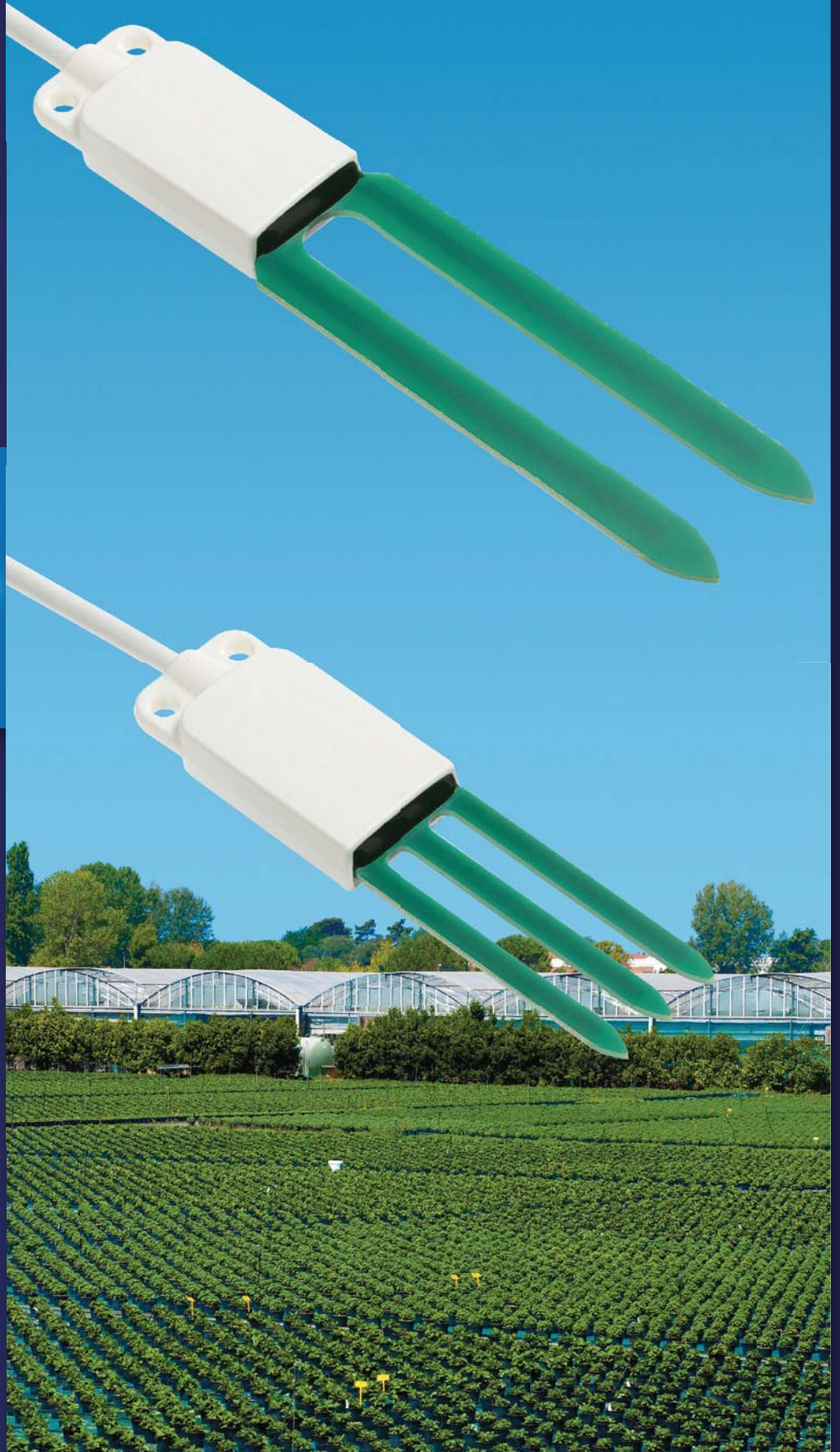


HD3910.1
HD3910.2

- ▶ [GB] Probes for soil moisture measurement



[GB] Characteristics

- Measurement of the soil moisture with 2 electrodes (**HD3910.1**) or 3 electrodes (**HD3910.2**) for restricted volumes
- Measurement of the soil temperature
- RS485 digital output with MODBUS-RTU protocol
- Accurate and stable measure over time
- Degree of protection IP 67
- Minimal invasiveness in the soil
- Easy to install

Application

- Agriculture
- Hydrology
- Geology

Description

The probes **HD3910.1** (two electrodes) and **HD3910.2** (three electrodes) measure the soil volumetric water content (VWC) by using a capacitive measurement principle which allows fast measurements in the field and with minimal invasiveness.

The three-electrode probe **HD3910.2** is particularly suitable for the measurement in small volumes, for example for cultivations in pots.

The probes are factory-calibrated and do not require any further calibration by the end user.

The circuit board is protected inside a housing made of plastic material and sealed with epoxy resin which allows achieving reliable measurements even in harsh environmental conditions.

The **RS485** digital output with **MODBUS RTU** protocol allows the use of even very long connection cables. It can be connected to the data loggers HD32MT.1 and HD32MT.3 or to any other data logger with RS485 MODBUS RTU input.

The probes are equipped with a fixed cable, 5 or 10m standard length, with open wires at the end.

Volumetric water content

The moist soil is composed of a solid part (minerals), a liquid part (generally water) and a gaseous part (air, water vapor).

The Volumetric Water Content (VWC) is defined as the ratio between the volume occupied by the water (V_w) in a certain portion of the soil and the total volume of the soil portion (V):

$$VWC = \frac{V_w}{V}$$

It can also be expressed as a percentage (% VWC) of the water volume in the total volume.

The volumetric water content is a parameter used in hydrology for the study of the hydraulic properties of the soil, and in agriculture to determine the need to irrigate crops.

Technical specifications

Soil moisture	
Measuring principle	Capacitive
Measuring range	0...100% VWC (Volumetric Water Content)
Resolution	0.1%
Accuracy (@ 23 °C)	± 3 % between 0 and 0.57 m ³ /m ³ (standard mineral soil up to 5 mS/cm)
Sensor operating temperature	-40...+60 °C
Soil temperature	
Sensor	NTC 10 kΩ @ 25°C
Measuring range	-40...+60°C
Resolution	0.1°C
Accuracy	± 0.5°C
Long-term stability	0.1°C / year
Power supply	5...30 Vdc
Consumption	2 mA average @ 12 Vdc (20 mA approx. @ 12 Vdc during the 100 ms measurement duration; a measurement per second is carried out.)
Output	RS485 with MODBUS RTU protocol
Materials	Handle: thermoplastic material and epoxy resin Electrodes: epoxy glass, thickness 2 mm
Connection	Fixed cable with open wires at the end, length 5 or 10 m standard
Protection degree	IP 67
Weight	150 g approx. (including the 5 m cable)

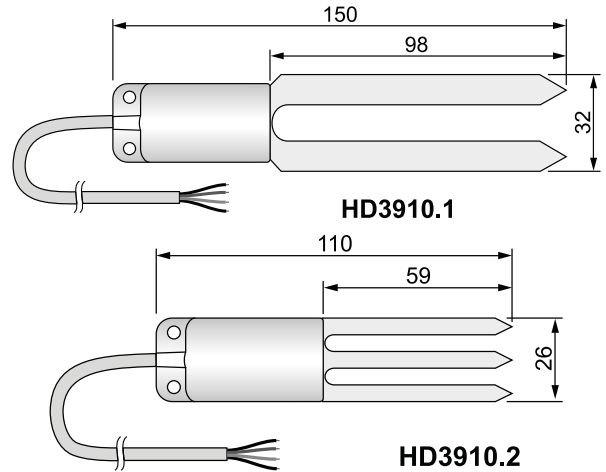


Fig. 1: dimensions (mm)

Installation

By means of an accessory, perform a hole into the soil deep enough to accommodate the probe. Never use the probe to make the hole in the soil, in order to avoid mechanical damage to the probe itself.

Once the hole was done, insert the probe **completely** into the soil so that the entire handle is covered by the ground: the temperature sensor is located inside the handle, close to the electrodes; therefore it is necessary that the handle is immersed in the soil for a correct detection of the temperature.

After the introduction of the probe, fill in the empty spaces between the soil and the probe with some soil made powder. To obtain accurate measurements, the soil should be in contact with the electrodes and the probe handle.



Probe 3910.1

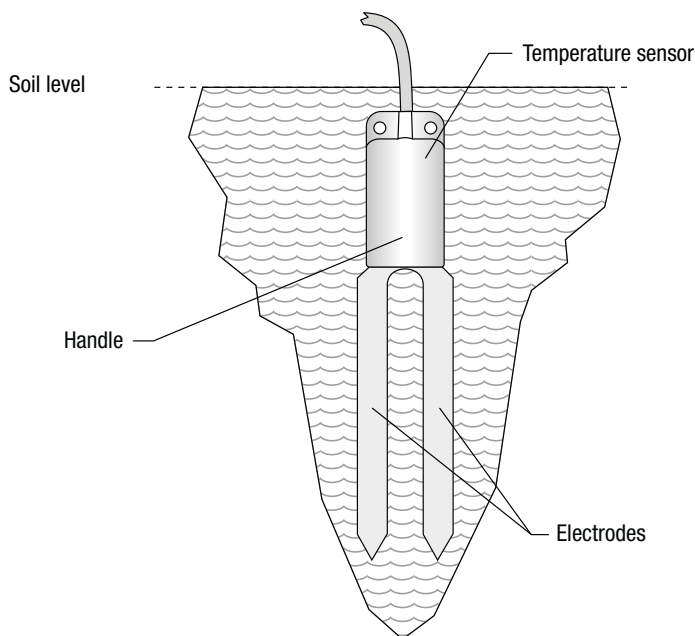
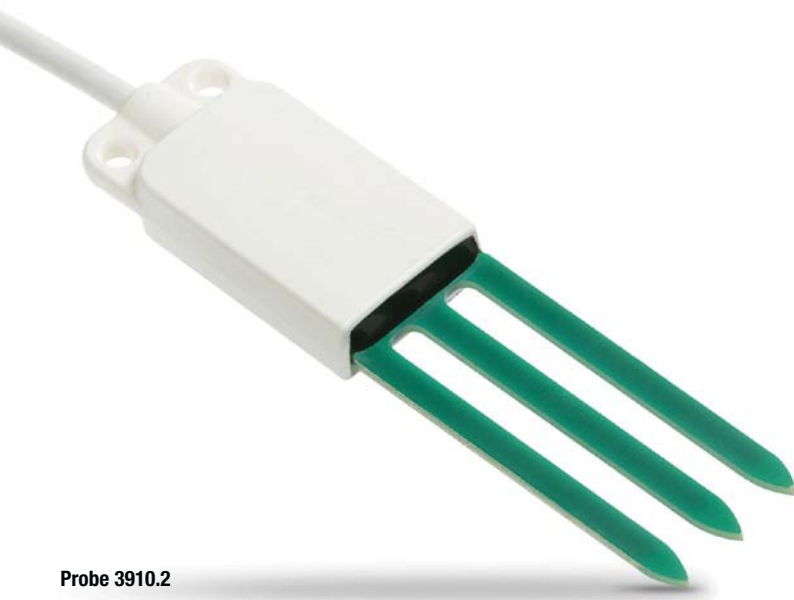


Fig. 2: Installation

The probe can be oriented in any direction, but it is advisable to place it vertically into the ground, so to not hinder the flow of water downward and to minimize the influence of the probe in the soil behavior.

Warnings:

- The portion of soil in which the probe is inserted must be uniform, without excessive air gaps, and not too compact as it would make the introduction of the probe difficult.
- Pay attention to the presence of roots, stones or other objects present in the subsurface that may come between the electrodes and affect the measure.
- Do not use excessive force when introducing the probe, s to avoid irreparable damage to the electrodes.
- The probe measures the water content of the soil volume immediately surrounding the electrodes: position the probe so that there are no objects close to the probe, such as metal poles for example, that may affect the field of action of the probe itself,.
- Indicate the presence of the probe during the maintenance operations of the soil (e.g. lawn mowing, ploughing, mechanized harvesting, etc.).
- In order to remove the probe from the soil, grab the handle and pull it upwards. **During the extraction, remove the probe vertically, by avoiding tilt that would damage the electrodes.**
- **Do not remove the probe by pulling the cable.**



Probe 3910.2

Connections

Wire color	Function
Black	Negative power supply
Red	Positive power supply
White	RS485 A/-
Green	RS485 B/+

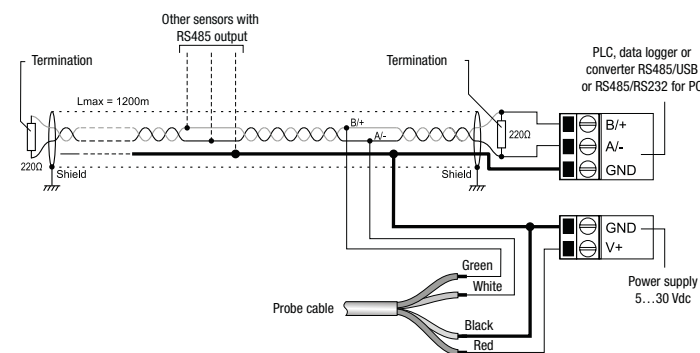


Fig. 3: Connections

Setting of RS485 communication parameters

Before connecting the probe to the RS485 network you must assign an address and set the communication parameters, if different from the factory preset.

The parameter setting is performed by connecting the probe to the PC by using a RS485/USB or RS485/RS232. The probe must be powered separately. If RS485/USB converter is used it is necessary to install the appropriate USB drivers in the PC.

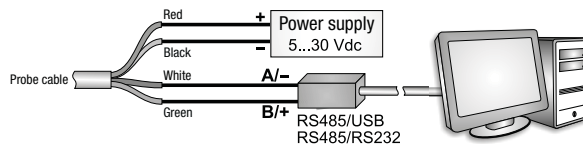


Fig. 4: connection to PC

Notes on the installation of unsigned USB drivers:

before installing unsigned USB drivers into Windows operating systems 7 and 8, it is necessary to restart the PC disabling the driver signature request. If the operating system is 64-bit, even after installation, it is necessary to disable the request of the driver signature every time the PC is restarted

Procedure for setting the parameters

1. Start while the probe is not powered.
2. Start a serial communication program, HyperTerminal for example. Set the Baud Rate to 57600 and set the communication parameters as follows (the instrument appears connected to a COM type port):
Data Bits =8, Parity =None, Stop Bits =2
In the program, set the number of the COM port to which you connect the probe.
3. Switch the probe on.
4. Wait until the probe transmits the & character, then send (within 10 seconds from probe power on) the command @ and press **Enter**.
Note: if the probe does not receive the @ command within 10 seconds from power on, the RS485 MODBUS mode is automatically activated. In such a case, it is necessary to switch off and power on the probe again.
5. Send the command **CAL USER ON**.
Note: the CAL USER ON command is disabled after an inactivity of 5 minutes.
6. Send the following serial commands to set the RS485 MODBUS parameters

Command	Reply	Description
CMA _{nn}	&l	Set address RS485 to nnn Ranging from 1 to 247. Preset on 1
CMB _n	&l	!Set RS485 Baud Rate: n=0 ==> 9600, n=1 ==> 19200 Preset on 1 ==> 19200
CMP _n	&l	Set RS485 transmission mode (data bits, parity, stop bits): n=0 => 8N1, n=1 => 8N2, n=2 => 8E1 n=3 => 8E2, n=4 => 8O1, n=5 => 8O2 Preset on 2 => 8E1
CMW _n	&l	Set receiving mode after RS485 transmission: n=0 => Violate protocol and go in Rx mode right after Tx n=1 => Respect protocol and wait 3.5 characters after Tx Preset on 1 ==> Respect the protocol

1. It is possible to check the settings of the parameters by sending the following commands:

Command	Reply	Description
RMA	<i>Address</i>	Read RS485 address
RMB	<i>Baud Rate</i> (0,1)	Read RS485 Baud Rate: 0 ⇒ 9600, 1 ⇒ 19200
RMP	<i>Tx Mode</i> (0,1,2,3,4,5)	Read RS485 transmission mode: 0 ⇒ 8N1, 1 ⇒ 8N2, 2 ⇒ 8E1, 3 ⇒ 8E2, 4 ⇒ 8O1, 5 ⇒ 8O2
RMW	<i>Rx Mode</i> (0,1)	Read reception mode after RS485 transmission: 0 ⇒ Violate the protocol and go in Rx mode right after Tx 1 ⇒ Respect the protocol and wait 3.5 characters after Tx

Note: the command CAL USER ON is not required for reading the settings.

Operating mode

The probe enters RS485 MODBUS RTU mode after 10 seconds from power on. During the first 10 seconds from power on, the probe does not respond to any request of the MODBUS master unit. After 10 seconds, it is possible to send MODBUS requests to the probe.

Reading the measurements

In MODBUS mode, it is possible to read the measured values by using the function code 04h (Read Input Registers). The following table shows the MODBUS Input Registers available:

Registri MODBUS – Input Registers

Register Number	Register Address	Datum	Format
2	1	Soil moisture % VWC (Volumetric Water Content) [x10]	16-bit integer
3	2	Apparent dielectric permittivity [x10]	16-bit integer
4	3	Soil temperature in °C [x10]	16-bit integer
5	4	Soil temperature in °F [x10]	16-bit integer

Maintenance

The probe does not require any special maintenance. We recommend a periodic cleaning with water and normal detergent of the electrodes in order to avoid the accumulation of substances that may alter the measures.

Ordering codes

HD 3910.1.5: Two-electrode probe for the measure of the soil moisture. Digital RS485 output with MODBUS RTU protocol. 5 m cable.

HD 3910.1.10: Two-electrode probe for the measure of the soil moisture. Digital RS485 output with MODBUS RTU protocol. 10 m cable.

HD 3910.2.5: Three-electrode probe for the measure of the soil moisture in restricted volumes. Digital RS485 output with MODBUS RTU protocol. 5 m cable.

HD 3910.2.10: Three-electrode probe for the measure of the soil moisture in restricted volumes. Digital RS485 output with MODBUS RTU protocol. 10 m cable.

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Photometry/Radiometry - Acoustics

CE CONFORMITY

- **Safety:** EN61000-4-2, EN61010-1 Level 3
- **Electrostatic discharge:** EN61000-4-2 Level 3
- **Electric fast transients:** EN61000-4-4 Level 3, EN61000-4-5 Level 3
- **Voltage variations:** EN61000-4-11
- **Electromagnetic interference susceptibility:** IEC1000-4-3
- **Electromagnetic interference emission:** EN55022 class B



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