

# Fast, Compact, High Strength Magnetic Pulse Generator

EE 491 Weekly Report

May 15-30

Week 14 (12/01/14-12/08/14)

Advisors: Mani Mina, John Pritchard, Robert Bouda  
Client: High Speed Systems Engineering Lab  
Members: Team Leader – Adam Kaas  
Team Webmaster – Gregory Fontana, Meiyong Himmtann  
Team Communication Leader – Brittany Duffy  
Team Key Concept Holder – Megan Sharp, Brandon Dixon  
Team Commissioner – Alain Ndoutoume  
Website: <http://may1530.ece.iastate.edu>

## Weekly Summary

This week, our group stepped up the time and effort towards our project to see it through documentation and presentation finals. We met multiple times over the course of this week, and feel ample prepared to present. We are very excited about the progress we have made thus far and are learning a lot about electromagnetism and circuit design and simulation throughout the course of this semester. The below image shows the design process we have circled through to be where we are today:

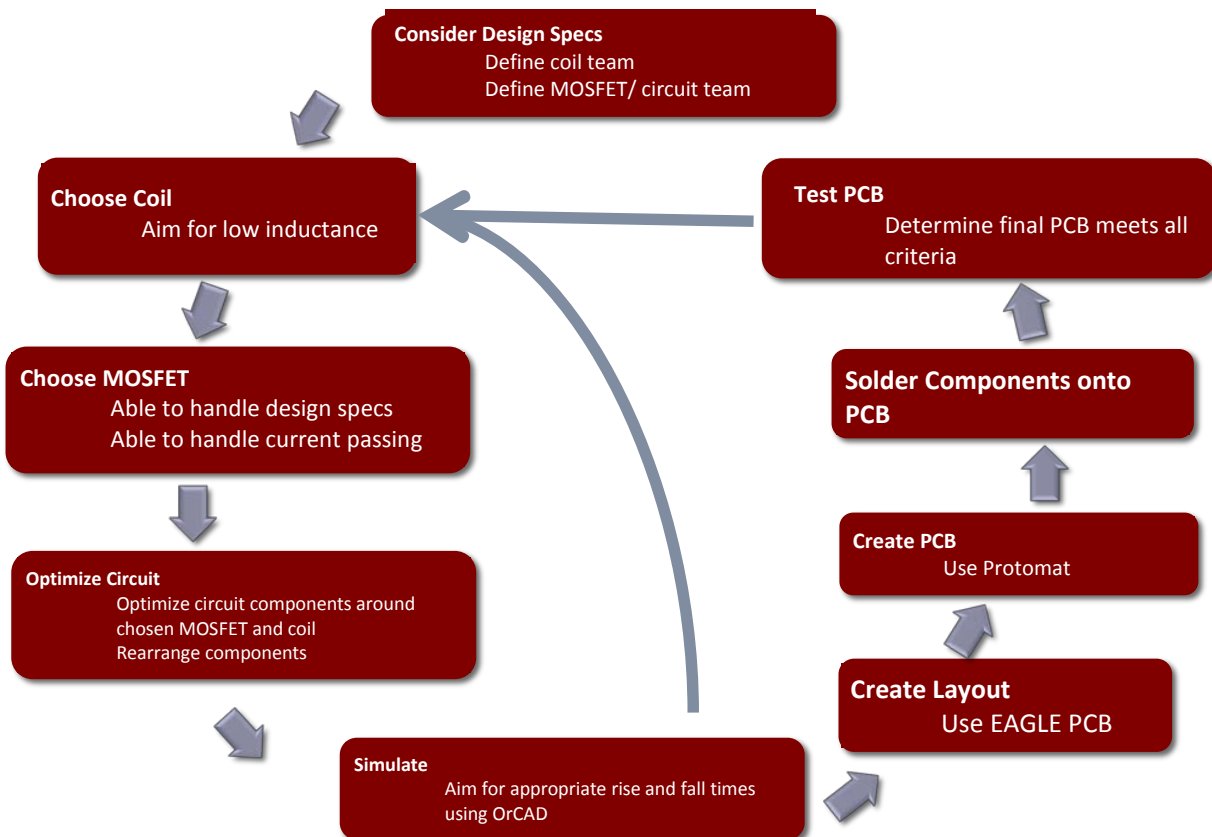


Figure 2: Systems Level Diagram

## Meeting Notes

### 12/1 Group meeting with core members

**Duration:** 1hr      **Members Present:** All

#### **Purpose and Goals:**

Discuss Importance of goals to meet this week.

#### **Achievements:**

Create TODOs for the Project Plan and Design Document. Have everyone begin thinking of what they would like to say during the presentation and/or if they would like to present. We will be meeting many times throughout the week to finalize documents and presentation.

### 12/1 Adam meeting with John

**Duration:** 1hr      **Members Present:** Adam + John

#### **Purpose and Goals:**

Learn how to tell the story of our project

#### **Achievements:**

Learned how to answer several questions regarding our project.

*What are we doing?* We are building a fast, compact, high strength magnetic pulse generator.

Essentially, a switch.

*How fast?* Pulses every microsecond

*That's not fast....* Fast is relative. Because we are generating such a high strength pulse, this speed is fast. It has been shown people can switch at 250ns but their strength is much smaller.

*Where are you generating the pulse?* At the center of the coil

*How strong?* 500 Gauss

*How big is the coil?* N number of turns, measures L length, with diameter D

*Why not bigger? Bigger would get you better results, right?* The size we are making the coil is to specification for our client. He needs it to fit on his optic cables and this is the size that works.

*Are you operating at pinch-off voltage?* No.

*Why not?* We are operating in the saturation region. Pinch-off voltage would put us in the triode region of operation which wouldn't allow us to obtain 20-25 A of necessary current while maintaining our 5V gate voltage.

*Why do you have a 5V gate voltage?* It is a standard we are operating at.

*What's up with the diode?* Used to prevent back EMF into the MOSFET

*And the current sense resistor?* It provides us a way to measure the drain current going through the MOSFET.

*Won't that mess with your gate-to-source voltage?* Yes it does. We are using a 0.05 Ohm resistor, and if we are expecting to use 20-25A, we should expect to see a 1.00-1.25V drop across the resistor, thus changing our gate-to-source voltage from 5V to 3.75-4.00V. It is something we need to account for, and ideally we wouldn't have the resistor as part of our circuit. It is primarily for testing purposes.

*Why do you use all those capacitors?* They are to ensure a quick transmission of 15V to our coil.

Without them, there is a delay in the transmission lines from our voltage supply to our circuit which is not ideal for us. This way, our capacitors can charge up and provide a steady stream of electrons.

*Why do you have some that are tantalum and some that are ceramic?* The tantalum ones are designed to provide a high amount of capacitance with a low amount of internal resistance. The ceramic capacitor is there primarily due to the fact we couldn't find a tantalum capacitor in that size since they are typically designed for a higher capacitance.

*What are the applications for this?* The applications are virtually limitless. Our client wants to use it in conjunction with magneto-optics, a project that is beyond the scope of ours.

### 12/3 Work Team Meeting

**Duration:** 1 hr      **Members Present:** All

**Purpose and Goals:**

Status update on PP and DD.

**Achievements:**

Assigned presentation roles. Work day. Get everyone up to speed on our project status thus far. Have everyone become comfortable with all sorts of questions that may be thrown at us during our final presentation.

### 12/5 Presentation Run Through with Advisor

**Duration:** 2.5 hr      **Members Present:** All+ John + Mani

**Purpose and Goals:**

Receive presentation feedback from advisor.

**Achievements:**

Realized certain parts of our presentation needed edits. We were also asked very good questions, which were great to practice and think about.

### 12/5 Meeting with Client

**Duration:** 1hr      **Members Present:** All + John + Mani

**Purpose and Goals:**

Introduce ourselves to our client and learn about his research.

**Achievements:**

Our client, all the way from Japan, traveled to Iowa State just in time to see our proof of concept. He was kind enough to stop by the senior design lab and see our circuit design. Our client was able to see preliminary stages of our PCB board be created on the Protomat. It was a great experience to meet him, and get a better understanding of his work. He very much appreciated our hard work on this project.

### **Pending Issues**

N/A

### **Plans for Next Week**

**Adam:** Present! Help get the board populated so we can start our testing

**Greg:** Present

**Meiyong:** Present. Make and populate the board.

**Brittany:** Present. See board population through.

**Megan:** Present. Test resistance of newly made coil on RLC meter in EE230 lab. Document protomat procedure while Alain and Meiyong make the board and help as needed with populating the board (although you guys probably have it covered.) If we get all the parts soldered, TEST!!!

**Brandon:** Present. Make sure PCB layout is ready for Protomat.

**Alain:** Spring 2014 final presentation and test our circuit.

### **Individual Contributions This Week**

**Adam:** Core team meeting (1 hr), Design Document edits/review (4.5 hrs), Project Plan editing/review (3.5 hrs), Meeting with John (1 hr), Meeting with Taichi Goto (1 hr), Practice

presentation (2.5 hrs), Work on presentation Thursday (5 hrs), Work on presentation Saturday (7 hrs), Practice presenting Sunday (1.25 hrs), Wednesday Meeting (1hr).

**Greg:** Monday meeting (1hr), Wednesday Meeting (1hr), Wednesday Simulation (5 hrs), Thursday Design Doc (5.5hrs), Meeting with Tachi Goto (1hr), Presentation Practice (2.5 hrs), Saturday Presentation prep (7hrs), Sunday presentation prep (1.25 hrs).

**Meiyong:** Core team meeting (1 hr), Wednesday Meeting (1hr), Meeting with Taichi Goto (1 hr), Practice presentation (2.5 hrs), Work on presentation Thursday (4.5 hrs), Attempted to get another prototype made (1.5 hr), upload final documents to website (.5 hr), Design Document edits/review (2 hrs).

**Brittany:** Core team meeting (1 hr), Wednesday Circuit Simulations (5 hours), Design Document edits/review (10 hrs), Project Plan editing/review (3.5 hrs), Meeting with Taichi Goto (1 hr), Practice presentation (2.5 hrs), Work on presentation Thursday (5 hrs), Work on presentation Saturday (7 hrs), Practice presenting Sunday (1.25 hrs), Complete weekly report (0.5 hrs), Wednesday Meeting (1hr).

**Megan:** Core team meeting (1 hr), Design Document coil write-up (8.5 hour), Project Plan/powerpoint info(1 hr), Coil calculations with new inductance information (2 hrs), Meeting with Taichi Goto (1 hr), Creating and taking pics of new 5 turn coil (0.5 hr), Presentation to Advisors/clients (2.5 hrs), Wednesday team meeting (1 hr).

**Brandon:** Meetings on Monday and Wednesday (2 hrs), Meeting with Taichi Goto (1 hr), Meeting with John (1.5 hr), Preparing Presentation on Thursday (3 hrs), Design Document and Project Plan (3.5 hrs), Creating and editing PCB layout as well as updating parts (7.5 hrs), Practicing Presentation with Mani and John (2 hrs) .

**Alain:** Meeting with team on Monday and Wednesday(2hr), worked on final design document and project plan (2.75hrs), Worked on presentation Thursday (4.5hrs), Attend layout of the new circuit meeting with Brandon (1 hr) presentation with Dr Mani Mina and John Pritchard (2.5hrs), Attempt to create our new PCB circuit (change drills size of the pcb circuit) (2hrs) meeting with Taichi Goto (1hr).

### **Total Contributions for Project (This Week / Total for Semester)**

**Adam:** 27.75 hrs / 83.90 hrs

**Greg:** 24.25 / 72 hrs

**Meiyong:** 14 hrs / 68 hrs

**Brittany:** 37.75 / 113.05

**Megan:** 17.5 hrs /66 hrs

**Brandon:** 20.5 hrs / 78.75 hrs

**Alain:** 15.75 hrs / 65 hrs