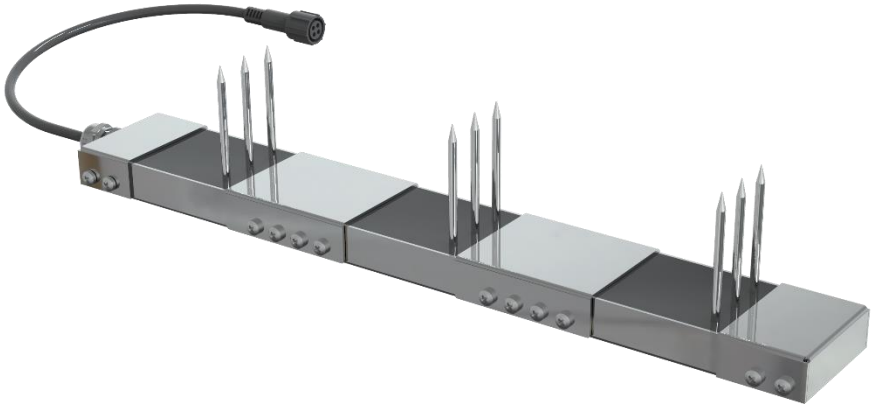
Multilayer soil parameter monitor sensor



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

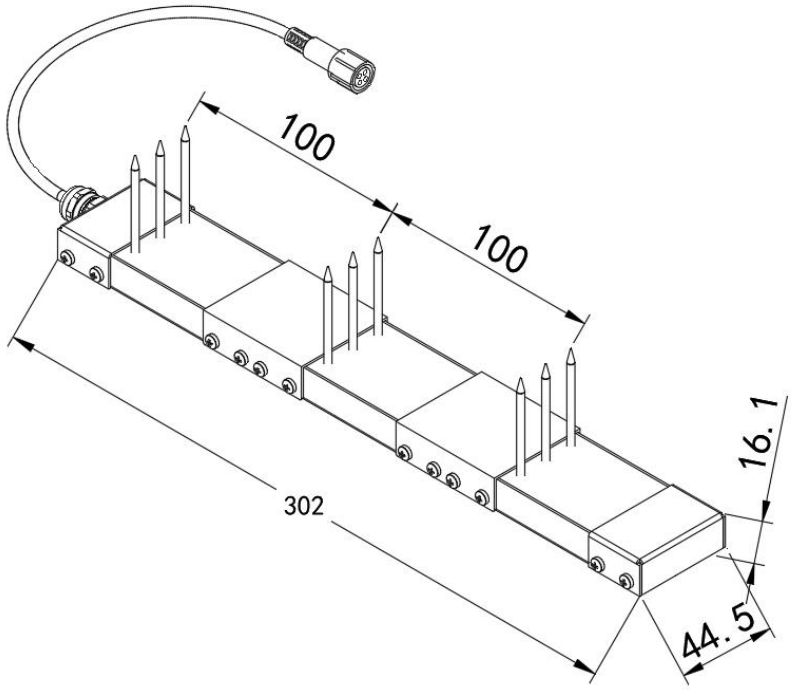
2. Physical parameter

➢ 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



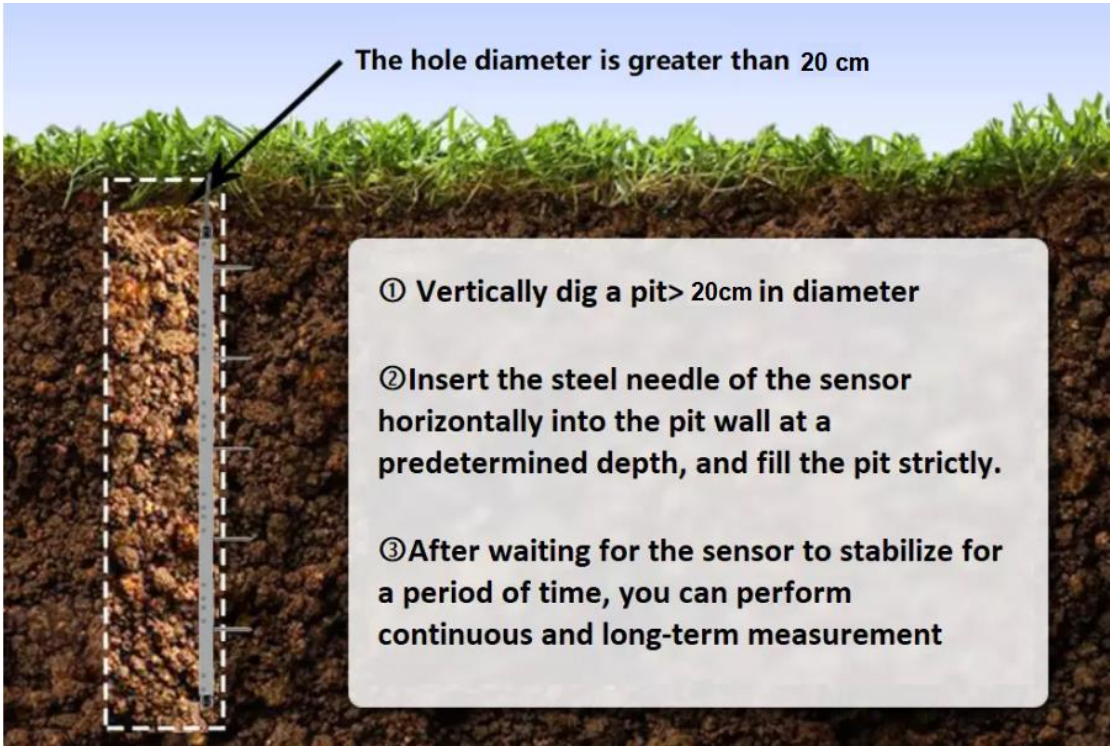
6. Connection method

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.