

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 2:00-2:30 p.m. Howe

Rectification Circuit: Abdul, Yan, Brian

-Meets Fridays 2:00-3:00 p.m. Marston

Power Circuit: Tania, Curtis, Abdul

-Meets Fridays 11:15-12:00 p.m. TLA

Micro Controller: Jon, Brian

-Meets Wednesdays 1:15-1:45 in TLA

Weekly Summary:

- Power Circuit:

Testing began on the IGBT. Details can be found in the weekly reflection folder. The tests were successful and next week we plan to test the IGBT in our circuit.

- Chassis Design:

The chassis construction has reached a point where testing may begin.

- Micro-Controller (M.C.):

- Tested various aspects MC waveform generation and interaction with IGBT gate. Investigated and prototyped simple RC filter circuits as a means of converting MC square wave outputs to sine/triangle waves.

- Rectification Circuit:

The soldering work is done and the connection has been tested using a multimeter and we have created a spare circuit in the chance of mishaps with the other two circuits.

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 Saturday at midnight

- II. Team Reports
 - a. Update your sub team sections accordingly

New Business:

1. Testing
 - a. The testing of the circuits should be noted in their designated documents.

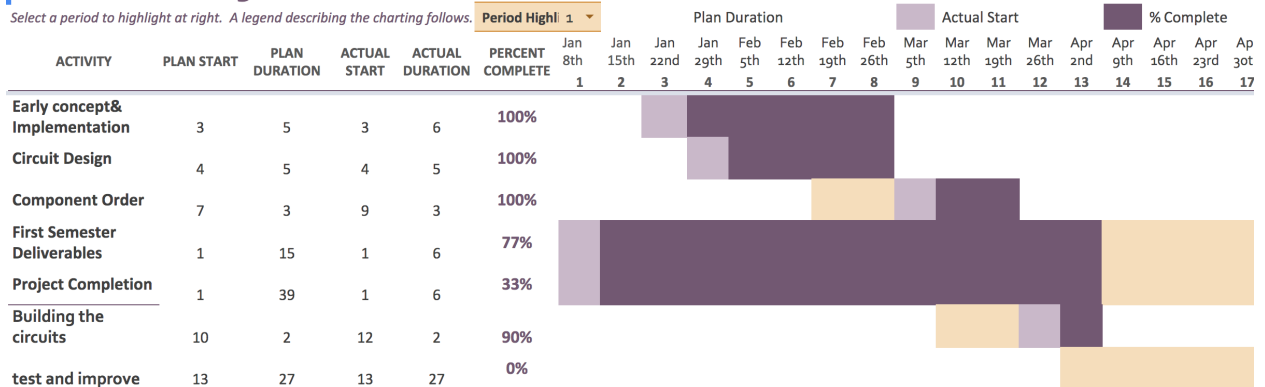
Individual Contributions:

Group	Accomplishments	Time	Total Time
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Member		Worked This Week	Worked
Abdul	Working on cost analysis for the project.	6	32
Yan	Wired the transformer and stripped wires for capacitor and a series of other component. Read about the power diodes. Assisted in overall construction of chassis, from marking where certain components will go, bolting down the limiting resistor, tested each rectification circuit to inspect abnormalities as well as screwing in some of the resistors and assisting Chuck in the installation of the wall with the voltmeter and switch attached to it. Also tested the rectification circuit to capacitor and analyze the charging time	12	50
Jon	Tested DC voltage component of PWM waveforms generated by Arduino to verify if a PWM signal can be used as IGBT gate voltage. Because IGBT functions as a high-speed switch, it appears that PWM output with a given duty cycle cannot be applied directly to the IGBT gate with the intention of applying the equivalent DC voltage. Prototyped conversion of square wave output to sine and triangle waves using simple RC filter circuits built with components from lab kit. Tested Arduino square wave output frequency with oscilloscope to verify that it matches frequency in code.	4	37
Brian	Took our capacitors to Coover and measured actual resistance with the LCR machine. Recreated a printed circuit board in Eagle that will be used in finished design. Ran testing on the prototype rectifier circuit to ensure that all soldered joints operated as expected. Helped assemble the chassis and route wiring to components.	12	53
Tania	Tested the IGBT with a multimeter and with an oscilloscope. Helped with the assembling of the chassis.	10	45
Chuck	I mounted the second resistor, and helped with testing of the capacitor bank.	10	87

Current Progress:

TMS Project Timeline



Individual tasks to be completed before next meeting:

Everyone:

- Weekly reflection
- Rectification Team
 - Complete Rectification Testing
- Power Team
 - IGBT Testing with Function Generator Input
 - IGBT Gate Voltage
 - Abdul
- Financial Analysis
- Chassis Team
 - IR Camera
- M.C.
 - Solder lead onto relay.

Summary of Weekly Advisor Meeting: