

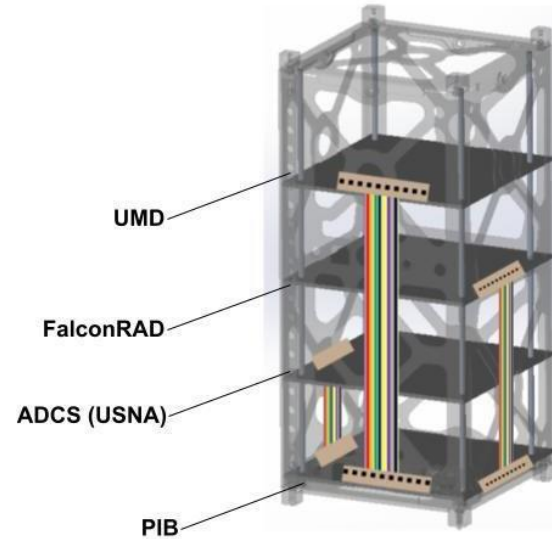
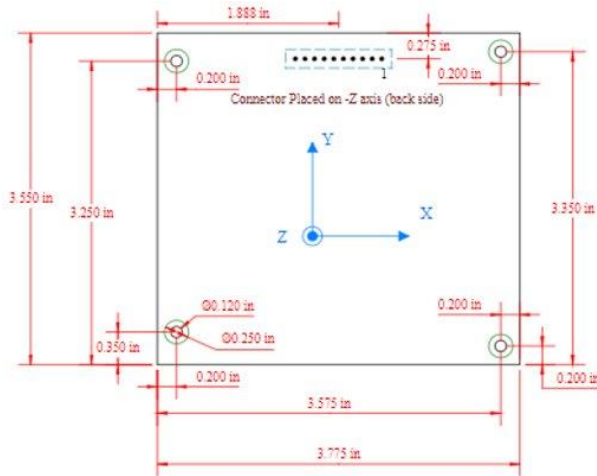


FALCON-RAD

25 April 2023



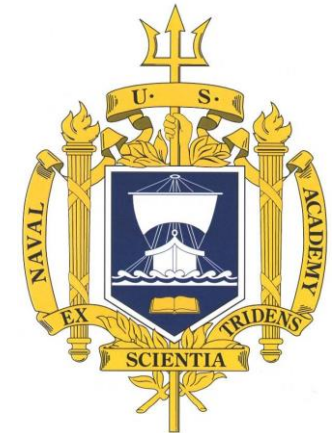
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C3C John R. Arne
 C3C Elliott O. Kmetz
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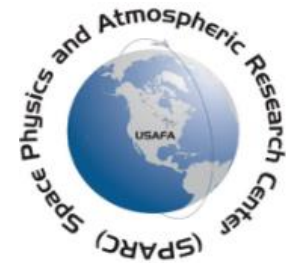
United States Air Force Academy
 Department of Physics

Space Physics and Atmospheric Research Center



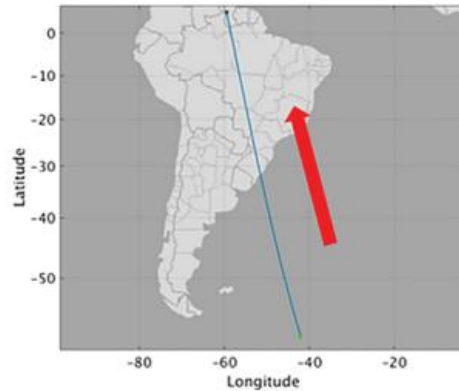
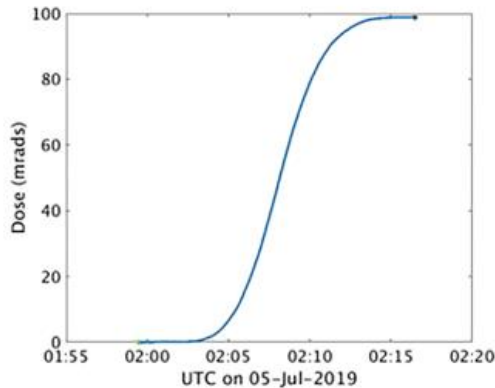
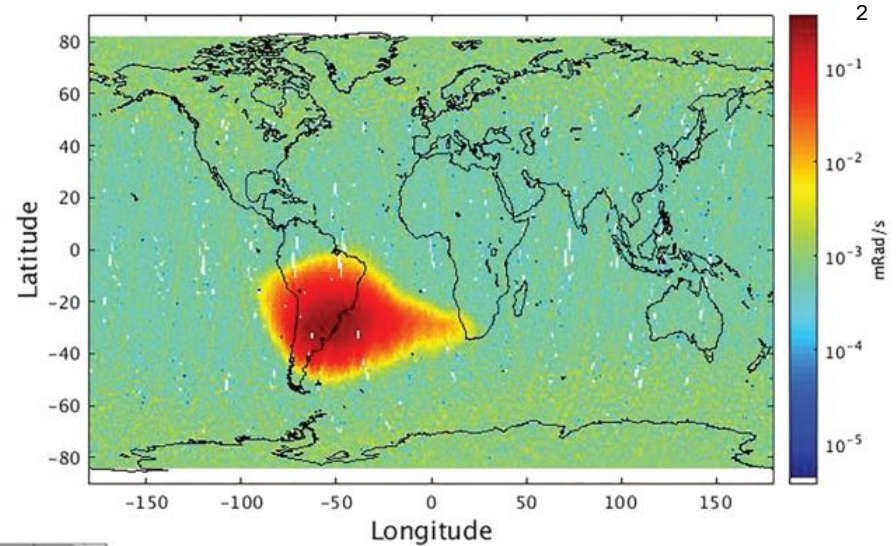


Research Purpose



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- South Atlantic Anomaly (SAA)
- Misalignment of Earth's dipole magnetic field & rotation axis
- Results in weaker magnetic field in south
- Allows high energy particles access to LEO



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Energetic electrons primary cause of spacecraft charging²
Charging caused more than half (161/198) of documented environmental anomalies¹

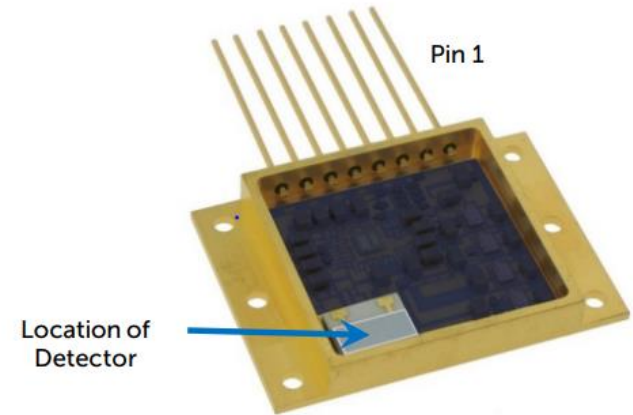
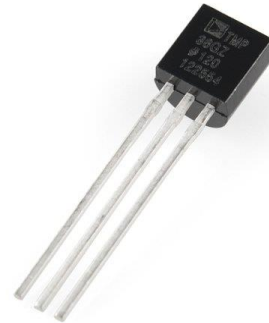
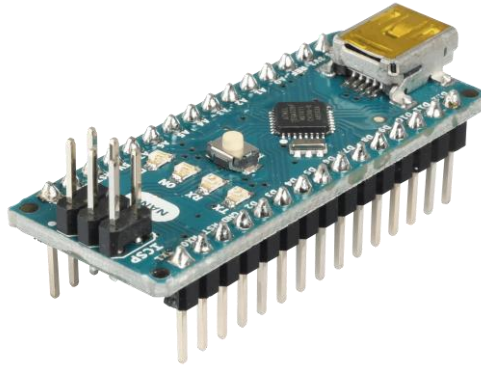


Component Overview



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- Arduino Nano microprocessor
- UDOS001-c commercial off the shelf micro-dosimeter
- TMP-36 Temperature Sensor



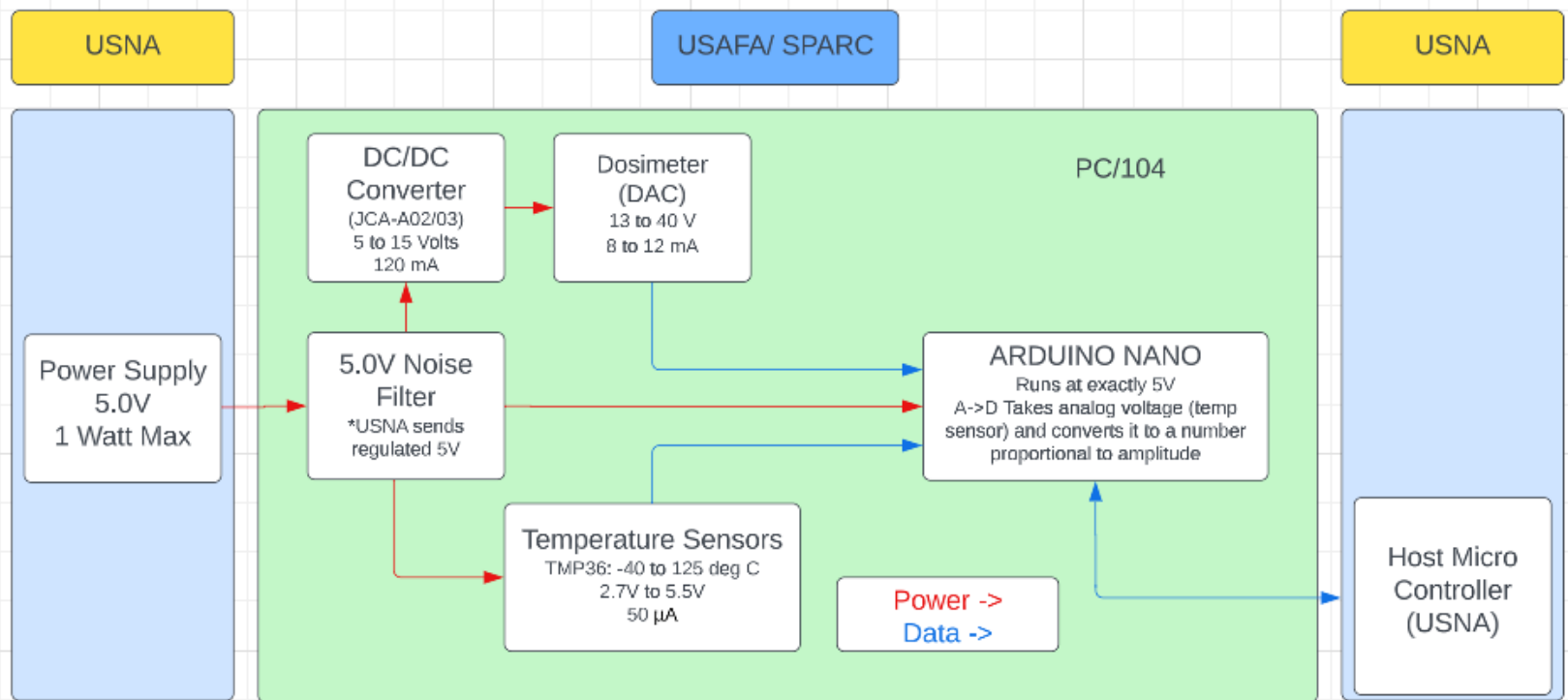
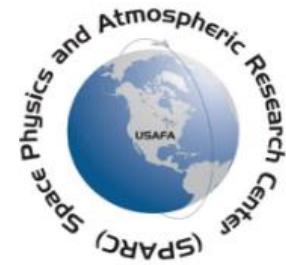
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DACx	Dose Conversion	Range
Low (Pin 5)	14 μ rad(Si)/19.5 mV	0 – 3.6 mrad(Si)
Medium (Pin 6)	3.6 mrad (Si)/19.5 mV	0 – 0.9 rad(Si)
High (Pin 7)	0.9 rad(Si)/19.5 mV	0 – 235 rad (Si)
Log (Pin 8)	Detailed table will be provided upon request	



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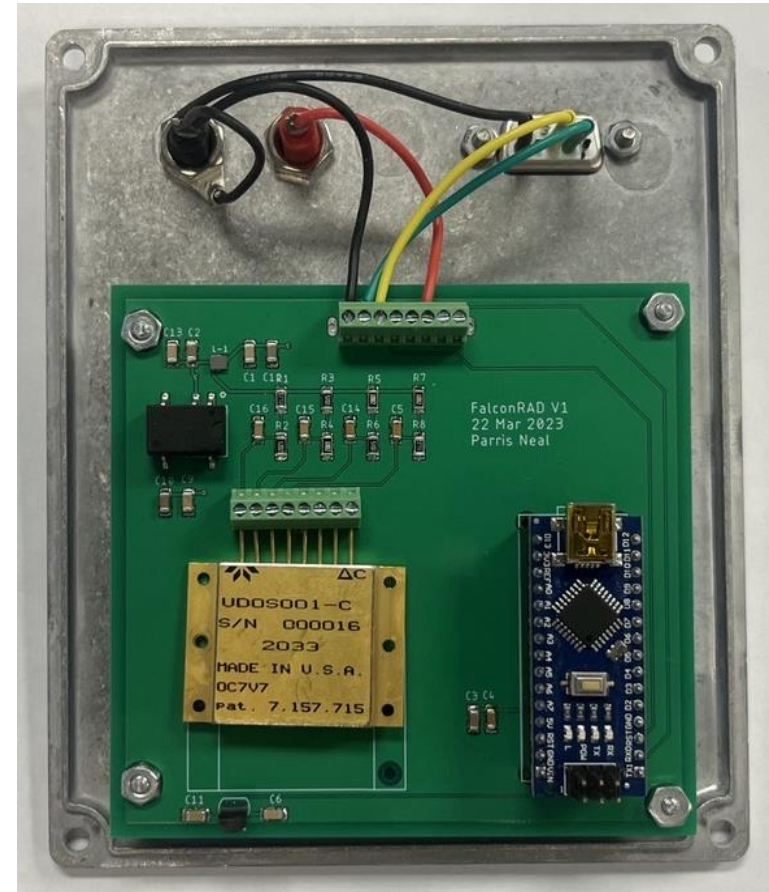
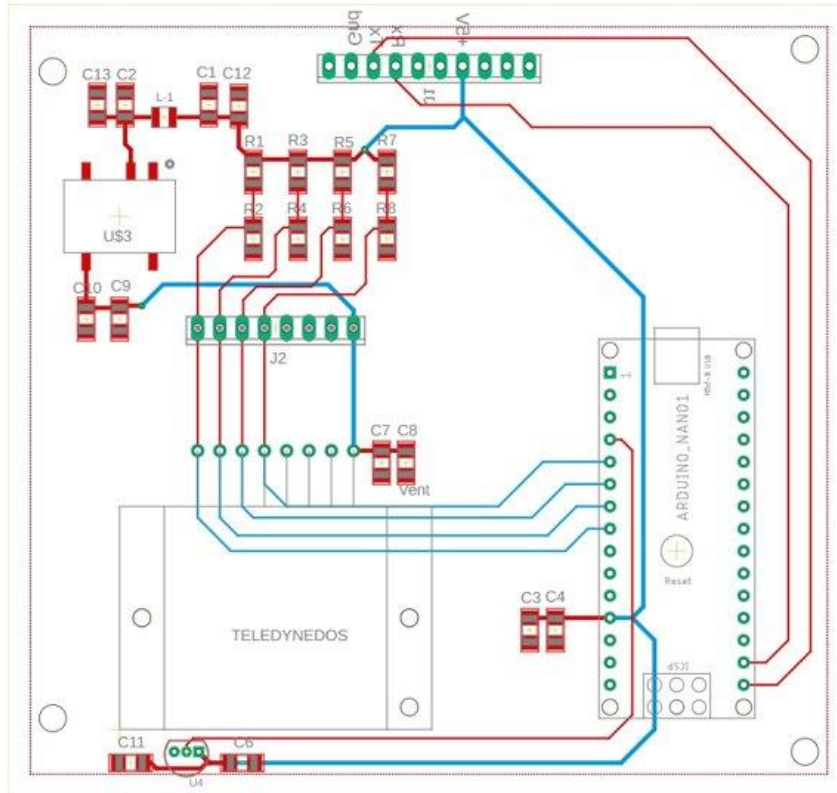
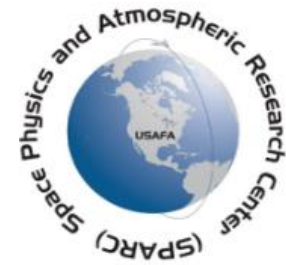
Electrical Overview Functional Block Diagram





Electrical Overview Prototype Testing Board

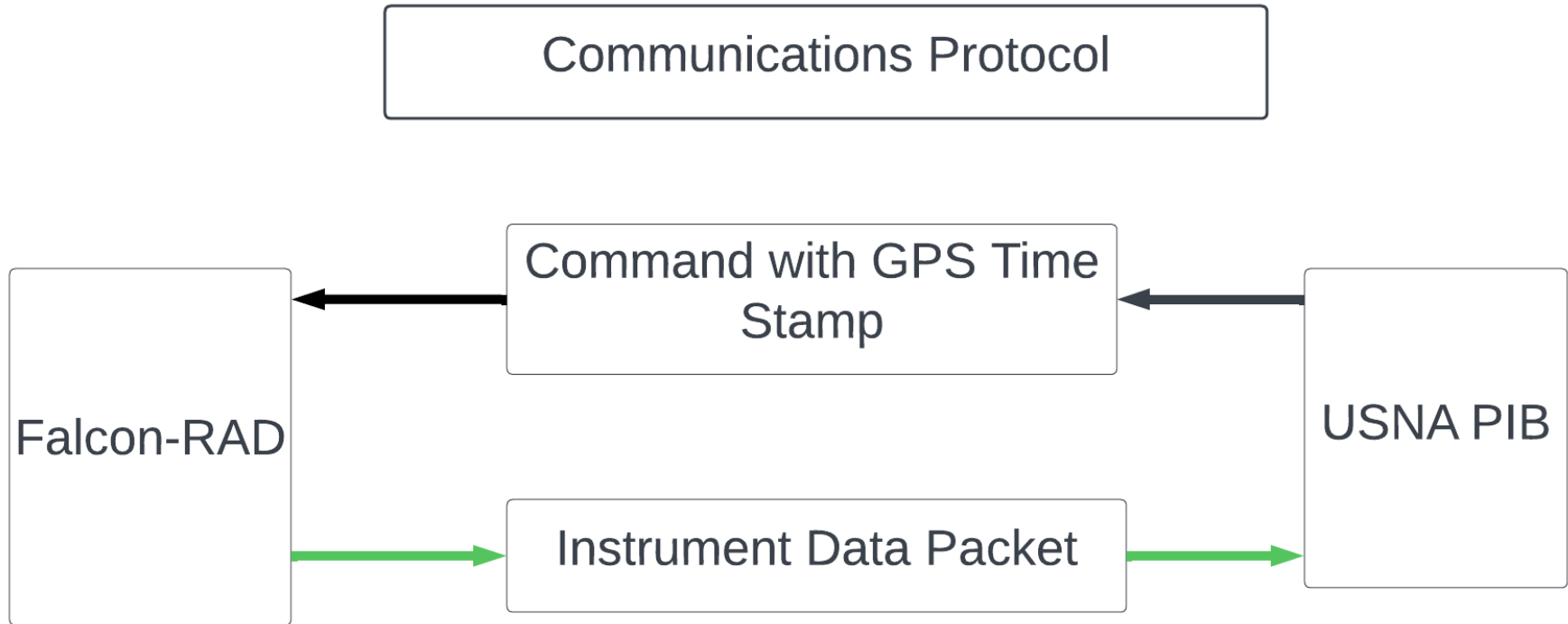
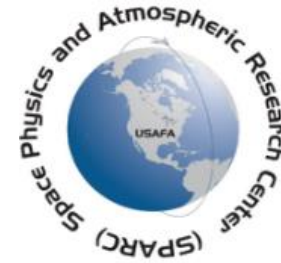
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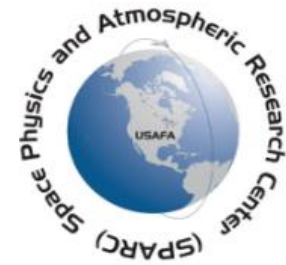
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Software Communication Protocol

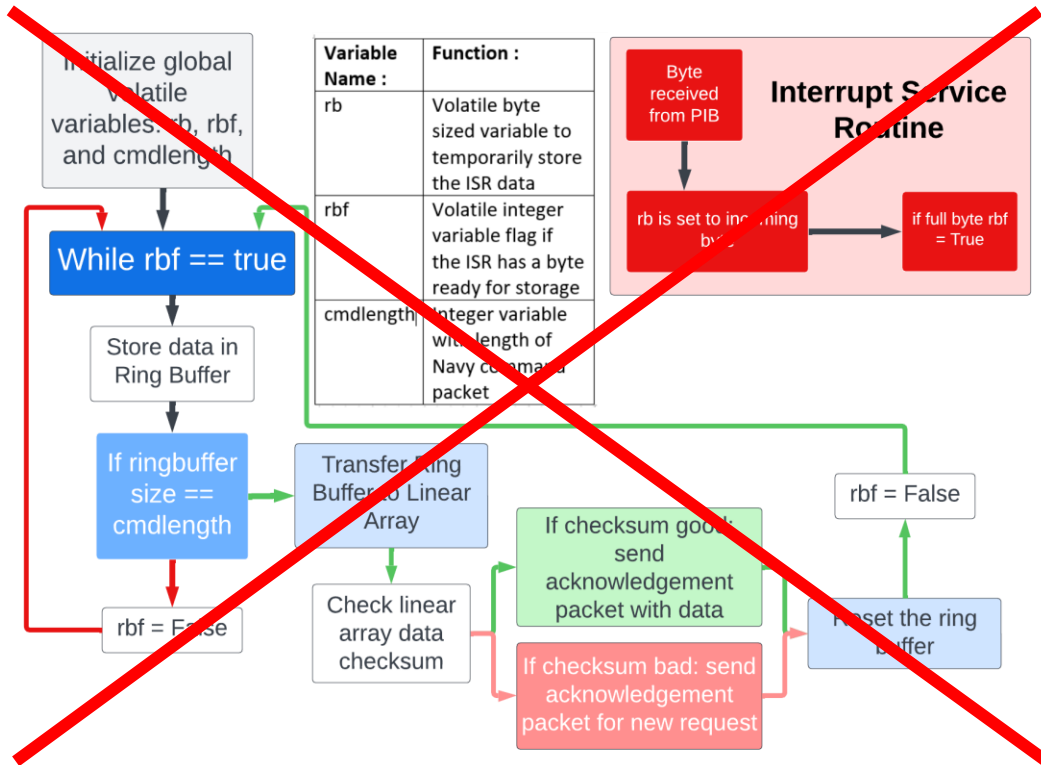




Software Modules/C&D Flow



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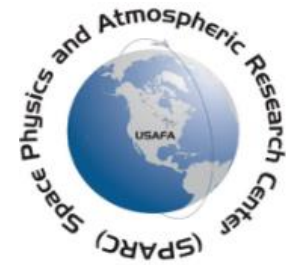


- Read(Command)
- Checksum(Command)
- Write(Data)

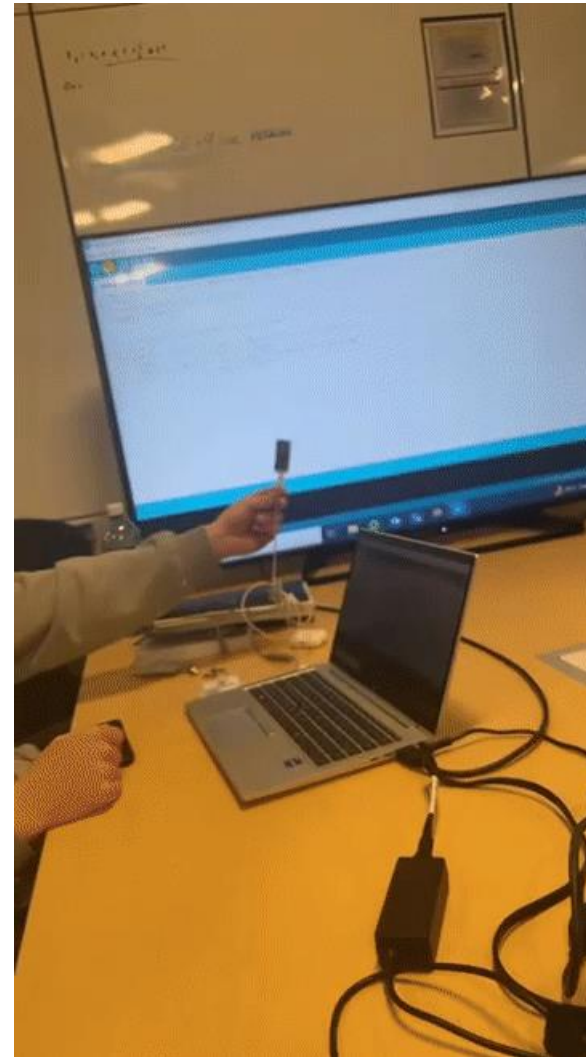


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Lessons Learned and Way Forward

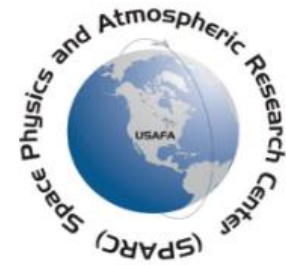


- Start as novices trying to make a microcontroller blink an LED
- Progressed to using microcontroller to measure simulated dosimeter and temperature voltages
- Currently simulating PIB from USNA on PC, and communicating to Falcon-RAD





Planned Calibration Testing



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- Looking to test complete system at Kirtland AFB with realistic radiation environment
- Data recorded from all outputs
- Produce calibration between dosimeter counts and rads for on-orbit use

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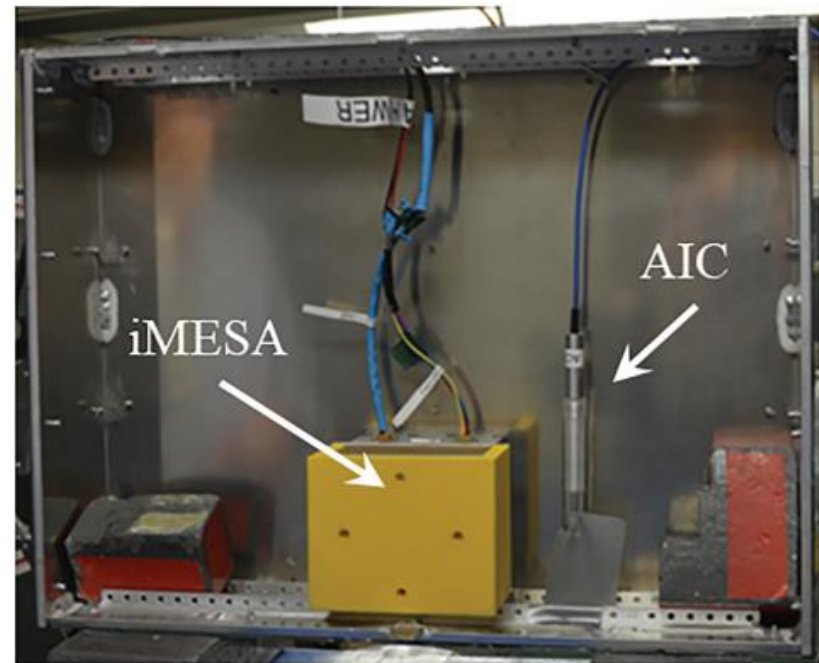
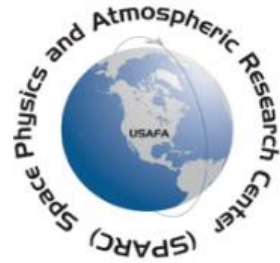


Image of previous dosimeter payload experiment setup

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Questions?





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References



- [1] J.F. Fennel, H.C. Koons, J.L. Roeder, and J.B. Blake, Spacecraft charging: Observations and Relationship to Satellite Anomalies, Spacecraft Charging Technology, Proceedings of the Seventh International Conference held 23-27 April, 2001
- [2] Maldonado, C. A., Cress, R., Gresham, P., Armstrong, J. L., Wilson, G., Reisenfeld, D., et al. (2020). Calibration and initial results of space radiation dosimetry using the iMESA-R . Space Weather, 18, e2020SW002473. <https://doi.org/10.1029/2020SW002473>
- [3] "μDOS001/007 Micro Dosimeters," Teledyne Defense Electronics, Apr 2021.