WIRELESS POWER TRANSFER

A Project and Thesis submitted in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Electrical and Electronic Engineering

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31 October 2019

Certification

This is to certify that this project and thesis entitled "**Wireless Power transfer**" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on 30 January 2019.

Signature of the candidates

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The project and thesis entitled **"Wireless power transfer,"** submitted by Muhammad Mohiuddin Alamgir, ID No:162-33-311, Session: Fall 2019 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** on 31 October 2019.

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Dedicated to

My Parents

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List of Abbreviations

CD	Chromatic Dispersion
EMI	Immune to Electromagnetic Interference
FBG	Fiber Bragg Gratings
FWHM	Full Width at Half Maximum
GVD	Group Velocity Dispersion
LED	Light Emitting Diodes
MD	Material Dispersion
NLSE	Nonlinear Schrödinger Equation
PMD	Polarization Mode Dispersion
PUA	Piecewise Uniform Approach
RMS	Root Mean Square
SSMF	Standard Single Mode Fiber
TFBG	Tilted Fiber Bragg Gratings
UV	Ultraviolet
WD	Wave-guide Dispersion
WDM	Wavelength Division Multiplexed

List of Symbols

λ	Wavelength
λ_B	Bragg wavelength
n_{eff}	Effective index
z	Position along the grating
n	Mode index
f	Fundamental Frequency
ω	Angular frequency
M	Modulation Index
T	Fundamental Time Period

ACKNOWLEDGEMENT

First of all, we give thanks to Allah or God. Then we would like to take this opportunity to express our appreciation and gratitude to our project and thesis supervisor **Provakar Mondol, Lecturer** of **Department of EEE** for being dedicated in supporting, motivating and guiding us through this project. This project can't be done without his useful advice and helps. Also thank you very much for giving us opportunity to choose this project.

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ABSTRACT

Nowadays, power is treated as one of the essential prerequisites to people. Be that as it may, the expense of making power is hazardous to the earth. As indicated by the vitality data records surmised half of all power plants are sullying coal plants. Different changes in the earth have occurred in the course of the most recent thirty years, which are harmful to the inevitable of this planet. To defeat this, here is an answer for diminish greenhouse gas emissions into the soil's atmosphere through an alternative power generation. This is one the sustainable innovation driving this charge is wireless power transmission (WPT).

CHAPTER 1

Introduction

1.1 Introduction:

These days, we can't envision our existence without electricity. From the earliest starting point of humanity, there consistently has been the need for power, which carried us to the creations of fire, steam engines and above all, power. The dominant part of the present habitations and business structures are fueled by alternating current (AC) from the power grid. Electrical power stations create AC power that is conveyed to load focuses through high voltage transmission lines and step transformers with misfortunes. This AC is a day by day important for our regular daily existence, for model, lights, fans, etc. Practically every one of the segments is standardized with the electrical wire.

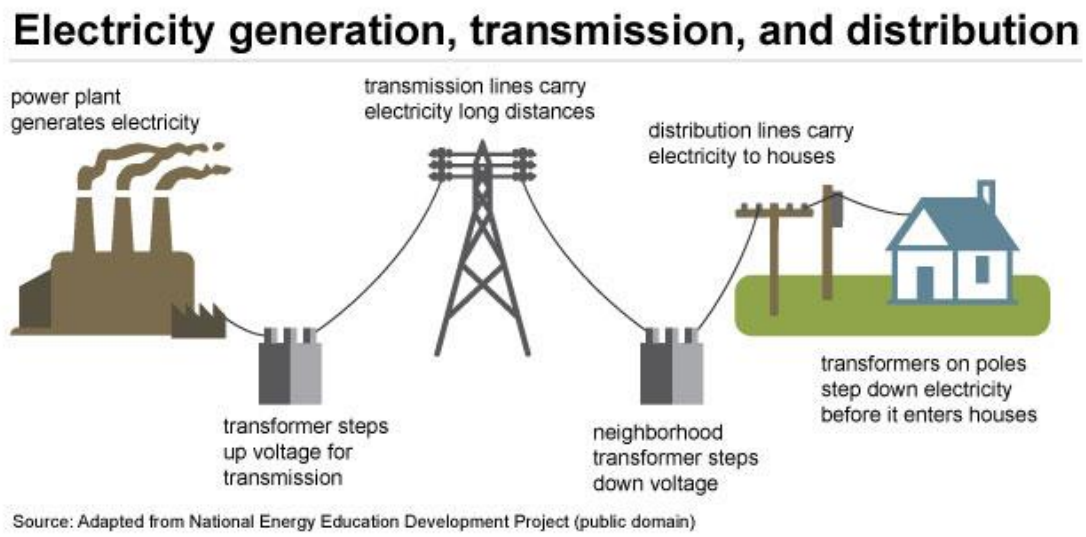


Fig 1.1: Power generation, transmission, and distribution

1.2 Problem statement:

The venture looks to take out the utilization of wires in the transmission of intensity from the source to the gadget to be controlled. Even though WPT depends on electromagnetic acceptance, different techniques are utilized. Some are less productive than others and expensive while others don't take into consideration a more drawn out scope of transmission. In this task, it is required to structure and develop an electronic gadget that will transmit

Control inside a little range. The gadget would then be able to be utilized to charge batteries for gadgets like pacemakers. In the task, an appropriate strategy will be utilized to guarantee that enough power is transmitted wirelessly with the goal that it would then be able to charge batteries. The significant test will be in the coupling circuit which includes the coils where electromagnetic induction happens.

1.3 Objective:

The principle objective of this project is to develop a device for wireless power transfer.

1. First of all design and assemble a power supply unit.
2. Then increases the dc supply
3. An appropriate oscillator must be design and assemble
4. Also need to design a battery charging circuit
5. Finally monitor and develop transmitter and receiver coils.

1.4 Scope:

In this project covers the equipment and programming structure and usage of a device that is destined to be ready to transfer power wirelessly. The examination will investigate the techniques that are at present being used furthermore, look to enhance the regions where the performance is low. The equipment for this system will include the structure and development of a transmitter and recipient modules. Once there is verification that power has been transmitted, a battery charging circuit will be structured and created to charge a 9V battery in order to demonstrate the utilization of a wireless power transfer device. The programming system will incorporate code that will work for the system is enough to decide the battery limit and furthermore to show the different parameters that are significant.

CHAPTER 2

Literature Review

This part contains an assessment of the present work as for the current works. It is given to a basic audit of the specialized and scholarly writing on past works done on wireless power transfer.

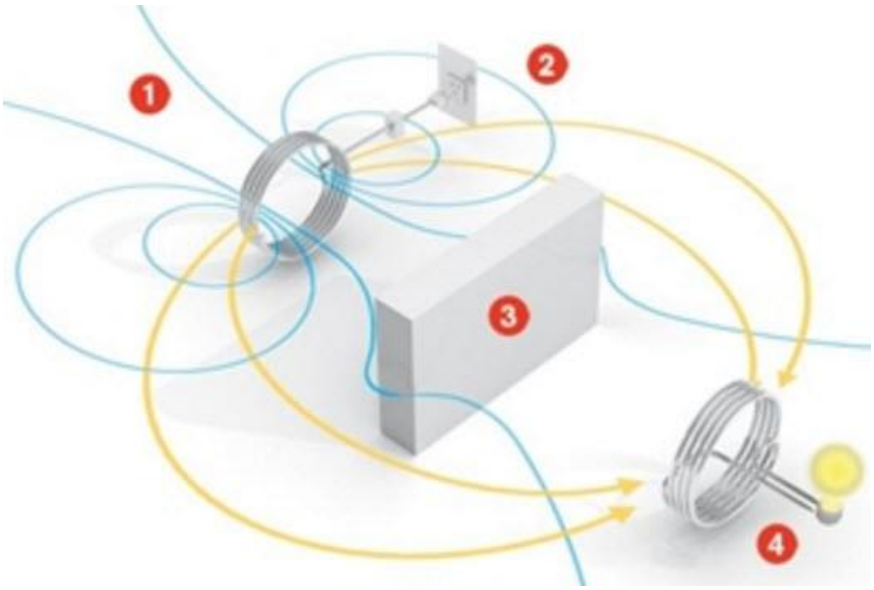


Fig 2.1: Wireless power transfer

History of wireless power transfer:

The man who is mostly famous for wireless power transfer his name is Nikola Tesla. Nikola Tesla successfully lighted electric bulbs wirelessly at his Colorado Springs Lab. In his experiment he used electrodynamics induction which is also known as resonant inductive coupling. While he was doing his own experiments in the lab, he invented an electrical resonating transformer in the year 1891. That transformer was also known as the tesla Coiler Tesla's Coil.

Fig: Nikola Tesla's Experiment

CHAPTER 3
ANALYSIS & SIMULATION

3.1 Introduction:

Wireless power transmission (WPT) is definitely not another innovation. Nikola Tesla previously presented the fundamental idea of wireless power transfer in the nineteenth century. Throughout the years, a few scientists proceed with their takes a shot at it. The significant inconveniences of wireless power transfer are low productivity. Along these lines, specialists are attempting to improve productivity utilizing severalty PSO methods.
The upsides of wireless power transfer are numerous that there has been an expanding enthusiasm for wireless power transfer innovation. Wireless power move innovation can take out all the charging inconvenient. It can make our everyday life so smooth and simple. The fundamental distinction among wired and wireless power transfer is the link. The customary wired power move has the issues of intensity misfortune, harming wire, electric sparkle and soon. Then, it is hard to utilize link to transmit power in some uncommon events. All things considered, wireless power transfer innovation is an answer.

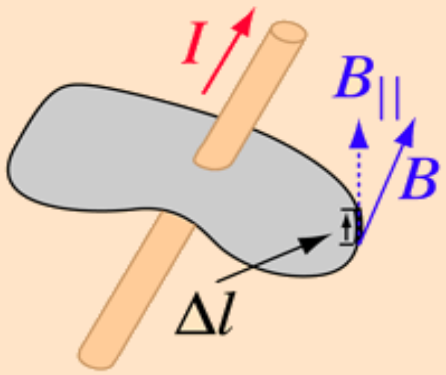
3.2 Basic concept of Wireless power transfer:

This is the process where electric power is transmitted from power source to electrical load without any wire connection. It's based on magnetic resonance close to the field coupling and that was reported by Nicola tesla before 100 years.

3.3 Ampere's law:

Ampere's Law

The magnetic field in space around an electric current is proportional to the electric current which serves as its source, just as the electric field in space is proportional to the charge which serves as its source. Ampere's Law states that for any closed loop path, the sum of the length elements times the magnetic field in the direction of the length element is equal to the permeability times the electric current enclosed in the loop.



$$\sum B_{||} \Delta l = \mu_0 I$$

In the electric case, the relation of field to source is quantified in Gauss's Law which is a very powerful tool for calculating electric fields.

Fig: Ampere's law

3.4 Ampere's law Application:

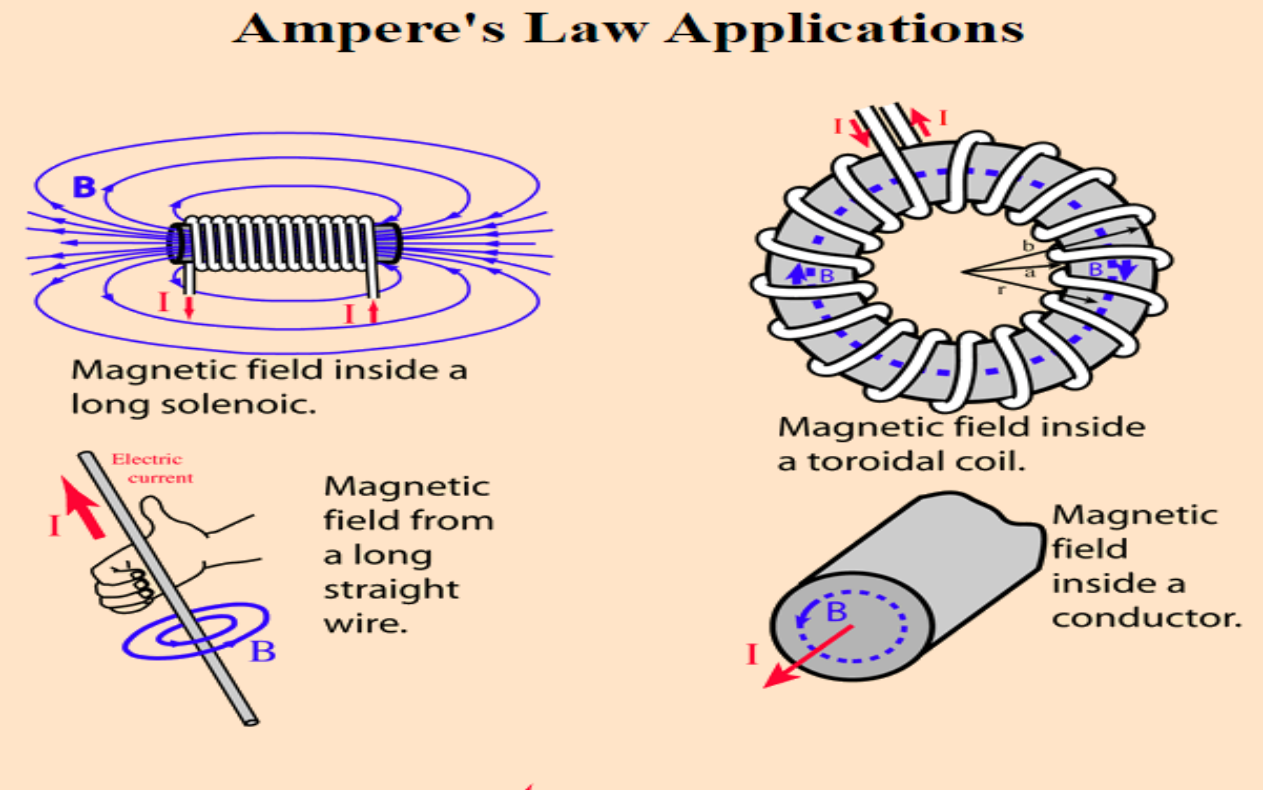


Fig: Application of Ampere's law

3.5 Faraday's law:

E=d*t*/dΦ

Where,
E=*electromotive force*
dΦ = the rate of change of magnetic flux
d*t*= *Change of the time.*

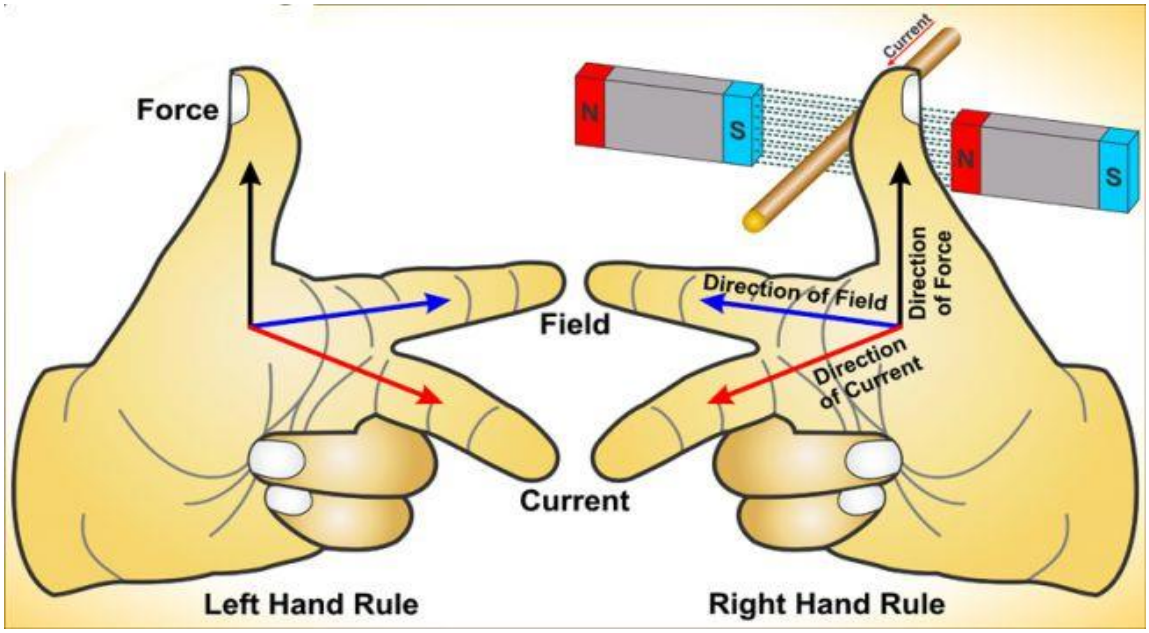


Fig: Left-hand and right-hand rule for a magnetic field due to a current in a straight wire.

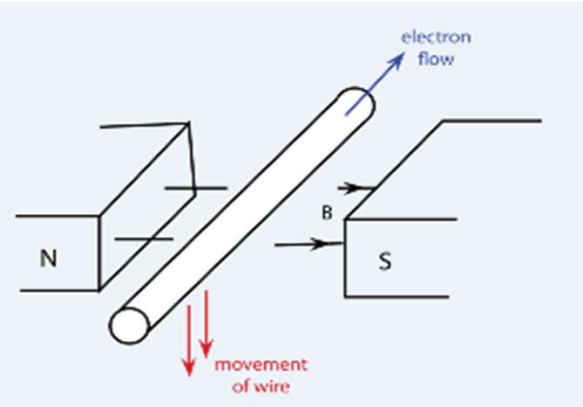
Lenz's law:

Emf=N (ΔϕΔt)
Where,

Electromotive force=EmF

The number of loops=N

Δϕ =Change in magnetic flux.
Δt =Change in time.



Wireless transfer power efficiency:
The use of wireless power transfer technology is increasing and also increase the efficiency day by day. It also use some highly efficient cases.

CHAPTER 4
HARDWARE DEVELOPMENT

Each electromagnetic source makes both electric (E-fields) and attractive (H-fields) fields around itself. And they are described by the radiative and non-radiative parts. Contingent upon the good ways from the source there are close field, change and far-field locales that are characterized by the manner in which they cooperate with the encompassing media.

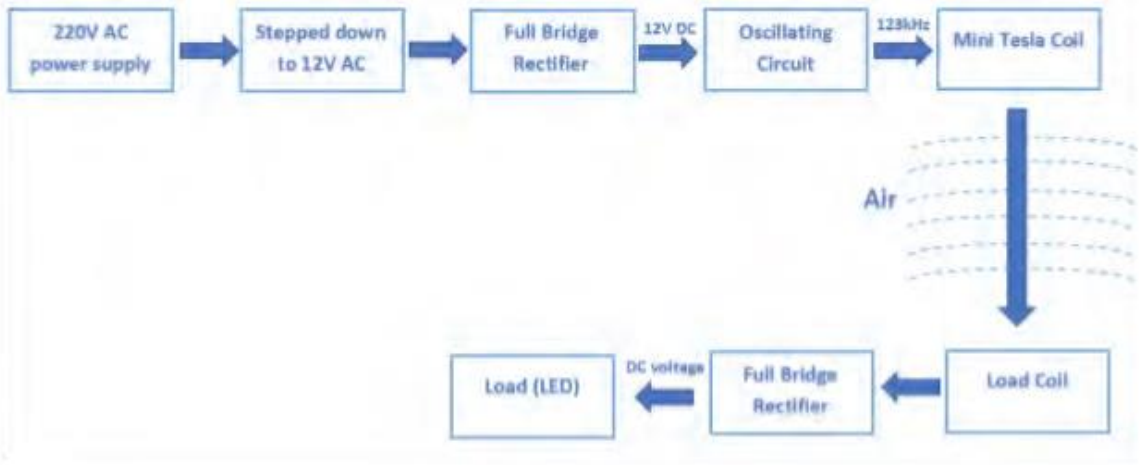


Fig. 5.1 Block diagram of the overall process

4.1 Equipment:

1. 220 AC power supply
2. Stepped down transformer.
3. Full bridge rectifier
4. Oscillating circuit
5. Mini tesla coil
6. LED
7. Load coil.
8. USB port.
9. 2Pin green connector.
10. PCB Board.
11. 7805 IC.
12. Electro light capacitor.
13. 1N4007 Diode.
14. Power transistor.
15. Heat sinker.

4.2 Classification of WPT:

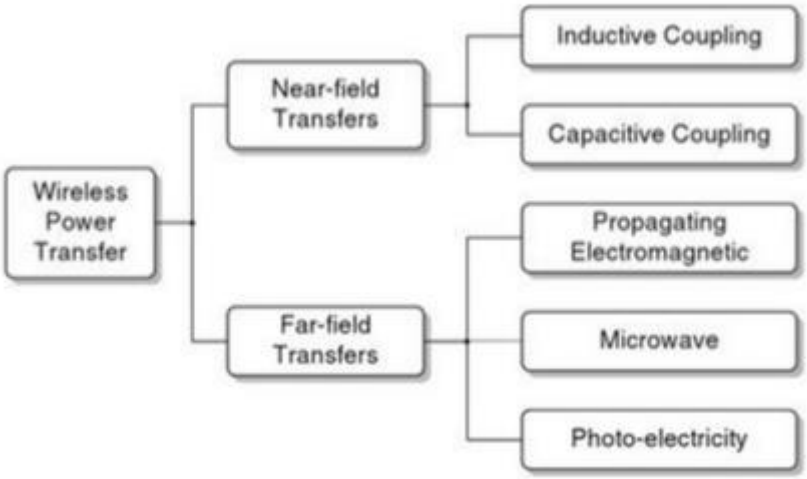


Fig: Classification of WPT

4.3 Microwave power transfer:

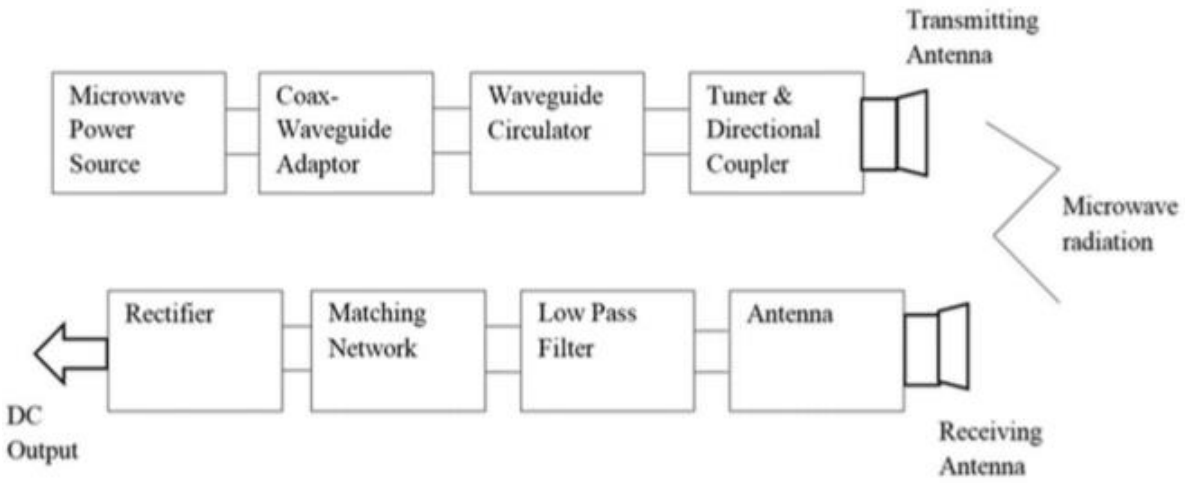
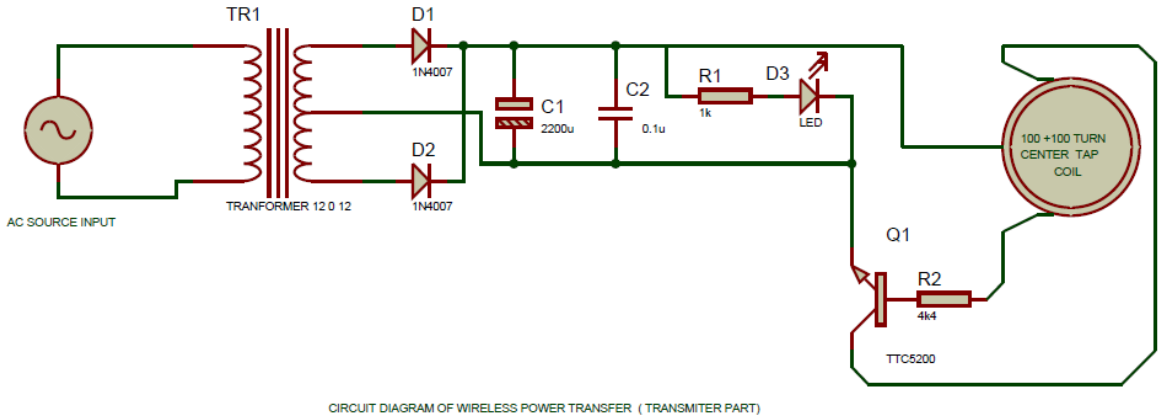


Fig: 2.3 Microwave Power Transfer

4.4 Transmitter of WPT:



CIRCUIT DIAGRAM OF WIRELESS POWER TRANSFER (TRANSMITER PART)

4.5 Receiver of WPT:

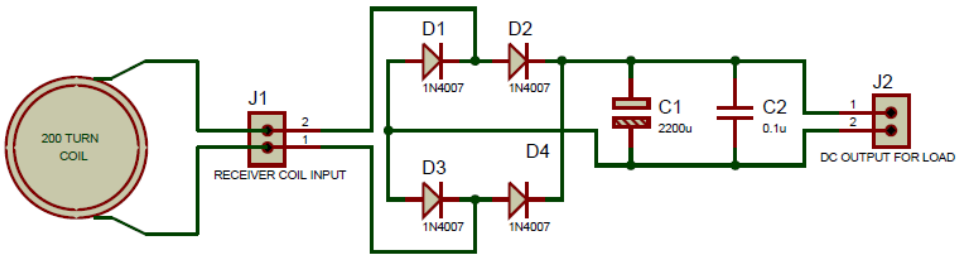


Fig: Receiver of WPT

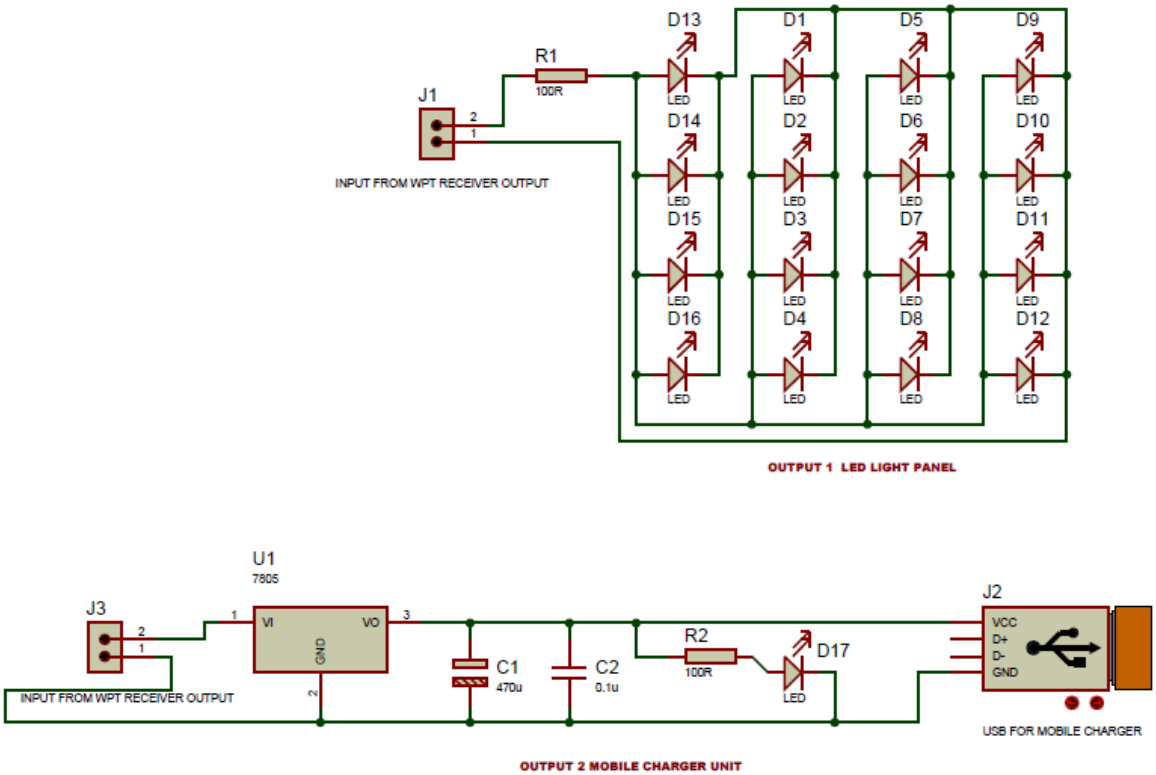


Fig 4.6: Output of WPT

Primary coil:

In this method we used tesla coil technique for power transfer wirelessly. Primary coil always stays primary side which produced voltage in the secondary side through electromagnetic induction.

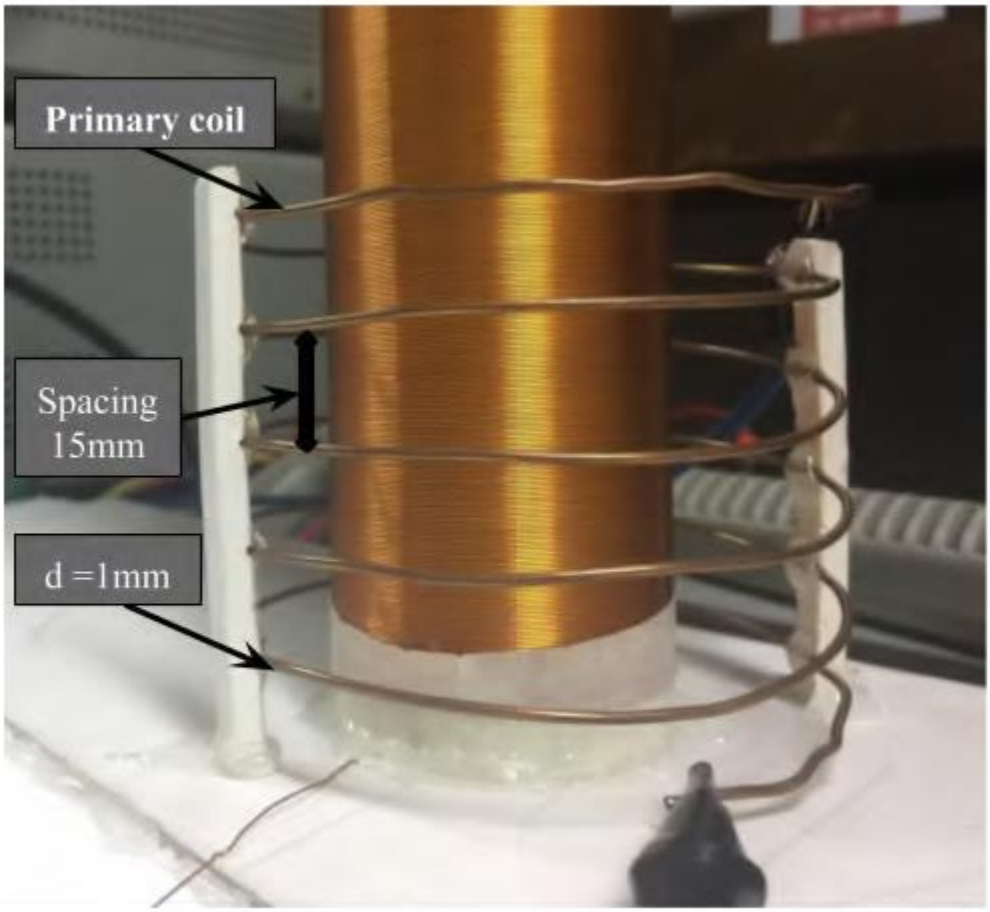


Fig. 5.2 Primary coil

Primary coil measurement:

Coil wire diameter	1 mm
Coil diameter	70 mm
Spacing between turns	15 mm
Number of turns	5 turns
Length of the wire	1.2 m

Table for primary coil measurement

4.8 Secondary coil:

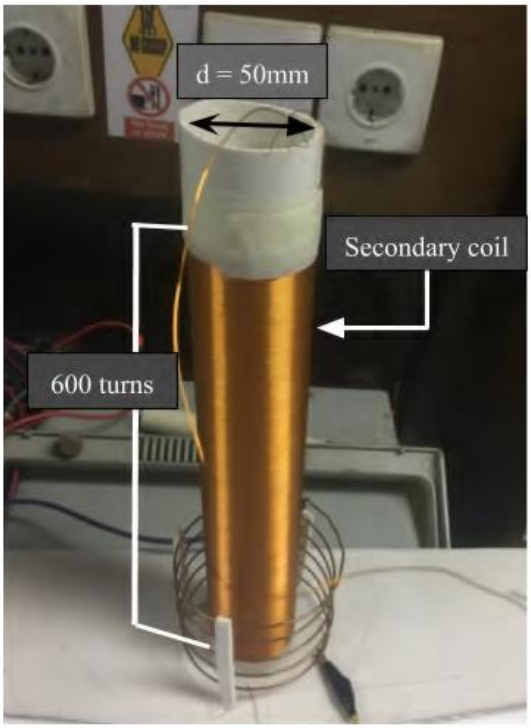


Fig: secondary coil

4.9Measurement of secondary coil:

Coil wire diameter	0.3211 mm
Coil wire AWG	28
Coil diameter	50 mm
Number of turns	600
Coil height	18 inch
Length of the wire	100 m

Fig: Table for secondary coil measurement.

4.10 Step down transformer:

A step down transformer is a gadget that changes over high essential voltage to a low auxiliary voltage. Ina step down transformer, the essential twisting of a loop has a larger number of turns than the auxiliary.

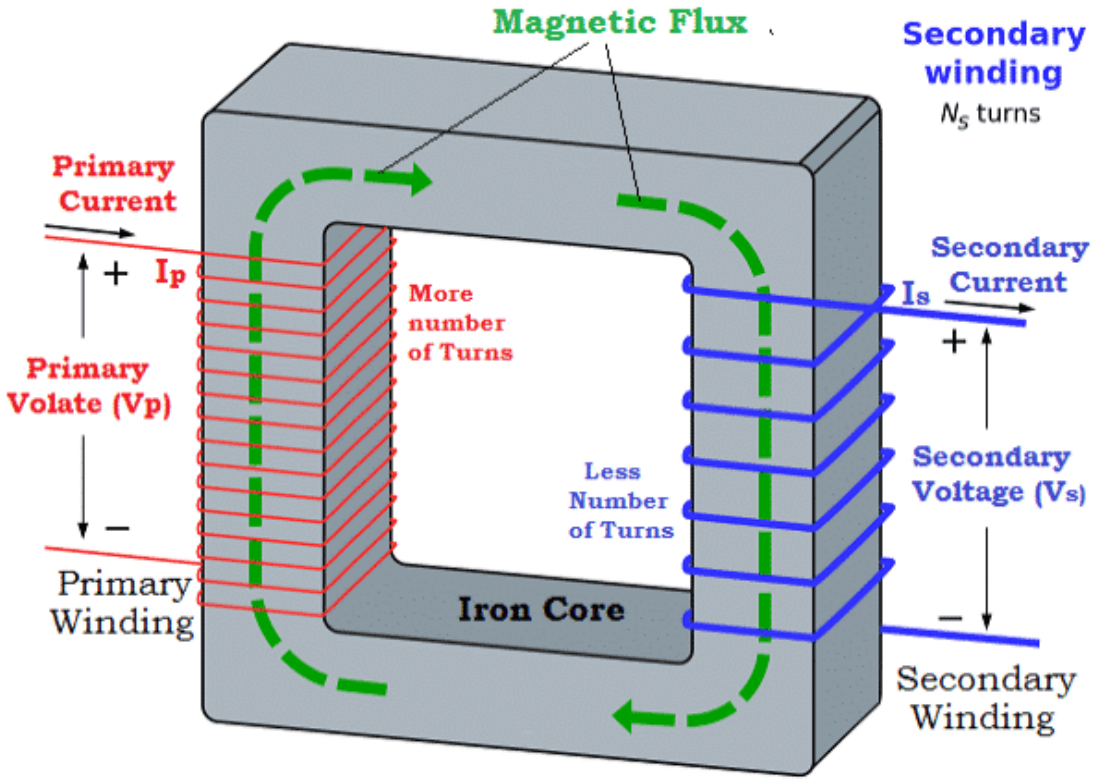


Fig: step down transformer winding.

The equation used to structure a step down transfer is,

$N_{s/}N_{p=}V_{s/}V_p$

Where,

Number of turns in secondary=N_s
Number of turns in the primary=N_p
voltage in secondary=Vs
Voltage is primary=V_P

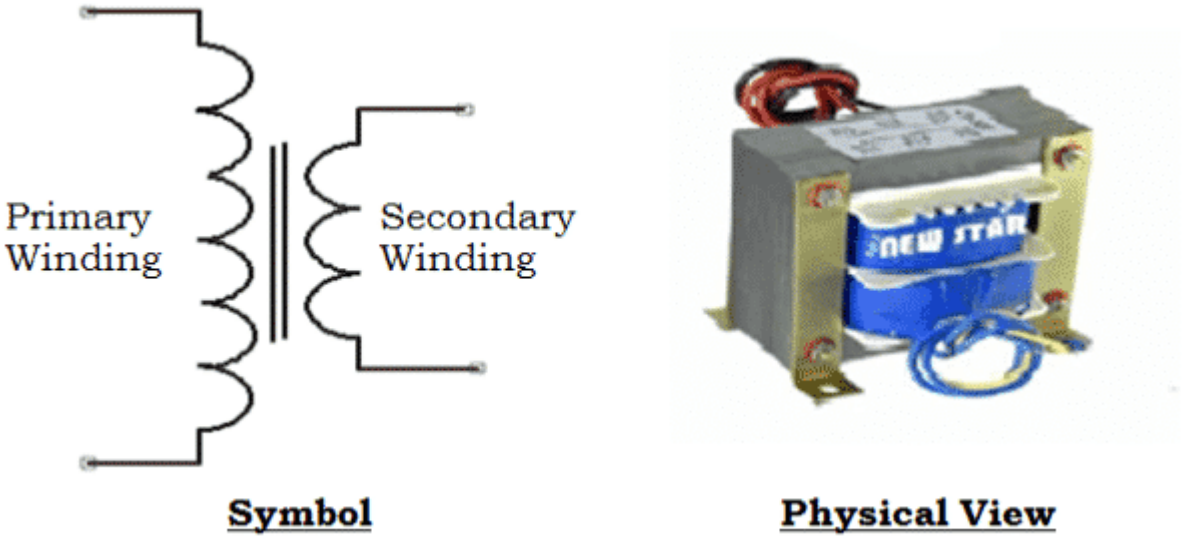


Fig: Single phase step down transformer symbol and physical view

4.12 Oscillator:

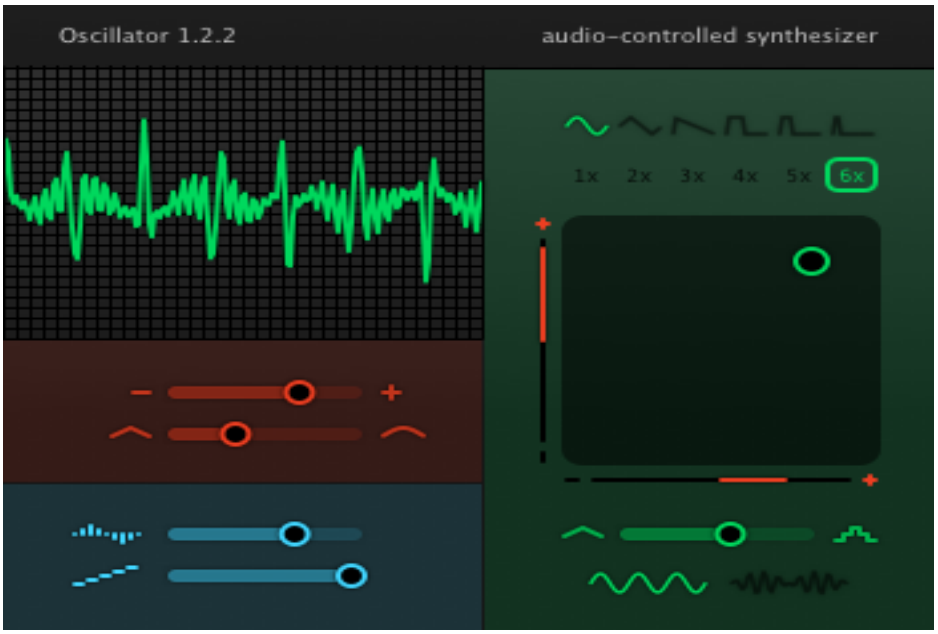


Fig: Image pf an Oscillator.

An oscillator gives a wellspring a dreary A.C. signal over its yield terminals without requiring any contrition. The sign produced by the oscillator is for the most part of consistent sufficiency.
The wave shape and efficiency are dictated by the structure of the oscillator circuit and decision of segment esteem. The recurrence of the yield wave might be fixed or variable, contingent upon the oscillator plan.

4.13 Rectifier:
Alternating current and direct current are two incessant term that you experience while concentrating the progression of electrical charge. Exchanging current, AC has the property to change its state ceaselessly. For instance, in the event that we consider a sine wave, the present streams a single way for a positive half cycle and the other way for the negative half cycle. Then again, DC streams just in one bearing.
An electronic circuit. Which delivers either DC signal or a throbbed DC sign, When an AC sign is applied to it is known as a rectifier. The part talks about operation amp based rectifiers in detail.

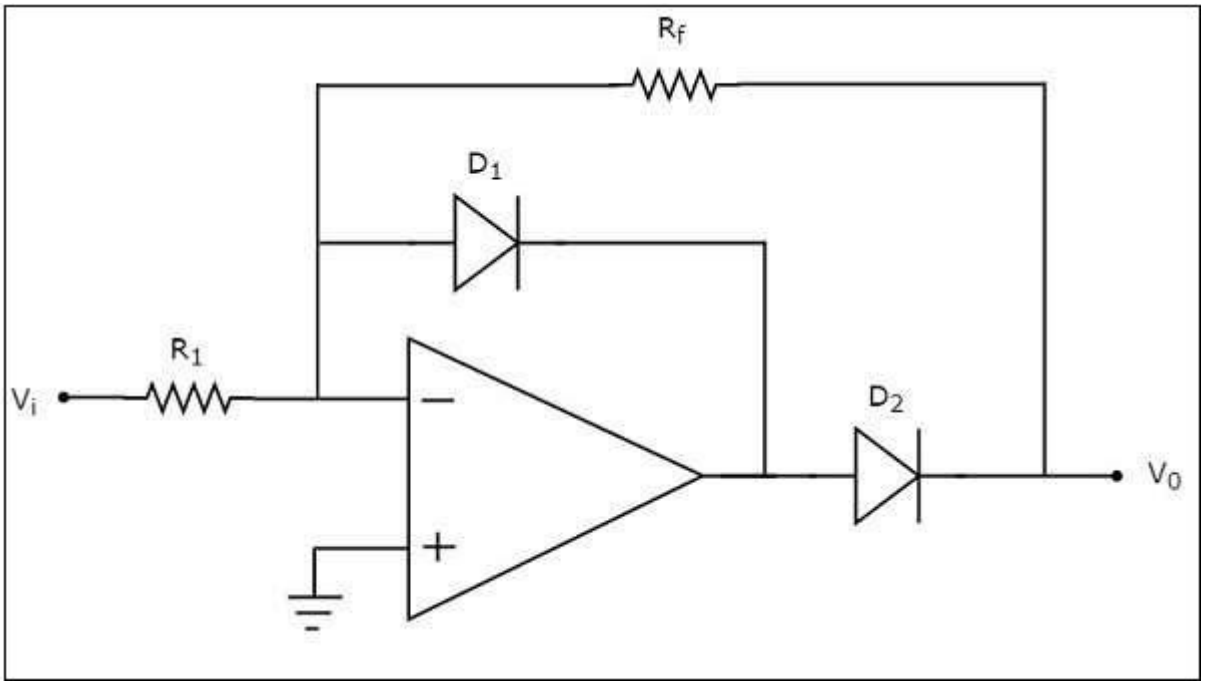


Fig: half wave rectifier

4.14 Output of Half wave rectifier:

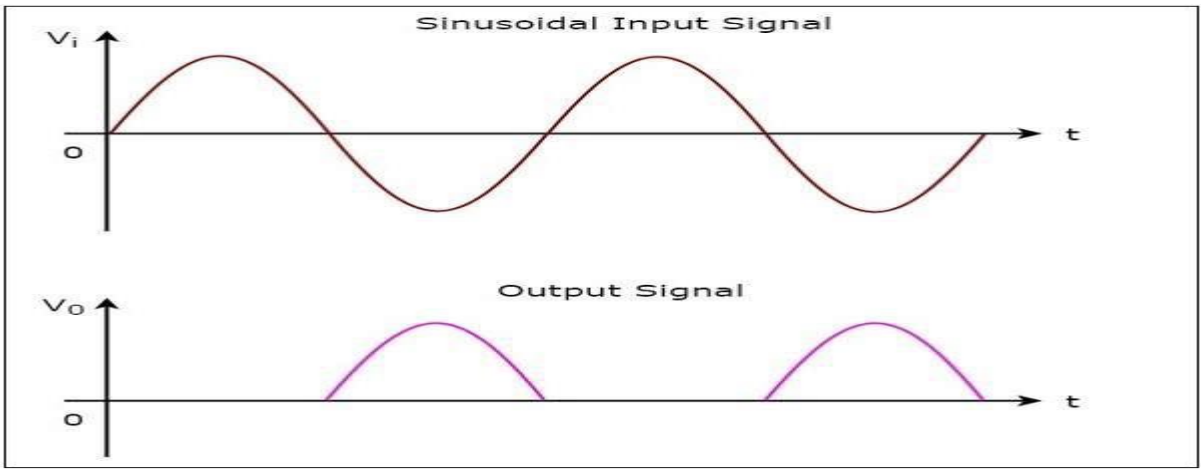


Fig: Output of half wave rectifier.

4.15 Full wave rectifier:

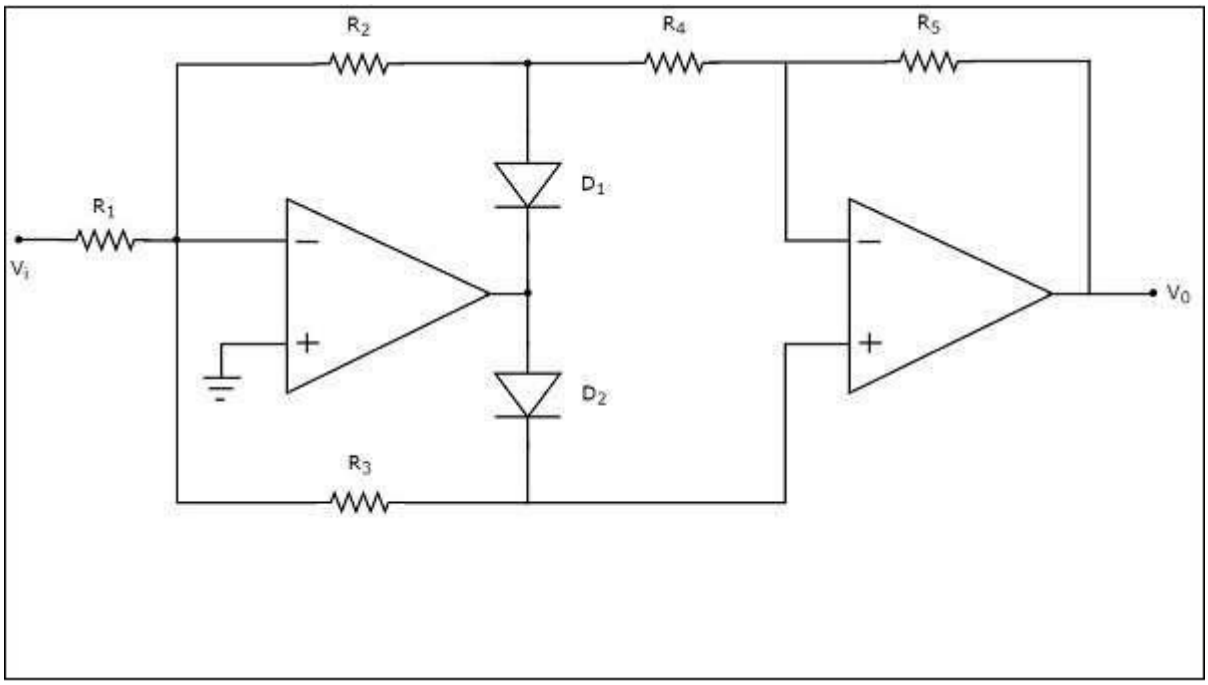


Fig: Full wave rectifier.

4.16 Output of full wave rectifier:

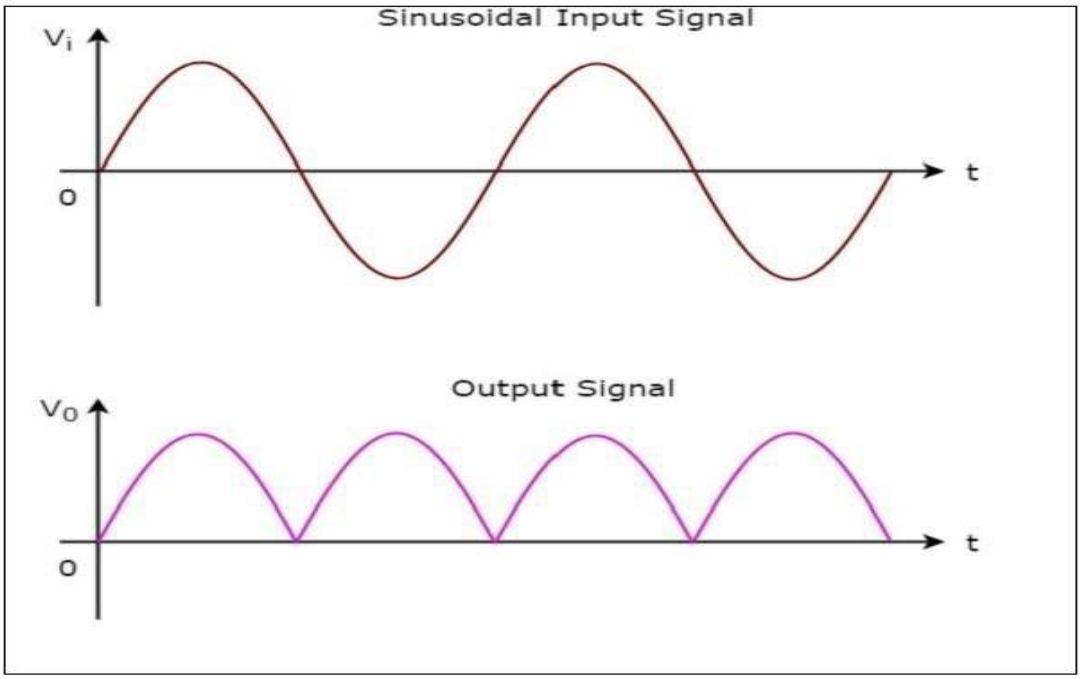


Fig: Output of full wave rectifier

4.17 Filter:

A rectifier is really required to deliver unadulterated DC supply for utilizing at different places in the gadgets circuits. Nonetheless, the yield of a rectifier is throbbing. That implies it contains both AC component and DC part. In the event that such a throbbing DC is applied in hardware circuit, it will create a murmur. So he AC segment in the throbbing rectifier yield is in fortune and must be avoided the heap. To do as such a channel circuit is utilized which expels the AC segment and permits just the DC part.

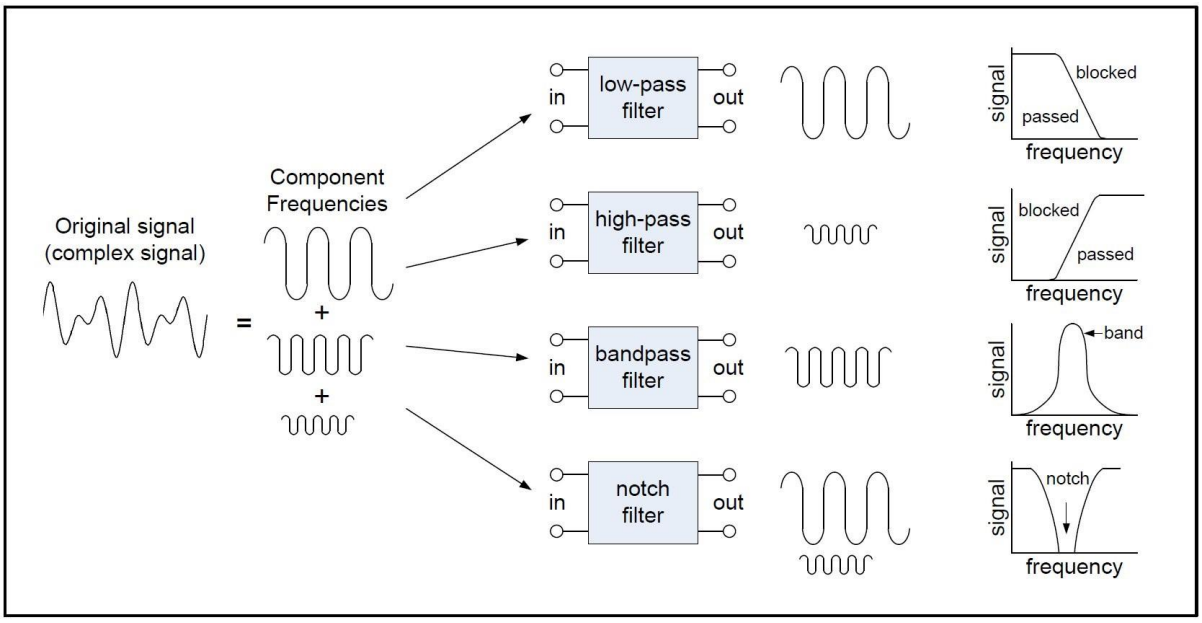


Fig: Filter circuit

Green connector:

Fig: Image of green connector.

CHAPTER 5

Results and Discussion

5.1 Results:

WPT project working principle:

It is work by the principle of IPT (INDUCTIVE POWER TRANSFER) by familiar transformer. Alternating current with high frequency produced by converting AC. There are few steps for WPT, first of all need to design a printed circuit board PCB. Then need to modify this and design then goes for layout. Also need to manufacture the PCB board. Finally transmit the power.

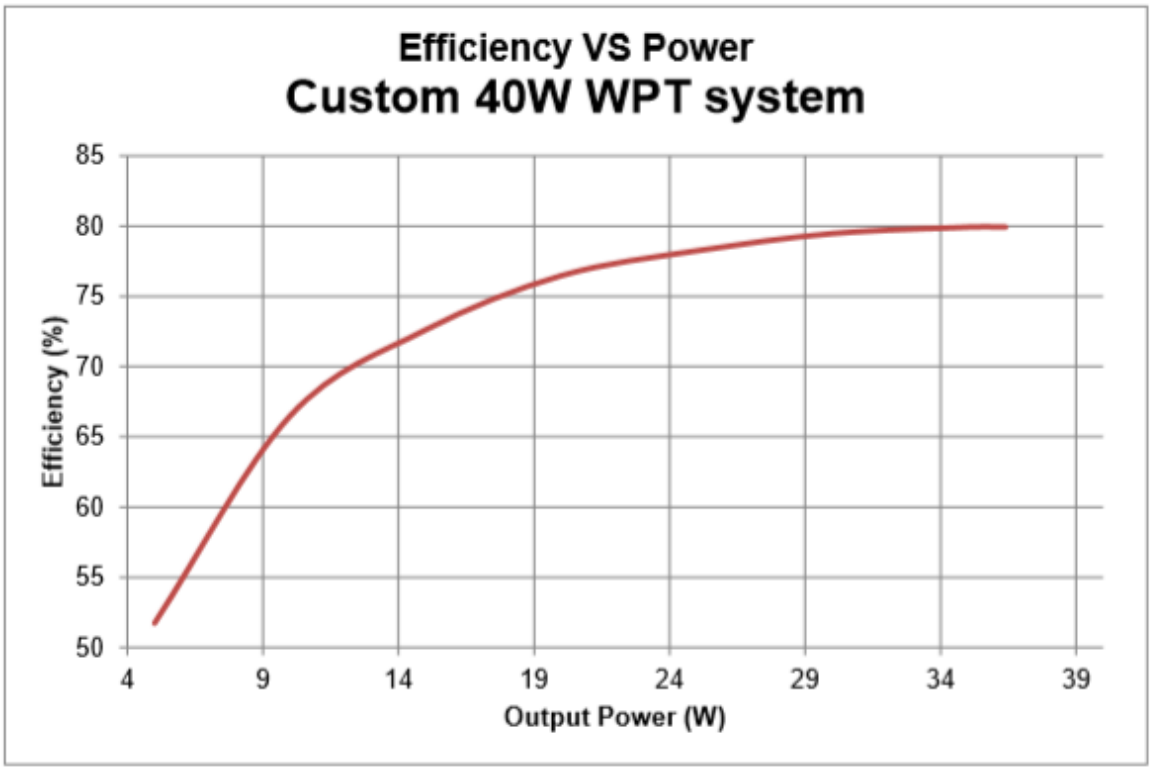
Distance inch	Output voltage from tesla coil with out load	Output voltage with load
0	15v	5v
1	14v	5v
2	12v	5v
3	10v	4.8v
4	8v	3.8v
5	6v	3.5v
6	5.5v	3v

Table 5.2 for WPT circuit result

5.3 Discussion:

The proposed wireless power move utilizing a tesla loop demonstrated a promising outcome As our primary goal was to build up a wireless power move method. I got some yield voltage To the recipient curl a good ways off up to 9inch which drops at 9.5. We changes over the Yield control.

The test results indicates awesome concurrences with the hypothetical foundation. On the off chance we increment the quantity of turn of the auxiliary loop, both the proficiency and the range increment. With the goal that proposed model can be utilized in useful applications.



Finally this is the efficiency of WPT

CHAPTER 6

CONCLUSION

The targets of the undertaking were met. An electronic gadget that remotely transmits control and at that point charges batteries were created. We had the option to structure discrete parts, for example, the Royer oscillator, curls and a full-extension voltage rectifier for the framework configuration process.

Ends that were drawn from the venture study are as per the following:

1. Because of the hypothesis of remote charging through inductive coupling, which was the strategy utilized in the task, it was seen those different perspectives for example separation, full recurrence, quality factor; loop turns proportion decide the effectiveness of WPT. What's more, there is an exponential rot for control versus the separation of division.

2. From the investigation, it was seen that at 0cm partition separation, the power move was most productive as observed by the splendor of the test lights.

3. From the task WPT for short-range or close to field happened up to a separation of 5cm after which the power moved started to fundamentally drop.

4. It can likewise be presumed that WPT can be utilized in different applications. In the undertaking we had the option to charge a 9V battery from the control that was transmitted remotely.

5. Ultimately, we can presume that WPT isn't influenced by non-attractive materials protecting the two curls. This along these lines implies that it tends to be successfully utilized in the therapeutic field to charge pacemakers and another gadget

6.2 Future work:

The equipment for this system will include the structure and development of a transmitter and recipient modules. Once there is verification that power has been transmitted, a battery charging circuit will be structured and created to charge a 9V battery in order to demonstrate the utilization of a wireless power transfer device. The programming system will incorporate code that will work for the system is enough to decide the battery limit and furthermore to show the different parameters that are significant.

World largest solar power plant

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Appendix

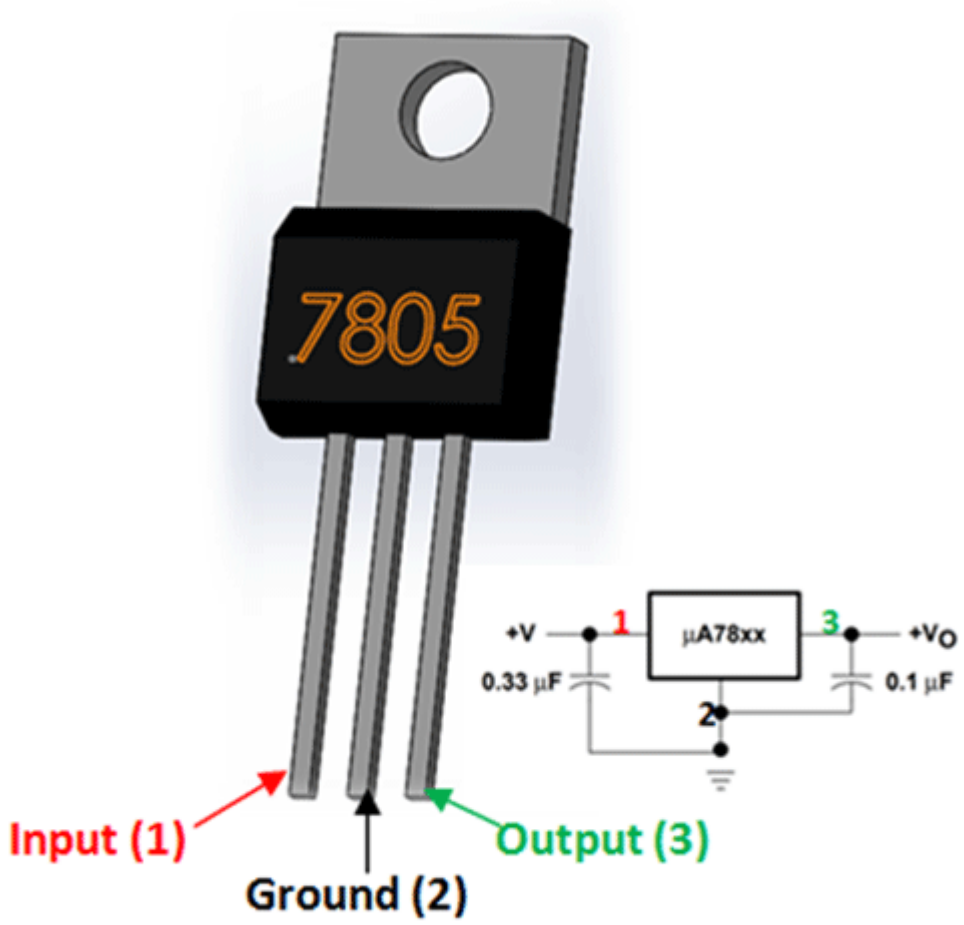


Fig: Symbol of 7805 IC

Feature of 7805 IC:
1. 5V positive voltage regulator.
2. Least input voltage is 7v.
3. Most extreme input voltage is 25V.
4. Working current is mA.
5. Intersection temperature most extreme 125 degree Celsius.

Appendix A
Schematic diagram

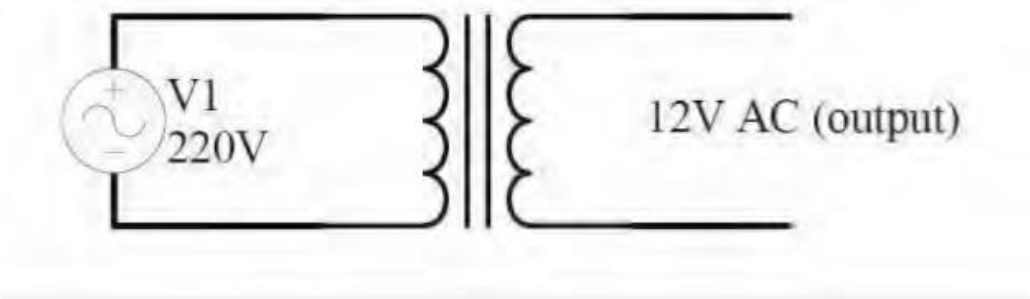


Fig. Step down Transformer

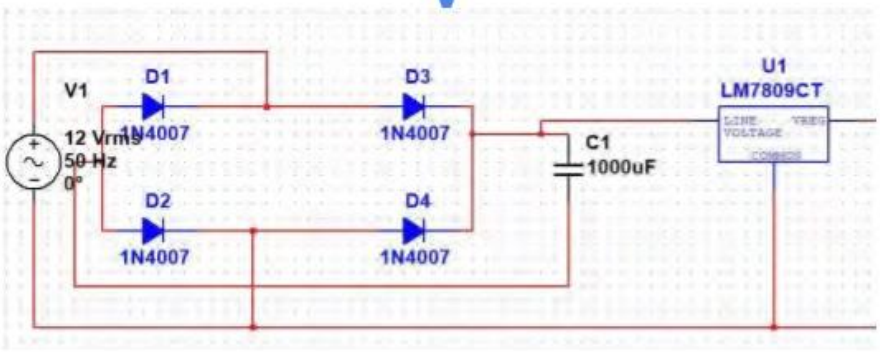
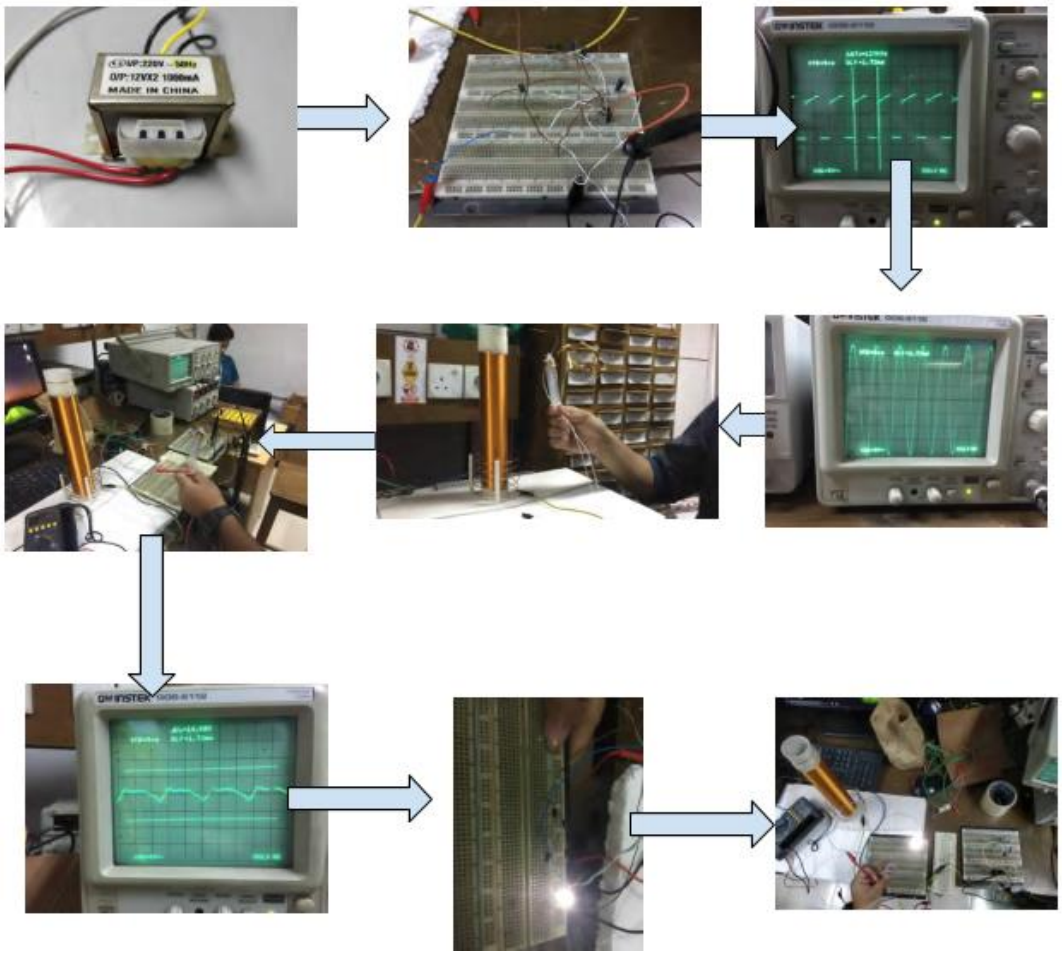


Fig. Full Bridge Rectifier

Appendix B

Chronological development of mini tesla coil



Appendix C

The Tesla coil at a glance

Fig. Experimental setup of the overall project