SISTEMES ELECTRÒNICS PROGRÉS

Manual

Teros 10 soil water content sensor

CODE 06140293

Sensor for reading the soil water content (VWC) in relation to the volumetric content m3 water / m3 soil.

TEROS 10 sensors use an electromagnetic field to measure the apparent dielectric permittivity of the surrounding medium.

The sensor applies a 70 MHz wave to the sensor spikes, which are charged according to the material's dielectric constant. The charging time is proportional to the dielectric and the VWC of the substrate.

The internal microprocessor of the TEROS 10 measures this charge field and converts it to a VWC value using a specific calibration equation for each substrate.

Due to the high measurement frequency, TEROS 10 is not sensitive to variations in soil texture and EC. Its generic calibration equations therefore have reasonable precision of 0.03 m3/m3 for most mineral soils up to 8 dS/m.

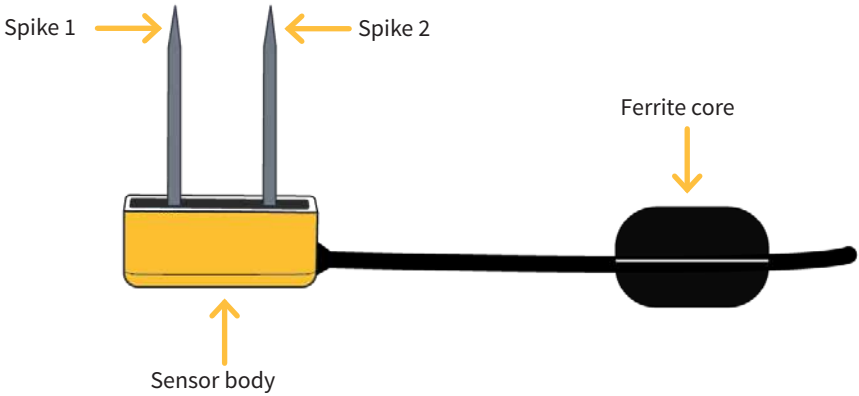
It can be read from any Agrónic controller by connecting it to an AgroBee-L H2O module or to an H2O transmitter up to a maximum of three sensors per device.

Some substrates have a very high dielectric permittivity constant (soil of volcanic origin or high titanium), if it is greater than six, the equations are not prepared, requiring custom equations that can only be provided by the manufacturer.

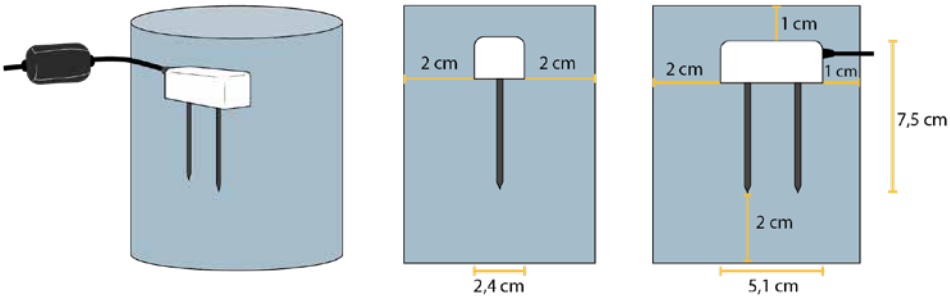
Technical specifications

Dimensions	Length: 5.1 cm - Width: 2.4 cm - Height: 7.5 cm
Temperature	Operating range: - 40 to 60ºC
Reading range	0 to 70%
Cable length	5 metres
Soil type	Mineral - Mulch
Resolution	± 0.03 m^3/m^3 in mineral soils with EC <8 dS/m
	± 0.05 m^3/m^3 in hydroponic soils with EC <8 dS/m

Sensor parts



The measurement sensitivity of the TEROS 10 VWC sensor is contained in a volume of approximately 430 ml. It is shown below:



Installation

The ferrite core placed on the TEROS 10 sensor cable 7.6 cm from the sensor body is used to isolate the sensor from any interference in the system. This mitigates any potential system noise in the measured sensor data.

IMPORTANT

Do not connect any other cables between the sensor body and the ferrite core, as this may influence the measurements.

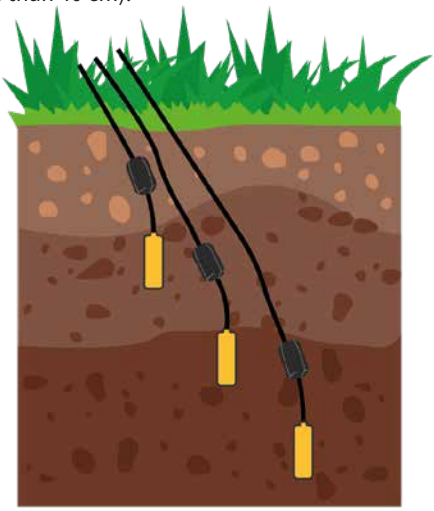
Recommendations to always take into account:

- Minimise soil disturbance at the measurement site.
- The correct thing to do is to install it in the native soil to get accurate soil moisture readings.
- Avoid air gaps around the sensor spikes as they can lead to low readings.
- When installing the sensors in rocky soil, be careful to avoid bending the sensor spikes.
- The TEROS 10 sensor can be placed in any direction (horizontally or vertically aligned spikes), however it is preferable that the sensor body is vertically aligned, providing less restriction to the flow of water through the soil because water will flow through the soil directly to the spikes.

INSTALLATION WITH TRENCH

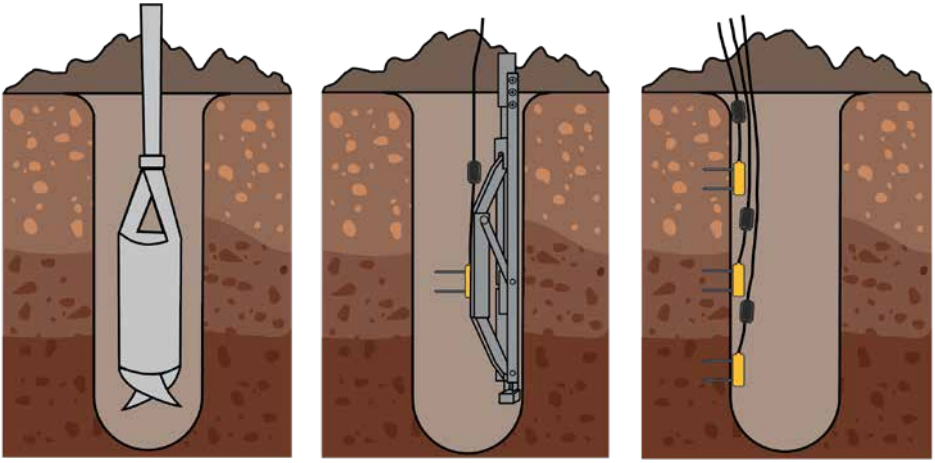
This method is best for shallow installations (less than 40 cm).

- Dig a trench or hole with a shovel, bulldozer, etc. The trench must be dug to the depth of the deepest sensor to be installed.
- Carefully install in the undisturbed soil on the side wall of the trench.
- Fill carefully, to preserve the apparent density of the soil and also to avoid dislodging the installed sensor, accidentally catching the ferrite core.



INSTALLATION WITH DRILL

This system provides comfortable installation for sensors deeper than 50 cm.



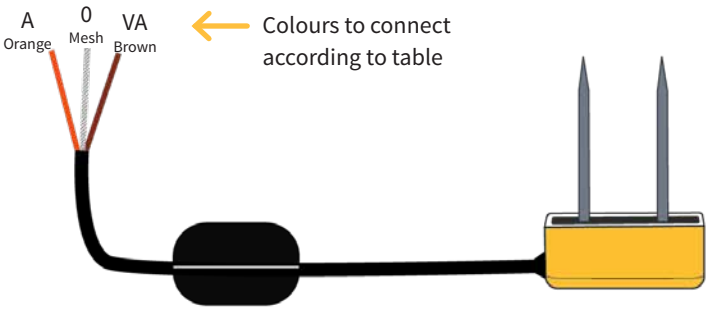
1. Drill and make the hole to the desired depth and direction according to the installation method and the different sensors to be installed.
2. Adjust the tool to the desired depth where the sensor is to be installed.
3. Place the TEROS 10 sensor in the installation tool (product not supplied by Progrés).
4. Insert the tool with the sensor into the hole with the back against the back wall, as shown in the image.
5. Pull the lever of the tool to activate the mechanism to drive the sensor into the side wall.

Check the installation with a drill video by clicking on the image,
via the link https://youtu.be/JHk2W8xQ0T4

Connections

The TEROS 10 sensor can be connected to the AgroBee-L H2O module, AgroBee H2O or to the H2O transmitter. A cable hose is provided for each unit that enables the different connections to be made easily with no need to access the inside of the module. All of the units use the following colour legend:

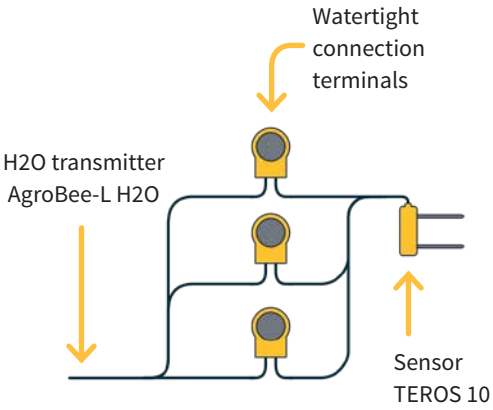
	SENSOR 1			SENSOR 2			SENSOR 3		
	Brown **VA1**	Mesh **0 V**	Orange **A1**	Brown **VA2**	Mesh **0 V**	Orange **A2**	Brown **VA3**	Mesh **0 V**	Orange **A3**
Transmitter H2O	Green	Brown	White	Pink	Grey	Yellow	Black	Red	Blue
AgroBee-L									



NOTE It is recommended that the cables that remain loose are also connected with a spare 3M connector to avoid possible short circuits or getting wet. These connectors are supplied together with the sensor.

To ensure the water tightness of the module's hose wire connections, it is recommended to use waterproof terminals. The connection through these terminals must be made without stripping the cable wires.

As connection elements, those of the 3M Scotchlok series (www.3m.com) can be used; ES Caps from TYCO Electronics (www.tycoelectronics.com); or the Cellpack splicing and resin diversion kits (www.cellpackiberica.com).

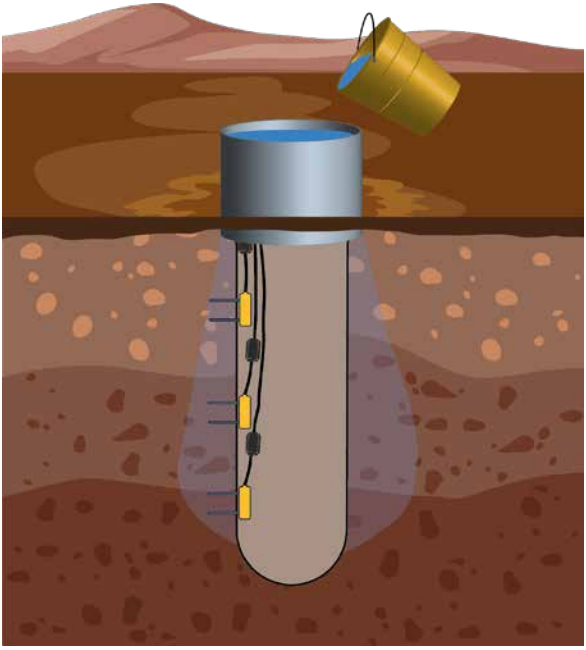


SOIL INFILTRATION

Once the sensor is installed, it is recommended to infiltrate the soil to achieve saturation and thus be able to view the field capacity value from the programmer.

This infiltration varies with soil texture and will be faster in sandy soils and slower in clay soils.

A ring-shaped container with a diameter and a height of approximately 30 cm is needed. You will also need a bucket of about 50-litre capacity to pour water into the container.



The steps to follow to infiltrate the soil are:

- Place the container in the centre where the Teros-10 probe is located and bury it about 10 cm.
- Pour 50 litres of water inside the ring in different doses and as the water infiltrates. This operation will take more or less time depending on the type of soil.
- Observe, through the programmer, the reading in % of water content in the soil of each of the sensors at different depths. The expected saturation values for each soil must be higher than the values marked as FC (Field Capacity) in the table shown on page 9.

Compatibility table

AGRÓNIC 2500	AGRÓNIC 4000	AGRÓNIC 5500	AGRÓNIC 7000	AGRÓNIC BIT
+H2O transmitter	+H2O transmitter	+H2O transmitter	+H2O transmitter	+H2O transmitter
✓	✓	✓	✓	✓

AGROBEE-L	AGROBEE	A. MONOCABLE	AGRÓNIC RADIO
		+H2O transmitter	+H2O transmitter
✓	✓	✓	✓

Sensor configuration

The sensor acts by delivering a current or a voltage proportional to what it measures. The format indicates the sensor units and the relationship between the voltage read by the input and the sensor reading values.

A format with at least two calibration points needs to be configured for the sensor calculation and is configured from the programmer menu as follows.

Go to:

Function | Settings | Analogue Sensors | Formats (Always validate with the Enter key)

Once in the "**Formats**" menu, configure the settings as shown in the table.

- For A-2500, A-4000, A-5500 and A-Bit units, choose format number 20.
- For the A-7000 unit, choose the function from 12 to 17 and then the sensor type 2.
- For AgroBee / AgroBee-L H2O models, the format is auto-assigned when the analogue sensor is configured.

TEROS-10 sensor format

Setting	Default value
No. of integers	2
No. of decimals	1
Sign	No
Units	%
Calibration Point 1	
Real value	800 mV
Logical value	00.0 %
Calibration Point 2	
Real value	4000 mV
Logical value	70.0 %

In the AgroBee, AgroBee-L modules and the transmitter, the soil type to be used can be selected. This configuration has a direct relationship with the calibration equations defined by the manufacturer.

NOTE It is important to check that the logical values are correctly configured, otherwise the sensor reading will be incorrect.

Troubleshooting

THE SENSOR DOES NOT RESPOND

- Check the supply voltage that the AgroBee-L supplies to the sensor.
  - If the voltage is **equal to or greater than 11.5 V**, it is correct.
  - If the voltage is **less than 11.5 V**, there is an over-consumption and the problem is possibly in the sensor.
  - If the voltage is **less than 9.4 V** there is an over-consumption and the device no longer takes a reading from the sensor.

To check this voltage in the same module, a Module Reader is needed and it is carried out as follows:
ENT. QUERY DIG.-ANAL. | VDC SENSORS

- Check the current generated by the transmitter towards the programmer or module (4-20 mA) in the following cases:
  - If "**Minimum error**" is read in the Agrónic analogue input report.

This current can be verified with an ammeter in series on cable S1, S2 or S3 of the transmitter or using a Module Reader (QUERY menu). If the output current is **0 mA**, it indicates that the sensor is not connected or there is a problem with the sensor.

- Check that the connection is correct according to the table detailed in this manual (page 5).
- Connect the sensor in one of the two additional inputs that the device has.

SENSOR READING TOO HIGH

- Check that the soil has not compacted too much. Too high a density can cause the sensor reading to be higher.
- Make sure that the soil that has been configured is correctly selected on the device where it will be connected. Each soil needs a specific calibration equation.

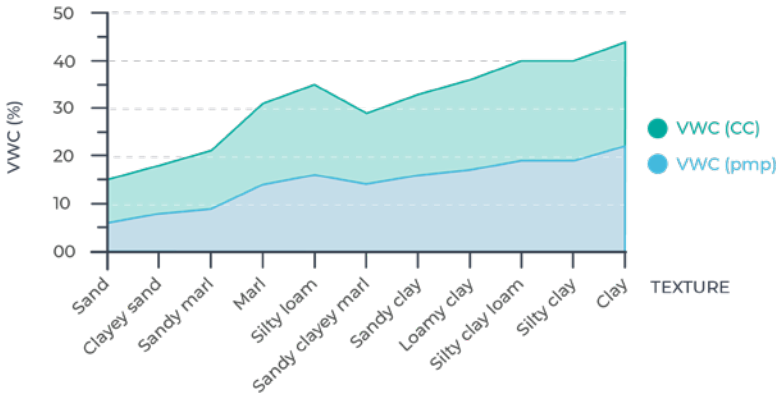
SENSOR READING TOO LOW

- Check that there are no air pockets around the spikes or the sensor body. These could be produced below the surface of the substrate when the spike makes contact with an obstacle and pushes it out of the way or if the sensor is not inserted perfectly linearly.
- Make sure that the soil that has been configured is correctly selected on the device where it will be connected. Each soil needs a specific calibration equation.

Indicative values of the type of soil texture for:

TEXTURE	VWC (FC) % Field capacity	VWC (pmp) % Wilting point	CRAD % Available water retention capacity
Sand	15	6	9
Clayey sand	18	8	10
Sandy marl	21	9	12
Marl	31	14	17
Silty loam	35	16	19
Sandy clayey marl	29	14	15
Sandy clay	33	16	17
Loamy clay	36	17	19
Silty clay loam	40	19	21
Silty clay	40	19	21
Clay	44	22	22

Source: New Mexico State University Climate Centre



NOTE

In certain external circumstances, such as in areas with a high probability of electrical storms (lightning), the use of extension cords and the presence of more than one sensor, even if grounded, it is not possible to guarantee 100% that the sensor will not be damaged from the lightning.

Further information

For further information about the sensor, please see the manufacturer's generic video:

https://youtu.be/-7qezpt8_1s

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