ADTEK

AFM-8A

High Performance Power Analyzer
Operation Manual

Rev 1.1

2025-06-05

Safety warning

Please read this manual carefully before installing, operating or maintaining this equipment. Please note the following special signs appearing in this manual or on the device, which are used to warn of potential hazards or to interpret and specify the operating procedures.

The presence of such safety signs indicates that there is a danger of electricity, and failure to follow certain instructions will result in personal injury.

This is a safety warning sign that warns of the risk of potential personal injury.
Please follow all the safety information after this mark to avoid possible injury or death.

The sign for the reminder, to avoid the operation due to inadvertently caused the instrument can not work or even damage the instrument or cause harm to the person.

The equipment must be turn off all power supplying and grounded before maintenance and overhaul.
Maintenance only work by qualified personnel.
This manual applies to persons who have been trained to use. The company are not responsible for any problems arising out of their abnormal use.

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Chapter 1. Meter overview

1.1 AFM-8A series function introduction

This is a powerful multifunction power meter

AFM-8A series is a powerful multifunction power meter, designed by high-speed microprocessors and advanced signal processing technology. With three-phase power measurement, display, power accumulation, power quality analysis, event logging, power quality event logging, waveform record, TOU and network communications functions. 3.5-inch high-definition color TFT-LCD display provides a variety of data display, so you can easily read the measurement data. User-friendly display and operation method allows users to easily operate without having to find the manual at any time.

Perfect choice for power SCADA system

AFM-8A series can be used as a stand alone meter, but also can be a power monitoring system (SCADA) of the front-end devices, through a variety of communication interface for remote data collection and control. The industry standard RS-485 communication interface and MODBUS communication protocol, as well as Ethernet and MODBUS TCP / IP protocol makes the network easy and convenient, is the perfect choice for SCADA system integration.

Energy management

AFM-8A series can calculate bidirectional and four-quadrant active power and reactive power accumulation, as well as the maximum / minimum value of the parameters and demand calculation function, with the system software can help users to measurement the energy consumption of each circuit loop and load trends.

Remote control

AFM-8A series is not only a measurement meter, in addition to includ DI, relay output and AO interface, also can via second RS-485 port to connect expansion DIO modules, to achieve flexible I / O function, become a powerful discrete RTU system.

Analysis of power quality

AFM-8A series using digital signal processing technology, it can real-time measurement the phase voltage and current total harmonic distortion (THD), individual harmonic (2-63rd), voltage and current unbalance.

Data logging function

The AFM-8A series provides 4MB flash RAM for data storage, it's recording the specified parameters on a regular time. Internal with high-precision real-time clock, each record with a timestamp.

Time of use function(TOU)

The AFM-8A series has a powerful TOU function and up to 5 years of holiday setting function. The user can be based on the local TOU price to settings for achieve energy cumulative calculation.

Power quality event logging

AFM-8A series in the voltage sag, swell and over current events occur, will record the time of the incident and the trigger conditions. It's up to 50,000 records of power quality events.

Waveform records

AFM-8A series can record 8 groups of each phase voltage and current waveform data, each cycle has 64 points sampling data of the record, the meter can record before and after the 8 cycle waveform data from trigger conditions establish. The trigger conditions can be setting by user, it's provided the data for power quality analyze.

1.2 AFM-8A series product features

Multi-function, high precision

AFM-8A multifunction meter series has a powerful data collection and processing ability, can measure many power parameters, and demand calculation, harmonic analysis, maximum / minimum values, event alarm, energy accumulation, data logging , TOU function, power quality event logging and waveform recording.

Voltage and current measurement accuracy is 0.1%, power is 0.25% and energy is 0.5%.

Compact design, easy installation

The dimensions of the AFM-8A series conform to the IEC standard 92mm DIN square shape, and thickness only 82mm. Installation by self-locking buckles without screws, installation or removal are very convenient.

Intuitive display, easy to learn and use

3.5-inch large screen, high-brightness LCD display, the screen clear and the content intuitive, easy to learn and use. All measurement data can be easily read through the panel keys operation, the parameters can be set by the panel keys, also can be written by the communication. The parameters setting and accumulated values are stored in the FRAM, even if the power down is not lost. LCD brightness can be adjusted, and standby screen brightness also can be set, allowing you to use in different environments.

Wiring flexible and convenient

Whether the system is high or low voltage, and whether it is single-phase or three-phase , you can choose the appropriate wiring to meter connection. AFM-8A series support multiple wiring method, can cover all the power system applications.

Safety, high reliability

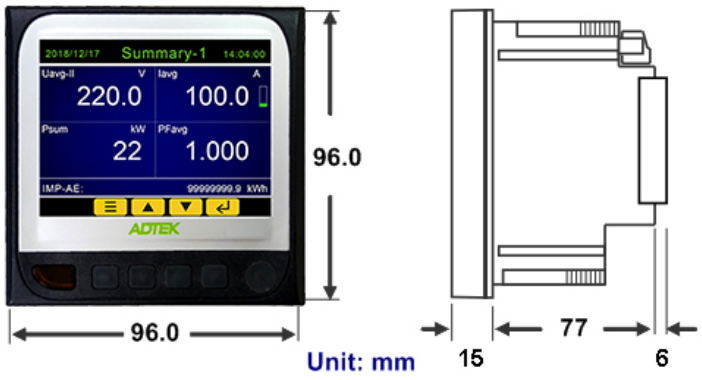
AFM-8A series with multiple isolation and anti-interference design, can operating in high-interference environment. The meter also approved by CE certification and IEC standards of EMC testing.

1.3 AFM-8A series applications

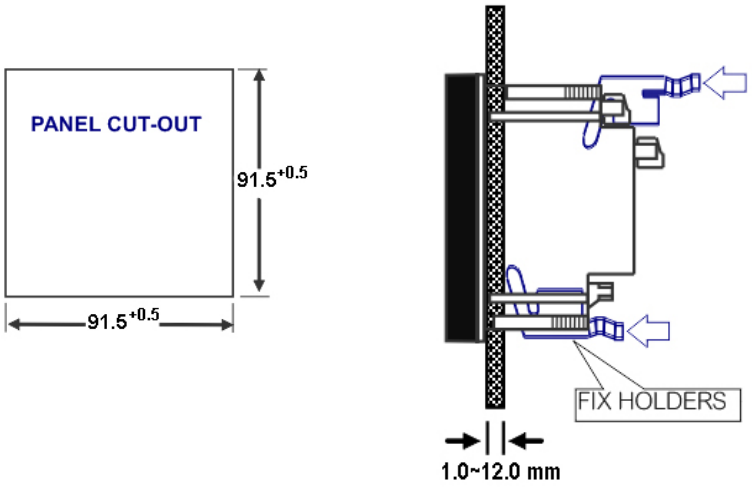
- Energy management system
- Industry automation
- Power monitoring
- Power grid automation
- Intelligent Building
- Intelligent switchboard, switchgear
- Substation automation

Chapter 2 Installation

2.1 Exterior and dimensions



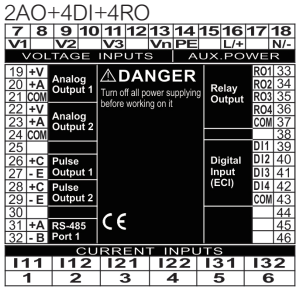
2.2 Meter installation



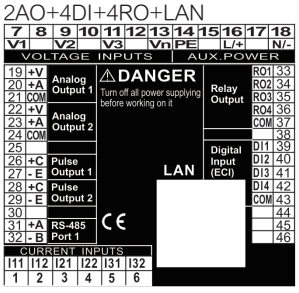
2.3 Meter connections and wiring

Terminal block

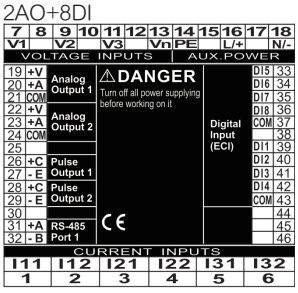
2AO+4DI+4RO



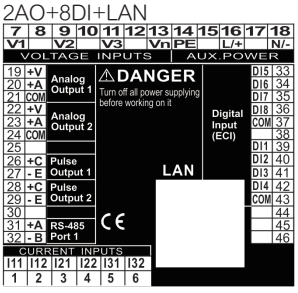
2AO+4DI+4RO+LAN



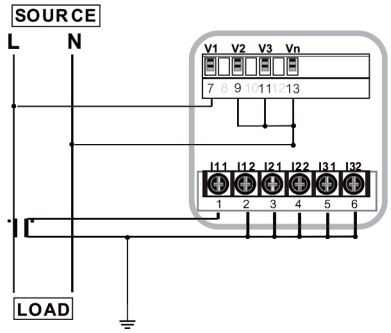
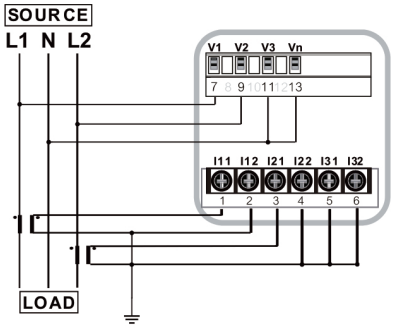
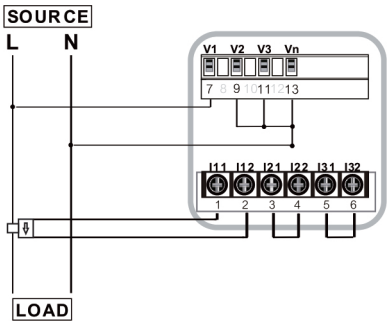
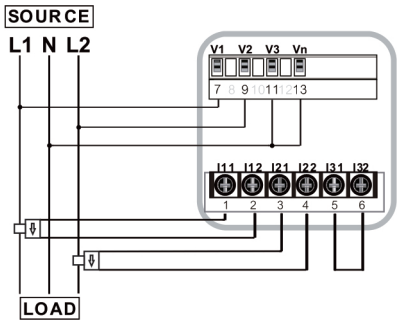
2AO+8DI



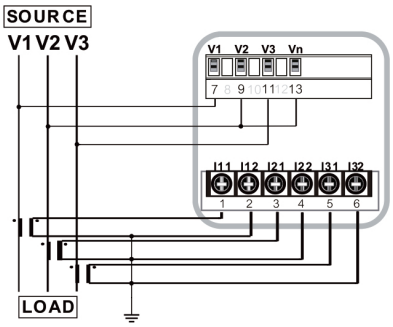
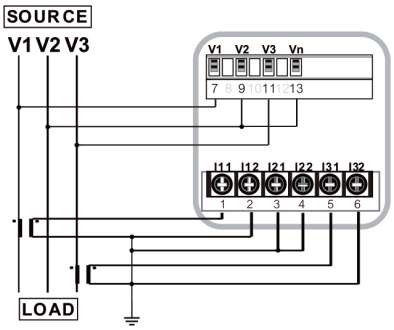
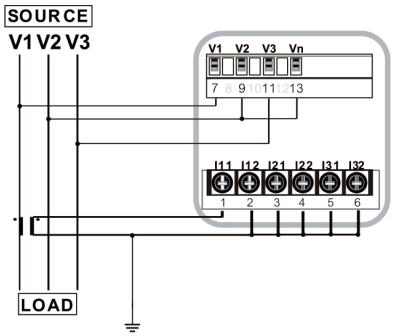
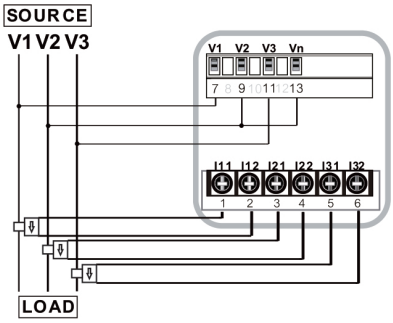
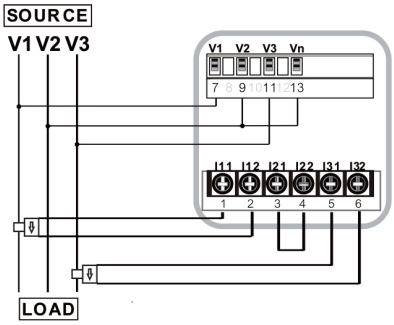
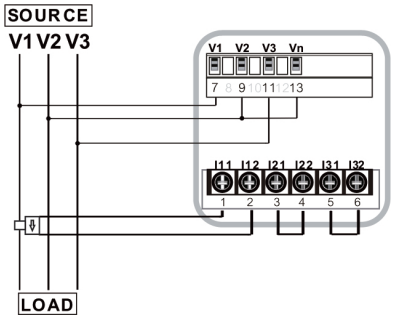
2AO+8DI+LAN



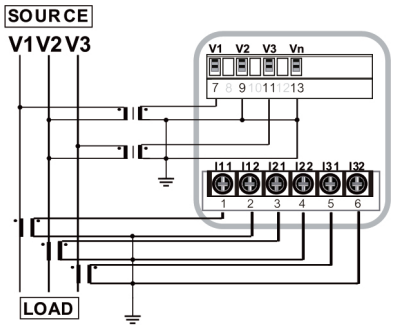
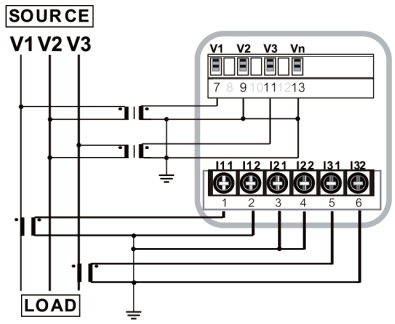
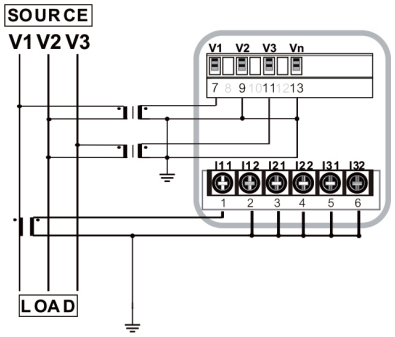
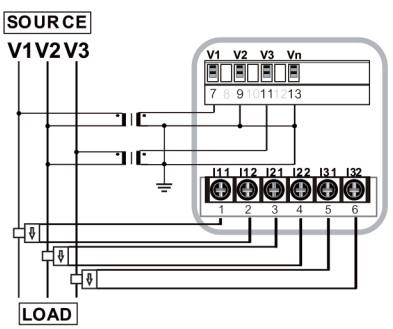
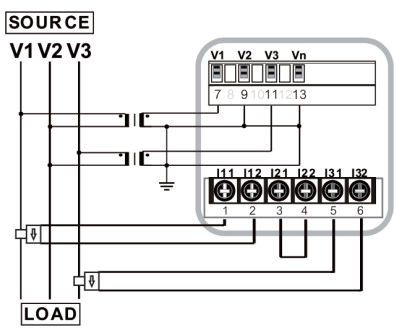
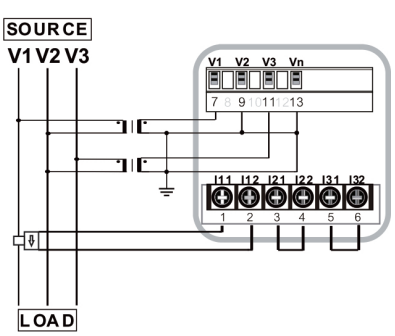
Voltage and current wiring (CT secondary side distinguishes 1A/5A and 333mV)

1 Phase	
1P2W(1A/5A)	1P3W(1A/5A)
	
1P2W(333mV)	1P3W(333mV)
	

3P3W w/o PT

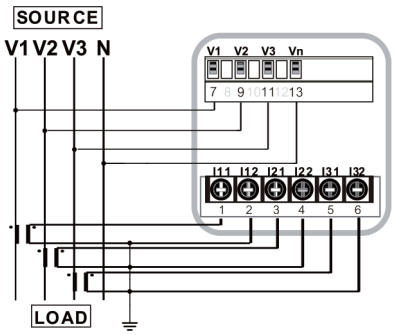
3CT(1A/5A)	2CT(1A/5A)	1CT(1A/5A)
		
3CT (333mV, not available with Rogowski coil)	2CT (333mV, not available with Rogowski coil)	1CT (333mV, not available with Rogowski coil)
		

3P3W 2PT

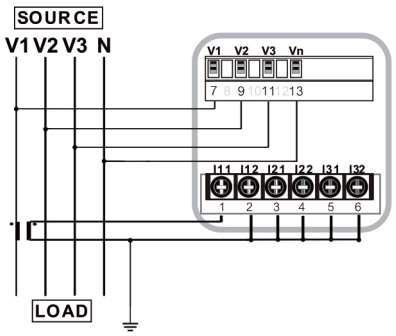
3CT(1A/5A)	2CT(1A/5A)	1CT(1A/5A)
		
3CT (333mV, not available with Rogowski coil)	2CT (333mV, not available with Rogowski coil)	1CT (333mV, not available with Rogowski coil)
		

3P4W w/o PT

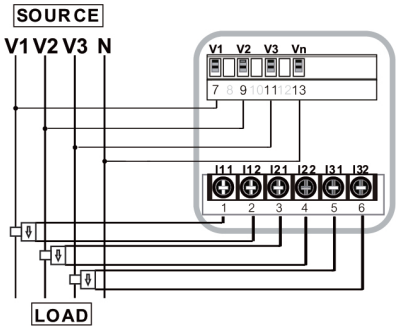
3CT(1A/5A)



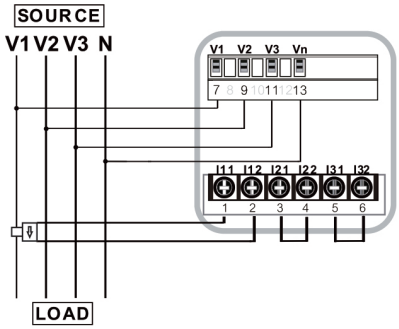
1CT(1A/5A)



3CT(333mV)

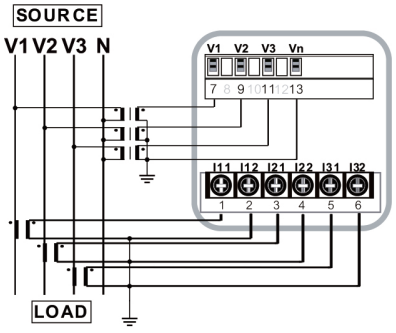


1CT(333mV)

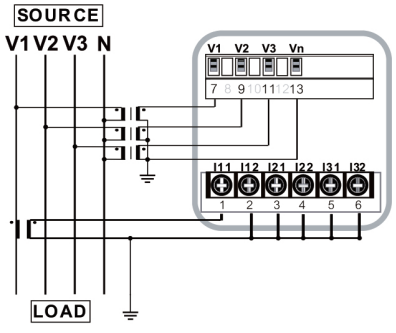


3P4W 3PT

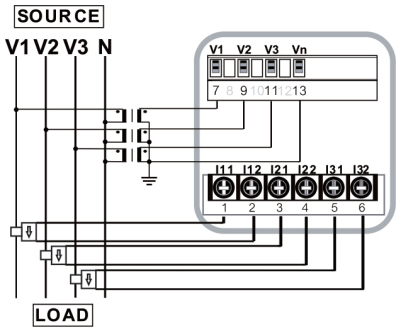
3CT(1A/5A)



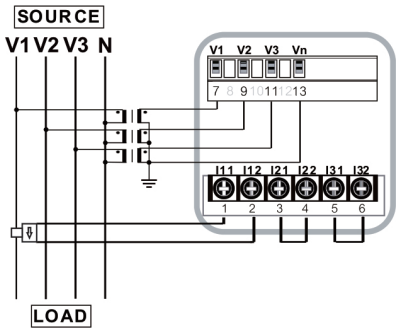
1CT(1A/5A)



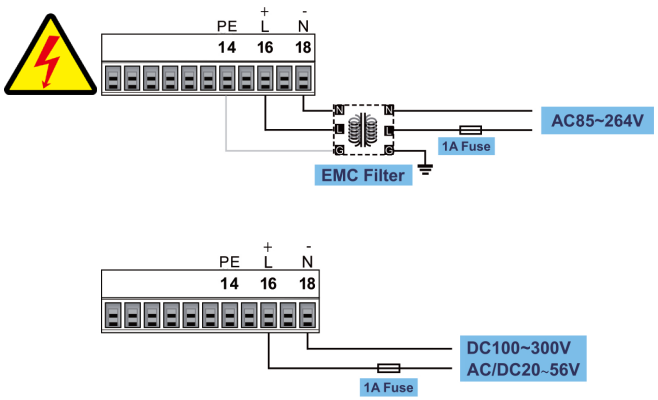
3CT(333mV)



1CT(333mV)

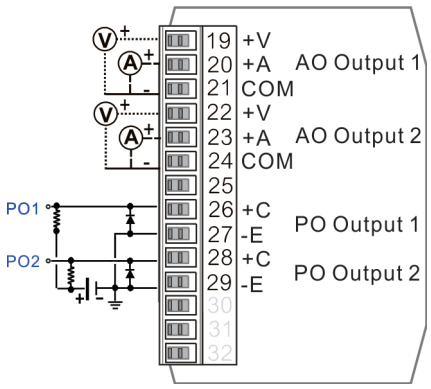


AUX. Power connection



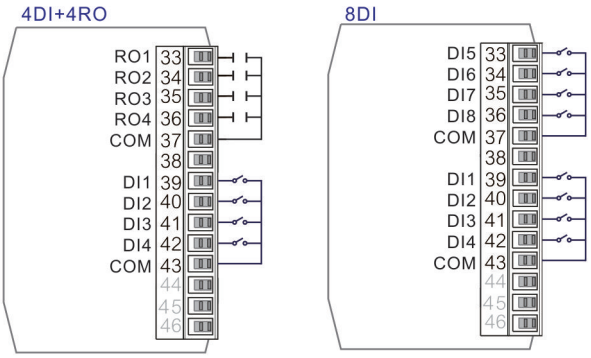
AUX. Power input range:
ADH: AC 85~264V / DC 100~300V
ADL: DC/AC 20~56V

Analog output(AO) / Pulse output (PO)



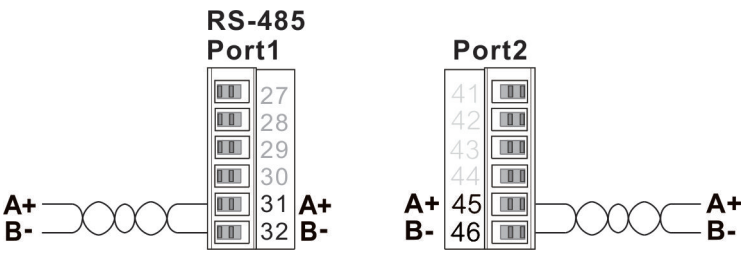
Voltage output: 0~5V / 1~5V / 0~10V , ≥1000Ω
Current output: 0~20mA / 4~20mA / 0~10mA
≤530Ω
Pulse output: Open Collector(O.C.)
30Vdc / 30mA(max)

Relay output (RO) / Digital input (DI)



Relay contact form: 5A/250Vac; 5A/30Vdc
DI input form: 12V/5mA

RS-485 communication port

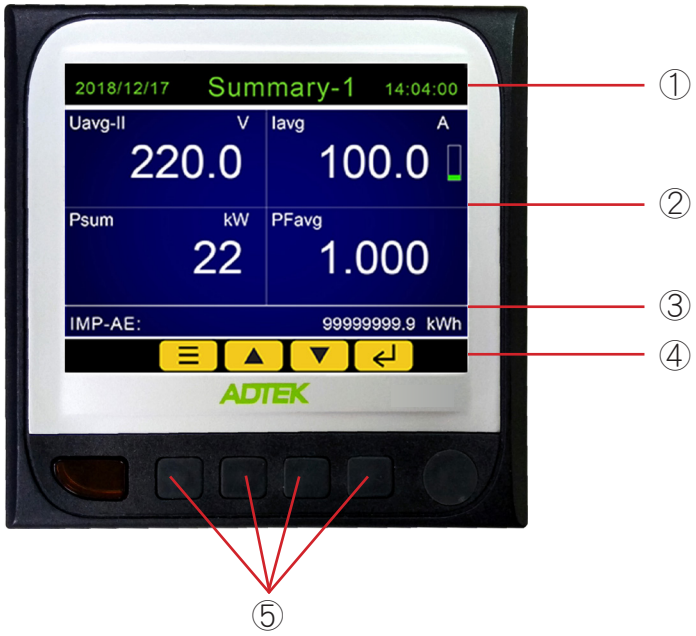


Distance: 1200M max
Terminate resistor (at last device): 120~300Ω/0.25W (typical: 150Ω)

Chapter 3 Meter display and operation

This chapter describes how to use the operation buttons to access the required power measurement information and how to set the relevant parameters correctly.

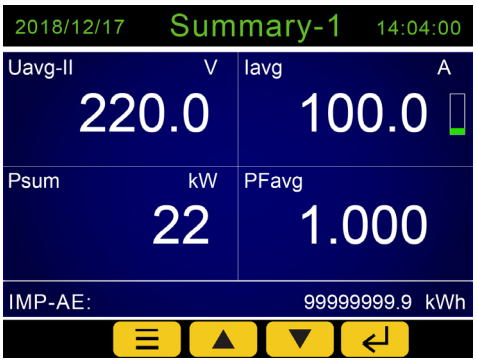
3.1 Meter panel

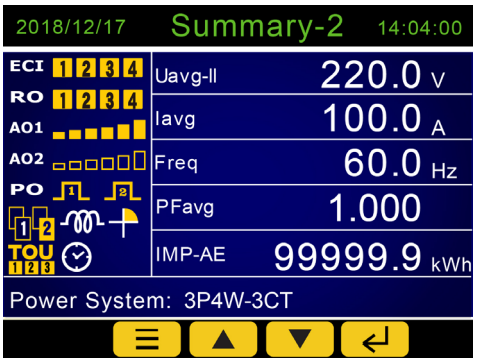


1. Screen title
2. Main display area
3. Notification area
4. Buttons symbols
5. Operation buttons

3.2 Display screen and operation buttons description

AFM-8A series display panel is a 3.5 inch TFT-LCD, the resolution is 320 * 240 pixels.The display content and the way will be flexible according to the actual needs. There are four physical buttons at the bottom of the panel.





3.2.1 Operation buttons

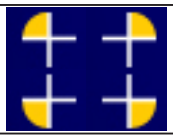
The buttons function below the screen will vary depending on the content of the screen,and function icon for the button is displayed at the bottom of the screen. The functions described are as follows:

Icon	Description
	Menu key Into quickly index list page
	Enter / Confirm key Go to the next menu page or confirm the input parameters
	ESC key Return to the previous page
	Up key Move the cursor or increase the number
	Down key Move the cursor or decrease the number
	Left key Move the number input position or press and hold 2 seconds to return to the previous page
	Right key Go to next page

3.2.2 Symbol icons in main screen

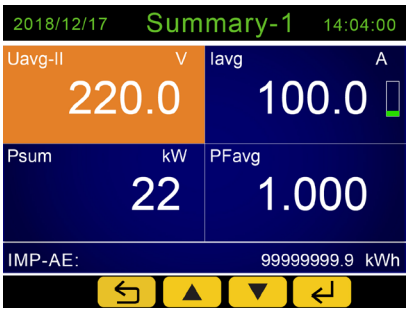
On the left side of the main screen is the I/O status and the system indication icon, describe as below:

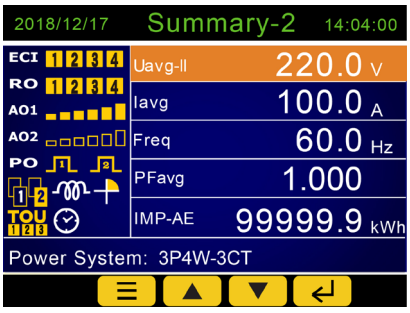
Icon	Description
	Digital input 1~8 status indication, the number is displayed when there is an input trigger.
	Relay output 1~4 status indication, the number is displayed when there is a relay output.
	Analog output status indication, each cell represents a 20% output percentage.
	Pulse output 1~2 status indication, the number is displayed when there is a pulse output.
	Communication indication, when the block to blink that mean is data being transmitted or received, upper block is receive, the lower block is transmission. 1 and 2 are port 1 and port 2.

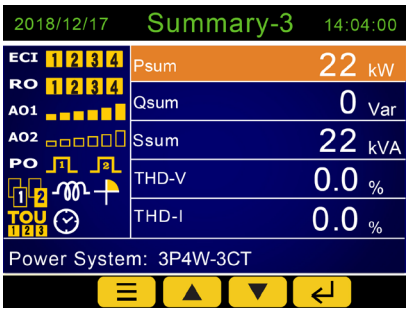
Icon	Description
	Load type indication, resistive / capacitive / inductive type.
	System power 1 ~ 4 quadrant indication.
	TOU execute indication, the numbers below are represented by left to right respectively: Season / Time table / Segment number
	Data logging execute indication.
	Current load indication, each cell represents a 10% load percentage.

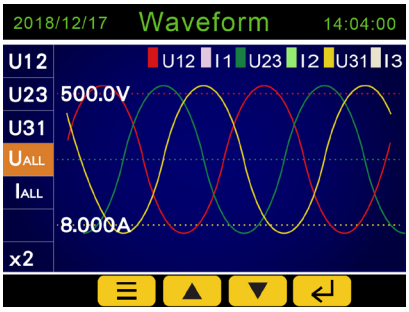
3.3 Measurement data display and key operation

The main screen of the meter has three kinds of summary display page and two function pags can be set, also can get these pages scrolling. Press ↵ in any of the summary display pages, will see the screen appears yellow cursor, press the up and down keys to move the yellow cursor to the measurement parameters you want to query and press ↵ again, then can get details of the parameters.

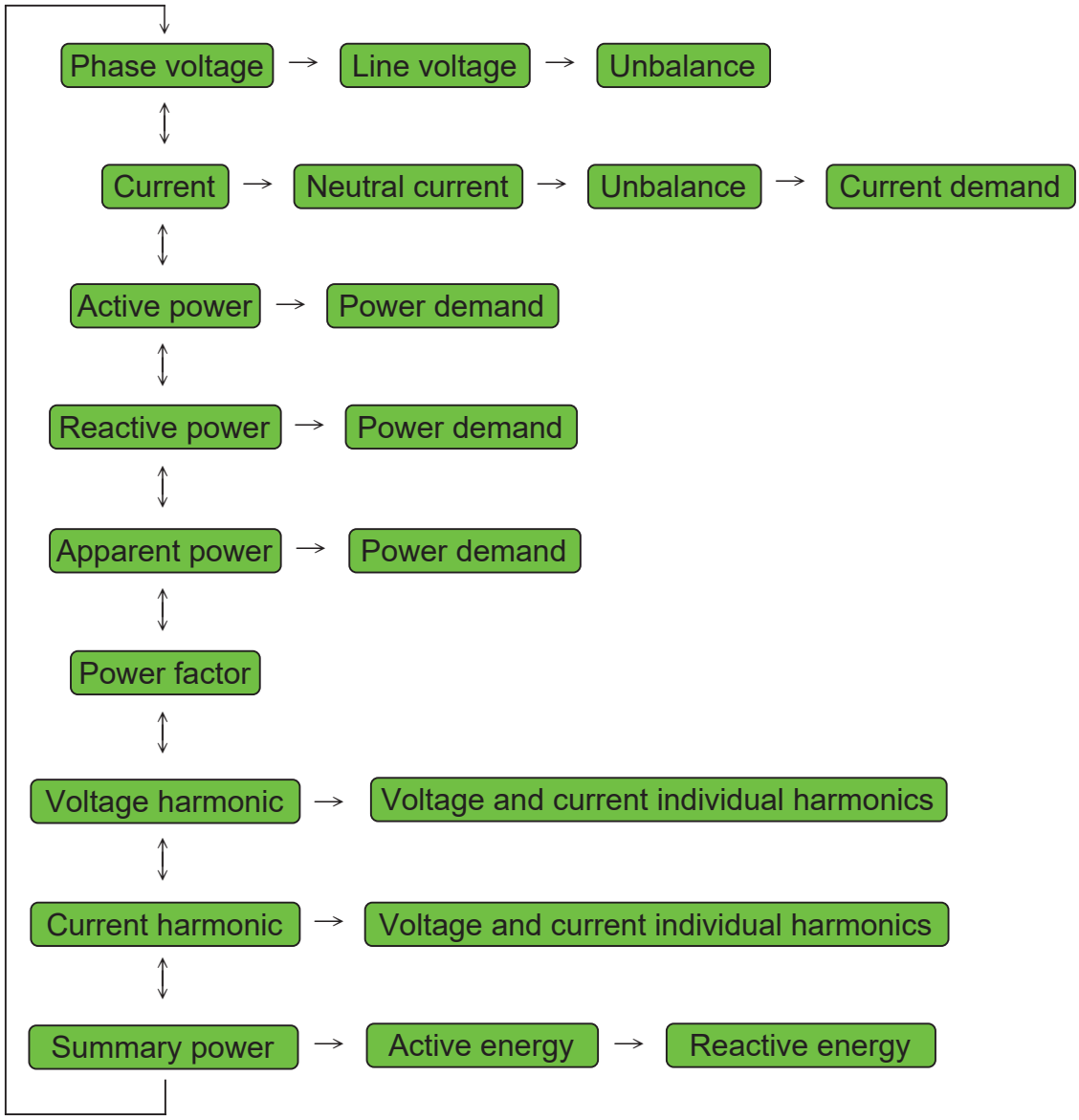


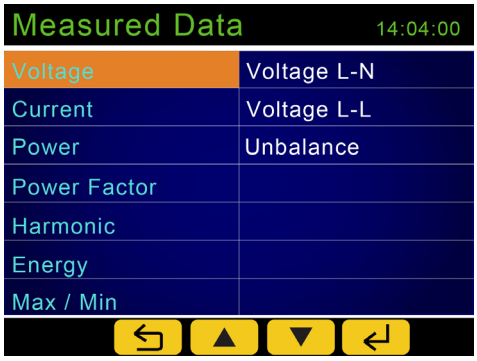






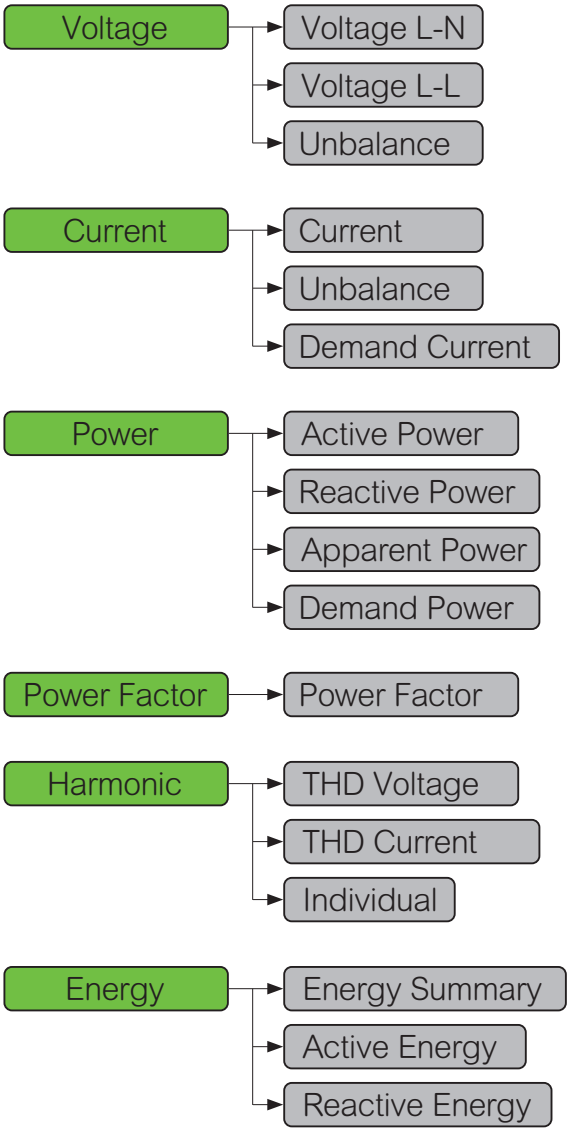
The measurement parameters are displayed as follows:

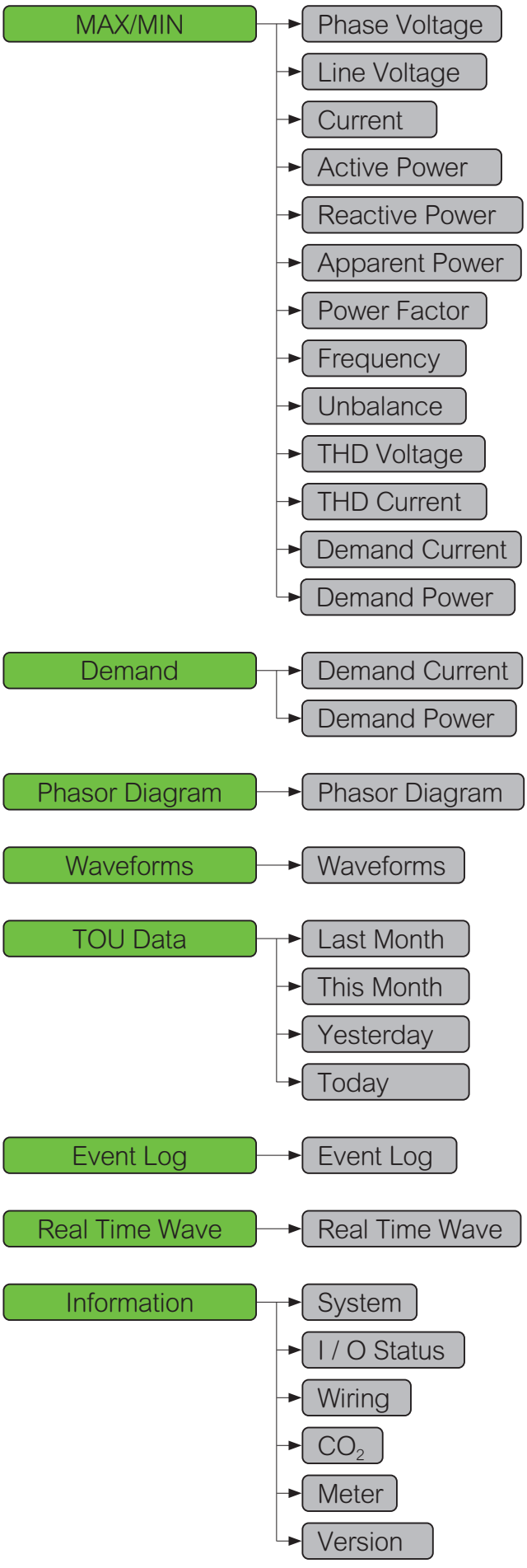




Also in any one of the summary display page press ☰ into quickly index list page. Press the up and down keys to select the item to be queried then press ↵

Quickly index list:




MAX/MIN
Phase Voltage
Line Voltage
Current
Active Power
Reactive Power
Apparent Power
Power Factor
Frequency
Unbalance
THD Voltage
THD Current
Demand Current
Demand Power
Demand
Demand Current
Demand Power
Phasor Diagram
Phasor Diagram
Waveforms
Waveforms
TOU Data
Last Month
This Month
Yesterday
Today
Event Log
Event Log
Real Time Wave
Real Time Wave
Information
System
I / O Status
Wiring
CO_2
Meter
Version

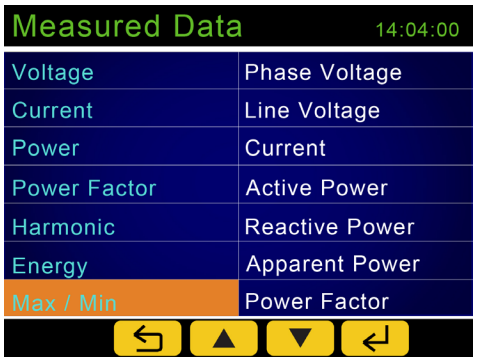
3.4 Max/Min data display and key operation

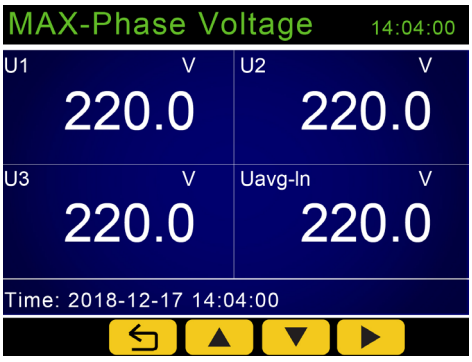
Enter the max/min query page after the parameter list appears on right of screen, press the up and down keys to select the item to be queried then press ↵

Press right key to switch the maximum / minimum screen.

Press the up and down keys to switch between different parameters.

Press ↩ return to the previous list page.

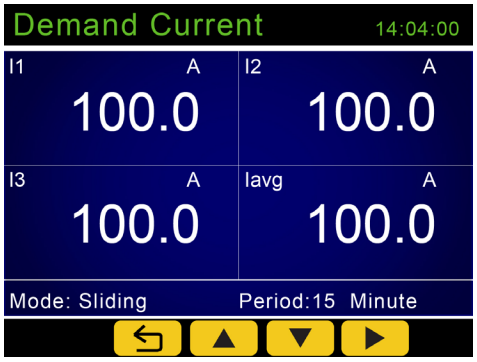


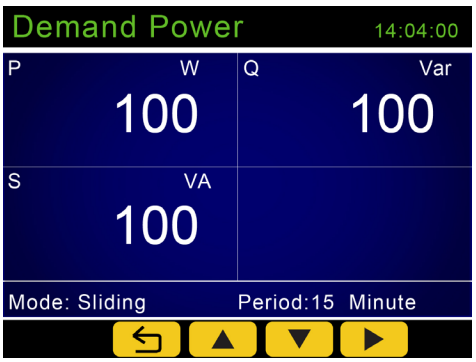


3.5 Demand data display and key operation

To query the demand data can enter from the summary display page or from the quickly index list into the query.

Demand of current or power is shown on one page. The notification area below shows the calculation of the demand and the calculated interval time.



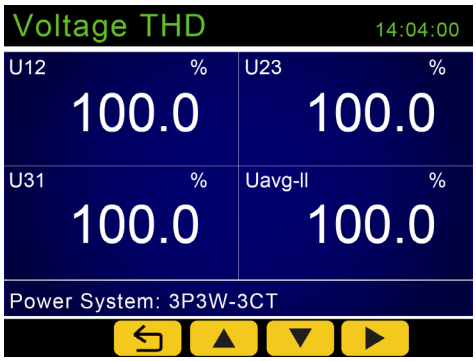


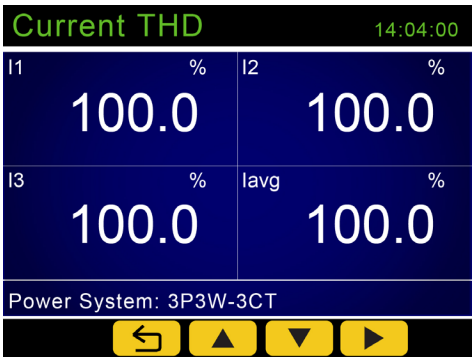
3.6 Harmonic data display and key operation

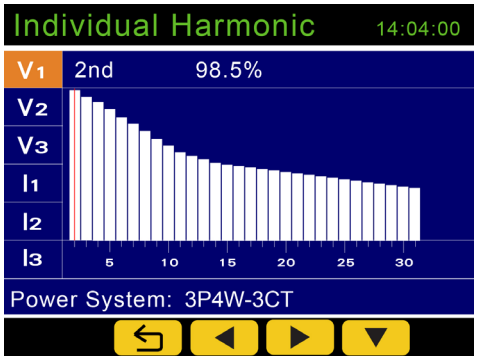
To query the harmonic data can enter from the summary display page or from the quickly index list into the query.

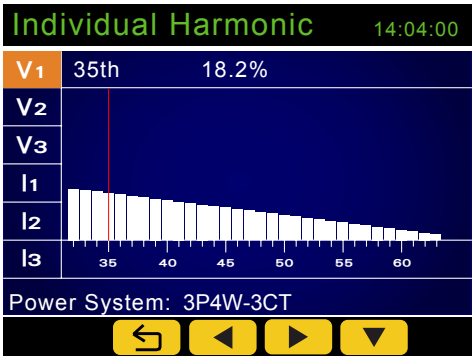
THD of voltage or current is shown on one page. 2nd~63rd individual harmonic divided into two page displays.

In the individual harmonic query page, press the left and right keys to move the cursor, then the top of the page will display the which harmonics and the value. Press down key to switch the voltage and current of each phase of the harmonic screen.





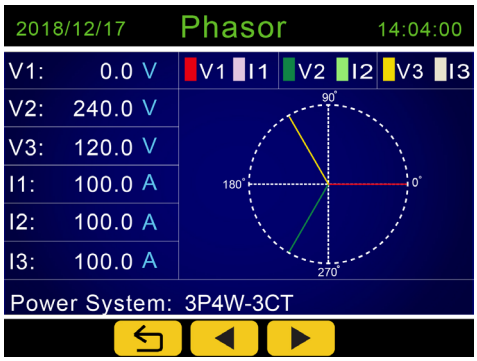


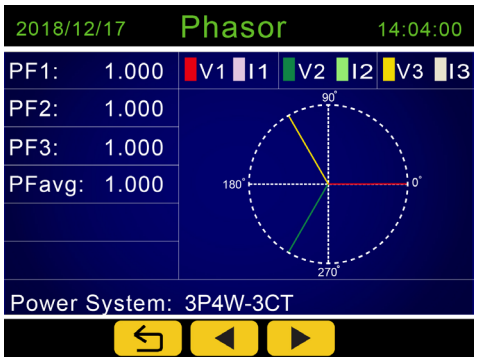


3.7 Phasor diagram display and key operation

To query the phasor diagram only can enter from the quickly index list.

The phasor diagram has three kinds of page, which can be switched by left and right keys. The contents of the screen in the left side were shown for each phase voltage and current angle, the each phase voltage and current value and the each phase power factor.



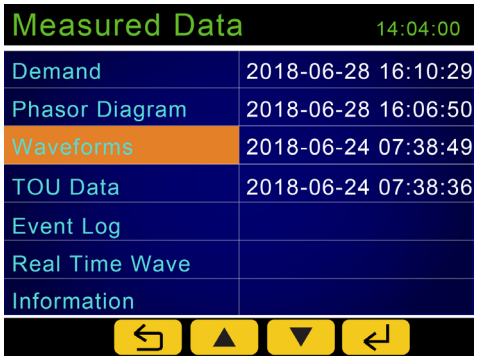


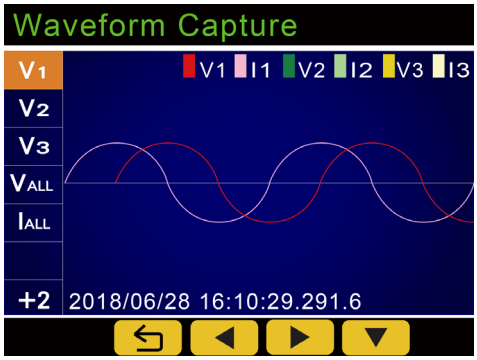
3.8 Waveform display and key operation

To query the waveform diagram only can enter from the quickly index list.

When you select the waveform capture in the quickly index list, the right side displays the date and time list of the captured, there is no list when there is no waveform record.Select the time to go to the query, you can see the waveform diagram.

Press the left and right keys to move the front 8 and rear 8 cycles waveform diagram, press the down key to switch the waveforms of the voltage and current of each group, and the waveform of all the voltage or all current.

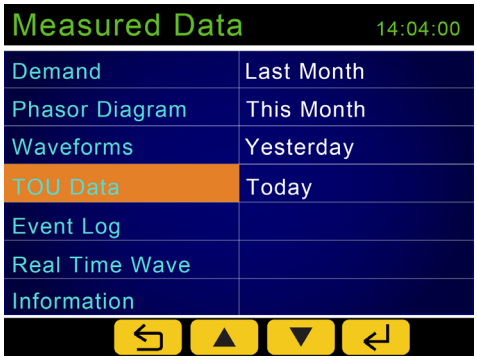


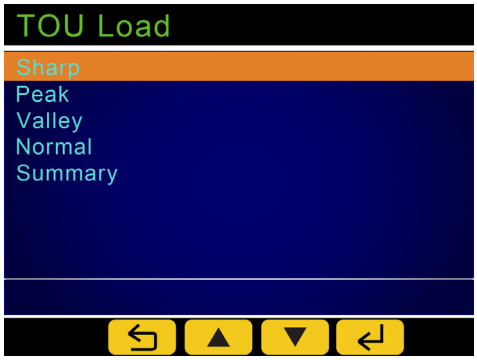


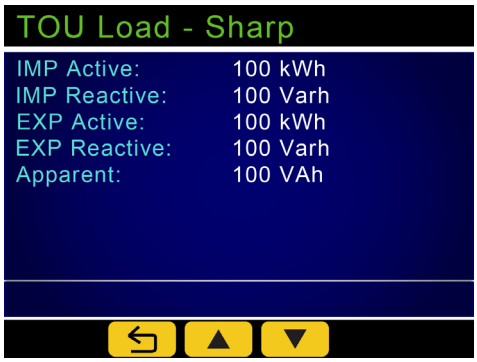
3.9 Time of use (TOU) data display and key operation

To query the TOU data only can enter from the quickly index list.

After entering the query, first need to select the data for this month, last month, today or yesterday, next select the tariff period to be queried, then can be seen each accumulation energy data.





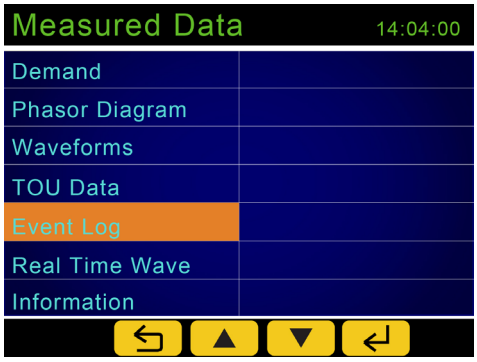


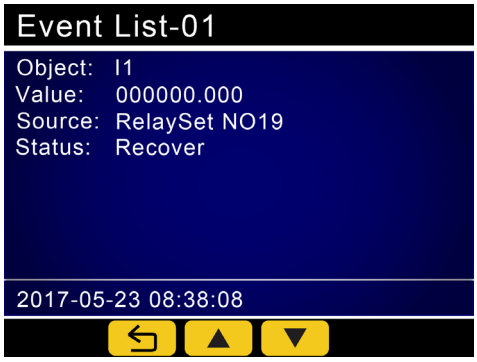
3.10 Event logging display and key operation

To query the event logging only can enter from the quickly index list.

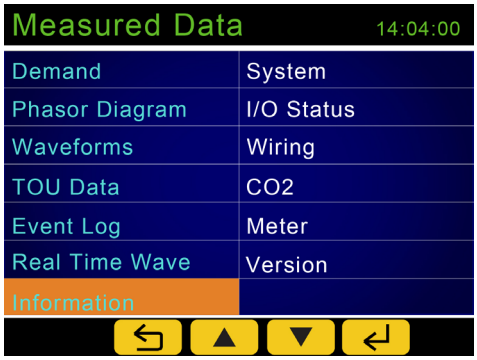
When you select the event log in the quickly index list, the right side displays the date and time list of the logging, there is no list when there is no logging record. Select the time to go to the query, you can see the logging content.

Press the up and down keys to move between the records, easy to quickly query.





3.11 Meter information and key operation

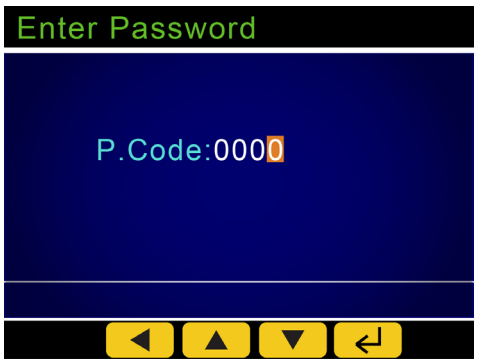


To query the meter information only can enter from the quickly index list.

When you select the information in the quickly index list, the right side displays the items of the information.

3.12 Setting display and key operation

3.12.1 Password input



To enter the setting function, must enter a set of password, the password is correct to enter the settings page, if the password is wrong, it will stay in the password input screen. It's to avoid non-managers to modify the parameters or misuse. To leave the input screen, press the left button for two seconds.

Password is 4 digits, 0000~9999 integer, the default is "1000", after entering the setting function, you can modify this password, and please be sure to keep in mind the new password.

Each time you enter the setting function must enter the correct password, when back to the measurement screen to enter the settings again, you must input the password again.

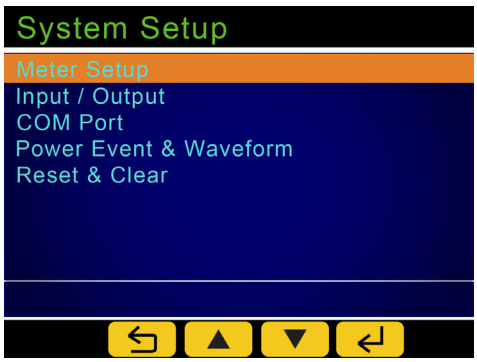
The procedure is to press and hold ▲ ▼ for one second at the same time, then will appear P.Code input screen.

◀ : Move the number input position

▲ ▼ : Number increase and decrease

↵ : Enter

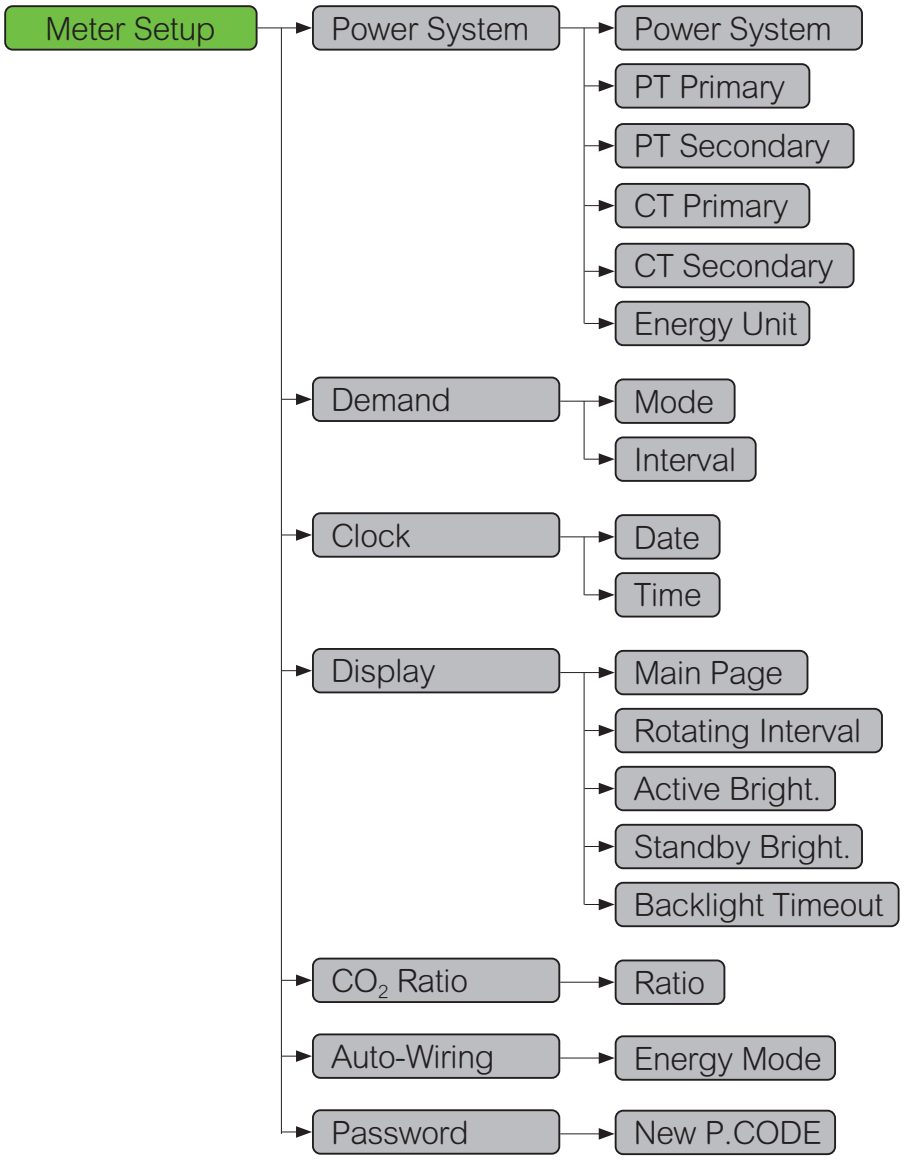
3.12.2 Parameter setting

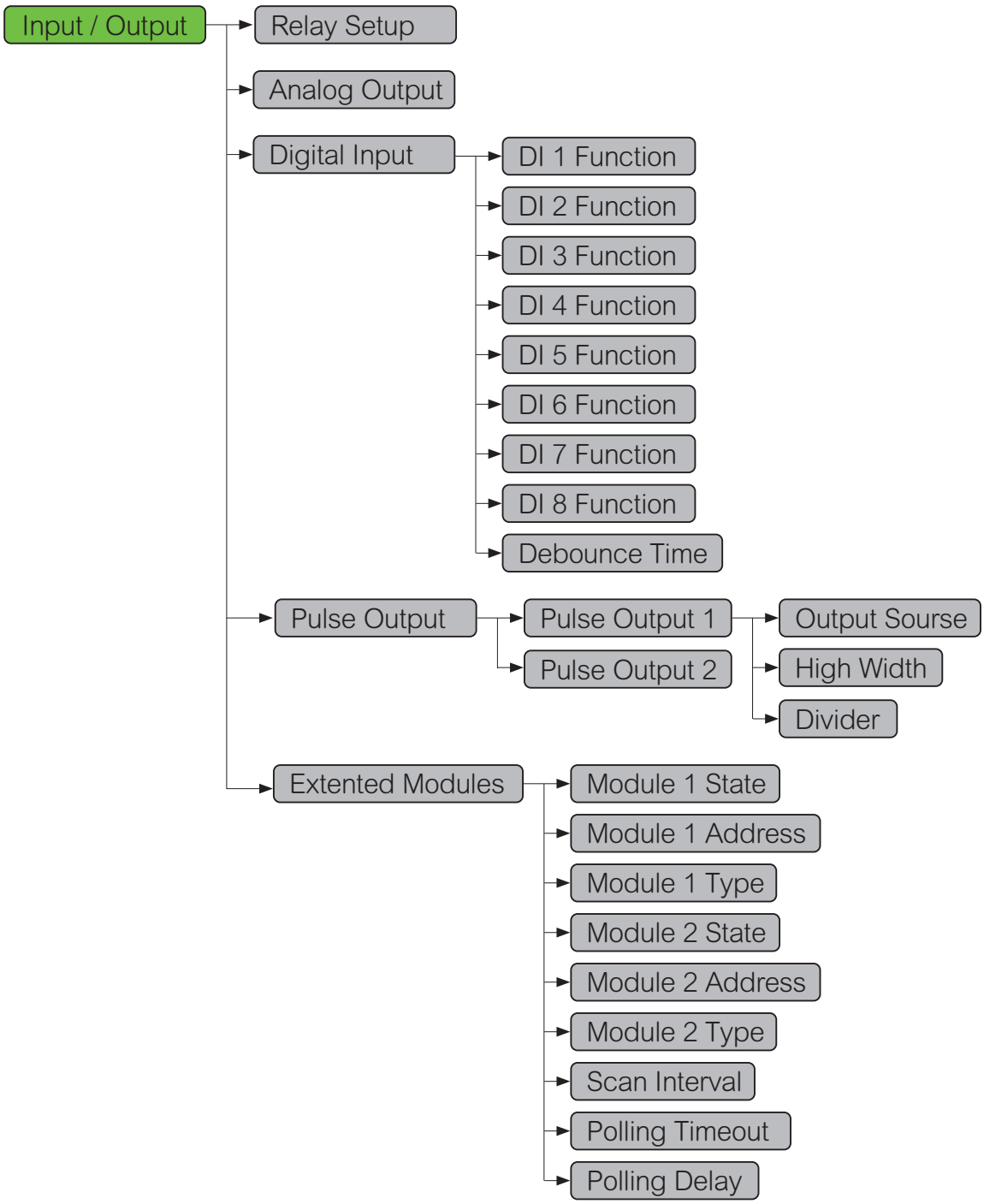


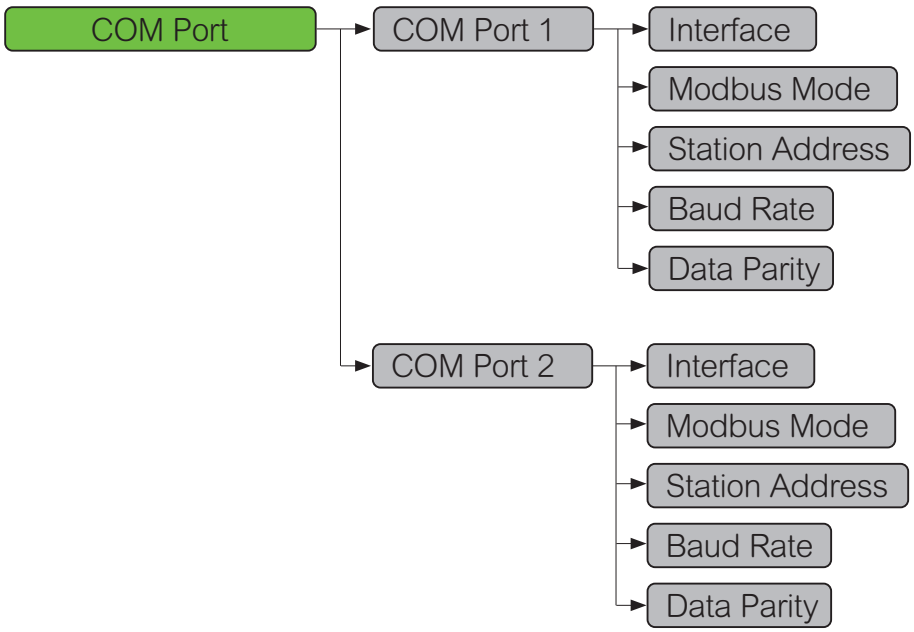
After the password is correct, it will enter the menu screen of parameter setting.

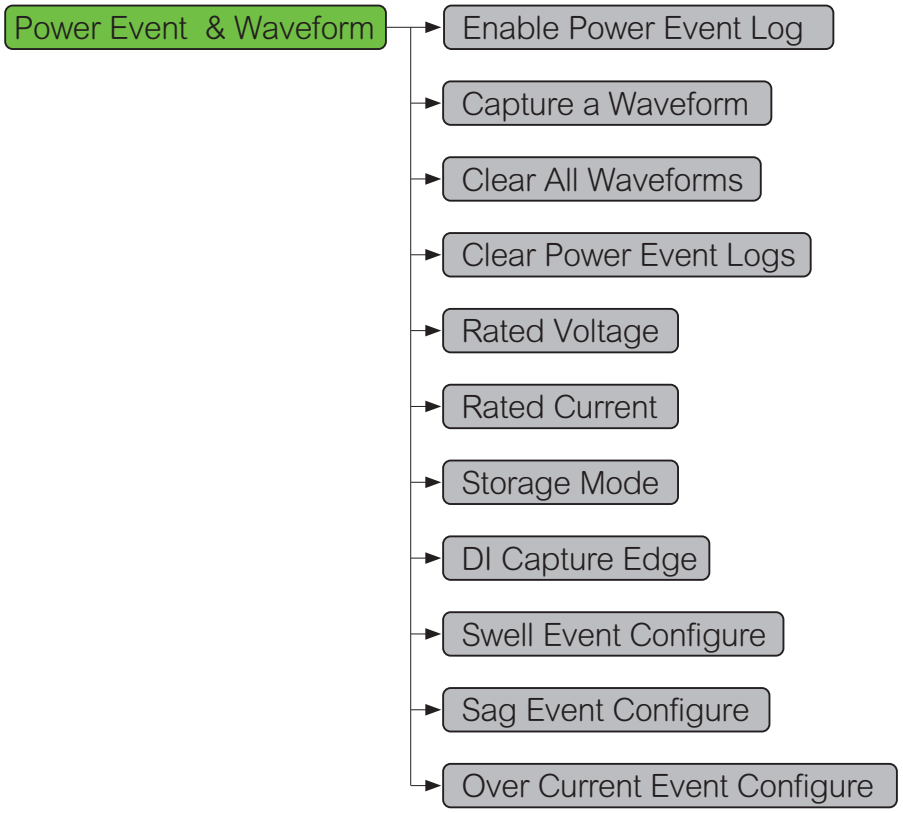
3.12.3 Setting menu list

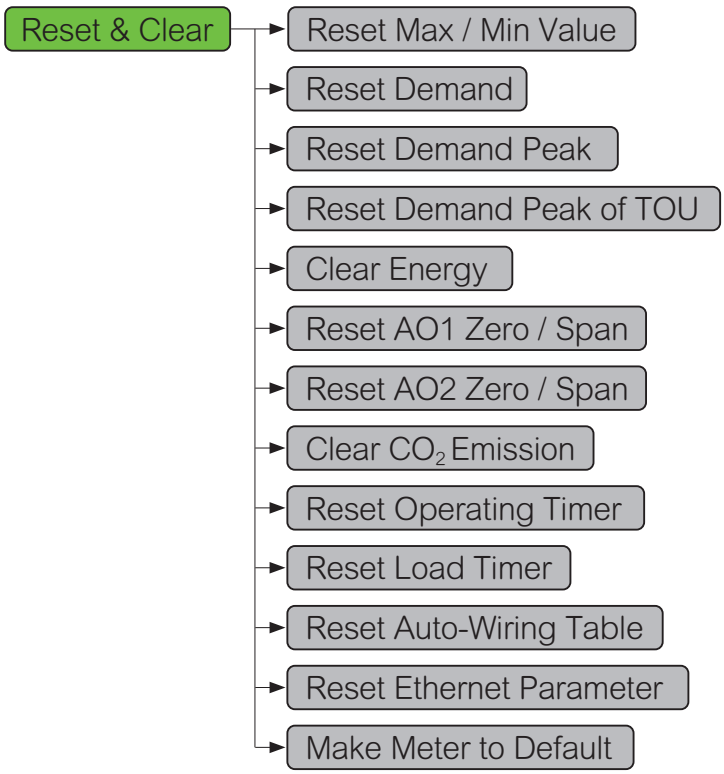
Into each item can be seen detail the parameters items, list as below:




Input / Output
Relay Setup
Analog Output
Digital Input
DI 1 Function
DI 2 Function
DI 3 Function
DI 4 Function
DI 5 Function
DI 6 Function
DI 7 Function
DI 8 Function
Debounce Time
Pulse Output
Pulse Output 1
Pulse Output 2
Output Sourse
High Width
Divider
Extented Modules
Module 1 State
Module 1 Address
Module 1 Type
Module 2 State
Module 2 Address
Module 2 Type
Scan Interval
Polling Timeout
Polling Delay


COM Port
COM Port 1
Interface
Modbus Mode
Station Address
Baud Rate
Data Parity
COM Port 2
Interface
Modbus Mode
Station Address
Baud Rate
Data Parity


Power Event & Waveform
Enable Power Event Log
Capture a Waveform
Clear All Waveforms
Clear Power Event Logs
Rated Voltage
Rated Current
Storage Mode
DI Capture Edge
Swell Event Configure
Sag Event Configure
Over Current Event Configure



3.12.4 Parameter setting input key operation

There are two conditions for parameter setting, one is option item selected, one is numeric input, so keys function will different according to the setting contents of the item.

In the option item selected, keys function as below:

: Abandon input, return to the previous page

: Select

: Enter

In the numeric input, keys function as below:

: Move the number input position

: Number increase and decrease

: Enter

If want to abandon input, press 2 seconds, then return to the previous page

3.12.5 Back to main page

In any screen of the measurement data query or setting page, if there is no key operation for more than 2 minutes, it will automatically return to the main page of the measurement.

Chapter 4 Detailed functions description

4.1 Basic Measurements

The AFM-8A series meter can measure voltage, current, power, frequency, power factor, demand, etc.

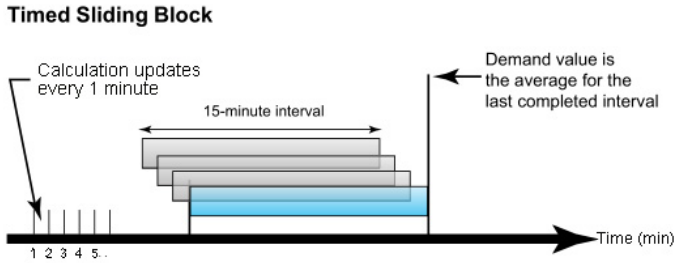
4.1.1 Demand

This meter consists of several types of demand calculation: total active power demand, total reactive power demand, total apparent power demand, phase A current demand, phase B current demand, and phase C current demand. When demand is reset, demand memory registers are set as 0.

Demand calculating mode can be set as sliding block and fix block according to user.

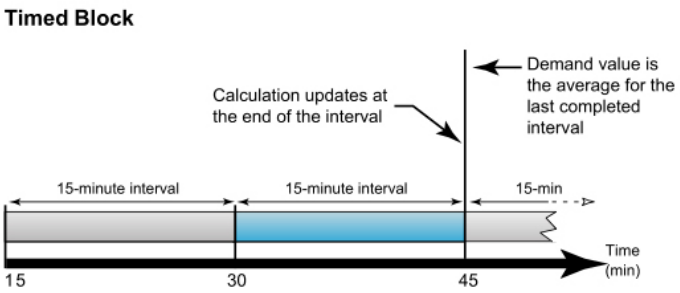
4.1.1.1 Sliding block

When using the sliding block interval method, user selects an interval from 1 to 60 minutes, which is the period of the calculation. The demand updates every 1 minute as the block slides once. The following figure description takes a 15-minute block interval as an example:



4.1.1.2 Fix block

Like the sliding block, a calculation period is set first, and the increment is also one minute. However, only one demand is calculated in the whole period, that is the demand update interval is the calculation cycle time. The following figure description takes a 15-minute block interval as an example:



4.1.2 Energy measurements

The meter provides fully bi-directional, 4-quadrant energy metering. The meter stores all accumulated active, reactive and apparent energy measurements in nonvolatile memory. Energy accumulated was from the last reset until the current moment.

4.1.2.1 Energy metering is full-wave based calculation is used to accumulate energy including fundamental and harmonics.

4.1.2.2 The reactive energy(power) calculating is:

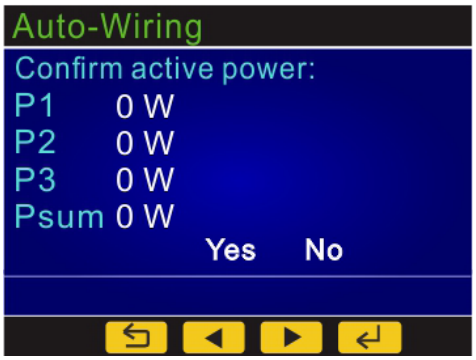
4.1.2.3 Energy metering is primary energy.

4.1.3 Auto wire change

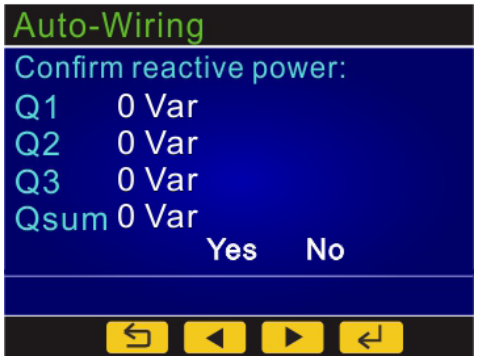
The Meter voltage and current wiring is a matching requirement. For example, V1, V2 and V3 need to correspond to I1, I2 and I3, and the input direction of current is also the same. For example, input I11 and flow out I12. In actual use, wiring errors may occur. In this case, you can compensate for the wiring errors through the meter's auto wire change function to obtain the correct measurement results without changing the wiring.

4.1.3.1 Into the auto wire change function, the first choice of power system mode.

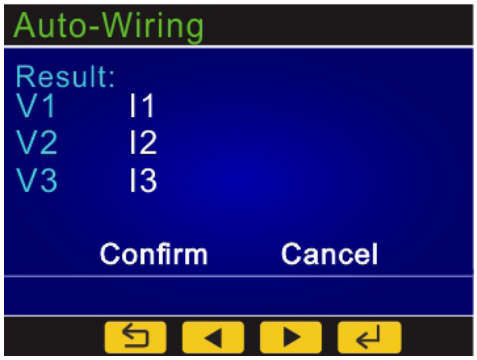
4.1.3.2 After meter calculation, confirm the active power value is correct, if correct, choose Yes to continue, if not choose No, the meter will recalculate or display the message to inform the adjustment of voltage wiring recommendations.



4.1.3.3 Then confirm the reactive power value is correct, if correct, select Yes to continue, if not correct, select No, the meter will return to the active power to recalculate or display the message to inform the adjustment of voltage wiring recommendations



4.1.3.4 Finally will show the results, if correct, select Confirm to save the result, if not correct, select Cancel to leave the function or execute function again.



4.1.3.5 The auto wire change function has different conditions under different input phase modes as follows:

4.1.3.5.1 3P4W-3CT : VN must be correct and θ< ±59˚
4.1.3.5.2 3P4W-1CT : θ< ±59˚
4.1.3.5.3 3P3W-2CT : V2 must be correct and θ< ±59˚
4.1.3.5.4 3P3W-3CT : V2 must be correct and θ< ±59˚
4.1.3.5.5 1P3W : VN must be correct and θ< ±59˚
4.1.3.5.6 1P2W : θ< ±59˚
4.1.3.5.7 3P3W-1CT : N/A

4.2 MAX/MIN

This meter logs maximum and minimum value statistics for phase/line voltages, current, active power, reactive power, apparent power, power factor, frequency, demand, unbalance factor, THD as well as the time they occur. All data is stored in non-volatile memory so that statistic information can be preserved even when meter is shut off. All maximum and minimum data can be accessed via communication or from the meter front. Statistics can be cleared via communication or from the meter front.

🔔 Note: The MAX/MIN value clear is not cleared to zero, it's becomes the value at the time of erasure and begins to record the maximum and minimum value from the time of erasure.

4.3 Harmonics and Power Quality Analysis

4.3.1 Harmonics

AFM-8A series meter can measure and analyze THD, 2nd to 63rd individual harmonics.

4.3.2 Phase angle

Phase angle indicates the angle between phase 1 or phase 1-2 voltage and other voltage/current parameters. Angle ranges from 0 to 360 degrees. This function is to help users find out the relationship between all input signals avoiding wrong wiring. When it is set to “3P3W”, it gives out the phase angles of V23, V31, I1, I2, I3 corresponding to V12. For other settings, it gives out the phase angles of V2, V3, I1, I2, I3 corresponding to V1.

4.3.3 Unbalance analysis

AFM-8A series meter analyzes the AC sampling values to obtain the values of voltage and current unbalance.

4.4 Event logging function

AFM-8A series meter has the function of event logging. That is, when a parameter changes so that the defined event triggering condition is established and the duration exceeds the preset time limit, the event record will be started. The parameter number and value of the event, the status of the event and the time stamp of the event are recorded, as events and up to 16 such records can be stored in the memory. In addition to the condition setting from event log, the alarm output of the relay and the DO alarm output of the extended DIO modules are also the source of the event log.

Before using the event logging function to complete the conditions set, logging enabled, any incomplete or incorrect settings will result in the failure of the record. The setting operation is completed by setting the corresponding register. It should be specially explained that the settings of these registers must be set by means of communication.

4.4.1 Setting of single event logging function

Table 4-1 indicates the first log of settings, there are 16 logs in total with the same format.

▼ Table 4-1

Reg	Description	Size	Range	Units	Default	R/W	Notes
0200h	Event logging function enable	1	0~1		0	R/W	0: OFF 1: ON
0201h	Logging enable of each log	1	0~65535	bit	0	R/W	BIT0: 1st event log BIT15: 16th event log 0: OFF 1: ON
0202h	Parameter assign of 1st event log	1	0~48		0	R/W	Refer to Table 1(P.2)
0203h	Trigger condition	1	0~2		0	R/W	0: more than(>) 1: equal(=) 2: less than(<)
0204h	Set point of 1st event log	2	Depend on parameter		1000	R/W	
0206h	Trigger delay time	1	0~3000	x10mS	0	R/W	

Parameter assign: select target parameter for event logging. For example: 1 is frequency, 13 is current average…etc.(see Table4-2)

▼ Table 4-2

No.	parameter	No.	parameter	No.	parameter	No.	parameter	No.	parameter	No.	parameter	No.	parameter
0	NONE	1	FREQ	2	U1	3	U2	4	U3	5	ULN. AVG	6	U12
7	U23	8	U31	9	ULL.AVG	10	I1	11	I2	12	I3	13	I.AVG
14	IN	15	P-1	16	P-2	17	P-3	18	P.SUM	19	Q-1	20	Q-2
21	Q-3	22	Q.SUM	23	S-1	24	S-2	25	S-3	26	S.SUM	27	PF1
28	PF2	29	PF3	30	PF.AVG	31	Uunbl	32	Iunbl	33	U1 (U12). THD	34	U2 (U23). THD
35	U3 (U31). THD	36	U.AVG. THD	37	I1.THD	38	I2.THD	39	I3.THD	40	I.AVG. THD	41	P.DM
42	Q.DM	43	S.DM	44	I1.DM	45	I2.DM	46	I3.DM	47	I.AVG. DM	48	P.MAX. DM
49	Q.MAX. DM	50	S.MAX. DM	51	I1.MAX. DM	52	I2.MAX. DM	53	I3.MAX. DM	54	I.AVG. MAX.DM	55	U.SAG
56	U.Swell	57	Over Current										

Trigger condition and set point: set logging condition, such as more than(>), equal(=), less than(<). For example: if you choose target parameter to be "frequency", condition to be "more than" and set point to be "50", logging will be triggered when the frequency is more than 50Hz.

Delay time: If the logging condition lasts for the preset time period, the event log will be triggered. The delay range is from 0 to 3000 (unit: 10mS). When it is set to 0, there is no delay, event log will be triggered when the log condition is met. If it is set to 20, there will be a 200ms (20 x 10mS) delay.

After the setting of a single event logging function is completed, the following functions need to be enabled, the logging function will be working.

4.4.2 Event logging function enable

Event logging enabled: Determines whether the meter is enabled for event logging.

Logging is only enabled when set to "1", and settings related to event logging take effect.

Each event Log enabled: Determines whether the corresponding log is enabled or not.

There are 16 logs in all and each one is corresponding to one bit of a 16-bit register. The corresponding bit must be set to "1" in order to activate the event log.

Complete the above settings correctly, event logging function can be used normally.

4.4.3 Event log read

Event logging has 16 entries can be recorded in total. The record sequence of these entries do not depend on the sequence of the 16 logs. The meter begins logging starting from the 1st record location to the last one. Event logs are being recorded in a "cycle" function which means the latest event will overwrite the oldest record. When over/under limit parameters return to normal, its value and time stamp will be recorded as well. Therefore, users can determine the over/under limit duration by checking the time difference. See Table 4-3.

Below is the 1st log of records. Other logs of records have the same format.

Trigger source: Indicates information of current status. It is a 16-bit unsigned integer. The high byte indicates the source of the event (0~2). Bit0 is the event log setting. Bit1 is the relay alarm. Bit2 is the DO alarm from the extended DIO module. Bit = 1 means yes, Bit = 0 means no. The low byte indicates the log number (1~16) of the source type. The number of event log and relays and DO are not the same. Take the event log as an example, bit0 ~ bit15 correspond to the 1st log to the 16th log, Bit = 1 means yes, Bit = 0 means no.

Event status: Indicates whether the event is alert or recover, 1 means alert, 0 means recover.

Parameter: Specifies the monitored parameter. Same as Table 4-2.

Value: Shows the recorded value of the selected parameter when an alert is triggered and when it recovers.

Date and Time: Indicates the time stamp of log.

The latest log number: 0~16, indicates which number is the latest record. After power-on the number is 0, and for each incremented record, the number is incremented by 1, and the event log number is cycle record.

▼ Table 4-3

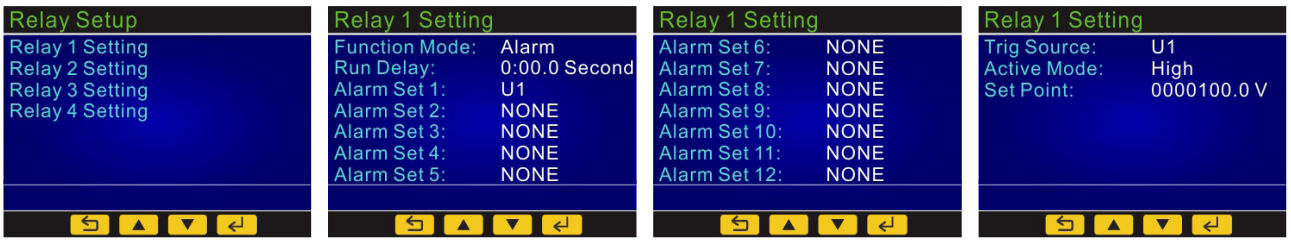
Reg	Description	Size	Range	Units	Default	R/W	Notes
2E80h	News number	1	0~16		0	R	0: None 1~16: News number
1st event logging data							
2E81h	Trigger source	1				R	High Byte: 0: Event log 1: Relay 2: External DO Low Byte: 1~16: Event log NO. 1~16 1~4: Relay NO. 1~4 1~32: External DO NO. 1~32
2E82h	Status	1	0~1			R	0: Recover 1: Alert
2E83h	Parameter	1	0~54			R	Refer to Table 1(P.2)
2E84h	Value	2	Depend on parameter			R	
2E86h	Year	1	2000~2099			R	
2E87h	Month	1	1~12			R	
2E88h	Day	1	1~31			R	
2E89h	Hour	1	0~23			R	
2E8Ah	Minute	1	0~59			R	
2E8Bh	Second	1	0~59			R	

4.5 Relay function

AFM-8A series meter have 4 relays, in addition to RO function can also be used, also as an alarm output. That is when the value of a parameter is higher or lower than the over limit setting value, the alarm will be started, the relay will be output , and the parameter code, value, alarm status and alarm occur time will be recorded in the event log.

Each relay can be set up to 12 sets of settings, before use to be sure to complete the conditions set, any incomplete or incorrect settings will lead to alarm failure. The setting operation is completed by setting the corresponding register or from the meter front.

Relay contactor capacity: 5A/250Vac; 5A/30Vdc



4.5.1 Alarm function setting

Table 4-4 indicates the first setting of first relay's settings, there are 12 sets in total with the same format. As long as one of the alarm conditions be triggered, the relay will be activated until all alarm conditions recovery.

▼ Table 4-4

Reg	Description	Size	Range	Units	Default	R/W	Notes
0010h	Relay 1 mode	1	0~2		1	R/W	0: OFF 1: Alarm 2: DO
0011h	Relay 1 energize delay time setting	1	0~5999	0.1 sec	0	R/W	
0012h	1st Alarm parameters setting Relay 1	1	0~57		2	R/W	Refer to Table 1
0013h	Energize mode of 1st alarm for Relay 1	1	0~3		1	R/W	0: LO 1: Hi 2: LO.HOLD 3: Hi.HOLD
0014h	Set point of 1st alarm for Relay 1	2	Depend on parameters		1000	R/W	When the unit of active power (P) is set to kW, the unit of set value of P is also kW. The units of the reactive power (Q) and the apparent power (S) are also changed to kVAR and kVA.

Parameter assign: select target parameter for alarm setting. For example: 1 is frequency, 13 is current average…etc(see Table4-2).

Action mode and set point: set alarm condition, such as the over or under the set value.

Which LO.HOLD and HI.HOLD function are after the relay action, when the alarm condition recovery, the relay remains in the active state, until manually release. Manually release can come from the DI input (the DI function set to relay reset) or through the communication relay output set to OFF.

Delay time: That is how long after the alarm condition is established to relay active. The delay range is from 0 to 5999 (unit: 0.1S). When it is set to 0, there is no delay, relay will be action when the alarm condition is met. If it is set to 20, there will be a 2S (20 x 0.1S) delay.

4.5.2 Alarm function enable

Must set the relay mode to alarm mode then alarm function and alarm related settings are available. If set to DO mode, the relay active and reset are controlled by means of communication.

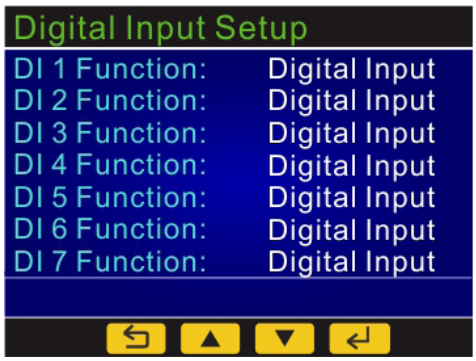
4.5.3 Alarm records read

The alarm records are also recorded in the event log, so if an alarm log is required, the event log function must be enabled.

4.6 Digital input(DI) function

The AFM-8A series meter have four digital input ports and can be expanded up to eight ports(there are no relay function when at eight ports due to the multiplexed pins). The setting operation is completed by setting the corresponding register or from the meter front.

DI contactor capacity: 12V/5mA



4.6.1 DI function setting

Table 4-5 indicates the setting contents and addresses of DI. If no DI5 ~ DI8 is selected, the corresponding register settings will be invalid.

▼ Table 4-5

Reg	Description	Size	Range	Units	Default	R/W	Notes
0190h	DI.1 MODE	1	0~9		7	R/W	0: Active energy reset 1: Reactive energy reset 2: Active/Reactive energy reset 3: MAX/MIN reset 4: Relay reset 5: Demand reset 6: MAX demand reset 7: DI 8: LCD backlight turn on 9: Waveform capture
0191h	DI.2 MODE						
0192h	DI.3 MODE						
0193h	DI.4 MODE						
0194h	DI.5 MODE						
0195h	DI.6 MODE						
0196h	DI.7 MODE						
0197h	DI.8 MODE						
0198h	Debounce time for DI	1	0~99	x5mS	5	R/W	

Mode setting: Each DI has 10 functions for designation, values clearing, relay reset, general DI function, and light on screen backlight or waveform capture.

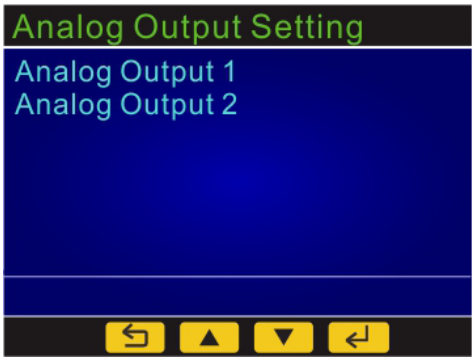
Debounce time setting: That is the input signal is established after how long to confirm the establishment of input, mainly to eliminate bounce generated when the mechanical switch on. The setting range is an integer from 0 to 99, the unit time is 8mS. When set to 0, there is no delay, and the specified function is executed immediately. For example, set the debounce time is 20, that is 20×8 = 160mS.

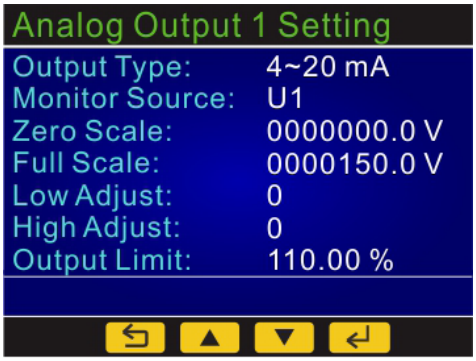
4.7 Analog output(AO) function

AFM-8A series meter provide two AO (analog output) circuits, by meter front or communication settings, select one of the meter parameters for convert output. AO output mode has 0 ~ 20mA, 4 ~ 20mA, 0 ~ 10mA, 0 ~ 10V, 0 ~ 5V and 1 ~ 5V for option, the load capacity as below:

0~10V / 0~5V / 1~5V: Load Resistance ≥ 1000Ω

0~20mA / 4~20mA / 0~10mA: Load Resistance ≤ 530Ω





4.7.1 AO function setting

Table 4-6 indicates the setting contents and addresses of AO. If no AO function, the corresponding register settings will be invalid.

▼ Table 4-6

Reg	Description	Size	Range	Units	Default	R/W	Notes
00E0h	Parameter assign of AO1	1	0~30		2	R/W	Refer to Table 2
00E1h	Output type of AO1	1	0~5		4	R/W	0: 0~10V 1: 0~5V 2: 1~5V 3: 0~20mA 4: 4~20mA 5: 0~10mA
00E2h	Low scale of AO1 output	2	Depend on parameter		0	R/W	When the unit of active power (P) is set to kW, the unit of set value of P is also kW. The units of the reactive power (Q) and the apparent power (S) are also changed to kVAR and kVA.
00E4h	Hi scale of AO1 output	2	Depend on parameter		1500	R/W	
00E6h	Maximum limit of AO1 output	1	0~11000	0.01%	11000	R/W	
00E7h	Output value of AO1	1	0~9999	0.01 V or mA		R	
00E8h	AO1 Zero / Span value reset	1	0 or 55h			R/W	0: None 55h: Reset
00E9h	AO2 setting	9					Setting format same as AO1

Parameter assign: select target parameter for AO convert output. For example: 1 is frequency, 13 is current average…etc(see Table4-7).

▼ Table 4-7

No.	parameter	No.	parameter	No.	parameter	No.	parameter	No.	parameter	No.	parameter	No.	parameter
0	NONE	1	FREQ	2	U1	3	U2	4	U3	5	ULN. AVG	6	U12
7	U23	8	U31	9	ULL.AVG	10	I1	11	I2	12	I3	13	I.AVG
14	IN	15	P-1	16	P-2	17	P-3	18	P.SUM	19	Q-1	20	Q-2
21	Q-3	22	Q.SUM	23	S-1	24	S-2	25	S-3	26	S.SUM	27	PF1
28	PF2	29	PF3	30	PF.AVG								

Hi / Low scale setting: Output signal corresponding to the high and low scale value of the setting, for example of output 4 ~ 20mA, the low scale value is set the any value of corresponding parameters to 4mA output, the high scale value is set the any value of corresponding parameter to 20mA output.

Output maximum limit: AO output limit setting, up to 110%.

Zero / Span value reset: Zero and Span setting of AO output can be set by meter front. The main function is to fine-tune the analog output upper or lower limit when there is an error with the corresponding value of the parameter. For fine tuning, zero point and full scale point are not required, as long as there is a lower value (corresponding to Zero) and a higher value (corresponding to Span), the meter will automatically correct the linearity to zero and full scale. When fine-tuning, connect the output terminal to a higher-precision instrument and measure the output signal to confirm that it is within the expected accuracy.

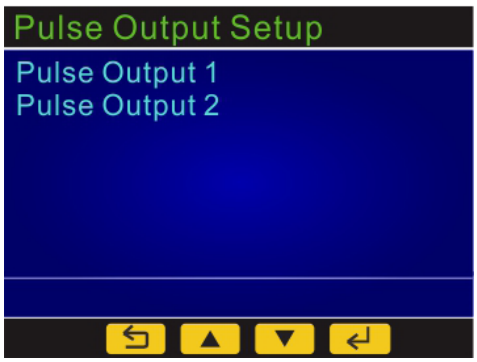
Output value read: The actual value of the AO output, the range of values, and the unit vary with the output category.

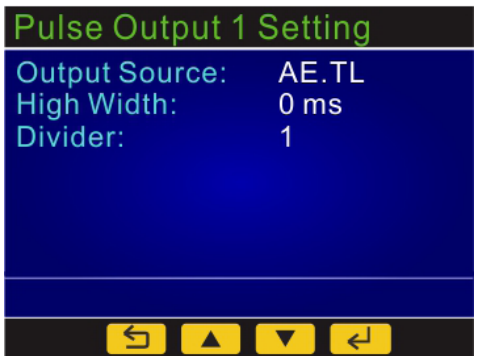
🔔 Note: The meter voltage and current AO output pins is different, the wiring should pay attention to the correctness.

4.8 Pulse output(PO) function

AFM-8A series meter provide two PO (pulse output) ports, by meter front or communication settings, select one of the meter energy parameters for convert output. The energy parameters are import active energy, export active energy, import reactive energy, export reactive energy and test pulse output.

PO contactor capacity: Open collector (O.C.), 30Vdc / 30mA.





4.8.1 PO function setting

Table 4-8 indicates the setting contents and addresses of PO.

▼ Table 4-8

Reg	Description	Size	Range	Units	Default	R/W	Notes
0180h	Parameter assign of PO1	1	0~5		1	R/W	0: OFF 1: Active Energy-IMP 2: Active Energy-EXP 3: Reactive Energy-IMP 4: Reactive Energy-EXP 5: Test Pulse Output
0181h	Pulse divider of PO1	1	1~9999		1	R/W	ex:1=0.1kWh/P 100=10kWh/P
0182h	Pulse width of PO1	1	0~5000	mS	0	R/W	0 is 50% duty cycle
0183h	PO2 setting	3					Setting format same as PO1

Parameter assign: select target energy parameter for PO convert output. Two ports of PO can be set corresponding output parameters.

Pulse divider setting: That is the energy value multiplied by a number to output a pulse.

The setting range is an integer from 1 to 9999, unit is 0.1kWh. For example, set the divider value to 100, that is each cumulative 100 × 0.1kWh = 10kWh output a pulse.

Pulse width time: That is each pulse high level time. The setting range is 0 ~ 5000, the unit time is 1mS. When set to 0, the pulse duty cycle is 50%.

🔔 Note: The maximum pulse output frequency is 40Hz. If it is test pulse output , it fixed output 1600 pulses per 1kWh.

4.9 Data logging function

In order to facilitate users to understand the history of the meter, the meter provides data logging function. Record a set of data at regular intervals. Meter internal 4MB of data storage space for recording data. The meter has a real-time clock and each data log has a time stamp.

4.9.1 Data logging function setting

The data logging function can set the parameters to be recorded according to required, up to 50 parameters can be set. There are 91 parameters to choose, see Table 4-9.

▼ Table 4-9

No.	parameter	No.	parameter	No.	parameter	No.	parameter	No.	parameter	No.	parameter	No.	parameter
0	NONE	1	FREQ	2	U1	3	U2	4	U3	5	ULN. AVG	6	U12
7	U23	8	U31	9	ULL.AVG	10	I1	11	I2	12	I3	13	I.AVG
14	IN	15	P-1	16	P-2	17	P-3	18	P.SUM	19	Q-1	20	Q-2
21	Q-3	22	Q.SUM	23	S-1	24	S-2	25	S-3	26	S.SUM	27	PF1
28	PF2	29	PF3	30	PF.AVG	31	Uunbl	32	Iunbl	33	Load Type*	34	P.DM
35	Q.DM	36	S.DM	37	I1.DM	38	I2.DM	39	I3.DM	40	I.AVG. DM	41	AE.IMP
42	AE.EXP	43	RE.IMP	44	RE.EXP	45	SE. Total	46	U1 (U12). THD	47	U2 (U23). THD	48	U3 (U31). THD
49	U.AVG. THD	50	I1.THD	51	I2.THD	52	I3.THD	53	I.AVG. THD	54	Phasor Diagram V2 lag V1	55	Phasor Diagram V3 lag V1
56	Phasor Diagram I1 lag V1	57	Phasor Diagram I2 lag V1	58	Phasor Diagram I3 lag V1	59	Phasor Diagram V23 lag V12	60	Phasor Diagram V31 lag V12	61	Phasor Diagram I1 lag V12	62	Phasor Diagram I2 lag V12
63	Phasor Diagram I3 lag V12	64	U1(U12). THD.MAX	65	U1(U12). THD.MIN	66	U2(U23). THD.MAX	67	U2(U23). THD.MIN	68	U3(U31). THD.MAX	69	U3(U31). THD.MIN
70	U.AVG. THD.MAX	71	U.AVG. THD.MIN	72	I1.THD. MAX	73	I1.THD. MIN	74	I2.THD. MAX	75	I2.THD. MIN	76	I3.THD. MAX
77	I3.THD. MIN	78	I.AVG. THD.MAX	79	I.AVG. THD.MIN	80	P.DM. MAX	81	P.DM. MIN	82	Q.DM. MAX	83	Q.DM. MIN
84	S.DM. MAX	85	S.DM. MIN	86	I1.DM. MAX	87	I2.DM. MAX	88	I3.DM. MAX	89	I.AVG. DM.MAX	90	AO1
91	AO2	*Load type: R: 82 L: 76 C: 67(ASCII code)											

The types of parameters are described below:

Basic measurement parameters: Frequency, voltage, current, neutral current, power, power factor, voltage and current unbalance, load type, current demand and power demand.

Energy: Import and export of active energy, reactive energy and apparent energy.

Harmonic distortion rate: The phase of voltage and current and the average total harmonic distortion rate.

Phase angle: Angle of other phase voltage and current relative to V1 phase voltage.

MAX and MIN: THD of voltage and current, current demand and power demand of the maximum and minimum.

AO: AO register output value.

Recording interval duration time: Can set any integer between 1 ~ 32767. Unit with the interval time, that is each data record interval time.

Record interval duration time unit: Can set the second, minute, hour, day.

Record period: Enable the data logging function to set the start time and end time. The time setting range is year, month, day, hour, minute and second. When enabled, a data log is recorded for each record interval duration time between the start time and the end time.

🔔 Note: Condition setting, recording function enable, etc. must be done before using the data logging function. Any incomplete or incorrect settings will result in the recorded failure. The setting operation is completed by setting the corresponding register. It should be specially explained that the settings of these registers must be set by means of communication. After the record full, data will be based on first-in-first-out principle of circular coverage. When cyclic overwriting occurs, the earliest recorded data will be overwritten sequentially. Therefore, user are advised to read and save the entire data record before it is full to prevent data loss.

When the contents of the record parameters have changed, then all the records will not be retained and start recording from beginning.

4.9.2 Data log read

Read data logs must be read via communication, see Table 4-10.

▼Table 4-10

Reg	Description	Size	Range	Units	Default	R/W	Notes
4000h	Byte count of each recording	1				R	
4001h	Number of unread data	1				R	
4002h	Data read	1				R	Reply 0020h if data empty
4003h	Status reply after read	1	0~2			W	0: Clear logging data (Index reset) 1: Abort this time read (Index will not any shift) 2: Read success (Index will shift to current position)

The length of each data log can be obtained by reading the byte count address. The length of the data obtained through the data read address for data log content read, as shown in the following figure:

Request:

Address	Code	Starting Reg		Byte count		CRC	
		Hi	Lo	Hi	Lo	Lo	Hi
01h	03h	40h	02h	xxh	xxh	xxh	xxh

Byte count: Read from 4000h

Data content will be returned in the following format:

Response:

Address	Code	Byte count	Year		Month		Day		Hour		Minute		Second		Values	CRC	
			Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo		Lo	Hi
01h	03h	xxh	07h	DFh	00h	0Ch	00h	01h	00h	0Dh	00h	19h	00h	2Ah	.....	xxh	xxh

Date : 07DFh=>2015 000Ch=>12 0001h=>01
Time : 000Dh=>13 0019h=>25 002Ah=>42

Each read order can only read a log record. Reading unread number shows how many logs remain unread. If there is no record that has not been read yet, then the data return will be 0020h, indicating that the data record has been read.

After reading a record of log must be send back the read status to meter, as a basis for recording indicators move. Can also give up the record read or clear data records via send back the read status.

4.10 Time of use (TOU) function

User can assign up to 4 different tariffs (sharp, peak, valley and normal) to different time period within a day according to the billing requirements. The meter will calculate and accumulate energy to different tariffs according to the meter's internal clock timing and TOU settings.

TOU setting: User can set a maximum of 4 TOU seasons, each season can be assigned to a TOU schedule, maximum of 8 TOU schedules are available. Each schedule can be divided up into 8 segments, each segment can have its own tariff (sharp, peak, valley and normal).

User can customize the TOU calendar (including its tariffs, seasons, schedules and segments) according to different applications. To make sure that the TOU calendar is setup correctly, the meter will check the TOU settings according to the predefined rules.

TOU function will be disabled if the TOU calendar is set up incorrectly. If no errors are found in the calendar and the TOU function is enabled, TOU energy accumulation will begin.

TOU setting format requirement:

4.10.1 Season setting

The calendar year will be divided up into different seasons depending on the season setting parameter. The parameter can be selected from any integer between 1 to 4. User must enter the correct value for the season setting parameter in accordance to the TOU season table. If the season setting parameter is set as 2, the first 2 slots of the TOU season table must be set, otherwise it will be considered as an invalid input, TOU function will be disabled.

4.10.2 TOU season format

Enter the start date into the TOU season table slot following this format "MM-DD ID", MM stands for the month, DD stands for the day and ID stands for the TOU schedule ID, available from 1 to 8. The dates should be organized so that they are in sequence according to the calendar year, the earlier date comes first and the later date comes last.

For example, if 3 seasons are selected, the date parameters are January 1, June 6 and September 7, and TOU schedule 02, 01, 03 will be used respectively, the first TOU season table slot shall enter 01-01 02, the second slot shall enter 06-06 01, and the third slot shall enter 09-07 03. Entering 01-01 02 for the first slot, 09-07 03 for the second slot and 06-06 01 for the third slot is considered invalid.

4.10.3 Schedule setting

The number of available TOU schedules depends on the schedule setting parameter. The parameter can be selected from any integer between 1 to 8. This parameter determines the number of TOU schedules available for the TOU calendar setting. A maximum of 8 TOU Schedules, from TOU Schedule #1 to TOU Schedule #8 can be used.

4.10.4 Segment setting

Each TOU schedule consists of various timing segments. The number of segments depends on the segment setting parameter setup. The parameter can be selected from any integer between 1 to 8. User must enter the correct value for the segment setting parameter in accordance to the TOU schedule table. If the segment setting parameter is set as 3, the first 3 slots of the TOU schedule table must be set, otherwise, it will be considered as an invalid input, TOU function will be disabled.

Each TOU schedule represents a 24 hour cycle. Similar to TOU season format, enter the start time into the TOU schedule table slot following this format “HH:MM ID”, HH stands for hour (in 24 hr format), MM stands for minutes and ID stands for tariffs (available from 00 to 03). The time should be organized according to the hour sequence. Entering time information in a wrong sequence (for example, entering 15:30, 01:00, 22:45) is considered as an invalid operation, TOU function will be disabled.

4.10.5 Tariff setting

This parameter corresponds to the number of tariffs available for the TOU calendar and can be selected from any integer from 0 to 3. The four tariffs: sharp, peak, valley and normal are represented by 4 integers: 0,1,2 and 3 respectively.

4.10.6 Holiday setting

This parameter can be set from any integer between 0 and 20, meaning a maximum of 20 holidays can be programmed to the TOU calendar. If the holiday setting parameter is set as 3, the first 3 slots of the holiday schedule must be set, otherwise it will be considered as an invalid input, TOU function will be disabled.

🔔 Note: User can reset the TOU calendar to default value via communication.

Holiday schedule

The holiday schedule uses the same format as the TOU seasons “MM-DD ID”. User can select which TOU schedule to be used for the holiday. The dates of the holiday schedule do not need to be organized in a sequential order (i.e. the first slot can be January 1, the second slot can be December 26 and the third slot can be December 25).

Holiday day can be set to use the same holiday day setting for the next 5 years, or 5 years holiday day can be setting separately. When multi-year holiday function is enabled, if the current year of the meter falls into the multi-year holiday setting, it automatically loads the multi-year holiday settings into the current TOU settings. If the current year of the meter does not fall into the multi-year holiday setting, it remains the current TOU settings.

🔔 Note: Holiday schedule has the highest priority among all the schedules.

Weekend schedule

Weekend setting: Definition of weekend is fixed as Saturday and Sunday. When the meter clock is within the Weekend Schedule, the energy will accumulate under the tariff that corresponds to the Schedule.

🔔 Note: Weekend schedule's priority is followed by Holiday schedule. When Holiday schedule is not enabled, Weekend schedule has the highest priority, overriding the normal (weekday) schedule.

TOU can record maximum power and current demand under different tariffs, as well as the time stamp of the maximum value. It can also clear by setting the corresponding register or from the meter front.

TOU has 2 separate logs: current month TOU and last month TOU. When setup appropriately and when TOU is enabled, energy will be accumulated in a month-to-month basis. The current energy usage will be stored under current Month TOU and is divided up into different tariffs. When next month or counting period starts, all current month TOU values will be moved to last month TOU.

There are two ways of automatic settle of current month TOU:

1. End of Month: This is the default method. All values from current month TOU will be copied over to last month TOU at the every beginning of each month (the first day of each month at time 00: 00: 00). Current month TOU will be cleared and reset to 0.
2. Fixed day: User can select when the values from current month TOU would be copied over to last month TOU. User can set the time in the following format “DD HH: MM: SS”, DD stands for day, HH stands for hour, MM stands for minute, SS stands for second.

Similar to the previous method, once current month TOU is transferred to last month TOU, all values from current month TOU will be cleared and reset to 0.

4.11 Power quality event logging and Waveform capture

AFM-8A series meter with power quality event logging and waveform capture functions, to provide user with the basis for the analysis of power quality. The 4MB FLASH of the meter to store the data, and ensure the data is not lost when the power is off.

Power quality event logging

When a power quality event happens, such as voltage sag and swell, meter will record the event timestamp and the triggering condition. It can save up to 50,000 events.

4.11.1 Event logging data format, see Table 4-11

▼Table 4-11

Reg	Description	Size	Range	Units	Default	R/W	Notes
2D83h	Year	1	2000~2099			R	
2D84h	Month	1	1~12			R	
2D85h	Day	1	1~31			R	
2D86h	Hour	1	0~23			R	
2D87h	Minute	1	0~59			R	
2D88h	Second	1	0~59			R	
2D89h	Trigger source	1	0~1056	bit		R	High Byte: 0: Voltage sag 1: Voltage swell 2: Current swell Low Byte: 0: U1/U12 (voltage), I1 (current) 1: U2/U23 (voltage), I2 (current) 2: U3/U31 (voltage), I3 (current)
2D8Ah	Set point	2	U: 5~1200000 I : 0~9999999			R	
2D8Ch	Trigger threshold	1	20~150	%		R	Voltage sag: 20~100 Voltage swell: 50~140 Over current: 50~150
2D8Dh	Half cycle count	1	4~200			R	Voltage sag: 4~200 Voltage swell: 4~200 Over current: 4~200
2D8Eh	Event value	2	U: 5~1200000 I : 0~9999999			R	

Event time: The date and time when the event log was triggered.
Trigger source: Event log caused by a voltage sag or voltage swell or over current.
Set point: Voltage or current set point.
Trigger threshold: The percentage of voltage sag or voltage swell or over current by triggered.
Half cycle count: The number of half cycles that an event triggered requires to last.

4.11.2 Logging events

The event logging feature can log 50000 events. If the 50000 events are full, no more events will be logged even if the triggering condition happens. The user must clear the event log, and then the logging will log the new event. When the log is cleared, the new event will be logged from the first event happening. There will be no data loss after the power is off.

4.11.3 Event logging triggering conditions

4.11.3.1 Voltage sag

When any phase of the three phase voltage is lower than the set value (voltage rated value x threshold %), there will be a voltage sag event. One or two phase of the three phase voltage sags does not influence the other voltage response to the voltage sag monitoring. In other words, if the voltage sag happens again at the same time, a new voltage sag event will still be logged. Only when the voltage phase in the voltage sag condition restores back to normal, this phase can response to the new voltage sag event.

4.11.3.2 Voltage swell

When any phase of the three phase voltage is higher than the set value (voltage rated value x threshold %), there will be a voltage swell event. When one phase voltage swell happens, the other phase will not respond to voltage swell event logging. Only when all of the phases voltage restore back to normal, a new voltage swell event will be responded.

4.11.3.3 Over current

When any phase of the three phase current is higher than the set value (current rated value x threshold %), there will be a over current event. When one phase over current happens, the other phase will not respond to over current event logging. Only when all of the phases current restore back to normal, a new over current event will be responded.

🔔 Note: To power quality event logging and waveform capture normal response, user need to set the appropriate parameters, the parameters set as shown in Table 4-12. In the parameter settings, voltage sag and voltage swell share the same voltage rated value.

The parameters for event logging includes: voltage rated value, current rated value, voltage sag threshold, voltage sag half cycle count, voltage swell threshold and over current threshold. Those parameters also fit waveform capture. The other triggering conditions for waveform capture can be set when necessary. When the waveform capture triggering by voltage sag, voltage swell and over current is enabled, the corresponding event log and waveform will be recorded when voltage sag or voltage swell or over current happens.

▼Table 4-12

Reg	Description	Size	Range	Units	Default	R/W	Notes
01C0h	DI input to trigger waveform capture setting	1	0~65535	bit	21845	R/W	bit15bit14: DI8 bit13bit12: DI7 bit11bit10: DI6 bit9bit8: DI5 bit7bit6: DI4 bit5bit4: DI3 bit3bit2: DI2 bit1bit0: DI1 00: Prohibit 01: OFF to ON capture 10: ON to OFF capture 11: Any change to capture
01C1h	Manual capture	1	0 or 55h		0	R/W	0: None 55h: Capture
01C2h	PT Primary voltage nominal value	2	100 ~ 1200000	V	600	R/W	
01C4h	CT Primary current nominal value	1	5~9999	A	5	R/W	
01C5h	Voltage sag trigger enable	1	0~1		0	R/W	0: OFF 1: ON
01C6h	Voltage sag threshold	1	20~100	%	50	R/W	
01C7h	Voltage Sag half cycle count	1	4~200		10	R/W	
01C8h	Voltage swell trigger enable	1	0~1		0	R/W	0: OFF 1: ON
01C9h	Voltage swell threshold	1	50~140	%	100	R/W	
01CAh	Voltage swell consecutive half-cycles	1	4~200		10	R/W	
01CBh	Over current trigger enable	1	0~1		0	R/W	0: OFF 1: ON
01CCh	Over current threshold	1	50~150	%	100	R/W	
01CDh	Current swell consecutive half-cycles	1	4~200		10	R/W	
01CEh	Waveform storage mode	1	0~1		0	R/W	0: FIFO 1: Fill&Hold
01CFh	Power quality event logging function enabled	1	0~1		0	R/W	0: OFF 1: ON
01D0h	All waveforms data reset	1	0 or 55h		0	R/W	0: None 55h: Reset
01D1h	All power quality event logging reset	1	0 or 55h		0	R/W	0: None 55h: Reset

4.11.4 Event log retrieve

When a new event log coming, the newest event number address contains the newest event number. When the log is being retrieved, the starting event log number and the event quantity for each retrieve must be set correctly. It must be ensured that the starting number of event log should equal or smaller than the newest log number. When setup is correct, reading logging data registers will acquire the event log data. Each time a maximum of 9 logged events can be retrieved. The modbus register address of the event log retrieve setting as shown in Table 4-13.

▼Table 4-13

Reg	Description	Size	Range	Units	Default	R/W	Notes
2D80h	Numbers of new logging data	1	0~50000		0	R	0: None 1~50000: News number
2D81h	Logging number to read	1	1~50000		1	R/W	If has new record, the number is valid when less than or equal to the newest number
2D82h	Read the number of records each time	1	1~9		1	R/W	

Waveform capture

AFM-8A series meter can record 8 groups of voltage and current waveform data at a sampling rate of 64 points per cycle. It provides the captured waveform of 8 cycles before and after the triggering point (including V1, V2, V3, I1, I2, I3). The triggering condition is settable.

4.11.5 Waveform capture data format

Timestamp + Triggering Condition + V1, V2, V3, I1, I2, I3(Before triggering point 8 waveforms)+ V1, V2, V3, I1, I2, I3(After triggering point 8 waveforms).

Timestamp: Year, Month, Day, Hour, Minute, Second.

Triggering condition:

Manual triggering: 0: NO, 1: YES.

DI triggering: bit1bit0: DI1;bit3bit2: DI2;bit5bit4: DI3;bit7bit6: DI4; bit9bit8: DI5;bit11bit10: DI6;bit13bit12: DI7;bit15bit14: DI8.

(Two bits meaning: 00: No DI triggering, 01: DI triggering from OFF to ON, 10: DI triggering from ON to OFF)

Voltage sag triggering: 0: NO, 1: YES.

Voltage swell triggering: 0: NO, 1: YES.

Over current triggering: 0: NO, 1: YES.

Waveform order:

Before triggering point 8 V1 waveforms, 8 V2 waveforms, 8 V3 waveforms, 8 I1 waveforms, 8 I2 waveforms, 8 I3 waveforms.

After triggering point 8 V1 waveforms, 8 V2 waveforms, 8 V3 waveforms, 8 I1 waveforms, 8 I2 waveforms, 8 I3 waveforms.

4.11.6 Waveform capture group

Waveform capture can log up to 8 groups of waveform data, the storage mode according to the setting as below:

First-In First-Out(FIFO) mode: When the 8 groups data is full, the next trigger condition comes, the new waveform data will starts from the first group, and cover the original data of the first group, record by loop.

Fill and Hold mode: When the 8 groups data is full, it does not respond to any waveform triggering condition. Only when all the waveform data is reset to emptied, waveform capturing function will be normal. When the waveform data is emptied, new waveform data starts from the 1st group.

🔔 Note: Since the amount of each waveform group data is large, it takes more time to write into the flash memory. Therefore, waveform capture only responds to one triggering condition at one time. During the process of writing data into the flash memory, it does not respond to new triggering condition. After the process of memory writing, it will respond to new waveform triggering condition. The waveform data will not be lost when the power is off.

4.11.7 Waveform capture triggering condition

4.11.7.1 Manual triggering

Manually trigger one group waveform capture can be operating the corresponding register or from the meter front.

4.11.7.2 DI triggering

DI triggering waveform capture is only suitable for the DI input on the meter itself, and the DI waveform capture function is only valid when the DI function is set to waveform capture.

This setting can also be operating via meter front.

The modbus address assigns two bits for the DI channel. When they are set as “00”, it means DI triggering Disabled, “01”means DI triggering will be implemented when DI state changes from OFF to ON, “10”means DI triggering will be implemented when DI state changes from ON to OFF, “11“means DI triggering will be implemented when DI state has any change.

4.11.7.3 Voltage sag triggering

As mentioned in voltage sag event logging, when voltage sag triggering waveform is enabled, both event logging and waveform capture will be implemented at the same time once a voltage sag happens.

4.11.7.4 Voltage swell triggering

As mentioned in voltage swell event logging, when voltage swell triggering waveform is enabled, both event logging and waveform capture will be implemented at the same time once a voltage swell happens.

4.11.7.5 Over current triggering

As mentioned in over current event logging, when over current triggering waveform is enabled, both event logging and waveform capture will be implemented at the same time once a over current happens.

4.11.8 Waveform capture retrieve

In Modbus address section, only one group of waveform is saved. When there is waveform data and it is being retrieved, firstly write group number 1-8 into record Number for read address, the group number written in must be smaller or equal to the newest number of records, otherwise the writing operation will be invalid and the desired waveform cannot be retrieved. After the group number is written correctly, read waveform data addresses in order to get the written group number waveform data.

The waveform capture retrieve address is shown in Table 4-14:

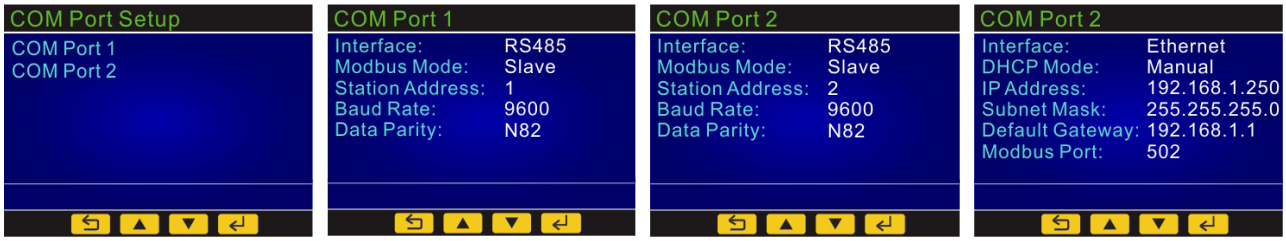
▼Table 4-14

Reg	Description	Size	Range	Units	Default	R/W	Notes
1510h	Active waveform	1	0~8			R	
1511h	New waveform flag	1	0~255	bit		R	0: No new waveform 1~255: New waveform BIT0: First group flag BIT7: Eighth group flag 0: OFF 1: ON
1512h	Specify waveform reading	1	1~8		1	R/W	
1513h	Specify waveform trigger time - year	1	2000~2099			R	
1514h	Specify waveform trigger time - month	1	1~12			R	
1515h	Specify waveform trigger time - day	1	1~31			R	
1516h	Specify waveform trigger time - time	1	0~23			R	
1517h	Specified waveform trigger time - minutes	1	0~59			R	
1518h	Specify waveform trigger time - second	1	0~59			R	
1519h	Specified waveform trigger time - 0.1 milliseconds	1	0~9999	0.1mS		R	
151Ah	Specify waveform trigger source	1	1~5		1	R	1: Manual 2: DI 3: SAG 4: SWELL 5: OVER CURRENT
151Bh	Specify Waveform DI Trigger Edge	1	0~1		0	R	0: positive edge 1: negative edge
151Ch	Voltage ratio	2				R	Floating Data
151Eh	Current ratio	2				R	Floating Data
1530h	Front 8 cycles of U1	512	-32768~32767			R	
1730h	Front 8 cycles of U2	512	-32768~32767			R	
1930h	Front 8 cycles of U3	512	-32768~32767			R	
1B30h	Front 8 cycles of current 1	512	-32768~32767			R	
1D30h	Front 8 cycles of current 2	512	-32768~32767			R	
1F30h	Front 8 cycles of current 3	512	-32768~32767			R	
2130h	Rear 8 cycles of U1	512	-32768~32767			R	
2330h	Rear 8 cycles of U2	512	-32768~32767			R	
2530h	Rear 8 cycles of U3	512	-32768~32767			R	

2730h	Rear 8 cycles of current 1	512	-32768~32767			R	
2930h	Rear 8 cycles of current 2	512	-32768~32767			R	
2B30h	Rear 8 cycles of current 3	512	-32768~32767			R	

4.12 Communication function

AFM-8A series meter in addition to the first port of RS-485 communication, also can optional second port of communication, include RS-485 or Ethernet.



4.12.1 The first port of RS-485 communication

The setting of RS-485 communication parameters can be completed by setting the corresponding register or from the meter front, see Table 4-15.

▼Table 4-15

Reg	Description	Size	Range	Units	Default	R/W	Notes
0100h	Device address	1	1~247		1	R/W	
0101h	Baud rate	1	0~7		3	R/W	0: 1200 1: 2400 2: 4800 3: 9600 4: 19200 5: 38400 6: 57600 7: 115200
0102h	Parity Check	1	0~3		1	R/W	0: N.8.1 1: N.8.2 2: O.8.1 3: E.8.1
0103h	Type of 2nd communication port	1	0~2			R	0: None 1: RS485 2: Ethernet
0104h	Mode of 2nd RS485	1	0~1		1	R/W	0: Master 1: Slave
0105h	Device address of 2nd RS485	1	1~247		1	R/W	Available on 2nd RS485 is slave mode
0106h	Baud rate of 2nd RS485	1	0~7		3	R/W	0: 1200 1: 2400 2: 4800 3: 9600 4: 19200 5: 38400 6: 57600 7: 115200
0107h	Parity Check of 2nd RS485	1	0~3		1	R/W	0: N.8.1 1: N.8.2 2: O.8.1 3: E.8.1

Communication protocol: Modbus RTU

Device address: Set the communication address of the meter. The setting range is an integer from 1 to 247.

Baud rate: Set the communication rate, up to 115200bps. 0: 1200, 1: 2400, 2: 4800, 3: 9600, 4: 19200, 5: 38400, 6: 57600, 7: 115200.

Parity check: Can be set none, odd or even parity check. 0: N.8.1, 1: N.8.2, 2: O.8.1, 3: E.8.1.

4.12.2 The second port of RS-485 communication

The setting same as first port of RS-485, can be completed by setting the corresponding register or from the meter front, see Table 4-15.

Mode setting: The second port of RS-485 can be set to Master or Slave mode, if want to use the extended DIO function, must set to Master mode.

🔔 Note: When set to Master mode, the device address of second port is invalid.

4.12.3 Ethernet communication

The second port communication of AFM-8A series meter also can be option Ethernet communication.

The setting of Ethernet communication parameters can be completed by setting the corresponding register or from the meter front, see Table 4-16.

▼Table 4-16

Reg	Description	Size	Range	Units	Default	R/W	Notes
0120h	DHCP setting	1	0~1		0	R/W	0: Manual 1: Automatic
0121h	IP address	2	0~255			R/W	192.168.1.250
0123h	Submask address	2	0~255			R/W	255.255.255.0
0125h	Gateway address	2	0~255			R/W	192.168.1.1
0127h	Reserved	2					
0129h	Reserved	2					
012Bh	Modbus TCP/IP port number	1	0~65535		502	R/W	
012Ch	Reserved	1					
012Dh	Ethernet reset	1	0 or 55h		0	R/W	0: None 55h: Reset
012Eh	Reserved	1					
0135h	MAC address	3				R	

Communication protocol: Modbus TCP.

DHCP setting: Dynamic Host Configuration Protocol, that is the device in the network to automatically obtain IP. 0: Manual, 1: Automatic.

IP address: The IP address of the meter.

Submask address: The submask address of the meter.

Gateway address: The gateway address of the meter.

Port number: Modbus TCP port number setting, the default is 502.

To read the MAC address of the meter, read the corresponding register.

The IP address format is shown in Table 4-17, for example 192.168.1.250:

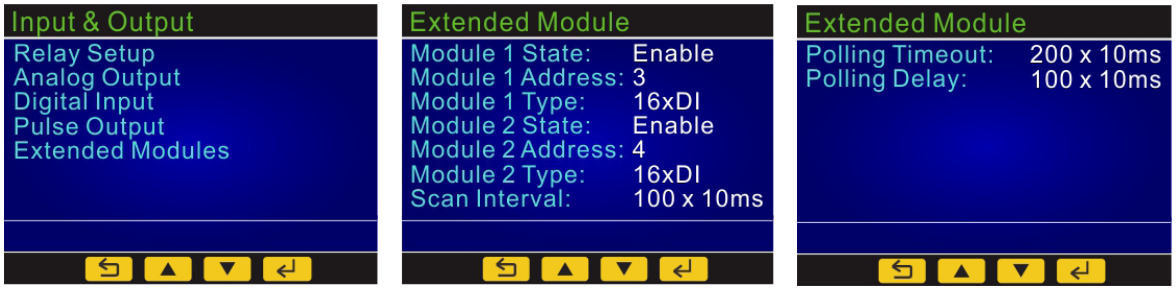
▼Table 4-17

0121h		0122h	
Hi	Lo	Hi	Lo
192	168	1	250

🔔 Note: If all the parameters need to be recovery to default value, it can be completed by setting the corresponding register or from the meter front.

4.13 Expansion DIO module function

AFM-8A series meter has DI input and RO output function, if the channel number is not enough to use, you can through the second RS-485 port to expand DIO module.



4.13.1 DIO expansion module setting

The parameter setting operation of the expansion module can be completed by setting the corresponding register or from the meter front, as shown in Table 4-18. The maximum number of expansion modules is two groups, each group has a maximum of 16 input or output channels, and the module can also be a mixed output and input.

▼Table 4-18

Reg	Description	Size	Range	Units	Default	R/W	Notes
02F0h	DI start address of I/O module 1	1	0000~FFFFh		0	R/W	
02F1h	DO start address of I/O module 1	1	0000~FFFFh		0100h	R/W	
02F2h	Reserved	1				R/W	
02F3h	Reserved	1				R/W	
02F4h	DI start address of I/O module 2	1	0000~FFFFh		0	R/W	
02F5h	DO start address of I/O module 2	1	0000~FFFFh		0100h	R/W	
02F6h	Reserved	1				R/W	
02F7h	Reserved	1				R/W	
0300h	I / O module 1 enable	1	0~1		0	R/W	0: Disable 1: Enable
0301h	I/O module 1 device address	1	1~247		1	R/W	
0302h	Type of I/O module 1	1	0~2		0	R/W	0: 8xDI+8xDO 1: 16xDI 2: 16xDO

0303h	I / O module 2 enable	1	0~1		0	R/W	0: Disable 1: Enable
0304h	I/O module 2 device address	1	1~247		1	R/W	
0305h	Type of I/O module 2	1	0~2		0	R/W	0: 8xDI+8xDO 1: 16xDI 2: 16xDO
030Ch	Modules polling time	1	10~3000	x10mS	100	R/W	All modules polling time
030Dh	I/O module Timeout time	1	10~3000	x10mS	100	R/W	

DI start address setting: Set the module's first DI address, as the meter reads the DI status of the starting address.

DO start address setting: Set the module's first DO address, as the meter reads or control the DO status of the starting address.

Module enable: 0: Disable;1: Enable.

Module address setting: Set the module's RS-485 communication address.

Module type setting: Set the module DIO function type. 0: 8 x DI + 8 x DO, 1: 16 x DI, 2: 16 x DO.

Polling time: Set the interval time for reading the expansion module. The setting range is an integer from 10 to 3000, the unit is 10mS. For example, set the polling time to 20, that is, 20 × 10 = 200mS.

The setting of module 2 is the same as module 1.

🔔 Note: Each expansion module must be set and enabled before use. Any incomplete or incorrect settings or not enabled will cause the module function to not work normally. When the actual number of input or output channels of the expansion module is less than the set number of types, the excess part of the channel may read incorrect data or respond to the communication when read or controlled.

4.13.2 DIO expansion module read and control

Expansion module can be used normally by the correct settings. DI and DO function settings are basically the same as DI and RO function settings of the meter. The differences are described as follows:

4.13.2.1 Differences DI functions between expansion module and meter

The meter itself can have up to 8 DI, the DI number of the expansion module starts from DI9 up to DI40.

In the functions, the DI of the expansion module has the same DI function of the meter except the waveform capture function.

4.13.2.2 Differences DO functions between expansion module and meter

The meter's own output code is RO, so the DO number is from DO1 to DO32, and the DO communication address starts from 0004h. See Table 4-19.

▼Table 4-19

Reg	Description	Size	Range	Units	Default	R/W	Notes
0004h	DO1 ~32 status and control	32	05h : 0000h or FF00h 01h : 0~1			R/W	0=off 1(FF00h)=on

In the functions, the DO of the expansion module is the same as the RO function of the meter, but the action mode is different. The DO action mode of the expansion module is the level or pulse output mode. When set to pulse mode, you can set the output pulse width time. In addition, DO output trigger can also set the trigger conditions, such as more than(>), equal to(=), less than(<) the set point. The setting address of the expansion module DO is shown in Table 4-20.

▼Table 4-20

Reg	Description	Size	Range	Units	Default	R/W	Notes
0380h	DO1 mode	1	0~2		2	R/W	0: OFF 1: Alarm 2: DO
0381h	DO1 trigger delay timer	1	0~3000	x10mS	0	R/W	
0382h	Parameter assign of DO1	1	0~48		2	R/W	Refer to Table 1(P.2)
0383h	Action mode of DO1	1	0~1		0	R/W	0: Level 1: Pulse
0384h	Pulse width of DO1	1	50~3000	x10mS	1000	R/W	
0385h	Set point of DO1	2	Depend on parameters		1000	R/W	
0387h	Trigger condition of DO1	1	0~2		0	R/W	0: more than(>) 1: equal(=) 2: less than(<)

🔔 Note: The communication protocol of DIO expansion module is Modbus RTU. Therefore, the command for reading DI or controlling DO is the standard command code such as 01/02/05, so the expansion module used should support the same communication protocol and above command code can be used normally.