ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

SOLAR PANEL MODELING AN ANALYSIS WITH DIFFERENT TEMPERATURE AND SOLAR IRRADIATION POWER

Pixy Saxena *, Dr. Sameena Elyas Mubeen
* Department of Electrical & Electronics Engineering, Bhopal.

Abstract

Solar panel is becomes an emerging topic foe the renewable energy world. The effective utilization of the solar panel and the constant power for small system to big energy system is required. The simulation and modeling of the solar panel is the initial point to enter in the research related to the solar energy system. The power output is highly depending on the environment condition and solar radiation. This paper presents the modeling and simulation of the solar panel with 36 solar cells. The characteristics of the solar panel are comparing in this paper for different operating temperature and irradiation power. The case study of Indore for temperature has been carried out and given in this paper.

Keywords: Grid conector, Soler cell, HVDC, Photovoltaic (PV), etc.

Introduction

The solar energy conversion into electricity takes place in a semiconductor device that is called a solar cell. In a solar cell is a unit that delivers only a certain amount of electrical power. In order to use solar electricity for practical devices, which require a particular voltage or current for their operation, in number of solar cells have to be connected together to form a solar panel, also called a photovoltaic (PV) module. For large-scale generation of solar electricity the solar panels are connected together into a solar array.

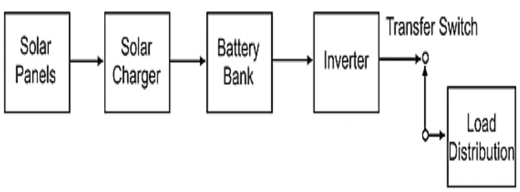

Fig: 1. Solar module

The solar panels are only a part of a complete PV solar system. Solar modules are the heart of the system and are usually called the power generators. One must have also mounting structures to which PV modules are fixed and directed towards the sun. For PV systems that have to operate at night or during the period of bad weather the storage of energy are required, the batteries for electricity storage are needed. The output of a PV module depends on sunlight intensity and cell temperature; therefore components that condition the DC (direct current) output and deliver it to batteries, grid, and/or load are required for a smooth operation of the PV system. These components are referred to as charge regulators. For applications requiring AC (alternating current) the DC/AC inverters are implemented in PV cell. These additional components form that part of a PV system that is called balance of system (BOS).

Photovoltaic systems require interfacing power converters between the PV arrays and the grid. These power converters are used for two major tasks. The first is to inject a sinusoidal current in to the grid. In second is to reduce the harmonics content in the grid injected voltage and current. There are two power converters. The first one is a DC/DC power converter that is used to operate the PV arrays at the maximum power point. In the other one is a DC/AC power converter to interconnect the photovoltaic system to the grid. Intensive efforts are being made to reduce the cost of photovoltaic cell production and improve efficiency and narrow the gap between photovoltaic and conventional power generation methods such as steam and gas turbine power generator. In order to decrease the cost of PV array production, improve the efficiency of the system and collecting more energy for unit surface area different efforts have been made.

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

Solar Photovoltaic overview

Photovoltaic cells look similar to solar panels but they work in a different way flow. Solar panels are use to produce hot water or even steam. The photovoltaic panels convert the sunlight directly into electricity. This type of device only needs a small amount of electrical power to work and can even be used in a room with artificial light Although we see photovoltaic cells powering small devices such as calculators they have a more practical application especially in the third world. A typical example of a device powered by photovoltaic cells is a solar powered calculator. Photovoltaic cells have been developed that will provide electrical power to pump drinking water from wells in remote villages. During the day the cells power the phone and also charge batteries. For the batteries power the phone during the night. In often photovoltaic cells are used as a backup to conventional energy. Its conventional fails the cells are used to produce electricity

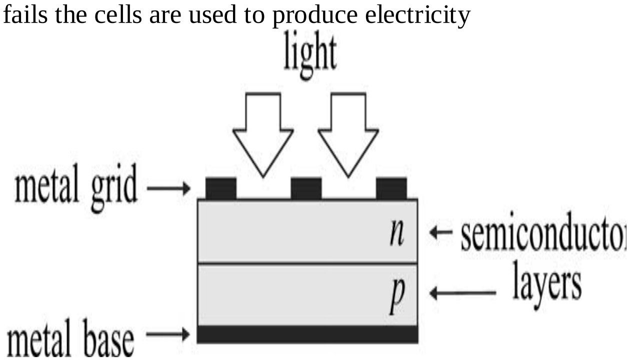

Fig: 2. Physical structure of a PV cell.

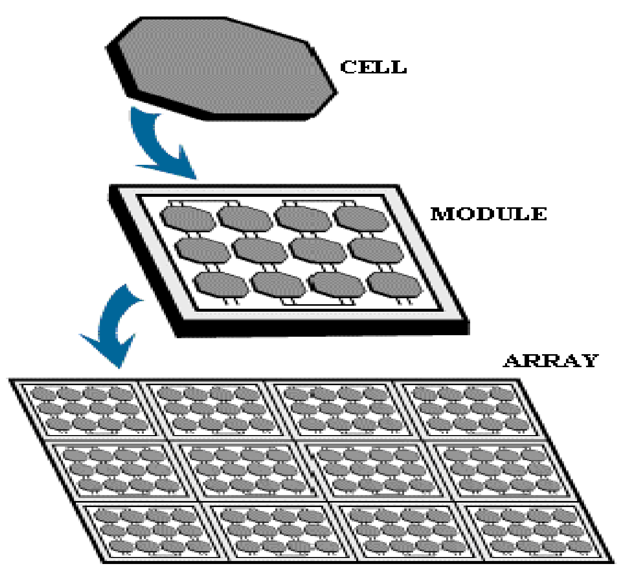

Fig: 3 Cell with array

A number of solar cells electrically connected to each other and mounted in a support structure or frame is called a photovoltaic module. The modules are designed to supply electricity at a certain voltage calculation, such as a common 12 volts. The current produced is directly dependent on how much light strikes the module.

Multiple modules can be wired together to form an array. In general, the larger, area, module or array systems, in the produced are more electricity. Photovoltaic modules and arrays produce direct-current (dc). They can be connected in both series and parallel electrical arrangements to produce any required voltage and current combination.

Solar Cell Modeling

The computer simulation of a physical system modeling should be done .It includes all the physical elements & all the parameters influencing the system. It is usually based on a theoretical analysis of the various physical processes occurring in the system and of all factors influencing these processes. Mathematical models describing the system characteristics are formulated and translated into computer codes to be used in the simulation system. Photovoltaic cell models have long been a source for the description of photovoltaic cell behavior for researchers and professionals. If the most common model used to predict energy production in photovoltaic cell modeling is the single diode circuit model that represents the electrical behavior of the pn-junction photovoltaic system works.

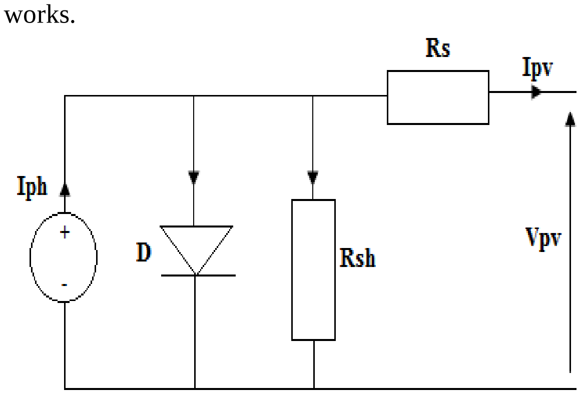

Fig: 4. The solar Cell modeling equivalent circuit used in single diode performance model

However, a second model, where the equivalent circuit diagram is shown in Figure 4, is also adopted. In this case, the electrical model is known as a double-diode model. The current source, or insulation, in both equivalent circuit diagrams is

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

represented by the photovoltaic current Iph. The PV cell current Ipv, for both models, is given by 1 and 2 equations, respectively.

$$I_{pv} = I_{ph} - I_0\left(e^{q(\frac{V_{pv}+R_vI_{pv}}{AKT})} - 1\right) - ((\frac{V_{pv}+R_vI_{pv}}{R_{sh}}) \quad (1)$$

$$I_{pv} = I_0\left(e^{q((\frac{V_{pv}+R_vI_{pv}}{AKT})} - 1\right) - I_{s2}\left(e^{\left(\frac{V_{pv}+R_vI_{pv}}{AKT}\right)} - 1\right) - (\frac{V_{pv}+R_vI_{pv}}{R_{sh}}) \quad (2)$$

For the situation corresponding to the maximum power point (MPP), the current and voltage are respectively Imppand Vmpp. Accordingly, and based on equation (2), the following equation can be deduced:

$$I_{mpp} = I_{ph} - I_0\left(e^{((\frac{V_{pv}+R_vI_{pv}}{AKT})} - 1) -\right)\left(\frac{V_{mpp}+R_sI_{mpp}}{R_{sh}}\right) \quad (3)$$

The power delivered to the load, and the quality factors of the diode that will make part of the modeling process are given respectively by:

$$P_{Pv} = I_{pv}v_{pv} \quad (4)$$

$$A = \frac{V_{mpp}+R_sI_{mpp}-V_{co}}{V_T\left\{Ln\left(I_{cc}-\frac{V_{mpp}}{R_{sh}}-I_{mpp}\right)-Ln\left(I_{cc}-\frac{V_{co}}{R}\right)+\frac{I_{mpp}}{I_{cc}-\frac{V_{co}}{R_s}}\right\}} \quad (5)$$

It is noted that the short-circuit current given in a PV module datasheet is for standard test conditions of irradiance and air mass at a temperature of 25°C (*G0* = 1000W/m², 25°C, AM1.5). Accordingly, for any given irradiance *G*, the PV cell current is adjusted using the following equation:

$$\frac{I_{se}}{G} = \left(\frac{G}{G_0}\right)\frac{I_{se}}{G_0} \quad (6)$$

The model described by equation (5) was constructed using MATLAB/Simulink. It includes the parameters that affect the behaviour of the PV cell in terms of output current and voltage. Those parameters are: the radiation *G*, the temperature *T (in Kelvin)*, the series resistance *Rs* and the shunt resistance *Rsh*. Figure 6 shows the effects of insulation variation.

Results and discussion

The above for different solar irradiation & constant temperature, it can be observe that current & power of the PV module increases with increasing solar irradiation.

The simulation results of i-v curve and p-v curve of PV model for constant solar irradiation and different temperature are shown in Fig-6-13.

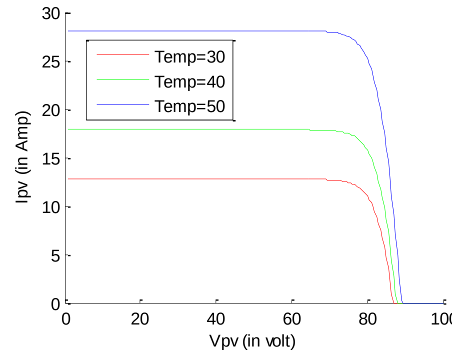

Fig: 6 Graphof Vpv Vs Ipv of solar panel for different temperature

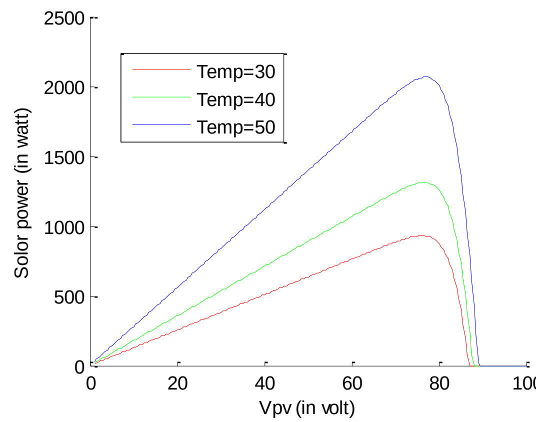

Fig: 7 Graphof Vpv Vs output solor powerl for different temperature

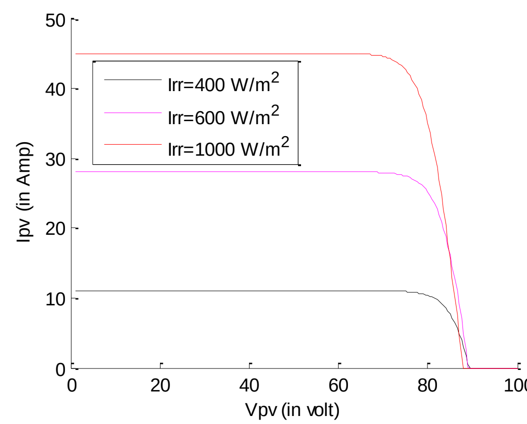

Fig: 8 Graphof Vpv Vs Ipv of solor panel for different Solar irradiation

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

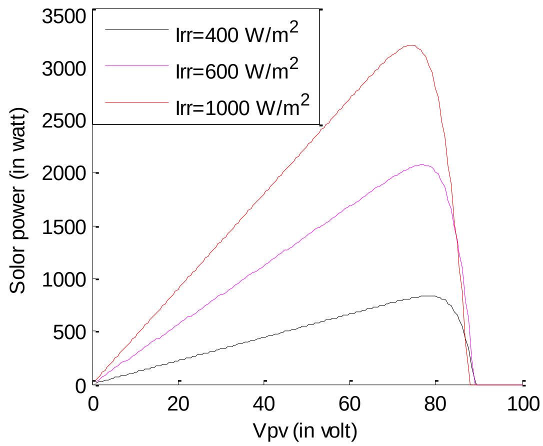

Fig: 9 The Graphof Vpv Vs Solar power for different Solar irradiation

Case study of indore for a typical daya is also simulated in the result ,

The temperature in indore for 4Th march 2015.

Time	Temperature	Solar irradition
08.30	16 °C	Assume 1000 Watt/m^2
12.30	27 °C	
17.30	25 °C	

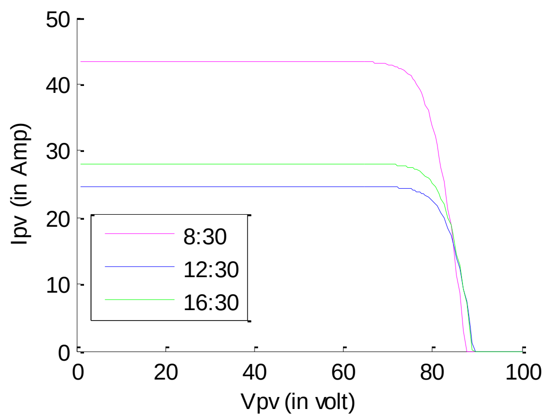

Fig: 10 Graphof Vpv Vs Ipv of solor panel for different day time

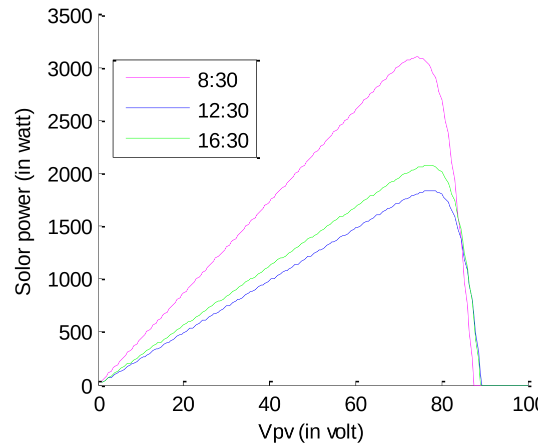

Fig:11 The Graphof Vpv Vs Solar power for different day time

Conclusion

Modeling and simulation of the solar panel with 36 solar cells has been completed. The characteristics of the solar panel is compare and found for different operating temperature the maximum power operating point is fixed. With different irradiation power, the maximum power point is shifted according the irradiation.

References example:

[1] *N. Pandiarajan and Ranganath Muthu, Mathematical Modeling of Photovoltaic Module with Simulink, International Conference on Electrical Energy Systems (ICEES 2011), 3-5 Jan 2011*

[2] *Aarti Gupta, Preeti Garg, grid integrated solar photovoltaic system using multi level inverter, Vol. 2, Issue 8, August 2013*

[3] *Mohamed A. Eltawil a,b, Zhengming Zhao, Grid-connected photovoltaic power systems: Technical and potential problems, Renewable and Sustainable Energy Reviews 14 (2010) 112–129*

[4] *Om prakash mahela & sheesh ram ola, modeling and control of grid connected*

ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

photovoltaic system: a review, Vol. 3, Issue 1, Mar 2013, 123-134

[5] *Shivananda Pukhrem, A photovoltaic panel model in matlab/simulink,*

[6] *Prakash Kumar Dewangan, Review of an Inverter For Grid Connected Photovoltaic (PV) Generation System international journal of scientific & technology research volume 3, issue 10, october 2014*

[7] *S.M.A.Faisal, Model of Grid Connected Photovoltaic System Using MATLAB/SIMULINK, Journal of Electrical Engineering*

[8] *P.Sudeepika, Analysis of Mathematical Model of PV Cell Module in Matlab/Simulink Environment, ijareeieVol. 3, Issue 3, March 2014.*

[9] *Tarak Salmi, MATLAB/Simulink Based Modelling of Solar Photovoltaic Cell, International journal of renewable energy research, Tarak Salmi et al., Vol.2, No.2, 2012*

[10] *M.Veerachary,"Power Tracking for Nonlinear PV Sources with Coupled Inductor SEPIC Converter," IEEE Transactions on Aerospace and Electronic Systems, vol. 41, No. 3, July 2005.*