The characteristic current-voltage curves of a solar cell (Item No.: P1382700)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 16-19
Topic: Energy
Subtopic: Solar energy (solar heat, photovoltaics)
Experiment: The characteristic current-voltage curves of a solar cell

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Difficult	10 Minutes	20 Minutes	2 Students

Additional Requirements:

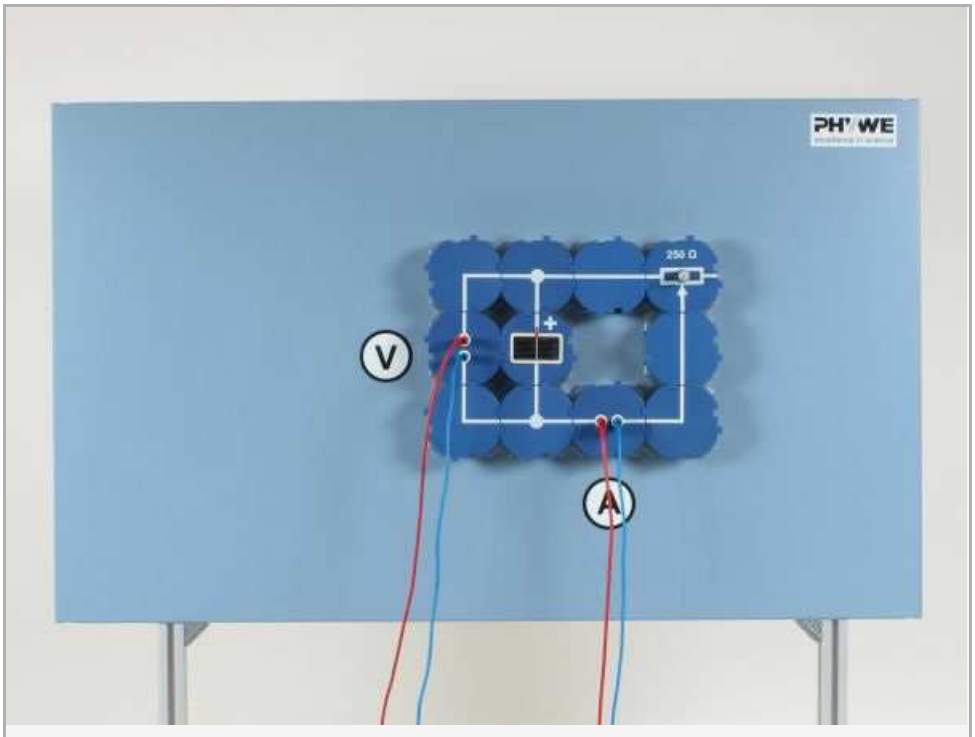
Experiment Variations:

Keywords:

Principle and equipment

Principle

A solar cell is to be subjected to various loads, to investigate how the current and the voltage behave with respect to each other, and to determine under which load the solar cell generates its maximum power.



Experimental set-up

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	2
2	Demo Physics board with stand	02150-00	1
3	Ceramic lamp socket E27	06751-01	1
4	Solar cell (2.5x5)cm,module DB	09470-00	1
5	Potentiometer 250 Ohm, module DB	09423-25	1
6	Clamp on holder	02164-00	1
7	Connector interrupted, module DB	09401-04	2
8	Electr.symbols f.demo-board,12pcs	02154-03	1
9	Connector, straight, module DB	09401-01	2
10	Connector, angled, module DB	09401-02	3
11	Connector, T-shaped, module DB	09401-03	2
12	Filament lamp,220V/120W,w.refl.	06759-93	1
13	Scale for demonstration board	02153-00	1
14	Bosshead, turnable	02048-04	1
15	Support rod, stainless steel, 500 mm	02032-00	1
16	Connecting cord, 32 A, 1000 mm, red	07363-01	2
17	Connecting cord, 32 A, 1000 mm, blue	07363-04	2

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

Set-up and procedure

- Set up the experiment as in Fig. 1; place the modules at the left edge of the board; fix the lamp at the top edge of the board, vertically above the solar cell, using the support material and clamp, and arrange the distance of the lamp from the solar cell so that the shortcircuit current is at the maximum of a measurement range.
- Select the 1 V- and 300 mA- measurement ranges.
- Adjust the potentiometer so that the maximum current is first registered.
- Note the measured values of voltage and current.
- Slightly change the potentiometer setting, so that there is only a small increase in the voltage; note the voltage and the current.
- Increase the resistance of the potentiometer in small steps and note the measured values.
- Increase the distance of the lamp from the solar cell and repeat the measurement procedure for two further distances.

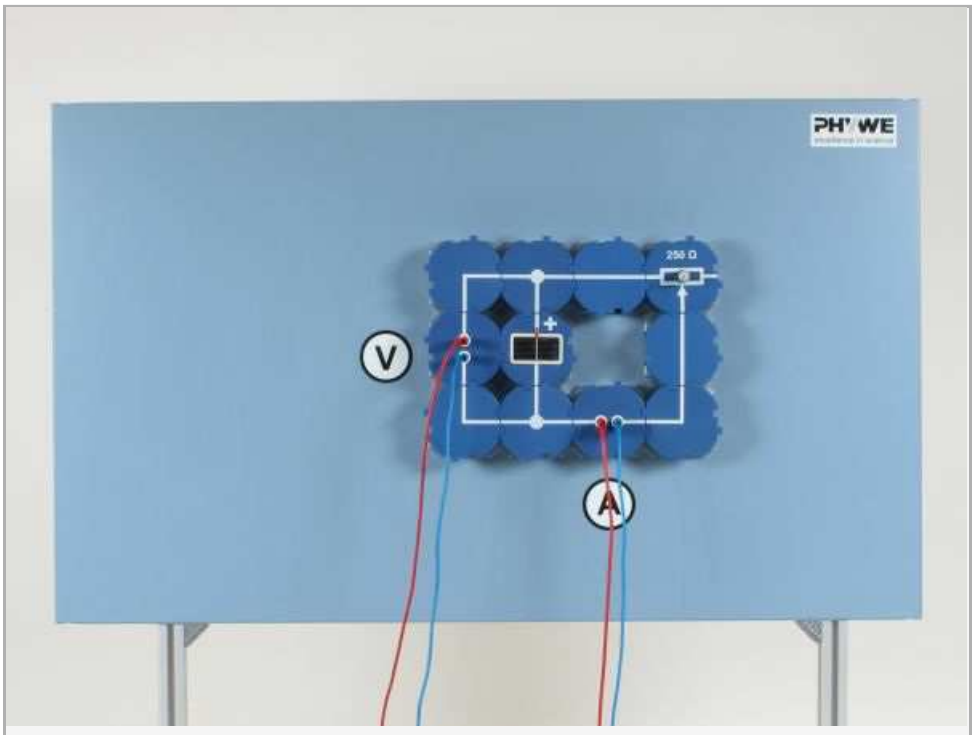


Fig. 1

Observation and evaluation

Observation

Table 1

Position	$\frac{U}{\mathrm{V}}$	$\frac{I}{\mathrm{mA}}$	$\frac{P}{\mathrm{mW}}$
1	0.24	285	68.4
	0.30	285	85.5
	0.42	262	110.0
	0.48	183	87.8
	0.49	138	67.6
	0.50	90	45.0
	0.51	60	30.6
	0.51	30	15.3
	0.51	10	5.1
	0.51	0	0.0
2	0.22	98	21.6
	0.24	98	32.5
	0.28	98	27.4
	0.30	98	29.4
	0.37	95	35.2
	0.43	86	37.0
	0.45	77	38.7
	0.47	67	31.5
	0.49	45	31.5
	0.50	33	22.1
	0.51	10	5.1
	0.51	2	1.0
3	0.20	29.0	5.8
	0.24	29.0	7.0
	0.27	28.5	7.7

	0.30	28.3	8.5
	0.34	27.5	9.4
	0.36	26.8	9.6
	0.38	26.0	9.9
	0.40	25.2	10.0
	0.42	23.5	9.9
	0.44	21.2	9.3
	0.46	15.2	7.0
	0.47	13.3	6..3
	0.48	9.2	4.4
	0.49	5.0	2.5
	0.50	2.0	1.0

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Evaluation

The curves shown graphically in Fig. 2, and which result from plotting measured values, are the characteristic current- voltage curves. It can be seen that with a low load, the solar cell generates nearly the same idle voltage of approx. 0.5 V for all illuminating intensities, and that with increasing load and high illuminating intensity (position 1), the voltage drop is first very small and then increasingly large, whereas with lower illuminating intensity (position 3) the voltage drop is already given at a low current.

Column 3 of Table 1 shows the power $P = U \cdot I$ generated by the solar cell and this is plotted in Fig. 3 as a function of the voltage. It can be recognized that the power reaches a maximum, and this lies for all illuminating intensities at a voltage of from 0.42 V to 0.45 V.These voltage values are to be found in the characteristic voltage-current curves in Fig. 2 at the marked positions, at which the curve passes from the steep to the flat region.

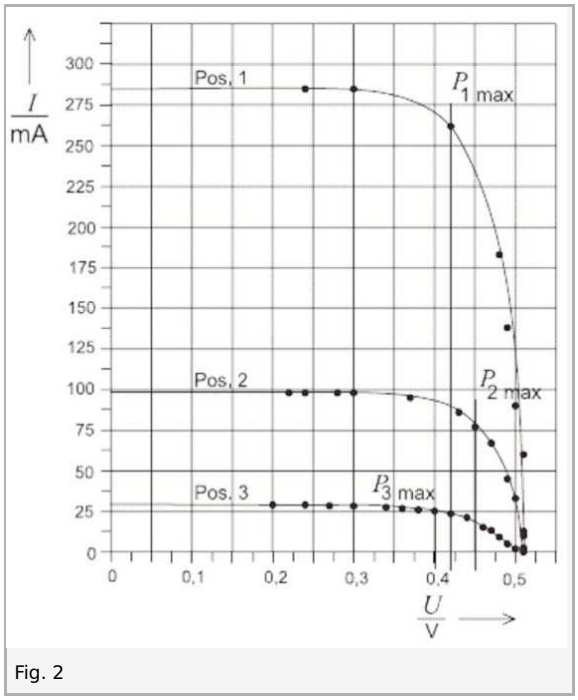

Fig. 2

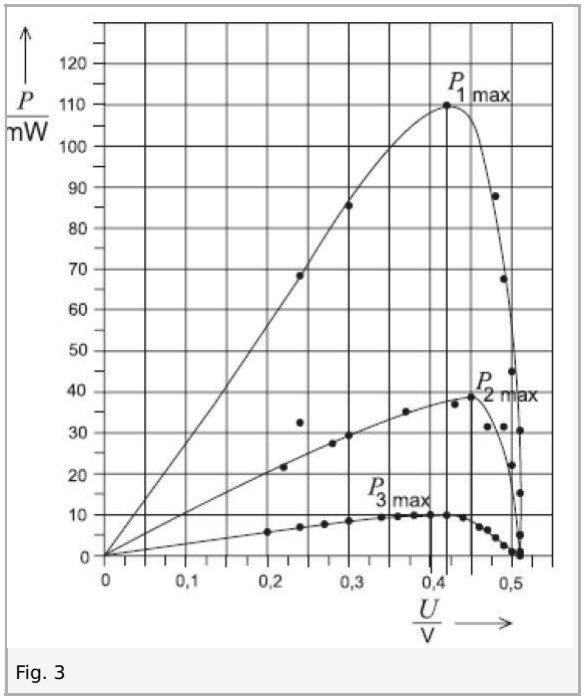

Fig. 3