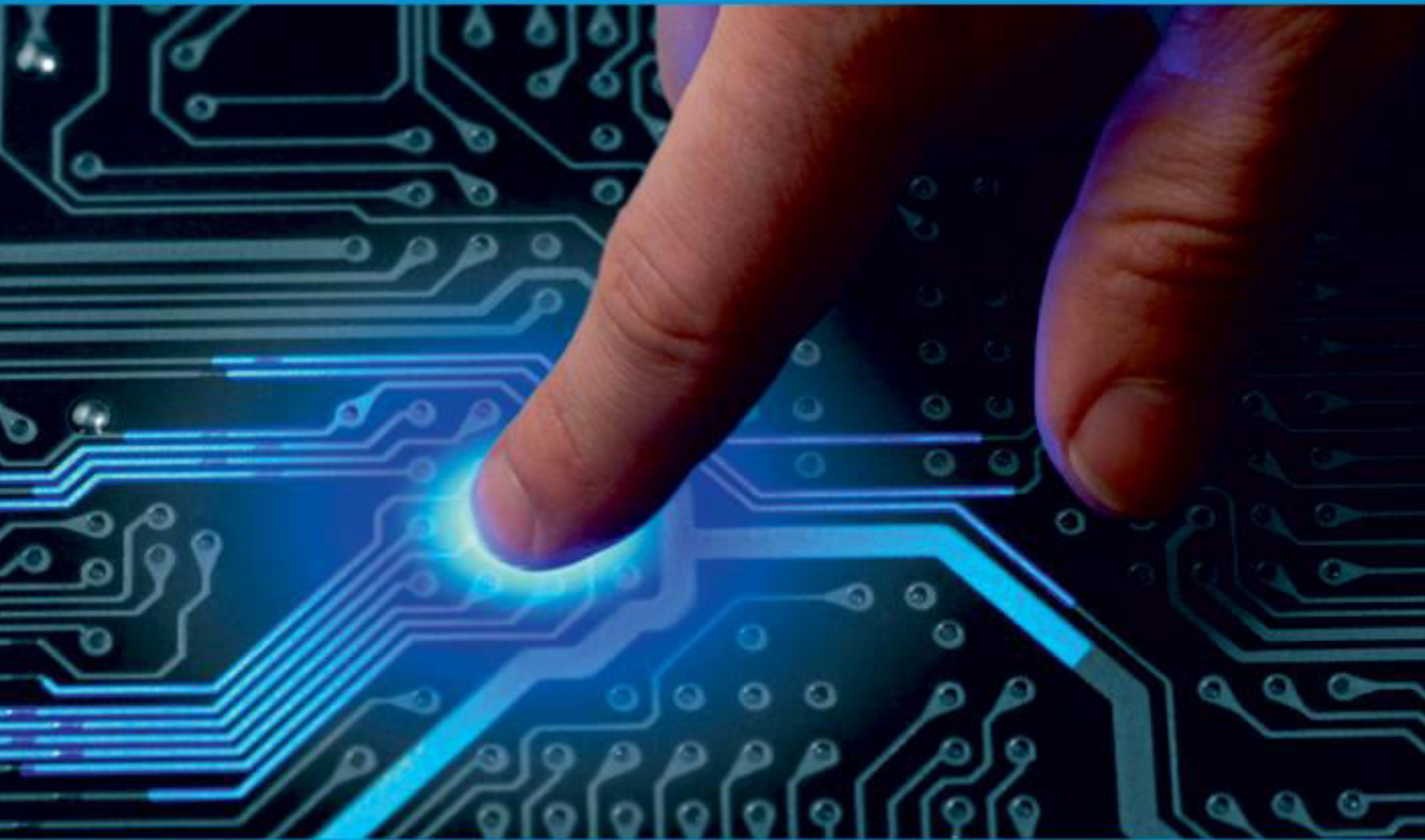
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 2, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal Of Multidisciplinary Research In Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| | Monthly Peer Reviewed & Refereed Journal |

|| Volume 7, Issue 1, April 2024 ||

International Conference on Recent Development in Engineering and Technology – ICRDET 24

Organized by

Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, Tamilnadu, India

Design and Implementation of Dc-Dc Converter for Photovoltaic Applications

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ABSTRACT: This paper presents the design and implementation of a DC-DC converter tailored specifically for photovoltaic (PV) applications. With the increasing demand for renewable energy sources, photovoltaic systems have become popular for generating electricity. However, the output voltage of PV panels is highly dependent on environmental factors, leading to the necessity of efficient DC-DC converters to regulate and optimize power transfer. The proposed converter employs [mention specific topology or control technique] to efficiently convert the variable DC output from the PV panels into a stable voltage suitable for various applications. The design considerations, simulation results, and experimental validation of the converter's performance are discussed in detail.

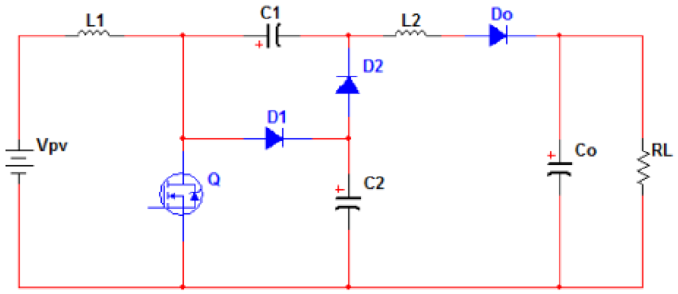
KEYWORDS: Solar panel, New *SEPIC DC-DC* Convertor, Invertor

I. INTRODUCTION

The introduction section provides an overview of the growing significance of photovoltaic systems in the context of renewable energy generation. It highlights the need for efficient power conversion solutions to harness the maximum potential of PV panels. Additionally, it outlines the objectives of the paper and the methodology adopted for designing and implementing the DC-DC converter.The primary goal of designing a DC-DC converter for PV applications is to optimize energy transfer from PV panels to loads or storage systems while ensuring high efficiency, reliable operation, and compatibility with different load requirements. This involves overcoming challenges such as varying input voltage levels, maximum power point tracking (MPPT) for maximizing energy yield, voltage regulation, and maintaining system stability under dynamic operating conditions.The design process encompasses several key considerations, including topology selection, component sizing and selection, control strategy development, simulation and modeling, prototype development, testing, optimization, and documentation. Each of these stages plays a crucial role in achieving an effective and reliable DC-DC converter tailored for PV applications.Topological choices for DC-DC converters in PV systems often include buck, boost, buck-boost, and *SEPIC* converters, each offering unique advantages based on input voltage ranges, efficiency requirements, and voltage regulation capabilities. Component selection involves choosing suitable power semiconductors, inductors, capacitors, and control ICs that can withstand the operating conditions and provide optimal performance.

II. PROPOSED METHODOLOGY

This project proposed an extended *SEPIC* for PV panels and other renewable energy resource applications that require a step-up conversion gain. The additional components involve one capacitor and two diodes to extend the voltage gain. The proposed converter is simple and lighter, the new topology utilizes a single switch.



Simplified Circuit Diagram

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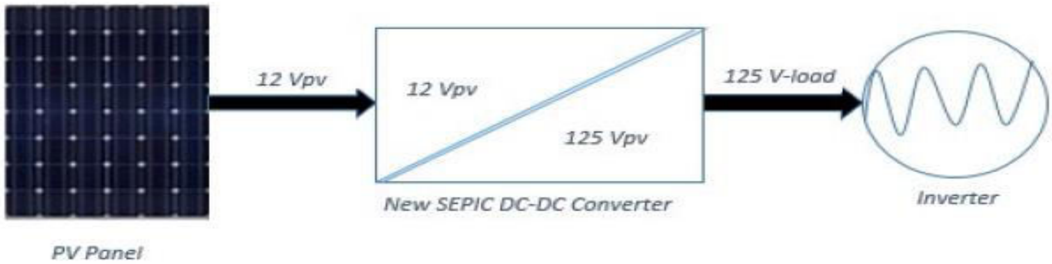
The proposed methodology for designing and implementing a DC-DC converter for photovoltaic (PV) applications involves several key steps and considerations. Here is an outline of the methodology.Define the specifications and requirements of the DC-DC converter based on the PV system's characteristics, such as input voltage range, maximum power output, efficiency targets, and environmental conditions.Choose an appropriate DC-DC converter topology based on the system requirements, considering factors like voltage regulation, efficiency, and complexity. Common topologies for PV applications include buck, boost, buck-boost, and *SEPIC* converters.Select suitable components such as power semiconductors (MOSFETs, diodes), inductors, capacitors, and control ICs based on the chosen topology and operating conditions. Consider parameters like voltage and current ratings, switching frequency, and thermal characteristics.Analyze test results and identify areas for improvement or optimization, such as efficiency enhancement, component selection refinement, or control strategy adjustments. Iterate the design and testing process to achieve desired performance targets.By following this methodology, designers can systematically develop and implement a DC-DC converter tailored for PV applications, ensuring efficient energy conversion and compatibility with renewable energy systems.

III. BLOCK DIAGRAM

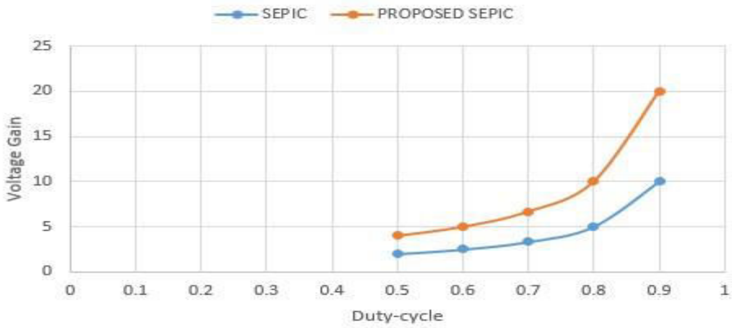


The first step in the block diagram involves the photovoltaic (PV) panel generating a nominal 12V direct current (DC) output. This DC output is the result of the PV panel's conversion of solar energy into electrical energy through the photovoltaic effect. The generated 12V DC current is then directed to the input of a *SEPIC* (Single-Ended Primary-Inductor Converter) DC-DC converter.The *SEPIC* converter plays a crucial role in the system by efficiently regulating the input voltage from the PV panel. It is specifically chosen for its ability to handle wide input voltage ranges, making it suitable for PV systems where the input voltage can vary due to factors like sunlight intensity and temperature variations. The *SEPIC* converter achieves this by utilizing a combination of inductors, capacitors, and switches to provide both step-up and step-down voltage regulation capabilities.

Within the *SEPIC* DC-DC converter, the input voltage is processed and converted to a stable intermediate voltage level, ensuring optimal power transfer and efficiency. This intermediate voltage level is then fed into an inverter, which is responsible for converting the DC input into alternating current (AC) output.The inverter's role is critical in PV systems as it enables the generated DC power to be transformed into AC power, which is commonly used in residential, commercial, and industrial applications. The inverter utilizes semiconductor devices such as MOSFETs or IGBTs to create a synchronized AC waveform that matches the desired voltage and frequency requirements of the load or grid connection.

Upon completion of the conversion process within the inverter, the system outputs a 12V AC current suitable for powering various AC loads or for grid-tied applications where the AC power can be synchronized with the utility grid. This final output represents the culmination of the PV panel's energy conversion journey, from solar radiation to usable AC electricity ready for consumption or distribution. In summary, the enhanced paragraph provides a detailed explanation of how the PV panel's 12V DC output is processed through a *SEPIC* DC-DC converter and subsequently converted into 12V AC output by an inverter, highlighting the key components and functionalities of each stage in the block diagram.

IV. OUTPUT



MATLAB/SIMULINK was used to carry out the simulation. An output voltage of 12V DC was realized with input and duty-cycle values of 12 V DC and 0.8 respectively. This means a voltage gain value of 10.45 was confirmed which is in line with the equation. For a stress-free converter, half of the output voltage is expected to pass through the power switch. A value of about 62.5 V voltage across the active power switch which can also be evaluated using equationThe prototype of the circuit was built in the laboratory A trainer connected with USB Dx9 was used to generate the signals depicts an input/output signals and 12V DC was realized from an input of 12 V DC, this means a voltage gain of 10.42 is obtained with 0.8 as a duty-cycle value. The 50 $\mu\mu$s per division (100 $\mu\mu$s per 2 divisions) depicted in fig. 5 represents the period per oscillation which was used to evaluate the switching frequency in equation. The values obtained from the new *SEPIC* were compared with conventional *SEPIC*.

V. CONCLUSION

An extended *SEPIC* DC-DC converter for micro-grid-based PV panel applications is presented in this work. The new topology has shown that addition of one capacitor and two diodes to the conventional *SEPIC* topology can extend its voltage gain at the expense of low duty-cycle as depicted the voltage stress across the power switch has been reduced to a minimum.

REFERENCES

[1] Isah H, Sagagi YM, Tampul HM (2020) A Conventional Double Boost Converter with Voltage Multiplier Cell for Photovoltaic (PV) Applications. Savanna J. Basic Appl. Sci 2(1):103–108.
[2] Asim A, Amir A, Seng H, El A, Abd N (2018) Comparative Analysis of High Voltage Gain DC-DC Converter Topologies for Photovoltaic Systems. Renew. Energy 18(2):163-167. https://doi.org/10.1016/j.renene.
[3] Tewari N, Sreedevi VT, (2018) A novel single switch dc-dc converter with high voltage gain capability for solar PV based power generation systems. Sol. Energy 171(1):466–477. https://doi.org/10.1016/j.solener.
[4] Saravanan S, Ramesh-Babu N, (2017) Analysis and implementation of high step-up DCDC converter for PV based grid application. Appl. Energy 190:64–72. https://doi.org/10.1016/j.apenergy.
[5] Ahmad R, Murtaza AF, Ahmed H (2019) Power tracking techniques for efficient operation of photovoltaic array in solar applications – A review. Renew. Sustain. Energy Rev 101(2):82–102. https://doi.org/10.1016/j.rser.
[6] Moral DL, Barrado A, Sanz M, Lázaro A, Fernández C, Zumel P (2019) Analysis and implementation of the Autotransformer Forward-Flyback converter applied to photovoltaic systems. Sol. Energy 194(2):995–1012. https://doi.org/10.1016/j.solener.
[7] Mitra L, Rout UK (2017) Performance analysis of a new high gain dc – dc converter interfaced with solar photovoltaic module. Reinf. Plast 19(1):63–74. https://doi.org/10.1016/j.ref.
[8] Krishna N, Prashanth M, Kumari NK, Krishna DSG, Kumar MP (2017) Transformer Less High Voltage Gain Step-Up DC-DC Converter Using Cascode Technique. in Energy Procedia 117:45–53. https://doi.org/10.1016/j.egypro.
[9] Gowtham S, Balaji M, Harish S, Pinto MSA, Jagadeesh G (2017) Fault Tolerant Single Switch PWM DC-DC Converters for Battery charging Applications. in Energy Procedia 117:753–760. https://doi.org/10.1016/j.egypro.
[10] Mirzaei A, Rezvanyvardom M (2020) High voltage gain soft switching full bridge interleaved Flyback DC-DC converter for PV applications. Sol. Energy 196(2):217–227. https://doi.org/10.1016/j.solener.

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