

# Kumu A'o CubeSat Project

(Source of Learning)

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# Agenda



- Kumu A'o Team
- Mission Objectives
- CubeSat Design
- Lessons Learned



# Kumu A'o Team



## At a Glance

- Created: Summer 2007
- Student Participated: 17
- Students Graduated: 8
- 15 Hawaiian/Pacific Islanders/Other Minorities



**This Spring 2009: Our Last Semester!**

- Then we work only for love



# Mission Objectives

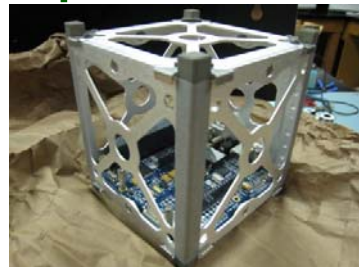


## ■ Primary:

- Develop Standard Cubesat Bus
- Build, Launch, and Operate Cubesat
- Provide opportunity for Native Hawaiian engineering students
- Accelerate next-gen mission development

## ■ Secondary:

- Evaluate Pumpkin Inc. "CubeSatKit" (CSK)





# Quick Specs



- C&DH
  - CubeSatKit FM430 Module (MSP430F1612)
  - Pumpkin's Salvo RTOS
  - Manages complete satellite operation
- Thermal Sensors
  - Measuring temperatures inside and out
- Structural
  - CubeSatKit 1U Skeletonized Structure
  - Antenna deployment by melting fishing line



# Telecommunications



- Radio: Yaesu VX-3R
  - 100mW or 1W RF Output, 70cm Band
  - ~30% Efficient
- TNC (Modem): Byonics TinyTrak4
  - 1200bps AFSK
- Morse Code Generator (FM430:TimerB0)
- Custom Protocol
  - Addresses unreliable link due to spinning
  - Connectionless messaging
  - Out of sequence file transfer





# TNC



- Custom built TinyTrak4 Based TNC
- Audio In/Out to PC104 via MHX DSR/CTS Pins

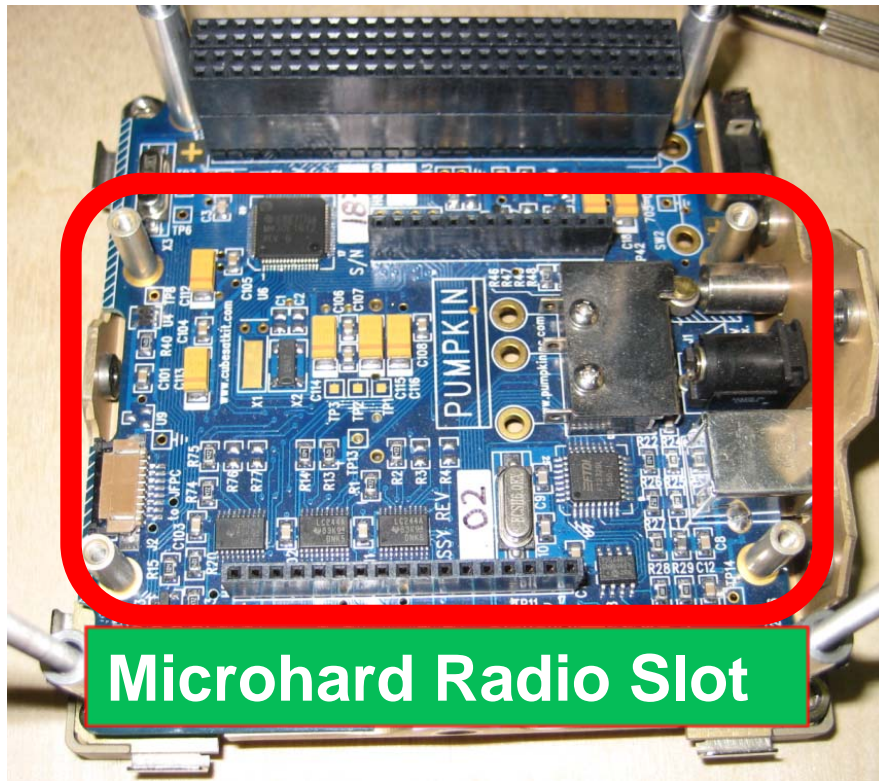


Figure 7a: CubeSatKit FM430

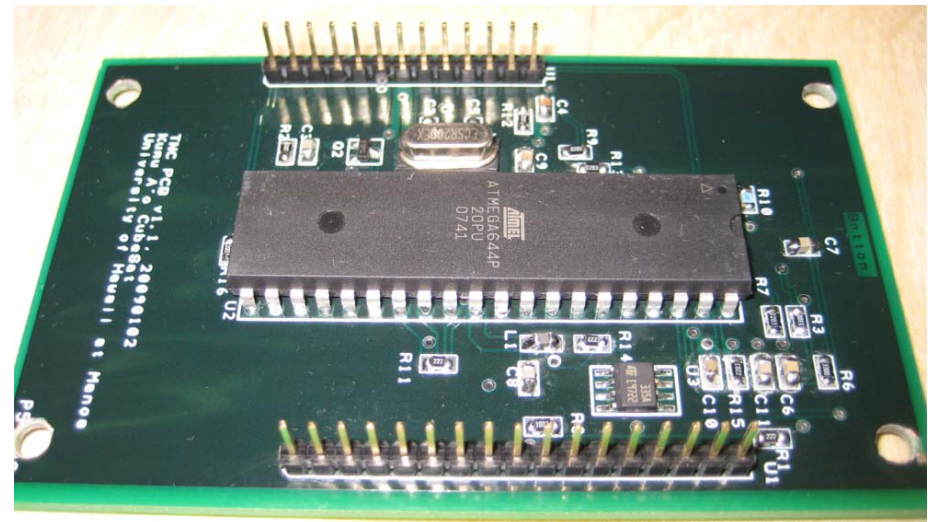


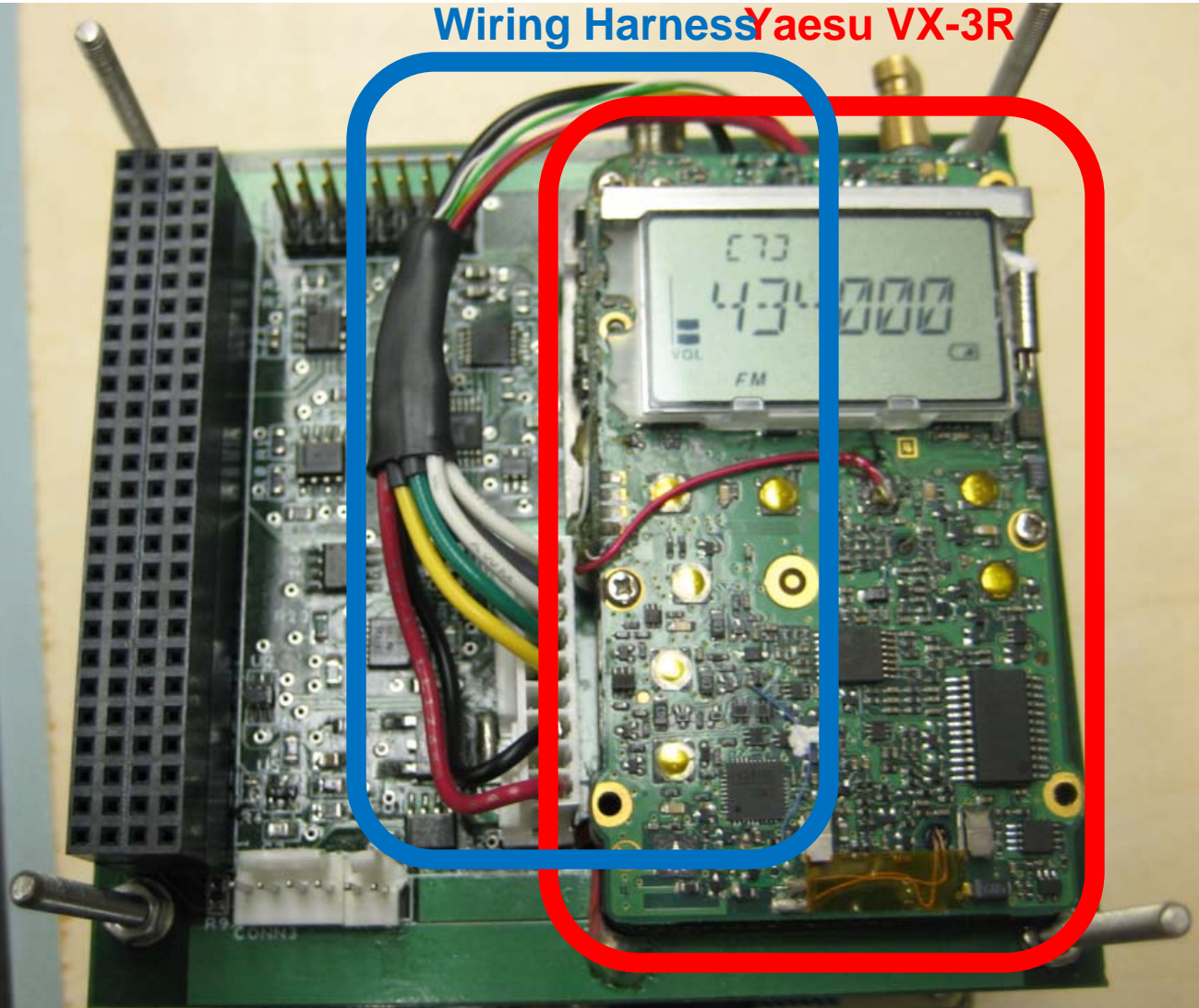
Figure 7b: MHX Radio Slot TNC



# Radio



Wiring Harness Yaesu VX-3R



- Switched Power
- Operating State Feedback
- Power Button
- Speaker
- Mic
- TX Power Control

Figure 8b: Yaesu VX-3R Radio on Shared Board (CSK Slot 1)





# Power Generation



- Spectrolab UTJ Cells (24.3% to 28% Eff.)
  - 2 Cells on Each Face Except Front
- Considering Front TASC Cells

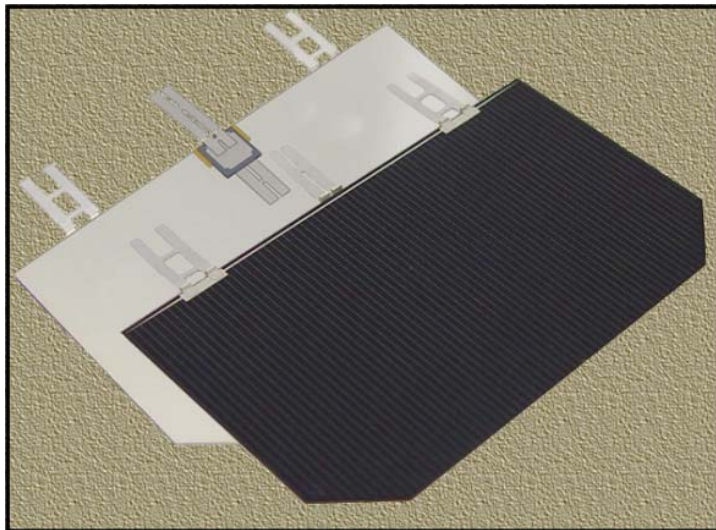


Figure 9a: Spectrolab UTJ Cells

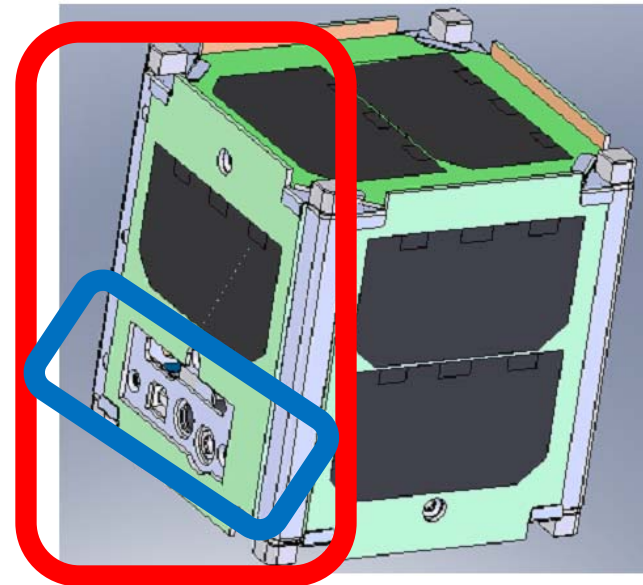


Figure 9b: Kumu A'o CubeSat Rendering



# Power Generation



- “Simple” MPPT System
  - Redundant power, solar & battery
  - MSP430F1612 Based
    - Low power idle
  - Battery Charger Current Control
  - >70% Efficient – Preliminary Results
    - Estimated Generation (1 Side): 24 WHr/Day
    - Normal Consumption: 10 WHr/Day
  - Harvests direct and albedo energy



# Simple MPPT System

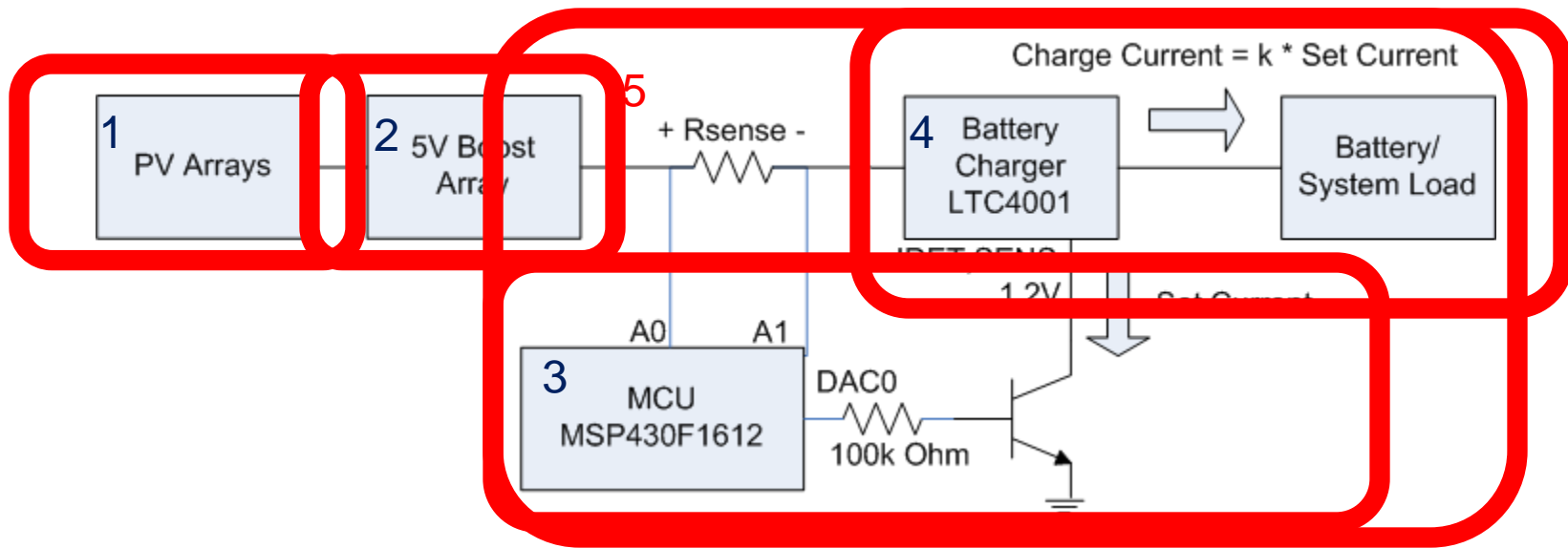


Figure 11: Simple MPPT Method

1. Power Generated
2. Power Boosted from ~4V to 5V
3. Power Sensed by MPPT, Increases Charge Current
4. Power Extracted from Array
5. MPPT Control Loop Maximizes Power



# Lessons Learned

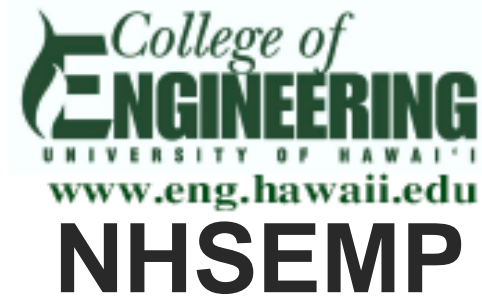
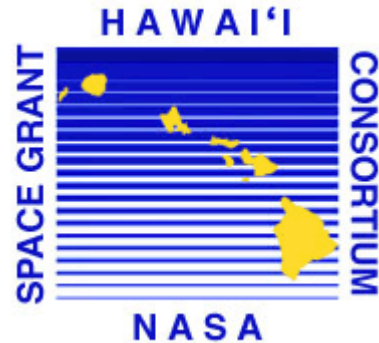


- Leadership
- Learning Curve
- Requires Commitment
- Data Sharing



# Acknowledgements

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# Thank You!

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