



A Novel PI Converter based High Voltage Gain DC – DC Converter

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ABSTRACT:In this project is widely employed in many industrial applications, such as fuel cell system, uninterrupted power supplies, electric traction, distributed photovoltaic generation system and some medical equipment's. This project a single switch high voltage gain dc-dc converter with coupled inductor and diode capacitor methods are used. The proposed converter is used to reduce voltage stress with help of coupled inductor and attain the high conversion ratio without operating at high duty cycle. To eliminate potential resonance between diode capacitor and leakage inductance. This converter is reliable and low cost. The nonlinear load produces abnormal conditions, such as voltage imbalance, harmonics current and ripple current. The error can be controlled by using PI controller. With the help of proposed converter, the above problems can be reduced and we can obtain the efficient power factor values. Finally the performance can be designed and verified using MATLAB

KEYWORDS:Boost converter, Coupled Inductor, Diode Capacitor, Voltage Multiplier cell, voltage stress

I.INTRODUCTION

Now a day, single switch high voltage gain dc –dc converters is used to reduce voltage stress and recycle the output by leakage inductance energy. In this converter used in many industrial applications such as fuel cell energy conversion systems, uninterrupted power supply electric traction and some medical equipment's. The above applications depend on the dc- dc converter types which are boost converter. Here with the help of boost converter rather than classical, high output voltage is equal to voltage stress of the main switch. The result of an extremely high duty cycle will give large conduction losses on power device and it is not realizing high voltage gain. This converter achieve high conversion ratio and reduced at extremely high duty cycle. In high voltage applications the rating of active switch is high voltage must be selected.

The converters based on transformers or coupled inductors or tapped inductors used to achieve the high conversion ratio of voltage [5]–[6]. The quadratic boost converter using a single active switch is another interesting topology for extending the voltage gain [1]–[3], the turn ratio of the coupled inductor or tapped inductor is increased. For improving the voltage conversion ratio, the input current ripple becomes larger [8]–[9].the digital based system has implemented for controlling the output [12].

A single switch high voltage dc-dc converter consist of switched capacitor, switched inductor ,clamper circuit and voltage doublers with capacitor and diode and these are the components used to reduced voltage stress and obtain reliable voltage high output. To attain the conversion ratio in high level, the transformer can be used without operating it in duty cycle in higher level. The filter circuit is used to the unwanted ripples. With the help of duty cycle, the level of output voltage can be estimated and moderate voltage gain is found. Advantages of a single switch high voltage gain converter with coupled inductor and diode capacitor method: (1)To eliminate potential resonance between leakage inductor and diode capacitor.(2)Coupled inductor used to increased efficiency of voltage gain and recycle leakage inductor energy. The existing system, proposed system, simulation results using MATLAB has been discussed in the following sections.



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II.EXISTING CONVERTER

The dc power supply is used many industries and domestic applications. The nonlinear load produces abnormal conditions such as voltage imbalance, sudden fluctuation, high ripple current and harmonics current. During these conditions the power factor will be low. Mostly power electronics applications are used rectifiers, that converter is convert DC to AC in a switch mode and conventional mode types, these contribute the high total harmonics distortion ,low power factor and low efficiency in the power system. Due to the harmonics current, voltage distortion and reduced supply energy capacity at lines, these are caused in the power system. So these problems reduced by using a single switch high voltage gain converter that is consist on clamped circuit, voltage doubler cell and capacitor filters are used. Then coupled inductor is used to reduce the ripple current in the converter. Thus the proposed converter is to reduced voltage stress and it is able to give high voltage gain. This converter is used to improve the high conversion ratio

III.COUPLED INDUCTOR, CLAMPED CIRCUIT AND VOLTAGE DOUBLER CELL

The proposed converter is consisting on coupled inductor or transformers, clamped circuit, voltage multiplier cell and diode capacitors. The coupled inductors have been used to achieve high voltage conversion ratio without operating extremely high duty ratio and high voltage gain. Then the clamped is an electronic circuit that prevents signal from exceeding a certain defined magnitude by shifting its dc value and it does not restrict the peak to peak excursion of the signal, but move it up and down by a fixed value. With the help of diode which conducts electric current in only one direction, then resistor and capacitor in the circuit are used to maintain an altered dc level at the clamper output. Then the voltage doublers cell is also electronic circuit which charges capacitors from the input voltage and switches these charges in such a way that, in the ideal case , exactly twice the voltage is produced at the output as its input. So using above elements to achieve high voltage gain, low voltage stress and recycle the output energy by using leakage inductance

IV.PROPOSED CONVERTER

The boost converter not able to provide high voltage gain ,so designed high efficiency of A single switch high voltage gain dc dc converter with coupled inductor and diode capacitor methods.The proposed converters of this project are to reduce the voltage stress and obtain high voltage gain by using the high voltage gain dc to dc converters. Therefore the active switch of voltage stress is reduced and improves the conversion efficiency. A high voltage gain dc-dc converters is consist on given parameters

Q=MOSFET switch
 N_1, N_2 = coupled inductors
 L_i =input inductor
 V_{in} = input voltage
 $D_1, D_2,$ and D_3 =diodes
 $C_1, C_2,$ and C_3 =capacitors
 D_0 = output diode
 D_r = regeneration diode
 C_0 =output capacitor
 V_0 =output voltage and
R = resistive load

The above mentioned parameters are shown in MATLAB diagram and we made the following assumptions to analysis the circuits

- All components are ideal except coupled inductor
- The voltage across the each capacitor is considered to be constant.
- Coupled inductors act as continuous conduction and discontinuous conduction mode. These are assumptions presents in the high voltage gain converters. The fig.1 block diagram of high voltage gain converter consist of dc supply clamper circuit, voltage doubler cell, PI controller and load.

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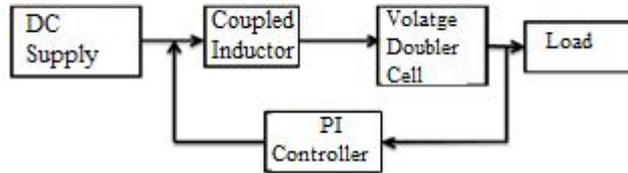


Fig.1. Block diagram of the proposed converter

V. CIRCUIT ANALYSIS OF CONDUCTION MODES PROCESS

A single switch high voltage gain converter with coupled inductor and diode capacitor is containing two modes of conduction process such as continuous conduction mode and discontinuous conduction mode. These modes are discussed by using stage time period and devices ON and OFF period. With help of PI controller reduced the error output. The circuit diagram of high voltage gain converter with coupled inductor and capacitor has been shown in the fig.2

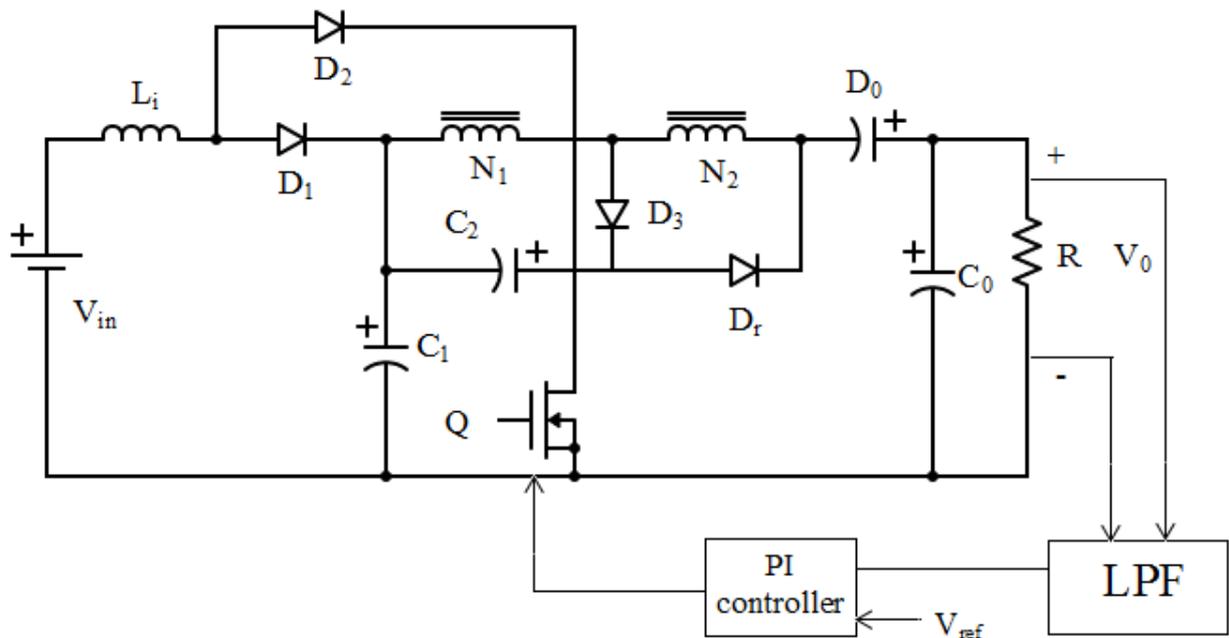


Fig.2. Circuit diagram of the proposed converter

Period	Q switch condition	Depends on the strategies on conditions	Depends on the strategies off condition
Time period $T_0 - T_1$	Switch Q is conduct	Diodes of D_{d2} and D_{dr} ON condition	The diodes of D_{d1} , D_{d0} and D_{d0} are reverse biased during OFF condition
Time period $T_1 - T_2$	Switch Q is OFF	Diodes of D_{d3} and D_{dr} ON condition	The diodes of D_{d2} and D_{d0} are reverse biased during OFF condition
Time period $T_2 - T_3$	Switch Q is OFF	Diode of D_{d0} is conduct	The diode of D_{dr} is blocked during OFF condition
Time period $T_3 - T_4$	Switch Q is OFF	Diode of D_{d0} is ON condition	The diodes of D_{dr} and D_{d2} are turned OFF, D_{d3} is blocked.
Time period $T_4 - T_5$	Switch Q is ON	Diodes of D_{d2} and D_{d0} are conducted	During the diodes of D_{d1} , D_{d3} and D_{dr} are reverse biased.

Table 1: Continuous conducting mode



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Period	Q switch conditions	Depends on the strategies on conditions	Depends on the strategies offCondition
Time period $T_0 - T_1$	Switch Q is ON	Diodes D_{d2} and D_{dr} conducted	Diodes D_{d1} , D_{d3} and D_{d0} are blocked
Time period $T_1 - T_2$	Switch Q is OFF	Diodes D_{d3} and D_{d1} are ON conditions	Diodes D_{d2} and D_{dr} are turned OFF conditions
Time period $T_2 - T_3$	Switch Q is OFF	Diodes D_{d1} and D_{d0} are ON conditions	Diodes D_{d2} and D_{dr} turned OFF conditions and diode D_{d3} is blocked
Time period $T_3 - T_4$	Switch Q is OFF	Diode D_{d1} is conducting	Diode D_{d2} is OFF and D_{d3} is blocked
Time period $T = T_4$	Switch Q is ON	Diodes D_{d2} and D_{dr} are conducts	Diodes D_{d1} , D_{d3} and D_{d0} are blocked

Table 2: Discontinuous conducting mode

VI. SIMULATION RESULT AND ANALYSIS

The operations of the proposed converter have been given in the table 1 & 2 in the form of continuous and discontinuous mode. The simulation circuit is used to verify the performance of output. The input voltage is 18-36V and to obtain the output voltage is 380V.

Simulation parameter for the given circuit Fig(4) has been given below

Input voltage = 18-36V

Capacitor (C_1, C_2, C_3, C_0) = 1 μ F, 220 μ F

Frequency = 40 KHZ

Input inductor = 40 μ F

Output voltage = 380V

The duty cycle ration and inductance value has been calculated using the below formula

Duty Ratio

$$D = 1 - \frac{V_s * \text{Efficiency}}{V_o} \quad (1)$$

V_{in} – Input Voltage

V_o – Output Voltage

Inductance

$$L = \frac{(V_s * (V_o - V_s))}{(\Delta I - L * F * V_o)} \quad (2)$$

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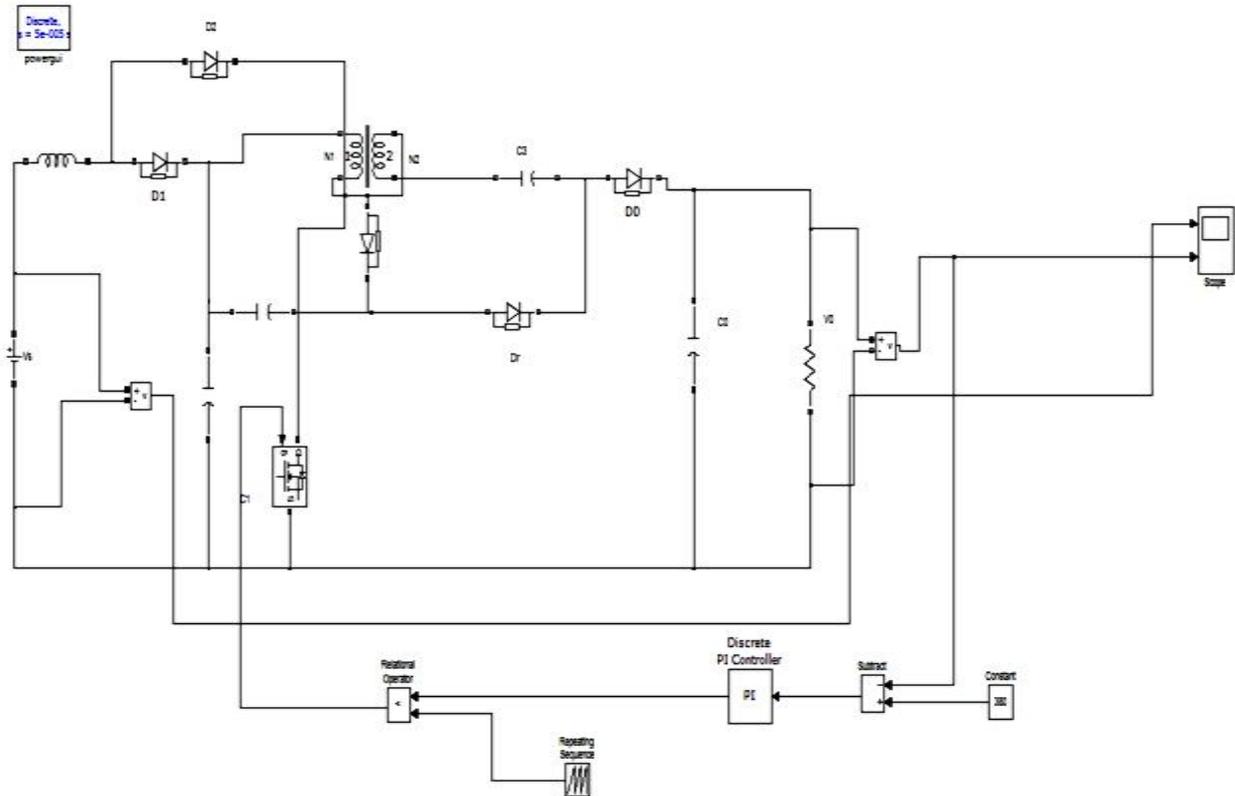


Fig.3.Simulation circuit for proposed converter

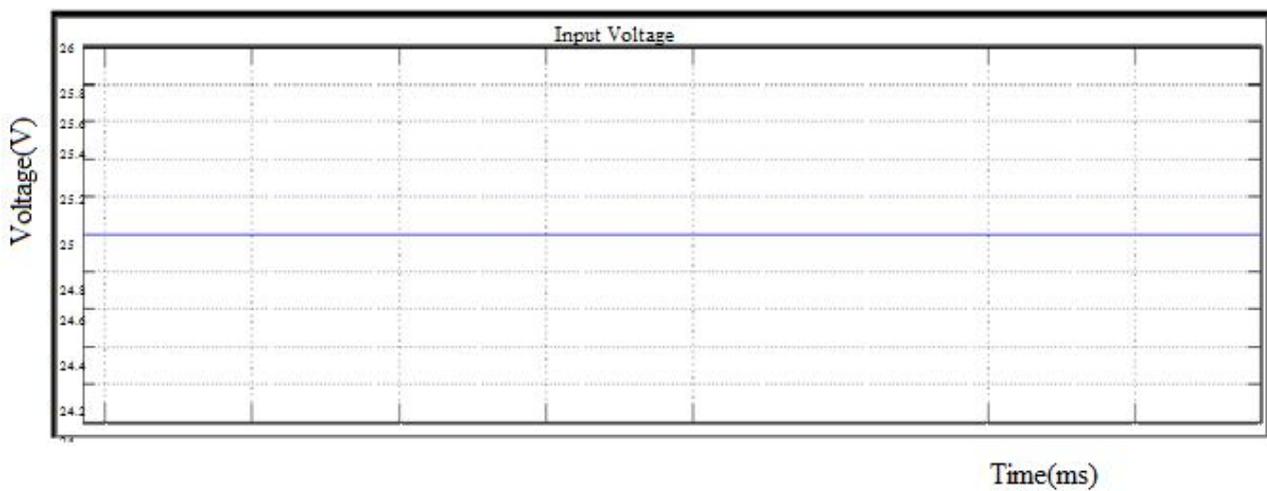


Fig.4(a)Input waveform for the proposed converter



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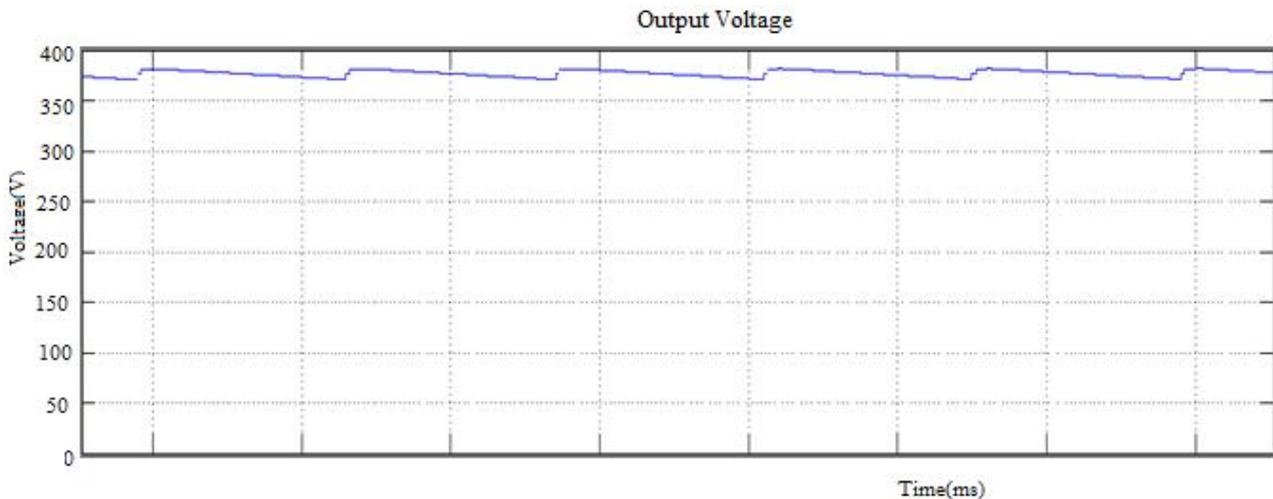


Fig.4(b). Output waveform for the proposed converter

From the proposed converter, input voltage is 25.1V and obtained the ripple free voltage of 375V shown in the waveform Fig.5. The reduced voltage distortion with high voltage gain is obtained in the proposed converter

VI.CONCLUSION

The proposed converter is used to reduce voltage distortion and using integrated coupled inductor to reduce voltage stress. To obtain high voltage gain by using high voltage gain converter with coupled inductor and diode capacitor and this converter mostly used in industrial applications. To achieve high conversion ratio depends on without high duty cycle. The proposed converter is reliable and cost of it is low and also leakage inductance of coupled inductor is used to recycle the energy efficiently

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