PMAC780H Power Quality Analyzer

Installation & Operation Manual

V1.5

ZHUHAI PILOT TECHNOLOGY CO., LTD.

Danger and warning!

This device can be installed only by professionals.
The manufacturer shall not be held responsible for any accident caused by the failure to comply with the instructions in this manual.

Note

- After removing the package of this instrument, please read this manual carefully, and be sure to install and set it according to the operation method of the manual.
- The device cannot be installed or changed wiring with power. When performing any wiring, the working power must be cut off first.
- All mechanical parts, doors and covers should be returned to their original position before powering up the unit.
- The device should be supplied with the correct rated voltage and should not exceed the rated working voltage.
- This manual is not intended to cover all the details or changes of the device, nor to provide all the conditions related to installation, operation and maintenance. If you encounter special problems, please contact us in time.

Failure to take these preventive measures could cause damage to equipment or injuries to people.

CONTENT

1. General Information

PMAC780H intelligent power meter (hereinafter referred to as PMAC780H) is a new generation of intelligent power meter independently developed by Zhuhai Pilot Technology Co., Ltd. The instrument has high-precision measurement and metering functions, timed recording and time-sharing charging functions; rich power quality monitoring functions, following the latest national standards for seven national standards for power quality and general requirements for power quality monitoring equipment, and integrates harmonic analysis, unbalance measurement, flicker monitoring, voltage sag/swell and short-term interrupt recording, rapid voltage change capture, waveform transient capture, event recording and other functions to meet power quality monitoring class A standard; Accurate fault diagnosis and positioning function, accurately record a large number of waveform information and event information for local anomaly or local faults in the power supply system, and sensitively identify and accurately determine potential, transient, or persistent local faults, ensure the safe and reliable operation of the user's power supply system.

The basic functions of PMAC780H are shown in the sheet below:

Basic functions		**Description**
Measuring channel	Number of voltage channels	4
	Number of current channels	4
Basic measurement	Voltage,current	■
	Power(P/Q/S)	■
	Power Factor	■
	Frequency	■
Energy metering	Full wave power	■
	Fundamental power	■
	Harmonic energy	2^{sec} ~31^{th}
	Rate power	■
Demand	Real-time demand	Sliding demand / fixed window demand

function	Forecast demand	Sliding demand / fixed window demand
	Maximum demand	Historical maximum demand
Multi-tariff function		■
Power quality analysis	Waveform sampling rate	1024 points / cycle
	Harmonic	63th
	Interharmonics	63th
	Voltage deviation	■
	Frequency deviation	■
	Unbalance	■
	Order component	■
	Flicker analysis	■
	Voltage sag/swell and Interrupt Monitoring	■
	Transient capture	20μs
	Rapid voltage change	■
Voltage event flag function	Voltage data mark during transient events	■
Voltage statistics evaluation	Measurement and evaluation of supply voltage quality	■
Over-limit monitoring and control	Normal setting exceeds limit (seconds)	24
Data and event logging	Maximum value record	■
	SOE event (1ms)	1024
	PQ event record (1ms)	1024
	PQ event count	■
	PQDIF statistical record	Recording space 1G
	Waveform record	Independently set two groups: 256, each group of 128 Recording mode 1: 1024 points / cycle @50 cycles; 2: 512 points / cycle

		@100 cycles; 3: 256 points / week @200 cycles; 4: 128 points / week @400 cycles; 5: 64 points / cycles @ 800 cycles; 6:32 points/cycle @1600 cycles; 7:16 points/cycle @3200 cycles, the number of cycles before failure can be set Adopt Comtrade file format
Display	Liquid crystal display	Color screen
	Resolution (pixels)	640*480
	Real-time waveform	Device interface displays real-time waveforms
I/O	Digital input (DI)	8,Optional external active（Externally supplied 110/220Vdc power supply）or External passive（30Vdc power supply inside）
	Relay output (RO)	4
	Digital output(DO)	2
communication	RS485communication port	2,ModbusRTU protocol
	Ethernet port (10/100M adaptive)	1,ModbusTCP；IEC-61850 protocol（Optional function）
	SNTP timing	■
GPS timing	IRIG-B code timing	■
	PPS second pulse timing	■
Manual recording	Communication manual recording	■

Remarks：■Inherent function □Optional function

2.Order information

The complete PMAC780H model specifications and the meaning of each code are shown in the following sheet:

Model specification：PMAC780H-①-②-③	
① Voltage and current rating (required)	
V1	3*220/380V rated measurement voltage, 5A rated measurement current
V2	3*220/380V rated measuring voltage, 1A rated measuring current
V3	3*57.7/100V rated measurement voltage, 5A rated measurement current
V4	3*57.7/100V rated measurement voltage, 1A rated measurement current
② Switch type (required)	
SW	External active switching
SD	External passive switching
③ Function selection (optional)	
CP	IEC61850 agreement

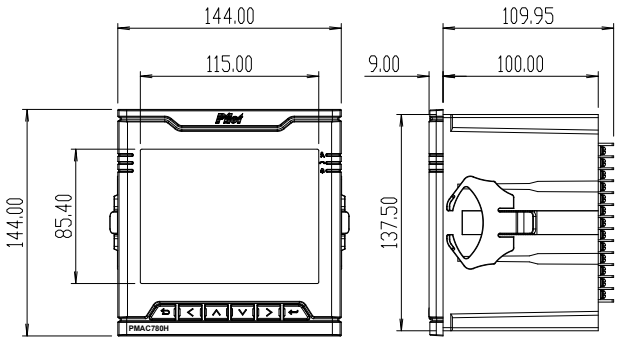
Remarks:The device is equipped with an Ethernet interface.,if the CP function is selected, the IEC61850 protocol is supported. Otherwise, it is not supported.

3. Installation and Wiring

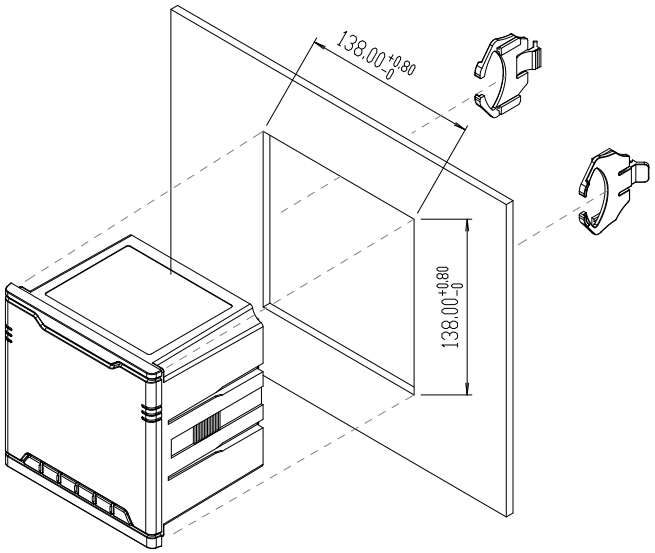
3.1 Use environment

Hole Size（mm）	138.00×138.00 （ + 0.80）	Operating temperature	-20℃~+55℃
Dimensions（mm）	144.00×144.00×118.95（LXWXH）	Storage temperature	-40℃~+85℃
IP rating	Operation panel：IP52，Side and back：IP30	Relative humidity	5%~95%,No condensation
Measurement mode	wye, delta		

3.2 Dimensions and installation diagram

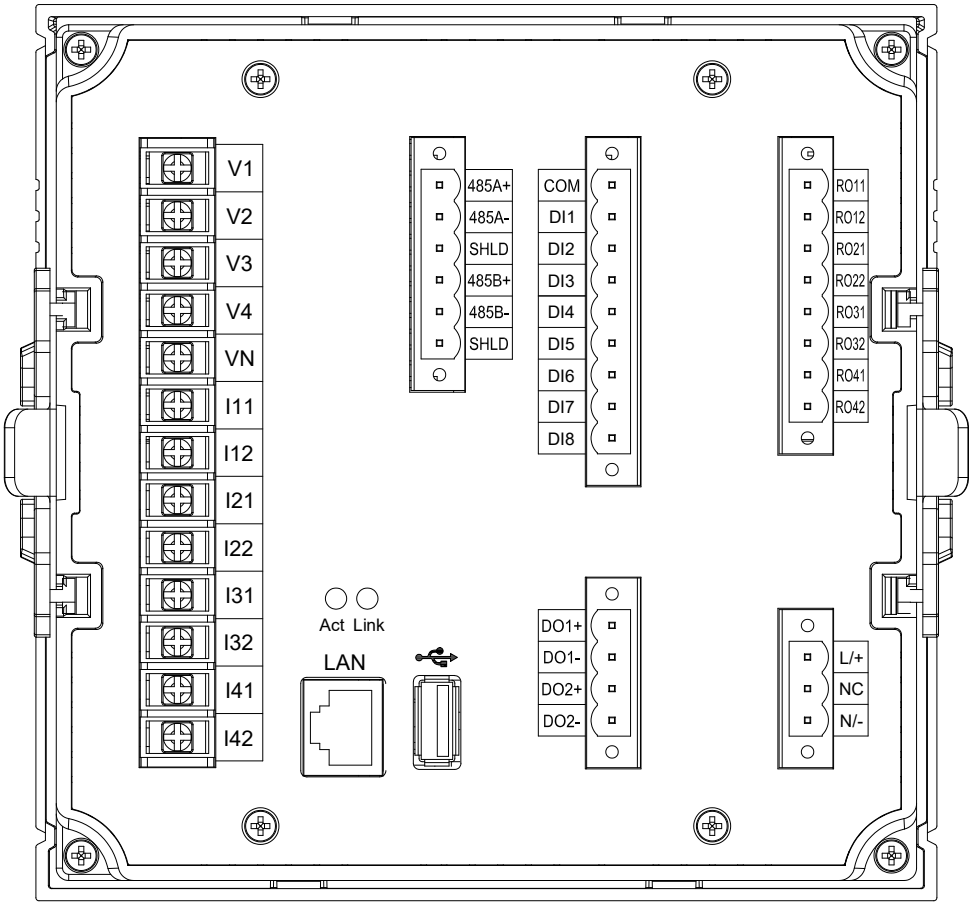


Product outline size diagram



Product installation diagram

3.3 Backplane terminal diagram



Main body terminal definition:

Numbering	Code	Definition
1	N/-	AC power 220V neutral or DC 220V negative
2	NC	Empty terminal
3	L/+	AC power 220V fire wire or DC 220V positive
4	V1	Phase A voltage
5	V2	Phase B voltage
6	V3	Phase C voltage
7	V4	Voltage neutral
8	VN	Neutral line
9	I 11	Phase A current incoming line
10	I 12	Phase A current outlet
11	I 21	Phase B current incoming line

12	I 22	Phase B current outlet
13	I 31	Phase C current incoming line
14	I 32	Phase C current outlet
15	I 41	Neutral current input line
16	I 42	Neutral current output
17	SHLD	RS485 shielding
18	485A+	RS485A communication port positive
19	485A-	RS485A communication port negative
20	SHLD	RS485 shielding
21	485B+	RS485B communication port positive
22	485B-	RS485B communication port negative
23	LAN	Network port
24	DI1	Switch input 1, positive
25	DI2	Switch input 2, positive
26	DI3	Switch input 3, positive
27	DI4	Switch input 4, positive
28	DI5	Switch input 5, positive
29	DI6	Switch input 6, positive
30	DI7	Switch input 7, positive
31	DI8	Switch input 8, positive
32	COM	Switch input public ground
33	RO11	Relay 1 output 1
34	RO12	Relay 1 output 2
35	RO21	Relay 2 output 1
36	RO22	Relay 2 output 2
37	RO31	Relay 3 output 1
38	RO32	Relay 3 output 2
39	RO41	Relay 4 output 1
40	RO42	Relay 4 output 2
41	DO1+	Switch output 1,positive
42	DO1-	Switch output 1 ,negative
43	DO2+	Switch output 2 ,positive
44	DO2-	Switch output 2 ,negative

3.4 Wiring

3.4.1 Working power wiring

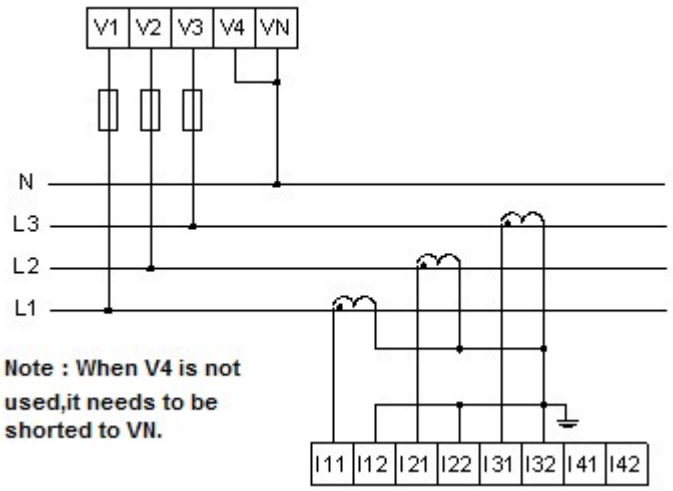
When used for the AC system, the phase line is connected to the L/+ terminal, and the neutral line is connected to the N/- terminal. When used for the DC power supply, the positive pole is connected to the L/+ terminal and the negative terminal is connected to the N/- terminal.

3.4.2 Voltage and current wiring

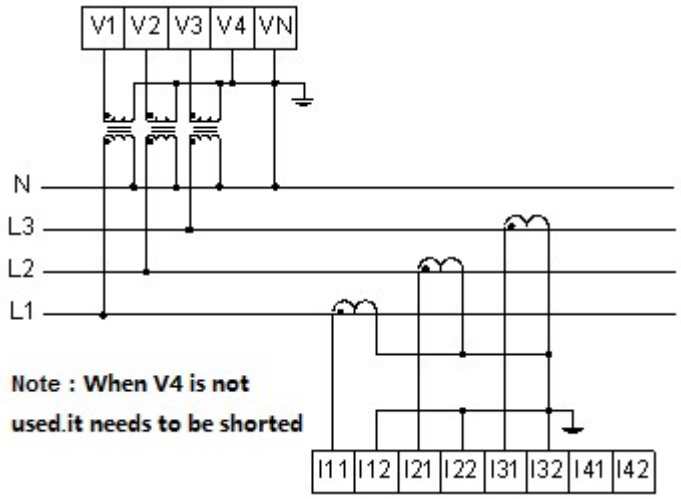
The PMAC780H offers both wye and delta measurement wiring patterns.

（1）Wye wiring mode

When the measuring line is a wye system, the measuring mode of the device should be set to “wye”, and the wiring is shown as below:



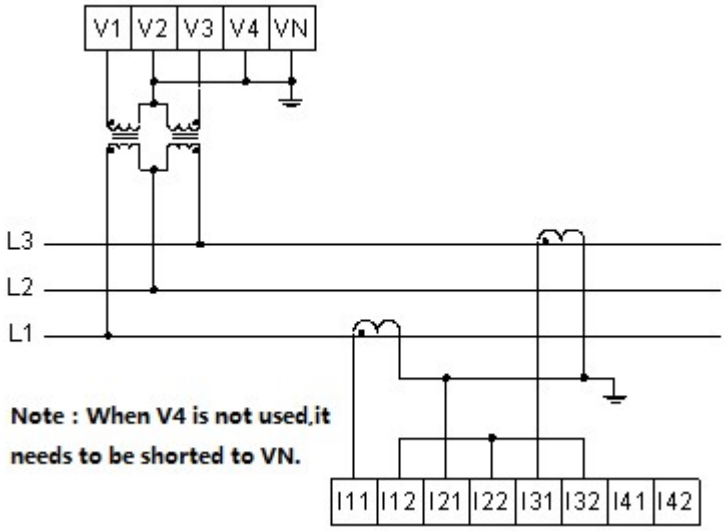
Low-voltage wye system（No PT、3CT）



High-voltage wye system（3PT、3CT）

（2）Delta wiring mode

This wiring method requires only 2 PT. The device is worth the value of the B-phase voltage according to the measurement of Phase A and Phase C. The measurement mode of the device should be set to “delta”. The wiring is as shown below:



High-voltage delta system（2PT、2CT）

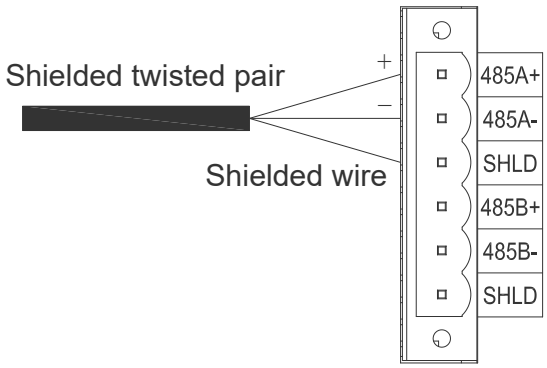
3.4.3 Communication line connection

（1）RS-485 communication port

Corresponding interface RS485A (communication serial port), RS485B port (communication serial port), terminals marked as 485A+ (or 485B+), 485A- (or 485B-), SHLD. It is isolated by 485 dedicated isolation chip and

has a protection circuit to prevent common mode, differential mode voltage interference, lightning strikes and miswires from damaging the communication port.

If the shielded twisted pair is long, it is recommended to connect a resistor of approximately 120 Ω at the end to improve communication reliability,the communication wiring is as follows:



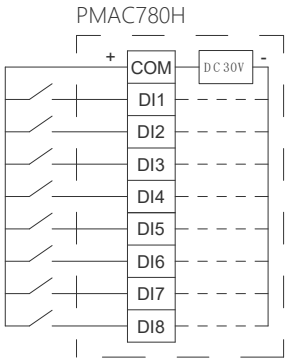
（2）Ethernet communication uses RJ-45 connector, corresponding to LAN (10/100M) socket

3.4.4 Switching input wiring

The PMAC780H provides 8-channel node input,the terminals are labeled DI1~DI8. It is suitable for monitoring status information such as circuit breaker position signal and knife gate position signal. It can be used for pulse counting or PPS second pulse pair. The device provides external passive nodes and external active nodes these two specifications. Users need to order according to actual conditions.

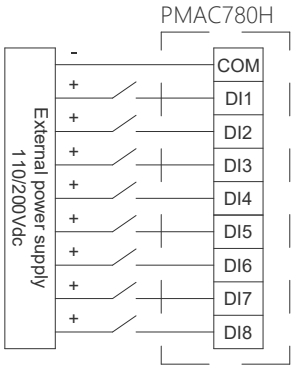
- External passive node

When the external status signal only provides a position information, the feedback signal when the internal output node of the device is closed is required, and the wiring mode of the following figure is usually adopted:



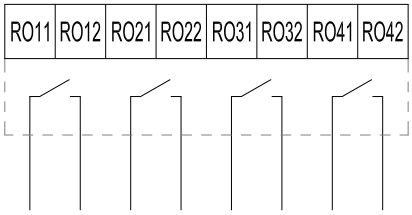
- External active node

When the external status signal not only provides position information, but also provides a feedback voltage signal, the external active node input mode should be selected at this time,the wiring diagram is as shown below:



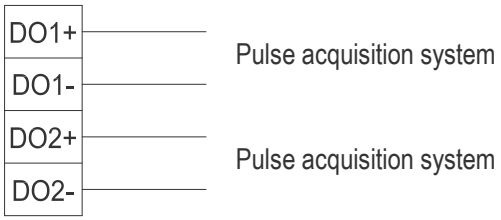
3.4.5 Relay output wiring

PMAC780H provides 4 relay outputs, terminal block marked as RO1 ~ RO4, are normally open contact output, can directly cut off the load of 250VAC/5A or 30VDC/5A, if applied to 220V DC, the breaking capacity is 0.2A. When the load current is large, it is recommended to add an intermediate relay.



3.4.6 DO wiring

The two DOs of the PMAC780H can be configured as pulse output functions, and the terminal blocks are labeled DO1 to DO2.

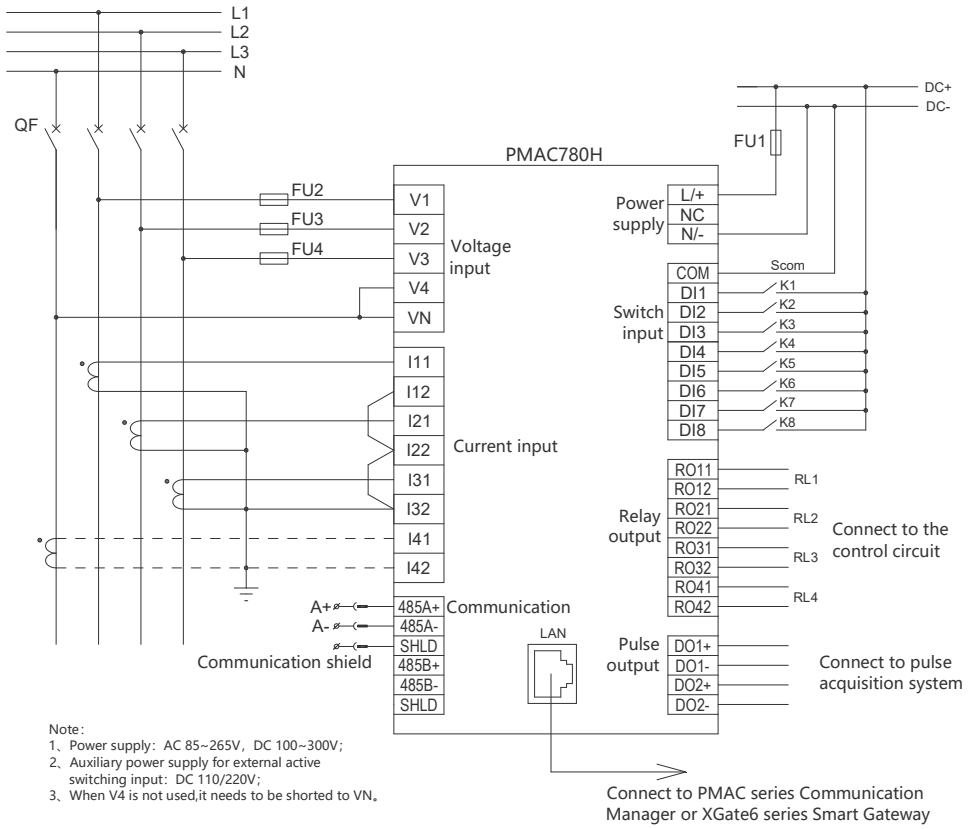


3.4.7 USB port

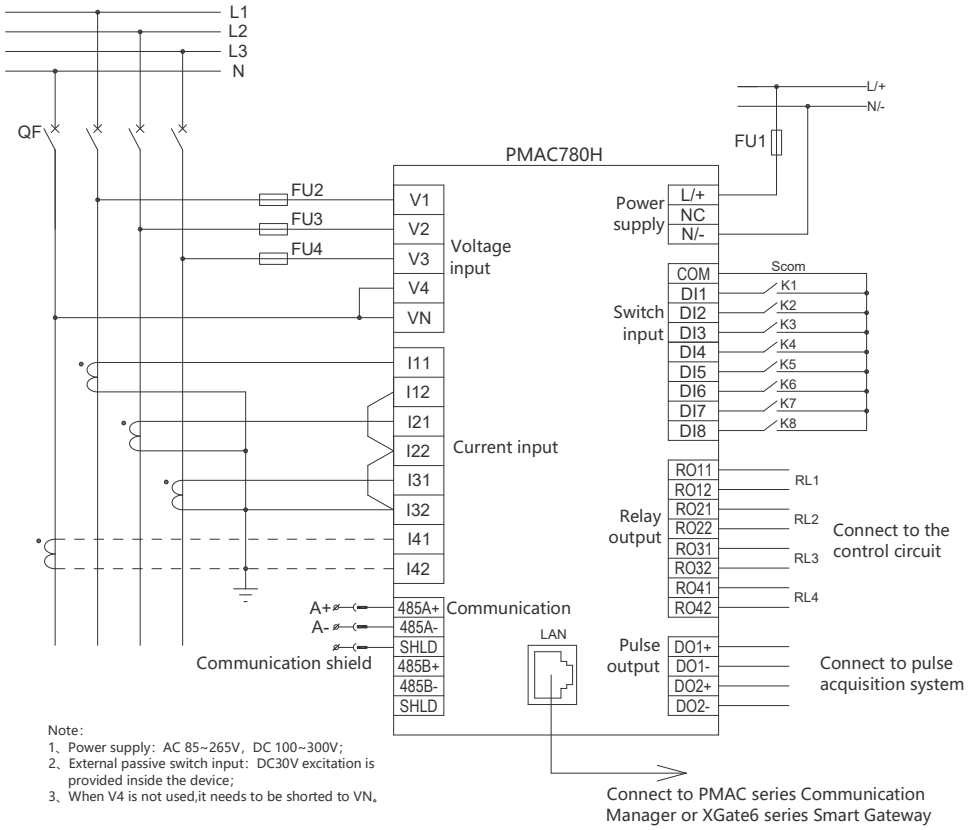
PMAC780H provides one USB 1.1 port, the maximum transmission speed is 12Mb/s; the external power supply voltage is 5V, and the current is 0.5A,currently used to install USB upgrades.

3.5 Typical wiring diagram

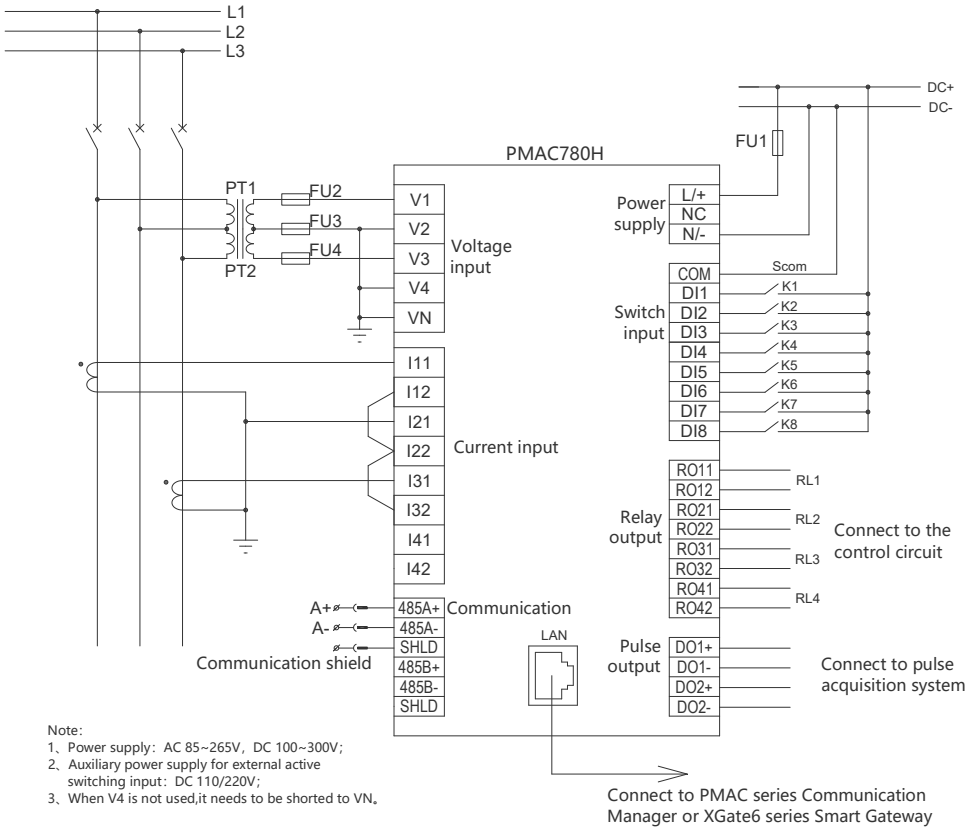
- PMAC780H-V1-SW low-voltage 3-phase four-wire wiring diagram



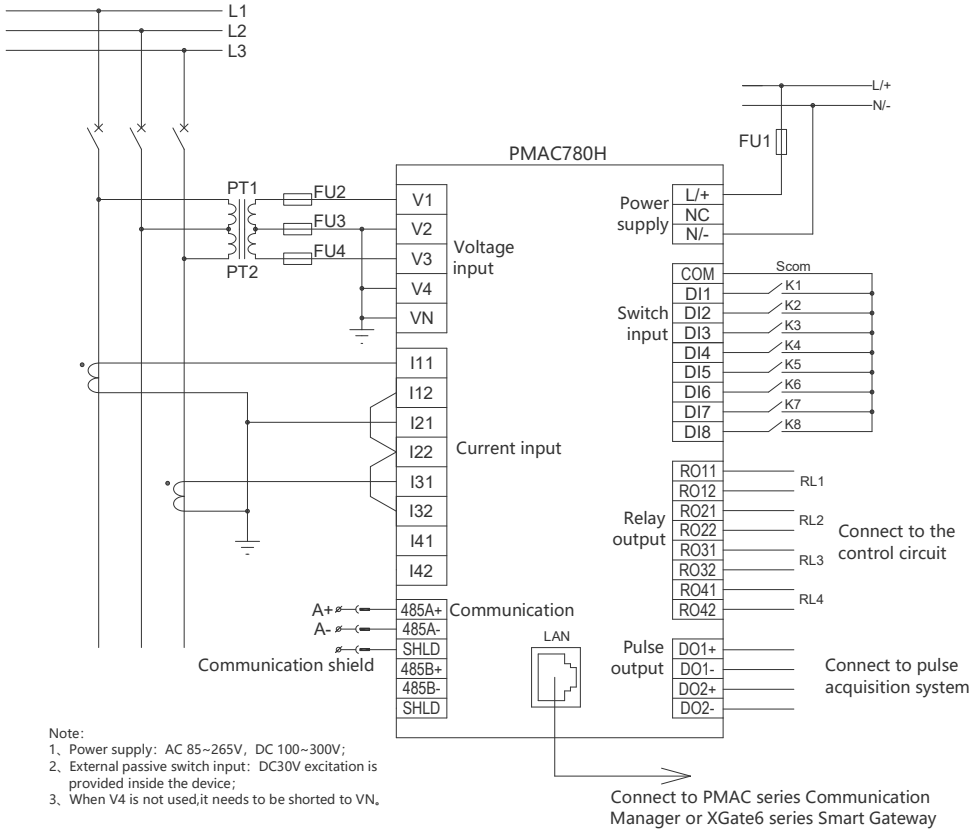
- PMAC780H-V1-SD low-voltage three-phase four-wire wiring diagram



- PMAC780H-V3-SW high voltage three-phase three-wire typical wiring diagram



- PMAC780H-V3-SD high-voltage three-phase three-wire typical wiring diagram



4. Function Introduction

4.1 Measurement function

4.1.1 Measurement parameter

The real-time data measurement function of PMAC780H includes basic measurement functions. The data of the basic measurement function can be read by display or communication. The basic measurement data includes the following data:

Sheet 4-1 Basic measurement data

Type	Description	A	B	C	Total	Average	Zero sequence	Update Cycle
Voltage	Phase	√	√	√		√	√	50cyc@50

	voltage							Hz
	Line voltage	√	√	√		√		60cyc@60 Hz
Current	Current	√	√	√		√	√	
Power	P	√	√	√	√			
	Q	√	√	√	√			
	S	√	√	√	√			
Power Factor	Power Factor	√	√	√	√			
Frequency	Frequency	√						10s

4.1.2 Frequency measurement

The frequency measurement accuracy of the device is ±0.01Hz, when the rated frequency is 50Hz the accuracy range is 42Hz ~ 58Hz, and when the rated frequency is 60Hz the accuracy range is 50Hz ~70Hz. It can realize online monitoring of power system frequency, and can set over-limit alarms and records. When measuring, if the wiring mode is three-phase four-wire, use the A-phase voltage as a reference; if the wiring mode is three-phase three-wire, use the AB line voltage as a reference.

4.1.3 Power factor definition method

Symbol of power factor, using the definition of IEC power factor symbol As shown in Figure 4-1:

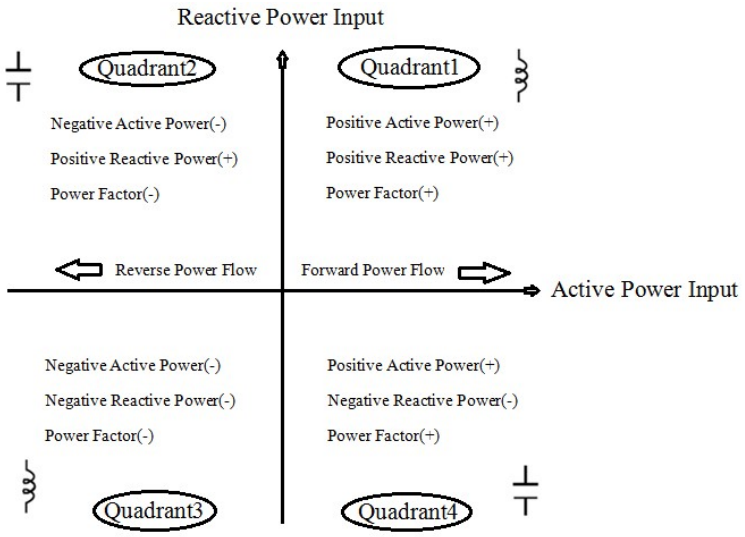


Figure 4-1 Power factor definition method

4.1.4 Total apparent power calculation method

The total apparent power calculation method is divided into: scalar method and vector method.The device uses the scalar calculation method formula as follow:

Scalar method:

$$kVA_{total} = kVA_a + kVA_b + kVA_c$$

4.2 Power quality monitoring function

4.2.1 Voltage deviation

When the power supply system is running, the difference between the actual voltage at that point and the nominal voltage of the system to the nominal voltage of the system is called the voltage deviation at that point, and the voltage deviation is divided into the voltage up-deviation and the voltage low-deviation.

（1）Voltage up-deviation

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

Among them, $U_{rms-over,i}$ Is the ith 10th cycle RMS value.

When $U_{\text{rms-200ms,i}} < U_{din}$,then $U_{\text{rms}-over,i} = U_{din}$

When $U_{\text{rms}-200ms,i} \geq U_{din}$,then $U_{\text{rms}-over,i} = U_{rms-200ms,i}$

（2）Voltage low-deviation

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

Among them,错误!未找到引用源。 $U_{rms-under,i}$ Is the ith 10th cycle RMS value.

When $U_{\text{rms}-200ms,i} > U_{din}$,then $U_{\text{rms}-under,i} = U_{din}$

When $U_{\text{rms}-200ms,i} \leq U_{din}$,then $U_{\text{rms}-under,i} = U_{rms-200ms,i}$

PMAC780H calculates the voltage deviation according to the requirements of GB/T12325-2008. The device's voltage measurement accuracy is 0.1%, which enables continuous monitoring of power system voltage deviation and alarm recording.

4.2.2 Frequency deviation

Under normal operating conditions, the difference between the actual value of the system frequency and the nominal value is called the frequency deviation of the system,the expression is:

Frequency deviation = actual frequency - nominal frequency

The frequency measurement accuracy of PMAC780H device is ±0.01Hz, which enables continuous monitoring of the power system frequency and the setting of over-limit alarms and recording.

4.2.3 Harmonic and interharmonic monitoring

4.2.3.1Harmonic and interharmonic

The PMAC780H device is fully compliant with the IEC61000-4-7 standard. It performs a spectrum analysis with 10 cycles as the time window at a nominal frequency of 50 Hz while sampling at 1024 points per cycle. At a rated frequency of 60 Hz, a spectrum analysis is performed with 12 cycles as a time window with a frequency resolution of 5 Hz, which provides the harmonic analysis data of sheet 4-2.

Sheet 4-2 Harmonic analysis data

	UA	**UB**	**UC**	**U4**	**IA**	**IB**	**IC**	**I4**
2~63th harmonic amplitude	√	√	√	√	√	√	√	√
2~63th harmonic content rate	√	√	√	√	√	√	√	√
Total harmonic distortion rate	√	√	√	√	√	√	√	√
Odd harmonic total distortion rate	√	√	√	√	√	√	√	√
Even harmonic total distortion rate	√	√	√	√	√	√	√	√
1~63th interharmonic amplitude	√	√	√	√	√	√	√	√
1~63th interharmonic content rate	√	√	√	√	√	√	√	√
Total interharmonic distortion rate	√	√	√	√	√	√	√	√
Current K factor	--	--	--	--	√	√	√	√
2-63th harmonic	√	√	√	--	√	√	√	--

active power								
2-63th harmonic reactive power	√	√	√	--	√	√	√	--
2-63th harmonic apparent power	√	√	√	--	√	√	√	--

4.2.3.2 Fundamental monitoring

PMAC780H provides users with complete fundamental data to meet the user's analysis of system operation.

Sheet 4-3 Fundamental data

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

4.2.3.3 K Factor

In the technical indicators of power quality, the K factor mainly reflects the influence of the frequency of the harmonic caused by the nonlinear load on the transformer loss. The K factor is defined primarily by the assumption that the transformer eddy current losses caused by harmonic currents are proportional to the square of the harmonic order. The calculation formula is:

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

Among them, h is harmonic number, I_h is the k-th harmonic current

RMS value. h_{max} is the highest number of harmonic currents to consider. The K factor measurement data provided by the device is shown in sheet 4-2.

4.2.4 Unbalance and order component measurement

In an ideal three-phase power supply system, the ABC three-phase voltage and current amplitude are equal, and the phase difference is 120°, which is in equilibrium. When the actual system deviates from the above situation, there arises an imbalance problem and a corresponding problem of reduced power utilization efficiency.

The PMAC780H device measures the positive and negative sequence and zero sequence amplitude and phase of voltage and current, and calculates and analyzes voltage and current imbalances, including negative sequence imbalance and zero sequence imbalance:

（1）Negative sequence imbalance of voltage and current

u_2 =（Voltage negative sequence/Voltage positive sequence）×100%

i_2 =（Current negative sequence/Current positive sequence）×100%

（2）Zero sequence imbalance of voltage and current

u_0 =（Voltage zero sequence/Voltage positive sequence）×100%

i_0 =（Current zero sequence/Current positive sequence）×100%

4.2.5 Voltage flicker

Flicker refers to people's feelings about the light and dark changes of incandescent lamps, which is people’s subjective feelings about fluctuations.

The main determinants of flicker are as follows:

- the amplitude, frequency and waveform of the supply voltage fluctuations;

Flicker measurement range : 1~20

The calculation of flicker for PMAC780H is carried out in accordance

with the recommended model of IEC61000-4-15, meeting relevant standards.

4.2.6 Voltage Sag/Swell/Stop

Power system load adjustment, normal operation (such as compensation capacitor switching) and long-distance short-circuit faults may cause voltage sag/swell, short-term voltage interruption, which is the main reason for industrial users' equipment not working properly.

A）Record the moment when each voltage transient change occurs and the voltage residual value of each phase.

B） Two outputs can be triggered each time the transient changes, the output includes the RO/DO exit, waveform record

The PMAC780H device can meet the national standard GB/T18481-2001 and IEC61000-4-30 standards.

4.2.7 Transient capture function

The PMAC780H device has a strong transient capture capability that captures voltage transients less than 0.5 cycles:

A） It can capture sub-cycle transients up to 20μs;

B） Record the moment when each voltage transient occurs;

C） Each time a transient is captured, two outputs can be triggered, including the RO/DO exit, waveform record

4.2.8 Rapid voltage change

The PMAC780H device provides rapid voltage change capture function. The rapid voltage change reflects the change in voltage RMS between the two steady states and the voltage amplitude. The rapid voltage change is captured based on the stable voltage tolerance, settling time, minimum step size detected, and minimum rate of change (%/s). Figure 4-2 explains this. When the voltage changes beyond the threshold of the sag/swell, it is considered to be sag/swell, rather than rapid voltage change. According to

the definition of rapid voltage variation in Norwegian FoL, it is detected by voltage step (Vstep), maximum voltage change (Vmax), and voltage change rate. When the voltage step (Vstep) and the voltage change rate are both greater than the limit value, and the voltage change does not exceed the transient threshold, it is considered that a rapid voltage change occurs. The rapid voltage change event is stored in the PQ event, recording the voltage step change and the duration of the change and the maximum voltage change relative to the nominal voltage.

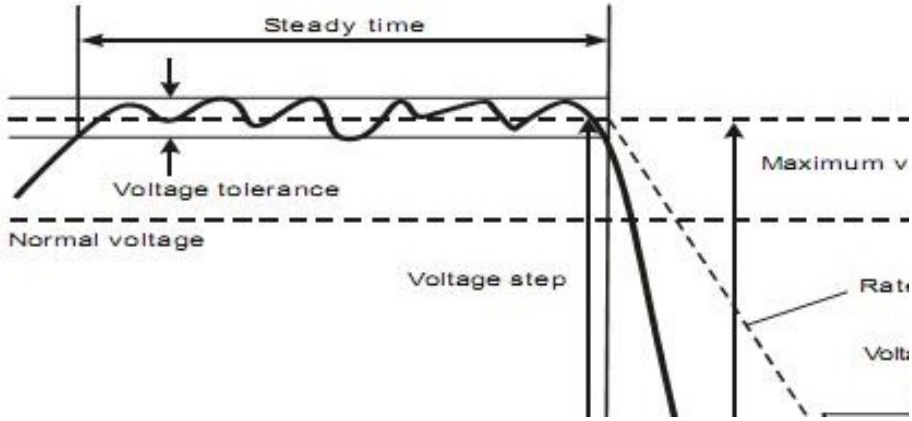


Figure 4-2rapid voltage change

4.2.8.1 Voltage tolerance

Determine if the voltage reaches the steady state limit for a period of time. For example, if the rated voltage is 100V , delta wiring, and the voltage tolerance is 0.5%, the allowable fluctuation range of the line voltage in a voltage steady state is:

$$\delta U_{\max} = \delta \times U_{rate} = 100 \times 0.005 = 0.5$$

Among them, $\delta U_{\max}$ is the maximum allowable voltage fluctuation, δ is voltage tolerance, U_{rate} is rated voltage.

4.2.8.2 Voltage steady state

The fluctuation of the voltage RMS value during the steady state time is considered to be a voltage steady state within the voltage tolerance range.

That is, it is satisfied in the steady state time:

$$\frac{ABS(U_{\max}-U_{\min})}{U_{rate}}<\delta$$

Among them, $U_{\max},U_{\min}$ is the maximum and minimum RMS voltage values during Steady time, U_{rate} is rated voltage, δ is voltage tolerance. For example, the steady-state time is 5s, the rated voltage is 100V, wye connection, the voltage tolerance is 0.5%, and the maximum and minimum voltages in the steady-state time are 57.25V and 57V, respectively. Since it is a wye connection, the rated voltage should be converted to $\frac{100}{\sqrt{3}}$,that is 57.735V. According to the steady state judgment formula:

$$\frac{ABS(57.25-57)}{57.735}<0.005$$

It indicates that the voltage reaches a steady state during this time.

4.2.8.3 Voltage step

It is the difference between the previous steady-state voltage value and the current steady-state voltage value in the rapid voltage change. For example, in a wye connection, the rated voltage is 100V, the previous steady-state voltage is 57V, and the current steady-state voltage is 65V, the voltage step is:

$$\Delta U_{step}=\frac{ABS(U_{steady}-U_{laststeady})}{U_{rate}}*100\%=\frac{ABS(57-65)}{57.735}*100\%=13.856\%$$

4.2.8.4 Voltage change rate

It is the rate at which the voltage changes from the previous steady state to the current steady state in a rapid voltage change. Voltage change rate is usually expressed as the ratio of the voltage step to the rapid voltage change transition time. For example, when the voltage step is 10% and the transition time is 1 s, the voltage change rate is:

$$\frac{dU}{dt}=\frac{\Delta U_{step}}{t_{transision}}=\frac{10\%}{1s}=10\%/s$$

Among them, $\frac{dU}{dt}$ is voltage change rate, ΔU_{step} is voltage step, $t_{transision}$ is rapid voltage change transition time .

4.2.8.5 Maximum voltage change

In the process of rapid voltage change, the maximum change of the voltage relative to the two steady-state voltages before and after the rated voltage is called the maximum voltage change.In the process of rapid voltage change, the maximum change of voltage relative to the two steady-state voltage before and after the proportion of the rated voltage is called the maximum voltage change.For example, under the wye connection, the rated voltage is 100V, the last steady-state voltage is 57V, the current steady-state voltage is 65V, the voltage at the maximum voltage change point is 69V during the change, and the voltage at the minimum voltage change point is 52V,the maximum voltage change is:

$$\Delta U_{\max} = \frac{ABS(MAX(MAX(((U_{\max change} - U_{laststeady}),(U_{\min change} - U_{laststeady})),MAX(((U_{\max change} - U_{steady}),(U_{\min change} - U_{steady}))))}{U_{rate}} * 100\%$$

$$= \frac{ABS(52-65)}{57.4} * 100\% = 22.648\%$$

Among them, $\Delta U_{\max}$ is Maximum voltage change, $U_{\max change}$ is Maximum change point voltage value, U_{rate} is rated voltage.

4.2.8.6 Rapid voltage change capture condition

- The voltage value does not exceed the transient threshold during the rapid voltage change. Otherwise, the voltage sag/swell event is considered to have occurred.
- Voltage change rate is greater than the value of the voltage change rate .
- Voltage step is greater than the value of the voltage step/Maximum voltage change is greater than the value of voltage step（Based on

different detection modes）.

- The rapid voltage change can trigger two outputs at the same time. The output includes: RO/DO outlet and waveform record.

4.2.9 Voltage event flag

PMAC780H provides a voltage event flagging function. When a voltage sag/swell, or an interrupt event occurs, the device flags the frequency, flicker, voltage amplitude, imbalance, and harmonic measurement results of the voltage event.

The role of the mark is to avoid the influence of transient events and accurately evaluate the flicker value when voltage fluctuation and flicker pass rate are evaluated. When the voltage pass rate is evaluated, the calculation of the voltage interruption event is effectively avoided, and the voltage amplitude of the supply voltage is accurately evaluated. When evaluating the harmonic pass rate, it effectively avoids instrument analysis and calculation errors and unreasonable measurement results, and accurately evaluates harmonic levels.

4.2.10 Voltage statistics evaluation

The PMAC780H provides voltage evaluation function. It mainly refers to the measurement and evaluation of the quality of the power supply voltage,the specific evaluation items are voltage amplitude, frequency, harmonics, voltage negative sequence imbalance, flicker, and give the evaluation conclusions of whether the parameters are qualified; and statistical transients , rapid voltage changes and the number of transient occurrences.

This evaluation function complies with the general requirements of the national standard GBT 19862-2016 power quality monitoring equipment.

4.3 Energy metering function

4.3.1 Energy metering data

The PMAC780H provides a wealth of energy metering data to allow users to analyze the system's energy consumption. The power data provided by the device is as follows.

Sheet 4-4 Energy metering data

	Positive	**Reverse**	**Net value**	**Total**
Full wave active	√	√	√	√
Full wave reactive	√	√	√	√
Full wave apparent				√
Fundamental wave active	√	√		
Fundamental wave reactive	√	√		
Total harmonics	√	√		
2~31 harmonics active	√			
2~31th harmonics reactive	√			

4.3.2 Power flip and energy value clear

The maximum energy value that PMAC780H can record is 999999999.999. When the electric energy is greater than the maximum recordable electric energy, the electric energy is turned over and the electric energy is accumulated again. The power can be cleared by communication.

4.3.3 Power pulse output

PMAC780H supports active energy pulse output and reactive energy pulse output.

4.4 Demand

Power systems often charge fees based on the user's power consumption (in the form of active energy) and the peak power level (in the form of active power). Demand is the average over a certain time interval (usually 15 minutes).

4.4.1 Demand data

In addition to providing common active demand, the device also provides total reactive power, total apparent, real-time demand and predicted demand of 3-phase current.

Real-time demand calculation mode: Fixed demand and Slip demand.

4.4.2 Demand algorithm

The demand uses the slip period/fixed period demand algorithm to add the calculated values per second, and at the end of the demand calculation period, the average value is obtained, and the calculation result is output. Current and power are calculated using this method. The demand calculation is calculated in whole seconds. The demand period can be set to 5, 10, 15, 30, 60; the unit is minutes.

【Fixed demand】

After the demand cycle time is reached, the average value of the

cycle is obtained according to a fixed demand cycle time, and the demand value is output.

【Slip demand】

The slip sub-period can be set to 1, 2, 3, 5, and the above units are minutes. After the demand calculation reaches the demand cycle time, the sub-cycle is slid, the average value in the demand cycle is calculated, and the demand value is output.【Forecast demand】

The normal demand is that the demand is output at the end of the demand calculation sub-period, and for the predicted demand, the demand at the end of the sub-period is calculated based on the current value predicted demand. For 780H, the forecast demand is updated every second because the demand calculation is performed once per second.

Note: The demand source refers to the amount of demand calculation. If it is the predicted demand for calculating the active power, the demand source is the current active power calculation value.

The predicted reaction value is the speed of the average heat update. If the value is larger, the average heat update is faster, and the update of the predicted demand is faster (0~100).

The average value of the average heat is 0, and then iterative calculations are performed every second.

Average calories: The calculation formula is shown in Equation 2 and Equation 3.

Demand sub-period remaining time：Calculate the remaining time of the sub-period. If the sub-period is 5 minutes, then at 3 minutes, the remaining time is 2 minutes.

Integral value: The integrated value of the sub-period has been accumulated. If the sub-period is 5 minutes, then at 3 minutes, if the demand is power, the integrated value should be the energy consumed in

the first 3 minutes.

Last demand value: The demand calculation value of the last calculation cycle, because it is the sliding demand,so it is the demand value calculated at the end of the previous sub-period.

The number of sub-cycles in the demand period: The number of sub-cycles owned by a demand period.

Sub-period length: Length of sub-period.

Note: The time involved here must use the same unit and should be in seconds.

4.5 Over-limit monitoring function

The setting limit system of PMAC780H device can only be adjusted by the host computer software through communication. Up to 24 sets of over-limit parameters can be set,each group of parameters includes the following contents:

（1）Trigger mode: upper limit / lower limit

（2）Monitoring object:

Sheet 4-5 Fixed value over limit monitoring parameters

Over-limit type	**Over-limit monitoring object**
Standard over-limit	Phase voltage,Line voltage,Phase current,Neutral line voltage、Neutral line voltage,Frequency, Total active power, Total reactive power, Total apparent power,Power factor, Displacement power factor,Input total active power real-time demand, Output total active power real-time demand, Input total reactive power real-time demand, Output total reactive power real-time demand, Input total active power forecast demand, Output total active power forecast demand, Input total reactive power forecast demand, Output total reactive power forecast demand, Input total apparent power real-time demand, Output total

	apparent power real-time demand, Total apparent power forecast demand, Voltage total harmonic distortion rate, Current total harmonic distortion rate, Voltage negative sequence imbalance, Voltage zero sequence imbalance, Current negative sequence imbalance, Current zero sequence imbalance,3/5/7/9/11/13th voltage harmonic content,3/5/7/9/11/13th current harmonic content,Short time flicker,Long time flicker

（3）Action upper limit/action lower limit: The action value and return value of the limit trigger.

When the upper limit is exceeded, the measured value of the monitoring object is greater than the action value and the duration exceeds the action delay, and the measured value is less than the return value and the duration exceeds the return delay, and the limit is returned;；

When the lower limit is reached, the measured value of the monitoring object is smaller than the action value and the duration exceeds the action delay, and the measured value is greater than the return value and the duration exceeds the return delay, and the limit is returned;；

（4）Action delay:Time when the delay is detected after the limit is exceeded.

For standard over-limit, the action delay time can be set from 0 to 999s.

（5）Return delay:The time that the delay returns after the limit is returned.

For standard over-limit,the return delay time can be set from 0 to 999s.

（6）Trigger type: Over-trigger action

All over-limit actions will generate SOE records, and can be set to trigger two outputs. The output actions include RO/DO exit and waveform record (the demand does not support waveform record).

The trigger mode of the limit value can be set to the upper limit and the lower limit. The following describes the judgment logic of the upper limit and the lower limit.：

Figure 5-4 depicts the case of the upper limit , taking the over limit trigger relay action as an example. When the measured parameter exceeds the upper limit of the action and the duration exceeds the action delay time, the limit trigger triggers the relay; when the measured parameter is less than the lower limit of the action and the duration exceeds the return delay time, the relay returns.

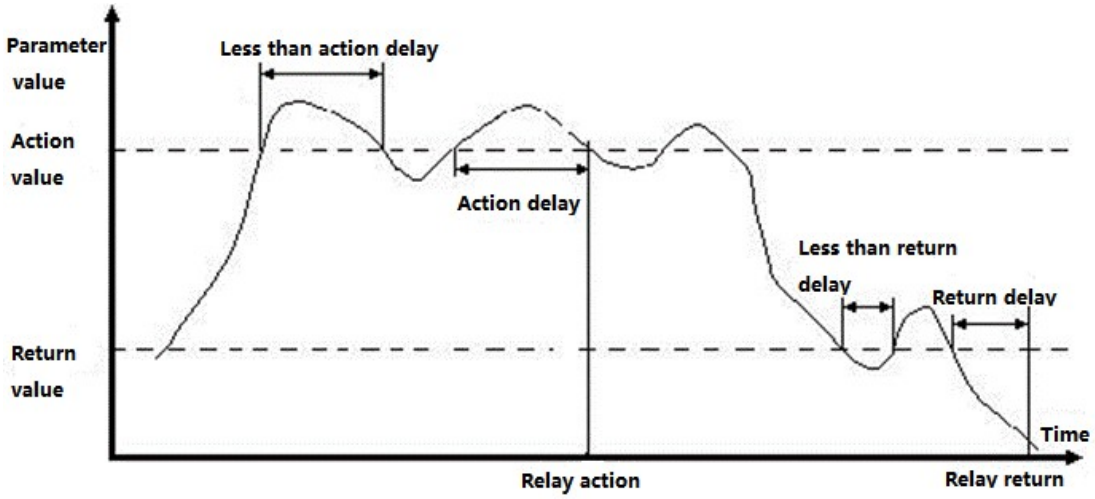


Figure 4-3 Lower limit

Figure 4-3 depicts the case of the lower limit，taking the trigger relay action as an example. When the measured parameter is lower than the lower limit of the action and the duration exceeds the action delay time, the limit trigger triggers the relay; when the measured parameter is higher than the upper limit of the action and the duration exceeds the return delay time, the relay returns.

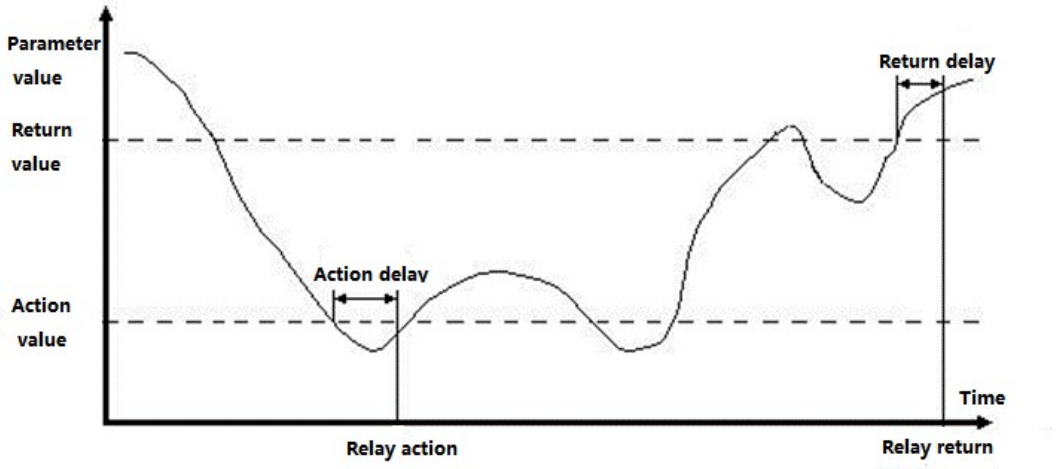


Figure 4-4 Lower limit

4.6 Multi-tariff function

The PMAC780H has two rate plans,each rate plan includes time zone setting, daily time sheet setting, and special day setting. In the power system, the electricity prices on working day, weekends, and holidays may be different, and the electricity prices during peak load periods and off-peak periods are also different. This function is an energy metering method provided to meet the needs of peak-to-valley time-of-use electricity price. It can calculate the amount of electricity accumulated by each time-sharing rate according to the preset billing time and rate to realize time-sharing measurement function.

In the TOU function, the time setting is in the year cycle, and the normal day and the special day can be set every year, and the special day can be set up to 60.Up to 12 time zones can be set in one year, and two types of workday/weekend day can be set in one week, and the corresponding daily timetable sheet numbers can be set separately; up to 8 timetable tables can be set, and each daily timetable sheet is 15 minutes. The long time divides 24 hours a day into a maximum of 12 time periods, each time corresponding to a unique rate, up to 4 types can be set. For holidays, if you need to set it separately, you can set it by setting the special day register to specify the special date and the corresponding day time table.

The two schemes can independently set the TOU scheme and automatically switch by setting the switching date of the two schemes.

The TOU function can realize separate-time measurement of positive/negative active/reactive/apparent energy, and provides the maximum demand value and its generation time for each rate period. The maximum power inversion value of each rate period is 1000000000KWh.。

The parameter range is as follows:：

Billing time zone: 1~12 time zones, time zone 1 start time is January 1st, cannot be changed. If set to 0xFFFF or other date that does not exist, it is considered an invalid date. If the date of a time zone in the time zone scenario is set to 0xFFFF, then all dates after this time zone should be set to 0xFFFF. The time zone plan setting rule is: the latter time zone date should be later than the previous time zone, unless the subsequent time zones are all set to 0xFFFF.

Billing day type: workday/weekend day, which can be set separately.

Daily time table: Up to 8 time table, each table can be set up to 12 time periods, and the minimum time unit in each time period is 15 minutes. If the value is 0, it means that in the current time zone, the daily timetable used is the daily timetable table 1, and the valid time is: the start date of the current time zone to the start date of the lower time zone, if the next time zone start date is set If it is 0xFFFF, its valid time is the start date of the time zone until the end of the current year. For each day time table, their time period setting rules are: the next time period should be later than the previous time, unless the following time periods are all set to 0xFFFF

Special day: 0~60, the daily timetable can be specified separately for each special day.

Rate: 4 rates.

This function only provides settings and views in communication.

4.7 Waveform recording function

The PMAC780H device provides two independent waveform records that can be set separately. The waveform recording function can be started by the over-limit, voltage sag/swell interruption, transient disturbance, and rapid voltage change, and the waveforms of the 3-phase voltage, 3-phase current waveform, and the neutral current and neutral voltage are recorded. In addition, the device also provides a communication trigger recording function, and the recording waves 1 and 2 of the communication trigger

recording correspond to the settings of the fault recording 1 and 2 respectively. When the communication is issued, the current waveform is recorded.

The number of sampling points can be set from 16 points/cycle to 1024 points/cycle, and the number of cycles also matches. The recorded waveform will be stored in the system file in COMTRADE format, and the record will not be lost even if power loss.

Setting parameters:

Setting the recording mode: The device provides the following setting modes: 1024 points/cycle @50 cycles, 512 points/cycle @100 cycles, 256 points/cycle @200 cycles, 128 points/cycle@400 cycles, 64 points/cycle@800 cycles, 32 points /cycle @1600 cycles, 16 points /cycle @3200 cycles. For example, it is set to 1024 points/cycle @50 cycles mode, which means that the group recording mode is 1024 points per cycle, and the recording length is 50 cycles.

Set the number of cycles before the fault: the number of cycles before the fault can be set, and the set number is not greater than the length of the recorded wave in the recording mode. It is generally recommended that the number of cycles before the fault is generally not more than 20% of the length of the recorded wave.

Number of waveform records: 2 sets of waveform records, the maximum number of each group is 128.

4.8 Maximum value recording function

The device can record the highest value of the real-time measured value, which includes the data of the maximum/minimum value and the time of occurrence.

Record the maximum value of the following quantities:

- 3-phase current,average current
- 3-phase phase voltage and average phase voltage

- 3-phase line voltage and average line voltage
- Neutral current, neutral voltage
- 3-phase active power / 3-phase reactive power / 3-phase apparent power
- Total active power / total reactive power / total apparent power
- Frequency
- 3-phase phase voltage/line voltage total harmonic distortion rate
- 3-phase current total harmonic distortion rate
- 3-phase current K factor
- Voltage negative sequence, zero sequence imbalance, current negative sequence, zero sequence imbalance
- 3-phase/line short time flicker,long time flicker

4.9 SOE Record

Up to 1024 events can be recorded and power outages are not lost. Recording events include power-on and power-off of the device, over-limit action, relay action, switch displacement and user setting. The SOE record includes the event type, occurrence time and feature value. The time resolution is 1ms.

All event records can be read by the host computer through the communication port. If the 1024 event is full, the old record will be overwritten from the first event. Therefore, in order to read all event records in time, the device and the host computer should be kept in real time communication.

The SOE record can be cleared through communication.

4.10 PQ Record

Up to 1024 events can be recorded and power outages are not lost. Mainly recorded power quality various dynamic events include: transient events, temporary sag interruptions, and rapid voltage changes. Each PQ

record includes event type, occurrence time and feature value. The time resolution of the event is 1ms.

4.11 Digital input

Each switch input of the device can be selected according to the actual application needs to achieve the following three functions:

（1）Ordinary switching

Used to detect the status of an external passive contact or the status of an external active contact. The real-time status of the digital input can be observed through liquid crystal display or communication. The switching displacement event is recorded in the SOE with a time resolution of 1ms.

（2）Pulse count

Used to receive pulses from meters or other devices and count them. When the DI state changes from off to on, the counter is incremented by one, and no SOE is generated at this time. Each pulse counter can be set and cleared.

(3) PPS Seconds pulse

Used for PPS seconds pulse timing.

4.12 Digital output

（1）RO Function

The relay provides two control modes, remote control and local control. When the local control is selected, the relay response is over-limit, transient and rapid voltage change; when set to remote control, it responds to the upper computer close/open command.

- Remote control: The relay reset time can be set,the setting range is 0~60 seconds,if the reset time is set to 0, it will not return.
  - The set limit action can trigger the relay action, and when the limit returns, the relay returns.
  - Sag/swell/interrupting/transient disturbance/voltage rapid change

triggers the relay action. When the trigger event ends, the relay returns.

Application example:

When the relay RO1 is in the open state, if the reset time is set to 1.0s and the host computer is remotely connected to RO1, RO1 will immediately act (close) and automatically return (open) after 1.0s.

（2）DO Function

The PMAC780H is configured with 2 Dos,the DO function can be configured through the DO output mode parameters. The functions of the DO are divided into two types:

- Export function (that is all functions of RO, but at this time RO and DO have different breaking capabilities, generally need external intermediate relay)
- Power pulse output function (secondary full-wave energy pulse).

4.13 Communication function

The PMAC780H device provides two RS485 interfaces and one Ethernet interface.

（1）RS-485 communication

The RS-485 communication interface supports the MODBUS communication protocol. The baud rate is 2400bps, 4800bps, 9600bps, 19200bps, 38400bps optional, parity and stop bits can be set.

（2）Ethernet communicatin

The Ethernet interface uses a standard RJ-45 interface with a communication rate of 10M/100M.

a）Support MODBUSTCP (port number 502) and MODBUSRTU (port number 27011)

Please refer to the MODBUS communication protocol of PMAC780H for the specific communication frame format.

b）Support 61850 Statute

4.14 Timing function

Device support software timing

Software timing supports SNTP network timing and Modbus communication timing. The SNTP network timing is that the device automatically acquires high-precision time from the network time server. Modbus communication timing is the upper machine to synchronize the device through the Modbus protocol.

The device supports GPS timing, including IRIG-B code timing and second pulse timing.

4.15 Storage function

The PMAC780H device has 8G of memory capacity and is mainly used to save waveform records, SOE records, PQ records, PQDIF,ect. The recorded data is stored in the COMTRADE format, and the event record data is stored in a format specified by the protocol.Statistical timing recording function

4.16 Statistical Timing Recording Function

The PMAC780H device has a statistical timing recording function that can perform statistical calculations on real-time measured values and record statistical values, including maximum, minimum, average, and 95% probability values during the interval. The storage format of the statistical data is PQDIF format. The reporting time and interval can be set.

The storage space of the record is 1G, and the data storage mode is a cyclic storage record, and the earliest record data is overwritten when the record is full.

4.17 Real-time waveform

The PMAC780H unit provides real-time waveform display. On the device interface, it can display two cycles of real-time waveforms and also display three-phase current, voltage, neutral line current and voltage

waveforms.

4.18 GATEWAY Function

The PMAC780H device utilizes a network port and a serial port 2 to implement a simple communication management function. The upstream network port supports the modbus_tcp protocol and the port number is 6000.The downstream serial port 2 supports the modbus_rtu protocol; the downstream device data is collected through the GATEWAY function.

4.19 Historical electricity

The PMAC780H provides the last 31 days of historical energy and the last 12 months of historical energy. The historical energy of the day and the month stores the active energy (including: input, output, sum and net value), reactive energy (including: input, output, sum and net value), apparent energy (including: input, output, sum and net value)
Four-quadrant reactive energy, various rates of energy (including input and output).

4.20 FTP Function

The PMAC780H provides FTP download function. Connect to the host address, port number is 21, anonymous login to download

5. Display and Settings

PMAC780H adopts TFT color LCD screen with resolution of 640×480, which is convenient and simple to operate.

5.1 Button

The PMAC780H has a total of six buttons on the front panel: up, down, left, and right four direction buttons, confirmation button, and exit button. The function of each button is showed as follows:

Button	Function Description
“⮌”	Exit to the previous menu ,or cancel the input value
“ < ”	Move the cursor to left ,or page to left
“ ^ ”	Move the cursor up ,or add 1 to the position of the cursor
“ v ”	Move the cursor down ,or the number at the cursor position minus 1
“ > ”	Move the cursor to right ,or turn the page to right
“↵”	Enter the next level menu ,or confirm the input value

5.2 Indicator light

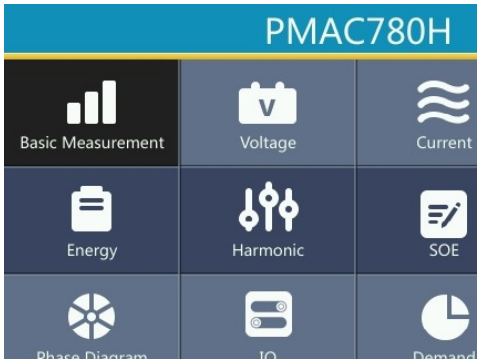
There are three indicators on the front panel of the PMAC780H: running , communication, and fault.

Indicator light	Function Description
	Indicates the running status of the device, and flashes when the device is normal
	Indicates the status of serial communication, flashing when there is

	serial communication
	Indicates the self-test status of the device, and lights up when there is a device failure.

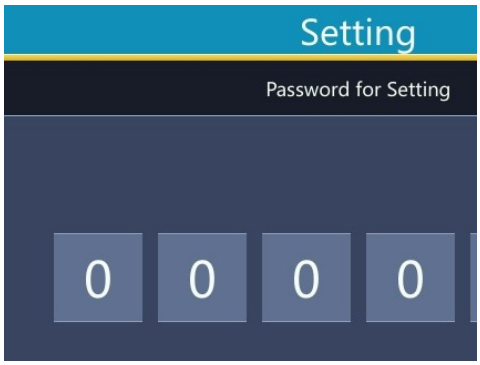
5.3 Instrument settings and display

When the device is powered on, the page is initialized. When the initialization is completed, the default main page is entered, which is divided into 14 menus.Show as below:



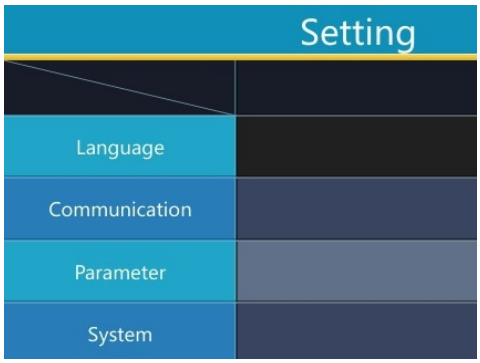
5.3.1 Enter password

Before using the PMAC780H device normally, the parameters of the device must be set. Before setting the parameters, you must enter the correct user password. The factory default password is "1" and the super password is "99".



After entering the correct user password, enter the settings interface,

which has 5 sub-menus.Show as below:

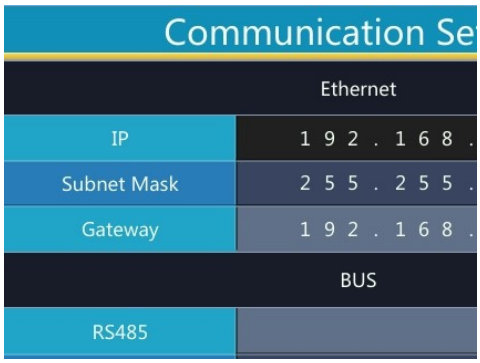


5.3.2 Language setting

The device provides switching between Chinese and English. After switching, the device needs to be restarted.

5.3.3 Communication setting

The communication setting interface displays the Ethernet port and the communication parameters of the two RS-485.Show as below:



Setting register	Factory default	Function
RS485 setting		
Mode	MODBUS-RTU	MODBUS-RTU
Device address	1	1～247, In the same communication link, each device should have a unique ID number
Baud rate	9600	2400/4800/9600/19200/38400bps
Ethernet settings		
IP Address	192.168.0.100	Network parameter settings need to meet the

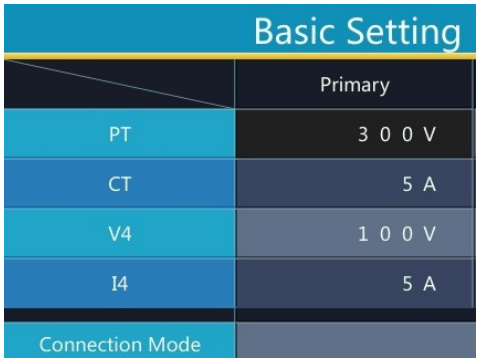
Subnet mask	255.255.255.0	following requirements: 1）The IP address and subnet mask cannot be 0. (Gateway 0 means no gateway.) 2）The IP address and the highest byte of the gateway range from 1 to 223. 3）IP address, gateway cannot be 127.x.x.x.
Gateway	192.168.0.1	

5.3.4 Parameter setting

The parameter setting interface includes five sub-menus: basic setting, PQ parameter, IO parameter, demand and frequency.

5.3.4.1 Basic setting

The basic setting interface displays the basic setting parameters, including voltage and current primary side, secondary side, wiring mode, rated voltage, and rated current.Show as below:



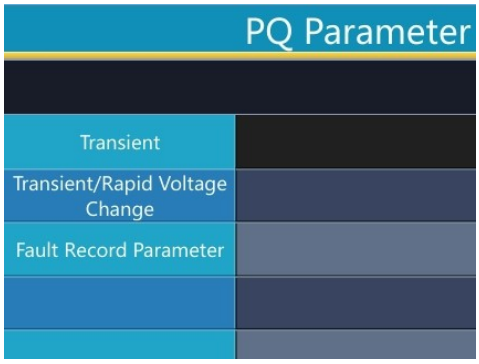
Basic parameter setting sheet:

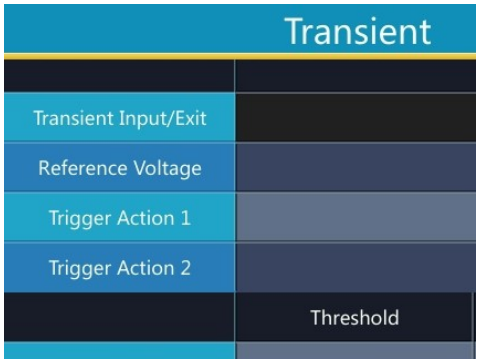
Setting parameters	**Factory default**	**Setting range**
Voltage primary side	100	100-1000000

Voltage secondary side	100	100-690
Current primary side	5	1-50000
Current secondary side	5	1-5
U4 Primary side	100	100-1000000
U4 Secondary side	100	100-690
I4 Primary side	5	1-50000
I4 Secondary side	5	1-5
Wiring mode	3P4W	3P4W or 3P3W
Rated voltage	100/381/690（According to the selection）	Cannot be set
Rated current	5A/1A	Cannot be set
Set interval	50cyc	10cyc/50cyc/150cyc/10min/2h

5.3.4.2 PQ Parameter

The PQ parameter setting interface includes: transient, voltage rapid change and fault recording parameters.Show as below:



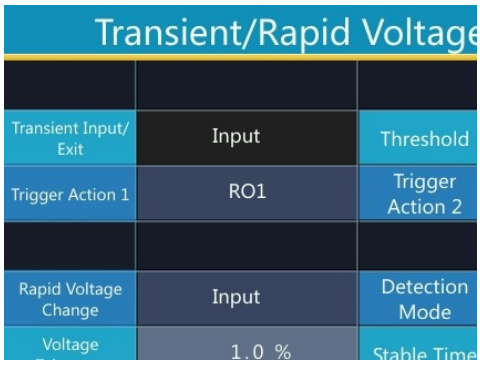


PQ Parameter Transient

Transient parameter setting sheet

Setting parameters	**Factory default**	**Setting range**
Transient retreat	Exit	Input/Exit
Reference voltage	Rated voltage	Rolling reference voltage / rated

			voltage
Trigger action 1、Trigger action 2		No	No/RO1/RO2/RO3/RO4/DO1/DO2/ Fault recording 1/ Fault recording 2
Sag	Limit	90%	10%-90%
	Hysteresis value	2%	0.5-10%
Swell	Limit	110%	110%-200%
	Hysteresis value	2%	0.5-10%
Interrupt	Limit	10%	5-10%
	Hysteresis value	2%	0.5-10%

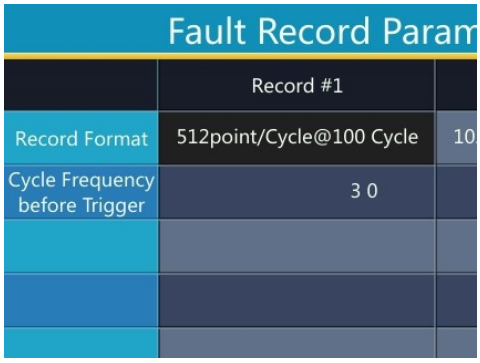


Transient/voltage rapid change

Transient/voltage rapid change parameter setting sheet

Setting parameters		**Factory default**	**Setting range**
Transient	Transient retreat	Exit	Input/Exit
	Limit	50%	10%-500%
	Trigger action 1、Trigger action 2	No	No /RO1/RO2/RO3/RO4/DO1/DO2/ Fault recording #1/ Fault recording #2
Rapid	Rapid voltage	Exit	Input/Exit

voltage change	change		
	Detection mode	Steady-state differential pressure	Steady-state differential pressure / maximum differential pressure
	Voltage tolerance	1%	0.1%-1%
	Stable time	1s	0.5-5s
	Minimum step size	1%	0.1-5%
	Minimum speed	5%/s	1-10%/s
	Trigger action 1、Trigger action 2	No	No /RO1/RO2/RO3/RO4/DO1/DO2/ Fault recording #1/ Fault recording #2



Fault recording parameter

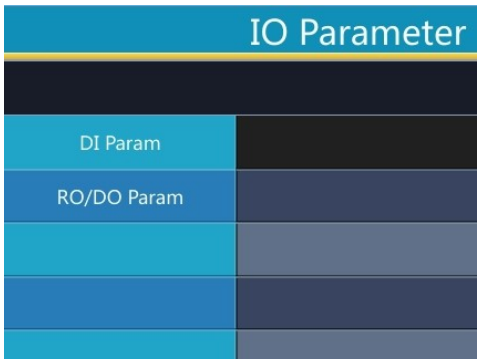
Fault recording parameter setting sheet:

Setting parameters		**Factory default**	**Setting range**
Fault recording #1~ Fault recording #2	Recording format	1024 points/cycle@50 cycles	16 points/cycle@3200cycles、32 points/cycle@1600 cycles 64 points/cycle@800 cycles、128 points/cycle@400 cycles 256 points/cycle@200 cycles、512 points/cycle@100 cycles 1024 points/cycle@50 cycles

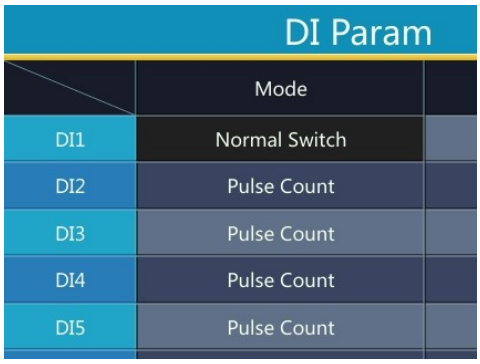
Fault recording #1~ Fault recording #2	Trigger front wave number	10	The number of cycles before the trigger is limited by the number of cycles defined by the “recording format”.(Generally set to 10%~20% of all recorded data)

5.3.4.3 I/O Parameter

The I/O settings interface includes: DI parameter and RO/DO parameter, shown as below:



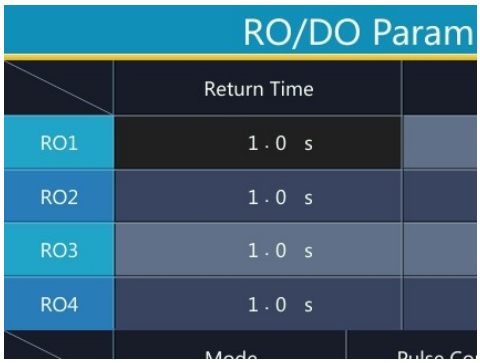
I/O Parameter



DI Parameter

DI parameter setting sheet:

Setting parameters		**Factory default**	**Setting range**
DI-1~DI-8	Mode	Ordinary switching	Ordinary switching / PPS seconds pulse / pulse count
	Delay	20ms	When the mode is ordinary switching, the range is 1~9999ms.

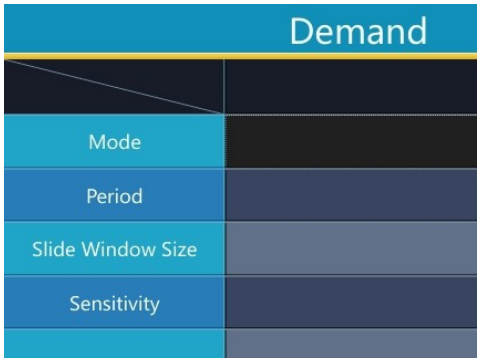


RO/DO Parameter

RO/DO parameter setting sheet:

Setting parameters		**Factory default**	**Setting range**
RO1~RO4	Return time	1.0s	0-60s, 0 means keep
	Mode	Local control	Local control / remote control
DO1~DO2	Mode	Active energy pulse	Active energy pulse / reactive energy pulse / alarm exit
	Pulse constant	3200	1000、3200、5000、6400、12800 pulse/kWh
	Pulse Width	80ms	60-100ms

5.3.4.4 Demand



Demand parameter setting sheet:

Setting parameters	**Factory default**	**Setting range**
Mode	Fixed	Fixed/slip
Cycle	5min	5min/10min/15min/30min/60min
Sliding window size	1min	1min/2min/3min/5min

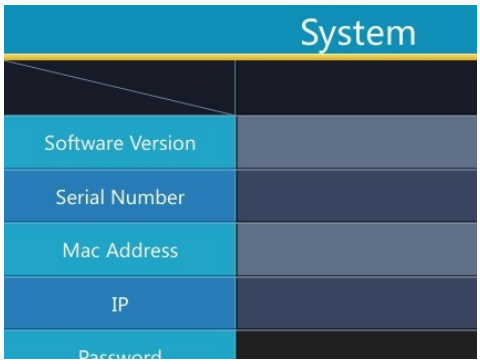
Sensitivity	70	70-99

5.3.4.5 Frequency

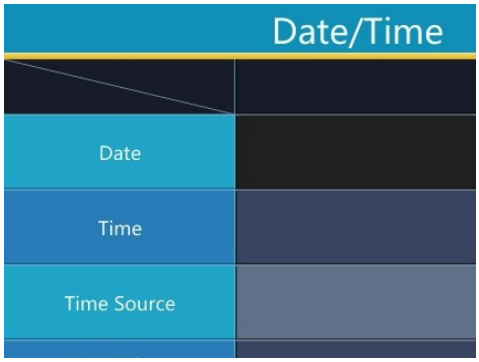
The system frequency can be set to: 50Hz or 60Hz, and the factory default is 50Hz.

5.3.5 System

In the “System” setting interface, you can view the software version, serial number, Mac address, and IP address of the device. You can query and set the user password and date/time of the device. as the picture shows:



On the date/time interface, you can set the date, time, clock source, and SNTP calibration interval (minutes) of the device.



Date/time parameter setting sheet:

Setting parameter	**Factory default**	**Setting range**
Date	Current date (calibrated at the	

	factory)	
Time	Current time (calibrated at the factory)	
Clock source	Local time	Local time / network / PPS seconds pulse / IRIG-B
SNTP calibration interval (minutes)	60	10-1440
SNTP server	xgate.pmac.com.cn	

6. Technical Specification

6.1 Instrument parameters

PMAC780H device meets the national standard GBT 19862-2016 general requirements for power quality monitoring equipment.

The specific indicators and display methods of the parameters are shown in the following sheet:

Measurement parameter		Display	Communication	Precision
Power quality value				
Voltage rapid change	Voltage	Event	Event	
Voltage deviation	Voltage	Percentage	Percentage	0.1%
Frequency deviation	Frequency	-	-	0.01Hz
Transient overvoltage	Voltage	Event	Event	20μs，1400V
Unbalance rate	Voltage、current	Primary side value	Primary side value	Class A
Harmonic content rate	63th voltage/current harmonic components	Percentage	Percentage	Class A
Harmonic power	63th harmonic components	Primary side value	Primary side value	Class A
Harmonic energy	2~31	Primary side value	Primary side value	Class A
Harmonic RMS value	63th voltage/current harmonic components	Primary side value	Primary side value	Class A
Inter-harmonic RMS value	63th voltage/current inter-harmonic components	Primary side value	Primary side value	10%
Harmonic	Total/odd/even harmonic	Percentage	Percentag	Class A

distortion	distortion rate		e	
Inter-harmonic distortion	Total inter-harmonic distortion rate	Percentage	Percentage	5%
Flicker	Voltage	-	-	5%
Real-time parameter RMS				
Voltage	Phase voltage / line voltage / average	Primary side value	Primary side value	0.1%
Current	Phase current / zero sequence current / average	Primary side value	Primary side value	0.1%
Active power	Single phase/total	Primary side value	Primary side value	0.2%
Reactive power	Single phase/ total	Primary side value	Primary side value	1%
apparent power	Single phase/ total	Primary side value	Primary side value	0.2%
Power factor	Single phase/ total	Primary side value	Primary side value	0.5%
Active energy	Single phase, input, output, total	Primary side value	Primary side value	Class 0.2S
Reactive energy	Single phase, input, output, total	Primary side value	Primary side value	Class 2
Maximum value	Phase voltage/current Total active/total reactive power	Primary side value	Primary side value	—
Demand	3-phase current Total active / total reactive / total apparent power	Primary side value	Primary side value	—
Multiple rate	Input and output	Primary side value	Primary side value	—
Frequency	Frequency	Primary	Primary	0.01Hz

		side value	side value	
Communication				
RS485 communication 2 channels, 1 channel Ethernet, 1 channel USB2.0 interface				
Relay output				
Configure 4 relays, normally open				
Switch input				
Provides 8 external passive or 8 external active switching inputs				
Pulse output				
Provides 2 pulse outputs, which can be configured as active energy and reactive energy output (for secondary side full-wave energy pulse)				
Storage				
Maximum 8Gbytes of internal storage space				
Clock				
Instrument local clock 0.5s / day				

6.2 Performance Specification

	Parameter	**Range**
Rated operating parameters	Working power supply	AC85~265V，DC100~300V
	Machine power consumption	＜10W
	Overload capability	The voltage is 2 times continuous, 4 times / 1s; the current is 4 times continuous, 10 times / 1s
	Switch input rated voltage	DC 110V/220V±20% or external passive (internal 30V DC)
	Relay output rated contact capacity	AC250V/5A,DC30V/5A
	DO output capacity	Maximum voltage 36VDC, maximum current 50mA
	Parameter	**Performance**
Insulation performance	Power frequency withstand voltage	AC2kV/Min~1mA Input-output-power supply
	Insulation resistance	＞50MΩ

	Impulse voltage	6kV（Peak），1.2/50μs	
	Item	**Reference standard**	**Test level**
Electromagnetic Compatibility	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 (impact) 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)	Correspond
	Electromagnetic disturbance limit	GB 4824-2013 （CISPR11：2010）	Correspond

7. Maintenance and trouble shooting

Possible problem	Possible cause	Possible solution
The meter has no indication after the control power supply is imposed	The power supply fails to be imposed on the meter	Check if the correct working voltage has been imposed on the L/+ and N/- terminals of the meter. Check if the fuse for the control power supply has been burnt down.
The measured value is not correct or does not conform to the expectation	The voltage measurement is not correct	Check if the neutral point has been connected reliably Check if the measured voltage matches the rated parameters of the meter Check if PT ratio has been set correctly
	The current measurement is not correct	Check if the measured current matches the rated parameters of the meter Check if CT ratio has been set correctly
	The power measurement is not correct	Check if the connection mode has been set correctly Check if the phase sequence corresponding to the voltage and the current is correct Check if the wiring of current terminals are correct
The DI status is not change	The DI operating voltage is not correct	Check if the types of external nodes match the rated parameters of the meter Check if the external connection is correct
The relay no respond	The relay does not receive the control command	Check if the communication link is correct

	The working mode of the relay is not correct	Check if the current relay is under the correct control mode
The upper end device can not communicate with the meter	Communication address error	Check if the address of the meter is consistent with its definition
	Baud rate error	Check if the baud rate setting on the meter is consistent with the upper end device
	The communication link has not been connected to the terminals resistor	Check if the 120Ω resistor has been connected
	The communication link suffers interference	Check if the communication-shielding layer has been earthed effectively
	The communication line is interrupted	Check if the communication cable has been disconnected

Notice:

- PILOT reserves the right to modify this manual without prior notice in view of continued improvement.
- Email: marketing@pmac.com.cn

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