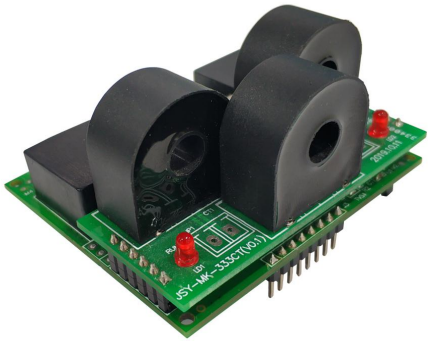
JSY-MK-333 Three-phase three wire embedded meter module



Product description

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1. Product introduction

1.1、 Introduction

JSY-MK-333 three-phase embedded metering module is a metering product developed by our company using microelectronics technology and special large-scale integrated circuits, applying advanced technologies such as digital sampling processing technology and SMT technology, and has completely independent intellectual property rights. The technical performance of this measurement module complies with the relevant technical requirements of Class 1.0 three-phase active energy meters in the IEC 62053-2 standard. It can directly and accurately measure the voltage, current, power, power factor, There are electrical parameters such as reactive energy. The module has built-in 1-channel RS485 communication interface, 1-channel TTL interface, and sampling MODBUS-RTU communication protocol, which is convenient for connection with various AMR systems. It has the characteristics of good reliability, small size, light weight, beautiful appearance, and easy installation.

JSY-MK-333 three-phase embedded metering module can be widely used in energy-saving renovation , electric power, communications, railways, and transportation, environmental protection, petrochemical, steel and other industries, used to monitor the current and power consumption of AC equipment.

1.2、 Features

1.2.1. Collect three-phasae alternating current parameters, including voltage, current, power, electric energy and other electrical parameters, with complete information;

1.2.2. Adopt special measurement chip, effective value measurement method, high measurement accuracy;

1.2.3. With 1 RS-485 communication interface and 1 TTL communication port (3.3V);

1.2.4. The communication protocol adopts standard Modbus-RTU, which has good compatibility and facilitates programming;

1.2.5. RS-485 communication interface with ESD protection circuit ;

1.2.6. Two power supply methods are available, either fixed DC3.3V power supply or DC5~ 12V power supply;

1.2.7. It adopts industrial-grade chips, built-in watchdog, and has complete lightning protection and anti-interference measures to ensure reliability;

1.2.8. High isolation voltage, withstand voltage up to AC: 2500V;

1.2.9. Optional single-turn through-core transformers or open-close type transformers of different specifications are available, which are convenient and easy to use;

(Note: Switching current transformers are mainly used in industrial and mid-city power grids, power transmission systems, and rural project transformation. They have

It is easy to install. There is no need to disassemble the primary busbar. It can also be operated with power. It does not affect the customer's normal power consumption and can be modified for users.

The project saves a lot of manpower, material and financial resources and improves the transformation efficiency.)

1.2.10. The module size is 65*57*41mm (length*width*height), which is small and easy

to embed into other systems.

1.3、 Technical Parameters

1.3.1 Three-phase AC input

1) Voltage range: three-phase four-wire input, 3*220/380V;
2) Current range: 50A, 80A,100A, 250A, 500A, etc. are optional, and external open current transformer models are optional;
3) Signal processing: using special measurement chip, 24 -bit AD sampling;
4) Overload capability: 1.2 times the range is sustainable; instantaneous (<200mS) current is 5 times, voltage is 2 times the range without damage;
5) Input impedance: voltage channel>1 kΩ/V;

1.3.2 Communication Interface

1) Interface type: Provides 1 RS-485 interface and 1 TTL interface (3.3V);
2) Communication protocol: MODBUS-RTU protocol;
3) Data format: can be set by software, "n,8,1", "e,8,1", "o,8,1", "n,8,2";
4) The baud rate of the two-way communication interface can be set to 4800, 9600, 19200Bps. The default communication format is, "n,8,1", 9600bps.
5) Communication data:

Multiple electrical parameters such as voltage, current, power, electric energy, etc., see Modbus data register list

1.3.3 measurement accuracy

Voltage , current , power : ± 1.0 % ; active electricity level 1;

1.3.4 power supply

1) When powered by DC3.3V, the peak voltage shall not exceed 3.6V; typical power consumption: ⩽ 20mA;
2) DC5~ 12 V, the peak voltage shall not exceed 13 V; typical power consumption: ⩽ 20mA;

1.3.5 isolation

Strong current and weak current are isolated through transformers, with isolation withstand voltage >2500V;

1.3.6 working environment

1) Working temperature: -20～+60℃ ; Storage temperature: -40～+85℃ ;
2) Relative humidity: 5~95%, no condensation (at 40 ℃) ;
3) Altitude: 0~3000 meters;
4) Environment: No explosive, corrosive gases and conductive dust, no significant shaking, vibration and impact;

1.3.7 Temperature drift: ⩽100ppm/ ℃ ;

1.3.8 Installation method: 2.54mm spacing pin header welding;

1.3.9 Module size : 65 × 57 × 41 mm

2. Application

2.1、 Product appearance

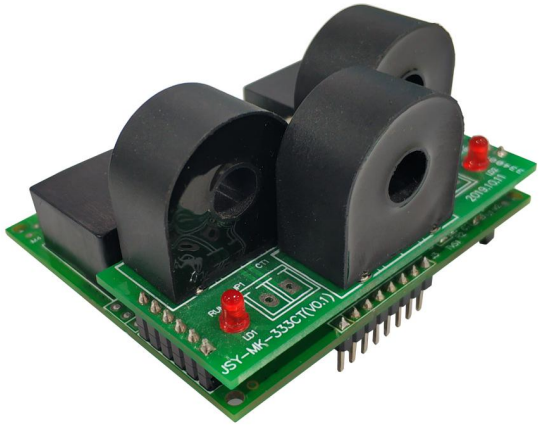
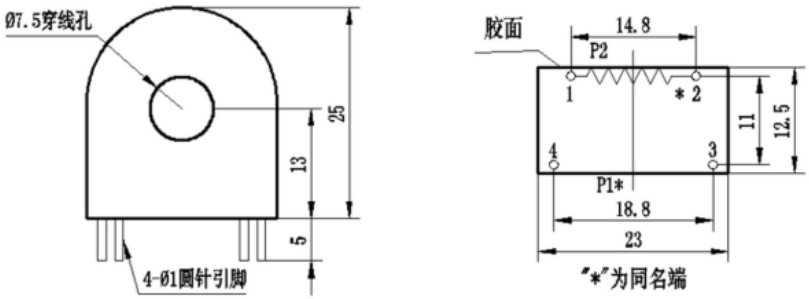


Figure 2.1 Product appearance diagram



Dimensional drawing of 50A core-type current transformer

2.2、 Terminal definition

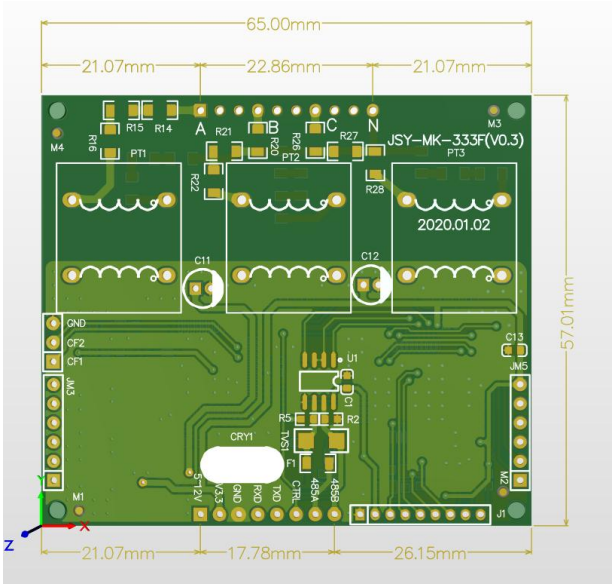
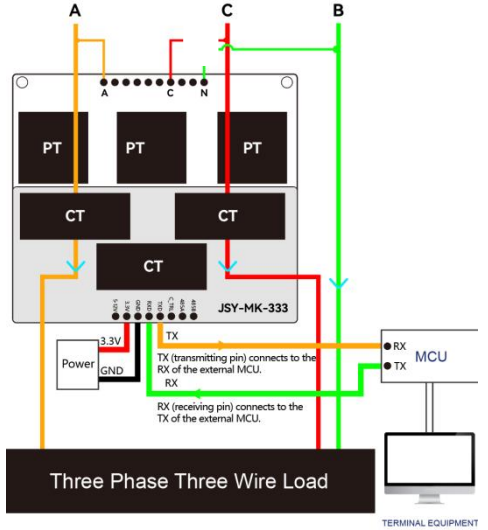


Figure 2.2.1 Product dimensions and functional pins

Terminal	illustrate
A	Measured phase A voltage input terminal
B	Empty feet
C	Measured C-phase voltage input terminal
N	Measured B-phase voltage input terminal
5-12V	Wide voltage power supply input positive (5~ 12 VDC)
3.3V	3.3VDC power supply input positive pole (you can only choose one of the two 5-12V/3.3V pins)
GND	Negative pole of power input
RXD	TTL receiving pin (3.3V level)
TxD	TTL sending pin (3.3V level)
ALARM (can be customized)	Alarm output pin, normally outputs low level, when the voltage and current exceeds the upper limit, or the phase sequence is abnormal, it outputs high level
485A	485 communication port A
485B	485 communication port B

Figure 2.2.2 Product function pin description **(Note: The pins not explained are all empty pins)**

2.3、 Typical wiring



In the case of three-phase and three-power, the voltage of item B of the mains power is connected to the N line position of the measurement module.

2.4、 Application Notes

Please refer to the above diagram for correct wiring according to product specifications and models. Make sure to disconnect all signal sources before wiring to avoid danger and damage to the equipment. After checking to confirm that the wiring is correct, turn on the power and test.

After the power is turned on, the "power " operating indicator light is always on, and the "communication" indicator light flashes synchronously during communication data transmission.

When the products leave the factory, they are set to the default configuration: address No. 1, baud rate 9600bps, data format "n,8,1", data update rate is 1000ms, and transformation ratio is 1;

You can use the JSY-MK-333 product testing software we provide to change the setting of product parameters and general testing of the product.

2.4.1、 RS-485 network connection:

JSY-MK-333 module has RS-485 communication interface, the computer host generally only RS-232 interface, at this time can be converted out of RS-485 interface through the RS-232 to RS-485 tool, the computer can communicate with JSY-MK-333. It is recommended to use RS-485 converter with isolation type to improve the reliability of the system.

The A+ terminals of all devices on a bus are connected in parallel, and the B- terminals are connected in parallel. They cannot be connected in reverse. Up to 255 network modules can be connected to one line at the same time. Each network module can set its communication address. The communication connection should use With shielded twisted pair, the wire diameter is not less than 0.5mm ^{2}. When wiring, communication lines should be kept away from strong current cables or other strong electric field environments .

RS - 485 communication lines should use shielded twisted pairs; the communication distance of 485 can reach 1200 meters. When there are many RS485 devices connected to a bus , or when a higher baud rate is used, the communication distance will be shortened accordingly. At this time, you can Expand using 485 repeater.

RS - 485 networking has a variety of topologies, and generally uses linear connection, that is, starting from the upper host, multiple devices are connected to the network one by one from near to far. A terminal matching resistor of 120 ~ 300 Ω /0.25 watt can be connected at the farthest end (it depends on the specific communication quality, that is, it does not need to be installed when the communication is very good).

2.4.2、 Electric energy measurement function:

Can provide three-phase voltage, current, power, power factor, active and reactive energy and other parameters;

The electricity data is a 4-byte unsigned number. It will not overflow for 10 consecutive years and the data will be saved when the power is turned off.

3. JSY-MK-333 Modbus register list

Table 1: Measurement electrical parameter register and communication data table (function code 03H, read-only)

serial number	definition	Register address	read/ write	Data types and calculation instructions
1	A phase voltage	0100H	read	Unsigned number, value=DATA/100, unit V
2	B phase voltage	0101H	read	Unsigned number, value=DATA/100, unit V
3	C phase voltage	0102H	read	Unsigned number, value=DATA/100, unit V
4	A phase current	0103H	read	Unsigned number, value=DATA/100, unit A
5	B phase current	0104H	read	Unsigned number, value=DATA/100, unit A
6	C phase current	0105H	read	Unsigned number, value=DATA/100, unit A
7	Phase A active power	0106H	read	Unsigned number, value=DATA, unit is W
8	B phase active power	0107H	read	Unsigned number, value=DATA, unit is W
9	C phase active	0108H	read	Unsigned number, value=DATA, unit is W

	power			
10	Three-phase total active power	0109H 010AH	read	Unsigned number, value=DATA, unit is W (The 0109H register corresponds to the high 16 bits)
11	Phase A reactive power	010BH	read	Unsigned number, value=DATA, unit is var
12	Phase B reactive power	010CH	read	Unsigned number, value=DATA, unit is var
13	C phase reactive power	010DH	read	Unsigned number, value=DATA, unit is var
14	Three-phase total reactive power	010EH 010FH	read	Unsigned number, value=DATA, unit is var
15	Phase A apparent power	0110H	read	Unsigned number, value=DATA, unit is VA
16	B phase apparent power	0111H	read	Unsigned number, value=DATA, unit is VA
17	C phase apparent power	0112H	read	Unsigned number, value=DATA, unit is VA
18	Three-phase total apparent power	0113H 0114H	read	Unsigned number, value=DATA, unit is VA (The 0114H register corresponds to the high 16 bits)
19	Voltage frequency	0115H	read	Unsigned number, value = DATA/100, unit is Hz
20	A phase power factor	0116H	read	Unsigned number, value=DATA/1000
21	B phase power factor	0117H	read	Unsigned number, value=DATA/1000
22	C phase power factor	0118H	read	Unsigned number, value=DATA/1000
23	Three-phase total power factor	0119H	read	Unsigned number, value=DATA/1000
24	Phase A active energy	011AH 011BH	read	Unsigned number, value=DATA/100, unit is kWh
25	Phase B active energy	011CH 011DH	read	Unsigned number, value=DATA/100, unit is kWh
26	Phase C active energy	011EH 011FH	read	Unsigned number, value=DATA/100, unit is kWh
28	Three-phase active total electric energy	0120H 0121H	read	Unsigned number, value=DATA/100, unit is kWh
29	Phase A reactive energy	0122H 0123H	read	Unsigned number, value=DATA/100, unit is kvarh
30	B phase reactive energy	0124H 0125H	read	Unsigned number, value=DATA/100, unit is kvarh
31	C phase reactive energy	0126H 0127H	read	Unsigned number, value=DATA/100, unit is kvarh
32	Three-phase reactive power total energy	0128H 0129H	read	Unsigned number, value=DATA/100, unit is kvarh
33	Phase A apparent electric energy	012AH 012BH	read	Unsigned number, value=DATA/100, unit is kVAh
34	Phase B apparent electric energy	012CH 012DH	read	Unsigned number, value=DATA/100, unit is kVAh
35	C phase apparent electric energy	012EH 012FH	read	Unsigned number, value=DATA/100, unit is kVAh

36	Three-phase apparent total electric energy	0130H 0131H	read	Unsigned number, value=DATA/100, unit is kVAh
37	Current power direction	0132H	read	The high byte is unused, and the low byte bit7~bit0 are the corresponding bits for total reactive power, phase C reactive power, phase B reactive power, phase A reactive power, total active power, phase C active power, phase B active power, and phase A active power respectively. (0 means forward, 1 means reverse), see status word 1
38	Current alarm status	0133H	read	When the high byte bit0 is 1, it represents the reverse phase sequence, and when it is 0, it is normal; The low byte bit6~bit4 means that the C~A phase current exceeds the standard, bit2~bit0 means the C~A phase voltage exceeds the standard, see status word 2
39	Phase A forward active energy	0134H 0135H	read	Unsigned number, value=DATA/100, unit is kWh
40	Phase B forward active energy	0136H 0137H	read	Unsigned number, value=DATA/100, unit is kWh
41	Phase C forward active energy	0138H 0139H	read	Unsigned number, value=DATA/100, unit is kWh
42	Three-phase forward total active energy	013AH 013BH	read	Unsigned number, value=DATA/100, unit is kWh
43	Phase A reverses active energy	013CH 013DH	read	Unsigned number, value=DATA/100, unit is kWh
44	Phase B reverse active energy	013EH 013FH	read	Unsigned number, value=DATA/100, unit is kWh
45	Phase C reverses active electric energy	0140H 0141H	read	Unsigned number, value=DATA/100, unit is kWh
46	Three-phase reverse total active electric energy	0142H 0143H	read	Unsigned number, value=DATA/100, unit is kWh
47	Phase A forward reactive energy	0144H 0145H	read	Unsigned number, value=DATA/100, unit is kWh
48	Phase B forward reactive energy	0146H 0147H	read	Unsigned number, value=DATA/100, unit is kWh
49	Phase C forward reactive energy	0148H 0149H	read	Unsigned number, value=DATA/100, unit is kWh
50	Three-phase forward total reactive energy	014AH 014BH	read	Unsigned number, value=DATA/100, unit is kWh
51	Phase A reverse reactive energy	014CH 014DH	read	Unsigned number, value=DATA/100, unit is kWh
52	Phase B reverse reactive energy	014EH 014FH	read	Unsigned number, value=DATA/100, unit is kWh
53	Phase C reverse	0150H	read	Unsigned number, value=DATA/100, unit is

	reactive energy	0151H		kWh
54	Three-phase reverse total reactive energy	0152H 0153H	read	Unsigned number, value=DATA/100, unit is kWh

Table 2: System parameter register address and communication data table (function code 03H read, 10H write)

serial number	definition	Register address	read/write	Specific instructions
1	Model 1	0000H	read	The value is 333H
2	Hardware version	0001H	read	0x1001->V1.00.1
3	Software version	0002H	read	0x1001->V1.00.1
4	Protocol version	0003H	read	0x1001->V1.00.1
5	Address and baud rate	0004H	read/write	The default value is 0106H; the default address is 01H, and the default communication format is 8, N, 1,9600bps illustrate: The 8-bit high byte is the address, 1~255; 0 is the broadcast address; The high 2 bits of the low byte are the data format bits. "00" means 10 bits, no check, that is, "8, N, 1"; "01" means 11 bits, even parity, that is, "8, E, 1"; "10" means 11 bits, odd parity, that is, "8, O, 1"; "11" means 11 bits, no parity, 2 stop bits, that is, "8, N, 2"; The lower four bits of the low byte are the baud rate, 5-4800bps, 6-9600bps, 7-19200bps. (The communication baud rates of port 485 and TTL port are related to this register, and the baud rates of the two are consistent)

Table 3: Alarm upper limit register and communication data table (function code 03H reads, 10H writes)

serial number	definition	Register address	read/write	Specific instructions
1	Voltage upper limit	0020H	read/write	Default value 0x104=260V
2	Current upper limit	0021H	read/write	Default value 0x1F4,0x1F4/10=50A

Table 4: Power Direction Register (Status Word 1)

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Total reactive power: 1—Reverse 0—forward	Phase C reactive power: 1—Reverse 0—forward	Phase B reactive: 1—Reverse 0—forward	Phase A has no power: 1—Reverse 0—forward	Total merit: 1—Reverse 0—forward	Phase C has merit: 1—Reverse 0—forward	Phase B has merit: 1—Reverse 0—forward	Phase A has merit: 1—Reverse 0—forward

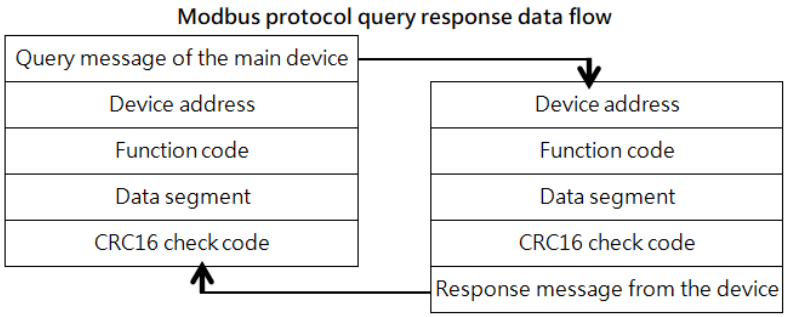
Table 5: Meaning of alarm status indicator word **(status word 2)** :

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Not used	C phase current: 1—Overcurrent 0—Normal	B phase current: 1—Overcurrent 0—Normal	A phase current: 1—Overcurrent 0—Normal	Not used	C phase voltage: 1—Overvoltage 0—Normal	B phase voltage: 1—Overvoltage 0—Normal	Phase A voltage: 1—Overvoltage 0—Normal

4. MODBUS communication protocol

This module provides a serial asynchronous half-duplex RS485 communication interface, using the standard MODBUS-RTU protocol, and various data information can be transmitted on the communication line. Up to 255 modules can be connected on one line at the same time. Each module can set its communication address. The communication connection should use a shielded twisted pair with a copper mesh, and the wire diameter should not be less than 0.5mm ^{2}. When wiring, communication lines should be kept away from strong current cables or other strong electric field environments.

The MODBUS protocol adopts the master-slave response communication connection method on one communication line. First, the signal from the host computer is addressed to a terminal device (slave) with a unique address. Then, the response signal from the terminal device is transmitted to the host in the opposite direction, that is, the signal is transmitted along a separate communication line. All communication data streams are transmitted in opposite directions (half-duplex operating mode). The MODBUS protocol only allows communication between the host (PC, PLC, etc.) and terminal devices, but does not allow data exchange between independent terminal devices. In this way, each terminal device will not occupy the communication line when they are initialized, but is limited to responding. Query signal arriving at this machine.



Host query: The query message frame includes device address, function code, data information code, and check code. The address code indicates the slave device to be selected; the function code tells the selected slave device what function it wants to perform. For example, function code 03 or 04 requires the slave device to read registers and return their contents; the data segment contains the requirements of the slave device. Any additional information that performs functions. The check code is used to verify the correctness of a frame of information. The slave device provides a method to verify whether the message content is correct. It uses the calibration rule of CRC16.

Slave response: If the slave device generates a normal response, the response message contains the slave address code, function code, data information code and CRC16 check code. Data information codes include data collected from the device: like register values or status. If an error occurs, we agree that the slave machine will not respond.

We specify the communication data format used in this module: bits per byte (1 start bit, 8 data bits, odd or even parity or no parity, 1 or 2 stop bits) .

The structure of the data frame, that is, the message format:

Device address	function code	data segment	CRC16 check code
1 byte	1 byte	N bytes	2 bytes (low byte first)

Device address: It consists of one byte. The address of each terminal device must be unique. Only the addressed terminal will respond to the corresponding query.

Function code: tells the addressed terminal what function to perform. The following table lists

the function codes supported by this series of modules and their functions.

function code	Function
03H	Read the value of one or more registers
10H	Write the value of one or more registers

Data segment: Contains the data required by the terminal to perform specific functions or the data collected when the terminal responds to queries. The content of these data may be numerical values, reference addresses or setting values.

Check code: CRC16 occupies two bytes and contains a 16-bit binary value. The CRC value is calculated by the transmitting device and then appended to the data frame. The receiving device recalculates the CRC value when receiving the data and then compares it with the value in the received CRC field. If the two values are not equal, an error occurs. mistake.

The process of generating a CRC16 is:

(1) Preset a 16-bit register to 0FFFFH (all 1s), called CRC register.

(2) Perform XOR operation on the 8 bits of the first byte in the data frame and the low byte in the CRC register, and store the result back into the CRC register.

(3) Shift the CRC register one bit to the right, fill the highest bit with 0, shift out the lowest bit and detect it.

(4) If the lowest bit is 0: repeat the third step (next shift); if the lowest bit is 1: perform an XOR operation on the CRC register and a preset fixed value (0A001H).

(5) Repeat steps 3 and 4 until 8 shifts. In this way, a complete eight bits are processed.

(6) Repeat steps 2 to 5 to process the next eight bits until all bytes are processed.

(7) The final value of the CRC register is the value of CRC16.

MODBUS-RTU communication protocol example:

4.1. Function code 0x03: Read multiple registers

Example: The host wants to read 3 slave register data with address 01 and starting address 0100H.

Host sends: 01 03 01 00 00 03 04 37

Address function code starting address data length CRC code

Slave response: 01 03 06 56 11 56 22 56 33 1F 77

Address function code returns byte number register data 1 register 2 register 3 CRC code

4.2. Function code 0x10: Write multiple registers

Example: The host wants to save 0104H, 01F4H to the slave registers with addresses 0020H, 0021H (the slave address code is 0x01)

Host sends: 01 10 00 20 00 02 04 01 04 01 F4 B1 9D

Address function code starting address number of write registers byte count saved data 1 2 CRC code

Slave response: 01 10 00 20 00 02 40 02

Address function code starting address write register number CRC code

4.3. Description

The register in the MODBUS-RTU communication protocol refers to 16 bits (ie 2 bytes), and the high-order bit is first.

When setting parameters, be careful not to write illegal data (that is, data values that exceed the data range limit);

The error code format returned by the slave is as follows:

Address code: 1 byte

Function code: 1 byte (the highest bit is 1)

Error code: 1 byte

CRC: 2 bytes

The response returns the following error code:

81: Illegal function code, that is, the received function code module does not support it.

82: Reading or writing illegal data address, that is, the data location exceeds the readable or writable address range of the module.

83: Illegal data value, that is, the data value sent by the module received by the host exceeds the data range of the corresponding address.

Examples of communication messages

4.4.1 Read data register (function code 03H): Read the three register values of the three-phase voltage. The result is: A-phase voltage 220.33V, B-phase voltage 220.5V, C-phase voltage 220.67V, and the module address is 1.

Host reads data frame:

address	Order	Starting address (high bit first)	Number of registers (high end first)	Check code (low digit first)
01H	03H	01H,00H	00H,03H	04H,37H

The module responds with a data frame:

address	Order	Data length	Data segment (6 bytes)	Check code
01H	03H	06H	56H,11H,56H,22H,56H,33H	1FH,77H

4.4.2 Write data register (function code 10H): Set the upper limit of voltage to 260V, the upper limit of current to 50A, and the module address to 1.

Host writes data frame:

address	Order	initial address	Number of registers	Number of bytes	data segment	Check code
01H	10H	00H,20H	00H,02H	04H	01H,04H,01H,F4H	B1H,9DH

The module responds with a data frame:

address	Order	initial address	Number of registers	Check code
01H	10H	00H,20H	00H,02H	40H,02H

4.4.3 Clear all electric energy data (function code 10H, write 2 registers starting from 000CH, the written data is 4 bytes of 00H):

address	Order	initial address	Number of registers	Number of bytes	data segment	Check code
01H	10H	00H,0CH	00H,02H	04H	00H,00H,00H,F0H	F3H,FAH

The module responds with a data frame:

address	Order	initial address	Number of registers	Check code
01H	10H	00H,0CH	00H,02H	81H,CBH

5. Precautions

1) Pay attention to the auxiliary power information on the product label. Do not connect the wrong auxiliary power level and polarity of the product, otherwise the product may be damaged.
2) Please refer to the diagram for correct wiring according to product specifications and models. Make sure to disconnect all signal sources and power before wiring to avoid danger and damage to the equipment. After checking to confirm that the wiring is correct, turn on the power and test.
3) The voltage circuit or the secondary circuit of the PT must not be short-circuited.
4) When there is current on the primary side of the CT, it is strictly forbidden to open the secondary circuit of the CT; it is strictly forbidden to make live connections or unplug terminals;
5) When using the product in an environment with strong electromagnetic interference, please pay attention to the shielding of the input and output signal lines.
6) When installed in a centralized manner, the minimum installation interval should not be less than 10mm.
7) This series of products does not have a lightning protection circuit inside. When the input and output feeders of the module are exposed to harsh outdoor weather conditions, lightning protection measures should be taken.
8) Please do not damage or modify the product's label or logo, and do not disassemble or modify the product, otherwise our company will no longer provide "three guarantees" (guaranteed replacement, guaranteed return, and guaranteed repair) service for the product.

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