

Dendrometer



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Vertical Dendrometer (Type DV)

For measuring changes in length of plant stems



User Manual

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1. Introduction

Thank you for purchasing an Ecomatik Dendrometer type DV. The vertical dendrometer is highly precise sensor for continuously measuring vertical variation of one section of plant stem under outdoor conditions. The data reflect important parameters of plant physiology. This includes:

- The variation of water content in the plant body and xylem water potential, respectively
- The variation of plant orientation during the growth

The vertical dendrometer can be used in following research fields:

- Indirectly, to continuously monitor the xylem water potential and water content of the plant tissues. In this case the user must establish the relationship between the vertical variations and the water potential.
- Measuring the variation of plant orientation due to competition pressure or mechanical impact.

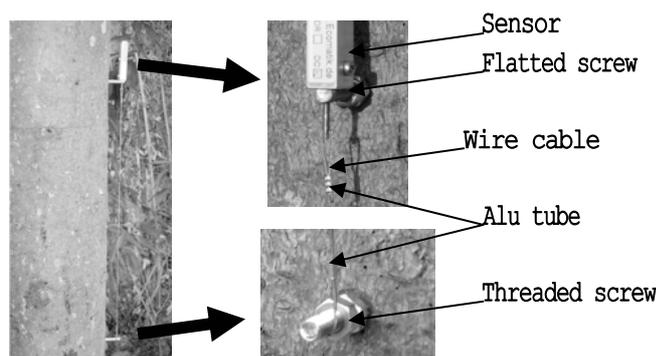
Usually, the recordings are combined effects of water potential and orientation. To mathematically isolate the different effects, three vertical dendrometers must be used.

2. Product Description

As shown below, the vertical dendrometer consists of:

- 1 Sensor with 2 m cable. The cable length is extendable to 100 m
- 1 m special wire cable for transmitting the vertical changes of tree stem to the sensor
- 2 Special screws, the upper one is for fixing the sensor while the lower one is for fixing the end of the wire.
- 2 Aluminum tubes for fixing the ends of the wire.

Contact your dealer should you miss any of these items.



3. Safety Information

The sensor is protected from water drops, but it is not waterproof. Please do not immerse the sensor in water.

To reduce tension on the sensor, the cable component of the sensor is isolated. Please never pull the cable from the sensor and avoid any tension between the cable and sensor during handling and operation.

Pay attention to written instructions. Wrong connections will give wrong results.

4. Installation

4.1 Cable Extension

The standard version is delivered with 2 m cable. It can be extended up to 100 m. Cable type 4×0.25 mm² with shield is recommended for extensions.

4.2 Required tools for installation and for operation

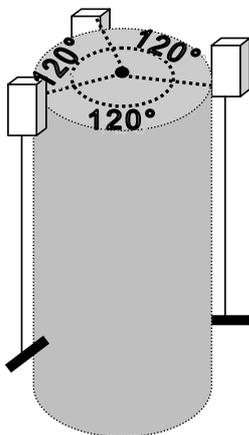
Data logger: One Dendrometer requires one or two single-ended channel(s) that can measure resistance between 0 and 50 kohm range.

Required tools for installation: A hand-held drill with 4 mm drill bit, natural resin, cable straps, 2 spanners for M6 screw nut (10mm), screw driver, a pair of pliers, voltmeter.

4.3 Mounting

Drill two holes ($\phi=4$ mm, 7 cm deep), one above the other directly below, one meter apart in the trunk. Dip the screws into the natural resin before screwing them into the trunk. The flattened screw is screwed in the top hole. The second screw is screwed into the bottom hole leaving approx. 3 cm of the shaft visible. It is easier to turn the screws when the two screw nuts are countered on the screw rod. The sensor is attached to the top screw with the wire drawn down through the hole in the second screw. Pass the wire-end through the small aluminum tube and fix it by pressing on the tube with pliers.

The second screw is turned slowly to achieve a desired initial resistance of about 10 kohm between yellow and green cable wires of the sensor.



If three vertical dendrometers are used, ensure that the three sensors are installed at the same height on the tree and have the same arc distance to each other.

Fix the cable onto the tree stem/branch so that the sensor is protected from any accidental pull/drag on the entire cable length. This can be done using a rope or cable straps. Ensure the suspension rope/strap is not so tight as to interfere with normal tree growth and expansion during the entire measurement period. Also, there should be no tension between the sensor and cable.

Ensure that no rain water can run along the cable into the sensor casing.

5 Wiring and Logger Configuration

One dendrometer requires one or two single-ended channels that can measure resistance between 0 and 50 kohm. With two channels temperature influences can be compensated and a higher precision is achieved (see technical specification). If you use ulogger for data recording, only one channel measurement can be configured.

The dendrometer is connected to both channels for measuring resistance as follows:

Wire color		Data Logger One-channel measurement	Data Logger Two-channel measurement	Voltmeter
Green	Connect to	-	- Channel 1	-
Yellow		+	+ Channel 1	+
White		Not connected	- Channel 2	-
Brown			+ Channel 2	+

Configure both channels of data logger to measure resistance from 0 to 50 kohm (e.g. 0–100 kohm). An interval 0.5-hour for data collection can reveal the diurnal course of radius changes very well.

6 Data Calculation

The vertical changes of tree trunk are given:

If measuring with two channels:

$$\text{Vertical Changes in } \mu\text{m} = \frac{\text{Values of Channel 1 in Ohm}}{\text{Values of Channel 2 in Ohm}} \times 11\,000$$

If measuring with one channel:

$$\text{Vertical Changes in } \mu\text{m} = \text{Values of Channel 1 in Ohm} \times \text{CF-Value}$$

The CF-Value is printed on the sensor.

7 Maintenance

Ensure that no falling branches, fruits or snow land on the sensor. The sensor is protected against water drops, but is not waterproof.

When the sensor is correctly installed, it will function under outdoor conditions without further maintenance.

8 Technical Specification

Type:	Vertical Dendrometer (DV)
Use area:	Measuring the vertical changes of tree trunk
Tree diameter:	> 8 cm
Range of the sensor:	11 mm
Accuracy of the sensor:	$\pm 2 \mu\text{m}$ (measurement with two channels)
Temperature coefficient of the sensor:	Measurement with two channels $< 0.1 \mu\text{m/K}$ Measurement with one channel $< 0.04 \text{ %/K}$ of the values measured
Temperature coefficient of the wire cable:	$< 1.4 \times 10^{-6}/\text{k}$
Environment:	Outdoor condition: -30 to 40°C air temperature, 0 to 100% relative air humidity
Weight of the sensor:	13 g without cable
Output:	Analog output, 0-50 kohm
Power supply:	No power consumption
Material:	Stainless steel and Aluminum
Cable length:	2 m, extendable up to 100 m