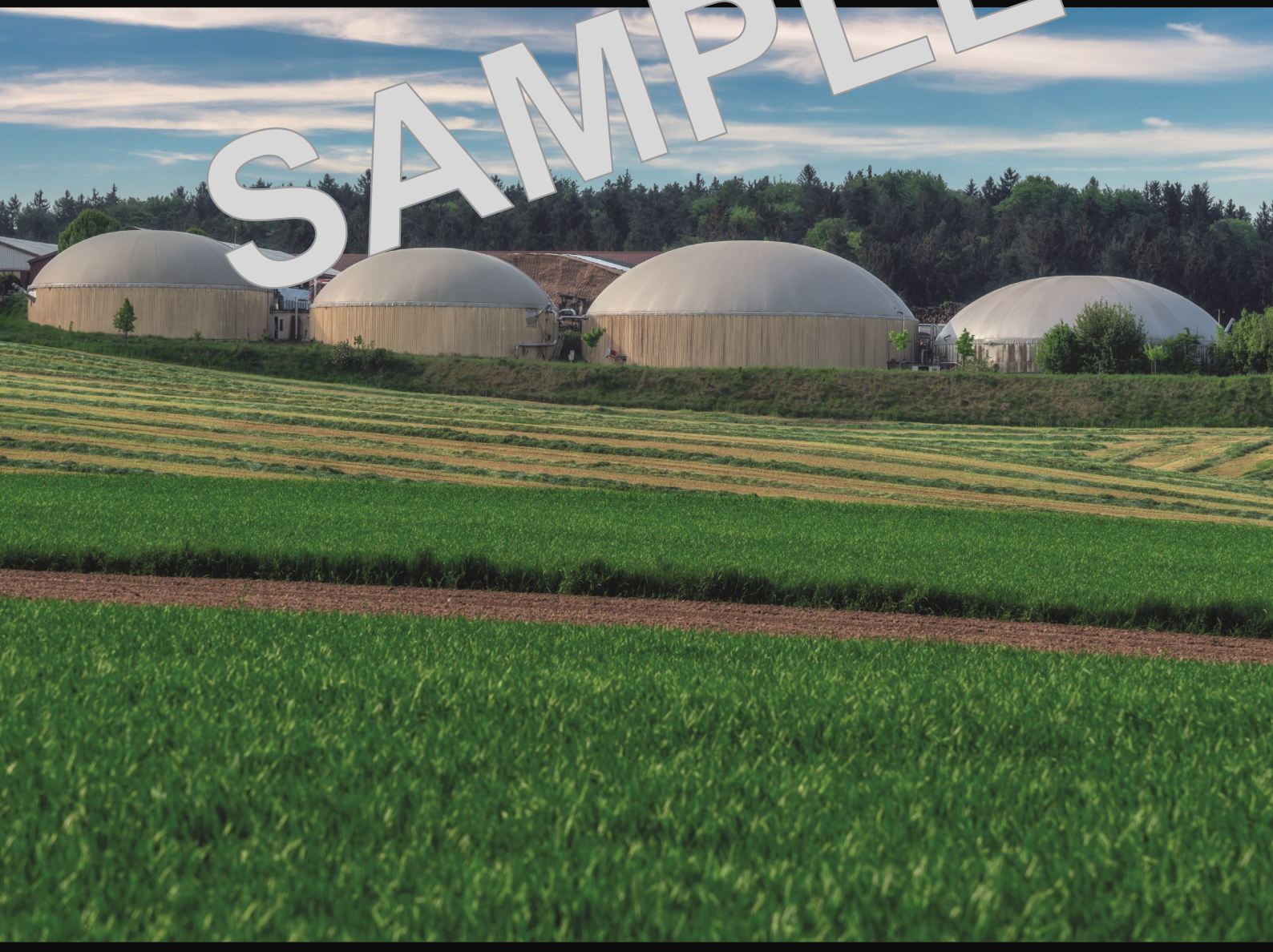
MATRIX | RENEWABLES

BioMass Cycle



MATRIX

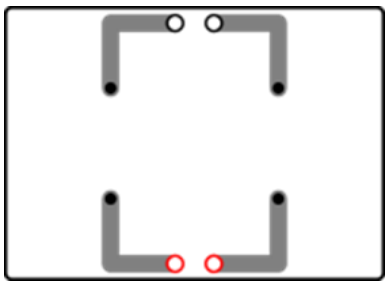
CP4772

www.matrixtsl.com

Contents

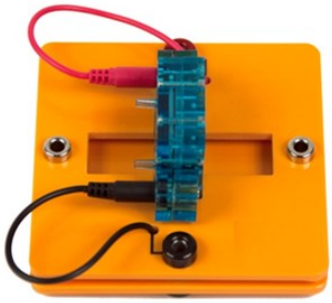
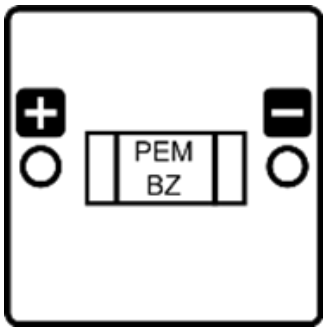
Small base unit (1602-01) with safety short-circuit plug (L2-06-033)





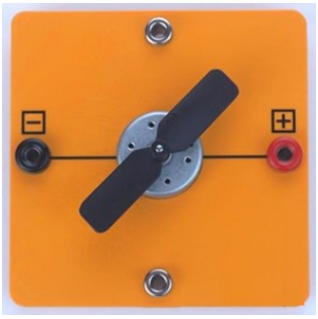
The small base unit is a plug-in board which can accommodate up to two modules. The electricity flows through the cables attached to the bottom sides. To connect the modules on the base unit with others, there are four connections on two opposite sides. Two short-circuit connectors also are available for connecting modules to the base unit.

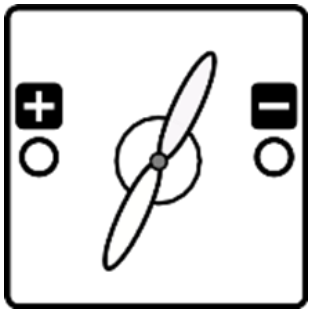
PEM-fuel cell module (1218-02)

High powered-PEM-fuel cell
Converts hydrogen and oxygen into electricity and water
Dimensions of fuel cell: 32x32x32 mm
Dimensions of bracket: 85x85 mm
Output voltage: 0.6 V (DC)
Output current: 0.45 A
Power: 270 mW

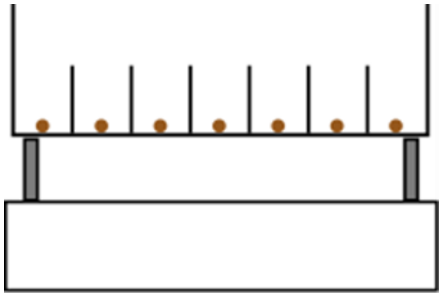
Motor module (1100-27) with propeller (L2-02-017)





Plug-in module with DC motor
Starting current: approx. 20 mA
Starting voltage: approx. 0.35 V
Equipped with automatic overvoltage protection
Version: plug-in module with 4 mm sockets
Pitch of the sockets: 70 mm
Module size 85 mm x 85 mm

Germination box (1700-12)



The germination box is used to germinate the plant seeds.
In 49 individual compartments, the plant seeds can be inserted and the germination process can be controlled and observed.
Holes in the compartments guarantee the drainage of water and thus prevent mold growth of the seeds and seedlings.

Expanded clay pebbles (1700-05)

The expended clay pebbles (Exclay) act as a substrate in the BioEnergy hydroponic culture. The exclay can be washed an reused .

Fertilizer (1700-06)

Plant nutrients for BioEnergy hydroponics:

Total Nitrogen (N) 18%, Phosphate (P_2O_5) 11%, Potassium Oxide (K_2O) 18%, Magnesium Oxide (MgO) 2.5%, Sulfur Trioxide (SO_3) 8%, Iron (Fe) 0.1%, Manganese (Mn) 0.04%, Boron (B) 0.01%, Copper (Cu) 0.01%, Molybdenum (Mo) 0.001%, Zinc (Zn) 0.01%

For more information see the link below:
https://icl-sf.com//global-en/products/ornamental_horticulture/2041-universol-blue/
Everris International BV, Nijverheidsweg 1-5; 6422 PD Heerlen (NL);

Compost Accelerator (1700-07)

Bio-active composting agent
starts and optimizes the heat fermentation
pure natural substances

For more information see the link below:
https://www.dehner.de/produkte/dehner-bio-kompostbeschleuniger-5-kg-X000141887/
Dehner GmbH & Co. KG, Donauwörther Str. 3-5, D-86641 Rain

Composter (1700-08)

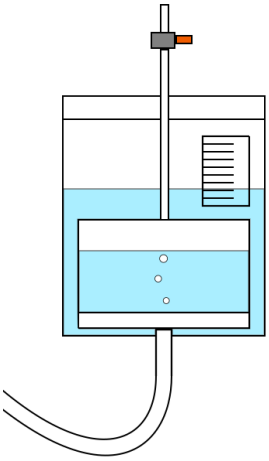
2-piece stick together compost container

The transparent cover makes it possible to visually observe all processes and changes.

The base plate with feet and holes allows the drainage of excess fluid and sufficient ventilation of the compost.

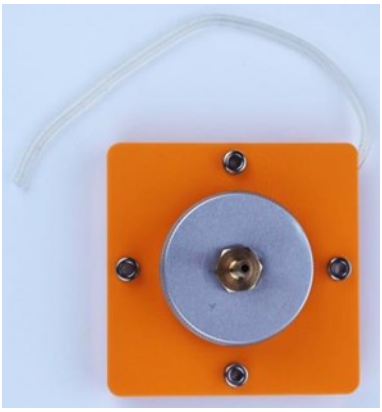
Should be placed on an appropriate plate.

Gas collecting vessel (1700-09)



The gas container allows the collection of the methane and hydrogen gases converted by biogas processing.
Via a silicone hose the gas can be distributed to the burner
Using the printed scale, the rate of gas formation can be observed depending on different parameters .

Bunsen burner (1700-10)



The burner is used for the controlled burning of gases from the biogas processes.
The gas collected in the gas receiver is fed to the burner via a silicone pipe and a ball valve.

Introduction
Components

Seed set (1700-15)

The seed-set contains the plant seeds for growing the biomass.
It contains corn, wheat, sugar beet, radish and salad seeds.

Rubber plug with tube (1700-16)

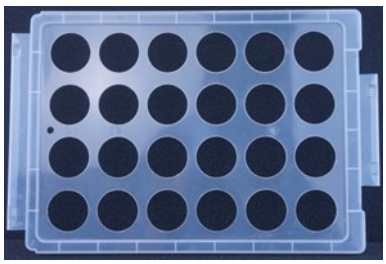
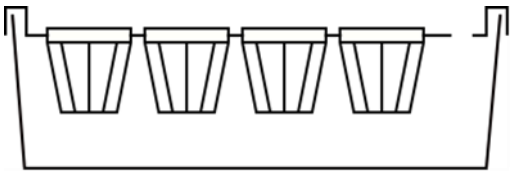
The rubber plug guarantees the airtight sealing of the Erlenmeyer flasks.

The formed biogas is fed into the gas collecting vessel through the hose.

ID tags (1700-17)

For numbering the plants

Box 75mm (L3-01-012) and pot holder (L2-01-120)

The pot holder keeps the net pots in hydroponic culture and can accommodate 24 pots.

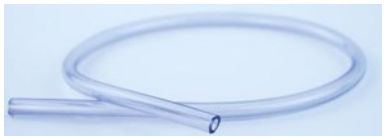
Outlet timer (L2-06-185)

The timer is used for the individual time settings of switching on and off of the connected electronic devices.

Minimum selectable time interval: 30 min

1. Adjust the current time
2. Set up the individual time interval by pressing the black buttons
3. Switch from continuous mode to interval mode

Air pump (L2-06-186), tube inside 4mm (L2-02-046) and air stone (L2-06-187)


The pump introduces the air into the hydroponic space through the tube and aeration stone to prevent algae growth in the water.

Net pot planter (L2-06-188) and stopper red (L2-06-199)

Using the expanded clay pebbles, seedlings and plants can be grafted in the net pots.
The plugs are used for sealing the free spots in the hydroculture, if no net cup planters are applied, to prevent the entering of light in order of algae growth.
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EC meter (L2-06-189)

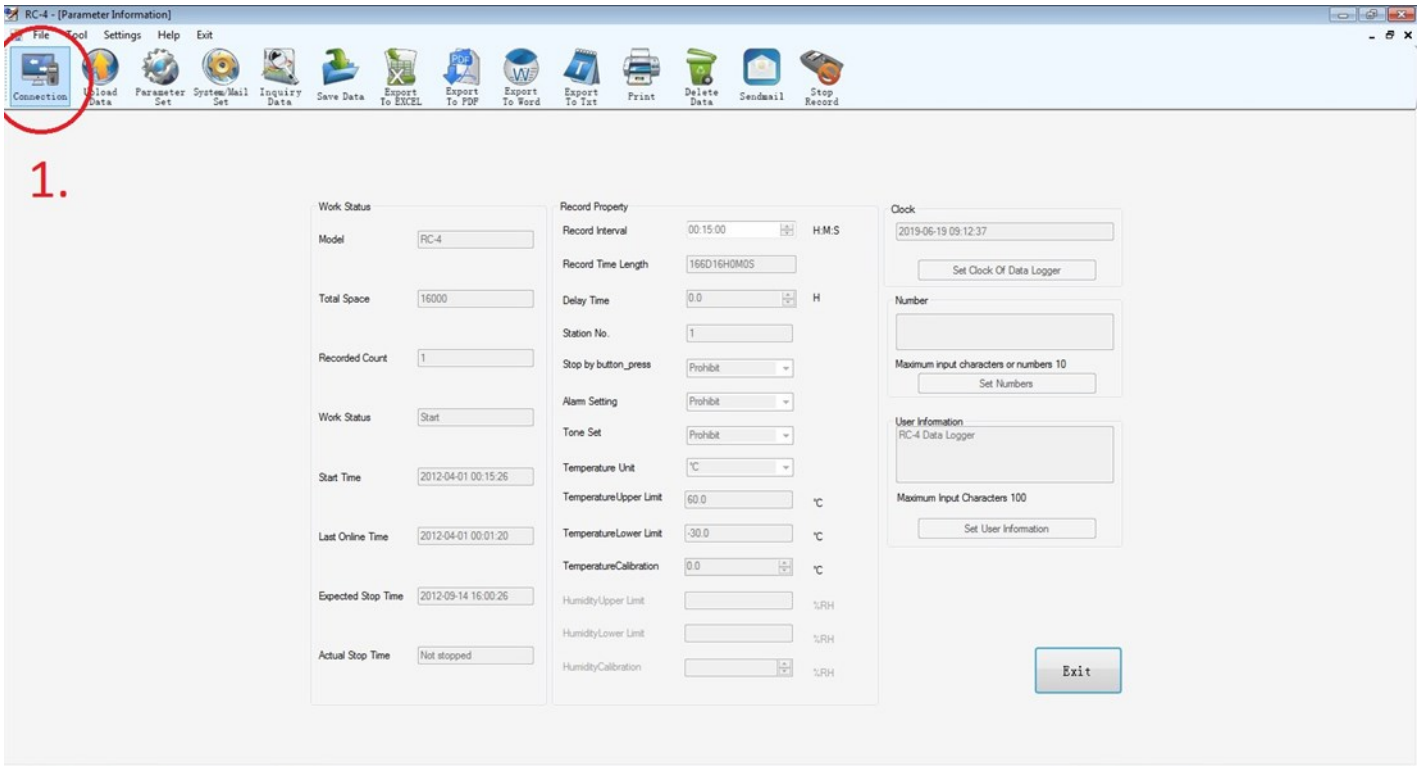
The meter measures the electrical conductivity of liquids. (Unit µS/cm)
This physical scale indicates a material's ability to conduct an electric flow.

Temperature logger (L2-06-190)

The device records temperature values in individually selectable time intervals.
The recorded data can be read via a USB interface and the associated software on the PC

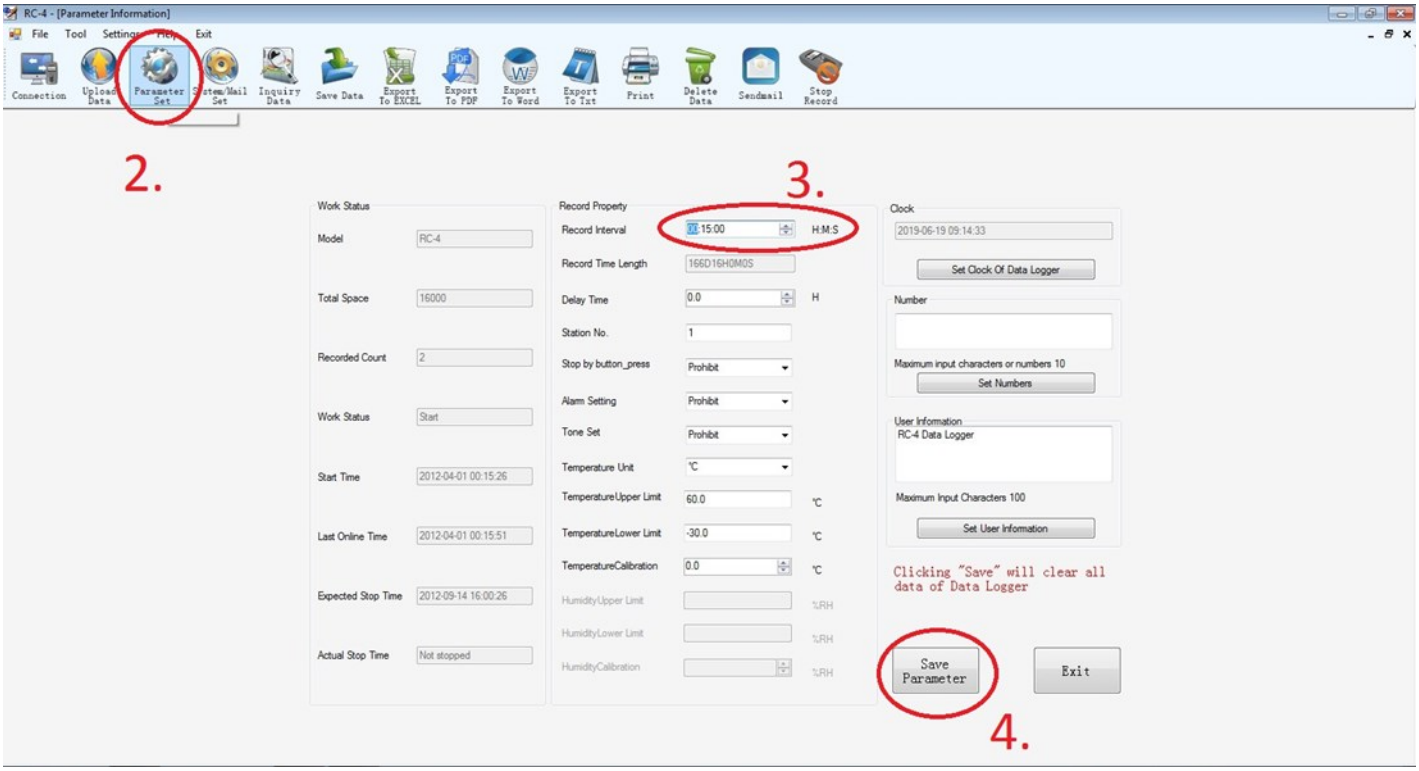
Introduction
Components

Programming the temperature logger:
Install the software on your PC.
You can download the software via: http://www.elitechlog.com/softwares/
Insert the coin cell into the logger as shown in the short description.
Connect the logger via USB to your PC.
Date and time should synchronize automatically as soon as you click on “connection” (1.)
(It can also be synchronized by clicking “Set Clock Of Data Logger”)

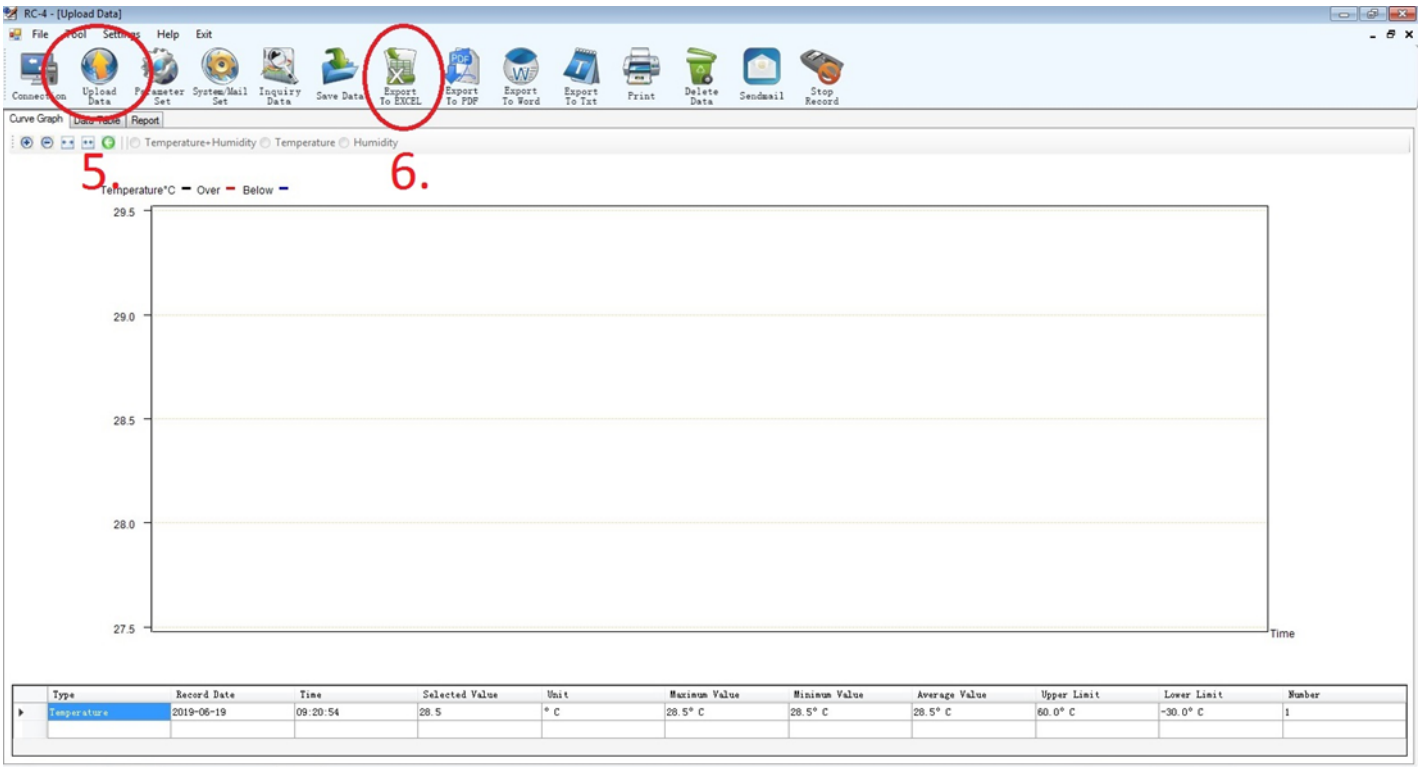


Introduction
Components

Via “Parameter Set” (**2.**) you can program different parameters for temperature recordings
Via “”Parameter Interval” (**3.**) u can set the time between the unique points of measurements
You can also choose between °C and °F
Via “Save Parameter” (**4.**) you can save your experiment data
Please note that all collected date will be erased, if u set new parameters
Start the logging procedure by pressing the “►” button for 4 seconds. The symbol ”►” also should appear on the screen of the temperature logger.



For evaluation you can use the program provided and export your data by clicking “Upload Data” (5.) or save the data as Excel, PDF, Word or TXT file. (6.)



Scale (L2-06-191)

Using the scale, the weight of the plants and thus the biomass growth is determined.
Effective range of measurement: up to 5 kg, tolerance: 1 g

Tweezers (L2-06-192)

Tool for gripping small objects, such as seedlings made of plastic

Hose clamp (L2-05-141)

To restrict or close the air hoses

Erlenmeyer flask (L2-06-075)

Erlenmeyer flask 1000 ml with grinding NS 29/32

Borosilicate glass

Atomizer (L2-06-200)

The atomizer is used to moisten the plant seeds in the germination box to germinate them.
Hight (d*H): 4,6*2,5 cm
Sprayed Volume: 350 ml/h
Depth of the water: 5-7 cm
Output: 24 V/ 1 A
Input: AC 100-240 V/ 50/60 Hz

Safety Instructions

Operators should wear protective clothing during handling of dangerous liquids.

Laboratory equipment and glassware should be inspected prior to each use to ensure that cracks, chips or other defects are not present.

Repaired equipment has to be cleaned and decontaminated.

Fertilizer (Universol Blue 323 18-11-18+2.5MgO+TE)

H318 Causes serious eye damage

H272 May intensify fire; oxidizer

P280 Wear protective gloves/protective clothing/eye protection/face protection

P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. — No smoking.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310 Immediately call a poison center or doctor/physician

Do not dispose the fertilizer directly into the sewage system, earth or water.

Compost accelerator

If on Skin: Wash your skin carefully with a lot of water

If in the eye: Flush the eye carefully and call a doctor

If swallowed: Rinse your mouth with water and drink a lot. Do not force regurgitation and call a doctor.

Do not dispose the accelerator directly into the sewage system, earth or water.

Carbon Dioxide

P403 Store in a well ventilated place.

Safety Instructions

Methane and Hydrogen

H220 Extremely flammable gas.

P220 Keep away from clothing/ other combustible materials.

P377 Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 In case of leakage, eliminate all ignition sources if safe to do so.

P403 Store in a well-ventilated place.

Glass equipment

Before experimentation search the glass equipment for damaged parts to avoid cuts and other injuries.
Broken glass can be a huge health threat and can lead to further laceration and chemical burn.

Please avoid fast variation in temperature. This can lead to tensions in the glass structure and to breakage of the glass.

Please avoid fast variation in pressure. This can also lead to breakage of the glass

Glassware can lead to deep cuts if handled incorrectly. Keep bandages and tweezers ready to remove any small pieces. For larger glass fragments near the arteries, immediately seek medical advice and do not remove chips on your own.

Operation of the PEM fuel cell
Specifications:

- Output power: 270 mW
- Output voltage: 0,6 V (DC)
- Output current: 0,45 A

Important handling guidelines:

- Whenever not in use, the fuel cell should be stored in an air-tight plastic bag, to keep it from drying out.

Safety Instructions

User instructions:

1. To operate the fuel cell, hydrogen gas is needed.

2. If the hydrogen is taken from the gas tank, the tube must be clamped to avoid hydrogen gas to leak.

3. The tube of the H_2 tank must be connected to the lower port of the fuel cell. The O_2 supply for this model is ensured by the ambient air.

4. The upper port of the fuel cell must be sealed, using a short piece of tube and a pin.

5. The fuel cell can now be placed onto the module plate and be connected to it using the respective cables (red for O_2, black for H_2).

6. Now, the unit can be connected to an electrical load by playing it onto the small base unit. (Mind the polarity!).

7. By opening the tube clamp the experiment can be started.

NOTE: For quantitative experiments like taking a characteristic curve, we recommend flushing the fuel cell with hydrogen gas by initiation the gas supply (opening the tube clamp on the tank or opening the valve on the H_2 storage) and removing the pin on the short tube for only 1-2 seconds.

Worksheet
Germination of plant seeds

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Germination

1. Write down in the table for each seed the associated ID number and the date on which you put it in the germination box.
2. Observe the seeds every day and record the date of germination.
3. After germination, you can measure the size of the seedlings daily and enter them in the database.
4. If the seedlings are big enough, you can put them into a net pot as described in Exercise 1.2.

(Tipp: Generally seedlings are big enough to be transferred in hydroculture, if they reach over the edges of the germination box)

Measurement

Plant species	Starting date	Date of germination	Size 1.day	Size 2.day	Size 3. day	…

Evaluation

Which seeds germinate quickly? Which ones slower?

Plant species										
Germ time										

Which seedlings are growing fast?

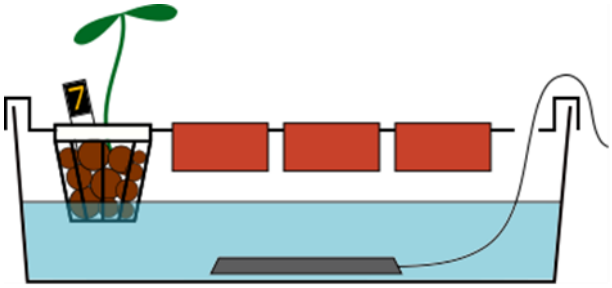
Worksheet
Plant growth in hydroponic culture

Build up the lighting

1. Set up the tripod for the lights. (Number 17 in the layout diagram)
2. Connect the light bulb holder to the tripod. (Number 11 in the layout diagram). Put the light bulbs into the holder.
3. Plug in the plant lighting through the outlet timer to a power outlet.
4. Set up the correct time; Program the timer that the light is active between 06:00 and 20:00. Adjust the current time with the small arrow in the middle of the clock and push all buttons between 06:00 and 20:00 down. (See page 13)
5. Put the tripod between both hydroponics and align the plant lamps so that both boxes are well lit.

Transfer the seedlings to hydroculture:

1. Once the height of the seedlings is higher than the walls of the germination box, they can be transferred into the hydroponic culture.
2. Prepare net cups and clay pebbles.
3. Use the tweezers to take a seedling from the germination box and hold it in the center of a net pot.
4. Fill the net pot with clay pebbles carefully so that the seedling can stand stably in it.
5. Put the corresponded ID number of the seedling in the potty.
6. Place the planted net pot in the hydroponic box.
7. You can cover the vacant places in the hydroponic culture with red plastic plugs.



Small sprouts, like lettuce seedlings, need to be transfered although they are still very small. Fill the net pots only with so many expanded clay pebbles that they just poke out from the water. Lay the seedlings onto the excaly pebbles, that the roots can reach the water and the leaves are out of the water.
Be patient, this procedure can take some time.

Addition of fertilizer and water:

To ensure that the plants always have the same environmental conditions, it is important to feed water and fertilizer regularly.

1. Every 2-3 days, check the EC value of the water in your hydroponic culture.
2. Add water and fertilizer if necessary until the EC value reaches to 1100 µd/cm.
3. Note in the data table with the corresponding date for both hydroponics that how much water you have added and if you have re-fertilized.

After about 3 weeks, you should completely change the water in the hydroponic cultures. Clean all materials with a little detergent and reassemble the hydroponic culture as described above. You can carefully remove the net pots with the plants. Make sure that the roots do not break off.

Worksheet
Plant growth in hydroponic culture

Observation of plant growth

Note the weight and size of your plants every 2-3 days.

Use the scale for specification of the weight.
Take a net pot with a plant from the hydroponic culture and drain the water well.
Weigh the net pot using the scale and note the weight and the plant ID in your data table.
By determining the weight in two different days, you can calculate how fast the plants gain weight.
If you add exclay to stabilize the plant, record the weight of the added pebbles so that you can recalculate this value the next time.

Example:
Day 1: 13,5 g
Day 2: 14,1 g
à After weighing, 3.4 g of expanded clay pebbles are added
Day 3: 18,3 g

Increased weight Day 1-2: 14,1 g – 13,5 g = 0,6 g
Increased weight Day 2-3: 18,3 g – 14,1 g – 3,4 g = 0,8 g

You can measure the size of the plants with a ruler or tape measure.
Start with measuring at the top of the pot and measure it to the highest tip of the leaf.
Note also any other changes that you can observe in the plants, such as yellowish or dry leaves, flower and bud formation or fruit and turnip formation.

The experiment shows good results after 2-3 weeks. You can also continue it for several months.

Worksheet
Plant growth in hydroponic culture

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Measurement

Record your measurement by specifying the corresponding plant ID in the data table in the section "Plant growth". Record the weight, size and other observations or deficiency symptoms.

	A	B	C	D	E	F	G	H	I
1	Plant growth in hydro culture								
2									
3	Task:	- record the size,weight and condition of the plants with their corresponding ID							
4									
5	**Date**	**ID**	**size (cm)**	**weight (g)**	**sprout**	**bloom**	**fruiting**	**deficiniency**	**picture**
6									
7									

Evaluation

1. **Which colors of the light spectrum does the plant LED send out and why?**

2. **Display the growth of your plants graphically with a diagram of the hight and the weight as a function of the number of days of your experimentations**

3. **Which plants grow up quickly?**

4. **Which plants make the biomass quickly?**

The full version of this curriculum is available upon purchase of the kit.

Please see contents for a full list of experiments from the full version.