



**Installation and Setup Instructions**  
**EC5, EC10, EC20**  
**Soil Moisture Sensors**

**Revision 2.2**

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## EC Series Soil Moisture Probes

EC series probes measure the dielectric constant of the soil in order to find its volumetric water content. Since the dielectric constant of water is much higher than that of air or soil minerals, the dielectric constant of the soil is a sensitive measure of water content.

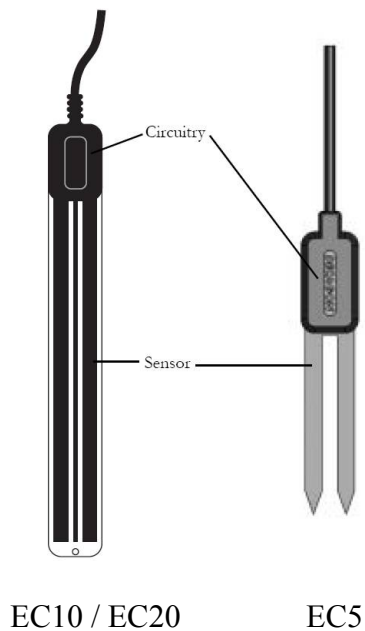
### EC10 and EC20

The EC10 and EC20 sensors have active sensing lengths of 10 cm and 20 cm respectively.

### EC5

The EC5 has a 5 cm active sensing length, and different electronics compared to the EC10 and EC20. The EC5 has a two-prong design and utilizes a higher measurement frequency, allowing the EC5 to measure accurately measure VWC from 0 to 100% in all soil types and a wider range of salinities.

*Note: The EC5 is incompatible with Pace XR440 and XR5-8x series Data Loggers.*



## Installation

When selecting a site for installation, it is important to remember that the soil adjacent to the probe surface has the strongest influence on the probe reading and that the probe measures the *volumetric* water content. Therefore any air gaps or excessive soil compaction around the probe can profoundly influence the readings. Also, do not install the probes adjacent to large metal objects such as metal poles or stakes. This can attenuate the probe's electromagnetic field and adversely affect output readings. Because the EC5 has gaps between its prongs, it is also important to consider the size of the media you are inserting the probe into. It is possible to get sticks, bark, roots or other material stuck between the probe prongs, which will adversely affect readings. Finally, be careful when inserting the probes into dense soil, as the prongs will break if excessive sideways force is used when pushing them in.

## Procedure

When installing the probe, it is best to maximize contact between the probe and the soil. There are two methods to accomplish this.

### EC10 and EC20

Use a thin implement like a trenching shovel, gardening spade, or flat bar to make a pilot hole in the soil. Then insert the probe into the hole, making sure the entire length of the probe is covered. Finally, insert the shovel again into the soil a few inches away from the probe, and gently force soil toward the probe to provide good contact between the probe and the soil. For deeper installation, excavate down to the level you wish to measure, then install the probe as described.

### EC5

Insert the probes into the soil, making sure that the prongs are buried completely up to the black overmolding, as shown at the right:

The tip of each prong has been sharpened to make it easier to push the probe in - *be careful with the sharp tips!* The probe may be difficult to insert into extremely compact or dry soil. If you have difficulty inserting the probe, try loosening the soil somewhat or wetting the soil. **Never pound it in!**



## Orientation

The probe can be oriented in any direction. However, orienting the flat side perpendicular to the surface of the soil will minimize effects on downward water movement.

## Removing the Probe

When removing the probe from the soil, **do not pull it out of the soil by the cable!** Doing so may break internal connections and make the probe unusable.

## Wiring:

All EC Series Soil Moisture Probes each have three connecting wires: A bare ground wire (braid), an Excitation wire (White), and an Analog Output wire (Red). Wiring is provided below for each Pace Data Logger family.

### **XR5-SE** (*compatible with all EC Probes: EC5, EC10, EC20*)

*For XR5-SE and any XR5 model beginning with "XR5-SE"*

Braid: Any C Terminal  
Red: Any Input Channel (set for 0-2.5v)  
White: D Terminal

### **XR440** (*EC10 and EC20 only; the XR440 is not compatible with the EC5*)

Braid: C Terminal  
Red: Any Input Channel  
White: E Terminal

### **XR5-8A-SE, XR5-8X-SE** (*EC10 and EC20 only; not compatible with the EC5*)

Braid: Any C Terminal  
Red: Any 0-2.5v Input Channel  
White: E Terminal

## Extension cable

You can safely connect up to 200 FT ( 60 meters) of extension cable without signal attenuation. Use cable that is suitable for the intended environment. For example, use UV resistant Sunlight-rated cable if the extension cable will be used outdoors. If the extension cable will be buried in the soil it should be rated for Burial use.

Use 2 conductor + shield, 22 AWG cable.

For most applications, you will want to seal the connections from the elements to maintain a good connection and to prevent corrosion.

### Scaling, EC10

#### Readings in %Volumetric Water Content

XR5-SE and derivative models; EC10 wired to D Terminal

Input Channel Type: 0-2.5v

Slope: 93.6 (most soil types)

Offset: -37.6 (most soil types)

XR440; EC10 wired to E Terminal

Low Value: -50.4 (sand) -32.5 (silt or clay)

High Value: 406.9 (sand) 251.0 (silt or clay)

XR5-8A-SE, XR5-8X-SE; EC10 wired to E Terminal

Input Channel Type: 0-2.5v

Slope: 71.3 (sand) 43.7 (silt or clay)

Offset: -50.4 (sand) -32.5 (silt or clay)

### Scaling, EC20

#### Readings in %Volumetric Water Content

XR5-SE and derivative models; EC20 wired to D Terminal.

Input Channel Type: 0-2.5v

Slope: 69.5 (most soil types)

Offset: -29.0 (most soil types)

XR440; EC20 wired to E Terminal.

Low Value: -33.5 (most soil types)

High Value: 241.0 (most soil types)

XR5-8A-SE, XR5-8X-SE; EC20 wired to E Terminal.

Input Channel Type: 0-2.5v

Slope: 41.5 (most soil types)

Offset: -33.5 (most soil types)

#### Note:

Using the above listed scaling values, the EC10 and EC20 will read approximately 40% VWC immersed in water and approximately -10% VWC in air.

## Scaling, EC5

### For all Mineral Soils

Readings in %Volumetric Water Content

XR5-SE and derivative models; EC5 wired to D Terminal.

Input Channel Type: 0-2.5v

Slope: 119.0

Offset: -40.1

### For Potting Soils

(such as Sunshine Mix or Miracle Grow Potting Mix)

Readings in %Volumetric Water Content

XR5-SE and derivative models; EC5 wired to D Terminal.

Input Channel Type: 0-2.5v

Slope: 103.0

Offset: -33.4

*The EC5 is incompatible with Pace XR440 and [XR5-8 Series Data Loggers](#).*

Using the slope and offset values listed above for Mineral Soils, the EC5 will read approximately 60% VWC immersed in water and approximately -13.5% VWC in air.

**Excitation Time requirement:**

EC5, EC10 and EC20 Probes require a minimum of 10ms of excitation. All Pace Data Loggers meet this requirement.

On the XR5, use the “Sensor Excitation” selection of “30 ms” unless other connected sensors require a longer excitation time.

**Maximum EC10 / EC20 Sensors per Pace Data Logger:**

Model	Excitation Terminal	Maximum EC10 / EC20 Probes
XR440	E	2
XR5-8A-SE	E	3
XR5-8X-SE	E	3
XR5-SE	D	8
XR5-SE	E	4

Note:

Powering the EC10 and EC20 Sensors from the E terminal of an XR5-SE\* is not recommended due to the higher current draw of EC sensors when powered from 5 vdc.

\* All XR5 models beginning with "XR5-SE".

**Maximum EC5 Sensors per Pace Data Logger:**

Model	Excitation Terminal	Maximum EC5 Probes
XR5-SE	D	4
XR5-SE	E	1

The following models do not have sufficient excitation current to power an EC5: XR440, XR5-8A-SE, XR5-8X-SE

Notes:

Powering an EC5 Sensor from the E terminal of an XR5-SE\* is not recommended. A single EC5 Sensor powered by the E terminal will consume about 27 ma, close to the E terminal's 30 ma maximum.

\* All XR5 models beginning with "XR5-SE".



## Specifications

**Minimum Excitation Time:** 10ms (milliseconds)

**Accuracy:**

*EC10 and EC20:*  $\pm .04 \text{ m}^3/\text{m}^3 (\pm 4\%) < 0.5 \text{ dS/m}$

With soil-specific calibration:  $\pm .02 \text{ m}^3/\text{m}^3 (\pm 2\%)$

*EC5:* at least  $0.003 \text{ m}^3/\text{m}^3$  all soils, up to  $8 \text{ dS/m}$

With soil-specific calibration:  $\pm .02 \text{ m}^3/\text{m}^3 (\pm 2\%)$

**Resolution:**

*EC10 and EC20:*  $0.002\text{m}^3/\text{m}^3$

*EC5:*  $0.001 \text{ m}^3/\text{m}^3$  VWC in mineral soils, 0.25% in growing media

**Power:**

*Requirements:*

*EC10 and EC20:* 2.5VDC @ 2mA, or 5VDC @ 7mA

*EC5:* 2.5VDC @ 10mA

*Output:* 10-40% of excitation voltage (250-1000mV at 2500mV excitation)

**Operating Environment:**

*EC10 and EC20:* 0 to  $50^\circ\text{C}$

*EC5:* -40 to  $+60^\circ\text{C}$

**Range of Measurement:**

*EC10 and EC20:* 0 to saturated VWC

*EC5:* 0 to 100% VWC

**Probe dimensions:**

*EC20:* 25.4cm x 3.17cm x .15cm

*EC10:* 14.5cm x 3.17cm x .15cm

*EC5:* 8.9cm x 1.8cm x 0.7cm

**Cable length:** 16 FT (5 meter)

**Electrical connection:** stripped and tinned lead wires (22 AWG)

## **Technical Support**

For questions or comments,  
please contact Pace Scientific Technical Support:

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