ECH$_2$O EA–10

Soil Moisture Sensor

Integrator's Guide

Version 3

DECAGON DEVICES

Decagon Devices, Inc.
2365 NE Hopkins Court
Pullman WA 99163
www.decagon.com

Contents

1. Introduction

Thank you for using the ECH$_2$O EA-10 Dielectric Soil Moisture sensor. The EA-10 sensor has a standard 2-wire, 4-20 mA analog interface for use with industrial data acquisition and control systems.

Specifications

Model: EA-10 Dielectric Soil Moisture Sensor.

Electrical specs:
Interface: 4-20 mA, 2-wire analog transmitter
Red: (+) supply; Black: (-) supply; Shield: NC
Supply voltage: line powered 7-32 Volt; DC
Overvoltage and reverse polarity protected

Sensor Specification:
Measurement type: Volumetric Water Content (VWC)
Measurement range: typical 0 to 40 percent VWC
Measurement resolution: depends on acquisition hardware
Measurement accuracy: ± 2% with soil specific calibration; accuracy at standard factory calibration varies depending on soil type
Measurement output: current linearly related to VWC.
Active sensor length: 10 cm
Minimum measurement time: 10 ms

Soils: all types; coarse sand to clay

Operating environment:
Temperature: -40 to +50 °C.
Humidity: 0-100%

Physical properties:
Dimensions: 14.5cm x 3.17cm x 0.15 cm
Cable: 2 meter, 26 AWG tinned, bare wire (*Custom length available upon request. Cost depends on length*).

Calibration:
Percent Volumetric Water Content = 0.0425 x current (mA)-0.342
Functional testing:
Sensor output in air: 4.0-5.5 mA
Sensor output in water: 16.0-18.5 mA.

Contact Information

If you need to contact Decagon:
- **E-mail us** at support@decagon.com
- **Send us a fax** at (509) 332-5158
- **Call us at:** (US and Canada only) 1-800-755-2751 or 509-332-2756.

Warranty Information

The EA-10 has a 30-day satisfaction guarantee and a one-year warranty.

Seller's Liability

Seller warrants new equipment of its own manufacture against defective workmanship and materials for a period of one year from date of receipt of equipment (the results of ordinary wear and tear, neglect, misuse, accident and excessive deterioration due to corrosion from any cause are not to be considered a defect); but Seller's liability for defective parts shall in no event exceed the furnishing of replacement parts F.O.B. the factory where originally manufactured. Material and equipment covered hereby which is not manufactured by Seller shall be covered only by the warranty of its manufacturer. Seller shall not be liable to Buyer for loss, damage or injuries to persons (including death), or to property or things of whatsoever kind (including, but not without limitation, loss of anticipated profits), occasioned by or arising out of the installation, operation, use, misuse, nonuse, repair, or replacement of said material and equipment, or out of the use of any method or process for which the same may be employed. The use of this equipment constitutes Buyer's acceptance of the terms set forth in this warranty. There are no understandings, representations, or warranties of any kind, express, implied, statutory or otherwise (including, but without limitation, the implied warranties of merchantability and fitness for a particular purpose), not expressly set forth herein.

2. Installing the EA-10

The EA-10 monitors the water content of the soil in which it is placed by measuring the dielectric constant of the soil and water surrounding the probe. While the probe measures just the soil which is adjacent to it, its reading is most useful if that measurement represents the general soil conditions in which the probe is placed. For that to happen, the monitoring site must be carefully selected, and the probe must be properly installed.

Procedure

When installing the EA-10 probe, it is best to maximize contact between the probe and the soil. There are two methods to accomplish this.

1. Use Decagon's Probe Installation Kit to install the probe. This kit has a custom-shaped blade to make the insertion in the soil, then another tool to place the probe into the insertion. For deeper installations, use an augur to reach the desired depth, then use the Installation kit with extension rods to install the probe.
2. 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.

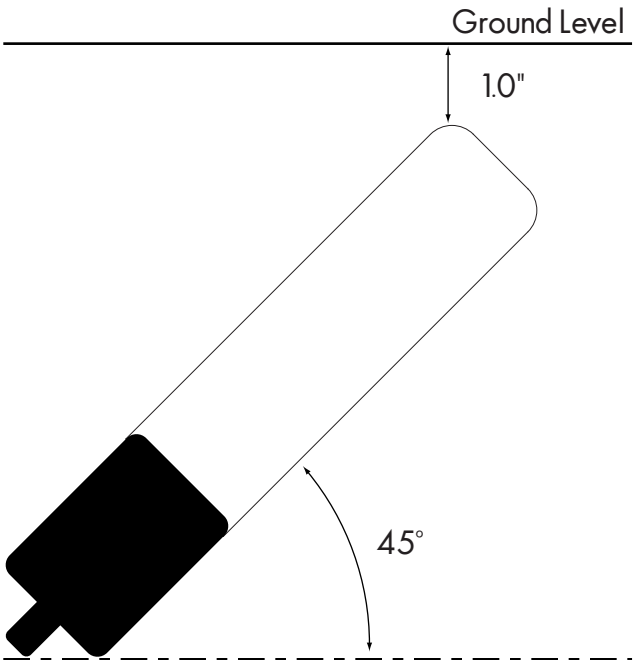
When selecting a site for installation, it is important to remember that the soil adjacent to the probe surface has the strongest influence on the probe reading and that the probe measures the *volumetric* water content. Therefore any air gaps or excessive soil compaction around the probe can profoundly 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.

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.

Turf Installation

When installing the EA-10, the installation procedure is almost the same, except that the probe is ofteplaced at a 45° angle to the ground, instead of straight down.

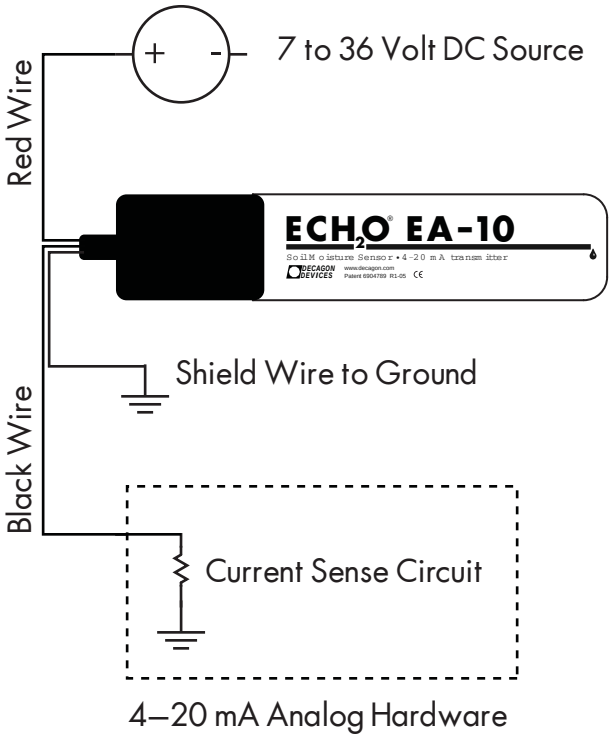


Removing the Probe

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.

Electrical Connection

The EA-10 is a 2 wire, 4 - 20 mA transmitter. When connected to a 7 - 32 volt source (line power), the current is linearly proportional to the water content of the soil.



The red wire is connected to the positive terminal and the black wire is the return for the negative terminal. The shield (bare wire) can be connected to a shield terminal, if available, or left open. The probe is electri-

cally floating, and the shield is not electrically connected to the probe circuitry. Extension wire can be used to connect the EA-10 to the 4-20 mA receiver. The extension wire should be a 2 conductor shielded, direct burial cable.

NOTE: It is essential that sensor wire connections be watertight! Use wire nuts with grease or silicon gel caps for all splices.

Hardware Requirements

The EA-10 is designed to work with industrial control and acquisition devices. The EA-10 is loop powered, drawing its operational power from the current used to measure volumetric water content. Any device capable of producing a 7 - 32 mA loop voltage should be compatible with the EA-10. The EA-10 is also reverse-polarity protected. If it is installed in the wrong direction, it will not operate, but will be protected from electrical overload.

NOTE: The EA-10 is intended for use with industrial control and acquisition devices which can provide a short pulse, leaving the probes turned off most of the time. Continuous power may cause the probe to exceed government FCC limits on electromagnetic emissions.

Troubleshooting

If you encounter problems with the EA-10, they will usually be in the form of negative or erroneous VWC readings. The most common solution to this problem is to make sure that you have adequate probe-to-soil contact. When inserted, the EA-10 should be completely covered up to the black overmolding. Doing this should remedy any reading errors. If it does not, please contact Decagon for assistance.

3. How the EA-10 Works

In essence, the EA-10 monitors the water budget of the soil in which it is placed. It senses water addition and water loss. If the soil is too wet, irrigation can be stopped. If the soil becomes too dry, additional irrigation time can be programmed.

Proper monitoring of the water budget requires that the moisture sensor be located in the active root zone of relatively homogeneous vegetation, and in well-drained soil of above-average moisture holding capacity. Avoid locations where water can run-on or pool, and locations with poor vegetative cover, or where vegetation tends to water stress because of poor moisture holding capacity of the soil or shallow root zone.

Vegetation in non-monitored zones will use water at a rate proportional to water use in the monitored zone. Water application rates in these zones must therefore be proportional for the entire system to remain properly irrigated. If trees use 30% more water than turf, and turf is being monitored, then the tree zone needs to be irrigated for 30% more time than the monitored turf to maintain adequate soil moisture.

Since dielectric probes (such as the EA-10) measure the moisture in the immediate vicinity of the probe, it is essential that the probe be installed so that the entire length of the probe is in intimate contact with the soil

(no air gaps). The soil must therefore be packed tightly around the entire probe length during installation. The probe is installed with the blade perpendicular to the surface to interfere as little as possible with water movement through the soil.

Calibration

The probe reading is converted to volumetric water content using the following equation:

Volumetric Water Content = 0.0425 x Current (mA)- 0.342

Water content is in m^3 m^{-3}, and current is in milli-amps. For water content in terms of percent of total volume, use the following equation:

Volume percent = 4.25 x Current - 34.2.

These calibrations are for typical soils with mid range texture, and are accurate enough for most irrigation scheduling purposes. For greater accuracy, a soil specific calibration should be undertaken, as outlined on the Decagon website.

Functional Testing

ECH_2O EA-10 sensors are tested to perform correctly in the following conditions:
Sensor output in air: 4.0-5.5 mA
Sensor output in distilled water: 16.0-18.5mA

4. Further Reading

ECH$_2$O Probes Soil-Specific Calibration
http://www.decagon.com/ag_research/literature/app_notes.php

ECH$_2$O Dielectric Probes vs. Time Domain Reflectometers (TDR)
http://www.decagon.com/ag_research/literature/app_notes.php

ECH$_2$O Probe insertion guide
http://www.decagon.com/ag_research/literature/app_notes.php

Index