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Comparative Study of Converter for Maximum Power Output for PV System

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***Abstract*--This paper presents in detail the comparative study between two most popular converters. Few comparisons such as efficiency, voltage, current and power output for each converter have been recorded. MATLAB Simulink tools have been used for performance evaluation on converter.**

***Keyword*-- Boost, Buck converter, Photovoltaic, PV, direct current, DC**

I. INTRODUCTION

The rapid increase in the demand for electricity for electricity and the recent environmental conditions there is a need for a new source of energy which is sustainable with less carbon emission. The global demand of energy is increasing day by day with economic growth. Renewable energy source has been increasingly used in order to develop clean and sustainable energy. India has high solar insolation and is the ideal place for solar power.

The harnessing of solar energy using PV cells can be the best options of it. .but the high initial cost of the PV cell is the major obstacle. Various deals of research have been done to improve the efficiency of same. A number of methods have been proposed to track the maximum power point of the PV module. This paper focuses on the comparison of various converters which would be the efficient for tracking of maximum power. . Different DC-DC converter (Buck, boost, CUK) will involve in comparative study.

II. PV ARRAY

The solar is just like a p-n semiconductor junction. When interfaced to the light, a DC current is generated. The equivalent circuit diagram is shown below:

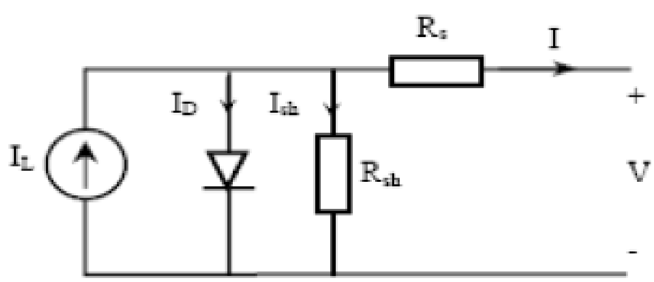


Fig. Block diagram of simple solar power unit

The V-I curve can be determine by following equations:

$$I_d = I_o\left[e^{\left(q\left(V+IV_s\right)/KT\right)} - 1\right]$$

The solar cell output current:

$$I = I_L - I_D - I_{sh}$$

$$I = I_L - I_o\left[e^{\left(q\left(V+IV_s\right)/KT\right)} - 1\right] - \left(V + I_{RS}\right)/R_{sh}$$

Where:

I : solar cell current

Io : Diode saturation current

K : Boltzmann constant

T : cell temperature

V : solar cell output voltage

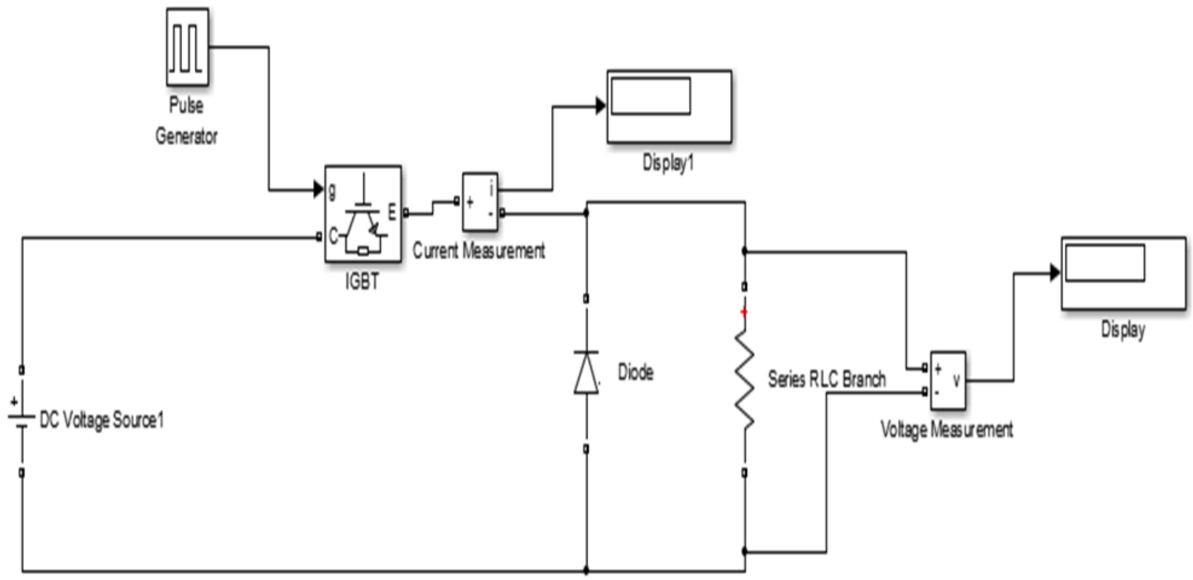
R : solar cell series resistance

Rsh: solar cell shunt resistance

III. DC-DC CONVERTER

Buck converter

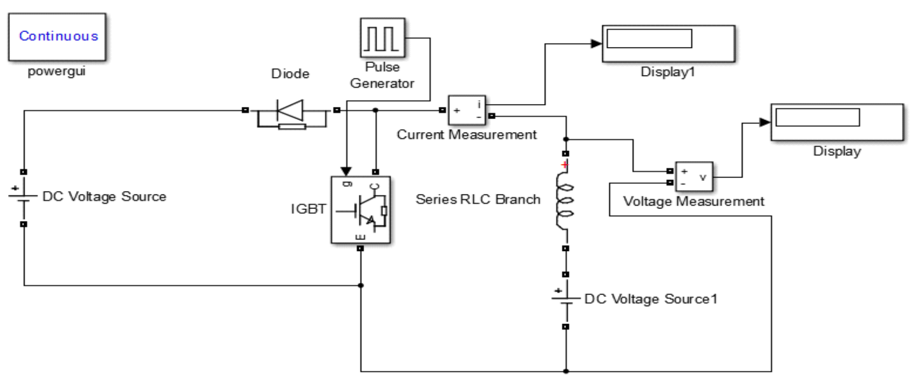
The circuit diagram of buck converter is shown in fig.



The power flow in buck converter is always from source to load. This converter is also known as step down converter as average output voltage is always less than the input DC voltage.

Boost converter

The circuit diagram of boost converter is shown in fig.



The power flow in boost converter is always from load to source.

As load voltage is more than source voltage so this is also known as step-up converter.

S.No.	Buck converter	Boost converter
1.	The output voltage is less than input voltage.	The output voltage is more than the input voltage.
2.	The output polarity is same as that of input voltage.	The output voltage polarity is the same as that of the input voltage.
3.	It is used as a DC step down transformer.	It can be used as a DC step up transformer.

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IV. GRAPHICAL ENVIRONMENT

Matlab Simulink Model

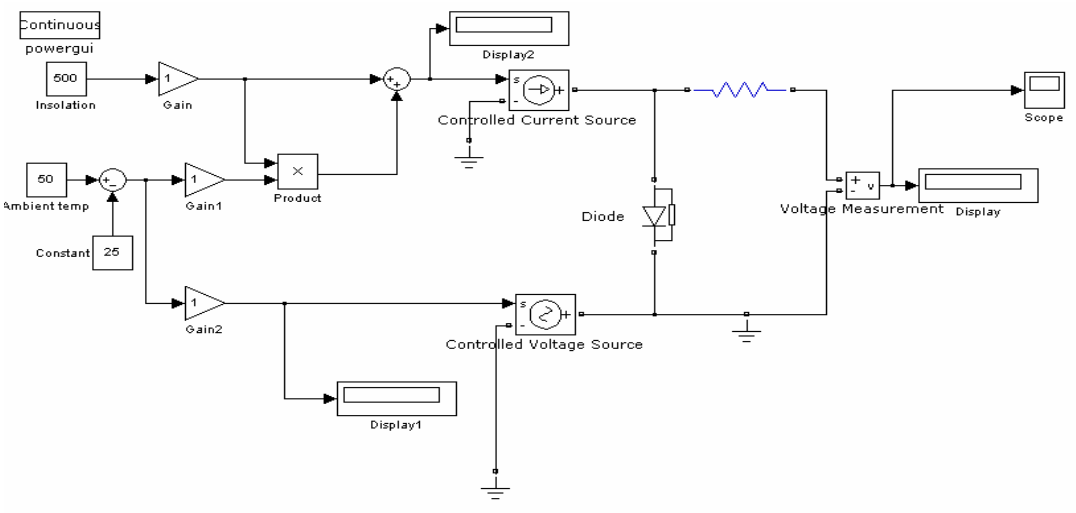

Fig. Simulink model of the solar PV module

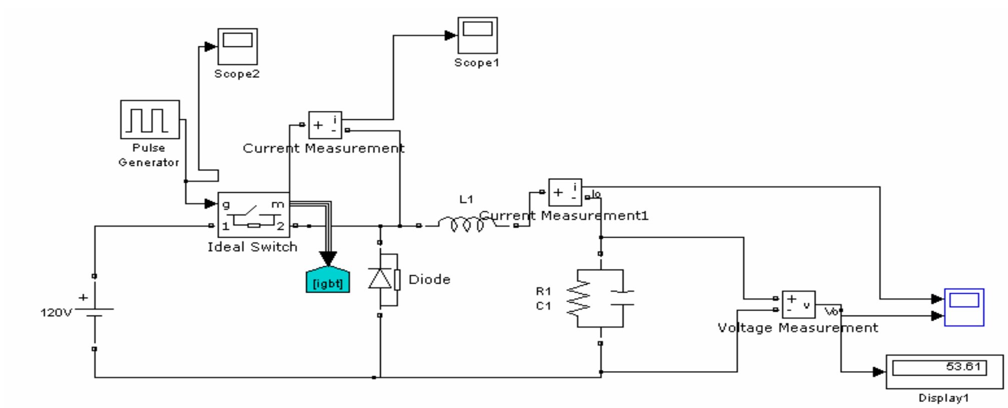

Fig. Simulink model of buck converter

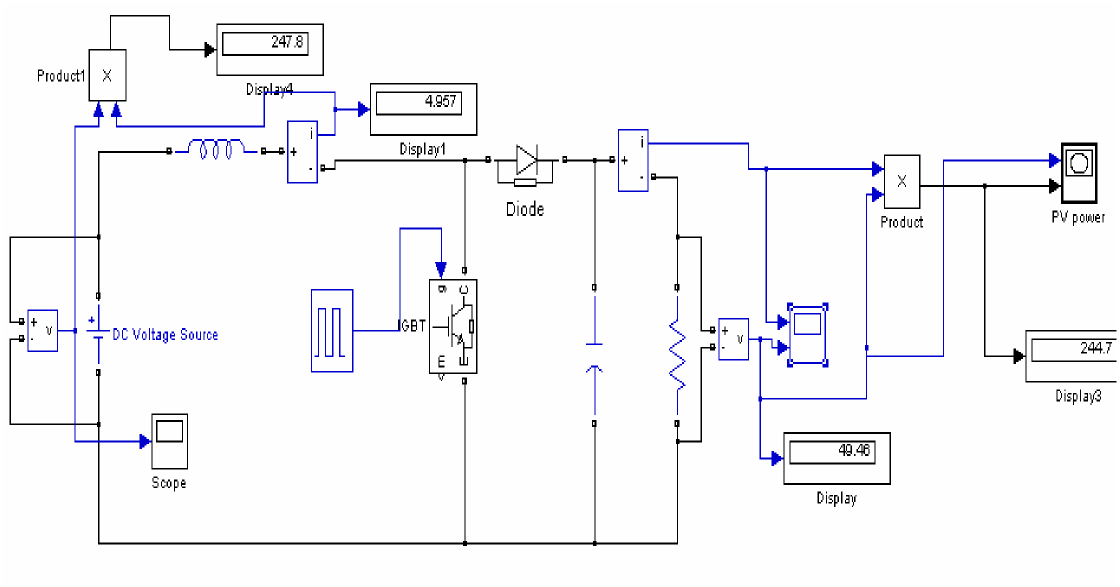

Fig. Simulink model of boost converter

V. Results And Simulation

The simulation of different converter has been shown for every converter.

The input, output current, voltage, power is the main consideration.

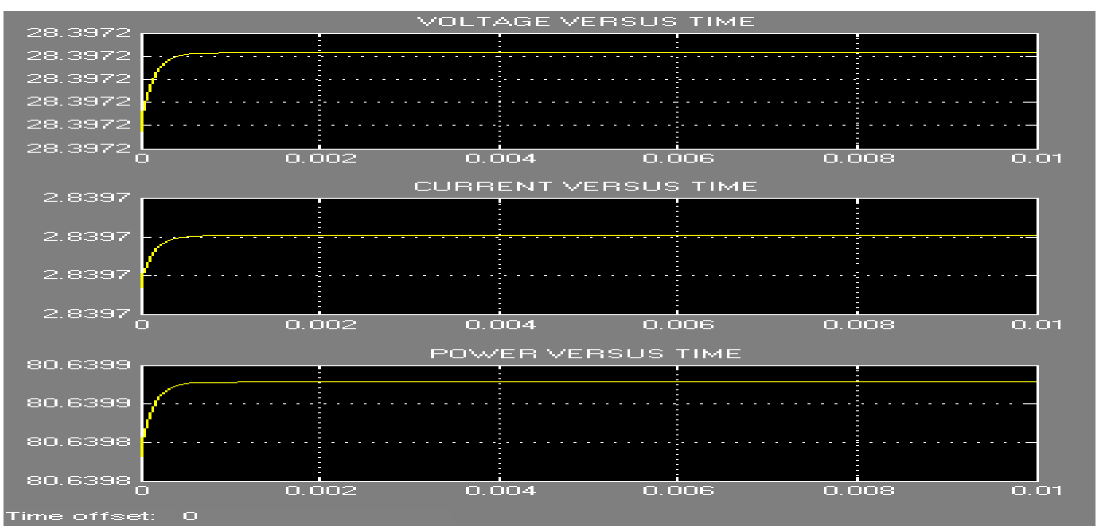

Fig. output Voltage, Current and Power for PV panel

Output voltage	Output current	Output power
28.4 V	2.84 A	80.64

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VI. CONVERTER SIMULATION

Theoretical value and simulation value of Buck, Boost Converter:

Converter	Analysis	Theoretical value	Simulation value	Percentage difference
Buck	Vin	12 V	12 V	0 %
	Vout	5 V	5.087 V	1.74 %
BOOST	Vin	12 V	12 V	0 %
	Vout	24 V	21.92 V	8.7 %

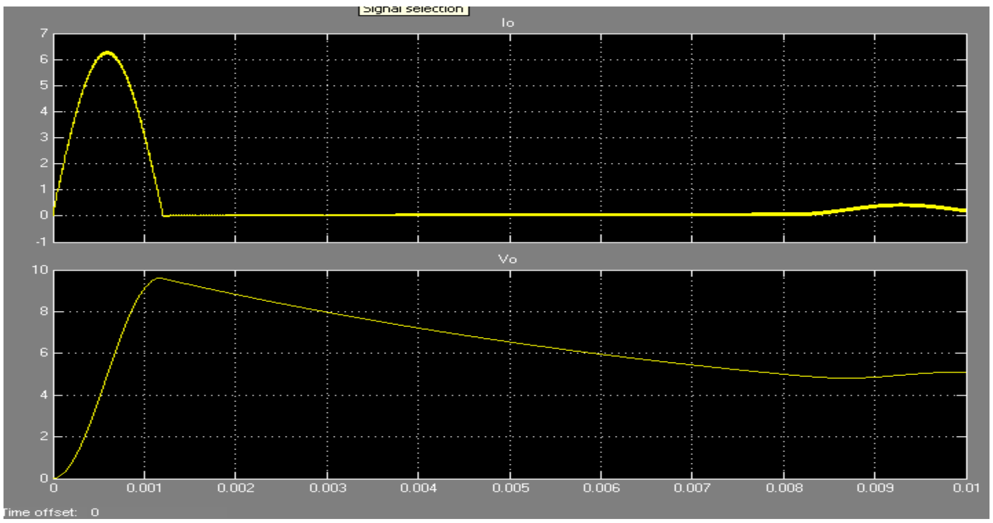

Fig. output current and voltage for Buck converter

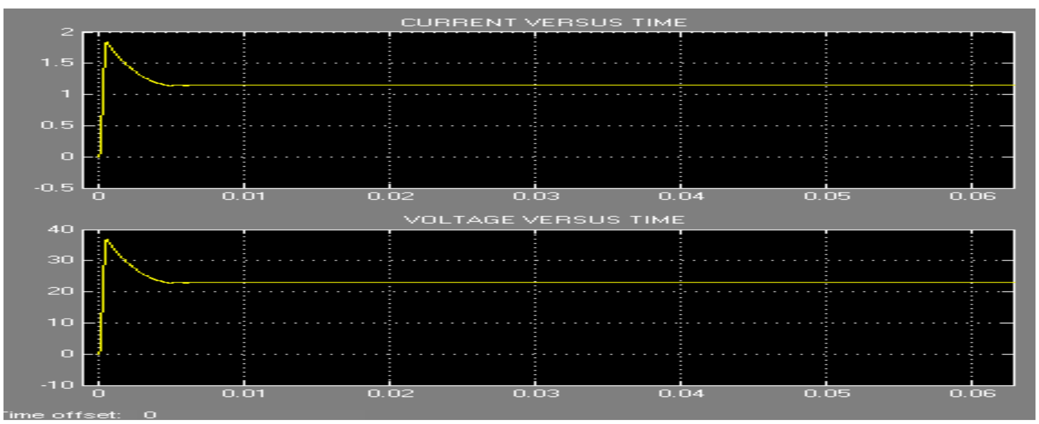

Fig. output current and voltage for Boost converter

VII. CONCLUSION

The percentage between the theoretical value and experimental value also can be seen from output. Theoretical values can be calculated from the basic equations of the converters. This involves the calculations when selection of component in MATLAB environment.

This comparison shows that buck converter will give the best result followed by boost converter.

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