Wireless Power Transmission

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***Abstract* - In this paper, design of High Frequency Wireless power transfer (HFWPT) system is to be proposed. HFWPT technology will be the next generation technology due to its vast applications. Scientists are mainly showing interest on improving the efficiency of magnetic link section. This work is to be concerned with the design of coils, driving converters and creating resonance. Design of HFWPT system is to be operated at resonance frequency of 50khz. It is to expect that the high frequency resonance coupling will improve the efficiency of transmission allowing one to transmit at lesser frequency nearly in a few kHz range . The total proposed work is to be designed in order to maintain the output voltage as required by changing the coupling coefficient.**

***Index Terms* - Wireless Power Transmission, Resonance, Efficient power transmission, High Frequency, Design of winding.**

I. Introduction

Wireless power transmission [1]concept is came into trend from past a few decades ago. There are many applications with the wireless power technology. Many sensor networks [2] are works one this method. Not only sensor networks but also cellular networks[3] are also use the same principle. There are many approaches[4] to adopt this. On the application of wireless power transmission some issues and initiatives are noticed in Japan [5]. After noticing the problems with old techniques a few more new methodologies[6] are invented.

Every method has its own advantages and disadvantages , after analyzing the old approaches we observed that to transfer wireless power *resonant inductive coupling[7]* method is more efficient as compared to other methods. Here we proposed our own *high frequency resonant inductive coupling* method and hoped more efficiency than other.

II. Design of wireless power transmission system

This design includes two sections
sending end
receiving end
In sending end first the ac power is given to the 1 full wave rectifier and is converted into dc output. This dc supply is given as input to the inverter. The frequency is increased by changing the switching frequency of the inverter gate pulses. The time intervals of switching are calculated based on the frequency we required. Hence frequency is inversely proportional to the time period would decreases. These values for this project are calculated as follows

$$f = \frac{1}{T} \quad (1)$$

here f = 50kHz
so $T = 20\mu s T = 20\mu s$

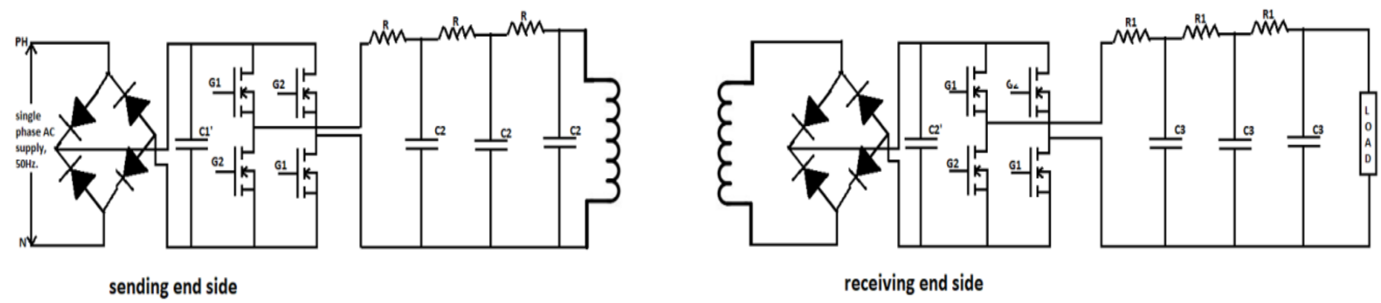

Fig. 1 Circuit Diagram of Adopted Work

A. Inverter

In this project one of the major thing is changing the frequency, it is done by using inverter [8]. Solar power inverters [9] are made popular because of wireless power transmission. The gating pulses giving to switches and working the inverter is very difficult because the switching frequency is high. For low values of frequency there is no difficulty with the MOSFET turning OFF process. But as the frequency increases the MOSFET does not turn OFF as quickly as possible. It is happened because of presence of junction capacitance present in the MOSFET.

In order to make successful operation of inverter there should be a delay time between the turning OFF and turning ON times of two MOSFETs. Even though the MOSFET can operate at high frequency but while applying it in full bridge inverter circuit there should be some delay time has to provide in the circuit.

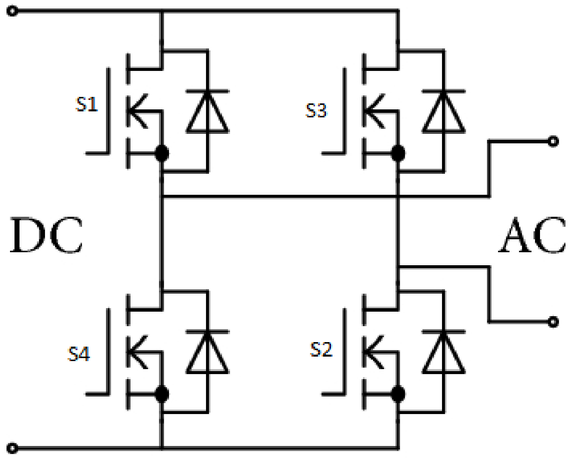

Fig. 2 Simple Inverter Circuit

The switches S1,S2 are switched ON at one time and S3,S4 are switched at other time. The delay time afterS1,S2 OFF and to turn ON S3,S4 is chosen 2µs.

B. Square to Sine wave Converter

The output of inverter is square wave and it has to be change to sine wave[10]. For this 3 step RC ladder circuit is used. The values of RC should be chosen properly for proper output sine wave. The RC network can be replaced with a LC network to minimize losses thereby increase in efficiency.

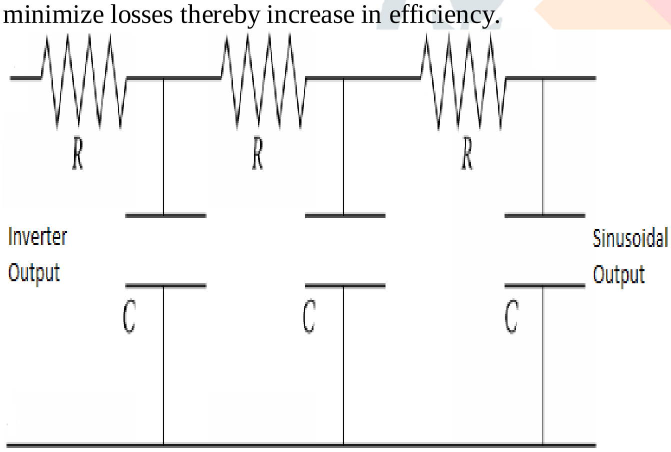

Fig. 3 Square to Sin Wave Converter

C. Programs(Ardiuno [11]*)*

1) Sending Side:

```
void setup() {
pinMode(8,OUTPUT);
pinMode(9,OUTPUT);
}
void loop() {
digitalWrite(8,HIGH);     //S1,S2 ON
delayMicroseconds(8);    //ON time
digitalWrite(8,LOW);      //S1,S2 OFF
delayMicroseconds(2);    //Dead time
digitalWrite(9,HIGH);     //S3,S4 ON
delayMicroseconds(8);    //ON time
digitalWrite(9,LOW);     //S3,S4 OFF
delayMicroseconds(2);    //Dead time
}
```

2) Receiving Side:

```
void setup() {
pinMode(8,OUTPUT);
pinMode(9,OUTPUT);
}
void loop() {
digitalWrite(8,HIGH);     //S1,S2 ON
delay(10);    //ON time(in milli seconds)
digitalWrite(8,LOW);      //S1,S2 OFF
digitalWrite(9,HIGH);     //S3,S4 ON
delay(10);    //ON time
digitalWrite(9,LOW);     //S3,S4 OFF
}
```

Here at receiving side there is no need of dead time because the operating frequency is 50Hz only.

Practically we wrote program to operate at 50kHz frequency but we got a lesser frequency than we expected.

III. Components Used

S.no	Name	Specification	Qty
1	MOSFET	IRF640	8
2	Resistor		
3	Capacitor		
4	Diode	FR306	8
5	Capacitor		
6	Optocoupler	TLP250	8
7	Pulse generator	Ardiuno	2

All the components are chosen on the basis of this project requirement.

Diodes FR306 are used for rectification and capacitor is used for filtering purpose. Ardiuno and optocoupler [12] & [13] forms the gate driver circuits to the MOSFETs.

IV. Proposed Output

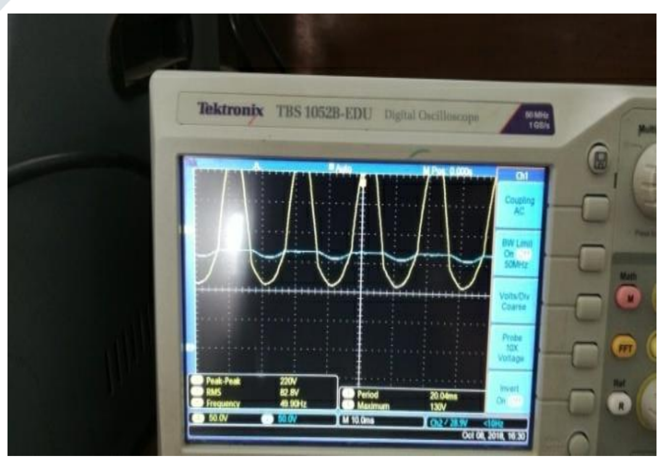

Fig. 4 Rectifier output

The output of rectifier is very close to ideal dc source. Ripple content in the output is being minimized with the help of filters. After the application of filter also the output is not a pure dc. But we have given it as a source to the inverter .

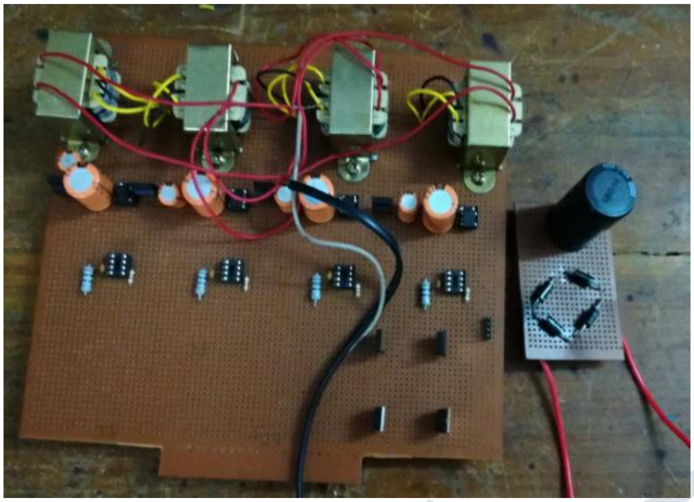

Fig. 5 Final view of rectifier and inverter

The above figure shows the actual model of this project and here in the 8 pin base we have to put the optocoupler. All the wiring is done in the back side of the PCB.

The main difficulty in the design of inverter is increasing frequency. To increase frequency switching frequency has to be varied. While we are doing the project the optocouplers are damaged due to operating them at high frequency. And at beginning some MOSFET's are fried due to internal capacitance effect. This problem is overcome by providing dead time between switching. Actually our project is not completed yet but the major part of our proposed work is completed and we applied this for testing with the help of some pre-designed coils but we won't get the output because of low impedance of the winding. The designing of winding to operate at high frequency will be done in further report.

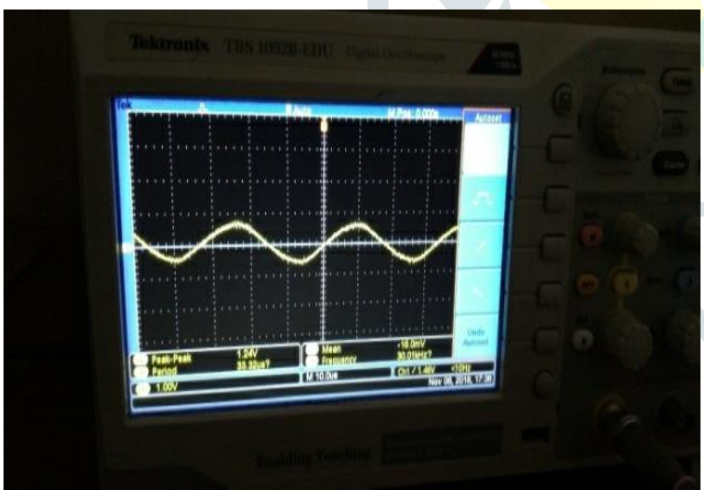

Fig.6 Sinusoidal output at increased frequency

V. Applications and Future Scope

Electric cars [14] are the present trend of automobiles and not all of these but most of these are charged through wireless means. In certain biomedical implants in body, research is occurring in the field of charging them wirelessly rather than replacing them. Use of wireless power in harsh environments like drilling, mining, also in situations where it is impossible to lay wires wireless power transfer finds its applications. Now a days drone [21] based business are fast growing and we can expect wireless power could help to charge those drone based systems.

Hence the high frequency resonant inductive coupling increases the efficiency of the system we hoped it will the next generation. And that is why researches are going on to put wireless power transfer to better use.

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