

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

Weekly Summary:

- **Power Circuit:** Right now our max current through the coil has been calculated to be around 49 Amps. We took out the resistors, and just measured the resistance of your original coil and the two wires that attach it to the emitter and ground. We have a total resistance of around .04 ohms. We test with a pulse with voltages varying from 7-17V for our gate. The voltage waveform kept virtually the same shape as we increased the gate voltage up to 17V. The voltage across the load also increased to around 1.9V with our maximum gate voltage of 17V. We have charged the capacitor to different levels so far(20V, 50V, 100V). Charging the capacitor to a greater voltage does have a small impact on our load voltage, but only a small one. Charging the capacitor from 20V to 100V maybe increased the load voltage by 0.6V.
- **Chassis Design:** n/a (Will finish chassis after circuit is tested and complete.)
- **Micro-Controller (M.C.):** Prepared MC and GUI for integration testing with main device.
- **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

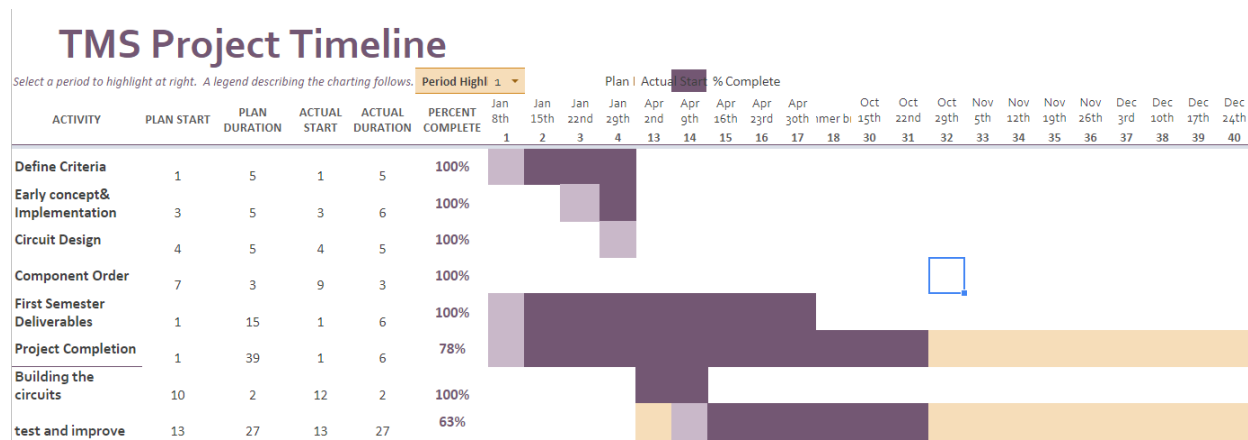
New Business:

Individual Contributions:

Group Member	Accomplishments	Time Worked This Week	Total Time Worked
Abdul	Ran Simulations	3	39.5
Yan	Tested the circuit to check our current's limit. Using the V/Z method for finding the current.	4	46.5

Jon	Tested integration and correct communication between GUI, Bluetooth and MC using oscilloscope. Tested parts of the GUI that connect/disconnect MC, set pulse count/frequency, and fire pulse The aspects tested above appear to be functioning correctly.	4	45
Brian	Assisted with amplifier circuit troubleshooting.	3	43
Tania	Tested the circuit to the new current limit.	4	44.5
Chuck	Tested the circuit to the new current limit. Using the V/Z method for finding the I (current).	4	47

wCurrent Progress:



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:

Current limits to our peak current maybe from a resistance occurred in the IGBT. Tania and Yan will look into this next week. Chuck will go back and rework the original design equations to check the limit.