

# ECH<sub>2</sub>O

## Dielectric Aquameter

**ECHO** Dielectric Aquameter is a new, low-cost sensor for measuring volumetric water content of soil and other porous materials.

- ▶ Lowest-cost dielectric water content sensor.
- ▶ Low sensitivity to salt and temperature.
- ▶ Very low power requirement.
- ▶ Voltage output proportional to water content.
- ▶ High resolution allows daily or hourly tracking of water use.

## Applications

- ▶ Irrigation management.
- ▶ Water balance studies.
- ▶ Landfill and hazardous waste site monitoring.
- ▶ Management of land application of waste water.
- ▶ Vadose zone monitoring studies.



▲ *Scheduling and water use.*



▲ *ECHO aquameter operates in all soil textures—from a clay loam to a loamy sand.*

## Volumetric water content.

More ECHO capabilities. Less TDR expense.

**E**CHO measures the dielectric constant or permittivity of the material in which it is embedded. Dielectric moisture sensors, or aquameters, are of two types. One measures dielectric constant of a medium by finding the time taken for an electromagnetic pulse to traverse a transmission line buried in the medium. This type of sensor is called a time domain reflectometer (TDR), and is expensive and relatively complex.

The second type of sensor measures the dielectric constant of a medium by finding the rate of change of voltage on a sensor that is embedded in the medium. ECHO and other low cost moisture probes are of this type. Water has a permittivity of about 80, while the value for soil minerals is around 4 and air is 1. This high value for water results in relatively large changes in

the permittivity of soil when the water content changes.

Any sensor which accurately measures the permittivity can be used to determine the volumetric water content. Confounding factors are temperature and salinity. The circuitry of ECHO minimizes effects due to temperature variation. The probe coating minimizes salinity effects. Soil texture affects ECHO calibration to about the same extent that it does any other dielectric sensor.

## DECAGON

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Preliminary

### ECHO Specifications

#### Range:

Zero to saturated  
volumetric water content.

#### Measurement time:

10ms.

#### Accuracy:

±2% typical  
±1% with soil specific  
calibration..

#### Resolution:

0.002m/m.

#### Output range:

500 to 1000mV  
*proportional to volumetric  
water content*

#### Power requirement:

2.5VDC @ 3mA.

#### Operating temperature:

0–50° C

#### Dimensions:

10" L x 1.25" W

#### Warranty:

1 year.

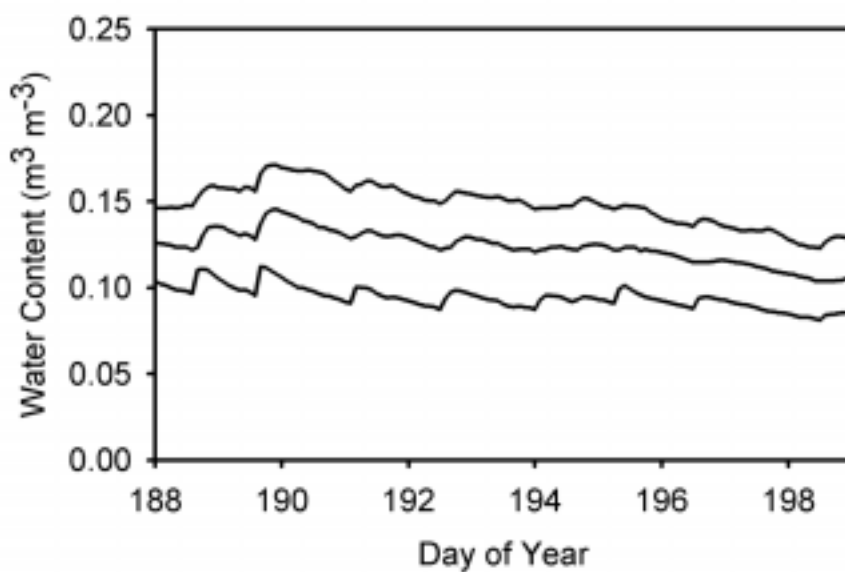
#### Datalogger compatibility:

Campbell Scientific CR10,  
CR10X, 21X, 23X.

*Uses one single-ended input  
channel per probe.*



◀ Sensor durability for long-term  
unattended soil moisture monitoring.



▲ The plot above shows the  
calibrated output of three ECHO  
probes installed in an irrigated  
potato field. Each probe was buried  
at a different location within a  
2 meter radius. Peaks in water  
content indicate the passing of the  
center-pivot sprinklers.

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