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Non Isolated Dual Input DC-DC Converter

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ABSTRACT:

Electric cars, or EVs, are now the greatest substitute for combustion vehicles that run on fossil fuels. Electric vehicles utilize the electricity generated while parked to recharge their batteries. The PV system wastes its electricity when the battery is completely charged. In typical EVs, the surplus power is sent to the car through a converter to prevent power waste. A new type of non-isolated dual input single output DC-DC converter (DISOC) is presented to accomplish the task. Depending on the PV power availability, battery condition, and EV operating condition, the DISOC structure may operate in six different ways. This project has demonstrated component design, converter operation, and the impact of parasitic components on converter performance. With MATLAB, simulations of the converter's design and control are carried out.

Keywords: - DISOC, Electric Vehicles (EVs),Combustion, fossil fuels, Efficiency and Reliability.

1. Introduction

A power electronic device that combines two separate input voltage sources—usually DC—into the required output voltage is called a non-isolated dual input DC-DC converter. Non-isolated converters share a common ground between their input and output and do not offer electrical isolation, compared to isolated converters that do.

An overview of the main elements and functioning of a non-isolated dual input DC-DC converter is provided below:

- Input Voltage Sources: Two input voltage sources are supported by this converter, as its name implies. The converter is made to effectively use both inputs in order to produce a consistent output, even if these sources may have different voltages.
- Control Circuitry: Control Circuitry: In order to regulate the conversion process, control circuitry is needed. It keeps an eye on the input voltages and modifies the converter's switching to keep the output voltage steady despite variations in the load or input source disturbances.
- Power Switches: These switches, often implemented using MOSFETs or IGBTs, control the flow of power through the converter. They are switched on and off rapidly to control the voltage transformation process efficiently.
- Inductors and Capacitors: These components are used to store and manage energy within the converter. Inductors smooth out the current flow, while capacitors help stabilize the output voltage.
- Output Voltage Regulation: The converter's output voltage is controlled to ensure that it satisfies the load's specifications. With the help of this regulation, the output voltage is guaranteed to stay constant regardless of changes in the load or input voltage fluctuations.
- Efficiency Considerations: Efficiency is a critical factor in the design of DC-DC converters. Non-isolated dual input converters aim to maximize efficiency by minimizing energy losses during the conversion process. This involves careful selection of components and optimization of control algorithms. Applications of non-isolated dual input DC-DC converters include automotive systems, renewable energy systems (where multiple input sources such as solar panels and batteries are common), and various portable electronic devices where power can be supplied from multiple sources. Overall, these converters play a crucial role in efficiently managing power from multiple sources and delivering it to the load in a stable and reliable manner.

2. Literature Survey

A novel DC–DC step-up converter with several inputs for hybrid energy systems. When attempting to integrate electricity from several sources, such as solar and wind, the control algorithm may become more intricate. Due of its complexity, the system may have trouble being stable and effective, particularly when handling various circumstances [1]. Single-inductor DC/DC converter that is not isolated and has a fully reconfigurable structure for use in renewable energy applications. This concept may result in more voltage fluctuations, inadequate safety isolation between the input and the output, the need for intricate control systems that could be difficult to implement and expensive, and it might not always be effective[2]. DC/DC converter for solar power generating systems that is non-isolated and has several inputs but only one output. The authors of this proposal provide buck-boost and boost procedures. This method's primary drawback is that bidirectional rear buck operation is not provided[3]. One-Cycle Control for a Double-Input DC/DC Converter. Various operating situations provide challenges to maintaining stability and performance, which might result in dependability difficulties in real-world applications [4]. For hybrid energy systems, the complexity of the multiple-input DC/DC converter architecture is a disadvantage. These systems use batteries, wind turbines, and solar panels among other energy sources. It is necessary to manage many voltages and power levels concurrently when using a multiple-input converter. Due to its complexity, the converter may be more difficult to build and regulate, which might lead to increased costs and decreased dependability [5]. Complexity is a problem for bidirectional non-isolated multi-input DC-DC converters used in hybrid energy storage systems in electric cars. These converters have to manage a variety of energy sources with different voltage and power profiles, such batteries and regenerative braking systems. The design and management of the converter are made more difficult when managing several inputs at once, which might lead to higher costs and lower dependability [6]. Multiple-input DC-DC converter topology's complexity is one of its drawbacks. Different energy sources, such solar panels and batteries, each with varying voltage and power levels, must be handled by these converters. The difficulty of developing and regulating the converter rises when these several inputs are managed at the same time, which might lead to higher costs and decreased dependability [7]. Complexity is a drawback of the new modular multiple-input bidirectional DC-DC power converter (MIPC) for use in fuel cell and hybrid electric vehicle (HEV) applications. Numerous energy sources, including fuel cells and batteries, which may have varying voltage and power characteristics, must be handled by this converter. The difficulty of developing and regulating the converter rises when many different inputs are managed concurrently, which might result in increased costs and decreased dependability [8].

3.Methdology

DISOC, a revolutionary DC-DC converter that can integrate two input energy sources, is the main objective of this research. Several essential characteristics define the DISOC. It uses a front-end converter configuration with a diode, two relays, and two semiconductor switches. This setup guarantees the converter will continue to work even in the event that one of the input sources isn't accessible. The converter also makes it easier for the input sources to operate in cascade, which raises the output voltage, by turning on switch S2. By appropriate control of the IGBTs, the DISOC performs six types of operation. The type of operation is decided based on the state of charge (SOC) of the battery, the irradiance of solar PV, and status of the EV.

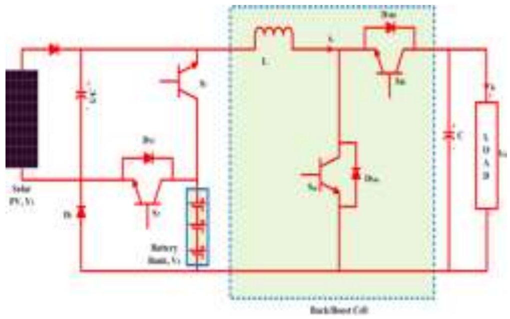

Figure 3.1 DISOC Configuration

The converter uses a single inductor to perform the following six types of operation.

- Combinational boost operation (C-boost).
- Battery powered operation.
- Solar PV-powered operation.
- Battery charging from solar PV in parking mode.
- Power flow from V2V or V2G in parking mode.
- Bidirectional rear-buck operation

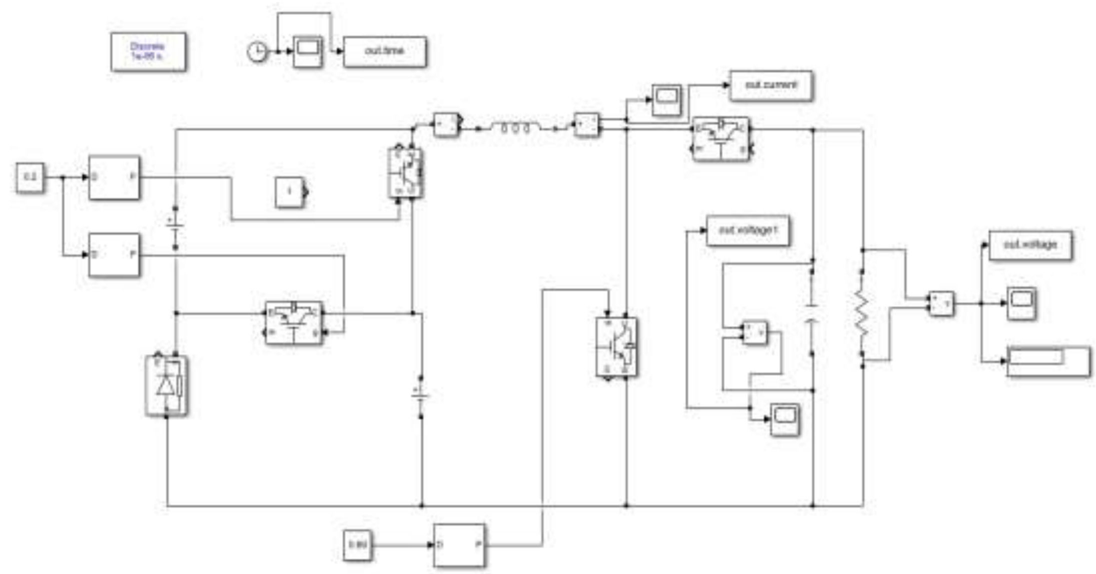

Figure 3.2 Open loop circuit

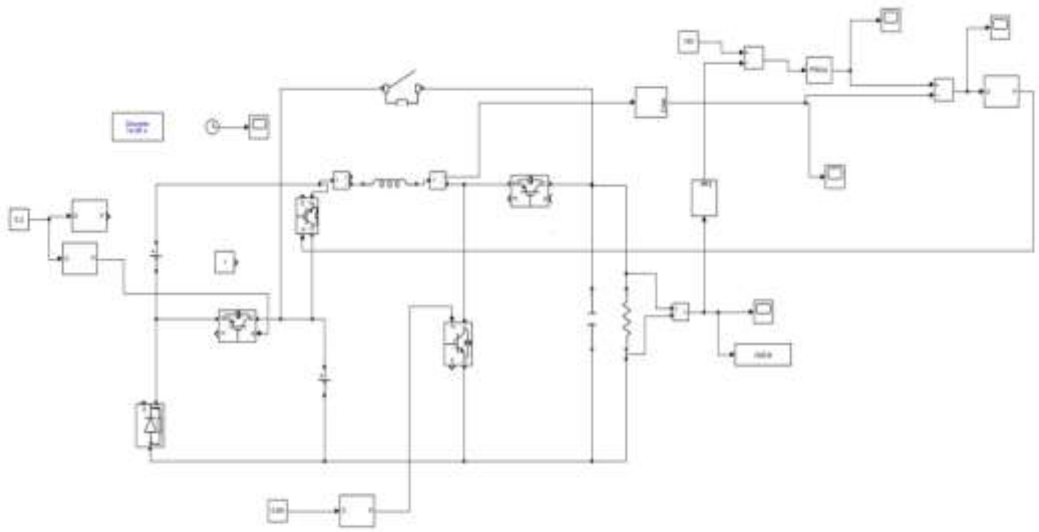

Figure 3.3 Closed loop circuit

4 Result and Discussions

The resultant graphs for a non-isolated dual input DC-DC converter encompass critical performance metrics including output voltage, current through inductor and voltage across the capacitor in open loop mode of operation. These graphs provide comprehensive insights into the converter's behaviour under diverse operating conditions, aiding in optimization efforts, reliability assessment, and selection of appropriate components and parameters for specific application requirements. The following are the resultant graphs obtained from open loop mode operation

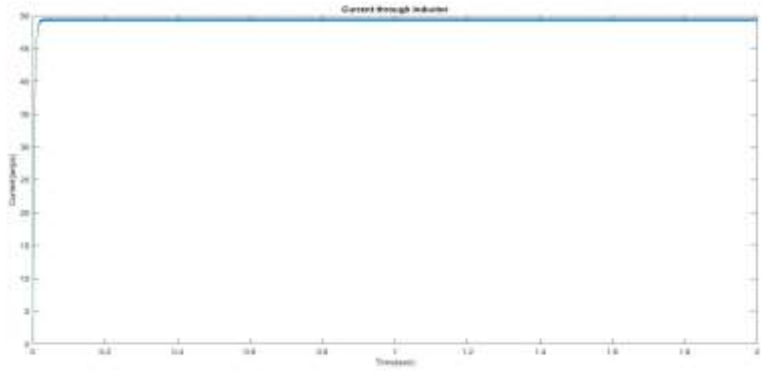

Figure 4.1 Current through inductor in open loop circuit

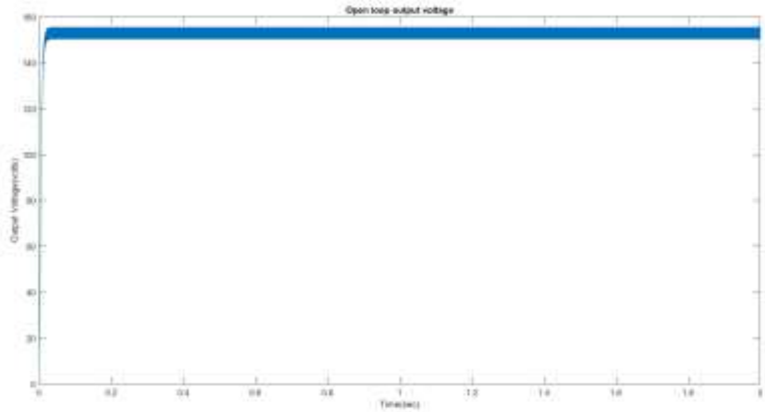

Figure 4.2 Open loop output voltage

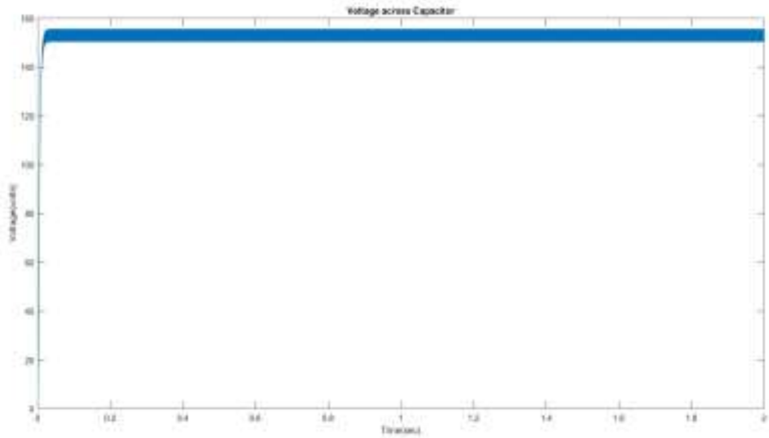

Figure 4.3 Voltage across capacitor in open loop circuit

The following graphs including output voltage, current through inductor and voltage across the capacitor in closed loop mode of operation:

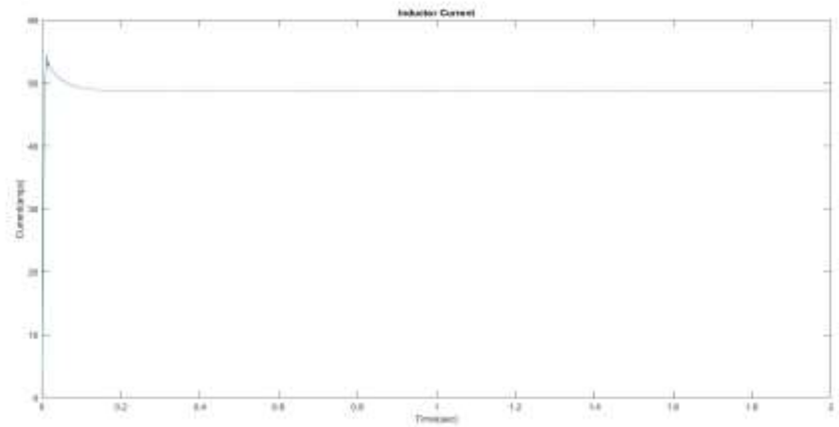

Figure 4.4 Current through inductor in closed loop circuit

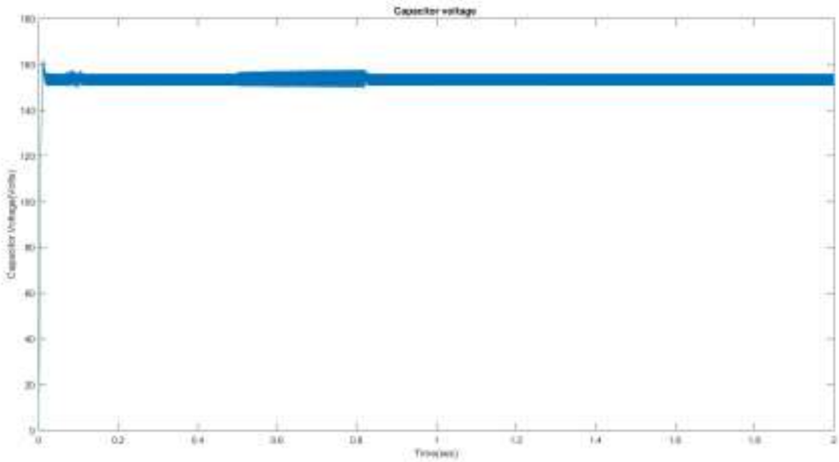

Figure 4.5 Voltage across Capacitor in closed loop circuit

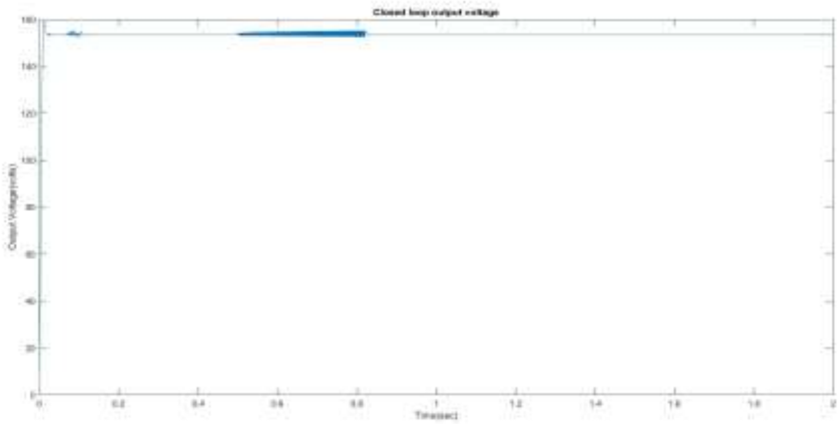

Figure 4.6 Closed loop output voltage

5 Conclusion

The DISOC (Dual Input Single Output) converter topology is recommended in order to effectively employ both energy sources and integrate two input sources, such as solar PV and battery power. With six different working modes, this converter enables efficient power regulation and transmission between the two input sources. To gain a complete understanding of the converter's behavior, analytical waveforms for each of the operation modes are described along with related output voltage formulae. Furthermore, a comprehensive voltage and current stress analysis is carried out during the component design phase of the DISO converter to guarantee peak performance and dependability. Through meticulous engineering and component analysis, the converter can efficiently harvest energy from solar photovoltaic and battery sources, meeting a variety of energy availability and demand scenarios.

References

[1] Deihimi A, Mahmoodieh ME, Iravani R. A new multi-input step-up DC–DC converter for hybrid energy systems. Electric Power Systems Research. 2017

[2] Cheng T, Lu DD, Qin L. Non-isolated single-inductor DC/DC converter with fully reconfigurable structure for renewable energy applications. IEEE Transactions on Circuits and Systems II: Express Briefs. 2017 Jun 6;65(3):351-5.

[3] Banaei MR, Ardi H, Alizadeh R, Farakhor A. Non-isolated multi-input–single-output DC/DC converter for photovoltaic power generation systems. IET Power Electronics. 2014 Nov;7(11):2806-16.

[4] Yang D, Yang M, Ruan X. One-cycle control for a double-input DC/DC converter. IEEE Transactions on Power Electronics. 2011 Aug 18;27(11):4646-55.

[5] Kumar L, Jain S. Multiple-input DC/DC converter topology for hybrid energy system. IET Power Electronics. 2013 Sep;6(8):1483-501.

[6] Akar F, Tavlasoglu Y, Ugur E, Vural B, Aksoy I. A bidirectional nonisolated multi-input DC–DC converter for hybrid energy storage systems in electric vehicles. IEEE Transactions on Vehicular Technology. 2015 Nov 13;65(10):7944-55.

[7] Khaligh A, Cao J, Lee YJ. A multiple-input DC–DC converter topology. IEEE Transactions on power electronics. 2009 Jan 23;24(3):862-8.

[8] Hintz A, Prasanna UR, Rajashekara K. Novel modular multiple-input bidirectional DC–DC power converter (MIPC) for HEV/FCV application. IEEE Transactions on Industrial Electronics. 2014 Dec 2;62(5):3163-72.

[9] Srun C, Samman FA, Sadjad RS. A high voltage gain DC-DC converter design based on charge pump circuit configuration with a voltage controller. In2018 2nd International Conference on Applied Electromagnetic Technology (AEMT) 2018 Apr 9 (pp. 79-84). IEEE.

[10] Lai CM, Cheng YH, Hsieh MH, Lin YC. Development of a bidirectional DC/DC converter with dual-battery energy storage for hybrid electric vehicle system. IEEE Transactions on Vehicular Technology. 2017 Oct 16;67(2):1036-52.

[11] Cheng T, Lu DD, Qin L. Non-isolated single-inductor DC/DC converter with fully reconfigurable structure for renewable energy applications. IEEE Transactions on Circuits and Systems II: Express Briefs. 2017 Jun 6;65(3):351-5.

[12] Santhosh TK, Govindaraju C. Dual input dual output power converter with one-step-ahead control for hybrid electric vehicle applications. IET Electrical Systems in Transportation. 2017 Sep;7(3):190-200.

[13] Haghighian SK, Tohidi S, Feyzi MR, Sabahi M. Design and analysis of a novel SEPIC-based multi-input DC/DC converter. IET Power Electronics. 2017 Oct;10(12):1393-402.