Wireless Power Transmission from Solar Input

Indhu G[1], Lisha R[2], Sangeetha V[3], Dhanalakshmi V[4]

[1,2,3]-Student,B.E, EEE, Dr. T. Thimmaiah Institute of Technology, K.G.F.,
[4]-M.E, Asst Professor, EEE, Dr. T. Thimmaiah Institute of Technology,K.G.F.,

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Abstract - The electrical power transmission from the source to destination takes place without any use of wires is known as wireless power transmission. Copper cables and conducting wires are eliminated for wireless transfer of electrical energy. Wireless power transmission (WPT) has a wide range of applications like charging of electric vehicles, Hybrid cars, electronic devices etc. Earlier transfer of wireless power has been achieved for charged batteries or AC source. In this paper the output from the solar panel is taken as the input to the system. DC-DC step up converter is been used since the solar panels output is very small it has to be stepped up to appropriate values. The stepped up dc voltage is given to the class-E amplifier and then converted into high frequency oscillating signal. This signal is further wirelessly transferred using a transformer. By achieving good magnetic coupling that exists between the transfer setup that is transmitter and receiver coil the power is been transferred. Later the bridge rectifier circuit converts the oscillating signal into DC before it is fed to the load.

Key Words: Solar, DC-DC converter, power transmission, wireless, load.

1.INTRODUCTION

The process of transmitting electrical power from one place to another without any conducting cables is called wireless power transmission. By the use of this technology transmission of electrical energy to remote areas without wires is possible. 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. Nikola tesla demonstrated transmission of electrical energy without wires in early 19th century by inventing Tesla coil, which was used to transfer power wirelessly using radiative method.

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. Charging low power devices and eventually mid power devices by means of inductive coupling could be the next big thing. Wireless power transmission for two meters of distance for 60 watt power with 60cm coil diameter was successfully done by MIT researcher's team. And achieved 40% efficiency.

2. METHODS OF WPT

2.1 Induction (Inductive Coupling):

This mode is the application of magnetic coupling which normally takes place in transformers. There are two coils transmitting and receiving coils and power is transferred due to mutual coupling. This mode is broadly classified in to short range and midrange. short range proved good efficiency and distance of transmission is limited and for midrange transmission distance is more but less efficient.

2.2 Electrical Resonance Mode:

It is advance method of inductive coupling along with resonance which proved good efficiency compared to induction mode. The mode is achieved by resonating transmitter and receiver coil for a particular frequency and power is transferred. The coils itself acts as inductors and by just attaching capacitance plate resonance can be achieved. we can use solenoid with capacitor plates placed closely. This method is known as wireless

2.3 Radio Waving and Microwaving:

To overcome the drawbacks of induction mode and electrical resonance mode of wireless power transmission and to achieve over a long distance transmission YAGI inventor from JAPAN developed YAGI ANTENNA which is directional array antenna used to transmit power using Radio wave.

It is further improved by power beaming by using Micro wave. In which DC power is converted into microwaves by RECTENNA at the transmitting end and using same antenna at receving end. Microwave is converted into electrical power. Rectenna is most suitable to receive beam of energy from solar panels which are in geocentric orbit and necessary precautions are taken to prevent harm to mankind and environment. Rectenna is a array of dipole consisting of positive and negative poles connect to semiconductor diodes. The antenna proved to be efficient upto 95%.

3 BLOCK DIAGRAM

Fig 1 shows the block diagram of the Wireless Power Transmission System model. It consists of a solar panel which will be used as an input source, whose input voltage will be boosted using a high step-up DC-DC converter. This high voltage is then converted high frequency AC using class E. power amplifiers. The oscillating signals are then fed into the transmitter setup. By achieving proper resonance coupling between the transmitter and the receiver setup power gets transferred wirelessly.

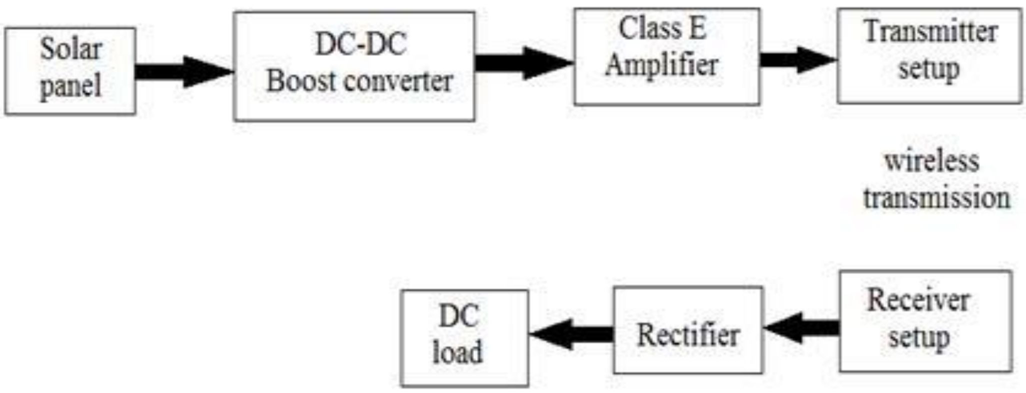

Fig -1: Block diagram of the proposed wireless power transmission system

4. DESCRIPTION OF THE PROPOSED WIRELESS POWER TRANSMISSION SYSTEM

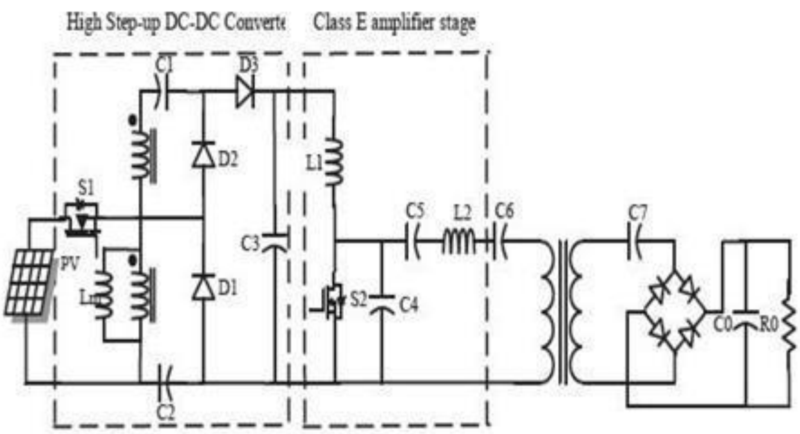

Fig -2: Circuit configuration of the proposed wireless power transmission system.

The fig 2 shows the two main stages of the proposed system. The first stage is the high step up dc-dc converter which converts the low input voltage from the PV Cell to a higher value. The step-up converter has following advantages:

I. The converter has a high step-up conversion ratio because of the connection of the coupled inductors, diodes and the capacitors.

II. It has very high efficiency and lower stress on the switches as the leakage inductor energy can be recycled. It consists of a coupled inductor T1 with the switch S1.The primary side winding N1 of a coupled inductor T1 is identical to the input inductor of the traditional boost converter, and diode D1, capacitor C1 receives leakage inductor energy from N1. The secondary side winding N2 of coupled inductor T1 is connected with another pair of diode D2 and capacitors C2, which are in series with N1 in order to increase the boost voltage. The rectifier diode D3 is connected to output capacitor C3.

The second stage is the class E amplifier which receives the dc input from the high step-up converter and converts to high frequency ac. The class E amplifier is a high efficient switch mode resonant converter. The high efficiency results from the reduced power losses in the transistor. The higher efficiency of the switch can be achieved by:

I. Using the transistor as a switch to reduce the power
II. Reducing the switching losses which result from finite transition time between ON and OFF states of the transistor. The Class E amplifier consists of a RF choke L1 and a parallel-series resonator circuit consisting of C4, C5 and L2. The output of the class E power amplifier is connected to the tank circuit formed by C6 and the transmitting coil as shown in the fig 2.
The receiver consists of a tank circuit formed by capacitor C7 and the receiving coil and a simple full bridge diode rectifier to convert the ac power transmitted from the transmitter coil to dc and a filter C0 is used to reduce the harmonics and then given to the load R0. The power gets transferred resonant frequency is achieved between transmitter and receiver pair.

4.1 DESIGN OF THE PROPOSED WIRELESS POWER TRANSMISSION SYSTEM

The design of the proposed WPT system requires the design of the high step-up dc-dc converter and the design of the class E power amplifier. Hence, there are two design stages which will be discussed in this section. During the design procedure, following assumptions are made:

I. All the components are assumed to be ideal
II. The ON state resistance and the parasitic capacitance of the switches are neglected.
III. The voltage drops across the diodes are neglected.
IV. The capacitors are assumed to have a very large value.

5 SIMULATION AND RESULTS

The specifications of various components used in the proposed model are tabulated below.

Sl No	Parameter	Value
1	L_m	15µH
2	C1	47µF
3	C2	47µF
4	C3	470µF
5	Duty ratio of S1	48.5%
6	turns ratio of T1	2
7	L1	80µH
8	L2	0.8µH
9	C4	690Pf
10	C5	132Pf
11	C6	150Pf
12	C0	68µF
13	R0	400Ω
14	Duty ratio of S2	50%

The simulation of the proposed wireless power transmission model has been carried out using MATLAB/SIMULINK. The proposed model has been verified for an input voltage of 12V from the solar panel and the output is obtained to be 110V.

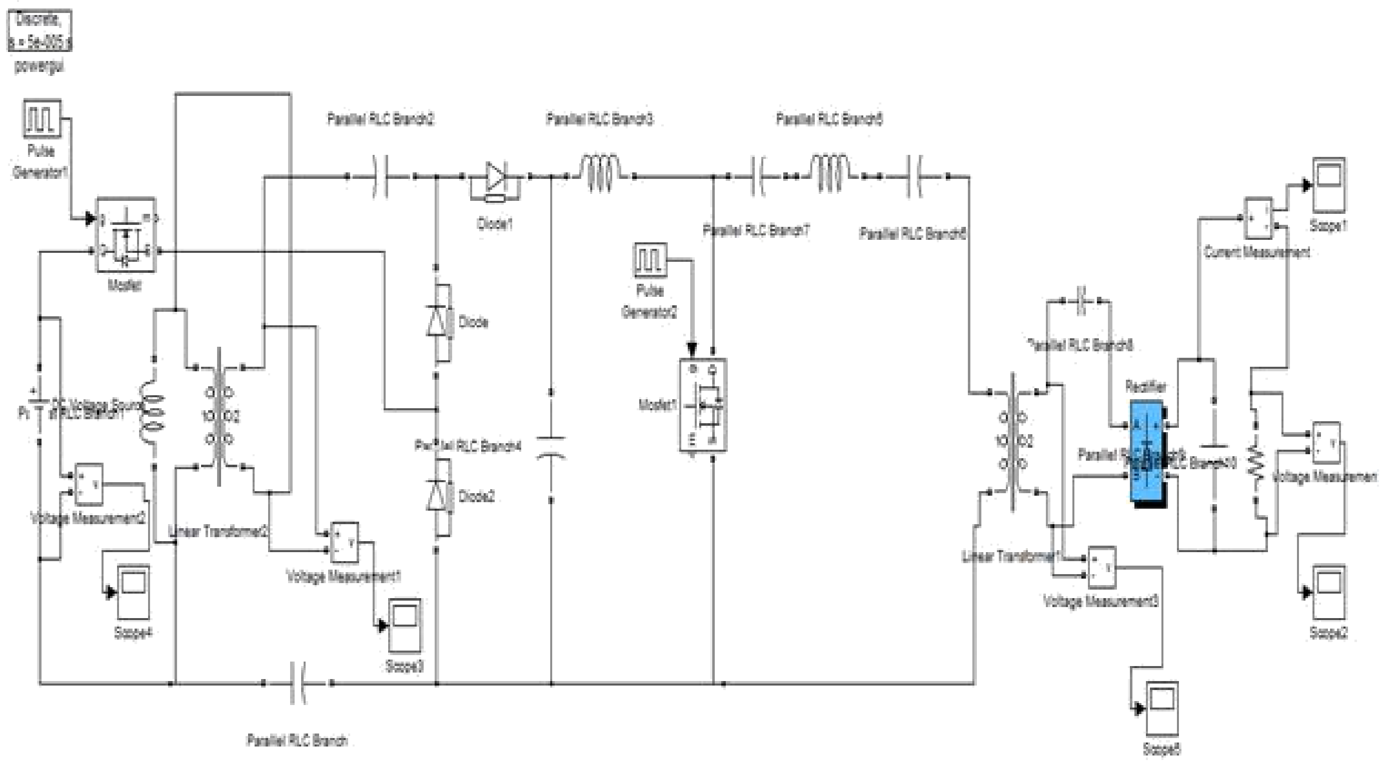

Fig 3: Circuit arrangement of the proposed wireless power transmission system using simulation

5.1 OUTPUT WAVEFORMS

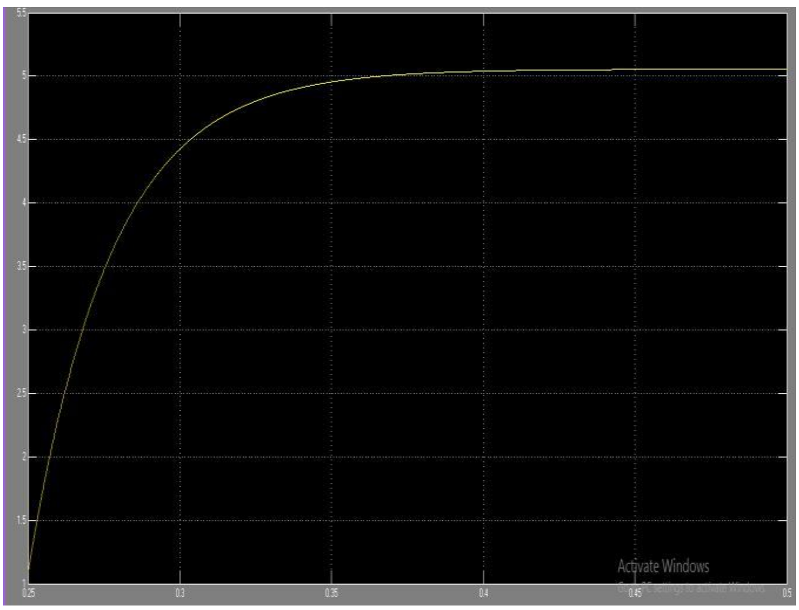

Fig 4(a): Output current of the proposed system

Fig 4(b): Output voltage of the proposed system

6 CONCLUSION

This project has introduced the transmission of power wirelessly using the input from the solar panel. The proposed wireless power transmission using high step-up dc-dc converter for PV cells has been built based on the simulation performed on MATLAB/ SIMULINK. The model uses the input from the solar panel and by using a high step-up dc-dc converter, the input of 12V has been stepped up to 70V which is the given as the input to the class E transmitter. The secondary or the receiver of the proposed model receives a DC output of 110V and the power delivered to the load is nearly 28W.

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BIOGRAPHIES

INDHU G pursuing 8th sem B.E (Electrical and Electronics Engineering) in Dr. T. Thimmaiah Institute of Technology, K.G.F. VTU

LISHA R pursuing 8th sem B.E (Electrical and Electronics Engineering) in Dr. T. Thimmaiah Institute of Technology, K.G.F. VTU

SANGEETHA V pursuing 8th sem B.E (Electrical and Electronics Engineering) in Dr. T. Thimmaiah Institute of Technology, K.G.F. VTU

DHANALAKSHMI V received B.E degree (Electrical and Electronics Engineering) in Dr. TTIT under VTU and M.E (Power Electronics) in UVCE, under Bangalore University. She is currently working as Assistant Professor in the Department of Electrical & Electronics Engineering, Dr. TTIT, KGF. Her research area is Power Electronics.