AHM1 AHM1TCP AHM1B and AHM1BC

Multifunction Power Meter

User Manual

Content

1 Safety Precautions

The manufacturer shall not be held responsible for failure to comply with the instructions in this manual.

The equipment must be installed and serviced only by qualified personnel. Never work alone.

Prior to any work on or in the equipment, isolate the voltage inputs and auxiliary power supplies，short the secondary of all CT, but never short the secondary of PT.

Always use a properly rated voltage sensing device to conform that all power is off.

Risk of damaging device

■ The voltage of the auxiliary power supply is beyond the rated range.

■ The frequency of the power distribution system is beyond the rated range.

■ The input polarity of the voltage or the current is wired improperly.

2. Product description

2.1 Overview

AHM1, AHM1TCP, AHM1B and AHM1BC are equipped with electrical variable measurement, energy metering and power quality analysis functions. AHM1 line of power meters can be used for monitor and control of equipment, system integration with different smart electricity distribution and energy management system. It can also share monitoring data and energy data.

2.3 Model selection

		AHM1	AHM1TCP	AHM1B	AHM1BC
Measurement	Electrical variables	●	●	●	●
	Bi-direction energy	●	●	●	●
	Four-quadrant reactive energy	●	●	●	●
	Apparent energy	●	●	●	●
	Spare energy	●	●	○	○
	Tariff energy	●	●	○	○
	Harmonics	●	●	●	●
	Unbalance	●	●	●	●
	Load curve record	●	●	○	○

RS485 communication	●	●	○	●
Ethernet communication	○	●	○	○
Digital input	●	●	○	○
Relay output	●	●	○	○
RTC	●	●	○	○

Note: ● Yes, ○ No,

2.3 Measurement

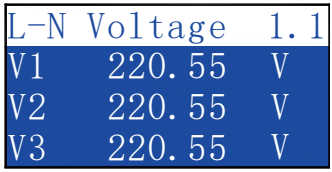
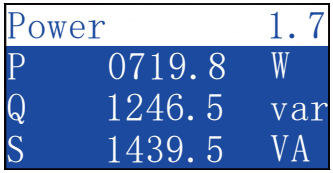
- Up to 230/400V can be connected directly. Higher voltages using voltage transforms.
- The ×/1A or ×/5A current transformers can be used

The following list shows variables which can be measured by AHM1, AHM1B and AHM1BC including relative variables calculated from basic electrical parameters.

Measurement variable	Instant	Max	Min	Demand	sum	unit
V1/V2/V3	√	√	√	-	-	[V,kV]
V12/V23/V31	√	√	√	-	-	[V,kV]
I1/I2/I3	√	√	√	√	-	[A,kA]
F	√	√	√	-	-	[Hz]
P1/P2/P3	√	√	√	-	-	[kW,MW,GW]
P	√	√	√	√	-	[kW,MW,GW]
Q1/Q2/Q3	√	√	√	-	-	[kvar,Mvar,Gvar]
Q	√	√	√	√	-	[kvar,Mvar,Gvar]
S1/S2/S3	√	√	√	-	-	[kVA,MVA,GVA]
S	√	√	√	√	-	[kVA,MVA,GVA]
PF1/PF2/PF3	√	-	-	-	-	-
PF	√	√	√	-	-	-
EP+/EP-	-	-	-	-	√	[kWh,MWh, GWh]
EQ1/EQ2/EQ3/EQ4	-	-	-	-	√	[kvarh,Mvarh,Gvarh]
Spare Energy	-	-	-	-	√	[kWh,MWh, GWh] [kvarh,Mvarh,Gvarh]

THDV1/THDV2/THDV3	√	-	-	-	-	[%]
THDI1/THDI2/THDI3	√	-	-	-	-	[%]
Harmonic RMS-U (1~31th)	√	-	-	-	-	[%]
Harmonic RMS-I (1~31th)	√	-	-	-	-	[%]
Unbalance-U	√	-	-	-	-	[%]
Unbalance-I	√	-	-	-	-	[%]

Examples for display pages

	Left picture shows three phase voltage. Click ⌄ or ⌃ to switch to other pages; click ← to return to main interface.
	Left picture shows three phase active power, reactive power and apparent power. Click ⌄ or ⌃ to switch to other pages; click ← to return to main interface.

2.4 Energy metering and tariff meter reading

This meter has excellent energy metering functions as follows:

- Bi-direction active and reactive energy metering
- Apparent energy metering
- Four-quadrant reactive energy
- Import active tariff energy metering
- Spare energy metering

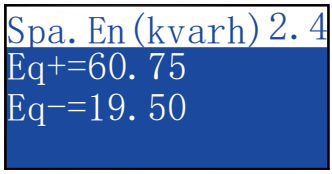
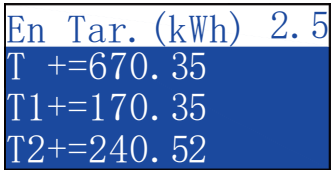
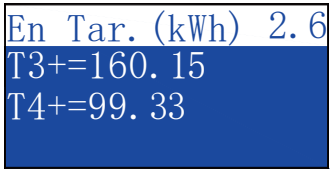
The meter shows primary value. Primary value is equal to the secondary value multiplied by voltage or current transformer ratio. Secondary value is the reference to all of the energy. The smallest resolution ratio of secondary value is 1Wh or 1varh. The smallest resolution ratio of energy shown on

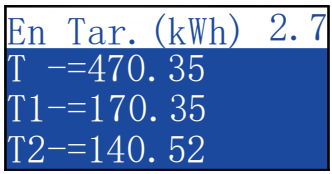
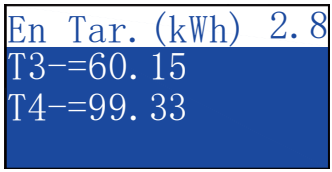
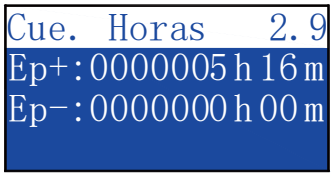
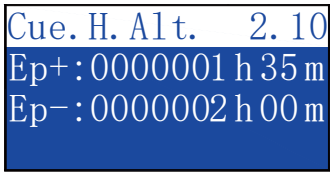
meter is 0.01kWh or 0.01kvarh.

The storage range of energy is secondary energy 4294967295 Wh, and the display range of energy is primary energy 99999999999 kWh (99.9 billion). The data will not exceed the range if the meter is in its mean time between failures. User can clear the energy data after entering correct password.

Tariff energy: meter can measure tariff energy in four time zones at most. It starts one time zone according to the status of digital input.

AHM1B does not support import active tariff energy metering and spare energy metering functions.

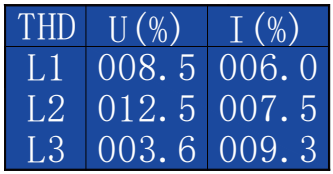
	Left picture show bi-direction active energy. Ep+= 670.35kWh, Ep- = 0.
	Left picture shows spare reactive energy. Eq+= 60.75kvarh, Eq- = 19.5kvarh.
	Left picture shows tariff energy of import active energy. T+ =670.35kWh, T1+ =170.35kWh, T1+ =240.52kWh.
	Left picture shows tariff energy of import active energy. T3+ =160.165kWh, T4+ =99.33kWh.

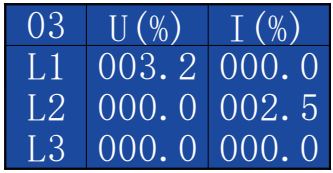
	Left picture shows tariff energy of import active energy. T+ =470.35kWh, T1+ =170.35kWh, T1+ =140.52kWh.
	Left picture shows tariff energy of import active energy. T3+ =60.15kWh, T4+ =99.33kWh.
	Left picture shows accumulation time of import active energy. Ep+ =5 hours 16 minutes, Ep- =0
	Left picture shows accumulation time of spare energy. T3+ =1 hour 35 minutes, T4+ =2 hours

2.5 Harmonics analysis

Meter can measure harmonics in grid as shown in the following list:

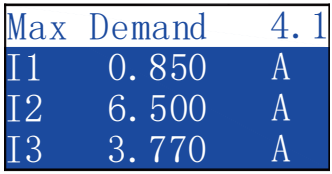
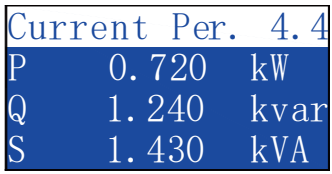
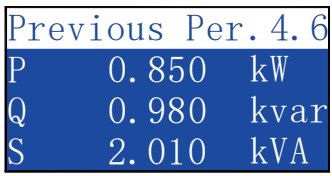
- Three-phase voltage/current THD
- Three-phase voltage/current 2nd to 31st harmonic content.

	Left picture show three-phase voltage and current THD.

	Left picture shows third harmonic content of three-phase voltage and current.

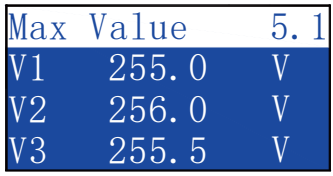
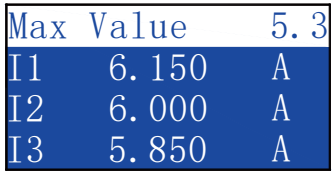
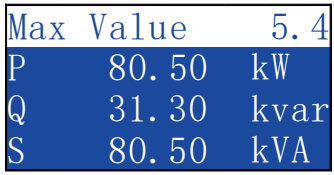
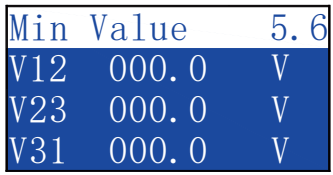
2.6 Demand measurement

Meter can measure max. demand, present demand and former demand of three-phase current, total active power, total reactive power and total apparent power.

	Left picture shows max. demand of three-phase total active power, reactive power and apparent power.
	Left picture shows present demand of three-phase current.
	Left picture shows three-phase total active power, reactive power, apparent power in last cycle.

2.7 Extreme value measurement

Meter can measure max. and min. value of phase voltage, line voltage, three-phase current, total active power, total reactive power and total apparent power.

	Left picture shows max. value of three-phase voltage.
	Left picture shows max. value of three-phase current.
	Left picture shows max. value of three-phase total active power, reactive power and apparent power.
	Left picture shows min. value of line voltage.

2.8 Data record

Meter can record 32 pieces of SOE events and 32000 pieces of electrical variables. As for detailed information, please refer to “AHM1 Modbus Manual”. AHM1B and AHM1BC do not support data recording function.

2.9 Extension functions

2.9.1 Time

Left picture shows time information.

2.9.2 Digital input

Digital input adopts dry contact mode. There is working power supply inside the meter, so that there is no need for external power supply. Digital input supports five working modes:

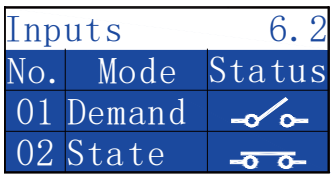
(a) Status monitoring: the meter receives the status of terminal node and shows it on the window. It also shows the newest status immediately when the status of terminal node changes.

(b) Synchronous demand: the meter starts to calculate demand when it receives digital input signal and stops calculating demand when external signal is off.

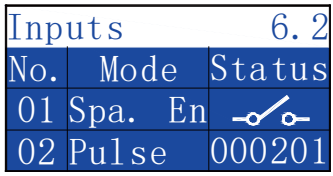
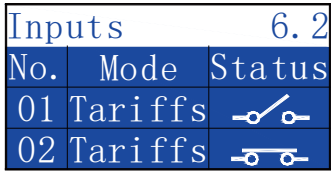
(c) Synchronous energy: the meter starts to measure spare energy when it received digital input signal and stops measuring spare energy when external signal is off.

(d) Pulse counting: the meter receives and counts up the number of pulses from terminals.

(e) Tariff energy: digital input is used as tariff setting function. There are four kinds of rates. Meter accumulates energy during a period to corresponding time zone.



Left picture shows working modes of two digitals inputs are synchronous demand and status monitoring. No. 2 digital input receives signal.

<table>
<tr><td> 
</td><td>Left pictures shows workings modes of two digital inputs are spare energy and pulse counting. No.2 digital input receives signal.</td></tr>
<tr><td> 
</td><td><table>
<tr><td>DI2</td><td>DI1</td><td>Tariff</td></tr>
<tr><td>0</td><td>0</td><td>T1</td></tr>
<tr><td>0</td><td>1</td><td>T2</td></tr>
<tr><td>1</td><td>0</td><td>T3</td></tr>
<tr><td>1</td><td>1</td><td>T4</td></tr>
</table>
Left picture shows working mode is tariff energy, and time zone is T2.</td></tr>
</table>

2.9.3 Relay output

The meter supports two relay outputs with three working modes which are energy pulse, off-limit alarm and remote control. As for detailed information about relay output setting, please refer to Part 5.2.

Notice:

(a) Energy pulse

Set interface output energy pulse.

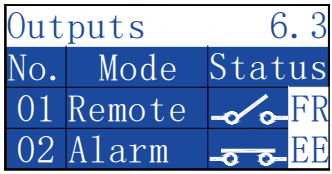
(b) Off-limit alarm

Set relay output as “Alarm” mode, “Mode” is used to select an electrical variable, “Delay” is used to set alarm delay time, “Value” is used to set alarm limit value, “Reset” is used to set alarm recovery value for electrical variable.

(c) Remote control

If user needs to remotely control relay output, please set the working mode as “Remote”.

Set delay as electrical level mode or set delay time as N * 100ms.

	Left picture shows the working mode of No.1 relay output is remote control and that of No.2 relay output is off-limit alarm. "FREE" indicates to release alarm by manual: if the working mode of relay output is off-limit alarm, and the status is locked, the relay will become closed when alarm occurs. When the condition does not meet limit alarm value, the relay is still closed. Now user can click ↵ to release alarm and the relay will become open.

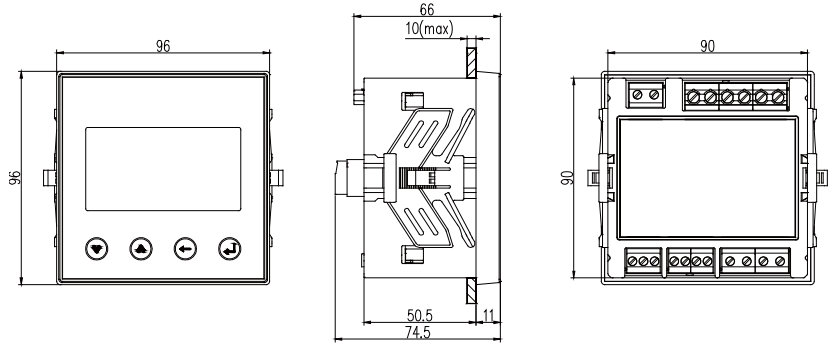
2.9.4 Software version

It shows the software version of meter.

	Left picture shows the software version of meter.

3. Installation and wiring

3.1 Outline dimension



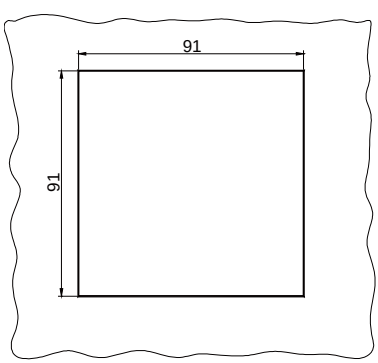
3.2 installation method

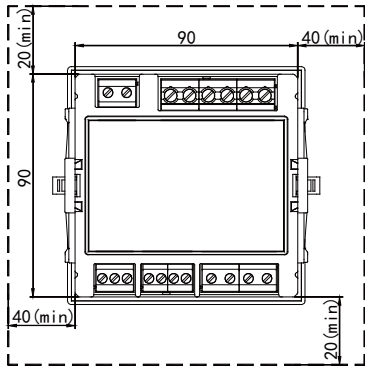
1) Choose a right place on the fixed distribution cabinet for cutout by size 91×91mm;

2) Take off the supporting clips of the meter;

3) Insert the meter into the cutout;

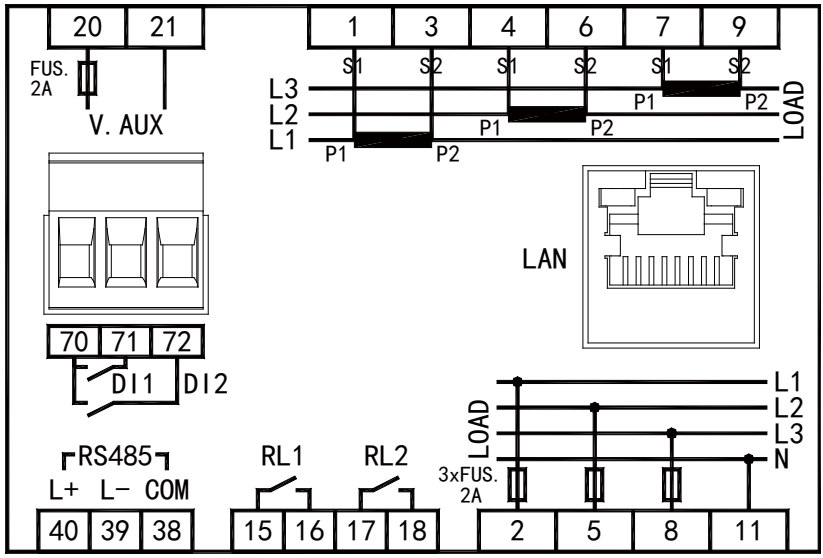
4) Insert and push the supporting clips to fix the meter.





3.3 Wiring

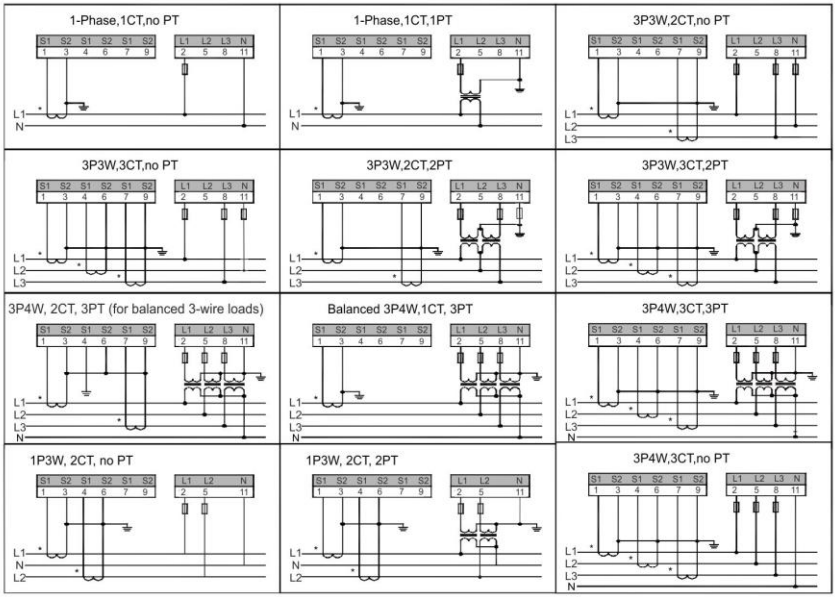
Typical wiring



Note:

1. Auxiliary power supply: AC/DC (80~270) V
2. Rated current of fuse: 0.5A

Signal wiring diagram



Wiring instruction:

(a) External wiring method must be the same with the inner wiring method of the meter. Otherwise the measured data will be incorrect.

(b) Voltage and current signals must be AC signals. Please do not connection DC signals to input terminals.

(c) Voltage input: make sure the input voltage in not higher than the rated voltage of the meter, otherwise, please connect external PT to the meter. If external PT is adopted, the accuracy of meter will depend on the accuracy of external PT. Please make sure the accuracy of external PT is equal to or better than that of meter. For your convenient maintenance, please adopt wiring terminal row.

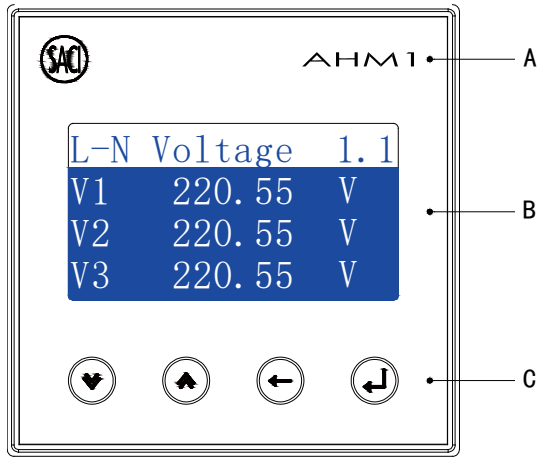
(d) Current input: make sure the input current in not higher than the rated current of the meter, otherwise, please connect external CT to the meter. If external CT is adopted, the accuracy of meter will depend on the accuracy of

external CT. Please make sure the accuracy of external CT is equal to or better than that of meter. If there is more than one meter connected to the CT, please connect them in serial. Before removing the current input wires of the meters, make sure to cut off the first loop of CT or short connect its second loop. For your convenient maintenance, please adopt wring terminal row.

(e) Make sure voltage and current of three phases corresponding to each other, that means the phase sequence and direction are same. Otherwise, the numbers and signals will be incorrect (power and energy).

4. Operation

4.1 Display



A: Model B. Display window C: Keys

5. Setting

5.1 Signs for keys and corresponding functions

User can set parameters for meter through keys.

Sign	Function
	Move downward, switch to next page, change parameter

	Mover upward, switch to former page, change parameter
	Return key
	Confirm key, click it to switch to next bit after changing the number at present bit.

The method of changing value

Click  or  to change the number at present bit, and then click  to save the number at present bit and switch to next bit.

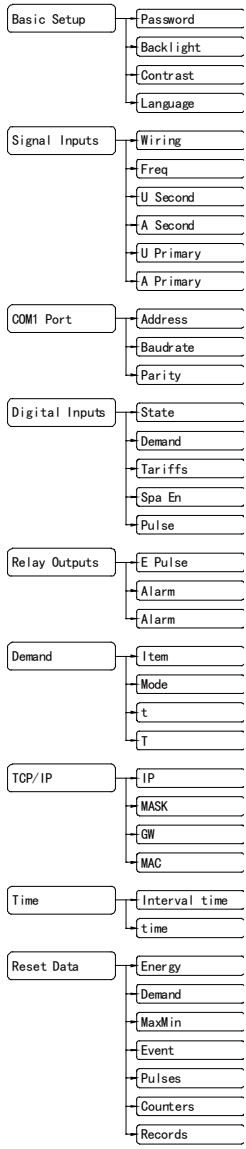
Enter and exit programming status

Enter programming mode: Click  or  to select “Setup” in main interface, and then click  to enter programming interface. Select “User” and input correct password to enter parameter setting mode. (Programming password is defaulted as 0001 in factory. User can change the password).

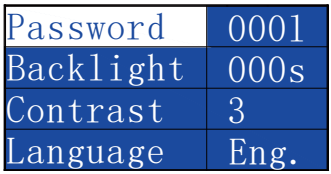
Exit programming mode: return to first level of menu at first, and then click  . The meter will indicate whether to save modified data or not at this step. If “Yes” is selected, the meter will save modified data and return to main interface; if “No” is selected, the meter will cancel modified data and return to main interface.

5.2 Programming and setting menu

Programming and setting menu adopts hierarchical mode. The main structure is shown in the following picture:

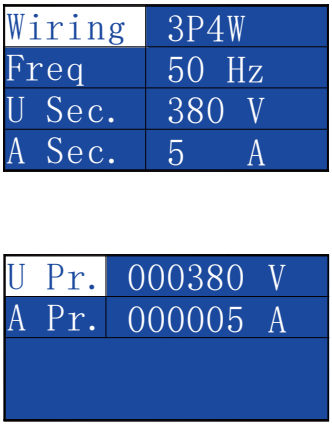

Basic Setup
Password
Backlight
Contrast
Language
Signal Inputs
Wiring
Freq
U Second
A Second
U Primary
A Primary
COM1 Port
Address
Baudrate
Parity
Digital Inputs
State
Demand
Tariffs
Spa En
Pulse
Relay Outputs
E Pulse
Alarm
Alarm
Demand
Item
Mode
t
T
TCP/IP
IP
MASK
GW
MAC
Time
Interval time
time
Reset Data
Energy
Demand
MaxMin
Event
Pulses
Counters
Records

Basic parameter setting



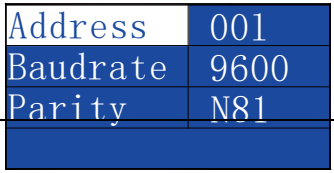
Password	0001-9999
Backlight	000s-999s 000s-backlight constant on
Contrast	0-7
Language	English

Signal input setting



Wiring method	1P2W,3P3W,3P4W,1P3W
Frequency	50Hz/60Hz
PT secondary value	0-690V
CT secondary value	0-6A
PT primary value	0-999999V
CT primary value	0-999999A

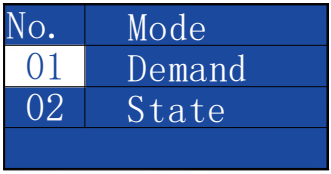
Communication setting

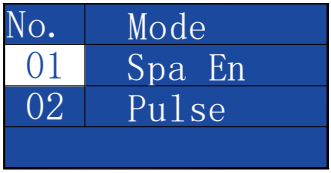
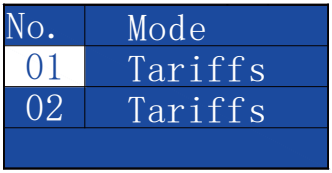


Address	1~247
Baud rate	1200~38400bps

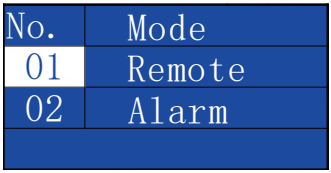
	Check mode	E81, O81, N81, N82

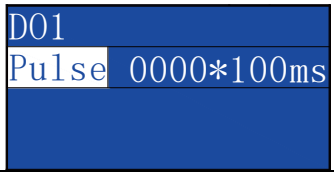
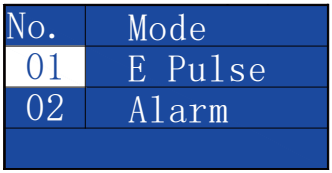
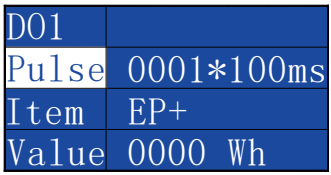
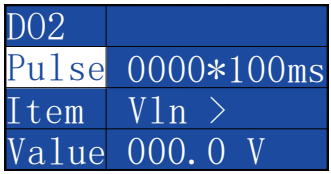
Digital input setting

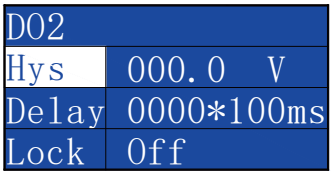
<table>
<tr>
<td> 


</td>
<td>Digital input supports five working modes which are synchronous demand, status monitoring, spare energy, tariff energy and pulse counting.</td>
</tr>
<tr>
<td> 
</td>
<td>
<table>
<tr><th>DI2</th><th>DI1</th><th>Tariff</th></tr>
<tr><td>0</td><td>0</td><td>T1</td></tr>
<tr><td>0</td><td>1</td><td>T2</td></tr>
<tr><td>1</td><td>0</td><td>T3</td></tr>
<tr><td>1</td><td>1</td><td>T4</td></tr>
</table>
Left picture shows the working modes of two digital inputs are tariff energy. The two digital inputs must be set as tariff energy.
</td>
</tr>
</table>

Relay output setting

<table>
<tr>
<td> 
</td>
<td>There are three working modes of relay output which are remote communication, energy pulse and alarm.</td>
</tr>
</table>

<table>
<tr><td> 
</td><td colspan="2">Remote control output mode</td></tr>
<tr><td rowspan="2"></td><td>Pulse</td><td>Pulse width:0~ ms</td></tr>
<tr><td> 
</td><td colspan="2">Energy Pulse output mode</td></tr>
<tr><td rowspan="4"> 
</td><td>Pulse</td><td>Pulse width: (0~9999)×100ms</td></tr>
<tr><td>Item</td><td>Energy Pulse：Ep+, Ep-, Eq+, Eq-</td></tr>
<tr><td>Value</td><td>Impulse constant：It indicates one pulse corresponds to *Wh energy.</td></tr>
<tr><td></td></tr>
<tr><td rowspan="7"> 


</td><td colspan="2">Alarm output mode</td></tr>
<tr><td>Pulse</td><td>Pulse width: (0~9999)×100ms</td></tr>
<tr><td>Item</td><td>See following list</td></tr>
<tr><td>Value</td><td>Limit value</td></tr>
<tr><td>Hys</td><td>Hysteresis value</td></tr>
<tr><td>Delay</td><td>Delay time: (0~9999)×100ms</td></tr>
<tr><td>Lock</td><td>Alarm hold</td></tr>
</table>

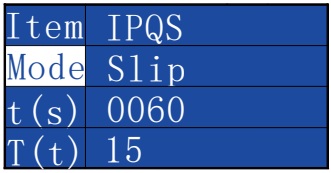
Electrical variables for alarm are shown in the following list:

Item	Format	Instruction	Item	Format	Instruction
OFF		Off	P <	xxxx W	Low total active power alarm
DI	0-5	Specified digital inputs	P >		High total active

		linkage			power alarm
THDi <	xx.xx%	Low current THD alarm	F <	xx.xx Hz	Low grid frequency alarm
THDi >		High current THD alarm	F >		High grid frequency alarm
THDv <		Low voltage THD alarm	Iavg >	x.xxx A	High average current alarm
THDv >		High voltage THD alarm	Iavg <		Low average current alarm
Iunb <	xxx.x %	Low current unbalance alarm	I <		Low phase current alarm (any phase)
Iunb >		High current unbalance alarm	I >		High phase current alarm (any phase)
Vunb <		Low voltage unbalance alarm	Vllavg <	xxx.x V	Low average line voltage alarm
Vunb >		High voltage unbalance alarm	Vllavg >		High average line voltage alarm
In <	x.xxx A	In Low current In alarm	Vlnavg <		Low average phase voltage alarm
In >		In High current In alarm	Vlnavg >		High average phase voltage alarm
PF <	x.xxx	Low total power factor alarm	Vll <		Low line voltage alarm (any line voltage)
PF >		High total power factor alarm	Vll >		High line voltage alarm (any line voltage)
S <	xxxx VA	Low total apparent power alarm	Vln <		Low phase voltage alarm (any phase voltage)

S >		High total apparent power alarm	Vln >		High phase voltage alarm (any phase voltage)
Q <	xxxx var	Low total reactive power alarm			
Q >		High total reactive power alarm			

Demand setting

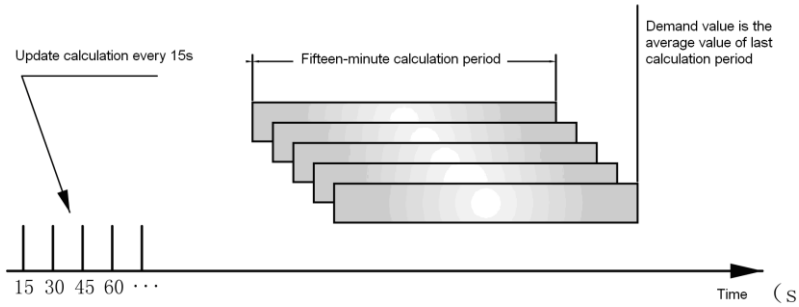


Item	I1, I2, I3, P, Q, S
Mode	Slip/Fixed
t	
T	T=n*t, n: integer

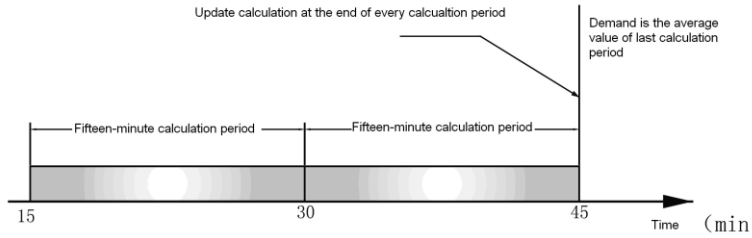
There are two demand measurement modes which are slip and fixed. The relative time parameters are set as t (updating time) and T (time zone). T is integral multiple of t.

Slip: meter calculates average demand during latest T minutes every t seconds, tests and records the value, automatically reads the demand every month;

Fixed: meter calculates average demand during latest T minutes after T minutes, tests and records the value, automatically reads the demand every month.



Slip mode



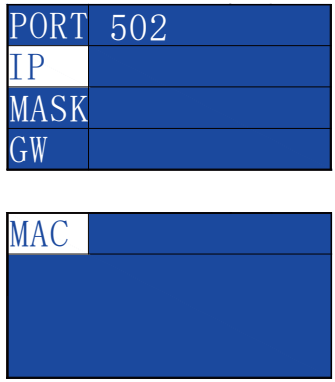
Fixed mode

Note: calculation method for upper pictures takes 15min as example.

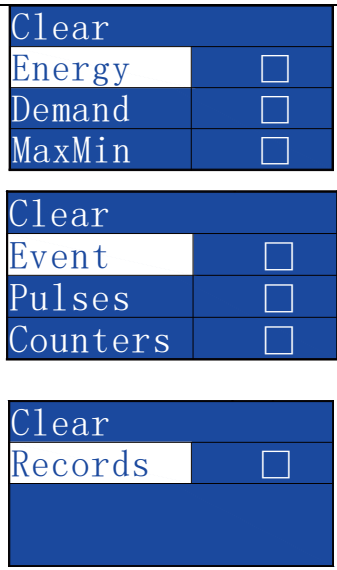
Time setting

Inter. 0005 Min Time 16-07-15 14:18:27	Data saving interval, unit: minute Setup real-time clock

TCP/IP setting

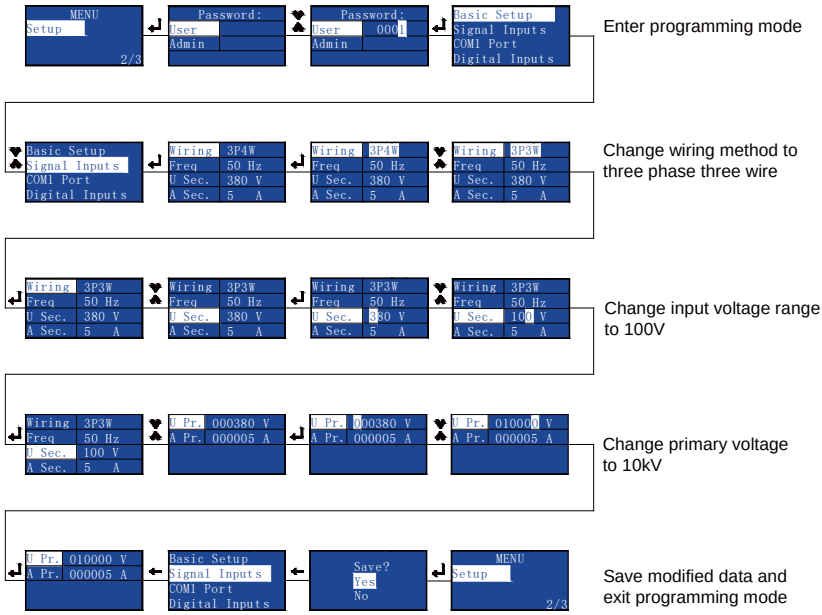
	Set IP address, subnet mask, network administrator GW and MAC address

Clear synchronous setting

	Clear data including energy, demand, extreme values, events, pulse counting, energy metering time and records.

5.3 Example for programming operation

Suppose the wiring method of meter is three phase four wire, input voltage range is 380V and primary voltage is 380V, change the wiring method to be three phase three wire, change input voltage range to be 100V and change primary voltage to be 10kV, the programming operation process is as follows,



6. Communication

Meter is defaulted to be equipped with one communication, RS-485 interface, Modbus-RTU protocol. It also can be extended with one Ethernet communication. As for detailed information of communication, please refer to AHM1 Communication User Manual.

7. Common problems and solutions

About communication

The meter does not send data back

First make sure the communication setting information of the meter such as address, baud rate and check mode correspond to the requirements of host computer. If several meters at field do not send data back, please check whether the communication bus at field is connected correctly and whether RS485 converter works normally.

If there is only one meter or a few meters communicate abnormally, related communication bus is also needed to be checked. User may check whether there is an error in the host computer by exchanging the addresses of normal meter and abnormal meter. User also can check whether there is a fault in the meter by exchanging the installation positions of normal and abnormal meters.

The data sent back by the meter is incorrect

Communication data which is opened to users includes primary grid “float” type data and secondary grid “int/long” type data. Please read the instruction for data storage address and format in Communication User Manual carefully, and make sure to transmit data according to relative format.

It is suggested to use software ModScan32 for Modbus-RTU communication protocol. This software adopts standard Modbus-RTU protocol which can display data in the formats such as integer, float and

hexadecimal, so that user can compare the data with measured data shown on the meter directly.

Incorrect measurement

Make sure input voltage and current are correct. The multimeter is used for measuring voltage signal, and the clip-on meter is used for measuring current signal.

Make sure the signal wire is connected correctly, for example the dotted terminals of current signal (i.e. inlet) as well as the phase sequence of each phase should be correct. Observe power display interface of the meter, power symbol is positive in usual condition. It is negative only generation condition. If the power symbol is negative, the input wiring of current or phase sequence may be wrong. This series meters support to change current directions of same polarity by software. User can set reverse current in setting menu online.

Electrical quantity shown on the meter is the value of primary grid; it may lead to wrong electrical quantity display if the ratio of voltage and current transformer is not same as that of transformer in-service. Connection method and voltage/current range can be modified according to actual connection at field, but wrong setting also can lead to wrong display.

About incorrect energy metering

Energy is accumulated on the basis of power measurement; check whether power value displayed is consistent with actual load. As the meter supports bi-direction energy measurement, energy will be accumulated to export energy instead of import energy if wires are not connected properly or total active power is negative. The most common problem at field is inlet and outlet wire of current transformer are in reverse connection. Observe signed active power in split phase, and it may be negative because of wrong connection, and what's more, wrong phase sequence may lead to wrong running.

Meter does not work

Ensure proper auxiliary supply is connected to the auxiliary supply terminal. As the meter may be damaged by auxiliary supply voltage which is beyond the rated range and it can not recover. Use multi-meter to measure the voltage of auxiliary supply, if the meter does not display when the voltage is proper, please electrify it again, then if the meter can not display normally, please contact with our technical service department

Another abnormal situation

Please contact our technical service department to give a detailed description of the field condition. Our technicians will analyze possible causes according to your description. The company will appoint technicians to deal with problems at field as soon as possible if the problem can not be settled.

8. Technical specification

Electric Characteristics			
Accuracy	Voltage and current		0.2%
	Power, Power Factor		0.5%
	Frequency		±0.01Hz
	Active power		IEC62053-22, class 0.5S
	Reactive power		IEC62053-23, class 2
Data update rate			1s
Input	Wiring mode		1P2W, 3P3W, 3P4W
	Voltage	Rated value	400 VAC L-N (690 VAC L-L)
		Overload	1.2Vln
		Impedance	>1MΩ
	Current	Rated value	1A or 5A
		Overload	Continuous: 1.2In
			Instantaneous: 10In/5s
		burden	<0.1VA
		Rated value	<20mΩ
	Grid frequency		(45~65) Hz
Auxiliary supply	Working range		AC/DC (80~270) V
	consumption		≤ 10VA

Energy pulse output	2 photo couple outputs, pulse width (80±20%) ms
Digital input	Dry contact input, isolation: 2000VAC
Relay output	Contact rated at AC 250V/5A or DC 30V/5A
	Isolation: 2500VAC
Communications (AHM1, AHM1TCP and AHM1BC)	
RS485 Port	Modbus-RTU, 2-wire, up to 38400bps
RJ45 Port	Modbus-TCP, Ethernet RJ45 10/100 Mbps
Digital input (AHM1 and AHM1TCP)	
Type	Dry contact input
isolation	2kV AC
Min. Pulse duration	5ms
Max. frequency of Pulse	100Hz
Digital output (AHM1 and AHM1TCP)	
Max. Load rating	AC 250V/5A or DC 30V/5A
Isolation	2kV AC
Mechanical Characteristics	
IP index	IP65 (front panel) and IP20 (meter body)
Dimensions	96×96×55mm
Environmental Characteristics	
Operating temperature	(-10~60) ºC
Storage temperature	(-25~70) ºC
Relative humidity	(5~ 95)% (no gel) (without condensation)
Insulation	IEC 61010-1
Electromagnetic Compatibility	
Immunity to electrostatic discharge	IEC 61000-4-2-Level III
Immunity to radio-frequency field	IEC 61000-4-3- Level III
Immunity to electrical fast transients/bursts	IEC 61000-4-4- Level IV
Immunity to impulse waves	IEC 61000-4-5- Level IV
Immunity to conducted disturbances	IEC 61000-4-6- Level III
Immunity to power frequency magnetic fields	IEC 61000-4-8- Level III
Immunity to voltage dips and short interruptions	IEC 61000-4-11- Level III