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Design of Dc to DC converter for PV system

[#1]Miss. Phadke Purva, [#2]Miss.Shelke Manisha, [#3]Miss.Belle Geetashri,
[#4]Prof. Sandeep Chawda, [#5]Prof.Shital Gudadhe

[1]purvasphadke@gmail.com
[2]manishashelke944@gmail.com
[3]gitu.kashinath.belle@gmail.com
[4]sandeep.chawda@gmail.com
[5]nishi.gud@gmail.com

[#1]Prof. Department of Electrical Engineering
[#2345]Department of Electrical Engineering, JSPM's BSIOTR, Pune.

ABSTRACT

Day-by-day the non-renewable energy sources are decreasing. Some example of conventional sources(coal, lignite, oil and gases) are vanishes soon, so people are looking for non-conventional sources (solar, wind, geothermal, tidal etc.).The purpose of this paper is to introduce design of DC to DC boost converter for PV system. The voltage getting from PV panel is variable DC voltage, the DC-DC boost converter boost up the input voltage level to desired output voltage level using PWM technique. The microcontroller PIC18F4520 will generate PWM which is given to switch of DC-DC boost converter. The MOSFET is used as switch in DC-DC boost converter circuit to reduce conduction losses and cost. The PWM generated from PIC18F4520 microcontroller is then given to gate pulse of MOSFETto vary the duty cycle. During day time the input to boost converter is given through the solar panel while during night time when sun is not available the input to boost converter is given through storage battery. The solar input voltage is stored to battery. Efficiency increases because of leakage inductance used in DC to DC boost converter circuit. Finally, the prototype circuit with 12-V input voltage,63-Voutput and power is operated to verify its performance.

***Keywords*—**Charge controller,Microcontroller,DC to DC boost converter,Photo-Voltaic system.

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I. INTRODUCTION

Conventional energy sources are decreasing due to increased demand of electricity. Normally, world primary energy consists 80% conventional energy sources which is huge impact on human life and environment. Because of this drawback we are focusing on use of renewable energy sources for production of electricity. Renewable energy sources (solar, wind, tidal, biomass etc.)plays an important role in power generation. As theseare abundant, pollution free, distributed throughout the earth and recyclable. As the energy from sun has advantages like ease of installation, free of pollution, cleanness, and available everywhereso the people are using solar energy sources widely. The voltage level of solar panel is very low thus DC to DC boost converter is employed for many renewable applications [1].

Photovoltaic systems are expected to play an important role in future energy production. Photovoltaic systems transform light energy into electrical energy, and DC to DC boost converter convert low voltage into high voltage [2].

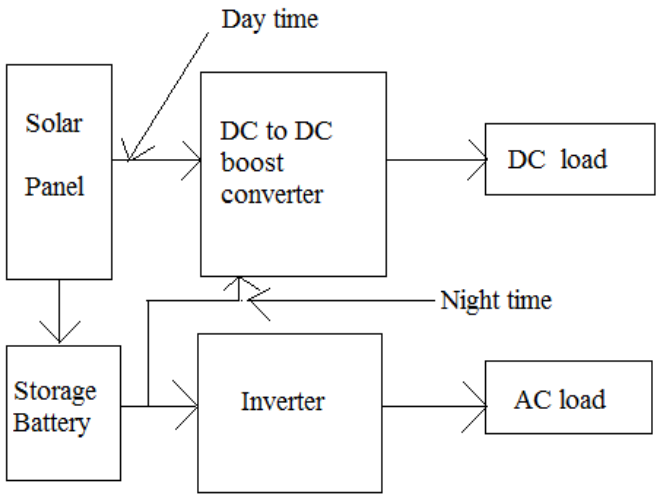

Fig 1.Basic block diagram of system

The typical photovoltaic system consist of solar module, charge-discharge controller, DC-DC boost converter, battery set, DC load.

The voltage output of solar module is in DC form. Then the voltage is given to DC-DC boost converter, microcontroller PIC18F4520 is used to generate PWM. The generated PWM of PIC18F4520 is given to switch used in DC-DC boost converter circuit. The switch used in DC-DC boost converter circuit is MOSFET. Charge controller is used to control charging and discharging of battery. During the day time when sun is available then input to DC-DC boost converter is given directly through solar module while during night period,in unavailability of sun the battery will give supply to DC-DC boost converter. The output voltage level of boost converter is higher than input voltage level [5].

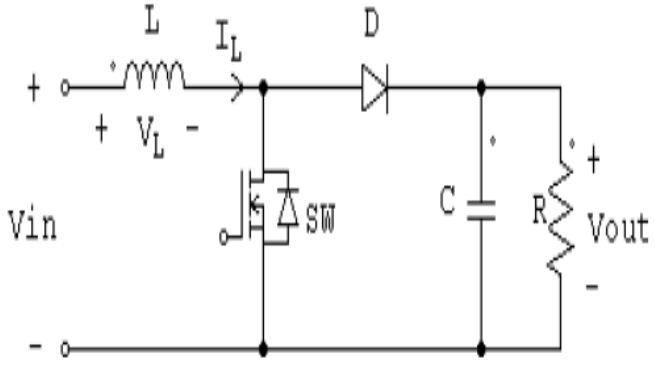

Fig. 2 Schematic of boost converter

II. PROPOSED SYSTEM

In this paper a proposed boost converter is so design which is operated in continuous conduction mode used to step up variable input voltage level available from the sun rays to a desired output voltage level. The specifications of this system are as shown in following table 1:

PARAMETERS	SPECIFICATION
Power Rating (P)	10 W
Input Voltage(v_{in})	12V
Output Voltage(V_{out})	63V
Input Current (I_{in})	0.65A

Table 1
Specifications of proposed boost converter

To produce the desired output voltage PWM technique is used. This system generated output voltage is measured and the microcontroller PIC18F4520 is used to generate PWM. As PIC18F4520 microcontroller having PWM generated (at pin no 16 & 17). This microcontroller works on 5V, 20MHz supply and hence the PWM gets operated when supply is given to microcontroller. The control system is as follow:

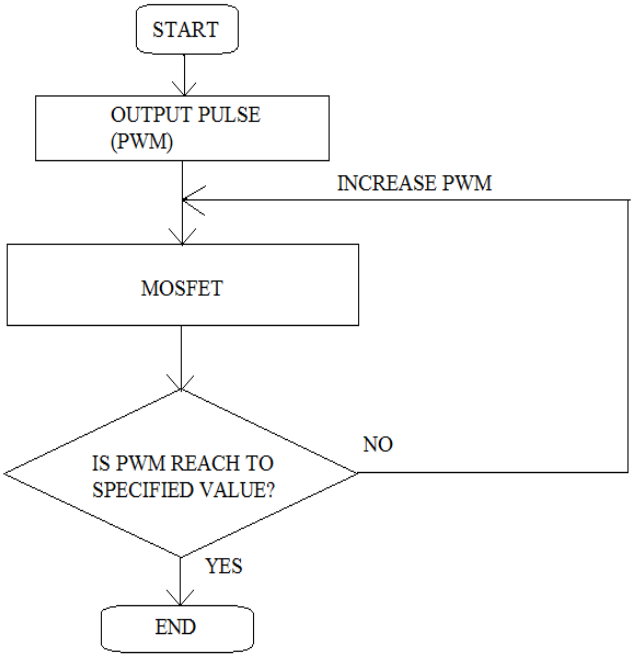

Fig 3.Control flow chart

A. Selection of Switch:

Any electronic device can be used as switch. The selection of switch is depend upon the value of input voltage and current rating which have to be higher than the maximum input voltage and current. As the MOSFET is used to control the voltage so the MOSFET is used in proposed system. With this there are some advantages as follow:

1] Fast switching speed

2] MOSFET has higher speed of operation compared to other electronic devices.

3]MOSFETs are somewhat easier to manufacture, they are more widely used.

B. Selection of Inductor:

For converter to operate in continuous conduction mode the inductor is selected having higher value than its calculated value.

C. Selection of Capacitor:

Similarly as an inductor, the selection of capacitor also depends on its value. Capacitors are so selected that it will have high value than its calculated value,also ESR(Equivalent Series Resistance) of the capacitor will affect the efficiency of the performances. So it has a prime importance in considerations. The capacitor having low value ESR is used to improve the performance. Also the ESR value of capacitor is reduced by connecting capacitor in parallel.

D. Selection of Diode:

A diode is such a device which can conduct current in only one direction. This is the main function of diode. For the selection of diode the reverse voltage is also considered. As when diode is forward biased by applied voltage (higher than barrier potential) then current shall conduct across the diode.

COMPONENTS	VALUE
Electronic Switch	MOSFET
Inductor	1mH
Diode	IN4007
Capacitor	1000µF
Microcontroller	PIC18F4520

Table 2
Boost Converter Parameters

Continuous Conduction Mode

There are two modes under continuous conduction mode. Mode 1 starts when MOSFET used as a switch in boost converter is turned on. While Mode 2 starts when switch is turned off.

Mode 1:($t = t_{on}$)

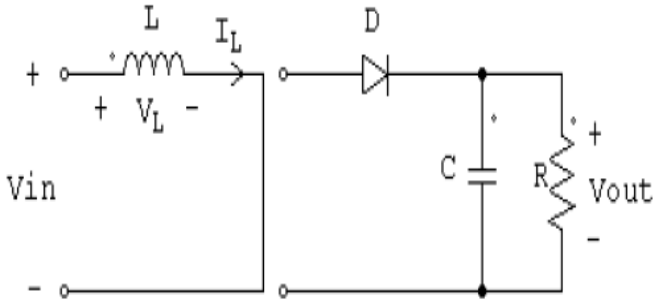

Fig 3.The ON state diagram of the boost converter

When switch is turned on (closed) then the energy gets stored in inductor. At $t = t_{on}$ the leakage inductor L charged by the input voltage as shown in Fig 3.

Mode 2($t = t_{off}$)

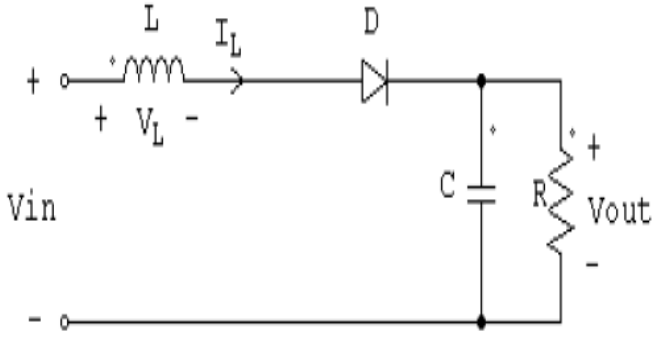

Fig 4. The OFF state diagram of the boost converter

When switch is turned off(opened) then the current flows through inductor L, resistance R, capacitor C and load.During this mode the stored energy in inductor transferred to the load hence we get boosted output voltage.

SIMULATION OF EXPERIMENTAL SETUP:

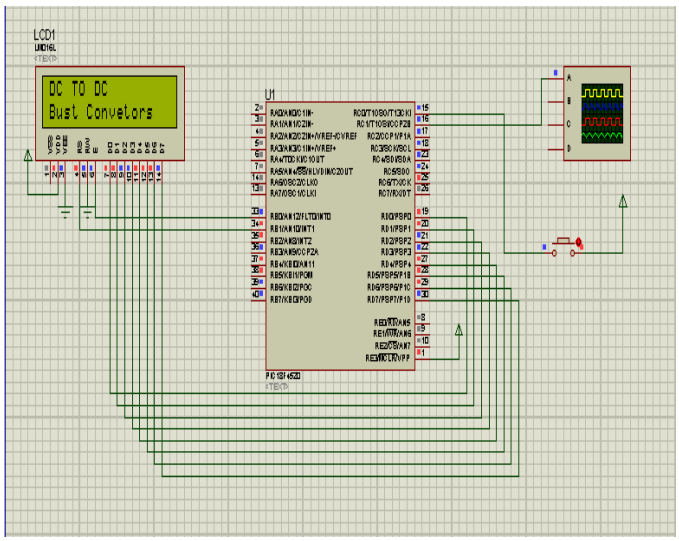

Figure 5: Simulation Block Diagram

III.HARDWARE DESCRIPTION

A prototype of the proposed step-up converter with a12 V input voltage is tested. Here, the proposed converter is controlled by the microcontroller PIC18F4520.The microcontroller PIC18F4520 works on 5V DC supply. In proposed system the battery is connected to microcontroller. The PWM generated at pin 16 &17 is then given to vary duty cycle of switch used in boost converter circuit as the input through solar panel is also varying. The input to boost converter is supplied from solar panel and when sun is not available input is given through battery which charged through solar panel. Practically PWM can vary from 0% to

99% but in the proposed system the PWM can vary till 5% to 10%. As shown in following fig. Solar panel is connected to input source of boost converter as well as to charging circuit of battery. When supply is provided to boost converter (very low level), the boost converter will boost up voltage upto desired voltage level the respective DC voltage is then measured or DC load may get connected.The storage charged battery through solar panel is given to inverter if AC load is connected.

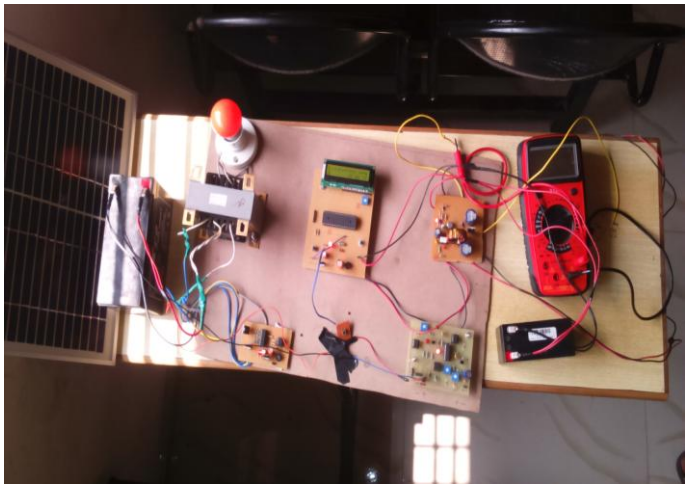

Fig.6 Prototype photograph of proposed converter

IV. ADVANTAGES

The advantages of proposed system are as follow:

1. The converter achieves the high step up voltage gain that renewable energy requires.
2. Low cost and High efficiency are achieved. Hencesuitable for high power applications.

And disadvantage of this system is Conventional step-up converters, such as the boost converter, cannotachieve a high step-up conversion with high efficiency because of the resistances of elementsor leakage inductance.

V. CONCLUSION

This paper has presented the prototype of proposed boost converter for PV system.The boost converter is able to produce a variable output voltage from variable input voltage to suitable value. From sun available voltage level is too small so to get desired voltage the input should get boost up. By using the PWM generated by microcontroller, the duty cycle of MOSFET changes and thereby changing the output voltage. The components of booster had been selected according to considerations. The operating principal of system and design of boost converter has been described in detail.

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