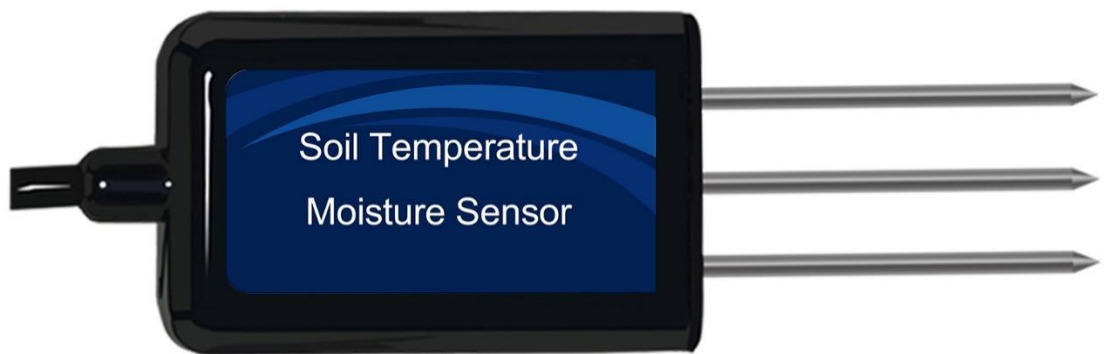


Soil Moisture and Temperature sensor Introduce



Type NO.: RD-SMT-P-O



1. Product Introduce

The sensor is a combination of soil moisture and soil temperature sensors. It has the advantages of convenient carrying, sealing and high precision. It is an ideal choice for soil moisture and soil temperature measurement.

The soil moisture part is a high-precision, high-sensitivity sensor manufactured by high-frequency electronic technology based on the principle of frequency domain reflection. By measuring the dielectric constant of soil, it can directly and stably reflect the true moisture content (volume water content) of various soils. It is the most popular soil moisture measurement method in the world.

The soil temperature is partly composed of the German-class imported Class A ST-1-PT1000 precision platinum resistance and high-precision transmitter. The transmitter part is composed of a power module, a temperature sensing module, a transmission module, a temperature compensation module and a data processing module, and has high applicability to the use environment.

2. Product Features

1. The sensor is compact in size, high in measurement accuracy, fast in response, and interchangeable.
2. Good sealing, waterproof grade IP68, can be directly buried in the soil, and is not corroded.
3. Real-time temperature and humidity monitoring function, which can measure the temperature of soil at different depths.
4. The soil quality is less affected and the application area is wide.
5. High measurement accuracy, reliable performance, ensuring normal operation, fast response, high data transmission efficiency.

3. Product application

Applicable to water-saving agricultural irrigation, meteorological monitoring, environmental monitoring, greenhouses, flowers and vegetables, grassland pastures, soil speed measurement, plant cultivation, scientific experiments, etc., which need to measure soil temperature and humidity.

4. Product Parameter

1. Technical Parameters

- (1) Measurement parameters: soil volumetric water content; soil temperature
- (2) Unit of measurement: % (m³/m³); °C
- (3) Water component range: 0 ~ 100% (can choose 30%, 50% equal range or custom any range);
- (4) Temperature range: -30 ~ 70 ° C (can be customized 0 ~ 50 ° C or any other range);
- (5) Measurement accuracy: ±2% (m³/m³) in the range of 0 to 50% (m³/m³); ±0.2°C
- (6) Working range: -30 ° C ~ 70 ° C
- (7) Output signal:



- A: voltage signal (0 ~ 2V, 0 ~ 2.5V, 0 ~ 5V, 0 ~ 10V Optional)
- B: 4 to 20 mA (current loop)
- C: RS485 (standard Modbus-RTU protocol, device default address: 01)

(8) Supply voltage:

- 5 ~ 24V DC (when the output signal is 0 ~ 2V, 0 ~ 2.5V, RS485)
- 12~24V DC (when the output signal is 0~5V, 0~10V, 4~20mA)

(9) Stabilization time: <1 second

(10) Response time: <1 second

(11) Measuring area: a cylinder with a diameter of 7 cm and a height of 7 cm centered on the center probe

2. Physical parameter

(1) Probe specifications: 55mm, $\phi 3\text{mm}$

(2) Probe material: 316L stainless steel;

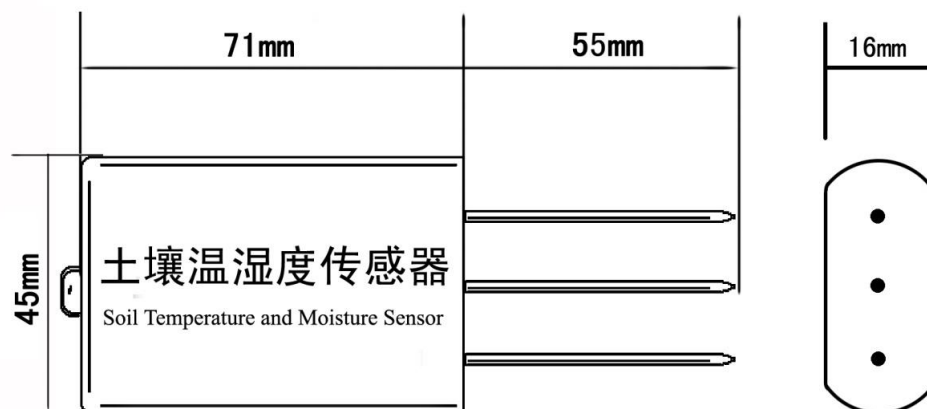
(3) Sealing material: ABS engineering plastic, epoxy resin, waterproof grade IP68

(4) Cable specification: standard 2 meters (can be customized for other cable lengths, up to 1200 meters)

3. Impedance requirements for current signals

| Supply Voltage | 9V | 12V | 20V | 24V |
|-------------------|--------------|--------------|--------------|---------------|
| Maximum impedance | 125 Ω | 250 Ω | 500 Ω | >500 Ω |

5. Product size



6. Connection diagram

| Colour | Description | Note |
|--------|----------------|------------|
| Brown | Power positive | 4.5-30V DC |
| Black | GND | GND |
| Yellow | 485-A | 485-A |
| Blue | 485-B | 485-B |

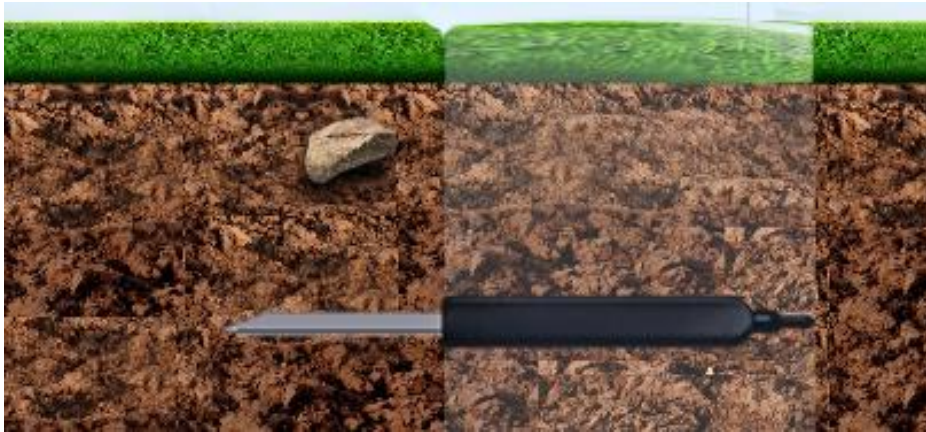
7. Measurement methods

1. Surface speed test



- (1) Select a representative soil environment to clean up surface debris and vegetation
- (2) Insert the sensor vertically and completely into the soil
- (3) If there is a hard object, the measurement location should be replaced and re-measured
- (4) For accurate data, it is recommended to measure multiple times and take the average
- (5) To measure deep soil moisture, it is recommended to use our company's dedicated soil drill

2. Ground measurement



- (1) Make a soil profile in the vertical direction, slightly deeper than the installation depth of the bottommost sensor, between 20cm and 50cm in diameter
- (2) Insert the sensor horizontally into the soil profile
- (3) After the installation is completed, the excavated soil is backfilled in order, layered and compacted, and horizontal installation is guaranteed.
- (4) If you have the conditions, you can put the removed soil in a bag and number it to keep the soil moisture unchanged, and backfill it in reverse order.

3. Three-tier installation





4. Six-tier installation





8. Data conversion method

The soil temperature and moisture sensor has good linear characteristics in the range of soil saturated water content. The following is a typical calibration formula, which can be used by the user. If higher precision is required, secondary calibration is required.

1. Current voltage analog output

θ_v : soil volumetric water content; T: soil temperature

V: voltage value collected by the collector, unit: V;

A: Current value collected by the collector, potential: mA

| output signal | Moisture conversion method | Temperature conversion method (-30 ~ 70 ° C) |
|---------------|----------------------------|--|
| 0 ~ 2V DC | $\theta_v = 50 * V$ | $T = 50 * V - 30$ |
| 0 ~ 5V DC | $\theta_v = 20 * V$ | $T = 20 * V - 30$ |
| 0 ~ 10V DC | $\theta_v = 10 * V$ | $T = 10 * V - 30$ |
| 4 ~ 20mA | $\theta_v = 6.25 * A - 25$ | $T = 6.25 * A - 55$ |

2. Standard Modbus-RTU protocol

Baud rate: 2400bit/s, 4800bit/s, 9600 bit/s can be set, the factory default is 9600bit/s

Check digit: none;

Data bit: 8; Stop bit: 1

3. 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 check = 16-bit CRC code

End structure ≥ 4 bytes of time

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

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

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

CRC code: two-byte check code.



Host inquiry frame structure

| Address code | Function code | Register start address | Register length | Check digit low | Check digit high |
|--------------|---------------|------------------------|-----------------|-----------------|------------------|
| 1 byte | 1 byte | 2 bytes | 2 bytes | 1 byte | 1 byte |

Slave response frame structure

| Address code | Function code | Effective bytes | Data 1 area | Data 2 area | Data N area | Check code |
|--------------|---------------|-----------------|-------------|-------------|-------------|------------|
| 1 byte | 1 byte | 1 byte | 2 bytes | 2 bytes | 2 bytes | 2 bytes |

4. Register address

| Register address | PLC or configuration address | Content | Operation | Definition description |
|------------------|------------------------------|------------------|----------------|---|
| 0000 H | 40001 (Decimal) | Soil Temperature | Read only | Real-time value of soil temperature value (expand 10 times) |
| 0001 H | 40002 (Decimal) | Soil Moisture | Read only | Real-time value of soil moisture value (expand 10 times) |
| 0030 H | 40049 (Decimal) | Device address | Read and write | 1~254 (factory default 1) |
| 0031H | 40050 (Decimal) | Baud rate | Read and write | Baud rate: 2400 Baud rate: 4800 Baud rate: 9600 Baud rate: 19200 |

5. Address Modification

For example, the sensor with address 1 is changed to address 2, and the host → slave

| Original address | Function code | Start register high | Start register low | High starting address | Low starting address | Low CRC16 | CRC16 High |
|------------------|---------------|---------------------|--------------------|-----------------------|----------------------|-----------|------------|
| 0X01 | 0X06 | 0X00 | 0X30 | 0X00 | 0X02 | 0X08 | 0X04 |

If the sensor receives correctly, the data returns according to the original route.

Remarks: If you forget the original address of the sensor, you can use the broadcast address 0XFE instead.

When using 0XFE, the host can only connect with one slave, and the return address is still the original address, which can be used as an address query method.

6. Query Data

Inquire the data of sensor (address 1) (soil temperature, soil moisture) , master → slave

| Address | Function code | Start register address high | Start register address low | High register length | Low register length | Low CRC16 | CRC16 High |
|---------|---------------|-----------------------------|----------------------------|----------------------|---------------------|-----------|------------|
| 0X01 | 0X03 | 0X00 | 0X00 | 0X00 | 0X02 | 0XC4 | 0X0B |

If the sensor receives correctly, return the following data, slave → host

| | | | |
|---------------|------|--|--|
| Address | 0X01 | | |
| Function code | 0X03 | | |



| | | | |
|----------------------|------|--|--------------------------|
| Data length | 0X04 | | |
| Register 0 data high | 0X00 | Soil Temperature: hexadecimal to decimal and divide by 10, and use the complement algorithm for negative numbers | Soil temperature:15.1 °C |
| Register 0 data low | 0X97 | | |
| Register 1 data high | 0X01 | Soil Moisture: hexadecimal to decimal and divide by 10 | Soil moisture: 35.6% |
| Register 1 data low | 0X64 | | |
| Low CRC16 | 0X4B | | |
| High CRC16 | 0XA4 | | |

7. Chang the baud rate

The default is 9600, if change into others, please send the following:

➤ Inquiry frame

| Change Baud rate | Address code | Function code | Register start address | Change value | Low check bit | Check code high |
|---------------------|-----------------|---------------|---------------------------|--------------|------------------|--------------------|
| 2400 | 0X01 | 0X06 | 0X00 0X31 | 0X24 0X00 | 0XC3 | 0X05 |
| 4800 | 0X01 | 0X06 | 0X00 0X31 | 0X48 0X00 | 0XEE | 0X05 |
| 9600 | 0X01 | 0X06 | 0X00 0X31 | 0X96 0X00 | 0XB7 | 0XA5 |
| 19200 | 0X01 | 0X06 | 0X00 0X31 | 0X19 0X20 | 0XD2 | 0X45 |

If success, it will feedback the same with the sending instruction.