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***Research Article***

# Design and Analysis of Super lift Boost Converter

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## Abstract

In this paper design and analysis of super lift boost converter is presented. The proposed circuit eliminates some of the drawbacks in the conversional full bridge boost converter such as voltage and current stresses. Today the power electronics devices are smaller, lighter more efficient, less expensive and more reliable system. The full bridge topology is adopted here to obtain higher power output capability and higher conversion efficiency. The increase of the switching frequency reduces the size of the magnetic components but increases the switching losses. The proposed high frequency transformer link DC-DC converter topology is based upon a new conceptual secondary-side series resonant principle and its inherent nature. The proposed techniques is presented with 100 V input and output voltage of 100 V and also 25 V as input and output voltage of 407 V has been simulated and modeled using MATLAB/SIMULINK. The simulation results compared with conventional bidirectional full bridge dc-dc converter is verified its effectiveness.

**Keywords**: DC-DC Super lift Boost Converter; Pulse Width Modulation; MATLAB/SIMULINK.

## Introduction

There is so much importance to DC-DC converters in our daily life for fulfilling domestic, business, agricultural and the industrial needs. Modern power system has required equipment like small in size, reliable, high quality in the sense of efficiency and low cost devices. DC-DC converters are the best replacements to the linear controllers. So much research is done and many advanced dc-dc converter technologies has been invented [1,2]. These DC-DC converters have many applications like electric vehicle, solar cell applications, traction, machine drives and fuel cell applications [3-5].

In transformer based topology current fed full bridge isolated boost converter comprises of inverter bridge and rectifier isolated by a transformer popularly used for high voltage application. It must be illustrated that there is possibility of current to surge through the bridge switches in [6]. Super lift dc-dc converter is added prevailing technique to enhance voltage transfer gain of the converter in geometric progression series stage-by-stage [7]. Active-clamp type isolated boost dc-dc converters achieve soft-switching while minimizing the circulation current and achieve relatively high efficiency power conversion [8]-[9]. DC-DC converters usually utilize rectifiers at the output side. However, rectifier having a relatively long recovery time will produce voltage spikes. The parasitic capacitance of the rectifier will resonate with the transformer's leakage inductance causing high frequency oscillations on the transformer's secondary side [10].

Today, the power electronics are in need of the development of smaller, lighter more efficient, less expensive and more reliable systems. The increase of the switching frequency reduces the size of the magnetic components but increases the switching losses [11]. Also some previous researches about a variety of DC-DC converter with high-frequency transformer are introduced to improve their efficiency and power density [12]. It includes series-resonant soft-switching DC-DC converter with high frequency transformer [13]. A PWM full-bridge boost converter can be implemented with either zero voltage switching (ZVS) or zero-current switching (ZCS) depending on the application [14,15]. To achieve a high step-up voltage ratio, a transformer or coupled inductor is usually used in converters [16]. In this paper design and

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analysis of super lift boost converter is presented. The proposed circuit eliminates some of the drawbacks in the conversional full bridge boost converter such as voltage and current stresses. The proposed high frequency transformer link DC-DC converter topology is based upon a new conceptual secondary-side series resonant principle and its inherent nature. In this paper presented with 100 V as input and output voltage of 100 V and also 25 V as input and output voltage of 407 V has been simulated and modeled using MATLAB/SIMULINK.

## Proposed Method

The super lift boost converter has been successfully employed in design of DC-DC converters (Fig. 1 and 2). However the output voltage increases in arithmetic progression. Re-lift and super- lift converters introduces a novel approach – Super lift technique that implements the output voltage increasing in geometric progression. It effectively enhances the voltage transfer gain in power series. Voltage Lift (VL) Technique is a popular method widely used in electronic circuit design. It has been successfully employed in DC-DC converter applications in recent years and opened away to design high voltage gain converters. A super lift converter introduces a novel approach – Super Lift (SL) technique that implements the output voltage increasing in stage by stage along the geometric progression. It effectively enhances the voltage transfer gain in power series. In DC-DC Converter circuit design, Voltage Lift (VL) and Super Lift (SL) technique are popular method widely used for boosting the voltage. In recent years these techniques have been successfully employed in DC-DC converters and have opened various opportunities to design high voltage gain converters. For smooth operation of proposed converter phase-shift PWM control is employed. The super lift converter significantly increases the voltage transfer gain stage by stage in geometric progression. The positive output elementary Super lift converter (performs the voltage conversion from positive source voltage to positive load voltage and thereby giving increased output voltage [17].

The super-lift technique considerably increases the voltage transfer gain stage by stage in geometric progression. An approach, positive output elementary super lift converters, that implements the output voltage increasing in geometric progression with a simple structured have been introduced. These converters also effectively enhance the voltage transfer gain in power-law terms. Due to the time variations and switching nature of the power converters, their static and dynamic behavior becomes highly nonlinear. The design of high performance control for them is a challenge for both the control engineering engineers and power electronics engineers. In general, a good control for DC-DC converters always ensures stability in arbitrary operating condition [18].

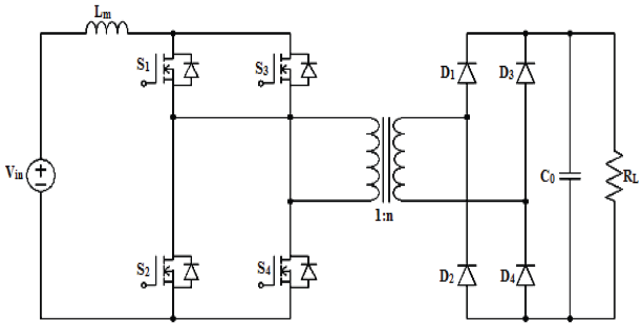


Fig. 1. Conventional Super lift Boost Converter

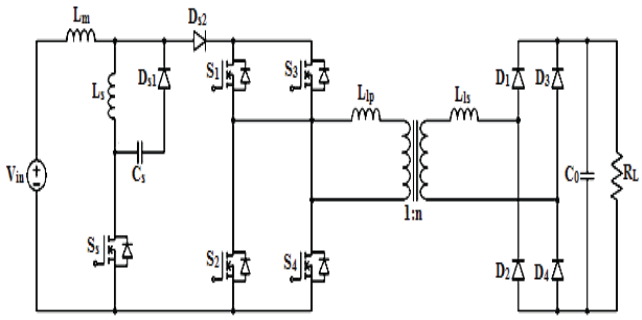


Fig. 2. Proposed Super lift Boost Converter

## Simulation Results

The simulation is performed of super lift boost converter in matlab/Simulink for investing open loop operation (Fig. 3 and 4). Input Voltage, Output voltage of super lift converter, Output current of super lift converter, Output power and load respectively were presented Table 1 and figures 5 to 12. From the simulink, its figure out that due to the 100 V as input and output voltage of 100 V and also 25 V as input and output voltage of 407 V. The duty cycle is deviated and compatible voltage and current is analyzed in the super lift boost converter. It is observed that the operation of super lift boost converter is better as compare to converter. According to this analysis, the output power of super lift boost converter is 10 W & 0.8278 W respectively.

***Proposed simulation for 100 V***

The input voltage of super lift boost converter is 100 V is done by MATLAB simulation (Fig. 5). The output voltage of super lift boost converter is 100 V is done by MATLAB simulation (Fig. 6). The output current of super lift boost converter is 10 mA is done by MATLAB simulation (Fig. 7). The output power of super lift boost converter is 10 W is done by MATLAB simulation (Fig. 8).

Table 1. Parameters

| Parameters | Values | |
|---|---|---|
| Input Voltage | 100V | 25V |
| Output Voltage | 100V | 407V |
| Output Current | 10mA | 2.034mA |
| Power | 10W | 0.8278 W |
| Switch | MOSFET | MOSFET |
| Switching Frequency | 50kHz | 50kHz |
| Resistance | 8000 ohm | 2e5ohm |

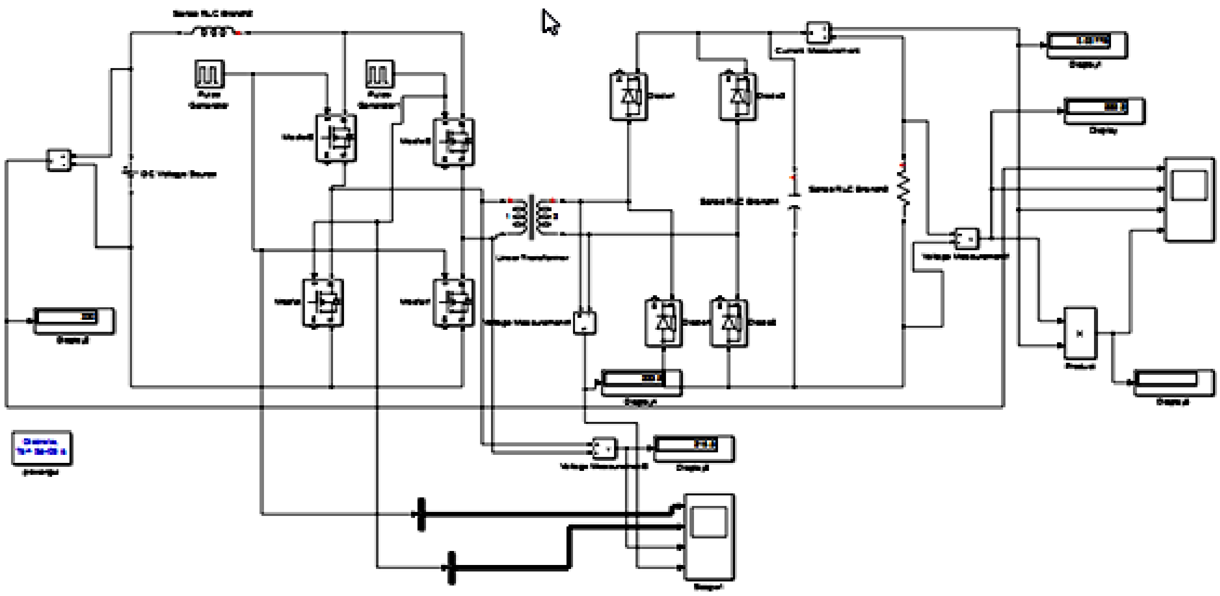

Fig. 3. Simulation of Conventional Super lift Boost converter

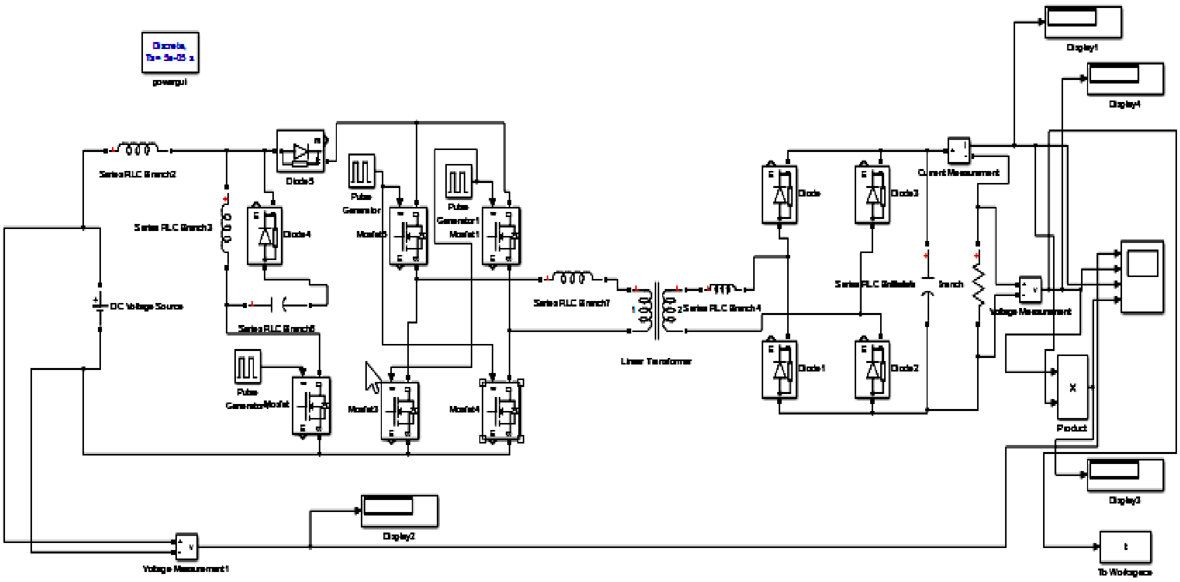

Fig. 4. Simulation of Proposed Super lift Boost converter

 

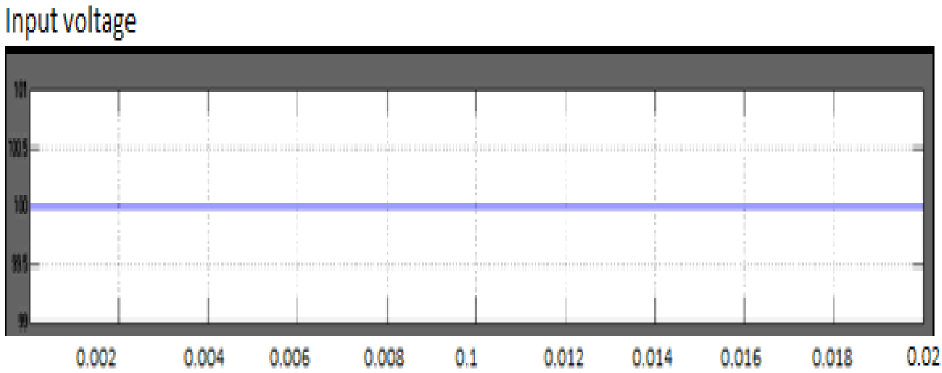


Fig. 5. Input Voltage

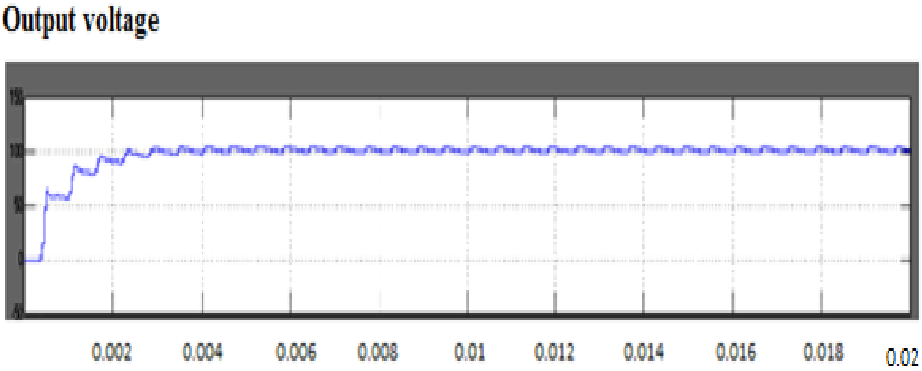


Fig. 6. Output Voltage

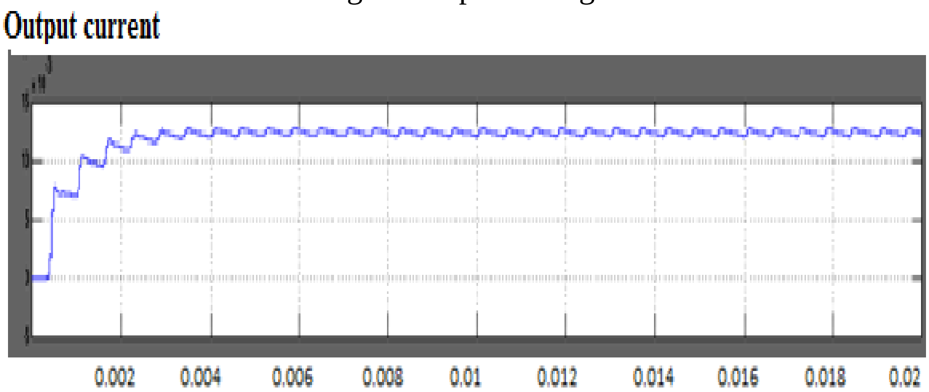


Fig. 7. Output Current

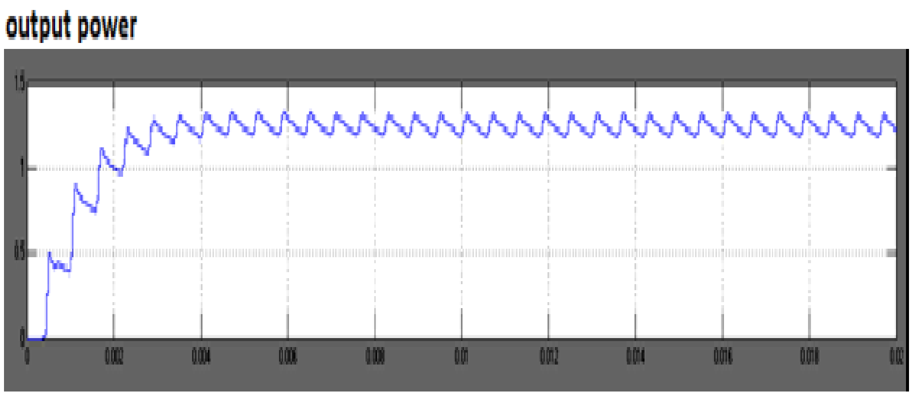


Fig. 8. Output Power

**Proposed simulation for 25 V**

The input voltage of super lift boost converter is 25V is done by MATLAB simulation (Fig. 9). The output voltage of super lift boost converter is 407 V is done by MATLAB simulation (Fig. 10). The output current of super lift boost converter is 2.034mA is done by MATLAB simulation (Fig. 11). The output current of super lift boost converter is 0.8278W is done by MATLAB simulation ((Fig. 12).

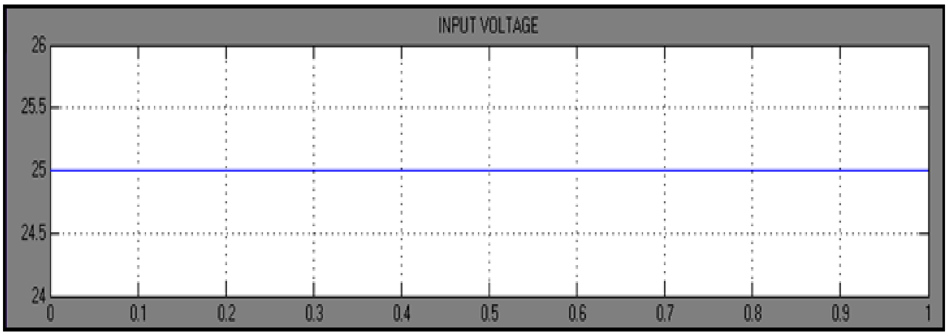


Fig. 9. Input Voltage

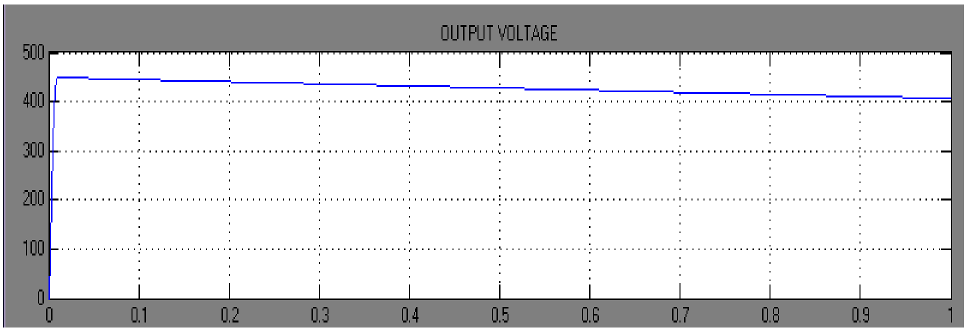


Fig. 10. Output Voltage

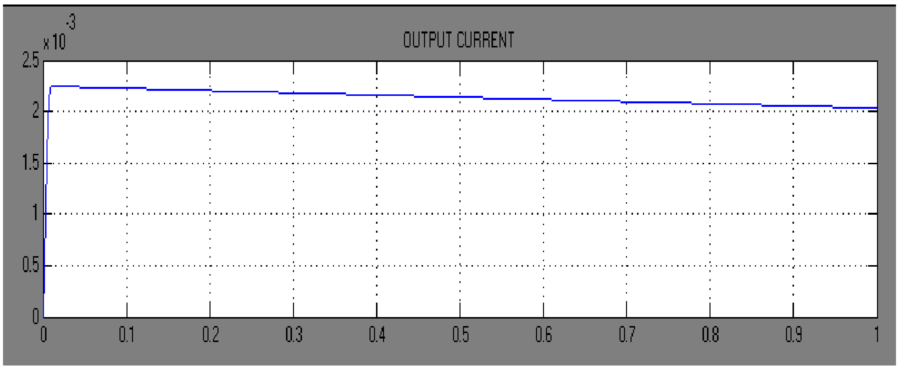


Fig. 11. Output Current

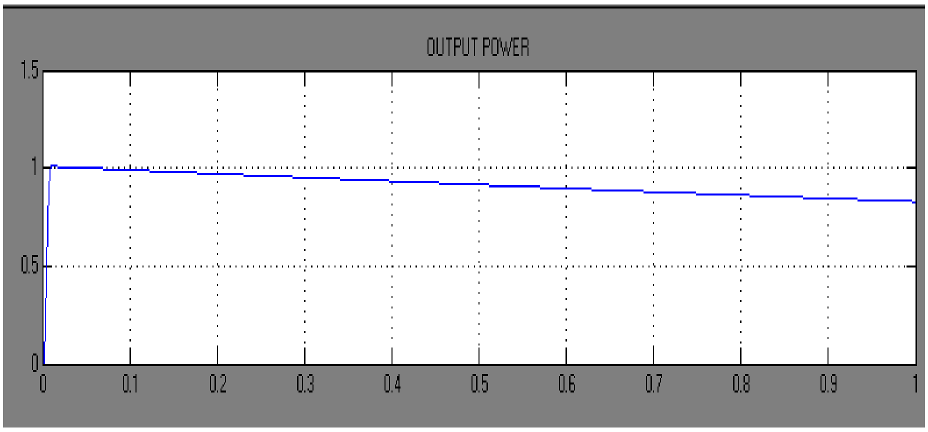


Fig. 12. Output Power

## Conclusions

This paper presents an isolated full bridge with super lift converter specifically applied for application that needs a higher voltage than the input voltage level. Positive Output Super lift Converter has been successfully analyzed and simulated by MATLAB/SIMULINK. It largely increases output voltage and voltage transfer gain in power circuit. It has been observed that the output voltage has increased in geometric progression. In conclusion, a new series of DC/DC converters – Positive Output Super-Lift Converters have been successfully created. It effectively increased the voltage transfer gain in the power series. A soft-commutating method and control scheme for an isolated boost full bridge converter is to implement dual operation of the well-known soft-switching full bridge dc/dc (buck) converter for bi-directional high power applications.

## Conflict of interest

Authors declare there are no conflicts of interest.

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