

Solar Power Generation Systems of Different Temperature and Irradiance Ranges

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Abstract— The hybrid system of solar and wind is very useful in your day-to-day life. The various sources generally we are using like sun energy, wave power generation, hydropower generation, tidal water power energy, and thermal gradient energy sources. This type of energy source is readily available in the environment and can consume maximum power from the actual solar panels and windmills. In this paper, we are using solar energy by using photovoltaic cells, and wind energy by using windmills generator. Solar and wind energy are cost-effective and easy to use. It can be used in mobile phones, Laptops, Daily Home appliances, and various types of lighting loads, which can be the best energy sources for urban, and rural, areas. As day by day, the electricity consumption is increased, because the demand has been increased day by day. We have to switch to other renewable energy sources and use the electricity from these sources. Power-Voltage and Current-Voltage characteristics of solar cell panels were accomplished at different values of irradiance and temperature levels of solar panels.

Index Terms— Sun Energy, Wave Power, Electricity Generation, Fill Factor, Power, Voltage, Current

I. INTRODUCTION

The sun is a huge glowing sphere of very hot gases, The fusion reaction is obtained by the hydrogen atoms emission process carried out on the sun's surface. The sun's rays are reflected on the earth's atmosphere at a very huge and long distance. Thus, the beam rays acquired from the sun on the Earth are almost parallel in conditions. From the standpoint of utilization of solar power, we are more inquisitive in the energy sustained at the earth's surface than in the extra-terrestrial energy.

The solar power system may be contemplated in three areas and descriptions: -

[01] Direct Thermal Applications make immediate benefit of heat, associated with the absorption of a solar flare or sun power, for space heating (and cooling) of roofs, lodgings, and other buildings, so as to provide hot water service for such buildings, and to contribute heat for the agricultural, industrial sector, and other regressions that require only moderate temperatures.

[02] Solar thermal methods associate suppresses of high temperatures, such as standing in need to boil water or

other working fluid to be in charge of turbines that drive electric generators. These are cogitated about under solar thermal electric conversion.

[03] Photovoltaic Methods fabricate devices (Solar Cells) that conceal solar energy forthwith into electrical energy without putting into service machinery, by pressing into service the thermos electric effect, is also think about it.

[04] Wind Power is a form of solar energy that can be swayed into mechanical (rotational) energy and hence into electrical energy signifies a generator. This indirect use of solar energy yields electricity.

[05] Ocean thermal energy conversion depends on the irregularity in temperature between solar-heated surface water and cold deep ocean water to achieve a vapor expansion in the turbine and electric generator.

[06] Energy from Biomass and Biogas refers to the alteration into clean fuels or other energy-pertained products of organic matter borrowed directly or indirectly from plants that use solar energy to grow. Biomass materials encompass agricultural, farm-works, forest, and animal residues, in addition to terrestrial and aquatic plants exclusively for these methods.

[a] *The PV Generator:* - A cluster of modules connected in series and parallel with one and all.

Series-connected modules: In this series connection, the overall voltage takes into consideration the sum of the voltage of the individual module. The total current of the series of connected modules generates the least current. A series of connected modules is called a 'String'. The total current of the photovoltaic generator takes into consideration the sum of the current exile into each string. The total voltage of the system is contrary to the equivalent of the voltage stemming from individual strings.

The Electrical Attributes of Solar Cells: - A solar cell can furnish a photovoltage-accustomed photocurrent. The total composition of both this value photocurrent and photo electrical alongside solar cell principle can be accomplished is called as 'Working Point'. The value of the working point of a solar cell is fixed with a load resistance (R) imputable to the application of Ohm's Law principle.

$$R = \frac{V}{I}$$

The following concepts can be used, in the application of Ohm's Law, the photo electrical has a very small value at very little R, and the photocurrent is very low value at very large R. The short circuit condition and open circuit condition of a solar cell principle are demarcated as a R which is equal to zero in short circuit condition & R which is infinitely high in open circuit condition. Accordingly, the value of photocurrent and photo electrical at short circuit condition and open circuit condition is called short circuit current (I_{sc}) and Open circuit voltage (V_{oc}) respectively. The value of electric power in the short circuit condition is zero and the open circuit condition is zero on the operation of solar cell principle.

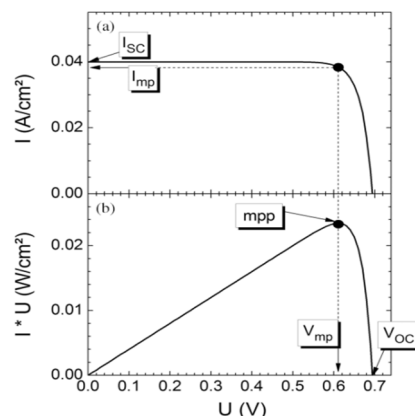


Figure 1: - (a) Current–Voltage characteristic of a solar cell (b) Power–Voltage characteristic of a solar cell

Figure 1 (a) Current Voltage characteristics (I - V characteristic) of solar cells (b) Power Voltage characteristics of solar cells. The maximum value of current is denoted as I_{max} and the maximum value of voltage is denoted as V_{max} . The maximum value of current I_{max} and maximum value of voltage is called as Maximum Power point (MPP).

$$P_{max} = I_{max} \times V_{max}$$

In the applying experiment in the solar array cell, the open circuit voltage V_{oc} and short circuit current I_{sc} are being applied. From these parameters of I_{max} , V_{max} , I_{sc} , and V_{oc} the ratio between these four parameters is called the Fill Factor.

$$FillFactor = \frac{I_{max} \times V_{max}}{I_{sc} \times V_{oc}}$$

The efficiency (η) of a solar cell is calculated as the proportion amidst the power abstraction at the maximum power point of the solar cell and the power of the sunlight at which the solar is enlightening (P_{sun})

$$\eta = FF \times \frac{I_{sc} \times V_{oc}}{P_{sun}}$$

II. MATHEMATICAL MODELLING OF PHOTOVOLTAIC GENERATOR

The simulation model of the photovoltaic generator is used to simulate the different values of irradiance data. The various value of irradiance data is calculated and the following results can be obtained. The power generation can be calculated by applying the photovoltaic Generator principle.

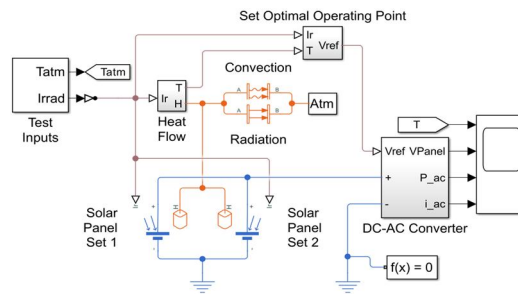


Figure 2: - Mathematical Modelling of Photovoltaic Generator

III. SIMULATION MODEL PARAMETERS VALUE

TABLE I: DIFFERENT PARAMETERS AND THEIR RATINGS TO CARRY OUT THE SIMULATION PROCESS

Sr. No	Different Parameters	Rating 1	Rating 2	Rating 3
	Cell Characteristics Solar Panel: -			
01.	Diode Saturation Current	3.15×10^{-7} Amp	3.15×10^{-7} Amp	3.15×10^{-7} Amp
02.	Solar Generated current measurement	3.80 Amp	3.80 Amp	3.80 Amp
03.	Irradiance used for measurements	1000 W/m ²	1100 W/m ²	1200 W/m ²
04.	Series Resistance (Rs)	0.0042 ohm	0.0042 ohm	0.0042 ohm
05.	Parallel Resistance (Rp)	10.1 ohm	10.1 ohm	10.1 ohm
	Panel Configurations: -			
01.	Number of series connected cells per string	700	800	900
02.	Number of parallel connected strings	01	01	01

	Temperature Dependence: -			
01.	First-order temperature coefficient	0.000805 1/K	0.000805 1/K	0.000805 1/K
02.	Energy Gap	1.14 electron volts	1.14 electron volts	1.14 electron volts
03.	Measurement Temperature	25° C	35° C	45° C

IV.RESULT

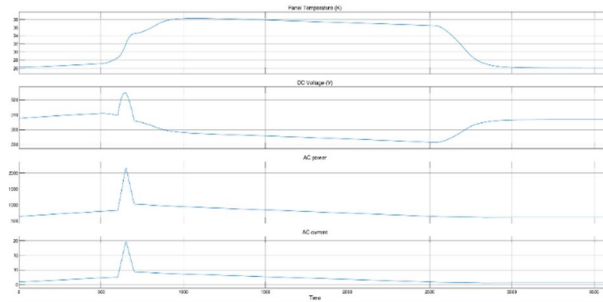


Figure: 3 Representation of Temperature, Voltage Power, Current

- (a) Irradiance used for measurements = 1000 W/m²
- (b) Number of series connected cells per string = 700
- (c) Measurement Temperature = 25 ° C

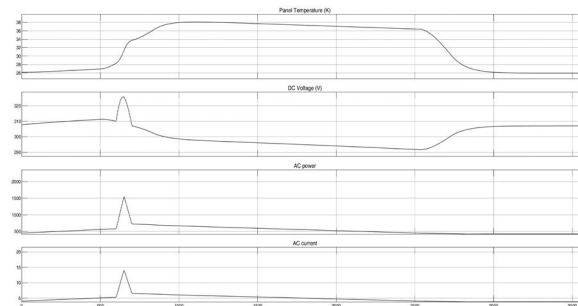


Figure:- 4 Representation of Temperature, Voltage Power, Current

- (a) Irradiance used for measurements = 1100 W/m²
- (b) Number of series connected cells per string = 800
- (c) Measurement Temperature = 35 ° C

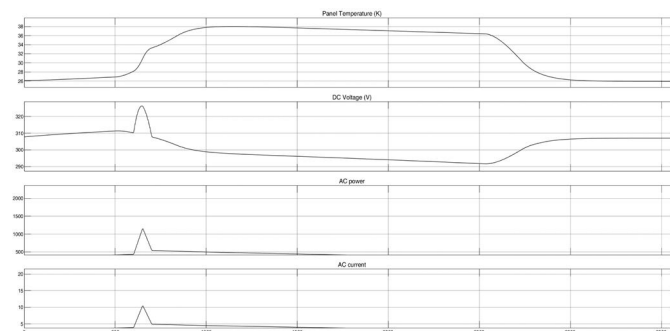


Figure:- 5 Representation of Temperature, Voltage Power, Current

- (a) Irradiance used for measurements = 1200 W/m²
- (b) Number of series connected cells per string = 900
- (c) Measurement Temperature = 45 ° C

V. CONCLUSION

The comparison is carried out by considering different ratings of Irradiance used for measurements, the Number of series connected cells per string, and Measurement Temperature. The result is observed that the AC power and AC if changed due to the change of these parameters. The Irradiance and temperature may affect the solar panel strings. The two parallel strings are connected and a simulation graph is being observed. The graphical representation of the characteristics curve of panel temperature (K), DC Voltage (V), AC Power (P), and AC Current (I). On the X-axis the Time curve is plotted on Y – the Y-axis the Panel temperature (K), DC Voltage (V), AC Power (P), and AC Current (I) are plotted and the following result has been observed.

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