

# Dendrometer

## Diameter Dendrometer Type DD-RO

For measuring diameter growth of roots and aquatic plants



## User Manual

Version 1.0

## 1. Introduction

Thank you for purchasing an Ecomatik Dendrometer type DD-RO. This is a highly precise sensor for continuous measurements of diameter changes of plant root in soil or under water conditions.

This manual is written to help you install and operate your DD-RO dendrometer with least difficulty and for desirable results. Please read it carefully before installing the sensor, and refer to it if you should have any difficulty with the sensor in the future.

The dendrometer is the sensor part of a measuring system. This means that the dendrometer should be connected to a data logger for continuous data recording. The dendrometer is compatible with the most data logger types. At Ecomatik a low-cost, special for dendrometers developed DL18 logger is available.

## 2. Product Description

As shown below, the DD-RO dendrometer consists of:

- 1 Waterproof Sensor with 5 m cable. The cable length is extendable to 100 m
  - 1 A stainless steel bracket fixed to the sensor by a pipe clamp
  - 1 Piece UV-resistant rubber cord for keeping the device firmly attached to the stem
- Please contact us should you miss anything of these items.



The standard cable length is 5 m. if you ordered cable extension, the cable length is the ordered extension + 5 m.

To meet the requirements of different loggers, there are 2 different types of cables:  **cable with plug**  and  **cable without plug** . Cable with plug can only be connected to Dendrometer Logger DL18. Cable without plug can be connected to other loggers.

## 3. Safety Information

Avoid any damage to the rubber insulation.

Avoid any tension between the cable and sensor during handling and operation.

Pay attention to connections to data logger. Wrong connections will provide wrong readings.

## 4. Installation

### 4.1 Cable Extension

The standard version is delivered with 5 m cable. It can be extended up to 100 m. Cable type 4x0.25 mm<sup>2</sup> with shield is recommended for extensions.

### 4.2 Required tools for installation and for operation

A spade, a screwdriver, a pair of scissors.

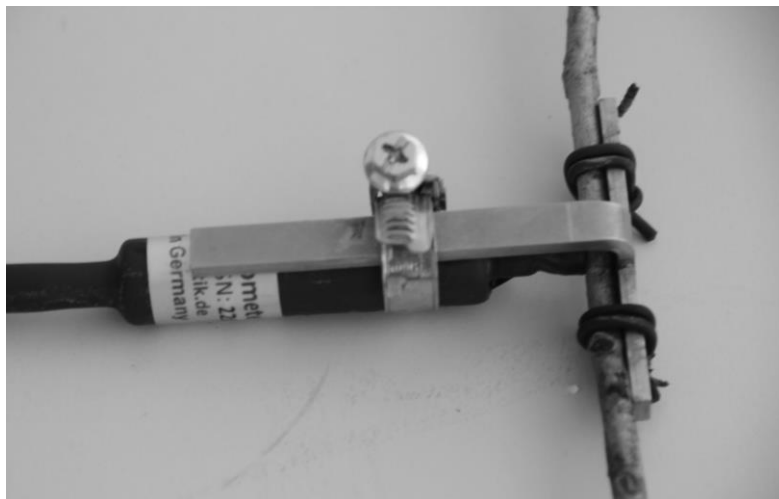
### 4.3 Mounting

4.3.1 Uncover the soil layer and release the root to be measured. Fix the dendrometer with the rubber cord.

4.3.2 Adjust the bracket clamp by setting the pipe clamp so that the sensor rod is pushed in about 3 mm.

4.3.3 Cover the sensor again with soil.

4.3.4 Mark the place, so that no one accidentally steps on the sensor.



## 5. Wiring and Logger Configuration

The dendrometer is compatible with most data loggers. In the following we describe the connection with Dendrometer Logger (DL18), Campbell Logger (CR1000). Please contact us if your logger is not described here.

### Dendrometer Data Logger (DL18)

The DL18 is a battery powered, waterproof logger for connecting 4 dendrometers. It is a very effective data logger for dendrometer measurement under outdoor conditions. For details please see the user manual of the DL18.

### Campbell Data Logger (CR1000)

The dendrometer can be measured both in single-ended voltage as well as differential voltage mode. Differential voltage mode provides better accuracy. But single-ended mode requires half as many channels as differential mode. One CR1000 can include 16 dendrometers in single-ended mode, but only 8 dendrometers in differential mode.

#### Single-ended Voltage Mode ( 2 dendrometers)

Connection		
	Cable Color	Input Port
1 <sup>st</sup> dendrometer	Yellow	1H
	Green	Ground
	Brown	Vx1
	White	Ground
2 <sup>nd</sup> dendrometer	Yellow	1L
	Green	Ground
	Brown	Vx1
	White	Ground
<b>Program Syntax</b> <i>ExciteV (Vx1,2500,0)</i> <i>VoltSe(SEVolt(),2,mV2500,1,True,0,_50Hz,Mult(),Offs())</i> If Multiplier=4.4, Offset=0, the results are measured in microns.		

#### Differential Voltage Mode ( 2 dendrometers)

Connection		
	Cable Color	Input Port
1 <sup>st</sup> dendrometer	Yellow	1H
	Green	1L
	Brown	Vx1
	White	Ground
2 <sup>nd</sup> dendrometer	Yellow	2H
	Green	2L
	Brown	Vx1
	White	Ground
<b>Program Syntax</b> <i>ExciteV (Vx1,2500,0)</i> <i>VoltDiff(DiffVolt(),2,mV2500,1,True,0,_50Hz,Mult(),Offs())</i> If Multiplier=4.4, Offset=0, the results are measured in microns.		

An interval 0.5-hour for data collection can reveal the diurnal course of diameter changes very well.

## 6. Adjustment and maintenance

When the sensor is correctly installed, it will function without the need for further maintenance.

Depending on the growth rate of the root, the sensor should be reset after some months or years of measurements. When the output approaches 11 mm, the sensor needs to be reset.

Relax the screw of pipe clamp slowly and move the bracket so that the sensor rod is pushed in by about 3 mm. Fix the pipe clam screw again.

## 7. Technical Specifications

<b>Name of the Sensor</b>	Root Dendrometer Type DD-RO
<b>Use area</b>	For measuring diameter growth of roots and aquatic plants
<b>Suitable for plant size</b>	Root diameter 0-2 cm (>2 cm on request)
<b>Range of the sensor</b>	11 mm
<b>Resolution</b>	The resolution of the sensor itself is infinite. The resolution of readings is determined by connected data logger, e.g. CR1000: 1.5 $\mu\text{m}$ Dendrometer logger DL18: 0.2 $\mu\text{m}$
<b>Accuracy</b>	Dendrometer dependent: Max. $\pm 4.5\%$ of reading (stable offset)  Dependent on the connected data logger, e.g.: CR1000: $\pm(0.04\%$ of reading + $4.4\mu\text{m}$ ) Dendrometer logger DL18: $\pm 0.1\%$
<b>Temperature coefficient of the sensor</b>	$<0.2 \mu\text{m} / ^\circ\text{C}$ in the whole range
<b>Linearity</b>	$<1\%$
<b>Environment</b>	In soil, under water or snow condition: $-25$ to $70^\circ\text{C}$ air temperature, 0 to 100% relative air humidity
<b>Weight of the sensor</b>	50 g without cable
<b>Power supply</b>	Stabilized Vex 0.5 – 10 VDC, power consumption practically zero
<b>Material</b>	Stainless steel and Aluminium
<b>Cable length</b>	5 m, extendable up to 100 m