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Flight Hardware for the 1U CubeSat EdgeCube

Student Lead
David House

Webpage:
http://lbym.sonoma.edu/edgecube/

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Overview

- EdgeCube
- Red Edge
- Science Instruments
- Attitude Control
- Solar Panel Circuit
- One-Wire
- Mechanical Structure
- Acknowledgments

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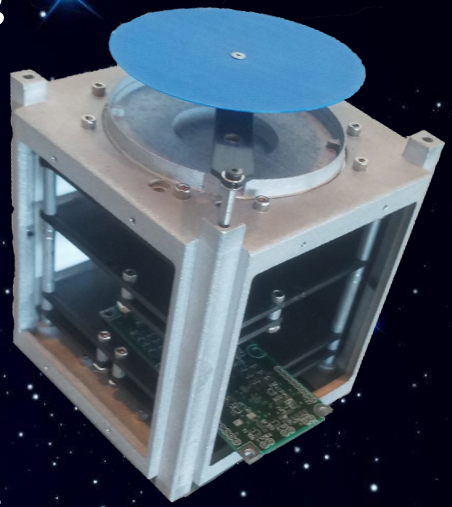
EdgeCube

- EdgeCube is a small satellite being built by students from SSU, Morehead State University, Santa Clara University and Moog
- Moog is working on the aluminum body and antenna deployment system
- Morehead is working on a particle detector
- Santa Clara is working on ground stations
- We (SSU) are working on the rest of the electronics
- The goal of EdgeCube is to track the Red Edge
- Launching on ELaNa XXIV, integration by SpaceFlight Industries
- Launch date ~October 1st, 2018



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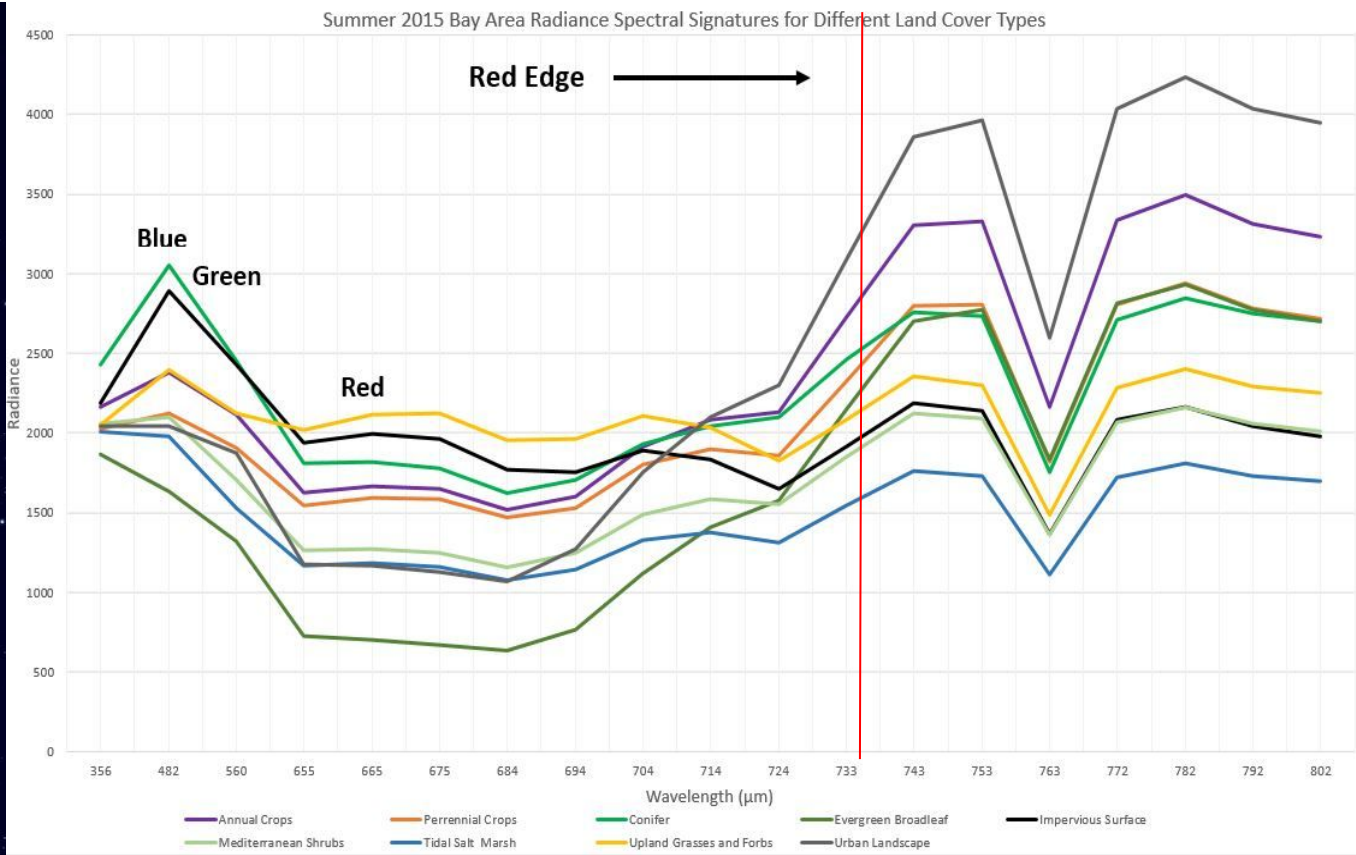
Leaf Index

- Natural Difference Vegetation Index (NDVI)
- Calculate vegetation using visible and infrared light
- NDVI bands in figure to the right.



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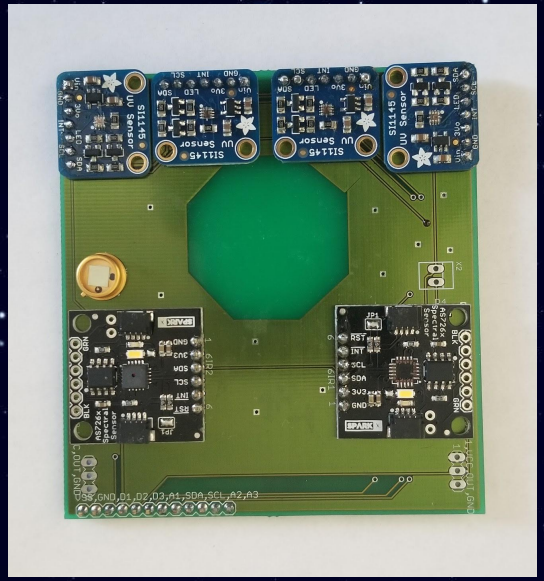

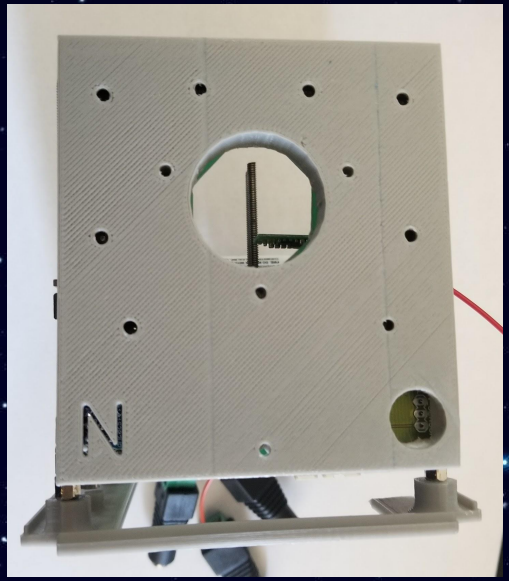

- Plug in sensor array to allow for ease of debugging
- AS7263: 610nm, 680nm, 730nm, 760nm, 810nm and 860nm each with 20nm FWHM
- SI1145: Visible and additional NIR filters

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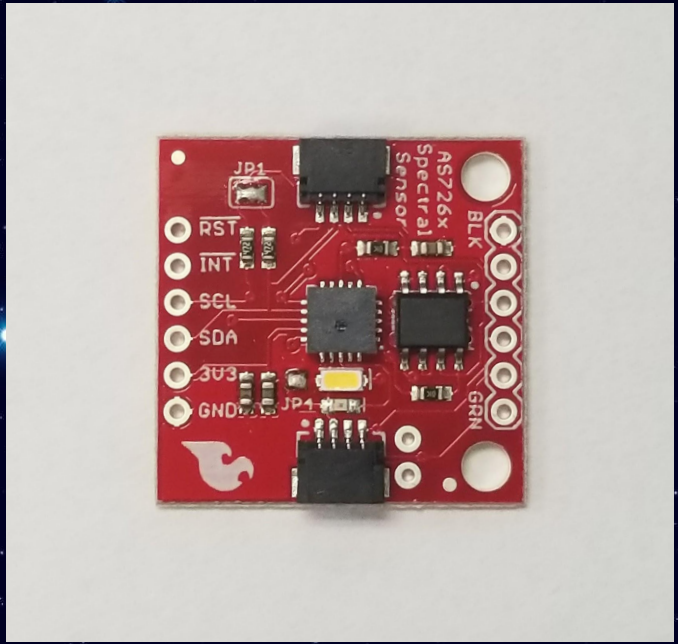
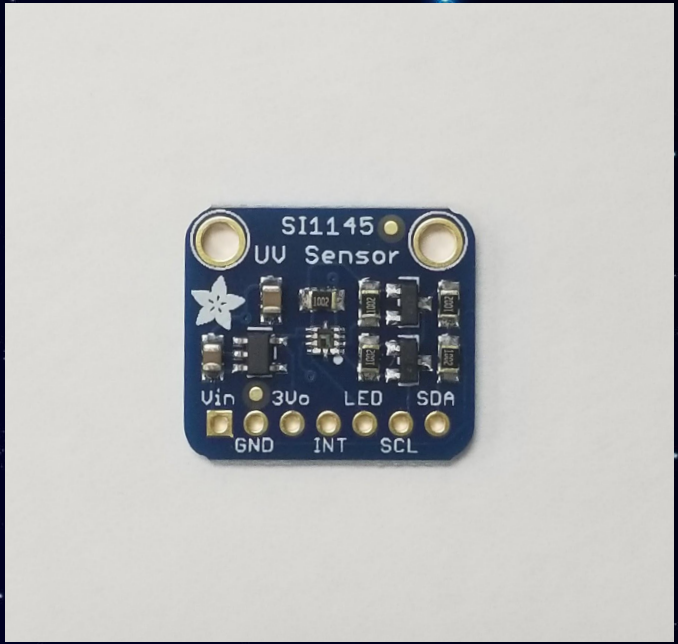
Science Instruments

AS7263 Near Infrared Spectral Sensor



SI1145 Visible and Near IR sensor



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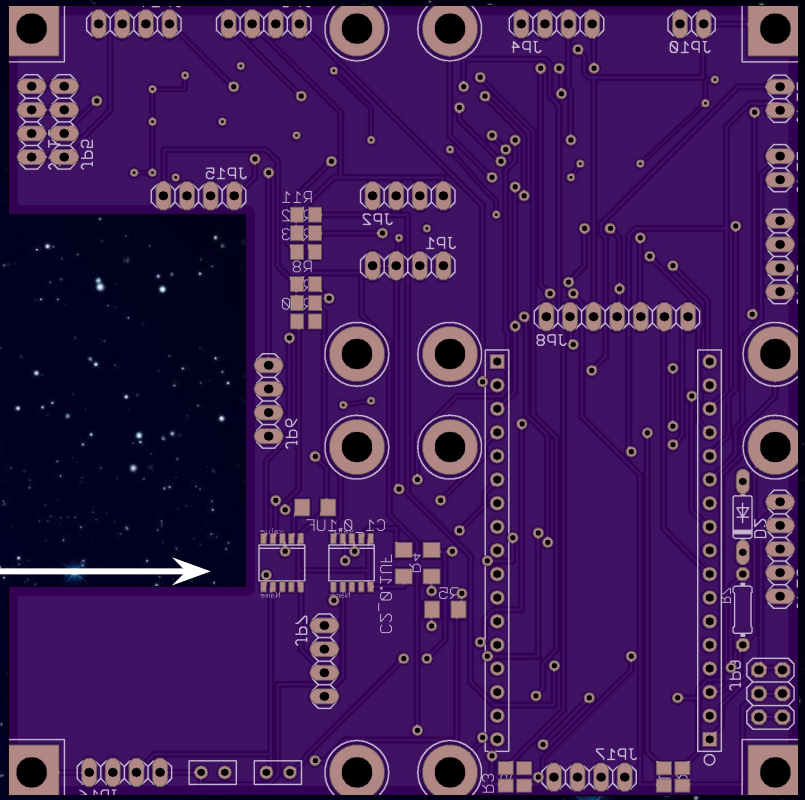
Attitude Control

- 2-axis magnetorquer provides spin rate control and detumbling capabilities.
- Onboard camera provides star tracking aid to the CubeSat.
- Connections to sun sensor on science panel provides sun altitude information to board MCU.

Sun Sensor Connections

Camera Cavity

Magnetorquer Control Circuit



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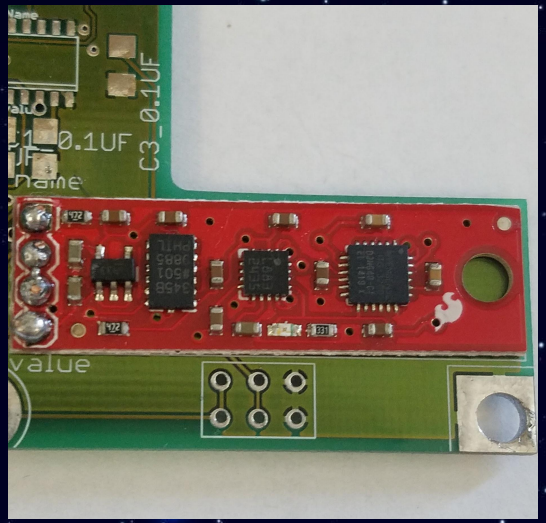
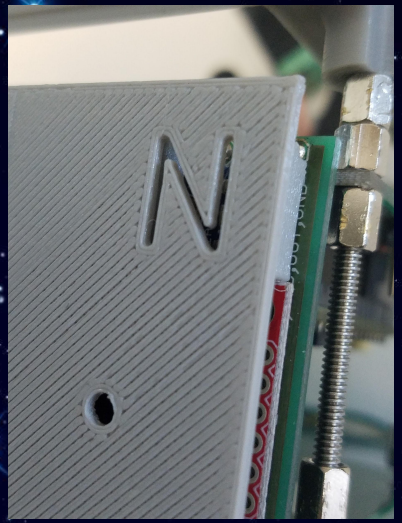
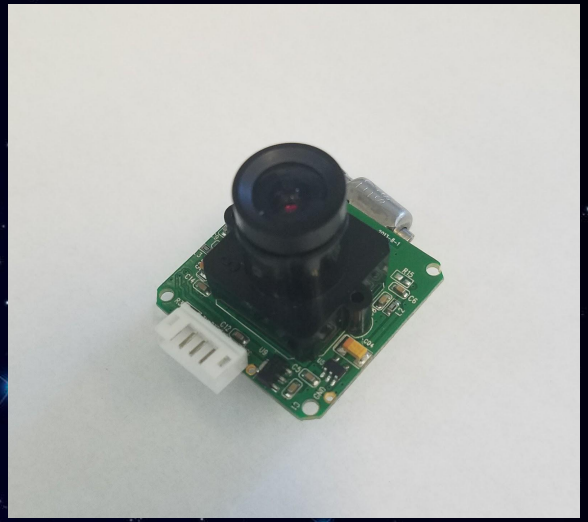
Attitude Control



3-Axis accelerometer (ADXL345)
3-Axis digital compass (HMC5883L)
3-Axis gyroscope (ITG-3200)



N Diffraction Slit with
GA1A12S202 Light Sensor



LinkSprite 2MP Camera

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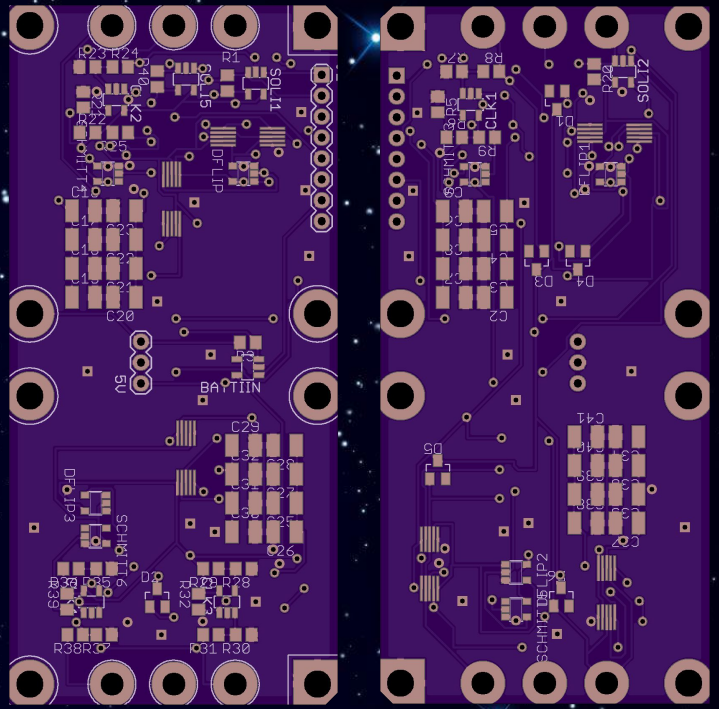
Solar Panel Circuit

- Solar Panels are attached at the ends with lugs
- The circuit can be adjusted to receive voltage from 3.3-12 volt panels by setting a voltage divider
- Frequency range set by capacitor values

Top

Bottom



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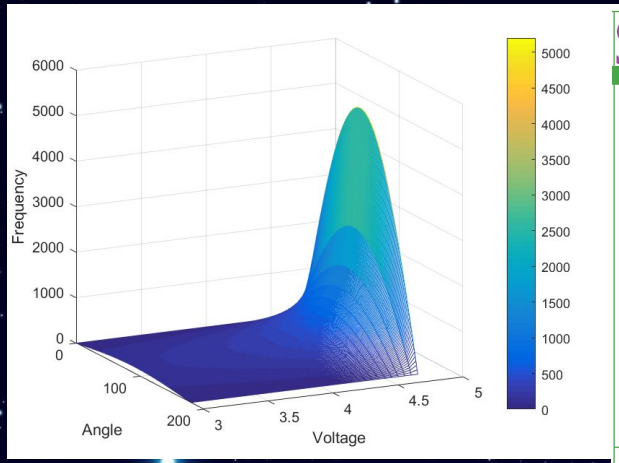
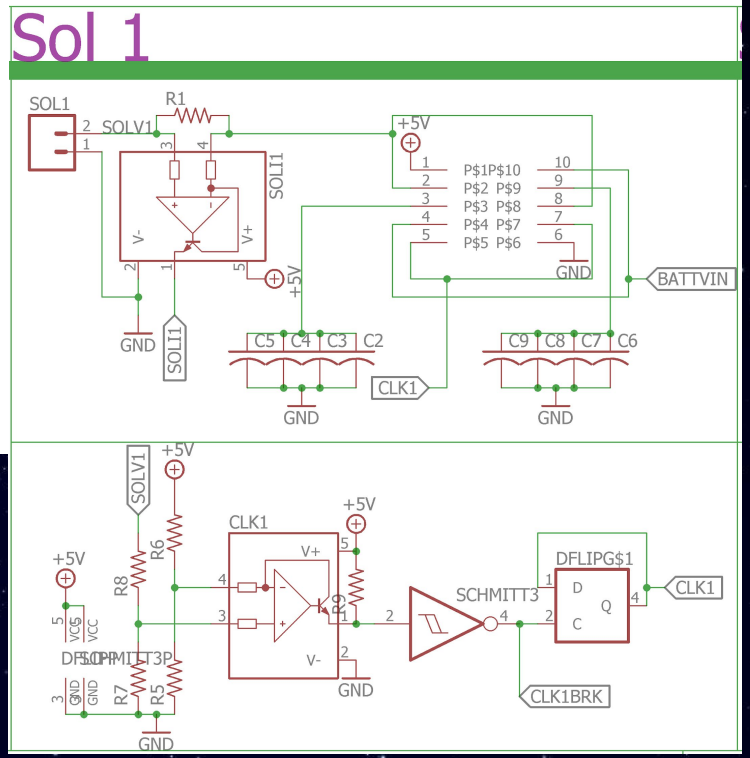
Battery and Super Capacitor

- NiCad Batteries: Higher reliability at the cost of power storage limitation
- Super capacitors to help the battery with impulses of power draw
- When batteries lose capacity SuperCaps will allow the CubeSat to continue running

Solar Panel Circuit



- The frequency of our circuit shifts based on the amount of power the panel can produce



- Many CubeSat power systems use microprocessors
- A set of capacitors that alternate based on the charge stored in them
- Each panel has its own circuit so the frequencies do not depend on one clock

Solar Efficiency Test

- Our circuits efficiency depends on angle and battery voltage

Efficiency

$P_{Battery}/P_{Solar} = P_{in\ \%Loss}$

$P_{in\ \%Loss} = 14.54\%$

Efficiency = 85.46% at 3.7 Volts

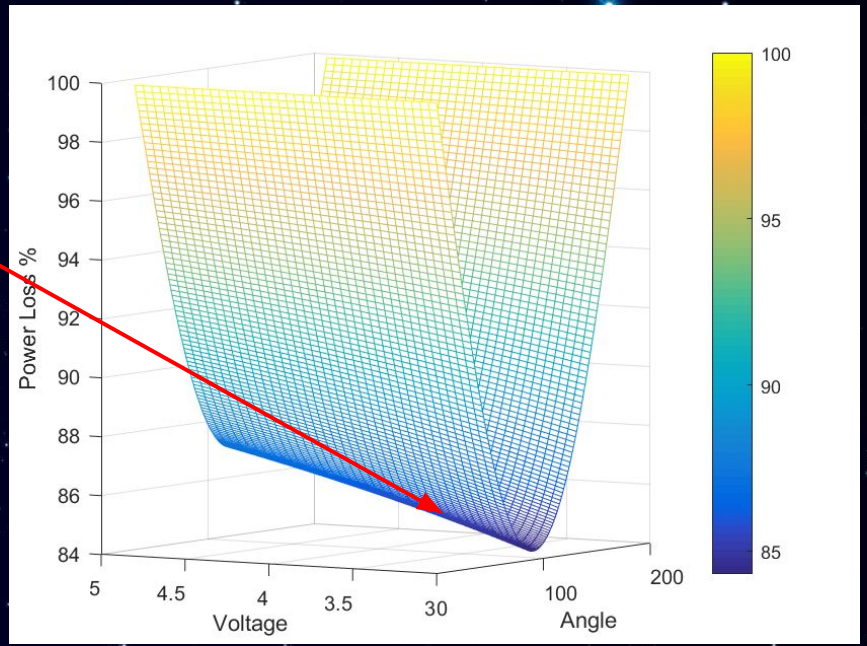
Circuit power

P = V * I

P = 3.7 V * 1 mA

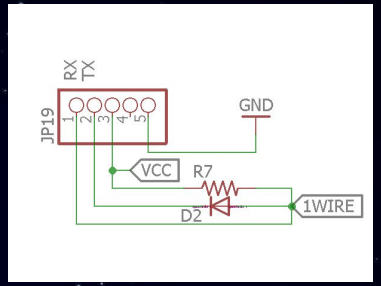
P = 3.7 mWatts

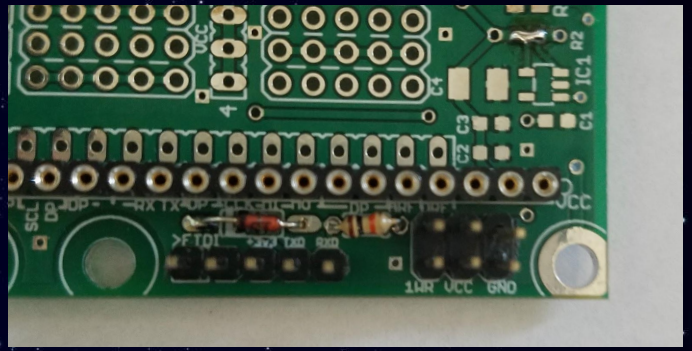
$P_{\%used} = 3.7/250 = 1.48\%$



One Wire

- The UART RX and TX pins for the microcontrollers are tied together to reduce board connections
- A simple circuit was added to allow a USB serial line to be connected to boards for debugging





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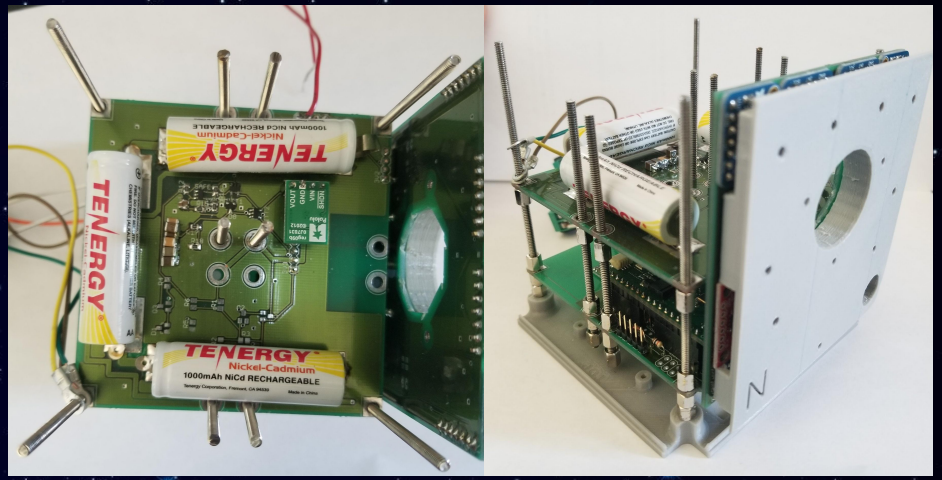
Mechanical Structure

- 16 rods spaced within the CubeSat hold the boards together
- The rods double as electrical connections between boards



Acknowledgements

EdgeCube Team

http://lbym.sonoma.edu/edgecube)

David House (SSU)

SSU Student Team
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Erin Hicks
Brian Twiggs
Andrew Vaziri

MSU Student Team
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Engineering Mentor	Dr. John Doty (NA)
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Engineering Mentor	Prof. Farid Farahmand (SSU)
Engineering Mentor	Tim Graves (former SSU)
Engineering Mentor	Kevin John (SSU)
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Business Mentor	Prof. Elizabeth Stanny (SSU)
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Institutions

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MSU (Morehead State Univ. also Montana State Univ.)
SCU (Santa Clara University)
NA (Noqsi Aerospace)
PICO (Playful Invention Company)
MOOG (Moog CSA)
* formerly Space Sciences Laboratory, UC Berkeley
** formerly Climate Research, NASA GSFC
***Volunteers working with Jernigan at SSU

Questions

Questions/Comments