Vehicles Charged Via Wireless Technology (Microwave Energy)

Avinash Shrotriya[1], Runa[2] , Syed Nabil Akhtar[3]

[1]M.Tech (per) DIT Dehradun, Dep. Of ECE, Drona's College of Mgt & Technical Education, Uttrakhand University, Dehradun,
[2,3]B.Tech (per), Drona's College of Management & Technical Education, Uttrakhand University, Dehradun
[1]avinash_shrotriya121@rediffmail.com, [2]runa3009@yahoo.com, [3]ujalanabil@gmail.com

***Abstract- Wireless* Power Transmission (WPT) is an inchoate side in every sector of science & technology. In this paper we present a model of Electric Vehicle (EV) charging with the help of renewable energy source using this WPT. We present a configuration, consist of two optimized square loop wire antennas in communication &tuned at mutual frequency with aim of showing the improvement of the size of the batteries & the power efficiency over longer distance. Through this wireless function Electric Vehicle system (EVs) get charged by microwave beam from transmitter & then receiver will capture thus microwave beam. This is then transferred into DC power & electrochemical storage is finally used to store the power. In this Li-ion battery replaces traditional fossil fuel system of automotive vehicles.**

***Keywords* - wireless power transmission; electric vehicle; renewable energy; microwave beam; DC power; electrochemical storage; Li-ion battery.**

I. INTRODUCTION

Our environment is being polluted by the fuel transport system severely because of the emission of CO_2, NO gases from the conventional vehicles. For fuel consumption & zero emission the Electric Vehicle (EV) transport system is more suitable & reliable in this Case. Today's hybrid EV, plug in EV becoming popular because of operating via electricity [1].

The microwave phased array transmitter will produce beam at 2.45GHz & 5.8GHz frequency from DC power & emit to vehicle rectenna which is set beneath the vehicle [2]. Finally the rectenna will convert the beam back to DC energy & store it via various mechanical & electrical devices. For this Li-ion battery has been introduced to store the energy for operating vehicles.

Wireless power can be transmitted via 3 techniques: Inductive coupling, Electromagnetic coupling & Microwave coupling [6]. It has been reported that inductive coupling techniques have high power transfer efficiency (on the order of 90%); however the power efficiency of such technique decreases for a longer distance drastically. This is used for very short lengths of (1-3 cm). Online EV system also based on electromagnetic coupling has an underground electric coil. It is having efficiency 72% & the distance between transmitting & receiving antenna's is 170mm. but in Microwave coupling, the power based on microwave transmission has larger efficiency approximately 75-80% within the same distance as above [2].

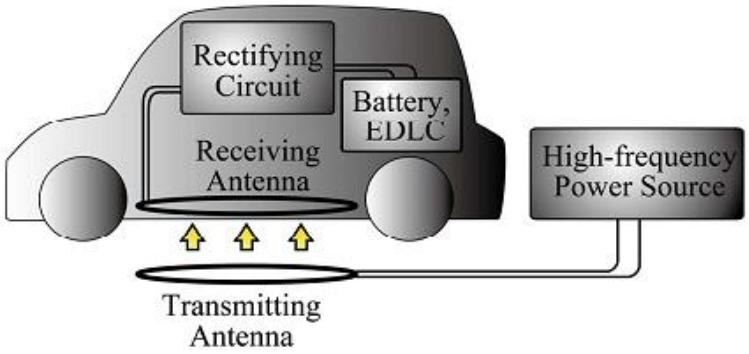

Figure 1: wireless car charging

II. HIGH POWER CONVERTER OF MICROWAVES INTO DC POWER

For many types of wireless power transmission (WPT) systems, diode-type rectenna (rectify antenna) is the best (and the simplest) device for back-conversion of microwaves into D.C. Diode-type rectennas have played and play a fundamental role at the stage of principal demonstration of the possibilities of high efficient wireless power transmission by microwaves. However they become not so much attractive for future real high power industrial WPT systems [4].

Microwave oscillators for example magnetron, klystron& travelling wave tube are used as microwave beam production. They take energy from renewable sources which help to produce more powered beam width. High power microwave amplifiers & oscillators are used.

A. High power Microwave Oscillator

Klystron: Klystrons amplify RF signals by converting the kinetic energy in a DC electron beam into radio frequency power. Klystron amplifiers have the advantage (over the magnetron) of coherently amplifying a reference signal so its output may be precisely controlled in amplitude, frequency and phase. The klystron amplifier is sensitive to the beam power supply variation. Typical values for a 3kW klystron have 8.5 kV for beam voltage. [7]

Travelling Wave Tubes (TWT) power supply: A TWT integrated with a regulated power supply and protection circuits is referred to as a traveling-wave-tube amplifier.[3] A TWTA consists of a traveling-wave tube coupled with its protection circuits (as in klystron) and regulated power supply Electronic Power Conditioner (EPC), which may be supplied and integrated by a different manufacturer[3]. A TWTA whose output drives an antenna is a type of transmitter. TWTA transmitters are used extensively in radar, particularly in airborne fire-control radar systems, and in electronic warfare and self-protection systems.

B. Transmitting beam by phase array antenna

The antenna which is termed as the phased array transmitting antenna radiates microwave beam to electric car's rectenna. Phase locked loop (PLL) Heterodyne system is needed to generate the microwave beam in the process [4]. Some of the examples of Phase Locked Loop (PLL) which are based on the phased array antennas are described below:

Phased & Amplitude Controlled Magnetron (PACM): the phase, frequency & amplitude of microwave power can be controlled with the help of PACM. As shown in the fig 2. We can see that the PACM has a feedback to magnetic field of the PCM.

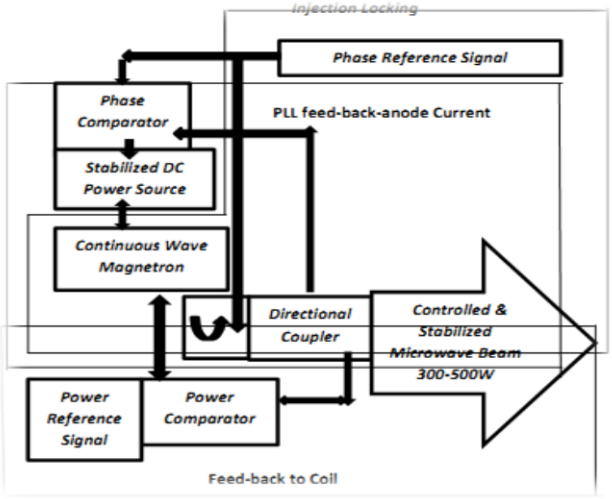

Figure 2: Block Diagram of PACM

It can control the amplitude of microwave of PACM from 300W to 500W.

Phase Controlled Magnetron (PCM): In PCM we can find that there is over 10% loss of microwave [7]. As we can see in the fig 3, PCM is having a circulator for injection locking.

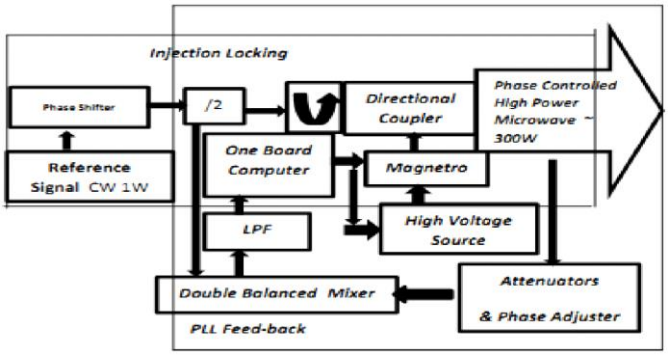

Figure 3: Block diagram of Phase Controlled Magnetron

We can control the phase of magnetron by PLL anode-current feedback. The microwave beam emitted by horn antenna (28×38cm) and its gain is 16.8dBi. PCM output power is 300W with 1W input only at 2.45 GHz.

III. ANTENNA OF ELECTRIC VEHICLE

Rectifying antenna is being used in the electric vehicle. Rectenna is defined as rectifying antenna. A basic rectenna consists of an antenna, a dipole rectifier and a DC bypass filter. The rectennas with integrated circular sector antennas can eliminate the need

of low pass filter (LPF) placed between the antenna and the diode as well as produce higher output with maximum efficiency [5]. The DC power is calculated from the microwave power.

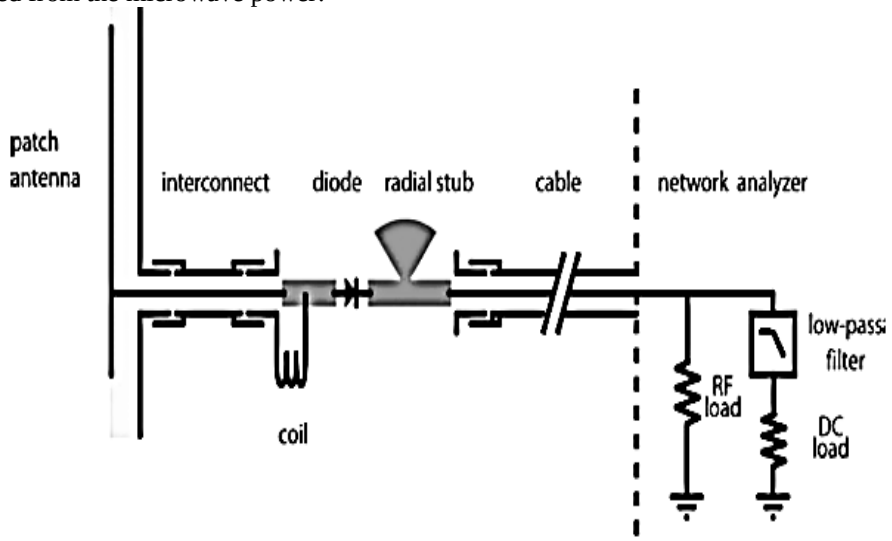

Figure 4: power management circuit of rectenna in electric vehicle.

$$P = \frac{1}{fhigh - flow} \int_{flow}^{fhigh} \int_{0}^{4\pi} s(\theta, \phi, f.t) Aeff(\theta, \phi, f) d\,\Omega df \quad \text{(1.1)} \quad \ldots\ldots$$

$$P\,dc = P\,(fi, t)\,\eta(p(fi, t), \rho, Zdc) \quad \text{(1.2)} \quad \ldots\ldots$$

IV. RECTENNA CELL

Rectenna of the electric vehicle is capable of producing high conversion efficiencies around 90%. As it is having low atmospheric loss, cheap components availability.

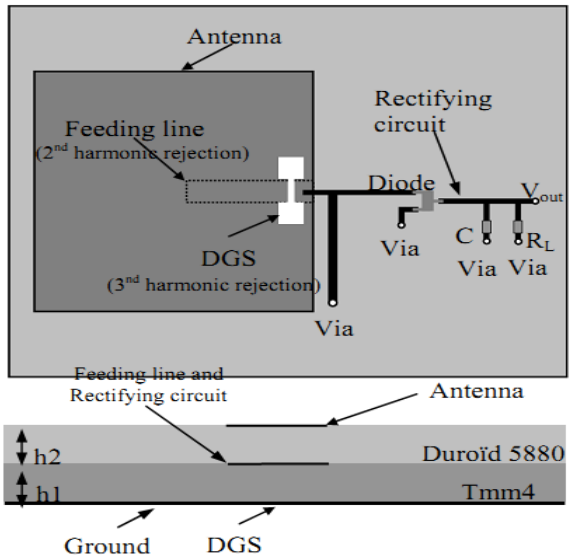

Figure 5: micro-strip antenna used for harmonic rejection

The conversion efficiency is high of the CP rectenna [4]. This is given by transmission power, gain of rectenna, gain of transmitting power, output voltage, and gain of rectenna.

$$\eta = \frac{\frac{V_d{}^2}{Rl}}{P_t G_t G_T (\frac{\lambda o}{4\pi r})^2 \;\; Lpol} \quad (2)$$

V. ENERGY STORAGE

A major impetus to the development of EVs is caused by the growth of the environmental problems such as global warming, pollution. Li-ion batteries are the most common and trustable power source for electric vehicle.

Advanced Flywheel Technology is the way of storing the energy. The flywheel is the system component responsible for the storing kinetic energy. Here in the table we are representing the characteristic of some composite materials for ultrahigh speed flywheel.

Materials	**Tensile strength s(MPa)**	**Specific Energy $\rho(kg/m^3)$**	**Ratio$\sigma/\rho(\frac{wh}{kg})$**
E-glass	1379	1900	202
Graphite epoxy	1586	1500	294
S-glass	2069	1900	303
Kevlar epoxy	1930	1400	383

VI. CONCLUSION

In our model we have elaborated microwave conversion to DC power by several methods and analyzed an efficient energy storage system in the electric vehicle system. We used the Li-ion batteries for better storing capacity and used rectenna cell for the process so that it should be cost effective and more efficient.

Of course, additional feature could be required in order to the power gain of the optimized antenna over the longer distance. This also makes them sufficient in EVs recharging system.

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