

DPMS X1 Series Power Meter

User's Manual

1087-351



AMETEK[®]
POWER INSTRUMENTS

User Notes Page

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The information contained in this document is believed to be accurate at the time of publication, however, AMETEK assumes no responsibility for any errors which may appear here and reserves the right to make changes without notice. Please ask your local representative for the latest product specifications before ordering.

Please read this manual carefully before installation, operation and maintenance of this product. The following symbols are used in this manual and on the meter to alert to danger or to prompt in the operating or set process.



Danger symbol, Failure to observe the information may result in injury or death.



Alert symbol, Alert to potential danger.

Observe the information after the symbol to avoid possible injury or death.

Dangerous

Near dangerous position, Failure to observe the information may result in injury or death.



Note Symbol, avoid result in meter damage or human injury or death.

The instrument should be well grounded and powered off before maintenance. Installation and maintenance of the meter should be performed by qualified personnel that have appropriate training and experience with high voltage and current devices.

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Chapter 1 Introduction

1.1 Description

Powerful and Economical

The DPMS X1 series power meter is design for single phase electrical value measurement using the latest microprocessor and digital signal processing technology. It can measure True-RMS Voltage, Current, Power, Reactive Power, Power Factor, Frequency and Energy. The meter can be used in high harmonic environments especially in middle and low voltage power systems, electric equipment, power system automation and factory automation. The measurements are available via digital RS-485 communication port running Modbus TM Protocol. The meter also has I/O functions that combine the metering, monitoring, remote controlling and Analog output into one unit.

Small Size & Easy Installation

The DPMS X1 series was designed to standard DIN96*48 and reduced depth of 60mm. It is suitable for small cabinet installation in switch gear. It is asy to install on panels by using clips.

Easy to Use

A large character LCD with blue back light makes the display easy to read even under low light conditions. All the Value reading and parameter setting can be accessed by using 4 panel keys or the communication port. The parameters are protected in EEPROM, which will maintain its content after the meter is powered off.

High Reliability and Safety

Multi-isolation and immunity methods were adopted in the DPMS X1 design according to industry standards. The meter can be installed in hazardous industry areas. Also the meter was tested under IEC standards and EMC standards. The meter house was designed by using glass polymer which is durable and antire.

1.2 Application Area

The DPMS X1 series meter can be used to replace analog meters, panel meters, transducers and small RTUs in power distribution or power automation systems. As it adopted a true-RMS measuring method, the DPMS X1 meters are used for measuring voltage and current in high distortion nonlinear load systems, such as VVVF, Electric Ballast, Computer etc.

Power Distribution Automation

Industry Automation

Energy Manage System

Intelligent Electric Switch Gear

Building Automation

Industry Apparatus

1.3 DPMS X1 Series

DPMS X1 series power meters are used mainly in single phase or balanced three phase systems.

The meter has measuring, communication and I/O functions. The DPMS X1 is a multi-function meter with communication port. For detail please refer to Table 1.1.

	Item	DPMS X1
Meter- ing	Voltage V	●
	Current I	●
	Power P	●
	Reactive Power Q	●
	Apparent Power S	●
	Power Factor PF	●
	Frequency Hz	●
Energy	Energy Ep	●
I/O Option	Digital Input DI	□
	Relay Output RO	□
AO Option	4~20mA or 0~1m or 0~5V	□
C o m - m u n i - c a t i o n	RS485 Modbus Protocol	●

● Function □ Option Blank NA

Table1.1 DPMS X1 Series Power Meter

User Notes Page

Chapter 2 Installation

2.1 Appearance and Dimensions

2.1.1 Appearance

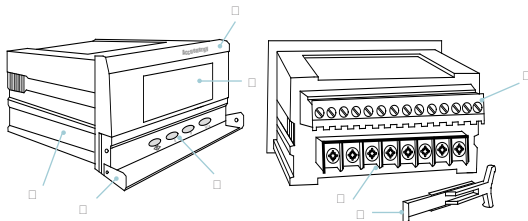


Fig 2.1 Appearance

Part Name	Description
□ House	Meter House is made of High Strength anti fire glass-polymer
□ Front Panel	Front Part of the Meter
□ Display Window	LCD Display Window
□ Key	Used to change display and setting the parameters
□ Key Door	Used to protect key Mis-press
□ Clip	Used fasten the meter on the panel
□ Input Terminal	Power supply, Voltage and Current Input Terminal
□ Auxiliary Terminal	Digital Input, Relay Output, Analog Output and Communication Terminal

Table 2.1 Part Name of Meter

2.1.2 Dimension(mm)

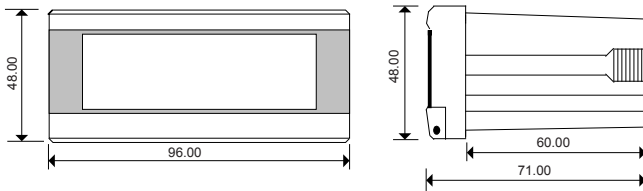


Fig 2.2 Dimension

2.2 Installation



Note

The environment temperature, humidity and position should be in the meter's specification range.

Environment

Before installation, please make sure that the environment satisfies the following conditions.

1. Temperature

The meter's working temperature range is from -20c - 70c. If the meter is used beyond this range, it will result in abnormal performance or even permanent damage to the meter.

Meter's storage range is from -40c - 85c.

2. Humidity

Meter's working humidity is from 0 - 95% non-condensing.

3. Position

The meter should be installed in a dry and dust free environment and avoid heat, radiation and high electrical noise sources.

Installation Steps

Normally, the meter was installed on the switch board panel.

1. Cut a rectangular hole in the panel of the switch gear. The cutting size is in fig 2.3.

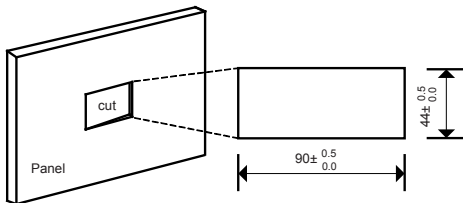


Fig 2.3 Panel Cutting

2. Remove the clips from the meter and insert the meter into the cut out hole from the front side.

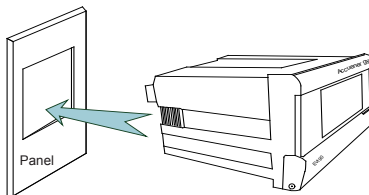


Fig 2.4 Put the meter into square hole

3. Put the clips back on the meter from the backside and push the clip tightly so that the meter is affixed on the panel.

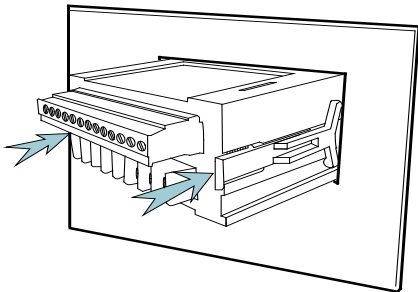
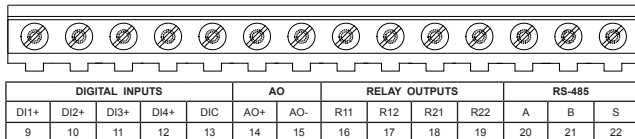


Fig 2.5 Use the clips to fasten the meter on the panel

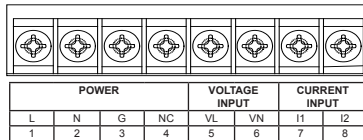
2.3 Wiring

Terminal Strips

There are 2 terminal strips on the back of the meter.



Upper terminal strip: Communication and I/O



Lower terminal strip: Power, Voltage and Current Input

Note: NC means No Connection. Certain terminals may not exist depending on options ordered.

Fig 2.6 Terminal Strips

**DANGEROUS**

Only qualified personnel should do the wire connection work. Make sure the power supply is off and all the wires are powerless. Failure to observe it may result in severe injury.

**Note**

Make sure the voltage of power supply is the same as what the meter needs for its auxiliary power.

Safety Earth Connection

Before doing the meter wiring connection, please make sure that the switch Panel has a safety Earth system. Connect the meter safety earth terminal to the switch gear safety earth system. The following safety earth symbol is used in the user's manual.

***Auxiliary Power***

The auxiliary power supply of the meter is 85~264Vac (50/60Hz) or 100~280Vdc. Typical power consumption is less than 2W. A regulator or a UPS should be used when the power supply varies too much. The terminals for the auxiliary power supply are 1, 2 and 3 (L, N, G). A fuse (typical 1A/250Vac) should be used in the auxiliary power supply loop. No.3 terminal must be connected to the safety earth system of the switchgear. An isolated transformer or EMI filter should be used in the

auxiliary power supply loop if there is a power quality problem in the power supply. Typical Wiring of Auxiliary Power Supply is shown in Fig 2.7.

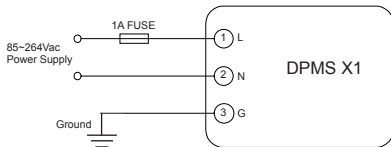


Fig 2.7 Wiring of Power Supply

The Best choice the wire of power supply could be AWG16~22 or 0.6~1.5mm².

Voltage Input



Note

The secondary of the PT can not be shorted , otherwise it may cause the severe damage to the instrument .

A 400Vac option is suitable for a low voltage system that is less than 480Vac. The voltage input should be directly connected to the meter terminal without the use of a PT.

A fuse (typical 1A/250Vac) should be used in the voltage input loop.

The wire gauge of the voltage input should be AWG16~22 or 0.6~1.5mm².

**Note**

The CT loop should not be open circuit in any simultaneously when the power is on. There should not be any fuse or switch in the CT loop and one end of the CT loop should be connected to the ground.

Current Input

In a practical engineering application, CTs should be installed in the measuring loop. Normally the secondary of the CT is 5A. A CT of accuracy over 0.5% (rating over 3VA) is recommended and it will influence the measuring accuracy. The wire between the CT and meter should be as short as possible. The length of the wire may increase the error of the

measurement.

The wire gauge of the current input should be AWG15~16 or 1.5~2.5mm².

Wiring of Current Input

Before Wiring, Please Make sure the voltage and current input of the meter corresponds to the power system measured.

Single Phase Voltage and Current Input Wiring Diagram is shown in Fig 2.8

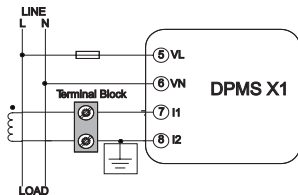


Fig 2.8 Current and Voltage Input

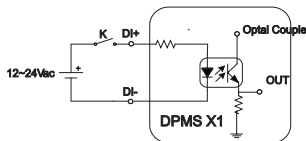


FIG 2.9 Digital Input

Digital Input

There are 4 Digital Inputs (Options) which require an external power supply. The Input terminals are DI1+(9), DI2+(10), DI3+(11), DI4+(12), DIC(13), as in Fig 2.9.

The external power supply used for the Digital Input is from 16Vdc - 30Vdc. If the switch is far from the meter, the voltage of the power supply could be higher. The maximum current in the circuit should not be over 10mA. The wire gauge of Digital input should be AWG16~22 or 0.6~1.5mm².

Relay Output

There are two additional relay outputs in the meter. The terminals are R11, R12 (16, 17) and R21, R22 (18, 19). These two relay outputs are used to remotely control an electric switch in power systems. The relay type is mechanical Form A contact with 3A/250V or 3A/30Vdc. An intermediate relay is recommended in the output circuit as in Fig 2.10.

There are two relay output modes for selection, one is latching, and the other is momentary. For the latching mode, the relay can be used to output two statuses on or off. For the momentary mode, the output of the relay changes from off to on for a period of time T_{on} and then goes off. T_{on} can be set from 50- 3000ms.

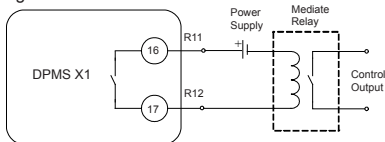


Fig 2.10 Relay Output

The wire gauge of the relay output should be between AWG22 (0.5mm²)~AWG16 (1.5mm²).

Alarm Output

There is an alarm function in the DPMS X1 series meter. The alarm will be triggered when a metering parameter is over the limit value and over the setting time limit. The alarm can be related to relay output or LCD back-light flashing. Setting of the alarm is as follows.

1. Set the relay output mode as alarm. (DO?_MODE=2)
2. Assign metering parameter to alarm. (Refer Table 2.2)
3. Set alarm time limit. (Min time: 1s, Range: 0~255s)
4. Set alarm value limit.
5. Sign of the inequation. (0: parameter<Value limit, 1: parameter>Value limit)
6. Relate to relays. (0: RO1, 1: RO2)

For the register of setting parameters please refer to 4.3 of this manual.

Serial number versus alarming parameter is listed in Table 2.2. Number 0 means no parameter is assigned to alarm.

Number	0	1	2	3	4	5	6	7
Parameter	—	Hz	U	I	P	Q	S	PF

Table 2.2 Serial number versus alarming parameter

Example:

Alarming parameter: I, Time limit: 15s,
 Alarm output relay: RO1, Rating of CT1 of I: 200A,
 Value limit: 180A.

The setting of alarm is as follows:

1. Set the relay output mode as alarm. DO?_MODE=2
2. The serial number of I is 3 from Table 2.2.
3. CT1=200, the equation converting between real value and register value is:

$$\text{Real value} = (\text{value in register} \times \text{CT1} \div 5) \div 1000$$

If real value is 180A, the register value is 4500.

4. Time limit is 15s. The register value is 15.
5. The value is high limit, so the sign of in equation is 1 (great than).

The alarm happens when register value>4500.

6. The alarm relating relay is RO1, so the RO select 0.

After completing the above setting, the alarm will trigger RO1 and back-light flashing when the value of I is over 180A and lasts over 15 seconds.

Analog Output

An Analog output (option) is provided in the DPMS X1 meter. Any one of the seven parameters could be selected as Analog Output. Refer to Chapter 3.

Analog Output could be one of the following outputs, 4-20mA, 0-1mA and 0-5V

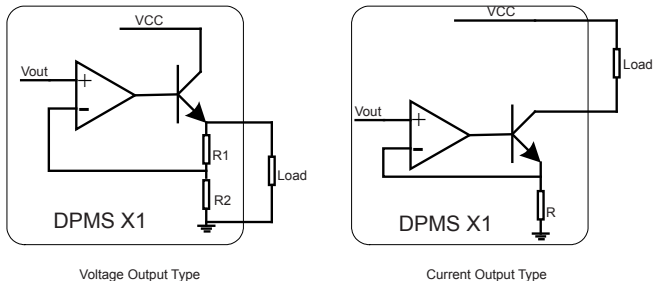


Fig 2.11 Analog Output Diagram

Output Capacity:

4-20mA Max Load Resistance 750ohms

0-1mA Max Load Resistance 10kohms

0-5V Max Output Current 20mA

Communication

The communication port and protocol are RS485 and Modbus-RTU. The terminals of communication are A, B, and S (20, 21, 22). A is differential signal +, B is differential signal - and S connected to the shield of the twisted pair cable. Up to 32 devices can be connected on an RS485 bus. Use good quality shielded twisted pair cable, AWG22 (0.5mm^2) or larger. The overall length of the RS485 cable connecting all devices can not exceed 1200m (4000ft). The meter is used as a slave device of a master like PC, PLC, data collector or RTU.

The topology of RS485 net can be line, circle and star.

A few points of recommendation for high quality communication are as follows:

- ☞ Good quality shielded twisted pair of cable AWG22 (0.6mm^2) or larger is very important.
- ☞ The shield of each RS485 cable segment must be connected to ground at one end only.
- ☞ Make sure of the right connection at each point.
- ☞ Avoid T connections at each point.
- ☞ Keep cables away as much as possible from sources of electrical noise.

Chapter 3 Basic Operation and Setup

3.1 Display Panel and Keys

There is one display panel and four keys on the front of the meter. All the display segments are illustrated in fig 3.1.

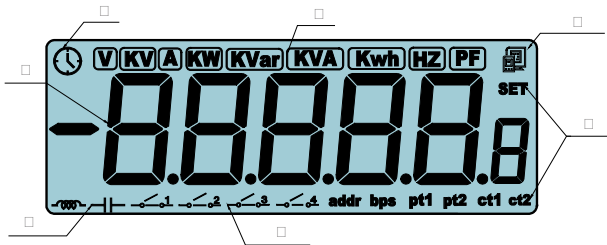


Fig 3.1 All Display Segments

Number	Display	Description
☐	Data and Parameters	Display metering data in metering mode. Display parameters in setting mode.
☐	Unit Label	Indicating Metering data unit. V and KV for Voltage, A for Current, KW for Power, KVar for Reactive Power, KVA for Apparent Power, KWH for Energy, PF for Power Factor, Hz for Frequency.
☐	Load Nature	"  " : Capacitive Load, "  " : Inductive Load
☐	Digital Input	Indicator No.1 to No.4 switch indicate statues of DI1 to DI4
☐	Parameter Label	"SET" label is on when the meter is in the setting mode. One of the following label is also on. Addr for communication address, bps for Communication Rate (Bit per Second), pt1 for primary voltage, pt2 for secondary voltage, ct1 for primary current, ct2 for secondary current and "  " for time of back light ☐
☐	Communication state	When "  " is on, it indicates that there is communication information between meter and master instrument.

Table 3.1 Display Panel Description

There are four keys labelled as “◀▶”, E, P and V/A. Use these four keys to read metering data and do parameter setting.

All the descriptions in this manual are about the DPMS X1 which is a full function single phase power meter. For other meters, please refer to the corresponding function or description.

3.2 Meter Data Reading

Normally, the meter displays the metering data, such as voltage, current, power etc. To read the metering data simply press the keys “P”, “E” and “V/A”.

Press “V/A” to read voltage, current and frequency.



Fig 3.2 Voltage Display

The first screen: Display Voltage, U=220.3V,
Inductive load, Communication Port Busy,
DI1, DI2, DI3 and DI4 Open.

Press “V/A”, to go to the second screen.



Fig 3.3 Current Display

The second screen: Display current. As in fig 3.3,
 $I=498.7A$.

Press “V/A”, to go to the third screen.



Fig 3.4 Frequency Display

The third screen: Display frequency. As in Fig 3.4,
 $F=50.00Hz$.

Press “V/A” again, to go back to the first screen.



Fig 3.5 Power Display

Press “P”, to display power related metering data.

First screen: Display Power.

In Fig 3.5, $P=350.6KW$, inductive Load, communication port busy, DI1 DI3 close and DI2 DI3 open.

Press “P”, to go to the second screen.



Fig 3.8 Power Factor Display



Fig 3.6 Reactive Power Display



Fig 3.7 Apparent Power Display

The second screen: Display reactive power.

In Fig 3.6, $Q = -29.81 \text{KW}$, capacitive load.

Press “P”, to go to the third screen.

The third screen: Apparent Power Display.

In fig 3.7, $S = 837.1 \text{KVA}$

Press “P”, to go to the forth screen.

The forth screen: Display Power Factor.

In fig 3.8, $PF = -0.999$.

Press “P”, to go back to the first screen.



Fig 3.9 Display Power with Six Digits

When the value of P, Q and S is greater than 9999, the display will change to six digit mode.

For example,

in fig 3.9, $P=23564.7$ KW.

Press E, to display energy.



Fig 3.10 Energy Display

In fig 3.10, $E=32768.9$ Kwh. Energy display range is from 0 - 999999Kwh. Over 106 Kwh, the energy register will turn to 0.

3.3 Parameter Setting

In metering mode, Press “” and V/A to go to the parameter setting mode.

**Note**

The setting should be done by professional personnel after they have read this user's manual and understand the application situation.

Press “◀▶” to move the cursor from left to right. The digit will flash when the cursor moves to it.

Press E to increase 1 one at a time. Press P to decrease 1 one at a time. Press V/A to confirm the former key input and press “◀▶” again to go to the next screen. In any screen, press “◀▶” and V/A at the same time to exit the parameter setting mode.

Before going into the parameter setting, the address of the meter will display for 3 seconds, then go to the parameter setting mode. There is a pass word input screen to protect the parameter setting mode.

A four digit Access code integer is used between 0000 and 9999. The default access code is 0000. Each time before going to the parameter setting mode, a correct access code must be entered.



Fig 3.11 Access Code Input

Asking for access code as in Fig 3.11.



Fig 3.12 Communication Address Setting

First Screen: Meter's Communication Address setting. The address can be any integer between 1 and 254. As in fig 3.12, the communication address is 84. If an address change is needed, press “◀▶” to move the cursor, press P to increase and press E to decrease. After the expected address is set, press V/A to go to the next setting screen. Press V/A to go to the next screen if there is no need to change the address.

Two or more meters should not be set to the same address in the same communication line according to the Modbus-RTU protocol.



Fig 3.13 Baud Rate Setting



Fig 3.14 PT1 Setting

The second screen: Baud rate setting page.

Modbus-RTU 8 data bit, no parity, 1 start bit and 1 stop bit. Baud rate could be one of five values, 1200, 2400, 4800, 9600, 19200bps. In fig 3.13 the baud rate is 19200bps. Press E to select baud rate. Press V/A to go to the next screen.

Only one baud rate should be selected on the same communication line.

The third screen: PT primary rating voltage PT1 setting page.

The PT1 value is an integer from 100 - 500,000. The unit is volt.

In fig 3.14, PT1=100000V, Use P, & E keys to change the PT1 value. Press “◀▶” V/A key for acknowledgment and for going to the next setting page.



Fig 3.15 PT2 Setting



Fig 3.16 CT1 Setting



Fig 3.17 CT2 Setting

The forth screen: PT secondary rating voltage PT2 setting page. The PT2 value is an integer from 100 - 400. The unit is volt. As in fig 3.15, PT2=400V, press P, E and “◀▶” to change the value. Press V/A for acknowledgment and to go to the next setting page.

Note: If there is no PT on the voltage input side, PT1 and PT2 should be the same and equal to the input rating voltage.

The fifth screen: CT primary rating current CT1 setting page. The CT1 value is an integer from 5 - 9999. The unit is Amp. As in fig 3.16, CT1=5000A, press P, E and “◀▶” to change the value. Press V/A for acknowledgment and to go to the next setting page.

The sixth screen: The default value of CT2 is 5 A. If the meter is a 1A option, CT2 should be 1A.



3.18 Analog Output Setting

The seventh screen: Analog output setting page.

One metering value can be selected as analog output. The number 0 to 6 corresponds to frequency, voltage, current, power, reactive power, apparent power and power factor. There is no setting page in a single function meter.

There are three output modes, 4~20mA, 0~1mA and 0~5V in the DPMS X1 series, which is chosen when ordering. The relation between the output mode and metering data is as Fig3.19(a), (b), (c).

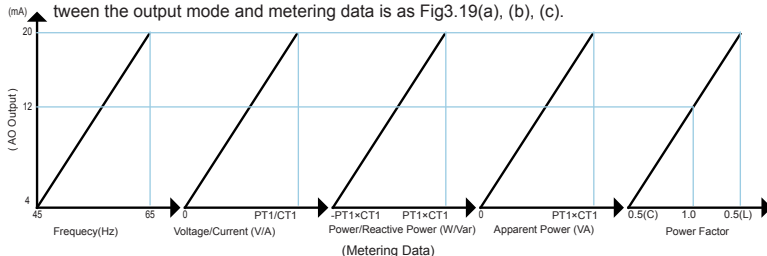


Fig 3.19(a) Analog Output (4~20mA) VS metering Data

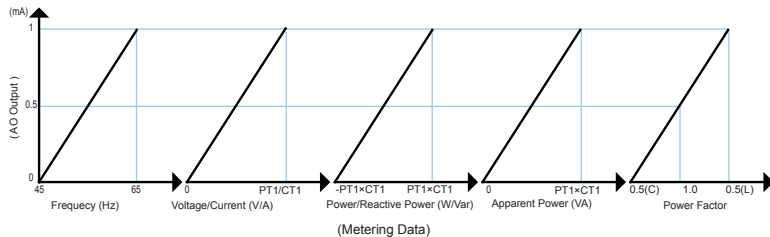


Fig 3.19 (b) Analog Output (0~1mA) VS Metering Data

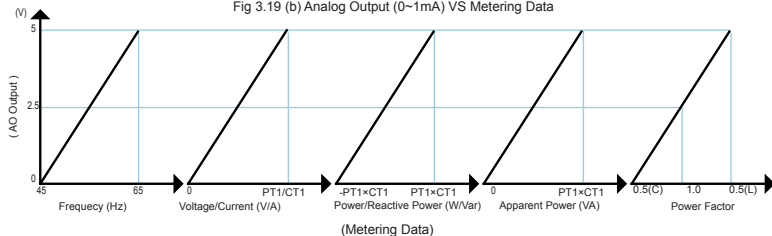


Fig 3.19 (c) Analog Output (0~5V) VS Metering Data



Fig 3.20 Back light "on" time



Fig 3.21 Access Code setting

The eighth screen: Display back light "on" time setting page. The backlight will go to "off" for the purpose of energy saving and component duration if the keys are untouched for a period of time. The "on" time can be set from 0 - 120 Minutes. The back light will always be "on" if the setting value is 0.

As in fig 3.20, the setting time of the back light is 5 minutes. The back light will automatically go to "off" if there is no touch on the keys in 5 minutes.

The ninth screen: Access code setting page.

This is the last screen of the setting page. The

access code can be changed in this setting page. It is important to remember the new access code after the setting.

As in fig 3.21, the access code is 0001. Press the V/A key, let the access code be stored in the meter and go back to the first setting page. After all the setting has been finished, press " $\blacktriangleleft$ $\blacktriangleright$ " and V/A to exit the setting mode.

The setting page may be different depending on the meter type. Please confirm the meter type before doing the parameter setting.

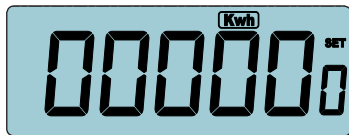


Fig 3-22 Real energy

The seventh page is the real energy presetting page, Use “◀▶”, E and P to preset the value of energy. As in Fig 3-22, the energy value is 0 Kwh, Press V/A to acknowledge and go to the next setting page.

Chapter 4 Communication

4.1 Introduction of Modbus Protocol

The ModbusTM RTU protocol is used for communication in the meter. The data format and error checking method are defined in Modbus protocol. The half duplex query and respond mode is adopted in Modbus protocol. There is only one master device in the communication net. The others are slave devices, waiting for the query of the master.

Only a master device can communicate with a slave device. The slave devices can not communicate with each other. They just respond to the query of a master device.

1. *Transmission mode*

The mode of transmission defines the data structure within a frame and the rules used to transmit data. The mode is defined as follows which is compatible with Modbus RTU Mode*.

Coding System	8 bit
Start bit	1 bit
Data bit	8 bit
Parity	None
Stop bit	1
Error Checking	CRC

2. Protocol

Framing

Address	Function	Data	Check
8-Bits	8-Bits	N×8-Bits	16-Bits

Table 4.1 Data Framing

Address Field

The address field of a message frame contains eight bits. Valid slave device addresses are 0~255 decimal. A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

Function Field

The function code field of a message frame contains eight bits. Valid codes are 1~255 decimal. When a message is sent from a master to a slave device the function code field tells the slave what kind of action to perform.

Code	Meaning	Action
01	Read Relay output	Status Obtain current status of Relay Output
02	Read Digital Input	Status Obtain current status of Digital Input
03	Read Registers	Obtain Current binary value in one or more registers
05	Control Relay Output	Force Relay to a state of on or off
16	Preset Multiple-Registers	Place specific binary values into a series of consecutive Multiple-Registers

Fig 4.2 Function Code

Data Field

The data field is constructed using sets of two hexadecimal digits, from 00 to FF hexadecimal. The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

Check Field

Check field is used in master and slave devices to find errors in the data transmitting process. There may be some error happening in a group of data when they are transmitted from one device to the other due to noise or other interference. The check field guarantees the device does not respond

with error messages so as to improve system safety and efficiency. The CRC16 error check method is adopted in Modbus Protocol.

3. Error Check Method

Messages include an error's checking field that is based on a Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message. The CRC field is two bytes, containing a 16 bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message.

The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error will be reported. The CRC is started by first preloading a 16-bit register to all 1's. Then a process begins of applying successive 8-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do not apply to the CRC. During generation of the CRC, each 8-bit character is exclusive ORed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive ORed with a preset, fixed value. If the LSB was

a 0, no exclusive OR takes place. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive ORed with the register current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value. When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

4.2 Format of Communication

All the examples in this chapter are following the format of Table 4.3. (All data is in Hex).

Addr	Fun	Data start reg hi	Data start reg lo	Data #of regs hi	Data #of regs lo	CRC16 Hi	CRC16 Lo
11H	03H	01H	00H	00H	08H	47H	60H

Table 4.3 Protocol Format

In table 4.3, the meaning of each abbreviated word is,

Addr: address of slave device

Fun: function code

Data start reg hi: start register address high byte

Data start reg lo: start register address low byte

Data #of reg hi: number of register high byte

Data #of reg lo: number of register low byte

CRC16 Hi: CRC high byte

CRC16 Lo: CRC low byte

1. Read Status of Relay

Function Code 01

Query

This function code is used to read status of Relay in the meter.

1=On 0=Off

There are 2 Relays in the meter. The Address of each Relay is Relay1=0000H and Relay2=0001H.

The following query is to read Relay Status of meter Number 17.

Addr	Fun	Data start reg hi	Data start reg lo	Data #of regs hi	Data #of regs lo	CRC16 Hi	CRC16 Lo
11H	01H	00H	00H	00H	02H	BFH	5BH

Table 4.4 Relay status query message

Response

The meter response includes the meter address, function code, quantity of data byte, the data, and error checking. An example response to read the status of Relay1 and Relay2 is shown in Table 4.5. The status of Relay1 and Relay2 is responding to the last 2 bits of the data. Relay1: bit0 Relay2: bit1.

Addr	Fun	Byte count	Data	CRC16 Hi	CRC16 Lo
11H	01H	01H	02H	D4H	89H

Table 4.5 Relay status responds

The content of the data is,

7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0

MSB

LSB

☐ Relay 1 = OFF , Relay 2=ON☐

2. Read the Status of DI

Function Code 02

Query

1=On 0=Off

There are 4 DIs in the meter. The Address of each DI is DI1=0000H, DI2=0001H, DI3=0002H and DI4=0003H. The following query is to read the 4 DI Status of meter Number 17.

Table4.6 Read 4 DIs Query Message

Addr	Fun	Data start reg hi	Data start reg lo	DI num hi	DI num lo	CRC16 Hi	CRC16 Lo
11H	02H	00H	00H	00H	04H	7BH	59H

Response

The meter response includes its address, function code, quantity of data characters, the data characters, and error checking. An example response to read the status of 4 DIs is shown in Table 4.7. The status of each is responding to the last 4 bits of the data. DI1: bit0 DI2: bit1 DI3: bit2 DI4: bit3.

Addr	Fun	Byte count	Data	CRC16 Hi	CRC16 Lo
11H	02H	01H	03H	E5H	49H

Table 4.7 Read Status of DI

Data

7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	1

MSB

LSB

3 Read Data (Function Code 03)

Query

This function allows the master to obtain the measurement results of the meter. Table 4.8 is an example to read the 3 measured data (F, V and I) from slave device number 17. The data address of F is 0000H, V1 is 0001H and V2 is 0002H.

Addr	Fun	Data start reg hi	Data start reg lo	Data #of regs hi	Data #of regs lo	CRC16 Hi	CRC16 Lo
11H	03H	00H	00H	00H	03H	07H	5BH

Table 4.8 Read F, V, I Query Message

Response

The meter response includes the meter address, function code, quantity of data byte, data, and error checking. An example response to read F, V and I (F=1388H (50.00Hz), V=03E7H (99.9V), I=1386H (4.998A)) is shown in Table 4.9.

Addr	Fun	Byte count	Data1 hi	Data1 lo	Data2 hi	Data2 lo	Data3 hi	Data3 lo	CRC16 hi	CRC16 lo
11H	03H	06H	13H	88H	03H	E7H	13H	86H	32H	E8H

Table 4.9 Read F, V and I Message

4. Control Relay (Function Code 05)

Query

This message forces a single Relay either on or off. Any Relay that exists within the meter can be forced to be either status (on or off). The address of Relays start at 0000H (Relay1=0000H Relay2=0001H). The data value FF00H will set the Relay on and the value 0000H will turn it off; all other values are illegal and will not affect that relay.

The example below is a request to meter number 17 to turn on Relay1.

Addr	Fun	DO addr hi	DO addr lo	Value hi	Value lo	CRC16 Hi	CRC16 Lo
11	05H	00H	00H	FFH	00H	8EH	AAH

Table 4.10 Control Relay Query Message

Response

The normal response to the command request is to retransmit the message as received after the Relay status has been altered.

Addr	Fun	DO addr hi	DO addr lo	Value hi	Value lo	CRC16 Hi	CRC16 Lo
11H	05H	00H	00H	FFH	00H	8EH	AAH

Table 4.11 Control Relay Response Message

5. Preset / Reset Multi-Register(Function Code 16)

Query

Function 16 allows the user to modify the contents of a Multi-Register. Any Register that exists within the meter can have its contents changed by this message. The example below is a request to meter number 17 to Preset E (17807.7KWH), with its Hex Value 0002B79DH. E data address is 0109H and 010AH. E register is 32bit or 4 byte.

Addr	Fun	Data start reg hi	Data start reg lo	Data #of reg hi	Data #of reg lo	Byte count
11H	10H	01H	09H	00H	02H	04H

Value hi	Value lo	Value hi	Value lo	CRC16 hi	CRC16 lo
00H	02H	B7H	9DH	7DH	0CH

Table 4.12 Control Relay Response Message

Response

The normal response to a preset Multi-Register request includes the slave address, function code, data start register, the number of registers and error checking.

Addr	Fun	Data start reg hi	Data start reg lo	Data #of reg hi	Data #of reg lo	CRC16 hi	CRC16 lo
11H	10H	01H	09H	00H	02H	92H	A6H

Table 4.13 Preset Multi-Registers Response Message

4.3 Address Table

Metering data is stored in the register area. Use Modbus 03 function code to read metering data.

Address	Parameter	Range	Object Type	Type of Access
0000H	Frequency F	0 ~ 6500	Word	R
0001H	Voltage V	0 ~ 65535	Word	R
0002H	Current I	0 ~ 65535	Word	R
0003H	Power P	-32768 ~ 32767	Integer	R
0004H	Reactive Power Q	-32768 ~ 32767	Integer	R
0005H	Apparent Power S	0 ~ 65535	Word	R
0006H	Power Factor PF	-1000~ 1000	Integer	R
0007H	Load Nature RT	76(L)/67(C)/82(R)	Word	R
0008H	AO Output	0~65535	Word	R
0109H	Energy E	0~9999999	Dword	R
010AH				

Table 4.14 Metering data address table

The Relationship between the numerical value in the meter register and the real physical value is in the following table. (Rx is the numerical value in the register of the meter)

Parameter	Relationship	Unit
Frequency F	$F = R_x / 100$	(Hz)
Voltage V	$U = R_x (PT1/PT2) / 10$	(V)
Current I	$I = R_x (CT1/5) / 1000$	(A)
Power P	$P = R_x (PT1/PT2) (CT1/5) / 10$	(W)
Reactive Power Q	$Q = R_x (PT1/PT2) (CT1/5) / 10$	(Var)
Apparent Power S	$S = R_x (PT1/PT2) (CT1/5) / 10$	(VA)
Power Factor PF	$PF = R_x / 1000$	—
Load Nature RT	ASCII: L, C, R 52H:R 43H:C 4CH:L	—
Energy Kwh	$Kwh = R_x / 10$	Kwh

Table 4.15 Measuring data convert table

Parameter Setting

Function code: 03 for Reading, 16 for Presetting

Address	Parameter	Type of access	Range	Object type
0101H	Access Code	R/W	0~9999	Word
0102H	Communication Address	R/W	1~254	Word
0103H	Baud Rate	R/W	0~4	Word
0104H	P T1 Lo	R/W	100~500000	Dword
0105H	PT1 Hi			
0106H	PT2	R/W	100~400	Word
0107H	CT1	R/W	5(1)~9999	Word
0108H	CT2	R/W	5(1)	Word
010BH	Relay1 work Mode	R/W	0-Latch, 1-Momentary, 2-Alarm	Word
010CH	Relay1 pulse width	R/W	50~3000	Word
010DH	Relay2 work Mode	R/W	0-Latch, 1-Momentary, 2-Alarm	Word
010EH	Relay2 pulse width	R/W	50~3000	Word
010FH	AO VS Metering Data	R/W	0~6, 0-Frequency, 1-Voltage, 2-Current, 3-Power, 4-Reactive Power, 5-Apparent Power, 6-Power Factor	Word

Table 4.16 System parameter address

Address	Parameter	Type of access	Range	Object type
0110H	LCD Back light Time	R/W	0~120 (Min)	Word
0111H	Alarm object select	R/W	0~7	Word
0112H	Time limited setting	R/W	0~255	Word
0113H	Alarm parameter value	R/W	-30000~30000	Integer
0114H	Inequation Sign	R/W	0:< 1:>	Word
0115H	Alarm relate RO	R/W	0:RO1 1:RO2	Word

Table 4.16 System parameter address

Digital Input (DI) Status:

Function code: 02 for Reading

Address	Parameter	Range	Object type	Type of access
0000H	DI1	1=ON, 0=OFF	Bit	R
0001H	DI2	1=ON, 0=OFF	Bit	R
0002H	DI3	1=ON, 0=OFF	Bit	R
0003H	DI4	1=ON, 0=OFF	Bit	R

Table 4.17 Digital Input (DI) Address

Relay Status and Control

Function code: 01 for Reading, 05 for Controlling.

Address	Parameter	Range	Object type	Type of access
0000H	DO1	1=ON, 0=OFF	Bit	R/W
0001H	DO2	1=ON, 0=OFF	Bit	R/W

Table 4.18 Relay Address

Note:

1. Object type: Bit - binary bit, word-unsigned integer of 16 bit, Integer - Signed integer of 16 bit, Dword -unsigned integer of 32 bit.
2. Type of Access: R - Read only, Digital input Relay status and Data are read by using function code 02, 01 and 03 respectively. R/W-Read and Write, Data is written by using function code 16 and control command is written by using function code 05. Writing to a read only field is forbidden.
3. Energy data is represented in 32 bit. Both high 16 bit and low 16 bit have successive address alone. The high 16 bit data should be multiplied by 65536 plus low 16 bit data to get the energy data in the master software. The unit is 0.1kwh or 0.1kvarh. It will be cleared to zero and start again when energy data accumulates to 1×10^6 kwh(kvarh). The energy register can be cleared or preset through the communication port.

Appendix A

Technical Data and Specifications

Input Ratings

<i>Voltage Input</i>		
Voltage Rating	-400V Option	400Vac 20% Over Range
Frequency Range		45 to 65Hz
Overload 2 times for continue		2500Vac for 1 Sec (None recurrence)
Voltage Range Through PT		500KV highest at primary side
PT Burden		<0.2VA
Measuring		True-Rms

Current Input	
Current Rating	5Amp, 20% Over Range Ordering on Special Rating
Current Range Through CT	10000A at primary side
Over Load	10A Continue, 100A/1sec (None Recurrence)
CT Burden	<0.5VA
Measuring	True-Rms

Digital Input (DI)	
Optical Isolation Isolate Voltage	4000Vac rms
Input Form	Contact with Power Supply
Input Resistance	2K ohm (typical)
Input Voltage Range	16~30Vdc
Close Voltage	> 16Vdc
Max Input Current	20mA

Accuracy and Resolution

<i>Parameter</i>	<i>Accuracy</i>	<i>Resolution</i>
Voltage	0.5%	0.1%
Current	0.5%	0.02%
Power	1.0%	0.1%
Reactive Power	1.0%	0.1%
Apparent Power	1.0%	0.1%
Power Factor	1.0%	0.1%
Frequency	0.5%	0.01Hz
Energy	1.0%	0.1Kwh
Drift with Temp.	<100ppm/ □	
Stability 0.1%/Year	0.1%/Year	

Relay Output	
Output Form	Mechanical Contact
Contact Resistance	30m ohm@1A
Max Break Voltage	250Vac, 30Vdc
Max Break Current	3A
Max Isolate Voltage	4000Vac rms

Analog Output		
Output Range 4~20mA or 0~1mA or 0~5V		
Resolution 12bit		
Output Capability	4~20mA	Max Resistance: 500Ω
	0~5V	Max Resistance: 10KΩ
	0~1mA	Max Resistance: 20mA

Standard	
Measuring	IEC60687 0.5 ANSI C12.16 Class10 IEC61036 class1 IEC61268 class2
Environment	IEC 60068-2
Safety	IEC 61557-2
EMC	IEC61000-4/2-3-4-5-6-8-11
Dimension	DIN43700

Suitable Condition	
Dimensions (mm)	96 ×48 ×60 (Cut 90 ×44)
Protection Level	IP54 (Front), IP20 (Cover)
Weight (g)	400
Temperature	-25℃~70℃
Humidity	0~95% Non-condensing
Power Supply	85~264Vac or 100V~280Vdc
Power	3W MAX

Appendix B Ordering Information

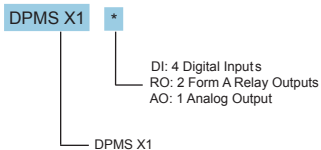


Fig 5.1 Ordering information

User Notes Page

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