

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, 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:

- Power Circuit: We tested the IGBT, and found a short in one of the transistors. Root causes for the op-amp explosion are theorized, but an absolute cause will most likely not be found. Our course of action to stop the likelihood of this happening again is to never charge capacitors while pulsing again.
- Chassis Design: n/a (Will finish chassis after circuit is tested and complete.)
- Micro-Controller (M.C.): Experimented with Arduino delay functions to determine if they are precise enough to use for our square pulse rather than interrupts.
- Precision Electronics: Redesigned the capacitor measuring circuit to use fewer parts with a higher degree of accuracy.

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:

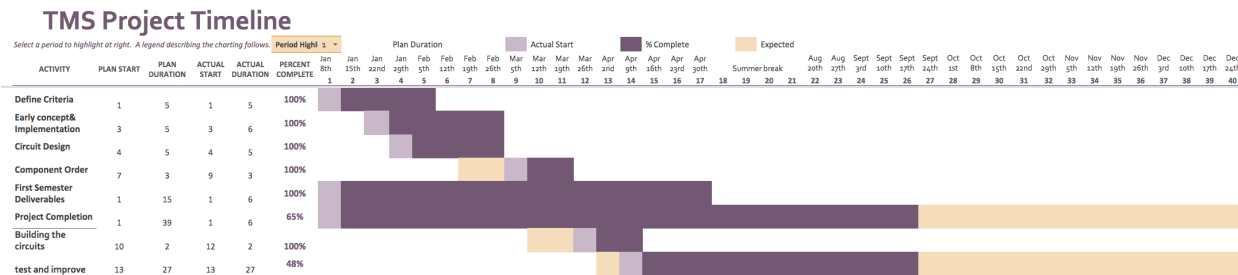
1. Meeting with Neelam and new Grad Students at 4:30 p.m.

Individual Contributions:

Group Member	Accomplishments	Time Worked This Week	Total Time Worked
Abdul	Continued reading and watching videos about IGBT and how to test it. Talked with professor about Op-Amp to amplify a non- DC current.	4.5	19.5
Yan	Worked on 492 presentation. Discussed with our advisors about what potentially may be the problem with why our op-amp caught on fire.	4	22.5
Jon	Created MC code to handle serial requests for different types of commands from GUI.	2	24

	Experimented with Arduino delay functions to determine if they are precise enough to use for our square pulse rather than interrupts.		
Brian	Redesigned the capacitor measuring circuit to use fewer parts with a higher degree of accuracy.	5	26
Tania	Researching more about the IGBT testing and causes for the part exploding on the last testing	4	22
Chuck	More investigation into root causes for the op-amp failure. Testing IGBT.	4	23

Current Progress:+



Individual tasks to be completed before next meeting:

Everyone:

- Weekly reflection
- Senior Design Report
- Chuck find SPICE file for transistor.
- Brian, Yan, Tania 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.
 - 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

Summary of Weekly Advisor Meeting:

We discussed the transistor and the op-amp explosion from last week. We tested the transistor to confirm it wasn't burned out. The second transistor is burnt from the emitter to gate. We will test using only the good of the two transistors in the unit from now on. Theories on why the op-amp explosion occurred were further discussed, but a root cause is yet to be found.