A COMPARISON OF SYNCHRONOUS AND NON-SYNCHRONOUS BOOST CONVERTER

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Abstract – *Basically, a boost converter a crucial component of a solar network improves the output voltage of renewable energy sources. In this converter, a diode can be swapped out for a MOSFET to increase the efficiency of boost converters. The adoption of MOSFET is anticipated to reduce power loss because its internal resistance is lower than a diode's. In this essay, synchronous and nonsynchronous boost converters are compared. MATLAB Simulation has been used to model a 50W prototype. The performance of the synchronous and non-synchronous boost converter topologies was evaluated. Both circuits' efficiency was compared and examined. The results of the simulation analysis show that, for a given input power, the output power of the synchronous boost converter is greater than that of the non-synchronous boost converter. As a result, synchronous boost converter efficiency is higher and is attained at 95%, whereas regular boost converter efficiency is only at 90%.*

Key Words: **Photo voltaic system, Synchronous boost converter, Non-Synchronous boost converter.**

1.INTRODUCTION

Renewable energy sources are developing quickly, particularly photovoltaic (PV) applications. These systems produce electricity using renewable energy. PV systems produce clean electricity and are more environmentally friendly than conventional energy sources.

Modern electronic systems demand resources with excellent efficiency. By switching out the diode for a MOSFET, the DC to DC converter can be more effective as a source of power for electronic devices. Synchronous DC to DC converter refers to the DC converter from DC operating in MOSFET synchronization mode. The MOSFET and the synchronous converter cannot operate simultaneously and must have the same frequency. It is envisaged that by using MOSFETs, which have low internal resistance in conduction mode, the power loss from DC to DC converters will be reduced.

The work that is currently being presented compares two topologies. The non-synchronous boost converter is the first. The synchronous boost converter is the second topology. In the experiment, the input and output power of synchronous and nonsynchronous boost converters will be calculated and compared, and the efficiency will be examined.

2. NON-SYNCHRONOUS BOOST CONVERTER

The provided voltage is increased to the desired level using a non-synchronous boost converter. Any DC source, whether a solar panel, batteries, or another device, may be used as the converter's input.

Figure 1 depicts the circuit diagram for the non-synchronized boost converter.

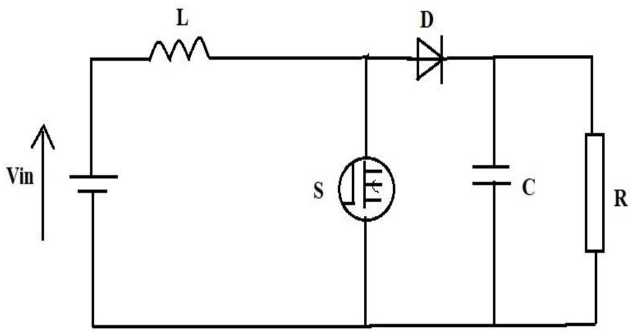
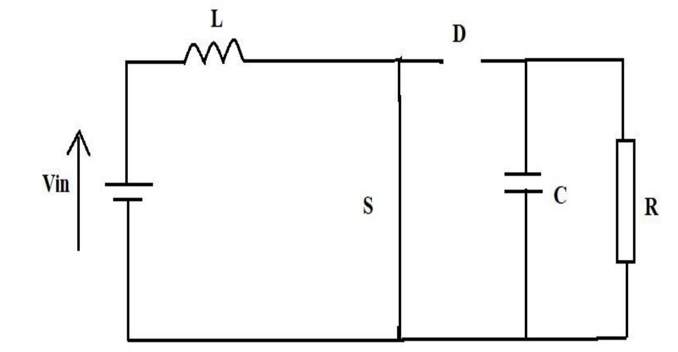


Fig -1: Non-Synchronous Boost Converter Circuit Diagram

The Nonsynchronous Boost Converter has two alternative architectures in continuous mode, as shown in Fig. 2.

The switch S is turned on. Through the supply voltage, the inductor stores energy and charges itself. The inductor current progressively rises under these circumstances.

The switch S is in the off-state. The inductor's polarity shifts, and energy stored there is used to power the diode and charge the capacitor.



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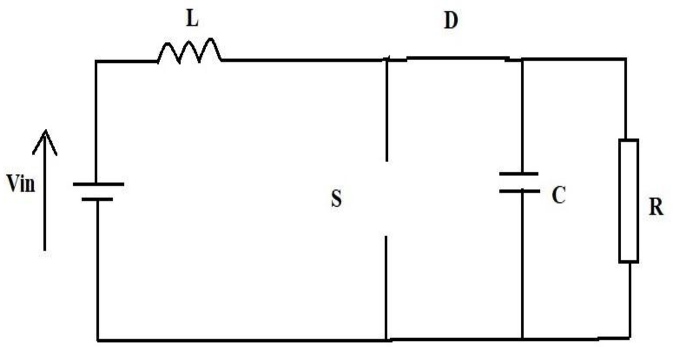

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Fig -2: Non-synchronous Boost Converter circuit configurations. (a) On-state; (b) Off-state

2.1 Design of the circuit:

The duty cycle is determined using the formula below:

$$D = 1 - \frac{Vin}{Vout}$$

the input voltage V_{in}, and the output voltage V_{out}

The source of the load R is:

$$R = \frac{Vout^2}{Pin}$$

where P_{in} denotes the power input

The following formula is used to determine the input and output currents:

$$I_{out} = \frac{Vout}{R}$$

$$I_{in} = \frac{Iout}{(1-D)}$$

The design of the inductor value involves:

$$L = \frac{D\,Vin}{f\,\Delta iL}$$

where i_L is the ripple current and f is the switching frequency

The value of the capacitor is created using:

$$C = \frac{D\,Vout}{\Delta Vc\,f}$$

Where ΔV_c is the ripple voltage

There is 50 w of input power. The circuit receives a 12 volt input and operates at a frequency of 40 kHz.

2.2 Results of the Non-Synchronous Boost Converter Simulation

The circuit for the non-synchronous boost converter is depicted in Figure 3 and is modelled using MATLAB simulation.

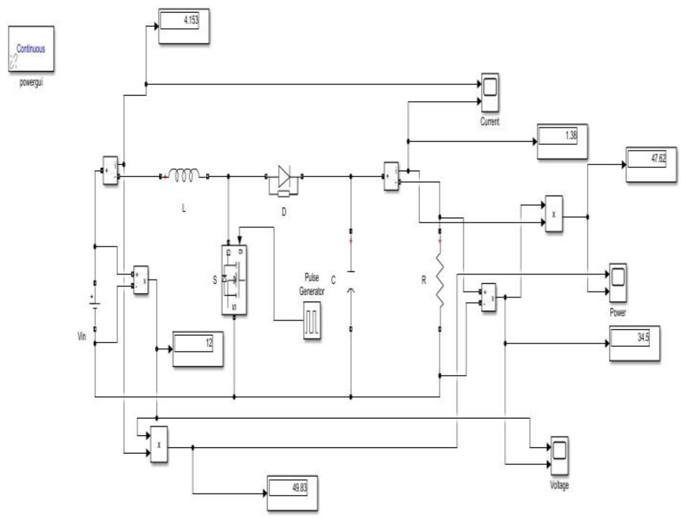
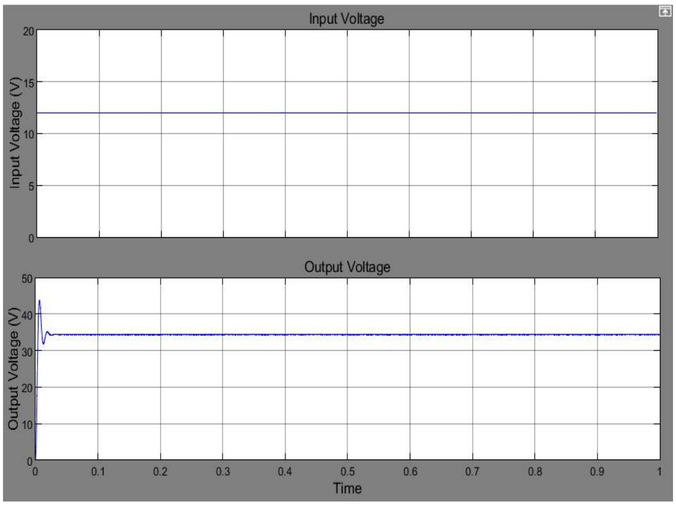


Fig -3: Diagram of the Non-Synchronous Boost Converter Simulation Circuit



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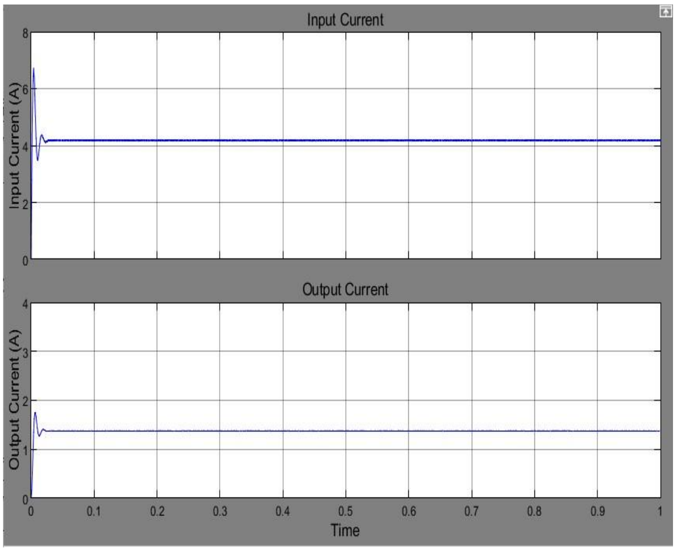


(b)

Fig -4: Electrical signal waveforms. The Non-Synchronous Boost Converter's (a) Input and Output Voltage and (b) Input and Output Current

3. SYNCHRONOUS BOOST CONVERTER

Figure 5 depicts the circuit schematic for the synchronous boost converter.

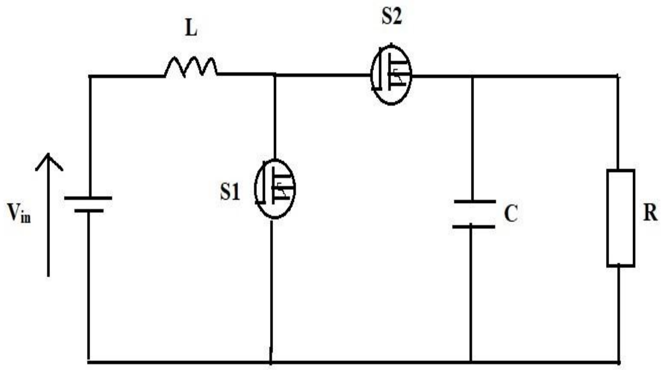


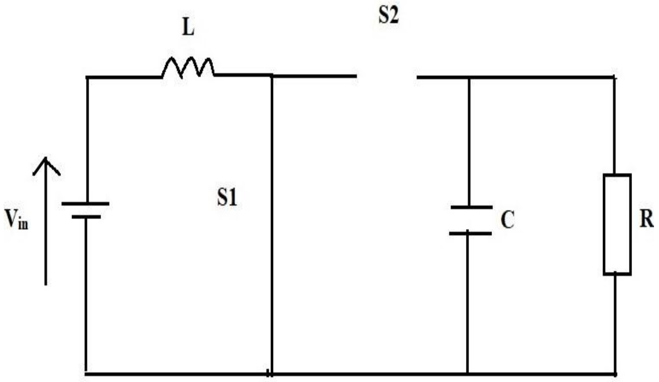
Fig -5: Diagram of the Synchronous Boost Converter's circuit

In continuous mode, the synchronous boost converter has two potential structures, as depicted in fig. 6.

Whenever switch S1 is activated. Through the supply voltage, the inductor stores energy and charges itself. The inductor current progressively rises under these circumstances.

While S1 is off and S2 is switched on. The output stage receives the energy that has been inductively stored. The inductor current gradually diminishes under these circumstances.

Switch S2 will be OFF when switch S1 is ON, and vice versa. This is how a synchronous boost converter's switches are activated. There is a dead interval between the activation of the two switches to prevent shot through scenarios.



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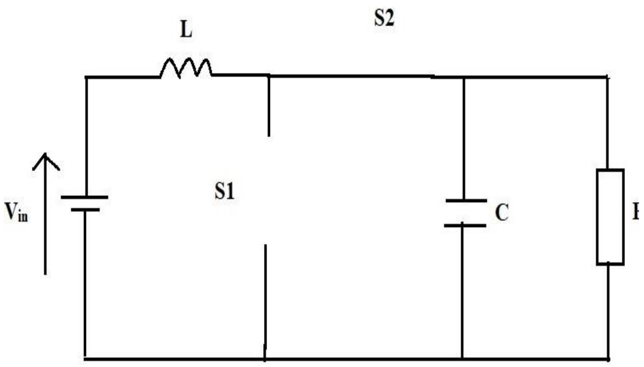

(b)

Fig -6: Synchronous boost converter circuit configuration. (a) S1 is turned on while S2 is off. (b) S2 is ON while S1 is OFF.

3.1 Design of the circuit:

The duty cycle is determined using the formula below:

$$D = 1 - \frac{Vin}{Vout}$$

the input voltage V_{in}, and the output voltage V_{out}.

The source of the load R is:

$$R = \frac{Vout^2}{Pin}$$

where P_{in} denotes the power input

The following formula is used to determine the input and output currents:

$$I_{out} = \frac{Vout}{R}$$

$$I_{in} = \frac{Iout}{(1-D)}$$

The design of the inductor value involves:

$$L = \frac{D\,Vin}{f\,\Delta iL}$$

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$$C = \frac{D\,Vout}{\Delta Vc\,f}$$

Where ΔV_c is the ripple voltage

There is 50 w of input power. The circuit receives a 12 volt input and operates at a frequency of 40 kHz.

3.2 Results of the Synchronous Boost Converter Simulation

The MATLAB simulation is used to simulate the synchronous boost converter, and Figure 7 depicts the circuit.

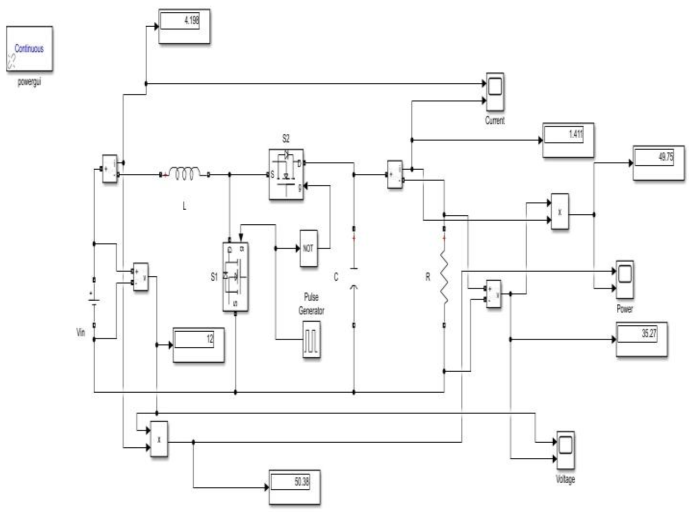
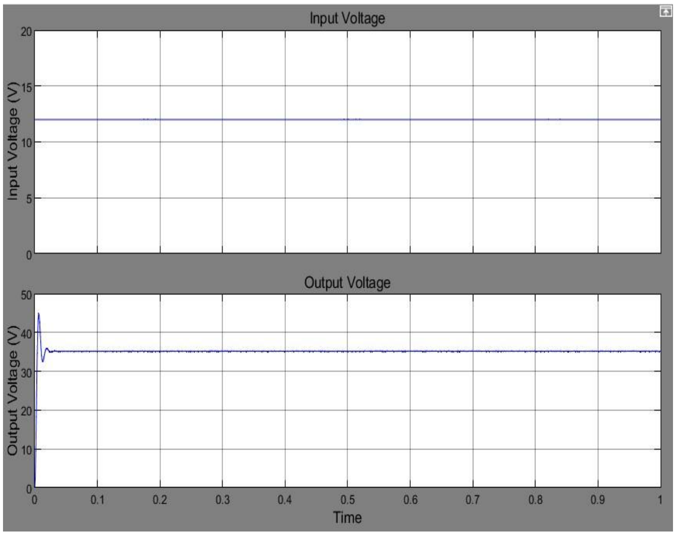


Fig -7: Diagram of the Synchronous Boost Converter Simulation Circuit



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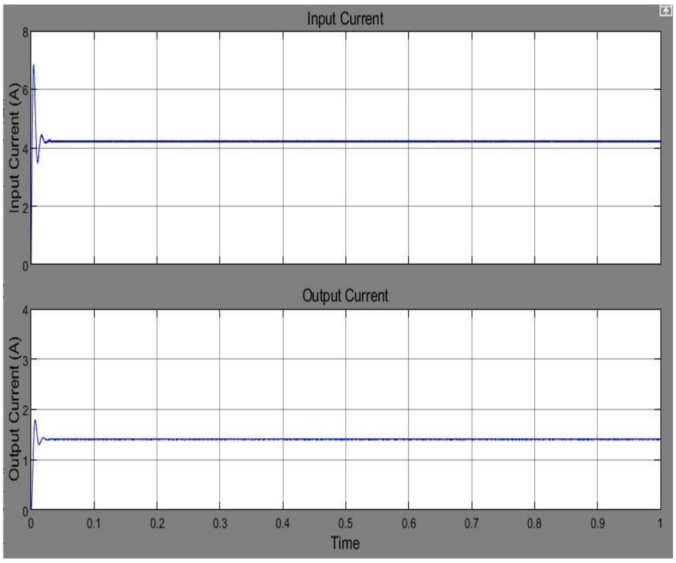

(b)

Fig -8: Electrical signal waveforms. A synchronised boost converter's (a) Input and Output Voltage (b) Input and Output Current

4. COMPARISON

Another important simulation result is the higher efficiency with the use of synchronous boost converters. Graphs in Figs. 9 and 10 show, respectively, the input and output powers of synchronous and non-synchronous boost converters. The values of the input-output power were calculated through simulation and are shown in TABLE I.

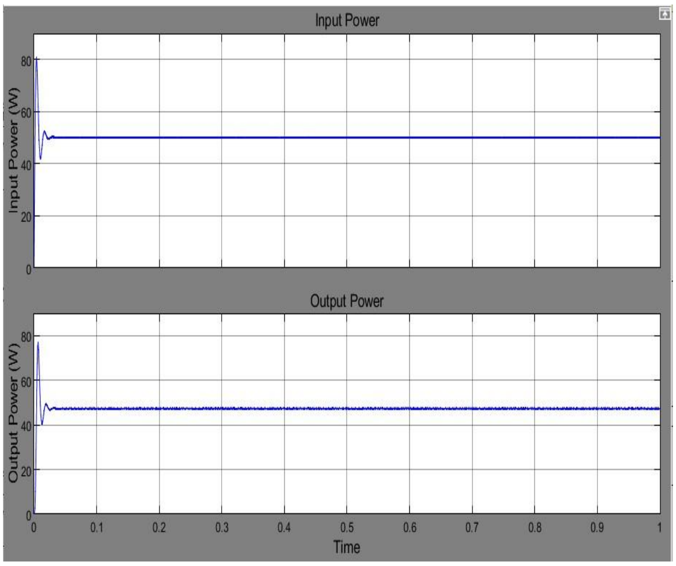

Fig -9: Power of a non-synchronous boost converter at input and output

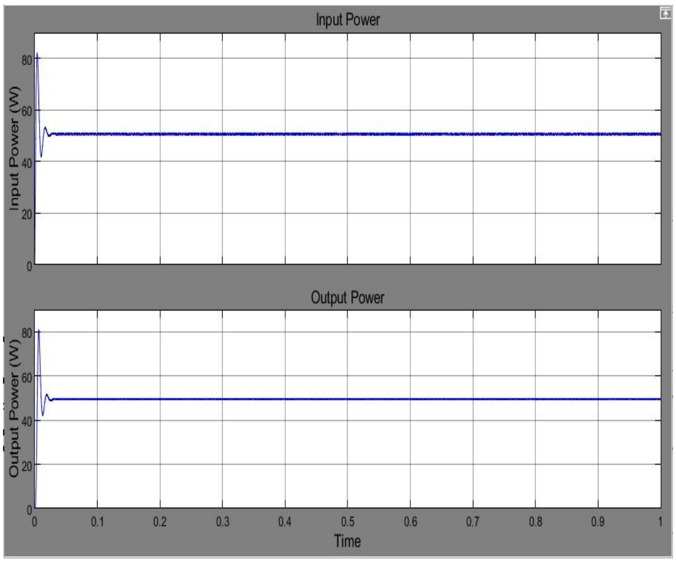

Fig -10: Power of the synchronous boost converter's input and output

Table -1: Comparing the efficiency of synchronous and non-synchronous boost converters for the same system parameters

	Power Input (W)	Power Output (W)	Efficiency (%)
Non-Synchronous Boost Converter	50	47.62	≈ 90
Synchronous Boost Converter	50	49.75	≈ 95

For the same input power, it is discovered that the synchronous boost converter's output power is higher than the non-synchronous boost converter. As a result, synchronous boost converter efficiency is higher, at 95%, compared to non-synchronous boost converter efficiency, which is only 90%.

5. CONCLUSIONS

In this paper, a comparison of synchronous and asynchronous boost converters is presented. Each topology's entire design was analyzed. The simulation outcomes for these converters are discussed. The output analysis shows that the synchronous boost may increase the voltage even with a low input voltage, in contrast to the other topologies. The synchronous boost converter topology is the best one, according to the efficiency analysis.

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