



**VAN WALT**  
monitoring your needs

# Soil Moisture

Equipment from Van Walt Ltd



# Importance of monitoring **Soil Moisture**

Soil hydrological processes drive many natural processes in the environment and monitoring soil moisture conditions provides important data to understand and predict the impact of changes in soil moisture and water availability for agriculture, industry, domestic consumption and the environment. **Measuring and monitoring soil moisture** and developing a knowledge of how it varies between places, soil types and through time, is fundamental to gain an insight into likely future growing conditions and mankind's impact on the environment.

Understanding how the natural environment functions, how it responds to change and knowing that soil is a medium in which to grow plants because it provides both an anchor to the plant and vital nutrients and water. **Knowing the amount of moisture in a soil is essential for vegetation to grow successfully.** In a natural landscape the vegetation will be suited to the soil type, the climate and also the soil moisture conditions; too little water and plants struggle to survive and too much water can be equally fatal.

In nature plants that are suited to particular conditions tend to do well. When we modify and exploit our environment and replace native vegetation with crops through intensive agriculture; withdraw water from rivers and aquifers for domestic supply and irrigation, we need to understand what impact this will have over time. For example, measuring soil moisture quantifies the need for irrigation in advance of a crop showing signs of distress. Knowing the soil moisture status enables highly efficient irrigation that provides the water as and when required and eliminates the wasteful

and costly use of water when irrigation is not needed.

Water enters the soil as rain that drains through to enter the groundwater, which may ultimately lead to either streams, rivers, lakes, wetlands or the ocean. This process can be fast, taking hours to days or extremely slow, perhaps taking thousands of years, if the water drains down into a large aquifer. Soil acts as part of a storage system that regulates the passage of water from rainfall to its return to the surface.

The moisture held in soils can also be lost to the atmosphere by evaporation and the evapotranspiration of plants. The more we understand about soil moisture the better we are able to recognise the plants that are suited to particular conditions, the availability of water to maintain surface waters and the impacts of modifying and exploiting nature.

**There are many techniques to measure soil moisture**, their varied characteristics mean that different techniques are suited to different applications. Soil moisture content is shown by mass or by volume.

Soil moisture content has always been one of the factors that **determines optimal plant growth and crop production.** But, as environmental factors like climate change, decreasing water resources, improved crop production and protecting threatened habitats have grown in importance; the need for accurate, consistent and timely soil moisture measurements has also increased. We need this information in order to deliver the data required to develop better policies to protect and improve our world.

# Applications



Agriculture



Flood forecasting



Crop irrigation & optimisation



Archaeology



Research into crop yield



Landslide studies



Sports turf research



Soil health studies



Soil research



Water saving & protection



Watershed management





### TECHNICAL SPECIFICATIONS

MEASUREMENT	ACCURACY	RANGE	RESOLUTION
Real dielectric permittivity (isolated)	< ± 0.5% or ± 0.2 dielectric units	1 to 80 where 1 = air, 80 = distilled water	0.001
Soil moisture for inorganic & mineral soil	± 0.01 WFV for most soils ± ≤0.03 max for fine textured soils*	From completely dry to fully saturated (from 0% to 100% of saturation)	0.001
Bulk electrical conductivity	± 2.0% or 0.02 S/m whichever is typically greater	0 to 1.5 S/m	0.001
Temperature**	± 0.3° C	-10°C to +60° C	0.1°C
Inter-sensor variability	± 0.012 WFV (θ m <sup>3</sup> m <sup>-3</sup> )	n/a	

\*Accuracy may vary with some soil textures. \*\* Extended temperature range sensor (down to -40° C) available

### ELECTRICAL AND COMMUNICATION

	SDI-12	RS485
Power supply	9-20 VDC	9-20 VDC
Power consumption	<1 mA idle / 10 mA active	<10 mA idle / 30 mA active
Cable	3-wire: power, ground, data	4-wire: power, ground, com+, com-
Max. cable length	60 m (197 ft.)	1,219 m (4,000 ft.) Non-spliced: 304.8 m (1,000 ft.)
Baud Rate	1200	9600
Communication protocol	SDI-12 Standard v. 1.2	Custom or open spec
Addressing	Serial; allows multiple sensors to be connected to any RS485 or SDI-12 data logger via a single cable.	

### ENVIRONMENTAL

Operating Temperature	<ul style="list-style-type: none"> <li>Standard temperature probe range: -10°C to +60°C</li> <li>Standard Extended temperature probe range: -30°C to +60°C</li> <li>Extra Extended temperature probe range: -40°C to +65°C</li> </ul>
Storage Temperature	-40°C to +65°C
Water Resistance	Tolerates continuous full immersion
Cable	18 gauge (20 gauge for RS-485/ analog), UV resistant, direct burial
Vibration and shock resistance	Excellent; potted components in PVC housing and 304 grade stainless steel tines

### PHYSICAL

Length	4.9" (124 mm)
Diameter	1.6" (42 mm). Optional slim housing version available: 1.4" (35.8 mm)
Weight	7 oz. (200 g). Optional slim housing version available: 6.5 oz. (184 g)
Cable weight	0.86 oz/ft (80g/m)
Sensing volume (cylindrical region)	Length: 2.2" (5.7 cm) Diameter: 1.2" (3.0 cm)

\*Accuracy may vary with some soil textures.

The HydraProbe is a rugged soil sensor with patented technology that provides continual, consistent accuracy to measure the three most significant soil parameters simultaneously - moisture, salinity and temperature.



### RELIABLE

Continual, long-term data without calibration.

- Stable—no sensor drift, ensuring continual accuracy.
- Patented technology that accurately measures moisture and bulk electrical conductivity permits more accurate optimization of watering and fertilization than with just moisture.
- Depended on by the USDA, NOAA, leading irrigation companies, and many universities for over 20 years. Used by the USDA Soil Climate Analysis Network for ground truthing of satellite-based soil imaging.
- Soil moisture calibration has been rigorously peer-reviewed, making it **one of the most trusted soil sensors available.**

### RUGGED

Durable stainless steel tines, fully potted components, compact sealed design and a **5-year warranty.**

- Can remain in-situ indefinitely, or relocated and redeployed without worry.
- Ideal for remote locations, harsh environments and applications where data is critical.
- Enables measurement of native (undisturbed) soil, even hard-packed clay.
- Industry-leading 5-year warranty.

### SIMPLE

Set it and forget it.

- Repeatable accuracy and stability **without the need for calibration** in most soils.
- Digital sensor using the SDI-12 or RS485 protocol—no setup, just connect to data logger. Compatible with any SDI-12/RS485 capable data logger.
- Zero maintenance required.

### ACCURATE

Consistent research-grade accuracy every season, every location.

- Unparalleled spatial and temporal measurement consistency. No sensor-to-sensor variations across locations, seasons, soil types or moisture range.
- Instant measurement of the 3 most significant soil parameters simultaneously.
- Unlike most TDR or capacitance-based sensors, **HydraProbe is less sensitive to changes** in temperature, salinity, and soil mineralogy.

## The Science Behind HydraProbe

The HydraProbe's "dielectric impedance" measurement principle differs from TDR, capacitance, and frequency soil sensors by taking into account the energy storage and energy loss across the soil area using a 50 MHz radio frequency wave. Unlike other soil sensors, this unique, patented method separates the energy storage (real dielectric permittivity) from the energy losses (imaginary dielectric permittivity). The HydraProbe's detailed mathematical and signal characterization of the dielectric spectrum helps factor out errors in the soil moisture measurement such as temperature effects, errors due to salinity, and soil type. This method has passed the most rigorous scientific peer review from dozens of journals such as the Vadose Zone Journal, American Geophysical Union, and The Journal of Soil Science Society of America.

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## Read-Out Options

### vanwaltDataHub

A self powered, flexible system of electronics, conveniently packaged in an IP rated, heavy duty aluminium enclosure which performs as a hub to collect data from sensors. It organises the data for distribution or sharing through on-board memory, radio frequency, GPRS or satellite portals.

### vanwaltDataSlave

The vanwaltDataSlave sits at the location of your monitoring – a field; well-head; arable land plot; stream, river or lakeside site – communicating between your deployed sensors to either the vanwaltDataHub or your laptop using radio waves. This sophisticated unit with a range up to 10 km line-of-sight, requires little power to act as an invisible wire linking SDI-12, Modbus or Pulse sensors to our telemetered data collection system.

### HydraGO Field Version

Wireless, sensor-to-smartphone interface for HydraProbe. Features a rugged, anodized aluminum housing that contains a rechargeable battery that powers the connected HydraProbe and built-in ad-hoc Wi-Fi radio. The app will display soil moisture content, temperature, conductivity and dielectric permittivity on-screen for immediate viewing.





### TECHNICAL SPECIFICATIONS

<b>Battery type</b>	Rechargeable NiMH battery, 3.6 V / 300 mAh
<b>Wireless protocol</b>	Bluetooth
<b>Housing</b>	Anodized aluminum with an acetal endpiece
<b>Operating temperature</b>	14°F to 149°F (-10°C to +65°C)
<b>Soil probe</b>	Stevens HydraProbe (ratiometric dielectric coaxial impedance)
<b>Soil tine assembly</b>	Marine grade stainless steel
<b>Parameters measured</b>	Soil moisture, temperature, bulk electrical conductivity, dielectric permittivities
<b>Dimensions</b>	Adjustable—70 cm to 153 cm including both the pole and the sensor body Sensor body is 20 cm in length including tines, 7.5 cm in diameter at the top of the main body
<b>Moisture</b>	Range: From completely dry to fully saturated (from 0% to 100% of saturation) Accuracy: $\pm 0.01$ WfV for most soils, $\pm \leq 0.03$ max for fine textured soils*
<b>Bulk electrical conductivity</b>	Range: 0 to 1.5 S/m $\pm 2.0\%$ or 0.02 S/m whichever is typically greater*
<b>Real dielectric permittivity (isolated)</b>	Range: 1 to 80 where 1 = air, 80 = distilled water Accuracy: $< \pm 0.5\%$ or $\pm 0.2$ dielectric units
<b>Temperature</b>	Range: -10°C to +60° C Accuracy: $\pm 0.3^\circ$ C

\* Accuracy may vary with some soil textures.

The HydraGO is a portable soil moisture data collection device, this wireless sensor-to-smartphone technology for soil moisture measurements is a rugged, accurate and easy-to-use, handheld sensor.



## Rugged, accurate and easy-to-use portable soil data collection

Take soil measurements anywhere for those applications not requiring a permanent soil monitoring system. Your Apple or Android device communicates wirelessly with the HydraGO using bluetooth.

HydraGO features a rugged, engineered, resin housing that contains a rechargeable battery good for a full day's heavy use. It comes with a detachable ergonomic pole so it can be inserted without bending over.

### Applications:

- Agriculture
- Scientific research
- Watershed management,
- Greenhouses
- Ground-truthing
- Soil quality assessments
- Soil surveys.



## How it works

### The application behind HydraGO

Simply insert the probe into the soil, and tap the "Sample" button in the HydraGO app. The app will display soil moisture content, temperature, conductivity, and dielectric permittivity on-screen for immediate viewing.

All data can be saved and emailed as a .CSV file for analysis in Excel. Notes and location names can be added to the data records.

HydraGO uses the same patented soil sensor as the HydraProbe.

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## HydraGO Field Version

Wireless, sensor-to-smartphone interface for HydraProbe

The HydraProbe Field Portable system features a rugged, anodized aluminum housing that contains a rechargeable battery and an LCD screen to indicate battery voltage as well as an on/off switch.

The HydraProbe Field Version comes with a carry strap for easy-on-the-go measurements. The HydraGO Field Version is available with and without a survey-quality, sub-meter GPS receiver.



# GroPoint Profile

Multi-Segment Soil Moisture & Temperature Profiling Probe

## TECHNICAL SPECIFICATIONS

### MOISTURE

Measurement range	7% to 42% of volumetric moisture content
Output unit	Volumetric percent
Repeatability	< 0.2%

### TEMPERATURE

Measurement range	-20°C to +70°C
Storage temperature	-40°C to +85°C
Accuracy	±0.5°C from 0-25°C to 100°C
Sensors	1 thermistor per 2 segments
Output	SDI-12 v.1.3 (RS-485 optional)
Connection	Flying leads (optional 4 pin, IP66/IP68 rated environmental connector)
Input voltage	6 to 14 VDC, max. 18 VDC
Input current	15mA (0.1 mA idle). Max. 100 mA
Current consumption	Quiescent: <0.5mA Active: 15-20 mA (depending on number of segments) for 100 mS

## Installation

Create a pilot hole the exact size required for the probe using the slide hammer tool attached to a sturdy steel pilot rod. This makes installation quick and easy, and provides minimum soil disruption, further increasing measurement accuracy.



The GroPoint Profile provides cost-effective measurement of volumetric water content over multiple depths using a single probe, eliminating the cumbersome excavation required for multiple sensors placed at different depths.

- Installs quickly and easily without excavating.
- Measures across the entire length of the probe, averaging the soil moisture and temperature in each segment
- One SDI-12 address is used to read all segments, providing for simplified installations. Optional RS-485 output.
- Moisture readings can be user-calibrated with 3rd-order polynomials to meet custom requirements.
- Eliminates need for multiple sensors and cabling systems.
- Low power requirements—suitable for remote, autonomous applications.
- Patented TDT<sup>5</sup> technology for extreme & repeatable accuracy, lower power consumption & maximum resilience
- Fully potted electronics for excellent durability.

## Configurations

GroPoint Profile is available in six different multi-segment lengths, suitable for a wide range of agricultural crop monitoring.

You can also choose from two different configurations for temperature sensors, depending on your requirements. You can configure it with no temperature sensors if you only require moisture measurement, or the standard configuration which places temperature sensors every 1 or 2 segments.

## The Science

### Behind GroPoint Profile

The GroPoint Profile is based on the field-proven Time Domain Transmission (TDT) method for reliably measuring changes in soil moisture. Like Time Domain Reflectometry (TDR), TDT also characterizes the time of travel of an electromagnetic signal through soil, but instead of being reflected, the signal propagates around a set path length. The high frequency and helical wave guide provides stability and precision to the measurements.

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## Read-Out Options

### vanwaltDataHub

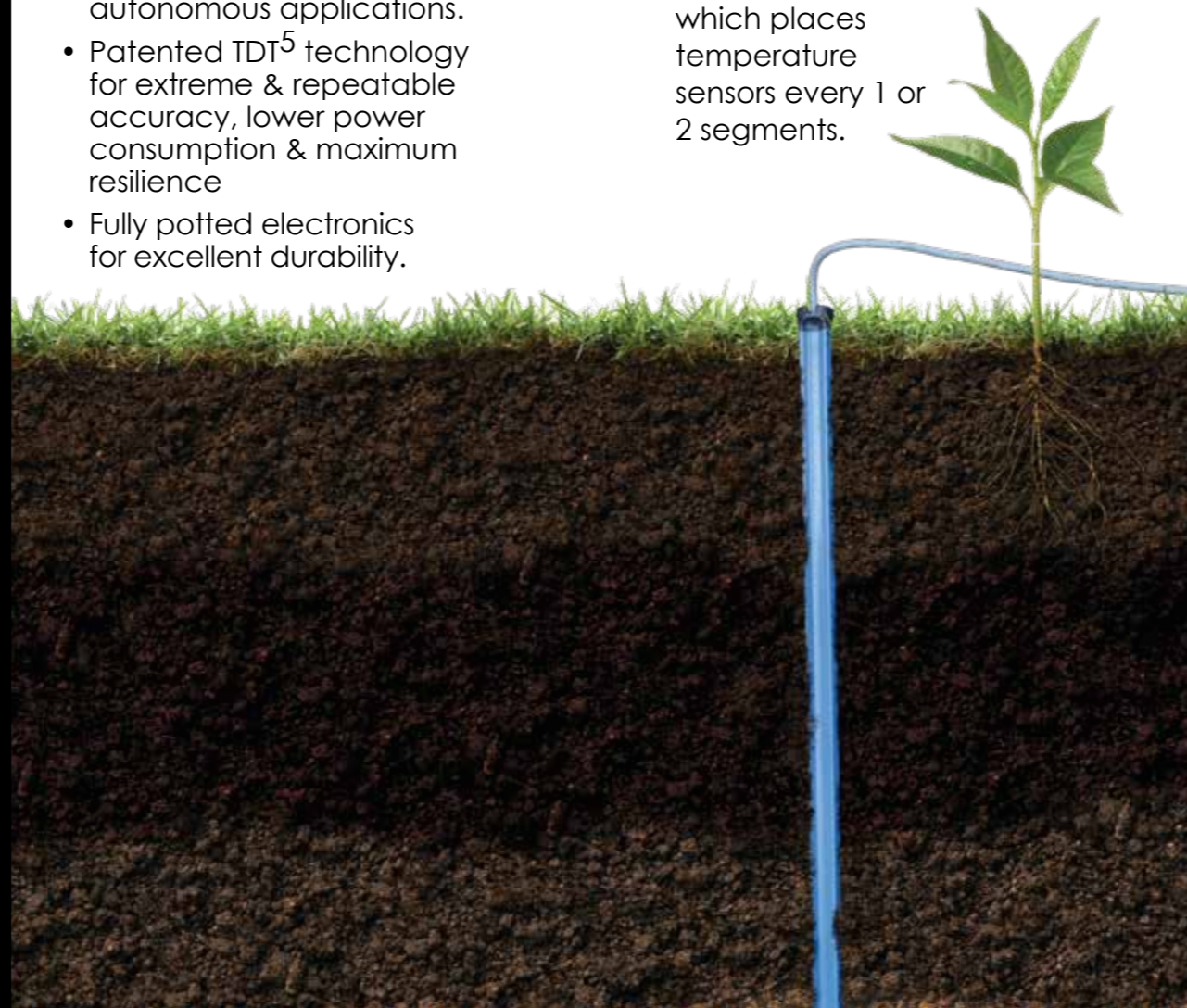
A self powered, flexible system of electronics, conveniently packaged in an IP rated, heavy duty aluminium enclosure which performs as a hub to collect data from sensors. It organises the data for distribution or sharing through on-board memory, radio frequency, GPRS or satellite portals.

### vanwaltDataSlave

The vanwaltDataSlave sits at the location of your monitoring – a field; well-head; arable land plot; stream, river or lakeside site – communicating between your deployed sensors to either the vanwaltDataHub or your laptop using radio waves. This sophisticated unit with a range up to 10 km line-of-sight, requires little power to act as an invisible wire linking SDI-12, Modbus or Pulse sensors to our telemetered data collection system.

### GP-DU Handheld Reader

Gives immediate readings of current measurement conditions from GroPoint sensors. It features a large display window in a robust weather resistant casing with a 3 pin EN3 connector.

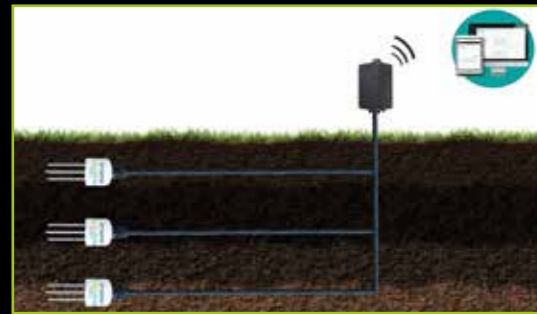


# Telemetry Options

## Choosing what's right for your application

Accessing your soil moisture data couldn't be easier. We have an option for every configuration from single monitoring points to fully integrated telemetered solutions for multi-point installations. Developed in-house to our own exacting specifications and manufactured in England, throughout the process we have been mindful of price, adaptability, location, reliability, consistency and accuracy. We have created a system that works with multiple inputs / outputs, has different power options, with no limit to the number of sensors and different protocols of the sensors attached and with redundancy built-in.

At the heart of our systems is the *vanwalfDataHub*. A self-powered, flexible system of electronics conveniently packaged in an IP rated, heavy duty aluminium enclosure which performs as a hub to collect data from sensors. The DataHub organises the data for distribution or sharing through on-board memory, radio frequency, GPRS or satellite portals.



### HydraProbe

Soil Moisture Probe  
Connected to a *vanwalfDataHub*



### GroPoint Profile

Multi-Segment Soil Profiling Probe  
Connected to *vanwalfDataSlaves*

The interface from which you can configure your sensors, visualise your data, analyse measurements, manage alarms and set up data routing is our *vanwalfCONNECT* system. A versatile, flexible, sophisticated, accurate cloud-based system which allows data collected to be accessed and shared only with users to whom you have given permission.

From legacy systems to brand-new installations the Van Walt telemetry options provide solutions for every monitoring situation.



## vanwalfDataSlave

A sophisticated two-way communication device connecting sensors by cable and transferring the data via radio waves to a central datalogger or directly to a PC.

The *vanwalfDataSlave* sits at the location point of your monitoring, acting as an invisible wire between onsite sensors to either the *vanwalfDataHub* or your laptop, by using radio frequencies. With a range up to 10 km line-of-sight the DataSlave runs on two AA lithium batteries and is a cost-effective solution for telemetered networks or individual monitoring points.

The *vanwalfDataSlave* is compatible with SDI-12, Modbus or pulse sensors and can work purely as a gateway for data if the deployed sensor is a datalogger with its own PC software to 'download' the data or for sensors that don't have this functionality built in, the DataSlave has additional memory on board, allowing you to store data inside the slave node. At usual logging rates of every 15 minutes and hourly uploads there is enough memory on board to store data for 3 years. Once the memory is full the DataSlave will start looping and erasing earlier data.

## vanwalfDataHub

*vanwalfDataHub* is a self powered, flexible system of electronics, conveniently packaged in an IP rated, heavy duty aluminium enclosure which performs as a hub to collect data from environmental and other sensors. It organises the data for distribution or sharing through on-board memory, radio frequency, GPRS or satellite portals.

Modbus, SDI-12, Analog and digital I/O are provided to connect sensors singly or in daisychain. *vanwalfDataHub* instructs, powers, interrogates and collects data from the sensors.

Data is stored on non-volatile memory and backed up for redundancy and for convenience by an industrial grade SD card. Data can be downloaded by cable, by radio frequency transceiver, by GPRS, by satellite transmission or simply by the removal of the SD card.

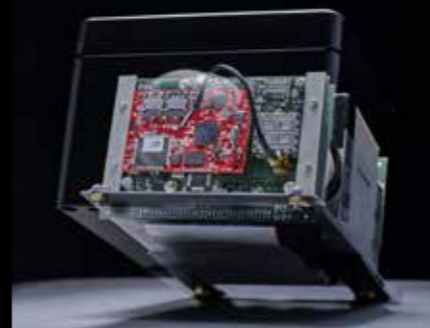
*vanwalfDataHub* is supplied as standard with on-board non-volatile logging memory, industrial SD Card memory, 2G or 3G/4G connectivity and batteries. Optionally it can be supplied with a Radio Frequency or Satellite Transceiver (Iridium) and solar panel. *vanwalfDataHub* can perform as a powerful

and flexible standalone, power-independent datalogger but it can also interface seamlessly with our proven and highly flexible *vanwalfCONNECT* data acquisition and data sharing server.

*vanwalfCONNECT* is a highly versatile, flexible, sophisticated and accurate web based system which allows data collected by the DataHub to be accessed from your desktop and shared between users to whom permission is given. Our server is housed, backed-up and maintained by world-leading provider Rackspace.

### Features

- FTP Data Forwarding
- Device Status
- Device Control
- Email Alarms
- Data Downloading
- Data Grouping
- Interactive Reporting
- Calculated Fields
- Map Position
- Visual Graph
- Applications.





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