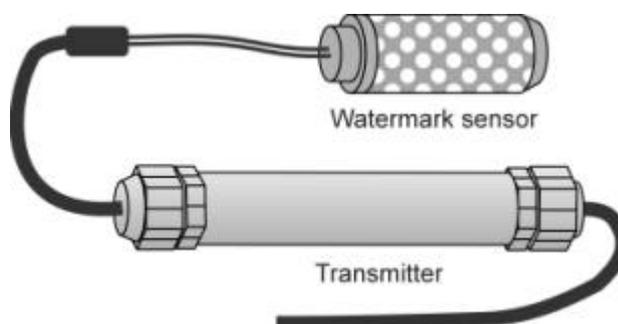


# WATERMARK TRANSMITTER

## DESCRIPTION:

The Watermark sensor is used to measure the humidity of the soil where the crop is grown. It is very useful to know the real irrigation supply, letting us know the real capacity of water retention of the our soils.

The transmitter for the Watermark sensor of Progrés transforms the sensor signal into a standard signal of 420 mA, allowing the readings in lines and obtaining representative values.



The Watermark transmitter has been developed in collaboration with IRTA.

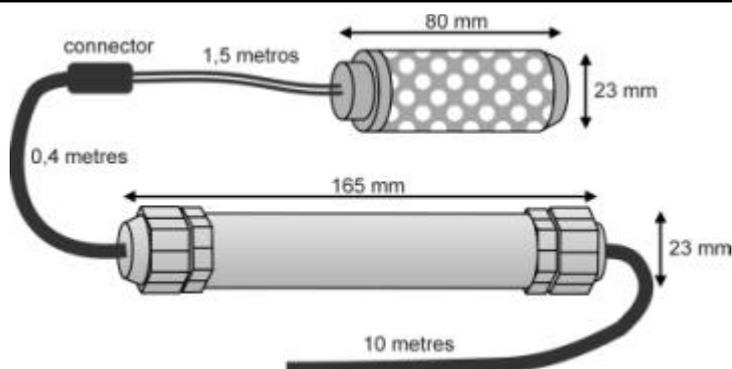
## TECHNICAL CHARACTERISTICS:

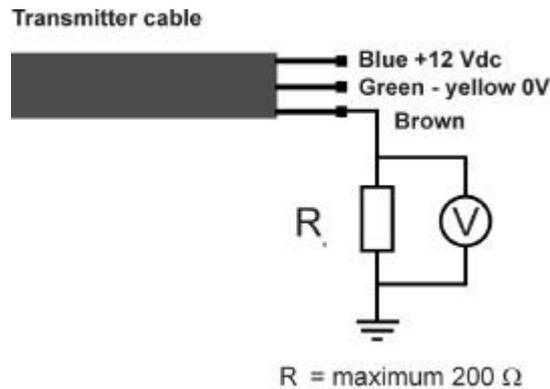
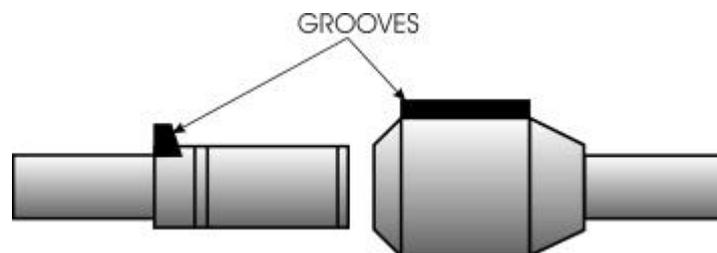
<b>Feeding</b>	Minimum	+10 Vdc (on 200 ohms)		
	Typical	+12 Vdc		
	Maximum	+15 Vdc		
<b>Outlet signal</b>	4 – 20 mA			
<b>Reading rank</b>	0 – 120 cbars			
<b>Linearity</b>	0 cbars	40,27 cbars	85,56 cbars	120 cbars
	4 mA	11,63 mA	17,11 mA	20 mA
<b>Connections</b>	Blue	+12 Vdc		
	Green-yellow	0 V		
	Brown	Outlet 4 – 20 mA		
<b>Maximum distance</b>	800 metros			
<b>Answer time</b>	50 milliseconds (Minimum time of power supply for receiving the reading)			
<b>Protections</b>	Reverse current:	Yes		
	Over tension:	Yes		

## INSTALLATION:

- The transmitter must be placed in a horizontal position to avoid humidity accumulating in the extremes.
- The transmitter must be placed in a site where it is not directly exposed to the sun.
- Do not place the transmitter cables near power lines.
- When there are more than one watermark sensor, they has to be installed with a minimum distance of 1 meter between them, in order to not have possible reading problems.

## DIMENSIONS:



**CONNECTION:****BETWEEN THE TRANSMITTER AND THE READING UNIT OR CONTROLLER.****BETWEEN THE TRANSMITTER AND WATERMARK SENSOR CONNECTORS.**

- Align the sensor and the transmitter connectors longitudinally in reference to the grooves.
- Link the connector softly, without enforce.

## WATERMARK SENSOR

### The measurement of the soil humidity

The soil works as a water deposit where the water between irrigations or from the rain accumulates. In this way, plants can use it whenever they need it for their development. The aim of using sensors to measure the soil water is to know better the consume of water in different parts of a piece of land. With this knowledge, irrigation can be programmed better and an evaluation of the incidence of rain can be valued more exactly. With the readings stored between irrigations we can obtain, little by little, quite an exact idea of this process and follow a plan of water application which can satisfy the water necessities of the crop. This allows you to eliminate estimations, diminish water supply, reduce the pumping expenses and cut out excessive cleaning of nutrients due to excessive irrigation.

### The situation of Watermark sensors

- In the **furrow or flooding irrigation**, the sensors are normally placed at the 2/3 of the length, that is to say at 1/3 of the end, as this is the area where water penetrates better and it is

also the one which is worst watered. When there are trees, the sensors should be placed at the south-east of the trunk, as this is the area which is more heated by the sun.

- In the **sprinkler irrigation**, generally the distribution of water is better, although there may be great differences of water penetration due to differences in the type of soil, to more or less permeable layers and to the topography of the land. Sensors must be placed according to these variations: in the tree crops, they are to be placed on the dropping line and in the row crops they have to be lined up with the plants. Make sure the sensors are not placed behind obstacles, such as branches or trunks, which can interfere in the water distribution of the working area of the sensor.
- With **pivots**, the sensors have to be placed at 4 or 5 points along the wing, among the towers, just in front of the start position. Many users of pivots also place sensors in different points of the field, such as very dry areas, areas of optimal production, etc. Make sure there are enough sensor stations to obtain a global knowledge of the field: in order to obtain this

objective, it is advisable to place a station every 5 or 7 hectares.

- With **localised irrigation**, the sensors must be placed in the humid bulb, that is to say, between 30 and 50 cm. from the dripping emitter or between 60 and 90 cm. from the micro-sprinkler. Frequent readings have to be done in order to have a global idea of the field or of the irrigation block and the soil variations. Light soil dry very quickly and heavy ones slowly, having to take into account both types.

### How deep must the Watermark sensor be placed

This depth depends on the depth of the roots of the crop, which depends, as well, on the texture and depth of the ground. The best criterion is to place the sensors in the effective root area. For crop with roots of less than 35 cm., it is enough with a sensor at just one depth. For crops with deeper roots, such as cereals, vines and trees, humidity must be measured at least at two depths. Normally, roots grow deeper in deep and well-drained soils if there is humidity. Roots do not grow so deep in soils which have a thick texture, are superficial or have limiting horizons.

Our recommendations for those who use sensors for the first time is to place a certain number of those in a limited area to get used to their working. Then, readings must be done all over the vegetative period in order to know the normal behaviours.

### Installation of the Watermark sensor

- 1) Soak the sensors with irrigation water during the night. If you have enough time to do so, it is advisable to let the sensors dry during one or two days and soak them once more. Repeat the cycle a couple of times. It is indispensable that the sensors are very humid when placing them.
- 2) In order to avoid damage to the external membrane of the sensors due to their rubbing with dry and abrasive particles, it is convenient that the soil is quite humid when they are placed. Use an iron bar to make a hole in the ground at the depth where the sensor is to be placed, whenever it is an effective root area. This iron bar has to make a hole which is wider than the sensor diameter all along it, except at the end where the hole has to have the exact diameter of the sensor (23mm.) so that it adjusts perfectly. It is possible that in soils with a very thick texture, the hole has to be made a bit bigger (up to 30 mm.) and then this can be filled in with some mud, so that the contact of the sensor with the soil is assured. It is very

important there is a good contact between the sensor and the soil, otherwise the results will not be precise.

- 3) Fill the hole with water and introduce the sensor until it reaches the bottom. A PVC tube can be used to do so.
- 4) Fill in the hole with soft mud to eliminate any air bag.
- 5) If you wish so, the PVC tube can be left in the hole attaching it to the superior part of the sensor with a suitable glue (PVC/ABS). The sensor cables have to be introduced through the tube and they have to be attached to the upper extreme of the tube which is open.
- 6) This method makes it easier to extract the sensor, later on, when the crops are annual. Before taking out the sensor, make sure the soil is humid. The sensor must never be taken out pulling the cables. When the sensors are deep, it may be necessary to dig, carefully, to take them out without damaging them.
- 7) Once the sensors have been taken out, they must be cleaned carefully and leave them to dry well. To keep them in good conditions, put them in a plastic bag during winter.
- 8) If there are more than one sensor connected, they have to be installed with a minimum distance of 1 meter between them, in order to not have possible reading problems.

### Soil temperature

The soil temperature affects the reading in about a 2 % per every degree centigrade. So it has to be compensated in the measurer. This variation is not high enough to be critic during a reading process and it is mainly used as a seasonal variation when the soil temperature in spring is about 16 °C and in summer about 23 °C.

### Checking

Watermark sensor: normally, any error in the sensor, due to its aging or a working defect, goes with an increment in its resistance level. This can be checked by taking the sensor out of the soil and introducing it in a water bucket at a temperature of between 15 and 20 °C during one hour and then do a reading. If this reading is 5 or more, the sensor must be replaced.

### Locating and correcting breakdowns

Due to the sensor sensitivity and the fact that it has to be installed in a very precise way and

following specific steps, in certain occasions you may think that the sensor is not working properly.

For this reason, it is advisable to follow the following tests to verify whether everything has been done correctly and avoid possible anomalies in the working.

At the sensors:

- a) With the sensor deepened in water the reading should be 0 (between -0.3 and 0.3). If it is so, go to the following point.
- b) Let the sensor dry in the air during 48 hours. Depending on the environmental temperature and humidity of the place, the reading should be over 120 cbars.
- c) Put the sensor in the water again and the reading should go back to 0 in a maximum time of 2 minutes.
- d) If the sensor passes the previous three points, it means that it is in perfect condition and the following considerations are to be taken into account.

### Most frequent problems

- 1) The sensor does not adjust to the soil and there are air bags around it.  
Solution: install the sensor again, making sure it is in intimate contact with the soil.
- 2) The sensor is not in the effective root area or the irrigation water does not reach the sensor. This may happen when the sensor is placed just over a stone or below an impermeable layer which does not allow the normal movement of water.  
Solution: install the sensor again, making sure it is in intimate contact with the soil.
- 3) The sensor loses intimate contact with the soil during dry periods, when the readings reach values superior to 80 centibars. In these conditions, the soil retracts from the sensor and essential contact is lost. Superficial irrigation, which are only suitable to reduce the soil tension to 40 centibars, for example, are not enough to reach the sensor and make it work normally. This condition is more common in heavy and compact soils and, precisely, in periods of mayor water consumption when the irrigation may not be enough.  
Solution: Apply abundant irrigation to soak the soil and in this way the sensor can recover its intimate contact with the soil.

### Irrigation management with Watermark

Collecting information about the humidity of the soil with certain frequency, you can really know what is happening in the root area of the soil. The graphics obtained from these readings can give

enough information to be able to appreciate the general tendency of the area which is being studied.

Depending on the soil texture, the readings correspond approximately to:

Centibars	Meaning
0-10	Saturated soil
10-30	Soil with enough humidity. Excepts soils of thick sand, which are starting to dry.
30-60	Normal margin to start irrigation. Except in very clayey soils.
60-80	Normal margin to start irrigation in very clayey soils.
80 or more	The soil is dangerously drying.

Every case will be different, due to differences in the crops, soil, climate... Maybe, it is more important to appreciate the difference between the readings of one day and the ones of the previous 3 or 4 days than the value of the reading itself. That is to say, finding out how fast the readings increase. If the readings increase slowly, the soil will be drying slowly. But if they increase very quickly, it will imply a fast loss of the humidity available. This information will help you know when you have to irrigate.

Using sensors at two or more depths of the root area (see how deep the Watermark sensor has to be installed) you will easily learn when you have to irrigate. That is to say, if the most superficial sensor indicates dryness, while the deepest one indicates the existence of enough humidity, irrigation can be applied in shorter cycles (more frequent and less volume) so that only the superior part of the root system is irrigated. On the other hand, if the deepest sensor indicates a real lack of water, it will be necessary to apply more abundant irrigations which are able to reach all the levels of the area. So this practice allows you to appreciate with exactitude the water capacity of retention of the soil after an irrigation or rain.  
The information given by the sensors as well as the knowledge of the soil, crop type and irrigation method used, will allow you to adapt the real irrigation necessities of the crop, giving you a better yield.

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