

# PR600

## Power Line Protection Relay

### User Manual



Version: 1.10

Revision: 2024-2

## Read me

**When you use PR600 power line protection relay, be sure to read this user manual carefully, and be able to fully understand the implications, the correct guidance of operations in accordance with user manual, which will help you make better use of PR600 power line protection relay, and help to solve the various problems at the scene.**

1. This device must be installed and maintained by professionals.
2. Input signals and power must be isolated before any internal or external work is performed on the unit.
3. The signal and auxiliary power provided to device must be within the allowable range.
4. Is the current input phase sequence correct?
5. Are the rated parameter settings correct?
6. Is the transformation ratio setting correct?
7. Is the relay working mode setting correct?
8. Are the protection mode and setting time reasonable?



- **Please read this user manual carefully**
- **Please save this document**

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# 1. - SUMMARIZE

PR600 power line protection relay is suitable for protection and monitoring of low-voltage lines with rated voltage below 690V and rated current up to 820A.

PR600 can monitor on-site signals in real time and provides system protection against harm to the line caused by faults such as overload, overcurrent, undervoltage, overvoltage, grounding or leakage. It can realize a variety of operation control functions and also has measurement functions, self-diagnosis, maintenance management, fieldbus communication and other functions.

PR600 power line protection relay realize measurement functions, protection functions, opening and closing control functions and remote communication functions; it has 10 channels relay monitoring, can be configured as needed, and supports MODBUS-RTU communication.

| Protection function<br>(Details please refer to <a href="#">chapter 7</a> )                     | Real-time monitor parameter |
|---|-----------------------------|
| Start overtime (Max. start time)  | Three-phase current         |
| Over load   | Current imbalance           |
| Overcurrent stall   | Heat capacity               |
| Phase failure (Phase loss)  | Ground residential current* |
| Jam in starting(Stall)  | Thermal resistance*         |
| Current imbalance   | Three-phase line voltage*   |
| Ground fault  | Frequency*                  |
| Short circuit   | Power factor*               |
| Under load  | Active power*               |
| Current leakage*  | Reactive power*             |
| Under power   | Apparent power*             |
| External failure  | Electrical energy*          |
| Over temperature*   |                             |
| Module failure  |                             |
| Over voltage  |                             |
| Under voltage   |                             |
| Abnormal frequency  |                             |
| Abnormal power factor   |                             |
| Restart   |                             |
| tE protection<br>(Increased safety motor overload)  |                             |
| Overflow failure<br>(failure current exceeds contactor breaking capacity) trips circuit breaker |                             |

**Notes:** \* marked is optional functions

## FEATURES

- Ultra-wide range working power supply AC85-265V.
- Undervoltage, overvoltage and frequency monitoring in AC systems.
- Digital measured value display via multi-functional LC display.
- Save the latest 100 trip records.
- Internal test/reset button, Integrated energy backup.
- Asymmetry, phase failure and phase sequence monitoring.
- Adjustable start-up delay, response delay and delay on release.
- The protection functions are complete, and each protection function can realize protection shutdown, alarm or trip.
- Built-in 5-way relay, which can set to protection mode and measurement and control mode.
- Programmable analog output function, standard RS-485 communication interface.
- 96\*96mm, Modular design, small size and flexible structure.
- Measurement voltage, current, temperature and frequency signals.

## 2. - SPECIFICATIONS

### Electrical parameters

|                        |   |
|------------------------|---|
| Power supply:          | 85-265V AC/DC                           |
| Power consumption:     | <10 VA                                  |
| Insulation resistance: | > 100MΩ                                 |
| Alarm relay:           | 5A @ 250VAC, or 5A @ 30VDC (NO contact) |

### Measuring accuracy

|                     |                                     |
|---------------------|-------------------------------------|
| Current:            | ± 0.5% @ 10%~200% of I <sub>e</sub> |
| Voltage:            | ± 0.5% @ 10%~150%U <sub>e</sub>     |
| Frequency:          | ± 0.1% @ 45~65Hz                    |
| Power factor:       | ± 1.0% @ 0~1.000                    |
| Power:              | ± 1.0% @ 0~500kW                    |
| Leakage current:    | ± 1% @ 10%~100% of I <sub>r</sub>   |
| Analog output:      | ± 1% @ 4~20mA                       |
| Thermal resistance: | ± 1% @ 0.1K~30K                     |

### Working environment

|                         |   |
|-------------------------|---|
| Motor rated voltage:    | AC380V / AC660V   |
| Motor rated current:    | 0.5-820A  |
| Working temperature:    | -10C ~ +55°C  |
| Storage temperature:    | -25C ~ +70°C  |
| Relative humidity:      | < 93% RH  |
| Altitude:               | No more than 3000 m   |
| Atmospheric conditions: | Operating place must not have the explosive medium and contain Gases that corrode metals and damage insulating and conductive medium. |

**Electrical test**

|                                  |  |
|----------------------------------|--|
| Electrostatic discharge:         | IEC 61000-4-2, Level III                               |
| Electrical fast transient burst: | IEC 61000-4-4, Level III                               |
| Surge shock:                     | IEC 61000-4-5 , Level III                              |
| Withstanding voltage:            | IEC 61010-1, AC2kV/1min Between power / input / output |

**Product standards**

|                              |  |
|------------------------------|--|
| GB / T 14048.1 (IEC 60947-1) | Low-voltage switchgear and control equipment General Provisions          |
| GB / T 14048.4 (IEC 60947-4) | Low voltage electromechanical contactors and motor starters requirements |
| JB / T 10613-2006            | General specification for digital motor combined protection equipment    |
| JB / T 10736-2007            | Low voltage motor protection   |

### 3. - PRODUCT SELECTION GUIDE

#### 3.1 - Selection instructions

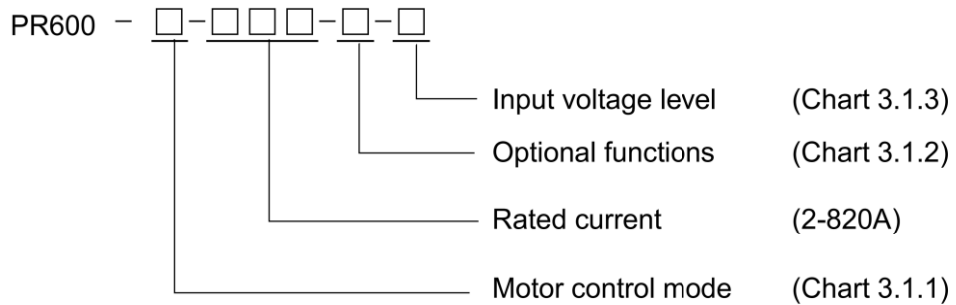


Chart 3.1.1

| SN | Preset Motor Start method         | Code |
|----|-----------------------------------|------|
| 1  | Line protection mode              | H    |
| 2  | Line measurement and control mode | K    |

Chart 3.1.2

| SN  | Optional function                          | Code |
|---|--|------|
| /   | Standard type without additional functions | /    |
| 1   | With zero-sequence CT                      | L    |
| 2   | 4~20mA analog port                         | M    |
| 3   | Temperature probe                          | T    |
| 4   | Profibus-DP communication port             | P    |
| 5   | Dual RS-485 communication ports            | C2   |
| Note:<br>Standard type without additional function, If need multiple additional functions the coded arranged in sequence after main code. |  |      |

Chart 3.1.3

| SN | Input voltage level              | Code |
|----|----------------------------------|------|
| 1  | 380V direct input                | V38  |
| 2  | 380/100V input via PT            | V31  |
| 3  | 660/100V input via PT            | V61  |
| 4  | Non-standard voltage level input | Vf   |



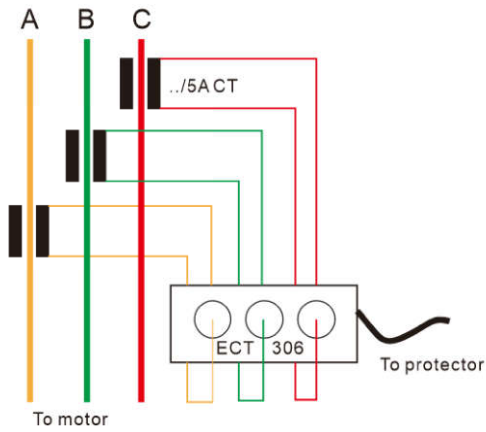
### 3.2 - External protection CT selection guide, typical in 380V motor system

PR600 use outside external protect CT for current signal reference, on body have 4pin terminal block (see [chapter 4.3](#)), following is typical selection guide for motor rated current less than 200A:

| Motor rated power (Kw) | Rated current (A) | Default CT range |
|------------------------|-------------------|------------------|
| 0.06                   | 0.22              | 10A<br>(CT306)   |
| 0.12                   | 0.42              |                  |
| 0.37                   | 1                 |                  |
| 0.55                   | 1.5               |                  |
| 0.75                   | 2                 |                  |
| 1.1                    | 2.5               |                  |
| 2.2                    | 5                 |                  |
| 3                      | 6.5               |                  |
| 5.5                    | 11                | 100A<br>(CT305)  |
| 7.5                    | 14.8              |                  |
| 11                     | 21                |                  |
| 15                     | 28.5              |                  |
| 18.5                   | 35                |                  |
| 22                     | 42                |                  |
| 30                     | 57                |                  |
| 37                     | 69                |                  |
| 45                     | 81                |                  |
| 55                     | 100               |                  |
| 75                     | 135               | 200A<br>(CT304)  |
| 90                     | 165               |                  |
| 110                    | 200               |                  |

**Notes:**

1. The external CT rating already set in Config. menu |> System| > Ext.CT.
2. If motor rated current more than 200A, need use ../5A external CT to expand measurement range. Typical wiring as following.



External 500/5 CT as an example:

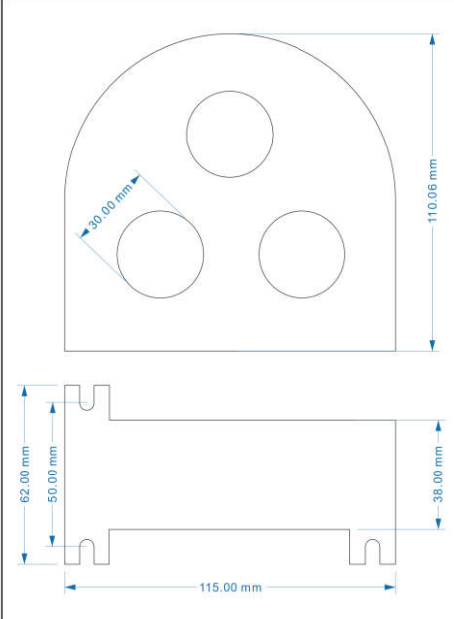
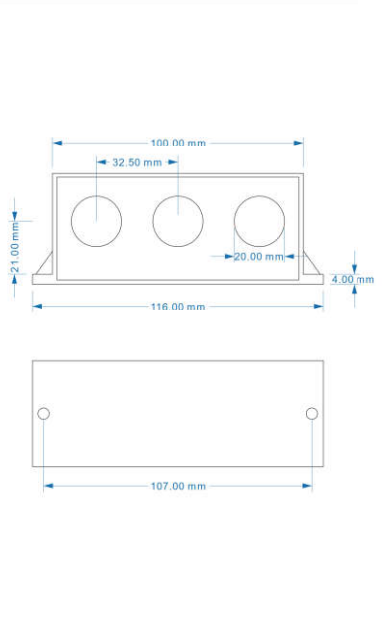
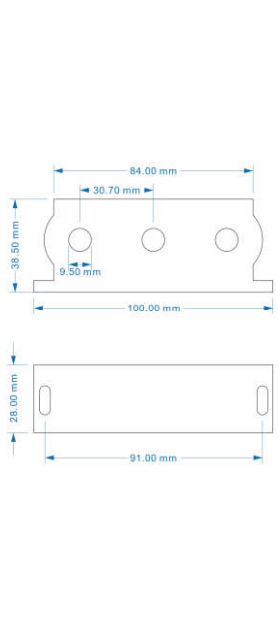
external CT should be 5P10, the measurement accuracy should be 0.5 class, and three transformers are a set.

| Rated power (Kw) | Rated current (A) | Connected ECT           | Expand CT |
|------------------|-------------------|-------------------------|-----------|
| 132              | 240               | CT306<br>Set Ext. CT 5A | 500/5     |
| 160              | 285               |                         |           |
| 200              | 352               |                         |           |
| 220              | 420               |                         |           |
| 250              | 480               |                         |           |

### 3.3 - Description of controller related accessories

#### 3.3.1 - External current transformer (ECT)

External CT specifications and dimensions:

| CT304  | CT305   | CT306  |
|--|---|--|
| Measurement 100A-200A  | 10-100A   | 0-10A  |
| Secondary to protector 100mA   | 100A/50mA   | 10A/5mA  |
| Maximum cable size 30mm  | 20mm  | 9mm  |
|  |  |  |

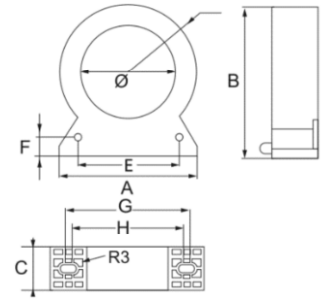
### 3.3.2 - Residual current sensor (ZCT)

Protector can connect separate residual current sensor to provide accuracy to measurement, need to do configuration in Menu |> System |> Addition |> GF. = External.

There are 2 types of residual current transformers: cable type and cooper bar type.

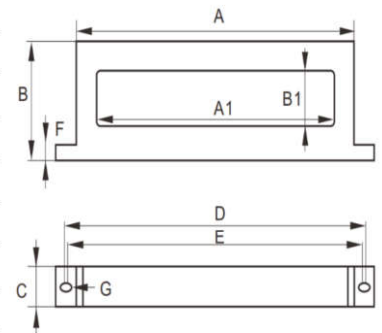
#### Wiring core for cable type:

| Current range | Dimension (mm) |     |     |    |     |     |      |     |     |
|---------------|----------------|-----|-----|----|-----|-----|------|-----|-----|
|               | φ              | A   | B   | C  | D   | E   | F    | G   | H   |
| 16-100A       | 45             | 77  | 85  | 24 | 38  | 54  | 9    | 64  | 54  |
| 100-250A      | 80             | 112 | 122 | 28 | 56  | 80  | 14   | 89  | 80  |
| 250-400A      | 100            | 131 | 136 | 24 | 66  | 96  | 14   | 108 | 107 |
| 400-800A      | 150            | 200 | 209 | 28 | 100 | 145 | 16.5 | 184 | 177 |



#### Wiring core for cooper bar type:

| Current range | Dimension (mm) |    |     |    |    |     |     |    |     |
|---------------|----------------|----|-----|----|----|-----|-----|----|-----|
|               | A1             | B1 | A   | B  | C  | D   | E   | F  | G   |
| 0-63A         | 100            | 20 | 133 | 50 | 16 | 144 | 140 | 3  | 2.0 |
| 0-100A        | 100            | 25 | 133 | 60 | 24 | 154 | 143 | 9  | 2.5 |
| 0-225A        | 140            | 32 | 172 | 72 | 24 | 189 | 184 | 9  | 2.5 |
| 0-250A        | 180            | 32 | 212 | 72 | 24 | 229 | 224 | 9  | 2.5 |
| 0-400A        | 220            | 45 | 254 | 86 | 24 | 269 | 264 | 11 | 2.5 |
| 0-630A        | 260            | 45 | 294 | 86 | 24 | 309 | 304 | 11 | 2.5 |
| 0-1600A       | 300            | 45 | 334 | 86 | 24 | 349 | 344 | 11 | 2.5 |
| 0-4000A       | 420            | 45 | 454 | 86 | 24 | 469 | 464 | 11 | 2.5 |



#### Note:

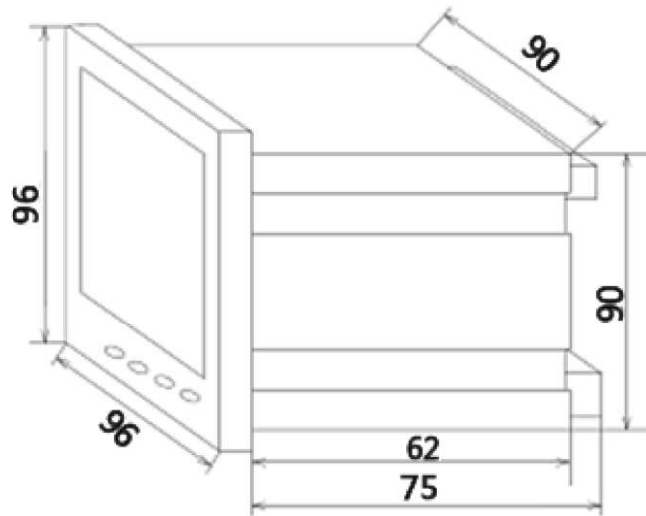
Protection function details, please refer to [chapter 7](#).

## 4. - INSTALLATION AND START-UP

### 4.1 - Installation dimension

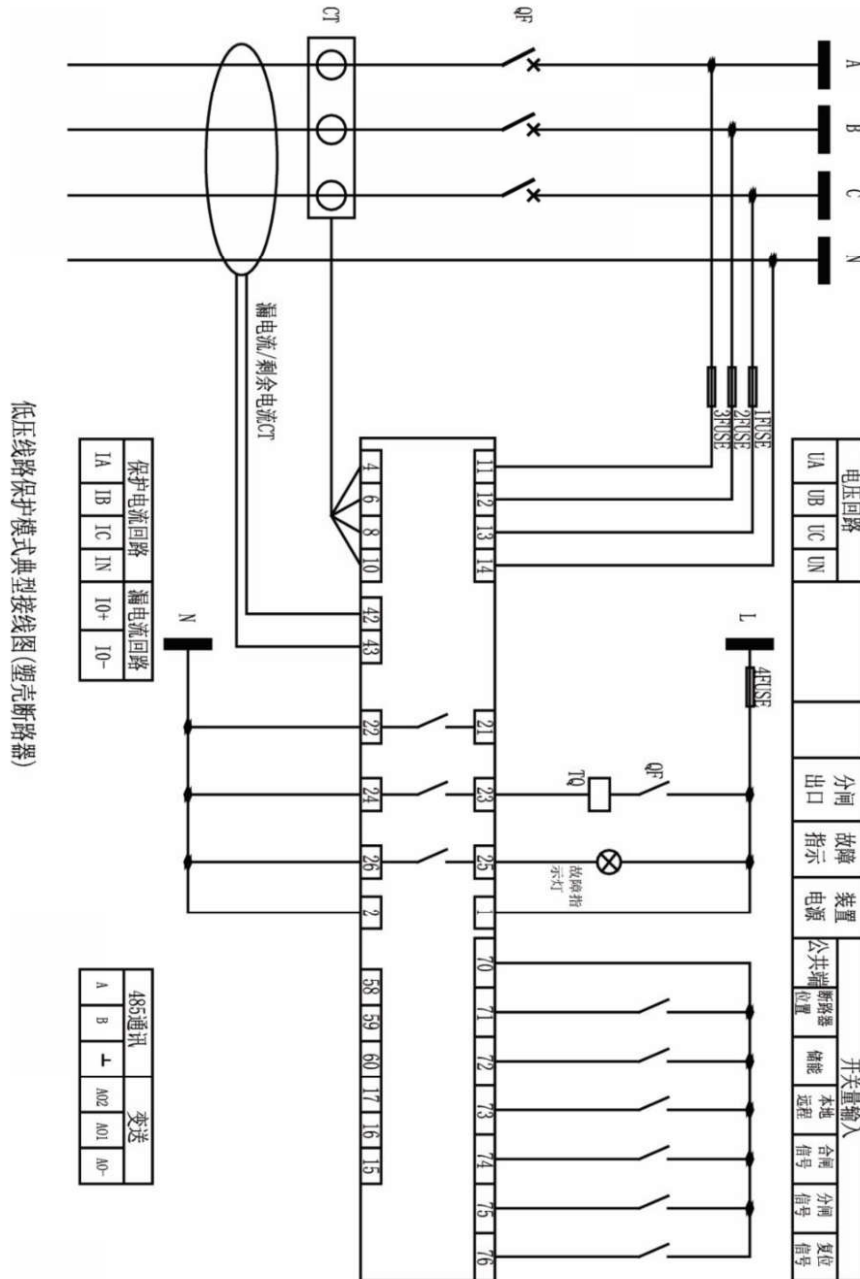
Note that with the instrument powered on, the terminals could be dangerous to touch and cover opening actions or elements removal may allow accessing dangerous parts. Therefore, the instrument must not be used until this is completely installed.

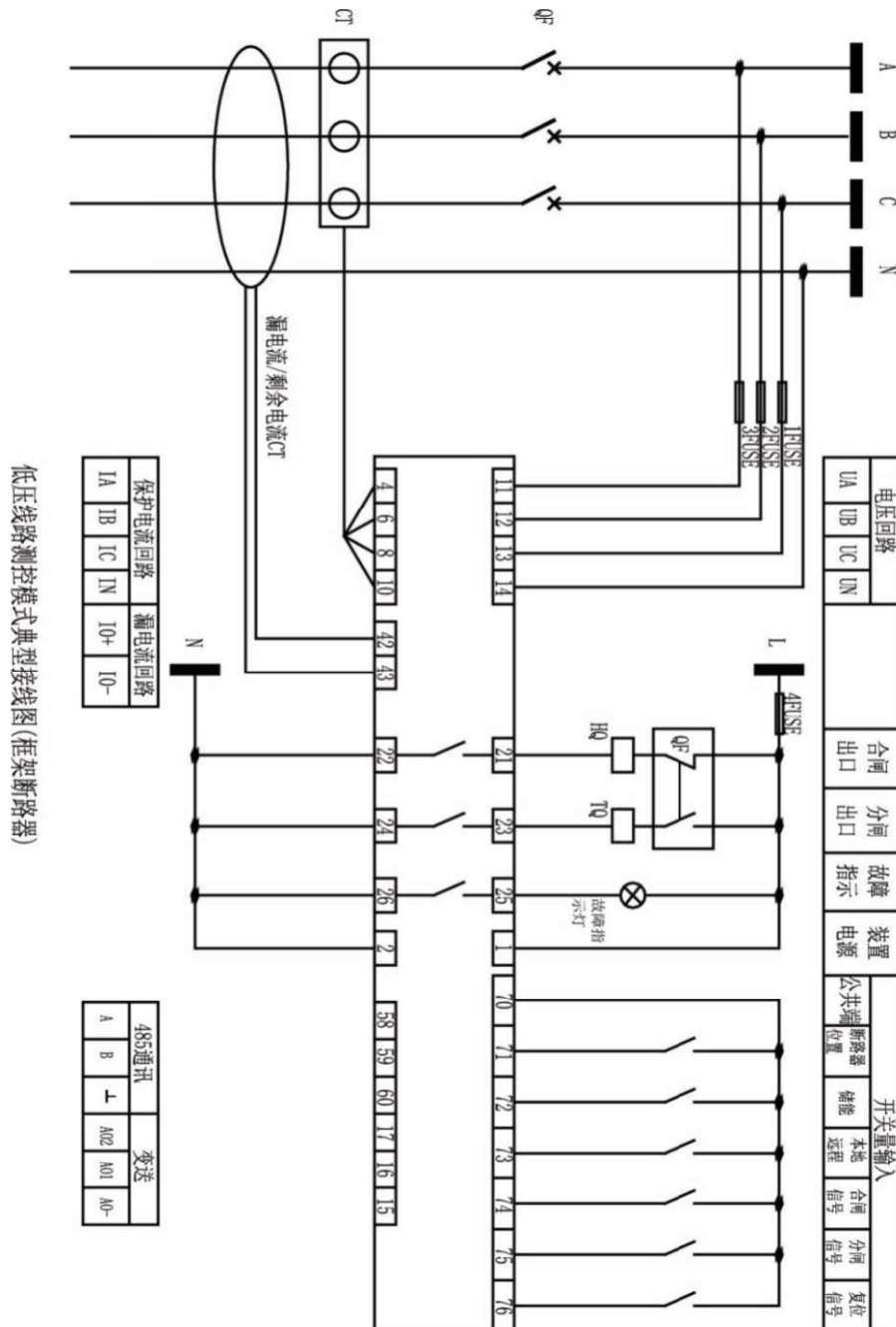
**Dimension:**



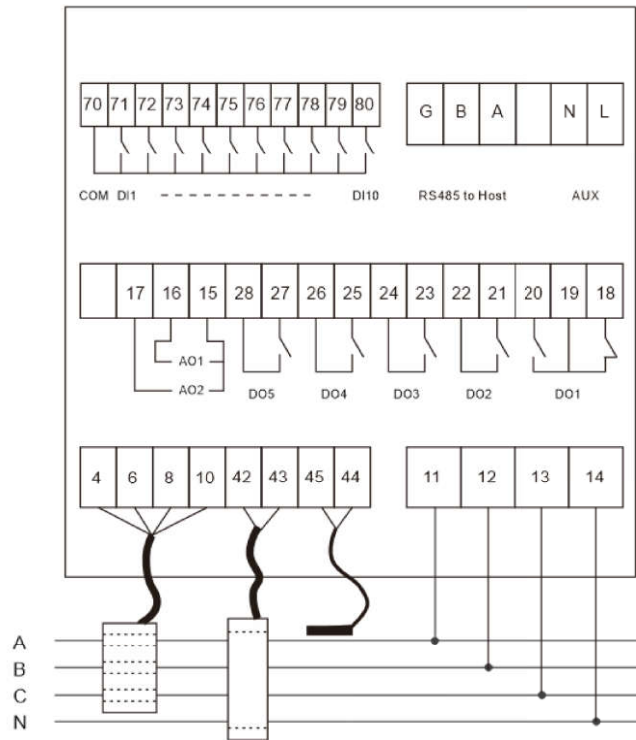
## 4.2 - Wiring method

### 4.2.1. Protection mode wiring (MCCB)



**4.2.2.- Measurement and control mode (frame circuit breaker)**


### 4.3 - Terminal definition



| Terminal No. | Description           |
|--------------|-----------------------|
| 70           | Common terminal of DI |
| 71           | DI 1                  |
| 72           | DI 2                  |
| 73           | DI 3                  |
| 74           | DI 4                  |
| 75           | DI 5                  |
| 76           | DI 6                  |
| 77           | DI 7                  |
| 78           | DI 8                  |
| 79           | DI 9                  |
| 80           | DI 10                 |
| G            | RS485-A               |
| B            | RS485-B               |
| A            | GND                   |
| N            | AUX 85-265V           |
| L            |                       |
| 15           |                       |
| 16           | AO1 - 4~20mA +        |
| 17           | AO2 - 4~20mA +        |

| Terminal No. | Description                 |
|--------------|-----------------------------|
| 18           | NC                          |
| 19           | DO1                         |
| 20           |                             |
| 21-22        | DO 2                        |
| 23-24        | DO 3                        |
| 25-56        | DO 4                        |
| 27-28        | DO 5                        |
| 4            | A-phase current             |
| 6            | B-phase current             |
| 8            | C-phase current             |
| 10           | Zero sequence current input |
| 42           | Leakage current lo+         |
| 43           | Leakage current lo-         |
| 44           | R - for NTC                 |
| 45           | R + for NTC                 |
| 11           | A-phase voltage             |
| 12           | B-phase voltage             |
| 13           | C-phase voltage             |
| 14           | Neutral line                |



## 5. - OPERATION MODE

### 5.1 - LCD display screen







After device be powered on, the default display interface is the measurement parameter. In this interface, short press the "SET" button to return to the main menu. User can operate the buttons to select measurement parameters, graphic vectors, fault information, operating information, system settings, user help and other functions.

Press the "◀" or "▶" key on the main interface to select the menu interface you want to enter, and press "↵" to enter.

### 5.2 - Panel LED indicator

| Indicator | Description |                             |
|-----------|-------------|-----------------------------|
| "CB ON"   | ○           | Line in "Non-CB ON" status  |
|           | ●           | Line in "CB ON" status      |
| "CB OFF"  | ○           | Line in "Non-CB OFF" status |
|           | ●           | Line in "CB OFF" status     |
| "ALM."    | ○           | Line in "Non-alarm" status  |
|           | ●           | Line in "Alarm" status      |
| "FAIL."   | ○           | Line in "Non-trip" status   |
|           | ●           | Trip event occurs           |
| "COMM."   | ○           | No communication            |
|           | ●           | Communication normal        |

### 5.3 - Keys introduction

|   |  |
|---|--|
|  | <p><b>Short press:</b> "Previous page": display measurement parameters, functions switch.</p> <p><b>Long press:</b> "CB ON" function.</p>                            |
|  | <p><b>Short press:</b> "Next page": display measurement parameters, functions switch.</p>  |
|  | <p><b>Short press:</b> "Return" function: to exit the menu step by step.</p> <p><b>Long press:</b> "CB OFF" function.</p>  |
|  | <p><b>Short press:</b> "Move down and confirm": Move down, confirm, and save the display/input information settings.</p> <p><b>Long press:</b> "Reset" function.</p> |

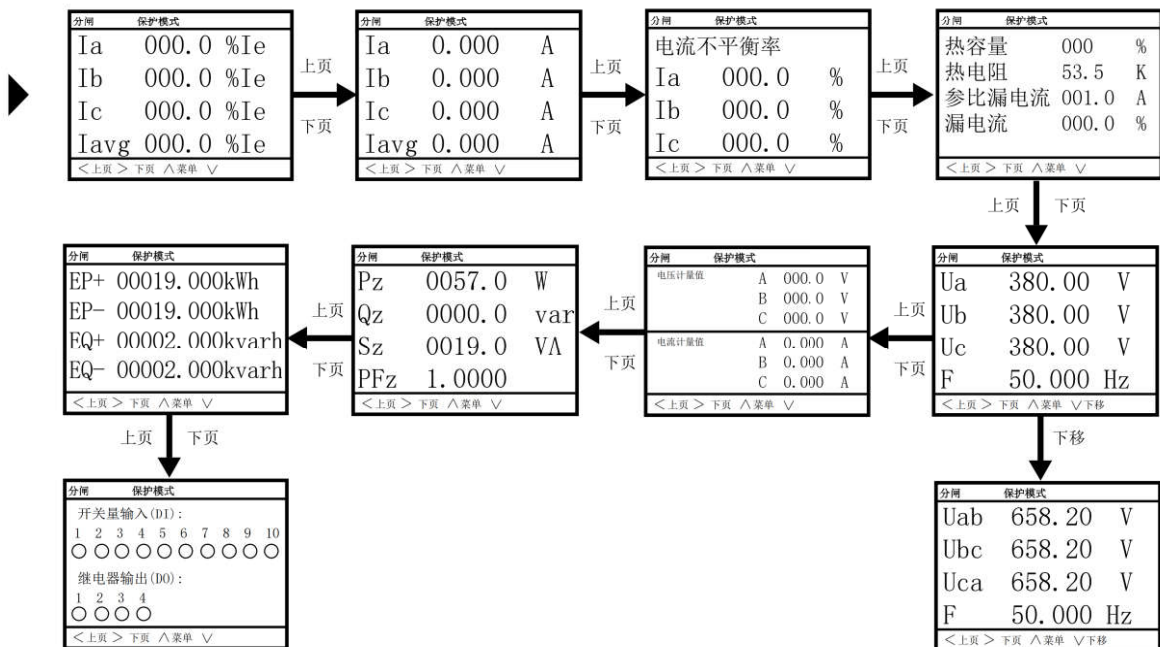
## 6. - SCREEN INTRODUCTION

### 6.1. - Display screen

#### 6.1.1. - Measurement parameters screen



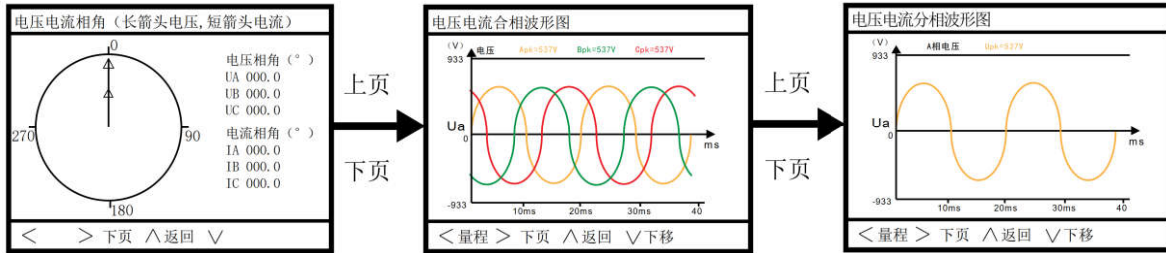
Press the ◀ and ▶ keys to switch to view the three-phase current and protection current percentage, three-phase current, three-phase current imbalance, line heat capacity, thermal resistance and leakage, three-phase line voltage, frequency, measurement values of voltage and current, active power, and reactive power, apparent power, power factor, active energy, reactive energy, signal input and other data.



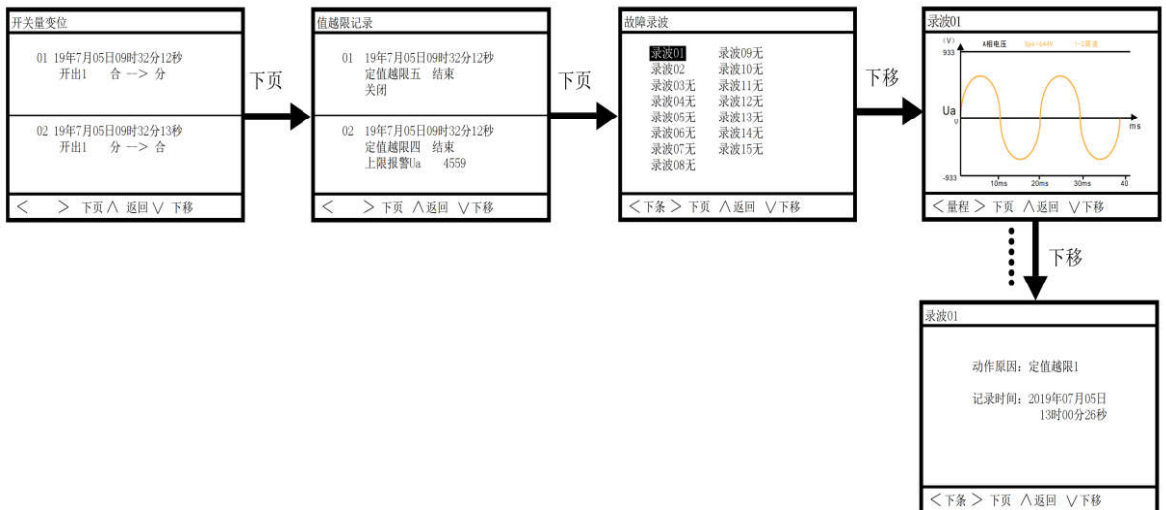
## Notes

1. In the measurement interface, the voltage, power, frequency, power factor, and voltage measurement parameters are only valid when the voltage function is optioned; the thermal resistance parameters are only valid when the temperature function is optioned;
2. The leakage current in the figure is calculated by software when built-in is selected in the system parameter settings (the reference value is the rated current of the protection transformer), and measured by the external leakage current transformer when external is selected (the reference value is the leakage value entered in the menu). current rating).
3. About the status of DI/DO, the hollow circle indicates that there is no signal input or no relay output action occurs; if there is signal input or relay output action, the corresponding hollow circle becomes a solid circle.
4. When the real measured current exceeds 1.3 times the rated current of the protection transformer, the electrical parameter errors of the 2nd and 7th screens will gradually increase.

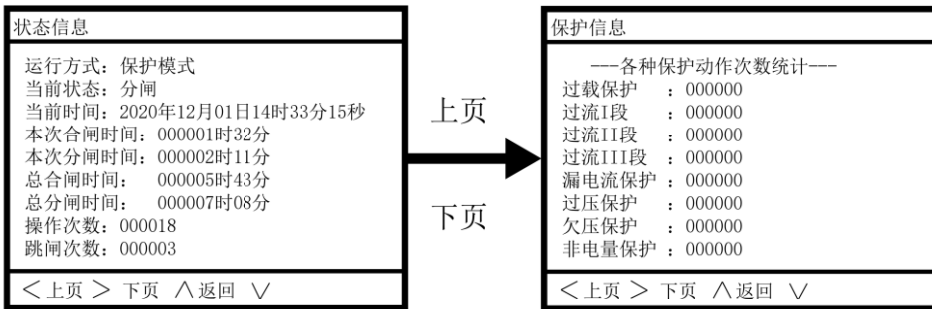
### 6.1.2. - Graphic vector screen



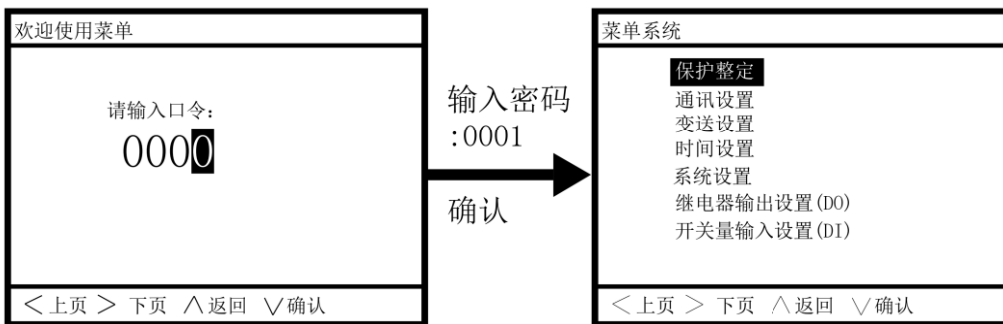
### 6.1.3. - Fault information screen



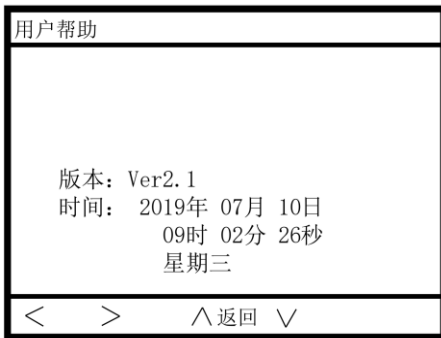
### 6.1.4. - Running information screen



### 6.1.5. - System settings screen

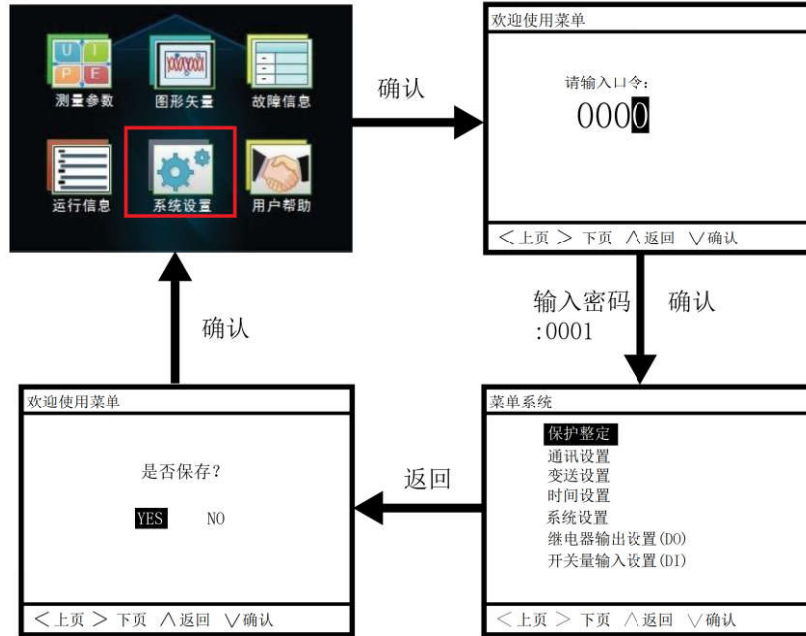


### 6.1.6. - User assistance screen




## 6.2. - Configuration screen


### 6.2.1. - Enter and exit configuration menu







#### Enter the configuration menu:

Press "" to enter in main menu to enter default password "0001", and confirm to set some parameters of the instrument.

#### Exit configuration menu:

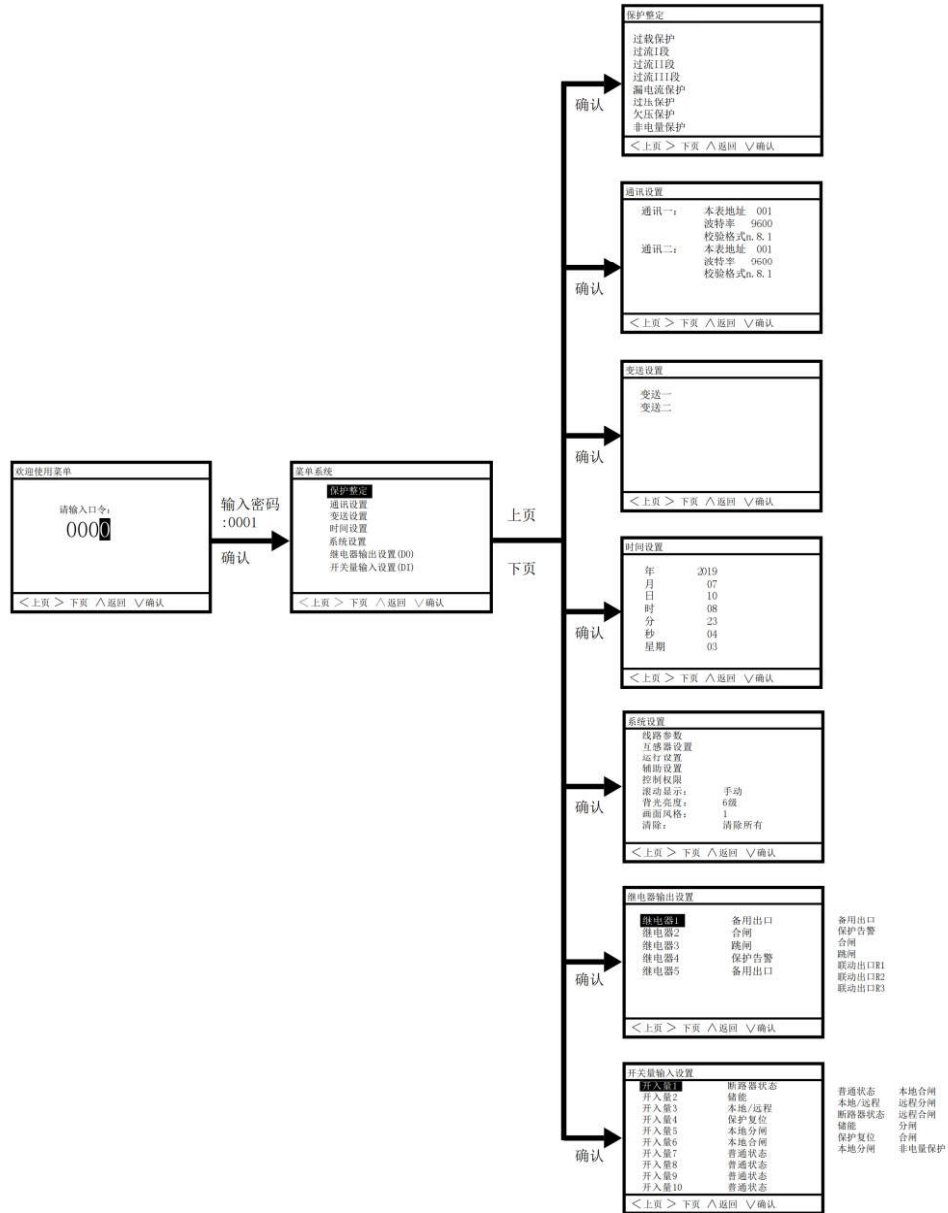
After parameter setting, press "" can return to first-level of configuration menu, then call out save selection page, you can choose following:

- (1) Press "" directly return to configuration menu.
- (2) Press " " and select "YES", press  for saving the parameter modify and exit.
- (3) Hold the setting status, press the "" key not to continue instrument setting.



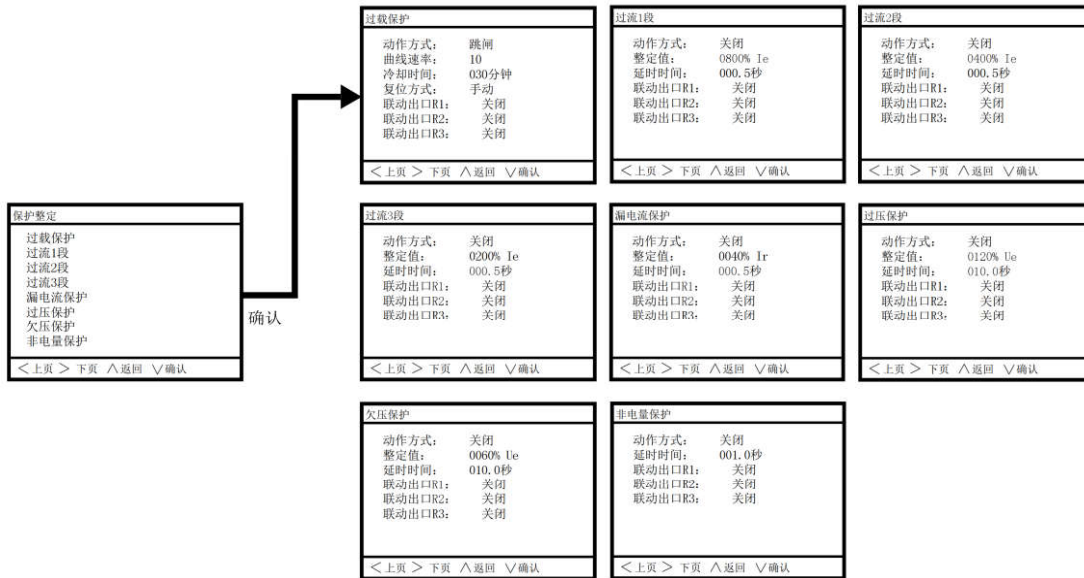
### 6.2.2. - Configuration menu structure

The overall structure is shown below, "Protection Setting" and "System Settings" contain sub-menus:

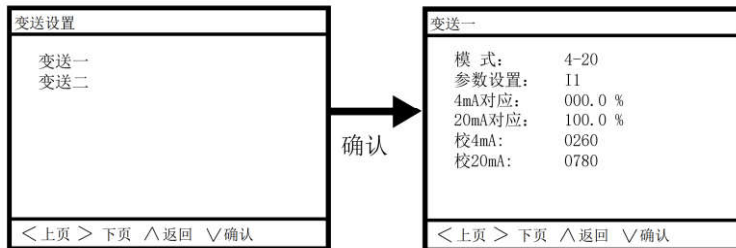


### 6.2.3. - "Protection Setting" and "System Settings" sub-menus:

#### "Protection Setting"



#### "Transmission settings"



#### "System Settings"



## 7. - PROTECTION FUNCTION INTRODUCTION

### 7.1. - Over current protection

Used to quickly cut off failure of phase-to-phase short-circuit and ground faults on lines.

#### Parameters:

##### Over current protection I

|                |                       |
|----------------|-----------------------|
| Protect action | OFF / Alarm / Trip DO |
| Start timer    | 100 ~ 1000% $I_e$     |
| Action delay   | 0.1 ~ 1.0 s           |

##### Over current protection II

|                |                       |
|----------------|-----------------------|
| Protect action | OFF / Alarm / Trip DO |
| Start timer    | 100 ~ 1000% $I_e$     |
| Action delay   | 0.5 ~ 20.0 s          |

##### Over current protection III

|                |                       |
|----------------|-----------------------|
| Protect action | OFF / Alarm / Trip DO |
| Start timer    | 100 ~ 1000% $I_e$     |
| Action delay   | 1.0 ~ 100.0 s         |

## 7.2. - Overload protection

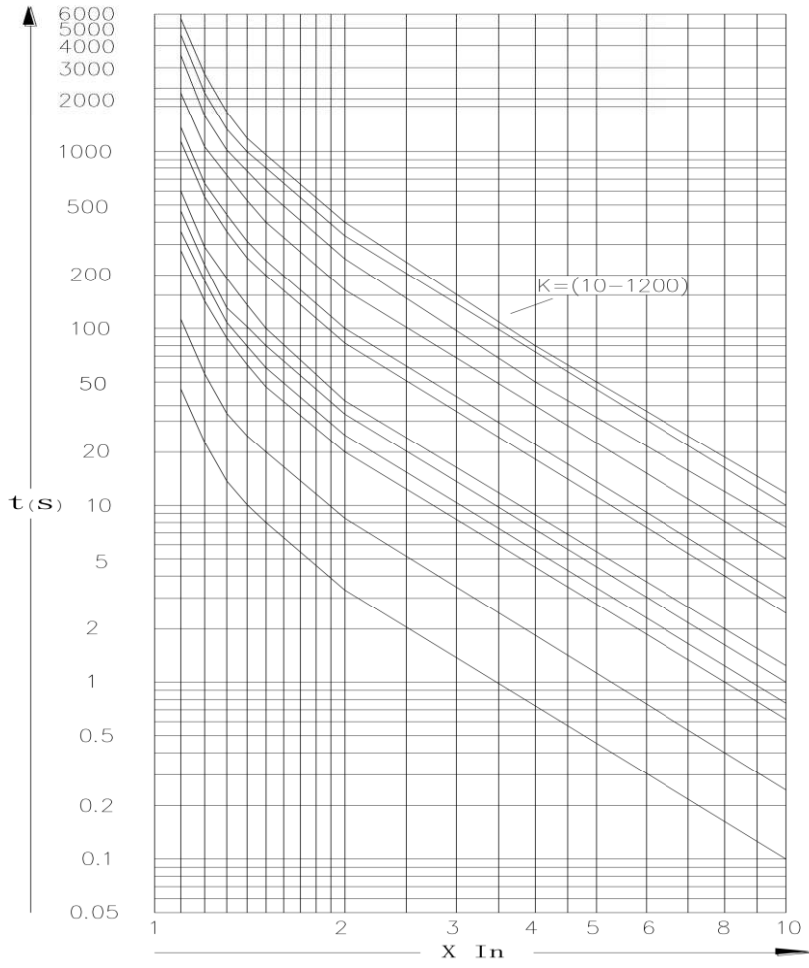
Device can calculate used thermal capacity (UTC) of the motor to avoid motor from overheating damage. Internal program simulates the used thermal capacity of the motor in a variety of operating conditions, can real-time monitoring of motor heating conditions. Ensure effective protection of the repeated starting of the motor overheating condition continuous run.

Device provide 12 inverse time protection curves; user can select suitable curve for different motor working condition.

|                      |  |  |
|----------------------|--|--|
| Inverse-time formula | $t = \frac{K}{\left(\frac{I}{I_e}\right)^2 - 1}$ | <b>t</b> Operating inverse time          |
|                      |  | <b>I</b> Motor working current value     |
|                      |  | <b>I<sub>e</sub></b> Motor rated current |
|                      |  | <b>K</b> K factor curve need set         |

### Parameters:

|                |                       |
|----------------|-----------------------|
| Protect action | OFF / Alarm / Trip DO |
| K factor value | 10 ~ 1200             |



**Overload inverse time curve**

**Typical trip time in different K factor and protection class**

| K factor | Class | I/le = 1.0         | I/le 1.2   | I/le 1.5 | I/le 7.2  |
|----------|-------|--------------------|------------|----------|-----------|
| 125      | 10S   | Without trip in 2h | Trip in 1h | Tp≤2min  | 2s<Tp≤10s |
| 250, 300 | 10    |                    |            | Tp≤4min  | 4s<Tp≤10s |
| 500      | 20    |                    |            | Tp≤8min  | 6s<Tp≤20s |
| 750      | 30    |                    |            | Tp≤12min | 9s<Tp≤30s |

**Overload inverse time curve quick select chart (time unit: sec)**

| $K$<br>$I/I_e$ | 10    | 25     | 60     | 75     | 100    | 125    | 250     | 300     | 500     | 750     | 1000    | 1200    |
|----------------|-------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|
| 1.1            | 47.62 | 119.05 | 285.71 | 357.14 | 476.19 | 595.24 | 1190.48 | 1428.57 | 2380.95 | 3571.43 | 4761.90 | 5714.28 |
| 1.2            | 22.73 | 56.82  | 136.36 | 170.45 | 227.27 | 284.09 | 568.18  | 681.82  | 1136.36 | 1704.55 | 2272.73 | 2727.27 |
| 1.3            | 14.49 | 36.23  | 86.96  | 108.70 | 144.93 | 181.16 | 362.32  | 434.78  | 724.64  | 1086.96 | 1449.28 | 1739.13 |
| 1.4            | 10.42 | 26.04  | 62.50  | 78.13  | 104.17 | 130.21 | 260.42  | 312.50  | 520.83  | 781.25  | 1041.67 | 1250.00 |
| 1.5            | 8.00  | 20.00  | 48.00  | 60.00  | 80.00  | 100.00 | 200.00  | 240.00  | 400.00  | 600.00  | 800.00  | 960.00  |
| 2.0            | 3.33  | 8.33   | 20.00  | 25.00  | 33.33  | 41.67  | 83.33   | 100.00  | 166.67  | 250.00  | 333.33  | 400.00  |
| 2.5            | 1.90  | 4.76   | 11.43  | 14.29  | 19.05  | 23.81  | 47.62   | 57.14   | 95.24   | 142.86  | 190.48  | 228.57  |
| 3.0            | 1.25  | 3.13   | 7.50   | 9.38   | 12.50  | 15.63  | 31.25   | 37.50   | 62.50   | 93.75   | 125.00  | 150.00  |
| 3.5            | 0.89  | 2.22   | 5.33   | 6.67   | 8.89   | 11.11  | 22.22   | 26.67   | 44.44   | 66.67   | 88.89   | 106.67  |
| 4.0            | 0.67  | 1.67   | 4.00   | 5.00   | 6.67   | 8.33   | 16.67   | 20.00   | 33.33   | 50.00   | 66.67   | 80.00   |
| 4.5            | 0.52  | 1.30   | 3.12   | 3.90   | 5.19   | 6.49   | 12.99   | 15.58   | 25.97   | 38.96   | 51.95   | 62.34   |
| 5.0            | 0.42  | 1.04   | 2.50   | 3.13   | 4.17   | 5.21   | 10.42   | 12.50   | 20.83   | 31.25   | 41.67   | 50.00   |
| 5.5            | 0.34  | 0.85   | 2.05   | 2.56   | 3.42   | 4.27   | 8.55    | 10.26   | 17.09   | 25.64   | 34.19   | 41.03   |
| 6.0            | 0.29  | 0.71   | 1.71   | 2.14   | 2.86   | 3.57   | 7.14    | 8.57    | 14.29   | 21.43   | 28.57   | 34.29   |
| 6.5            | 0.24  | 0.61   | 1.45   | 1.82   | 2.42   | 3.03   | 6.06    | 7.27    | 12.12   | 18.18   | 24.24   | 29.09   |
| 7.0            | 0.21  | 0.52   | 1.25   | 1.56   | 2.08   | 2.60   | 5.21    | 6.25    | 10.42   | 15.63   | 20.83   | 25.00   |
| 7.2            | 0.20  | 0.49   | 1.18   | 1.48   | 1.97   | 2.46   | 4.92    | 5.90    | 9.83    | 14.75   | 19.67   | 23.60   |
| 7.5            | 0.18  | 0.45   | 1.09   | 1.36   | 1.81   | 2.26   | 4.52    | 5.43    | 9.05    | 13.57   | 18.10   | 21.72   |
| 8.0            | 0.16  | 0.40   | 0.95   | 1.19   | 1.59   | 1.98   | 3.97    | 4.76    | 7.94    | 11.90   | 15.87   | 19.05   |

### 7.3. - Ground fault protection

The magnitude of the leakage current depends on the position of the fault point on the coil of the motor. It is desirable to set a low leakage current fault action value to protect as many stator coils as possible and prevent the motor casing from becoming dangerous due to electrification.

In the direct grounding system, the action time should be set as short as possible to avoid system damage; in the grounding system through resistance, the leakage current value is limited in a safer range, and a longer action time can be selected.

#### Parameters:

|                             |                         |
|-----------------------------|-------------------------|
| Protect action              | OFF / Alarm / Trig DO   |
| Threshold <sup>(1)</sup>    | 10 ~ 100%I <sub>r</sub> |
| Action delay <sup>(2)</sup> | 0.1 ~ 50.0 s            |

#### Notes:

1. When the residual current mode is set to built-in, the controller calculates the residual current according to the three-phase current vector sum.
2. When the residual current mode is external, the controller measures the residual current according to the external residual current transformer.

#### 7.4. - Over voltage protection

Any of the three phase voltage > Threshold set value

**Parameters:**

|                |                       |
|----------------|-----------------------|
| Protect action | OFF / Alarm / Trip DO |
| Threshold      | 105 ~ 150% Ue         |
| Trip delay     | 0.1 ~ 50.0s           |

**Notes:** This protection will valid in both starting and running period.

#### 7.5. - Under voltage protection

Any of the three phase voltage < Threshold set value

**Parameters:**

|                |                       |
|----------------|-----------------------|
| Protect action | OFF / Alarm / Trip DO |
| Threshold      | 50 ~95% Ue            |
| Trip delay     | 0.1 ~ 50.0s           |

#### 7.6 - Custom trip function

The user provides a pair of passive contacts to the device, which are connected to the "custom trip" DI (it needs to be configured), and will act after a set delay. Protection can choose to trip or alarm.



## 8. - COMMUNICATION INTERFACE

### 8.1. - MODBUS © protocol

#### 8.1.1. - Modbus RTU frame format:

|                         |               |  |
|-------------------------|---------------|--|
| <b>Address code</b>     | <b>1 BYTE</b> | <i>Slave device address 1-247</i>  |
| <b>Function code</b>    | <b>1 BYTE</b> | <i>Indicates the function codes like read coils / inputs</i>   |
| <b>Data code</b>        | <b>4 BYTE</b> | <i>Starting address, high byte<br/>Starting address, low byte<br/>Number of registers, high byte<br/>Number of registers, low byte</i> |
| <b>Error check code</b> | <b>2 BYTE</b> | <i>Cyclical redundancy check ( CRC )</i>   |

#### 8.1.2. - Modbus function code

| <b>Code</b>        | <b>Meaning</b>                         | <b>Description</b>   |
|--------------------|--|--|
| <b>FUNCTION 01</b> | Read multiple coils                    | <i>This function permits to read internal bits or physical coils</i>         |
| <b>FUNCTION 02</b> | Read signal coils                      | <i>This function permits to read physical discrete inputs</i>                |
| <b>FUNCTION 03</b> | Reading of n words of holding register | <i>Read protection setting, system parameters, starting parameters, etc.</i> |
| <b>FUNCTION 04</b> | Reading of n words of input register   | <i>Read measurement values (voltage, current, power, etc.)</i>               |
| <b>FUNCTION 05</b> | Force single coil                      | <i>This function permits to write internal bits or physical coils</i>        |
| <b>FUNCTION 06</b> | Write single register                  | <i>This function permits to write</i>  |

### 8.1.3. - Command example

#### Example\_1: Read A, B, C phase current value

Host inquiry:

| Addr. | Func. | Data Address (high) | Data Address (low) | Data Number (high) | Data number (low) | CRC |    |
|-------|-------|---------------------|--------------------|--------------------|-------------------|-----|----|
| 01    | 04    | 00                  | 00                 | 00                 | 03                | BE  | F7 |

Slave response:

| Addr. | Func. | Data length | A-phase current |    | B-phase current |    | C-phase current |    | CRC |    |
|-------|-------|-------------|-----------------|----|-----------------|----|-----------------|----|-----|----|
| 01    | 04    | 06          | 03              | E8 | 03              | E8 | 03              | E7 | C0  | 7D |

#### Example\_2: Write motor rated current from 1A to 1.5A

Host inquiry:

| Addr. | Func. | Data Address (high) | Data Address (low) | Data Value (high) | Data Value (low) | CRC |    |
|-------|-------|---------------------|--------------------|-------------------|------------------|-----|----|
| 01    | 06    | 02                  | 05                 | 00                | 0F               | 80  | 7E |

Slave response:

| Addr. | Func. | Data Address (high) | Data Address (low) | Data Value (high) | Data Value (low) | CRC |    |
|-------|-------|---------------------|--------------------|-------------------|------------------|-----|----|
| 01    | 06    | 02                  | 05                 | 00                | 0F               | 80  | 7E |

#### Example\_3: MODBUS command control relay to tripped

Host inquiry:

| Addr. | Func. | Data Address (high) | Data Address (low) | Data Value (high) | Data Value (low) | CRC |    |
|-------|-------|---------------------|--------------------|-------------------|------------------|-----|----|
| 01    | 05    | 00                  | 01                 | FF                | 00               | DD  | DA |

Slave response:

| Addr. | Func. | Data Address (high) | Data Address (low) | Data Value (high) | Data Value (low) | CRC |    |
|-------|-------|---------------------|--------------------|-------------------|------------------|-----|----|
| 01    | 05    | 00                  | 01                 | FF                | 00               | DD  | DA |

## 8.2. - Register map

### Cautions!

1. This chapter register map in default products the write function is disable in standard PR600, that to avoid unexpected damage due to frequent write operations, only opened for customer requirement!!
2. Registers support maximum 100,000 times writes, wrong write registers may cause device irreparable damage! Please ensure that host software engineer proficient in RS485 MODBUS protocol.
3. When the customer request valid the register write function, Blue Jay Technology Co., Ltd. will not responsible for any damage caused by the register write operation!!

### 8.2.1 - Motor status parameter (Read only, Funx04)

| Address | Item                    | Description  |
|---------|-------------------------|--|
| 0x00    | A-phase current         | Unit: 0.1A   |
| 0x01    | B-phase current         |  |
| 0x02    | C-phase current         |  |
| 0x03    | AB line voltage         | Unit: 0.1V   |
| 0x04    | BC line voltage         |  |
| 0x05    | CA line voltage         |  |
| 0x06    | Active power (Ps_avg)   | Unit: 0.1KW  |
| 0x07    | Reactive power (Qs_avg) | Unit: 0.1KVar  |
| 0x08    | Apparent power (Ss_avg) | Unit: 0.1KVA   |
| 0x09    | Power factor            | Unit: 0.001  |
| 0x0A    | Frequency               | Unit: 0.01Hz   |
| 0x0B    | Residual current        | Unit: 0.1mA  |
| 0x0C    | Reserve                 |  |
| 0x0D    | I_poit                  |  |
| 0x0E    | U_poit                  |  |
| 0x0F    | PQS_poit                |  |
| 0x12    | Digital input status    | 0: without signal<br>1: with signal in<br>BIT0:DI1<br>BIT1:DI2<br>BIT2:DI3<br>BIT3:DI4<br>BIT4:DI5<br>BIT5:DI6<br>BIT6:DI7 |

|           |  |  |
|-----------|--|--|
| 0x13      | Digital output status                  | 0: Opened<br>1: Closed<br>BIT0:DO1<br>BIT1:DO2<br>BIT2:DO3<br>BIT3:DO4   |
| 0x14      | A-phase current percentage             | Unit: 0.1%   |
| 0x15      | B-phase current percentage             | Unit: 0.1%   |
| 0x16      | C-phase current percentage             | Unit: 0.1%   |
| 0x17      | AB line voltage percentage             | Unit: 0.1%   |
| 0x18      | BC line voltage percentage             | Unit: 0.1%   |
| 0x19      | CA line voltage percentage             | Unit: 0.1%   |
| 0x1A      | Active power percentage                | Unit: 0.1%   |
| 0x1B      | Reactive power percentage              | Unit: 0.1%   |
| 0x1C      | Apparent power percentage              | Unit: 0.1%   |
| 0x1D      | Power factor percentage                | Unit: 0.1%   |
| 0x1E      | Frequency percentage                   | Unit: 0.1%   |
| 0x1F      | Residual current percentage (External) | Unit: 0.1%<br>Sampling from external zero-sequence sensor  |
| 0x20      | Residual current percentage (Internal) | Unit: 0.1%<br>Calculated from fundamental frequency  |
| 0x23      | Average voltage percentage             | Unit: 0.1%   |
| 0x24      | Average current percentage             | Unit: 0.1%   |
| 0x25      | Peak voltage percentage                | Unit: 0.1%   |
| 0x26      | Peak current percentage                | Unit: 0.1%   |
| 0x28      | A-phase current imbalance              | Unit: 0.1%   |
| 0x29      | B-phase current imbalance              | Unit: 0.1%   |
| 0x2A      | C-phase current imbalance              | Unit: 0.1%   |
| 0x32-0x35 | Active energy (Ep)                     | Unit: 1WH  |
| 0x36-0x39 | Reactive energy (Eq)                   | Unit: 1varH  |
| 0x48      | Reserve                                |  |
| 0x49      | Device present alarm type              | 0x0000: No alarm<br>0x0001: Over load<br>0x0002: Over current I<br>0x0004: Over current II<br>0x0008: Over current III<br>0x0010: Residual current<br>0x0020: Over voltage<br>0x0040: Under voltage<br>0x0080: tE protection<br>0x0100: CB off failure<br>0x0200: Trip failure |

|      |                                      |  |
|------|--------------------------------------|--|
| 0x4A | Device present failure type          | 0x0000: No alarm<br>0x0001: Over load<br>0x0002: Over current I<br>0x0004: Over current II<br>0x0008: Over current III<br>0x0010: Residual current<br>0x0020: Over voltage<br>0x0040: Under voltage<br>0x0080: tE protection<br>0x0100: CB off failure<br>0x0200: Trip failure |
| 0x4B | Present CB ON hours (Lower 16 bits)  | Unit: Second   |
| 0x4C | Present CB ON (High 16 bits)         |  |
| 0x4D | Present CB OFF hours (Lower 16 bits) | Unit: Second   |
| 0x4E | Present CB OFF hours (High 16 bits)  |  |
| 0x4F | Total CB ON hours (Lower 16 bits)    | Unit: Second   |
| 0x50 | Total CB ON hours (High 16 bits)     |  |
| 0x51 | Total CB OFF hours (Lower 16 bits)   | Unit: Second   |
| 0x52 | Total CB OFF hours (High 16 bits)    |  |
| 0x53 | Total operation times(Lower 16 bits) | Unit: times  |
| 0x54 | Total operation times(High 16 bits)  |  |
| 0x55 | Total tipped number(Low 16 bits)     | Unit: times  |
| 0x56 | Total tipped number(High 16 bits)    |  |
| 0x64 | Year                                 | RTC info   |
| 0x65 | Month                                |  |
| 0x66 | Date                                 |  |
| 0x67 | Hour                                 |  |
| 0x68 | Minute                               |  |
| 0x69 | Second                               |  |
| 0x6A | Week                                 |  |

**8.2.2 - Motor basic configuration (Read and write)**

| Address     | Item   | Description   |
|-------------|--|---|
| 0x200       | Password   | Range: 1-9999   |
| 0x201       | External CT rating value                             | Range: 1-9999 (real value 0.1-999.9 A)  |
| 0x202       | CT ratio   | Range: 1-9999   |
| 0x203       | Leakage current transformer rating (I <sub>r</sub> ) | Range: 1-9999 (real value 0.1-999.9 A)  |
| 0x204       | Motor rated voltage                                  | Range: 0-690  |
| 0x205       | Motor rated current (I <sub>e</sub> )                | Range: 1-9999 (real value 0.1-999.9 A)  |
| 0x206       | MODBUS ID-1  | Range: 1~247  |
| 0x207       | Baud ratio-1   | 0:2400<br>1:4800<br>2:9600<br>3:19200   |
| 0x208       | Data format-1  | 0: n.8.1<br>1: o.8.1<br>2: e.8.1<br>3: n.8.2  |
| 0x209       | Wiring method  | 0:3P4W 1:3P3W   |
| 0x20A       | Leakage current detect mode                          | 0: Internal<br>Calculated from fundamental<br>frequency component<br>1: External<br>Sampling from external zero-<br>sequence sensor |
| 0x20B-0x20F | Reserve  |   |
| 0x210       | Motor rated power                                    | Unit KW   |
| 0x211       | MODBUS ID-2  | Range: 1~247  |
| 0x212       | Baud ratio-2   | 0:2400<br>1:4800<br>2:9600<br>3:19200   |
| 0x213       | Data format-2  | 0: n.8.1<br>1: o.8.1<br>2: e.8.1<br>3: n.8.2  |

**8.2.3. - Motor protection functions configuration (Read and write)**

| Address     | Parameters                         | Description  |
|-------------|------------------------------------|--|
| 0x300       | Reserve                            |  |
| 0x301       | Over load protect action           | 0: Invalid<br>1: Alarm<br>2: Trig DO   |
| 0x302       | Over load K factor                 | 0: K=10      6: K=250<br>1: K=25      7: K=300<br>2: K=60      8: K=500<br>3: K=75      9: K=750<br>4: K=100     10: K=1000<br>5: K=125     11: K=1200 |
| 0x303-0x304 | Reserve                            |  |
| 0x305       | Over current I protect action      | 0: Invalid<br>1: Alarm<br>2: Trig DO   |
| 0x306       | Over current I protect threshold   | Range: 100-1000% Ie  |
| 0x307       | Over current I protect timer       | Range: 0.5-50.0sec   |
| 0x308       | Reserve                            |  |
| 0x309       | Over current II protect action     | 0: Invalid<br>1: Alarm<br>2: Trig DO   |
| 0x30A       | Over current II protect threshold  | Range: 100-1000% Ie  |
| 0x30B       | Over current II protect timer      | Range: 0.5-50.0sec   |
| 0x30C-0x311 | Reserved                           |  |
| 0x312       | Leakage current protect action     | 0: Invalid<br>1: Alarm<br>2: Trig DO   |
| 0x313       | Leakage current protect threshold  | Range: 10-100% Ir  |
| 0x314       | Leakage current protect timer      | Range: 0.1-50.0sec   |
| 0x315-0x31B | Reserved                           |  |
| 0x31C       | Over current III protect action    | 0: Invalid<br>1: Alarm<br>2: Trig DO   |
| 0x31D       | Over current III protect threshold | Range: 100-1000% Ie  |
| 0x31E       | Over current III protect timer     | Range: 0.1-50.0sec   |
| 0x31F       | Over voltage protect action        | 0: Invalid<br>1: Alarm<br>2: Trig DO   |
| 0x320       | Over voltage protect threshold     | Range: 105-150% Ue   |
| 0x321       | Over voltage protect timer         | Range: 0.1-50.0sec   |
| 0x322       | Under voltage protect action       | 0: Invalid<br>1: Alarm<br>2: Trig DO   |
| 0x323       | Under voltage protect threshold    | Range: 50-95% Ue   |
| 0x324       | Under voltage protect timer        | Range: 0.1-50.0sec   |
| 0x325-0x32E | Reserved                           |  |

### 8.2.4 - Motor start mode configuration (Read and write)

| Address     | Parameters                           | Description  |
|-------------|--------------------------------------|--|
| 0x32F       | CB ON/OFF failure judgment delay     | Range: 1.0~600.0sec  |
| 0x330-0x331 | Reserved                             |  |
| 0x332       | Control switch permissions           | BIT0: Panel button control,<br>0: disabled, 1: abled<br>BIT1: DI control, 0: disabled, 1: abled<br>BIT2: Communication control,<br>0: disabled, 1 :abled                                   |
| 0x333       | Motor start mode                     | 0: Protection mode<br>1: Measurement and control mode  |
| 0x334-0x336 | Reserved                             |  |
| 0x337       | tE protection action                 | 0: Invalid<br>1: Alarm<br>2: Trig DO   |
| 0x338       | tE protection timer                  | Range: 0.1-50.0sec   |
| 0x339-0x33F | Reserved                             |  |
| 0x340       | AO1 output zero span(0mA)            | Default 0.0%, modifiable   |
| 0x341       | AO1 output full span(20mA)           | Default 100.0%, modifiable   |
| 0x342       | AO1 output selection                 | 0: 0-20mA<br>1: 4-20mA   |
| 0x343       | AO1 transmit parameters              | 0: I1                      6: Ps<br>1: I2                      7: Qs<br>2: I3                      8: Ss<br>3: U1                      9: Pf<br>4: U2                      10: Fr<br>5: U3 |
| 0x344H      | AO2 output zero span(0mA)            | Default 0.0%, modifiable   |
| 0x345H      | AO2 output full span(20mA)           | Default 100.0%, modifiable   |
| 0x346H      | AO2 output selection                 | 0: 0-20mA<br>1: 4-20mA   |
| 0x347H      | AO2 transmit parameters              | 0: I1                      6: Ps<br>1: I2                      7: Qs<br>2: I3                      8: Ss<br>3: U1                      9: Pf<br>4: U2                      10: Fr<br>5: U3 |
| 0x348-0x34F | Reserved                             |  |
| 0x350-0x352 | Overload linkage R1-R3               | 0: ON 1: OFF   |
| 0x353-0x355 | Over current I-stage linkage R1-R3   | 0: ON 1: OFF   |
| 0x356-0x358 | Over current II-stage linkage R1-R3  | 0: ON 1: OFF   |
| 0x359-0x35B | Over current III-stage linkage R1-R3 | 0: ON 1: OFF   |
| 0x35C-0x35E | Leakage linkage R1-R3                | 0: ON 1: OFF   |
| 0x35F-0x361 | Overvoltage linkage R1-R3            | 0: ON 1: OFF   |
| 0x362-0x364 | Undervoltage linkage R1-R3           | 0: ON 1: OFF   |
| 0x365-0x367 | tE protection linkage R1-R3          | 0: ON 1: OFF   |
| 0x368-0x37F | Reserve                              |  |
| 0x380       | R1 linkage pulse time                | 0-999.9 sec., setting to 0 means level mode  |
| 0x381       | R2 linkage pulse time                | 0-999.9 sec., setting to 0 means level mode  |



|             |                       |  |
|-------------|-----------------------|--|
| 0x382       | R3 linkage pulse time | 0-999.9 sec., setting to 0 means level mode  |
| 0x383       | DO1 output mode       | 0: Reserve DO<br>1: Protection alarm<br>2: CB ON<br>3: CB OFF<br>4: Linked DO R1<br>5: Linked DO t R2<br>6: Linked DO R3   |
| 0x384-0x387 | DI2-DO5 output mode   | Functions same as above<br>(Only 0 can be set repeatedly)  |
| 0x388-0x38F | Reserve               |  |
| 0x390       | D11 output mode       | 0: Normal state<br>1: Local/remote<br>2: Circuit breaker status<br>3: Energy storage<br>4: Protection reset<br>5: Local CB OFF<br>6: Local CB ON<br>7: Remote CB OFF<br>8: Remote CB ON<br>9: CB OFF<br>10: CB ON<br>11: tE protection |
| 0x391-0x399 | DI2-DI10 output mode  | Functions same as above<br>(Only 0 can be set repeatedly)  |
| 0x3A0       | Signal input mode     | BIT0-BIT9: DI0-DI10 judgment method<br>0: closed valid, 1: disconnected valid  |

**8.2.5 - Sequence of event record (Read only, code 04)**

| Address     | Parameters                            | Description   |
|-------------|---------------------------------------|---|
| 0x500-0x504 | SOE_001                               | SOE_001 is latest record<br>Details see Notes             |
| 0x505-0x509 | SOE_002                               |   |
| 0x50A-0x50E | SOE_003                               |   |
| 0x50F-0x513 | SOE_004                               |   |
| 0x514-0x518 | SOE_005                               |   |
| 0x519-0x51D | SOE_006                               |   |
| ...         | ...                                   |   |
| 0x6EF-0x6F3 | SOE_100                               |   |
| ...         | ...                                   |   |
| 0x800H      | Clear SOE                             |   |
| 0x900H      | Clear heat capacity                   | Write:0A0A  |
| 0xA00H      | Clear running information             | Write:0A0A  |
| 0xD00H      | Control start A, start B, stop, reset | Restart:0x10<br>Stop:0x20<br>Start B:0x40<br>Start A:0x80 |
| 0xF00H      | Clear energy                          | Write:0A0A  |

**Note:** Each event is represented by 10 bytes.

|                              |  |  |   |
|------------------------------|--|--|---|
| BYTE 0-1<br>for failure type | 01: Start overtime<br>02: Over load<br>03: Phase failure<br>04: Jam in starting<br>05: Current imbalance | 06: Under power<br>07: Jam in running<br>08: Ground fault<br>09: tE protection<br>10: Over voltage | 11: Under voltage<br>12: Abnormal frequency<br>13: Abnormal power factor<br>14: Over temperature<br>15: Short circuit |
| BYTE 2-3                     | Failure value  |  |   |
| BYTE 4-9                     | Failure event timestamp  |  |   |
| BYTE 4                       | Year   |  |   |
| BYTE 5                       | Month  |  |   |
| BYTE 6                       | Date   |  |   |
| BYTE 7                       | Hour   |  |   |
| BYTE 8                       | Minute   |  |   |
| BYTE 9                       | Second   |  |   |

## 9. - SAFETY CONSIDERATIONS



All installation specification described at the previous chapters named:  
**INSTALLATION AND STARTUP, INSTALLATION MODES and SPECIFICATIONS.**

Note that with the instrument powered on, the terminals could be dangerous to touching and cover opening actions or elements removal may allow accessing dangerous parts. This instrument is factory-shipped at proper operation condition.

## 10. - MAINTENANCE

The PR600 not require any special maintenance. No adjustment, maintenance or repairing action should be done when the instrument is open and powered on, should those actions are essential, high-qualified operators must perform them.

Before any adjustment, replacement, maintenance or repairing operation is carried out; the instrument must be disconnected from any power supply source.

When any protection failure is suspected to exist, the instrument must be immediately put out of service. The instrument's design allows a quick replacement in case of any failure.

For any inquiry about the instrument performance or whether any failure happens, contact to Blue Jay's technical service.

*Blue Jay - After-sales service*

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