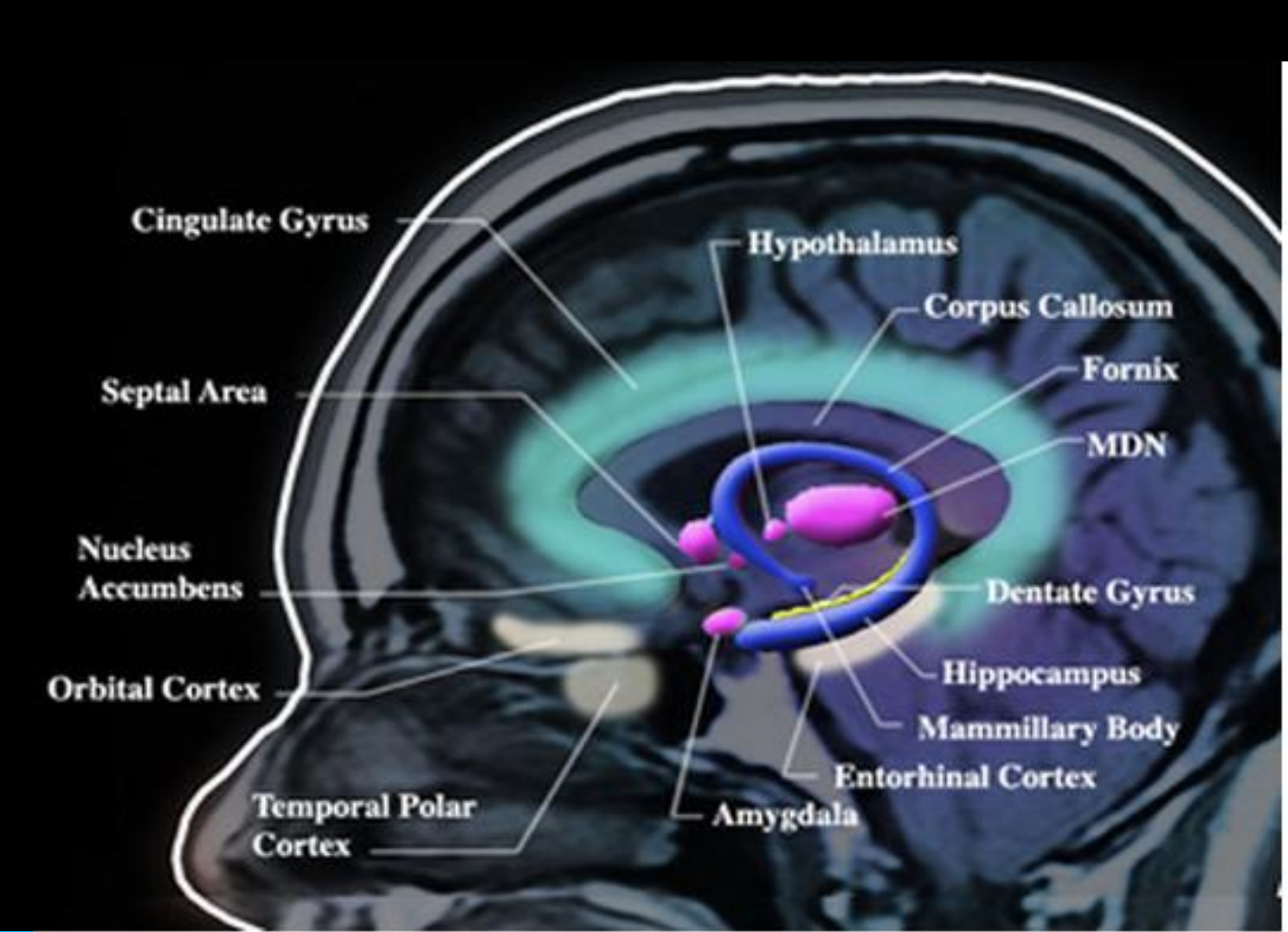


Transcranial Magnetic Stimulation (TMS) High Current Pulse Amplifier



DEC14-06: Joshua Abbott, Spencer Ulven, Kaiyue Zheng, Zhongheng Wang, Nikhil Reddy Purma
Advisers: Dr. Mani Mina, Robert Bouda

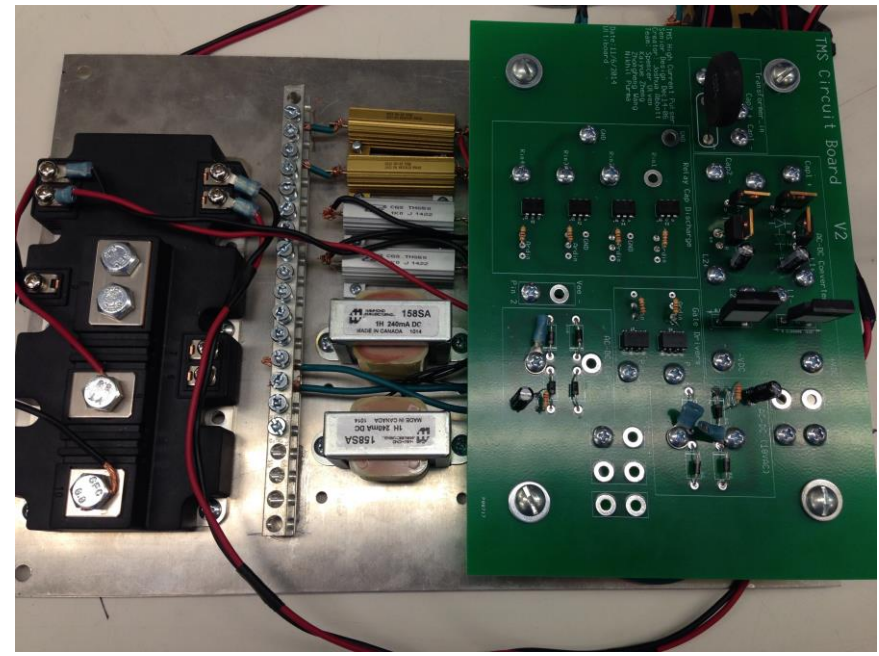
Problem Statement

Transcranial Magnetic Stimulation (TMS) is cutting edge technology that is currently being explored to cure mental disorders and diseases. Researchers are looking for an affordable, high power system that will deliver the control necessary for driving TMS coils. Our goal is to create such a system that will further develop this technology.

Requirements

Functional Requirements:

- Monophasic and Biphasic waveforms
- 100 to 400 μ s pulse width
- Output +/-1000 Amps
- Support consecutive pulses



Nonfunctional Requirements:

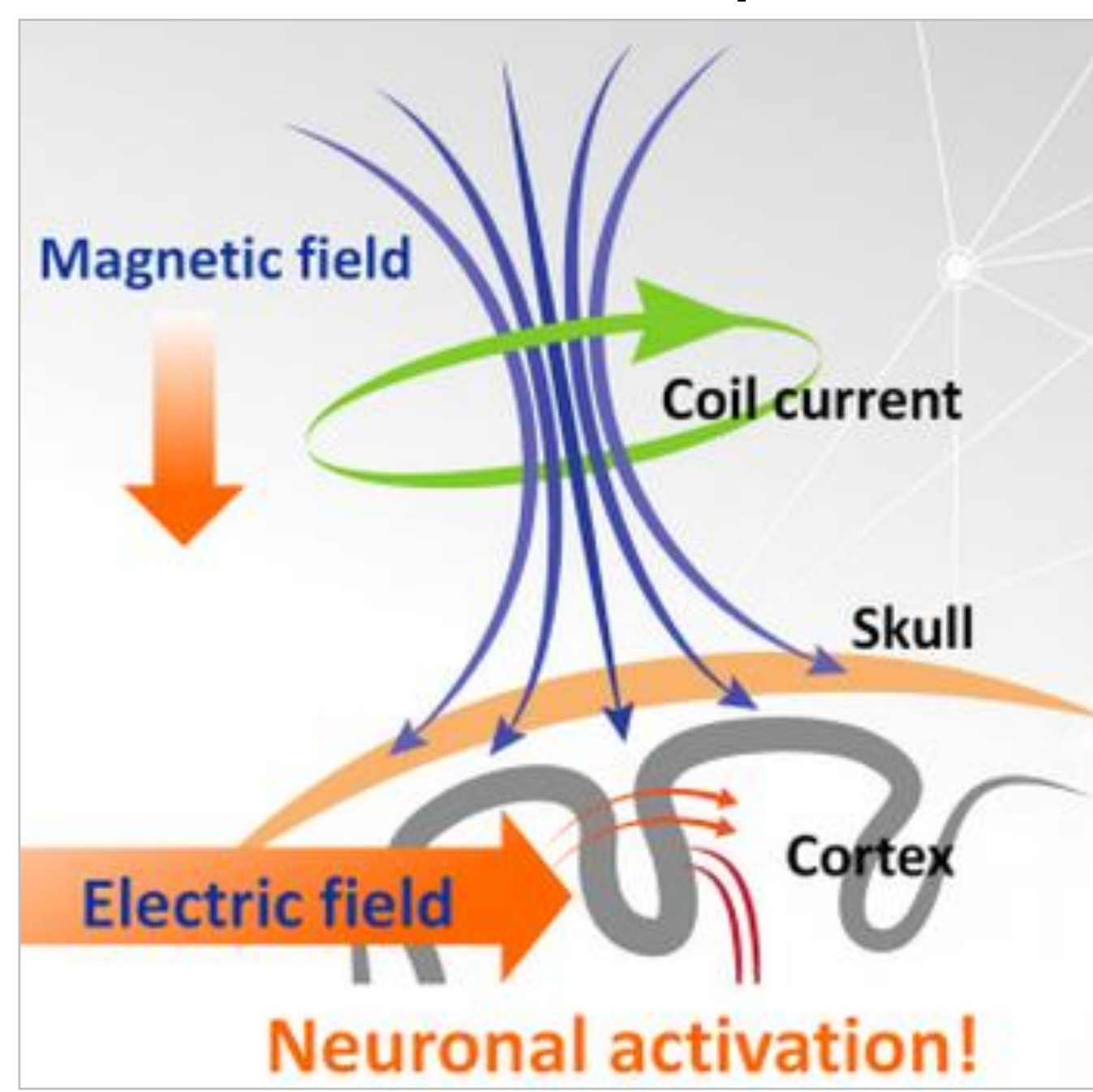
- Cost under \$500 dollars
- Graphical user interface (GUI)
- Safe and easy to use

Project Overview

TMS Potential Uses

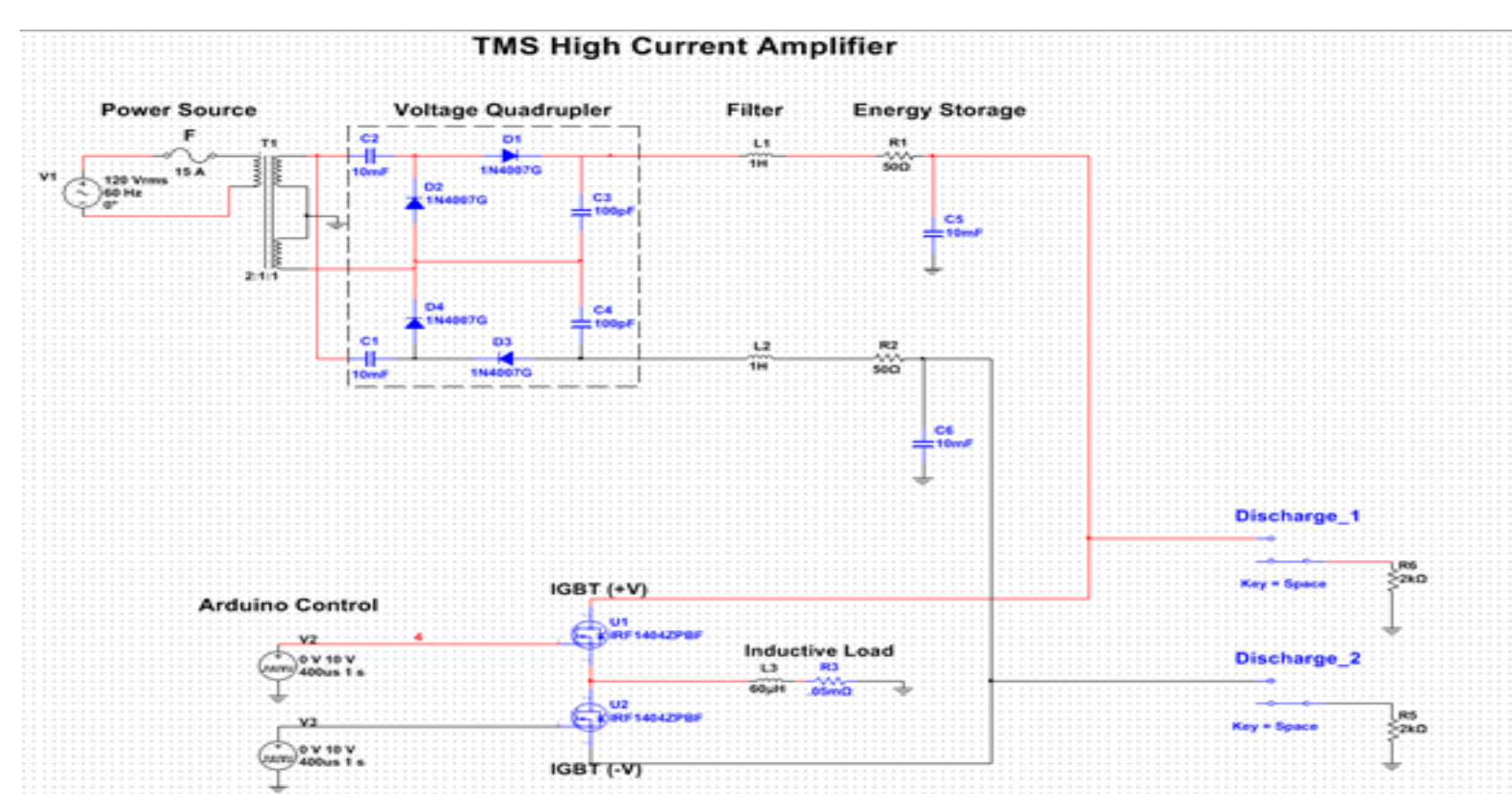
- Parkinson's Disease
- Alzheimer's
- Chronic Pain
- Schizophrenia
- PTSD
- Anxiety

TMS Concepts

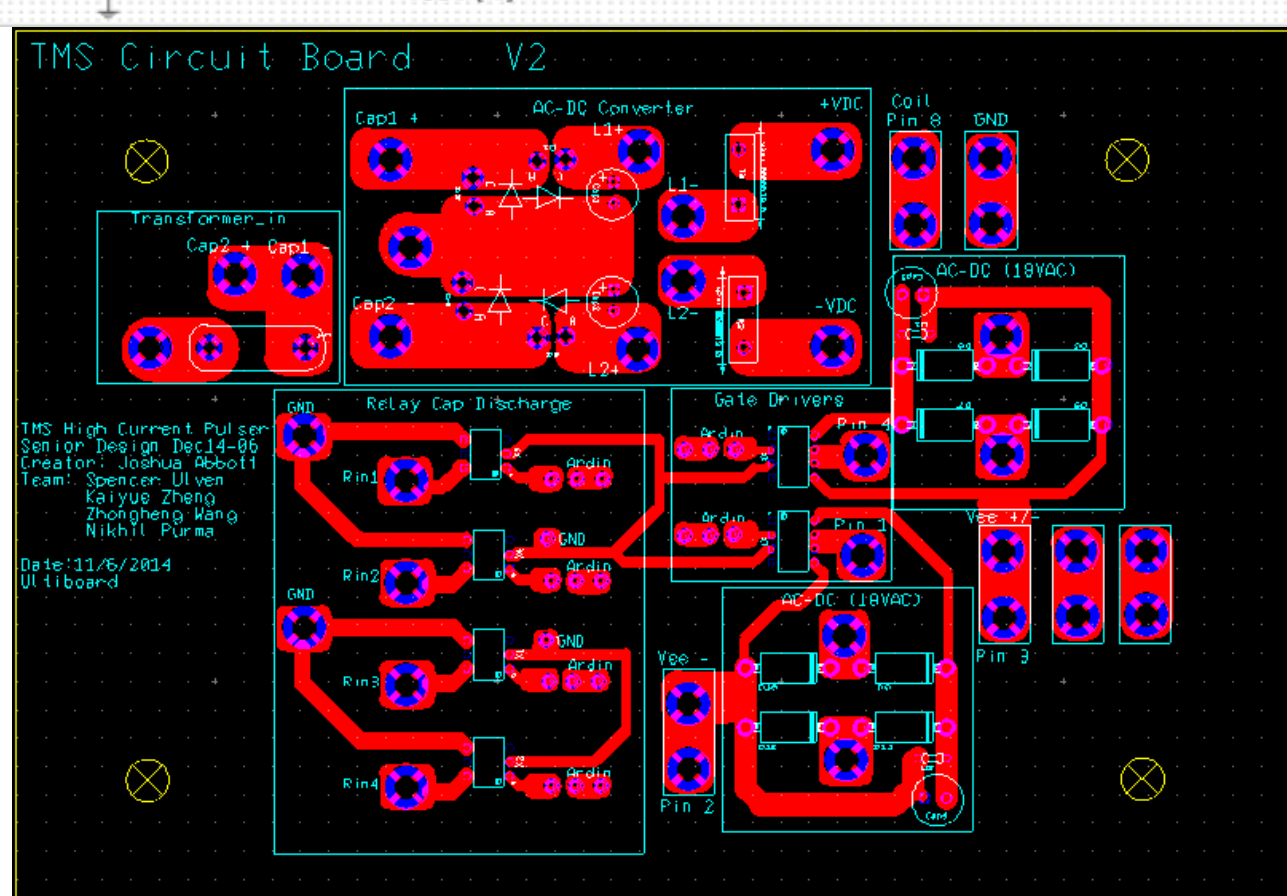


Circuit Schematic

Multisim



Ultiboard



Block Diagram

Voltage Quadrupler

Quadruples input and converts AC-DC

Filter

Reduces ripple of AC-DC conversion

Capacitor Bank

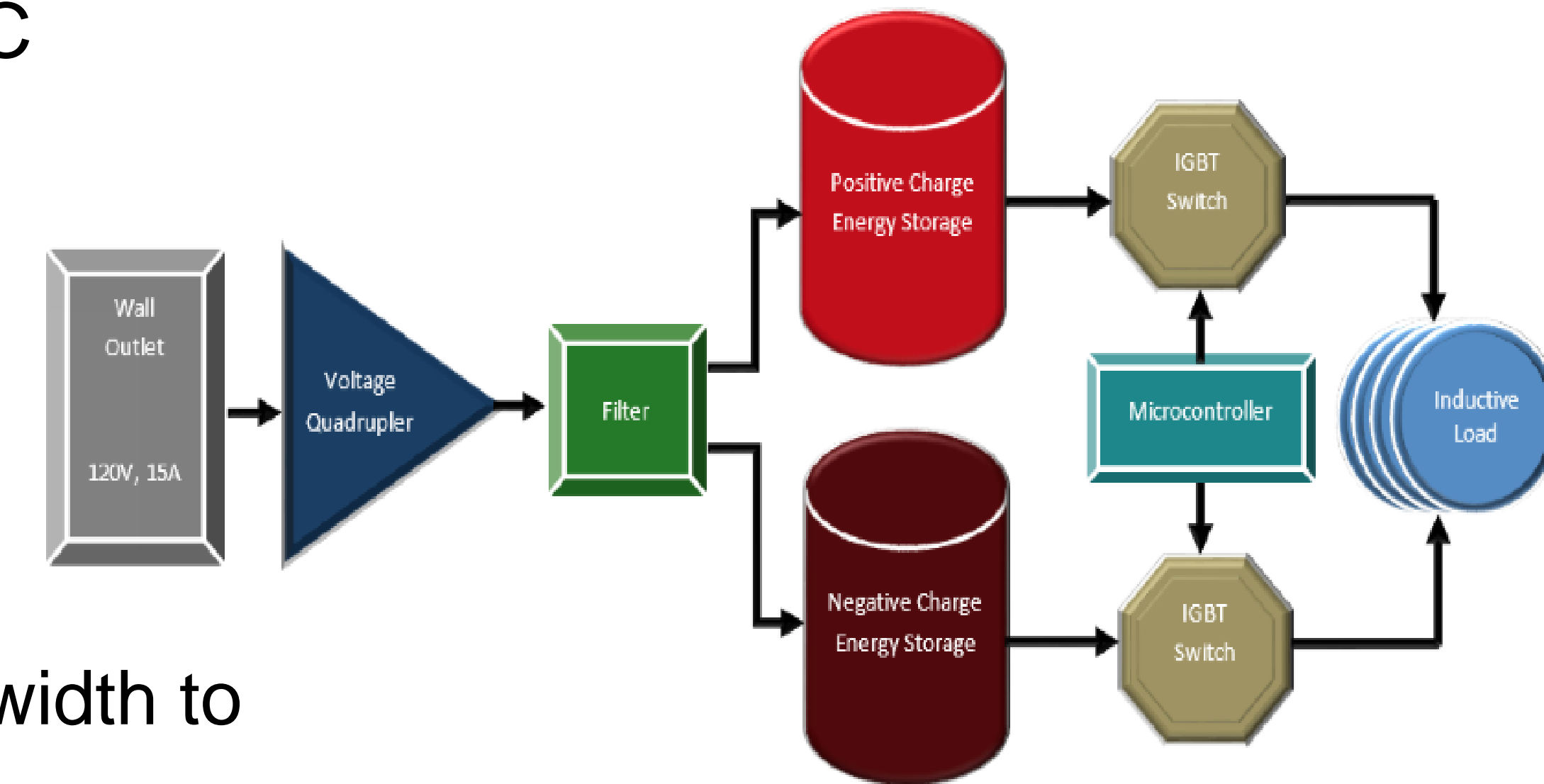
Stores energy for large pulse

Microcontroller

Arduino sends a 5V pulse at desired width to two gate drivers that run the IGBT's

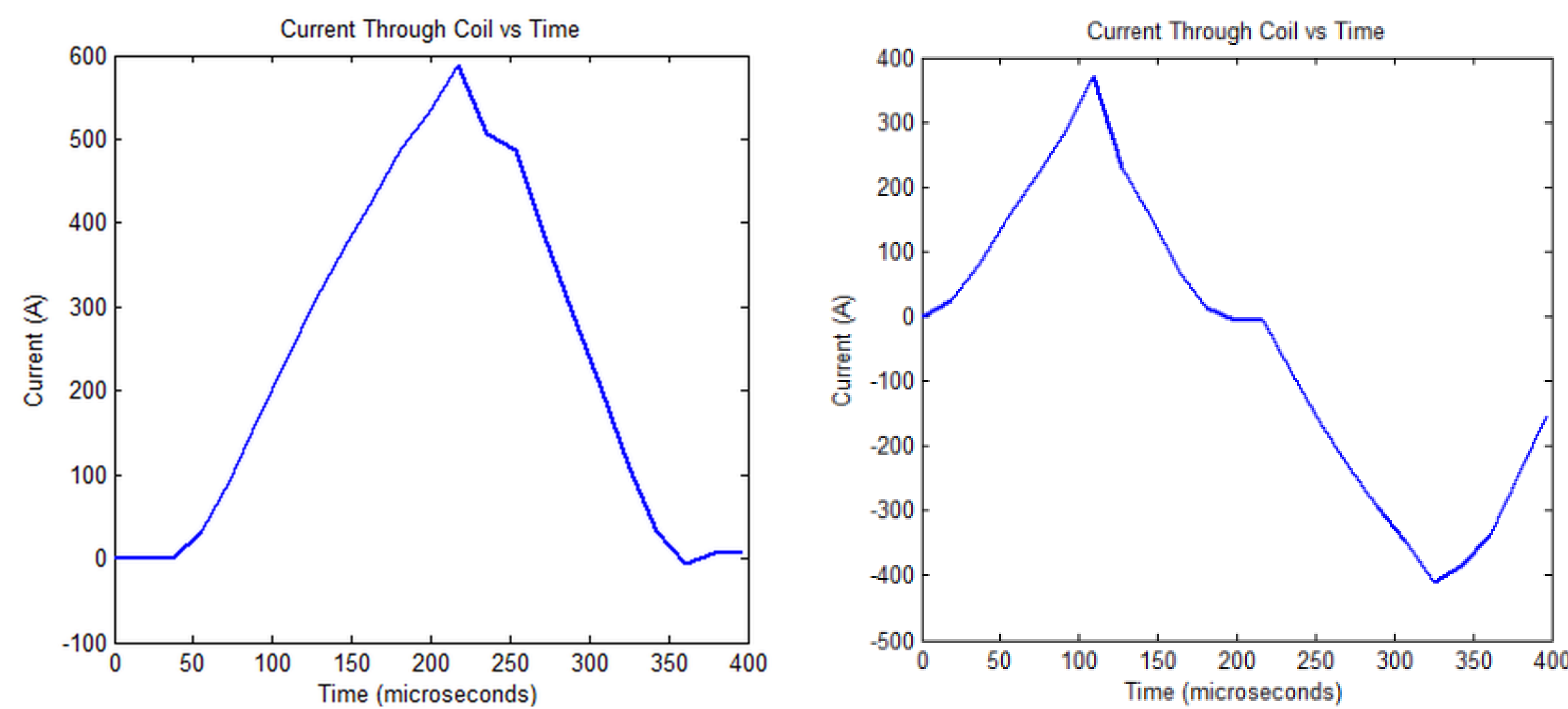
IGBT

Discharges capacitor bank into inductive load

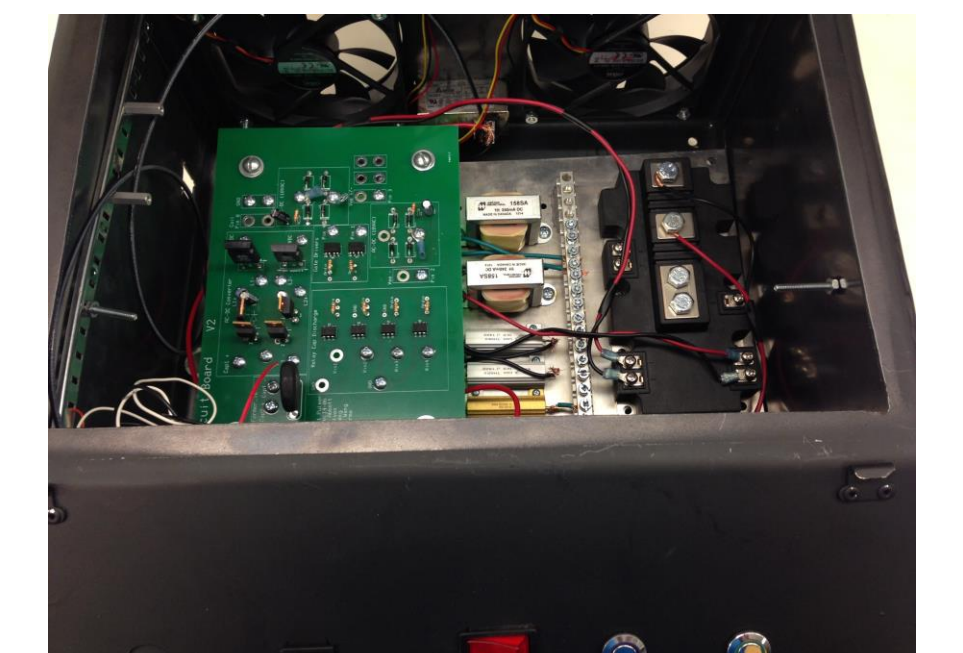


Results

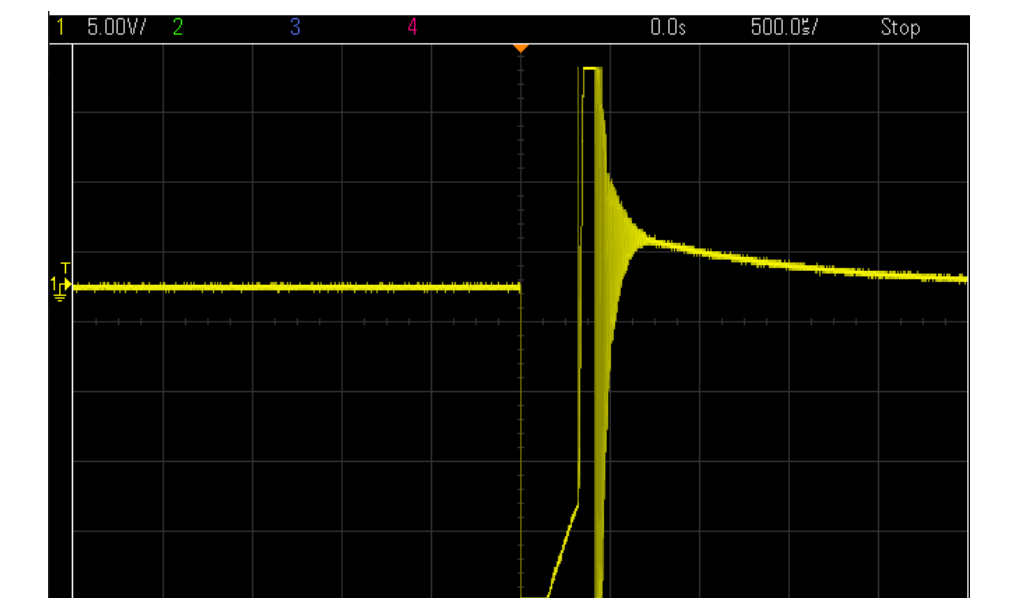
TMS Current Output
(Load = 32 μ H, ~0.3 ohm @150V)



Front Panel



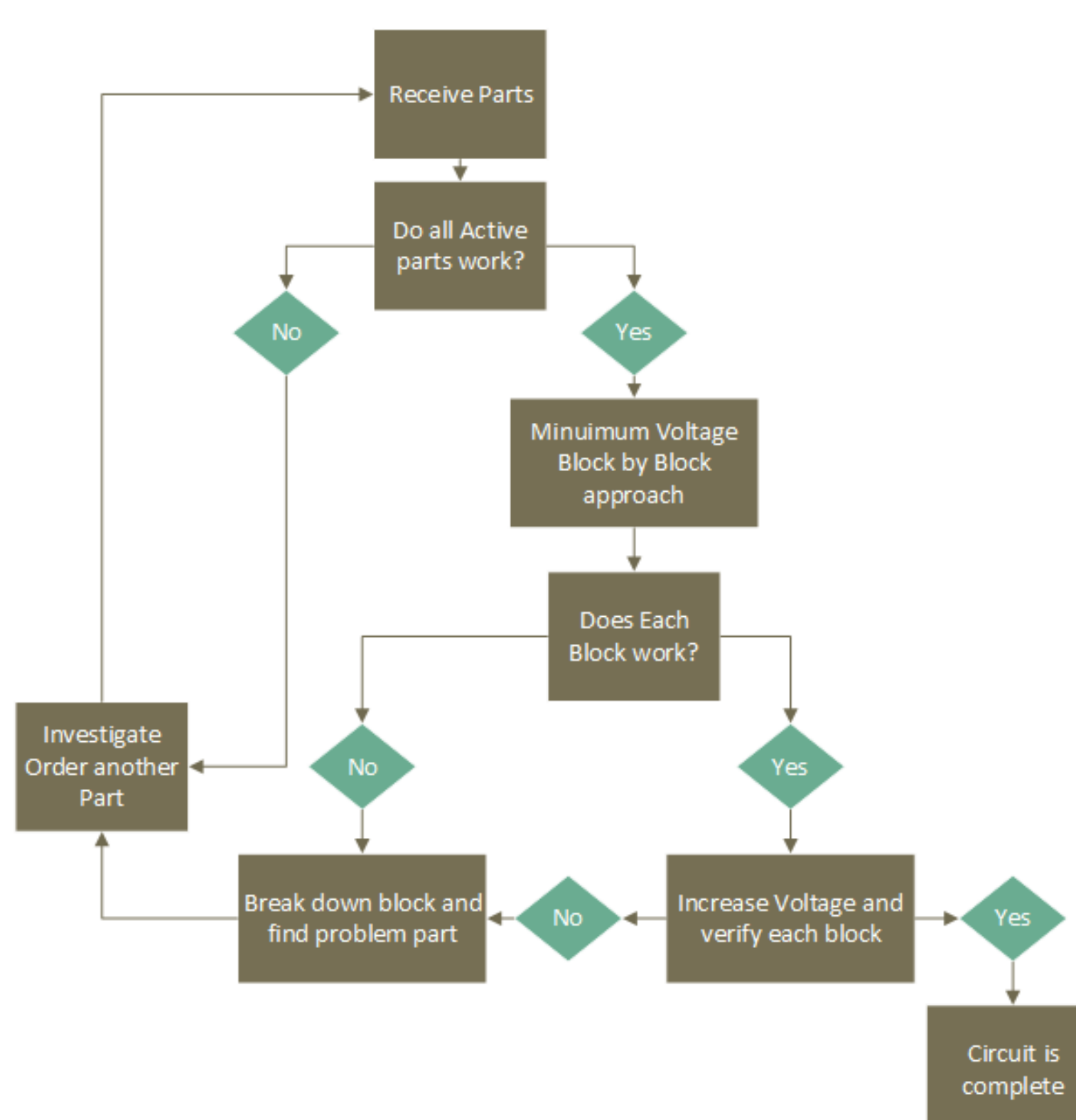
Hood Allows Easy Access



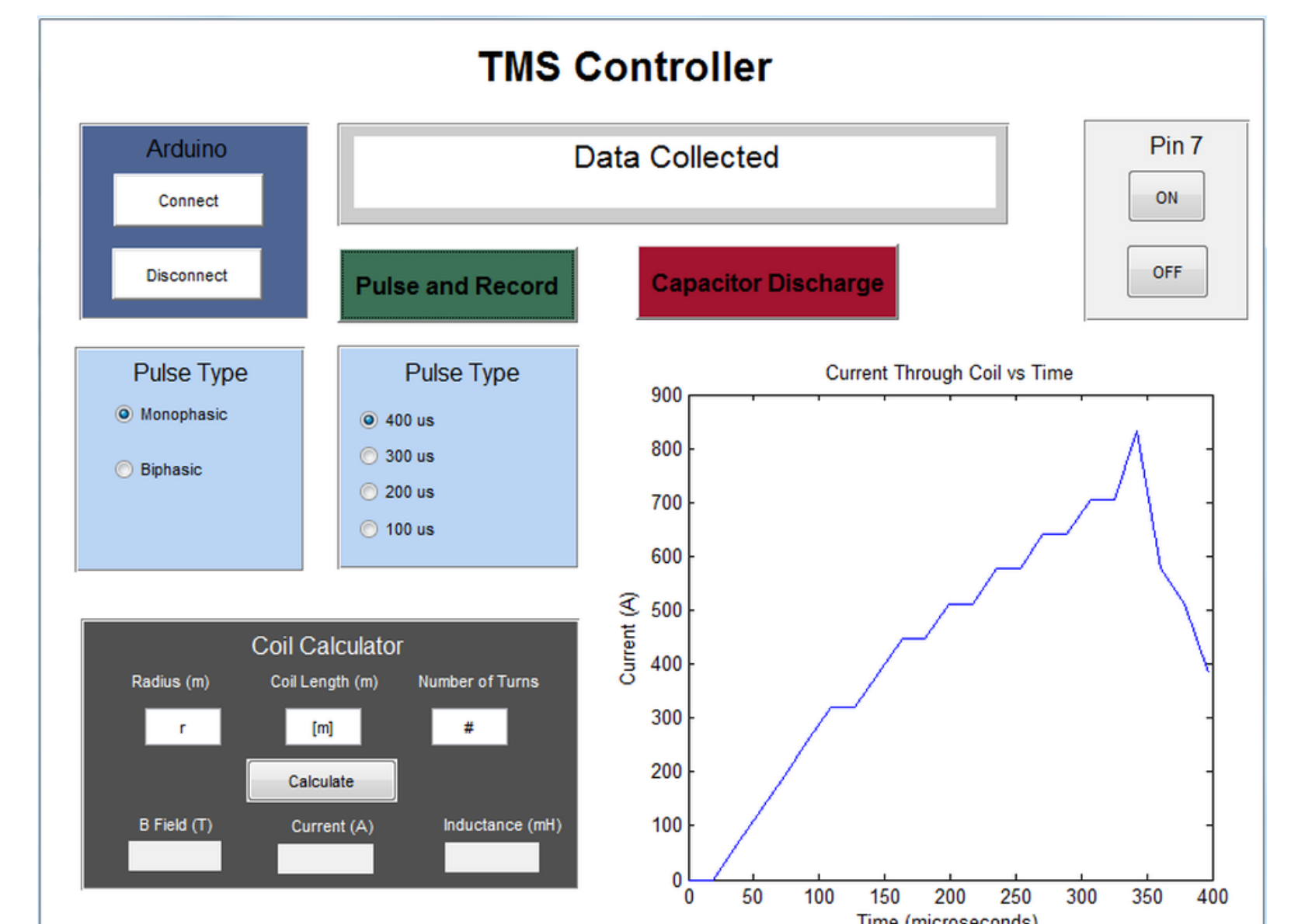
Voltage Pulse

- Acquired Monophasic and Biphasic pulses
- System can be controlled via GUI or front panel
- Current can be read and displayed
- Easy to use and modify/upgrade
- Circuit produces consistent voltage levels on both positive and negative sides

Testing Procedure



User Interface



- Sends desired pulse width and shape
- Records current through inductive load
- Discharges capacitors for safety
- Calculates coil characteristics