, which indicates that the memory saving operation has been successfully carried-out by the APFC Unit.

▪ "Early Warning Power Failed" additionally has one critical functionality for taking care of critical value storage in EEPROM. This prevents any data loss in Interval or Events records or Energy Counters or Capacitor kVAr values to be lost in case of Battery Fault or Replacement of Battery even with Power-Down condition.

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 I/C 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. 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 highly fluctuating load conditions during "Auto-Sync" Operation, or 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 do not get opened and there is 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.

4. MOV or Free-Wheeling Diode across contactor coil

It is **essential** to install 320V AC (+/- 5% Tolerance) rated MOV of 20 mm diameter, directly across the 230V AC rated coil of **EACH** of the capacitor-duty 3-phase Power Contactor, for the protection purpose.

If a suitable MOV is not available, then, at least a suitably rated R-C Snubber must be placed across the 230 V AC Rated Contactor Coil, for protection purpose.

The recommended values for the Series Connected Resistor & Capacitor (R & C) Components are:

R =330 Ohm, +/- 5% Tolerance, 1 Watt, CFR Type.
C = 0.1 micro-farad / 1000 V DC, El-Ci-Ar, India, Make, axial, cylindrical.

The above are the right values for a 230 / 240V AC rated Three-Phase Contactor Coil.

In case of Power Contactor Coil is 12 or 24 V DC rated, then, use a Free-Wheeling Diode such as 1N4007 (1 Amp Rating) / 1N5408 (3 Amp Rating) across the Power Contactor Coil, with proper free-wheeling Diode Anode (A) – Cathode (K) polarity.

The Cathode (K) Terminal of the Diode should go to +12 V DC or +24 V DC Supply so that while Power Contactor Coil is energized, the free-wheeling diode remains in blocking (non-conducting) mode due to the reversed bias voltage across the diode. The free-wheeling diode conducts only at the time of coil current interruption, that is Coil going off, to dissipate energy stored in the coil.

After 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 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 banks in off mode. Remove the shorting of 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.

Troubleshooting procedure:

Nature of Fault	Probable Reason	Action to be taken
Unit does not turn ON.	•Input auxillary supply not coming. •Input side fuse blown.	•Check the input supply & restore. •Check fuse in the unit is OK & of Proper rating.
Unit does turn 'ON' but 'I AM OK' LED is steady ON or steady OFF	Processor may be hanged.	Switch OFF the APFC Unit and again Switch it ON.
LCD Display is not properly visible.	The contrast of the LCD may not be Set properly. It may be either very low or high.	Adjust the contrast of the LCD using Left and Right keys of the Keypad. Left key reduces the contrast whereas right key increases the contrast.
Unit does not turn ON any capacitor Banks even if PF is below Lower PF limit.	•If auto-sync failure message is there at Power On. • The load KW is too low. • Control connections from APFC Unit to contactor coils are not proper.	• Load may be highly fluctuating not allowing Auto-Synch. • Disable Auto-Synch and check connections manually. •Check control supply and connections from APFC to contactor coil.
"BATTERY LOW!!!" message on Display *OR* BF Fault on Display OR Corruption of date & time.	In all these three conditions, the battery needs to be checked. • Internal Lithium 3.0 Vdc battery CR2032 used for RTCC, must have been drained.	• Replace this battery with a brand new one of original manufacturer. •Battery Part Number is CR2032 (Maxell Make) • Observe correct positive & negative polarity while replacing.
Some Capacitor banks are declared as faulty even if they are checked to be OK.	•Individual step health monitoring is enabled and tolerance limits set are too stringent.	•Set the kVAr tolerance limits for individual steps monitoring appropriately.

Troubleshooting procedure ... continued

Nature of Fault	Probable Reason	Action to be taken
1] Serial Communication is not working with Hand Held Unit (HHU). 2] Serial Communication Not working with Lap-top (PC).	• Baud rate and other communication parameters selection is not proper. • Serial communication cable connections are not proper. • APFC may be in MANUAL Mode or EDIT Mode. In such a case, Serial Communication would not work.	• Select proper baud rate and other communication parameters. • Check the serial cable continuity as per the connections given earlier in this manual. • Check whether the APFC is in the AUTO Mode. • Try using Lower Baud Rate setting. • Try using shorter Cable.
Data down-loading is not taking place.	•Improper settings in HHU or PC software.	•Ensure proper settings in date/time format of PC, and settings in the PC S/W are correct.
APFC resets occasionally on turning OFF of any contactor.	• The contactor supply phase may be the same as used for **APFC** auxiliary supply. • MOVs or R-C Snubbers are not put across AC Contactor coils.	• Use the different phase for control supply of contactors and for **APFC** supply. • Usage of MOVs or R-C Snubbers for AC Coils is **mandatory.**

Factory Default Settings

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
GENERAL I/O				
Password (Enable:/ Disable)	Disable	Enable	-	Disable
Change password	0000	9999	1	0000
Load default (Yes/ No)	No	Yes	-	No
THD to display (F–THD/ R-THD),	R-THD (RMS)	F-THD (Fundamental)	-	F-THD (Fundamental)
Reset energy counter (Yes/No)	No	YES	-	No
Aux OP1 FUNCTION (None / Trip Flt/ Sys Flt/ OutOfBank.	None	Out of Banks	-	None
Aux IP1 FUNCTION (None / O/P En Di / Mains/Gen/ Reset Bnk Flt.	None	Reset Bnk flt	-	None

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
SYSTEM				
Rated Supply Voltage. (Line-to-Neutral)	60	290	1	254.0
EXT-PT Ratio	1	299.9	1	1
Load Current CT Primary (Amp) (only in user editable steps option)	1	8000	1	1000
NOTE: PT ratio and CT Ratio are adjusted such that Panel VA Rating Should not Exceed 50 MVA.				
DT (Distrib. Trafo.) Ratio	1	299.9	1	1
PF Upper limit: Mains	0.700	0.999	1	CAP 0.999
PF Lower limit: Mains	0.700	0.999	1	IND 0.990
PF Upper limit: Gen	0.700	0.999	1	CAP 0.820
PF Lower limit: Gen	0.700	0.999	1	CAP 0.800
Phase Auto Synch (Enable/Disable)	Enable	Disable	-	Disable

Factory Default Settings

PARAMETER	MIN	MAX	STEP SIZE	FACTORY SETTINGS
Faults				
Over Voltage limit (%)	(resume % set) +1	119	1	113
Over Voltage resume (%)	101	(Limit % Set)-1	1	110
Under Voltage limit (%)	60	(resume % set) -1	1	68
Under Voltage resume (%)	(Limit % Set)+1	99	1	71
Under Ld. kW Fault Disable, Off Step, Off Fix	Disable	Off Fix	-	Off step
Under load limit (%)	1	(resume % set) -1	1	02
Under load resume(%)	(Limit % Set)+1	60	1	03
Over Current Limit (%)	Over current resume limit	150	1	100
Over Current Resume (%)	50	Over Current limit	1	095
Temperature Fault (Fast off/ Disable)	Disable	Fast off	1	Fast off
Temp upper limit	(lower limit 1 set)+1	70	1	70
Temp lower limit	0	(Upper limit 2 set) -1	1	60
Out of Banks Fault (Enable/Disable)	Disable	Enable	-	Enable
Harmonic Overload (Disable/Fast Off)	Disable	Fast off	-	Fast off
V- THD Threshold limit (%)	1	20	1	05
I THD Threshold limit (%)	3	150	1	25
Harmonic fault auto Reset (Enable/Disable)	Disable	Enable	-	Enable
Harmonic Limit Ext loading(%)	2	50	1	20
Low Rng. Mul. Fact For V- THD	1.1	5.0	0.1	3.0
Low Rng. Mul. Fact For I- THD	1.1	5.0	0.1	4.0
Control Fault 1 (Enable, Disable)	Disable	Enable	-	Enable
Control Fault 2(Enable, Disable)	Disable	Enable	-	Enable
Bank health tolerance (%)	3	99	1	20

Factory Default Settings

PARAMETER	MIN	MAX	STEP SIZE	FACTORY Setting
STEP				
1] Steps Connected : 16	1	16	1	08 (as per Model)
2] Define kVAr Rated Voltage	110	810	1	440
3] Smallest kVAr Safety Fact	1.1	1.9	0.1	1.5
3] Correction Time (Seconds)	1	240	1	120
4] Discharge Time (Seconds)	1	300	1	60
6] IntrLeaving Dely (Second)	1	1	1	1
5] Fixed bank setting	1	16	1	_
6] Unequal Bank [1] KVAr	1	250	1	12
7] Unequal Bank [2] KVAr	1	250	1	12
8] Unequal Bank [3] KVAr	1	250	1	12
9] Unequal Bank [4] KVAr	1	250	1	18
10] Unequal Bank [5] KVAr	1	250	1	18
11] Unequal Bank [6] KVAr	1	250	1	20
12] Unequal Bank [7] KVAr	1	250	1	40
13] Unequal Bank [8] KVAr	1	250	1	50
14] Unequal Bank [9] KVAr	1	250	1	60
15] Unequal Bank [10] KVAr	1	250	1	70
16] Unequal Bank [11] KVAr	1	250	1	80
17] Unequal Bank [12] KVAr	1	250	1	90
18] Unequal Bank [13] KVAr	1	250	1	100
19] Unequal Bank [14] KVAr	1	250	1	125
20] Unequal Bank [15] KVAr	1	250	1	150
21] Unequal Bank [16] KVAr	1	250	1	180

Factory Default Settings, EACH Panel ID MUST be an Unique Number in the Project. Avoid Duplications!

PARAMETER	MIN	MAX	STEP SIZE	FACTORY Settings
Communication				
1] Panel ID (MUST be an "UNIQUE"!)	00000000	99999999	1	00000001
2] Erase Data 4 New ID (Yes/ No)	Yes	No	-	No
3] Baud Rate – COM1 4,800 bps 9,600 bps 19,200 bps 57,600 bps	4,800 bps	57,600 bps	1	57,600 bps
4] Set Time (HH/MM/SS) 24 Hours Clock	–	–	–	Current Time
5] Set Date (DD/MM/YY)	–	–	–	Current Date
6] Initialize R.T.C.C. (Yes/No)	–	–	–	No
7] Clear R.T.C.C. Battery fault (Yes/ No)	–	–	–	No
8] Select Data Log Interval Time: 60 MIN 30 MIN 15 MIN 10 MIN	10 MIN	60 MIN	-	60 MIN
9] Erase data 4LOGTIME (Yes/No)	No	Yes	-	Yes
10] Ovr Wrt INTER LOG (Yes/No)	No	Yes	-	No
11] Ovr Wrt EVENT LOG (Yes/No)	No	Yes	-	Yes
12] COM 2 Function :None Mod-Bus ASCII Mod-Bus RTU GSM on RS-232	None	GSM	-	Mod-Bus RTU
13] Baud Rate – COM 2 4,800 /9,600/19,200/57,600 bps	4,800 bps	57,600 bps	1	9,600 bps
14] Service Provider Mobile No.	0000000000	9999999999	1	0000000000
15] SMS Receiver Mobile Number	0000000000	9999999999	1	0000000000

Factory Default Settings

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
Utilization Counters (not editable in the field)				
1] Bank [1]	0000000000	9999999999	1	0000000000
2] Bank [2]	0000000000	9999999999	1	0000000000
3] Bank [3]	0000000000	9999999999	1	0000000000
4] Bank [4]	0000000000	9999999999	1	0000000000
5] Bank [5]	0000000000	9999999999	1	0000000000
6] Bank [6]	0000000000	9999999999	1	0000000000
7] Bank [7]	0000000000	9999999999	1	0000000000
8] Bank [8]	0000000000	9999999999	1	0000000000
9] Bank [9]	0000000000	9999999999	1	0000000000
10] Bank [10]	0000000000	9999999999	1	0000000000
11]Bank [11]]	0000000000	9999999999	1	0000000000
12] Bank [12]	0000000000	9999999999	1	0000000000
13] Bank [13]	0000000000	9999999999	1	0000000000
14] Bank [14]	0000000000	9999999999	1	0000000000
15] Bank [15]	0000000000	9999999999	1	0000000000
16] Bank [16]	0000000000	9999999999	1	0000000000

Maintenance Copy, to be filled-in properly at the end of successful commissioning:

PARAMETER	As on Date	As on Date	As on Date
GENERAL I/O			
Password (Enable:/ Disable)			
Change password			
Load default (Yes/ No)			
THD to display (F–THD/ R-THD) F = Fundamental, R = RMS			
Reset energy counter (Yes/No)			
Aux OP1 FUNCTION (None / Trip Flt/ Sys Flt/ Out-of-Banks.			
Aux IP1 FUNCTION (None / O/P En Di / Mains/Gen/ Reset Bnk Flt.			

PARAMETER	As on date	As on date	As on date
SYSTEM			
Rated Supply Voltage. (Line-to-Neutral)			
EXT-PT Ratio			
Current CT Primary (Amp) (only in user editable steps option)			
NOTE: PT ratio and CT Ratio are adjusted such that Panel VA Rating Should not Exceed 50 MVA.			
D.T. (Distr. Trafo.) Ratio			
PF Upper limit: Mains			
PF Lower limit: Mains			
PF Upper limit: Gen			
PF Lower limit: Gen			
Phase Auto-Synch (Enable/Disable)			

PARAMETER	As on date	As on date	As on date
Faults			
Over Voltage limit (%)			
Over Voltage resume (%)			
Under Voltage limit (%)			
Under Voltage resume (%)			
Under Load, (kW) Fault Disable, Off Step ,Off Fix			
Under load limit (%)			
Under load resume(%)			
Over Current Limit (%)			
Over Current Resume (%)			
Temperature Fault (Fast off/ Disable)			
Temperature upper limit			
Temperature lower limit			
Out of Banks Fault (Enable/Disable)			
Harmonic Overload (Disable/Fast Off)			
V- THD Threshold limit (%)			
I THD Threshold limit (%)			
Harmonic fault auto Reset (Enable/Disable)			
Harmonic Limit Ext loading(%)			
Low Rng. Mul. Fact For V- THD			
Low Rng. Mul. Fact For I- THD			
Control Fault 1 (Enable, Disable)			
Control Fault 2(Enable, Disable)			
Bank health tolerance (%)			

PARAMETER	As on date	As on date	As on date
STEP			
1] Steps Connected : 16 (Max.)			
2] Define kVAr Voltage			
3] Smallest kVAr Safety Fact			
3] Correction Time (Seconds)			
4] Discharge Time (Seconds)			
6] Intr Leaving Dely. (Second)			
5] Fixed bank setting			
6] Unequal Bank [1] KVAr			
7] Unequal Bank [2] KVAr			
8] Unequal Bank [3] KVAr			
9] Unequal Bank [4] KVAr			
10] Unequal Bank [5] KVAr			
11] Unequal Bank [6] KVAr			
12] Unequal Bank [7] KVAr			
13] Unequal Bank [8] KVAr			
14] Unequal Bank [9] KVAr			
15] Unequal Bank [10] KVAr			
16] Unequal Bank [11] KVAr			
17] Unequal Bank [12] KVAr			
18] Unequal Bank [13] KVAr			
19] Unequal Bank [14] KVAr			
20] Unequal Bank [15] KVAr			
21] Unequal Bank [16] KVAr			

PARAMETER	As on date	As on date	As on date
Communication			
1] Panel ID			
2] ErasData 4 New ID (Yes: 1/ No: 0)			
3] Baud Rate – COM1 0: 4800 1: 9600 2: 19200 3: 57600			
4] Set Time (HH/MM/SS) 24 Hours clock			
5] Set Date (DD/MM/YY)			
6] Initialize RTCC (Yes: 1/No: 0)			
7] Clear Battery fault (Yes: 1/ No: 0)			
8] Select Data Log Interval Time: 60 MIN 30 MIN 15 MIN 10 MIN			
9] Erase data 4LOGTIME (Yes/ No)			
10] Ovr Wrt INTER LOG (Yes/ No)			
11] Ovr Wrt EVENT LOG (Yes/ No)			
12] COM 2 Function :None/ Mod-Bus ASCII/ Mod-Bus RTU/ GSM/			
13] Baud Rate – COM 2 4800/ 9600/19200/57600			
14] Service Provider Number			
15] SMS Receiver Number			

Contact us:
The Sales & Marketing / 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
Land-Line Phones: +0091-253-6694956 (Sales & Marketing)
+0091-253-6694955 (Customer Support & Service)
Fax: +0091-253-6694 955

Working Hours: 9:30 AM to 6:30 PM Weekly Off: Saturdays
E-mail: sales@taspowertek.com Web: www.taspowertek.com

This Product is completely Designed, Developed, Manufactured, Assembled, Tested and Calibrated in India by,

TAS PowerTek Pvt. Ltd., Nasik – 422 010, India.

Would you like to learn in-depth on the subject then, buy e-Book on-line from Amazon.com

Book Title: Reactive Power Compensation on LV Supply.

Author: Mr. Tushar P. Mogre, CEO, Director, TAS PowerTek Pvt. Ltd.

e-Book Published by: Amazon.com

Weblink: http://www.amazon.com/gp/aw/d/B00o7YLLYY