The Study Of The Performance Of Thin-Film Solar Panels Established In Afyonkarahisar

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***Abstract*— Electricity has an essential place in the life of humanity with the rapidly developing technology. It has been seen that the use of fossil fuels for electrical energy production harms the environment. People have turned to renewable energy sources that have the least damage to the environment in order to meet the needs of electricity. The systems that produce electricity from solar (photovoltaic systems) are the most preferred renewable energy sources. Because there is no the payment of fees to the raw energy sources and staff expenses are little during operation. Also the low maintenance costs due to the small parts are among the advantages. In this study, thin-film solar panel installation was conducted in Afyonkarahisar. Solar panels have been placed at an angle of approximately 45°. The solar panel production data (voltage and power) were instantly monitored from the PC and recorded to Access database at 10 second intervals by the help of micro-controller control board and C# software. Energy production of the solar panels is determined using the one-year data.**

Keywords—component; **Renewable energy, photovltaic system , thin film potovoltaic**

I. INTRODUCTION

Photovoltaics (PV) were first found in 1893 by Becquerel by observing that the voltage between electrodes immersed in electrolyte were depend on the light falling on the electrolyte [1]. Although the photovoltaic systems have so much history, the use of them has been a rapid growth in the last quarter century. The energy costs increased at a high rate as a result of big oil crisis occurred in the 1970s [2]. In addition, it has been found that energy production using fuel results in environmental disasters such as environmental pollution, seasonal changes and global warming. Human beings have turned its attention to renewable energy sources for these reasons [3].

The thin-film solar panels on the roof of Technology Faculty in Afyon Kocatepe University were installed with an angle of about 45°. Electricity production of thin film solar panel (volt-watt) examined instantaneously. The opportunity to display all the data on a computer screen was presented with the interface done by C # programs. All the data was recorded to Access database in the desired time interval with autosave. In this study, the time interval of 10 seconds is preferred. Data were recorded during the year. Daily energy production of solar panels has been determined using this data.

II. MATERIALS AND METHODS

In the carried out study, they were placed on the roof of Technology Faculty in Afyon Kocatepe University as inclined to receive the solar rays best. The panel was wall-mounted because there has been an insulation on the roof and the established system is seen in Figure 1. Thin-film panel was used in the system.

Figure 1. The appearance of thin film solar panels.

Thin film solar cells are much less material. Thin film solar panels placed on top consists of very thin semiconductor layer [4]. Semiconductor materials in thin film solar panels on many different materials and can be applied to large surfaces. PV modules and arrays using thin films it is easier to design and appropriate [5]. Properties of thin-film solar panel used in the system shown table 1.

Table 2.1. properties of thin film solar panels used in the system

The high voltage load	45,05 V
The high current load	1,11 A
The high open circuit voltage	61,8 V
Short circuit current	1,44 A
Operating temperature range	-40 - 85

A. Voltage Sensor

The PIC microcontroller is used to measure the voltage produced by thin-film solar panels and transfer to the computer. This microcontroller can measure the voltage between 0V and 5V structurally. Therefore, the voltage divider circuit shown in Figure 2, is used for reducing the voltage generated by the solar panels to the limits of the microcontroller can measure.

Two pieces of series resistance, 10KΩ and 470Ω, were connected to the ends of solar panels. The falling voltage on the 470Ω was applied to input end of the microcontroller.

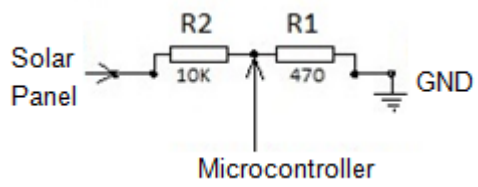

Figure 2. The voltage divider circuit

B. Current Sensor

LEM LA-55 P current sensor is used for measuring the current drawn from the solar panel. It can be measured up to 50 amps thanks to this current sensor. Conversion ratio is 1:2000. LEM LA 55-P current sensor is seen Figure 3.

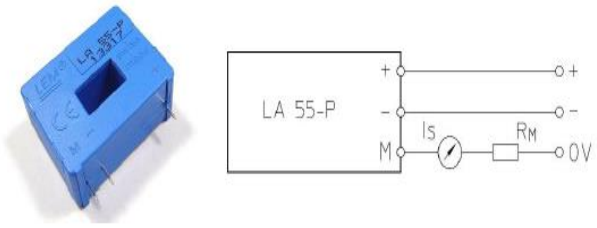

Figure 3. LA 55-P LEM current sensor

LA 55-P LEM current sensor is produced by the company is designed to measure 55 Amps. But the high current of the thin-film solar panel is 1.11 amperes we use in our system. To increase the sensitivity of the system by the output current sensor amplifier circuit sensitivity is increased. In figure 4 current sensor amplifier circuits are shown.

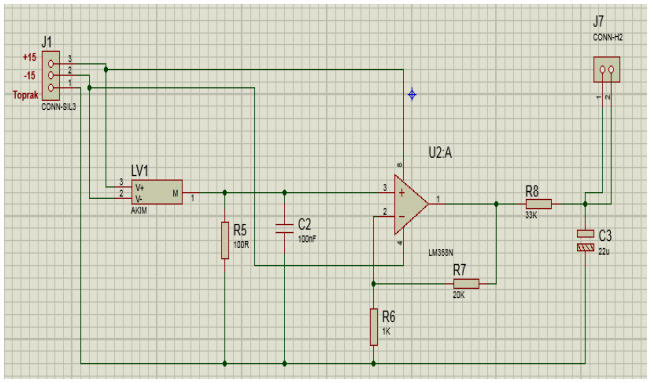

Figure 4. Flow sensor amplifier circuit.

C. Mikro-controller, USB ve Sensor Card

PIC18F4550 microcontroller is used to convert the analog data from voltage and current sensors to digital data and send these data to the computer. The designed and implemented micro-controller, USB and the sensor board are seen in Figure 5.

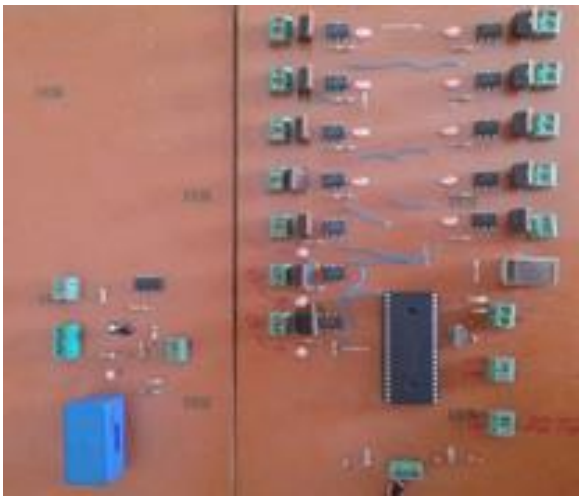

Figure 5. Microcontroller, USB and sensor card

D. COMPUTER INTERFACE

The interface prepared by C# program to display the digital data from the micro-controller on the computer screen is seen in Figure 6. The electrical data of solar panels and power measurements are displayed as instantaneously. The measured data can be recorded to the database manually or in set time intervals if requested. In this carried out application, the data obtained from the solar panel is recorded with intervals of 10 seconds.

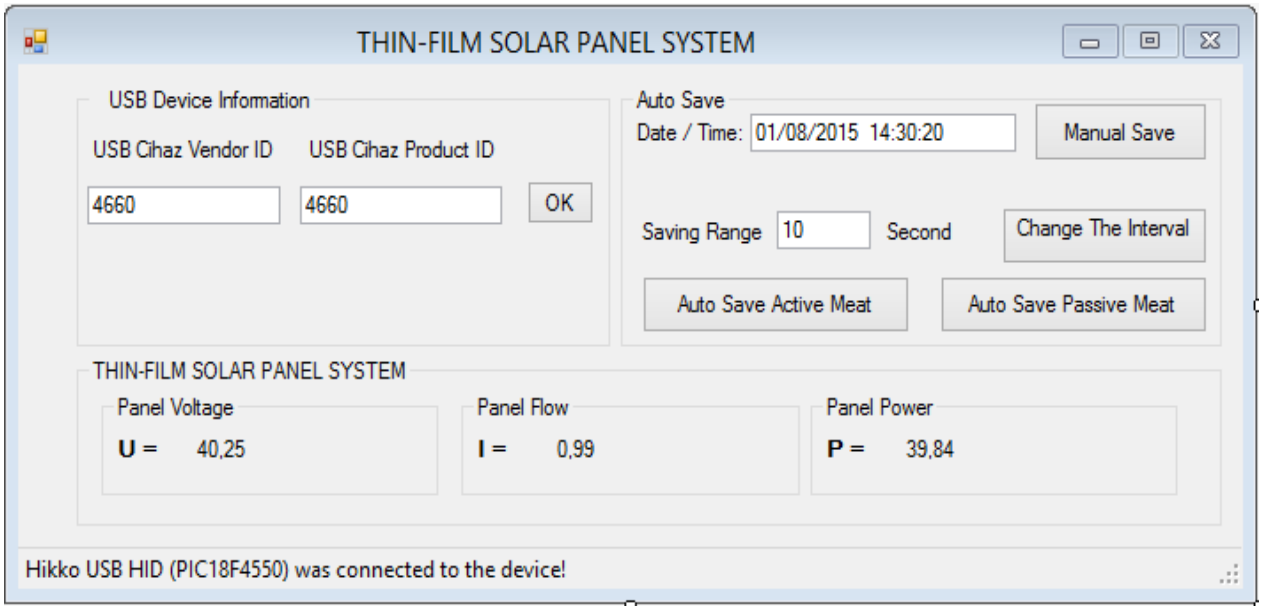

Figure 6. C.# prepared by the interface program

III. RESULT

Many factors influence the energy production of solar panels. The values of solar radiation, the angle of incidence of solar radiation, sunshine duration, temperature and atmospheric events are the most important factors. The energy production of the solar panel comes to its lowest level especially in cloudiness and snowfall or never occurs. The energy production of thin film solar panels was recorded 10 seconds intervals between the dates May 1, 2014 and June 30, 2015. daily total energy production of thin film solar panels are displayed in Figure 7 in waat/time.

Considering the total energy production on a daily basis; it is seen that the energy production is low particularly in the winter months and it rises with the onset of summer. The most important two factors are the values of solar radiation and the increase in sunshine duration.

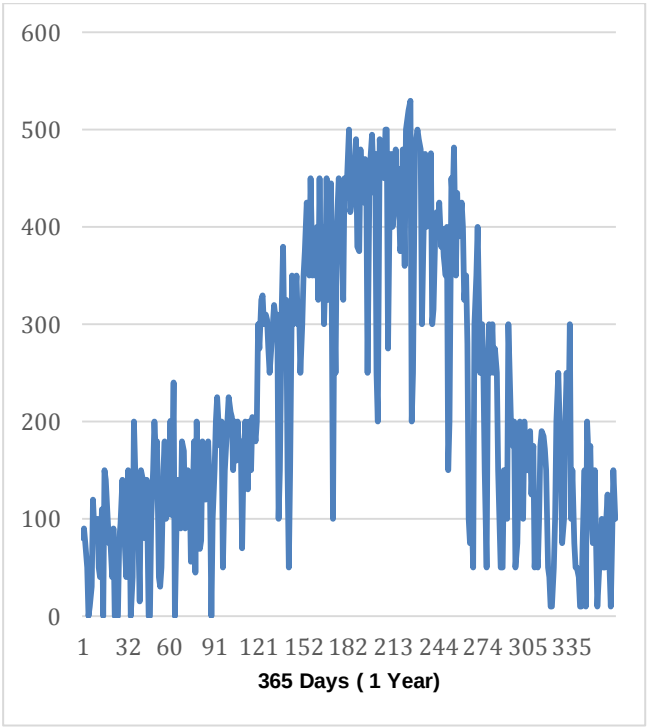

Figure 7. The total daily energy production of thin film solar panels (W/hr)

Although there is no fixed daily energy production of thin film solar panels, on some days it is very high and on some days it is very low. This variability is much more especially in winter. In order to produce the energy of the solar panel, it must be exposed to sunlight. The sun's rays are prevented from coming into the world due to the events such as atmospheric rain and snow in the winter. For this reason, there is much more variation in the winter in energy production of thin film solar panels. Total monthly basis produced energy are shown on Table 3.1.

Table 3.1. The total energy produced on a monthly basis .

Monthly	The total power generated (W/hr)
January	2052,98
February	3102,34
March	3807,42
April	5288,08
May	8343,92
June	11246,7
July	12770,2
August	12555,5
September	9860,58
October	5238,58
November	3840,42
December	2244,25

When the energy production of thin film solar panels is examined on a monthly basis; it was 2052 W/hr with the lowest production in January. The highest energy production occured in July with 12770 W/hr. There is a 620% percent increase in energy production between July and January. The biggest factor in this great rate is sunshine duration. In winter, Afyonkarahisar has an average of 2-3 hours of sunshine duration per day. In the summer time sunshine duration is as high as 11-12 hours.

While the energy production of thin-film solar panels in the winter is average of 3,000 W/hr, this rate is 12000 W/h in the summer months. Figure 8 includes a graphical representation of the total energy production on a monthly basis.

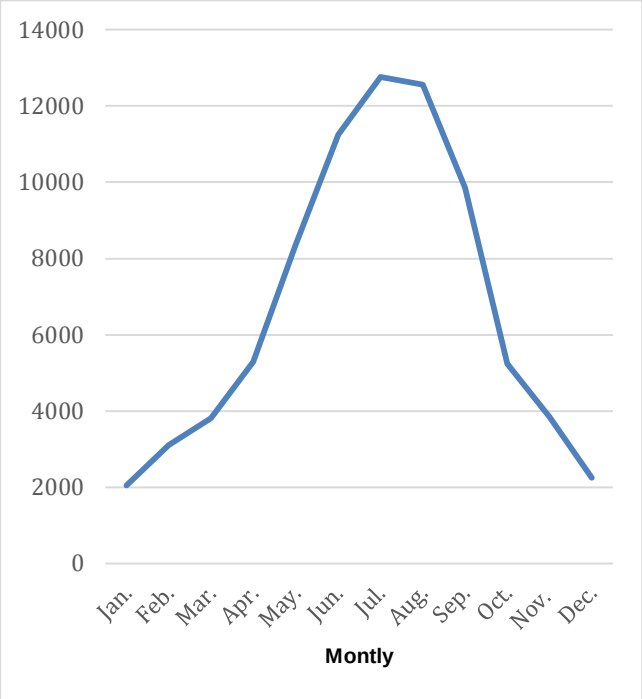

Figure 8 The total energy produced on a monthly basis.

The solar panel does not need to take the sun's rays directly to produce energy. Energy production occurs with the sun's rays fall on panel. If the sun's rays are perpendicular to the panel, it increases energy production. Daily energy production on a monthly basis of thin film solar panels installed in Afyonkarahisar are shown in Figure 9.

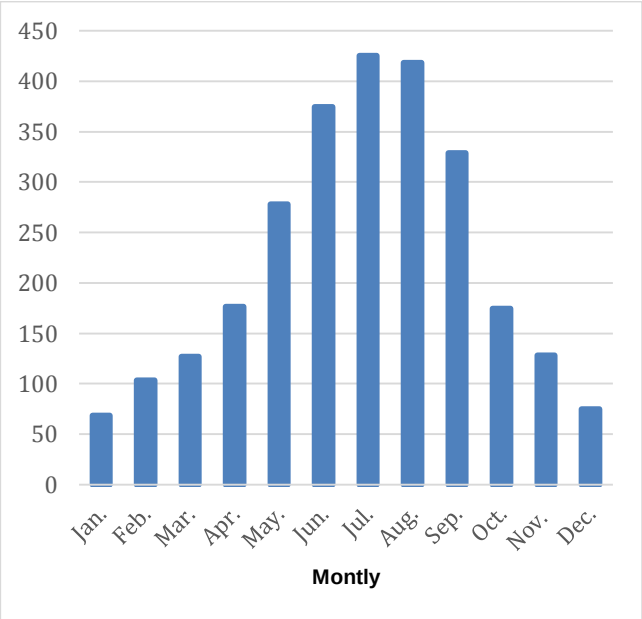

Figure 9 Afyonkarahisar daily energy production on a monthly basis of thin-film solar panels that are installed in the province.

IV. Conclusion

Semiconductors are used in many industries especially in the computer industry. Many investigations are carried out and important developments are provided on semiconductors for the development of the computer industry. These developments contribute to the development of the PV industry. The biggest contribution of them has been thin-film solar panels. The thin-film solar panel consists of very thin semiconductor material that is placed as one after the other.

In this study, thin-film solar panels were established in Afyonkarahisar. The parameters of thin-film solar panels and energy production were monitored on the computer screen transiently and recorded 10 second intervals with microcontroller card, USB, sensor and the software made in C# program. The production of thin film solar panel energy were recorded for one year.

When the energy production of thin film solar panels is examined on a monthly basis; it was 2052 W/hr with the lowest production in January. The highest energy production occured in July with 12770 W/hr. There is a 620% percent increase in energy production between July and January.

When the energy production of thin film solar panels examined on a seasonal basis; energy production during the winter months is 2987 W/hr and 11728 W/Hr during the summer months. Monthly energy production in spring and autumn months are approximately the same. While energy production in spring is 5813 W/hr, it is 6313 W/hr in autumn.

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