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Line and Load Regulated KY Buck – Boost Converter

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ABSTRACT:In this paper a step–up converter, a combination of KY and traditional buck- boost converter is presented. The converter having a good gain with improved properties like reduced output voltage and current ripple. A PI controller based feedback circuit is designed to get a constant output voltage irrespective of the changes in input voltage and load. The simulation results are also presented.

KEYWORDS:KY converter, Buck – Boost converter, PI controller.

I.INTRODUCTION

Renewable energy sources have a key role in the current power sector. Depletion of fossil fuels and the attractive features like availability, non - toxic are the main reason for the increase in demand of such energy sources. DC micro grids are the main application of such system, in which solar cells and fuel cells are the main sources. Output voltages of such systems are very low. In order to drive large loads, an efficient interface is required. Power electronics boost converters are the most efficient interface for this. Many converters replaced the traditional boost and buck-boost converters due to their disadvantages like low gain and high voltage and current ripple. Ripple may affect the sensitive electronics equipments. Many techniques are implemented in boost converters like, several inductors are connected in series and magnetized together, voltage doubler with clamping capacitor and coupling inductor, interleaving technology etc. Most of these converters having problems regarding ripple, stability and floating output.

In this paper, a step –up converter is presented combing a KY and traditional buck-boost converter with a LC filter in the output side. The capacitor in the output having low equivalent resistance in order to reduce the ripple. The converter presented here always operated in continuous conduction mode. There is no right half poles or zeros for this converter. In order to get a constant performance inspite of changes in input and output disturbances a feedback circuit is designed and simulated to validate the preformances.

II. LITERATURE SURVEY

Many techniques are implemented in trditional boost converters in order to increase gain and other features. Inductors and capacitors are the important components in all of these converters. Voltage doubler circuit with clamping capacitors are used to improve the gain. In the case of interleaved boost converter topology one phase boost converter changed in to two phase converter. So the total circuit current is divided in to two different paths. Due to this total stress across the components reduced. Voltage ripple and current ripple are the main problems faced by these converters. Stability is also a problem. In order to reduce all these problems KY converters are introduced. There are many converters like first derivative and two second derivative converters, having gain ratio 1+D,1+2D,2+D respectively. In these converters as the derivative increases no of components also increases.But here the converter having good gain with good gain and reduced ripple.

III.SYSTEM CONFIGURATION

The system consists of a buck-boost converter which is formed by two switches S1 and S2, inductor L1 and energy transferring capacitor C1 whereas KY converter is formed by S1,S2, charge pumping capacitor C2 and output filter.

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The switches will be on for D and off for (1 – D), where D is the duty cycle. The system is always operated in the continuous conduction mode. For the analysis, there are assumptions as follows. The dead time between the switches are neglected, all components are ideal, the capacitors are large enough such that voltage across them is always constant.

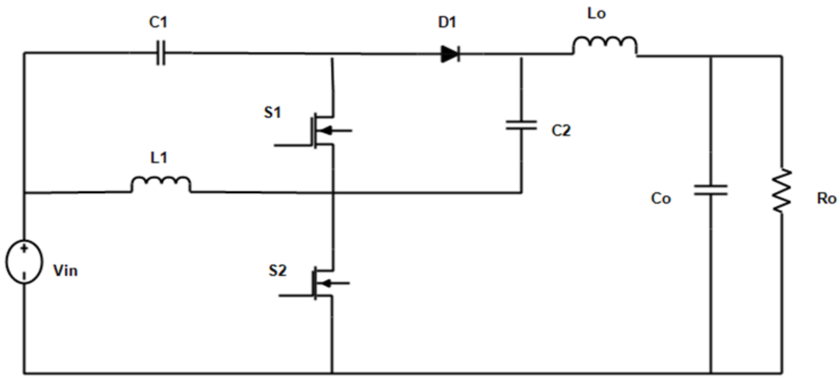

Fig. 1 KY buck-boost converter

IV.MODES OF OPERATIONS

Mode 1: In this mode switch S2 is on and S1 is off. Inductor L1 is magnetizing whereas inductor L2 is demagnetizing. In this mode energy stored in C1 is transferred to C2 . Diode D1 is forward biased.

$$V_{Li} = V_i \qquad (1)$$

$$V_{L2} = V_{C2} - V_o \qquad (2)$$

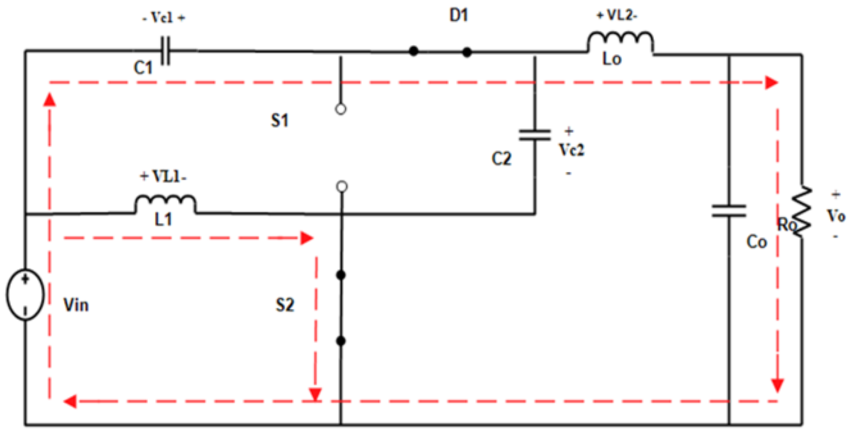

Fig. 2 Power flow in mode 1

Mode 2 : In this mode S1 is on whereas S2 is off. Energy stored in C2 is pumped to the load and L2 is magnetized.

$$V_{L1} = -V_{C1} \qquad (3)$$

$$V_{L2} = V_i + V_{C1} + V_{C2} - V_o \qquad (4)$$

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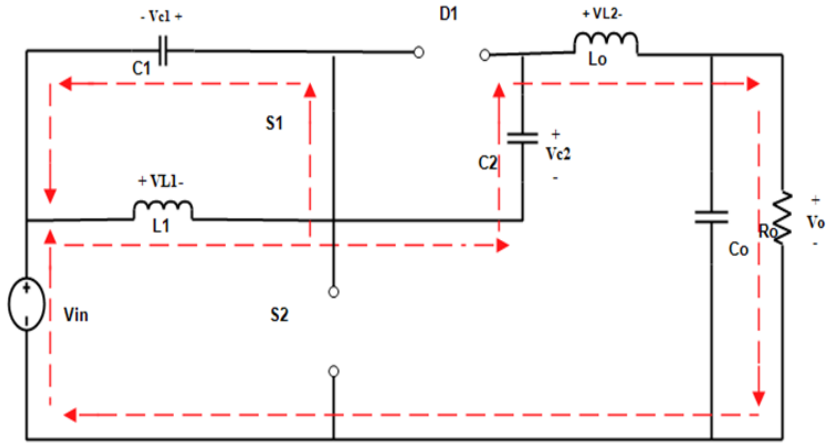

Fig. 3 Power flow in mode 2

By applying the volt – second balance in L1, voltage across the energy transferring capacitor can be obtained as

$$V_{C1} = \frac{D}{1-D} V_i \qquad (5)$$

Voltage across the charge pump capacitor can be obtained as

$$V_{C2} = \frac{V_i}{1-D} \qquad (6)$$

By solving these equations and volt second balance across the L2

$$\frac{V_0}{V_i} = \frac{2-D}{1-D} \qquad (7)$$

V. SIMULATION RESULTS

In order to validate the performance the converter is simulated using Matlab – Simulink. Important parameters of the simulation listed below. The circuit is simulated for 12V input voltage and switching frequency is selected as 195kHz. K_P and KI values are .01 and 4 respectively.

Table. 1 Simulation Parameters

Parameters	Values
L_1	25µH
L_2	100µH
C_1	450µF
C_2	150µF

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The simulated results are as shown below

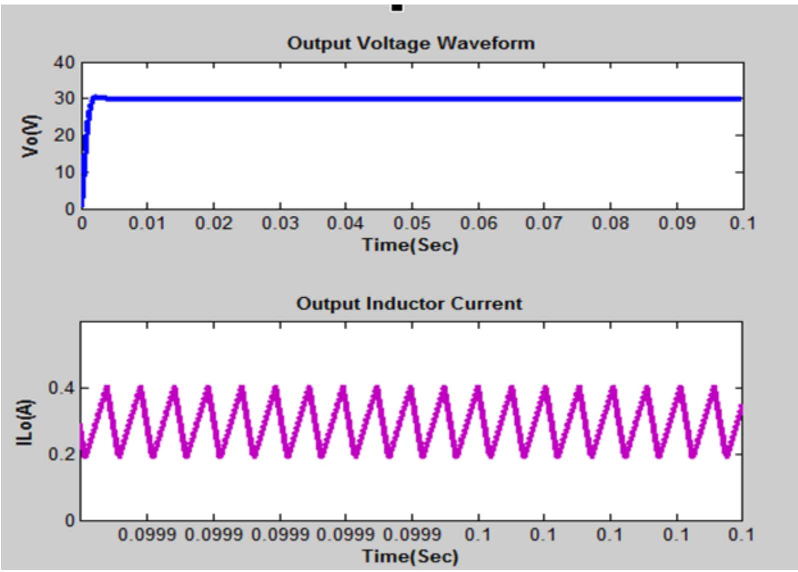

Fig. 4 Simulation output(without change in input or load).

Figure 4 represent the simulated output waveforms of the converter at rated input voltage and load. The ouput is obtained as 30 V.

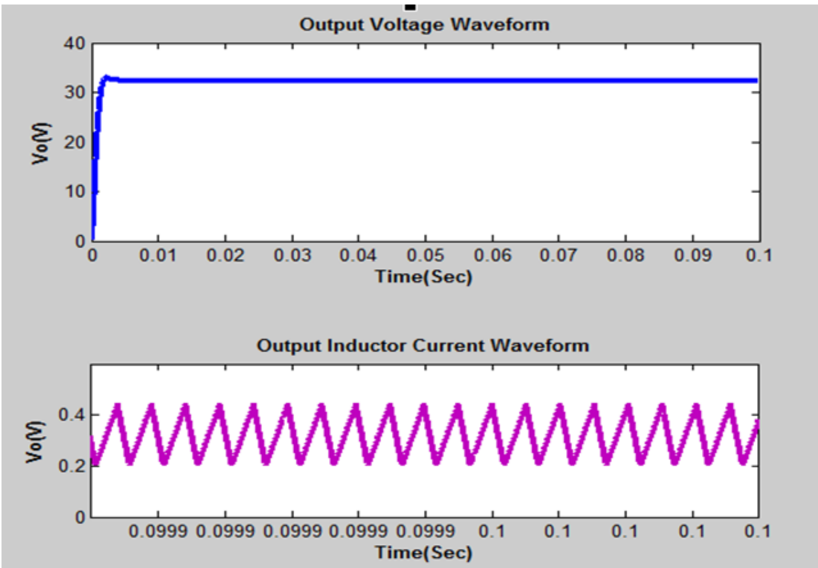

Fig 5. Simulation result(Change in input voltage)

In figure 5, converter is simulated at different input voltage with rated load. But the output voltage and ripple current is same as that of previous case.

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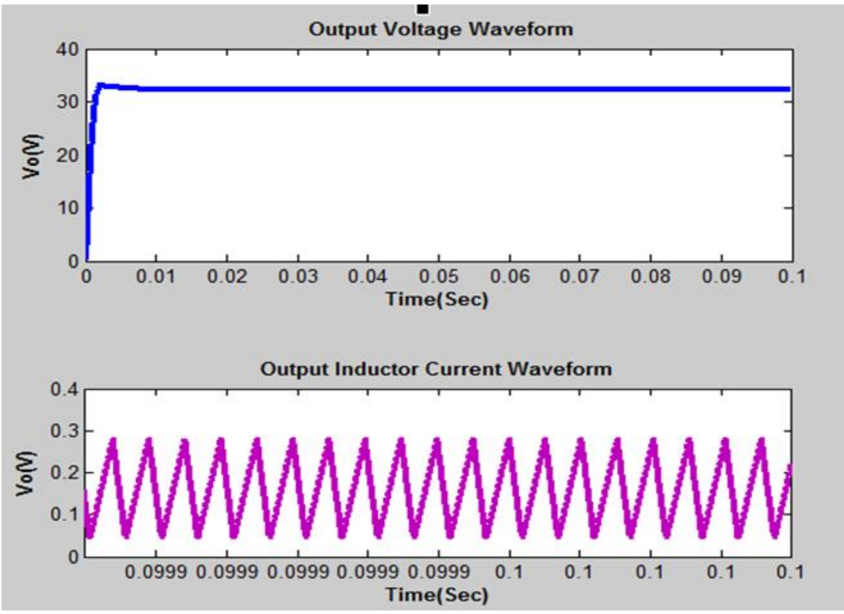

Fig 6. Simulation result (Change in load)

Above figure represent the load regulation output. Here the converter is simulated at different load with rated input voltage.

VI.CONCLUSION

A step-up converter is presented here which is formed by the combination of KY and buck-boost converter with good gain and reduced voltage and current ripple. A PI controlled based feedback circuit is designed and simulated to validate the performance. Here the output voltage is constant inspite of changes in input voltage and load.

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