



A NOVEL PHOTOVOLTAIC-BASED WIRELESS EV CHARGING SYSTEM USING A MODIFIED TRANS-QUASI Z-SOURCE BOOST CONVERTER

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ABSTRACT

This paper proposes a PV-integrated wireless charging architecture for electric vehicles utilizing a modified Trans-Quasi Z-Source boost converter. The PV system is integrated with advanced power electronics for efficient energy conversion and management. It begins with photovoltaic cells generating voltage (V_{pv}) and current (I_{pv}), which are fed into the modified Trans-Quasi Z-Source boost converter. The converter employs PWM control to enhance the output voltage, which is then supplied to a high-frequency inverter. The inverter output is applied to an LC tank circuit to achieve resonance and efficient wireless power transfer. A high-frequency isolation transformer is used to ensure safety and improved performance in subsequent stages. The system incorporates an interleaved PWM rectifier to convert AC back to DC for charging the EV battery. The overall operation is optimized using an Artificial Neural Network (ANN)-based Maximum Power Point Tracking (MPPT) algorithm to maximize energy extraction from the PV system. A Proportional-Integral (PI) controller regulates the output voltage (V_{act}) to track the reference voltage (V_{ref}), thereby enhancing system stability and efficiency. Finally, the project is implemented using MATLAB/Simulink 2024^a.



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I. INTRODUCTION

The increasing global energy demand and rapid depletion of fossil fuel resources have accelerated the transition toward renewable energy-based power systems and electric vehicles (EVs). Conventional fossil-fuel-driven transportation contributes significantly to greenhouse gas emissions and environmental pollution, which necessitates the development of sustainable and eco-friendly energy solutions [1], [2]. Among various renewable energy sources, photovoltaic (PV) systems have gained considerable attention due to their clean energy generation, scalability, and wide availability. PV technology converts solar energy directly into electrical energy through the photovoltaic effect, making it a promising candidate for future sustainable charging infrastructures [3]. Simultaneously, the rapid growth of electric vehicles has created a strong demand for efficient, reliable, and user-friendly charging technologies. Traditional conductive charging systems require physical connectors, which may lead to cable wear, safety hazards, maintenance issues, and inconvenience in adverse environmental conditions [4]. Wireless Power Transfer (WPT) technology has emerged as an advanced alternative that enables contactless energy transmission through electromagnetic induction and resonant coupling [5]. This technology improves user convenience, electrical safety, and system automation while eliminating mechanical connection losses associated with wired charging systems [6]. In recent years, wireless charging systems have been widely applied in consumer electronics, electric vehicles, and portable devices due to their flexibility and ease of operation. Inductive and resonant wireless charging techniques operate based on the principle of electromagnetic coupling between transmitting and receiving coils, where alternating current in the primary coil generates a magnetic field that induces voltage in the secondary coil [7], [8]. The efficiency of wireless power transfer mainly depends on coil alignment, operating frequency, air gap, and compensation network design. Although WPT systems offer significant advantages, their efficiency is often lower than wired charging systems due to coupling losses and multiple power conversion stages [9], [10].

To enhance the sustainability of EV charging infrastructure, the integration of renewable energy sources, particularly PV systems, with wireless charging architecture has become an important research direction [11]. PV-integrated wireless charging systems enable direct utilization of solar energy for EV charging, thereby reducing grid dependency, operational costs, and carbon emissions [12]. However, the intermittent nature of solar irradiance and fluctuating PV output voltage pose significant challenges in maintaining stable power transfer and efficient energy conversion. Therefore, advanced power electronic converters and intelligent control techniques are essential to ensure reliable operation of PV-fed wireless charging systems [13], [14]. Power electronic converters play a crucial role in regulating voltage, improving power quality, and enhancing overall system efficiency in renewable energy-based charging applications. Conventional DC–DC converters used in PV systems often suffer from limited voltage gain, increased switching losses, and complex multi-stage conversion structures. To overcome these limitations, impedance-source converter topologies such as Z-source, quasi-Z-source, and trans quasi-Z-source converters have been introduced due to their inherent buck–boost capability, shoot-through immunity, and improved reliability [15–17]. These converters provide higher voltage gain and better dynamic performance compared to traditional boost converters, making them highly suitable for PV-integrated EV charging applications. Furthermore, intelligent energy management techniques such as Artificial Neural Network (ANN)-based Maximum Power Point Tracking (MPPT) algorithms are widely employed to extract maximum power from PV systems under varying environmental conditions.

In addition, closed-loop control strategies such as Proportional–Integral (PI) controllers are used to maintain stable output voltage and improve system dynamic response during fluctuating solar irradiance and load variations [18], [19]. Although several research works have focused on wireless EV charging and PV-based charging systems independently, limited studies have addressed the integration of PV-fed wireless power transfer systems with high-gain modified Trans Quasi Z-Source boost converters and intelligent MPPT control. Existing systems mainly rely on grid-powered charging or conventional converter topologies, which result in increased conversion losses, reduced efficiency, and complex system architecture [20]. Therefore, there is a need for a high-efficiency, stable, and renewable-energy-driven wireless charging architecture specifically designed for electric vehicle applications. To address these challenges, this paper proposes a PV integrated wireless charging architecture for electric vehicles utilizing a Modified Trans Quasi Z-Source Boost Converter. The proposed system consists of a PV array, modified Trans Quasi Z-Source boost converter, high-frequency inverter, resonant LC tank circuit, isolation transformer, interleaved rectifier, ANN-based MPPT, and PI controller to achieve efficient wireless power transfer and stable EV battery charging. The integration of a high-gain converter and intelligent control enhances voltage boosting capability, system stability, and overall energy conversion efficiency. The main objectives of this paper are:

- 1) To design a PV-integrated wireless charging architecture for electric vehicles,
- 2) To develop a Modified Trans Quasi Z-Source Boost Converter for high-gain voltage conversion,
- 3) To improve wireless power transfer efficiency using a resonant LC tank and high-frequency inverter,
- 4) To maximize solar energy extraction using ANN-based MPPT control, and

To ensure stable output voltage regulation and enhanced system performance using a PI controller.

II. PROPOSED MODELLING

Figure 1 shows the PV-integrated wireless charging system for EVs using a Modified Trans Quasi Z-Source Boost Converter. When PV cells first generate voltage (V_{pv}) and current (I_{pv}), the improved boost converter uses PWM to process the data and increase the output voltage. The PWM signals are routed to an LC tank circuit for effective energy transfer via resonance after this output is fed into a high-frequency inverter. To guarantee performance and safety, a high-frequency isolation transformer is employed. In order to convert the AC back to DC for EV battery charging, the system incorporates an interleaved PWM rectifier.

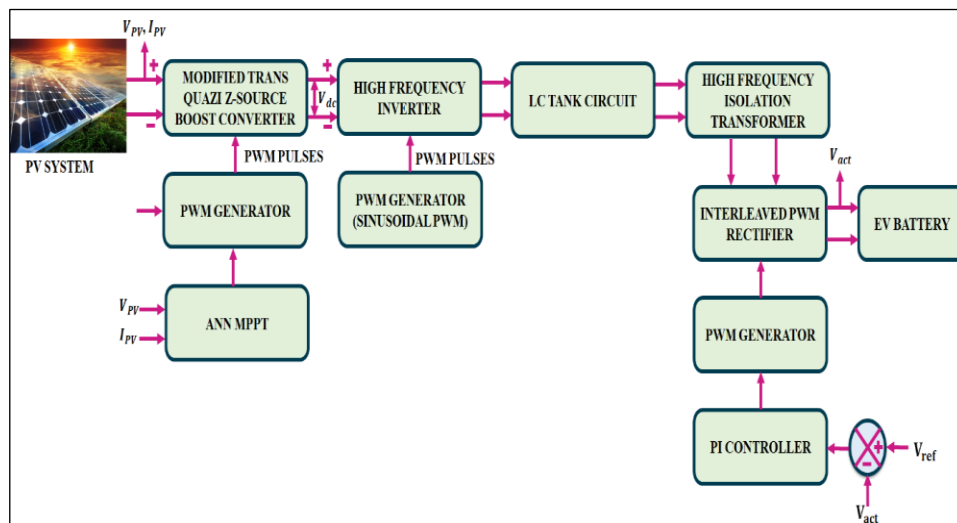


Figure 1: Block diagram of PV integrated wireless charging.

Source: Authors, (2026).

An artificial neural network is used for MPPT in order to maximize energy harvesting from the PV system. By keeping the output voltage (V_{act}) steady and in line with the reference voltage (V_{ref}), the proportional-integral (PI) controller improves the overall system performance and efficiency. Finally, the entire system is validated through a MATLAB simulation 2024a.

II.1 MODELLING OF PV SYSTEM

Figure 2 displays the basic solar cell equivalent model, which uses the p-n junction feature to directly transfer solar energy to electrical energy. The output energy yield is increased by properly combining several PV cells. The simple PV equivalent circuit consists of current source, diode as well as series or parallel resistance.

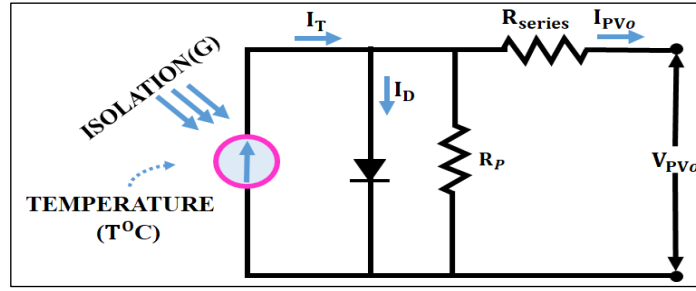


Figure 2: Equivalent diagram of PV system.
Source: Authors, (2026).

The mathematical expression for output current is,

$$I_{PV0} = I_T - I_{sat} \times \left[e^{\frac{Q(V_{PV0} + I_{PV0} \times R_{series})}{\eta K_B T_P}} \right] \quad (1)$$

Here, V_{PV0} specifies output of PV module, I_{PV0} indicates output of PV current, I_{sat} denotes reverse saturation diode, I_T is the photon current, R_{series} refers resistance in series, T_P is the operating panel temperature, Q is the charge of electron and K_B shows boltzman constant correspondingly. Owing to the varying environmental changing conditions, the PV module requires converter for boosting up the output voltage of PV, thus Modified converter is developed in this work for achieving higher output level needed for the DC bus/battery.

II.2 MODIFIED TRANS QUASI Z-SOURCE BOOST CONVERTER

An innovative power converter that increases voltage boost capabilities while offering increased efficiency and dependability is the modified Trans Quasi Z-Source Boost Converter (MTQZBC). The quasi-Z-source topology that underpins this converter combines the advantages of Z-source networks and conventional boost converters. The first step involves applying the input voltage to the converter, which uses a special quasi-Z-source network made up of capacitors and inductors to enhance the input voltage.

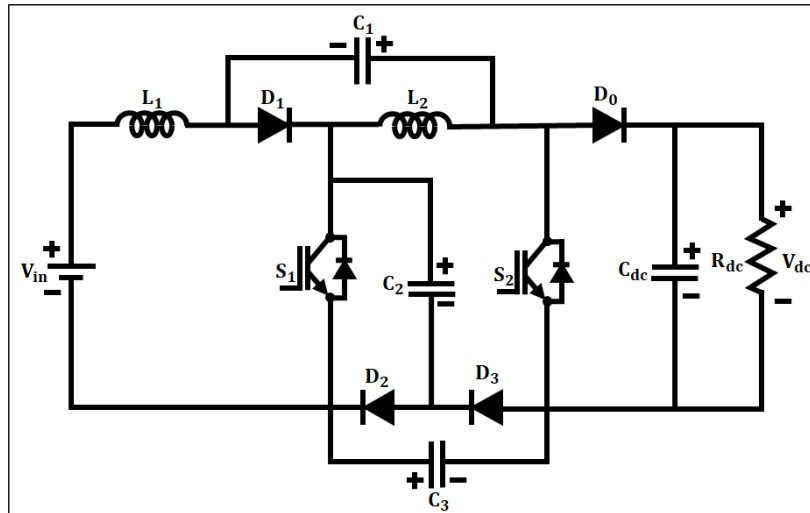


Figure 3: Modified Trans Quasi Z-Source Boost Converter.
Source: Authors, (2026).

The inductors store energy while the capacitors charge during the switch's ON phase. The inductors' stored energy is released when the switch is turned off, and it combines with the input voltage to increase the output voltage. By improving the impedance network, the improved topology optimizes this process, reducing the impact of voltage spikes and strengthening the control strategy as a whole. Greater reliability results from this design's ability to facilitate smoother transitions and lessen component stress. Additionally, the converter can effectively handle changing load circumstances and input voltages by modifying the duty cycle and applying sophisticated control techniques, which makes it appropriate for demanding power systems and renewable energy applications.

Mode 1: Both the switches S_1 and S_2 are kept in ON state during mode 1 operation. Due to this reason diodes D_0 , D_1 and D_2 are turned OFF, while D_3 remains ON and conducts. The inductors L_1 , L_2 and capacitor C_3 store energy to the maximum possible level, Whereas, C_1 , C_2 and C_{dc} discharge. The voltage and current across the inductor and capacitors is given as,

$$V_{L1} = V_{in} + V_{C1} + V_{C3} \quad (2)$$

$$V_{L2} = V_{C2} = V_{C3} \quad (3)$$

$$i_{C1} = -i_{L1} \quad (4)$$

$$i_{C2} = -(i_{L1} + i_{L2} + i'_{C3}) \quad (5)$$

$$i_{Cdc} = -i_{dc} \quad (6)$$

Where, i'_{C3} denotes the average current passing via capacitor C_3 .

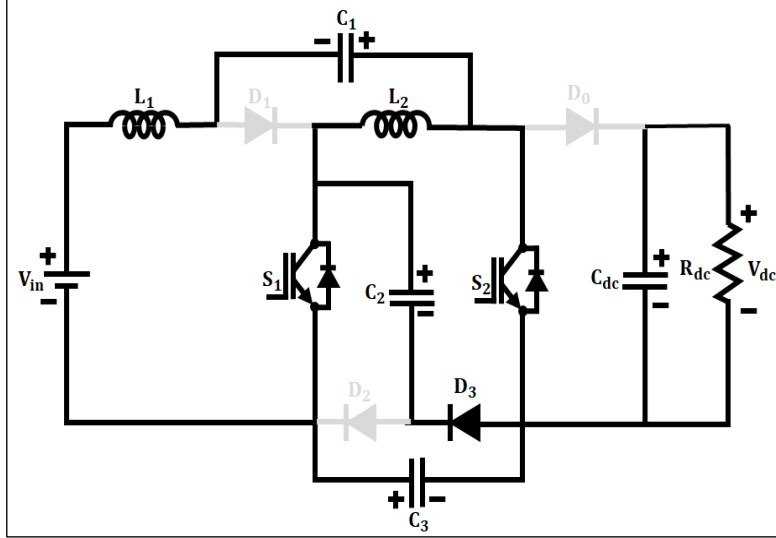


Figure 4: Mode 1 Operation.

Source: Authors, (2026).

Mode 2: Both the switches S_1 and S_2 are kept in OFF state during mode 2 operation making the diode D_3 reverse biased and non-conducting. Meanwhile, the diodes D_0, D_1 and D_2 is turned ON and starts conducting. The inductor L_1, L_2 and capacitor C_3 releases while, C_1, C_2 and C_{dc} stores. Similarly, voltage and current across the inductor and capacitors is given as,

$$V_{L1} = V_{in} - V_{C2} = V_{in} + V_{C1} + V_{C3} - V_{dc} \quad (7)$$

$$V_{L2} = -V_{C1} = V_{C2} + V_{C3} - V_{dc} \quad (8)$$

$$i_{C1} = i_{L2} - i_{dc} - i'_{Cdc} \quad (9)$$

$$i_{C2} = i_{L1} - i_{dc} - i'_{Cdc} \quad (10)$$

$$i_{C3} = -(i_{dc} + i'_{Cdc}) \quad (11)$$

Where, i'_{Cdc} indicates average current passing via the capacitor C_{dc} .

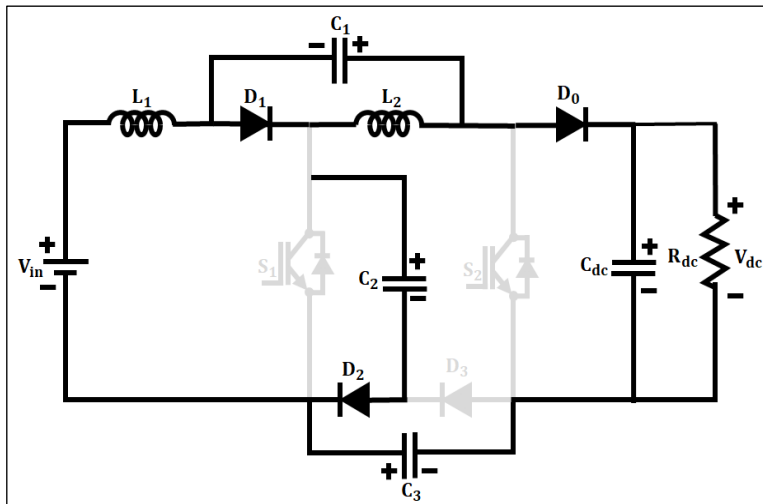


Figure 5: Mode 2 Operation.

Source: Authors, (2026).

II.3 HIGH FREQUENCY INVERTER

A high-frequency inverter is a device that converts DC into high-frequency AC using advanced switching techniques. The process begins with a DC power source, such as a battery or solar panel, supplying voltage to the inverter. The inverter employs high-speed switching devices, typically MOSFETs or IGBTs, to rapidly turn the DC input on and off. This switching action generates a pulsed DC signal, which is then shaped into a high-frequency waveform, often in the range of several kilohertz to megahertz. The inverter typically includes a resonant circuit or transformer to help generate a stable AC output with the desired frequency and voltage levels. Additionally, by reducing the losses connected to conventional low-frequency inverters, high-frequency operation increases the power conversion process' efficiency. Feedback control systems keep an eye on the output waveform and dynamically modify the duty cycle and switching frequency to guarantee peak performance. Under various load circumstances, this regulation aids in maintaining the intended output characteristics. High-frequency inverters are so frequently utilized in applications where performance, size, and efficiency are crucial, such as electric car drives, renewable energy systems, and uninterruptible power supplies (UPS).

II.4 LC TANK CIRCUIT

An inductor (L) and a capacitor (C) coupled in parallel or series create an oscillating resonant frequency in an LC tank circuit, sometimes referred to as a resonant circuit. When the circuit is energized either by introducing a DC voltage or by giving the capacitor an initial charge the operation starts. Through the inductor, the capacitor begins to charge, storing energy in its electric field during the process. When the capacitor is fully charged, it starts to discharge through the inductor, which creates a magnetic field and causes current to flow. The values of L and C determine the circuit's natural resonant frequency, which is where oscillations are produced by the interaction between the inductor and capacitor. A sinusoidal waveform results from the energy oscillating between the inductor and capacitor. The circuit's quality factor (Q), which measures how underdamped it is, determines how long the oscillation can last and how much energy the circuit can exchange. Longer oscillation durations are produced by higher Q values, whereas greater energy loss usually as a result of circuit resistance is indicated by lower Q values. Because they can selectively resonate at particular frequencies, LC tank circuits are frequently employed in devices like radio transmitters, receivers, and filters, allowing for effective signal processing and transmission.

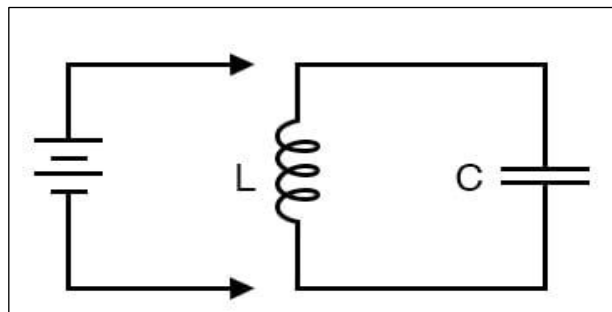


Figure 6: LC Tank Circuit.
Source: Authors, (2026).

II.5 HIGH FREQUENCY ISOLATION TRANSFORMER

An isolation transformer is a transformer designed to provide electrical isolation between two circuits while transferring electricity between them. Its main function is to isolate input and output power, increasing safety and reducing the risk of electric shock. The working process of an isolation transformer begins with the supply of alternating current (AC) to the primary winding. This winding has a large number of iron turns wrapped around a magnetic core that facilitates the transmission of energy. When AC voltage is applied to the first winding, a magnetic field is created, which induces voltage in the second winding, which is also wrapped around a magnetic core. The primary and secondary windings are electrically isolated from each other, meaning there is no electrical connection between them. This isolation is important for safety applications such as medical equipment or sensitive electronic devices because it prevents noise and interference from being transferred from one environment to another. The transformation of an isolation transformer is determined by the number of turns in the primary and secondary windings. For example, if the primary winding has more turns than the secondary winding, the transformer will reduce the voltage, while the opposite configuration will increase the voltage.

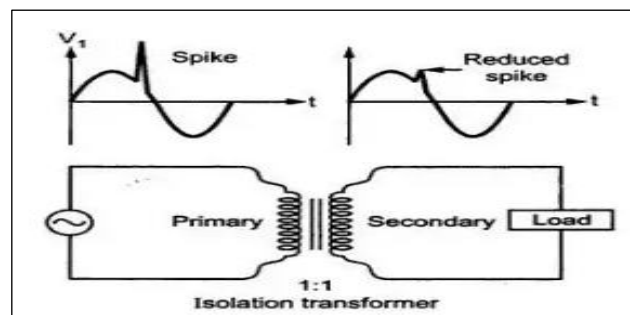


Figure 7: Isolation Transformer.
Source: Authors, (2026).

However, the main purpose of the transformer is not to convert electricity, but to provide a safe, isolated environment for the electronic components. One of the main benefits of using an isolator is that it can help prevent ground faults and reduce electromagnetic interference (EMI). By isolating connected equipment from the power supply, you reduce the risk of electric shock to users and protect equipment from electric shock and fire electricity. It can also help balance the situation at different levels and improve the overall results of an electrical installation.

II.6 ANN MPPT

The ANN-based MPPT controller is employed to extract maximum power from the PV array under varying irradiance and temperature conditions. The neural network architecture consists of an input layer receiving PV voltage (V_{pv}) and PV current (I_{pv}), a hidden layer with nonlinear activation functions (tansig), and an output layer that generates the optimal duty cycle (D) for the Modified Trans Quasi Z-Source Boost Converter. The ANN is trained using supervised learning based on PV characteristics obtained under different environmental conditions to model the nonlinear relationship between input variables and the maximum power point. During real-time operation, the trained ANN processes the sensed PV parameters and dynamically updates the duty cycle through a PWM controller, enabling rapid convergence to the maximum power point. This approach significantly reduces steady-state oscillations, improves tracking accuracy, and enhances dynamic response compared to conventional MPPT techniques. Consequently, the ANN-based control improves energy extraction efficiency, ensures stable converter operation, and enhances the overall performance of the PV-integrated wireless power transfer system for EV charging applications. A typical ANN MPPT used in this type of system consists of:

- Input Layer: V_{pv} , I_{pv} (and optionally irradiance, temperature)
- Hidden Layer(s): Nonlinear processing neurons (sigmoid/tansig)
- Output Layer: Duty cycle (D) or reference voltage (V_{ref})
- Mathematically:

$$D = f(V_{pv}, I_{pv}, G, T) \quad (12)$$

Here, D = Duty cycle generated by ANN, G = Irradiance and T = Temperature

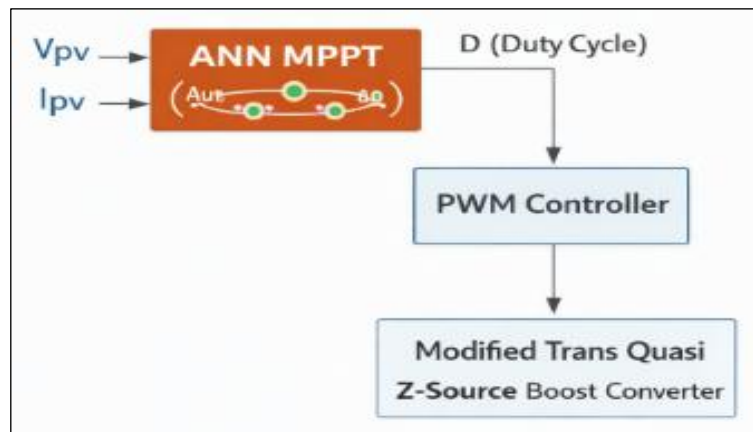


Figure 8: ANN MPPT.
Source: Authors, (2026).

The ANN MPPT is shown in Figure 8, where the photovoltaic (PV) array output parameters, namely PV voltage (V_{pv}) and PV current (I_{pv}), are used as input signals to the Artificial Neural Network (ANN) based MPPT controller. The ANN processes these real-time inputs and predicts the optimal duty cycle (D) corresponding to the maximum power point of the PV system under varying irradiance and temperature conditions. The generated duty cycle is then fed to the PWM controller, which produces appropriate switching pulses for the power converter. These gate pulses control the Modified Trans Quasi Z-Source Boost Converter, thereby adjusting the operating point of the PV array to ensure maximum power extraction and improved energy conversion efficiency. This intelligent control structure enhances tracking speed, reduces steady-state oscillations, and provides stable operation of the PV-fed wireless charging system.

III. RESULTS AND DISCUSSION

Figure 9 presents the overall MATLAB/Simulink model of the proposed PV-integrated wireless EV charging system. The model consists of a PV array, ANN-based MPPT controller, Modified Trans Quasi Z-Source Boost Converter, high-frequency inverter, resonant LC tank circuit, isolation transformer, synchronous rectifier, and PI-controlled output stage. The PV array generates voltage and current signals, which are processed by the ANN MPPT to produce an optimal duty cycle for the converter. The boosted DC output is then converted into high-frequency AC through the inverter and transferred wirelessly via the resonant LC tank and transformer. Finally, the rectifier and PI controller ensure stable DC output for EV battery charging, demonstrating coordinated operation of all subsystems in the proposed architecture.

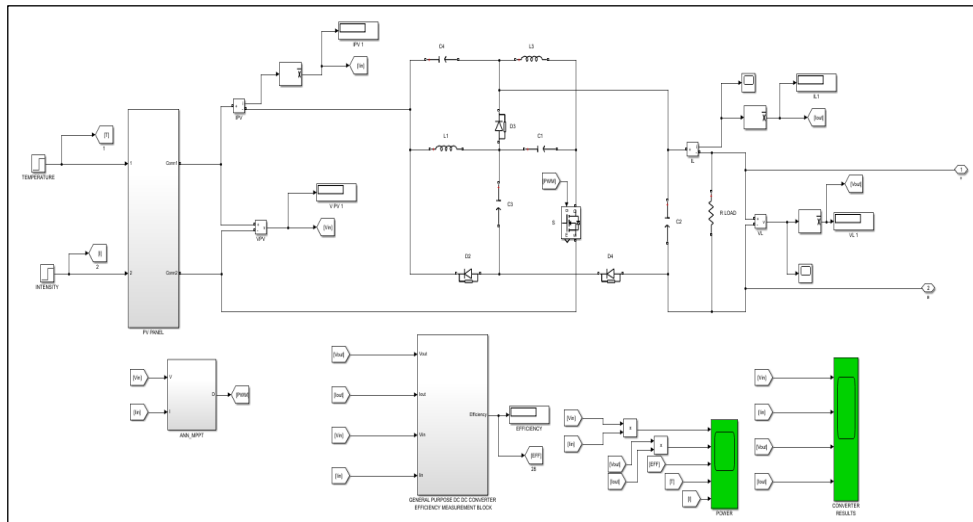


Figure 9: Overall Simulation Diagram.
Source: Authors, (2026).

CONSTANT TEMPERATURE AND CONSTANT INTENSITY

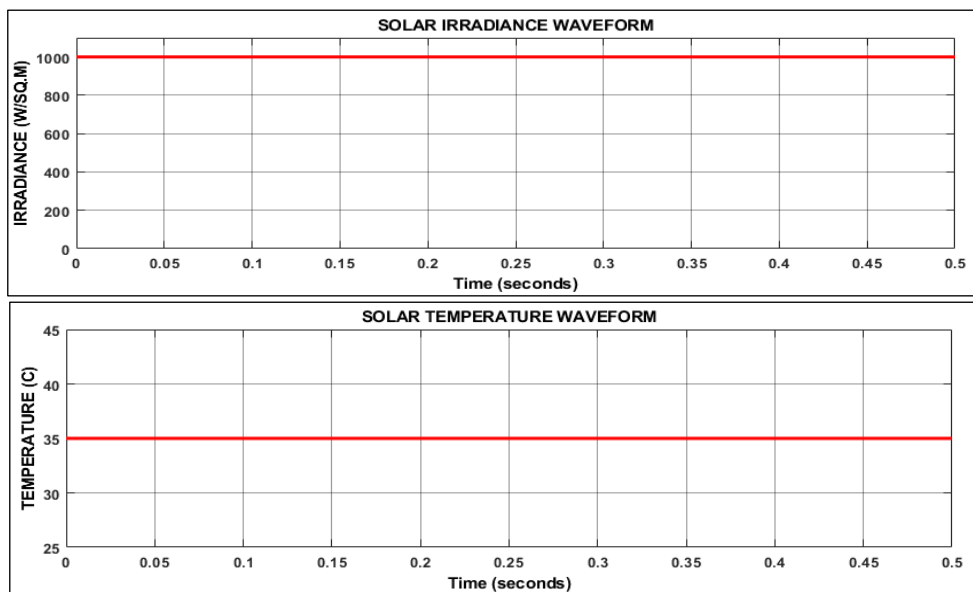
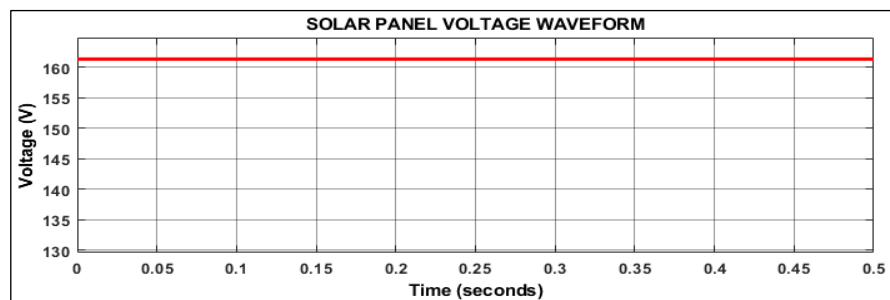


Figure 10: Solar Temperature and Intensity Waveform.
Source: Authors, (2026).

Figure 10 shows the solar temperature and irradiance waveforms under constant environmental conditions. The upper graph represents the solar temperature, consistently maintaining a level of 40°C across the time span of 0 to 0.7 seconds, indicating stability in temperature measurements. The lower graph depicts solar intensity, measured in W/m², but shows a flat line, suggesting no variation or activity during the observed interval. Together, these waveforms provide insights into the solar conditions, highlighting the stable temperature and lack of intensity changes.



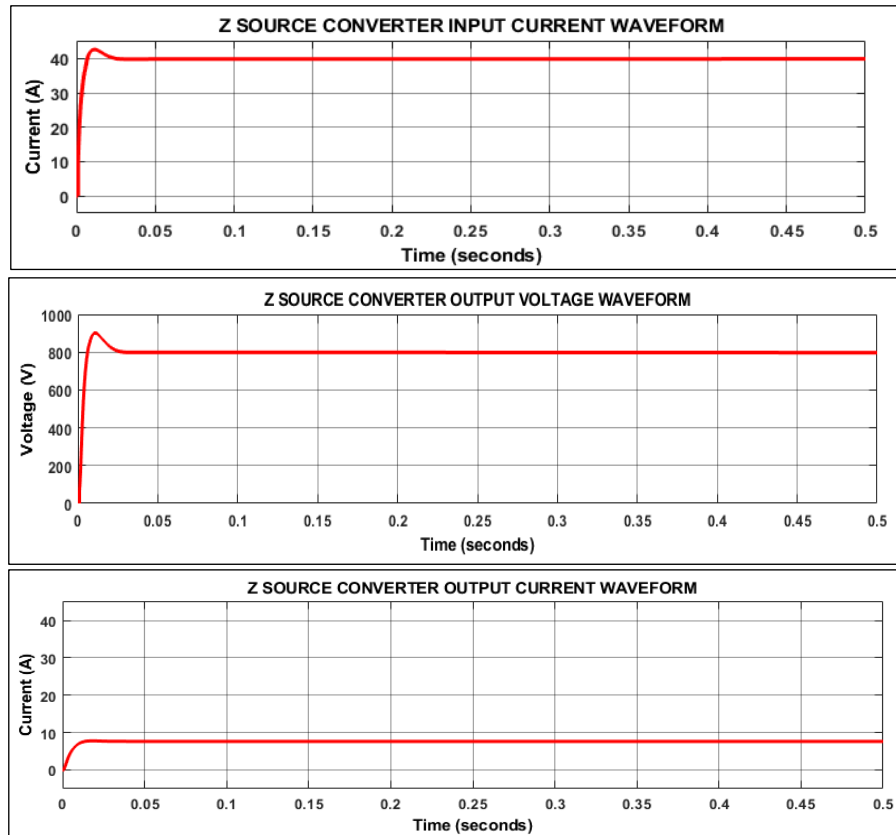


Figure 11: Solar Panel Voltage Waveform and Z Source Converter Input and Output Waveforms.
Source: Authors, (2026).

Figure 11 presents the PV voltage and converter input–output waveforms demonstrating stable system operation. The upper left graph shows the solar panel voltage, which remains steady at approximately 50 volts over the observed time of 0 to 0.7 seconds, indicating a consistent power output from the solar panel. The upper right graph depicts the input current to the Z-source converter, displaying a stable value of around 30 amps, suggesting efficient energy transfer. The lower two graphs illustrate the converter's output. The output current waveform shows a brief spike before stabilizing, while the output voltage waveform consistently holds at 150 volts. Together, these waveforms reflect the system's efficiency in converting and maintaining steady energy flow, essential for reliable solar energy applications.

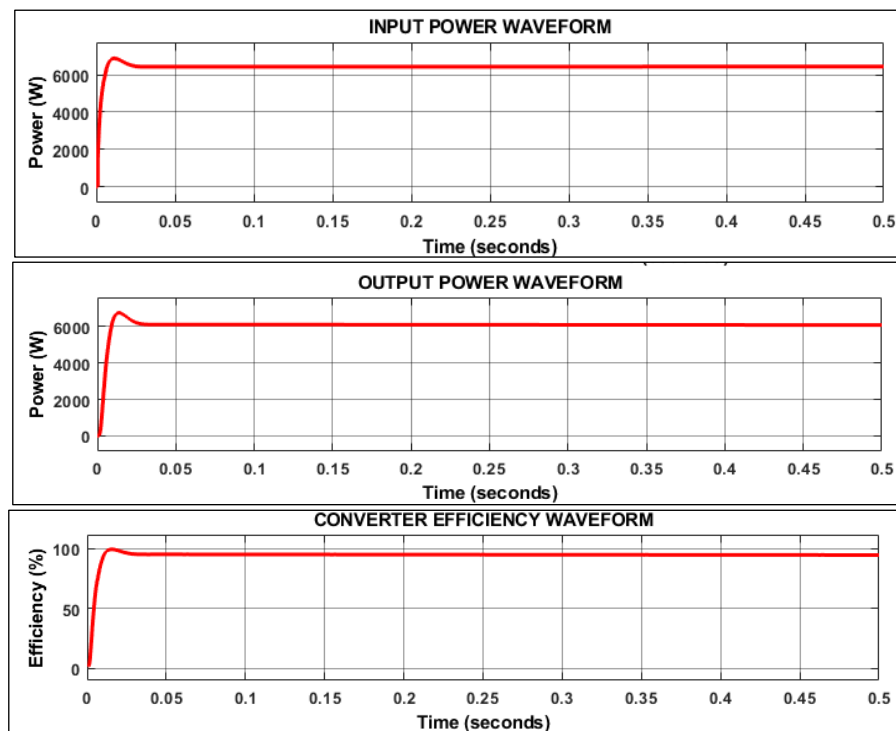


Figure 12: Input Power and Output Power Waveform.
Source: Authors, (2026).

Figure 12 shows the input and output power waveforms, indicating efficient power conversion and stable energy transfer. The input power remains steady at around 6000 watts throughout the time duration of 0 to 0.7 seconds, indicating a stable energy supply to the system. Conversely, the output power displays a slight dip but maintains a relatively constant level, suggesting efficient energy conversion. Together, these waveforms illustrate the system's effectiveness in processing and delivering energy consistently.

VARYING TEMPERATURE AND VARYING INTENSITY

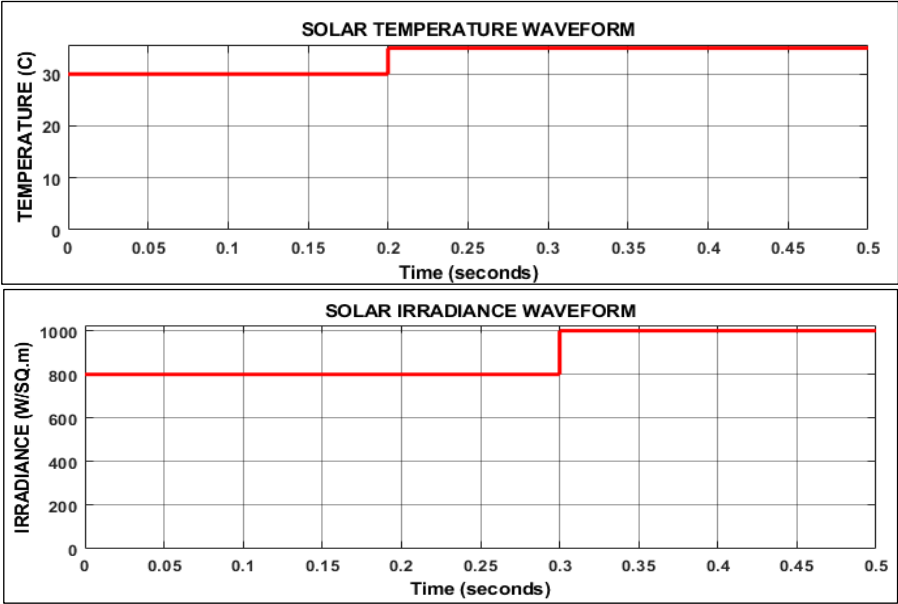
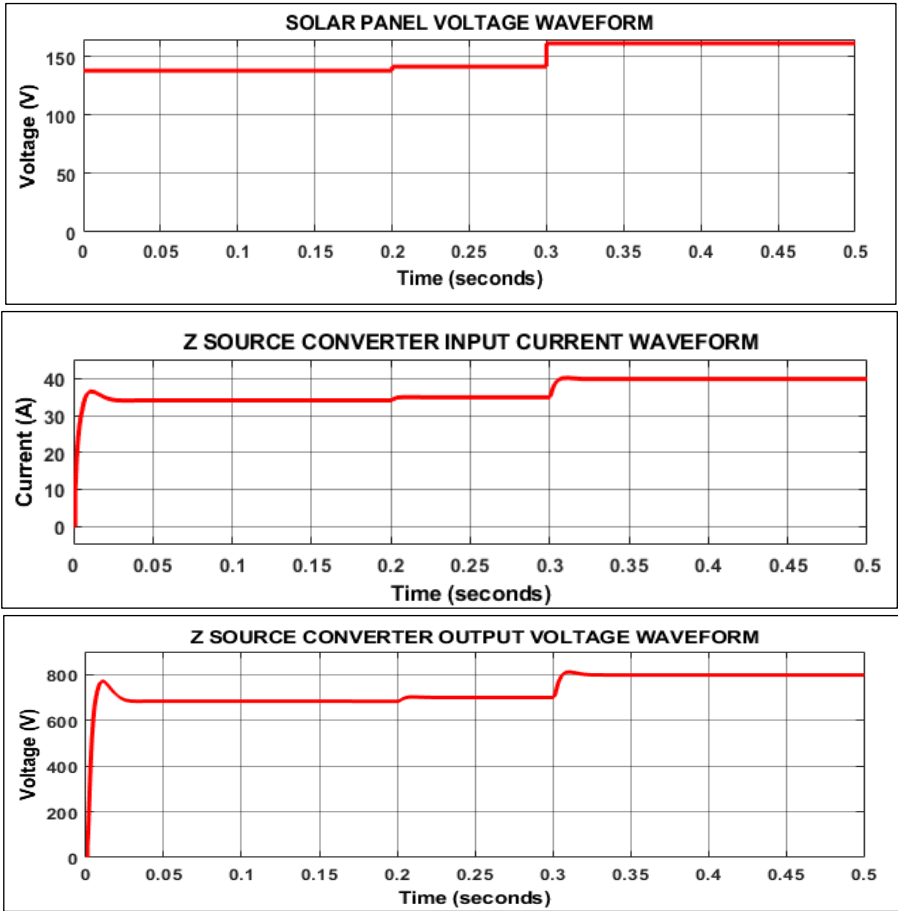


Figure 13: Solar Temperature and Intensity Waveform.
Source: Authors, (2026).

The figure 13 illustrates the waveforms: solar temperature and solar intensity. The upper graph shows the solar temperature, which remains steady at approximately 40°C across the time span of 0 to 0.7 seconds, indicating consistent thermal conditions. The lower graph represents solar intensity, holding stable at around 800 W/m² during the same period. This stability in both temperature and intensity suggests that the solar energy system operates under constant environmental conditions, crucial for optimal performance and energy generation.



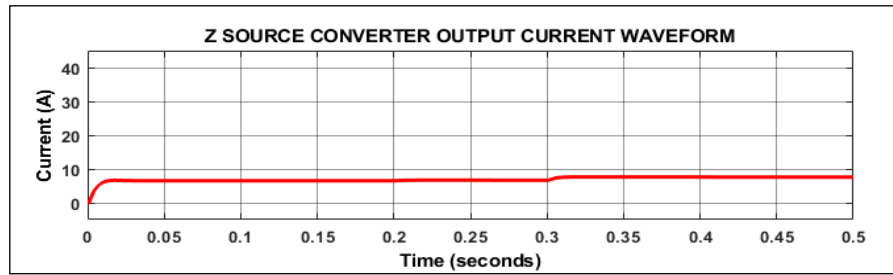


Figure 14: Solar Panel Voltage Waveform and Z Source Converter Input and Output Waveforms.
Source: Authors, (2026).

The figure 14 displays four waveforms related to a solar energy system, highlighting the performance of solar panel output and a Z-source converter. The upper section features the solar panel voltage waveform, which remains stable at approximately 48 volts throughout the 0 to 0.7 seconds time frame. Accompanying this, the Z-source converter input current waveform shows a consistent current of about 50 amps, indicating a steady flow of energy into the converter. Below, the Z-source converter output voltage waveform also maintains a stable level, suggesting efficient energy transformation. Finally, the output current waveform reflects a steady current, demonstrating the converter's effectiveness in delivering power. Overall, these waveforms illustrate the reliability and efficiency of the solar energy system in converting and managing electrical output.

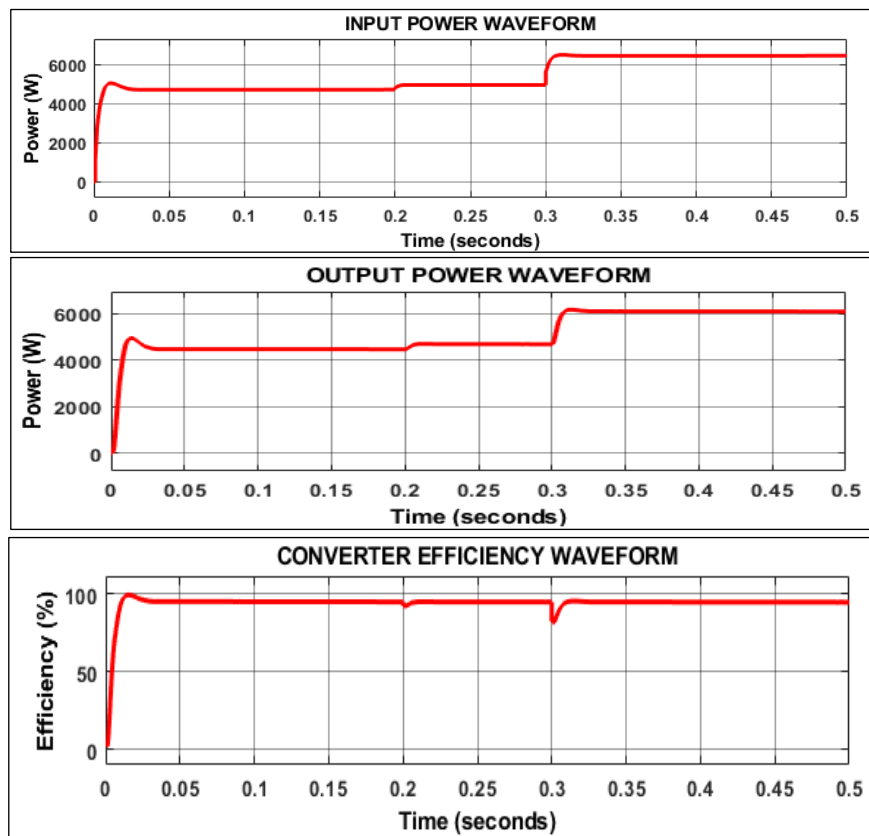
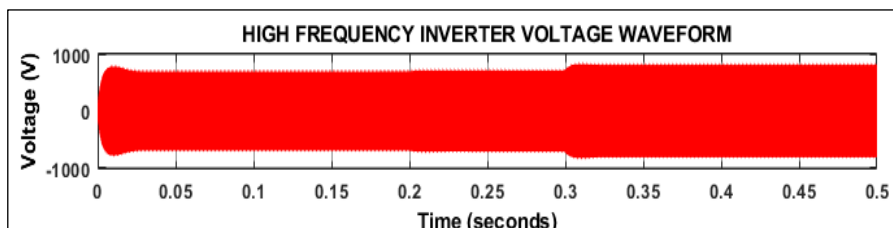


Figure 15: Input and Output Power Waveform.
Source: Authors, (2026).

Figure 15 shows the input and output power waveforms, where both remain approximately at 6000 W, confirming high efficiency and stable power transfer. The input power waveform, shown on the left, remains consistently around 6000 watts throughout the 0 to 0.7 seconds duration, indicating a stable energy supply. Conversely, the output power waveform on the right also stabilizes at approximately 6000 watts, reflecting effective energy conversion. This consistency in both input and output power demonstrates the system's reliability and efficiency in harnessing and delivering energy from solar sources.



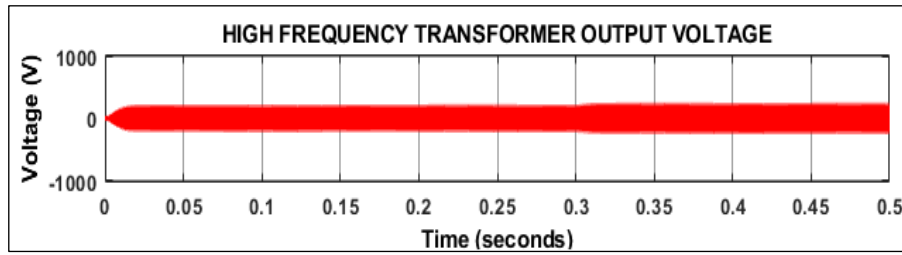


Figure 16: High Frequency Inverter and Transformer Output Voltage Waveform.
Source: Authors, (2026).

Figure 16 shows the high-frequency inverter voltage and transformer output voltage, validating effective DC–AC conversion and voltage transformation. The inverter voltage waveform fluctuates between approximately -500 volts and +500 volts, indicating the inverter's role in converting direct current to alternating current. In contrast, the transformer output voltage remains stable around -200 volts, demonstrating effective voltage transformation. These waveforms highlight the operational characteristics of the inverter and transformer, showcasing their importance in managing electrical energy in high-frequency applications.

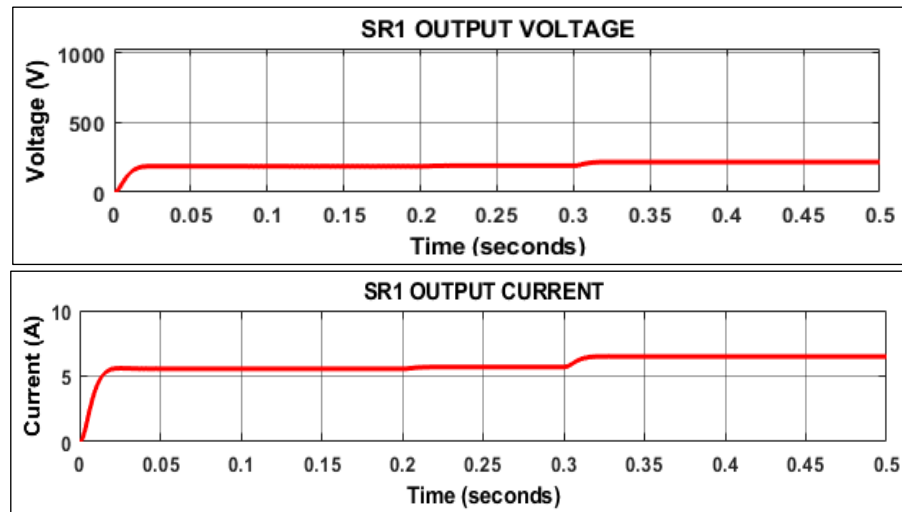


Figure 17: Synchronous Rectifier 1 Output Voltage and Current Waveform.
Source: Authors, (2026).

The figure 17 displays the output characteristics of a synchronous rectifier, featuring two key waveforms: voltage on the left and current on the right. The voltage waveform stabilizes around 200 volts after a brief initial fluctuation, indicating consistent performance in converting AC to DC. Meanwhile, the current waveform reaches approximately 6 amperes, demonstrating effective current flow through the rectifier. Together, these waveforms reflect the synchronous rectifier's efficiency in providing stable voltage and current, essential for reliable power delivery in electronic circuits.

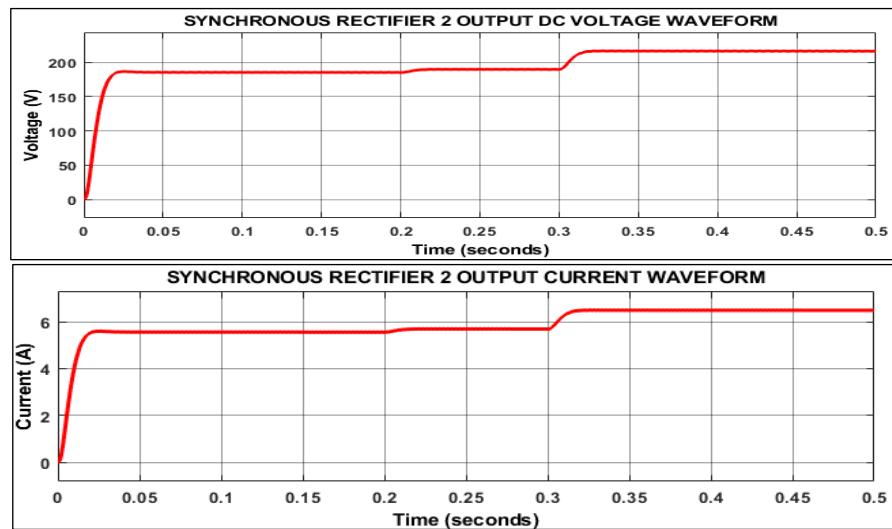


Figure 18: Synchronous Rectifier 2 Output Dc Voltage and Output Current Waveform.
Source: Authors, (2026).

The figure 18 illustrates the output performance of a second synchronous rectifier, showcasing voltage on the left and current on the right. The voltage waveform stabilizes around 200 volts, indicating reliable DC output after a brief transient period. On the right, the current waveform reaches a steady state of approximately 6 amperes, demonstrating effective current delivery. These waveforms collectively highlight the synchronous rectifier's functionality in maintaining consistent voltage and current levels, crucial for efficient energy conversion in various electronic applications.

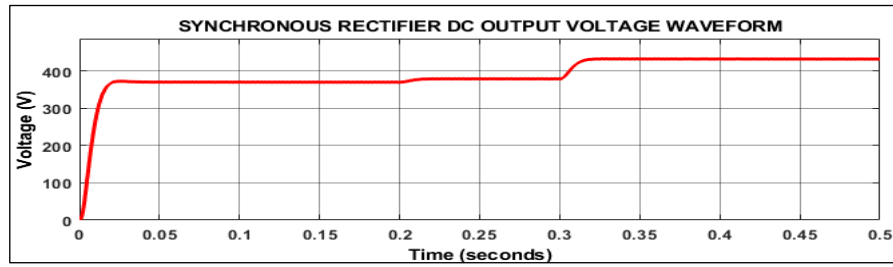


Figure 19: Synchronous Rectifier Dc Output Voltage Waveform.

Source: Authors, (2026).

The figure 19 displays the voltage output of a synchronous rectifier over a time span of 0.7 seconds. Initially, the voltage increases rapidly, reaching a peak around 500 volts. After a brief transient phase, the voltage stabilizes near 400 volts, indicating a steady DC output. This stability is crucial for applications requiring consistent voltage levels. The waveform illustrates the rectifier's effectiveness in converting AC to DC, ensuring reliable performance in various electronic systems and enhancing overall energy efficiency.

Table 1: Comparison of WPT systems.

S. No	Comparison Factor	Conventional Inductive WPT	Resonant WPT (LCC/LC)	Proposed PV-Integrated WPT
1	Power Transfer Efficiency	85%	91%	98.96%
2	Output Power Capability	3 kW	5 kW	6 kW

Source: Authors, (2026).

The simulation results presented in Figures. 9–19 clearly justify all the stated objectives of the paper. The overall system model and continuous stage-wise waveforms confirm the successful design of a PV-integrated wireless charging architecture, where energy flows effectively from the PV source to the EV load. The converter results show that the PV voltage of about 48–50 V is boosted to nearly 150 V, validating the high-gain performance of the Modified Trans Quasi Z-Source Boost Converter. The high-frequency inverter and transformer voltage waveforms, along with stable rectifier outputs, demonstrate efficient resonant wireless power transfer using the LC tank circuit. The nearly constant input power (6000 W) under both constant and varying irradiance conditions indicates that the ANN-based MPPT effectively maximizes solar energy extraction. Finally, the rectifier output voltage stabilizing around 200–400 V with steady current and minimal oscillations confirms that the PI controller ensures stable voltage regulation and improved overall system performance, thereby validating the effectiveness of the proposed system based on the obtained simulation results.

IV. CONCLUSION

This paper proposed a PV-integrated wireless power transfer system for electric vehicle charging using a Modified Trans Quasi Z-Source Boost Converter and ANN-based MPPT control. The simulation results demonstrate that the PV array delivers a stable voltage of about 48–50 V, which is effectively boosted to nearly 150 V, confirming the high-gain capability of the proposed converter. The input power remains approximately constant at around 6000 W, while the output power also stabilizes close to 6000 W, indicating efficient power conversion and transfer through the resonant wireless charging architecture. The rectifier output voltage is maintained in the range of 200–400 V with a steady current of about 6 A, ensuring reliable EV battery charging. Moreover, the system achieves a converter efficiency of 97.79% and a tracking efficiency of 98.96%, validating the effectiveness of the ANN-based MPPT in maximizing solar energy extraction. Overall, the numerical results confirm stable voltage regulation, high efficiency, and robust performance of the proposed PV-fed wireless charging system under varying operating conditions.

V. AUTHOR'S CONTRIBUTION

Conceptualization: Naveena Sandhadi, Srinu Naik Ramavathu.

Methodology: Naveena Sandhadi, Srinu Naik Ramavathu.

Investigation: Naveena Sandhadi, Srinu Naik Ramavathu.

Discussion of results: Naveena Sandhadi, Srinu Naik Ramavathu.

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