JSY-MK- 211 Single-phase AC/DC metering module
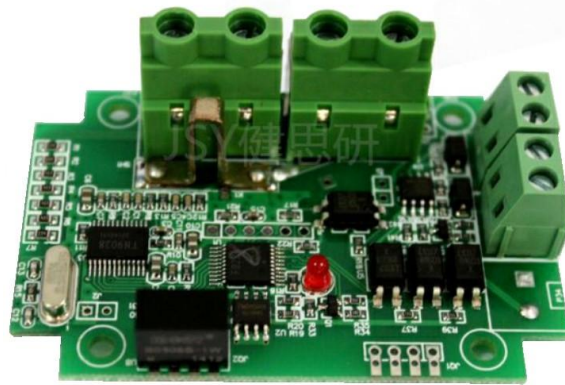
Product description

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1. Product introduction

1.1、 Introduction

　　JSY-MK-211 single-phase AC/DC metering module is a single-phase AC/DC metering module with complete independent intellectual property rights developed by our company using microelectronics technology and dedicated large-scale integrated circuits, digital sampling and processing technology, SMT technology and other advanced technologies. The technical performance of this module fully complies with the relevant technical requirements of the 1-level single-phase active energy meter in the IEC 62053-21 national standard, and can accurately measure the voltage, current, power, power factor, electricity and total amount of electrical parameters in the single-phase AC power grid with a rated frequency of 50HZ or 60HZ. The module has a built-in RS485 communication interface, a TTL level interface (optional), and 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-211 single-phase AC/DC metering module can be widely used in energy-saving transformation , power, communication, railway, transportation, environmental protection, petrochemical, steel and other industries to monitor the voltage, current and power consumption of AC or DC equipment .

1.2、 Features

　　1.2.1. Collect single-phase AC or DC: voltage, current, power, electric energy and other electrical parameters, complete information

　　1.2.2. Adopting special measurement chip, effective value measurement method, high measurement accuracy

　　1.2.3. With RS-485 communication interface , optional TTL communication

　　1.2.4. The communication protocol adopts standard Modbus-RTU, which has good compatibility and is convenient for programming.

　　1.2.5. Wide operating voltage AC80～2 64 V , DC 5V

　　1.2.6. It adopts industrial-grade chips and has complete lightning protection and anti-interference measures to ensure reliability.

　　1.2.7. High isolation voltage, withstand voltage up to AC: 2000V

1.3、 Technical Parameters

　　1.3.1 Single phase AC input

　　　　1) Voltage range: AC 1 ~ 300 V

　　　　2) Current range: 10M A -10 A

　　　　3) Signal processing: using special measurement chip, 24 -bit AD sampling.

　　　　4) Overload capacity: 1 0A range sustainable.

　　　　5) Input impedance: voltage channel >1 kΩ/V. current channel $\leqslant$ 100mΩ .

　　1.3.2 Single phase DC input

　　　　1) Voltage range : DC 1 ~ 300 V

　　　　2) Current range: 10mA-10A

　　　　3) Signal processing: using special measurement chip, 24 -bit AD sampling.

　　　　4) Overload capacity: 1 0A range sustainable.

　　　　5) Input impedance: voltage channel >1 kΩ/V. current channel $\leqslant$ 100mΩ .

　　1.3.3 Communication Interface

　　　　1) Interface type: optional RS-485 , TTL interface .

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) Communication rate: RS-485 communication interface baud rate can be set to 1200, 2400, 4800, 9600Bps.

5) Communication data: voltage, current, power, electric energy and other electrical parameters, see the Modbus data register list .

1.3.4 measurement accuracy

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

1.3.5 Power supply

1) AC : 80V ~ 260V.

When powered by AC220V, the peak voltage shall not exceed 265V. typical power consumption: ≤ 2W.

2) DC: 5V ±5%

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 Module size :   75 × 50 mm

1.4、   Product Categories

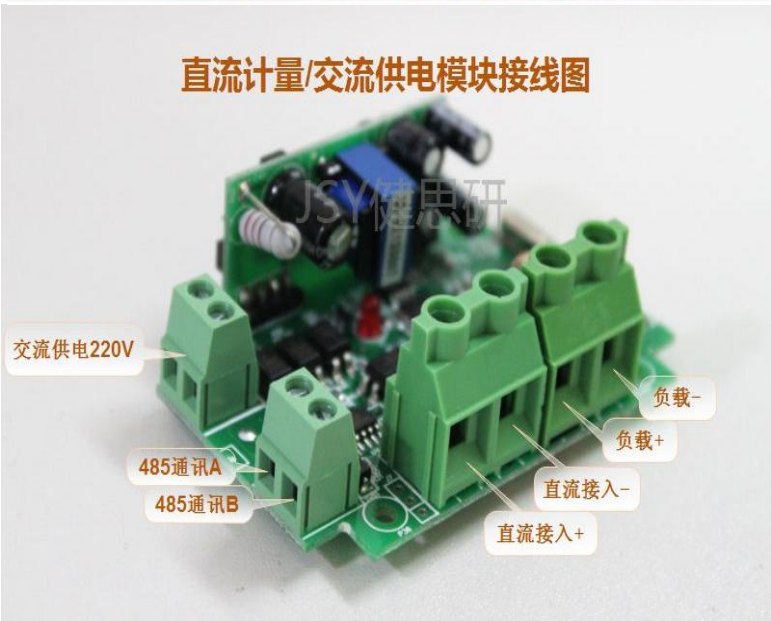| product name	Naming convention
JSY-MK-211A-2	Single-phase AC metering module 220V power supply
JSY-MK-211A-5	Single-phase AC metering module 5V power supply
JSY-MK-211D-2	Single-phase DC metering module 220V power supply
JSY-MK-211D-5	Single-phase DC metering module 5V power supply

2. Application

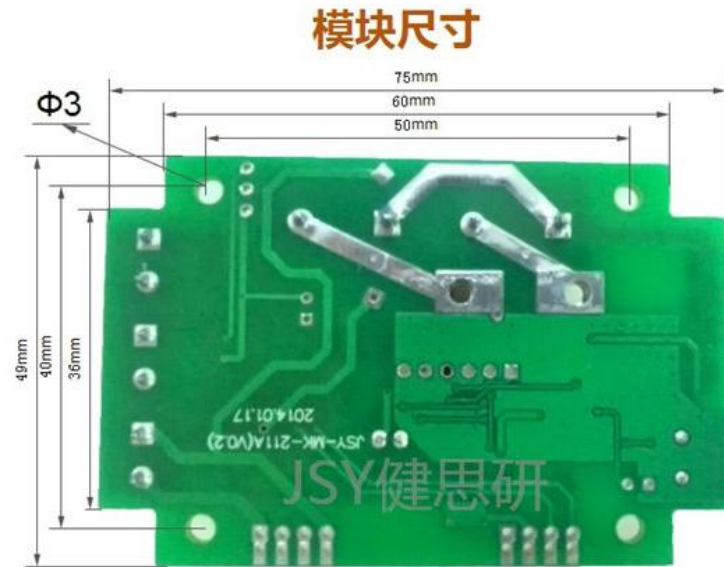### 2.1.1 AC wiring instructions

交流计量/直流供电模块接线图

交流计量/交流供电模块接线图

2.1.2 DC wiring instructions

负载-   负载+   直流接入-   直流接入+

485通讯B
485通讯A
直流供电电
源：+5V
直流供电电
源：GND

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直流计量/直流供电模块接线图

直流计量/交流供电模块接线图

交流供电220V

JSY健思研

485通讯A
485通讯B

负载-
负载+
直流接入-
直流接入+

2.2 Size Description

模块尺寸

Φ3

75mm
60mm
50mm

49mm
40mm
36mm

JSY-MK-211A(V02)
2014.01.17

JSY健思研

2.3 Application Notes

Please wire correctly according to the product specifications and models and refer to the above diagrams. Make sure to disconnect all signal sources before wiring to avoid danger and damage to the equipment. After checking and confirming that the wiring is correct, turn on the power supply for testing.

After the power is turned on, the "Power " indicator light is always on.

When the product leaves the factory, it is set to the default configuration: address 1, baud rate 4800bps, data format "n,8,1", data update rate 1000ms, ratio 1.

211 product testing software we provide can be used to change and set product parameters and perform general product tests.

2.4.1、 RS-485 network connection:

The host usually only has an RS - 232 interface. In this case, it can be connected to the 485 network through an RS - 232/ RS -485 converter. It is recommended to use an isolated 485 converter to improve the reliability of the system.

The A+ and B- terminals of all devices on a bus are connected in parallel, and they

cannot be connected in reverse. Up to 255 network instruments can be connected to one line at the same time. Each network instrument can set its communication address. The communication connection should use shielded twisted pair cables with a wire diameter of not less than 0.5mm2 . When wiring, keep the communication line away from strong electric cables or other strong electric field environments .

The RS‐485 communication line should use shielded twisted pair cable. the communication distance of 485 can reach 1200 meters. When there are many RS485 devices connected to a bus , or a higher baud rate is used, the communication distance will be shortened accordingly. At this time, a 485 repeater can be used for expansion.

RS‐485 networking has a variety of topological structures, generally using linear connection, that is, starting from the upper host, multiple devices are connected to the network one by one from near to far. At the farthest end, a 120 ~ 300 Ω / 0.25 watt terminal matching resistor can be connected (depending 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 metering function:

Can provide single ‐phase voltage, current, power, power factor, active energy, carbon emissions and other parameters.

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

三、JSY-MK-211 Modbus register list

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

Serial number	definition	Register Address	Read/ Write	Data Type and Calculation Instructions
1	Total active energy (high level)	000CH	read	Reading value /3200 = total active energy, unit kWh
2	Total active energy (low level)	000DH	read	
3	Voltage	0048H	read	Unsigned number, value=DATA/100, unit V
4	current	0049H	read	Unsigned number, value=DATA/1000, unit A
5	Active power	004AH	read	Unsigned number, value=DATA, unit is W
6	Total active energy (high level)	004BH	read	Reading value /3200 = total active energy, unit kWh, The value is the same as the 000CH and 000DH registers
7	Total active energy (low level)	004CH	read	
8	Power Factor	004DH	read	Unsigned number, value=DATA/100 0 ,
9	CO2 emissions (high)	004EH	read	Reading value /1000 = carbon dioxide emissions in kilograms
10	CO2 emissions (low)	004FH	read	
11	temperature	0050H	read	Reserved (this module does not have this function)
12	frequency	0051H	read	Unsigned number, value = DATA/100 , unit HZ

Table 2 : DC measurement electrical parameter register and communication data table (function code 03H, read only)

Serial number	definition	Register Address	Read/ Write	Data Type and Calculation Instructions
1	Total power (high)	000CH	read	Reading value /100 = total power, unit Wh
2	Total power (low)	000DH	read	
3	Voltage	0048H	read	Unsigned number, value = DATA/100, unit V
4	Current	0049H	read	Unsigned number, value = DATA/1000, unit A
5	Instantaneous power	004AH	read	Unsigned number, value = DATA/ 10 , unit is W

6	Accumulated electric energy (high level)	004BH	read	Reading value /100=accumulated energy, unit: Wh,
7	Accumulated electric energy (low level)	004CH	read	The value is the same as the 000CH and 000DH registers.

Table 3 : System configuration reading parameter register address and data communication table (function code 03H read, 10H write)

serial number	definition	Register address	read/ write	Specific instructions
5	Address and baud rate	0004H	read/write	The default value is 0105H. the default address is 01H, and the default communication format is 8, N, 1,4800bps 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, 0, 1". "11" means 11 bits, no parity, and 2 stop bits, that is, "8, N, 2". The lower four bits of the low byte are the baud rate, 3-1200bps, 4-2400bps, 5-4800bps, 6-9600bps,

Table 4 : System read-only parameter register address and communication data table (function code 03H, read-only)

Serial number	definition	Register Address	Read/ Write	Specific instructions
1	Model 1	0000H	read	The value is 0211 H
2	Model 2	0001H	read	The high byte 01H is the AC module, 02H is the DC module The low byte is the program version number
3	Voltage range	0002H	read	Default is 250V, value is FAH
4	Current range	0003H	read	The default is 16 A, the value is A0 H (10 times relationship)

Table 5: Power cleaning degree : Use function code 10H, the written data must be 0, writing other data is invalid, the written data can refer to the following table

serial number	initial address	Number of write registers	Byte calculation	data	illustrate
1	000CH	2	4	00 00 00 00	Active electrical energy

4. MODBUS communication protocol

 This instrument 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 network instruments can be connected to one line at the same time. Each network instrument 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 uses a master-slave response communication connection method on a communication line. First, the signal of the host computer is addressed to a terminal device (slave) with a unique address, and then the response signal sent by the terminal device is transmitted to the host in the opposite direction, that is: on a separate communication line, the signal transmits all communication data streams in two opposite directions (half-duplex working mode). The MODBUS protocol only allows communication between the host (PC, PLC, etc.) and the terminal device, and does not allow data exchange between independent terminal devices, so that each terminal device will not occupy the communication line when they are initialized, but is limited to responding to the query signal that reaches the machine.
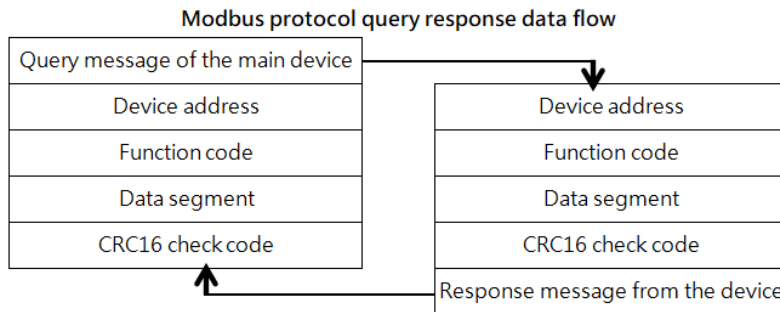
Host query: The query message frame includes device address, function code, data information code, and check code. The address code indicates the slave device to be selected. the function code tells the selected slave device what function it wants to perform. For example, function code 03 or 04 requires 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 instrument: 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 instruments and their functions.

function code	Function
03H	Read the value of one or more registers
10H	Write the value of one or more registers
01H	Read the output status of relay 1
05H	Write the output status of relay 1

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 an 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 in the CRC register.

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

(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 are made. This completes the processing of a full eight bits.

(6) Repeat steps 2 to 5 to process the next eight bits until all bytes have been 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 the data of two slave registers with address 01 and starting address 0048H.

Host sends: 01 03 00 48 00 02 CRC

       Address function code starting address data length CRC code

Slave response: 01 03 04 12 45 56 68 CRC

Address Function Code Return Bytes Register Data 1 Register Data 2 CRC Code

4.2. Function code 0x10: Write multiple registers

Example: The host wants to save 0000,0000 to the slave register at address 000C,000D (the slave address code is 0x01)

Host sends: 01 10 00 0C 00 02 04 00 00 00 00 F3 FA

Address Function Code Starting Address Write Register Quantity Byte Count Save Data 1 2 CRC Code

Slave response: 01 10 00 0C 00 02 81 CB

Address function code starting address write register quantity 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.

4. 4. Examples of communication messages

4. 4.1 Read data register (function code 03H): Read the three register values of phase A. The result is: voltage 231.5V, current 10.123A, power 2343W, instrument 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	00H,48H	00H,03H	85H,DDH

The instrument responds with a data frame:

address	Order	Data length	Data segment (6 bytes)	Check code
01H	03H	06H	5AH,6EH,27H,8BH,09H,27H	F8H,92H

4. 4.2 Write data register (function code 10H): Set the upper limit of phase A voltage to 260V, the upper limit of phase A current to 50A, and the instrument 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 instrument 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 **AC measurement instruction analysis example:**

（1）Read electrical parameter command (taking module address 0x01 as an example):

Send data: 01 03 00 48 00 06 45 DE (read 6 registers starting from 0048)

Receive data: 01 03 0C 57 E4 09 D9 02 2D 00 00 03 40 03 D6 3F 17

The red part is the relevant electrical parameters, and the decomposed results are as follows:

The red data 57 E4 corresponds to the 0048 register, which is the voltage: 0x57E4=22500 . Divided by 100 is 225V . The data in each register is 2 bytes. The other data can be obtained according to the calculation formula.

4. 4 . 4 Example of **DC measurement command analysis:**

（1）Read electrical parameter instructions (take the module address as 0x01 as an example):

Send data: 01 03 00 48 00 0 5 0 5 D F (read 5 registers starting from 0048)

Receive data: 01 03 0A 02 6C 11 D7 01 1B 01 02 03 04 DB 6F

The red part is the relevant electrical parameters, and the decomposed results are as follows:

Decomposing the data, the result is: voltage=0x026C/100=620/100=6.2V
Current=0x11D7/1000=4567/1000=4.567A
Power=0x011B/10=283/10=28.3W
                    Electric
energy=0x01020304/100=16909060/100=169090.6Wh

5. Things to note

1) Pay attention to the auxiliary power information on the product label. The auxiliary power level and polarity of the product must not be connected incorrectly, otherwise the product may be damaged.

2) Please connect correctly according to the product specifications and models and refer to the diagram. Before connecting, make sure to disconnect all signal sources and power to avoid danger and damage to the equipment. After checking and confirming that the wiring is correct, turn on the power for testing.

3) The voltage circuit or the secondary circuit of the PT cannot 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 connect wires or unplug terminals when there is current on the primary side of the CT.

5) When the product is used in an environment with strong electromagnetic interference, please pay attention to the shielding of the input and output signal lines.

6) When installing centrally, 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 feeder lines of the module are exposed to harsh outdoor weather environments, lightning protection measures should be taken.

8) Please do not damage or modify the product labels or logos, and do not disassemble or modify the product. Otherwise, our company will no longer provide the "Three Guarantees" (exchange, refund, and repair) service for this product.

Contact Information:

Shenzhen Jiansiyan Technologies Co., Ltd.

Address: 901, Building 1, Taijiale Technology Industrial Park, Tongguan Road, Tianliao Community, Yutang Street,Guangming District,Shenzhen,Guangdong, 518100, China.

Tel.:　(+86) 0755 86524536　Fax:　(+86) 0755 26628850

Web: www.jsypowermeter.com , E-mail: jsykj@outlook.com