

MINI SOLID STATE TESLA COIL

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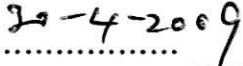
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**Especially dedicate to my lovely father, mother, my whole family members, my friends
and my supervisor**

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ABSTRACT

This project discusses of design a circuit which produces a high voltage but low current and produce high frequency. Apart from that, this circuit also result a large spark resulted as high voltage production. This circuit was the basis of Nikola Tesla classic's circuit only used capacitor, converter and also some different components. This project is very important to increase student knowledge of how to generate a large force from small entry. This circuit only used a few voltages only and will produce a large voltage. Apart from that this circuit is also substantial because it is one circuit miniaturized and could be used for goods which required large force. This circuit also is circuit so hard to be built because it uses expertise and require thinking creative. Apart from that, designer must be careful to build this circuit. The methodology for this project is firstly preparing Gantt chart, doing literature review, software simulation and demonstration of the complete project. The result hopefully can fulfill the theory of the mini solid state Tesla coil which main point is to generate the high voltage from the low input voltage.

ABSTRAK

Projek ini membincangkan tentang merekabentuk sebuah litar yang menghasilkan suatu voltan yang tinggi tetapi arus yang rendah dan menghasilkan frekuensi yang tinggi. Selain itu, litar ini juga menghasilkan suatu percikan api yang besar hasil daripada pengeluaran voltan yang tinggi. Litar ini merupakan asas daripada litar klasik Nikola Tesla yang hanya menggunakan kapasitor, pengubah dan juga beberapa komponen yang lain. Projek ini amat penting untuk menambah pengetahuan pelajar tentang bagaimana untuk menghasilkan suatu kuasa yang besar dari masukan yang kecil. Litar ini hanya menggunakan beberapa voltan sahaja dan akan menghasilkan suatu voltan yang besar. Selain itu litar ini juga penting kerana ianya adalah suatu litar yang bersaiz kecil dan boleh digunakan untuk barang yang memerlukan kuasa yang besar. Litar ini juga merupakan litar yang begitu susah untuk dibina kerana ianya menggunakan kepakaran dan memerlukan pemikiran sifat untuk mencipta. selain itu, pereka perlu berhati-hati untuk membina litar ini. Metodologi untuk projek ini pertama adalah menyediakan carta gantt, melakukan ulasan karya dan perisian simulasi serta demonstrasi untuk projek yang telah disiapkan. Semoga hasil yang diperolehi diharap dapat memenuhi teori mini solid state Tesla coil di mana tujuan utama adalah untuk membina litar dan menghasilkan keluaran voltan yang tinggi daripada voltan input yang rendah.

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LIST OF ABBREVIATION

SSTC	Solid State Tesla Coil
AC	Alternating current
DC	Direct Current
HV	High Voltage
R3	Resistor 3
R4	Resistor 4
PCB	Printed Circuit Board

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CHAPTER I

INTRODUCTION

1.1 Background of Project

The electrical energy become most important since it introduced in the world. This is because it a source supply power use in daily. Without the electrical energy, we can imagine how the human use their strength to do their work every day. The electrical energy makes people easy to do their work and life. Otherwise, the electrical energy can give more benefit to world and human, for example we know the car using the petrol but nowadays with new technology, battery or eclectic power supply can use in car to replace the petrol.

In this world, there has much designer electrical power energy and which one is Nikola Tesla. [2] **Nikola Tesla** (Serbian Cyrillic: Никола Тесла) (10 July 1856 – 7 January 1943) was an inventor and a mechanical and electrical engineer. Born in Smiljan, Croatian Krajina, Austrian Empire, he was an ethnic Serb subject of the Austrian Empire and later became an American citizen. Tesla is often described as the most important scientist and inventor of the modern age, a man who "shed light over the face of Earth". He is best known for many revolutionary contributions in the field of electricity and magnetism in the late 19th and early 20th centuries. Tesla's patents and

theoretical work formed the basis of modern alternating current electric power (AC) systems, including the polyphase power distribution systems and the AC motor, with which he helped usher in the Second Industrial Revolution. Contemporary biographers of Tesla have regarded him as "*The Father of Physics*", "*The man who invented the twentieth century*" and "the patron saint of modern electricity."

This document describes some ideas that I had about the design of a "solid-state Tesla coil". The output of this device is to produce an effects similar to a classical capacitor-discharge Tesla coil while is basically an electronic inverter that switch a DC power supply over a network and resonate at the driver's frequency, it convert the switched signal to a high-voltage output and produce sparks and "streamers", or radio frequency corona. It is then a kind of Tesla coil that operates using the zero-state response of the network, instead of the zero-input response as happens in a capacitor-discharge Tesla coil.

This research will simulate a circuit and develop the hardware. This project is about electrical where it produces a high voltage, high frequency but low current. The basic component or material that can be use is transformer, capacitor, resistor, coil, semiconductor and some additional part as a safety for this project. [2] The first thing about Solid State Tesla Coils is that they are not truly Tesla Coils. In fact, Solid State Tesla Coil is sort of an oxymoron, as in order to be a true Tesla Coil, the machine needs a spark gap. This spark gap is obviously not solid state. That aside, there are a few similarities and differences that should be pointed out. Solid State Tesla Coils are similar in the respect that they use the same basic principle of operation a high frequency resonant transformer. Because the primary and secondary are so perfectly tuned, there is a huge increase in voltage. This is basically where the difference ends though. Perhaps the most major difference is in how the transformer is constructed and driven. As the name implies, Solid State Tesla Coils are not air core transformers. Instead, they are usually wound on a ferrite form, much like a regular transformer (except that regular transformers are usually wound on an iron core). This is how TV

flyback transformers are made. The other way they differ is how they are driven. Instead of a spark gap, Solid State Tesla Coils use transistors or MOSFETs.

1.2 Objectives of Project

The purposes of doing this project are stated below;

1. To design of mini solid state tesla coil
2. To construct circuit which is produce high voltage
3. To produce lightning and sparking from a high voltage

1.3 Scopes of Project

Scope of this project basically involve on can a how low voltage produce a high voltage. This project begins from search in internet and studying from the book. Beside that, the tips and advises from lecturer are also important to me make this project. The circuit will be simulated prior based on construction of the circuit before construct on PCB. Finally, the circuit will be constructed on PCB to complete the hardware and the value will be compared from each output in simulation and hardware.

1.4 Problems statement

To complete this project and research, there have some problem when during the PSM 1:

- i) The designer must be carefully constructed has since it a high voltage output.
- ii) Problems occur when trying to simulate the circuit because some components not include on the software.

- iii) There are some difficulties to find some components use in this project.
- iv) Software use to simulate the circuit

1.5 Summary of methodology

There are some methodologies and procedures to complete the objectives for this project. The procedures are written as follows:

- i) Collect the idea from book, internet and tips given by lecturer.
- ii) Compare and choose the best one solution for project problem
- iii) Design circuit and simulate the circuit in multisim software
- iv) Make sure that circuit no problem when during the simulation
- v) Construct the circuit on board after simulate the circuit
- vi) Test the circuit and compare the output value between simulated and measured.

1.6 Outline of Thesis

This thesis consists of five chapters. The first chapter discuss about background, objective and scope of this project. Chapter two discuss more on theory and include literature reviews that have been done. It also will discuss on components of the hardware and software used in this project. Chapter three discuss on the methodology hardware and software development of this project. Chapter four will discuss about project's testing and results. Finally in chapter five it will discuss about conclusion and future work proposal for the project.

CHAPTER II

LITERATURE REVIEW

2.1 Literature Review Overview

This chapter discuss about reviews of existing project created to get an idea about the project design, conception and any information that related to improve the project. With different concept and design, there are other creations and innovations of projects done by other people. Researches related to this project also covered in this chapter.

2.2 How Tesla coil work

A tesla coil is an air cored resonant transformer. The first component in the system is a step up transformer. This transformer takes the line current coming out of your wall socket and steps it up to several thousand volts. There are several easily obtained transformers available. Common choices include a Neon Sign Transformer (NST), an Oil Burner Ignition Transformer (OBIT), or a Microwave Oven Transformer (MOT). Some people use the large pole mounted transformers, or even wind their own transformers.

The next step for the now high voltage is a capacitor, which acts as a sort of storage battery, for short term current storage. There are many different types of capacitors available. Currently, most coilers opt for a string of small (mini) capacitors connected together to achieve the desired storage and voltage characteristics, this is called a Multi Mini Capacitor (MMC). Large industrial capacitors can also be found, or a home made capacitor can be used.

The next component is a spark gap. This acts as a switch to turn on and off the power as it charges the capacitor. Once the capacitor is charged, the spark gap fires, releasing all of the stored energy in a very brief powerful burst. There are many choices in gap design, from a simple gap, multi gaps, rotary gaps, synchronized rotary gaps, and solid state gaps.

From the spark gap, the current flows to the primary coil, usually made from copper pipe or large copper wire of 5 - 20 turns. This is the coil seen at the base of the tesla coil. The coil can be shaped in a flat (saucer), cone, or helical coil shape. This coil produces a magnetic field, and the current is then picked up by the next component.

The secondary coil, as in a traditional transformer consists of many turns of smaller gauge wire. In traditional coils there is a direct relationship between the primary number of turns and the secondary number of turns. For example a coil with 10 primary turns and 20 secondary turns will double the voltage output, 10 primary turns and 100 secondary turns will result in 10x voltage output. The typical tesla coil would have about 100X increase in the secondary, however, due to the resonant rise of the tesla system, even greater increases are achieved.

The final part of the tesla coil is the top (usually a torroid or sphere), which serves as a capacitor (storage area) for the electricity before discharge. This is where all the action takes place. Sparks emanate from here, as does the beautiful corona discharge.

2.3 Research about SSTC

From my research about SSTC, I have found similar circuit of SSTC. The first circuit I get from book and the second circuit from internet as my literature review. This project actually using concept of classically Nikola tesla coil which is the based component part use is common transformer, large capacitor, flyback transformer and spark gap. When the power is supply to the circuit in will charge the capacitor and then after capacitor have reach at fully charge it will discharge and supply the flyback transformer and the same time capacitor still charging, this call a resonant. After a few second the toronoid will produce a sparking which that is a high voltage. The basic operation of Tesla Coil as in steps below:

- i. capacitor reaches a high enough voltage, the spark gap fires
- ii. voltage power supply charges up a capacitor C1
- iii. It goes on when the voltage gets high, and turns off when the voltage gets low
- iv. When the spark gap fires, the energy stored up in the capacitor dumps into a 1:100 step-up transformer
- v. The primary (L1) is about 10 turns of heavy wire. The secondary (L2) is about 1000 turns of thin wire
- vi. The output ratio about 1:100