Version 2.0

User Manual for the

WET150 sensor

SDI-12

Delta-T Devices

Introduction

Cables
To Meter
Extension cables
To GP2 and other loggers

SDI-12
Industry-standard digital interface, compliant to version 1.3

Connector
Fully waterproof M12 connector

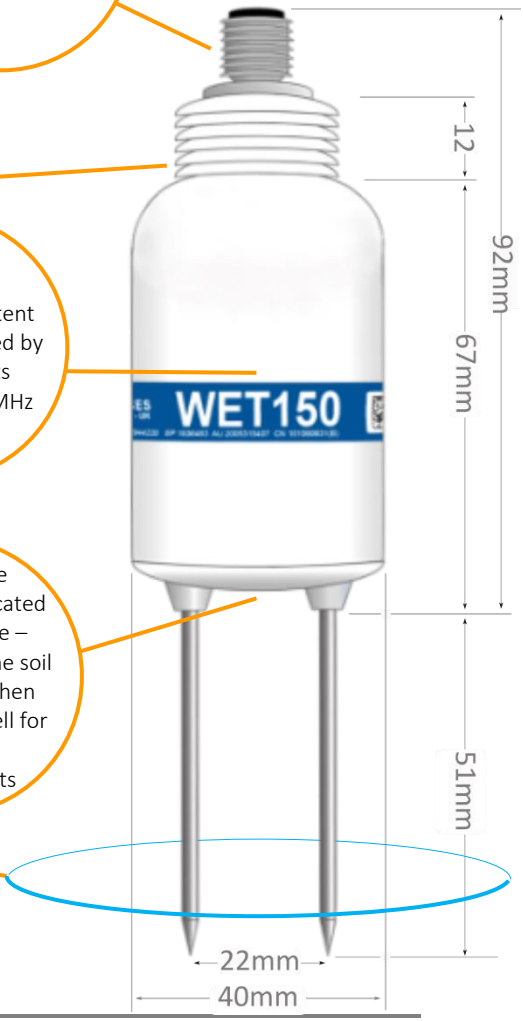
Installation
Threads enable extension rods to be screwed on for easy insertion in augured holes – minimising soil disturbance

Detectors
Soil moisture content and EC are detected by sensitive circuits operating at 100MHz

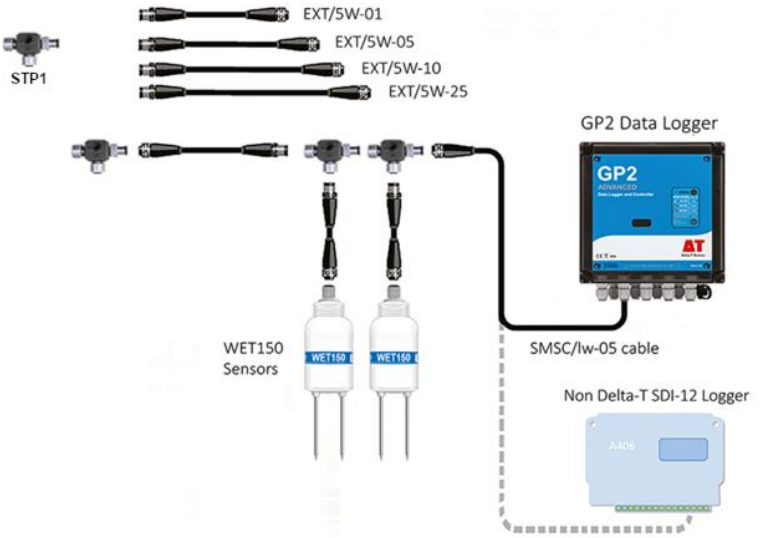
Outputs
Sophisticated correction algorithms ensure accurate readings across the full range of water content, EC and temperatures

Temperature
Thermistor is located within the base – equilibrates to the soil temperature when installed, less well for portable measurements

Sensing field
Extends ~100mm into the soil, but field is strongest close to the rods - install carefully to avoid air gaps



Networking



One WET150 can be read with a WET150 Meter. Multiple WET150s need a GP2 or other SDI-12 controller.

Delta-T extension cables are terminated in M12 thumb-screw connectors. Other cable types can be used, but this system has several advantages. Cables can be joined together to extend runs, or can be connected via a T-piece to branch the network and to connect to sensors. The M12 connector system makes it quick and easy to build and modify SDI-12 networks. Later if a network fails due to a faulty sensor or damaged cable, it is easy to isolate sections by temporarily disconnecting network branches or individual sensors to trace the fault.

M12 connectors on cables and the WET150 are waterproof to an IP rating of IP68, but must be screwed together tightly to form this waterproof seal. Failure to sufficiently tighten the collar may allow water ingress into the cable or sensor, leading to premature failure which is not covered by warranty. However, we do not recommend tightening with a spanner or other tool as there is a risk of overtightening and damaging the o-ring seal.

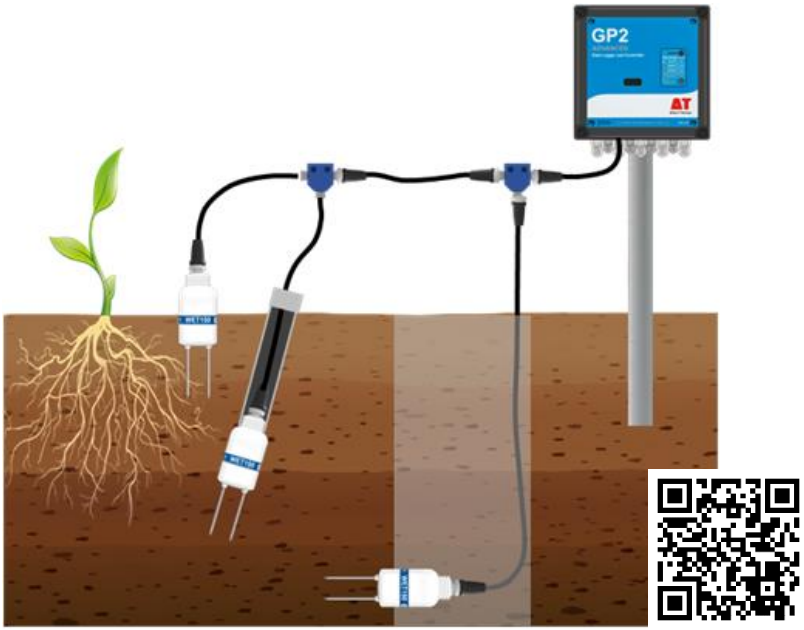
M12 plugs with screw connectors (also known as “field-attachable connectors”) are available for adding other sensors to the SDI-12 network.

Before connecting on a network each WET150 sensor must be individually set up with a unique address. To do this they must be individually connected to either to a GP2 logger controller, or WET150 Meter or other SDI-12 controller.

This is also a good opportunity to change individual sensor parameters, e.g. for soil type

See also: SDI-12 for GP2 User Manual

Installation in the Ground



A video showing how to install the WET150 in the ground can be found at: https://youtu.be/ZRMUkiy-f3g or via the QR code.

Surface installation and spot measurements

Spot measurements

Consistent technique is critical for repeatable results when taking spot measurements. Varying how hard the sensor is inserted can be the dominant form of error in some soil types. Too much pressure will squeeze the soil/substrate, changing the bulk density and reading. Too little pressure and you may not push the hole length of the rods in and therefore be reading air.

- Clear away any stones. Pre-form holes in very hard soils before insertion.
- Push the WET150 into the soil, fully inserting the pins to ensure good soil contact.
- If you feel strong resistance when inserting the WET150 into soil, you may have hit a stone. Stop, and re-insert at a new location.

SDI-12 commands

SDI-12 details are best handled by the GP2 logger controller itself within a logging program, as described in these previous sections. For system integrators and users of loggers from other companies see the WET150 SDI-12 Programmer's Guide.

This section gives a brief introduction to SDI-12 commands. The following command sequences are reviewed:

1. **Address Query** – find out the existing address of the single WET150 connected to the GP2
2. **Address Assign** – change the sensor's existing address to a new address
3. **Identify** – query the model, serial number and version of a sensor at a particular address
4. **Take a measurement**

The following examples explain what you need to type in the command entry box and how to interpret responses in the terminal window. The examples assume that the GP2's internal +12V supply (labelled +12V 0.5A) is being used for SDI-12 power. The GP2 automatically enables this supply when sending SDI-12 commands.

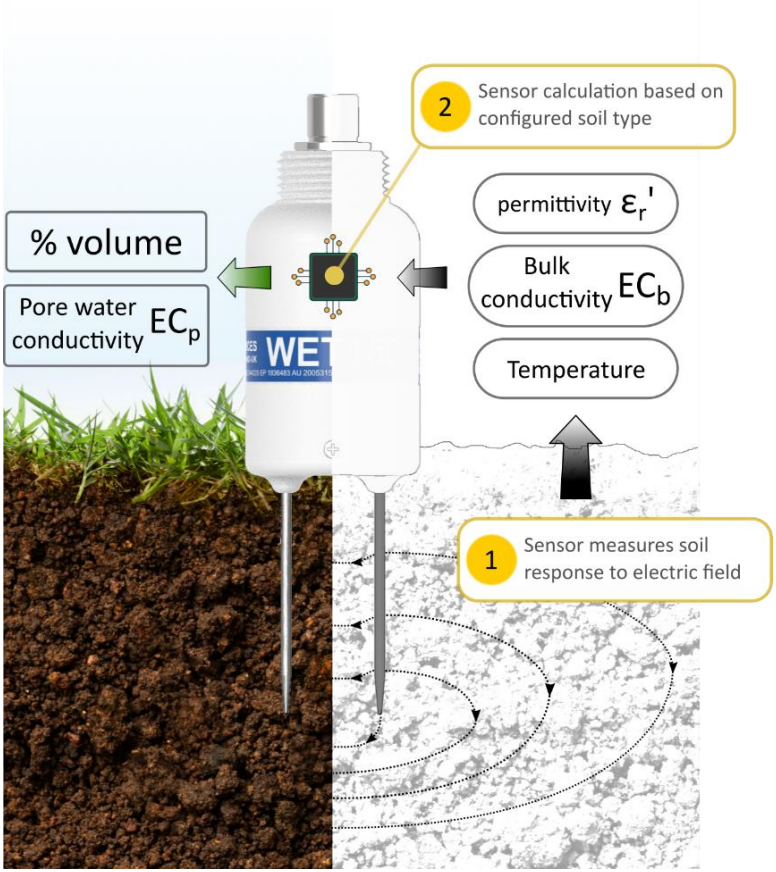
Specifications

Volumetric Water Content (%vol)		
Accuracy	± 3%vol (with a calibration matching the soil / substrate)	
Range	Accurate range: 5 to 100%vol, EC_b 0 to 500mS.m^{-1}. Full range: 0 to 100%vol	
Permittivity (ε')		
Accuracy	± (3% of reading + 0.8 ε') 1 → 40 for ECp ≤ 800mS.m^{-1} ± 5% of reading 40 → 80 for ECp ≤ 500mS.m^{-1}	
Range	Accurate range: 1 to 80, full range: 1 to 90	
Bulk soil conductivity (EC_b)		
Accuracy	**± (6% of reading + 10 mS.m^{-1})**	
Operating range	Accurate range: **0 to 1200mS.m^{-1}** Full range: 0 to 2000mS.m^{-1}	
Temperature *(WET150 must be fully buried to accurately measure soil temperature)*		
Accuracy	**± 0.5 °C**	± 0.7 °C
Range	Accurate range: 0 to +40 °C	Full range: -20 to +60 °C
Operating specifications		
Interface	SDI-12 version 1.3	
Max cable length[5]	>100 m see page 23	
Power requirement	6 to 20 V, ~22 mA over 12 ms (with short 45mA peak) (see page 23)	
Operating range	-20 to +60 °C (sensor does not detect ice)	
Environmental	IP68[6]	
Sample volume	55 x 70 mm diameter	
Dimensions	143 x 40 mm diameter	
Weight	77 gm (without cable)	

[5] On an SDI-12 network

[6] Submerged in water to depth 4.5m for 24 hours

When these and other materials are combined together to form a soil or substrate, the WET150 detects the overall permittivity which is formed from their individual permittivity contributions, depending upon their relative quantity in the mix.



Converting permittivity to water content

The relationship between soil permittivity (ε′) and its equivalent water content (θ), depends upon the mix proportions of its constituent materials (sand, organic matter, water, air, etc). This relationship between soil permittivity and water content is also non-linear.

However, for any given soil it can generally be assumed that the permittivity contribution from the soil particles is constant, so the permittivity measured by the WET150 is only affected by changes in water content. Also, by using the square-root of permittivity (called the *refractive index*), it is possible to further simplify the