

# Studying and Detecting the Influences of the Solar Irradiance and Temperature Regarding the Characteristic of Photovoltaic at Al- Nasiriya City

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**Abstract** Solar energy is obtainable in the earth as an unlimited source of clean energy. There is an increasing bearing in the carbon release in the world. There are two parameters mainly affect the efficiency of the solar system that are solar radiation and temperature. In this research, the Effect of the Solar Irradiance and Temperature on the Characteristic of Photovoltaic in Al-Nasiriya City is studied. Pvsyst simulation facility is to be used for design and optimization. A computation has been conducted to verify the change in i-v and p-v characteristics of the system. The suggest model is based on a behavioral cell model for styling solar radiance to electricity transformation and to confirm the different factors assuming the solar PV system competence. The temperature and radiation data has been possessed from the position of Al-Nasiriya City in Iraq south.

**Keywords** Solar PV Cell, Pvsyst Software, Efficiency, Solar Radiation, Cell Temperature

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## 1. Introduction

A standout amongst the most potential sustainable power source found is sunlight based vitality. Sun oriented vitality is the brilliant warmth and light from the sun that has been utilized by people since antiquated occasions utilizing an extensive variety of advancements. One of the wide uses of sun oriented vitality is photovoltaic (PV). PV is the field of innovation and research identified with the utilization of sun oriented cells for vitality by changing

over daylight specifically into power by the photovoltaic impact. Sunlight based boards; photovoltaic clusters and sun powered modules are made by gatherings of sun oriented cells. There are numerous innovations used to extricate the power from these characteristic assets. Additionally numerous elements are affecting to deliver the power from these common assets, for example, environmental temperature, weight, wind speed and climatic condition. Among sustainable power source assets, sunlight based vitality is the quickest development on the planet (at the rate of 20-25% every year) in many built up the creating nations over the most recent 20 years [1,2]. There are two sorts of technology utilize to change over the sun oriented vitality, for example, sunlight based warm and sun oriented cell. Sun based cell (PV) changes over the daylight into electrical vitality by the photovoltaic impact. Sun powered PV cell are comprised of semiconducting material which having PN intersection. Figure 1 demonstrates the photocurrent fundamentals of PV cells and its operation. To investigate the performance on the basis of change in i-v and p-v characteristics of the PV system, Pvsyst is a simulation program which is able to simulate both stands alone and grid connected PV systems [7]. It provides the design proposals (Area required, module size, inverter size etc.). Pvsyst. It consists of input radiation units files of many locations in itself and can be import from NASA-SSE Worldwide [4,5]. PV units are the main power conversion unit system of a PV generator. The produce features of PV units depend on the cell temperature, solar radiation, and the output voltage that arrive from PV unit. Moreover, mathematical modeling of PV module is constantly refreshed to empower specialist to have a superior comprehension of its working [6].

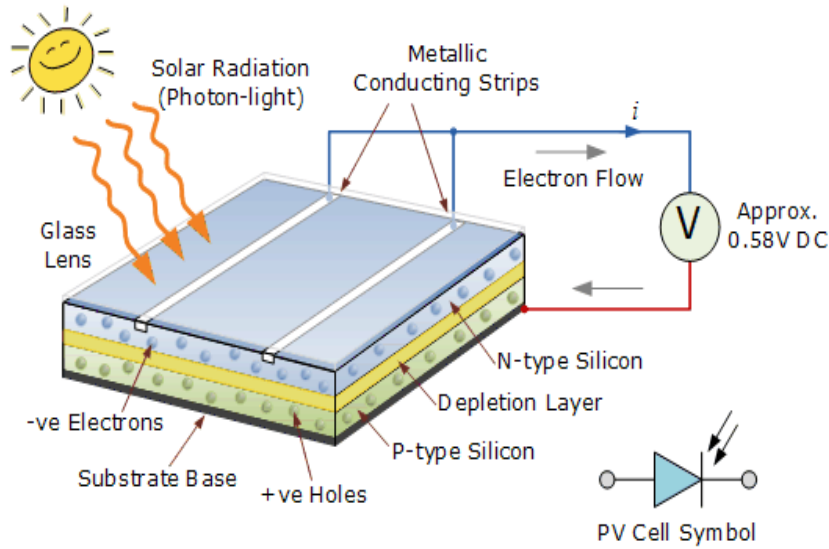


Figure 1. Photovoltaic Solar PV cell construction and operation [1]

Solar energy obtained from a solar PV cell is not constant all the time. Solar energy is influenced by outside conditions like sun based irradiance and temperature. Solar irradiance and cell temperature are indicated out influence PV cell yield to a significantly more noteworthy degree than alternate conditions [7,8]. Besides, the measure of extricated control from a PV framework is an element of the PV cluster voltage and current set point. Because of these reasons expressed above, it is vital to augment the yield electric power accessible from the PV cell. As a matter of fact the sunlight based PV cell has nonlinear I-V and P-V qualities which is relies upon the irradiance and the working temperature additionally in load state of the cell [8, 12]. The solar energy is availability varies widely with time. So, it is very necessary to make a complete utilization of solar energy in available time. For this purpose an improved PV module has been introduced which is the development of mathematical modeling of PV arrays. The objective is to validate the P-V & I-V characteristics of practical solar PV arrays.

## 2. PV Cell Modeling

The sun based cell is the essential unit of a PV framework. Sunlight based Cell or Photovoltaic (PV) cell is a gadget that is comprised of semiconductor materials, for example, silicon, gallium arsenide and cadmium telluride, and so on that that converts sunlight immediately into electricity. The voltage of a sun based cell does not depend emphatically on the sun powered irradiance but rather depends fundamentally on the cell temperature. PV modules can be intended to work at various voltages by interfacing sun based cells in arrangement. At the point when sun powered cells ingest daylight, free electrons and openings are made at positive/negative intersections. On

the off chance that the positive and negative intersections of sun based cell are associated with DC electrical gear, current is conveyed to work the electrical tools.

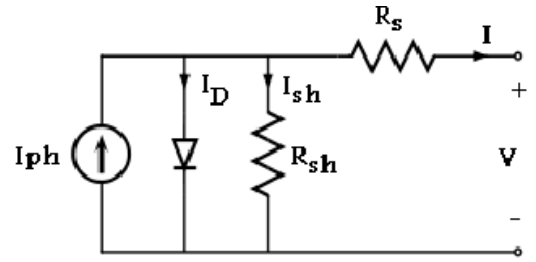


Figure 2. Communal model circuit of PV cell

The voltage-current distinctive formula of a solar cell [1], is given as:

$$I = I_{ph} - I_s \left\{ \exp \frac{q(V+IR_s)}{A.K.T} - 1 \right\} - \frac{(V+IR_s)}{R_{sh}} \quad (1)$$

Where  $I_{ph}$  is photocurrent or a light-generated current,  $T_c$  is the cell's working temperature, the cell saturation of dark current is  $I_s$ , and charge of electron  $q = 1.6 \times 10^{-19}C$ , Boltzmann's constant  $k = 1.38 \times 10^{-23}J/K$ ,  $A$  is refer to perfect factor, the ideal factor  $A$  is based on PV technology [ $R_s$  is a series resistance and  $R_{sh}$  is a shunt resistance. The output voltage of PV cell is a function of the photocurrent which at most specified by load current build on the solar irradiation level through the process. The open circuit voltage and short circuit current depend on parameters like solar irradiance and the temperature [11] as shown in equations 2 and 3.

$$V_{oc} = \frac{kT}{q} \ln \frac{I_{sc}}{I_s} \quad (2)$$

$$I_{sc} = bH \quad (3)$$

Where  $H$  is the incident light intensity and  $b$  is a constant depending on the properties of the semiconductor junction.

### 3. Research Procedure

The efficiency of a solar PV plant is highly depends on the azimuth angle and tilt angle of PV modules. So these are adjusted in such a manner to get maximum irradiance from the sun and albedo factor taken for this study is 0.2. Geographical location provides the (x,y,z) co-ordinates of a site that of a site that of is latitude, longitude and altitude which defines the position of a point on the earth and time zone[ 9,10].

Meteo file includes complete information of geographical site parameters that is horizontal global, beam and diffusive irradiations, ambient temperature and wind velocity (If available).

**Table 1.** Location Details

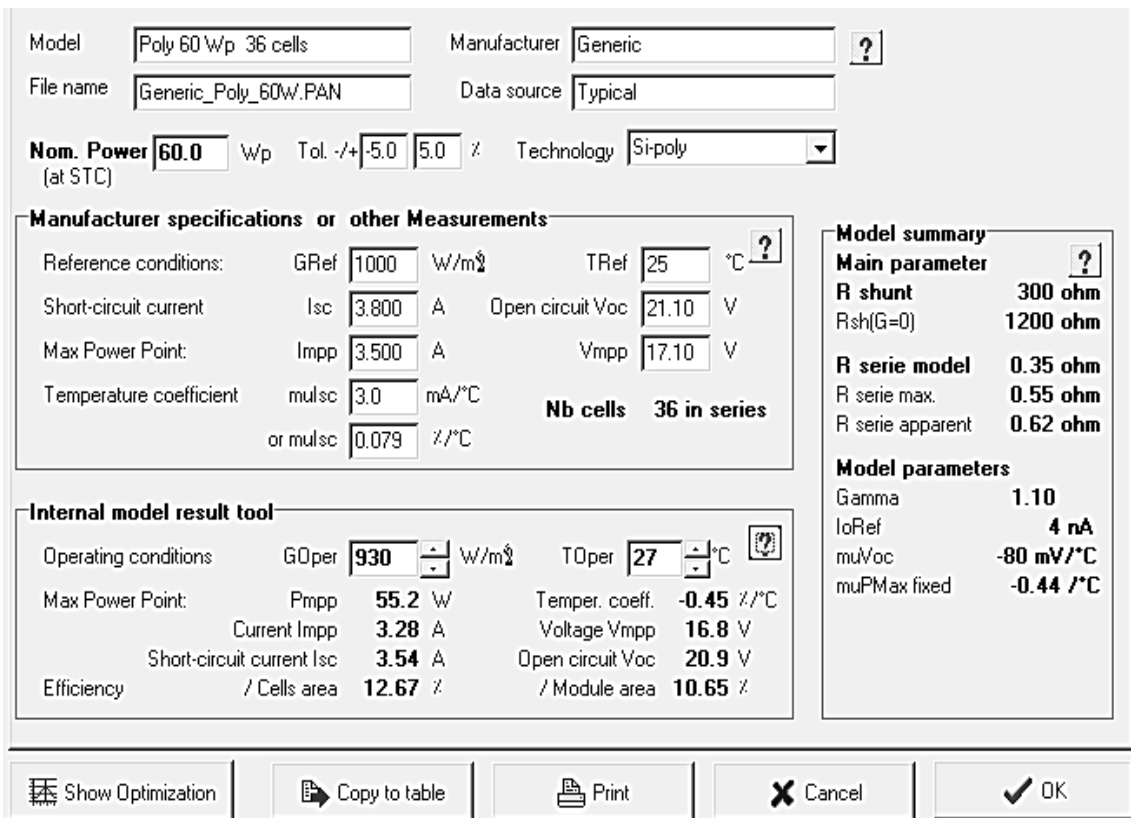
country	Iraq
City	al-Nasiriyah
Latitude	31.1
Longitude	46.1
Altitude	9m
Time Zone	3hr

**Table 2.** Technical details of the 60W solar PV Panel

Description	Si-Poly
Model	60 w
Model Dimension	502×1109 mm
Model weight	7.2 kg
Open circuit voltage	21.1 V
Short circuit current	3.8 A
Voltage at peak power point	17 V
Current at peak power point	3.53A

Using the PVsyst the impact of temperature and irradiation on the power output of the system has been examined. In this work the special two model of the solar PV configuration with subsystem and tested.

In this model, 60W solar panel makings data has been stabled to work the model. The outcomes have been explained in the figure 4 to 9 as Voltage Vs current and Voltage Vs Power. Thus, the PV cell current is robustly following on the solar radiation. In general, for a given sunlight based radiation, when the temperature of cell increases, the open circuit voltage Voc, drops somewhat, while the short out current increments. This conduct is validated and presented in Figure 10 to 15.



**Figure 3.** PV system model for solar PV system

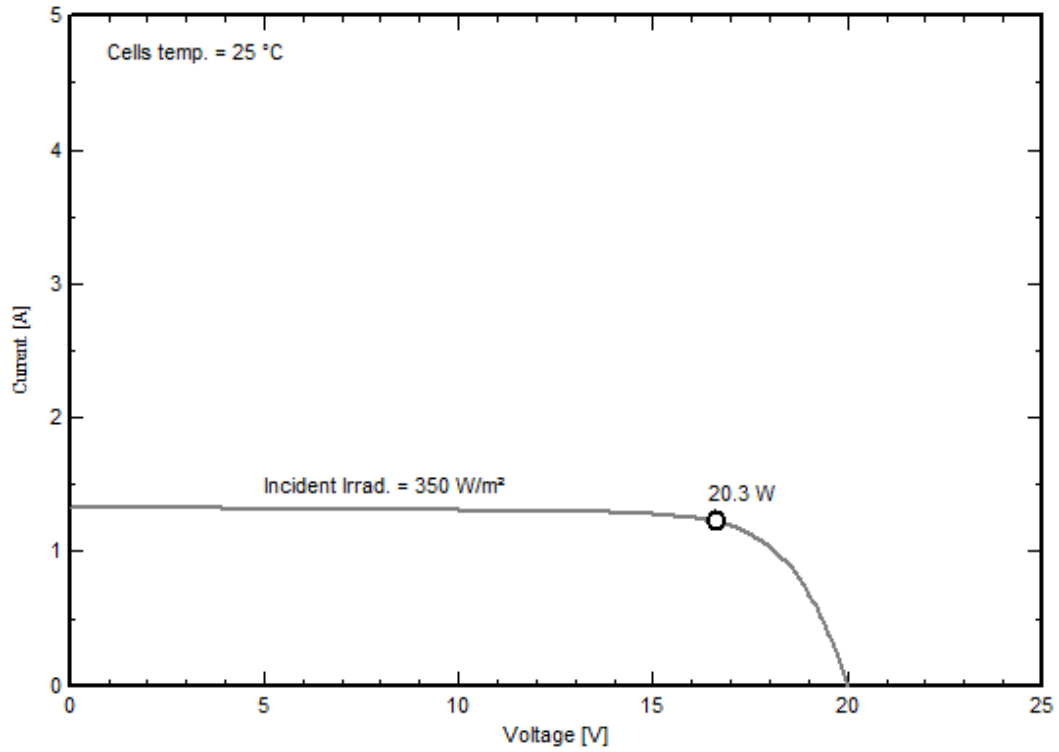


Figure 4. Current vs voltage, Temperature 25°C and Solar Radiation 350 W/m<sup>2</sup>

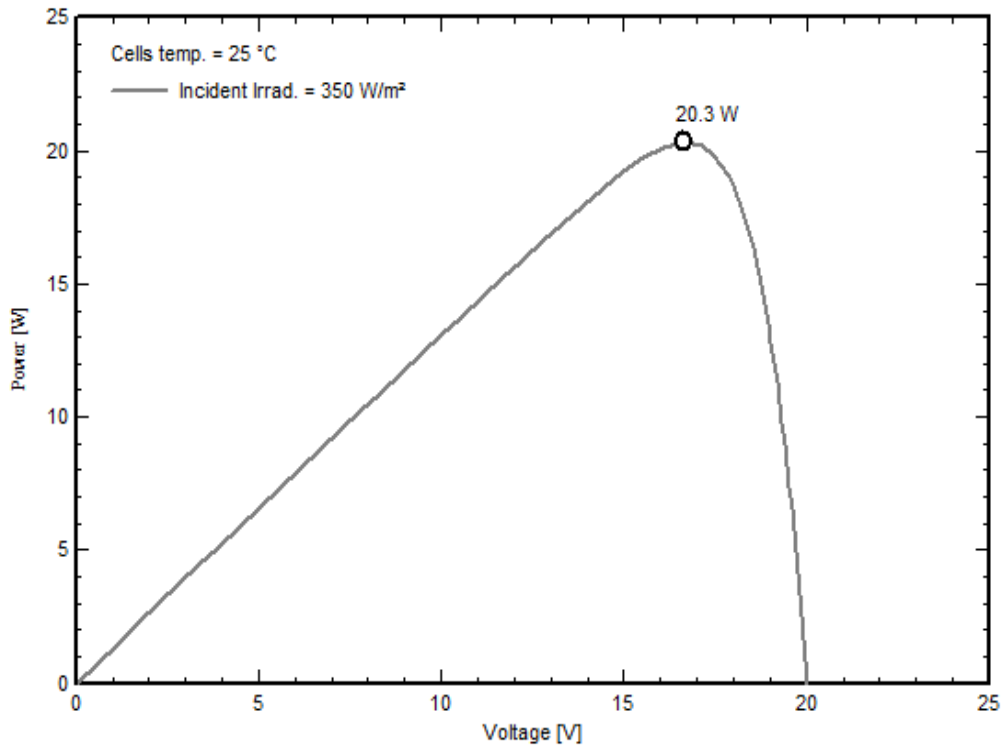


Figure 5. Power vs voltage, Temperature 25°C and Solar Radiation 350 W/m<sup>2</sup>

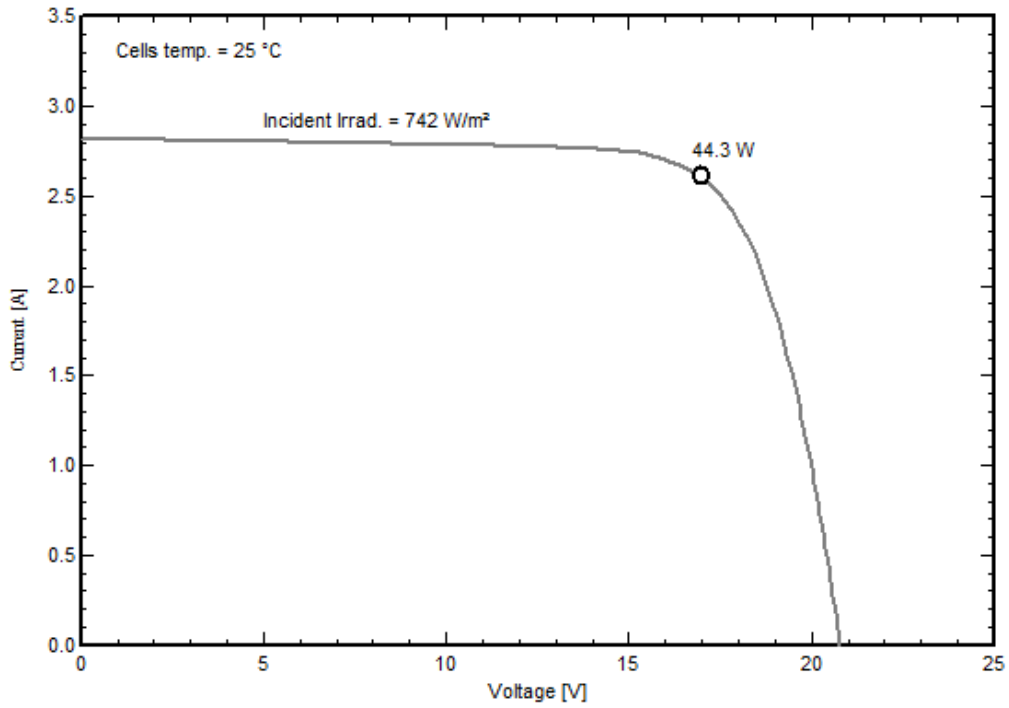


Figure 6. Voltage vs current, Temperature 25°C and Solar Radiation 742 W/m<sup>2</sup>

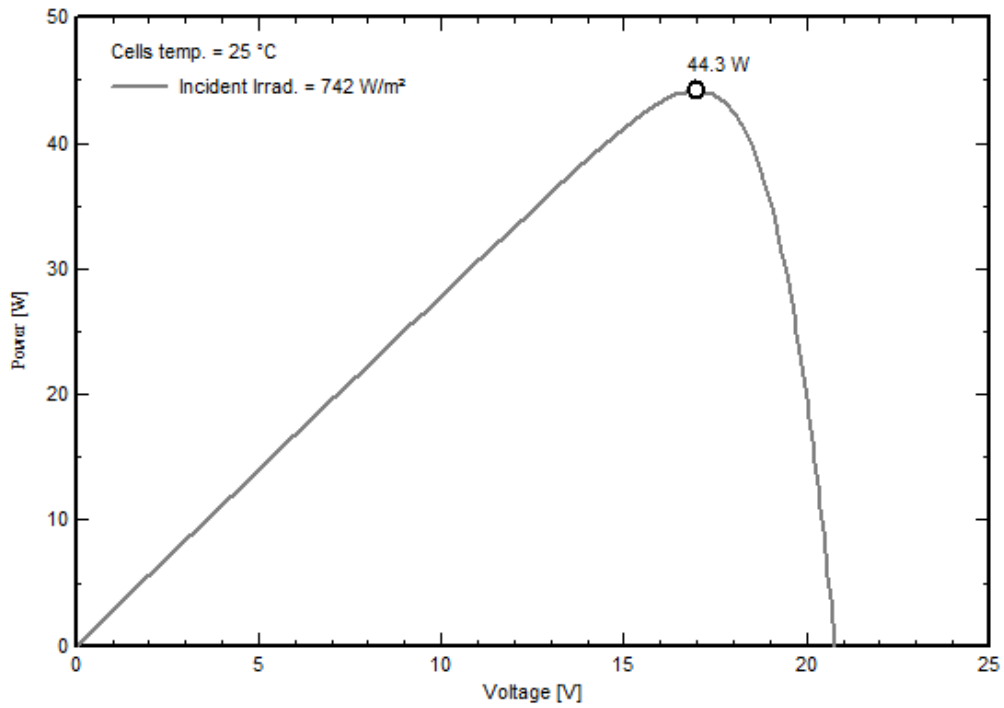


Figure 7. Power vs voltage, Temperature 25°C and Solar Radiation 742 W/m<sup>2</sup>

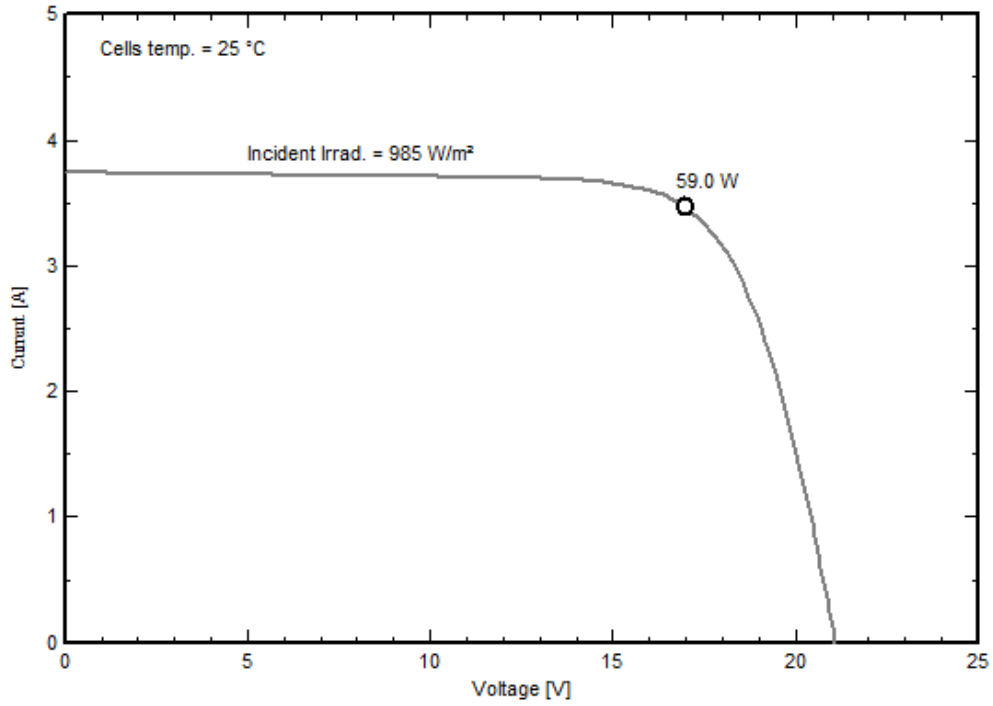


Figure 8. Voltage vs current, Temperature 25 °C and Solar Radiation 985 W/m<sup>2</sup>

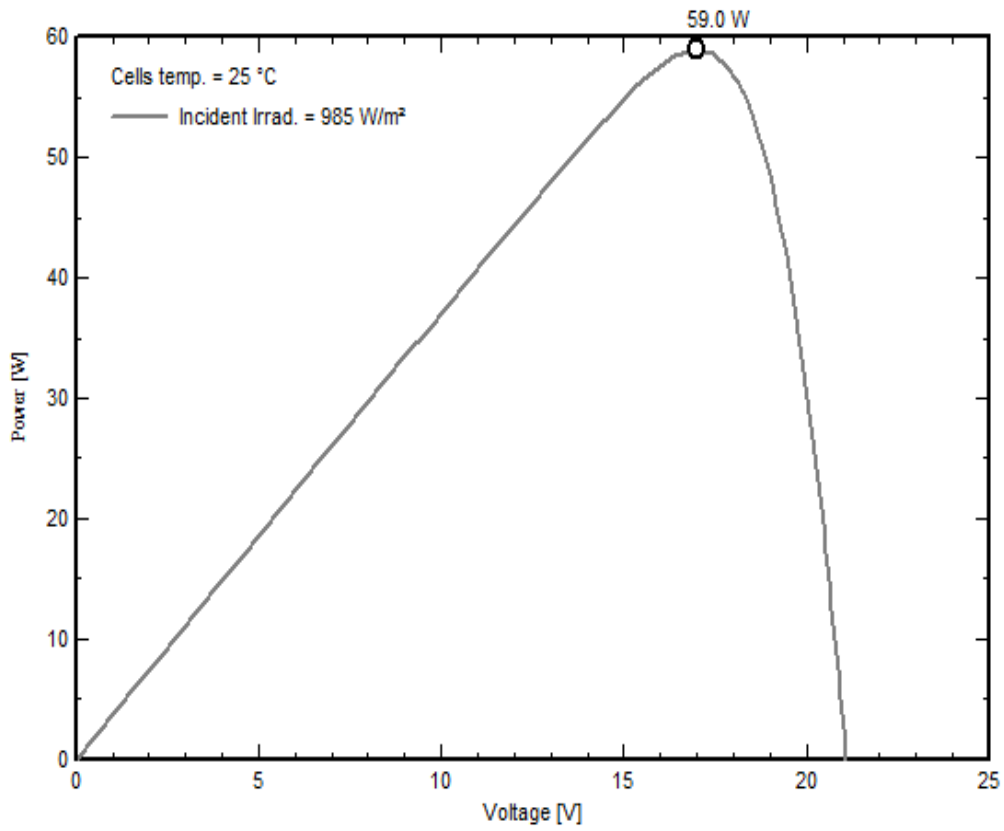


Figure 9. Power vs voltage, Temperature 25 °C and Solar Radiation 985 W/m<sup>2</sup>

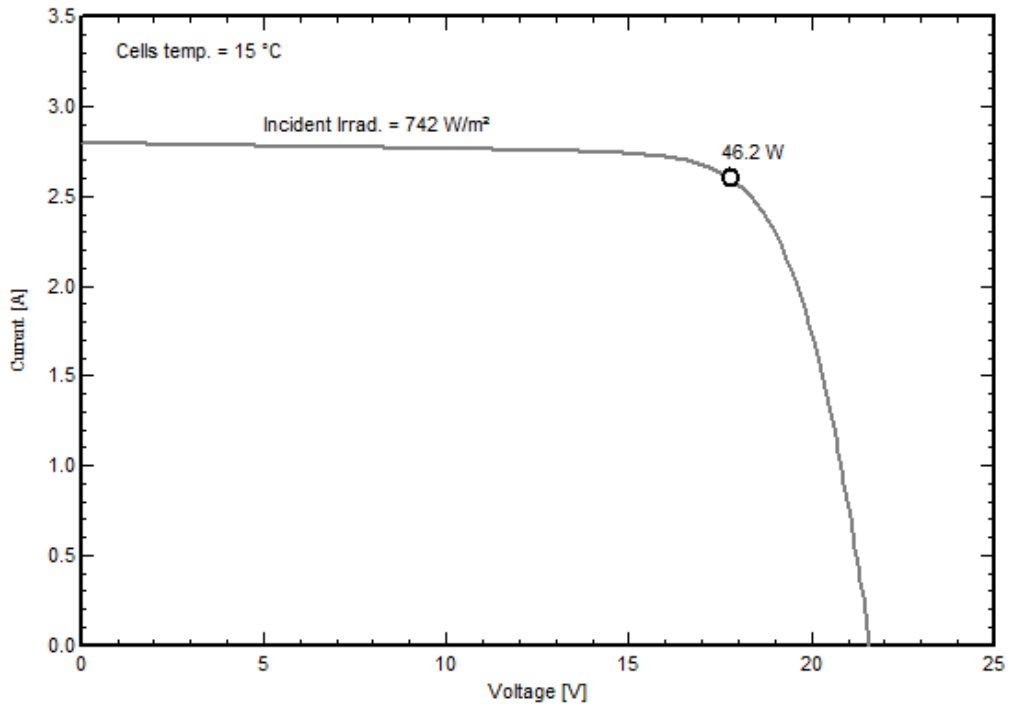


Figure 10. Voltage vs current, Solar Radiation 742W/m<sup>2</sup>, Temperature 25 °C

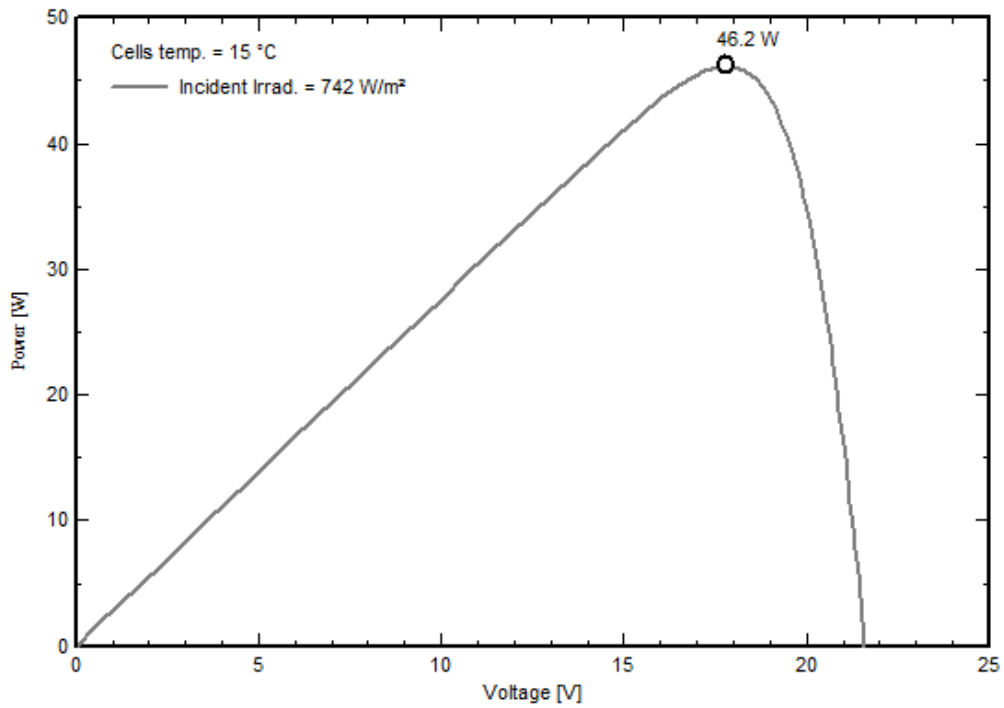


Figure 11. Power vs voltage, Solar Radiation 742W/m<sup>2</sup>, Temperature 25 °C

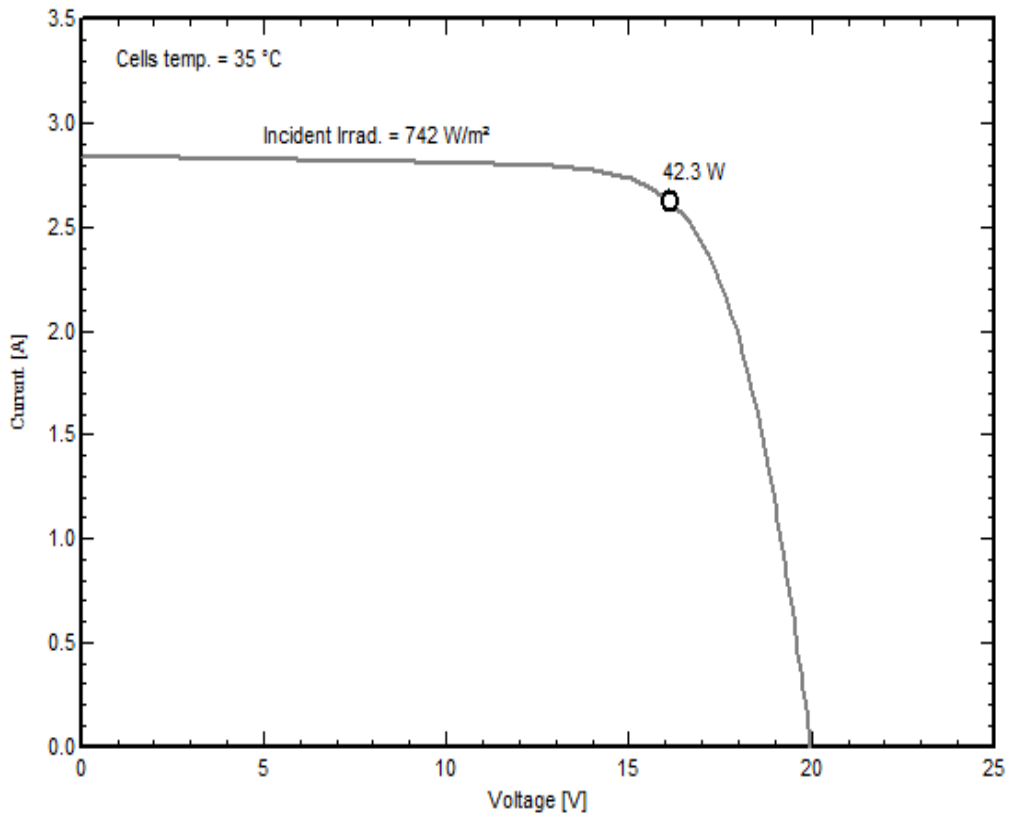


Figure 12. Voltage vs current, Solar Radiation 742W/m<sup>2</sup>, Temperature 35°C

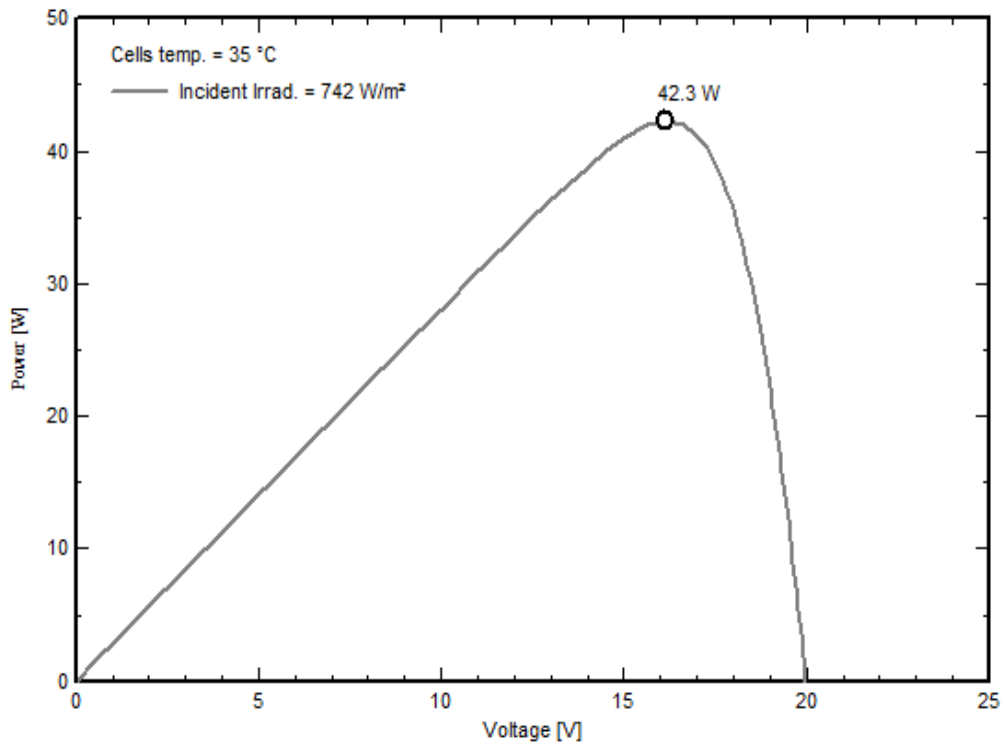


Figure 13. Power vs voltage, Solar Radiation 742W/m<sup>2</sup>, Temperature 35°C



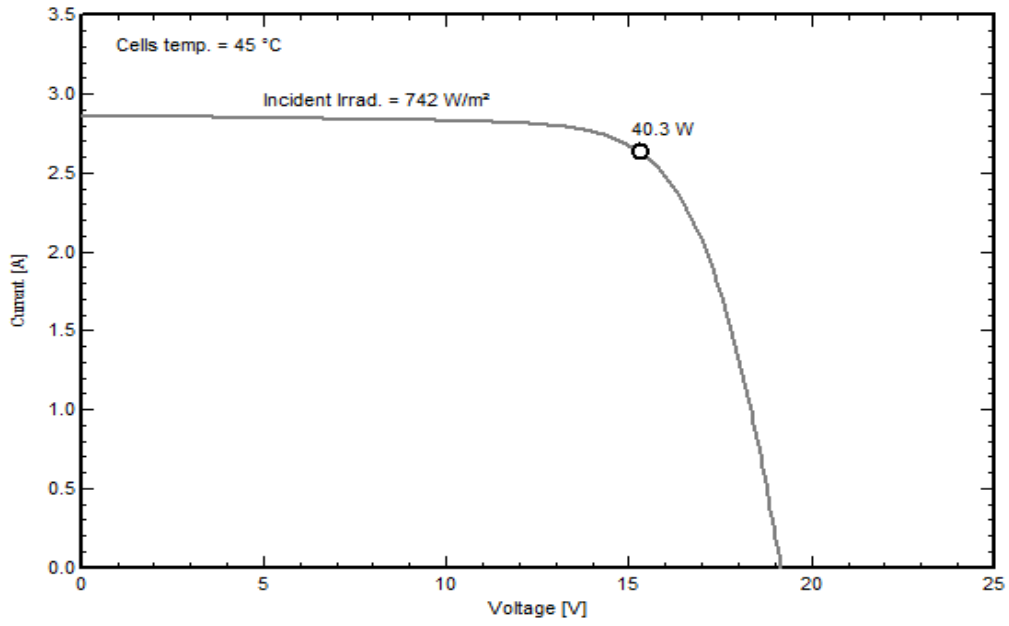


Figure 14. Voltage vs current, Solar Radiation 742W/m<sup>2</sup>, Temperature 45 °C

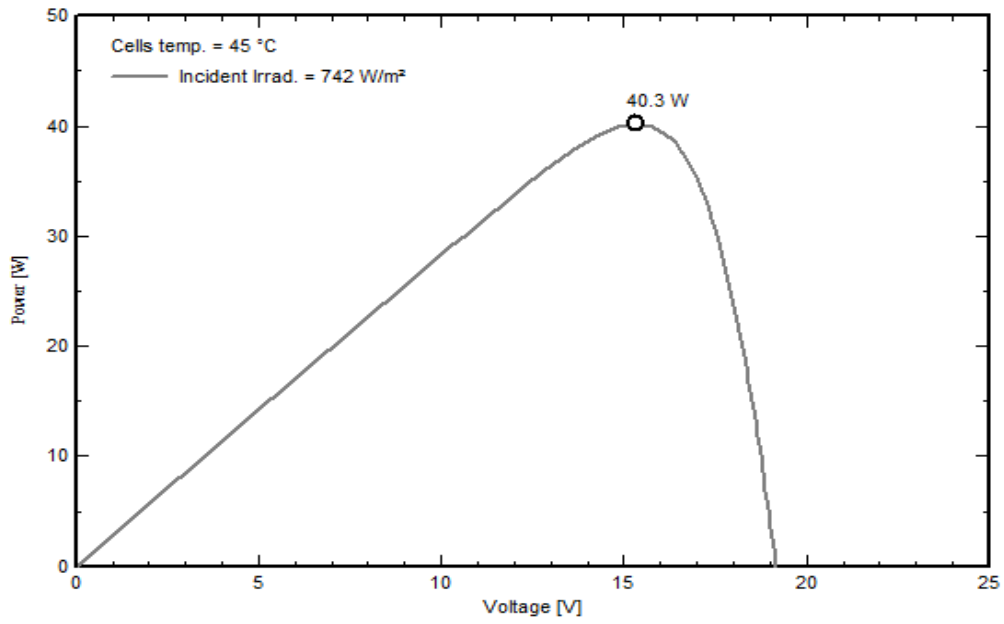


Figure 15. Power vs voltage, Solar Radiation 742W/m<sup>2</sup>, Temperature 45 °C

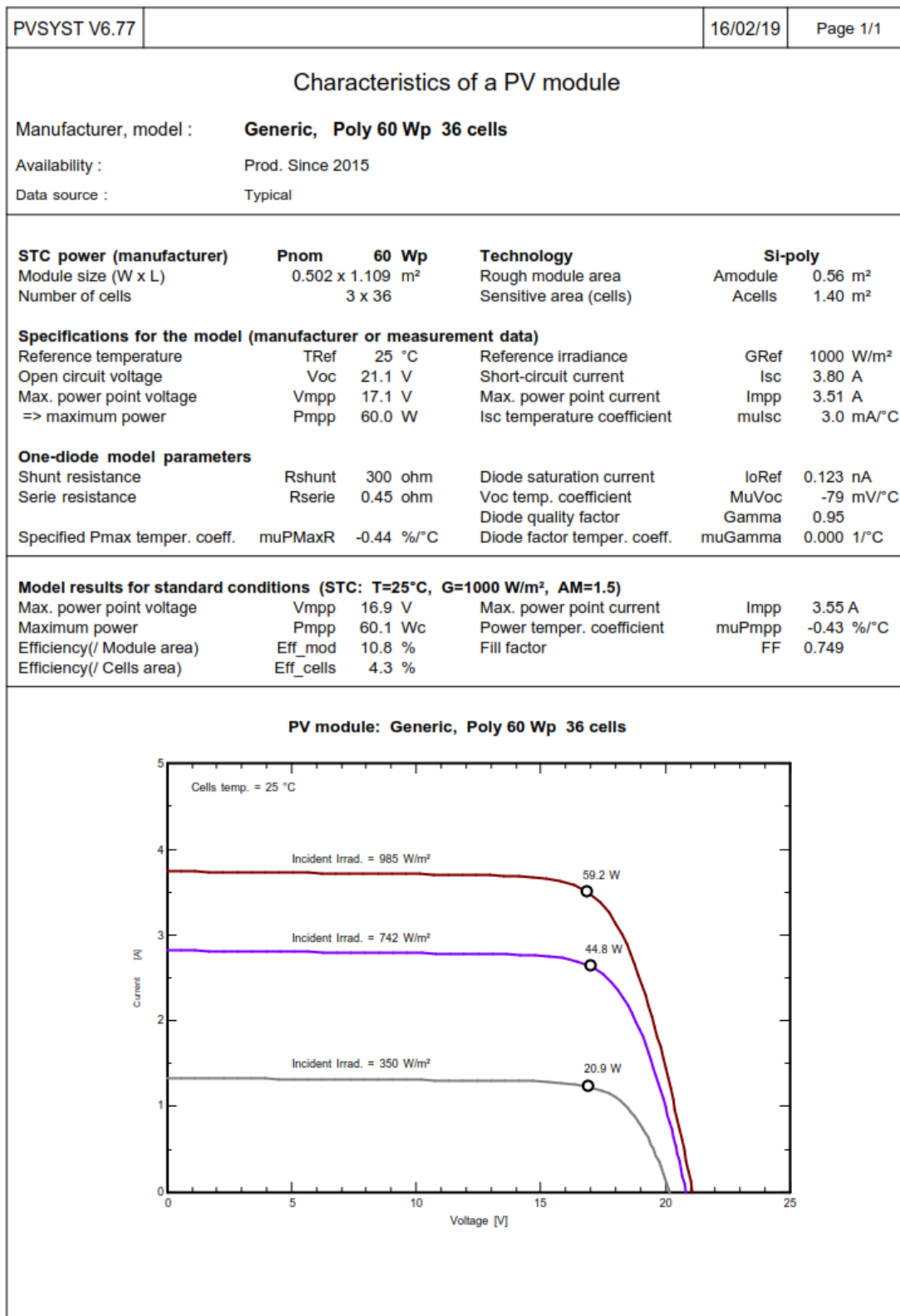


Figure 16. Shows the current versus voltage curve at various irradiance level

In the figure16, the V-I characteristics of previous sample at light intensities 350, 742, and 985 W/m<sup>2</sup> have been shown. As can be seen, V-I characteristics of solar

cell vary under different levels of illumination. The measurements were performed at 25, 35, and 45 c o temperature showed in figure 18.

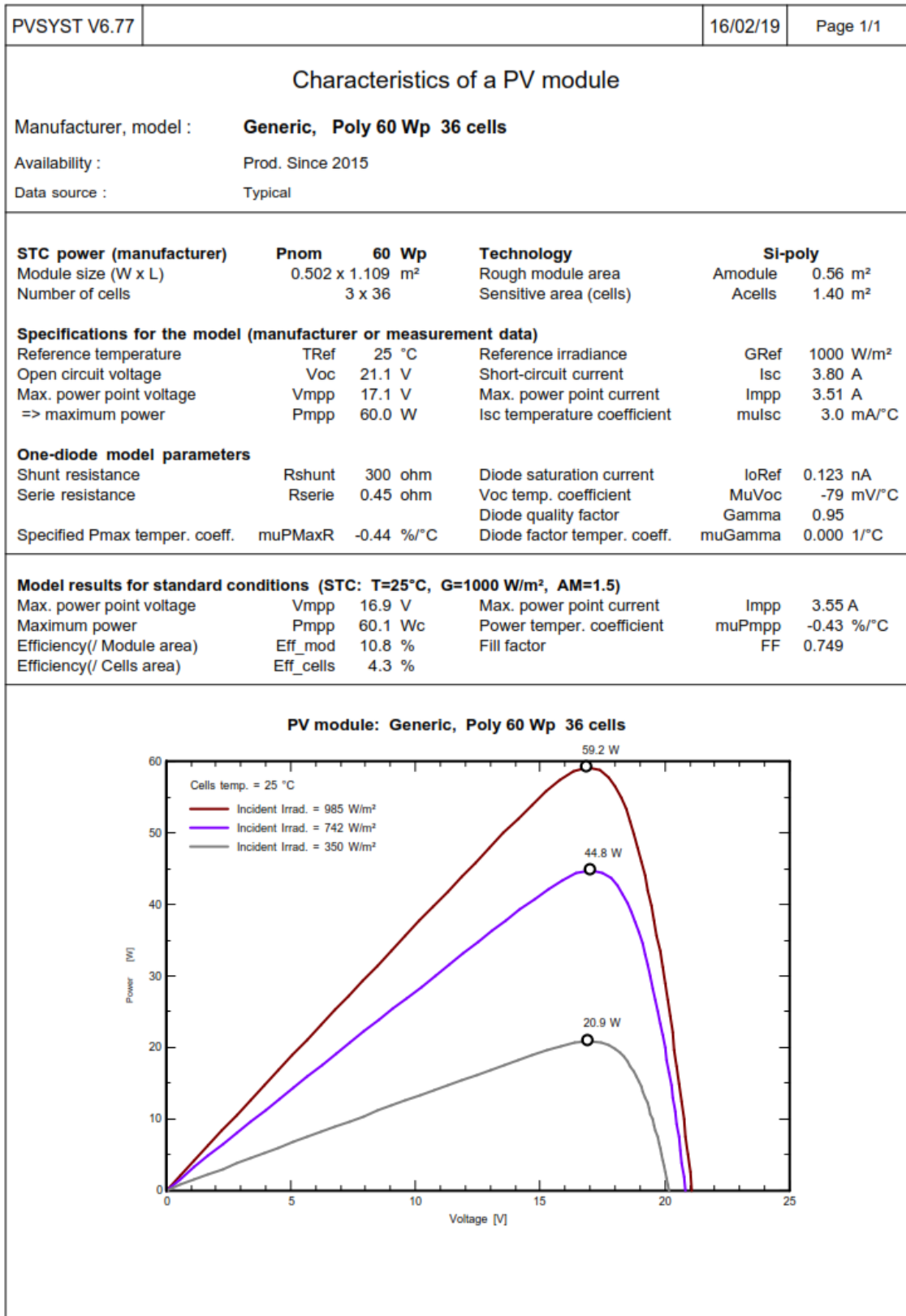


Figure 17. Shows the power versus voltage characteristics at three different irradiance levels

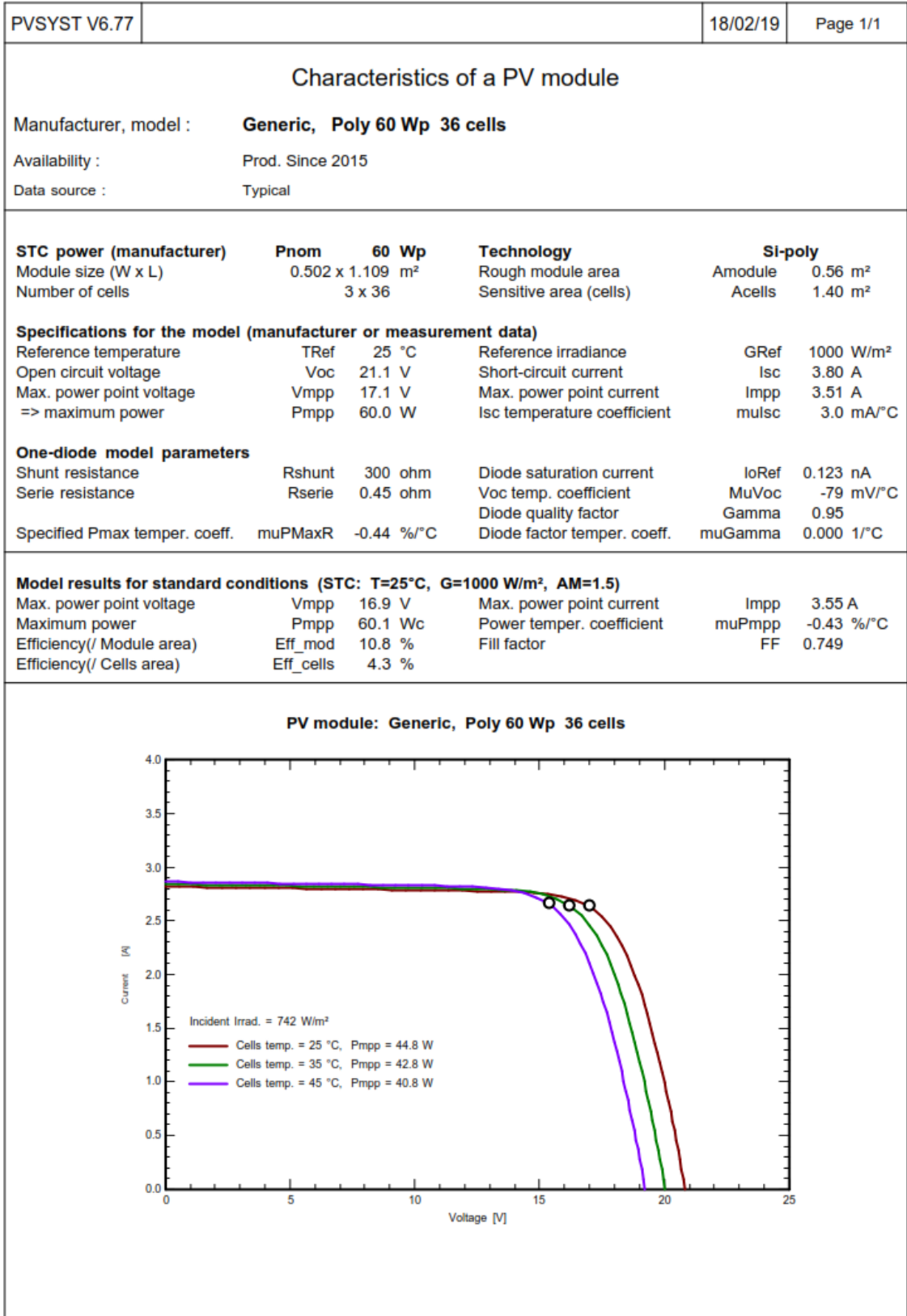


Figure 18. Shows how the I-V curve varies with varying temperature

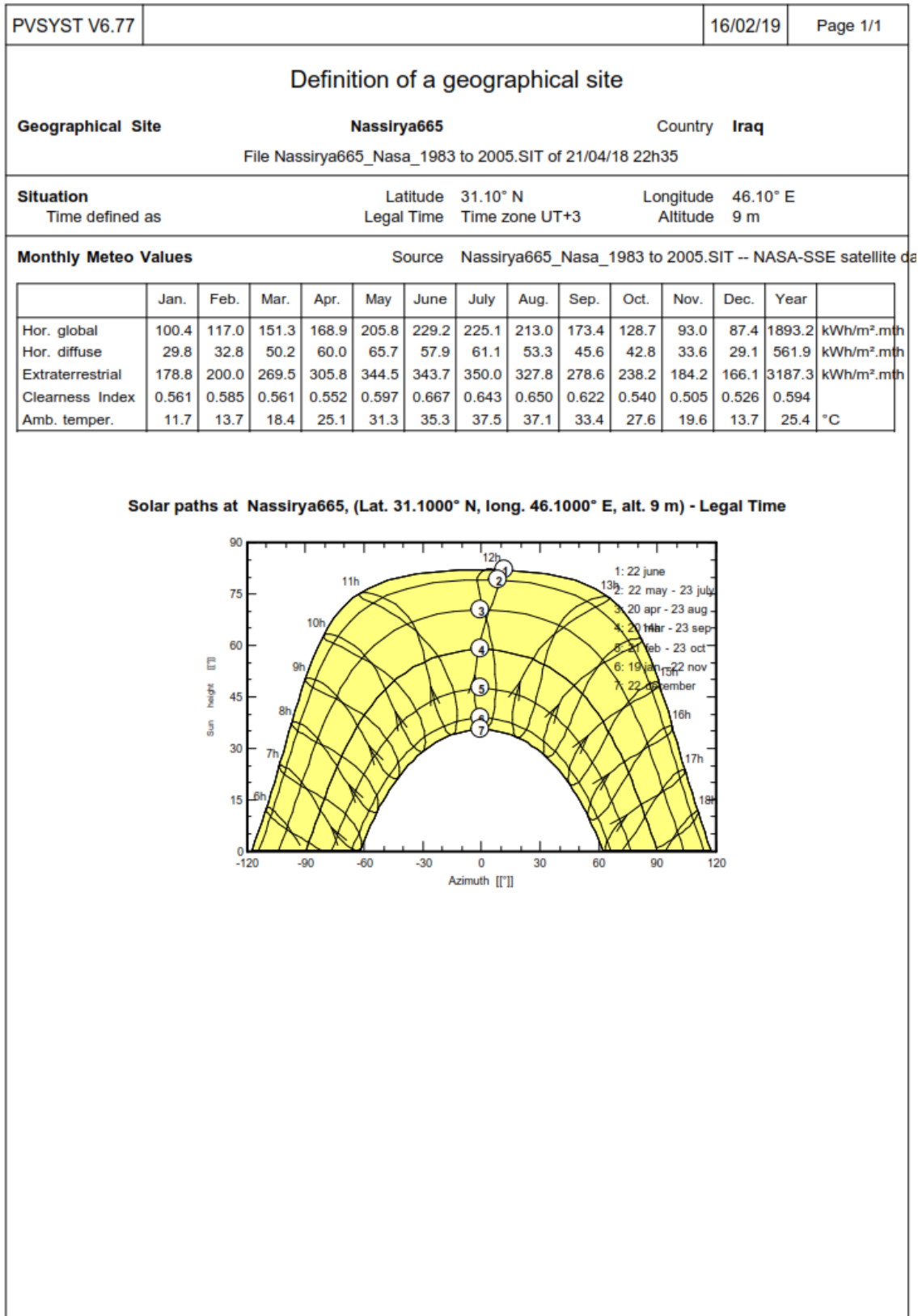


Figure 19. Shows solar paths of Nasiriya city

The orientation and tilt of the photovoltaic panels determine the amount of light intensity that the panel surface Receives. Variation of the light intensity incident on a solar cell changes all solar cells parameters.

## 4. Conclusions

Cell temperature and solar radiation are significant parameter to optimize the competence of the solar PV cell. A PVsyst model has been enhanced for the solar PV sample which introduced in this paper has created dependent on the essential circuit conditions of sunlight PV cell with counting of physical and ecological parameter. From the outcome, increment in temperature the average of photon age builds accordingly invert saturation current expands quickly and this outcome on decrease in band hole. Thus this prompts to minor changes in current but major changes with voltage. Optimization of these operators is highly critical for efficiency of solar cell the optimum operators make it possible to get the large benefits of solar electricity at a less cost.

Irradiance and Irradiation are related to solar components. As the solar insolation keeps on changing through tout the day similarity I-V and P-V characteristics varies. Temperature acts like a negative factor affecting solar cell performance. Therefore solar cells give their full performance on cold and sunny days rather on hot and sunny weather.

It's shown from this investigation that, it is very successful to build a solar photovoltaic system for al-Nasiriya city that's due its environmental representation and geographical position.

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