Journal of Applied Mechanics, Mechatronics and Energy System,
Vol. 1, Issue 1
October 2026

Analysis of a DC–DC SEPIC Converter Using Coupled Inductor and a Multiplier Capacitor in a Photovoltaic System

Hariyadi[1], Prima Dewi Permatasari[2]*, Joke Pratilastiarso[3]
[1,2,3] *Department of Mechanical Engineering and Energy, Politeknik Elektronika Negeri Surabaya, Indonesia*

**Corresponding author: Prima Dewi Permatasari; email:* primadewi@pens.ac.id

Manuscript received July 20, 2026, revised September 9, 2026, accepted October 20, 2026
DOI: zz.yyyyy/xxxxx.pp134-1199

Abstract – *Photovoltaic system output voltage depends on solar irradiance and temperature, causing fluctuations that reduce battery-charging effectiveness. Conventional Single-Ended Primary Inductor Converter (SEPIC) topologies require a high duty cycle for voltage conversion ratios, increasing switching losses and semiconductor voltage stress. This study uses a fixed voltage gain ratio of 1:2, meaning a 10 V input produces an approximately 20 V output. The converter was designed and evaluated in PSIM simulation using a PV-battery system. Performance was analyzed using solar irradiance data collected on 13, 14, and 15 April 2026 under battery-connected and battery-disconnected conditions. Results show that the converter increased voltage from an input range of 9.20–13.32 V to an output range of 18.42–26.67 V. The coupled inductor increased the conversion ratio through magnetic coupling, while the voltage multiplier capacitor reduced voltage ripple and switching stress. Converter operated under irradiance variations from 810.5 to 1050.8 W/m². Because it operates in open-loop mode, it cannot maintain an identical output voltage as irradiance and temperature vary; constant output voltage requires closed-loop control. Nevertheless, it maintains a voltage gain characteristic at the same duty cycle. These findings indicate its suitability for photovoltaic battery charging and renewable energy applications requiring high-gain DC conversion.*

Keywords: *Coupled Inductor, High Gain Converter, Photovoltaic System, PSIM Simulation, SEPIC Converter*

I. Introduction

Renewable energy has become one of the primary solutions for reducing dependence on fossil fuels while minimizing greenhouse gas emissions. Among various renewable energy technologies, photovoltaic (PV) systems have experienced rapid development because they provide clean, environmentally friendly, and sustainable electrical energy [1]. However, the electrical output generated by photovoltaic modules is highly dependent on solar irradiation and ambient temperature, causing the output voltage to fluctuate continuously during operation. Consequently, an efficient DC-DC converter is required to stabilize the voltage before supplying electrical loads or charging energy storage systems [2], [3].

The Single-Ended Primary Inductor Converter (SEPIC) has been widely implemented in photovoltaic applications due to its capability to operate as both a step-up and step-down converter while maintaining non-inverted output voltage polarity. Compared with conventional Buck-Boost converters, SEPIC provides lower input current ripple and greater flexibility for renewable energy systems. Nevertheless, the voltage conversion gain of a conventional SEPIC converter mainly depends on the switching duty cycle. Achieving high output voltage therefore requires operation at an extremely high duty cycle, which increases conduction losses, current stress, switching losses, and thermal dissipation in the power semiconductor devices [4], [5].

Several approaches have been proposed to overcome the limitations of conventional SEPIC converters. One promising technique is the utilization of a coupled inductor, which increases the voltage conversion ratio through magnetic coupling instead of relying solely on duty cycle adjustment. Previous studies have demonstrated that coupled inductors provide higher

voltage gain while simultaneously reducing voltage stress across the power switch. Furthermore, leakage inductance energy can be partially recovered through an appropriate passive clamp or voltage multiplier network, leading to improved converter efficiency and reduced switching losses [6].

Although coupled-inductor-based converters have shown considerable advantages, many previous studies mainly focused on Boost converters or isolated high-gain topologies. Limited studies have investigated the integration of coupled inductors and voltage multiplier capacitors into SEPIC converters specifically for photovoltaic applications. In addition, several published works only evaluate converter performance under constant input conditions, whereas practical photovoltaic systems experience continuous irradiation and temperature variations throughout the day.

Therefore, this research proposes a high-voltage-gain SEPIC converter employing a coupled inductor and a voltage multiplier capacitor for photovoltaic applications. The proposed topology is designed to improve voltage conversion capability while maintaining low voltage ripple and stable gain output voltage under varying environmental conditions. The converter is modeled and analyzed using PSIM software based on photovoltaic operating characteristics.

II. Research Method

A. Proposed System Configuration

The proposed converter is designed to increase the low output voltage generated by a photovoltaic (PV) module into a higher DC voltage suitable for battery charging and DC load applications. The overall system consists of four main components, namely a photovoltaic module, a high-gain SEPIC converter employing a coupled inductor and voltage multiplier capacitor, a battery storage unit, and a DC load [4], [7].

The photovoltaic module acts as the primary energy source whose output voltage continuously varies according to solar irradiation and ambient temperature. To overcome these fluctuations, a SEPIC converter is employed because of its capability to operate in both step-up and step-down modes while maintaining positive output polarity. In this study, the conventional SEPIC converter is modified by incorporating a coupled inductor and a voltage multiplier capacitor to improve voltage gain and converter efficiency [2].

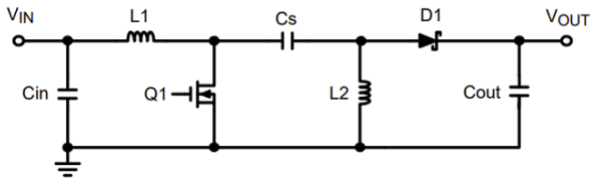


Fig. 1. Basic configuration of the proposed SEPIC converter

TABLE I
COMPARISON OF DC-DC CONVERTER TOPOLOGIES FOR PHOTOVOLTAIC APPLICATIONS

Topology	Step-Up / Step Down	Output Polarity	Suitability for PV
Buck	Step Down	Non-Inverting	Low
Boost	Step Up	Non-Inverting	Low
Buck-Boost	Both	Inverting	Moderate
Cuk	Both	Inverting	Moderate
SEPIC	Both	Non-Inverting	Hiigh

Sarwar et al. (2022) reported that the selection of a DC-DC converter for photovoltaic systems should consider voltage-conversion capability, voltage stress, component count, and application requirements. Among the available topologies, the SEPIC converter offers the advantage of both buck and boost operation while preserving positive output polarity, making it well suited for photovoltaic applications with fluctuating input voltage [12].

B. Operating Principle of the Proposed SEPIC Converter

The proposed converter operates in Continuous Conduction Mode (CCM), where the current flowing through the coupled inductor never reaches zero during one switching period. The switching operation is controlled using Pulse Width Modulation (PWM), which regulates the MOSFET duty cycle according to the desired output voltage.

The converter operates in two switching states.

Mode 1 (MOSFET ON)

When the MOSFET is turned ON, the input source transfers energy to the primary winding of the coupled inductor. Simultaneously, the secondary winding stores magnetic energy due to mutual inductance. During this interval, the coupling capacitor is charged while the output capacitor supplies energy to the load. Since the output diode is reverse-biased, no current flows toward the output stage.

The magnetic energy accumulated in the coupled inductor during this period will later be transferred to the output during the OFF state.

Mode 2 (MOSFET OFF)

When the MOSFET is switched OFF, the polarity of the coupled inductor reverses. Consequently, the output diode becomes forward-biased, allowing the stored magnetic energy from both windings to be delivered simultaneously to the output capacitor and load.

At the same time, the voltage multiplier capacitor contributes additional voltage, thereby increasing the overall conversion ratio while suppressing voltage spikes caused by leakage inductance.

The combination of these operating states enables the converter to achieve a significantly higher voltage gain compared with a conventional SEPIC converter without requiring an extremely large duty cycle.

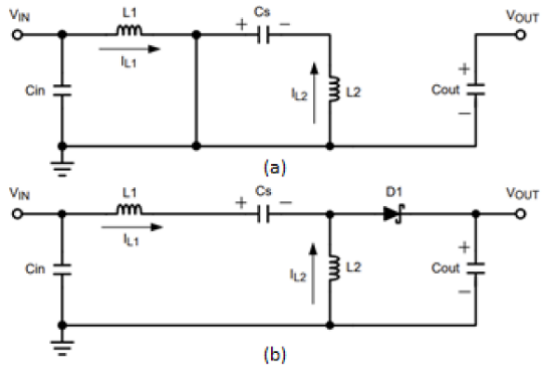


Fig. 2. Operating modes of the proposed SEPIC converter

C. Coupled Inductor Design

The coupled inductor is the primary component responsible for increasing converter voltage gain. Two windings are wound on the same magnetic core, allowing magnetic flux generated in one winding to induce voltage in the other winding [8], [9].

The mutual inductance is calculated as

$$M = k\sqrt{L_1 L_2} \qquad (1)$$

Where:

M = mutual inductance,
k = coupling coefficient,
L_1 = primary inductance,
L_2 = secondary inductance.

A coupling coefficient approaching unity indicates efficient magnetic coupling and reduced leakage inductance. Based on previous studies, the coupling coefficient is selected close to 0.95, providing a good compromise between converter efficiency and practical core implementation.

D. Voltage Multiplier Capacitor Design

A voltage multiplier capacitor is integrated into the converter to compensate for leakage inductance and further enhance voltage gain. During switching transitions, energy stored within the capacitor contributes additional voltage to the output stage, resulting in higher voltage conversion efficiency [10].

The coupling capacitor is determined using

$$C = \frac{I_{in} D}{\Delta V_c f_s} \qquad (2)$$

Where:

- I_{in} = input current,
- D = duty cycle,
- ΔV_c = capacitor voltage ripple,
- f_s = switching frequency.

The output capacitor is calculated as

$$C_{out} = \frac{I_{out} D}{\Delta V_{out} f_s} \qquad (3)$$

These capacitor values ensure stable output voltage with minimum ripple throughout converter operation.

E. Ripple Voltage and Ripple Current

The output voltage and current produced by the conversion process are not entirely pure DC signals. Small periodic fluctuations in voltage and current remain present at the output, exhibiting a certain frequency and amplitude. These fluctuations are commonly referred to as ripple.

Therefore, the performance of a converter circuit can be evaluated based on its ripple characteristics. Excessive ripple levels may degrade power quality and potentially damage components or devices supplied by the converter.

The voltage ripple and current ripple are determined using

$$\mathrm{V_{ripple}}(\%) = \frac{V_{max} - V_{min}}{V_{out}} \times 100\% \qquad (4)$$

$$\mathrm{I_{ripple}}(\%) = \frac{I_{max} - I_{min}}{I_{out}} \times 100\% \qquad (5)$$

Where:

- $\mathrm{V_{ripple}}(\%)$ = voltage ripple percentage,
- V_{max} = maximum steady-state voltage,
- V_{min} = minimum steady-state voltage,
- V_{out} = nominal steady-state voltage.
- $\mathrm{I_{ripple}}(\%)$ = current ripple percentage,
- I_{max} = maximum steady-state current,
- I_{min} = minimum steady-state current,
- I_{out} = nominal steady-state current.

The output capacitor is calculated as

F. Converter Design Parameters

The proposed converter is designed according to the electrical specifications summarized in Table III.

TABLE II
DESIGN PARAMETERS OF THE PROPOSED SEPIC CONVERTER

Parameter	Symbol	Value
Input Voltage	Vin	12 V
Output Voltage	Vout	24 V
Resistor Load	R	2.3 Ω
Switching Frequency	fs	50 kHz
Vout Ripple	V_{ripple}(%)	1% (0.24V)
Current Output Ripple	I_{ripple}(%)	20%
Coupling Coefficient	K	0.95
Duty Cycle	D	0.67
Multiplier Capacitor	C_1	1300 uF
Output Filter Capacitor	C2	600 uF
Coupled Inductor	L_1	34.5 uH
	L_2	76.67 uH
Diode	D1, D2	Ideal Condition
Mosfet	Q1	Ideal Condition
Battery	Model Type	Ideal Condition Lithium-Ion
	Nominal Voltage per Cell	3.7V
	Number of Cells	6 Cells

The remaining parameters were included mainly as supplementary filtering terms to enhance switching performance, while their impact on the simulation results was negligible.

G. Simulation Model

The proposed of the proposed converter is evaluated using PSIM software under different photovoltaic operating conditions with fixed gain ratio 1:2. The simulation model consists of a photovoltaic source, a coupled-inductor-based SEPIC converter, PWM switching controller, battery load, and measurement blocks [5].

The simulation evaluates several electrical variables, including input voltage, output voltage, input current, output current, converter efficiency, and output voltage ripple under ideal operating conditions.

Solar irradiation data obtained from three different measurement days are used as converter input to investigate the converter response under varying environmental conditions.

The simulation time is selected sufficiently long to ensure that steady-state operation is achieved before measurement data are recorded.

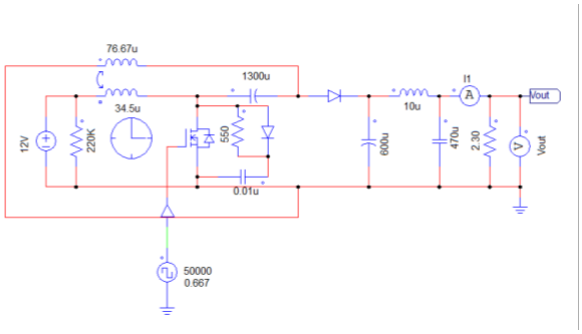


Fig. 3. PSIM simulation model of the proposed converter.

H. Design Analysis

The proposed a SEPIC converter was designed to increase the low output voltage of the photovoltaic (PV) module for battery charging applications. Alhamrouni et al. (2019) reported that the integration of a coupled inductor and a voltage-multiplier capacitor can significantly increase the voltage conversion ratio while reducing conduction losses and voltage stress compared with a conventional SEPIC converter operating at high duty cycles [11].

Figure 4 shows the proposed converter topology consisting of a PV source, a coupled inductor, a voltage multiplier capacitor, a MOSFET switch, a diode, an output capacitor, and a battery load. The coupled inductor improves voltage gain through magnetic coupling, whereas the voltage multiplier capacitor suppresses leakage inductance effects and enhances converter stability. The converter is designed to operate in Continuous Conduction Mode (CCM) with a switching frequency of 50 kHz to ensure stable operation and low current ripple.

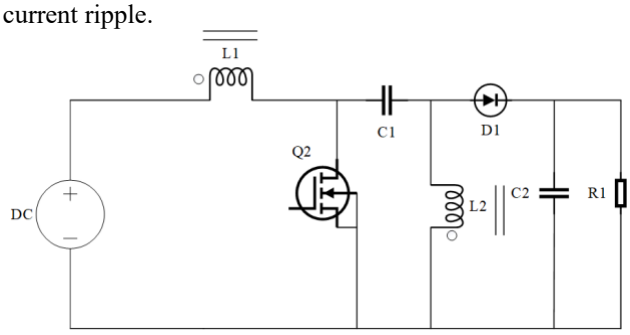


Fig. 4. Proposed a SEPIC converter employing a coupled inductor and a multiplier capacitor.

The design parameters listed in Table I were implemented in the PSIM simulation model to analyze the converter performance under different photovoltaic operating conditions. The simulation results are presented and discussed in the results and discussion.

III. Results and Discussion

A. Performance of the Proposed SEPIC Converter

Fig. 5 illustrates the complete simulation model of the photovoltaic power conversion system developed in this research. The proposed system consists of a photovoltaic module, a SEPIC converter employing a coupled inductor and voltage multiplier capacitor, a battery storage unit, and a DC load. The simulation was carried out using PSIM software to evaluate the converter performance under different solar irradiation conditions.

The photovoltaic module acts as the primary energy source, while the SEPIC converter converts the fluctuating input voltage into a higher output voltage with a fixed voltage gain ratio, suitable for battery charging and supplying DC loads. The coupled inductor serves as the main component responsible for increasing the voltage conversion ratio through magnetic coupling between the primary and secondary windings. In addition, the voltage multiplier capacitor assists in recovering leakage inductance energy, thereby improving converter efficiency and suppressing voltage overshoot during switching transitions.

The simulation model also incorporates voltage sensors, current sensors, and battery monitoring circuits, allowing the electrical characteristics of the system to be observed continuously. These measurement blocks provide comprehensive information regarding the photovoltaic output, converter response, battery charging characteristics, and load performance. Consequently, the developed model is capable of representing practical operating conditions encountered in standalone photovoltaic systems.

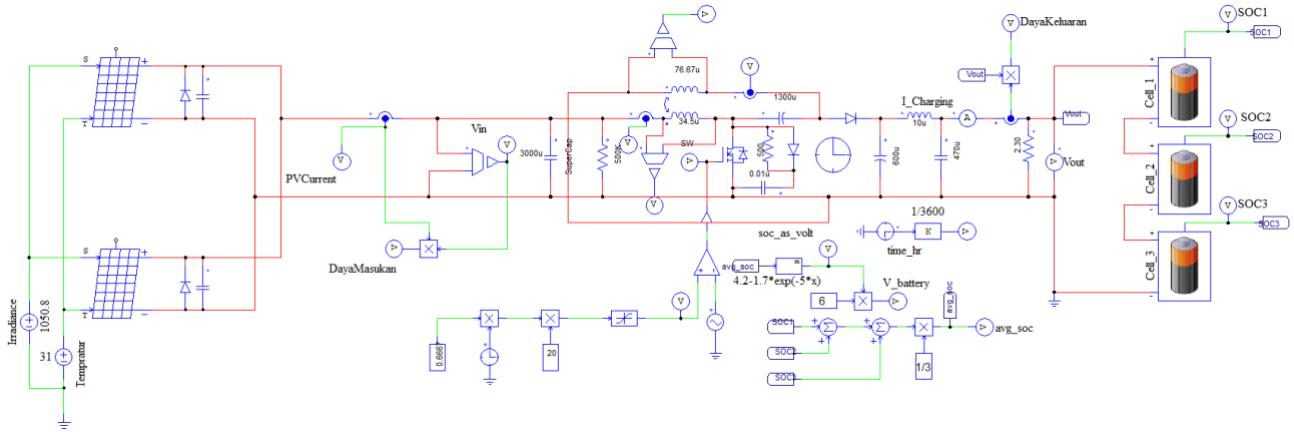


Fig. 5. Overall PSIM simulation model of the proposed photovoltaic system integrated with the SEPIC converter and battery.

B. Voltage and Current Characteristics

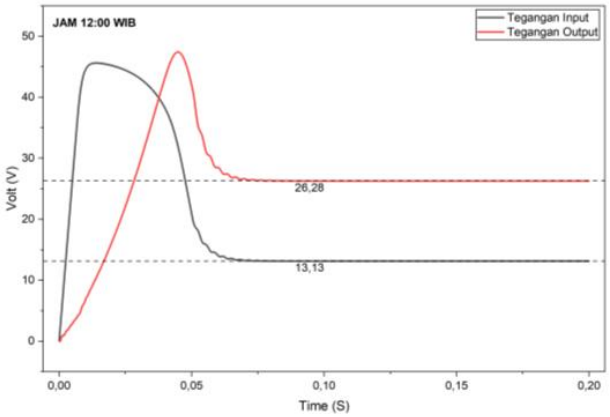


Fig. 6. Input-output voltage characteristics of the proposed converter.

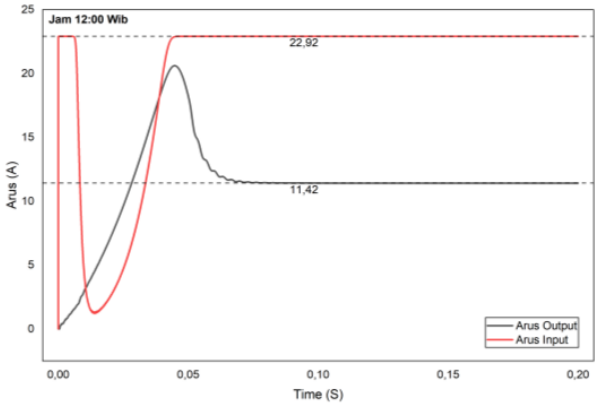


Fig. 7. Input-output current characteristics of the proposed converter.

Figures 6 and 7 present the simulated voltage and current characteristics of the proposed SEPIC converter during photovoltaic operation. The simulation results show that the converter successfully increases the photovoltaic output voltage while maintaining stable electrical characteristics throughout the operating period.

As the solar irradiation increases, the photovoltaic module generates higher input voltage and current. These variations directly influence the input power delivered to the converter. Nevertheless, the proposed converter maintains a relatively constant output voltage due to the energy transfer mechanism provided by the coupled inductor. During the ON interval of the switching cycle, magnetic energy is stored in the coupled inductor, whereas during the OFF interval the stored energy is released simultaneously to the output capacitor and load. This operating principle enables the converter to achieve a higher voltage conversion ratio without requiring an excessively large duty cycle.

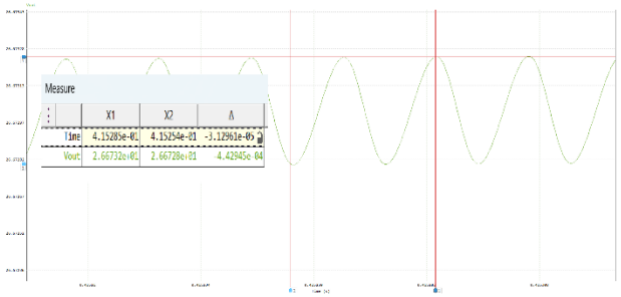


Fig. 8. Voltage Ripple of Proposed Converter.

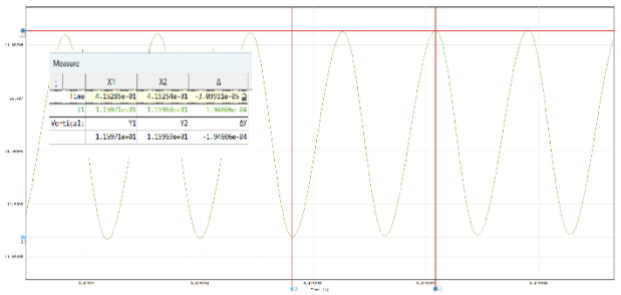


Fig. 9. Voltage Ripple of Proposed Converter.

The output voltage under steady-state conditions exhibits a small alternating waveform component that can be expressed as voltage ripple. Measurements were conducted to determine the maximum voltage (Vmax) and minimum voltage (Vmin). Similarly, the output current also contains a small ripple component within a narrow

range. Based on the measurements, the voltage ripple and current ripple values of the SEPIC converter are presented in Table 2.

TABLE III
VOLTAGE AND CURRENT CHARACTERISTICS OF THE PROPOSED SEPIC CONVERTER

Parameter	Value	Unit
Voltage		
Vin	13.13	Volt
Vout	26.6730	Volt
Vmax	26.6732	Volt
Vmin	26.6728	Volt
ΔVout	0.0004	Volt
Vripple	0.001	%
Current		
Iin	22.92	Volt
Iout	11.5970	Volt
Imax	11.5971	Volt
Imin	11.5969	Volt
ΔIout	0.0002	Volt
Iripple	0.0017	%

Another important observation is the relatively small voltage ripple obtained at the converter output. The voltage multiplier capacitor effectively suppresses switching-induced voltage fluctuations while recovering part of the leakage inductance energy. As a result, the converter produces a smoother DC output suitable for charging batteries and supplying DC loads.

Overall, the simulated voltage and current characteristics confirm that the proposed converter is capable of providing stable electrical performance under varying photovoltaic operating conditions.

C. Performance under Different Solar Irradiation Conditions

TABLE IV
DATA DATED APRIL 13, 2026
RESULTS OF THE OVERALL SYSTEM SIMULATION

Performance Data of the Proposed SEPIC Converter Without Battery on April 13, 2026

Time (WIB)	Solar Irradiance (W/m²)	Temperature (°C)	Input Voltage, Vin (V)	Output Voltage, Vcs (V)
10:00	810.5	30	10.28	20.50
11:00	950.7	30	12.05	24.12
12:00	1035.4	31	13.13	26.28
13:00	1050.8	31	13.32	26.67
14:00	930.1	31	11.80	23.61

Performance Data of the Proposed SEPIC Converter With Battery on April 13, 2026

Time (WIB)	Solar Irradiance (W/m²)	Temperature (°C)	Input Voltage, Vin (V)	Output Voltage, Vcs (V)
10:00	810.5	30	9.20	18.42
11:00	950.7	30	9.27	18.56
12:00	1035.4	31	9.32	18.65
13:00	1050.8	31	9.32	18.66
14:00	930.1	31	9.26	18.54

TABLE V
DATA DATED APRIL 14, 2026
RESULTS OF THE OVERALL SYSTEM SIMULATION

Performance Data of the Proposed SEPIC Converter Without Battery on April 14, 2026

Time (WIB)	Solar Irradiance (W/m²)	Temperature (°C)	Input Voltage, Vin (V)	Output Voltage, Vcs (V)
10:00	889.1	30	11.27	22.56
11:00	950.0	31	12.05	24.12
12:00	1006.5	32	12.77	25.56
13:00	1016.2	33	12.90	25.82
14:00	900.0	31	11.42	22.85

Performance Data of the Proposed SEPIC Converter With Battery on April 14, 2026

Time (WIB)	Solar Irradiance (W/m²)	Temperature (°C)	Input Voltage, Vin (V)	Output Voltage, Vcs (V)
10:00	889.1	30	9.24	18.54
11:00	950.0	31	9.27	18.56
12:00	1006.5	32	9.30	18.62
13:00	1016.2	33	9.31	18.63
14:00	900.0	31	9.25	18.51

TABLE VI
DATA DATED APRIL 13, 2026
RESULTS OF THE OVERALL SYSTEM SIMULATION

Performance Data of the Proposed SEPIC Converter Without Battery on April 15, 2026

Time (WIB)	Solar Irradiance (W/m²)	Temperature (°C)	Input Voltage, Vin (V)	Output Voltage, Vcs (V)
10:00	860.1	31	10.91	21.84
11:00	930.9	31	11.81	23.63
12:00	1024.2	33	13.00	26.02
13:00	1020.1	33	12.95	25.92
14:00	988.8	31	12.54	25.10

Performance Data of the Proposed SEPIC Converter With Battery on April 15, 2026

Time (WIB)	Solar Irradiance (W/m²)	Temperature (°C)	Input Voltage, Vin (V)	Output Voltage, Vcs (V)
10:00	860.1	31	9.23	18.47
11:00	930.9	31	9.26	18.54
12:00	1024.2	33	9.31	18.64
13:00	1020.1	33	9.31	18.63
14:00	988.8	31	9.29	18.60

The converter performance was further evaluated using photovoltaic data obtained on three different measurement days. These datasets represent variations in solar irradiation and ambient conditions commonly encountered in practical photovoltaic systems.

On the first measurement day, the converter produced a stable output voltage despite moderate fluctuations in the photovoltaic input voltage. During the second measurement day, increased solar irradiation resulted in higher photovoltaic power generation, allowing the converter to deliver higher output power while maintaining voltage stability. Similar behaviour was observed during the third measurement period, although minor variations in photovoltaic voltage were recorded

due to changes in weather conditions.

The simulation results indicate that the proposed converter adapts effectively to varying environmental conditions. Regardless of fluctuations in solar irradiation, the converter maintains a nearly constant output voltage and stable battery charging characteristics. These results demonstrate that, despite variations in photovoltaic operating conditions, the SEPIC converter maintains a fixed voltage gain ratio, producing an output voltage approximately twice the input voltage.

The comparison among the three measurement days also reveals that converter performance is primarily influenced by the available photovoltaic input power rather than by the converter topology itself. Therefore, the proposed converter exhibits good adaptability for renewable energy applications operating under continuously changing environmental conditions.

D. Overall Discussion

The simulation results demonstrate the operating characteristics of the proposed SEPIC converter incorporating a coupled inductor and a voltage multiplier capacitor for photovoltaic applications. The converter was able to step up the low DC voltage generated by the photovoltaic module and provide an output voltage suitable for battery charging and DC load applications under the investigated operating conditions.

The coupled inductor contributed to the voltage step-up capability through magnetic coupling between the primary and secondary windings, while the voltage multiplier capacitor assisted the energy transfer process and increased the attainable output voltage. The converter maintained continuous operation under solar irradiance variations ranging from 810.5 W/m² to 1050.8 W/m², demonstrating its capability to operate under varying photovoltaic conditions.

In addition, the integration of the battery energy storage system helped mitigate the effects of photovoltaic power fluctuations and supported converter operation during changes in solar irradiance. The obtained results indicate that the proposed converter configuration can be applied in standalone photovoltaic systems, battery charging systems, DC microgrids, and other renewable energy applications requiring DC voltage step-up conversion.

Future work should include experimental validation and a detailed performance comparison with other high-gain SEPIC converter topologies to further evaluate the practical performance of the proposed system.

IV. Conclusion

This study presented the design and performance analysis of a SEPIC converter incorporating a coupled inductor and a voltage multiplier capacitor for photovoltaic applications. The proposed converter was modeled and analyzed using PSIM software under various solar irradiance conditions, both with and without battery integration. The simulation results showed that the proposed topology was capable of increasing the low output voltage generated by the photovoltaic module and providing a higher DC output voltage suitable for battery charging and DC load applications.

The coupled inductor contributed to the voltage step-up capability through magnetic coupling between the primary and secondary windings, while the voltage multiplier capacitor assisted the voltage boosting process and energy transfer within the converter. The converter maintained continuous operation under solar irradiance variations, demonstrating its capability to operate under varying photovoltaic conditions.

Performance analysis using experimental solar irradiation data collected on 13, 14, and 15 April 2026 demonstrated that the proposed converter consistently maintained an output voltage approximately twice the input voltage. During operation without battery integration, the converter produced an output voltage ranging from 20.50 V to 26.67 V for input voltages between 10.28 V and 13.32 V. When the battery was connected, the converter maintained a stable output voltage within the range of 18.42 V to 18.66 V, despite variations in solar irradiance from 810.5 W/m² to 1050.8 W/m². These results indicate that the proposed converter provides good voltage regulation and reliable performance under practical photovoltaic operating conditions.

Compared with the conventional SEPIC converter, the proposed topology offers several advantages, including higher voltage gain, lower current and voltage ripple, reduced switching stress, and improved output voltage stability. These characteristics make the converter suitable for photovoltaic battery charging systems, standalone solar power systems, and other renewable energy applications requiring efficient DC–DC power conversion.

Although the proposed converter demonstrated promising performance in simulation, this study is limited to software-based validation. Therefore, future work should focus on hardware implementation and experimental verification under real operating conditions. Further research may also investigate the integration of Maximum Power Point Tracking (MPPT) algorithms, closed-loop digital control, and optimization of the coupled inductor design to further improve converter efficiency, dynamic response, and long-term reliability.

Acknowledgements

The authors would like to express their sincere gratitude to the Department of Mechanical Engineering and Energy, Politeknik Elektronika Negeri Surabaya (PENS), for providing academic guidance and research facilities during this study. The authors also appreciate all lecturers and laboratory staff who contributed valuable

technical support throughout the completion of this research.

References

[1] A. Saleh, W. Hadi, and M. C. Anwar, "Desain Kontrol Maximum Power Point Traker (Mppt) Menggunakan Incremental Conductance (Inc) Pada Dc / Dc Tipe Sepic," *Semnastek*, no. November, pp. 1–8, 2017, [Online]. Available: https://jurnal.umj.ac.id/index.php/semnastek/article/view/1907.

[2] T. Alamsyah, A. Hiendro, and Z. Abidin, "Analisis Potensi Energi Matahari Sebagai Pembangkit Listrik Tenaga Surya Menggunakan Panel Mono-Crystalline dan Poly-Crystalline Di Kota Pontianak dan Sekitarnya," *Jurnal Teknik Elektronika*, p. 10, 2021, [Online]. Available: https://jurnal.untan.ac.id/index.php/jteuntan/article/viewFile/48425/75676590121.

[3] T. Shimizu, K. Wada, and N. Nakamura, "Flyback-type single-phase utility interactive inverter with power pulsation decoupling on the DC input for an AC photovoltaic module system," *IEEE Transactions on Power Electronics*, vol. 21, no. 5, pp. 1264–1272, 2006, doi: 10.1109/TPEL.2006.880247.

[4] I. Dilianto, H. Suryoatmojo, and P. D. Suwito, "Desain dan Implementasi Konverter DC-DC Topologi SEPIC Termodifikasi dengan Gain yang Tinggi untuk Aplikasi pada Photovoltaic," vol. 2, no. 1, pp. 22–28, 2017.

[5] P. Tyag, V. C. Kotak, and V. P. S. Sing, "Design High Gain Dc-Dc Boost Converter With Coupling Inductor and Simulation in Psim," *International Journal of Research in Engineering and Technology*, vol. 03, no. 04, pp. 156–163, 2014, doi: 10.15623/ijret.2014.0304029.

[6] Destiarani, I Ketut Wiryajati, and I Nyoman Wahyu Satiawan, "Analisis dan Simulasi Efisiensi Kinerja Sepic Konverter Berbasis Kontroler Konvensional," *Sci-tech Journal*, vol. 2, no. 2, pp. 265–275, 2024, doi: 10.56709/stj.v2i2.184.

[7] T. P. Raharjo and I. Krisnadi, "Analisis Optimalisasi Solar Home System (Shs) Dan Ketersediannya Di Indonesia," *Academia.Edu*, 2016, [Online]. Available: https://www.academia.edu/download/63492390/Analisis___Optimalisasi_Solar__Home_System__SHS_dan_ketersediaannyadi_Indonesia20200601-68184-brivej.pdf.

[8] A. S. Rohman and B. Sujanarko, "Maximum Power Point Tracking Panel Surya dengan Menggunakan High Step Up Zeta Converter Coupled Inductor Dalam Mensuplai Beban," *Dielektrika*, vol. 9, no. 2, pp. 118–129, 2022, doi: 10.29303/dielektrika.v9i2.291.

[9] A. Y. Setyanto, "Desain Dan Implementasi Konverter Non-Isolated Dc-Dc Bidirectional Double Boost Dengan Coupled Inductor Untuk Aplikasi," p. 88, 2017, [Online]. Available: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwie2OHy9OzsAhX063MBHaSyD5QQFjAAegQIAxAC&url=http%3A%2F%2Frepository.its.ac.id%2F44132%2F1%2F2213100160-Undergraduate_Theses%2520.pdf&usg=AOvVaw07kFR78yRbdLpmZiGOAlkH.

[10] A. Pradipta, "Perancangan Dan Implementasi Konverter Zeta Dengan Induktor Gandeng Dan Kapasitor Pengali Untuk Aplikasi Fotovoltaik," *Jurnal Teknik ITS*, vol. 5, no. 2, 2016, doi: 10.12962/j23373539.v5i2.16041.

[11] I. Alhamrouni, M. K. Rahmat, F. A. Ismail, M. Salem, A. Jusoh, and T. Sutikno, "Design and development of SEPIC DC-DC boost converter for photovoltaic application," Int. J. Power Electron. Drive Syst. (IJPEDS), vol. 10, no. 1, pp. 406–413, 2019, doi: 10.11591/IJPEDS.V10.I1.PP406-413.

[12] S. Sarwar, S. Kiran, et al., "Comparative Study of DC-DC Converters for Solar PV with Microgrid Applications," Energies, vol. 15, no. 20, p. 7569, 2022, doi: 10.3390/en15207569. Available: https://doi.org/10.3390/en15207569.