Determination Of Parameters Of A Given Spv Module Using Solar Pvtr

[1]B.Prem Charan, [2]Dr.G.Suresh Babu, [3]Priyanka shukla
[1]Assistant Professor, [2]Professor, [3]Assistant Professor
[1,2,3]EEE Department, Abhinav HI-Tech college of Engineering, Hyderabad, India

Abstract: Indeed, it is undoubtedly accepted that the presence of SPV (solar photovoltaic) module is ubiquitous. The power voltage characteristic of photovoltaic (PV) module operating under partial shading conditions, under different tilt angles the output power obtained will be varied. In this paper a new method of obtaining maximum power by using bypass diode is implemented on a PVTR (photo voltaic trainer research system), such that uninterrupted output power can be achieved. The experimental results verify that the output power is varied with the varying of panel cells that are under shading area and with the change in the angle. Compared to many ways of studying the performance of a SPV module at different places, It is very convenient to study the effects that impact the electrical parameters which can be observed on a single equipment at one place named as standalone PVTR system.

Index terms: PVTR system, PV module, Bypass diode, partial shading, Pyranometer.

1. Introduction

In typical photovoltaic (PV) installations, PV arrays are formed by connecting multiple PV modules in various configurations (i.e, series, parallel, series-parallel)[1].A Bypass diode is connected in parallel with each PV module to protect the solar cells against efficiency degradation and hot-spot failure effects. When there is no effect of shade on the cells of a module or no change in the tilt angle i.e, under uniform conditions maximum power obtained will be constant. However, under partial shading conditions (due dust on the cells, shading due to trees or poles etc..) and the module subjected to change with an angle, the constant power cannot be achieved i.e, power is varied. But power output can be increased with the help of Bypass diode, for which modules are preferred to connect parallel to avoid partial shading effect.

In order to realize this concept, three hardware experiments are carried out on solar PVTR system which are discussed in the subsequent sections chronologically.

II. Experimentation

1. The effect of variation in tilt angle on PV module power

***Motivation*:** To draw the graphs of radiation Vs tilt and tilt Vs power. Tilt is the angle between the plane surface under consideration and the horizontal plane. It varies between 0-900. PV arrays work best when the sun's rays shine perpendicular to the cells. When the cells are directly facing the sun in both azimuth and altitude, the angle of incidence is normal. Therefore, tilt angle should be such that it faces the sun rays normally for maximum number of hours.

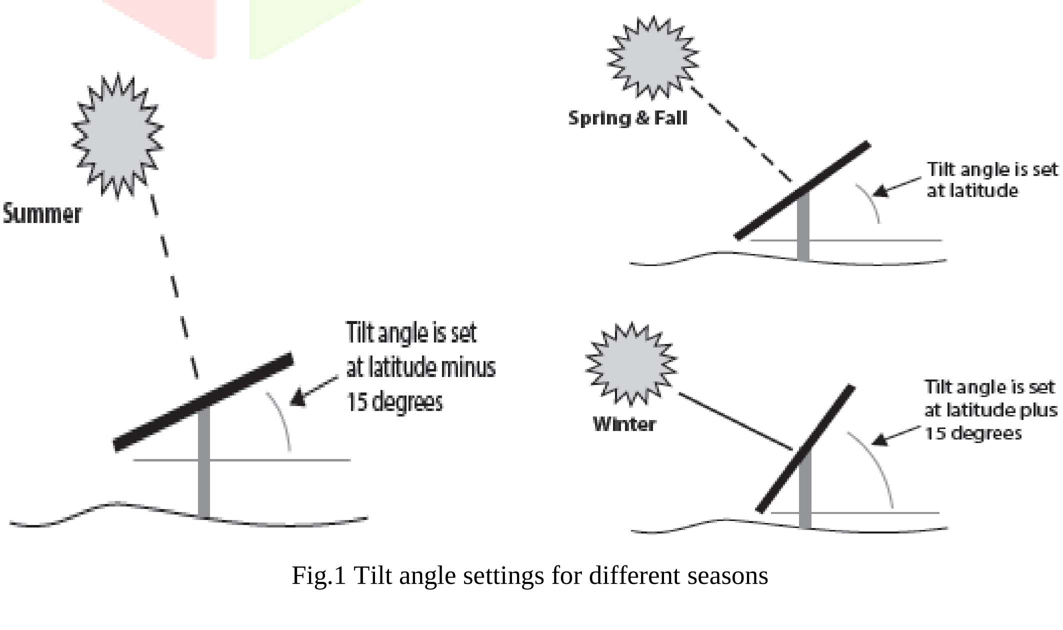

Fig.1 Tilt angle settings for different seasons

The tilt angle settings for different seasons are shown in Figure1, PV systems that are designed to perform best in the winter; array should be tilted at an angle of equal to latitude +15°. If the array is designed to perform best in the summer, then the array needs to be tilted at an angle of equal to latitude−15°. In this way the array surface becomes perpendicular of the sun rays. For best performance throughout the year, tilt should be equal to the latitude angle.

`The tilt angle of the module can be changed by rotating the lever below the module. Lit the halogen lamp and change the tilt of the module by rotating the lever.

To evaluate effect of tilt on power output of the module, following connections are to be done in the control board and reading of tilt can be observed and noted from the figure d. The pot meter in this case has to be fixed at constant position so that the effect of tilt can be seen. The radiation can be measured with the help of a instrument called Pyranometer. The voltage and current readings are recorded and power is calculated with respect to the tilt angle as shown in the table 1.1 and graph is drawn shown in figure 2.

Table.1.1 Effect of tilt angle w.r.t power

Tilt (degree)	Radiation (W/m2)	V (Volts)	I (Ampere)	P (Watt)
15	353.8	12.3	0.13	1.599
20	336.6	10	0.11	1.1
25	318	7.8	0.09	0.702
30	288	6.4	0.08	0.512
35	230	5.2	0.05	0.26
40	186	3.2	0.033	0.1056
45	124	2.1	0.01	0.021

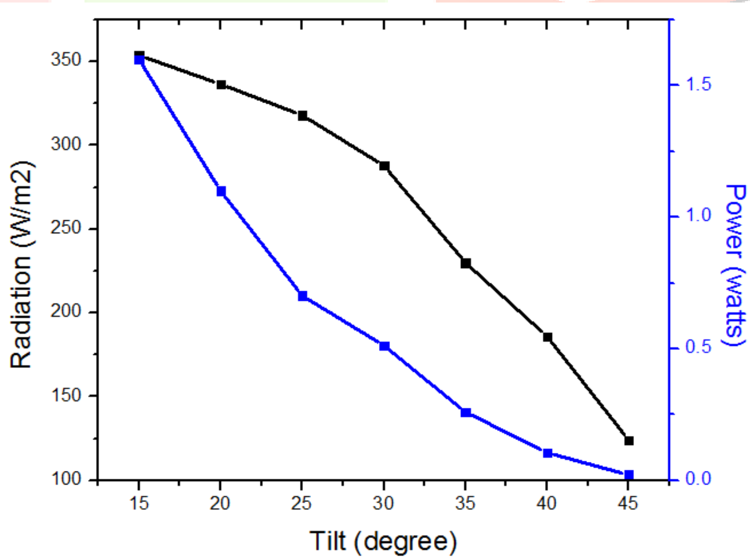

fig.2 Graph showing the tilt effect on Radiation & Power

TERMINATION:

From the figure 2 it is observed that as the tilt of the solar photovoltaic system changes or increases, the radiation effect decreases and consequently the power also reduces.

2. The effect of shading on module output power

***Motivation*:** To record the variation of power output while gradual shading of the module occurs.

There are 36 solar cells in a module. These 36 solar cells are in series as shown in Figure3 which makes the module as series connected solar cells. These cells are in series without bypass diode so shading of one cell will be sufficient to reduce the power to zero. This arrangement gives zero power if the entire row of cells gets shaded.

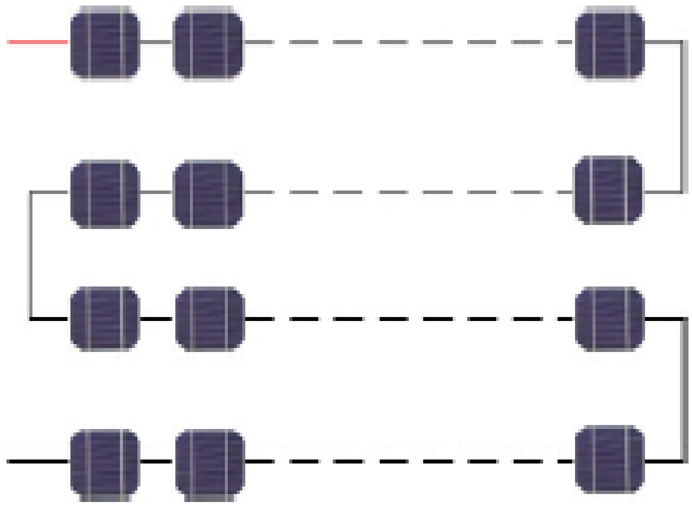

fig.3 Internal structure of the module

There are shading elements of different sizes (single cell, two cells, four cells and 9 cells of module) for covering the solar cell (or cells) of module completely. For executing this experiment [1], [5],[8],[9], put one of these shading elements on the solar cell(s). After making the cells shaded by different sizes of shading elements, note down the readings of current and voltage.

Table.2.1 Voltage and current readings w.r.t shaded cells

Type of shading elements	**Voltage** (Volts)	**Current** (Ampere)	**Power** (Watt)
0	17.2	0.27	4.644
1	7.6	0.11	0.836
2	2.9	0.04	0.116
4	1.7	0.02	0.034
9	1.1	0.01	0.011

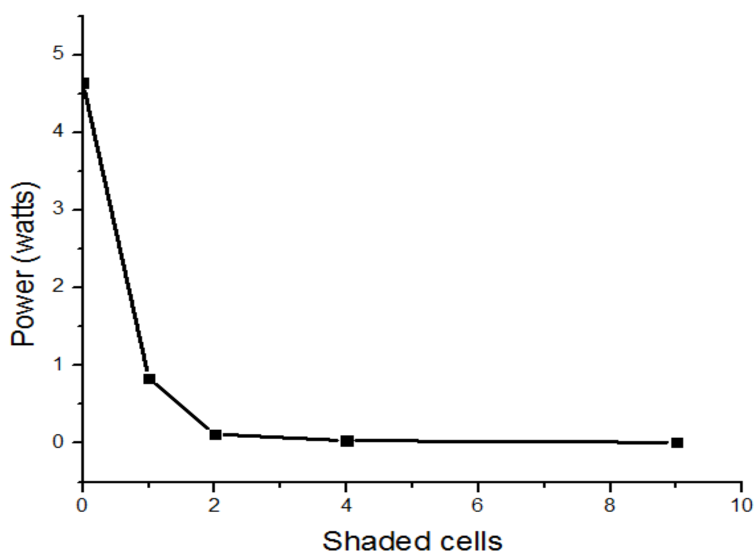

fig.4 Graph showing variation of power w.r.t shaded cells

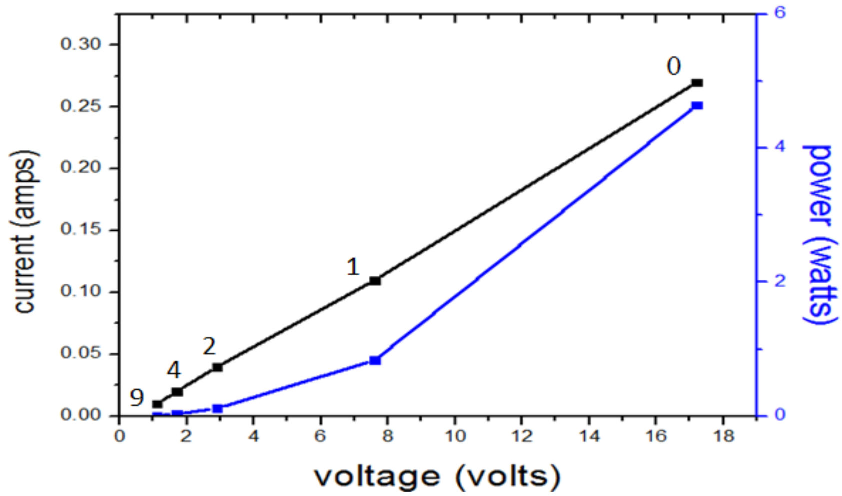

fig.5 graph showing IV and PV curves for shaded cells

TERMINATION:

As the number of cells getting shaded increases the output power gets reduced. This is an alarming indication to shun away the solar photovoltaic system from any type of shading.
From the IV curve drawn in figure5, observed that it is a linear curve.

3. The significance of Bypass diode

Motivation**:** To study the importance of a bypass diode when the module is shaded.

If two modules are in series then the current in circuit will be decided by the module which is generating less current. Hence if one module is completely shaded then the current in the circuit will be zero. If there is a diode in parallel with the shaded module then power output of non-shaded module gets bypassed by diode and will be available at load terminals.
There are two diodes which can be used as a blocking diode as well as bypass diode [1]. But in our experiment we have conducted for the bypassing of a diode. To show the effect clearly the voltage and current reading s are taken before shading the panel.
Voltage and current Readings are taken for the modules connected in series from PVTR system after shading one module completely and the diode is connected across the module.

Table 3.1voltage & current Readings for with and without bypass diode

	Current (A)	Voltage (V)	Power (W)
Module Connected In series	0.29	18.9	5.481
After Shading 1 Module	0	0	0
After Diode Connected Across Shaded Module	0.25	15.8	3.95

TERMINATION:

Power output of series connected modules before using bypass diode with shaded module will be close to zero. After using bypass diode with shaded module, power output of series connected modules gets increased from nearly zero to higher value. which is shown in the table 3.1.

Fig.6 single panel completely shaded

fig.7 some cells of a solar panel is shaded

fig.8 solar PVTR system with control board connections

fig.9 Tilt angle indicator in solar PVTR system

Conclusion:

The PV and IV characteristics of a given SPV module are recorded by performing the three chronological experiments.

1. From the figure 2, it is observed that as the tilt of the solar photovoltaic system changes or increases, the radiation effect decreases and consequently the power also reduces. It is inferred from the first experiment that the power reduction is approximately 70% for the corresponding 33% increase in the tilt angle position .

2. As the number of cells getting shaded increases the output power gets reduced. This is an alarming indication to shun away the solar photovoltaic system from any type of shading. From the IV curve drawn in figure5, observed that it is a linear curve. The results of the second experiment reveal that as the shading of cells increases the output powerreduces drastically 3.

Power output of series connected modules before using bypass diode with shaded module will be close to zero. After using bypass diode with shaded module, power output of series connected modules gets increased from nearly zero to higher value. which is shown in the table 3.1. The outcome of the third experiment is noteworthy that the presence of bypass diode has enhanced the output power to approximately 50% in the event of shading effect.

Some more experiments may be carried out by connecting AC and DC loads on it.

References

1) comparative analysis of I-V & P-V characteristics of a series and parallel connected SPV modules

2) Hiren Patel and Vivek Agarwal, "MATLAB-Based Modeling to Study the Effects of Partial Shading on PV Array Characteristics", *IEEE,march 2008*

3) Tey Kok Soon and Saad Mekhilef, "A Fast-Converging MPPT Technique for Photovoltaic System Under Fast-Varying Solar Irradiation and Load Resistance" *in IEEE,* VOL. 11, NO. 1, FEBRUARY 2015.

4) Izete Zanesco, Sérgio Boscato, Garcia Adriano Moehlecke, Sérgio Boscato Garcia, "Development of a PV System as a Way to Promote the Technology" JULY 2011 IEEE.

5) Manish Khemariya and Arvind Mittal, "Modeling & Simulation of different components of a stand-alone Photovoltaic and PEM Fuel Cell Hybrid System" International Journal on Emerging Technologies.

6) Eftichios Koutroulis and Frede Blaabjerg, "A New Technique for Tracking the Global Maximum Power Point of PV Arrays Operating Under Partial-Shading Conditions" IEEE journal of photovoltaic's, vol. 2, no. 2, April 2012.

7) DIKE,DAMIAN OBIOMA, "Characterization of high penetration of photovoltaic system" International journal of engineering and science

8) parvathy suresh , jaimol Thomas, "performance analysis of standalone PV system using PV SYST".

9) Basim A. Alsayid, Samer Y. Alsadi, Ja'far S. Jallad, Muhammad H. Dradi, "Partial Shading of PV System Simulation with Experimental Results" http://dx.doi.org/10.4236/sgre.2013.46049 Published On September 2013.