SEM225 ALL IN ONE SOIL SENSORS

(RS485 Type)

Product Manual

V22080512W

OVERVIEW

SEM225 transmitter has stable performance, high sensitivity, fast response, stable output, and is suitable for various soil qualities. 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. Can be buried in the soil for a long time, resistant to long-term electrolysis, corrosion resistance, vacuum potting, and completely waterproof.
The transmitter 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 for temperature and humidity, electrical conductivity, PH value testing .

FEATURES

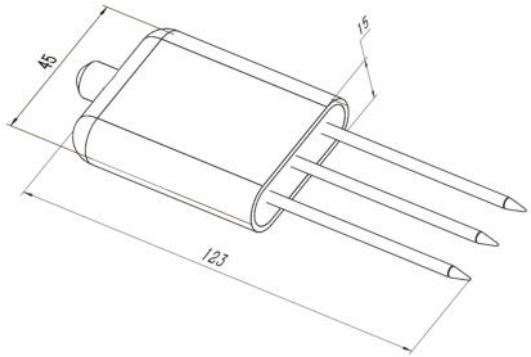
① The seven items of soil moisture content, electrical conductivity, temperature, nitrogen, phosphorus and potassium, and pH value are all in one.
② The threshold is low, the steps are few, the measurement is fast, no reagents are needed, and the number of detections is unlimited.
③ The electrode is made of specially treated alloy material, which can withstand strong external impact and is not easy to damage.
④ Completely sealed, resistant to acid and alkali corrosion, and can be buried in soil or directly into water for long-term dynamic testing.
⑤ High precision, fast response, good interchangeability, probe plug-in design to ensure accurate measurement and reliable performance.
⑥ It can also be used for the conductivity of water and fertilizer integrated solutions, as well as other nutrient solutions and substrates.
⑦ PH value measurement accuracy is high, up to ±0.3PH accuracy, fast response speed and good interchangeability.

SPECIFICATION

DC powered（default）	5~30VDC	
Maximum power consumption	0.5W (24V DC power supply)	
Working temperature	-20°C~+60°C	
Conductivity parameter	Range	0-20000us/cm
	Resolution	1us/cm
	Precision	±3%FS in the range of 0-10000us/cm; ±5%FS in the range of 10000-20000us/cm
Soil moisture parameters	Range	0-100%
	Resolution	0.1%
	Precision	2% within 0-50%, 3% within 50-100%
Soil temperature parameter	Range	-40~80°C
	Resolution	Resolution: 0.1°C
	Precision	±0.5°C (25°C)
Soil PH parameter	Range	3~9PH
	Resolution	0.1
	Precision	±0.3PH

Soil NPK parameter	Range	1-1999 mg/kg(mg/L)
	Resolution	1 mg/kg(mg/L)
	Precision	±2%FS
Conductivity temperature compensation	Built-in temperature compensation sensor, compensation range 0-50°C	
Protection grade	IP68	
Probe material	Anti-corrosion special electrode	
Sealing material	Black flame-retardant epoxy resin	
Default cable length	2 meters, the cable length can be customized as required	
Dimensions	45*15*123mm	
Output signal	RS485 (Modbus protocol)	

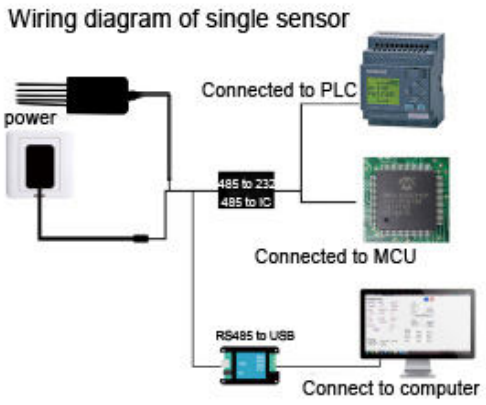
DIMENSION



Equipment size drawing (unit: mm)

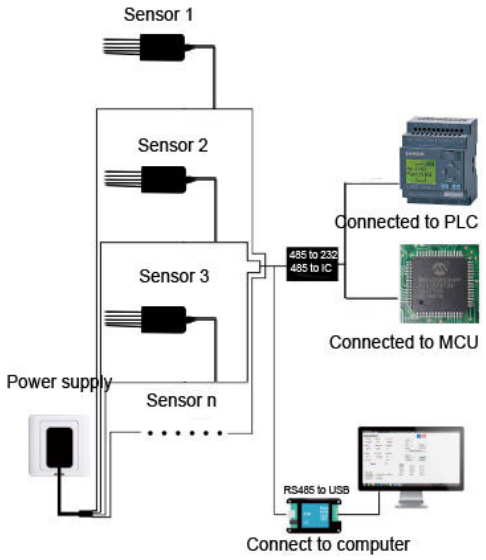
System framework diagram

The sensor can be connected and used alone. First, 12V DC power supply is used. The equipment can be directly connected to PLC with 485 interface, and can be connected to MCU through 485 interface chip. Through the Modbus protocol specified later, the MCU and PLC can be used together with the sensor. At the same time, USB to 485 can be used to connect with the computer, and the sensor configuration tool provided by our company is used for configuration and test.



This product can also be combined with multiple sensors in a 485 bus. In theory, a bus can be connected with more than 16pc RS485 sensors. If more 485 sensors need to be connected, more 485 devices can be expanded by using 485 repeater. The other end can be connected to PLC with 485 interface, MCU is connected through 485 interface chip, or USB to 485 can be used to connect with computer The sensor configuration tool provided by the company is used for configuration and testing.

Multi sensor wiring diagram



Inspection before equipment installation

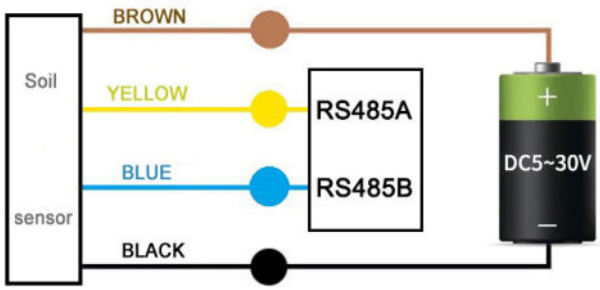
Equipment list:
- Transmitter
- USB to 485 conventer(optional)
- warranty card, certificate, wiring instructions, etc

1. INTERFACE DESCRIPTION

Wide voltage power input 5 ~ 30V can be used. When connecting the 485 signal line, pay attention to that the A and B lines can not be reversed, and the addresses of multiple devices on the bus can not conflict.

2. WIRING INSTRUCTIONS

Color of wires	Description	Remark
Brown	Positive power supply	5~30V DC
Black	Negative power supply	GND
Yellow	485-A	485-A
Blue	485-B	485-B



APPLICATION

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.

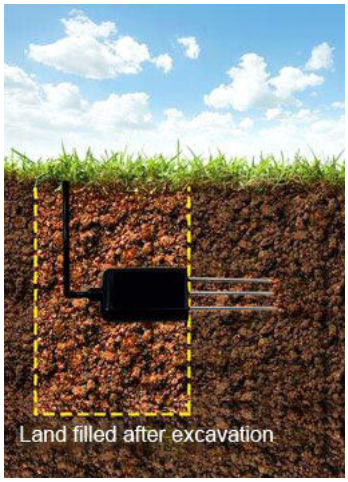
If you are measuring on a hard surface, you should drill holes first (the hole diameter should be smaller than the diameter of the probe), then insert the soil and compact the soil before measuring; the transmitter should be protected from severe vibration and impact, let alone knocked with hard objects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

1.RAPID MEASUREMENT

Choose a suitable measurement location, avoid stones, ensure that the steel needle does not touch hard objects, throw away the topsoil according to the required measurement depth, maintain the original tightness of the soil below, hold the sensor vertically into the soil, insert It is not allowed to sway from side to side. It is recommended to measure multiple times to get the average value within a small range of a measuring point.

2.BURIED MEASUREMENT

Dig a pit with a diameter >20cm 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.

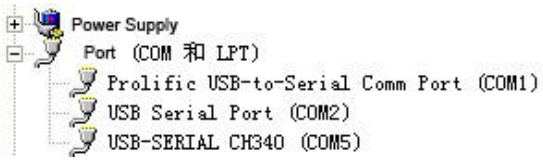


3. WARNINGS

- The steel needle must be fully inserted into the soil during measurement.
- Avoid direct sunlight on the sensor causing excessive temperature. Pay attention to lightning protection when using in the field.
- Do not bend the steel needle violently, do not pull the sensor lead forcibly, and do not drop or hit the sensor violently.
- The protection grade of the sensor is IP68, which can soak the sensor in the water.
- Due to the existence of radio frequency electromagnetic radiation in the air, it should not be energized in the air for a long time.

SOFTWARE CONFIGURATION

① After the sensor is correctly connected to the computer via USB to 485 and supplied with power, you can see the correct COM port in the computer (check the COM port in "My Computer—Properties—Device Manager—Port").



②Open the data package, select "Debugging Software" --- "485 Parameter Configuration Software", find "485 Configuration Software" and open it.
If the COM port is not found in the device manager, it means that you have not installed the USB to 485 driver (included in the data package) or the driver has not been installed correctly, please contact a technician for help.

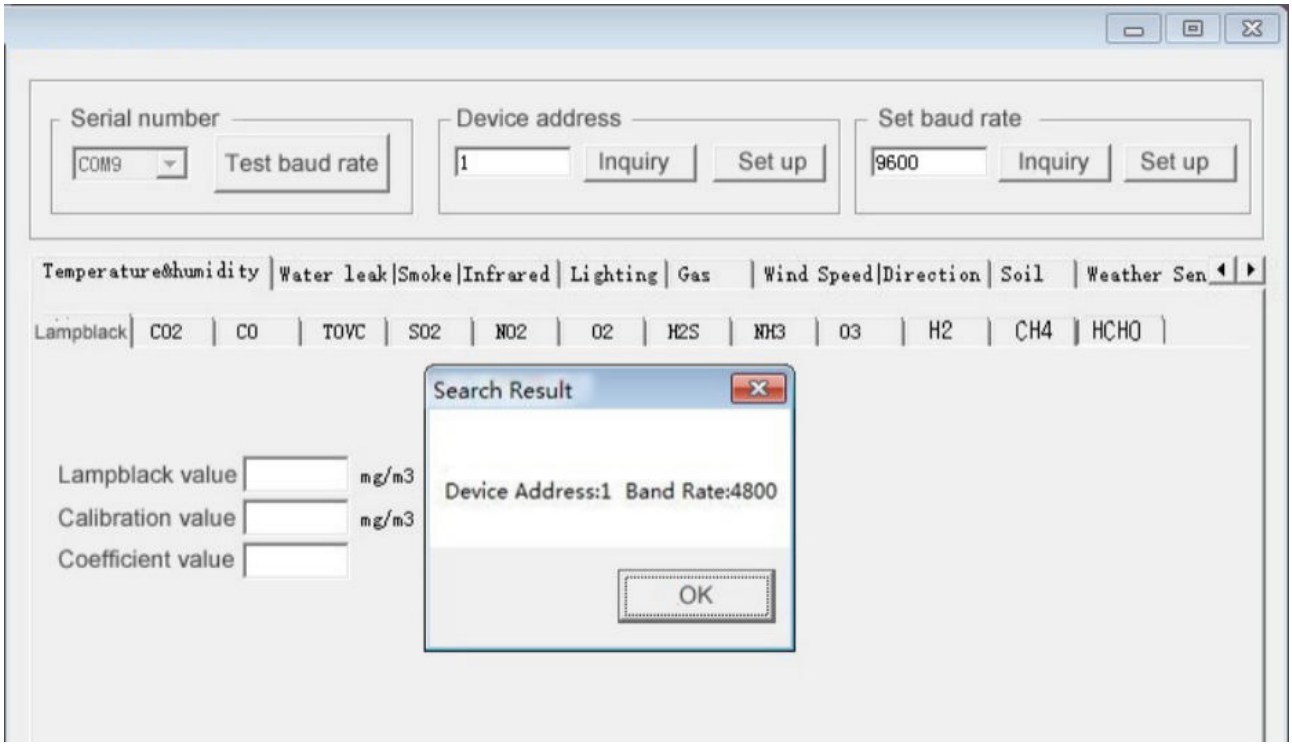
Use of sensor monitoring software

①. The configuration interface is shown in the figure. First, obtain the serial port number according to the method in chapter 3.1 and select the correct serial port.

②. Click the test baud rate of the software, the software will test the baud rate and address of the current device, the default baud rate is 4800bit/s, and the default address is 0x01.

③. Modify the address and baud rate according to the needs of use, and at the same time query the current function status of the device.

④. If the test is unsuccessful, please recheck the equipment wiring and 485 driver installation.



COMMUNICATION PROTOCOL

1. SPECIFICATION

Coding	8-bit binary
Data bit	8 bit
Parity bit	no
Stop bit	1 digit
Error checking	CRC (Redundant Cyclic Code)
Baud rate	2400bps, 4800bps,9600bps (available),4800bps (default)

2. DATA FRAME FORMAT DEFINITION

Apply Modbus-RTU communication rules, the format below：

Initial structure ≥4 bytes time

Address code = 1 byte

Function code = 1 byte

Data area = N byte

Incorrect revision = 16 bytes CRC code

Ending structure ≥4 bytes time

Address code：The address of the transmitter， and will be the only (factory default 0x01) in the communication net..

Function code：The instruction function instruction issued by the host, the transmitter uses the function code 0x03 (reading register data)

Data area：Data area is the specific communication data, attention16bits data high byte in front!

CRC code：two bytes revision code.

* Query Frame:

Address code	Function code	Register start address	Register length	CRC_L	CRC_H
1byte	1byte	2byte	2byte	1byte	1byte

* Answering frame:

Address code	Function code	Valid bytes	1st Data area	2nd Data area	Data N area	CRC
1byte	1byte	1byte	2byte	2byte	2byte	2byte

3. REGISTER ADDRESS

Register address	PLC or configuration address	Content	Operation	Definition
0000 H	40001 (decimal)	Moisture content	Read only	Real-time value of water content (expanded 10 times)
0001 H	40002 (decimal)	Temperature value	Read only	Real-time temperature value (expanded 10 times)
0002 H	40003 (decimal)	Conductivity	Read only	Real-time conductivity value
0003 H	40004 (decimal)	PH value	Read only	PH real-time value (expanded ten times)
0004H	40005 (decimal)	Nitrogen content	Read only	Actual value of nitrogen content
0005H	40006 (decimal)	Phosphorus content	Read only	Actual value of phosphorus content
0006H	40007 (decimal)	Potassium content	Read only	Actual value of potassium content
0007 H	40008 (decimal)	salinity	Read only	Salinity real-time value
0008 H	40009 (decimal)	Total dissolved solids TDS	Read only	TDS real-time value
0022 H	40035 (decimal)	Conductivity temperature coefficient	Read and write	0-100 corresponds to 0.0%-10.0% Default 0.0%
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 (expanded by 10 times)

0051 H	40082 (decimal)	Water content calibration value	Read and write	Integer (expanded by 10 times)
0052 H	40083 (decimal)	Conductivity calibration value	Read and write	Integer
0053 H	40083 (decimal)	PH calibration value	Read and write	Integer
04E8 H	41001 (decimal)	Sixteen higher nitrogen content coefficient	Read and write	Real value (IEEE754 standard floating point type)
04E9 H	41002 (decimal)	Sixteen lower nitrogen content coefficient	Read and write	
04EA H	41003 (decimal)	Nitrogen content calibration value	Read and write	Integer
04F2 H	41011 (decimal)	Sixteen higher phosphorus content coefficient	Read and write	Real value (IEEE754 standard floating point type)
04F3 H	41012 (decimal)	Sixteen lower phosphorus content coefficient	Read and write	
04F4 H	41013 (decimal)	Phosphorus content calibration value	Read and write	Integer
04FC H	41021 (decimal)	Sixteen higher potassium content coefficient	Read and write	Real value (IEEE754 standard floating point type)
04FD H	41022 (decimal)	Sixteen lower potassium content coefficient	Read and write	
04FE H	41023 (decimal)	Potassium content calibration value	Read and write	Integer
07D0 H	42001 (decimal)	Device address	Read and write	1~254 (factory default 1)
07D1 H	42002 (decimal)	Device baud rate	Read and write	0 means 2400 1 is 4800 2 is 9600

*Note: The conductivity moisture equipment has no temperature value and its calibration value register

4. EXAMPLE AND EXPLANATION OF COMMUNICATION PROTOCOL

- **Example: Read the conductivity and temperature and moisture value of a four-in-one device with conductivity, temperature and moisture (address 0x01)**

* Inquiry frame

Address code	Function code	Starting address	Data length	CRC_L	CRC_H
0x01	0x03	0x00 0x00	0x00 0x04	0x44	0x09

*Replay frame

Address code	Function code	Returns the number of valid bytes	Moisture value	Temperature value	Conductivity value	PH value	CRC_L	CRC_H
0x01	0x03	0x08	0x02 0x92	0xFF 0x9B	0x03 0xE8	0x00 0x38	0x57	0xB6

Temperature calculation:
When the temperature is lower than 0 °C, the temperature data is uploaded in the form of complement code.
Temperature: FF9B H (hexadecimal) = -101 => temperature = -10.1°C
Moisture calculation:
Moisture: 292 H (hexadecimal) = 658 => Humidity = 65.8%, that is, the soil volumetric moisture content is 65.8%.
Conductivity calculation:
Conductivity: 3E8 H (hexadecimal) = 1000 Conductivity = 1000 us/cm
PH value calculation:
PH value: 38H (hexadecimal) = 56 => PH value = 5.6

COMMON PROBLEMS AND SOLUTIONS

- **No output or output error**

Possible reason:

① The computer has a COM port, and the selected port is incorrect.

② The baud rate is wrong.

③ The 485 bus is disconnected, or the A and B wires are connected reversely.

④. Too much equipment or too long wiring, power supply nearby, add 485 booster, and add 120Ω terminal resistance at the same time.

⑤ The USB to 485 driver is not installed or damaged.

⑥ The equipment is damaged.