

Dendrometer

Fruit Dendrometer (Type DF4)

For continuous measurements of diameter of
fruit and vegetables



User Manual

1. Introduction

Thank you for purchasing an Ecomatik Dendrometer type DF4. This is a precise and factory calibrated sensor for continuous measurements of absolute fruit and vegetable diameter of up to 130 mm, under both indoor and outdoor conditions.

This manual is written to help you install and operate your DF4 dendrometer with least difficulty and for most 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 types of data loggers and microcontrollers (i.a. Arduino).

2. Product Description

As shown below, the DF4 dendrometer consists of:

1x Sensor with fruit gripper, 5 m cable

1x Piece re-usable UV-resistant rubber reusable to fix the sensor cable at the branch/stem for strain relief.



DF4 Fruit Dendrometer

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

3. Safety Information

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

Max. fruit diameter 135 mm, exceedance may cause sensor damage!

4. Installation

Tools & accessories: light resistant rubber cord for strain relief.

- a) Select a representative fruit for instrumentation.
- b) Use the included rubber cord to strain relief the sensor by fixing the sensor cable on the fruit carrying branch. Please leave enough cable between the fixation point on the branch and the sensor. In the final installation position, the fruit sensor should be able to move freely with the instrumented fruit, without tension on the cable.
- c) Pull apart the sensor clamping system and carefully insert the fruit into the fruit gripper. Make sure that the sensor is attached firmly to the fruit and that the fruit grippers are in firm contact to the fruit surface.
- d) Fix the cable onto the stem or on a ground stake for strain relief of the sensor cable between instrumented plant and data logger. This can be done using a rope or cable straps. There should be no tension between the sensor, fixation point at the fruit carrying branch and the remaining sensor cable.

!! IMPORTANT !!

Fix the cable onto the tree stem/branch so that the sensor is protected from any accidental pull/ drag of the entire cable length. This can be done using a rope or cable straps. In addition, there should be no tension between the sensor and cable.

Ensure that no rain water can run along the cable, or the sensor rod and enter the sensor casing. Rod entrance, as well as wire outlet should hence always be inclined downwards.

5. Wiring and Logger Configuration

The dendrometer is compatible with most data loggers and microcontrollers (i.a. Arduino). This section provides required information for wiring the sensor in to a data logger and convert raw data from volts into micrometers. Please contact us if you require further information or assistance.

The dendrometer requires one single-ended logger channel and a precisely regulated excitation voltage source (V_{ex}) between 0.5 and 10 VDC (recommended is a switched source).

Recommended is a logger measurement resolution of at least 12 bits in the voltage range of 0 to V_{ex} :

- Time of excitation ca. 100 mS
- Conversion of voltage output in mm fruit diameter (ball shaped fruits):

$$D_{\text{Fruit}} \text{ (mm)} = V_{\text{out}} / V_{\text{ex}} * 150$$

IMPORTANT NOTE:

The here specified function is for units with SN2481 and above. In case you should require the conversion function for a DF4 device with a SN below 2481, please contact us.

- Conversion of voltage output in mm central point distance (CPD, distance between central points of the fruit gripper).

$$CPD = D_{\text{Fruit}} / \cos(30^\circ)$$

Wiring as single-ended voltage measurement:

4-wire connection

(cable type: 4-wires + shield)

Single-ended Voltage

Cable Color	Input Port
Yellow	H (Signal, Vout +)
Green	GND
Brown	Vex
White	GND
Black	GND

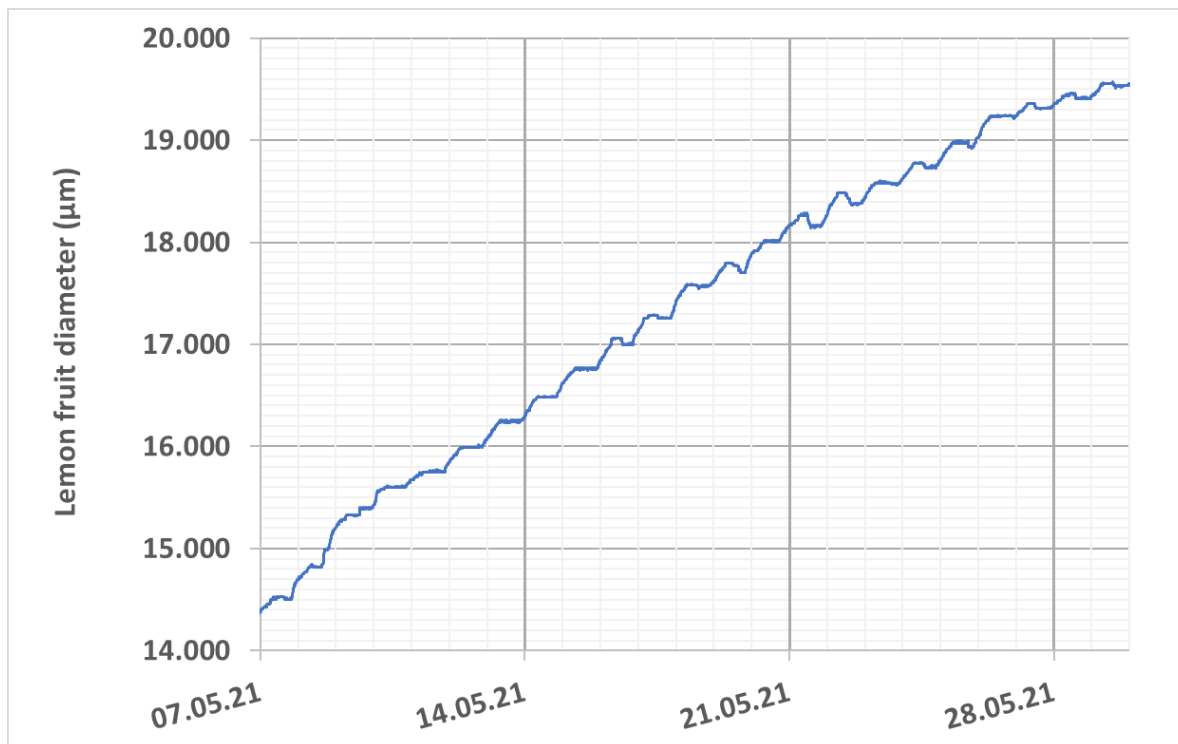
Differential Voltage

Cable Color	Input Port
Yellow	H (Signal, Vout +)
Green	L (Signal, Vout -)
Brown	Vex
White	GND
Black	GND

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

5. An Example of measured data

The figure shows the diameter changes of a lemon fruit measured with an Ecomatik DF4 fruit dendrometer.



6. Technical Specification

Name of the Sensor	Clamping fruit dendrometer Type DF4, fast mounting for toolless installation
Use area	For continuous measurements of diameter of fruit and vegetables
Suitable for fruit diameter (ball shaped)	10 - 130 mm
Range of the sensor	130 mm (full scale, FS)
Resolution	The resolution of the sensor itself is infinite. The resolution of readings is determined by connected data logger, e.g. CR300: 0.15 μm Dendrometer logger DL18: 2.5 μm
Accuracy	Dendrometer dependent: Max. $\pm 0.8\%$ of reading (stable offset) Dependent on the connected data logger, e.g.: CR300: $\pm (0.1\%$ of reading + 3.5 $\mu\text{m})$ Dendrometer logger DL18: (0.1% of reading + 5.5 $\mu\text{m})$
Temperature coefficient of Sensor	< 0.015 % of FS / $^{\circ}\text{C}$
Linearity	< 1%
Environment	Outdoor condition: -25 to 70 $^{\circ}\text{C}$ air temperature, 0 to 100% relative air humidity
Weight of the sensor	48 g without cable
Power supply and sensor output	Stabilized Vex of 0.5 – 10 VDC, power consumption practically zero. Vout always < Vex. Factory calibrated sensor signal: Vout = 0.8 * Vex (VDC) at 120 mm diameter (ball shaped fruit)
Material	Stainless steel and Aluminium
Cable length	5 m, extendable up to 100 m