Portable Multi-Channel Electrotactile Haptic Feedback System

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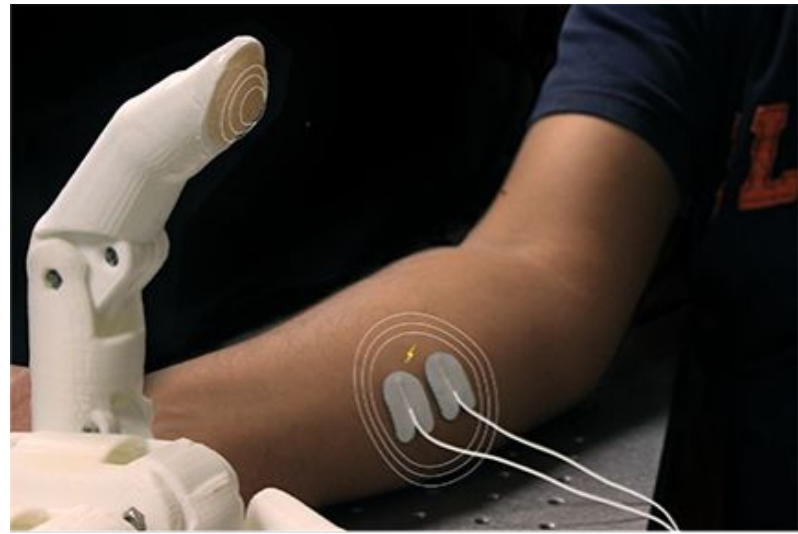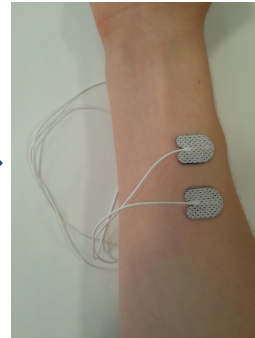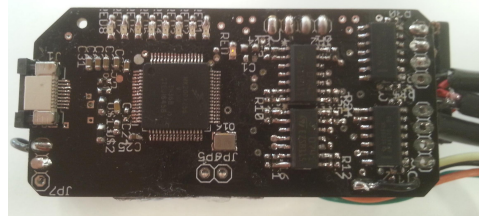
Group 2

ECE ILLINOIS

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Objective

Restore sensation of touch to amputees

No commercial solutions

Our solution: Electrotactile
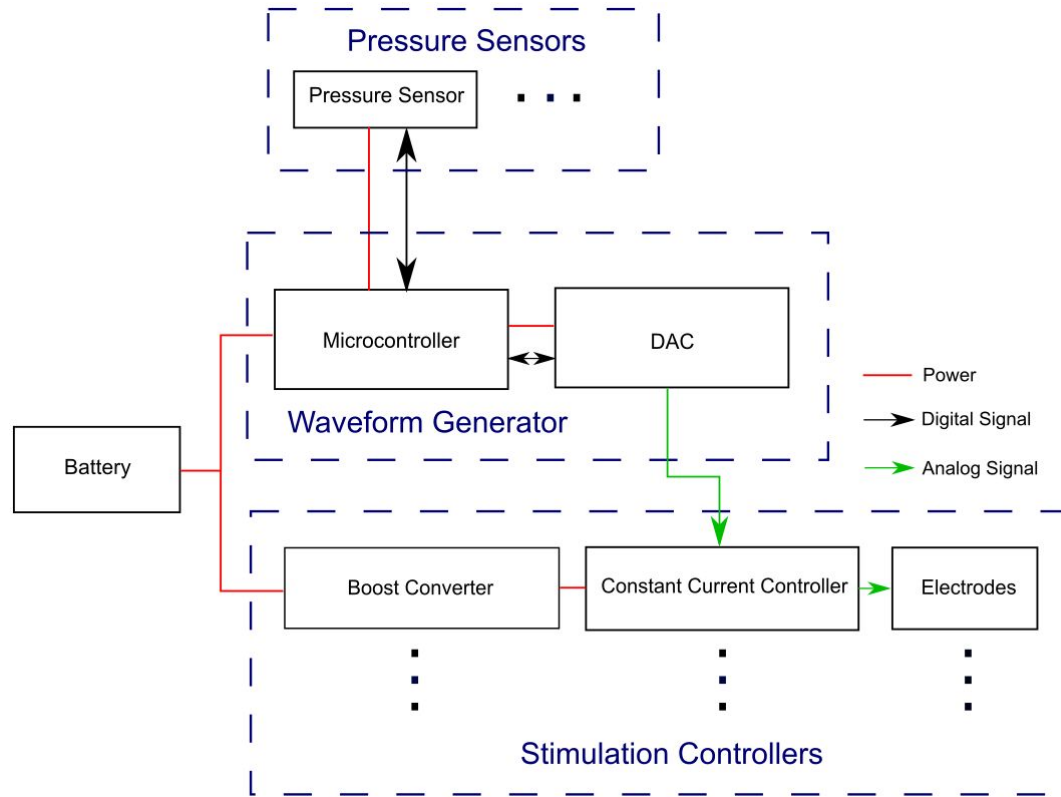
Bigger Picture: PSYONIC

Low cost robotics prosthetics
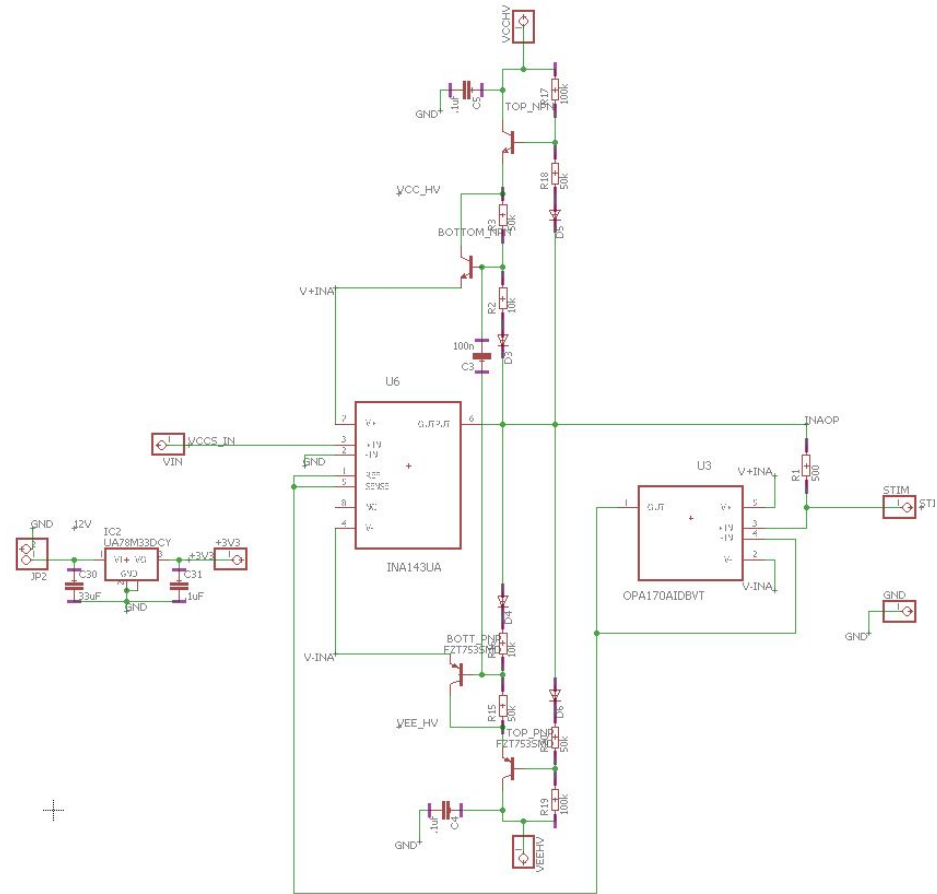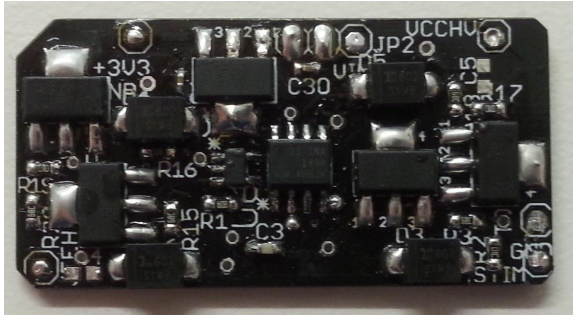
EMG control

System integration
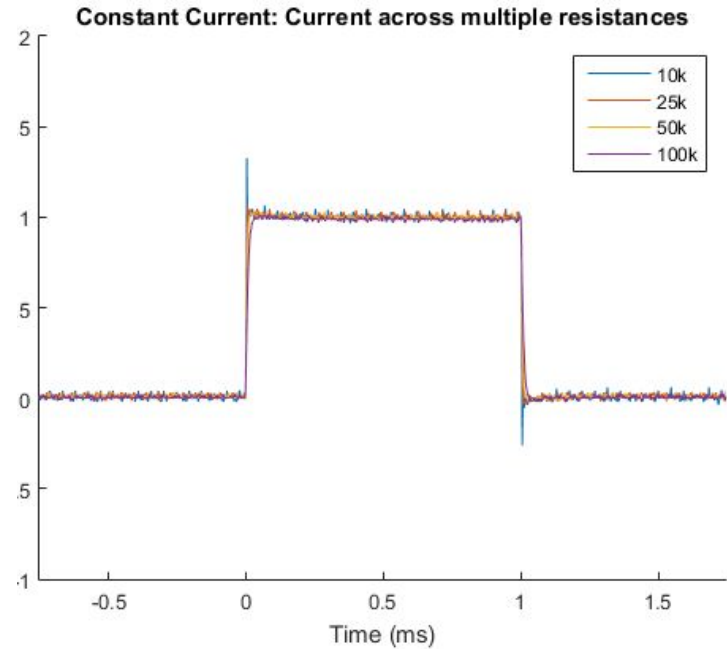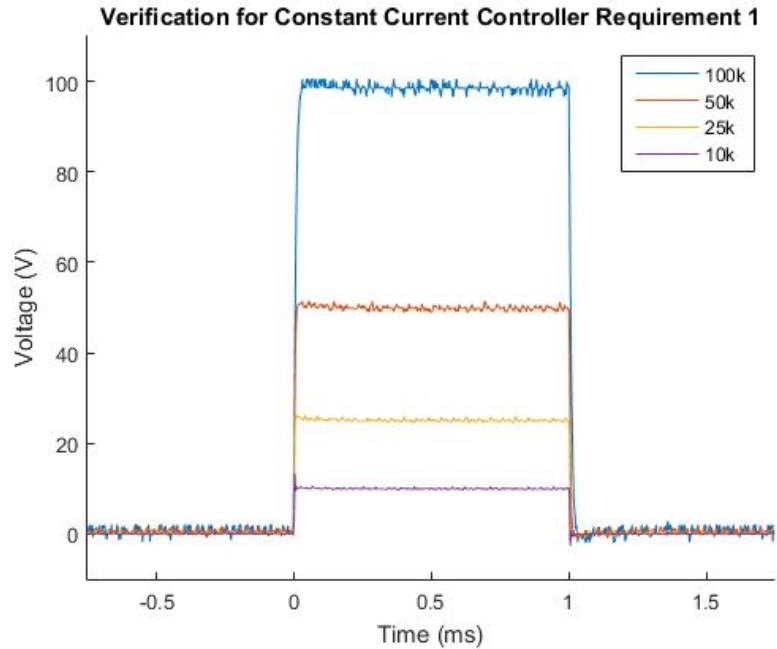
Design

Constant Current Controller
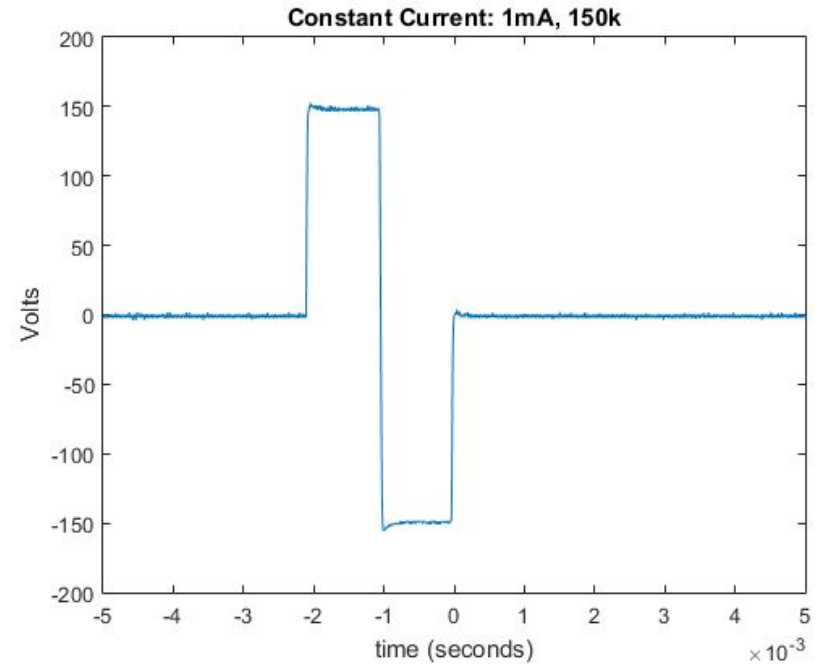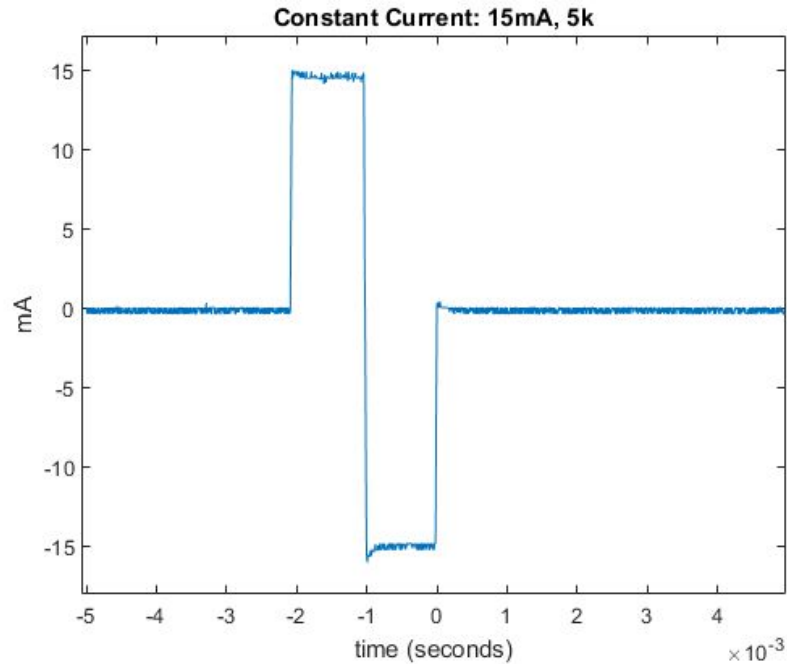
+/- 15mA regulated current

Input-output steady-state::

$$\frac{V_{in}}{R_{gain}} = I_{out}$$
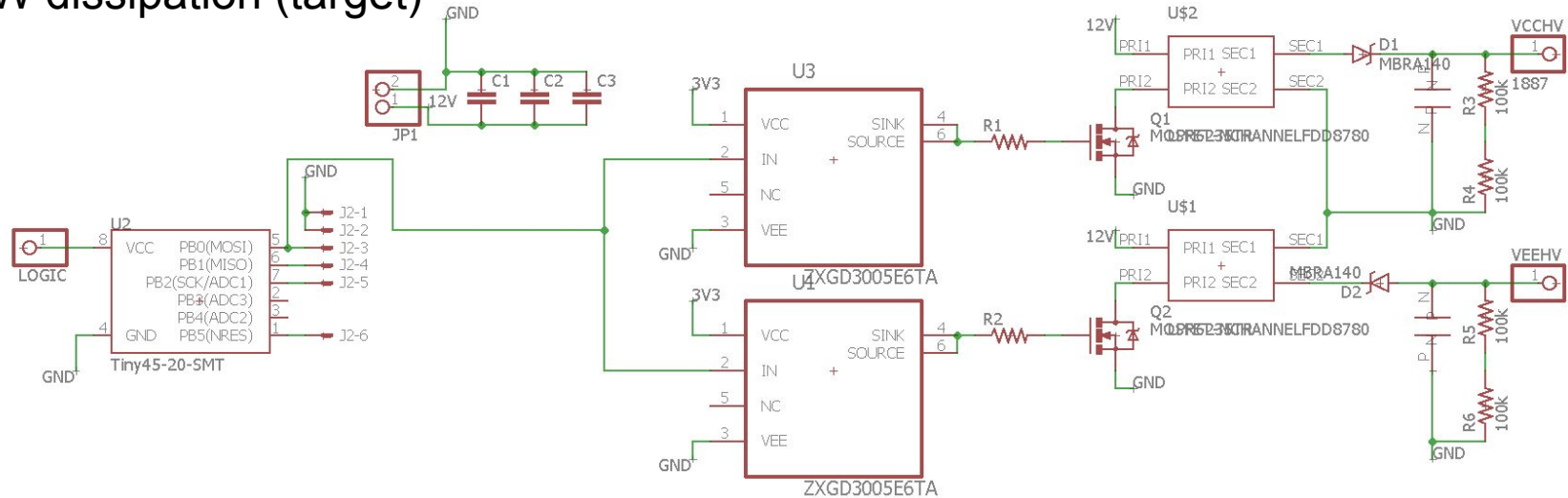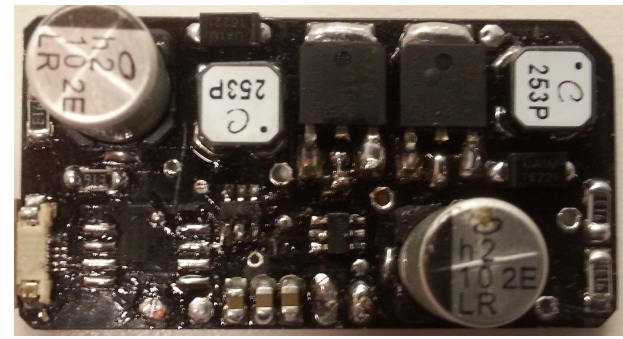
Results: Constant Current

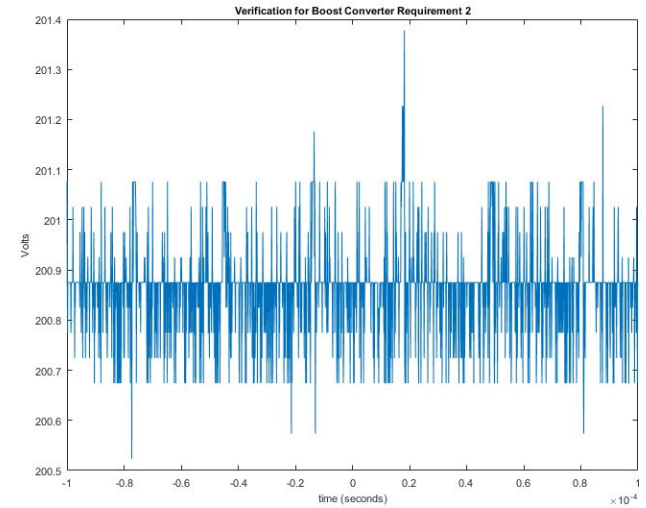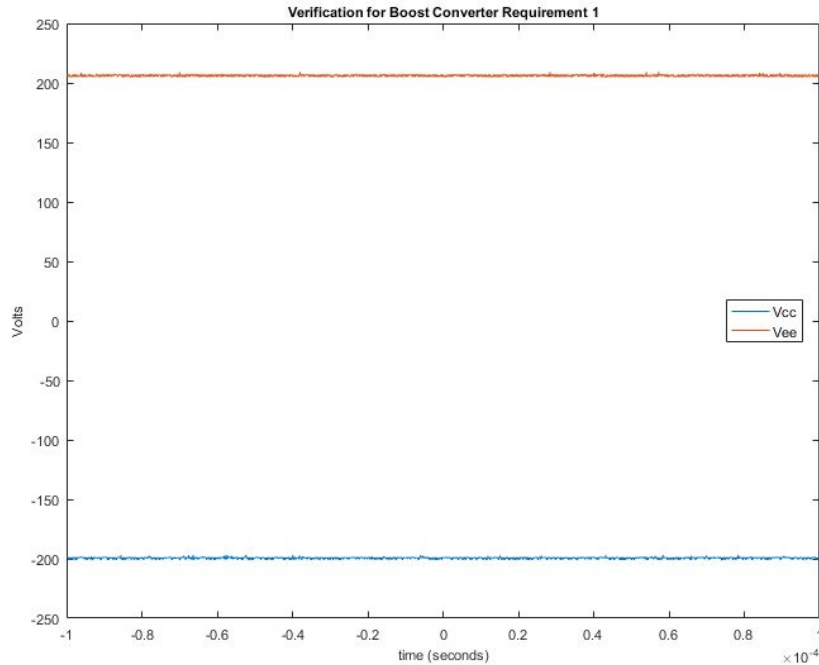# Results: Constant Current

Dual-Flyback Converter

9-12VDC to +/-200VDC

<1W dissipation (target)
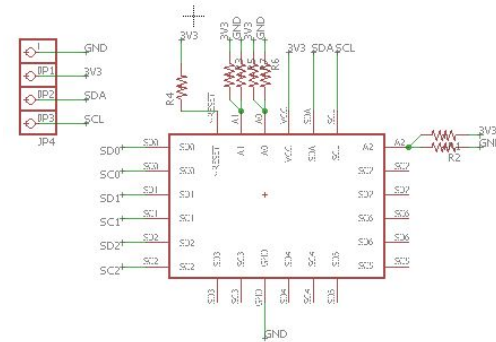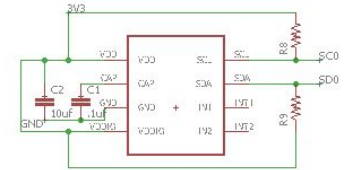
Results: Boost Converter
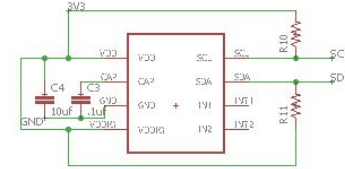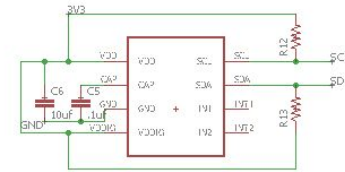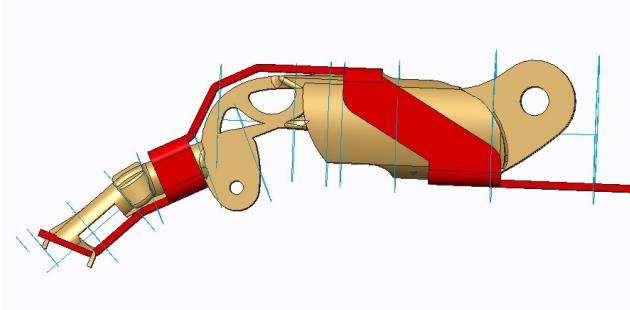
Pressure Sensor

Low cost

Barometric pressure sensors

Layout

Compensation filter (PSYONIC)

Drift+Hysteresis

Results: Pressure Sensor

Pressure vs. Time for 3 channels
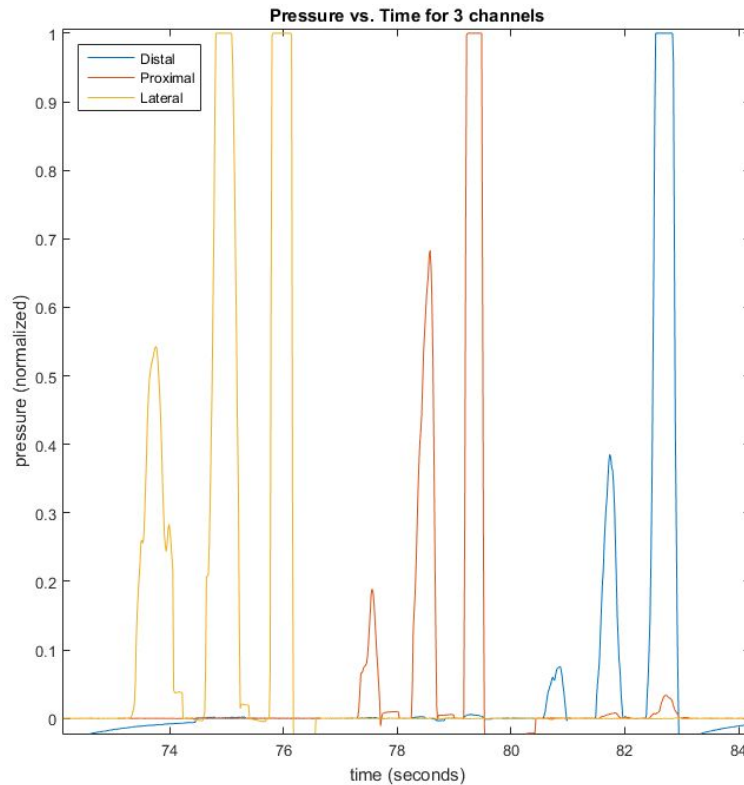
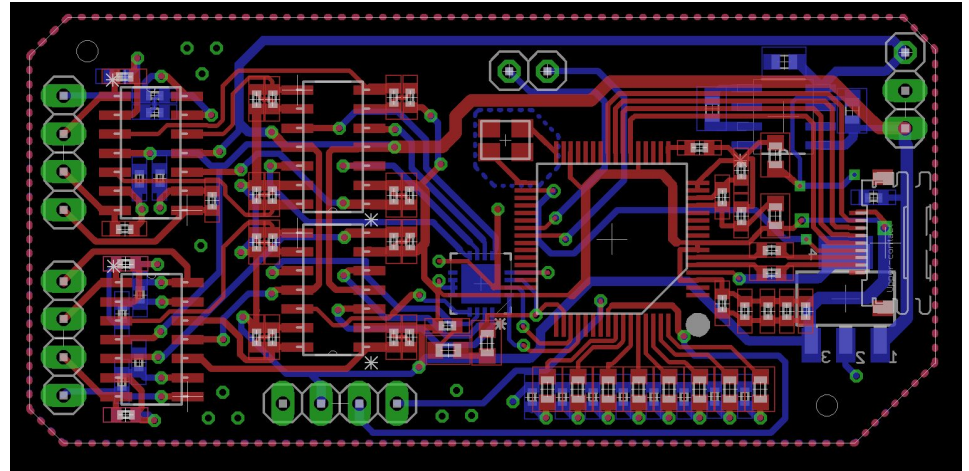# Pressure Sensor (video)

Digital to Analog Converter (DAC)

Provides tracking voltage references

Based on desired current:
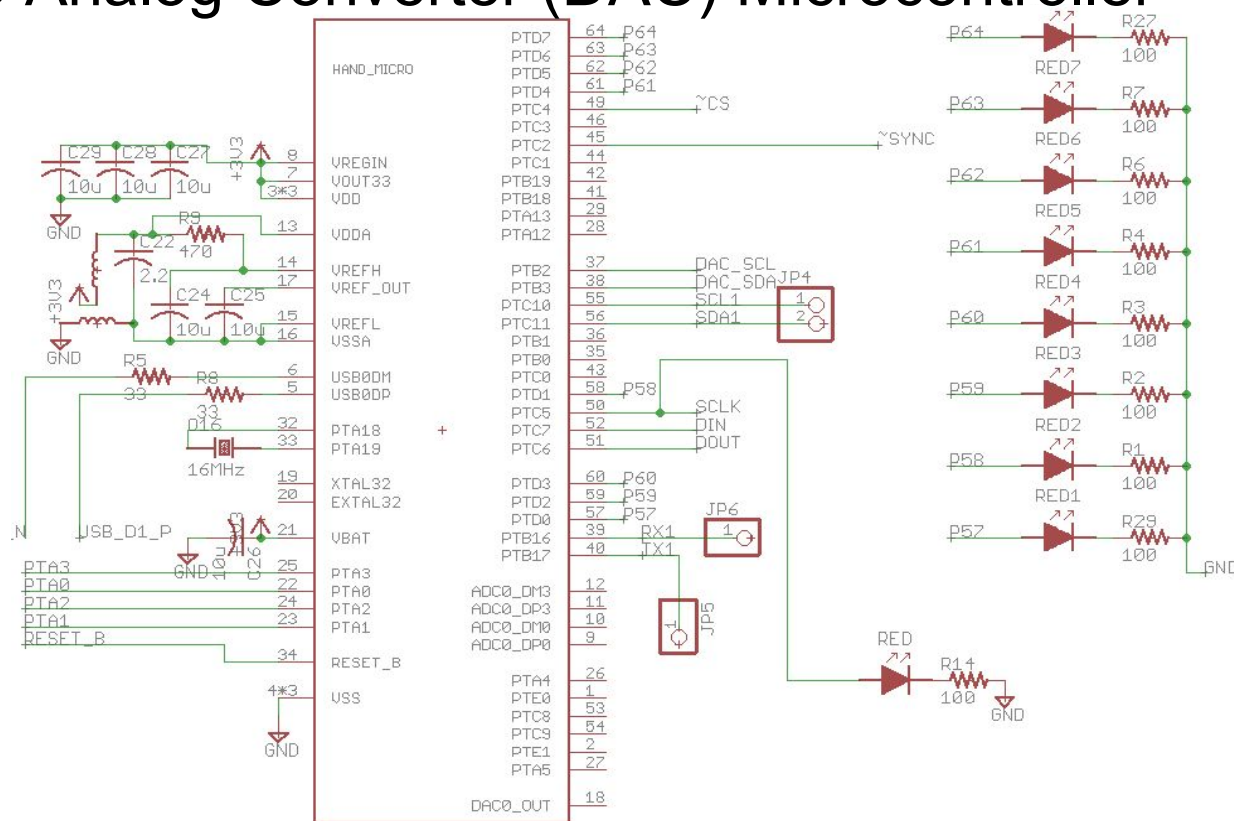
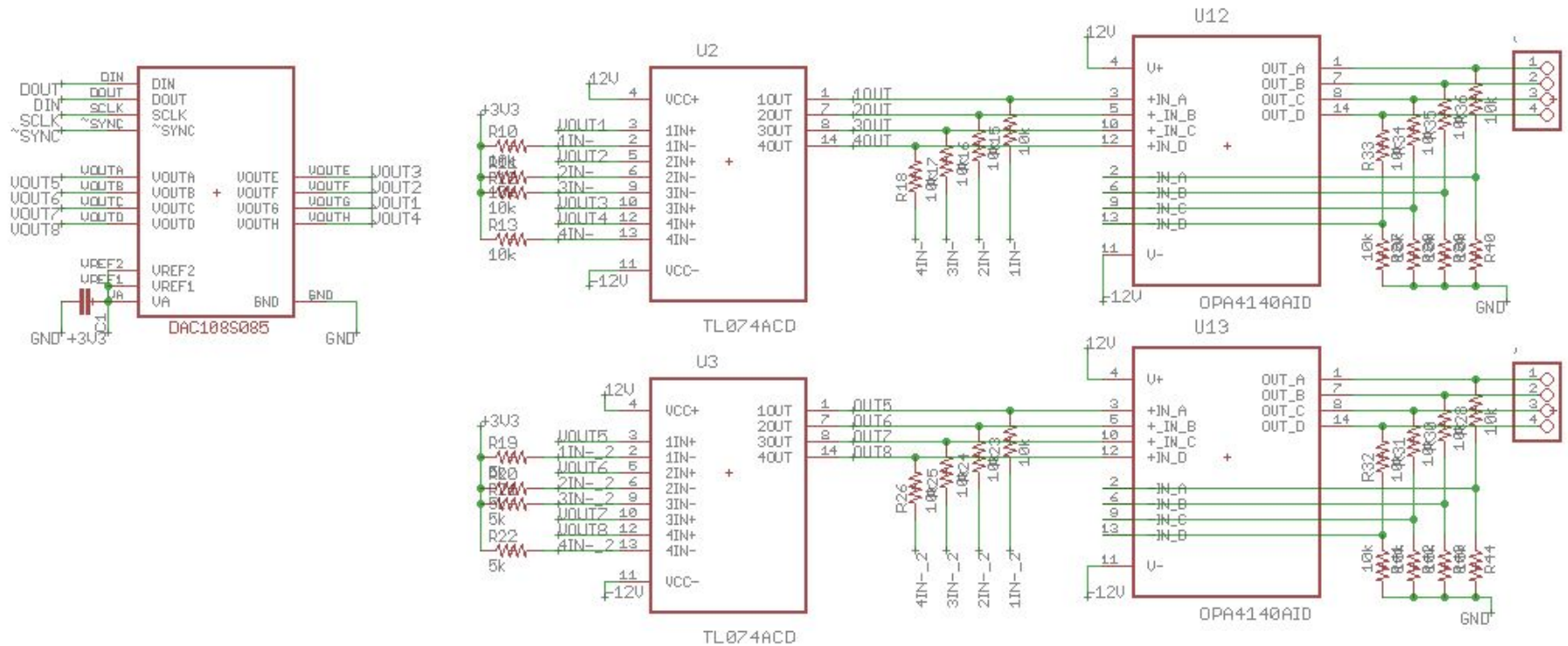$$V_{ref} = \frac{I_{des}}{R_{gain}}$$

DAC value over SPI:

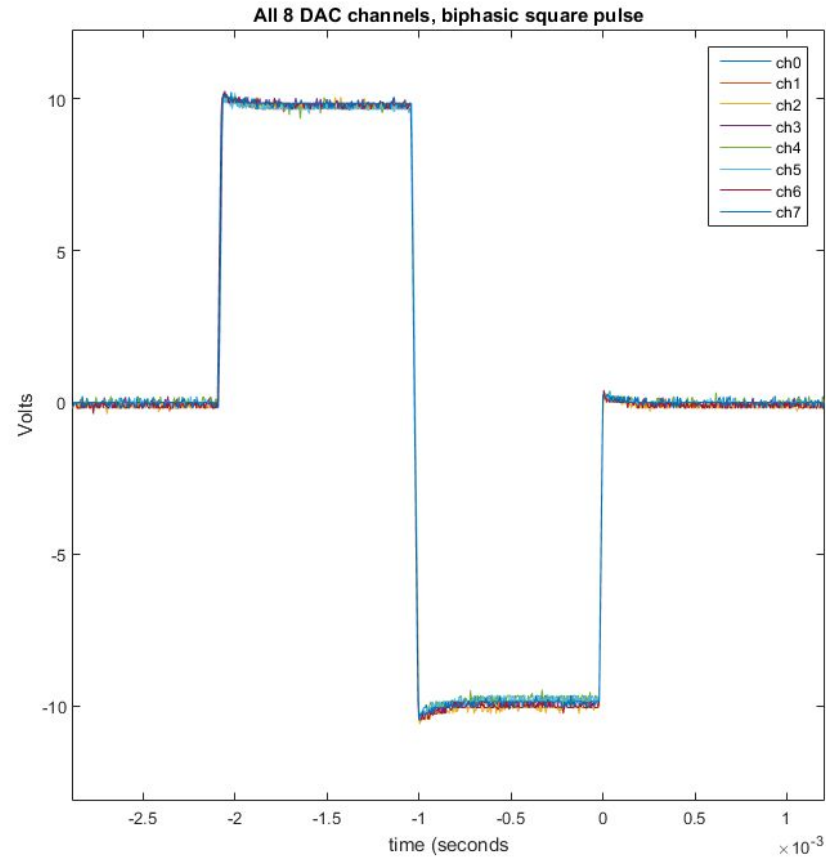$$D = V_{ref} \frac{1024}{20} + 512$$

Digital to Analog Converter (DAC) Microcontroller

Digital to Analog Converter (DAC) Post-Amplifier

Results: DAC

Conclusion

Achieved all of our requirements

Low Cost: $100 for all 3 channels, DAC, and pressure sensors

BIOPAC: $1500 per channel, no DAC, no pressure sensors

Beyond prosthetics...

Localization Demo:

Stim+EMG Control:

Future Work

Multiplexing (tradeoff)

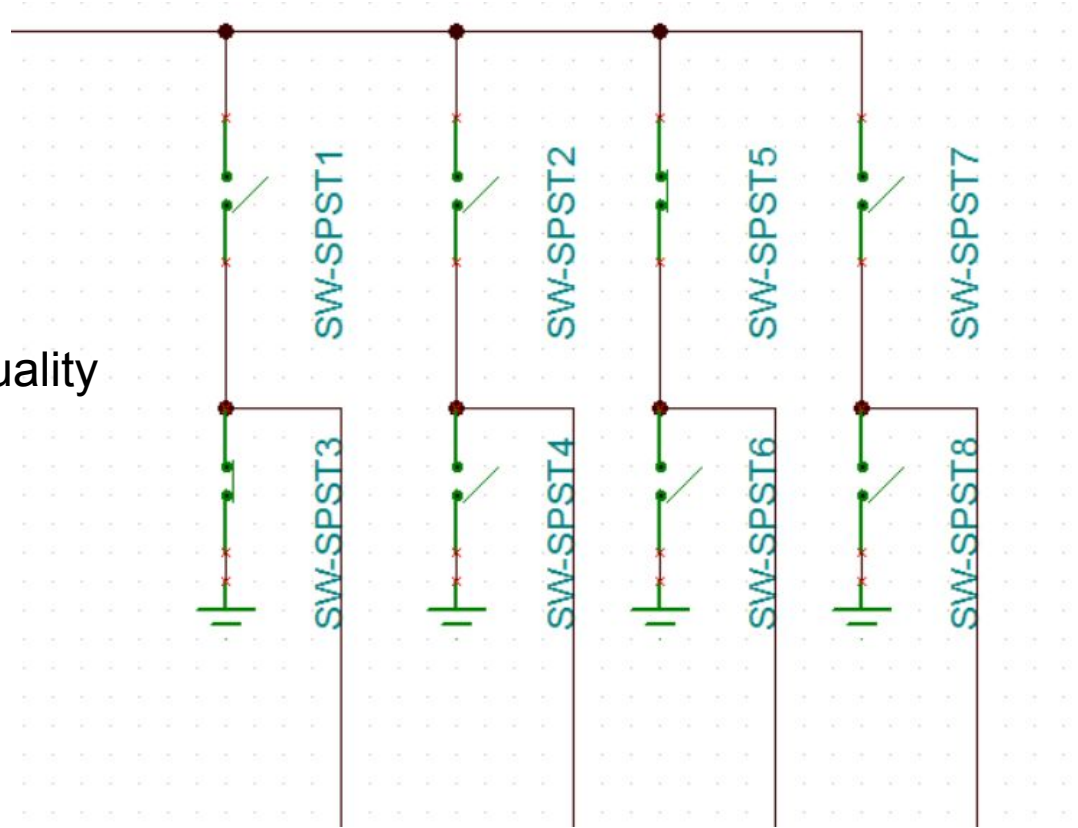Waveform Shape/Sensation Quality

Testing on Patient

Future Work

Multiplexing (tradeoff)

Waveform Shape/Sensation Quality

Testing on Patient

References

[1] (5/2/2017) PSYONIC [Online] Available: www.psyonic.co