EE/CPRE/SE 491 Weekly Report 17 Meeting Time 1:00 – 2:00 P.M. Thursday in Durham
Date: Week of Sept. 27, 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:

- Power Circuit: Tania and I went back to IGBT Testing. After testing the transistor and circuit to make sure there were no possible ways to make a mistake. We charged the capacitor to 20V and had a square input signal with a period of 10 seconds, 50% duty cycle. We successfully discharged the capacitor through the IGBT. Then we disconnected the coil, and signal wire from the function generator, to minimize risk of burnt components. We began charging the capacitor, but it would not go above 4.5 V. We quickly stopped the circuit since it was not operating as designed. Then began another extra step of troubleshooting. We disconnected the Capacitor and charged it using a power supply, and it was deemed functional. Then a test on the transformer was made, and it was also deemed functional. Reconnecting the capacitor in the circuit we began looking for short circuits. We were able to follow the cables to find a short circuit across the emergency discharge switch. One of the wires that connect to the coil was laid over the wood shield and had made contact shorting the positive of the capacitor to ground. This was rectified and to stop that from happening again each output coil clamp shall be clamped to a piece of wood to keep it mechanically isolated.
- Chassis Design: n/a (Will finish chassis after circuit is tested and complete.)
- Micro-Controller (MC): Fault currents/voltages from the device causing damage to a laptop connected were a concern. To isolate the control PC, a Bluetooth module was selected to allow wireless communication between GUI and the MC embedded in the device. An HC-05 Bluetooth module was purchased and tested for basic functionality, and a connection between Matlab running on the control PC and the MC was established. Some simple test commands were successfully sent to the MC.
- Precision Electronics: Calculated current limiting resistor requirements for the microcontroller to safely read the data of capacitor charge status. Started PCB design of the additional circuits for monitoring

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:

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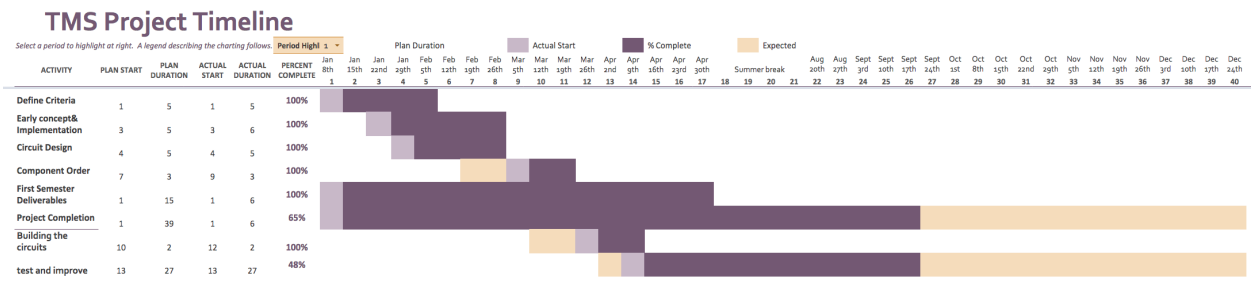
1. Meeting with Neelam and new Grad Students at 4:30 p.m.

Individual Contributions:

Group Member	Accomplishments	Time Worked This Week	Total Time Worked
Abdul	Worked on using a simulation software to simulate an IGBT, from watching and reading tutorials to build all the way up to what is needed.	5	24.5
Yan	Recreated and tested the op amp circuit to check for issues. Assisted in charging the capacitor to check for faulty capacitor.	6	28.5
Jon	Selected and purchased HC-05 Bluetooth module for microcontroller to allow wireless control of MC from GUI to protect laptop from faults. Connected and tested Bluetooth module. Verified basic functionality of the module: configuring, pairing, etc. Verified that commands from Matlab are successfully sent over Bluetooth to the microcontroller. OK.	4	28
Brian	Calculated current limiting resistor requirements for the microcontroller to safely read the data of capacitor charge status. Started PCB design of the additional circuits for monitoring.	4	30
Tania	Tested the capacitor using the rest of the circuit after making sure the capacitor and transformer were working correctly. Continued testing on IGBT	6	28
Chuck	Troubleshoot the capacitor charging circuit and furthered testing on the IGBT	7	30

Current Progress:+



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Individual tasks to be completed before next meeting:

Everyone:

- 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
    - Begin testing using old pulsar
    - Wire in the Relay
- Chassis Team
    - IR Camera
- M.C.
    - Continue to test bluetooth module integration with MC/Matlab.
    - Work out the bugs for the new amplifier from the micro-controller to IGBT
    - Add relay into circuit.
    - Investigate built-in IGBT temp sensor and evaluate potential to sense temp with MC
    - Test IGBT Signal Output system
    - Work with Brian on capacitor charge level detection circuit integration with MC

Summary of Weekly Advisor Meeting:

Abdul will now be in charge of the circuit simulation. Chuck and Tania will fix the capacitor charging circuit and then continue the IGBT testing. Jon will use a bluetooth chip to send the signals from our GUI to microcontroller so his computer won't be directly connected to the circuit.