Design of Non Isolated Converters for Voltage Improvement

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***Abstract*—Recently, there has been a huge rise in the amount of energy that is needed to meet our global business and domestic needs. Getting energy from old-fashioned sources like oil and gas isn't valued these days because they cause a lot of pollution and thermal imbalance. To solve these problems, hybrid green energy is being chosen and studied all over the world as a way to make energy. However, green energy sources do have some problems. For example, photovoltaic systems depend on the temperature and amount of light around them, wind systems have trouble with steady wind speeds, and fuel cells are pricey and not very good at what they do. Also, the energy that comes from green sources keeps changing over time. Inverters, active power filters, voltage regulators, power quality conditioners, and DC-DC converters are some of the power electronic devices that experts use to deal with these problems. When it comes to these power electronics, DC-DC converters are the best at controlling DC voltage and making green energy systems work better. Choosing the right DC-DC converter is an important factor that has a big effect on how well these power systems work generally. Additionally, picking a good DC-DC converter technology and combining it with the right control method is also very important for its optimal performance. This article talks about the features of different types of non-isolated converters, such as buck, boost, buck-boost and Cuk DC-DC converters. The performance factors are looked at using MATLAB Simulink. The parameters settling problem, response time, and complexity are all looked at while integrating with non-isolated DC-DC converters in power systems.**

***Keywords*—Buck,Boost,Buck-boost, Cuk converter**

1. INTRODUCTION

The photovoltaic systems are major contributors in the electrical power. These are utilized effectively with interface to the existing systems through DC-DC converters. The major challenge is to extract power under varying operating conditions which influence the output voltage. The worldwide dc–dc converter market has grown an average of 7.5% in recent years. In addition to its high growth rate, the dc–dc converter market is undergoing drastic changes because of two major trends in the electronics industry: low voltage and high power density. The production of dc–dc converters in the world market is now much higher than that of ac– dc converters. The divided market comprises three sub segments, including low power, medium power, and high power. In recent years, different techniques for multiple dc outputs and different voltage levels have been studied and developed.

2. DC-DC CONVERTER

DC-DC converters are extensively utilized for renewable energy generation applications. However, non-isolated DC-DC converter topologies are more beneficial than the isolated converter topologies.

2.1 BUCK CONVERTER

Buck Converter is a type ofchopper circuitthat is designed to perform step-down conversion of the applied dc input signal. In the case of buck converters, the fixed dc input signal is changed into another dc signal at the output which is of lower value shown in Fig 1.

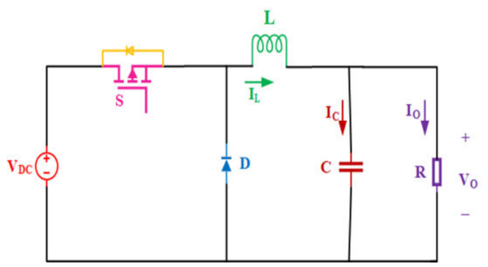

Fig.1: Buck Converter

2.2 BOOST CONVERTER

Boost Converters sometimes, also known as step-up choppers are the type of chopper circuits that provides such an output voltage that is more than the supplied input voltage is shown in Fig 2.

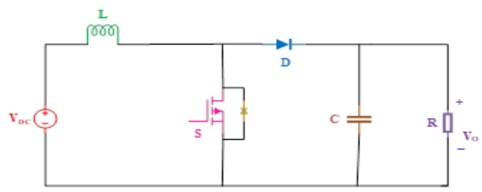

Fig.2: Boost Converter

2.3 BUCK-BOOST CONVERTER

ThebuckboostconverterisDC -DCconverter. The output voltage of the DC-DC converter is less than or greater than the input voltage. The output voltage of the magnitude depends on the duty cycle is shown in Fig 3.

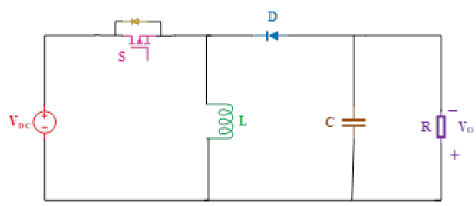

Fig.3: Buck-Boost Converter

2.4 CUK CONVERTER

The Cuk converter (pronounced chook; sometimes incorrectly spelled Cuk, Cuk or Cuk) is a type of DC/DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude is shown in Fig 4.

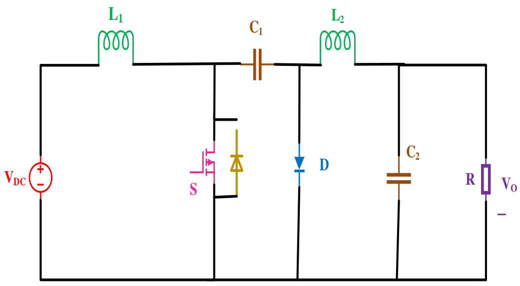

Fig.4: Cuk Converter

3. SIMULATION RESULTS

3.1 Simulation results of buck converter.

The simulation of buck converter is done by using Matlab/Simulink. The simulation diagram for buck converter shown in Fig 5.

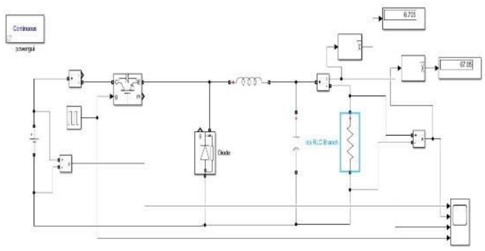

Fig 5. Simulation diagram of buck converter

The parameters of buck converter are shown in table1.

Parameters	value
Input voltage(V_{DC})	200V
Switching frequency(f)	10kHZ
Power	10kW
Inductor(L)	0.839mH
Capacitor(C)	0.8505µF
Resistance (R)	0.7348Ω
Output voltage(V_o)	85.17V
Output current(I_o)	115.9A
Efficiency(η)	99.42%
Duty Cycle	0.45%

Table 1. buck converter parameters

The output voltage and output current of buck converter under 45% duty cycle is representing is shown in Fig 6.

Fig 6. Simulation results of buck converter

3.2 Simulation results of boost converter.

The simulation of boost converter is done by using Matlab/Simulink. The simulation diagram for boost converter shown in Fig 7.

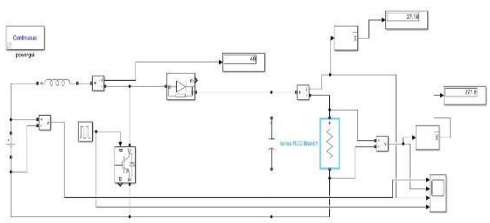

Fig 7. Simulation diagram of boost converter

The parameters of boost converter are shown in table2.

Parameters	value
Input voltage(V_{DC})	200V
Switching frequency(f)	10kHZ
Power	10kW
Inductor(L)	6.0mH
Capacitor(C)	3.5mF
Resistance (R)	12.25Ω
Output voltage(V_o)	349.1V
Output current(I_o)	28.57A
Duty Cycle	0.45
Efficiency(η)	99.1%

Table 2. boost converter parameters

The output voltage and output current of buck converter under 45% duty cycle is representing is shown in Fig 8.

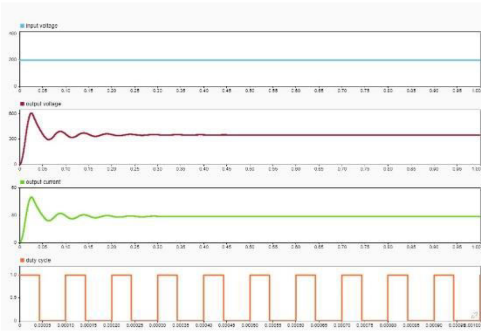

Fig 8. Simulation results of boost converter

3.3 Simulation results of buck-boost converter.

The simulation of buck-boost converter is done by using Matlab/Simulink. The simulation diagram for buck-boost converter shown in Fig 9.

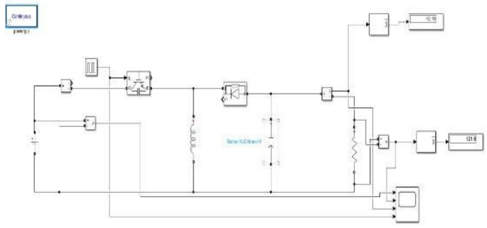

Fig 9. Simulation diagram of buck-boost converter

The parameters of buck-boost converter are shown in table 3.

Parameters	value
Input voltage(V_{DC})	200V
Switching frequency(f)	10kHZ
Power	10kW
Inductor(L)	2.6mH
Capacitor(C)	19mF
Resistance (R)	2.25Ω
Output voltage(V_o)	149.2V
Output current(I_o)	66.28A
Duty cycle	0.45
Efficiency(η)	99.07%

Table3. buck-boost converter parameters

The output voltage and output current of buck converter under 45% duty cycle is representing is shown in Fig 10.

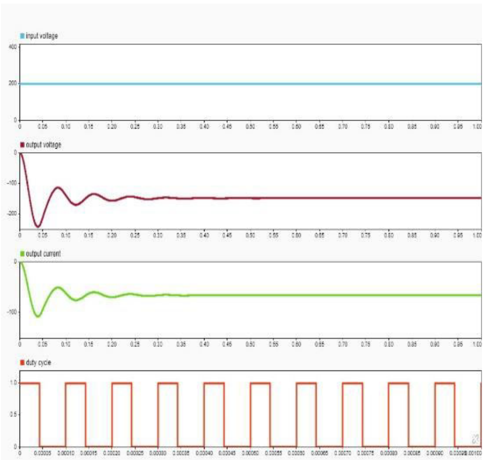

Fig 10. Simulation results of buck-boost converter

3.4 Simulation results of cuk converter

The simulation of cuk converter is done by using Matlab/Simulink. The simulation diagram for cuk converter shown in Fig 11.

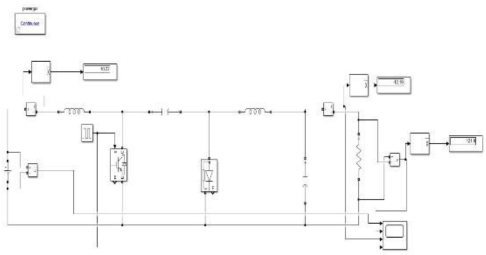

Fig 11. Simulation diagram of cuk converter

The parameters of cuk converter are shown in table 4.

Parameters	value
Input voltage(V_{DC})	200V
Switching frequency(f)	10kHZ
Power	10kW
Inductors(L1,L2)	2.6mH, 2.6mH
Capacitor(C1,C2)	3.8mF, 0.2777mF
Resistance (R)	2.25Ω
Output voltage(V_o)	149.2V
Output current(I_o)	66.28A
Duty cycle	0.45
Efficiency(η)	98.87%

Table 4. cuk converter parameters

The output voltage and output current of cuk converter under 45% duty cycle is representing is shown in Fig 12.

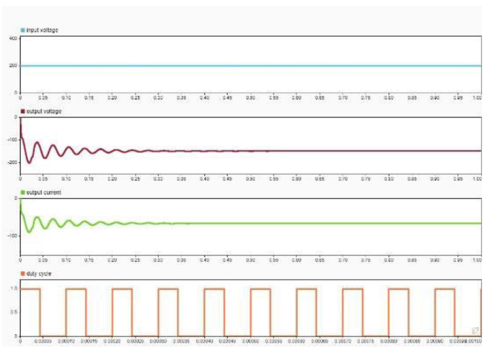

Fig 12. Simulation results of cuk converter

4. CONCLUSION

Non-Isolated DC-DC Converters (buck, boost, buck-boost Cuk converters) are analysed through modelling and simulations. and also observed the efficiency, voltage gain and voltage stress across switches under different duty cycles.

Modelling of Non-Isolated DC-DC Converters i.e. buck, boost, buck-boost and cuk converters are analyzed.

Simulations of these converters under different duty cycles is done also observed the voltage gain, output current and efficiency under different duty cycles.

The design of non-isolated DC-DC converters for renewable energy applications represents a critical step towards achieving a more sustainable energy future. Bycan seamlessly integrate renewable energy sources into the grid while ensuring stable and efficient power delivery. As technology continues to evolve, further advancements in converter design will play a pivotal role in accelerating the transition towards cleaner and more resilient energy systems worldwide.

REFERENCES

[1] Jotham Jeremy L, Ooi CA, Teh J. Non-isolated conventional DC-DC converter comparison for a photovoltaic system: A review. Journal of Renewable

and Sustainable Energy. 2020 Jan 1;12(1).

[2] Mumtaz F, Yahaya NZ, Meraj ST, Singh B, Kannan R, Ibrahim O. Review on non-isolated DC-DC converters and their control techniques for renewable energy applications. Ain Shams Engineering Journal. 2021 Dec 1;12(4):3747-63.

[3] Veerachary M. Fourth-order buck converter for maximum power point tracking applications. IEEE Trans Aerosp Electron Syst2022;47:896–911.

[4] Yang D, et al. One-cycle control for double-input DC/DC converter. IEEE Trans Power Electron 2018:1.

[5] Pernia AM, Jorge A, Prieto MJ, Martı´nez JA. Amodular strategy for isolated photovoltaic systems based on microcontroller. Renew Energy 2019;34:1825–32.

[6] Smrithi R, Venugopal LV, Vanitha M. Hardware implementation of linear current booster for solar pumping applications. ARPN J EngApplSci 2016;11(2), (January).

[7] Taufik AO, Anwari M, Taufik M. Modeling and simulation of photovoltaic water pumping system. Proc Third Asia IntConf Model Simul, AMS '09 2009:497–502.

[8] Kummara VGR, et al. A comprehensive review of DC–DC converter topologies and modulation strategies with recent advances in solar photovoltaic systems 2020;9(1).

[9] DG, Singh SN. Selection of non-isolated DC-DC converters for solar photovoltaic system. Renew Sustain Energy Rev 2017;76 (August 2016):1230–1247