Design of wireless power transfer using flyback converter and tesla coils

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Abstract. This research to design a wireless electric power transfer system by utilizing a used TV flyback transformer. Flyback TV is used as a Tesla coil power supply with a flyback converter circuit. The principle of wireless in this study is the resonance of electromagnetic waves produced by the Tesla coil. Experiments are carried out by providing switching frequencies and changing distances. The results showed that the power produced was 31.24 W (highest) at a switching frequency of 6.8 kHz and at a distance of 10 m. Efficiency at the same condition is 56.768%.

1. Introduction
The progress of wireless technology is currently increasing in use. This increase, due to several things such as innovation in electronic device technology so that it is easy to consume power or recharge batteries and save cable production materials to be more economical and effective use[1]. It will be more effective and efficient if you can recharge more than one battery at the same time without having to use a cable. One of the concepts of wireless electric power delivery is by sending electrical power from a device to another device or commonly referred to at the sending side of the electric power (transmitter) to the electric receiver side (receiver) without connecting cables with the principle of electromagnetic wave resonance [2].

In this final project the design of wireless electric power is designed using a flyback converter and also a Tesla coil with DC current, where the DC source is an accumulator [3]. The advantage of this flyback converter compared to other converters is the isolation between the input side and the output side and the simpler circuit [4].

Currently tube users of television models are starting to switch to flat television with a simpler form, because many television tube models are already unused and damaged. In this final project, the flyback converter circuit used utilizes the tube model flyback television transformer components to be reused and not become electronic waste. On the secondary twist side of this television flyback transformer produces high voltage as a source of Tesla coils [5]. The triggering signal of the MOSFET on the flyback converter circuit uses a PWM NE555 circuit [6].

2. Methodology
2.1 Research Block Diagram
Hardware design is a design of power electronics used for wireless power transfer in the form of a 12 V<sub>DC</sub> voltage regulator circuit. MOSFET driver circuit using PWM IC NE555 signal, flyback converter
circuit, make a Tesla coils, make a high voltage capacitor and receiver circuit. Figure 1 is a block diagram of research the design of wireless power transfer.

![Block Diagram of Wireless Power Transfer Design](image)

**Figure 1.** Block Diagram of Wireless Power Transfer Design

### 2.2 Research Design

The research design is an explanation of the system that will be made as a whole both that includes hardware, and software. In Figure 2, we can see the whole series in this research.

![Electric Circuit of Wireless Power Transfer Design](image)

**Figure 2.** Electric Circuit of Wireless Power Transfer Design

In this research, capacitors on Tesla coils were used for 1.905 nF and primary windings which had an inductance value of 5.140 µH and resonance frequency for capacitors and inductors of 1.608 MHz.

### 3. Analysis and Discussion

#### 3.1 PWM NE555 Signal

The measurement results using an oscilloscope are shown in Figure 6. The generated PWM signals are set to its frequency output to be analyzed for its effect on electric power transfer. The PWM signals with a frequency of 2.2 kHz has an off time and an on time which is longer in duration or commonly called the duty width of the cyclic compared to the 6.8 kHz time duration on and faster off time. In testing the square wave PWM NE555 signal circuit has a value of duty cycle and frequency as triggering MOSFET switching which can be seen in Table 1. The shape of the PWM square wave signal has a high and low value, when a low state can be interpreted in an off condition and when a high value is interpreted as on condition. So that in both conditions such as automatic switching.

| MOSFET | Switching |
|--------|-----------|
| ON     | OFF       |

![Pulse Width Modulation (PWM) NE555 Circuit Output Signal Test](image)

**Table 1.** PWM NE555 Circuit Output Signal Test
To find out the shape of the PWM NE555 signal output, a series of oscilloscopes were tested. The shape of the PWM NE555 circuit output signal is shown in Figure 3. At a frequency of 2.2 kHz the wave signal square has a longer duration of on and off. When the frequency is increased the time on and off gets faster and has more square wave signals.

![Figure 3. PWM NE555 Output Signal](image)

(a) 2.2 kHz, (b) 3 kHz, (c) kHz, (d) 5 kHz, (e) 6 kHz, (f) 6.8 kHz

### 3.2. The Flyback Converter Circuit

Measurement the value voltage and current output of the flyback converter circuit with a changeable frequency from 2.2 kHz to 6.8 kHz resulted from the PWM NE555 circuit output waveform. Output Voltage on the flyback TV transformer has a high voltage value in kilo Volt units, because of the limitations of the high voltage measurement test equipment in this research made measuring instruments using the voltage divider method to facilitate the retrieval of research data. Tests are carried out by mounting the input probe of the measuring instrument in parallel to the transformer and the output probe in parallel to the multimeter. The voltage divider circuit has a value of R1 100 MΩ and R2 1 kΩ. The following data from the test results of the flyback converter circuit are shown in Table 2.

| Frequency (kHz) | Voltage Input Transformer (V) | Current Input Transformer (A) | Power Input Transformer (W) | Voltage Output Transformer (V) | Current Output Transformer (A) | Power Output Transformer (W) |
|----------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|-------------------------------|-------------------------------|
| 2.2            | 35.76                         | 5.811                         | 207,801.36                  | 11500                         | 0.01753                       | 201,595                       |
| 3              | 41.28                         | 5.757                         | 237,648.96                  | 13000                         | 0.01711                       | 222,243                       |
| 4              | 46.83                         | 5.47                          | 256,160.91                  | 14100                         | 0.01665                       | 234,765                       |
| 5              | 50.77                         | 4.848                         | 246,132.96                  | 15100                         | 0.01619                       | 244,469                       |
| 6              | 54.41                         | 4.311                         | 234,561.51                  | 16100                         | 0.01568                       | 252,448                       |
| 6.8            | 60.98                         | 3.785                         | 230,809.93                  | 16900                         | 0.01554                       | 262,626                       |

When a frequency of 2.2 kHz produces a voltage of 11500 V and a current of 0.01753 A, the more frequencies are added to 3 kHz, 4 kHz, 5 kHz, 6 kHz and 6.8, the voltage and current values change. At
a maximum frequency of 6.8 kHz the voltage value of 16900 V is generated and the current is 0.01554 A. The change in frequency of the PWM circuit affects the value of the flyback transformer output voltage and current. So that in this research we used frequencies of 2.2 kHz, 3 kHz, 4 kHz, 5 kHz, 6 kHz and 6.8 kHz according to the PWM circuit output to be able to determine the effect on electric power transfer.

3.3. Electric Power Transfer

The transfer of electrical power from the Tesla coils circuit transmitter to the receiver coils circuit which is shown in Figure 5 with MOSFET switching frequency of 2.2 kHz to 6.8 kHz.

![Electric Power Transfer Test](image)

**Figure 4. Electric Power Transfer Test**

**Table 3. Electric Power Transfers at 2.2 kHz and Transmitter 10.6 kV, 0.52 mA, 5.512 W**

| Distance (cm) | Receiver Voltage (kV) | Receiver Current (mA) | Receiver Power (W) | Efficiency% | Secondary Receiver Coils Voltage (V) | Secondary Receiver Coils Current (A) | Secondary Receiver Coils Power (W) | Electric Field (V/m) | Magnetic Field (μT) |
|--------------|-----------------------|-----------------------|-------------------|------------|--------------------------------------|-------------------------------------|----------------------------------|---------------------|---------------------|
| 10           | 9.31                  | 0.298                 | 2.774             | 50.333     | 14.37                                | 0.32                                | 4.5984                          | 1172                | 27.96               |
| 20           | 5                     | 0.154                 | 0.770             | 13.969     | 6.96                                 | 0.251                               | 1.74696                         | 1016                | 25.19               |
| 30           | 3.1                   | 0.073                 | 0.226             | 4.105      | 4.72                                 | 0.14                                | 0.6608                          | 987                 | 23.76               |
| 40           | 1.2                   | 0.046                 | 0.055             | 1.001      | 3.66                                 | 0.094                               | 0.34404                         | 806                 | 19.17               |
| 50           | 0.7                   | 0.023                 | 0.016             | 0.292      | 2.31                                 | 0.066                               | 0.15246                         | 765                 | 15.2                |
| 60           | 0.587                 | 0.018                 | 0.010             | 0.191      | 1.48                                 | 0.054                               | 0.07992                         | 644                 | 13.11               |
| 70           | 0.527                 | 0.015                 | 0.007             | 0.143      | 1.12                                 | 0.043                               | 0.04816                         | 531                 | 10.67               |
| 80           | 0.519                 | 0.012                 | 0.006             | 0.112      | 0.78                                 | 0.032                               | 0.02496                         | 298                 | 7.01                |
| 90           | 0.482                 | 0.009                 | 0.004             | 0.078      | 0.772                                | 0.022                               | 0.016984                        | 159                 | 5.22                |
| 100          | 0.427                 | 0.007                 | 0.002             | 0.054      | 0.61                                 | 0.018                               | 0.01098                         | 102                 | 3.46                |

Analysis of measurement results with a frequency of 2.2 kHz, based on Table 3 that with the initial distance of 10 cm between the transmitter coil and receiver coil, the value of received electrical power the further the measurement distance on the receiver coil, the smaller the electric power and power efficiency, along with increasing the distance of the receiver coil to the transmitter coil up to a distance of 100 cm. At the receiver coils there are secondary coils that have smaller coils value to reduce the voltage and will be connected to the load, the measurement results at a frequency of 2.2 kHz with the distance of the receiver coils from 10 cm to 100 cm. The nearest distance of 10 cm voltage is 14.37 V and current is 0.32 A and the power produced is 4.5984 W. When compared with the furthest distance of 100 cm the voltage is 0.61 V and the current is 0.018 A and the power is 0.01098 W. When the frequency of 2.2 kHz with a distance of 10 cm from the transmitter the value of the electric field and magnetic field is 1172 V / m and 27.96 μT. Along with the addition of distances of up to 100 cm, it can be seen in Table 3 that the resulting electric field decreased by 102 V/m and the magnetic field was 3.46 μT.
Table 4. Electric Power Transfers at 3 kHz and Transmitter 12.6 kV, 0.65 mA, 8.19 W

| Distance (cm) | Receiver Voltage (kV) | Receiver Current (mA) | Receiver Power (W) | Efficiency % | Secondary Receiver Coils Voltage (V) | Secondary Receiver Coils Current (A) | Secondary Receiver Coils Power (W) | Electric Field (V/m) | Magnetic Field (µT) |
|---------------|-----------------------|-----------------------|-------------------|-------------|--------------------------------------|-------------------------------------|-----------------------------------|----------------|-------------------|
| 10            | 11.53                 | 0.358                 | 4.127             | 50.339      | 19.64                                | 0.408                               | 8.01312                          | 1248           | 25.33             |
| 20            | 7                     | 0.164                 | 1.148             | 14.017      | 10.77                                | 0.38                                | 4.0926                           | 1146           | 19.77             |
| 30            | 4.3                   | 0.094                 | 0.404             | 4.935       | 7.23                                 | 0.227                               | 1.64121                          | 1012           | 16.59             |
| 40            | 1.4                   | 0.006                 | 0.084             | 1.025       | 5.22                                 | 0.146                               | 0.76212                          | 965            | 14.63             |
| 50            | 0.8                   | 0.055                 | 0.044             | 0.537       | 3.81                                 | 0.11                                | 0.4191                           | 877            | 13.52             |
| 60            | 0.687                 | 0.038                 | 0.026             | 0.318       | 2.717                                | 0.087                               | 0.23679                          | 765            | 11.09             |
| 70            | 0.652                 | 0.034                 | 0.022             | 0.270       | 1.95                                 | 0.067                               | 0.13065                          | 655            | 9.54              |
| 80            | 0.62                  | 0.03                  | 0.018             | 0.227       | 1.331                                | 0.054                               | 0.07184                          | 517            | 4.12              |
| 90            | 0.571                 | 0.023                 | 0.013             | 0.160       | 0.95                                 | 0.039                               | 0.03705                          | 401            | 3.14              |
| 100           | 0.554                 | 0.011                 | 0.006             | 0.074       | 0.708                                | 0.026                               | 0.018408                         | 378            | 2.43              |

At a frequency of 3 kHz in this research the voltage value of the transmitter circuit is 12.6 kV and the current value is 0.65 mA with a power of 8.19 W and the measurement of the receiver with the highest voltage at a distance of 10 cm is 11.53 kV, 0.358 mA and 4.127 W power has an efficiency of 50.339%, while the furthest distance of 100 cm the voltage is 0.554 kV, 0.011 mA, and power is 0.006 W with efficiency of 0.0074%. Furthermore, the secondary winding of the receiver is measured with the results as in Table 4. Voltage at a distance of 10 cm is 19.64 V, current is 0.408 mA power is 8.01312 W.

In Table 5 test the transfer of electrical power with a 4 kHz frequency measurement on a receiver coil with a distance of 10 cm produces a voltage of 14.9 kV, current of 0.46 mA and power of 4.127 W with an efficiency of transferring electrical power 50.440%. At the farthest distance of 100 cm the voltage is 0.675 kV, the current is 0.015 mA and the power is 0.006 W with an efficiency of 0.0074%. In the secondary windings with a distance of 10 cm the resulting voltage is 25.47 V, the current is 0.547 A and the power is 13.9320 W, and at the farthest distance of 100 cm the voltage is 1.082 V, the current is 0.042 A with a power of 0.0454 W.

Table 5. Electric Power Transfers at 4 kHz and Transmitter 17.2 kV, 0.79 mA, 13.54 W

| Distance (cm) | Receiver Voltage (kV) | Receiver Current (mA) | Receiver Power (W) | Efficiency % | Secondary Receiver Coils Voltage (V) | Secondary Receiver Coils Current (A) | Secondary Receiver Coils Power (W) | Electric Field (V/m) | Magnetic Field (µT) |
|---------------|-----------------------|-----------------------|-------------------|-------------|--------------------------------------|-------------------------------------|-----------------------------------|----------------|-------------------|
| 10            | 14.9                  | 0.46                  | 4.127             | 50.440      | 25.47                                | 0.547                               | 13.9320                          | 1320           | 15.71             |
| 20            | 10.4                  | 0.236                 | 1.148             | 18.062      | 14.53                                | 0.51                                | 7.4103                           | 1279           | 12.15             |
| 30            | 8                     | 0.115                 | 0.404             | 6.770       | 11.21                                | 0.36                                | 4.0356                           | 1136           | 11.2              |
| 40            | 1.6                   | 0.092                 | 0.084             | 1.083       | 7.25                                 | 0.241                               | 1.7472                           | 1076           | 8.72              |
| 50            | 1                     | 0.078                 | 0.044             | 0.574       | 5.13                                 | 0.18                                | 0.9234                           | 980            | 6.98              |
| 60            | 0.973                 | 0.065                 | 0.026             | 0.465       | 3.72                                 | 0.145                               | 0.5394                           | 877            | 5.33              |
| 70            | 0.79                  | 0.040                 | 0.022             | 0.232       | 2.66                                 | 0.112                               | 0.2979                           | 701            | 2.89              |
| 80            | 0.745                 | 0.037                 | 0.018             | 0.202       | 1.973                                | 0.091                               | 0.1795                           | 593            | 1.84              |
| 90            | 0.715                 | 0.033                 | 0.013             | 0.173       | 1.43                                 | 0.062                               | 0.0886                           | 470            | 1.08              |
| 100           | 0.675                 | 0.015                 | 0.006             | 0.074       | 1.082                                | 0.042                               | 0.0454                           | 386            | 0.57              |

Decreasing the value of the power produced is influenced by changes in the magnetic field and the electric field received at the receiver. At a distance of 10 cm the electric field 1320 V / m magnetic field 15.71 µT, decreased when the distance of 100 cm with an electric field of 386 V / m and a magnetic field of 0.57 µT.

Table 6. Electric Power Transfers at 5 kHz and Transmitter 21.4 kV, 0.95 mA, 20.33 W

| Receiver | Secondary Receiver Coils |
|----------|--------------------------|


The result with a frequency of 5 kHz can be seen in Table 6 when the distance of 10 cm voltage is 19.59 kV, current is 0.526 mA and power is 10.304 W with efficiency of 50.685%, the furthest distance of 100 cm is decreased to 0.752 kV, current is 0.041 mA and power 0.031 W with efficiency of 0.154%. The secondary windings with a distance of 10 cm produce a voltage of 32.26 V, a current of 0.755 A and a power of 24.3563 W. At the distance of 100 cm, voltage 1.341 V, current 0.067 A and power 0.0898 W. When compared with a lower frequency the value of the power produced at a frequency of 5 kHz is greater, because the influence of the magnetic field and the electric field emitted is of greater value.

| Distance (cm) | Voltage (kV) | Current (mA) | Power (W) | Efficiency (%) | Voltage (V) | Current (A) | Power (W) | Electric Field (V/m) | Magnetic Field (µT) |
|--------------|--------------|--------------|-----------|----------------|-------------|-------------|-----------|---------------------|--------------------|
| 10           | 19.59        | 0.526        | 10.304    | 50.685         | 32.26       | 0.755       | 10.304    | 15.36               | 12.44              |
| 20           | 15.1         | 0.272        | 4.107     | 18.05          | 20.202      | 0.605       | 10.9202   | 14.60               | 11.67              |
| 30           | 9            | 0.148        | 1.332     | 6.551          | 14.37       | 0.47        | 6.7339    | 13.55               | 9.02               |
| 40           | 2.9          | 0.113        | 0.327     | 1.611          | 9.55        | 0.31        | 2.9605    | 12.31               | 8.4                |
| 50           | 1.112        | 0.084        | 0.093     | 0.459          | 6.93        | 0.25        | 1.7325    | 11.04               | 6.79               |
| 60           | 1.090        | 0.072        | 0.078     | 0.386          | 4.69        | 0.207       | 0.9708    | 10.27               | 5.12               |
| 70           | 0.943        | 0.063        | 0.059     | 0.292          | 3.02        | 0.147       | 0.4439    | 9.83                | 1.53               |
| 80           | 0.835        | 0.052        | 0.043     | 0.213          | 2.33        | 0.131       | 0.3052    | 807                 | 1.06               |
| 90           | 0.791        | 0.044        | 0.034     | 0.171          | 1.78        | 0.097       | 0.1726    | 689                 | 0.77               |
| 100          | 0.752        | 0.041        | 0.031     | 0.154          | 1.341       | 0.067       | 0.08984   | 521                 | 0.52               |

Testing at 6 kHz distance 10 cm generated voltage 23.2 kV, current 0.64 mA and power 14.848 W with efficiency 55.147%, at the farthest distance 100 cm voltage 0.873 kV, current 0.048 mA and power 0.155 W with efficiency 0.155%. In the secondary coils receiver the distance is 10 cm voltage 40.2 V, current is 0.852 A and power is 34.2504 W, the farthest distance of 100 cm is 1.62 V, current is 0.082 A and power is 0.1328 W. With an electric field at a distance of 10 cm 1611 V/m, the magnetic field is 10.59 µT. The farthest distance of 100 cm of the generated electric field is 750 V/m with a 0.11 µT magnetic field.

The highest frequency testing in this research is 6.8 kHz. Electricity transfer measurement data obtained can be seen in Table 8. The voltage generated at the receiver is 10 cm 24.3 kV, the current is 0.730 mA and the power is 17.739 W with an efficiency of 56.768%. The distance of 100 cm voltage is 0.92 kV, current is 0.066 mA, power is 0.066 W with efficiency of 0.194%. In the secondary coil the distance of 10 cm the resulting voltage is 46.82 V, the current is 0.967 A and the power is 45.2749 W, with a distance of 100 cm the voltage is 1.952 V, the current is 0.097 A and power is 0.1893 W. The farther the receiver's measurement distance, the less the efficiency and power received. At a distance of 10 cm the receiver's electric field is 1735 V/m, the magnetic field is 9.21 µT and at the farthest distance 100 cm the electric field is 848 V/m magnetic field of 0.09 µT.

| Table 7. Electric Power Transfers at 6 kHz and Transmitter 25.4 kV, 1.06 mA, 26.924 W |
|----------------|----------------|----------------|-----------|----------------|-------------|-------------|-----------|---------------------|--------------------|
| Distance (cm) | Receiver Voltage (kV) | Current (mA) | Power (W) | Efficiency (%) | Secondary Voltage (V) | Current (A) | Power (W) | Electric Field (V/m) | Magnetic Field (µT) |
| 10            | 23.2           | 0.64          | 14.848    | 55.147         | 40.2         | 0.852       | 34.2504   | 1611                | 10.59              |
| 20            | 17.3           | 0.46          | 7.958     | 19.61          | 29.557       | 0.685       | 13.4320   | 1588                | 8.39               |
| 30            | 11.5           | 0.272         | 3.128     | 11.617         | 15.52        | 0.507       | 7.8686    | 1472                | 7.28               |
| 40            | 7.11           | 0.185         | 1.315     | 11.5            | 4.885       | 0.36        | 4.1400    | 1367                | 5.78               |
| 50            | 2.4            | 0.169         | 0.405     | 1.506          | 8.63         | 0.298       | 2.5717    | 1211                | 4.76               |
| 60            | 1.92           | 0.125         | 0.240     | 0.891          | 6.1          | 0.241       | 1.4701    | 1176                | 2.11               |
| 70            | 1.113          | 0.104         | 0.115     | 0.429          | 4.32         | 0.184       | 0.7948    | 1037                | 1.17               |
| 80            | 1.046          | 0.081         | 0.084     | 0.314          | 3.31         | 0.164       | 0.5428    | 972                 | 0.69               |
| 90            | 0.955          | 0.068         | 0.064     | 0.240          | 2.29         | 0.114       | 0.2610    | 889                 | 0.21               |
| 100           | 0.873          | 0.048         | 0.041     | 0.155          | 1.62         | 0.082       | 0.1328    | 750                 | 0.11               |

| Table 8. Electricity Power Transfers at 6.8 kHz and Transmitter 27.9 kV, 1.2 mA, 31.24 W |
|----------------|----------------|----------------|-----------|----------------|-------------|-------------|-----------|---------------------|--------------------|

6
Distance (cm) & Receiver & Efficiency & Secondary Receiver Coils & Electric Field & Magnetic Field  

| Distance (cm) | Voltage (kV) | Current (mA) | Power (W) | Voltage (V) | Current (A) | Power (W) | Voltage (V/m) | Current (µT) |
|--------------|--------------|--------------|-----------|-------------|-------------|-----------|---------------|--------------|
| 10           | 24.3         | 0.730        | 17.739    | 46.82       | 0.967       | 45.27494  | 1735          | 9.21         |
| 20           | 19.14        | 0.633        | 12.115    | 23.01       | 0.759       | 17.46459  | 1631          | 7.91         |
| 30           | 15.3         | 0.367        | 5.615     | 17.969      | 18.31       | 10.85783  | 1526          | 6.54         |
| 40           | 9.7          | 0.203        | 1.969     | 6.301       | 13.28       | 5.82992   | 1425          | 4.11         |
| 50           | 5.1          | 0.186        | 0.948     | 3.035       | 9.81        | 3.26673   | 1322          | 3.28         |
| 60           | 2            | 0.163        | 0.326     | 1.043       | 7.72        | 2.19248   | 1217          | 1.79         |
| 70           | 1.27         | 0.144        | 0.183     | 0.586       | 5.382       | 1.081782  | 1109          | 1.01         |
| 80           | 1.11         | 0.122        | 0.136     | 0.435       | 3.78        | 0.70686   | 992           | 0.43         |
| 90           | 1.07         | 0.088        | 0.094     | 0.302       | 2.87        | 0.38458   | 920           | 0.17         |
| 100          | 0.92         | 0.066        | 0.060     | 0.194       | 1.952       | 0.189344  | 848           | 0.09         |

From the data that has been obtained in the testing of electrical power transfer with a frequency of 2.2 kHz to 6.8 kHz can be graphed as shown in Figure 5 to Figure 7.

**Figure 5.** Voltage and Current with Variable Distance

In Figure 5 are a graph of voltage and current to distance comparison with different frequency. It can be seen that the 6.8 kHz frequency has a voltage value of 46.82 V at the receiver measuring distance of 10 cm and the lowest voltage at a frequency of 2.2 kHz with voltage amounting to 0.61 V.

**Figure 6.** Electric Power and Efficiency of Electrical Power Transfer

The highest current value in the study is 0.967 A at a distance of 10 cm and the lowest current value at a distance of 100 cm with a value of 0.018 A. This change in frequency affects the value of electric power transfer, because the larger the frequency has a lot of waves so the average voltage supplied from the flyback converter is also large, so the current flowing in the primary coil of the Tesla coil induces
the Tesla coi secondary coil and affects the value power generated as shown in Figure 6. The greatest efficiency value at a distance of 10 cm at a frequency of 6.8 kHz and the lowest efficiency at a distance of 100 cm at a frequency of 2.2 kHz.

![Figure 6](image)

**Figure 6. Electric Field vs Distance at Different Frequency**

The greatest efficiency value at a distance of 10 cm at a frequency of 6.8 kHz and the lowest efficiency at a distance of 100 cm at a frequency of 2.2 kHz.

![Figure 7](image)

**Figure 7. Electric Field the Magnetic Field**

In Figure 7 shows changes in the value of the electric and magnetic fields every change in distance. The distance of 10 cm from the transmitter has an electric field value of 1735 V/m and a magnetic field of 9.21 µT at a frequency of 6.8 kHz, thus affecting the value of the power produced at the receiver coil. The lowest value of the electric field and magnetic field on the graph at the frequency level of 2.2 kHz with an electric field value of 102 V / m and a magnetic field of 3.46 µT at a distance of 100 cm from the transmitter so that it has a lower electrical power transfer efficiency.

4. **Conclusion**

In this research, wireless transfer of power using flyback and tesla coils was successfully designed and tested. Tests carried out with variations in switching frequency, distance and voltage on the transmitter. The experiment results show that the largest power generated is equal to 31.24 W at a 6.8 kHz switching frequency, 46.2749 V voltage and 10 cm distance. The greatest efficiency (56.79%) was also obtained at a switching frequency of 6.8 kHz and a distance of 10 cm.

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