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Analysis and Simulation of an Integrated Double Boost Flyback Converter

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Abstract:* *The proposed converter increases the voltage gain with medium duty cycle by a combined integrated and boost fly-back topology. Its voltage stress across the switch also lower than the output voltage. In the proposed converter core is not used therefore the number of components are less when compared to the conventional boost-fly-back converter. This topology reduces the input current ripple in relation to the conventional fly-back topology. The proposed converter used in low input voltage applications that require a high gain, such as systems powered by photovoltaic panels, fuel cells, electric vehicles, and low voltage batteries.

I. INTRODUCTION

Boost flyback converter is used in SMPS design. However, each topology has limitations that are hard to solve. Flyback is modified topology of buck boost converter .Like boost topology this is for low power application. The proposed converter have the advantage over the fly-back converter where high output current are required .since the output current is not pulsating, it is used for the application where the current high. Its efficiency that of fly-back plus boost topology. Compared with fly-back and boost converters, integrated boost flyback converters require two additional output inductor, although they have less number of output capacitor. It have the drawback of having an extra inductor on the output and it is not suited for high voltage. It is used in low-cost applications ranges from thousand to five watts. It has common primary and secondary output inductor which save in cost and volume. Flyback operation is recognized from the position of the dots in primary and secondary of transformer. When switch conducts dot ends of secondary winding is negative with respect to no-dot end. Output diodes are reverse-biased and all the output load currents are supplied from storage and filter capacitors. This topology combines conventional and boost and flyback topology with direct power transfer produces high power factor and regulation. The coupled inductor primary act as boost converter inductor and secondary winding acts as flyback converter. Both windings are wound on single ferrite core for the purpose of harmonic and ripple reduction.

Block Diagram

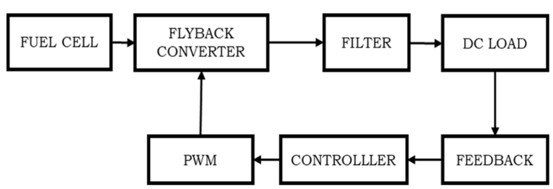

Fig.1 block diagram

A. Fuel Cell

It is a chemical device that creates voltage through an electrochemical reaction not combustion. In a fuel cell hydrogen and oxygen act as fuel to generate power, heat and water.

B. Converter

It is integration of two boost flyback converter topology for achieving high voltage gain. The input connection reduces the input current ripple and output connection adds the output voltage appears across the capacitors.

C. Filter

Filter capacitors of boost converter and flyback converter share the same voltage and current. Capacitance value is determined according to the limitation of output voltage ripple.

D. Controlller
Controller selection is based on control modelling of converter or data driven control technique. PI controller is selected for inner and outer loops. It is aimed to achieving zero error for input, reference tracking and noise rejection.

E. Pulse Width Modulation
PWM is a technique of varying the average power of an electrical signal. It is done by turning on and off switch between power supplies at high rate of switching frequency.

F. DC Load
Electrical vehicle application is focused on this paper. Proposed converter is used for application when unidirectional power is required.so equivalent dc resistance is referred as load.

II. PROPOSED CONVERTER
The proposed converter shown above is a combination boost and flyback topology termed as integrated boost flyback converter. Two above said converter is connected as interleaved (180 degree phase shift) topology to increase a voltage gain of a proposed converter.

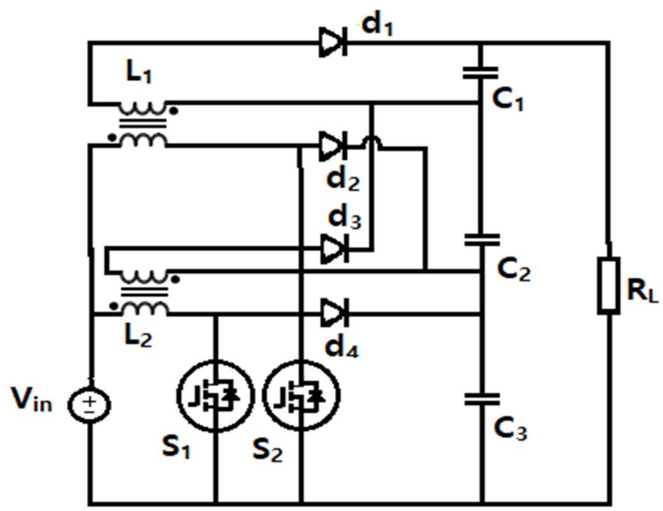

Fig.2 Proposed converter

Capacitor output voltage for boost converter

$$V_{cboost}=V_{in}/(1-D)$$

Capacitor output voltage for flyback converter

$$V_{cflyback}=nDV_{in}/(1-D)$$

Output voltage of each boost flyback converter is

$$V_1=V_{in}/(1-D) + nDV_{in}/ (1-D) \quad \text{and}$$

$$V_2=V_{in}/ (1-D) +nDV_{in}/ (1-D)$$

Proposed converter output voltage is

$$V_{out}=V_1+V_2$$

Capacitor across boost and flyback converter

$$C_{boost}= I_{out}D/(f_sV_{cboost}*0.3)$$

$$C_{flyback}= I_{out}D/(f_sV_{cflyback}*0.3).$$

A. Mode 1 Operation

In this mode Mosfet power switch S_1 turns on and S_2 turns off. Diode $d_{3,}$ d_4 are reverse biased $d_{1,}$ d_2 are forward biased. Inductor1 primary and core stores energy from source. Both boost and flyback converter output is open circuited so capacitor C_2 and C_3 are connected to load which discharges the energy stored initially. At the same time S_2 is off. Both boost and flyback converter output is connected to the load due to d_1 and d_2 are forward biased. Energy stored in coupled $inductor_1$ is dissipated through primary and secondary coil.

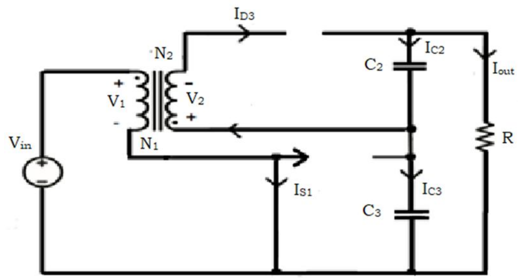

Fig.3 Mode 1 Operation

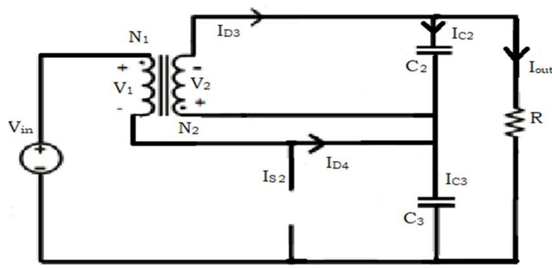

Fig.4 Mode 1 Operation

B. Mode 2 Operation

In this mode Mosfet switch S_2 turns on and S_1 turns off. Diode $d_{1,}$ d_2 are reverse biased $d_{3,}$ d_4 are forward biased. $Inductor_1$ primary and core stores energy from source. Both boost and flyback converter output is open circuited so capacitor C_1 and C_2 are connected to load which discharges the energy stored initially.

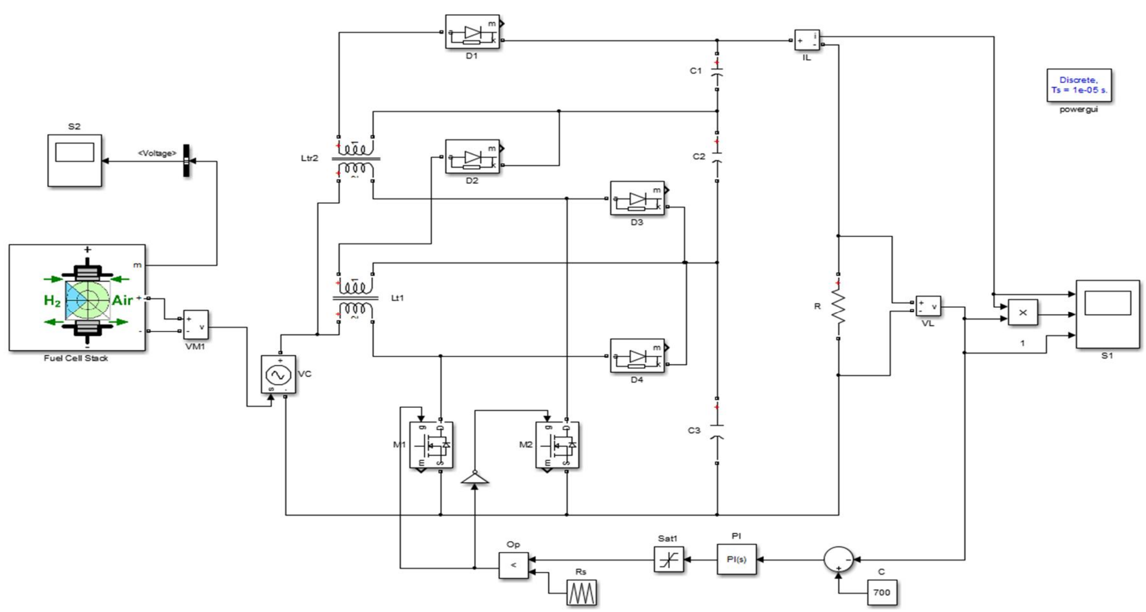

Fig.7 simulation diagram

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At the same time $S_1$is off. Both boost and flyback converter output is connected to the load due to d_3 and d_4 are forward biased. Energy stored in coupled $inductor_2$ is dissipated through primary and secondary coil.

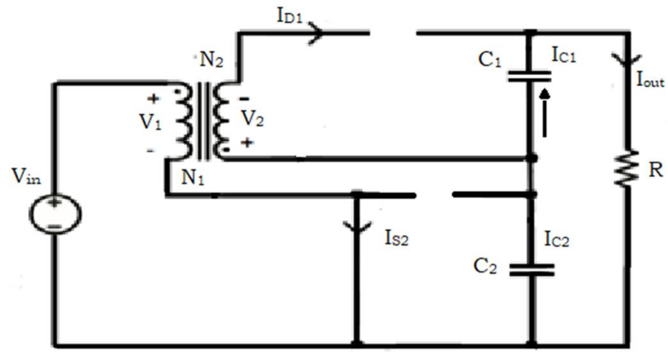

Fig.5 Mode 2 operation

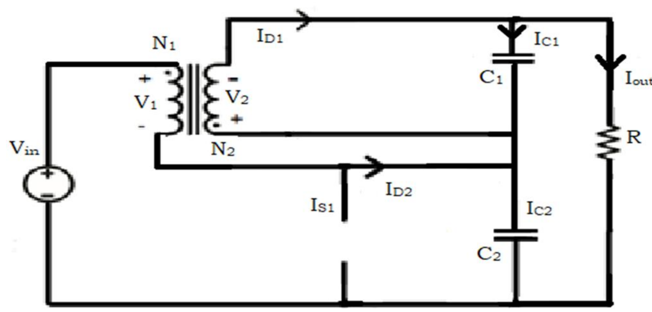

Fig.6 Mode 2 Operation

III. SIMULATION RESULTS

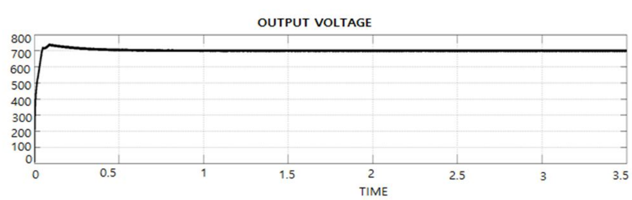

Fig.8 output voltage waveform

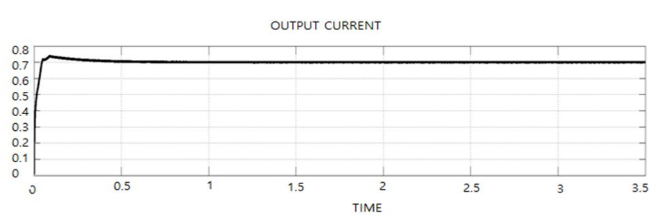

Fig.9 output current waveform

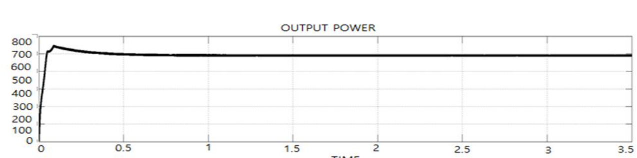

Fig.10 output power waveform.

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Parameters Comparison

	Converter 3	boost fly back converter	Proposed converter
Static gain	(1+3nd)/(1-d)	((2+2n.d)/(1-d))-1	((2+2.nd)/(1-d)
No of diodes	3	4	4
No of switches	6	2	2
Diode voltage stress	V_{out}/(1+nd)	V_{out}/(1+nd)	V_{out}/(1+nd)
Switch voltage stress	V_{out}/(1+nd)	V_{out}/(1+nd)	V_{out}/(1+nd)
Duty cycle range	0<d<1	0<d<1	0<d<1

IV. CONCLUSION

This paper presents the analysis and simulation of high efficiency double stage converter. This converter gives more efficiency with low duty ratio and high voltage gain using the coupled-inductor technique. Output voltage is fifteen times higher than the input voltage when compared to conventional voltage stress across the switch and diodes are not higher in this topology.

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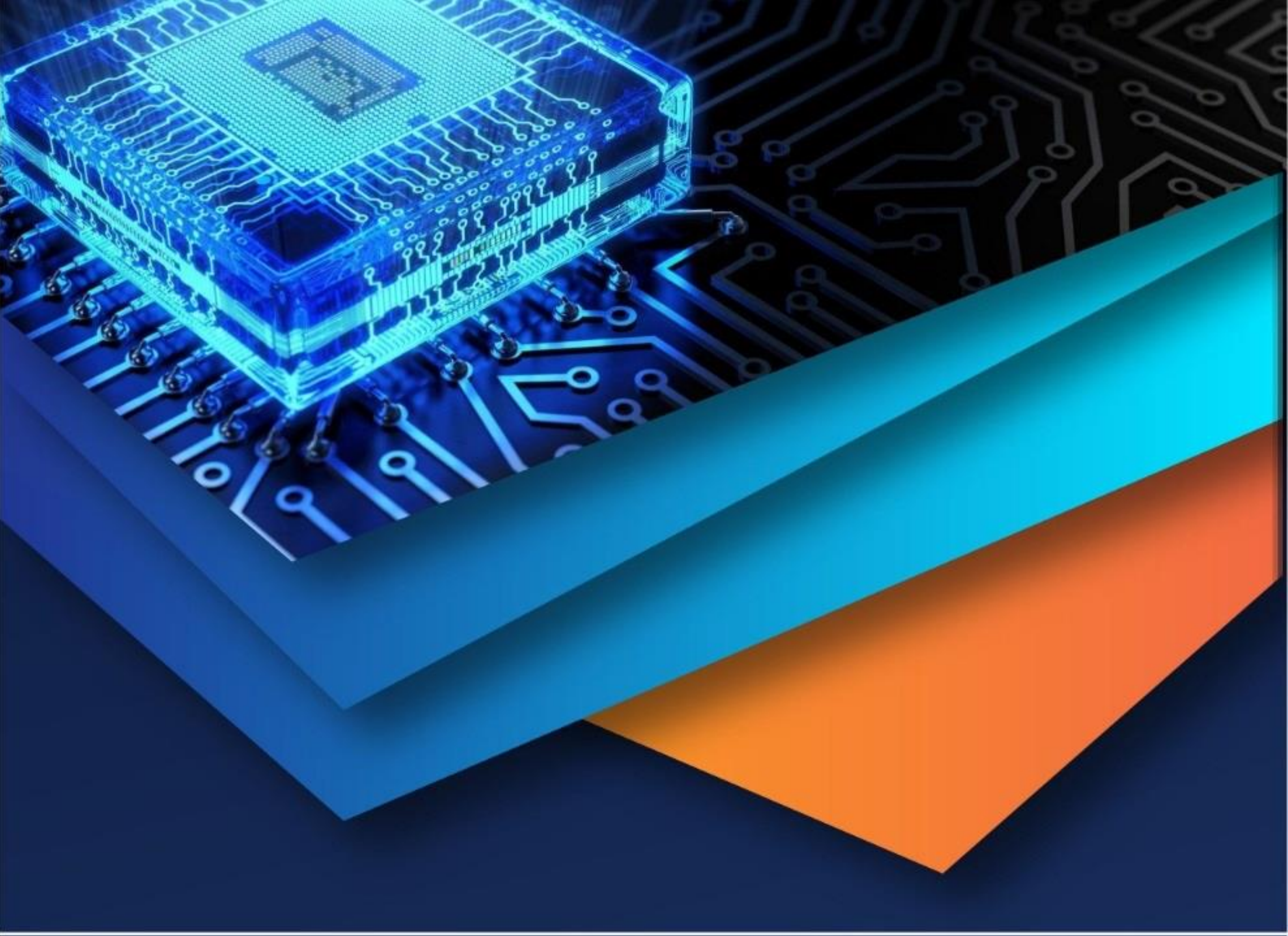

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