



## ***Aquaflex Soil Moisture Sensor (SI.78 & SI.79)*** ***-User Manual-***

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These Aquaflex sensors provide a 4 to 20mA output for connection to third party dataloggers, irrigation controllers, weather stations etc.

### **Important**

There are two models of Aquaflex with 4-20mA outputs. Model SI.78 has only one output, for moisture. Model SI.79 has two outputs, one for moisture and one for temperature.

**NOTE: References in this guide to temperature refer only to the model SI.79 sensor.**

### **Sensor Location**

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

|                                                         |
|---------------------------------------------------------|
| Serial Number _____ Date Installed _____ Location _____ |
|---------------------------------------------------------|

### **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.

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.

### **Shallow Installations (eg Turf)**

- ◆ Mark where the sensor is to be installed with a string line. **Position the sensor where it can be easily located in future** – eg on a marker line on a sports field or at the edge of a golf green marked by sight markers.
- ◆ Cut a slit to the desired depth (eg 75 to 100mm) for the sensor. A slightly larger cavity is needed for the electronics block at the cable end of the sensor.
- ◆ Prepare some method for running the round data cable between the sensor and its destination (eg a data logger or irrigation controller etc). This might be an additional long slit in the turf, or a shallow trench etc. This should be sufficiently deep to prevent damage to the buried data cable.
- ◆ Push the flat sensor cable into the slit in the turf on its edge to the desired depth.
- ◆ Tamp down the slits in the turf and sprinkle fine sand or topsoil into the slit, packing it in as much as possible to avoid air pockets.
- ◆ Water the turf well to 'bed' the sensor in. Roll the ground if possible
- ◆ Run the data cable to its destination.



Run string line and cut a slit in turf



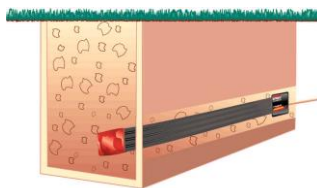
Push sensor to desired depth



Completed Installation

### Deeper Installations (eg Agriculture or Vineyard)

- ◆ For deeper installations a trench should to be dug to the desired depth for the sensor



- ◆ 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.
- ◆ Prepare an additional trench to accommodate the round data cable between the sensor and its destination (eg a data logger or irrigation controller etc). This trench should be sufficiently deep to prevent damage to the buried data cable.
- ◆ 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.**
- ◆ Firmly pack loose soil around the sensor cable ensuring that there are no air pockets around or beneath the sensor cable. In some soils (eg. clay) it may help to water the soil to assist in this.

- ◆ 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.
- ◆ Install the data cable in its trench and refill the trench, leaving excess cable coiled up in the trench below the logger/irrigation controller.
- ◆ Mark the location of the sensor so that it can be identified in the future.
- ◆ Refer to the installation hints on the final page for additional ideas to assist installation.

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.

### 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.

When installing several sensors at one site, only one power supply is required for all sensors. All sensor power and ground connections are connected to the power supply terminals.

### General

- ◆ The 4-20mA sensors provide a signal that represents soil moisture in volumetric percent and an optional signal (model SI.79 only) that represents the soil temperature in degrees Celsius.
- ◆ The output signals are currents in the range 4 to 20mA representing soil moisture of 0 to 60% or a temperature of -10°C to 50°C.
- ◆ The sensor can be configured to output a voltage instead of the 4 to 20mA current.
- ◆ The temperature sensor is located in the electronics module at the end of the flat cable and measures the soil temperature in the region of the module.
- ◆ While power is applied the sensor takes one measurement every minute.

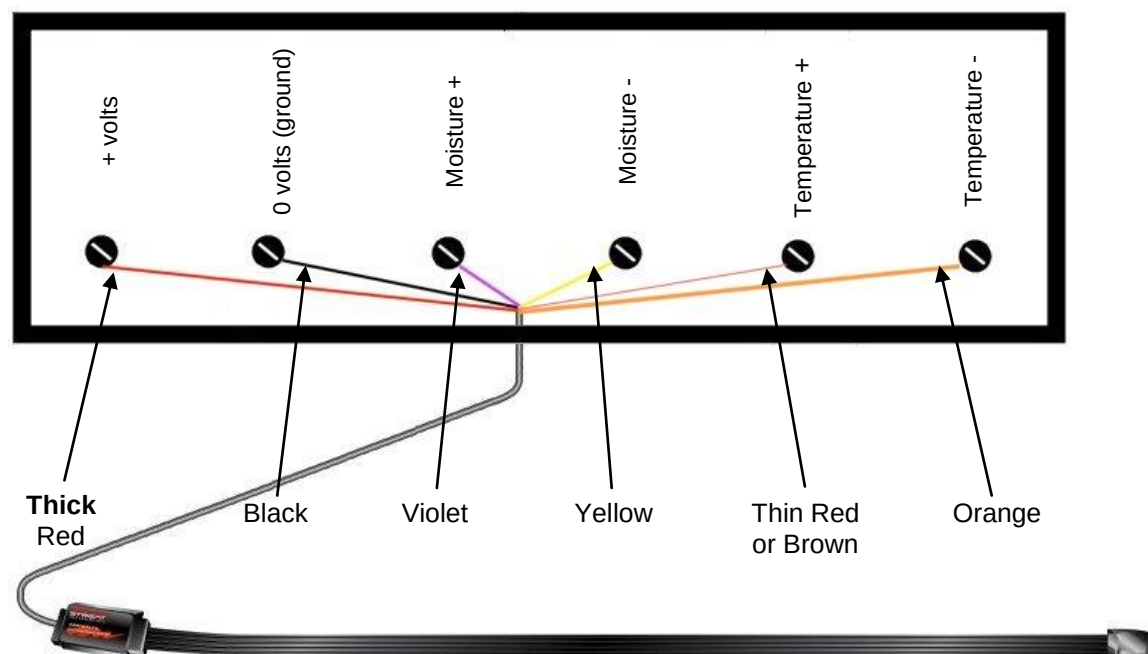
## Electrical Connection

The sensors have the following connections.

| Wire Colour                | Description   | Connection            | Cable Pairs |
|----------------------------|---------------|-----------------------|-------------|
| <b>Thick Red</b> (White 1) | Sensor Power  | +Volts                | Pair 1      |
| Black (Black 1)            | Sensor Ground | 0 Volts (ground)      |             |
| Violet (White 3)           | Moisture +    | 4 – 20mA              | Pair 2      |
| Yellow (Black 3)           | Moisture -    | Signal ground         |             |
| Brown/Thin Red (White 4)   | Temperature + | 4 – 20mA              | Pair 3      |
| Orange (Black 4)           | Temperature - | Signal ground         |             |
| White (White 2)            | Factory Only  | <b>Do not connect</b> | Pair 4      |
| Blue (Black 2)             | Factory Only  | <b>Do not connect</b> |             |

**Note 1:** Colours in brackets are alternatives for some types of data cable.

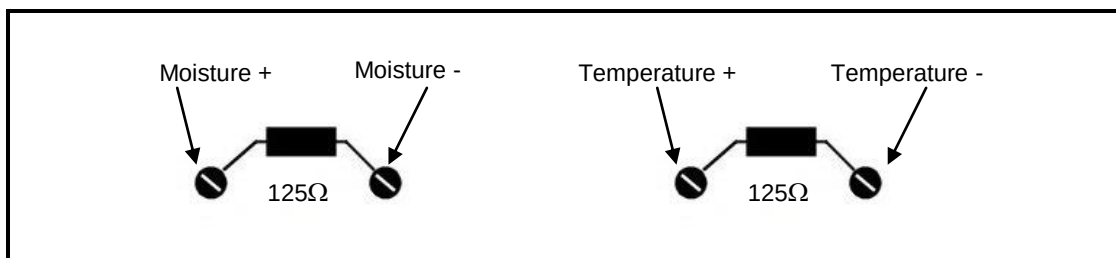
**Note 2:** Sensor Ground and Signal Ground are connected internally within the sensor, therefore this sensor is not suitable for situations that require fully isolated outputs.



## Connecting the sensor in Voltage mode

In voltage mode 125Ω resistors are used to convert the 4-20mA signals to voltages of 0.5 to 2.5 volts, representing moisture content of 0% to 60% or temperature of -10°C and 50°C.

Connect the sensor to the logger/controller as shown above, but with the 125Ω resistors connected between "Moisture +" and "Moisture -", and between "Temperature +" and "Temperature -":



## Converting the Signal to Soil Moisture and Temperature

There are two methods to convert the output signals into soil moisture and temperature. The simplest is to use the graph on the next page, alternatively use the formulas shown below:

### Standard 4 to 20mA Output

For sand, silt and sandy and silty loams:

$$\text{Moisture (\%)} = 3.75 \times C - 15$$

For clay and clay loams:

$$\text{Moisture (\%)} = -14 + 2.87 \times C + 0.214 \times C^2 - 0.0086 \times C^3$$

For temperature:

$$\text{Temp (°C)} = 3.75 \times C - 25$$

Where C is the output current in mA

### When a 125 ohm resistor is used to convert the signal to a voltage

For sand, silt and sandy and silty loams:

$$\text{Moisture (\%)} = 30 \times V - 15$$

For clay and clay loam soils:

$$\text{Moisture (\%)} = -14 + 23 \times V + 13.7 \times V^2 - 4.4 \times V^3$$

For temperature:

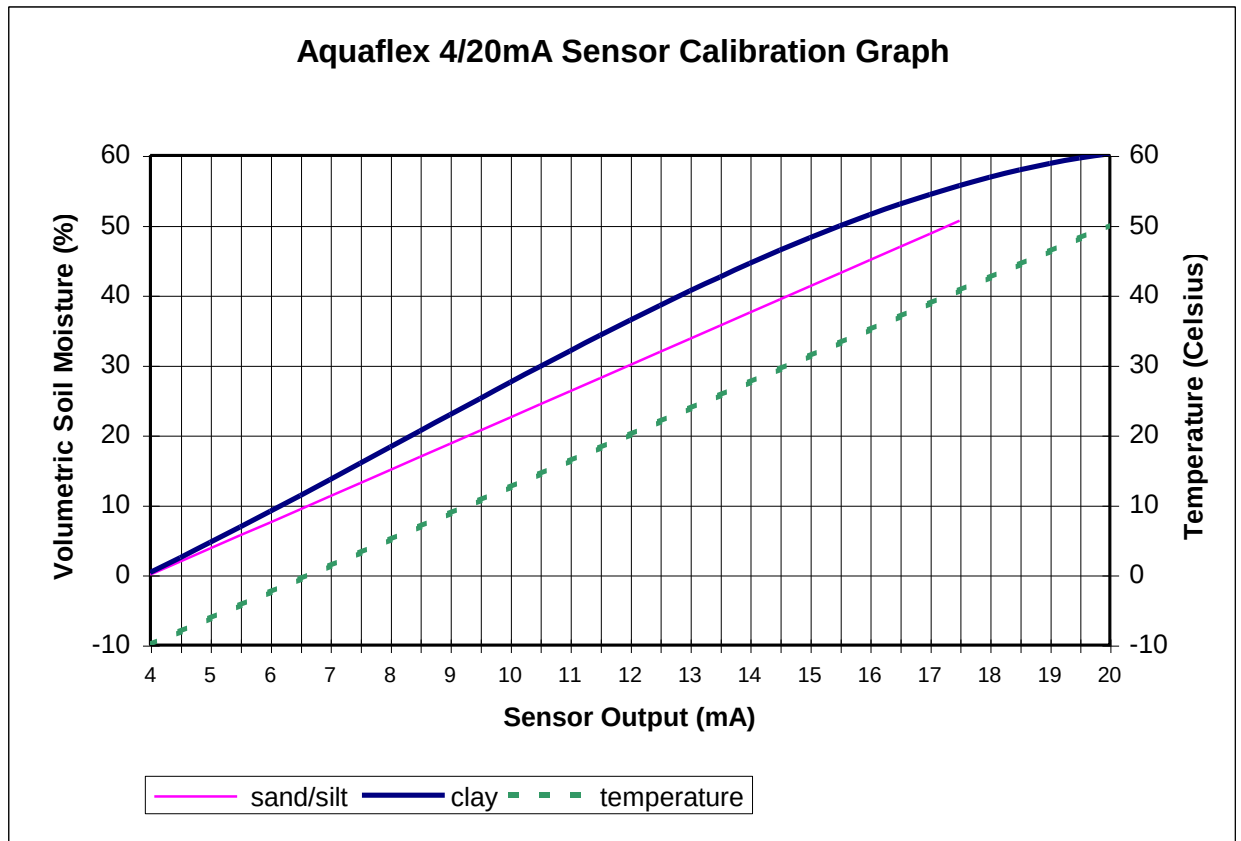
$$\text{Temp (°C)} = 30 \times V - 25$$

Where V is the Output voltage

## Graph

Three curves are included:

1. Sand, silt and sandy or silty loam soils
2. Clay and clay loams
3. Temperature.



## Specification

|                           |                                                                                                                 |
|---------------------------|-----------------------------------------------------------------------------------------------------------------|
| Power supply voltage      | 9 to 26 volts, DC                                                                                               |
| Power supply current      | 10mA average, 150mA peak (for 60 milliseconds during measurement) <b>plus</b> current loops of up to 20mA each. |
| Maximum load resistance   | 250 $\Omega$ with 9 Volts supply<br>1 k $\Omega$ with 24 Volts supply                                           |
| Time to measure           | 1 second after power is applied (max). Typically 0.8 seconds.                                                   |
| Time between measurements | 1 minute                                                                                                        |

## Sensor faults

If a fault occurs, the sensor outputs special currents of less than 4mA as shown below:

| Current | Fault condition                                                                                                          |
|---------|--------------------------------------------------------------------------------------------------------------------------|
| 0 mA    | A broken wire or total failure of the sensor. Check the wiring and repair. Contact your distributor if wires are intact. |
| 1 mA    | Moisture reading out of expected range. If this output continues, contact your distributor.                              |
| 2 mA    | Low battery or supply voltage. Replace the batteries or check power supply.                                              |
| 3 mA    | Critical sensor settings have been lost. Contact your distributor.                                                       |

### Conditions of Use

Aquaflux must be installed as specified. Use of Aquaflux 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 Aquaflux.

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



Streat Instruments Limited  
PO Box 24071  
Christchurch  
New Zealand

Ph: +64 3 384 8900  
Fax: +64 3 384 8901  
mail@streatsahead.com  
www.streatsahead.com



*envirofactors*

Envirofactors Limited  
3 Water Lane  
Bradford BD1 2JL  
United Kingdom

Ph: +44 1274 733 145  
Fax: +44 1274 732 410  
mail@envirofactors.com  
www.envirofactors.com



Streat Moisture Solutions (USA), LLC  
PMB 304  
516-D River Hwy  
Mooresville, NC 28117-6830  
USA

Ph: +1 704 718 7945  
streatusa@streatsahead.com  
www.streatsahead.com