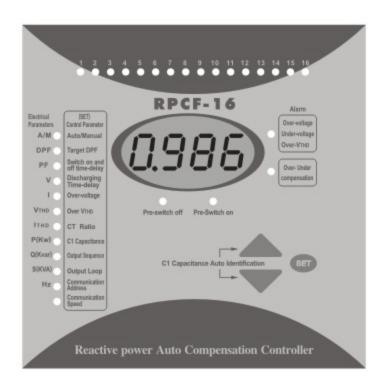
RPCF-16

Reactive power Auto Compensation Controller



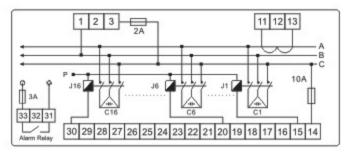
User Manual

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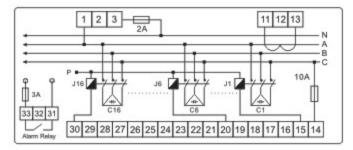
- 4. DPF/Target DPF Indicator: Under Automatic Mode, when this light is selected by pressing UP and DOWN buttons, nixie tube will really time display power network fundamental wave power factor. By pressing SET button 3 seconds you enter into SET menu, target power factor can be made by selecting this light.
- PF/Switch On anf off Time-delay Indicator: Under Automatic Mode, when this light is selected by pressing UP and DOWN buttons, nixie tube will really time display power network total power factor. By pressing SET button 3 seconds you enter in to SET menu, switch on and switch off timedelay time can be made by selecting this light.
- 6. V/Discharging Time-Delay Indicator: Under Automatic Mode, when this light is selected by pressing UP and DOWN buttons, nixie tube will really time display power network voltage. By pressing SET button 3 seconds you enter into SET menu, capacitor discharging time can be made by selecting this light.
- 7. I/Over voltage Indicator: Under Automatic Mode, when this light is selected by pressing UP and DOWN buttons, nixie tube will really time display power network primary current. By pressing SET button 3 seconds you enter into SET menu, overvoltage threshold value can be made by selecting this light.
- 8. VTHD/ Distortion Rate Indicator: Under Automatic Mode, when this light is selected by pressing UP and DOWN buttons, nixie tube will really time display power network voltage distortion rate. By pressing SET button 3 seconds you enter into SET menu, voltage distortion rate protective value can be made by selecting this light.
- 9. ITHD/CT Rate Indicator: Under Automatic Mode, when this light is selected by pressing UP and DOWN buttons, nixie tube will really time display power network current distortion rate. By pressing SET button 3 seconds you enter into SET menu, signal current transformer rate numerator value can be made by selecting this light.
- 10. P (KW)/C1 Capacitance Indicator: Under Automatic Mode, when this light is selected by pressing UP and DO-WN buttons, nixie tube will really time display power network reactive power. By pressing SET button 3 seconds you enter into SET menu, primary loop capacitor capacitance (Kvar) can be made by selecting this light.
- 11. Q (Kvar) / Output sequence Indicator: Under Automatic Mode, when this light is selected by pressing UP and DOWN buttons, nixie tube will really time display power network apparent power. By pressing SET button 3 seconds you enter into SET menu, control output sequence project can be made by selecting this light.
- 12. S (KVA)/Output Loop Indicator: Under Automatic Mode, when this light is selected by pressing UP and DOWN buttons, nixie tube will really time display power network apparent power. By pressing SET button 3 seconds you enter into SET menu, control output loop can be made by selecting this light.
- 13. Hz / Communication Address Indicator: Under Automatic Mode, when this light is selected by pressing UP and DOWN buttons, nixie tube will really time display power network frequency. By pressing SET button 3 seconds you enter into SET menu, communication add can be made by selecting this light. Note: only Model RPCFC controller has this function.
- Communication Speed Indicator: Under Automatic Mode, pressing SET button 3 seconds you enter into SET Menu, Communication Add Speed (baud rate).
 - Note: only Model RPCFC controller has this function.
- 15. Over-voltage, under-voltage, voltage distortion rated overnorm alarm indicator: If this light ON, controller will switch off the switch on capacitor group with 1 s per step time-delay, and alarm relay OFF alarm.
- 16. Over-compensation, under-compensation indicators: If it is not enough to compensate or be compensated the extra capacitor or electric network display capability when the capacitor switch on fully, the alarm relay will OFF.
- 17. Pre-switch on Indicator: If this lamp ON that means the controller is waiting for capacitor group's switch on.
- 18. Pre-switch off Indicator: If this lamp ON that means the controller is waiting for capacitor group's switch off.
- 19. Up Button: To select Menu or to move up in the Menu.
- 20. Parameter SET Button: To start parameter Adjustment Program by pressing this Key 3 seconds.
- 21. DOWN Button: To select Menu or to move down in the Menu.
- 22. C1 Capacitance and Signal Homonymic Terminal Auto Identification: To start C1 capacitor capacitance and signal homonymic terminal auto identification program by pressing UP and DOWN Button together for 3 seconds.

7. Connection Diagram

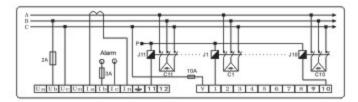


Connection Diagram for Model PRCF-PP-XX Hole Dimension 138mm×138mm

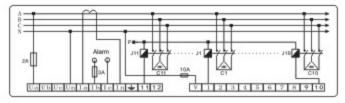
Point P connects with B when the AC connector rated working voltage is 380V; connects with N if it is 220V.



Connection Diagram for Model PRCF-PN-XX Hole Dimension 138mm×138mm
Point P connects with B when the AC connector rated working voltage is 380V; connects with N if it is 220V.



Connection Diagram for Model PRCFX-PP-XXS Hole Dimension 110mm × 110mm Point P connects with B when the AC connector rated working voltage is 380V; connects with N if it is 220V₀



Connection Diagram for Model PRCFX-PN-XXS Hole Dimension 110mm ×110mm Point P connects with B when the AC connector rated working voltage is 380V; connects with N if it is 220V.

8. Preset parameter

All settings are made by Pressing SET button at the RPCF front panel for 3 seconds. The set values are kept EEPROM even if the device is switched off. When it is switched on, RPCF sets control parameter with the data kept in EEPROM. After entering into pre-set Menu, pressing SET Button at the RPCF panel for 3 seconds, or if you do not make any adjustments during 20 seconds, pressing RPCF will store the changed parameter and return to Automatic Operating Mode or Manual Operating Mode.

8.1 Preset of Operating Mode (Automatic/ Manual Mode)

Two Operating Modes are valid for switching on/off the capacitor group. Automatic Operating Mode is the capacitor groups are controlled by RPCF automatically; Manual Operating Mode is the capacitor groups are switched on/off manually.

Mode selection is done as followed:

By pressing SET button at RPCF panel 3 seconds, nixie tube starts to display:

Auto/Manual light is selected by using UP-DOWN button. The light is ON, the nixie tube is displayed: RUE o . Pressing SET key if the nixie tube displays: R On , Which means the present operating mode is Manual Operating Mode. If the nixie tube displays: R OF .

Which means the present operating mode is Auto Operating Mode.

Automatic Mode or Manual Mode can be selected by using UP-DOWN buttons.



By pressing SET Button, the nixie tube displays: [AUL o], selecting others preset parameter by using UP and DOWN buttons.

RPCF will store the changed control parameter and exit Parameter Preset Menu by pressing SET button 3 seconds. A/M light starts blinking under Manual Mode. A/M light is continuously ON under Automatic Mode.

8.1.1 Operation of Manual Operating Mode

It wants to switch on under Manual mode by pressing UP button, the light is ON, RPCF connects the capacitor groups after a delay time according to user's preset code. It wants to switch off under Manual Mode after pressing DOWN button, the light is in ON, RPCF disconnects the capacitor groups after a delay time according to user's preset code.

8.2 Preset of Target Power Factor

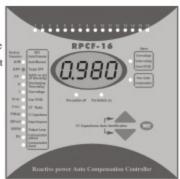
Pressing SET button at RPCF panel 3 seconds, nixie tube starts display:



The power factor is selected by using UP and DOWN buttons, the light is ON and the nixie tube displays: [DoS]. Power Factor Preset Value is shown at the nixie tube by pressing SET Button. A value between 0.70ind-0.70cap is adjusted by using UP-DOWN buttons.

By pressing SET Button, the nixie tube displays [05], selecting others preset parameter by using UP and DOWN buttons.

Pressing SET button 3 seconds, RPCF will store the changed control parameter and exit Parameter Preset Menu.



8.3 Preset of Switch On/Off time delay

Pressing SET button at RPCF panel 3 seconds, nixie tube starts display:

Time delay is selected by pressing UP and DOWN buttons, the light is ON and the nixie tube displays: del . Time delay time preset value of the capacitor is shown at the nixie tube by pressing SET Button. A value between 2-200 seconds is adjusted by using UP-DOWN buttons.

By pressing SET Button, the nixie tube displays: dEL, selecting others preset parameter by using UP and DOWN buttons.



Pressing SET button 3 seconds, RPCF will store the changed control parameter and exit Parameter Preset Menu.

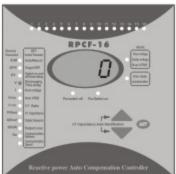
8.4 Preset of Capacitor Discharging Time delay

Pressing SET button at RPCF panel 3 seconds, nixie tube starts display:;

Capacitor Discharging Time-delay is selected by pressing UP and DOWN buttons, the light is ON and the nixie tube displays: dd&l. Capacitor Discharging Time-delay Preset Value is shown at the nixie tube by pressing SET Button. A value between0-240 seconds is adjusted by using UP-DOWN buttons, please refer to the User Manual of Capacitor for the specific values.

By pressing SET Button, the nixie tube displays: ddEL

Selecting others preset parameter by using UP and DOWN buttons.



Pressing SET button 3 seconds, RPCF will store the changed control parameter and exit Parameter Preset Menu.

The usage of this parameter: RPCF will forbid to the capacitor switching on (named as locking function) within the time accounting from a capacitor group switch-off to user preset capacitor discharging time delay.

8.5 Preset of Over Voltage

Pressing SET button at RPCF panel 3 seconds, nixie tube starts display:

Over voltage is selected by pressing UP and DOWN buttons, the light is ON and the nixie tube displays:

Over voltage Value is shown at the nixie tube by pressing SET Button. A value between 400V or 220V - 480V or 260V is adjusted by using UP-DOWN buttons.

By pressing SET Button, the nixie tube displays:

Selecting others preset parameter by using UP and DOWN buttons.

Pressing SET button 3 seconds, RPCF will store the changed control parameter and exit Parameter Preset Menu.



8.9 Preset of Output Sequence

Pressing SET button at RPCF panel 3 seconds, nixie tube starts display: [----]

Output Sequence is selected by pressing UP and DOWN buttons, the light is ON and the nixie tube displays: Prog. Output Code Value is shown at the nixie tube by pressing SET Button. The output Sequence mode from Pr-1 and Pr-12 can be selected by pressing UP-DOWN buttons:

Pr11=> 1; 1; 2; 3; 6; ...; 6 Pr12=> connect and disconnect as per sequence

By pressing SET Button if the nixie tube displays: Prog., Selecting others preset parameter by using UP and DOWN buttons.

Pressing SET button 3 seconds, RPCF will store the changed control parameter and exit Parameter Preset Menu.

8.10 Preset of Output Loop

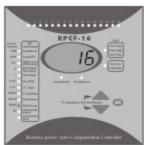
Pressing SET button at RPCF panel 3 seconds, nixie tube starts display: ----

Output Loop is selected by pressing UP and DOWN buttons, the light is ON and the nixie tube displays: Output Loop Preset Value is shown at the nixie tube by pressing SET Button. A value between 1 and Output Max Loop of RPCF is adjusted by using UP-DOWN buttons.

By pressing SET Button, the nixie tube displays: OUEP

Selecting others preset parameter by using UP and DOWN buttons.

Pressing SET button 3 seconds, RPCF will store the changed control parameter and exit Parameter Preset Menu.



RPCF-16

8.11 Preset of Communication Address

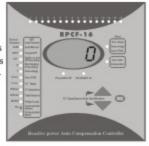
Pressing SET button at RPCF panel 3 seconds, nixie tube starts display: ----

Communication Address is selected by pressing UP and DOWN buttons the light is ON and the nixie tube displays: [[Rdd]]. Communication Address Preset Value is shown at the nixie tube by pressing SET Button. The Communication Add between 1 and 255 is selected by using UP-DOWN buttons.

By pressing SET Button, the nixie tube displays: [Rdd]

Selecting others preset parameter by using UP and DOWN buttons.

Pressing SET button 3 seconds, RPCF will store the changed control parameter and exit Parameter Preset Menu.



8.12 Preset of Communication Speed

Pressing SET button at RPCF panel 3 seconds, nixie tube starts display: ----

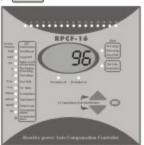
Communication Speed (Baud Rate) is selected by pressing UP and DOWN buttons the light is ON and the nixie tube displays [5PE]. Communication Speed Preset Value is shown at the nixie tube by pressing SET Button. The Communication Speed among 4800, 9600, 19200, 38400, 115200 is selected by using UP-DOWN buttons.

By pressing SET Button, the nixie tube displays: [SPE]

Selecting others preset parameter by using UP and DOWN buttons.

Pressing SET button 3 seconds, RPCF will store the changed control parameter and exit Parameter Preset Menu.

Note: Real Communication Speed = Display value × 100, for example: If display value is 96, the real communication speed=96×100=9600, see testsoft help for details of communication stipulation MODBUS-RTU,RS485.



9. Display of Electric Network Parameter

9.1 Display of fundamental power factor (DPF)

Under Automatic Operating Mode, the DPF Indicator is ON by means of Up and DOWN buttons. And fundamental power factor value is displayed this time. When the power factor value is negative, the system is capacitive and if the power factor value is positive, the system is inductive.

9.2 Display of Total Power Factor (PF)

Under Automatic Operating Mode, the PF Indicator is ON by means of Up and DOWN buttons. And Total Power Factor value is displayed this time.

Note: in a system without harmonics or harmonic wave is small, DPF and PF are equal to each other.

9.3 Display of Signal Voltage Value (V)

Under Automatic Operating Mode, the V Indicator is ON by means of Up and DOWN buttons. Signal Voltage Value is displayed this time.

9.4 Display of Signal Current Value (I)

Under Automatic Operating Mode, the I Indicator is ON by means of Up and DOWN buttons. Signal Current Value is displayed this time.

9.5 Display of Signal Voltage Distortion Rate (VTHD)

Under Automatic Operating Mode, the VTHD Indicator is ON by means of Up and DOWN buttons. Signal Voltage Distortion Rate is displayed this time.

9.6 Display of Signal Current Distortion Rate (ITHD)

Under Automatic Operating Mode, the ITHD Indicator is ON by means of Up and DOWN buttons. Signal Current Distortion Rate is displayed this time.

9.7 Display of Electric Network Active Power Value [p (Kw)]

Under Automatic Operating Mode, the p Indicator is ON by means of Up and DOWN buttons. Electric Network Active Power Value is displayed this time.

9.8 Display of Electric Network Reactive Power Value [Q (Kvar)]

Under Automatic Operating Mode, the Q Indicator is ON by means of Up and DOWN buttons. Electric Network Reactive Power Value is displayed this time...

9.9 Display of Apparent Power Value [S (KVA)]

Under Automatic Operating Mode, the S Indicator is ON by means of Up and DOWN buttons. Apparent Power Value r is displayed this time.

9.10 Display of Signal Frequency Value (HZ)

Under Automatic Operating Mode, the HZ Indicator is ON by means of Up and DOWN buttons. Signal Frequency Value is displayed this time.

10. Capacitor Capacitance and Signal Homonymic Terminal Auto Identification

Under Automatic Mode, C1 Capacitor Capacitance and Signal Homonymic Terminal Auto Identification program will be started by pressing UP and DOWN at the same time for 3 seconds, RPCF calculates C1 the capacitance through switch-ON/OFF capacitor groups (code C1) indirectly 10 times. After the Auto Identification Program finished, RPCF will display the checking result. If EE is displayed, it means the checking is failed; if OP is displayed, it means the checking is correct and the checking result will be stored in the EEPROM, at that time, user presses R-PCF button at will to enter into Automatic Operating Mode. The accounted checking result may be wrong when the load of electric network is changed so fast or suddenly changed even through the checking result is displayed correctly during Auto Identification Program. The best method is input the C1 capacitance through Preset Menu by manual. If voltage signal and current signal is on the non homonymic terminal state, the connecting wire of current signal should be exchanged by manual; if it is allowable to break load at site before operating the capacitor capacitance auto identification process to reduce the influence from load changed during auto identification process.

11. How to estimate whether the voltage and current signal in homonymic terminal?

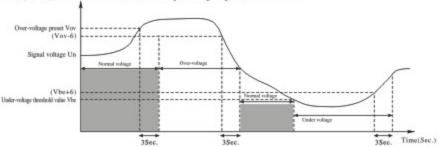
Under the condition of making voltage and current signal sampling correct, connecting on capacitor group by manual function and treat according to the follows:

- The power factor is inductive (positive) before have not switched on capacitor group. If power factor increasing unceasingly or being capacitive (negative) along with the switching-on of capacitor group, the voltage current signal can be judged in homonymic terminal from the above condition.
- 2). The power factor is capacitive (negative) before have not switched on capacitor group. If power factor reducing unceasingly or being capacitive (negative) along with the switching-on of capacitor group, the voltage current signal can be judged in homonymic terminal from the above condition.
- 3). The power factor is inductive (positive) before have not switched on capacitor group. If power factor reducing unceasingly and being inductive (positive) along with the switching-on of capacitor group, the voltage current signal can be judged in non-homonymic terminal from the above condition. User should exchange the cable of connecting current signal.
- 4). The power factor is capacitive (negative) before have not switched on capacitor group. If power factor increasing unceasingly and being inductive (positive) along with the switching-on of capacitor group, the voltage current signal can be judged in non-homonymic terminal from the above condition. User should exchange the cable of connecting current signal.

12. Reason of Alarm

12.1 Alarm of Over-voltage Under-voltage

If the signal voltage exceeds the protective voltage value (Vov) preset by user for 3 seconds, Overvoltage alarm light is ON, alarm relay closes. During over-voltage state, the over-voltage state will disappear if the signal voltage is lower or equal to Vov-6 for 3 seconds. If the signal voltage is lower than undervoltage threshold value, the under-voltage alarm light is ON, the alarm relay closes. Under undervoltage state, if the signal voltage is higher than Vbe+6 for 3 seconds, the undervoltage sate will disappear. Under overvoltage or under-voltage state, RPCF will switch off the switch-on capacitor group with 1 second per step. When signal voltage exceeds 450V (260V), RPCF will switch off all capacitor groups with 1 second.



12.2 Alarm of Over Distortion Rate

When the signal voltage distortion rated exceeds 3 seconds of the protective value preset by user, the over distortion alarm light is ON, alarm relay closes. RPCF will switch off the connected capacitor group as per 1 second time delay per step.

12.3 Alarm of Over Compensation

If the AC connector locked or contact burned and lead to RPCF control signal losing control action, or taking lighting as electric network system of and electric network capacitive, in addition, it is possible that the electric network to be in capacitive in the electric network system which taking lighting as main load, so that can make the system power factor is higher than target power. By now, the over compensation alarm light is ON, the alarm relay closes.

12.4 Alarm of Under Compensation

The capacitance of capacitor is reducing with the growing of time or the dropping of high breaking fuse, which leads to the system power factor failed to reach target power factor value after the capacitor group sending switch-in signal. By now, under compensation alarm light is ON, the alarm relay closes.

13. Examples for Out Sequence Application

RPCF has 12 different output sequence modes:

Correspond to relations; C1:	C2:	C3:	C4:	C5:: C16	C1: C2: C3: C4: C5:: C16
Pr-1 => 1:	1:	1:	1:	1:: 1	Pr-2 => 1: 2: 2: 2: 2:: 2
Pr-3 => 1;	2:	4:	4;	4:: 4	Pr-4 => 1; 2; 4; 8; 8;; 8
Pr-5 => 1:	1:	2:	2:	2:: 2	Pr-6 => 1; 1; 2; 4; 4;; 4
Pr-7 => 1:	1:	2:	4:	8:: 8	Pr-8 => 1: 2: 3: 3: 3:: 3
Pr-9 => 1;	2:	3:	6;	6:: 6	Pr10=> 1; 1; 2; 3; 3;; 3
Prl1=> 1;	1:	2:	3:	6:: 6	Pr12=> connect and disconnect as per sequence

1)Significance of sequence output

The biggest benefits of sequence output is that can get various kinds of capacitance output through different combination of capacitance capacitor, and avoid the problem of under compensation, over compensation and witch-on off vibration of non-sequence output mode.

2)When the total capacitance of compensation is about 75 Kvar, output loop is 4-loop, the combination category of different capacitance capacitor of different sequence mode.

Pr-1 ===> 20: 20: 20: 20 Pr-2 ===> 10: 20: 20: 20 Pr-3 ===> 6: 12: 24: 24 Pr-4 ===> 5: 10: 20: 40

Different combination capacitances of Pr-1 code mode: 20,40,60,80, total 4 kinds.

Different combination capacitances of Pr-2 code mode: 10,20,30,40,50,60,70 total 7 kinds.

Different combination capacitances of Pr-3 code mode: 6,12,18,24,30,36,42,48,54,60,66 total 11 kinds. Different combination capacitances of Pr-4 code mode: 5, 10, 15, 20, 25,30, 35, 40,45, 50, 55, 60, 65, 70,

and 75,total 15 kinds.

From the above, we can get the result that the number of Pr-4 is the most, Pr-1 is the less. Standing at the technology, Pr-4 is the best compensation project, but, this program will bring a certain inconvenience for the elements purchasing and after sales service because it needs much more capacitor specifications. Therefore, user should select the proper sequence modes to install, purchase, do after sales service according to need at side.

3)Explanation: Output Sequence

There are two meanings in this User Manual for the out Sequence:

a.Defining Proportional relations between capacitor groups

RPCF takes C1 capacitor capacitance as reference capacitance (C1 is defined by user). User calculates

others capacitor capacitance value by capacitance proportional relations defined by selected output code mode. If user selects the output code mode as Pr-3, the output loop is 4,C1 capacitor capacitance is 5.0Kvar, then, the capacitance of C1-C4 capacitor group is 5.0Kvar, 10.0Kvar, 20.0Kvar, 20.Kvar respectively according to proportional relations stipulated by Pr-3. The rest code mode can be got as per the above.

b.Defining Controlling Program of Control Output In order to explain the problem, the switch-on state of capacitor group is shown by "1", the switch-off state of capacitor group is shown by

C1	C2	C3	C4	output potal cepecity
5.0kvar	10.0kvar	20.0kvar	20.0kvar	
1	0	0	0	5.0kvar
0	1	0	0	10.0kvar
1	1	0	0	15.0kvar
0	0	1	0	20.0kvar
1	0	1	0	25.0kvar
0	1	1	0	30.0kvar
1	1	1	0.	35.0kvar
0	0	1	1	40.0kvar
1	0	1	1	45.0kvar
0	1	1	1	50.0kvar
1	1	1	1	55.0kvar

"0", the code output controlling process is explained by Section a assumed parameter shown as Table 1.

14. RPCF Switch-On/Off Principle

- When the capacitor group can not connect automatically, user should take the following condition into account to see whether it is true or not. Note: the following conditions all are necessary conditions, must meet: a.System power factor value is lower than target power factor value;
- b.Alarm indicator does not light.
- c. Taking P as the active power of the present electric network, Q as the reactive power of the present electric network, $\cos\varphi$ as target power factor, the formula 1 condition must be true:

C1 capacitance
$$< Q-P \times \sqrt{\frac{1}{\cos v^2} - 1}$$
 (formula 1)

2) When electric network power factor is higher than target power factor, capacitor group cannot auto disconnect, user should take the following condition into account to see whether it is true or not: Taking P as the active power of the present electric network, Q as the reactive power of the present electric network, cosy as target power factor 1, the formula 2 condition must be true:

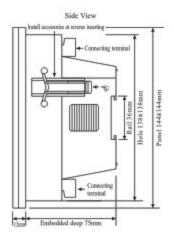
C1 capacitance
$$< P \times \sqrt{\frac{1}{\cos \theta^2} - 1} - Q$$
 (formula 2)

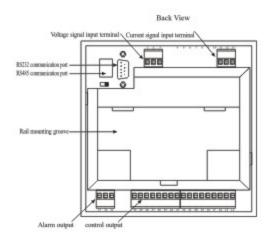
15. Control Parameter Factory Default

- 1) Auto/Manual Operating Auto
- 3). Switch-on/Off time delay time 10 Sec.
- 5). Over-voltage line 420V/(phase 240V)
- 7). CT ratio 500/5A
- 9). Output Code Pr-12
- 11). Communication Address 1

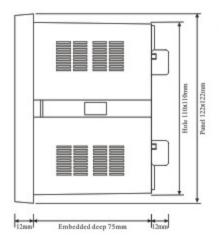
- 2). Power Factor 0.950 ind
- 4). Capacitance discharging time 0Sec.
- 6). Distortion rate 5.0%
- 8). C1 capacitance 10.0 Kvar
- 10). Output Loop Max Loop hardware can support
- 12). Communication Speed 9600

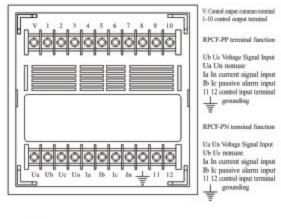
16. RPCFX-XX-XX Overall Dimensions and Installation Mode



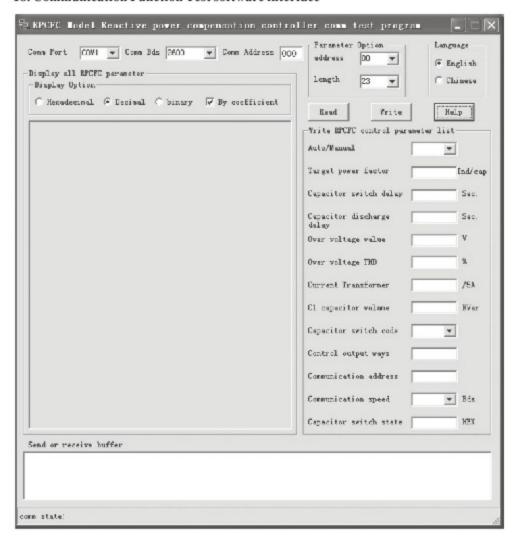


17. RPCFX-XX-XX S Overall Dimensions and Installation Mode





18. Communication Function Test software interface



19. Packaging List

- 19.1 RPCF (C) controller one set
- 19.2 Installation accessory 2 purchase
- 19.3 User's Manual 1 copy
- 19.4 CD for Model RPCFC controller.