

S24W13: Updates:

Ground Station

- Identified 915MHz noise source at Gascola

Software

- CRC working on both GS and Satellite
- Quick transfer of files/images (Increased payload size & reduced number of acknowledgements.)



Milestones:

This week

- Ridge Test #4

Next week

- Final Ridge Test of Semester? (Complete Satellite?)

Possible Blockers:

- Antenna mount too high ?
- 915MHz power output ?

Cross Team Info:

- Flight software
- Avionics: Z+ PCB v2 ?
Battery Boards working ?
PyCubed v3 - GND pad ?
- Mechanical: antenna mounting ?

S24W12: Updates:



Possible Blockers:

- Noise source at Gascola on 915MHz ?
- Antenna mount too high ?
- 915MHz power output ?

Milestones:

This week

- GS LNA debug
- 915MHz noise source resolution

Next week

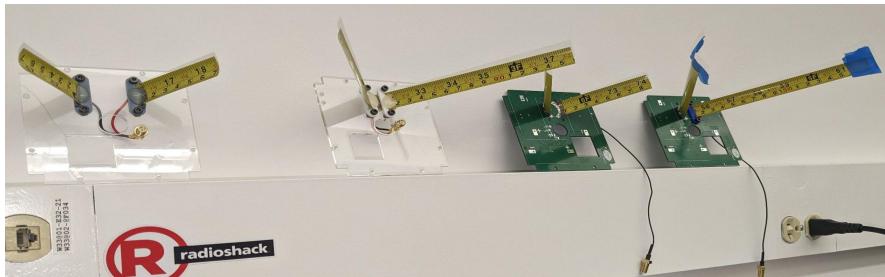
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Cross Team Info:

- Flight software
- Avionics: Z+ PCB v2 ?
Battery Boards working ?
PyCubed v3 - GND pad ?
- Mechanical: antenna mounting ?

S24W11: Updates:

- OTA updates
- Cyclic heartbeats from SAT
- Satellite 433Mhz Antenna 0.9



Possible Blockers:

- Noise source at Gascola on 915MHz ?
- Antenna mount too high ?
- 915MHz power output ?

Milestones:

This week

- GS Software v0.8
- + z board updates
- PyCubed board updates

Next week

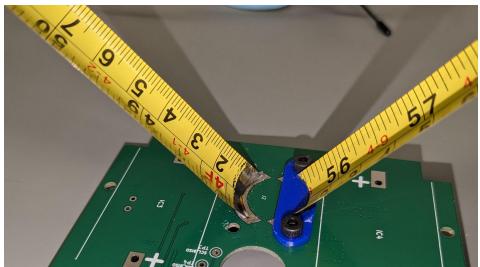
- GS LNA debug
- 915MHz noise source resolution

Cross Team Info:

- Flight software
- Avionics: Z+ PCB v2 ?
Battery Boards working ?
PyCubed v3 - GND pad ?
- Mechanical: antenna mounting ?

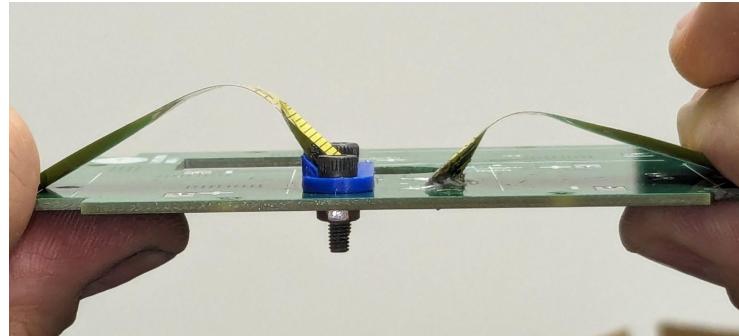
S24W10: Updates:

- Ridgtest #2 - 915MHz, 2 miles, +attenuation ✓
- Remote access at Gascola ✓
- New +z board ant mount ✓
- New 915MHz antenna ✓



Possible Blockers:

- Noise source at Gascola on 915MHz ?
- Antenna mount too high ?



Milestones:

This week

- GS Software v0.6
- Satellite 433Mhz Antenna Finalized

Next week

- GS LNA debug
- 915MHz noise source resolution

Cross Team Info:

- Flight software
- Avionics: Z+ PCB v2 ?
Battery Boards working ?
PyCubed v3 - GND pad ?
- Mechanical: antenna mounting ?

S24W9: Updates:

- First successful PY4 messages received
- Ridgetest #1.5
 - 433MHz ✓
 - 915MHz ✗

```
CMU_RExLab_GS_TimsBackyard
-0.3201219512195122
3.9024390243902443
-3.3689024390243905
```



Possible Blockers:

- Remote access at Gascola (SSH? other?)

Milestones:

This week

- PyCubed v2 power testing
- 915MHz debug
- Ridgetest #2

Next week

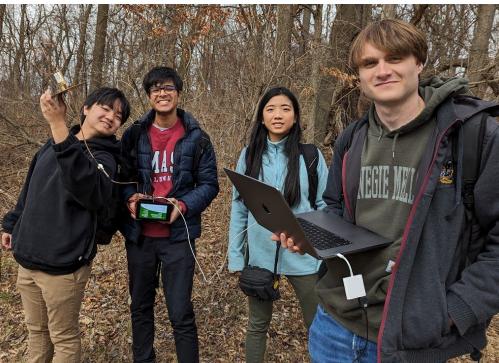
- GS Software v0.6
- Satellite 433Mhz Antenna Finalized

Cross Team Info:

- Flight software
- Avionics: Z+ PCB?
Battery Boards working?

S24W8: Updates:

- PY4 Local Ridge Tests Semi-Successful
 - Gascola site access and network issues
 - On-campus ridge test successful
 - No successful satellite comms yet



Milestones:

This week

- Ensure PY4 GS is operational and has an internet connection.

Next week

- Ridgetest #2
- Satellite Antenna Finalized

Possible Blockers:

- RF scope / probe / attenuator ?
- Internet restored at Gascola



Cross Team Info:

- Flight software
- Avionics: Z+ PCB?
Battery Boards working?

S24W7: Updates:

- Ridgetest #0.5
433MHz 😊
915MHz 😞



Possible Blockers:

- RF scope / probe / attenuator ?
- Ground Station 915MHz noise ?

Milestones:

This week

- Ridgetest #1
- Ground station hardware complete ?
- PY4 Mission Ready ?

Next week

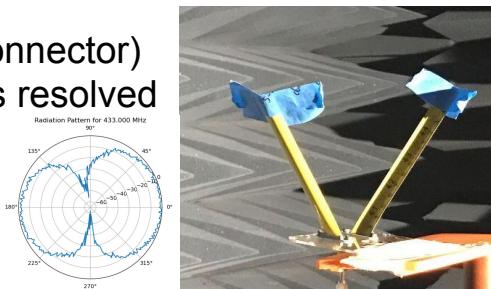
- Spring Break

Cross Team Info:

- Flight software
- Avionics: Z+ PCB?
Battery Boards working?

S24W6: Updates:

- New GS PiHat board: assembled, working
- Bench Test #3:
Py³ + sat antenna ↔ eggbeater + PiHat + Pi
- Update to +z PCB
(balun, ant mount, connector)
- Gascola wiring issues resolved
- Autoencoder update
- Antenna patterning



Possible Blockers:

- RF scope / probe / attenuator (?)

Milestones:

This week

- Continue developing/testing GS and Sat software
- Prepare GS Rpi with Py4 SW

Next week

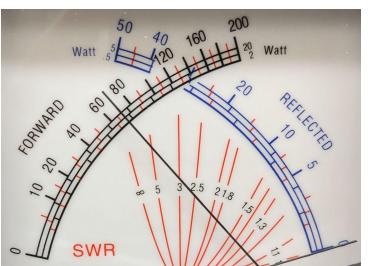
- Ground station hardware complete?
- Ridgetest #1 (1 week early)?
- Ready for Py4?

Cross Team Info:

- Flight software

S24W5: Updates:

- Wiring at ground station done (-ish)
- GS software robustness; handles communication interruptions and uploads data to external server.
- TX power testing



Possible Blockers:

- RF scope / probe / attenuator (?)

Milestones:

This week

- Continue developing/testing GS software
- Assemble new GS boards
- Load PY4 on GS Raspberry Pi
- TX power testing

Next week

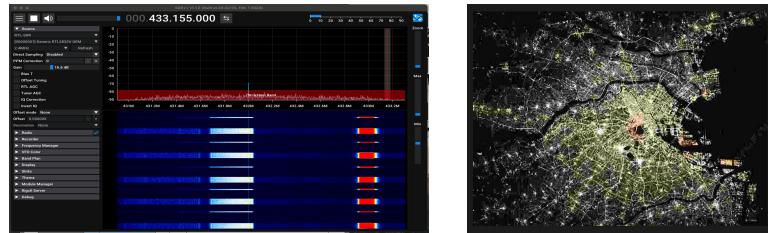
- Benchtop test with new GS boards, real antennas
- State machine implemented
- Autoencoder finalized

Cross Team Info:

- Avionics & GNC: Meet to finalize messages and signal definitions, discuss FSW implementation

S24W4: Updates:

- Wiring at ground station (WIP)
- Review of Comms Spec
- Updates to Avionics PyCubed board
- Implemented basic 2-way RF comms
- TX and RX 20KB image @ 148 feet



Milestones:

This week

- Continue developing/testing GS state machine
- Implement+document feedback from spec review
- Assemble new GS boards

Next week

- Benchtop tests using new GS boards
- State machine implemented
- Autoencoder finalized

Possible Blockers:

- RF scope /probe ?

Cross Team Info:

- Avionics & GNC: Meet to finalize messages and signal definitions, discuss FSW implementation
- Mechanical: Ant antenna mount refinement

S24W3: Updates:

- First Communications Specification ready for review
- Ground station PCB ordered
- Ground station HW ordered



Argus-1 Communications Specification
Spacecraft Design-Build-Fly Lab
Fall 2023 - Spring 2024
Carnegie Mellon University
5000 Forbes Ave
Pittsburgh, PA 15213

Release	Release Notes	Author	Release Date
v0.1	Initial Specification	David J. Moray	Jan. 23, 2024

Milestones:

This week

- Comms Specification review
 - document will be on GitHub
- Comms protocol implementation
- Ground station site wiring
- Antenna prototype #2

Next week

- Benchtop tests #1 & #2

Possible Blockers:

- RF oscilloscope ?

Cross Team Info:

- All teams:
Feedback on Communications Specifications.
 - Please let us know what information you would like to send and receive!
- Mechanical: Antenna prototype #2
- Avionics: Radio power path review

S24W2: Updates:

- Comms Team all have FCC licenses
- KC3YHI (Jacky), KC3YCQ (Akshat)
 - KE8ZJK (D.J.) - Tech→General



→ Ground station
wiring started

Possible Blockers:

- Ground station PCB order → 2+ month delay
- Remaining ground station HW order ?

Goals for this Week:

- Order remaining ground station components
- Finalize telemetry data and formatting
- Finalize and document packet structure, layout, and synchronization

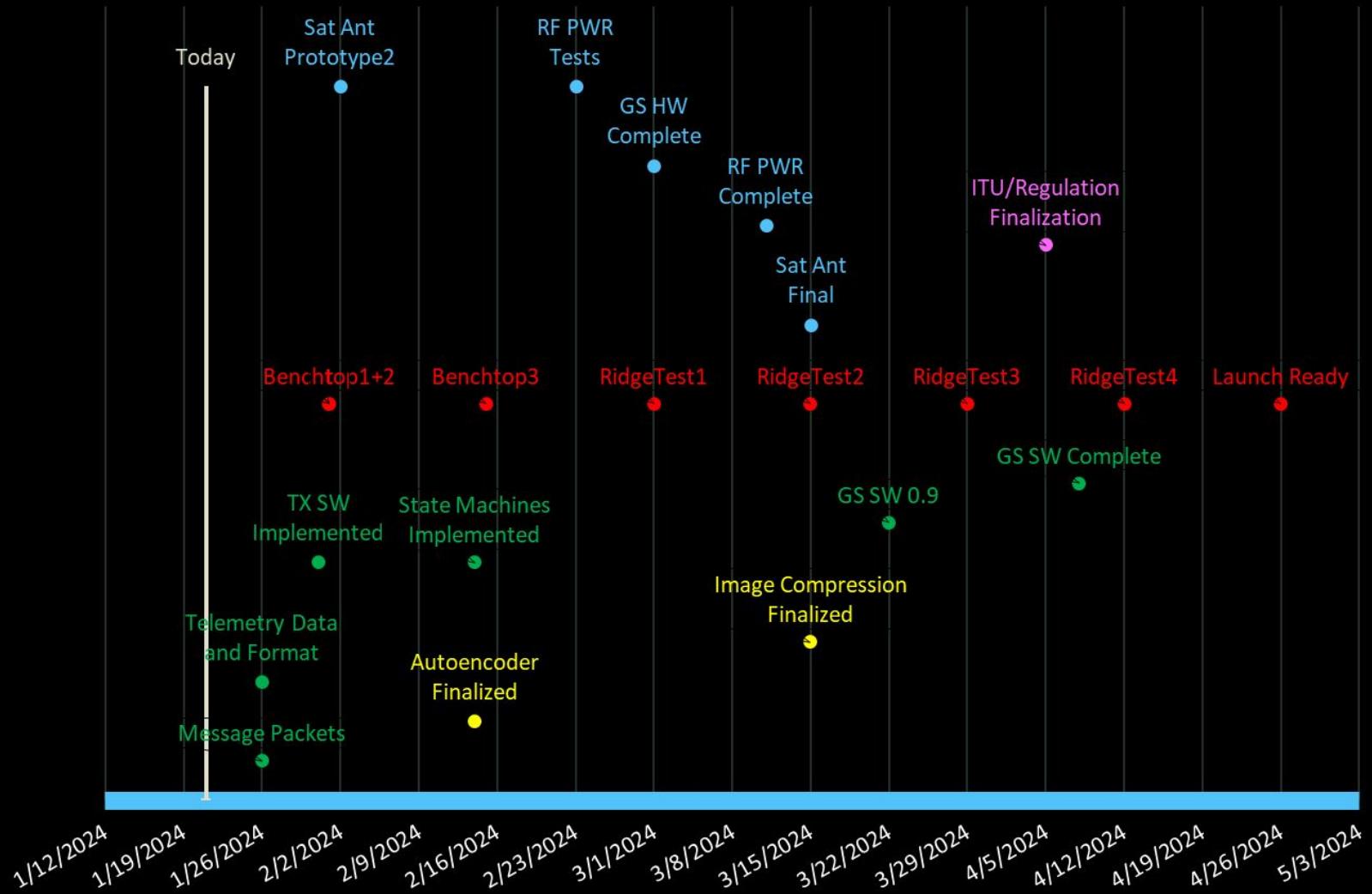
Milestones:

Fall 2023 Recap

- Ground station antennas and amplifiers mounted.
- PiHat PCB finalized
- TX and RX Link Budget v1.0
- Defined a generic communications protocol and state machine
- Transferred generic information and text file from board to board. Programmed all in C

Cross Team Info:

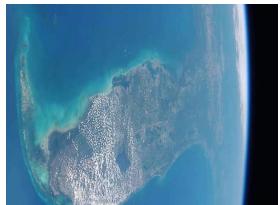
- Vision: Autoencoder for image compression
- Avionics: Power path to RF amplifier
- Mechanical: Rev. 2.0 of prototype antenna



W11: Updates:

- Image transmission between Pis (likely 1kb/s, 62.5 KHz)

Lossless
40 min



640x480 image,
95% JPEG
compression
1 min @ 915 MHz,
125 kHz BW, SF 7



97% JPEG
compression
30 sec



Possible Blockers:

- Ground station antenna mount is taking longer than desired.
- Bitrates/BWs for past missions with RFM98.
- Risk: RF power FET may only be rated for 20V. Currently running at 19.8V?

Milestones:

This week

- GS boards ready to order/ordered
- Porting GS software to work on Pi
- Image transmission between Pis
- Image compression format/level
- Reverse engineered RF module amplifier

Next week

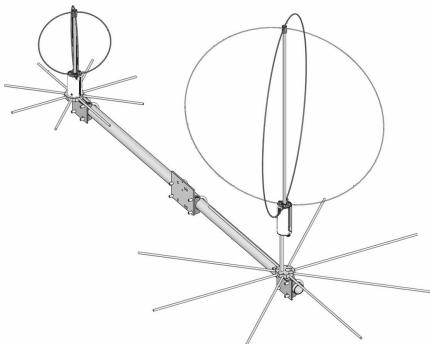
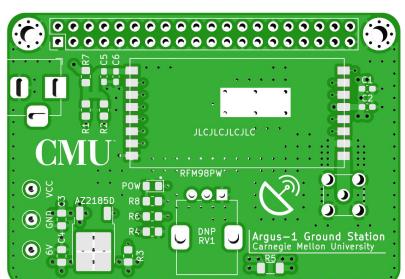
- Assemble GS boards

Cross Team Info:

- GNC: Comms protocol / message scheduling
 - D.J. working on statechart
- Vision: Image compression / format

W10: Updates:

- Board redesign finished, will order soon
 - Ordered a lot of GS hardware



Possible Blockers:

- Ground station installation progress moving slower than we would like

Milestones:

This week

- Response from AMSAT
 - Porting GS software (Arduino to C for RPi)
 - Board redesign complete, order this week
 - Satellite antenna demo

Next week

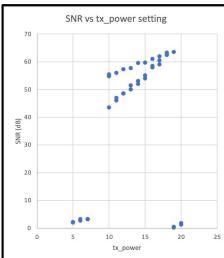
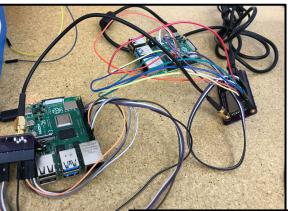
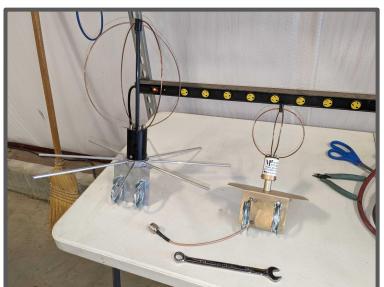
- GS software testing
 - Continue GS software development (Mature protocols and send large packets, i.e. images)

Cross Team Info:

- GNC: Comms protocol / message scheduling
 - Mech: Sat antenna mount
 - Avionics & Mechanical: GPS antenna mount

W9: Updates:

- Antennas assembled (not mounted)
- LoRa communication between two ground stations



```
From: 2
Received: b'Hello there!'
RSSI: -122.87; SNR: 59.0
From: 2
Received: b'D.J. said hello!'
RSSI: -121.8; SNR: 57.0
```

Possible Blockers:

- Permission to drill holes in building
- Anechoic chamber

Milestones:

This week

- Antennas assembled
- GS equipment at Gascola site
- GS board redesign
- Module to module RF comms
- More communication with AMSAT person

Next week

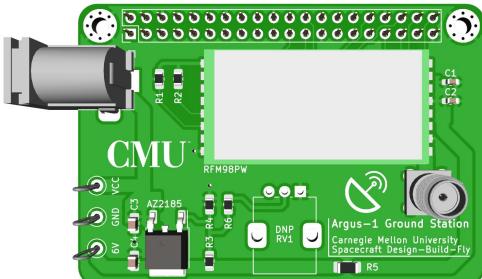
- Order new GS board
- Satellite antenna demo + testing

Cross Team Info:

- Mechanical:
Satellite antenna v0

W8: Updates:

- GS board redesign
- 1 more HAM licensee - Congrats DJ!



Possible Blockers:

- Labspace access needed for antenna prototypes and equipment migration
- Ground Station antenna mount

Milestones:

This week

- Link Budget v0.5 (lives in wiki)
- GS antenna - eggbeater
- Will move GS hardware into RES lab
- Got response from AMSAT
- Reverse engineering HopeRF module

Next week

- Order new GS boards
- Prototype satellite antenna (V-dipole)

Cross Team Info:

- Avionics:
 - Progress on FPrime?
 - Power path from battery to radio?

W7: Updates:

- Tested GS boards, works but needs redesign
- 1 more HAM licensee - Congrats Neil !
- Ground station inventory



Possible Blockers:

- Labspace access needed for antenna prototypes and equipment migration
- Eagerly awaiting link-budget class
- Expectations for design review?

Milestones:

This week

- Link budget v0.3
- Comms Block Diagram v0.1
- GS board bringup

Next week

- Update on link budget
- Check on ground station facilities progress
- GS board redesign
- Data transmission between GS boards

Cross Team Info:

- Mechanical: Continue development for sat antenna
- GNC: Comms protocol / message scheduling

W6: Updates:

- Socket-based comms development environment in C
- Ground Station site visit.

Packet sent from cubesat!

```
Version number: 0
Packet type: 0
Secondary header flag: 0
APID: 110
Sequence flag: 3
Sequence count: 0
Data length: 200
```



Possible Blockers:

- Pis for ground station development & benchtop module <> module communication

Milestones:

This week

- Developing packet protocol
- Developed initial packet transmission simulation
- Visited ground station site, planned antenna, mount

Next week

- Update on link budget
- Expanding digital packet transmission simulation with message payloads
- GS board bringup using a Pi

Cross Team Info:

- Avionics: meeting on satellite RF software + using FPrime for it
- GNC: meeting to decide data to/from satellite, message scheduling
- Vision: image format & compression

W5: Updates:

- Assembled 2 x Ground Station pHATs
- Link Budget v0.2
- SQL Command Database



Milestones:

This week

- Ground station pHAT assembly
- Link budget v0.2

Next week

- Continue initial satellite <> ground station command database file
- Setup demonstration of satellite <> ground station communication (Digital only, packet passing)
- Assemble another ground station pHAT

Possible Blockers:

- Access to 2 x Raspberry Pis (2, 3, 4, Zero) for initial LoRa communication

Cross Team Info:

- Continue to send DJ command/telemetry variables (Vbat, sensor outputs)
- GNC: Attitude control & detumbling

W4: Updates:

- Selected the CSDC Space Packet Protocol for the satellite <> ground station communication

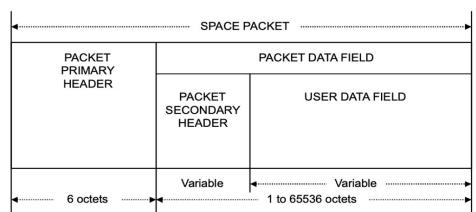
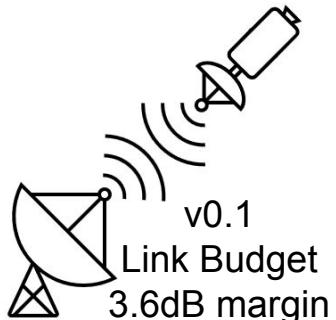


Fig. 1: SPP



Possible Blockers:

- Access to lab / ground station inventory

Milestones:

This week

- Link Budget v0.1
- SPP + low level RF libraries
- Antenna trade study / analysis

Next week

- Link Budget v0.2
- RF pHAT assembly, board bringup
- Pi-Pi RF communication

Cross Team Info:

Vision

- Image transmission format
- May need to transmit image in parts (dividing in 4 parts should transmit in 4 passes)
- Any data that teams will need to communicate from ground <> satellite, please share with D.J.
- Will develop database with message IDs and data field formatting.

W3: Updates:

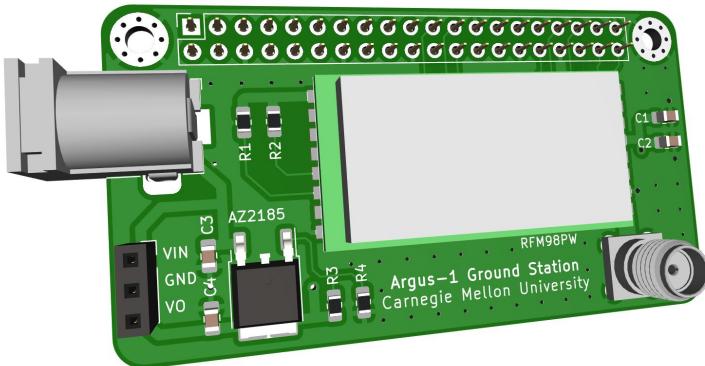


Fig. 1: Groundstation Pi pHAT

Milestones:

- v1.0 ground station schematic and PCB
- Subdivision of responsibilities for Comms team
- v0.0 ground station GUI



Fig. 2: GS GUI

Possible Blockers:

- LoRa use and licensing in U.S. ?
- Experimental license ?
- ISM bands ?

Cross Team Info:

Comms Team Point of Contacts

- RF Power Use: Jason
- Antenna: Tim
- RF Software: DJ

Cross Team Interfaces/Dependencies

- Mechanical: Antenna
- GNC: GS to sat information
- Avionics: RF software + protocols

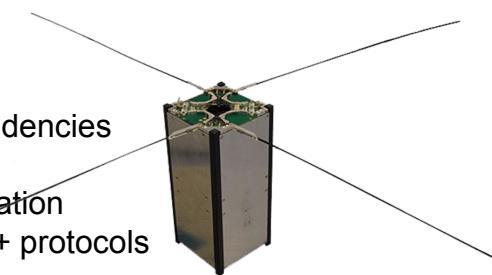


Fig. 3: Turnstile Antenna