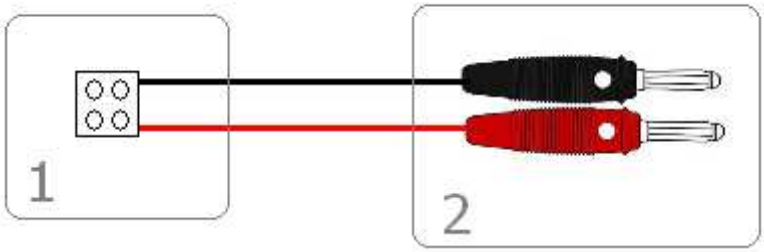
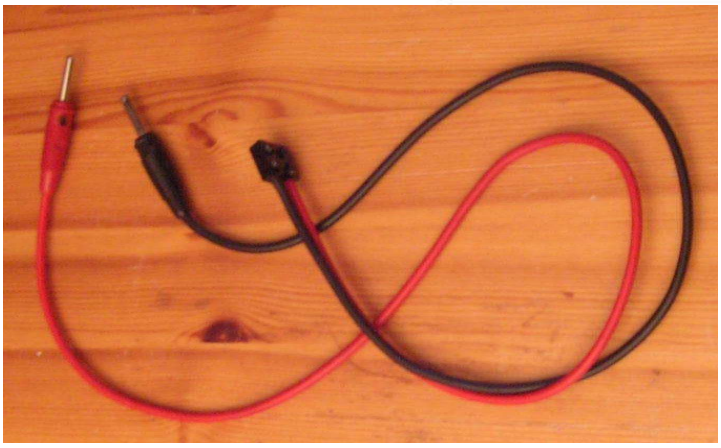
LEGO solar panel and capacitor

Because we will have a race with LEGO vehicles powered by green energy in the month of May I'm doing some measurements of the solar panel and the capacitor.

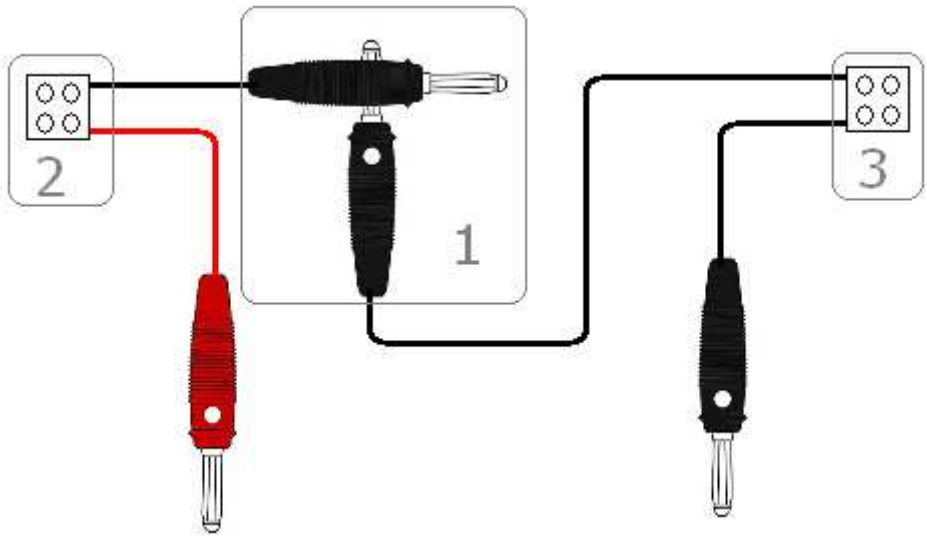
Measurement of voltage and electric current

Unfortunately the standard LEGO connections don't fit on a digital multimeter. Therefore I had to create my own wire. This wire uses a LEGO connector (1) and two standard 4 mm plugs (2).





Now we're able to measure voltage by simply putting our LEGO connector on any other LEGO connector. However if we want to measure electric current we'll need two of our self-made wires and and we''l have to connect (1) them as seen in the picture below:



Now we measure electric current in the circuit between the red and black plugs. We can connect the voltage source (a solar panel) to one connection (2) and the voltage consumer to the other (3) connection.

The capacitor

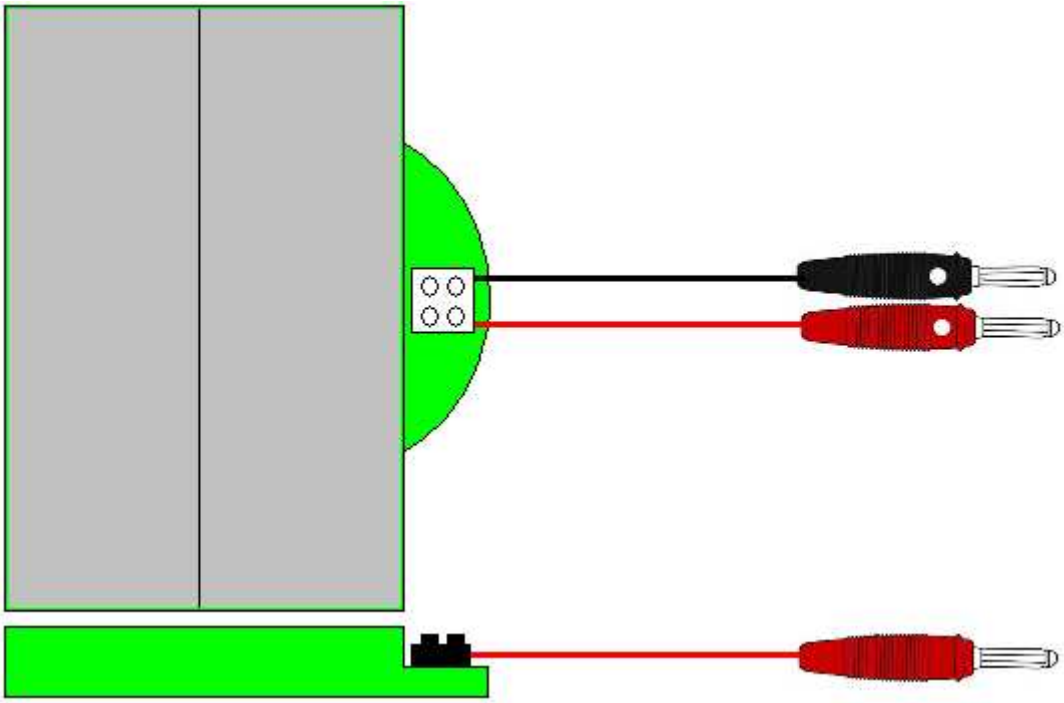
The capacitor has a capacity of 1 Farad and is protected against an excessive voltage of 18 Volts. Completely charged up to 2,5 Volt it will contain 3,125 Joules. The LEGO brick also contains a LED which will start blinking when the capacitor is fully charged.

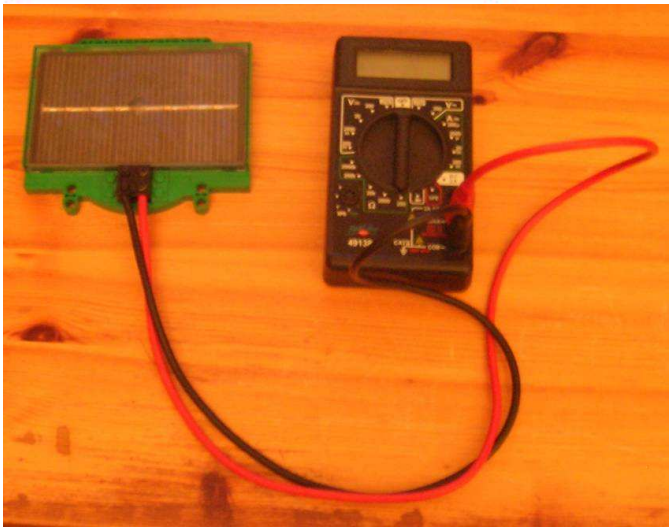
The solar panel

The solar panel consists of seven solar cells and one diode. The solar cells are connected in series. The solar panel will have a maximum voltage of 7 x 0,4 V. In full sunlight the solar panel will produce 100 mA indoors and 200 mA outdoors. Using 60 W lamp at a distance of 25 cm the solar panel will produce 2,5 V and 8mA. However if we decrease this distance to 8 cm it will produce 2,5 V and 40 mA.

Measurement 1: measuring the voltage of the solar panel

Circuit diagram





Measurement results

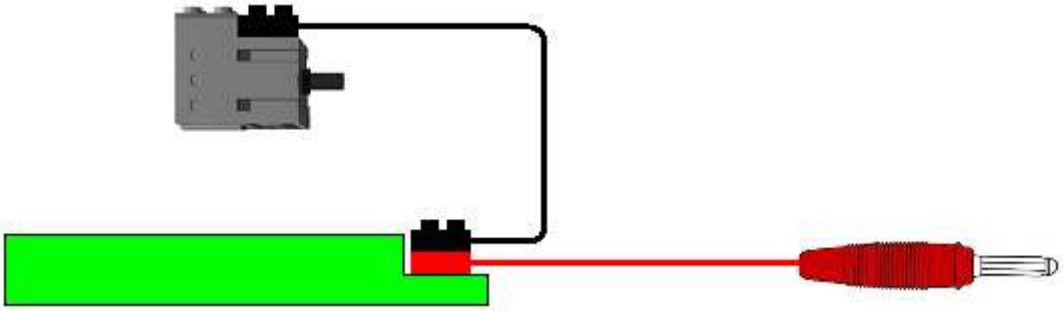
Measurement	Voltage
First	4,79 V
Second	4,84 V
Third	4,80 V
Fourth	4,85 V
Average	4,82 V

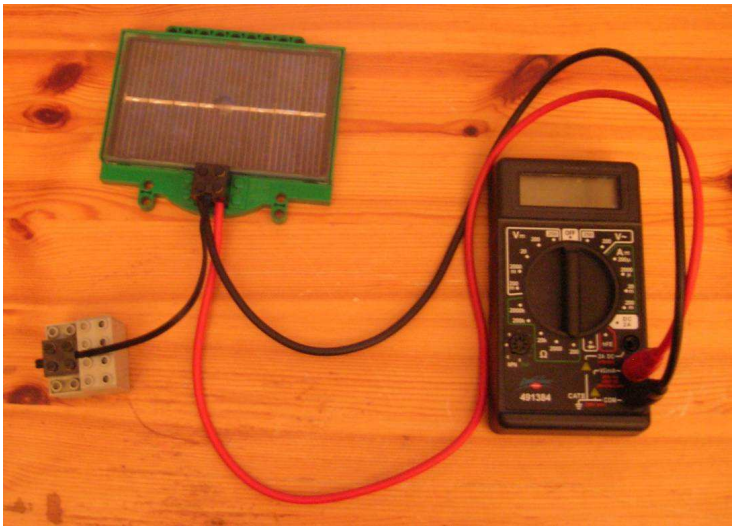
Summary

In full sunlight the solar panel will produce 4,82 Volts.

Measurement 2: measuring the voltage of the solar panel when connected to the motor

Circuit diagram

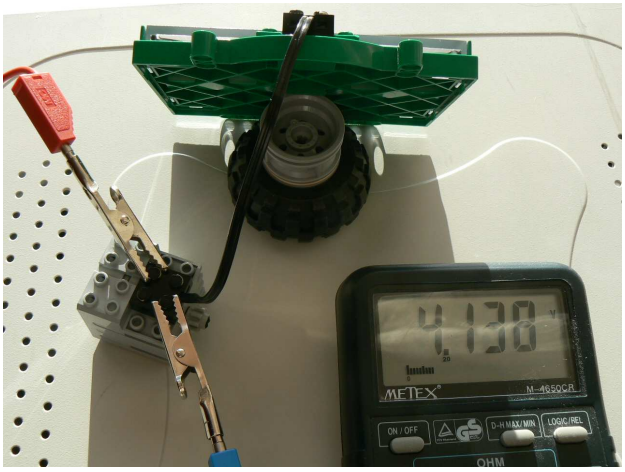




Measurement results

Measurement	Voltage
First	4,43 V
Second	4,41 V
Third	4,47 V
Fourth	4,39 V
Average	4,43 V

Our Hungarian colleagues also measured a voltage upwards of 4 volts.



Summary

Likely we have a newer version of the LEGO solar panel than has been described in the LEGO/DACTA sheets. This information may be outdated.

Measurement 3: measuring the voltage of the solar panel connected to a motor which has to move itself forward as seen in the picture below

Circuit diagram

The circuit diagram is identical to measurement 2.

Measurement results

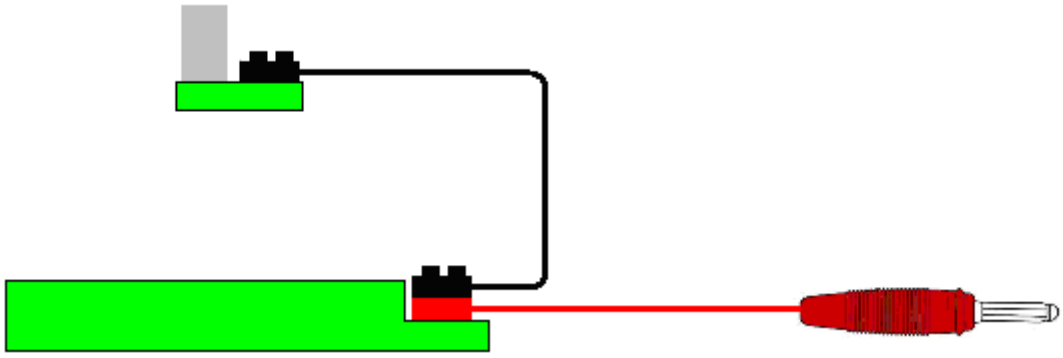
Measurement	Inside	Outside
First	3,57 V	3,64 V
Second	3,48 V	3.71 V
Third	3,55 V	3,68 V
Fourth	3,62 V	3,80 V
Average	3,56 V	3,71 V

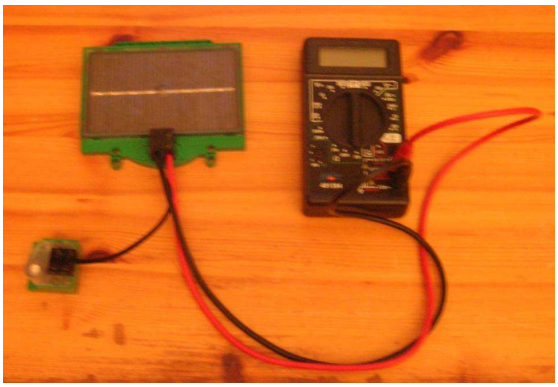
Summary

We notice that the solar panel will produce a higher voltage outdoors than indoors, which is exactly what we had in mind.

Measurement 4: charging the capacitor with the solar panel

Circuit diagram



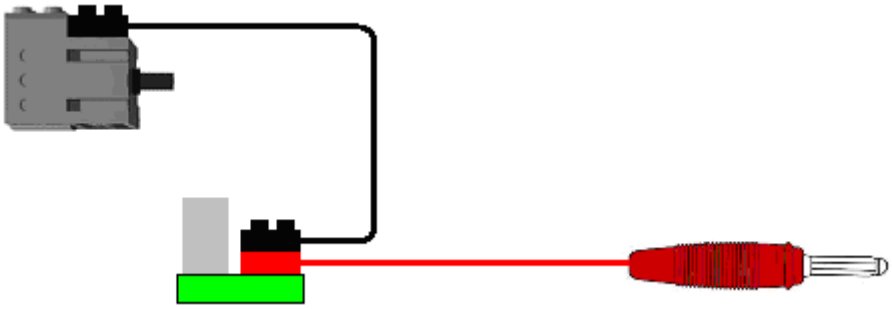


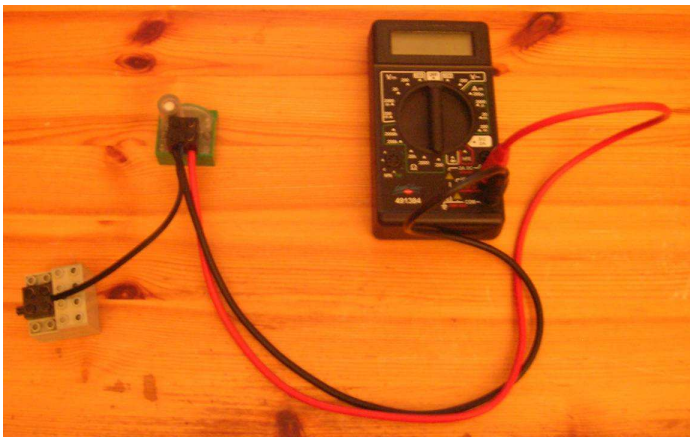
Summary

When we use a lamp (50 W) at a distance of 50 cm from the solar panel it takes about 5 minutes and 20 seconds to charge the capacitor up to the complete 2,5 Volts

Measurement 5: using the motor to uncharge the capacitor

Circuit diagram





Summary

It will take the capacitor, charged up to 2,5 Volts, about 18 minutes and 45 seconds to completely uncharge. We notice that the motors keep running until the voltage drops below 0,17 Volts. According to LEGO Dacta this should already occur at 1 volt.