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Controlled Single Switch Step down AC/DC Converter without Transformer

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Abstract:- This paper presents a transformer less ac/dc converter which can be used in voltages between 90- 230 Vrms. Instead of a transformer, this topology consists of a buck dc/dc converter and a buck boost dc/dc converter. By the absence of transformer, reduce the complexity of converter and it is cost effective. Buck dc/dc converter keeps o/p voltage below the line voltage; limit the leakage current. By controlling the circuit with feedback, we can increasing the efficiency and reduce total harmonic distortion. Output voltage is 40 V with THD 12.36%. And output current is near 4 A. For further modification a feedback PI controller is used. After using PI controller THD is reduced to 6.231%.Thus using controlled circuit harmonic content is reduced and efficiency is improved. Working of the proposed circuit and verification by simulation results are discussed in this paper. MATLAB Simulation is done.

***Index Terms*—Direct power transfer (DPT), integrated buck– buck–boost converter (IBuBuBo), power-factor correction (PFC), single-stage (SS), transformerless.**

I. INTRODUCTION

AC/DC converters are mainly single stage and two stage converters. Single stage converters are reduces cost, size, complexity and it has simple control mechanism [1]-[2]. Present single stage ac/dc converters are consist of mainly a boost power factor correction cell. But using the boost PFC cannot attain a voltage below the input line voltage and it have several disadvantages, it cannot reduce the input surge current .To decrease the voltage below input line voltage a high step down transformer is needed, by the presence of transformer leakage inductance is increased and it causes lower efficiency in conversion [1].So we have to introduce a new topology to overcome these disadvantages. To decrease the line voltage below the input voltage we combined a buck power factor correction cell and buck-boost dc/dc converter. This topology eliminates the transformer, thus we can achieve high conversion efficiency without any leakage inductance. By the use of buck power factor correction cell, this circuit reduces the inrush of surge current at input. Proposed topology is known as integrated buck- buck boost converter (IBuBuBo converter).It can be limit bus voltage below 400v. Positive output voltage is possible by using this converter. Another advantage of this converter is it uses one ideal switch, this helps to make simple circuitry and control mechanism. Power factor correction reduces the harmonic distortion. Furthermore improvement, we can control the circuit by giving feedback control.

Proposed circuitry consists of an ac/dc bridge rectifier and a combination of buck PFC and buck-boost converter. It eliminates the transformer, thus obtain a simple circuit. It eliminates surge current due to the series connection of input source and switch [1].The purpose of this paper to obtain a step down voltage without a transformer at high efficiency.

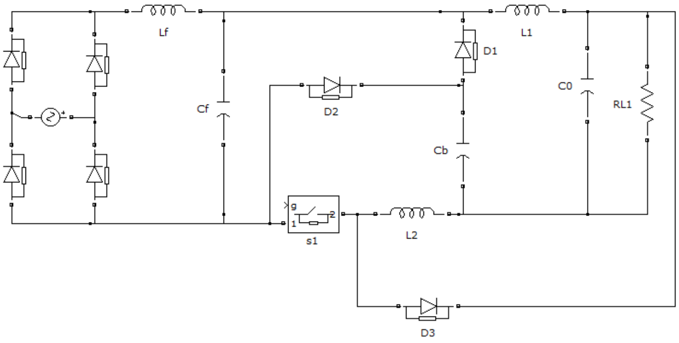


Fig. 1. (a) Proposed IBuBuBo SS ac/dc converter

capacitors, further reduction of the bus voltage can be achieved.

Therefore, a transformer is not needed to obtain the low output voltage. To sum up, the converter is able to achieve:

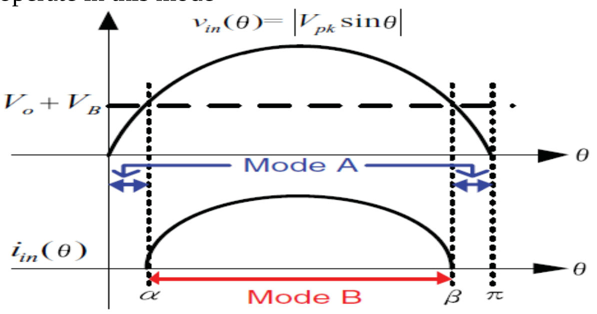
1) low intermediate bus and output voltages in the absence of transformer;
2) simple control structure with a single-switch;
3) positive output voltage;
4) high conversion efficiency due to part of input power is processed once and
5) input surge current protection because of series connection of input source and switch.

II. WORKING OF IBUBUBO CONVERTER

In this proposed circuit, bridge rectifier converts ac input to dc and this dc will be the input to buck PFC and it step down the input. It is then given to buck – boost dc/dc cell and again step down process achieved. Thus output will be a low value of dc . In the circuit (L1 , S1, D1, C0 and CB) is the buck PFC and (L2 , S1, D2, D3, C0, and CB) is the buck-boost dc/dc converter. L2 is not present electrically in PFC operation. Both cells are operated in discontinuous conduction mode so there are no inductor current in the beginning of the switching period [1].

Proposed circuit have two modes of operation. Mode A and Mode B.

Mode A : (Vin(θ)<VB+Vo) When input voltage less than the sum of output and bus voltages mod A will operate , two dead angles are present in this mode .Buck PFC will not operate in this mode



(b)

Fig 2 . Modes of operation

Mode A operations are given by the figures given below:

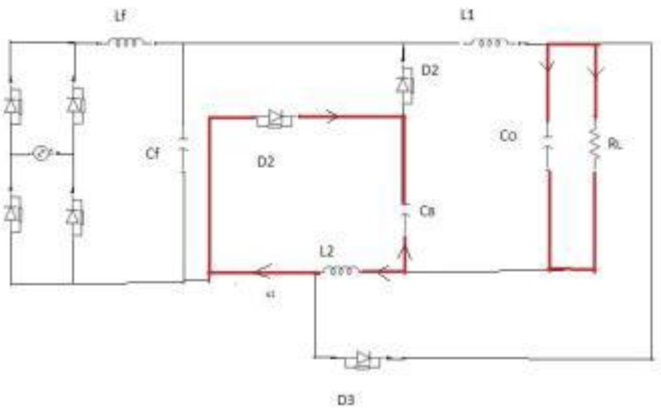


Fig 3..stage 1

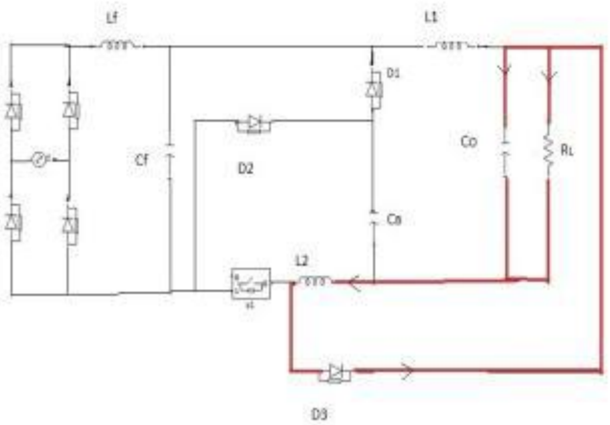


Fig 4. Stage 2

In this stage1 switch is on, bridge rectifier convert ac input to dc and LC filter filters harmonic contents then inductor L2 is charged linearly and D2 is conducting. Output capacitor delivers power to the load. In stage 2 switch is off, dc current is passed through diode D3 and energy stored in L2 is released to output capacitor and load.

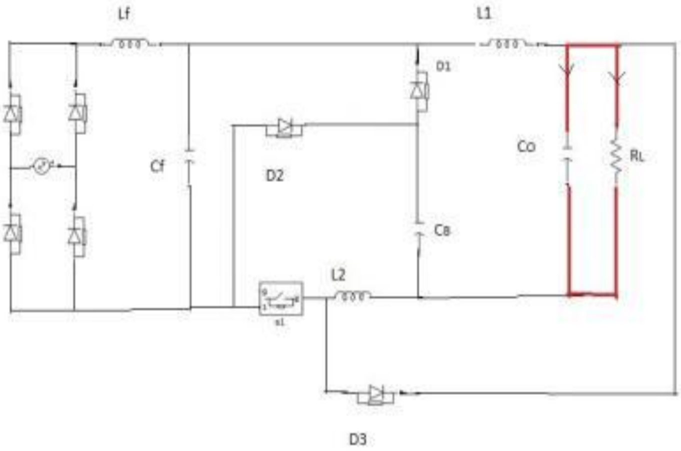


Fig 3. Stage 3

In this stage 3 switch is open , inductor current IL2 is totally discharged and only output capacitor sustains the load current.

Next is the **Mode B** operation, : (Vin(θ)>VB+Vo) In this mode, input voltage is greater than the sum of output and bus voltages.

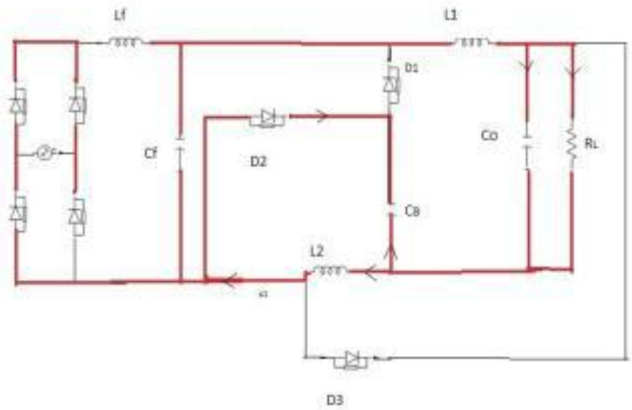


Fig 4.stage 1

In this stage 1, switch is on, converter converts AC to DC and both inductors charge linearly dc current will pass through diode D2.

In this stage2 switch is open , inductor current IL1 decreases linearly to charge the capacitors through D1.In this stage a part of the input power is transferred to the load directly[1].Energy stored in L2 released and current is supplied through diode D3 .This stage ends inductor current IL2is fully discharged.

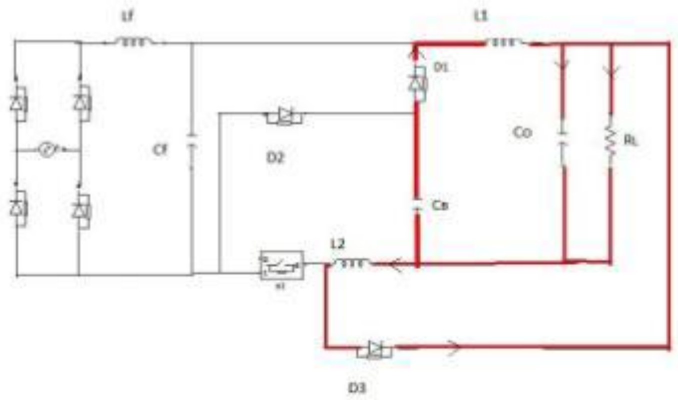


Fig 5. Stage 2

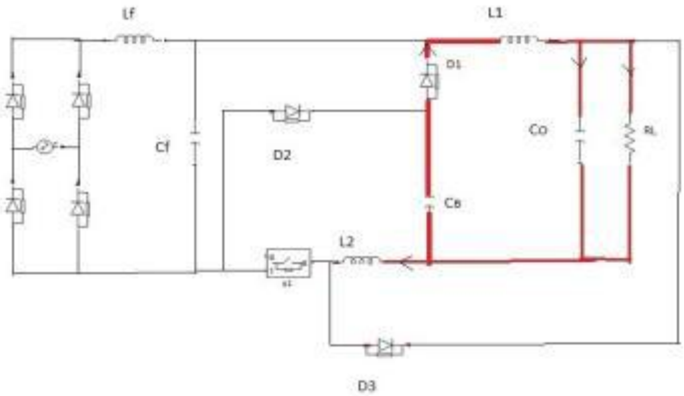


Fig 6. Stage 3

In stage 3, L1 continues to deliver current to output capacitor C0 and the resistor load until its current reaches zero.

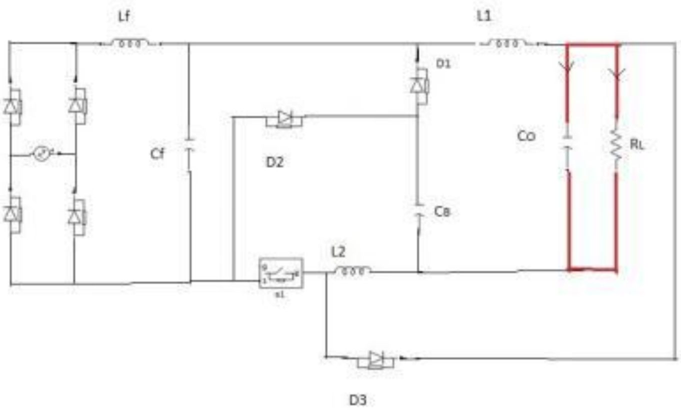


Fig 7 .stage 4

In this stage 4, switch is open and only output capacitor C0, delivers all the output power. Using this topology we can attain a low output voltage without a transformer. It has simple control structure with a single ideal switch and high conversion efficiency due to part of input power is processed once. Input surge current protection because of a series connection of input source and switch.

III. SIMULINK MODEL

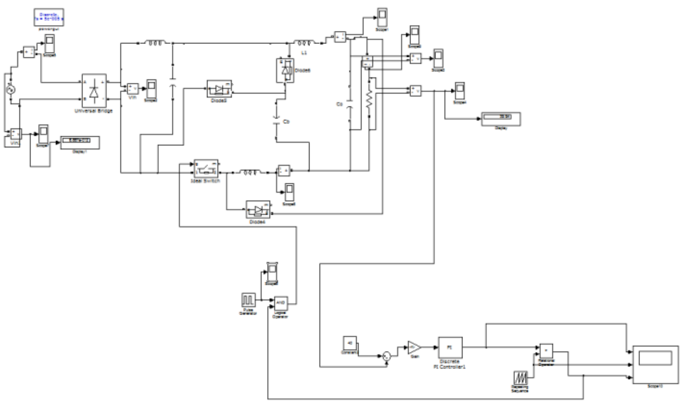


Fig 8. Simulink model

IV. SIMULATION RESULTS AND ANALYSIS

For simulation, following components are used: an LC filter with L= .3H,C=.0003F.And L1=.004H ,CB=.005F ,L2=.003H, CO=.05F.By using these components the output voltage is viewed .AC input is given to the bridge rectifier, this DC is step downed by using buck and buck-boost converter. Output voltage is dc ,40 volt with THD 12.36%. And output current is near 4 A. For further modification a feedback PI controller is used. After using PI controller THD is reduced to 6.231%.Thus using controlled circuit harmonic content is reduced and efficiency is improved.

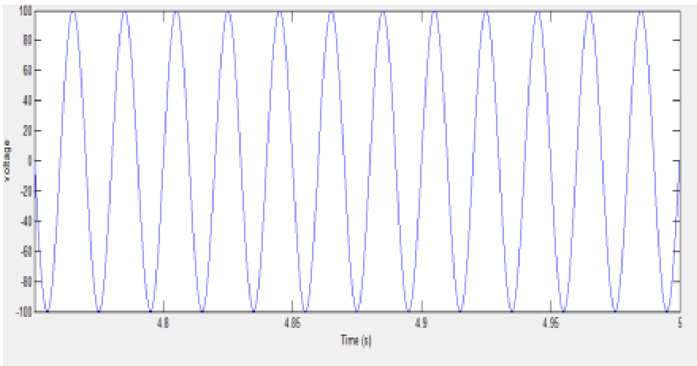


Fig 9. Input Voltage

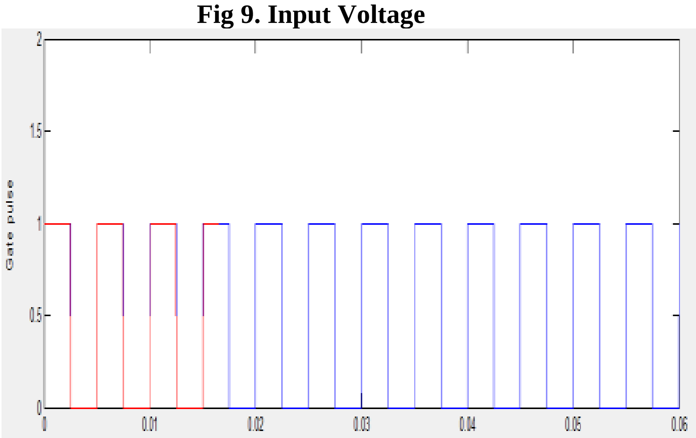


Fig 10. Gate pulse

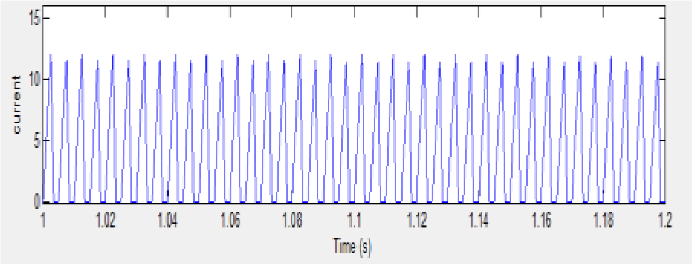


Fig 11. Inductor current

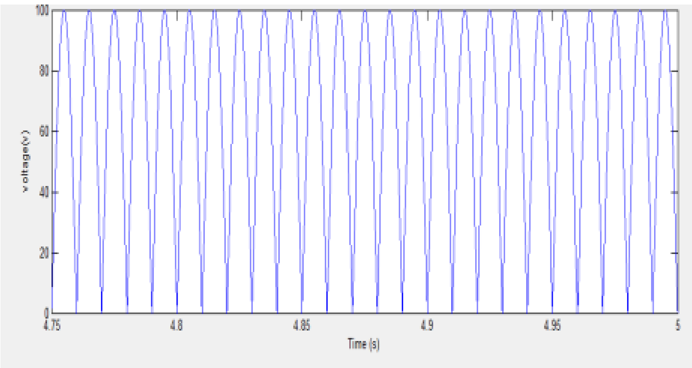


Fig 12. Converted output

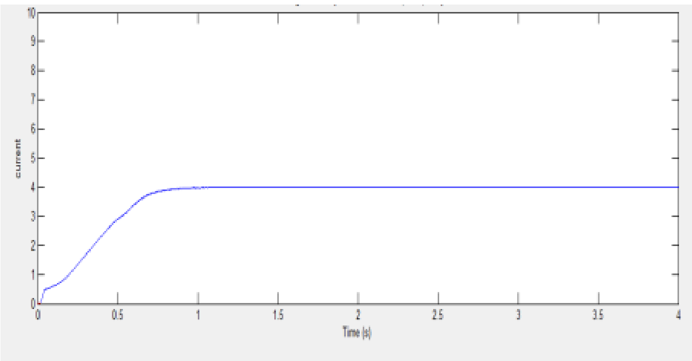


Fig 13. Output current

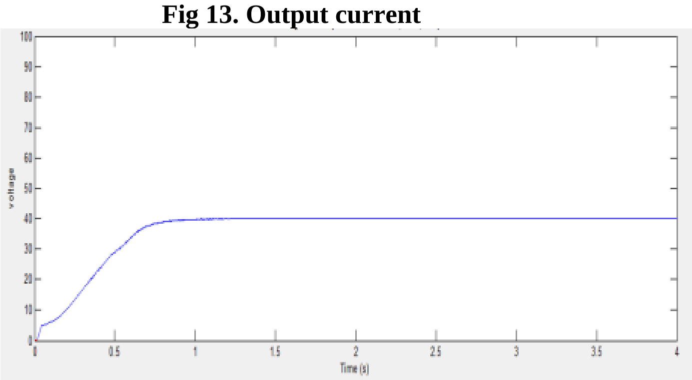


Fig 14. Output voltage

V. CONCLUSION

Proposed AC/DC converter has been simulated and wave forms have been observed. This topology is able to obtain low output voltage without a high step down transformer. Output voltage is achieved about 40 volt and output current is obtained 4 A. Because of the direct power transfer, it is able to achieve high efficiency. Basic circuit has no control loop, for more efficiency and to reduce harmonic distortion added a feedback controller. Output voltage is direct current with THD 12.36%. For further modification a feedback PI controller is used. After using PI controller THD is reduced to 6.231%.Thus using controlled circuit harmonic content is reduced and efficiency is improved. Using the control loop, we can achieve the desired output by changing the PI controller constant. Total harmonic distortion is decreased and efficiency is increased. We can also develop a high step up ac/dc converter without transformer by replacing buck converter with a boost converter. Proposed converter is used only for the voltages between 90-230Vrms, it keeps intermediate bus voltage below the input line voltage. Thus efficient step down can be achieved. Because of the series connection of source and switch, input surge current can be prevented. Output voltage will be positive in this converter. Simple control mechanism due to single switching. Complexity due to transformer is eliminated, thus leakage inductance and spikes in active switching is absent leads to high efficient conversion.

REFERENCES

[1]. Shu-Kong Ki, Dylan Dah-Chuan Lu, “A High Step-Down Transformerless Single-Stage Single-Switch AC/DC Converter” IEEE Trans.Power Electron., vol. 28, no. 1, Dec. 2013.

[2]. Q. Zhao, F. C. Lee, and F.-s. Tsai, “Voltage and current stress reduction in single-stage power-factor correction AC/DC converters with bulk capacitor voltage feedback,” IEEE Trans. Power Electron., vol. 17, no. 4,pp. 477–484, Jul. 2002.

[3]. L. Antonio, B. Andrs, S. Marina, S. Vicente, and O. Emilio, “New power factor correction AC-DC converter with reduced storage capacitor voltage,” IEEE Trans. Ind. Electron., vol. 54, no. 1, pp. 384–397, Feb. 2007.

[4]. S. K. Ki and D. D. C. Lu, “Implementation of an efficient transformerless single-stage single-switch ac/dc converter,” IEEE Trans. Ind. Electron., vol. 57, no. 12, pp. 4095–4105, Dec. 2010.

[5]. M. A. Al-Saffar, E. H. Ismail, and A. J. Sabzali, “Integrated buck–boost–quadratic buck PFC rectifier for universal input applications,” IEEE Trans.Power Electron., vol. 24, no. 12, pp. 2886–2896, Dec. 2009.

[6]. Y. Jang and M. M. Jovanovic, “Bridgeless high-power-factor buck converter,”IEEE Trans. Power Electron., vol. 26, no. 2, pp. 602–611, Feb.2011.

[7]. O. Garcia, J. A. Cobos, R. Prieto, P. Alou, and J. Uceda, “An alternative tosupply DC voltages with high power factor,” IEEE Trans. Ind. Electron.,vol. 46, no. 4, pp. 703–709, Aug. 1999.