IMPACT: International Journal of Research in Engineering and Technology
ISSN (P): 2347–4599; ISSN (E): 2321–8843
Vol. 10, Issue 8, Aug 2022, 1–8

COMPARISON OF SINGLE SWITCHED CASCADED CONVERTER AND BOOST CONVERTER IN OPTIMIZING THE USE OF SOLAR PANELS

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Received: 11 Aug 2022 **Accepted: 13 Aug 2022** **Published: 22 Aug 2022**

ABSTRACT

The world's need for energy is growing at an alarming rate. To make the most use of the energy that is currently accessible on Earth, an emphasis on renewable energy sources is being applied globally. As is well known, solar cells' maximum output power rises as light intensity does. Therefore, it is clear that the solar cell performs better at generating power the more intense the light is. The purpose of this work is to demonstrate when and how to select the kind of DC/DC power converter to be used in the optimization process of a standalone PV solar system, which is required to characterise the area's climatic conditions for the system implementation and take into account the partial shading effect on the Photovoltaic System (PVG). Additionally, using the direct coupling responses of the PVG, calculate the resistivity of the load that will be injected. We could plot the current-voltage (I-V) and power-voltage (P-V) characteristic, using the manufacturer data and determining the maximum power point (MPP), as a function of the area's weather conditions variations, while also observing the direct coupling response of the load adapted to the PVG, based on the MATLAB/Simulink software and the PVG data sheet selection. We can determine the type of DC/DC power converter to use in the production optimization process of a standalone PV solar system based on this observation. Thus, if the direct coupling voltage responses, we must employ a Boost converter type. Boost converter type, or both at once Buck-Boost converter type, if we need to increase and reduce the voltage, are higher than those of MPP replies.

KEYWORDS: *DC-DC Converter, Cascade Converter.*

INTRODUCTION

The world's need for energy is growing at an alarming rate. To make the most use of the energy that is currently accessible on Earth, an emphasis on renewable energy sources is being applied globally. Solar, water, wind, and other energy sources are a few of them. However, the range of renewable energy sources is not sufficient due to their consistency throughout the year for a number of different reasons. Additionally, such systems have substantially higher beginning costs for delivering a satisfied load demand. Despite being pure and non-polluting, these sources are not frequently used due to the aforementioned drawbacks. Numerous strategies are being put out to boost the effectiveness of various renewable energy systems.

The sun is one of the most often used sources of renewable energy. Solar thermal and sun photovoltaic methods are the two ways that solar energy can be transformed into electrical energy. The solar thermal approach is comparable to the creation of AC electricity using steam without the use of fossil fuels. With the exception of using silicon or another type of semiconductor material in the solar photo voltaic cell, which transforms incident light energy, or the photons present in the sunshine, into DC electricity, solar thermal is identical to traditional AC power generation through steam generation.

OBJECTIVES OF THE STUDY

- To discuss various dc-dc boost converters.
- To find dc-dc boost converter type with best output through simulation method.
- To increase the output of solar energy system.

REVIEW OF LITERATURE

The fundamental component in a photovoltaic chain, the boost converter, is used to increase output voltage in renewable energy sources, according to N. Boujelben, F. Masmoudi, M. Djemel, and M. Derbel [4]. The output voltage is decreased in this converter because the switching frequency is constrained. Two topologies are suggested as a solution to this issue: the quadratic boost converter results from the association of two identical elementary boost converters connected in parallel, and the double cascade boost converter results from the combination of the components of two boost converters using a single switch. In the proposed paper, the effectiveness of the two converter topologies with boost converters is compared and addressed.

M. B. Uddin and S. Nahar, [5] Power DC-DC converters have been emphasised as a crucial component in a variety of topologies and applications. Interleaving methods are important in overcoming the main drawbacks of DC-DC power converters, such as large voltage and current waves, low efficiency, etc. In comparison to a standard boost converter, the interleaved boost converter has various benefits, including minimal voltage and current ripples, low switching loss, improved efficiency, etc. The interleaved boost converter connects 'n' paralleled converters to improve the converter's overall performance. This research analyses the performance of an interleaved boost converter with numerous phases. Interleaved boost converter with many phases (two, three, and four) is simulated and analysed.

In this research, H. Wu, T. Mu, F. Ge, and Y. Xing offer a new way for constructing isolated buck-boost (IBB) converters with single-stage power conversion and exhibit unique IBB converters based on high-frequency bridgeless-interleaved boost rectifiers. Integrating the interleaved boost converters into the full-bridge diode-rectifier considerably lowers the semiconductors, conduction losses, and switching losses.

Boost Converter

Solar panels' output voltage is not always optimal; in other words, the output values may be either smaller or larger than required. As a result, we require an electronic device known as a DC/DC converter that can change the solar panel's output voltage as needed. Different kinds of DC/DC converters are in use. A power semiconductor MOSFET switch (T), a diode (D), an inductor (L), and a storage capacitor, in the output (Cout), but usually typically in practise includes an input capacitor. Boost converters can contain as few as four components (Cin). Switching on and off the power semiconductor is the circuit's primary control mechanism. The energy stored in the inductor increases when the switch is turned on, increasing the current flowing through it. When the switch is off, current continues to pass through the inductor, discharging energy through the diode, capacitor, and load before returning to the source.

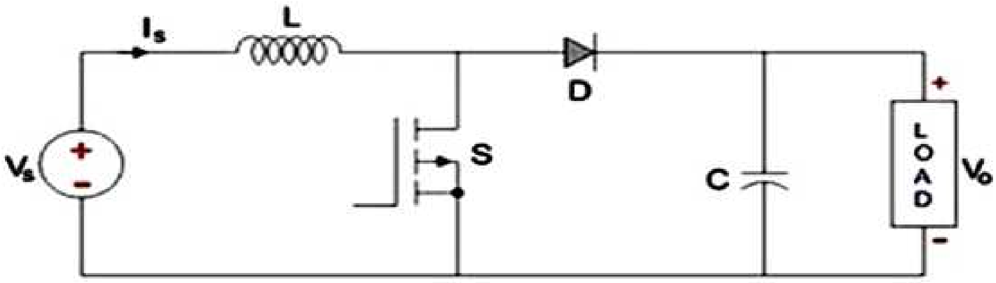

Figure 1: Boost Converter.

When the switch is closed, the inductor functions as a pump, drawing energy in and sending it to the capacitor and load when the switch is open. The output voltage stays largely constant since the time constant is substantially larger than the switch's on period. The ensuing project provides and illustrates the information required to plan and implement a boost converter DC-DC. It does so in great depth, outlining each point as a separate block of information that was then further separated into smaller chapters.

Converter booster In a boost converter, the output voltage is higher than the input voltage, and the converter is switch mode DC to DC. It also goes by the name "step up converter." Since the input voltage is increased to a level higher than the input voltage, the step up converter gets its name from a similar step up transformer. The input power must match the output power in accordance with the rule of conservation of energy (assuming no losses in the circuit).

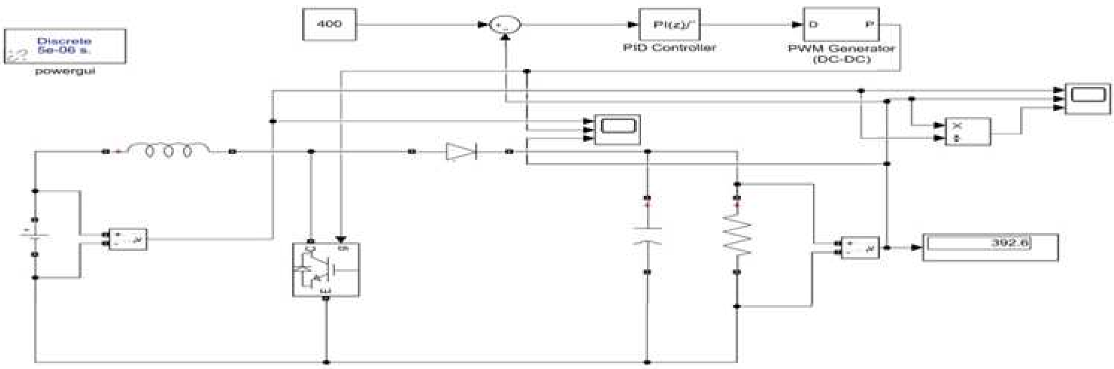

Figure 2: Boost Converter Stimulation Diagram.

Output power Equals input power (Pin) (Pout) It follows that the output current in a boost converter is lower than the input current because Vin V out. Consequently, Vin Vout and Iin > Iout in boost converter Principle of Boost converter operation The inductor in the input circuit resists abrupt changes in input current, which is how boost converters function. The inductor accumulates magnetic energy when the switch is OFF and releases it when the switch is ON.

Single Switches Cascade Converter

In Fig. 2.7, the SSCC circuit is depicted. The switching elements S, the diodes D1, D2, and D3, the input and output inductors L1 and L2, the capacitor C1's energy storage elements, and the output capacitors CO make up this circuit. It is expected that the L1 input inductance is sufficiently large to ensure continuous input current iL1. Due to the size of capacitors C1 and CO and the assumption that the VIN voltage is constant for one switching cycle. L2-CCM is used to denote the mode of operation when the iL2 inductor current is operating in continuous conduction mode (CCM), and L2-DCM is used when the iL2 is operating in discontinuous conduction mode (DCM).

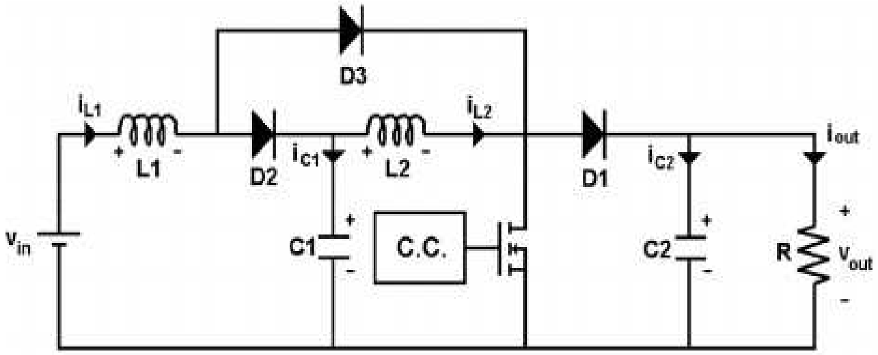

Figure 3: The Topology of Single Cascaded Converter.

Figure 3 depicts the SSCC circuit with the simulation node. The circuit in concern has seven nodes. Node 1 is connected to the source of the input voltage, node 4 is the output of the converter, and node 6 is the MOSFET M switching frequency connection point. The SSCC component values are displayed in Table 3.3. This figure was derived from earlier research.

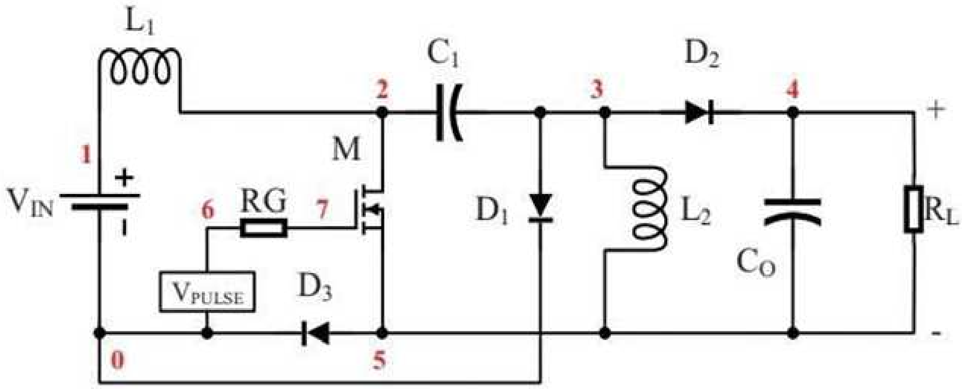

Figure 4: SSCC Block Diagram Simulation.

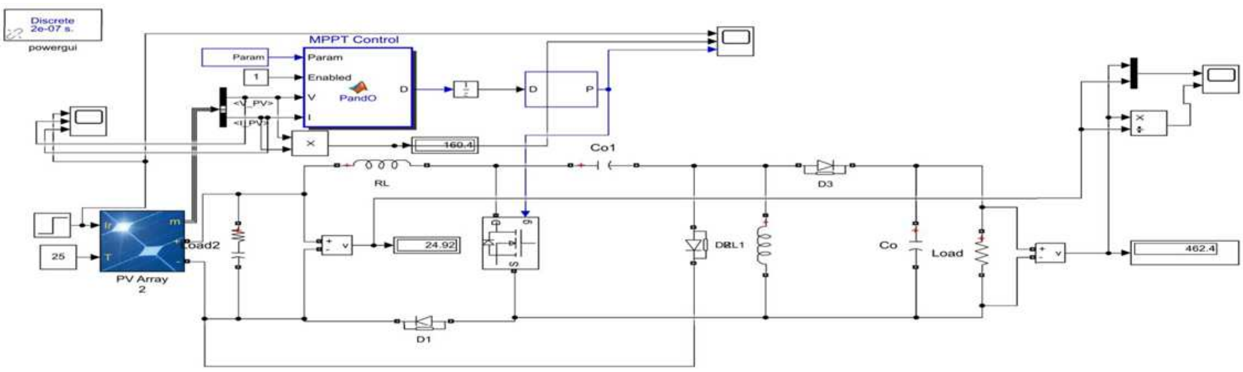

Figure 5: SSCC Simulation Diagram.

OUTPUT

Boost Converter

In boost converter only have 1.4 gains but it not suitable for solar panel applications when we use this type of converters in solar panel the initial cost of solar panel is increases.

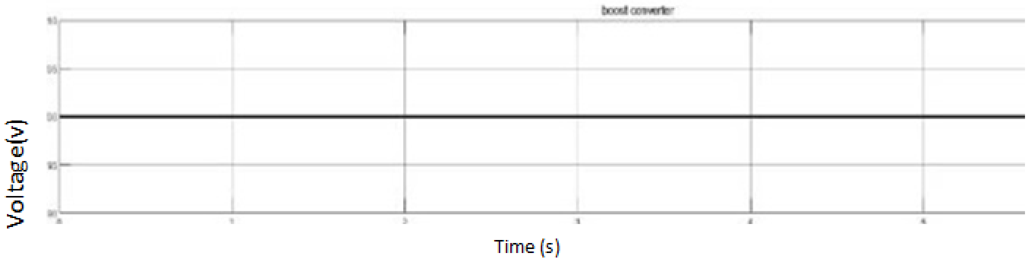

Figure 6: Input Wave Form of Boost Converter.

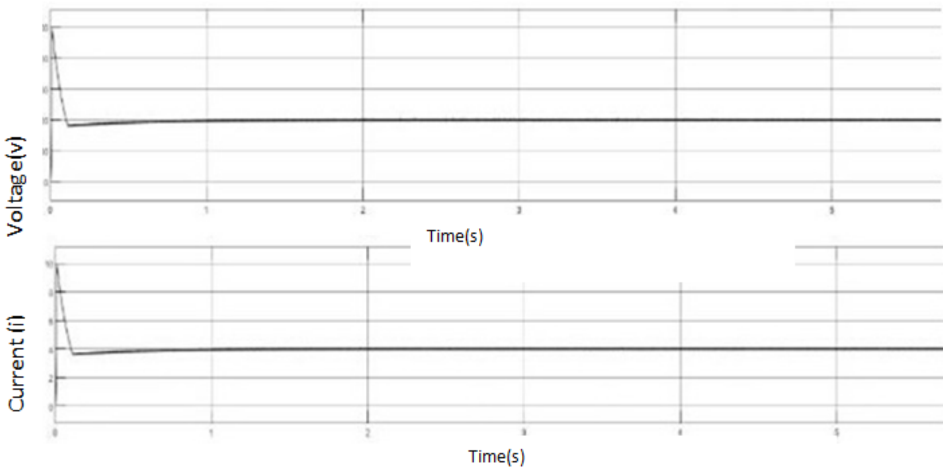

Figure 7: Output Wave Form of Boost Converter.

Single Switched Cascaded Converter

This is the most effective controller used in solar panels because it's voltage gain is around 20 so this converter more better. By using this converter we can reduce number of panels with maintain the output with constant voltage.

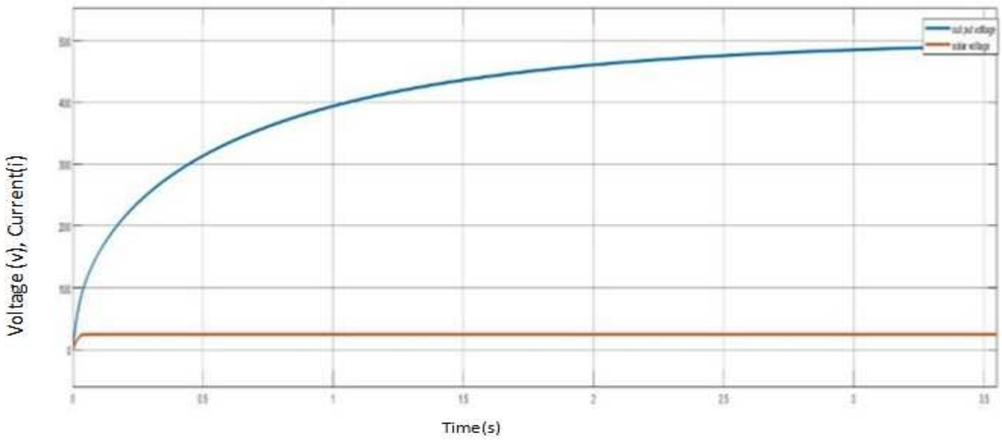

Figure 8: Input Wave Form of Single Switched Cascaded Converter.

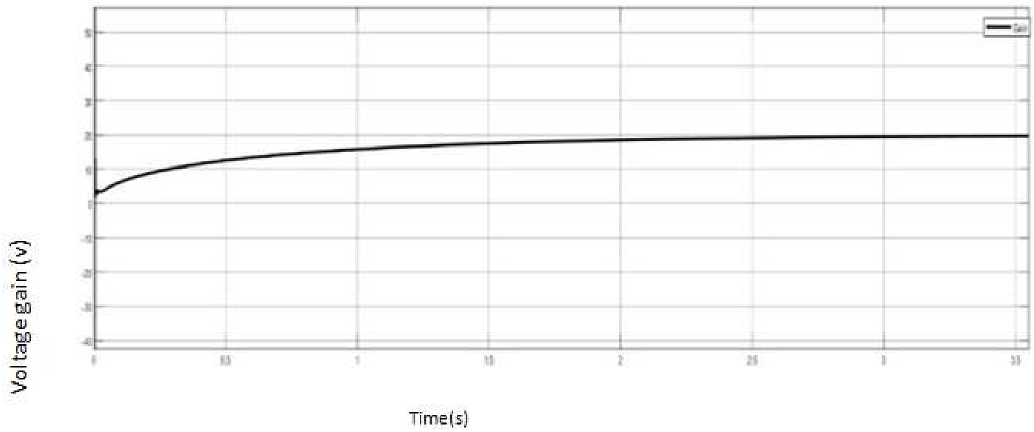

Figure 9: Output Voltage Gain Wave Form of Single Switched Cascaded Converter.

RESULT AND DISCUSSION

Comparison of Converter Gain

Here we are comparing the boost converter and single switched cascaded converter first comparing voltage gain, input and out put voltage of these converters.

Boost Converter

In boost converter only have 1.4 gain but it not suitable for solar panel applications when we use this type of converters in solar panel the initial cost of solar panel is increases.

Single Switched Cascaded Converter

This is the most effective controller used in solar panels because it's voltage gain is around 20 so this converter more better. By using this converter we can reduce number of panels with maintain the out put with constant voltage.

CONCLUSION

The largest simulation scenario uses a load resistance of 1 KOhm; the higher the resistance value, the higher the output voltage. In each converter, there is a variable effective switching frequency. In SSCC, QBC, and DCBC, the lowest frequency value is 1 KHz, while in MLBC, the highest frequency value is 100 KHz. The converter under test is capable of generating voltage gains ranging from 1.4 times at the BC, which has an output of 42 V, to 32.96 times at the SSCC, which has an output of 988.8 V. Since it has the maximum voltage gain of 32.96 times with an output voltage of 988.8 V at the lowest switching frequency of 1KHz and uses the fewest amount of components when compared to other boost converter types, the Single Switch Cascaded Converter is the most ideal type of boost converter.

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