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HARDWARE IMPLEMENTATION OF DC-DC BUCK BOOST CONVERTER USING MPPT ALGORITHM

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ABSTRACT

Photovoltaic (PV) is the most important energy resources since it is clean, pollution free and inexhaustible. Due to rapid growth in semiconductor and power electronics technique, PV energy is of increasing interest in electrical power application. It is important to operate PV energy conversion system near the maximum power point to increase the output efficiency of PV array. A MPPT plays a very vital role for extracting the maximum power from the solar PV module and transferring that power to the load. Nowadays solar energy has great importance. Because it is easily available resources for energy generation. But the only problem is efficiency of solar system. And to increase the efficiency many MPPT techniques are used. Large number of paper were published on maximum power point techniques. As therefore many techniques are available for use. Incremental and conductance algorithm is one of the most important technique in the system and because of its high steady state accuracy and environmental adaptability widely implemented tracked control strategy.

KEYWORDS--*Buck Boost Converter, Maximum power point Tracking, output voltage sensor based MPPT algorithm.*

I. INTRODUCTION

Tracking the maximum power point (MPP) of a photovoltaic array is usually an essential part of a PV system. Also, solar energy is the most readily available source of energy and it is free.

A MPPT is used for extracting the maximum power from the solar PV module and transferring that power to the load. A DC-DC converter (step up\step down) serve the purpose of transferring maximum power from the solar PV module to the load. By changing the duty cycle the load impedance seen by the source is varied and matched at the point of peak power with the source so as to transfer the maximum power. MPPT is fully electronic system that varies the electrical operating point of the module, so that the module able to deliver maximum available power. MPPT can be used in conjunction with a mechanical tracking system. Solar cell can act as constant current source.The MPPT is responsible for extracting maximum power from the photovoltaic cell and fed it to the load via buck boost converter with step up the voltage to required level. Buck

boost converter can act as impedance matching circuit. The maximum power is transferred to the load when load impedance is equal to source impedance.

II.PROTOTYPE DESCRIPTION

It Consist of Buck Boost Converter, Micro Controller, Solar panel, Gate Driver Circuit and Voltage Divider Circuit. Buck Boost Converter consist of inductor, Capacitor, Mosfet and diode. Gate Driver Circuit Consist of TLP 250.The Controller consist of Voltage Regulator and rectifier.

1. MOSFET

In this project we used,IRF840 Metal oxide semiconductor Field effect transistor.MOSFET stands for metal oxide semiconductor field effect transistor. It is most commonly fetched by controlled oxidation of silicon.It has an insulated gate, whose voltage determine the conductivity of device. The output voltage is adjustable based on the duty cycle of switching transistor.MOSFET is a semiconductor device is widely used for switching in buck boost converter. The MOSFET is a four terminal device with source(S) ,Gate(G), Drain(D),and Body(B) terminal.

2.solar panel

Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity. A photovoltaic (PV) module is a packaged, connected assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. The Output of solar panel is given as input to DC-DC converter. Solar panel open circuit voltage is 21.6V. Solar panel Short circuit current is 0.68A. The Dimension of solar panel is 351*291*17mm. Maximum Power is obtained at Knee point of I-V Characteristic of solar panel. Maximum power of solar panel is 10W.

3.DC-DC Converter

In this project we used Buck Boost converter. Buck Boost Converter is mainly used for impedance matching. when load resistance is equal to source resistance, the maximum power get transferred from source side to load side. Impedance of Buck Boost converter is mainly depend on gate pulse of mosfet.

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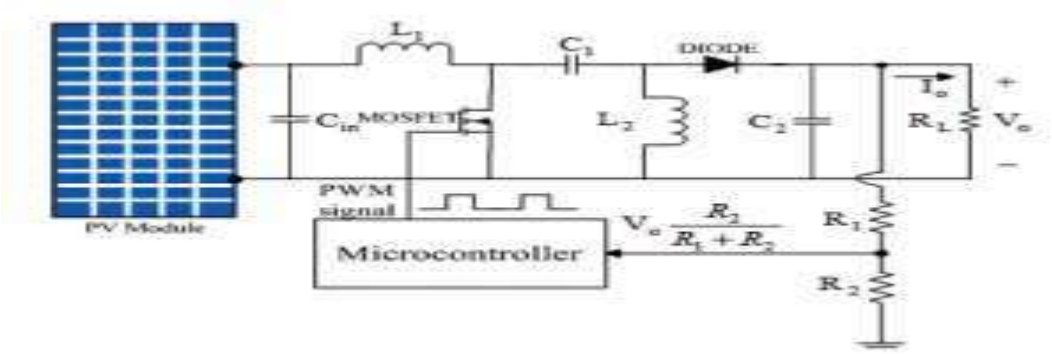


Figure.1 Maximum power point tracking

Buck Boost Converter either increase or decrease the input voltage. The Input of Buck Boost converter is 21V.Buck Boost Converter consist of inductor, capacitor and diode. A DC-DC Converter is an electronic circuit that converts a source of direct current from one voltage level to another. Power levels range from very low (small batteries) to very high (high-voltage power transmission).

4. Gate Driver circuit

Gate Driver circuit is mainly used to give the pulse to MOSFET. Gate Driver Circuit consist of TLP 250. TLP 250 is otherwise called as optocoupler. It isolate from low level voltage to high level voltage. The output of microcontroller is given as input to TLP250 which is in the range of 5v. It consist of rectifier and capacitor. Rectifier is used to convert from alternating current to direct current. The supply of TLP 250 is given by capacitor. The output of TLP250 is given as input to gate of mosfet.

5.microcontroller

The output of voltage divider circuit is given as input to microcontroller which is in the range of 3.5V to 5V.PIC 30F 2010 is a 16 bit microcontroller. It consist of 28 pins.PIC 30F 2010 controller consist of rectifier, voltage regulator.PIC 30F 2010 convert from anolog signal to digital signal. The maximum operating range for PIC microcontroller is 5v.It consist of 8 output pins. Rectifier converts from 230 V_{rms} to 16V. The output of rectifier is given as input to voltage regulator.It converts from 16V to 5V.

6. voltage divider circuit

Voltage divider circuit is connected at output of DC-DC converter. Voltage divider circuit also act as voltage sensor. This voltage sensor

senses the output of DC-DC converter. It consist of two resistor are connected in series. The resistance values are 1K and 10K.. The output of voltage sensor is given as input to ds PIC 30F 2010. Output voltage sensor based MPPT algorithm is encoded in PIC microcontroller.

III.BUCK BOOST CONVERTER DESIGN

The Buck Boost Converter is a type of DC-DC converter that has an output voltage magnitude that is either greater than or less than the input volage magnitude.When Duty cycle less than 0.5, it will act as buck mode. When Duty cycle greater than 0.5,it will act as Boost mode.It consist of inductor, Capacitor and diode. By using formulas we calculated the value of inductance and capacitance. In this project inductance value is 5mH,capacitance value is 47 micro farad and 25v.

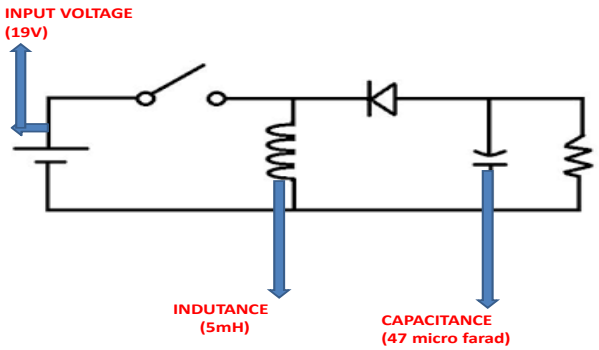


Figure.2 Buck Boost converter circuit

IV. MPPT ALGORITHM

Output voltage sensor based MPPT is used in this project. This MPPT algorithm is mainly depend on output voltage and Duty cycle. Maximum power is available at the knee point of (V_o – D) characteristic. By using this MPPT algorithm we get maximum power at all time in load side. $dV_o/dD = 0$ (at MPP)

$dV_o/dD > 0$ (left side of MPP)

$dV_o/dD < 0$ (right side of MPP)

Thus the maximum power from the PV module can be tracked by evaluating dV_o / dD by sensing only the output voltage. The Duty cycle can be incremented or decremented by del D depending on the sign of voltage.

V(K) =present value of output voltage
V(K-1) =past value of output voltage
dv =Difference in past and present value of output voltage
D(K) =present value of Duty cycle
D(K-1) =past value of Duty cycle
dD =Difference in past and present value of Duty cycle
V(K+1) =future value of output voltage
D(K+1) =future value of Duty cycle

Output voltage sensor based MPPT is encoded in PIC 30F 2010. The maximum power is available at $dV_o/dD=0$. When $dV_o/dD>0$, we should increase the Duty cycle. When $dV_o/dD<0$, we should decrease the duty cycle. Finally we update the value of output voltage and duty cycle.

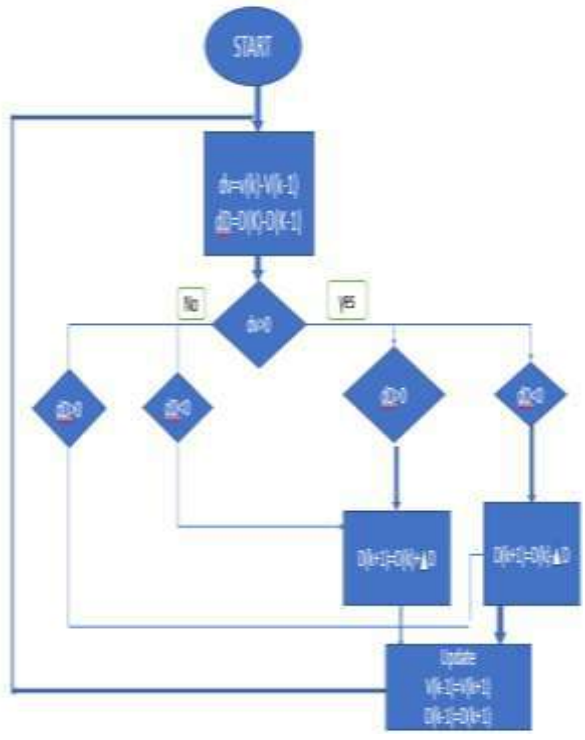
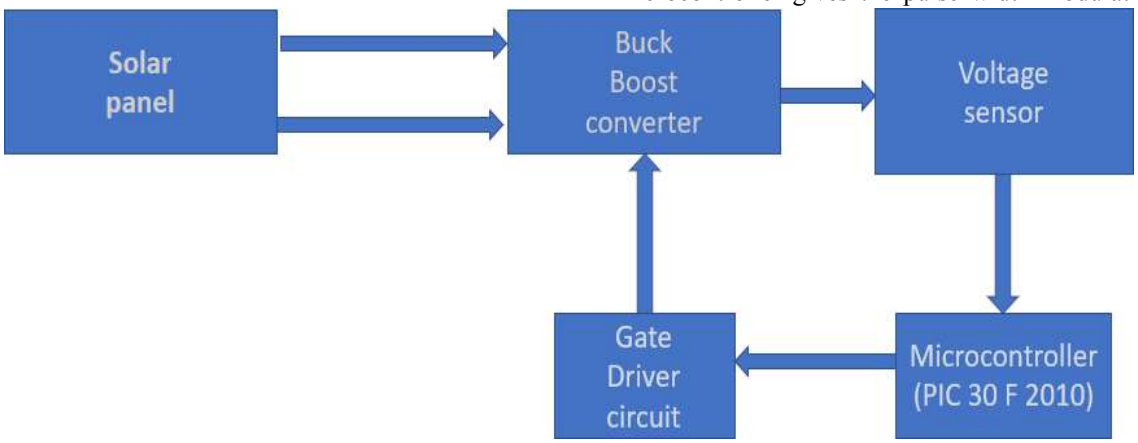


Fig 3:MPPT algorithm

BLOCK DIAGRAM OF MPPT

The output of solar panel is directly given as input to Buck Boost converter. Buck Boost converter can act as impedance matching circuit. Impedance of

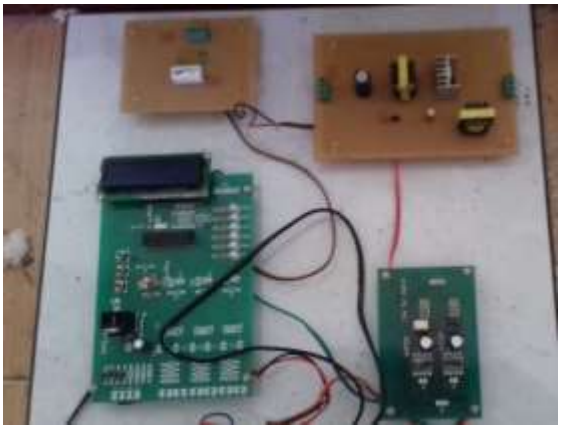


Buck Boost converter is controlled by gating signal of MOSFET. Voltage divider circuit act as a voltage sensor. The output voltage of Buck Boost converter is sensed by voltage divider circuit. The output of voltage sensor is given as input to PIC microcontroller. Output voltage sensor based MPPT algorithm is encoded in microcontroller. The output of PIC microcontroller is in the range of 5V. The output of PIC microcontroller is given as input to Gate driver circuit. The output of gate driver circuit is given as input to gate of MOSFET. Zener diode is connected in voltage divider circuit. The output of Zener diode is 5V. In this microcontroller we used rectifier and voltage divider circuit. The output of step down transformer is given as input to rectifier circuit. The output of rectifier circuit is connected by voltage regulator. The output of voltage regulator is given as supply to microcontroller. In this voltage divider circuit we used 1K and 10K resistor. 10K resistor is connected at upper side of voltage divider circuit. 1K resistor is connected at bottom of voltage divider circuit. Gate driver consist of rectifier and filter. The output of rectifier is given as input to filter circuit. Filter circuit converts from pulsating signal to D.C signal. TLP 250 is one type of optocoupler. It is otherwise called as Electronic isolator. It isolates the high voltage and low voltage signal. The output of microcontroller is given as input to gate driver circuit. The output of gate driver circuit is given as input to gate of the MOSFET. TLP 250 is suitable for gate driver circuit of IGBT or MOSFET.

V.METHODOLOGY

Output voltage sensor based MPPT algorithm is encoded in DSPIC 30F 2010.By using this MPPT algorithm we get maximum power in load at all time. We give the pulse to MOSFET through tlp 250. The output of PIC microcontroller is given as input to tlp 250. This MPPT is based on output voltage and Duty cycle. MPPT algorithm is encoded in PIC 30F 2010 using MPLAB IDE. Due to variation of irradiance and temperature we cannot get maximum power. Voltage sensor senses the output voltage and give the input to pic microcontroller. Based on MPPT algorithm, microcontroller gives the pulse width modulation. Based on pulse width modulation, it tracks the maximum point.

HARDWARE



CONCLUSION

A Renewable energy system like the one implemented here, is suitable for residential and/or industrial application. The result suggest that, on the output voltage sensor based MPPT method, already by far the most commonly used algorithm in commercial converters, has the potential to be very competitive with the other methods if it is properly optimized for the given hardware.Thus a system such as this can be deployed easily with little concern about adapting a home or business electrical wiring to take advantage of solar energy. Many areas allow surplus energy generated by system such as this to be sold to the utility grid in a policy known as “net metering”.After accomplishing the model of PV modules, the model of DC-DC buck boost converter and MPPT system are combined with it to complete the PV simulation

system with the MPPT function. The accuracy and execution efficiency for each MPPT algorithm can then be simulated under different whether voltage.

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