EE/CPRE/SE 491 Weekly Report 22 Meeting Time 1:00 – 2:00 P.M. Thursday in TLA
Date: Week of November 1 2018
Group Number 4

High Current Pulse Generator for the Application of Transcranial Magnetic Stimulation

Clients/ Advisors: Priyam Rastogi, Neelam Gaunkar, Jayaprakash Selvaraj, Dr. Mani Mina

Project Objective: Over the course of 2 semesters, design, fabricate, and test a high-current pulse generation device for use in TMS research.

- Objective of Circuit
  - Peak Current of 2 kA +10%
    - EMF feedback must be considered
  - Peak Current Sustained for 400 µs
  - Rise/fall time of 100 µs
  - Up to 36 Hz pulse frequency (Commercial Benchmark)
  - Circuit Input is 120 V wall outlet.
  - Range of Load - 5 micro-Henry (min) to Max(Undefined)
  - 10 pulses a minute max
  - Circuit shall be monophasic;
    - If successfully completed then a biphasic version shall be built.
  - The device shall output multiple waveforms (Square, Sawtooth, Triangle, Sine)

Team Members:

Brian Kirkpatrick: Head of Circuit Design
Jon Rothfus: Head of Micro-Controllers, Team Communications Leader, Webmaster
Tania Alvarado Carias: Head of Electrical Safety
Abdul Bahashawn: Head of Rectification Circuits
Yan Wang: Head of Component Selection
Curtis Richards: Team Leader

Sub Teams:

Chassis Design: Tania, Curtis, Yan	-Meets Thursdays 3:00-5:00 p.m. Durham
Rectification Circuit: Abdul, Yan, Brian	-Meets Thursdays 3:00-5:00 p.m. Durham
Power Circuit: Tania, Curtis, Abdul	-Meets Thursdays 3:00-5:00 p.m. Durham
Micro Controller: Jon, Brian	-Meets Thursdays 3:00-5:00 p.m. Durham

Weekly Summary:

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- Power Circuit: Testing was done to find an accurate resistance of the coil. Using 4 wire ohm testing we found it to between .012 Ohms and .025 Ohms. The former and latter would put us at a current of 108A and 520A respectively. A more effective test will need to be concluded to be confident about our current.

- Chassis Design: n/a (Will finish chassis after circuit is tested and complete.) The team will have the final chassis put together before thanksgiving.

- Micro-Controller:
  Added error checking and status reporting to code to improve robustness. Additional code tweaks, improvements, cleanup.

  Continued integration testing of the GUI, Bluetooth, microcontroller, and IGBT gate driver op amp on the lab test bench using power supplies and oscilloscope in preparation of integrating these parts into the main device next week. Lab bench testing looks OK.

- Precision Electronics:

Accomplishments of the Past Week:

Each member is to write up a reflection on their work throughout the week. The reflections can be found at https://iastate.app.box.com/folder/46145323949

Pending Issues:

I. Due Dates
   a. Weekly Report to be filled out by Wednesday at midnight

II. Team Reports
   a. Update your sub team sections accordingly

New Business:

I. Meeting on Tuesday 6th at 1 p.m. in the TLA for starting our final project and poster

Individual Contributions:

Group Member	Accomplishments	Time Worked This	Total Time Worked

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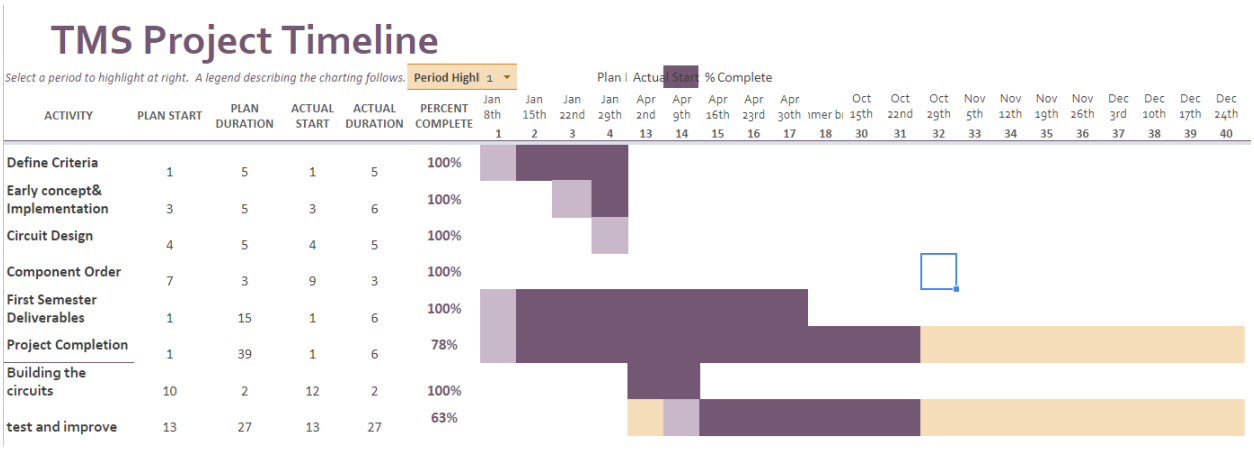
		Week	
Abdul	Ran more simulations	4.5	41
Yan	Tested IGBT to check functionality and continuing testing to see if we can get a higher limit for current.	4	46.5
Jon	Added error checking and status reporting to code to improve robustness. Additional code tweaks, improvements, cleanup. Performed integration testing of the GUI, Bluetooth, microcontroller, and IGBT gate driver op amp on the lab test bench using power supplies and oscilloscope in preparation of integrating these parts into the main device next week. Lab bench testing OK.	4	49
Brian	Parts researched and ordered, calculations for micro-controller sensing circuit. Read through data sheet to find limits for calculations.	4	44
Tania	Tested circuit with Chuck. Worked on errors in the accuracy of our measurement of the current.	4.5	45
Chuck	Tested the circuit to the new current limit., Discussed drawbacks with the accuracy of our current measuring. Held conference call with JP about moving forward.	7	54

Current Progress:



Individual tasks to be completed before next meeting:

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Everyone:

- PIRM Meeting 11/8
- Weekly reflection
- Senior Design Report
- Chuck find SPICE file for transistor.
- Abdul simulate circuit sweep for the inductor coil
- Test IGBT
- Electronic Measurements Team
    - Measure inductance of test coil
    - Additional Voltage measurement for Capacitors
    - Build Capacitor Charging Indicator Circuit
- Power Team
    - Wire in the second Capacitor
    - Measure IGBT resistance
    - Wire in the Relay
- Chassis Team
    - IR Camera
- M.C.
    - Continue preparing and testing for integration of MC with charge detection and control circuit and with main device
    - Add relay into circuit (waiting on components and Precision Electronics team)
    - Investigate built-in IGBT temp sensor and evaluate potential to sense temp with MC (low priority, heat not a concern)
    - Continue testing IGBT signal output system (MC --> op-amp --> IGBT)
    - Work with Brian on capacitor charge level detection circuit integration with MC (waiting on components)

Summary of Weekly Advisor Meeting:

A meeting was had with Dr. Tuttle. Under his suggestion the circuit should be modeled as a capacitor and inductor with a switch to better understand it. Then the load should be relocated to the collector, and a group of .1 Ohm resistors should be brought in parallel to the emitter side to measure the current dump. The modeling of the capacitor/inductor circuit was completed in the past; Chuck will dig this up.

Chuck had a conference call with JP about the project. During the conference call it was decided to take 3 actions and focus on measuring the current.

1. Rope in Neelam to use the Gaussmeter to measure the magnetic field from the coil, and using the solenoid approx. calculate current.

   a. Have the 1 ohm resistance in series with the load and measure the voltage across to find current and compare.
2. Rough up a piece of wire until it has a measurable resistance and use that as a load
3. Buy Hall effect current sensors.