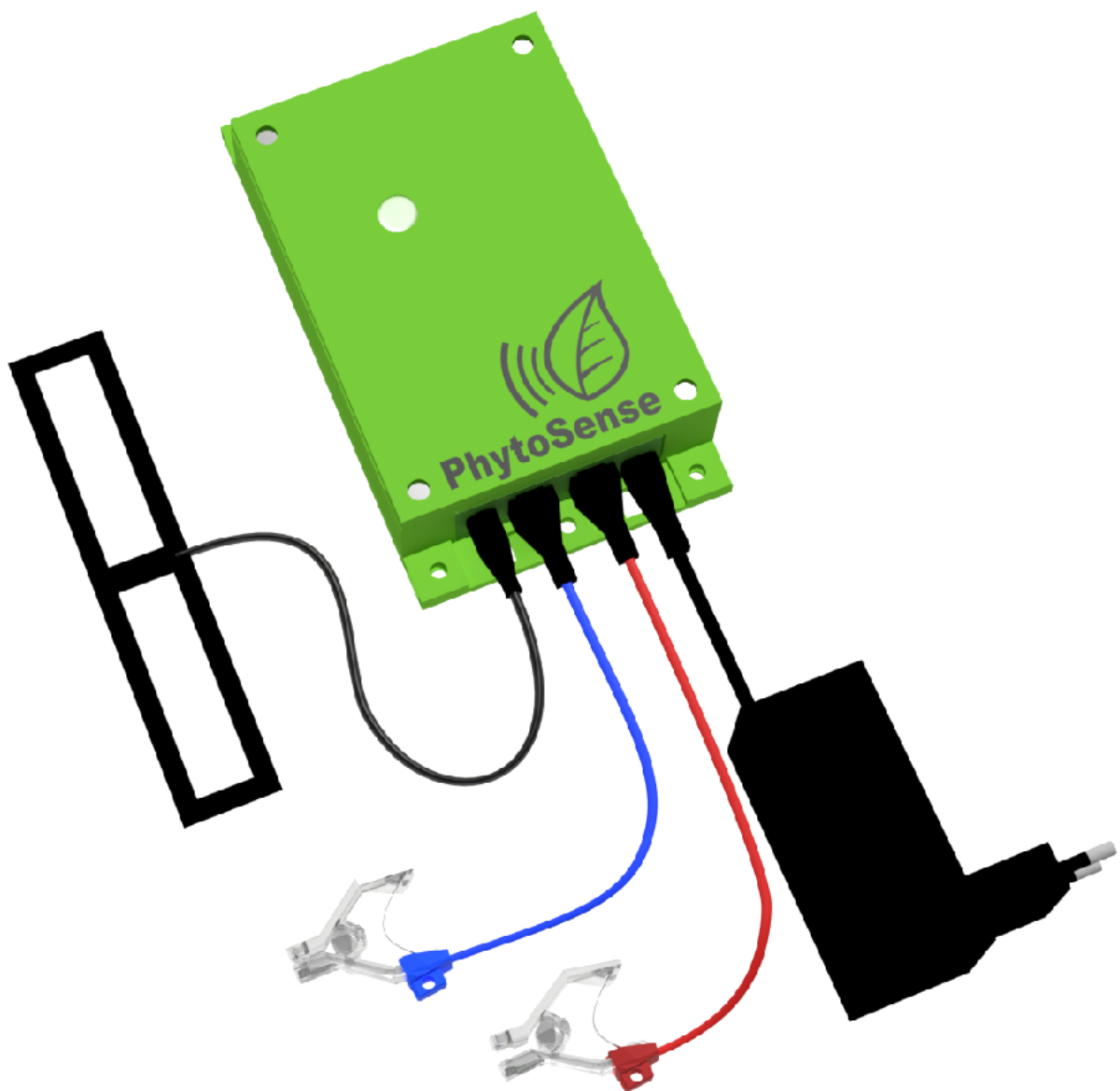


# PhytoClip User Guide

Powered by PhytoSense



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# Overview

## Product description

The PhytoClip plant monitoring system allows measuring leaf thickness or diameter variations of thin stems which are directly linked to the water and carbon status of the plant.

PhytoClips come in 3 different models: (1) PhytoClip Leaf for monitoring leaves with thicknesses between 0 and 2 mm, (2) PhytoClip Thin Stem for monitoring stem diameters between 1 and 2 mm and (3) PhytoClip Thick Stem for monitoring stem diameters between 2 and 6 mm.

PhytoClip benefits:

- Temperature corrected measurement
- Transparent sensor: blocks less light going to the leaf
- Dedicated leaf and stem clips for optimal attachment to the plant
- Robust installation and positioning system
- Weather proof

## What you'll find in the box

**PhytoSensor data logger**

**2 PhytoClip sensors (free choice from 3 models)**

- PhytoClip Leaf (0 - 2 mm, blue tags)
- PhytoClip Thin Stem (1 - 2 mm, green tags)
- PhytoClip Thick Stem (2 - 6 mm, red tags)

**Sensor accessories**

- Sensor positioning wire
- Wire clips (already attached to the clips)

**Power adapter**

**Antenna**

Please keep the system stored in the box when it is not being used.

## Not included (but most likely needed during installation)

Cable ties, wire cutter, calliper.

# General usage

## Optimal operating environment

**Temperature:** 10 - 50 °C

**Relative humidity:** 10 - 90 % (non-condensing)

**Altitude:** less than 2000 m

**Inside use**

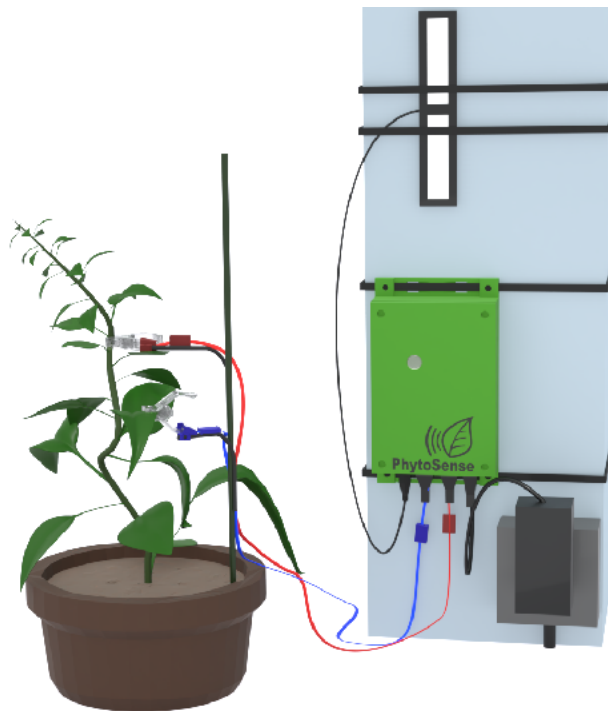
**Ventilation:** no special ventilation is required



The manufacturer cannot be held accountable when the equipment is operated outside these ranges.

## Typical installation

(see “Sensor installation instructions” and “Mounting instructions” for more details)



Since the equipment consists of sensitive electronics and sensors, care should be taken to protect the equipment from direct sunlight and water exposure. Additional measures should be taken to avoid these conditions as they may negatively impact the measurements.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

# Sensor installation instructions

1



Install suitable support in the pot, container or soil. Ideally, firmly attached to the pot or container.

2



Select a suitable location (leaf or stem) on the plant to install the sensor.

**Measure the leaf or stem thickness with a caliper.**

PhytoClip Leaf: 0 - 2 mm (blue tags)

PhytoClip Thin Stem: 1 - 2 mm (green tags)

PhytoClip Thick Stem: 2 - 6 mm (red tags)



**Respect the measurement range.**

The sensors have been calibrated in the indicated ranges and measurements outside these ranges will not be accurate.

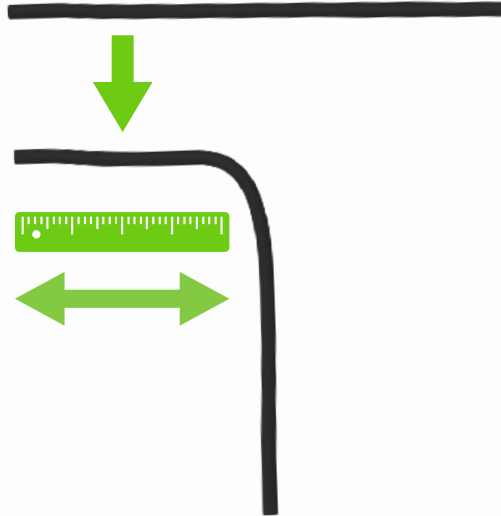
3



Measure the distance between the installation location on the plant and the support.

# Sensor installation instructions

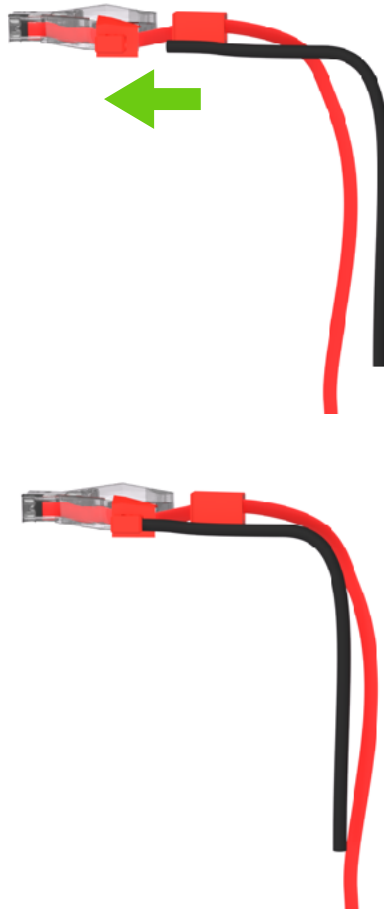
4



Bend the sensor positioning wire in an L-shape using the measured distances.

If possible don't cut the support wire or at least think about future installations.

5



Attach the sensor to the end of the positioning wire using the wire clip.



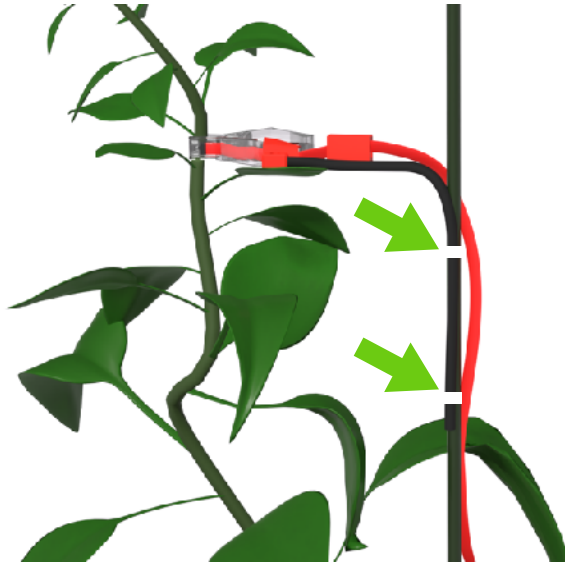
Make sure to only hold the sensor side of the clip when inserting the positioning wire.

The sensor should be firmly attached to the wire.

If more appropriate, the positioning wire can also be attached to the wire clip from below.

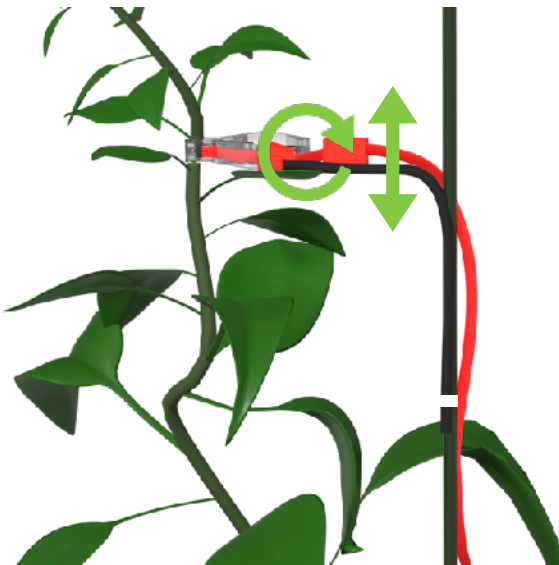
# Sensor installation instructions

6



Attach the positioning wire to the support (e.g. using cable ties).

7



Fine-tune the sensor positioning by bending the wire and/or rotating the sensor around the wire.



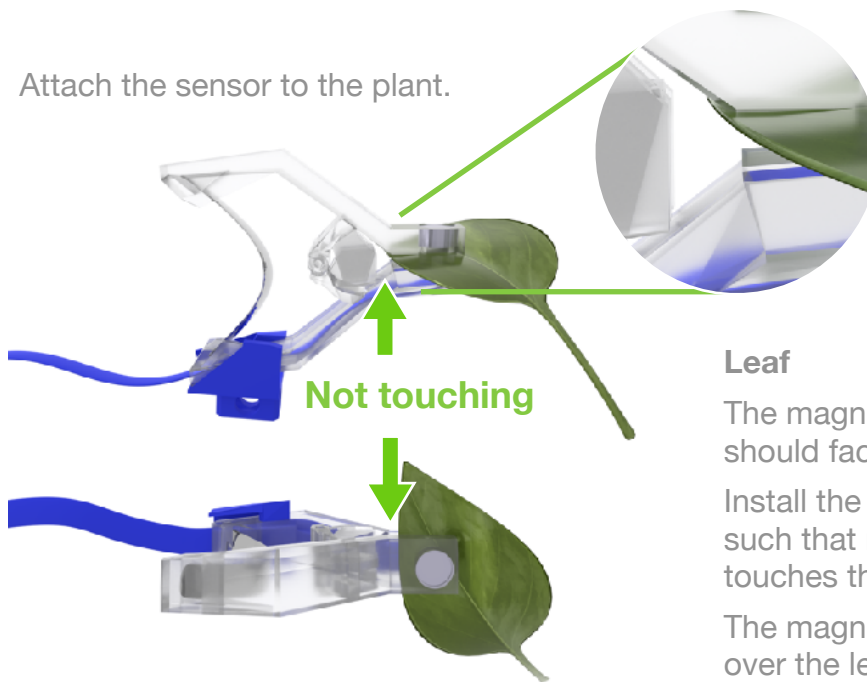
**Caution: avoid strong magnetic fields.**

Try to keep the PhytoClip sensors and logger away from electricity boxes and electric cables or other objects generating magnetic fields. The magnetic fields emanating from these objects might cause interference with the sensor measurements.

# Sensor installation instructions

8

Attach the sensor to the plant.

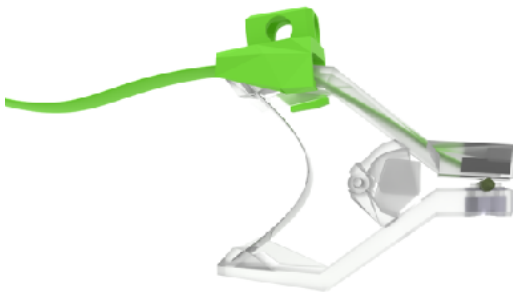


## Leaf

The magnet side of the clip should face up (top of the leaf).

Install the clip on the leaf edge such that no part of the leaf touches the hinge of the clip.

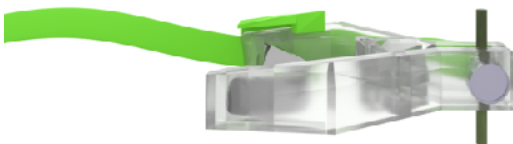
The magnet should be completely over the leaf edge.



## Thin stem

The clip should be installed perpendicular on the stem.

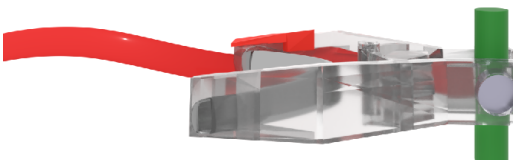
Position the clip such that the stem is in the two grooves on both sides of the clip.



## Thick stem

The clip should be installed perpendicular on the stem.

Position the clip such that the stem is in the large groove on the magnet side of the clip.

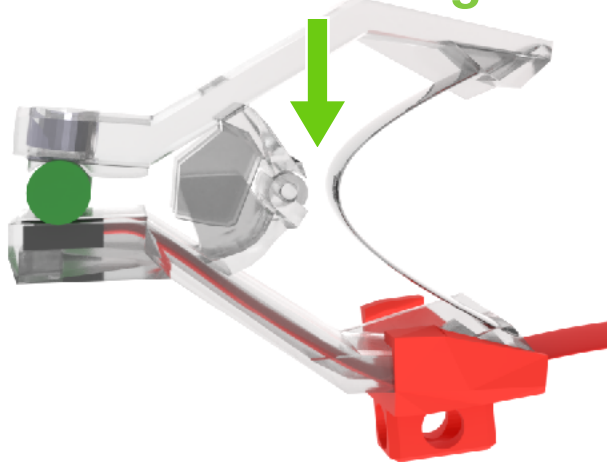




# Sensor installation instructions

9

Not touching

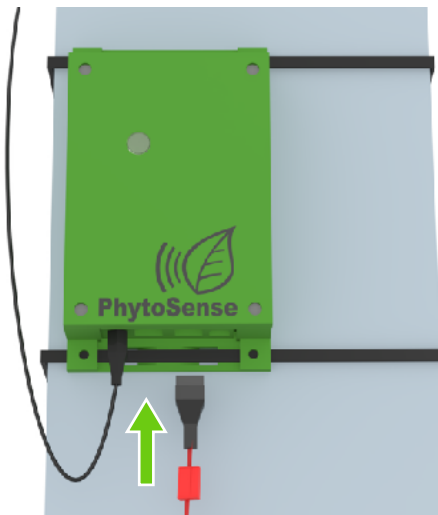


**Check the spring.**

Make sure the spring is pushed back into both ends of the clip.

The spring should not touch the hinge of the clip.

10



**Connect the sensor to the logger.**

**Note down the serial number of the sensor and to which connector of the logger it is connected (left or right).**

Proceed with the installation of a second sensor or continue to the section on setting up the sensor(s) in PhytoSense.

# Spring installation and removal

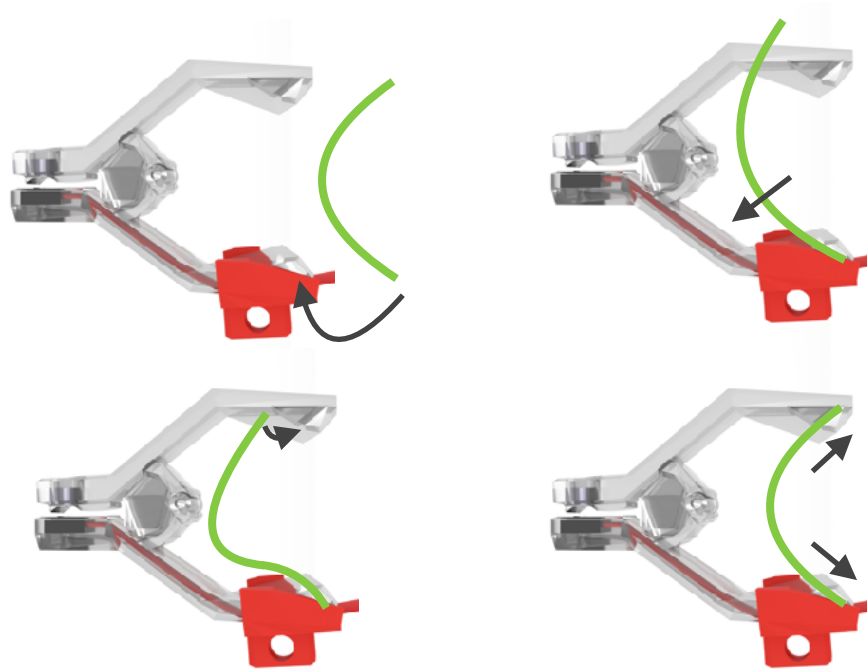


The spring comes pre-installed in the PhytoClip and should normally **not be installed or removed**.

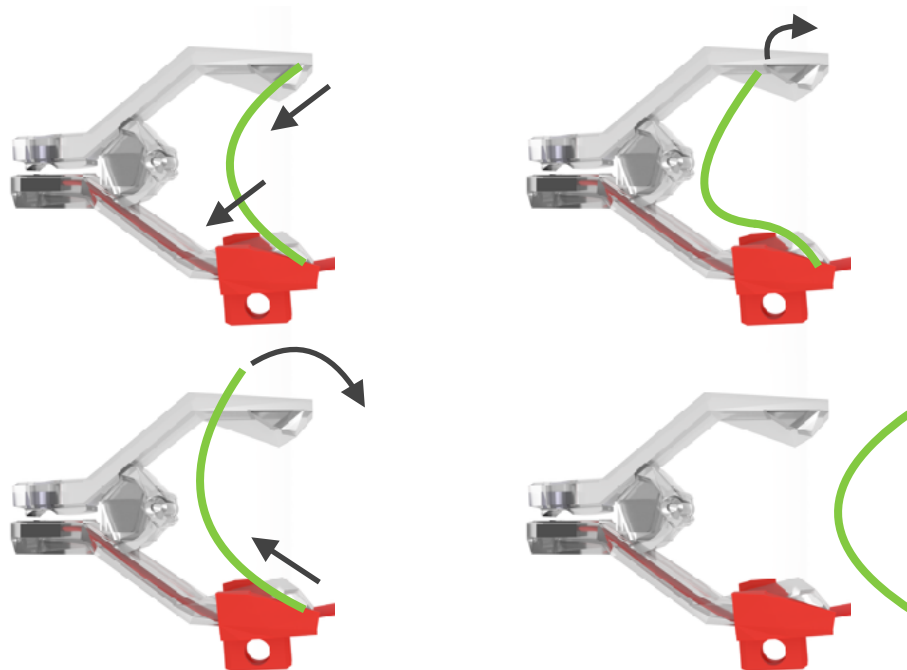
Follow these instructions to install the spring in case it needs to be replaced.

**Remember:** the clip and the hinge are very fragile.

## Installation

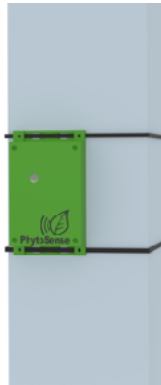


## Removal



# Logger mounting instructions

1



Firmly secure the PhytoSensor data logger to the greenhouse structure. E.g. using cable ties going through the holes in the enclosure.

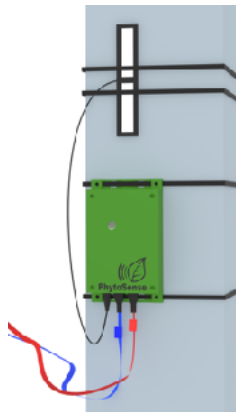
**The data logger needs to be installed as shown on the figure** with the connectors pointing down. This is to minimise the chance of water entering the data logger.

2



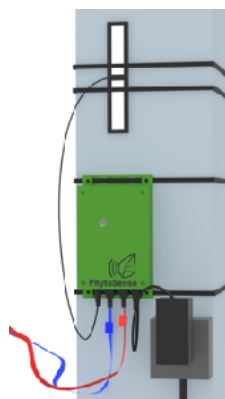
Connect the antenna to the data logger. If cellular reception is poor at the installation location, the antenna should be moved higher up the greenhouse (e.g. above the canopy) or be moved away from metal objects which might interfere with the cellular reception.

3



Connect the sensor cables to the data logger.

4



Plug in the power adapter.

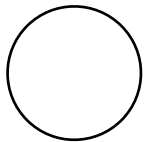


**Only plug in the power adapter in an appropriate and safe power socket. The power socket should be easily accessible in case of an emergency.**

# Operating instructions

## Data logger startup sequence

Once the data logger is powered up, the indicator LED will turn on. Different colours indicate different parts of the boot sequence:



Color: White  
State: Not blinking  
Duration: A few seconds  
Meaning: Startup



Color: Green  
State: Blinking  
Duration: Several seconds to minutes  
Meaning: Looking for the cellular or Wi-Fi network



Color: Cyan  
State: Blinking rapidly  
Duration: Several seconds  
Meaning: Connecting to internet



Color: Cyan  
State: Breathing. Slowly alternating between on and off.  
Duration: Continuous  
Meaning: The data logger is connected and working normally. Data should appear in PhytoSense after about 5 minutes.

In rare circumstances the LED might turn magenta during power-up or normal operation.



Color: Magenta  
State: Blinking  
Duration: About 1 minute  
Meaning: The data logger is performing a firmware update.  
**DO NOT SWITCH OFF THE LOGGER DURING THIS PROCESS.**

For other LED colors, see the 'Troubleshooting' section below.

# PhytoSense configuration

## Adding PhytoClip devices

In the setup configuration dialog new setup devices can be added for the PhytoClips. Depending on the PhytoClip type, two Device Types can be used: 'Leaf Thickness > PhytoClip Leaf' for leaf clips and 'Diameter Variation > PhytoClip Stem' for thin and thick stem clips.

In order to extract calibration coefficients from the system at a later stage, naming of the setup device should be done according to the PhytoClip serial number. This number can be found on the sensor tags. The device name should be something like: PhytoClip[number] (e.g. PhytoClip123). If required, additional text can also be included in the name field.

The image shows two side-by-side screenshots of the 'Add Setup Device' dialog box. Both windows have a title bar with standard macOS window controls (red, yellow, green buttons). Each window contains three tabs: 'New Device' (selected), 'New Combined Device', and 'Existing Device'. Below the tabs are three dropdown menus: 'Category', 'Type', and 'Name'. In the left window, 'Category' is 'Leaf Thickness', 'Type' is 'PhytoClip Leaf', and 'Name' is 'PhytoClip123'. In the right window, 'Category' is 'Diameter Variation', 'Type' is 'PhytoClip Stem', and 'Name' is 'PhytoClip123'. Below the 'Name' field, there is a small text hint: 'Leave blank for default name: PhytoClip Leaf [DID]' (left) and 'Leave blank for default name: PhytoClip Stem [DID]' (right). At the bottom of each window, there is a small text instruction: 'Add a new device of a certain device type to this setup.' and two buttons: 'Add' and 'Close'.

## Data mapping

Each PhytoClip generates two measurements: a 'Reading (mV)' and a 'Temperature (°C)'. If the logger is configured to measure two clips, 4 values are generated and sent to PhytoSense: two for the left connector (elements 1 and 2) and two for the right connector (elements 3 and 4). Map the elements to the correct setup devices and verify that the sensors are indeed connected to the appropriate logger connector.

The image shows a screenshot of the 'Data mapping elements' dialog box. It has a title bar with standard macOS window controls. On the left side, there are four icons: a green plus sign, a green battery icon, a blue location pin icon, and a blue location pin icon. The main area is a table with 5 columns: 'Part', 'Element', 'Setup', 'Device', and 'Channel'. The table contains 4 rows of data. The last row is highlighted in blue. At the bottom of the dialog, there are two buttons: 'Ok' and 'Cancel'.

Part	Element	Setup	Device	Channel
1	1	Phyto-IT Test Setup	PhytoClip059	Reading
1	2	Phyto-IT Test Setup	PhytoClip059	Temperature
1	3	Phyto-IT Test Setup	PhytoClip060	Reading
1	4	Phyto-IT Test Setup	PhytoClip060	Temperature

# PhytoSense configuration

## Adding a PhytoClip transformation

In order to obtain calibrated and temperature corrected values for each PhytoClip, a 'PhytoClip' transformation can be added to a PhytoClip device.

If the name or the serial number of the device contains a known PhytoClip (e.g. PhytoClip123), correct temperature correction and calibration coefficients will automatically be used when the transformation is calculated (if 'autodetect' is selected). If 'autodetect' is switched off, manual coefficients can be entered. If both the name and serial number of a device contain references to conflicting PhytoClips, then the one from the 'name' takes precedence.

Each PhytoClip transformation calculates two values: 'Temperature corrected (mV)' and 'Calibrated ( $\mu\text{m}$ )'. The first value is the temperature corrected reading and the second value is the calibrated thickness in  $\mu\text{m}$ .

The calibrated values should be within the calibration ranges for the different PhytoClip types:

- PhytoClip Leaf (0 - 2 mm, blue tags)
- PhytoClip Thin Stem (1 - 2 mm, green tags)
- PhytoClip Thick Stem (2 - 6 mm, red tags)

If this is not the case, the sensor should be moved to a more appropriate part of the plant.

Device transformation

Name:  ☐ Start at:

Type:  ☐ Stop at:

Unit:  ☐ Hidden

Minimum calculation interval:  s

Reading channel:

Temperature channel:

☒ Autodetect temperature and calibration coefficients.

The name or the serial number of the device should contain a known PhytoClip serial number (e.g. PhytoClip123).

Possible PhytoClip calculation error values:

- 10 failed to autodetect sensor serial number
- 20 no sensor connected
- 30 bad temperature
- 40 not within calibration range (too small)
- 50 not within calibration range (too large)

This transformation applies temperature correction and sensor calibration calculations to raw PhytoClip data.

Ok Cancel

▼ PhytoClip072

- Reading (mV)
- Temperature (°C)
- PhytoClip - Temperature corrected (mV)
- PhytoClip - Calibrated ( $\mu\text{m}$ )

# PhytoSense configuration

## Adding additional transformations

Once a PhytoClip transformation has been added to the device, other transformations can be added if required.



Caution: only apply other transformations to the 'Calibrated ( $\mu\text{m}$ )' channel of the PhytoClip transformation. Never to the 'Reading (mV)' channel since this will interfere with the calibration coefficients of the PhytoClip transformation.

# Removal and maintenance

Please follow these instructions in order to ensure an optimal lifetime of your PhytoClip system.



Opening the PhytoSensor datalogger is only allowed by Phyto-IT or an authorised service provider.

## Maintenance during operation

Once installed, the PhytoClip system required little or no maintenance. For most crops, the sensors can remain on the same part of the leaf or stem.

However, the measured thickness should always remain in the calibration ranges for the different PhytoClip types. The sensor should be moved to a more appropriate part of the plant if it goes outside of its calibration range.

## Disconnecting the data logger

1. Unplug the power adapter from the power socket and disconnect the power cable from the data logger.
2. Unplug the sensor cables from the data logger.
3. Unscrew the antenna connector from the data logger.
4. Remove the data logger from the greenhouse structure.
5. If required, the data logger can be cleaned with a wet cloth and some detergent.

## PhytoClip storage

When a PhytoClip is not being used, keep it stored in its protected pouch in which it was delivered. Also make sure the cable is rolled-up and secured with the rubber band.



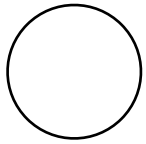
## Disinfection

It is allowed to disinfect the **sensor tips** after each use. This can be done using standard disinfectants (e.g. isopropyl alcohol). However, keep the contact between the clip and the disinfectant as short as possible. Dry the sensor tips after disinfection.



# Troubleshooting

In case **no data** is being received by PhytoSense please check for following failure conditions.

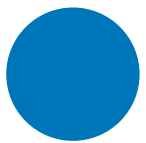


Color:

No light

Meaning:

The data logger is not getting power. Please check if the power adapter is plugged in the data logger and the power socket. Also check if the power socket has power.



Color:

Dark blue

State:

Blinking

Duration:

Continuously.

Meaning:

There is a problem with the SIM card. Try to reboot the unit and/or contact support.



Color:

Red

State:

Blinking

Duration:

Continuously or in combination with other LED colours.

Meaning:

There is a problem with the cellular module. Try to reboot the unit and/or contact support.



Color:

Green

State:

Blinking

Duration:

Continuously for more than 5 minutes.

Meaning:

The data logger is unable to connector to the cellular network. If possible, reposition the antenna. Preferably moving it above the canopy.



Color:

Cyan

State:

Blinking rapidly

Duration:

Continuously for more than 5 minutes.

Meaning:

The data logger has problems connecting to internet. If possible, reposition the antenna. Preferably moving it above the canopy.

In case **bad data** is being received by PhytoSense please check if all the sensor cables are properly connected to the sensors and the data logger.

# Technical specifications

## PhytoSensor data logger

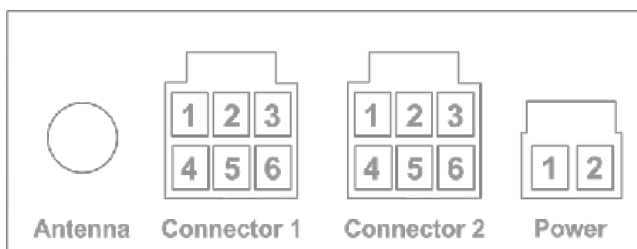
Manufacturer	Phyto-IT
Model	PhytoSensor M1
Input voltage	9 VDC
Power consumption	<b>Cellular</b> 0.35 W (min), 1.1 W (max) 0.48 W (average of 1.1 W during 25 seconds, 0.35 W during 125 seconds) (good cellular signal, measuring at 2.5 minute intervals with sensors) <b>Wi-Fi</b> 0.58 W (min), 0.63 W (max) 0.58 W (average of 0.63 W during 2 seconds, 0.58 W during 148 seconds) (good Wi-Fi signal, measuring at 2.5 minute intervals with sensors)
Operating temperature	10 - 50 °C
Operating relative humidity	10 - 90 % (non-condensing)
Weight	281 g
Dimensions	170 mm x 35 mm x 100 mm

### Connectors

Connector 1	1	PhytoClip signal
	2	Not used
	3	Not used
	4	NTC signal
	5	VSS (-)
	6	VDD (+, 3.3 V)

Connector 2	1	PhytoClip signal
	2	Not used
	3	Not used
	4	NTC signal
	5	VSS (-)
	6	VDD (+, 3.3 V)

Power	1	VSS (-)
	2	VDD (+, 9 V)



## PhytoClip sensor

Manufacturer	Phyto-IT
Cable length	2 m
Weight	19 g (with cable), 3.5 g (without cable)
Dimensions	40 mm x 35 mm x 9 mm

# Technical specifications

## Cellular or Wi-Fi module (indicated on logger)

Manufacturer	Particle
Model	Electron (Cellular) or Photon (Wi-Fi)
Data sheets	<a href="http://www.phyto-it.com/downloads/documents/datasheets/Particle_Electron.pdf">http://www.phyto-it.com/downloads/documents/datasheets/Particle_Electron.pdf</a> <a href="http://www.phyto-it.com/downloads/documents/datasheets/Particle_Photon.pdf">http://www.phyto-it.com/downloads/documents/datasheets/Particle_Photon.pdf</a>
Certification	FCC, IC, CE, TELEC, RoHS, PTCRB, GCF, UL

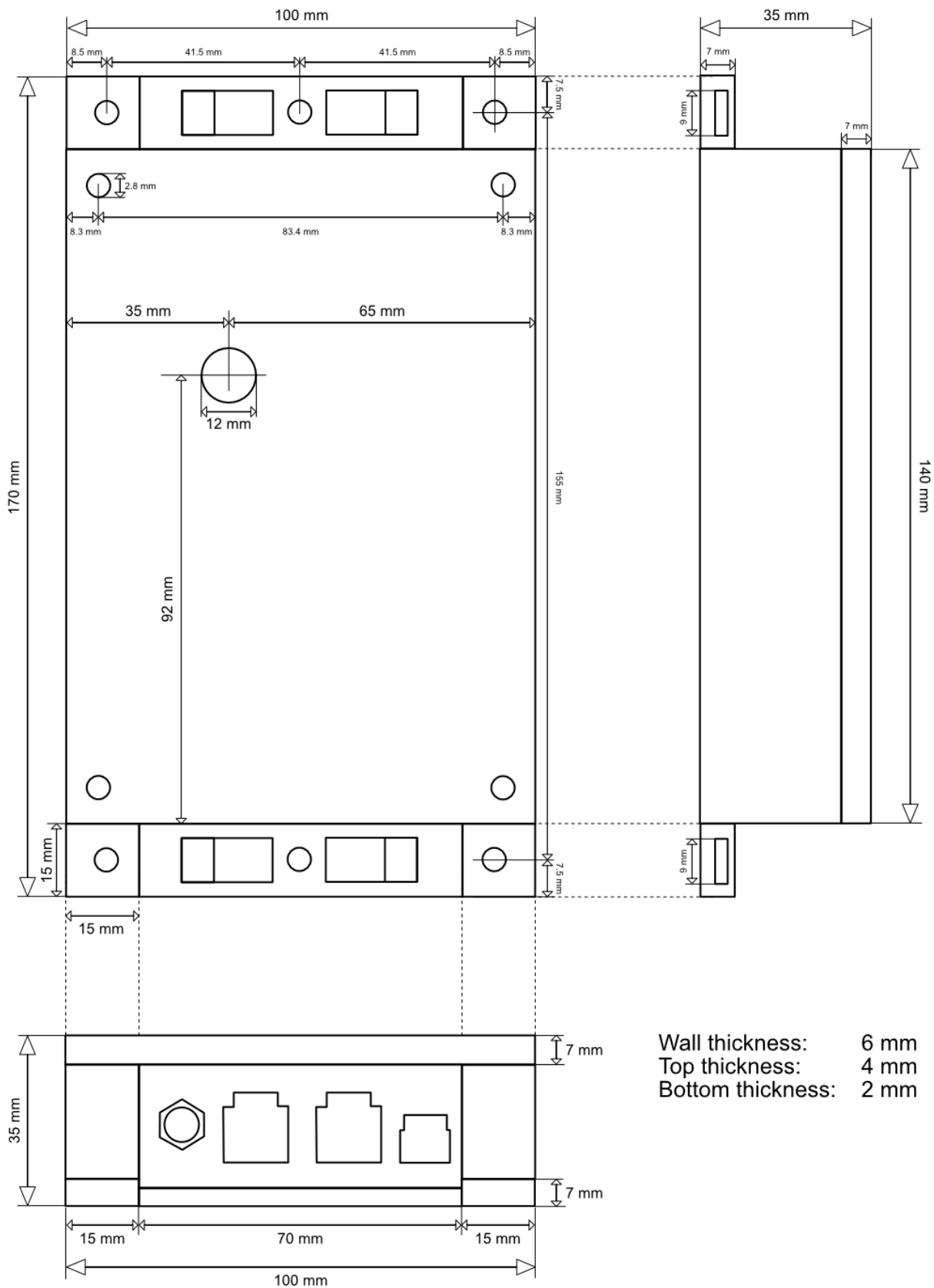
## Power adapter

Manufacturer	XP Power
Model	VER18US090-JA
Input voltage	90 ~ 264 VAC 50/60 Hz
Output power	18 W (max)
Output voltage	9 V
Output current	2 A
Operating temperature	0 - 60 °C
Cable length	1.5 m
Weight	80.29 g
Dimensions	90.0 mm x 43.0 mm x 42.7 mm
Data sheet	<a href="http://www.phyto-it.com/downloads/documents/datasheets/XPPower_SFVER18.pdf">http://www.phyto-it.com/downloads/documents/datasheets/XPPower_SFVER18.pdf</a>

## Antenna

Manufacturer	Siretta
Model	ALPHA40/5M/SMAM/S/S/29
Impedance	50 ± 5 Ohm
Gain	0.5 (700-824 MHz) / 1 (1710-2170 MHz) / 2 (2300-2700 MHz) dBi
Operating temperature	-30 - 60 °C
Cable length	5 m
Dimensions	155 mm x 30 mm x 4.5 mm
Weight	88 g
Data sheet	<a href="http://www.phyto-it.com/downloads/documents/datasheets/Siretta_Alpha40.pdf">http://www.phyto-it.com/downloads/documents/datasheets/Siretta_Alpha40.pdf</a>

# Mechanical drawing



# Additional information

## Certification

The cellular and Wi-Fi modules used in the PhytoClip system are FCC, IC, CE, TELEC, RoHS, PTCRB, GCF, UL certified. For reports see:

<https://docs.particle.io/datasheets/certifications/certification/>

Designed and manufactured by Phyto-IT in Belgium

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<http://www.phyto-it.com>  
<http://www.phytosense.net>

