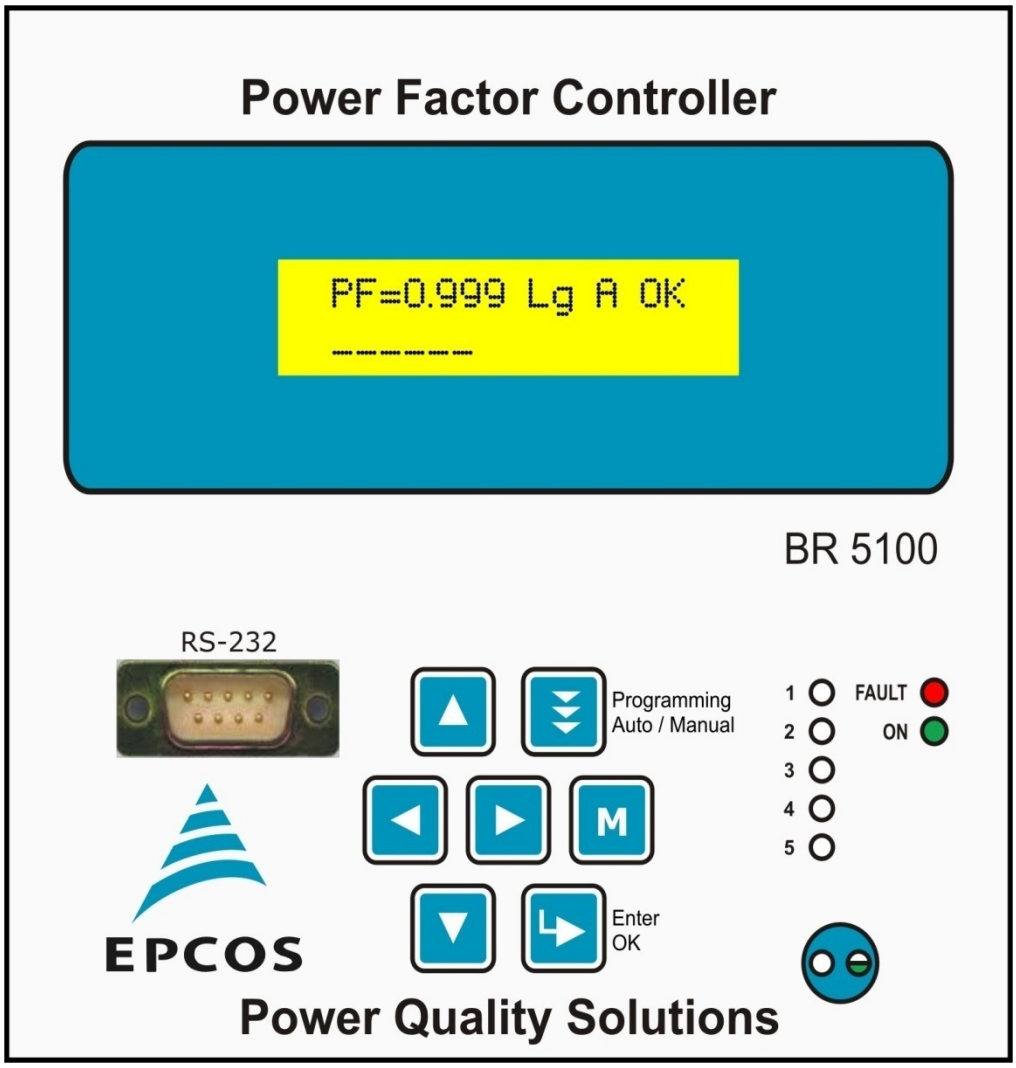
BR5100
Power Factor Controller For Contactor Switching Application

OPERATIONS MANUAL



EPCOS

NOTE

These instructions not 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 EPCOS India Pvt. Ltd. offices.

The contents of this instruction Manual shall not become part of or modify any prior or existing agreement or relationship. The sales contract contains the entire obligations of EPCOS India Pvt. Ltd. The warranty contained in the contract between the parties is the sole warranty of EPCOS India Pvt. Ltd. Any statements contained herein do not create new warranties or modify the existing warranty.

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Features

•Measurements are with Class-1 accuracy.
• Advance Automatic synchronization feature. It is capable of giving correct results even for wrong connections at CT terminals (& also wrong polarity of CTs).
• Load V,I and THD measurement .
• Mode for switching:
  ▪Un-equal (user defined)
•Capable of doing reactive power measurements on every cycle of the mains waveform.
•Standard 144 X 144 cabinet for panel door flush mounting.
• Serial communication through standard Dedicated protocols.
•One RS-232 communication port is provided on front fascia.
• Four months of data logging is possible. data in the form of *Hourly Records & Fault Records*– recording all electrical values.
•Event Protections :
  - Over/under Voltage(OV/UV)
  - Over/Under frequency(OF/UF)
  - Under load(UL).
  - Over Current(OC).
  - Over temperature(OT).
  - Neutral Fault(NF).
  - Control Fuse fault(CF).
  - Over Temperature(OT).
  - Voltage THD(VH).
  - Current THD(IH).

  User can configure some of these events for different conditions like:-Indicate,Disable,Trigger(Capacitor) Off, Fast OFF.etc.

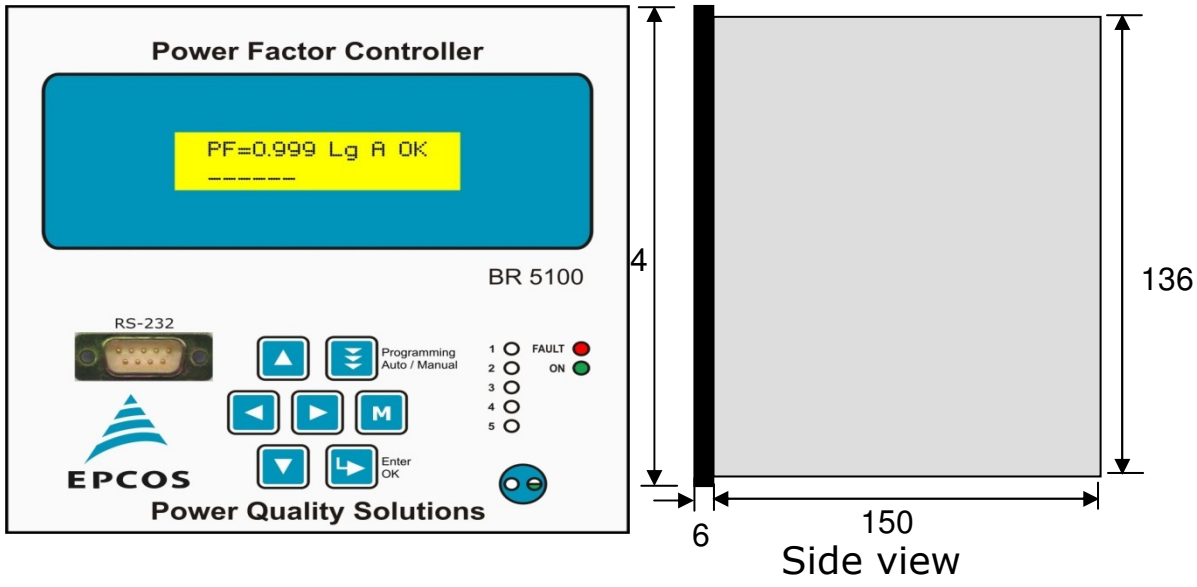
  ▪Warnings :
    - Battery Low Indication
    - Out of Bank (Insufficient Capacity)
    - Current Over-Load on transformer

Specifications

- Measurement Accuracy: 1% (Dynamic range 10).
- Feed-back Voltage: Nominal 254 V (L-N), 3-Phase, 4-Wire configuration.
- Current input: Selectable 1Amp or 5Amp.
- Auxiliary Supply: Ph-Ph 415V (+20% to –40%).
- Correction time: Selectable in seconds from 1sec. to 2500sec.
- Output commands: 5 (BR5100). (Isolated 'NO' contacts of rating 5Amp ac / 250Vac).
- Dedicated RS232 port on front fascia.
- Operating temperature: 0 to 70°C.
- RS-232 baud rate selectable up to 38.4kBPS.
- Class-1 measurement operating temperature: 0 to 50°C.
- Storage temperature: 0 to +75°C.
- Humidity: 0 to 95%.
- Supply frequency: 45Hz to 55Hz.

Mechanical dimensions:

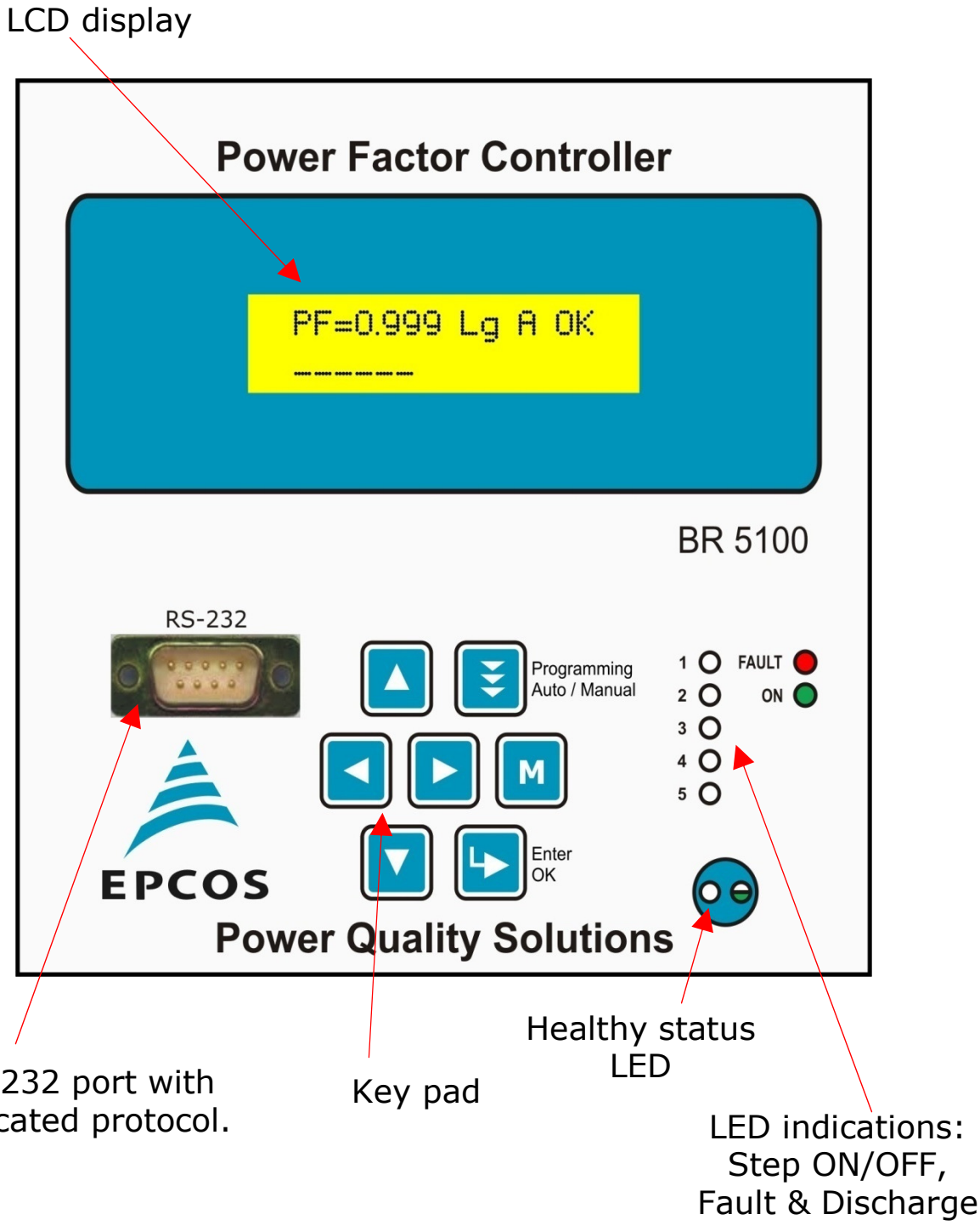
All Dimensions given are in mm.



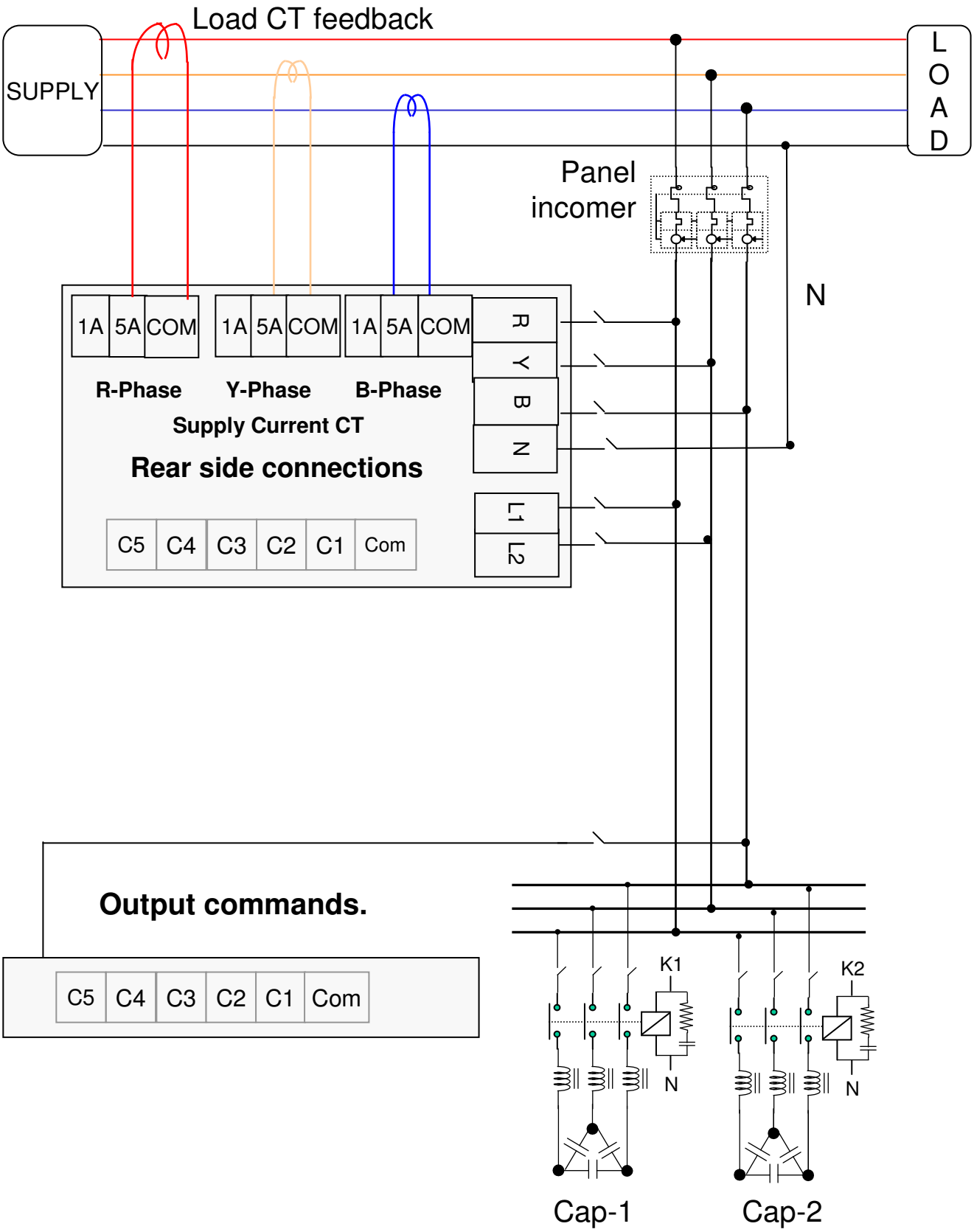
Recommended size for cutout on panel door is 138 X 138.
Maximum weight: (with clamps and terminals) = 2.5kg(approx.).

Front fascia

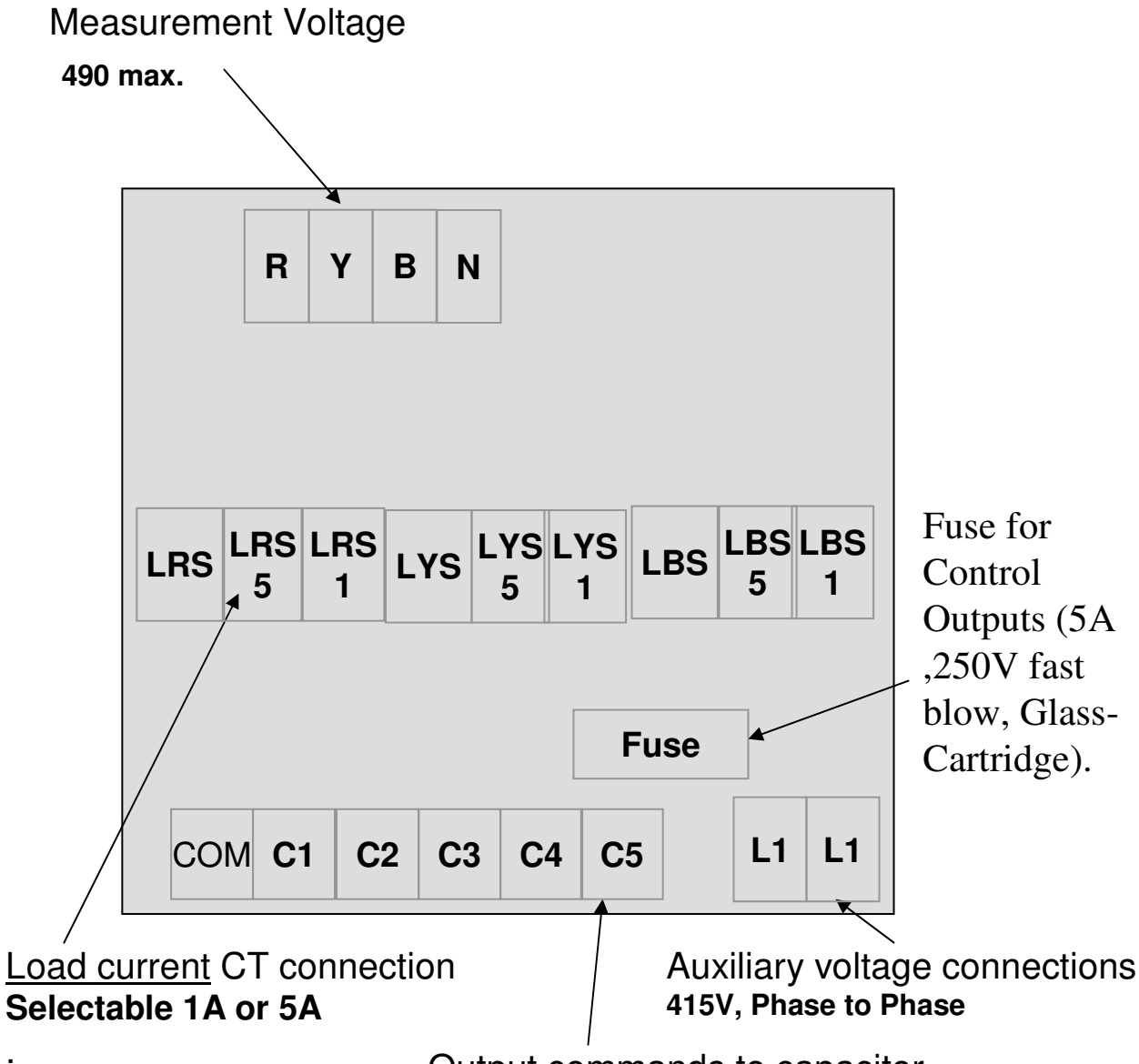
Keyboard, LCD display, LED indications and communication port



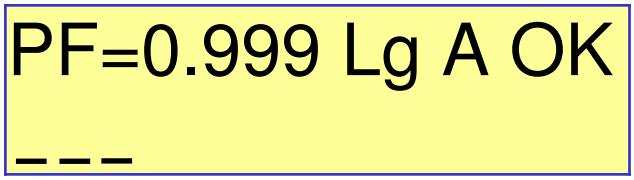
Typical wiring diagram for PF correction



Rear side terminals – measurement voltages, measurement currents, auxiliary voltage.



Front Screen –



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

"PF = 0.999" indicates the overall PF of the system.
"Lg" or "Ld" indicates if this PF is inductive or capacitive respectively.
"A" or "M" indicates the Auto and Manual mode of operation respectively.
"OK" (blinking) indicates status of the system is healthy.

Last two characters represent one of the following status:

OK	Controller status is okay
ZV	Measurement voltage is absent
NF	Neutral Fault
ZC	Zero Current
BL	Battery Low
CF	Control Fault
NV	NV RAM error
VH/IH	Voltage/Current Harmonics
OB	Out of bank (under compensation)

PD	Power Fail
UL	Under Load
OC	Over Current
OT	Over internal temperature
UF	Under frequency
OF	Over frequency
UV	Under voltage
OV	Over voltage
CB	Capacitor Banks faulty

Second line indicates the status of each capacitor bank by symbols. The status is also shown by LEDs provided on the front fascia. Following table gives the description of symbols & LEDs.

Symbol	LED	Description
+		Capacitor is in ON state.
=		Capacitor is in OFF state.
‡		Capacitor is declared as FIXED & is in ON state.
X		Cap. is declared FAULTY.
D		Cap. is in Discharging. (blinking the red LED).
		Blinking Green LED(controller is in healthy condition).

Front fascia –
LCD screen, RS232 communication port

Example of a typical LCD display screen is show below:

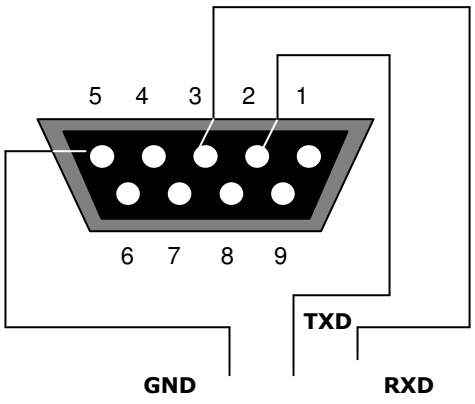
PF=0.990 Lg A OK

Meaning of this screen contents:
Total no. of banks connected is .
Power Factor at Load sensing CT is 0.990 'Lg' Inductive. ('Ld' defines Capacitive).
Unit is operating in 'A' Auto mode. ('M' defines Manual mode)
Total number of banks that are operational are Five.
Bank no. 1 is declared as fixed and is in ON condition.
Bank no. 2 is ON condition.
Bank no. 3 is in off state. Ready to be switched on.
Bank no. 4 is declared as faulty.
Bank no. 5 is in discharging state.

Front side RS232 communication port connection

This port is used for downloading of data logged in the controller memory. The protocol used is RS232. Following gives the pin configuration:

Pin	PC side	Connect	BR5100
1	NC		
2	RXD		TXD
3	TXD		RXD
4			
5	GND		GND
6			
7	NC		
8	NC		
9	NC		



RS232, 9 pin D type connector

Keyboard

Keyboard with soft touch keys are provided on the front fascia of the controller. The various keys are:

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. By pressing this key from the default screen LCD contrast can be set.

LEFT key. Used to shift the cursor to left. By pressing this key from the default screen LCD contrast can be set

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

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

MEMORY key. Used to save all changes made in Programming menu.

Display of various electrical parameters:

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

PF=0.990 Lg A OK

This is factory set default display screen gives information of PF, mode(Auto/Manual), number of banks & controller status.

Realtime Electrical Values

- **Average Voltage** — 00000.0 V (L-N)
- **Average Current** — 0000.0 A
- **Active Power** — 000000.0 KW
- **Reactive Power** — 000000.0 KVAr
- **Apparent Power** — 000000.0 KVA
- **Frequency** — 00.0 Hz
- **C-KVAR** — 000000.0
- **Load side PF** — 1.000 IND
- **Load Side KVAR** — 000000.0
- **Load Side KVA** — 000000.0

Electrical Val contains Following Electrical parameters – Average Voltage, Average Current, Total Active Power (kW), Total Reactive Power (kVAr) , Total Apperent Power (kVA) & frequency.

continued…..

Realtime
Per-Phase RMS

R-Phase Voltage
00000.0 V (L-N)
Y-Phase Voltage
00000.0 V (L-N)
B-Phase Voltage
00000.0 V (L-N)
R-Phase Current
0000.0 A
Y-Phase Current
0000.0 A
B-Phase Current
0000.0 A

It gives Per Phase RMS values of voltage & current of each phase.

Realtime
Electrical Power

R-Phase PF
1.000 IND
Y-Phase PF
1.000 IND
B-Phase PF
1.000 IND
R-Phase KW
000000.0
Y-Phase KW
000000.0
B-Phase KW
000000.0
R-Phase KVAR
000000.0
Y-Phase KVAR
000000.0

It gives Various electrical Power parameters which are as follows : PF of each phase , per phase KW, per phase KVAR and per phase KVA.

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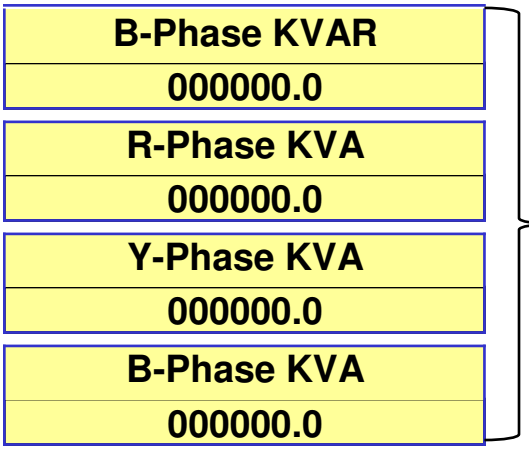
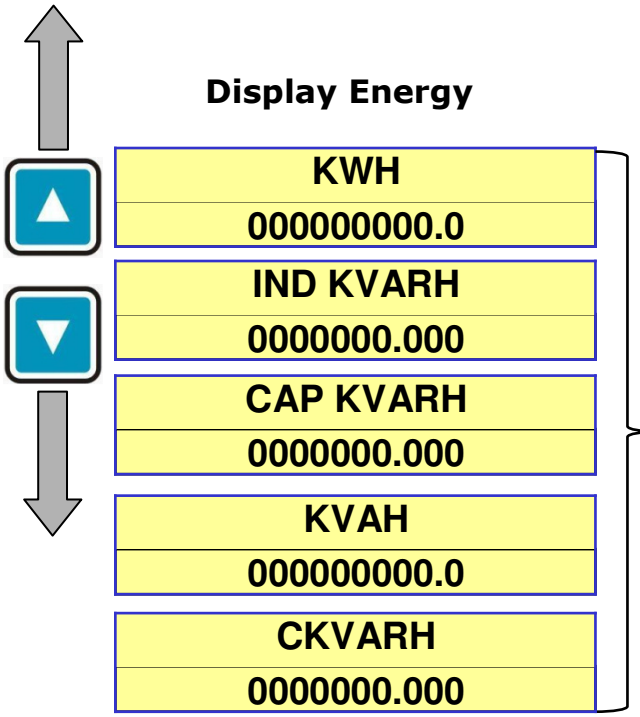


It gives Various electrical Power parameters which are as follows : PF of each phase , per phase KW, per phase KVAR and per phase KVA.



It gives energy counter values. like KWH, Inductive KVARH.

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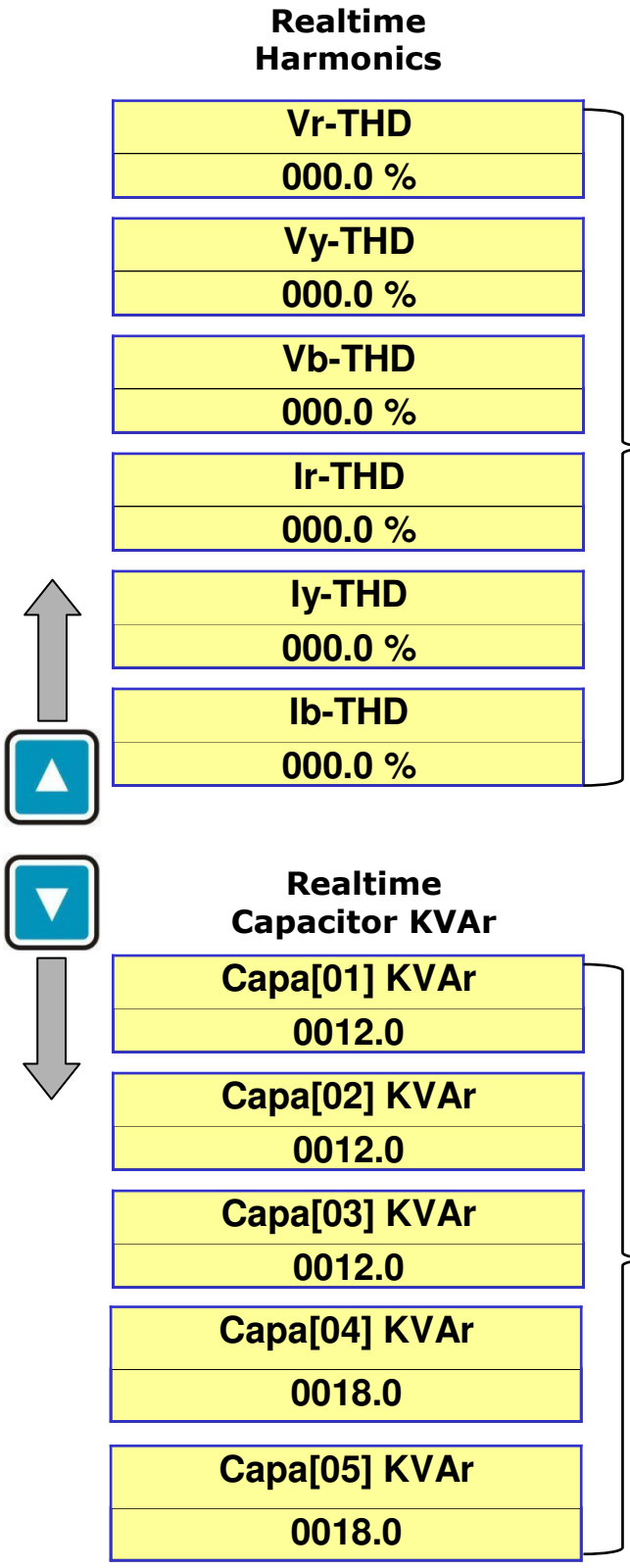

Harmonics of per phase THD for Voltage & Current.

It gives Capacitor KVAR of each capacitor bank

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Realtime
Aux-Function

INT-Temperature
30 Deg C

Internal temperature of Power Factor controller unit.

Time: 11:15:45
Date: 18/09/13
EPCOS
BR 5100
SR00000000000000000
EPCOS-1001.0.6.4

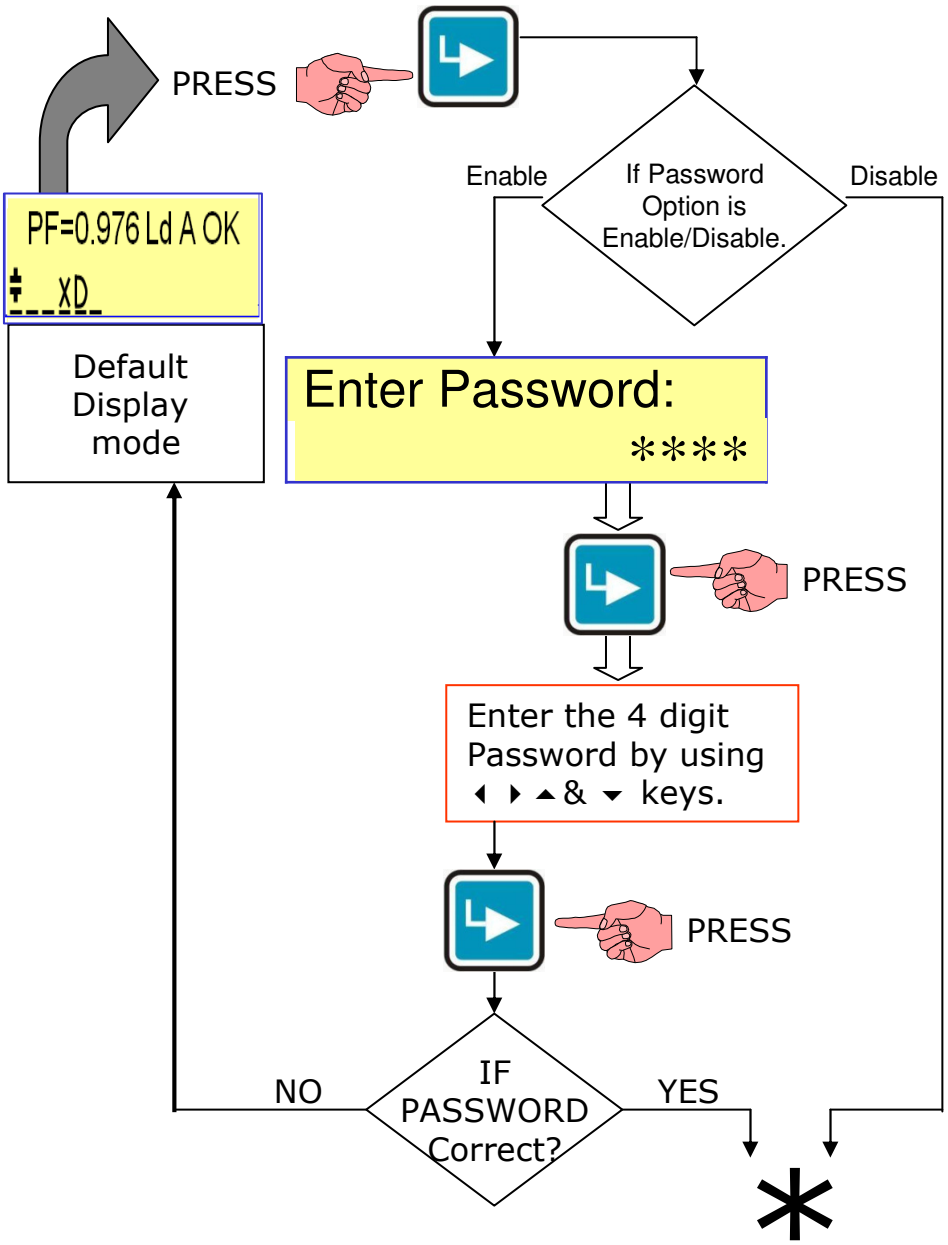
Displays current time & date that is set on internal Real Time Clock.

Displays the Company Name with version of software.

Displays the serial number of the PF controller.

Method for keyboard / display usage

Flowchart for entering into different modes:



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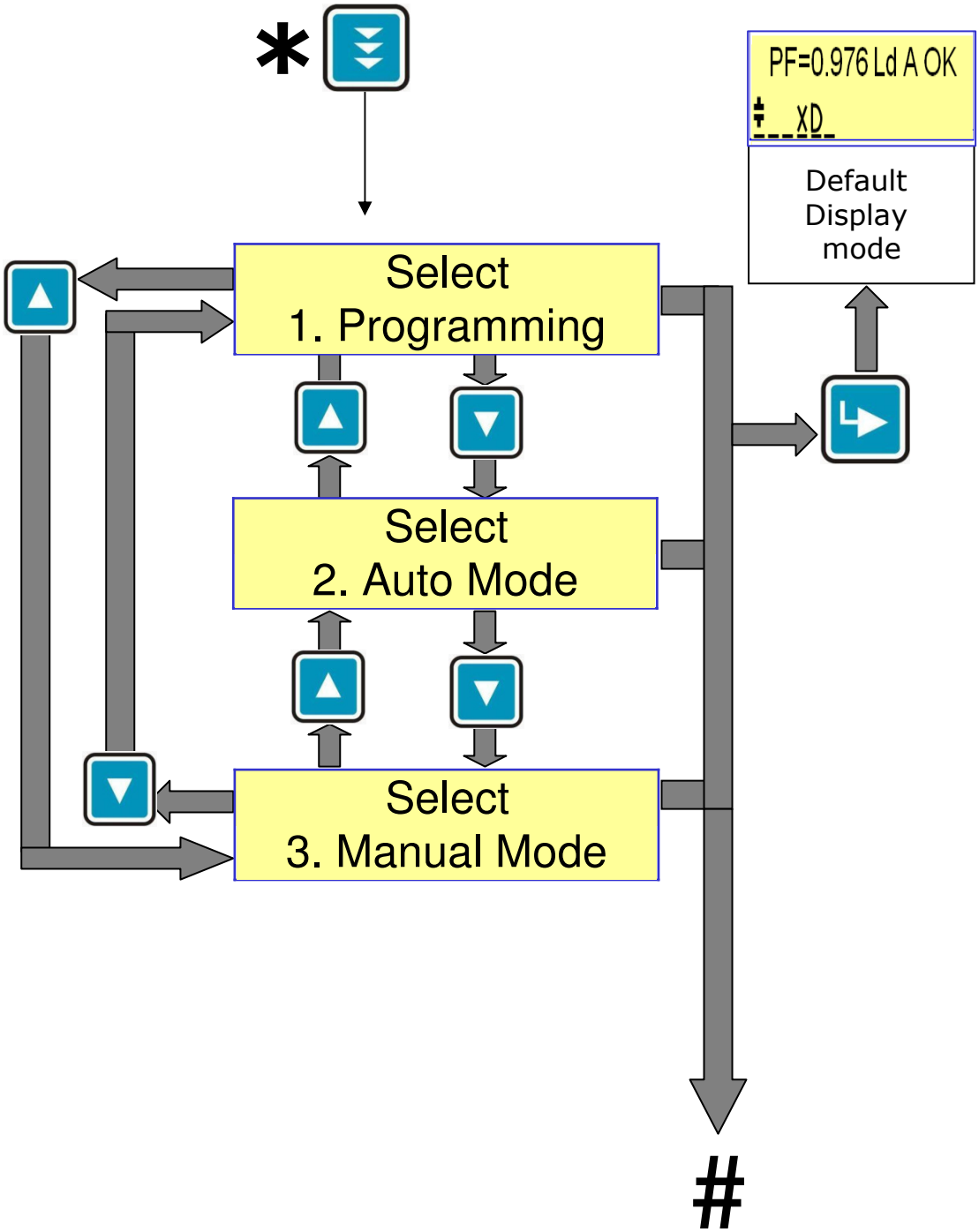

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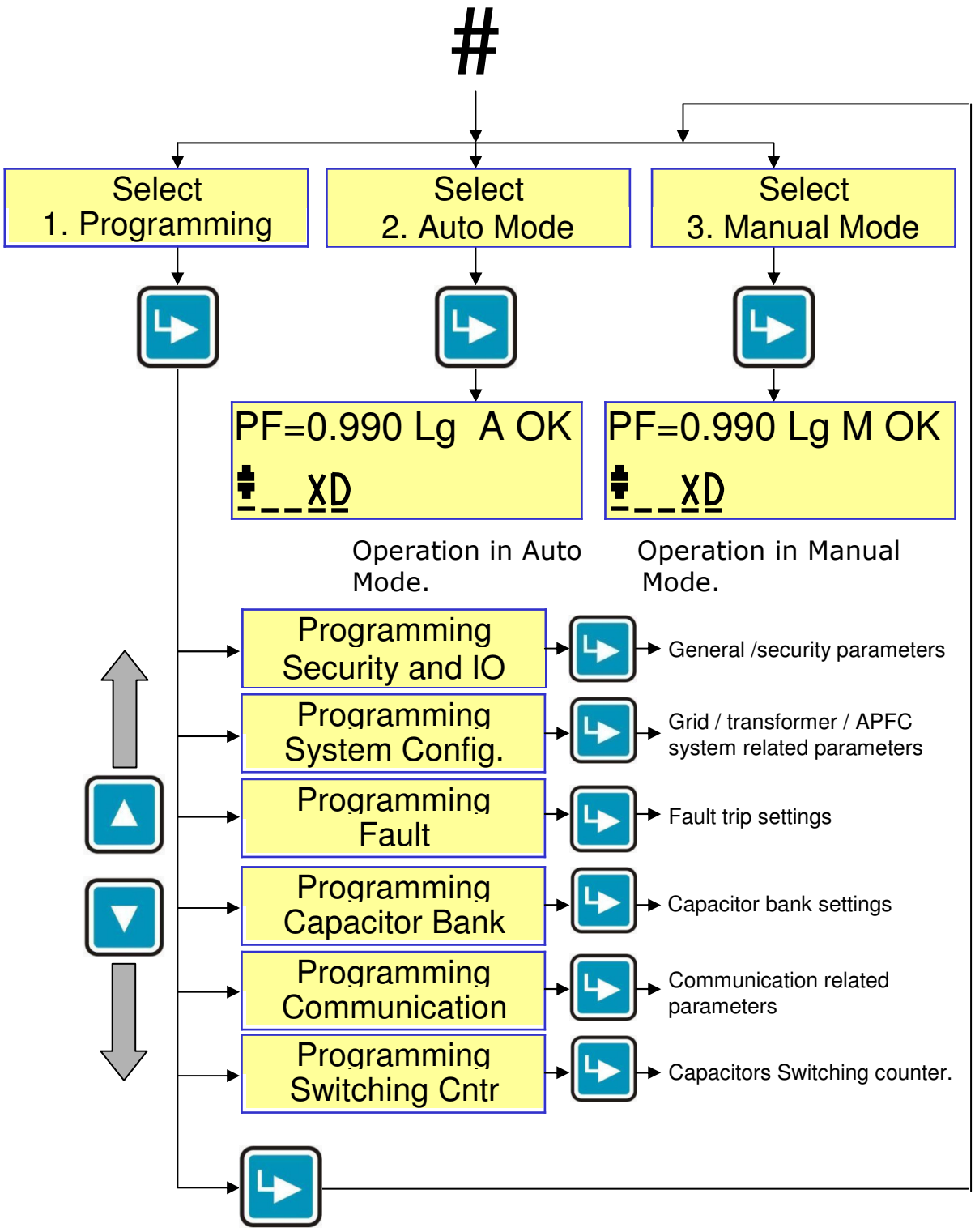
#
Select
1. Programming
Select
2. Auto Mode
Select
3. Manual Mode
PF=0.990 Lg A OK
PF=0.990 Lg M OK
Operation in Auto Mode.
Operation in Manual Mode.
Programming Security and IO
General /security parameters
Programming System Config.
Grid / transformer / APFC system related parameters
Programming Fault
Fault trip settings
Programming Capacitor Bank
Capacitor bank settings
Programming Communication
Communication related parameters
Programming Switching Cntr
Capacitors Switching counter.

Display operations

Mode Selection

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

- **AUTO Mode**
- **MANUAL Mode**
- **PROGRAMMING**

Then press ENTER to enter the specific mode.

Auto Mode: For functioning in automatic compensation.
Manual Mode:
Pressing ENTER button on this screen will put BR5100 in Manual mode. This mode would continue to run till it is purposefully changed or power down occurs.

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/s faulty. Masking of the banks so that once auto mode is selected, these faulty declared banks would not be used for PF correction.
- In manual mode if no key is press then for more than 5 minutes, the controller goes into AUTO mode.

For Declaring banks faulty or Resetting faulty banks:
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. (Default as Auto or Manual is set in Programming menu).

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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.

Programming:
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:

Security & IO : For general settings.
System Config. : Transformer / APFC system related settings.
Fault : Fault settings.
Capacitor Bank : Capacitor bank step settings.
Communication : Communication parameters.
Switching counter: Capacitors switching 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 PROGRAM key once.
To store the edited parameters permanently, press SAVE when you are either in the Programming menu or any sub-menu area.
To come out of Programming menu without saving the changes press PROGRAM key again.

Note: In the Programming area, if no keys are pressed for more than two minutes, the default display screen comes on and the changes done till that time are discarded.

Programming Security & IO

Password Enable : 0
Modify password : 0000
THD To Display F-THD : 1
Clear Energy Cnt No : 0

Password: Enable or disable the password. Enable=1, Disable=0.

Modify password: Set a new password (4-digit).

It is use to select F-THD or R-THD . 1=F-THD,0 =R-THD.

It used to reset the Energy Counter's.

Programming System Config

Load CT Primary Mains : 1000
PANEL KVAR EDITKvar : 3
PF upper L: Mains [CAP:0] 0.999
PF upper L: Mains CAP:0 [0.999]
PF lower L: Mains [IND:1] 0.990
PF lower L: Mains IND:1 [0.990]
Phase Auto Sync NO : 0

PANEL RATING: This is panel KVAR rating. If panel KVAR is defined then all other parameters(like CT ratio, Capacitor Bank KVAR) all These parameters are set automatically. Its factory settable parameter. User can change the Panel KVAR setting.0 for 18Kvar,1 for 27KVAR,2 for 72Kvar & 3 for "EditKvar"(user defined).
Load CT Primary Mains: This parameter gives CT ration of Load CT.
Power factor limits: Two PF limits can be set for PF correction (lower limit & upper limit). Each of these can be set either inductive or capacitive.

•Phase Auto Synchronization:
Automatic synchronization is capable of giving correct results even for wrong connections at CT terminals (& also wrong polarity of CTs).

Programming Fault
Over Voltage Flt Fast Off : 4
Over Voltage Flt % : 113
Over Voltage Flt Resume (%): 110
Under Volt Flt Fast Off : 4
Under Volt Flt Limit (%) : 068
Under Volt Flt Resume (%) :071
Under Ld. KW Flt Off Cap : 2
Under Load Flt Limit (%) : 002
Under Load Flt Resume (%) :003
Over Current Indicate : 1
Over Current Limit (%) : 100
Over Current Resume (%) :095

For most of the faults defined here the options available are as follows:
0=Disable.
1=Indicative. Flash a fault message.
2=Off Step. Switch off non-fixed steps one by one.
3=Fixed Off. Switch off all fixed step.
3=Fast Off Step. Switch off all steps in one shot.

For all the faults, normally two limits are defined. One is Detection Limit and other is Resume Limit. If detection limit is exceeded any one of the above action is performed as set by the user. Similarly if the fault limit drops below the resume limit, then the action is deactivated.

Over voltage fault: As the name suggests it is for over voltage condition.
Under voltage fault: For under voltage.

Under load kW fault: The value here is set as the percentage of Maximum rated kW. This is useful in case of banks are put in circuit to take care of no-load compensation.

Over Current: As the name suggests it is for over Current condition.

continued..

Temperature Flt Fast Off : 4
Temperature Lower Limit: 70
Temperature Upper Limit: 60
Out Of Banks Flt Enable : 1
Harmonic Overld Off Fix : 3
Voltage THD Limit (%) : 005
Current THD Limit (%): 025
Rated Curr. H. Flt Tolerance: 20 %
Har Flt Auto-Rst Enable : 1
Hormonic Flt Rst Seconds : 0180
Control Fault Enable: 1
Control Fault SET TIME: 001
Cap Health Chk Enable: 1

Internal Temperature Fault: The unit monitors temperature inside the housing. This temperature can go up either due to ambient within the APFC panel or due to component failure within BR5100. Set upper limit to trip and lower limit to resume.

Out OF Banks Fault: If corrected PF is not within the limit even though all banks ON, then Controller set this "OB" fault.

Harmonic Overload: As the name suggest it is a harmonic overload on the line.

Voltege THD: When voltage THD is more than set limit then PF controller will set this fault as a "VH".

Current THD: When current THD is more than set limit then PF controller will set Current THD("IH") fault .

Rated Curr. H. Flt Tolerance: This is the mains current limit over the current THD fault.

Har Flt Auto-Rst: This is the enable/Disable parameter for Auto restart time of Voltage & Current THD fault.

Harmonic Flt Rst. Seconds: V-THD or I-THD fault gets reset after this time.

Control fault :This is control Fuse fault. If fuse gets blown then PF controller will show "CF" fault. Default setting is 1 Enable.

Control Fault set time: This is set time for CF fault.

Cap health check: The unit carries out on line monitoring of the kVAr values of every step. This is when the step is put in the circuit. In case the tolerance limit defined here is exceeded, that specific bank is declared faulty.

Cap. KVAR Fault Tolerance: 40%
Cap.KW Fault Tolerance: 0.5 %
STEP KVAR LIMIT(%): 002
NEUTRAL FL SET VAL : 009
Auto-syncron Tolerance: 15
CONTROL FUSE FT BANKS : 005
BANK_HEALTH FT BANKS: 005
OB FAULT TIME OUT: 250

Cap.KVAR fault: This is tolerance limit of capacitor step KVAR for deciding the healthiness of it.

Cap.KW Fault: This is percentage tolerance limit for load variation when healthiness of capacitor step decided.

STEP KVAR LIMIT: If Display step kvar is within this limit then PF Controller will displays rated(defined) step kvar for each capacitor bank.

NEUTRAL FL SET VAL: This is internal limit used for the neutral fault. This is internal threshold limit used for neutral fault.
Auto-Syncron. Tolerance: This limit is used during the Auto-Syncronisation. Summation of all available capacitor banks KVAr are compared with the integral multiple of total rated capacitor Kvar and percentage of Auto sync. tolerance limit.
CONTROL FUSE FT: This parameter is used only when there is software detection of CF fault. But this is not relevant if hardware CF is implemented.
BANK_HEALTH FT BANKS: This is parameter is used for deciding the healthiness of capacitor bank. This is nu number of switching operations required to declared bank as a faulty .
OB FAULT TIME: This is used for software implementation of CF fault. For hardware implementation This parameter does not have any relevance.

Programming Capacitor Bank

Total Capacitors : 05
Correction Period Seconds :00120
Discharge Period Seconds :00060
Fix-Capacitor _ _ _ _ _
Capacitor volt (L-L): 00440V
Capacitor [1] kVAr : 012
Capacitor [2] kVAr : 012
Capacitor [3] kVAr : 012
Capacitor [4] kVAr : 018
Capacitor [5] kVAr : 018

Total Capacitors: Defines the number of Capacitors connected in panel.

Correction time: Time between two consecutive kVAr compensations.

Discharge Time: Time defined here is the time for discharge of the capacitors ,so that they can be turned ON again.

Fix-bank setting: Defines the banks that are to be declared as fixed.

Capacitor voltage: The line-line voltage at which the kVAr is defined.

Capacitor kVAr [--]: capacitor KVAR for each step is defined .Default values of capacitor KVAR are depends on the panel KVAr setting. User can edit these values.

Programming
Communication

PFC Unit ID : 00001
Baud Rate 38400 : 3
Time 09:58:40
Date 18:09:13
Initialize RTC No : 0
Clear NVRAM No : 0

Unit ID: Value can be 00000 to 61000. Default value 00001. This ID is used for serial communication on RS232.

RS-232 port will be used for data logging feature. Baud rate is selectable up 38.5Kbps.

Time: Defines the time setting.

Date: Defines the date setting.

Initialize RTC: 0=No; 1=Yes. If 'yes' it initializes the real time clock.

Clear NVRAM: 0=No; 1=Yes. Defining Yes clears the NVRAM (real time clock). This is generally used to clear the NVRAM Check sum fault. Press Save after setting this parameter. After clearing NVRAM all Energy counters get reset ie. KWH,KVAH,LEAD/LAG KVARH & CKVARH = 000000.00.

Programming
Switching Cntr

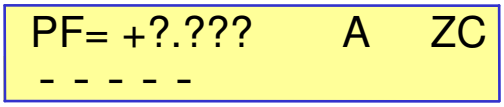
Switching Countr Cap.[1] :000000
Switching Countr Cap.[2] :000000
Switching Countr Cap.[3] :000000
Switching Countr Cap.[4] :000000
Switching Countr Cap.[5] :000000
Clr Cap[1] Cntr No :0
Clr Cap[2] Cntr No :0
Clr Cap[3] Cntr No :0
Clr Cap[4] Cntr No :0
Clr Cap[5] Cntr No :0

Switching Countr: Bank nn:
This gives the number of ON/OFF operations of the "nn"th bank.

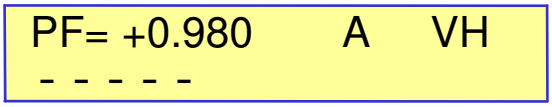
Clear Switching Counter: Bank nn:
Options are "Yes" and "No".
Declaring specific bank no with Yes and pressing save command will clear the specific capacitor switching counter to zero. This is normally done in case the specific bank is replaced with the new one.

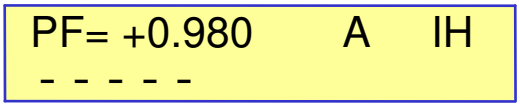
Please note the following events:

(1) If there is no current feedback given to the BR 5100 unit or the measured current is below 0.9% of rated load current in any one of the phases then, BR 5100 displays following event on LCD.



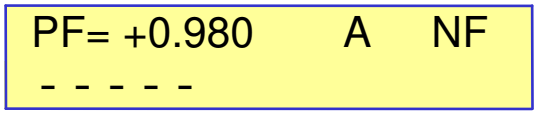
(2) If **Harmonics overload** fault is enabled, and if the voltage or current THD exceeds respective set limits, then BR 5100 would show the following display on the LCD.





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.IH fault is set when current THD is more than set limit & mains current is more than % Rated Curr. H. Flt tolerance. "I_rms".BR5100 has a parameter called **Harmonic Fault Auto-Reset**. If this parameter is enabled, then user can set this time as per site requirement . The voltage or current harmonic fault will get automatically reset after this time.

(3**)** **Neutral fault**: If "Neutral" gets removed from the rear-terminal block of the BR 5100 unit, this is indicated as neutral fault "NF" on the LCD display.



If the neutral connection is given to the BR 5100 then it sense automatically & clears the "NF " fault.
If there is neutral fault, all the capacitor banks are switched off to protect them.

(4) **Battery Low** :If the internal Lithium coin Battery Voltage of nominal 3V drops below 2.2 V then the controller will flash **"**BatteryLow**"** (BL) 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(BL)" 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 specifically during Source supply power down condition. If the Battery Voltage falls below certain limit the RTC will stop functioning. All Data Logging operations are prohibited if the RTC (Real Time Clock) is Stopped even momentarily.

BR5100 Controller fault indications and fault actions

Sr.No.	Status on LCD Display	Status / Fault Description	Programmable Options provided on Fault	Fault description	Action taken by APFC controller	Status in Data Logging
			Enable / Disable / Indicative / Fast OFF/Fixed OFF/Cap OFF		If Enabled	Yes / No
1	OK	Controller status is OK				Yes
2	ZV	Zero Voltage	Not Programmable	If voltage absent in all three phases	Fast OFF	Yes
3	OV	Over voltage	Programmable	If voltage exceeds than defined limit in any one of the 3 P-N values	Fast OFF	Yes
4	UV	Under Voltage	programmable	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	NV	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 0.9% in any one of the three phases	Fast OFF	Yes
9	OB	Out of Banks	Enable	Insufficient bank kvar	Indicative	Yes
10	OT	Over temperature	Fast off / Disable	Indicates temperature inside the micro-controller	Fast OFF	Yes
11	CF	Control fault	Enable / Disable	Contactor fuse failure fault	Detects bank faulty	Yes
12	UF	Under frequency	Not programmable	If reduces below 47Hz (limit)	Fast OFF	Yes
13	OF	Over frequency	Not programmable	If exceeds 53Hz (limit)	Fast OFF	Yes
14	NF	Neutral fault	Not programmable	Neutral is removed from the rear side of BR 5100	Fast OFF	Yes
15	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
16	OC	Over current	Enable / Disable	Load Current exceeds than defined limit, in any one of the 3 P-N values	Indicative	Yes
17	Battery Low!!!	Low battery	Not programmable	No action	Indicative	Yes

Auto Synchronization:

▪In normal industrial loads, Inductive reactive power is compensated by using capacitive reactive power of the right magnitude to bring the PF 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 diagram 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 voltage and corresponding 3 phase current can get disturbed (mainly due to manual errors).

▪In such a situation, a PF controller without Auto Synchronization, will not be able to do its operation correctly,& will not do the PF improvement properly.

▪BR5100 has an in built intelligence, if Auto Sync.enabled,BR5100 detect the correct voltage phase sequence as well as corresponding current input channels, even if the wrong CT & Wrong phases connections . It is even intelligent enough to detect the 'reverse' polarity of CT connections.

▪At the time of APFC Unit powered 'ON' , in case, if following Fault occurs while performing Auto Synch or before performing Auto Sync, the "Auto Sync" is kept pending until all faulty 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 (VH)
7] I-THD Fault (IH)
8] Neutral Fault (NF)
9] Control Fault (CF)

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

Events and interval based data logging :

▪ The APFC 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 RTC date & time stamping for the event data.

▪ Up to 1048 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 downloading Application Software for PC, is provided to the users of APFC Unit to download and process the data directly from the APFC using a laptop/PC or download from Hand Held Unit(HHU).

▪ 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 and then, analyzed and presented to the User in various ways.

▪ Data downloading software 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 BR5100 Unit is capable of logging the Hourly Data for a maximum duration of 4 months. The Data Downloading software downloads all logged data of 4 months period.

▪ Data Downloading software 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.

▪ 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 BR5100 Unit, at a specified date and time.

❖Please refer page no.10 of this user manual for the connection diagram between PC and BR 5100.

APFC panel commissioning instructions
Before panel is powered up for the first time:

1. Panel Wiring Check

Ensure that all connections in the panel is tightened properly and there are no loose connections. Also ensure that the wiring is done as per the wiring diagram.

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.

3. Load Feed Back CT connection

Ensure that the load feed back CT connections are done properly. Confirm that correct phase CT is connected with the correct phase input terminals. (Even though auto sync is capable of taking care of wrong CT polarities or CT position interchanging, but then on display, the Phase readings may be seen to be interchanged. (May be R-phase reading would be seen in B-phase and vice-versa.

CT connections to be done carefully so as to ensure that the wire does not get open and there is no loose connection.

Loose connection or open CT secondary can result in very high voltages getting developed in the circuit which can damage the CT and also produce high levels of noise in the system.

After the panel is powered up:

•Remove the fuses/switch-off MCBs/MCCBs which are in series with every capacitor bank. Connect supply to the **PF Controller**. Keep the load feedback in shorted condition.

•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.

•Once the parameterization is complete, put the PF Controller in Manual mode to check if every bank command is being transmitted to the Contactor switch. The corresponding output should be checked for physical turn ON / OFF of the Contactor.

•Once all the Capacitor banks 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 PF Controller 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 giving the desired current, check for capacitor bank healthiness or power circuits.

6. Keep all the banks in off mode. Remove the short of Load feedback CT. In case KW value is seen as –ve for any phase, CT is with wrong polarity. change CT polarity(If Auto Synchronization is enable then no need to do this step).

7. Now turn ON the capacitor banks one by one and observe that capacitor current increases as per the rating of the steps on capacitor Current display. Turn ON all the Capacitor banks to see that almost full rated current flows through the capacitors.

Observe panel performance for about 1hrs after commissioning.

Troubleshooting procedure

Nature of Fault	Probable Reason	Action to be taken
Unit does not turn ON.	•Input auxiliary supply not coming. •Input side fuses blown	•Check the input supply to restore. •Check fuses in the unit are OK.
"NV RAM Checksum error" display. *OR* Corruption of date & time.	In all these three conditions the battery needs to be checked. • Internal Ni-Cd 3.2V D.C. battery used for RTC and NV RAM must be drained down.	• Replace this battery in consultancy with trained personnel.
Some steps 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 tolerance limits for individual steps monitoring as relaxed.

Troubleshooting procedure ... continued

Nature of Fault	Probable Reason	Action to be taken
Serial Communication is not working.	• Default Baud rate is 9.6Kbps so PC side baud rate should be equal to 9.6Kbps. • Unit ID is not set properly. • Serial communication cable connections are not proper.	• Select proper baud rate at PC side . • Set the unit ID correctly. • Check the serial cable continuity as per the connections given earlier in this manual.
Data logging is not taking place.	• If Battery Health monitoring is enabled and battery is Low/Weak, possibility of battery unhealthy message being displayed. •Improper settings in PC software and/or PC.	• Change the battery with the help of authorized personnel only. •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				
1] Password (Enable: 1/ Disable: 0)	-	-	-	0
2] Change password	0000	9999	1	0000
3] THD to display (F–THD: 1/ R- THD: 0)	-	-	-	F–THD: 1
4] Reset energy counter (Yes: 1/No: 0)	-	-	-	0
Systems				
1] Current CT Primary (Amp) (only in user editable steps option)	1	2500	1	1000
2] PF Upper limit	0.100	0.999	0.001	[Cap:0] 0.999
3] PF Lower limit	0.100	0.999	0.001	[Ind:1] 0.990
4] Phase Auto Synch (Yes: 1/No: 0)	-	-	-	0
5] PANEL KVAr (0:18kvar, 1:27kvar, 2:72kvar, 3:EDITKvar/(User defined)	0	3	1	3
Faults				
1] Over Voltage limit (%)	(resume % set) +1	149	1	113
2] Over Voltage resume (%)	101	(limit % set) -1	1	110
3] Under Voltage limit (%)	60	(Resume % set) -1	1	68
4] Under Voltage resume (%)	(Limit % set) +1	99	1	71
5] Under Ld. KW Fault(Disable: 0/ Off Step: 2 / Off Fix : 3)	-	-	-	2
Under load limit (%)	0	(Resume % set) -1	1	02
Under load resume (%)	(limit % set) +1	99	1	03
Over Current Limit (%)	Over current resume	180	1	100
Over Current Resume (%)	60	Over Current Limit	1	095

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
6] Temperature Fault (Fast off: 4/ Disable: 0)	-	-	-	4
Temp upper limit	(lower limit 1 set) +1	70	1	70
Temp lower limit	0	Upper limit 2 set -1	1	60
7] Out of Banks Fault (Enable:1/Disable: 0)	-	-	-	1
8] Harmonic Overload (Disable: 0 / Fast Off : 4)	-	-	-	4
V- THD Threshold limit (%)	1	99	1	05
I THD limit (%)	1	150	1	25
Rated Curr.H.Flt(Tolerance)	10	99	1	20
9] Harmonic fault auto Reset (Enable: 1/ Disable: 0)	-	-	-	1
Harmonic fault reset (seconds)	10	1500	1	180
10] Control Fault (Enable:1/ Disable: 0)	-	-	-	1
Control Fault set time(seconds)	1	240	1	0
11) Cap Health Chk (Enable:1/Disable: 0)	-	-	-	1
Cap. Kvar Fault tolerance (kvar) (%)	30%	70%	1	40%
Cap. KW Fault tolerance (kvar) (%)	0.1%	5%	0.1	0.5%
STEP KVAR LIMIT	-	-	-	2
12) Neutral Fl SET VAL	0	50	1	9
13) Auto-syncron.Tolerance:	1	60	1	15
Control Fuse FT Banks:	0	6	1	5
Bank Health FT Banks	0	15	1	5
OB FAULT TIME OUT	0	250	1	250
Capacitor Banks: 1)Total Capacitors	1	5	1	5
2) Correction Time Seconds	1	600	1	120
3) Discharge period Seconds	1	600	1	60

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
Capacitor Volt(L-L)	350	499	1	440
Fixed bank setting				
6] Unequal Bank 1				12
7] Unequal Bank 2				12
8] Unequal Bank 3				12
9] Unequal Bank 4				18
10] Unequal Bank 5				18
Communication				
1] PFC Unit ID	00001	61000	1	00001
3] Baud Rate: 0: 4800 1: 9600 2: 19200 3: 38400	0	3	1	3
4] Set Time (hh/mm/ss) 24Hrs clock	-	-	-	Current time
5] Set Date (dd/mm//yy)	-	-	-	Current date
6] Initialize RTC (Yes: 1/No: 0)	-	-	-	0
7] Clear NVRAM fault (Yes: 1/ No: 0)	-	-	-	0

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
Switching Cntr				
1] Cap. [1]	000000	999999	1	-
2] Cap.[2]	000000	999999	1	-
3] Cap. [3]	000000	999999	1	-
4] Cap.[4]	000000	999999	1	-
5] Cap. [5]	000000	999999	1	-
6] Clear Cap. [1] Cnt	0	1	1	0
7] Clear Cap. [2] Cnt	0	1	1	0
8] Clear Cap. [3] Cnt	0	1	1	0
9] Clear Cap. [4] Cnt	0	1	1	0
10] Clear Cap. [5] Cnt	0	1	1	0

Model kvar	Bank[1] kvar	Bank[2] kvar	Bank[3] kvar	Bank[4] kvar	Bank[5] kvar	Total Steps	LOAD CT (MAINS)
18 kvar: 0	3	6	6	-	-	3	150
27 kvar: 1	3	6	6	6	-	4	400
36 kvar: 2	6	6	6	9	-	4	400
72 kvar: 3	12(fixed bank)	12	12	18	18	5	800
Edit KVAr (User Defined): 4	Editable from [1]---[250]	Editable from [1]---[250]	Editable from [1]---[250]	Editable from [1]---[250]	Editable from [1]---[250]	5	Editable from [1]---[6500]

Factory Default Settings

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
General I/O				
1] Password (Enable: 1/ Disable: 0)				
2] Change password				
3] THD to display (F–THD: 1/ R- THD: 0)				
4] Reset energy counter (Yes: 1/No: 0)				
Systems				
1] Current CT Primary (Amp) (only in user editable steps option)				
2] PF Upper limit				
3] PF Lower limit				
4] Phase Auto Synch (Yes: 1/No: 0)				
5] PANEL KVAr (0:18kvar, 1:27kvar, 2:72kvar, 3:EDITKvar/(User defined)				
Faults				
1] Over Voltage limit (%)				
2] Over Voltage resume (%)				
3] Under Voltage limit (%)				
4] Under Voltage resume (%)				
5] Under Ld. KW Fault(Disable: 0/ Off Step: 2 / Off Fix : 3)				
Under load limit (%)				
Under load resume (%)				
Over Current Limit (%)				
Over Current Resume (%)				

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
6] Temperature Fault (Fast off: 4/ Disable: 0)				
Temp upper limit				
Temp lower limit				
7] Out of Banks Fault (Enable:1/Disable: 0)				
8] Harmonic Overload (Disable: 0 / Fast Off : 4)				
V- THD Threshold limit (%)				
I THD limit (%)				
Rated Curr.H.Flt(Tolerance)				
9] Harmonic fault auto Reset (Enable: 1/ Disable: 0)				
Harmonic fault reset (seconds)				
10] Control Fault (Enable:1/ Disable: 0)				
Control Fault set time(seconds)				
11) Cap Health Chk (Enable:1/Disable: 0)				
Cap. Kvar Fault tolerance (kvar) (%)				
Cap. KW Fault tolerance (kvar) (%)				
STEP KVAR LIMIT		-	-	
12) Neutral Fl SET VAL				
13) Auto-syncron.Tolerance:				
Control Fuse FT Banks:				
Bank Health FT Banks				
OB FAULT TIME OUT				
Capacitor Banks: 1)Total Capacitors				
2) Correction Time Seconds				
3) Discharge period Seconds				

PARAMETER	MIN	MAX	STEP SIZE	FACTORY DEFAULT
Capacitor Volt(L-L)				
Fixed bank setting				
6] Unequal Bank 1				
7] Unequal Bank 2				
8] Unequal Bank 3				
9] Unequal Bank 4				
10] Unequal Bank 5				
Communication				
1] PFC Unit ID				
3] Baud Rate: 0: 4800 1: 9600 2: 19200 3: 38400				
4] Set Time (hh/mm/ss) 24Hrs clock				Current time
5] Set Date (dd/mm//yy)				Current date
6] Initialize RTC (Yes: 1/No: 0)				
7] Clear NVRAM fault (Yes: 1/ No: 0)				

Please refer the table at the end