

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 μ s

- Rise/fall time of 100 μ s

- 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, etc.)

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:

- Power Circuit: We developed a safety procedure for working on the machine. Took out Circuit to prepare for testing.
- Chassis Design: Was not required for this week.
- Micro-Controller (M.C.): Rectifying relay has been testing and confirmed to work. Unfortunately we need a 3.3V supply voltage to run it. We suggest 2 AA batteries with a 3.3V zener diode 1N4728A to supply this. IGBT signal gate voltage through the past micropulsar circuit is being investigated. Backup plan is being conducted by Jon, Yan, and Abdul.
- Rectification Circuit: Printed circuit board design is completed. It shall be ordered this week.

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:

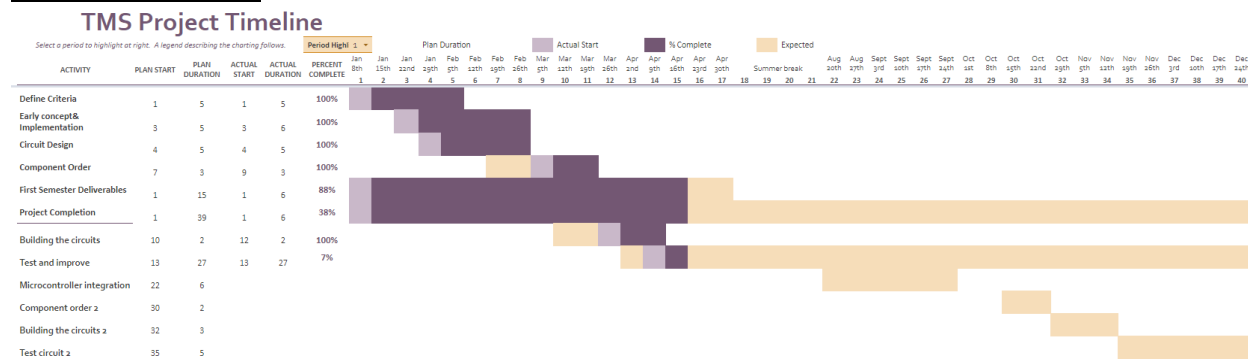
1. Meeting with Neelam and new Grad Students at 4:30 p.m.

Individual Contributions:

Group Member	Accomplishments	Time Worked This Week	Total Time Worked
Abdul	Worked on using simulation software got an IGBT and safety procedure, and facilitated meeting times for this semester.	4	4
Yan	Researched the math behind the trace width in a PCB board. Reviewed where we left off and see what still needed to be done. Reviewed the safety procedure to better understand the safety regulations	4	4

	for our design.		
Jon	<p>Connected relay to microcontroller and tested switching from the Matlab GUI. Switching works as expected.</p> <p>Converted old GUI to new AppDesigner template in Matlab.</p> <p>Added initialization code for several GUI elements and error checking code for determining state of the serial connection and notifying the user.</p> <p>Worked on various bits of code for indicator lamps and other GUI elements.</p>	4	4
Brian	<p>Incorporated fuses into the rectification circuit and researched some PCB requirements from our expected vender, Oshpark. Soldered some components onto the relay for the circuit protection unit.</p>	4	4
Tania	<p>Reviewed circuit design, safety procedures to be implemented this semester, and tasks to complete to finalize project</p>	4	4
Chuck	<p>Developed Safety Procedure, and worked modeling the circuit for additional coil designs</p>	4	4

Current Progress:



+

Individual tasks to be completed before next meeting:

Everyone:

- Weekly reflection

- Rectification Team
 - Have a finished design for the rectification circuit board.
 - Detailed Calculations on Conductor Channel size
 - Begin design for measurement circuit
- Power Team
 - Develop safe Testing Procedure and begin testing
- Chassis Team
 - IR Camera
- M.C.
 - Investigate means of driving various output waveforms with MC
 - Further test rectifier relay under control of MC and GUI

Summary of Weekly Advisor Meeting:

We met with the Neelam and the new advisor Tom to reconvene our efforts in the same direction. The rectification team shall have a completed board design for next Thursday's meeting, and then will refocus the group to handle a more accurate way of measuring our peak current than what is currently used. Jon will work with Tim to integrate the smaller pulsar to work with his GUI system this week. The power team is developing a safe testing procedure since none such exist. As a secondary item, Abdul, Brian, and myself are trying different programs to try and get an accurate model of how the circuit will perform with coils outside our parameters of design.