EE/CPRE/SE 492 Weekly Report 14 Meeting Time 1:00 – 2:00 P.M. Thursday in TLA
Date: Week of Sept. 6, 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

*NOTE: Teams with Brian need to reschedule their times after his schedule is finalized.

Weekly Summary:

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- Power Circuit: Supported the Micro-Controller team with the integration of the transistor control voltage circuit.
- Chassis Design: n/a (Will finish chassis after circuit is tested and complete.)
- Micro-Controller (M.C.): Created non-inverting op-amp configuration to boost 4.5 V microcontroller signals to approximately 16 V amplitude for driving IGBT gate. Investigated IGBT threshold voltage and how to DC bias the op-amp output so that the gate drive signal is in the IGBT's "ON" region, but does not inappropriately turn on the IGBT.
- Precision Electronics: Design and research the comparator circuit. Did the proper calculation and obtain the parts through ETG for test of concepts. Built the comparator circuit and tested it. Obtained PCB board ready to solder. Searched for proper components for the PCB boards.

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:

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	Designed and tested a varying output voltage circuit on a breadboard, and then built and soldered it on a through-hole circuit board and tested it.	4	12
Yan	Did calculations for a circuit to test capacitor. Built a circuit to measure the fullness of the capacitor,	6	14.5

	received the PCB and looked for fuse and fuse holder that will work with our PCB board.		
Jon	Tested pulsar/amplifier card which was developed by previous senior design team to determine if it could be used to boost microcontroller signal for driving IGBT gate. Determined that it passes and amplifies square pulses, but not other waveforms such as sinusoidal or triangle. Got op-amps from ETG and successfully boosted 4.5 V signal from microcontroller to ~16 V for driving IGBT gate using 18 V supply. Investigated issue with IGBT threshold voltage and how to DC bias the op-amp output so that the op-amp output which is driving the IGBT gate is always in the IGBT's "ON" voltage range during signal pulses. The op-amp output needs to be below the threshold voltage when op-amp is powered on but not passing signals to avoid turning the IGBT on inappropriately. More work needs to be done on this issue.	6	18
Brian	Worked on the capacitor charge circuit and built some small scale test circuits for proof of concept. Researched into incorporating a comparator op amp to send the signal back to microcontroller. PCB parts research.	6	17
Tania	Worked on the mathematics for the control voltage for the transistor	4	13
Chuck	Supported designs and integration of the microcontroller circuit into the pulsar.	5	14

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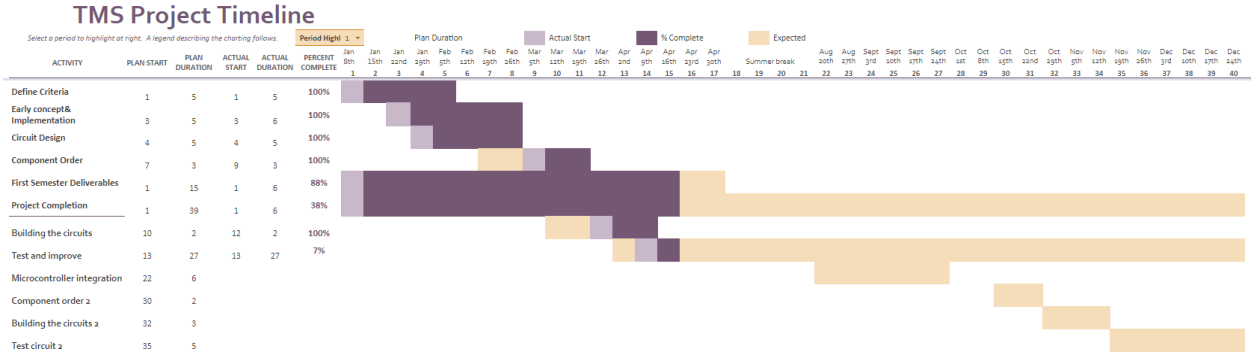
Current Progress:



Individual tasks to be completed before next meeting:

Everyone:

- Weekly reflection
- Chuck find SPICE file for transistor.
- Electronic Measurements Team
  - Measure inductance of test coil
  - Begin design for measurement circuit
  - Additional Voltage measurement for Capacitors
  - Build Capacitor Charging Indicator Circuit
- Power Team
  - Begin testing
  - Wire in the Relay
- Chassis Team
  - IR Camera
- M.C.
  - Continue working on amplifying microcontroller signals to an amplitude/offset appropriate to drive the IGBT gate. Meet with Gary Tuttle for help with this.
  - Add relay into circuit.
  - Investigate built-in IGBT temp sensor and evaluate potential to sense temp with MC

Summary of Weekly Advisor Meeting:

Discussed problems we were having with integrating the micro-controller, and our plan of action for the next week. With the difficulties we are having with the micro-controller integration we feel that we would not be able to integrate a second negative pulsar in time for the final presentation, so we will focus on the monophasic design and manipulating the signal output.