EE/CprE/SE 492 GROUP PROGRESS REPORT

Group Number: ***sdmay22-39***
Project title: ***Fast, Compact, High Strength Magnetic Pulse Generator***
Client: ***Mani Mina, Wei Shen Theh***
Advisor: ***Robert Bouda***
Team Members: ***Ben Newell, Harith Arsyad, James Camp, Tom Zaborowski, Tyler Bolton, Raheem Alqunais***

- **Project Summary:**

The goal of the project is to design and fabricate a device that is capable of producing magnetic field pulses greater than or equal to 500 gauss with a duration of 100 ns or less, be powered by a source voltage of less than or equal to 15 volts DC, and be less than 3.5” by 2” in physical size. The main application for this type of technology would be for magneto-optic switches. These devices convert optical energy to electrical energy to optical energy once again. This causes a bandwidth bottlecap within optic fiber networks due to the lower communication speed in an electrical connection. By incorporating a fast, high-strength magnetic pulse generator, there is hope to address this bottleneck by placing magneto-optic material between two fiber optic cables and then applying an external magnetic field over said material to modify the phase and/or polarization of the light traveling through the optic cables. With this method, there would not be an optical-electrical conversion, which would increase the bandwidth of optic fiber networks. Given the design requirements and resources from the previous iterations of this project, we plan to create an improved design including a reduced rise time of 10ns, functional programmable control of the magnetic field generation, reduced overall noise, and increased stability. Currently, the team has a monophasic magnetic pulse generator prototype on a perforated board. As of this semester, the team is trying to add an op-amp into the pulse generator/resistor network portion of the circuit. The team is also designing and testing a monophasic and biphasic magnetic pulse generator.

- **Accomplishments**

The team has optimized the monophasic and biphasic zero voltage switching circuits. The values of components were adjusted to get the least amount of power loss in simulation, and with that, the team has sent their final zero voltage switching monophasic design for review. The team has the finalized monophasic and biphasic PCB circuit designed also. Through talks with ETG personnel, the team has found a PCB manufacturer that is fairly cost-efficient and with fast lead times. With this discovery, the plan is to get the monophasic design approved so that the team can send the PCB design to ETG and ultimately have a PCB arrive within three business days. The monophasic circuit has been tested on the breadboard, and the oscilloscope seems to show a waveform similar to what the Multisim transient shows. A p-channel MOSFET has been selected for the biphasic circuit. It shows great results for being a p-channel MOSFET (usually, p-channel MOSFETs are slower than their n-channel counterpart). A couple of team members have completed a soldering practice kit provided by ETG. It has surface mounts and through-hole mounts for many different types of components. With advice from our advisor, Wei Shen Theh, the team was able to improve their soldering skills so that when it comes to soldering PCB components, the extra impedance from soldering will be minimal.

- **Pending issues**

There are some roadblocks in making a magnetic coil with an inductance of 11.7 nH. A couple of team members are in charge of constructing coils to the given dimensions of the coils the team designed. The team specifically designed the coil to be made physically; however, there must be errors in the way some of the team members go by constructing it. The lowest inductance the team can go is 28 nH. The team either needs to redesign the coil to new dimensions or adjust the circuit to accommodate the inductor with the lowest inductance the team can physically make. The second option should not affect the circuit design rather the component values. 28 nH is still a low inductance for this circuit, and it should not drastically affect the rise time of the magnetic field waveform. Also, the intertwined coil for the biphasic circuit has not been made yet but is planned to be constructed between March 21st and March 25th. The biphasic circuit with no zero voltage switching was initially tested on a breadboard before spring break. It was not giving desired results. The team believes it was because the function generator was not set up correctly and it was also not the zero voltage switching circuit that the team has been optimizing for a few weeks. With the monophasic zero voltage switching circuit giving desirable results, the team plans to construct a monophasic zero voltage switching circuit again but with the p-channel side of the biphasic circuit. If the p-channel circuit shows promising results, it will be time to combine both the n-channel and p-channel sides so that the team can test the zero voltage switching biphasic design and ultimately have the biphasic PCB design ordered after getting desirable results on the breadboard.

- **Advisor Input: It is very important that you meet regularly with your advisor. Please have your advisor select one of the options below.**

________ I am pleased with the progress the team is making.

____ The teams progress could use some minor improvements.

________ The team's progress has some major concerns.

Your advisor's selection must be confirmed by either an email attached to this report (merge files into a single pdf) or a physical signature obtained from an in person meeting. Please provide this report to your advisor at least 1 week before the due date so that they have time to respond.

Signature: ____