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Multi-Switched Non-isolated High Gain DC–DC Converter

Prof.Babu Thomas[1], Abdul Raheem P K[2], Anakha Shaji[3], Emil G Illickal[4], Joona P[5]

Assistant Professor, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India[1]

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam,Kerala, India[2]

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India[3]

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India[4]

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India[5]

ABSTRACT: Renewable energy based distributed generation of power production got tremendous development as a most essential power producing sector due its clean and environment friendly nature. And these power production results in low voltage profiles where there is a need for different converter topologies. A new single switch high step-up DC-DC converter with high voltage gain is discussed. This high gain converter utilizes two inductors which are connected in series or parallel. The converter topology is suitable for renewable energy based applications having low DC voltages. The converter provides high voltage conversion without using transformer and coupled inductor. In this topology, the voltage stress across the semiconductor power device is reduced and produces low switching voltage. The converter is analysed and simulation results are obtained using MATLAB Simulink R2017a. An input of 20 V_i to the converter can yield 200 V_0 at the output.

KEYWORDS: Non-isolated high gain converter, Simulink Model

I.INTRODUCTION

The use of distributed energy sources are increasing nowadays, thereby necessiates an increase in the use of dc-dc converters. However those converters must produce high gain compared to that of conventional ones due to the gradual increase in the dc load requirements. There comes the use of our high gain dc-dc boostconverter which meet all the requirements that the conventional converters cannot assure.Also these converters can be used in many fields other than renewable energy conversions, such as in electric tractions, medical equipments etc..These converters are made by increasing the number of switches without affecting its complexity for the reduction of voltage stress(output voltage appearing across switch).

As in the case of conventional dc-dc converters where the voltage stress is very much high, it requires high rated switches to withstand the voltage appearing across them thereby adds to a greater increase in cost.Higher voltage stress also plays a greater role in the occurrence of high conduction losses across the switch. So this greater disadvantage is rectified in the proposed converter. Here we uses a non-isolated configuration of the converter and the complexity of the circuit is reduced since here we do not include any type of voltage multiplier cells, hybrid switch capacitor technique etc.. for the need of increasing the gain. Combining all these factors the proposed converter is simple and boosts the input voltage in such a way to produce a gain which is very much higher than that of the conventional converters.

II.CIRCUIT CONFIGURATIONAND WORKING

A Non-isolated high gain DC-DC converter consists of three switches with two different duty ratios to attain a high voltage gain. Three switches S_1, S_2 and S_3operates at a switching frequencies of 50KHZ. The duty ratios of S_1, $S_2$and $S_3$are d1 and d2 respectively. The circuit employs two inductors L_1 andL_2, two diodes D1 and D2 and one output capacitor C_0.

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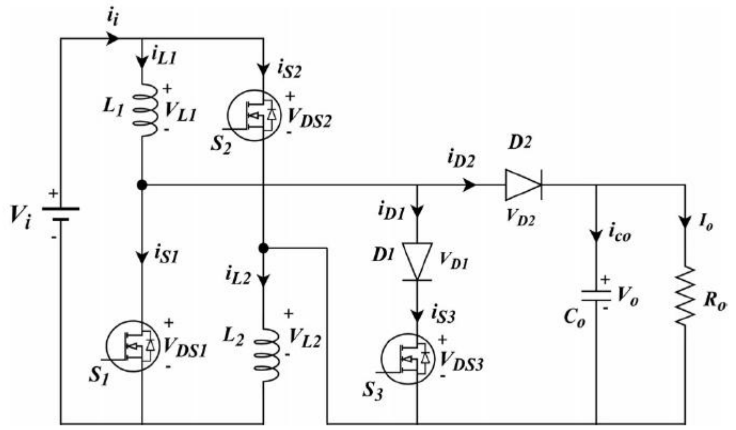

Fig.1: High gain DC-DC Converter

The working of this converter consists of three mode of operations. In the first mode,gate pulse is given to switches S_1 and S_2. Therefore these switches are in ON condition and switch S_3 is in OFF condition. In the mode 2,the gate pulse is given to switch S3. Therefore switch S3 will be turned on and the other switches are turned off. In the last mod i.e.in mode 3 all the switches are tuned off. In the case of diodes :both diodes D1 and D2 are reverse biased in mode 1,diodes D1 forward biased and D2 reverse biased in mode 2,diodes D1 reverse biased and D2 reverse biased in mode 3. The figure corresponding to each mode is given below;

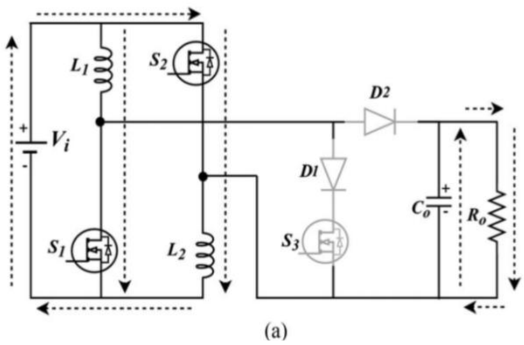

Fig. 2:Mode 1

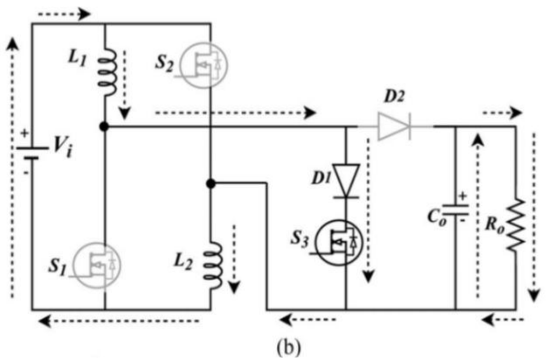

Fig. 3: Mode 2

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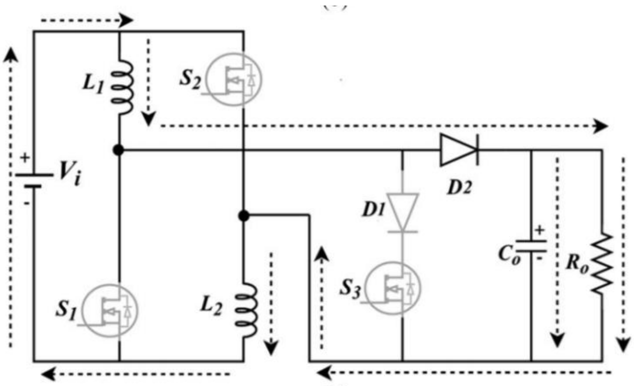

(c)

Fig. 4: Mode 3

III.MATLAB SIMULATION

The converter is simulated in MATLAB/SIMULINK by the simulation parameters and the simulation model is given below;

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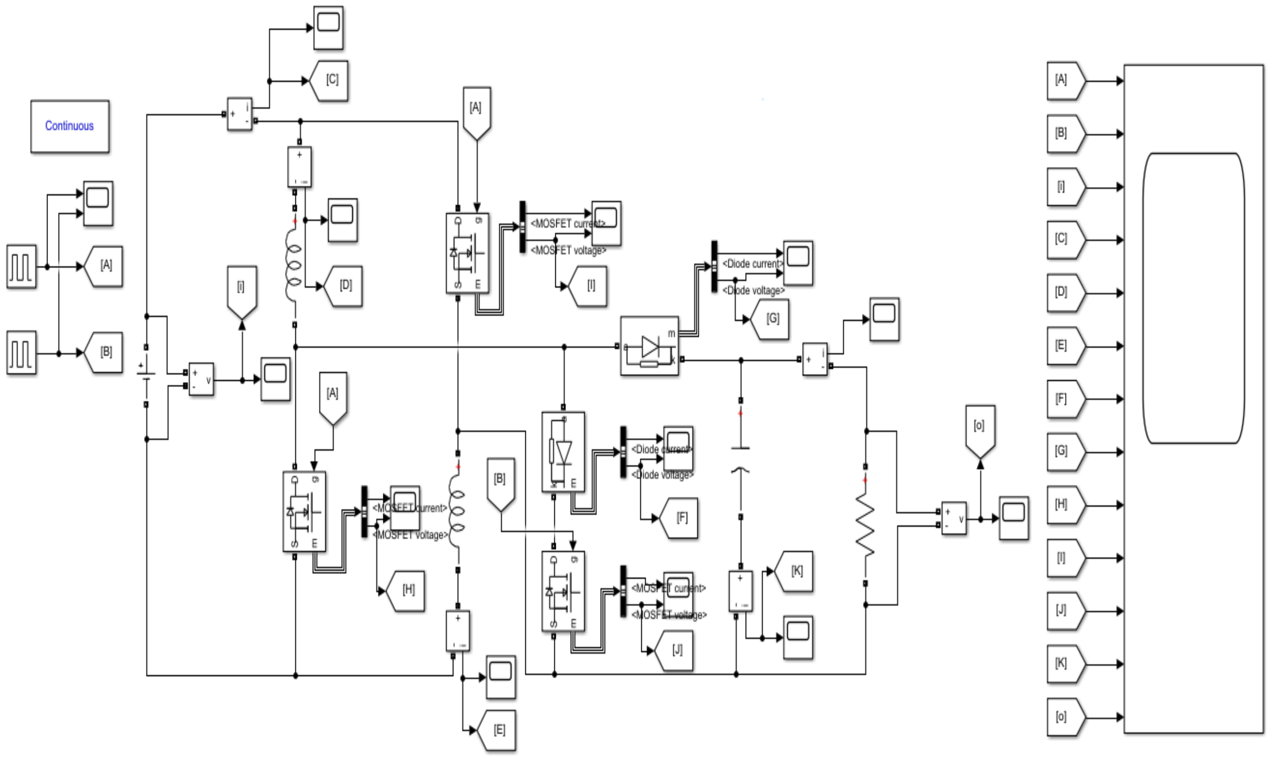

Fig. 5:Simulink Model

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V. RESULTS AND ANALYSIS

The switching frequency is choosen to be 50 kHz. The gate pulse of power device has a duty cycle of 50% for switches S_1 and S_2 and 35% for S_3. Figure. 6 (a) and (b)shows the gate pulse for the switches S_1, S_2 and S_3.Figure .6(c) and (i) shows the input voltage V_i and the output voltage V_0. It can be seen that input voltage V_i is 20V and the output voltage V_0 is 200V. This verifies the high voltage gain. The ouput voltage ripple is about 0.049.The average input current is equal to 5.37A. Figure .6(e) and (f) shows the current through the inductor $L_1$and L_2. The input current shown in Figure .6(d) is equal to the current through inductors $L_1$and L_2. Figure .6(g) and (h)shows the voltage across the diodes d1 and d2. Figure. 6(j) shows the current across the capacitor C_0. The simulation result obtained from simulink is shown in the figure.6:

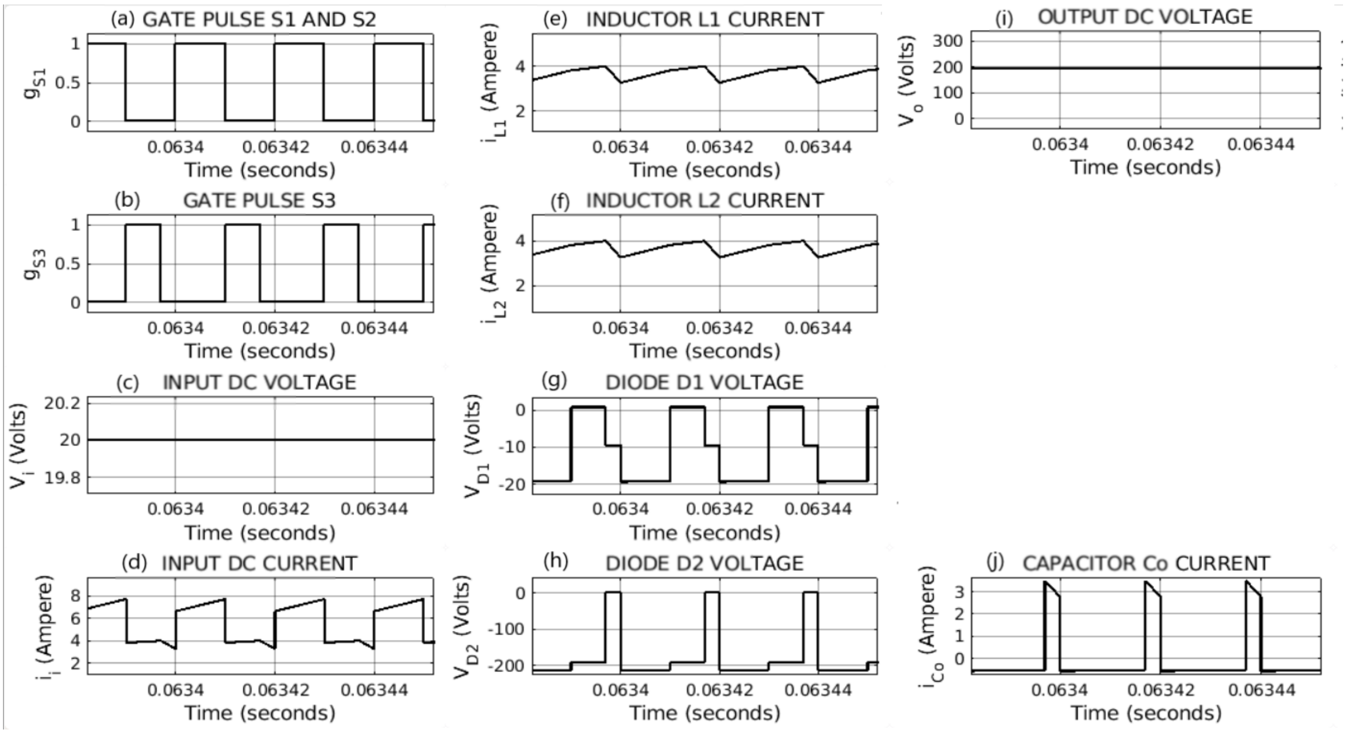

Fig. 6 Simulation Result

Analysis of the voltage stress, efficiency and output voltage ripple can be concluded as:

Voltage stress in the two switches S1 and S2=$\frac{Vo+Vi}{2} = \frac{200+10}{2} = 110$

Voltage stress in switch S3=V_0=200

Efficiency=$\frac{\frac{Vo^2}{R}}{vi*Ii} = \frac{\frac{200^2}{400}}{20*5.37} = .931 = .931*100 = 93.1\%$

Output ripple voltage=(Vmax-Vmin)/output power=$\frac{194.068-193.97}{200} = \left(\frac{.098}{200}\right)*100 = .049$

Time required for the final output voltage =0.125 s

VI.CONCLUSION

The non-isolated high step up dc-dc converter offers a high conversionratio, low switch voltage stress. The switches and diodes have relatively low voltage stresses and hence the switching and conduction losses are reduced. It achieves an improved overall efficiency. The input voltage is 20 V and output voltage is 200 V, this verifies the high step up voltage gain. The converter has an efficiency of 93.1 % and voltage gain of 10. The converter is employed with

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switches of two duty ratios and hence high gain obtained. The converter can be used for applications with battery backup systems for uninterrupted power supplies, high intensity discharge lamp ballasts for automobile headlamps, electric tractions and some medical equipments.

REFERENCES

[1] M. Forouzesh, K. Yari, A. Baghramian, and S. Hasanpour, "Single-switchhigh step-up converter based on coupled inductor and switched capacitor techniques with quasi-resonant operation," IET Power Electron., vol. 10,no. 2, pp. 240-250 october 2017

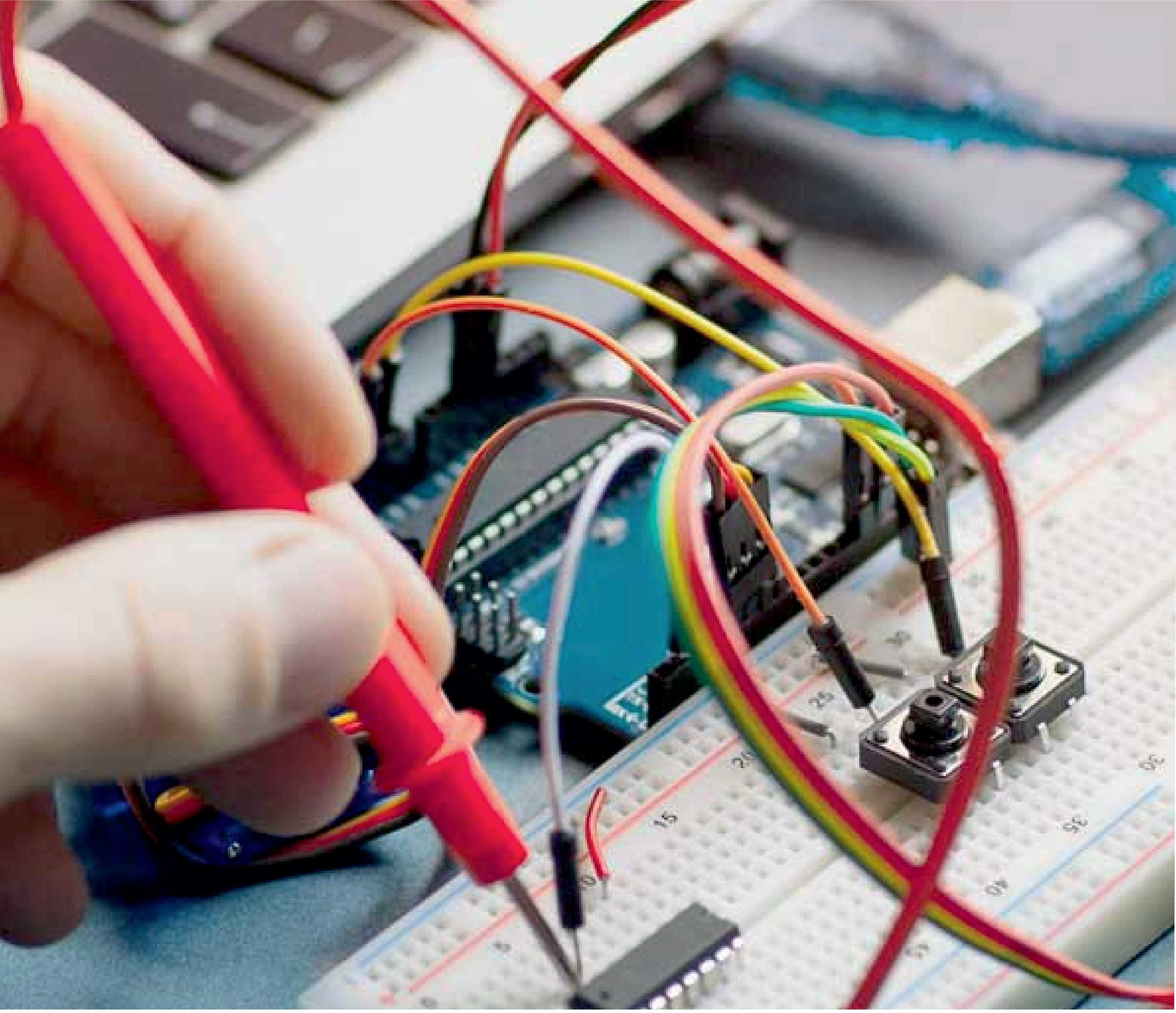
[2] M. Chen, K. Li, J. Hu, and A. Ioinovici, "Generation of a family of veryhigh DC gain power electronics circuits based on switched-capacitor-inductor cells starting from a simple graph," IEEE Trans. Circuits Syst. I,Reg. Papers, vol. 63, no. 12, pp. 2381–2392, Dec. 2016.

[3] S. M. Chen, M. L. Lao, Y. H. Hsieh, T. J. Liang, and K. H. Chen, "A novelswitched-coupled-inductor DC–DC step-up converter and its derivatives,"IEEE Trans. Ind. Appl., vol. 51, no. 1, pp. 309–314, Jan./Feb. 2015.

[4] L. Tofoli, D. d. C. Pereira, W. Josias de Paula, and D. d. S. OliveiraJunior, "Survey on non-isolated high-voltage step-up dc–dc topologies ´based on the boost converter," IET Power Electron., vol. 8, no. 10,pp. 2044–2057, Oct. 2015.

[5] B. Singh, V. Bist, A. Chandra, and K. Al-Haddad, "Power factor correctionin bridgeless-luoconverter-fed BLDC motor drive," IEEE Trans. Ind.Appl., vol. 51, no. 2, pp. 1179–1188, Mar./Apr. 2015.

[6] A. Ajami, H. Ardi, and A. Farakhor, "A novel high step-up DC/DC converter based on integrating coupled inductor and switched-capacitor techniques for renewable energy applications," IEEE Trans. Power Electron.,vol. 30, no. 8, pp. 4255–4263, Aug. 2015.



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