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STUDY OF MAXIMUM POWER POINT TRACKING(MPPT) IN SOLAR PV ARRAY SYSTEM

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ABSTRACT

The problem being solved using maximum power point tracking MPPT techniques is to find the voltage VMPP or current IMPP at which a photovoltaic module should operate to obtain the maximum power output PMAX under a given temperature and illumination (solar irradiation). This paper gives an overview about some used techniques for power point tracking. The results which will be presented will also demonstrate the influence of temperature and solar irradiation (illumination) on the output power.

KEYWORDS: Photovoltaic array, Maximum power point, Solar cell.

INTRODUCTION

The growing energy demand coupled with the possibility of reduced supply of conventional fuels, evidenced by petroleum crisis along with growing concerns about environmental conservation has driven research and development of alternative energy sources that are cleaner, renewable, and produce little environmental impact. Among the alternative sources, the electrical energy from solar energy is currently regared as a natural energy source that is more useful since it is free, abundant, clean, and distributed over the earth and participates as a primary factor of all other processes of energy production on earth.

The overall socio economic growth results in escalating energy demand as conventional sources of energy is not sufficient to fulfill present energy need. One of the greatest concerns is due to the skyrocketing growth of fossil fuels prices. Another factor is the carbon emission due to conventional energy sources lead to global warming. Renewable energy sources like solar and wind energy are best options available of to achieve the entire above objective.

Solar energy is an abundant source, which is free of cost and available to all. Two methods are there to extract the solar energy 1) Solar thermal plants 2) Solar cells i.e. photovoltaic cells. Among wide variety of renewable energy projects in progress, photovoltaic cell (Solar PV) is one of the most promising future energy technologies options. The direct conversion of solar radiation to electricity by PV cells has a number of significant advantages as an electricity generator but some significant challenges to be overcome to make use of Solar energy like energy cost, energy fluctuation, location dependence, huge investment requirements. The efficiency enhancement is a big issue in reducing cost of PV system since maintenance requirement is very low in PV systems the only real cost savings to be made is in reducing capital cost of installation.

PV MODELING:- A PV array consists of several photovoltaic cells in series and parallel connections. Series connections are responsible for increasing the voltage of the module whereas the parallel connection is responsible for increasing the current in the array. Typically a solar cell can be modeled by a current source and an inverted diode connected in parallel to it. It has its own series and parallel resistance. Series resistance is due to hindrance in the path of flow of electrons from n to p junction and parallel resistance is due to the leakage current.

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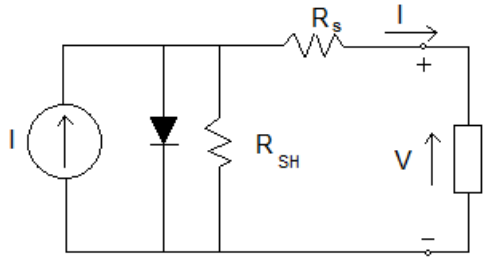


Fig(1):single diode model of PV cell

The output current **I** is:

$$I = I_{ph1} - I_{s1} * \left(e^{(V+I*R_s)/(N_1 V_t)} - 1\right) - I_{s2} * \left(e^{(V+I*R_s)/(N_2 V_t)} - 1\right) - \left(V + I * R_s\right)/R_p$$

Where,

Iph is the solar-induced current:

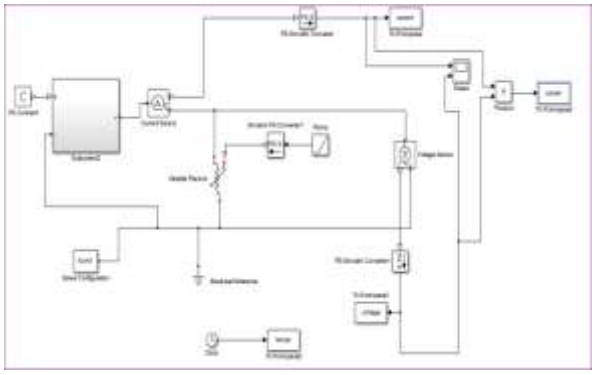
$$I_{ph} = I_{ph0} \times \frac{I_r}{I_{r0}}$$

- **Ir** is the irradiance (light intensity) in W/m2 falling on the cell.
- **Iph0** is the measured solar-generated current for the irradiance **Ir0.**
- **Is** is the saturation current of the first diode.
- **Is2** is the saturation current of the second diode.
- **Vt** is the thermal voltage, **kT/q**, where:
- **k** is the Boltzmann constant.
- **T** is the Device simulation temperature parameter value.
- q is the elementary charge on an electron.
- **N** is the quality factor (diode emission coefficient) of the first diode.
- **N2** is the quality factor (diode emission coefficient) of the second diode.
- **V** is the voltage across the solar cell electrical ports.

The quality factor varies for amorphous cells, and is typically 2 for poly crystalline cells.

SIMULATION MODEL OF SOLAR CELL DESIGN AND PARAMETER

Above model shows the simulation of solar photovoltaic cell. In this model two subsystems are connected in parallel and in every parallel subsystem six solar cell are connected in series. Subsystems2 are connected with current sensor and voltage sensor which measure the value of current and voltage with different solar irradiation and temperature



Fig(2). Simulink model of solar cell

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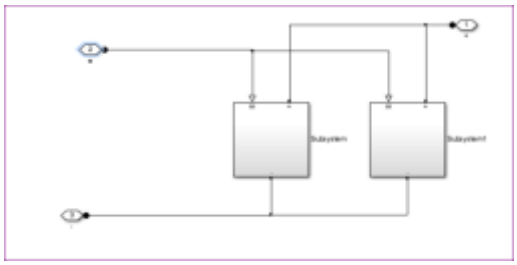
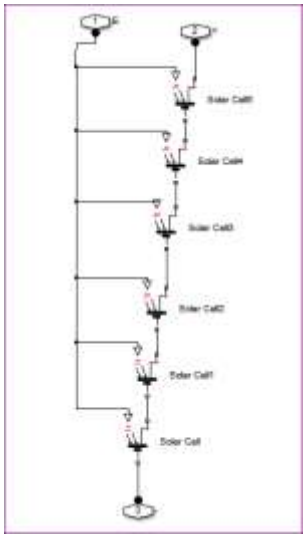


Fig(3). Simulink Model of subsystem2



Fig(4).Simulink model of subsystem

Where,
Isc :- Short circuit current(7.34A)
Voc :- Open circuit voltage(0.6V)
Iro :- Irradiation(1000W/M^2)
N :- Quality factor(1.5)
Rs :- Series resistance(0)
Rsh :- shunt resistance(infinite)

Data sheet In the month of march:- This data sheet shows the value of temperature and radiation in the month of march. It represents the different values of temperature and radiation with different time. Temperature and radiation are shown below:-

Table 1 :-

Time	Avg.Temp	Avg.Radiation
8-10AM	25	500
10-12AM	28	700
12-02PM	33	1000
02-04PM	38	800
04-06PM	30	200

MAXIMUM POWER POINT FOR DIFFERENT CONDITION

Three operating temperature $25°c, 50°c, 100°c$ and three operating radiation 1000W/m^2, 500W/m^2, 200W/m^2 is considered. With change in time solar radiation also changes. Solar PV in this example with a load resistive type gives

three characteristic with different time also the maximum power points would be change. Maximum power point tracking is all about solar PV module to run at the maximum power point. The electronic circuitry used to track the maximum power point is known as maximum power point tracker. There are methods are there to track the maximum power point.

V-I Characteristics Curves of the PV array with different solar irradiation:-

In the below three figure current is constant with voltage and in particular point of voltage current is decrease,in this point current is maximum.amplitude of current is decreases in different solar irradiation.

Irradiation:- 1000W/m^2

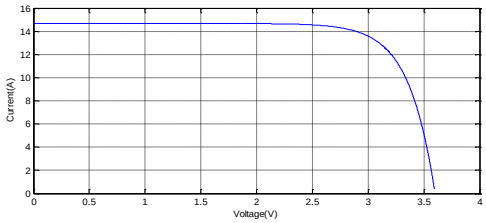


Fig1.Graph between voltage and current

Irradiation:- 500W/m^2

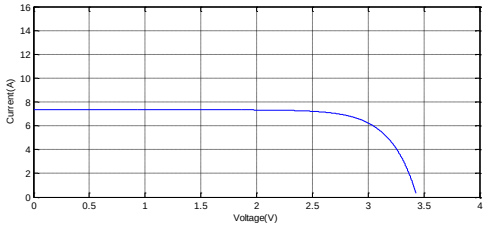


Fig2.Graph between voltage and current

Irradiation:- 200W/m^2

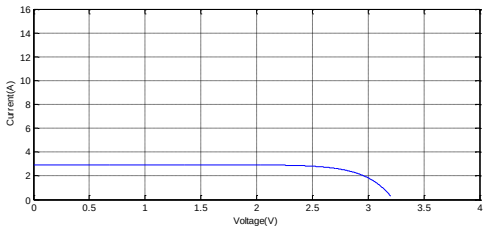


Fig3.Graph between voltage and current

P-V Characteristics Curves of the PV array with different solar irradiation:-

In the below three figure power is increases with voltage but in particular point of voltage power is decreases.At which point when power is decreases,it is a maximum power point.

Irradiation:- 1000W/m^2

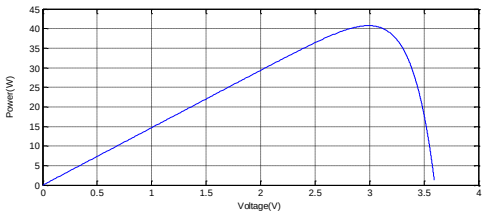


Fig1.Graph between voltage and power

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Irradiation:- 500W/m^2

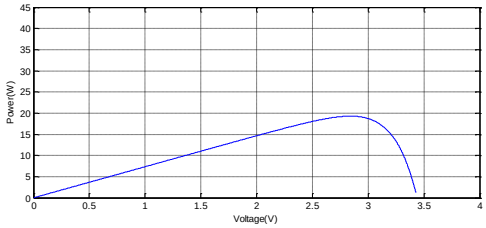

Fig2.Graph between voltage and power

Irradiation:- 200W/m^2

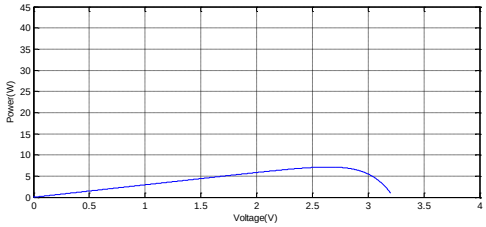

Fig3.Graph between voltage and power

V-I Characteristics Curves of the PV array with different solar temperature:-

In the below three figure current is constant with voltage and in particular point of voltage current is decrease,in this point current is maximum. Value of current is constant but voltage is changes in different solar temperature.

Temperature:- 25°*c*

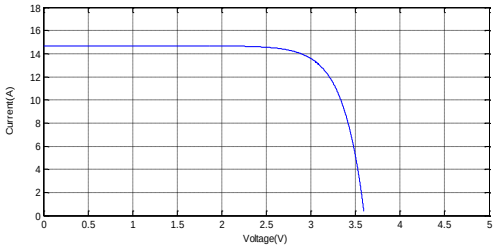

Fig1.Graph between voltage and current

Temperature:- 50°*c*

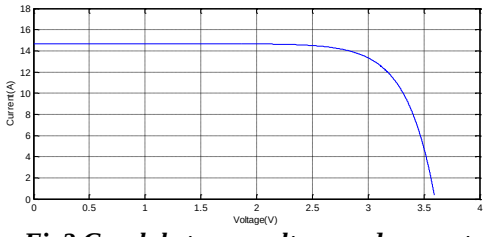

Fig2.Graph between voltage and current

Temperature:- 100°*c*

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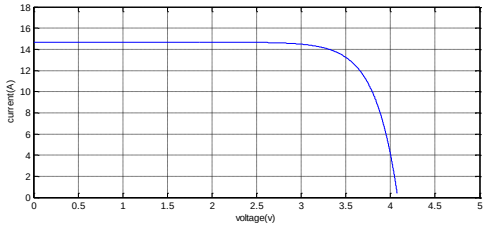

Fig3.Graph between voltage and current

P-V Characteristics Curves of the PV array with different solar temperature:-
In the below three figure power is increases with voltage but in particular point of voltage power is decreases.At which point when power is decreases,it is a maximum power point.

Temperature:- 25°*c*

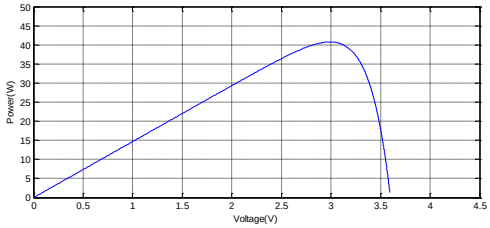

Fig1.Graph between voltage and power

Temperature:- 50°*c*

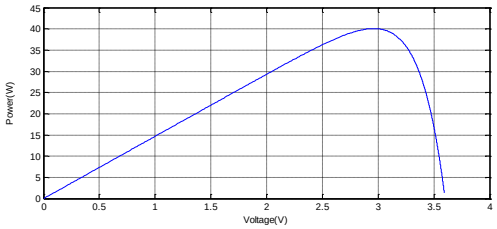

Fig2.Graph between voltage and power

Temperature:- 100°*c*

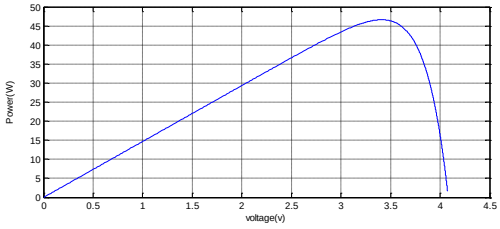

Fig3.Graph between voltage and power

CONCLUSION

Simulink model of solar photovoltaic panel are discussed in this paper. The plots obtained in the different scopes have been seen.Various system to obtain Maximum Power Point in solar PV have been discussed.Maximum power point is obtained in different solar radiation and temperature. From the simulation's results, one can conclude that the performance of the solar generator degrade with an increase in temperature and a decrease of the intensity of the solar irradiation.

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