A SINGLE INPUT MULTI OUTPUT INTERLEAVED DC-DC BUCK BOOST CONVERTER

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Abstract

In this work, the operation of a microgrid-based dc grid-based wind power production system was detailed. The suggested fix gets rid of the need for frequency and voltage synchronisation, allowing wind turbines to run in parallel. Here, an ANN (Artificial Neural Networks) control technique is presented for controlling the system's reactive and actual power as well as the inverter's o/p frequency and voltage. In order to control frequency, load, and damage detection in power networks, ANN was a non-linear framework. In this system, the microgrid oscillations are controlled by using ANN to deliver continuous controlled power with quick frequency responsiveness. Numerical simulations and a number of test scenarios have been used to validate this idea. Following an explanation of the proposed converters' operating modes, a thorough steady-state and dynamic modelling was done.

INTRODUCTION

In present day world, interleaveddc-dc converters are an essential part in the field of power electronics. They are used for matching of two different levels of voltage, prevention of noise propagation, regulation of a power bus voltage and power supply applications etc. Researchers are trying to increase the efficiency of these converters, keeping the power density high in a simple structure with low cost.[1-3]The Interleaved Boost converter is the most widely used converter for a wide range of applications. Even though the theoretical gain of the ideal Boost converter can reach up to infinite value with the increase in the operating duty cycle, but the presence of the parasitic makes it really difficult to reach up to a voltage gain. At the same time, the efficiency of the power conversion also drops down with the increase of the voltage gain. [4]Hence, for the voltage Boosting application, if we go for cascading of the converters, then the overall system efficiency will drop down in geometric progression. Moreover, the topologies having transformers also have a disadvantage due to the poor efficiency of the transformer. Under these circumstances, the intention would be to add the output voltage of two converters to get an overall higher voltage.

A novel soft-switching high-frequency (HF) resonant (HF-R) inverter for induction heating (IH) applications is presented in this paper.[5] By adopting the current phasor control of changing a phase shift (PS) angle between two half-bridge inverter units, the IH load resonant current can be regulated continuously under the condition of wide range soft-switching operations. [6]In addition to this, the dual mode power regulation scheme based PS angle control & asymmetrical pulse-width modulation (PWM) in one inverter unit is proposed for improving the efficiency in low output power settings. The essential performances on the output power regulation and soft-switching operations are demonstrated in an experiment using its 1kW- 60 kHz HF-R inverter prototype, then the topological validity is evaluated from a practical point of view.

[7]This project proposes a unique topology of voltage fed high frequency series load resonant inverter with a lossless snubber capacitor and an auxiliary switched cell for induction heating appliances.

Fuel cell–powered electric vehicles (FCPEV) require an energy storage device to start up the fuel cells and to store the energy captured during regenerative braking. Low-voltage (12 V) batteries are preferred as the storage device to maintain compatibility with the majority of today's automobile loads. [8]A dc/dc converter is therefore needed to interface the low-voltage batteries with the fuel cell–powered higher-voltage dc bus system (255 V ~ 425 V), transferring energy in either direction as required.

3. SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

A new two-input and multi-output interleaved DC_DC boost converter is proposed. This converter is a high gain and non-isolated boost converter, which can be used in satellites power system. This converter has several dc links with different gains in the output to feed other satellite subsystems. This converter is an interleaved boost converter, so it performs better than the conventional converters.

The main tasks of this converter in the subsystem of satellite energy supply are maximum power points tracking (MPPT), battery charging and line dc voltage regulation. Normally, three separate converters are required to provide these tasks. By increasing the power electronic devices, the volume and weight of the satellite will go up.

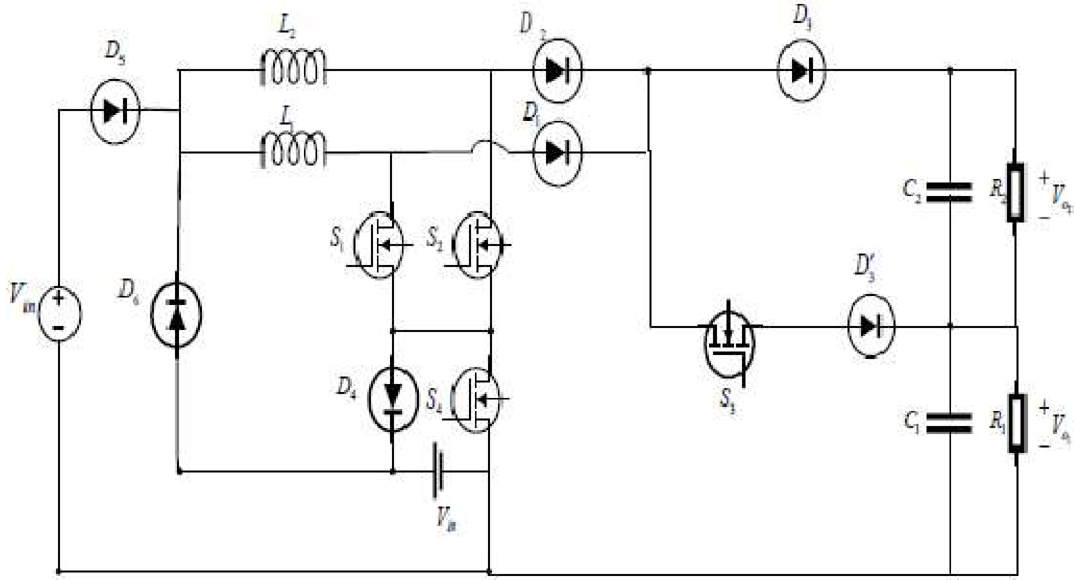

Figure 3.1 Circuit Diagram of Existing System

This is not desirable, therefore, must use a comprehensive circuit to perform the three above tasks at the same time. The proposed converter has an integrated structure with only four switches that controlled by different duty cycles. Also this converter has a uni-directional input for connecting the solar array and a bi-directional input for connecting the battery.

Based on charging or discharging state of the battery, three operation modes are defined for this converter. One of the prominent features of the proposed converter is the battery bases grounded, so the noise cannot damage the battery and so on increase the useful life of battery. Theoretical analysis of the proposed converter is verified by simulation results for different operation conditions.

3.1.1 Existing System Drawback

1. They are physically larger for the same capacitance and working voltage as other types.
2. They have a higher leakage current than most other types.
3. They are not very good for low frequency applications.
4. They can only be mounted vertically because of the liquid electrolyte inside them.

3.2 PROPOSED SYSTEM

The Interleaved Boost converter is the most widely used converter for a wide range of applications. Even though the theoretical gain of the ideal Boost converter can reach up to infinite value with the increase in the operating duty cycle, but the presence of the parasitic makes it really difficult to reach up to a voltage gain.

At the same time, the efficiency of the power conversion also drops down with the increase of the voltage gain. Hence, for the voltage Boosting application, if we go for cascading of the converters, then the overall system efficiency will drop down in geometric progression.

3.3PROPOSED SYSTEM BLOCK DIAGRAM

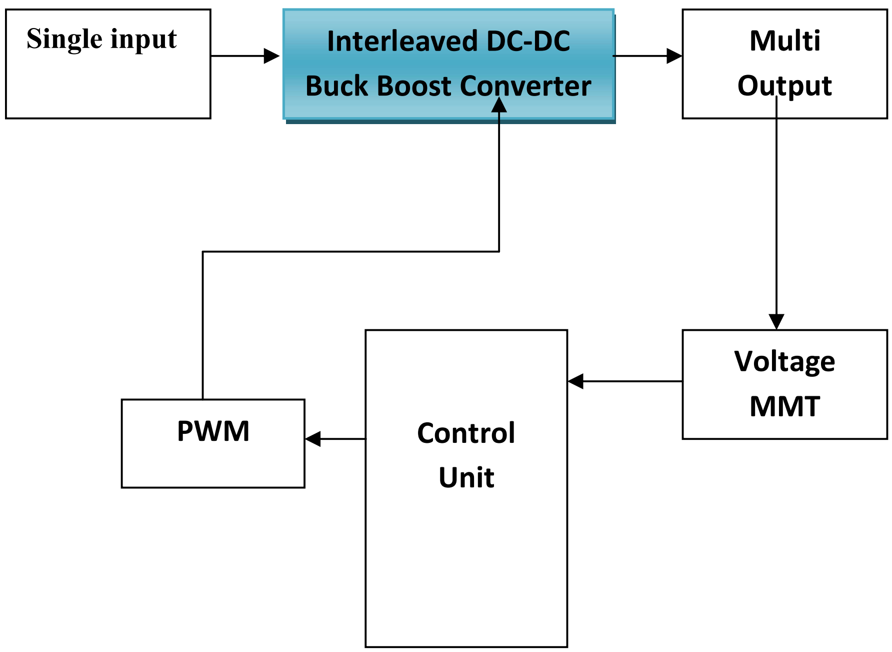

Figure 3.2 Block Diagram of Proposed System

3.4BLOCK DESCRIPTION

3.4.1 Interleaved Boost Converter

The interleaved boost converter, it operates depending upon the Interleaving property. The circuit contains two boost converters in parallel operating 180° out of phase. The inductor‘s ripple currents are out of phase, so They tend to cancel each other and reduce the input ripple current caused by the boost switching action. The input current is the sum of the two inductor currents ILB1 and ILB2. Moreover, the effective switching frequency is increased by switching 180° out of phase and introduces smaller input current ripples. So the EMI filters in the input side will be smaller.

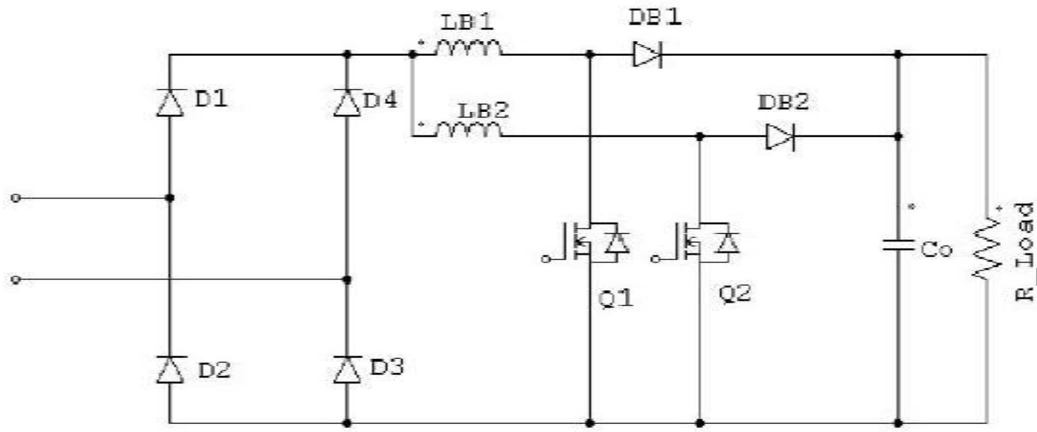

Figure 3.3 Circuit Diagram of Interleaved Boost converter

3.5 DC TO DC CONVERTERS

DC to DC converters are important in portable electronic devices such as cellular phones and laptop computers, which are supplied with power from batteries primarily.

Such electronic devices often contain several sub-circuits, each with its own voltage level requirement different from that supplied by the battery or an external supply (sometimes higher or lower than the supply voltage). Additionally, the battery voltage declines as its stored power is drained. Switched DC to DC converters offer a method to increase voltage from a partially lowered battery voltage thereby saving space instead of using multiple batteries to accomplish the same thing.

Most DC to DC converters also regulate the output voltage. Some exceptions include high-efficiency LED power sources, which are a kind of DC to DC converter that regulates the current through the LEDs, and simple charge pumps which double or triple the input voltage.

3.6 BUCK CONVERTER

A buck converter is a step-down DC to DC converter. Its design is similar to the step-up boost converter, and like the boost converter it is a switched-mode power supply that uses two switches (a transistor and a diode), an inductor and a capacitor.

The simplest way to reduce a DC voltage is to use a voltage divider circuit, but voltage dividers waste energy, since they operate by bleeding off excess power as heat; also, output voltage isn't regulated (varies with input voltage). Buck converters, on the other hand, can be remarkably efficient (easily up to 95% for integrated circuits) and self-regulating, making them useful for tasks such as converting the 12–24 V typical battery voltage in a laptop down to the few volts needed by the processor.

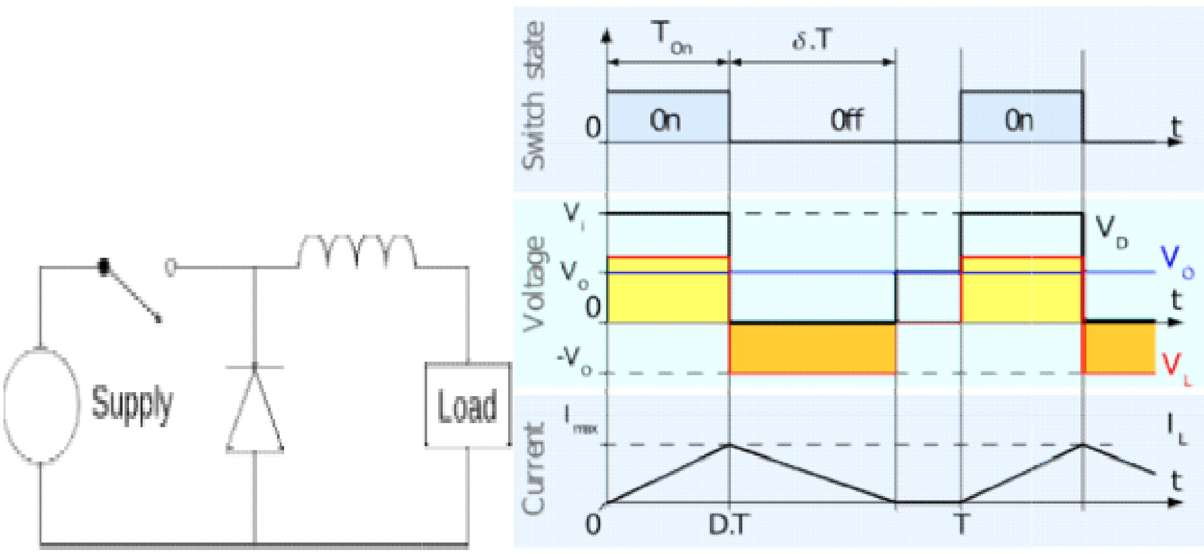

Figure 3.4 Circuit Diagram of Buck Converter With Model Output

3.7 BOOST CONVERTER

A boost converter (step-up converter) is a power converter with an output DC voltage greater than its input DC voltage. It is a class of switching-mode power supply (SMPS) containing at least two semiconductor switches (a diode and a transistor) and at least one energy storage element. Filters made of capacitors (sometimes in combination with inductors) are normally added to the output of the converter to reduce output voltage ripple.

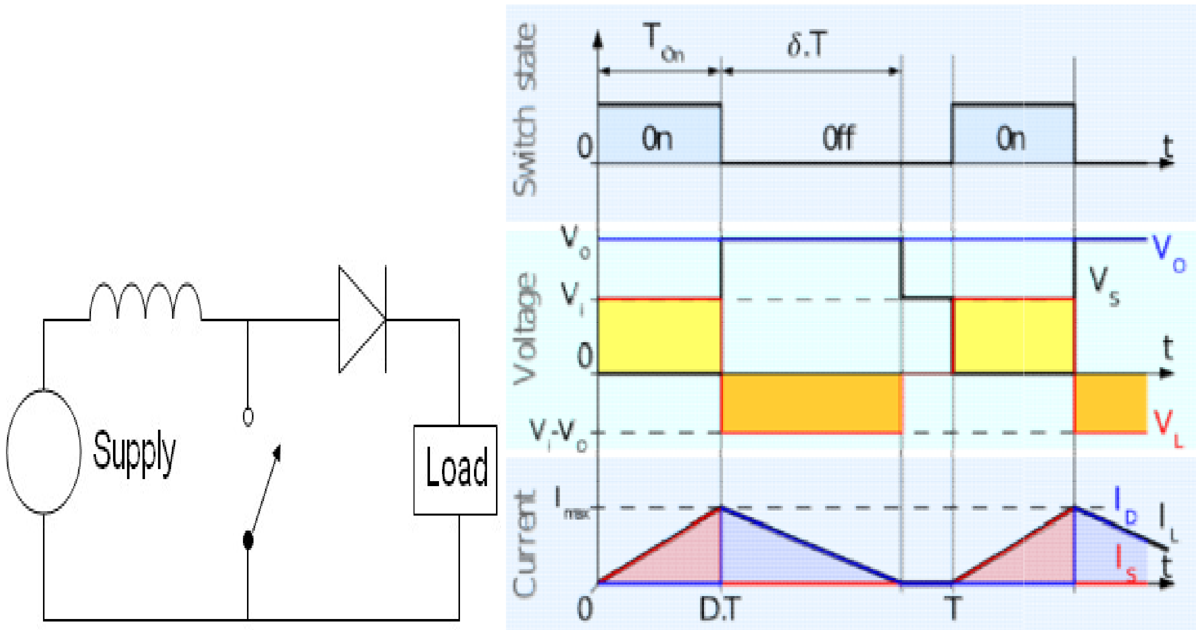

Figure 3.5 Circuit Diagram of Boost Converter With Model Output

Continuous Current Mode - Current and thus the magnetic field in the inductive energy storage never reach zero.

Discontinuous Current Mode - Current and thus the magnetic field in the inductive energy storage may reach or cross zero.

Noise - Since all properly designed DC-to-DC converters are completely inaudible, "noise" in discussing them always refers to unwanted electrical and electromagnetic signal noise.

RF noise - Switching converters inherently emit radio waves at the switching frequency and its harmonics. Switching converters that produce triangular switching current, such as the Split-Pi or Ćuk converter in continuous current mode, produce less harmonic noise than other switching converters.[1] Linear converters produce practically no RF noise. Too much RF noise causes electromagnetic interference (EMI).

Input noise - If the converter loads the input with sharp load edges. Electrical noise can be emitted from the supplying power lines as RF noise. Which should be prevented with proper filtering in the input stage of the converter.

Output noise - The output of a DC-to-DC converter is designed to have a flat, constant output voltage. Unfortunately, all real DC-to-DC converters produce an output that constantly varies up and down from the nominal designed output voltage. This varying voltage on the output is the output noise.

All DC-to-DC converters, including linear regulators, have some thermal output noise. Switching converters have, in addition, switching noise at the switching frequency and its harmonics. Some sensitive radio frequency and analog circuits require a power supply with so little noise that it can only be provided by a linear regulator. Many analog circuits require a power supply with relatively low noise, but can tolerate some of the less-noisy switching converters.

RESULT AND DISCUSSION

SIMULATION DIAGRAM

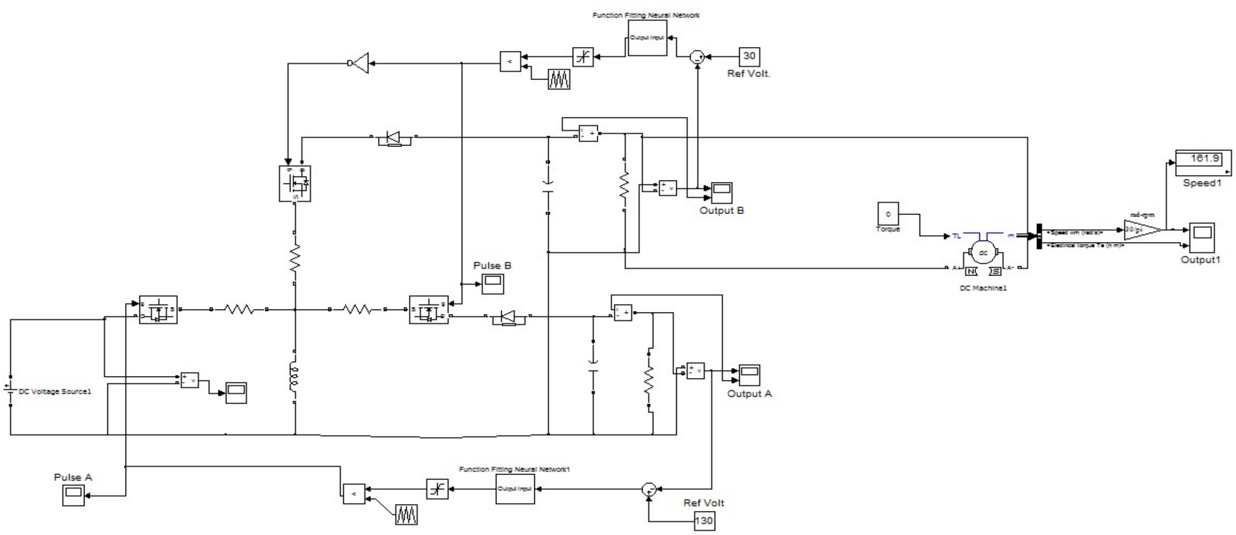

Figure 6.1 Simulation Diagram

6.1 SIMULATION RESULT

6.1.1 Input Voltage

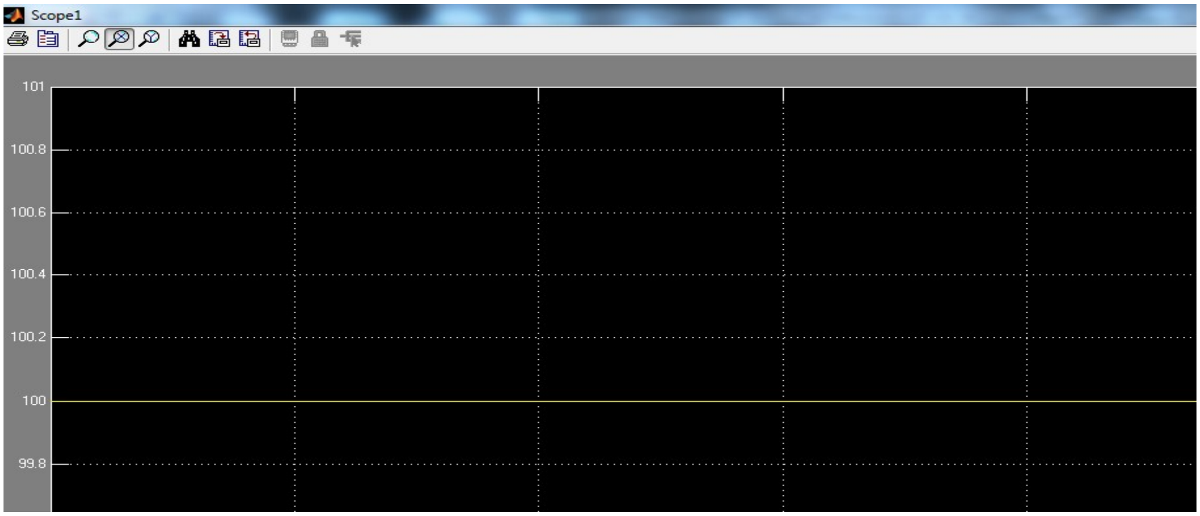

Figure 6.2 Input Voltage

6.1.2 Output Voltage (Boost)

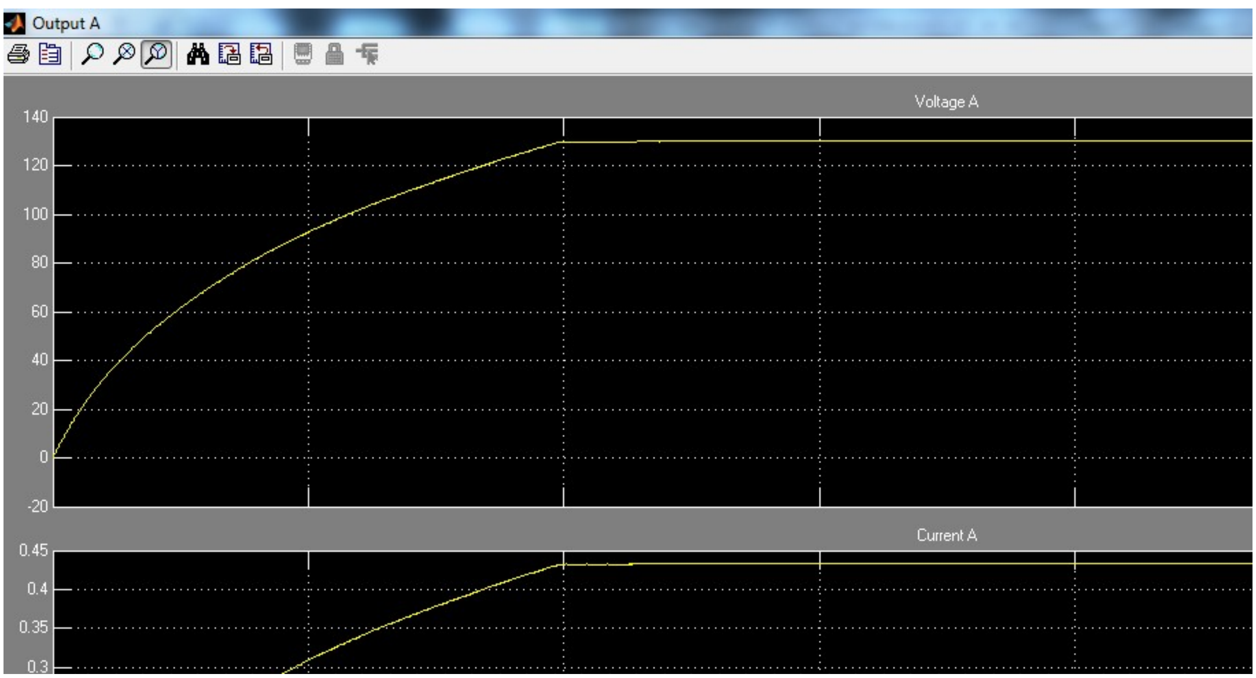

Figure 6.3 Output Voltage (Boost)

6.1.3 Output Voltage (Buck)

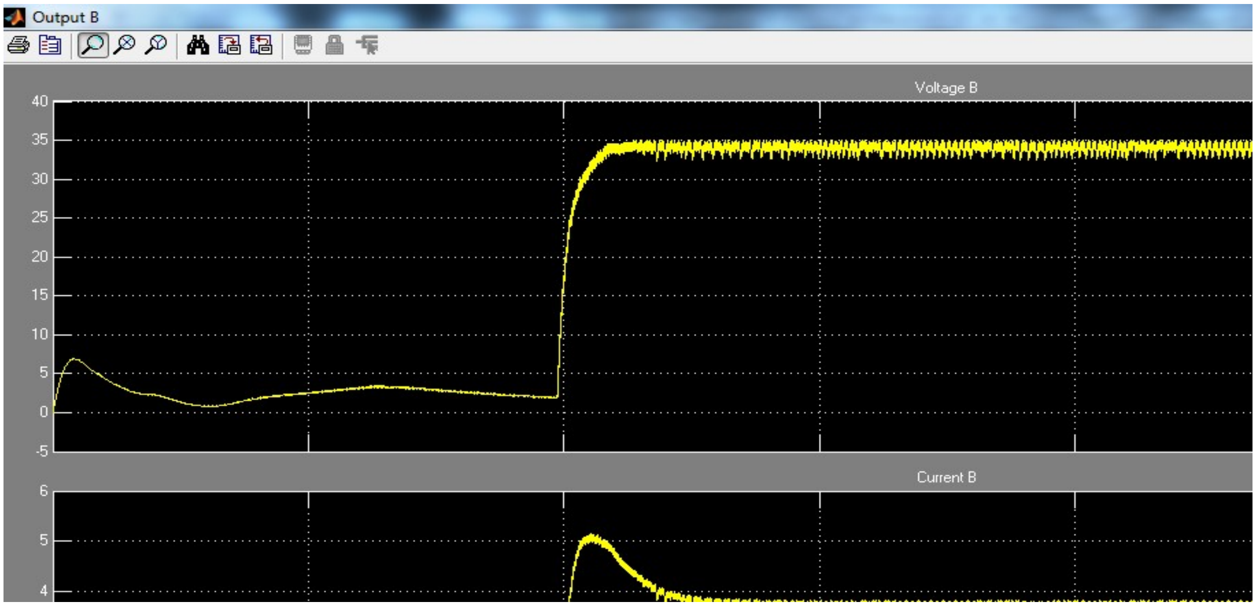

Figure 6.4 Output Voltage (Buck)

- The interleaved boost converter has several advantages in renewable source and power factor correction applications.

CONCLUSION

The topology proposed in this project combines the advantages of both the interleaved boost converters. In this topology, both the interleaved Boost converters share the same source, inductor, and switch. Hence, it makes the system more compact. Individual converter outputs can also be used in specific applications. Moreover, we can take an output whose value is higher than the value of the Boost converter. If we use two separate modules of the input side inductor and the switch, then two independently controllable output voltages can be generated from the same input source (single input multiple output converters). The load can be connected across the terminals of which the voltage is the summation of the voltages of the individual converters. Moreover, if we provide 180-degree phase delay between the gate pulses of the two switches, then the net ripple which appears in the input source current is reduced rustically which will improve MPPT efficiency of sauces connected as the input for this kind of systems.

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