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# Wireless Power Transmission for Charging Mobile Devices Using Microwave

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**Abstract:** *When the world is moving towards the edge of technological development there should be best available technology for the most used gadget in the world that is mobile devices. The world is going smarter and automation is being introduced in all aspects of life, but at the same time the power needs to sustain this automation is also becoming equally important. As the size of devices goes on decreasing day by day with increasing processing capability, there is need of power that will keep the system running all the technologically advanced products like the smart phones, tablets, Bluetooth headsets, and many such new age devices. To improve the productivity of gadgets, a new charging technique is essential. The development in wireless power transmission has given rise to new charging techniques which are efficient and less time-consuming. From various possible methods of wireless transmission of electrical power, microwave power transmission is best suited for charging mobile devices.*

**Keywords:** *Wireless Power Transmission (WPT), Slotted Wave Guide (SWG), Antenna, Rectifier, Rectenna.*

## 1. INTRODUCTION

The theoretical idea of wireless power transmission (WPT) was suggested by Sir Nicolas Tesla in 1890's. He illustrated the illumination of vacuum bulbs without using wires for power transmission at the World Columbian Exposition in Chicago. It shows that the technology was well advanced at that time but it took us more than a century for initiating the practical implementations of his work.

WPT could take up the traditional way of charging since the major drawback with current distribution system are related with numerous non-avoidable transmission loses. Also, loses are proportional to power supply. In WPT system, no physical conductor is required. Moreover, the major advantages of WPT include cordless power solution, expandable power range, mobility and many more. WPT is used to transfer high power while near field (NFC) communication is used high date rate with low power.

Wireless Power Transmission is defined as the transfer of power from power source to an electrical load across an air gap without interconnection wires.

Microwaves are radio waves whose wavelength ranges from 1mm to 1m and frequency ranges from 300 MHZ to 300 GHZ. Out of the vast radio frequency spectrum, microwave is selected for WPT for charging mobile devices because:

- They can be easily focused into narrow beams.
- Large bandwidth.
- High data transmission rate

Since

Antenna size $\propto$ 1/ (transmitted frequency)

Hence smaller antenna size is required in this which has proper practical implementations.

## 2. METHODS OF WPT

### 2.1. RF (Radio Frequency)

Radio frequency is a wireless Electro-Magnetic signal used for communication. They are a form of EM radiation ranging from 3KHZ to 300GHZ. With the help of antennas and transmitters RF field can be used for wireless communication. All the wireless communication devices uses RF spectrum. Only some devices operate at IR frequencies.

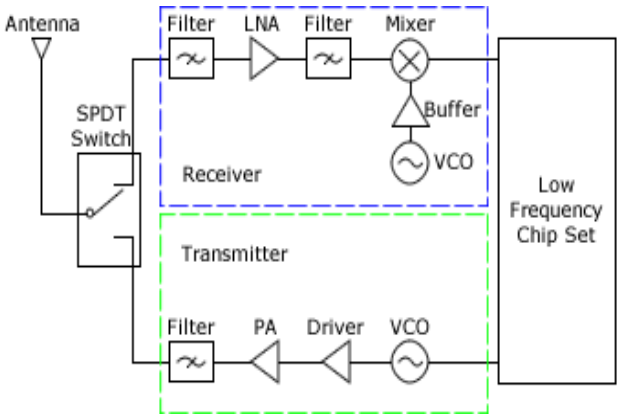


**Figure2.1.** *RF (Radio Frequency)*

### 2.2. Inductive Coupling

In this type of coupling two conductors are coupled inductively or magnetically. These two conductors are placed in such a manner that when the current through one wire is altered a voltage is developed across the other wire through the process of electromagnetic induction. The inductive coupling between two wires can be increased by coiling them heavily and adjusting them on a common axis in order to pass the magnetic field from one coil to another. By using material like iron or ferrite in the coils inductive coupling can be increased which would further increase the magnetic flux. These coils can be used separately or can be used in a single unit.

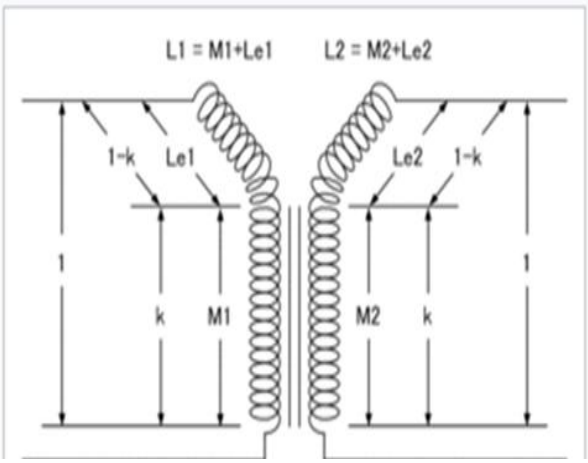


**Figure2.2.** *Inductive Coupling*

### 2.3. Laser

Light emissions from the laser are coherent in nature. Spatial coherence allows it to be concentrated into a tight spot. Power can be transmitted by conversion of electric energy to light energy and then to electric energy via using a photovoltaic cell. This mechanism is known as "power beaming". But the efficiency of photovoltaic cell is of only 40% to 50%. This method is greatly implemented in military and aerospace due to its effectiveness of the coded message transmission.

## 3. LITERATURE REVIEW

The process of transferring electrical energy for low power device in near field region is known as non -radiating technique. [10] The process of radiating electromagnetic energy in far field region is called as power beam technique [11].

A radiator based on magnetic resonance coupling is used to transfer electrical energy for wireless power charging system. Radiator in this system operated at 10 MHz with reflection coefficient less than -10dB and transmission coefficient is near to 0dB. Highest efficiency achieved by this system is 37% for a varied AC input signal and 58% by introducing gap separation of 0.8mm between 2 stack radiators [9].

In magnetic resonance coupling based Wireless power charging system utilizes near field approach. In this system electrical energy is transferred wirelessly for very short distance between transmitter and receiver with the help of inductive coupling through magnetic field. This system is capable to charge mobile device by producing DC voltage of 40.11 volt [13].

Frequency selective loop isolator utilizes dual resonance for mobile charging systems. In this method, WPT loop of receiving loop matched at 6.78 MHz while transmitting loop or NFC loop matched at 13.56 MHz For this technique, characteristics of transmission coefficient and isolation coefficient for different shape of dielectric substrate are drawn with reference to frequency. Frequency selection loop is require to control mutual inductance between transmitter and receiver. [14]

## 4. WIRELESS CHARGING USING MICROWAVE

### 4.1. Functioning

*4.1.1. Microwave Transmitter Circuit*

**Magnetron:** A magnetron is a transmitter that produces RF energy and radiates energy where it could be received through the receiver. It is a vacuum tube oscillator generating high power signals in microwave frequency range.

**Figure4.1.1.** *Magnetron*

**Slotted wave guide antenna:** It is a directive antenna for microwaves which can be used here as a high power transmitter. The slots are uniformly distributed in the antenna.

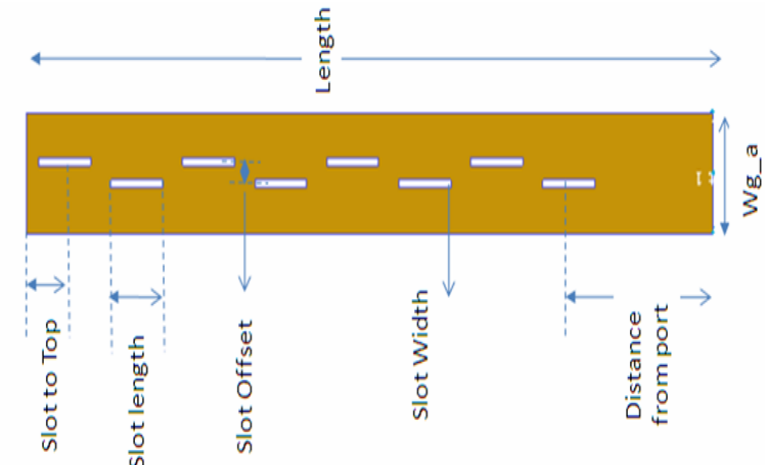


**Figure4.1.2.** *Slotted wave guide antenna*

*4.1.2. Transmitting Medium*

The channel or the transmitting medium through which the RF signals radiates from transmitter to receiver. Here air acts a channel.

*4.1.3. Receiver*

We need to convert microwave energy which is emitted through transmitter into DC output.The sensor used here is RECTENNA which is combination of rectifier and antenna. When the microwave signals are received, the sensor circuitry starts working and sends acknowledgment. Rectenna circuit converts microwave energy to dc output. Mobile devices start charging when then user is on a call using his mobile phone.

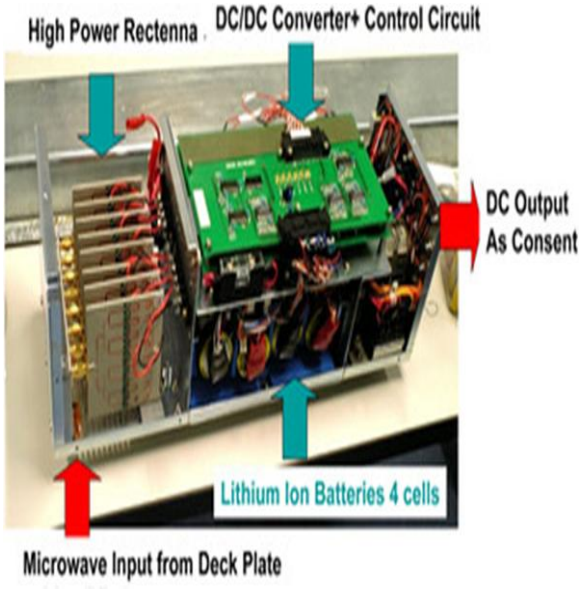


**Figure4.1.3.** *Receiver*

*4.1.4. Working*

A special type of receiver is used which can be called as RECTENNA (Rectifier + Antenna) It receives microwave from antenna transmitter. Rectenna is highly efficient combination with efficiency above 85% for converting microwave energy into DC output. A rectenna contains mesh of dipoles and diodes for absorbing microwave energy from transmitter and converting it into electric current. The diode here used is Schottky diode. It diode placed between antenna dipoles. With the improvement in nanotechnology, the size of rectenna elements can be reduced to molecular level. Front and Back of Rectenna is shown below.

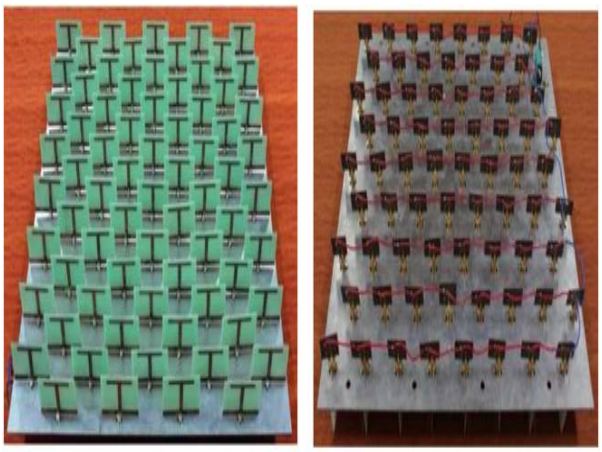

**Figure4.1.4.** *Working*

## 4.2. Practical Applications

- Phone Charging station at coffee tables or restaurants such as Starbucks.

- Cordless kitchen applications for homes.
- Less power drill applications in construction sites, suitable for Bosch.
- In cabin phone charging in offices and infotainment systems for vehicles.
- Integrated interior home lighting with furniture for entirely wireless homes.

## 5. CONCLUSION

It has been proved both quantitatively and qualitatively that electrical energy can be feasibly transmitted over the distances without the use of physical connections of wires. In this competitive era where world demands the best technology for everything, it's just a matter of time when the wireless transmission will take over physical connections.

During my study of wireless power transmission, I came across its several limitations. It includes:

- High capital investment to flip the current method of wireless transmission.
- Energy theft" across the globe.
- Interference of microwaves with the present communication system.

We need to concentrate physical size of the antenna with high efficiency and less cost. With the help of proper research of wireless transmission, we can achieve minimum power loss and maximum efficiency. In this competitive environment of day to day changing technology wireless power transmission is the game changer in today technology market. In this paper, we cover a unique way of using microwave signals to charge mobile batteries.

## REFERENCES

[1] Matsumoto, H.N. Kaya, I. Kimura, S. Miyatake, M. Nagatomo, and T. Obayashi: MINIX Project toward the Solar Power Satellites -Rocket Experiment of microwave energy transmission and associated plasma physics in the ionosphere. ISAS space energy symposium, pp 69-76, 1986.

[2] J.J Schelesak, A. Alden and T. Ohno : A microwave powered high altitude platform, IEEE MTT-S Int. Symp. Digest, pp – 283-286, 1998.

[3] Benjamin L. Cannon, James F. Hoburg, Dabiel D. Stancill, Seth Copen Goldstein, Magnetic Resonant Coupling as a Potential Means for Wireless Power Transfer to Multiple Small Receivers, IEEE Transactions on Power Electronics, Vol. 24, No.7, July 2009.

[4] Joe T. Howell Advanced receiver/converter experiments for laser wireless power transmission, , 5th Wireless power transmission conference, pp 1-8, Granada Spain 2004

[5] W.C. Brown, J.R. Mims and N.I. Heenan, "An Experimental MicrowavePowered Helicopter", 965 IEEE International Convention Record, Vol. 13, Part 5,pp.225-235.

[6] Wireless Power Transmission – A Next Generation Power Transmission System; International Journal of Computer Applications (0975 – 8887) Volume 1 – No. 13.

[7] Muthupriya, M. and Vinothini, S. (2013). Wireless Power Transmission Via Solar Power Satellite International Journal of Scientific and Engineering Research, Vol. 1(5), ISSN 2229-5518.

[8] Electric Power Research Institute (2009). Program on Technology Innovation: Impact of Wireless Power Transfer Technology: Initial Market Assessment of Evolving Technologies. EPRI, Palo Alto, CA: 2009. 1020562.

[9] Achmad Munir, Ni Wayan Dessy Eka Rahayu and Biru Tutur Ranum : Radiator of Wireless Power Charging for Mobile Device and Its Efficiency Characterization. Telecommunications Energy Conference (INTELEC), 2015 IEEE International ISSN: 2158-5210.

[10] N. Shinohara, Wireless Power Transfer via Radiowaves, 1st ed., NJ: John Wiley & Sons, Inc., 2014.

[11] R. M. Dickinson, "Performance of a high-power, 2.388-GHz receiving array in wireless power transmission over 1.54 km," in Proceeding of IEEE-MTT-S International Microwave Symposium (IMS), Chery Hill, USA, Jun. 1976, pp. 139–141.

[12] N. W. D. E. Rahayu and A. Munir, "Radiator for wireless charging application based on electromagnetic coupling resonant," in Proceeding of International Conference on EECSI, Yogyakarta, Indonesia, Aug. 2014, pp. 496–499.

[13] Achmad Munir and Biru Tutur Ranum : Wireless Power Charging System for Mobile Device Based on Magnetic Resonance Coupling. International Conference on Electrical Engineering and Informatics 2015, Bali, Indonesia.

[14] DukSoo Kwon, Tae-Dong Yeo, Kyoung-Sub Oh, Jong-Won Yu, , and Wang-Sang Lee: Dual Resonance Frequency Selective Loop of Near-Field Wireless Charging and Communications Systems for Portable Device, IEEE MICROWAVE AND WIRELESS COMPONENTS LETTERS, VOL. 25, NO. 9, SEPTEMBER 2015.

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**Professor Shashikant Patil,** is a Fellow of Institution of Engineers, India as well as Senior ACM Member and Senior Members IEEE along with over 20 years of teaching experience. He is also associated with CSI, ISTE, NHRDN, E4C and IETE. He is recipient of Best Researcher Award 2014 of SVKMs NMIMS Shirpur. In addition to this he had been nominated as IEEE Day 2014 Section Ambassador for region 10; Member Executive Committee on IEEE CSI India Council as well as Core Team Member of Social Media and Online Content Management Team, Visibility Committee of IEEE SPS Society at International Level. He has also volunteered as a Regional Lead Ambassador for Region 10 for IEEE Day 2015 and IEEE Day 2016 event. He is member IEEE RFID Technical Council and SIG Member of IoT. His research interests are Signal Processing and Imaging. He is also serving as a Managing Editor for IEEE SDN Newsletter; IEEE RFID Steering Committee and EiC for IEEE C-RFID Newsletter. He has also rendered his services as a Member of Jury for IEEE SIGHT (AIYEHUM) 2016 Competition at Asia Pacific level for R10. Recently he shouldered the responsibility of a Student Travel Grant Chair for IEEE DySPAN 2017 USA Conference. As a Technical Program Committee Member (TPC) he has served more than 250 International Conferences of IEEE and other organizations. He is having more than 41 publications at national and international level in various conferences and Journals.

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