IoT Monitored Portable Wind Energy Based Energy Generation for Charging Applications

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***Abstract:* In recent days power generation using renewable energy sources gained more attraction. The most commonly available and used energy resources are solar and wind. The objective presented here is charging of low power electronic gadgets using the wind energy available during travelling. A DC generator with a sepic converter provides voltage required for charging the gadgets when the vehicle speed exceeds 40 km/hr. Even though the speed fall is observed, the gadgets will get continuously charged by the external battery source which is connected to the proposed circuit. This could be used as emergency source for charging electronic gadgets while travelling in a vehicle.**

***Keywords:* Battery, Charging Controller, DC Motor, Sepic Convertor, Voltage Regulator, Wind Energy.**

I. INTRODUCTION

With the rapid industrialization development and exploitation of natural resources. Many times condition occurs which result in non charging of our daily use gadgets and mobile. But this problem can be tackled by using renewable energy resources Technologies like solar charger, charging pins powered through automobile battery and gadgets through hand operated dynamo through a combination of many gears are used for charging mobile phones. But a problem occurs when there is no sunlight or the light is not in a condition to charge the other one and also the use of hand operated gadget is very laborious work and also not effective for long. In order to overcome these types of problem, exploration has been carried out with mobile phone and at present we have come with a solution of maintaining sustainability of energy stored in the phone battery by " Wind Driven Mobile Battery Charger". This concept utilizes wind generated electrical energy to charge the mobile phones battery.

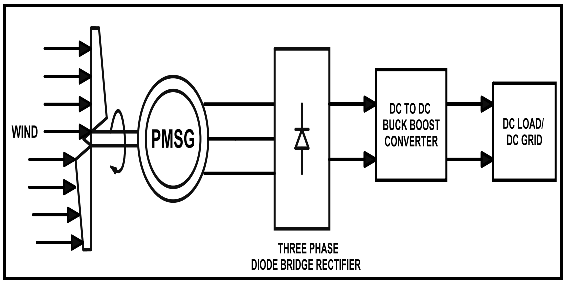


Figure 1 Block diagram of whole setup

II. MATERIALS AND METHODS

A. Propeller

A Propeller is a type of fan that transmits power by converting rotational motion into thrust. A pressure difference is produced between the forward and rear surfaces of the airfoil shaped blade, and a fluid (such as water or air) is accelerated behind the blade. The number of blades decides the rotational speed of the propeller and differs with the pitch angle and the angle between the blades. If the number of blades is more the speed output is more and thus give more output voltage and vice versa.

B. 12 Volt PMSG Generator

A simple D.C generator is preferred over the A.C generator so as to avoid the use of rectifier circuit and to make the circuit cheap and compact and also to avoid extra cost. The main difference in the A.C and D.C generator lies in the manner in which the rotating coil is connected to the external circuit connecting the load. In an A.C generator both end of the coil is connected to the external circuit. In an oil D.C generator the two ends of the coil are attached to the different halves of a single split ring which co-rotates with the coil. The split ring is connected to the external circuit by means of metal brushes. The combination of split rings and the stationary metal brushes is called a commutator. The purpose of the commutator is to ensure that the emf in the external circuit is equal to the emf generated around the rotating coil for half the rotating period.

C. Charging Regulator Circuit

This is a combination of a 6v/22µf capacitor. The bypass capacitor is hooked up at the output terminal of the DC generator. The capacitor is there to filter out any noise coming from the voltage source. The voltage regulator I.C will work best if a clean D.C is fed to it. To avoid any A.C noise imposed on the D.C line voltage, the capacitor in essence act as a bypass capacitor. It shorts the A.C signal of the village signal to ground and only the D.C portion of the signal goes to the regulator.

I.C 7805: I.C 7805 voltage regulator employ built in current limiting, thermal shutdown, and safe area protection which make them virtually immune to damage from output overload. With adequate heat sinking it can deliver in excess of 0.5 A of current. Typical application will include local regulators which can eliminate the noise and degrade performance associated with single point regulation. As the most prominent voltage for charging the mobile phones is 5 volts.

Battery: In ordinary mobile a 3.7 volts li+ battery is used 3.70 wh rating the battery when fully charged shows the voltage of about 3.95 volt and when discharged it shows 1.75volts.

COMPONENTS:

- 12V DC Motor
- Step Up Module
- 1N4007 Diode
- AMSII7JC Driver Board
- 5V DC Power Supply
- Electrolytic Capacitor ranges (10 – 100uf)

III. DESIGN AND ANALYSIS OF SEPIC CONVERTER

In a single ended primary inductance converter design, the output voltage can be higher or lower than the input voltage. The SEPIC converter. The two inductors can be wound on the same core since the same voltages are applied to them throughout the switching cycle.

A.DESIGN PARAMETER:

1. Duty Cycle Consideration:
For a Buck Boost converter operating in a continuous conduction mode (CCM).

1. <u>Calculating the Voltage Conversion Ratio (VCR):</u>

Using the formula VCR = $V_{out} / V_{in} = (1 – D) / D$, we can determine the required voltage conversion ratio:

VCR = (1 – 0.3) / 0.3 = 0.7 / 0.3 = 2.33

2. <u>Verifying Output Voltage:</u>

To ensure that the desired output voltage is achieved, we can use the VCR to calculate the expected V_{out}:

$V_{out} = V_{in} \times VCR = 6V \times 2.3 = 13.8V$

As expected, the output voltage is indeed 13.8V.

3. <u>Calculating the Current Conversion Ratio (CCR):</u>

Using the formula CCR = $I_{out} / I_{in} = D / (1 – D)$, we can find the current conversion ratio:

CCR = 0.3 / (1 – 0.3) = 0.3 / 0.77 = 0.48

4. <u>Calculating Power Conversion Efficiency:</u>

Assuming ideal conditions, we can calculate the power conversion efficiency (η) using the formula $\eta = P_{out} / P_{in} = V_{out}I_{out} / V_{in}I_{in}$:

$\eta = (12V \times 1.7A) / (6V \times 3.5A) / = 20.4 / 21W =$ or 97%

A good rule for determining the inductance is to allow the peak-to-peak ripple current to be approximately 40% of the maximum input current at the minimum input voltage.

fsw is the switching frequency and Dmax is the duty cycle at the inductor, to ensure the indicator does not saturate and the indicator value is given by:

Power Mosfet selection: The parameters governing the selection of the MOSFET are the minimum threshold voltage Vth (min), the on-resistance RDS(ON), gate-drain charge QDG, and the maximum drain to source voltage, VDS(max). Logic level or sublogic level threshold MOSFETs should be used based on the gate driven voltage. The peak switch voltage is equal to Vin + Vout.

IV. OUTPUT DIODE SELECTION

The output diode must be selected to handle the peak current and the reverse voltage. In a Buck

Boost Converter, the diode peak current is the same as the switch peak current IQ1(peak).

Similar to the boost converter, the average diode current is equal to the output current. The power dissipation of the diode is equal to the output current multiplied by the forward voltage drop of the diode. Schottky diodes are recommended in order to minimize the efficiency loss.

V. BUCK BOOST CONVERTER SELECTION

The SEPIC capacitor must be rated for a large RMS current relative to the output power. This property lower power applications where the RMS current through the capacitor is relatively small. The voltage rating of the SEPIC capacitor must be greater than the maximum input voltage. Tantalum and ceramic capacitors are the best choice for SMT, having high RMS current ratings relative to size.

Electrolytic capacitors work well for through-hole applications where the size is not limited and they can accommodate the required RMS current rating.

A capacitor that meets the RMS current requirement would mostly produce small ripple voltage on Cs. Hence, the peak voltage is typically close to the input voltage.

I. Output Capacitor Selection:

In a SEPIC converter, when the power switch Q1 is turned on, the inductor is charging and the output current is supplied by the output capacitor. As a result, the output capacitor sees large ripple currents. Thus the selected output capacitor must be capable of handling the maximum RMS current.

The output cap must meet the RMS current, ESR and capacitor requirements. In surface mount applications, tantalum, polymer electrolytic, and polymer tantalum, multilayer ceramic capacitors are recommended at the output.

II. Input Capacitor Selection:

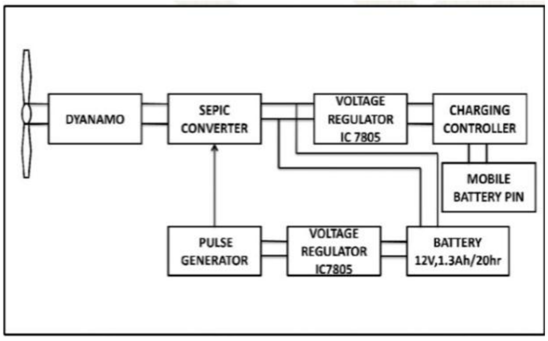
Similar to a boost converter, the SEPIC has an inductor at the input. Hence, the input current waveform is continuous and triangular. The inductor ensures that the input capacitor sees fairly low ripple currents.

The input capacitor should be capable of handling the RMS current. Although the input capacitor is not so critical in a SEPIC application, a 10μF or higher value, good quality capacitor would prevent impedance interactions with the input supply.

VI.EXPERIMENTAL RESULTS

Proposed Block Diagram of Wind Energy based mobile battery charging and battery applications.

Figure 2a Block Diagram of proposed converter



Proposed Circuit of Sepic Converter is shown in figure

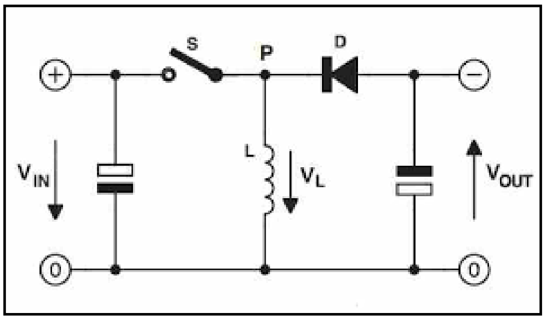


Figure 2b DC-DC Buck Boost Converter –Circuit Diagram

2. A fixed voltage is boosted to a voltage level necessary to change a battery. It is boosted with the design parameters and simulated using the matlab.

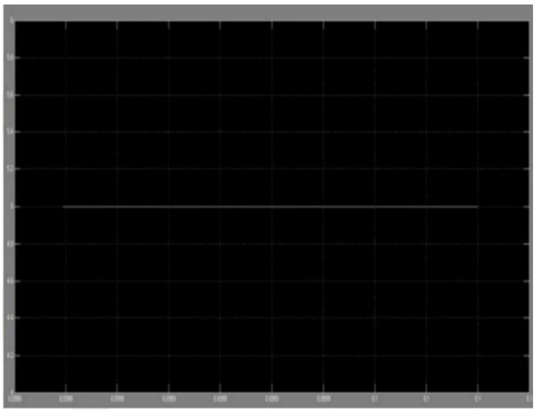


Figure 3 shows Input Voltage Waveform

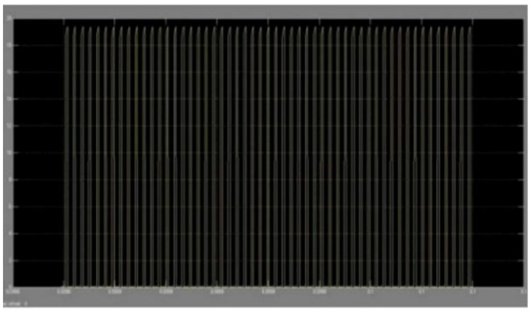


Figure 4 shows Switching Pulse for Mosfet

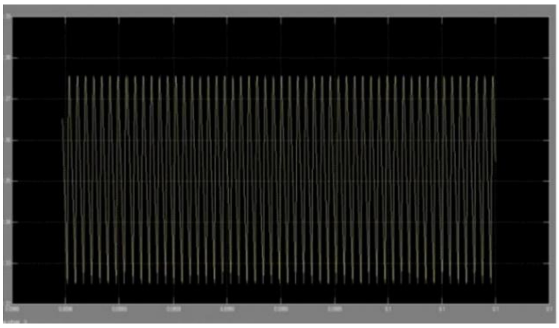


Figure 5 shows Output Voltage Waveform

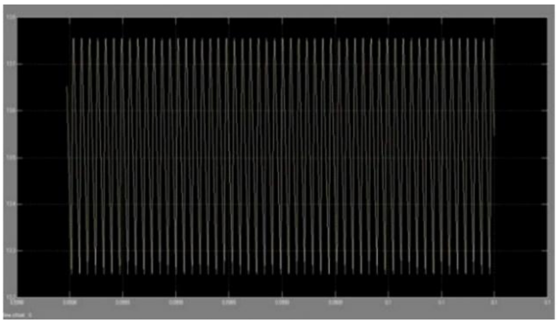


Figure 6 shows Output Voltage Waveform

PROTOTYPE DEVELOPMENT:

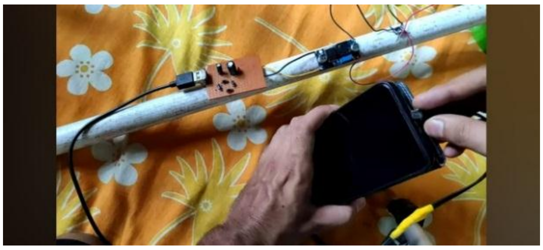


Figure 7

Figure 8

Input Speed m/s	Output Voltage	Power Output
2.5	5.8	19.72
2.6	5.82	19.78
2.7	5.89	20.02
2.8	5.91	20.09
2.9	5.92	20.13
3	5.98	20.33

V. CONCLUSION

In this a wind battery charger has been investigated to charge the mobile phone or battery while travelling. This technology can help to meet the emergency power requirement when grid electricity is not available. The wind-driven mobile charger is also poratble, csot effective and energy efficient. By further suitable modifications, the system could be used to charge gadgets for daily use. In the Future work charging of laptop and high power gadgets will be accomplished.

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