PROJECT ABSTRACT

Microwave Wireless Power Transmission Prototype

A benchtop wireless power transmission prototype: a transistor RF oscillator drives a tuned transmitter coil and a resonant receiver coil lights an LED array through the air, demonstrating the microwave power-beaming chain at safe low power. Delivered built-to-order with the assembled prototype, tuning procedure, report, PPT and viva kit.

01. Title

Microwave Wireless Power Transmission Prototype

02. Introduction / Background

Transferring electrical power without conductors has fascinated engineers for over a century, from Tesla's resonance experiments to modern research on wireless device charging and space-based solar power. Microwave wireless power transmission formalizes the idea as a chain: RF energy is generated, radiated, captured by a receiving element and rectified back to usable DC. Building the full microwave-band system needs expensive RF instrumentation, but the underlying physics — resonance, inductive coupling and rectification — can be demonstrated on a bench with ordinary components. This project builds that benchtop analogue: a transistor-based RF oscillator drives a hand-wound transmitter coil, a second coil tuned to the same resonant frequency couples to its field, and a rectifier board converts the received energy to light an LED array, with no wired connection between the two sides.

03. Problem Statement

Students hear about wireless charging and microwave power beaming but rarely get to measure the physics themselves: commercial chargers are sealed black boxes and true microwave-band systems are beyond a college budget and safety envelope. The project addresses this by building an open, measurable benchtop prototype where every stage of the chain is visible — oscillator, resonant coils, rectifier, load — and where coupling versus coil gap can be measured directly with a multimeter, giving the student real transfer data for the report instead of textbook figures.

04. Objectives

- Build a transistor-based RF oscillator PCB that drives a hand-wound transmitter coil.

- Wind and tune a resonant transmitter/receiver coil pair for maximum coupling at the design gap.
- Implement a receiver rectifier board that converts coupled AC into DC for an LED array load.
- Develop a documented coil-spacing and frequency-tuning procedure the student performs during calibration.
- Deliver the complete student kit: assembled prototype, wiring documentation, report, PPT and viva Q&A.

05. Proposed Methodology

The build follows three stages. (1) Oscillator: a transistor LC oscillator is assembled on a small PCB; its frequency is set by the coil inductance and tuning capacitor and verified during bench testing. (2) Coils: transmitter and receiver coils are hand-wound from copper wire on identical formers and mounted on a plywood base a few centimeters apart; resonance is matched by adjusting the tuning points while watching LED brightness. (3) Measurement: with the included multimeter procedure, supply current and LED behavior are recorded at several coil gaps, producing the transfer-versus-distance curve that forms the report's results section.

06. System Architecture / Working

A regulated 12 V DC supply powers the transistor oscillator, which produces an RF-range alternating current at the tuned LC frequency. The current flows through the transmitter coil, creating an oscillating magnetic field. The receiver coil, tuned to the same resonant frequency, couples to the field and develops an induced voltage; a rectifier on the receiver board converts it to DC for the LED array. Changing the coil gap or lateral alignment changes the coupling, and the LEDs visibly brighten or dim. The calibration procedure records supply current and LED behavior at several gaps so the student builds the transfer curve from their own measurements.

07. Hardware / Software Requirements

- Transistor-based RF oscillator PCB (LC tuned driver)
- Hand-wound resonant copper coil pair (transmitter + receiver)
- Receiver rectifier board with LED array load
- Regulated 12 V DC power supply
- Plywood mounting base, hookup wire and hardware
- Digital multimeter for measurement and calibration
- Soldering iron and basic hand tools; no software or microcontroller required

08. Expected Outcomes

- Assembled benchtop prototype with a wireless LED load lit through the air.

- Tuned resonant coil pair with a documented 2–5 cm design transfer gap.
- Multimeter-based transfer-versus-distance measurements recorded by the student.
- Complete documentation: report, PPT, wiring documentation, tuning procedure and viva Q&A.

09. Applications

- Teaching demonstration of resonance, inductive coupling and rectification.
- Concept model for the microwave power-beaming chain taught in EEE curricula.
- Reference build for other wireless-power student experiments (charging pads, sensor powering).
- Viva demonstration where coupling, gap and tuning can be shown live.

10. Future Scope

- True 2.4 GHz source-and-rectenna variant demonstrating far-field microwave beaming.
- Efficiency measurement with a calibrated load and power meter.
- Multi-receiver coupling: one transmitter feeding several tuned loads.
- Closed-loop resonance tracking that auto-tunes as the gap changes.

11. References

- Brown, W. C. — The History of Power Transmission by Radio Waves (IEEE Transactions on Microwave Theory and Techniques, 1984).
- Tesla, N. — Experiments with Alternate Currents of High Potential and High Frequency (1892).
- Kurs, A. et al. — Wireless Power Transfer via Strongly Coupled Magnetic Resonances (Science, 2007).
- Matsumoto, H. — Research on Solar Power Satellites and Microwave Power Transmission in Japan (IEEE Microwave Magazine, 2002).