

Soil Moisture Smart Sensors (S-SMx-M005)

The Soil Moisture smart sensor is used for measuring soil water content and is designed to work with smart sensor-compatible HOBO® data loggers. It combines the innovative ECH₂O® Dielectric Aquameter probe, from Decagon Devices, Inc. with Onset's smart sensor technology. All sensor parameters are stored inside the smart sensor adapter, which automatically communicates configuration information to the logger without any programming or extensive user setup.



Specifications	S-SMA-M005	S-SMB-M005	S-SMC-M005
Measurement Range	In soil: 0 to 0.405 m ³ /m ³ (0 to saturated volumetric water content) Extended range: -0.29 to 1.4475 m ³ /m ³ (full scale) See note 1	In soil: 0 to 0.450 m ³ /m ³ (0 to saturated volumetric water content) Extended range: -0.376 to 1.964 m ³ /m ³ (full scale) See note 1	In soil: 0 to 0.550 m ³ /m ³ (0 to saturated volumetric water content) Extended range: -0.401 to 2.574 m ³ /m ³ (full scale) See note 1
Accuracy	±0.041 m ³ /m ³ (±4%) typical 0 to +50°C (+32° to +122°F); ±0.020 m ³ /m ³ (±2%) with soil specific calibration; See note 2 on next page	±0.041 m ³ /m ³ (±4%) typical 0 to +50°C (+32° to +122°F); ±0.020 m ³ /m ³ (±2%) with soil specific calibration; See note 2 on next page	±0.031 m ³ /m ³ (±3%) typical 0 to +50°C (+32° to +122°F); ±0.020 m ³ /m ³ (±2%) with soil specific calibration; See note 3 on next page
Resolution	±0.0004 m ³ /m ³ (±0.04%)	±0.0006 m ³ /m ³ (±0.06%)	±0.0007 m ³ /m ³ (±0.07%)
Soil Probe Dimensions	254 x 32 x 1.0 mm (10 x 1.25 x 0.04 in.)	152 x 32 x 1.0 mm (6 x 1.25 x 0.04 in.)	89 x 15 x 1.5 mm (3.5 x 0.62 x 0.06 in.)
Weight	200 grams (7.0 oz)	190 grams (6.7 oz)	180 grams (6.3 oz)
Decagon ECH ₂ O Probe Part No.	EC-20	EC-10	EC-5

Specifications	All models
Sensor Operating Temperature	0° to +50°C (+32° to +122°F). While the sensor probe and cable can safely operate at below-freezing temperatures (to -40°C/F) and up to +75°C (+167°F), the soil moisture data collected at these extreme temperatures is outside of the sensor's accurate measurement range.
Bits per Sample	12
Number of Data Channels *	1
Measurement Averaging Option	No
Cable Length Available	5 m (16 ft)
Length of Smart Sensor Network Cable *	0.5 m (1.6 ft)
CE Specification	This product meets CE specification EN61326 criterion C for ESD, criterion C for Radiated Immunity, criterion C for Fast Transient, criterion B for Conducted Immunity, criterion A for Power Frequency Magnetic Fields, and Radiated Emissions Group 1, Class B. To minimize measurement errors due to ambient RF, use the shortest possible probe cable length and keep the probe cable as far as possible from other cables.

* A single smart sensor-compatible HOBO logger can accommodate 15 data channels and up to 100 m (328 ft) of smart sensor cable (the digital communications portion of the sensor cables).

Note 1: The sensor is capable of providing readings outside the standard volumetric water content range. This is helpful in diagnosing sensor operation and installation. See the Operation section below for more details.

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Note 2: This is a system level accuracy specification and is comprised of the ECH₂O probe's accuracy of $\pm 0.04 \text{ m}^3/\text{m}^3$ typical ($\pm 0.02 \text{ m}^3/\text{m}^3$ soil specific) plus the smart sensor adapter accuracy of $\pm 0.001 \text{ m}^3/\text{m}^3$ at $+25^\circ\text{C}$ ($+77^\circ\text{F}$). There are additional temperature accuracy deviations of $\pm 0.003 \text{ m}^3/\text{m}^3 / ^\circ\text{C}$ maximum for the ECH₂O probe across operating temperature environment, typical $< 0.001 \text{ m}^3/\text{m}^3 / ^\circ\text{C}$. (The temperature dependence of the smart sensor adapter is negligible.)

Note 3: This is a system level accuracy specification and is comprised of the ECH₂O probe's accuracy of $\pm 0.03 \text{ m}^3/\text{m}^3$ typical ($\pm 0.02 \text{ m}^3/\text{m}^3$ soil specific) plus the smart sensor adapter accuracy of $\pm 0.001 \text{ m}^3/\text{m}^3$ at $+25^\circ\text{C}$ ($+77^\circ\text{F}$). There are additional temperature accuracy deviations of $\pm 0.003 \text{ m}^3/\text{m}^3 / ^\circ\text{C}$ maximum for the ECH₂O probe across operating temperature environment, typical $< 0.001 \text{ m}^3/\text{m}^3 / ^\circ\text{C}$. (The temperature dependence of the smart sensor adapter is negligible.)

Inside this Package

- Soil Moisture Smart Sensor

Installation

This sensor measures the water content in the space immediately adjacent to the probe surface. Air gaps or excessive soil compaction around the probe can profoundly influence soil water content readings. Do not mount the probes adjacent to large metal objects, such as metal poles or stakes. Maintain at least 8 cm (3 inches) of separation between the probe and other objects. Any objects, other than soil, within 8 cm (3 inches) of the probe can influence the probe's electromagnetic field and adversely affect output readings.

To install the ECH₂O probe:

1. Use a thin implement like a trenching shovel, gardening spade, or flat bar to make a pilot hole in the soil. Make sure the hole is straight in the direction you will be orienting the probe. See *Installation Considerations* below.
2. Insert the probe into the hole, making sure the entire length of the probe is covered.
3. Insert a shovel 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.
4. Water the soil surrounding the sensor to facilitate settling of the soil.
5. Do not excessively pack or compress the soil adjacent to the sensor. The soil should contact the sensor surface, but should not be packed.

For deeper installation, excavate down to just above the level you wish to measure, then install the probe as described above.

If you need to calibrate your probe for the soil, you may want to gather soil samples from each sample depth at this time.

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.

Installation Considerations

- 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.
- Secure the sensor cable to the mounting pole or tripod with cable ties.
- The gray tube on the sensor cable that houses the smart sensor electronics is weatherproof; mount it to the pole or tripod outside the logger enclosure with cable ties.
- If you are running sensor cables along the ground, it is recommended that you use conduit to protect against animals, lawn mowers, exposure to chemicals, etc.

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Connecting

To start using the Soil Moisture smart sensor, stop the logger and insert the sensor's modular jack into an available port on the logger. If a port is not available use a 1-to-2 adapter (Part # S-ADAPT), which allows you to plug two sensors into one port. The next time you use the logger, it will automatically detect the new smart sensor. Note that the logger supports a maximum of 15 data channels; this sensor uses one data channel. Launch the logger and verify that the sensor is functioning correctly. See the logger user's guide for more details about connecting smart sensors to the logger.

Operating Environment

The Soil Moisture smart sensor provides accurate readings for soil between 0 and +50°C (+32° and +122°F). The sensor will not be damaged by temperatures as low as -40°C (-40°F); it is safe to leave the sensor in the ground year-round for permanent installation. The smart sensor adapter electronics (housed in the gray tube on the sensor cable) are rated to +75°C (+167°F) and are mounted outside the logger enclosure and secured to the mounting pole. The cable and smart sensor adapter are weatherproof.

Operation

The Soil Moisture smart sensor measures the dielectric constant of soil in order to determine its volumetric water content. The dielectric constant of water is much higher than that of air or soil minerals, which makes it a sensitive measure of the water content. During operation, values of 0 to 0.4 m³/m³ (models EC-10 and EC-20), or 0 to 0.5 m³/m³ (model EC-5) are possible. A value of 0 to 0.1 m³/m³ indicates oven-dry to dry soil respectively. A value of 0.3 or higher normally indicates a wet to saturated soil. Values outside the operating range may be a sign that the sensor is not properly installed (poor soil contact or foreign objects are adjacent to the sensor) or that a soil-specific calibration is required. Note that sudden changes in value typically indicate that the soil has settled or shifted, which are signs that the sensor may not be installed properly or that it has been altered or adjusted during deployment. This sensor does not support measurement averaging. (See your logger user's guide for more information about measurement averaging.)

Maintenance

The Soil Moisture smart sensor does not require any regular maintenance. If cleaning, rinse the sensor with mild soap and fresh water.

Calibration

The Soil Moisture smart sensor comes pre-calibrated for most soil types. If, however, your soil type has high sand or salt content, the standard calibration will not be accurate. In such cases, you will need to convert the data provided by the probe with a specific calibration for your individual soil type. To determine the soil specific calibration formula, refer to the *Calibrating ECH₂O Soil Moisture Probes* application note, available at <http://www.1800loggers.com>.

Verifying Sensor Functionality

To quickly check sensor functionality before deployment, perform the following two tests:

1. Wash the probe with water and let it dry.
2. Plug the sensor into the logger.
3. Open the logging software and go to the status screen.
4. Conduct an air test: Hold the sensor by the cable letting the sensor hang freely in the air, and compare the value in the status screen with the table below.

Sensor	Air	Water
S-SMA-M005	-0.119 to -0.106	+0.356 to +0.404
S-SMB-M005	-0.147 to -0.128	+0.401 to +0.466
S-SMC-M005	-0.193 to -0.139	+0.521 to +0.557

5. Distilled water test: Insert the probe in a room temperature container of fresh water, completely covering the entire ECH₂O probe. Compare the value in the status screen with the table above.

If these tests pass, your sensor is working normally. If not, please contact Onset® for assistance. If you believe your sensor is defective or broken, you can send the smart sensor back to Onset for testing if needed. Contact Onset or your place of purchase for a Return Merchandise Authorization (RMA) number and associated costs before sending it.

Warranty

As part of Onset’s ongoing efforts to provide 100% customer satisfaction, our Continuing Engineering Group constantly monitors and evaluates all of our products and software. In the unlikely event any significant defect is found, Onset will notify you. If you find a defect, please e-mail us at loggerhelp@onsetcomp.com.

Onset Computer Corporation (Onset) warrants to the original end-user purchaser for a period of **one year** from the date of original purchase that the HOB0 product(s) purchased will be free from defect in material and workmanship. During the warranty period Onset will, at its option, either repair or replace products that prove to be defective in material or workmanship. This warranty shall terminate and be of no further effect at the time the product is (1) damaged by extraneous cause such as fire, water, lightning, etc. or not maintained in accordance with the accompanying documentation; (2) modified; (3) improperly installed; (4) repaired by someone other than Onset; or (5) used in a manner or purpose for which the product was not intended.

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Returns

Please direct all warranty claims and repair requests to place of purchase.

Before returning a failed unit directly to Onset, you must obtain a Return Merchandise Authorization (RMA) number from Onset. You must provide proof that you purchased the Onset product(s) directly from Onset (purchase order number or Onset invoice number). Onset will issue an RMA number that is valid for 30 days. You must ship the product(s), properly packaged against further damage, to Onset (at your expense) with the RMA number marked clearly on the outside of the package. Onset is not responsible for any package that is returned without a valid RMA number or for the loss of the package by any shipping company. Loggers and sensors must be clean before they are sent back to Onset or they may be returned to you.

Repair Policy

Products that are returned after the warranty period or are damaged by the customer as specified in the warranty provisions can be returned to Onset with a valid RMA number for evaluation.

ASAP Repair Policy

For an additional charge, Onset will expedite the repair of a returned product.

Tune Up Service

Onset will examine and retest any HOBO data logger or sensor.

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CE The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

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