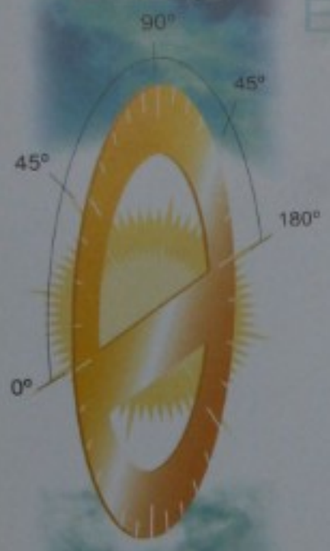
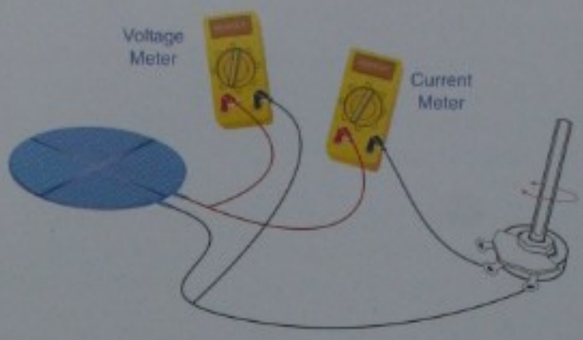


Experiment 02

The Current Voltage Relation or
The IV Curve of a Solar Module



Objective

At short circuit, the solar module produces electric current but no voltage. At open circuit, the solar module produces voltage but no current. Electric power is defined as the product of the current and the voltage; hence, in both the short circuit and open circuit configurations the solar module produces zero power. Somewhere in between these two operating points is the Maximum Power Point of the solar module where the maximum power possible is being generated. The student is to find the values of current and voltage such that their product, and therefore the power generated by the module, is at its maximum value.

Value

For a given illumination and temperature a solar module has one operating point of current and voltage where it will deliver the maximum possible power. A solar module that is too large for the needed power will be more expensive than necessary. A solar module that is too little will not be able to supply the needed power. The graphical representation of power (the product of current and voltage) in this experiment shows a point where the power is at its maximum. This also, is where the slope of the power curve is zero. This is a fundamental method used when there is a need to maximise or minimise the value of an effect.

Notes

By taking current and voltage measurements of a solar module while supplying power to a variable resistor, the student determines the current-voltage relation or "IV curve" of a solar module. This relation is graphed using a spreadsheet. The current and voltage of each data set are multiplied together to yield the corresponding power at that operating point. The power is then plotted as a function of current.

The maximum value of the power curve is at the maximum power point of the solar module. The student should determine the current, the voltage, and the power for the maximum power for the solar module.

Solar Module, Resitor and Meters ready for Current-Voltage Measurements.

Equipment

One 4-cell 2-volt solar module, two multimeters with alligator clips, and one 5-ohm 3-watt wire wound variable resistor.

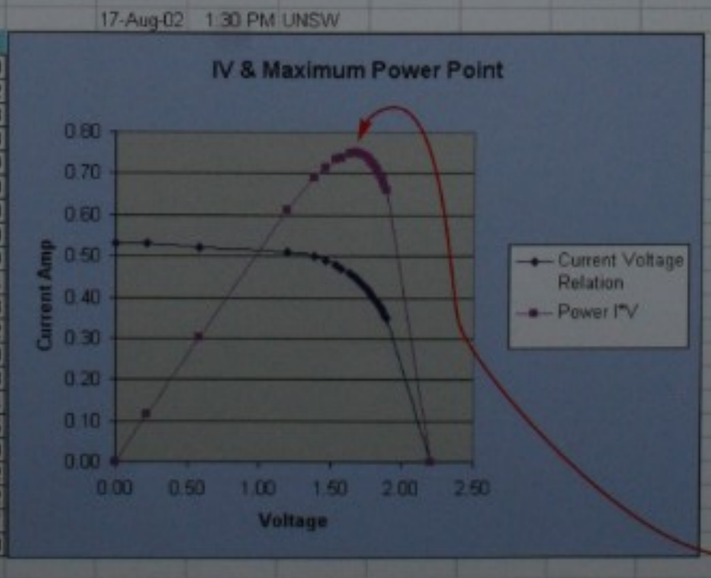
Method

The solar module is placed in full sunshine facing the sun. Students set up the two meters, one to measure current from the solar module and one to measure voltage across the solar module. A 5-ohm wire wound variable resistor is used as a variable load.

The student starts with the resistor shaft fully anticlockwise and then records the current and voltage. The shaft is turned clockwise until a 10 milliamp change occurs. The new voltage and current readings are recorded. The student continues adjusting and recording in 10 milliamp increments until the resistor shaft has been turned fully clockwise. Two additional data points should be added: the short circuit current (when voltage = 0) and the open circuit voltage (when current = 0). This is done by removing the resistor and directly measuring the short circuit current with the ammeter then removing the ammeter and directly measuring the module voltage.

The data is placed in a spreadsheet (it is easiest with current first then voltage in two columns) and graphed (current along the y axis, voltage on the x). This shows the current-voltage relation of the solar module. The current and voltage of each data set is then multiplied together giving a value for power and placed in a third column. The data sets are then plotted giving two curves; the original IV curve and a new power curve. The power curve will have a maximum value at some point. The student should write down the three values: current, voltage and power where this maximum occurs.

Voltage	Current	Power
2.20	0.00	0.000
1.89	0.35	0.662
1.87	0.36	0.673
1.86	0.37	0.688
1.84	0.38	0.699
1.82	0.39	0.710
1.80	0.40	0.720
1.78	0.41	0.730
1.76	0.42	0.739
1.73	0.43	0.744
1.70	0.44	0.748
1.67	0.45	0.752
1.63	0.46	0.750
1.57	0.47	0.738
1.53	0.48	0.734
1.46	0.49	0.715
1.38	0.50	0.690
1.20	0.51	0.612
0.58	0.52	0.302
0.22	0.53	0.117
0.00	0.53	0.000



Sample data with a spreadsheet scatter plot showing the current-voltage (IV) relation and the derived power. Note: maximum power point.