AQUAFLEX

The Soil Moisture Sensor that Speaks VOLUMES

Aquaflex Soil Moisture Sensor (Model SI.99) -User Manual-

The AQUAFLEX Sensor (part # SI.99) uses the unique AQUAFLEX measurement technique using a 3m (10') long flexible tape to measure a volume of 6 litres (370 cubic inches) of soil.

The Aquaflex Sensor has multiple outputs of soil moisture (in volumetric percent), and soil temperature:

- **Frequency**, for connection to pulse inputs (eg a flow meter input in an irrigation controller). Only soil moisture can be accessed from this sensor output.
- **4 to 20mA**, two separate outputs for soil moisture and soil temperature. For connection to irrigation controllers, telemetry systems etc

These signals may be used separately or simultaneously at any time without any changes to the sensor

The Aquaflex Sensor SI.99 can also be connected to the AQUAFLEX Handheld Reader if the optional connector is fitted.

Sensor Installation

Recommendations for sensor installation are given below. Your local AQUAFLEX Distributor will be pleased to give advice about the most suitable method of installation for your application.

It is important that the sensor serial number and the location of the sensor are recorded:

Serial Number	Date Installed	Location

There are two main methods for installing the sensors, the choice of which to use depends on the required installation depth for the sensor.

- For shallow installation (eg turf applications) the sensor can be simply 'slit' into the turf.
- For deeper installations a trench must be dug for the sensor.

Installation Hints

- Always unroll the data cable. Pulling cables off the side of a roll results in the cable coiling, which makes it difficult to install in the trench.
- Install the data cable in a metal or plastic conduit if there is risk of damage from spiking etc. **NOTE: The flat sensor cable must not be similarly protected**.
- Ensure that the sensor cable is at least 150mm away from any foreign objects.

Shallow Installations (e.g. Turf)

S Select and mark the position of the sensor with a string line. **Position the sensor where it can be easily located in future** – e.g. on a marker line on a sports field or in a position on a golf green marked by sight markers (e.g. between two known points).

S With a turf cutter or sharp, flat blade, carefully cut a slit in the turf.

S Carefully insert the sensor into the slit to the desired depth. Note: The sensor must be installed on its edge.

S For the electronics block at the end of the sensor, carefully peel back sufficient turf to create a slightly larger and deeper cavity in which to bury the block. Fold the turf back.

S Gently push from behind each side of the slit to close it. Pack from the sides to recreate original density and remove air pockets.

S Repair and smooth as necessary.

S Apply a liberal amount of irrigation/water to allow the sensor to bed in and remove air pockets.

S Run the data cable in a slit or trench to the desired location (e.g. an Adcon Telemetry addIT 720 Wireless Sensor Interface).

Note: ensure that the cable is buried deep enough to avoid damage during maintenance.

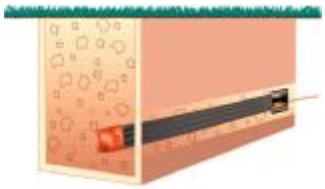
Run string line and cut a slit in turf

Push sensor to desired depth

Completed Installation

Deeper Installations (e.g. Agriculture or Vineyard)

S For deeper installations a trench should be dug to the desired depth for the sensor.



S Ensure there is a layer of loose soil in the bottom of the trench. This is to prevent air pockets beneath the flat sensor cable.

S Install the flat sensor cable on its edge at the bottom of its trench as shown above.
It is essential that the flat sensor cable be installed on its edge to prevent water lying on top of the cable, resulting in false moisture readings.

S Firmly pack loose soil around the sensor cable ensuring that there are no air pockets around or beneath the sensor cable. In some soils (e.g. clay) watering may help.

Carefully refill the trench taking care to keep the soil profile and density as close to its original state as possible. It is important that there are no air pockets within 150 mm (6 inches) of the sensor.

S Run the data cable in a slit or trench to the desired location (e.g. an Adcon Telemetry addIT 720 Wireless Sensor Interface). Note: ensure that the cable is buried deep enough to avoid damage during maintenance.

S Mark the location of the sensor so that it can be identified in the future.

After installation, allow time for the disturbed soil to settle before using the data from your Aquaflex Sensors. This can take some time depending on soil type and local conditions. The settling process can be accelerated by applying several heavy irrigations, ideally taking the soil to saturation each time.

Converting the Signal to Soil Moisture or Temperature

4 - 20mA Outputs

For sand, silt and sandy and silty loams:

Moisture (%) = 3.75 x C - 15

For clay and clay loams:

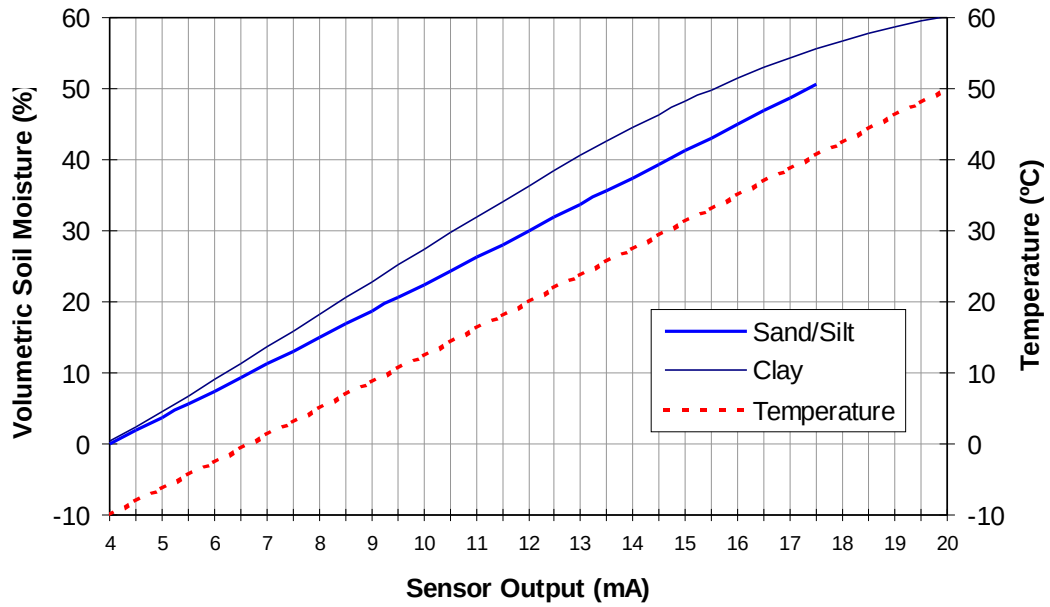
Moisture (%) = -14 + 2.87 x C + 0.214 x C^2 - 0.0086 x C^3

For temperature:

Temp (°C) = 3.75 x C – 25

Where C is the output current in mA.

Aquaflex 4 - 20mA Sensor Calibration Graph



When a 125Ω Resistor is Used to Convert the 4 - 20mA Signal to a 0.5 to 2.5 volt Signal

For sand, silt and sandy and silty loams:

Moisture (%) = 30 x V - 15

For clay and clay loam soils:

Moisture (%) = -14 + 23 x V + 13.7 x V^2 - 4.4 x V^3

For temperature:

Temp (°C) = 30 x V - 25

Where V is the output voltage.

Frequency Output, Standard Configuration

For Sand, silt and sandy and silty loams:

Moisture (%) = 0.5 x (ppm-10)

For Clay and clay loams:

Moisture (%) = -4.9 + 0.51 x ppm + 0.0026 x ppm² - 0.0000205 x ppm³

Where ppm = pulses per minute.

Electrical Connections

Wire Colour	Description	
Red	Sensor power +ve, 6.0 to 26 Volts.	
Black	Sensor ground, 0 Volts.	Moisture output, frequency.
Violet	Moisture output, frequency 0-5 Volt.	
White	Moisture output, mA +	Moisture output, 4-20 mA.
Blue	Moisture output, mA -	
Brown	Temperature output, mA +	Temperature output, 4-20mA.
Orange	Temperature output, mA -	
Yellow	Factory only, do not connect.	

Note: The Sensor Ground and mA - cores are connected internally within the sensor, therefore this sensor is not suitable for situations that require fully isolated outputs.

Specifications

Power supply voltage	+6.0 to +26 Volts, DC.
Power supply current	10mA average, 150mA peak (for 60 milliseconds during measurement) **plus** two current loops of up to 20mA each.
4-20mA outputs	**Moisture Output** 4-20mA representing the moisture range 0-60%. **Temperature Output** 4-20mA representing the temperature range -10 to 50 °C. Maximum load resistance **S** 250 Ω with 9 Volts supply. **S** 1 kΩ with 24 Volts supply. The 4-20mA signals may be converted to voltage signals by connecting external resistors across the 4-20mA outputs. Using a 125Ω resistor results in a 0.5 to 2.5V range.
Frequency output signal (Soil Moisture Only)	0 to 5 volts logic signal. 10 pulses per minute = 0% Volumetric Soil Moisture Content 130 pulses per minute = 60%. Volumetric Soil Moisture Content Special frequency ranges are available on request.
Time to measure	0.8 seconds after power supplied (typical). 1 second maximum.
Time between measurements	1 minute, if power applied constantly.
Operating Temperature	-10 to 40°C (14 to 104°F)
Soil Moisture Measurement Range Precision / Repeatability Accuracy	 0 to 60% volumetric moisture content ± 0.5% volumetric moisture content ± 2% volumetric moisture content
Soil Temperature Measurement Range Accuracy	The temperature is measured at the body of the sensor, not along the moisture-sensing cable. -10 to 50°C (14 to 122°F) ± 0.5°C (0.9°F)

Sensor Fault Indicators

If a fault occurs, the sensor outputs special signals, as follows:

Signal (V across 125Ω load)			**Fault condition**
0mA	0 V	0 ppm	A broken wire or possible failure in the sensor. Check the wiring and repair. Contact your distributor if wires are intact.
1 mA	0.125 V	2.5 ppm	Moisture reading out of expected range. If this output continues, contact your distributor. (Note: sensors will often give this output when in air, before burial – this is normal)
2 mA	0.250 V	5.0 ppm	Low battery or supply voltage. Replace the batteries or check power supply.
3 mA	0.375 V	7.5 ppm	Critical sensor settings have been lost. Contact your distributor.

Conditions of Use

Aquaflex must be installed as specified. Use of Aquaflex data is entirely at the discretion of the user and should therefore be subject to current best practice principles of soil moisture management and agronomic management.

Neither Streat Instruments nor its Distributors shall be liable (whether in contract, tort or otherwise) for any loss (including but not limited to loss of profits and consequential loss) of any kind whatever arising out of any published material or in connection with the performance or use of Aquaflex.

The serial number marked on each Aquaflex Sensor must be recorded and quoted for warranty claims.

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