Soil Temperature and Humidity Sensor

Type NO.: RD-SMTR-S-01

1. Product introduction and principle

This Soil temperature and humidity integrated sensor integrates soil moisture and soil temperature sensor, which is convenient for measuring soil moisture and soil temperature. It has the advantages of convenient carrying, sealing and high precision. It is soil moisture and soil temperature. Ideal for measurement. Soil moisture is a soil volumetric water content measuring instrument developed by the FDR principle. In addition to being directly used with the control instrument, the device can also be connected to various data collectors, handheld terminals. For scientific research or irrigation management, the sensor's stainless steel probe can be inserted into the soil surface or soil profile to quickly measure soil temperature and humidity, by permanently burying the probe underground and connecting to a data logger for long-term measurements.

Frequency Domain Reflectometry (FDR) is a method for measuring soil moisture content by measuring the frequency change caused by the change of the dielectric constant of the sensor in the soil and converting it into a voltage or current relationship corresponding to the soil water content. It has the characteristics of high measurement accuracy, fast, accurate, continuous fixed point measurement, no radioactivity and no disturbance to the soil.

It can be widely used in soil moisture monitoring, water saving irrigation, greenhouse control, precision agriculture, road monitoring, hydrometeorology and other fields.

2. Product Features

1. Less thermal response time, reducing dynamic error;
2. Small diameter and unlimited length;
3. High measurement accuracy and good consistency;
4. Imported probe components, reliable and stable performance

3. Technical Parameters

Item	Content
Output signal	RS485 standard modbus protocol
Measuring range	-20~80℃, 0~100%（（m3/m3））
Response time	＜1s
Precision	±1°C (25°C); ±2% (0 to 50% (m3/m3), 25°C
Working voltage	DC5~24V
Working current	12mA（DC5V）

Power consumption	DC5V <=0.06W
Measuring area	90% of the effect is in a cylinder 2.5 cm in diameter and 6 cm in length around the central probe
Sealing material	ABS (abrasive processing)
Size	110*30mm(Probe:60mm)
Cable length	5 meters
Cable pins	4 pins
Stabilization time	about 1 seconds after power on
Protection level	IP68

4. Dimensions

5. Wiring definition

Wire colour	**Interface**
Red	Power positive (12-24VDC)
Black	Power negative
Yellow	RS485A
Green	RS485B

6. Installation instructions

1. The steel needle of the sensor is completely inserted into the soil to be tested, and the sensor cannot be shaken when inserted to prevent the sensor probe from being affected;

2. The sensor can be used for multi-layer observation to establish a soil moisture monitoring station;

3. When you feel that there is a hard object in the soil, please reselect the measured point to prevent damage to the sensor probe.

4. Do not connect the probe into the hard clod to avoid damage to the probe; when measuring, the measured soil density should be as uniform as possible;

5. When removing the sensor from the soil, do not pull the cable directly; after use, clean and dry the probe to keep the probe clean.

6. Improper measurement points (>10% vol) may result if the measurement points are not selected properly. Barbaric installation will cause damage to the stainless steel needle of the sensor, which will affect the measurement accuracy. Attention must be paid to the following aspects during installation:

(1) abnormal holes or pores. If there are holes or air holes in the sensing range of the sensor, measurement errors will occur, especially when the sensor is inserted and removed, it is necessary to avoid repeated operation at the same position;

(2) Mounting angle. Sensors can be installed in different applications in different applications, usually in two, horizontal and vertical installations. The distribution of water in the soil medium is affected by many factors such as space and time. The reasonable installation of the sensor must eliminate these effects to the greatest extent. In the vertical installation, the sensor measures the average moisture of the sensing area of approximately 6 cm long;

(3) the sampling point. The choice of sampling points must be carefully considered. In addition to the two points mentioned above, there are many other factors that affect the measurement accuracy of the sensor. It can be listed as: soil density and composition change, crushed stone, plant roots, cockroach loosening effect, soil drainage state, soil surface moisture Volatilize and so on.

7. Due to the different water sources, the water quality will change accordingly. The measured voltage output value of the sensor placed in the simple water sample will fluctuate within a range. This measurement value can only be used as a reference value and cannot be used to judge the measurement accuracy of the sensor itself.

7. Communication protocol

1. Basic agreement

- Sensor default station number: 0x00FF
- Baud rate: 9600
- Data bits: 8
- Stop position: 1
- Check digit: none
- Flow control: none

2. Write station number

For example, change the sensor address from 01 to 02 , send

Device address	Function code	Register address	Data (new address)	CRC check
01	06	01 00	00 02	09 F7

If success, it will reply: 01 06 01 00 00 02 09 F7

3. Reading data (host computer)

Device address	Function code	Start register address	Number of registers	CRC check
01	03	0000	0002	C4 0B

Data reply

Device address	Function code	Data length	Soil temperature	Soil moisture	CRC check
01	03	04	09C4	0E10	BD FE

Soil temperature: Change the HEX to DEC , then divided by 100,

09C4(HEX)=2500(DEC), so the soil temperature is 25.00 ℃

Soil moisture: Change the HEX to DEC , then divided by 100,

0E10(HEX)=3600(DEC), so the soil moisture is 36.00% (V/V)

Soil Temperature and Humidity Sensor

Type NO.: RD-SMS-03

1. Product introduction and principle

RD-SMS-03 soil temperature and humidity integrated sensor integrates soil moisture and soil temperature sensor, which is convenient for measuring soil moisture and soil temperature. It has the advantages of convenient carrying, sealing and high precision. It is soil moisture and soil temperature. Ideal for measurement. Soil moisture is a soil volumetric water content measuring instrument developed by the FDR principle. In addition to being directly used with the control instrument, the device can also be connected to various data collectors, handheld terminals, and the like. For scientific research or irrigation management, the sensor's stainless steel probe can be inserted into the soil surface or soil profile to quickly measure soil temperature and humidity, by permanently burying the probe underground and connecting to a data logger for long-term measurements.

Frequency Domain Reflectometry (FDR) is a method for measuring soil moisture content by measuring the frequency change caused by the change of the dielectric constant of the sensor in the soil and converting it into a voltage or current relationship corresponding to the soil water content. It has the characteristics of high measurement accuracy, fast, accurate, continuous fixed point measurement, no radioactivity and no disturbance to the soil.

It can be widely used in soil moisture monitoring, water saving irrigation, greenhouse control, precision agriculture, road monitoring, hydrometeorology and other fields.

2. Product Features

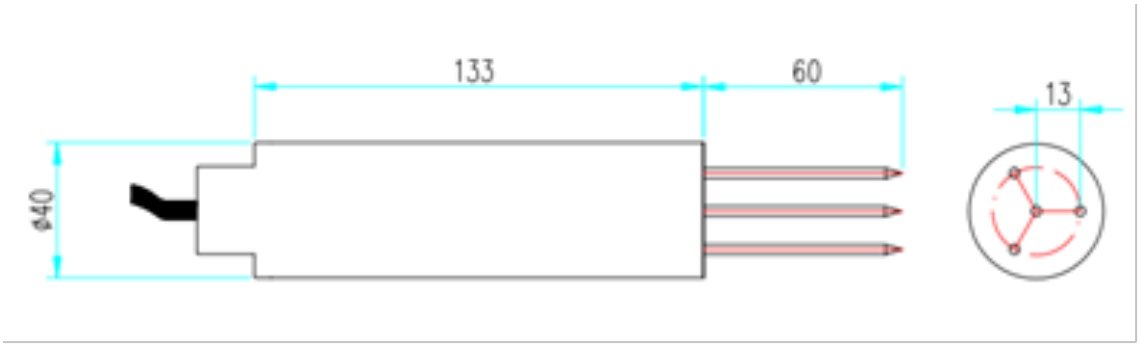
1. Less thermal response time, reducing dynamic error;
2. Small diameter and unlimited length;
3. High measurement accuracy and good consistency;
4. Imported probe components, reliable and stable performance

3. Technical Parameters

Item	Content
Output signal	RS485 standard modbus protocol
Measuring range	-20~80℃, 0~100%（（m3/m3））
Response time	＜1s
Precision	±1°C (25°C); ±2% (0 to 50% (m3/m3), 25°C
Working voltage	DC12~24V
Working current	40ma（DC12V）

Power consumption	DC12V <=0.6W
Measuring area	90% of the effect is in a cylinder 2.5 cm in diameter and 6 cm in length around the central probe
Sealing material	ABS (abrasive processing)
Size	130*40mm(Probe:60mm)
Cable length	3 meters
Cable pins	4 pins
Stabilization time	about 10 seconds after power on
Protection level	IP68

4. Dimensions



5. Wiring definition

Wire colour	Interface
Red	Power positive (12-24VDC)
Black	Power negative
Yellow (gray) color	RS485A
Blue	RS485B

6. Installation instructions

1. The steel needle of the sensor is completely inserted into the soil to be tested, and the sensor cannot be shaken when inserted to prevent the sensor probe from being affected;

2. The sensor can be used for multi-layer observation to establish a soil moisture monitoring station;

3. When you feel that there is a hard object in the soil, please reselect the measured point to prevent damage to the sensor probe.

4. Do not connect the probe into the hard clod to avoid damage to the probe; when measuring, the measured soil

density should be as uniform as possible;

5. When removing the sensor from the soil, do not pull the cable directly; after use, clean and dry the probe to keep the probe clean.

6. Improper measurement points (>10% vol) may result if the measurement points are not selected properly. Barbaric installation will cause damage to the stainless steel needle of the sensor, which will affect the measurement accuracy. Attention must be paid to the following aspects during installation:

(1) abnormal holes or pores. If there are holes or air holes in the sensing range of the sensor, measurement errors will occur, especially when the sensor is inserted and removed, it is necessary to avoid repeated operation at the same position;

(2) Mounting angle. Sensors can be installed in different applications in different applications, usually in two, horizontal and vertical installations. The distribution of water in the soil medium is affected by many factors such as space and time. The reasonable installation of the sensor must eliminate these effects to the greatest extent. In the vertical installation, the sensor measures the average moisture of the sensing area of approximately 6 cm long;

(3) the sampling point. The choice of sampling points must be carefully considered. In addition to the two points mentioned above, there are many other factors that affect the measurement accuracy of the sensor. It can be listed as: soil density and composition change, crushed stone, plant roots, cockroach loosening effect, soil drainage state, soil surface moisture Volatilize and so on.

7. Due to the different water sources, the water quality will change accordingly. The measured voltage output value of the sensor placed in the simple water sample will fluctuate within a range. This measurement value can only be used as a reference value and cannot be used to judge the measurement accuracy of the sensor itself.

7. Communication protocol

1. Basic agreement

- Sensor default station number: 0x00FF
- Baud rate: 9600
- Data bits: 8
- Stop position: 1
- Check digit: none
- Flow control: none

2. **Read station number: (fixed command)**

Device address	Function code	Start register address	Number of registers	CRC check
00	03	0001	0001	CRCloCRChi

Reply

Device address	Function code	Data length	Data	CRC check
00	03	02	00XX	CRCloCRChi（XX=01-ff）

Example: Read station number

Command: 00 03 00 01 00 01 D4 1B

Reply: 00 03 02 00 FF C5 C4

3. Write station number

Device address	Function code	Start register address	Number of registers	Data length	Data (new station number)	CRC check
00	10	0001	0001	02	00XX	CRCloCRChi（XX=0X01-0XFF）

Reply:

Device address	Function code	Start register address	Number of registers	CRC check
00	10	0001	0001	CRCloCRChi

Example

Command: 00 10 00 01 00 01 02 00 33 EA 04

Reply: 00 10 00 01 00 01 51 D8

(4) Reading data (host computer)

Device address	Function code	Start register address	Number of registers	CRC check
XX	03	0000	00XX	CRCloCRChi

Data reply

Device address	Function code	Data length	Data	CRC check
00	03	XX	XXXXXXXX	CRCloCRChi

Example

Command: FF 03 00 00 00 02 D1 D5

Reply: FF 03 04 01 2C(Soil moisture) 11 94(Soil temperature) A1 61

Note: The number of command responses is in hexadecimal format.

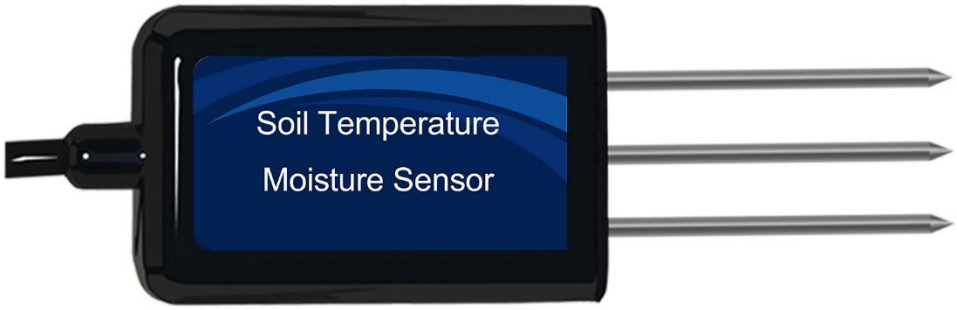
04 (decimal 4) is the length of the sensor data. A1 61 is the CRC check value.

Two-factor data sequence: soil moisture, soil temperature.

soil moisture =（0x01*256+0x2C）/10 = 30 %VOL

soil temperature =（0x11*256+0x94）/100-20 = 25 ℃

Soil Temperature and Moisture sensor



Type: RD-SMT-P-O-V2

Honde Technology CO.,LTD
https://hondetec.en.alibaba.com/

1. Product Introduce

The newer generation of soil moisture, temperature 2-in-one sensor is a soil sensor developed with a new technical solution. It can measure soil moisture, temperature at the same time, and perform compensation calculations between parameters.

This product can be used to measure the water content of saline-alkali land without being affected by the salt content of the soil and accurately measure the water content of the soil.

Adhering to the company's consistent product quality, strong and durable. Imported epoxy resin, high-quality stainless steel, more resistant to acid and alkali corrosion, steel needle isolation, never electrolysis.

It has multi-directional protection functions for power lines, ground lines, and signal lines to prevent damage caused by reverse connection and wrong connection.

It added TVS, a transient protection diode, which has been protected against lightning.

2. Product Features

1. Easy measurement

Soil moisture and temperature testing are no longer limited to laboratories and professionals, and can be measured by inserting into the soil.

2. Low measurement cost

Compared with traditional laboratory measurement, this product has low cost, fewer steps, no reagents required, and unlimited testing times.

3. High precision

High accuracy, fast speed, can reach accuracy within 3-5%, increase stability.

4. Portable measurement

Convenient to carry, can be read by inserting the soil, can grasp the soil condition at any time, make the soil fertility balanced, and reach the suitable growth environment of the plant.

3. Product application

It is suitable for water-saving agricultural irrigation, greenhouses, flowers and vegetables, grassland pastures, soil measurement, plant cultivation, scientific experiments, underground oil transportation, gas pipelines and other pipeline anti-corrosion monitoring.

4. Product Parameter

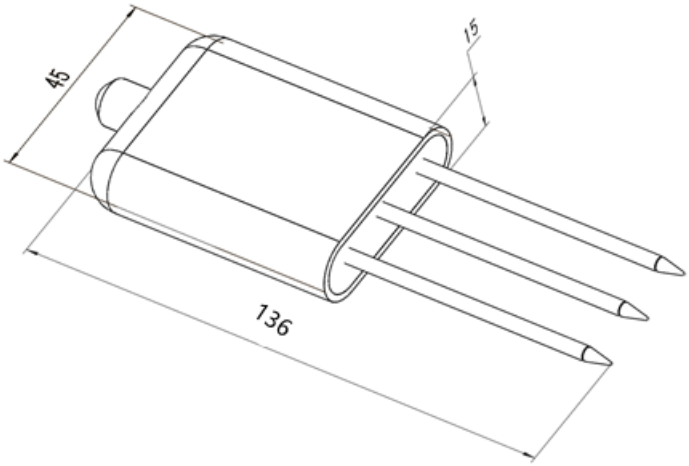
1. Technical Parameters

- Measurement parameters: soil moisture and temperature
- Measuring range
  - Temperature: -40° C~80° C
  - Moisture: 0~100% RH
- Measurement accuracy:
  - Temperature: ±0.5° C
  - Moisture: 0-50%, ±2%; 53%-100%, ±3%
- Resolution:
  - Temperature: 0.01℃
  - Moisture: 0.01%RH
- Measuring principle
  - Temperature: RTD thermal element, plus nonlinear correction
  - Moisture: Frequency domain (FDR), plus temperature and conductivity correction
- Response time: ＜1s
- Measuring stable time: ＜2s
- Output signal: RS485 (standard Modbus-RTU protocol, default address: FE)
- Baud rate: 9600/4800/2400bps, default is 9600bps
- Supply voltage: 5-24VDC(2-5V DC can be custom made)
- Quiescent current: peak value <30mA, average <10mA
- Working temperature range: -40° C~80° C

2. Physical parameter

- Sealing material: ABS engineering plastic, epoxy resin, waterproof grade IP68
- Probe Material: Austenitic 316 stainless steel which Anti-rust, anti-electrolysis, salt and alkali resistance, Suitable for all kinds of soil
- Measuring area: centered on the central probe, inside a cylinder with a diameter of 7cm and a height of 10cm
- Cable length: standard 3.5 meters (5-core sheathed wire, UL2464-22AWG-5C), user can customize the length

5. Product Size



6. Connection method

The soil sensor can be connected to various data collectors, data acquisition cards, remote data acquisition modules and other equipment carrying differential inputs.

1. RS485 connection

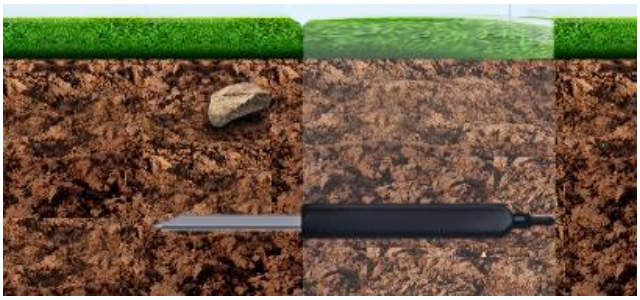
Wire colour	**Interface**
Red	Power positive
Black	Power negative
Yellow	RS485A
White	RS485B

7. Measurement methods

1. Soil Surface measure method

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

2. Buried measure method



- Make a soil profile in the vertical direction, slightly deeper than the installation depth of the bottommost sensor, between 20cm and 50cm in diameter
- Insert the sensor horizontally into the soil profile
- After the installation is completed, the excavated soil is backfilled in order, layered and compacted, and horizontal installation is guaranteed.
- 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

5. Measure Notes

(1). All steel needles must be inserted into the soil during measurement.

(2). Avoid direct sunlight on the sensor, which will cause excessive temperature. Field ambassador use caution against lightning strikes.

(3). Do not bend the steel needle violently, do not pull the sensor lead wire with force, do not beat or violently impact sensor.

(4). The protection grade of the sensor is IP68, which can soak the sensor in water.

(5). Due to the presence of radio frequency electromagnetic radiation in the air, it should not be left in the air for a long time power-on state

8. Data conversion method

1. Standard Modbus-RTU protocol

Baud rate: 9600bps can be set, factory default is 9600bps; Check digit: none;

Data bit: 8; Stop bit: 1

2. Brief description of MODBUS-RTU protocol

1. Function code: the content of the second byte sent by the host. Among them, the function code 03 and 04 are to read the register value; the function code 06 is to write a single register; the function code 16 is to write multiple registers; the function code 17 is to read the device ID. No response to other function codes.

2. Acronym description:

TT: station address, address range 1-255 (factory default 254, 0xFE);

SS: start address, 2 bytes, high byte first;

NN: number of registers (NN≤11), 2 Byte, high byte first;

MM: number of bytes, 1 byte;

RR: register address, a group of 2 bytes, high byte first;

VV: register value, a group of 2 bytes, high byte Before;

CRC: CRC check code;

? ? :version number

1) 03, 04 function codes, read single (or multiple) registers (read up to 8 registers at a time)

Host sends: TT 03 SS SS NN NN CRC1 CRC2, 8 bytes,

Slave response: TT 03 MM VV VV. . . CRC1 CRC2, up to 21 bytes

2) 06 function code, write a single register

Host sending: TT 06 RR RR VV VV CRC1 CRC2, 8 bytes

Slave response: TT 06 RR RR VV VV CRC1 CRC2, 8 bytes

3) 16 (0X10) function code, write multiple registers

Host sending: TT 10 SS SS NN NN MM VV VV .. .. CRC1 CRC2, up to 9+16=25 bytes

Slave response: TT 10 SS SS NN NN CRC1 CRC2, 8 bytes

4) 17 (0X11) function code, read the device ID

Host sending: TT 11 CRC1 CRC2, 4 bytes

Slave response: TT 11 0B "SMET-3A-485??" CRC1 CRC2, 19 bytes

3. Communication protocol examples and explanations

1. For example, to get the value in the sensor address 01:

Host sends: 01 03 00 00 00 02 C4 0B

The meaning of the data:

01-station address 01;

03-function code;

0000-register start address;

0002-read 2 registers;

C40B-CRC check code

Sensor response: 01 03 04 0A D6 08 63 5F FA

The meaning of the data:

01-station address 01;

03-function code;

04-byte number, indicating that there are 4 bytes of data behind;

0AD6- converted to decimal is 2774, divided by 100 is equal to 27.74, representing 27.74% moisture;

0863- converted to decimal It is 2147, divided by 100 equals21.47, which means that the temperature is 21.47°C;

5FFA-CRC code

Note: The FE is the broadcast address (universal address), if you forget the present sensor address, you can use the broadcast address FE to obtain the value:

FE 03 00 00 00 02 D0 04 to obtain sensor moisture, temperature data.

2. Example of setting address

For example, change the sensor address from 01 to 02, need send the following instruction:

Host send: 01 06 02 00 00 02 09 B3

The meaning of the data:

01-present sensor address 01;

06-function code;

0200-register address;

0002-set new address 02

09 B3-CRC check code.

If success, it will feedback: 01 06 02 00 00 02 09 B3

Note: If you forget the present sensor address value, you can check the sensor address by the following instruction:

Host sends: FE 03 02 00 00 01 91 BD

If feedback: FE 03 02 00 01 6D 90

It mean the sensor address is 01.

5. Sensor internal register address table:

Register address:	Register address HEX:	Content	Read and write	Value range	Function code	Numerical meaning	Note
00	00	Soil moisture	Read only	0-10000	3/4	0.00-100.00%	
01	01	Soil temperature	Read only	-4000-+8000	3/4	-40.00℃~80.00℃*	
02	02	Reserve	Read only	0	3/4		
03	03	Reserve	Read only	0	3/4		
04	04	Original AD value of moisture	Read only	0-65535	3/4	Original AD value of moisture	
05	05	Reserve	Read only	0	3/4		
06	06		Read only	0-65535	3/4	0-65535	Factory use
07	07		Read only	0-65535	3/4	0-65535	Factory use
37	0X26	Soil Moisture Coefficient Correction	Read and write	-1000~2000	3/6/16	-1.000~+2.000	0
38	0X27	Soil moisture addition and subtraction correction	Read and write	-2000~2000	3/6/16	-20.00%~+20.00%	0
512	0X200	Sensor address	Read and write	1-255	3/6/16	MODBUS station address,	
513	0X201	Baud rate	Read and write	0-5	3/6/16	0-1200 1-2400 2-4800 3-9600, Default 4-19200 5-38400	
514	0X202	Parity check	Read and write	0,1,2	3/6/16	0-no check, default 1- odd parity 2-even parity	
515	0X203	Receive stop bit	Read and write	0,1	3/6/16	0-1 stop bit, default 1-2 stop bits	
516	0X204	Send stop bit	Read and write	0,1	3/6/16	0-1 stop bit 1-2 stop bits, default	

Note: Serial communication is a fixed 8-bit data bit

Soil EC Sensor Introduce

Type NO.: RD-SE-P-O

1. Product Introduce

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

The part of soil conductivity is converted into analog or digital signal of soil conductivity by stainless steel probe through sensor. In the development process, the conductivity value is converted into corresponding analog or digital signal. After the conductivity sensor is embedded in soil, the conductivity of soluble salt ions in soil solution can be directly measured.

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 EC

(2) Unit of measurement: μ S/cm

(3) EC range: 0-20000us/cm , (can be customized 0 ~ 2000 μ S/cm, 0 ~ 10000 μ S/cm,);

(4) Measurement accuracy: ±2%

(5) Working range: -30 ° C ~ 70 ° C

(6) 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)

(7) 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)

(8) Stabilization time: <1 second

(9) Response time: <1 second

(10) 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, φ3mm

(2) Probe material: 316L stainless steel;

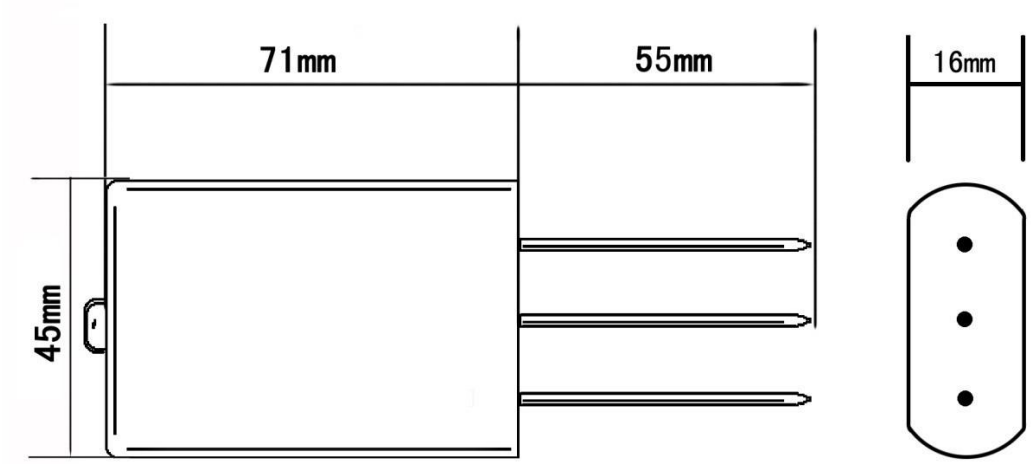
(3) Sealing material: ABS engineering plastic, epoxy resin, waterproof grade IP68

(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	125Ω	250Ω	500Ω	>500Ω

5. Product size



6. Connection diagram

1. For the RS485 output

Colour	Description	Note
Red	Power positive	5-24 V DC
Black	GND	GND
Yellow	485-A	485-A
Green	485-B	485-B

2. For the 0-10V output

Colour	Description	Note
Red	Power positive	12-24V DC
Black	GND	GND
Yellow	Temperature voltage output	GND is the negative output
Green	EC voltage output	

7. Measurement methods

1. Surface speed test

(1) Select a representative soil environment to clean up surface debris and vegetation

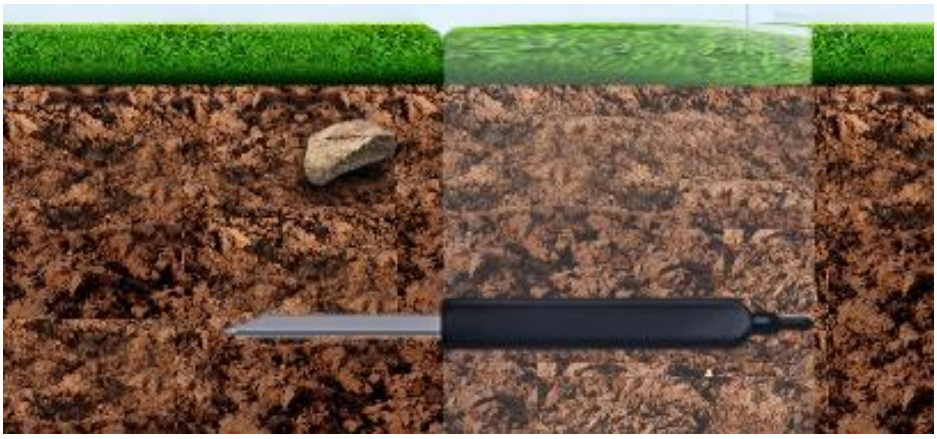
(2) Insert the sensor vertically and completely into the soil

(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



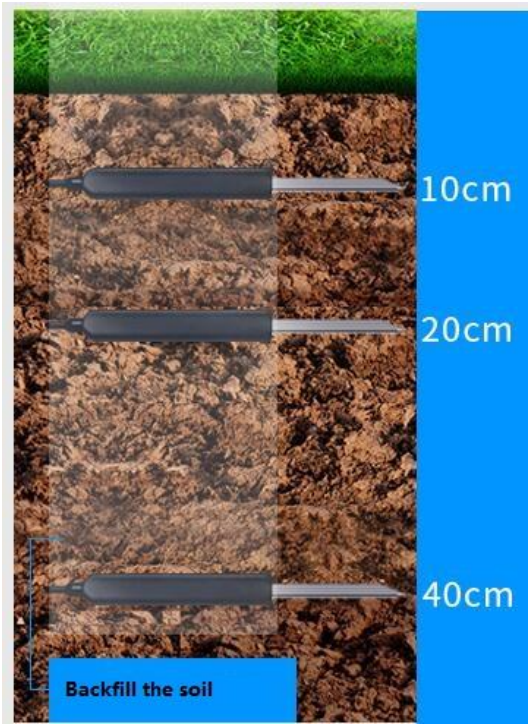
(1) Make a soil profile in the vertical direction, slightly deeper than the installation depth of the bottommost sensor, between 20cm and 50cm in diameter

(2) Insert the sensor horizontally into the soil profile

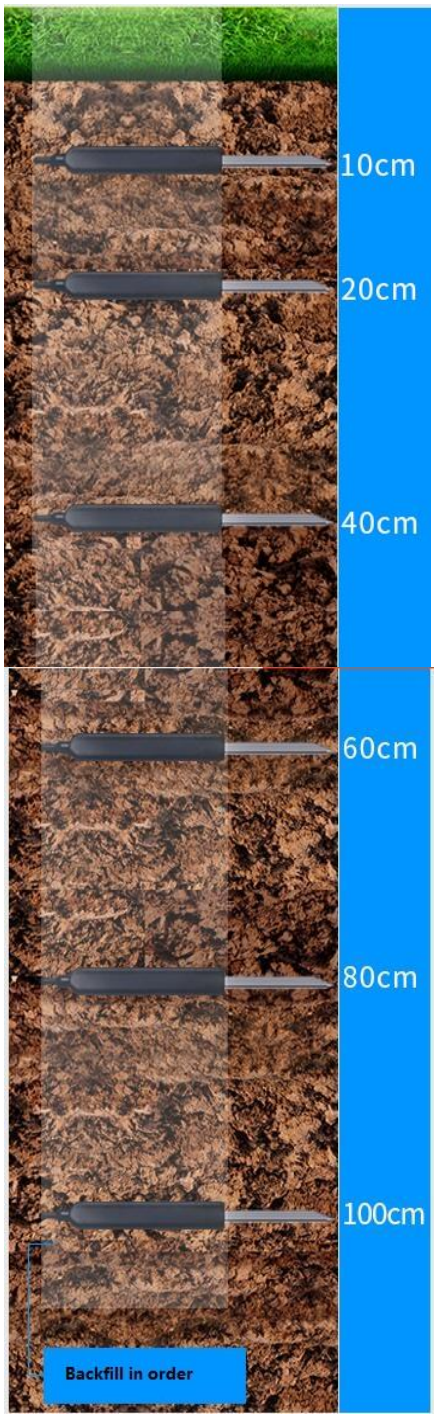
(3) After the installation is completed, the excacated soil is backfilled in order, layered and compacted, and horizontal installation is guaranteed.

(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 EC sensor has good linear characteristics in the range of soil saturated water content.

1. Current voltage analog output

EC: soil EC

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

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

Output signal	EC conversion method (0 ~ 20000us/cm)
0 ~ 2V DC	EC = 10000*V
0 ~ 5V DC	EC = 4000*V
0 ~ 10V DC	EC = 200*V
4 ~ 20mA	T = 1250*A – 5000

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 EC	Read only	Real-time value of soil moisture value
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 EC) , 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	0X01	0X84	0X0A

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

Address	0X01		
Function code	0X03		
Data length	0X02		
Register 0 data high	0X01	Soil EC: hexadecimal to decimal	Soil EC: 356us/cm
Register 0 data low	0X64		
Low CRC16	0XB8		
High CRC16	0X3F		

Change the HEX(0164) to decimal(356), so the soil EC=356us/cm.

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.

Soil PH and temperature 2 in 1 sensor AgCl type Introduce

Type: SPHA-RD-01

1. Product Introduce

The new soil PH sensor, based on the latest research results, is developed using solid AgCl reference electrode and pure metal PH sensitive electrode. It has the characteristics of high measurement accuracy and long-term stable signal, which can replace glass electrodes. In addition, the isolation circuit design is suitable for burying in soil for long-term online measurement.

The PH sensor has temperature compensation inside, which can realize the pH value stabilization within a certain temperature range.

It has multi-directional protection functions for power lines, ground lines, and signal lines to prevent damage caused by reverse connection and wrong connection.

2. Product Features

1. Easy measurement

Soil PH testing is no longer limited to laboratories and professionals, and can be measured by inserting into the soil.

2. Low measurement cost

Compared with traditional laboratory measurement, this product has low cost, fewer steps, no reagents required, and unlimited testing times.

3. High precision

High accuracy, fast speed, can reach accuracy within 0.25, increase stability.

4. Portable measurement

Convenient to carry, can be read by inserting the soil, can grasp the soil condition at any time, make the soil fertility balanced, and reach the suitable growth environment of the plant.

3. Product Parameter

1. Technical Parameters

※Working voltage: /L: 2 ~ 5V (Max 6V)

※Working voltage: 5 ~ 24V (Max 26.7V)

※Quiet current: measured peak value <50mA, average <2mA.

※Response time: 2 ~ 15 seconds (adaptive)

※Measurement stabilization time: 30 minutes to 24 hours

※Protection level: IP68

※Working temperature range: -10℃ ~ 70℃,

※Cable length: standard 3.5 meters (2464-5C)

2. Measurement parameter (PH)

※Measurement range: 3-10

※Output signal: RS-485/RS-232/UART, MODBUS-RTU protocol

※Measurement accuracy: <0.25

※Exchange accuracy: <0.25

※Re-test error: <0.2

※Temperature compensation range: 0-50℃

3. Measurement parameter (temperature)

※Measuring range: -40℃ ~ 85℃

※Output signal: RS-485/UART, MODBUS-RTU protocol

※Measurement accuracy: <±0.4℃ (10℃ ~ 40℃), <±0.6℃ (other)

※Interchangeability: <0.5℃ (-10℃ ~ 70℃)

※Re-test error: <0.1℃

4. Product size

4. Connection diagram

Wire colour	Interface
Red	Power positive
Black	Power negative
Yellow	RS485A
White	RS485B

5. Measurement methods

1. Preparation before measurement

It should be placed in pure water for 24 hours to activate before being placed in the air for more than 7 days. If it is not activated, it should be pre-buried in the soil for at least 24 hours to ensure measurement accuracy.

2. Quick measurement method

Select a place where the soil is relatively soft and moist, and pave the surface soil according to the required measurement depth. It is best to wet the measurement point with distilled water, purified water or rainwater to form a slurry, pick out the rocks, and then Insert the probe into the soil gently and slowly,

remember not to use excessive force, make sure that the probe does not touch hard objects such as rocks, and do not shake back and forth when inserting. After inserting, pile up the soil to cover the sensor body and fix it, after stabilizing for a period of time, the PH can be measured.

3. Buried measurement method

Dig a pit of appropriate diameter vertically to the depth as required for measurement, then bury the sensor at the bottom of the pit according to the rapid measurement method, and then fill and compact the pit. After stabilizing for a period of time, you can perform continuous measurement and recording for several days, months or even longer.

4. Precautions

1. The PH-sensitive electrode metal is very brittle and has low strength. Avoid force and impact. After being buried in the soil for a long time (3 months to half a year), the electrodes need to be cleaned. They can be lightly polished with high-grade sandpaper, or washed with 5% hydrochloric acid and soaked for a few minutes. The metal turns silver as bright as new, and then rinsed with pure water.

2. The non-metallic probe of the reference electrode is relatively thin, and the strength is not high, so force and impact should be avoided.

3. When the reference electrode is not in use, it should be kept moist.

4. Do not touch oily substances between the two electrodes to avoid oil film covering and blocking the electrical circuit.

5. The sensor's protection grade is IP68, so the entire sensor can be soaked in water.

6. RS485 Communication protocol

1. Communication parameter setting

1.The RS-485 interface is a physical interface, and the communication line is generally bus type, and all communication stations are connected to the 485 bus. The communication protocol adopts the MODBUS-RTU protocol, which is a master-slave protocol. There is a master station and multiple slave stations on a bus. The communication parameters between each station must be consistent, including baud rate, data bits, and parity. Check mode and number of stop bits. The station address of each slave station must be different, otherwise it will cause the slave station response conflict.

2. Brief description of MODBUS-RTU protocol

1. The function code is the description: the content of the second byte sent by the host, among which the 03 and 04 function codes are to read the register value; the 06 function code is to write a single register; the 16 function code is to write multiple registers; the 17 function code is to read Get the device ID. No response to other function codes.

2. Acronym description: TT: module address, address range 1-255; SS: register start address, 2 bytes, high byte first; NN: number of registers (NN≤8), 2 bytes, high byte First; MM: number of bytes, 1 byte; RR: register address, a group of 2 bytes, high byte first; VV: register value, a group of 2 bytes, high byte

first; CRC: CRC Check code;? ? :version number

1) 03, 04 function codes, read single (or multiple) registers (read up to 8 registers at a time)

Host request: TT 03 SS SS NN NN CRC1 CRC2, 8 bytes,

Slave response: TT 03 MM VV VV. . . CRC1 CRC2, up to 21 bytes

2) 06 function code, write a single register

Host request: FF 06 RR RR VV VV CRC1 CRC2, 8 bytes

Slave response: FF 06 RR RR VV VV CRC1 CRC2, 8 bytes

3) 16 (0X10) function code, write multiple registers

Host request: FF 10 SS SS NN NN MM VV VV .. .. CRC1 CRC2, up to 9+16=25 bytes

Slave response: FF 10 SS SS NN NN CRC1 CRC2, 8 bytes

4) 17 (0X11) function code, read the device ID

Host request: TT 11 CRC1 CRC2, 4 bytes

Slave response: TT 11 0B “SMTS-II-485??” CRC1 CRC2, 19 bytes

3. For example:

To get the sensor PH value in the address 01:

Host sends: 01 03 00 00 00 03 05 CB

The meaning of the data:

01-sensor address 01;

03-function code;

0000-register starting address;

0003-read 3 registers

05 CB-CRC code

Sensor response: 01 03 06 02 B7 00 46 00 FE B4 D8

The meaning of the data:

01-station address 01;

03-function code;

06-byte number;

02B7- converted to decimal is 695, divided by 100 is equal to 6.95, indicating that the PH value is 6.95;

046- converted to decimal is 70, divided If 10 is equal to 7.0, the PH value is 7.0;

00FE- converted to decimal is 254, divided by 10 is equal to 25.4, which means the temperature is 25.4°C.

B4 D8-CRC check code

Note: The FE is the broadcast address (universal address), if you forget the present sensor address, you can use the broadcast address FE to obtain the value:

FE 03 00 00 00 04 50 06 to obtain sensor PH value.

4. Example of setting address

For example, change the sensor address from 01 to 02, need send the following instruction:

Host send: 01 06 02 00 00 02 09 B3

The meaning of the data:

01-present sensor address 01;

06-function code;

0200-register address;

0002-set new address 02

09 B3-CRC check code.

If success, it will feedback: 01 06 02 00 00 02 09 B3

Note: If you forget the present sensor address value, you can check the sensor address by the following instruction:

Host sends: FE 03 02 00 00 01 91 BD

If feedback: FE 03 02 00 01 6D 90

It mean the sensor address is 01.

3. Register address

Register address:	Register address HEX:	Content	Read& Write	Value range	Applicable function code	Numerical meaning
00	00	High resolution PH value	Read only	0~1400	3/4	0.00-14.00，Resolution 0.01
01	01	Low resolution PH value	read only	0~140	3/4	0.0~14.0，Resolution 0.1
02	02	Temperature	read only	-400~800	3/4	-40.0℃~80.0℃
03	03	PH electrode millivolt value	read only	-20000~+20000	3/4	0 ~ ±2000.0mV
04	04	Reserve	read only	0	3/4	
05	05	Reserve	read only	0	3/4	
06	06	High resolution PH value	read only	100-1400	3/4	PH1.00~PH14.00
10	0A	User calibration	Read & Write	0,4,6,9,15	3/4/6/16	
13	0D	Low resolution PH value	read only	10-140	3/4	PH1.0~PH14.0
512	0X200	Sensor address	Read & Write	1-255	3/4/6/16	Factory set to 254
513	0X201	Baud rate	Read & Write	0-5	3/4/6/16	0-1200 1-2400

						2-4800 3-9600，default 4-19200 5-38400
514	0X202	Parity check	Read & Write	0,1,2	3/4/6/16	0-no check, default 1- odd parity 2-even parity
515	0X203	Stop bit	Read & Write	0,1	3/4/6/16	0-1 stop bit, default 1-2 stop bits
523	0X20B	Product serial number 1	read only	0-65535	3/4	Reserved
524	0X20C	Product series number 2	read only	0-65535	3/4	Reserved

Note: Serial communication is a fixed 8-bit data bit.

4. Calibration instruction

This sensor supports user calibration, but it is limited to the calibration of three PH standard solutions of 4.00, 6.86, and 9.18, which are available on the market. Before calibration, clean the electrode and put it in the PH standard solution. Observe that the signal is stable. The immersion time of the newly cleaned electrode may take up to 24 hours to stabilize. When the signal is stable, the calibration can be performed. When calibrating, write a calibration command to register 10, see the following table:

For example, for the sensor address of the 01, the calibration as following:

PH standard solution	Value written to register 10	Write command data string	Reading value after calibration of register 10
4.00	4	01 06 00 0A 00 04 A8 0B	41
6.86	6	01 06 00 0A 00 06 29 CA	61
9.18	9	01 06 00 0A 00 09 69 CE	91
Restore factory value	15	01 06 00 0A 00 0E 28 0C	151

7 in 1 soil parameters monitor sensor

HONDE TECHNOLOGY CO,LTD

1. Product Introduce

The sensor has stable performance and high sensitivity, and can simultaneously monitor soil temperature, humidity, conductivity, salinity, nitrogen, phosphorus, and potassium data. It is an important tool for observing and studying the occurrence, evolution, improvement, and water and salt dynamics of saline soil. 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. By measuring the electrical conductivity of the soil, the salinity reflects the salinity of the soil in time, and by measuring the nitrogen, phosphorus and potassium content of the soil, it reflects the nutrient status of the soil in time, providing a data basis for scientific planting.

2. Product Features

1. The seven parameters of soil water content, electrical conductivity, salinity, temperature and nitrogen, phosphorus and potassium are combined into one.

2. Low threshold, few steps, fast measurement, no reagents, unlimited detection times.

3. It can also be used for the conductivity of water and fertilizer integrated solutions, and other nutrient solutions and substrates.

4. The electrode is made of specially processed alloy material, which can withstand strong external impact and is not easy to damage.

5. Completely sealed, resistant to acid and alkali corrosion, can be buried in soil or directly into water for long-term dynamic testing.

6.High precision, fast response, good interchangeability, probe plug-in design to ensure accurate measurement and reliable performance.

3. Product application

The sensor 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.

4. Product Parameter

1. Technical Parameters

- Measurement parameters: soil moisture and temperature and EC and salinity and NPK
- Measuring range
  - Temperature: -40° C~80° C
  - Moisture: 0~100% RH
  - EC:0~20000μs/cm

- Salinity:0~10000ppm
- NPK: 1-1999 mg/kg(mg/L)

➢ Measurement accuracy:

- Temperature: ±0.5° C
- Moisture: 0-50%, ±2%; 53%-100%, ±3%
- EC: ±3%
- Salinity: ±3%
- NPK: ±2%FS

➢ Resolution:

- Temperature: 0.1℃
- Moisture: 0.1%RH
- EC: 1 us/cm
- Salinity:1ppm
- NPK: 1 mg/kg(mg/L)

➢ Response time: ＜15s

➢ Conductivity temperature compensation: Built-in temperature compensation sensor, compensation range 0-50 ℃

➢ Output signal: RS485 (standard Modbus-RTU protocol, default address: 01)

➢ Baud rate: 9600/4800/2400bps, default is 9600bps

➢ Supply voltage: 5 ~ 30V DC

➢ Power consumption≤0.15W（@12V,25 ° C）

➢ Working temperature range: -40° C~80° C

➢ Working humidity range: 0-100% (Relative humidity, non-condensing)

➢ Protect level: IP68

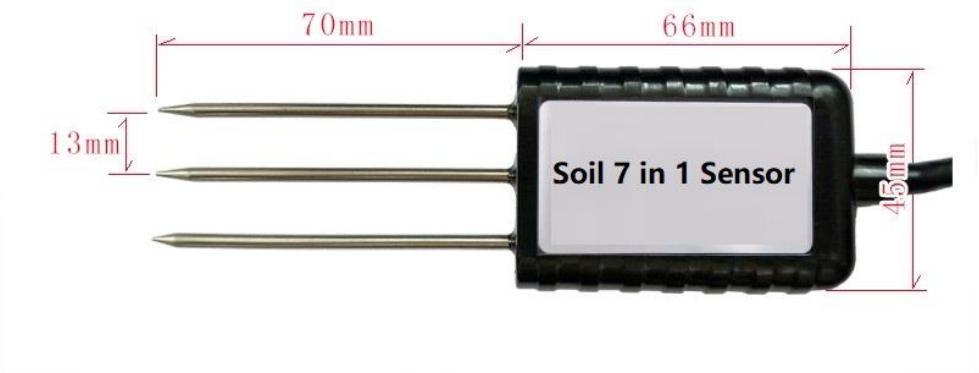
2. Physical parameter

➢ Sealing material: ABS engineering plastic, epoxy resin, waterproof grade IP68

➢ Probe Material: Austenitic 316 stainless steel which Anti-rust, anti-electrolysis, salt and alkali resistance, Suitable for all kinds of soil

➢ Low power consumption, high sensitivity, signal stabilization

5. Product Size



6. Connection method

The wide voltage power input can be 5~30V. When connecting the RS485 signal line, please note that the two lines of A/B cannot be reversed, and the addresses of multiple devices on the bus must not conflict. RS485 connection

M12 PIN NO.	Wire colour	Interface
1	Brown	Positive power(5-30VDC)
2	Black	GND
3	Yellow	RS485 A
4	White	RS485 B

7. Measurement methods

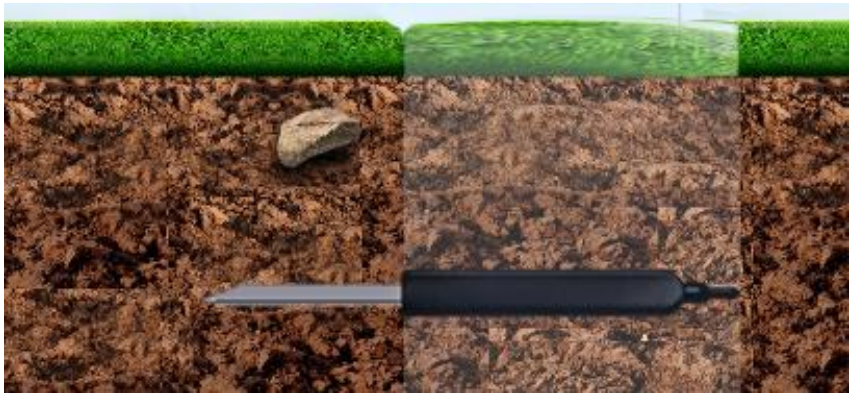
Since the electrode directly measures the conductivity of the soluble salt ions in the soil, the soil volumetric water content must be higher than about 20% when the soluble ions in the soil can accurately reflect the conductivity of the soil. In the long-term observation, the measured value after irrigation or rainfall is closer to the true level. If you are performing a quick test, you can water the soil to be tested first, and perform the measurement after the water is fully penetrated.

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

1. Soil Surface measure method

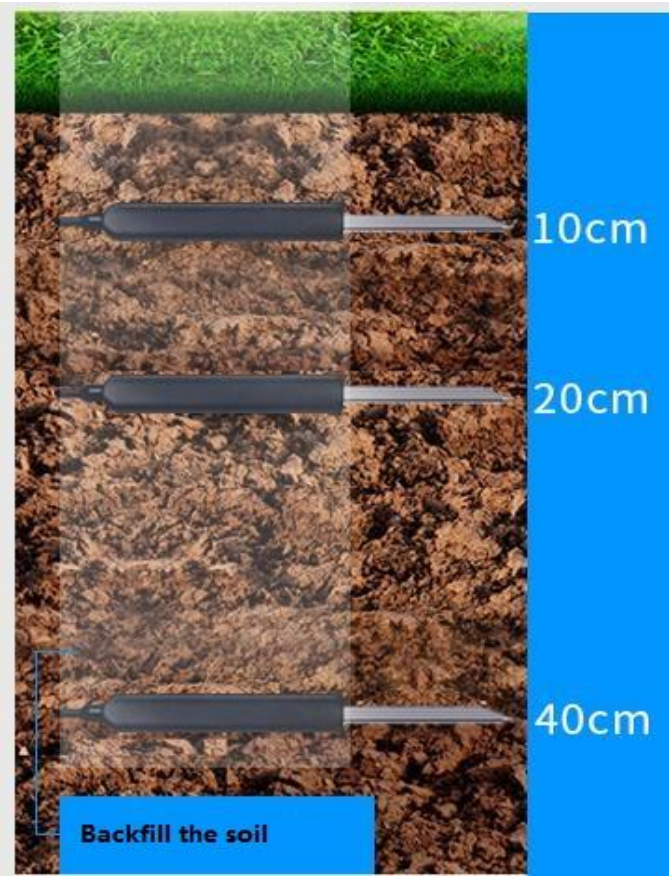
- Select a representative soil environment to clean up surface debris and vegetation
- Insert the sensor vertically and completely into the soil
- If there is a hard object, the measurement location should be replaced and re-measured
- For accurate data, it is recommended to measure multiple times and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

2. Buried measure method

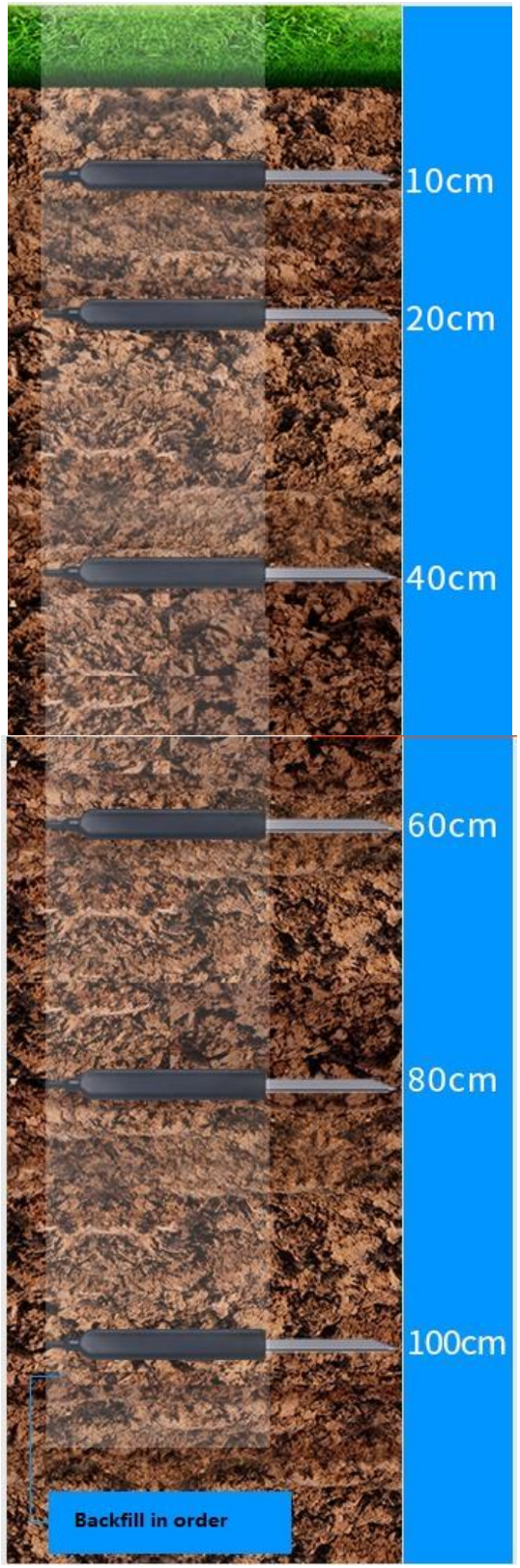


- Make a soil profile in the vertical direction, slightly deeper than the installation depth of the bottommost sensor, between 20cm and 50cm in diameter
- Insert the sensor horizontally into the soil profile
- After the installation is completed, the excavated soil is backfilled in order, layered and compacted, and horizontal installation is guaranteed.
- 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



1. Measure Notes

(1). All steel needles must be inserted into the soil during measurement.

(2). Avoid direct sunlight on the sensor, which will cause excessive temperature. Field ambassador use caution against lightning strikes.

(3). Do not bend the steel needle violently, do not pull the sensor lead wire with force, do not beat or violently impact sensor.

(4). The protection grade of the sensor is IP68, which can soak the sensor in water.

(5). Due to the presence of radio frequency electromagnetic radiation in the air, it should not be left in the air for a long time power-on state

8. Data conversion method

1. 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

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 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

Function code: The command function instruction issued by the host. The transmitter uses function codes 0x03 (read register data) and 0x06 (write register data).

Data area: The data area is the 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

3. Register address

Register	PLC or configuration	Content	Operation	Definition description

address	address			
0000 H	40001 (Decimal)	Soil Moisture	Read only	Real-time value of water content (expand 100 times)
0001 H	40002 (Decimal)	Soil Temperature	Read only	Real-time temperature value (enlarge 100 times)
0002 H	40003 (Decimal)	Soil EC	Read only	Real-time conductivity
0003H	40004 (Decimal)	Nitrogen content	Read only	Real-time value of nitrogen content
0004H	40005 (Decimal)	Phosphorus content	Read only	Real-time value of phosphorus content
0005 H	40006 (Decimal)	Potassium content	Read only	Real-time value of potassium content
0006 H	40007 (Decimal)	Salinity	Read only	Salinity real-time value
0026H	40039(Decimal)	Soil Moisture Coefficient Calibration	Read/Write	Coefficient range -1.000~+2.000
0027H	40040(Decimal)	Soil Moisture offset calibration	Read/Write	Calibration range -20.00%~+20.00%
0028H	40041(Decimal)	Soil EC Coefficient Calibration	Read/Write	Coefficient range -1.000~+2.000
0029H	40042(Decimal)	Soil EC offset calibration	Read/Write	Calibration range -2000us/cm~2000us/cm
0200 H	40513 (Decimal)	Device address	Read and write	1~255
0201 H	40514 (Decimal)	Device baud rate	Read and write	0-1200 1-2400 2-4800 3-9600, default 4-19200 5-38400

4.Communication protocol examples and explanations

1. Modify the address, for example: change the address of the transmitter with address 1 to 2, host → slave

Original address	Function code	Register address low	Register address high	New address low	New address high	CRC16 low	CRC16 high
0X01	0X06	0X02	0X00	0X00	0X02	0X09	0XB3

If success, the slave will send: 01 06 02 00 00 02 09 B3

Note: If you forget the present sensor address value, you can check the sensor address by the following instruction:

Host sends: FE 03 02 00 00 01 91 BD

If feedback: FE 03 02 00 01 6D 90

It mean the sensor address is 01.

Note: The FE is the broadcast address (universal address), if you forget the present sensor address, you can use the broadcast address FE to obtain the sensor address.

(2) Read soil Moisture &Temperature & EC & N & P & K & Salinity at device address 0x01

➢ Inquiry frame

Address code	Function code	Register start address	Register length	Low check bit	Check code high
0X01	0X03	0X00 0X00	0X00 0X07	0X04	0X08

➢ Response frame

Address code	Function code	Number of valid bytes	Data area							Low check bit	High Check bit
			Moisture	Temp	EC	N	P	K	Salinity		
0X01	0X03	0X0E	0x27 0X10	0x05 0XD9	0x01 0XDB	0x00 0X3F	0x00 0X19	0x00 0X9A	0x00 0XED	0XF1	0X62

Calculation instructions:

Moisture: 2710(hexadecimal) = 10000 (Decimal) => Moisture = 100.00%

Temperature: 05D9(hexadecimal)= 1497(Decimal) => Temperature = 14.97℃

EC: 01DB(hexadecimal) = 475(Decimal) => EC = 475us/cm

N:003F((hexadecimal) = 63(Decimal) => N = 63mg/KG

P:0019(hexadecimal) = 25(Decimal) => P = 25mg/KG

K:009A(hexadecimal) = 154(Decimal) => K = 154mg/KG

Salinity:00ED(hexadecimal) = 237(Decimal) => Salinity= 237ppm

Note: When the temperature is lower than 0 degrees, the complement code is used

➢ Example: Write the coefficient to change the EC content of the device address 0x01

Inquiry frame (hexadecimal): change to 0.933 times the original value, as the original coefficient is 1, then need minus 0.067 in the coefficient, then , write -67=FFBD(HEX)

Address	Function code	Start address	EC content coefficient	Check code low	Check code high
0x01	0x06	0x00 0x28	0XFF 0XBD	0x88	0X43

Response frame (hexadecimal): If success, it will feedback: 01 06 00 28 FF BD 88 43

Example: Write the offset data to change the EC value in the device address 01

Inquiry frame, for example add 10 to the present EC value, (converted the hexadecimal data is 00 0A)

Address	Function code	Start address	EC content coefficient	Check code low	Check code high
0x01	0x06	0x00 0x29	0x00 0X0A	0XD8	0X05

Response frame (hexadecimal): If success, it will feedback: 01 06 00 29 00 0A D8 05

9. Common problems and solutions

The device cannot be connected to the PLC or computer possible reason:

1. The computer has multiple COM ports and the selected port is incorrect.

2. The device address is wrong, or there are devices with duplicate addresses.

3. The baud rate, check method, data bit and stop bit are wrong.

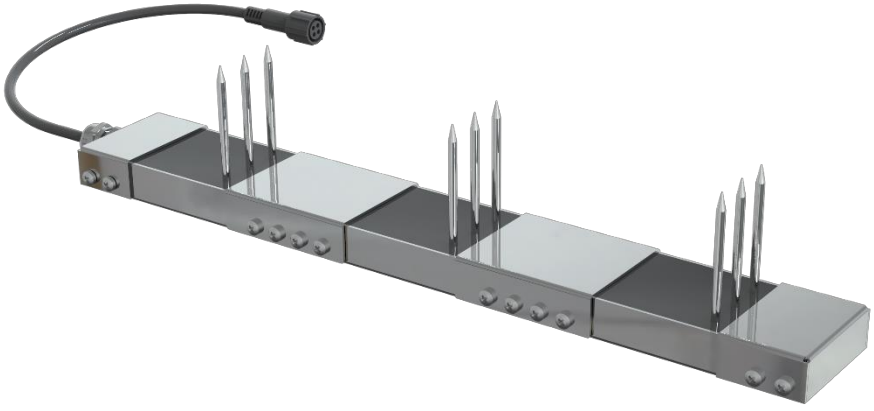
4. The 485 bus is disconnected, or the A and B wires are connected reversely.

5. If the number of equipment is too large or the wiring is too long, power should be supplied nearby, and a 485 booster should be added and a 120Ω terminal resistance should be added at the same time.

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

7. The equipment is damaged.

Multilayer soil parameter monitor sensor



HONDE TECHNOLOGY CO,LTD

1. Product Introduce

Multi-soil layer soil parameter monitor is a sensor developed by our company that can measure soil parameters of multi-soil layer. It can dynamically observe the soil electrical conductivity, moisture content, soil temperature state and the content of nitrogen, phosphorus and potassium in the soil at different levels. This detector can detect the soil electrical conductivity, temperature, humidity, nitrogen, phosphorus and potassium status of 3 layers, which can quickly and comprehensively understand Collect soil parameter information. The product adopts standard Modbus-RTU485 communication, which can communicate up to 2000 meters, and supports secondary development.

The product shell is made of stainless steel, completely sealed with black flame-retardant epoxy resin, resistant to acid and alkali corrosion, and can be buried in the soil for long-term dynamic testing.

2. Product Features

1.Able to dynamically observe the soil conductivity, moisture content and temperature status NPK values at different levels.

2. Completely sealed, resistant to acid and alkali corrosion, can be buried in the soil or directly into the water for long-term dynamic detection.

3.The electrode adopts specially treated alloy materials, which can withstand strong external impact and is not easy to damage.

4.High precision, fast response, good interchangeability, probe insertion design ensures accurate measurement and reliable performance.

3. Product application

The product is suitable for soil moisture monitoring, scientific experiments, water-saving irrigation, greenhouses, flowers and vegetables, grassland pastures, rapid soil testing, plant cultivation, sewage treatment, precision agriculture, etc.

4. Product Parameter

1. Technical Parameters

- Measurement parameters: soil moisture and temperature and EC and salinity and NPK
- Measuring range
  - Temperature: -40° C~80° C
  - Moisture: 0~100% RH
  - EC:0~20000μs/cm
  - Salinity:0~10000ppm
  - NPK: 1-1999 mg/kg(mg/L)
- Measurement accuracy:

- Temperature: ±0.5° C
- Moisture: 0-50%, ±2%; 53%-100%, ±3%
- EC: ±3%
- Salinity: ±3%
- NPK: ±2%FS

➢ Resolution:

- Temperature: 0.1℃
- Moisture: 0.1%RH
- EC: 1 us/cm
- Salinity:1ppm
- NPK: 1 mg/kg(mg/L)

➢ Response time: ＜15s

➢ Conductivity temperature compensation: Built-in temperature compensation sensor, compensation range 0-50 ℃

➢ Output signal: RS485 (standard Modbus-RTU protocol, default address: 01)

➢ Baud rate: 9600/4800/2400bps, default is 9600bps

➢ Supply voltage: 5 ~ 30V DC

➢ Power consumption≤0.15W（@12V,25 ° C）

➢ Working temperature range: -40° C~80° C

➢ Working humidity range: 0-100% (Relative humidity, non-condensing)

➢ Protect level: IP68

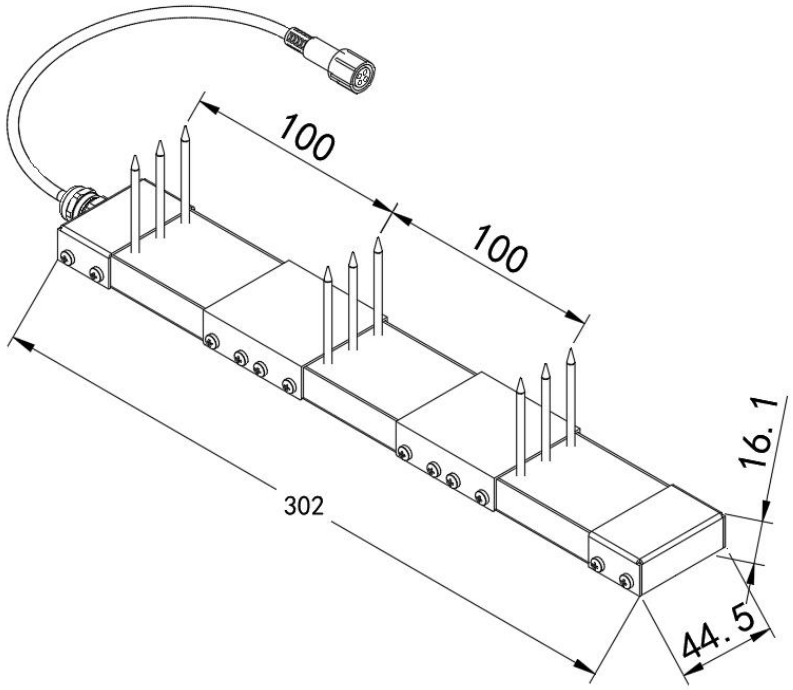
2. Physical parameter

➢ Sealing material: ABS engineering plastic, epoxy resin, waterproof grade IP68

➢ Probe Material: Austenitic 316 stainless steel which Anti-rust, anti-electrolysis, salt and alkali resistance, Suitable for all kinds of soil

➢ Low power consumption, high sensitivity, signal stabilization

5. Product Size



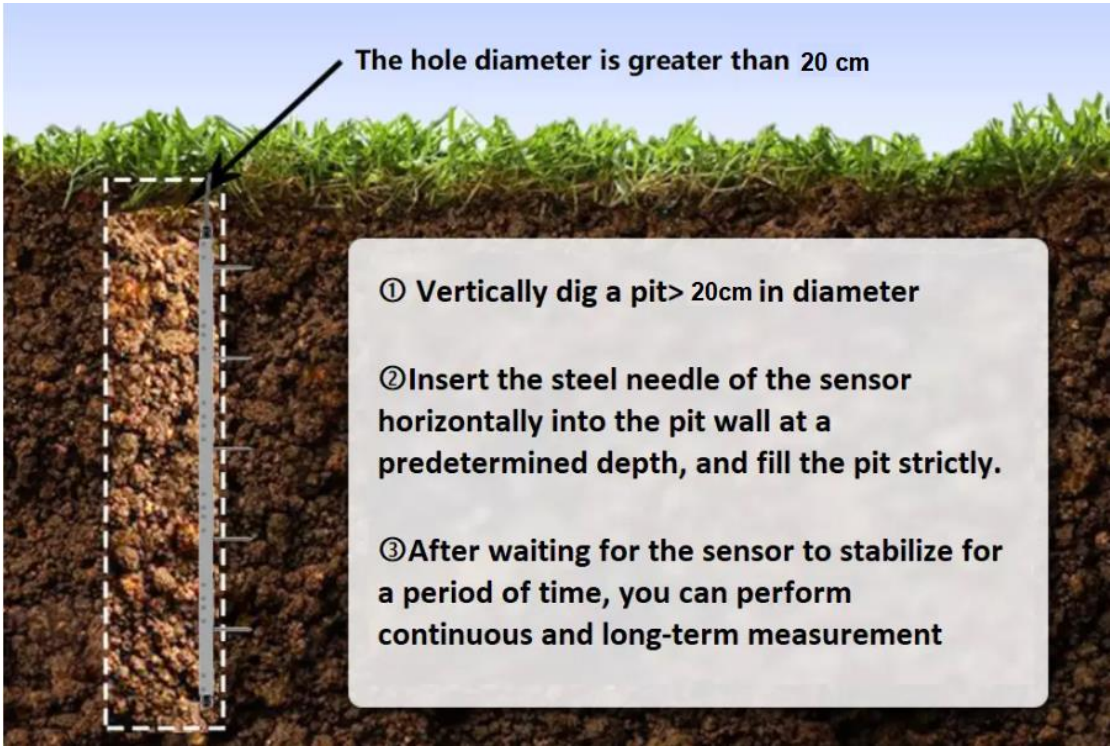
6. Connection method

The wide voltage power input can be 5~30V. When connecting the RS485 signal line, please note that the two lines of A/B cannot be reversed, and the addresses of multiple devices on the bus must not conflict. RS485 connection

Wire colour	**Interface**
Brown	VCC(5-30VDC)
Black	Ground
Yellow/Green	RS485 A
Blue	RS485 B

7. Measurement methods

Dig a pit> 20cm in diameter vertically, insert the steel needle of the sensor horizontally into the pit wall at a predetermined depth, and fill the pit tightly. After a period of stability, it can be measured and recorded for several days, months or even longer.



1. Measure Notes

(1). All steel needles must be inserted into the soil during measurement.

(2). Avoid direct sunlight on the sensor, which will cause excessive temperature. Field ambassador use caution against lightning strikes.

(3). Do not bend the steel needle violently, do not pull the sensor lead wire with force, do not beat or violently impact sensor.

(4). The protection grade of the sensor is IP68, which can soak the sensor in water.

(5). Due to the presence of radio frequency electromagnetic radiation in the air, it should not be left in the air for a long time power-on state

9. Data conversion method

1. 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

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 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 the top layer is 0X01, the middle layer is 0X02, the bottom layer is 0x03).

Function code: The command function instruction issued by the host. The transmitter uses function codes 0x03 (read register data) and 0x06 (write register data).

Data area: The data area is the 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

3. Register address

According to the device installation method, different soil layers have different ModBus addresses, which are addresses 1-3, the top device address is No. 1, the next layer device address is No. 2, and the bottom device address is No. 3.

Register address	PLC or configuration address	Content	Operation	Definition description
0000 H	40001 (Decimal)	Soil Moisture	Read only	Real-time value of water content (expand 10 times)
0001 H	40002 (Decimal)	Soil Temperature	Read only	Real-time temperature value (enlarge 10 times)
0002 H	40003 (Decimal)	Soil EC	Read only	Real-time conductivity
0003H	40004 (Decimal)	Nitrogen content	Read only	Real-time value of nitrogen content
0004H	40005 (Decimal)	Phosphorus content	Read only	Real-time value of phosphorus content
0005 H	40006 (Decimal)	Potassium content	Read only	Real-time value of potassium content
0006 H	40007 (Decimal)	Salinity	Read only	Salinity real-time value
0022 H	40035 (Decimal)	Conductance temperature coefficient	Read and write	0-100 corresponds to 0.0%-10.0% 0.0% by default
0023 H	40036 (Decimal)	Salinity coefficient	Read and write	0-100 corresponds to 0.00-1.00 Default 55 (0.55)
0024 H	40037 (Decimal)	TDS coefficient	Read and write	0-100 corresponds to 0.00-1.00 Default 50 (0.5)

0050 H	40081 (Decimal)	Temperature calibration value	Read and write	Integer (expand 10 times)
0051 H	40082 (Decimal)	Calibration value of water content	Read and write	Integer (expand 10 times)
0052 H	40083 (Decimal)	Conductivity calibration value	Read and write	Integer
0045 H		Conductivity coefficient High sixteen	Read and write	actual value (IEEE754 standard floating point type)
0046 H		Conductivity coefficient Low sixteen	Read and write	
02E8 H	40475 (Decimal)	Nitrogen content coefficient High sixteen	Read and write	actual value (IEEE754 standard floating point type)
02E9 H	40476(Decimal)	Nitrogen content coefficient Low sixteen	Read and write	
02EA H	40747 (Decimal)	Calibration value of nitrogen content	Read and write	Integer
02F2 H	40755 (Decimal)	Phosphorus content coefficient High sixteen	Read and write	actual value (IEEE754 standard floating point type)
02F3 H	40756 (Decimal)	Phosphorus content coefficient Lower sixteen	Read and write	
02F4 H	40757(Decimal)	Calibration value of phosphorus content	Read and write	Integer
02FC H	40765(Decimal)	Potassium content factor High sixteen	Read and write	actual value (IEEE754 standard floating point type)
02FD H	40766(Decimal)	Potassium content factor Lower sixteen	Read and write	
02FE H	40767(Decimal)	Calibration value of potassium content	Read and write	Integer
07D0 H	42001 (Decimal)	Device address	Read and write	1~254
07D1 H	42002 (Decimal)	Device baud rate	Read and write	0 for 2400 1 for 4800 2 for 9600

4.Communication protocol examples and explanations

(1) Modify the address, for example: change the address of the transmitter with address 1 to 2, host → slave

Original address	Function code	Register address low	Register address high	New address low	New address high	CRC16 low	CRC16 high
0X01	0X06	0X07	0XD0	0X00	0X02	0X08	0X86

If success, the slave will send: 01 06 07 D0 00 02 08 86

(2) Read soil Moisture &Temperature & EC & N & P & K & Salinity at device address 0x01

- Inquiry frame

Address code	Function code	Register start address	Register length	Low check bit	Check code high
0X01	0X03	0X00 0X00	0X00 0X07	0X04	0X08

- Response frame

Address code	Function code	Number of valid bytes	Data area							Low check bit	High Check bit
			Moisture	Temp	EC	N	P	K	Salinity		
0X01	0X03	0X10	0x03 0XA8	0x01 0x11	0x05 0XB3	0x00 0X69	0x00 0X8F	0x01 0X63	0x03 0X22	0X02	0XD9

Calculation instructions:

Moisture: 03A8(hexadecimal) = 936(Decimal) => Moisture = 93.6%

Temperature: 0111(hexadecimal)= 273(Decimal) => Temperature = 27.3℃

EC: 05B3(hexadecimal) = 1459(Decimal) => EC = 1459us/cm

N:0069((hexadecimal) = 105(Decimal) => N = 105mg/KG

P:008F(hexadecimal) = 143(Decimal) => P = 143mg/KG

K:0163(hexadecimal) = 355(Decimal) => K = 355mg/KG

Salinity:0322(hexadecimal) = 802(Decimal) => Salinity= 802ppm

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

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

(3) Change the measured value factor

- Example: Write the coefficient to change the nitrogen content of the device address 0x01 (change the coefficient of nitrogen, phosphorus and potassium and the calibration value can only use 10 function code)

  Inquiry frame (hexadecimal): change to twice the original value, that is, write 2.0 (converted to hexadecimal floating point is 40000000H)

Address	Function code	Start address	Data length	Number of valid bytes written	Nitrogen content coefficient High 16 bits	Nitrogen content coefficient Low 16 bits	Check Code low	Check code high
0x01	0x10	0x02 0xE8	0x00 0x02	0x04	0x40 0x00	0x00 0x00	0xF0	0xE1

Response frame (hexadecimal):

Address	Function code	Start address	Data length	Check code low	Check code high
0x01	0x10	0x02 0xE8	0x00 0x02	0xC0	0x44

Inquiry frame (hexadecimal): Check whether the 0x02 0xE8 register has been changed

Address	Function code	Start address	Data length	Check code low	Check code high
0x01	0x03	0x02 0xE8	0x00 0x02	0x45	0x87

Response frame (hexadecimal): 0x02 0xE8 register value has been changed to 4000000H, which is 2.0

Address	Function code	Returns the number of valid bytes	Nitrogen content coefficient High sixteen	Nitrogen content coefficient Low 16 bits	Check code low	Check code high
0x01	0x03	0x04	0x40 0x00	0x00 0x00	0xEF	0XF3

- Example: Write the coefficient to change the EC content of the device address 0x01 (change the coefficient of EC and the calibration value can only use 10 function code)

  Inquiry frame (hexadecimal): change to 0.66 times the original value, that is, write 0.66 (converted to hexadecimal floating point is 3F 28 F5 C2)

Address	Function code	Start address	Data length	Number of valid bytes written	EC content coefficient High sixteen	EC content coefficient Low 16 bits	Check code low	Check code high
0x01	0x10	0x00 0x45	0x00 0x02	0x04	0x3F 0x28	0XF5 0XC2	0x7D	0x7D

Response frame (hexadecimal):

Address	Function code	Start address	Data length	Check code low	Check code high
0x01	0x10	0x00 0x45	0x00 0x02	0x50	0x1D

Inquiry frame (hexadecimal): Check whether the 0x00 0x45 register has been changed

Address	Function code	Start address	Data length	Check code low	Check code high

0x01	0x03	0x00 0x45	0x00 0x02	0XD5	0xDE

Response frame (hexadecimal): 0x00 0X45 register value has been changed to 3F28F5C2 which is 0.66

Address	Function code	Returns the number of valid bytes	EC content coefficient High sixteen	EC content coefficient Low 16 bits	Check code low	Check code high
0x01	0x03	0x04	0x3F 0x28	0XF5 0XC2	0x93	0X2E

Note: Do not modify the device address, if the address conflicts, the device will be scrapped

4. Common problems and solutions

4.1 The device cannot be connected to the PLC or computer possible reason:

1) The computer has multiple COM ports and the selected port is incorrect.

2) The device address is wrong, or there are devices with duplicate addresses.

3) The baud rate, check method, data bit and stop bit are wrong.

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

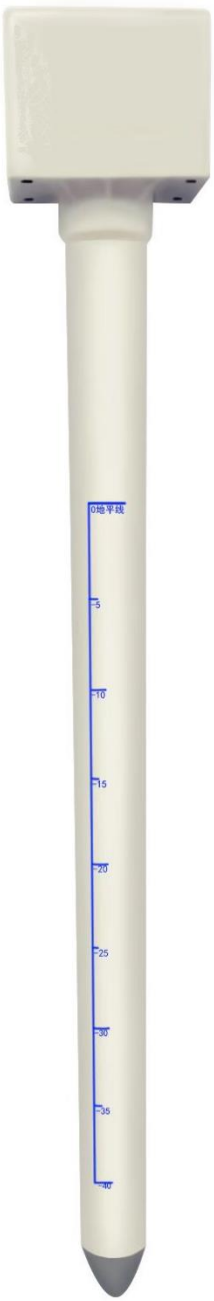
5) If the number of equipment is too large or the wiring is too long, power should be supplied nearby, and a 485 booster should be added and a 120Ω terminal resistance should be added at the same time.

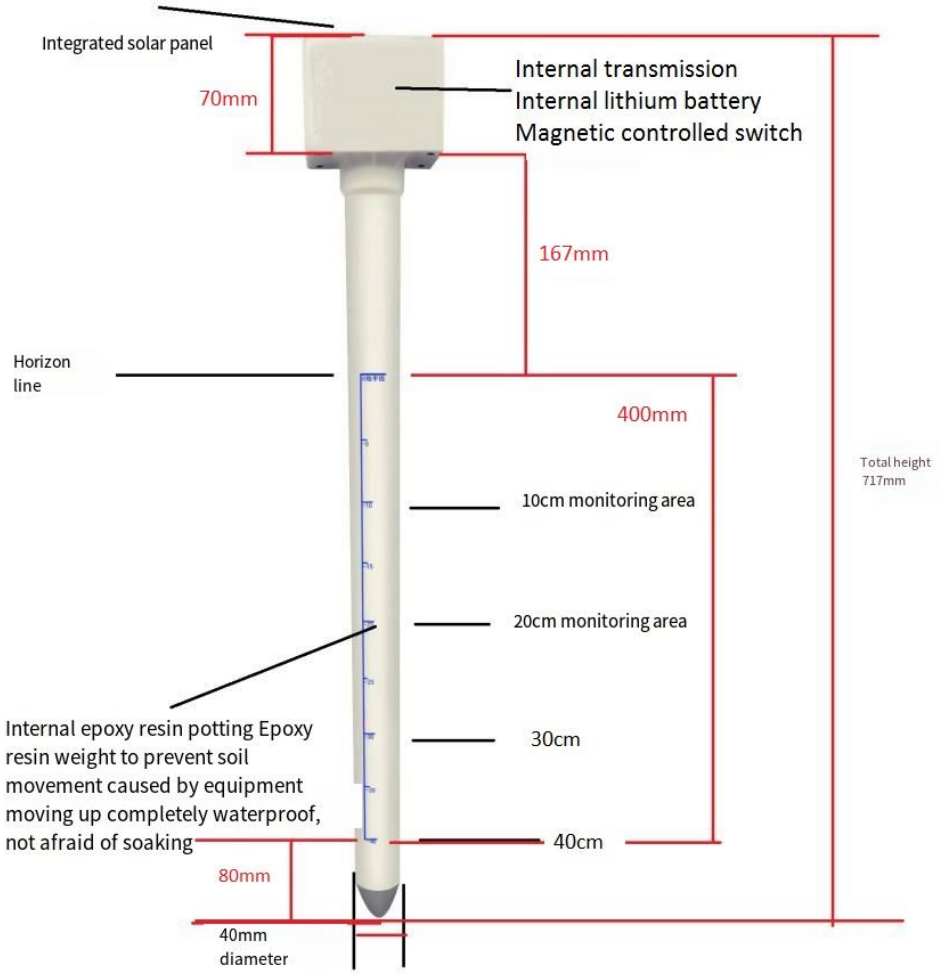
6) The USB to 485 driver is not installed or damaged.

7) The equipment is damaged.

Tubular soil sensor

Product instruction manual





Four layer tube moisture dimension chart

1. Scope of application

Tubular soil sensor is a newly developed product of our company. This sensor adopts high-precision chip and advanced algorithm as well as IOT technology, which can measure multi-depth soil parameters, RS485 output or 4G network uploaded to the data center.

The product can be widely used in real-time monitoring of soil temperature and humidity in farmland, forest area, grassland and irrigation area. It can also be used in water conservancy and land disaster industries to provide data support for monitoring natural disasters such as landslides and debris flows.

2. Functional Features

- The product is designed to be flexible and can measure the temperature and humidity of the soil at any depth between 10-80cm (generally 10cm layer). Default for 4 layer, 5 layer, 8 layer standard tube. Support customization.
- It consists of sensing, collecting, transmitting and power supplying parts, and is an integrated design for easy installation.
- With domestic version, international version of the data transmission program, convenient for users outside the mainland. (Please inform the sales staff in advance of the international version)
- The collector configuration software adopts WeChat applet to connect with cell phone through Bluetooth, which can be used to manipulate the device in any Android or Apple cell phone end equipped with WeChat APP, and realize the deep interaction, configuration and remote sending between cell phone APP and the device. (Some functions are currently open to users)
- Sensor built-in high-efficiency lithium battery, RTU with low-power consumption design, fully charged state in the case of continuous rainy days can work for more than 180 days.
- Adopt magnetic switch design, can be used with the magnet supplied with the collector for switching control. Prevent the station in the field occurs human error shutdown situation.
- Adopting cloud platform storage technology, the data sent each time can be saved to the autonomous cloud platform or the third-party platform that meets the *Hydrological Monitoring Data Communication Statute SL651-2014.* It supports MQTT service docking to the third-party platform, and supports protocol customization. Default API interface docking.
- Other features: battery indicator, network location.
- Expandable elements: GPS positioning for more accurate positioning. Expandable parameters such as temperature, humidity, air pressure, dew point

temperature and body temperature.

- Expandable function: open the user's secondary calibration function (function of cubic term + quadratic term + primary term + constant), providing more accurate data for professional researchers. Users can provide data, our company to assist the coefficient calculation of the function.

3. Technical Parameters

Measured parameter: volumetric soil water content (soil moisture)

- Unit: % (m^3/m^3), or %Vol (volumetric water content)
- Humidity range: 0~100%Vol; Resolution:0.01%Vol
- Accuracy: ≤3% Vol within the valid range
- Measuring area: 90% of the influence is within the cylindrical measuring carrier with a diameter of 10 cm around the sensor
- Precision drift: none
- Probability of linear dispersion deviation of the sensor: 1%.

Measured parameters: soil temperature

- Soil temperature range: -40~+60℃; Resolution:0.01℃.
- Accuracy: ±0.5℃
- Stabilization time: approx 1 second after power-on
- Response time: Response goes to steady state within 1 second
- Sensor operating voltage: sensor input 5-24V DC
- Sensor operating current: quiescent current 4mA, acquisition current 35mA
- Sensor waterproof level: IP68
- Working Temperature: -40℃~+80℃
- RTU power consumption: standby 10μAh, transmission 100mAh.
- Transmission: default 4G output to own platform. Optional RS485 and other outputs, optional third-party docking.
- Actual power supply capacity of solar panel: ≤0.6W
- RS485 output power supply: DC5-24V, current less than 25mA.

4. Device Communication Protocols and Wiring

- *Hydrological Monitoring Data Communication Statute SL651-2014*; TCP protocol; other third-party customized protocols, MQTT, API interfaces, etc.
- The RTU and the sensing part are connected by internal cables. The

IoT card costs 3 years (one year for the international version).

- Solar panel Internal wiring of lithium batteries for power.

5. Selection of collection sites

The selection of representative plots for moisture monitoring should take into account their geomorphology, soil, meteorological and hydrogeological conditions, as well as the representativeness of species and plants. The scope of collection can be based on the county level, and a few representative areas can be selected at the county level (the reference basis for representativeness can be based on the categories of landforms and the extent of the areas of priority crops).

If you are located in a hilly area, you should set the testing point in a plot with a small slope ratio drop and a large area, and you should not collect in the bottom of a ditch or in a plot with a large slope.

Representative plots in plain areas should be collected on flat and non waterlogging plots

Detailed collection plots should be more than 10 meters away from the edge of representative plots, roadsides and in level plots, avoiding low-lying places prone to waterlogging plots, and maintaining a distance of more than 20 meters from ditches and flood channels to avoid the impact of seepage of water from ditches on soil water content.

For the collection of plots within the hydrological station, it is strictly forbidden to be in the middle of the vegetable field within the station to avoid the impact of watering on the collection accuracy. It is recommended to choose the collection point in a more open location, not close to houses or fences;

6. Sensor installation and data reporting

6.1 Installation Precautions

（1） Observe the data through the platform and confirm that the data is normal.

（2） Preparation of tools for installation (basin, water, shovel (or earth auger), sieve with 2-4 mm aperture)

（3） Holes shall be punched vertically downward;

（4） Drill holes to a suitable depth and note if there are more stones. There are many stones and it is recommended to relocate;

（5） Backfill the mud and insert the sensor vertically. (very important and fundamental to the accuracy of the response data);

（6） Verify that the sensor is mounted at a depth where the horizon is level with the ground.

6.2 Sensor Installation

（1） Select a more level installation location and make a hole in the ground directly with an earth auger:

（2） Remove the blue tube cap from the bottom of the tube test soil auger to take out the handles, and screw the two handles into the ends of the pair of wires in a clockwise direction; as shown below:

（3） Insert the pipe soil auger vertically along the center hole of the flange, press down with appropriate force. At the same time, rotate both hands left and right parallel to each other until it reaches the required depth (this process can feel whether there are stones in the soil, and if there are too many stones, you need to re-select the site), and in the process of punching, every maximum depth of 10cm, you need to raise the soil auger to fling the soil out of the pipe with force, and you can also use the extended screwdriver to take the hammer (can not use the hammer to hit the pipe body, so as not to cause deformation of the pipe body) to knock the lower part of the soil auger pipe body to vibrate the soil out or from the bottom of the screwdriver to dig the soil until all the soil

falls, with a ruler to measure the depth of the hole should be deeper than the sensor's measurement of the depth of 7-8cm; the following figure:

（4） The soil removed from the perforations is sieved and made into a slurry; as follows:

（5） Fill the drilled hole with slurry to a depth of at least 2/3 of the hole, as shown below.

（6） Simply insert the sensor into the backfilled mud ground hole with the sensor labeled with the horizon line flush with the ground. Figure below:

6.3 Voice recognition of the collector

“Beep” for power on;

Two “beeps” means it is off;

7. System setup, data reporting, data queries

7.1 Equipment switching and configuration

（1） Scan the QR code with your cell phone to see the data, and use the magnetic peg to power up the sensor (the default state of power on in China, restart after brushing the magnetic, power on the data).

（2） If you need to configure, you can enter the small program after clicking

on the “click to connect Bluetooth” 2 seconds after the interface will appear in the lower part of the button, click on the button will prompt the “connection is successful”, (this feature has the option to open, generally configured in accordance with the user’s requirements before leaving the factory)

7.2 Data reporting

Each time the sensor is turned on, the RTU automatically reports a test message to the receiving center. After the initial installation is completed, the sensor can be turned on for about 1 minute to view the last reported data.

7.3 Platform operation and data query

You can log in to the platform to view real-time data, historical records, data export and more.

8. Problem Determination and Solution

Description of the problem	Solutions
1. No start-up beep	● Go to a sunny spot to light the solar panel and charge the sensor for at least one day; ● After charging, it still can not be turned on.It can be returned to the factory for inspection and repair.
2. Unable to collect data	● Whether the sensor has been inserted into the soil or is in the measurement carrier; ● If the cause cannot be determined, it can be returned to the factory for inspection and repair.
3. Inability to report data (No communication)	● Check whether the cell phone has a signal, if it is in the state of no signal RTU can not report data; ● It can be returned to the factory for service after ruling out other causes; ● No communication for RS485 version. Check that the power supply and RS485 wiring, communication parameters are configured correctly and communication commands are sent correctly.

Note: This hardware and WeChat small program, PC may be updated at any time, if no

special circumstances without notice!

Selection List:

HCS Series Catheterized Soil Senosr				
Selection table				
Serial number	**Name**	**Model number**	**Output**	**Note**
1	Conduit soil monitor	HCS-4	RS485	5 Meter Cable
2	Conduit soil monitor	HCS-5	RS485	5 Meter Cable
3	Conduit soil monitor	HCS-8	RS485	5 Meter Cable
4	Conduit soil monitor	HCS-4/G	4G	3-year flow
5	Conduit soil monitor	HCS-5/G	4G	3-year flow
6	Conduit soil monitor	HCS-8/G	4G	3-year flow
Note: Standard 10cm layer, customized protocols and customized layers are available.				

Modbus RTU communication protocol

MODBUS RTU communication protocol (for Catheterized Soil Moisture Sensor. **Protocol supports customization.**)

Baud rate: 9600; Data bits: 8; Stop bits: 1; Parity bit: none

CRC Notes:

In all the following descriptions, the two bytes of CRC16 in the MODBUS RTU protocol, according to MODBUS regulations: the low byte comes first and the high byte comes second.

1. Return error code provisions:

The sensor does not return the error code for the reception of error commands (including CRC16 validation errors). The host computer can consider that the instruction has failed when no return data is received 100ms after the instruction is issued, and can resend the instruction.

2. Standard MODBUS Register Description

Special Note: The number or length of registers in MODBUS commands are in two-byte 16-bit units (high byte first, low byte second), not single-byte 8-bit units.

The user should ensure that the range of the two parameters, address and number of registers in the command is within the range specified by the system. If they are out of range, the sensor output results will be unpredictable. The user should ensure that the MODBUS commands comply with the requirements of this manual in the design of the host computer software.

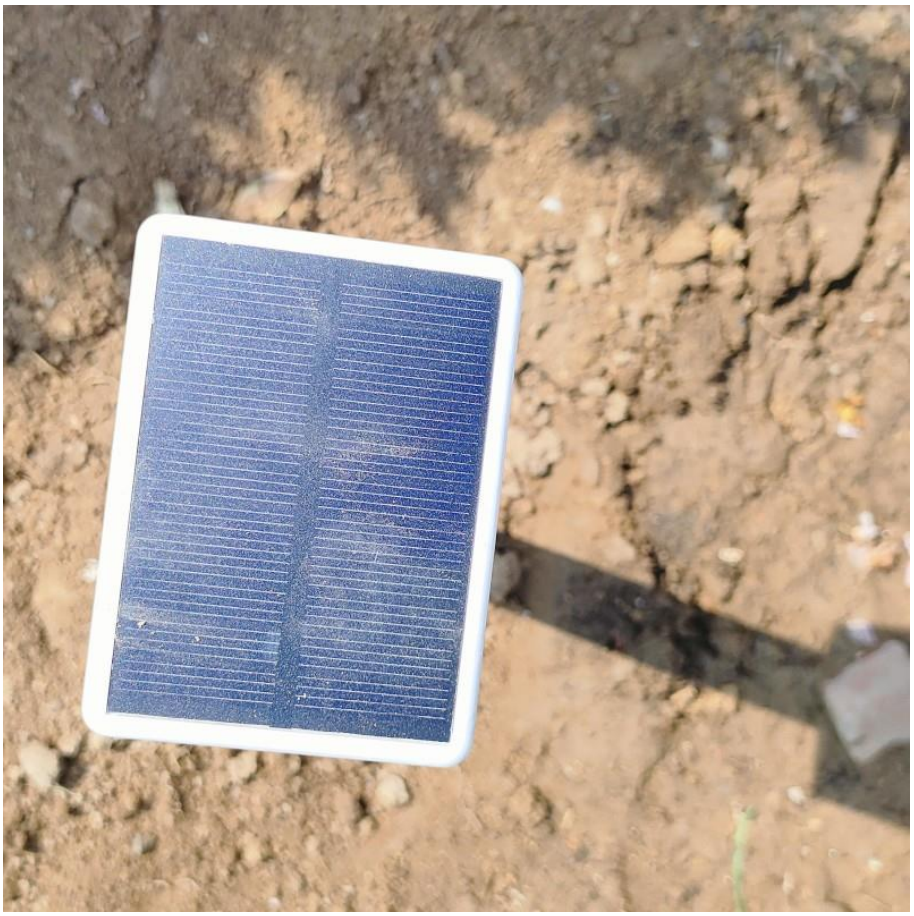
3. Internal registers: read with function code 03; write with function code 06.

Order	Register address	Parameter description	Note
	Ox0100	Device address, default ox01.	fill out or in (information on a form)
1 layer	ox0020	Soil volumetric water content 1 layer (10 cm depth). A hexadecimal number magnified 100 times, e.g. 0x08D0 means 2256/100=22.56%Vol	read-only
	ox0021	Soil temperature 1 layer, (10cm depth), magnified 100 times hexadecimal number, e.g. 0x08D0 indicates 2256/100 = 22.56°C. Negative numbers are expressed as complements.	read-only
2 layer	ox0022	Soil moisture content by volume2	read-only
	ox0023	Soil temperature2	read-only
3 layer	ox0024	Soil moisture content by volume3	read-only
	ox0025	Soil temperature 3	read-only
4 layer	ox0026	Soil moisture content by volume4	read-only
	ox0027	Soil temperature 4	read-only
5 layer	ox0028	Soil moisture content by volume 5	read-only
	ox0029	Soil temperature 5	read-only
6 layer	ox002A	Soil moisture content by volume6	read-only
	ox002B	Soil temperature 6	read-only
7 layer	ox002C	Soil moisture content by volume 7	read-only
	ox002D	Soil temperature 7	read-only
8 layer	ox002E	Soil moisture content by volume 8	read-only
	ox002F	Soil temperature 8	read-only

Note: Address data is represented in hexadecimal. For example: address 20 (decimal) read/write value is 0x14.

HONDE TECHNOLOGY CO.,LTD

Tube Soil Sensor with Solar Power Storage



1. Application scope

It adopts imported high-precision chip and advanced IOT technology, which can measure relevant soil parameters at different depths and can be uploaded to data center by 4G wireless network.

The product can be widely used for real-time monitoring of soil temperature and humidity in agricultural fields, forest areas, grasslands and irrigation areas, and can also provide data support for monitoring landslides, mudslides and other natural disasters.

2. Functional features

- The product is designed to be flexible and can measure the temperature and humidity of the soil at any depth between 10-80cm (generally 10cm layer). Default is 4-layer, 5-layer and 8-layer standard tubes.
- It is composed of sensing, acquisition, transmission and power supply parts, with an integrated design and easy installation.
- The collector configuration software uses WeChat applet to connect with cell phone through Bluetooth, which can be controlled by any Android or Apple cell phone end equipped with WeChat APP to realize deep interaction, configuration and remote sending of cell phone APP and equipment. (Some functions are currently open to users)
- Sensor built-in high-efficiency lithium battery, RTU with low-power design, fully charged state in the case of continuous rainy days can work for more than 180 days.
- Adopt magnetic switch design, available with the random magnet attached to the collector to switch on and off control. It prevents the station from being turned off by mistake by human in the field.
- Using cloud platform storage technology, each time the sent data can be saved to the independent cloud platform or the third-party platform that meets the "Hydrological Monitoring Data Communication Statute SL651-2014", supporting MQTT service docking to the third-party platform and supporting protocol

customization.

- Other functions: power display, network positioning.
- Expandable elements: GPS positioning, more accurate positioning; temperature, humidity, air pressure, dew point temperature, body temperature and other parameters expansion.
- Expandable function: open the user's secondary calibration function (function of three terms + secondary terms + primary terms + constants) to provide more accurate data for professional researchers. Users can provide data, our company to assist the coefficient calculation of the function.

3. Technical parameters

- Measurement parameter 1: soil volumetric water content (soil moisture)
- Unit: % (m^3/m^3), or %Vol (volumetric water content, volumetric water content)
- Humidity range: 0~100%Vol; Resolution:0.1%Vol
- Accuracy: Error ≤ 3%Vol in the effective range
- Measurement area: 90% of the influence is within the 10 cm diameter cylindrical measurement carrier surrounding the sensor
- Amount of precision drift: None
- Probability of dispersion of sensor linearity: 1%
- Measurement parameter 2: Soil temperature
- Soil temperature range: -40~+60℃; Resolution:0.1℃
- Accuracy: ±1.0℃
- Stabilization time: about 1 second after power on
- Response time: response in 1 second to a stable state
- Sensor working voltage: Sensor input is 5-24V DC
- Sensor operating current: quiescent current 4mA, acquisition current 35mA
- Sensor waterproof level: IP68
- Operating temperature: -40℃~+80℃
- RTU power consumption: 10 μAh for standby, 100mAh for transmission.
- Transmission: default 4G output to own platform. Optional RS485 and other

outputs, optional third-party docking.

- Solar panel actual power supply capacity: 0.6W max

4. Device communication protocol and wiring

- Hydrological Monitoring Data Communication Statute SL651-2014; TCP protocol; other third-party custom protocols, MQTT, etc.
- The RTU and the sensing part are connected by internal cables. IoT card 3 years cost (one year for international version)
- Solar panel Power supply by internal wiring of lithium battery.

5. Site selection of collection sites

The selection of representative plots for moisture monitoring should take into account their geomorphology, soil, meteorological and hydrogeological conditions as well as the representativeness of the species and plants. The scope of collection can be based on the county level, and several areas with representativeness can be selected in the county level units (the reference basis for representativeness can refer to the categories of geomorphology and the regional scope of key crops).

If located in a hilly area, the detection point should be set in a plot with a small slope ratio drop and a large area, and should not be collected in the bottom of a ditch or in a plot with a large slope.

Representative plots in the plains should be collected in plots that are flat and less prone to waterlogging.

Detailed collection plots should be more than 10m away from the edge of representative plots, roadside and level plots, should avoid low-lying areas prone to waterlogging, and with ditches and flood channels to maintain a distance of more than 20m to avoid the impact of ditch seepage on soil water content.

For the collection of plots in the hydrological station, it is strictly forbidden to be in the middle of the vegetable field in the station to avoid the impact of watering on the accuracy of the collection. It is recommended that the collection point be chosen in a more open location, not close to houses or fences;

6. Installation of sensors and data reporting

1、Installation precautions

(1) Observe the data through the platform and confirm that the data is normal.

Prepare tools for installation (basin, water, shovel (or earth auger), sieve with 2-4mm holes)

(2) Perforation should be vertical downward;

(3) Punching holes to a suitable depth and noting whether there are more rocks, more rocks suggest re-siting;

(4) Backfill mud and vertical insertion of the sensor. (Very important, fundamental to the accuracy of the response data);

(5) Confirm the installation depth of the sensor with the horizon line level with the ground.

2. Sensor Installation

(1) Select a relatively flat installation location and make holes directly into the ground with an earth drill:

(2) Take off the blue tube cover at the bottom of the tube test soil drill to remove the handle, and screw the two handles into the ends of the pair of wires in clockwise direction respectively; as follows:

(3) Insert the pipe auger vertically along the center hole of the flange, press down with appropriate force while turning both hands parallel to each other until the required depth is reached (this process can feel whether there are stones in the soil, if too many stones need to be re-sited), during the drilling process every 10cm of maximum depth, the auger

needs to be raised and shaken to shake the soil out of the pipe, or you can use an extended screwdriver handle or a hammer handle. (Do not use hammer head to hit the tube body, so as not to cause deformation of the tube body) knock the lower part of the tube body of the soil auger to vibrate the soil out or dig the soil from the bottom with a screwdriver until all the soil falls off, measure the depth of the hole with a ruler should be 7-8cm deeper than the sensor measurement depth; as follows:

(4) The soil removed from the perforation is sieved and mixed into a slurry; as follows:

(5) Fill the mud into the punched hole with the penetration amount reaching at least 2/3 depth of the hole; as follows

(6) The sensor is inserted into the ground hole backfilled with mud, and the position of the sensor marking the horizon line is flush with the ground. As shown below:

3、The sound recognition of the collector

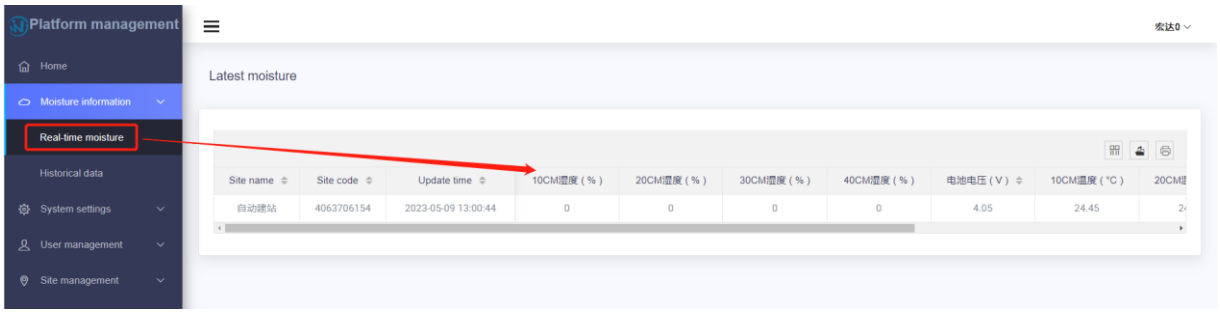
"Beep" for power on;

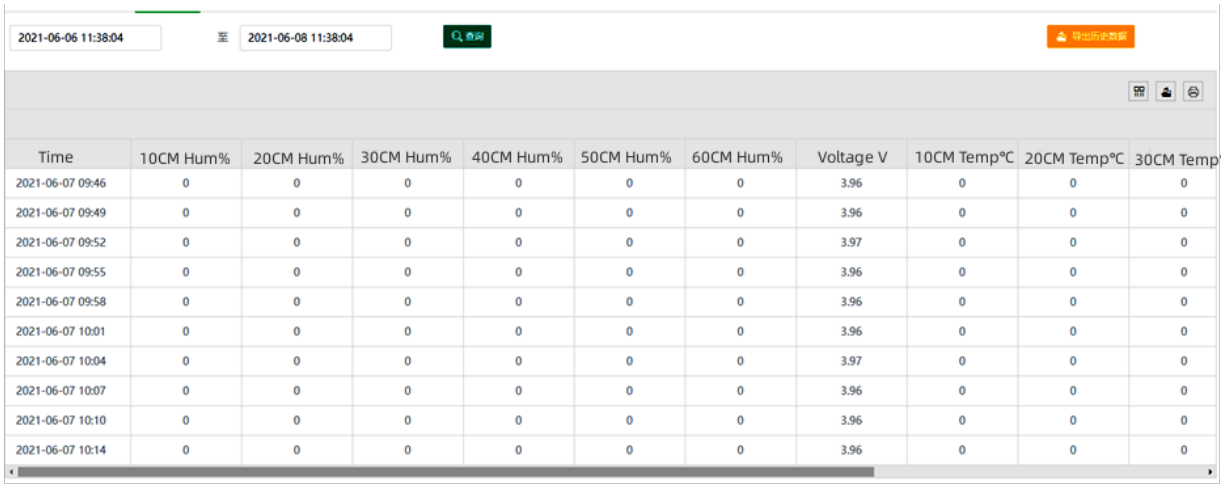
Two "ticks" for shutdown;

7. software and data

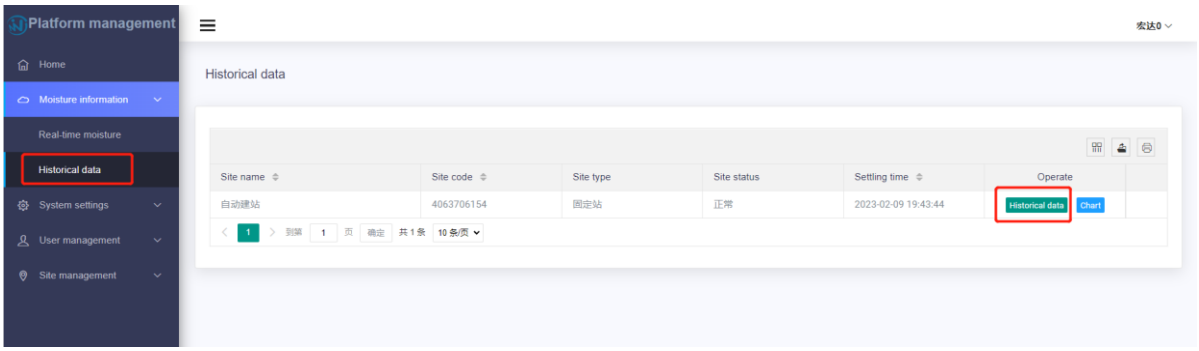
We provide software, after logging in, you can manage and view the data of each site;

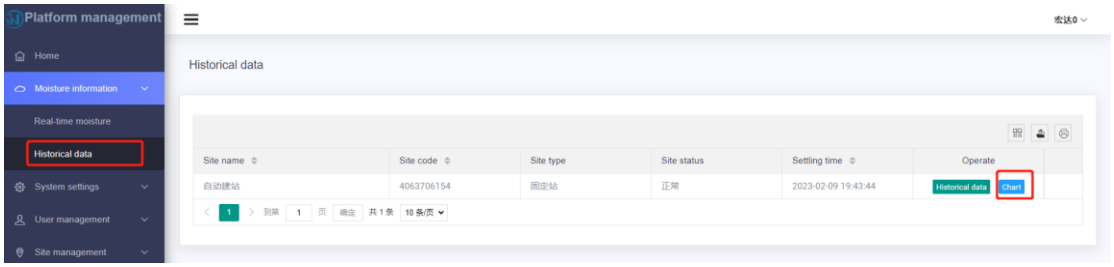
1. View the real-time data of the site;

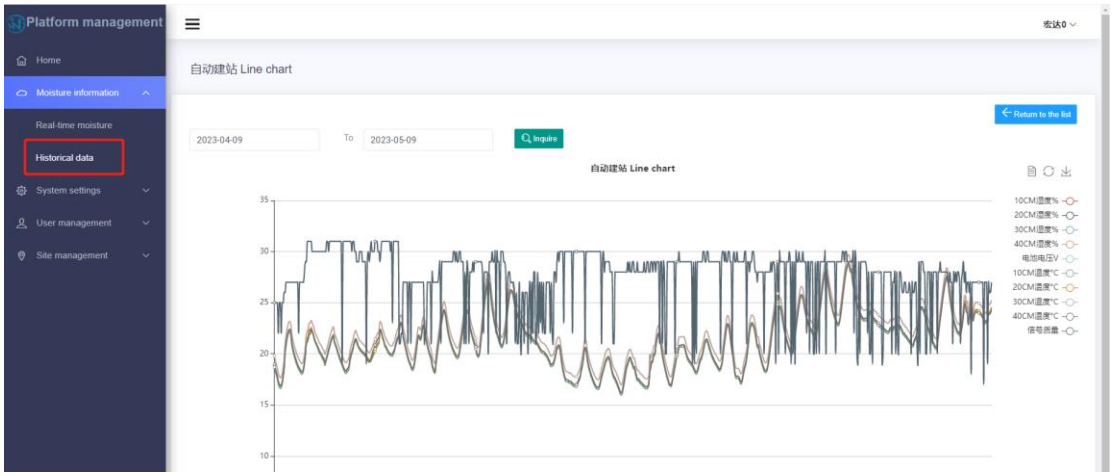




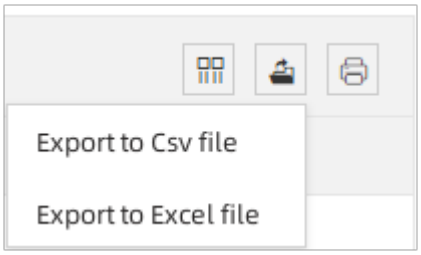
2. View historical data and charts of the site;

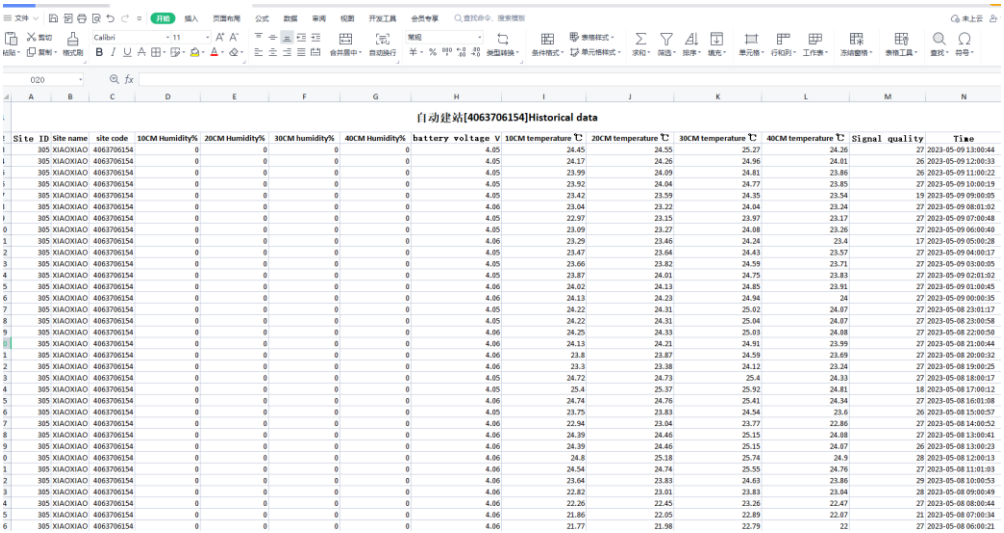






3. You can download the data sheet.





自动建站[4063706154]Historical data

Site ID	Site name	site code	10CM Humidity%	20CM Humidity%	30CM humidity%	40CM Humidity%	battery voltage V	10CM temperature	20CM temperature	30CM temperature	40CM temperature	Signal quality	Time
305	XIAOXIAO	4063706154	0	0	0	0	4.05	24.45	24.55	25.27	24.26	27	2023-05-09 13:00:44
305	XIAOXIAO	4063706154	0	0	0	0	4.05	24.17	24.26	24.96	24.01	26	2023-05-09 12:00:33
305	XIAOXIAO	4063706154	0	0	0	0	4.05	23.99	24.09	24.81	23.86	26	2023-05-09 11:00:22
305	XIAOXIAO	4063706154	0	0	0	0	4.05	23.92	24.04	24.77	23.85	27	2023-05-09 10:00:19
305	XIAOXIAO	4063706154	0	0	0	0	4.05	23.42	23.59	24.35	23.54	19	2023-05-09 09:00:05
305	XIAOXIAO	4063706154	0	0	0	0	4.06	23.04	23.22	24.04	23.24	27	2023-05-09 08:01:02
305	XIAOXIAO	4063706154	0	0	0	0	4.05	22.97	23.15	23.97	23.17	27	2023-05-09 07:00:48
305	XIAOXIAO	4063706154	0	0	0	0	4.05	23.09	23.27	24.08	23.26	27	2023-05-09 06:00:40
305	XIAOXIAO	4063706154	0	0	0	0	4.06	23.29	23.46	24.24	23.4	17	2023-05-09 05:00:28
305	XIAOXIAO	4063706154	0	0	0	0	4.05	23.47	23.64	24.43	23.57	27	2023-05-09 04:00:17
305	XIAOXIAO	4063706154	0	0	0	0	4.05	23.66	23.82	24.59	23.71	27	2023-05-09 03:00:05
305	XIAOXIAO	4063706154	0	0	0	0	4.05	23.87	24.01	24.75	23.83	27	2023-05-09 02:01:02
305	XIAOXIAO	4063706154	0	0	0	0	4.06	24.02	24.13	24.85	23.91	27	2023-05-09 01:00:45
305	XIAOXIAO	4063706154	0	0	0	0	4.06	24.13	24.23	24.94	24	27	2023-05-09 00:00:35
305	XIAOXIAO	4063706154	0	0	0	0	4.05	24.22	24.31	25.02	24.07	27	2023-05-08 23:01:17
305	XIAOXIAO	4063706154	0	0	0	0	4.05	24.22	24.31	25.04	24.07	27	2023-05-08 23:00:58
305	XIAOXIAO	4063706154	0	0	0	0	4.06	24.25	24.33	25.03	24.08	27	2023-05-08 22:00:50
305	XIAOXIAO	4063706154	0	0	0	0	4.06	24.13	24.21	24.91	23.99	27	2023-05-08 21:00:44
305	XIAOXIAO	4063706154	0	0	0	0	4.06	23.8	23.87	24.59	23.69	27	2023-05-08 20:00:32
305	XIAOXIAO	4063706154	0	0	0	0	4.06	23.3	23.38	24.12	23.24	27	2023-05-08 19:00:25
305	XIAOXIAO	4063706154	0	0	0	0	4.05	24.72	24.73	25.4	24.33	27	2023-05-08 18:00:17
305	XIAOXIAO	4063706154	0	0	0	0	4.05	25.4	25.37	25.92	24.81	18	2023-05-08 17:00:12
305	XIAOXIAO	4063706154	0	0	0	0	4.06	24.74	24.76	25.41	24.34	27	2023-05-08 16:01:08
305	XIAOXIAO	4063706154	0	0	0	0	4.05	23.75	23.83	24.54	23.6	26	2023-05-08 15:00:57
305	XIAOXIAO	4063706154	0	0	0	0	4.06	22.94	23.04	23.77	22.86	27	2023-05-08 14:00:52
305	XIAOXIAO	4063706154	0	0	0	0	4.06	24.39	24.46	25.15	24.08	27	2023-05-08 13:00:41
305	XIAOXIAO	4063706154	0	0	0	0	4.06	24.39	24.46	25.15	24.07	26	2023-05-08 13:00:23
305	XIAOXIAO	4063706154	0	0	0	0	4.06	24.8	25.18	25.74	24.9	28	2023-05-08 12:00:13
305	XIAOXIAO	4063706154	0	0	0	0	4.06	24.54	24.74	25.55	24.76	27	2023-05-08 11:01:03
305	XIAOXIAO	4063706154	0	0	0	0	4.06	23.64	23.83	24.63	23.86	29	2023-05-08 10:00:53
305	XIAOXIAO	4063706154	0	0	0	0	4.06	22.82	23.01	23.83	23.04	28	2023-05-08 09:00:49
305	XIAOXIAO	4063706154	0	0	0	0	4.06	22.26	22.45	23.26	22.47	27	2023-05-08 08:00:44
305	XIAOXIAO	4063706154	0	0	0	0	4.06	21.86	22.05	22.89	22.07	21	2023-05-08 07:00:34
305	XIAOXIAO	4063706154	0	0	0	0	4.06	21.77	21.98	22.79	22	27	2023-05-08 06:00:21

8.Problem Determination and Solution

Problem Description	Solution
1、No power-on beep	● Go to a sunny location to light the solar panel and charge the sensor for at least one day; ● After charging or can not be turned on can be returned to the factory inspection and maintenance;
2、Unable to collect the data	● whether the sensor is inserted in the soil or in the measurement carrier; ● Can be returned to the factory for inspection and repair if the cause cannot be determined;
3、Unable to report data	● Check whether the cell phone network has a signal, if the phone is in a state of no signal RTU is also unable to report data; ● (a) The case can be returned to the factory for overhaul after excluding other causes;

1) Note: This hardware and WeChat applet may be updated at any time without notice in special circumstances!