

MULTI-DEPTH SOIL MONITORING FOR SMART AGRICULTURE

Surface Conditions Don't Tell the Whole Story.

Gain deeper visibility into soil conditions with OmniWOT's Multi-Depth IoT Soil Monitoring Solution. Make data-driven decisions for irrigation, nutrient management and higher crop productivity.

MONITOR 7 KEY SOIL PARAMETERS



Soil Moisture



Soil Temperature



Electrical Conductivity (EC)



Soil pH



Nitrogen (N)



Phosphorus (P)



Potassium (K)

WHY MULTI-DEPTH MONITORING?



Understand moisture distribution across different depths.



Support data-driven irrigation planning.



Monitor key soil parameters for crop management.



Improve visibility across monitoring locations.



Integrate data into OmniWOT's Unified IoT Platform.



Know how soil conditions change beneath your crops with multi-depth soil monitoring from OmniWOT.



Contact OmniWOT to discuss your large-scale agricultural monitoring requirements.



COMMERCIAL FARMS



ORCHARDS



PLANTATIONS

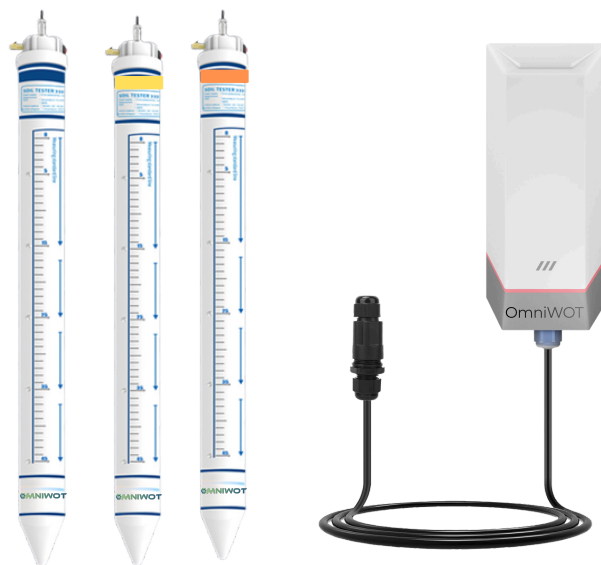


CORPORATE AGRICULTURE



PRECISION AGRICULTURE

LoRaWAN Multi Depth Soil Sensor



LXBS-3001

Multi Depth Soil Sensor

RS485 / MODBUS / LoRaWAN

PRODUCT MODEL NO & SENSOR SIZES

Model No.	Item Description	Monitoring Function
LXBS-3001-SMT3	3 depths; 10cm distance	Soil Moisture + Temperature
LXBS-3001-SMT5	5 depths; 10cm distance	Soil Moisture + Temperature
LXBS-3001-SMTC3	3 depths; 10cm distance	Soil Moisture+Temperature+EC
LXBS-3001-SMTC5	5 depths; 10cm distance	Soil Moisture + Temperature + EC
LXBS-3001-SMTNPK3	3 depths; 10cm distance	Soil Moisture + Temperature + NPK
LXBS-3001-SMTNPK5	5 depths; 10cm distance	Soil Moisture + Temperature + NPK
LXBS-3001-SWP30	30cm	Soil Water Potential (Tension)
LXBS-3001-SWP50	50cm	Soil Water Potential (Tension)
LXBS-3001-SWP75	75cm	Soil Water Potential (Tension)
LXBS-3001-SWP120	120cm	Soil Water Potential (Tension)
LXBS-3001-PD20	20cm Distance	Price Difference (Extra Price)

1. INTRODUCTION

1.1 Product Overview

The multi depth soil sensor is a sensor based on the principle of dielectric constant, which can monitor the soil temperature and humidity of different soil layers quickly, accurately and comprehensively.

Soil temperature and moisture play a vital role in crop growth, root development, and overall agricultural productivity. The multi-depth soil sensor enables accurate and continuous monitoring of soil temperature and moisture at different depths, providing reliable data for evaluating soil conditions and supporting informed irrigation and crop management decisions. By analyzing these measurements, users can optimize water usage, maintain suitable soil conditions, and improve crop yield.

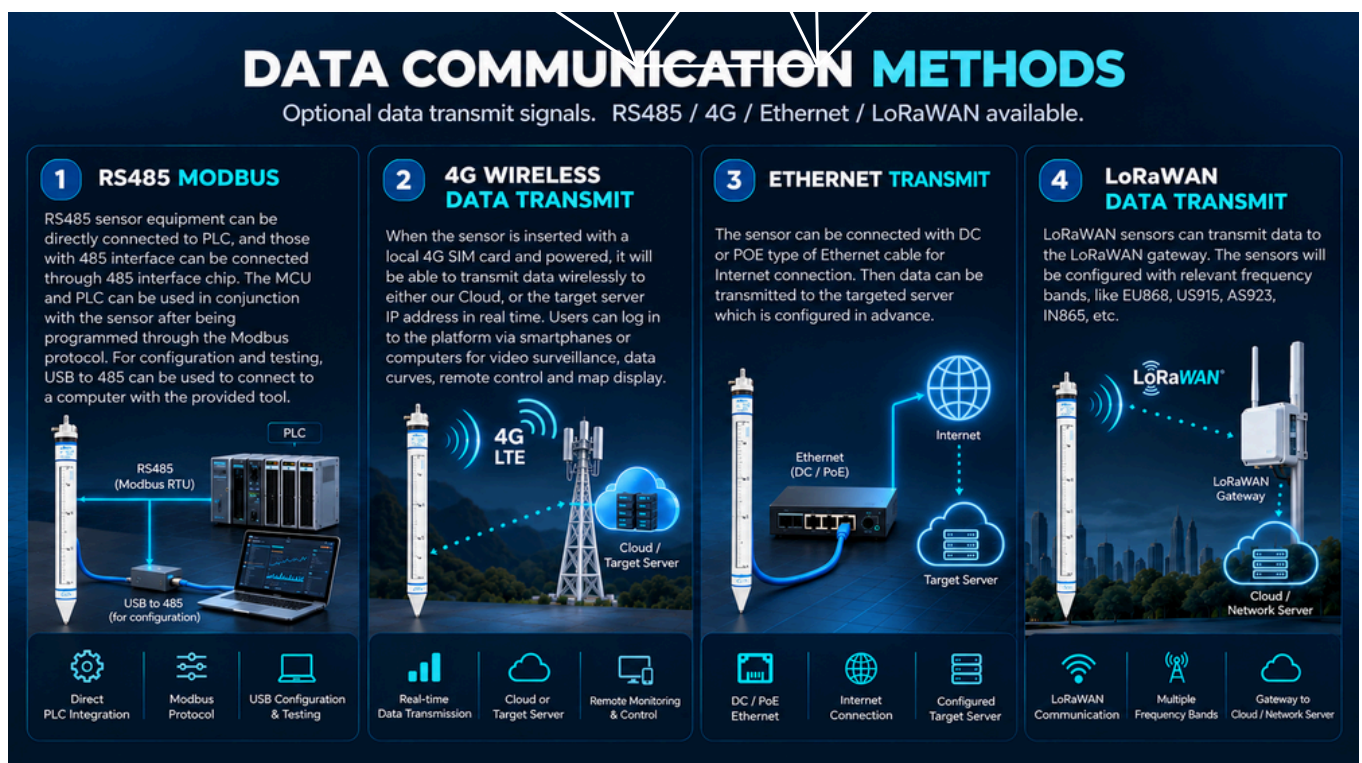
The device supports multiple communication options, including standard RS485 with the Modbus protocol and wireless technologies such as 4G, LoRa, and NB-IoT, depending on the model configuration. When integrated with a compatible LoRaWAN data logger, the system enables wireless data transmission, remote monitoring, and centralized access to soil measurements through a cloud-based platform.

The integrated LoRaWAN-based multi-depth soil monitoring system is suitable for a wide range of applications, including garden and agricultural irrigation monitoring, soil moisture and temperature monitoring, precision agriculture, agricultural research, water conservancy projects, mine monitoring, geological exploration, scientific experiments, and grassland management. With its ability to collect soil data at multiple depths and transmit measurements wirelessly for remote monitoring, the system supports efficient water management, soil condition assessment, and data-driven decision-making across agricultural and environmental applications.

1.2 Features & Function

Real time monitoring of soil temperature and humidity at different levels. The plastic pipe moves up and down to realize the dynamic observation of soil moisture content in each soil layer. The equipment adopts standard Modbus protocol with below advantages:

- 1.- Adopts high sensitive probe and has fast response speed
- 2.- Stable, reliable and accurate
- 3.- Low zero drift and good repeatability
- 4.- Product protection grade IP67, temperature and humidity resistance
- 5.- Passed a variety of environmental tests and has anti-interference capability
- 6.- Remote Cloud View Data



1.3 Measurement and Hardware Parameters

Parameters	Specs
Power Supply	12-24V DC
Communication Protocol	RS485 Modbus
Temperature Range	-40°C~80°C
Temperature Accuracy	±0.5°C
Moisture Accuracy	±3% @ 0-53%RH ±5% @ 53-100%RH
Electrical conductivity measurement range	0-10000us/cm
Conductivity resolution	10us/cm
Measure Range	0-1999mg/kg
Accuracy	±2%F.s
Resolution	1mg/kg(mg/l)
Response Time	<1s
Power Consumption	≤0.15W (@12V DC , 25°C)
Protection Level	IP68
Working Pressure	0.9-1.1atm

1.4 Calculation Method & Meaning of Soil Moisture

The soil moisture calculated by this sensor is soil volume moisture content (also known as soil volume moisture content), which is commonly known as "soil moisture" and "soil moisture". The calculation method of soil volume moisture content is the ratio of soil water volume to total soil volume. 0% represents completely dry soil without any moisture, and 100% represents completely water without any soil.

II. HARDWARE CONNECTIONS

2.1 Interface & Wiring

Before you wiring and use, please read this article in detail, Improper use may result in irreversible damage to the product.

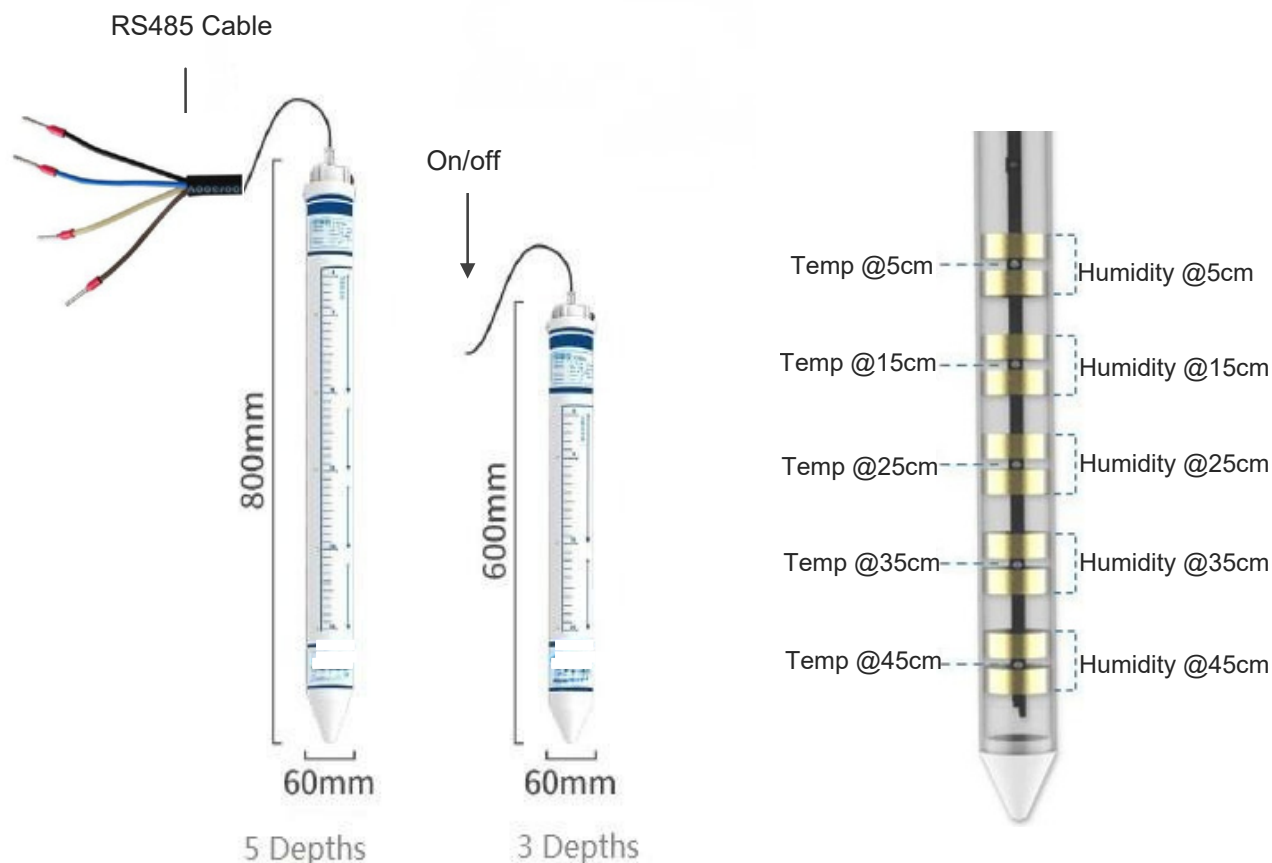


TABLE 1 Product Size

TABLE 2 Product Internal Design

Function	Cable Color	Specs
Power	Brown	Power supply +
	Black	Power supply -
Communication	Yellow (grey)	485-A
	Blue	485-B

We provide default cable length of 1.5 meters, you can extend the cable yourself according to your needs.

2.2 Installation

2.2.1 Make a hole in the ground First, take the soil drill bit, handle, and support rod. After completion, put the soil drill vertically on the ground, hold the handle with both hands and press it down and slowly rotate it clockwise. (Note: Don't use too much force, make sure to rotate a few more times slowly to prevent the drill bit from straying to the hole.)

Secondly, take the soil drill out of the hole and put it in the basin. Use tools to collect the drilled soil into the basin to mix with the mud. If there is too much sand and rock, choose finer soil. (Note: The first drilling soil is not collected due to excessive impurities)

Finally, repeatedly continue the above-mentioned drilling and soil extraction, and in the process, try to put the sensor into the hole (do not force the device to touch the bottom) to test whether the depth of the hole is appropriate; if there is a jam, then Use a soil drill to make corrections to ensure that the sensor is placed and removed smoothly; until the depth of the hole is flush with the installation position marked by the sensor, the drilling is completed

2.2.2 Mix Mud First, pick out soil impurities in the pot, stones, roots, and insoluble clods. Rub the soil finely to mix with the mud.

Secondly, pour in an appropriate amount of water and stir well until it becomes viscous; the loam mud is generally not thicker than "sesame paste"; and the mud is complete.

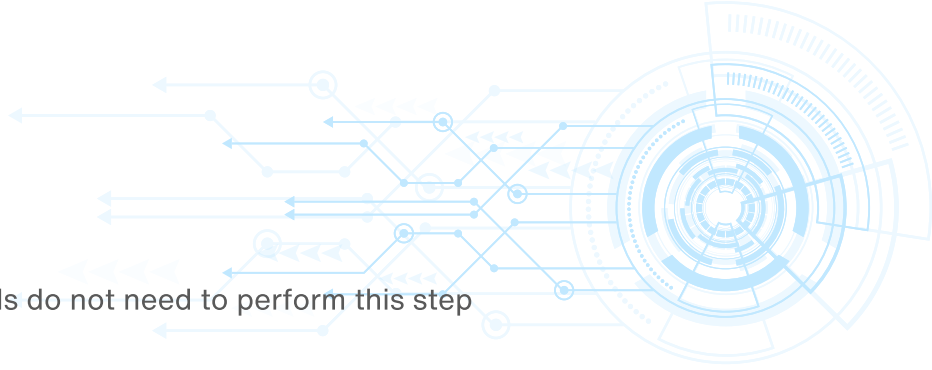
2.2.3 Grouting First, slowly pour the mud into the hole, about 1/2 of the hole; it can be increased or decreased according to the actual situation.

Secondly, slowly put the sensor into the hole, slowly turning and pressing down in one direction, too fast speed may cause the bubbles to not be completely discharged.

(NOTE: Do not pull up the sensor during the process of turning and pressing again to prevent gas from being sucked into the hole again).

Finally, when the sensor is installed to the correct depth, some mud will overflow around the equipment and the grouting is completed; at this time, the installation depth of the sensor is flush with the hole. (Note: Remove excess mud beyond 3CM around the sensor to prevent agglomeration from affecting moisture infiltration)

2.2.4 Installation Complete After pulling out the top cover of the device, press the power button, the device can work normally. It is recommended to perform normal work after the mud returns to normal state



2.3 Solar panel installation

Users who do not use solar power panels do not need to perform this step

2.3.1 Site selection of solar panels The installation position of the solar panel should be as far away as possible from the sensor, generally more than 50cm away, but not beyond the length of the power cord. The panel of the solar power supply panel should face the sun, that is, the south, and the front should be as clear as possible, and the solar panel support can be inserted in the selected position.

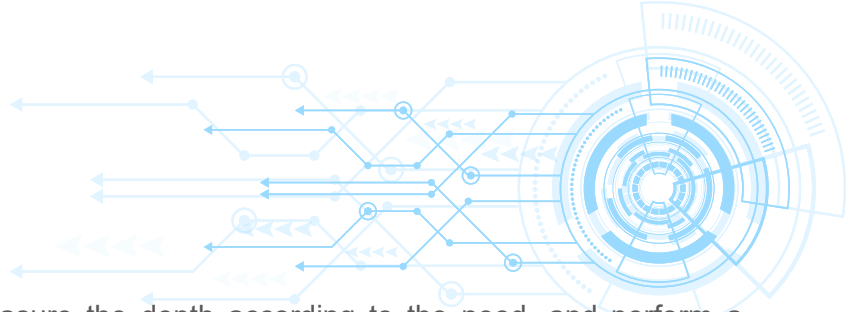
2.3.2 Fix solar panels Install and fix the solar panel on the bracket, align the four holes on the back of the metal frame of the solar panel with the four holes on the bracket, and then tighten with screws and nuts to complete the installation.

2.3.3 Connect the solar power supply board and the measuring instrument First, connect the panel and the terminal on the bracket together, and screw them together;

Secondly, align the other end of the power cord of the bracket with the sensor interface and insert it, and tighten the bolts to complete the installation of the solar panel.

Finally, after the installation is complete, press the power button and the device can work normally. It is recommended to perform normal work after the mud returns to its normal state, as shown in the figure:





2.4 Measurement Method

Select a suitable measurement location, measure the depth according to the need, and perform a punch test according to the size of the measuring instrument, and fill the pit tightly, press the power switch button of the measuring instrument, and the measuring instrument will start to work. It can measure and record continuously for several days, months or even longer. The collection method is shown in the figure:



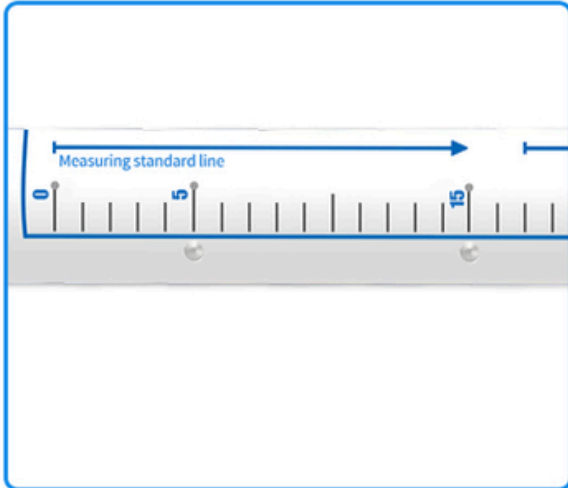
2.5 Precautions

The measuring instrument must be inserted vertically into the test environment.

- When the equipment is buried in the test environment, do not press too hard.
- Not suitable for absolute moisture measurement of saline-alkali soil, sandy soil, or other powdery objects with high salt content.
- Do not use in the environment with soil impurities, stones, roots, or in hardly dissolve soil condition
- The measuring instrument cannot be completely buried in the soil, and the equipment is marked

Product Details

Details Create Quality. Designed for the Agri Industry



Customizable Measuring Points

Gauge can measure soil at different depths. Collect Temperature and Humidity values at the same time.

The measuring points can be customised

Good Sealing Performance

The product shell adopts a sealed structure, which effectively protects the internal structure of the product and has a long service life



The measuring instrument cannot be completely buried in the soil, and the equipment is marked

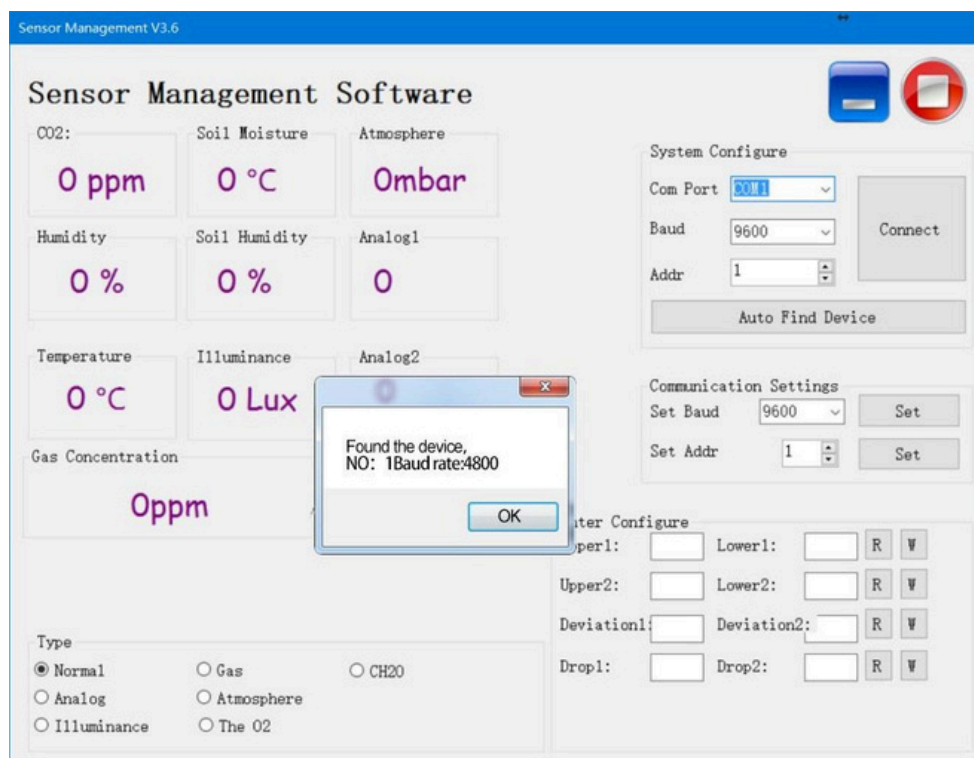
III. CONFIGURATION TOOL INSTALLATION AND USE

We provide CONFIGURATION TOOL , which can be easily used to test our sensor device.

3.1 Sensor Access Computer

Transmitter can be connected to PC with the RS485 to USB adapter. You can check the COM port number through Device Manager (right click My Computer).

3.2 How To Use Configuration Tool



Please note that this software can only test one device at the same time. After connecting the physical device, click the **CONNECT** button to read the information. In the UNCONNECT state, you can modify BAUD and ADDR in COMMUNICATION SETTINGS.

Under the software, different check boxes can be selected according to different situations. For example, you can choose the GAS option to test the RS485 OXYGEN SENSOR , you can choose the NORMAL option to test the RS485 TEMPERATURE AND HUMIDITY SENSOR .

IV. COMMUNICATION PROTOCOL

4.1 Communication Basic Parameters

TABLE 3 Communication Basic Parameters

PARAMETERS	
Protocol	Modbus RTU
Data bits	8 bit
Parity bit	No
Stop bit	1 bit
Error checking	CRC (redundant loop code)
Baud rate	2400 bps/ 4800 bps/ 9600 bps can be set; factory defaults 9600 bps

For more information about **MODBUS RTU** please visit the "www.modbus.org".

4.2 Data frame format definition

Using Modbus-RTU communication protocol, the format is as follows: Time of initial structure ≥ 4 bytes Address code = 1 byte Function code = 1 byte Data area = N bytes Error check = 16-bit CRC code Time to end structure ≥ 4 bytes Address code: The address of the transmitter, which is unique in the communication network (factory default 0x01). Function code: the command function instruction issued by the host, this transmitter only uses function code 0x03 (read register data).

Data Area: The data area is the specific communication data, pay attention to the high byte of 16bits data first! CRC code: two-byte check code.

Enquiry Frame:

Address Code	Function Code 1	Register Address	Register Length	Check Code Low Bit 1	Check Code High Bit 1
1 Byte	Byte	2 Bytes	2 Bytes	Byte	Byte

Answer Frame:

Address Code	Function Code	Numbers of Effective Bytes	1st Data Zone	2nd Data Zone	Nth Data Zone	Check Code
1 Byte	1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes	2 Bytes

Register Address	Plc Configuration Address	Content	Operation
0001H	40002	Depth1: Device Address	Read-Only
0002H	40003	Depth1: Soil humidity(unit 0.1%RH)	Read-Only
0003H	40004	Depth 1: Soil temperature(unit 0.1°C)	Read-Only
0004H	40005	Depth2: Device Address	Read-Only
0005H	40006	Depth2: Soil humidity(unit 0.1%RH)	Read-Only
0006H	40007	Depth 2: Soil temperature(unit 0.1°C)	Read-Only
0007H	40008	Depth3: Device Address	Read-Only
0008H	40009	Depth3: Soil humidity(unit 0.1%RH)	Read-Only
0009H	40010	Depth 3: Soil temperature(unit 0.1°C)	Read-Only
001E H	4001F (4002)	Nitrogen content (unit mg/kg)	Read-Only
001F H	40020 (40022)	Phosphorus content(unit mg/kg)	Read-Only
0020 H	40021 (40023)	Potassium content (unit mg/kg)	Read-Only

0100H	40257	Device Address(0-252)	Read & Write
0101H	40258	Baud Rate (2400/4800/9600)	Read & Write

TABLE 4 Register Address

Note: This register address is for products connected with 3 collection boards. Please refer to the actual number of collection boards. If there is one more collection board, there will be 3 more register addresses in the future, which respectively represent the device address and the soil moisture of this layer. , The soil temperature of this layer.

4.3 Communication Example

4.3.1 Read Device Address 0x01's Soil Temperature & Humidity of 3 depths

Inquiry Frame

Address Code	Function Code	Start Address	Data Length	Check Code Low	Check Code High
0x01	0x03	0x00 0x01	0x00 0x09	0Xd4	0x0C

Answer Frames

Address Code	Function Code	Number Of Valid Bytes	Depth1: Device Address	Depth1: Humidity	Depth1: Temperature	Depth2: Device Address
0x01	0x03	0x18	0X00,0X01	0x01,0x4C	0x00,0xE1	0X00,0X02
Depth2: Humidity	Depth2: Temperature	Depth3: Device Address	Depth 3: Humidity	Depth3: Temperature	Check Code Low	Check Code High
0x01,0x41	0x00,0xDB	0X00,0X03	0x01,0x39	0x00,0xD9	0x90	0xC6

Depth 1 Soil Temperature: 00E1H(Hexadecimal)=225=>Soil temperature=22.5°C

Depth 1 Soil Moisture: 014CH(Hexadecimal)=332=>Soil humidity=33.2%RH

Depth 2 Soil Temperature: 00DBH(Hexadecimal)=219=>Soil Temperature=21.9°C

Depth 2 Soil Moisture: 0141H (hexadecimal) = 321 => soil moisture = 32.1%RH

Depth 3 Soil Temperature: 00D9H (hexadecimal)=217=>soil temperature=21.7°C

Depth 3 Soil Moisture: 0139H (hexadecimal) = 313 => soil moisture = 31.3%RH

4.3.2 Read the Soil NPK Value from Device Address 0x01

Inquiry Frame

Address	Code	Function Code	Register Start Address	Register Length	CRC_L	CRC_H
0x01		0x03	0x00 0x1E	0x00 0x03	0x34	0x0D

Answer Frame

Address Code	Function Code	Effective number of bytes	Nitrogen content	Phosphorus content	Potassium content	CRC_L	CRC_H
0x01	0x03	0x06	0x00 0x20	0x00 0x25	0x00 0x30	0x5 A	0x3D

NPK content:

0020H (hexadecimal) =32=>Nitrogen=32mg/kg
 0025H (hexadecimal) =37=>Phosphorus=37mg/kg
 0030H (hexadecimal) =48=>Potassium=48mg/kg

4.3.3 Reading the value of soil nitrogen at device address 0x01

Inquiry Frame

Address Code	Function Code	Register Start Address	Register Length	CRC_L	CRC_H
0x01	0x03	0x00 0x1e	0x00 0x01	0xB5	0xCC

Answer Frame

Address Code	Function Code	Effective No. of bytes	Nitrogen content	CRC_L	CRC_H
0x01	0x03	0x02	0x00 0x20	0x5A	0x3D

Nitrogen Content: 0020H (Hexadecimal) =32=> Nitrogen =32mg/kg

4.3.4 Reading the Value of Soil Phosphorus in Device Address 0x01

Inquiry Frame

Address Code	Function Code	Register start address	Register length	CRC_L	CRC_H
0x01	0x03	0x00 0x1f	0x00 0x01	0xE4	0x0C

Answer Frame

Address Code	Function Code	Effective No. of bytes	Phosphorus content	CRC_L	CRC_H
0x01	0x03	0x02	0x00 0x25	0x5A	0x3D

Phosphorus Content: 0025 H (16hexadecimal =37=>Phosphorus=37mg/kg

4.3.5 Reading the Value of Soil Potassium in Device Address 0x01

Inquiry Frame

Address Code	Function Code	Register start address	Register length	CRC_L	CRC_H
0x01	0x03	0x00 0x20	0x00 0x01	0x85	0xC0

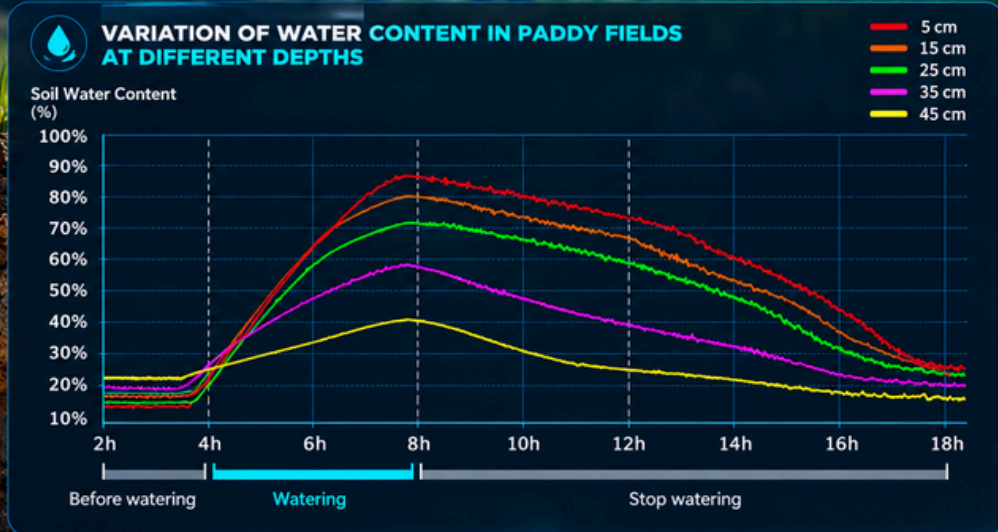
Answer Frames

Address Code	Function Code	Effective No. of bytes	Potassium content	CRC_L	CRC_H
0x01	0x03	0x02	0x00 0x30	0x5A	0x3D

Potassium : 0030 H (16hexadecimal) =48=>Potassium=48mg/kg

VISUALIZATION OF CROP GROWTH AND WATER LEVEL CHANGES

Forecast the onset and duration of crop water stress.
Forecast the current soil water storage and the duration of the current soil water storage that can be absorbed.



RELATED SOLUTIONS



Silos / Storage Monitoring

Cattle Health Monitoring & Tracking

