

# 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  $\mu$ s

- Rise/fall time of 100  $\mu$ 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 circuit testing was help up because the op amp was not working as designed. We had to rebuild the op amp to reach the correct gate voltages for the IGBT.
- 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:**

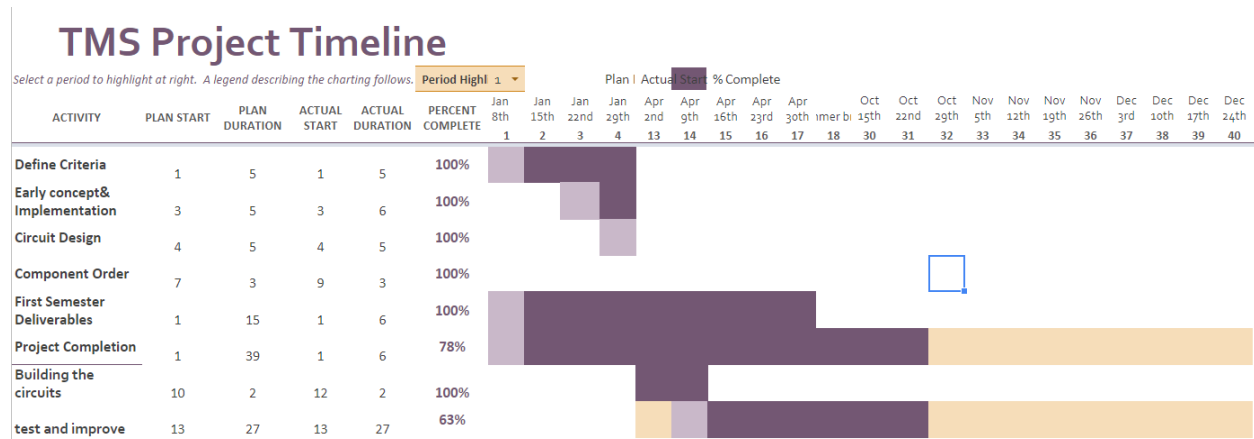
1. JP and Priyam suggest we remove the current sensing resistors on the load, and replace it with a wire of minimal resistance.

### **Individual Contributions:**

Group Member	Accomplishments	Time Worked This Week	Total Time Worked
Abdul	Ran simulations for team on inductance values for our coils and wire resistance values.	4	36.5
Yan	Rebuilt certain op-amp circuit to search for the error, discovered it and continued testing. Updated Gantt chart.	6	42.5
Jon	Soldered new PCB rectification circuit for Brian.  Assisted with troubleshooting op-amp IGBT driver circuit.  Prepared MC for integration testing with rest of circuit.	4	41

Brian	Parts order came in, worked with Jon on soldering the components that came in on to the board.	3	40
Tania	Incremented input gradually and recorded output current. Worked on the op-amp circuit for testing.	4	40.5
Chuck	Worked on the op amp circuit for amplifying the gate voltage for the IGBT	4	43

**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
  - Begin testing using old pulsar
  - 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:**