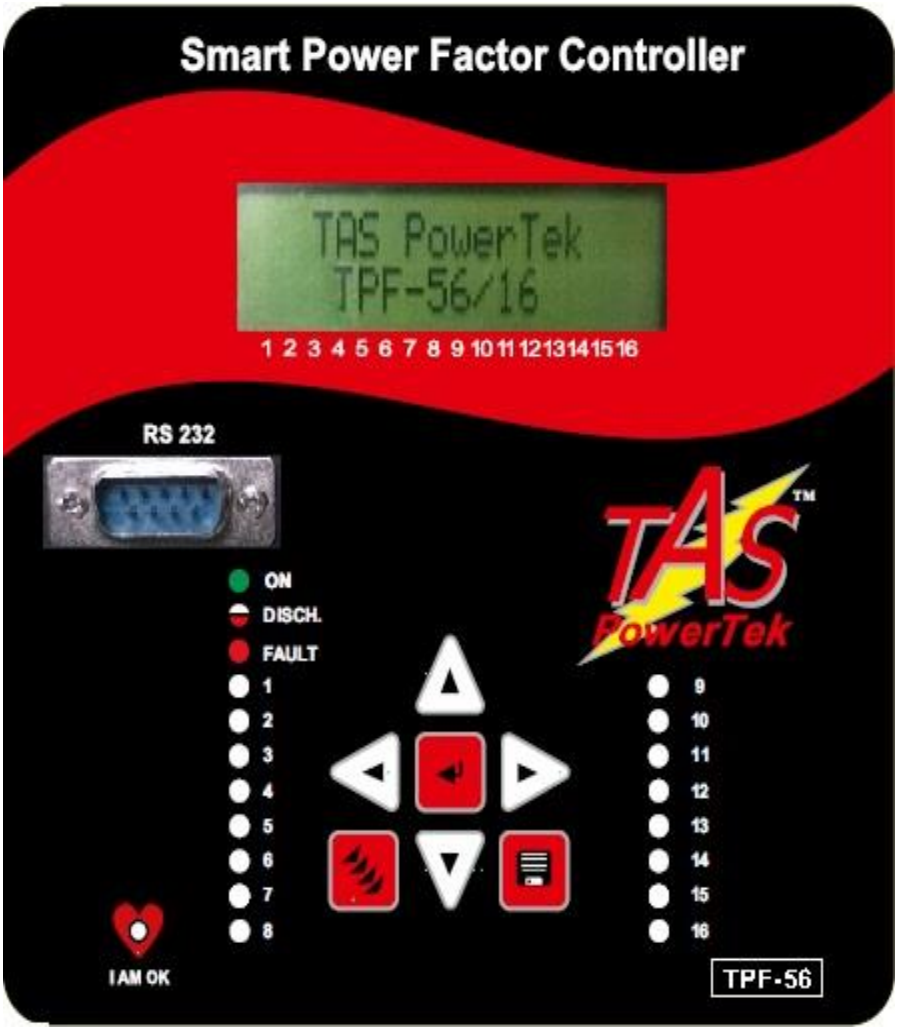
TPF-56

LT Intelligent Automatic Power Factor Controller & Data Logger
For Capacitor-Duty Thyristor Switches,
For High-Speed Power Factor Correction



User Manual

Version 1.1.5

Updated on: 22nd March 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. Make sure that the discharge time set in the controller matches the capacitor discharge time!

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

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

6. This User Manual is applicable to TPF-56 Unit with Firmware Version 1.0.7 as on 25 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)

TPF-56 / nn

nn: Number of Current-sourcing, 20 milli-Amps Current-Limiting, Transistor Output stages: 04,08, 12, or 16.
Please specify the "nn" while quoting, ordering, buying etc.

Note that the Isolated +12 V DC Supply is from User Side, and the "Return" for all Command Outputs of TPF-56/nn are "Commoned" to 0 V of the +12 V DC Supply, at the TAS Thyristor Switches Side.
The TPF-56 Units with TAS Capacitor-Duty Thyristor Switches make ideal combinations for Applications in Welding Shops, Reciprocating Piston Air-Compressors, Electric Arc Furnaces, Induction Furnaces, Rolling-Mills etc.

(Similar APFC Unit is available with Potential-Free, Normally-Open (N. O.) Relay Contacts, as **SPF-56**, for Medium-Speed, P. F. Corrections, based on Three-Phase, Capacitor-Duty, Power Contactors & Three-Phase, Delta Connected Power Capacitors, with Discharge Resistor and optional Current-Limiting I de-tuned Inductive Reactors in EACH Phase to the Power Capacitor.

The **SPF-56** Firmware is compatible for the Relays and the Contactors based Medium-Speed PF Correction Applications with TAS Reactors and Capacitors.

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

Features:

- Totally Micro-Controller based logic for measurements, monitoring, analysis & control.
- Functionality 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 thyristor.
- Communication port RS-232 for logged data downloading and for other convenience functionalities.
- Completely Fire Retardant ABS grade plastic material body with sufficient ventilation for cooling.
- Externally replaceable 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.
- Keypads with soft touch 7 Nos. of 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 PQ 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 transistor outputs.
- Capacitor Banks – same value Equal Utilization logic.

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, 30min,15min,10min 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 TPF-56 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 TPF-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 TPF-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.
- RS485 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 Modbus 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 TPF-56/xx Unit:

1. Rated supply values:

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

2. Auxiliary Supply:

- Line to Line sinusoidal voltage range $100V_{AC}$ - $500V_{AC}$.
- Supply frequency range 47 Hz to 63 Hz.
- Supply VA burden – 8 VA maximum. (typical 6 VA)
- Protected by externally replaceable 0.8 A/$500V_{AC}$ slow-blow glass 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 $300V_{AC}$.
- 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 1Amp or 5Amp AC.
- Current measurement range: $1.5\%I_{Nominal}$ to $130\%I_{Nominal}$
  For 1Amp terminals: 15mA to 1.3Amp.
  For 5Amp terminals: 75mA to 6.5Amp.
- Maximum current withstanding capacity: $4xI_{Nominal}$ 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.

Specifications (continued)**:**

5. Transistorized Output:

- Total No. of Transistorized Output for capacitor banks switching ON / OFF : Maximum up to 16 Numbers.
- Voltage & Current Rating, Transistorized O/Ps (Short-Circuit Protected) : +12 VDC to +24 VDC, Current-Sourcing Output, 20 mA max.
- Protected by Glass cartridge fuse – 200mA,+12/24V DC/fast blow.

6. Connection Terminals (rear side):

- All the connectors are on rear side and suitable for connecting fork type copper lugs with 1.5mm^2 or 2.5mm^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 N-met.
- Voltage rating across 2 adjacent terminals – 380V_{AC}.
- Continuous Current rating (RMS value) – 8 Amp.

7. Battery for RTCC (Real Time Clock-Calendar) & NV RAM:

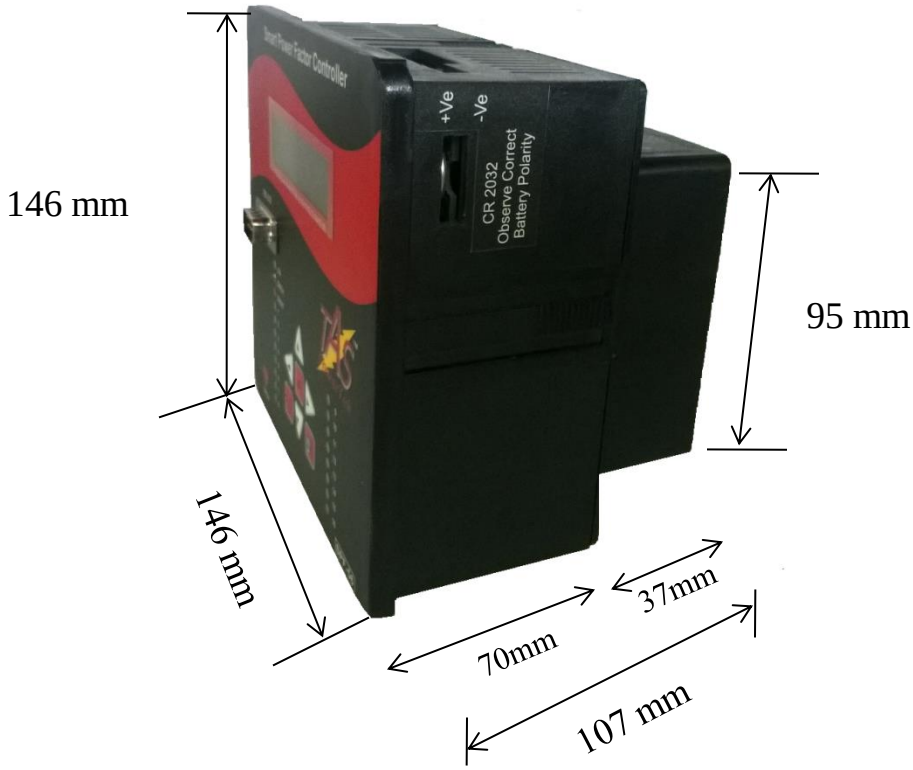
- Battery type to be used : CR2032. (Maxell make preferred)
- Battery Voltage (New) : 3.3V_{DC} to 3.1V_{DC}.
- Low Battery Alarm : 2.6V_{DC}. (Range 2.65V_{DC} to 2.55V_{DC})
- Battery Fault Indication : < 1.8 V_{DC}.
- Expected Battery Life: @ 2½ Years to 3 Years.
- Time frame for Battery replacement after Low Battery Alarm is Maximum 6 months. Recommended period < 3months.

8. Data Log Non-Volatile Memory:

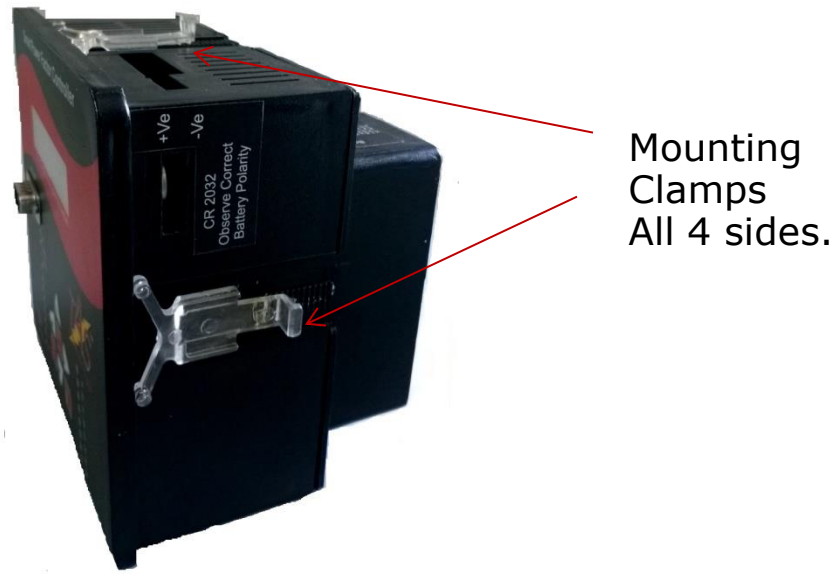
- Used for TPF-56 Program Parameter storage, 1 Hour, 30min,15min,10min interval data log, latest 1024 events data log and Power-down values storage with "Early-Warning-Power-Failed (EWPF)" sequence.
- Critical storage even with RTCC Battery Fail or Replacement for ensuring no data loss or maintain Energy values.

Specifications (continued)**:**

9. Mechanical Dimensions:



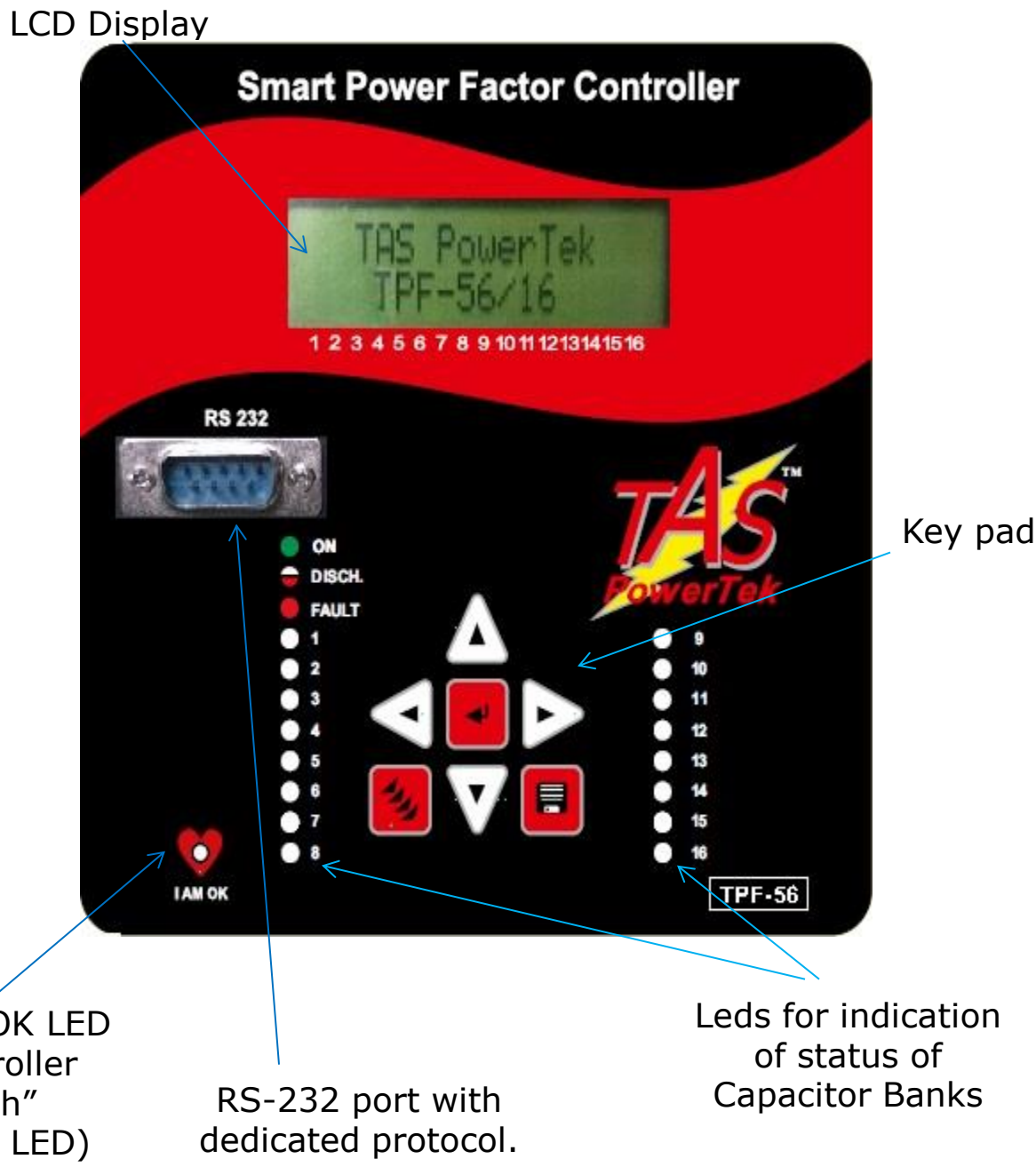
All Dimensions in mm.



•Un-packed net weight of the Unit: 880 gm.

Specifications (continued)**:**

Front fascia

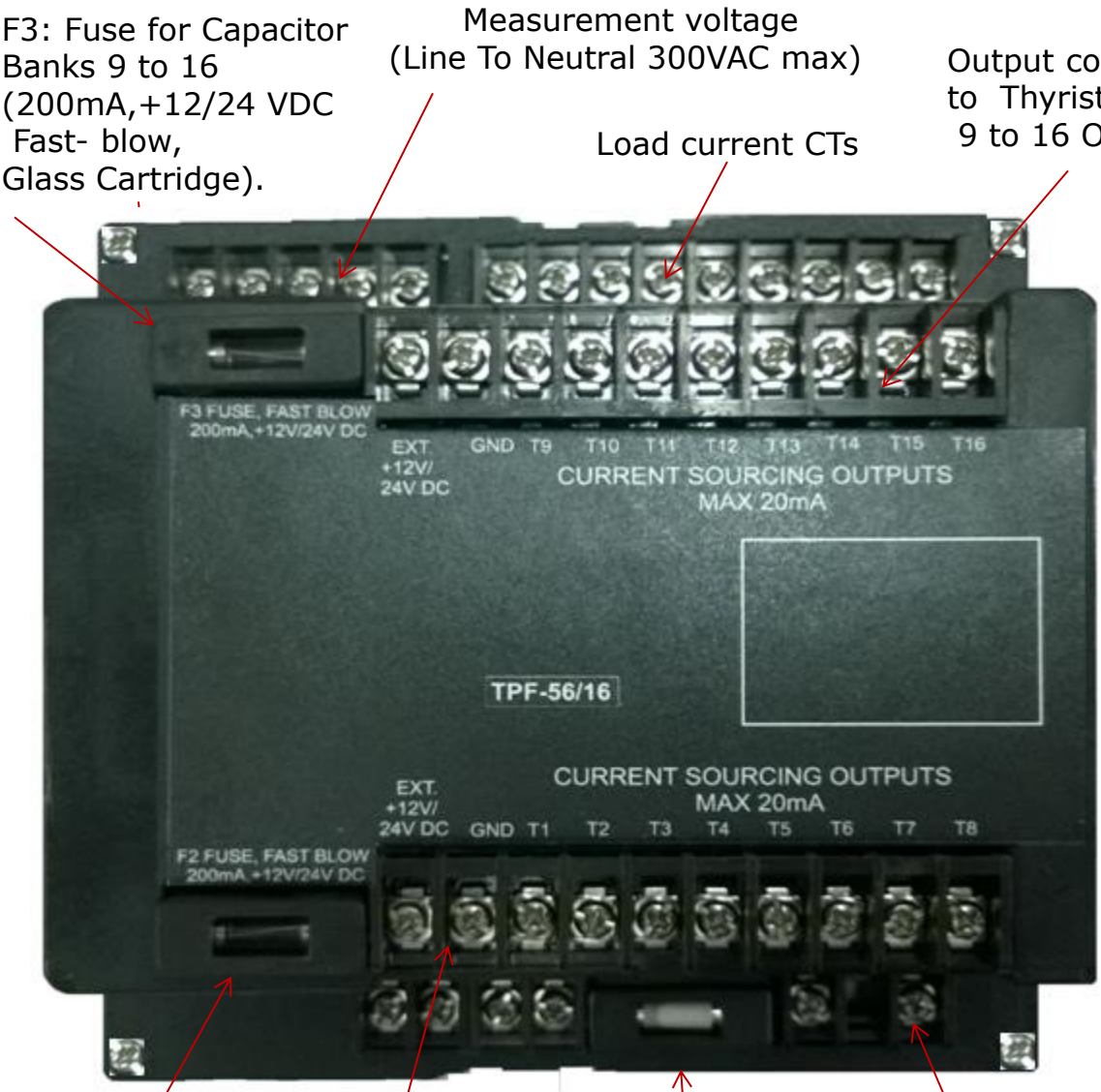


Specifications (continued)**:**

Back side terminals

Note:

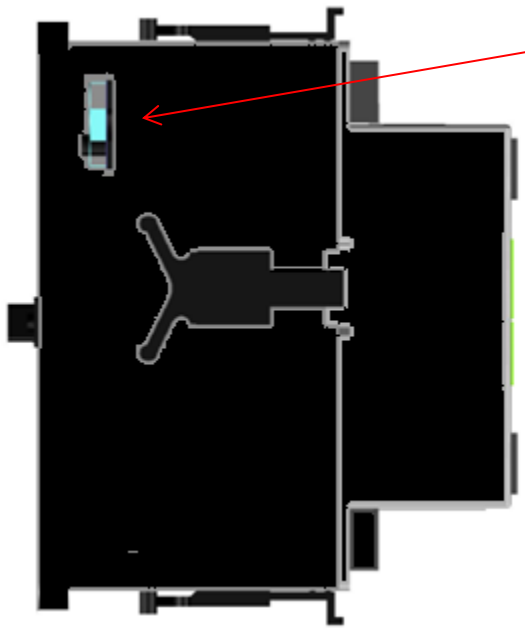
Use appropriately rated and type, while replacing the fuse(s) in the field



Specifications (continued)**:**

Other Auxiliary Arrangements:

RTCC Battery insertion slot.



Battery Slot for replacement
Of CR2032, 3 Vdc Li. Battery.

(Remove black sticker over the slot
to see the battery inside)

Recommended to change the Battery with Auxiliary Supply to Unit in ON condition. RTCC would not be disturbed.

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

In case the Aux. Supply was OFF and then this RTCC Battery is replaced, user will have to set RTCC once again to correct date & time.

Side view of TPF-56 for seeing 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:

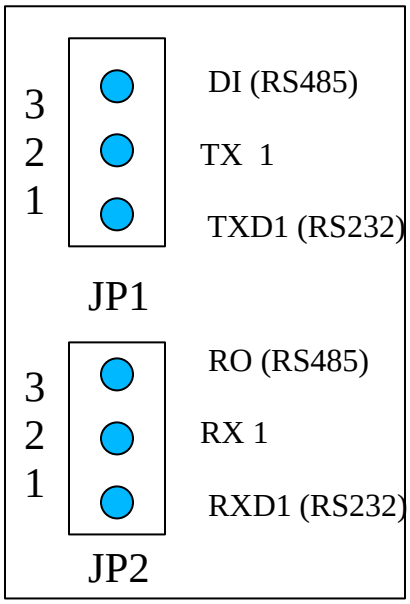
- Operating temperature range: 0°C to +55°C.
- Storage temperature range: 0°C to +65°C.
- Altitude: up to 3500 meters above sea level.
- Relative Humidity range: 10% to 95% RH (Non-condensing).

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 RS485 and GSM communication (Continued):



Selecting positions 1 & 2 in both JP1 and JP2 enables RS232 communication for external GSM Modem.

Selecting positions 2 & 3 in both JP1 and JP2 enables RS485 for MOD-Bus ASCII or MOD-Bus RTU protocol.

Contact us for RS232 to RS 485 converter module for RS 485 communication between TPF-56 and PC / PLC's RS-232 Port, with Auto-Data-Direction Control.

Fig: Berg Jumpers selection for RS232 or RS485 Interface.

D+ (RS485)

D- (RS485)

GND

TXD-GSM(RS232)

RXD-GSM(RS232)

Figure shows connector for RS232 and RS485 Communication. RX and TX for RS 232 communication and D- and D+ for RS485 communication. Note that the Signal Ground Terminal is common for RS-232 or RS-485.

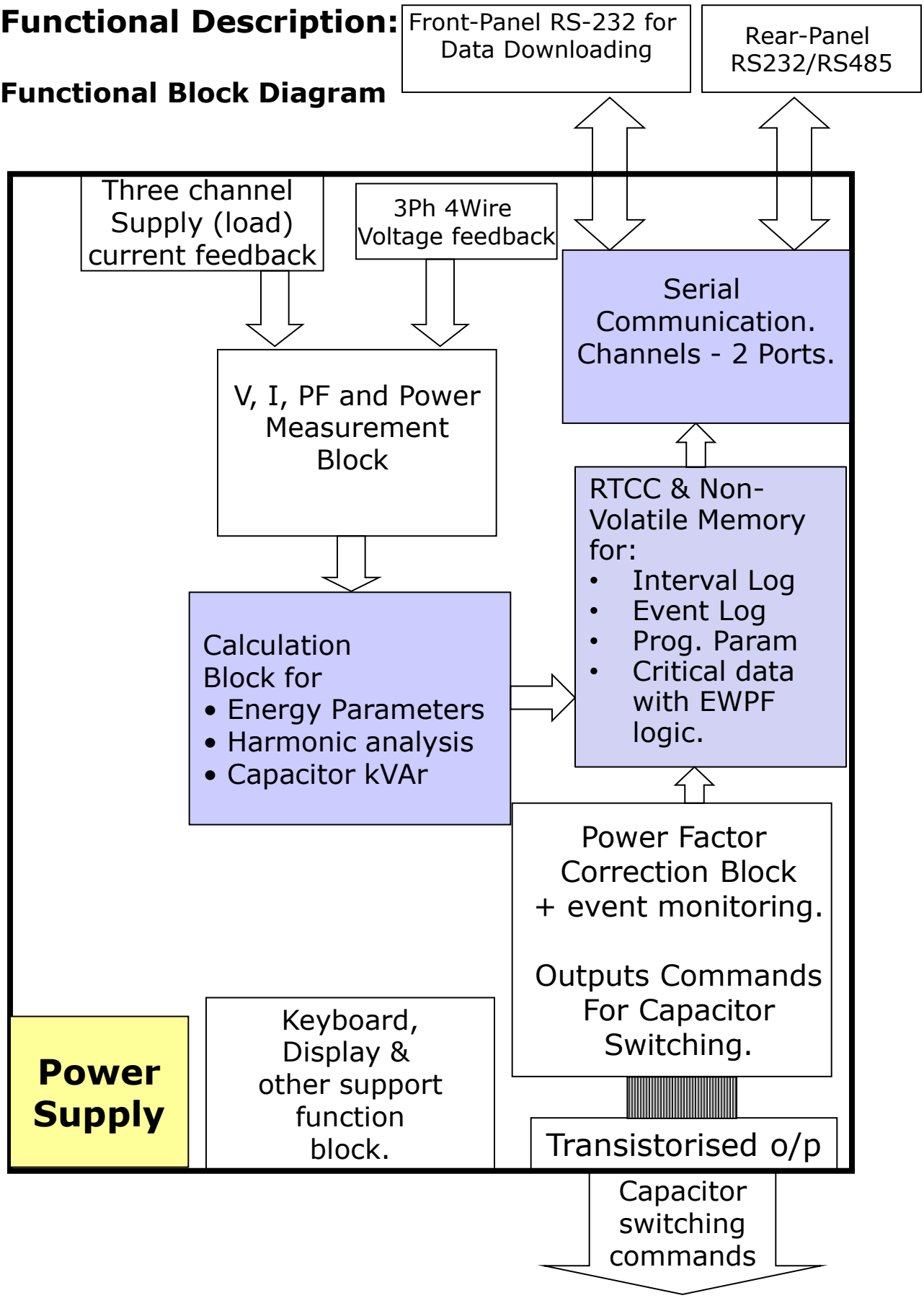
Contact us for Separate Documents for MOD-Bus and GSM Functionality Implementations.

Fig: Connector for RS232 and RS485

Note:
Please remove the 5-way mating 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.

Functional Description:

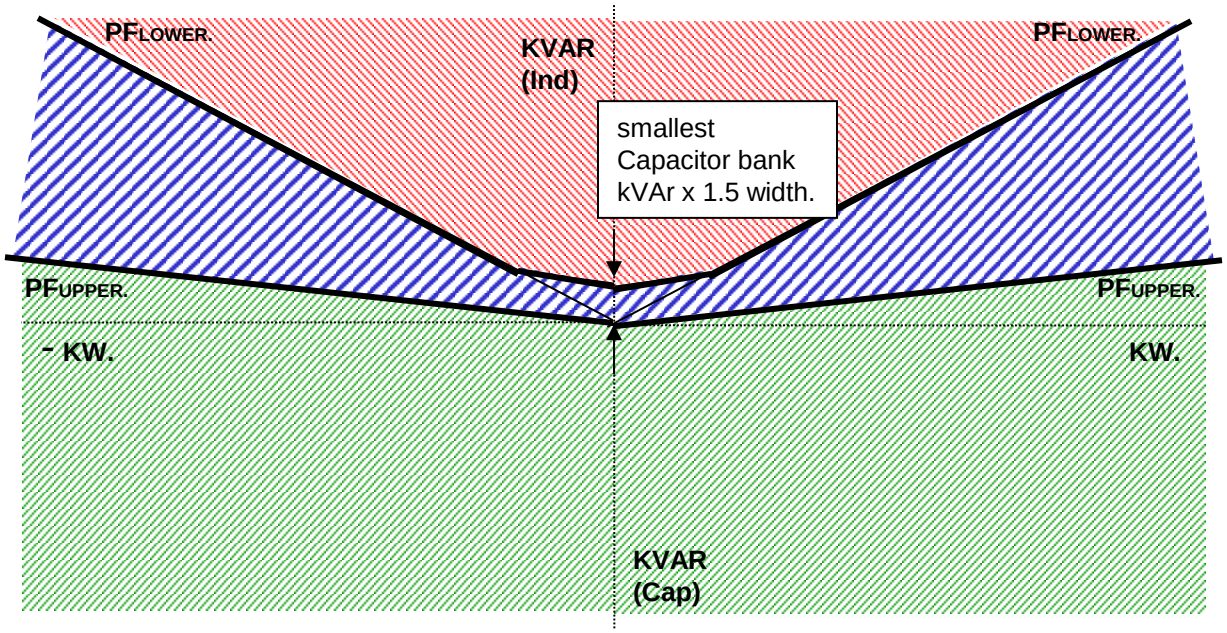
Functional Block Diagram



Functional Description (Continued):

PF correction technique

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

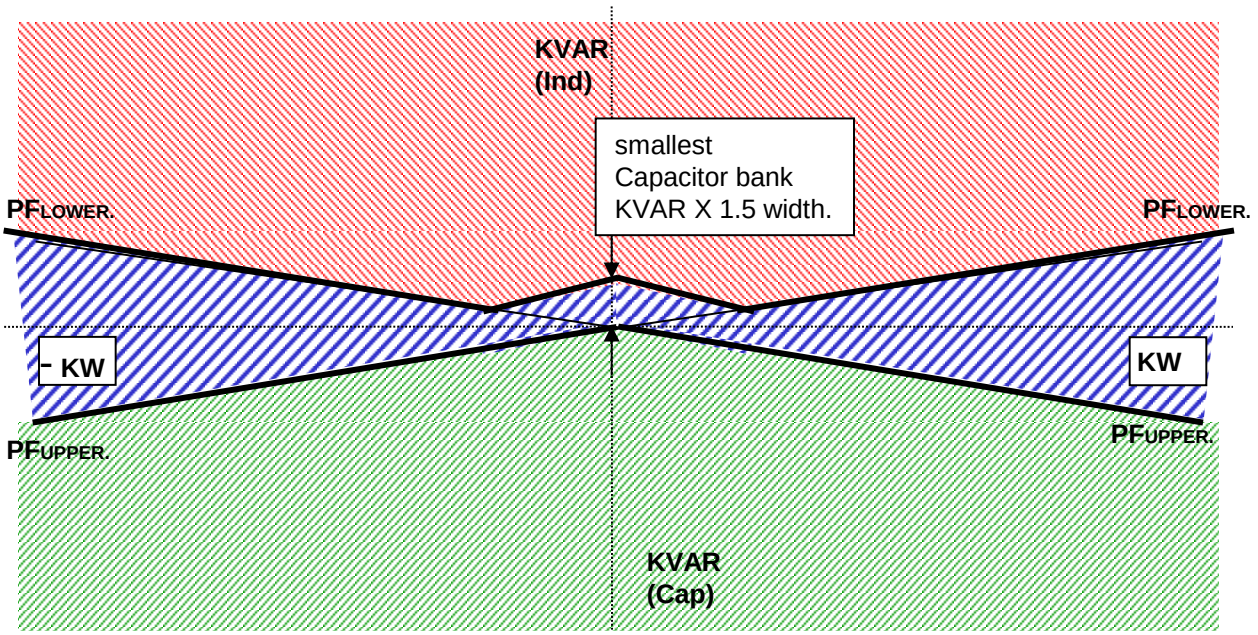


No change band.

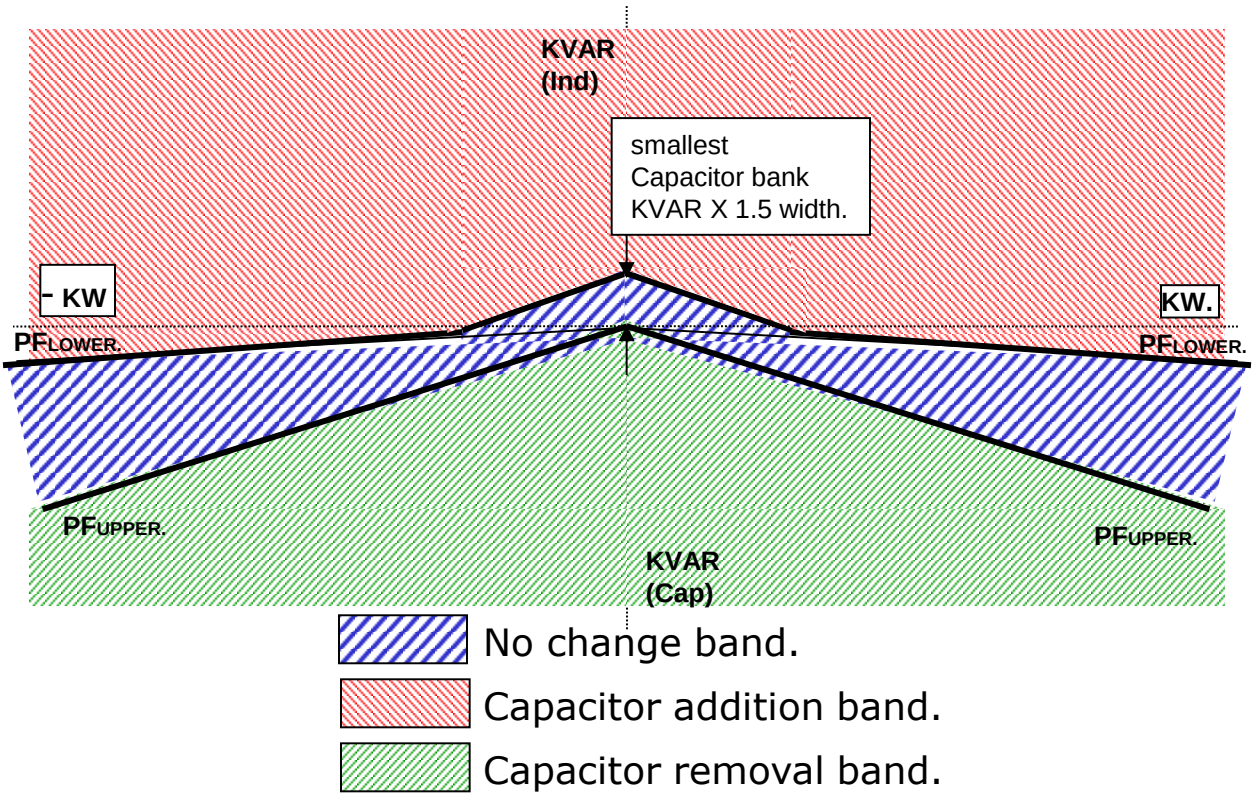
Capacitor addition band.

Capacitor removal band.

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



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



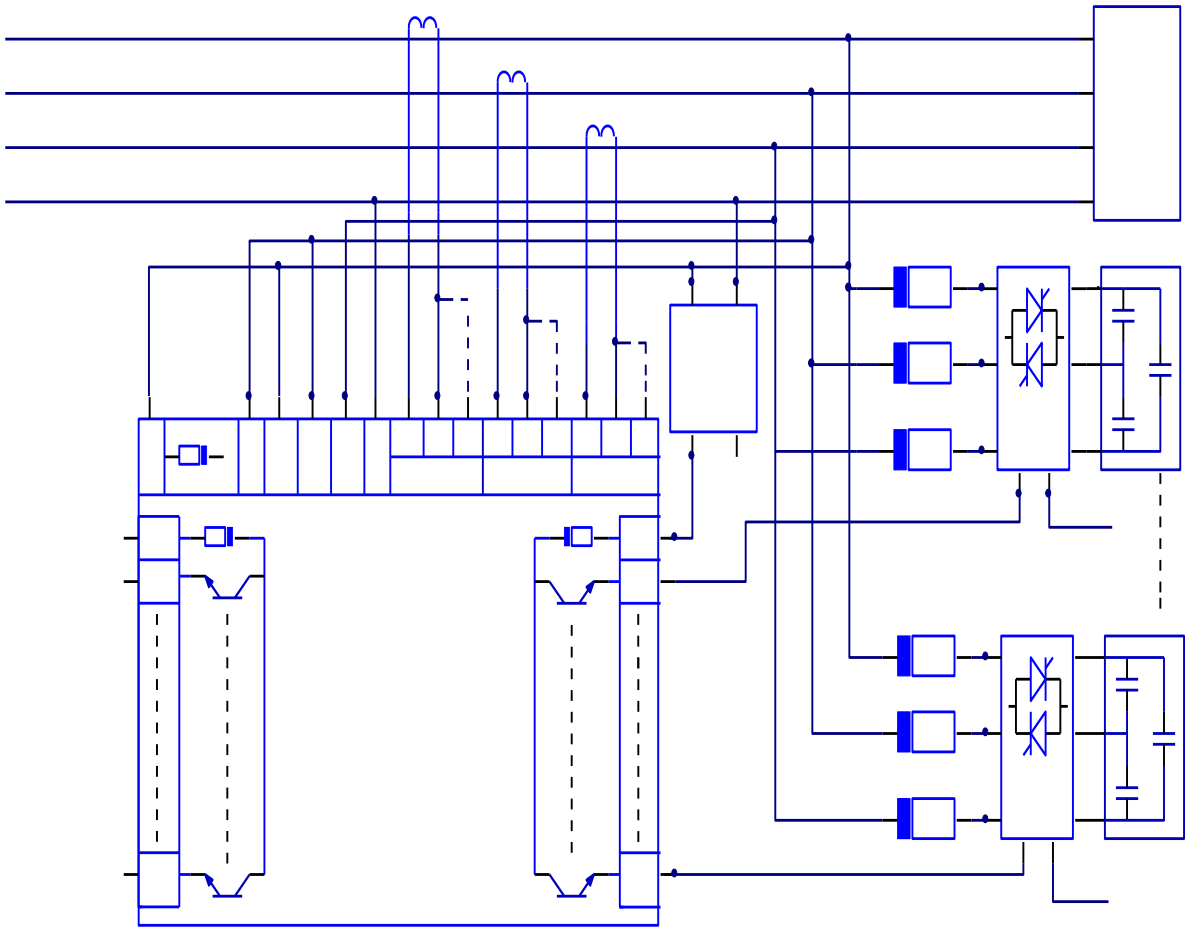
There are two PF set-points to be set in TPF-56/16. The UPPER limit and the LOWER limit. TPF-56 ensures that PF-UPPER is never exceeded. Additionally, "No change band" to minimum KVAR band size equal to smallest bank KVAR x 1.5 ensures no hunting during the low KW loading.

TPF-56 is normally set for PF settings as per first two diagrams shown where PFLOWER 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 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 TPF-56 user friendly and thus easy to commission.

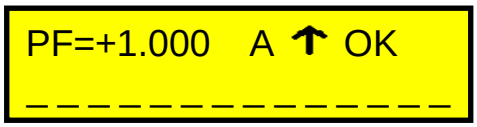
For all the three conditions shown in the above diagrams, 4-quadrant operation is achieved. Typical example of 4-quadrant operation is "Co-Generation Plants" and "Wind-Power Generation". But with most conventional consumer applications, only +Ve KW is seen, where the Auto Synchronization feature can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

Typical wiring diagram for PF correction



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
OV	Over voltage
UV	Under voltage
VH	Voltage over-harmonics THD%
IH	Current over-harmonics THD%
BF	Battery Fail for Battery or RTC faulty
ZC	Zero current in any one phase
AS	Auto-Synchronization Pending

OB	Out of Banks (Insufficient Total Capacitive kVAr – Warning.
OT	Over Temperature
UF	Under Frequency
OF	Over Frequency
UL	Under Load
BL	Low Battery Warning
OC	System Over Current Warning

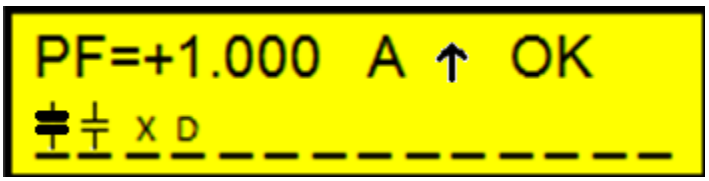
Second line indicates the status of each capacitor bank by symbols.
'I AM OK' Blinking LED indicates the controller's health status ,i.e. the controller is working okay. If this LED stays continuously ON or continuously OFF, then, it means the Controller is not functioning properly.

- 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:



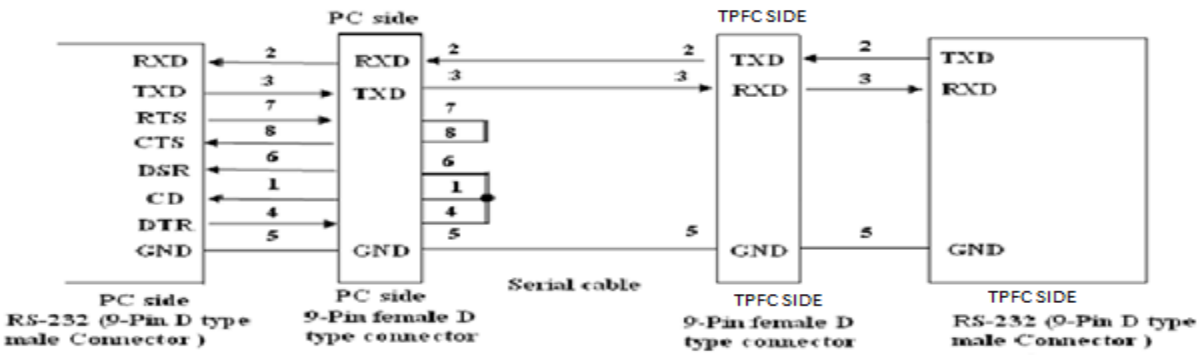
Meaning of this screen contents:
Total no. of banks connected is 16.
Power Factor at Load sensing CT is '+1.000'
'+' indicates Inductive.('-' indicates Capacitive)
Unit is operating in 'A' Auto mode. ('M' defines Manual mode)
"↑" indicates controller is on mains.
"↓" indicates controller is on Generator.
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.

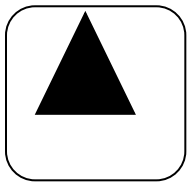
On powering up the unit, there is power-on discharge time given for the capacitors to discharge completely. However, if the user is sure that the capacitors are discharged, then on pressing the **left key** would allow the controller to come out of the discharge time and thus user need not wait for the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

Front side RS232 communication port connection

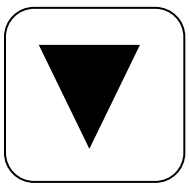
This port is used for downloading of data logged in the controller.
The interface is Standard, 3-wire, RS232. For further description about the data logging, please refer Page No. 36 of this user manual.
Following gives the pin configuration:



Front fascia –
Keypad

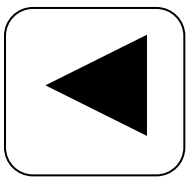


UP key. Used to scroll up the menu screen; increment values when entering numbers. Also used for changing the status of banks.

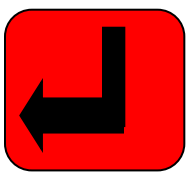


DOWN key. Used to scroll down the menu screen; decrement values when entering numbers. Also use to change status of bank.

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.



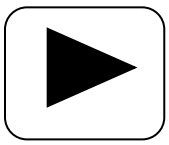
ENTER key. Used for entering a submenu or for setting up values.

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

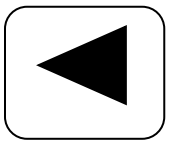
SAVE key. Used to save all the changes made in the Program mode menu.

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 TPF-56.

Any key on the Keypad pressed once, will turn on the Back-light of LCD display.

Any non-activity on the keyboard for more than 1 Minute would 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 TPF-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 Hr) & date is in DD/MM/YY format.
TAS POWERTEK VER. 1.0.5	Displays Name and the version of software.
UNIT SR.NO 4600054100001	Display Sr. No of Controller. It is used for Data downloading.

Sub-menu for display of parameters

Overall Values	Max. Values	Per Phase RMS	Display Power	Display Energy	Display Harmonics
Average Voltage 00000.0 (L-N)	Maximum Voltage 0000.0 V	R-Phase Voltage 00000.0 (L-N)	R-Phase PF 1.000 IND	KWH 000000000.0	Vr-THD -F 000.0 %
Average Current 0000.0 A	Maximum Current 0000.0 A	Y-Phase Voltage 00000.0 (L-N)	Y-Phase PF 1.000 IND	IND KVARH 000000000.0	Vy-THD-F 000.0 %
Active Power 00000.0 KW	Maximum 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 %
Reactive Power 00000.0 KVAr	Maximum KVAR 00000.0 KVAR	R-Phase Current 0000.0 A	R-Phase KW 000000.0	KVAH 000000000.0	Ir-THD -F 000.0 %
Apparent Power 00000.0 KVA	Maximum KVA 00000.0 KVA	Y-Phase Current 0000.0A	Y-Phase KW 000000.0		Iy-THD -F 000.0 %
C-KVAR 000000.0	RESET MAXIMUM VALUES NO/YES	B-Phase Current 0000.0A	B-Phase KW 00000.0		Ib-THD -F 000.0 %
Frequency 00.0 Hz		Neutral Current 0000.0A	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 000000.0		
			B-Phase KVA 000000.0 KVA		

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 Harmonics

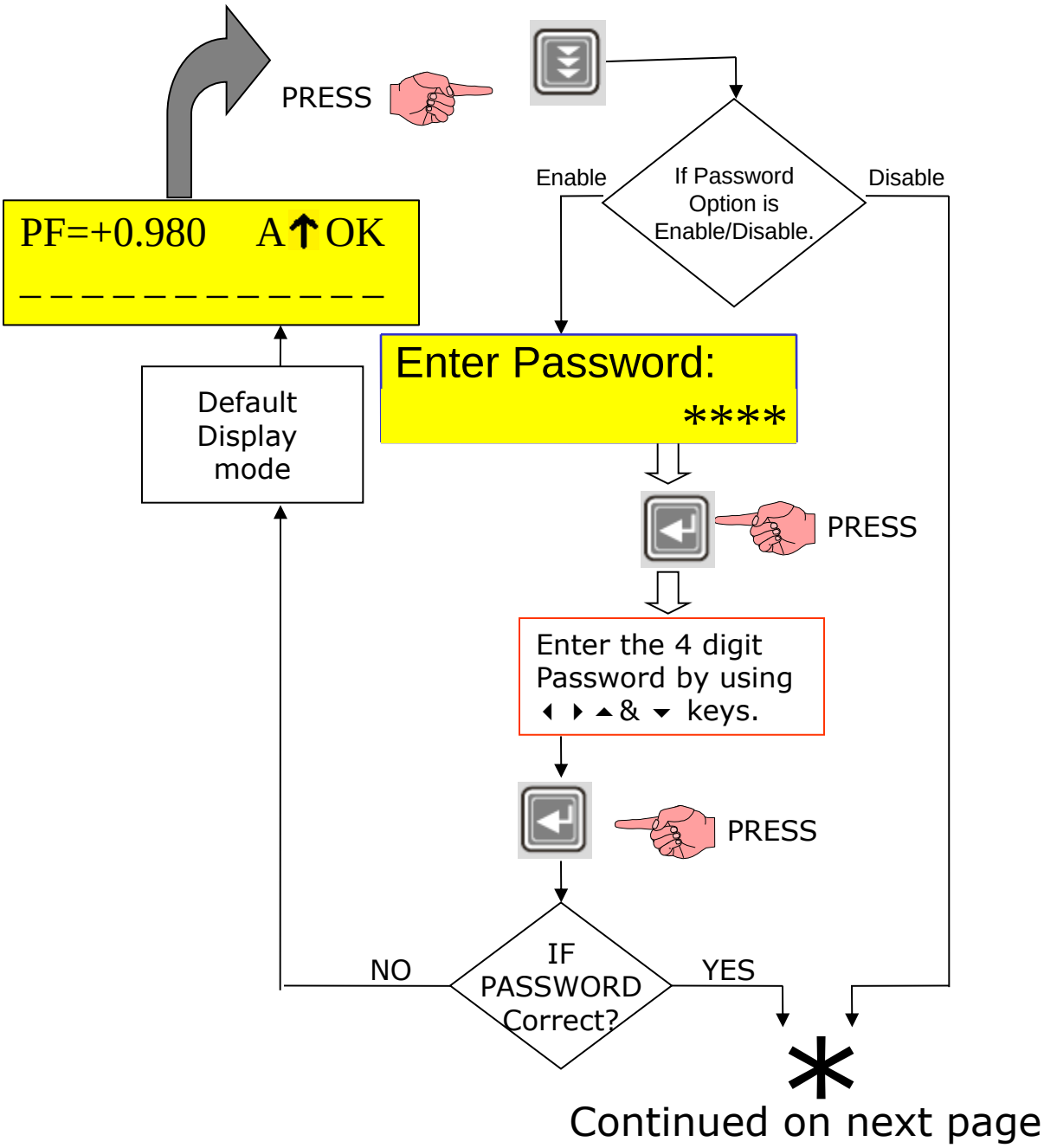
Vr Harmonics 3rd:00.0%	Vy Harmonics 3rd:00.0%	Vb Harmonics 3rd:00.0%
Vr Harmonics 5th:00.0%	Vy Harmonics 5th:00.0%	Vb Harmonics 5th:00.0%
Vr Harmonics 7th:00.0%	Vy Harmonics 7th:00.0%	Vb Harmonics 7th:00.0%
Vr Harmonics 9th:00.0%	Vy Harmonics 9th:00.0%	Vb Harmonics 9th:00.0%
Vr Harmonics 11th:00.0%	Vy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

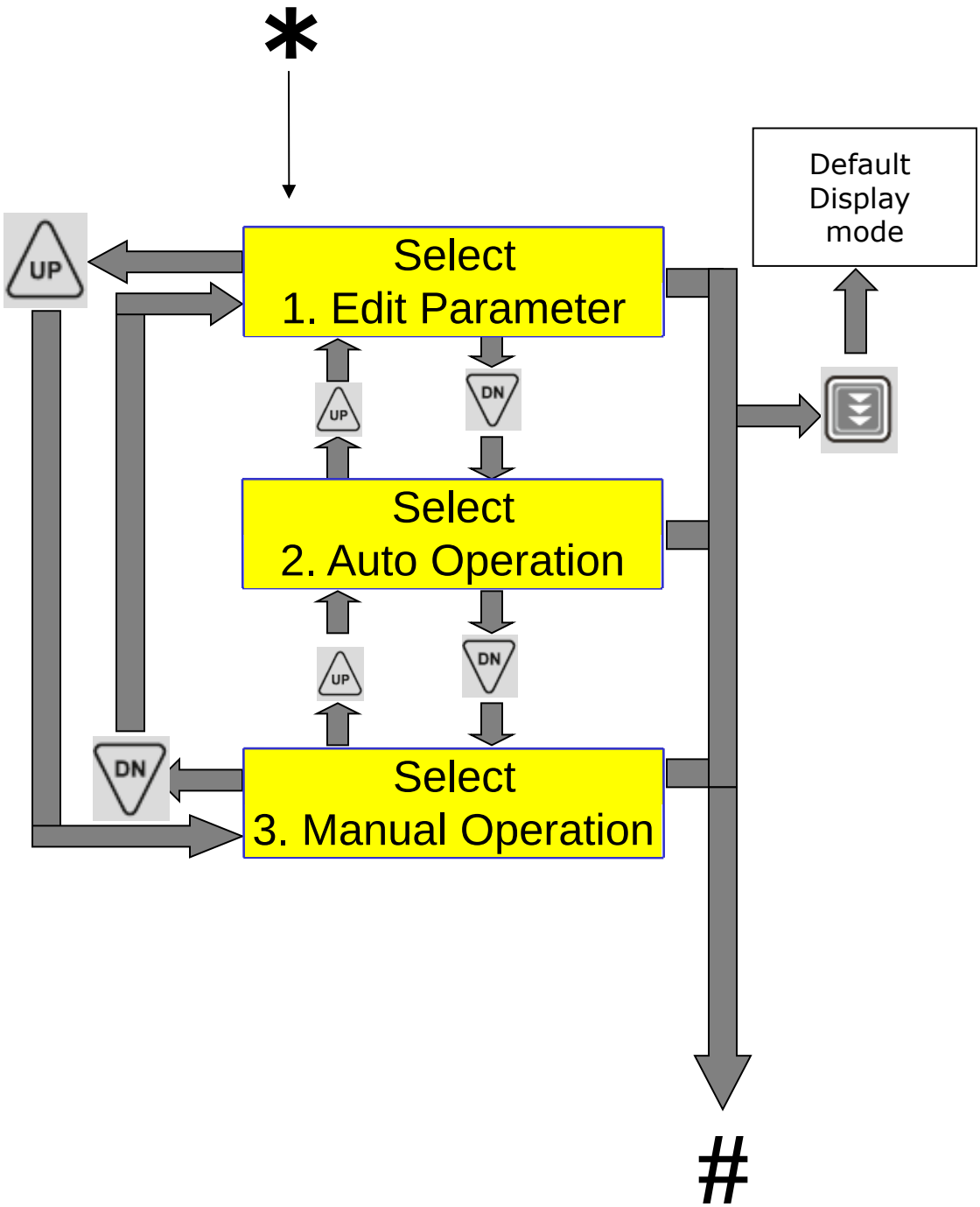
I Harmonics

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

Flowchart for entering into different modes:





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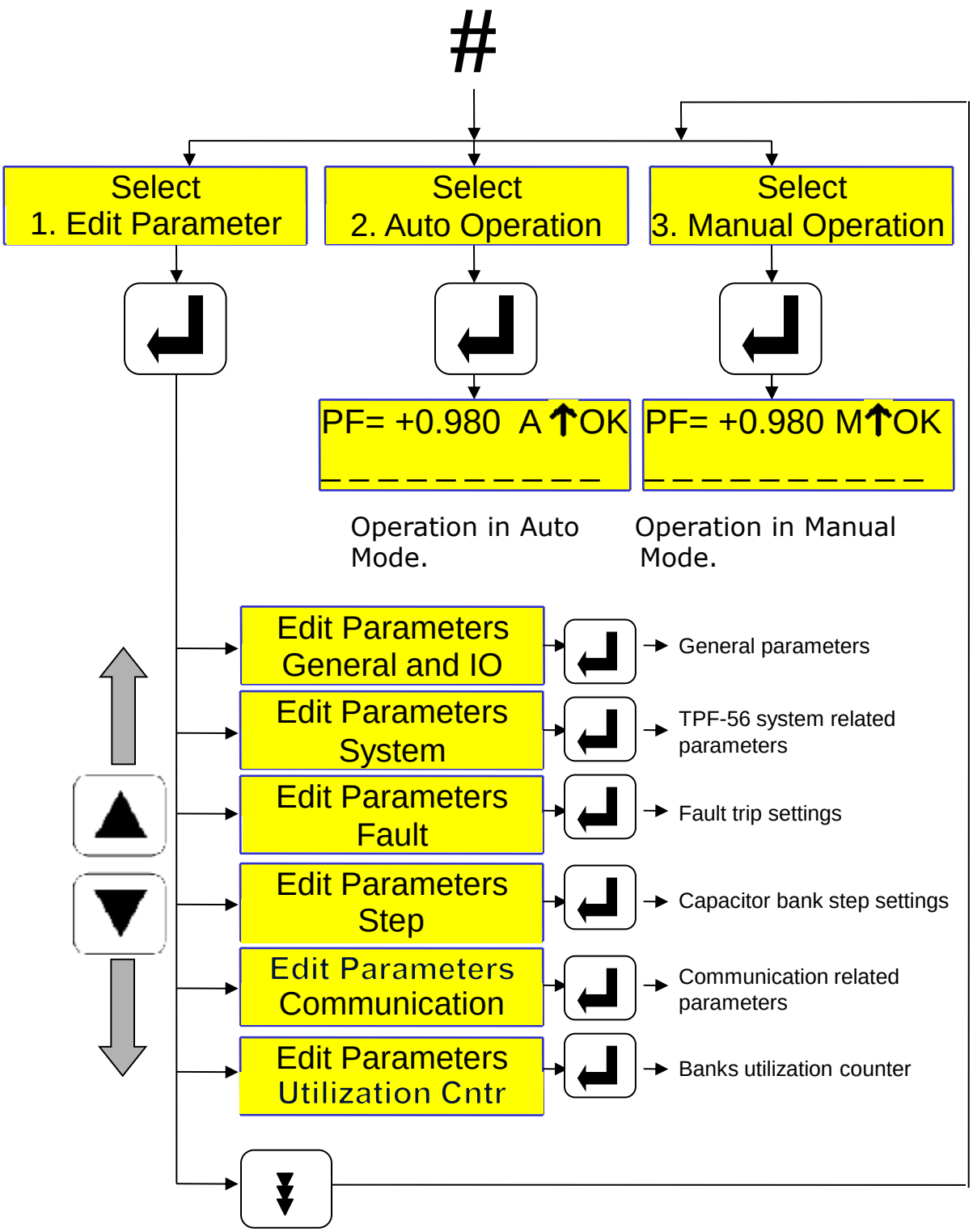

#
Select
1. Edit Parameter
Select
2. Auto Operation
Select
3. Manual Operation
PF= +0.980 A OK
PF= +0.980 M OK
Operation in Auto Mode.
Operation in Manual Mode.
Edit Parameters General and IO
General parameters
Edit Parameters System
TPF-56 system related parameters
Edit Parameters Fault
Fault trip settings
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 PF correction mode.

Manual Operation:

Pressing ENTER button, while on this screen, will put TPF-56 in Manual mode. If user has switched to Manual Mode and for 5 minutes no key on the keypad is pressed, then TPF-56 will automatically switch to Auto Mode.

In manual mode the user can manually turn ON/OFF the banks. But this is not allowable for all the faults. In case of the following faults, turning ON the banks in manual mode is NOT allowed:

1] Under Voltage (UV)
2] Over Voltage (OV)
3] Under Frequency (UF)
4] Over Frequency (OF)

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.

continued..

…continued.

For Testing 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 TPF-56 system related settings.
Fault : Fault settings.
Step : Capacitor bank step settings.
Communication : Communication parameters.
Utilization counter: 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.

THD to Display: Type of THD to be displayed for V and I. R-THD (RMS), 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, OutOfBank.

AUX IP1 FUNCTION : Set an action through auxiliary input None ,O/P En Di (output enable disable) , Mains/generator, Reset Bank Flt. When controller is on Mains mode then on main screen shows ↑ (arrow). And if controller is on generator mode 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] 0.999
PF Up Lim: Mains Cap: 0 [0.999]
PF Low Lim: Mains [Ind : 1] 0.990
PF Low Lim: Mains Ind : 1 [0.999]
PF Up Lim: Gen [Cap : 0] 0.820
PF Up Lim: Gen Cap: 0 [0.820]
PF Low Lim: Gen [Cap : 0] 0.800
PF Low Lim: Gen Cap : 0 [0.800]

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

Ext-PT ratio: In case the external PT is used, this ratio can be set.

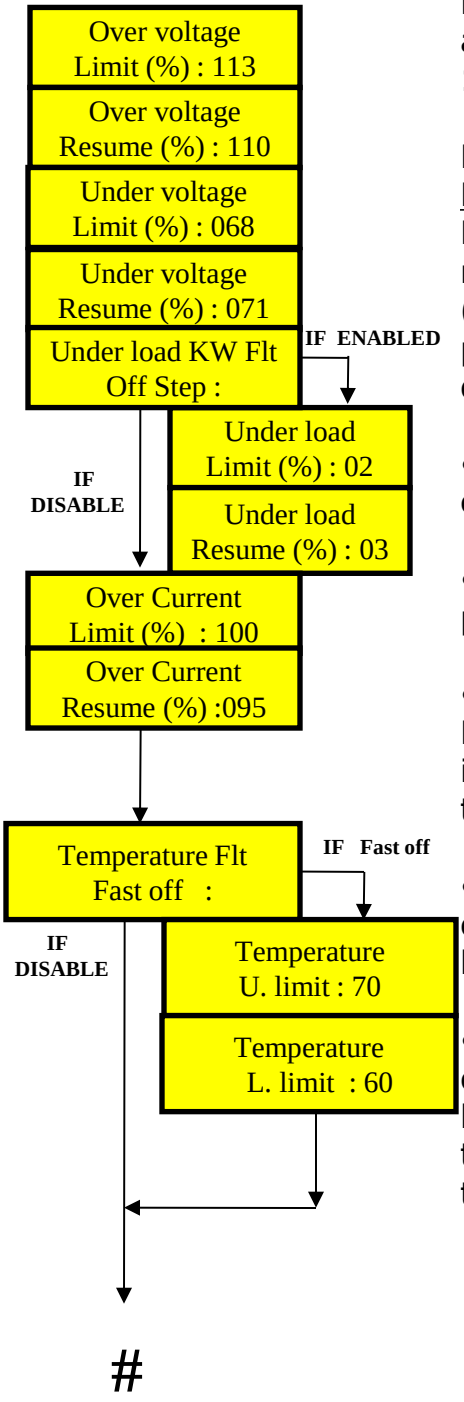
Cur CT Primary: Rated Feedback Load current for mains. NOTE: PT ratio and CT Ratio are adjusted such that Panel VA Rating Should not Exceed 50 MVA.

DT Ratio: Set the distribution transformer ratio.

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.

continued..

Fault



For over-voltage and under-voltage fault, the option available is as hereunder:
1=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 deactivated.

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

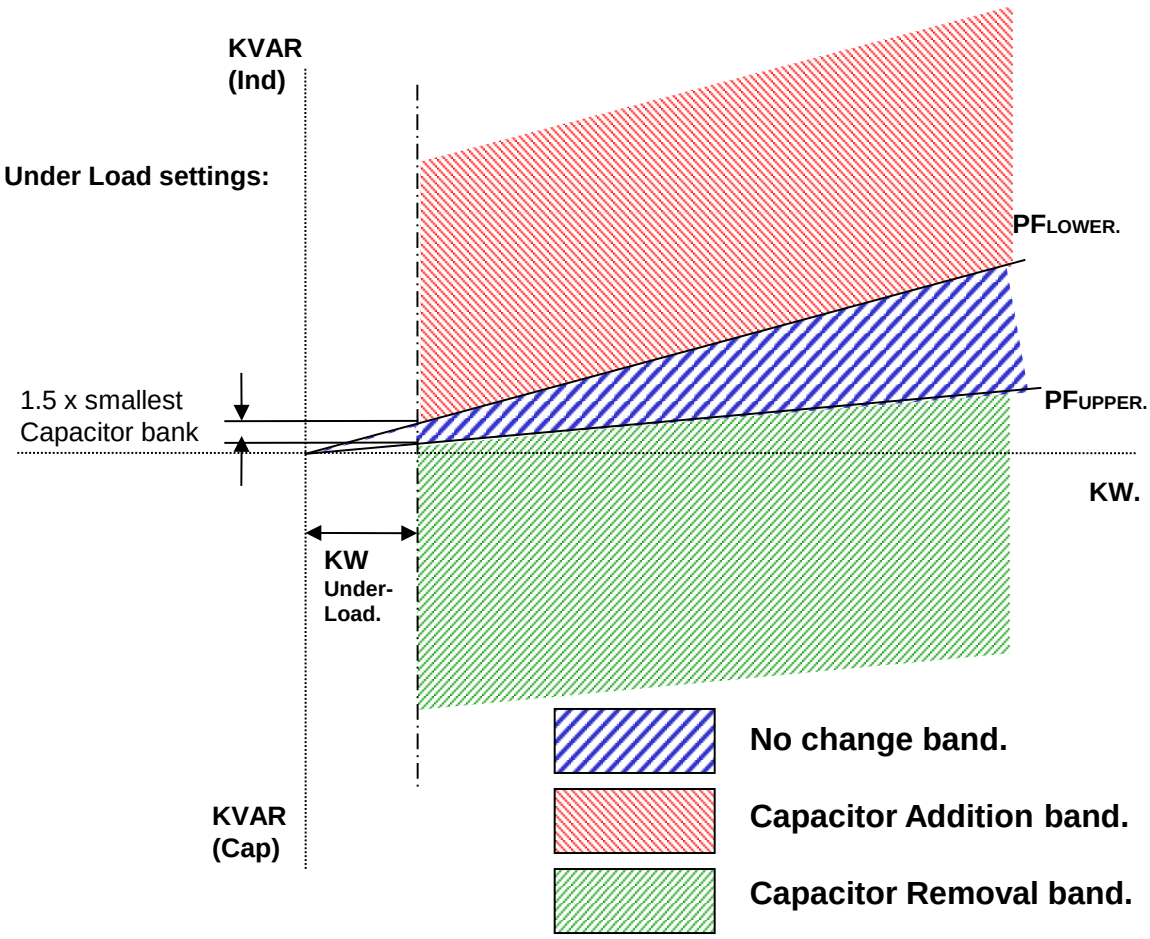
• Under-Voltage: For Under-Voltage conditions in any one phase persisting for 3 sec.

• 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 here.

•Over current: The TPF-56 detects if the supply system is overloaded, then it is for warning indication. No capacitor banks are switched off with this detection.

•Temperature fault: As the name suggests, it displays the over temperature fault if the temperature exceeds the set limits. There are two parameters related to it, i.e. the temperature upper limit and lower limit. If fault is set, then "Fast Off step" action is undertaken.

continued..



For PF_{UPPER} Inductive and PF_{LOWER} Inductive :

$$\textbf{Under-Load kW value setting} = \frac{\textbf{1.5 x Smallest Bank kVAr.}}{[\tan\{\cos^{-1}(PF_{LOWER})\} - \tan\{\cos^{-1}(PF_{UPPER})\}]}$$

For PF_{UPPER} Capacitive and PF_{LOWER} Inductive :

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

For PF_{UPPER} Capacitive and PF_{LOWER} Capacitive:

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

…continued.

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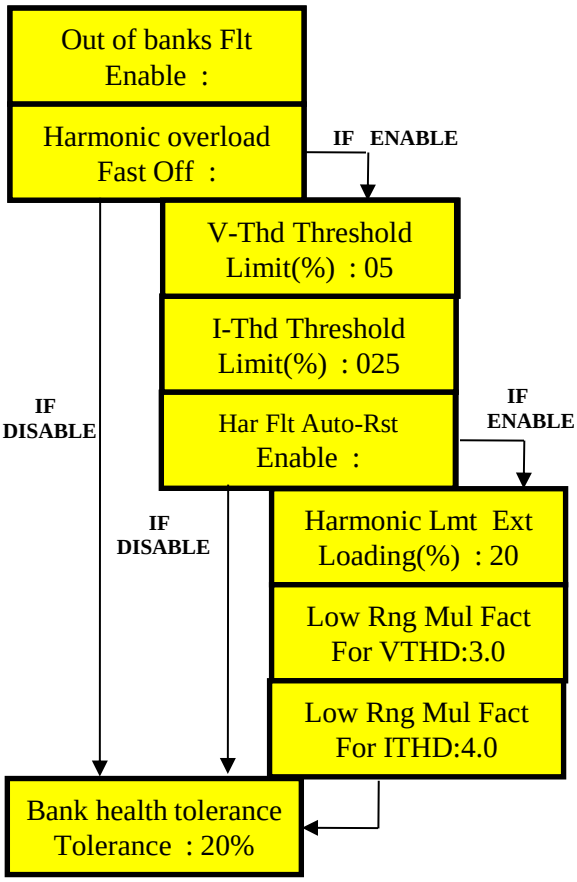


•Out of Banks Fault: This is only with Disable and Enable options. If Enabled, then unit will indicate the out of bank fault if for two consecutive correction cycles, PF is more inductive than Lower PF set point and all the healthy capacitor banks are in ON state. In short, the total Capacitive KVAr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

Harmonic Overload: This 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 min 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 min 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.

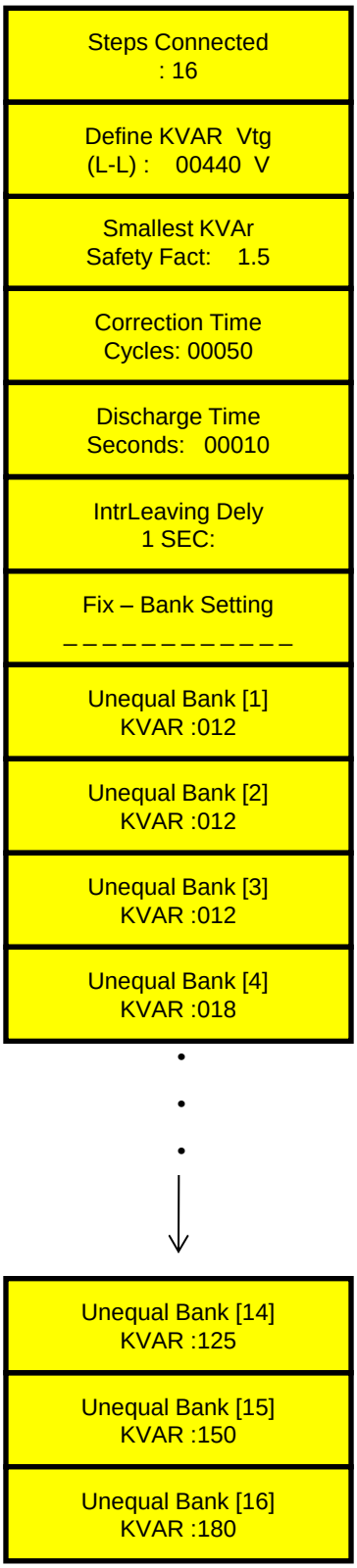
•Harmonic Lmt Ext Loading: User can set the actual load limit in percentage of rated load here for which harmonic fault can be detected.

•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.

•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 banks can be connected.

- Capacitor Bank 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 defines the no action zone prohibiting the capacitor bank On/Off operation to avoid hunting.

- Correction Time: Defined in cycles. 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 1 to 240 line Cycles.

- Discharge Time: Time defined here is the time for discharge of the capacitors to a level, so that they can be turned ON again. This can be set within the range of 1 sec to 300 sec.

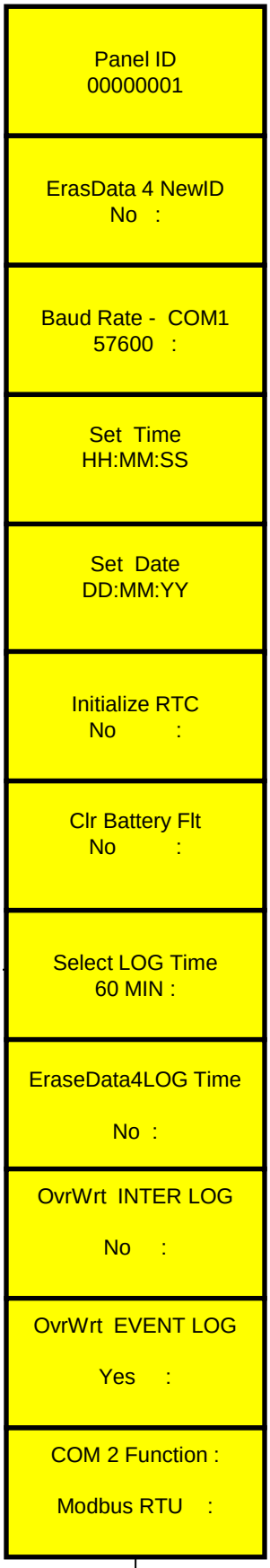
- IntrLeaving Dely: This is the switching delay between two bank execution. User can set it as instantaneous or 1 Sec as a option.

- Fixed bank setting: In this, any bank(no of banks depends upon the steps connected) can be set as fixed 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). TPF-56 has an in-built intelligent algorithm to select the best possible combination to suit the exact kVAr requirement for compensation.

continued..

Communication



•Panel ID: Value - 00000001 to 99999999. Default value 00000001. 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 Panel ID can be saved only if all the logged data is Erased from the EEPROM. This is to prevent false data.

• Erase Data for New ID: Yes and No.
It erases all the logged data in the EEPROM. The panel ID can be changed and a new Panel ID can be saved only if all the logged data is Erased from the EEPROM.

• Baud Rate: selectable.
4800bps, 9600bps, 19200bps, 57600 bps. The Baud rate should match on both sides, TPF-56 & 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 applicable only after saying "Yes" to initialize RTC, by pressing Up key.
• Initialize RTC: Yes and No.
Defining "Yes" initializes RTC (real time clock) to the specified set values.

• Clear Battery fault: Yes and No.
Defining "Yes" clears Battery fault and/or NV RAM fault in TPF-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 MIN interval period.Default value is 60 min.

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

•COM 2 Function : None, Mod-bus ASCII , Mod-bus RTU, GSM. Option Mod-bus ASCII & Mod-bus RTU for RS485 communication and GSM for RS 232 communication for an external GSM/GPRS MODEM.

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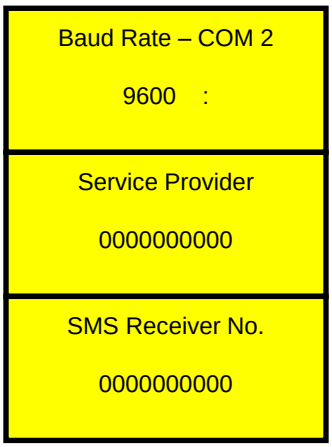
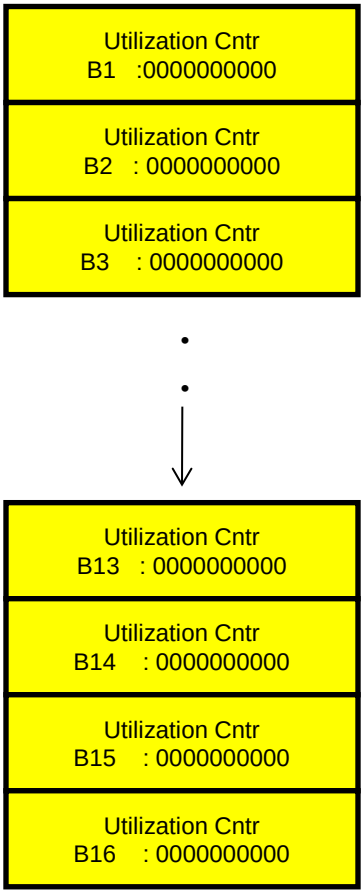


- Baud Rate: selectable.
4800bps, 9600bps, 19200bps, 57600bps. The Baud rate should match on both sides, TPF-56 & GSM/GPRS for communication.

- GSM Service Provider: GSM service provider number is to be given. It is a 10digit number. The Country Code of 91 is internally pre-fixed by the Controller.

- SMS Receiver No: 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.

Utilization Counter, (NOT editable in the field):

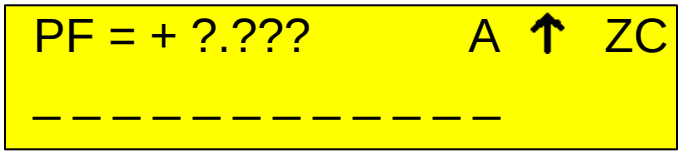


Utilization counters: Bank nn: This gives the time in seconds for which the bank is ON.

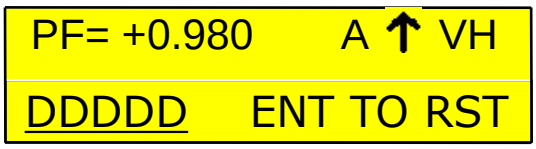
All Counters are initially set to "0000000000" at the time of factory testing.

Notes on Protection and Functionalities:

(1)If current CT connections are not connected to the TPF-56 unit i.e. if no current is detected or the detected current is below 1.5% of rated load current, then, TPF-56 would show the following display on the LCD.



(2) If **Harmonics overload** fault is enabled, and if the voltage or current THD exceeds the set limit, then *TPF-56* would show the following display on the LCD.



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 limit, all capacitor banks are switched off to protect them.

TPF – 56 also have 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 falls down below the Set limits

(3) **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 Battery Voltage falls below certain limit, the RTCC will stop functioning. All Data Logging operations are prohibited if the RTCC is Stopped.

(4) Battery Replacement: The RTCC Battery is Maxell Make, CR2032 type. This 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 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 of the Battery should be towards the viewer (LCD Side) and the negative 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 RTCC date. Still if one wishes, it can be safely done with unit in Power down condition too without fear of loosing data.

Note: Unit is equipped with EWPF logic. With Battery Faulty condition or Battery Low condition, Battery Replacement can be safely done without 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 power down condition.

TPF-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 TPF-56 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 RTC 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 APFC controller	Fast OFF	Yes
11	UF	Under frequency	Not programmable	If reduces below 47Hz (limit)	Fast OFF	Yes
12	OF	Over frequency	Not programmable	If exceeds 53Hz (limit)	Fast OFF	Yes
13	UL	Under Load	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 battery	Not programmable	Battery Voltage drops below 2.6 V	Indicative	Yes
16	NF	Neutral Fault	Not programmable	Shifting of neutral voltage away from balanced condition	Fast OFF	Yes

Events and interval based data-logging facilities:

▪ The TPF-56 has non-volatile memory where internal operational status is monitored and change of state, called as an "Event", is internally recorded in the non-volatile memory, with RTCC date & time stamping for the event data.

▪ Up to 1024 latest events are held in the 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 TPF-56 Unit to download and process the data directly from the TPF-56 using a laptop/PC or download from Hand Held Unit(HHU), if the HHU already has the data from TPF-56. A separate User Manual is available for the "Data View" Software.

▪ "Data View" is for not only for data downloading from the TPF-56 Units, but also for presenting the captured information in a User-Friendly manner.

▪ TPF-56 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 TPF-56 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 TPF-56 Unit is capable of logging the Hourly Data for a maximum duration of 124 days. The "Data View" downloads all logged data of 124 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 TPF-56 Unit, at a specified date and time.

Please refer page no. 20 of this user manual for the connection diagram between PC and the TPF-56 Unit.

Aux. Input AC Power "Early Warning Power-failed" monitoring (EWPF):

The TPF-56 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 TPF-56 saves all the dynamic parameters in its non-volatile memory (EEPROM) along with RTCC 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 TPF-56 did not receive Power Supply.

▪ After "saving" in to non-volatile memory operation, the LCD back-light which was off at the detection of "Power-Failing", it flashes on once which indicates that the memory saving operation has been successfully carried-out by the TPF-56 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 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 Feed back CT, 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.

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 will damage the CT and also damage the TPF-56 Unit as well.

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 **TPF-56 Unit**. Keep the load current feedback 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.
3. Once the parameterization is complete, put the TPF-56 Unit in Manual mode to check every bank command is transmitted to the Thyristor switch . This can be observed by turning ON the Thyristor Switch supply MCB on. The corresponding output should be checked for physical turn ON / OFF of the Thyristor Switch.
4. Once all the Thyristor switches 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 TPF-56 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.
7. Manual synchronization is mandatory by physically checking the CT connections and polarity.

   Observe panel performance for about 2 Hours after commissioning.

➢ Fault finding Guidelines and Trouble shooting procedures

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 TPF-56 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.	•The load kW is too low. • Control connections from TPF-56 Unit to Thyristor Switch 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 TPF-56 to Thy-Switch.
"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.

continued..

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 Laptop (PC).	• Baud rate and other communication parameters selection is not proper. • Serial communication cable connections are not proper. • TPF-56 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 TPF-56 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.

Factory Default Settings

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
GENERAL I/O				
Password (Enable/ Disable)	Enable	Disable	-	Disable
Change password	0000	9999	1	0000
Load default (Yes/ No)	No	Yes	-	No
THD to display (F–THD/ R-THD)	F-THD	R- THD	-	F-THD
Reset energy counter (Yes/No)	No	Yes	-	NO
Aux OP1 FUNCTION (None / TripFlt / Sys Flt/ Out Of Bank.	None	Out Of Bank	-	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 Vtg. (L-N)	60	290	1	254
EXT-PT Ratio	1	299.9	1	1
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 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

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	150	1	100
Over Current Resume (%)	50	Over current limit	1	095
Temperature Fault (Fast off, Disable)	Disable	Fast off	-	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 Lmt Ext loading(%)	2	50	1	20
Low Rng Mul Fact For V- THD	1.1	5.0	1	3.0
Low Rng Mul Fact For I- THD	1.1	5.0	1	4.0
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	16
2] Define KVAR Voltage	110	810	1	440
3] Smallest KVAr Safety Fact	1.2	2.5	0.1	1.5
3] Correction Time (cycles)	1	250	1	50
4] Discharge Time (Seconds)	1	300	1	10
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

PARAMETER	MIN	MAX	STEP SIZE	FACTORY Settings
Communication				
1] Panel ID	00000000	99999999	1	00000001
2] ErasData 4 New ID (Yes/ No)	No	Yes	-	No
3] Baud Rate – COM1 4800 9600 19200 57600	4800	57600	1	57600
4] Set Time (HH/MM/SS) 24Hrs clock	–	–	–	Current Time
5] Set Date (DD/MM/YY)	–	–	–	Current Date
6] Initialize RTC (Yes/No)	–	–	–	No
7] Clear Battery fault (Yes/ No)	–	–	–	No
8] Select Log Time: 60 MIN 30 MIN 15 MIN 10 MIN	60 MIN	10 MIN	1	60 MIN
9] Erasedata 4LOGTIME (Yes/ No)	No	Yes	-	No
10] OvrWrt INTER LOG (Yes/ No)	No	Yes	-	No
11] OvrWrt EVENT LOG ((Yes/ No)	No	Yes	-	Yes
12] COM 2 Function :None Modbus ASCII Modbus RTU GSM	NONE	GSM	-	Mod-bus RTU
13] Baud Rate – COM 2 4800 /9600	4800	9600	1	9600
14] Service Provider	000000000	9999999999	1	0000000000
15] SMS Receiver No	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:

PARAMETER	As on Date	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)				
Reset energy counter (Yes/No)				
Aux OP1 FUNCTION (None / TripFlt / Sys Flt/ OutIOfBank .				
Aux IP1 FUNCTION (None / O/P En Di / Mains/Gen/ Reset Bnk Flt.				

PARAMETER				
SYSTEM				
Rated Supply Vtg. (L-L)				
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.				
DT Ratio				
PF Upper limit: Mains				
PF Lower limit: Mains				
PF Upper limit: Gen				
PF Lower limit: Gen				

PARAMETER	As on Date	As on Date	As on Date	As on Date
Faults				
Over Voltage limit (%)				
Over Voltage resume (%)				
Under Voltage limit (%)				
Under Voltage resume (%)				
Under Ld. KW Fault Disable , Off Step , Off Fix .				
Under load limit (%)				
Under load resume(%)				
Over Current Limit (%)				
Over Current Resume (%)				
Temperature Fault (Fast off, Disable)				
Temp upper limit				
Temp 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 Lmt Ext loading(%)				
Low Rng Mul Fact For V- THD				
Low Rng Mul Fact For I- THD				
Bank health tolerance (KVAR) (%)				

PARAMETER	As on Date	As on Date	As on Date	As on Date
STEP				
1] Steps Connected : 16				
2] Define KVAR Voltage				
3] Smallest KVAr Safety Fact				
3] Correction Time (cycles)				
4] Discharge Time (Seconds)				
6] IntrLeaving 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	As on Date
Communication				
1] Panel ID				
2] ErasData 4 New ID (Yes/ No)				
3] Baud Rate – COM1 4800 9600 19200 57600				
4] Set Time (HH/MM/SS) 24Hrs clock				
5] Set Date (DD/MM/YY)				
6] Initialize RTC (Yes/No)				
7] Clear Battery fault (Yes/ No)				
8] Select Log Time: 60 MIN 30 MIN 15 MIN 10 MIN				
9] Erasedata 4LOGTIME (Yes/ No)				
10] OvrWrt INTER LOG (Yes/ No)				
11] OvrWrt EVENT LOG ((Yes/ No)				
12] COM 2 Function :None Modbus ASCII Modbus RTU GSM				
13] Baud Rate – COM 2 4800 /9600				
14] Service Provider				
15] SMS Receiver No				

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