

# Boost Converter and Chopper Circuit for Solar Power Based PMDC Drive

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**Abstract-** Among all renewable energy the solar energy is available in abundant amount and it is clean, inexhaustible source of thermal as well as light energy. This paper consists of boost converter circuit used for charging the battery from solar panel. Chopper circuit used to smoothly start the PMDC motor by automatically varying the duty cycle.

**Keywords-** Solar Panel, Boost converter, Chopper, PMDC motor.

## I. INTRODUCTION

Electricity is the basic need of human being. In world wide large amount of electricity is generated through fossil fuel such as oil, gases, coal, etc but main disadvantage of fossil fuels are the are exhaustible. Electricity generation process from that fuel emits CO<sub>2</sub> and green house gases which are harmful to both human beings and the environment. This problem can be reduced by increasing the use of Renewable source of energy such as Electricity generation from Solar panel.

Utilization of solar energy is increasing day by day almost all over the world .Currently solar installed capacity of India is about 20GW .By 2022 India is targeting install 60GW of medium and large scale grid connector solar project and 40GW of solar rooftop connected project. The main advantage of solar energy is it is clean energy and it is in exhaustible .With the help of photovoltaic effect solar light energy can be efficiently converted into electricity. Generated electrical energy via solar panels is store in batteries for power backup purpose but output voltage of solar panel is not constant, it varies continuously depending on sun radiations incident on solar panel which in turn depends on seasons, period of day, clouds barrier, in order to get constant and step up voltage for storing electrical energy into storage system boost converter plays an important role and is used extensively and promotes the use of Renewable Source of Energy.

The practical block diagram for execution of above idea is shown below. The boost converter step up the low voltage of the solar panel and provides a constant DC voltage

for charging the battery. The type A chopper uses the energy from the batteries and provides variable increasing voltage(uptil rated) for starting motor.

## II. DESCRIPTION OF SYSTEM PARTS

The solar output voltage is not sufficient to charge the battery and it also varies time to time, for this reason boost converter is used to charge battery by supply the required voltage.

Chopper circuit converters fixed dc voltage to variable dc voltage, there are 5 types of chopper circuit as per working of load in the respected quadrants. Chopper can also be used as the starter to the dc motors, because they have high starting current initially. PermanentMagnet DC motor, type of dc motor in which instead of field winding permanent magnet are present. This motor are simple in construction, the magnet field strength is fixed, field control not possible. By varying the supply voltage the speed can be controlled.

PWM signal to gate terminals of N- channel IRF540 MOSFET used in both boost converter and typeA chopper is provided by Arduino uno microcontroller.

## III. BLOCK DIAGRAM OF SYSTEM

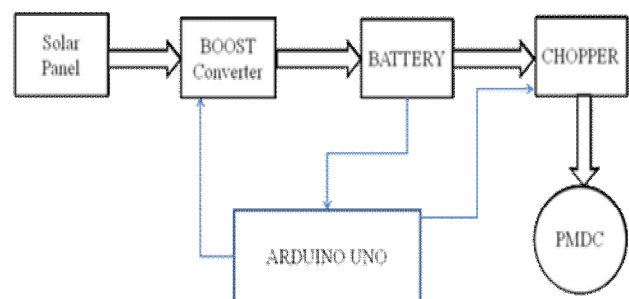


Diagram 1: Block diagram of system.

The power flow from solar panel to PMDC motor is shown by broad arrows. Which is flow solar panel- boost converter- battery- chopper- PMDC motor.

Arduino Uno is used to generate pwm for the boost converter and the chopper.

1. Solar Panel: It collects and converts the sun energy into electricity. Sun is natural reactor which release photon and this photon hit solar cell, electrons are release. If conductor connected to positive and negative terminals of cells we get current and respective voltage across the cells. In this case the output of solar module is connected to the boost converter.
2. Boost Converter: Converter is used to boost the input voltage to a higher value. By varing the duty cycle of switching device used the voltage can be varied, and also by changing the value of inductor and capacitor the higher voltage can be obtained.
3. Chopper: Converts the fixed dc value to variable dc voltage, which can be used for speed control of dc motor, or for the initial starting of the motor. By varying supply voltage speed of motor is control.
4. Battery: To supply constant voltage to pm dc motor a constant power supply is required which is fullfield by Lithium-ion battery. This battery are light in weight, compare to other battery of same size. Lithium is high reactive element, lot of energy can be stored in its atomic bonds. This translates high energy density for lithium-ion batteries.

Lithium-ion battery pack loses only about 5% of its charge per month, compare to 20% per month for NiMH batteries. Lithium-ion batteries can handle hundreds of charge and discharge cycle.

Li-ion battery charging method:

Constant voltage charging method is used. A constant voltage charger sources current into the battery, force the voltage up to pre-set value. Once, this voltage is reached the charger will source only enough current to hold the voltage of battery at this constant voltage.

5. Arduino Uno: Arduino Uno is microcontroller board based on AT Mega 328. Has 32 kilobytes of memory, clock frequency of 16MHz. Arduino IDE( integrated development environment) software is used to write program. We have basic support circuit for the micro controller chip. Arduino board has:

Table 1: Technical Specification of Arduino Uno board

Microcontroller	AT Mega 328
Operating voltage	5V
Digital I/O pins	14(6-pwm pins provided)
Analog input pins	6
DC Current per I/O pin	40mA
Flash memory	32KB
SRAM	2KB
EEPROM	1KB
Clock Speed	16MHz

**IV. SIMULATION**

1. Boost converter:

It boosts the voltage higher than the input. The boost converter consists of components such as the inductor connected in series. With the diode, and the capacitor connected in parallel across the load for constant and stable value across the output. A power switch is used which is connected in parallel towards the input side, and on- off condition can be varied and according to that the inductor is charged and discharge in the circuit.

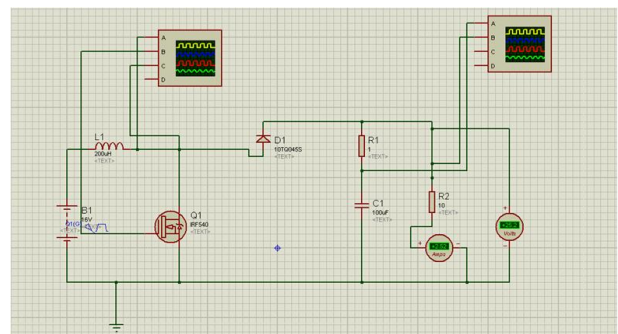


Diagram 2: Simulation Boost converter circuit

During the switch in on the power flow is through input supply- inductor-power switch- back to input source. When the switch is off the power store in inductor is release and the capacitor is charged. Diode is used for the unidirectional flow of current in the circuit. Capacitor is charged to a fix value and when switch is on the capacitor discharge by flowing the power towards the load.

**Simulation output of boost converter:**

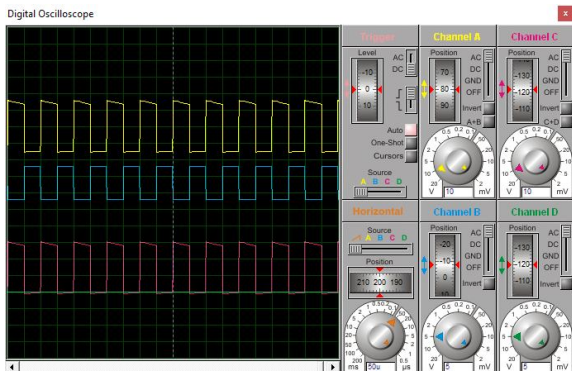


Diagram 3: Boost converter output

**Oscilloscope 1 (Input) :**

- Channel A (Yellow) = Inductor Waveform
- Channel B ( Blue) = Pulse Generator Waveform
- Channel C ( Pink) = MOSFET waveform.

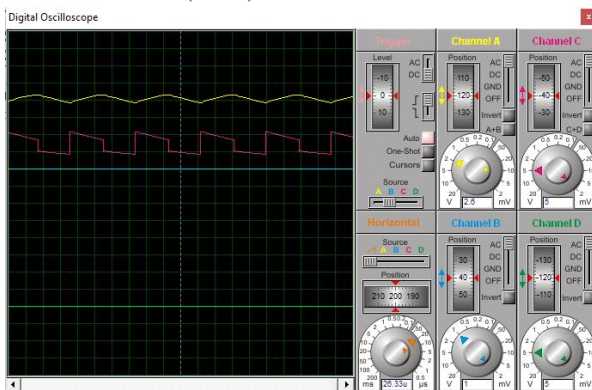


Diagram 4: Boost converter output

**Oscilloscope 2 (Output):-**

- Channel A (Yellow) = Capacitor Waveform
- Channel C ( Pink) = Load Waveform

**2. Chopper circuit:**

A chopper is device which converts fixed dc input voltage to variable dc output voltage directly. It is high speed on/off semiconductor switch. It connects the source to load and load to source at fast speed. Chopped waveform is obtained from dc source of magnitude  $V_s$ . Depending upon the quadrant of operation chopper as 5 types: Type A, B, C, D, E.

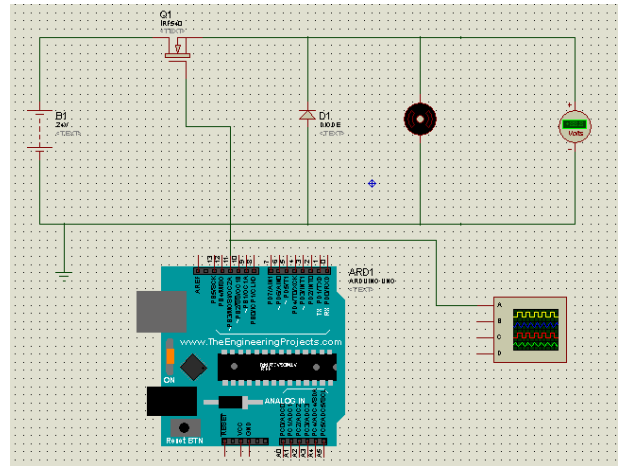


Diagram 5 :- Chopper Circuit diagram .

The above circuit represents the basic circuit diagram of chopper where a switching device in this case MOSFET is used. Freewheeling diode is connected across the load and it conducts when the switch is in off position. By varying the on and off time of switching device the output voltage can be varied.

**Simulation output result:**

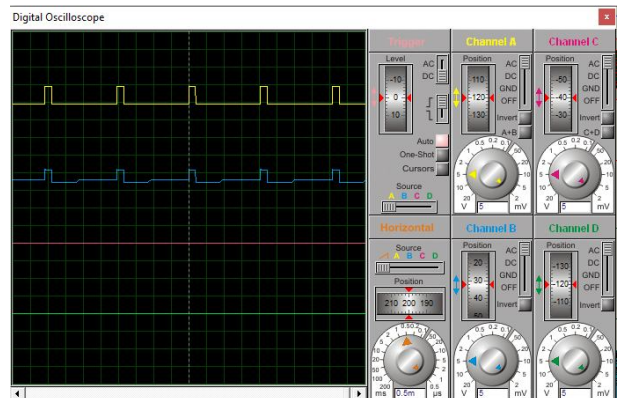


Diagram 6:Chopper output (duty cycle=10%)

- Channel A ( Yellow) = Pulse Waveform
- Channel B ( Blue) = Inductor Waveform

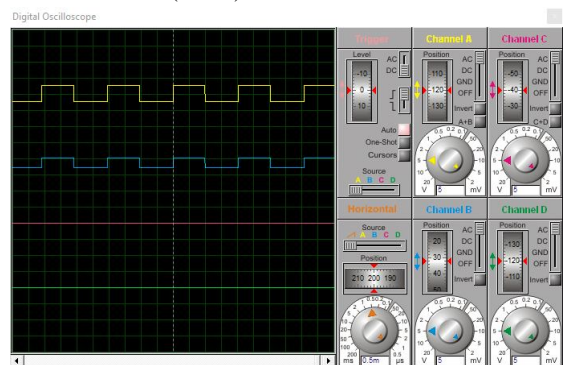


Diagram 7: Chopper output (duty cycle=50%)

## V. CONCLUSION AND FUTURE SCOPE

The use of solar panel for small scale application is useful. As in this paper it is used to charge the battery. For high power application the number of solar panel required will be more and respect to that the components and system will change. In this paper considering pmc motor as load required circuits are being designed, and for this application required battery and charging method is used. Simulation of boost converter and chopper circuit is done and by varying the duty cycle the pwm pulse width can be change and the required output of voltage can be get to drive the load.

Future scope connection of heavy load and designing the system. Which will increase the number of solar panel to be connected, choice of battery or inverter for the a load.

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