7in1 Soil Nutrient Sensor with RS485 Output

(measures 7 Soil parameters of Temperature, Moisture, EC-electrical conductivity, pH, N-nitrogen, P-pottasium, K-phosphorus)

Data Sheet User Manual v1.5

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1. Product introduction

Product description

The transmitter has stable performance, high sensitivity, fast response, stable output, and is suitable for various soil qualities. It is an important tool for observing and studying the occurrence, evolution and improvement of saline soil and the dynamics of water and salt. By measuring the dielectric constant of the soil, it can directly and stably reflect the true moisture content of various soils. It can measure the volume percentage of soil moisture, which is a soil moisture measurement method that meets the current international standards. Can be buried in the soil for a long time, resistant to long-term electrolysis, corrosion resistance, vacuum potting, and completely water proof. The transmitter is suitable for soil moisture monitoring, scientific experiments, water-saving irrigation, greenhouses, flowers and vegetables, grassland pastures, soil rapid testing, plant cultivation, sewage treatment, precision agriculture and other occasions for temperature and humidity, electrical conductivity, PH value testing.

Features:

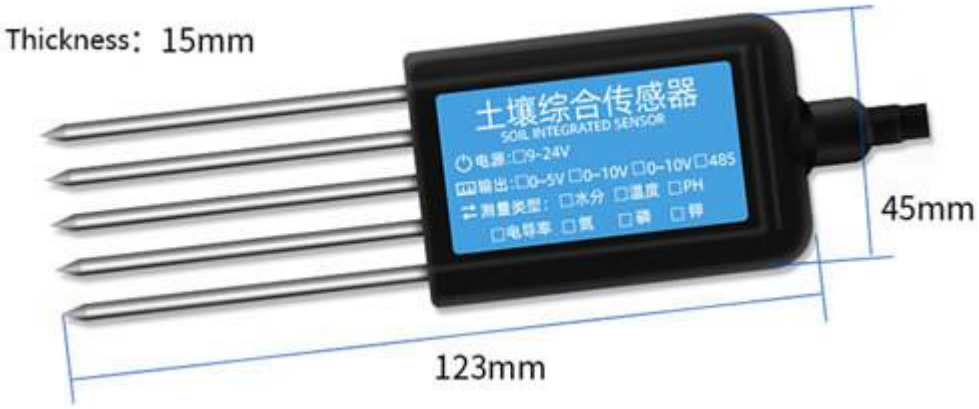
- The seven items of soil moisture content, electrical conductivity, temperature, nitrogen, phosphorus, potassium, and pH value are combined inane.
- Low threshold, few steps, fast measurement, no Low reagents, unlimited detection times
- The electrode is made of specially treated alloy material, which can withstand strong external impact and is not easy to damage.
- Completely sealed, resistant to acid and alkali corrosion, can be buried in the soil or directly into the water for long-term dynamic testing.
- High precision, fast response, good interchangeability, probe insertion design to ensure accurate measurement and reliable performance.

- It can also be used for the conductivity of water and fertilizer integrated solutions, as well as other nutrient solutions and substrates.
- High pH measurement accuracy, up to ±0.3PH accuracy, fast response speed and good interchangeability.

Specification:

DC power supply	DC 4.5-30V	
Maximum power consumption	0.7W (24V DC power supply)	
Operating temperature	-20℃~+60℃	
Core chip temperature resistance	85℃	
Conductivity parameter	Range	0-20000us/cm
	Resolution	10us/cm
	Accuracy	±3% in the range of 0-10000us/cm; ±5% within the range of 10000-20000us/cm
Soil moisture parameters	Range	0-100%
	Resolution	0.1%
	Accuracy	2% within 0-50%, 3% within 50-100%
Soil temperature parameter	Range	-40~80℃
	Resolution	0.1℃
	Accuracy	±0.5℃（25℃）
Soil PH parameter	Range	3~9PH
	Resolution	0.1
	Accuracy	±0.3PH
NPK parameters	Range	1-1999 mg/kg(mg/L)
	Resolution	1 mg/kg(mg/L)
	Accuracy	±2%FS
Conductivity temperature compensation	Built-in temperature compensation sensor compensation range 0-50℃	
Protection level	IP68	
Probe material	Anti-corrosion special electrode	
Sealing material	Black flame-retardant epoxy resin	
Default cable length	Default 2 meters, can be customized	
Dimensions	45*15*123mm	
Output signal	RS485 (Modbus protocol)	
Country of Origin	China	

Shell Size

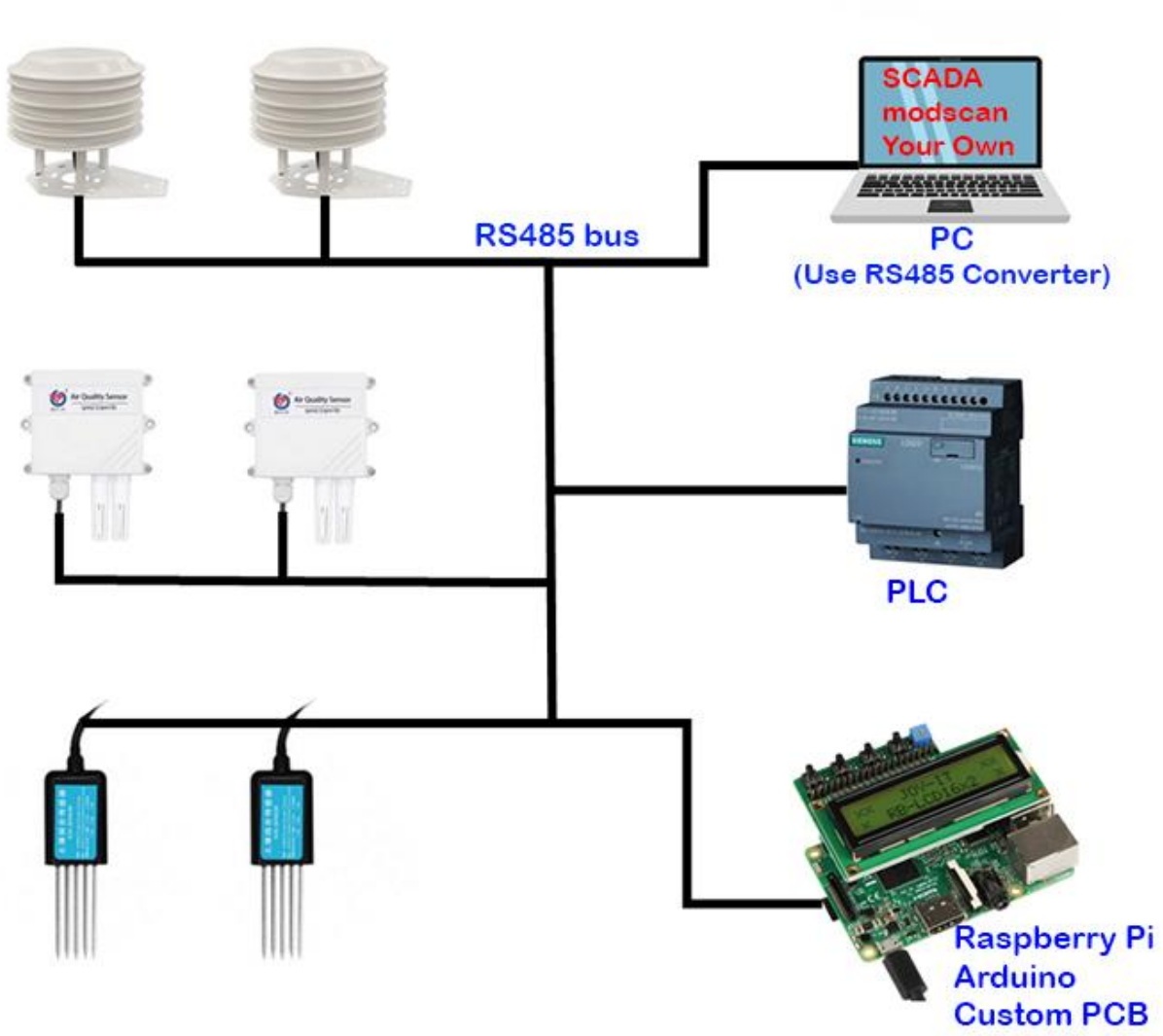


Equipment size drawing (unit: mm)

Connection:

This product can also be combined with multiple sensors on a 485 bus. It can be interfaced with PC or PLC or any other hardware board as shown in below image

- with PC
  - via Ethernet (Use our RS485 to Ethernet Converter or Gateway)
  - via WiFi (Use our RS485 to WiFi Converter or Gateway)
  - via USB (Use our RS485 to USB Converter)
- with PLC
  - via RS485 port directly
- with Your Own hardware or Arduino or Raspberry Pi
  - via RS485 circuit or use above converters for Ethernet, Wi-Fi or UART



Product Model Selection

					Base Code
		TR-			Soil Detector Housing
			NPKPH-		Nitrogen Phosphorus Potassium pH
			THNPKPH-		Temperature Moisture Nitrogen Phosphorus Potassium pH
			ECNPKPH-		Conductivity Nitrogen Phosphorus Potassium pH
			ECTHNPKPH-		Conductivity Temperature Moisture Nitrogen Phosphorus Potassium pH
			THPH-		Temperature Moisture pH
			ECPH-		Conductivity pH
			ECTHPH-		Conductivity Temperature Moisture pH
				N01	RS485 (Modbus-RTU protocol)

2. Hardware Connection

Inspection before equipment installation

Check the equipment list before equipment installation:

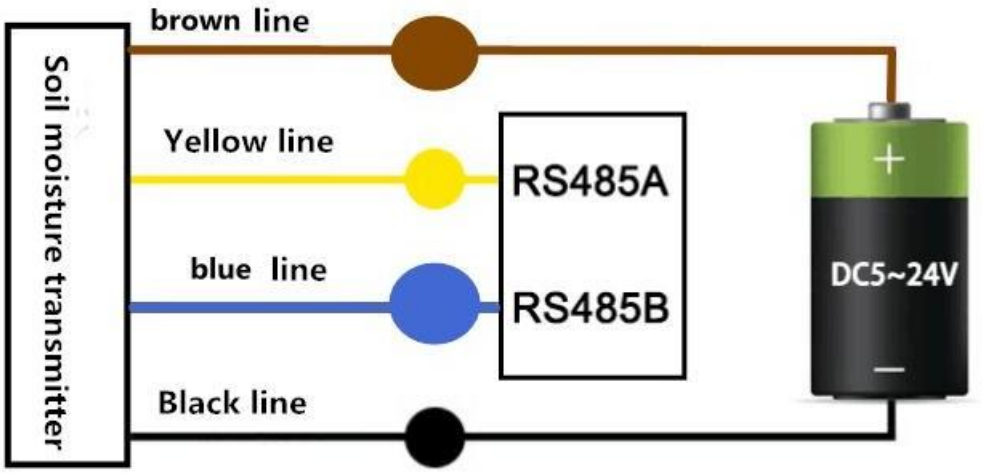
- Transmitter equipment1
- Certificate of conformity, wiring instructions, etc.
- USB to 485(optional)

Interface Description

Wide voltage power input can be 4.5~30V. When wiring the 485 signal line, pay attention to the A/B two lines cannot be reversed, and the addresses of multiple devices on the bus cannot conflict.

Sensor wiring

Line color	Description	Remarks
brown	Power supply	4.5~30V DC
black	Power ground	GND
yellow	485-A	485-A
blue	485-B	485-B



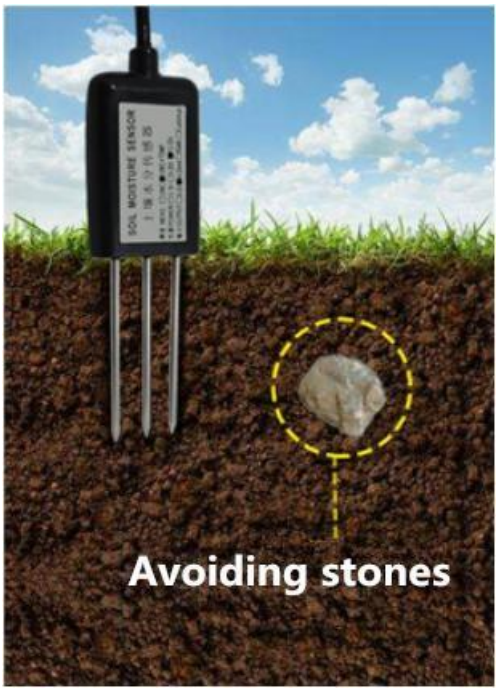
3.Instructions

Since the electrode directly measures the conductivity of the soluble salt ions in the soil, the soil volumetric water content needs to be higher than about 20% in order to accurately reflect the conductivity of the soil. In the long-term observation, the measured value after irrigation or rainfall is closer to the true level. If you conduct a quick test, you can first water the soil to be tested, Measure after the moisture has penetrated sufficiently.

If you are measuring on a hard surface, you should drill holes first (the hole diameter should be smaller than the diameter of the probe), then insert the soil and compact the soil before measuring; the transmitter should be protected from severe vibration and impact, let alone knocked with hard objects hit. Because the transmitter is a black package, the transmitter will heat up rapidly (up to 50℃) under strong sunlight. In order to prevent excessive temperature from affecting the temperature measurement of the transmitter, please place it in the field or in the field. Pay attention to shading and protection when using.

Quick test method

Select a suitable measurement location, avoid rocks, ensure that the steel needle does not touch hard objects, throw away the surface soil according to the required measurement depth maintain the original tightness of the soil below, hold the sensor vertically and insert it into the soil. Do not shake left and right. It is recommended to measure multiple times to find the average value within a small range of a measuring point.



Buried measurement method

Dig a pit with a diameter of >20cm vertically, insert the transmitter steel needle horizontally in to the pit wall at a predeter mined depth, and fill the pit tightly. After a period, stability, measurement and Measurement can be carried out for several days, months or even longer recording.

Note:

1. All steel needles must be inserted into the soil during measurement.
2. Avoid strong sunlight directly shining on the transmitter and cause excessive temperature. Pay attention to lightning protection when using in the field.
3. Do not bend the steel needle violently, pull the lead wire of the transmitter forcefully, and do not hit or violently hit the transmitter.
4. The transmitter protection level is IP68, and the transmitter can be soaked in water.
5. Due to the presence of radio frequency electromagnetic radiation in the air, it is not suitable to stay energized in the air for a longtime.

4. Configuration software installation and use

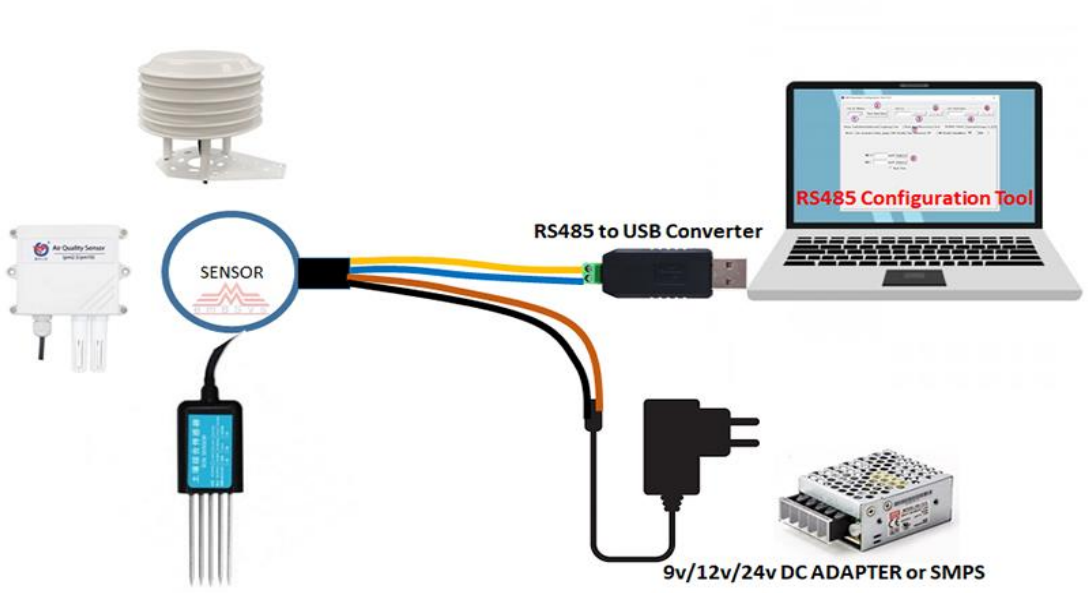
Tools Required

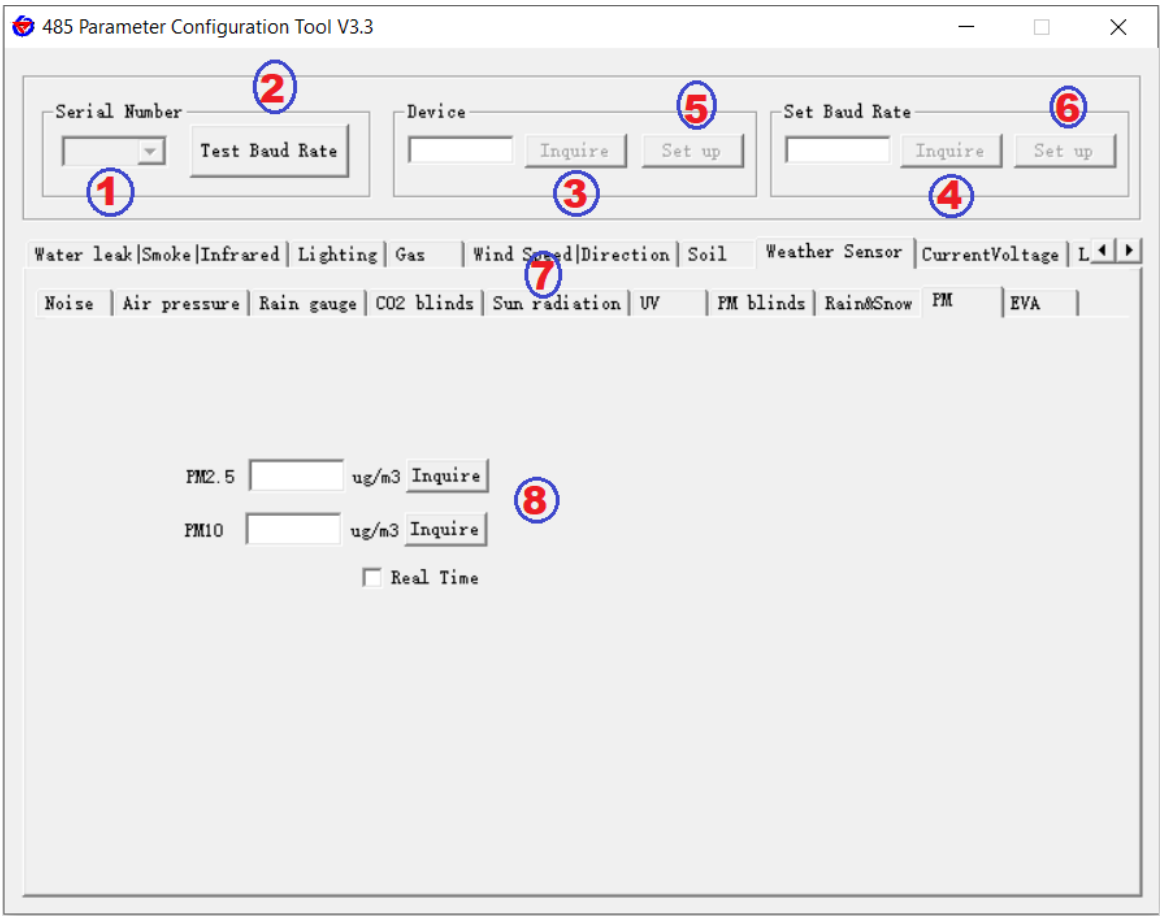
We need below tools to set or change the parameters of the sensors.

1. RS485 to USB Converter (To connect the sensor with your laptop. You should get a RS485 to USB converter and install corresponding driver. You can purchase from us too)
2. Power Supply Unit (To give power supply to the sensor)
3. RS485 Parameter Configuration Tool (You can download from our website or contact us)

Parameter settings

After Connected RS485-USB converter and Sensor and PC as shown in below image, open RS485 Parameter Configuration Tool. (Also you can check the sensor with modscan or similar software)





1. Choose CM port Serial Number
2. Click this button to test the baud rate
3. Click this button to check the Modbus device ID
4. Click this button to check the Baud rate of the device
5. Enter a value in the [Device] field and click this button to change the device ID
6. Enter a value in the [baud rate] field and click this button to change the baud rate
7. Choose your sensor from Main Tab and then Sub Tab
   Click Inquire button to read the values from the sensor

5.Output Format

Basic communication parameters:

Code	8-bit binary
Data bit	8 digits
Parity bit	No
Stop bit	1person
Error check	CRC (redundant cyclic code)
Baud rate	2400bit/s, 4800bit/s, 9600 bit/s can be set, the factory default is 4800bit/s

Data frame format definition:

Adopt Modbus-RTU communication protocol, the format is as follows:

Initial structure ≥ 4 bytes of time

Address code = 1 byte

Function code = 1 byte

Data area = N bytes

Error check = 16-bit CRC code

End structure ≥ 4 bytes of time

Address code: It is the address of the transmitter, which is unique in the communication network (factory default 0x01).

Function code: The command function instruction issued by the host, this transmitter only uses function code 0x03 (read register data).

Data area: The data area is the specific communication data, pay attention to the 16bits data high byte first!

CRC code: Two-byte check code. Host inquiry

address code	function code	Register start address	Register length	CRC Checksum LOW	CRC Checksum HIGH
1 byte	1 byte	2 bytes	2 bytes	1 byte	1 byte

Frame structure:

Slave machine response frame structure:

Address code	function code	Effective number of bytes	1st Data	2nd Data	Nth Data	CRC
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes	2 bytes

Address

Register address	PLC or Config address	Content	Read Write Type	Definition description
0000 H	40001 (decimal)	Moisture content	Read only	Real-time value of water content (expanded by 10 times)
0001 H	40002 (decimal)	Temperature	Read only	Real-time temperature value (expanded 10 times)
0002 H	40003 (decimal)	Conductivity	Read only	Conductivity real-time value
0003 H	40004 (decimal)	PH value	Read only	PH real-time value (expanded 10 times)
0004H	40005 (decimal)	Nitrogen content	Read only	Actual value of N Nitrogen content
0005H	40006 (decimal)	Phosphorus	Read only	Actual value of P Phosphorus content
0006H	40007 (decimal)	Potassium	Read only	Actual value of K potassium content
0007 H	40008 (decimal)	Salinity	Read only	Salinity real-time value
0008 H	40009 (decimal)	Total dissolved solids TDS	Read only	TDS real-time value
0022 H	40035 (Decimal)	Conductivity temperature coefficient	Read & write	0-100 Corresponds to 0.0%-10.0% Default 0.0%
0023 H	40036 (decimal)	Salinity coefficient	Read & write	0-100 Corresponds to 0.00-1.00, Default 55 (0.55)
0024 H	40037 (decimal)	TDS coefficient	Read & write	0-100 Corresponds to 0.00-1.00, Default 50 (0.5)

0050 H	40081 (Decimal)	Temperature calibration value	Read & write	Integer (extended by 10 times)
0051 H	40082 (Decimal)	Water content calibration value	Read & write	Integer (extended by 10 times)
0052 H	40083 (Decimal)	Conductivity calibration value	Read & write	Integer
0053 H	40083 (Decimal)	PH calibration value	Read & write	Integer
04E8 H	41001 (decimal)	Nitrogen content coefficient 16 bits Upper	Read & write	Real value (IEEE754 standard floating point type)
04E9 H	41002 (decimal)	Nitrogen content coefficient 16 bits Lower	Read & write	
04EA H	41003 (decimal)	Nitrogen content calibration value	Read & write	Integer
04F2 H	41011 (decimal)	Phosphorus content Coefficient 16 bit Upper	Read & write	Real value (IEEE754 standard floating point type)
04F3 H	41012 (decimal)	Phosphorus Content Coefficient 16 bit Lower	Read & write	
04F4 H	41013 (decimal)	Phosphorus Content Calibration value	Read & write	Integer
04FCH	41021 (decimal)	Potassium content coefficient 16 bits Upper	Read & write	Real value (IEEE754 standard floating point type)
04FDH	41022 (decimal)	Potassium content coefficient 16 bits Lower	Read & write	
04FE H	41023 (decimal)	Potassium content calibration value	Read & write	Integer
07D0 H	42001 (decimal)	Device address	Read & write	1~254 (factory default 1)
07D1 H	42002 (decimal)	Device baud rate	Read & write	0 means 2400 1 means 4800 2 means 9600

Example Modbus Polling and explanation

Example: Read the conductivity and temperature and moisture value of a four-in-one device with conductivity, temperature and moisture (address 0x01)

Command Frame:

Address code	Function code	Starting address	Data length	CRC LOW	CRC HIGH
0x01	0x03	0x00 0x00	0x00 0x04	0x44	0x09

Response frame:

Address code	Function code	Number of bytes	Humidity value	Temperature value	PH value	CRC LOW	CRC HIGH
0x01	0x03	0x08	0x02 0x92	0XFF 0x9B	0x00 0x38	0x57	0xB6

Temperature calculation:

When the temperature is lower than 0℃ , the temperature data is uploaded in the form of complement code.

Temperature: FF9B H (hexadecimal) = -101 => temperature = -10.1℃

Moisture calculation:

Moisture: 292 H (hexadecimal) = 658 => Humidity = 65.8%, that is, the soil volumetric moisture content is65.8%

Conductivity calculation:

Conductivity: 3E8 H (hexadecimal) = 1000 Conductivity = 1000 us/cm

PH value calculation:

PH value: 38H (hexadecimal) = 56 => PH value = 5.6

4. Common problems and solutions

No output or output error

possible reason:

① The computer has a COM port, and the selected port is incorrect.

② The baud rate is wrong.

③ The 485 bus is disconnected, or the A and B wires are connected reversely.

④ There are too many devices or the wiring is too long, the nearest power supply should be added, and a 485 booster should be added and a 120Ω terminal resistance should be added at the same time.

⑤ The USB to 485 driver is not installed or damaged.

⑥ The equipment is damaged.

6.Contact information

EmbSys Technologies Pvt Ltd

3/50, 2nd Cross Street

Sundar Nagar, Ekkattuthangal

Chennai, India. Pincode – 600032

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