International Journal of Scientific Research and Modern Education (IJSRME)
International Peer Reviewed - Refereed Research Journal, Website: www.crystalpen.in
Impact Factor: 7.137, ISSN (Online): 2455 - 5630, Volume 11, Issue 1, January - June, 2026

IMPLEMENTATION OF A BRIDGELESS MANITOBA RECTIFIER TOPOLOGY FOR HIGH-EFFICIENCY WIRELESS POWER TRANSFER

R. Sathish*, R. Rishabananthan, L. Sri Kanth**, M. Varunraj** & M. Raja Sithick****

* Assistant Professor, Department of Electrical and Electronics Engineering, Dhanalakshmi Srinivasan Engineering College (Autonomous), Perambalur, Tamil Nadu, India

** UG Student, Department of Electrical and Electronics Engineering, Dhanalakshmi Srinivasan Engineering College (Autonomous), Perambalur, Tamil Nadu, India

Cite This Article: R. Sathish, R. Rishabananthan, L. Sri Kanth, M. Varunraj & M. Raja Sithick, "Implementation of a Bridgeless Manitoba Rectifier Topology for High-Efficiency Wireless Power Transfer", International Journal of Scientific Research and Modern Education, Volume 11, Issue 1, January - June, Page Number 82-85, 2026.

Type of Review: Peer Reviewed as per |C|O|P|E| Guidance.

Abstract:

Wireless power transfer (WPT) enables the transmission of electrical energy without physical connections, commonly used in charging devices and electric vehicles. Traditional methods often face drawbacks such as limited range, inefficiencies in energy transfer, and high costs associated with infrastructure. And also electromagnetic interference can hinder widespread adoption. Therefore this project proposes a Bridgeless Manitoba Rectifier aimed at enhancing the efficiency of wireless power transfer systems for charging applications. This work presents the design and control of an isolated AC–DC power conversion system based on a high-frequency link architecture. The system converts an AC source into a regulated DC output suitable for sensitive loads while ensuring galvanic isolation, high power density, and improved efficiency. The input AC voltage is first processed through a source inductance stage and a bridgeless rectifier to reduce conduction losses and improve power factor performance. The rectified DC is then fed to a single-phase high-frequency inverter, which generates high-frequency PWM signals using DSP-based controllers and gate driver circuits (TLP250). Finally, this project is implemented by DSPIC30F4011 Controller.

1. Introduction:

Wireless Power Transfer (WPT) is a revolutionary technology that enables the transmission of electrical energy without physical connectors or wires. This method of energy transfer is based on the principles of electromagnetic induction, resonant inductive coupling, or capacitive coupling. Unlike traditional power delivery systems, WPT eliminates the need for direct electrical contact, making it a safer, cleaner, and more convenient solution for powering and charging devices. The concept of wireless energy dates back to the early 20th century when Nikola Tesla first demonstrated wireless power transmission, but only in recent decades has this technology become viable for practical and commercial applications due to advancements in power electronics, control systems, and materials science.The primary motivation behind wireless power systems is to enhance mobility and reduce dependency on bulky or vulnerable cable connections.

2. Related Works:

Various research works related to wireless power transfer systems, power convertion stages, Manitoba rectifier topology are reviewed in this section.

A. Need for Wireless Power Transformer:

The need for Wireless Power Transfer (WPT) arises from the increasing demand for convenience, safety, and efficiency in power delivery systems. Traditional wired power transmission methods, while widely used, suffer from several inherent limitations such as physical wear and tear, wire clutter, contact corrosion, and safety hazards due to exposure to electricity. WPT provides an innovative solution to these issues by enabling contactless energy transfer, offering a cleaner and more flexible alternative to conventional methods. One of the primary reasons for adopting WPT is enhanced mobility and convenience. In applications like mobile phone charging or wearable electronics, users are often constrained by the presence of cables. Wireless power allows charging without direct connection, enabling seamless user experiences and reducing cable-related failures. Similarly, in medical devices such as pacemakers or implanted sensors, wireless energy transfer is essential because wired connections through the skin are not only impractical but also pose infection risks.

B. Basic Principle of Operation:

Wireless Power Transfer (WPT) operates on the principle of electromagnetic field coupling, allowing electrical energy to be transmitted from a power source to a load without physical wires. The fundamental idea is based on Faraday's Law of Electromagnetic Induction, which states that a time-varying magnetic field can induce a voltage (electromotive force) in a nearby conductor. WPT systems typically rely on magnetic coupling (inductive or resonant) or electric field coupling (capacitive), depending on the application, range, and efficiency requirements.

C. Design and Construction:

The design and construction phase is a critical part of any Wireless Power Transfer (WPT) system. It involves the hardware layout, component selection, circuit architecture, coil design, and overall integration of the transmitter and receiver sides to ensure efficient energy transfer.

D. Power Consvertion Stages:

In a WPT system, power conversion is essential to process electrical energy at both ends from source to usable output. It includes AC/DC, DC/AC, and regulation stages for both transmitter and receiver.

- AC to DC Conversion (If Using Mains Supply)
- DC to High-Frequency AC Conversion (Inverter Circuit)
- Electromagnetic Power Transfer
- AC to DC Conversion at Receiver (Rectification Stage)
- Voltage Regulation and Output Conditioning
- Optional Feedback/Control Loop (Advanced Designs)

3. Proposed System:

Wireless Power Transfer (WPT) is an innovative technology that allows energy to be transmitted without the need for physical wires or cables. It relies on the principles of electromagnetic fields, primarily using inductive or capacitive coupling to transfer power over short distances. WPT has applications in numerous fields, including mobile device charging, electric vehicles (EV), medical implants, and consumer electronics.

This rectifier converts the AC input into a pulsating direct current (DC) that is further processed to maintain consistent power flow. Once the AC is rectified into pulsating DC, the power is sent to a high-frequency inverter. The role of this inverter is crucial, as it converts the low-frequency DC signal into a high-frequency AC signal suitable for wireless transmission. The inverter operates using Pulse Width Modulation (PWM) controlled by a PWM generator, typically a DSPIC30F4011 controller, which adjusts the frequency and timing of the AC signal.

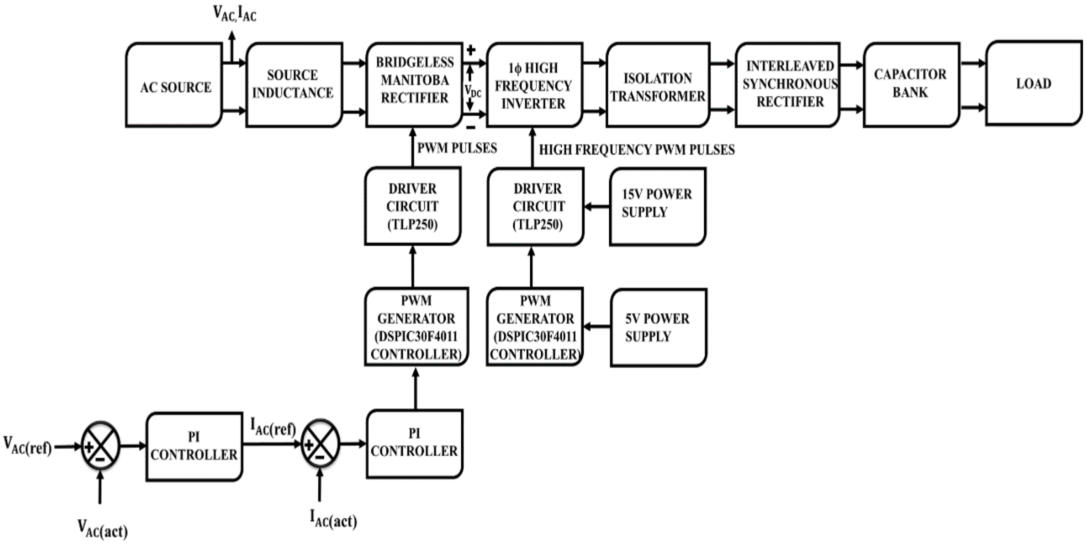

Figure 1: Math block and ANN block

4. Hardware Implementation:

The dsPIC30F4011 is a high-performance 16-bit digital signal controller from Microchip, combining microcontroller and digital signal processor features. It comes in a 40-pin package, providing flexible I/O, 9 analog input channels (10-bit ADC), and 6 PWM outputs for precise control of motors, inverters, and converters. Operating at 30 MIPS and 4.5–5.5 V, it includes multiple timers, UART, SPI, and I²C interfaces for real-time applications. Its Harvard architecture ensures fast execution, while integrated peripherals support voltage/current sensing and signal processing, making it ideal for embedded power electronics and automation systems requiring compact and efficient design. Thus, the PC can address up to 4M instruction words of user program space. An instruction prefect mechanism is used to help maintain throughput. Program loop constructs, free from loop count management overhead, are supported using the DO and REPEAT instructions, both of which are interruptible at any point. The working register array consists of 16x16-bit registers, each of which can act as data, address or offset registers. One working register (W15) operates as a software Stack Pointer for interrupts and calls

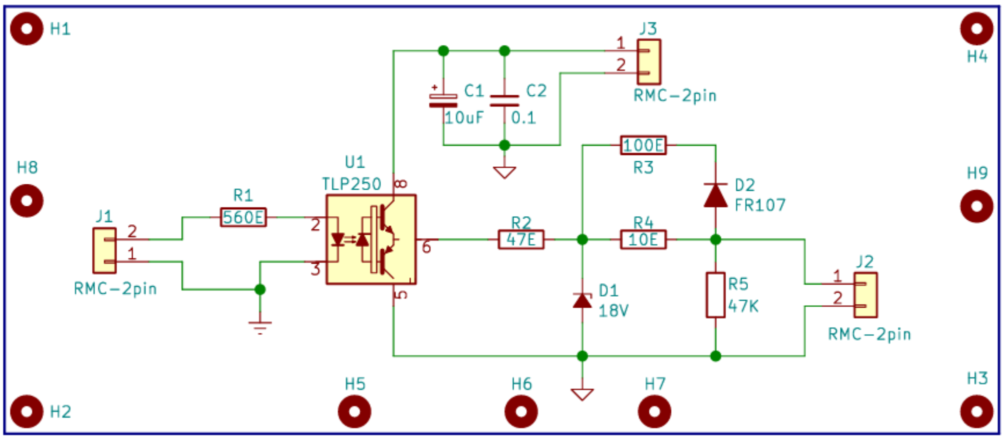

Figure 2: Driver Circuit TLP250 pin diagram

5. Results:

An AC source is used as input, with voltage boosted through a bridgeless Manitoba rectifier. The system integrates a DSPIC30F4011 controller with an isolation transformer for effective power tracking, and the performance outcomes are analyzed using a digital storage oscilloscope.

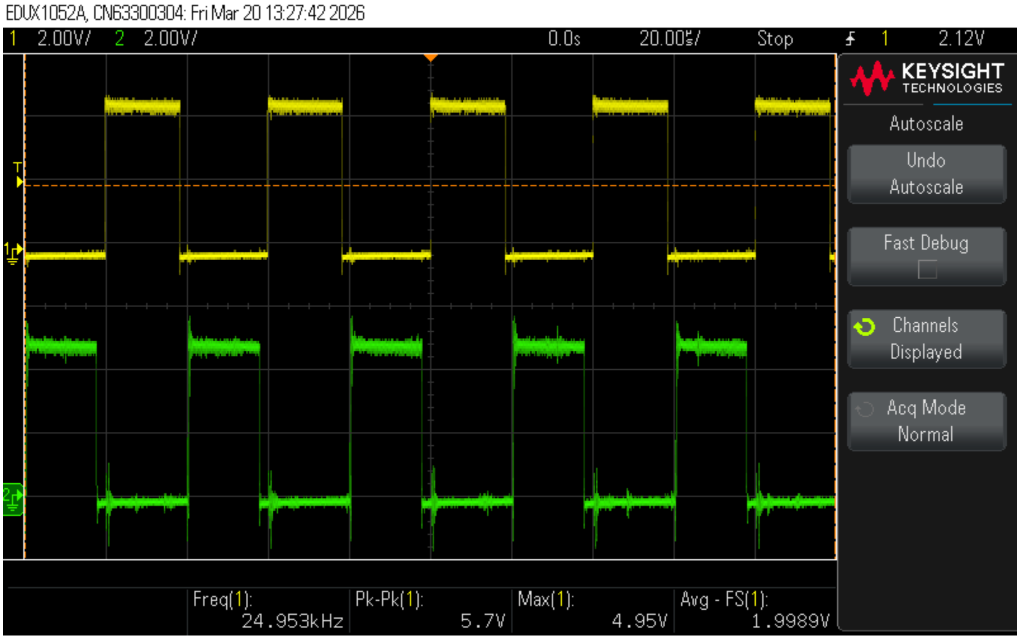

Figure 3: High frequency Inverter PWM 1&2

The measured waveform indicates a frequency of approximately 50 Hz. This AC input is supplied to the converter, where it is processed and boosted to obtain a higher voltage output for the proposed system.

The low input voltage obtained from the AC source is boosted using the proposed rectifier. The corresponding waveform indicates a clear rise in voltage level, demonstrating effective conversion, with the output voltage reaching approximately 32.4 V.

. The waveforms exhibit synchronized switching across both inverter legs, ensuring balanced operation. Uniform pulse timing and amplitude indicate stable modulation, confirming effective control of the voltage source inverter for reliable and efficient high-frequency power conversion.

S.No	Device Name	Range / Specification
1	dsPIC30F4011 (Controller)	Operating Voltage: 5 V, 10-bit ADC
2	TLP250 (Driver Circuit)	Supply Voltage: 35 V, Output Current: 1 A
3	MOSFET IRF840 (Switch)	Voltage: 500 V, Current: 8 A, 150 MHz
4	1N4007 Diode	Voltage: 1000 V, Current: 1 A
5	Switching Frequency	50 kHz

6. Conclusion:

In conclusion, the proposed wireless power transfer system using a bridgeless Manitoba rectifier demonstrates significant improvements in efficiency, power quality, and overall system performance. By eliminating conventional diode bridge losses, the system enhances energy conversion efficiency and reduces thermal stress. The integration of a high-frequency link with an isolated AC–DC converter enables compact design, reduced transformer size, and improved power density. The use of a DSP-based controller (DSPIC30F4011) with PWM generation ensures precise control and stable operation under varying load conditions. Additionally, the implementation of dual PI controllers provides effective regulation of both voltage and current, maintaining system reliability. The inclusion of an interleaved synchronous rectifier further minimizes ripple and enhances output stability. Overall, the system successfully addresses the limitations of traditional wireless power transfer methods, such as inefficiency and electromagnetic interference, making it suitable for modern charging applications including electric vehicles and portable devices.

References:

1. A. K. Karmaker, M. A. Hossain, H. R. Pota, A. Onen and J. Jung, "Energy Management System for Hybrid Renewable Energy-Based Electric Vehicle Charging Station," in IEEE Access, vol. 11, pp. 27793-27805, 2023.
2. Z. Ullah et al., "Distributed Consensus-Based Optimal Power Sharing Between Grid and EV Charging Stations Using Derivative-Free Charging Scheduling," in IEEE Access, vol. 12, pp. 127768-127781, 2024.
3. T. Aldhanhani, A. Abraham, W. Hamidouche and M. Shaaban, "Future Trends in Smart Green IoV: Vehicle-to-Everything in the Era of Electric Vehicles," in IEEE Open Journal of Vehicular Technology, vol. 5, pp. 278-297, 2024.
4. Y. Ding, F. Chen, J. Feng and H. Cheng, "Competition and Pricing Strategy of Electric Vehicle Charging Services Considering Mobile Charging," in IEEE Access, vol. 12, pp. 88739-88755, 2024.
5. A. A. Sadawi, E. Elghanam, M. S. Hassan and A. H. Osman, "On the Utilization of Blockchain and Smart Contracts in Charging Coordination of Roadway-Powered Electric Vehicles," in IEEE Access, vol. 12, pp. 29222-29237, 2024.
6. K. Vaishali and D. R. Prabha, "The Reliability and Economic Evaluation Approach for Various Configurations of EV Charging Stations," in IEEE Access, vol. 12, pp. 26267-26280, 2024.
7. S. Hamdare et al., "EV Charging Management and Security for Multi-Charging Stations Environment," in IEEE Open Journal of Vehicular Technology, vol. 5, pp. 807-824, 2024.

8. Y. Jin, M. A. Acquah, M. Seo and S. Han, "Optimal Siting and Sizing of EV Charging Station Using Stochastic Power Flow Analysis for Voltage Stability," in IEEE Transactions on Transportation Electrification, vol. 10, no. 1, pp. 777-794, March 2024.
9. S. Palanisamy and H. Lala, "Optimal Sizing of Renewable Energy Powered Hydrogen and Electric Vehicle Charging Station (HEVCS)," in IEEE Access, vol. 12, pp. 48239-48254, 2024.
10. C. Diaz-Londono, P. Maffezzoni, L. Daniel and G. Gruosso, "Comparison and Analysis of Algorithms for Coordinated EV Charging to Reduce Power Grid Impact," in IEEE Open Journal of Vehicular Technology, vol. 5, pp. 990-1003, 2024.
11. S. Adnan Albarri, A. Khalil, S. Mukhopadhyay and H. Rehman, "Electric Vehicle Traction System Performance Enhancement Using a High-Gain Adaptive Controller," in IEEE Access, vol. 12, pp. 95972-95985, 2024.
12. V. Ramakrishnan, D. Savio A, M. Shorfuzzaman and W. Mohammed Abdelfattah, "An Enhanced Vehicle-to-Vehicle Wireless Power Transfer System for Electric Vehicle Applications Using a Reconfigurable Coil Approach," in IEEE Access, vol. 13, pp. 9931-9941, 2025.
13. Z. Meira Gomes, E. d. O. Prado, Y. Le Gall, G. Damm, C. Ripoll and J. R. Pinheiro, "Design, Model, and Control of a Dynamic Wireless Power Transfer System for a 30-kW Electric Vehicle Charger Application," in IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 13, no. 3, pp. 3882-3894, June 2025.
14. D. Sirianni, T. Ohno and S. Mirić, "Wireless Power and Data Transfer for Robotic Joints Using High Coupling Magnetic Cores and Photodiode-Based Communication," in IEEE Open Journal of Industry Applications, vol. 6, pp. 525-538, 2025.
15. A. Azarbahram, O. L. A. López and M. Latva-Aho, "Waveform Optimization and Beam Focusing for Near-Field Wireless Power Transfer With Dynamic Metasurface Antennas and Non-Linear Energy Harvesters," in IEEE Transactions on Wireless Communications, vol. 24, no. 2, pp. 1031-1045, Feb. 2025.
16. D. -A. Nguyen, Y. Choi and C. Seo, "Dual-Band Rectifier Design With High Efficiency Using Simple Dual Band-Stop Network for Wireless Power Transfer," in IEEE Access, vol. 13, pp. 43218-43223, 2025.
17. F. Amadei, M. Quercio and F. RigantiFulginei, "Recent Results on the Use of Artificial Intelligence Techniques Applied to Wireless Power Transfer Systems," in IEEE Access, vol. 13, pp. 58443-58464, 2025.
18. P. Lu et al., "Power-Efficient Simultaneous Wireless Information and Power Transfer (SWIPT) for BatterylessIoT Devices Using a Co-Designed Rectifying Metantenna," in IEEE Journal of Microwaves, vol. 5, no. 1, pp. 34-47, Jan. 2025.
19. Z. Zheng, X. Chen, Y. Wang, H. Zhang, H. Wang and F. Lu, "High-Frequency Power Loss Investigation of Pavement Materials in Roadway Inductive Charging System," in IEEE Transactions on Transportation Electrification, vol. 11, no. 3, pp. 7475-7487, June 2025.
20. M. Falchi, A. Masi, P. Usai, A. Monorchio and D. Brizi, "An Electronically Reconfigurable Magnetic Metasurface for Enhanced Low-Frequency Wireless Power Transfer Applications," in IEEE Journal of Microwaves, vol. 5, no. 2, pp. 312-321, March 2025.