



DESIGN OF A COMMON GROUNDED HIGH STEP- UP DC -DC CONVERTER

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ABSTRACT :

This paper presents the design and analysis of a common-grounded high step-up DC–DC converter operating under open-loop control. The proposed converter employs two switches (S1 and S2) with a fixed 50% duty cycle to achieve high voltage gain without the need for extreme duty ratios. The topology maintains a common ground between the input and output, which helps reduce electromagnetic interference (EMI) and enhances system reliability. The converter operates in continuous conduction mode (CCM), ensuring a smooth input current profile, making it suitable for renewable energy applications such as photovoltaic systems and battery storage. Simulation results demonstrate that the converter achieves high voltage gain with low voltage stress across the switches and maintains a stable output voltage. Overall, the proposed converter offers a simple, efficient, and cost-effective solution for high step-up applications, with improved performance and reliability. It is well-suited for use in renewable energy systems, battery charging, and DC microgrid applications.

Keywords: High step-up DC–DC converter, common-grounded topology, open-loop control, continuous conduction mode (CCM), voltage multiplier, coupled inductor, high voltage gain, low switch stress, renewable energy systems, photovoltaic (PV) applications, battery charging, DC microgrid

1.INTRODUCTION

The increasing demand for renewable energy systems, electric vehicles, and modern power electronic applications has created a need for efficient high step-up DC–DC converters. These systems typically use low-voltage sources such as photovoltaic panels, fuel cells, and batteries, which must be converted to higher voltage levels for practical applications. As a result, developing converters with high efficiency, reliability, and compact design has become an important research focus. Chapters (1). Conventional converters, such as the boost converter, are commonly used due to their simple structure. However, achieving high voltage gain requires operation at very high duty cycles, leading to increased voltage stress, higher losses, reduced efficiency, and significant electromagnetic interference (EMI). To address these issues, advanced topologies such as coupled-inductor, switched-capacitor, and voltage multiplier converters have been proposed. While these methods improve voltage gain, they often increase circuit complexity, cost, and component count. Additionally, many of these converters lack a common ground between input and output, which complicates system integration and increases EMI. The proposed converter operates based on energy storage and transfer principles, where inductors store energy during the ON state and release it during the OFF state, while capacitors assist in voltage boosting. By optimizing the switching operation and component design, high voltage gain can be achieved without extreme duty cycles.

2 PROPOSED SYSTEM

The proposed system is a Common Grounded High Step-Up DC–DC Converter operating in open-loop control. Its main goal is to obtain a high voltage gain from a low DC input while keeping the control simple, reducing voltage stress. The converter uses two inductors (L_1 , L_2), three capacitors (C_1 , C_2 , C_3), three diodes (D_1 , D_2 , D_3), and two switches (S_1 , S_2). The input and output share a common ground, which helps reduce electromagnetic interference (EMI) and improves system stability. This makes the converter suitable for applications such as photovoltaic systems and fuel cells. The system operates using a fixed 50% duty cycle in open-loop mode. The two switches work in a complementary manner. When the switches are ON, the inductors store energy. When they are OFF, the stored energy is transferred to the load through the diodes and capacitors. The capacitors act as voltage multipliers, increasing the output voltage. This topology achieves high voltage gain without using extreme duty cycles, which reduces switching losses and improves efficiency. It also provides continuous input current, which reduces input current ripple. Because of these advantages, the converter is suitable for renewable energy systems, electric vehicles, fuel cells, and other high-gain DC power applications.

2.1 CIRCUIT DIAGRAM OF PROPOSED SYSTEM.

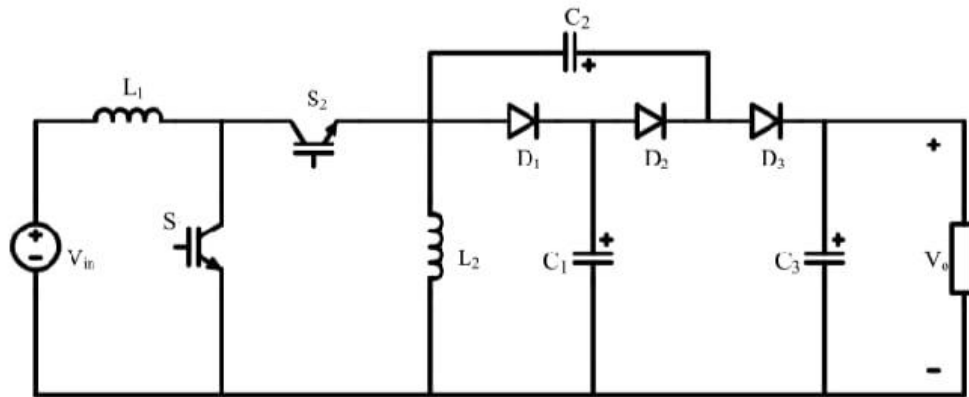


FIG.1 CIRCUIT DIAGRAM OF PROPOSED SYSTEM

3.DESIGN OF PROPOSED SYSTEM

Inductors L_1 and L_2 are essential for the proper functioning of the proposed converter. They enable energy storage and transfer, ensure continuous current flow, and play a major role in achieving high voltage gain and efficient operation. **SELECTION OF INDUCTOR**

$V_{in}=24V$

$D = 0.5$

$F_s = 24kHz$

Ripple current $\Delta I_L = 20\%$ of I_L

$\Delta I_L = 0.2 \times 2 = 0.4A$

$L = 0.619$

SELECTION OF CAPACITOR

A High Gain converter has two main capacitors: Coupling capacitor (C_1, C_2): transfers energy between inductors. Output capacitor (C_3): filters the output voltage. 1. Coupling Capacitor (C_1, C_2)

The voltage across $C_1 \approx V_{in}$.

Coupling Capacitor (C_1, C_2) = $10\mu F$

Output Capacitor (C_3) = $9\mu F$

4.SIMULATION RESULTS

The obtained waveforms confirm that the converter operates in continuous conduction mode (CCM) under the specified conditions. The inductor current exhibits a stable triangular waveform without discontinuity, while the capacitor voltages remain well regulated throughout the switching cycles. The output voltage reaches the desired 150 V steady-state value after a short transient period, demonstrating good dynamic response of the system. Furthermore, the voltage stress across the switching devices is observed to be significantly lower compared to conventional boost converters, thereby improving overall efficiency and reliability. The low ripple content in both output voltage and inductor current validates the effectiveness of the proposed topology for low-power DC–DC conversion applications such as renewable energy systems and battery-powered devices.

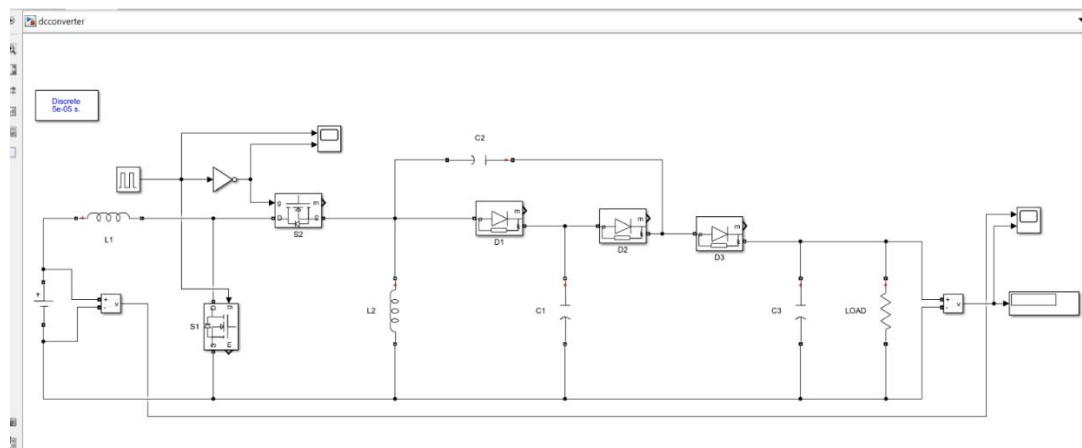


FIG.2 SIMULATION DIAGRAM OF PROPOSED CONVERTOR

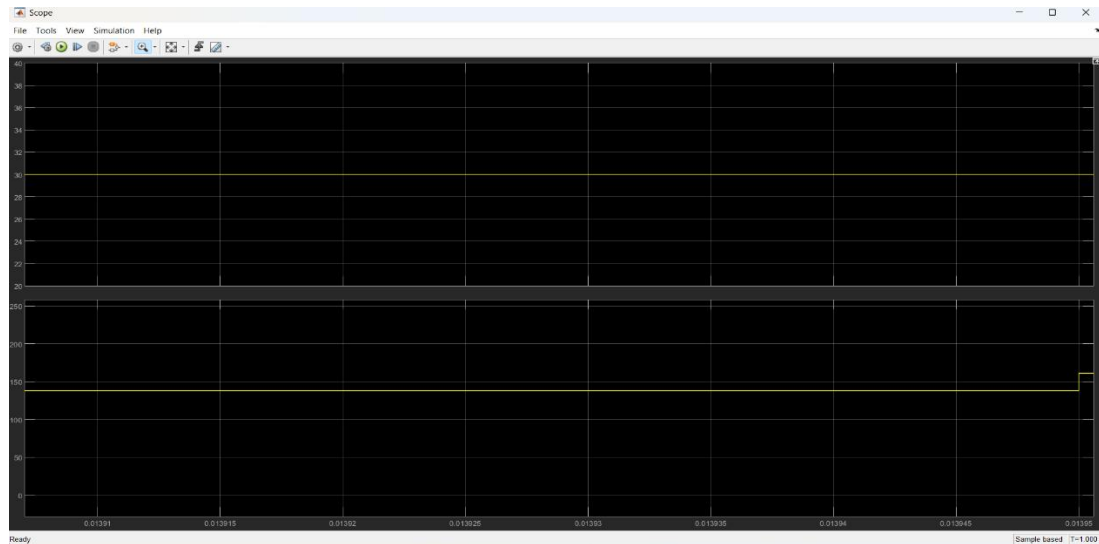
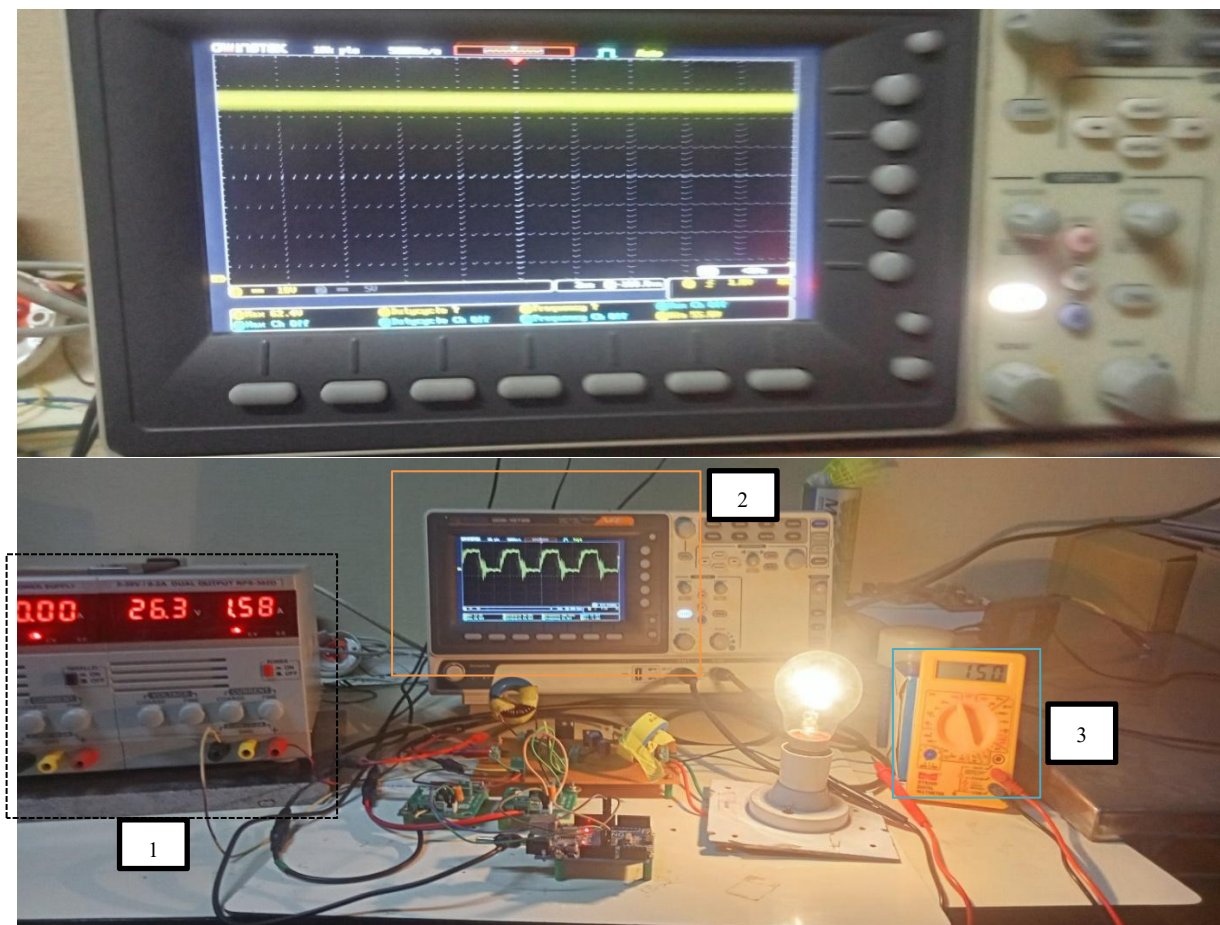


FIG.3 OUTPUT WAVEFORM OF PROPOSED CONVERTOR

5.HARDWARE IMPLEMENTATION

The proposed DC–DC converter was experimentally implemented to verify the simulation performance under real-time operating conditions. A prototype was constructed using a DC source, MOSFET switches with driver circuitry, inductors, capacitors, diodes, a control section, and a resistive load. The system was assembled as per the designed parameter values, and the output voltage and current were recorded using standard measurement equipment. The experimental observations confirm stable switching behavior and effective voltage regulation. The obtained hardware results show close agreement with the simulation results, validating the practical feasibility of the proposed converter topology



1.Input Reading ,2.gate pulse,3.output reading

6.CONCLUSION AND SCOPE

The design of a Common Grounded High Step-Up DC–DC Converter (Open-Loop Control) has been successfully completed. The proposed converter achieves high voltage gain using inductors, capacitors, and switches without requiring extreme duty cycles.

It operates with two MOSFETs (S_1 and S_2) at 50% duty cycle in Continuous Conduction Mode (CCM), with energy transfer occurring through three operating modes. Voltage multiplier capacitors (C_1 , C_2) enhance the gain, while the output capacitor (C_3) reduces ripple and maintains a stable DC output.

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