EE/CPRE/SE 491 Weekly Report 23 Meeting Time 1:00 – 2:00 P.M. Thursday in TLA
Date: Week of November 8 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: A more accurate way of testing was found using the Gaussmeter. With that testing we have reached around 320 Amperes at a gate voltage of 16 V.

- 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: Integrated Microcontroller, Bluetooth and IGBT gate driver op amp with the rest of the device. Tested pulsing the device via the GUI with Chuck. Tested OK!

  Worked with Chuck and Yan to test integrated device and verified operation using Gauss Meter.

  Discussed issues related to capacitor charge detection circuit and Microcontroller current/voltage limits with Brian. We believe issues are resolved.

- 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

III. Final Report and Poster to be Completed over Thanksgiving Break

New Business:

I. Integrate the capacitor voltage sensing in with microcontroller and capacitors

Individual Contributions:

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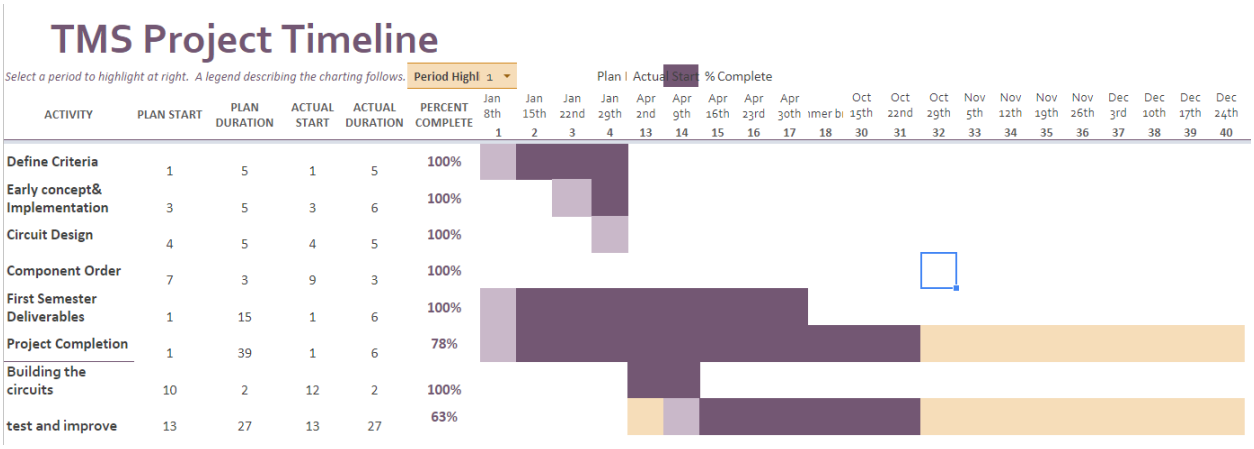
Group Member	Accomplishments	Time Worked This Week	Total Time Worked
Abdul	Measured the resistance of wires we are using and ran more simulations.	4	45
Yan	Tested IGBT to check functionality and continuing testing to see if we can get a higher limit for current.	4	50.5
Jon	Integrated Microcontroller, Bluetooth and IGBT gate driver op amp in place in the main device. Tested pulsing the device via the GUI with Chuck. Using Gauss Meter, tested OK! Worked with Chuck and Yan to test integrated device using Gaussmeter. Discussed issues related to capacitor charge detection circuit and Microcontroller current/voltage limits with Brian. We believe issues are resolved.	5	54
Brian	Worked with Abdul on capacitor charge circuit simulations. Bread board tested capacitor charge circuit. Soldered perf-board version of circuit.	6	50
Tania	Gone for SHPE National Convention 2018	0	45
Chuck	Lead the Gaussmeter testing. It is found to be a more accurate way of measuring high currents through the coils.	7	61

Current Progress:



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Individual tasks to be completed before next meeting:

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:

As discussed last time we took the 3 step approach to finding a more accurate way of measuring current. They are as follows;

1. 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.

Notes on number 1.;

The gaussmeter proved accurate at lower current levels with the resistor voltage drop current equation. As we removed the resistors we found a peak current of 320 Amps with a gate voltage of 16V.

Notes on number 2.;

A wire was found with a resistance, but because of the success of 1. we did not move forward with testing it to give more time to testing with the Gaussmeter.

Notes on number 3.;

The Hall effect current sensors were ordered.