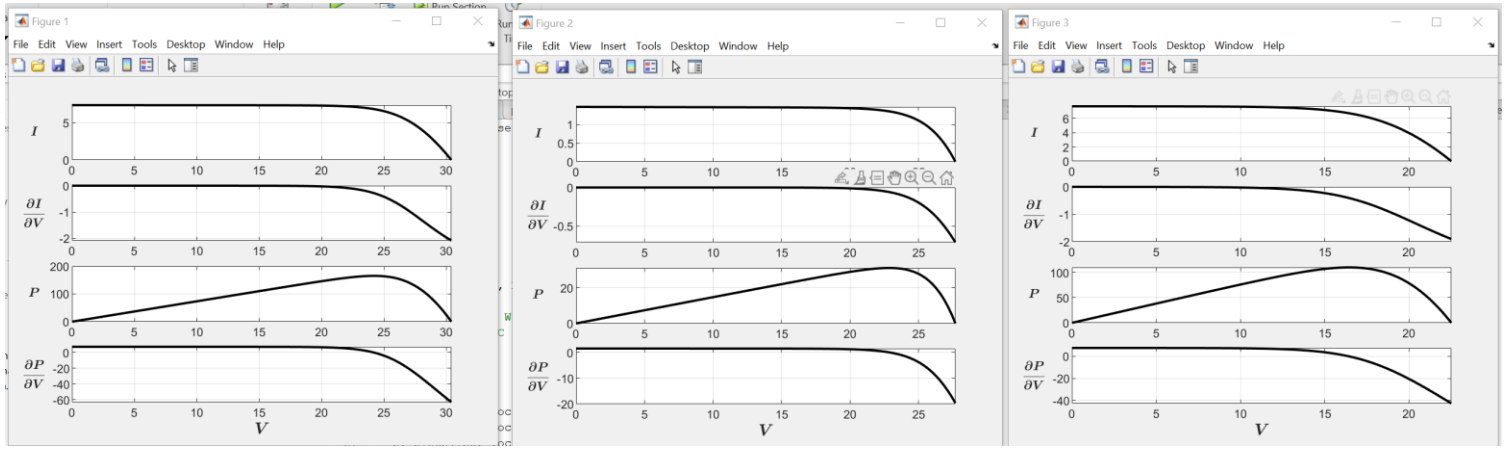
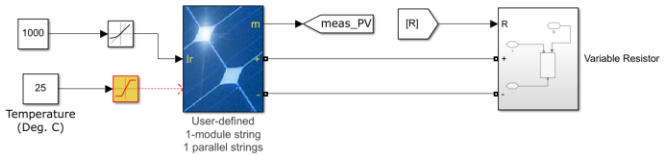
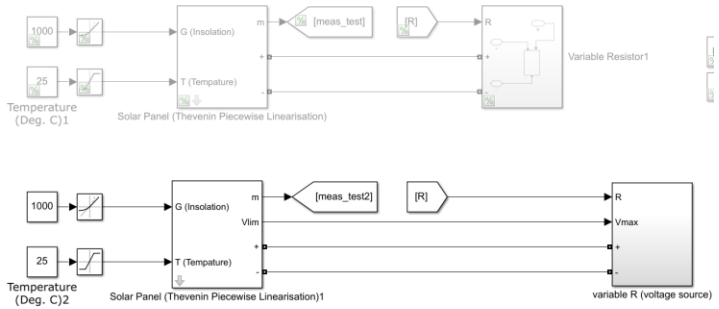
Brief Electronics Project Portfolio

By Matthew Smith





Datasheet Values		Estimated Parameters	
I_{sc}	7.36 A	I_{ph}	7.36 A
V_{oc}	30.4 V	I_o	0.104 uA
V_{mpp}	24.2 V	A	1.310
I_{mpp}	6.83 A	R_s	0.251 ohms
n_s	50	R_{sh}	1168 ohms
Temperature Coefficients			
K_i	0.057%	K_v	-0.346%



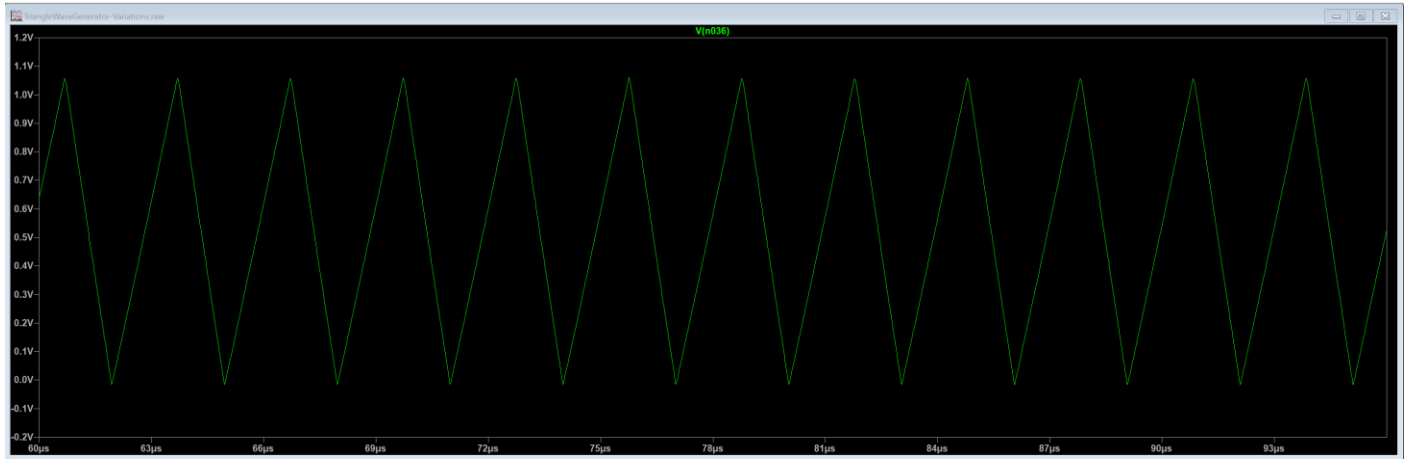
Custom 5-parameter solar panel model shows good agreement with built in Simulink model

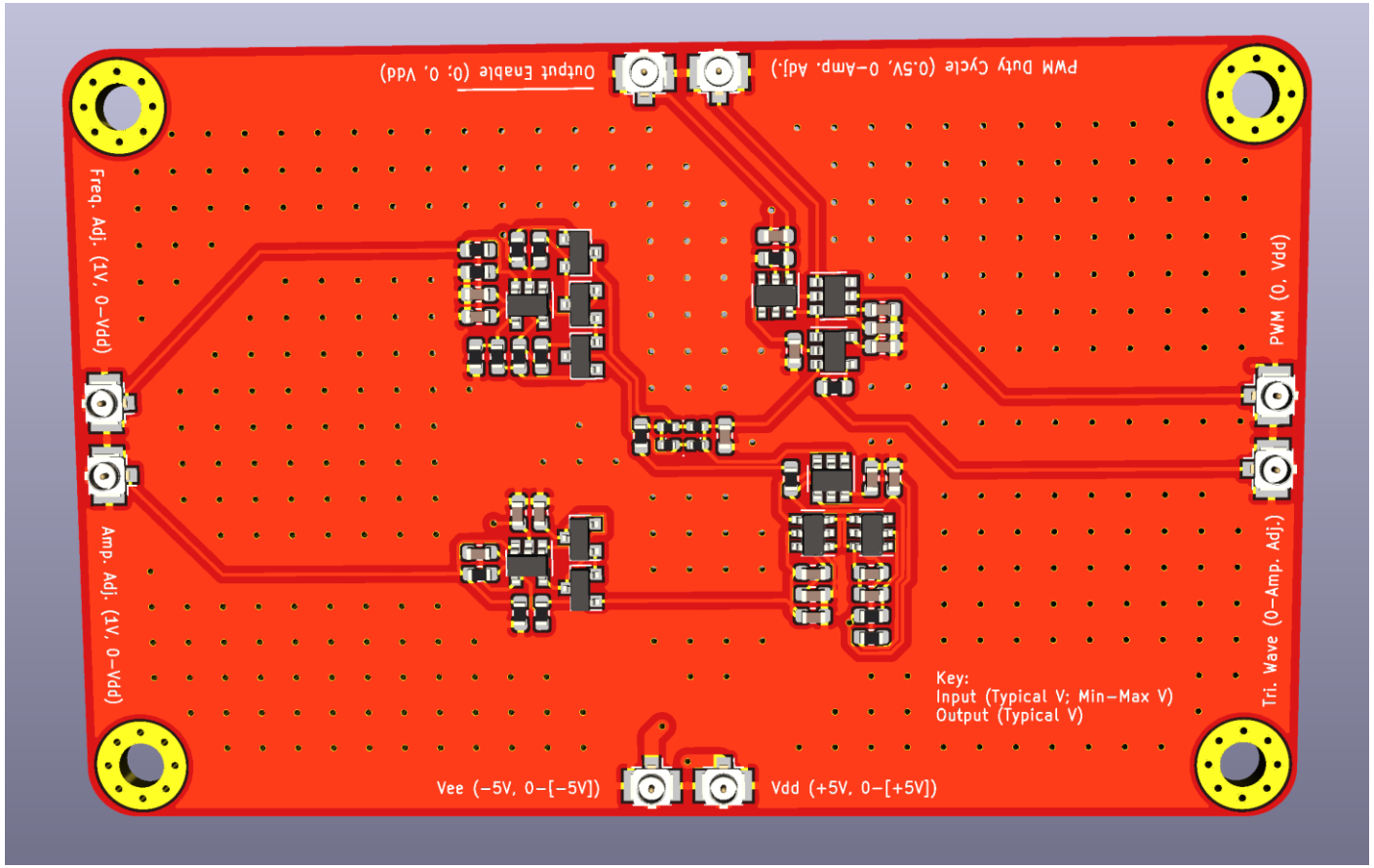
Real-time hardware solar panel simulator [work in progress]

Project Type: Hobby

Knowledge and Skills:

- Solar panel simulation with voltage and current control of 1 kW (0-80V output range) isolated full-bridge buck converter
- Simulation of solar panels for converter control based upon five-parameter photovoltaic model to allow simulation of arbitrary solar panels from easily found parameters (Voc, Isc, Vmpp, Impp)
- PFC Boost Rectifier input stage (universal input to 400 VDC) for solar panel simulator
- MPPT (incorporating extremum seeking controller) and single-phase grid tie inverter modules to be designed and developed to aid in testing and verification of the solar panel simulator
- Scale and complexity of project intended to help familiarise understanding and intricacies of all stages of design, modelling, and construction of high-power, isolated, power electronics converter, along with designing robust control systems for power electronics



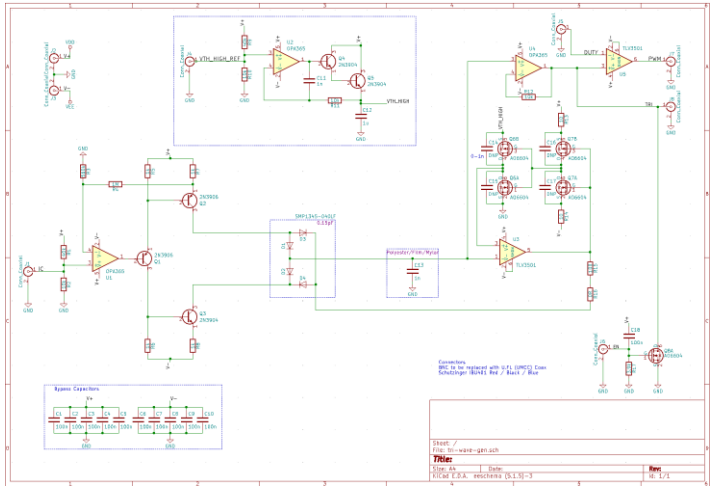


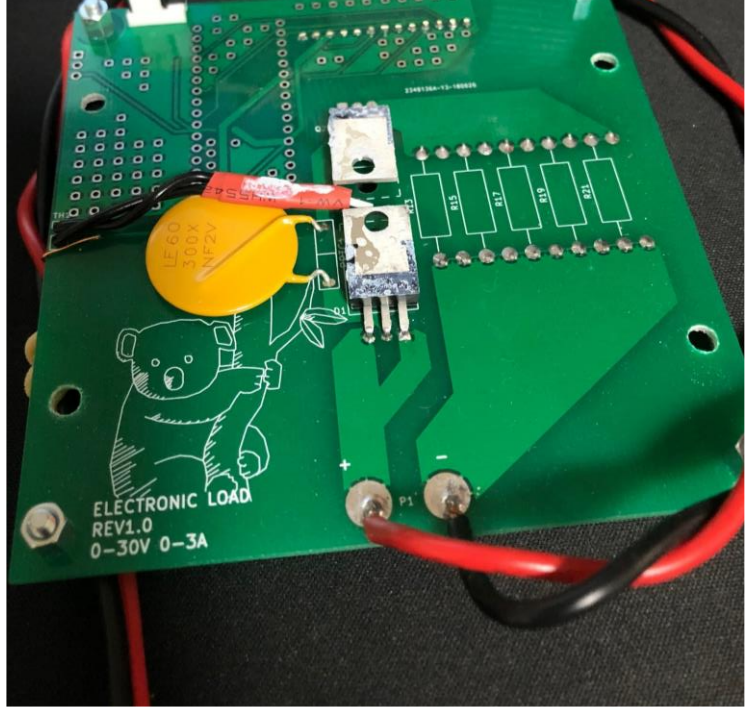
High-speed high-linearity analog triangle wave generator

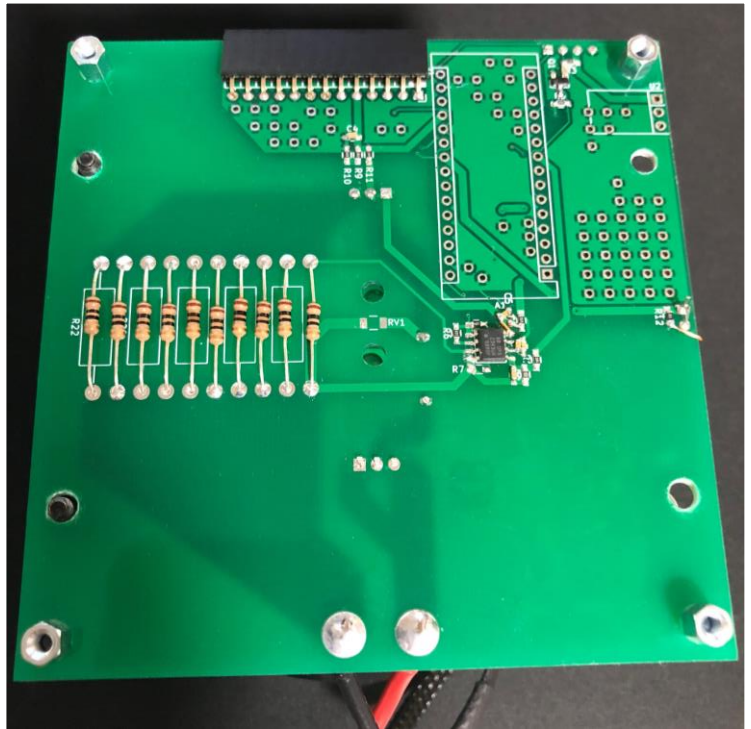
Project Type: Hobby

Knowledge and Skills:

- 1 MHz, high-linearity triangle wave generator using full-bridge bi-directional current steering
- Exercise in learning about higher speed, precision analog signal generation
- Small form-factor PCB designed in Kicad







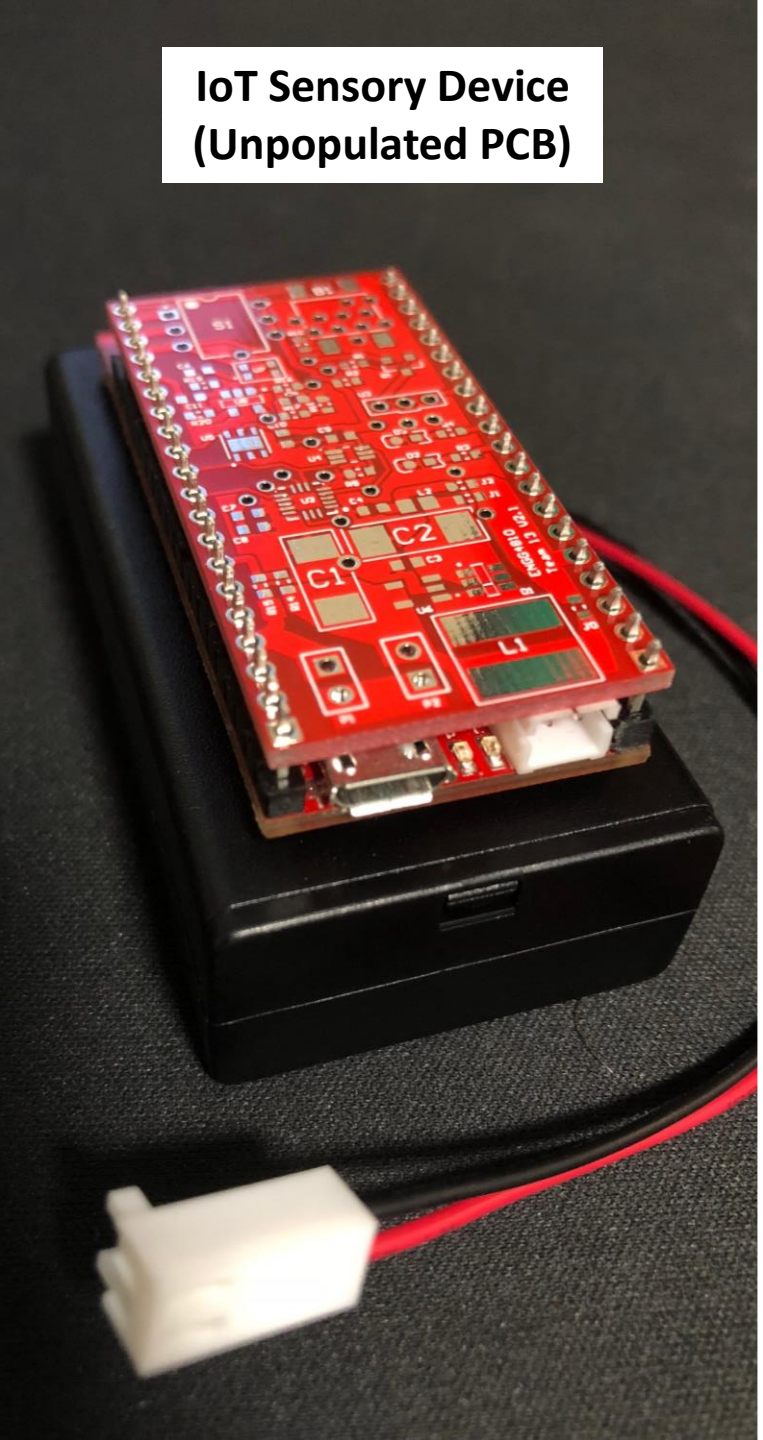
Electronic Load (Bench Test Equipment)

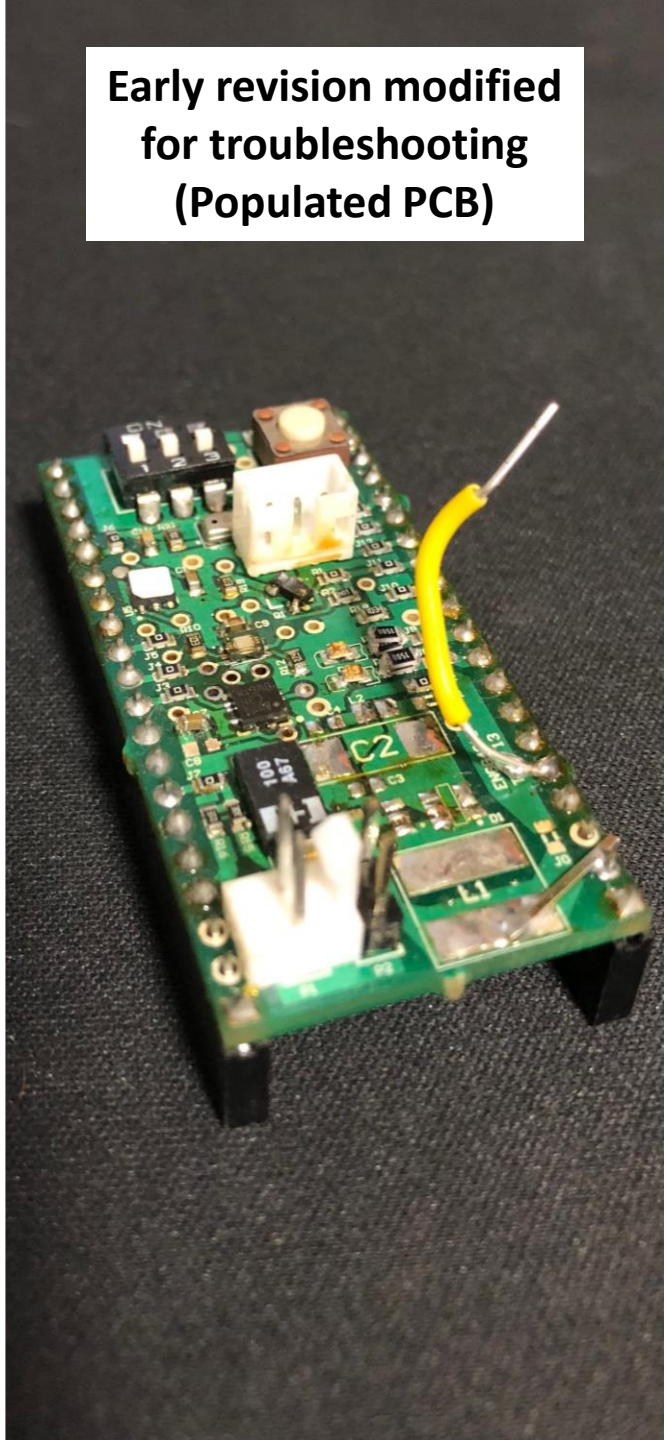
Project Type: Hobby

Knowledge and Skills:

- **Control loop design and stability analysis**
- **Thermal analysis and heat management solution design**
- **Input protection design (device protection)**
- **PCB design**
- **Electronics troubleshooting**
- **Firmware (external control of electronic load through software)**

Outcome: Reliable electronic “dummy” load (0-30 V, 0-3 A) primarily used for testing project power supplies. For thermal management, the system has been designed to use an off-the-shelf CPU fan.





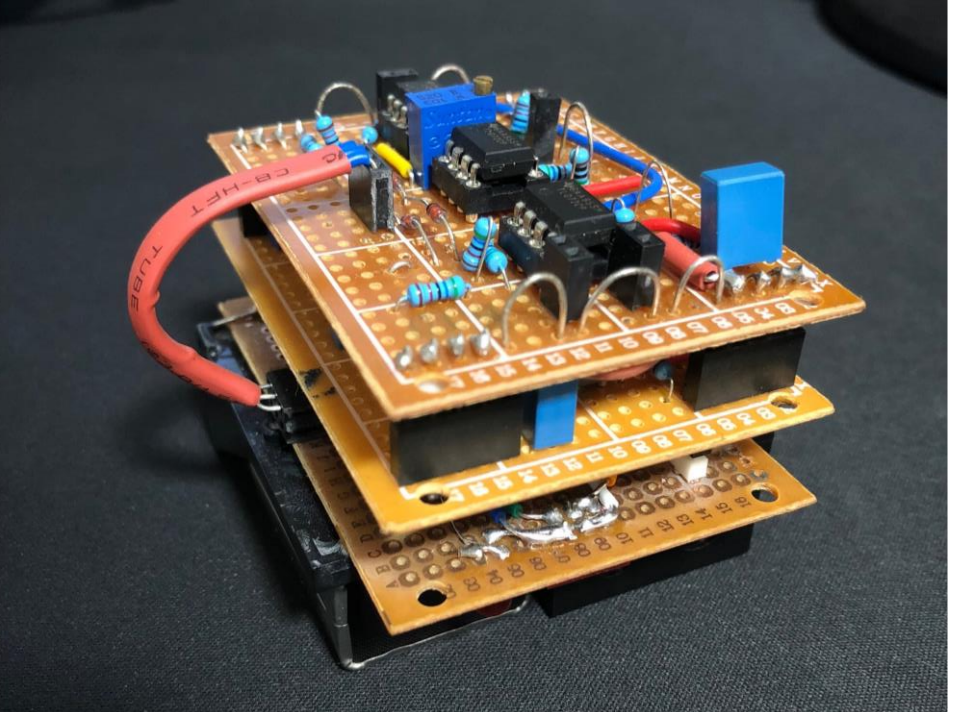
Portable IoT (Internet of things) Data Monitoring Device

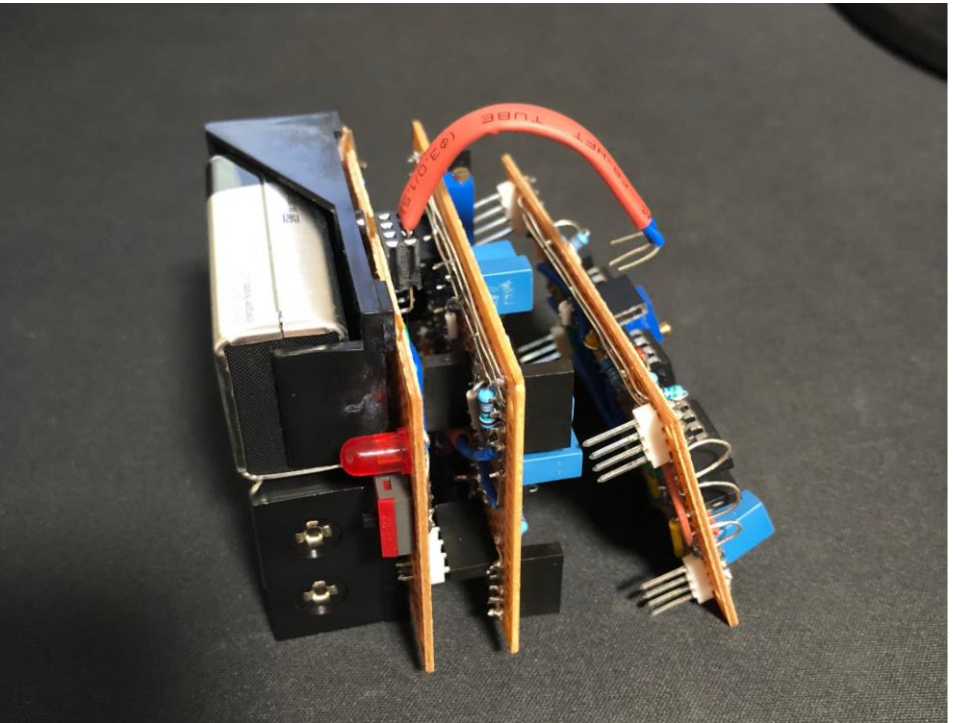
Project Type: University Assessment

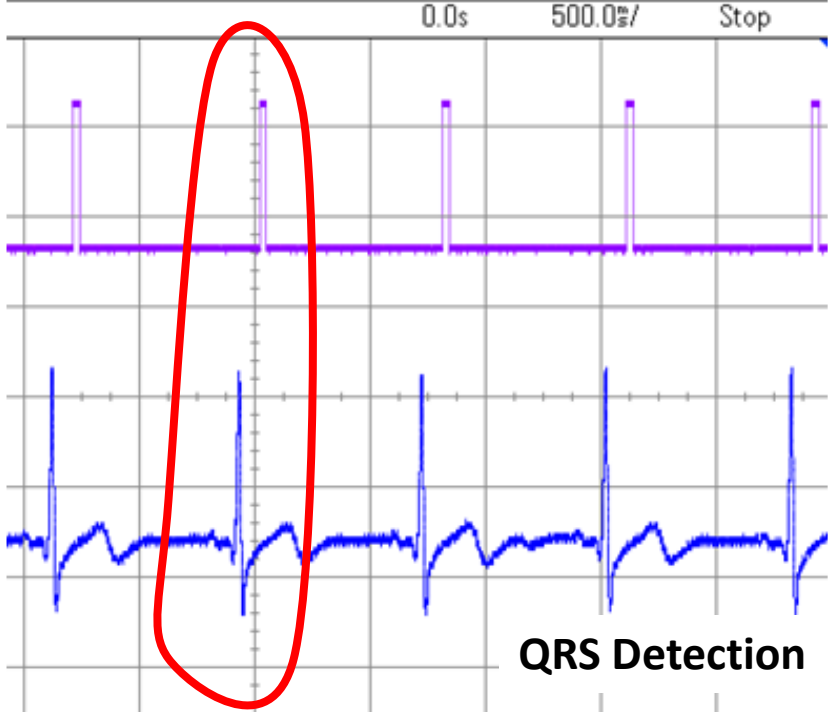
Knowledge and Skills:

- **Analog circuit design**
  - **Component selection to meet budget (2 x devices for AUD$100) and size constraints (another cost reduction strategy)**
  - **Low power circuitry design**
  - **PCB design to act as stackable board for a Sparkfun ESP32 Thing (commercially available microcontroller board)**
- **Firmware**
  - **Periodically poll sensor data (temperature, humidity, GPS data)**
  - **Tone detection (listening for select frequency)**
  - **Send secure data packets over WiFi via MQTT**
  - **Adhere to strict power consumption goals (< 1.5 mW)**

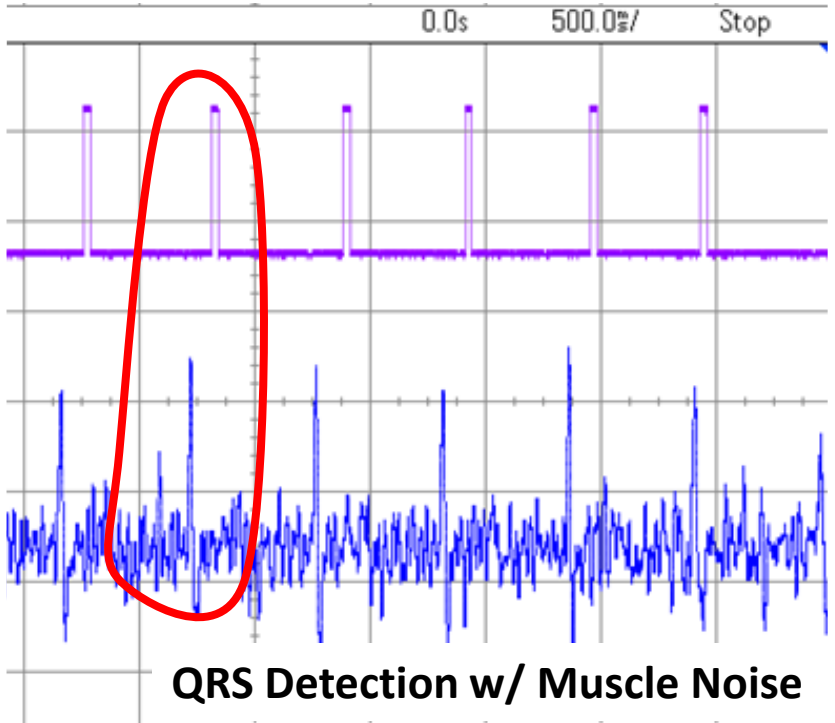
Outcome: Reliable data sensing and WiFi data logging while adhering to budget and power consumption







QRS Detection



QRS Detection w/ Muscle Noise

Portable ECG with QRS Wave (Heartbeat) Detection

Project Type: Assessment

Knowledge and Skills:

- Analog circuit design
  - Amplifier design
  - Analog signal filtering and conditioning
- Prototyping
  - Modular and compact prototype
- Electronic safety
  - Considerations for safety where a human forms part of the circuitry
- Digital signal processing on MCU
  - Digital signal filtering
  - Signal feature detection

Outcome: Reliable QRS wave detection even under noisy conditions.