# Stirring Subsystem

Leader: Iason Chaimalas

# Construction

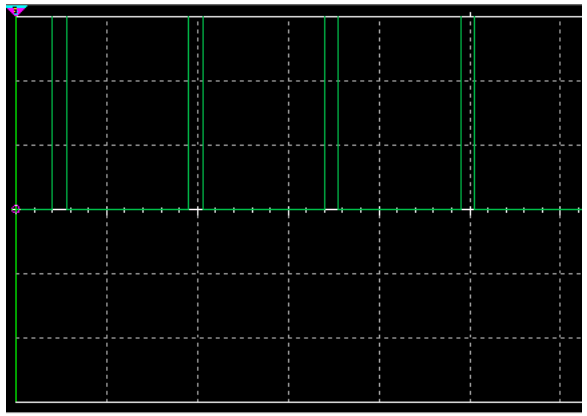
Leader: Iason Chaimalas

# The DC Motor Actuator

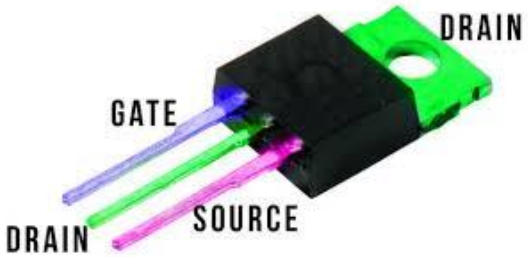
MOTOR DATA. (RE-140)

| MODEL | VOLTAGE | | NO LOAD | |
|---|---|---|---|---|
| | OPERATING RANGE | NOMINAL | SPEED R.P.M. | CURRENT A |
| RE - 140 | 1.5 - 3.0 | 3.0v CONSTANT | 14800 | 0.300 |

*Stirring DC Motor Datasheet*



*PWM in Bioreactor Oscilloscope*




*MOSFET – (1) Oscar Liang*

Even with no load, the motor can draw over 300mA → High-Current Load

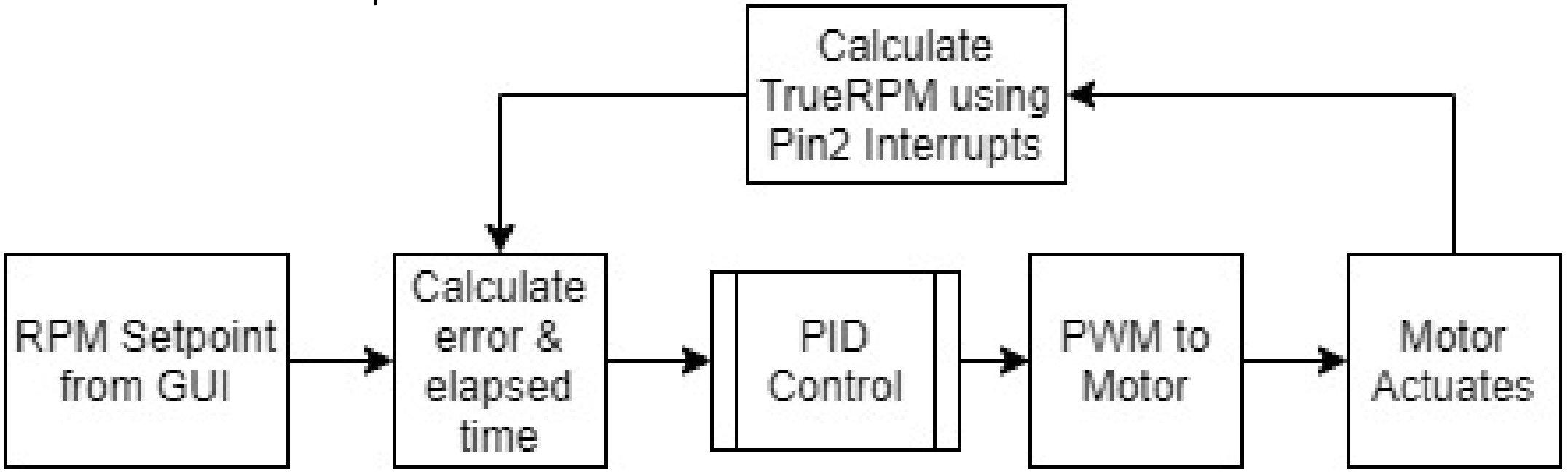
Turning the Gate ON makes the Drain conduct to the Source – switch behaviour.

Options:

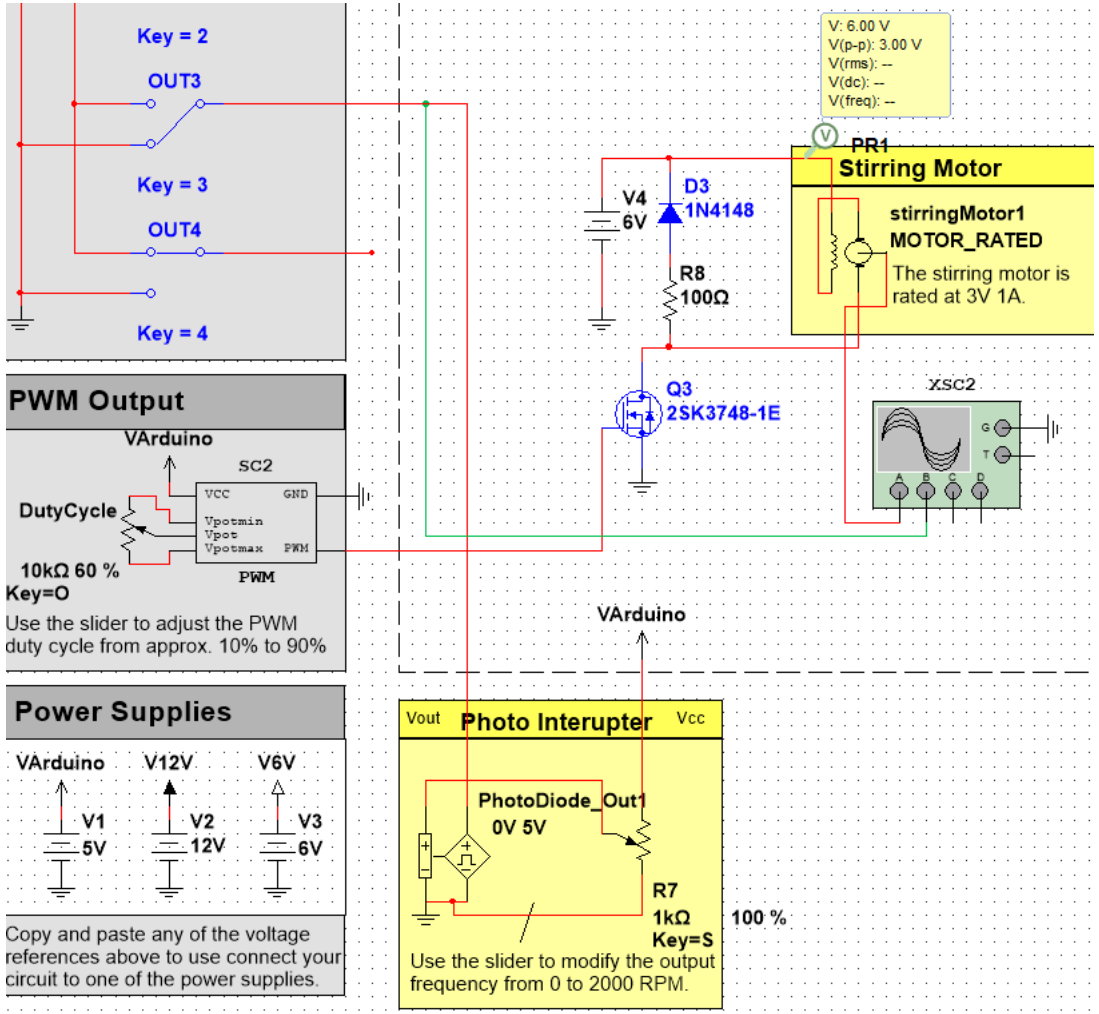
- digitalWrite → HIGH or LOW write
  - Manual write
  - Cannot control RPM
- PWM
  - Duty Cycle easily varied
  - Transistor ON for PWM HIGH (Vcc), OFF for LOW (GND)

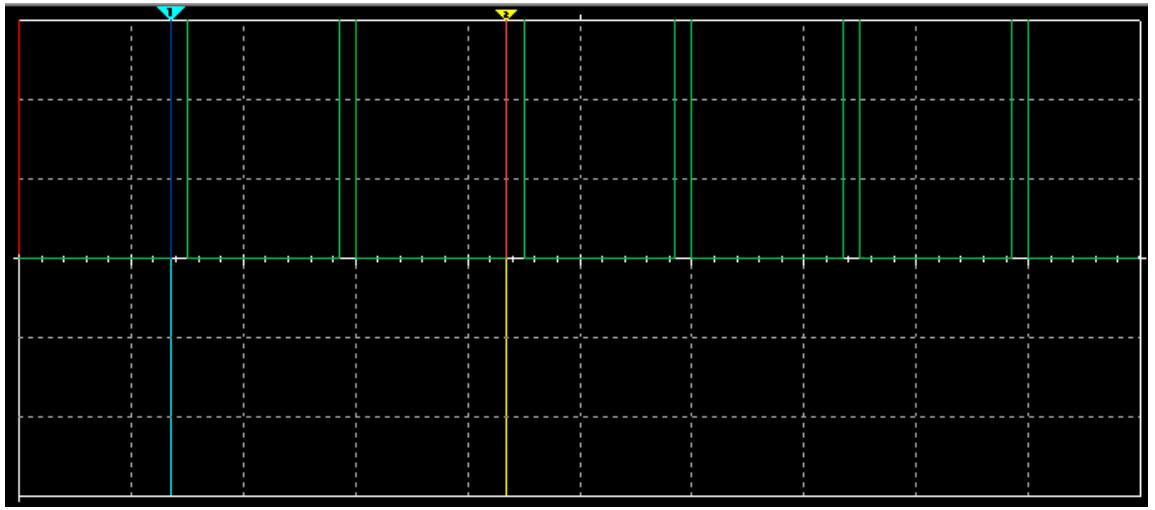
# Stirring Code

- Implementing Closed-Loop PID Control
- Error = Setpoint – TrueRPM
- ElapsedTime = time since last loop – used in D and I paths
- Very small tuning constants due to large P, I and D error terms
- Interrupts attached to Pin2, ISR used to collect number of changes of Pin2 over ElapsedTime



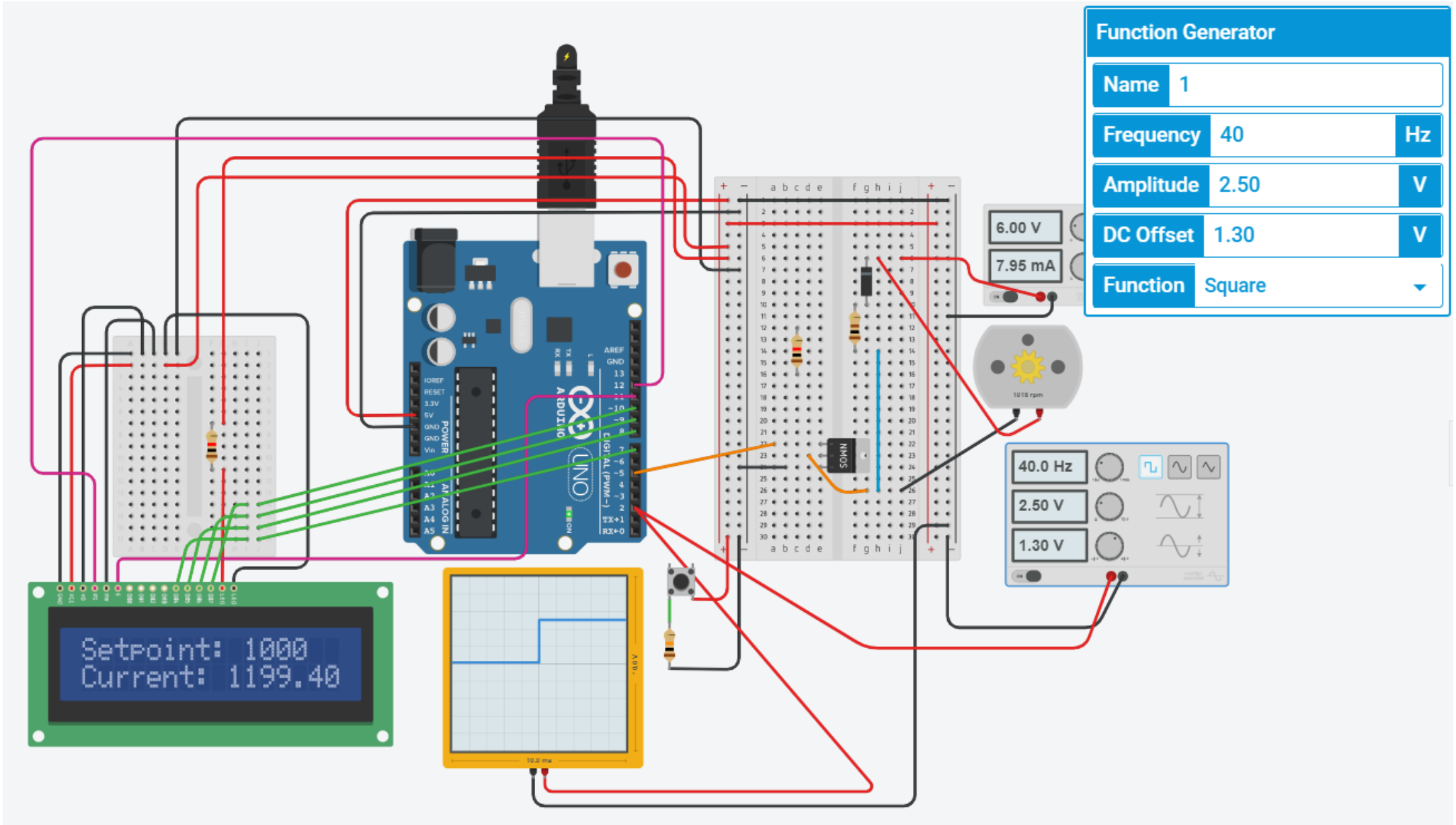
# Final Stirring Subsystem in Multisim



Oscilloscope Reading over Photointerrupter - Green

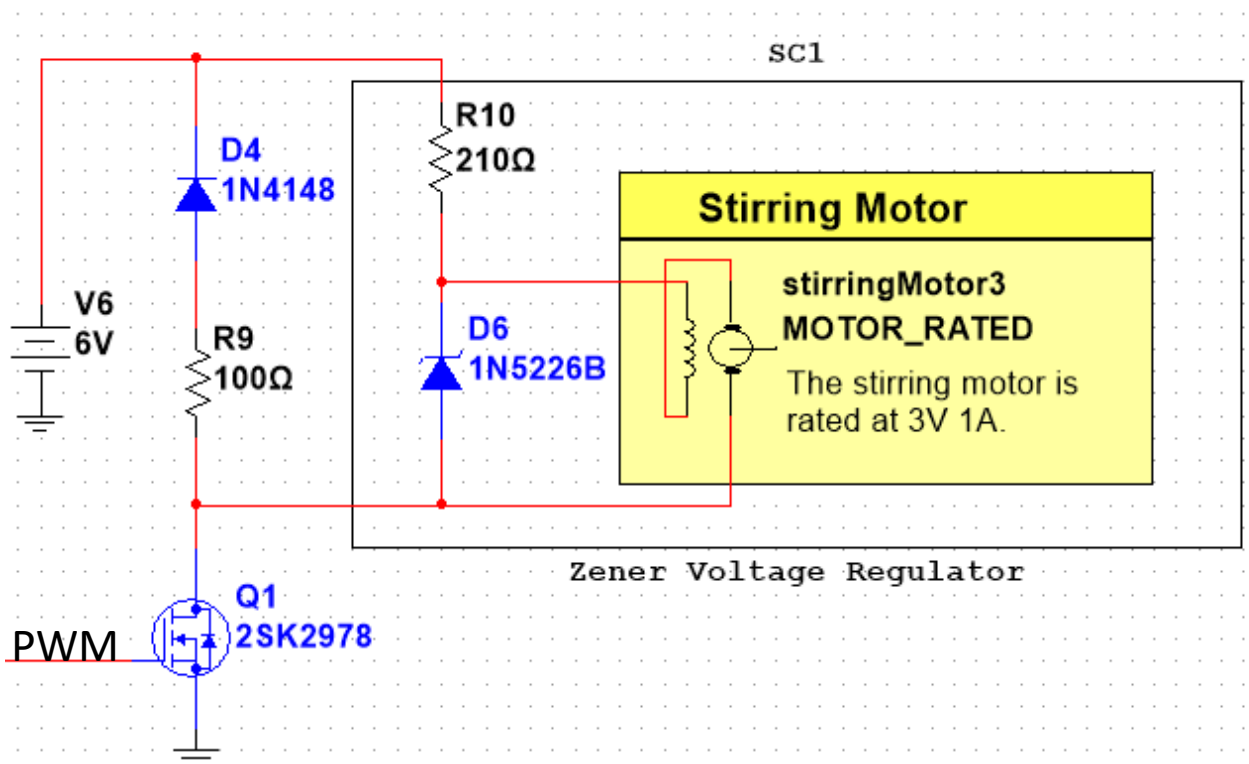
# Final Stirring Subsystem in Tinkercad

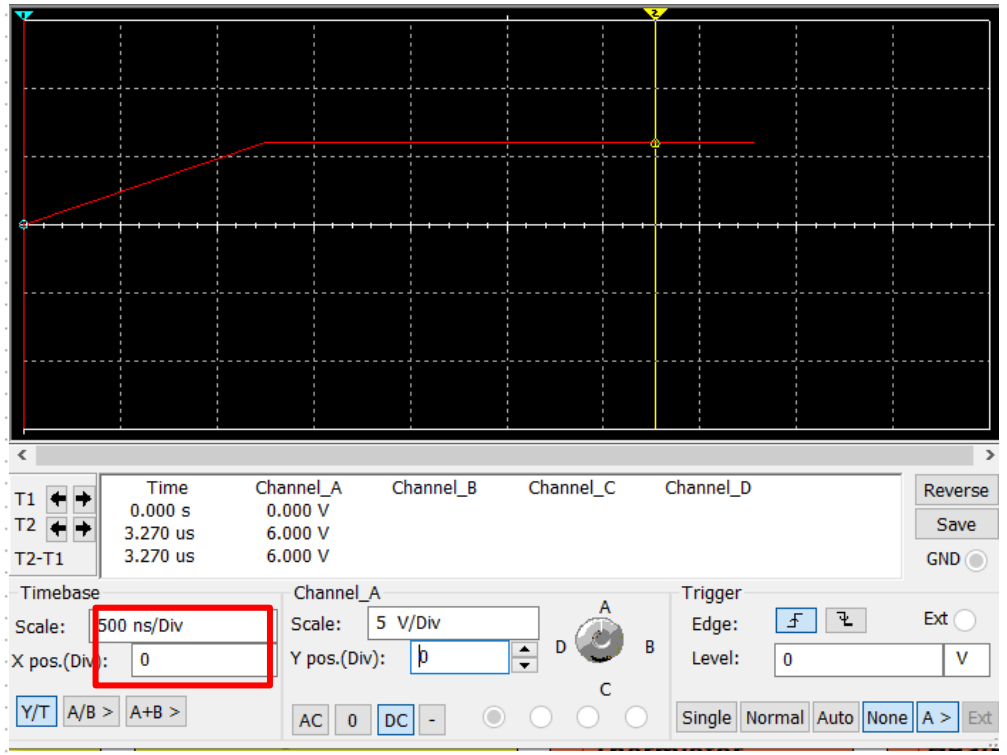


# Discussion

Leader: Iason Chaimalas

# Zener Voltage Regulator

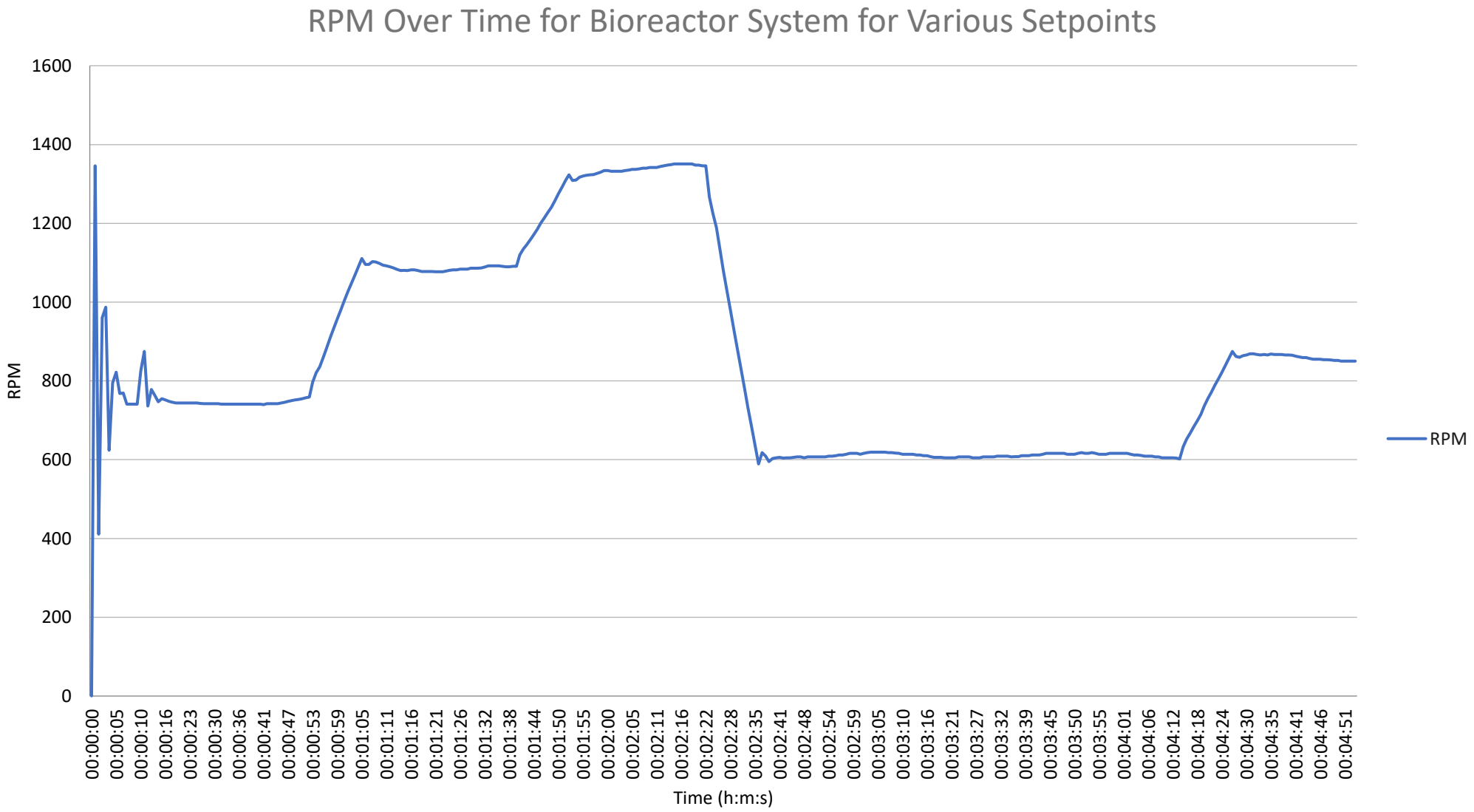


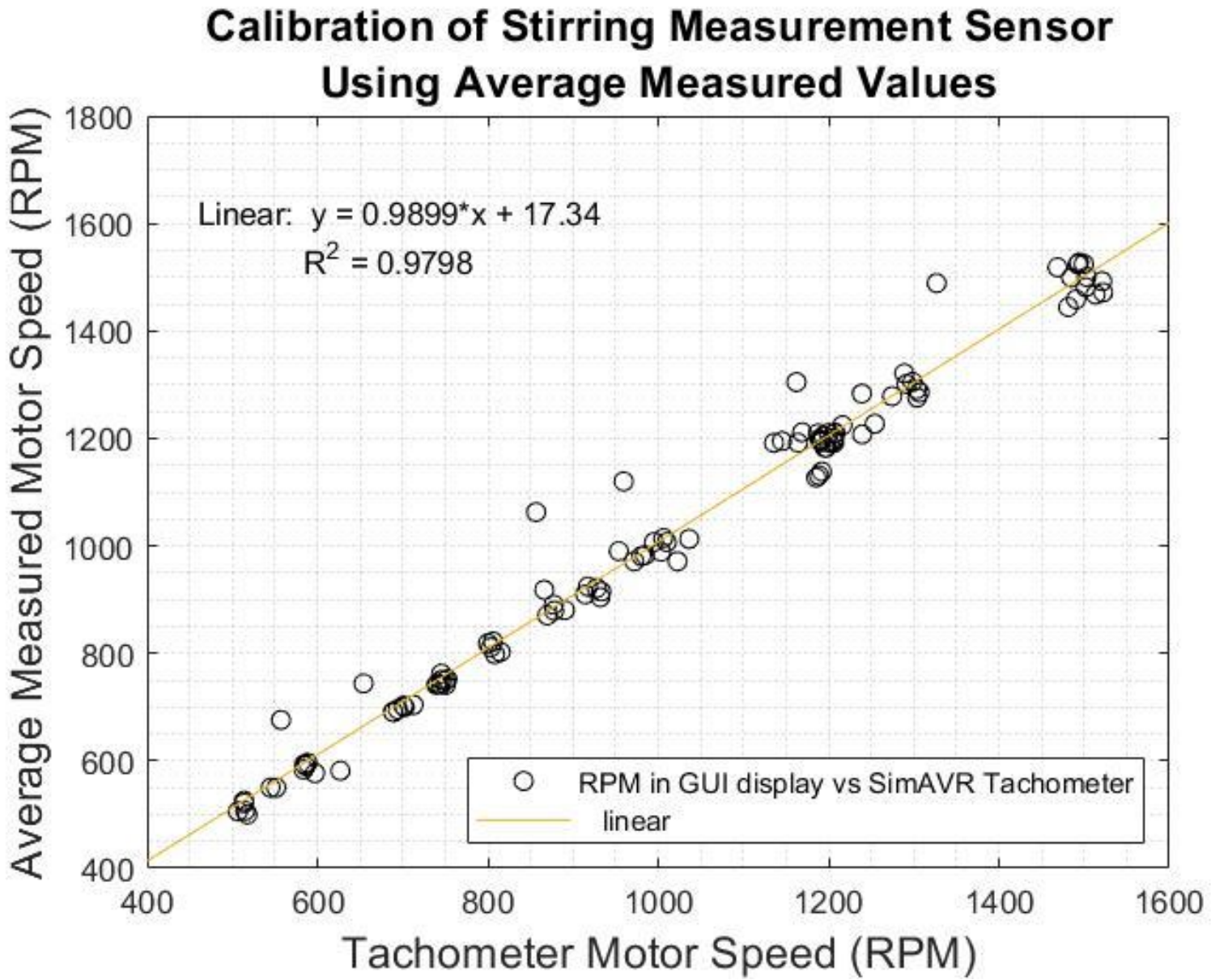
# Results

Leader: Iason Chaimalas

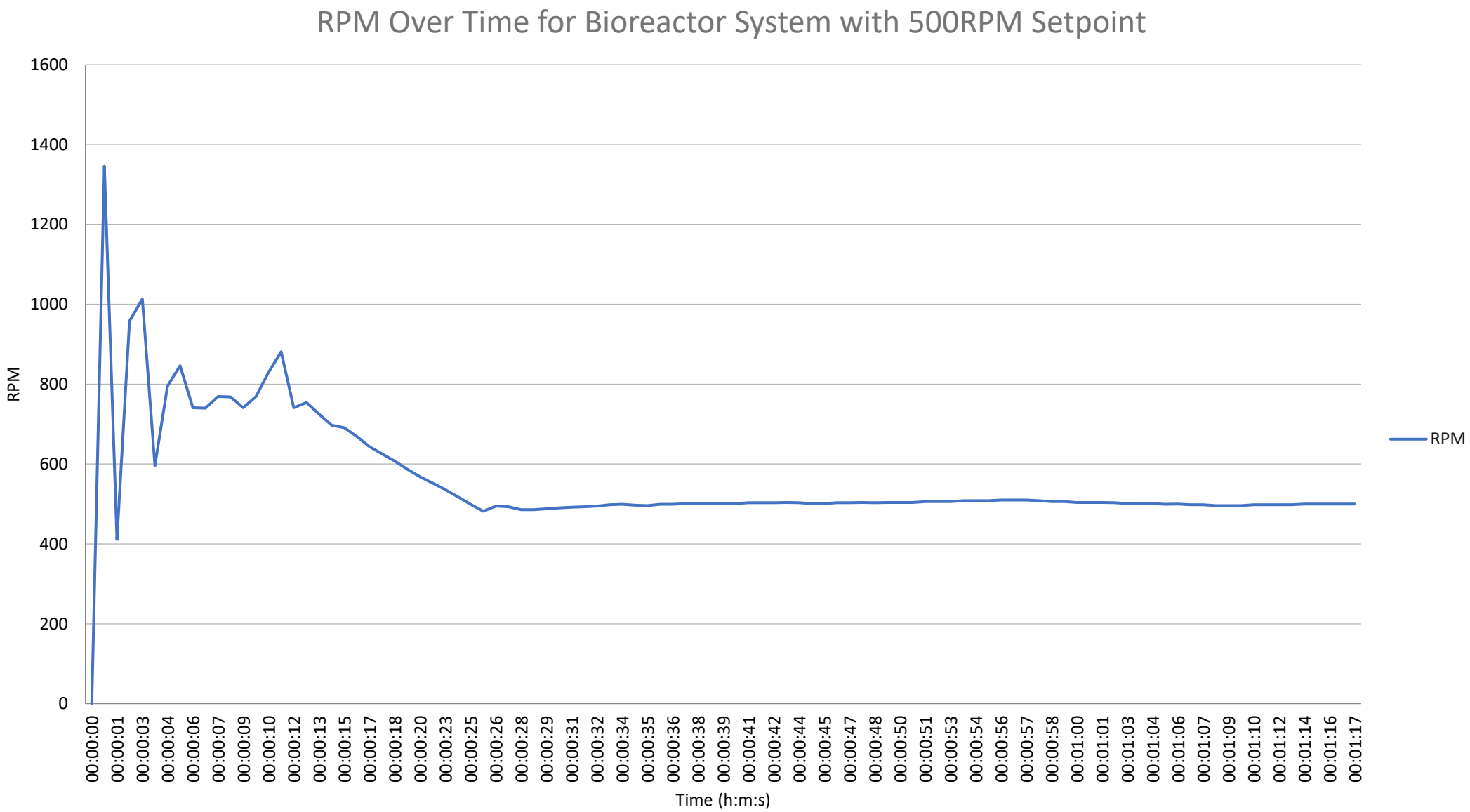
# Testing Edge Cases



# Calibration Curve



# Testing Edge Cases



# Testing Edge Cases