International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Maximum Power Point Tracking of Isolated Solar System

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***Abstract:** With increasing challenges in the field of power utility Industries, it is important to focus on increasing efficiency of photovoltaic system. In this paper, hardware results are tested for Perturb and observe (P&O) algorithm for maximum power point tracking (MPPT) of 10kw Solar panel. The Result tested shows the validity of the work. The P&O algorithm is designed in Arduino microcontroller to vary the duty cycle of DC to DC converter. Designed hardware topology, increases power delivered to load considerably.*

***Keywords:** Photovoltaic, Maximum Power Point Tracking, Perturb and Observe, Incremental Conductance, Buck Boost convertor*

I. INTRODUCTION

The increasing demand in the utility side that causes introduction to harmonics and fluctuations are the major issue. The conventional sources of energy have the probability to last for limited time. But renewable energy like solar is infinite and also eco-friendly. With also increased power efficiency with the use of power electronic devices to provide the energy to the customer. The only limitation of solar is It so expensive. The output of photovoltaic (PV) is depends on many factors such as solar radiations, temperature etc. with variation of these two parameters the output also get changed. That cause introduces fluctuations and harmonics on the utility side which is totally unpleasant. So it is important to have a control on the solar system which is totally independent on the weather conditions. For to control the power electronic devices the duty cycle (Ton and Toff time) changed by the using microcontroller. The different programing methods are used to control and achieve the desired output range. Now currently used algorithms are incremental conductance (IC), perturb and observe (P&O) . in these paper we are totally concentrate on the perturb and observe method for the change of duty cycle as per change in weather condition. In this method the input voltage, output voltage and Current are always observed and as per load requirement the duty cycle are changed.

The MPPT controller are connected across the between the load input and source output (solar output).the voltage and current parameters are sensed by the current sensor and voltage sensor and it fed to the microcontroller. The voltage at output of PV cell is to large so it need to reduce the range between that the microcontroller that can read. The potential divider technic are used to reduce the voltage range between the range that microcontroller will read it and convert it in Analog to digital form. Dc Current are sensed by using Hall effect sensor and Analog signal fed to microcontroller.

The microcontroller have done program that can always read the input current and voltage parameters and calculate duty cycle that will fed to DC to DC converter. The DC to DC convertor is a Buck Boost convertor. The buck boost convertor will boost the voltage or buck the voltage as per change in duty cycle. The MPPT controller (microcontroller) have program of perturb and observe algorithm so that microcontroller always try to sense a input signal parameters that have fed to it and trying to get the output that have equal to load input range.[1],[2].

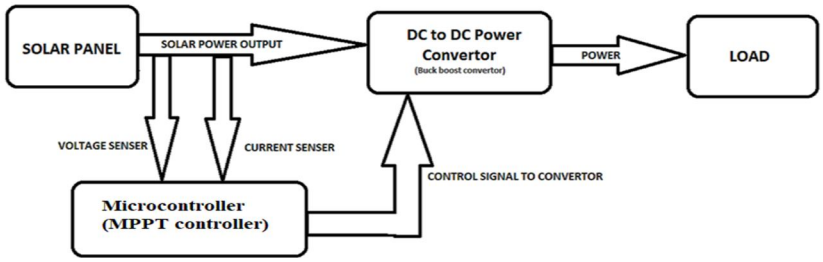

Fig.1 .Block diagram of MPPT controller.

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II. DIFFERENT MPPT TECHNIQUE

A. Perturb and Observe Method(P&O)

P&O often known as hill climbing method, in this method the output voltage of PV cell is continues perturbed and the duty cycle changed as per change in the output voltage of PV cell. The P&O tries to get better output Maximum Power Point at side of utility. The perturb and observe tries to gr maximum power in the number of steps. Up to the maximum power every step get greater power than privies power. At the maximum power the perturb and observe tries to get correct maximum power to deliver the maximum power to the load, but at the maximum power point it create the oscillations near to the maximum power point. [3],[4].

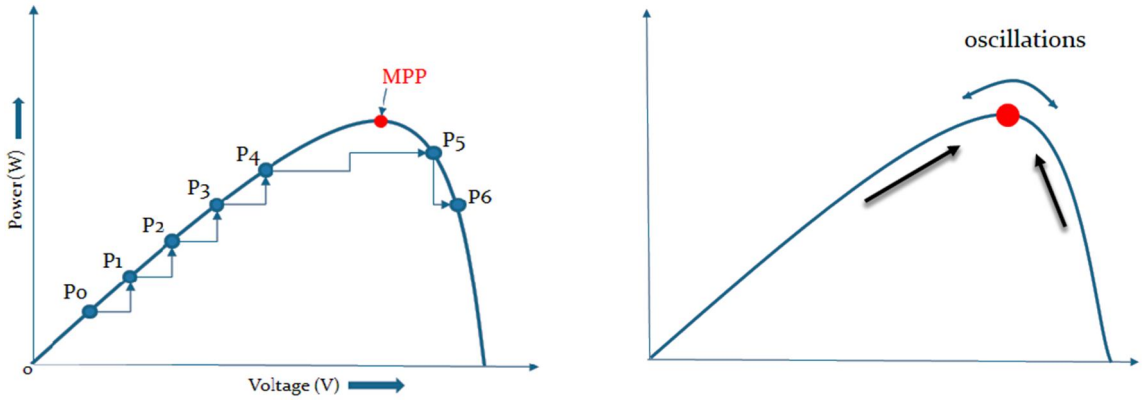

Fig.2. perturb and observe running characteristics.

B. Incremental Conductance

MPPT can be tracked by comparing the conductance ratio that is instantaneous conduction (i/v) to the incremental conductance ($\Delta i/\Delta v$). It totally depends on the ration of instantaneous conductance (i/v) to the incremental conductance ($\Delta i/\Delta v$). In this method the input current and input voltage are sensed and also output side current and voltage are sensed.[10].

III.HARDWARE TOPOLOGY

A. Solar Panel

Solar panel are Mainly a PV cells and Consisting of other Components such as inverters. PV cells consist of two layers of semiconductors material with opposite charges. As the Sunlight Enter the cells, its Energy strike a surface of electrons, thus spread in both layer, Due to the opposite charges of layers, the Electrons should change the place from the N-type layer to P-type Layer, thus PN junction creates an electric field that keeps from happening an complicit electrons to flow only from P to N. Thus the circuit other than solar panel which connected to PV cells allows the electron of N junction to travel to P junction. So the flow of this electrons flowing through this circuit provides direct current (DC) electricity. Thus the inverter then converts DC into alternating current (AC) electricity. Then the AC power is transmits to various applications from electrical circuit panel.[7].

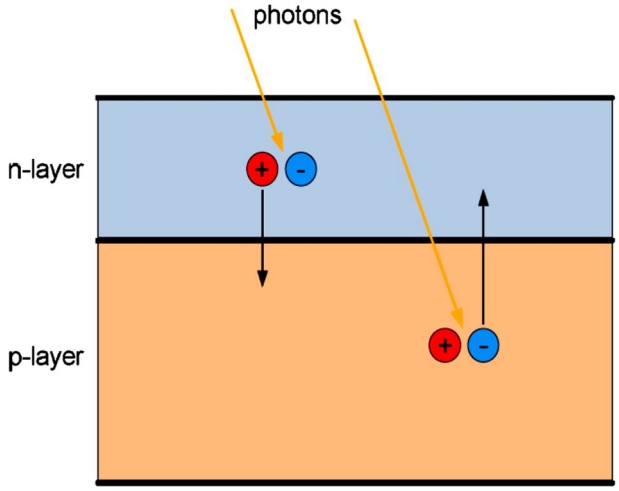

Fig.3. PV cell construction.

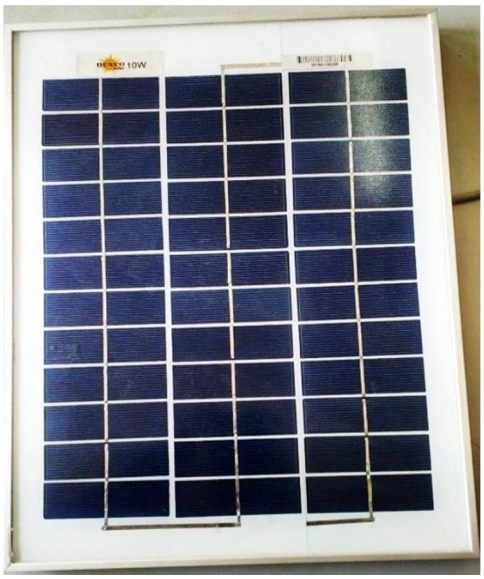

Fig.4. Solar panel.

B. I-V & P-V Characteristics of Solar Cells

The Current and Voltage relation of solar battery cells makes visible of I-V and P-V characteristics of the cells. This two characteristics gives requisite clues of extracting maximum power from solar panels. In this paper it is important topic to obtain the highest efficiency and maximum power from solar panel. As shown in fig. of I-V Characteristics , the solar panel act as a current source while, from a certain point onward, it act as a voltage source. In Case of short circuit fault the current value found from solar panels does not changed. It is important to achieve the maximum power from solar panel in any radiation and temperature conditions. In normal case the photovoltaic (PV) solar cells attains their maximum power point (MPP) near about 25º C of temperature. The MPP of PV solar cells vary according to ambient temperature and radiation of sun. This two characteristics are non-linear in nature. Thus the effect of radiation and ambient temperature on I-V and P-V characteristics are shown in fig below. As the radiation falling on the surface of solar panel increases, according to it the voltage among with power from solar panel also increases up to a certain level, then power goes to decrease rapidly as shown in fig. As shown in fig. the maximum voltage is open circuit voltage at which the current drawn from the circuit is zero and maximum current is short circuit current at which the voltage across circuit is zero.[16].

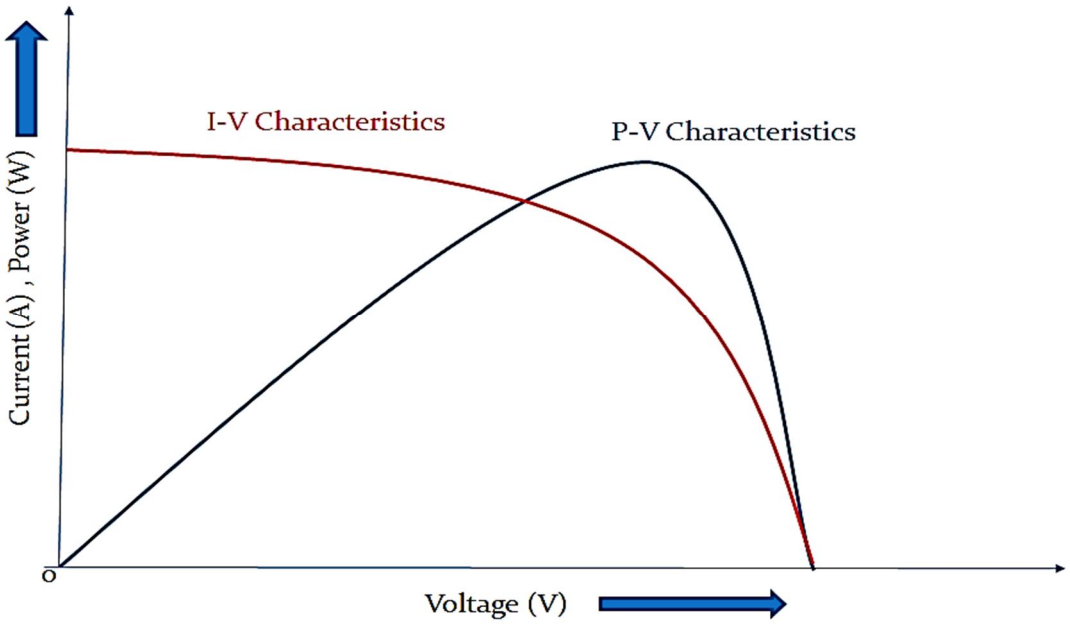

Fig.5. I-V and P-V Characteristics of solar cells

IV. RESULT ANALYSIS

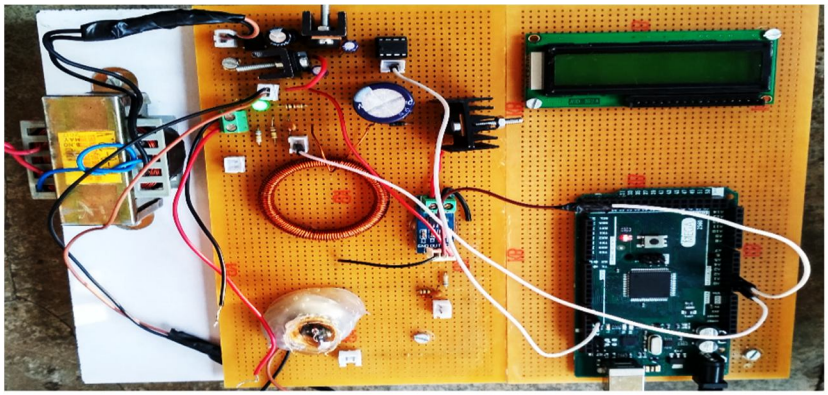

Fig.6. Hardware Model Designed.

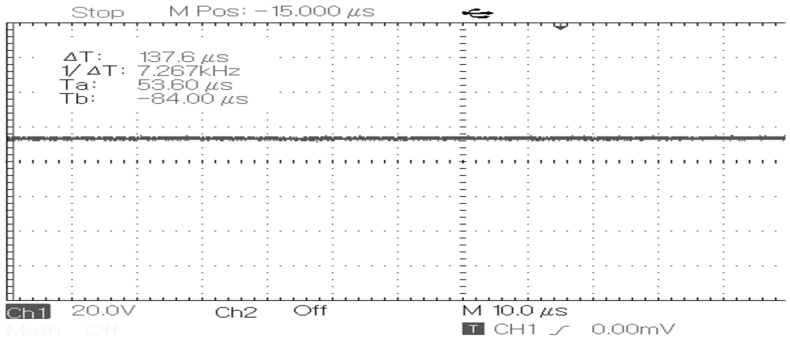

Figure.7. Solar panel output.

Output of solar panel is in DC form but varying in magnitude as per weather condition. That will give to the DC to DC convertor. That need to varying the output voltage.

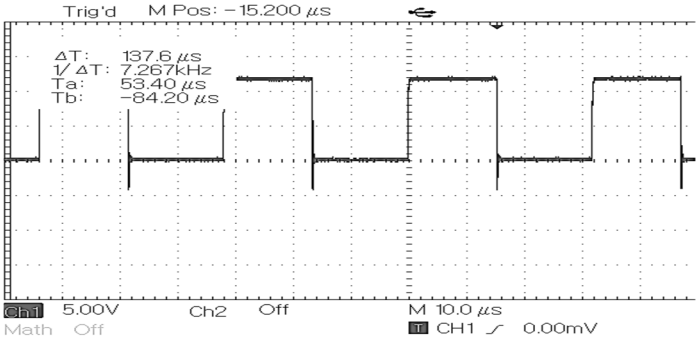

Fig.8. Output Waveform of switching MOSFET.

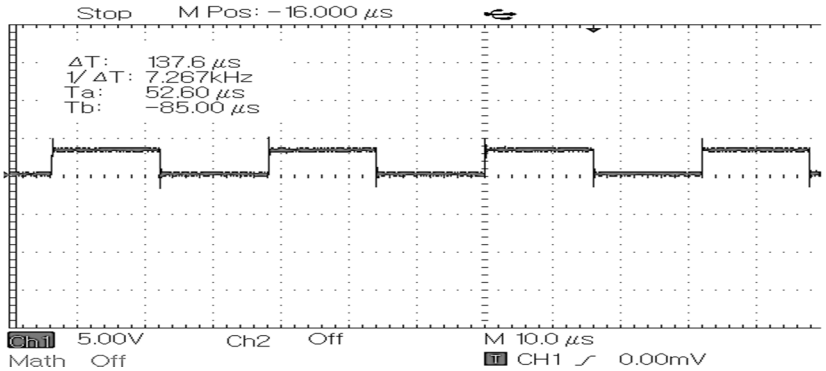

Fig.9. control duty signal from MPPT controller.

Result Without MPPT

Voltage(volt)	Current(Amp)	power
5.46volt	0.417A	2.27watt

Table.1. Result Without MPPT

Result With MPPT

Voltage(volt)	Current(Amp)	Power
13.97volt	0.383A	5.35watt

Table.2. Result With MPPT

V. CONCLUSIONS

In this paper perturb & observe and incremental conductance method of MPPT are discussed. The P&O method create oscillation at near to the maximum power point so it take more time to track maximum power point at specific radiation and ambient temperature of solar panel as shown in P-V characteristics. The output results are analyzed by designing hardware model. As we have got result the output power and efficiency of solar panel gets increased.

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