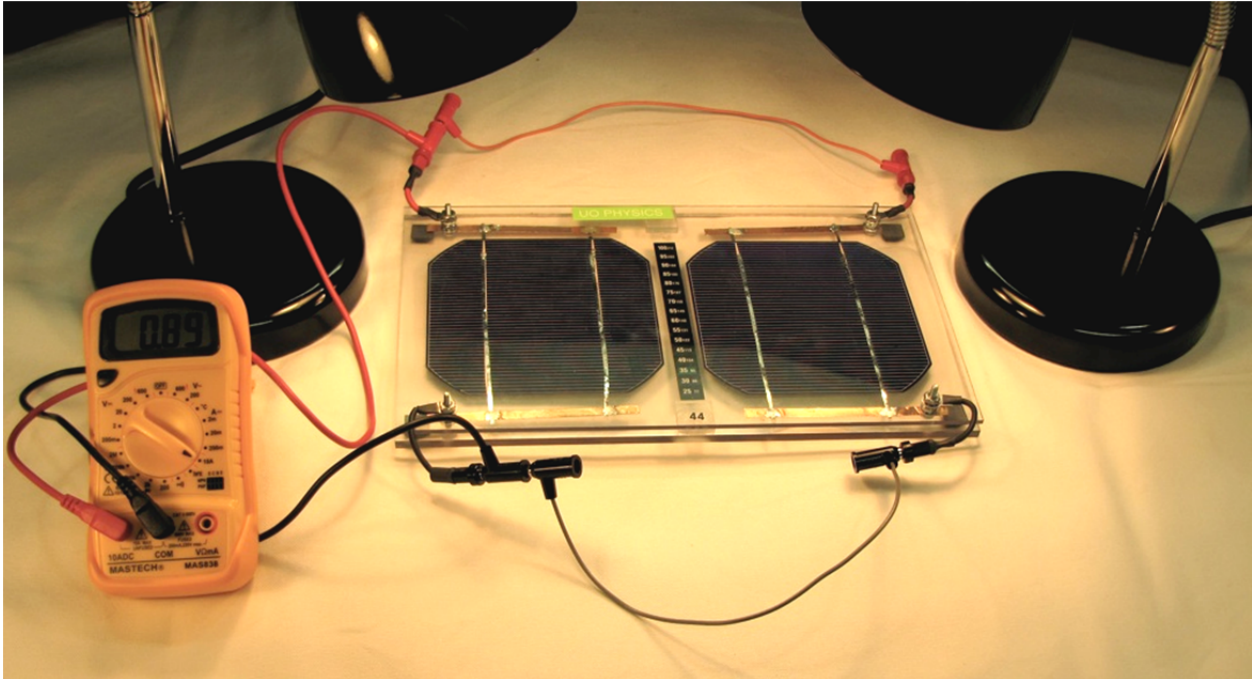


PV Activity 1: Series and Parallel PV Cell Connections©

- To teach how to measure the current and voltage output of photovoltaic cells.
- To investigate the difference in behavior of solar cells when they are connected in series or in parallel.
- To help answer the question of how solar cells behave like batteries.



Current meter measuring short circuit current for two cells connected in parallel.
(For lab measurements, better results are obtained when the lamps are closer to the cells.)

MATERIALS

The following materials are required for Lab Activity 2

- PV cell module
- Electrical leads
- DC ammeter
- DC voltmeter
- 2 Lamps or access to direct sunlight
- Multimeter instruction sheet

Overview: The experiments are separated into three parts. The first section measures the direct current and voltage from one solar cell. The second section measures the voltage and current of two solar cells in parallel. The third section measures the current and voltage of the solar cells when they are connected in series. The questions at the end ask for a comparison of solar cell reading when they are connected in parallel and in series.

Part I: One Cell – Measuring Short Circuit Current, Open Circuit Voltage

First: a reminder on how to use a **Multimeter** as an Amp meter (to measure *current*) or a Voltmeter (to measure *potential difference*). The multimeter can either be an Amp meter or

Volt meter Amp meter



Volts depending on the position of the dial and the placement of the connecting cables.

The current, measured in amperes (A), is how many electrical charges come from the cell each second. The voltage, measured in volts (V), is how much electrical potential each electrical charge contains and can be thought of as how much electrical pressure exists to push charges through the circuit.

Start of the first experiment: Measuring short circuit current: Connect one Solar Cell of the PV Module as shown in Fig. 2.1. The red connector is the + output of the cell and the black connector is the – output of the cell. Best results are obtained by **placing the desk lamp close** to the PV cell.

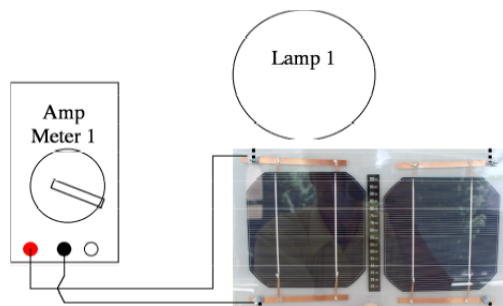


Fig. 2.1: Measuring short circuit current

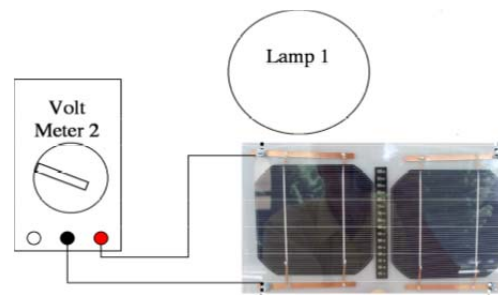


Fig. 2.2: Measuring open circuit voltage

- 1. Measure and record** the distance between cell and lamp on the page provided. **For consistent results this distance should be the same for all measurements in this experiment!!!**
2. Connect the red connector on the cell to the 10ADC input on the meter. Connect the black connector of the cell to the COM input of the meter input of the meter. Set the meter dial to the 10A setting. **Measure and record** the short circuit current (If the ammeter shows no current, check the wire connections.)
3. Set the meter dial to the 2 VDC setting, that is the “2” setting on the left side of the dial, and set the cables as shown in Fig. 2.2. With the distance the same, **measure and record** the open circuit voltage in the table provided on the last page. (Open Circuit means that the circuit is incomplete (open) and therefore no current can flow.)

Part II: Two Cells Connected in Parallel - Measuring Short Circuit Current and Open Circuit Voltage

Connect the second cell in parallel to the first cell by connecting the red and black connectors on the PV module together with jumper wires as shown in Fig. 2.3 and the photograph on the coversheet.

4. Illuminate the two cells with desk lamps and **record** the **Short Circuit Current** produced by the **2 Cells in Parallel** (both lamps being the **same distance** from the cells as in **Part I**).

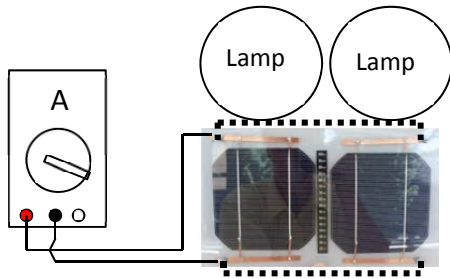


Fig. 2.3: Measuring short circuit current for two cells in parallel.

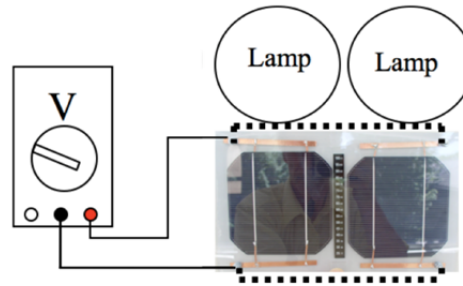


Fig. 2.4: Measuring open circuit voltage for two cells in parallel.

5. To measure **Open Circuit Voltage** produced by **2 Cells in Parallel**, replace the CURRENT meter with the VOLTMETER. Set the dial for 2 VDC and switch the red cable (see Fig. 2.4). **Measure** and **record** the voltage from the two cells connected in parallel.

Part III: Cells Connected in Series:

To connect the cells in series you need to connect the negative (black) terminal of the first cell to the positive (red) terminal of the second cell with a jumper wire (See Figures 2.5 and 2.6). The output from the module is then taken from the + red terminal of cell 1 and the - black terminal of cell 2.

6. **Measure** and **record** the short circuit current of the two cells in series. (Lamps the same distance as before.)

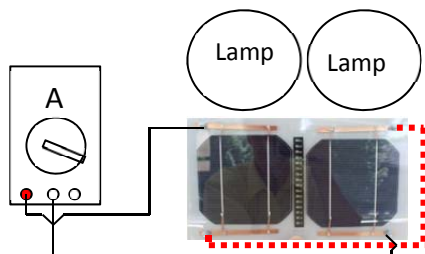


Fig. 2.5: Measuring short circuit current for two cells in series.

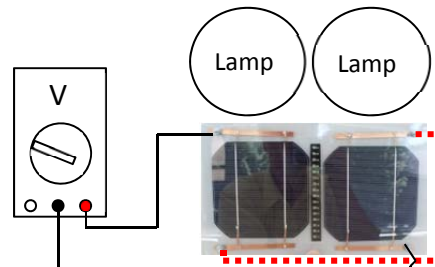


Fig. 2.6 Measuring open circuit voltage for two cells in series.

7. Leave the cells connected as in step 6. Reconnect the Volt meter to **measure** and **record** the open circuit voltage of the two cells in Series (See Fig. 2.6).

Name: _____

Kit # _____

Per. _____

DATA to record:

Distance from Lamp to cells: _____ (*Keep this constant*)

I. One Cell

Current: _____

Voltage: _____

II. Two Cells in Parallel

Current: _____

Voltage: _____

III. Two Cells in Series

Current: _____

Voltage: _____

QUESTIONS:

Current:

1. Compare the current from Parts II and III with the current measured in Part I. How much did the current change in each case?

2. How do you connect cells to obtain a higher current output?

Voltage:

3. Compare the voltage from Parts II and III with the voltage measured in Part I. How much did the voltage change in each case?

4. How do you connect cells to obtain a higher voltage output?

DISCUSSION:

Solar cells behave much like batteries powered by sunlight instead of chemical reactions. How does this experiment demonstrate that solar cells act like batteries?