HIGH GAIN INPUT-PARALLEL OUTPUT-SERIES CHOPPER WITH DUAL COUPLED INDUCTORS

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Abstract

Large electric drives and utility applications require advanced power electronics converters to meet the required power demands. It results that, power converter structure has been introduced as an alternative in high power and medium voltage situations using Renewable Energy Sources (RES). Renewable energy sources playa vital role in rural areas where the power transmission from conventional energy sources is complicated. Other merits of renewable power source are dirt free, light and does not pollute environment. In order to meet the required load demand, it is better to integrate the renewable energy power with the application of drive connected system by using inverter module. A new interleaved high step-up converter with voltage multiplier cell is introduced in this project to avoid the extremely slight turn-off period and to reduce the current ripple. The voltage multiplier module is composed of the secondary windings of the coupled inductors, a series capacitor, and two diodes. In addition, the switch voltage stress is reduced due to the transformer function of the coupled inductors, which makes low-voltage-rated MOSFETs available to decrease the conduction losses.The simulations results are conferred using MATLAB/ Simulink platform.

Keywords: Renewable energy sources, drive, step up converter.

1. INTRODUCTION

Now a days we use all kinds of natural resources for generation of electricity. Those are minerals, wood, coal, natural gas, wind, water, plants, animals and many more. Some of these are renewable and some are non-renewable. The difference is that some renew at faster rates than others, making them more sustainable than those that do not renew very fast. Non-renewable resources can generally be separated into two main categories; fossil fuels and nuclear fuels. DC-DC converters are electronic devices that are used whenever we want to change DC electrical power efficiently from one voltage level to another. Generically speaking the use of a switch or switches for the purpose of power conversion can be regarded as a SMPS. From now onwards whenever we mention DC-DC Converters we shall address them with respect to SMPS.

2. PROPOSED SYSTEM

This paper proposes an input-parallel output-series boost converter with dual coupled inductors for high step up and high power applications. This configuration inherits the merits of high voltage gain, low output voltage ripple, and low voltage stress across the power switches. Moreover, the presented converter is able to turn ON the active switches at zero current and alleviate the reverse recovery problem of diodes by reasonable leakage inductances of the coupled inductors.

3. OPERATION PRINCIPLE OF THE PRESENTED CONVERTER

This circuit can be divided as two parts. These two segments are named a modified interleaved boost converter and a voltage double module using capacitor–diode and coupled inductor technologies. The basic boost converter topology shown in Fig. 1.1(a) and (b) is another boost version with the same function in which the output diode is placed on the negative dc-link rail. Fig. 1.1(c) is called a modified interleaved boost converter, which is an input-parallel and output-series configuration derived from two basic boost types. Therefore, this part based on interleaved control has several main functions: 1) it can obtain double voltage gain of the conventional interleaved boost; 2) low output voltage ripple due to the interleaved series connected capacitors; and 3) low switch voltage stresses. Then the double independent inductors in the modified interleaved boost converter are separately replaced by the primary windings of coupled inductors that are employed as energy storage and filtering as shown in Fig.1.1(d). The secondary windings of two coupled inductors are connected in series for a voltage multiplier module, which is stacked on the output of the modified converter to get higher voltage gain.

Fortunately, this connection is also helpful to balance the currents of two primary sides. The coupling references of the inductors are denoted by the marks "∗" and "·". The equivalent circuit of the presented converter is demonstrated in Fig.1.2,

where:

1) L_{m1}, L_{m2}: magnetizing inductances;
2) L_{k1}, L_{k2}: leakage inductances;
3) C_1, C_2, C_3 : output and clamp capacitors;
4) S_1, S_2: main switches;
5) D_1,D_2: clamp diodes;
6) D_r, C_r: regenerative diode and capacitor;
7) D_3: output diode;
8) N: turns ratio of N_s/N_p;
9) V_{N1}, V_{N2}: the voltage on the primary sides of coupled inductors.

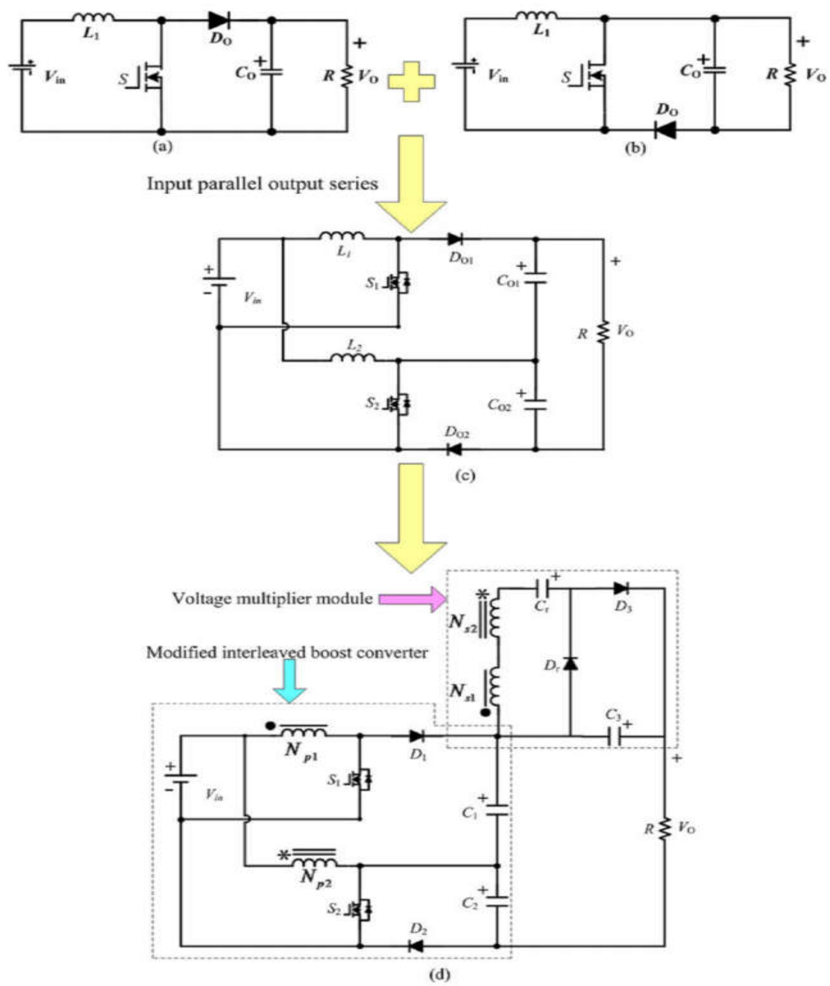

Fig 1.1. Procedure to obtain the proposed converter with high voltage gain. (a) Conventional boost converter. (b)Other structure of boost converter. (c) Modified interleaved boost. (d) High gain input-parallel output-series dc/dc converter with dual coupled inductors.

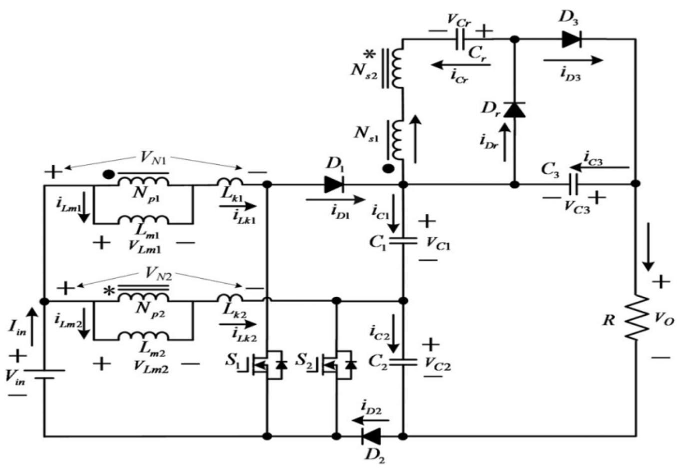

Fig.1.2 Equivalent circuit of the presented converter

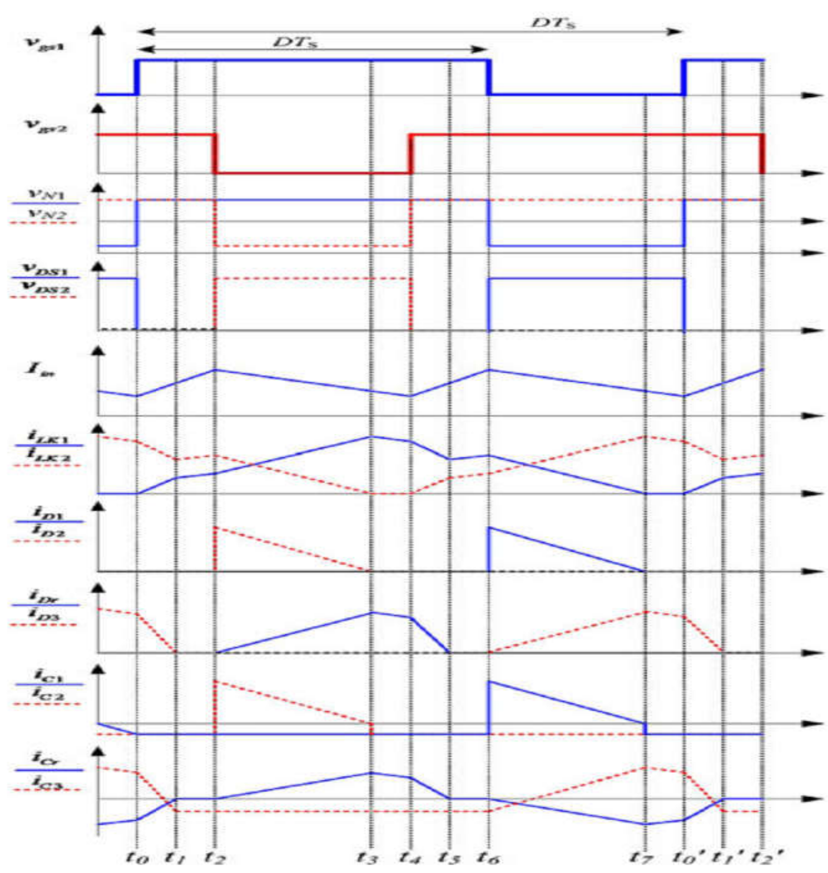

Fig.1.3 Key theoretical waveforms.

Fig. 1.3 shows the theoretical waveforms when the converter is operated in continuous conduction mode (CCM). The duty cycles of the power switches are interleaved with 180◦ phase shift, and the duty cycles are greater than 0.5. That is to say, the two switches can only be in one of three states (S_1: ON, S_2: ON; S_1: ON, S_2: OFF; S_1:OFF,S_2: ON), which ensures the normal transmission of energy from the coupled inductor's primary side to the secondary one.

UTILIZED COMPONENTS AND PARAMETERS OF PROTOTYPE

COMPONENTS	PARAMETERS
Input voltage V_{in}	18-36 V
Output voltage V_o	200 V
Maximum output power P	500 W
Switching frequency f_s	40 KHz
Turns ratio N_s/N_p	19/18
Magnetizing inductor L_m	120uH
Leakage inductor L_{k1}, L_{k2}	2.1uH
Capacitors C_1 and C_2	220uF /100 V
Capacitor C_r	47uF /100 V
Capacitor C_3	470uF /200 V

4. SIMULATION RESULTS:

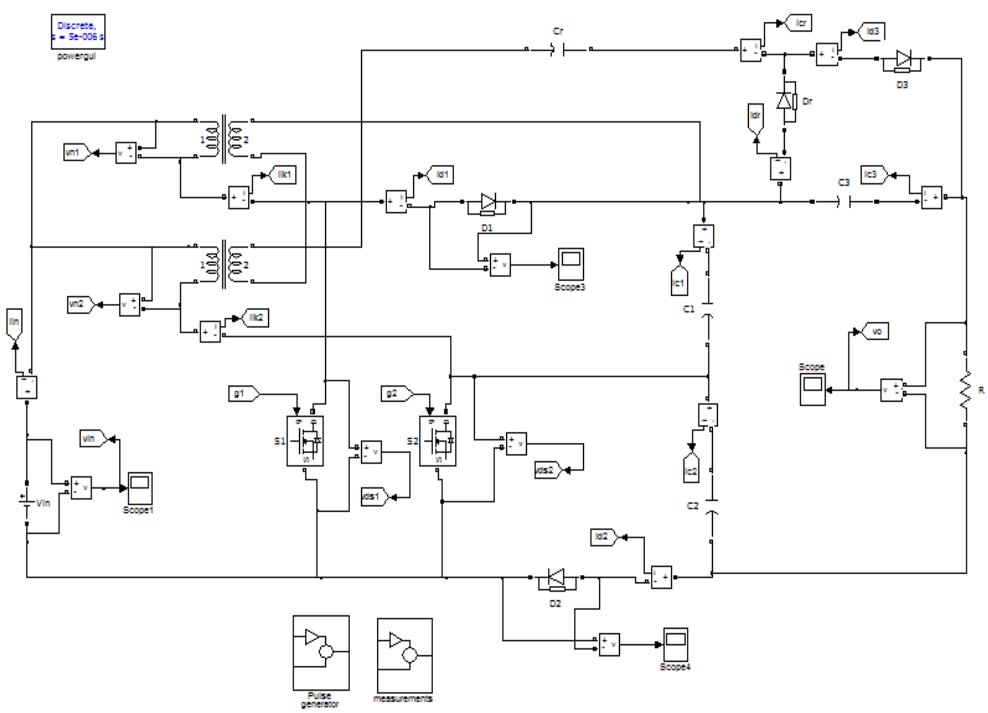

Fig.2.1.Mat Lab\Simulink Circuit

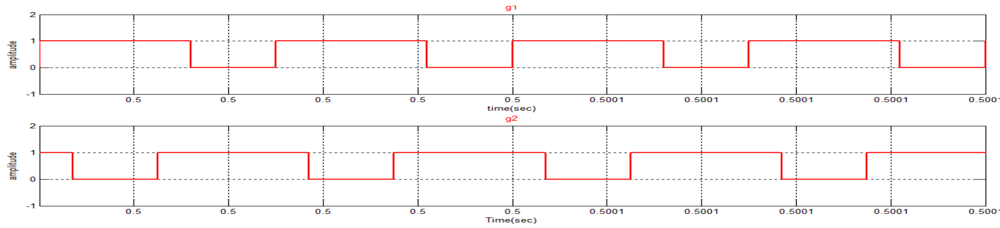

Fig.2.2.Gate Pulses For Switches

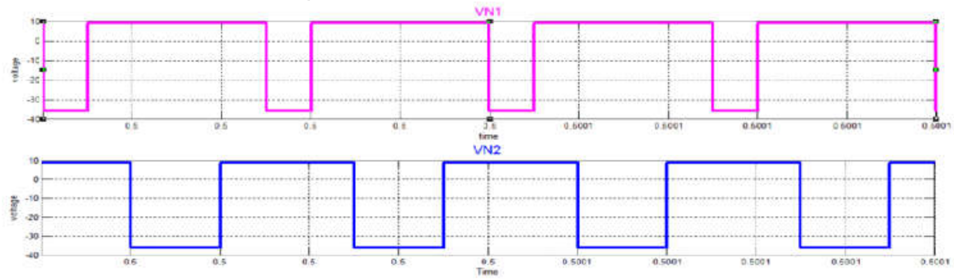

Fig.2.3.Voltage Across The Primary Sides Of Coupled Inductors

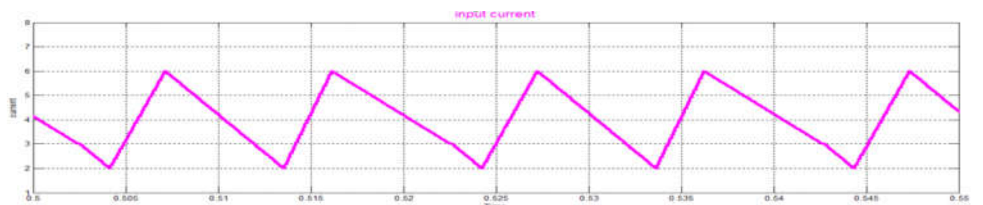

Fig.2.4.Input Current

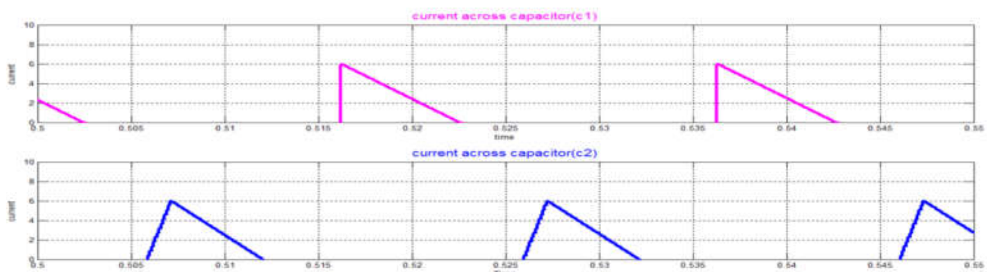

Fig.2.5.Currents Passing Through Capacitors C_1 , C_2

Fig.2.6.Input Voltage

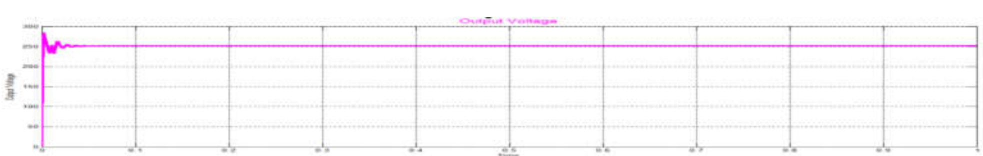

Fig.2.7.Ouput Voltage

5. CONCLUSION

This paper proposes an input-parallel output-series boost converter with dual coupled inductors for high step up and high power applications. This configuration inherits the merits of high voltage gain, low output voltage ripple, and low voltage stress across the power switches. Moreover, the presented converter is able to turn ON the active switches at zero current and alleviate the reverse recovery problem of diodes by reasonable leakage inductances of the coupled inductors.

6. FUTURE SCOPE

A high step up and high voltage gain interleaved converter is proposed. In future PI controller will be used to improve the performance and PWM technique also used for generate the gate pulses. This converter is implemented to high power applications. And this converter is also implemented to different type of DC loads.

7. REFERENCES

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