Journal of Engineering Sciences
Vol 11, Issue 4 , April/2020
ISSN NO:0377-9254

Comparative study of KY Boost Converter using different Controllers

Mr.G. Shiny Vikram[1] , Mr.B. Ashok Kumar[2]
[1]Assistant Professor, Department of EEE, Ramachandra college of Engineering, Eluru, A.P-India
[2]Associate Professor, Department of EEE, Ramachandra college of Engineering, Eluru, A.P-India

Abstract: **Renewable energy is the energy that is collected from renewable resources and due to the rising depletion of fossil fuels, renewable energy is the source that humanity turns to for harnessing electrical power. The power so obtained often needs DC- better DC conversion for supplying the load properly. The boost converters are used currently for the chopper control in wind and solar power systems that provides a response characteristics that can be improved, by implementing a KY converter in place of the boost converter. In this topology, the implementation of KY converter has been done in MATLAB/ SIMULINK and compared with open loop and PI controller.**

Keywords: **KY Converter, Boost Converters, Open loop Controller, PWM Controller, PI Controller**

1. INTRODUCTION

In the modern society, DC-DC converters were widely used in portable electronic devices such as: mobile phones, laptops and digital still cameras (DSC). In order to converts the battery voltage into different voltage domains. For power supply applications using low
Voltage battery, in most instances, it is necessary uplift from low voltage to high voltage, thus a boost converter is usually applied, but with a pulsating output current leading to a large voltage ripple [2]. Moreover, the boost converter consists of a right hand plane zero, which deteriorates the converter stability and transient response performances. Recently, a voltage-boosting converter has been proposed, named as KY converter. When this converter is operating in continuous conduction mode (CCM), it has a lot of advantages such as non-pulsating current, low output ripple, and good load transient response [2], [3], which can eliminate the problems exhibited by the boost converter thus a KY converter can be used instead of boost converter which will have better output response comparing with the traditional boost converter. Hence this KY converter can be employed for delivering power to the grid. A solar panel is being used for delivering the DC supply and this DC voltage is stored in the battery. The voltage thus stored in the battery is then given to the KY converter for boosting its voltage level. Then the output of KY converter circuit is given directly to the load. By this a continuous output can be obtained with reduced ripple counts. The circuit of KY converter can be designed which consists of a diode, capacitors, a resistor and inductors. Thus a better transient response can be obtained by using KY converter. Hence a ripple free output with comp
aratively high efficiency can be obtained which can be implemented for low power applications as mentioned above.

2. KY CONVERTER

As generally recognized, the power supply applications such as the low voltage battery, analog circuits, such as RF amplifier, audio amplifier, etc., they often need high voltage in the output for enough power and voltage amplitude. This can be achieved by boosting the low voltage to the required high voltage. Therefore, for electronics, portable communications systems, such as MPEG-3 (MP3) players, blue-tooth devices, personal digital assistant, etc. some converters are needed to supply one boosted voltage or more under a given low voltage. For such applications, the output voltage ripple must be taken into account seriously. A KY boost converter is presented here, in which the KY converter is combined with the traditional synchronously rectified (SR) boost converter [5, 6]. Such a converter has continuous input and output inductor currents, different from the traditional SR boost converter, and has a larger voltage conversion ratio than the traditional SR boost converter does, and hence, this converter is very suitable for low-ripple applications. The Operating Principles of KY boost Converter is discussed here with some assumptions made as follows:

1) Dead times between the switches are omitted.
2) During the turn- ON period, voltage drops across the switches and diodes are negligible.

As the input voltage is applied to the converter, the capacitor C_m is charged via the body diode D_1 of the switch S_1. Then pulse width-modulated (PWM) control signals are generated and fed to the switches. At the moment, the switch S_2 is turned on, and the capacitor C_b is abruptly charged to the voltage across the capacitor C_m. After some switching periods, the steady state occurs in the converter. Since this converter is a single-stage converter combining the KY converter and the traditional SR boost converter, it operates always in CCM all over the load range. There are only two operating modes in this converter, and the turn- ON type of two switches is defined to be (1 − D, D), where "1 – D" and "D" are for S_1 and S_2, respectively, and D is the duty cycle of the gate driving signal for S_2.

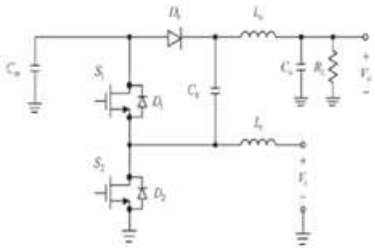

Fig. 1 KY Boost Converter

3. SIMULATION RESULTS

Initially the proposed KY converter was executed with Open loop controller then the circuit was executed with PWM controller and PI controller. A comparative study has been done for three cases in terms of Peak time, Rise time, Voltage Gain and Voltage regulation etc.

3.1 SIMULATION RESULTS FOR OPEN LOOP CONTROL

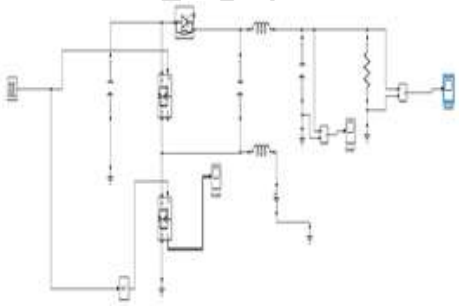

Fig. 2 Simulation circuit of KY Converter with Open loop control

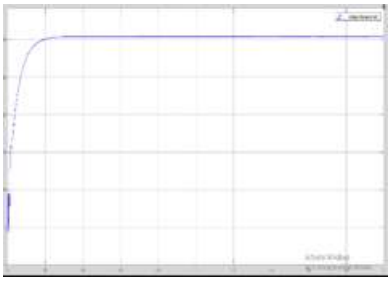

Fig. 3 Simulation results of KY Converter with Open loop control

3.2 SIMULATION RESULTS FOR PWM CONTROLLER

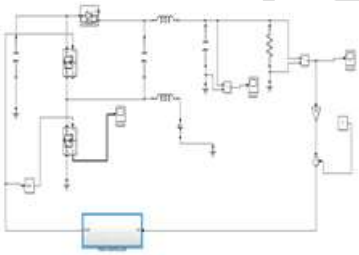

Fig. 4 Simulation circuit of KY Converter with PWM controller

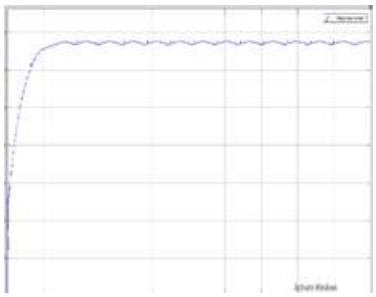

Fig. 5 Simulation Result of KY Converter with PWM controller

3.3 SIMULATION RESULTS FOR PI CONTROLLER

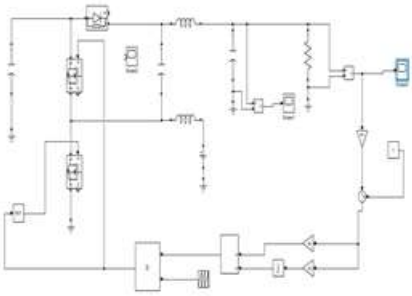

Fig. 6 Simulation circuit of KY Converter with PI controller

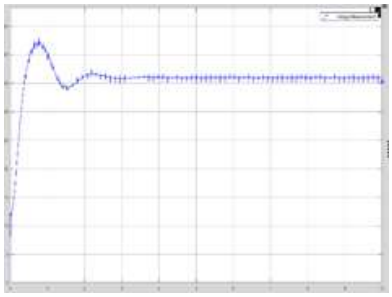

Fig. 7 Simulation Result of KY Converter with PI controller

4. COMPARATIVE STUDY

The following table shows the different parameters comparison between open loop, PWM controller and PI Controller. The comparison has done for various parameters like Pre-shoot, over shoot, under shoot, Mean Voltage, Rise time, Voltage Gain and Voltage regulation. It has been observed that KY Converter with PI controller gives better performance compared to other two controllers. For open loop controller it was observed that voltage gain is 82.88% where as for PWM controller, 91.13% and finally for PI controller, it is 99.80% which shows better performance. Similarly in voltage regulation point of view also, PI controller gives better voltage regulation compared to other two controllers.

TABLE I. Comparison between Open loop controller, PWM Controller and PI Controller

Legend	Open loop Control	PWM Control	PI Control
Pre-shoot	99%	95%	51.818 %
Over shoot	0.996%	0.980%	30%
Under shoot	2.076%	2.768%	4.58%
Mean Voltage	29.84V	32.81V	35.93 V
Rise time	105.25 ms	132.1ms	284.6ms
Voltage Gain	82.88%	91.13%	99.80%
Voltage Regulation	-20.64%	-9.72%	-0.19%

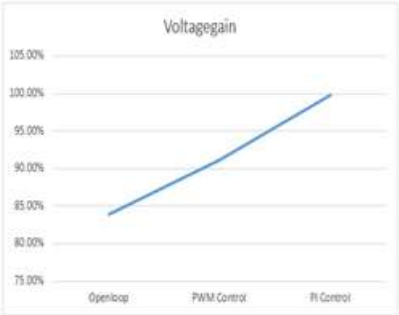

Fig. 8 Comparative graph of KY Converter for Voltage Gain with Open loop, PWM Controller and PI Controller

Fig. 9 Comparative graph of KY Converter for Voltage Regulation with Open loop, PWM Controller and PI Controller

5. CONCLUSION

In this paper, a basic model of KY converter has been designed and executed. A open loop controller, PWM controller and PI controller has been applied to KY converter. A comparative study has been done between three cases. It was observed that better voltage gain and good voltage regulation were observed using PI controller and PWM controller compared to open loop controller. In future, the circuit can be executed using other closed loop controllers like PID, Fuzzy logic and ANN controller etc.

REFERENCES

[1] Hwu,K.I.; Jiang,W.Z.2014 Voltage Gain Enhancement for a Step-Up Converter Constructed by KY and Buck-Boost Converters IEEE Transactions on Industrial Electronics, Volume:61,issue:4 Publication year:2014,page(s) 1758-1768.

[2] Hwu,K.I.; Jiang,W.Z.2013 Applying Couple inductor to stepup Converter Combining KY and buck-boost conveters,IEEE 10 th International Conference on Power Electronics and Drives System Publication year:2013,page(s) 21-25.

[3] K. I. Hwu and Y. T. Yau, KY boost converters, IEEE Trans. Ind. Electron., vol. 25, no. 11, pp. 2699-2703, May. 2012.

[4] S.Radhika and B S Manikanda Prabhu, Introduction to KY Converter for Voltage ripple reduction: A Technological Literature Survey, Chennai Fourth International Conference on Sustainable Energy and Intelligence Systems (SEISON 2013) 12-14 December 2013.

[5] K. I. Hwu and Y. T. Yau, "KY converter and its derivatives," IEEE Trans. Power Electron., vol. 24, no.1,pp. 128–137, Nov. 2010.

[6] B. Axelrod, Y. Berkovich, and A. Ioinovici, "Hybrid switched-capacitor-Cuk/Zeta/Sepic converters in step-up mode," Proc. IEEE Int. Symp. Circuits Syst., pp. 1310–1313, 200