Artemis CubeSat Kit V1
Kit Assembly Tutorial

Table of Contents

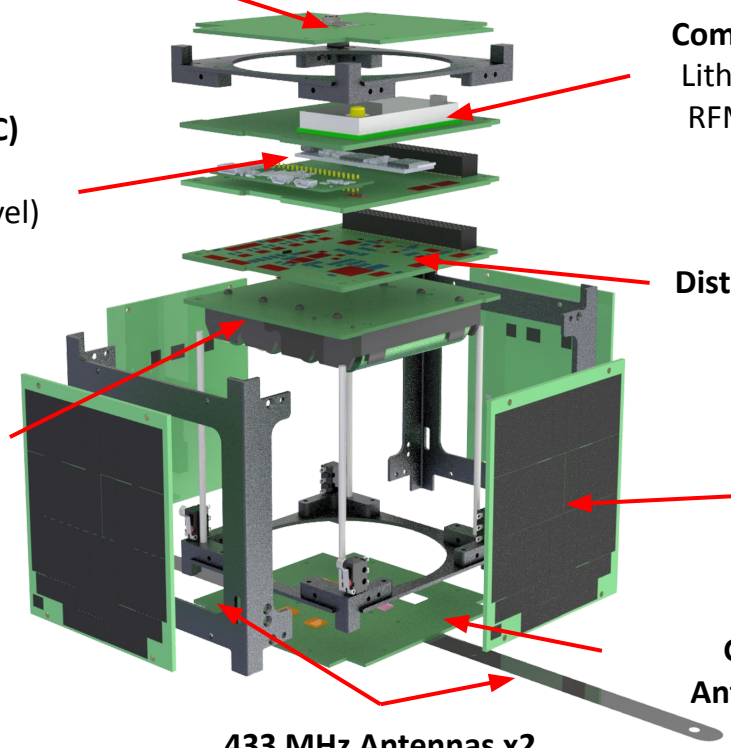
Revision Log

- 05/XX/2023 – Completed Kit Assembly Tutorial (CA, KN, RL)

Raspberry Pi
Camera Module v2

On Board Computer (OBC)
Teensy 4.1 (Low Level)
Raspberry Pi Zero (High Level)
RFM23 (FSK)

Battery Board:
Samsung INR18650-35E
x4 (40Whr)



Comms Payload
Lithium 3 (FSK)
RFM98 (LoRa)

Power
Distribution Unit
(PDU)

Solar Panels

GPS
Antenna

433 MHz Antennas x2

Artemis CubeSat Kit V1

This presentation will cover the V1 kit assembly process, which will take 3 - 5 hours in total. We recommend splitting this process in two work sessions or more.

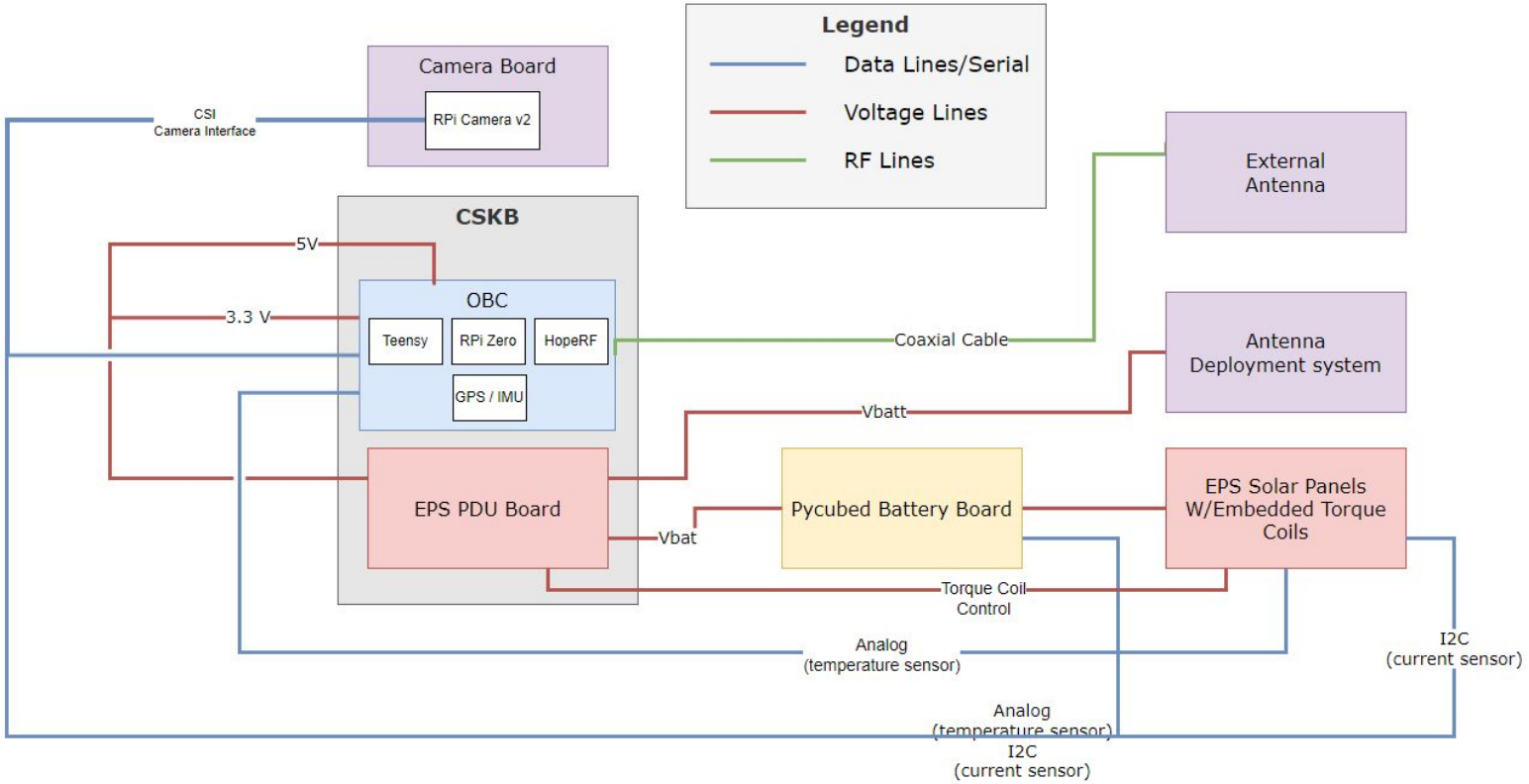
Background on Artemis CubeSat Kit V1

Artemis CubeSat Subsystems

- Altitude Determination and Control Systems (ADCS)
  - ADCS consists of sensors, actuators, and algorithms to determine and maintain the spacecraft's orientation or attitude in space.
- Communication Systems (COMMS)
  - The COMMs is responsible for establishing communication between the satellite to ground station
- Electrical Power System (EPS)
  - Composed of the Power Distribution Unit (PDU), Batteries and Battery Board, and Solar Panel Boards, this subsystem aims to distribute and regulate the power to the CubeSat
- On-Board Computer and Flight Software (OBC/FSW)
  - Composed of both hardware and software, the OBC/FSW is responsible for establishing communication between the satellites' PCBs (Printed Circuit Board); monitoring and controlling the CubeSat so that it is capable of successfully executing the objectives of the mission
- Payload (PLD)
  - The Artemis CubeSat Kit includes a PLD that houses a functional camera with AI feature matching
- Structure and Mechanisms (S&M)
  - S&M is responsible for designing and implementing the spacecraft structure and mechanical systems, and ensuring these comply with launch vehicle and space environment requirements. This subsystem is also responsible for the antenna deployment mechanism for launch.
- Thermal Control Systems (TCS)
  - This subsystem is tasked with stabilizing temperature change within the CubeSat during orbit

Please refer to:
Artemis User's Manual

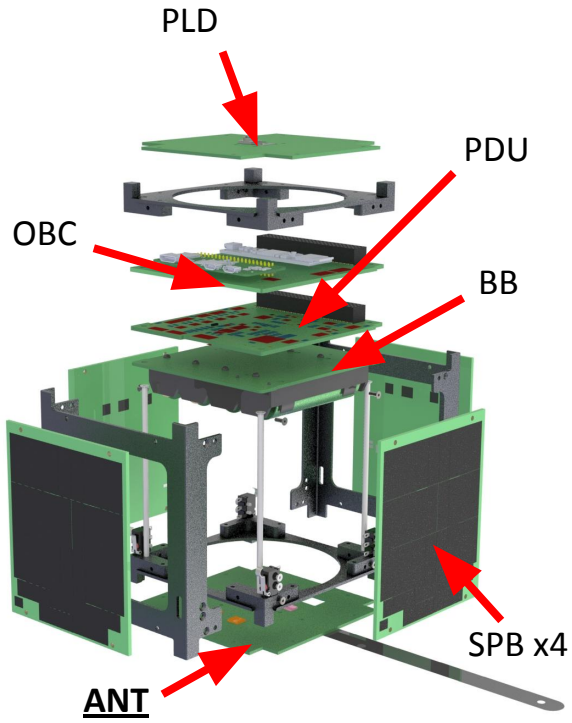
Artemis Kit Functional Block Diagram



Source

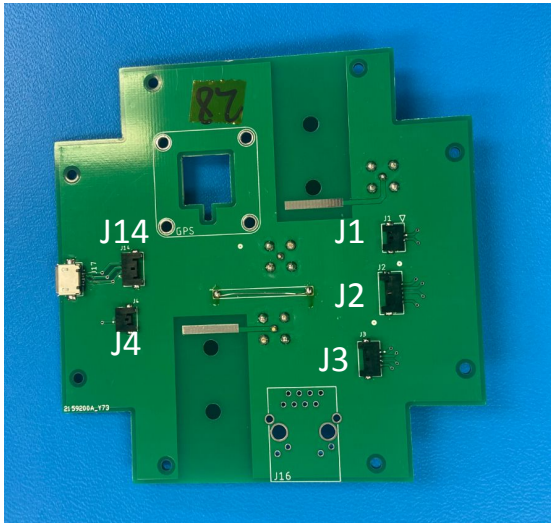
Antenna Board (ANT) – COMMS

- The Antenna Board (ANT) is part of the Communications System (COMMS).
  It houses:
  - Connectors – functions as Ground Support Equipment (GSE)
  - Radio antenna – allows the CubeSat to send/receive data and commands
  - Burn wire – aids in antenna deployment
  - GPS Antenna – acquires signals for the satellite's GPS

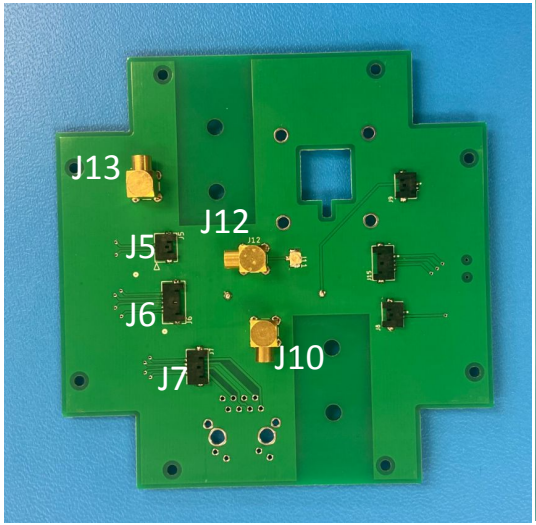


Antenna Board (ANT) – COMMS

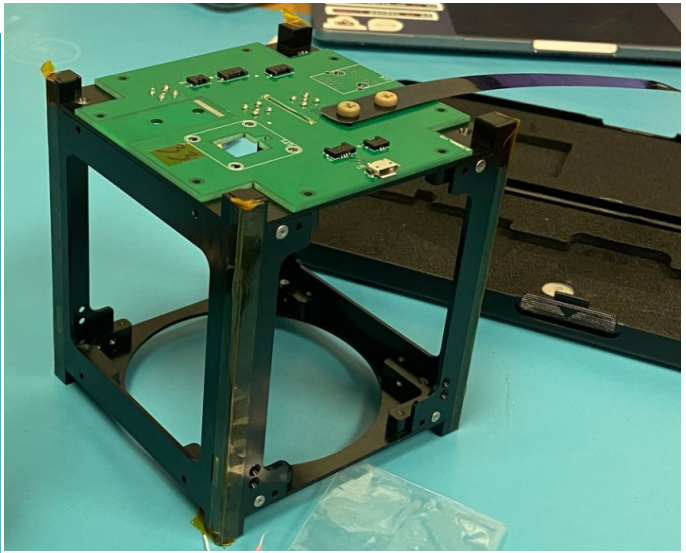
- The Antenna Board (ANT) is part of the Communications (COMMS) subsystem



Top Side of Antenna Board
(External Side of CubeSat)



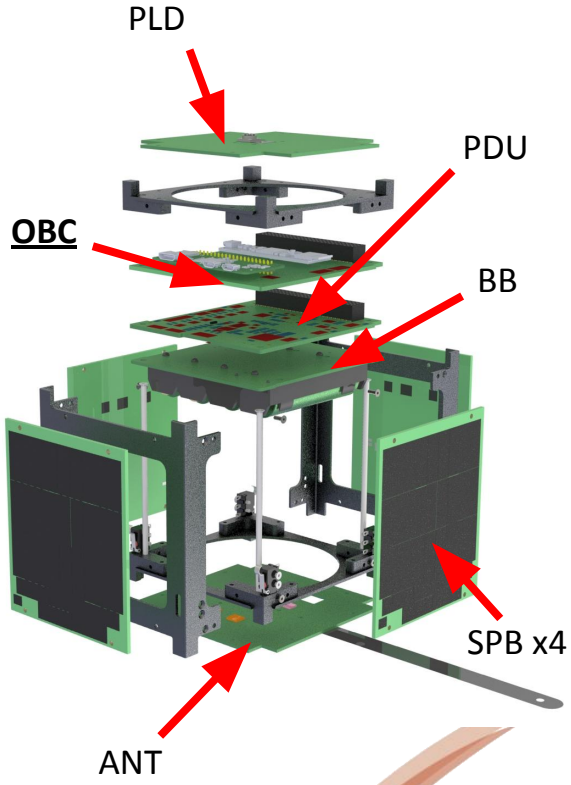
Bottom Side of Antenna Board
(Internal Side of CubeSat)



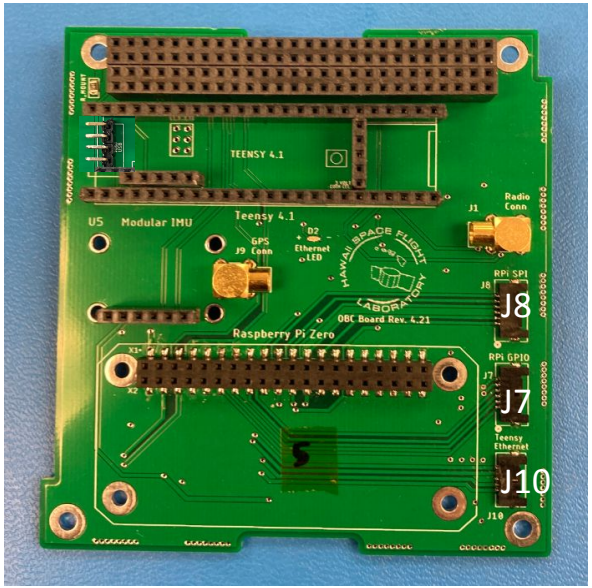
Prepped Antenna Board Placement on
CubeSat: Resting on Bottom Structure

On-Board Computer (OBC) – OBC/FSW, ADCS, COMMS

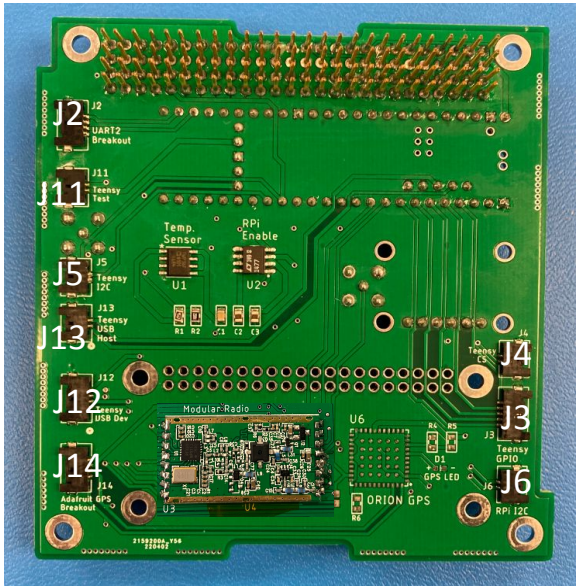
- The On-Board Computer (OBC) is part of the ADCS, OBC/FSW, and COMMS. It houses:
  - Teensy 4.1 – acts as integrated spacecraft controller and low power mode microcontroller. It collects data from all sensors, and controls almost all aspects of the satellite. Runs Micro Cosmos
  - Raspberry Pi Zero W – high processing power computer, used to interface with the raspberry pi camera and runs the full version of COSMOS
  - Adafruit IMU – collects gyroscope, magnetometer, and accelerometer data
  - GPS – collects locational data
    - Orion: Flight-Ready; Adafruit: Non-Flight-Ready
  - Temperature Sensors – collects temperature data on the OBC PCB. This data is then analyzed by the OBC's Teensy to aid in thermal regulation of PCBs



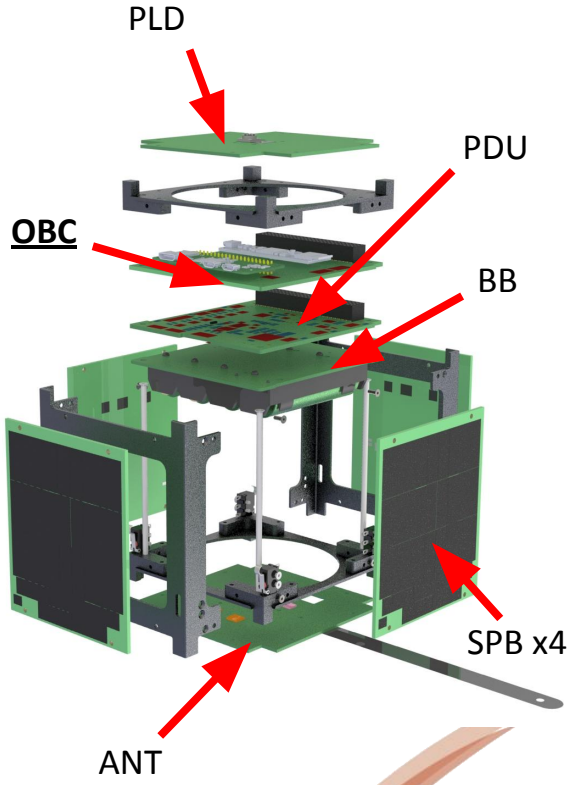
On-Board Computer (OBC) – OBC/FSW, ADCS, COMMS



Top Side

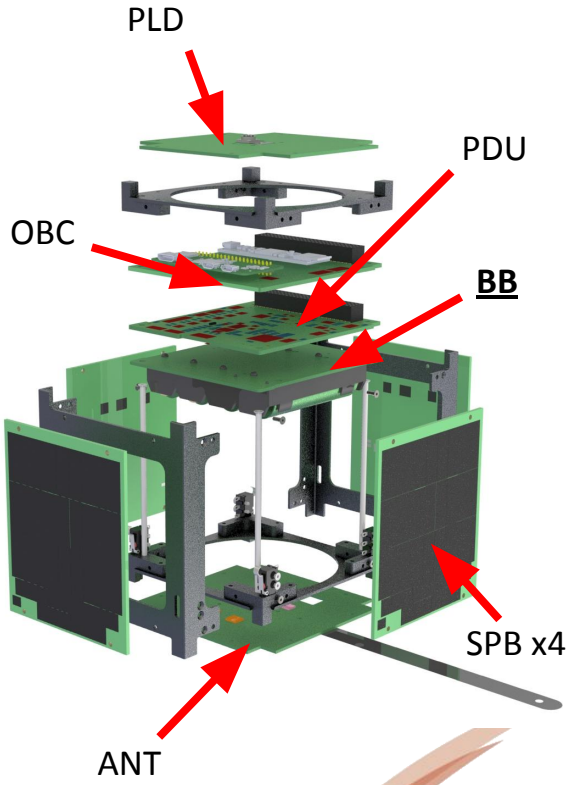


Bottom Side



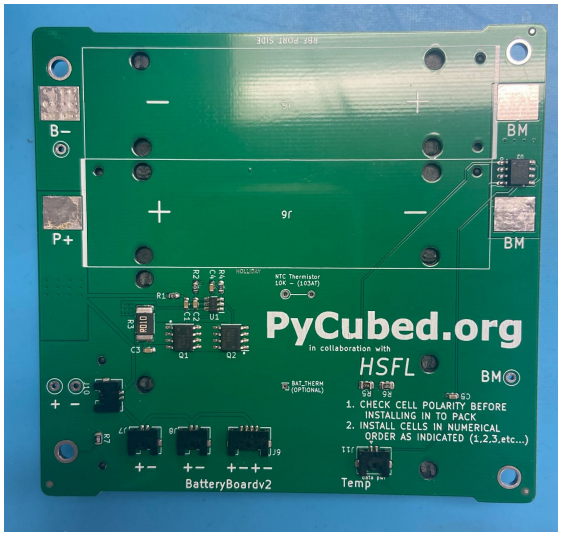
Battery Board (BB) – EPS

- The Battery Board (BB) is one of three main elements of the Electrical Power System (EPS). It houses:
  - Batteries – powers the satellite and are charged by the solar power generated by the solar panel boards
  - Battery Protection Circuit – Protects batteries from over-charge, over-discharge, short-circuit, and excess charge-current
  - Temperature Sensor – collects temperature data on the BB PCB. This data is then analyzed by the OBC's Teensy to aid in thermal regulation of PCBs
  - Inhibit switch – prevents VBatt (battery power source) from flowing through the satellite while inside the rocket

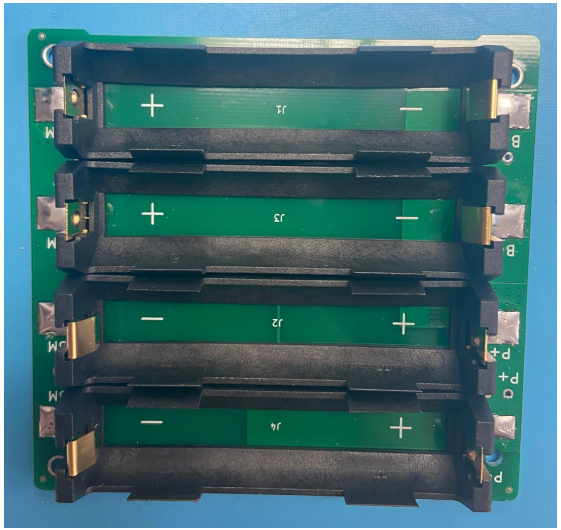


Battery Board (BB) – EPS

- The Battery Board (BB) is one of three main elements of the Electrical Power System (EPS). It houses the batteries, battery protection circuit, temperature sensor, and inhibit switch.



Top Side

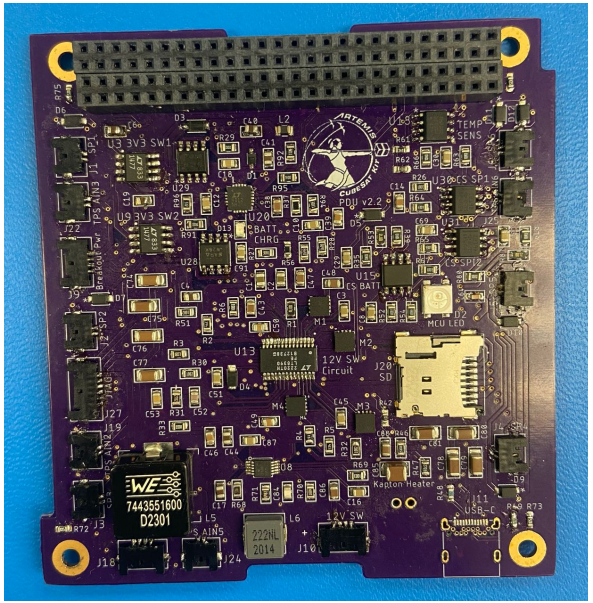


Bottom Side

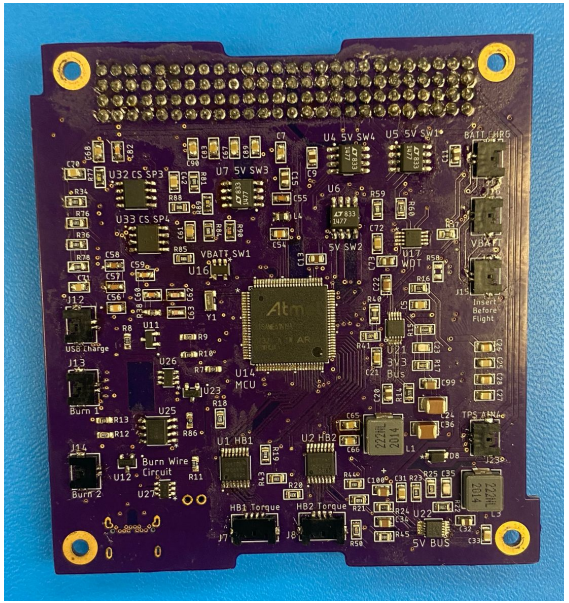
Power Distribution Unit (PDU) – EPS

- The power distribution unit (PDU) is one of three main elements of the Electrical Power System (EPS). It houses:
  - PC 104 Header & Connectors – connect power and communication lines to other PCBs and components
  - Buses – provides main power sources (always on)
  - Switches (a.k.a Switch Regulators) – provides power sources that can be switches on or off
  - H-Bridge Circuits – stabilize spacecraft movement by controlling direction of current on the solar panel board's torque coils
  - Burn Wire Circuit – antenna deployment mechanism involving nichrome wire
  - Microprocessor/Microcontroller (MCU) – controls certain circuit and functions on CubeSat
  - Temperature Sensors – collects temperature data on the PDU PCB. This data is then analyzed by the OBC's Teensy to aid in thermal regulation of PCBs
  - Current & Power Sensors – collects current and power data of all SPB PCBs and VBatt (main power supply from battery); aids in determining which side of the CubeSat is facing the sun and current state of batteries, respectively
  - Battery Charging Circuit – harness solar power from solar panel boards to charge the Li-ion batteries on Battery Board
  - Insert Before Flight Circuit – allows battery power to be disconnected and reconnected

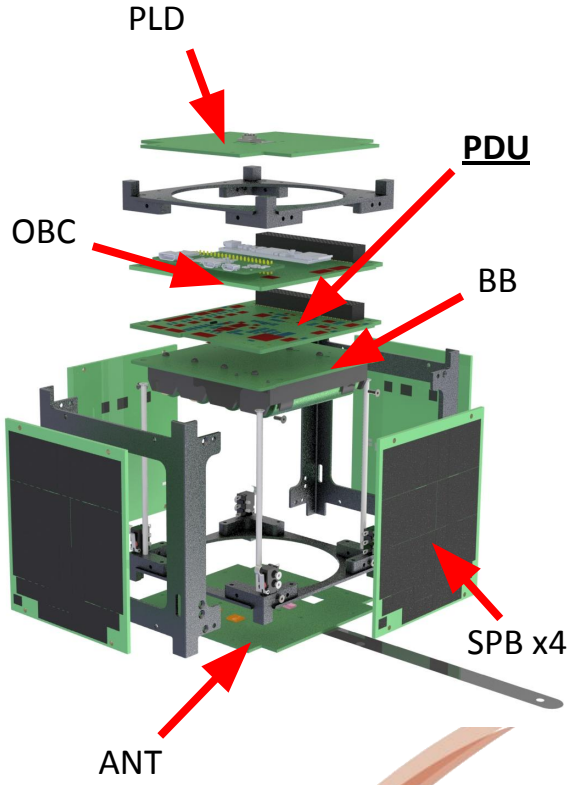
Power Distribution Unit (PDU) – EPS



Top Side

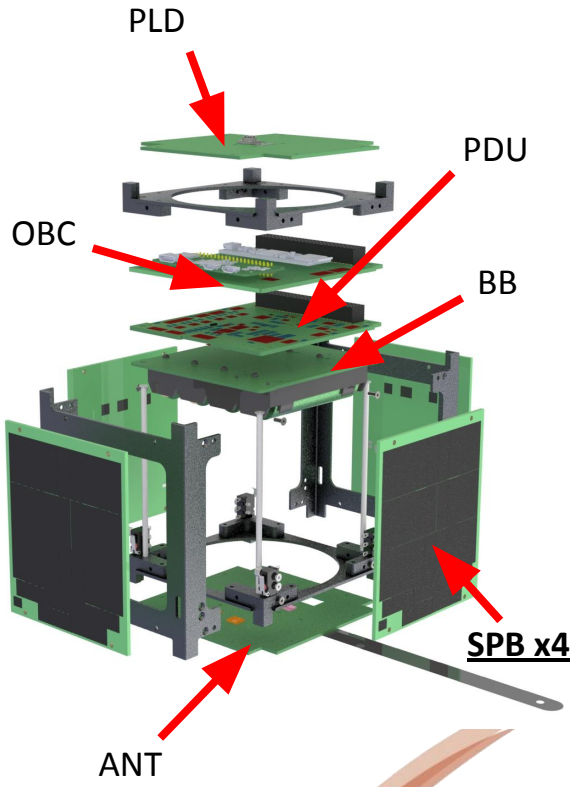


Bottom Side



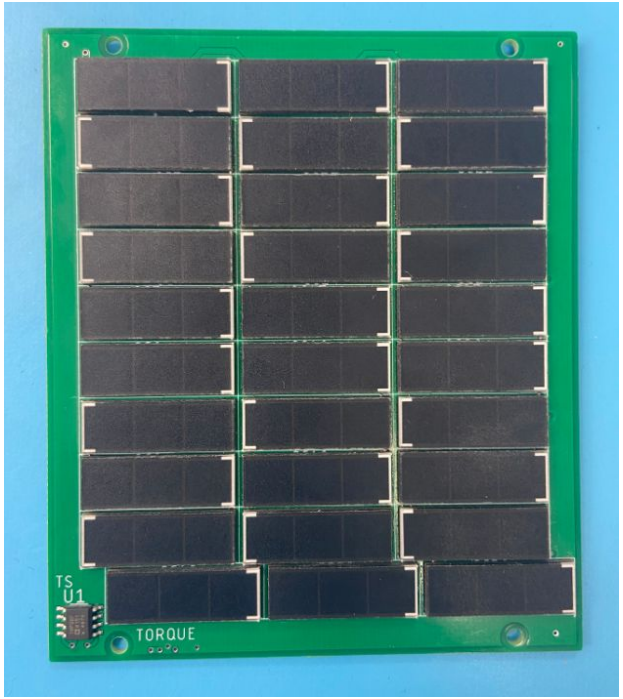
Solar Panel Board (SPB) – EPS, ADCS

- The Solar Panel Board (SPB) is one of the three main components of the Electrical Power System (EPS). It houses:
  - Solar Cells – in the panel configuration, it generates solar energy that charge the batteries on the battery board
  - Torque Coils – react with Earth's magnetic field to change the orientation of the satellite
  - Temperature Sensor – collects temperature data on the SPB PCB. This data is then analyzed by the OBC's Teensy to aid in thermal regulation of PCBs

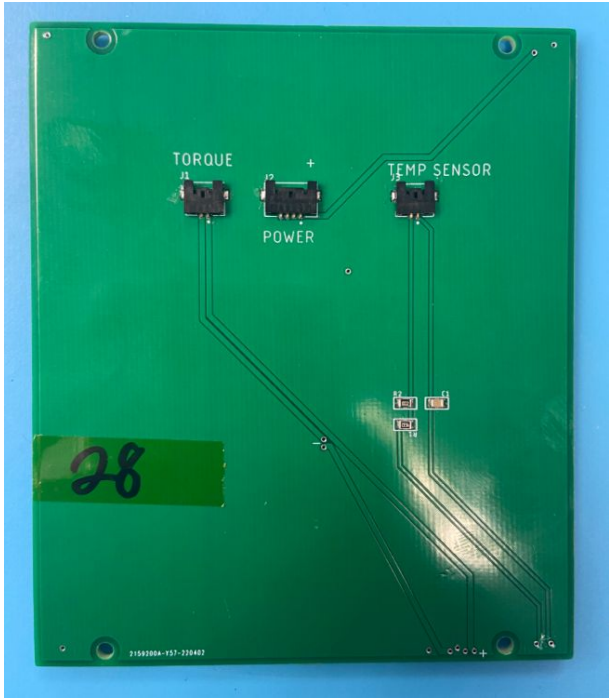


Note: SPB (Solar Panel Board) is interchangeable with SP (Solar Panel)
For all extensive purposes, this document will use the SPB term
However, the actual wire harness labels will use the SP term

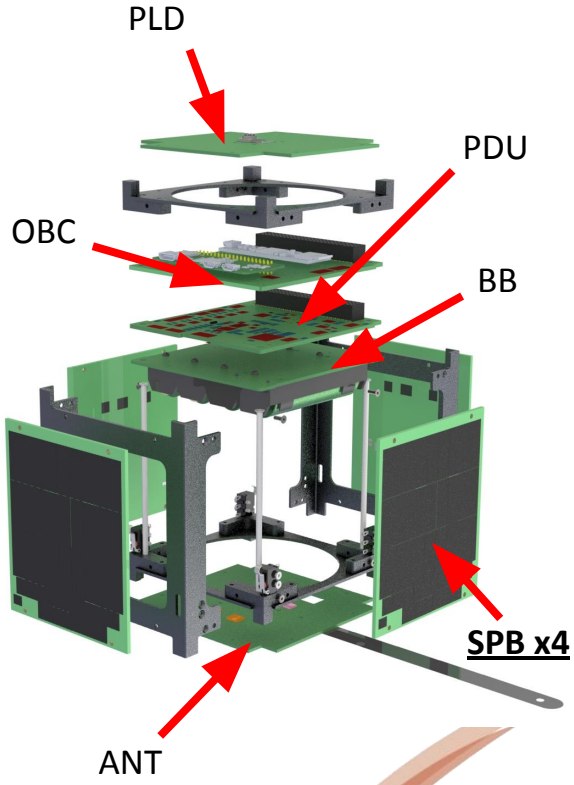
Solar Panel Board (SPB) – EPS, ADCS



Top Side of Antenna Board
(External Side of CubeSat)



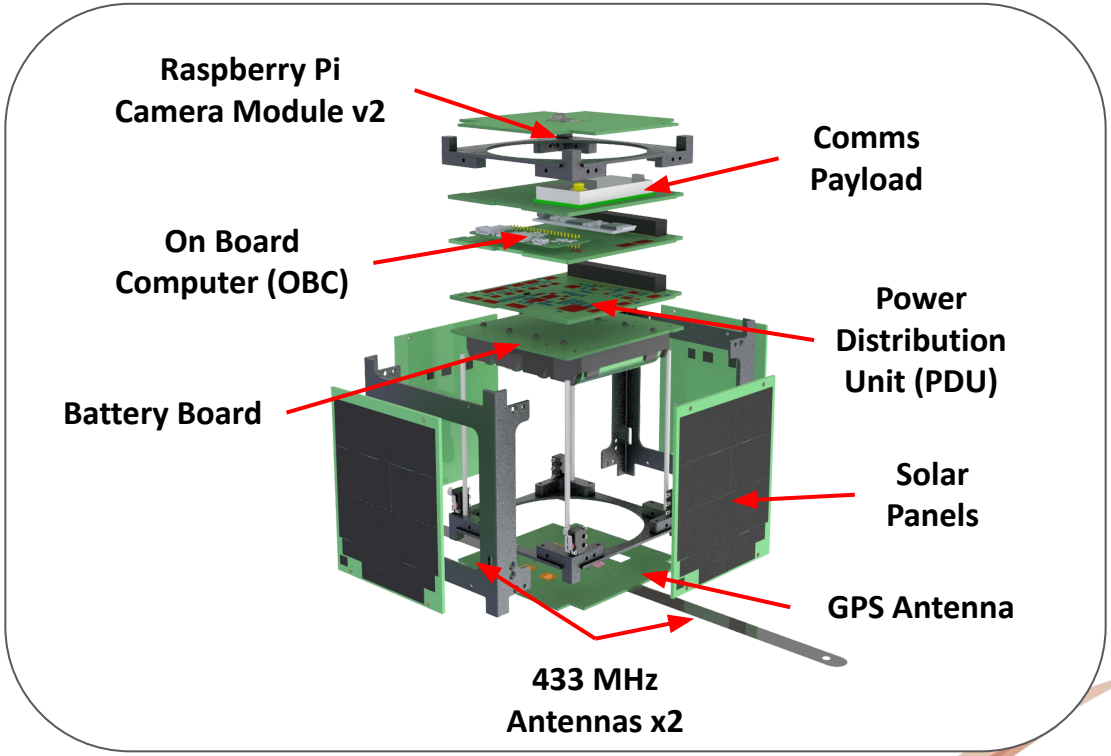
Bottom Side of Antenna Board
(Internal Side of CubeSat)



Materials

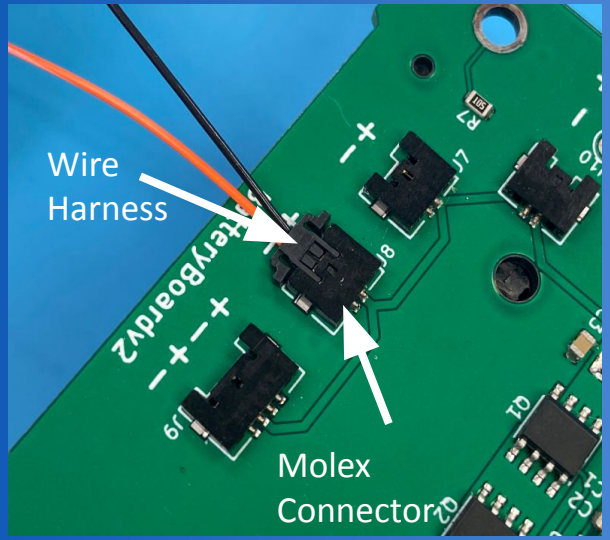
Material Lists for Kit Assembly

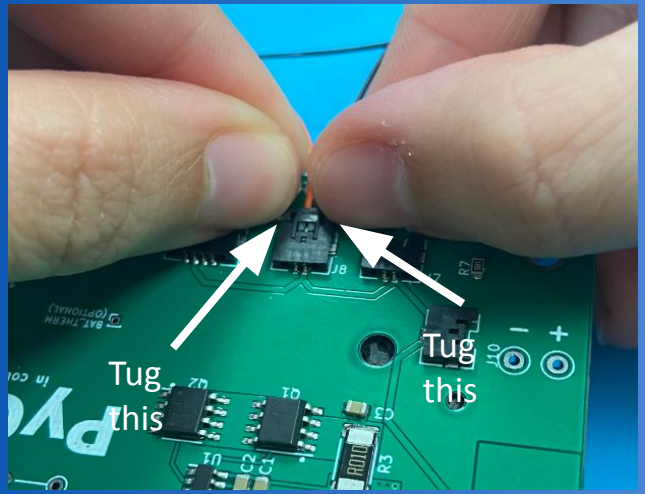
- Artemis Bill of Materials
  - Hardware
  - Wire Harnesses
- Wire Harness Guide
  - This document contains information that will help explain the Molex wire harness discussed in the tutorial



Disclaimer on Wire Harness Guide (Click Here)

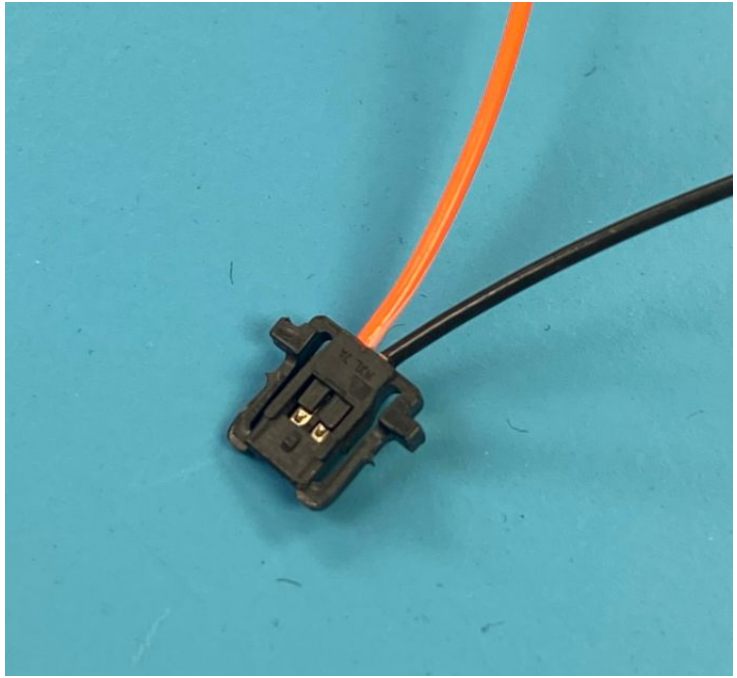
- Please be aware that the wire harness included in your kit may have wire colors that differ from the ones depicted in the wire harness guide and this kit assembly tutorial
- Before integrating the wire harness with the kit, we recommend that you review the guide to familiarize yourself with its contents
- Additionally, *please be aware* some wires may have different colors than shown in the guide. This does not have any effect on the fabrication or functionality of the kit
- This will help ensure that you correctly orient the wire harness and connect each pin to the appropriate location



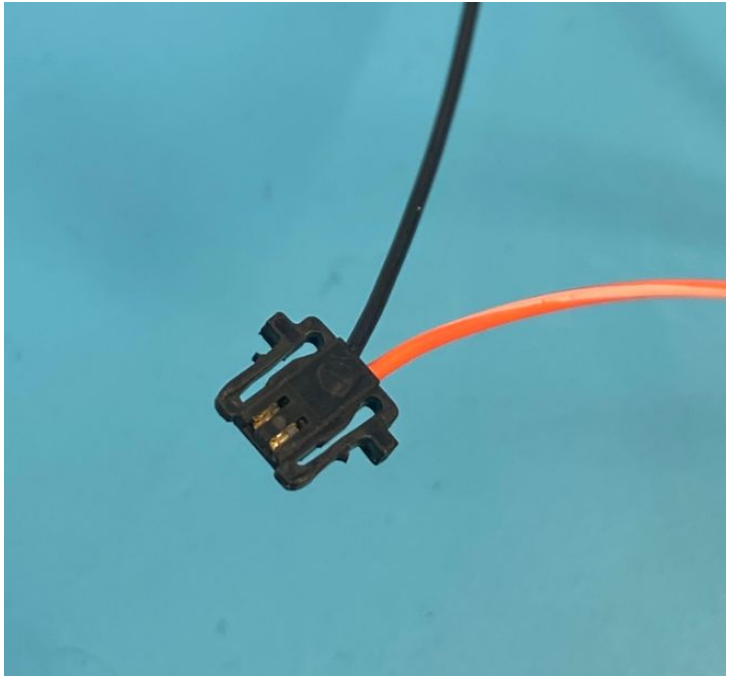


Tutorial on Inserting & Removing Wires

Orientation of Harness Wires

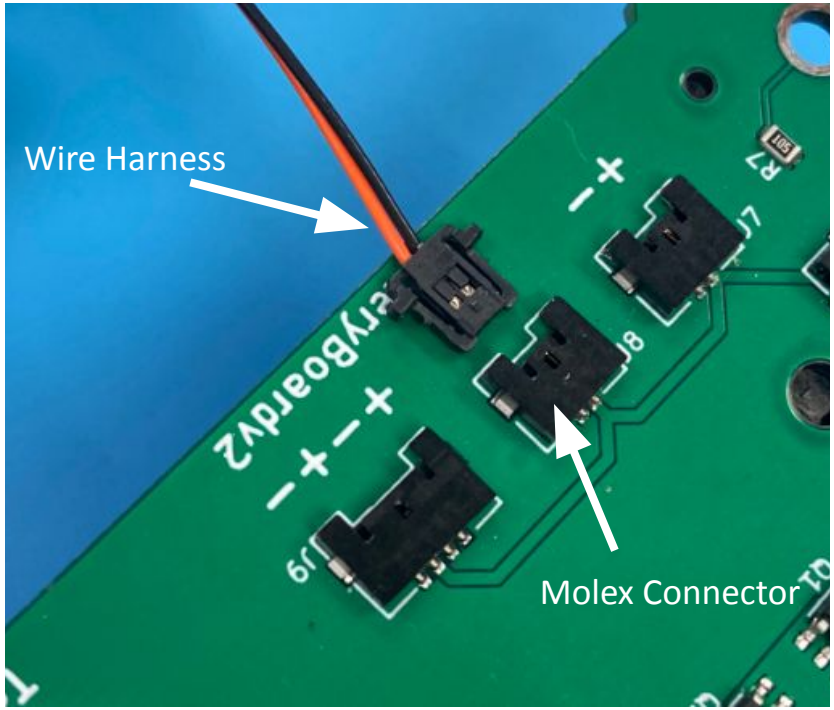


Top Side of Harness Wires

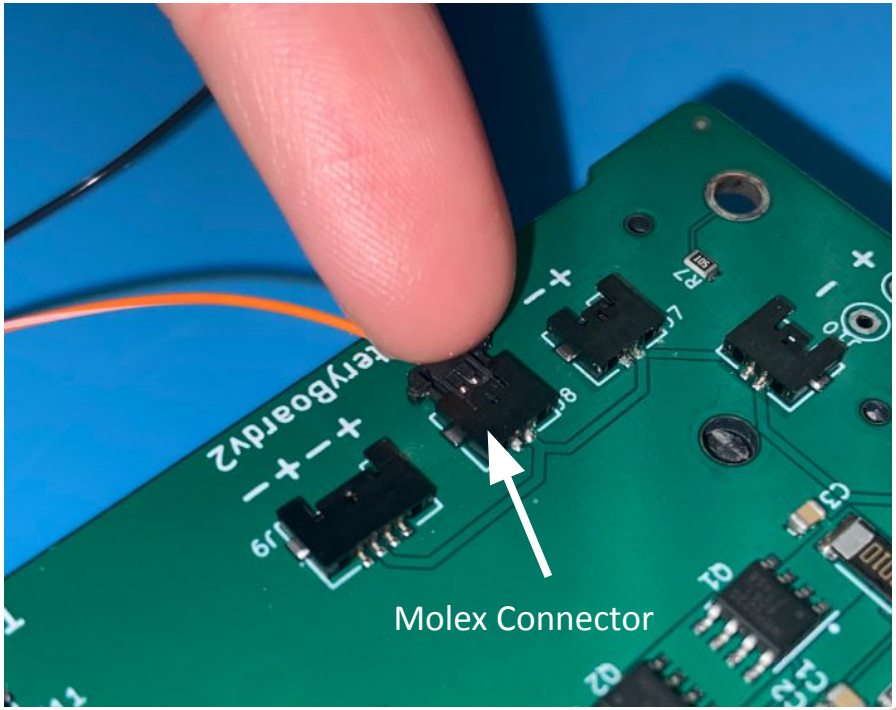


Bottom Side of Harness Wires

Inserting Wires into Molex Connectors on the PCB

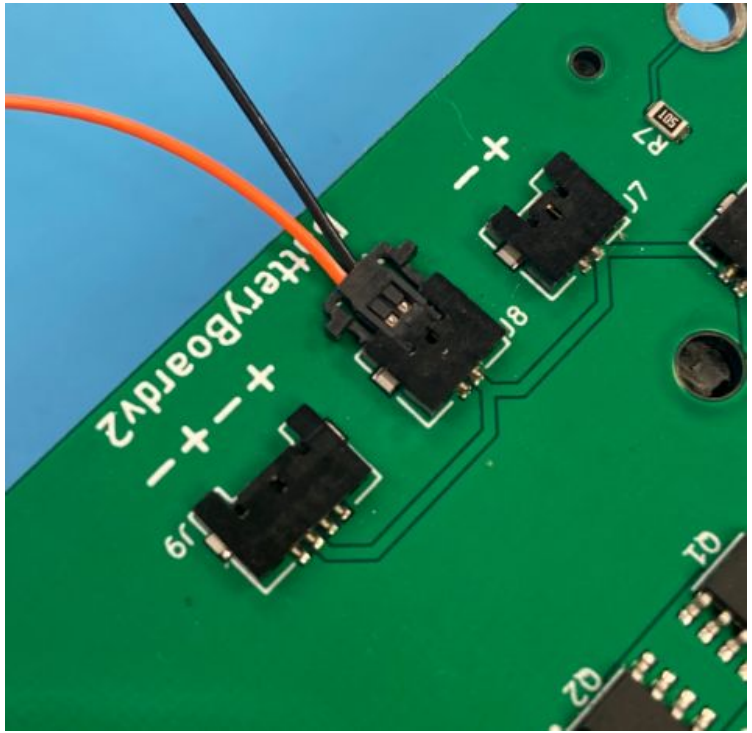


Have the top side of the harness wire visible to you, as shown in the figure.

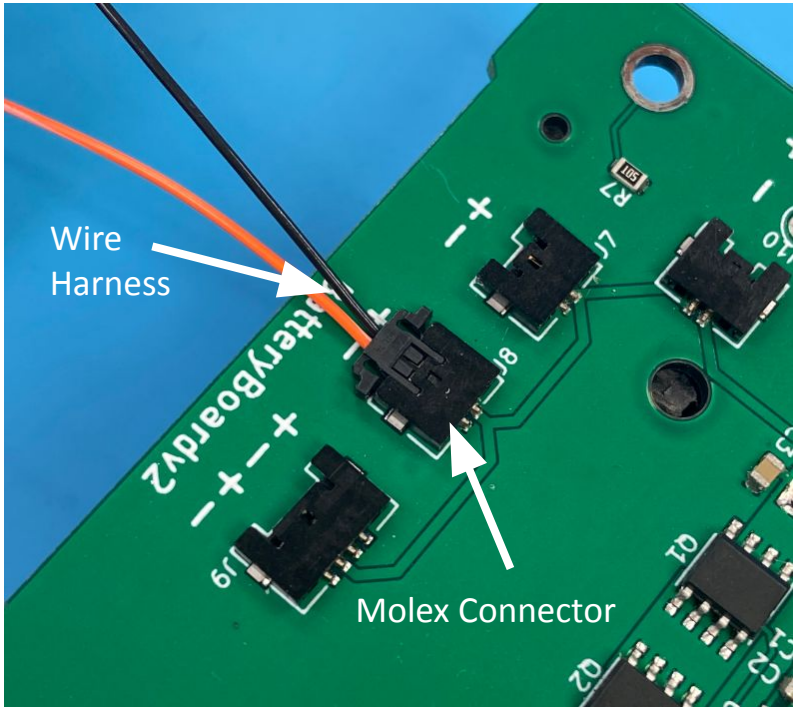


Use your finger and fingernails to firmly and evenly insert the wire harness into the molex connector.

Inserting Wires into Molex Connectors on the PCB

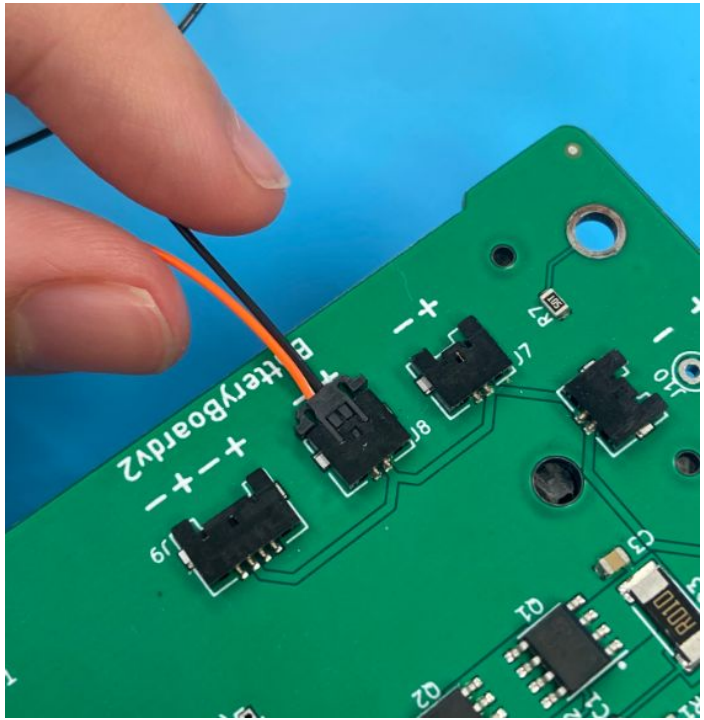


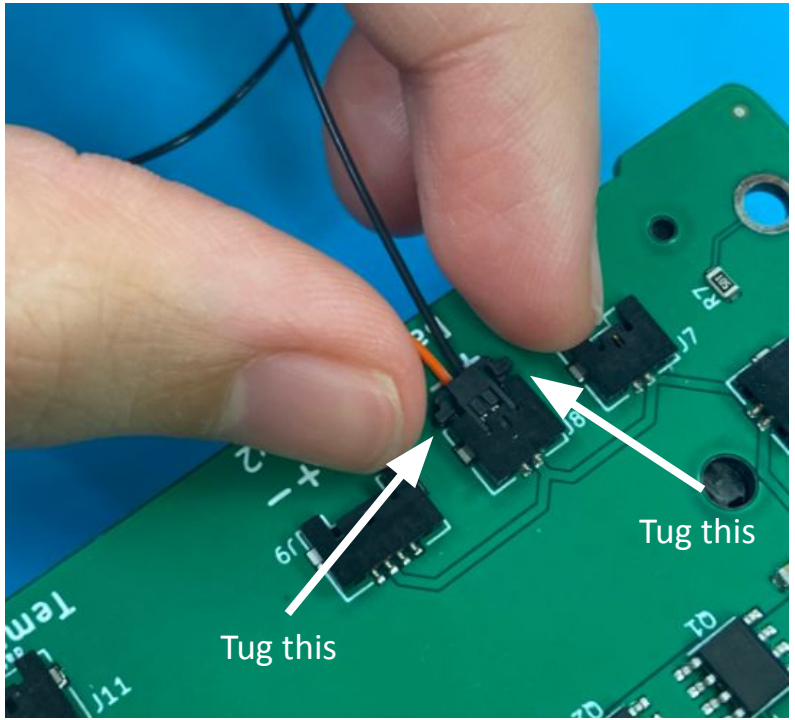
This figure shows that the wire harness is not completely inserted.



This figure shows a properly inserted wire harness. You will hear a light clicking sound when the wire harness is secured in this way.

Removing Wires into Molex Connectors on the PCB

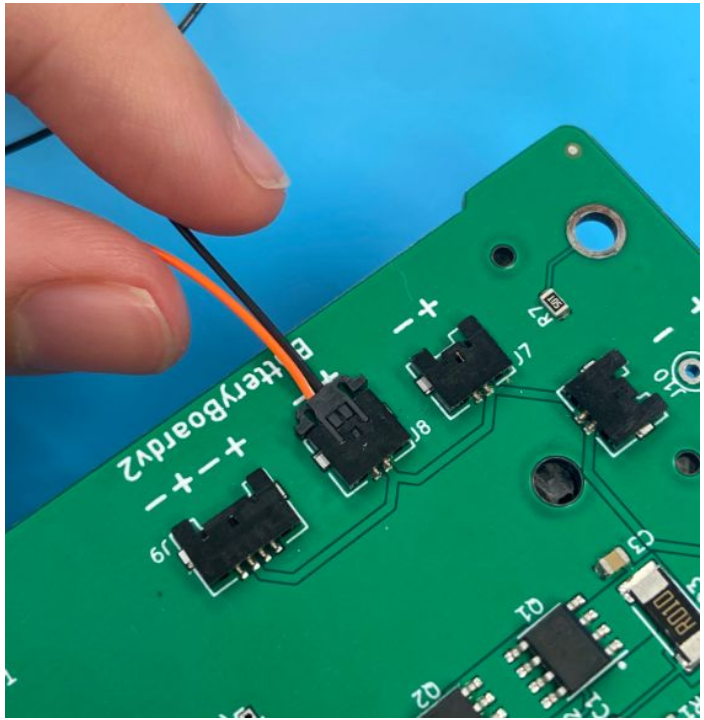


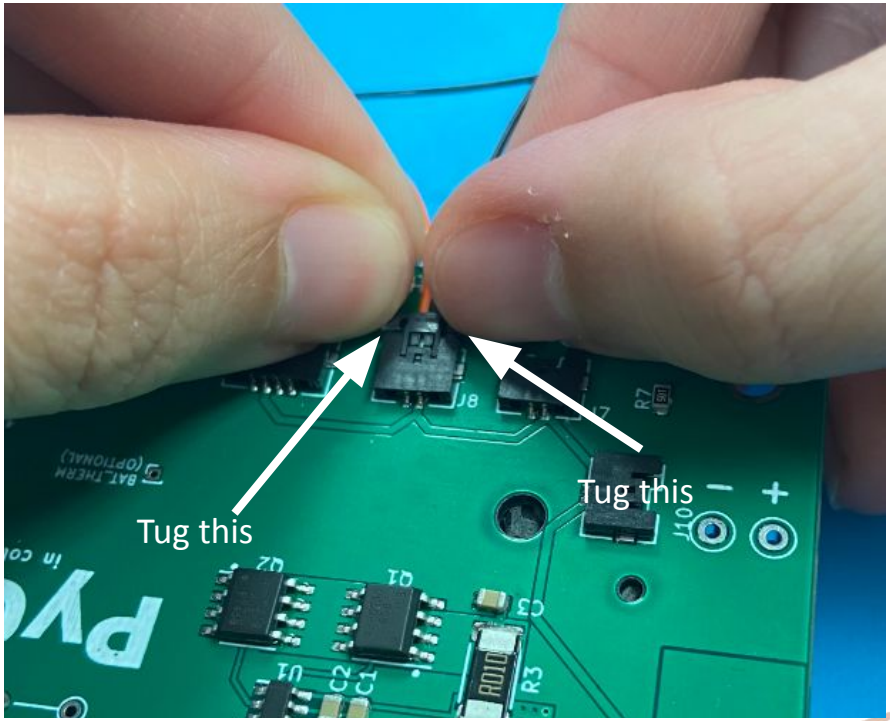


DO NOT REMOVE THE HARNESS WIRES BY PULLING THE WIRES. THIS WILL POTENTIALLY BREAK THEM.

Instead, use your fingernails to tug and remove the two ends of the wire harness. (Method 1)

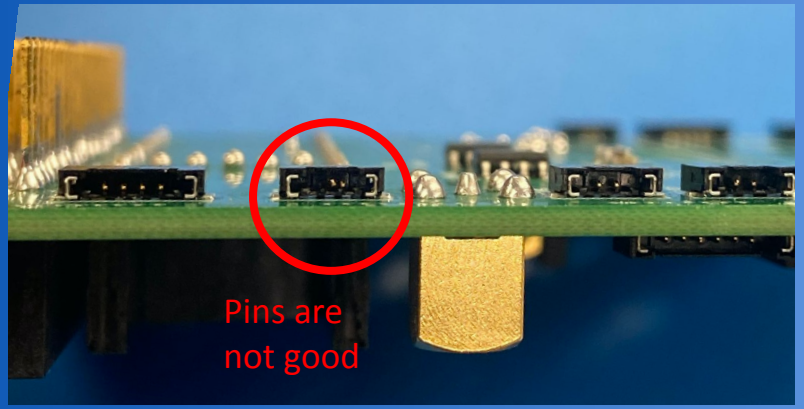
Removing Wires into Molex Connectors on the PCB

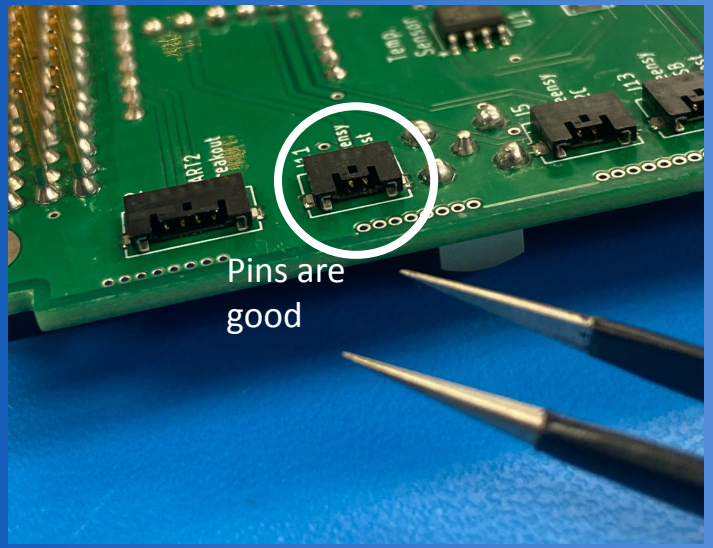




DO NOT REMOVE THE HARNESS WIRES BY PULLING ON THE WIRES. THIS WILL POTENTIALLY BREAK THEM.

Instead, use your fingernails to tug and remove the two ends of the wire harness. (Method 2)

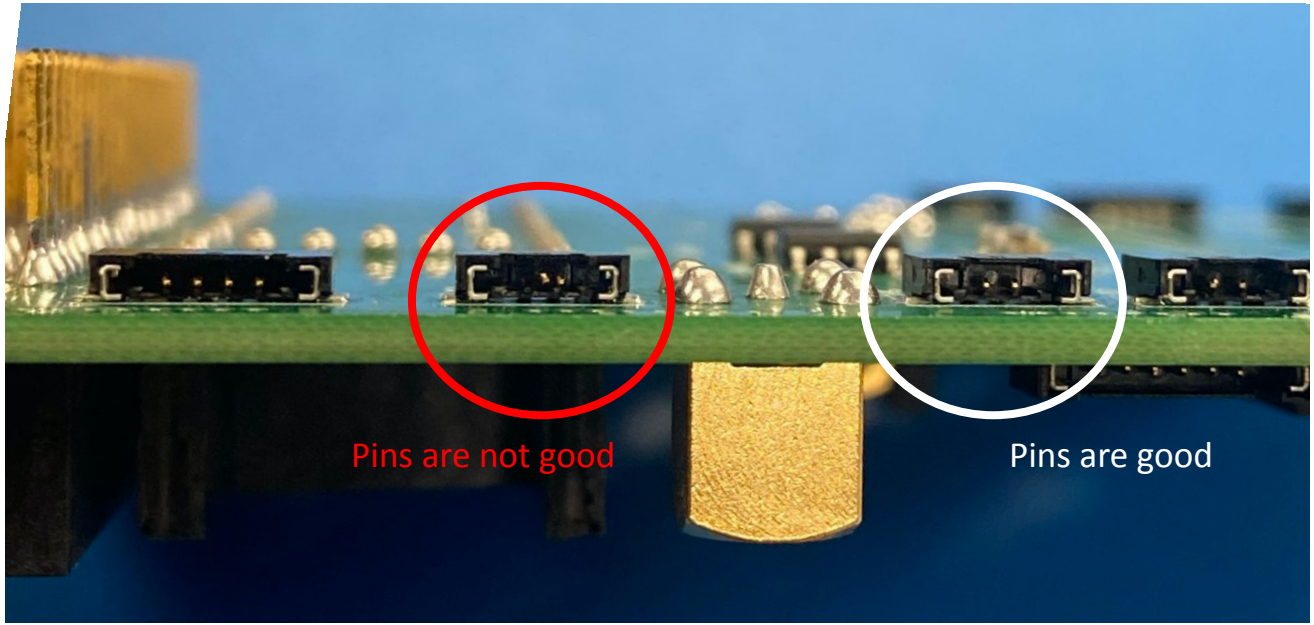




Fixing Converging Molex Connector Pins

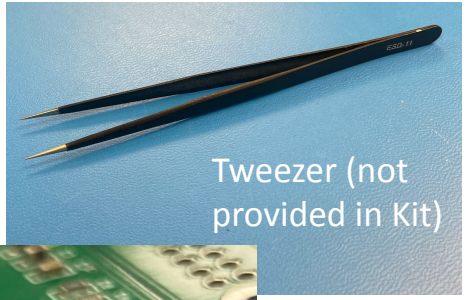
Fixing Converging Molex Connectors' Pins

This slide set will go over what to do when the Molex Connectors pins converge on each other, as seen in the figure. This is often the result of improper insertion and removal of the Molex Wire Harness.

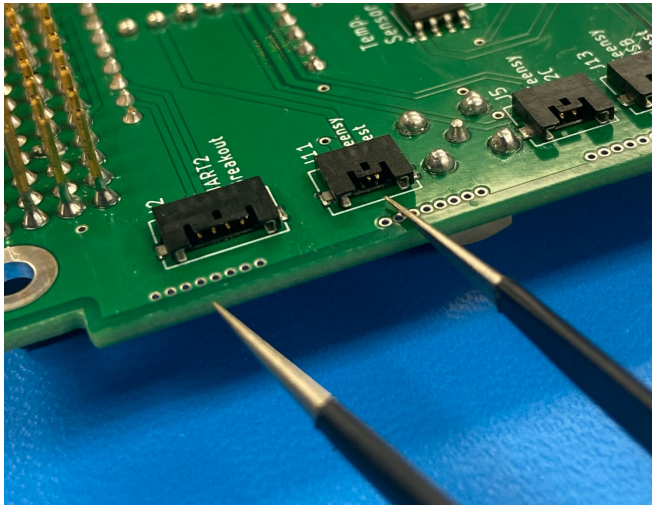


Fixing Molex Connectors' Pins

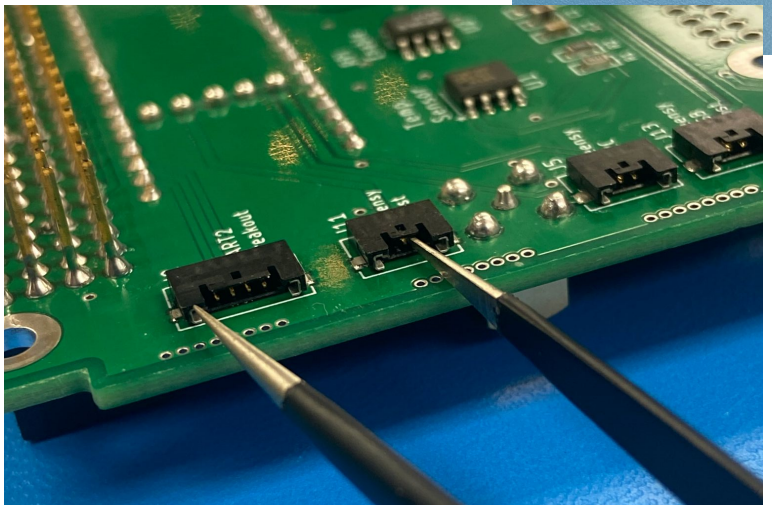
Use a tweezer to separate and straighten the pins back to its original form.



Tweezer (not provided in Kit)



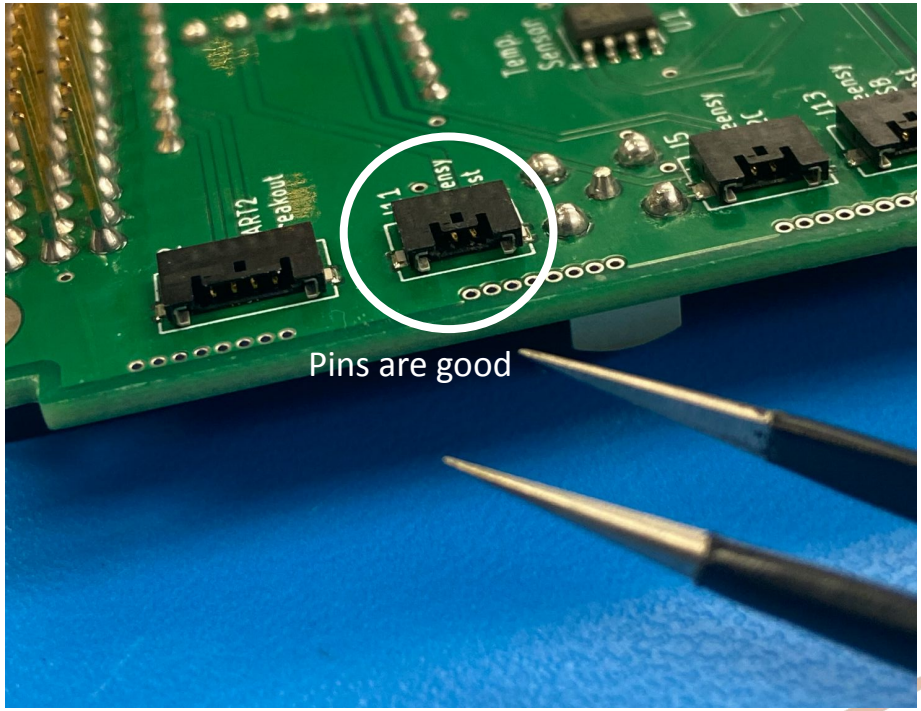
Tweezer is about to enter the Molex Connector

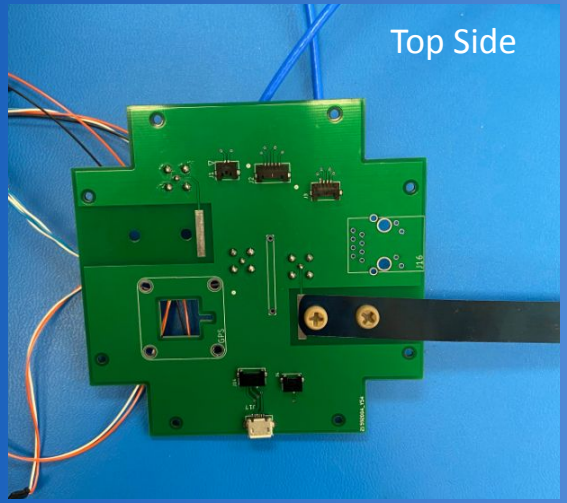


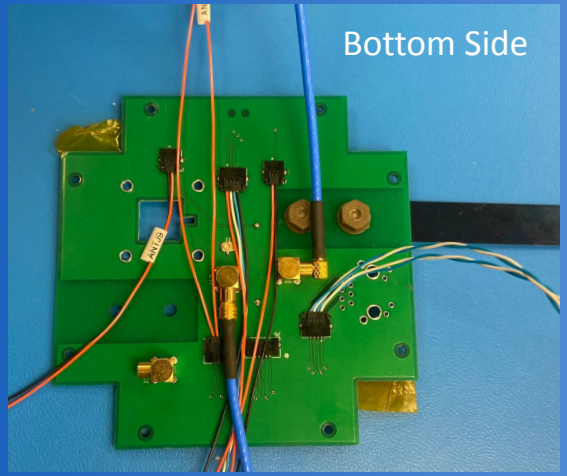
Tweezer is inserted between the two converged pins and gently used to pull the pins apart

Fixed Molex Connectors' Pins

You now have successfully repaired the pins!





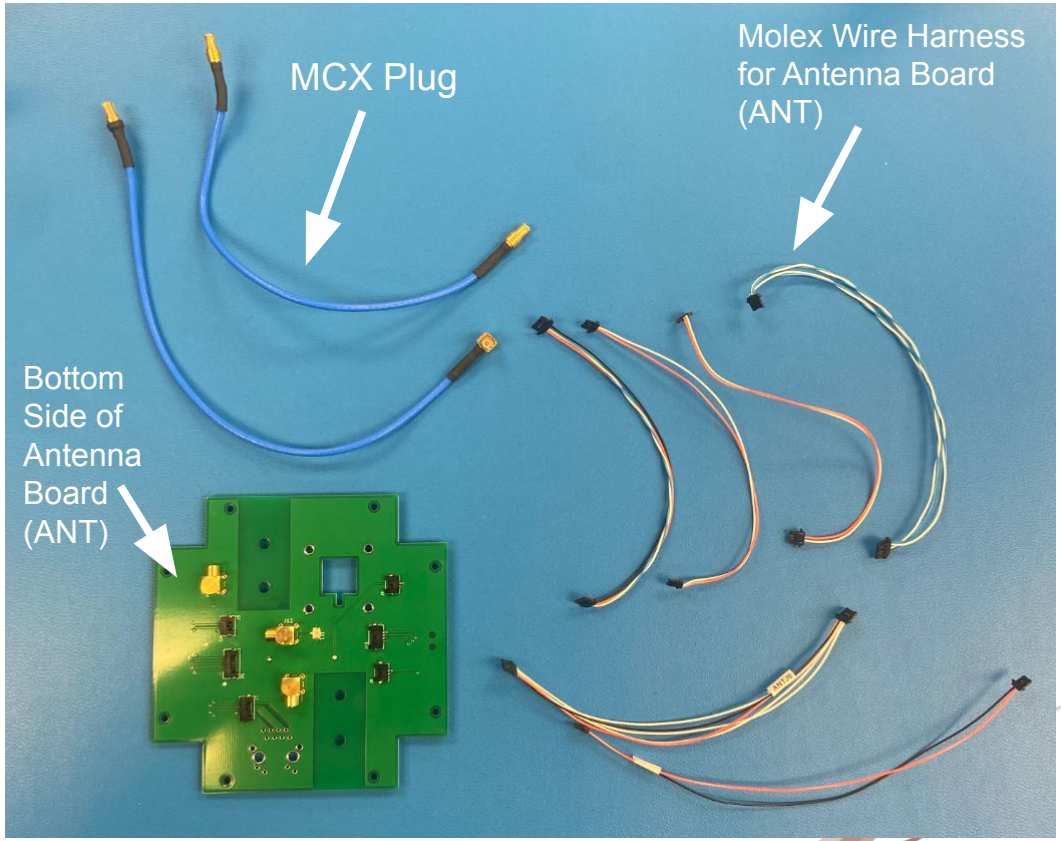


Preparing the Antenna Board

Prepare Antenna Board (ANT) Assembly Components

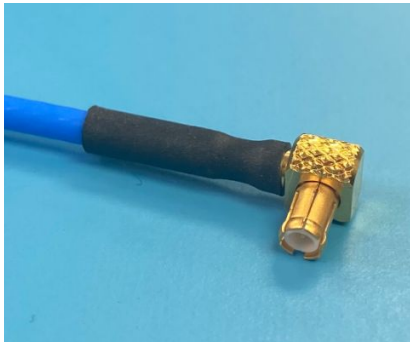
Materials:

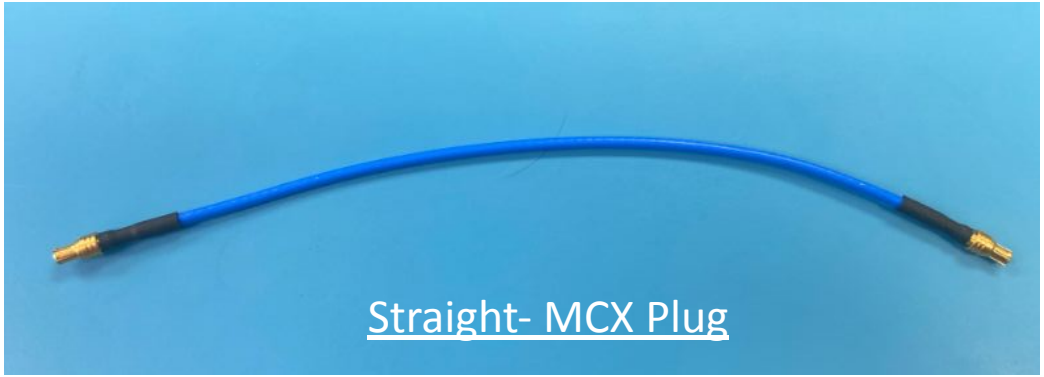
- 6 Molex Wire Harness with Wire Labels:
  - ANT J5
  - ANT J6
  - ANT J7
  - ANT J8
  - ANT J9
  - ANT J15
- 1 Right-Angle to Straight MCX Plug for ANT J10
- 1 Straight to Straight MCX Plug for ANT J12
  - See next slides for better pictures of MCX Plugs



Antenna MCX Cables: Two Types

Right-Angle MCX Cable





Straight- MCX Plug

Overview of Antenna Board (ANT) Wire Harness

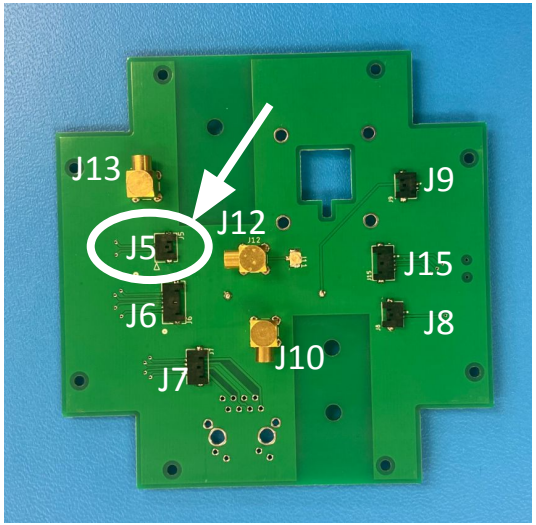
- Insert Before Flight
  - ANT J1 → Wires Soldered Together
    (2-Pin to N/A)
  - **ANT J5 to PDU J15**
    (2-Pin to 2-Pin)
- Programmable MCU
  - ANT J2 → JTAG Connector
    (5-Pin to N/A)
  - **ANT J6 to PDU J27**
    (5-Pin to 6-Pin)
- Teensy via Ethernet
  - ANT J3 → Ethernet Cable*
    (4-Pin to N/A)
  - **ANT J7 to OBC J10**
    (4-Pin to 5-Pin)
- Battery Power Breakout*
  - ANT J4 → Breakout
    (2-Pin to N/A)
- USB Charge
  - **ANT J8 to PDU J12**
    (2-Pin to 2-Pin)
- Burn Wire
  - **ANT J9 to PDU J13**
    (2-Pin to 2-Pin)
- Teensy via Micro-B
  - ANT J14 → Micro-B Cable*
    (2-Pin to N/A)
  - **ANT J15 to OBC J12**
    (4-Pin to 4-Pin)

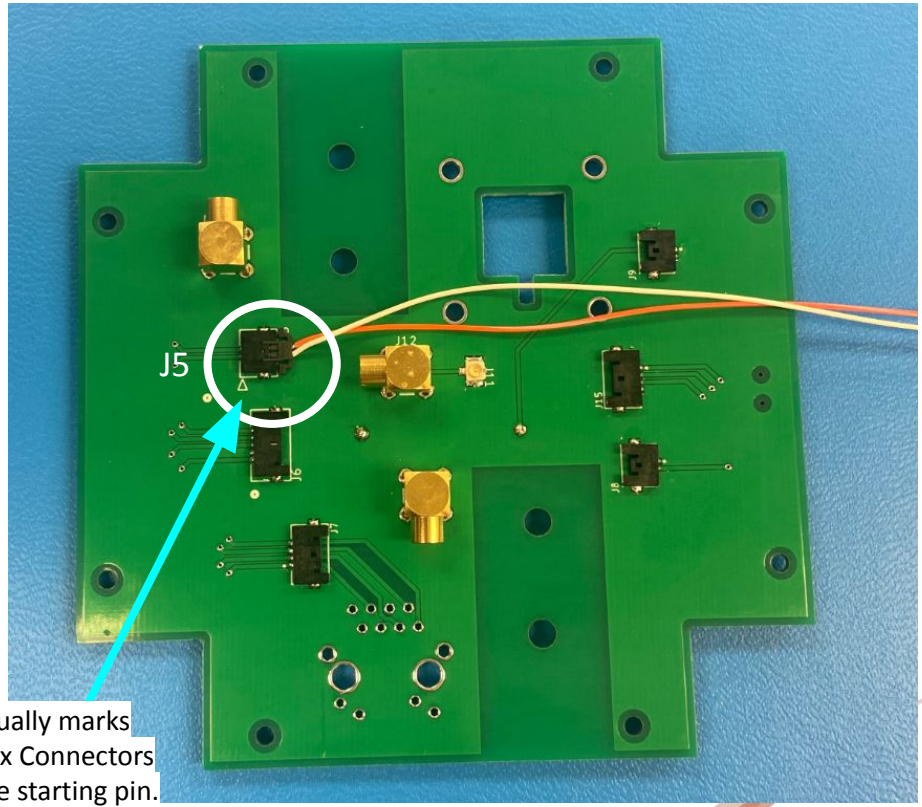
Antenna Board (ANT)
Battery Board (BB)
Power Distribution Board (PDU)
On-Board Computer (OBC)
Solar Panel Board (SPB)
* Not required for Kit operation
Bolded - Current Focus for Prep
Underlined - Wire Label

Disclaimer: Actual wire colors may be different than slide diagrams!

Antenna Board (ANT) Wire Harness: J5

- Wire Label - ANT J5
- Purpose - Connects antenna board to PDU for Insert Before Flight pin

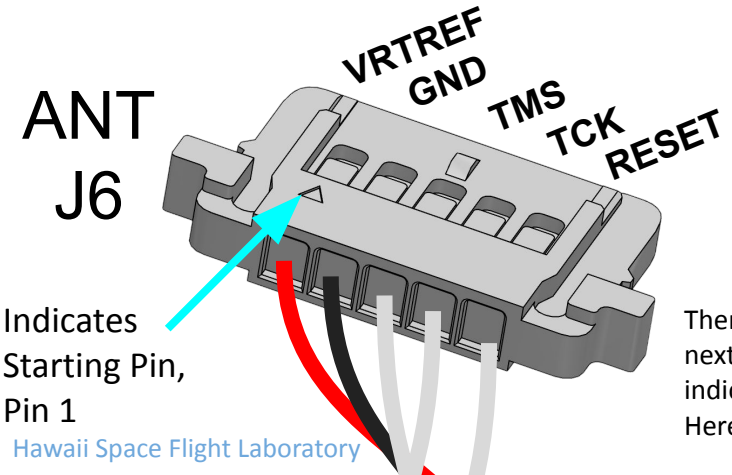


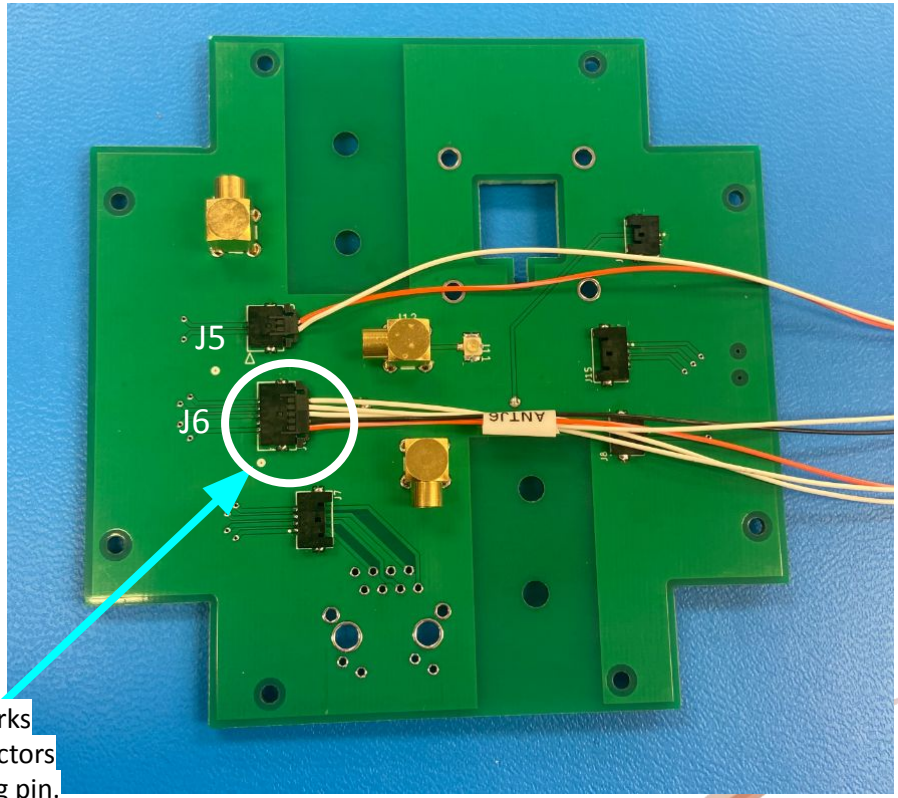


There are usually marks next to Molex Connectors indicating the starting pin. Here, it is an arrow.

Antenna Board (ANT) Wire Harness: J6

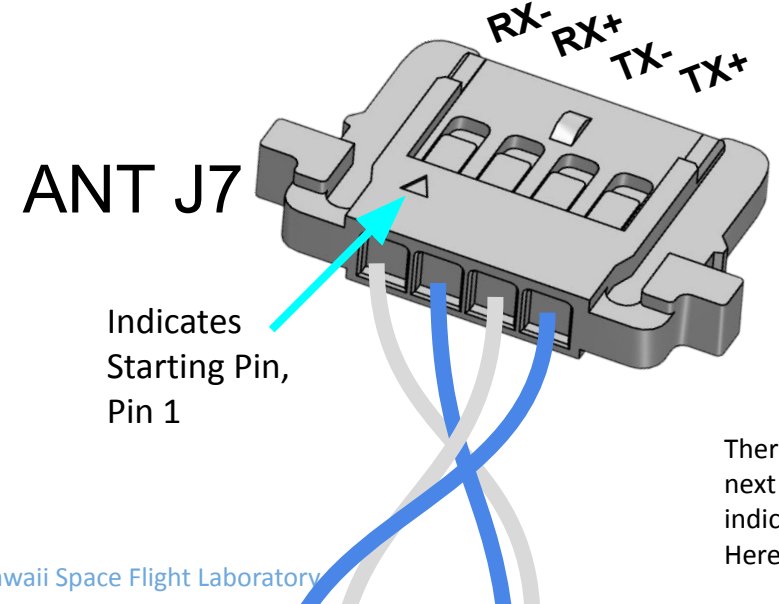
- Wire Label - ANT J6
- Purpose - Connects antenna board to PDU for external PDU programming
- Note - This 5-wire harness connects a 5-pin Molex on ANT and a-6 pin Molex on the PDU. Insert the 5-wire harness into ANT J6

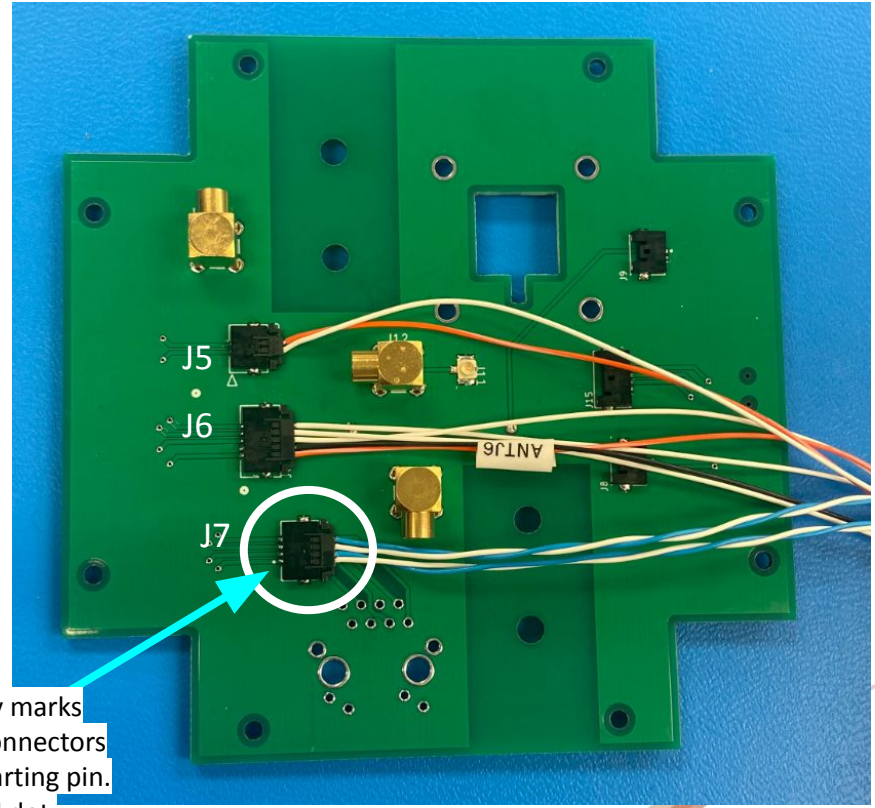




Antenna Board (ANT) Wire Harness: J7

- Wire Label - ANT J7
- Purpose - Connect Antenna board to OBC for Teensy Ethernet

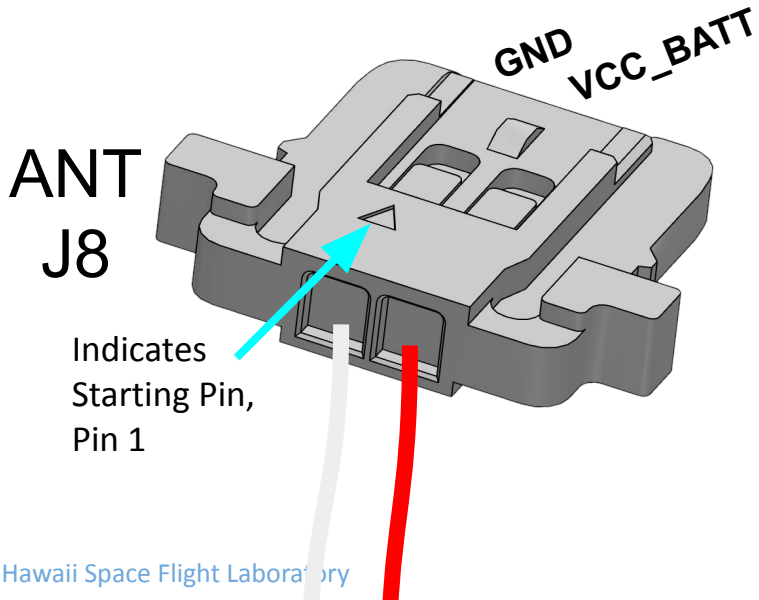


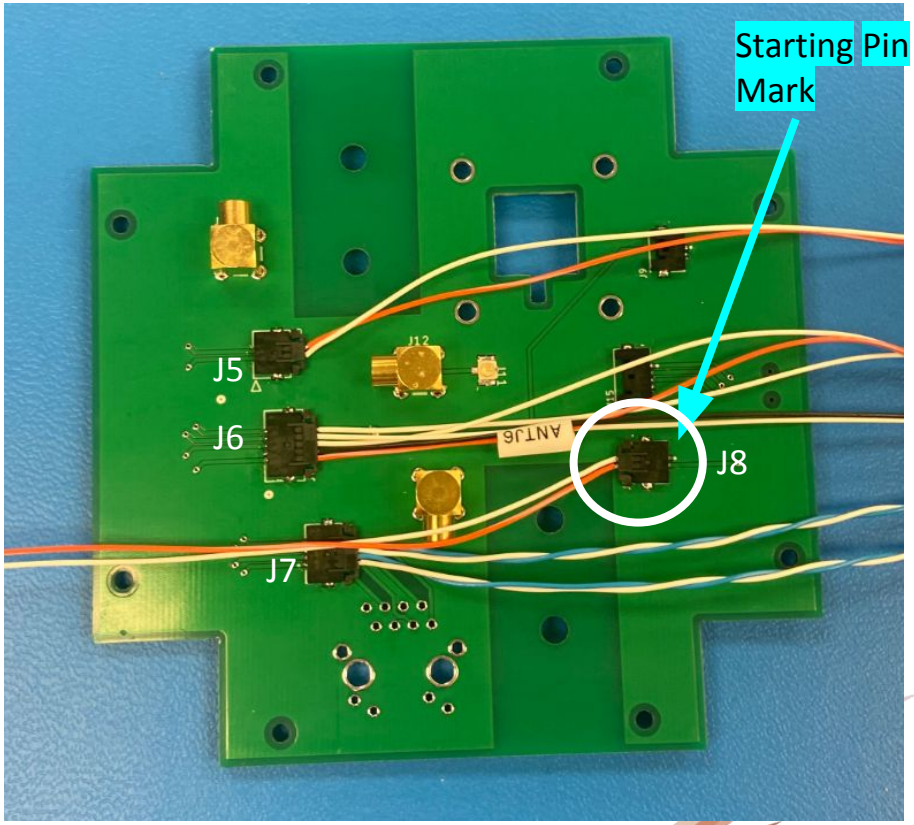


There are usually marks next to Molex Connectors indicating the starting pin. Here, it is a small dot.

Antenna Board (ANT) Wire Harness: J8

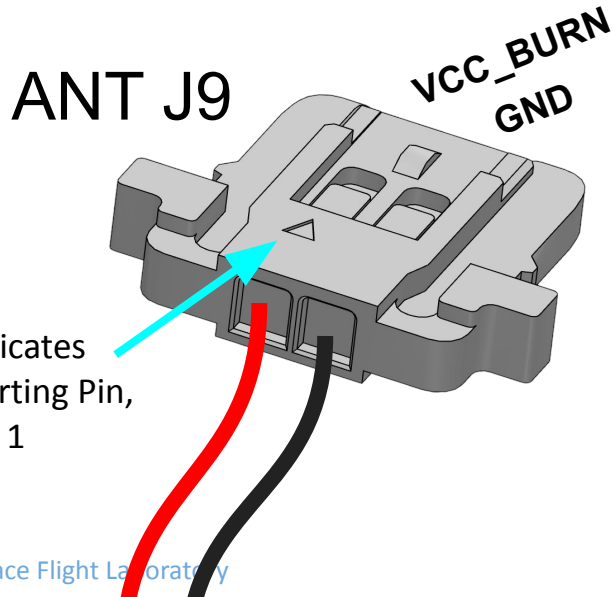
- Wire label - ANT J8
- Purpose - Connect Antenna board to PDU for external battery charging

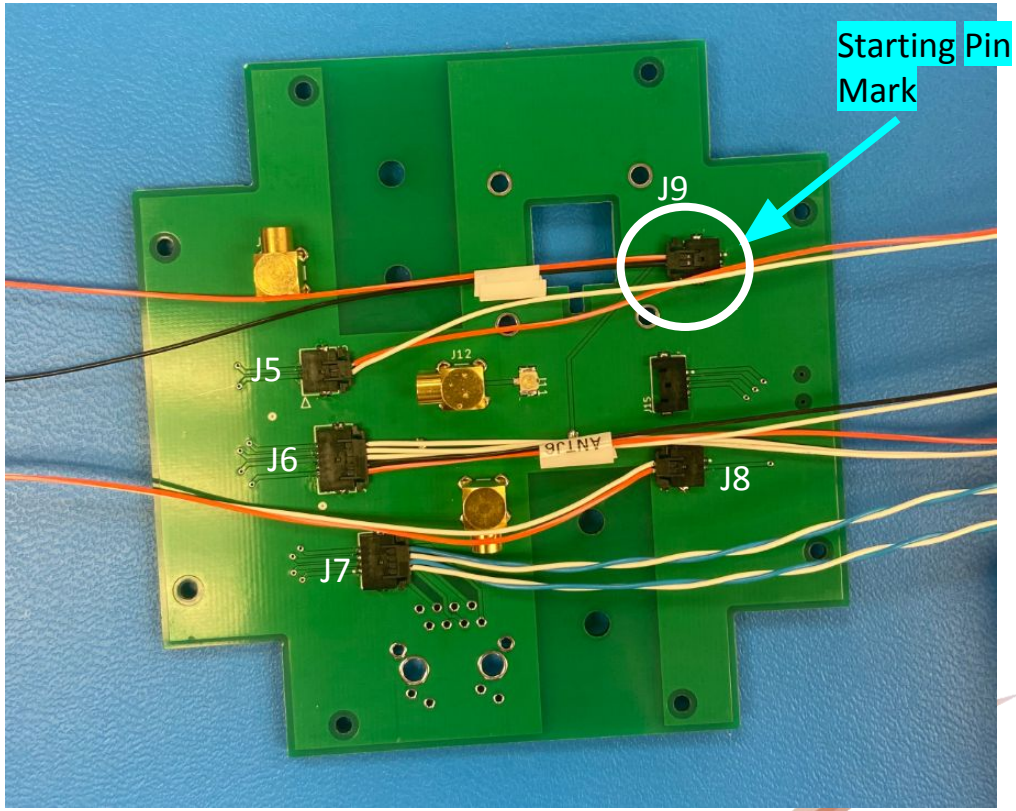




Antenna Board (ANT) Wire Harness: J9

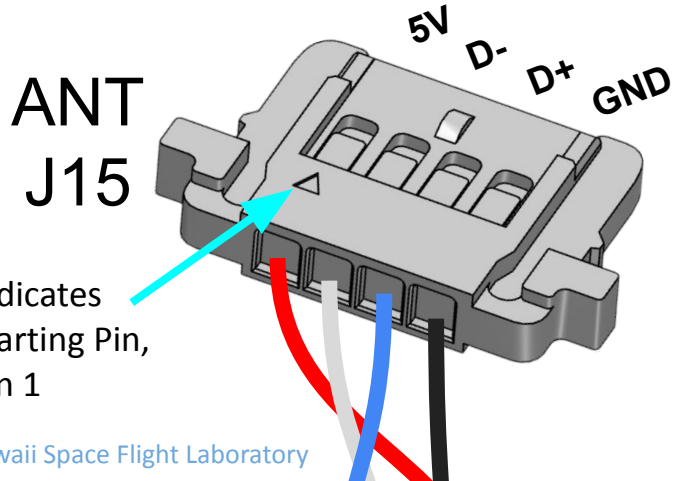
- Wire Label - ANT J9
- Purpose - Connect Antenna board and PDU for Burn Wire

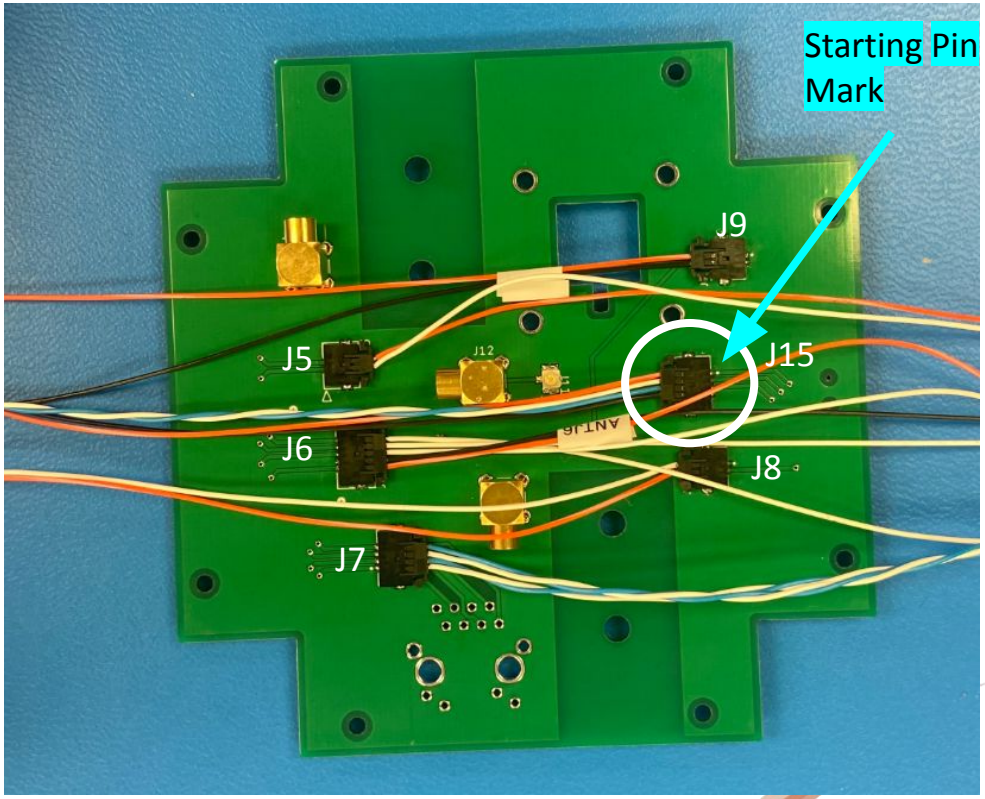




Antenna Board (ANT) Wire Harness: J15

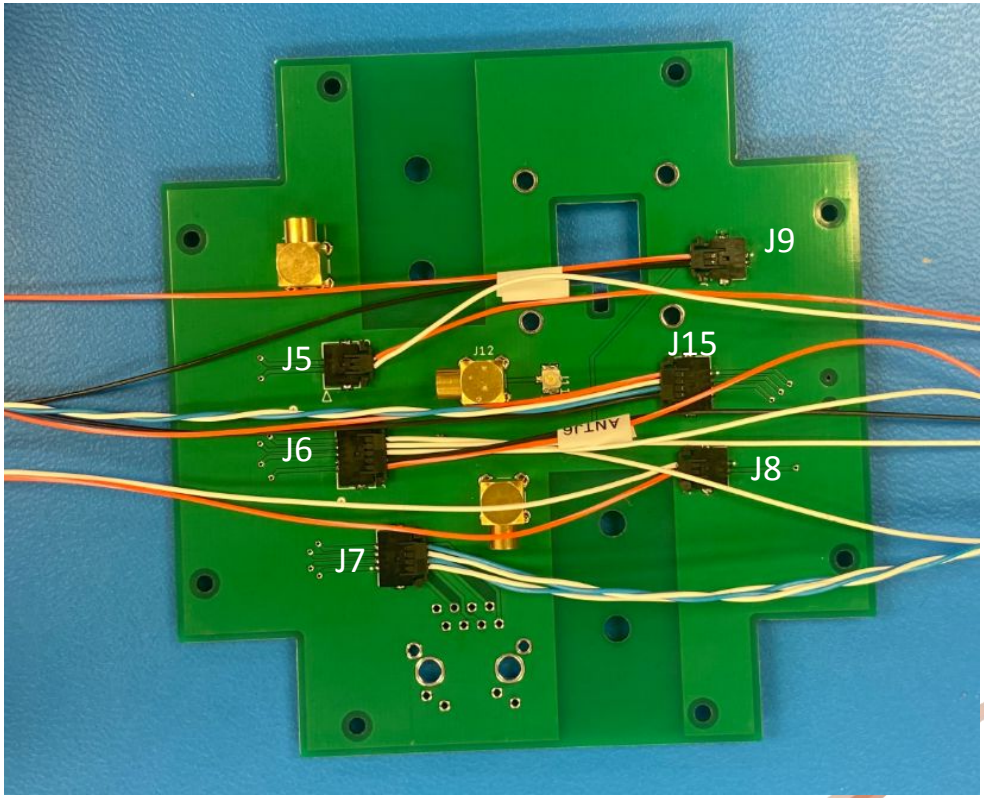
- Wire Label - ANT J15
- Purpose - Connect Antenna board to OBC for Teensy Micro USB





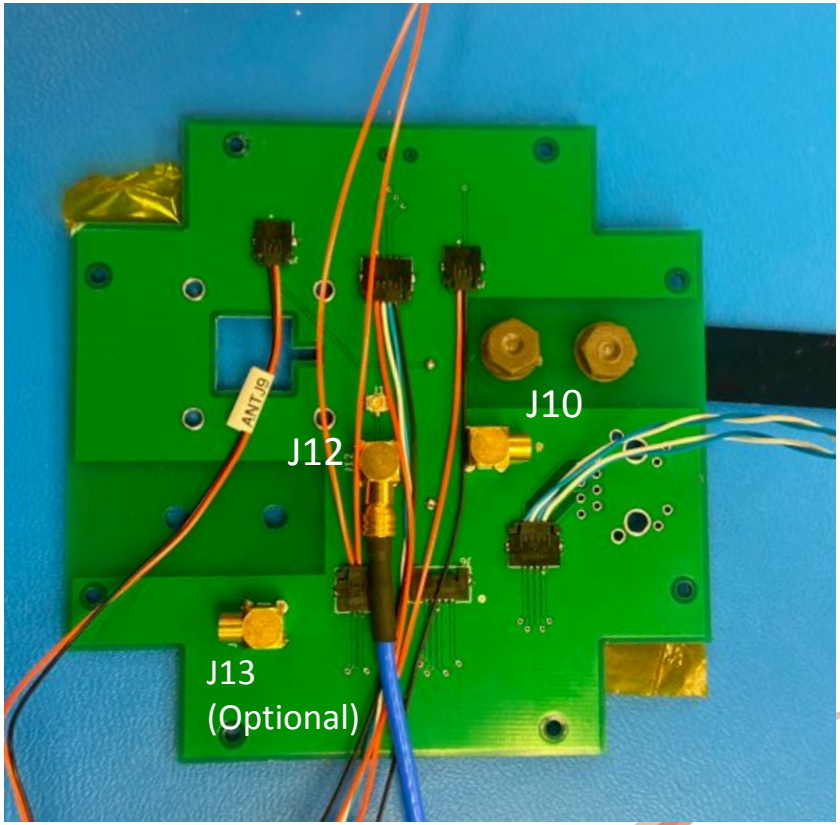
Completed Harness Wiring for Antenna Board (Bottom Side)

- After completion of Harness Wiring, the bottom side of the Antenna board should like the figure on the right
- Ensure all wires are connected and secured onto its respective Molex connector



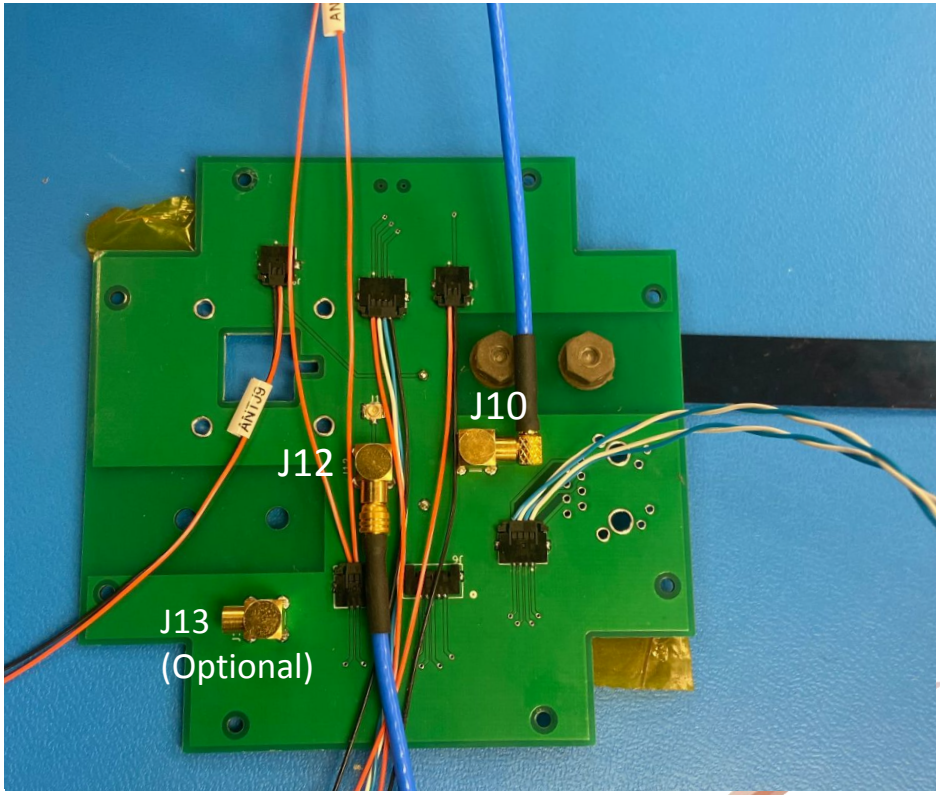
Attach the Right-Angle MCX Plug to J10 (ANTENNA1)

- J10, J12, and J13 are Antenna Jacks
- Attach the Straight- MCX Plug to J12 (GPS)



Attach the Straight- MCX Plug to J12 (GPS)

- Attach the Right-Angle MCX Plug to J10 (ANTENNA1)
- If using two Antennas, attach an additional Right-Angle MCX Cable to J13 (optional step at this time)
- You now have a prepped Antenna Board!



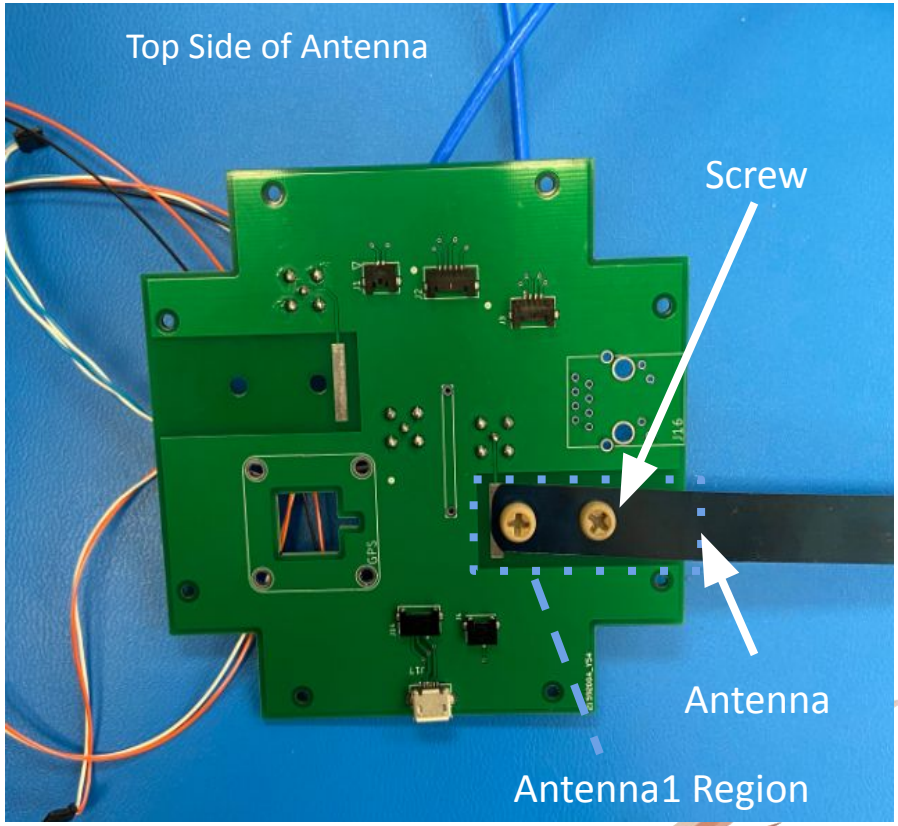
Attach Antenna to Antenna Board (Top Side) **Testing**

You will need:

- 2 Antenna Screws [W] (Black, Plastic)
- 2 Antenna Washer [R] (Natural, PEEK)
- 2 Antenna Nut [W] (Black, Plastic)
- 1 Antenna [V]

- Line up the Antenna with the holes (Top side of PCB, Antenna1 Region)
- Insert screw onto Antenna Holes (you do not need a tool at this moment)

NOTE: If you are doing Vacuum Testing, please follow the instructions on the support slides. Black Plastic components are NOT LOW OUTGASSING!



Rule of Thumb for Tightening Nuts

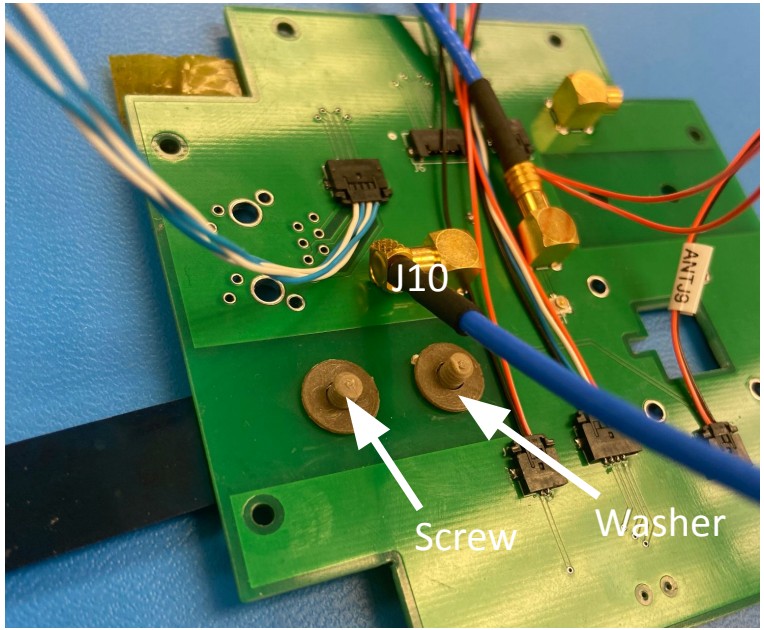
Tighten the nut using a Philips Screwdriver* until the nut makes contact with the washer and the screw is firmly holds the Antenna in place.

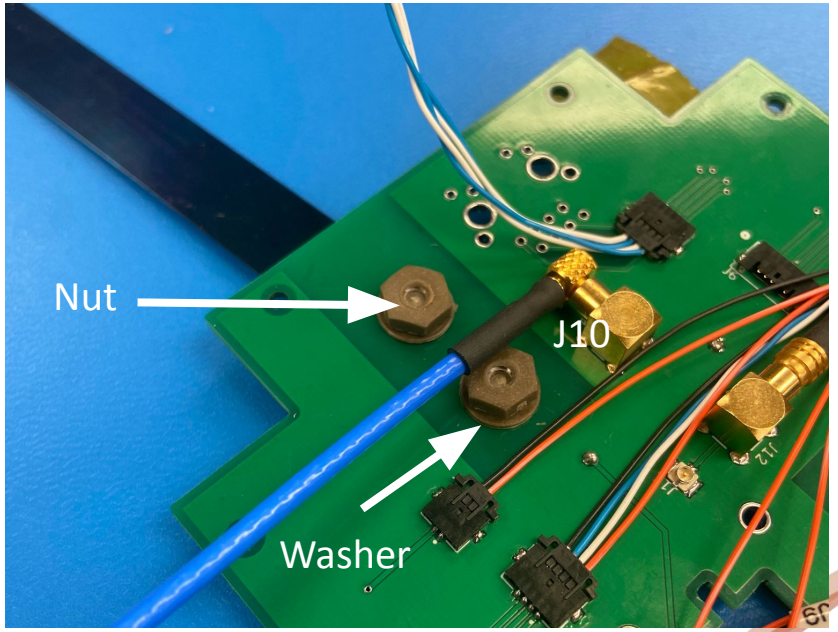
- If you tighten the nut too much, the materials will break. So do not force it.
- If you keep it too loose, everything will fall apart.

*Philips Screwdriver not provided by the Kit

Attach Antenna to Antenna Board (Bottom Side)

- Insert washer onto the screw (Bottom Side of Antenna Board)
- Insert nut onto the washer and tighten the nut using Philips Screwdriver* (see next slide for specifics)

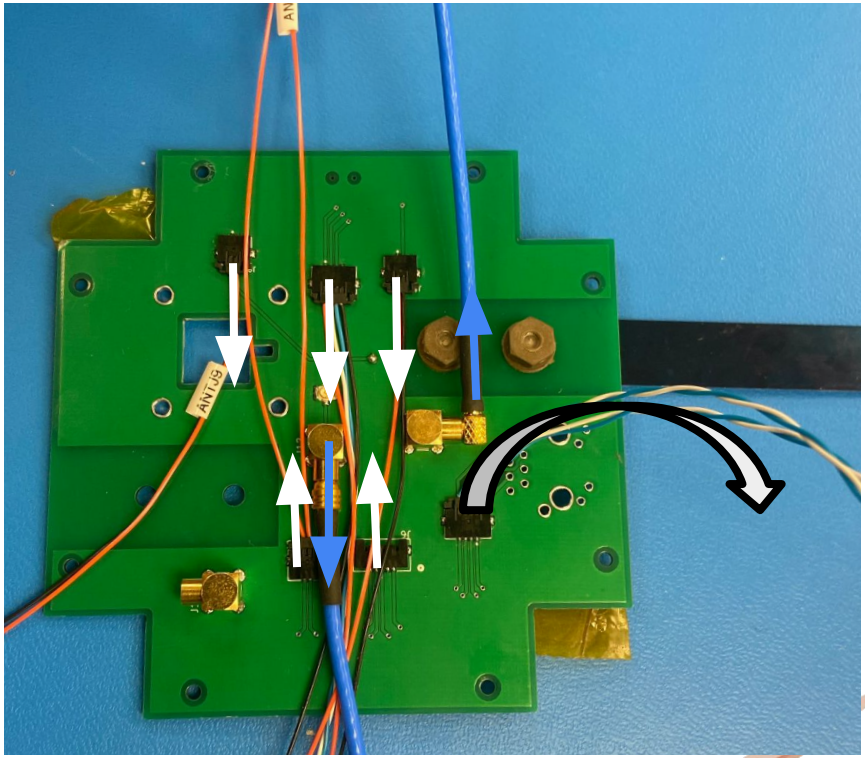




*Philips Screwdriver not provided by the Kit

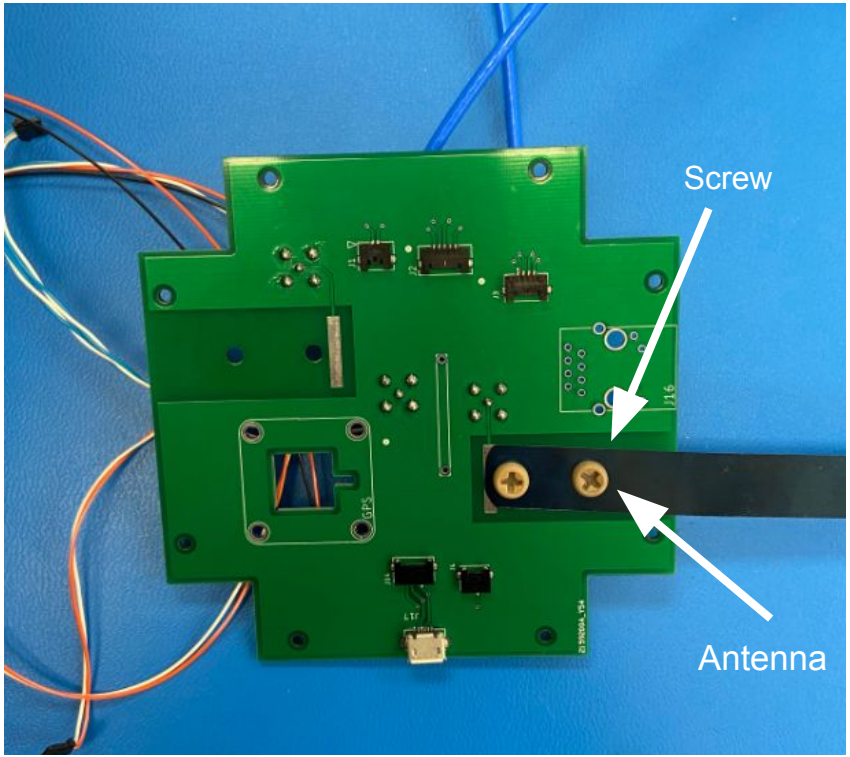
Antenna Board Orientation Review

- The MCX Plugs should be resting in opposite ways
- All harness wires shall flow in the same direction they are inserted except for Antenna Board (ANT) J7 which flow in the opposite direction of insertion

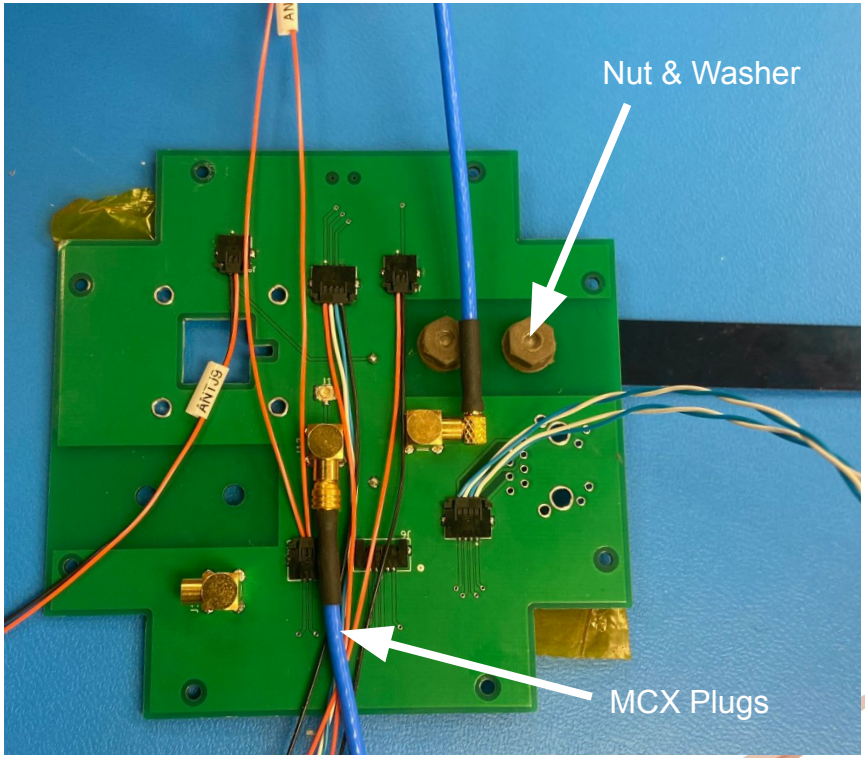


Bottom Side

Prepped Antenna Board

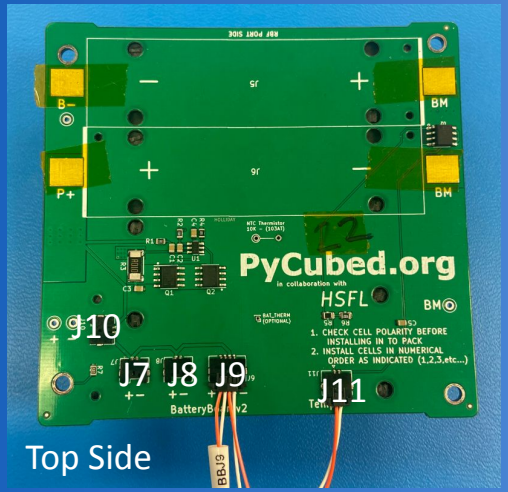


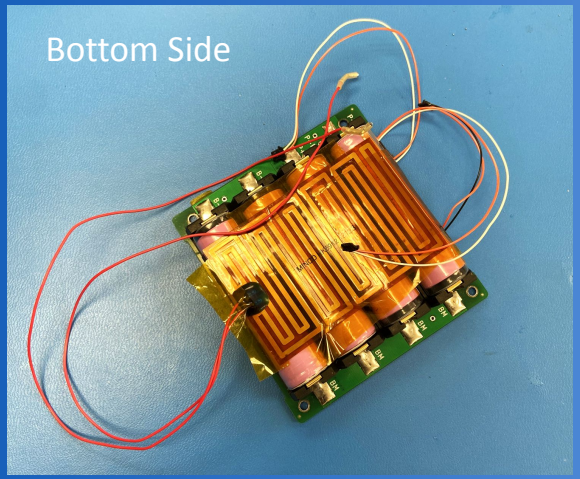
Top Side



Bottom Side

Preparing the Battery Board

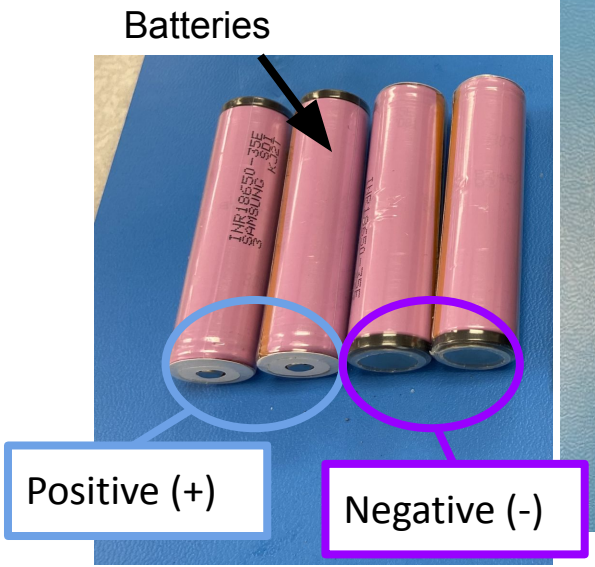


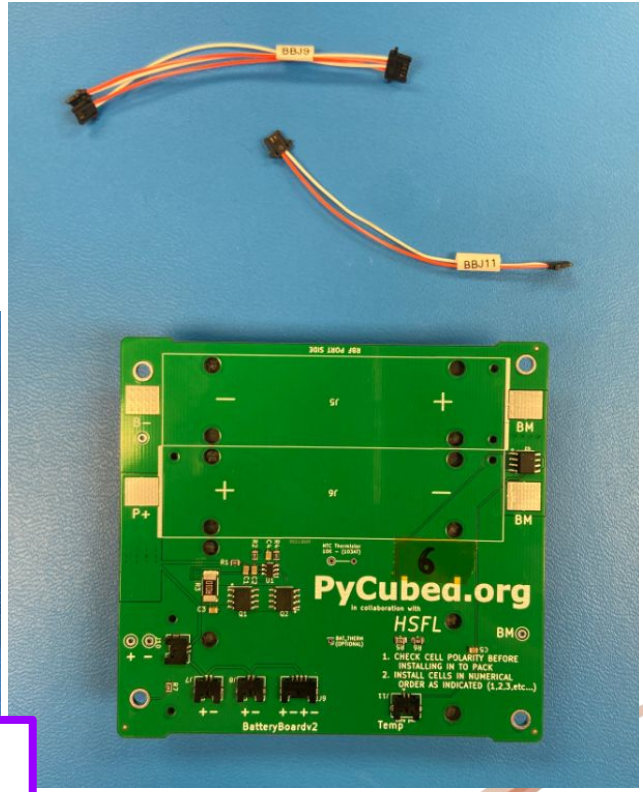


Prepare Battery Board (BB) Components

Materials:

- 4 Batteries (Samsung 35E 18650 3500mAh 8A)
- 2 Molex Wire Harness with Wire Label:
  - BB J9
  - BB J11





Overview of Battery Board (BB) Wire Harness

- Battery Power Breakout*
  - BB J7 → Breakout
  - BB J8 → Breakout
    (Both are 2-Pin to N/A)
- Pre-Insert Before Flight VBatt & Battery Charge
  - **<u>BB J9</u> to PDU J16 & J17**
    (4-Pin to two 2-Pin)
- Deployment Switch
  - **<u>BB J10</u> → Deployment Switch Receptacle #1**
    (2-Pin to N/A)

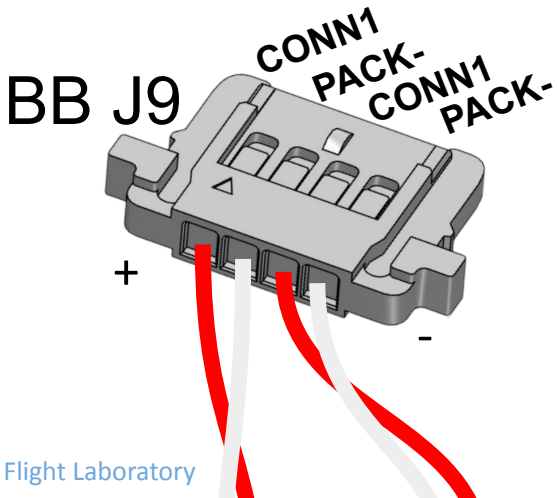
- BB Temperature Sensor
  - <u>BB J15</u> to PDU J19
    (2-Pin to 2-Pin)

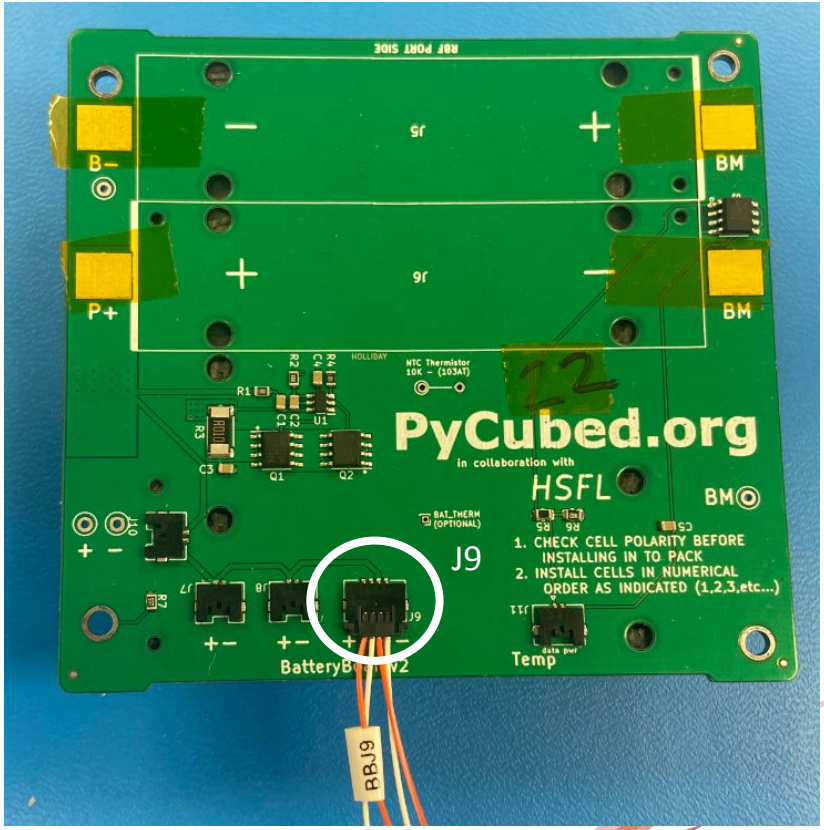
Antenna Board (ANT)
Battery Board (BB)
Power Distribution Board (PDU)
On-Board Computer (OBC)
Solar Panel Board (SPB)
* Not required for Kit operation
Bolded - Current Focus for Prep
<u>Underlined</u> - Wire Label

Disclaimer: Actual wire colors may be different than slide diagrams!

Battery Board (BB) Wire Harness: J9

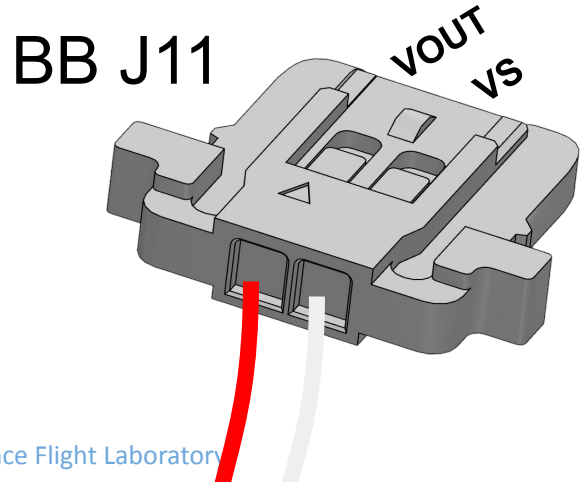
- Wire Label - BB J9
- Purpose - Connects Battery board to PDU for battery power and battery charging

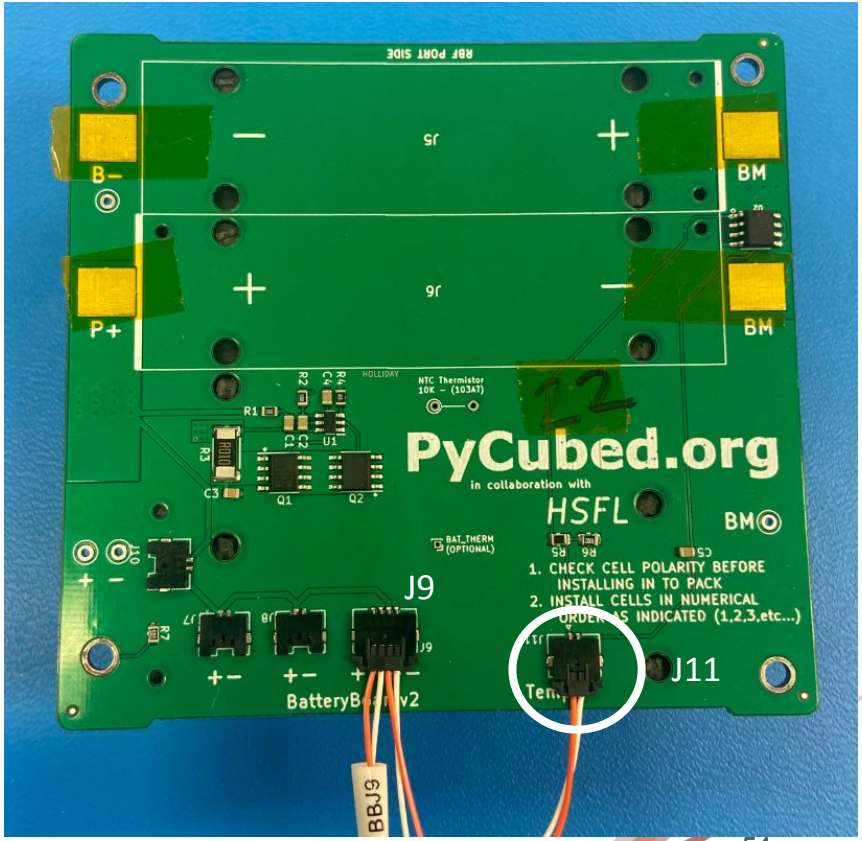




Battery Board (BB) Wire Harness: J11

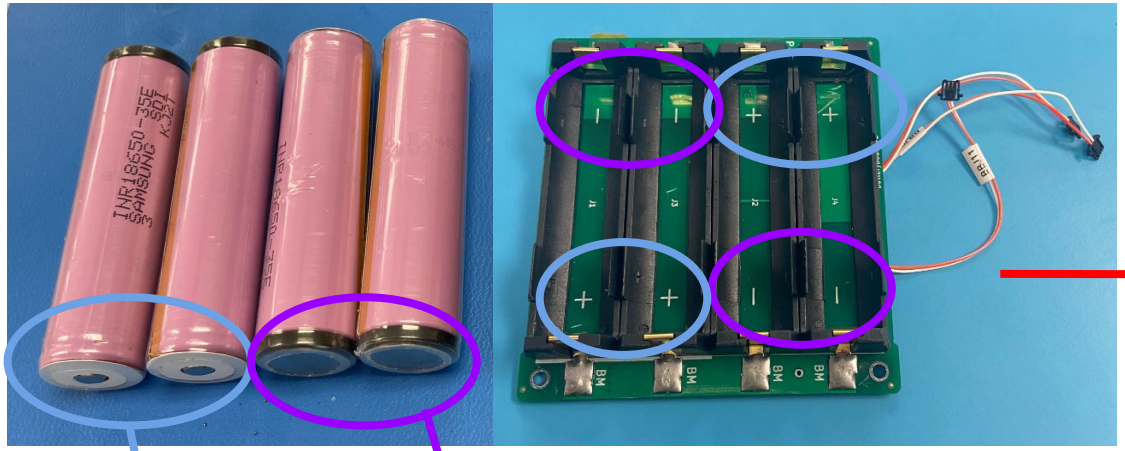
- Wire Label - BB J11
- Purpose - Connect Battery board to PDU for Temperature Sensor data

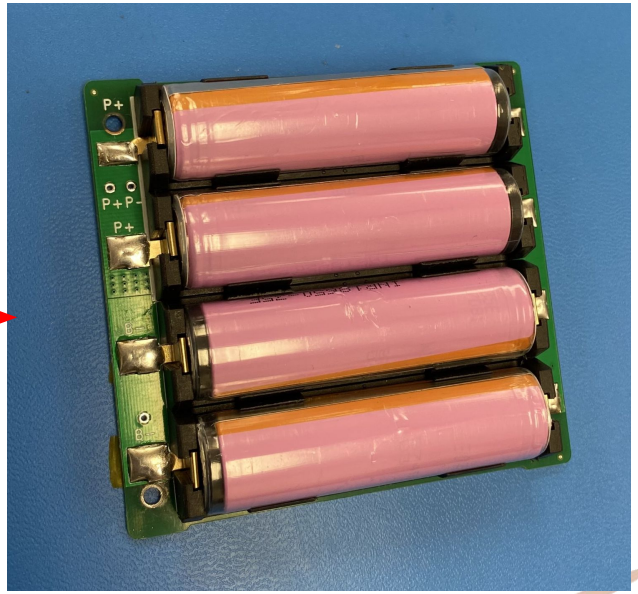


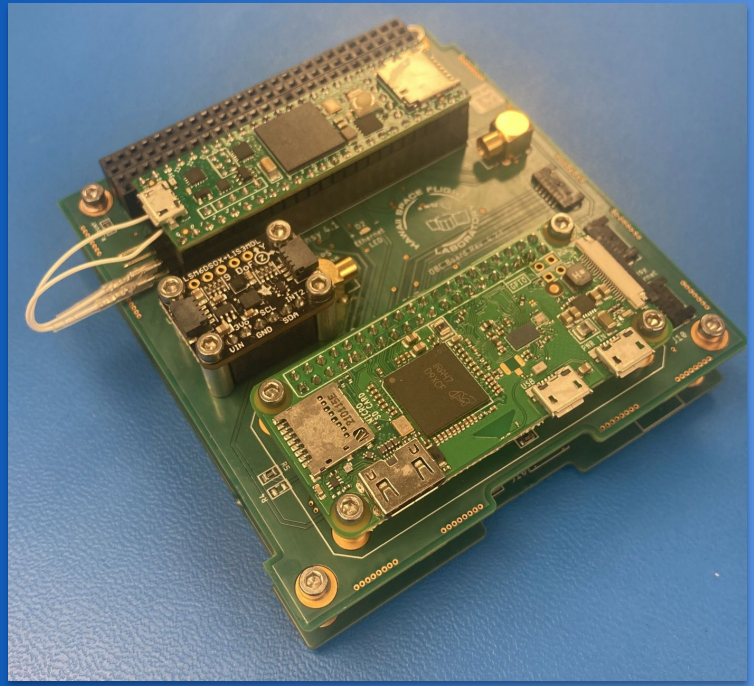


Place Batteries into Battery Holders (Bottom Side)

- Ensure the batteries are properly placed according to their terminals (+ or -)



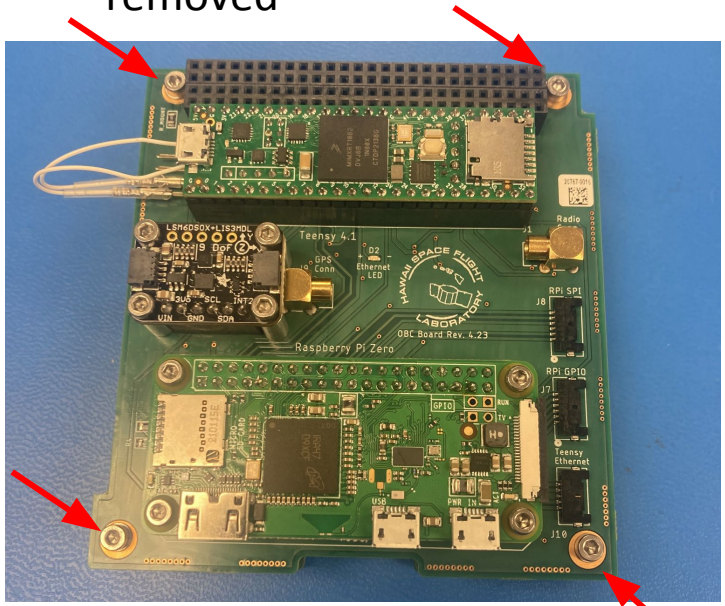


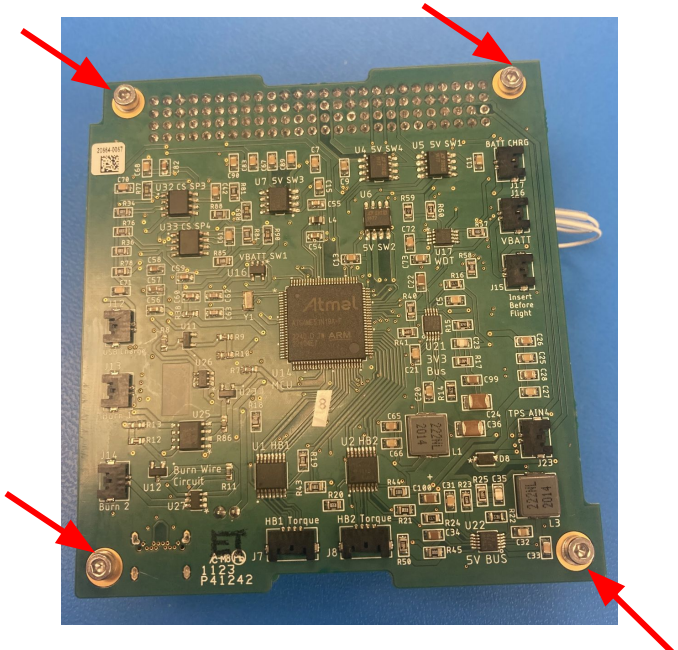


Disassembling OBC and PDU

Out of box Assembled OBC and PDU

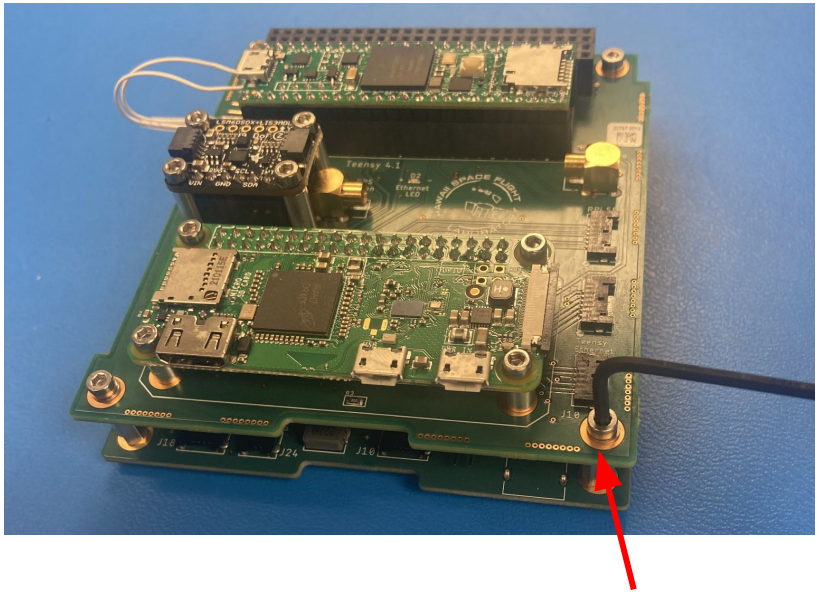
- The boards are connected to protect the pins during shipping.
- In each rod hole, there are 2 screws, 2 washers, and a standoff that need to be removed

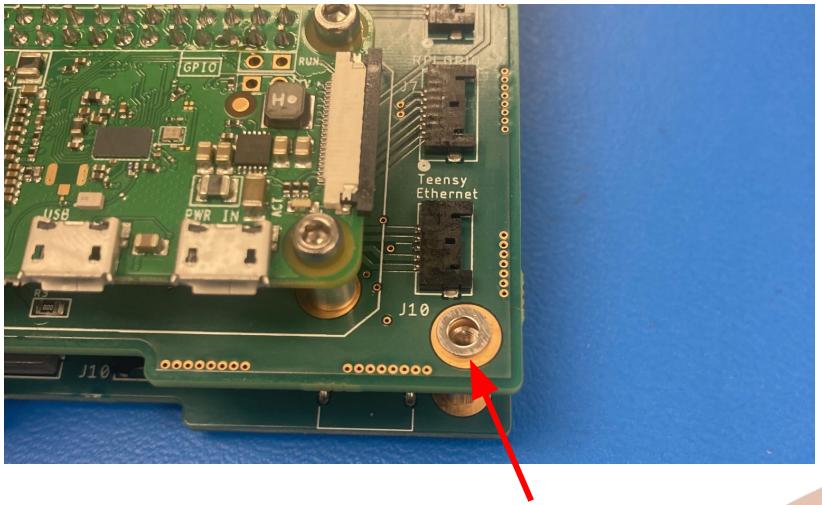




Removing Screws

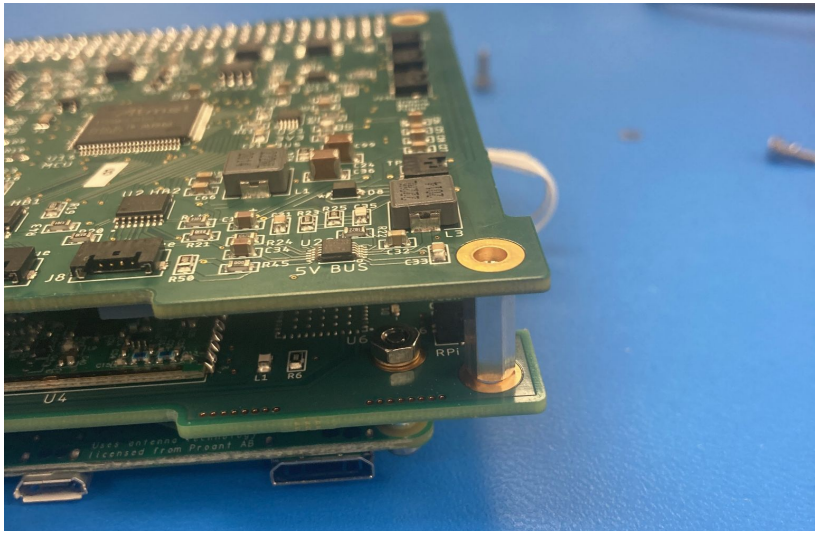
- Remove all 8 screws and washers from the boards





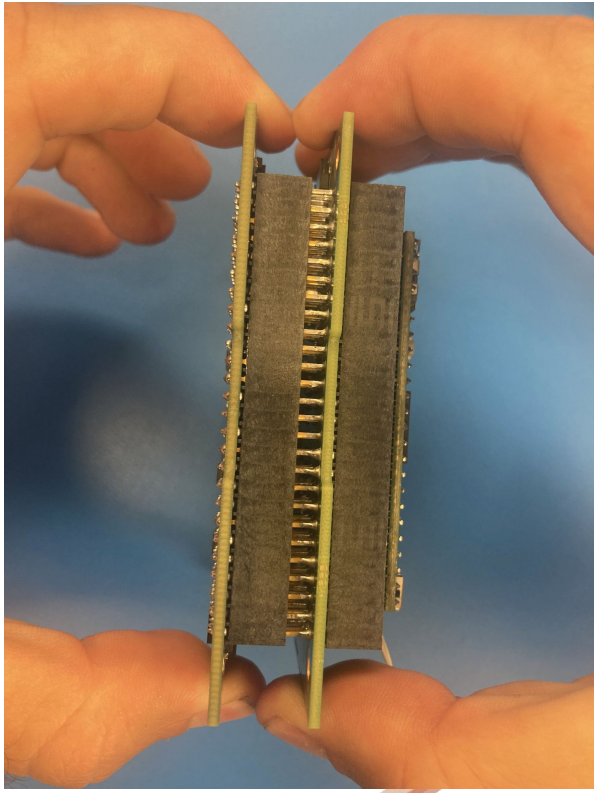
Remove Standoffs

- Each corner will contain a standoff
- Simply slight the standoffs out from between the boards

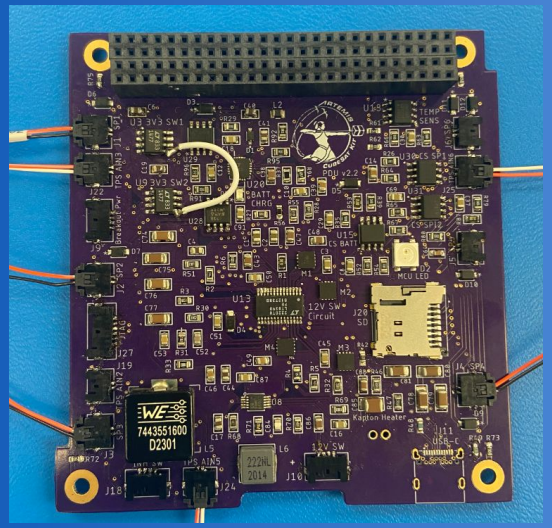


Separate the Boards

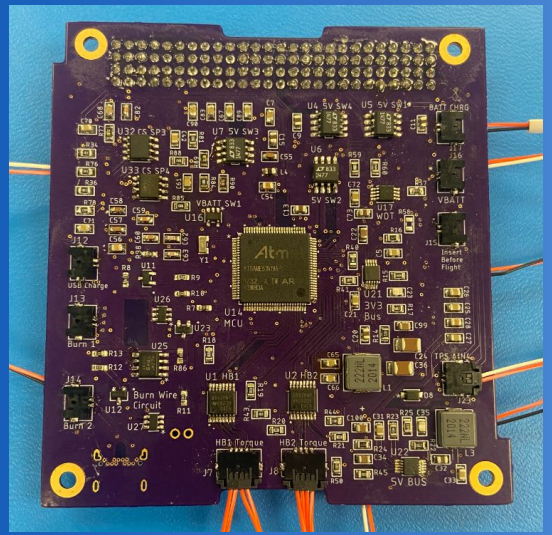
- To separate the boards, place your fingers in the position shown in the picture where each finger is near the PC104 headers
- Slowly pry apply pressure on one side at a time then switch sides to evenly separate the boards and reduce risk of bending the pins



Top Side



Bottom Side



Preparing the PDU

Overview of PDU Wire Harness Pt. 1

- Solar Power
  - **PDU J1 → SPB1 J2**
  - **PDU J2 → SPB2 J2**
  - **PDU J3 → SPB3 J2**
  - **PDU J4 → SPB4 J2**
  - PDU J5, J6*
    (All are 2-Pin to 4-Pin)
- Torque Coils
  - **PDU J7 → SPB3 J1, SPB4 J1**
  - **PDU J8 → SPB1 J1, SPB2 J1**
    (All are 4-Pin to Two 2-Pin)
- Inhibit Switch
  - PDU J18 → Deployment Switch Receptacle #2
    (4-Pin to N/A)
- 5V USB Charge
  - **PDU J12 → ANT J8**
    (2-Pin to 2-Pin)

- Breakout*
  - 3V3 Switch 1 & 5V Switch 3: PDU J9
    (4-Pin to N/A)
  - 12V Switch 1: PDU J10
    (4-Pin to N/A)
  - Burn Wire #2: PDU J14
    (2-Pin to N/A)

Antenna Board (ANT)
Battery Board (BB)
Power Distribution Board (PDU)
On-Board Computer (OBC)
Solar Panel Board (SPB)
Source: Wire Harness Guide
Bolded – Current Focus of Tutorial
* = Not necessary for Kit Operation

Disclaimer: Actual wire colors may be different than slide diagrams!

Overview of PDU Wire Harness Pt. 2

- Burn Wire
  - PDU J13 → ANT J9
    (2-Pin to 2-Pin)
- Insert Before Flight
  - PDU J15 → ANT J5
    (2-Pin to 2-Pin)
- Pre-Insert Before Flight & VBATT Charge
  - PDU J16 & J17 → BB J9
    (Two 2-Pin to 4-Pin)
- Temperature Sensor
  - PDU J19 → BB J15
  - **PDU J22 → SPB1 J3**
  - **PDU J23 → SPB2 J3**
  - **PDU J24 → SPB3 J3**
  - **PDU J25 → SPB4 J3**
    (All 2-Pin to 2-Pin)

- Programmable MCU
  - PDU J27 → ANT J6
    (6-Pin to 5-Pin)

Disclaimer: Actual wire colors may be different than slide diagrams!

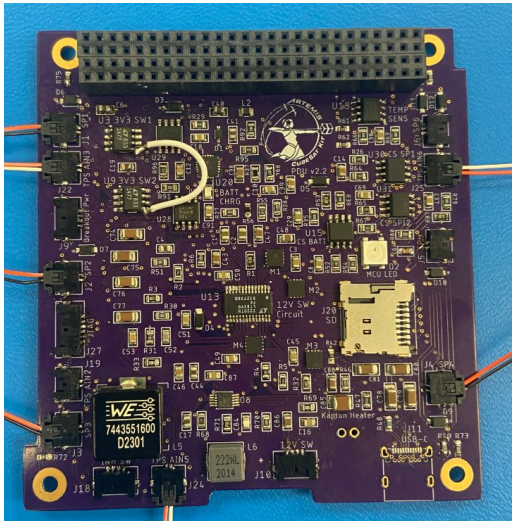
Antenna Board (ANT)
Battery Board (BB)
Power Distribution Board (PDU)
On-Board Computer (OBC)
Solar Panel Board (SPB)
Source: Wire Harness Guide
Bolded – Current Focus of Tutorial
* = Not necessary for Kit Operation

Prepare PDU Assembly Components

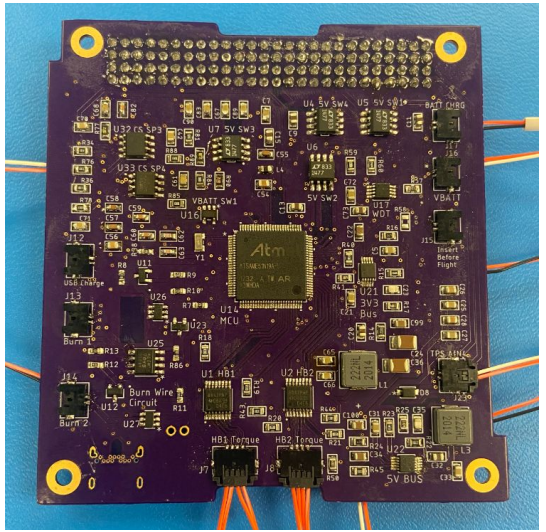
You will need 12 Molex Wire Harness for:

- PDU J1 (Wire Label: SP1 J2)
- PDU J2 (Wire Label: SP2 J2)
- PDU J3 (Wire Label: SP3 J2)
- PDU J4 (Wire Label: SP4 J2)
- PDU J22 (Wire Label: SP1 J3)
- PDU J24 (Wire Label: SP3 J3)
- PDU J7 (Wire Label: SPB3 J1, SPB4 J1)*
- PDU J8 (Wire Label: SPB1 J1, SPB2 J1)*
- PDU J23 (Wire Label: SP2 J3)
- PDU J25 (Wire Label: SP4 J3)

*Two Wire Harness Required



Top Side



Bottom Side

Attach the Wire Harness to PDU (Top Side)

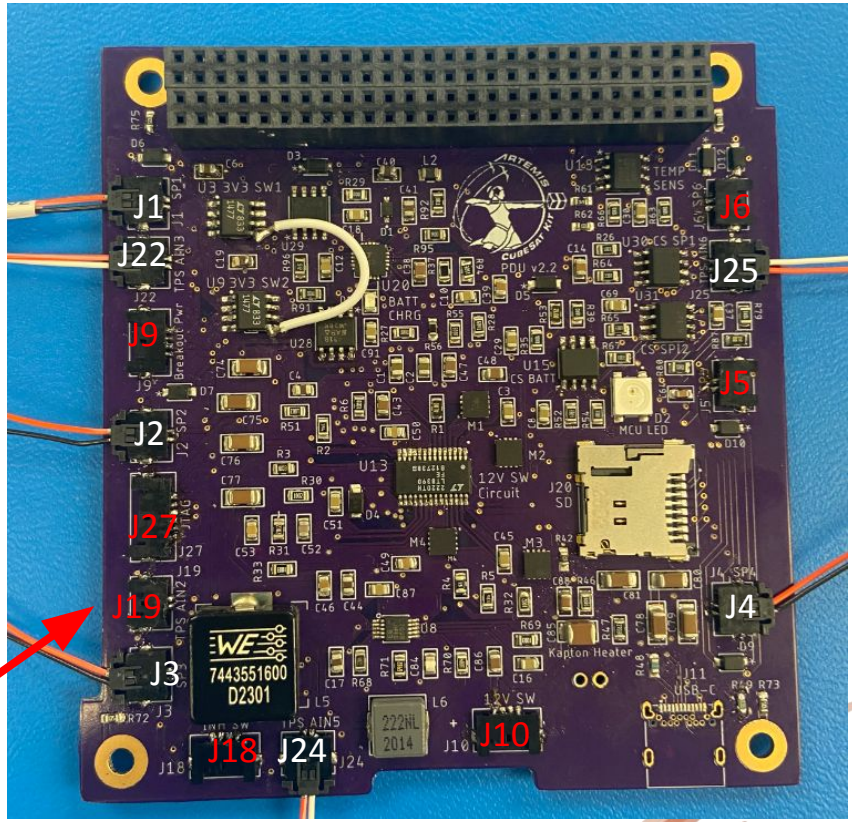
You will need 7 Molex Wire Harness for:

- PDU J1 (Wire Label: SP1 J2)
- PDU J2 (Wire Label: SP2 J2)
- PDU J3 (Wire Label: SP3 J2)
- PDU J4 (Wire Label: SP4 J2)
- PDU J22 (Wire Label: SP1 J3)
- PDU J24 (Wire Label: SP3 J3)
- PDU J25 (Wire Label: SP4 J3)

Insert the wire harness to its respective component.

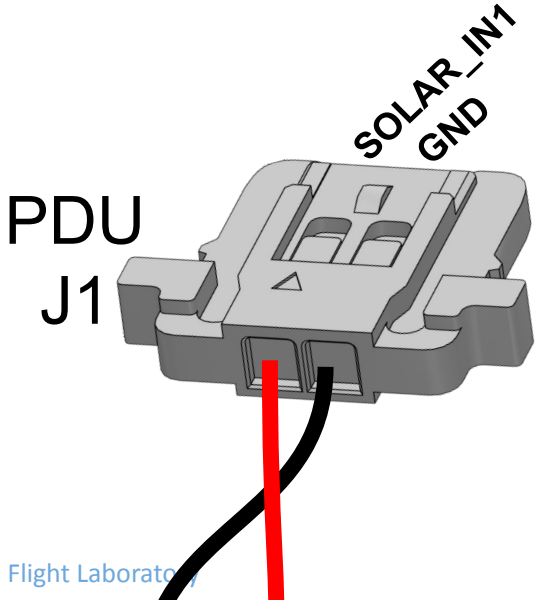
Ensure inserted Molex Wire Harness colors match the Molex Component Pins.

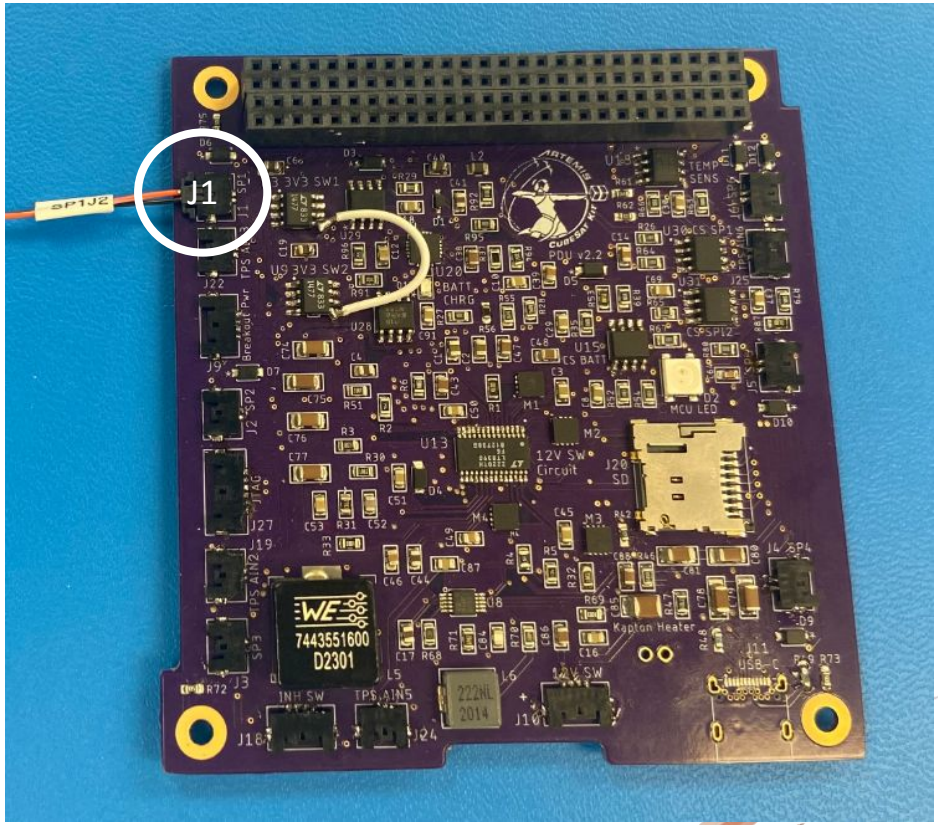
Red Font – Do not connect wire at this point in the slide



PDU Wire Harness: J1 (SP1 J2)

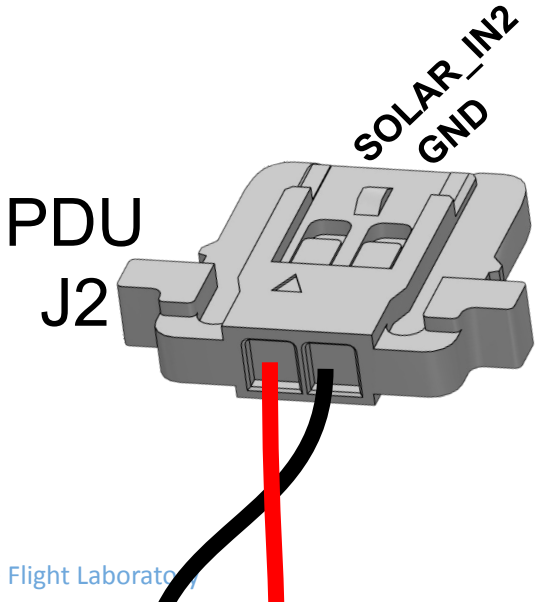
- Wire Label- SP1 J2
- Purpose - Connect Solar Panel 1 solar power

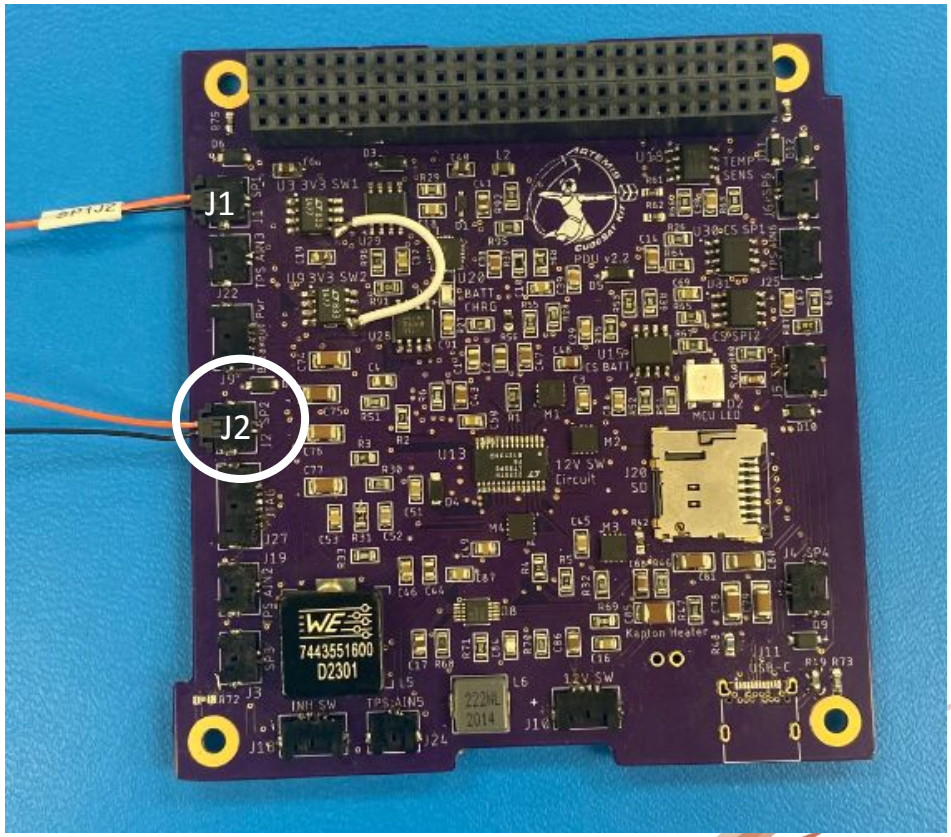




PDU Wire Harness: J2 (SP2 J2)

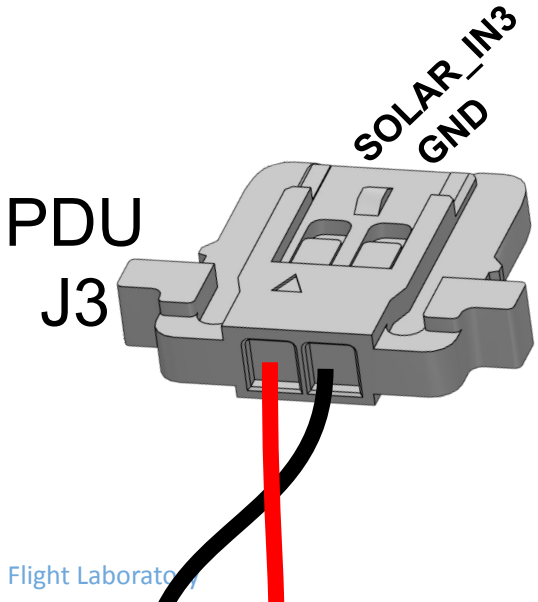
- Wire Label- SP2 J2
- Purpose - Connect Solar Panel 2 solar power

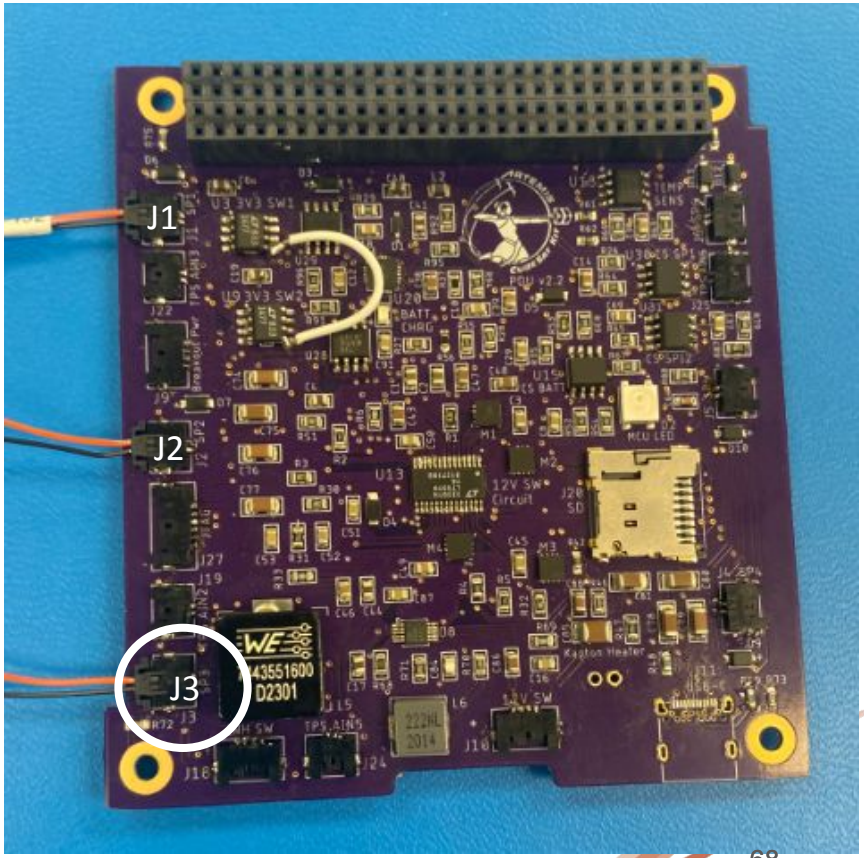




PDU Wire Harness: J3 (SP3 J2)

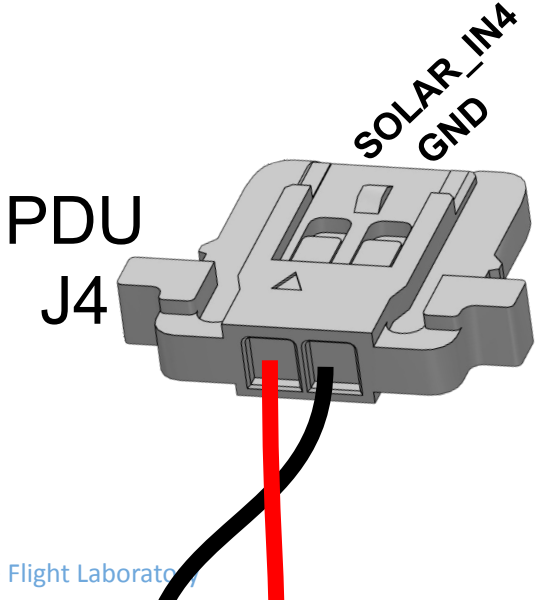
- Wire Label- SP3 J2
- Purpose - Connect Solar Panel 3 solar power

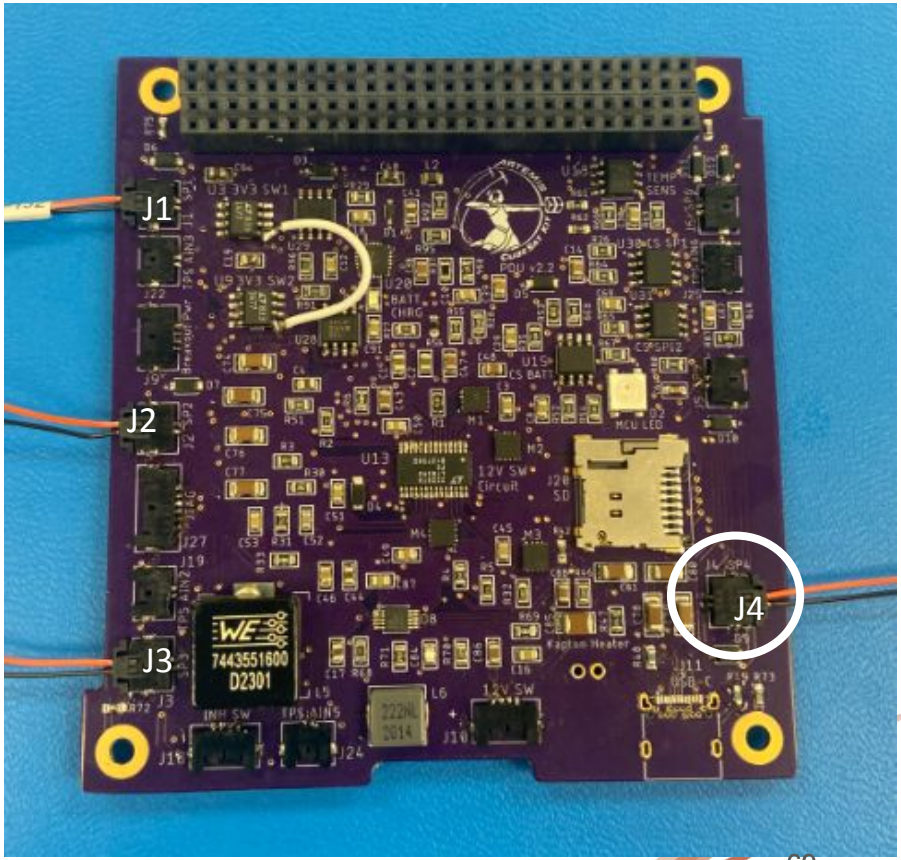




PDU Wire Harness: J4 (SP4 J2)

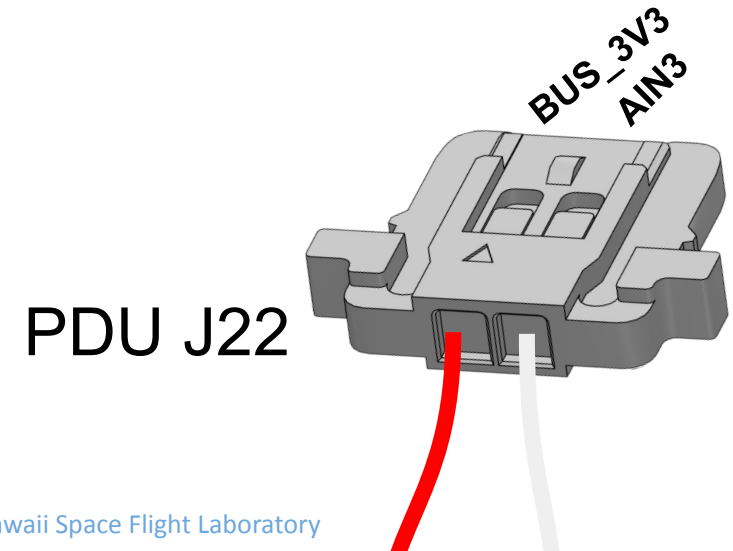
- Wire Label- SP4 J2
- Purpose - Connect Solar Panel 4 solar power

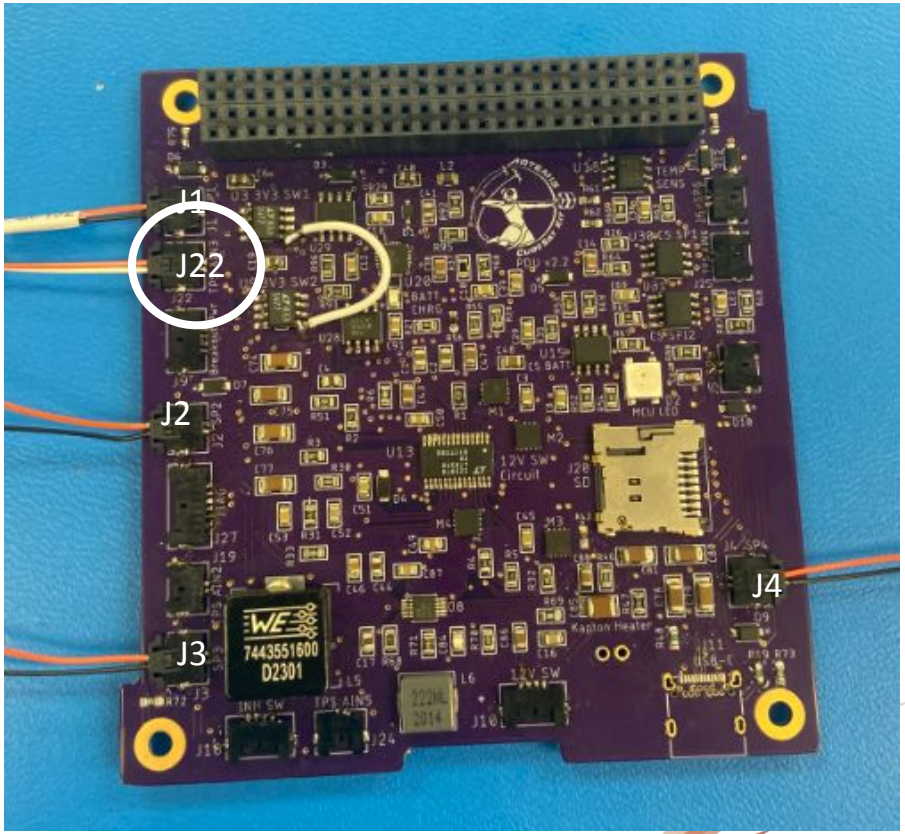




PDU Wire Harness: J22 (SP1 J3)

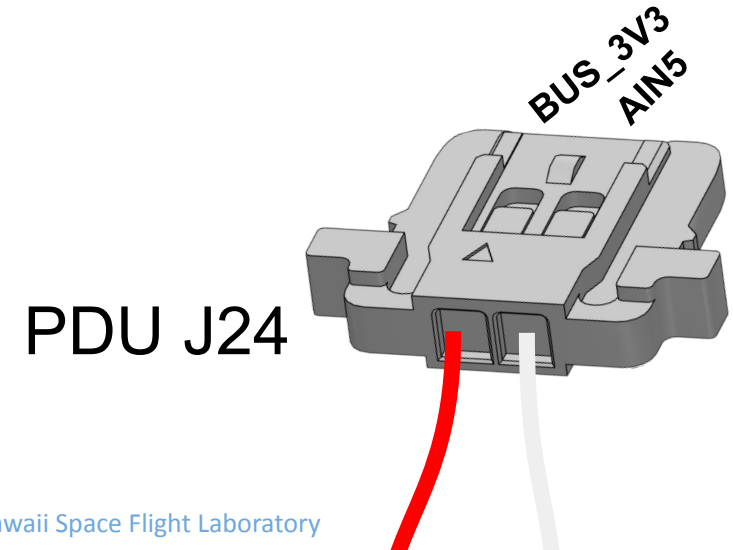
- Wire Label- SP1 J3
- Purpose - Connect Solar Panel 1 temperature sensor

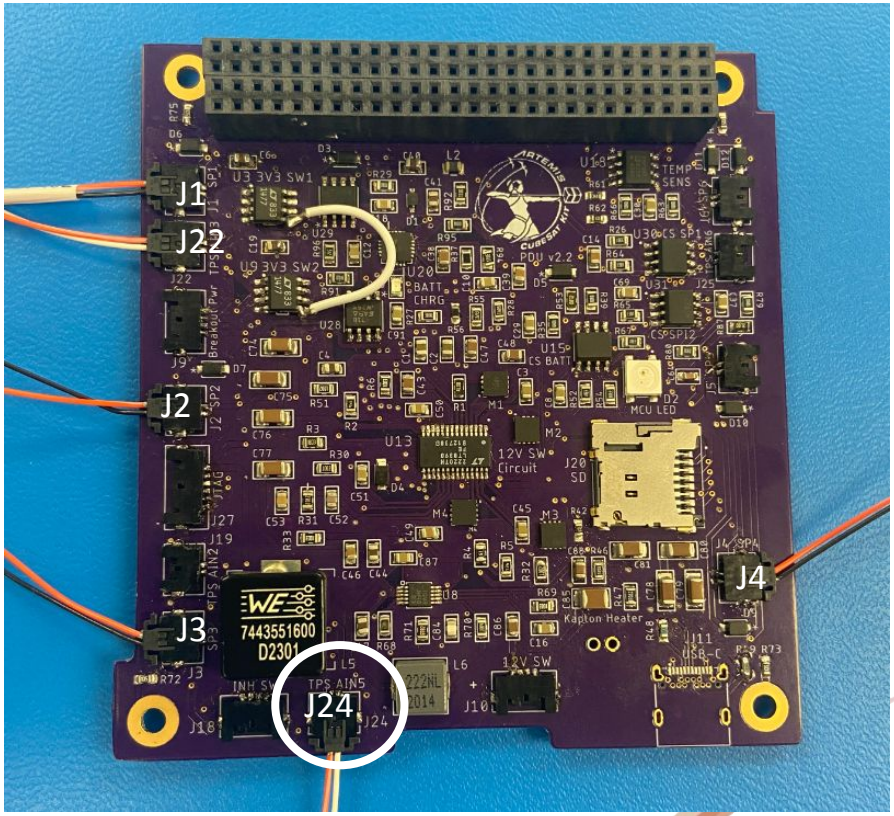




PDU Wire Harness: J24 (SP3 J3)

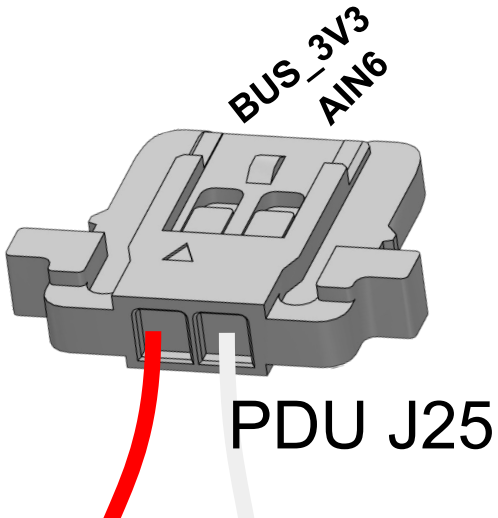
- Wire Label- SP3 J3
- Purpose - Connect Solar Panel 3 temperature sensor

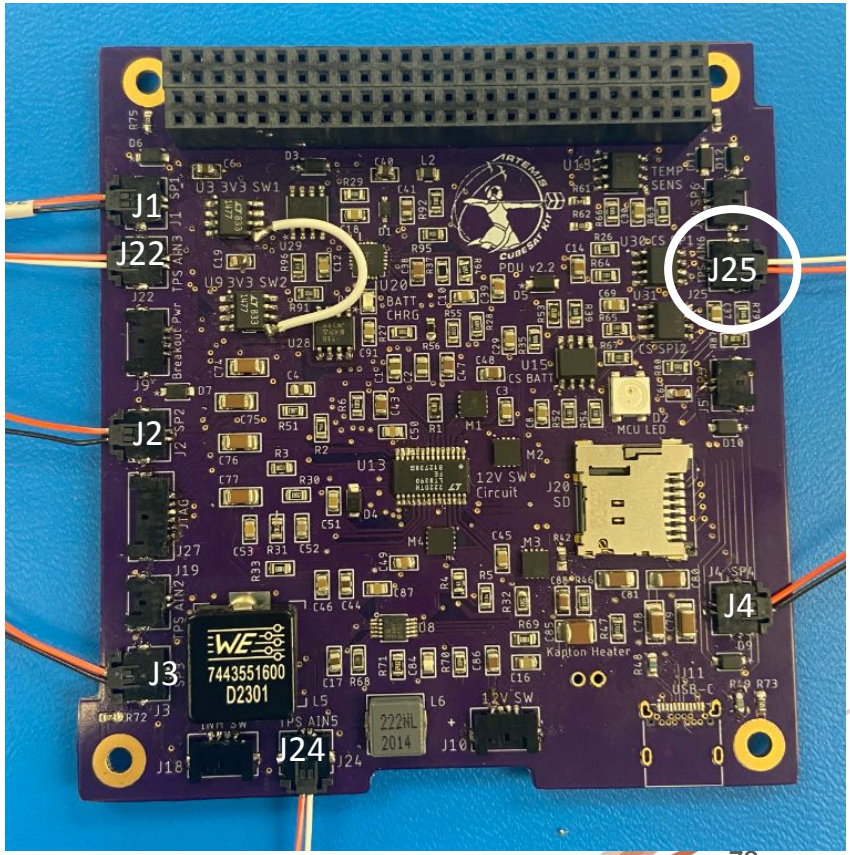




PDU Wire Harness: J25 (SP4 J3)

- Wire Label- SP4 J3
- Purpose - Connect Solar Panel 4 temperature sensor





Attach the Wire Harness to PDU (Bottom Side)

You will need 5 Molex Wire Harness for:

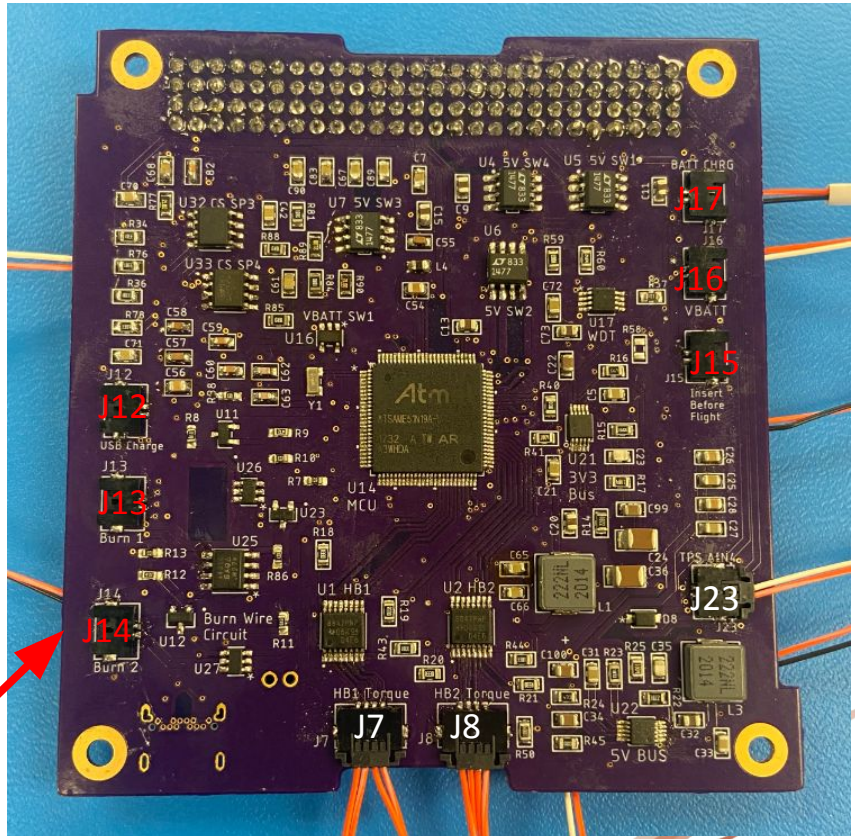
- PDU J7 (SPB3 J1, SPB4 J1)*
- PDU J8 (SPB1 J1, SPB2 J1)*
- PDU J23 (SP2 J3)

Insert the wire harness to its respective component.

Ensure inserted Molex Wire Harness colors match the Molex Component Pins.

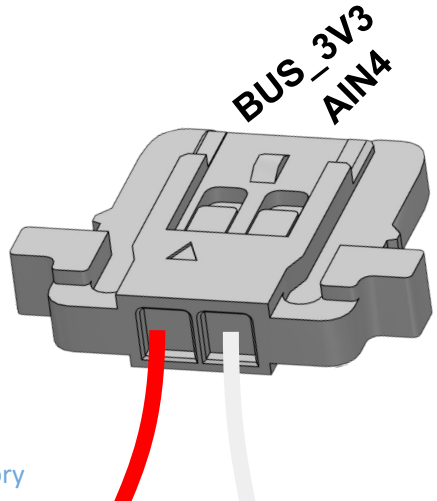
*Two Wire Harness Required

Red Font – Do not connect wire at this point in the slide

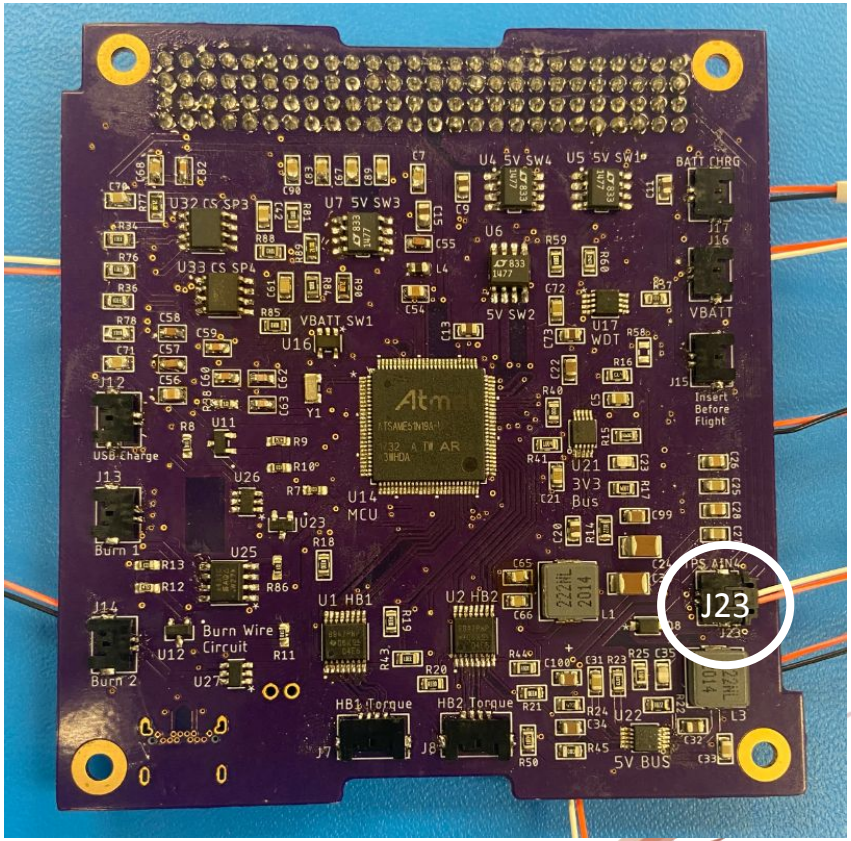


PDU Wire Harness: J23 (SP3 J3)

- Wire Label- SP2 J3
- Purpose - Connect Solar Panel 2 temperature sensor

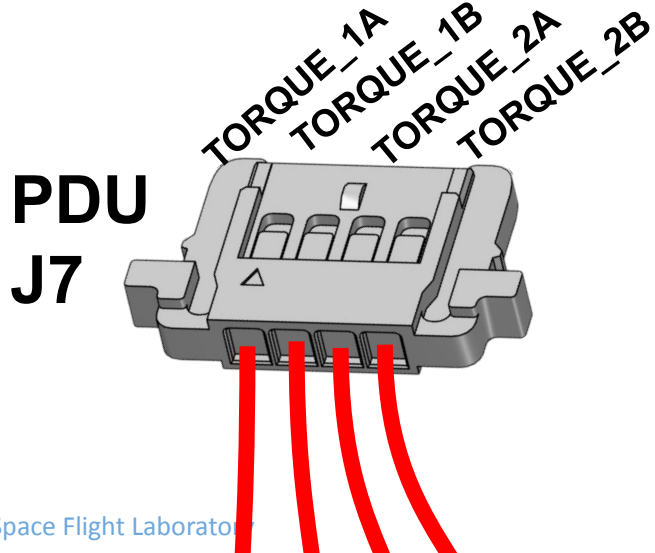


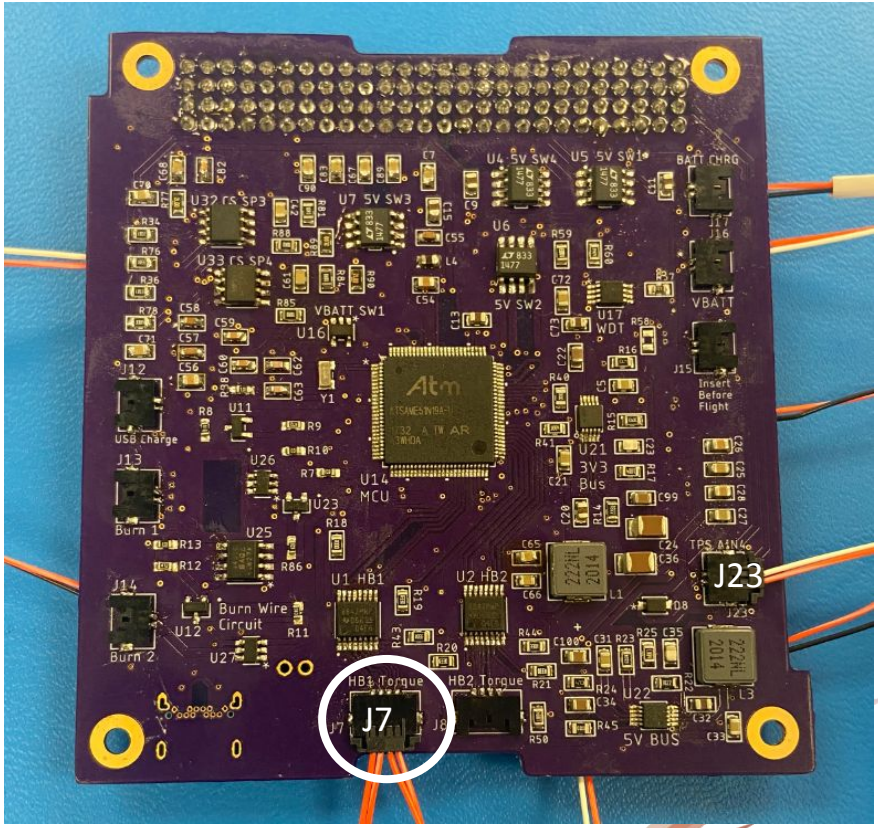
PDU J23



PDU Wire Harness: J7 (SP3 J1, SP4 J1)

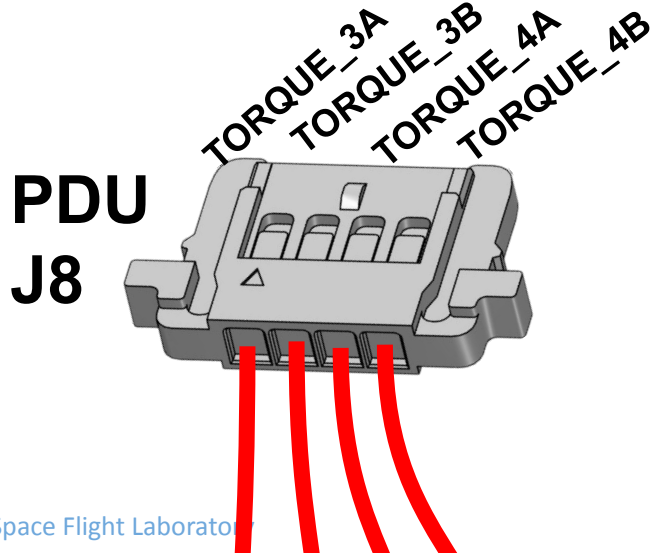
- Wire Label- SP3 J1 and SP4 J1
- Purpose - Connect Solar Panel 3 and 4 torque coils

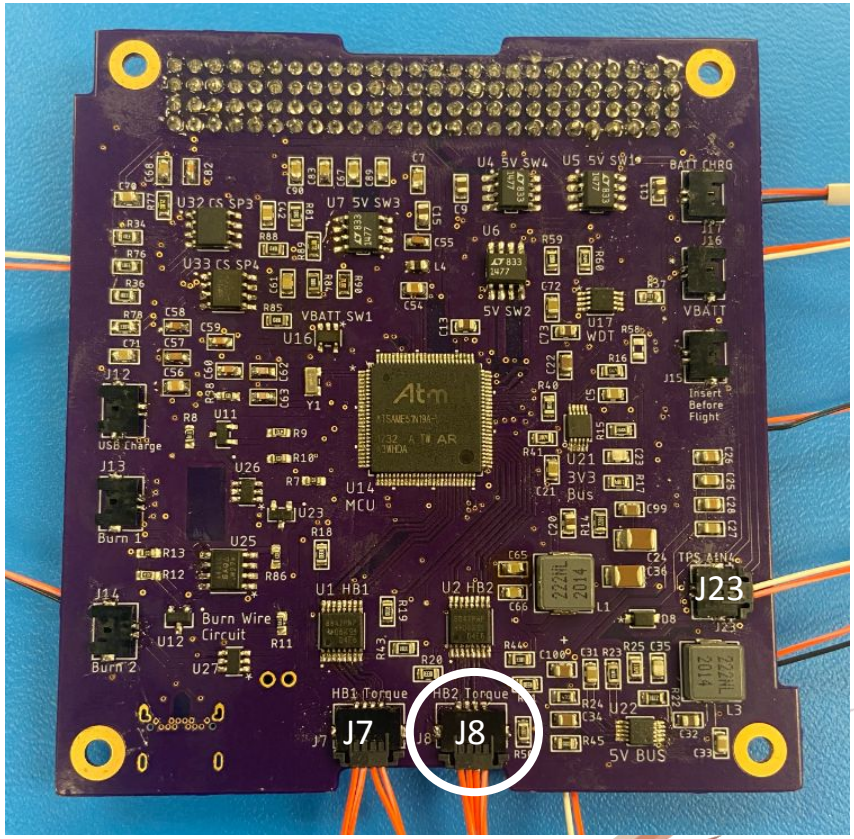




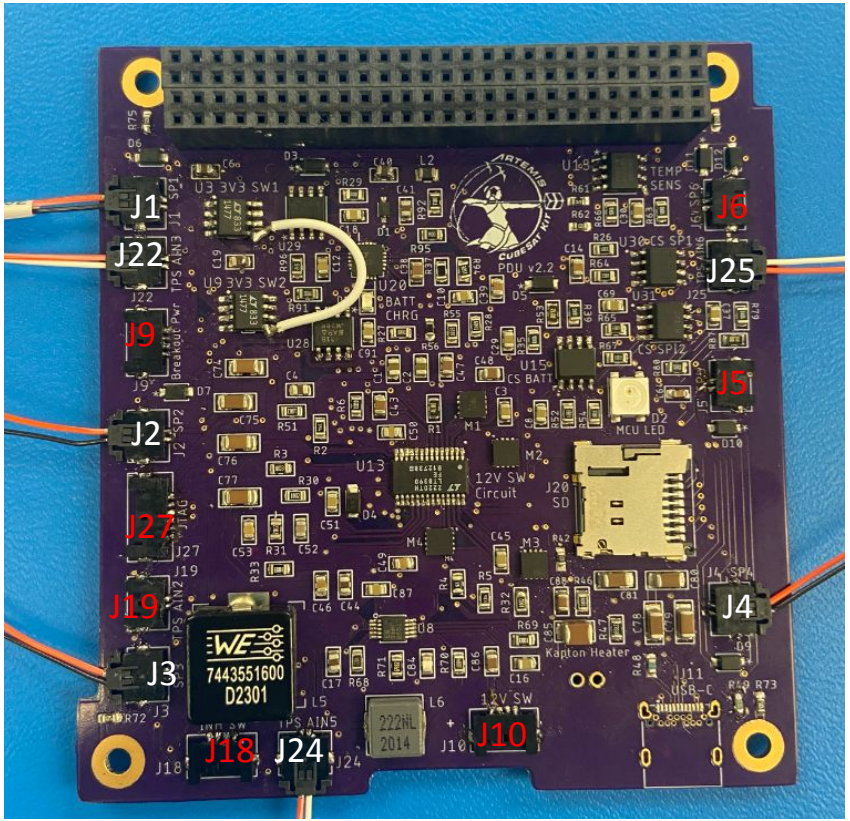
PDU Wire Harness: J8 (SP1 J1, SP2 J1)

- Wire Label- SP1 J1 and SP2 J1
- Purpose - Connect Solar Panel 1 and 2 torque coils

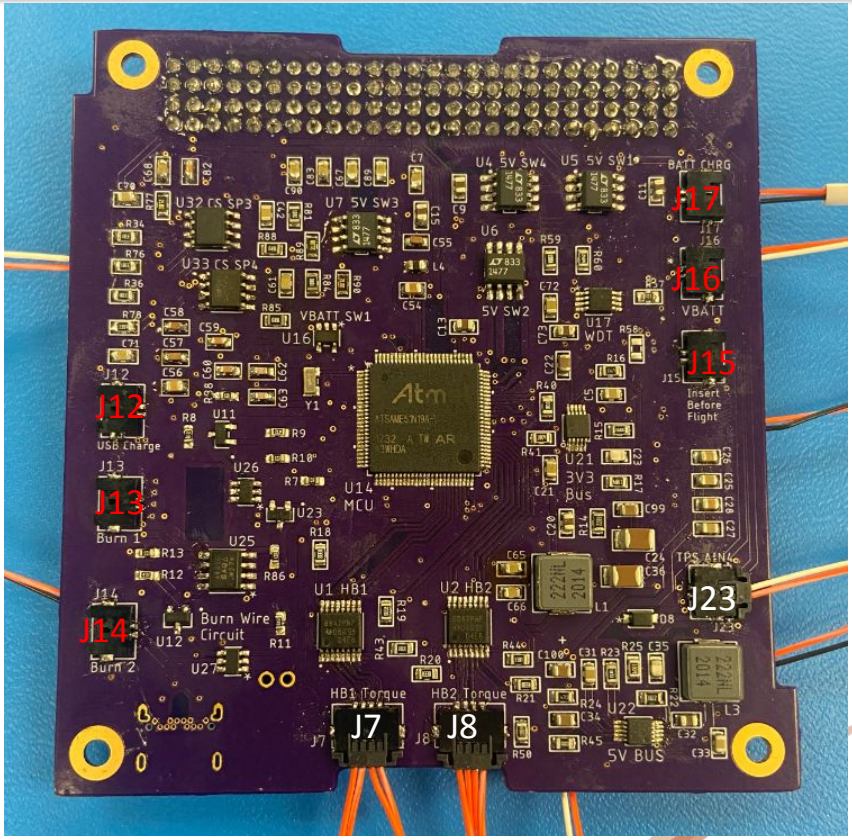




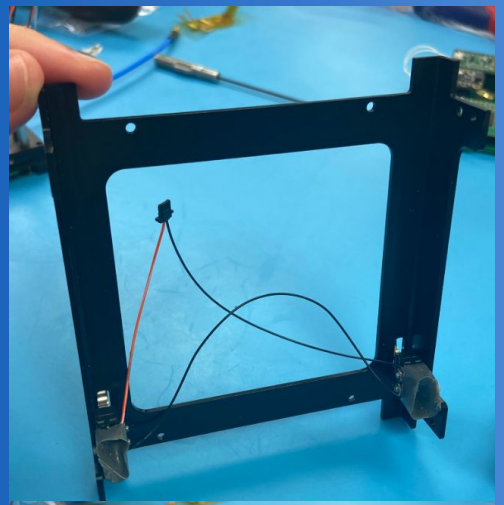
Prepped PDU

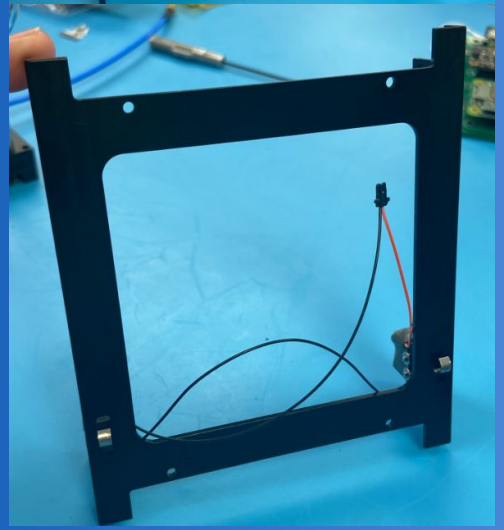


Top Side



Bottom Side



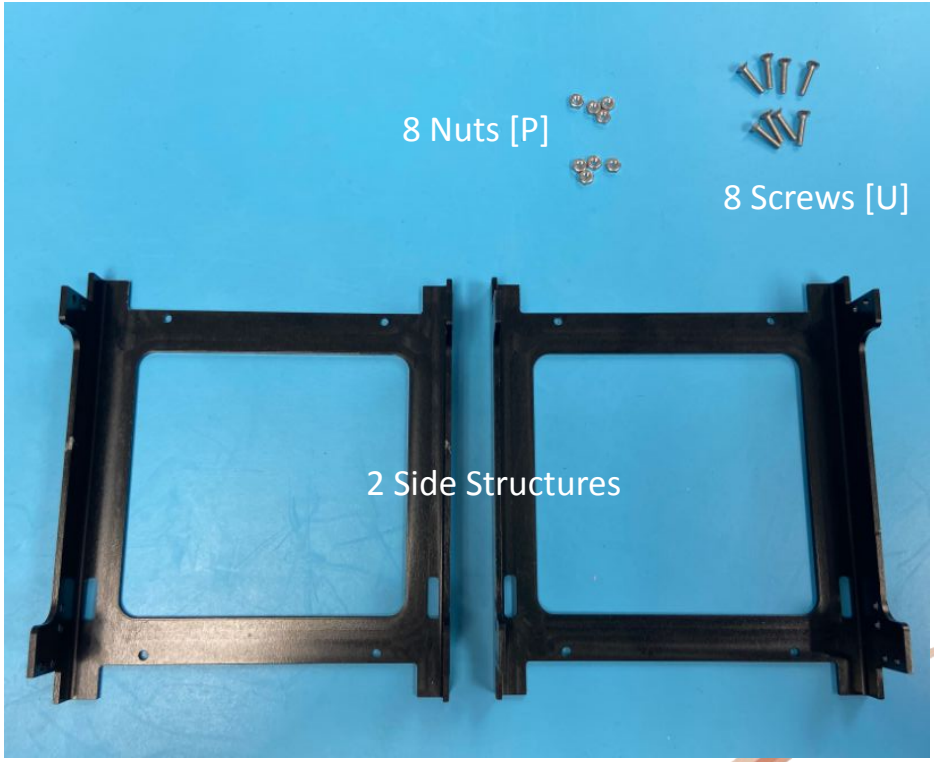


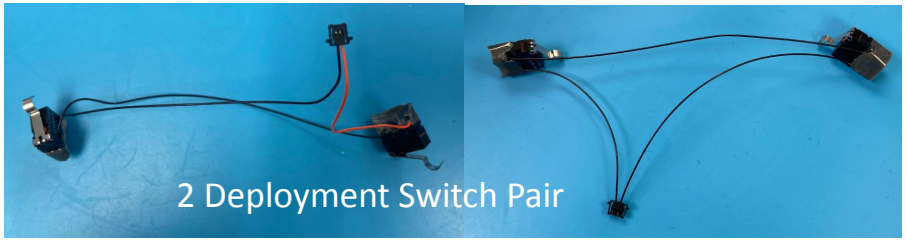
Preparing the Deployment System & Side Structures

Prepare Deployment Switch Materials

You will need:

- 8 Deployment Screws [U]
- 8 Deployment Nut [P]
- 2 Side Structures
- 2 Deployment Switch Pairs (See next slide for more details)

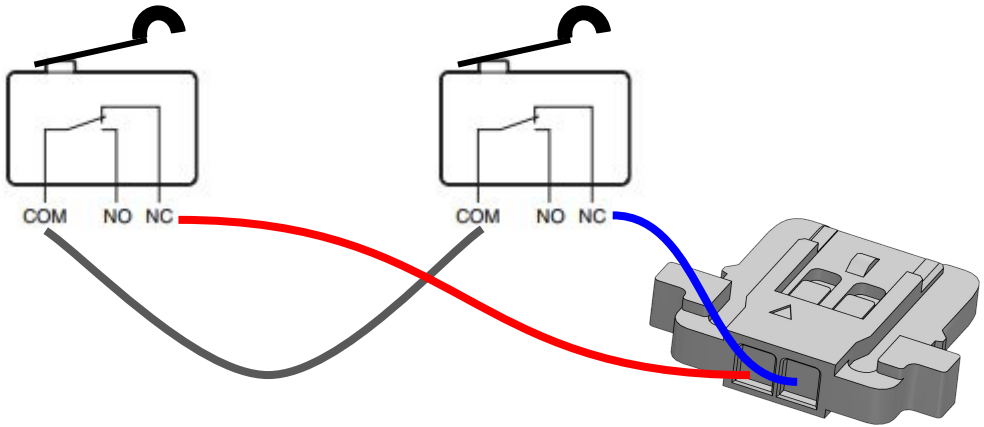


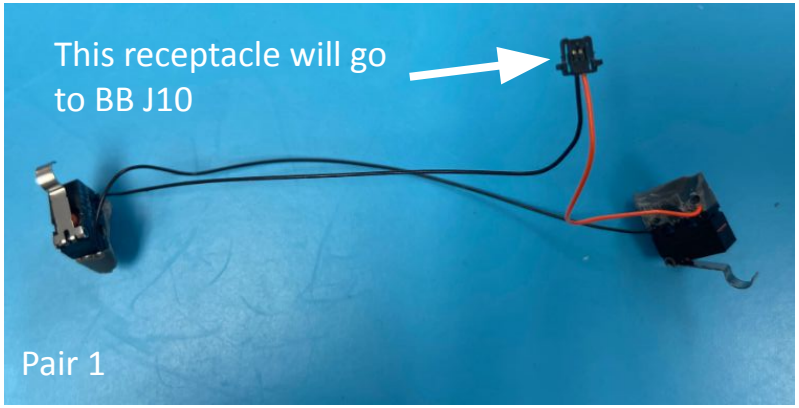


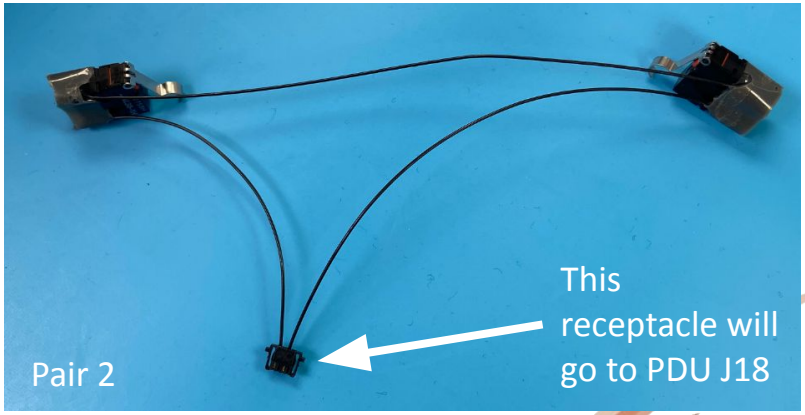
Obtain Two Prepped Deployment Switch Pair

You will need 2 Prepped Deployment Switch Pairs.

A single Prepped Deployment Switch Pair is essentially two “Deployment Switches” with their Receptacles attached via Epoxy.



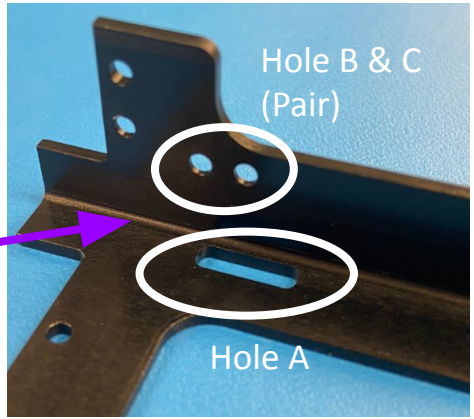




Recognize Deployment Switch Holes

- During these next few steps, our focus is on three holes located on the side structure
  - Hole A will be designated for the deployment switch
  - Hole B and C (as a pair) will serve as the insertion point for screws

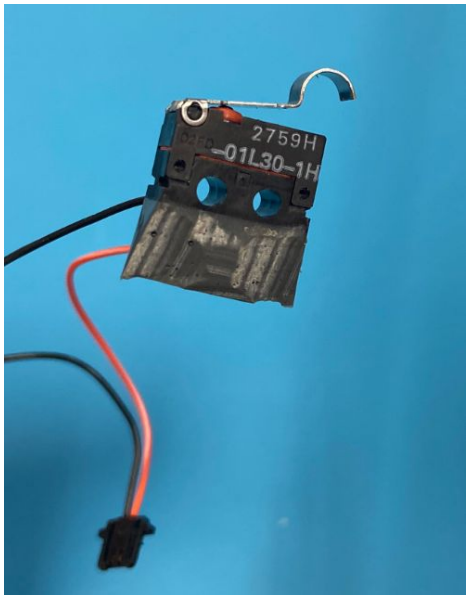
Side Structure



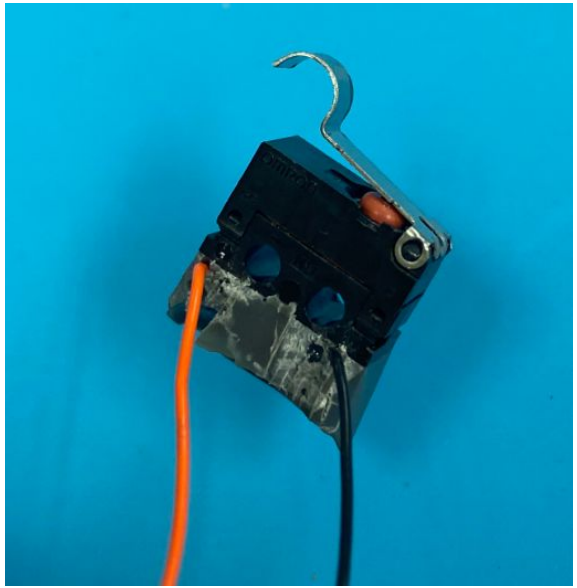
Interior View

Recognize Orientation of Deployment Switch

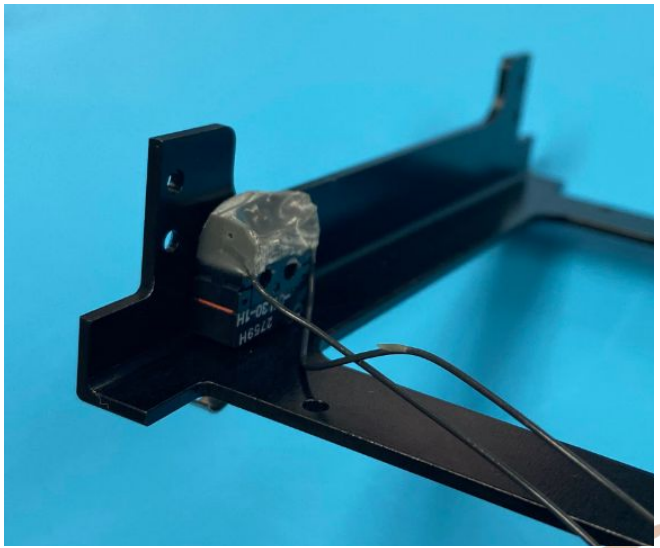
- As a rule of thumb, the deployment switch side that has wires coming out from it will rest on the interior of the side structure



Side with no wires



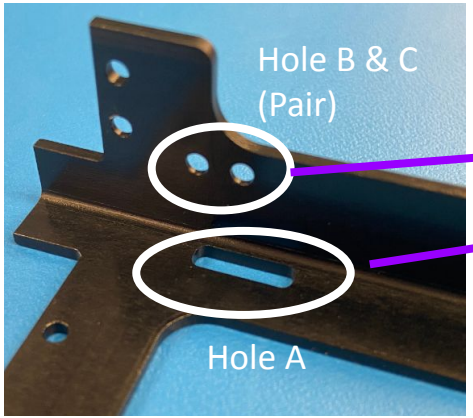
Side with wires



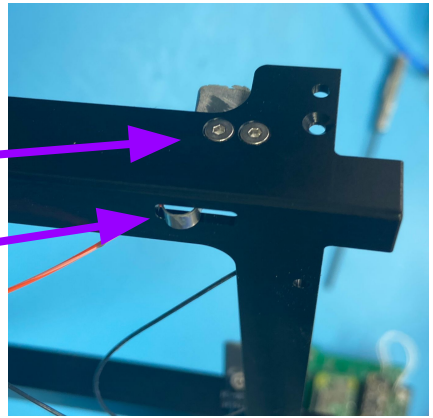
(Example) Side with wires resting on interior of side structure

Attach Deployment Switch Pairs to Structure

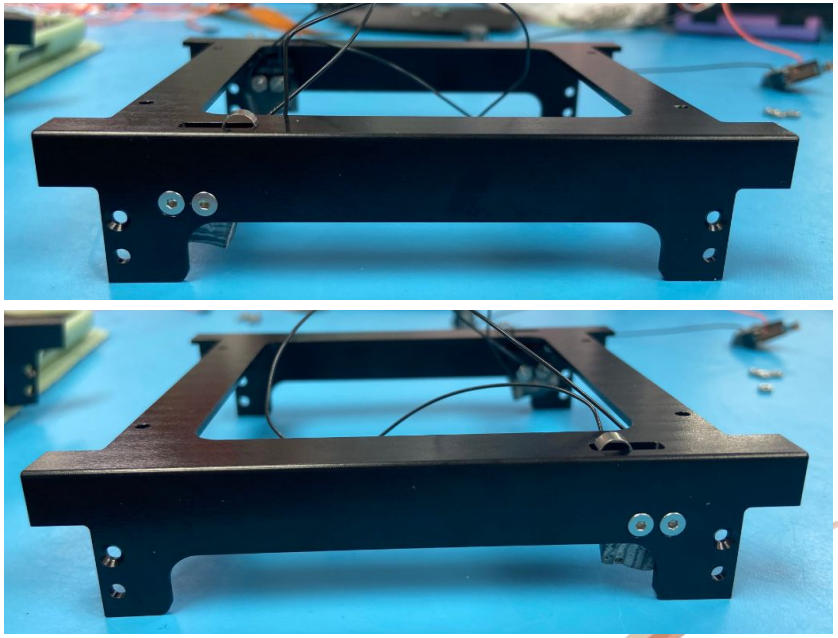
- Insert the deployment switch into Hole A (**Orientation** matters!)
- Then, insert two screws [U] into Hole B and C (as a pair). Use your hands to initially tighten the two nuts [P] and then use Tool B on the screws to secure the deployment switch in place (More pictures on the next slide)
- Repeat for the other deployment switch hole on the same side structure



Interior View



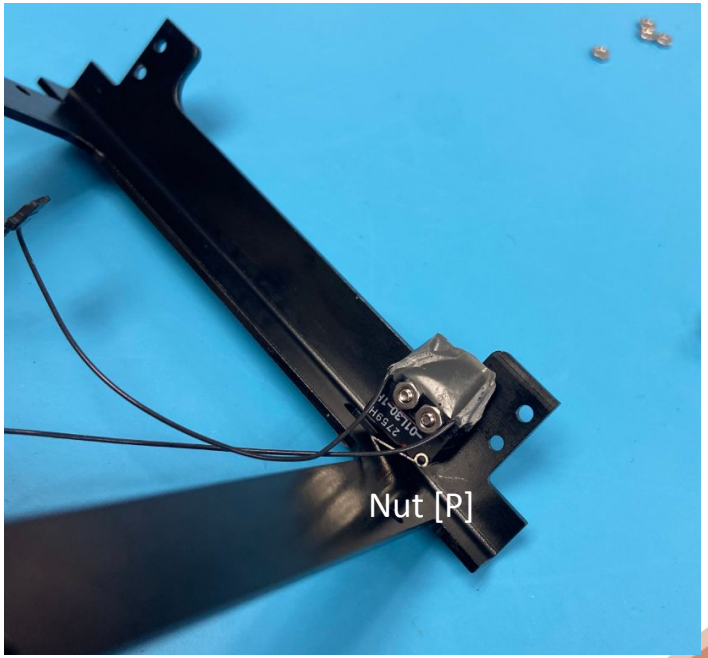
Exterior View with Screws Inserted



Orientation

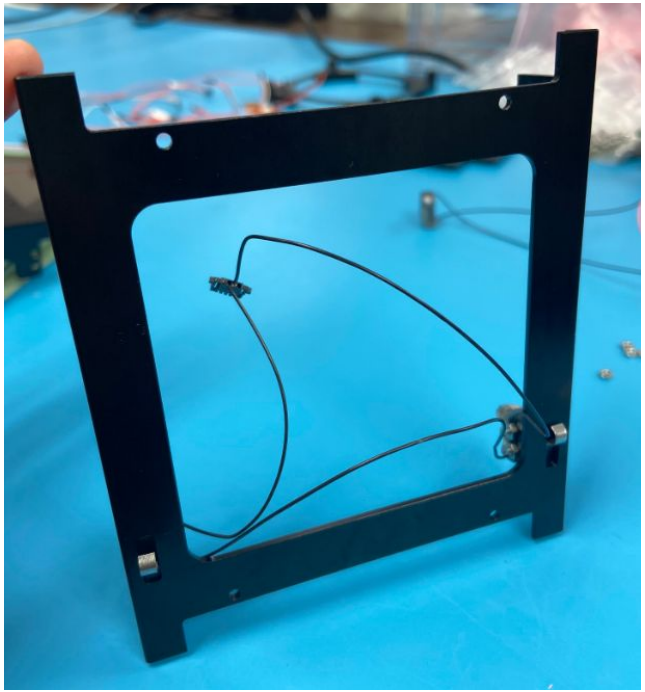
Attach Deployment Switches to Structure

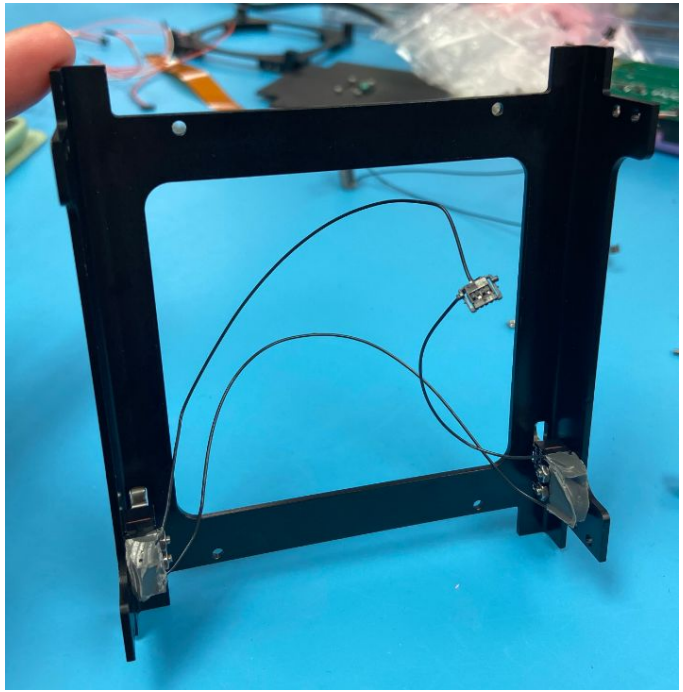
- Insert two screws [U] into Hole B and C (as a pair). Use your hands to initially tighten the two nuts [P] and then use Tool B on the screws to secure the deployment switch in place



Prepped Deployment Switch Pair #1

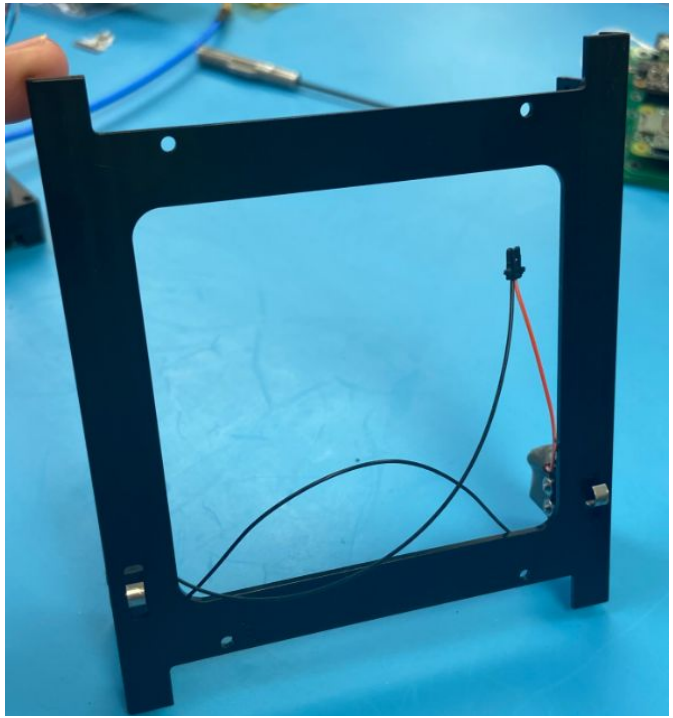
- You prepped the first deployment switch pair (shown in figure)
- Repeat the previous slides for deployment switch pair 2 (see next slide for final pictures)

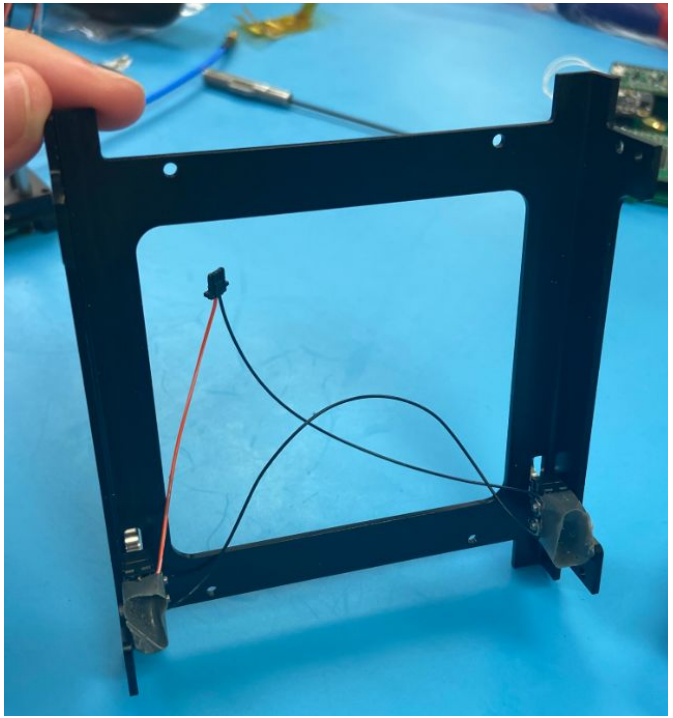




Prepped Deployment Switch Pair #2

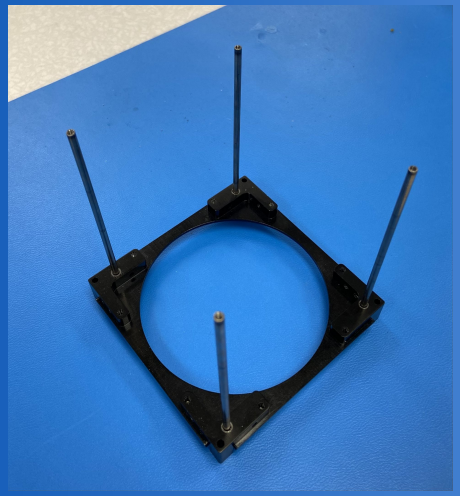
- You prepped the second deployment switch pair (shown in figure)





Break Time!

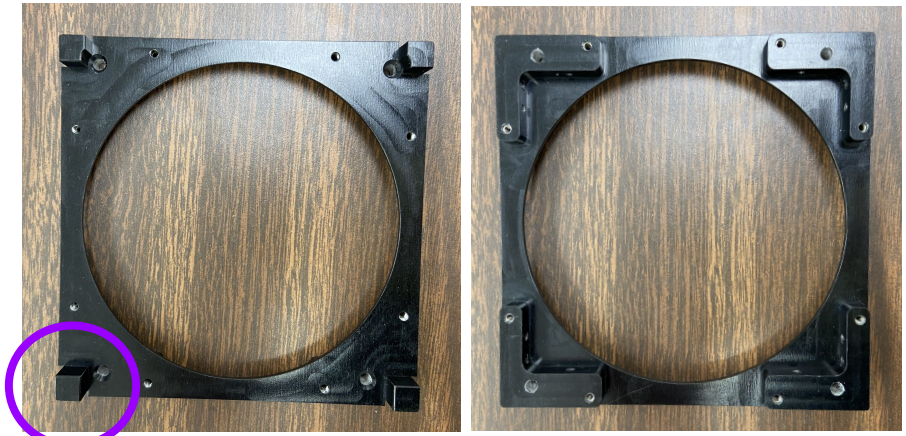
You worked very hard… So, please take a break now!
Alternatively, continue this process in your
next work session.



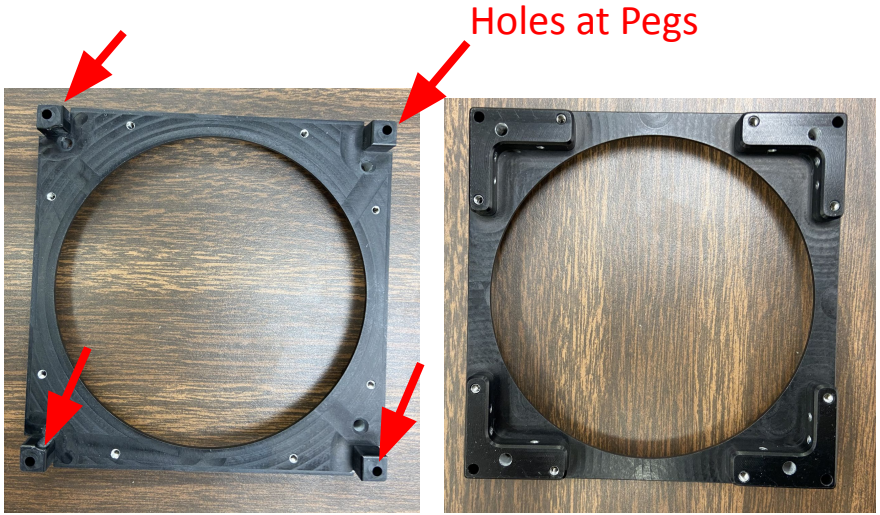
Preparing the Bottom Structure

Differentiating Between the Top vs. Bottom Structure

The top structure is similar to the bottom structure, except the bottom structure has holes at the pegs. More information on the next slide.

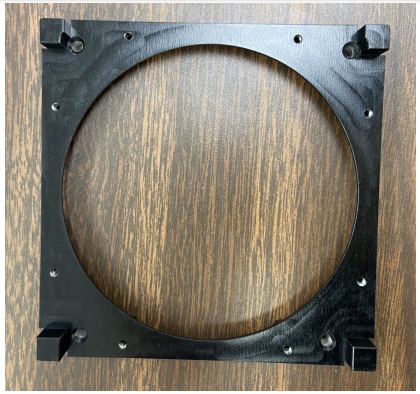


Top Structure

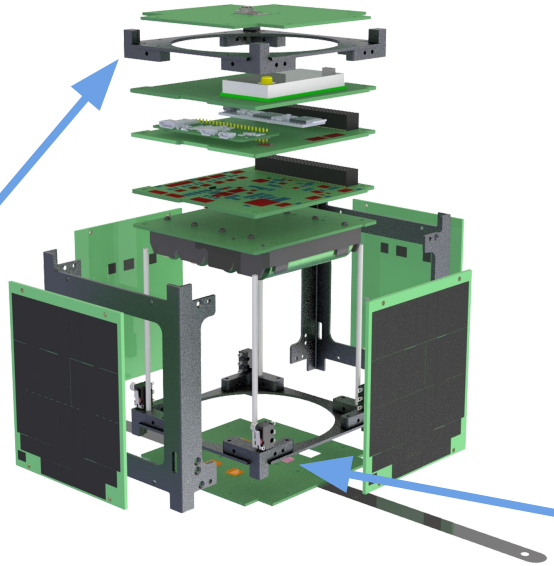


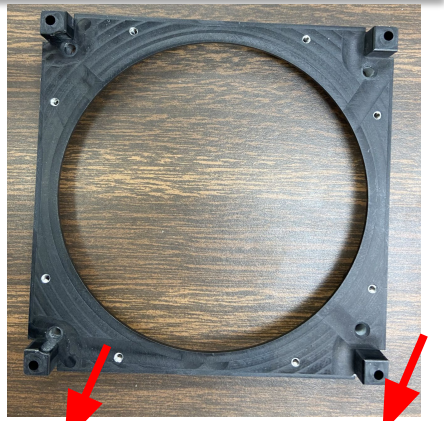
Bottom Structure

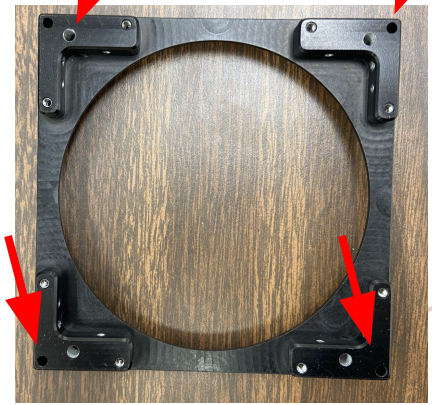
Placement of Top & Bottom Structure in CubeSat



The top structure is similar to the bottom structure, except the bottom structure has holes at the pegs.







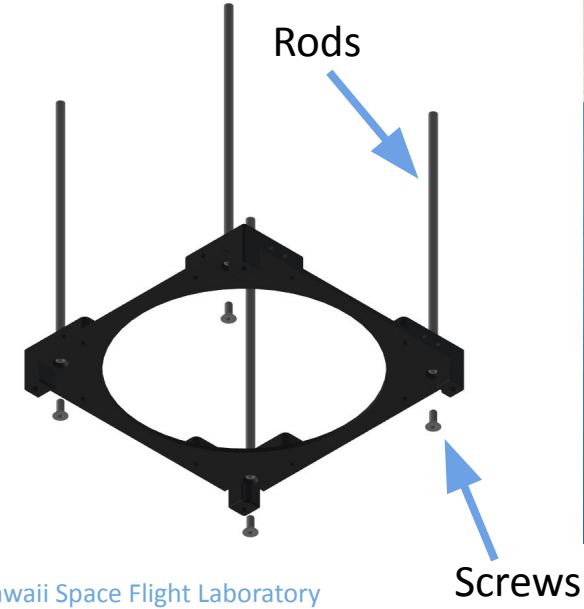
Top Structure

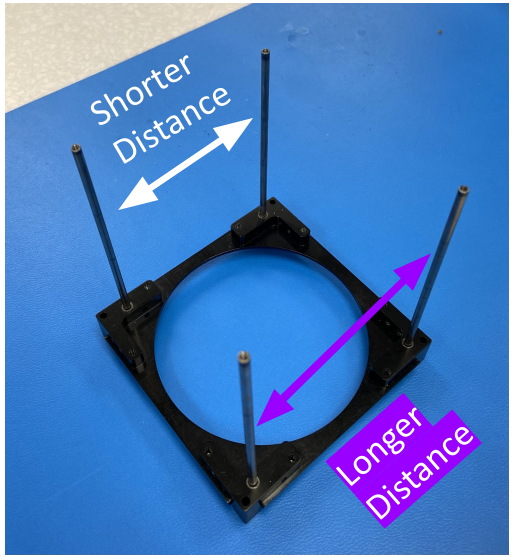
Bottom Structure

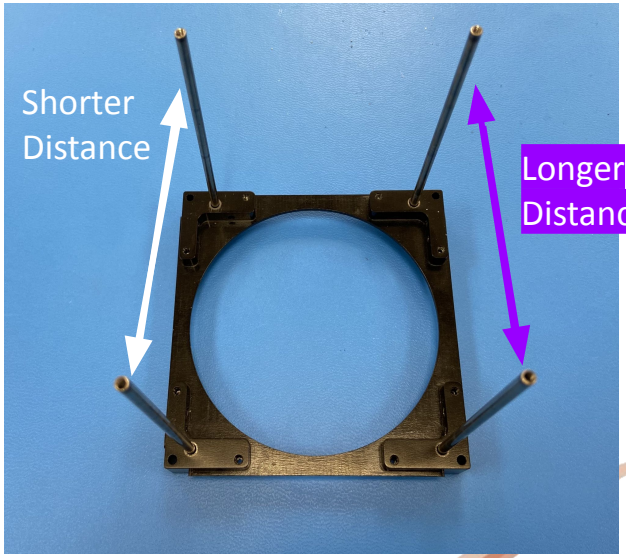
Insert Rod Screws & Structure Rods into Bottom Structure

You will need 4 Rod Screws [D] and 4 of Stainless Steel Rods [A].

Using Tool A, insert rod screws [D] into bottom structure.
Then, insert stainless steel rods [A] thereafter.



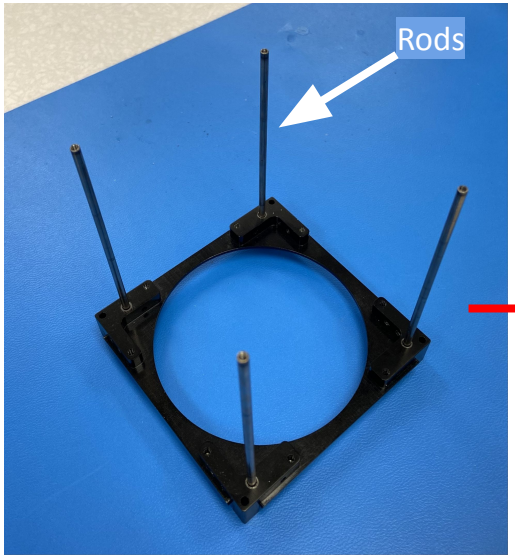


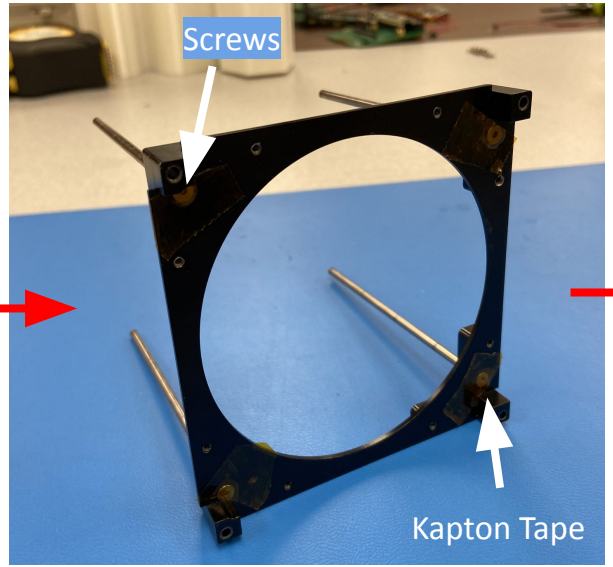


Attach Kapton Tape Onto Screws (IMPORTANT)

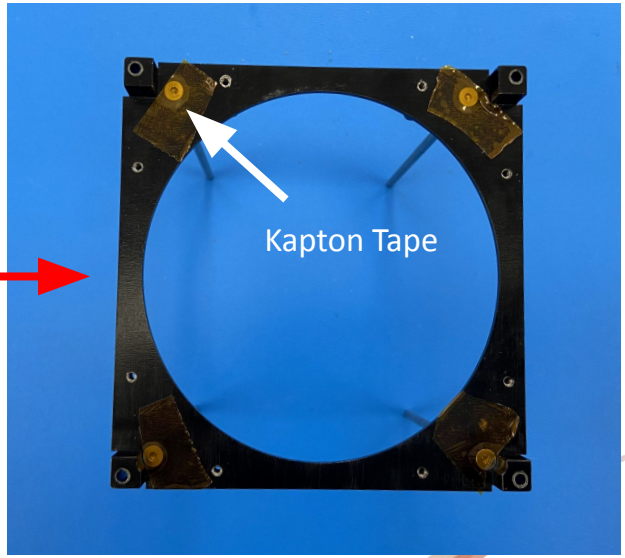
You will need Kapton Tape. Avoid crumpling it during this step.

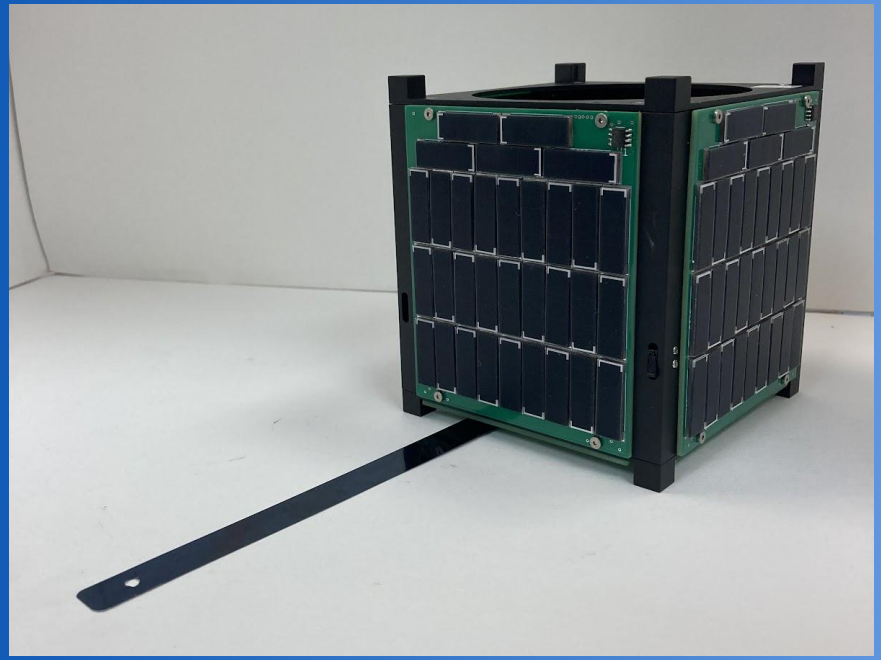
With rods and screws inserted, flip the structure like so:





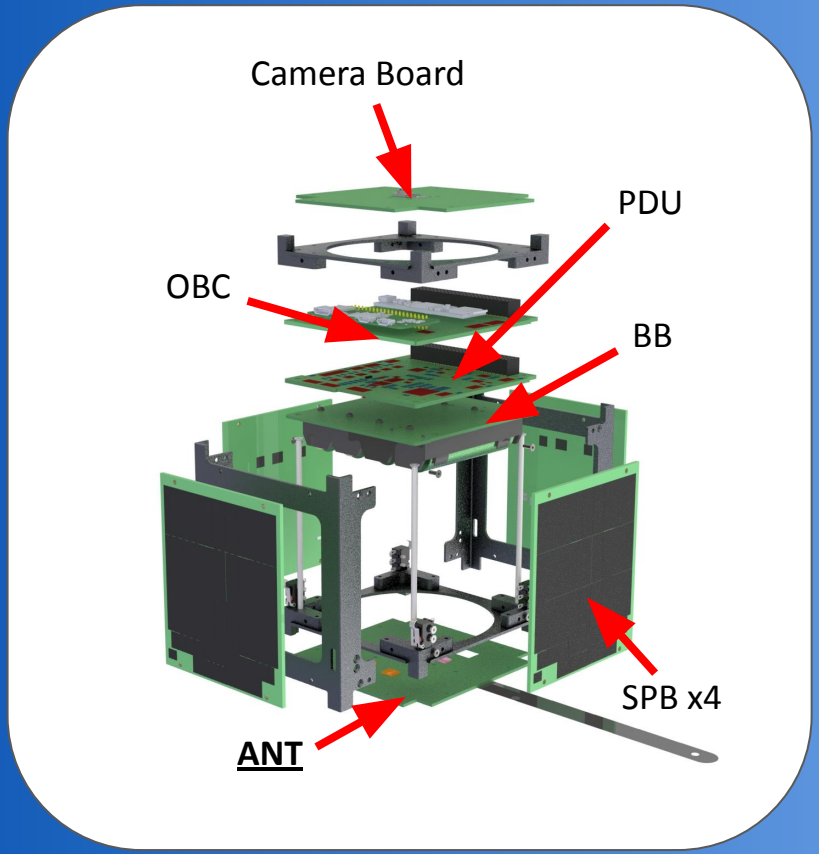
Attach Kapton Tape onto screws to provide secondary support and protection for the structure





Kit Assembly Implementation

In this section, you'll learn how to effectively assemble the prepped PCBs to create a fully assembled kit.

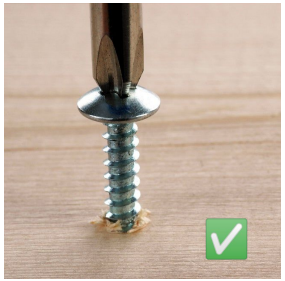


Antenna Board Assembly

This step involves incorporating the side and bottom structure.

Avoid Stripping Screws

A *stripped screw* generally refers to a screw that had its head damaged to the point where it cannot be tightened or loosened using a regular screwdriver.



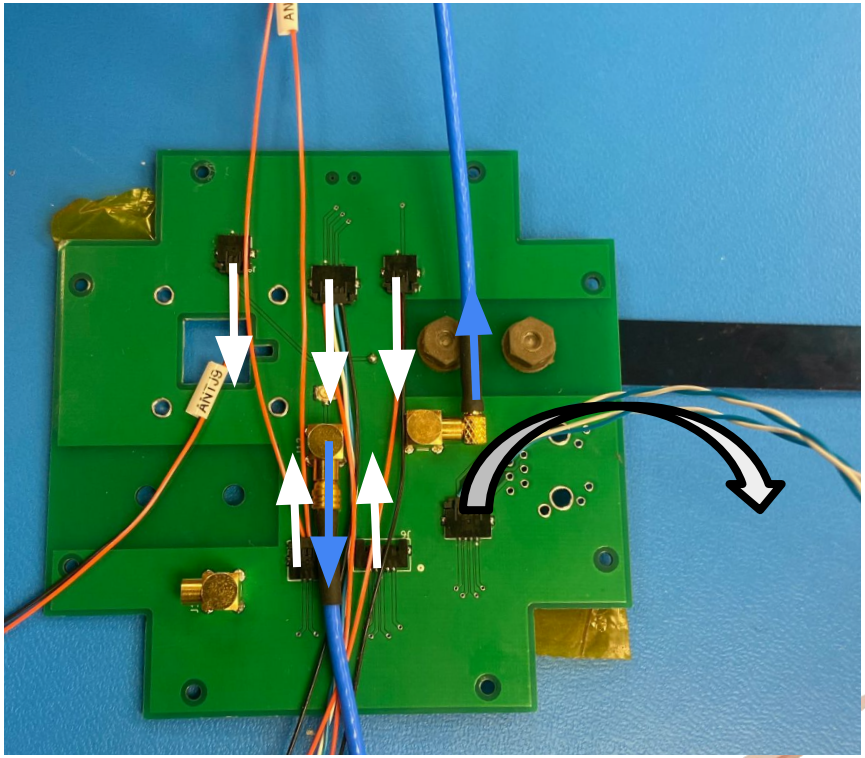
To avoid stripping screws:

- Whether you are using a screwdriver or an impact driver, it is important that you hold it straight, in-line with the screw
- Apply the right amount of force
- when you notice that your screw is starting to strip or that your screwdriver keeps coming out of the drive, immediately stop tightening it and re-assess the situation.

For more information, read: https://handymansworld.net/how-to-avoid-stripping-screws/

Before Proceeding, Review the Antenna Board Orientation

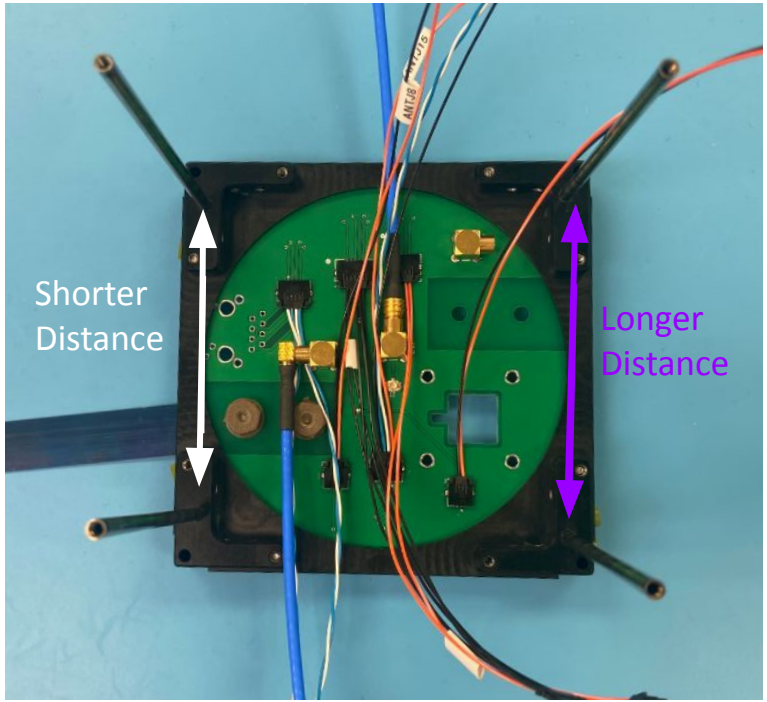
- The MCX Plugs should be resting in opposite ways
- All harness wires shall flow in the same direction they are inserted except for Antenna Board (ANT) J7 which flow in the opposite direction of insertion

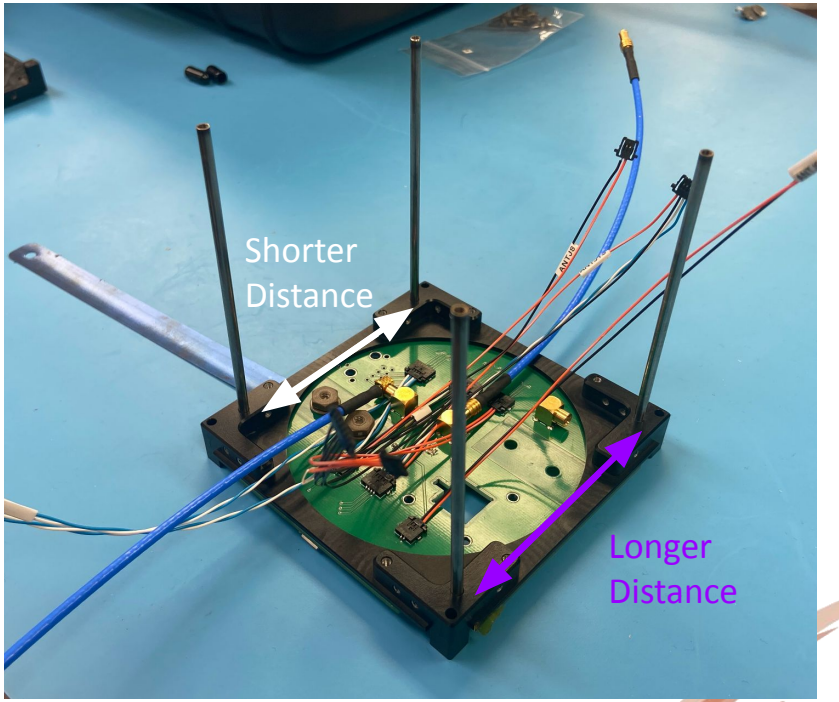


Bottom Side

Insert Antenna Board Into Bottom Structure

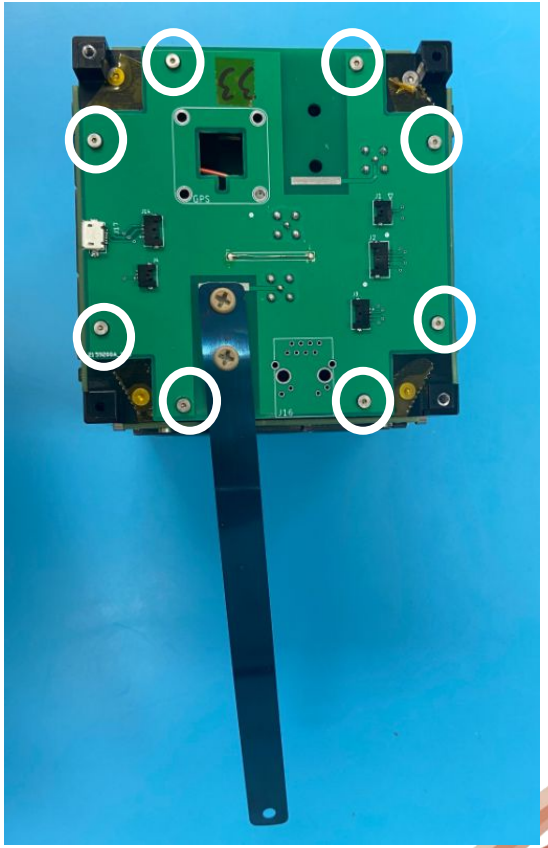
- Insert the Antenna Board (ANT) onto the bottom structure
- The Antenna shall fall between the two rods with the shorter distance





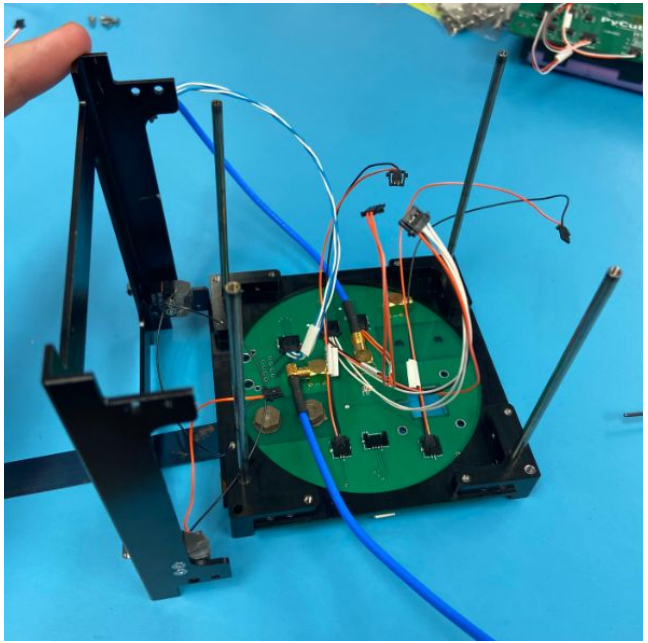
Attach Antenna Board onto the Bottom Structure

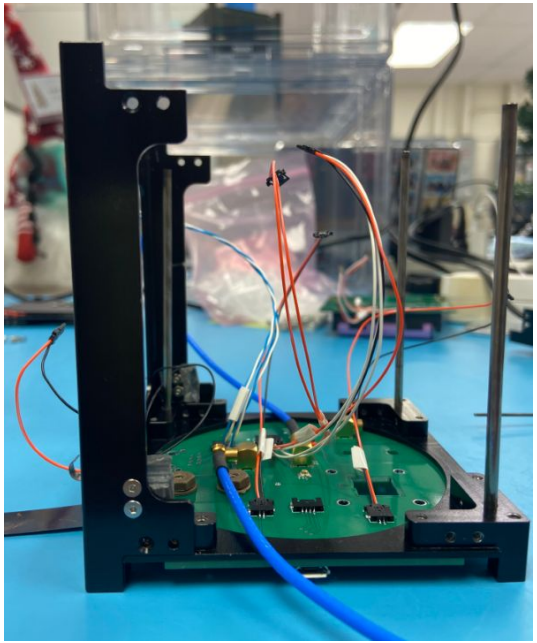
- Using Tool B and 8 Outer PCB Screws [N], secure the antenna board onto the bottom structure.



Attach First Side Structure to Bottom Structure

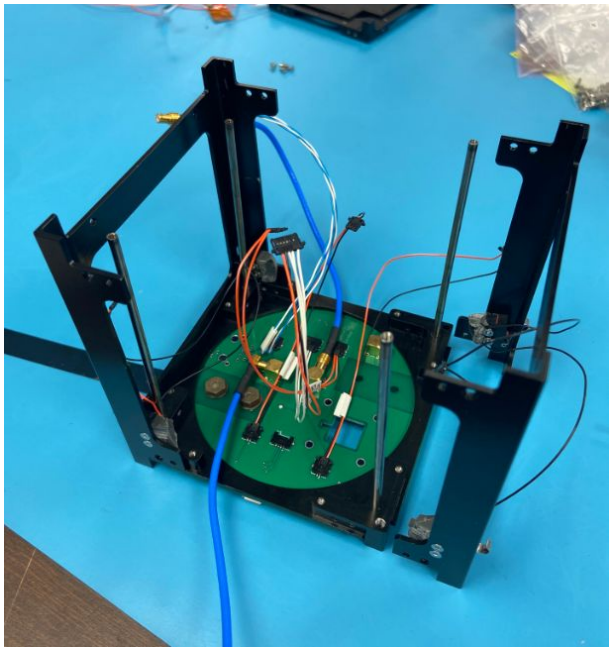
Connect the side structure containing the black and red wired deployment switch pair (BB J10) to the bottom structure side with the protruding antenna. Since there is deployment switch interference, insert the side structures from the top (rather than the side).

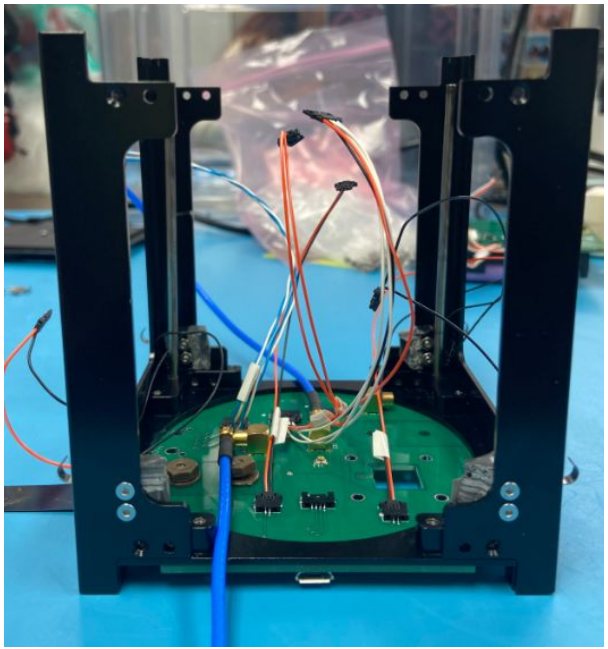




Attach Second Side Structure to Bottom Structure

Connect the side structure containing the only-black wired deployment switch pair (PDU J18) to the bottom structure side, opposite of the protruding antenna. Since there is deployment switch interference, insert the side structures from the top (rather than the side).

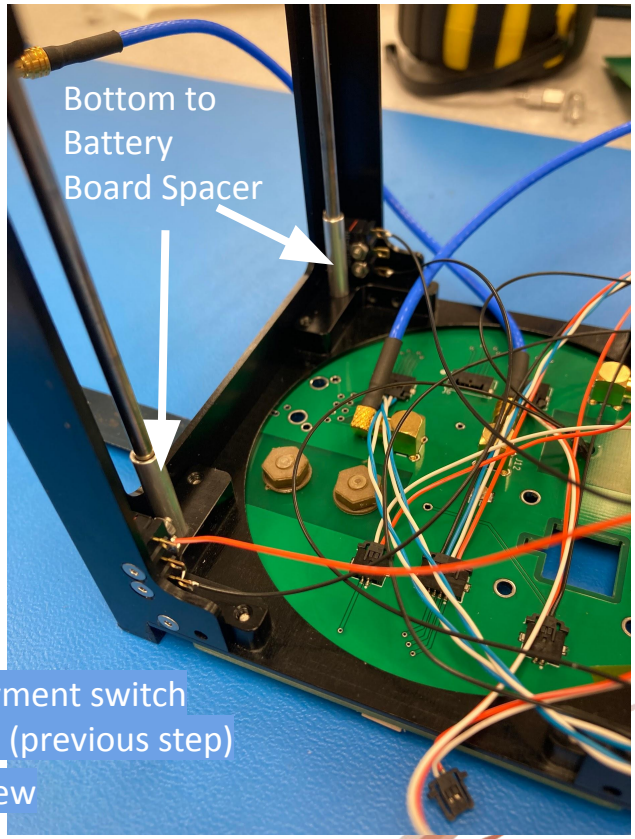


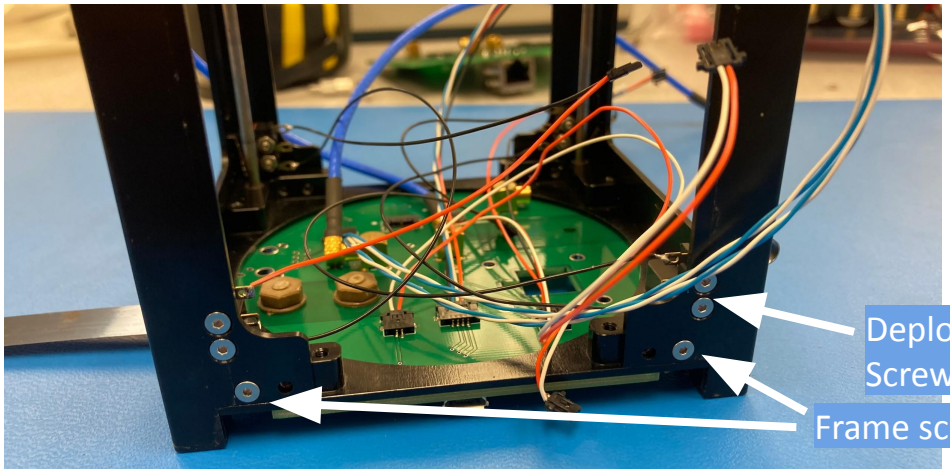


Attach Structure Side Panels to Bottom Structure and Place Spacers (Bottom to BB)

Using Tool B and 4 Frame Screws [C], connect the side structures to the bottom structure.

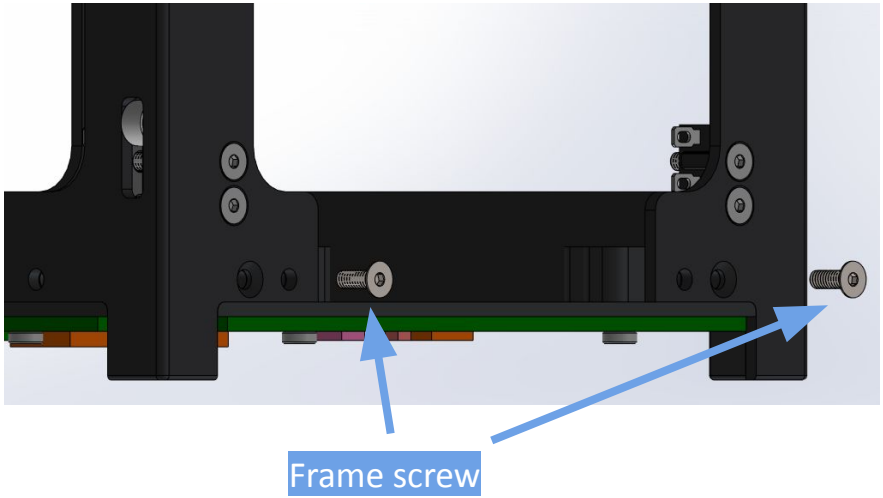
Using 4 Bottom to Battery Board Spacer [M], place a spacer onto the rod at each corner. See the next two slides for more details.

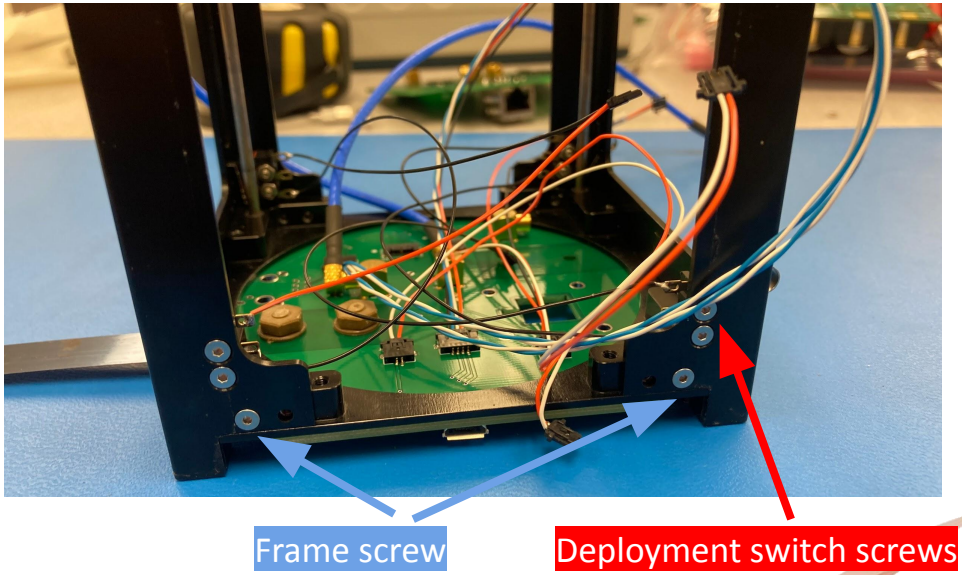


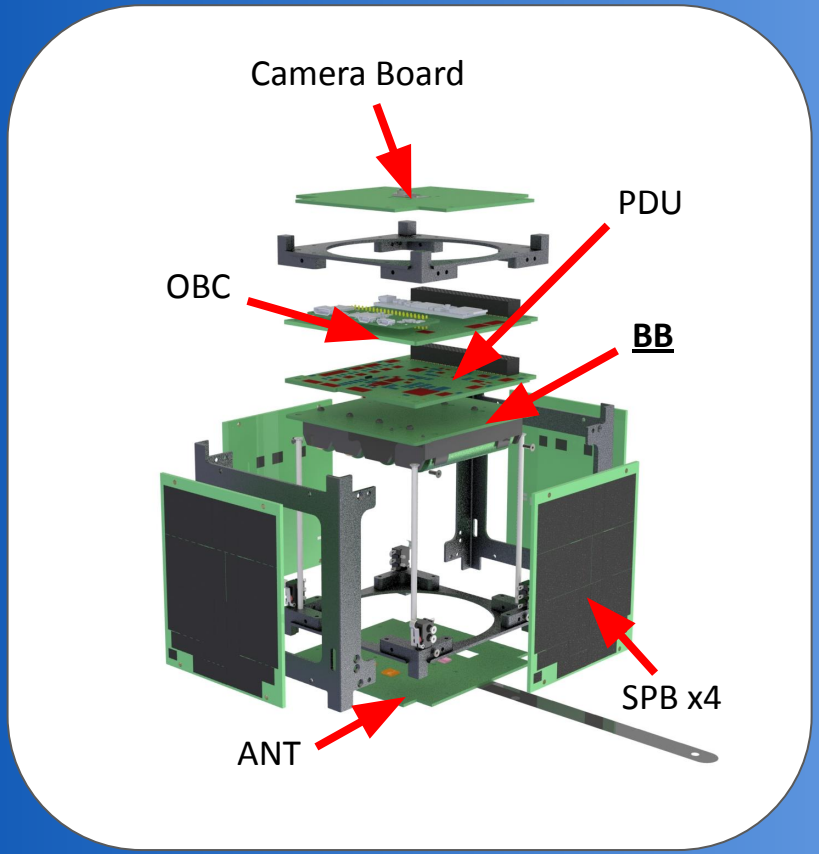


Attach Structure Side Panels to Bottom Structure

Using Tool B and 4 Frame Screws [C], connect the side structures to the bottom structure.



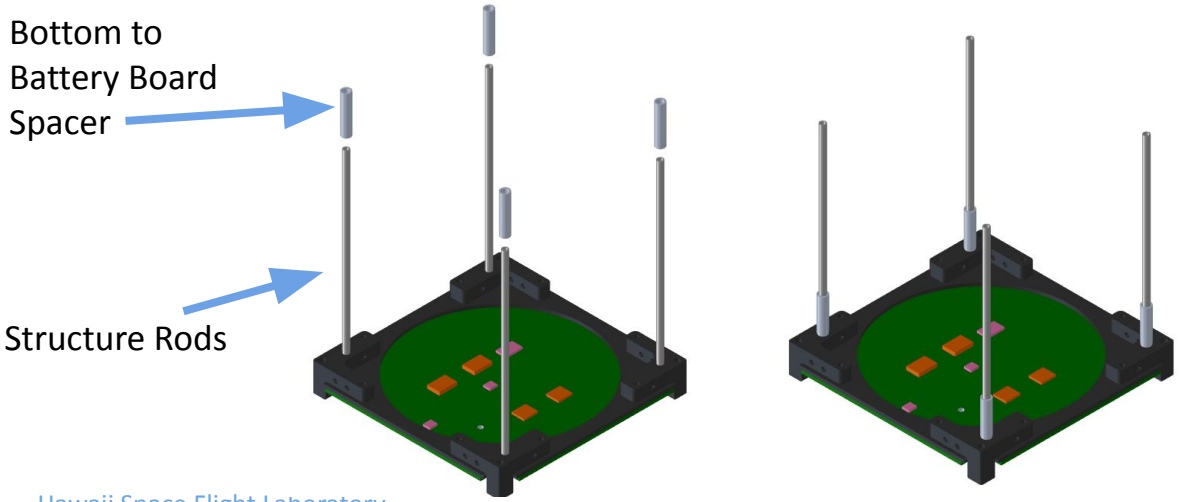


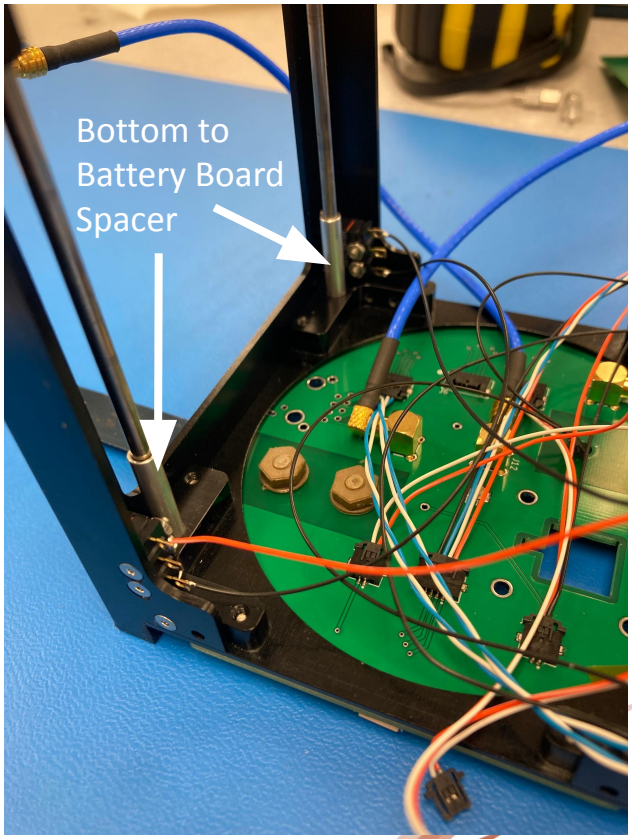


Battery Board Assembly

Attach Structure Side Panels to Bottom Structure and Place Spacers (Bottom to BB)

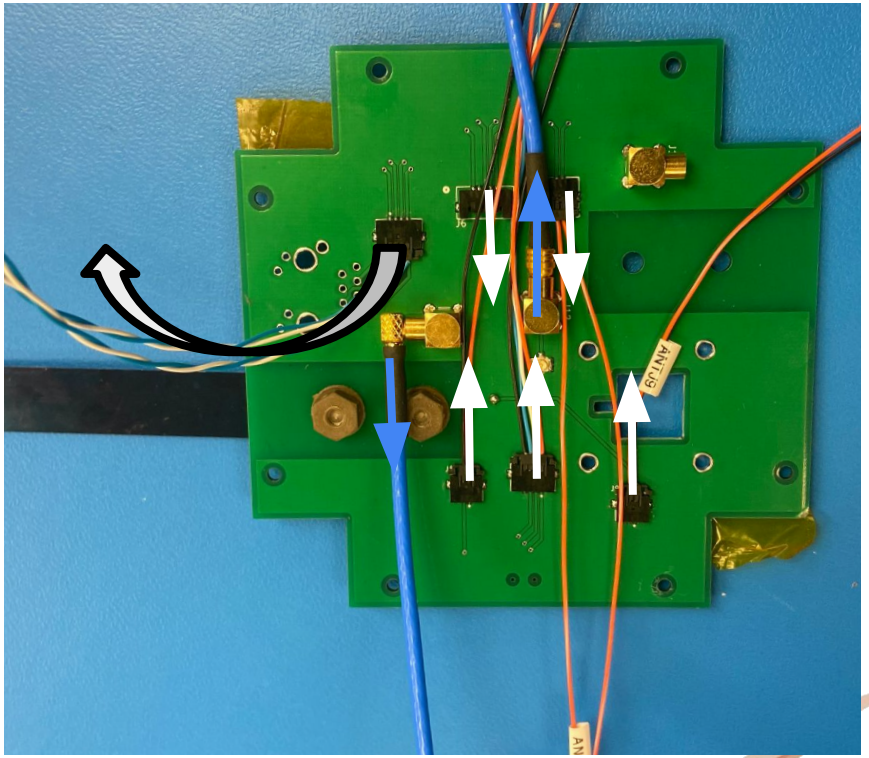
Using 4 Bottom to Battery Board Spacer [M], place a spacer onto the rod at each corner. If you're having difficulty fitting the spacers because the deployment switches are obstructing them, try tightening the deployment switches again to ensure that the spacers fit properly.





Before Proceeding, Review the Antenna Board Orientation

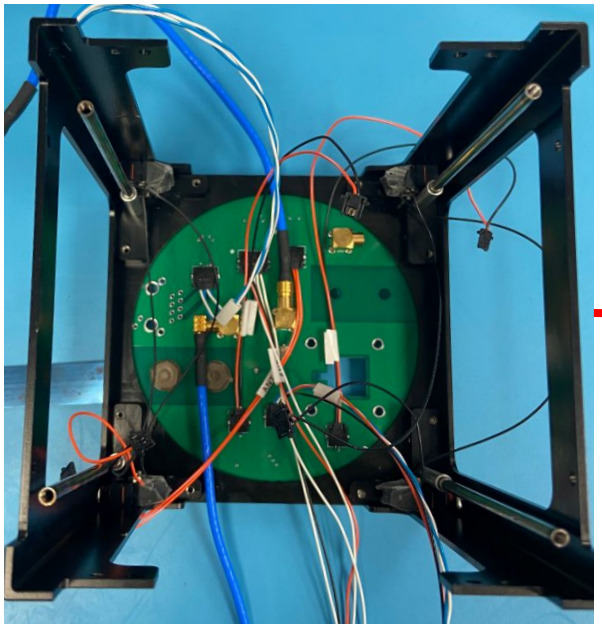
- The MCX Plugs should be resting in opposite ways
- All harness wires shall flow in the same direction they are inserted except for Antenna Board (ANT) J7 which flow in the opposite direction of insertion

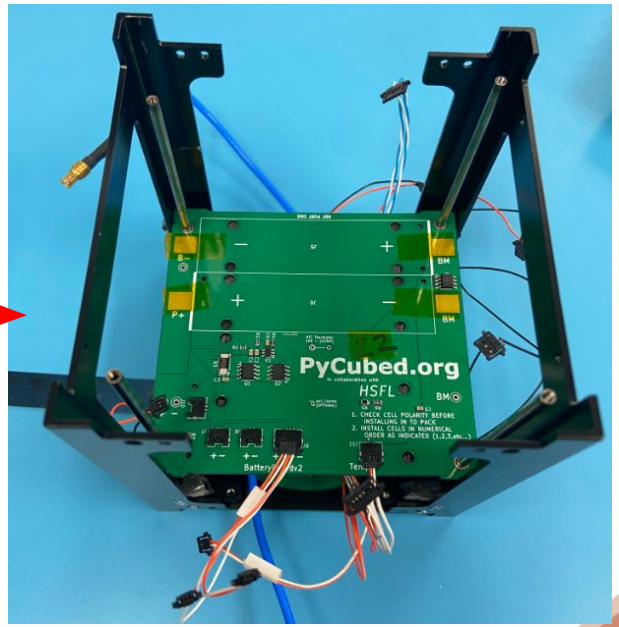


Bottom Side

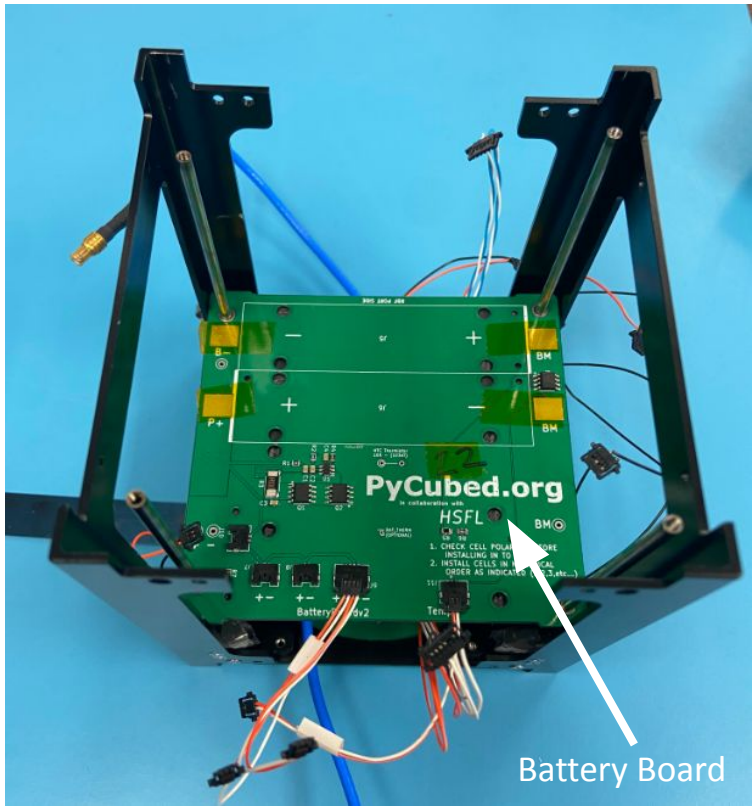
Stack on the Battery Board (BB to PDU)

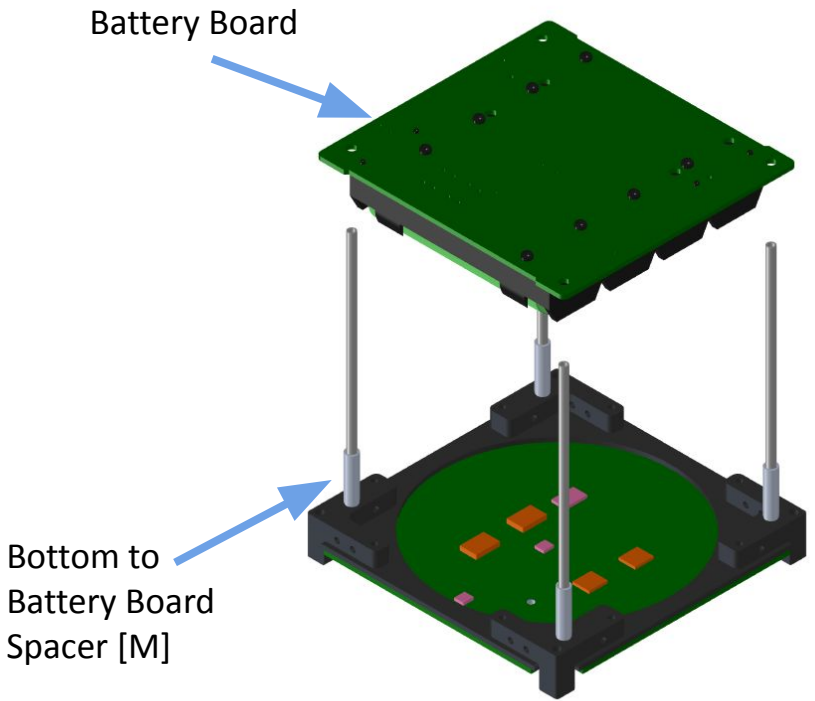
- Move and keep the Antenna Board's Wire Labels at the end near you
- While maintaining the correct orientation of the Antenna Board, stack the Battery Board on top of the Bottom to Battery Board Spacer [M]. See next slide for another perspective





Stack on the Battery Board (BB to PDU)

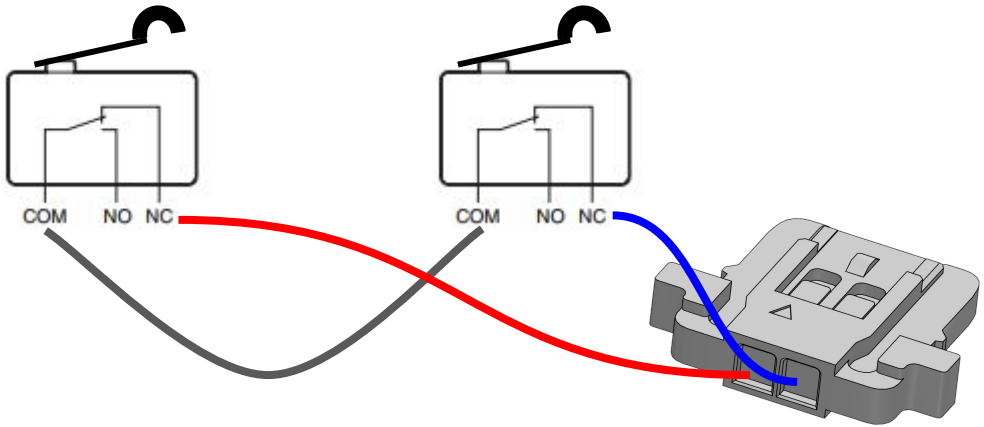


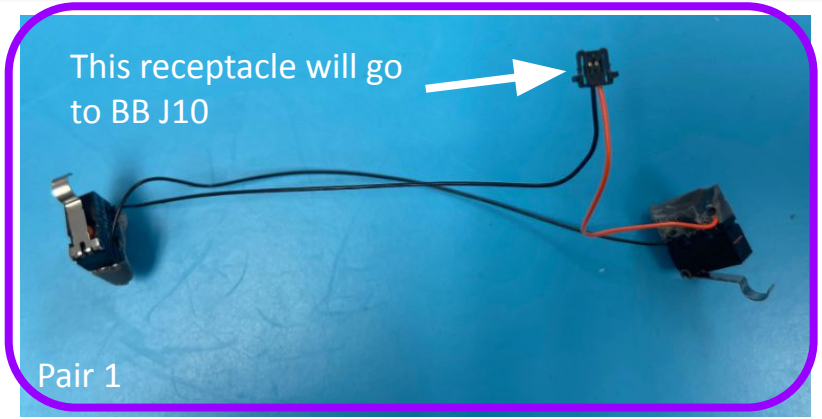


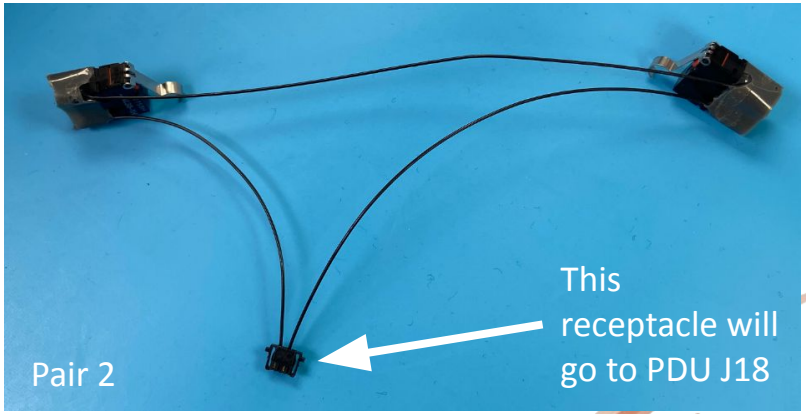
Recall the Previous Slide: Prepped Deployment Switch Pair

There are 2 Prepped Deployment Switch Pairs in this Kit. Your focus now is setting up Pair 1 (in Purple).

A single Prepped Deployment Switch Pair is essentially two “Deployment Switches” with their Receptacles attached via Epoxy.

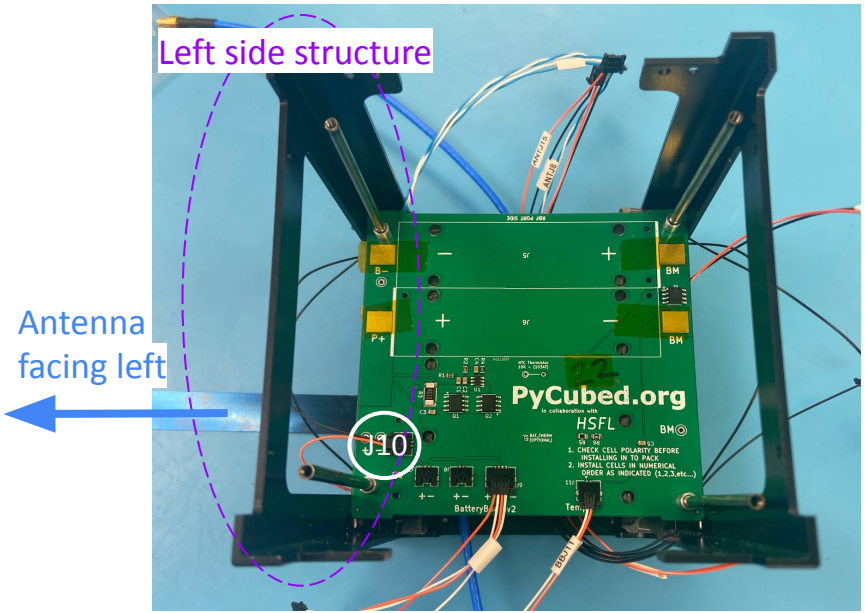


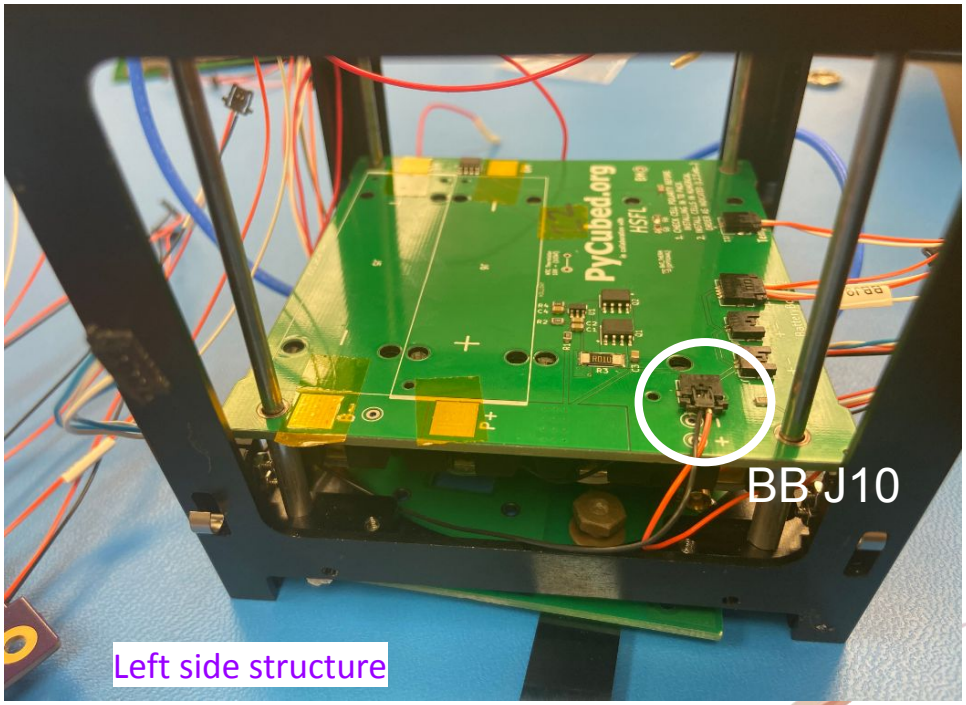


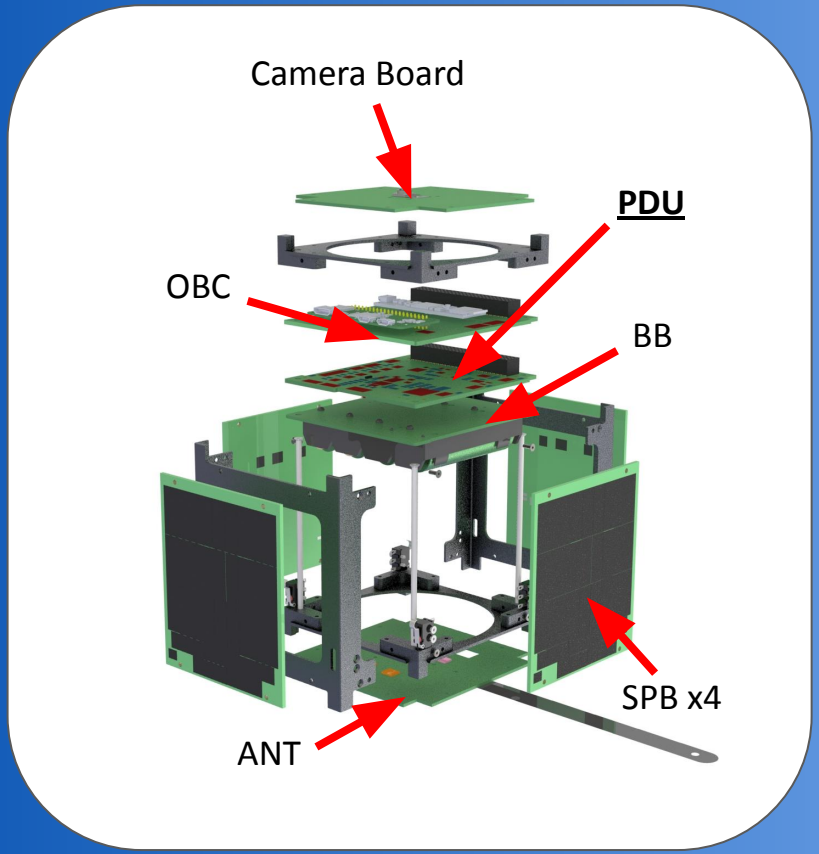


Connect Deployment Switch Receptacle onto BB J10

With the antenna facing left, connect the left side structure's deployment switch pair's receptacle end to BB J10



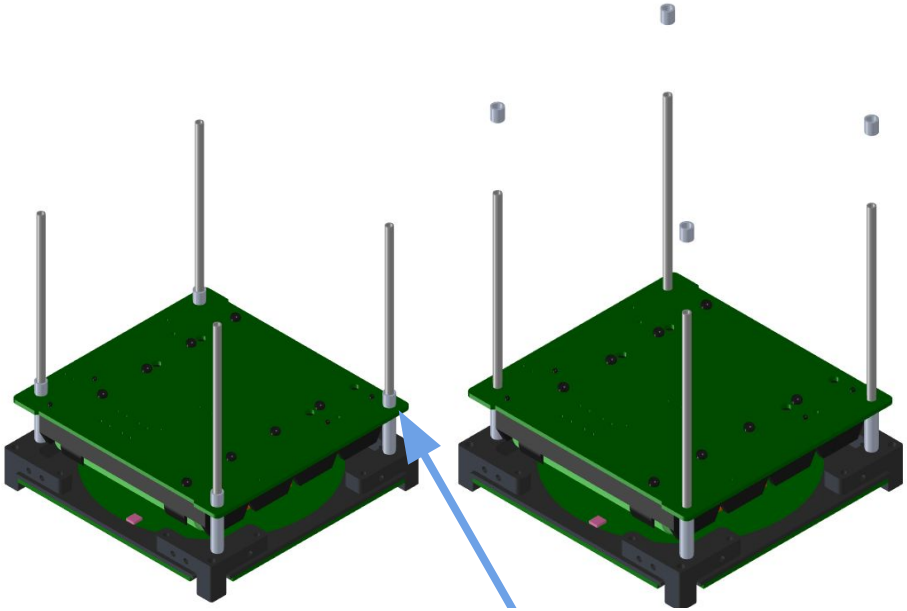


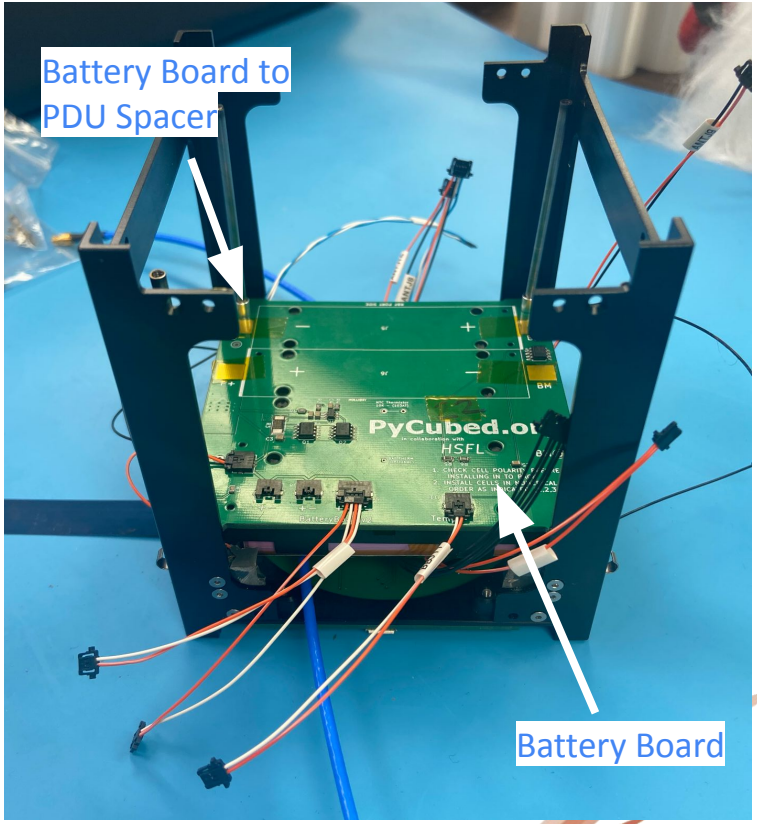


PDU Assembly

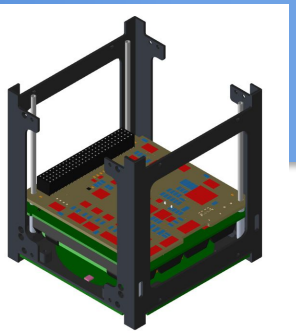
Insert Spacers after stacking Battery Board (BB to PDU)

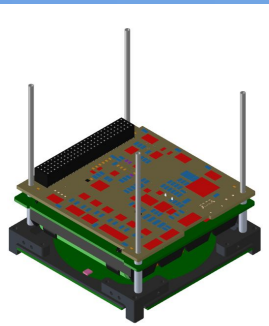
Place 4 Battery Board to PDU Spacer [E] onto the rod at each corner. This spacer separates the BB and the PDU.





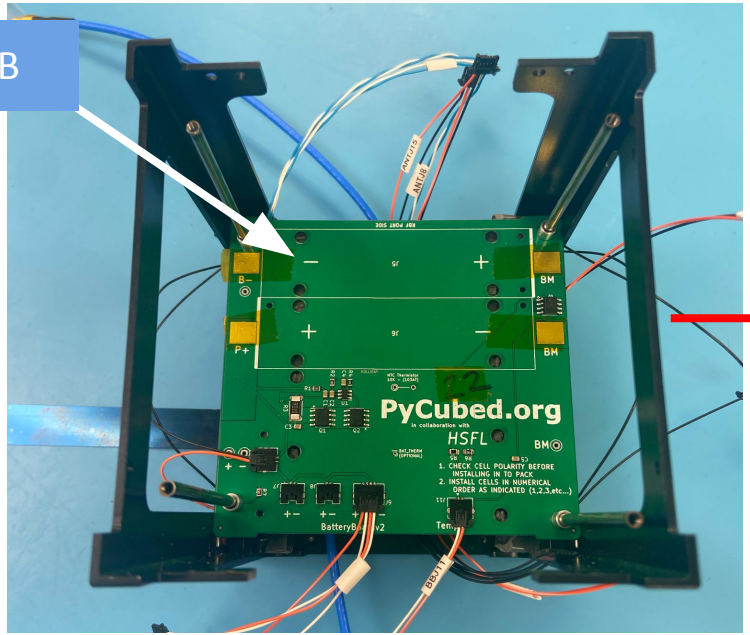
Stack on the PDU



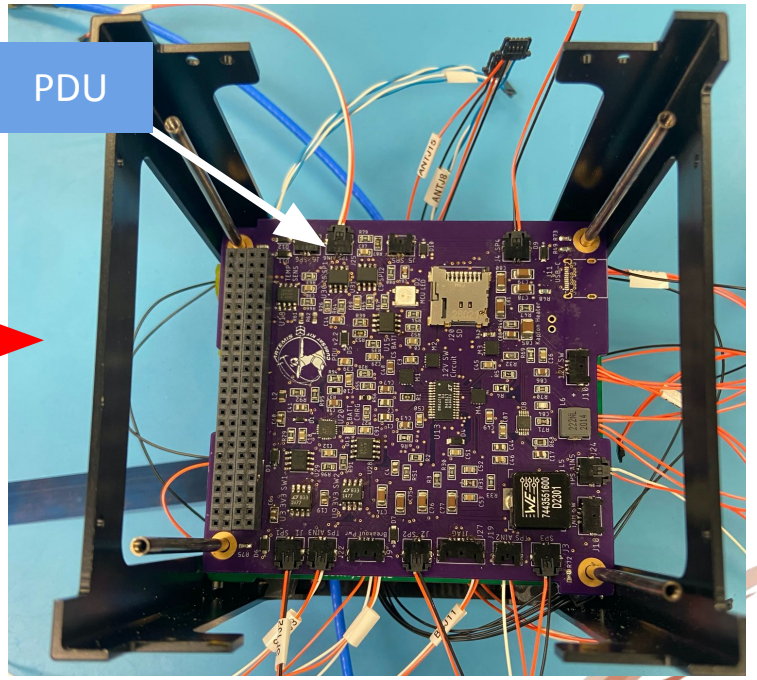


Stack the PDU on top of the Spacer [E].

BB



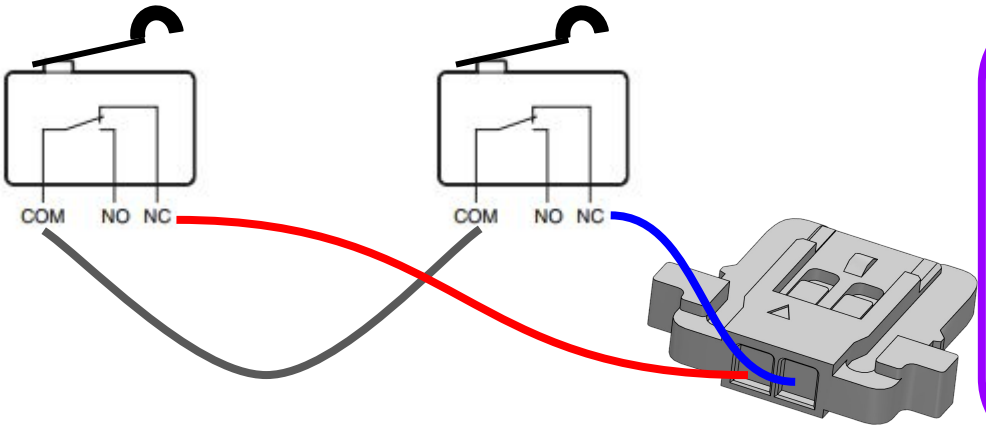
PDU

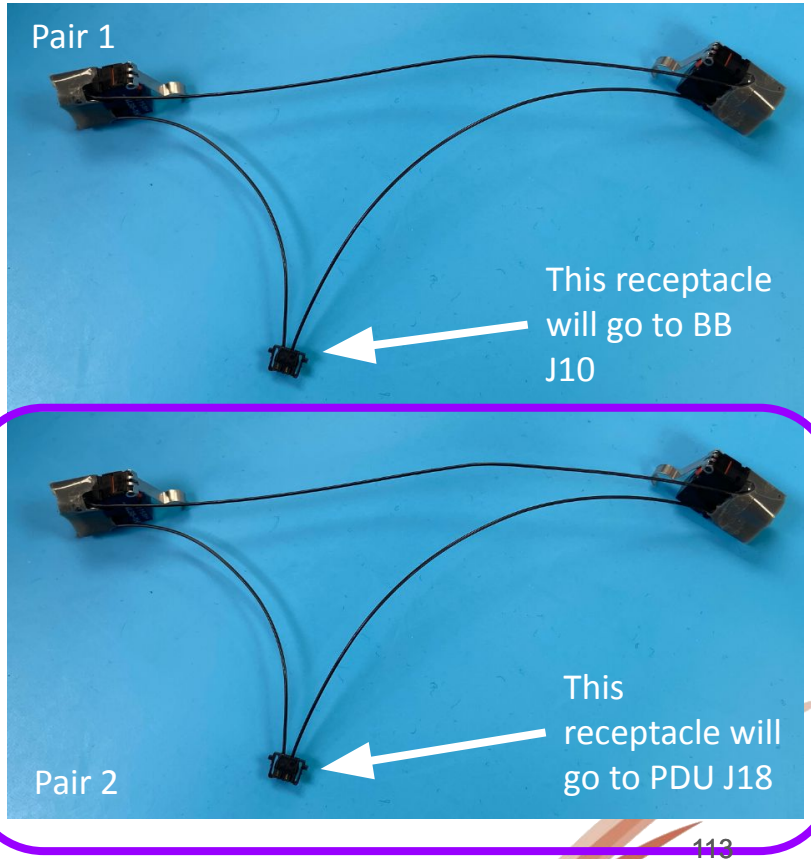


Recall the Previous Slide: Prepped Deployment Switch Pair

There are 2 Prepped Deployment Switch Pairs in this Kit. Your focus now is setting up Pair 2 (in Purple).

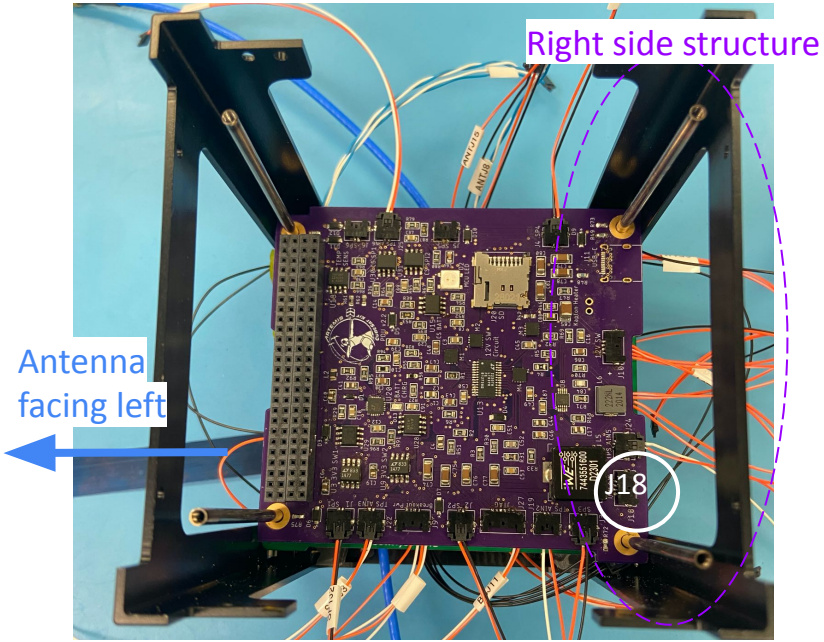
A single Prepped Deployment Switch Pair is essentially two “Deployment Switches” with their Receptacles attached via Epoxy.

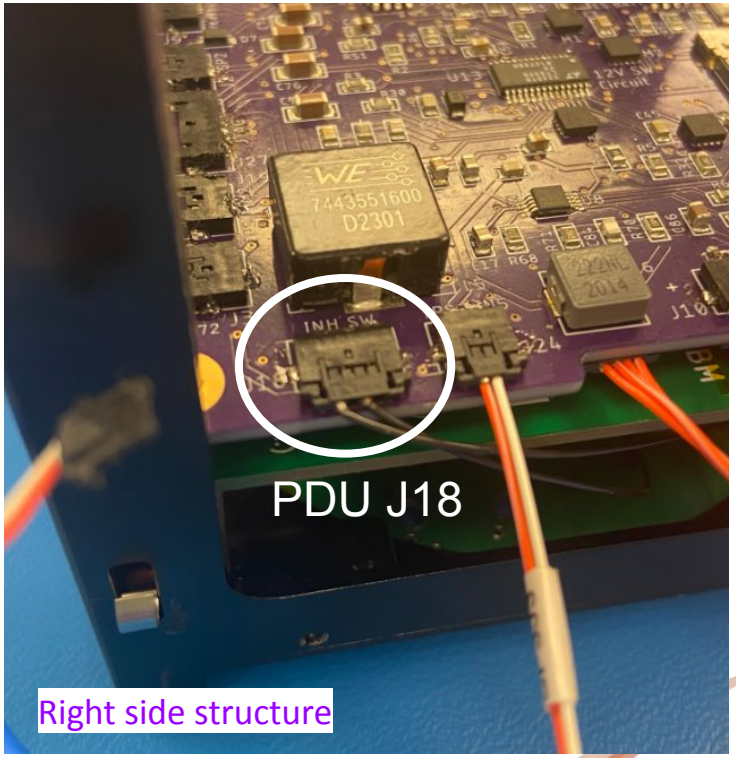




Connect Deployment Switch Receptacle onto BB J18

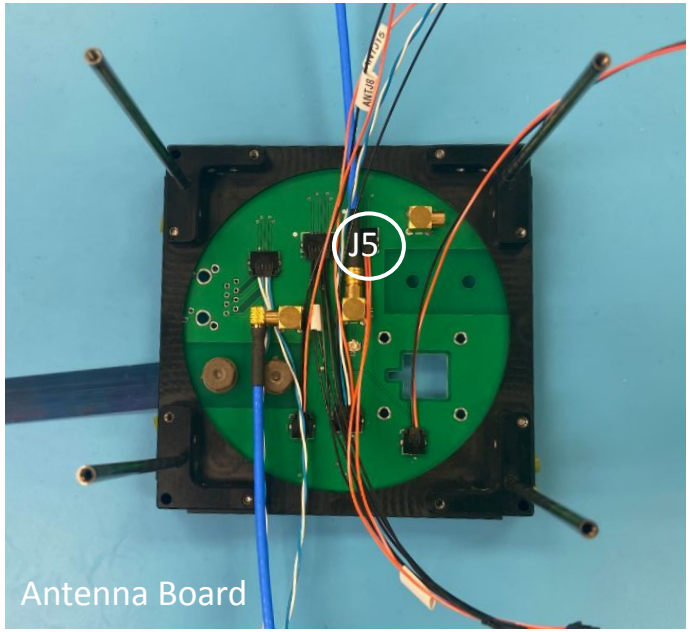
With the antenna facing left, connect the right side structure's deployment switch pair's receptacle end to PDU J18

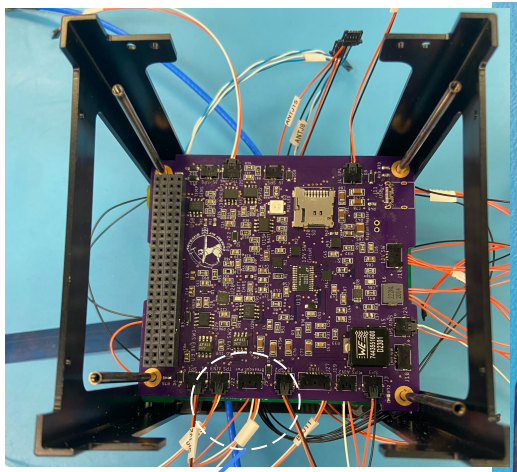


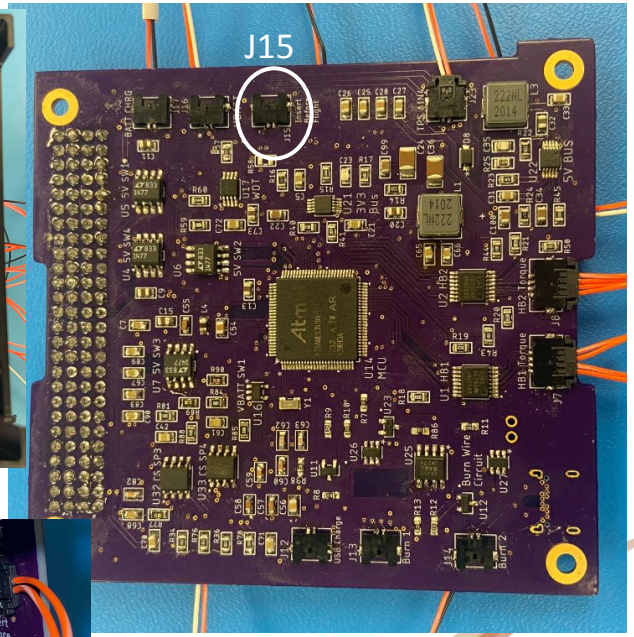


Connect Antenna (Bottom Side) and PDU (Bottom Side) Wires

- ANT J5 to PDU J15 (Wire Label: ANT J5)
  - Insert Before Flight – Find the wire already inserted onto the Antenna, and connect other end to PDU



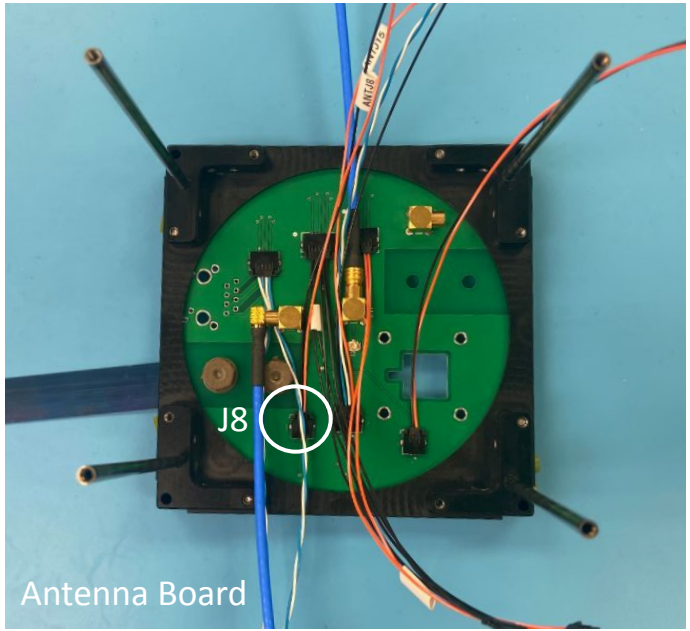


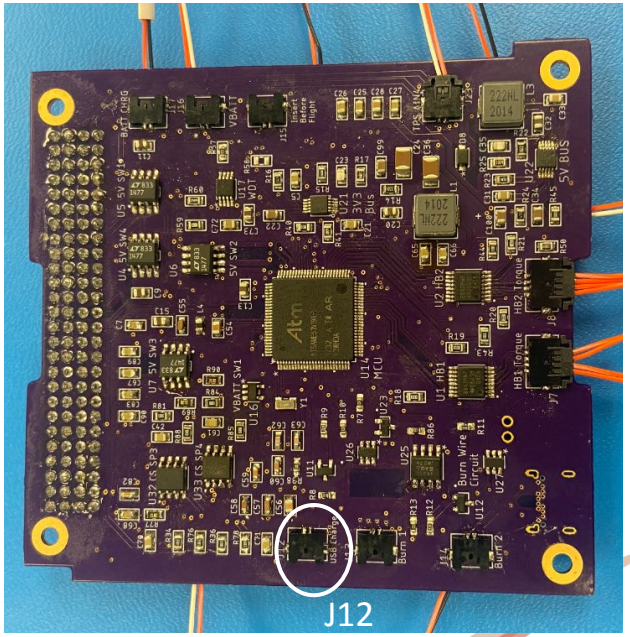


J15 is underneath here

Connect Antenna (Bottom Side) and PDU (Bottom Side) Wires

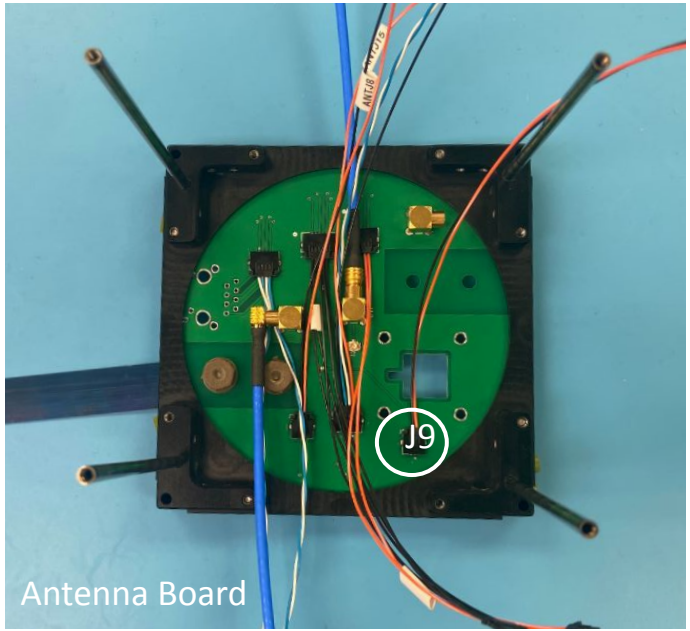
- ANT J8 to PDU J12 (Wire Label: ANT J8)
  - USB Charge – Find the wire already inserted onto the Antenna, and connect other end to PDU



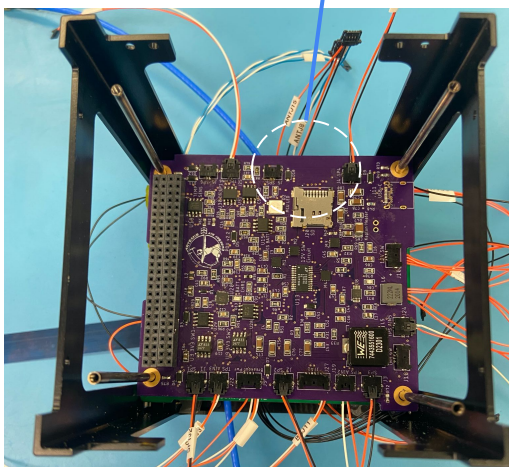


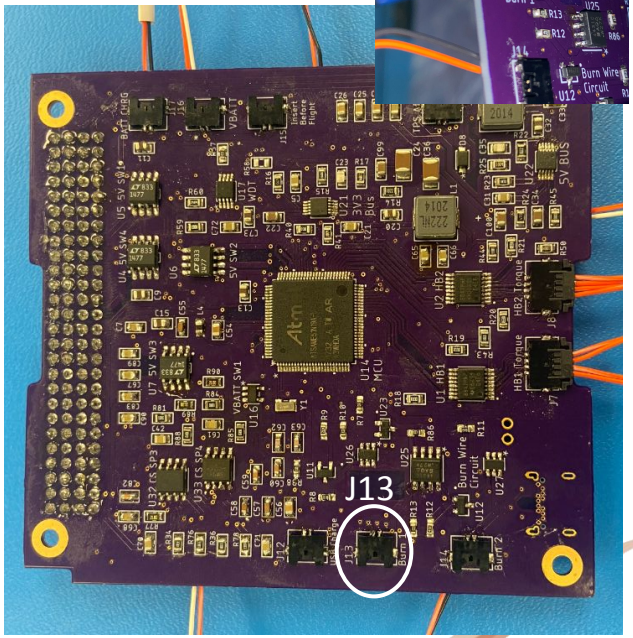
Connect Antenna (Bottom Side) and PDU (Bottom Side) Wires

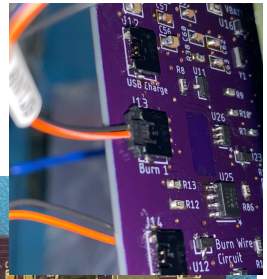
- ANT J9 to PDU J13 (Wire Label: ANT J9)
  - Burn Wire – Find the wire already inserted onto the Antenna, and connect other end to PDU



J13 is underneath here

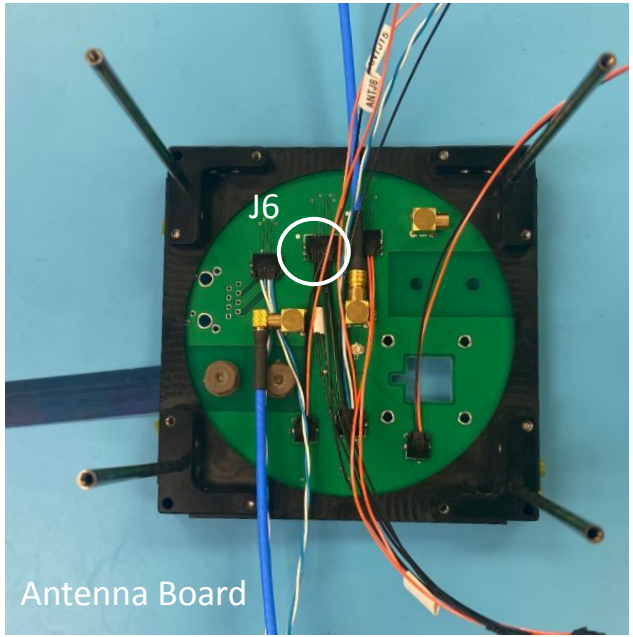


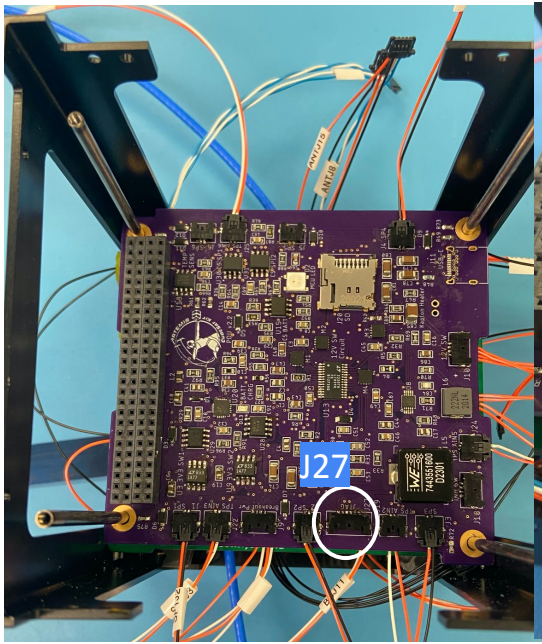


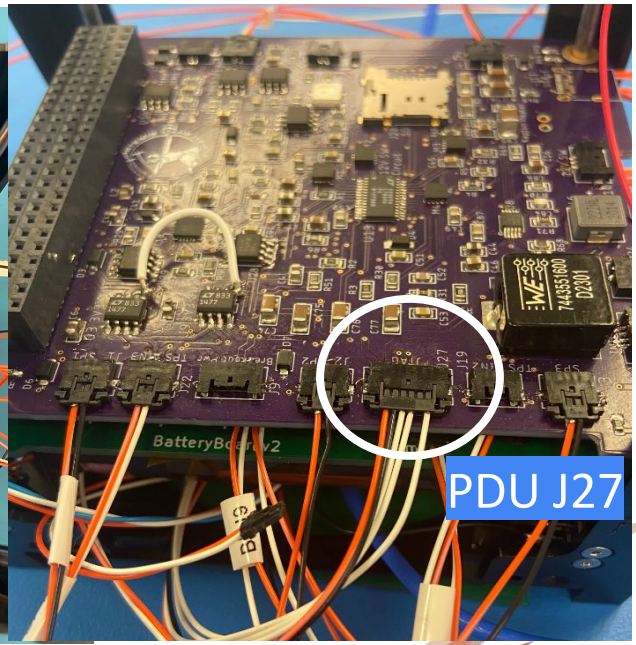


Connect Antenna (Bottom Side) and PDU (Top Side) Wires

- ANT J6 to PDU J27 (Wire Label: ANT J6)
  - Programmable MCU via JTAG Connector – Find the wire already inserted onto the Antenna, and connect other end to PDU

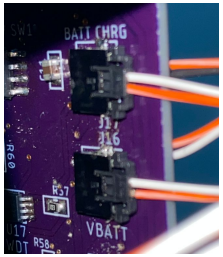


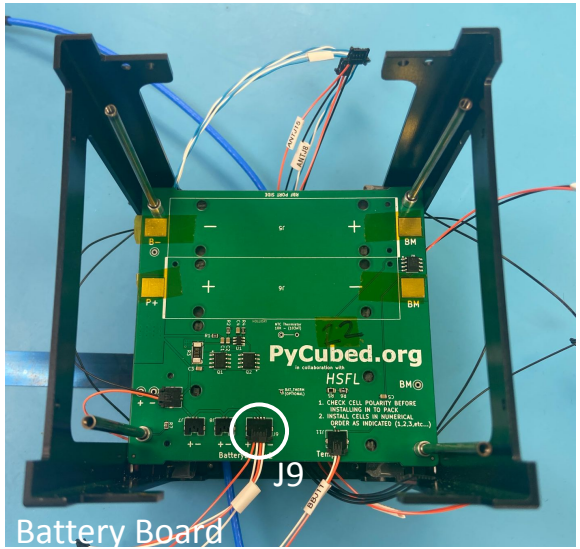


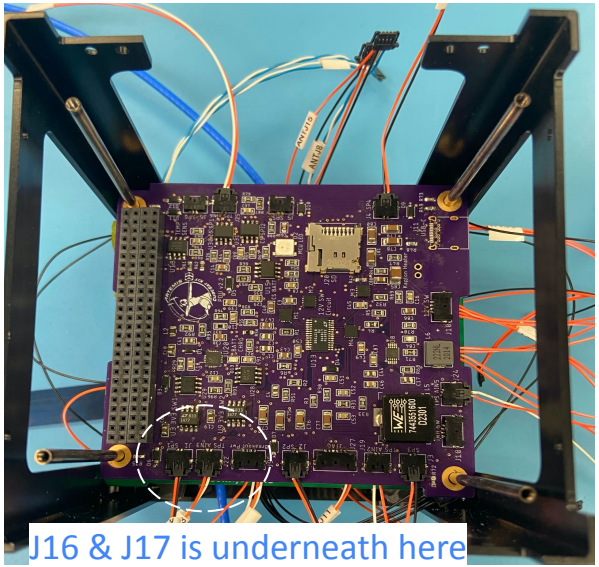


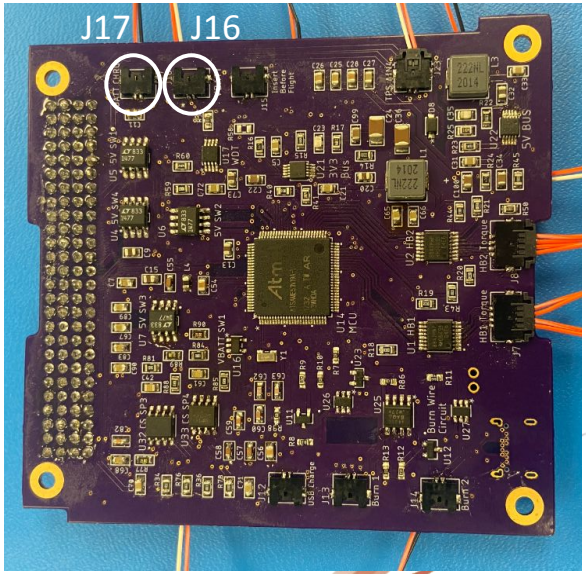
Connect Battery Board (Top Side) and PDU (Bottom Side) Wire

- BB J9 to PDU J16 & PDU J17 (Wire Label: BB J9)
  - VBatt & Battery Charge – Find the wire already inserted onto the BB, and connect other end to PDU
  - The ends of BB J9 are *interchangeable*, meaning that it doesn't make a difference which end of the BB J9 wire is inserted into which PDU connector (J16/J17)



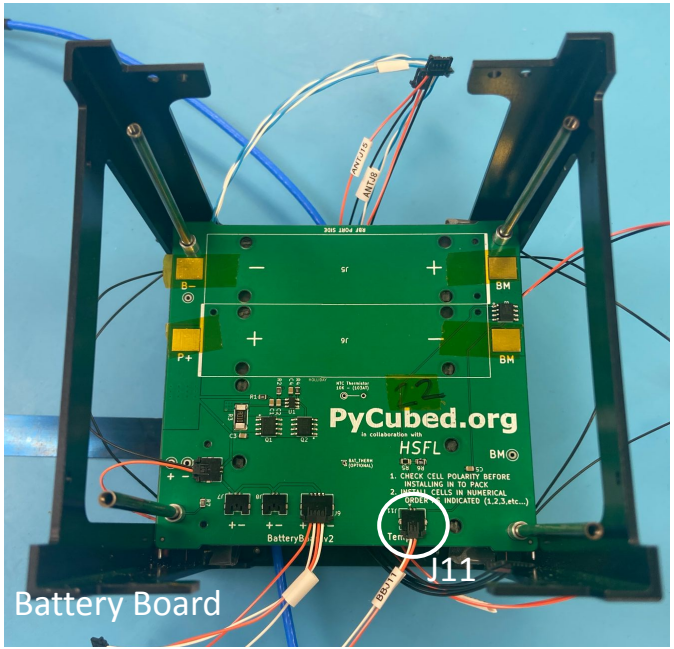


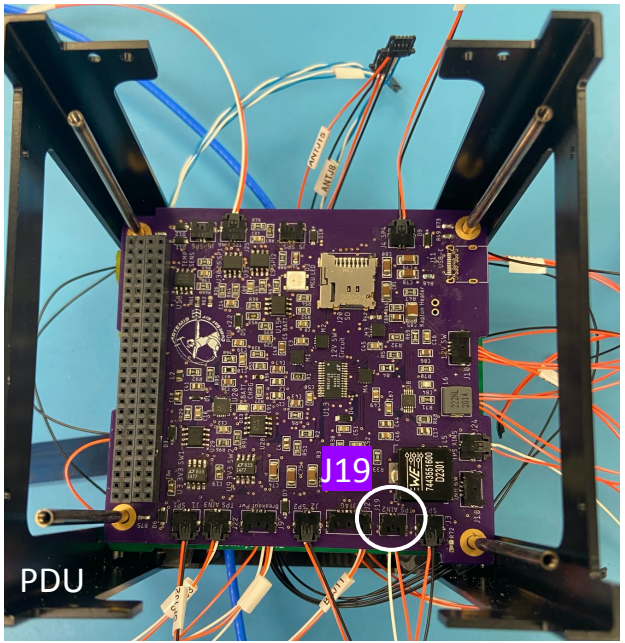


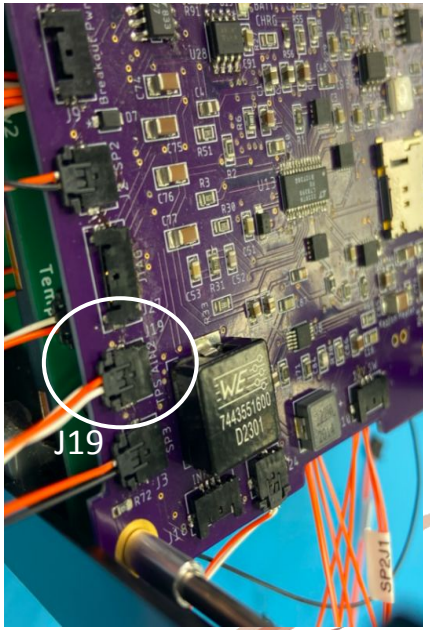


Connect Battery Board (Top Side) and PDU (Top Side) Wire

- BB J11 to PDU J19 (Wire Label: BB J11)
  - BB Temperature Sensor – Find the wire already inserted onto the BB, and connect other end to PDU

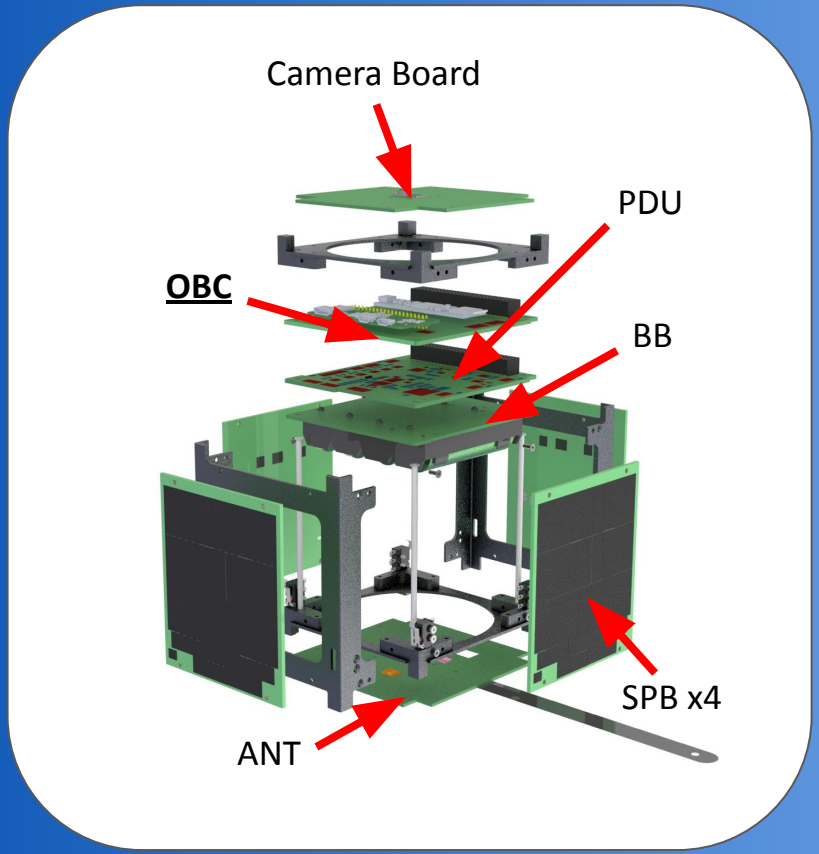






Break Time!

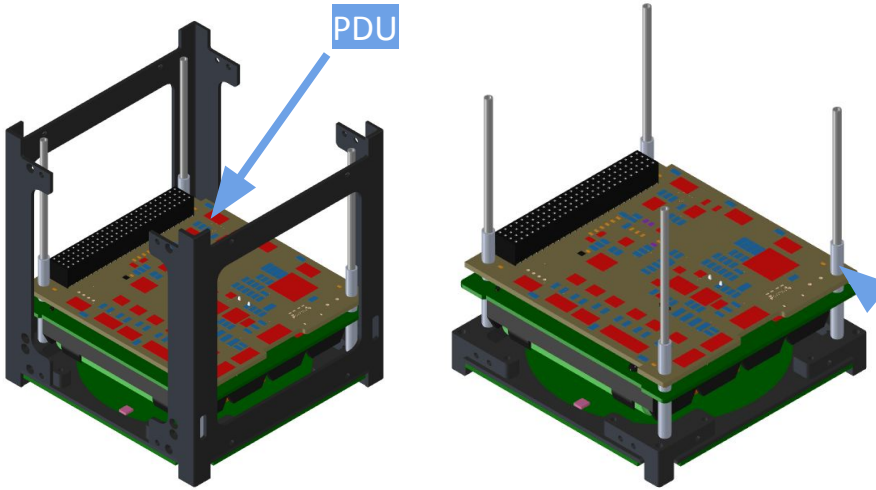
You worked very hard… So, please take a break now!
Alternatively, continue this process in your
next work session.

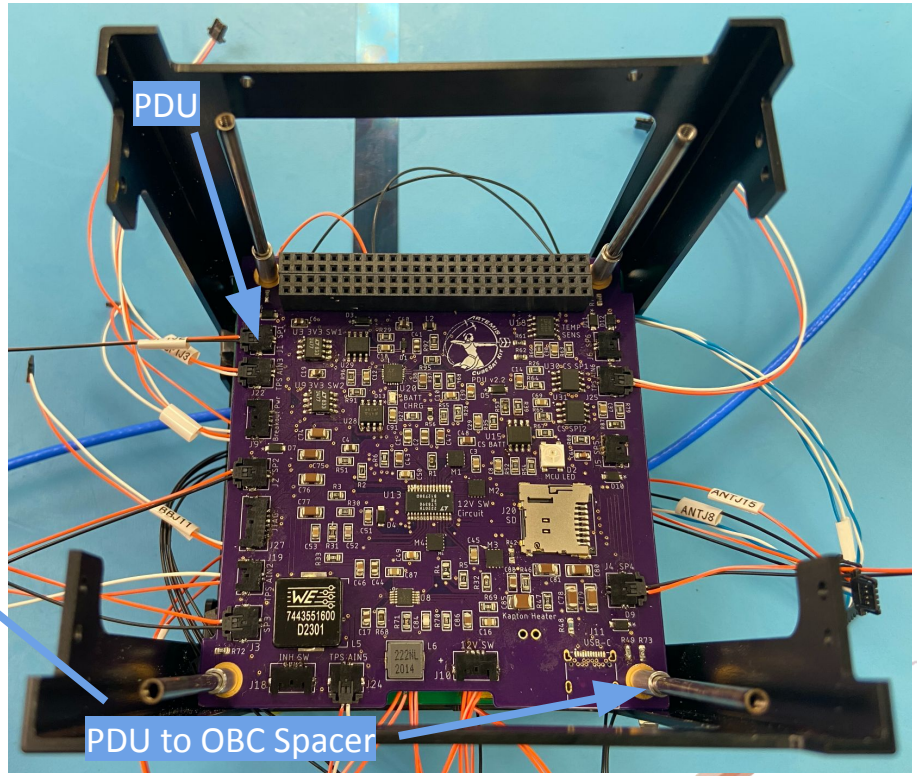


OBC Assembly

Place Spacers After Stacking PDU (PDU to OBC)

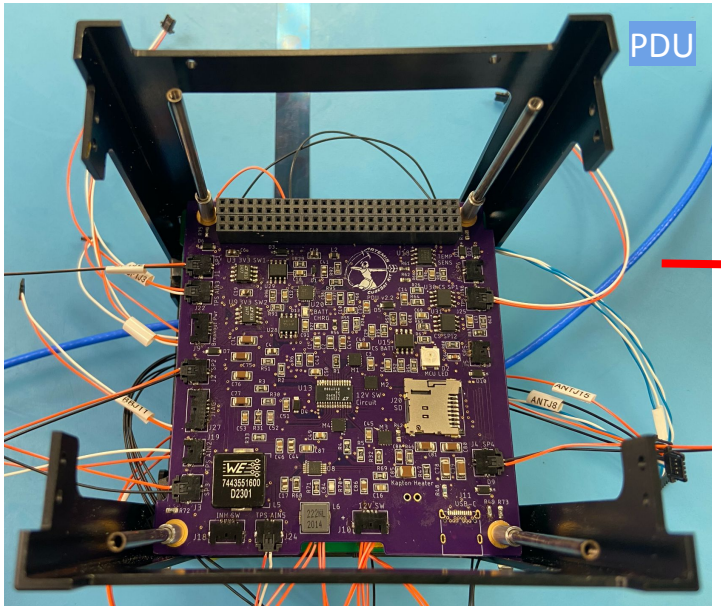
Place 4 PDU to OBC Spacer [B] onto the rod at each corner. This spacer will separate the PDU and OBC.

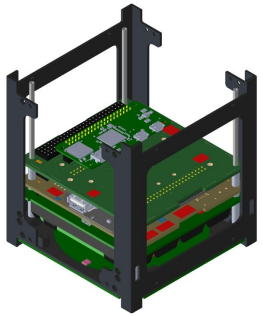


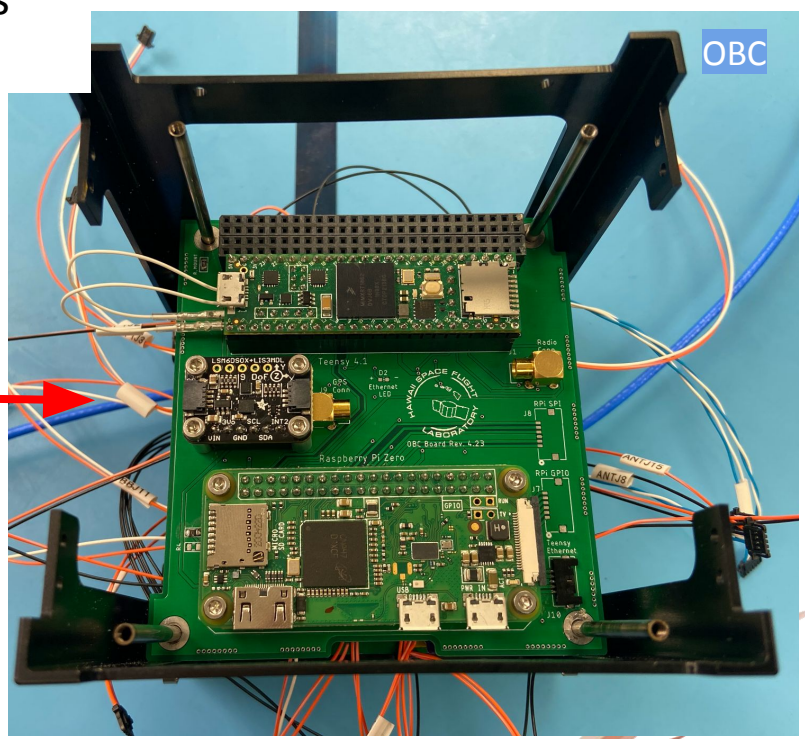


Stack on the OBC

Stack the OBC on top of the Spacer [B]. Do not fully insert the OBC's PC 104 Header onto the PDU's at this time. We will do this at a later step.

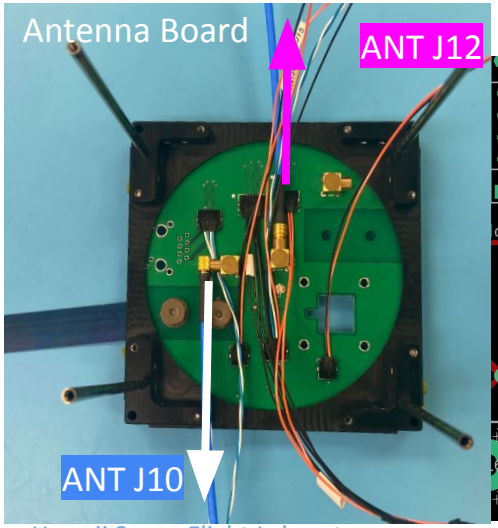


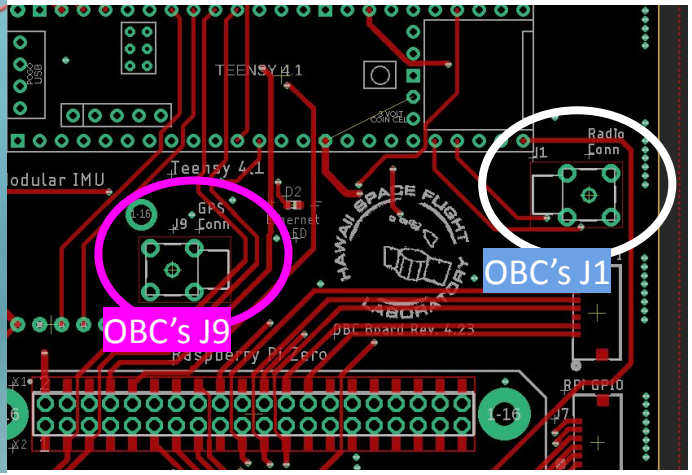


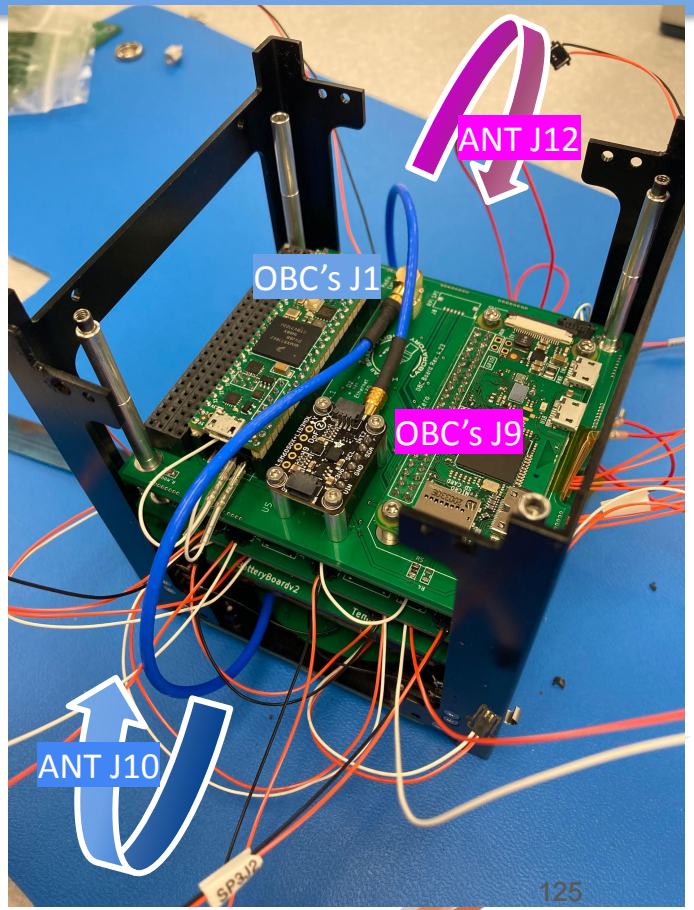


Attach Antenna Cables to OBC

- Connect Antenna Board's J10 to OBC's J1 (Radio)
- Connect Antenna Board's J12 to OBC's J9 (GPS)
- See next slide on how to correctly connect the MCX Plugs

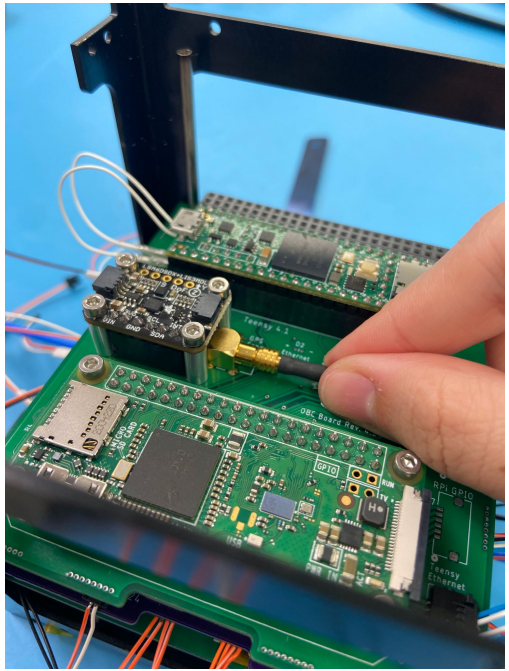




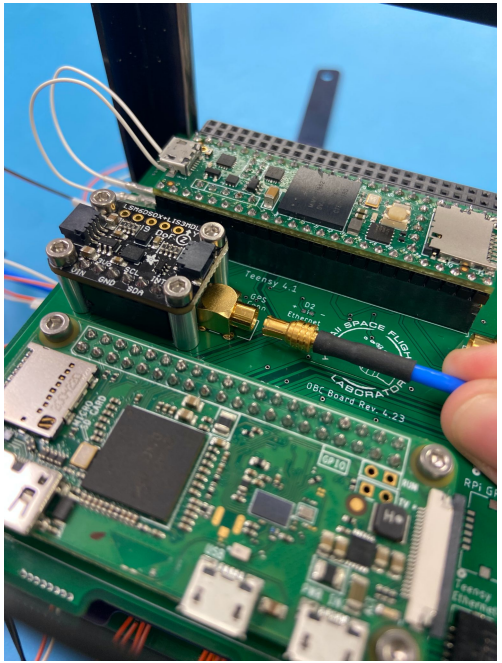


Attach Antenna Cables to OBC

When inserting or removing the MCX plugs, firmly hold the black region of the plugs and not the blue – as it can bend or potentially break.



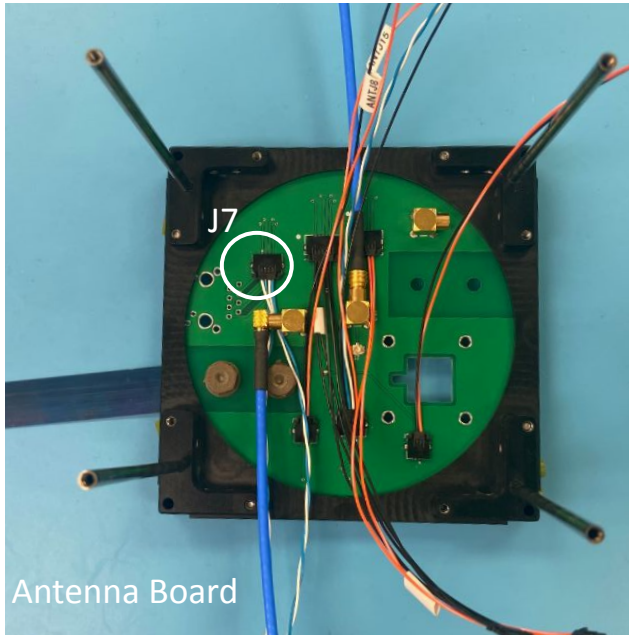
Correct

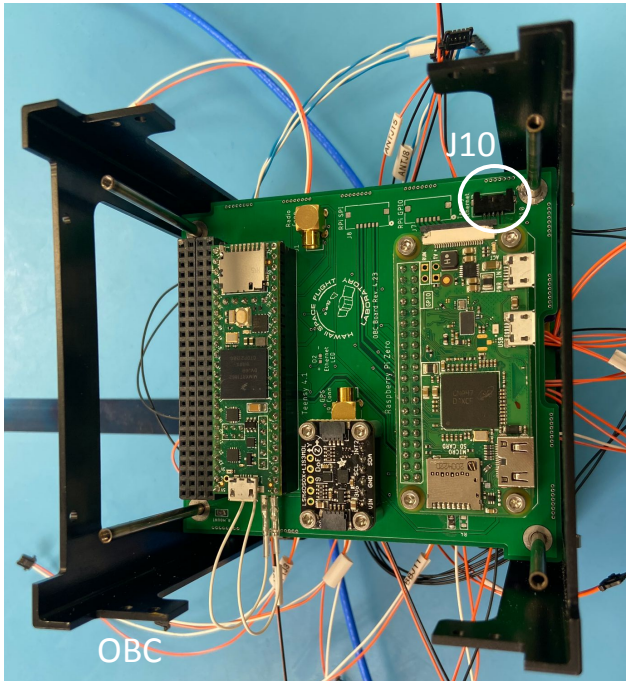


Incorrect

Connect Antenna (Bottom Side) and OBC (Top Side) Wires

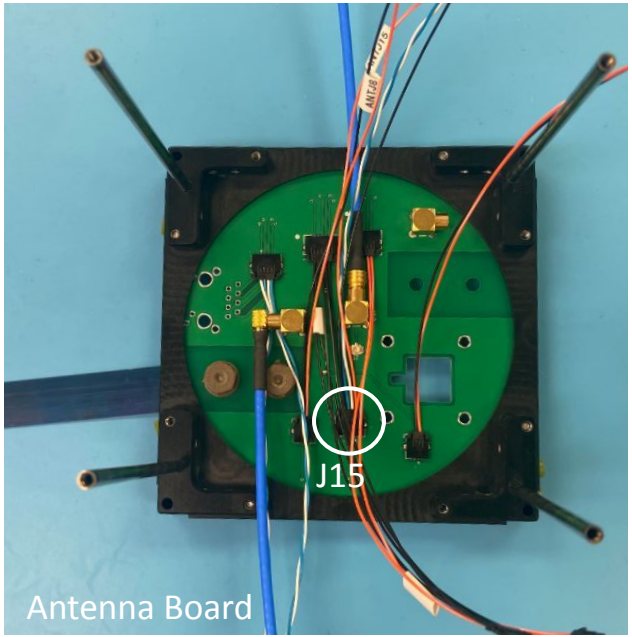
- ANT J7 to OBC J10 (Wire Label: ANT J7)
  - Teensy via Ethernet – Find the wire already inserted onto the Antenna, and connect other end to OBC

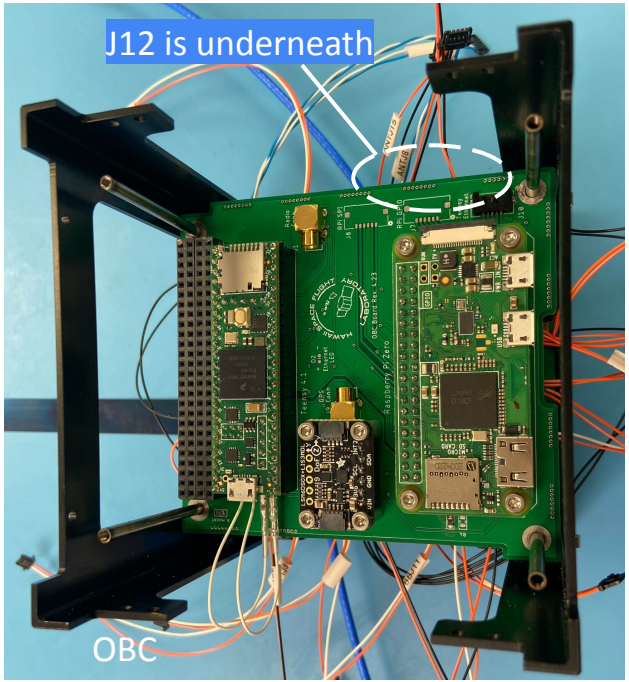


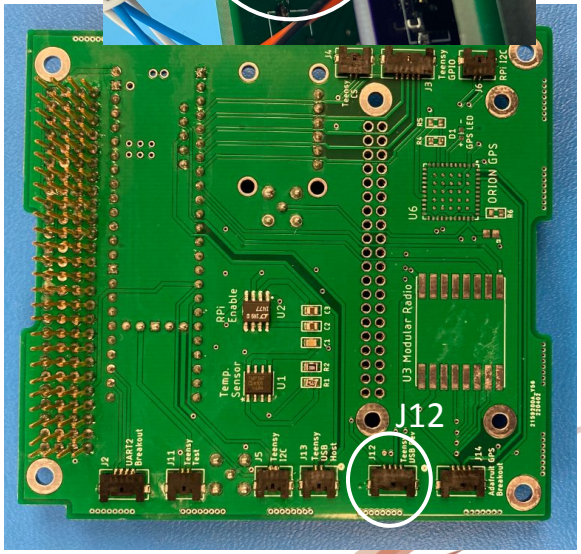


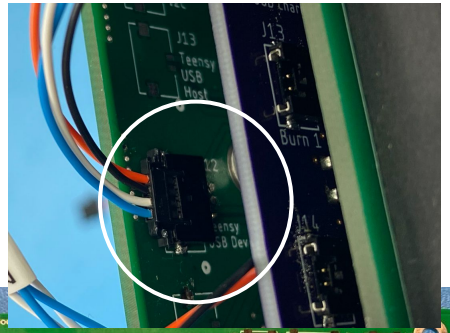
Connect Antenna (Bottom Side) and OBC (Bottom Side) Wires

- ANT J15 to OBC J12 (Wire Label: ANT J15)
  - Teensy via Micro-B – Find the wire already inserted onto the Antenna, and connect other end to OBC



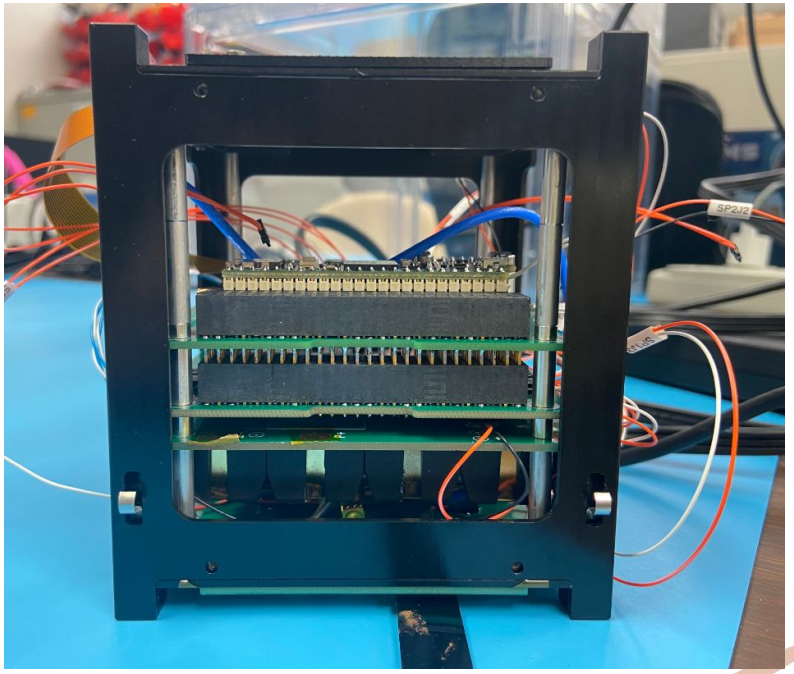




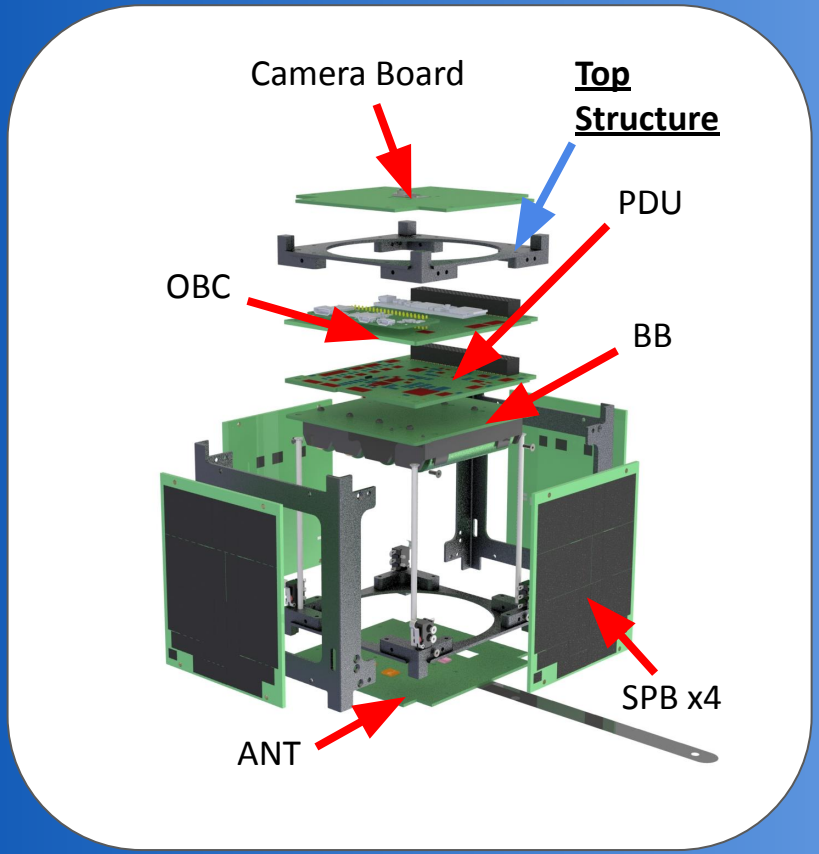


OBC-PDU PC 104 Header Connection

Insert the OBC's PC104 Header onto the PDU's firmly. Ensure when pressing straight-down the PC 104 Header, the pins are not bent.



PC104 Header connects PDU and OBC

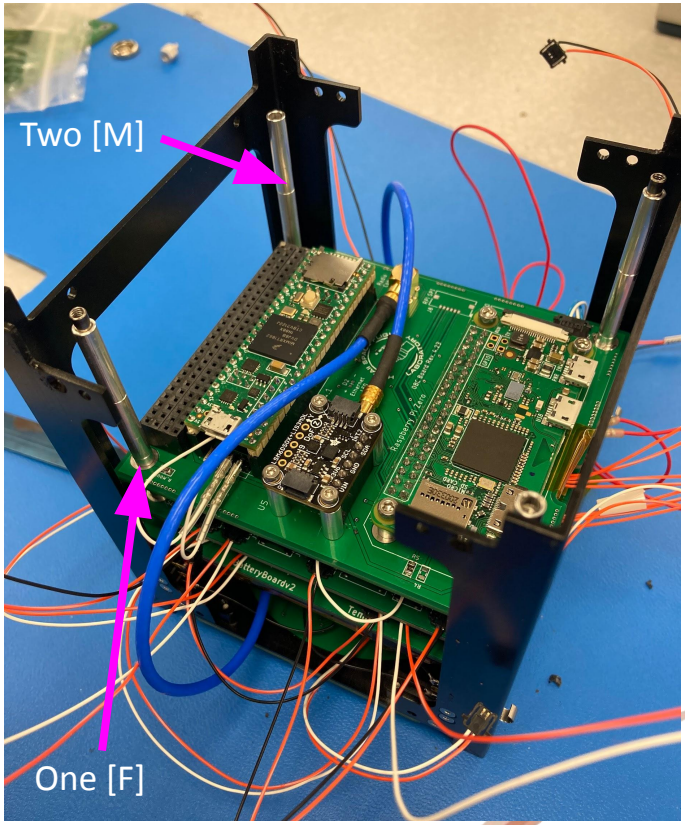


Top Structure Assembly

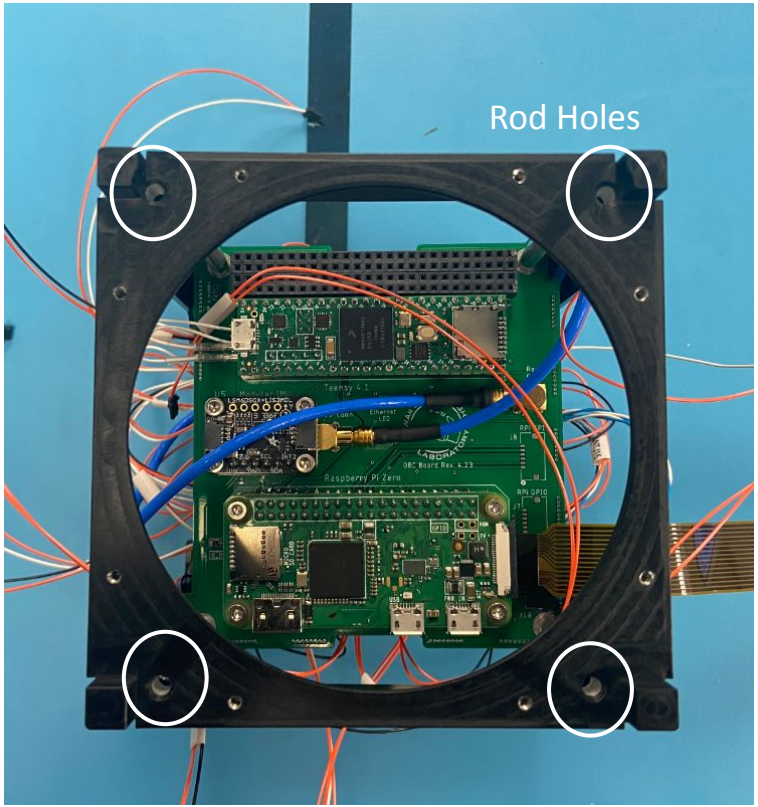
Place Spacers on Rods (OBC to Top)

You will need 4 OBC To Top Spacer Pt. 1 [F] and 8 of OBC To Top Spacer Pt. 2 Spacer [M].

Place one [F] and two [M] onto the rod at each corner. The spacer length will be 3+20+20= 43 mm between the OBC and the top of the CubeSat.



Aligning Top Structure

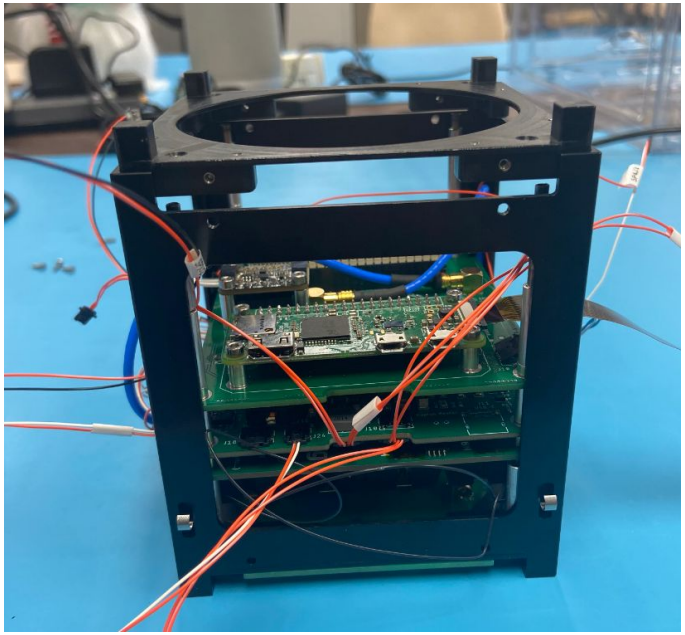


Align the top structure to the spacecraft you assembled thus far. Refrain from pushing it down just yet.

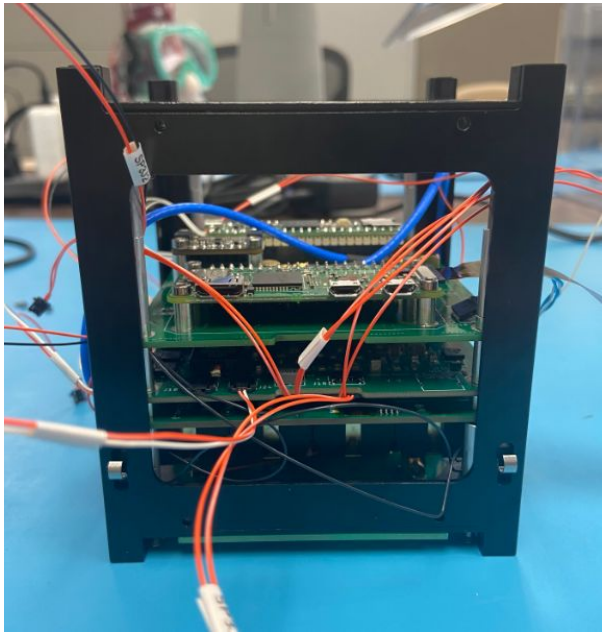
You'll be able to tell that the top structure is properly oriented when you can see the rods clearly through the rod holes.

Connecting the Top Structure

Firmly and evenly push down the top structure to the assembled spacecraft.



Impartially connected top structure

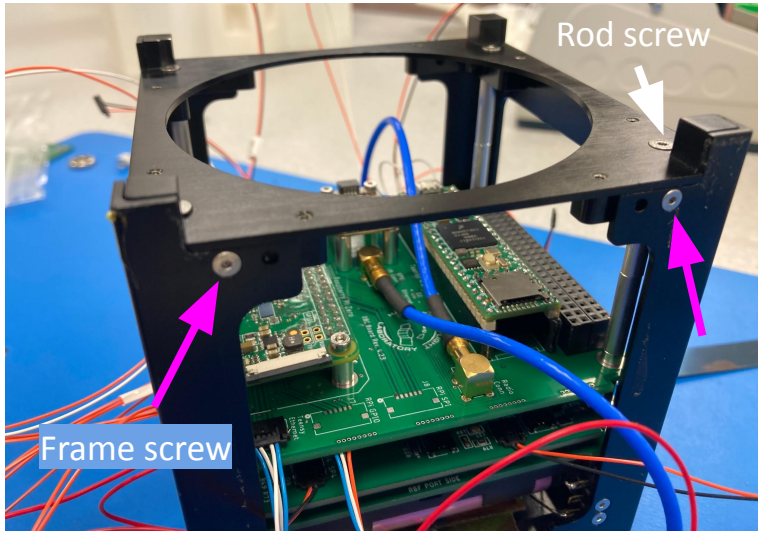


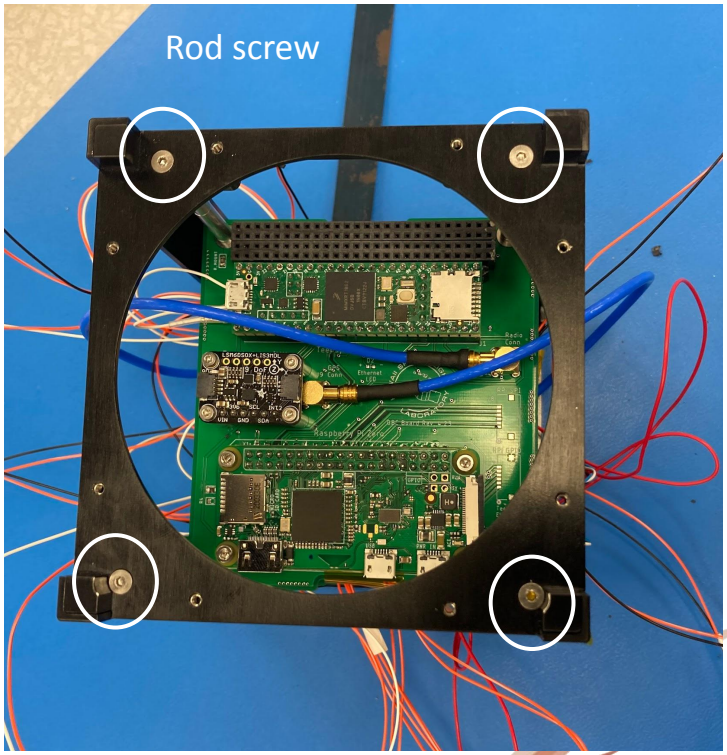
Fully connected top structure

Reinforce Top of Structure

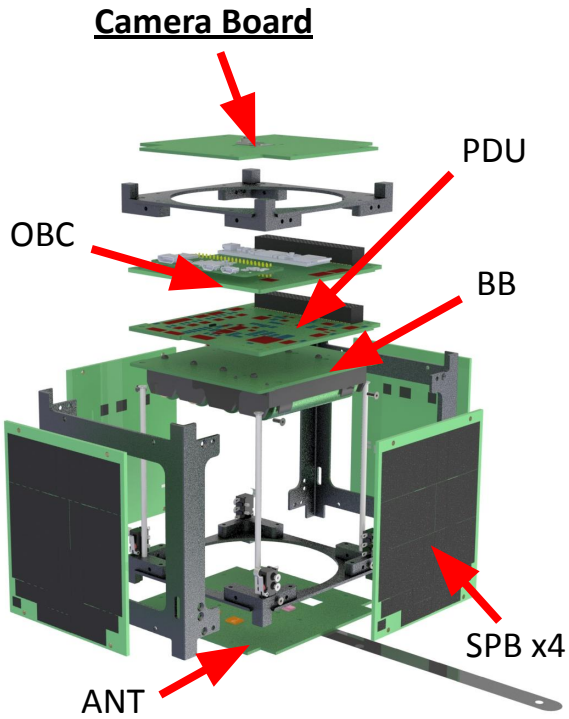
- Using Tool A and 4 Rod screws [D], connect the top structure to the rods
- Using Tool B and 4 Frame screws [C], connect the side structures to the top structure

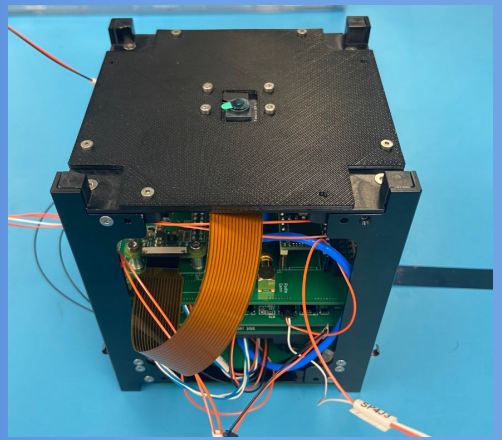
If there is not enough space to attach the top structure, firmly push the boards down – ensuring the PDU and OBC PC 104 Headers are fully connected, and each spacer separates the PCBs/structures.





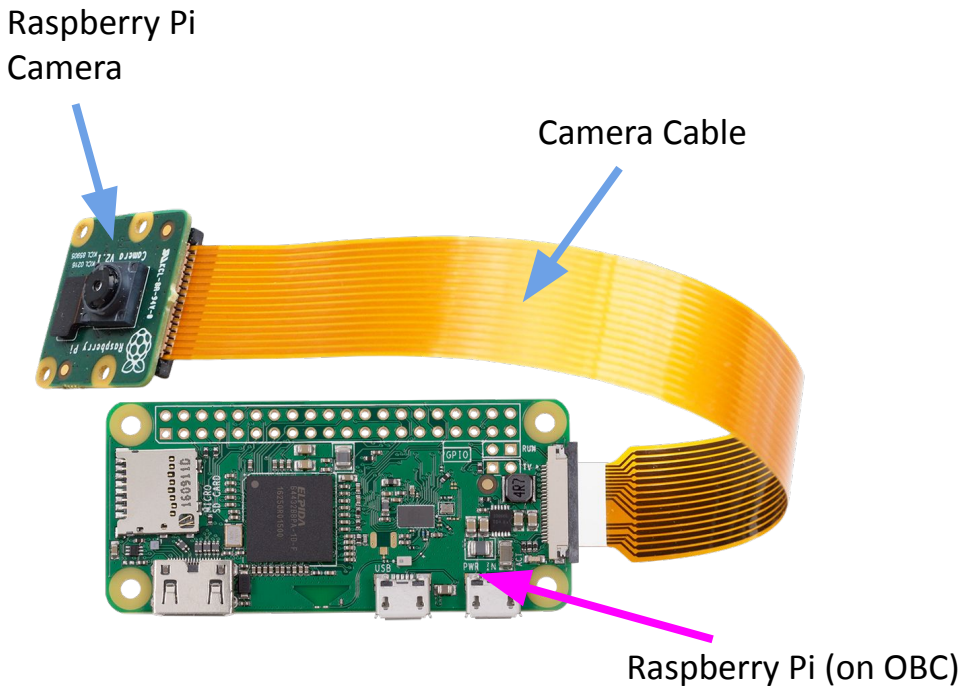
Camera Board Assembly



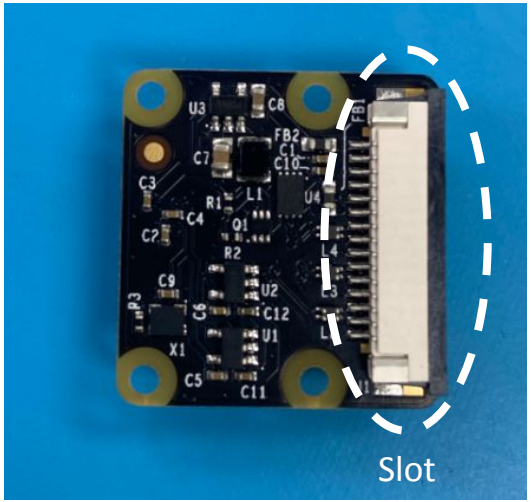


Materials for Attaching Camera Cable to Spacecraft

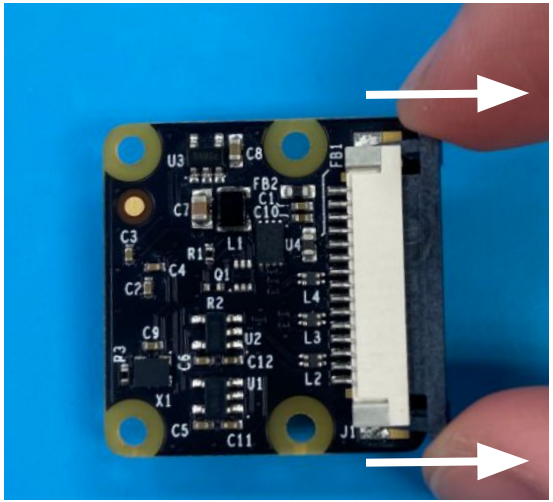
For the next steps, you will need a Raspberry Pi camera and a camera cable.



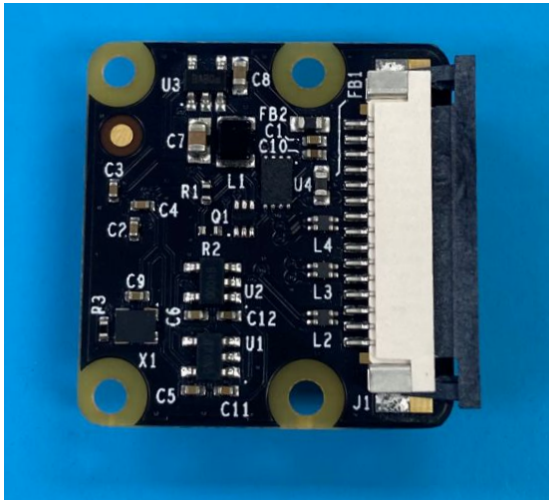
Properly Open the Raspberry Pi Camera



Obtain the Raspberry Pi Camera. Have the camera cable slot face-up like in the figure.

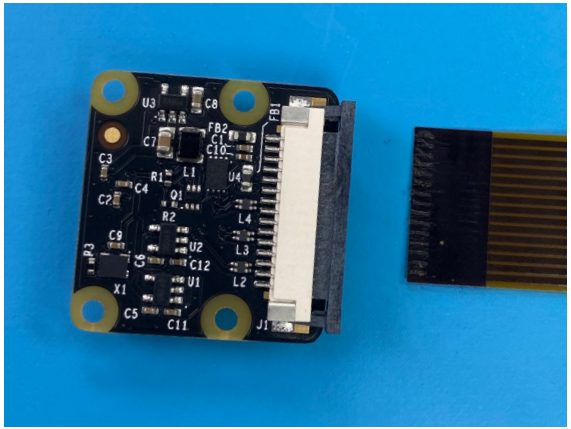


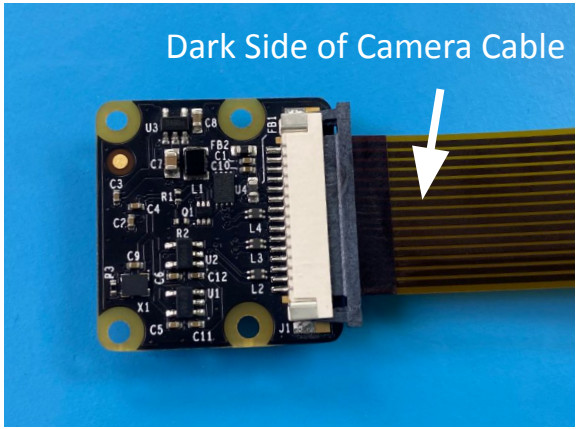
Use your fingers to firmly tug the black portion open.



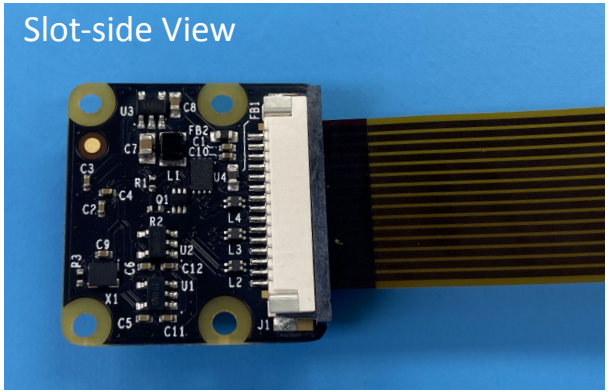
The Raspberry Pi Camera is now ready for the next step.

Insert the Camera Cable onto the Raspberry Pi Camera

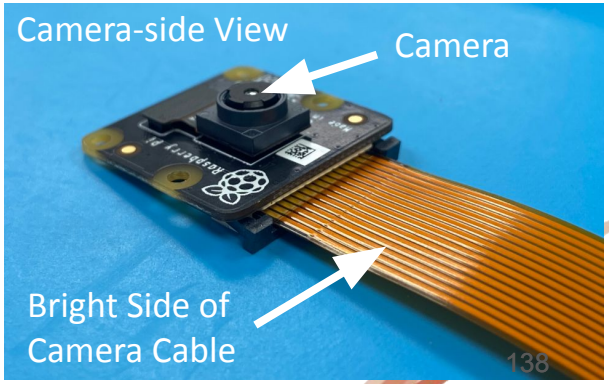




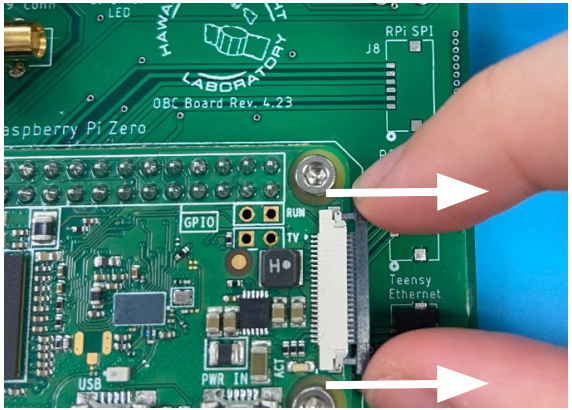
Insert the camera cable into the Raspberry Pi Camera slot.
The dark side of the cable is shown when the slot is facing up.
The bright side of the cable is shown when the camera is facing up.



Close the slot using your fingers.



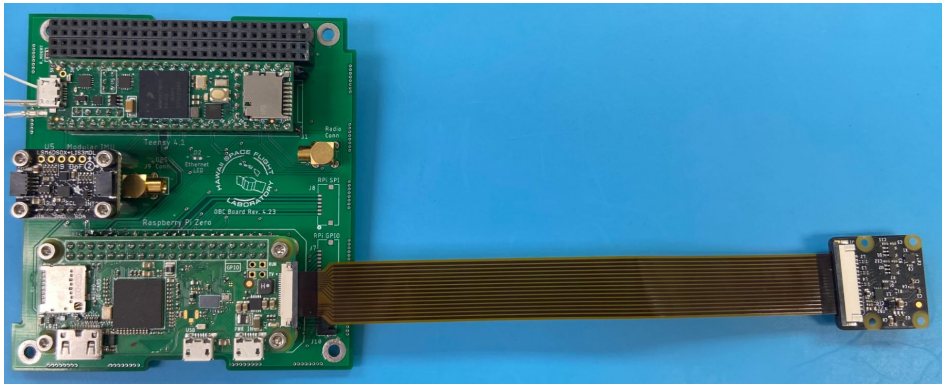
Attach Camera Cable to Raspberry Pi

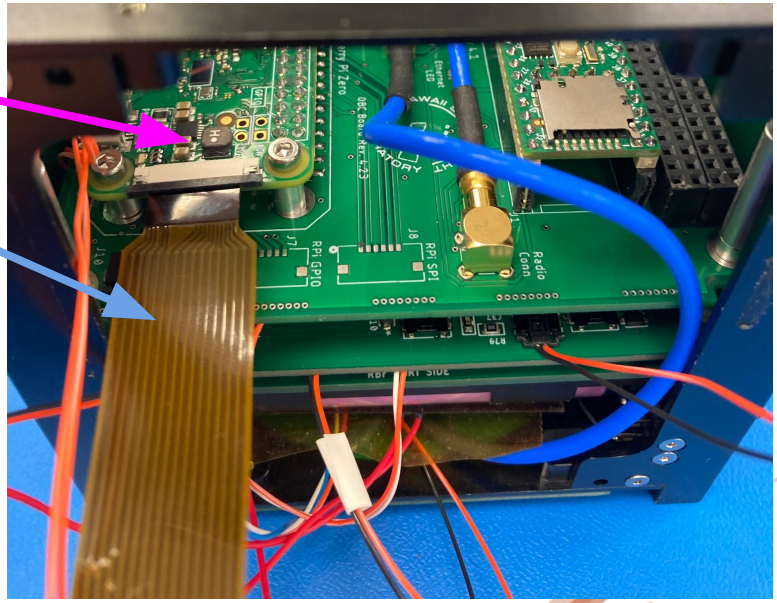


Properly open the slot of the OBC's Raspberry Pi and insert the other end of the camera cable (dark side facing up).
Then close the slot of the OBC's Raspberry Pi.

Raspberry Pi
(on OBC)

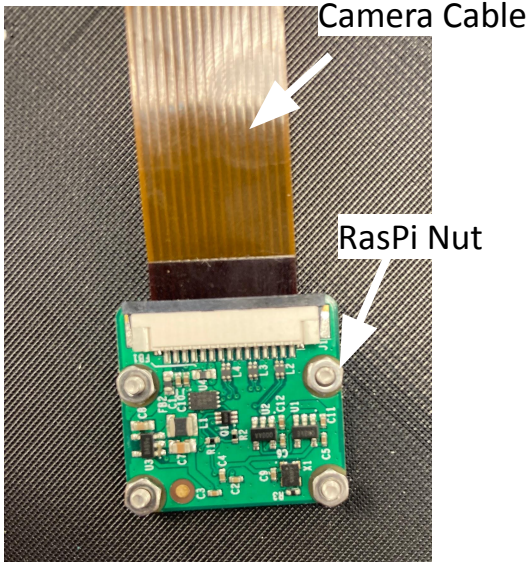
Camera Cable

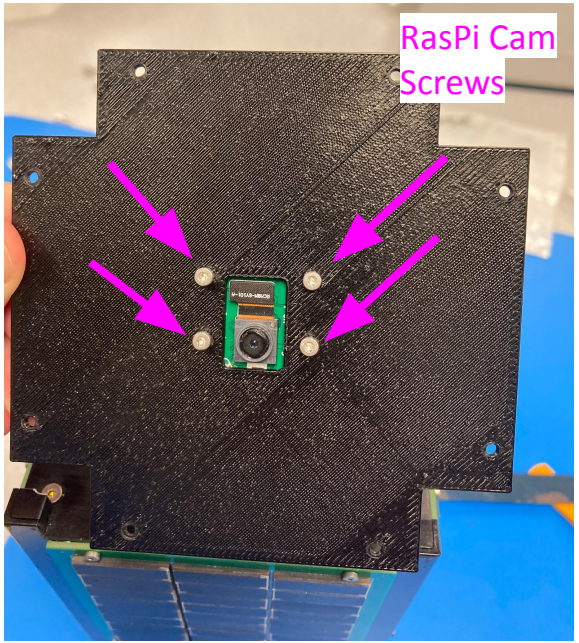


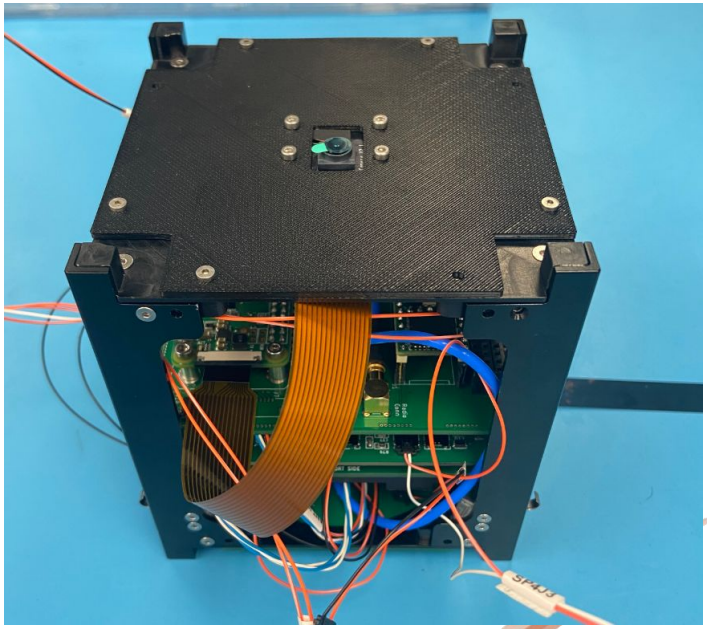


Attach Camera to Camera Board

Using Tool A, 4 Raspberry Pi Camera Screws [O], and 4 Raspberry Pi Camera Nut [P], attach the camera onto the camera board.

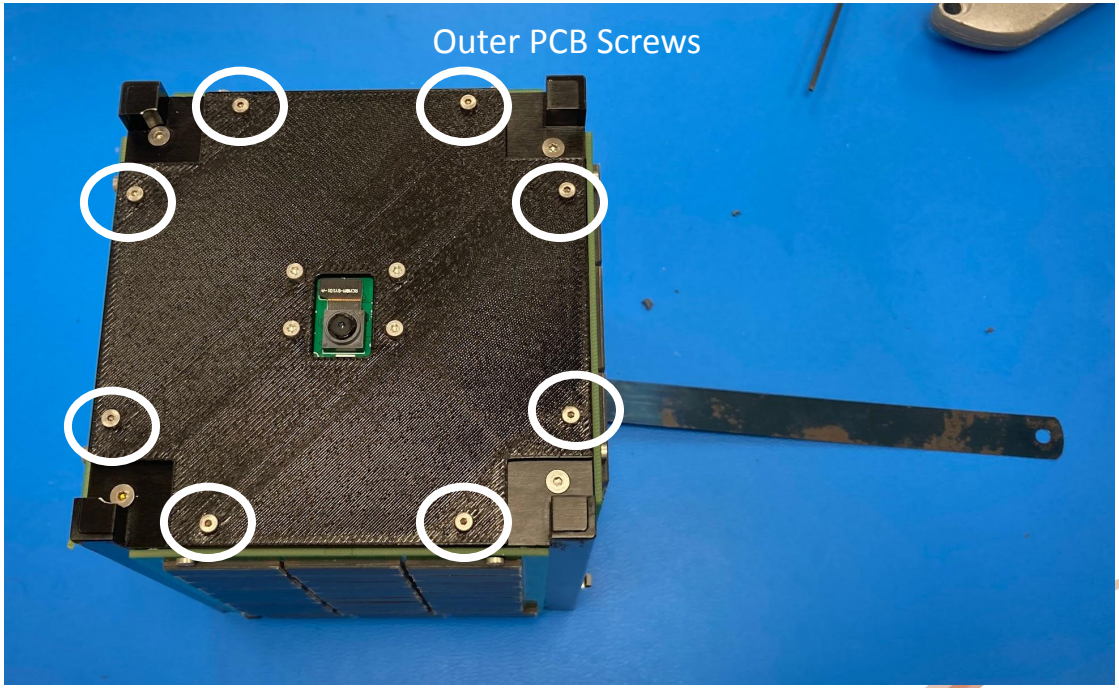


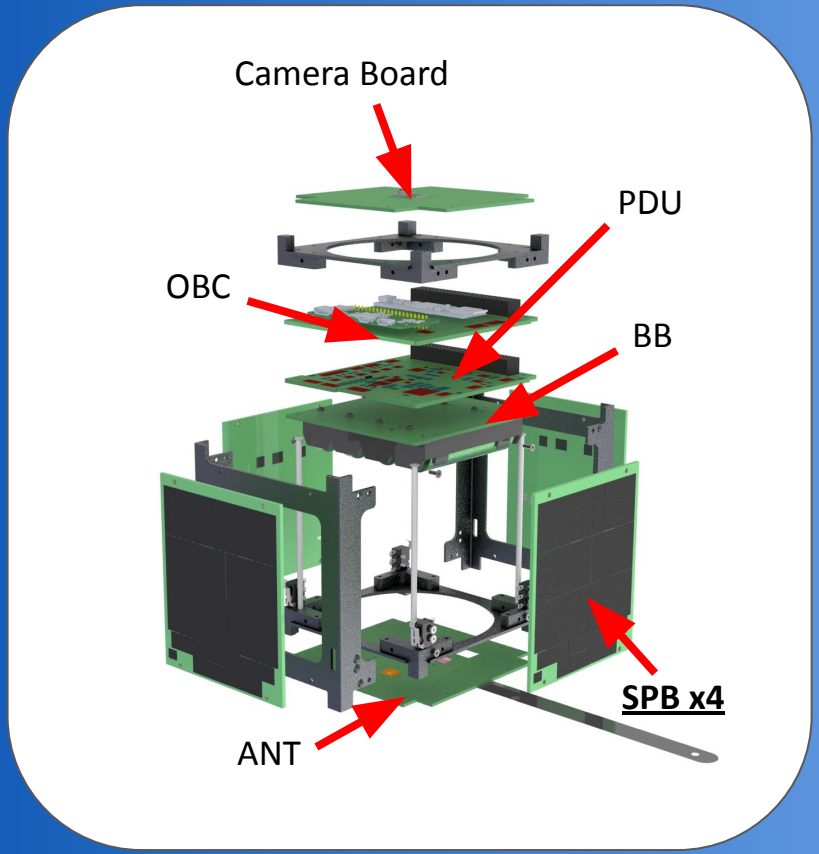




Attach Camera Board to Structure

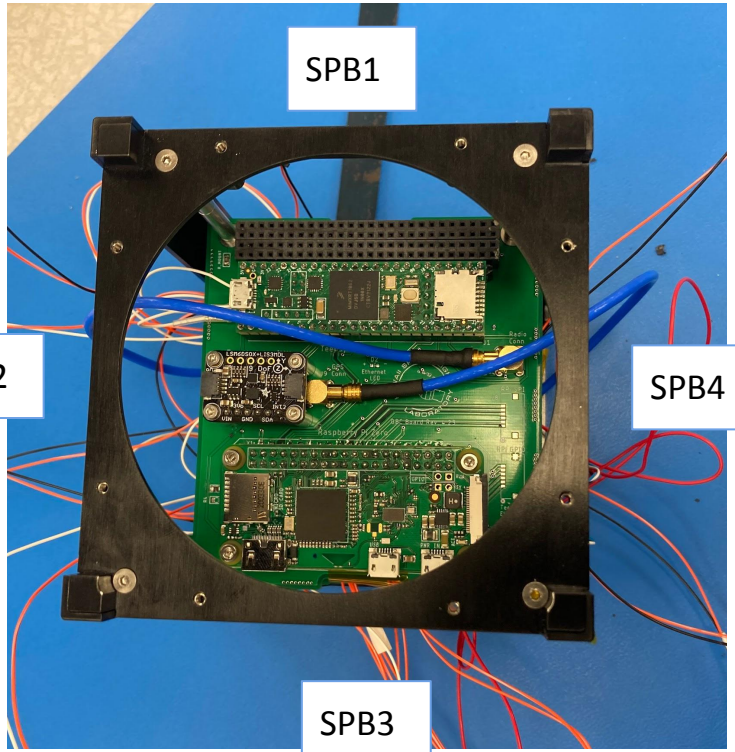
Using Tool B and 8 Outer PCB Screws [N], secure the camera board onto the structure (in white).

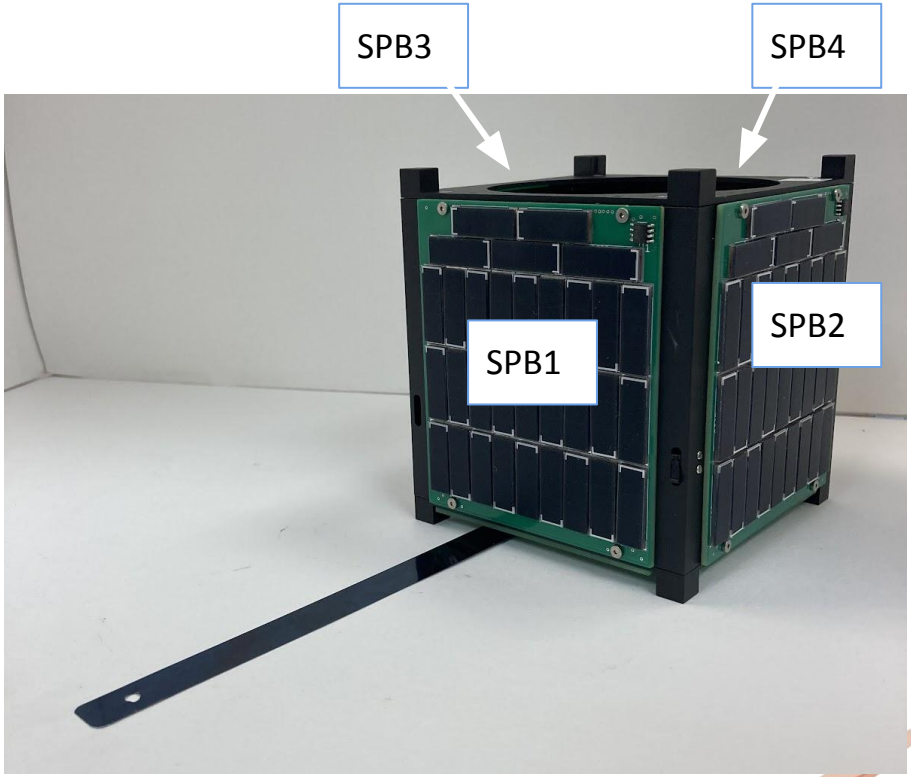




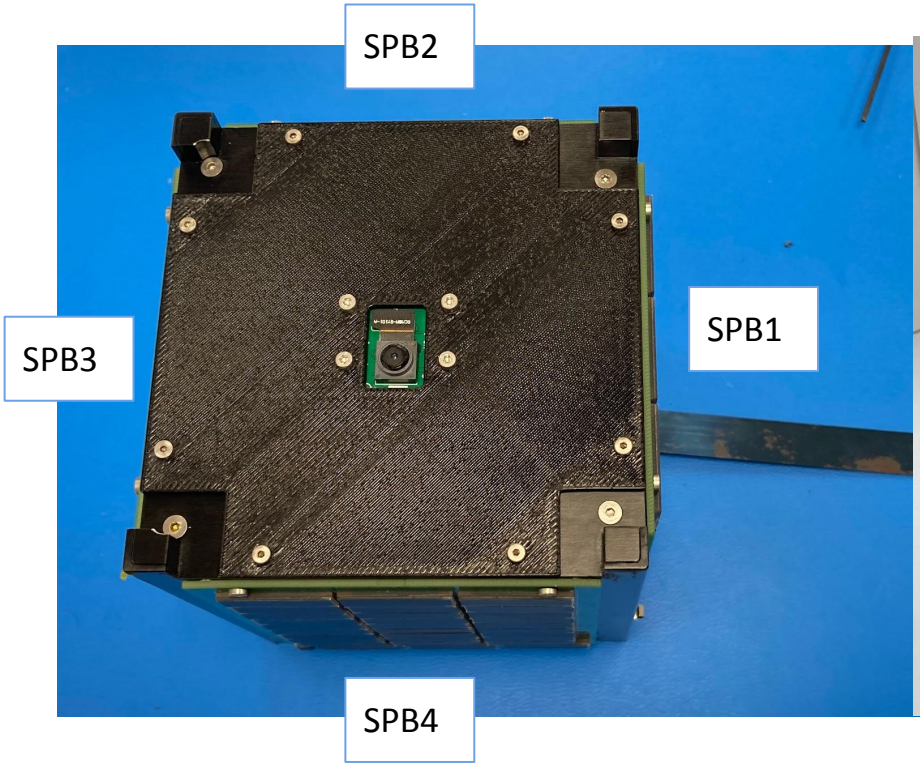
Solar Panel Board Assembly

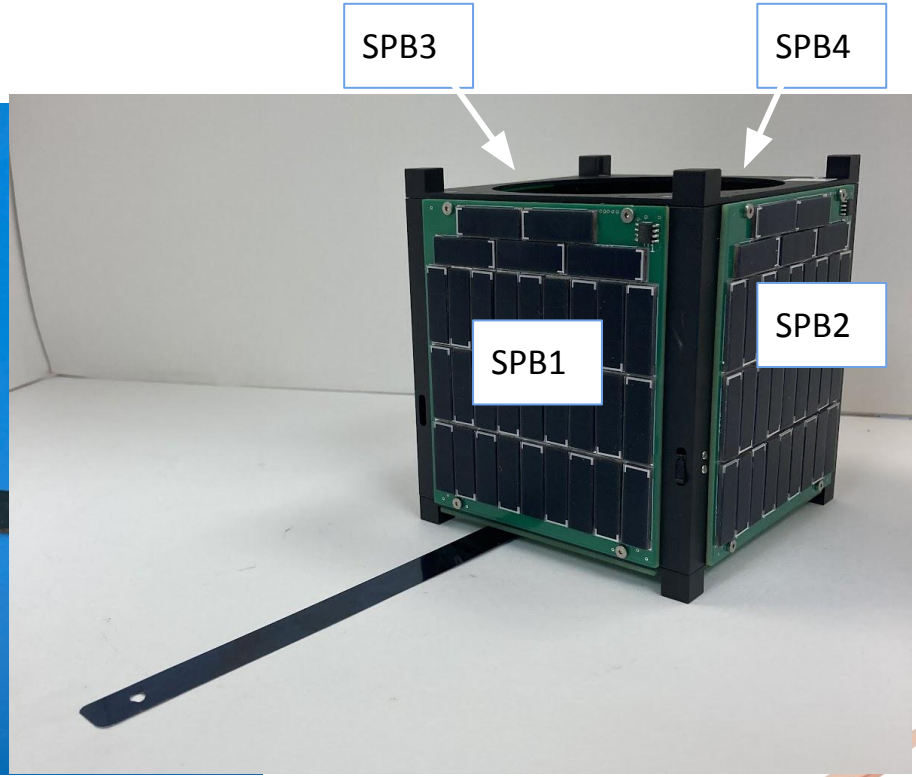
Solar Panel Board Placement





Solar Panel Board Placement





Solar Panel Boards Wires #1-4 (Summary)

- Torque Coils
  - SP1 & SP2 J1 to PDU J8
    (Two 2-Pin to 4-Pin)
- Solar Power
  - SPB1 J2 to PDU J1
  - SPB2 J2 to PDU J2
    (Both are 4-Pin to 2-Pin)
- Temperature Sensor
  - SPB1 J3 to PDU J22
  - SPB2 J3 to PDU J23
    (Both are 2-Pin to 2-Pin)

- Torque Coils
  - SP3 & SP4 J1 to PDU J7
    (Two 2-Pin to 4-Pin)
- Solar Power
  - SPB3 J2 to PDU J4
  - SPB4 J2 to PDU J5
    (Both are 4-Pin to 2-Pin)
- Temperature Sensor
  - SPB3 J3 to PDU J24
  - SPB4 J3 to PDU J25
    (Both are 2-Pin to 2-Pin)

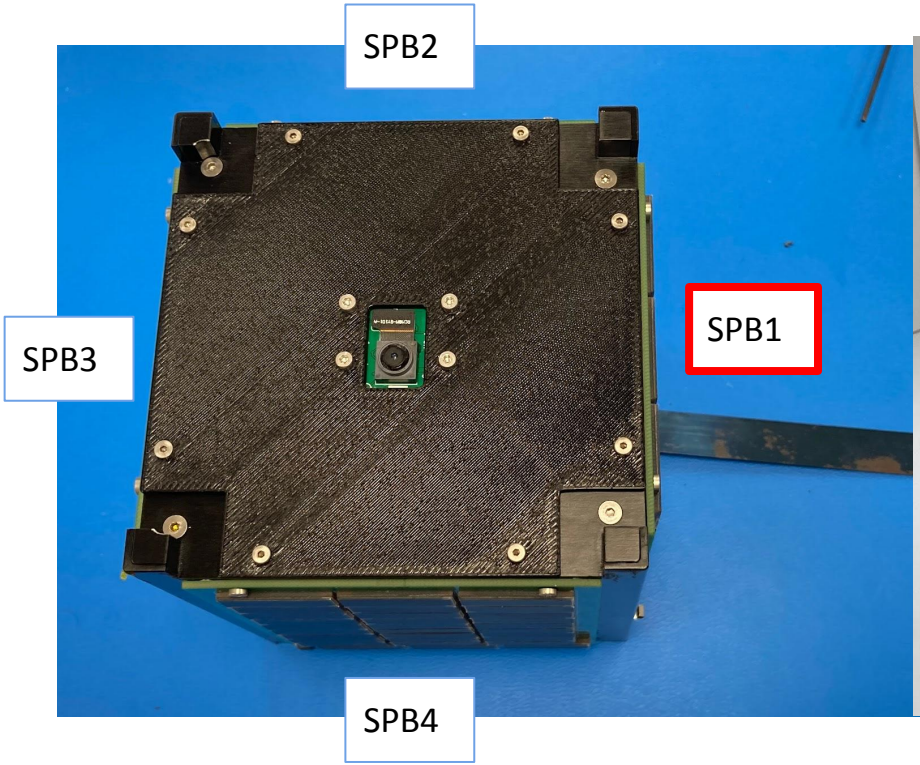
Antenna Board (ANT)
Battery Board (BB)
Power Distribution Board (PDU)
On-Board Computer (OBC)
Solar Panel Board (SPB)
Source: Wire Harness Guide
Bolded – Current Focus of Tutorial
* = Not necessary for Kit Operation

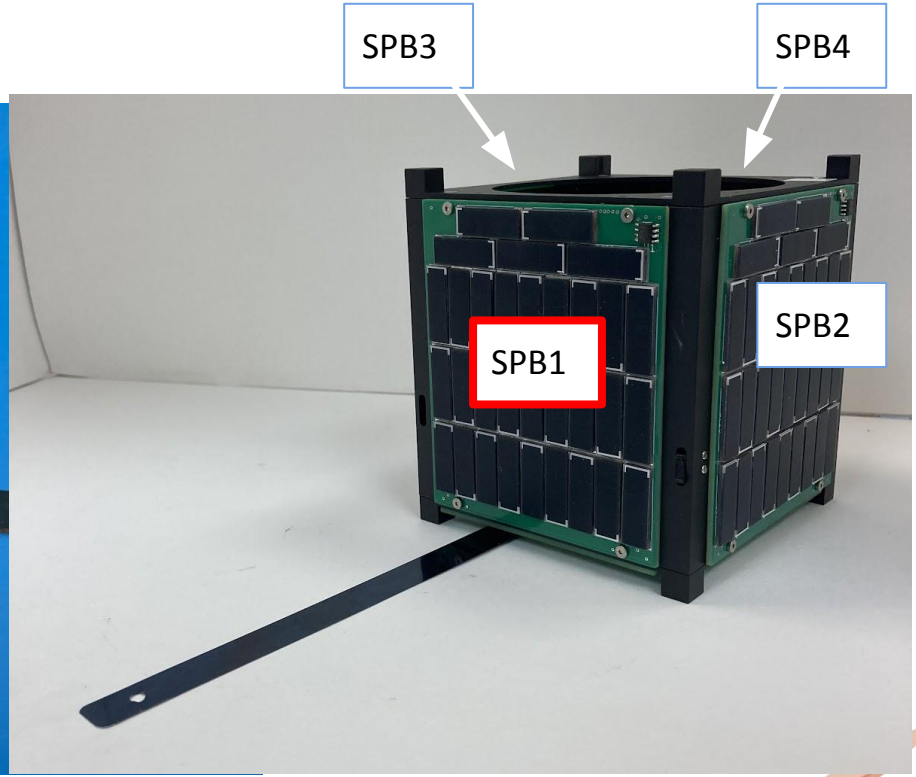
Attach Wires to Solar Panel Board 1 (Summary)

- SPB1 J1 (Bottom Side) to PDU J8 (Bottom Side)
  - Torque Coils – Find the wire already inserted onto the PDU, and connect other end to SPB1
- SPB1 J2 (Bottom Side) to PDU J1 (Top Side)
  - SPB1 Solar Input – Find the wire already inserted onto the PDU, and connect other end to SPB1
- SPB1 J3 (Bottom Side) to PDU J22 (Top Side)
  - SPB1 Temperature Sensor – Find the wire already inserted onto the PDU, and connect other end to SPB1
- See next slides for more details

Antenna Board (ANT)
Battery Board (BB)
Power Distribution Board (PDU)
On-Board Computer (OBC)
Solar Panel Board (SPB)

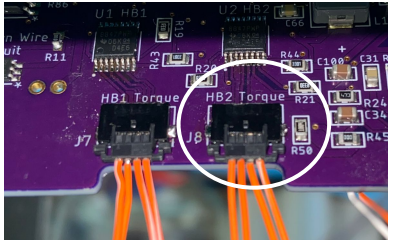
Solar Panel Board 1 Placement

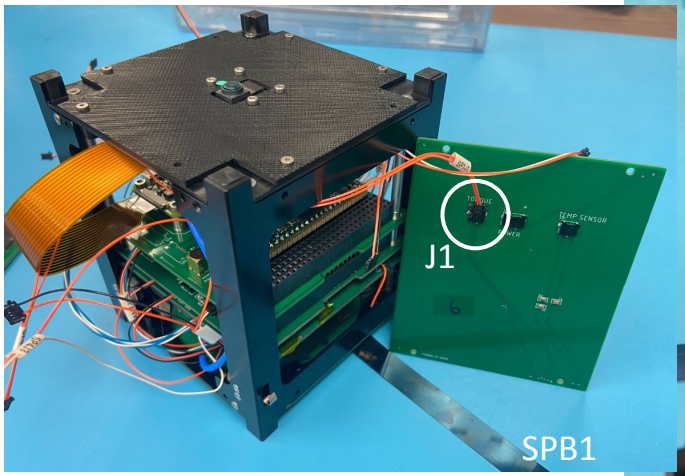


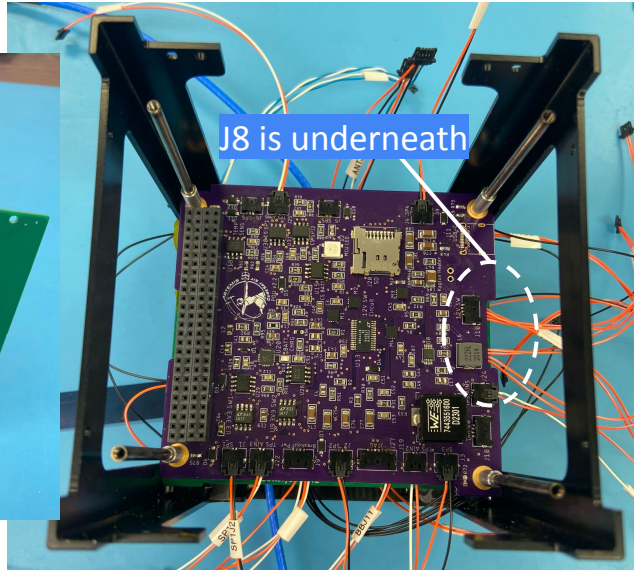


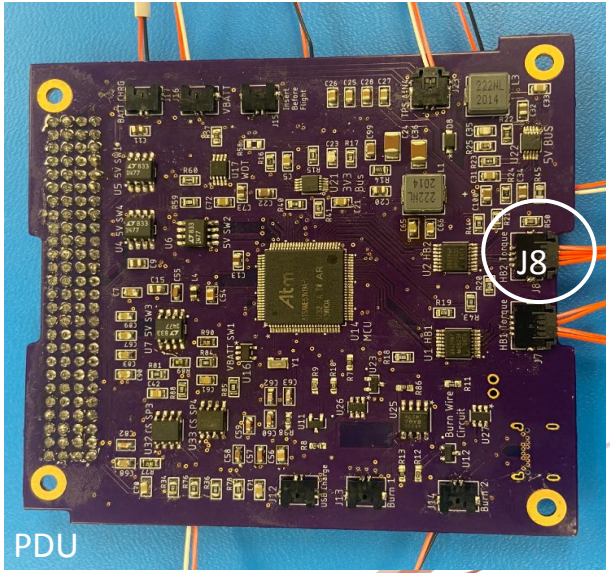
Attach Wire SPB1 (Bottom Side) to PDU (Bottom Side)

- SPB1 J1 to PDU J8 (Wire Label: SPB1 J1)
  - Torque Coils – Find the wire already inserted onto the PDU, and connect other end to SPB1



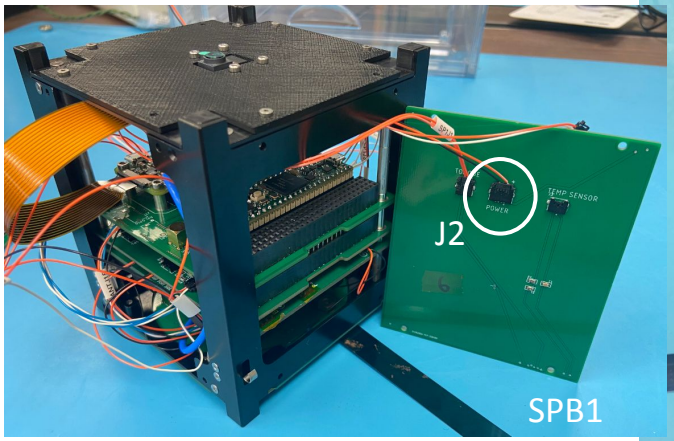


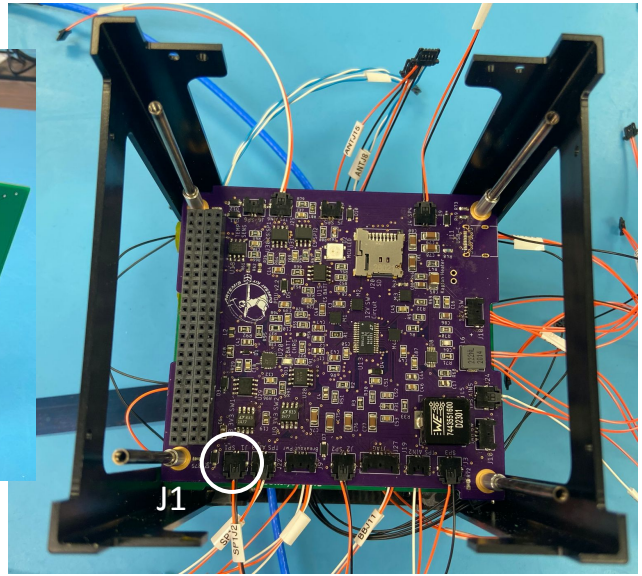


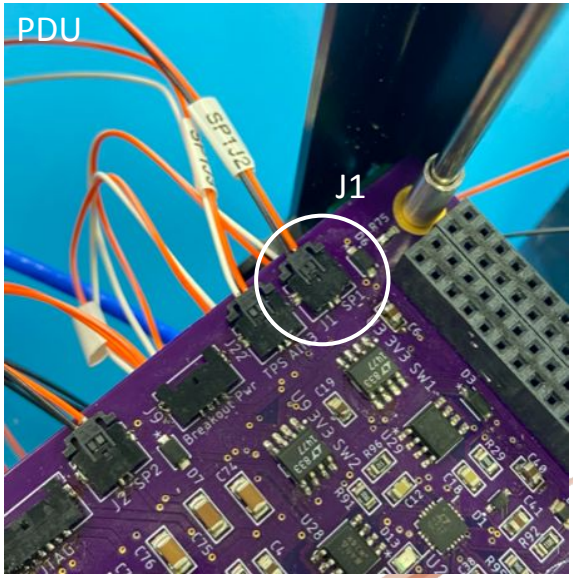


Attach Wire SPB1 (Bottom Side) to PDU (Top Side)

- SPB1 J2 to PDU J1 (Wire Label: SP1 J2)
  - SPB1 Solar Input – Find the wire already inserted onto the PDU, and connect other end to SPB1

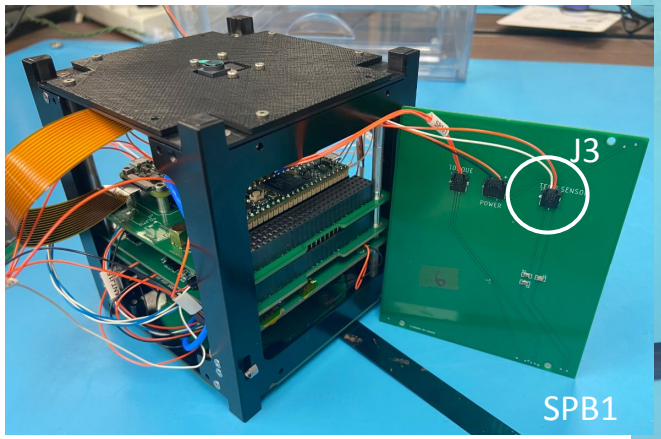


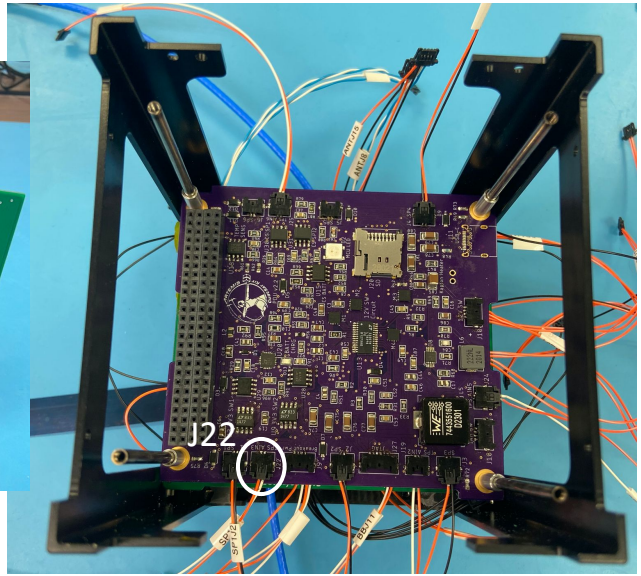


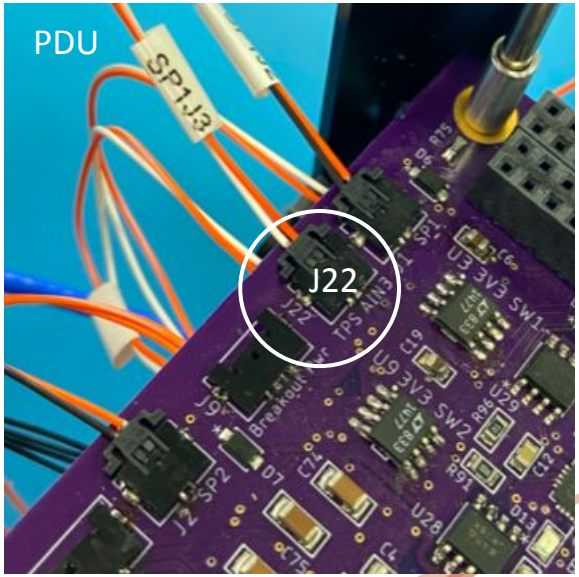


Attach Wire SPB1 (Bottom Side) to PDU (Top Side)

- SPB1 J3 to PDU J22 (Wire Label: SPB1 J3)
  - SPB1 Temperature Sensor – Find the wire already inserted onto the PDU, and connect other end to SPB1

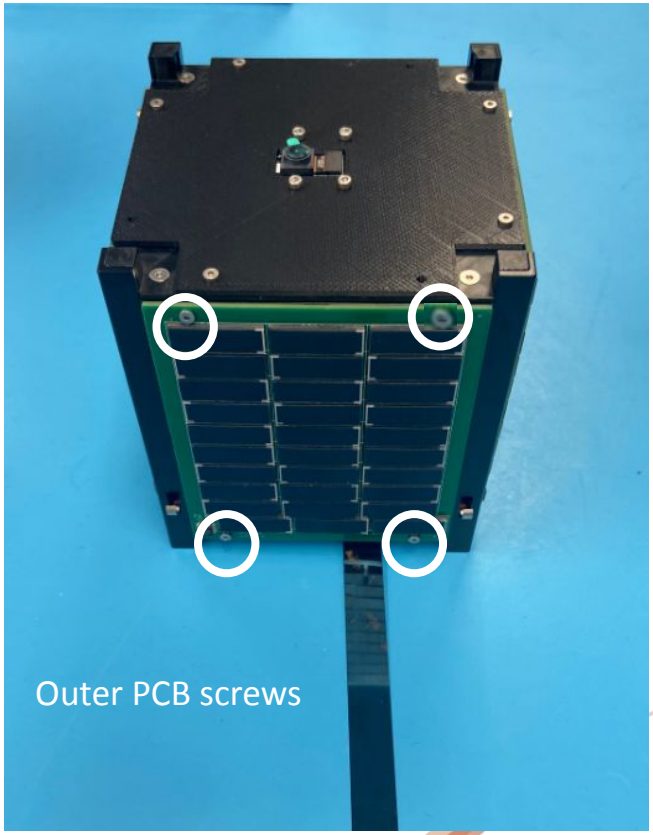






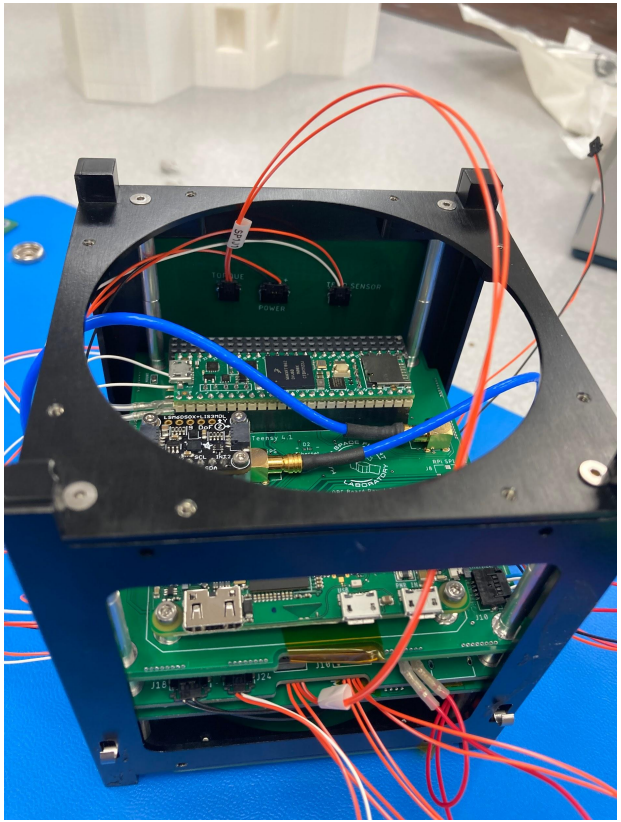
Attach Solar Panel Board 1 to Structure

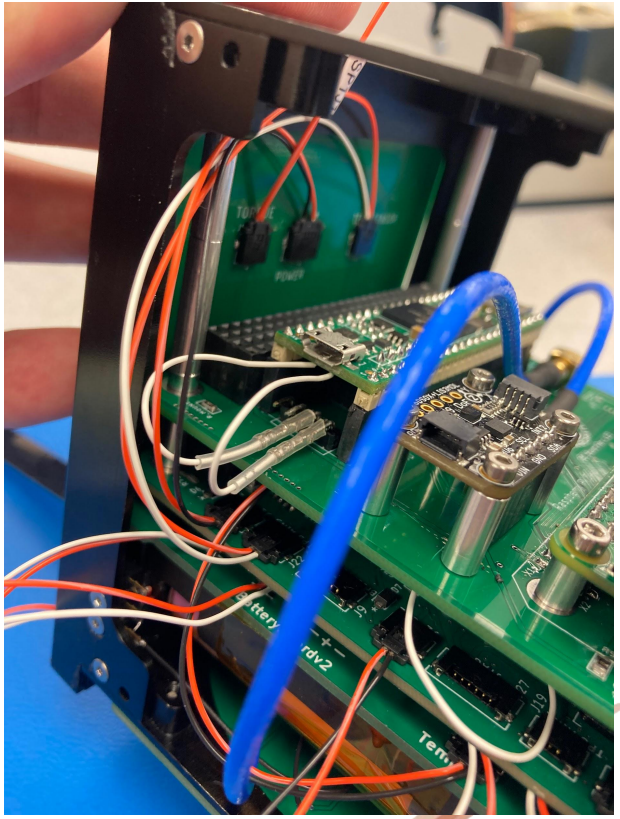
Using Tool B and 4 Outer PCB Screws [N], secure the solar panel board 1 (SPB1) onto the structure.



Completed Construction of SPB1

Nice! You just attached the SPB1 onto the CubeSat. Three more to go…



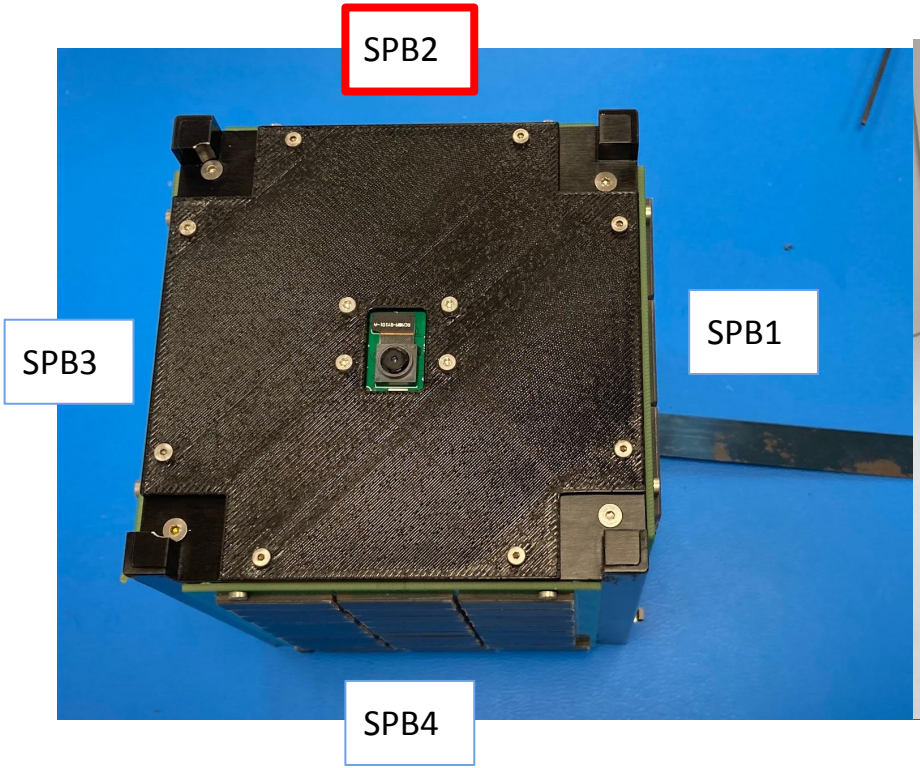


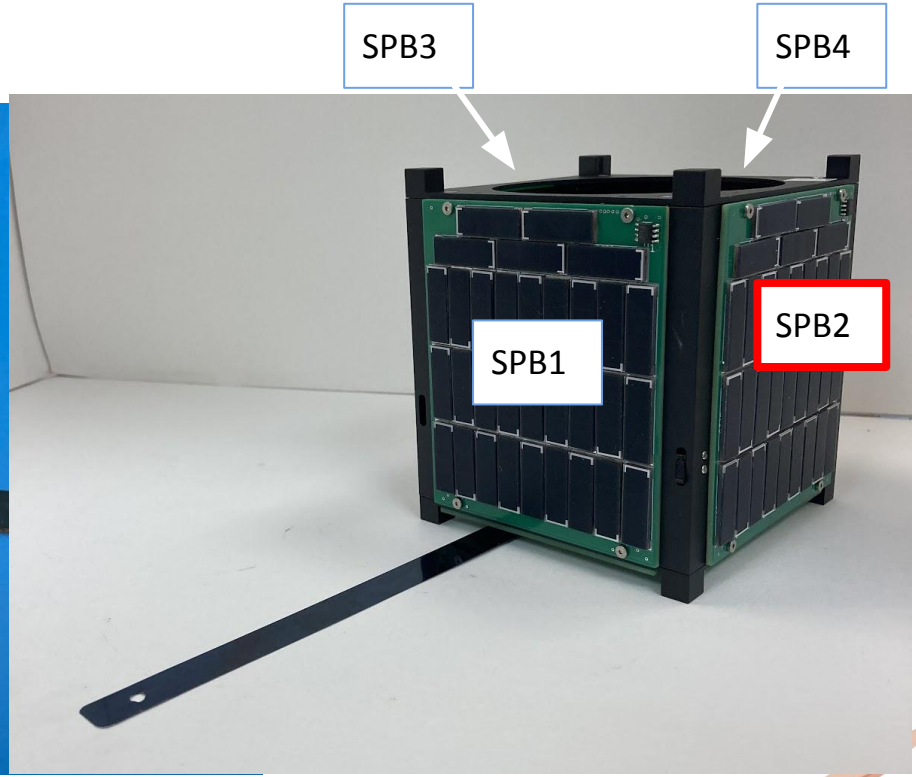
Attach Wires to Solar Panel Board 2 (Summary)

- SPB2 J1 to PDU J8
  - Torque Coils – Find the wire already inserted onto the PDU, and connect other end to SPB2
- SPB2 J2 to PDU J2
  - SPB2 Solar Input – Find the wire already inserted onto the PDU, and connect other end to SPB2
- SPB2 J3 to PDU J23
  - SPB2 Temperature Sensor – Find the wire already inserted onto the PDU, and connect other end to SPB2
- See next slides for more details

Antenna Board (ANT)
Battery Board (BB)
Power Distribution Board (PDU)
On-Board Computer (OBC)
Solar Panel Board (SPB)

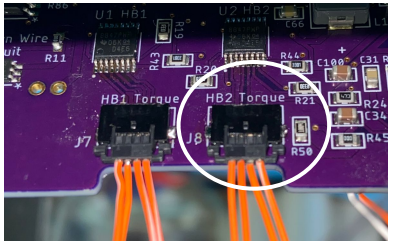
Solar Panel Board 2 Placement

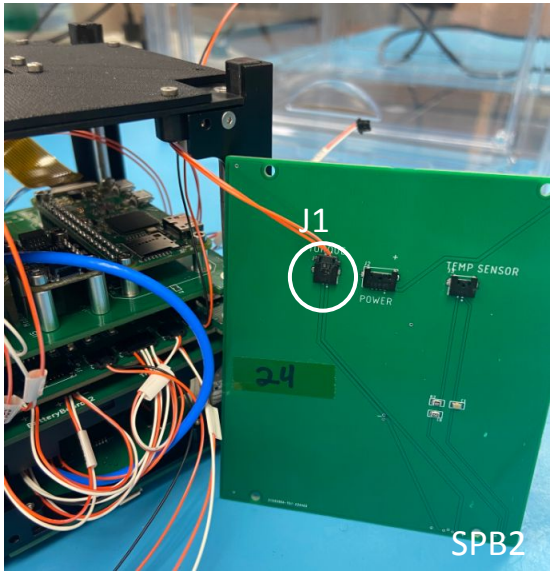


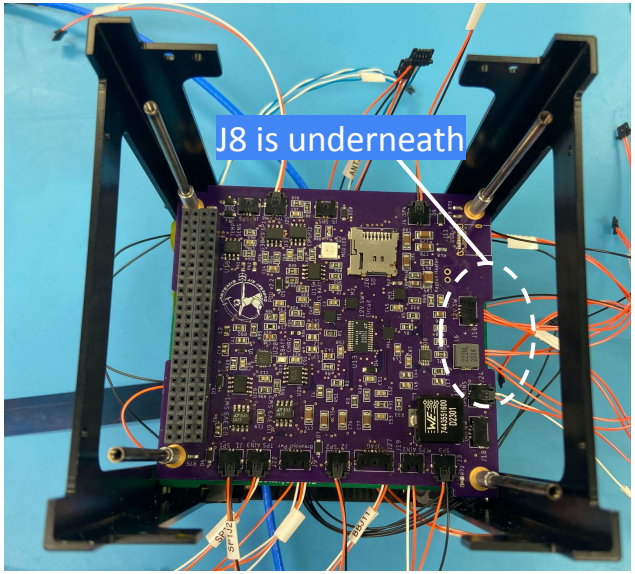


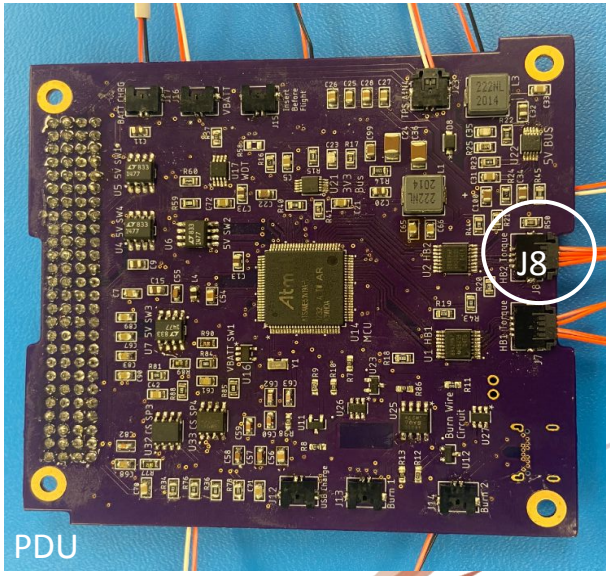
Attach Wire SPB2 (Bottom Side) to PDU (Bottom Side)

- SPB2 J1 to PDU J8 (Wire Label: SPB2 J1)
  - Torque Coils – Find the wire already inserted onto the PDU, and connect other end to SPB2



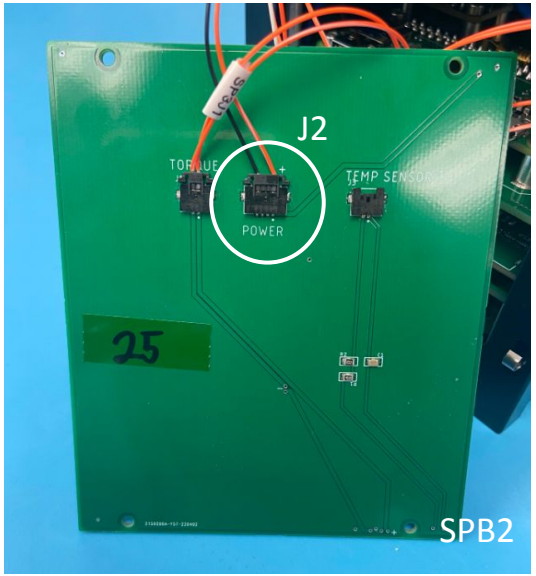


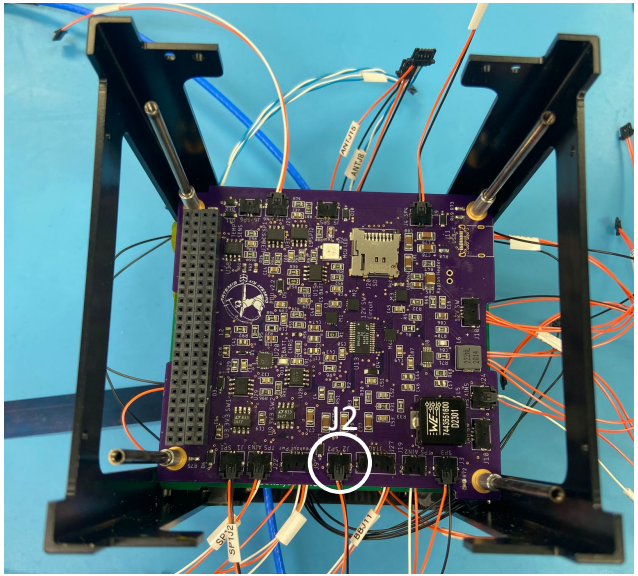


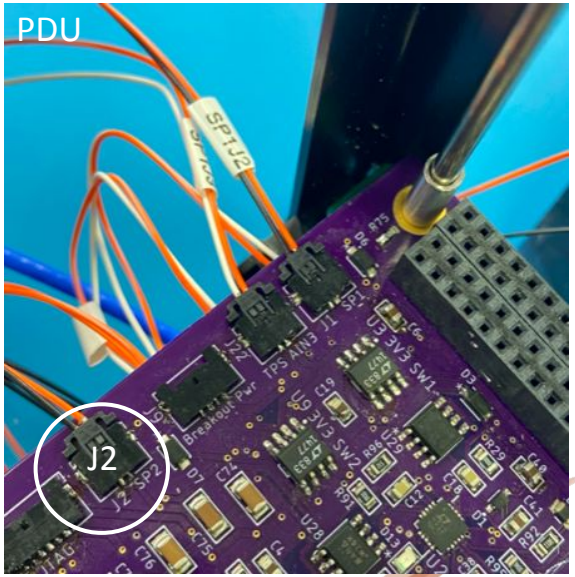


Attach Wire SPB2 (Bottom Side) to PDU (Top Side)

- SPB2 J2 to PDU J2 (Wire Label: SPB2 J2)
  - SPB2 Solar Input – Find the wire already inserted onto the PDU, and connect other end to SPB2

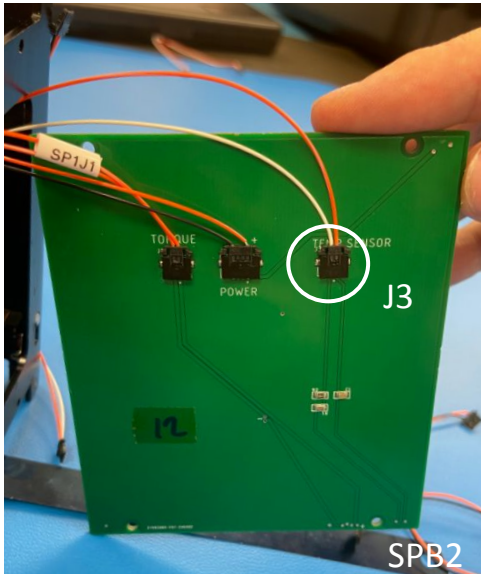


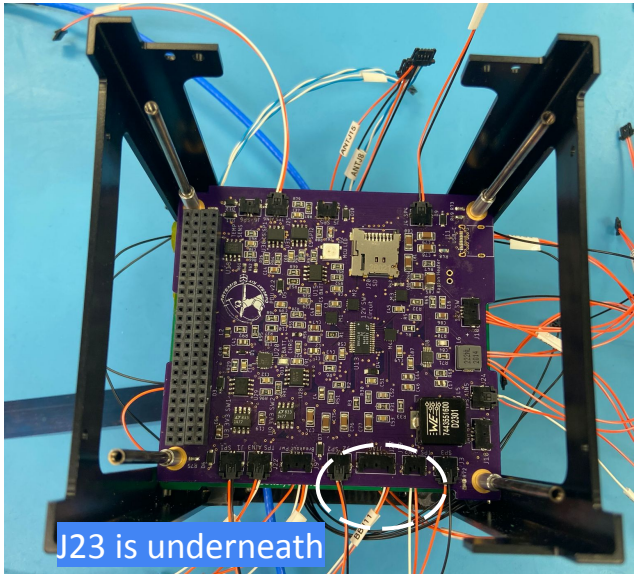


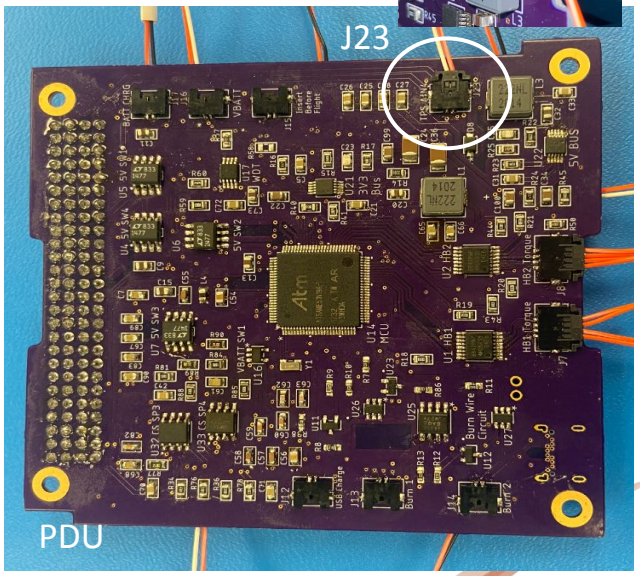


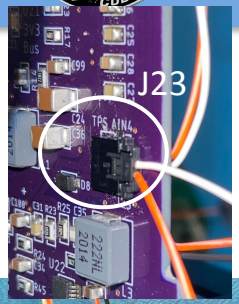
Attach Wire SPB2 (Bottom Side) to PDU (Bottom Side)

- SPB2 J3 to PDU J23 (Wire Label: SPB2 J3)
  - SPB2 Temperature Sensor – Find the wire already inserted onto the PDU, and connect other end to SPB2



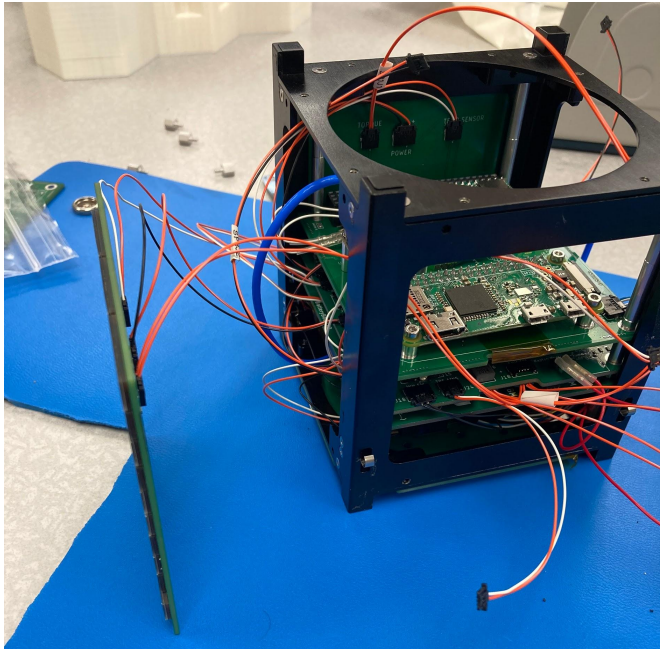


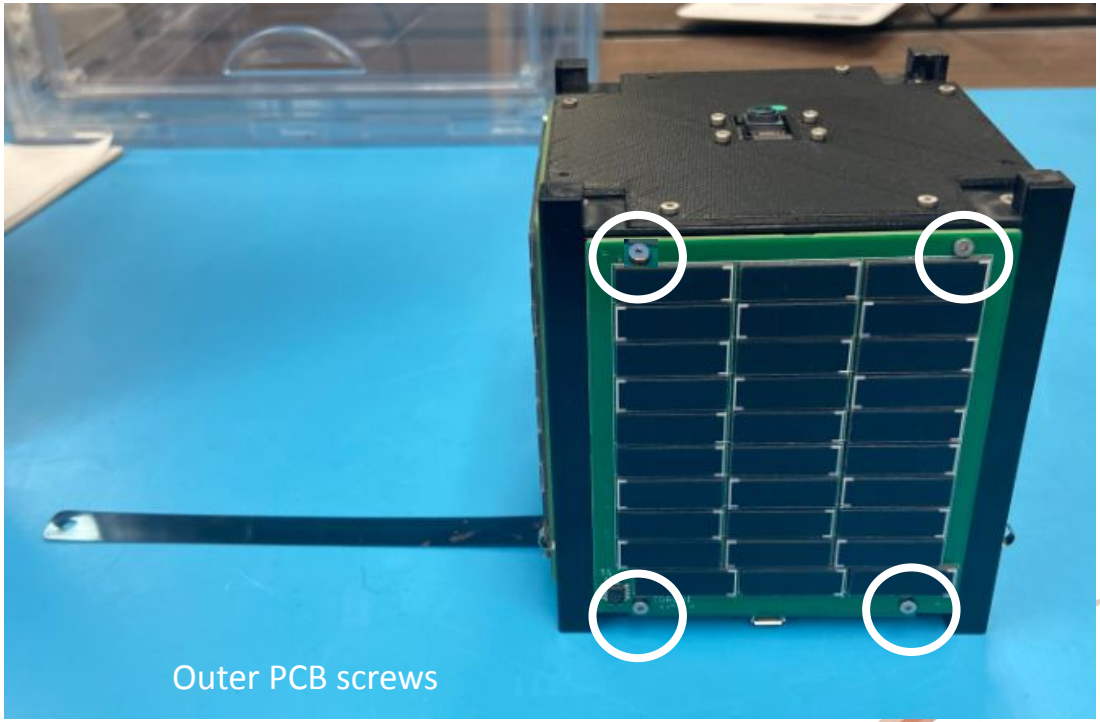




Attach Solar Panel Board 2 to Structure

Using Tool B and 4 Outer PCB Screws [N], secure the solar panel board 2 (SPB2) onto the structure.



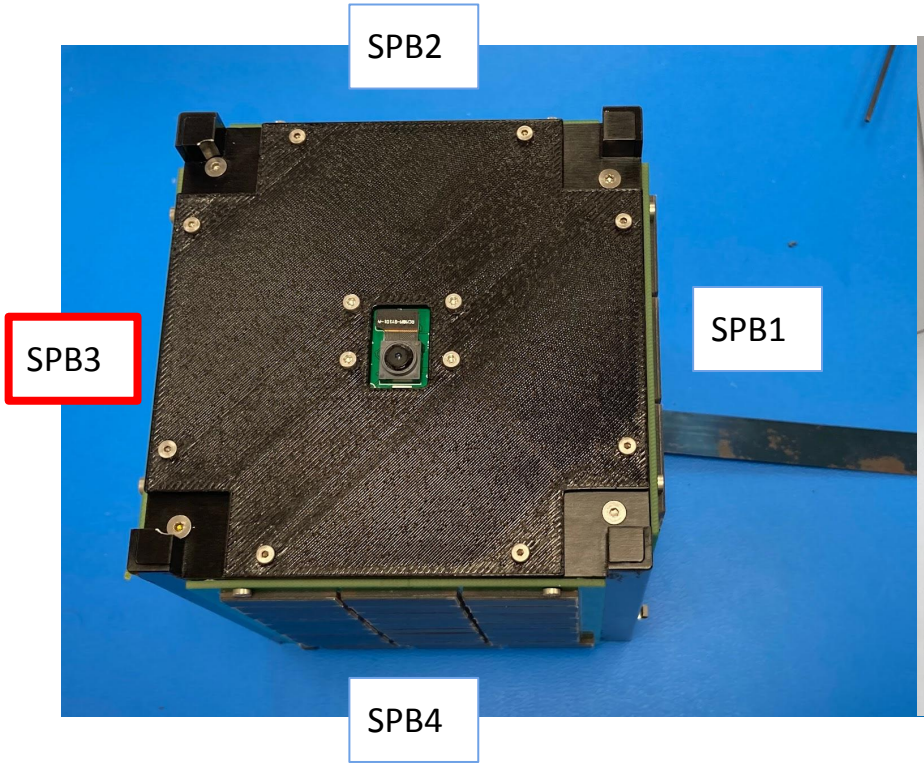


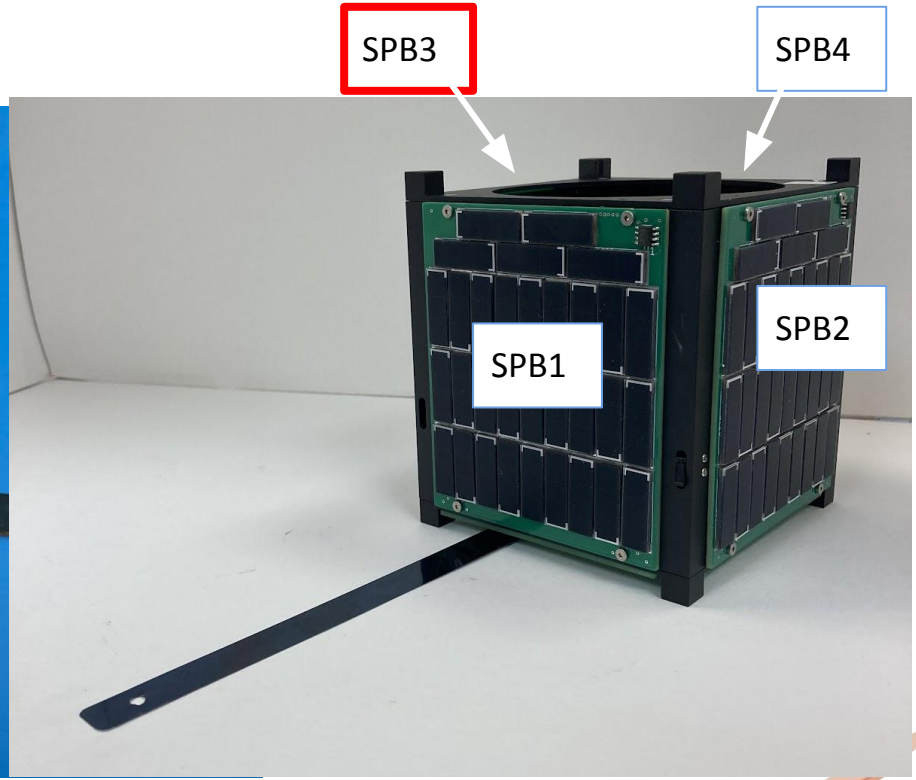
Attach Wires to Solar Panel Board 3 (Summary)

- SPB3 J1 to PDU J7
  - Torque Coils – Find the wire already inserted onto the PDU, and connect other end to SPB3
- SPB3 J2 to PDU J3
  - SPB3 Solar Input – Find the wire already inserted onto the PDU, and connect other end to SPB3
- SPB3 J3 to PDU J24
  - SPB3 Temperature Sensor – Find the wire already inserted onto the PDU, and connect other end to SPB3
- See next slides for more details

Antenna Board (ANT)
Battery Board (BB)
Power Distribution Board (PDU)
On-Board Computer (OBC)
Solar Panel Board (SPB)

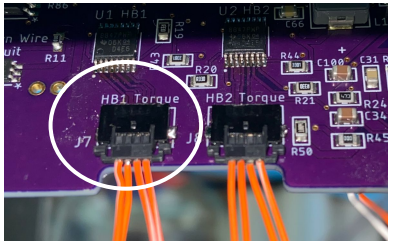
Solar Panel Board Placement

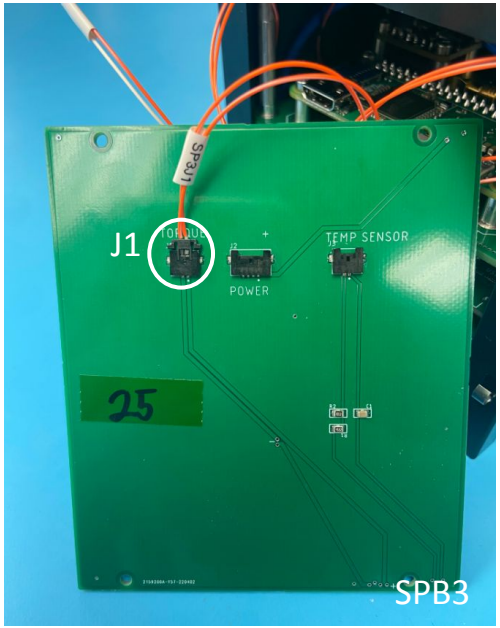


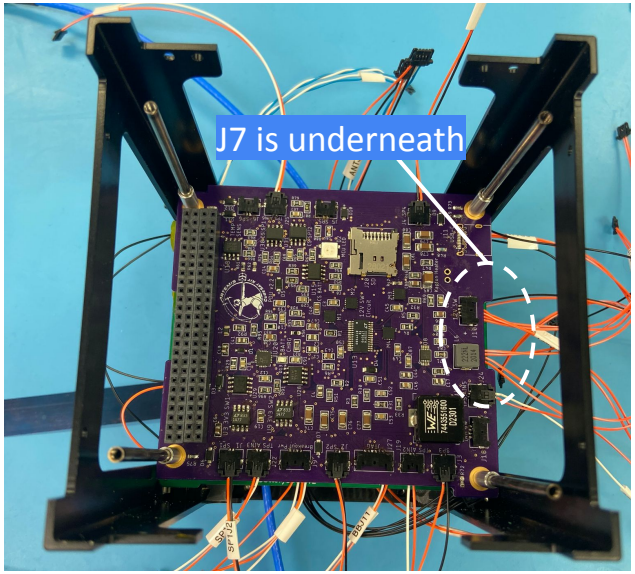


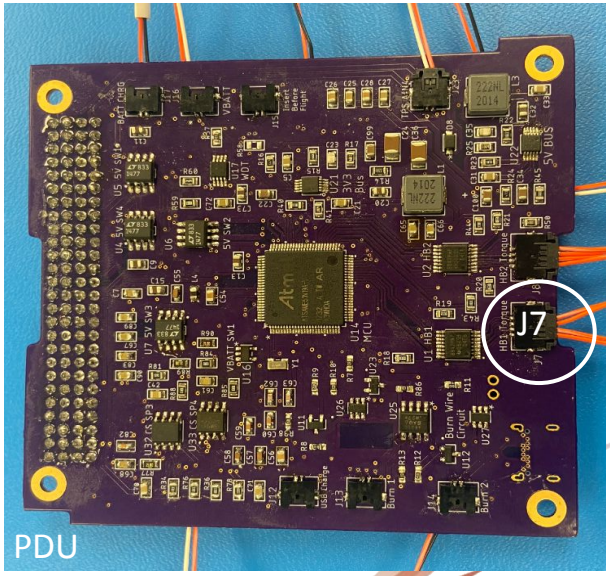
Attach Wire SPB3 (Bottom Side) to PDU (Bottom Side)

- SPB3 J1 to PDU J7 (Wire Label: SPB3 J1)
  - Torque Coils – Find the wire already inserted onto the PDU, and connect other end to SPB3



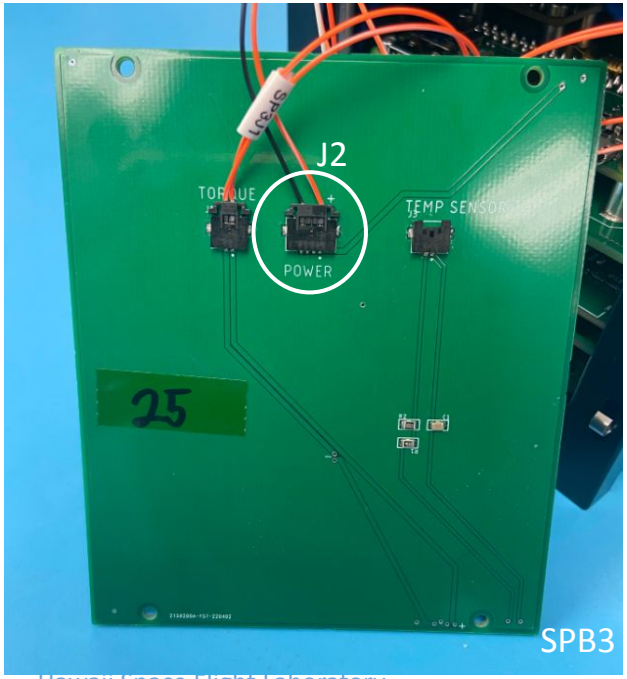


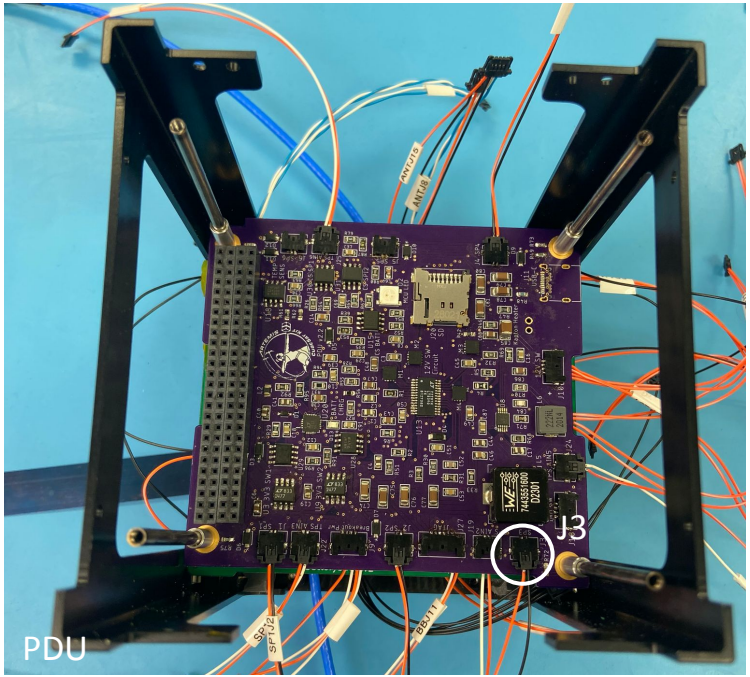


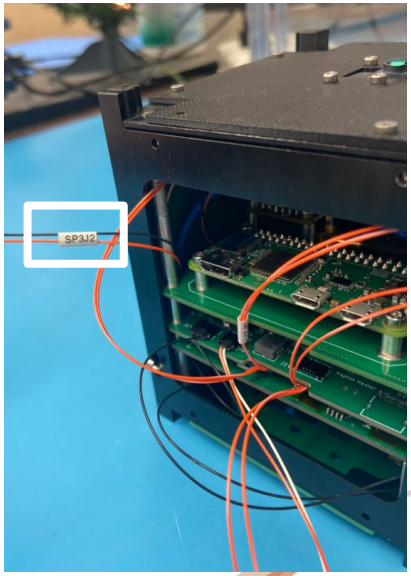


Attach Wire SPB3 (Bottom Side) to PDU (Top Side)

- SPB3 J2 to PDU J3 (Wire Label: SPB3 J2)
  - SPB3 Solar Input – Find the wire already inserted onto the PDU, and connect other end to SPB3

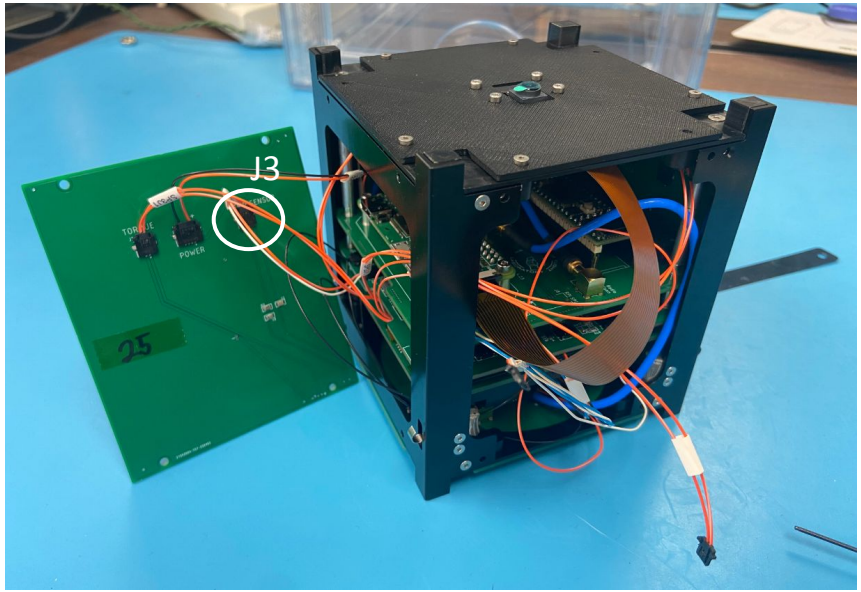


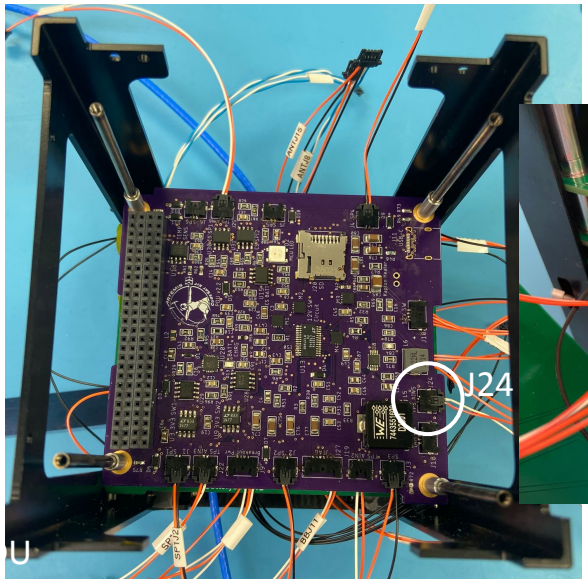


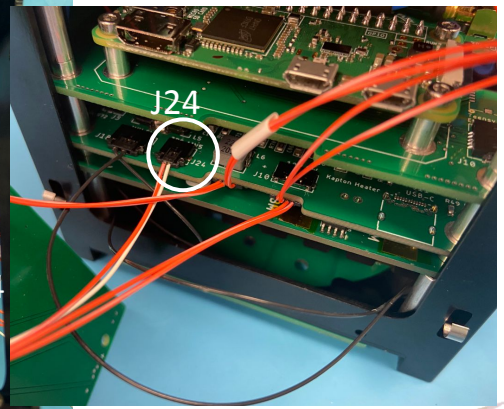


Attach Wire SPB3 (Bottom Side) to PDU (Top Side)

- SPB3 J3 to PDU J24 (Wire Label: SPB3 J3)
  - SPB3 Temperature Sensor – Find the wire already inserted onto the PDU, and connect other end to SPB3

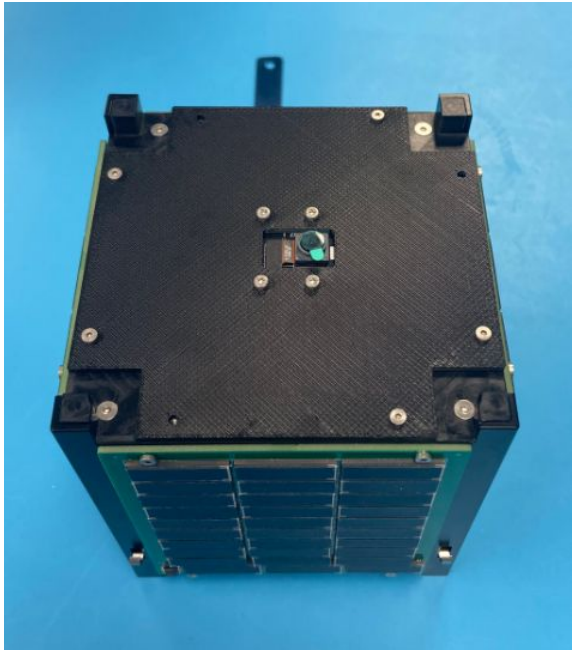


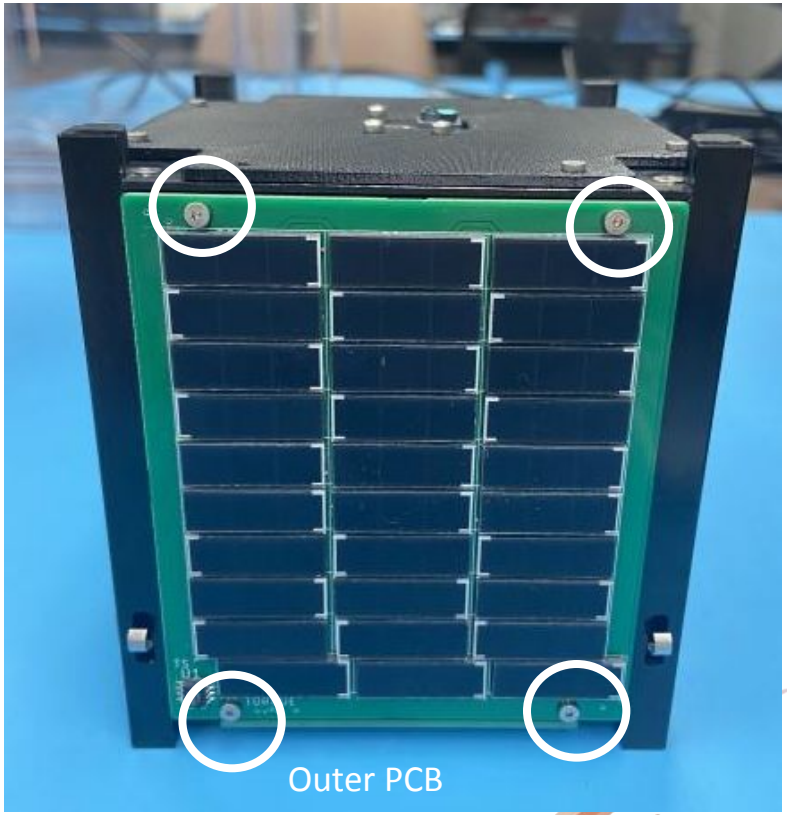




Attach Solar Panel Board 3 to Structure

Using Tool B and 4 Outer PCB Screws [N], secure the solar panel board 3 (SPB3) onto the structure.



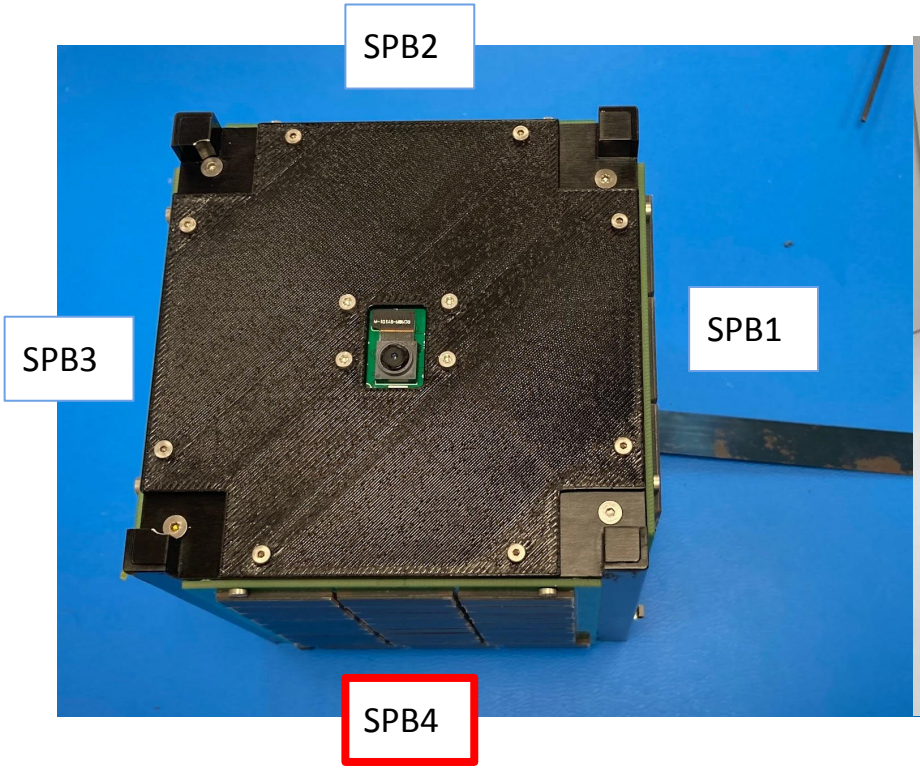


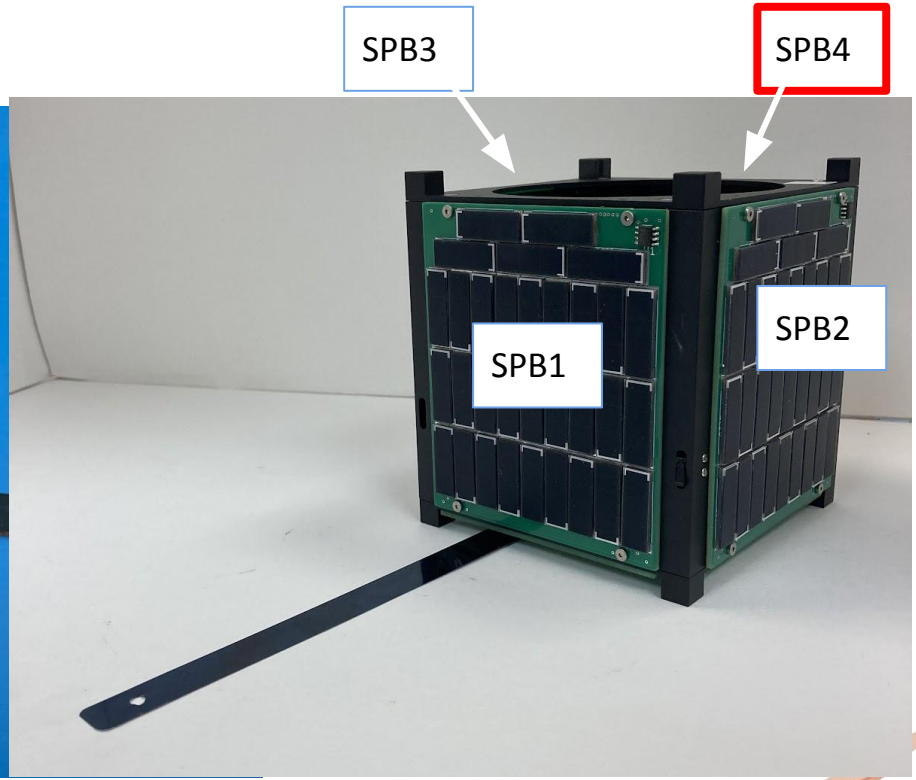
Attach Wires to Solar Panel Board 4 (Summary)

- SPB4 J1 to PDU J7
  - Torque Coils – Find the wire already inserted onto the PDU, and connect other end to SPB4
- SPB4 J2 to PDU J4
  - SPB4 Solar Input – Find the wire already inserted onto the PDU, and connect other end to SPB4
- SPB4 J3 to PDU J25
  - SPB4 Temperature Sensor – Find the wire already inserted onto the PDU, and connect other end to SPB4

Antenna Board (ANT)
Battery Board (BB)
Power Distribution Board (PDU)
On-Board Computer (OBC)
Solar Panel Board (SPB)

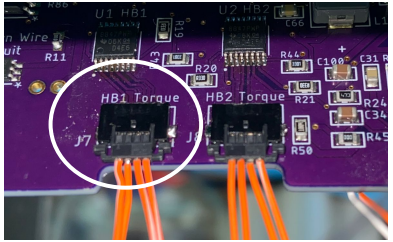
Solar Panel Board Placement

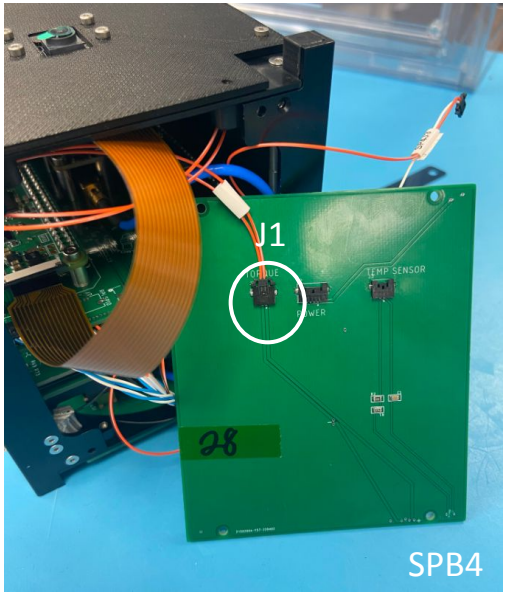


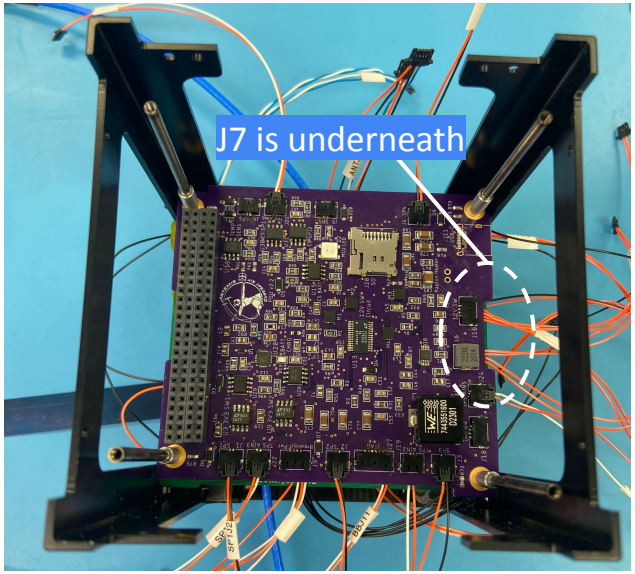


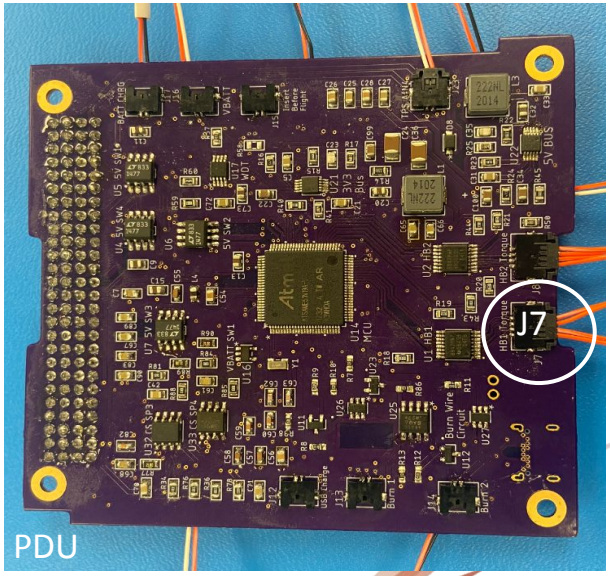
Attach Wire SPB4 (Bottom Side) to PDU (Bottom Side)

- SPB4 J1 to PDU J7 (Wire Label: SPB4 J1)
  - Torque Coils – Find the wire already inserted onto the PDU, and connect other end to SPB4



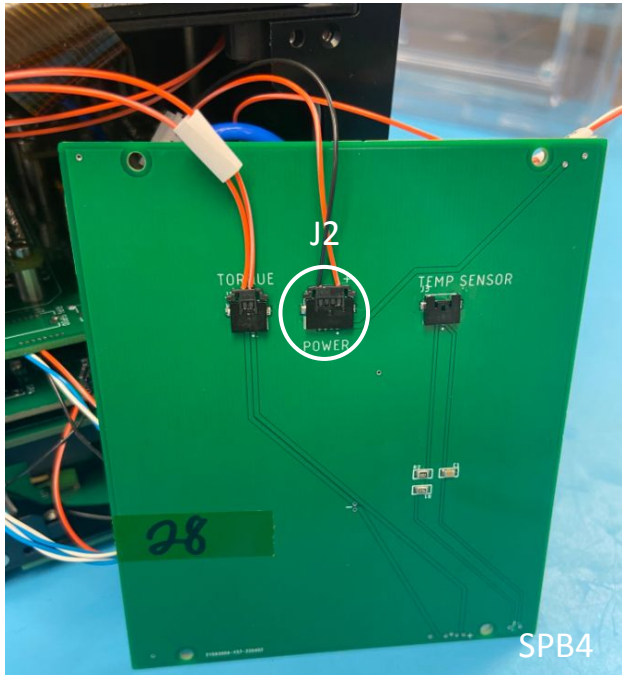


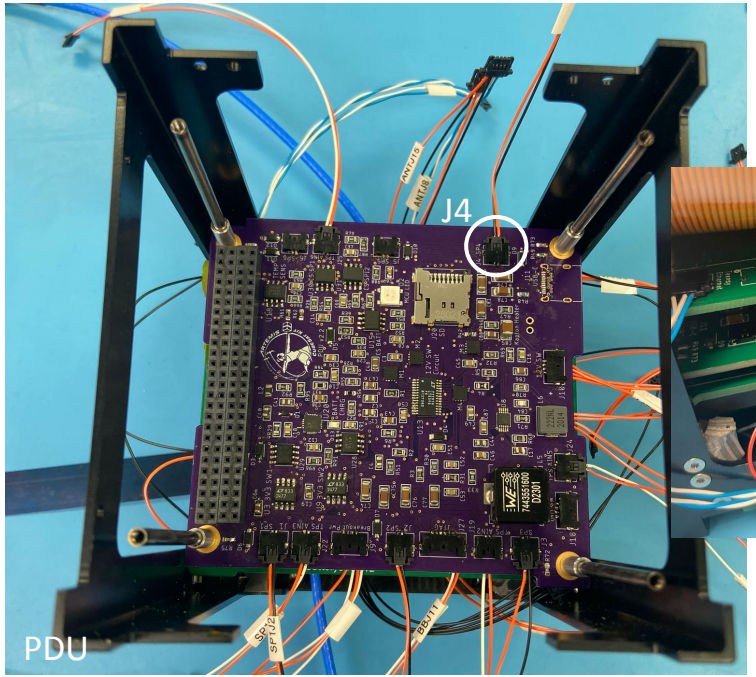


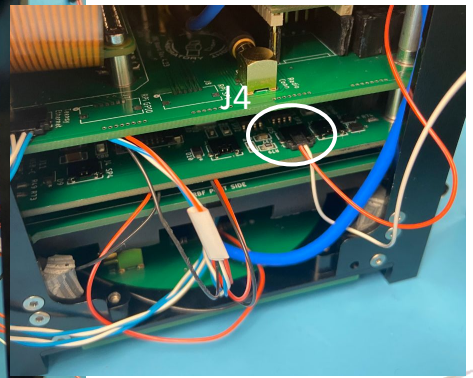


Attach Wire SPB4 (Bottom Side) to PDU (Top Side)

- SPB4 J2 to PDU J4 (Wire Label: SPB4 J2)
  - SPB4 Solar Input – Find the wire already inserted onto the PDU, and connect other end to SPB4

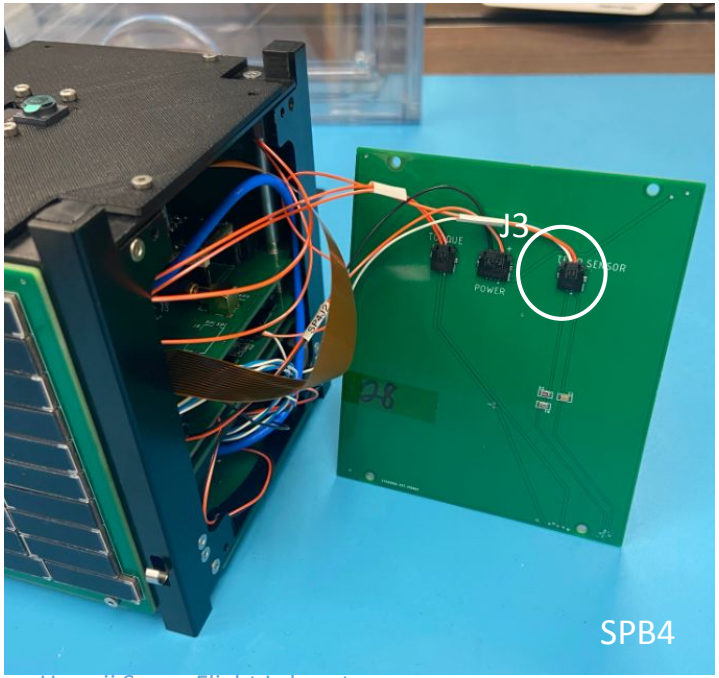


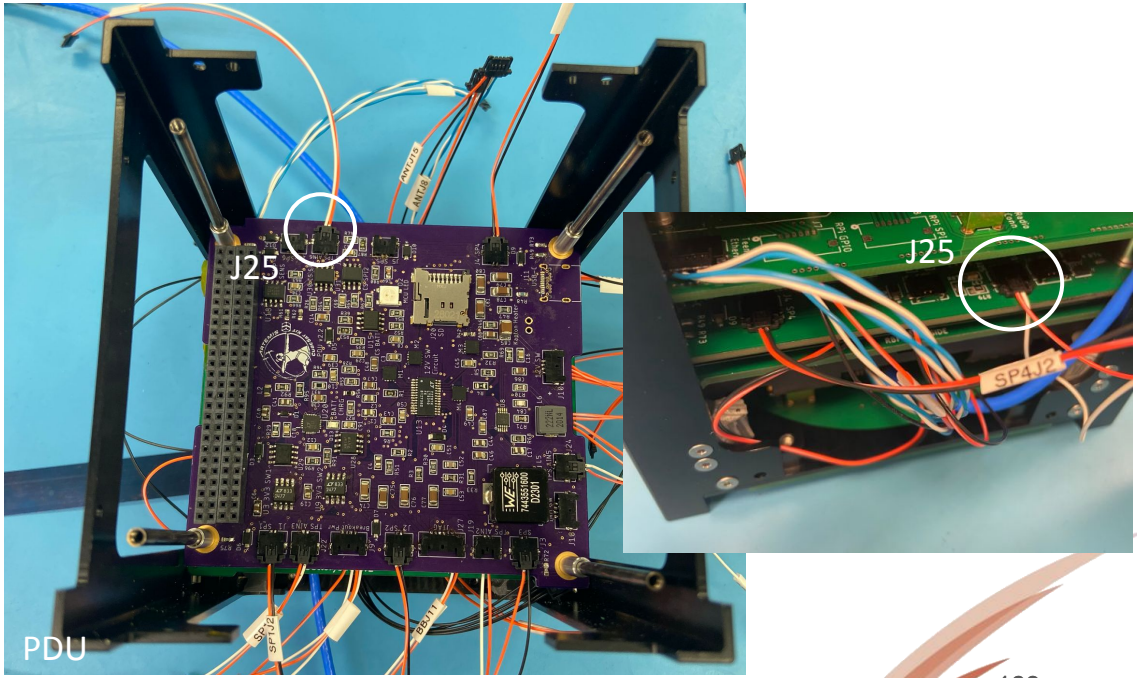




Attach Wire SPB4 (Bottom Side) to PDU (Top Side)

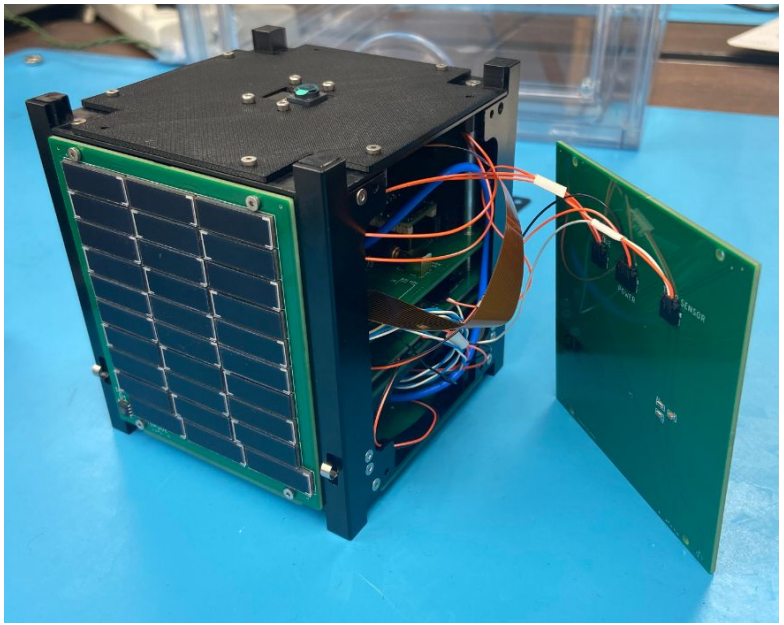
- SPB4 J3 to PDU J25 (Wire Label: SPB4 J3)
  - SPB4 Temperature Sensor – Find the wire already inserted onto the PDU, and connect other end to SPB4





Attach Solar Panel Board 4 to Structure

Using Tool B and 4 Outer PCB Screws [N], secure the solar panel board 4 (SPB4) onto the structure.



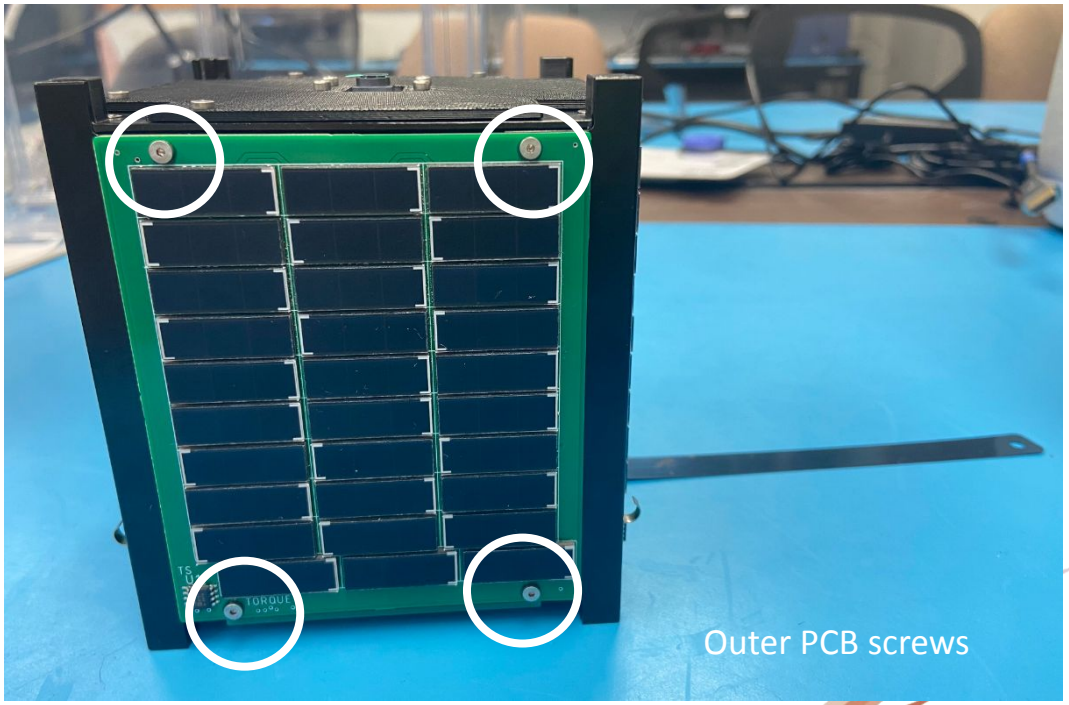
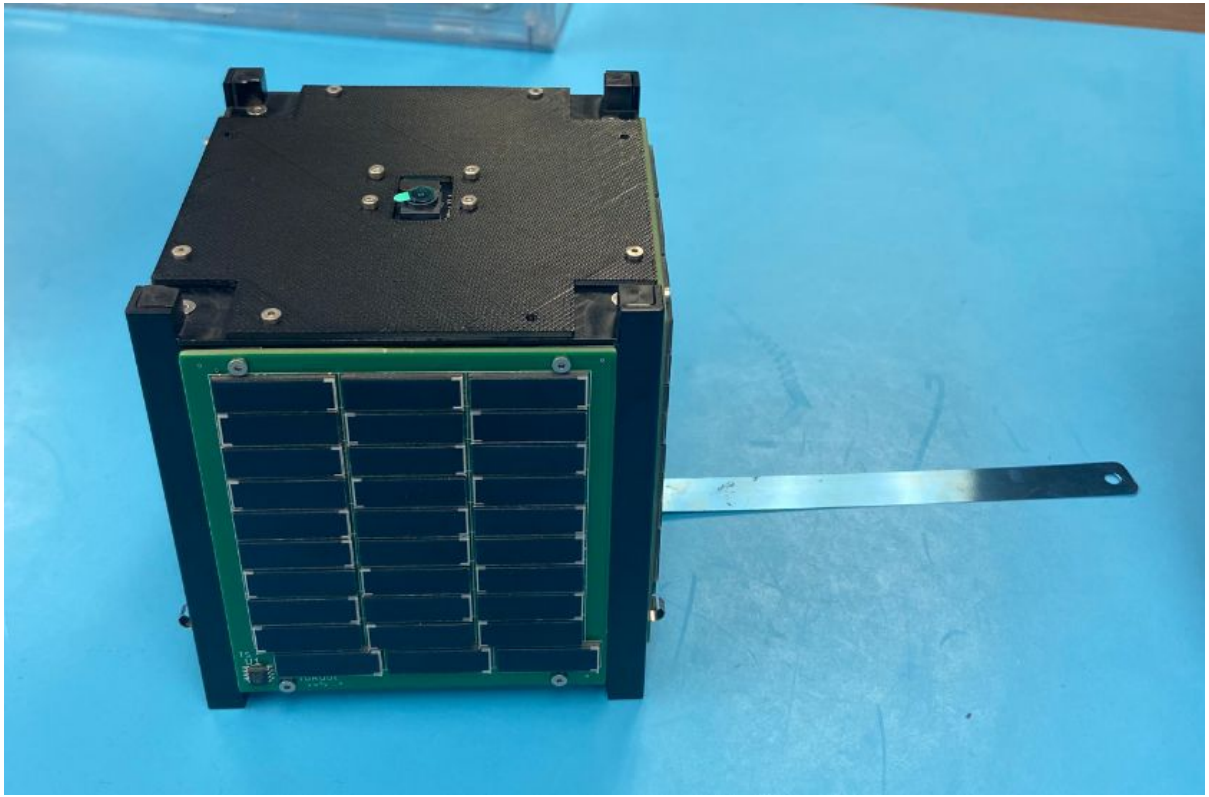
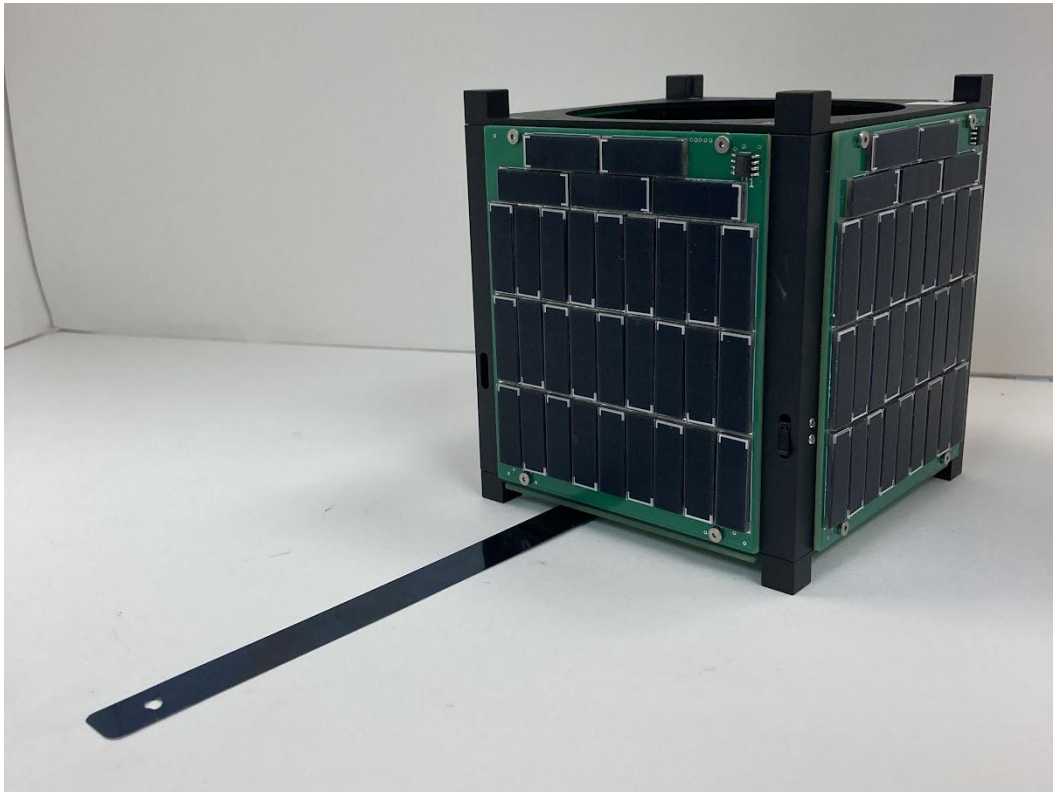


Figure of Attached Solar Panel Board 4 to Structure



Kit Assembly Complete!



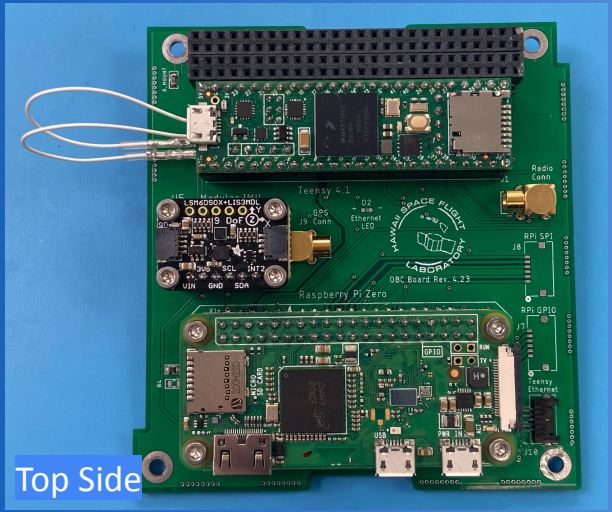
Congratulations! You just assembled your first spacecraft.

To learn more about the Artemis CubeSat Kit, visit: https://hsfl.github.io/artemis/

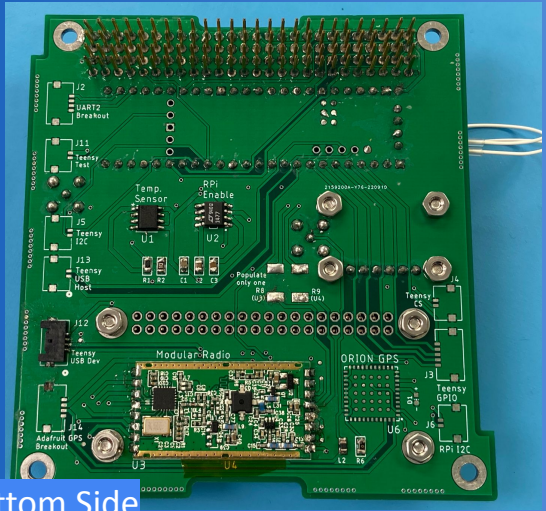
Before you go, please scan the QR code to take our survey. Your feedback is important to us and greatly appreciated!

Supporting Slides

Preparing The OBC



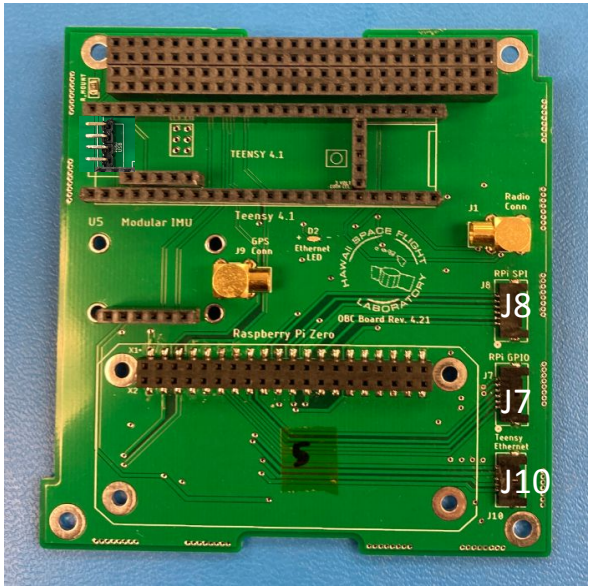
Top Side



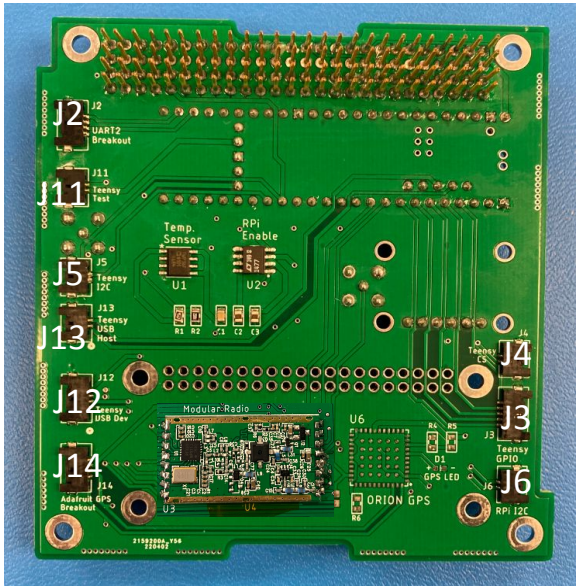
Bottom Side

Prior Conditions Before Proceeding

- Upon completion of a successful fabrication of the On-Board Computer (OBC) and confirmation of its proper functioning through comprehensive testing and verification, you may proceed to the next slide



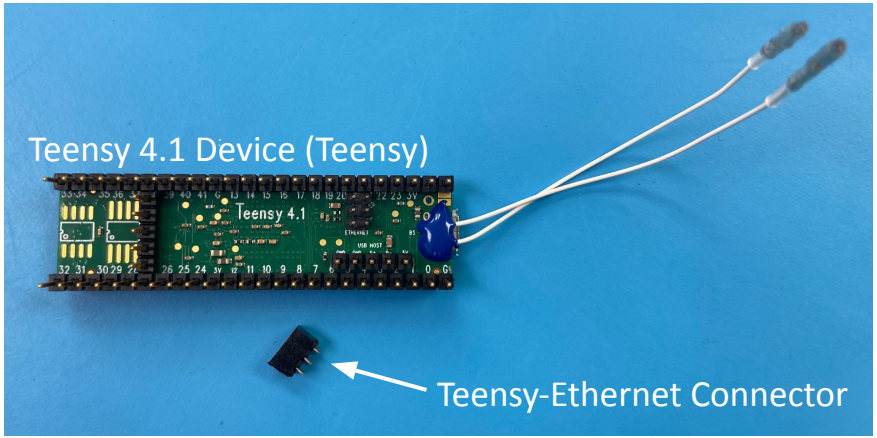
Top Side

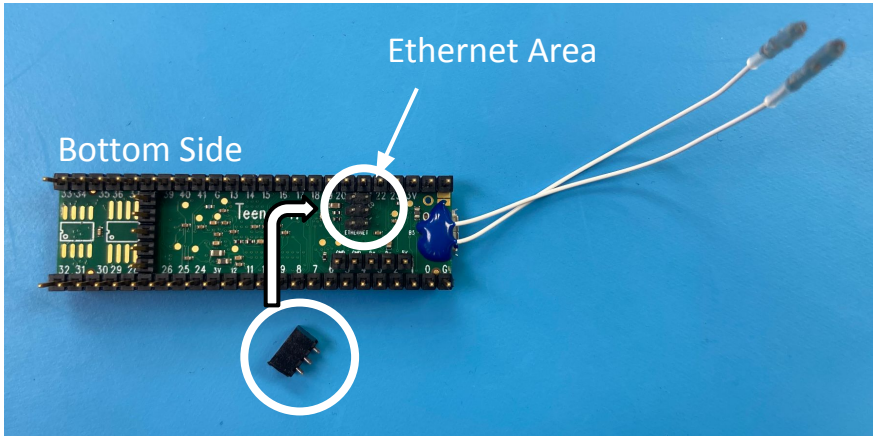


Bottom Side

Preparing the Teensy 4.1 Device

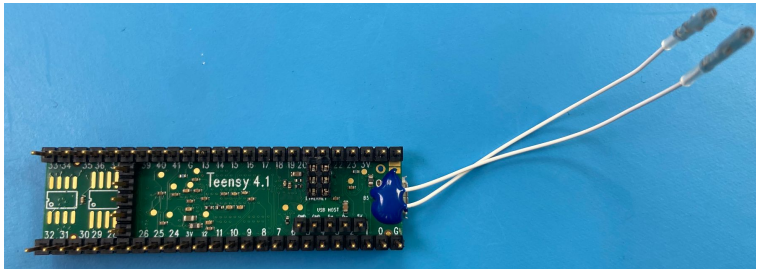
You will need a Teensy 4.1 Device and a Teensy-Ethernet Connector.
Insert the Teensy-Ethernet Connector onto the Teensy 4.1 Device's Bottom Side's Ethernet Area (more pictures on the next slide).

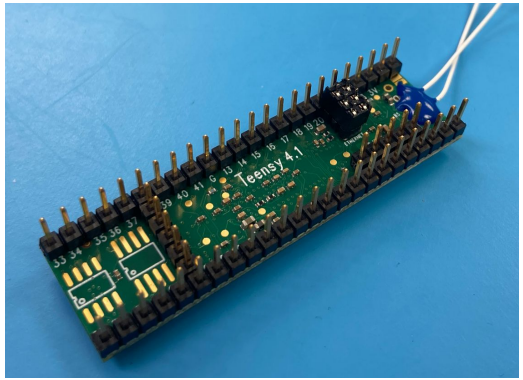


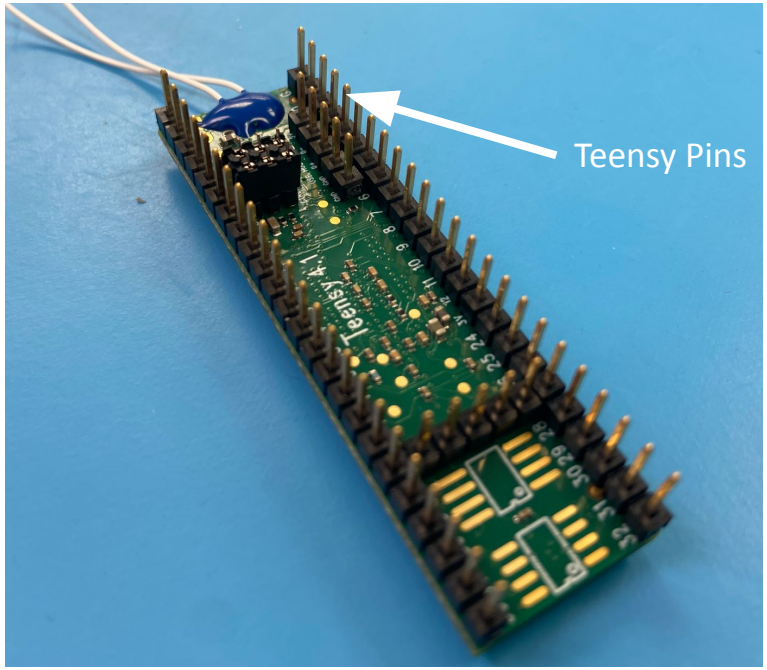


Prepped Teensy 4.1 Device

Result of inserting Teensy-Ethernet Connector onto the Teensy 4.1 Device (pictures below). Congrats, now you have a prepped Teensy 4.1 Device!

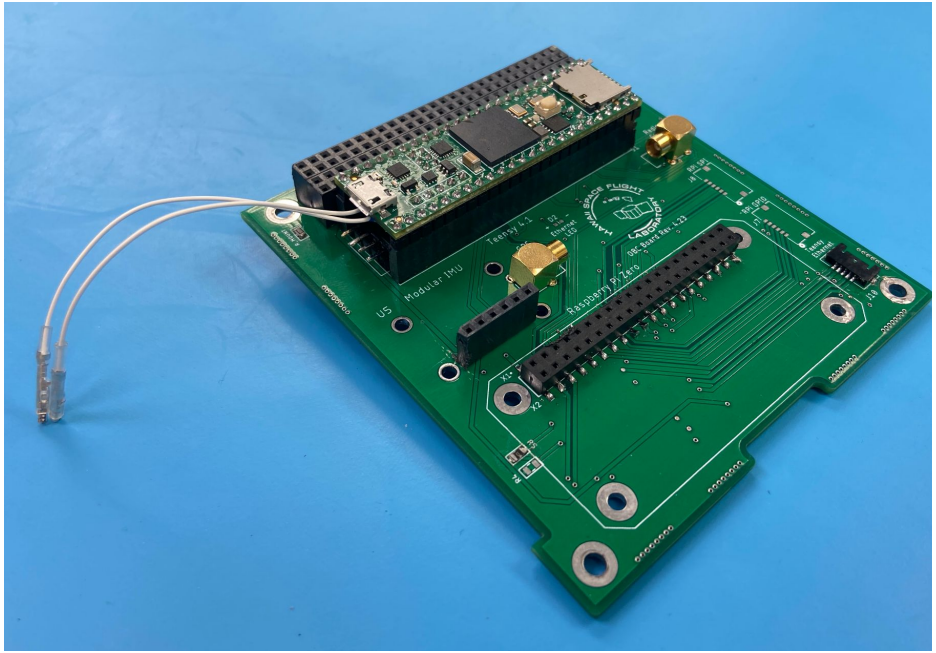


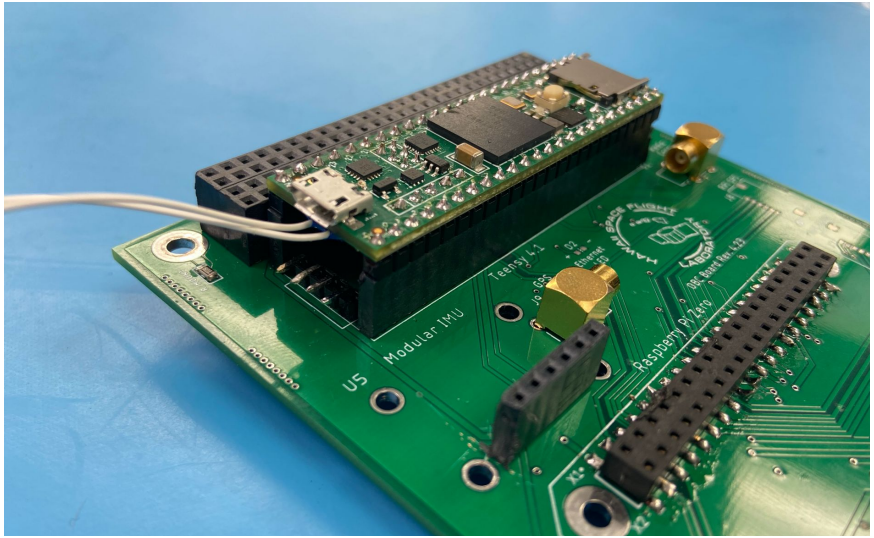




Mount the Teensy 4.1 Device onto OBC

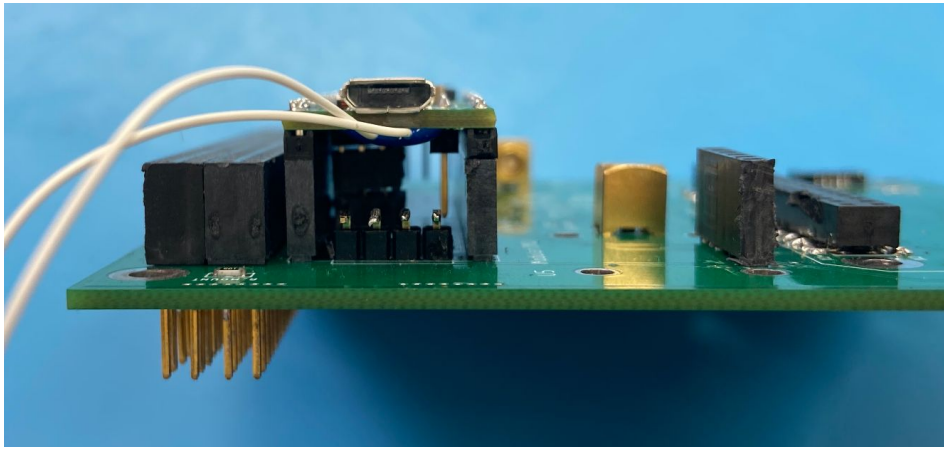
Mount the Teensy 4.1 Device onto OBC PCB. The bottom side of the Teensy (Teensy Pins) makes contact with the OBC PCB. More pictures on the next slide.



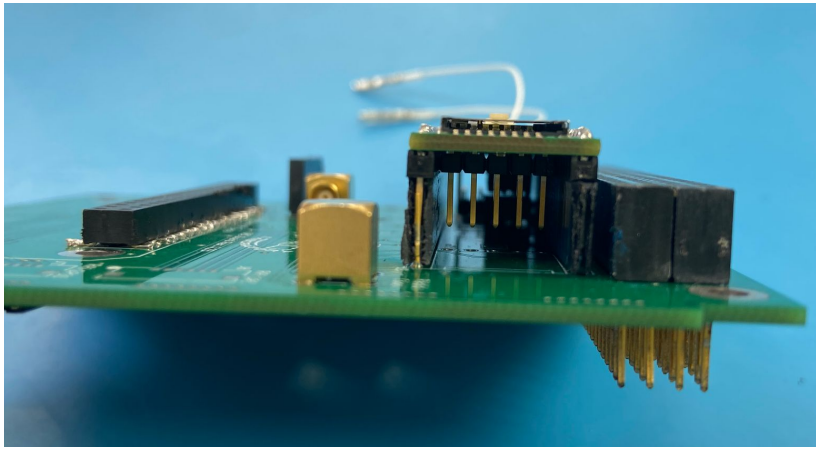


Mount the Teensy 4.1 Device onto OBC

Mount the Teensy 4.1 Device onto OBC PCB. The bottom side of the Teensy (Teensy Pins) makes contact with the OBC PCB.



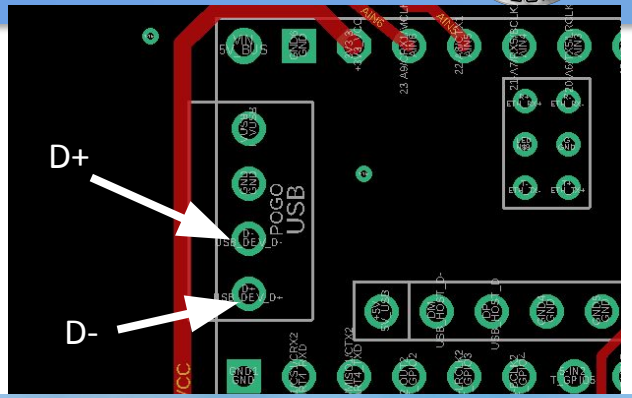
Left Side View

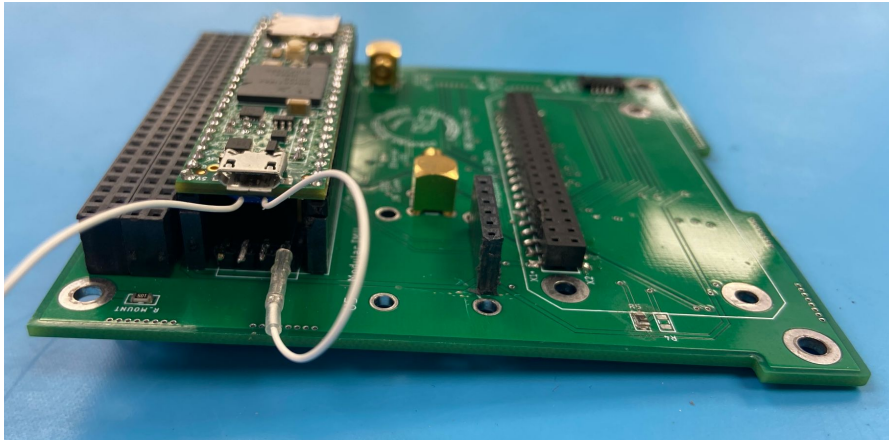


Right Side View

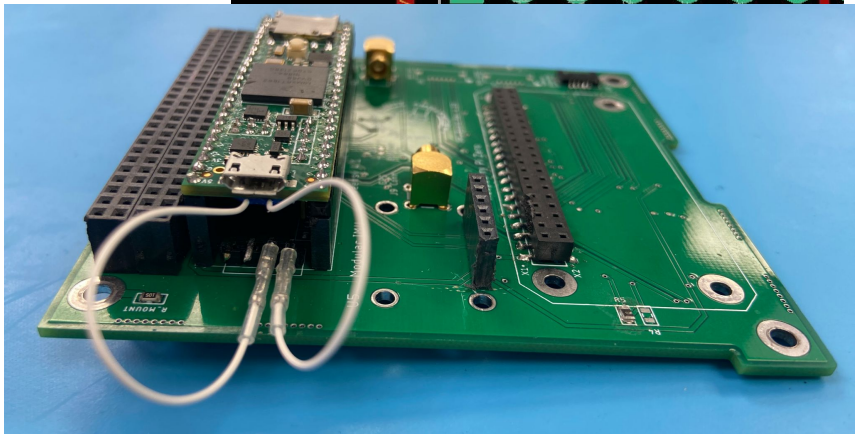
Mount the Teensy 4.1 Device onto OBC

Connect USB Host Cables (White) on the Teensy 4.1 Device to the Allocated PCB Slots. You now have a prepped Teensy!





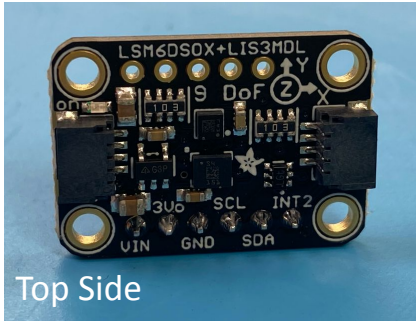
Insert USB Host Cable 1 into D+



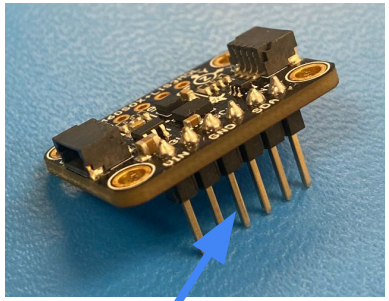
Insert USB Host Cable 2 into D-

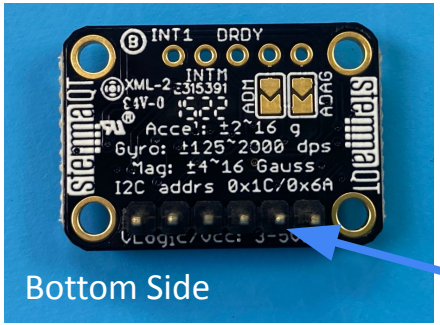
Preparing IMU Device

You will need an IMU Device. Insert the IMU onto the OBC. The bottom side of the IMU (IMU Pins) makes contact with the OBC PCB. (More pictures on next slide)



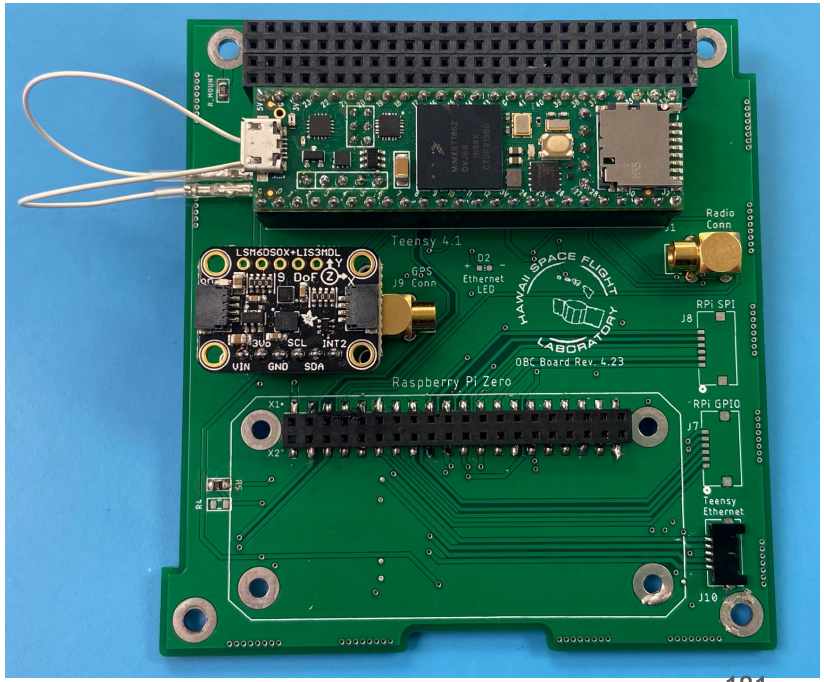
Top Side





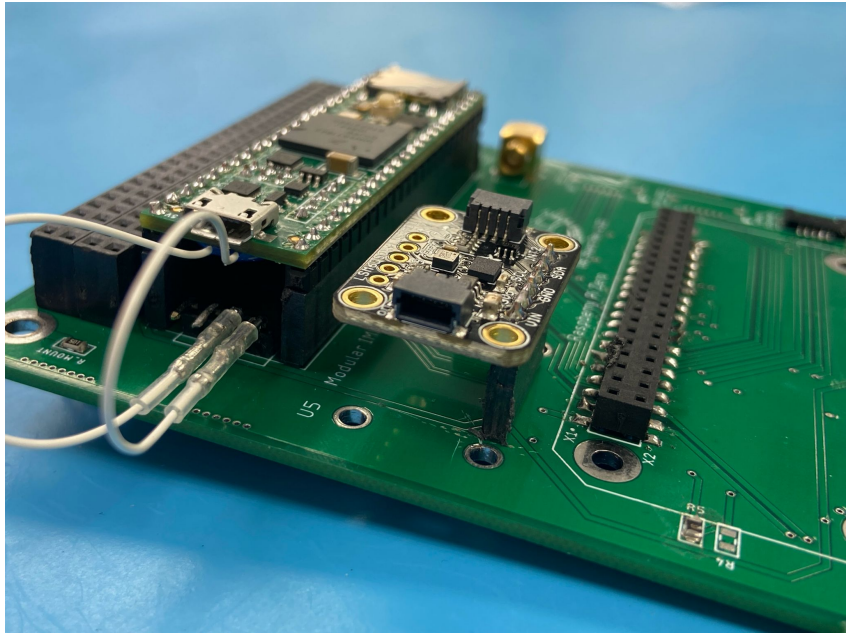
Bottom Side

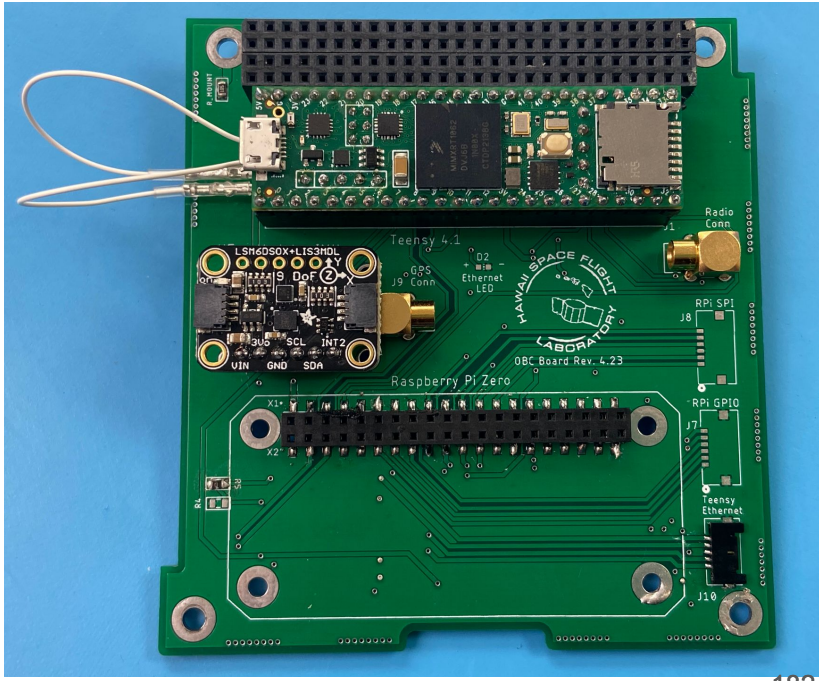
IMU Pins



Mount the IMU onto OBC

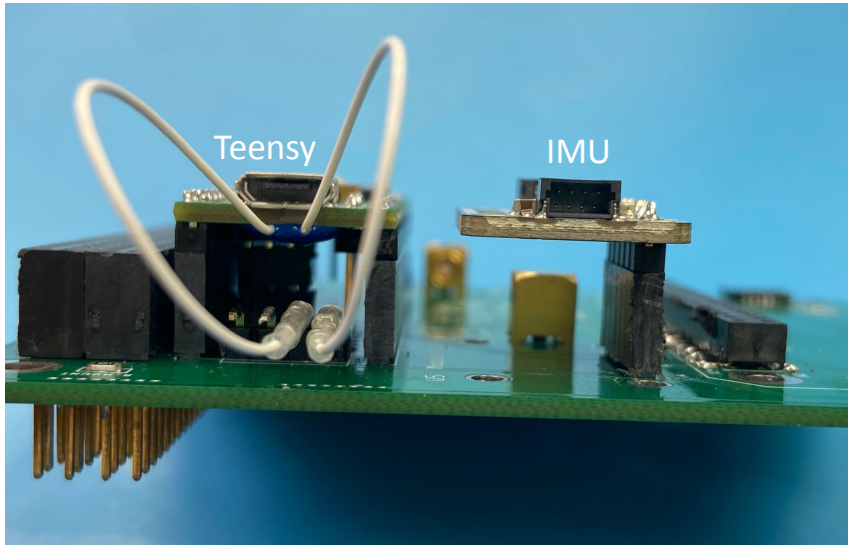
Insert the IMU onto the OBC. The bottom side of the IMU (IMU Pins) makes contact with the OBC PCB. (More pictures on next slide)



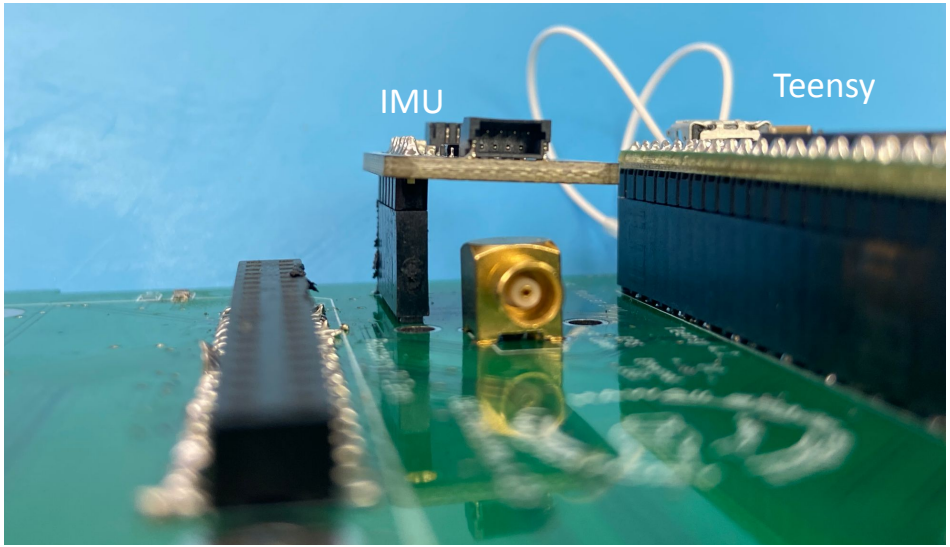


Mount the IMU onto the OBC

Mount the IMU onto OBC PCB. The bottom side of the IMU (IMU Pins) makes contact with the OBC PCB.



Left Side View



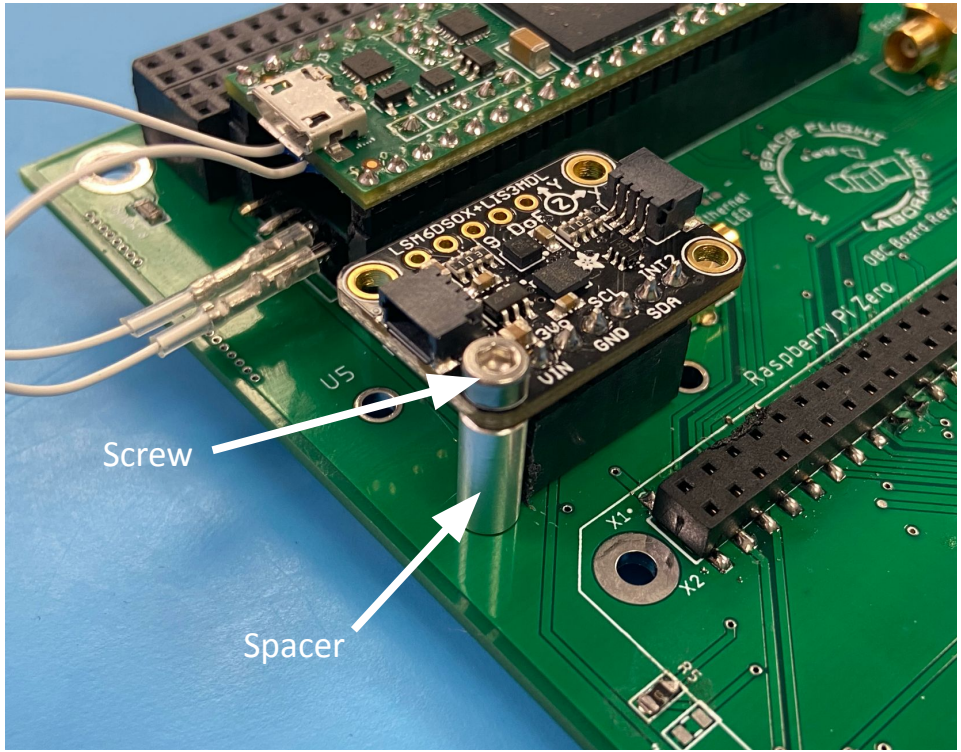
Right Side View

Top Side of OBC Preparation

You will need:

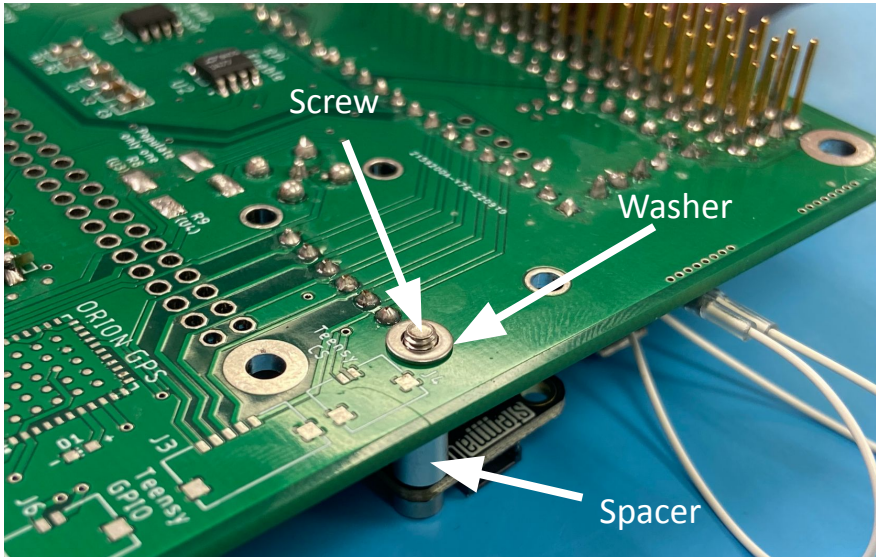
- 4 IMU Spacers [G*]
- 4 IMU Screws [H*]
- 4 IMU Washers [I*]
- 4 IMU Nuts [J*]

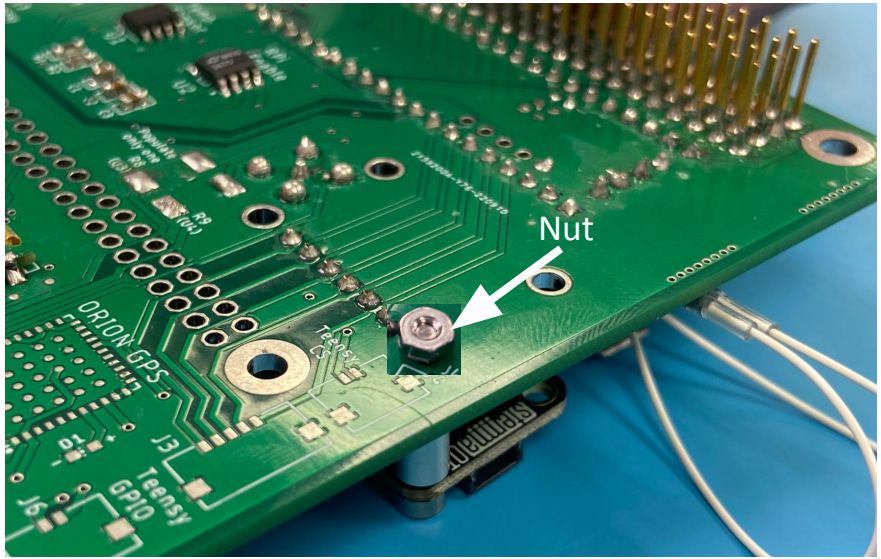
- Align and place a single IMU Spacer [G*] below any IMU hole
- Align and place a single IMU Screw [H*] on top of any IMU hole



Bottom Side of OBC Preparation

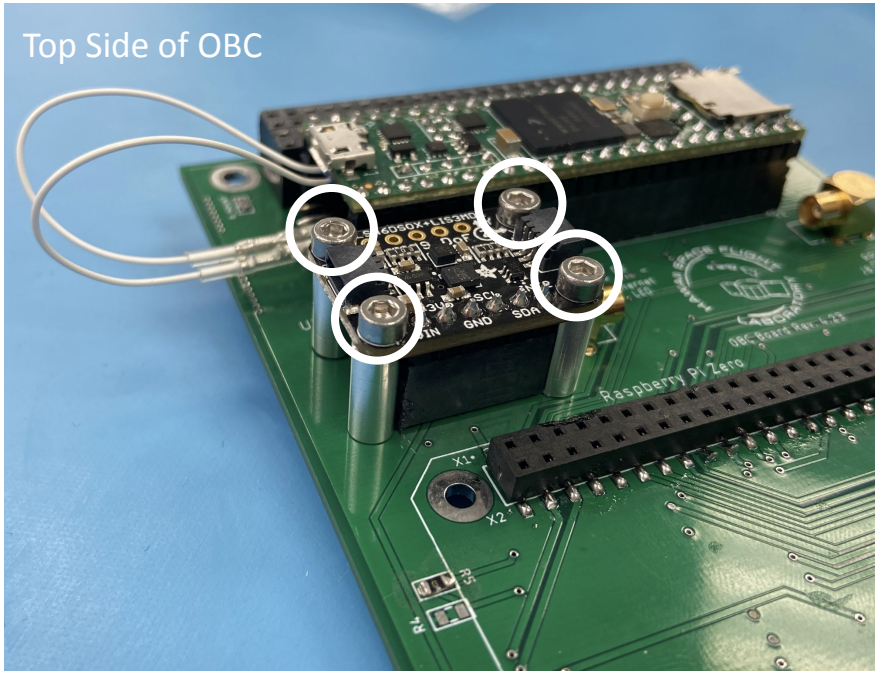
- While holding the screw and spacer from the previous step in-place, place the IMU nut [I*] on top of the screw (on the bottom side of the OBC)
- Use Tool C to tighten the IMU nut [J*] onto the screw

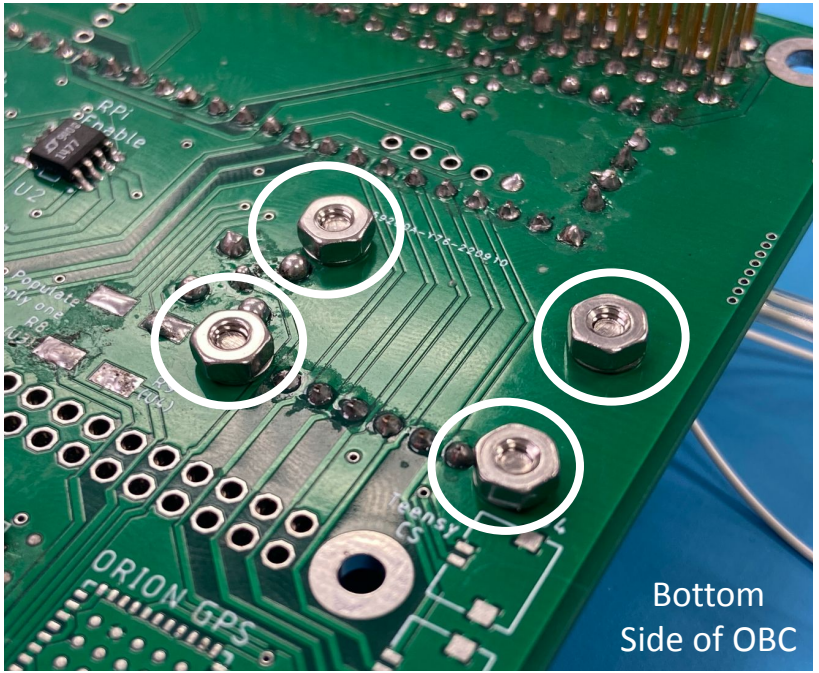




IMU on OBC Preparation

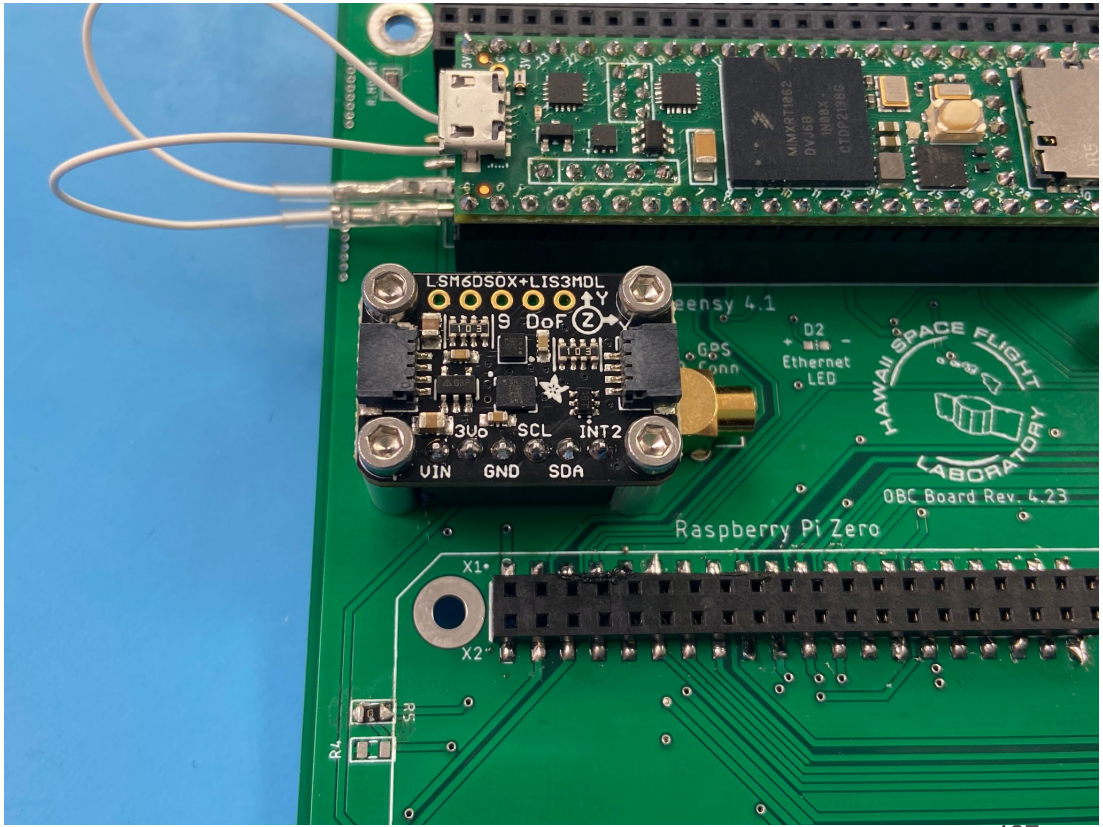
- Repeat the steps outlined in the previous two slides until all four IMU holes are prepped





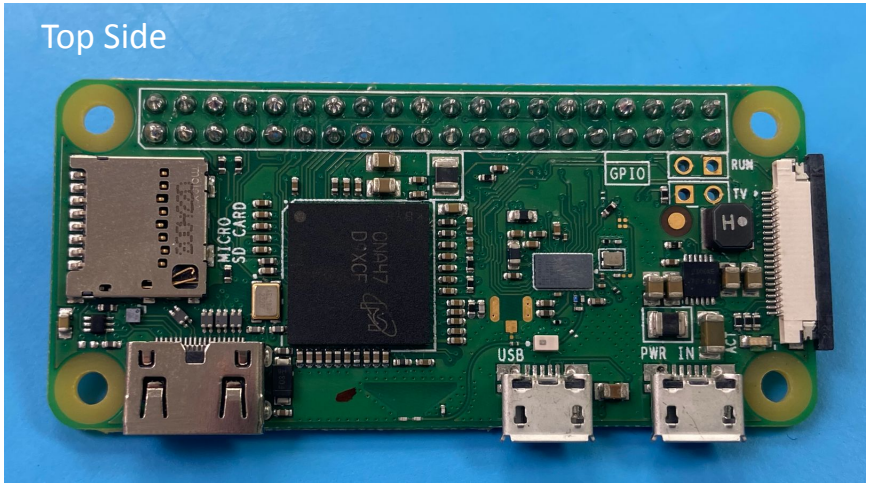
Prepped IMU

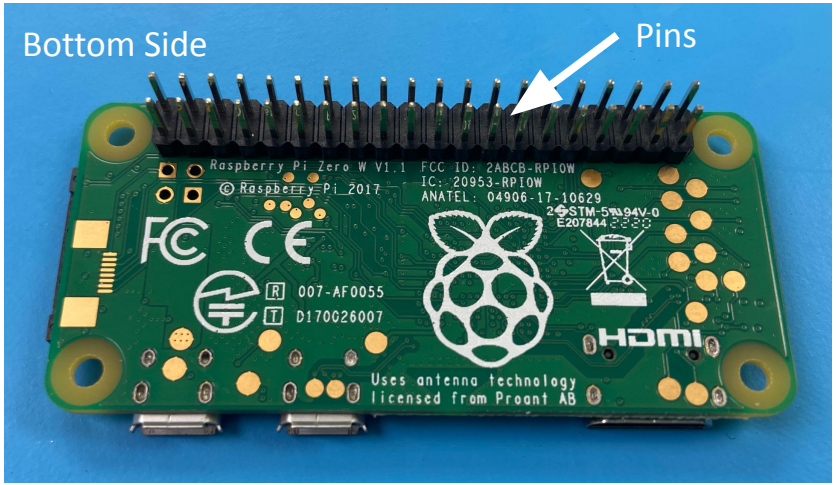
- Congrats! You now have a prepped IMU.



Preparing Raspberry Pi (RPi)

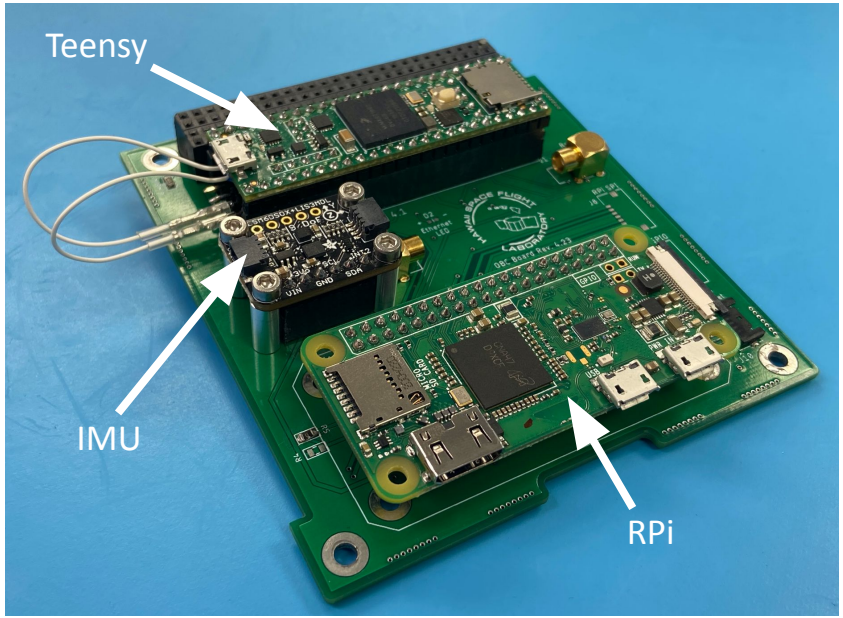
You will need a Raspberry Pi (RPi). Mount the RPi onto the OBC. The bottom side of the RPi (RPi Pins) makes contact with the OBC PCB. (More pictures on next slide)

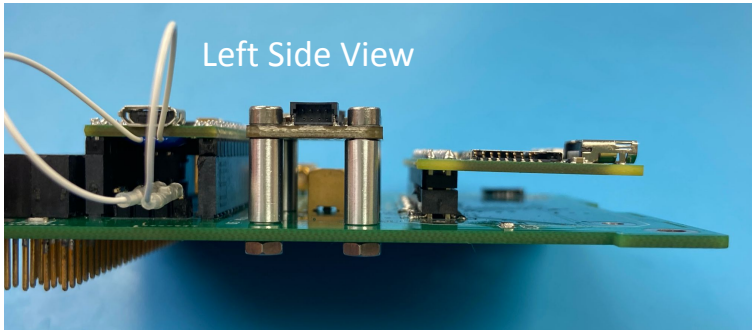


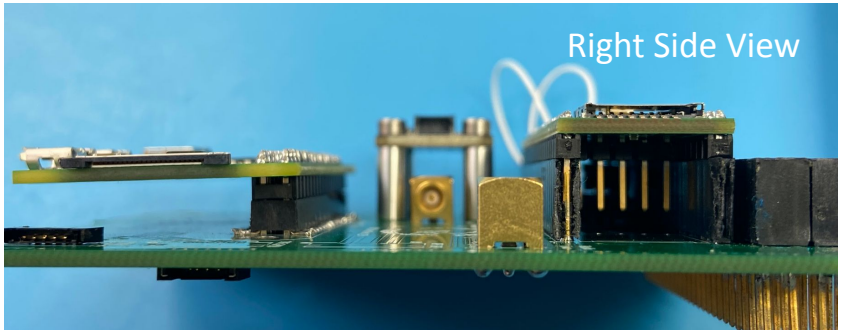


Mount the RPi onto OBC

Insert the RPi onto the OBC. The bottom side of the RPi (RPi Pins) makes contact with the OBC PCB.





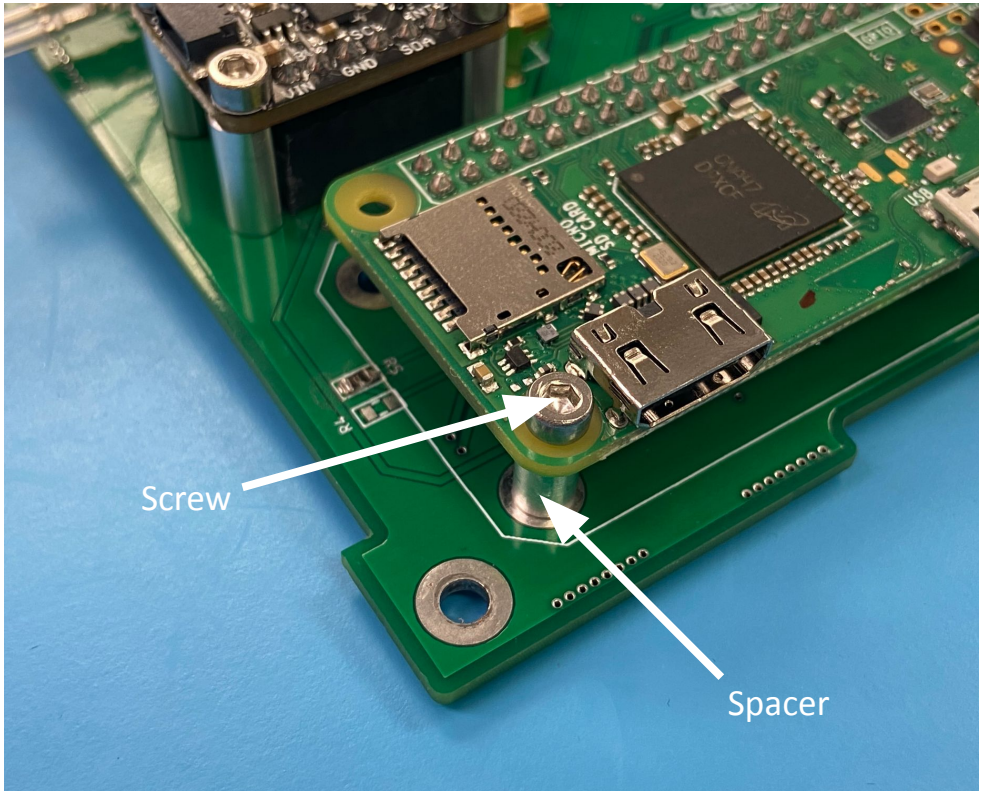


Top Side of OBC Preparation

You will need:

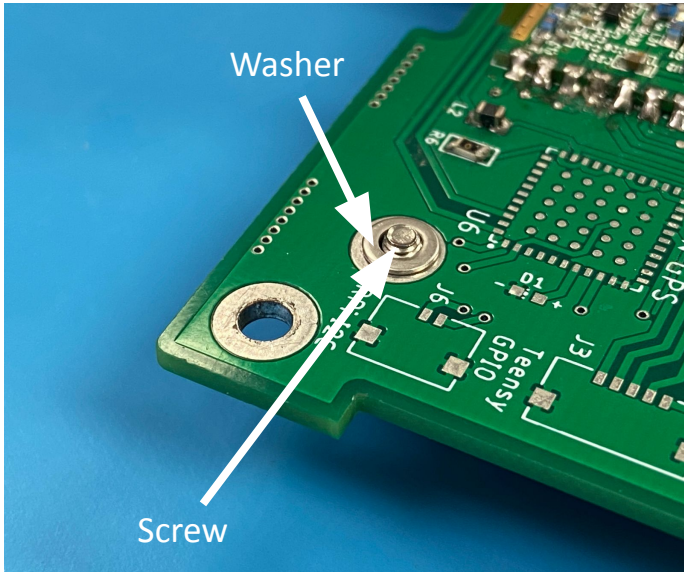
- 4 RPi Washers [I*]
- 4 RPi Nuts [J*]
- 4 RPi Spacers [K*]
- 4 RPi Screws [L*]

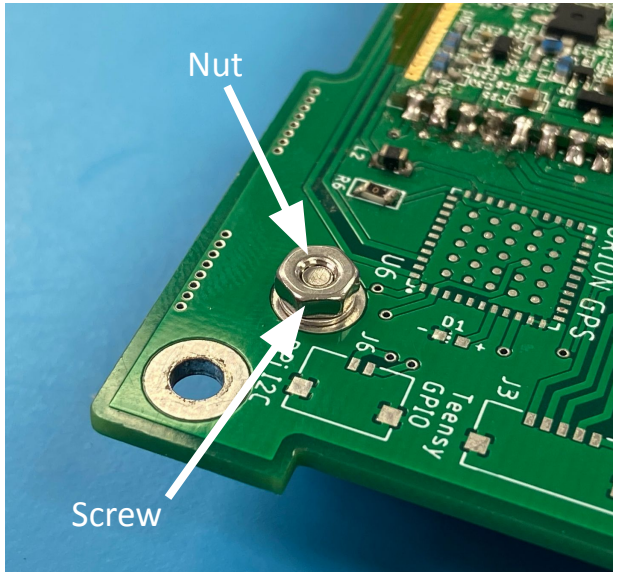
- Align and place a single RPi Spacer [K*] below the RPi hole
- Align and place a single RPi Screw [L*] on top of any RPi hole



Bottom Side of OBC Preparation

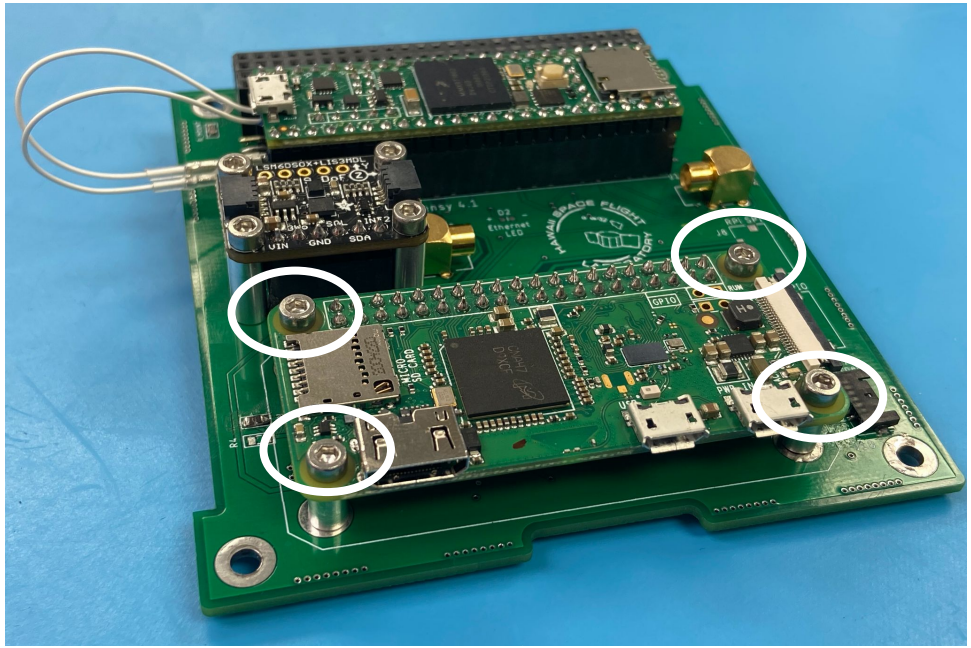
- While holding the screw and spacer from the previous step in-place, place the RPi nut [I*] on top of the screw (on the bottom side of the OBC)
- Use Tool C to tighten the RPi nut [J*] onto the screw

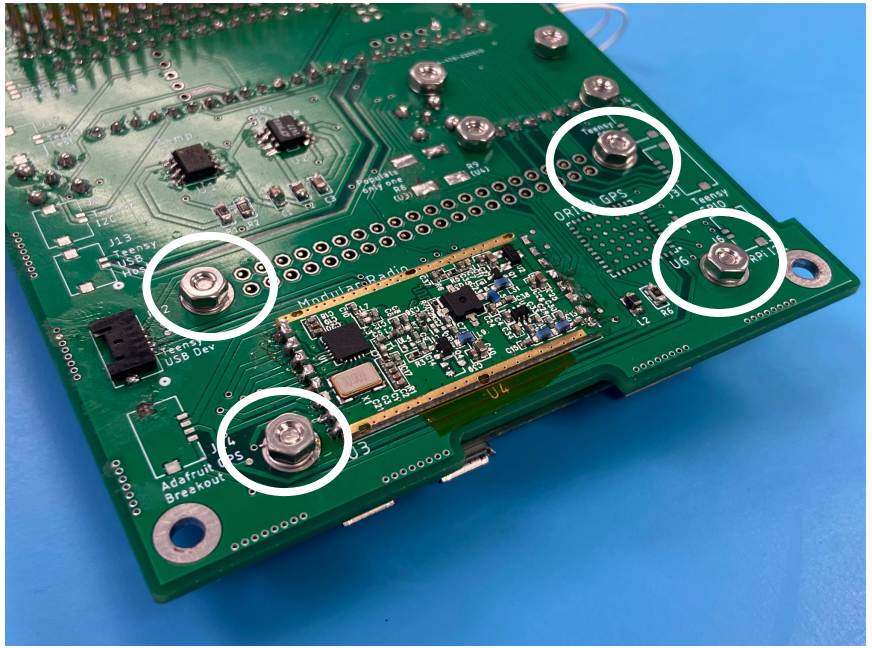




RPi on OBC Preparation

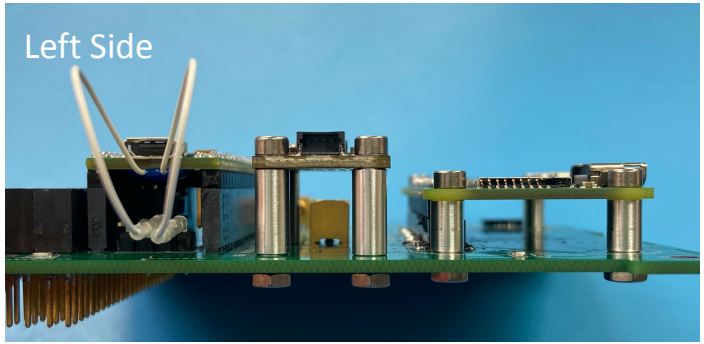
- Repeat the steps outlined in the previous two slides until all four RPi holes are prepped

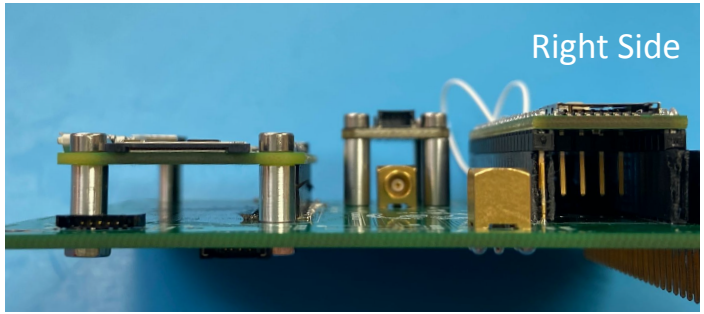


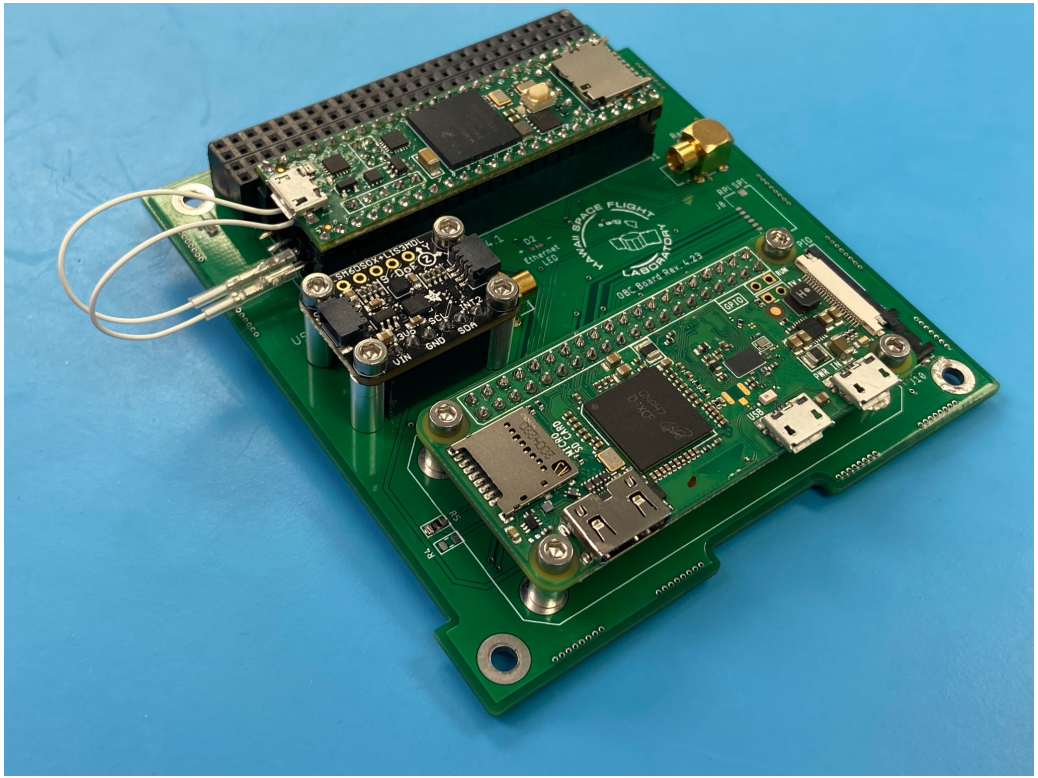


Prepped RPi

- Congrats! You now have a prepped RPi.







Low Outgassing Antenna Integration

Practice for Attaching Antenna to Antenna Board for Low Outgassing Tests

For the next step, you will need:

- 2 Antenna Screws [Q]
- 2 Antenna Washer [R]
- 2 Antenna Nut [S]
- 1 Antenna [V]
- Phillips Screwdriver* (not provided in the Kit)

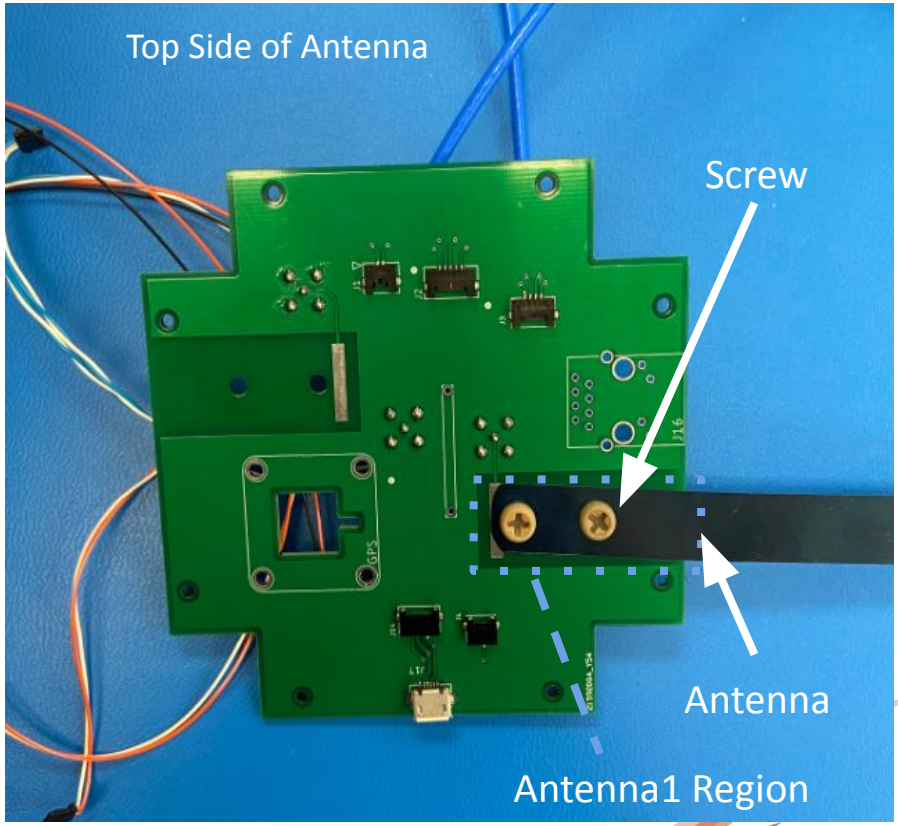
Before you start, try fitting the washer onto the screw and using the nut to fasten it. Familiarize yourself with how tightly the nut fits onto the screw since the material is delicate and may break if you apply too much force while tightening.

Attach Antenna to Antenna Board (Top Side) **Low Outgassing**

You will need:

- 2 Antenna Screws [Q] (Natural, PEEK)
- 2 Antenna Washer [R] (Natural, PEEK)
- 2 Antenna Nut [S] (Natural, PEEK)
- 1 Antenna [V]

- Line up the Antenna with the holes (Top side of PCB, Antenna1 Region)
- Insert screw onto Antenna Holes (you do not need a tool at this moment)



Kapton Heater

Attach Kapton Heater to Battery Pack (Bottom Side)

- If you procure a Kapton Heater for your battery pack:
  - Place and tape the Kapton Heater (using Kapton Tape) onto the Battery Pack