iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** III **Month of publication:** March 2019

DOI: http://doi.org/10.22214/ijraset.2019.3146

Bidirectional Full Bridge Configuration for Inductive Wireless Power Transfer

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Abstract: The wireless power transfer (WPT) offers a band new way for energy acquisition in electric-driven devices. An active resonance circuit is used to wirelessly transfer power from the transmitter to the receiver. In traditional circuits parallel L-C resonant tank in transmitter circuit is commonly used, where as our project utilizes series-parallel CLC tank circuit. Capacitive WPT is used for low power applications whereas the wireless inductive power transfer (IPT) is used for both low and medium power applications. Various WPT applications are electric vehicles, electronic gadgets, lighting, material handling and biomedical implants. Day by day new technologies are making our life simpler. Wireless charging through resonance could be one of the next technologies that bring the future nearer. In this project it has been shown that it is possible to charge low power devices wirelessly via inductive coupling. It minimizes the complexity that arises for the use of conventional wire system. In addition, the project also opens up new possibilities of wireless systems in our other daily life uses.
Keywords: Wireless power transfer, Transmitter, Receiver, Bidirectional power transfer

I. INTRODUCTION

We live in a world of technological advancement. New technologies emerge each and every day to make our life simpler. The conventional wire system creates a mess when it comes to charging several devices simultaneously. It also takes up a lot of electric sockets and not to mention the fact that each device has its own design for the charging port. The solution to all these dilemma lies with inductive coupling, a simple and effective way of transferring power wirelessly.

Wireless Power Transmission (WPT) is the efficient transmission of electric power from one point to another trough vacuum or an atmosphere without the use of wire or any other substance. This can be used for applications where either an instantaneous amount or a continuous delivery of energy is needed, but where conventional wires are unaffordable, inconvenient, expensive, hazardous, unwanted or impossible. The power can be transmitted using Inductive coupling for short range, Resonant Induction for mid-range and Electromagnetic wave power transfer for high range. WPT is a technology that can transport power to locations, which are otherwise not possible or impractical to reach.

A. Components

Timer 555
Op amp741
Coil copper 22awg
Full wave rectifier

B. Methods

Technology	Energy Transfer	Enabling the Power Transfer
Inductive coupling	Magnetic fields	Coils of wire
Resonant inductive coupling	Magnetic fields	Resonant circuits
Capacitive coupling	Electric fields	Conductive coupling plates
Magnetodynamic coupling	Magnetic fields	Rotating permanent magnets
Microwave radiation	Microwaves	Phased arrays/dishes
Optical radiation	Light/infrared/ultraviolet	Lasers/photocells

C. Existing System

The WPT technique has been taken as an ideal technical solution for energizing electric-driven devices within some specific regions in the near future, especially for smart home applications. The reason why WPT technologies is so crucial is regarding to two fundamental problems of battery-powered devices that limit their popularization - short battery life and high initial cost. Battery-powered devices can harness wireless power from electromagnetic field in air and then charge their batteries cordlessly even in the moving state. Existing older systems mainly use the following types of technology:

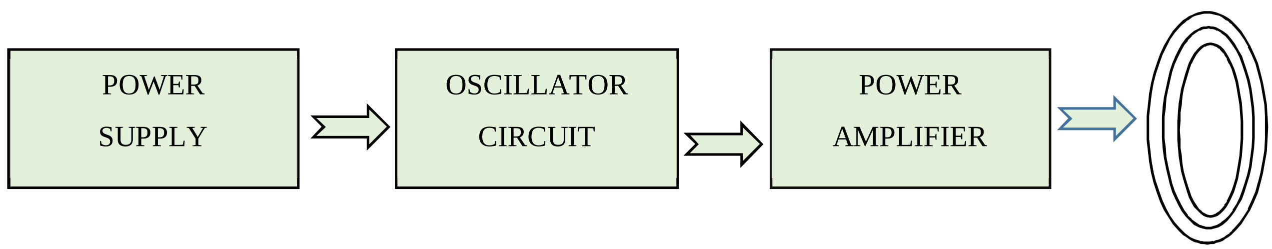
1) Capacitive Compensation Network
2) Magnetic Resonant Coupling
3) Capacitive Coupled Power Transfer

D. Proposed System

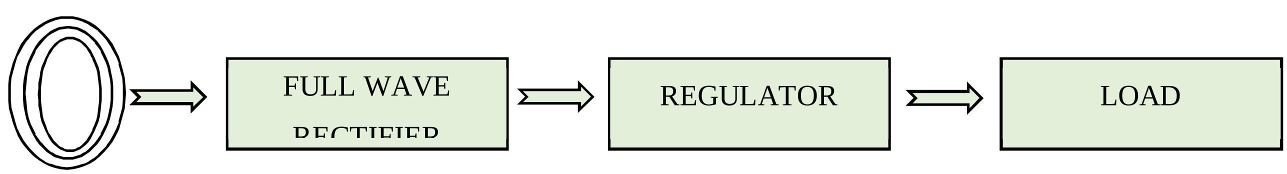
Our project utilizes Inductive Power Transfer (IPT) to transfer power over a short range. Series – Parallel CLC resonant tank circuit is used, to reduce high voltage stresses and ensure soft switching. Transmission coil is multi-directional in nature, to compensate for misalignment between transmitter and receiver coils. Full wave rectification is used, to improve on the power transmission loss. The power transmission capacity is considerably increased to about a maximum of 1.2Kw.

E. Block Diagram

1) *Transmitter*



2) *Power Supply:* Converts the AC current to DC current.
3) *Oscillator Circuit:* An oscillator is an electronic circuit that produces a periodic, oscillating electronic signal, often a sine wave or a square wave. Oscillators convert direct current (DC) from a power supply to an alternating current (AC) signal. They are widely used in many electronic devices.
4) *Power Amplifier:* The function of a power amplifier is to raise the power level of input signal. It is required to deliver a large amount of power and has to handle large current. The function of a power amplifier is to raise the power level of input signal. It is required to deliver a large amount of power and has to handle large current.
5) *Transmitting Coil:* By driving a sinusoidal alternating current through this loop at the Larmor frequency, an oscillating magnetic field perpendicular to the coil is produced.
6) *Receiver*



7) *Receiver Coil:* Receiver coil is located near to the magnetic field of the transmitting coil, then the magnetic field can induce an AC current in the receiving coil. Which is supplied to the load.
8) *Full Wave Rectifier:* A Full Wave Rectifier is a circuit, ac voltage.which converts an AC voltage into a pulsating dc voltage using both half cycles of the applied ac voltage. It uses two diodes of which one conducts during one half cycle while the other conducts during the other halfcycle of the applied Depending on the type of alternating current supply and the arrangement of the rectifier circuit, the output voltage may require additional smoothing to produce a uniform steady voltage. Many applications of rectifiers, such as power supplies for radio, television and computer equipment, require a steady constant DC current (as would be produced by a battery). In these applications the output of the rectifier is smoothed by an electronic filter, which may be a capacitor, choke, or set of capacitors, chokes and resistors, possibly followed by a voltage regulator to produce a steady current.

9) *Regulator:* A regulator is an electricity regulation device designed to automatically convert voltage into a lower, usually direct current (DC), constant voltage.Voltage regulators or stabilizers are used to compensate for voltage fluctuations in mains power. Large regulators may be permanently installed on distribution lines. Small portable regulators may be plugged in between sensitive equipment and a wall outlet.
10) *Load:* A device which is to be powered. Example LED, MOTOR.

Circuit Diagram

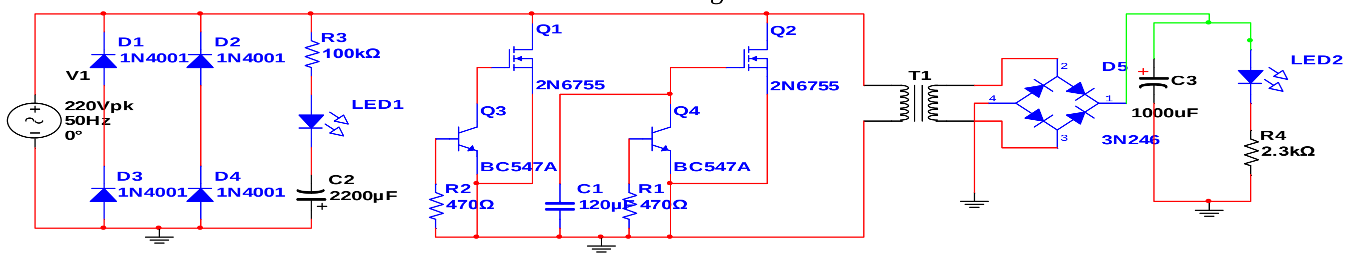


Fig. Circuit diagram in Multisim

F. Simulation Output

1) *Transmitter Output*

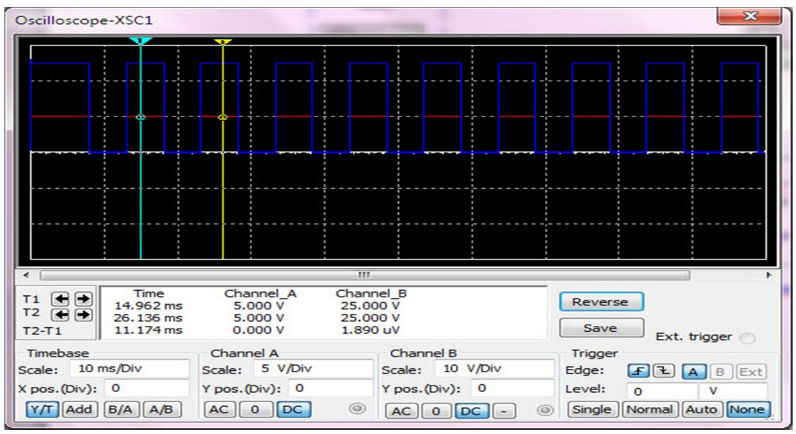


Fig. Simulation transmitter output

2) *Output*

a) *Oscillator Output:* Channel A of scope gives the output value of the Oscillator circuit.

b) *Power Amplifier output:* Channel B of the scope gives the output value of the amplifier circuit.

G. Receiver Output

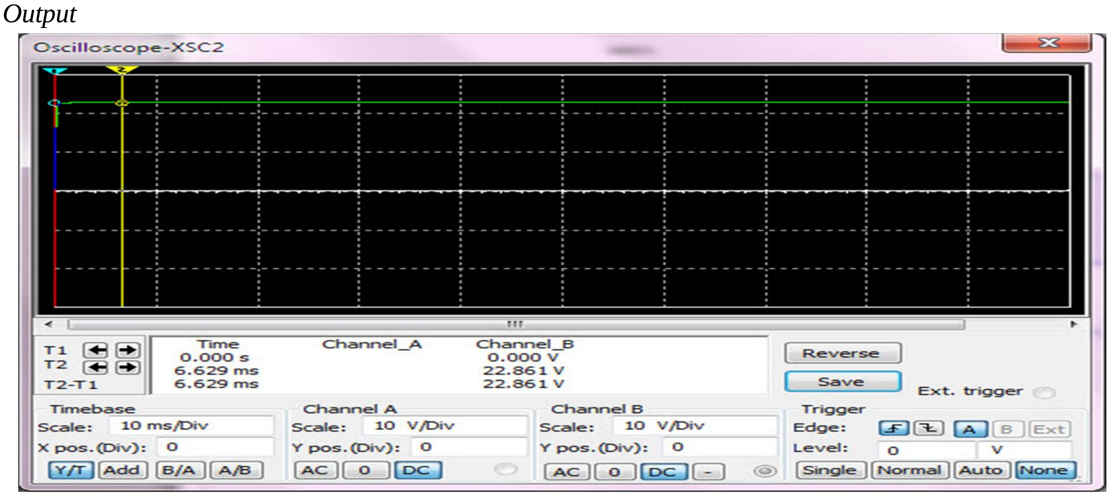


Fig. Simulation receiver output

H. Rectifier Output

The output from the transmitter coil passes through the receiver coil and then rectified by a full wave rectifier. The voltage provided to the load is shown.

II. CONCLUSION

The goal of this project was to design and implement a wireless charger for low power devices via resonant inductive coupling. After analyzing the whole system step by step for optimization, a circuit was designed and implemented. Experimental results showed that significant improvements in terms of power-transfer efficiency have been achieved.

It was described and demonstrated that resonant inductive coupling can be used to deliver power wirelessly from a source coil to a load coil and charge a low power device.

The fundamental aim of this project is to introduce the working mechanism of IPT systems. The key technical issues of WPT systems have been summarized in terms of the efficiency, power, distance, misalignment, bi-directional charging, and energy security. Effective method of power transfer is proposed.

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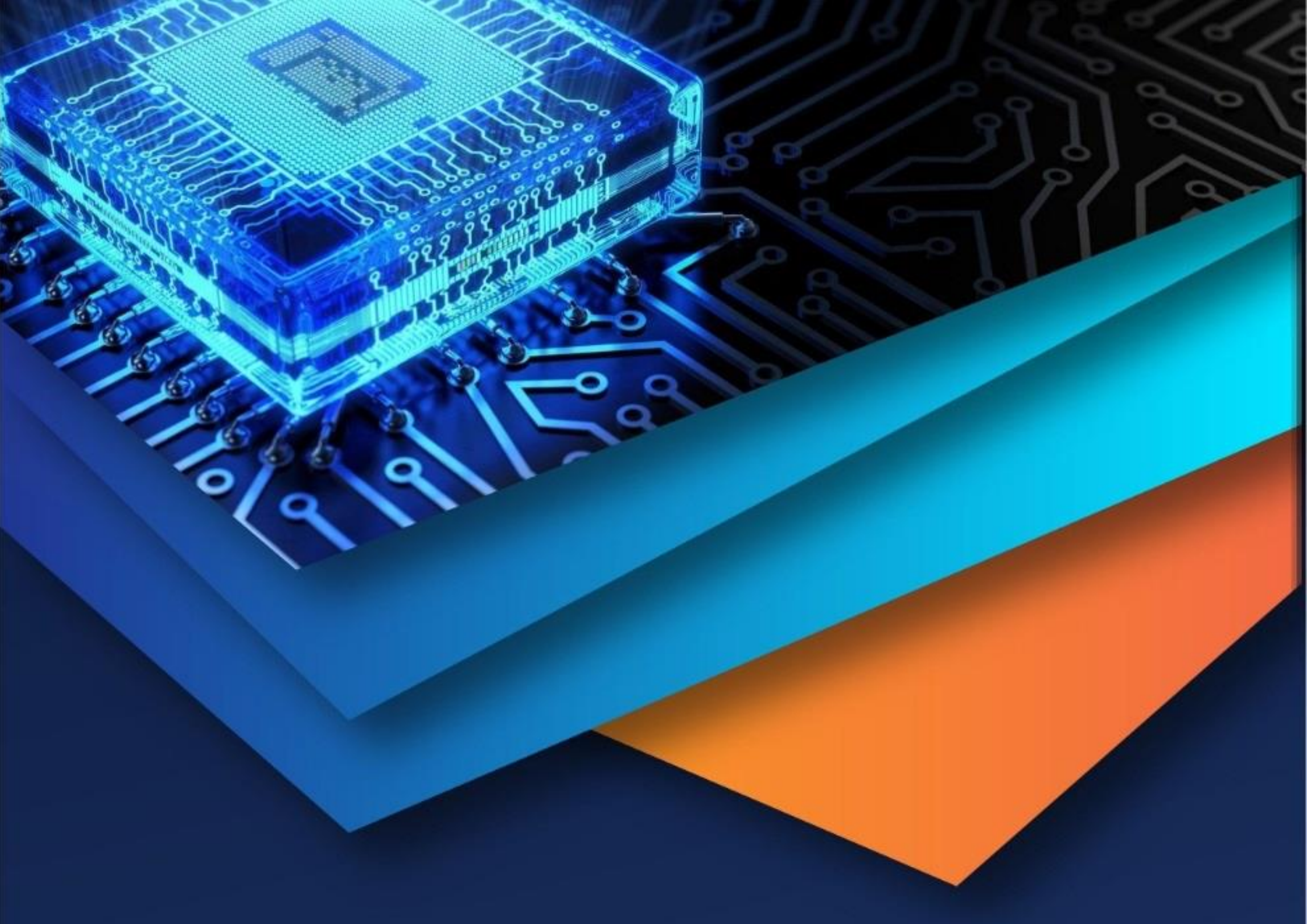

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