

### Photosynthesis Monitor



#### Why to monitor photosynthesis?

Photosynthesis is not merely a chemical reaction turning the light, water and CO<sub>2</sub> into organic matter. Photosynthesis is also a key to the crop production and optimal use of resources, photosynthesis rate is an indicator of plant's wellbeing, growth and productivity. By constant monitoring of photosynthesis it is possible to optimize for the maximum yield almost any controllable plant growing parameters, the most common of which are:

- Open fields and orchards: irrigation and application of fertilizers;
- Greenhouses: light intensity, CO<sub>2</sub> concentration, air temperature and many more.

#### Why Photosynthesis Monitor?

Unlike other systems in the market, the Photosynthesis Monitor does not make one (or two, or five) photosynthesis measurements on a plant, but instead it provides a continuous monitoring of plant's photosynthesis on 24/7 basis during a week or a month or whatever time is needed for adjustment and fine-tuning of the growing conditions.

#### Is it only photosynthesis?

Along with photosynthesis, the Monitor is monitoring simultaneously many other essential parameters:

- Net photosynthesis, gross photosynthesis, photorespiration, dark respiration
- Leaf transpiration
- Stomatal conductance
- Photosynthetically active radiation
- Air temperature
- Air humidity
- Ambient CO<sub>2</sub> concentration in the air
- Atmospheric pressure
- Leaf wetness
- Leaf temperature

In addition, simultaneous monitoring from up to eight (out of tens) optional sensors can be done. They include:

- Sap flow
- Stem diameter
- Fruit growth
- Soil moisture
- Soil temperature
- Soil EC
- Auxanometer
- Pyranometer
- Quantum sensor
- etc.

Thus, the Photosynthesis Monitor is a true state-of-the-art system for long-term automatic recording of many physiological characteristics on intact plants.

#### How does it work?

The Photosynthesis Monitor is connected to 4 original automatic self-clamping leaf chambers. The chambers are normally open; they close on the leaf for only 30 seconds one-by-one to take readings of both CO<sub>2</sub> and H<sub>2</sub>O exchange rates. The short measurement time provides minimal disturbance to the leaf's natural state. A sampling rate for the fully automatic continuous operation can be adjusted within 5 to 120 minutes. During each sampling all the data from all other sensors are stored in the Monitor memory as well.

#### How can the automatically collected data be used?

The data are downloaded to a computer via USB wireless adaptor for further analysis. Then the data in CSV format can be analyzed by using provided graphical data viewer or any other relevant software. It can also be automatically interpreted, using an expert system or, for example, specialized comments and advice of orchard management specialists.

System Unit

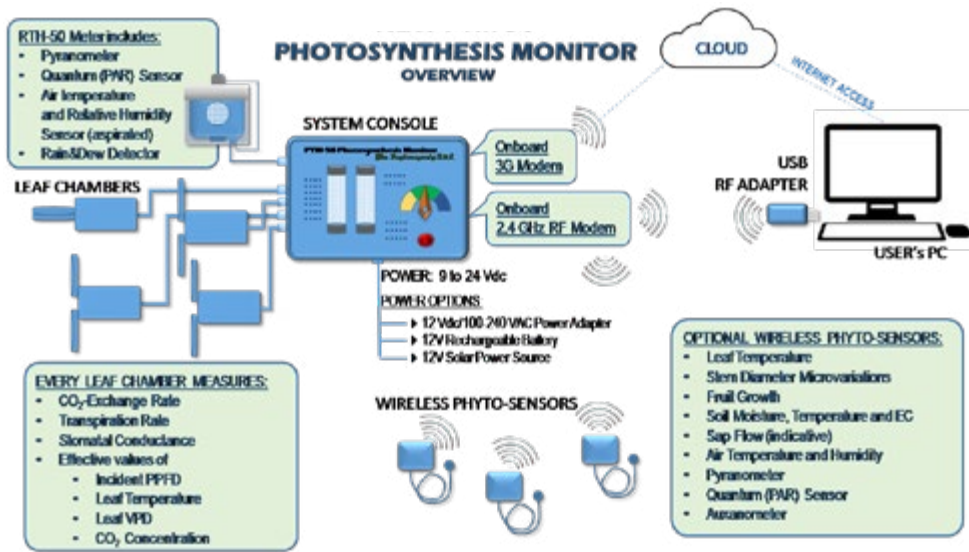


Leaf Chamber



Sap Flow Sensors





Technical data	
Mode of operation	continuous automatic
Number of leaf chambers	2 (min.) to 4 (max.)
Type of leaf chamber	motorized, normally open
Leaf chamber sampling mode	sequential
Chamber measurement cycle duration	about 20 s
Sampling time interval	5 to 120 min, user-defined
Leaf chamber aperture	10 cm <sup>2</sup>
Standard hose length and inner diameter	4 m, ID=2.4 mm
CO <sub>2</sub> measurement principle	non-dispersive infrared analyzer
CO <sub>2</sub> concentration measurement range	0 to 1000 ppm
Measurement range of CO <sub>2</sub> exchange	-70 to 70 μmolCO <sub>2</sub> m <sup>-2</sup> s <sup>-1</sup>
H <sub>2</sub> O measurement principle	integrated air temperature and humidity sensor
Air flow control rates	adaptive, from 0.25 LPM to 0.5 LPM,
Power requirements	9 to 24 Vdc
Interface	<ul style="list-style-type: none"> <li>• built-in 2.4 Ghz RF modem with the USB RF adapter for PC</li> <li>• optional 3G modem</li> </ul>
Operating temperature	10 to 40 °C
Environmental protection index	IP55

**What are the tasks the Photosynthesis Monitor can handle?**

**The typical for the protected crop tasks include:**

- Optimization of a supplementary lighting, based on daily light curve of photosynthesis.
- The cost of electricity can also be accounted for, when determine the thresholds for turning on the lamps.
- Comparison of various light sources and their space distribution.
- Adjustment of CO<sub>2</sub> enrichment.
- Adjustment of air temperature.
- Effect of nutrition.
- Effect of ventilation.
- Effect of shading.
- Comparison of various plant species productivity.
- Distribution of plant productivity inside the canopy.
- Effect of fruit load, picking and harvesting.

**Typical for both protected and unprotected crops tasks include:**

- Transpiration monitoring for correction of the daytime and nighttime irrigation schedule.
- Simultaneous monitoring of CO<sub>2</sub> and H<sub>2</sub>O exchange to reveal the stomatal limitation of photosynthesis related to a water stress.
- Effect of fertilization on productivity.
- Detection of insufficient watering at nighttime, due to a common underestimation of nighttime transpiration in arid and semi-arid climatic zones.
- Control of the fruit growth when a standard size is required at harvesting.

**Typical basic set for ordering:**

- 1 x system unit
- 1 x AC/DC power adapter
- 1 x USB communication adapter
- 1 x RTH-50 Meter with the pyranometer, quantum (PAR) sensor, air temperature, air relative humidity, rain & dew sensors
- 4 x leaf chamber
- 4 x cable/hose duct for connecting leaf chambers (3.5 m)
- 2 x stainless steel tripod (1.5 m)
- optional wireless phyto-sensors
- 1 x container with CO<sub>2</sub> absorber
- software (English, Windows)
- user's manual (English)

Phyto-Monitoring System in 30 sec



Item-no.	
27000	Photosynthesis Monitor

Leaf Temperature Sensor



Stem Micro-Variation Sensors



Fruit Growth Sensors

