

RS485 4-in-1 Soil Moisture, Temperature, pH & EC Sensor



Overview

This sensor is suitable for measuring soil temperature and moisture. It has a 5-30V wide voltage power supply and RS485 output. It can detect soil temperature, humidity, electrical conductivity (EC) and PH. It has fast response and stable output. It can be used with Arduino UNO R3 and TTL to 485 expansion board to quickly build and test.

The protection level of the soil sensor is IP68, and it is vacuum filled and sealed with black flame-retardant epoxy resin. The probe material is made of 316 stainless steel, which is rust-proof, waterproof, anti-corrosion, salt-alkali corrosion resistance, and long-term electrolysis resistance. It is more affected by the soil salt content. It is small, can be buried in the soil for a long time, and is suitable for various soil types.

The soil sensor has an automatic temperature compensation function for conductivity, which can ensure the accuracy of measurement no matter how the environment changes. It is widely used in agricultural irrigation, greenhouses, flowers and vegetables, grassland pastures, rapid soil testing, plant cultivation, scientific experiments, grain Storage and measurement of moisture content and temperature of various particulate matter.



Order Code

Order Code	Brand	Description
E30002-001	DFRobot	RS485 4-in-1 Soil Moisture, Temperature, pH & EC Sensor

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Overview

Soil electrical conductivity (EC) is the level of salt in the soil (salinity). These parameters are important indicators of soil fertility and health, and ultimately affect plants. When soil has high salt content, the salt makes it difficult for plants to absorb water, even if the moisture content in the soil is high. This condition will eventually "burn" the plant. Plants grow best in their preferred environment within the optimal range of soil moisture, temperature and EC levels. Growers need data on these parameters and understand what actions need to be taken to ensure plant health and higher yields.

Soil pH, also known as "soil reaction". It is an acid-base reaction of the soil solution, which mainly depends on the concentration of hydrogen ions in the soil solution, expressed by the pH value. A solution with a pH value equal to 7 is a neutral solution; a solution with a pH value less than 7 is an acidic reaction; a solution with a pH value greater than 7 is an alkaline reaction. Soil pH can generally be divided into the following levels:

PH value Soil acidity and alkalinity

< 4.5 Extremely acidic
4.5-5.5 Strongly acidic
5.5-6.5 acidic
6.5-7.5 Neutral
7.5-8.5 alkaline
8.5-9.5 Strongly alkaline
> 9.5 Extremely alkaline

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Features

- 5-30V wide voltage power supply
- RS485 output, can be used with Arduino
- With automatic temperature compensation, high precision, fast response and stable output
- Stainless steel probe can be buried in soil or water for a long time
- Resin vacuum filling and sealing, IP68 protection level

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Specification

- Power supply voltage: DC5-30V
- Power consumption: 0.5W@24V
- Output mode: RS485
- Detection parameters: temperature, humidity, conductivity (EC), PH
- Humidity parameters
 - Measuring range: 0-100%
 - Resolution: 0.1%
 - Accuracy: 0-50%@±2%, 50-100%@±3%
- Temperature parameters
 - Measuring range: -40°C~+80°C
 - Resolution: 0.1°C
 - Accuracy: ±0.5°C
- EC parameters
- Measuring range: 0-20000us/cm
- Resolution: 1us/cm
- Accuracy: 0-10000us/cm@±3%FS, 10000-20000us/cm@±5%FS
- Temperature compensation: memory temperature compensation, compensation range 0-50°C
- PH parameters
 - Measuring range: 3-9PH
 - Resolution: 0.1PH
- Protection level: IP68
- Probe material: anti-corrosion special electrode
- Sealing material: black flame retardant epoxy resin
- Working temperature: -20°C~+60°C
- Size: 127x45x15mm
- Cable length: 2m

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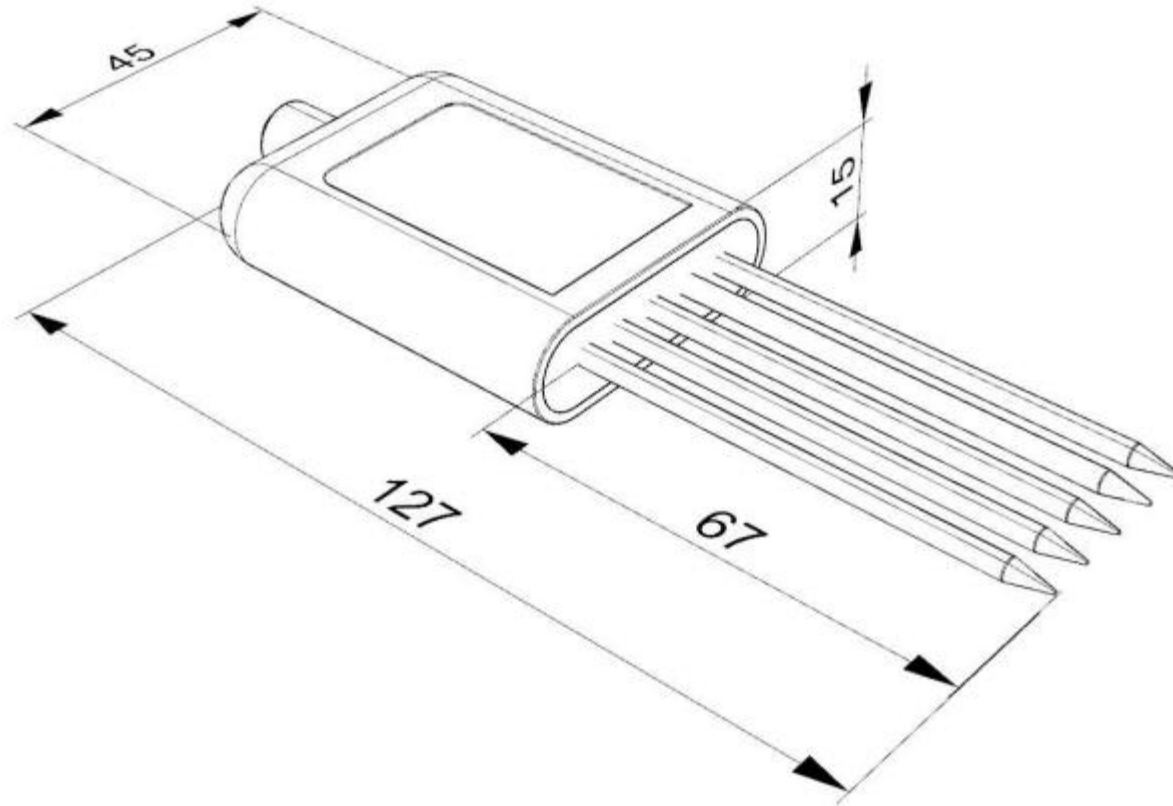
Board Overview

Num	Label	Description
Brown line	VCC	Power input positive pole, DC5-30V power supply
Black line	GND	Power ground wire
Yellow line	485-A	RS485 data line A
Blue line	485-B	RS485 data line B

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Dimension



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Communication Protocol

1. Basic communication parameters

Interface	Encoding	Data bits	Parity bits	Stop bits	Error checking	Baud rate
RS485	8-bit binary	8	None	1	CRC	2400bit/s, 4800bit/s, 9600 bit/s configurable, default 9600bit/s

Communication Protocol

2. Data frame format definition

Using ModBus-RTU communication protocol, the format is as follows:

- Time for initial structure ≥ 4 bytes
- Address code = 1 byte
- Function code = 1 byte
- Data area = N bytes
- Error checking = 16-bit CRC code
- Time to end structure ≥ 4 bytes
- Address code: It is the address of the sensor, which is unique in the communication network (factory default 0x01).
- Function code: Function indication of the command sent by the host. This sensor reads the register function code 0x03 and writes the register function code 0x06
- Data area: The data area is specific communication data. Note that the high byte of 16bits data is first!
- CRC code: two-byte check code.

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Communication Protocol

Host query frame structure:

Address code	Function code	Register starting address	Register length	Check code low bit	Check code high bit
1byte	1byte	2byte	2byte	1byte	1byte

Slave response frame structure:

Address code	Function code	Number of valid bytes	Data area 1	Data area 2	Nth data area	Check code
1byte	1byte	1byte	2byte	2byte	2byte	2byte

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Communication Protocol

3. Communication protocol examples and explanations

Example: Read the parameter values of the temperature and humidity ECPH four-in-one device (address 0x01)

Inquiry frame (hexadecimal):

Address code	Function code	Register starting address	Register length	Check code low bit	Check code high bit
0x01	0x03	0x00 0x00	0x00 0x04	0x44	0x09

Response frame (hexadecimal):

Address code	Function code	Return the number of valid bytes	Humidity value	Temperature value	EC value	PH value	Low bit of check code	High bit of check code
0x01	0x03	0x08	0x02 0x92	0xFF 0x9B	0x03 0xE8	0x00 0x38	0x57	0xB6

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Communication Protocol

Humidity calculation:

- Humidity: 0292 H (hex) = 658 = 65.8%RH

Temperature calculation:

- When the temperature is lower than 0°C, the temperature data is uploaded in complement form.
- Temperature: FF9B H (hex) = -101 => Temperature = -10.1°C

EC calculation:

- EC: 03E8 H (hex) = 1000 => EC = 1000 us/cm

PH calculatio:

- PH: 0038 H (hex) = 56 => PH = 5.6

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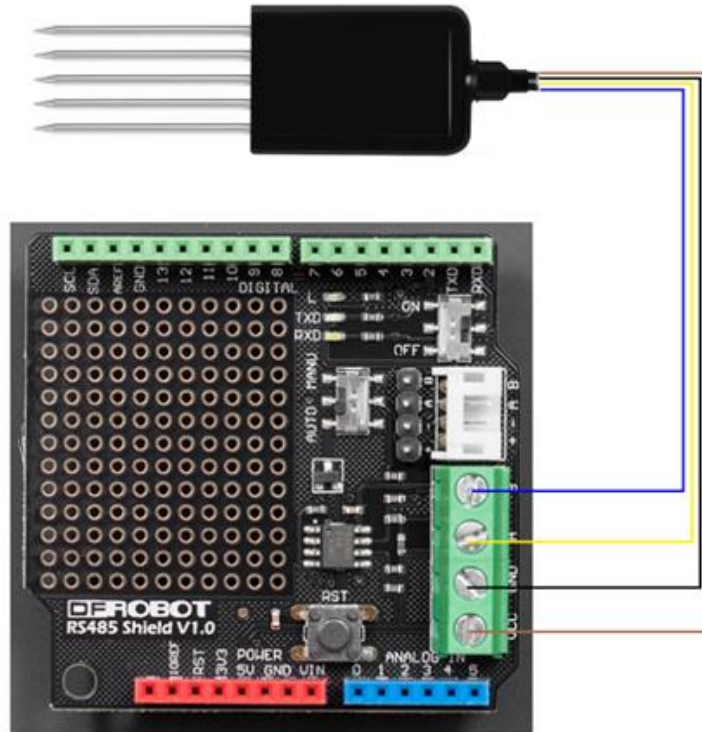
Communication Protocol

4. Register address

Register address	PLC or configuration address	Content	Operation	Definition description
0000H	40001(decimal)	Moisture content	Read only	Moisture content real-time value (expanded 10 times)
0001H	40002(decimal)	Temperature value	Read only	Temperature real-time value (expanded 10 times)
0002H	40003(decimal)	Conductivity	Read only	Conductivity real-time value
0003H	40004(decimal)	PH value	Read only	PH real-time value (expanded 10 times)
0007H	40008(decimal)	Salinity	Read only	Salinity real-time value (for reference only)
0008H	40009(decimal)	Total dissolved solids TDS	Read only	TDS real-time value (for reference only)
0022H	40035(decimal)	Conductivity temperature coefficient	Read and write	0-100 corresponds to 0.0%-10.0% Default 0.0%
0023H	40036(decimal)	Salinity coefficient	Read and write	0-100 corresponds to 0.00-1.00 Default 55 (0.55)
0024H	40037(decimal)	TDS coefficient	Read and write	0-100 corresponds to 0.00-1.00 Default 50 (0.5)
0050H	40081(decimal)	Temperature calibration value	Read and write	Integer (expanded 10 times)
0051H	40082(decimal)	Water content calibration value	Read and write	Integer (expanded 10 times)
0052H	40083(decimal)	conductivity calibration value	read and write	integer
0053H	40084(decimal)	pH calibration value	read and write	integer
07D0H	42001(decimal)	device address	read and write	1-254 (factory default 1)
07D1H	42002(decimal)	device baud rate	read and write	0 represents 2400 1 represents 4800 2 represents 9600

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Connection and Sample Code



Please download the [sample code](#)

Expected Results

Insert the soil sensor into the soil, and the serial port will print out the temperature, humidity, EC, and PH values detected by the sensor

Note: Before burning the code, please switch the transceiver mode switch of the expansion board to AUTO, and switch the run/compile switch to OFF. After burning the code, switch the run/compile switch to ON, and select the serial port baud rate to 9600.

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How to install and Use it

1、 Quick test method

Select a suitable measurement location, avoid stones, and ensure that the steel needle does not touch hard objects. Throw away the topsoil according to the required measurement depth and maintain the original tightness of the soil below. Hold the sensor tightly and insert it vertically into the soil. Do not move left and right when measuring. It is recommended to measure multiple times within a small range of a measuring point and average it.



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How to install and Use it

2、Buried measurement method

Dig a pit with a diameter >20cm vertically, insert the sensor steel needle horizontally into the pit wall at a predetermined depth, fill the pit tightly, and after a period of stabilization, measurements and recordings can be made for days, months or even longer.



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How to install and Use it

3、 Things to note

- The steel needle must be fully inserted into the soil during measurement.
- Avoid strong sunlight directly shining on the sensor, which may cause the temperature to be too high. When using in the field, be careful to prevent lightning strikes.
- Do not violently bend the steel needle, do not pull the sensor lead wire forcefully, and do not drop or violently impact the sensor.
- The sensor protection level is IP68, and the entire sensor can be immersed in water.
- Due to the presence of radio frequency electromagnetic radiation in the air, it is not advisable to leave it powered on for a long time in the air.

FAQ

Possible reasons for no output or output errors:

- The computer has a COM port, but the selected port is incorrect.
- TTL to 485 module operation/programming toggle switch selection is incorrect.
- Wrong baud rate.
- The 485 bus is disconnected, or the A and B lines are connected reversely.
- If there are too many devices or the wiring is too long, power supply should be provided nearby.
- Equipment damage.

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Revision History

Date	Revision	Change description
30/10/2025	1.0	Initial release