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High Gain Modified Based on Switched Inductor

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Abstract: The proposed work represents the Modified boost converter is able to regulate the output voltage and the choice of second inductor can give its current as positive and whereas for boost increases in the voltage will not able to regulate the output voltage. It has low semiconductor device voltage stress and switch usage factor is high. A power with 125 W is developed with a 20V input voltage and yields 222 V output voltage and the outcomes are approved through recreation utilizing MATLAB/SIMULINK/MODEL.

Keywords: High Gain DC-DC Converter, Modified Boost Converter, Switched Inductor

I. INTRODUCTION

A modified boost converter is a type of DC-DC power converter that allows for voltage step-up and regulation. It is an improved version of the conventional boost converter, designed to provide better efficiency, reduced size, and improved performance. The boost converter is commonly used in various applications, such as renewable energy systems, battery charging, electric vehicles, and portable electronic devices. It works by converting a lower input voltage to a higher output voltage using an inductor, a diode, a capacitor, and a power switch (typically a transistor). The modified boost converter incorporates certain enhancements and additional control features to overcome some limitations of the conventional boost converter. Here are a few key features and improvements:

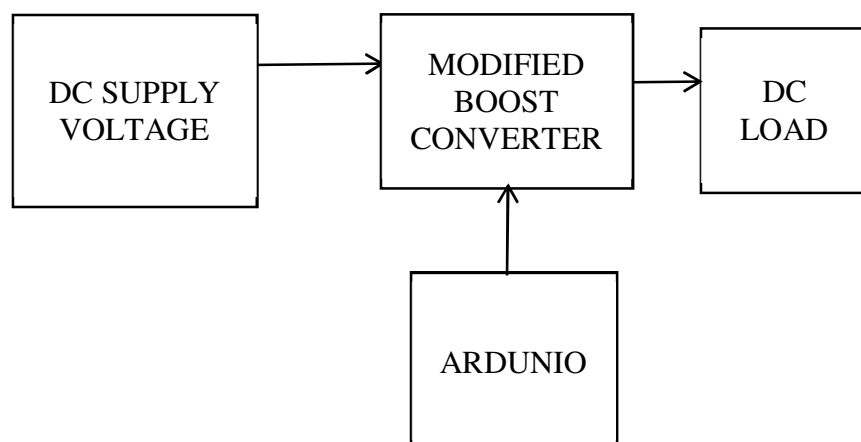
A. High Efficiency

The modified boost converter aims to achieve higher efficiency by minimizing power losses during the conversion process. This is achieved through the use of advanced-power semiconductor devices with lower conduction and switching losses.

B. Improved control Techniques

The modified boost converter employs advanced control techniques, such as pulse width modulation (PWM) and feedback loops, regulate the output voltage accurately. These control techniques help maintain a stable and constant output voltage despite variations in the input voltage and load conditions. Reduced size and weight: The modified boost converter often incorporates advanced components and designs that allow for a more compact and lightweight converter. This is particularly beneficial applications where space is limited or weight is a critical factor, such as in portable electronic devices or electric vehicles.

II. BLOCK DIAGRAM MODIFIED BOOST CONVERTER



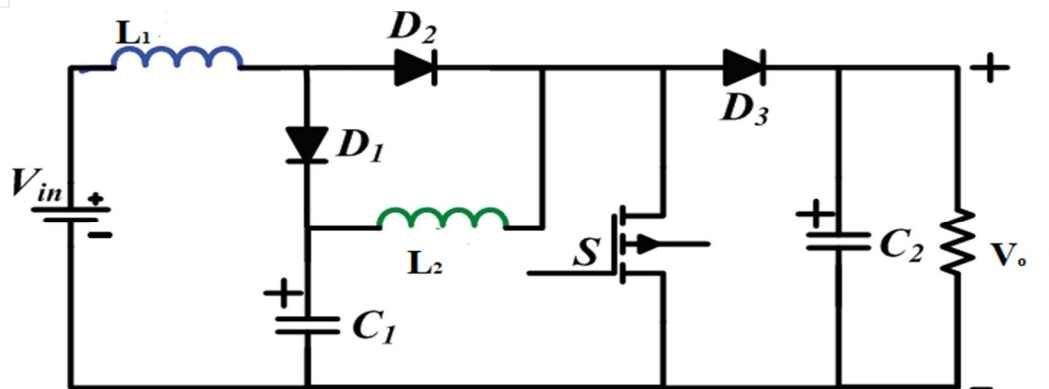


Fig (2) Modified boost converter diagram

III. SWITCHED INDUCTOR

A Switched inductor modified boost converter, also known as modified boost converter with switched inductor, a power electronics circuit used for DC-DC voltage conversion. It is a modification of the traditional boost converter, which is widely used for stepping up voltage level.

In a modified boost converter with a switched inductor, an additional inductor is introduced into the circuit. This inductor is connected in series with the main boost inductor and is switched between two states on and off.

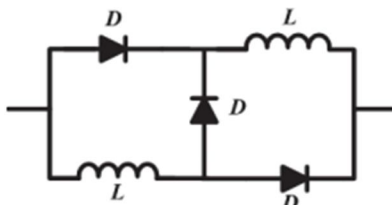


Fig (3) Switched inductor

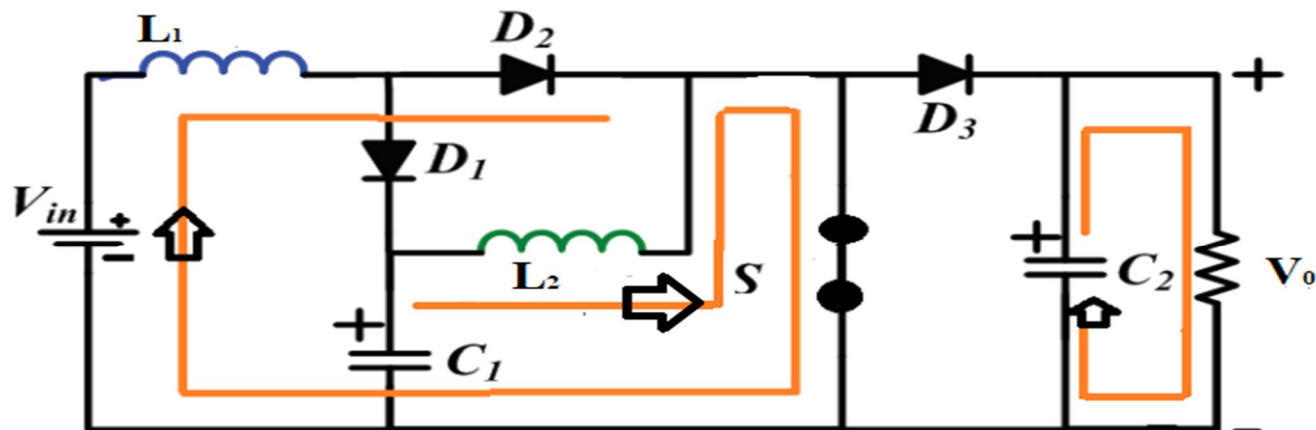
IV. MODIFIED BOOST CONVERTER MODES OF OPERATION

A. Modes Of Operation Modified Boost Converter

1) Switch is Off (MODE1)

In this mode of operation, Diode D_2 is in forward bias condition due to the input supply V_{in} . Diodes D_1 and D_2 are not conducting due to reverse bias condition ensured by capacitors C_1 and C_2 respectively.

In this circuit diagram, assume the voltage across the inductor MOSFET switch is closed.

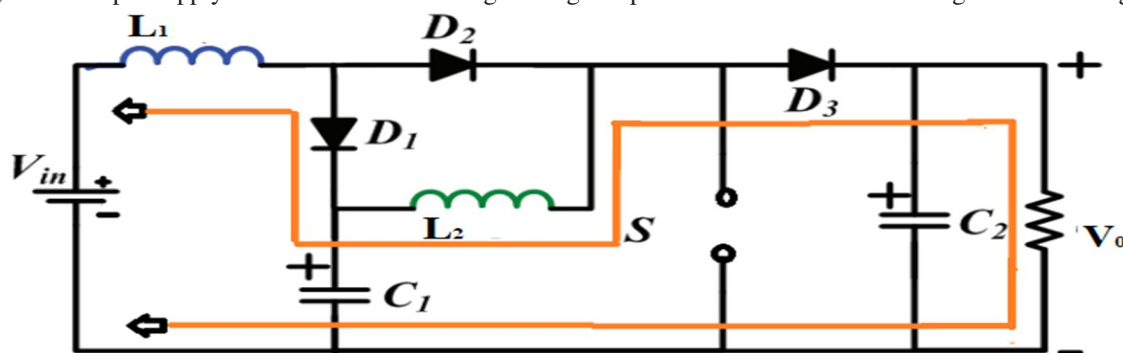


$$\begin{aligned} -V_{in} + V_{L1} &= 0 \\ V_{in} &= V_{L2} \end{aligned} \quad (1)$$

$$\begin{aligned} -V_{C1} + V_{L2} &= 0 \\ V_{C1} &= V_{L2} \end{aligned} \quad (2)$$

2) Switch Open (MODE -2)

The inductors L_1 and L_2 are charged from input supply V_{in} and capacitor C_1 respectively. The current flowing through the inductor is rising and slope of capacitor voltage is decreasing due to its discharging nature. Capacitor C_2 is discharged, the load and L_2 are demagnetized along with input supply V_{in} into capacitor C_2 through diode D_3 . In mode switch open, two inductors are demagnetized or current flowing through inductor L_1 and L_2 is decreasing as . The two capacitors C_1 and C_2 are charged from inductor L_1 , L_2 and input supply V_{in} . The current flowing through capacitor C_1 and C_2 is increasing. The circuit diagram



$$\begin{aligned} -V_{in} + V_{L1} + V_{C1} &= 0 \\ -V_{in} + V_{L1} + V_{L2} + V_{C2} + V_{O} &= 0 \end{aligned} \quad (3)$$

$$V_{L1} = V_{in} - V_{C1}$$

$$V_{L1} + V_{L2} = V_{in} - V_{O}$$

$$V_{L2} = V_{in} - V_{O} + V_{C1}$$

Voltage self balanced mode

$$V_{L1}D + V_{L1}(1-D) = 0$$

$$V_{in} + (V_{L1} - V_{C1})(1-D) = 0$$

$$V_{C1} = V_{in}/(1-D) \quad (4)$$

$$V_{L1}D + (V_{C1} - V_{O})(1-D) = 0 \quad (5)$$

$$V_{L1}D + V_{C1}(1-D) - V_{O}(1-D) = 0$$

$$V_{C1} = V_{O}(1-D) \quad (6) \quad \text{Combine equations 5 and 6}$$

$$V_{O} = V_{in}/(1-D)^2$$

B. Design Of Modified Boost Converter

The inductor (L1) is selected as per the formula given

$$L1 = V_{in} / \Delta I_{L1} f \quad (7)$$

Rate of change of inductor I1

$$2) \quad I_{LX} = I_O / (1-D)^2 \quad (8)$$

2) The inductor (L2) is selected as per the formula given below

$$2) \quad L2 = V_{in} \cdot D / (1-D) \Delta I_{L2} \quad (9)$$

2) Rate of change Inductor current I2

$$2) \quad I_Y = I_O / (1-D) \quad (10)$$

2) To find the maximum inductor L1 and L2 current is given

$$2) \quad I_{L1(max)} = \Delta I_{L1} / 2 + I_{L1} \quad (11)$$

$$2) \quad I_{L2(max)} = I_2 + \Delta I_{L2} / 2 \quad (12)$$

2) To find minimum inductor current L1 is given

$$2) \quad I_{L1(min)} = \Delta I_{L1} / 2 - I_{L1} \quad (13)$$

2) To find minimum inductor current LY is given

$$2) \quad I_{L2(min)} = I_{LY} - \Delta I_{L2} / 2 \quad (14)$$

The capacitor (C1) is selected as per the formula given below

$$C1 = I_O \cdot D / f(1-D) \Delta V_{C1} \quad (15)$$

ΔV_{C1} if we assume the ripple current of 2% of V_{C1}

$$V_{C1} = V_{in} / (1-D) \quad (16)$$

The capacitor C2 is selected as per the formula given below

$$C2 = I_{DO} / f \Delta V_{C2} \quad (17)$$

ΔV_{C2} if we assume the ripple current of 2% of V_{C2}

$$V_{C2} = V_{in} / (1 - D)^2 \quad (18)$$

V. SIMULATION RESULT-TABLE 1

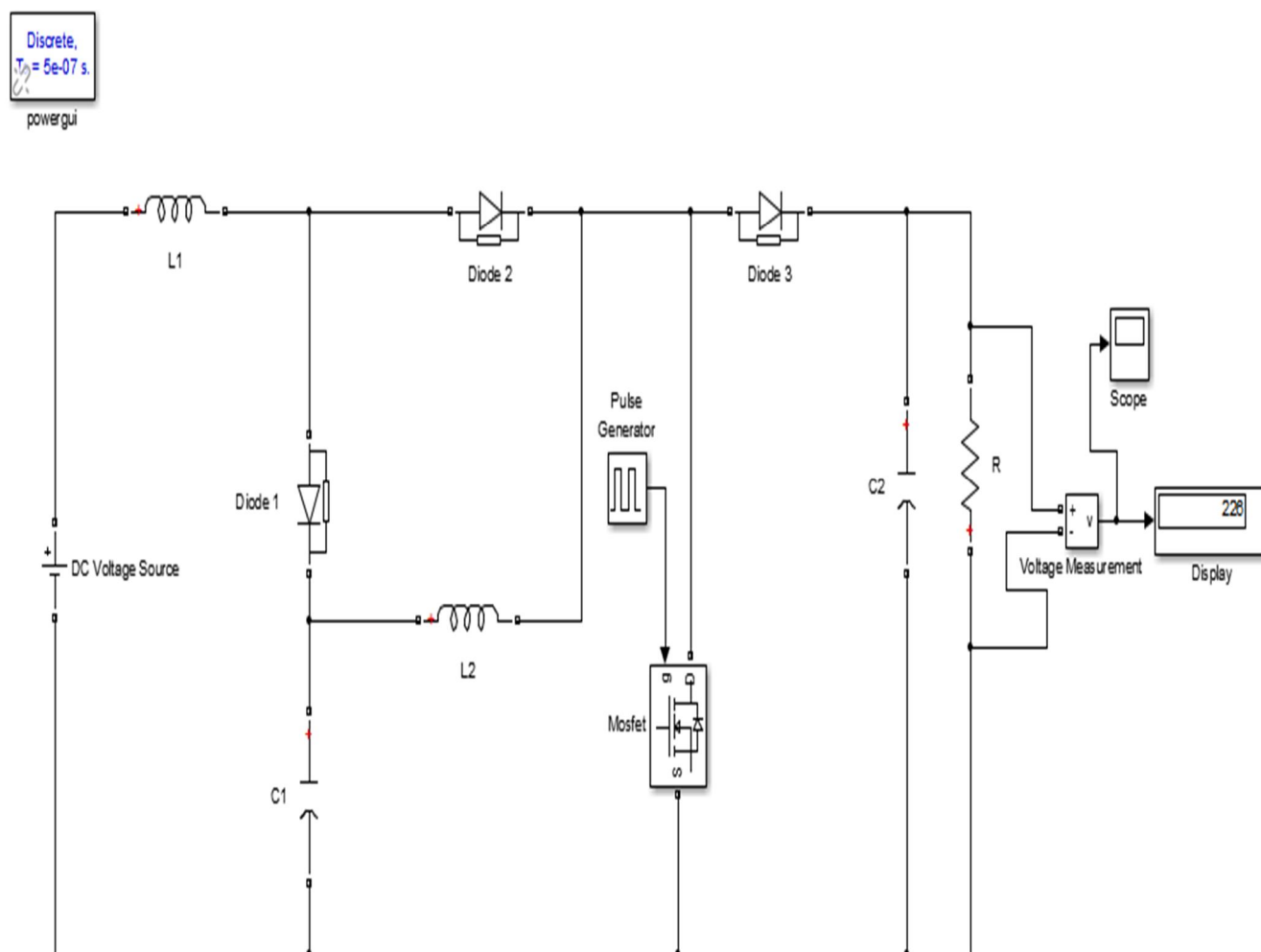
A. Specification Of High Gain Dc-Dc Boost Converter

INPUT VOLTAGE	20V
OUTPUT VOLTAGE	222.22
OUTPUT POWER	125W
RIPPLE VOLTAGE	20%
RIPPLE CURRENT	2%
SWITCHING FREQUENCY	40kHz
DUTY CYCLE	70%

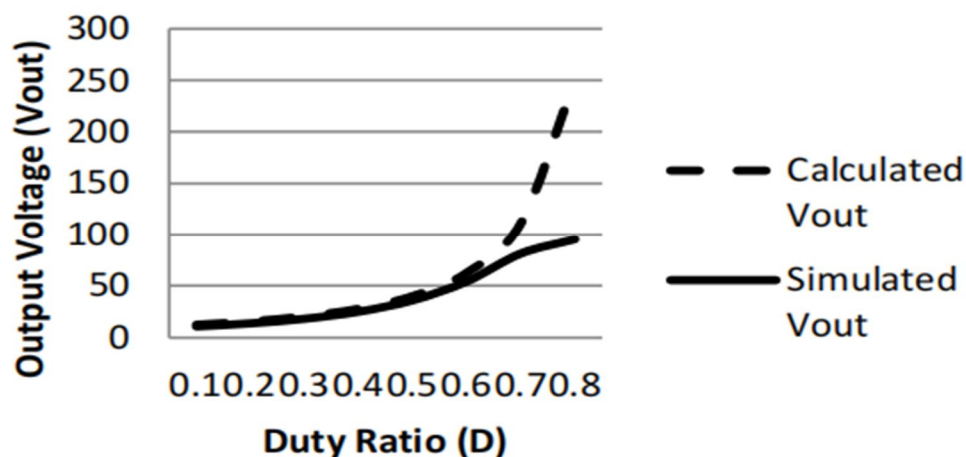
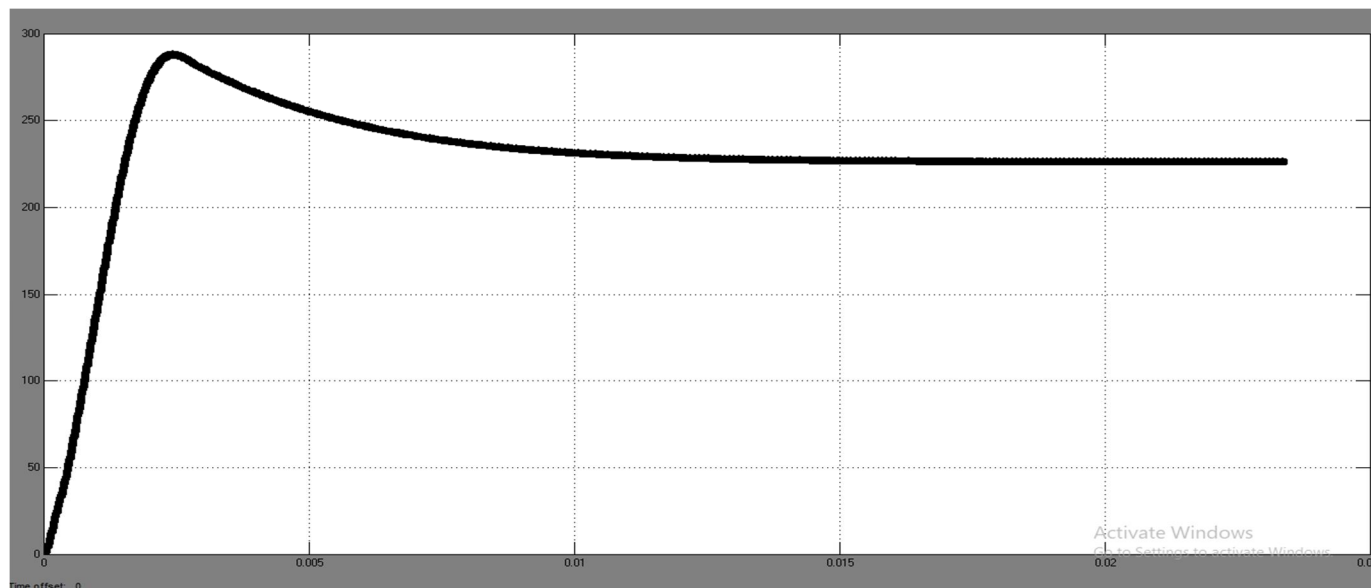
VI. MATLAB SIMULATION OF MODIFIED BOOST CONVERTER

A. Experimental Results Matlab / Simulation Waveform

If $V_s = 20\text{V}$, duty cycle = 0.7 then the output voltage is given at 222.22 for the duty cycle 0.7 whereas the simulation output is 222 for the same input voltage. The simulation output of Modified boost converter



B. Voltage Waveform High Gain Dc-Dc Converter Boost Converter



Calculated and Simulated Output Voltage for Modified Boost converter

VII.CONCLUSION

The Modified boost converter achieves high power conversion efficiency, minimizing power loss and enhancing overall system efficiency. This efficiency is essential for reducing energy consumption, improving performance, and prolonging the lifespan of an electronic system. The quadratic boost converter DC-DC converter that efficiently steps up voltage levels using a quadratic relationship between the input and output voltages. It offers several advantages, including a wider voltage conversion range, high power conversion efficiency and simple circuit design.

The Modified boost converter finds application in diverse fields such as renewable energy systems, electric vehicles, and a high-power electronic devices. Its play a crucial role in stepping up the voltage generated by the renewable sources for grid intergration or battery charging. In electric vehicles, it enables efficient power delivery and allows for the use of smaller and lighter components. Moreover, essential, in high power electronic devices, the quadratic boost converter is achieve the necessary high voltage level. By controlling switch and optimizing the energy transfer process, the quadratic boost converter achieves high power conversion efficiency, minimizing power loss and enhancing overall system efficiency. This efficiency is for reducing energy consumption, improving performance, and prolonging the lifespan of electronic system.

Furthermore, the simplicity of circuit design and control implementation in the quadratic boost converter facilitates manufacturing process, reduces cost and enhances reliability.

In summary, the quadratic boost converter is a valuable component in power electronics, providing efficient voltage step-up capabilities, wide range conversion range, high efficiency, and simplicity in design.

Its versatility and benefits make it a key player in various industries, contributing to the development of a sustainable energy system and high-performance electronic devices.

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