Environmental monitoring
system and remote control

# Soil Temperature and Moisture

# ( and/or conductivity) sensor

# Mod. SM.x

## Manual

## Summary

## 1. Packaging and mounting

The sensor is placed in its original packaging already mounted.

**RS485/ModBus version**

Includes:

- SM
- Cable 5-10m

**Analog output version**

Includes:

- SM
- cable 5-10m

## 2. Functioning and features

The SM-2 soil moisture sensor is a very precise sensor and integrates **temperature and soil moisture measurements (and conductivity for SM.3 model) in a single instrument**. The operating principle is based on the FDR (Frequency Domain Reflectometry 70MHz) system for a precise measurement of the soil dielectric constant and therefore to measure the volume of soil moisture content. For the temperature part it uses a PT100 thermo-resistance sensor. Steel spikes are inserted into the surface of the ground or in the section for a quick measurement of the ground parameters. This method is the main one for this type of measurement. It can be left permanently left in the ground or even just to make quick and accurate measurements.
This sensor is built according to the WMO standards (World Meteorological Organization) and is available with output **0÷2Vdc,4÷20mA or RS485/Modbus**

| Measure | Humidity (VWC) | Temperature | Conductivity |
|---|---|---|---|
| Range | 0-100% $m^3$ | -40°C ÷ +80°C | 0 – 20 mS/cm |
| Accuracy | ± 3% (0-50%) | ± 0.2°C | ± 2% FS |
| Resolution ($m^3/m^3$) | <0.002 $m^3/m^3$ | <0.05°C | <0.001mS/cm |
| Signal Output | 4÷ 20mA, 0÷2V, ModBus RS485 | | ModBus RS485 |
| Response time | < 1s | | |
| Power supply and consumption | 12÷24Vdc (max 12mA ÷ 60mA) | | |
| Measure area | 7-10cm ray around probe | | |
| Made of | ABS | | |
| Size | 71 x 45 x 16mm (spikes Ø4 x 55mm) 5m cable | | |
| Operative range | -30 ÷ +70°C | | |
| Protection | IP68 | | |
| Spikes | Inox 316L | | |

Features written in the table can be modified. For updating always see the latest version of the datasheet.

## 3. Available electrical outputs and interfacing

The sensor is usually available with 3 different outputs (pre-configured in factory), that correspond to 3 order codes:

| Wire | Analog output | Modbus RS485 output |
|---|---|---|
| Red | + 12/24 Vdc | + 12/24 Vdc |
| Black | GND common | GND common |
| Blue | Out temperature °C | N.C. |
| Brown | Out humidity Rh% | N.C. |
| Yellow | N.C. | RS485A |
| White | N.C. | RS485B |
| Green | N.C. | N.C. |

The sensor is usually available with 3 different outputs (pre-configured in factory), that correspond to 3 order codes, respectively (named SM-X the sensor code):

SM.x – **A** : Sensor with voltage output 0-2Vdc according to the chosen range

**[moisture = (mV/2000•100%) ]**

**[temperature = (mV/2000•120°) - |40°|]**

**[conductivity= (mV/2000•20mS)**

SM.x – **B** : Sensor with current output 4-20mA according to the chosen range

**[moisture = (100%)•(mA - 4)/16 ]**

**[temperature = (120°)•(mA - 4)/16 - |40°|]**

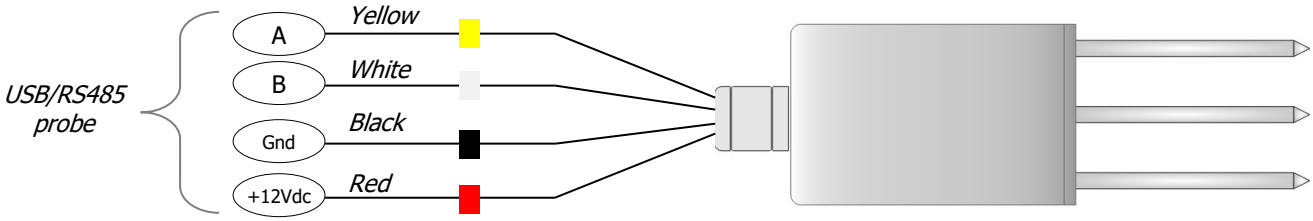
**[conductivity= (20mS)•(mA - 4)/16 ]**

SM.x – **C** : Sensor with digital output RS485 o ModBus- see below.

In case of sensors with digital output, consider this setting for **READING MODE** from sensor:

- ***RS845-MODBUS Interface (Half duplex)***
  *We suggest to use a standard software like putty.exe (free software : Download PuTTY - a free SSH and telnet client for Windows) and set it for an RS485 communication, using an USB/RS485 interface:*


  - Connect *the probe to an USB/RS485 interface as follows:*




  - Standard communication settings are:

| | |
|---|---|
| baud rate: | **9600** |
| parity: | **N** |
| data bit: | **8** |
| stop bit: | **1** |

- The sensor answers to ModBus RTU command only with **FUNCTION CODE 0x03** (Read Holding Register), on **the slave address is 01H (00H to FFHH)**; the protocol allows the reading of the measure value.

- The 04H Function Code

***Example:***

**read the Temperature, Moisture and EC on: 0x01 address**

Host scan command

**01 04 00 00 00 03 B00B**

Slave response

**01 04 06 08 90 0E 93 02 4E D257**

Temperature calculation:

**(0890)Hex < 0x8000 → (0890)Hex = (2192)Dec => 2192/100 = 21,92°C**

if the data >= 0x800 (example 0xFF05) use this formula:

**0xFF05-0xFFFF-0X01 = (65285)Dec–(65535)Dec–(1)Dec= (-251)Dec => -251/100 = -2,51°C**

Moisture calculation:

**(0E93)Hex = (3731)Dec => 3731/100 = 37.31%**

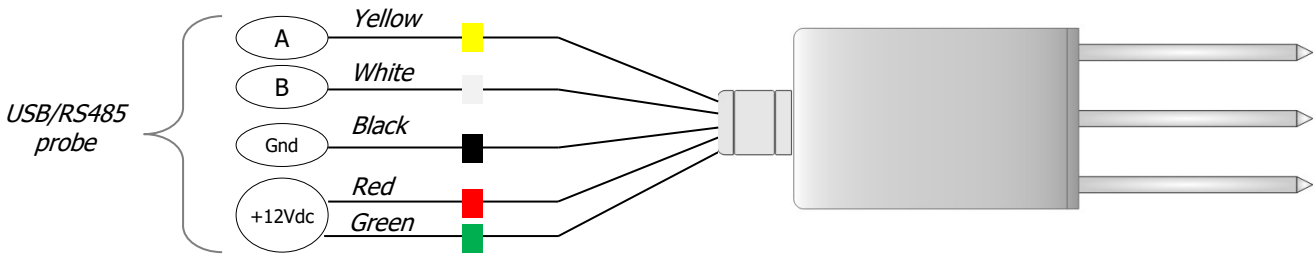
EC calculation:

**(024E)Hex = (590)Dec => 3731/1000 = 3,731mS/cm**

In case of sensors with digital output, consider this setting for **WRITING MODE** to the sensor:

- ***RS845-MODBUS Interface (Half duplex)***
  *We suggest to use a standard software like putty.exe (free software : Download PuTTY - a free SSH and telnet client for Windows) and set it for an RS485 communication, using an USB/RS485 interface:*

- Connect *the probe to an USB/RS485 interface as follows:*

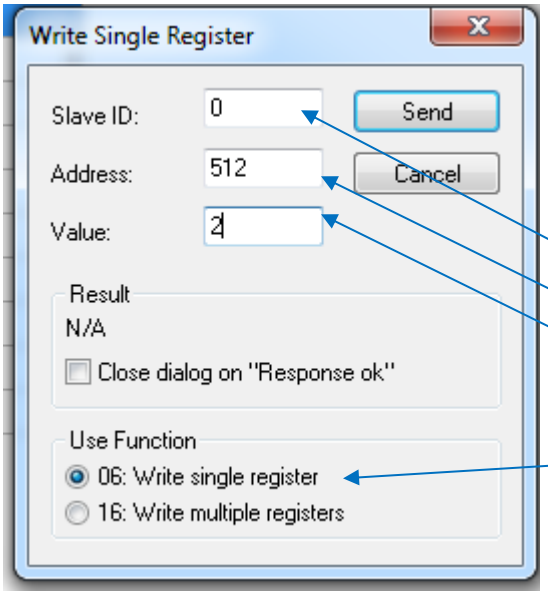



- Standard communication settings are:

  baud rate: **9600**
  parity: **N**
  data bit: **8**
  stop bit: **1**

- ***Change the slave address (only after the restart it will take effect)***

  *Set the putty mode into "write a single register"*




Set:
- ID: 0
- Addr: 0x200 (**512**)
- New ID value
- Function: 06H

- Or use the the 06H Function Code

**Example (change from 01 to 02H the ID):**

Host set command
**01 06 02 00 00 02 09B3**

Slave response
**01 06 02 00 00 02 09B3**

***NOTE:*** *If you forget the address is possible to use the set mode to change address, using 00H as default address value. After the ID change, disconnect the sensor and reconnect from the power supply*

***Table of register:***

| *Parameters* | *Register Addr. HEX/DEC)* | *Data type* | *Modbus Function Code (DEC)* | *Range and Comments* | *Default Value* |
|---|---|---|---|---|---|
| **TEMPERATURE** | 0x0000/0 | INT16 RO | 3/4 | -4000..8000 for-40,0°C to +80.0°C | N/A |
| **VWC- Volumetric water content** | 0x0001/1 | UINT16 RO | 3/4 | 0-10000 for 0-100% | N/A |
| **EC-Electrical Conductivity** | 0x0002/2 | UINT16 RO | 3/4 | 0-20000 for 0 to 20000µs/cm | N/A |
| **SLAVE ADDRESS** | 0x0200/512 | UINT16 R/W | 3/6/16 | 0-255 | 1 |
| **BAUD RATE** | 0x0201/513 | UINT16 R/W | 3/6/16 | 0-6 equal to:<br>0: 1200bps<br>1: 2400bps<br>2: 4800bps<br>3: 9600bps<br>4: 19200bps<br>5: 38400bps | 3: 9600bps |

## 4. Calibration

Each instrument is calibrated and verified by comparison with a primary instrument with known behavior. This determines the dynamic of the sensor to be calibrated.

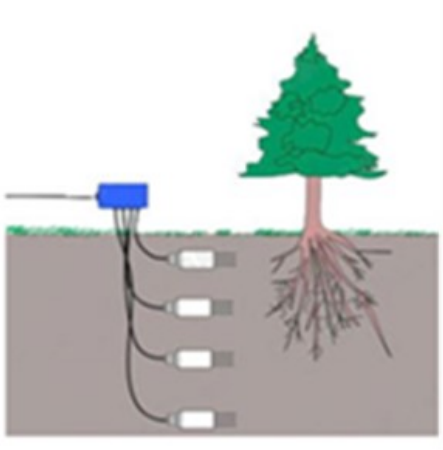
## 5. Cleaning and maintenance

None.

## 6. Installation

The installation can be made both horizontal or vertical position according to the area to be measured.

- Identify a measurement area where water does not stagnate. If the interested measure is superficial, insert the sensor vertically according to the depth of interest.
- If you want to make a measurement on several layers, the sensor or sensors must be positioned horizontally.
- Do not move the sensor after it has been positioned.
- When removing the sensor DO NOT pull it by the cable but dig with suitable tools until complete recovery
- If not in use, wash the sensor and store it in a dry and clean place, leaving it unplugged.



## *7. Validity of certificates*

Unless otherwise indicated, the sensor warranty is 24 months from the manufacturing date, while the validity of the certification is 12 months from first use if stored in a depot suitably to the characteristics written on the datasheet.