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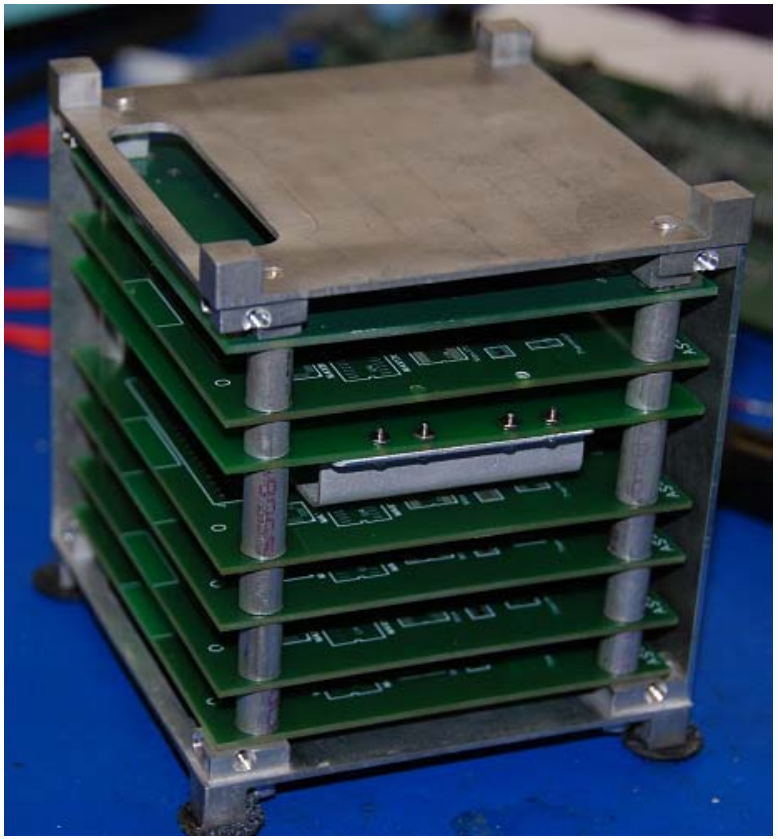
AubieSat-1



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AubieSat-I Mission

- Workforce Development:
  - Students develop leadership, technical, team working, and management skills
- First step in developing a student satellite building capability at Auburn University
- Science mission: determine electron density of ionosphere and corelate it with solar activity

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Workforce Development

- Over 150 students have participated and entered the workforce
- NASA funding for AubieSat by the Alabama Space Grant Consortium
- Approximately $20,000 per year
- Also supported by Auburn University

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Participants

- Students
  - Volunteers
  - Students taking it as a physics class
  - Engineering Senior Design students (ME, ECE, SECS)
  - Industrial Engineering students
  - Approximately 25 Students per semester
- Faculty Advisors (Physics, ECE, ME, Sotware Eng.)
- Technical advisors (retired senior managers)

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Management

- Program emphasizes process
- Students learn
  - Planning
    - Create a WBS (work breakdown structure)
    - Turn WBS into a Gantt Chart
- Execution
  - Weekly status reports at all hands meetings
  - Weekly management team meetings to control schedule

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Weekly Status Report - <date>

<Subsystem Name>

Activities Planned for Last Week

Activities Accomplished Last Week

Activities Planned for Next Week

New Issues

Old Issues

Tests planned for the week ahead

Integration planned for the week ahead

Additional meetings required between subsystems? Yes/No

System Engineering Tools Used

- System engineering management plan
- Document control
  - Change request with change request boards
- Plans and procedures
- Requirements and verification
- Risk management
- Quality control

Assignments	Item/Status	Cycle 1		Cycle 2			
		Jan 22 - 28	Jan 29 - Feb 4	Feb 5 - 11	Feb 12 - 18	Feb 19 - 25	Feb 26 - Mar 4
Beard	Understand TNC-X						
Lewis	Define interfaces						
Bradshaw	Choose platform						
Lewis	Interface 2 PICS w/ correct timing over I/O pins						
Bradshaw	Interface PIC to Atmega						
Lewis	Interface to Audacious						
Bradshaw	Detect incoming tx/rx packet						
Beard	Compute/Check FCS						
Bradshaw	Add/remove header/trailer bytes						
Lewis	Bit stuffing						
Beard	Work on tx/rx timing						
Beard	Fully working separate tx/rx programs						
Lewis	Tx/rx simultaneously						
Bradshaw	Increase window size						
Bradshaw	Integrate with real Audacious radios						
Beard	Final testing and documentation						

Risk Title	CalPoly Acceptance			
Risk Statement	AubieSat-1 must meet all requirements set by Calpoly to be accepted and launched			
Context (Background)	All items and tests required for acceptance by CalPoly must be identified and met			
Closure Criteria (Mitigation Steps)		Date	New Risk #	
	-Test to requirements -Test beyond requirements	6/01/08 1/01/09	10 (5*2) 2 (5*.4)	
Consequence	Rationale	Likelihood		Rationale
5	Non-acceptance prevents launch	3		What needs to be done to get accepted by Calpoly is well documented

Date	
Earliest Occurrence	Delivery Date
Latest Occurrence	Launch Date
Risk Assignment ID	

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Project Design Philosophy

- All electronics boards are custom made (no off the shelf devices used)
- Custom Structure

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Satellite Quick Reference

- Electrical connections made through pin header
- EPS: 5V regulated, 1.5 A continuous, 2A max
- C&DH: ATMEGA 128
- Software: Real Time Operating System
- Primary Comm: Melexis Tx/Rx chip set
- Secondary Comm: Melexis Rx chip
- Antenna: Nichrome wire .022 in diameter
- Batteries: 2 Li-Ion, 3.7V 1.8Ah

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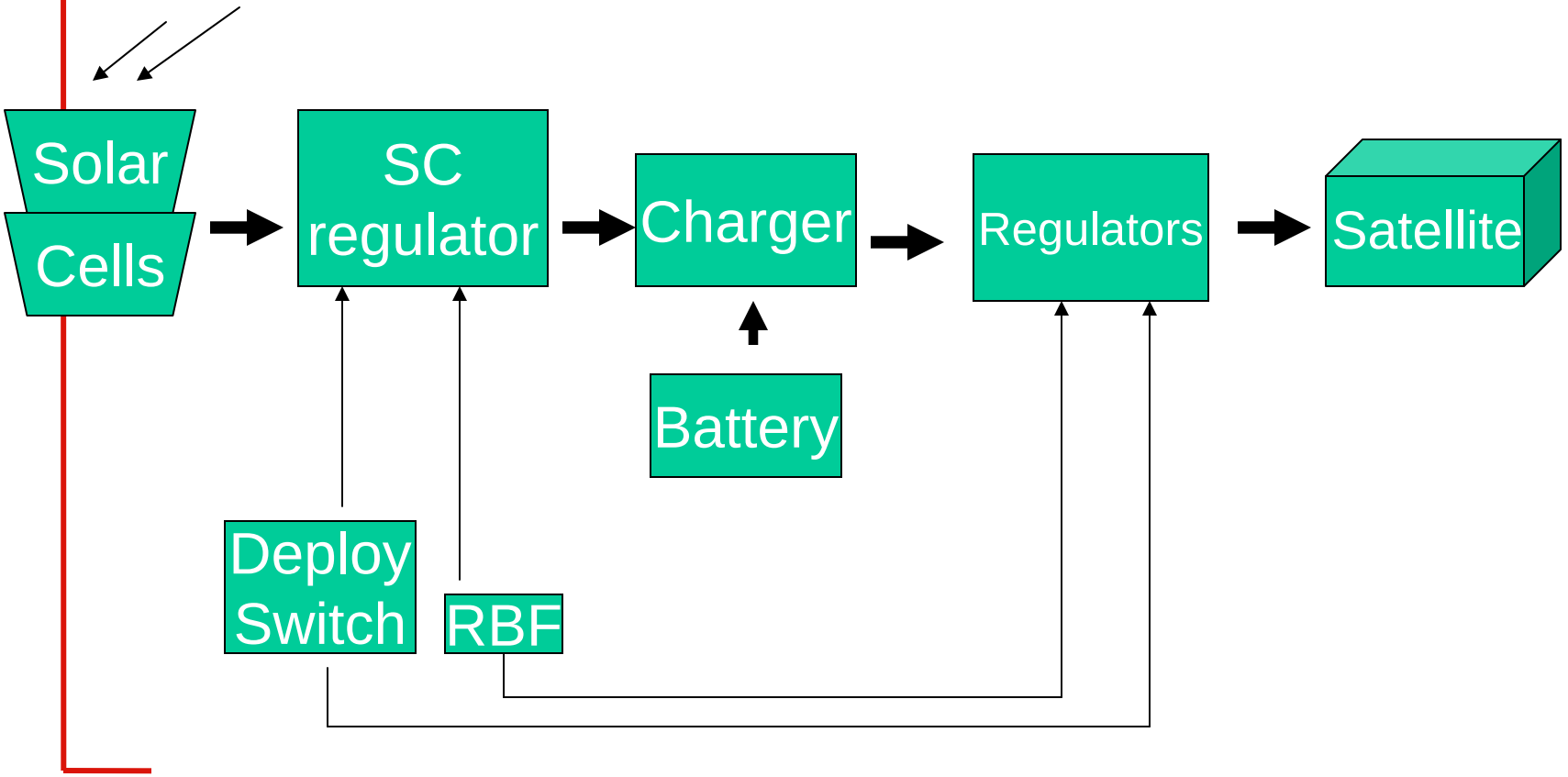
Electrical Power



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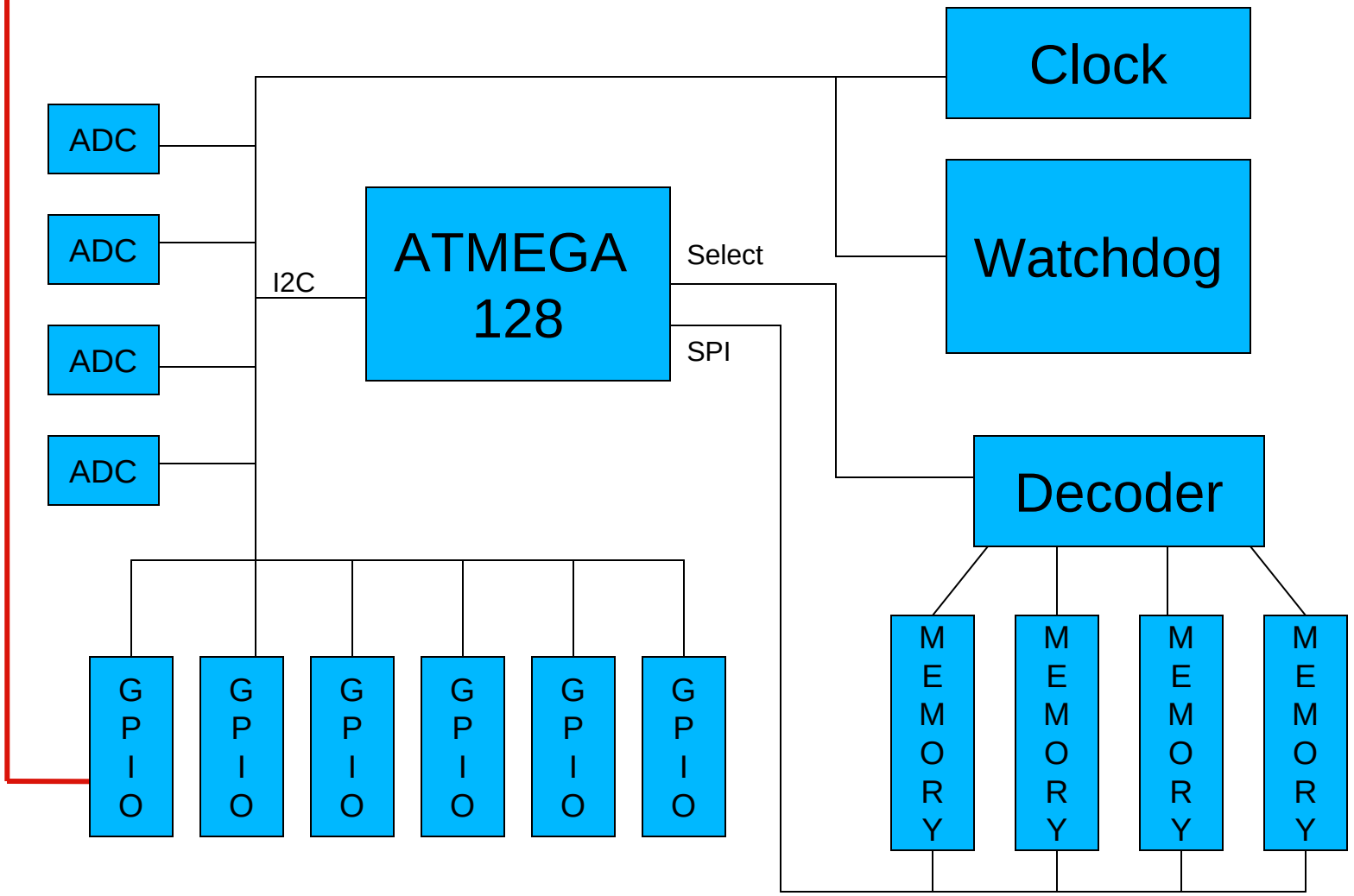
Command & Data Handling



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Primary Comm: AUdacious
Quick Reference

- Auburn University digital access communications interface, operational UHF subsystem
- Melexis TH72011 (Tx) and TH71102 (Rx)
- FSK modulation scheme
- High FSK deviation possible for wideband data transmission
- FSK deviation and center frequency independently adjustable
- Adjustable current consumption from 3.4 mA to 10.6 mA

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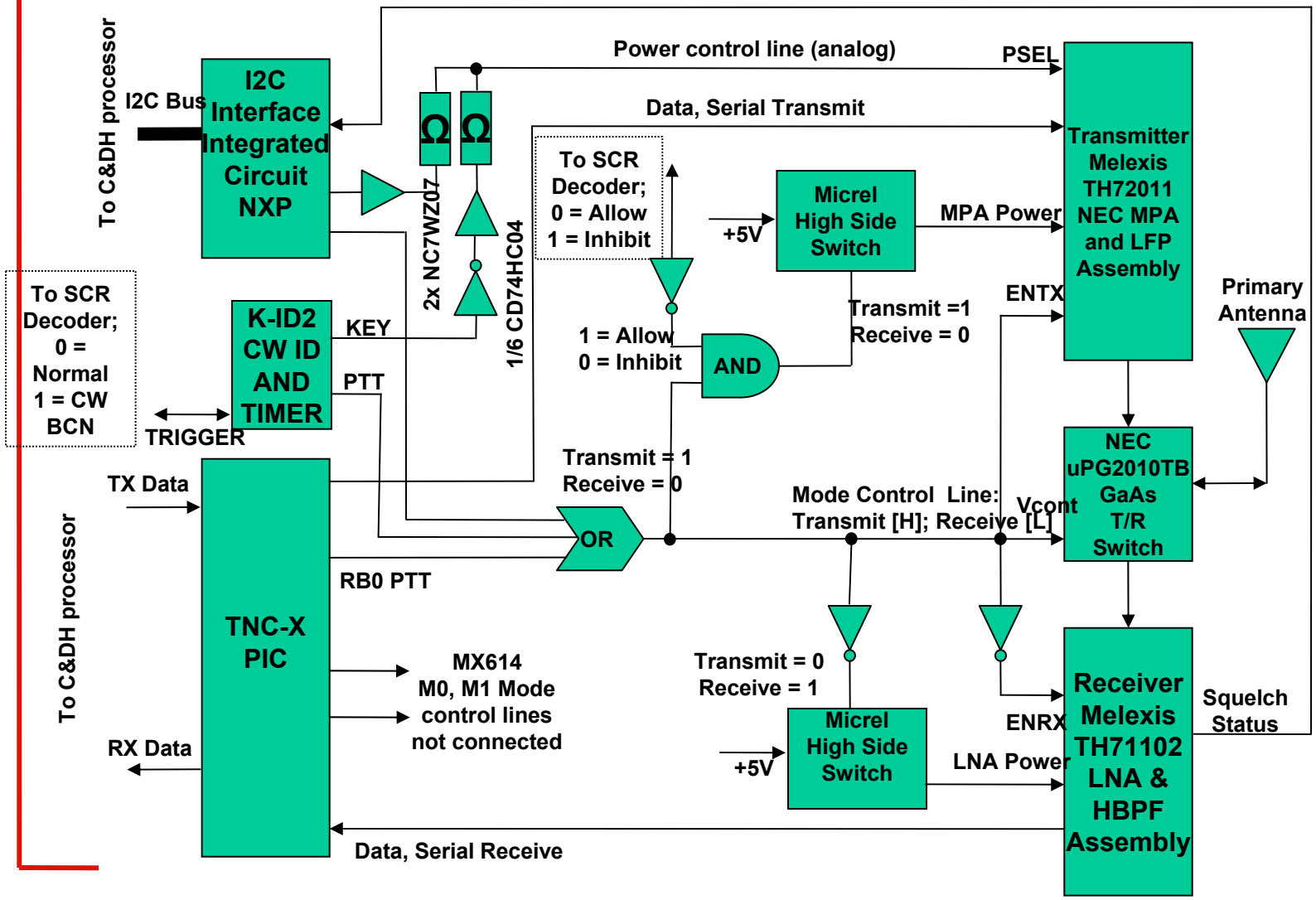

AUdacious Transceiver board functional block diagram Rev 3 16 SEP 08 J. H. Klingelhoeffer

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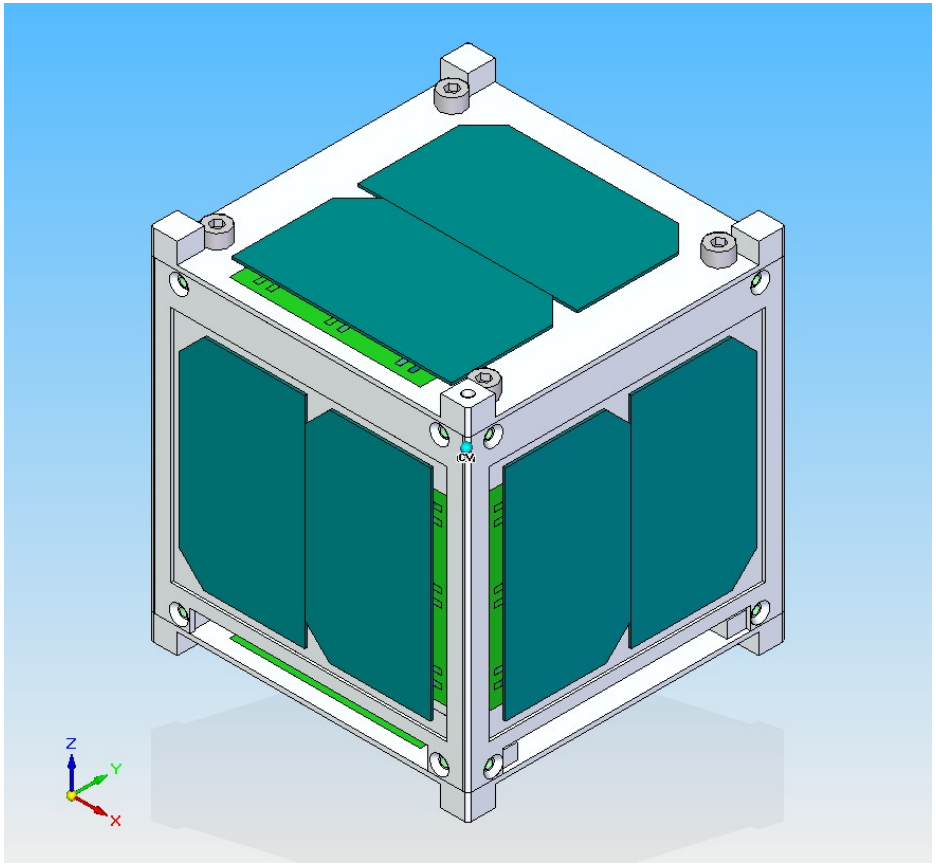
External Structure

Structure

- Aluminum 7076
  - 6 external pieces
  - 24 spacers
  - 2 battery / 2 magnet mounts
- Fasteners
  - 4 – 10-24 100mm long bolts
  - 16 - 6-32 machine screws



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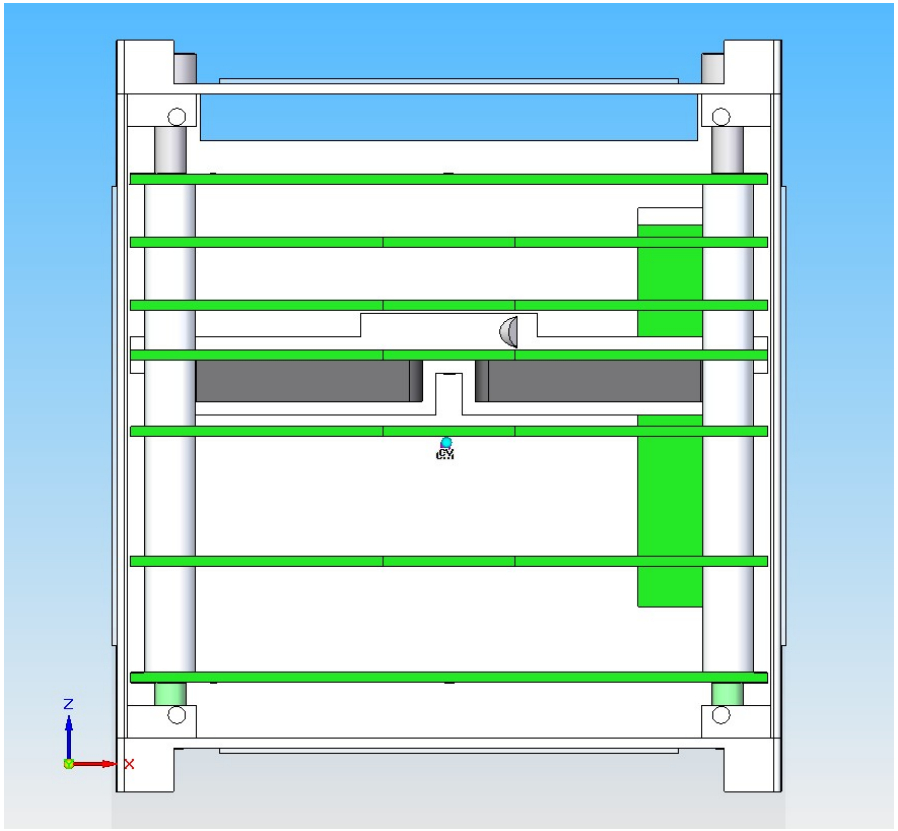
Internal Structure

- Stackable

•Antenna deployment 1
•EPS
•C&DH
•Batteries
•Primary communications
•Secondary receiver
•Antenna deployment 2



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Antenna Deployment Mechanism

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Ground Station

- Fully functional ground station
- Two-way communications
  - ISS (APRS data packet)
  - AO-51 (AMSAT-OSCAR 51 - Echo) Mode V/U (J) FM Voice Repeater
- Received communications
  - CAPE-1 (cubesat) (picosat)
  - Cubesat XI-V (CO-58) (picosat)
  - Cabesat XI-IV (CO-57) (picosat)

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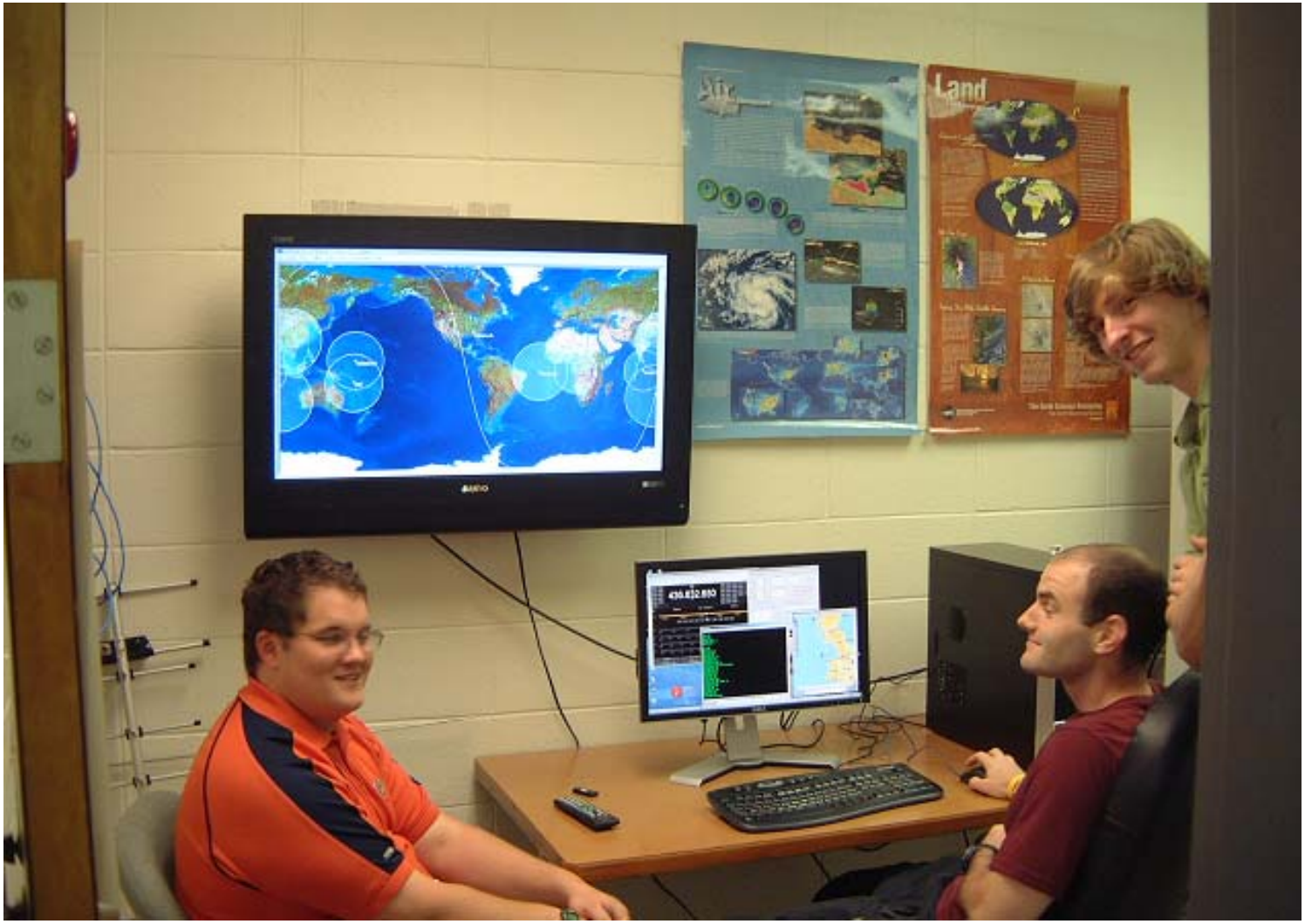
Ground Station



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AubieSat-1 Science Overview

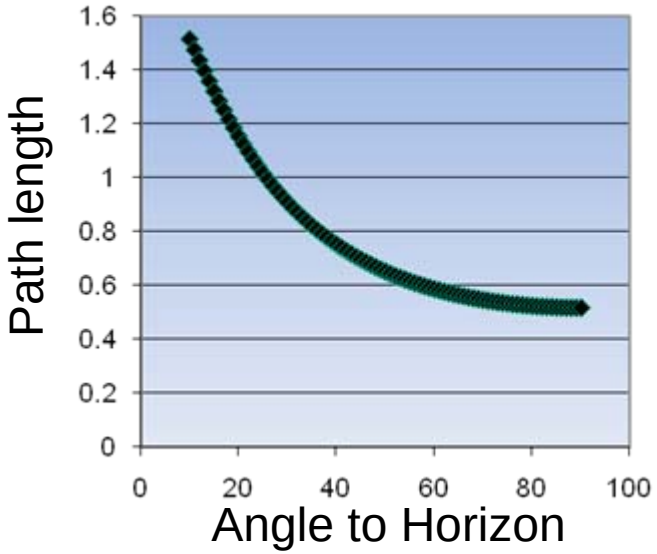
• Science mission: measure average density of ionospheric electrons along line of sight between AubieSat and ground station.

• Method: use Faraday rotation effect. Measure rotation of linear polarization angle of EM wave between satellite and ground. Dipole antenna produces linearly polarized wave at satellite.

•Preliminary calculations show that for standard ionospheric plasma density polarization rotation is between 0.24-2.4 radians (~14-137^{o}) => should therefore be observable.

AubieSat-1 Science

- The rotation effect depends on plasma density, on magnetic field intensity and on path length along the field line.
- Two observational angles (and altitude information) are required in order to calculate an average plasma density.



Component	B-Field (in nT)
X (North-South)	~20000
Y (East - West	~1000
Z (Vertical)	~37000

*Data acquired from the NOAA Geophysical Data Center

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Science & Technical Goals

- Study variations in plasma electron density during diurnal cycle and as a function of solar activity
- Use data to analyze potential mitigation techniques to combat ‘spin modulation’ on non-attitude stabilized spacecraft.

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Future of AubieSat Program

- Develop an ionospheric research program based on CubeSats
- Student effort will be part of this research program
- Develop state-wide effort with other universities and the NASA MSFC

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Questions?

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