Voltage and current of a solar cell as a function of light intensity

Task and equipment

Information for teachers

Additional Information

Solar cells play an important role in the development of alternative, non-fossil energy sources. They convert light energy directly into electric energy.
This experiment examines the influence of the intensity of illumination an the open circuit voltage and the short-circuit current. The intensity of illumination can be varied by changing the distance to the source or by changing the angle of illumination.

Notes on the Setup and Procedure

When measuring the short-circuit current, I_K, ideally there should be no resistance in the circuit. The measuring device has an internal resistor which places a load on the solar cell. The measuring range of the device should therefore be no smaller than 30 mA, and should not be changed while making the measurements. When measuring the open circuit voltage, U_0, the circuit is open. This is made evident by the absence of the module to which the current meter was connected.

Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

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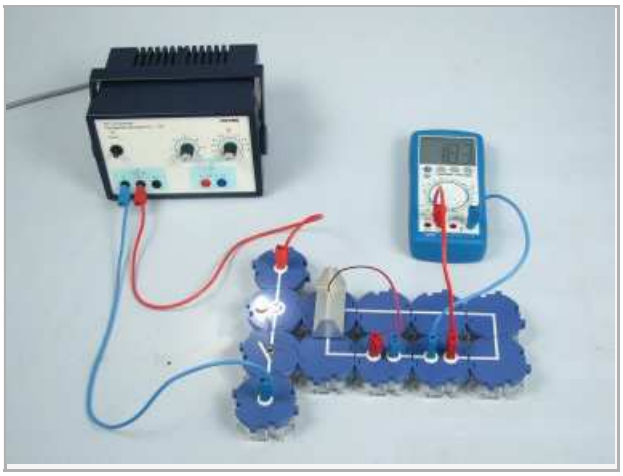
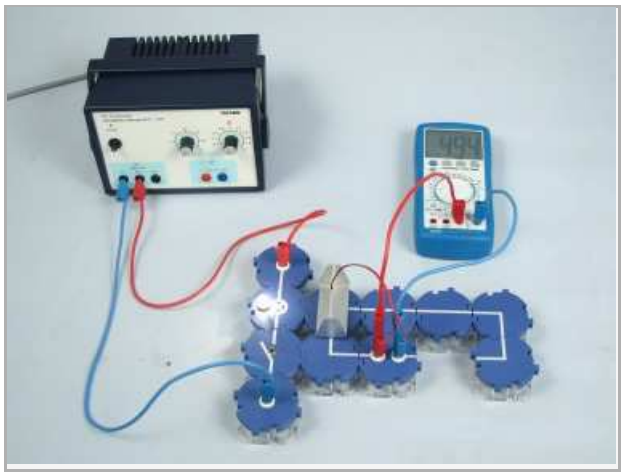
Task and equipment

Task

What influence does the intensity of illumination have on the voltage and current of a solar cell?

Change the intensity of illumination and measure the short-circuit current and the open circuit voltage of the solar cell. Draw a diagram of the measurement values.





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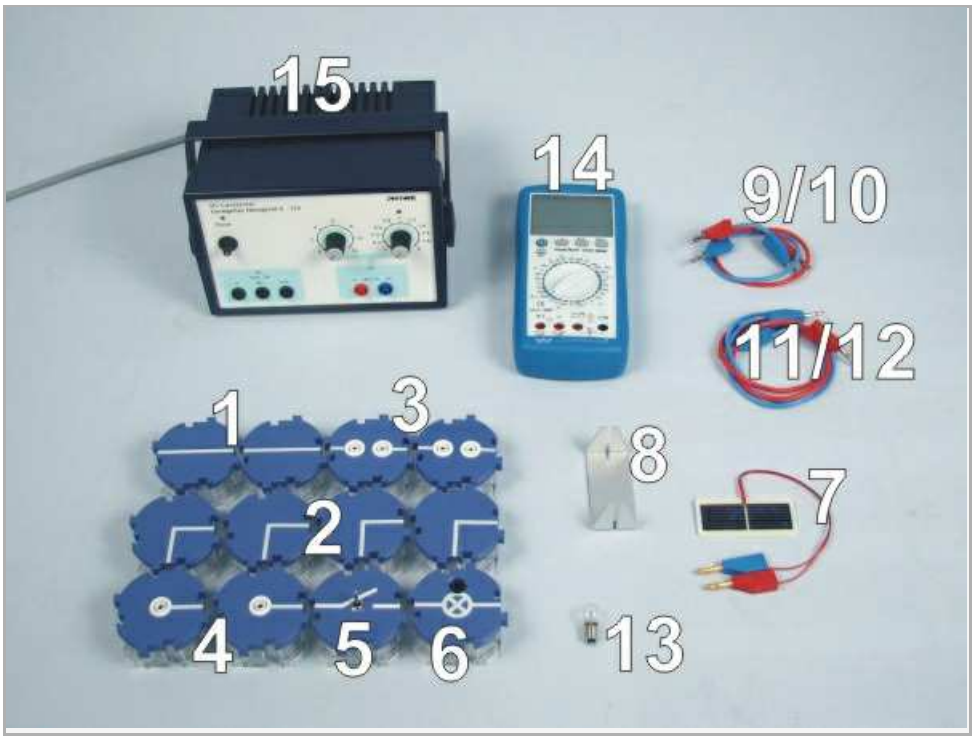
Equipment



Position No.	Material	Order No.	Quantity
1	Straight connector module, SB	05601-01	2
2	Angled connector module, SB	05601-02	4
3	Interrupted connector module, SB	05601-04	2
4	Junction module, SB	05601-10	2
5	On-off switch module, SB	05602-01	1
6	Socket module for incandescent lamp E10, SB	05604-00	1
7	Solar cell 2.5 x5 cm, with plugs	06752-11	1
8	Holder for solar cell 2.5 x5 cm, with plugs	06752-12	1
9	Connecting cord, 32 A, 250 mm, blue	07360-04	1
10	Connecting cord, 32 A, 250 mm, red	07360-01	1
11	Connecting cord, 32 A, 500 mm, blue	07361-04	1
12	Connecting cord, 32 A, 500 mm, red	07361-01	1
13	Filament lamp 6 V/3 W, E10, 10 pcs.	35673-03	(1)
14	DMM with NiCr-Ni thermo couple	07122-00	2
15	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

Set-up and procedure

Set-up

The light bulb is off. In order to measure the short-circuit current, I_K, set up the experiment as shown in Fig. 1 and Fig. 2, and place the solar cells in their holders on the modules (Fig. 3, Fig. 4).

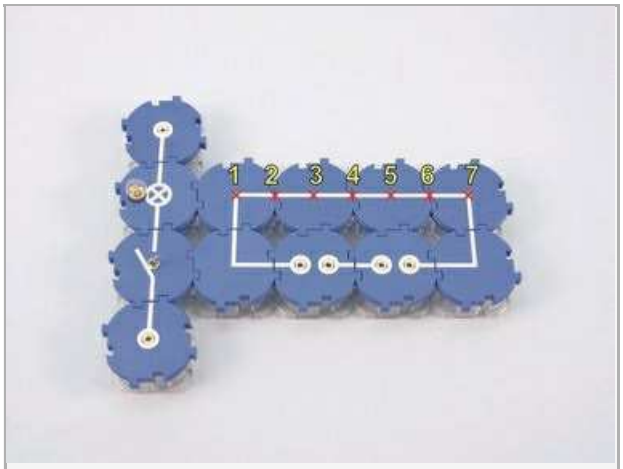


Fig. 1

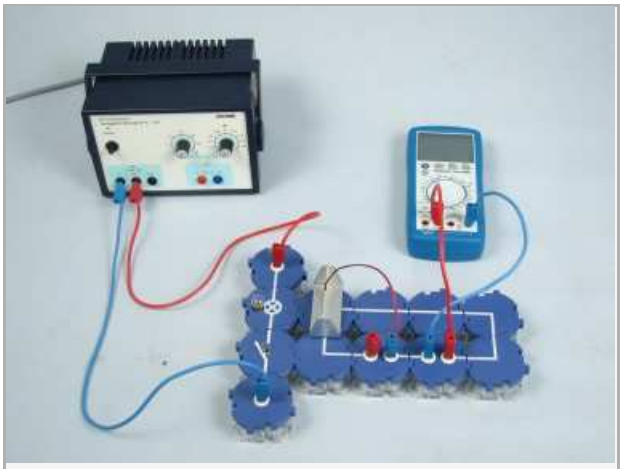


Fig. 2

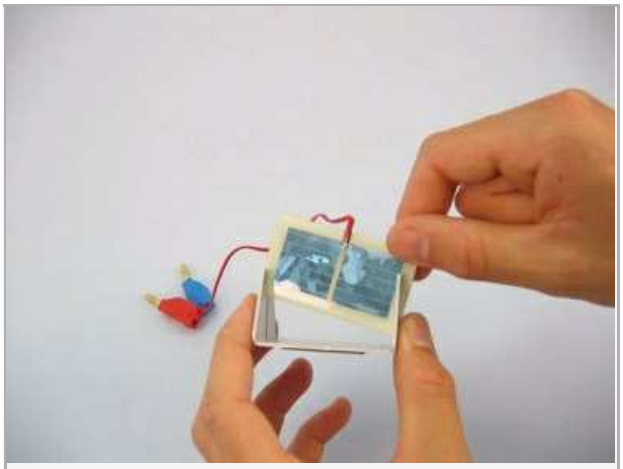


Fig. 3

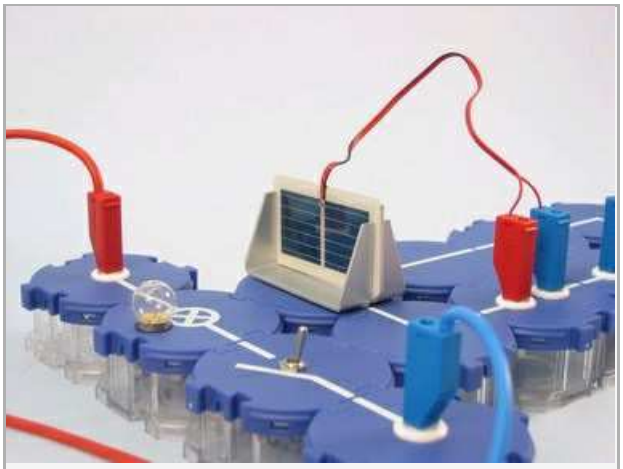


Fig. 4

Procedure

Switch on the light bulb.

Place the solar cell on position 1 (Fig. 1), so that it is at a right angle with respect to the light bulb. Turn the cell in every direction so as to change the angle of illumination. Observe the short-circuit current and describe it under Result - Observations in the report.

Return the solar cell to the right-angle position, measure the short-circuit current, I_K, and enter this value in Table 1 (second column) in the report.

Repeat this measurement for the other positions (1-7, see Fig. 1), without changing the measurement range.
Switch off the light bulb.

To measure the open circuit voltage, U_0, set up the experiment as shown in Figs. 5 and 6.

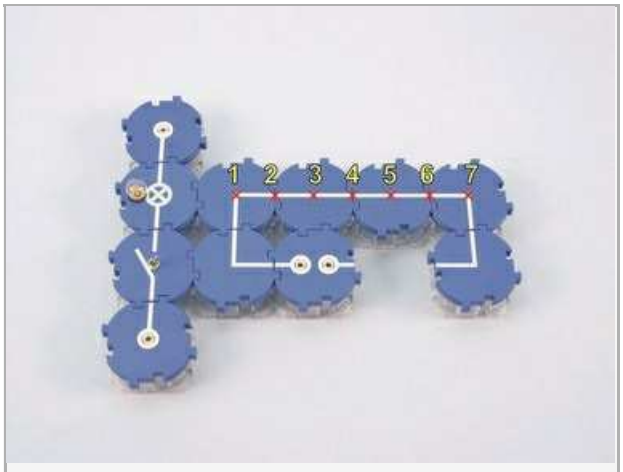


Fig. 5

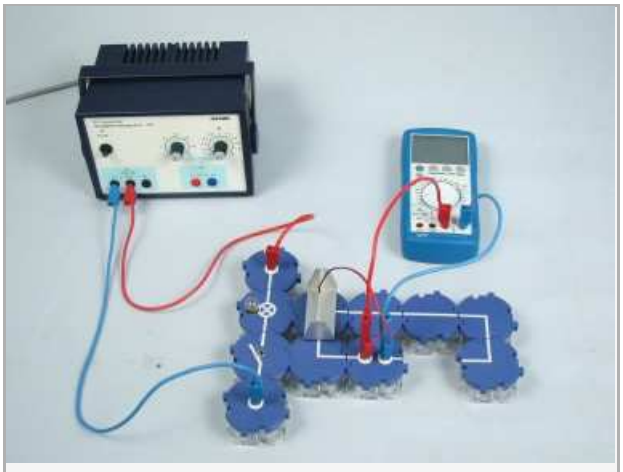


Fig. 6

Switch on the light bulb.

Measure the open circuit current, U_0, at different positions for the solar cell (1-7, Fig. 5), and record these values on Table 1 (3rd column).

Switch off the light bulb.
For all positions (1-7), measure the distance, a, of the solar cell to the light bulb and record this on Table 1 (4th column).

Report: Voltage and current of a solar cell as a function of light intensity

Result - Observations

Note your observations.

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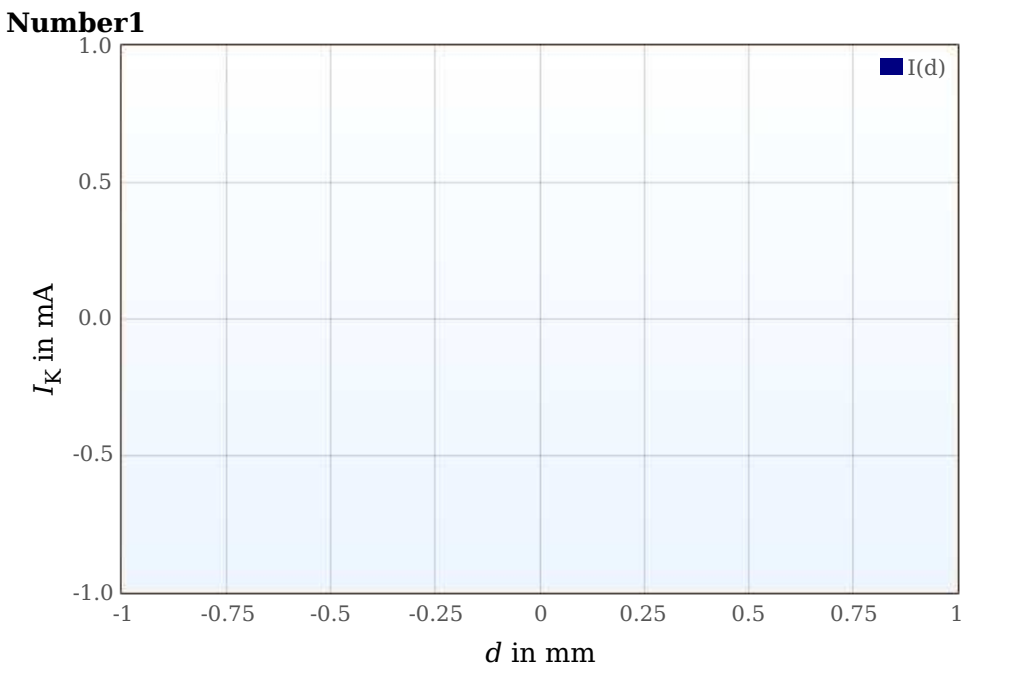
Result - Table 1

Record your measured values for the current.

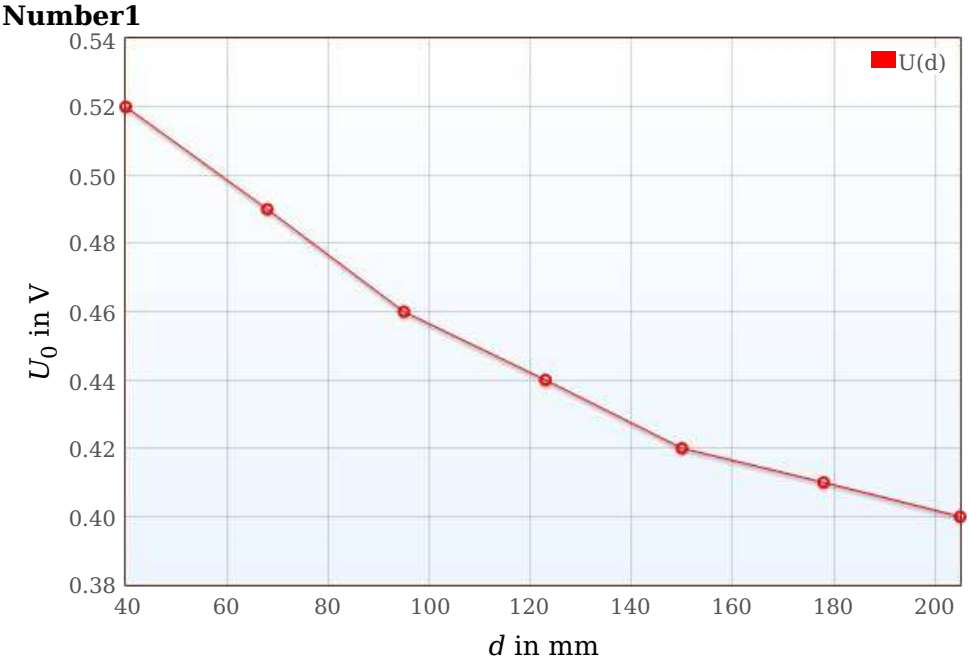
Position	I_K in mA	d in mm
1	1 ±0	1 ±0
2	1 ±0	1 ±0
3	1 ±0	1 ±0
4	1 ±0	1 ±0
5	1 ±0	1 ±0
6	1 ±0	1 ±0
7	1 ±0	1 ±0



Result - Table 2

Record your measured values for the voltage.

Position	U_0 in V	d in mm
1	0,52 1	40 1
2	0,49 1	68 1
3	0,46 1	95 1
4	0,44 1	123 1
5	0,42 1	150 1
6	0,41 1	178 1
7	0,40 1	205 1



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Evaluation - Question 1

How do I_K and U_0 change with the distance, a ?

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Evaluation - Question 2

Explain the relation between the angle of illumination and I_K which was observed.

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Robert-Bosch-Breite 10
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info@phywe.de
www.phywe.com