

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: The second IGBT was added. Testing was successful and the peak current reached was 1970 A.
- Chassis Design: n/a (Will finish chassis after circuit is tested and complete.) The team will have the final chassis put together before thanksgiving.
- Micro-Controller:
 - Final bench testing of Microcontroller/relay/capacitor charge detection circuit. All tested OK.
 - Final tweaks and testing of code.
 - Integrated Microcontroller/relay/capacitor charge detection circuit into main TMS device and tested charging the capacitors. Found that the voltage output from the transformer is slightly higher than relay can switch. Will most likely need to reconfigure transformer.
- 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
- III. Final Report and Poster to be Completed over Thanksgiving Break

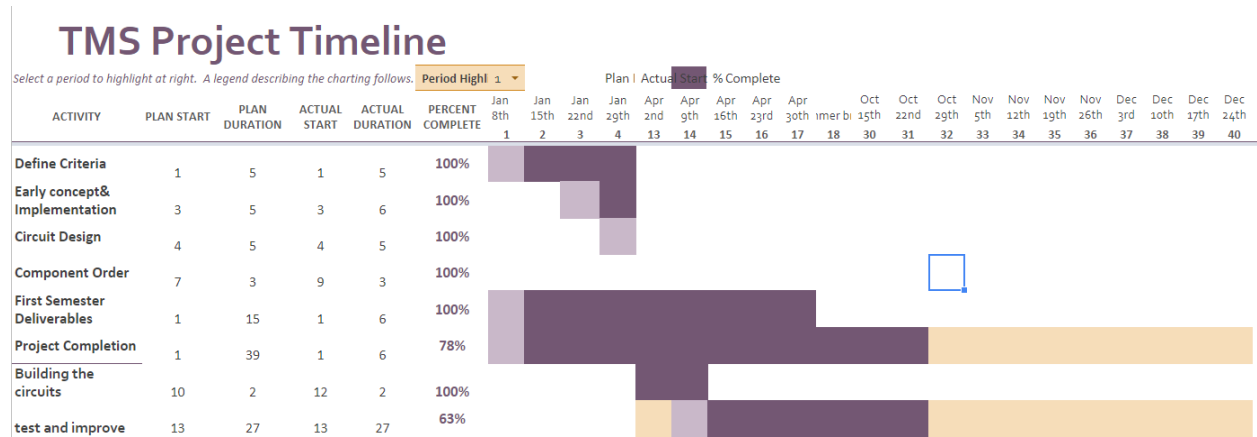
New Business:

- I. Integrate the capacitor voltage sensing in with microcontroller and capacitors

Individual Contributions:

Group Member	Accomplishments	Time Worked This Week	Total Time Worked
Abdul	Worked on more simulations, and class presentation.	4	49
Yan	Create multiplying with a gain to saturate with the power supply. Solder hall sensor onto a perf board.	4	54.5
Jon	Final bench testing of Microcontroller/relay/capacitor charge detection circuit. All tested OK. Final tweaks and testing of code. Integrated Microcontroller/relay/capacitor charge detection circuit into main TMS device and tested charging the capacitors. Found that the voltage output from the transformer is slightly higher than relay can switch. Will most likely need to reconfigure transformer.	5	59
Brian	Assisted Jon on bench testing the microcontroller and relay. Calibrated the analog to DC voltage values to our preset numbers. Created and sent off our PCB of our capacitor sensing circuit.	5	55
Tania	Finalized testing of the circuit adding the remaining components. Used a gaussmeter to measure the magnetic field and the op amp circuit to boost the signal being sent to the IGBT gate.	5	50
Chuck	Added in the remaining components, oversaw the final testing.	6	67

Current 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.
 - Work with team to reduce voltage output from the transformer to the relay's rated level
 - Finalize MC-related documentation for final report

Summary of Weekly Advisor Meeting:

We reached 1970 amperes. We did have a failure in one component that caused us to stop testing. An alligator clip exploded. See picture below for reference.

