Design of Zeta Converter for free Energy Generation from Bicycle

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Abstract- *As the power crisis is increasing day by day in order meet our demands we are in search of alternative reduce this and to generate the power the simple and elegant way is to utilize the energy which is generated while pedaling the cycle. A permanent magnet generator is coupled to it .Zeta converter is used to boost up the power generated from it. A battery is used to store the generated power which feeds the DC load.*

Keywords- pedaling; cycle; permanent magnet generator ; zeta converter; battery

I. INTRODUCTION

The fossil fuels in our country are getting depleted in a faster rate. Their utilization as the energy source causes environmental degradation due to unfinished ignition. In addition to this as the world population keep on increasing day by day, we are in search of efficient alternative to power up our electrical necessities at low cost . The pollutants emitted during the burning of fuels causes the environmental hazards. The issue of a steady replacement of fossil fuels is a great thirst for everyone . There is very simple and efficient method to produce the power from the wasted energy during cycling. While ongoing revolution the clean power generation is a main constrain .Electricity is generated at a small level by using bicycle pedalling. Bicycle is the main mode of transportation in many villages of our country. Power generated by pedalling can be converted from mechanical to electrical energy by using a generator. In order to meet our energy demands due to increased consumption of energy a smart alternative which does not emit any toxic gas emitants should be found.The generated power from the generator is further boosted up by the zeta converter and it is stored in a battery to light up the loads.

II. LITERATURE REVIEW

ZETA CONVERTER AND ITS OPERATION

Power converters used now a days has the front end rectifiers, this kind of rectifiers draw pulsating currents which results in large amount of harmonics and it has considerably low power factor. The harmonics and power factor may not be a serious problem in single converter of this type which is used with a single phase load such as consumer electronic equipment. However large number of those equipment in parallel connection at a point of common coupling (PCC) to draw the power simultaneously will introduce some serious effects concerning reactive power and harmonics. These phenomena are quite common in offices and industries. An isolated zeta converter has some advantages including safety at the output side and flexibility for output adjustment. Extracting power from bicycle pedaling with high efficiency is a great challenge. A best boost converter should be employed to extract the maximum power and to utilize it properly. In order to choose a best converter with maximum efficiency is a tedious task. Among these various available converter topology zeta converter is a great choice in this process of power extraction. The maximum power will be withdrawn from this converter. For withdrawing the power from bicycle pedalling a efficient boost operation is required to utilize the maximum power. In this step up operation is implemented by the isolated zeta converter. zeta converter is able to fulfill the requirements such as power factor correction and amount of harmonics is reduced. The equivalent circuit of Zeta converter is as shown. It comprises of a switch, a diode, two capacitors $C1$ and $C2$, two inductors L1and $L2$ and a standing resistive load. The operation of zeta converter is designed in Continuous Conduction Mode (CCM) and the circuit operation can be defined by two modes of operation are shown.

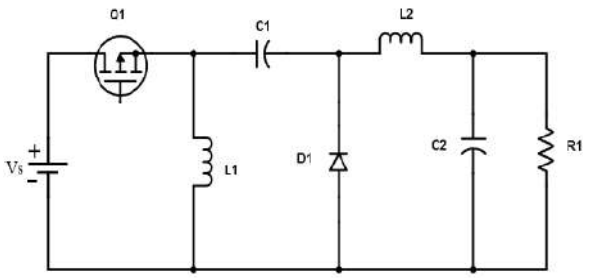

Figure 1. Zeta converter

Mode 1

In this mode, the switch $Q1$ is ON and the diode $D1$ is reverse biased. Inductors $L1$ and $L2$ is charged from the

source and the inductor current $IL1$ and $IL2$ increases linearly. Also, discharging of $C1$ and C2 takes place.

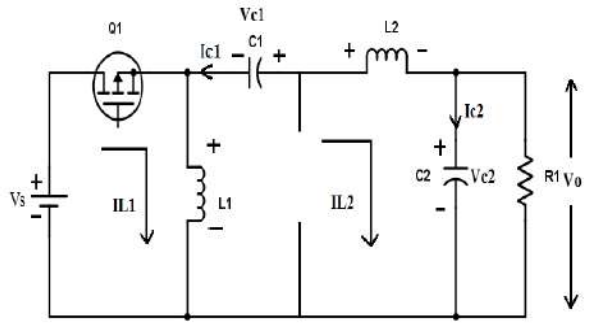

Figure 2. When switch is ON

Mode 2

In this mode, the switch $Q1$is OFF and the diode $D1$ is forward biased. During this interval, previously charged inductor $L1$ starts to discharge. So stored energy in $L1$ and $L2$ are discharged through capacitors $C1$ and $C2$. Therefore, the inductor currents iL1 and iL2 decrease gradually

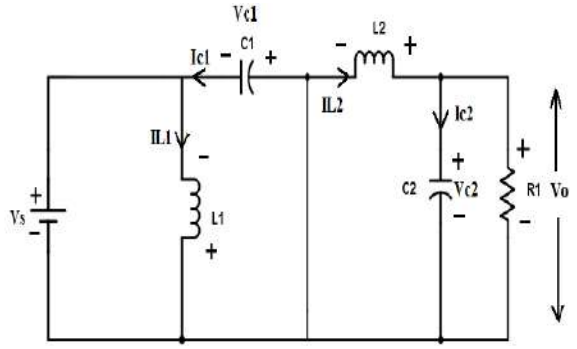

Figure 3. When switch is OFF

III. GEAR RATIO

Bicycle gearing in a bicycle drive train which determines the relation between the number of revolutions per minute .That is the rate at which the rider pedals and the rate at which the drive wheel turns. Some bicycles have the fixed gear ratio and few contemporary bicycles have the multiple gear system, and thus it has multiple gear ratios. A cyclist will produce the power optimally within a narrow pedaling speed range. Gearing which can be used to optimize the use of narrow range as efficient as possible. The gear ratio is closely related to the mechanical advantage of the drive train of the bicycle. Gear ratio is used in by bicycle to increase the speed and to reduce the difficulty while pedaling. It is used to increase the number of rotation while pedaling . The gear ratio used here is 3:1. In this it has around 60 teeths in front end and twenty teeth in back end. As a ratio of 1:1 will results in one rotation this will not be efficient for power generation .The generator cannot be rotated to the required speed. In order to rotate the generator according to the requirement needed the gear ratio has been used to speed up . The gear ratio of 1:1 will result in lot of difficulties while pedaling .If it has a chain ring with 60 teeth and a sprocket with 20 teeth, the chain ring is 3 times bigger than the sprocket; one full revolution of the pedals will result in three full revolutions of the wheel. As a ratio, this is 3 to 1 (3:1). In simple terms, a gear ratio on a bicycle refers to how many times the back wheel will rotate for each full turn of the crank arms (pedals). If it has a chain ring with 30 teeth and a sprocket with 30 teeth, there is no difference between the two; one full revolution of the pedals will result in one full revolution of the wheel. As a ratio, this is 1 to 1 (1:1). In this case the chain ring with 60 teeth and a sprocket with 20 teeth which results in one full revolution of the pedal will have three revolutions.

Figure 4. Bicycle coupled with geneartor

IV. PERMANENT MAGNET GENERATOR

A permanent magnet generator is a device that the converts mechanical energy to electrical energy. The rotor windings have been replaced with permanent magnets. It does not require a separate DC supply for the excitation circuit or

do they have slip rings and contact brushes .These machines are superior alternatives to traditional the induction motors this can be coupled with turbines, diesel generators and used for hybrid vehicles. The major advantage in these machines is that it does not require any specific work environment

Permanent magnet generator used here is of four pole machine which runs at the maximum speed of 1500 rpm. It generates the voltage upto 24 volts. Its capacity of 0.5 horse power. The maximum permissible winding temperature is 40◦C.

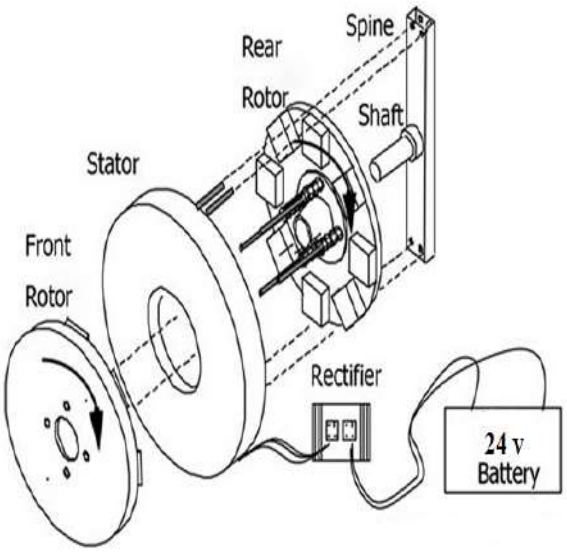

Figure 5. PMG with rectifier

V. HARDWARE SETUP

A cycle which is coupled with the permanent magnet generator by the means of chain sprocket is used here. The generator gets rotated whenever the cycle gets pedalled. The output from the generator gets boosted by the Zeta converter. The output from the generator is 24 volts which gets boosted upto 48 volts by the Zeta converter.

Figure 6. output from generator

Fig 6 shows the output voltage from the permanent magnet generator.

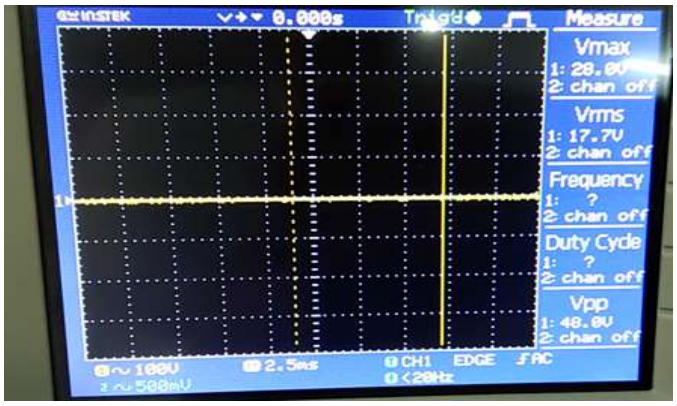

Figure 7. output voltage from zeta converter

Fig 7 shows the output voltage from the Zeta converter .24 volts from the permanent magnet generator has been boosted to 48 volts in Zeta converter.

Figure 8. Bicycle setup with Zeta converter

VI. CONCLUSION

Permanent magnet generator coupled bicycle to generate power. The Zeta converter is used to boost up the power generated from permanent magnet generator. Output voltage from the permanent magnet generator has been boosted up to 48 volts from 24 volts using Zeta converter. The experimental results has been shown. The hardware setup of bicycle with Zeta converter has been shown

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