



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.



Risks of electric shocks, burning, or explosion

- This device can be installed and maintained only by qualified people.
- Before operating the device, isolate the voltage input and power supply and short-circuit the secondary windings of all current transformers.
- Put all mechanical parts, doors, or covers in their original positions before energizing the device.
- Always supply the device with the correct working voltage during its operation.

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



Operating environment

- Operating temperature: $-10^{\circ}\text{C}\sim+55^{\circ}\text{C}$
- Storage temperature: $-40^{\circ}\text{C}\sim+70^{\circ}\text{C}$
- Relative humidity: 5%~95%, non-condensing
- Operating power supply: 85Vac ~265Vac, 85Vdc ~265Vdc , 45-65Hz
Or 18~72Vdc (Optional)



Note for Communication:

1. Communication setting:

① Meter ID address:

There is ID sticker on the meter house. The last two numbers is the meter's ID address. (But if the last two numbers are "00", then use "100" as meter ID address)



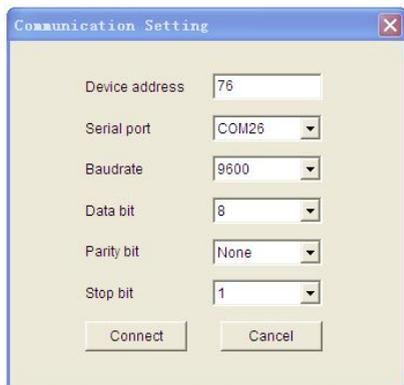
② Meter Baud rate: default 9600bps

③ Data bit: 8

④ Parity Bit: None

⑤ Stop Bit: 1

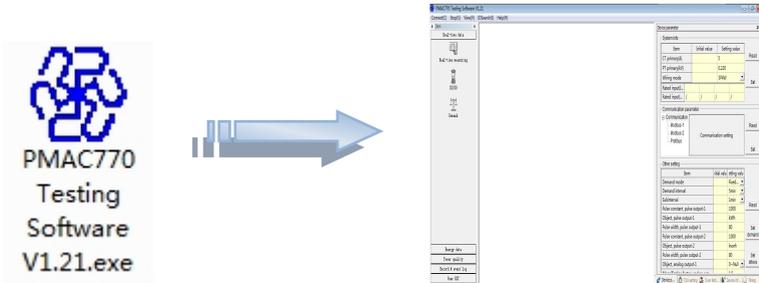
For example



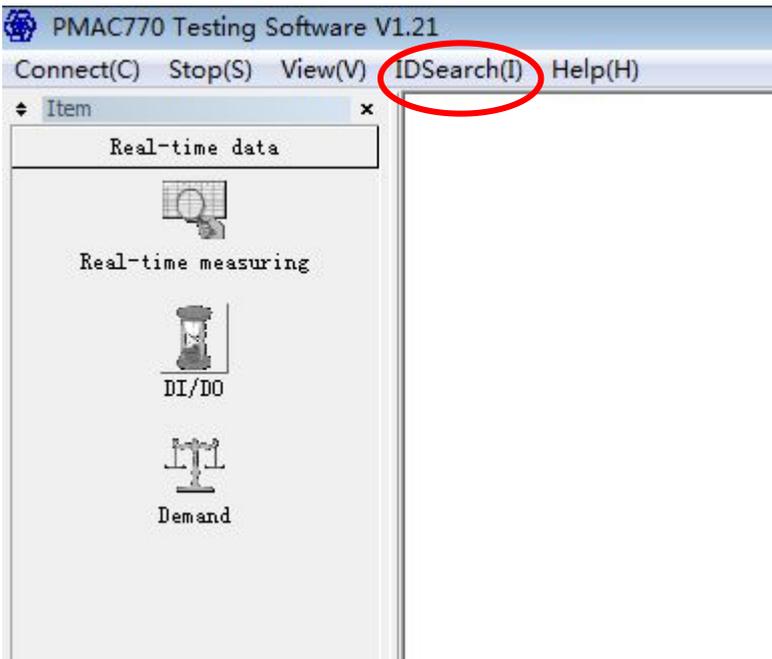
2. **Customers need to remember the Communication address once they modify it.**

If customers forget the meter address, please open Pilot “PMAC770 Testing Software V1.21.exe”, the search the meter address via “IDsearch(I)” menu. Steps as below:

Step 1: Double-click “PMAC770 Testing Software V1.21.exe” to open the software



Step 2: Click “IDsearch(I)” menu on the left top



Step 3: Sub menu pop up, input the correct serial port of your computer, then click search button. Then you can get the meter address.

ID Search ✕

ID Range ~

Serial port ▾

Baudrate ▾

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1 General Information

PMAC770-DR Three Phase Multifunction Power Meter is designed for monitoring all kinds of electricity parameters. It's widely used in low voltage and medium voltage distribution/ automation system.

PMAC770-DR provides the main function as below:

- ◆ Real-time measuring data, true RMS
- ◆ All energy data (include real energy, multi-tariff energy, history energy, 1st ~13th harmonic energy).
- ◆ Power quality analysis
- ◆ Demand calculation
- ◆ Maximum/Minimum value
- ◆ Clock and event record
- ◆ Over/ under limit alarm
- ◆ Phase sequence checking
- ◆ Modbus communication
- ◆ Digital input/ Digital output (3 DI/ 2 DO)

1.1 Measuring

PMAC770-DR offer full function measuring function, can fulfill monitoring both low and high voltage three phase grid. The parameters are as followed:

Parameter	Main module
Per phase L-N voltage & Average L-N voltage	•
Per phase L-L voltage & Average L-L voltage	•
Per phase current & Average current	•
Per phase active power& Total active power	•
Per phase reactive power & Total reactive power	•
Per phase active apparent power & Total active apparent power	•
Per phase active power factor & Total power factor	•
Per phase Input /output kWh & Total Input /output kWh	•
Per phase Input /output kvarh & Total Input /output kvarh	•
Frequency	•
Demand	•
Multi-tariff	•

Phase sequence	•
Total voltage/ current harmonic	•
Total odd voltage/ current harmonic	•
Total even voltage/ current harmonic	•
Voltage/ current harmonic (2 nd ~31 st)	•
True RMS of current/ kWh (0~31 st)	•
kWh harmonic (1 st ~13 th)	•
Voltage crest, Current K factor	•
Voltage unbalance	•
100 event record	•
Voltage/ frequency deviation record	•
Voltage unbalance record	•
Max/ mini demand record	•
Real-time Max/ mini demand record	•
Historical multi-tariff kWh record	•
DI	3
DO	2
Modbus communication	•

2 Connection & Installation

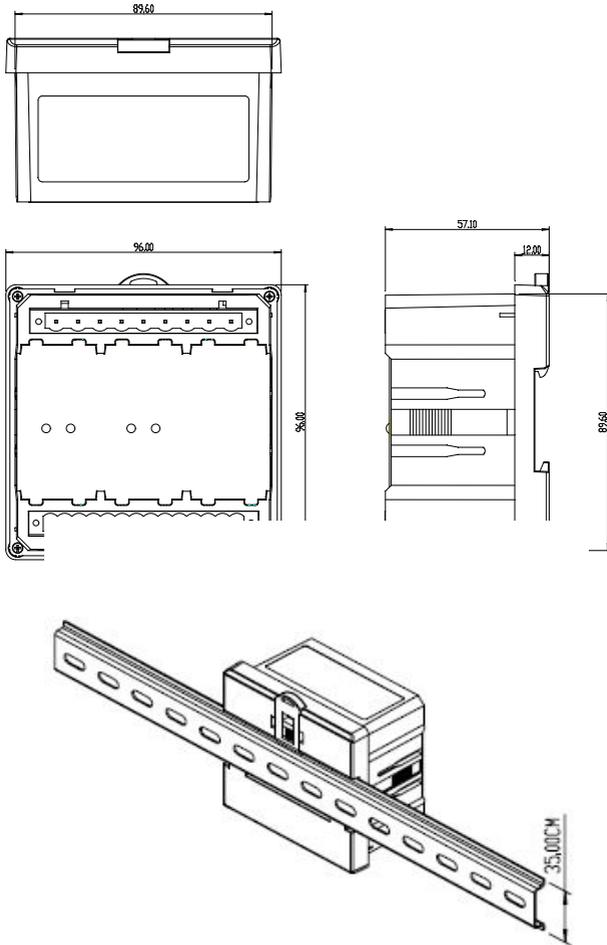
2.1 Environment

2.1.1 Environment condition

- ◇ Standard working temperature: -10°C ~ +55°C
- ◇ Limited working temperature: -25°C ~ +55°C
- ◇ Storage temperature: 40°C ~ +70°C
- ◇ Working humidity: 5% ~ 95%RH , non-condensing

2.1.2 Dimension & Terminals

Unit: mm



No.	Mark	Definition
1	NC	Null
2	N/-	Negative wire, Aux. power supply AC/ DC 220V
3	L/+	Positive wire, Aux. power supply AC/ DC 220V
4	V1	Phase A voltage
5	V2	Phase B voltage
6	V3	Phase C voltage
7	VN	Voltage neutral line
8	485-	RS485 com port-1, negative wire
9	485+	RS485 com port -1, positive wire
10	RL21	Relay output 2, positive
11	RL22	Relay output 2, negative
12	RL11	Relay output 1, positive
13	RL12	Relay output 1, negative
14	SG	Digital input, common earth
15	S3	Digital input 3, positive
16	S2	Digital input 2, positive
17	S1	Digital input 1, positive
18	I1+	In line, phase A current
19	I1-	Out line, phase A current
20	I2+	In line, phase B current
21	I2-	Out line, phase B current
22	I3+	In line, phase C current
23	I3-	Out line, phase C current

2.2 Power supply

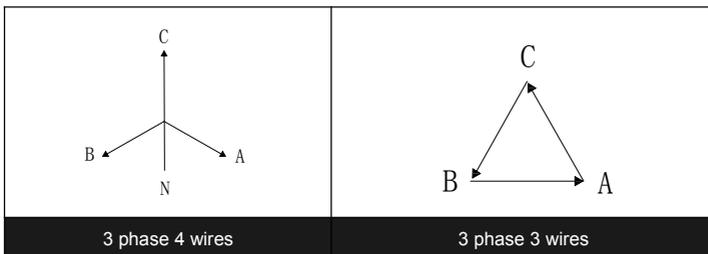
Power supply range	Power loss
85Vac ~ 265Vac , 85Vdc ~ 265Vdc , 45-65Hz	<10VA
100~420Vac,100~400Vdc , 45~60Hz	<15VA
18~72Vdc	

2.3 Order Information

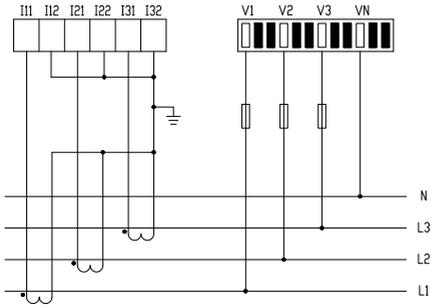
Model No. PMAC770-DR - ① - ② - ③ - ④ - ⑤	
① Rated input voltage(Vph-N/ Vph-ph) and current	
V1	57.7/100V (via PT), 5A
V2	57.7/100V (via PT), 1A
V3	220/380V (direct), 5A
V4	220/380V (direct), 1A
V5	120/208V (direct), 5A
V6	240/415V (direct), 5A
V7	277/480V (direct), 5A
V8	63.5/110V (via PT), 5A
V9	120/208V (direct), 1A
V10	240/415V (direct), 1A
V11	277/480V (direct), 1A
V12	63.5/110V (direct), 1A
② Rated input frequency (Not choose will be deem as 50Hz)	
F1	50Hz
F2	60Hz
③ Aux. power supply (Not choose will be deem as P1)	
P1	85~265Vac, 85 ~ 265Vdc, 45-65Hz
P2	100 ~ 420Vac , 100 ~ 400Vdc, 45~60Hz
P3	18~72Vdc

2.4 Connection Mode and Wiring

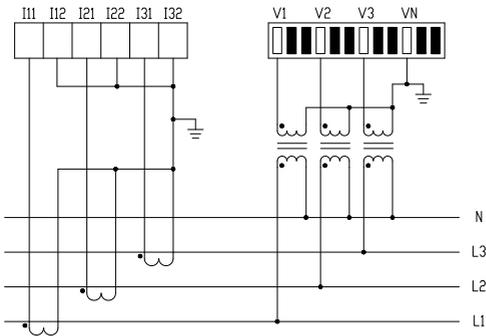
PMAC770-DR supports 2 kinds of connection mode: 3P4W and 3P3W..



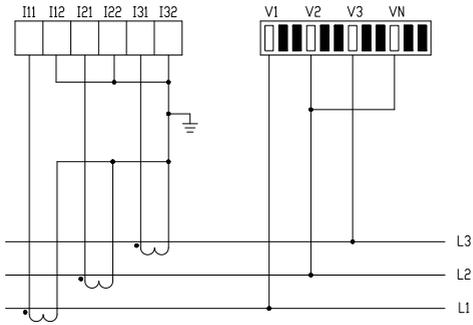
(1) 3-phas 4-wire, no PT, 3CT:



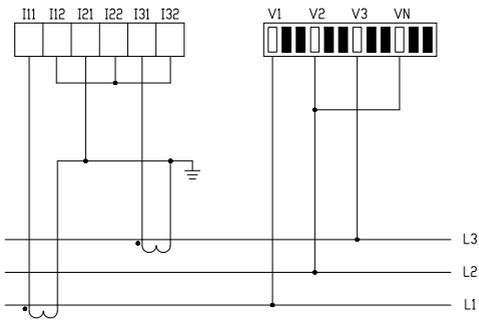
(2) 3-phas 4-wire, 3PT, 3CT:



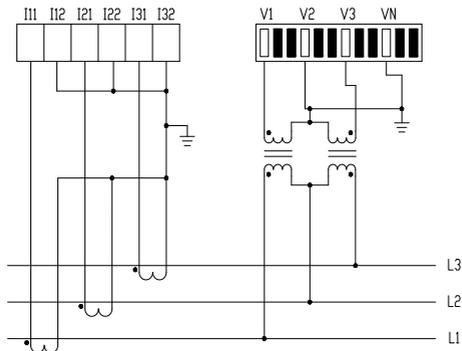
(3) 3-phas 3-wire, no PT, 3CT:



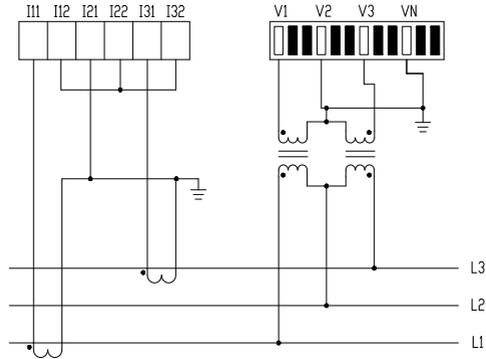
(4) 3-phas 3-wire , no PT, 2CT:



(5) 3-phas 3-wire , 2PT, 3CT:



(6) 3-phas 3-wire, 2PT, 2CT:



3 Measuring Function Description

Parameter	Accuracy	Resolution	Measuring Range
Voltage	0.2%	0.01V	Direct: 500Vph-ph PT primary: 0~65.00kV PT secondary: 100Vph-ph or 110V
Current	0.2%	0.001A	CT primary: 0~9,999A CT secondary: 1 A or 5A
Power	0.5%	0.1W/var/ VA	Per phase: 0~649.9MW/ Mvar/ MVA Total: 0~1949.8MW/ Mvar/ MVA
Power factor	0.5%	0.001	-1.000~+1.000
Frequency	1.0%	0.01Hz	45~ 65 Hz
Active energy	0.5%	0.1kWh	0~ 99,999,999.9 kWh
Reactive energy	2.0%	0.1kvarh	0~ 99,999,999.9 kvarh
THD	1.0%	0.001	0~100.0%
Individual harmonic	1.0%	0.001	0~100.0%
Un-balance	1.0%	0.001	0~100.0%

Measuring Parameter	Range
Voltage	0~65KV
Current	0~9999A
Active power	Per phase 0~649.9MW
Reactive power	Per phase 0~649.9MVar
Apparent power	Per phase 0~649.9MVA
Frequency	45~65Hz

3.1 Voltage

While measuring voltage lower than 277Vph-N / 480Vph-ph, PMAC770-DR dose not need to connect external PTs, it can be input directly. While measuring other voltage, PMAC770-DR needs external PTs. If PMAC770-DR is connected via PTs, the PTs direct affect the measurement accuracy of the meter. So, users should consider the linearity and accuracy rate of PTs.

Normally, Overload capacity of voltage measurement is120% of rated voltage. Users should pay attention on the voltage input when using the device, and avoid getting wrong data caused by over-scope measurement. Max. rated measuring range is 65KV.

Connection mode of voltage input can be set via panel or communication.

When choose low voltage meter, the connection mode is fixed 3-phase 4-wire

When choose high voltage meter, user can set the connection mode: 3-phase 4 wire or 3-phase 3-wire

Tips: It is recommended to clear the energy after change the connection mode

PT primary setting range: 0.1KV to 65KV, and PT primary value should not smaller than the rated voltage value

3.2 Current

Only when adopt CTs can PMAC770-DR measures current.

CT secondary rated output must comply with rated current input of PMAC770-DR (5A or 1A). When connecting external CTs, users must make sure the current is not open circuit. Otherwise, primary excitation will generate high voltage at secondary circuit, causing personal injury or death and equipment damage.

Normally, overload capacity of current measurement is 120% of rated current. Users should pay attention to the current input when using the device, and avoid getting wrong data caused by over-scope measurement.

Rated measuring range of current is 0 to 9999A.

CT primary setting range is from 1A to 9999A, and it should not smaller than the rated current value.

3.3 Active power

PMAC770-DR calculates three phase active power and total active power: Pa, Pb, Pc, and Ptot

Measuring range: per phase 0~ 649.9MW, total: 0~ 1949.8MW.

3.4 Reactive power

PMAC770-DR calculates three phase reactive power and total reactive power: Qa, Qb, Qc, and Qtot

Measuring range: per phase 0~ 649.9MVar, total: 0~ 1949.8MVar

Attention
<ol style="list-style-type: none">1. Both active power and reactive power value have signs.2. When wiring, users should pay attention to the phase sequence of voltage and current. Otherwise, it may cause wrong measuring data. Besides, it is necessary to connect the CTs terminals correctly; otherwise there will be negative power value.

3.5 Apparent power

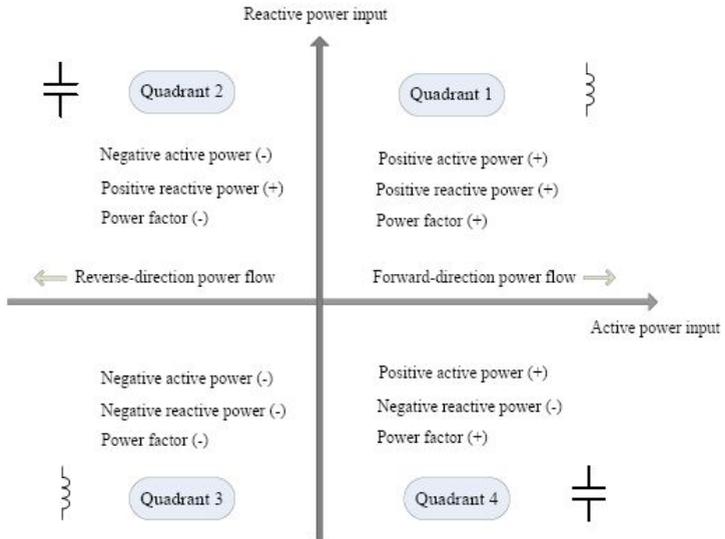
PMAC770-DR calculates three phase apparent power and total apparent power: Sa, Sb, Sc and Stot.

Measuring range: per phase 0~ 649.9MVA, total: 0~ 1949.8MVA

3.6 Power factor

PMAC770-DR measures per phase power factor and total power factor: PFa, PFb, PFc and PFtot. Measuring range: -1.000 to +1.000.

Like active / reactive power value, the wiring and CTs terminals connecting will affect actual calculated value of power factor.



3.7 Frequency

In different connection modes, PMAC770-DR samples the system frequency from different channels. In 3-phase 3-wire connection mode, PMAC770-DR samples the frequency from line AB voltage channel. In other connection modes, it samples frequency from phase A voltage channel. In case phase A voltage is failure, it samples frequency from phase C voltage channel. In case both phase A and C voltage are failure, it samples from phase B voltage channel.

3.8 Demand calculation

PMAC770-DR provides demand analysis for three phase current, total active power, total reactive power and total apparent power.

PMAC770-DR supports two demand modes: Fixed Block and Rolling Block.

Users can set demand interval as 5min, 10min, 15min, 30min or 60min.

In Fixed Block mode, users do not need to set the subinterval.

In Rolling Block mode, users should set subinterval the subinterval: 1min, 2 min, or 3 min. Show as below sheet:

Optional Intervals (mins)	Programmable Subintervals (mins)
5	1
10	1 or 2
15	1 or 3

30	1, 2, or 3
60	1, 2, or 3

In nonvolatile memory, PMAC770-DR maintains a running maximum for power and current demand values with date & time stamp, called "Max. Demand".

User can read and clear the demand value from RS485 communication.

4 Power Quality Analysis

Item	Parameter	Measuring Range	Accuracy
THD	THD for voltage	0~100%	Class B
	TOHD for voltage	0~100%	Class B
	TEHD for voltage	0~100%	Class B
	THD for current	0~100%	Class B
	TOHD for current	0~100%	Class B
	TDHD for current	0~100%	Class B
Harmonic Ratio	HR for voltage	2~31 st	Class B
	HR for current	2~31 st	Class B
Harmonic RMS	Harmonic voltage RMS	0~31 st	Class B
	Harmonic current RMS	0~31 st	Class B
	Harmonic power RMS	0~31 st	Class B
	Harmonic energy RMS	1~13 th	Class B
Other	Voltage crest factor	/	Class B
	Current K factor	/	Class B
	Frequency deviation	0~100%	Class B
	Voltage deviation	0~100%	Class B
	Voltage unbalance	0~100%	Class B

4.1 General Description

Harmonics are any "non-linear" current or voltage in an electrical distribution system. With these harmonics flowing into the power system, it will affect the reliability of the transformers and protection relays, and it will accelerate the ageing of metalized polyester film, increase the power loss of transmission, and disturb communication or measurement accuracy of instruments.

PMAC770-DR provides up to 31st harmonics analysis which is strong helpful for power quality analysis.

4.2 THD

PMAC770-DR measures voltage and current harmonic up to 31st, and calculates THD, TOHD (Odd) and TEHD (Even).

Users can read THD data (%) from communication. For example, the data is 20.00, the actual THD value is 20.00%.

4.3 Harmonic Ratio for Voltage

PMAC770-DR measures up to 31st voltage harmonic. Users can read 2~31st voltage harmonic (%) from communication. For example, the data is 10.00, the actual harmonic value is 10.00%

Tips
Harmonic data can be read via panel and communication.

4.4 Harmonic Ratio for Current

PMAC770-DR measures up to 31st current harmonic. Users can read 2~31st current harmonic (%) from communication. For example, the data is 10.00, the actual harmonic value is 10.00%

4.5 Voltage Crest Factor

PMAC770-DR measures 3 phase voltage crest factor, data resolution: 0.001. If no voltage input, the CF value is 0. Users can read CF value from communication.

Crest Factor Formula:

$$CF = 1.414 \times \sum_{h=1}^N U_h / U_1$$

In the formula, U_h is the h harmonic RMS, U_1 is fundamental harmonic RMS. N is the highest order harmonic.

4.6 Current K Factor

PMAC770-DR measures 3 phase current K factor, data resolution: 0.001. If no current input, the K Factor value is 0. Users can read K Factor value from communication.

K Factor Formula:

$$K \text{ Factor} = \sum_{h=1}^N (I_h \times h)^2 / \sum_{h=1}^N (I_h)^2$$

In the formula, I_h is the h harmonic current ratio, h is the harmonic order number, N is the highest order harmonic.

4.7 Harmonic Voltage RMS

PMAC770-DR measures 0 ~31st harmonic voltage RMS, data resolution: 0.01V. Users can read every order of harmonic voltage RMS from communication.

4.8 Harmonic Current RMS

PMAC770-DR measures 0 ~31st harmonic current RMS, data resolution: 0.0001A. Users can read every order of harmonic current RMS from communication.

4.9 Harmonic Power RMS

PMAC770-DR measures 0 ~31st harmonic power (total active power) RMS, data resolution: 0.1W. Users can read every order of harmonic power RMS from communication.

4.10 Harmonic Energy RMS

PMAC770-DR measures 0 ~13th harmonic energy (total kWh) RMS, data resolution: 0.1 kWh. Users can read every order of harmonic energy RMS from communication.

4.11 Frequency Deviation

PMAC770-DR calculates the Frequency Deviation, data resolution: 0.01Hz

Frequency deviation means the difference between the actual frequency and the nominal frequency

Formula: $Frequency\ Deviation = Actual\ Frequency - Nominal\ Frequency$

Users can set the *Nominal Frequency* in PMAC770-DR via communication. There are 50Hz or 60Hz for option.

Besides, PMAC770-DR records the over-limit event for frequency deviation. Users can set a limit value for the frequency deviation.

When the real-time frequency deviation is out of limit, PMAC770-DR will record the event with time stamp, its duration time and the Peak value. PMAC770-DR can store 30 events log for frequency deviation.

4.12 Voltage Deviation

PMAC770-DR calculates 3-phase voltage deviation which is the percentage of deviation compared with its nominal value.

Formula:

$Voltage\ Deviation\ (\%) = (Actual\ voltage - Nominal\ voltage) / Nominal\ voltage \times 100\%$

In above formula, the *Nominal voltage* is rated voltage. The voltage deviation has a negative or positive sign.

Besides, PMAC770-DR records the over-limit event for voltage deviation. Users can set a limit value for the

voltage deviation.

When the real-time voltage deviation is out of limit, PMAC770-DR will record the event with time stamp, its duration time and the Peak value. PMAC770-DR can store 30 events log for voltage deviation.

4.13 Voltage Unbalance Rate

PMAC770-DR calculates 3 phase voltage unbalance rate. Data resolution: 1%.

Formula:

$$\varepsilon_U = \frac{U_2}{U_1} \times 100\%$$

U1 is 3-phase voltage positive-sequence component RMS

U2 is 3-phase voltage negative-sequence component RMS

Besides, PMAC770-DR records the over-limit event for voltage unbalance. Users can set a limit value for the voltage unbalance.

When the real-time voltage unbalance is out of limit, PMAC770-DR will record the event with time stamp, its duration time and the Peak value. PMAC770-DR can store 30 events log for voltage unbalance. Meanwhile, PMAC770-DR also records the Peak unbalance in present day/ month/ history.

Note: PMAC770-DR do not calculate the current unbalance.

5 Energy and Multi-tariff Energy Statics

5.1 General Description

According to the direction of power, PMAC770-DR calculates 4 quadrant kWh/ kvarh, and statics multi-tariff energy and history energy data,

PMAC770-DR accumulates the energy value since it was powered on at the first time. (In case that users clear the energy to 0, the meter will re-accumulate the energy from 0)

Until the value reach 99,999,999.9 kWh/ kvarh, it will auto-turnover.

Under different connection mode, PMAC770-DR accumulates the energy in different way, as below sheet:

Connection mode	Energy calculation
3-phase 4-wire	Per phase 4 quadrant energy
	Total energy
	Multi-tariff energy
	History energy

3-phase 3-wire	Total energy
	Multi-tariff energy
	History energy

Tips
User can clear the energy to 0 on panel by keys, or clear from communication.

5.2 Active Energy

PMAC770-DR calculates the active energy according to the accumulated active power. And it distinguishes the direction of active/ reactive power to separately calculate per phase/ total active energy in 4 quadrants.

5.3 Reactive Energy

PMAC770-DR calculates the reactive energy according to the accumulated reactive power. And it distinguishes the direction of active/ reactive power to separately calculate per phase/ total reactive energy in 4 quadrants.

5.4 Multi-tariff Energy

PMAC770 statistics the import/ export kWh and import/ export kWh in different tariff.

PMAC770 supports 2 tariff lists. Users can set the 2 lists separately. Each tariff list can be set max. 8 periods in one day and 4 different tariff (F1, F2, F3, F4 means 4 kinds of tariff, and F1 for Sharp, F2 for Peak, F3 for Flat, F4 for Valley).

Below example for setting the tariff lists:

Tariff List	Num. of period	Period order	Starting time (to end time)	Tariff
Tariff List 1	8	1st period	00:00 (to 03:00)	F1
		2nd period	03:00 (to 06:00)	F2
		3rd period	06:00 (to 09:00)	F4
		4th period	09:00 (to 12:00)	F3
		5th period	12:00 (to 15:00)	F1
		6th period	15:00 (to 18:00)	F4
		7th period	18:00 (to 21:00)	F2
		8th period	21:00 (to 00:00)	F3
Tariff List 2	5	1st period	06:00 (to 10:00)	F1

		2nd period	10:00 (to 12:00)	F2
		3rd period	12:00 (to 14:00)	F1
		4th period	14:00 (to 20:00)	F3
		5th period	20:00 (to 06:00 of next day)	F4

There are 2 modes to calculate the multi-tariff energy: Date Mode and Holiday Mode.

Under Date Mode, it divides one year (365 days) into 2 periods

Under Holiday Mode, it divides the days by working day and holiday. Working day is from Monday. to Friday.

Holiday is from Saturday to Sunday.

Below example for setting the mode:

Mode	Time Zone 1 (use the Tariff List 1)	Time Zone 2 (use the Tariff List 2)
Date Mode	From Apr.1 to Sep. 30	From Oct.1 to Mar.31 of next year
Holiday Mode	From Mon. to Fri.	From Sat. to Sun.

Attention
<ol style="list-style-type: none"> 1. Users can divide one day (24 hours) up to 8 periods, and set 4 tariff maximum. 2. Each period must >15 minutes, and the duration must be a multiple of 15. 3. The starting time of each period must be in ascending order 4. The multi-tariff only can be set from communication. It can't be set on panel. 5. If 2 different periods use the same tariff, the meter will combine the energy of 2 periods together. 6. The system default that: Time Zone 1 uses the Tariff List 1, and Time Zone 2 use the Tariff List 2. User can't change it.

5.5 History Energy

PMAC770-DR statistics daily energy of last 31 days, and statistics monthly energy of last 12 months. User can read the history energy as below:

Daily energy of last 31 days	Import kWh/ kvarh, Export kWh/ kvarh
Monthly energy of last 12 months	(Each tariff) Import kWh/ kvarh, (Each tariff) Export kWh/ kvarh

6 Record Function

6.1 General Description

In order to facilitate users to do various fault analysis, PMAC770-DR provides up to 100 records of SOE event and 30 records of over-limit event for frequency deviation/ voltage deviation/ voltage unbalance. Users can easily and quickly position seeking the fault from the SOE event counter.

Additional, PMAC770-DR also provides records of Max. demand and Max./ Min. data for users doing analysis of electricity consumption.

6.2 SOE Event Log

PMAC770-DR can record the event of switch and relay position (i.e. ON/ OFF status.) The event is recorded with time stamp which is stored in PMAC770-DR by UNIX time format. Time resolution is 1ms. The UNIX time is a system for describing instances in time, defined as the number of seconds that have elapsed since the midnight 00:00:00 on January 1, 1970.

From PILOT software, users can see the event as below format:

No.	Event
1	2011-07-28 09:31:34 792ms Relay 1 ON

. For more details, please refer to **PMAC770-DR Modbus Register List**

6.3 Frequency Deviation Record

User can set the frequency deviation over-limit value in PMAC770-DR (default limit: 0.2Hz, setting range: 0~10Hz). When the $|\text{frequency deviation}| > \text{limit}$, PMAC770-DR records the deviation starting time, ending time, and the Max. deviation (value with sign). Users can find the record from communication.

Once the event happen, users can find the record in PILOT software as below format:

No.	Event
1	2011-07-28 09:31:34 to 2011-07-28 09:32: 15, frequency deviation, Max. value is 0.50Hz

For more details, please refer to **PMAC770-DR Modbus Register List**

6.4 Voltage Deviation Record

User can set the voltage deviation over-limit value in PMAC770-DR (default limit: 10%, setting range: 0~99.99%).When the $|\text{voltage deviation}| > \text{limit}$, PMAC770-DR records the deviation starting time, ending time,

and the Max. deviation (value with sign). Users can find the record from communication.

Once the event happen, users can find the record in PILOT software as below format:

No.	Event
1	2011-07-28 15:02:25 to 2011-07-28 15:30:46, voltage deviation, Max. value is -14%

For more details, please refer to ***PMAC770-DR Modbus Register List***

6.5 Voltage Unbalance Record

User can set the voltage unbalance over-limit value in PMAC770-DR (default limit: 20%, setting range: 0~100%).When unbalance > limit, PMAC770-DR records the unbalance starting time, ending time, and the Max. unbalance value. Users can find the record from communication.

Once the event happen, users can find the record in PILOT software as below format:

No.	Event
1	2011-07-28 06:05:25 to 2011-07-28 06:28:35, voltage unbalance Max. unbalance value is 24%

For more details, please refer to ***PMAC770-DR Modbus Register List***

6.6 Max. Demand Record

PMAC770-DR records the max. demand for 3-phase current, total active power, total reactive power, total apparent power.

When the instant demand exceeds the history maximum demand, PMAC770-DR will record the new maximum data with time stamp.

User can clear the Max. demand record from communication.

6.7 Max./ Min. Record

PMAC770-DR records the max./ min. for 3-phase voltage (ph-N and ph-ph)/ 3-pase current/ active power/ reactive power/ apparent power.

When the instant value exceeds the history maximum or lower than history minimum, PMAC770-DR will record the new max./ min. data with time stamp.

User can clear the Max./ Min. record from communication.

7 Set point Alarm

7.1 General Description

PMAC770-DR provides set point alarm for all parameters. It supports monitor 2 parameters at the same time.

There are 2 set point types: Over-limit and Under-limit. Users can set the limit as per requirement.

7.2 Setpoint alarm

7.2.1 General Description

PMAC770 provides setpoint alarm for all parameters. It supports monitor 2 parameters at the same time.

There are 2 setpoint types: Over-limit and Under-limit. Users can set the limit as per requirement.

7.2.2 Set point Object

PMAC770-DR can monitor 27 kinds of parameters, as below:

Object	Parameter
Voltage	Va, Vb, Vc, neutral voltage, average phase voltage, Vab, Vbc, Vca, average line voltage
Current	Ia, Ib, Ic, neutral current, average current
Power factor	PFa, PFb, PFc, Pftot
Frequency	Frequency
Power quality	Voltage unbalance, Phase A voltage THD Phase B voltage THD Phase C voltage THD Phase A current THD Phase B current THD Phase C current THD
Null	No object

7.2.3 Set over/ under limit

After set the monitoring object, users need to set the alarm condition, i.e. set the over/ under limit value. For setting range of the parameter, please refer to **PMAC770-DR Modbus Register List**

Note: When setting the over/ under limit, if the limit value is out of measuring range, the setting will be invalid.

Take the frequency for example:

Measuring range for frequency: 45-65Hz, default rated voltage is 50Hz. Setpoint limit range: 0-120%

If users set the under-limit: 20% (20% of rating, i.e. 10Hz), which is out of measuring range, the setpoint is invalid, it will not alarm.

7.2.4 Set the delay time

After set the over/ under limit, users need to set the delay time. Setting range: 0~99s. Only it satisfy two conditions that, the monitored object over/ under limit and lasting to delay time, will the setpoint channel be activated. If set the delay time to 0, it means setpoint channel will be activated once the object over/ under limit

7.2.5 Alarm Output

When the setpoint channel of one relay output is activated, the relay will output signal. One SOE event is record.

7.2.6 Example

Users want to monitor phase A voltage and set the over-limit to 120% Ue, linking with relay 1, set the delay time to 30s. If the actual phase A voltage exceed to the limit and lasting to 30s, then the relay 1 will output the signal. If the phase A voltage return to limit value within 30s, the relay 1 will not respond.

Note
1. If set the delay time to 0, it means setpoint channel will be activated once the object over/ under limit.
2. If no setting the monitor object, it means no relay alarm function.

8 LED light Explanation

There is two LED light on the PMAC770-DR: RUM, COM

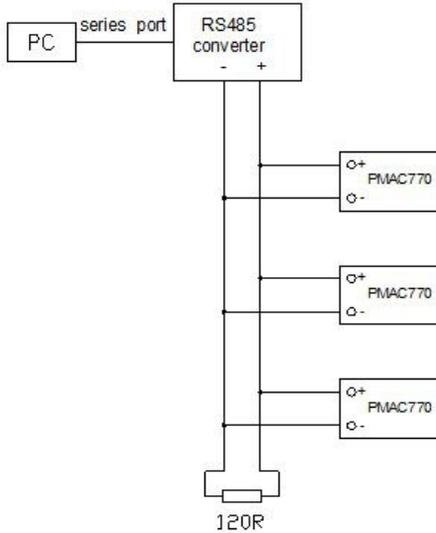
- 1) RUN: means running. It flashes when it is power on and run OK. When the meter stop running, the RUN LED light is off or keep lighting
- 2) COM: means communication. It flashes when it is power on and run OK. When the meter stop running, the COM LED light is off or keep lighting

9 Auxiliary Function

9.1 Communication

PMAC770-DR provides one RS485 port in basic module.

Attention: In the field, in order to avoid signal reflecting, it's common to connect a 120Ω resistance at the end of RS485 network for signal matching.



9.1.1 Communication Medium

The communication medium is No. 22 STP (Shielded twisted pair). Maximum 32 units of meters can be connected in one RS485 circuit. If there is no repeater, the communication bus should not longer than 1,200m.

9.1.2 Communication Protocol

PMAC770-DR support standard Modbus-RTU protocol. For more details, please refer to ***PMAC770-DR Modbus Register List***.

9.1.3 Communication Parameters

Communication between master and slave device will be available under correctly setting the communication parameters.

The parameters include:

- ◇ Address: Every meter has its exclusive address. Setting range: 1~247.

Note: Customer need to remember the Communication address once they modify it.

- ◇ Baudrate of RS485 port: 2400, 4800, 9600, 19200, 38400 (programmable)

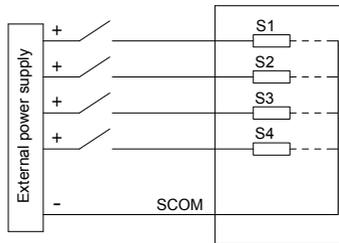
9.1.4 Strong Power Prevention

The RS485 terminals of PMAC770-DR have the strong power burning prevention function. It means that, even

there is 220VAC access to the RS485 terminals (within 5 minutes), the communication board will not be burnt. And the communication will be recovered once cut off the power.

9.2 Status Input

PMAC770-DR provides 3 status input as basic feature apply to monitor the ON/ OFF position of breakers or switchers etc..The status input of PMAC770-DR is wet contact, requires connecting external power supply 220VAC/ 50Hz. The example of 4 status input connection as below:



External active contact input (wet contact)

Generally, when external contact is ON, the linking status input channel on PMAC770-DR will be ON. When external contact is OFF, the linking status input channel on PMAC770-DR will be OFF.

From the communication, 0 means OFF, 1 means ON.

9.3 Relay Output

PMAC770-DR basic unit provides 2 relay output, relay node capacity: 250VAC/5A. There are 2 kinds of relay control mode: Local control and Remote control.

The default setting is Local control, user can set relay function via panel, or through communication to swift in Local and Remote control.

- ◆ Remote control (external) – Relay is controlled by PC or PLC via communication;
- ◆ Local control (internal) – Relay set as acted objectives of fixed limit value

Under remote control mode, local control conditions will be invalid. Only under local control mode, the over limit alarm will act normally.

- ◆ **Time delay** (Only valid under local mode)

Time delay: When relay action' s condition occurs, relay will act after N time (N= Action delay time, it can be set via panel or communication. When N=0, relay will act as soon as action condition occurs.) ;

◆ **Resetting time** (Only valid under remote mode)

Resetting time: The relay will recover from action after N time.(N = recover time, can be set via panel and communication. When N=0, relay will not recover to initial status.)

10 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.	<p>Check if the correct working voltage has been imposed on the L/+ and N/- terminals of the meter.</p> <p>Check if the fuse for the control power supply has been burnt down.</p>
The measured value is not correct or does not conform to the expectation.	The voltage measurement is not correct.	<p>Check if the neutral point has been connected reliably.</p> <p>Check if the measured voltage matches the rated parameter of the meter.</p> <p>Check if PT ratio has been set correctly.</p>
	The current measurement is not correct.	<p>Check if the measured current matches the rated parameter of the meter.</p> <p>Check if CT ratio has been set correctly.</p>

	The power measurement is not correct.	<p>Check if the connection mode has been set correctly.</p> <p>Check if the phase sequence corresponding to the voltage and the current is correct.</p> <p>Check if the wiring of current terminals are correct</p>
The DI status is not change	The DI operating voltage is not correct.	<p>Check if the types of external nodes match the rated parameters of the meter.</p> <p>Check if the external connection is correct.</p>
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 operating time has not been set correctly.	Check the setting of the operating time of the relay. For the specific information, refer to the content regarding relays of the operation manual.
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 or if there are more than two identical addresses in the same network.

	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 terminal resistor.	Check if the 120-Ohm 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.

11 Technical Specification

Metering	True RMS, 1 sec refresh time
Input	Rated current : 1A or 5A Rated voltage: direct 120 to 277Vph-N (optional) PT secondary: 100Vph-ph or 110V (optional) Frequency: 50 or 60 Hz (optional)
Overload	120% of rated, continuously Instantaneous current: 10 times / sec Instantaneous voltage: 2 times / sec
Status input	Wet contact, external power supply
Relay output	Node capacity: 250VAC/5A
Starting current	0.1%I _n
Power frequency withstand voltage	AC 2KV/minute
Insulation resistance	≥50MΩ
Impulse withstand voltage	4kV (peak), 1.2/50μS
Power supply	85 ~265VAC , 85~265VDC 100 ~ 420Vac , 100 ~ 400Vdc , 45~60Hz

	18~72Vdc (Optional)
Power loss	< 10VA
Communication	RS485 serial, support Modbus-RTU Baud rate: 2400, 4800, 9600, 19200, 38400bps Address: 1~247
Dimension (L x W x H)	Panel: 96 x 96 x 13.5 mm Cut-out: 96 x 96 x 58.6mm (basic unit)
IP index	IP52 (front panel) and IP30 (case)
Weight	Basic unit: approx 400gr.
Environment	Operating temperature: -10℃~ +55 ℃ Storage temperature: -40℃~ +70 ℃ Humidity: 5%~95% non-condensing

Parameter	Accuracy	Resolution	Measuring Range
Voltage	0.2%	0.01V	Direct: 500Vph-ph
			PT primary: 0~65.00kV
			PT secondary: 100Vph-ph or 110V
Current	0.2%	0.001A	CT primary: 0~9,999A
			CT secondary: 1 A or 5A
Power	0.5%	0.1W/var/ VA	Per phase: 0~649.9MW/ Mvar/ MVA
			Total: 0~1949.8MW/ Mvar/ MVA
Power factor	0.5%	0.001	-1.000~+1.000
Frequency	0.5%	0.01Hz	45~ 65 Hz
Active energy	0.5%	0.1kWh	0~ 99,999,999.9 kWh
Reactive energy	2.0%	0.1kvarh	0~ 99,999,999.9 kvarh
THD	1.0%	0.001	0~100.0%
Individual harmonic	1.0%	0.001	0~100.0%

Un-balance	1.0%	0.001	0~100.0%
Time	0.5s		0~ 24 hours

Item	Standard	Level
Oscillatory waves immunity test	IEC61000-4-12:1995	III
Electrostatic discharge immunity	IEC61000-4-2:2001	III
Radiated,radio-frequency,Electromagne field immunity test	IEC61000-4-3:1998	IV
Electrical fast transient/burst immunity test	IEC61000-4-4:1998	III
Surge immunity test	IEC61000-4-5:2005	III
Immunity to conducted disturbances, induced by radio-frequency fields	IEC61000-4-6:1998	III
Power frequency magnetic field immunity test	IEC61000-4-6:2001	III
Electromagnetic emission limit value	IEC60255-25:2000	OK
Power frequency immunity test	IEC61000-4-8:2001	A