SISTEMES ELECTRÒNICS PROGRÉS

Manual

TEROS 21 sensor

CODE 06140326

The TEROS 21 sensor is a resistive device that responds to changes in soil moisture and is used to measure soil water potential and soil temperature.

The sensor measures changes in moisture of two porous ceramic discs sandwiched between two stainless steel sheets and the circuit board.

The TEROS 21 sensor uses a thermistor to take temperature readings and it is located inside the black body of the sensor structure. If the black plastic body of the sensor is exposed to solar radiation, the temperature measurement may be high.

Soil water is an electrical conductor that provides a relative value of the soil moisture status.

As the soil dries out, water is removed from the sensor and the resistance value increases. On the contrary, when the soil is moist, the resistance decreases.

The TEROS 21 sensor uses the SDI-12 communication protocol to connect with the different devices. Through this protocol, and through the data bus, more than one sensor can be connected on the AgroBee-L SDI-12. A unique SDI-12 address will be configured for each of them.

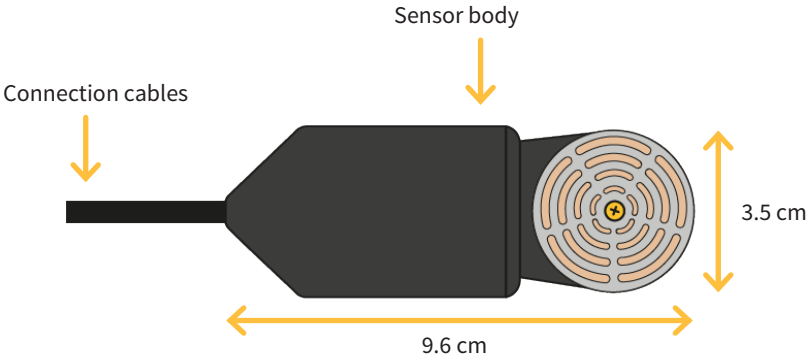
Technical specifications

Sensor details	
Dimensions	Length: 9.6 cm Width: 3.5 cm Height: 1.5 cm
Cable length	5 metres
Soil type	Mineral - Peat
Output type	SDI-12 communication bus

Reading range	
Potential (kPa)	-9 to -2000 kPa
Temperature (°C)	- 40 to 50°C
Precision (kPa)	± 10%
Precision (°C)	± 1°C

Sensor parts

The following image shows the parts of the sensor and their measurements.



Installation

When selecting the location of the sensor, it is very important to remember that the volume of soil in contact with it has the greatest influence on the sensor reading. Any air pocket or excessive compaction around the sensor can also influence the measurements taken. Avoid creating preferential channels for water to pass between the sensor and the volume of soil in contact.

IMPORTANT

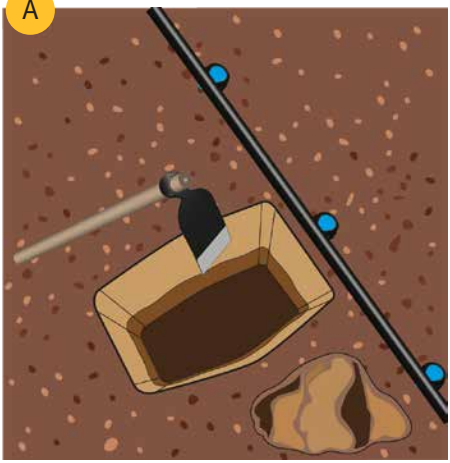
Do not install the sensor in contact with any metal surface, since the sensor's electromagnetic field may be attenuated and therefore affect the measurement result.

Recommendations to always take into account:

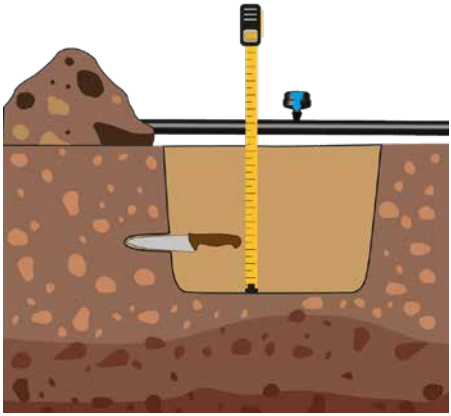
- Take the diameter of the soil particles around the sensor into account and make sure there are no large stones that could negatively affect the measurements.
- Maximise the contact between the sensor surface and the soil at the time of installation. The more homogeneous the terrain, the more precise the measurements that can be taken.

SHALLOW INSTALLATION

A



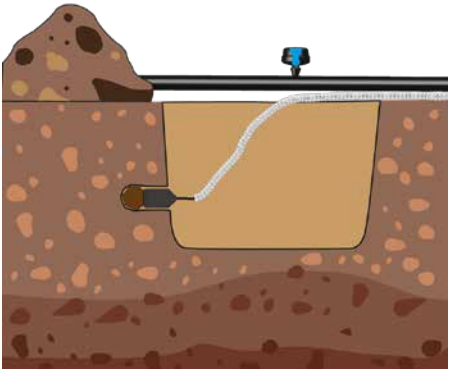
B



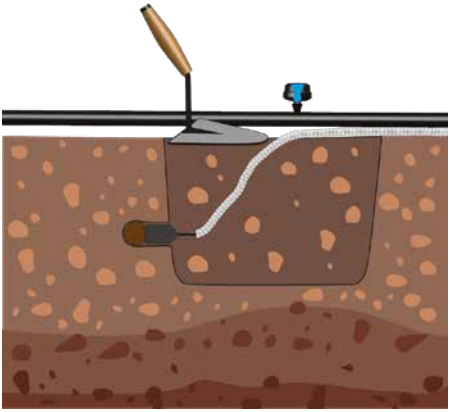
C

D

E



F



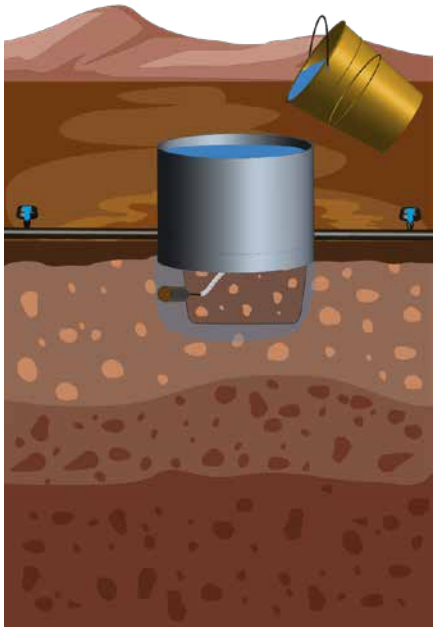
1. Use a hoe to make a trench in the soil at the point where the probe is to be installed. A
2. For installations with a depth of less than 30 cm, use a blade make a narrow hole to insert the sensor. B
3. For installations with a depth greater than 30 cm, it is advisable to prepare a mud paste with the extracted soil and then bury it to ensure compaction between the soil and the sensor. C
4. With the mud paste, wrap the sensor discs so that it is firmly compacted as shown in the image. D
5. If more than one sensor will be installed, it is advisable to label the cable to know to the depth to which each sensor corresponds.
6. Insert the sensor into the hole made until it partially covers the entire body and pass the cable through a corrugated tube to protect it from animals or other external factors. E
7. Replace the soil in the order in which it was initially removed. F
8. Compact the soil to ensure good final compaction.

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-21 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.

WATER RETENTION THRESHOLDS IN THE SOIL

Maximum: Field capacity

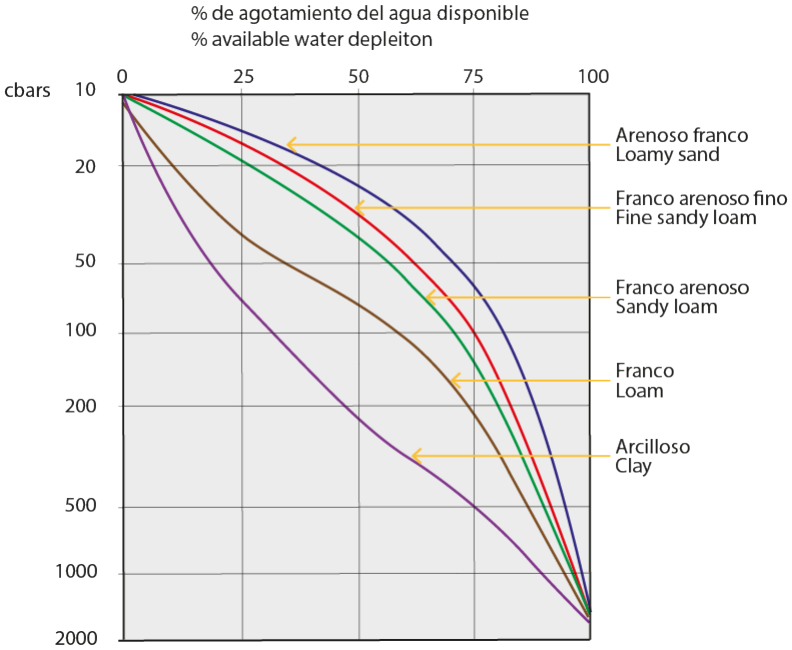
It is the water content in the saturated soil after heavy irrigation is applied and when the drainage rate changes from fast to slow. This point is achieved when all gravitational water has been drained and all spaces are filled with water. Field capacity is normally achieved two or three days after irrigation when the soil water tension is approximately 0.3 bar (30 cbar or 3 m water column) in clay soils or 0.1 bar in medium-texture soils.

Minimum: Permanent wilting point

It is the water content in the soil at which plants cannot recover and wilt even when sufficient moisture is added. This parameter can vary depending on the plant species and soil type and is determined by greenhouse experiments. This point is reached when the water tension in the soil reaches approx. 15 bar.

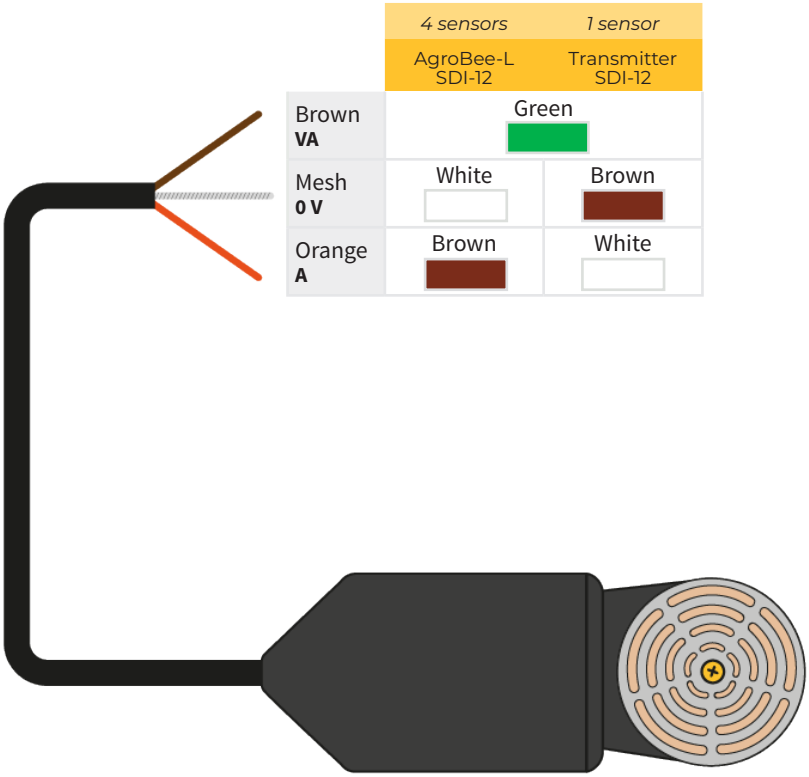
Available water: the water retained between the field capacity and the permanent wilting point.

Tension curves - depletion of available water according to soil type:



Connections

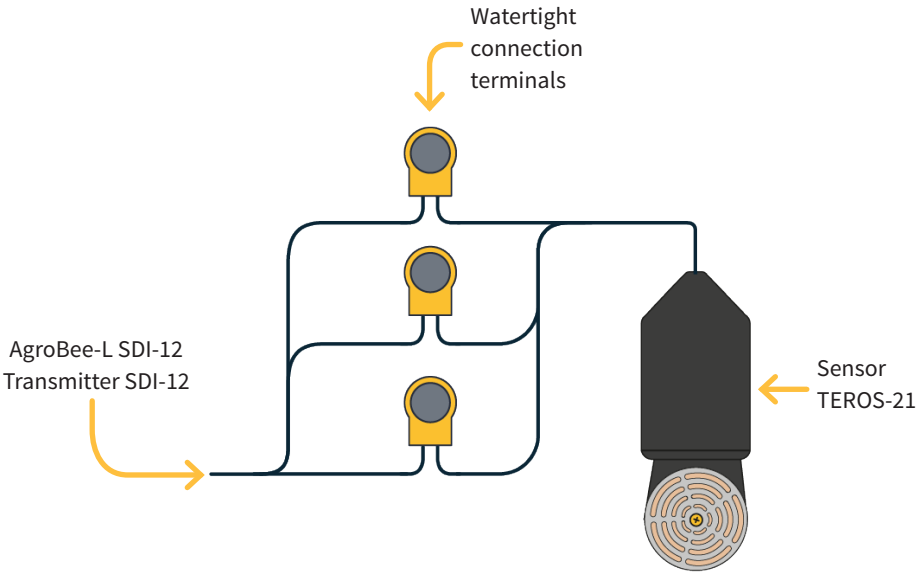
The TEROS 21 sensor can be connected to the AgroBee-L SDI-12 module or to the Agrónic 2500/4000/5500/7000/BIT/Monocable/Radio through the SDI-12 transmitter. A terminal/connector or a cable hose is provided for each unit that enables the different connections to be made easily with no need to access the inside of the unit. They all use the following colour legend:



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).



Compatibility table

AGRÓNIC 2500	AGRÓNIC 4000	AGRÓNIC 5500	AGRÓNIC 7000	AGRÓNIC BIT
+ Transmitter SDI-12	+ Transmitter SDI-12	+ Transmitter SDI-12	+ Transmitter SDI-12	+ Transmitter SDI-12
✓	✓	✓	✓	✓

AGROBEE-L	AGROBEE	A. MONOCABLE	AGRÓNIC RADIO
AgroBee-L SDI-12		+ Trans. SDI-12 + 5 W panel + Bat. 7A + Regulator	+ Trans. SDI-12 + 5 W panel + Bat. 7A + Regulator
✓		✓	✓

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-5500 and A-Bit units, choose format numbers between 22 and 31.
- For the A-4000 unit, choose format numbers between 21 and 26.
- For the A-7000 unit, choose the format 13 (kPa) and 15 (ºC).
- For AgroBee-L SDI-12 models, the format is auto-assigned when configuring the analogue sensor.

Teros-21 sensor format

Setting	Default value	
	Value 1	Value 2
	Potential [kPa]	Temperature [ºC]
No. of integers	4	2
No. of decimals	1	1
Sign	Yes	Yes
Units	kPa	ºC
Calibration Point 1		
Real value	800 mV	800 mV
Logical value	-9.0	-40.0
Calibration Point 2		
Real value	4000 mV	4000 mV
Logical value	-2000.0	+50.0

Troubleshooting

THE SENSOR DOES NOT RESPOND

- Check the supply voltage that the device supplies to the sensor.
  - If the voltage is **equal to or greater than 10 V**, it is correct.
  - If the voltage is **less than 10 V**, there is an over-consumption and the problem is possibly in the sensor or sensors.

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

- Check that the connection is correct according to the table detailed in this manual (page 7).

INCORRECT SENSOR READING

- Check that the sensor is installed correctly.
- Check that the sensor cables are in perfect condition as they could cause a malfunction.
- Check that the sensor's ceramic disc is not damaged or contaminated.

SENSOR READING WITH MAXIMUM ERROR

- If the sensor gives a reading of "**Maximum Error**", this indicates that the water potential is below -2,000 kPa and the sensor is outside the effective measurement range. When the soil gets wet again, the sensor should return to its normal measurements.
- Check that the sensor cables are in perfect condition as they could cause a malfunction.

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

INSTALLATION VIDEO

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

https://youtu.be/Wk3-BETrmy0

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