# ЭНЕРГОМЕТРИКА
## www.energometrika.ru

## PMAC770H Power Meter
## Installation & Operation Manual

# Safety and precautions

## ⚠️ Dangers and warnings

- This equipment should only be installed by professionals.
- The manufacture shall not be responsible for failures caused by non-compliance with the instructions in this manual.

## ⚠️ Precautions

- After removing the package of the equipment, please read this manual carefully first, and be sure following the instructions for installation and setup.
- Please do disconnect the power supply before performing installation or changing wiring.
- All mechanical parts and covers shall be returned to the original position before powering on the equipment.
- The equipment shall be powered by a rated voltage supply, should not over the rated voltage value.
- This manual is not intended to contain all details or changes to the equipment, please contact us when there is any problem in installation, operation and maintenance.

## Failure to take these precautions may cause serious injury!

# Contents

# Chapter 1. Overview

PMAC770H multi-function power meter (hereinafter referred as PMAC770H) is a new generation of intelligent power meter which was developed independently. The instrument has high precision measurement and meterin g functions, timer recording and multi -tariff billing functions. It also equips with comprehensive power quality measuring functions, which including harmonic analysis, imbalance components measurement, flicker monitoring, voltage swell/sag/interruption re cording, voltage fast change capture, fault recording, event recording etc. With above features PMAC770H can meet the S level of power quality monitoring standard. Accurate fault diagnosis and positioning functions, for local abnormalities or local faults in the power supply and consumption system. It can accurately record a large amount of waveform and event information to identify and accurately judge potential, transient or continuous local faults to ensure the safe and reliable operation of users' power supply system.

PMAC770H basic technical features table:

| Technical feature | | Description |
|---|---|---|
| Measuremen t channels | Voltage channel quantity | 4 |
| | Current channel quantity | 3 |
| Basic measuremen ts | U,I | ■ |
| | P,Q,S | ■ |
| | PF | ■ |
| | Frequency | ■ |
| Electrical energy | Full-wave energy | ■ |
| | Bid-directional energy | ■ |
| | Four quadrant energy | ■ |
| | Multi-tariff energy | ■ |
| Demand | Real-time demand | Slip/Fixed |

| function | Forecast demand | Slip/Fixed |
|---|---|---|
| | Extreme demand | Historical extreme demand |
| Multi-tariff | | ∎ |
| Power quantity analysis | Waveform sampling cycle | 256 points/cycles |
| | Harmonic | 63rd |
| | Voltage deviation | ∎ |
| | Frequency deviation | ∎ |
| | Imbalance | ∎ |
| | Sequence components | ∎ |
| | Flicker analysis | ∎ |
| | Voltage swell/sag/interruption | ∎ |
| | Rapid voltage change | ∎ |
| Over-limit monitoring | Settable limits(in seconds) | 68 sets |
| Data & event record | Extreme value record | ∎ |
| | SOE event（1ms) | 128pcs |
| | PQ(power quality) event （1ms) | 128pcs |
| | PQ(power quality) event counting | ∎ |
| | Waveform recording | Provides 128 transient interrupt recordings Adopt COMTRADE file format |
| Display | LCD | Colorful LCD |
| | Resolution | 320*240 |
| | Real-time waveform | Real-time waveform display |

| | | |
|---|---|---|
| I/O | Digital input(DI) | **Max 11 digital inputs**<br>✓ 3 active switches(DI) are equipped as standard(rate input 220V±35%)<br>✓ 8 DI are optional (active or passive switch can be selected) |
| | Relay output(RO) | **Max 6 relay outputs**<br>✓ 2 RO are equipped as standard<br>✓ 4 RO are optional |
| | Analog output(AO) | **Max 4 analog outputs(4~20mA)**<br>✓ 4 AO are optional |
| Communication | RS485 interface | **Max 2 RS485 output**<br>✓ 1 RS485 is equipped as standard<br>✓ 1 optional RS485(Either one with the Ethernet port) |
| | Ethernet port(10/100M) | 1 standard Ethernet port<br>(Either one with the 2$^{nd}$ RS485 module) |
| | SNTP timing | ■ |
| Waveform recording | Waveform recording | ■ |

Note：■Inherent functions    □Optional functions

# Chapter 2. Product model

Order information：

| Model：PMAC770H-①-②-③ | |
|---|---|
| ① ：expansion module 1 | |
| N | None this module |
| SW | 4 active DI(rated input 220V±35%) |
| SD | 4 passive DI(rated input 30VDC) |
| R | 2 RO |
| AO | 2 AO(4~40mA) |
| ② ：expansion module 2 | |
| N | None this module |
| SW | 4 active DI(rated input 220V±35%) |
| SD | 4 passive DI(rated input 30VDC) |
| R | 2 RO |
| AO | 2 AO(4~40mA) |
| EP | 2 electrical energy pulse outputs |
| ③ ：expansion module 3 | |
| N | None this module |
| LAN | 1Ethernet port(10/100M) |
| C | 1 RS485 |

# Chapter 3. Installation and wiring

## 3.1 Using environment

| | |
|---|---|
| Hole size （mm） | 90.00×90.00 （＋0.80） |
| Dimensions （mm） | （L*W*H） |
| | 96.00×96.00×45.1（without expansion module） |
| | 96.00×96.00×66.6（with expansion module） |
| IP level | Front panel：IP52，side & back：IP30 |
| Measuring mode | 3P4W,3P3W |
| Working temperature | -20℃~+60℃ |
| Storage temperature | -40℃~+85℃ |
| Relative humidity | 5%~95%,no condensation |

## 3.2 Dimensions and installation diagrams
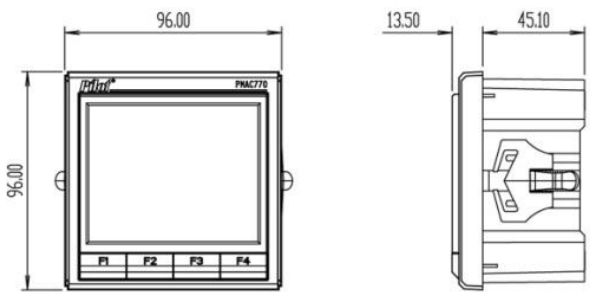


**Without expansion module**
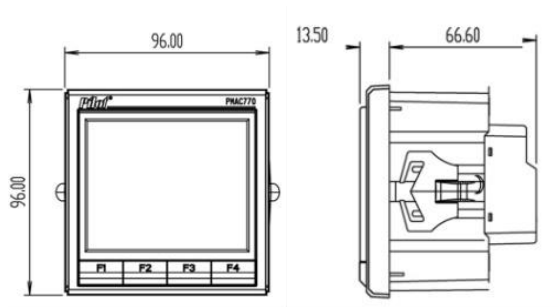
**With expansion module**

Dimensions diagram
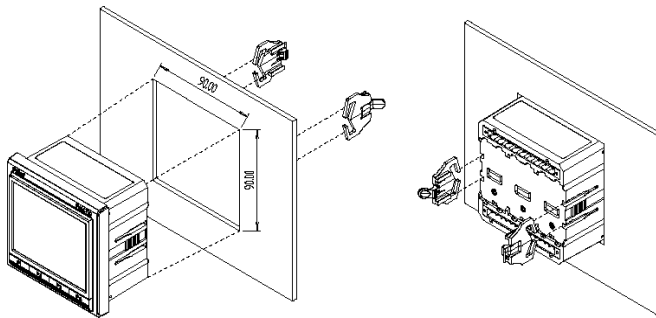


Installation diagram

## 3.3 Terminal diagram

### 3.3.1 Main body terminals definition
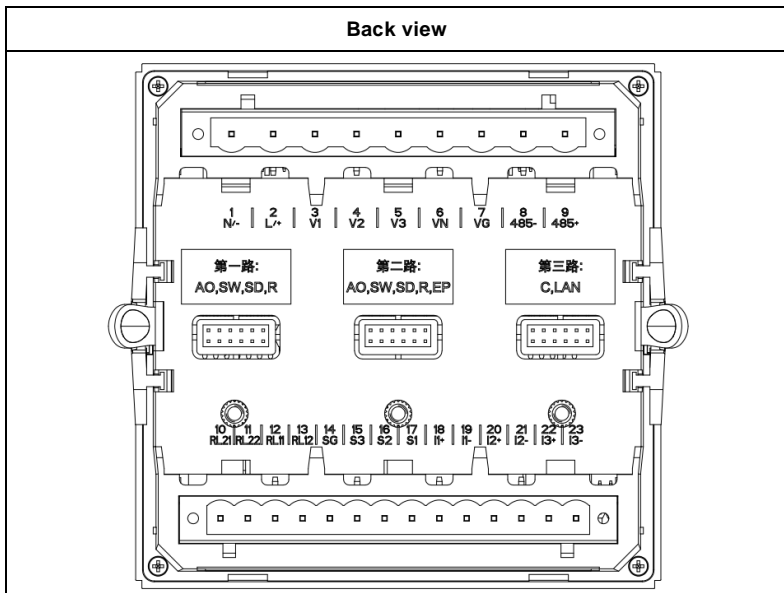
| Back view |
|:---:|
|  |

| No. | Mark | Definition |
|:---:|:---:|:---:|
| 1 | N/- | 220VAC neutral wire/220VDC negative pole |
| 2 | L/+ | 220VAC phase wire/220VDC positive pole |
| 3 | V1 | Ua |
| 4 | V2 | Ub |
| 5 | V3 | Uc |
| 6 | VN | Un |
| 7 | VG | $U_{n-G}$ |
| 8 | 485- | RS485A(-) |
| 9 | 485+ | RS485A(+) |

| 10 | RL21 | 2nd RO_1 |
|----|------|----------|
| 11 | RL22 | 2nd RO_2 |
| 12 | RL11 | 1st RO_1 |
| 13 | RL12 | 1st RO_2 |
| 14 | SG | Digital input common poit(-) |
| 15 | S3 | 3rd DI(+) |
| 16 | S2 | 2nd DI(+) |
| 17 | S1 | 1st DI(+) |
| 18 | I1+ | Ia(+) |
| 19 | I1- | Ia(-) |
| 20 | I2+ | Ib(+) |
| 21 | I2- | Ib(-) |
| 22 | I3+ | Ic(+) |
| 23 | I3- | Ic(-) |

## 3.3.2 Expansion module terminals definition

| Back view |
|---|
|  |
|  |
| Expansion module installation diagram |
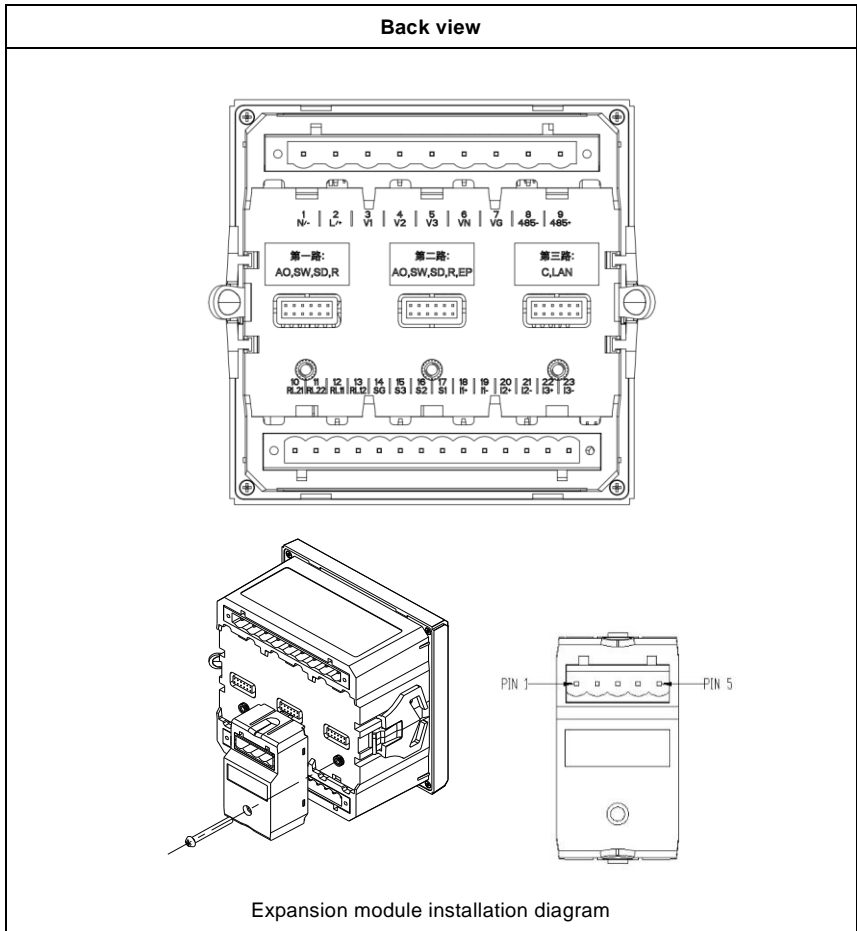
### 3.3.2.1 SW module definition
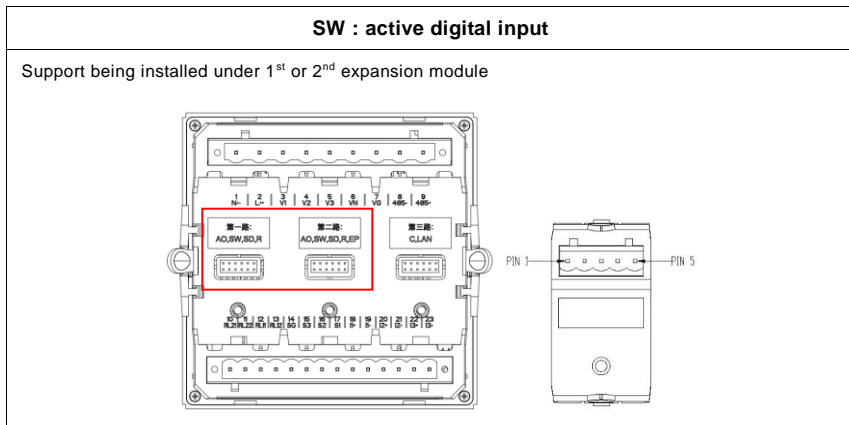
| SW : active digital input |
| --- |

Support being installed under 1<sup>st</sup> or 2<sup>nd</sup> expansion module

Support being installed under 1st or 2nd expansion module



**1st expansion module position**

| No | Mark | Definition |
| --- | --- | --- |
| PIN1 | EX S4 | 4th digital input |
| PIN2 | EX S5 | 5th digital input |
| PIN3 | EX S6 | 6th digital input |
| PIN4 | EX S7 | 7th digital input |
| PIN5 | EX SG1 | Common point |

**2nd expansion module position**

| PIN1 | EX S8 | 8th digital input |
| --- | --- | --- |
| PIN2 | EX S9 | 9th digital input |
| PIN3 | EX S10 | 10th digital input |
| PIN4 | EX S11 | 11th digital input |
| PIN5 | EX SG2 | Common point |

### 3.3.2.2 SD module definition

| SD : passive digital input |
|---|
| Support being installed under 1st or 2nd expansion module |



**1st expansion module position**

| No | Mark | Definition |
|---|---|---|
| PIN1 | EX S4 | 4th digital input |
| PIN2 | EX S5 | 5th digital input |
| PIN3 | EX S6 | 6th digital input |
| PIN4 | EX S7 | 7th digital input |
| PIN5 | EX SG1 | Common point |

**2nd expansion module position**

| No | Mark | Definition |
|---|---|---|
| PIN1 | EX S8 | 8th digital input |
| PIN2 | EX S9 | 9th digital input |
| PIN3 | EX S10 | 10th digital input |
| PIN4 | EX S11 | 11th digital input |
| PIN5 | EX SG2 | Common point |

### 3.3.2.3 R module definition

<table>
<tr><td colspan="3"><strong>R : relay output</strong></td></tr>
<tr><td colspan="3">Support being installed under 1<sup>st</sup> or 2<sup>nd</sup> expansion module</td></tr>
</table>

| R : relay output |
|:---:|
| Support being installed under 1$^{st}$ or 2$^{nd}$ expansion module |



**1$^{st}$ expansion module position**

| No | Mark | Definition |
|:---:|:---:|:---:|
| PIN1 | EX RL31 | 3$^{rd}$ relay output_1 |
| PIN2 | EX RL32 | 3$^{rd}$ relay output_2 |
| PIN3 | NC | Null |
| PIN4 | EX RL41 | 4$^{th}$ relay output_1 |
| PIN5 | EX RL42 | 4$^{th}$ relay output_2 |

**2$^{nd}$ expansion module position**

| No | Mark | Definition |
|:---:|:---:|:---:|
| PIN1 | EX RL51 | 5$^{th}$ relay output_1 |
| PIN2 | EX RL52 | 5$^{th}$ relay output_1 |
| PIN3 | NC | Null |
| PIN4 | EX RL61 | 6$^{th}$ relay output_1 |
| PIN5 | EX RL62 | 6$^{th}$ relay output_1 |

### 3.3.2.4 AO module definition

| AO : analog output(4~20mA) |
|---|

Support being installed under 1st or 2nd expansion module
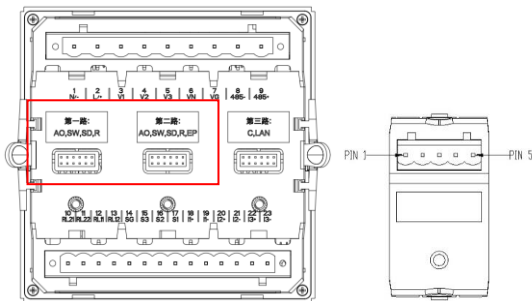


**1st expansion module position**

| No | Mark | Definition |
|---|---|---|
| PIN1 | EX AO11 | 1st AO_1 |
| PIN2 | EX AO12 | 1st AO_2 |
| PIN3 | NC | Null |
| PIN4 | EX AO21 | 2nd AO_1 |
| PIN5 | EX AO22 | 2nd AO_2 |

**2nd expansion module position**

| No | Mark | Definition |
|---|---|---|
| PIN1 | EX AO31 | 3rd AO_1 |
| PIN2 | EX AO32 | 3rd AO_2 |
| PIN3 | NC | Null |
| PIN4 | EX AO41 | 4th AO_1 |
| PIN5 | EX AO42 | 4th AO_2 |

### 3.3.2.5 EP module definition

| EP：electrical energy pulse output |
|---|

Only support being installed under 2<sup>nd</sup> expansion module
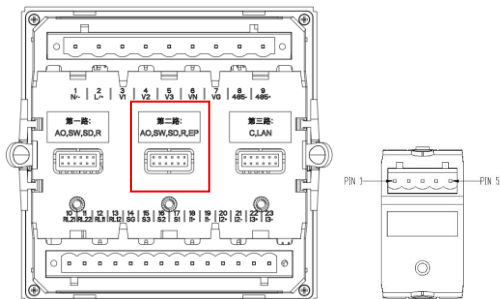


| No | Mark | Definition |
|---|---|---|
| PIN1 | EX P1+ | Active energy pulse output(+) |
| PIN2 | EX P1- | Active energy pulse output(-) |
| PIN3 | NC | Null |
| PIN4 | EX P2+ | Reactive energy pulse output(+) |
| PIN5 | EX P2- | Reactive energy pulse output(-) |

### 3.3.2.6 C module definition

| C: RS485 communication module |
|---|

Only support being installed under 3$^{rd}$ expansion module
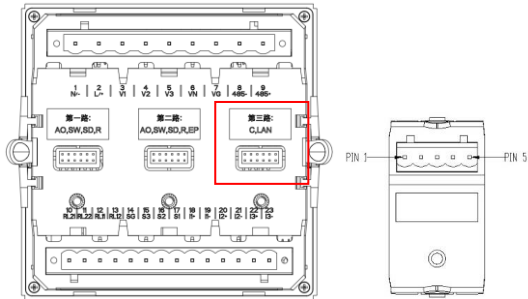


| No | Mark | Definition |
|---|---|---|
| PIN1 | NC | Null |
| PIN2 | NC | Null |
| PIN3 | NC | Null |
| PIN4 | EX 485- | RS485 - |
| PIN5 | EX 485+ | RS485 + |

### 3.3.2.7 LAN module definition

| LAN：Ethernet module | | |
|---|---|---|
| Only support being installed under 3$^{rd}$ expansion module | | |
|  | | |
| **No** | **Mark** | **Definition** |
| RJ45 | RJ45 | RJ45 Ethernet port |
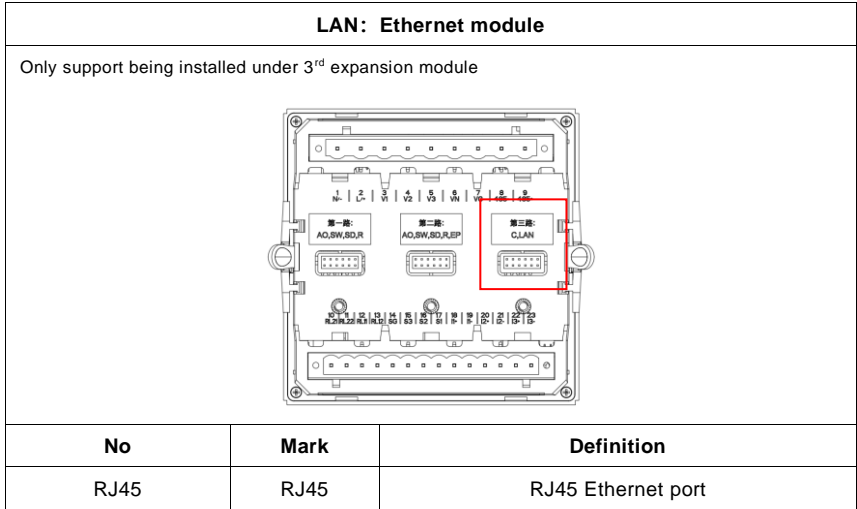
# 3.4 Wiring

## 3.4.1 Power supply

When powered by AC power system, phase wire connected to L/+, neutral wire connected to N/-. While powered by DC power system, positive pole connected to L/+, negative pole connected to N/-.

## 3.4.2 Voltage & current wiring

PMAC770H supports multiple wiring modes, show as below

| | |
|---|---|
|  |  |
| 3P4W vector | 3P3W vector |

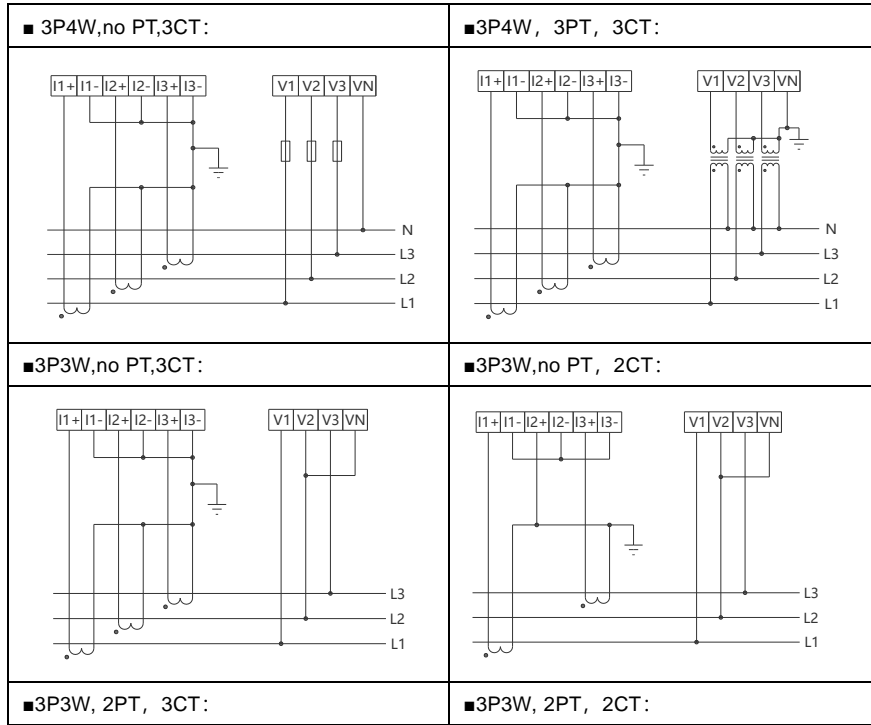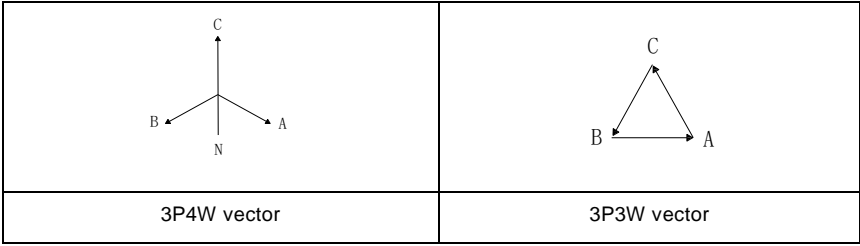| ■ 3P4W,no PT,3CT: | ■3P4W，3PT，3CT: |
|---|---|
| I1+ I1- I2+ I2- I3+ I3-　　　V1 V2 V3 VN<br><br>　　　　　　　　　　　　　　　　　　N<br>　　　　　　　　　　　　　　　　　　L3<br>　　　　　　　　　　　　　　　　　　L2<br>　　　　　　　　　　　　　　　　　　L1 | I1+ I1- I2+ I2- I3+ I3-　　　V1 V2 V3 VN<br><br>　　　　　　　　　　　　　　　　　　N<br>　　　　　　　　　　　　　　　　　　L3<br>　　　　　　　　　　　　　　　　　　L2<br>　　　　　　　　　　　　　　　　　　L1 |
| ■3P3W,no PT,3CT: | ■3P3W,no PT，2CT: |
| I1+ I1- I2+ I2- I3+ I3-　　　V1 V2 V3 VN<br><br>　　　　　　　　　　　　　　　　　　L3<br>　　　　　　　　　　　　　　　　　　L2<br>　　　　　　　　　　　　　　　　　　L1 | I1+ I1- I2+ I2- I3+ I3-　　　V1 V2 V3 VN<br><br>　　　　　　　　　　　　　　　　　　L3<br>　　　　　　　　　　　　　　　　　　L2<br>　　　　　　　　　　　　　　　　　　L1 |
| ■3P3W, 2PT，3CT: | ■3P3W, 2PT，2CT: |

| | |
|---|---|
| I1+ I1- I2+ I2- I3+ I3-    V1 V2 V3 VN<br><br>L3<br>L2<br>L1 | I1+ I1- I2+ I2- I3+ I3-    V1 V2 V3 VN<br><br>L3<br>L2<br>L1 |
| ■ Single phase，no PT, no CT： | |
| I1+ I1- I2+ I2- I3+ I3-    V1 V2 V3 VN<br><br>N<br><br>L | |
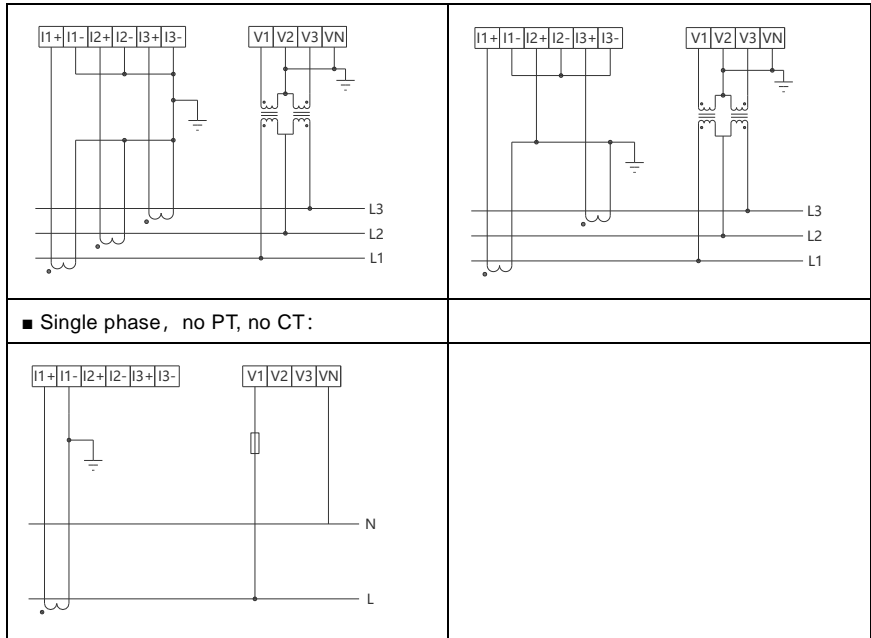
### 3.4.3 Communication wiring

（1）RS-485 interface

PMAC770H provides 2 RS485 interfaces：

> ➢ 1 equipped as standard: RS485A+/RS485A-

> ➢ 1 equipped as expansion module: RS485B+/RS485B-

When the RS485 shielded twisted pair is too long, one 120Ω resister is recommended to

connect at the wire end to ensure the communication quality.

（2）Ethernet interface equips with RJ-45 connector and 10/100M port.

### 3.4.4 Digital input wiring

PMAC770H provides 11 digital inputs (marks as DI1~D11) at maximum to monitor

switch/breaker position signal, there are passive DI and active DI can be selected as per requirement.

- Passive DI

The below wiring mode is used usually when outer source just provides a switch position and requests the DI reflecting a switch close signal.
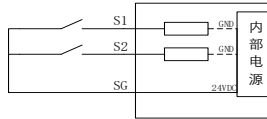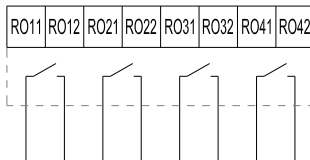


- Active DI

The below wiring mode is used usually when outer source provides switch position and voltage signal(input voltage 220VDC±35%).
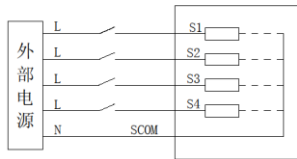


### 3.4.5 Relay output wiring

PMAC770H provides 6 relay outputs (marks as RO1~RO6) at maximum, all are normal open(NO) relays, can be used to cut off load of 250VAC/5A or 30VDC/5A or 220VDC/0.2A, an intermediate relay is recommended when the load current is large.



### 3.4.6 Pulse output wiring

PMAC770H provides two pulse outputs as optional function to reflect electrical energy measuring, the first pulse output channel used to reflect total active electrical energy, the

second pulse output used to reflect total reactive electrical energy, the pulse constant is 3600, and the width is 80ms.
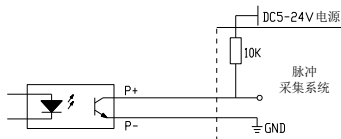


### 3.4.7 Analog output wiring

PMAC770H provides 2 expansion modules for adding analog output interface, the max load for AO is 750Ω， output range is 4~40mA, 1.2 times overload.

# Chapter 4. Technical features introduction

## 4.1 Measurement function

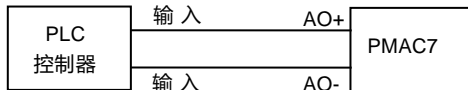### 4.1.1 Measurement parameters overview

| Type | Description | A | B | C | Total | Average | Zero sequence | Measure range |
|------|-------------|---|---|---|-------|---------|---------------|---------------|
| U | Phase voltage | √ | √ | √ | | √ | √ | 0~690kV |
| | Line voltage | √ | √ | √ | | √ | | |
| | Phase angle | √ | √ | √ | | | | |
| I | Current | √ | √ | √ | | √ | √ | 0~50000A |
| | Phase angle | √ | √ | √ | | | | |
| Power | P | √ | √ | √ | √ | | | 1 phase:0~34500MW |
| | Q | √ | √ | √ | √ | | | 1 phase:0~34500MVar |
| | S | √ | √ | √ | √ | | | 1 phase:0~34500MVA |
| PF | PF | √ | √ | √ | √ | | | |

| Freque ncy | Frequenc y | √ | | | | | | 35~65Hz |
|---|---|---|---|---|---|---|---|---|

**Note:** Under 3P3W wiring mode, phase voltage, active power, reactive power, apparent power and power factor are meaningless for each phase.

## 4.1.2 Voltage

PMAC770H can be used as direct connect when the measured phase voltage is lower than 398V or line voltage is lower than 690V, it shall work with PT when input voltage is larger than above value. To keep the meter reflect accurate measuring, please pay attention to the linearity and accuracy of the PT when wiring.

The overload capacity for voltage measuring by PMAC770H is 120%, the rated max measuring range is 690KV, the wiring mode of voltage measuring can be set over the panel or Modbus register, both 3P4W and 3P3W methods are supported for low voltage and high voltage situation.

**Note:**

1) **Please clear the electrical energy after changing the wiring method if any.**
2) **PT ratio range is 1.00~6900.00**

## 4.1.3 Current

PMAC770H shall work with external CT for current measuring, and the secondly value of the CT shall be 5A to connect to PMAC770H, please avoid open circuit when doing CT wiring, as this may damage the device, most importantly this may bring danger to installation and maintenance people

The overload capacity for current measuring by PMAC770H is 120%, the rated max measuring range is 50000A, the CT ratio range is 1.00~10000.00.

### 4.1.4 Active power

PMAC770H supports measuring each phase active power (Pa, Pb, Pc) and total active power, single phase max measuring range is 34500MW, three phase max measuring range is 103500MW.

### 4.1.5 Reactive power

PMAC770H supports measuring each phase reactive power(Qa, Qb, Qc) and total reactive power, single phase max measuring range is 34500MVar, three phase max measuring range is 103500MVar.
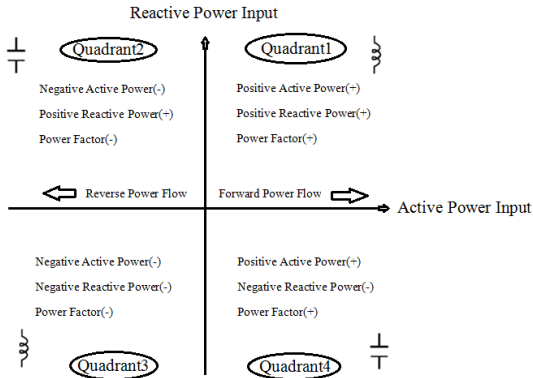
**Note:**

1) **Active and reactive power are signed values**
2) **Please pay attention to the phase sequence correspondence between voltage and current when wiring, as this may impact the accuracy of power calculating.**
3) **Please pay attention to the wiring of CT homonymous ends, wrong wiring may bring a measured negative value for power**

### 4.1.6 Apparent power

PMAC770H supports measuring each phase apparent power(Sa, Sb, Sc) and total apparent power, single phase max measuring range is 34500MVA, three phase max measuring range is 103500MVA.

## 4.1.7 Power factor

PMAC770H supports measuring each phase and total power factor, and the measure range is -1.000~+1.000.

Reactive Power Input

Quadrant2

Negative Active Power(-)
Positive Reactive Power(+)
Power Factor(-)

Quadrant1

Positive Active Power(+)
Positive Reactive Power(+)
Power Factor(+)

Reverse Power Flow

Forward Power Flow

Active Power Input

Negative Active Power(-)
Negative Reactive Power(-)
Power Factor(-)

Positive Active Power(+)
Negative Reactive Power(-)
Power Factor(+)

Quadrant3

Quadrant4

## 4.1.8 Frequency

The frequency measuring range of PMAC770H is 36~65Hz, the measuring channel is different under different wiring mode. Under 3P3W wiring mode, PMAC770H takes frequency sample from line AB as default, if line AB is phase loss then takes from line CA, if both line AB and line CA are loss then the value will be 0. Under other wiring mode, PMAC770H will take frequency sample from phase channel (A/B/C).

## 4.2 Power quality analysis function

### 4.2.1 Voltage deviation

In a running power supply system, the difference between the actual measured voltage at the measuring point and the nominal voltage of the system as a percentage of the nominal voltage of the system is called voltage deviation, and voltage deviation including upper and lower deviation.

(1) Upper deviation

$$U_{over}(\%) = \frac{\sqrt{\dfrac{\sum\limits_{i=1}^{n} U_{rms-over,i}^2}{n}} - U_{din}}{U_{din}} \times 100\%$$

$U_{rms-over,i}$ : i-th 10 points/cycles RMS value

When $U_{rms-200ms,i}$ is less than $U_{din}$, then $U_{rms-over,i}$ equals $U_{din}$

When $U_{rms-200ms,i}$ is larger or equals $U_{din}$, then $U_{rms-over,i}$ equals $U_{rms-200ms,i}$

(2) Lower deviation

$$U_{under}(\%) = \frac{U_{din} - \sqrt{\dfrac{\sum\limits_{i=1}^{n} U_{rms-under,i}^2}{n}}}{U_{din}} \times 100\%$$

$U_{rms-over,i}$ : i-th 10 points/cycles RMS value

When $U_{rms-200ms,i}$ is larger than $U_{din}$, then $U_{rms-under,i}$ equals $U_{din}$

When $U_{rms-200ms,i}$ is less or equals $U_{din}$, then $U_{rms-under,i}$ equals $U_{rms-200ms,i}$

PMAC770H calculates the voltage deviation according to the requirements of GB/T12325-2008 standard, the voltage measurement accuracy of the device is 0.1%, it can achieve continuous voltage deviation monitoring and alarm recording for power system.

### 4.2.2 Frequency deviation

In a normal running power system, the frequency difference between the actual measured and nominal values of the system is called frequency deviation, the formula is

show as below：

$$\text{Frequency deviation} = \text{actual frequency} - \text{nominal frequency}$$

PMAC770H has a frequency measurement accuracy of ±0.01Hz, enabling it can achieve continuous frequency monitoring, and it equips over limit alarm and recording features as well.

## 4.2.3 Harmonic

### 4.2.3.1 Harmonic

PMAC770H is fully compliant with IEC61000-4-7 standard, and takes 256 sampling points at each cycle for harmonic analysis.

| Type | Parameters | UA | UB | UC | IA | IB | IC | Range | Accuracy |
|------|-----------|----|----|----|----|----|----|-------|----------|
| Harmonic distortion rate | Voltage THD | √ | √ | √ | √ | √ | √ | 0~100% | S class |
| | Voltage odd THD | √ | √ | √ | √ | √ | √ | 0~100% | S class |
| | Voltage even THD | √ | √ | √ | √ | √ | √ | 0~100% | S class |
| | Current THD | √ | √ | √ | √ | √ | √ | 0~100% | S class |
| | Current odd THD | √ | √ | √ | √ | √ | √ | 0~100% | S class |
| | Current even THD | √ | √ | √ | √ | √ | √ | 0~100% | S class |
| Harmonic ratio | Harmonic voltage ratio | √ | √ | √ | √ | √ | √ | 2~63$^{rd}$ | S class |
| | Harmonic current ratio | √ | √ | √ | √ | √ | √ | 2~63$^{rd}$ | S class |
| Harmonic RMS | Harmonic voltage RMS | √ | √ | √ | √ | √ | √ | 0~63$^{rd}$ | S class |
| | Harmonic current RMS | √ | √ | √ | √ | √ | √ | 0~63$^{rd}$ | S class |
| | Harmonic power RMS | √ | √ | √ | √ | √ | √ | 0~63$^{rd}$ | S class |
| Other | Voltage crest factor | √ | √ | √ | √ | √ | √ | / | S class |
| | Current K factor | √ | √ | √ | √ | √ | √ | / | S class |
| | Frequency deviation | √ | √ | √ | √ | √ | √ | 0~100% | S class |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Voltage deviation | √ | √ | √ | √ | √ | √ | 0~100% | S class |
| Voltage imbalance rate | √ | √ | √ | √ | √ | √ | 0~100% | S class |

**4.2.3.2 Fundamental wave parameters measurement**

PMAC770H provides complete fundamental data for power system running status analysis

| | Phase A | Phase B | Phase C | Total | Neutral line |
|---|---|---|---|---|---|
| Phase voltage | √ | √ | √ | | √ |
| Line voltage | √ | √ | √ | | |
| Current | √ | √ | √ | | √ |
| Active power | √ | √ | √ | √ | |
| Reactive power | √ | √ | √ | √ | |
| Apparent power | √ | √ | √ | √ | |

## 4.2.4 Imbalance and sequence components measurement

In an ideal three-phase power supply system, the A/B/C phase voltage and current shall be equal correspondingly and with 120° phase angle difference, that's a balance situation. When the actual system deviates from the above situation, the issue of imbalance and the corresponding reduction in power utilization efficiency arises.

PMAC770H can measure the positive sequence, negative sequence and zero sequence amplitude and phase angle of voltage and current, and calculate and analysis voltage and current imbalance degree which including negative and zero sequence imbalance.

（1）Negative sequence imbalance of voltage and current

$U_2$=(voltage negative sequence component/ voltage positive sequence

component)X100%

$I_2$=(current negative sequence component/ current positive sequence component)X100%

(2) Zero sequence imbalance of voltage and current

$U_0$=(voltage zero sequence component/ voltage positive sequence component)X100%

$I_0$=(current zero sequence component/ current positive sequence component)X100%

## 4.2.5 Voltage flicker

The voltage flicker measurement range of PMAC770H is 1~20, its calculation mode is based on the IEC61000-4-15 standard, can fully meet the requirements.

## 4.2.6 Voltage swell, sag and interruption

There are many causes can bring voltage swell, sag and interruption to the power system, such as load adjustment, throwing of compensation capacitors and short-circuit fault at long distance, the above voltage changes are the main causes of abnormal operation of industrial equipment.

A) record each moment of the occurrence of voltage transient change and each phase voltage missing value

B) waveform recording can be triggered on each voltage transient change

PMAC770H voltage swell, sag and interruption measurement can meet standards of GB/T18481-2001 and IEC61000-4-30

## 4.2.7 K factor

Among the power quality technical analysis indicators, K factor is mainly used to reflect the influence of the frequency harmonic which caused by non-linear loads on transformer losses,

the K factor is defined mainly under the assumption that the transformer eddy current losses caused by harmonic currents are proportional to the square of the number of harmonics, the calculation formula is show as below:

$$K = \frac{\sum_{h=1}^{\infty} I_h^2 h^2}{\sum_{h=1}^{\infty} I_h^2} = \frac{\sum_{h=1}^{h=h_{max}} I_h^2 h^2}{\sum_{h=1}^{h=h_{max}} I_h^2}$$

In above formula, h represents harmonic order, $I_h$ is the harmonic current RMS of h-th order, $h_{max}$ is the highest harmonic order

## 4.2.8 Voltage crest factor

PMAC770H supports voltage crest factor measurement and this can be checked over Modbus register list. The crest factor is the ratio of the load's crest voltage to the RMS voltage, the normally crest value for most electronic device is 1.4

## 4.2.9 Current TDD

TDD is an abbreviation of total distortion rate of demand parameter, PMAC770H supports three-phase current TDD measurement and this can be checked over Modbus register list.

## 4.2.10 Load impedance

PMAC770H supports three-phase load impedance and total load impedance detection function, the load impedance is judged by active and reactive power.

1)  When P=0 and Q=0, then the load impedance is resistive

2)  When P>0 and Q>0, then the load impedance is inductive

3)  When P<0 and Q<0, then the load impedance is inductive

4)  When P<0 and Q>0, then the load impedance is capacitive

5)  When P>0 and Q<0, then the load impedance is capacitive

## 4.3 Electrical energy measurement function

### 4.3.1 Electrical energy measurement

PMAC770H provides full electrical energy data measurement technical feature as below table:

| | Positive | Reverse | Net value | Total |
|---|---|---|---|---|
| Full wave(P) | √ | √ | √ | √ |
| Full wave(Q) | √ | √ | √ | √ |
| Full wave(S) | | | | √ |
| Fundamental wave (P) | √ | √ | √ | √ |
| Fundamental wave (Q) | √ | √ | √ | √ |
| Fundamental wave (S) | | | | √ |

### 4.3.2 Electrical energy overturn and clear

The max electrical energy that PMAC770H can record is 99999999.999, when the actual electrical energy is larger than that, then the device will overturn the energy to zero and record further, energy clear operation can be done over Modbus register list.

### 4.3.3 Electrical energy pulse output

PMAC770H supports active energy and reactive energy pulse output function.

### 4.3.4 Multi-tariff electrical energy

PMAC770H equips with two tariff solutions, each tariff solution consists of settings including time zone (counting season), normal day period and special day period. In a power supply system, the electricity price may be different in working days, weekend and holiday, as well as during peak and off-peak periods. So the multi-tariff function is used to meet the needs of different electricity price periods, multi-tariff function can measure the positive and negative active/reactive/apparent electrical energy, and the max measurement range is 99999999.9KWH.

Parameter setting range：

Counting season：1~12 time zone, times zone 1 counting from 1st of January and cannot

be modified. When setting to 0xFFFF or other non-existent date, then it will be judged as invalid date. If any time zone in the counting solution has been set to 0xFFFF, then all dates after the time zone should be set to 0xFFFF. The time zone setting rule is the later time zone date should be later than the date of previous time zone, except for all the later time zone have been set to 0xFFFF.

Counting day type: working day/weekend/holiday/special day, time period can be set under each type.

Time period: 20 daily time period tables can be set at maximum, and each daily period table can set up to12 time periods, the minimum time unit for each time period is 15 min. If the value is 0, then it means the current time period uses daily period table 1 for counting, the valid time from the start date of the time zone to the start date of next time zone, if the start date of next time zone has been set to 0xFFFF, then the valid time shall be from the start date of the time zone to the end of the year, the time period setting rule is the time of later time period shall be later than the time of the previous time period, except for all the later time periods have been set to 0xFFFF.

Special day: 0~90 pcs, each special day can set daily time period separately.

Tariff: sharp, peak ,flat, valley

**This multi-tariff function can only be set and read over Modbus register list.**

Time period setting sample:

| Time period | Start time | Tariff |
|---|---|---|
| 1# period | 0:00 | 1 |
| 2# period | 3:15 | 2 |
| 3# period | 5:30 | 3 |
| 4# period | 7:45 | 4 |
| 5# period | 9:00 | 1 |
| 6# period | 12:15 | 4 |
| 7# period | 15:45 | 2 |
| 8# period | 18:00 | 3 |
| 9# period | 20:30 | 1 |

| 10# period | 22:00 | 4 |
|:---:|:---:|:---:|
| 11# period | 22:30 | 2 |
| 12# period | 23:15 | 3 |

### 4.3.5 Historical electrical energy

PMAC770H supports recording the latest 31 days daily historical energy data, latest 12 months monthly historical energy data and latest 5 years yearly historical energy data.

## 4.4 Demand

In a power system demand usually refers to the average power consumption over a certain time interval (usually is 15 minutes).

### 4.4.1 Demand data

PMAC770H measures active power demand, total reactive power demand, total apparent power demand, three-phase current demand and forecast demand, and provides fixed demand and slip demand two measurement methods.

### 4.4.2 Demand measurement methods

There are slip cycle and fixed cycle measurement methods for demand calculating, the system add the calculated values per second, then take the average value at the end of the demand calculation cycle and output the result. The system use the same calculation principle for current and power demand measurement, the demand measurement cycle can be set to 5/10/15/30/60min.

Fixed demand method：once the demand measurement cycle is reach, the system will calculate the average value as per the fixed demand cycle and output the value.

Slip demand method：the slip cycle can be set to1/2/3/5min, once the demand measurement cycle is reach, the system will slip based on the set slip cycle(1/2/3/5min) to calculate the average value and output the value.

Forecast demand：for normal demand measurement, the value is output after the demand measurement cycle, but for forecast demand, the output demand value at the end of

the measurement cycle is calculated based on the current forecast value. PMAC770H refresh the forecast demand at each second.

## 4.5 Over limit measurement function

PMAC770H over limit measurement settings can only master software via communication, and the maximum over limit setting is 69 sets, each set including below contents：

(1) Trigger way：on or off

(2) Object：

Table 4-5 Settable alarm parameters

| Over limit type | Objects |
|---|---|
| | Phase voltage |
| | Line voltage |
| | Phase current |
| | Frequency |
| | Total active power |
| | Total reactive power |
| | Total apparent power |
| | Power factor |
| | Import total active power real-time demand |
| | Export total active power real-time demand |
| | Import total reactive power real-time demand |
| | Export total reactive power real-time demand |
| | Import total active power forecast demand |
| | Export total active power forecast demand |
| | Import total reactive power forecast demand |
| | Export total reactive power forecast demand |

| |
|---|
| Import total apparent power real-time    demand |
| Export total apparent power real-time    demand |
| Voltage THD rate |
| Current THD rate |
| Voltage negative sequence imbalance degree |
| Voltage zero sequence imbalance degree |
| Current negative sequence imbalance degree |
| Current zero sequence imbalance degree |
| 3th/5th/7th/9th/11th/13th voltage harmonic ratio |
| 3th/5th/7th/9th/11th/13th current harmonic ratio |
| DI state |
| Phase voltage deviation upper limit |
| Line voltage deviation upper limit |
| Frequency deviation upper limit |
| Phase voltage deviation rate upper limit |

(3) upper limit/lower limit:

1) upper limit: recovery value= action value - hysteresis value

If the measured value of the monitoring object is larger than the action value and the duration time exceeds the action delay, the alarm will be triggered, and if the measured value is less than the recovery value then the alarm will be recovery

2) lower limit: recovery value=action value + hysteresis value

If the measured value of the monitoring object is less than the action value and the duration time exceeds the action delay, the alarm will be triggered, and if the measured value is larger than the recovery value then the alarm will be recovery

(4) action delay: the time interval from detected an over limit to take an action, the setting

range is 0~120s

(5) trigger type： over limit trigger action

All over limit action will generate SOE record, and there are relay and light signal output can be set.

Note： DI state

1) value 0 means alarm open

2) value 1 means alarm close

3) None means alarm action delay

(6) Below is the logic description for upper limit alarm and lower limit alarm actions :

Figure 4-3 describes the situation of upper limit alarm, here takes relay output as trigger object. When measurement value of the measured parameter is larger than the set upper limit and the duration is over action delay time, then an alarm will be generated and trigger the relay output, after the measurement value of the measured parameter is less than the set lower limit and the duration is over return delay, then relay return to original state.
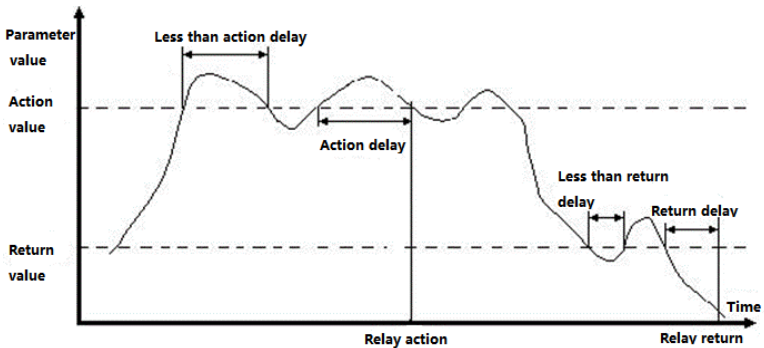


Figure 4-3 Upper limit

Figure 4-4 describes the situation of lower limit alarm, here takes relay output as trigger object. When measurement value of the measured parameter is less than the set lower limit and the duration is over action delay time, then an alarm will be generated and

trigger the relay output, after the measurement value of the measured parameter is larger than the set upper limit and the duration is over return delay, then relay return to original state.
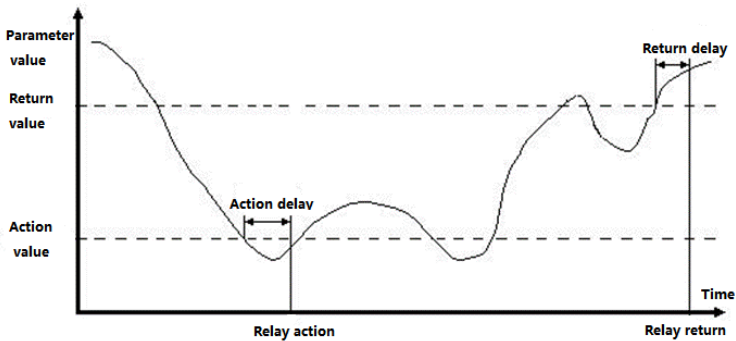


Figure 4-4 Lower limit

**Note**: An alarm will be generated once any phase trigger, and the alarm can be eliminated only when three phases recovery to normal value.

## 4.6 SOE record

PMAC770H supports recording up to 128pcs SOE events and without data loss even power outage, the events including over limit alarms, relay action, digital input state etc. SOE event is consists of event type, occur time and value, the time resolution is 1ms.

All SOE events can be read by master device over Modbus register list, and the record will be overturn when the capacity is reach to 128pcs.

## 4.7 PQ record

PMAC770H supports recording up to 128pcs PQ events and without data loss even power outage, it mainly records the power quality events including voltage swell, sag and interruption and voltage rapid change, each PQ event is consists of event type, occur time

and value, the time resolution is 1ms.

## 4.8 Waveform record

PMAC770H supports recording up to 128pcs waveform which including three phase voltage and three phase current, the default sampling cycle is 256 points/cycles, the recorded waveform will be installed into system file as COMTRADE format, and without data loss even power outage.

## 4.9 Extreme data record

PMAC770H supports recording the real-time extreme measured value and timestamps, parameters including:

- Three-phase current
- Phase voltage and line voltage
- Neutral line current/ neutral line to ground voltage
- Three-phase active power/reactive power/apparent power
- Total active power/reactive power/apparent power
- Frequency

## 4.10 Digital input

PMAC770H provides 11 digital inputs which marked as DI1~DI11, they are used to measure the switch position and state, digital inputs including active and passive two types, shall be selected as per actual needs.

Digital input state can be checked from LCD directly or via reading Modbus register, DI event is collected into SOE record, the time resolution is 1s.

| DI No. | Position | Type |
|--------|----------|------|
| S1,S2,S3 | Main body equipped | Active digital input: |
| S4,S5,S6,S7 | Expansion module 1 | SW model: active digital input(143~297VAC rated input)<br>SD model: passive digital input(dry contact) |

| S8,S9,S10,S11 | Expansion module 2 | SW model: active digital input(143~297VAC rated input) |
| | | SD model: passive digital input(dry contact) |

## 4.11 Relay output

PMAC770H supports two control modes for relay output which is remote control and local control, when local control is selected, then relay output is represent alarm output, when remote control is selected, then relay shall respond to the master device to perform open/close command.

## 4.12 Analog output

PMAC770 can add 2 expansion modules for adding analog output function, each module can configure 2 analog outputs, the max output load is 750Ω, output range is 4~20mA, 120% overload limit.

The relative objects for analog output are show as below:

| Ua | Ub | Uc | Uab | Ubc | Uca | Frequency |
|----|----|----|-----|-----|-----|-----------|
| Ia | Ib | Ic | $P_t$ | $Q_t$ | $PF_t$ | |

AO calculation formula:

$$K = (Value - Vmin) / (Vmax - Vmin)$$

$$AO = 4 + 16 * K \qquad (mA)$$

K: 0-100%

Vmax: max value

Vmin: min value

Value: actual input value

## 4.13 Communication

PMAC770H provides 2 RS485 ports(one is standard, one is optional) and 1 optional Ethernet port.

1) RS485 port supports Modbus communication protocol, and settable baud rate including 2400bps, 4800bps, 9600bps, 19200bps, 38400bps

2) Ethernet port using standard RJ-45 interface, equip with 10/100M communication speed, and supports Modbus-TCP/IP communication protocol(port number 502)

## 4.14 Timing

PMAC770H supports SNTP network timing and Modbus communication timing,

1) SNTP: the device will obtain the high precision real time from Ethernet server(only supported by model with LAN)

2) Modbus: master device adjust the system time over writing Modbus register list number.

## 4.15 Store function

PMAC770H provides 128MB storage capacity for storing data including waveform record, SOE record, PQ events etc.

## 4.16 Real-time waveform

PMAC770H provides a real-time waveform display function, waveform including real-time, three-phase current and three-phase voltage.

# Chapter 5. Display and settings

PMAC770H equips with a TFT colorful LCD which with resolution of 320×240.

## 5.1 Button

PMAC770H equips with 4 buttons on front panel, functions of each button are show as below：

| Button | Description |
|--------|-------------|
| " ⟨ " | Move cursor to left, or turn page to left |
| " ⟩ " | Move cursor to right, or turn page to right |
| " ↰ " | Exit to previous menu or cancel the entered value |
| " ← " | Enter next menu or confirm the entered value |

## 5.2  Indicator light

PMAC770H equips with 4 indicator lights on front panel:

| Indicator | Description |
|-----------|-------------|
| 🏃 | Running status indicator, flashing when device is under normal operation |
| ☎ | Communication status indicator, flashing when series port is under normal communication |
| 🔔 | Fault indicator, flashing when the device is faulty |
| ∿ | Pulse output indicator |

## 5.3 Settings and display

The device will refresh the page after powering on, and will enter the default main menu after refreshing, the main menu includes 8 sub menus, show as below picture:
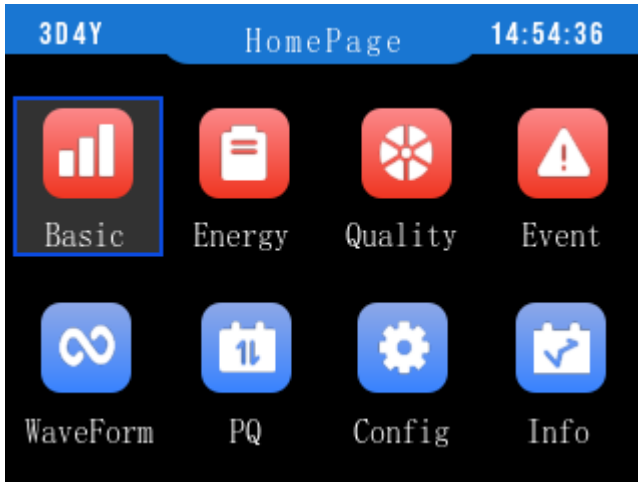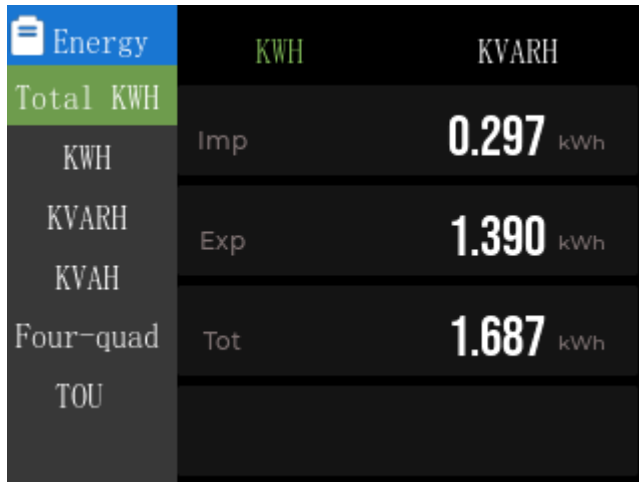
### 5.3.1 Basic measurement

The basic parameter measurement page is consists of 11 sub menus, which including phase voltage, line voltage, phase current, active power, reactive power, power factor, frequency, current demand, power demand, digital input, relay etc.

### 5.3.2 Electrical energy measurement

Electrical energy measurement page is consists of 6 sub menus, which including total energy, active energy, reactive energy, apparent energy, four quadrant energy and multi-tariff energy etc.：



### 5.3.3 Power quality

Power quality page is consists of 7 sub menus, which including phase diagram, imbalance rate, sequence components, deviation, crest factor, flicker and current etc.
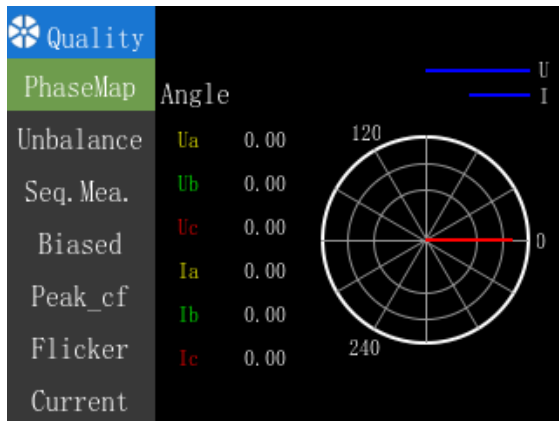
### 5.3.4 Event record

Event record page display the events including phase voltage over limit, phase voltage under limit etc. For more detailed events please refer to parameter settings->alarm setting.

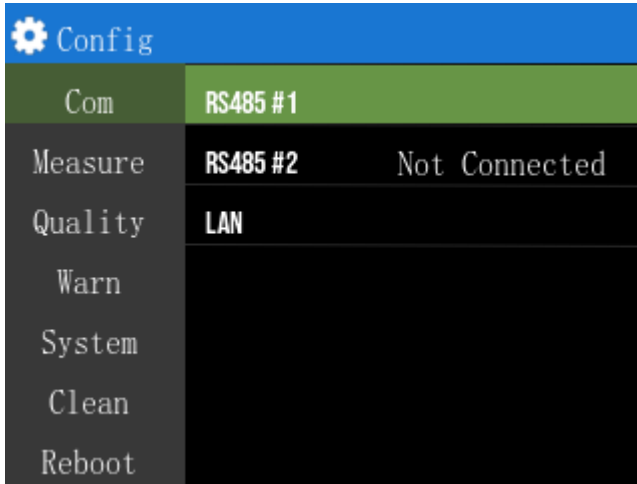| Item | Description |
|------|-------------|
| Previous page | Turn to previous page |
| Next page | Turn to next page |
| Turn to"1/1"page | Turn to specified page, 1/1：1：current page 1：total page(s) |

### 5.3.5 Real-time waveform

Real-time waveform page including three-phase current and three-phase voltage waveform.
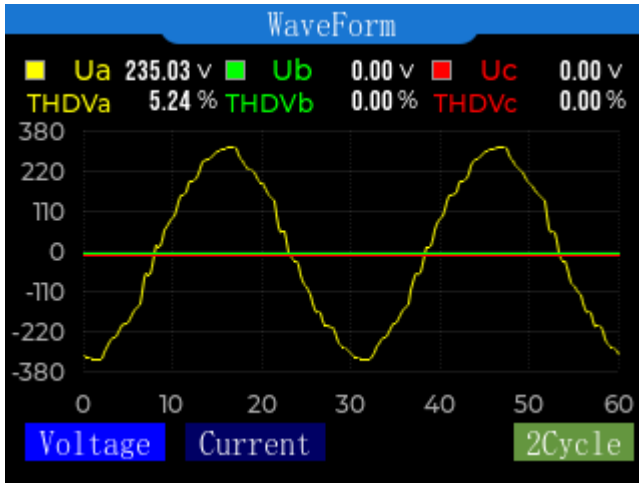


| Item | Description | Switching button |
|------|-------------|------------------|
| Voltage | Voltage secondly value(220V/480V system) | "<" / ">" |
| Current | Current secondly value | |
| 2 points/cycles | 1point/ cycles, 2 points/cycles(default), 4 points/cycles | "⏎" |

### 5.3.6 Waveform recording

Waveform recording function records three phase voltage swell, sag and interruption events.



Waveform details can be read by selecting the corresponding event

| Item | Description |
|------|-------------|
| Previous page | Turn to previous page |
| Next page | Turn to next page |
| Turn to"1/26"page | Turn to specified page, 1/26：1：current page 26: total pages |

### 5.3.7 Parameter settings

Please setup the parameters before using the equipment, the default password for performing parameter settings is 01.
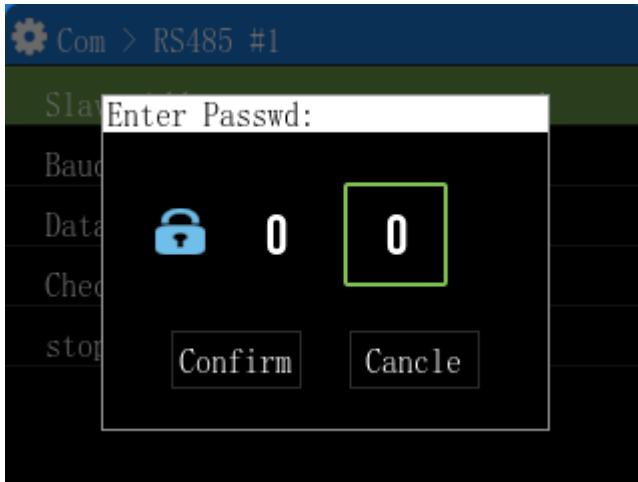
**5.3.7.1 Communication setting**

Communication setting page shows parameters including Ethernet and 2 RS485 interface info：

Config

| Com | RS485 #1 | |
|---|---|---|
| Measure | RS485 #2 | Not Connected |
| Quality | LAN | |
| Warn | | |
| System | | |
| Clean | | |
| Reboot | | |

| Set via register list | Factory default | Description |
|---|---|---|
| **RS485#1 setting** | | |
| Device ID | 1 | 1 ~ 247, each device shall have a unique ID for devices connected in a same circuit |
| Baud rate | 9600 | 1200/2400/4800/9600/19200/38400bps |
| Data bit | 8 | 7 or 8 |
| Parity bit | None | None, Odd, Even |
| Stop bit | 1 | 1 or 2 |
| **RS485#2 setting** | | |

| Settings same as **RS485#1** | | |
|---|---|---|
| **Ethernet setting** | | |
| IP | 192.168.0.100 | The Ethernet parameters setting shall meet below requirements： |
| Sub mask | 255.255.255.0 | 1）IP add and sub mask cannot be 0(gateway IP is o means no gateway) |
| Gateway | 192.168.0.1 | 2）IP add and gateway  should be in range of 1~223  3）IP add and gateway cannot be 127.x.x.x。 |
| DNS | 8.8.8.8 | |

### 5.3.7.2 Measurement settings

Measurement settings page is consists of 6 sub menus, which including wiring mode setting, pulse setting, demand setting, AO setting, relay setting and load setting.



### 5.3.7.2.1 Wiring mode setting

Wiring mode setting page is used to modify wiring mode, PT ratio, CT ratio etc.

Parameters table:

| Item | Factory Default | Range |
|------|----------------|-------|
| Wiring mode | 3P4W | 3P4W,3P3W |
| PT ratio | 1.00 | 1.00-6900.00 |
| CT ratio | 1.00 | 1.00-10000.00 |

**5.3.7.2.2 Pulse setting**
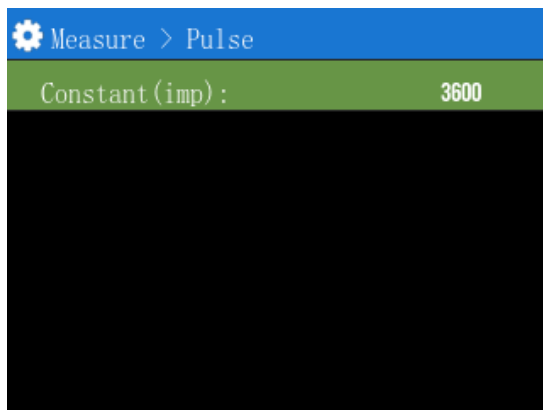
Pulse setting page is mainly used to set pulse constant.

| Item | Factory default | Range |
|------|-----------------|-------|
| Pulse constant（imp） | 3600 | 0-65536 |

**5.3.7.2.3 Demand parameter setting**
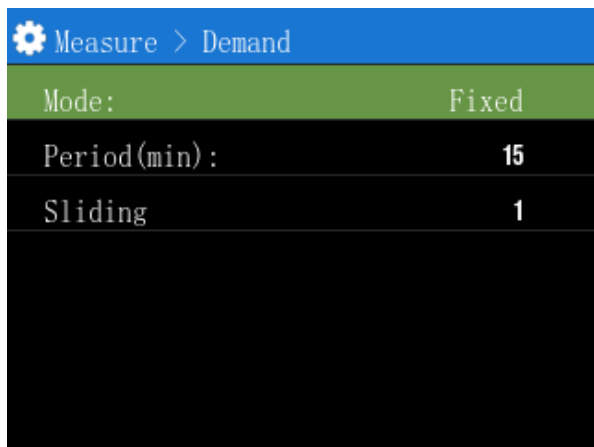
Demand parameter setting page is used to set demand mode, demand cycle and slip width:

| Item | Factory default | Range |
| --- | --- | --- |
| Demand mode | Fixed mode | Fixed/slip mode |
| Demand cycle(min) | 15 | 5min/10min/15min/30min/60min |
| Slid width(min) | 1 | 1min/2min/3min/5min |

### 5.3.7.2.4 AO setting (connect expansion module)

AO setting page including setting for AO1、AO2、AO3、AO4：
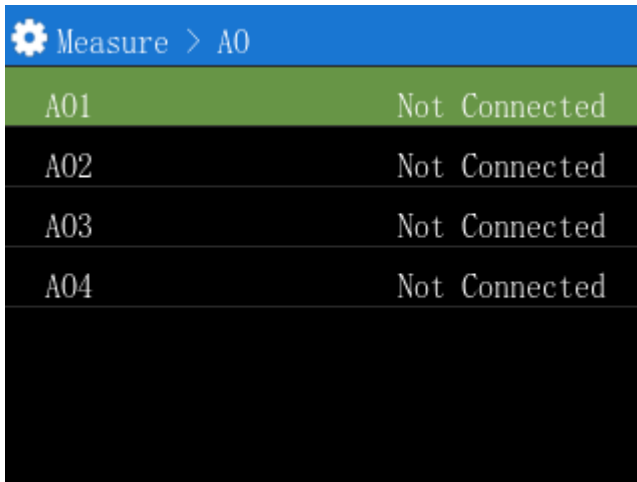


Select the right AO channel and enter the setting page accordingly
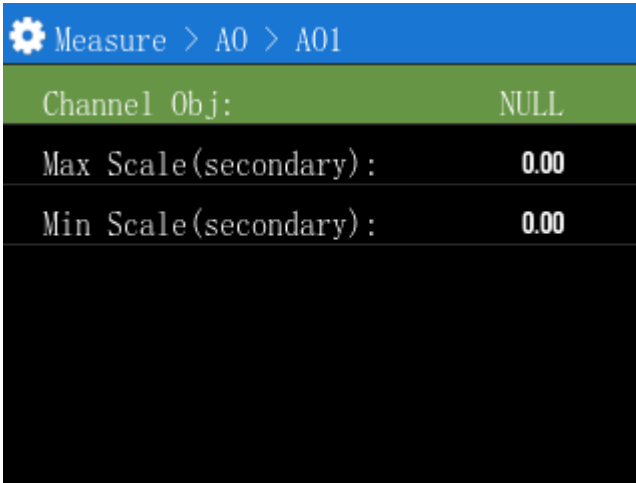
AO parameter setting table：

| Item | Factory default | Range |
|---|---|---|
| Object | Null | Null/Ua/Ub/Uc/Uab/Ubc/Uca/Ia/Ib/Ic/ $P_t$/$Q_t$/$PF_t$/frequency |
| Max range(secondly value) | 0.00 | U/I/frequency：0.00~9999.99 |
| Min range(secondly value) | 0.00 | $P_t$/$Q_t$： -9999.99~9999.99 PF:-1.000~+1.000 |

**5.3.7.2.5 Relay setting**

Relay setting page is used to setup the relay working mode, when local control is selected, then relay output is represent alarm output, when remote control is selected, then relay shall respond to the master device to perform open/close command.

Setting table：

| Item | Factory default | Range |
|------|-----------------|-------|
| 1~6 relay | Local | Local mode or remote mode |

**5.3.7.2.6 Load setting**

Load setting page including upper limit setting for voltage, current and total active power, and lower limit for voltage only.
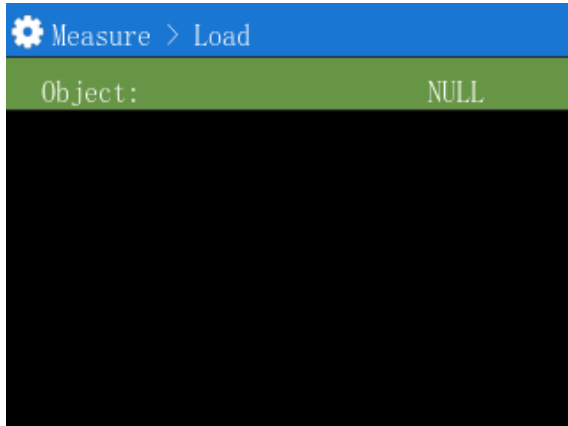
Setting table：

| Item | Factory default | Range |
| --- | --- | --- |
| Object | Null | Null,voltage,current,total active power |
| Upper limit | 0.00 | Voltage： 0.00 - 999.99(kV) |
| | | Current： 0.00 - 999.99(kA) |
| | | $P_t$： -20MW - 20MW |
| Lower limit | 0.00 | Voltage： 0.00 - 999.99(kV) |

**5.3.7.3 Power quality**

Power quality page is consists of 4 sub menus, which including voltage swell, voltage sag, voltage interruption and other.

**5.3.7.3.1 Voltage swell/sag/interruption**

This page can be used to set voltage swell, sag and interruption for each phase(Ua,Ub,Uc)：



The parameter settings including threshold and hysteresis value：

Setting table：

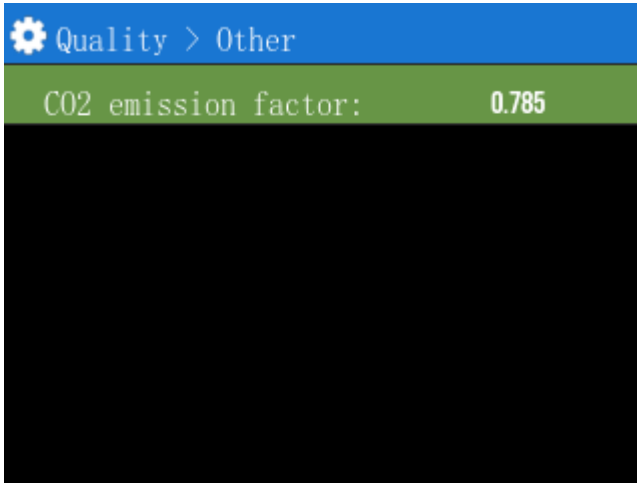| Item | Factory default | Range |
|------|----------------|-------|
| Threshold | 220.00V | 0-999.99V |
| Hysteresis | 220 | 0-999 |

**5.3.7.3.2 Other**

This page is mainly used to set CO2 emission factor.

Setting table：

| Item | Factory default | Range |
|------|-----------------|-------|
| CO2 emission factor | 0.785 | 0 - 65.536 |

**5.3.7.4 Alarm setting**

Alarm setting page consist of 7 sub menus, they are voltage setting, current setting, frequency setting, power setting, imbalance setting, harmonic distortion setting and other settings.

**5.3.7.4.1 Voltage setting**

Voltage setting page including 11 sub setting menus for phase voltage over limit, phase
voltage lower limit, average phase voltage over limit, average phase voltage over limit, line
voltage over limit, line voltage lower limit, average line voltage over limit, average line
voltage lower limit, neutral line to ground voltage over limit, neutral line to ground voltage
lower limit, voltage loss etc.

Voltage parameters setting show as below：

Setting table:

| Item | Factory default | Range |
|------|-----------------|-------|
| Enable | Off | On or off |
| Relative | None | None/R1/R2/R3/R4/R5/R6(R stands for relay) |
| Threshold(V,kV) | 1.00 | 0.00 - 999.99(kV) |
| Hold time(S) | 0 | 0 - 999 |
| Hysteresis（V） | 0 | 0.00-655.35 |

**5.3.7.4.2 Current setting**

Current setting page including 6 sub setting menus for current over limit, current lower limit,

neutral line current over limit, neutral line current lower limit, average current over limit,

average current lower limit.
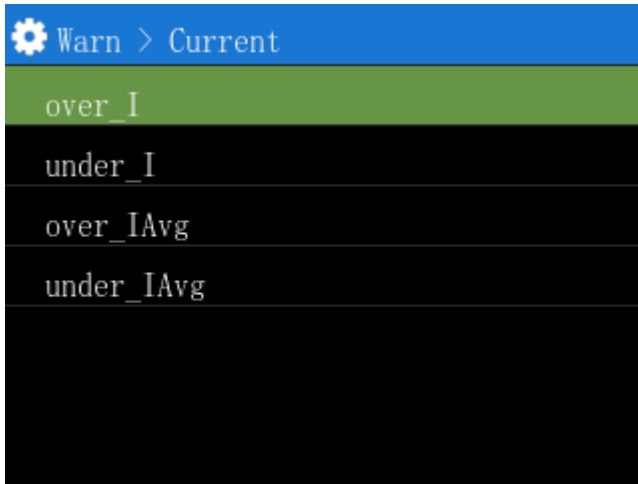


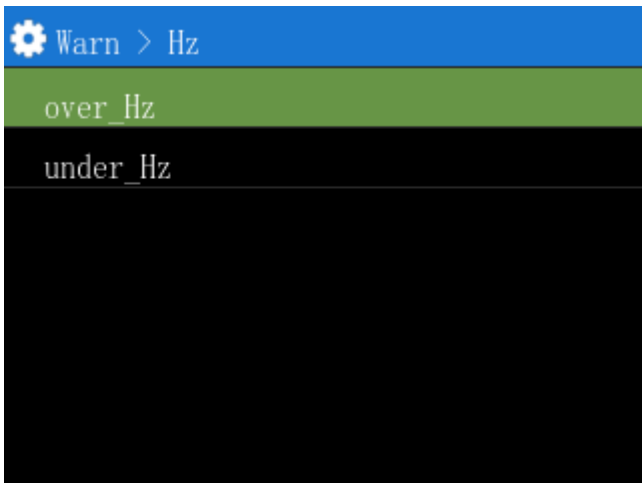Current parameters setting show as below：

Setting table:

| Item | Factory default | Range |
|---|---|---|
| Enable | Off | On or off |
| Relative | None | None/R1/R2/R3/R4/R5/R6(R stands for relay) |
| Threshold(A,kA) | 1.00 | 0.00 - 999.99(kA) |
| Hold time（S） | 0 | 0 - 999 |
| Hysteresis （A） | 0 | 0.00-65.53 |

**5.3.7.4.3 Frequency setting**

Frequency setting page including upper and lower limit setting for frequency parameter.

Frequency parameter setting show as below：

Setting table:

| Item | Factory default | Range |
|------|-----------------|-------|
| Enable | Off | On or off |
| Relative | None | None/R1/R2/R3/R4/R5/R6(R stands for relay) |
| Threshold （pf） | 1.00 | 0.00 - 999.99 |
| Hold time （S） | 0 | 0 - 999 |
| Hysteresis （%） | 0 | 0.00-655.35 |

### 5.3.7.4.4 Power setting

Power setting page is consists of 17 sub menus, which including active power upper limit, active power lower limit, total active power upper limit, total active power lower limit, reactive power upper limit, reactive power lower limit, reactive power lower limit, total reactive power upper limit, total reactive power lower limit, apparent power upper limit, apparent power lower limit, total apparent power upper limit, total apparent power lower limit, power factor upper limit, power factor lower limit, total power factor upper limit, total power factor lower limit, total active power demand upper limit etc.
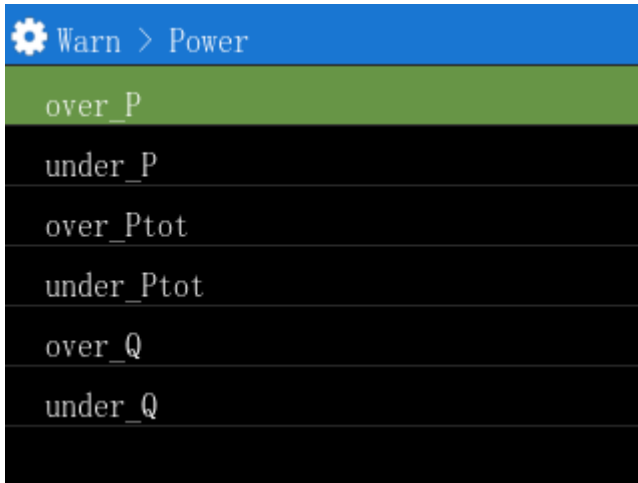
Power alarm settings page is show as below:



Active power setting table(reactive power setting same as this part):

| Item | Factory default | Range |
|---|---|---|
| Enable | Off | On or off |
| Relative | None | None/R1/R2/R3/R4/R5/R6(R stands for relay) |
| Threshold(W,kW,MW) | 1100.00 | -20MW - 20MW |
| Hold time（S） | 0 | 0 - 999 |
| Hysteresis (W) | 0 | 0 - 655.35 |

Apparent power setting table:

| Item | Factory default | Range |
|---|---|---|
| Enable | Off | On or off |
| Relative | None | None/R1/R2/R3/R4/R5/R6(R stands for relay) |
| Threshold(VA,kVA,MVA) | 1100.00 | 0 - 20MVA |
| Hold time（S） | 0 | 0 - 999 |
| Hysteresis（VA） | 0 | 0 - 655.35 |

Power factor setting table:

| Item | Factory default | Range |
|---|---|---|
| Enable | Off | On or off |

| Relative | None | None/R1/R2/R3/R4/R5/R6(R stands for relay) |
|---|---|---|
| Threshold(pf) | 0 | -1.00 - 1.00 |
| Hold time （S） | 0 | 0 - 999 |
| Hysteresis （pf） | 0 | 0 - 1.00 |

**5.3.7.4.5 Imbalance rate setting**

Imbalance rate setting page is consists of 4 sub menus, which including negative sequence voltage imbalance rate upper limit, negative sequence current imbalance rate upper limit, zero sequence voltage imbalance rate upper limit, zero sequence current imbalance rate upper limit.
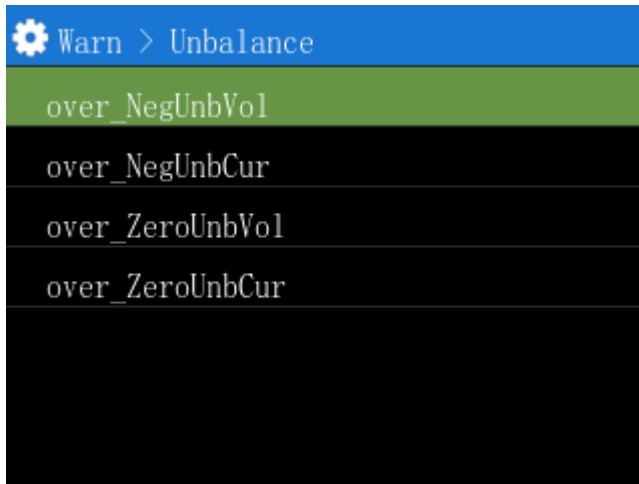


Imbalance rate alarm parameter setting page show as below：

Setting table:

| Item | Factory default | Range |
|---|---|---|
| Enable | Off | On or off |
| Relative | None | None/R1/R2/R3/R4/R5/R6(R stands for relay) |
| Threshold(%) | 0 | 0 - 100.00 |
| Hold time(S) | 0 | 0 - 999 |
| Hysteresis (%) | 0 | 0 - 100.00 |

**5.3.7.4.6 Harmonic distortion setting**

Harmonic distortion setting page is consists of 14 sub menus, which including voltage THD upper limit, current THD upper limit, voltage $3^{rd}$ harmonic upper limit, voltage $5^{th}$ harmonic upper limit, voltage $7^{th}$ harmonic upper limit, voltage $9^{th}$ harmonic upper limit, voltage $11^{th}$ harmonic upper limit, voltage $13^{th}$ harmonic upper limit, current 3th harmonic upper limit, current $5^{th}$ harmonic upper limit, current $7^{th}$ harmonic upper limit, current $9^{th}$ harmonic upper limit, current $11^{th}$ harmonic upper limit, current $13^{th}$ harmonic upper limit etc.

Harmonic distortion alarm setting page is show as below：

Setting table:

| Item | Factory default | Range |
|---|---|---|
| Enable | Off | On or off |
| Relative | None | None/R1/R2/R3/R4/R5/R6(R stands for relay) |
| Threshold (%) | 0 | 0 - 100.00 |
| Hold time (S) | 0 | 0 - 999 |
| Hysteresis (%) | 0 | 0 - 100.00 |

**5.3.7.4.7 Other settings**

Other settings page is consists of 15 sub menus, which including DI1 open, DI2 open, DI3 open, DI4 open, DI5 open, DI6 open, DI7 open, DI8 open, DI9 open, DI10 open, DI11 open, phase voltage deviation upper limit, line voltage deviation upper limit, frequency deviation upper limit, phase voltage deviation rate etc.
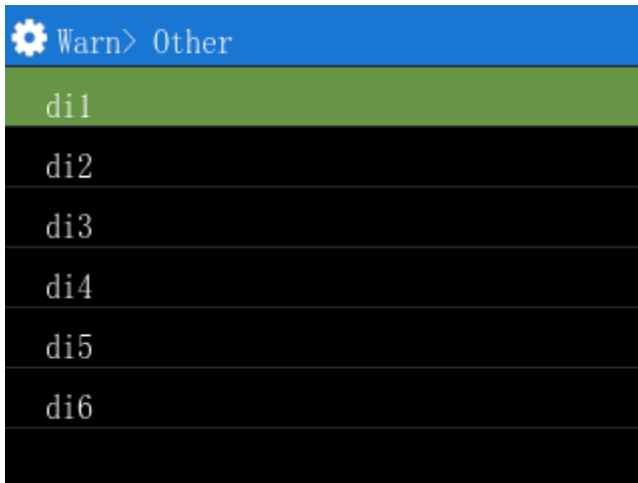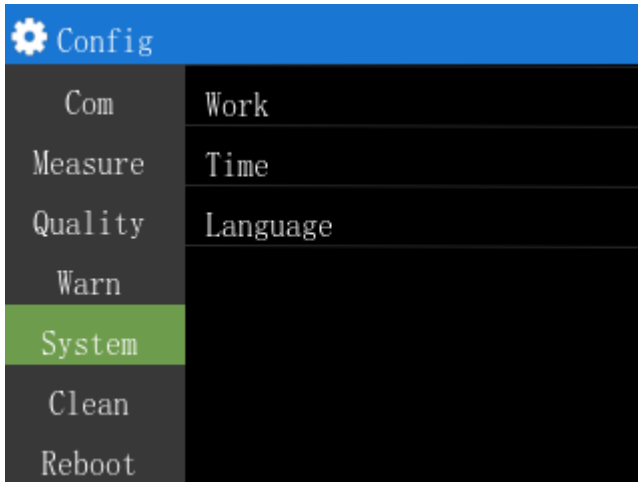
DI parameter setting page：



Setting table:

| Item | Factory default | Range |
|------|-----------------|-------|
| Enable | Off | On or off |
| Relative | None | None/R1/R2/R3/R4/R5/R6(R stands for relay) |
| Threshold | open | Open or close |

### 5.3.7.5 System settings

System settings page including 3 sub setting menus, they are   working mode setting,系统

time setting and language setting.

**5.3.7.5.1 Working mode setting**
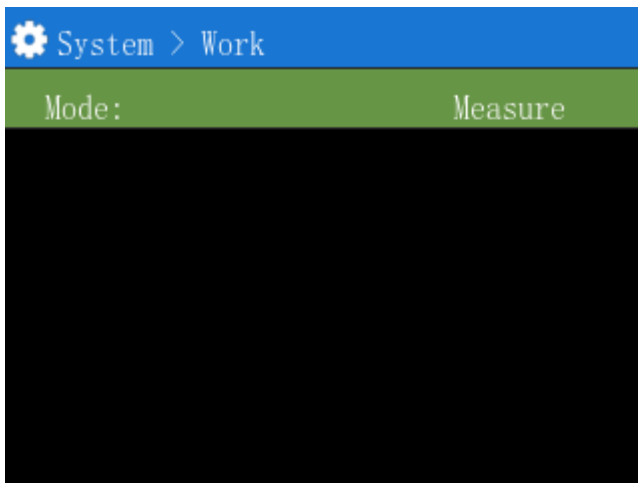
Setting table:

| Item | Factory default | Range |
|------|-----------------|-------|
| Mode | Measurement mode | Measurement mode, commissioning mode |

### 5.3.7.5.2 Time setting
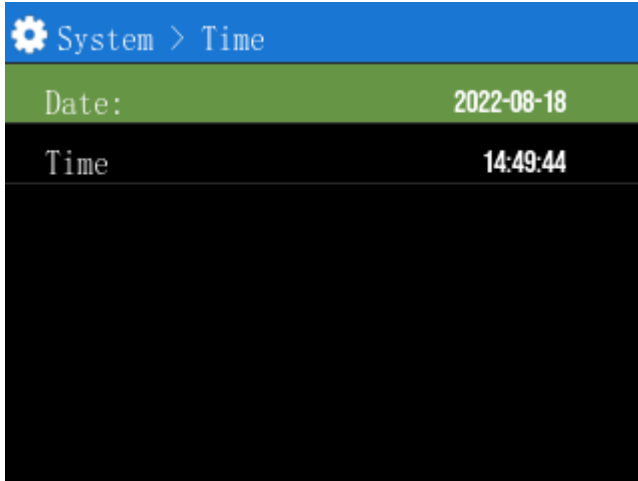


Setting table:

| Item | Factory default | Range |
|------|-----------------|-------|
| Date | Current date(factory calibrated) | 2022-01-01 - 2099-01-01 |
| Time | Current time(factory calibrated) | 00:00:00-23:59:59 |

**5.3.7.5.3 Language setting**
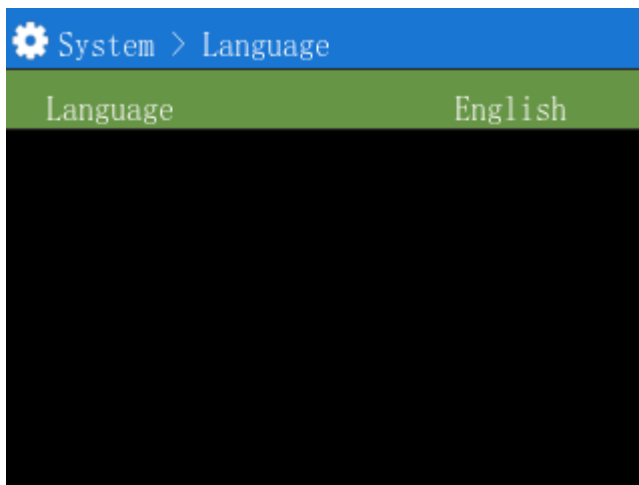


Setting table:

| Item | Factory default | Range |
|------|-----------------|-------|
| Language | Chinese | Chinese or English |

**5.3.7.6 Clear record**

Clear record page including user parameter and demand extreme value 2 sub menus :
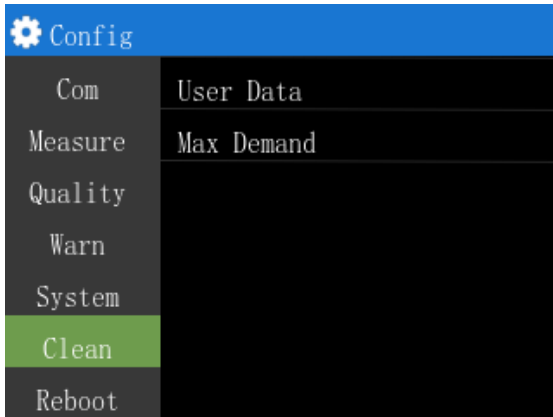
**5.3.7.6.1 User parameter**

User parameter clear page is show as below, a password is needed to proceed the operation, the default password is 888.
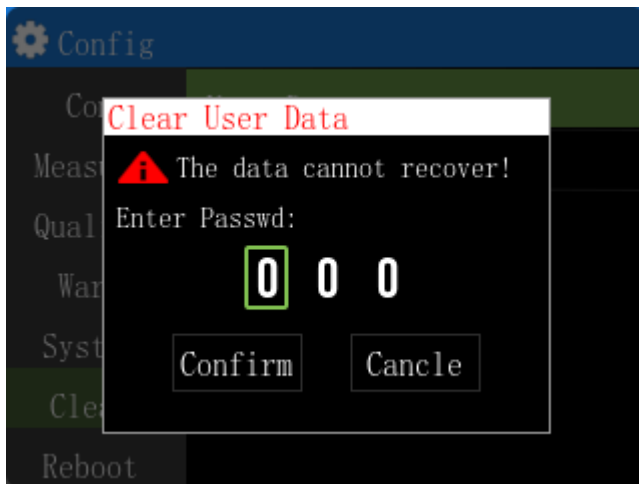


**5.3.7.6.2 Demand extreme value**

Demand extreme value clear page is show as below, a password is needed to proceed the

operation, the default password is 888.
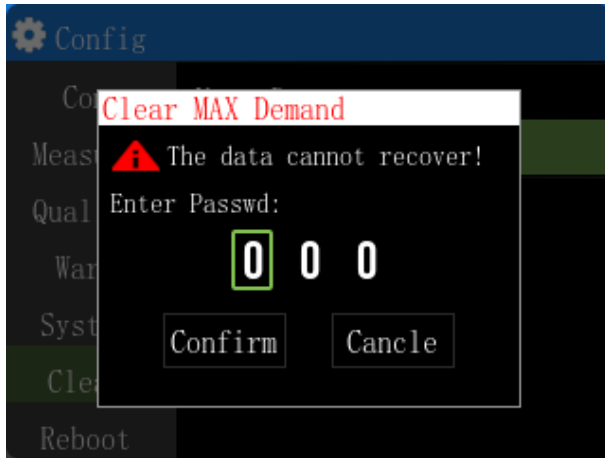


### 5.3.7.7 System reboot

A password is needed for proceeding system reboot operation, the default password is 888.
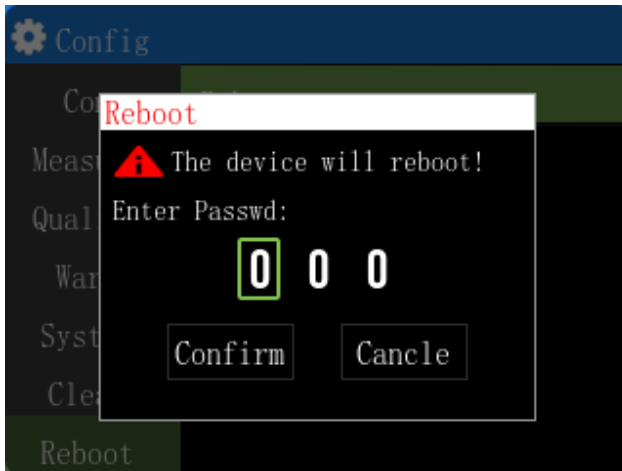
### 5.3.8 System info



| Item | Contents |
|------|----------|
| Device state | Product name, model, SN, software version, MAC add, manufacturer info |
| System state | Operation system, CPU, running time, RAM,ROM, system temperature |

# Chapter 6. Technical specification

## 6.1 Device parameters

PMAC770H meets standard of GB/T 17215.321-2021 for static meters for active energy class D requirement, and meets the standard of GB/T 19862-2016 for general requirements for monitoring equipment of power quality.

| Measured parameters | | Display | Communication | Accuracy |
|---|---|---|---|---|
| **Power quality parameters** | | | | |
| Rapid voltage change | Voltage | Event | Event | |
| Voltage deviation | Voltage | % | % | 0.1% |
| Frequency deviation | Frequency | - | - | 0.01Hz |
| Imbalance rate | Voltage, current | Primary value | Primary value | S class |
| Harmonic ratio | 63$^{rd}$ voltage/current harmonic components | % | % | S class |
| Harmonic power | 63$^{rd}$ | Primary value | Primary value | S class |
| Harmonic RMS | 63$^{rd}$ voltage/current harmonic components | Primary value | Primary value | S class |
| Harmonic distortion rate | Total/odd/even harmonic distortion rate | % | % | S class |

| Flicker | Voltage | - | - | 5% |
|---|---|---|---|---|
| **Real-time RMS** | | | | |
| U | Phase/line/average | Primary value | Primary value | 0.1% |
| I | Phase/zero sequence/average | Primary value | Primary value | 0.1% |
| P | Single/three phase | Primary value | Primary value | 0.2% |
| Q | Single/three phase | Primary value | Primary value | 0.5% |
| S | Single/three phase | Primary value | Primary value | 0.2% |
| PF | Single/three phase | Primary value | Primary value | 0.2% |
| Active energy | Single phase/import/export/total | Primary value | Primary value | 0.2S class |
| Reactive energy | Single phase/import/export/total | Primary value | Primary value | 2 class |
| Extreme value | Phase voltage/phase current/total active power/total reactive power | Primary value | Primary value | — |
| Demand | Three phase current/total active power/total reactive power/total apparent power | Primary value | Primary value | — |
| Multi-tariff | Import and export | Primary value | Primary value | — |

| Frequency | Frequency | Primary value | Primary value | 0.01Hz |
|---|---|---|---|---|
| **Communication** | | | | |
| 2 RS485 ports, 1 10/100M Ethernet port | | | | |
| **Relay output** | | | | |
| 4 normal open relays | | | | |
| **Digital input** | | | | |
| 8 active digital inputs or 8 passive digital inputs | | | | |
| **Pulse output** | | | | |
| 2 settable pulse outputs for active energy and reactive energy( secondly full wave energy pulse) | | | | |
| **Clock** | | | | |
| Device local clock(0.5s/day) | | | | |

## 6.2 Performance specification

| | Parameter | Range |
|---|---|---|
| **Rated parameters** | Working power supply | AC85~265V，DC100~300V |
| | Power consumption | < 10VA |
| | Overload capacity | 2 times of voltage continuous, 4 times/1ss4times of current continue, 10 times/1s |
| | Digital input | Active: outer power supply 220Vac±35% or 220Vdc±35%<br>Passive: internal power supply 30VDC |
| | Relay output | 250Vac/5A or 30Vdc/5A |
| | **parameter** | **Performance** |
| **Insulation** | Power frequency withstand voltage | AC2kV/Min~1mA |
| | Insulation resistance | ≥100MΩ |

| | Impulse voltage | 6kV(peak value), 1.2/50μs | |
|---|---|---|---|
| | **Item** | **Standard** | **Test level** |
| **IEC** | Electrostatic discharge immunity | GB/T17626.2-2006 (IEC61000-4-2:2001) | Class 4 |
| | Radio frequency electromagnetic field radiation immunity | GB/T17626.3-2006 (IEC61000-4-3:2002) | Class 3 |
| | Electrical fast transient burst immunity | GB/T17626.4-2008 (IEC61000-4-4:2004) | Class 4 |
| | Surge immunity | GB/T17626.5-2008 (IEC61000-4-5:2005) | Class 4 |
| | Conducted disturbance immunity of RF field induction | GB/T17626.6-2008 (IEC61000-4-6:2006) | Class 3 |
| | Power frequency magnetic field immunity | GB/T17626.8-2006 (IEC61000-4-8:2001) | Class 4 |
| | Voltage dip, short-term interruption immunity | GB/T17626.11-2008 (IEC61000-4-11:2004) | Comply |
| | Electromagnetic disturbance limit | GB 4824-2013 (CISPR11: 2010) | Comply |

# Chapter 7. Maintenance and troubleshooting

| Issue | Cause | Solution |
|---|---|---|
| No display after powering on | Device power on failed | Check if terminal L/+ and N/- are connected with a right rated power supply. Check if the fuse has been burned down |
| Incorrect measurements | Incorrect voltage measurement | Check if the neutral line connection is well Check if the measured voltage is matched to the rated parameter Check if the PT setting is right |
| | Incorrect current measurement | Check if the measured current is matched to the rated parameter Check if the CT setting is right |
| | Incorrect power measurement | Check if the measurement mode setting is right Check if the phase sequence correspondence between voltage and current is right Check if the current homonymous ends are wrong |
| DI state no change | DI action voltage is not correct | Check if the external contact type is compatible with the rated input parameter Check if the external wiring is well |
| Relay no action | No control command is received | Check if the communication circuit connection is well |
| | Relay working mode is not correct | Check if the current relay is under a right working mode |
| Master device cannot | Device ID is not correct | Check if the device ID is same as defined |

| communicate with the meter | Device baud rate is not correct | Check if the device baud rate is same as defined |
|---|---|---|
| | Resistance did not connect to communication end | Check if the 120Ω resistance has been connected to the communication circuit |
| | Interference with the communication circuit | Check if the communication shielded twisted pair connection is well |
| | Communication circuit interrupted | Check if the communication circuit is disconnect |

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