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# PZEM-003/017 DC communication module

## Overview

This document describes the specification of the PZEM-003/017 DC communication module, the module is mainly used for measuring DC voltage, current, active power and energy consumption, the module is without display function, the data is read through the RS485 interface.

PZEM-003: Measuring Range 10A (Built-in Shunt)

PZEM-017: Measuring Range 50A、100A、200A、300A (the current range is depend on the external shunt specification )

## 1. Function description

### 1.1 Voltage

1.1.1 Measuring range:0.05-300V. (when the test voltage is  $< 7V$ , please use the independent power supply mode)

1.1.2 Resolution:0.01V.

1.1.3 Measurement accuracy:1%.

### 1.2 Current

1.2.1 Measuring range:0.01-10A (PZEM-003) ;0.02-300A (PZEM-017;can be matched with 50、100、200、300A four kinds of shunt).

1.2.2 Resolution:0.01A

1.2.3 Measurement accuracy:1%

### 1.3 Power

1.3.1 Measuring range:0.1-3kW (PZEM-003) ;0.2-90kW (PZEM-017)

1.3.2 Resolution: 0.1W

1.3.3 Measurement accuracy:1%

### 1.4 Energy Consumption

1.4.1 Measuring range: 0-9999kWh

1.4.2 Resolution: 1Wh

1.4.3 Measurement accuracy:1%

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1.4.4 Reset energy: use software to reset.

## 1.5 Over Voltage alarm

Voltage threshold can be set, divide into high voltage and low voltage threshold, when the measured voltage exceeds the threshold, it can alarm

The default high voltage threshold is 300V, the default low voltage threshold is 7V.

## 1.6 Communication interface

RS485 interface.

## 2. Communication protocol

### 2.1 Physical layer protocol

Physical layer use UART to RS485 communication interface.

Baud rate is 9600, 8 data bits, 2 stop bit, no parity.

### 2.2 Application layer protocol

The application layer use the Modbus-RTU protocol to communicate. At present, it only supports function codes such as 0x03 (Read Holding Register), 0x04 (Read Input Register), 0x06 (Write Single Register), 0x41 (Calibration), 0x42 (Reset energy).etc.

0x41 function code is only for internal use (address can be only 0xF8), used for factory calibration and return to factory maintenance occasions, after the function code to increase 16-bit password, the default password is 0x3721.

The address range of the slave is 0x01 ~ 0xF7. The address 0x00 is used as the broadcast address, the slave does not need to reply the master. The address 0xF8 is used as the general address, this address can be only used in single-slave environment and can be used for calibration etc.operation.

### 2.3 Read the measurement result

The command format of the master reads the measurement result is(total of 8 bytes):

Slave Address + 0x04 + Register Address High Byte + Register Address Low Byte + Number of Registers High Byte + Number of Registers Low Byte + CRC Check High Byte + CRC Check Low Byte.

The command format of the reply from the slave is divided into two kinds:

Correct Reply: Slave Address + 0x04 + Number of Bytes + Register 1 Data High Byte + Register 1 Data Low Byte + ... + CRC Check High Byte + CRC Check Low Byte

Error Reply: Slave address + 0x84 + Abnormal code + CRC check high byte + CRC check low byte

Abnormal code analyzed as following (the same below)

- 0x01,Illegal function;
- 0x02,Illegal address;
- 0x03,Illegal data;
- 0x04,Slave error.

The register of the measurement results is arranged as the following table

Register address	Description	Resolution
0x0000	Voltage value	1LSB correspond to 0.01V
0x0001	Current value	1LSB correspond to 0.01A
0x0002	Power value low 16 bits	1LSB correspond to 0.1W
0x0003	Power value high 16 bits	
0x0004	Energy value low 16 bits	1LSB correspond to 1Wh
0x0005	Energy value high 16 bits	
0x0006	High voltage alarm status	0xFFFF is alarm, 0x0000 is not alarm
0x0007	Low voltage alarm status	0xFFFF is alarm, 0x0000 is not alarm

For example, the master sends the following command (CRC check code is replaced by 0xHH and 0xLL, the same below):

0x01 + 0x04 + 0x00 + 0x00 + 0x00 + 0x08 + 0xHH + 0xLL

Indicates that the master needs to read 8 registers with slave address 0x01 and the start address of the register is 0x0000.

The correct reply from the slave is as following:

0x01 + 0x04 + 0x10 + 0x27 + 0x10 + 0x00 + 0x64 + 0x03 + 0xE8 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 + 0xHH + 0xLL

The above data shows

- Voltage is 0x2710, converted to decimal is 10000, display 100.00V;
- Current is 0x0064, converted to decimal is 100, display 1.00A;
- Power is 0x000003E8, converted to decimal is 1000, display 100.0W;
- Energy is 0x00000000, converted to decimal is 0, display 0Wh;
- High voltage alarm status 0x0000, indicates the current voltage is lower than the high voltage threshold.
- Low voltage alarm status 0x0000, indicates the current voltage is higher than the low voltage threshold.

## 2.4 Read and modify the slave parameters

At present, it only supports reading and modifying slave address and power alarm threshold

The register is arranged as the following table

Register address	Description	Resolution
0x0000	High voltage alarm threshold (5~350V), default is 300V	1LSB correspond to 0.01V

0x0001	Low voltage alarm threshold (1~350V) , default is 7V	1LSB correspond to 0.01V
0x0002	Modbus-RTU address	The range is 0x0001~0x00F7
0x0003	The current range (only for PZEM-017)	0x0000: 100A 0x0001: 50A 0x0002: 200A 0x0003: 300A

The command format of the master to read the slave parameters and read the measurement results are same (described in details in Section 2.3), only need to change the function code from 0x04 to 0x03.

The command format of the master to modify the slave parameters is (total of 8 bytes):

Slave Address + 0x06 + Register Address High Byte + Register Address Low Byte + Register Value High Byte + Register Value Low Byte + CRC Check High Byte + CRC Check Low Byte.

The command format of the reply from the slave is divided into two kinds:

Correct Response: Slave Address + 0x06 + Number of Bytes + Register Address Low Byte + Register Value High Byte + Register Value Low Byte + CRC Check High Byte + CRC Check Low Byte.

Error Reply: Slave address + 0x86 + Abnormal code + CRC check high byte + CRC check low byte.

For example, the master sets the slave's high voltage alarm threshold:

0x01 + 0x06 + 0x00 + 0x00 + 0x4E + 0x20 + 0xHH + 0xLL

Indicates that the master needs to set the 0x0000 register (high voltage alarm threshold) to 0x4E20 (200.00V) .

Set up correctly, the slave return to the data which is sent from the master.

For example, the master sets the low voltage alarm threshold of the slave

0x01 + 0x06 + 0x00 + 0x01 + 0x03 + 0xE8 + 0xHH + 0xLL

Indicates that the master needs to set the 0x0001 register (low voltage alarm threshold) to 0x03E8(10.00V).

Set up correctly, the slave return to the data which is sent from the master.

For example, the master sets the address of the slave

0x01 + 0x06 + 0x00 + 0x02 + 0x00 + 0x05 + 0xHH + 0xLL

Indicates that the master needs to set the 0x0002 register (Modbus-RTU address) to 0x0005

Set up correctly, the slave return to the data which is sent from the master.

## 2.5 Reset energy

The command format of the master to reset the slave's energy is (total 4 bytes):

Slave address + 0x42 + CRC check high byte + CRC check low byte.

Correct reply: slave address + 0x42 + CRC check high byte + CRC check low byte.

Error Reply: Slave address + 0xC2 + Abnormal code + CRC check high byte + CRC check low byte

## 2.6 Calibration

The command format of the master to calibrate the slave is (total 6 bytes):

0xF8 + 0x41 + 0x37 + 0x21 + CRC check high byte + CRC check low byte.

Correct reply: 0xF8 + 0x41 + 0x37 + 0x21 + CRC check high byte + CRC check low byte.

Error Reply: 0xF8 + 0xC1 + Abnormal code + CRC check high byte + CRC check low byte.

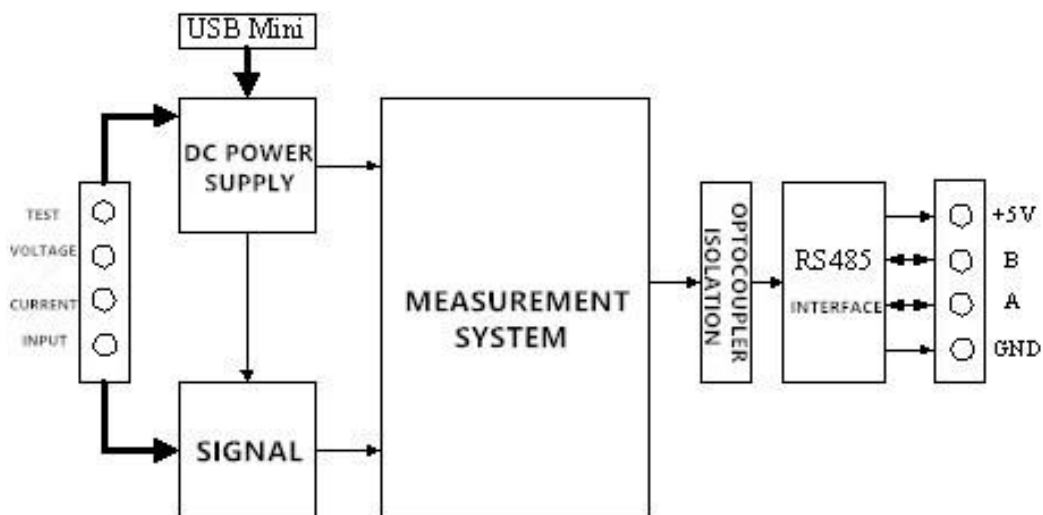
It should be noted that the calibration takes 3 to 4 seconds, after the master sends the command, if the calibration is successful, it will take 3 ~ 4 seconds to receive the response from the slave.

## 2.7 CRC check

CRC check use 16bits format, occupy two bytes, the generator polynomial is  $X^{16} + X^{15} + X^2 + 1$ , the polynomial value used for calculation is 0xA001.

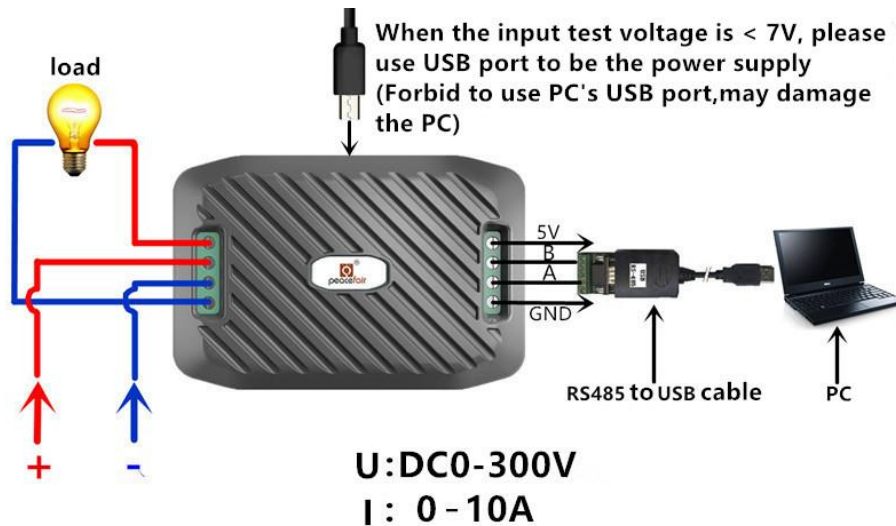
The value of the CRC check is all results of a frame data checking divide CRC

## 3. Functional block diagram

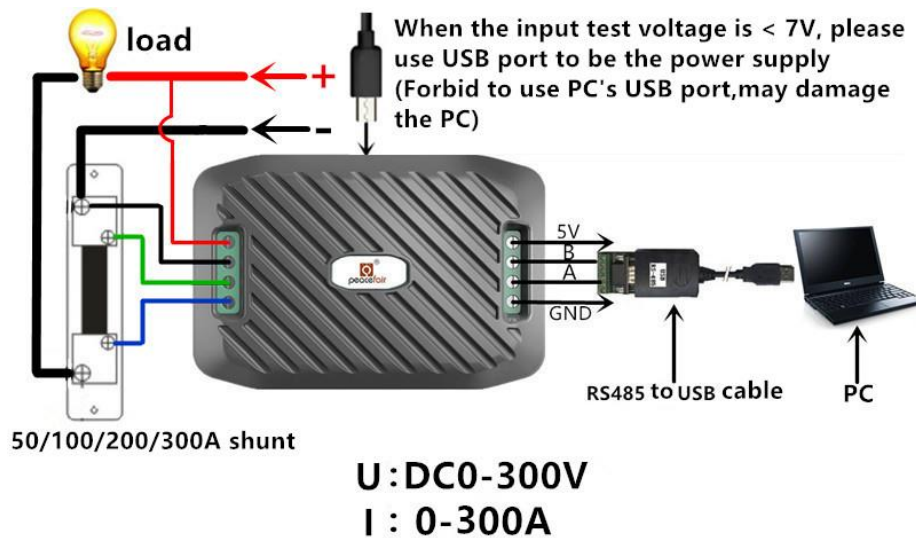


Picture 3 Functional block diagram

## 4. Wiring diagram



Picture 4.1 PZEM-003Wiring diagram



Picture 4.2 PZEM-017 Wiring diagram

## 5. Other instructions

5.1 RS485 interface is passive output, need external connect 5V power supply and the the external power supply should > 100mA.

5.2 When the input test voltage is less than 7V, it must supply 5V independent work voltage through MICRO USB port;

**Note: Do not use the USB port bring by your PC to be the independent power supply, otherwise it may damage your PC !**

## 5.3 Working temperature

-20°C ~ +60°C。