Document Title: Description, AN, Calibration & Evaluation of an Improved low-cost Soil moisture sensor		Part # and Rev. 13492-01	
		Release Date:	
Rev.	Description	Revision By	Date

Production Filename: 13492 (In Product Library)

Path to Working Files: DecaDoc\Application Notes\Master

Dimensions: 8.5 inch wide, 11 inch tall

Material: Paper, 92 Bright White or better, 75g/m² or heavier

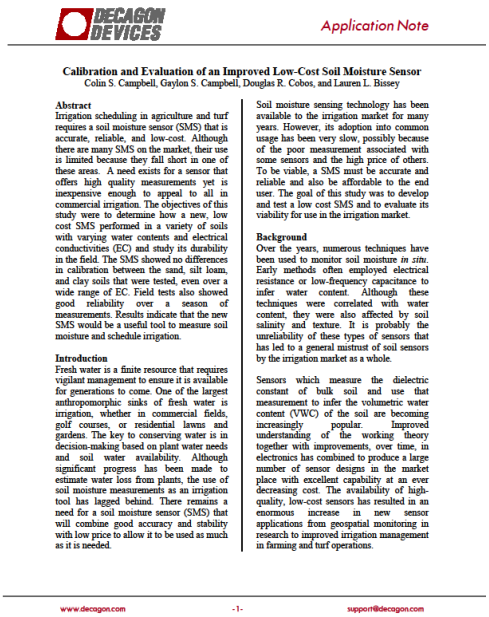
Colors: Color Print on White

Printer: HP Color LaserJet 8550-PS

Finish: None

Adhesive: None

Special Notes: Illustrations are Ref Only ** Not to Scale ** (Shown page 1 of 13)



DECAGON DEVICES Application Note

Calibration and Evaluation of an Improved Low-Cost Soil Moisture Sensor

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Abstract
Irrigation scheduling in agriculture and turf requires a soil moisture sensor (SMS) that is accurate, reliable, and low-cost. Although there are many SMS on the market, their use is limited because they fall short in one of these areas. A need exists for a sensor that offers high quality measurements yet is inexpensive enough to appeal to all in commercial irrigation. The objectives of this study were to determine how a new, low cost SMS performed in a variety of soils with varying water contents and electrical conductivities (EC) and study its durability in the field. The SMS showed no differences in calibration between the sand, silt loam, and clay soils that were tested, even over a wide range of EC. Field tests also showed good reliability over a season of measurements. Results indicate that the new SMS would be a useful tool to measure soil moisture and schedule irrigation.

Introduction
Fresh water is a finite resource that requires vigilant management to ensure it is available for generations to come. One of the largest anthropomorphic sinks of fresh water is irrigation, whether in commercial fields, golf courses, or residential lawns and gardens. The key to conserving water is in decision-making based on plant water needs and soil water availability. Although significant progress has been made to estimate water loss from plants, the use of soil moisture measurements as an irrigation tool has lagged behind. There remains a need for a soil moisture sensor (SMS) that will combine good accuracy and stability with low price to allow it to be used as much as it is needed.

Soil moisture sensing technology has been available to the irrigation market for many years. However, its adoption into common usage has been very slow, possibly because of the poor measurement associated with some sensors and the high price of others. To be viable, a SMS must be accurate and reliable and also be affordable to the end user. The goal of this study was to develop and test a low cost SMS and to evaluate its viability for use in the irrigation market.

Background
Over the years, numerous techniques have been used to monitor soil moisture *in situ*. Early methods often employed electrical resistance or low-frequency capacitance to infer water content. Although these techniques were correlated with water content, they were also affected by soil salinity and texture. It is probably the unreliability of these types of sensors that has led to a general mistrust of soil sensors by the irrigation market as a whole.

Sensors which measure the dielectric constant of bulk soil and use that measurement to infer the volumetric water content (VWC) of the soil are becoming increasingly popular. Improved understanding of the working theory together with improvements, over time, in electronics has combined to produce a large number of sensor designs in the market place with excellent capability at an ever decreasing cost. The availability of high-quality, low-cost sensors has resulted in an enormous increase in new sensor applications from geospatial monitoring in research to improved irrigation management in farming and turf operations.