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Investigation Factors in Photovoltaic System Design

A. Zatirostami

Department of Science and Engineering, Behshahr branch, Islamic Azad University, Behshahr, IRAN

Abstract: In order to design photovoltaic systems, consciousness and behavior characteristics of solar cells are required and are important. As intensity of solar radiation increases, the amount of electrical power output of the cell also increases. With increasing temperature, the cell power output decreases. These are the major limitations of solar cells. Also, according to the shadow effect in reducing the production of photovoltaic cells, it is necessary to make possible the shadows on the panel by artificial and natural agents to prevent them. Even if a cell is placed in the shade, the total output module, and influences are greatly reduced. So, the phenomenon of photovoltaic systems should be designed as a shadow of the important parameters to be considered in the design. The easiest and cheapest method is to use photovoltaic systems are designed in the day and these systems usually include modules that are not storage device directly with solar radiation, to produce electricity.

Key words: photovoltaic Cells, Electricity, Radiation, Solar, Power

1. Photovoltaic Cells Electrically Profiled:

In a PN junction diode a link occurs if the voltage v $_d$ is applied to a double diode, the current I $_d$ from the p to the n-layer will be observed and reduced low voltage and V is by about a tenth. In reverse, the current I $_0$ is approximately equal to zero (10^{-12} A / cm^{2}).

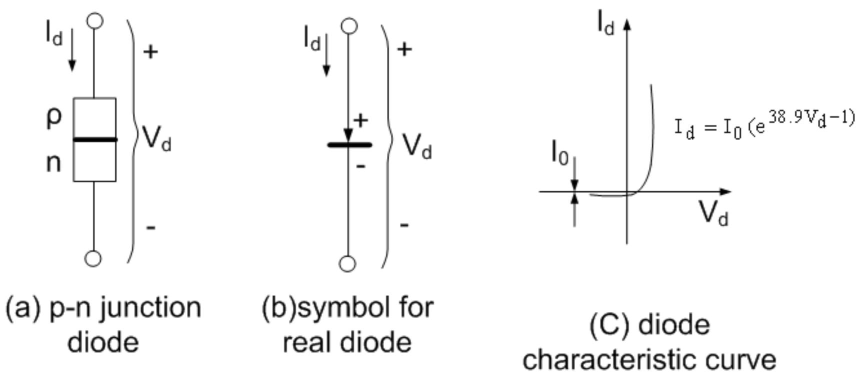

Fig. 1: Schematic and flow performance curve - voltage pn diode.

$$I_d = I_0 (e^{qVd/kT} - 1) \tag{1}$$

Where the external current I, I $_0$ saturated flow in reverse, q electrons so much time, V $_d$ voltage applied to the double diode, k Boltzmann constant and T is absolute temperature. In large voltages (reverse bias) the exponential term is negligible compared with an amount of approximately I (-I $_0$).

Now, if the above constant values in equation (1) alternative, we can simplify the above equation to:

$$\frac{qV_d}{kT} = \frac{1.602\times10^{-19}}{1.381\times10^{-23}}.11.600\frac{V_d}{T(K)}$$

Now if the temperature 25 degrees Celsius standard links in the above equation we use equation (1) is obtained as follows:

Corresponding Author: A. Zatirostami, Department of Science and Engineering, Behshahr branch, Islamic Azad University, Behshahr, IRAN
E-mail: Zati@iausari.ac.ir Ahmad.Zati@iausari.ac.ir

$$I_d = I_0(e^{38.9V_d} - I) \quad (at 25^{\cdot} C) \tag{2}$$

When the connection is not established during photovoltaic cell is zero and the open circuit voltage can be achieved:

$$V_{oc} = \frac{kT}{q} in \left(\frac{1sc}{1_0} + 1 \right) \tag{3}$$

Temperature 25 degrees Celsius:

$$I = I_{sc} - I_0(e^{38.9V} - 1) \tag{4}$$

$$V_{OC} = 0.0257\, In \left(\frac{I_{SC}}{I_0} + I \right) \tag{5}$$

Current I_{sc} in these relations in a direct relationship with the amount of solar energy is twisted and so can flow curve - different voltage for the photovoltaic cell under variable solar radiation received. Also, in some cases the performance profile photovoltaic cells in laboratories per unit area or square centimeters is provided.

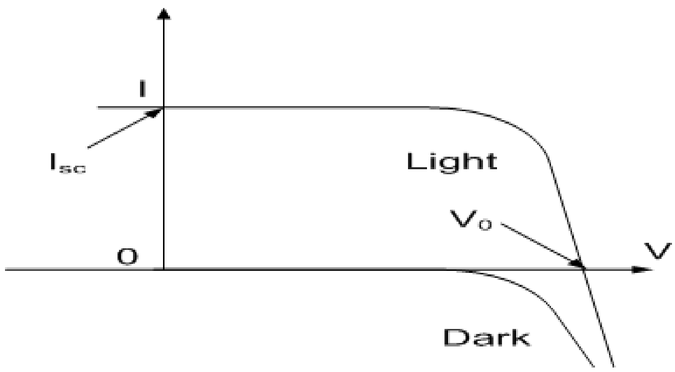

Fig. 2: Index Change in dark current-voltage lighting systems for photovoltaic.

As is clear from the curves, the dark curve is exactly the reverse diode curve and light curves, the sum of the dark curve is the short circuit current.

2. Photovoltaic Cell Equivalent Circuit:

Equivalent circuit of a photovoltaic cell that includes a parallel resistance R_p is shown below. Ideal current source feeding current I_{sc} and shunt diode and the load is charged.

$$I = (I_{SC} - I_d) - \frac{V}{R_p} \tag{6}$$

Phrase in parentheses is the same amount of current that there was in a simple model. So what is being asked in this regard is that for every given voltage, causes the shunt flow through the amount of time reduced. For each cell losses due to the parallel resistance should be less than 1% it is essential that:

$$R_p > \frac{100V_{OC}}{I_{SC}} \tag{7}$$

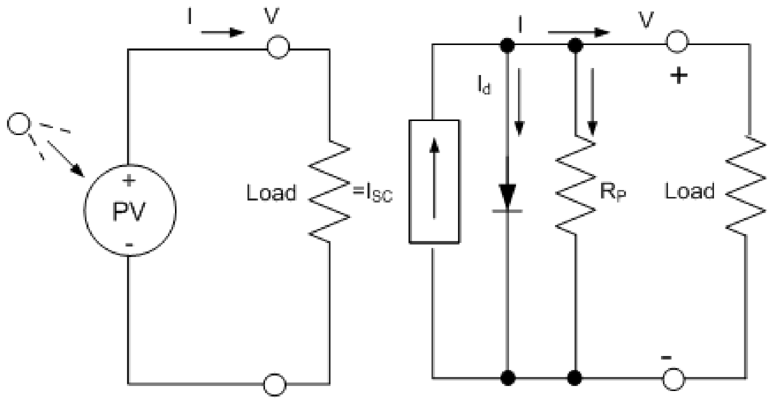

Fig. 3: Photovoltaic cell equivalent circuit with parallel resistance added.

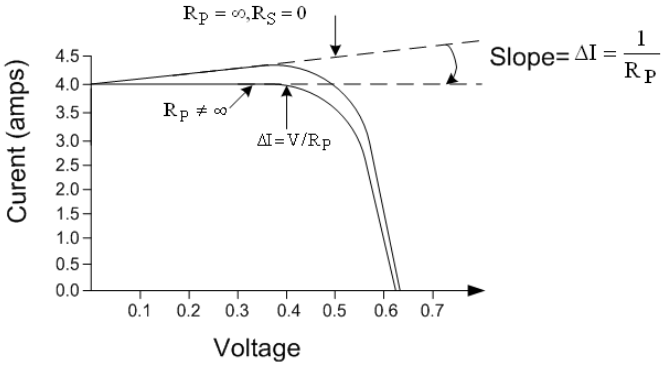

Fig. 4: Changes in Photovoltaic cell equivalent circuit by adding a parallel resistance.

For larger cells, flow around 7A I_{sc} V_{oc} and voltage can be approximately 0.6V, in which case the parallel resistance equal to or greater than is 9 Ω.

Exact equivalent circuit for a photovoltaic cell must be a strength as well as a series of parallel resistance which is added. Before developing such a model attention is paid better to considering a model that has only a series resistance R_s. This resistance can be various reasons such as resistance wires and connections between cells and their resistance in semiconductors exists.

$$I = I_{SC} - I_0 (e^{qV/kT} - 1) \tag{8}$$

And then discussed is the effect of series resistance which is:

$$V_d = V + I.R_S \tag{9}$$

The result is as follows:

$$I = I_{SC} - I_0 \left\{ \exp\left[\frac{q(V + I.R_S)}{kT} \right] - 1 \right\} \tag{10}$$

The relationship curves of the main stream - Photovoltaic cell voltage gives the voltage with the difference that each flow as $\Delta V = IR_s$ has shifted to the left.

Adding series resistance for each cell series resistance due to the difference must be less than 1% and it is essential that:

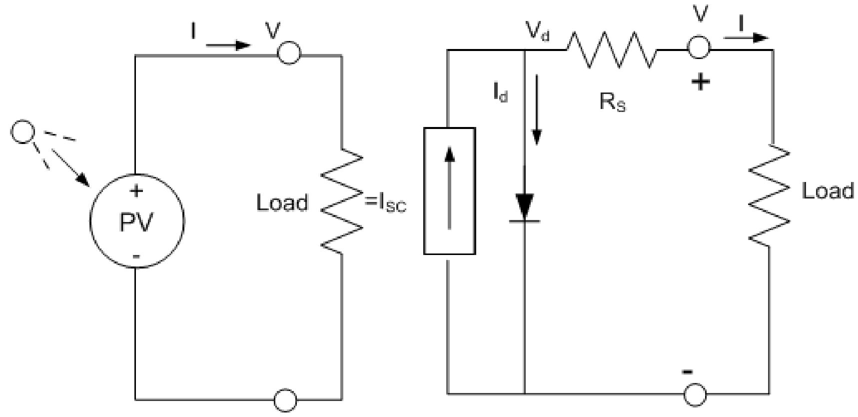

Fig. 5: Photovoltaic cell equivalent circuit by adding series resistance.

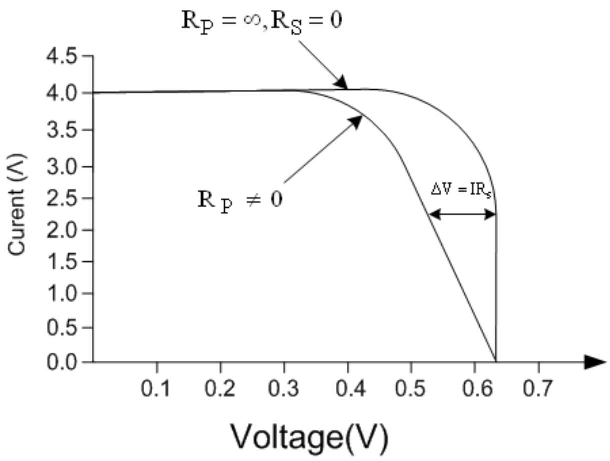

Fig. 6: Changes in equivalent circuit photovoltaic cells.

$$R_S < \frac{0.01\, V_{OC}}{I_{SC}} \tag{11}$$

And the amount of series resistance for large cell current equal to I $_{sc}$ V $_{oc}$ 7A and voltage equals 0.0009 Ω is less than 0.6v.

Finally, Photovoltaic cell equivalent circuit presented in Kyle both series and parallel resistance are considered, is essential. The relationship between voltage and current are discussed as follows:

$$I = I_{SC} - I_0 \left\{ \exp\left[\frac{q(V + I.R_S)}{kT} \right] - 1 \right\} - \left(\frac{q(V + I.R_S)}{Rp} \right) \tag{12}$$

Considering the standard temperature 25 degrees Celsius, the equation above is as follows:

$$I = I_{SC} - I_0 \left[e^{38.9q(V+I.R_S)} - 1 \right] - \frac{1}{Rp} q(V + I.R_S) \tag{13}$$

Using Figure 7, and R. Kirchhoff current law for use of the diode, the result is:

$$I_{SC} = I + I_d + I_P \tag{14}$$

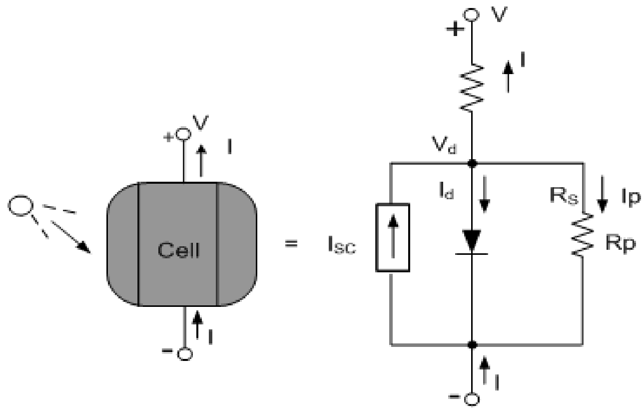

Fig. 7: Photovoltaic cell equivalent circuit including series and parallel resistance.

The standard temperature 25°C:

$$I = I_{SC} - I_0 (e^{38.9V_d} - 1) - \frac{V_d}{R_p} \tag{15}$$

Considering that a value for Vd, I flow easily from the above relationship is calculated.
But the cell voltage can be calculated from the following equation:

$$V = V_d - I\,R_S \tag{16}$$

Flow curve - equivalent circuit for a voltage R_s = 0.05 Ω and R_p = 1 Ω in the figure below is shown.

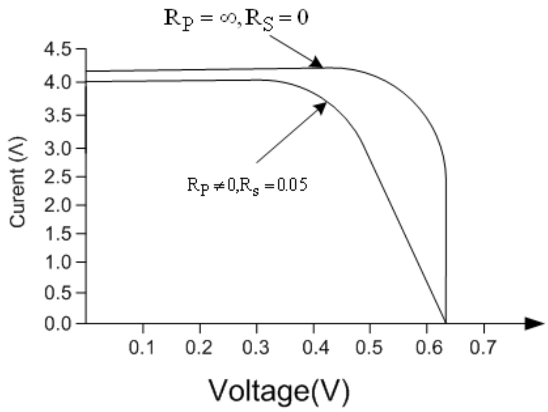

Fig. 8: Effect of series and parallel resistance on the flow curve - voltage.

Resistance in series and parallel equivalent circuit for photovoltaic cells is producing reduced voltage and current. Cells to increase performance, increase the amount of reduction in the amount of R_p and R_s are necessary.

Diode equivalent circuit model, a better description of the solar cells, is expressed in most cases. In this model, the secondary diode parallel to the first diode is connected. It should be noted that both the diode saturation currents are different.

Conclusion:

For photovoltaic systems for use at night or in cloudy situations, the systems equipped with storage batteries are used. The important thing about rechargeable batteries is that they last for longer periods, but the batteries should be fully discharged and then be fully charged again. Size and shape of the source should be

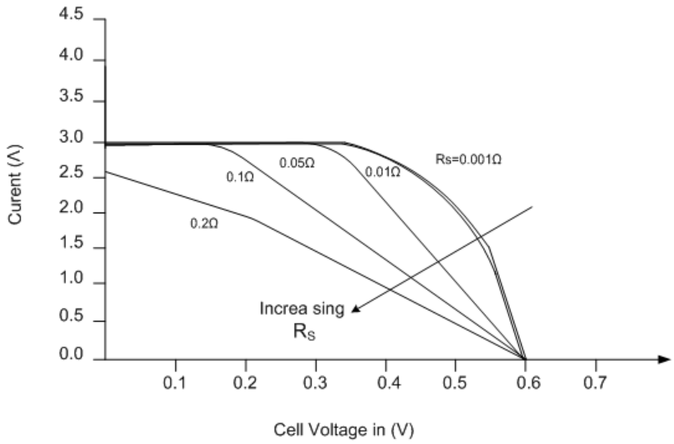

Fig. 9: Effect of series resistance on the IV curves.

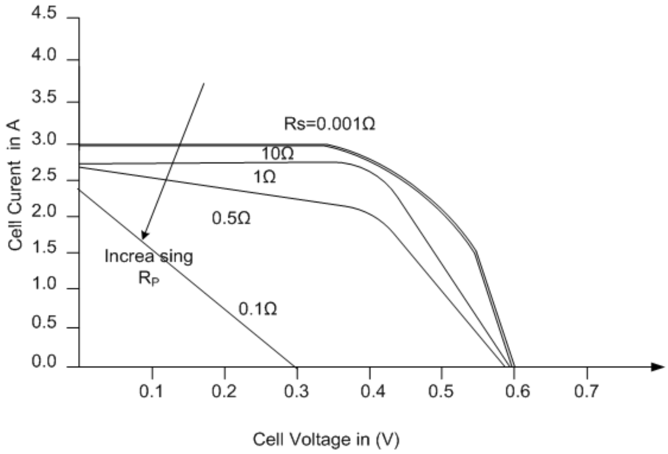

Fig. 10: Effect of shunt on the IV curves.

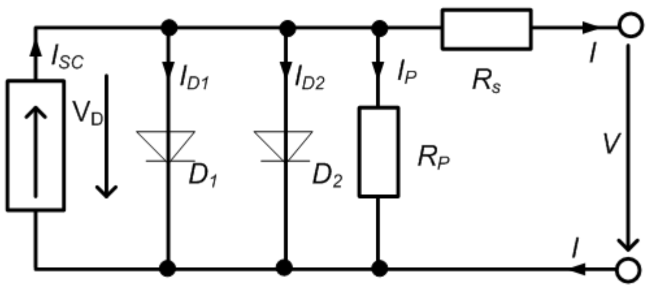

Fig. 11: Photovoltaic cell equivalent circuit of two diodes.

proportional to the battery system voltage performance, the amount used at night and weather location will be in the designe. In some systems a charge controller is designed to charge batteries or control excessive abnormal discharge them from the source module and disconnect the battery, prevent, and maintain this quality and durability and is effective.

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