International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 4, Issue 4, April – 2020, Pages: 59-61

Study of the Electrical Characteristics of a Solar Panel for Multi-Residential Apartments Using a Computerized Measuring Stand "Eph 2 Advancedphotovoltaics Trainer"

Mirzaev Uchkun, Abdullev Elnur

Faculty of Electro mechanics and Radio electronics, Jizzakh polytechnic institute, Jizzakh city, Uzbekistan
Uchqun8822@gmail.com

Abstract- *In this paper, these parameters are evaluated based on the results of a study of the voltage characteristic of a solar panel obtained in automatic mode using a computer and a digital measuring device "EPH 2 Advanced photovoltaics trainer". In order to determine the prospects of using a solar panel as the basis for creating a charger, you need to know a number of parameters: short-circuit current, no-load voltage, efficiency, etc.*

Keywords: solar cell, solar panel, solar battery, current source, charger, voltage characteristic, efficiency coefficient, irradiation meter.

Recently, there has been a significant increase in interest in developing chargers [1,2] based on alternative energy sources. The most popular choice of energy source for implementing charger designs is solar panels. The solar battery is assembled by a parallel connection of solar modules, each of which consists of sequentially connected solar cells (SC) and is implemented as an independent panel. The electro physical characteristics of a solar panel (SP) are the most important parameters, evaluating which you can make a reasonable choice about the prospects of using the panel to create a solar battery with the necessary value of the output electrical power.

This paper provides an example of the study of the main electro physical characteristics of a polysilicon-based solar panel with dimensions of 23cm x 35cm.

In the simplest case, the SC may consist of a single p-n junction located at a relatively small depth from the illuminated surface of the semiconductor. The main electro physical characteristic of the p-n junction is its voltage-current characteristic (VICh). Voltage-current characteristic of SC is a superposition of the dark current of the p-n junction and the current resulting from light generation and separation by the internal electric field of carriers, the so-called light current SC. As a result, the voltage-current characteristic of the illuminated p-n transition is shifted to the fourth quarter of the coordinate axes. It is known that a device with such a voltage-current characteristic can serve as a DC source [3-5]. With the appropriate selection of load resistance, the power in the load can reach 80% of the product of the short-circuit current $I_{sh.c}$ and the no-load voltage U_{nv}.

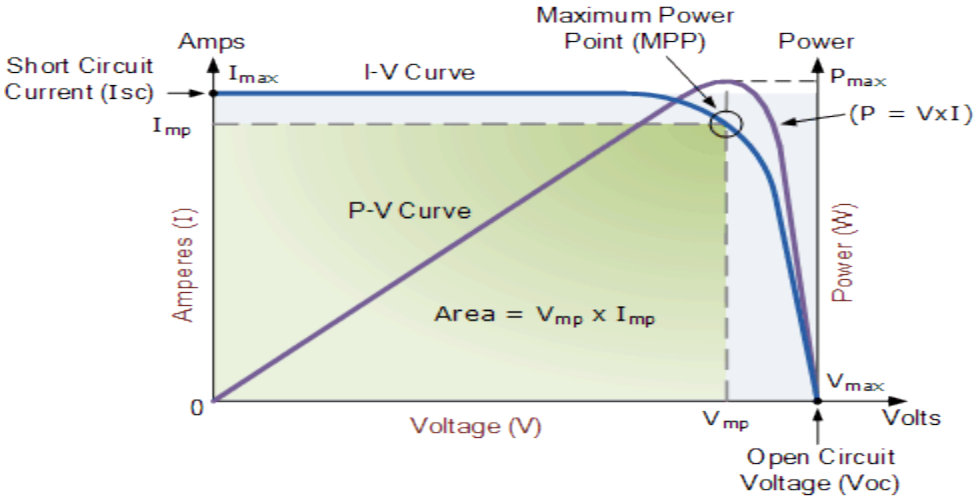

Fig 1. Solar Cell I-V Characteristic Curve

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According to the voltage-current characteristic schedule, first of all, it is necessary to determine the two most important parameters of the SC: short-circuit current and no-load voltage. Short-circuit current is the current flowing through the SC when the load resistance is zero. For an ideal SC, the $I_{sh.c}$ is equal to the light current, so the $I_{sh.c}$ can be considered the maximum current that can create the SC. The value of $I_{sh.c}$ depends largely on the diffusion length of charge carriers in a semiconductor [3] and the quality of passivation of the SC surface. For the panel under study, the $I_{sh.c}$ value was 2.0 A.

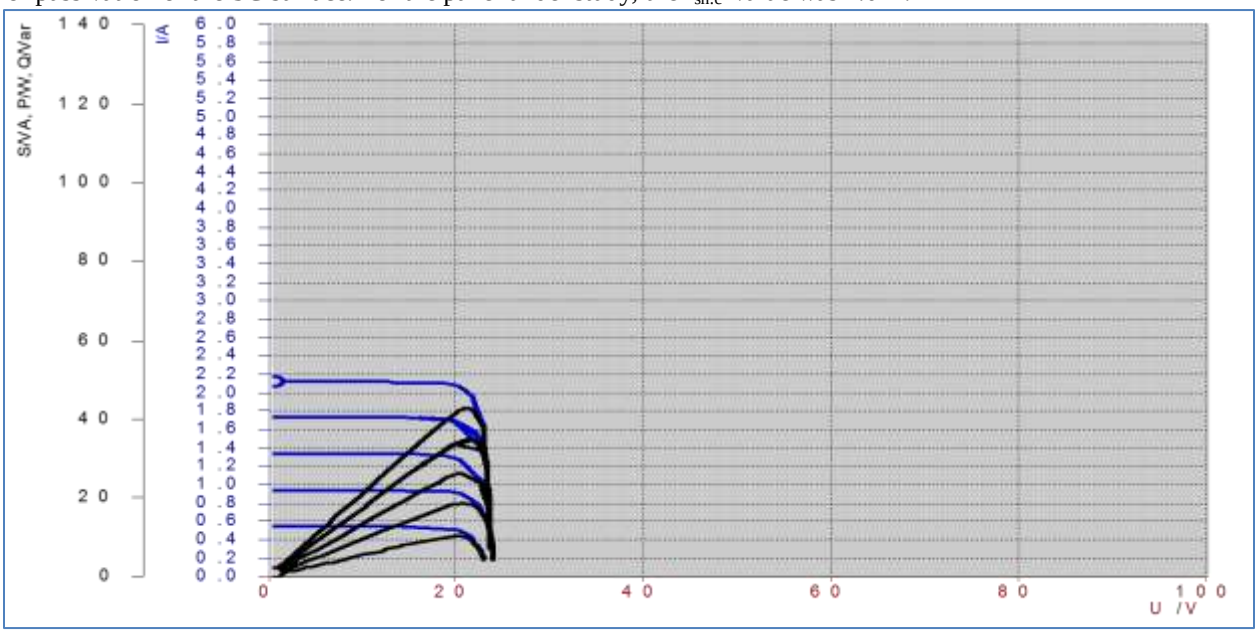

Fig. 2. VIC of the solar panel (1) and the power dependence in the external circuit on the voltage at its terminals (2)

The no-load voltage U_{nv} is the maximum voltage at the SC output that occurs at zero current through the SC. The no-load voltage corresponds to the forward displacement of the p-n junction, and depends on its saturation current and light current.

Short-circuit current and no-load voltage are the maximum current and voltage that can be obtained from the SC. However, the output power of the SC is zero. The dependence of the power in the external circuit on the voltage at the terminals of the solar panel under study is shown in Fig. 2., curve 2. It can be seen that with the optimal choice of the resistance of the external circuit R_{opt}, the power given by the panel to the external circuit will be the maximum P_{max}. The Value Of $R_{opt} = U_{opt} / I_{opt}$.

For the SC used as a DC source, the concept of the fill factor (FF) is introduced, which is defined as the ratio of the maximum power of the SC to the product of U_{nv} and $I_{sh.c}$. Figure 1 shows: rectangle A, built in the coordinates U_{nv} and $I_{sh.c}$, and rectangle B, built in the coordinates U_{opt} and I_{opt}. The FF is equal to the ratio of the areas of rectangles A and B and represents a measure of the quadraticity of the voltage-current characteristic of SC, determining the maximum area of a rectangle that can be inscribed in the VAC SE. In fact, the KZ is the coefficient of conversion of the electric power of the SC into useful thermal power.

The most common parameter for evaluating the efficiency of converting solar energy into electric power is the efficiency coefficient (efficiency). Efficiency is defined as the ratio of the maximum electrical power at the output of the SC to the power of the solar radiation flux normally incident on the surface of the SC. For the studied solar panel with an area of 700 cm^2, the efficiency value was equal to 12% for the incident radiation power of 46 W/m2. This value is typical for the polysilicon-based SC class [7]. Based on the results of voltage-current characteristic measurement at 100000 LX illumination, we will Make a table with the main electro physical parameters of the solar panel.

Table 1

№ п/п	**Name of the electrophysical parameter of the solar panel**	**Measured/calculated value of the electrophysical parameter of the solar panel**
1	$I_{sh.c}$	2 A
2	U_{nv}	24V
3	P_{max}	46 W
4	R_{opt}	1,0 kΩ
5	FF	70%
6	Efficiency	12%

The study of the SP electrophysical parameters using a computerized stand, including the digital radiation meter " EPH 2 Advanced photovoltaics trainer" and the program for processing the results of direct measurements of currents and voltages in LABSoft, is a convenient and highly informative automated method that differs favorably from a number of existing ones [8-10]. The research results allow us to make a reasonable conclusion about the quality of the solar panel and the feasibility of using it for the Assembly of a solar battery, followed by the use of a non-charging device, etc.

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