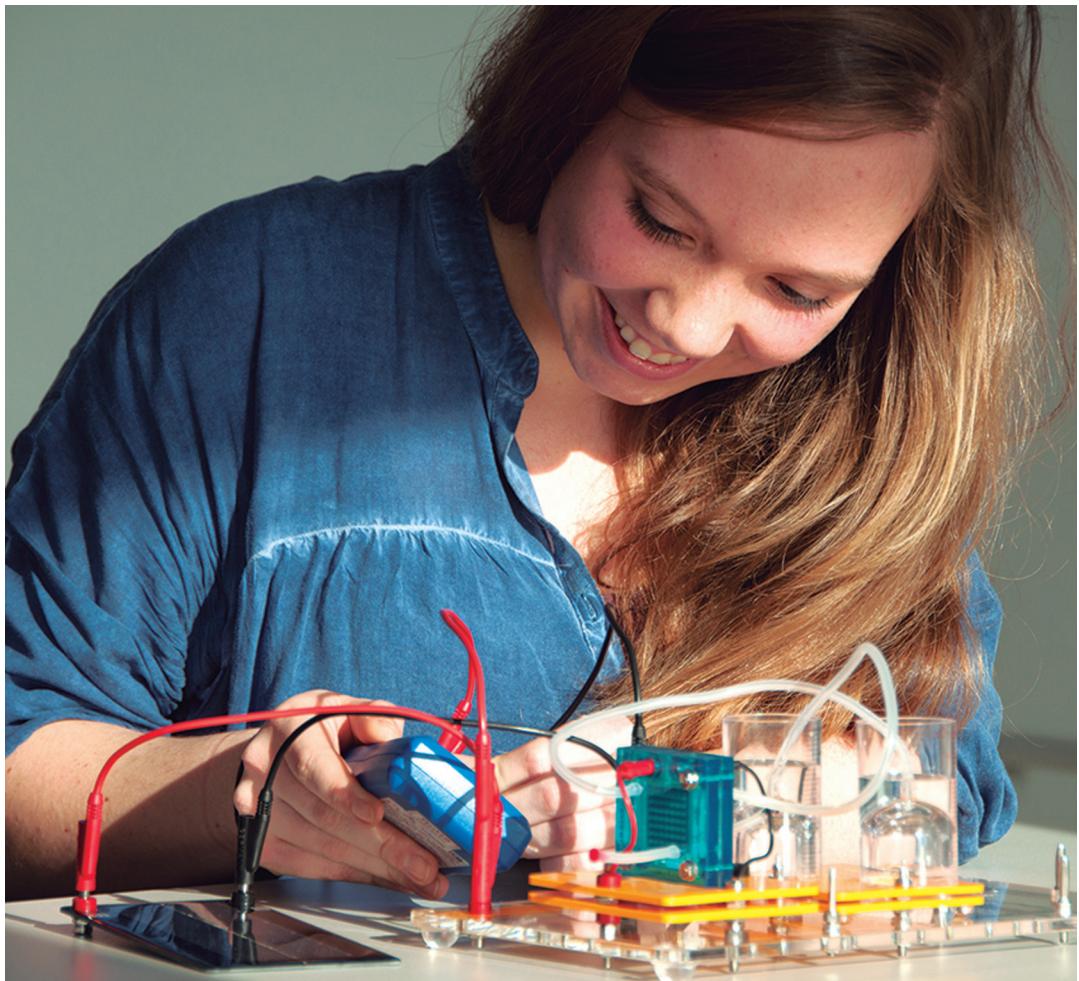


leXsolar-H₂ Professional



Instructions manual

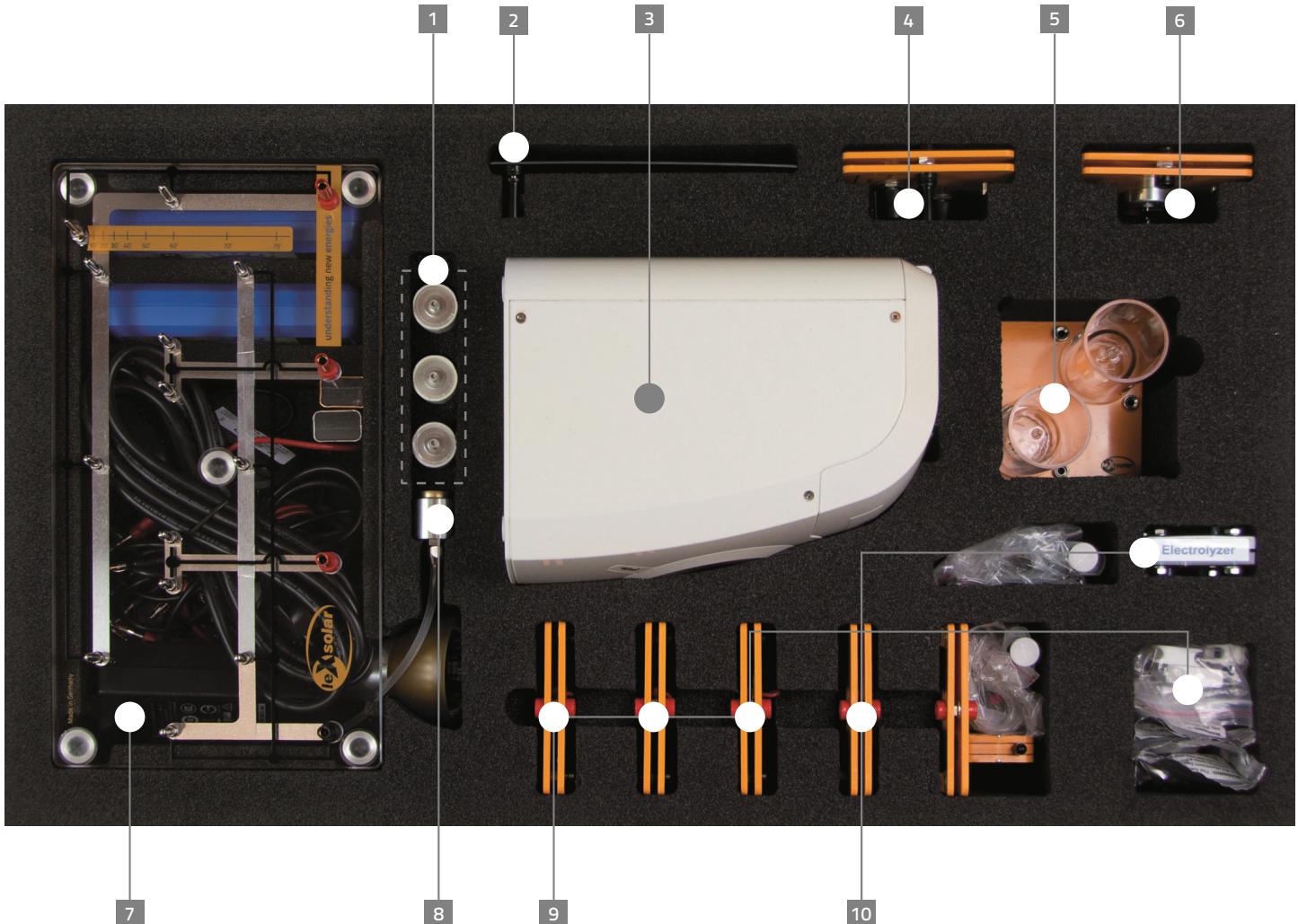

www.lexsolar.de/feedback

Layout diagram leXsolar-H₂ Professional

Item-No.1217

Bestückungsplan leXsolar-H₂ Professional

Art.-Nr.1217



- | | |
|---|---|
| 1
1200-18 H ₂ Storage + 2xoptional expansions
1200-18 H ₂ Storage + 2xoptionale Erweiterung | 7
1100-19 Base unit large
1100-19 Grundeinheit groß |
| 2
1100-31 Solar panel 2.5 V, 420 mA
1100-31 Solarmodul 2.5 V, 420 mA | 8
L2-06-132 Valve for H ₂ Storage
L2-06-132 Ventil für H ₂ Storage |
| 3
1200-17 H ₂ Charger
1200-17 H ₂ Charger | 9
3x1218-02 PEM-Fuel cell module
3x1218-02 PEM-Brennstoffzellenmodul |
| 4
1100-23 Potentiometer module
1100-23 Potentiometermodul | 10
1218-03 Electrolyzer module 2.0
1218-03 Elektrolyseurmodul 2.0 |
| 5
1213-01 Gas storage module
1213-01 Gasspeichermodul | |
| 6
1100-27 Motor module with
L2-02-017 Yellow propeller
1100-27 Motormodul ohne Getriebe mit
L2-02-017 Luftschaube (Propeller) gelb | |

Version number
Versionsnummer

II-01.24_L3-03-195_04.05.2017

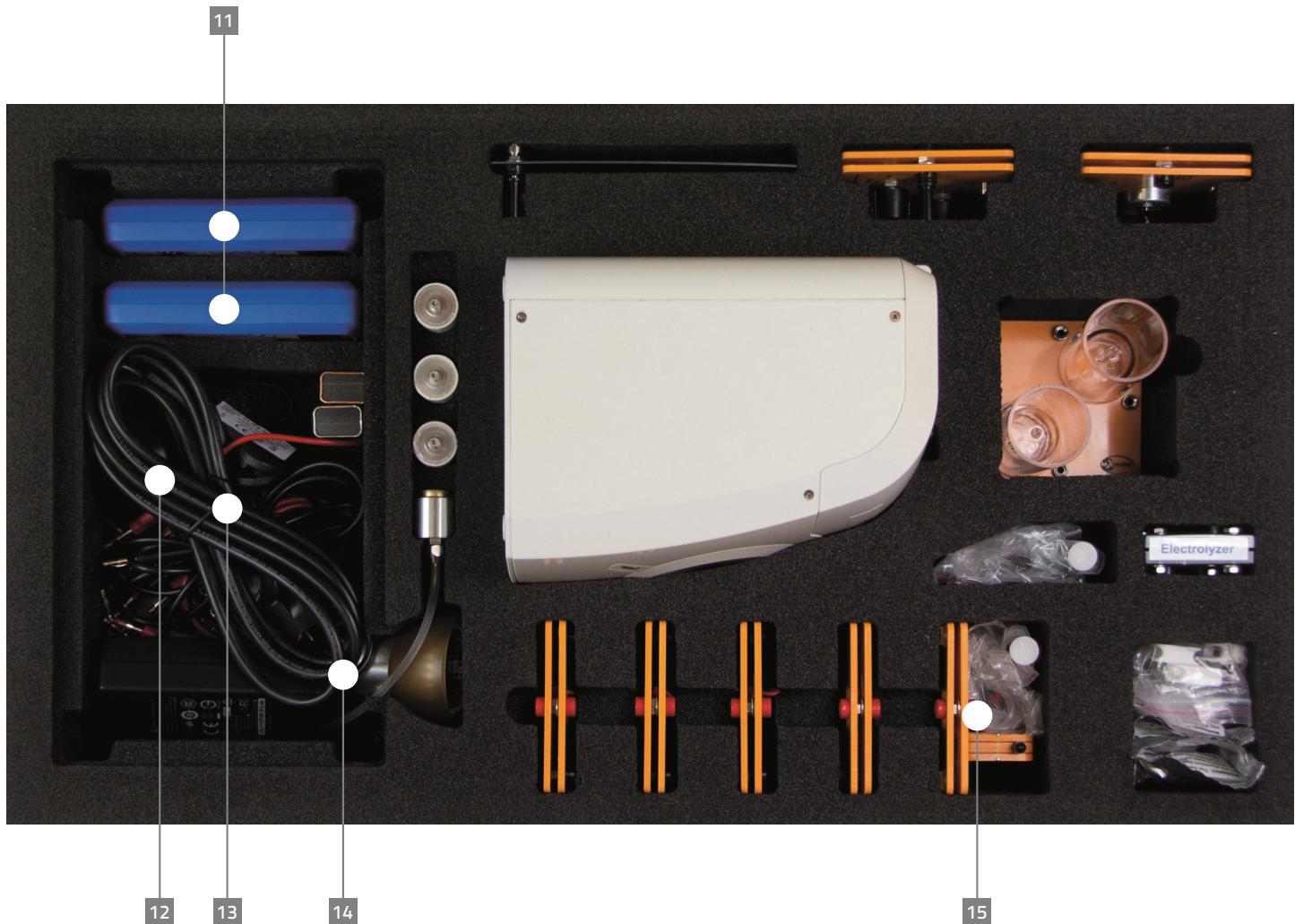
CE RoHS 2

Layout diagram leXsolar-H₂ Professional

Item-No.1217

Bestückungsplan leXsolar-H₂ Professional

Art.-Nr.1217



- 11** 2xL2-06-011 Digital multimeter
2xL2-06-011 Digitalmultimeter
- 12** 2xL2-04-066/067 Test lead black/red 25 cm
2xL2-04-066/067 Messleitung schwarz/rot 25 cm
- 13** L2-06-059/060 Test lead black/red 50 cm
L2-06-059/060 Messleitung schwarz/rot 50 cm
- 14** L2-04-022 Lamp with table clamp
L2-04-022 Lampe mit Tischklemme
- 15** 1700-01 Ethanol fuel cell module
1700-01 Ethanol-Brennstoffzellenmodul

leXsolar-H₂ Professional

Instructions manual

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2.2	<i>Operation of the PEM fuel cell</i>	10
2.3	<i>Operation of the H₂-Charger and H₂-Storage</i>	11

II Experiments

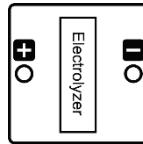
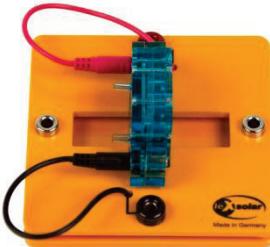
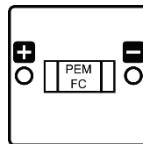
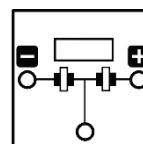
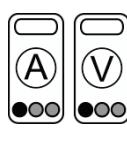
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Components

1 Designation of components

Standard equipment of leXsolar-H ₂ Professional		
Designation	Component	Symbol in the Experimental Setup
The leXsolar main board is a clear plastic board with blue printed circuit traces. It features several metal pins for connecting components. A small orange label in the center reads "Parallelschaltung" (parallel connection). The leXsolar logo is visible at the bottom left.	leXsolar main board	A square symbol containing seven open circles arranged in a grid pattern, with one solid black circle at the bottom left corner.
A rectangular solar panel with a black frame and a grid of blue cells. It has two red wires extending from the back side. The leXsolar logo is printed on the back.	Solar module (2.5V, 420mA)	A vertical rectangle divided into four horizontal sections. The top three sections each contain four parallel lines, and the bottom section contains a small square with a minus sign and a plus sign.
A yellow rectangular module with a central circular component. It has two black terminals labeled with a minus sign and a plus sign, and two smaller terminals at the bottom. To its right is a small yellow propeller.	Motor module without gear	A square symbol with a central wavy line. It has a plus sign terminal on the left and a minus sign terminal on the right.
A yellow rectangular module featuring a large black potentiometer. It has three terminals labeled R_min, R_max, and R_mitt. The leXsolar logo and "Made in Germany" text are printed at the bottom.	Potentiometer module	A square symbol with a central circle containing a double-headed arrow. It has two terminals on the left and two terminals on the right.
An orange base plate holding two clear plastic beakers. The left beaker is labeled "H ₂ " and the right beaker is labeled "O ₂ ". Both beakers have measurement markings.	Gas storage module	A square symbol containing two circles. The top circle is labeled "O ₂ " and the bottom circle is labeled "H ₂ ".

Components

	Electrolyzer module	
	PEM fuel cell module	
	Ethanol fuel cell module	
	H ₂ -Charger	
	H ₂ -Storage	
	Voltmeters / ammeters and cables	



Handling suggestion

Specifications H₂-Storage:

- Capacity: 10 l hydrogen
- Storage material: AB5 metal hydride
- Load pressure: 3 MPa
- Working temperature: 0-55°C

Important handling guidelines:

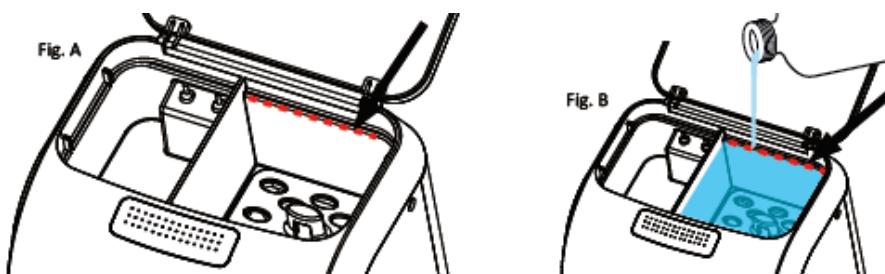
- The H₂-Charger must not be disassembled.
- Both the H₂-Charger and the H₂-Storage must be kept away from heat or flames.
- The H₂-Charger should be operated in an upright position.
- Operations should be done in a well-vented room.
- All electric connections should be kept away from water.

Status light:

green	red	System status
on		H ₂ -Storage full
1 second on, 1 second off		Filling of H ₂ -Storage is halted
	on	H ₂ -Storage is being filled
	1 second on, 1 second off	Add water or empty the waste water container

Usage instructions:

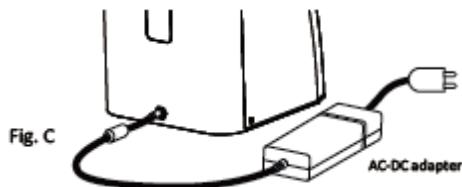
1. Firstly, fill distilled or deionized water up to the mark (see red line and arrow in the figure).



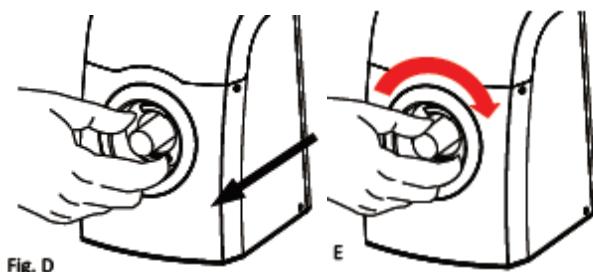


Handling suggestion

2. Connect the power adaptor to the H₂-Charger. The status light should flash green.



3. Insert the H₂-Storage into the opening on the front side of the H₂-Charger. For this, the stick should be turned clockwise until it locks in place. Don't apply too much force!



4. While the status light is flashing red, the H₂-Storage is being filled. Only when the status light flashes green, the cartridge is completely filled. The stick may now be removed by turning it counter clockwise.

5. Now remove the power adaptor and empty the water tank, in case the H₂-Charger will not be used within the following week. If further cartridges must be filled, revisit this procedure, starting at point 3.

NOTE: Distinct noises (gargling and whistling) are normal during the charging process and are being produced by the self-cleaning of the device.

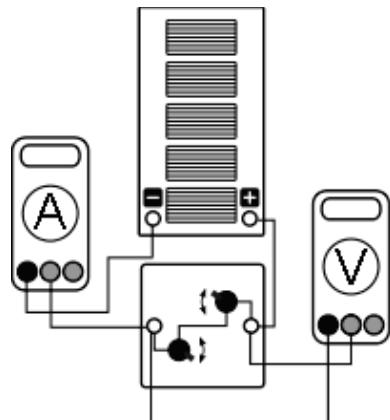


1. I-V curve of a solar module

Goals

Take the I-V curve of a solar module and interpret its behavior.

Setup



Equipment needed

- Solar module
 - Lamp
 - Cables
 - Ammeter
 - Voltmeter
 - Potentiometer module

Procedure

1. Set up the experiment in accordance with the drawing.
 2. Place the lamp in front of the solar module (distance ca. 30 cm) and switch on the lamp.
 3. Set sensible values for the voltage and measure the resulting current. For this, first adjust the $1\text{k}\Omega$ resistor and then the 100Ω resistor for better control.
 4. Enter your measurements into the table.

Measurements



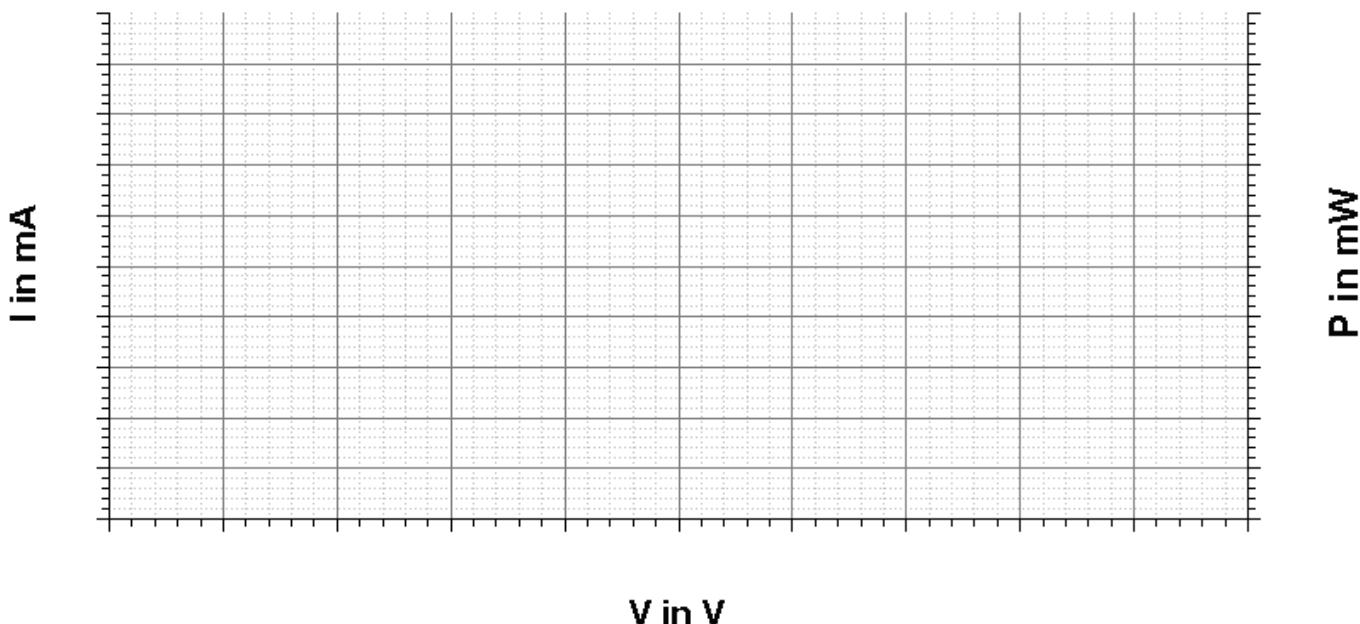
1. I-V curve of a solar module

Evaluation

1. Calculate the power for every pair of voltage and current values and enter your results into the table.
2. Plot the respective value in the given diagram.
3. Describe the behavior of the current and the power in dependence of the voltage.

Diagrams

2.



3.

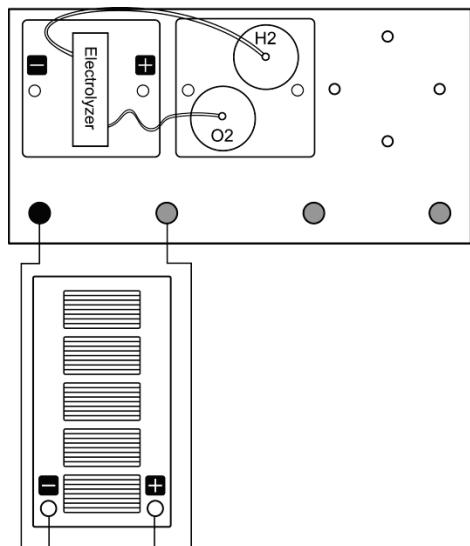


2.1 Properties of an electrolyzer

Goals

Investigate the ability of the electrolyzer to split water.

Setup



Equipment needed

- leXsolar main board
- Electrolyzer module
- Gas storage module
- Tubes
- Solar module
- Lamp
- Cables
- Distilled water

Procedure

1. Assemble the electrolyzer module and the gas storage module in accordance with the drawing. Place the lamp in front of the solar module (distance ca. 30 cm).
You can find notes on how to set up and use the electrolyzer in chapter "Operation of the electrolyzer" on page 8.
2. Switch on the lamp.
3. Watch what happens inside the gas storage tanks.
4. Note the filling level after 15 minutes.

Observation

Produced amount of H₂:

Produced amount of O₂:

Evaluation

1. What is the composition of water? Use the measured amounts of gas in for your explanation.



3.1 Properties of a PEM fuel cell

Evaluation

1.

2.

3.

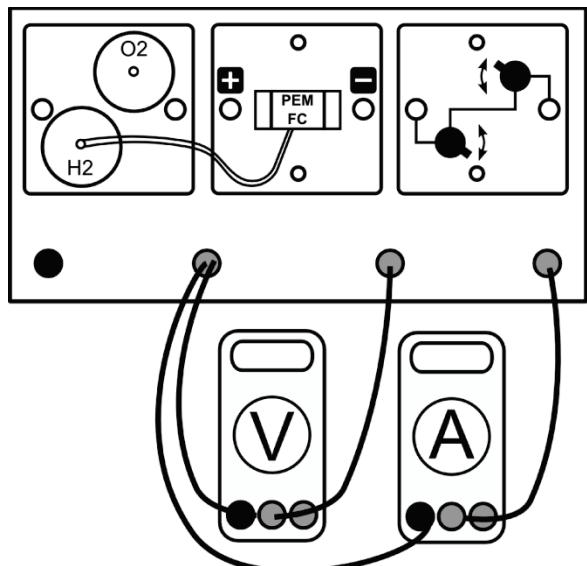


3.2 I-V-curve of a PEM fuel cell

Goals

Take the I-V-curve of a PEM fuel cell.

Setup



Equipment needed

- leXsolar main board
- PEM fuel cell module
- Potentiometer module
- Voltmeter
- Ammeter
- Cables
- Tubes
- Distilled water
- Gas storage (full), alternatively H₂-Storage

Procedure

1. Set up the experiment in accordance with the drawing. The gas storage has to be filled prior to the experiment. You can find notes on how to set up and use the electrolyzer in chapter "Operation of the electrolyzer" on page 8. Alternatively, you can use an H₂-Storage container.
2. Set the potentiometer to the highest resistance by tuning both knobs to their respective maximum.
3. Quickly flush the fuel cell with hydrogen. You can find hints on how to do this on page 10.
4. Determine and set sensible voltage values and measure the resulting current. For this, first adjust the 1kΩ resistor and then the 100Ω resistor for better control.
5. Enter your measurements into the table.

Measurements

V in V	I in mA	P in mW

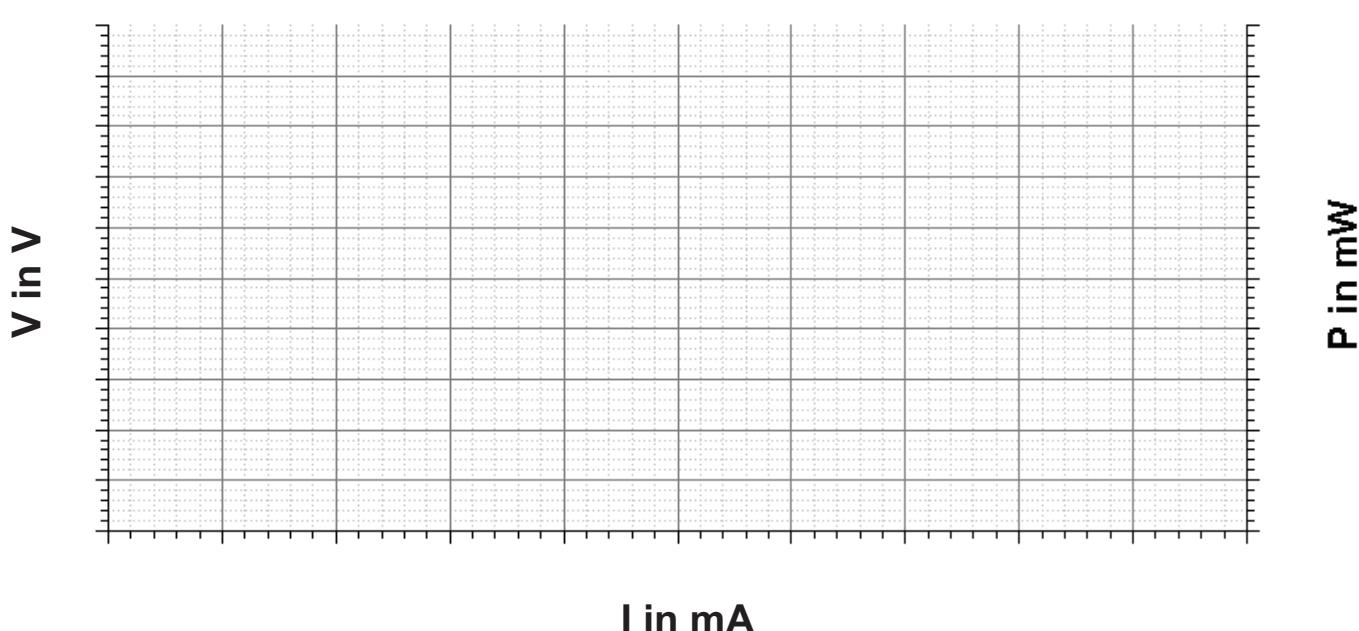


3.2 I-V-curve of a PEM fuel cell

Evaluation

1. Calculate the resulting power for every voltage and current value pair and plot your results as well as the value pair in the provided diagram.
2. Describe the behavior of the I-V curve and of the P-I-diagram.
3. Which part of the curve should be used to power a consumer? Justify your answer.
4. Explain the behavior of the I-V curve.

Diagrams



Evaluation

3.

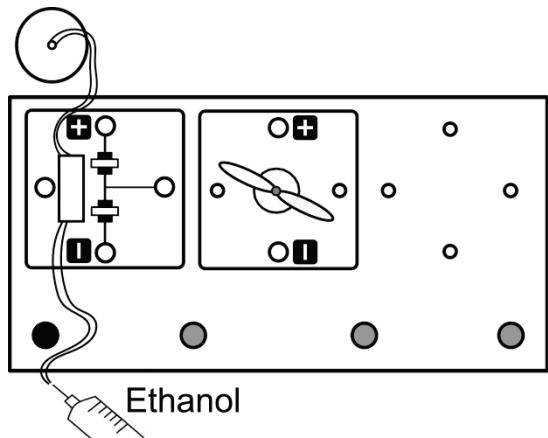


4.1 Working principles of an ethanol fuel cell

Goals

Investigate the working principles of an ethanol fuel cell.

Setup



Equipment needed

- leXsolar main board
- Ethanol fuel cell
- Motor module
- Tubes
- Beaker
- Syringe
- Ethanol

Procedure

1. Set up the experiment in accordance with the drawing.
2. Use the tubes and the syringe to fill the fuel cell with ethanol. Write down your observations.
3. When the motor has started to turn, clutch the syringe tightly in your hand in order to warm up the ethanol. Press the remaining ethanol into the fuel cell. Write down your observations.

Evaluation

1. What can you smell at the fuel cell?
2. Which reactions do occur? Explain the working principle of this reaction

Observations



4.1 Working principles of an ethanol fuel cell

Evaluation

1.

2.



4.4 Concentration dependence of an ethanol fuel cell

Evaluation

1. Calculate the cell's power output for each value and enter your results into the table.
2. Plot your measurements as well as the results of your calculations in the diagrams.
3. How can the curves be interpreted?

Diagrams

V in mV



P in mW



Evaluation

3.

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