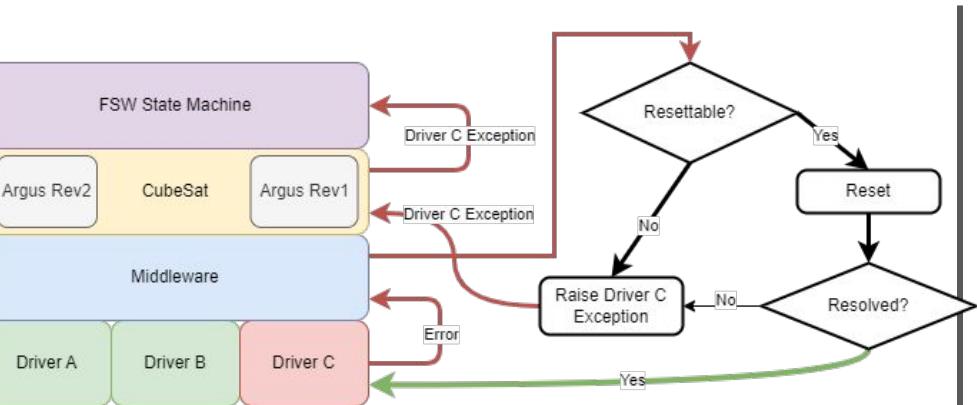


# Avionics Week 12 16/18-873S23



## Blockers

- Mechanical cutouts for USB hub

## Weekly Results:

- Ordered Z axis torque board
- Driver exception middleware

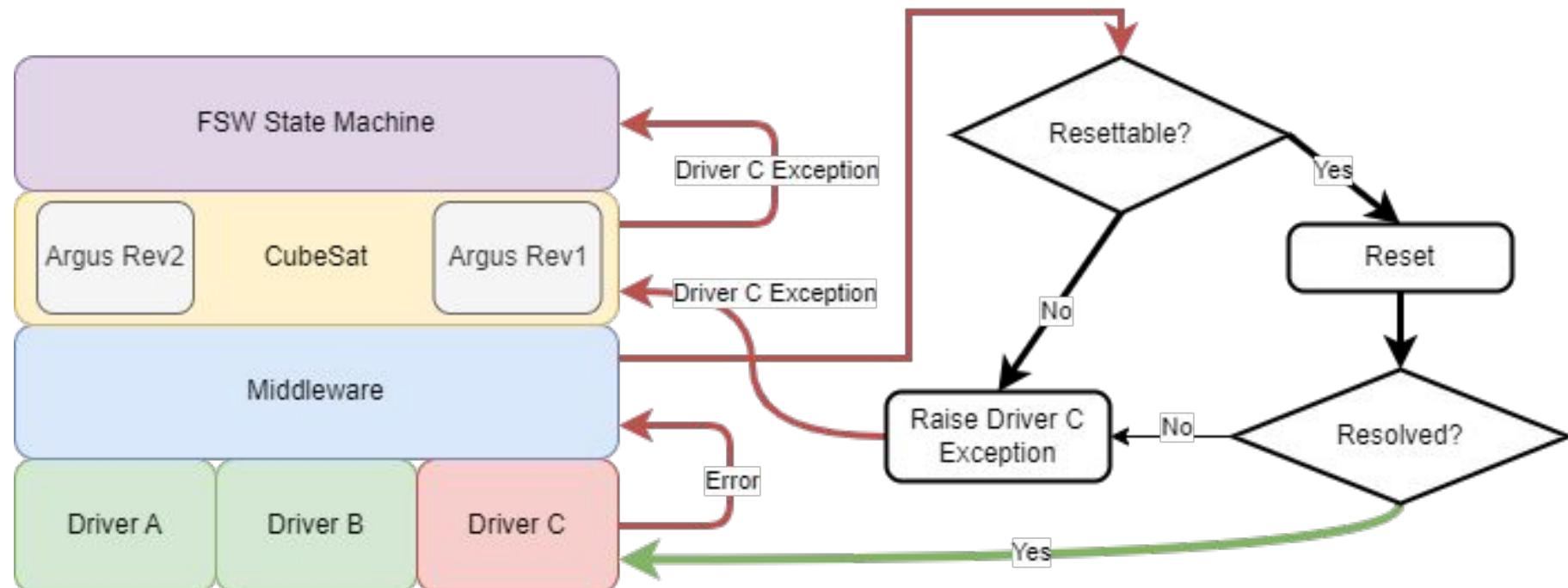
## This week:

- Hardware debugging - battery board, USB
- Diagnostics error handling
- Jetson carrier power testing, integration testing
- Rev 2 of battery board, main board, and XY
- Rev 2 of Argus

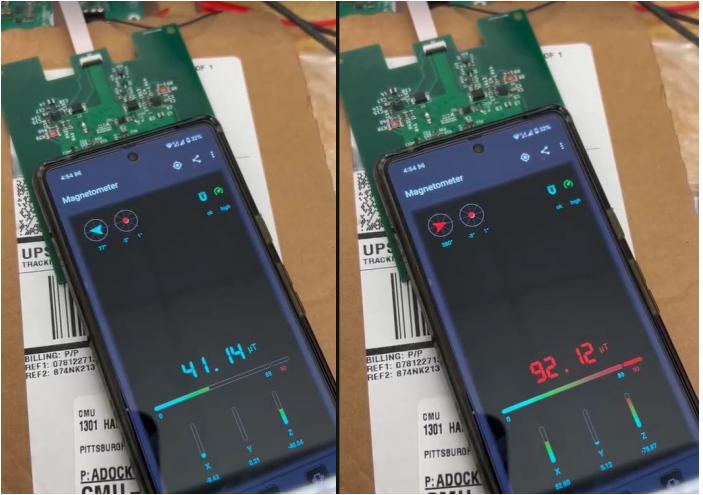
## Interfaces

Vision/GNC - Work towards image passing integration

# Middleware + Fault Handling



# Avionics Week 11 16/18-873S23



## Weekly Results:

- Argus <-> Jetson comm established
- Tested XY, Z+ board - connected to solar sensors and torquers
- Designed Z axis torquer - order today
- Initial Jetson power testing
- Full Argus testing (fix Jetson power switch)
- Full battery board testing (change protection IC)

## This week:

- Continue to test USB hub - create Rev 2
- Rev 2 of battery board, main board, and XY
- Rev 2 of Argus

## Blockers

- None

## Interfaces

Vision/GNC - Work towards image passing integration

# Initial Jetson Power Testing Results

Mode	Voltage (V)	Current (A)	Power (W)	Notes
Boot up from shut down	12	0.88	10.56	Boot up takes around 45-60s - ranges from 0.48 to 0.88
Idle (Screen off)	12	0.346	4.152	
CPU 0 online 115200 (Screen on)	12	0.45	5.4	Min available frequency per core is 115200
All procs online at 115200 (Screen on)	12	0.46	5.52	
Deep Sleep	12	0.029	0.348	Deep sleep, no I/O, has to be restarted. Boot from suspend takes 5-10s Can only be woken up with timer, keyboard press, or complete reboot

# Implications

## Assumptions:

EOL capacity of 47.02 Wh

Peak load power 7W

60% battery available

## Operating Limit:

4.02 Hours

## Solar Input:

~3 Wh / Orbit

Battery Storage Capacity		
Number of Batteries	6	
Series	2	
Parallel	3	
Nominal Voltage	3.64	V
Individual Charge Capacity*	3400	mAh
Total Charge Capacity	20400	mAh
Total Energy Capacity	74.26	Wh
Total Energy Capacity	267.32	kJ
Capacity Loss Rate	3	%/year
EOL Battery Capacity (15 years)	47.02	Wh
EOL Battery Capacity (15 years)	169.3	kJ

# Avionics Week 10 16/18-873S23

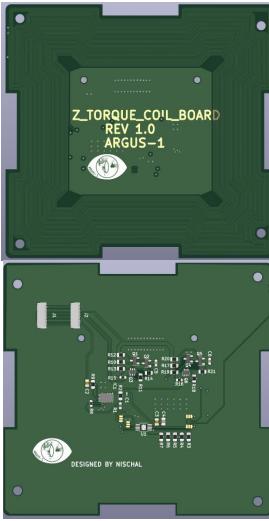
```
Running diagnostics...
Running ADM1176 Tests
ADM1176: All tests pass!

Running BMX160 Tests
All tests passed

Running BQ25883 Tests
All tests passed

Running RFM9X Test

Running DRV8830 Tests
Could not initialize DRV8830.
0xc0
DRV8830
```



## Blockers

- Waiting on components for Z, USB Hub, Adapters

## Weekly Results:

- Diagnostics on external board connections
- Integrate diagnostics into overall flight software
- Designed Z axis torquer

## This week:

- Build the Z panels and USB hub and test
- Design Z axis torque coil board
- End-to-end test
- Rev 2 of battery board, main board, and XY
- Power management testing on Jetson

## Interfaces

Vision/GNC - Work towards image passing integration

# Avionics Week 9 16/18-873S23



## Blockers

- Updated XY cutouts for rev 2
- Deployable cutouts

## Weekly Results:

- Successfully flashed all Argus1/PyCubed Rev1 boards
- Designed USB Hub
- Ordered USB Hub, Z+, Z-
- Initial solar board testing - success!

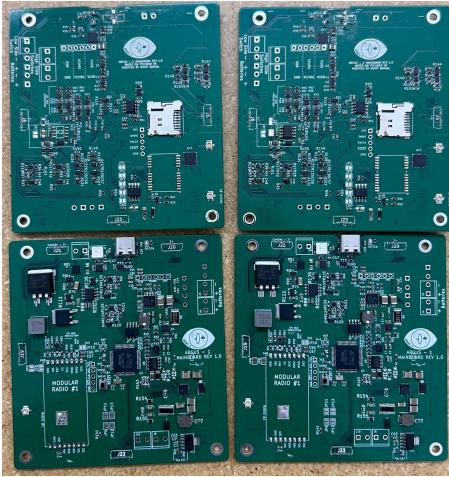
## Next week:

- Run diagnostics on new Argus1/PyCubed Rev1 boards
- Design Z axis torque coil board
- End-to-end test
- Power management testing on Jetson
- Start integrating Rev2 design updates

## Interfaces

Vision/GNC - Work towards image passing integration

# Avionics Week 7 16/18-873S23



## Weekly Results:

- Build 4 Argus 1 boards - awaiting cleanup and tests
- Tested USB hubs... designed our own
- Diagnostic tests nearly done

## Next week:

- Order updated camera and Z boards after checklist complete
- End-to-end test
- Create codes/file for diagnostic results
- Solar board testing
- Power management testing on Jetson
- Start integrating Rev2 design updates

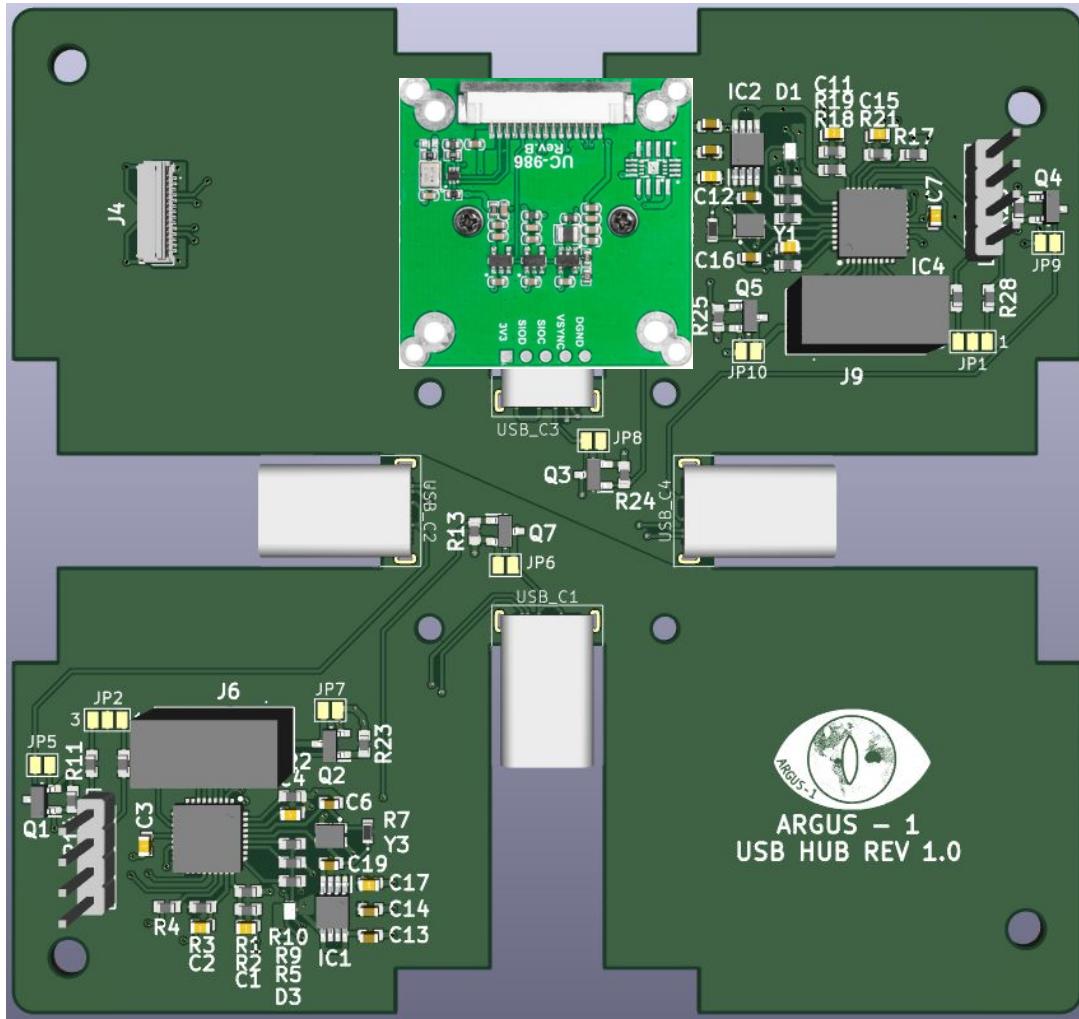
## Blockers

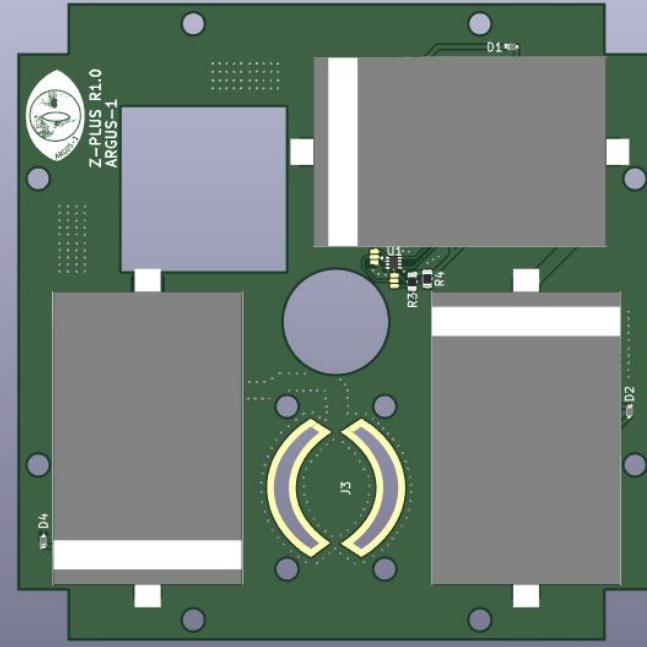
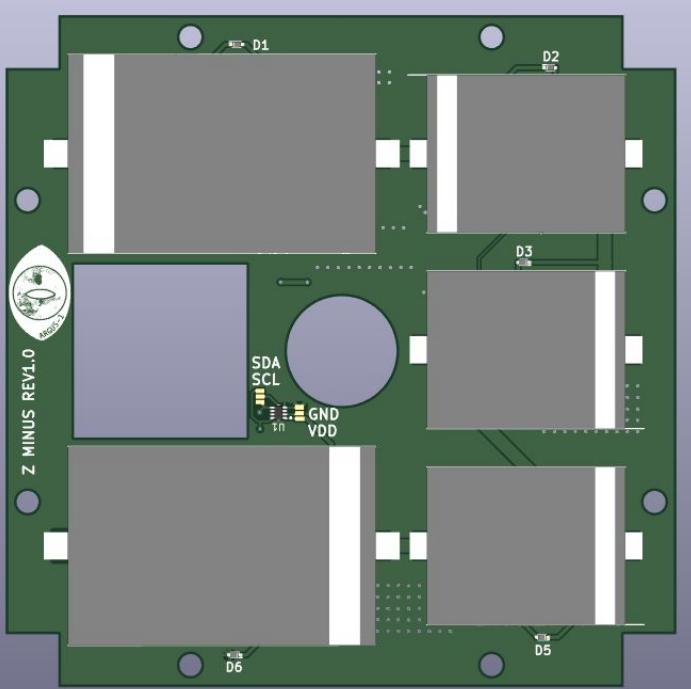
- Cutouts for camera board
- Updated XY cutouts for rev 2
- Deployable cutouts

## Interfaces

Vision/GNC - Work towards image passing integration - pycubed/jetson comms

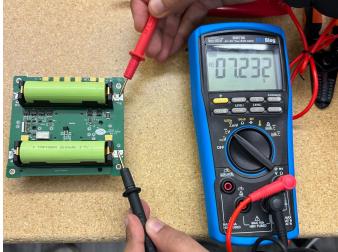
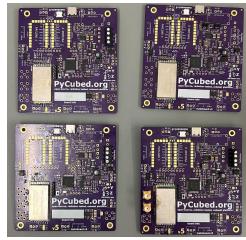
Mechanical - USB hub design, checklist for design fabrication send-off





- Nischal picked up Z minus cutouts from <https://a360.co/4bLZFds> at 23rd Feb. 4.06PM
- Colton A updated cutouts on 23rd Feb 6PM
- Avionics Signoff made by Nischal M at time 2.34PM ; 24th Feb
- Mechanical Signoff made by Colton A at time 9:44PM and date 24th Feb
- TA signoff by \_\_ at time \_\_ and date \_\_
- Board list sent by -- to -- at time \_\_ and date \_\_
- Parts list by -- to -- at time \_\_ and date \_\_
- Board ordered by -- at time \_\_ and date \_\_
- Parts Ordered by -- at time \_\_ and date \_\_

- Nischal received cutouts from Colton A (Z\_Keep\_Out\_Zones\_Feb\_23\_2024.dxf)
- Avionics Signoff made by Nischal at time 8.02 PM on 24th Feb
- Mechanical Signoff made by Colton A at time 9:44 PM and 24th Feb
- TA signoff by \_\_ at time \_\_ and date \_\_
- Board list sent by -- to -- at time \_\_ and date \_\_
- Parts list by -- to -- at time \_\_ and date \_\_



# Avionics Week 6 16/18-873S23

## Blockers

- Still waiting on Pycubed Rev1 boards...

### Weekly Results:

- Got 6 PyCubed V5 boards functional. ( 1 without USB Power)
- Built 4 battery boards - 1 tested
- Initial build of 4 XY boards done; need to do final touches and testing.

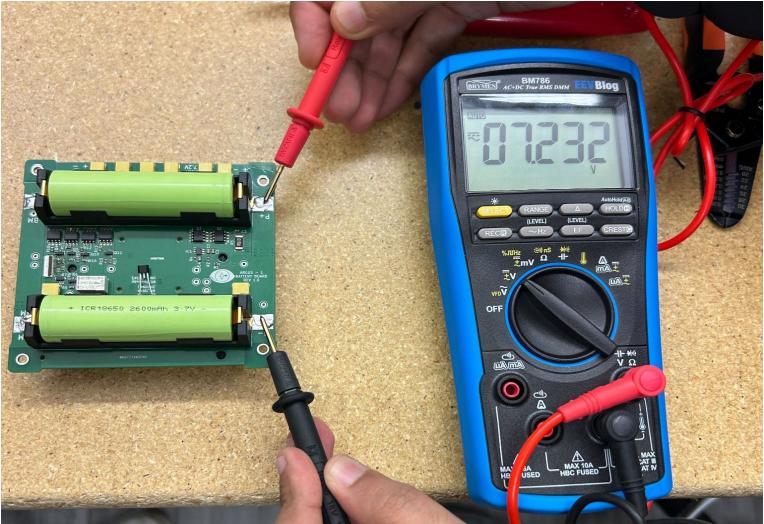
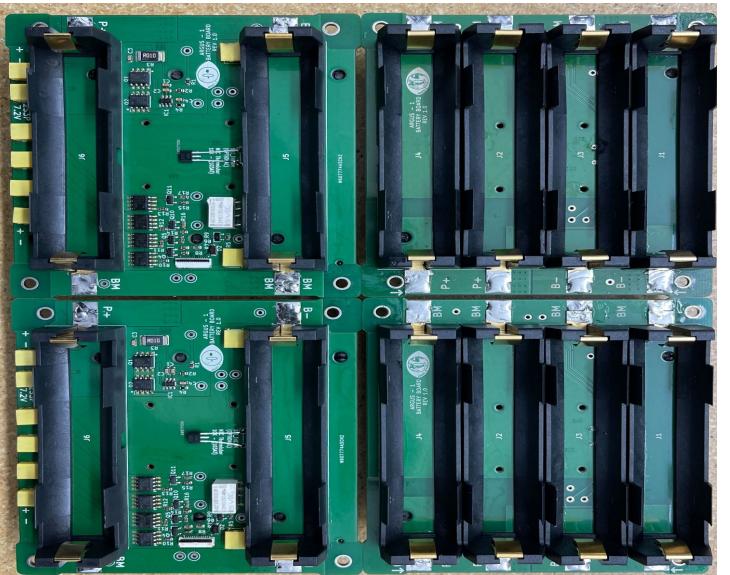
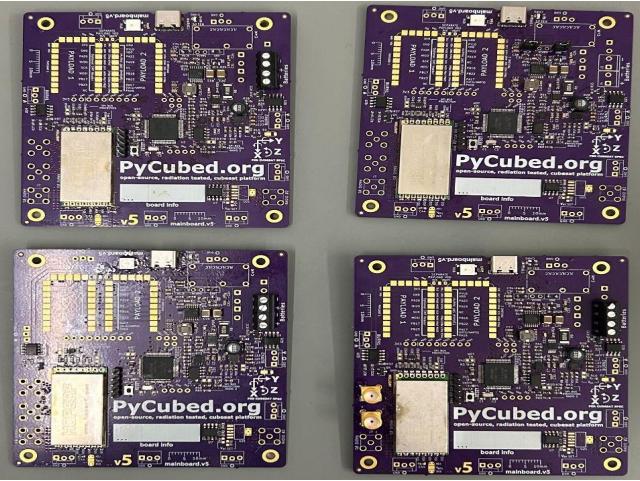
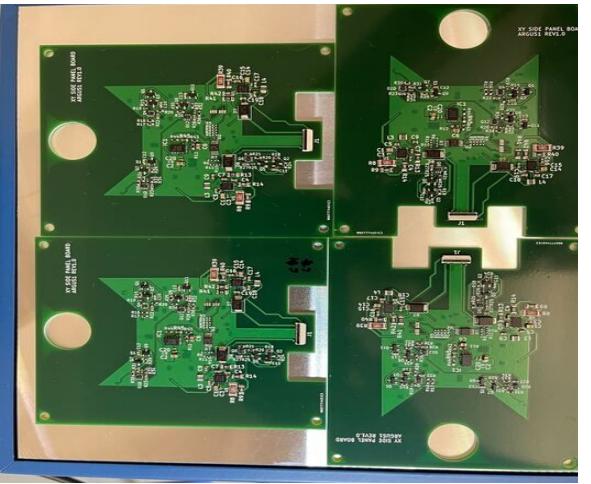
### Next week:

- Order camera, Z boards after updates
- Finish diagnostic tests for each component
- Argus1-PyCubed build?
- Assisting in end-to-end test (comm protocol)
- Test new USB hubs (dimension good)
- Solar board testing
- Power management testing on Jetson (low)

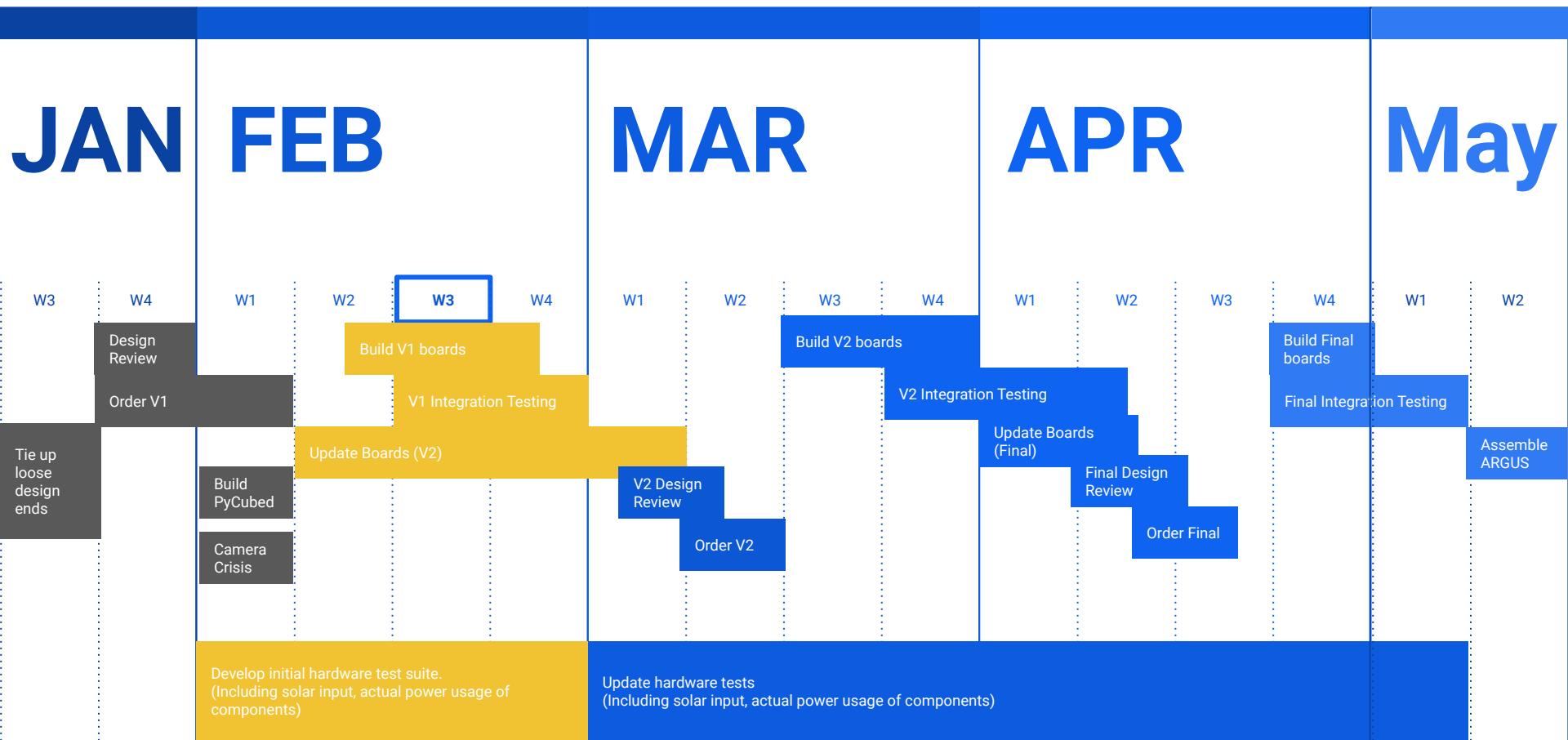
## Interfaces

Vision/GNC - Work towards image passing integration - pycubed/jetson comms

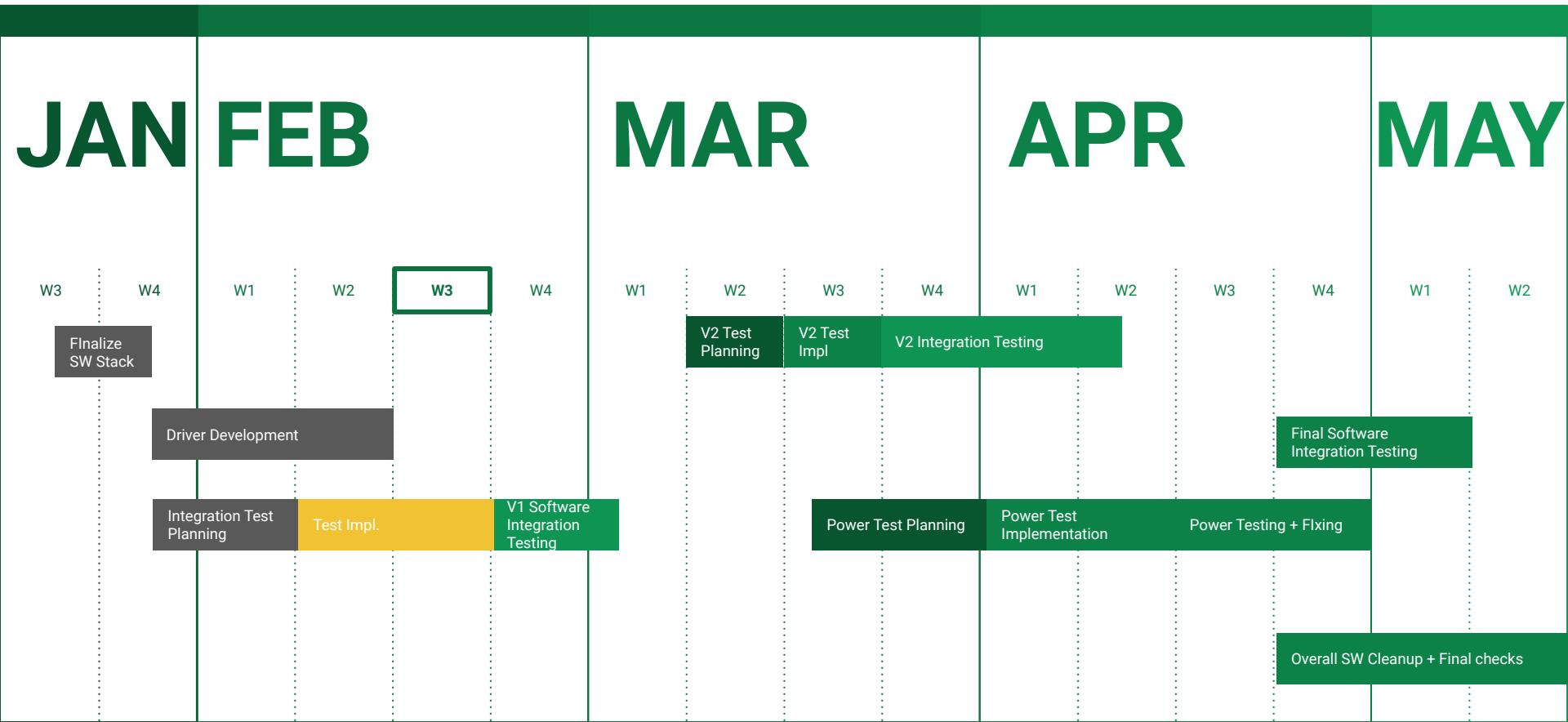
Mechanical - Updated camera board Outline.



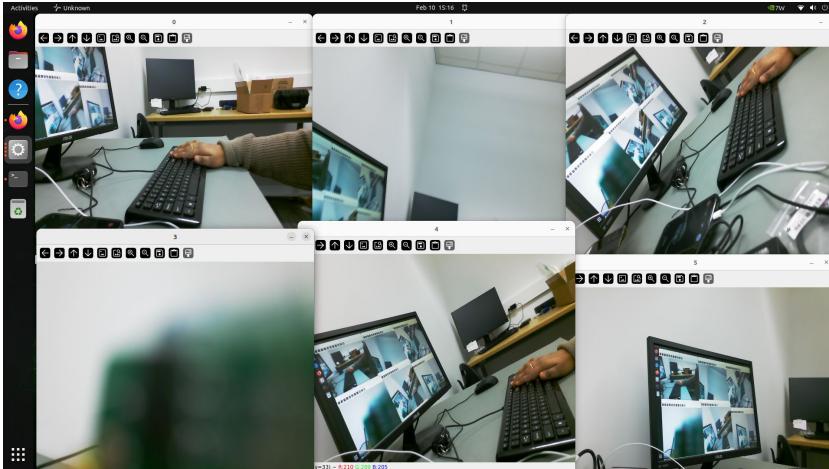
# Hardware Timeline



# Software Timeline



# Avionics Week 5 16/18-873S23



## Blockers

- Just waiting on hardware...

## Weekly Results:

- All orders for boards and components are placed
- 6 USB - C cameras worked on jetson
- 4 pycubed v5 boards built
- Argus1 CircuitPython build successful

## Next week:

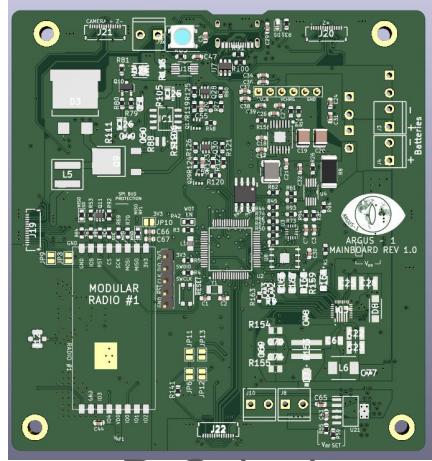
- Improve jetson comm interface
- Integration test implementation
- State of charge estimation algorithms
- Test other jetson carrier boards

## Interfaces

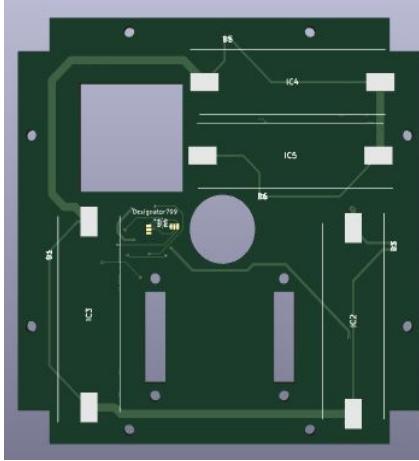
Vision/GNC - Work towards image passing integration

Ops - Joint meeting with GNC to discuss detailed software needs

# Avionics Week 4 16/18-873S23



PyCubed



Z Board

## Blockers

- Deployment issues for CircuitPython firmware and bootloader (reach out to Max)

## Weekly Results:

- PyCubed and Z+/- boards designed
- CircuitPython configured for new PyCubed board
- Drivers: solar sensor, h-bridge, jetson comm included in software

## Next week:

- Deploy CircuitPython build (successfully)
- Validate jetson comm library
- Integration test planning
- Test cameras protocols (USB and SPI)
- Build more PyCubed

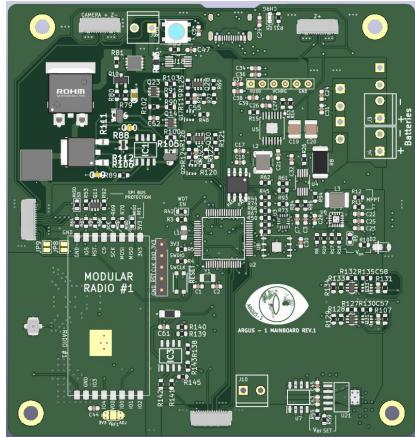
## Interfaces

Vision/GNC - Communication Interface  
Feedback, Camera discussions

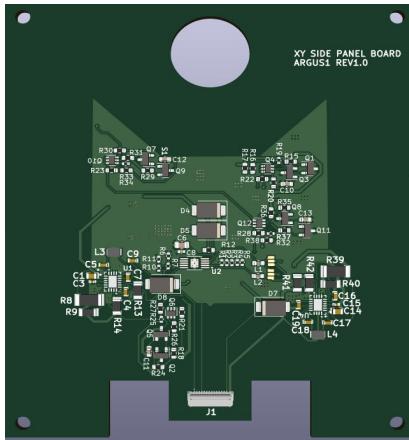
Ops - Set up Meeting about Data Packaging & Communication Protocols

Mech - Need to discuss all Cabling Plans

# Avionics Week 3 16/18-873S23



PyCubed



XY Torque

## Blockers

- New camera interface selection (vision/gnc)
- Top board keepout for the radio antenna

## Interfaces

Vision/GNC - None

Ops - Discuss CircuitPython Integration

Mech - Updated cutouts for deployables/z outers

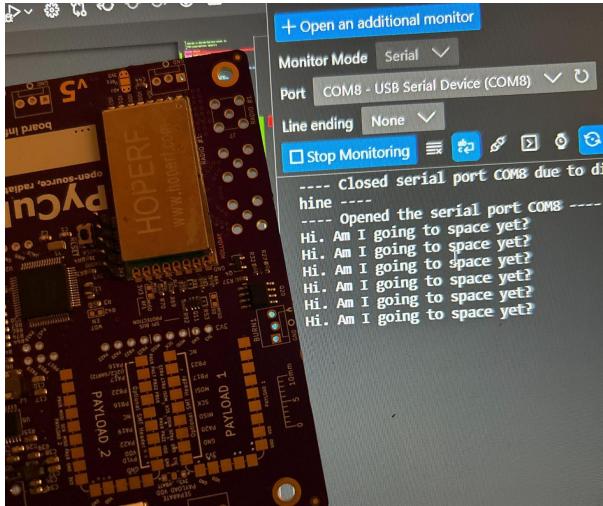
## Weekly Results:

- V1 PyCubed & XY torque boards ready to order
- V1 Camera board (Z torque)
- V1 Battery Board

## Next week:

- Order completed boards (after class today)
- Setup flight software repo for CircuitPython & deploy
- CircuitPython driver development
- Integration test planning
- Finalize Designs V1 deployable, camera, z-radiator boards

# Avionics Week 11 16/18-873F23



## Weekly Results

- Hello World with PyCubed/Zephyr
- Successful build with FPrime/Zephyr
- Hardware block diagram 2.0
- Initial power measurement for Jetson
  - 2 cores vs 4 cores in 7W => ~50% power savings on cores

## Next week

- Build Fprime/Zephyr/PyCubed (total integration)
- Start driver development for FPrime
- Jetson power estimates
- Hardware, hardware, hardware

## Blockers

- None

## Requirements

- Antenna (RFM, GPS) keepouts
- New camera keepouts out outer boards

## Interfaces

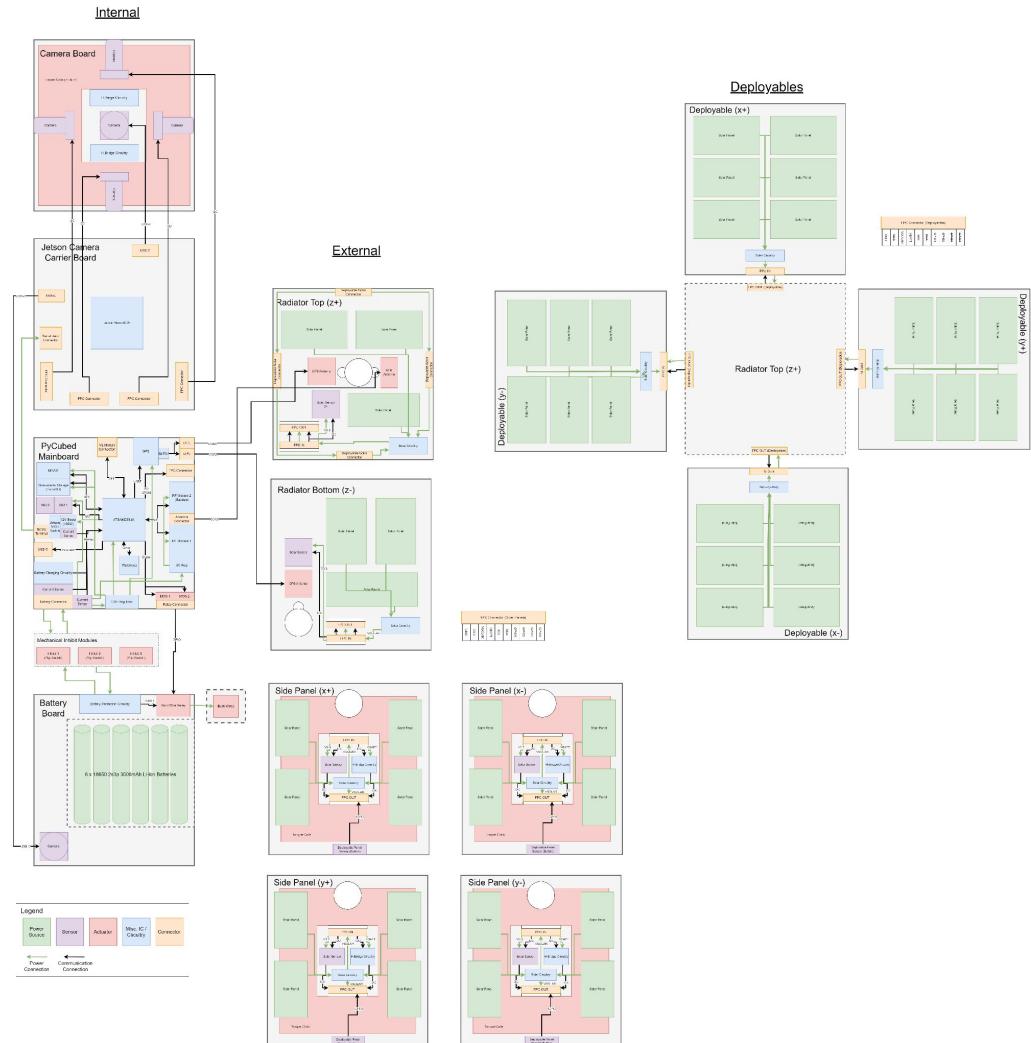
**Vision:** Jetson power estimations

**GNC:** Attitude workload for Jetson power estimate

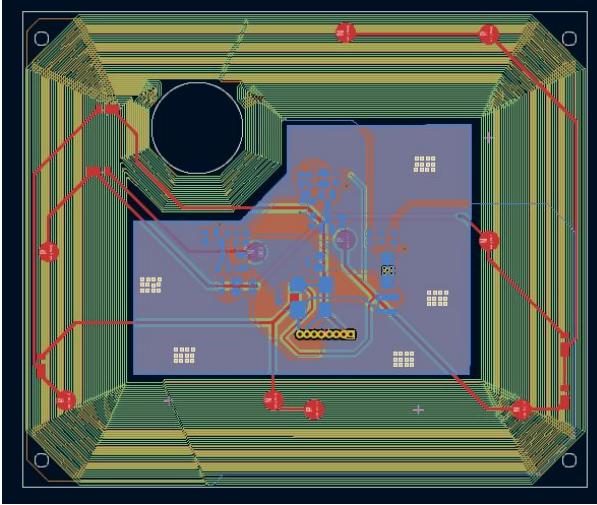
**Ops:**

**Mechanical:** Cable management discussions

# Diagram Link



# Avionics Week 10 16/18-873F23



## Weekly Results

- Updated solar/torque coil boards
  - Selected LUX sensor instead of incidence angle
  - Selected GPS patch antenna to integrate
- Compiled Zephyr for PyCubed hardware

## Next week

- Update Pycubed hardware
  - (Jetson relay, Jetson comm, solar sensor connections, redundant IMU)
- Continue Zephyr board configuration
- Continue Zephyr integration with FPrime
- Build battery boards

## Blockers

- FPrime requires WSL on Windows, Zephyr not supported on WSL

## Requirements

## Interfaces

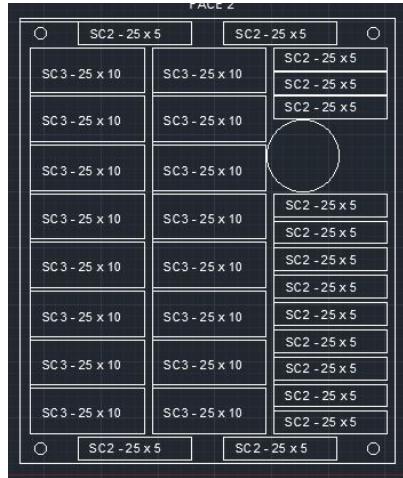
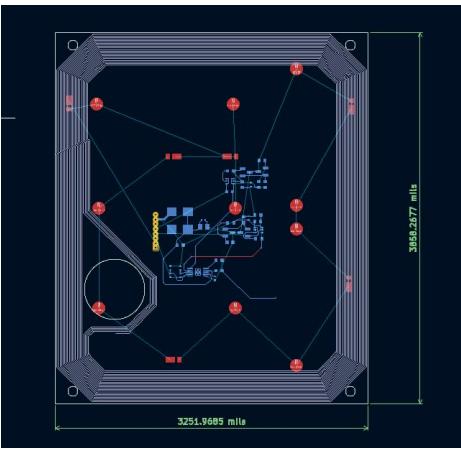
**Vision:** Jetson power estimations

**GNC:** Attitude workload for Jetson power estimate

**Ops:** PyCubed RFM driver

**Mech:** RFM antenna positions (keepouts)

# Avionics Week 9 16/18-873F23



## Blockers

- FPrime deployment setup

## Requirements

- 

## Weekly Results

- Solar cell layout for outer boards
- Torque coil boards v1
- Ordered parts for solar/torque board v1

## Next week

- JPL Meeting
- Update PyCubed hardware (solar sensor & Jetson support)
- FPrime deployment setup
- Driver development

## Interfaces

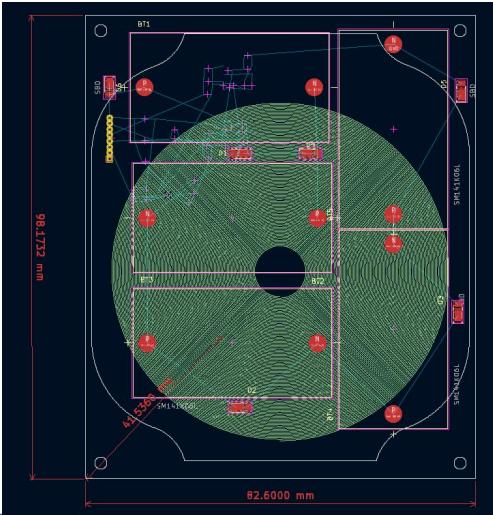
**Vision:** Communication interface between Jetson and PyCubed, Jetson power estimate

**GNC:** Attitude workload for Jetson power estimate

**Ops:** PyCubed RFM driver

**Mech:** Antenna keepouts, deployable panel outline and keepouts

# Avionics Week 8 16/18-873F23



## Blockers

- Mechanical: Camera keepout region, limit switches location for solar/torque coil boards.

## Requirements

- Mechanical: Mounting holes for internal stackup
- Vision: Camera interface selection

## Weekly Results

- Development of solar/torque coil boards
- Chose GPS module (easy integration to PyCubed)
- Power budget updates

## Next week

- Solar/Torque coil board
  - Finish the torque coil integration to PCB
  - Integrate selected solar sensor
- Plan PyCubed redesign
- Finish FPrime deployment setup

## Interfaces

**Vision:** Power estimates for Jetson, waiting for camera hat, connection adapters

**GNC:** FPrime development, solar sensor selection, GPS selection

**Ops:** None

**Mech:** Chose silicon solar cells, number of burn wires

To-do 15

... +

In progress 8

Complete 13

▼ Hardware 23 ... +

📄 Develop Camera Mounts? ↗ ...

Master BOM

📝 List of Data from Avionics for Ops

Rohan Raavi

🤖 GPU Payload Board (ML Board)

Rohit Banjal

. Nischal Mahadeshwar Rohan Raavi

☀️ Solar Estimation for Solar Board Design

Harry Rosmann Rohit Bangal

+ New

⚡ Solar & Torque Coil Boards

N. Nischal Mahadeshwar

📄 Choose solar sensor

N. Nischal Mahadeshwar

Karen Abruzzo Harry Rosmann

🕹️ Update Block Diagram

Harry Rosmann

📄 Burn Wire Mapping

N. Nischal Mahadeshwar

Plan PyCubed Redesign

Harry Rosmann

N. Nischal Mahadeshwar

📄 Order GPS

Harry Rosmann

⚡ Power Budget

H. Harry Rosmann R. Rohit Bangal

R. Rohan Raavi Y. Yifan Yan

K. Karen Abruzzo

💻 PyCubed Hardware Overview

H. Harry Rosmann R. Rohit Bangal

N. Nischal Mahadeshwar

SOLVED: USING PYCUBED LORA;  
Meeting with Ops team for LoRA  
module selection and power  
consumption associated with it.

1

Find Suitable Jetson Carrier Board

Find solar boards

📄 Specification of LoRA module  
recommended by OPS.

N. Nischal Mahadeshwar

⌚ Select IMU based on GNC  
requirements

R. Rohan Raavi H. Harry Rosmann

1

📄 Integrate GPS into PyCubed

H. Harry Rosmann

Driver for RFM

Driver for Cameras

Driver for IMU

Driver for GPS

Driver for Torque Coils

Driver for Solar Sensors

Driver for SD Card

Driver for Watchdog

Driver for Jetson/Pycubed Comm

Driver for Burn Wires

+ New

Generate FPrime Executable



Karen Abruzzo



Yifan Yan



Rohan Raavi



Harry Rosmann

+ New

Configure FPrime to compile for PyCubed



Harry Rosmann

Driver Implementation Timeline



Harry Rosmann

+ New



Add cover Add comment

# Sprint Planning Timeline

Add new sprint

▼ @Next Wednesday for Sprint #1 (11/1/2023)

Finish deployment setup for PyCubed

▼ @November 8, 2023 for Sprint #2 (11/8/2023)

Driver for IMU

Driver for Torque Coils

Driver for Solar Sensors

Driver for Burn Wires

▼ @November 15, 2023 for Sprint 3

Driver for RFM

Driver for Jetson/Pycubed Comm

▼ @November 22, 2023 for Sprint 4

Driver for RFM

Driver for Jetson/Pycubed Comm

▼ @November 29, 2023 for Sprint 5

Driver for GPS

Driver for SD Card

▼ @December 6, 2023 for Sprint 6

Driver for GPS

Additional Overflow

# Avionics Week 6 16/18-873F23

```
s/Utils.dir/CRCChecker.cpp.obj  
[ 98%] Linking CXX static library ../../lib/pycube  
d/libUtils.a  
[ 98%] Built target Utils  
[ 98%] Generating TlmLinearChanComponentAc.cpp, Tl  
mLinearChanComponentAc.hpp  
[100%] Generating TlmLinearChanComponentAi.xml  
Scanning dependencies of target Svc_TlmLinearChan  
[100%] Building CXX object Svc/TlmLinearChan/CMake  
Files/Svc_TlmLinearChan.dir/TlmLinearChan.cpp.obj  
[100%] Building CXX object Svc/TlmLinearChan/CMake  
Files/Svc_TlmLinearChan.dir/TlmLinearChanComponent  
Ac.cpp.obj  
[100%] Linking CXX static library ../../lib/pycube  
d/libSvc_TlmLinearChan.a  
[100%] Built target Svc_TlmLinearChan
```

Successfully compiled FPrime for PyCubed

## Blockers

- None

## Requirements

- Keepouts for camera on solar boards

## Weekly Results

- Integrated toolchain to compile FPrime for ARM device
- Battery board verified and ordered

## Next week

- Flash one of the Pycubed boards with FPrime (need toolchain to output executable)
- Implement a blink test on Pycubed board using FPrime
  - IMU data
- Develop and order torque coil boards

## Interfaces

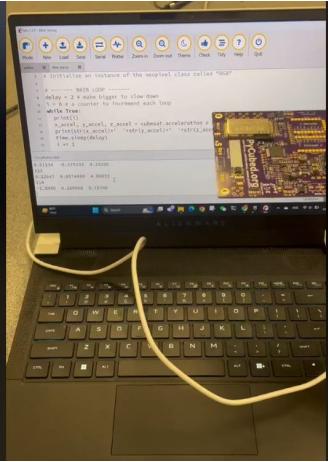
**Vision:** Software support for interfacing with cameras using Jetson. 6 Camera HAT board discussion.

**GNC:** Get GNC setup to start developing flight software

**Ops:** Develop RFM interface on FPrime

**Mech:** Deployables, solar cells, mounting holes

# Avionics Week 5 16/18-873F23



## Collecting IMU data:

<https://drive.google.com/file/d/1Q1CBaLEFpnNZ1WbjKNR-YIwaHFroKiW/view?usp=sharing>

## Blockers

- 

## Requirements

- Mechanical: Need to know internal layout of cameras so we can adjust board designs

## Weekly Results

- 2 more PyCubed assembled and powered successfully
- Basic example codes tested - NeoPixel, IMU

## Next week

- FPrime onboarding, run FPrime on PyCubed
- Start development of Solar Cell/ Magnetic torque coil board.
- Start development of battery board.

## Interfaces

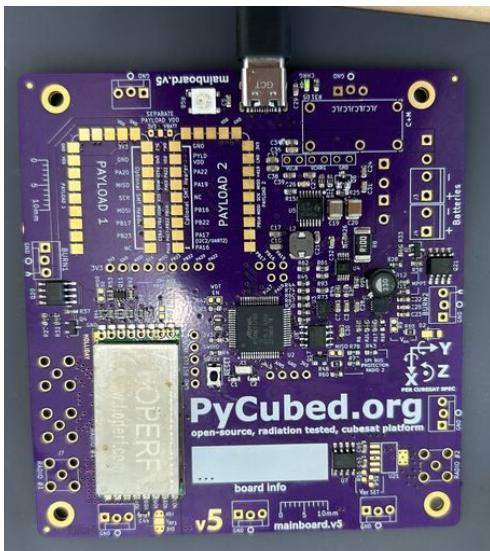
**Vision:** Software support for interfacing with cameras using Jetson

**GNC:** F' meeting

**Ops:** F' & RFM meeting

**Mech:** Internal layout, deployables, solar cells

Avionics Week 4 16/18-873F23



## Weekly Results

- First PyCubed assembled and powered successfully
  - Updates to power budget

## Next week

- Initial interfaces test on PyCubed module.
  - Build 2 more PyCubed boards.
  - Start designing Camera/ Solar and magnetic torque coil boards.
  - Evaluate off the shelf/ design the Carrier Board for Jetson compute Module.

## Blockers

- Camera selection for hardware development

## Requirements

- Actual compute module power consumption

Interfaces

**Vision:** Communication interface with ML module and control module

GNC: Meeting about software stack

## Ops: Meeting about software stack

**Mech:** Fitting all six cameras with telephoto lens inside the CubeSat (PCB outline and arrangement)

# Avionics Week 3 16/18-873F23

## Block Diagram V1.1

### Blockers

- Waiting for the PyCubed board to arrive
- Parts selections for more accurate power budget estimation

### Weekly Results

- Created initial estimated Power Budget for major components
- Created more Fleshed Out Block Diagram
- Did initial Research on PyCubed Software Stack and F Prime Flight Software
- Started Designing the Drivers for Magnetic Torque Coils

### Next week

- Select software stack - CircuitPython or F Prime
- Talk with GNC Team about dividing Software Work
- Build pycubed boards for initial integration testing.

### Interfaces

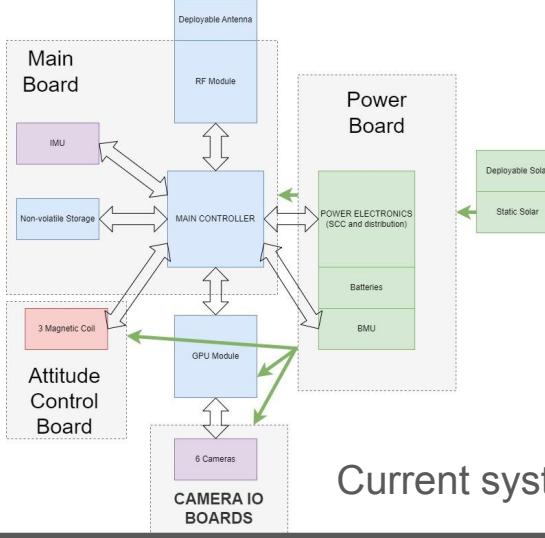
**Vision:** Compute module(s?) and camera selection

**GNC:** Division of software work, torque coil specifications

**Ops:** Develop command and data list for transmission

**Mech:** None

# Avionics Week 2 16/18-873F23



Current system block diagram

## Blockers

- None

## Requirements

- Camera and Processor specs from vision team
- IMU and Coil requirements from GNC team

## Weekly Results

- Created block system level diagram
- Discussed with all other teams about primary requirements
- Updated requirements

## Next week

- Get PyCube board running and run simple interface code with available sensors or other boards
- Solar estimation to determine whether we need deployable panels
- Power source and drain calculations with burst usage availability

## Interfaces

### Vision

- Camera and Processor Specs
- # of cameras and duty cycle

### GNC

- Power consumption of magnetic torque coils
- Orbit estimation for determining solar power, comm time

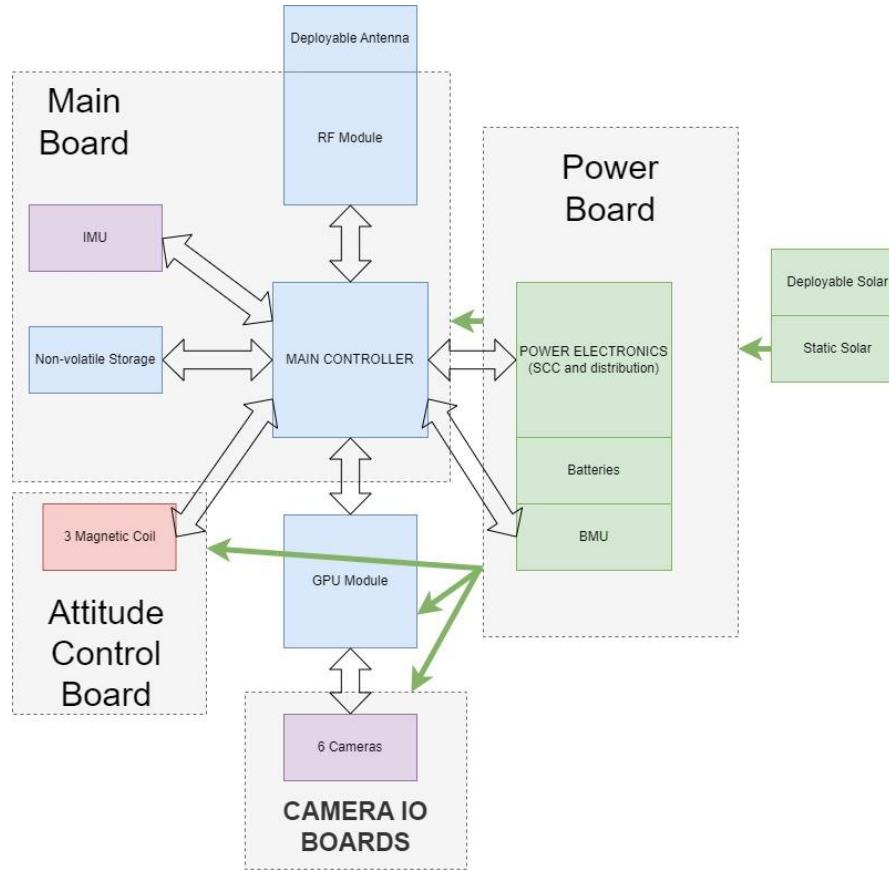
### Ops

- Data input and output
- Detailed power consumption for RF Module

### Mech

- Board dimensions and mounting options
- Deployable Switches

# Hardware Block Diagram



# Avionics Week X 16/18-873F23

