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Application of Buck-Boost Converter for Solar Energy Control

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ABSTRACT: In this paper we represent use of Buck- Boost Converter for Solar energy control. We can overcome the problem of the voltage variation of the electrical output from Solar Energy. So the output voltage will be constant throughout generation of electricity. Eventually there have been much advancement in Solar Energy technology but the technological advancements are still needed for Solar power control for different loading conditions. By using the buck booster convertor, we can keep the voltage constant which is helping for distribution the electricity during any environmental condition. The power is controlled with the help of Buck-Boost Converter connected across the dc link to keep constant voltage supply at output side. The simulation is carried on MATLAB/ SIMULINK.

KEYWORDS: Solar Energy, Buck Converter, Boost Converter

I . INTRODUCTION

The Solar Energy is one of the source of non-conventional energy power generation though there are some drawback of such system that when Solar Energy is variable output which is changing as per rate of flow of Sun light naturally the o/p is also varying thus the grid power is variable so we can't get constant or a span of voltage which can further process The Solar Energy research has done for long duration to invent the basic method not only maintain the o/p voltage but to study via communication protocol using GSM the wireless system monitors from remote end the parameters like voltage current & Solar control o/p using buck & boost technology.

Developing local sources to meet our energy needs means that we import less fuel from other states, regions, and nations, thus our energy funds are plowed back into the local economy. Solar energy can also help diversify the economies of rural communities and can generate jobs. Solar energy is a hedge for the future as our traditional fossil fuels become scarcer and public policies assign environmental costs to sources of pollution. While there is a general appreciation of the fact that Solar energy is a clean source of power, and is also economical in the long term, there has been some public concern about their possible role in local climatic anomalies.

In particular, the occurrence of drought conditions in some of the areas where Solar Energy have been erected has led to the spread of the belief that the Solar Energy have something to do with the decrease in rainfall. A number of articles appeared in the newspapers highlighting the claims that the Solar Energy are the main cause of reduced rainfall. There have indeed been sincere attempts to assuage these fears through scientific arguments by some individuals/eminent scientists, but they did not have the desired effect.

II.SOLAR ENERGY SYSTEM

A. Solar Panel

Fig. 1 shows the equivalent circuit of the ideal photovoltaic cell. The basic equation from the theory of Semiconductors that mathematically describes the I-V characteristic of the ideal photovoltaic cell is:

$$I = I_{pv.CELL}[\exp(\frac{qV}{akT}) - 1] \quad (1)$$

Where Ipv, cell is the current generated by the incident light (it is directly proportional to the Sun irradiation), Id is the Shockley diode equation, I0,cell is the reverse saturation or leakage current of the diode, q is the electron charge [1.60217646 * 10−19C], k is the Boltzmann constant [1.3806503* 10−23J/K], T [K] is the temperature of the *p-*

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n junction, and a is the diode ideally constant. The basic Eq.1 of the elementary photovoltaic cell does not represent the I-V characteristic of a practical photovoltaic array. Practical arrays are composed of several connected photovoltaic cells and the observation of the characteristics at the terminals of the photovoltaic array requires the inclusion of additional parameters to the basic Eqn. 1.
Eq. 2 describes the single-diode model presented in Fig.1.

$$I=I_{pv}-I_o[\exp(\frac{v+RsI}{Vta})-1]-\frac{v+RsI}{Rp} \quad (2)$$

Where I_{pv} and I_0 are the photovoltaic and saturation currents of the array and Vt = NskT/q is the thermal voltage of the array with Ns cells connected in series. Cells connected in parallel increase the current and cells connected in series provide greater output voltages. If the array is composed of Np parallel connections of cells the photovoltaic and saturation currents may be expressed as: Ipv=Ipv,cell Np, I0=I0,cellNp. In Eq. 2 Rs is the equivalent series resistance of the array and Rp is the equivalent parallel resistance.

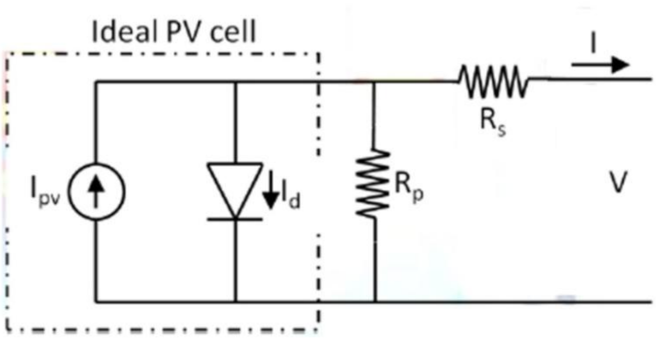

Fig 1. Single Diode Model of the Theoretical Photovoltaic Cell

III BUCK-BOOST CONVERTER

Several researchers have worked to detect the Boost DC–DC Converter using different methods. DC–DC buck–boost converter can be an excellent alternative to dc-link converters. Being a buck–boost converter, this converter is capable of both stepping-up and stepping-down the voltage. Due to use of buck and bust converter voltage variation problems can be reduced. Then electricity generation by using Solar energy source. The following diagram shows the working operation of the buck converter. In the buck converter first transistor is turned ON and second transistor is switched OFF due to high square wave frequency. If the gate terminal of the first transistor is more than the current pass through the magnetic field, charging C, and it supplies the load. The D1 is the Schottky diode and it is turned OFF due to the positive voltage to the cathode.

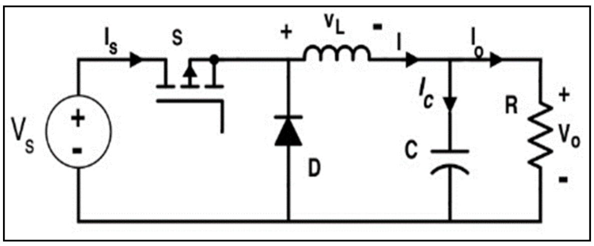

Fig 2. Buck Converter

The inductor L is the initial source of current. If the first transistor is OFF by using the control unit then the current flow in the buck operation. The magnetic field of the inductor is collapsed and the back e.m.f is generated collapsing field turn around the polarity of the voltage across the inductor. The current flows in the diode D2, the load and the D1 diode will be turned ON.

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The discharge of the inductor L decreases with the help of the current. During the first transistor is in one state the charge of the accumulator in the capacitor. The current flows through the load and during the off period keeping V_{out} reasonably. Hence it keeps the minimum ripple amplitude and V_{out} closes to the value of Vs.

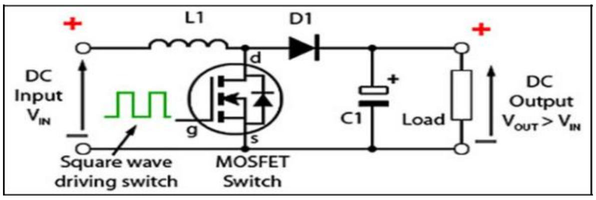

Fig 3. Boost Converter

In this converter the first transistor is switched ON continually and for the second transistor the square wave of high frequency is applied to the gate terminal. The second transistor is in conducting when the on state and the input current flow from the inductor L through the second transistor. The negative terminal charging up the magnetic field around the inductor. The D2 diode cannot conduct because the anode is on the potential ground by highly conducting the second transistor.

By charging the capacitor C the load is applied to the entire circuit in the ON State and it can construct earlier oscillator cycles. During the ON period the capacitor C can discharge regularly and the amount of high ripple frequency on the output voltage. The approximate potential difference is given by the equation below.

$$VS + VL$$

During the OFF period of second transistor the inductor L is charged and the capacitor C is discharged. The inductor L can produce the back e.m.f and the values are depending up on the rate of change of current of the second transistor switch. The amount of inductance the coil can occupy. Hence the back e.m.f can produce any different voltage through a wide range and determined by the design of the circuit. Hence the polarity of voltage across the inductor L has reversed now. The input voltage gives the output voltage and at least equal to or higher than the input voltage. The diode D2 is in forward biased and the current applied to the load current and it recharges the capacitors to VS + VL and it is ready for the second transistor.

In DC-DC converter, the average dc output voltage must be controlled to equal a desired level, through the input voltage and output may fluctuate. In a DC-DC converter with a given input voltage, the average output voltage is controlled by controlling the switch on and off durations. One of the methods for controlling the output voltage employs switching at a constant frequency and adjusting the on duration of the switch to control the average output voltage. In this method, called pulse width modulation (PWM) switching, the duty ratio D, which is defined as the ratio of the n duration to the switching time period, is varied.

Variation in the switching frequency makes it difficult to filter the ripple components in the input and output waveforms of the converter. In the PWM method which is switching at a constant frequency, the switch control signal, which controls the state of switch, is generated by comparing a signal level control voltage with a repetitive waveform. The frequency of the repetitive waveform with a constant peak, establishes the switching frequency. This frequency is kept constant in a PWM control and is chosen to be in a few kilohertz to few hundred kilohertz range. The comparator output is high when the repetitive signal is greater than control signal otherwise output is zero.

IV SIMULATION AND RESULTS

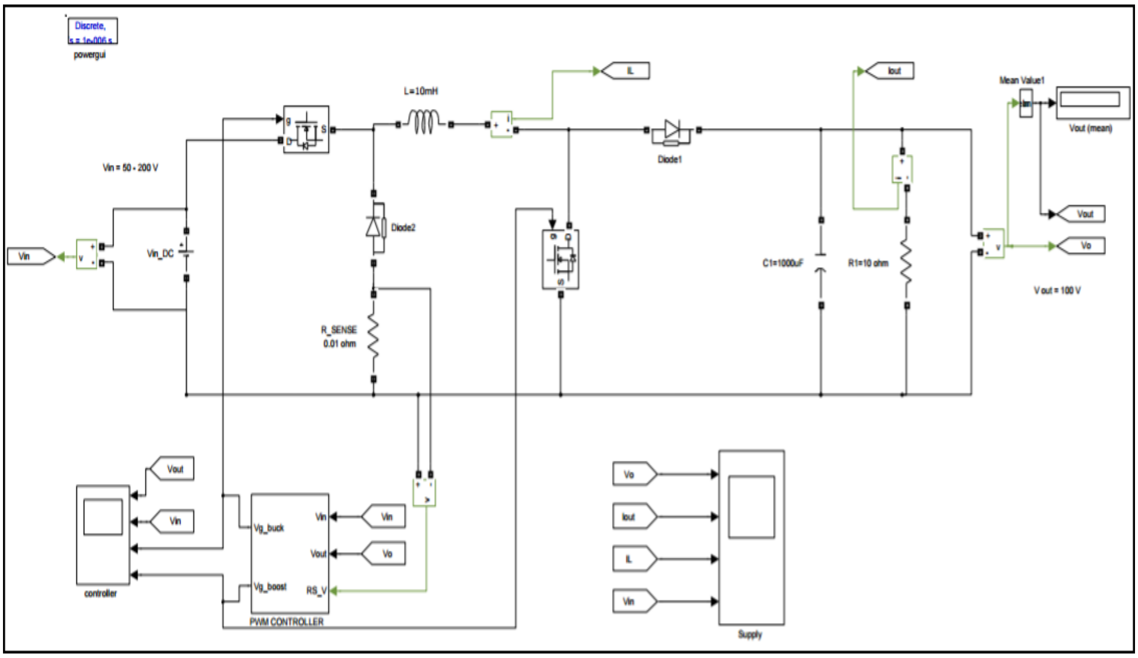

Fig 4. Simulation Diagram

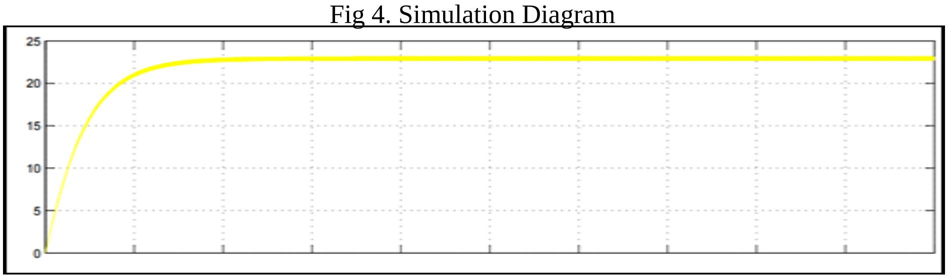

Fig 5. Boost input current

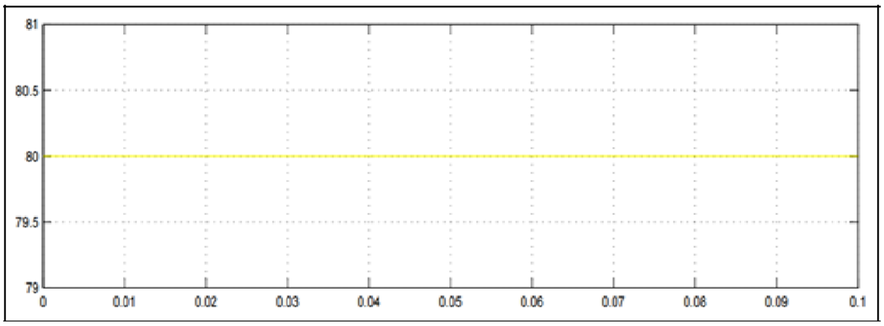

Fig 6. Boost input voltage

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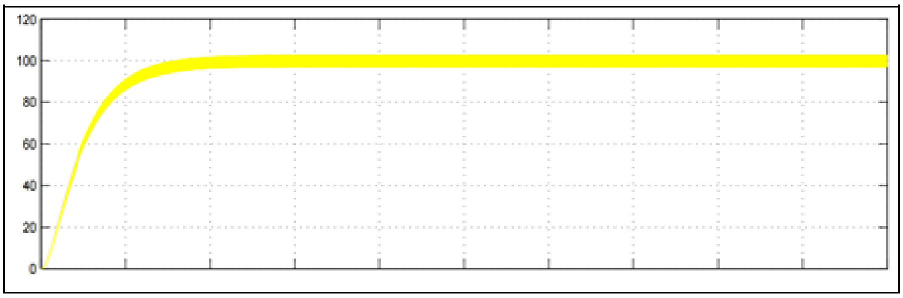

Fig 7. Boost Output Voltage

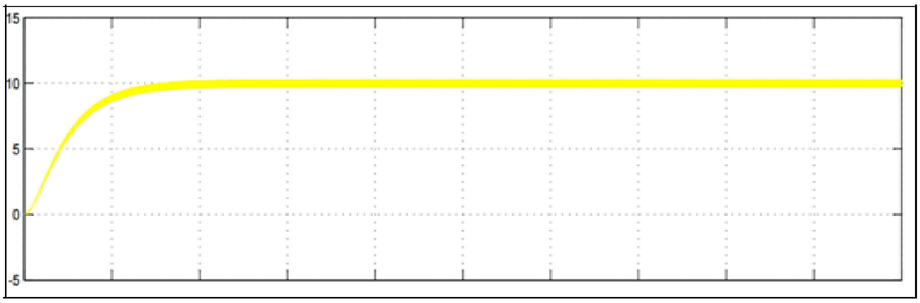

Fig 8. Boost Output Current

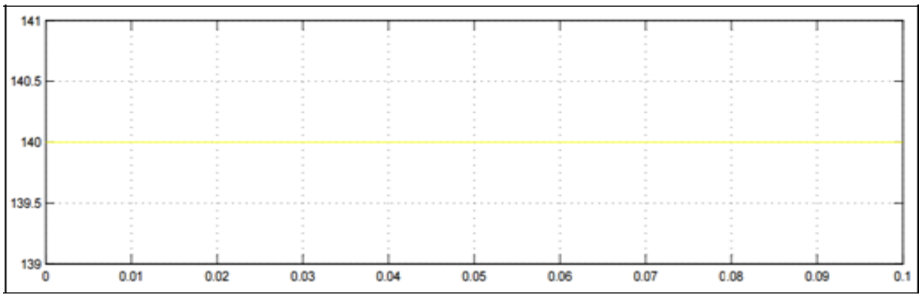

Fig 9. Buck Input Voltage

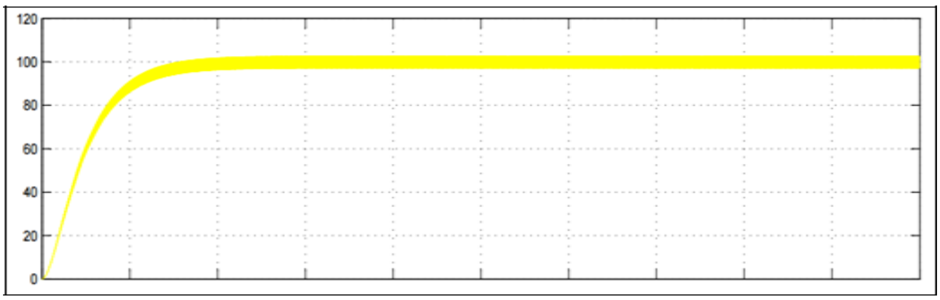

Fig 10. Buck Output Voltage

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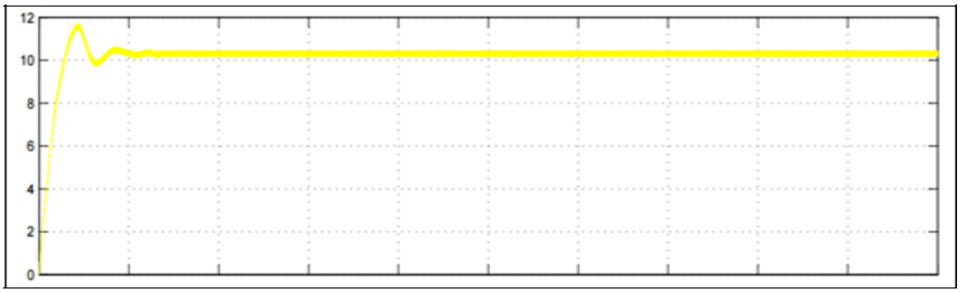

Fig 11. Buck Input Current

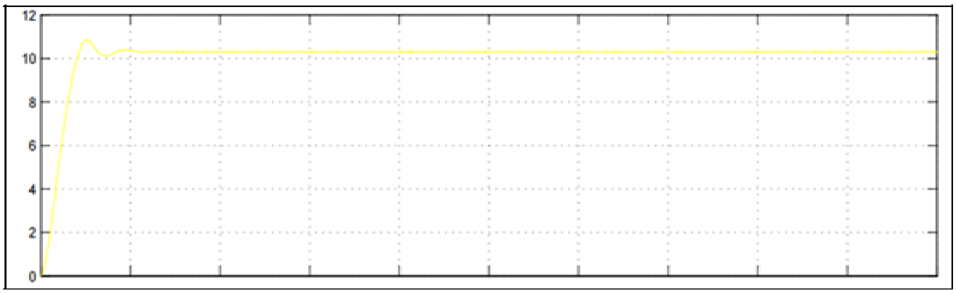

Fig 12. Buck Output Current

V CONCLUSION

Constant dc voltage is found to be improved by the use of the PWM controlling techniques in the Buck-Boost Converter switches incorporated in the WECS. The output dc voltage can be controlled for the values as per simulation between 50- 150 V and output Voltage of inverter could be constant automatically. In this way the dc or ac output is improved if WECS output is not constant.

VI FUTURE SCOPE

Solar energy is play vital role in day to day life. The buck boost converter is useful for control voltage variation. For extension we can interface solar power with same system so the output voltage remains constant with the help of buck-boost converter. In addition we can use artificial intelligence control instead of PWM technique so that the output voltage becomes more constant and stable. We can use GSM technology to monitor the system output over mobile or computer

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