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Optimization and Implementation of Solar PV System to Using Boost Inverter with MPP Tracking for Electrification

Bikash Chandra Saha[1]* Dr. S. R. Awasthi[2]

[1]Asst. Prof., Cambridge Institute of Technology, Ranchi (Jharkhand) India

[2]Professor & Dean of Electrical Engineering Dept., RNTU, Bhopal (M.P.) India

Abstract – In 21 century, the utilization of renewable sources of energy has been increased rapidly. Nowadays, Solar energy is emerged as a vital renewable or non-conventional energy sources. The main advantages associated with the Solar energy is it's clean, pollution free and in exhaustible nature. This Paper involves integration of Solar panel to an array of three 24V batteries via boost converter. Boost converter maintains the desired potential of 72V (24V each battery) for charging from solar panel. The output of battery was further boosted using simple boost circuitry to 230V and converted to 230 V AC supplies of 50Hz using PWM VSI inverter. Boost inverter consisted of simple boost circuitry and a PWM VSI inverter. Other inverter configuration was also tried out to get better waveforms such as multistep inverter and for 3 phase applications 3 –phase VSI. In this paper solar Photovoltaic panel (SPV), Boost transformer used to step up DC-DC with Maximum Power Point Tracking (MPPT). The hole system to be optimized to increase the efficiency. Finally, most economical solution of boost inverter is in favour with PWM VSI. It is suggested for lesser economical expense and satisfactory performance for domestic electrification. Best result was obtained in case of multistep inverter configuration having Low THD.

Keywords: - MPPT, boost converter, PMW VSI, Inverter, Battery

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I. INTRODUCTION

The plenty of energy is necessity for the sustainable development of industrial and economic growth. The limited availability of popular conventional energy resources like coal, crude oil, natural gas, etc., there is a strong need of an alternative renewable and clean source of energy. Now, the solar energy is one the most versatile and widely used renewable source of energy. Recently, several research works have been accomplished in this field. Most of the daily natural life's in the earth are completely depending on the daily flow of solar energy. Recent trends show, that the utilization of energy resources in India increases day by day and with the limitation in conventional energy resources, there is a strong need of non-conventional energy sources in the future. The Solar energy utilizes the heat energy of the sun by converting heat energy into electrical energy by using solar photovoltaic cells. In recent days, the research and development increased in the field of Solar photovoltaic (SPV) for increasing the efficiency of solar photo voltaic as well as the improvements of latest technology of solar panels. The Solar photovoltaic cells can used in a stand-alone off-grid as well as on grid mode. The tracking of solar energy plays an important role in the efficiency of solar panel. This phenomenon is known as maximum power point tracking (MPPT). The output of solar system depends on irradiance, temperature and the load. The boost converter used to increase or improving the output power of solar panel.

The efficient conversion of solar energy is possible with using optimizing methods to obtain Maximum Power Point Tracking (MPPT) algorithm. Solar panel depends on atmosphere condition; the output power of a solar Photo Voltaic panel depends on the output voltage of the SPV system. The output voltage of the solar Photo Voltaic system has maximized using DC-DC boost converter. Boost Converter used to maximum demand from non-conventional energy sources and conventional energy sources.

II. SYSTEM CONFIGURATION

The system consists of solar photo voltaic panel, Boost converter (DC-DC step-up), Boost inverter and Battery Bank. All parts explained in the system configuration.

(a) Solar PV Panels- The Solar Photo Voltaic panels generate electricity and phenomenon is called as "Photo-voltaic Effect". In the Photovoltaic effect, when the solar lights fall on the solar cells, then electron-hole pairs are generated and which causes the electric current to flow. The electric current is the difference between the solar light generated current and diode current.

Mathematically,

$I = I_L - I_D$

$I = I_L - I_0 [\exp (eV_j/K_cT) -1]$

where, I = Saturation current

I_L = Light Generated current

I_D= Diode Current

e = charge of Electron

V_j = junction Voltage

K_c = Boltzmann's constant

T = temperature

This phenomenon is known as the photovoltaic effect.

The flowing electrons light generated current that is directed out of the solar panel to load. Thus, the photovoltaic effect converts heat energy into the Electric energy in useful form of power, electricity.

(b) Boost Converter- A DC – DC power electronics converter used to step –up or increase the voltage from its input to output voltage of solar photovoltaic system. It containing at least semiconductor device as like a diode and a transistor. The boost converter also contains one energy storage element i.e. Inductance, a capacitor. The capacitor reduces ripple voltage and filters.

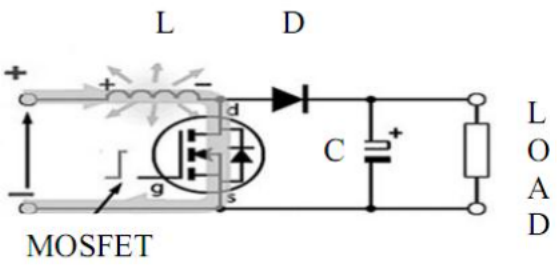


Fig. 1 Boost Converter

(c) Boost Inverter- Boost DC-AC inverter generally generates in a single stage an ac voltage whose maximum value can be minimum or higher than the DC input voltage. In this work input of array of three 24V batteries is boosted to 230V AC supply of 50 Hz for purpose direct use under domestic electrification. Operation boost circuitry in boost inverter is same as that of boost circuit connected between battery and solar panel. Only thing in addition is an inverter is further added to convert 230V DC output to AC using PWM VSI or multistep inverter or if desired to have 3 phase VSI output using 3 phase output.

III. MAXIMUM POWER POINT TRACKING

It is tried to use maximum power from solar energy system. This technology is known as maximum power point tracking (MPPT).A Maximum power point tracking system tracks the Maximum power Point under atmospheric conditions. It is improving and implements using different optimisitation algorithm to obtain Maximum power point. The power converter used to increase the solar output power. To measure output current and output voltage after tracking of solar panel to obtain power output of solar photovoltaic. The power converter made to the convert the power low voltage to high voltage. It controlled by change in the duty cycle controlling the converter. The change of duty cycle changes the output voltage. The power converter not connected to solar photovoltaic panel. The characteristics of a solar Photovoltaic panel coupled with this effect are allowing Maximum Power Point Tracking to occur. There are many optimization methods to obtain Maximum power point.

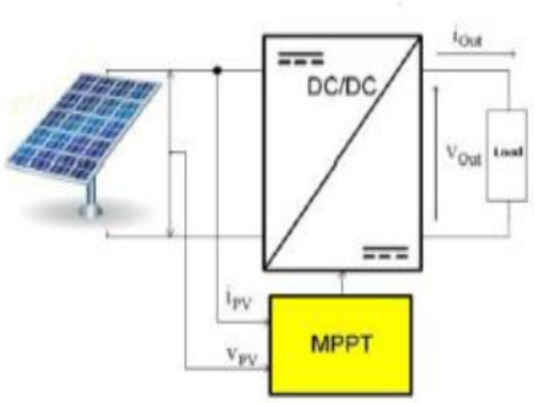


Fig. 2 Implementation of MPPT

IV. Matlab Simulation Circuit Diagram

(a) Simulation Model of Boost Converter

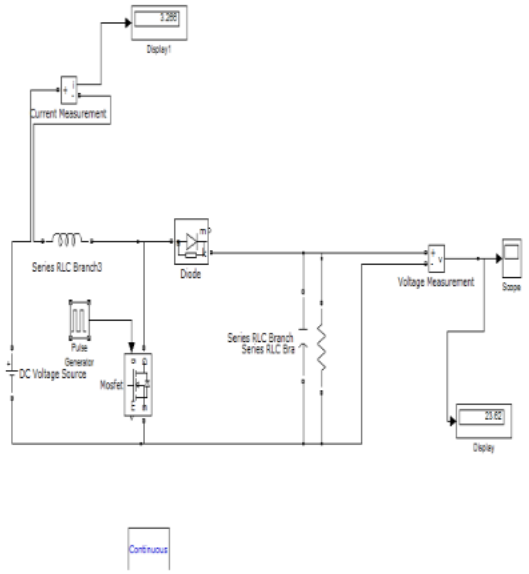


Fig. 3 Simulation Model

(b) Matlab Simulation Main System

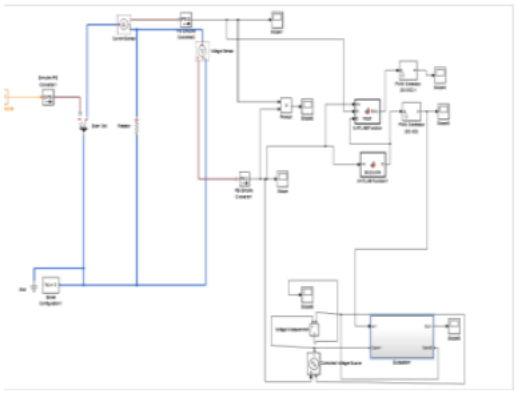
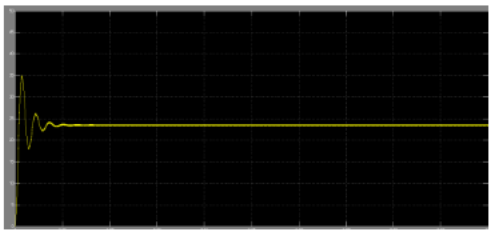


Fig. 4 Simulation Model

(a) Simulation Result

Simulation Output of Boost Converter



Time in sec

Fig. 5 Output of Boost Converter

(b) Output of Main System

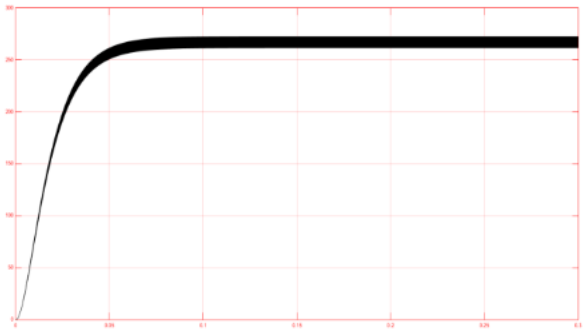


Fig. 6 Output of Main System

V. CONCLUSION

In research work is going on extracting power from the solar Pv System in many directions, one direction being the capture the maximum power point of the solar Photovoltaic system under given environmental conditions.Integration of Solar panel to an array of three 24V batteries via boost converter. Boost converter maintains the desired potential of 72V (24V each battery) for charging from solar panel. The output of battery was further boosted using simple boost circuitry to 230V and converted to 230 V AC supplies of 50Hz using PWM VSI inverter. Boost inverter consisted of simple boost circuitry and a PWM VSI inverter. MPPT can be extended from the DC-DC converter to form a system, by connecting an inverter at the output terminals of the DC-DC converter.

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Corresponding Author

Bikash Chandra Saha*

Asst. Prof., Cambridge Institute of Technology, Ranchi (Jharkhand) India

E-Mail – bcsaha1012@gmail.com