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## MODELING OF PHOTOVOLTAIC MODULE USING BUCK-BOOST CONVERTER WITH PWM CONTROLLING

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## ABSTRACT
Our aim is to increase the efficiency and get the maximum power from the pv system. It is also required that constant voltage be supplied to the load irrespective of the variation in solar irradiance and temperature. To achieve stabilization from above two variation. We have designed a buck boost circuit such that it delivers constant dc voltage to the load. The photovoltaic module is analyzed using MATLAB SIMULINK software. Then we coupled the PV array with the buck boost converter..Now there are cases when isolation level is high and low that it may cause dangerously high power across the load. Under such conditions this DC-DC buck boost converter will automatically start working in buck/boost mode. Now every time when the power crosses its upper limit the DC-DC converter will switch to buck/ mode and when safe power is reached. The output voltage is adjustable based on the duty cycle of the switching transistor. which will control the pwm controller and maintain constant load voltage.

**KEYWORDS**: Pv module, Buck-Boost Converter, PWM Controlling etc.

## INTRODUCTION
The conversion of solar energy into electric energy is performed by means of photovoltaic (PV) generators. Photovoltaic offer the highest versatility among renewable energy technologies. Electricity produced from photovoltaic (PV) systems has a far smaller impact on the environment than traditional methods of electrical generation. The most attractive features of solar panels are the nonexistence of movable parts, the very slow degradation of the sealed solar cells and the extreme simplicity of its use and maintenance. Another advantage is the modularity. All desired generator sizes can be realized, from the mill watt range to the megawatt range. Solar energy is a pollution-free source of abundant power. During their operation, PV cells need no fuel, an give off no atmospheric or water pollutants and require no cooling water. The use of PV systems is not constrained by material or land shortages and the sun is a virtually endless energy source.

Worldwide energy consumption has increase The photovoltaic (PV) cell is basically a p-n junction fabricated in a thin wafer of semiconductor. The solar energy is directly converted to electricity through photovoltaic effect. PV cell exhibits a nonlinear P-V and I-V characteristics which vary with cell temperature (T) and solar irradiance (S). Different

equivalent circuit models of PV cell have been discussed in literature. The system performance can be optimized by connecting the pv model with buck-boost converter.
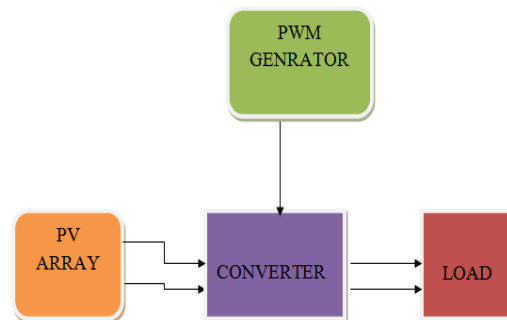


*Fig: 1 Solar system module*

Solar powered electrical generation relies on photovoltaic system and heat engines. The solar energy's uses are limited only by human creativity. To harvest the solar energy, the most common way is to use photo voltaic panels which will receive photon energy from sun and convert to electrical energy source. Solar technologies are broadly classified as either passive solar or active solar depending on the way they detain, convert and distribute solar energy.

Solar energy is abundantly available that has made it possible to harvest it and utilize it properly. A solar energy can be a standalone generating unit or can be a grid connected generating unit depending on the availability of a grid nearby. Thus it can be used to power rural areas where the availability of grids is very low.

## PHOTOVOLTAIC

A Photovoltaic (PV) system directly converts solar energy into electrical energy source. The basic device of a PV system is the PV cell. In the cells may be grouped to form arrays. In the voltage and current available at the terminals of a PV device may directly feed small loads such as lighting systems and DC motors by using proper energy conversion. This photovoltaic system consists of main parts such as PV module, battery, charger, inverter and load.

### Equivalent model

A Photovoltaic cell is a device used to convert solar radiation directly into electricity signal. It consists of two or more thin layers of semiconducting material, and most commonly silicon. When the silicon is exposed to light , electrical charges are generated. PV cell is usually represented by an electrical equivalent one-diode model shown in fig.2.
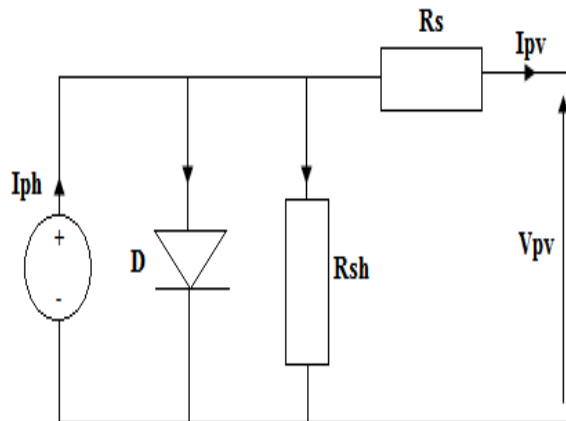


*Fig: 2 Photovoltaic cell modeling as diode circuit*

The current source $Iph$ represents the cell photocurrent. In usually the value of $Rsh$ is very large and that of $Rs$ is very small signal, hence they may be neglected to simplify the analysis. The photovoltaic (PV) cells are grouped in larger units called PV modules which are further interconnected in a parallel-series configuration to form PV arrays.

Modeling photo-current

$$I_{ph} = [I_{SCr} + K_i i(T - 298)] * \lambda/1000 \quad (1)$$

Module reverse saturation current – Irs

$$I_{rs} = I_{SCr}/[\exp\left(\frac{qV_{OC}}{N_s kAT}\right) - 1] \quad (2)$$

The module saturation current $I_0$ varies with the cell which is given by

$$I_0 = I_{rs}\left[\frac{T}{T_r}\right]^3 \exp\left[\frac{q*E_{g0}}{Bk}\left\{\frac{1}{T_r} - \frac{1}{T}\right\}\right] \quad (3)$$

$$I_{pv} = N_p * I_{ph} - N_p * I_0\left[\exp\left\{\frac{q*(V_{PV}+I_{PV}R_S)}{N_s kAT}\right\}\right] - 1 \quad (4)$$

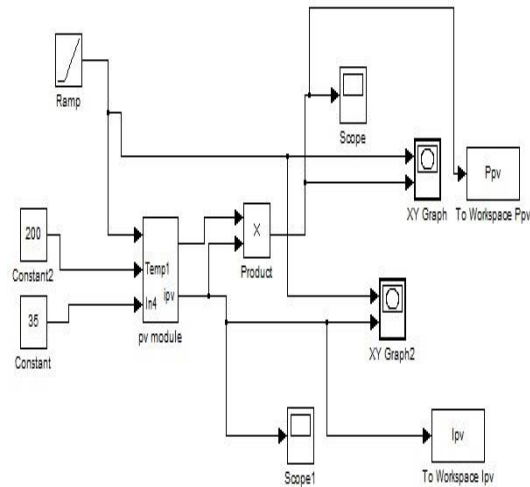Where Vpv = Voc, Np = 1 and Ns = 36



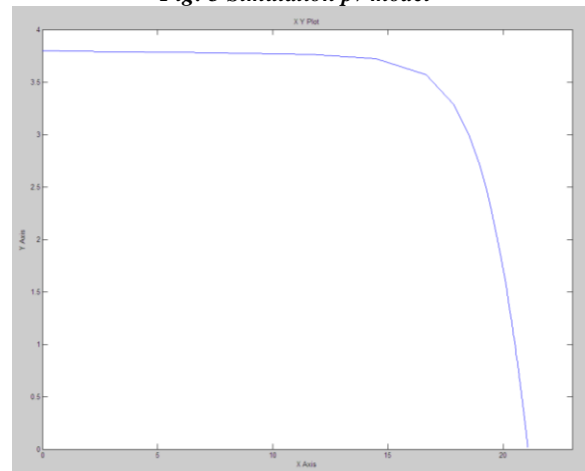*Fig: 3 Simulation pv model*

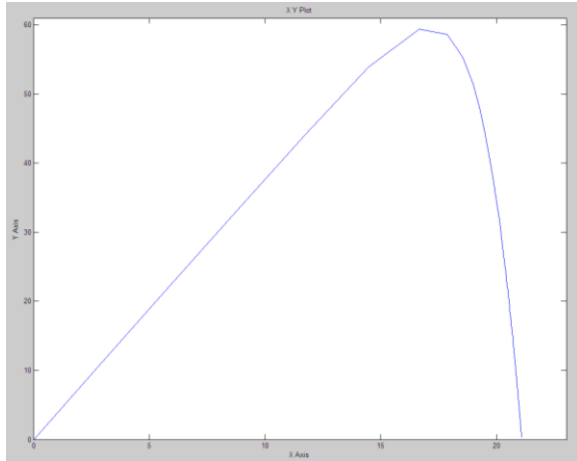

*Fig: 4 Characteristic for PV*

*Fig: 5  P-V curve*

### *Buck-Boost Converter Modeling*

A buck boost converter is a DC-to-DC power converter with an output voltage either greater or smaller than its input voltage source. It is a combination of the buck converter topology and a boost converter topology in cascade. Output to input conversion ratio is also a product of ratios in buck converter and the boost converter. In the output voltage is controlled by controlling the switch-duty cycle. In term D is the duty ratio and defined as the ratio of the on time of the switch to the total switching period. In this shows the output voltage to be hgher or lower than the input voltage, based on the duty-ratio D.
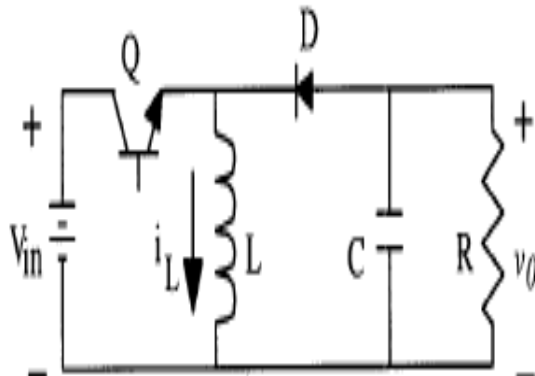


*Fig: 6 Buck boost converter*

## RESULTS AND DISCUSSION
### *System description*
In this paper, the simulation model is developed with MATLAB/SIMULINK.. The circuit needs independent dc source which is supplied from photovoltaic cell (PV cell). The inputs are fed by voltage and current of the photovoltaic terminals, while the output provides duty cycle for the buck

boost converter. The buck boost converter injected the power from the pv panel and the P controller starts function, varies the value of duty cycle which will change the input value that is sensed by the Pcontroller. For using the P controller the error has been minimized in the system and the efficiency is improved.

The switching frequency control or PWM duty ratio control is required. In the  buck-boost converter. The input voltages from are possible to produce constant output which will be use in the design of solar home applications effectively. The average value of (voltage and current) fed to the load is controlled by turning the switch between supply and load. Its main use is to allow the control of power supply to electrical drive the advantage of pwm is power loss in switching is low the  duty cycle of pwm signal is proportional to control voltage and determine the percentage of time that switching element conduct . Pwm also work well with digital controls which because of their on/off nature can easily set the needed duty cycle.
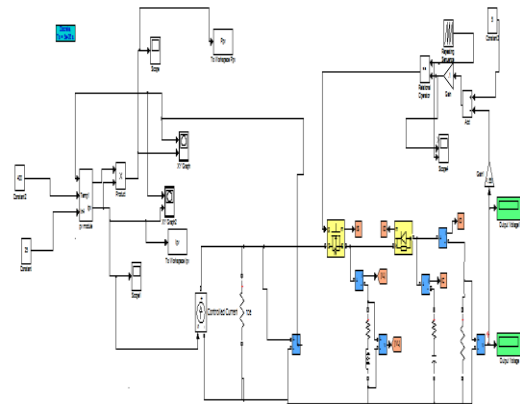


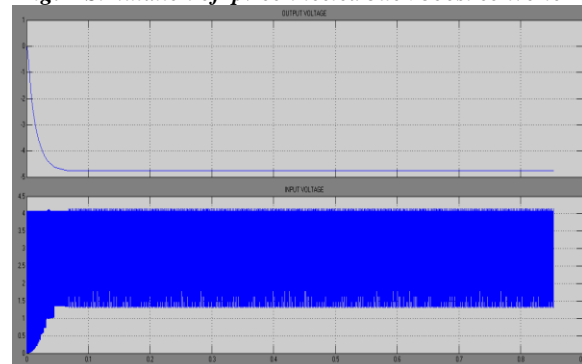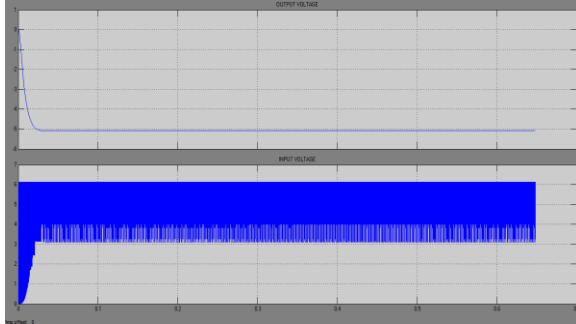*Fig: 7 Simulation of  pv connected buck boost converter*

*Fig: 8   Constant  output voltage in boost mode*



*Fig: 9 Constant output  voltage of buck mode*

In fig 8 . give the 400 w/m2  radiation and give the 5 V(approx..) constant output voltage.In fig.9 giv the 600 w/m2 radiation and give 5V constant output voltage.

## CONCLUSION

Simulated pv module circuit with Buck-boost converter. This will help to understand the PV characteristics dc to dc converter topologies, component calculation & circuit design. A step by step procedure of modeling a PV module is shown in the simulation model. The curve between P-V & V-I is shown for varying temperature & varying irradiance. PV interfaced with a buck-boost converter. Vary the input radiation  and get the constant output voltage connect to the load .This output is buck/boost condition because variation in irradiation The output voltage is controlled by controlling the (pwm)switch-duty cycle

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