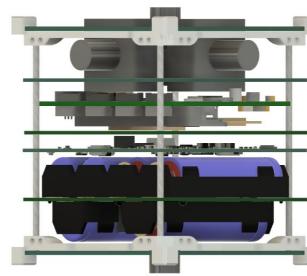


Mechanical Quad Chart- 2/5/2024

Updates

- Battery location, camera board, +z face, new cutouts, torque coil problems, gps and antenna



Milestones

- Collaboration with Avionics
 - Finalized keep out regions on all faces
 - Adjusted Pycube board
 - Spi Cameras: 25mm -> 33 mm
 - Worked through Solar Cell stack up issue
- Finished reconstructing and updating new geometry in Thermal Desktop
- Sent in v1 chassis order for PCB way
- Printing updated antenna mount based COM prototype

Team Blockers/Questions

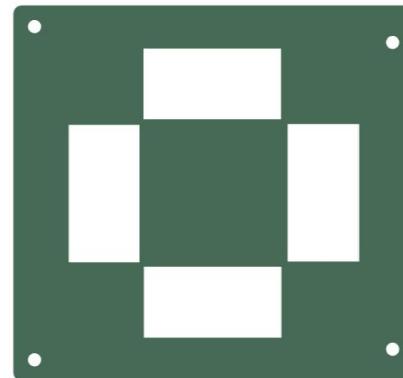
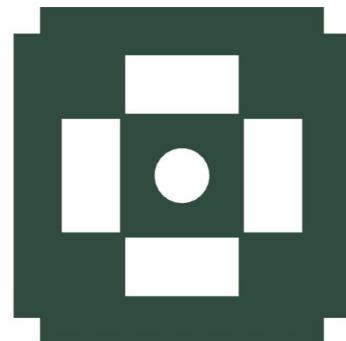
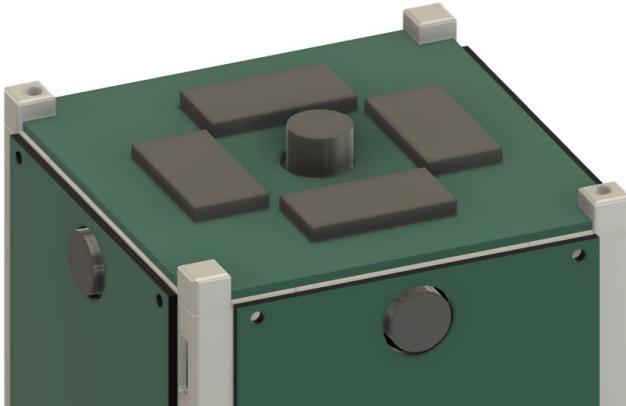
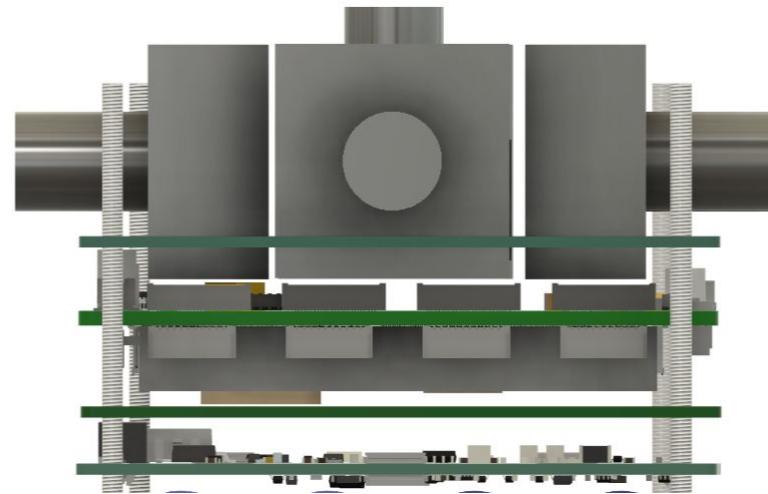
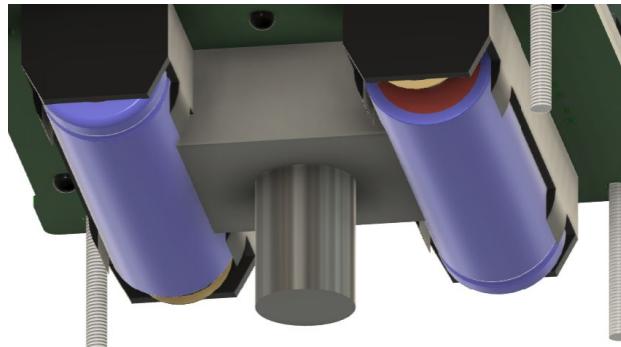
- Waiting on boards and parts to arrive
- Clean room updates?

Cross Team interfaces

- Avionics: board connections, board cutouts
 - Harnessing meeting today
 - Continued work with Spi Cameras

COMS: continuing integrating antenna mount iterations

Design Review this Wednesday



Updated Chassis Order from PCBWay:

Order summary

Subtotal:	\$ 294.90
Shipping Cost:	\$ 23.33
Paypal Fee	\$ 14.62

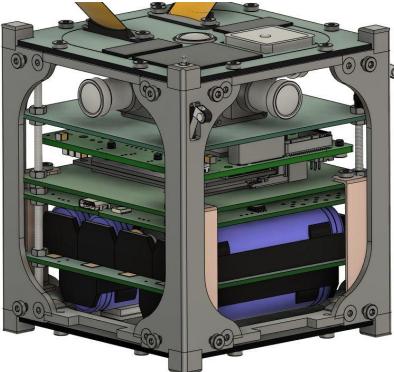
All Total

US \$332.85

- Current estimated machine time is at 9-11 days with 3-5 days of shipping
 - Earliest turnaround time at 12 days or 2/19/24
 - Latest turnaround time at 16 days or 2/23/24
 - Guaranteed arrival by 3/5/24

Mechanical Quad Chart- 1/29/2024

Updates



Team Blockers/Questions

- Waiting on boards and parts to arrive
- Approval of current shopping list for material and shop equipment

Milestones

- Meeting with avionics
 - Adjusted board heights
 - Finalized board cutouts for v1
 - Chassis being sent off for machining v1
 - Obtained quotes
 - Implemented final chassis changes after techspark feedback
 - Deep dive in Thermal Desktop simulation
 - Initiated plan for Jetson thermal management/heat strap

Cross team interfaces

- Avionics: board connections
 - Need the predicted locations of connectors to outer boards for implementation in CAD
- COMS: continuing integrating antenna mount iterations
- Vision: new lenses selected
 - need to integrate in our CAD model if finalized

Chassis Quote 1: Protolabs



Legs_28Jan2024 v2.step
1203-9989-002
Current Revision: 1
Aluminum 6061-T651 UT/ with Materi...
Edges broken (tool marks visible)
Anodizing Type II Clear
Mill
Threading (0 features selected view)
X: 27.85mm Y: 100.00mm Z: 27.85mm
Machining Tolerance: +/- 0.005 in. (0....

[View Analysis](#)
[Configure Part](#)
[Upload Revision](#)
[Part Options ▾](#)

[View analysis details & approve](#)

Quantity: 3

3 Parts @ \$262.84	\$788.52
Anodizing Type II	\$57.00
Total	\$845.52



Top_28Jan2024 v2.step
1254-0771-003
Current Revision: 1
Aluminum 6061-T651 UT/ with Materi...
Edges broken (tool marks visible)
Anodizing Type II Clear
Mill
Threading (27 features selected view)
X: 100.00mm Y: 13.35mm Z: 100.00mm
Machining Tolerance: +/- 0.005 in. (0....

[View Analysis](#)
[Configure Part](#)
[Upload Revision](#)
[Part Options ▾](#)

 Ready to Order!

Quantity: 2

2 Parts @ \$543.05	\$1,086.10
Anodizing Type II	\$53.00
Total	\$1,139.10



Leg_2_28Jan2024 v2.step
1590-1179-002
Current Revision: 1
Aluminum 6061-T651 UT/ with Materi...
Edges broken (tool marks visible)
Anodizing Type II Clear
Mill
Threading (0 features selected view)
X: 27.85mm Y: 100.00mm Z: 27.85mm
Machining Tolerance: +/- 0.005 in. (0....

[View Analysis](#)
[Configure Part](#)
[Upload Revision](#)
[Part Options ▾](#)

[View analysis details & approve](#)

Quantity: 1

1 Part @ \$416.89	\$416.89
Anodizing Type II	\$53.00
Total	\$469.89

Order Summary

Subtotal	\$2,454.51
Shipping	\$31.09
Estimated Tax Tax exempt?	\$139.20
Total	\$2,624.80

[Checkout Now](#)

Chassis Quote 2: Xometry

1 

[Leg_2 28Jan2024 v2.step](#) v0

[Configure Part](#) [Revise CAD](#) [+ Upload Drawings](#) [Remove](#)

Measurement: 100.00 mm x 27.86 mm x 27.86 mm | 6409.95 mm³ / 3.937 in x 1.097 in x 1.097 in | 0.391 in³

Process: CNC Machining

Material: Aluminum 6061-T6

Finish: Clear Anodize

Threads and Tapped Holes: Threads and Tapped Holes, None

Inserts: Inserts: 0

Tolerances: Tightest Tolerance: +/- .005" (+/- 0.13mm)

Surface Roughness: Smallest Roughness: 125uin/3.2um Ra

Inspection: Standard Inspection

Certificates and Supplier Qualifications: ITAR/EAR Registration, Finishing Certification

Quantity

Expedite Made in USA 8 business days	\$684.58 ea.
Standard Made in USA 12 business days	\$464.21 ea.
Economy Made in USA 19 business days	\$386.89 ea.



3 

[Top_28Jan2024 v2.step](#) v0

[Configure Part](#) [Revise CAD](#) [+ Upload Drawings](#) [Remove](#)

Measurement: 100.00 mm x 100.00 mm x 13.35 mm | 16360.26 mm³ / 3.937 in x 3.937 in x 0.526 in | 0.998 in³

Process: CNC Machining

Material: Aluminum 6061-T6

Finish: Clear Anodize

Threads and Tapped Holes: Threads and Tapped Holes, None

Inserts: Inserts: 0

Tolerances: Tightest Tolerance: +/- .005" (+/- 0.13mm)

Surface Roughness: Smallest Roughness: 125uin/3.2um Ra

Inspection: Standard Inspection

Certificates and Supplier Qualifications: ITAR/EAR Registration, Finishing Certification

Quantity

Expedite Made in USA 8 business days	\$998.78 ea.
Standard Made in USA 12 business days	\$614.32 ea.
Economy Made in USA 19 business days	\$499.37 ea.



2 

[Legs_28Jan2024 v2.step](#) v0

[Configure Part](#) [Revise CAD](#) [+ Upload Drawings](#) [Remove](#)

Measurement: 100.00 mm x 27.86 mm x 27.86 mm | 6232.19 mm³ / 3.937 in x 1.097 in x 1.097 in | 0.380 in³

Process: CNC Machining

Material: Aluminum 6061-T6

Finish: Clear Anodize

Threads and Tapped Holes: Threads and Tapped Holes, None

Inserts: Inserts: 0

Tolerances: Tightest Tolerance: +/- .005" (+/- 0.13mm)

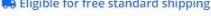
Surface Roughness: Smallest Roughness: 125uin/3.2um Ra

Inspection: Standard Inspection

Certificates and Supplier Qualifications: ITAR/EAR Registration, Finishing Certification

Quantity

Expedite Made in USA 8 business days	\$1,625.07
Standard Made in USA 12 business days	\$1,006.14
Economy Made in USA 19 business days	\$820.92



Lead Time Options

Made in USA

Expedite - 8 Business Days \$4,307.21

Standard - 12 Business Days \$2,698.99

Economy - 19 Business Days \$2,206.55



[Learn About Delivery Options](#)

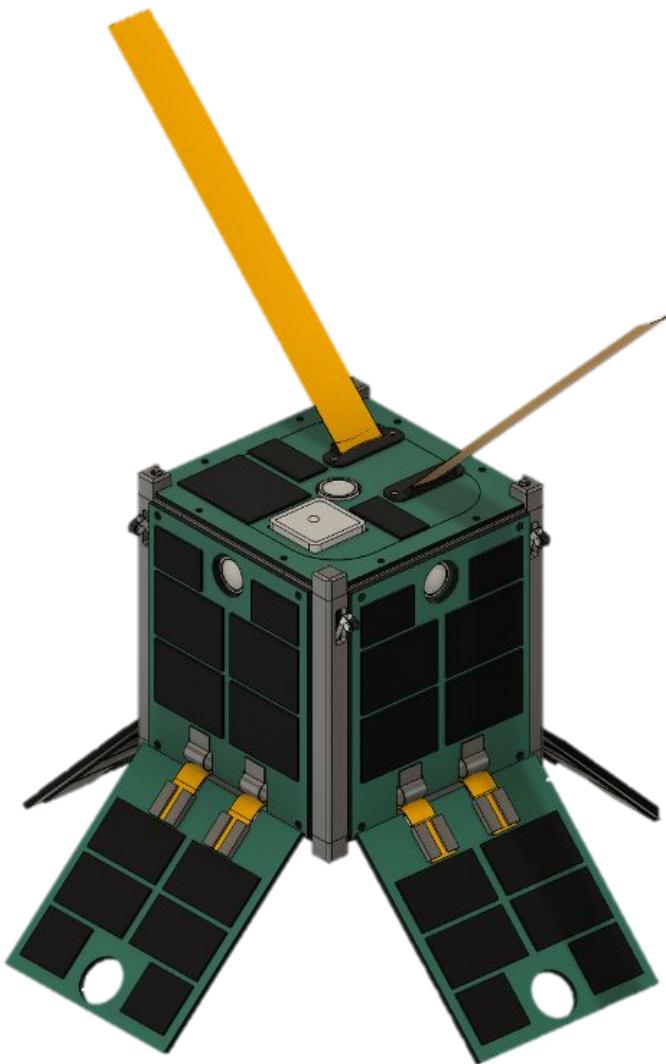
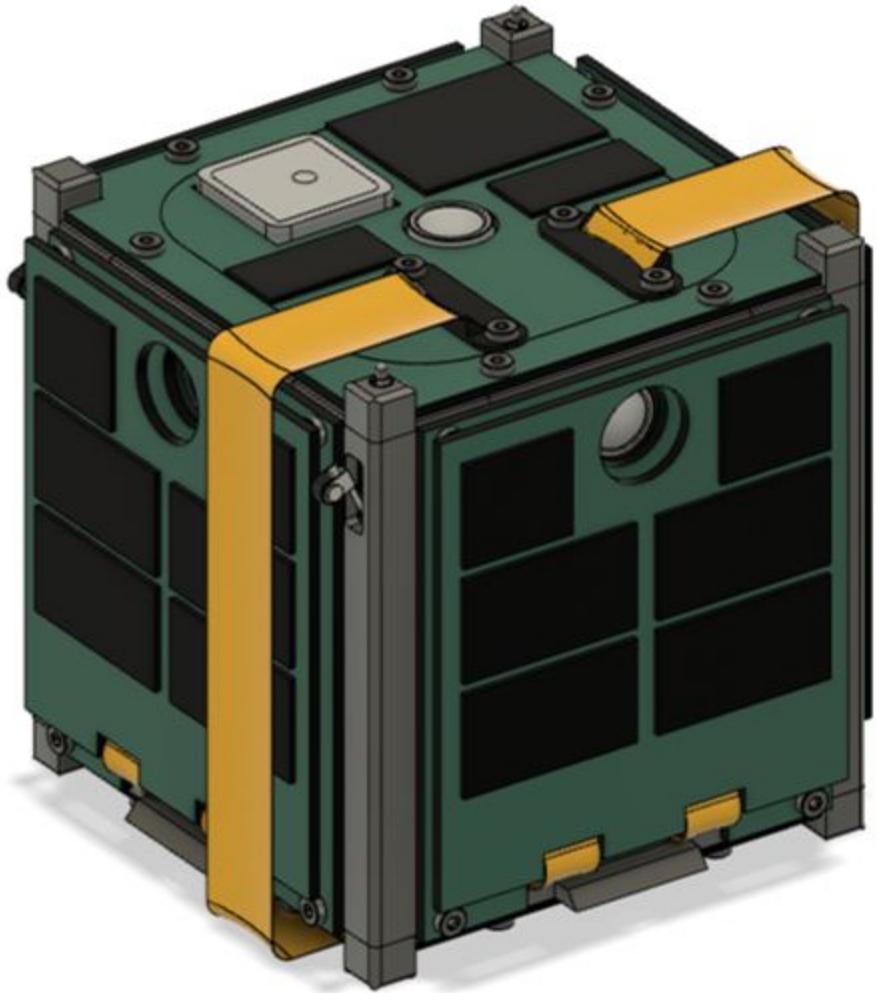
[Apply Promo](#)

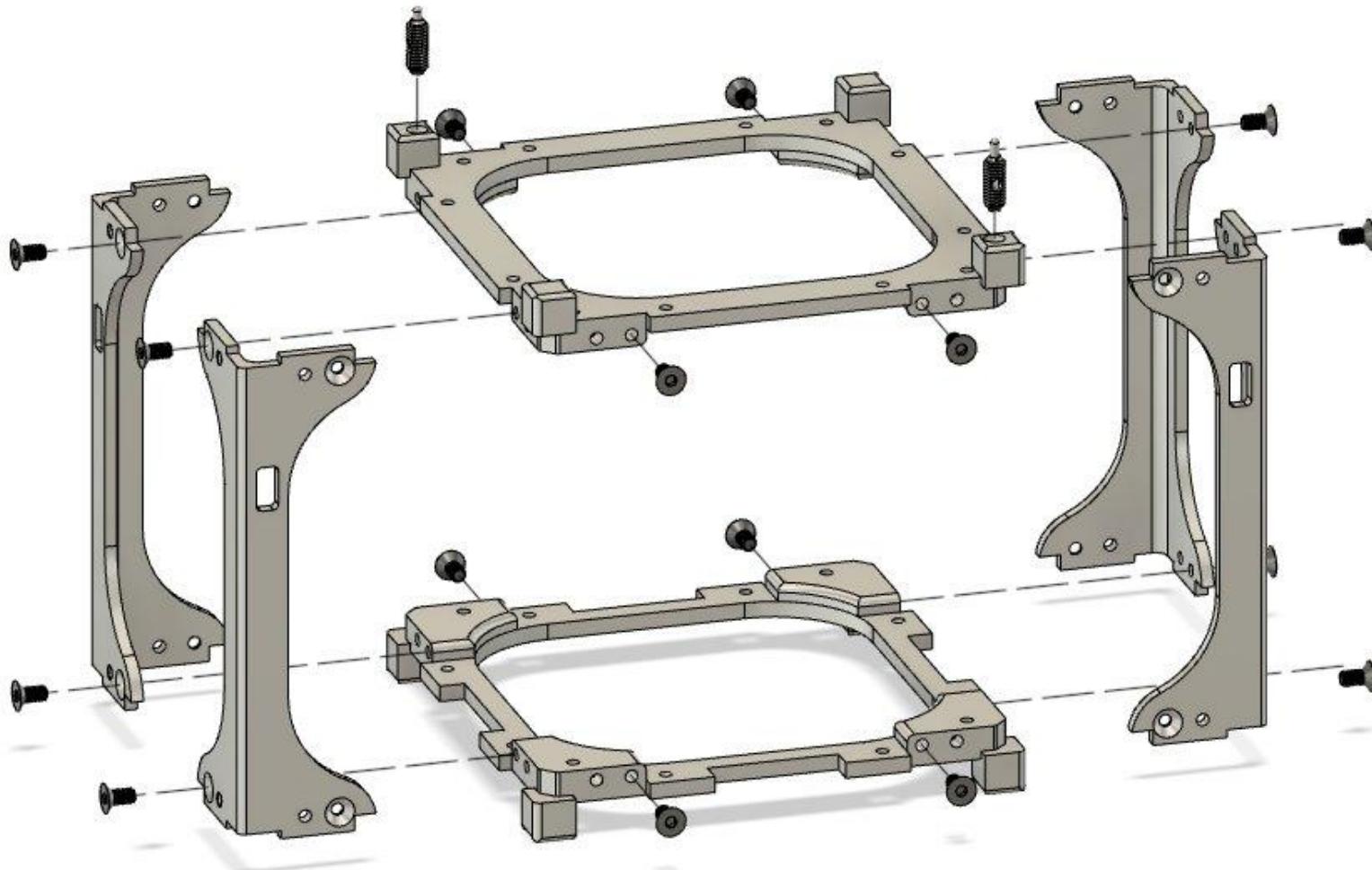
All CNC, Sheet, and 3D printing orders are eligible for free ground shipping!

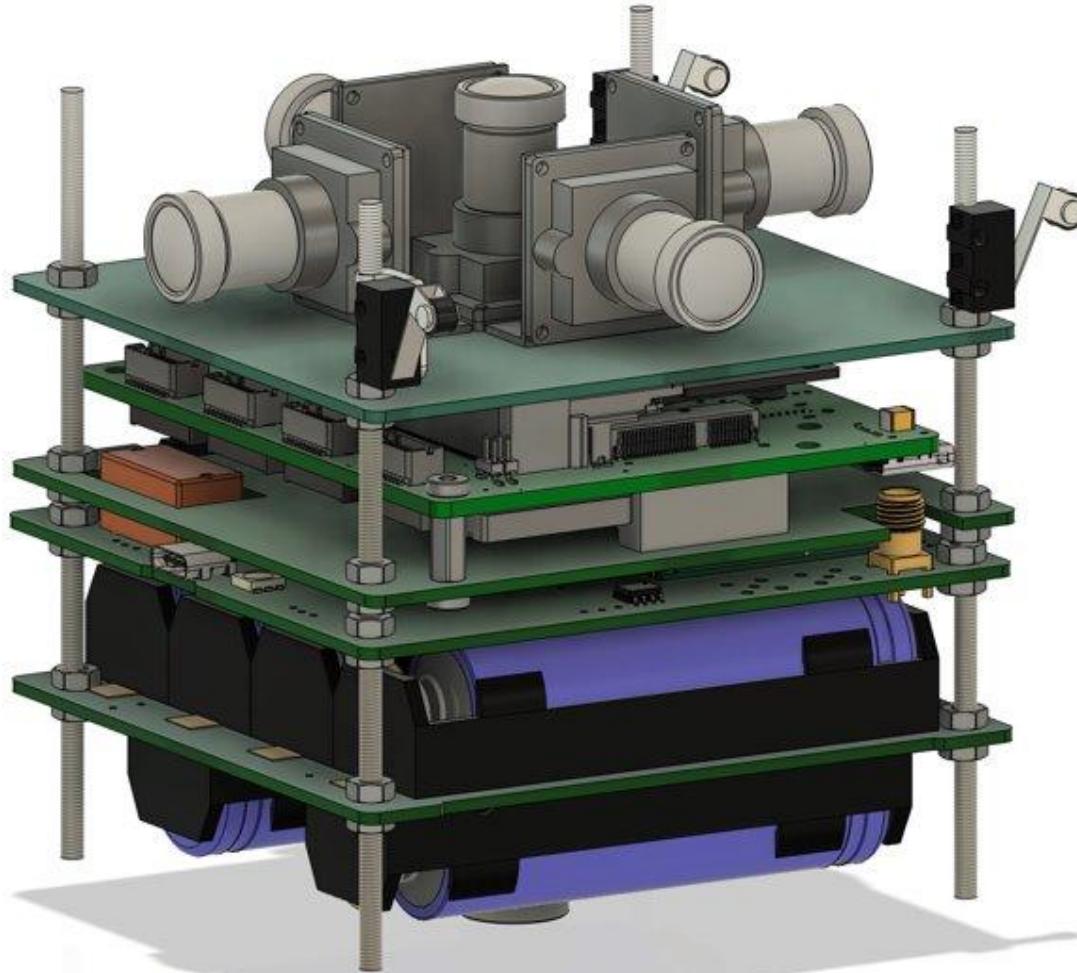
Subtotal **\$2,206.55**

Mechanical Quad Chart- 1/22/2024

Current Status *Semester schedule on next slides	Team Blockers/Questions <ul style="list-style-type: none">- Techspark currently machining parts- Preliminary designs complete- Need to work on board connections and harnessing- Error margins in protrusion analysis- Further work needed on thermal management and heat strap- Need to place order of shop equipment and BOM items
Main PDR Feedback to Address <p>CAD updates:</p> <ul style="list-style-type: none">- Jetson spacing- Tolerances for machining- Deployable panels - protrusion margins and reflections- Inhibit switches location and bracket <p>Thermal:</p> <ul style="list-style-type: none">- TVAC test is must- Heat straps location and vendor quotes- Sun Synchronous simulation <p>Other:</p> <ul style="list-style-type: none">- Recheck CDS requirements and ensure documentation is complete	Cross team interfaces <ul style="list-style-type: none">- Avionics: board connections, solar cells selection and design<ul style="list-style-type: none">- When do you want to order boards (specifically, the outer boards on the XY/deployable side)- Final verification if USB-C port on Jetson carrier board is being used? <p>COMS: antenna</p> <p>GNC: sun sensor design, pyramids?</p>







TENTATIVE

Spring Semester Build

Schedule

January

Week of 1/22:

- Make small design and fitment changes to chassis and interior board stack
 - Update drawings to be machined
 - Work with avionics on finalizing board stack
 - Integrate heat strap
- Reach out to TVAC and Vibe facilities for availability/pricing
- Establish plan for chassis machining
- Place order for shop equipment

Week of 1/29:

- Place order for needed build material and components for build
- Adjust thermal desktop simulation to a sun synchronous orbit
- Finalize plan for heat strap
 - Reach out to vendors for quotes
- Finalize design of outer PCB boards and work to order with avionics
- Identify clean room and start preparing for build

February

Week of 2/5:

- Meet with Anh from PDR review to finalize all mechanical aspects of design?
- All parts arrive
 - Organize and prepare work spaces
- Add further detail of thermal simulations
- Begin working on random vibe simulations

Week of 2/12:

- Final design of chassis being machined
- Ensure all internal board stack materials and boards have arrived
- Ensure all external deployable materials and boards have arrived

Week of 2/19:

- Start building initial internal board stack
- Start building initial exterior deployable and exterior components
- Start working on harnessing between boards with avionics

Week of 2/26:

- Receive final machined chassis
- Start integrating build of board stack and exterior deployables onto machined chassis
- Prepare for another round of design review

March

Week of 3/4:

- Spring break no classes
- Try to make small adjustments to build and add detail to simulations

Week of 3/11:

- Hold design review meeting of built design
- Make TVAC testing plan
 - Cross check against thermal simulations
- Make vibe testing plan

Week of 3/18:

- Make adjustments to design and initial build based on review meeting
- Time for any schedule slippage during build
- Have simulations finalized and ready for TVAC and vibe testing
- Perform testing of all deployables and burn wire

Week of 3/25:

- Prepare for TVAC and vibe testing
- Schedule TVAC and vibe testing dates
- Make adjustments to design and build based on review meeting
- Time for any schedule slippage during build

April

Week of 4/1:

- Build final flight model
- Build final engineering units

Week of 4/8:

- Spring Carnival Week
- Make any changes to final build

Week of 4/15:

- Finish final builds
- Potential TVAC and Vibe testing dates

Week of 4/22:

- Final testing with all subteams
 - Ensure all features function as intended
- Prepare for final CDR meeting and send off

Week of 4/29:

- Work on CDR presentation
- Have CubeSat flight model DONE

May

Week of 5/6:

- CDR presentation week?
- Final Exams and Grades due on Wednesday (5/8)

Week of 5/13:

- Graduation

Draft Overview of Tentative Spring Build Schedule

January

- Redo camera mounts
- Quotes for everything
 - Machining
 - Vibration
 - TVAC
- Deployables redesign/update
- Update CAD drawings
- Try to schedule testing dates
 - Ask paulo advice on this
- *** adjust avionics stack
 - Final plan for stack/connections, etc.
- Have plan for manufacturing of chassis
- Add detail to thermodesktop simulation
 - Help inform heat strap decision
- Organize and prep all materials, designs and work with other
- Figure out where the clean room is/if we need to order our own bunny suits/hats
 - Start communicating with them about scheduling
- Make decision on outer/deployable boards with avionics and order

Feb

- Beginning of Feb
 - Final design meeting (with Anh?)
 - parts /hardware/tools arrive
- Begin build/order chassis
- End of Feb
 - Board stack built
 - Deployable panels built
 - Chassis built
 - Pretty close to final
- Make plan for final design edit to chassis/stack

March

- Begin final build/order chassis
- Choose companies to do our testing
- Burn wire testing/practice
- Continue build

Draft Overview of Tentative Spring Build Schedule

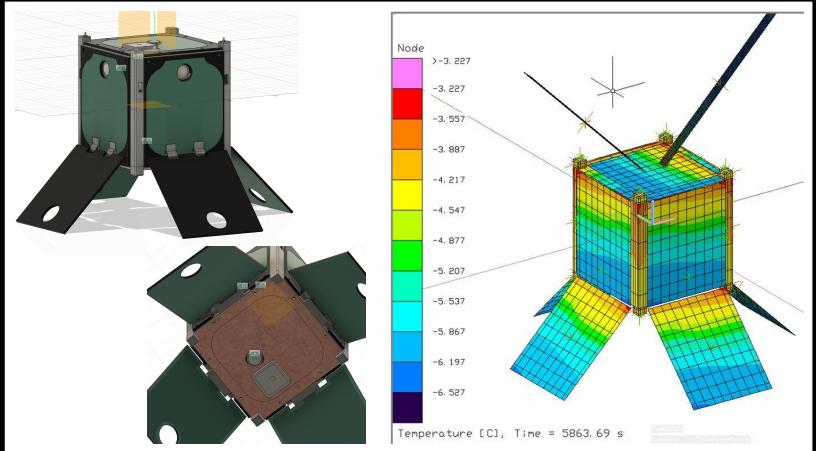
April

- TVAC and vibe testing ideally
- Full scale integration done
- Complete testing with all subteams
 - Comms
 - Camera functionality
 - Gnc and detumbling
 - Fully working software
- Ensure deployables work

May

- Final test runs of satellite
- CDR presentation
- Prepare for Launch

Mechanical Quad Chart- 11/15/2023



Team Blockers

- Endurosat...????
 - Really only for comparison at this point...
- Avionics: none
- Coms/Ops: none
- Vision: none
- GNC: none
- Copper vs aluminum as radiator
- **Report internal components and materials for the PDR BOM**
 - submit to us by 11/26 (preferably earlier)

Milestones

- Tech Spark moving forward with machining
- Initial Thermal Simulation running
- CAD updates for Jetson carrier board
- Camera board updates
- -Z face update
 - Radiator for thermal management
 - Heat pipes considerations
- Mass budget updates

Next Week

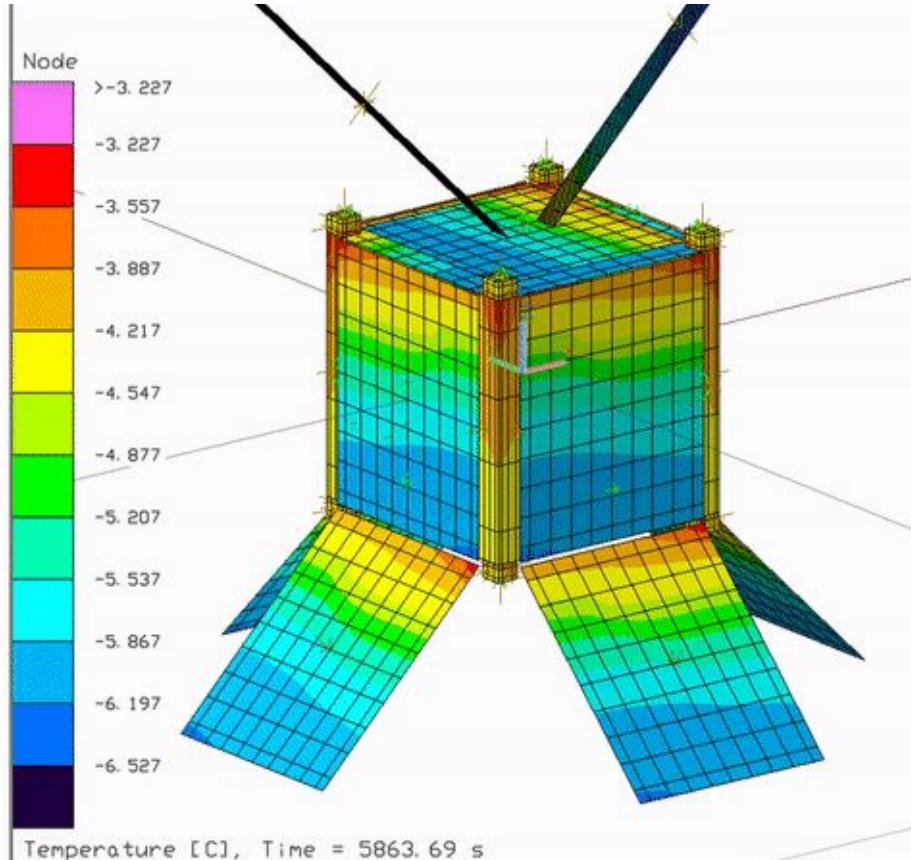
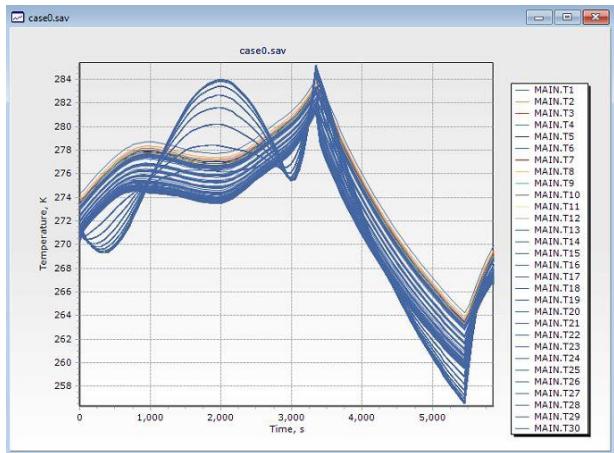
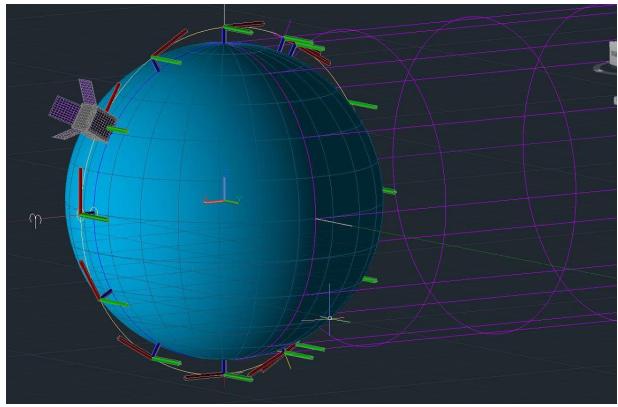
- Ribbon cables/power cable placement
- Test of antenna mount with Comms & Ops
- PDR presentation

Cross team issues and interfaces

-
- Avionics- meeting Thursday or Friday for connectivity
- GNC- team meeting for Helmholtz coil timeline
- Comms/Ops- antenna mount iterations



One Full Polar Orbit:

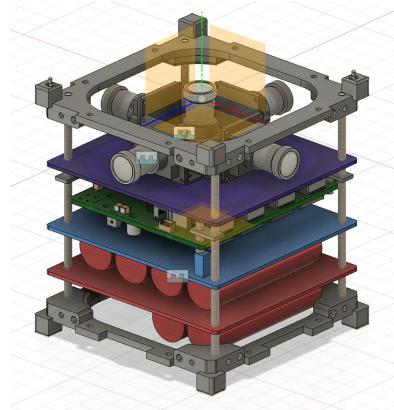
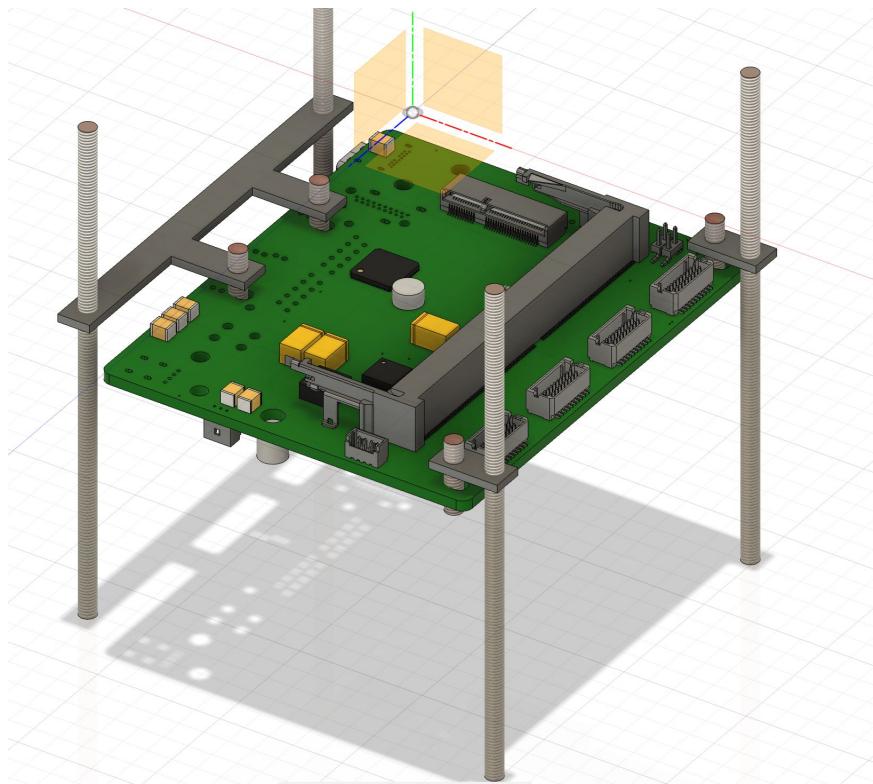


Lab Shopping List:

Item	Quantity	Unit Cost	Total Cost	Link to Purchase
hand tool set	1	\$135.99	\$135.99	https://www.amazon.com/dp/B03C3VH7FDW/ref=sspa_dk_detail_4?pf_rd_p=f7341d2a-0b94-4a26-ad34-e1b9e6a5a75&pf_rd_r=XD92XSRBFQXBJZQCA
screw driver set	1	\$33.99	\$33.99	https://www.amazon.com/HORUSDY-100-Piece-Screwdriver-Electrician/dp/B07BT2PVTW/ref=sr_1_16?cid=3880VU1HL4CK&keywords=scre
Epoxy	1	\$3.59	\$3.59	https://www.amazon.com/Locite-Instant-0-47-Fluid-Syringe-136588/dp/B004F9KFKl/?th=1
Epoxy Dispenser Gun	1	\$19.99	\$19.99	https://www.amazon.com/NEWCOMDIGI-Dispenser-Impression-Dispensing-Applied/dp/B07Y45N1TP/
loctite (purple 222ms)	2	\$15.99	\$31.98	https://www.amazon.com/Genuine-Henkel-Locite-Threadlocking-Adhesive/dp/B072JTXPG6/ref=asc_df_B072JTXPG6/?tag=hprod-20&linkCode=df0&hvadid=1700
Nitrile Gloves - Large	1	\$9.99	\$9.99	https://www.amazon.com/MedPride-Powder-Free-Nitrile-Gloves-Medium/dp/B00GSVGP6/
Nitrile Gloves - Medium	1	\$9.99	\$9.99	https://www.amazon.com/MedPride-Powder-Free-Nitrile-Gloves-Medium/dp/B00GSW3T4/
expoy masks	3	\$16.14	\$48.42	https://www.amazon.com/Respirator-mask-Filters-Set-Woodworking/dp/B09V2LVTB/d?ref_sr_1_4?cid=50A4GR57W38V&keywords=resin+mask&qid=1700
cotton swabs	1	\$9.99	\$9.99	https://www.amazon.com/Precision-Double-ended-Excellent-Effective-Personal/dp/B086D9QWN4/ref=sxin_17_pa_sp_search_thematic_ssap?content_id=a
Tap and die set (PURCHASED)	1	\$95.76	\$95.76	https://www.mcmaster.com/26025A41/
punch and chisel set	1	\$48.07	\$48.07	https://www.mcmaster.com/3535A12/
rubber mallet	1	\$24.84	\$24.84	https://www.mcmaster.com/6051A29/
nylon nuts and bolts M3 (for tuning antenna)				
fishing line/burn wire				
precision scale	1	\$290.65	\$290.65	https://www.mcmaster.com/1760T9/
exacto knives	4	\$4.65	\$18.60	https://www.mcmaster.com/35435A11/
cutting mat	1	\$41.95	\$41.95	https://www.mcmaster.com/70875A13/
scissors	3	\$24.31	\$72.93	https://www.mcmaster.com/3438A47/
long nosed bottle for cleaning	3	\$5.29	\$15.87	https://www.amazon.com/Economy-Bottle-Squeeze-Medical-Tattoo/dp/B00WTHLR18/ref=asc_df_B00WTHLR18/?tag=hprod-20&linkCode=df0&hvadid=1700
table clamps	3	\$12.34	\$37.02	https://www.mcmaster.com/5070A16/
table vise	1	\$86.91	\$86.91	https://www.mcmaster.com/5312A3/
alligator clamps	1	\$24.19	\$24.19	https://www.mcmaster.com/5007A17/
calipers	2	\$193.71	\$387.42	https://www.mcmaster.com/8647A43/
electrical tape	1	\$11.78	\$11.78	https://www.amazon.com/3M-Scotch-Electrical-Value-10457NA/dp/B001B19FDK/ref=sr_1_10?cid=2LDFFF7Y9H1R0&keywords=electrical%2Btape&qid=1
duct tape	1	\$33.11	\$33.11	https://www.amazon.com/3M-Industrial-Strength-Multi-Use-Professional/dp/B0977P9W4X/ref=sr_1_2_ssap?cid=21NHQ081ZDCV1&keywords=duct+tape&qid=1
masking tape	1	\$7.50	\$7.50	https://www.amazon.com/Scotch-Office-Masking-3436-3-4-inch/dp/B00347ABE4/ref=sr_1_16?cid=2lG2h12QYBEUCH&keywords=masking%2Btape&qid=1
stacking bins/tower with drawers	1	\$29.99	\$29.99	https://www.amazon.com/Ykpogir-Organizer-Stackable-Storage-Accessories/dp/B0BVY6JXP/ref=sxin_17_pa_sp_search_thematic_ssap?variant=39371669176423
Pro Dust Blower	1	\$18.99	\$18.99	https://www.ifixit.com/products/dust-blower?variant=39371669176423
Anti Static Brush - Small	2	\$2.99	\$5.98	https://www.ifixit.com/products/anti-static-brush
anti Static Brush - medium low profile	2	\$3.99	\$7.98	https://www.ifixit.com/products/anti-static-brush?variant=39371675369575
anti Static Brush - medium	2	\$2.99	\$5.98	https://www.ifixit.com/products/anti-static-brush?variant=3937167527121
Kim wipes	1	\$16.31	\$16.31	https://www.amazon.com/Professional-Kimtech-Science-Kimwipes-280/dp/B00T24KABO/
Shop towels	1	\$18.38	\$18.38	https://www.amazon.com/Scott-Shop-Towels-12-rolls/dp/B00NO7BWJE/
Banana connectors	1	\$8.99	\$8.99	https://www.amazon.com/VCELINK-Speaker-Banana-Plugs-Open-Connectors/dp/B0897LB83Z/
toothpicks	1	\$4.91	\$4.91	https://www.amazon.com/1000-Count-Natural-Bamboo-Toothpicks/dp/B00PBK4NG6/
5 minute epoxy	1	\$9.99	\$9.99	https://www.amazon.com/Bob-Smith-Industries-BSI-201-Cuik-Cure/dp/B0166FFFD4/
Spreading sticks	1	\$7.49	\$7.49	https://www.amazon.com/Mibly-Style-Assorted-Wooden-Sticks/dp/B091FLVBBQ/
Scotchweld 2216	1	\$7.92	\$7.92	https://www.mcmaster.com/75045A65/
Dremel	1	\$62.79	\$62.79	https://www.amazon.com/Dremel-3000-1-24-Attachment-Accessories/dp/B005JRJE56/
Dremel polishing wheels	1	\$12.99	\$12.99	https://www.amazon.com/Rocaris-Abrasives-Buffing-Polishing-Dremel/dp/B075C72PGK/
Dremel cutting wheels	1	\$8.99	\$8.99	https://www.amazon.com/Dremel-409-Cut-off-Wheels-thick/dp/B0000UDGX/
Wire Stripper	1	\$15.16	\$15.16	https://www.amazon.com/Hakko-CSP-30-1-Stripper-Maximum-Capacity/dp/B00FZPHMUG/
Straight Tweezers	1	\$4.50	\$4.50	https://www.sparkfun.com/products/10603
Curved Tweezers	1	\$4.50	\$4.50	https://www.sparkfun.com/products/10602
Super Glue	1	\$2.59	\$2.59	https://www.amazon.com/Scotch-Super-Glue-0-07-Ounce-2-Pack/dp/B0013FS1KC/
Sandpaper	1	\$9.99	\$9.99	https://www.amazon.com/Fandeli-Sandpaper-Furniture-Finishing-Automotive/dp/B08F8HKJK1?ref_=ast_sto_dp
Non Precision Scale	1	\$11.02	\$11.02	https://www.amazon.com/AmazonBasics-Stainless-Digital-Batteries-Included/dp/B06X9NQ8GX/
Post-IT Notes	1	\$11.50	\$11.50	https://www.amazon.com/3M-Miami-Post-Sticky-4423-155SMA/dp/B078XG2KRS/
Trash Can	2	\$20.49	\$40.98	https://www.amazon.com/AmazonCommercial-Gallon-Commercial-Office-Wastebasket/dp/B08PDV3YY7/
Bins - Small	2	\$51.99	\$103.98	https://www.amazon.com/dp/B01H2NWCGM/?ref=emc_b_1_1?th=1
ESD Bags	1	\$9.99	\$9.99	https://www.amazon.com/Electronics-Graphics-Resealable-Computer-Accessories/dp/B089KRQ8XB/
Desk Organizer	2	\$15.99	\$31.98	https://www.amazon.com/Organizer-Supplies-Storage-Accessories-Compartments/dp/B08BGCRV95P/
Deionized Water	1	\$17.49	\$17.49	https://www.amazon.com/Premium-Grade-Laboratory-Demineralized-Purification/dp/B06ZZ75FGT/
Acetone	1	\$17.09	\$17.09	https://www.amazon.com/Proto-100-Pure-Acetone-Professional/dp/B009WT4464/
Magnets	1	\$10.48	\$10.48	https://www.amazon.com/Lovimag-Whiteboard-20-Refrigerator-Classroom/dp/B09TD1FDT1/
Mixing Cups	1	\$5.30	\$5.30	https://www.mcmaster.com/1865T77/

Total Cost: \$2,089.76

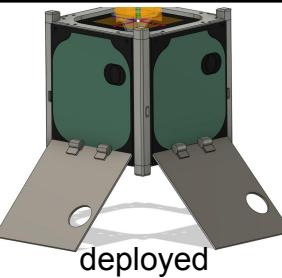
Jetson carrier board mount



Mechanical Quad Chart- 11/8/2023

Update

stowed



deployed



Milestones

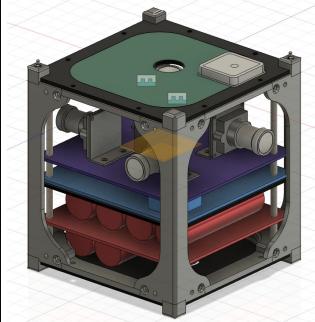
- Deployment mechanism in CAD
 - Outer PCB design, hinge & tape measure mount
- Thermal desktop simulation on going
- Preliminary ribbon cable planning
- Antenna mount update and redesign
- Three 3rd party CNC quotes obtained

Next Week

- Structural changes to accommodate new deployable hinge
- Further work on design of ribbon cables
- Test of antenna mount with Comms & Ops
- Initial work on PDR requirements
- Update detailed mass budget

Team Blockers

- Avionics
 - mass of designed boards with components
 - Confirmation on ribbon cables
- Thermal Desktop licensing issues
 - Switching over to Ansys Workbench
- Confirmation on 3rd party CNC quotes



Cross team issues and interfaces

- Boards - continue to reference PC104 document on mechanical wiki
- **Report internal components and masses so we can start formulating testing protocols more fully (thermal, etc.)**
- Need to figure out tape measure mounting for deployable solar panels - holes vs epoxy
- Got information on GPS modules, planning to mount on top and bottom

Obtained Quote: Protolabs

 Frame Top Test v2.step
1852-7138-002
Current Revision: 1
Aluminum 6061-T651 UT/ with Material Cert
Edges broken (tool marks visible)
Anodizing Type II Clear
Mill
Threading (0 features selected view)
X: 100.00mm Y: 100.00mm Z: 14.35mm
Machining Tolerance: +/- 0.005 in. (0.13mm)

Quantity: 2

[View analysis details & approve](#)

Order by:
Today 8:10 PM

Expedite Fri, Nov 17	Expedite Mon, Nov 20	Standard Tue, Nov 21	Economy Tue, Nov 28	Economy Tue, Dec 5	Economy Wed, Dec 13
+ \$611.62	+ \$322.80		- \$161.40	- \$237.85	- \$305.81

Receive by:
Tue, Nov 21

[Get volume pricing from Hubs](#)

Total \$760.88

 Frame Legs Test v2.step
1573-2174-003
Current Revision: 1
Aluminum 6061-T651 UT/ with Material Cert
Edges broken (tool marks visible)
Anodizing Type II Clear
Mill
Threading (0 features selected view)
X: 27.85mm Y: 27.85mm Z: 100.00mm
Machining Tolerance: +/- 0.005 in. (0.13mm)

Quantity: 4

[View analysis details & approve](#)

Order by:
Today 8:10 PM

Expedite Fri, Nov 17	Expedite Mon, Nov 20	Standard Tue, Nov 21	Economy Tue, Nov 28	Economy Tue, Dec 5	Economy Wed, Dec 13
+ \$746.99	+ \$394.24		- \$197.12	- \$290.49	- \$373.49

Receive by:
Tue, Nov 21

[Get volume pricing from Hubs](#)

Total \$940.56

Obtained Quote: Xometry

 [Configure Part](#) [Revise CAD](#) [+ Upload Drawings](#) [Remove](#)

⚠ Drawing Required

Quantity **2**

Measurement: 100.00 mm x 100.00 mm x 14.35 mm | 18211.63 mm³ / 3.937 in x 3.937 in x 0.565 in | 1.111 in³

Process: CNC Machining

Material: Aluminum 6061-T6

Finish: Clear Anodize

Threads and Tapped Holes: Threads and Tapped Holes, None

Tolerance: Tightest Tolerance: +/- .004" (+/- .102mm), Locations: 1

Surface Roughness: Smallest Roughness: 125uin/3.2um Ra

Inspection: Standard Inspection

Certificates and Supplier Qualifications: Finishing Certification

Expedite Made in USA 6 business days	\$826.34 ea.	\$1,652.68
Standard Made in USA 10 business days	\$487.74 ea.	\$975.48
Economy Made in USA, Canada, or Mexico 16 business days	\$400.32 ea.	\$800.64
Economy Made Internationally 13 business days	\$182.34 ea.	\$364.68

 [Configure Part](#) [Revise CAD](#) [+ Upload Drawings](#) [Remove](#)

⚠ Drawing Required

Quantity **4**

Measurement: 100.00 mm x 27.86 mm x 27.86 mm | 6282.16 mm³ / 3.937 in x 1.097 in x 1.097 in | 0.383 in³

Process: CNC Machining

Material: Aluminum 6061-T6

Finish: Clear Anodize

Threads and Tapped Holes: Threads and Tapped Holes, None

Tolerance: Tightest Tolerance: +/- .004" (+/- .102mm), Locations: 1

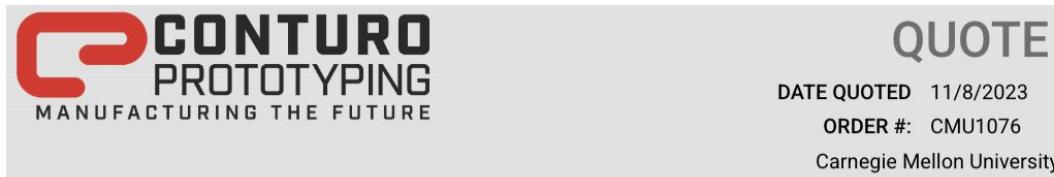
Surface Roughness: Smallest Roughness: 125uin/3.2um Ra

Inspection: Standard Inspection

Certificates and Supplier Qualifications: Finishing Certification

Expedite Made in USA 6 business days	\$397.96 ea.	\$1,591.84
Standard Made in USA 10 business days	\$243.86 ea.	\$975.44
Economy Made in USA, Canada, or Mexico 16 business days	\$200.53 ea.	\$802.12
Economy Made Internationally 13 business days	\$91.56 ea.	\$366.24

Obtained Quote: Conturo



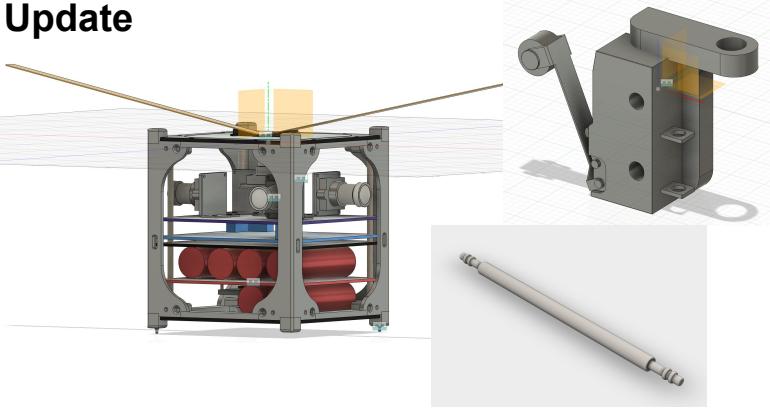
LINE	PART NUMBER	PART DESCRIPTION	REV	MATERIAL	FINISH	QTY	RATE	AMOUNT
1	Leg 1	Leg 1		Aluminum 6061-T6	Tumble	1	\$931.71	\$931.71
2	Leg 2	Leg 2		Aluminum 6061-T6	Tumble	1	\$874.59	\$874.59
3	Leg 3	Leg 3		Aluminum 6061-T6	Tumble	1	\$900.48	\$900.48
4	Leg 4	Leg 4		Aluminum 6061-T6	Tumble	1	\$897.14	\$897.14
SUBTOTAL								\$3,603.92
TAX RATE								0%
SALES TAX								\$0.00
TOTAL								SEE BELOW

Available Lead Time Options		
Leadtime (business days)	Expedite Fee*	Total Price
6	\$720.78	\$4,324.70

* Line items with special lead times may have different expedite fees.

Mechanical Quad Chart- 11/1/2023

Update



Team Blockers

- Update on Endurosat?
- Avionics
 - New camera requirements?
 - Access port locations?
 - Weights of electronics and sensors
- Thermal Desktop licensing issues

Milestones

- Model sent to TechSpark for machining
- Updated 3D print for reference
- Thermal desktop simulation on going
- Proof of concept for tape measure deployment
- Updated detailed mass budget
- 3D printed antenna mounts
- Designed internal mount for rail limit switches

Next Week

- Working on locking hinge mechanism
- Structural changes to accomodate hinge?
- Start cabling table

Cross team issues and interfaces

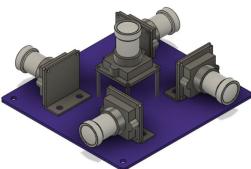
- Boards - continue to reference PC104 document on mechanical wiki
- **Report internal components and materials so we can start formulating testing protocols more fully (thermal, etc.)**
-

	number	mass estimate (g)	total mass (g)	
frame	1	150	150	
outer solar panel boards- XY	4	53	212	
outer solar panel boards- Z	2	53	106	
deployed solar panel boards	4	53	212	
main board	1	100	100	
battery board	1	100	100	
batteries	6	47	282	
jetson board	1	18	18	
camera board	1	100	100	
cameras	6	12	72	
mounts for cameras	6			
PC104 rods	4	22.62292	90.49168	
M3 screws	24	0.385554	9.253296	
M4 screws	16	0.5	8	
antenna system	1	100	100	
inhibit switches	3		0	total mass: 1669.74498
hinges	4		0	
solar cells(size unknown)	1	110	110	
rail springs	2		0	
helicoil	8		0	

Mechanical Quad Chart- 10/25/2023

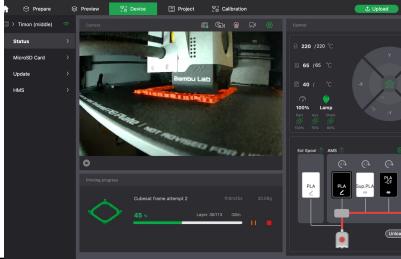
Update/Milestones

- Updated structure based on TechSpark machining recommendations
- 3D print
- Thermal desktop workup continuing based on just chassis
- Multiple hinge designs considered for solar panels
 - Consulted former lab member on thoughts



Team Blockers

- Endurosat chassis has not arrived
- Avionics
 - Updated board requirements?
 - Access ports location



Next Week

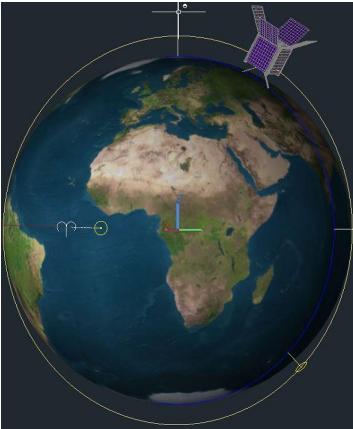
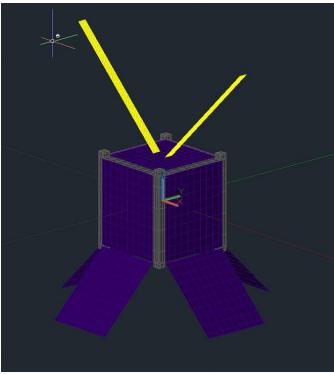
- Crash course on FEA
- EOW- Submit for machining at Tech Spark
- Parts order: PC104 rod selection, screws/fasteners
- Start ribbon cable design
- Update keep out zones for XY panels with new cameras
- Deployable solar panels
 - Attempt at hinge printing
 - construct design ideas
- Check for fit on solar panel deployment sides

Cross team issues and interfaces

- Boards - continue to reference PC104 document on mechanical wiki
- **Continue thinking about internal components and materials so we can start formulating testing protocols more fully (thermal, etc.)**
- Outer boards will be thicker than previously thought to accommodate torque coils
- Any vibe test implications of epoxying limit switches to PCBs?

Mechanical Quad Chart- 10/11/2023

Update

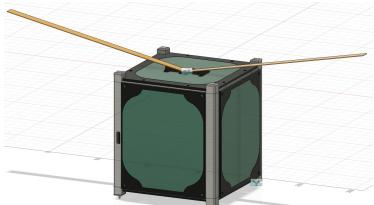


Milestones

- Updated CAD model for chassis
- Interior stack integrated to model
- Currently building thermal model
- DXF file for “keep out zones” on wiki
- Met with machine shop at TechSpark

Next week

- Play with endurosat structure if we get it
- Start machining our chassis design?

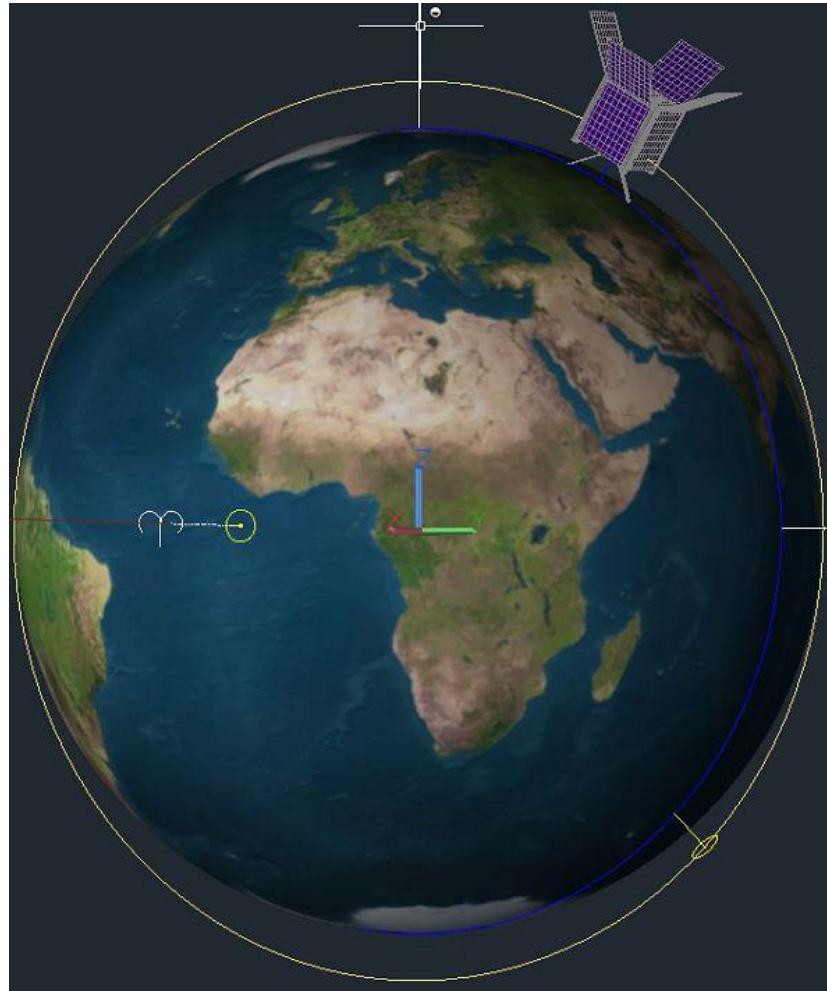
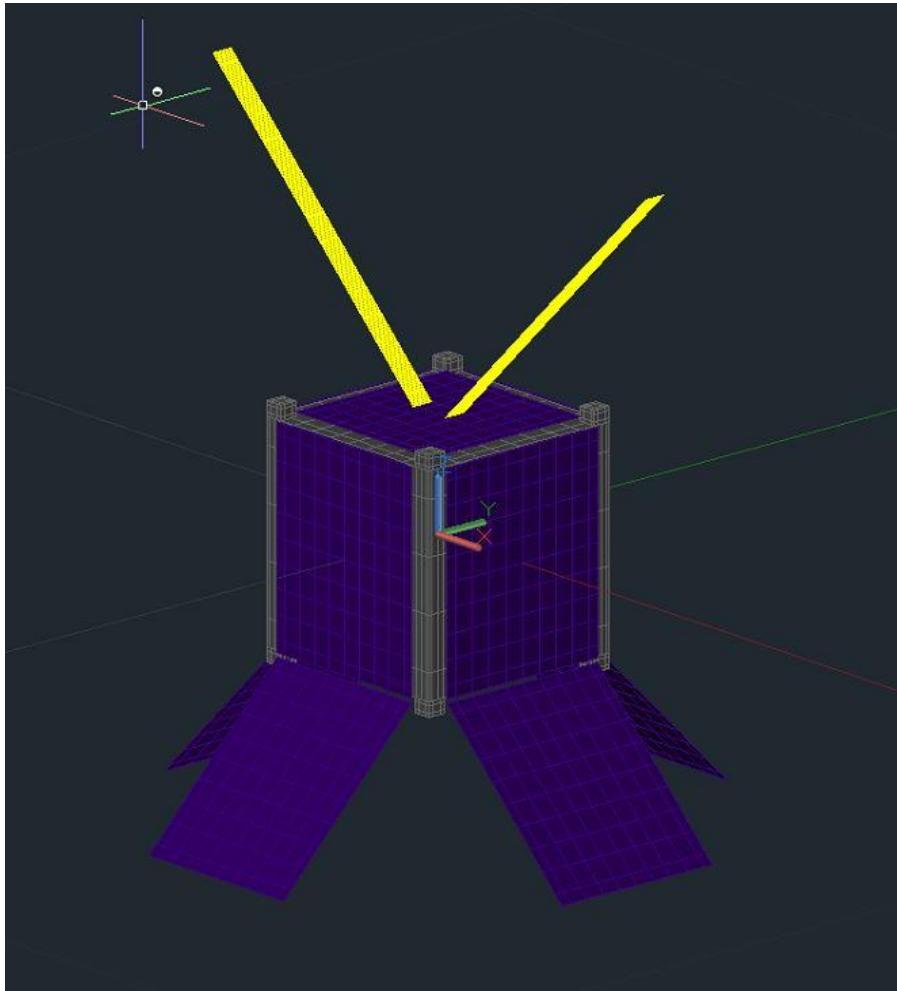


Team Blockers

- Missing physical components- Endurosat and springs
- Solar panel surface area
 - To determine need for deployable solar panels
 - Surface area we can provide without deployables= approx. 70 cm² per side
- Need to know exact camera boards being used to rebuild interior board stack

Cross team issues and interfaces

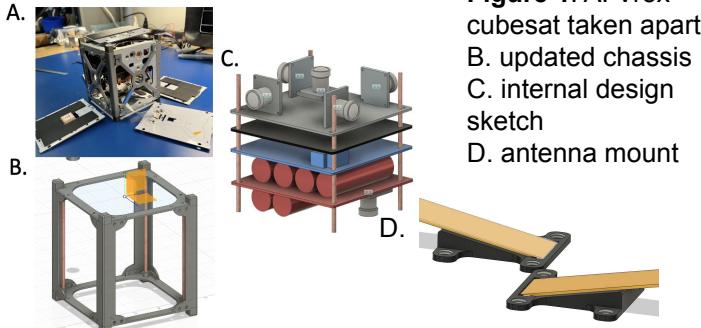
- Boards - continue to reference PC104 document on mechanical wiki
- Avionics-
 - number of access ports (charging, etc.) so we can work on structure adaptation for that
 - Updated final power budget
- **Continue thinking about internal components and materials so we can start formulating testing protocols more fully (thermal, etc.)**



Mechanical Quad Chart- 10/4/2023

Update

Took apart 1u cubesat in lab to better understand board infrastructure and connectivity



Team Blockers

- Chassis hasn't arrived
- Springs haven't arrived
- Solar panel surface area
 - To determine need for deployable solar panels
- Not critical right now: thermal offloading capabilities of the chassis
 - Do we need an additional radiator?

Milestones

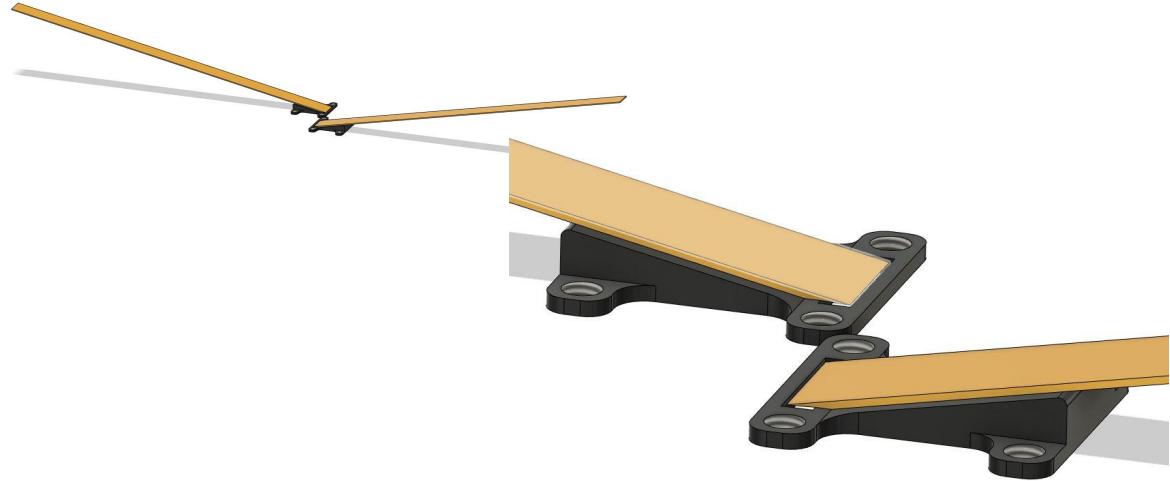
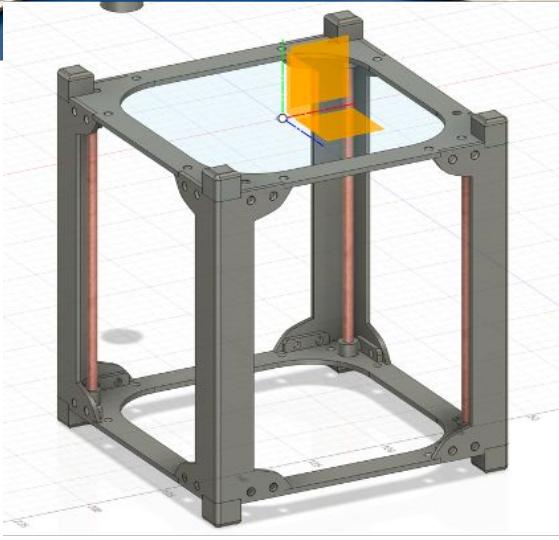
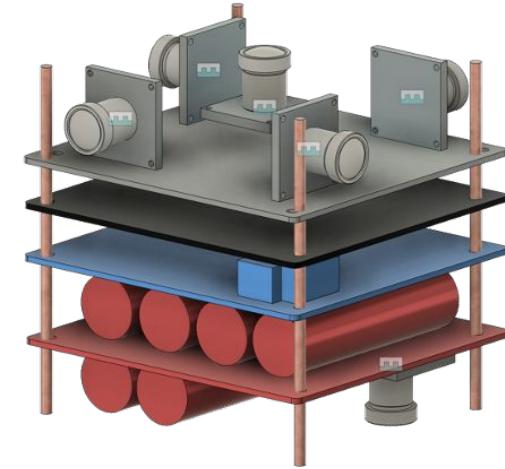
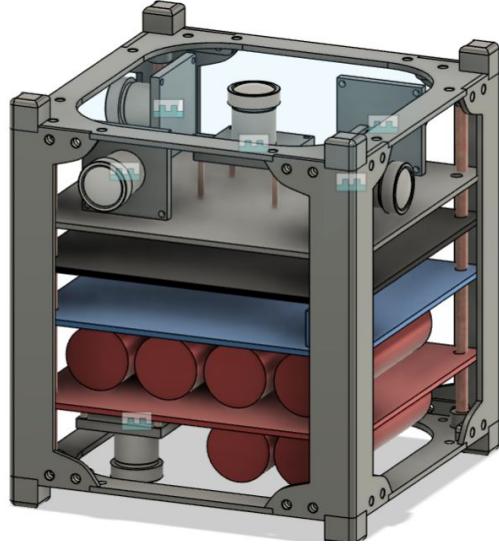
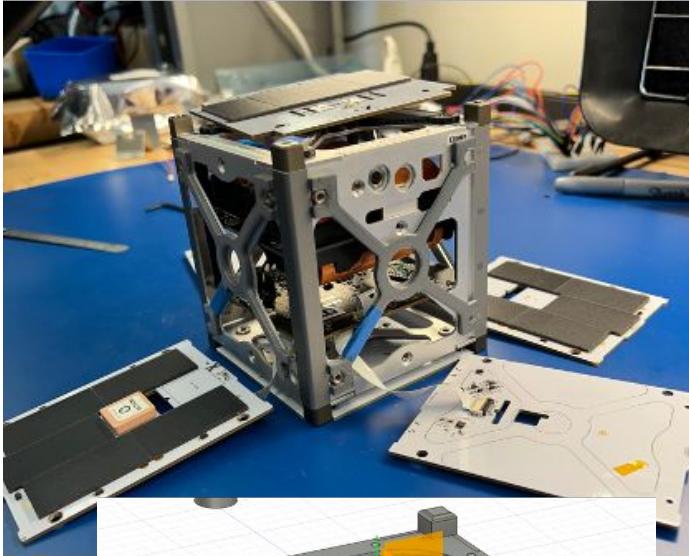
- Updated CAD model for chassis
- Z dimension/board heights determined
- Number of boards determined/more refined interior stack
- Antenna design

Next week

- Continued manufacturability considerations:
 - Integrating switches/holes on chassis
 - How to take apart/build: ie top comes off
- Play with endurosat structure if we get it
- Start machining our chassis design?

Cross team issues and interfaces

- Boards - use PC104 board dimensions
 - Will give "keep out" zones for passive components on pcbs due to frame
- Avionics- number of access ports (charging, etc.) so we can work on structure adaptation for that
 - Where will they be?
- **Starting thinking about internal components and materials so we can start formulating testing protocols (thermal, etc.)**
- **All sizes locked in by 10/6- try to avoid major component size changes after this date**



Mechanical Quad Chart- 9/27/2023

Update

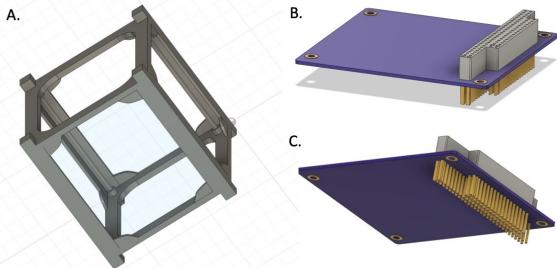


Figure 1: A. chassis structure B. top view of PCB C. bottom view of PCB

Team Blockers

- Endurosat chassis purchase
 - Don't have arrival date
- Power budget
 - To determine solar panel surface area needed
 - Thermal offloading capabilities of the chassis
 - Do we need an additional radiator?
- Component sizes for each team to determine stack height for each board
 - Number of boards you need

Milestones

- Cad model: chassis and PC104 start
- Placing orders for switches, springs, chassis
- We have a deployable solar panel idea if needed and would adjust structure accordingly

Next week

- Integrating antenna design to structure
- Manufacturability:
 - Integrating switches/holes on chassis
 - How to take apart/build: ie top comes off
- Play with endurosat structure if we get it

Cross team issues and interfaces

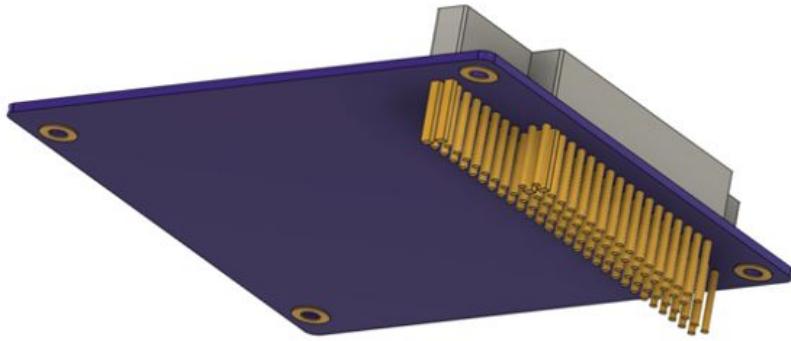
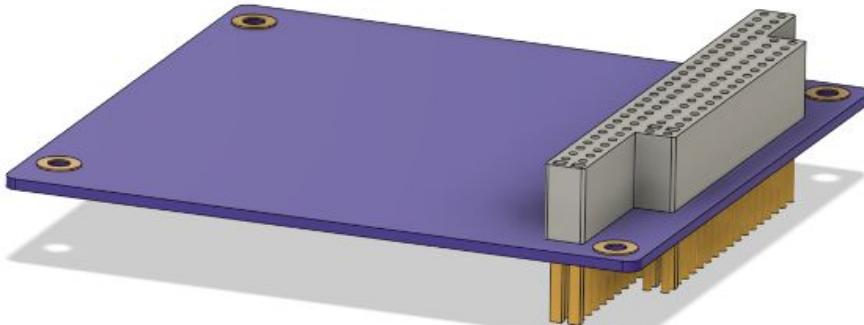
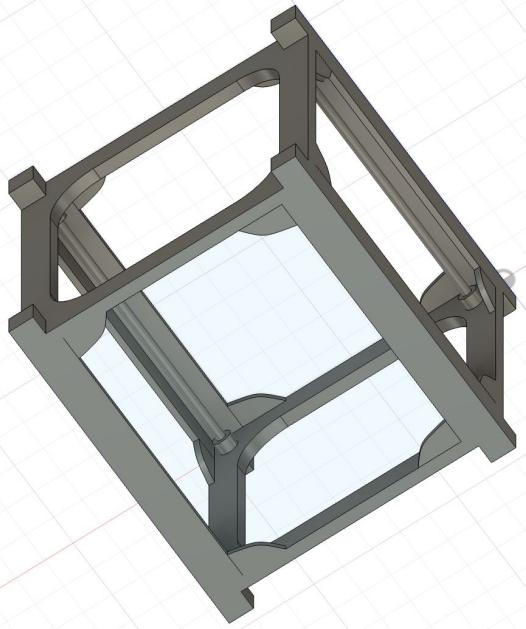
- Boards - use PC104 board dimensions and hole positions
 - Will post the dimensions on the mechanical wiki by end of week
- Camera dimensions - will need cutouts in some boards
- Avionics- number of access ports (charging, etc.) so we can work on structure adaptation for that
- **By 10/6, have all internal component sizes sent to us for inner cad model**
 - Like batteries, cameras, tall board components, etc.

Mass budget estimate updated

1500g target (up to 2000g)

- Chassis- 120 g (Endurosat)
- Batteries- 282g if we use 6
- GPU/vision- 500g
- ~~Torque coil- 46g (probably 2 coils so 92g)~~
- Antenna design- 100g
- PCBs- 70g per board? (so 420g for all 6 potential boards, ~~then additional 70 for back panel?~~)
- Solar panels/outer panels- approx. 50g per side (around 300 total depending on size on each side)
- Ballast- ??g
- Deployable solar panels (4)- 176g

Total right now: **1878g**



Mechanical Quad Chart- 9/20/2023

Update

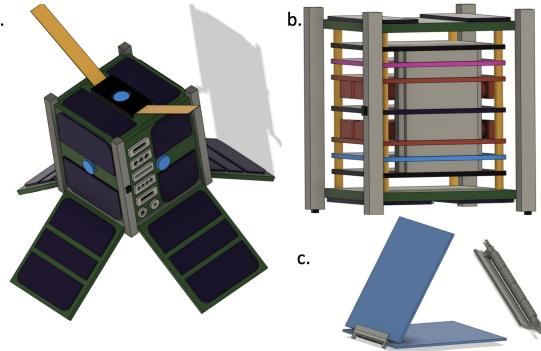


Figure 1: a. Overall design with outside panels. b. Internal board stack. c. initial design for solar panel deployment (hinges)

Milestones

- Came up with initial deployable solar panel idea
- Refined initial CAD design
 - No magnetic torquer rod (embedded in outer panels)
 - Board connection and support with chassis
- No turn-style antenna
 - Thinking V shape

Next week

- Finalize inner board design and maybe 3D print a model so everyone has dimensions and constraints
- Continue buy/build considerations for chassis

Team Blockers

Endurosat

- Potential chassis design
- Requires CMU legal representative to start looking at CAD drawings
- Was sent the data sheet

Other

- Power budget to determine final solar panel surface area

Cross team issues and interfaces

Vision- camera and GPU selection

- Will potentially having antenna in camera view be something you can work around?

GNC- updated size with solar panels (each deployed panel will be an additional 10cm with an additional 176g at the bottom)

Avionics- power budget

Coms/ops- link budget

Main structure: 10 cells

+ Deployable structure: 16 cells

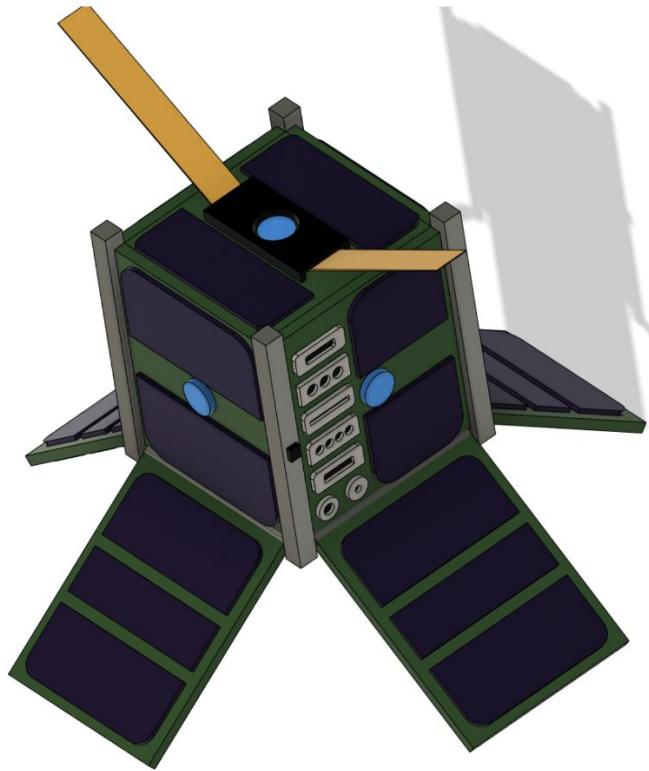
Total cells: 26 cells

2.4 W per cell x 26 cells= 62.4W

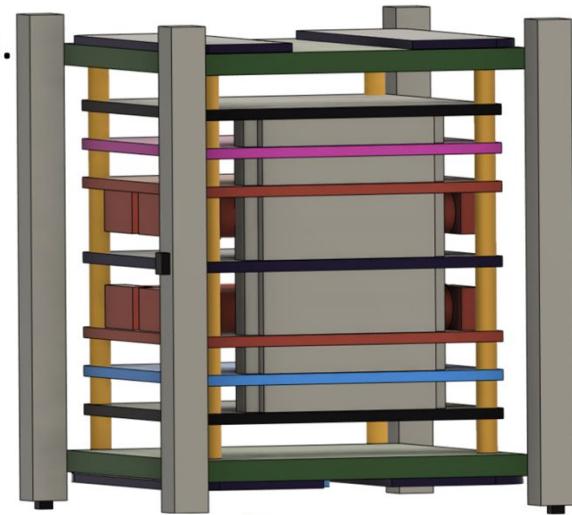
X 29.5% efficiency

Total power generated= 18.408W

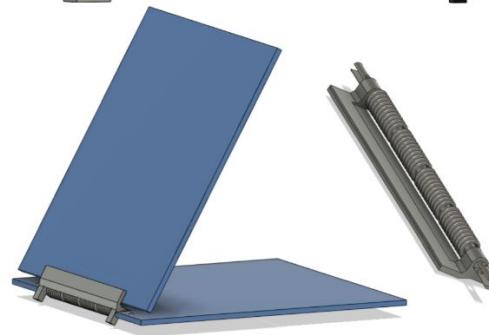
a.



b.



c.



Mass budget estimate updated

1500g target (up to 2000g)

- Chassis- ideally less than 100 g
- Batteries- 282g if we use 6
- GPU/vision- 200g worst case
- Torque coil- 46g (probably 2 coils so 92g)
- Antenna design- 100g
- PCBs- 70g per board? (so 420g for all 6 potential boards, then additional 70 for back panel?)
- Solar panels/outer panels- approx. 50g per side (around 300 total depending on size on each side)
- Ballast- ??g
- Deployable solar panels (4)- 176g

Total right now: 1740g

Mechanical Quad Chart- 9/13/2023

Update

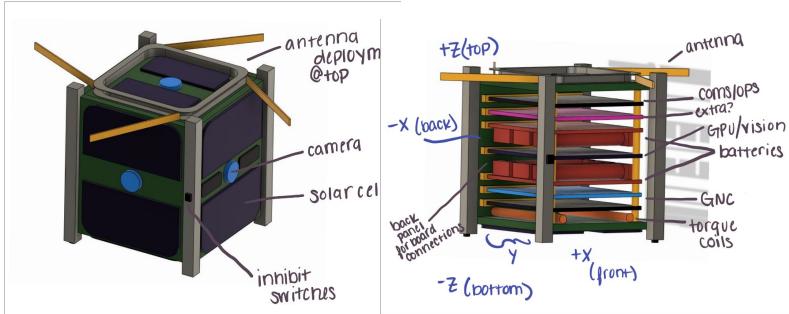


Fig.1- initial CubeSat Rev.1 sketch

Milestones

- interfacing with the other teams
- Revised Level 2 requirements
- Started visualizing first iteration model with initial stack ideas
- First idea for antenna

This week

- Finalizing initial mass budget estimate as we collect more information from other teams
- Starting CAD models for chassis design
- Deciding how to organize the boards

Team Blockers

Need link budget to get power budget to get solar panel size and design

We need to know when each team decides what physical components they want to use so we can finalize mass budget (ie work towards more than just an estimate)

Make sure to keep track of what materials you will be using (or if they can be coated with NASA-approved materials)- we are comprising a list

Cross team issues and interfaces

Figure out power and link budget to begin determining battery number and subsequent solar arrays (ASAP)\

Vision- camera size to determine placement location- next week?

GNC- sensor and actuator selection- early next week

Coms/Ops- working on antenna design first iteration

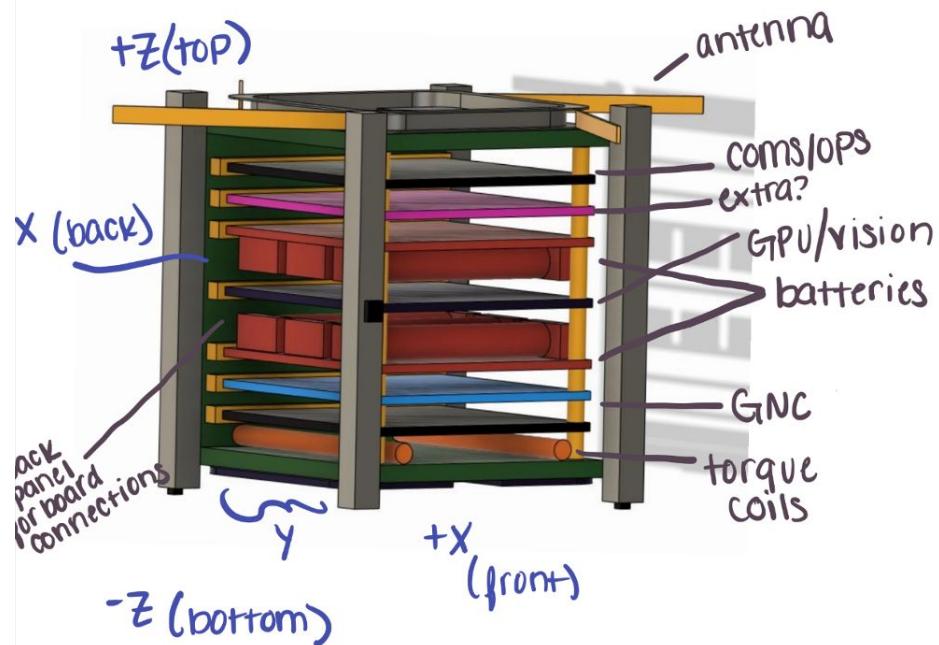
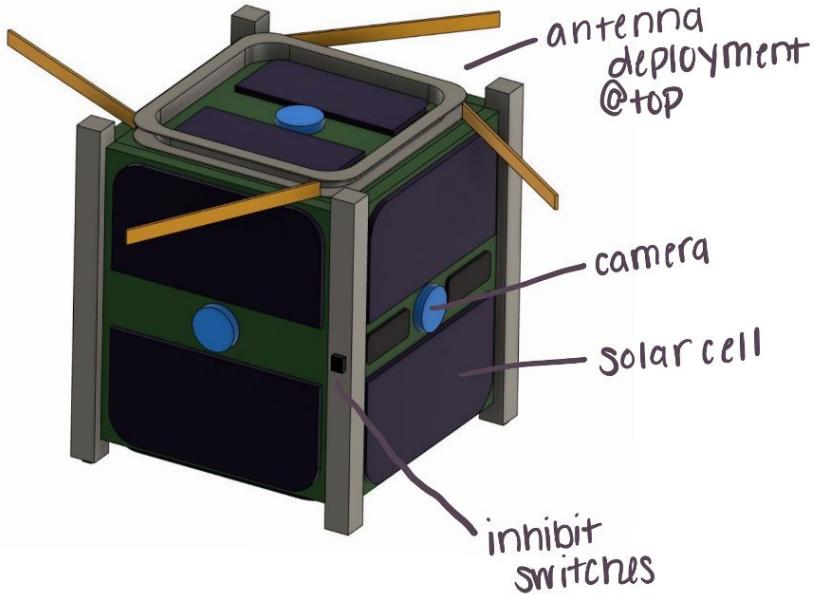
Mass budget estimate (rough)

1500g target (up to 2000g)

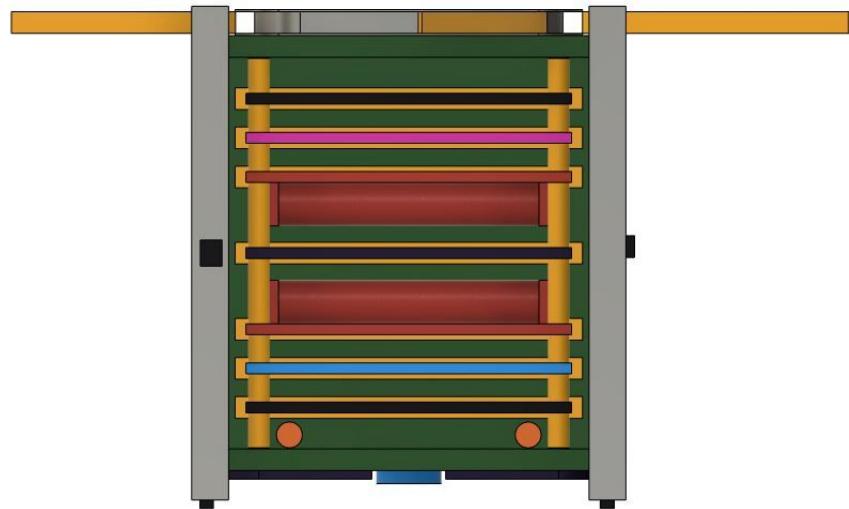
- Chassis- ideally less than 100 g
- Batteries- 282g if we use 6
- GPU/vision- 200g worst case
- Torque coil- 46g (probably 2 coils so 92g)
- Antenna design- 100g
- PCBs- 70g per board? (so 420g for all 6 potential boards, then additional 70 for back panel?)
- Solar panels/outer panels- approx. 50g per side (around 300 total depending on size on each side)
- Ballast- ??g
-

Total right now: 1564g

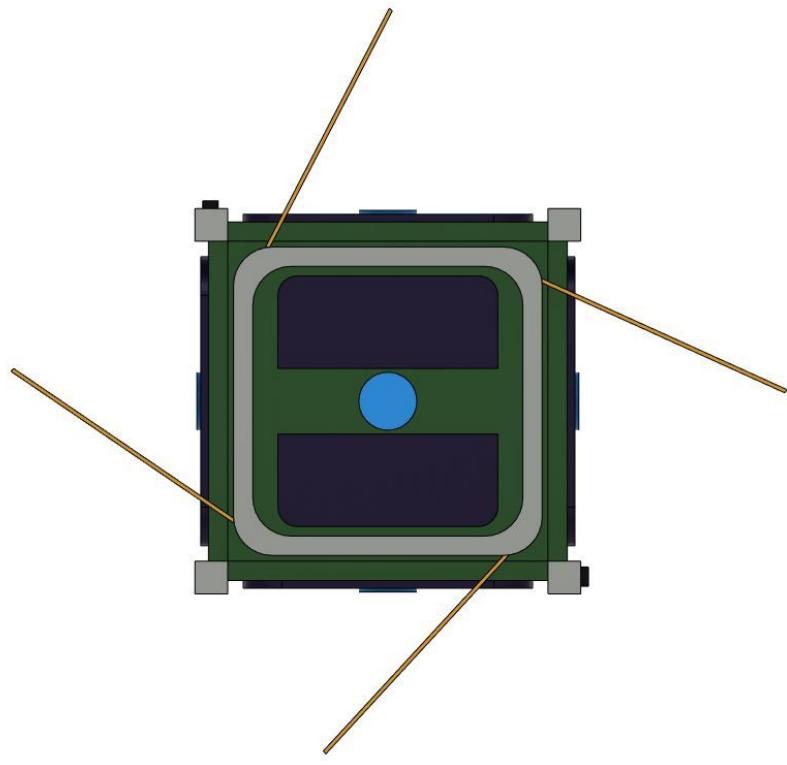
Close-up images if needed



Close-up images if needed



Inside front



top

PDR slides

- Update requirements
- Satisfy requirements
- Describe design
 - Overview (main board, hardware, battery board added to CAD)
 - Chassis
 - Internal stack
 - Jetson & mount
 - Limit switch
 - Outer boards
 - GPS
 - Solar panels
 - Antenna
 - Deployment
- Solar panel deployment
 - Hinge, stop, tape measure, tape measure attachment
 - Prototype and video
 - Breakdown of prototype (radius, materials)
- Mass Budget
- COF
- BOM?
- Thermal
 - Thermal desktop
 - Bounds
 - Risks
- Risks
 - Identify
 - Fix or accept risks
- Todo
 - Ribbon
 - Build
 - Deployment tests
- I&T
 - TVAC (waive)
 - Bakeout (waive)
 - Vibe
 - Potential quote, get vendor
- Hardware in the loop
- Deployment tests
- Materials (outgassing)

To do

This week

- Each team create their subsystem slides
- Take relevant slides already in powerpoint for our team and organize them
- Things that will be for us to grab as well
 - Integration and test
- Mission patch ideas? Names?
- Plan to share first pass of slides on next quad chart

Exolaunch ICD- waivers for tests, etc.

- Presentation should be 90 minutes to leave time for Q&A

To get done for PDR

- Mass budget
- BOM
 - Checked against NASA list
- Center of mass/inertia
- Risk mitigation list
- Prelim thermal analysis
- Proof of concept for burn wire
 - Physical prototype?
 - 3D print
 - Knots?
 - Choose fishing line- look in shopping list
- List of tests
- Flush out details on heat strap/direct connection to Jetson
 - Thermal paste
 - Find a way to push heat strap onto top of jetson
- Quotes for custom thermal straps/heat pipes

Cad

- Add screws/fasteners
- Add inhibit switches
 - Look for smaller ones? Figure out how to get them to fit. Neil
- Tape measure on hinges
 - 3D printed mount
- Add inhibit switch mounts to PC104 stack
- aluminum thermal straps
- Prelim ribbon cables
- Fix jetson mount
 - Bolt through mount and pcb, nut on other side of pcb, 3d printed spacer to sit on board
- Antenna mount stuff
- GPS mount- I shaped or rectangle

Risk mitigation

- Solar panels don't deploy
 - floppy
 - Don't open all the way
 - Test as if we only have one tape measure per deployable
- Antenna doesn't deploy
- Jetson gets too hot
 - Radiator not dispersing enough heat
- Limit switches get stuck
 - Or disengage early
- Frame falls apart
 - Fatigue failure?
 - Get proper torque of chosen fasteners
- Doesn't come out of deployer
 - Followed cubesat specs and distance from rails, etc.
- Loose connectors
 - Flight model- epoxy all connectors
 - Secure down batteries- loctite/epoxy
 - Secure down cameras- loctite/epoxy
- Correct build
 - Proper cable routing/ order of operations
- Cold welding
-

Tests to run

No tvac

Vibe

Bake out

Offgassing- is flight heritage for boards enough for avoiding conformal coating boards?

Tape measure

Antenna- flatter is better

Deployables- curved: less floppy, more snappy

Testing

- Rig for testing/proof of concept
- Thicker is better?
- Radius test?

avionics

- Rotating usb a
- Thermocouple placement for health data?
- Ribbon cables
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