



THE GEORGE WASHINGTON UNIVERSITY

μ CAT Sub-system Integration Manual

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I Introduction

This document will contain all the mechanical integration information necessary to piece together the μ CAT Sub-system, as well as integrate it with Yonsei University's Satellite. The μ CAT Sub-system will be delivered fully assembled and should not be pulled apart. If absolutely necessary, instructions on how to put the μ CAT Sub-system together are provided.

A brief outline of putting the Sub-system together:

1. Connect the Bottom Board to the Back Plane Left and Back Plane Right
2. Connect the Thrusters to B2
3. Connect B2 to the Side Panels
4. Solder the Thruster's connections to the anode, cathode, and magnetic coil
5. Connect the Top Board to the Back Plane Left and Back Plane Right
6. Connect the Thrusters to T2
7. Solder the Thruster's connections to the anode, cathode, and magnetic coil
8. Connect T2 to the Back Plane Left and Back Plane Right

A brief outline of integrating the μ CAT Sub-system with Yonsei University's Satellite:

1. Slide the Bottom Wheel Mount into the bottom of the μ CAT Sub-system
2. Insert the Top Wheel Mount over top of the μ CAT Sub-system and connect to the other Wheel Mounts
3. Connect the 60 Pin Connectors from the Bottom Board to the Top Board
4. Connect the 50 Pin Connector from Back Plane Left to Back Plane Right

NOTE: When assembling, instructions are written in a way such that the thrusters are facing the user and the CubeSat Kit Connector is facing upwards.

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Part A

TOOLS AND PIECES

II Tools Required



Flat Head (FH) Screwdriver



Phillips Head (PH) Screwdriver



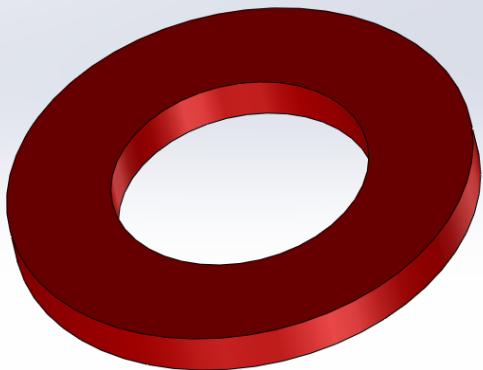
Soldering Iron



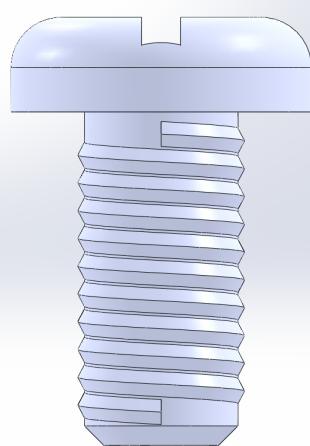
Solder

III μ CAT Sub-system Components

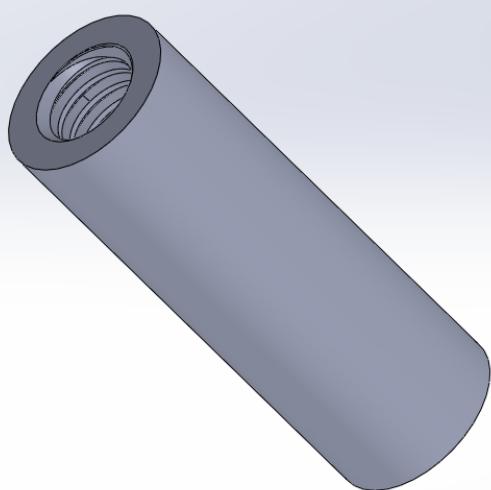
T2 and B2 Spacer Connection



M3 Belleville Spring Lock Washer; Quantity: 3



M3 (FH) Spacer Screw; Length: 6 mm; Quantity: 6

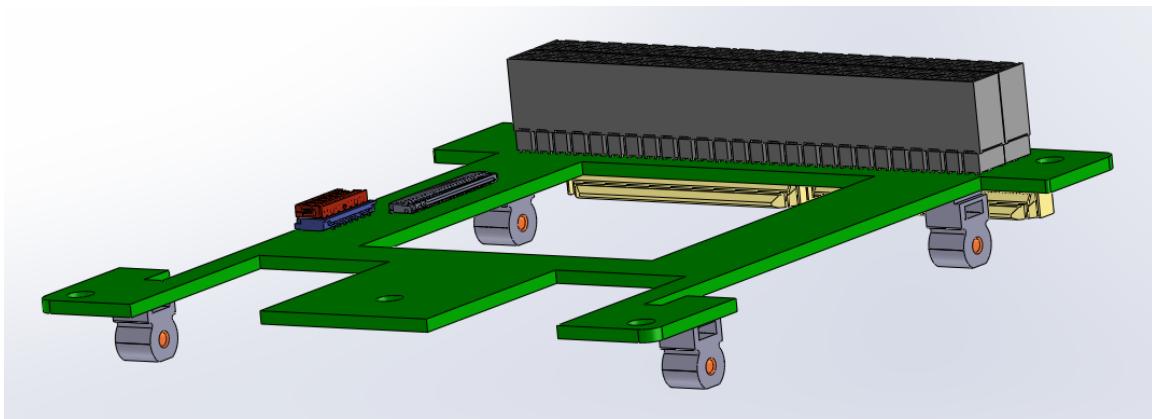


14 mm Length Spacer; Quantity: 2

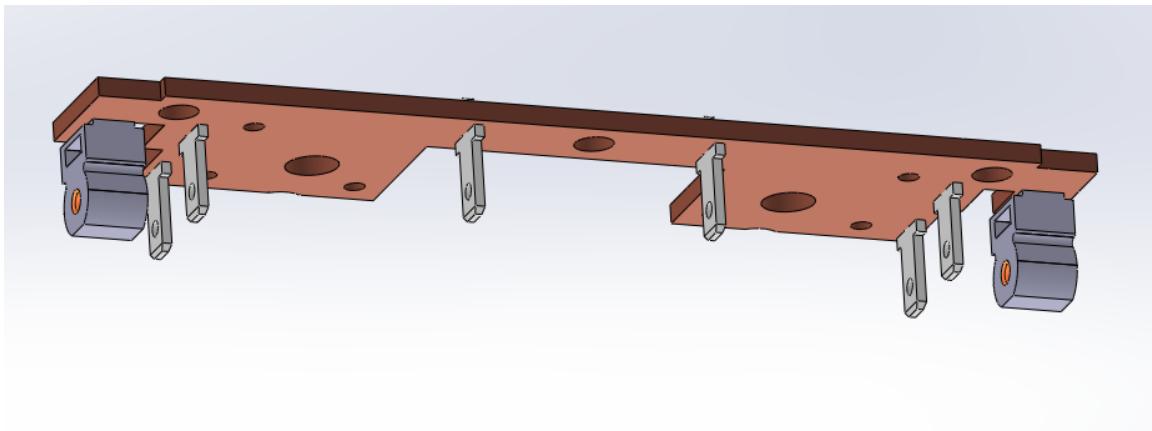


16 mm Length Spacer; Quantity: 1

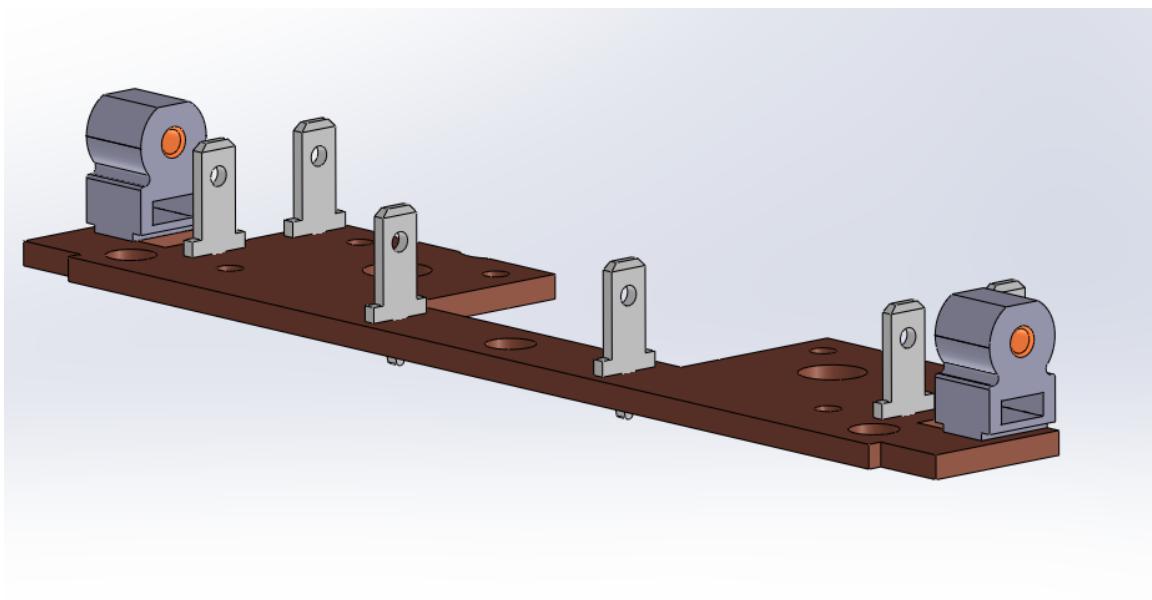
Boards



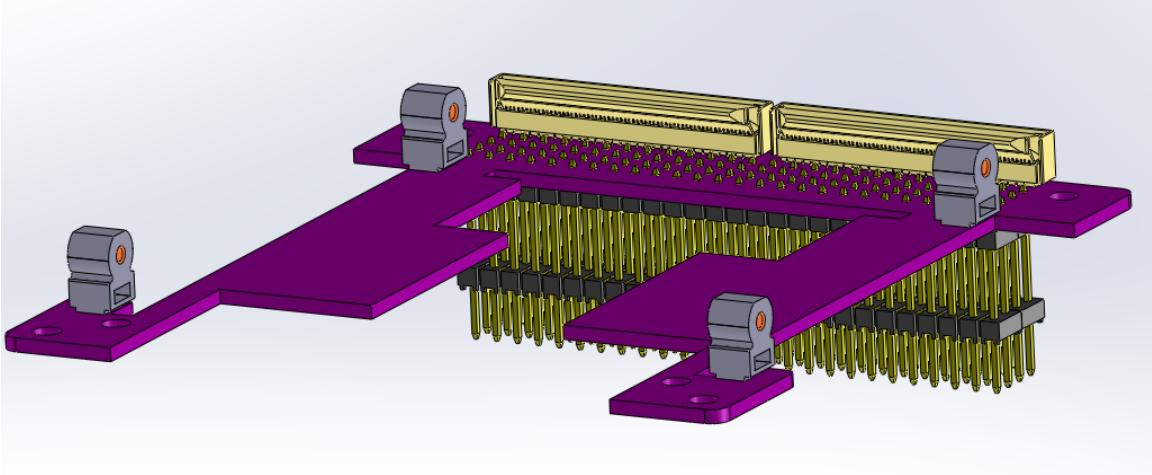
Top Board; Quantity: 1



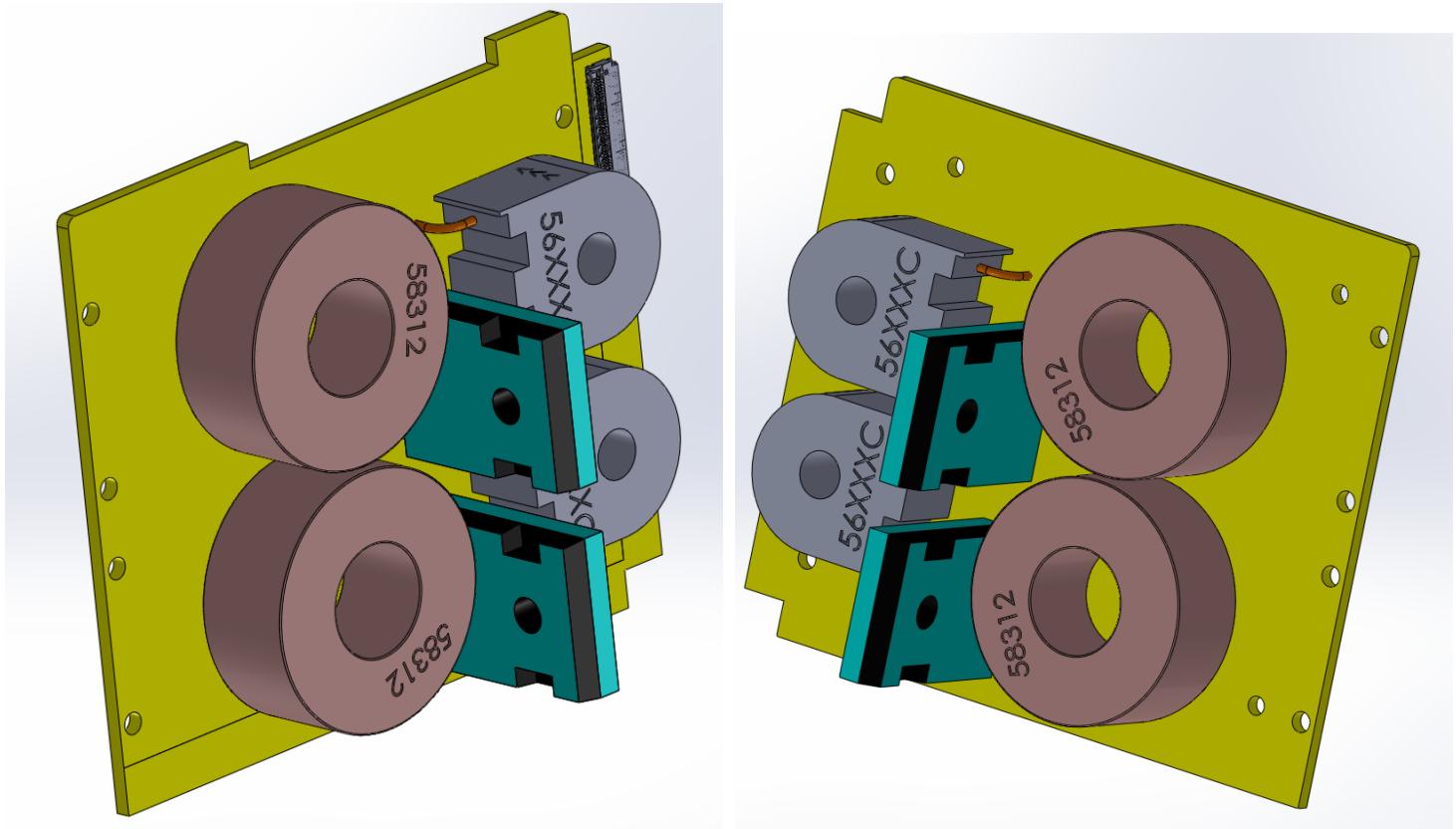
T2 Board; Quantity: 1



B2 Board; Quantity: 1



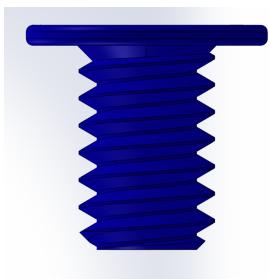
Bottom Board; Quantity: 1



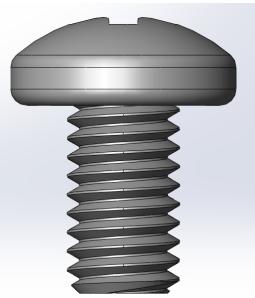
Back Plane Left (BPL); Inside Shown; 50 Pin Connector is located on the INSIDE; Quantity: 1

Back Plane Right (BPR); Inside Shown; 50 Pin Connector is located on the OUTSIDE; Quantity: 1

Board Connection Screw



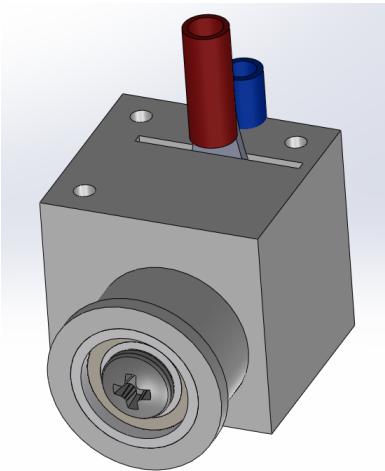
Graphical Representation of M2 Screw



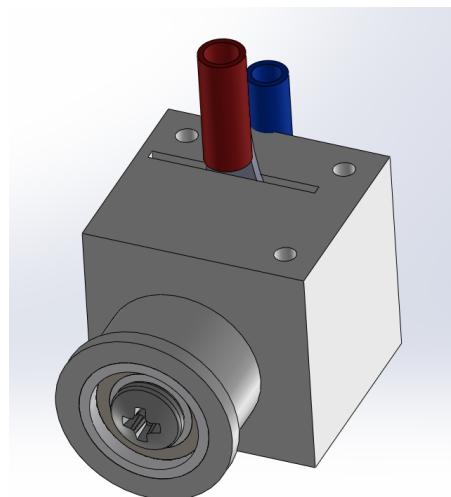
Actual M2 (PH) 5 mm Long Screw; Quantity: 12

NOTE: When building, the Pan Head, 5 mm long M2 screw (Right) should be used in place of the blue, flat head M2 screw.

Thruster Pieces



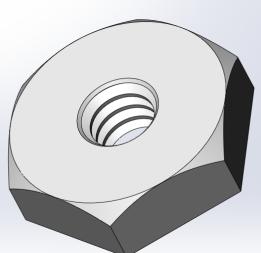
Thruster One; Quantity: 2



Thruster Two; Quantity: 2



1 inch (PH) 0-80 Screw; Quantity: 6



Thruster Fastener Hex Nut; Quantity: 12

Part B

BUILDING THE μ CAT SUB-SYSTEM

IV Step One: Bottom Board to BPL and BPR

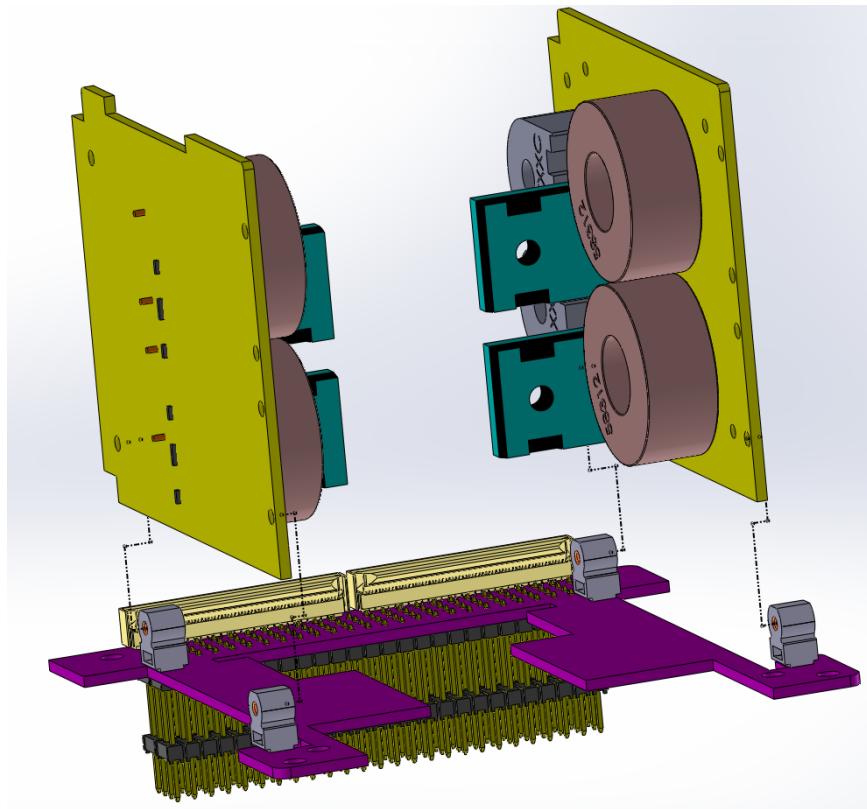


Figure 1: Line up the Right Angle Connectors on the Bottom Board with the holes shown on BPL and BPR.

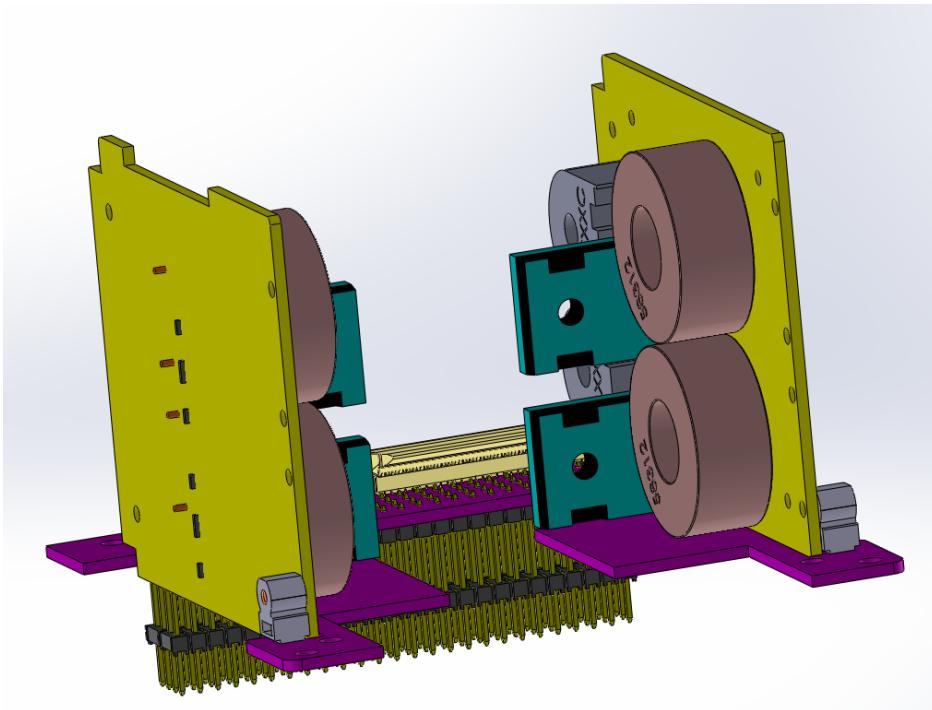


Figure 2: The Bottom Board, BPL and BPR should now look like this.

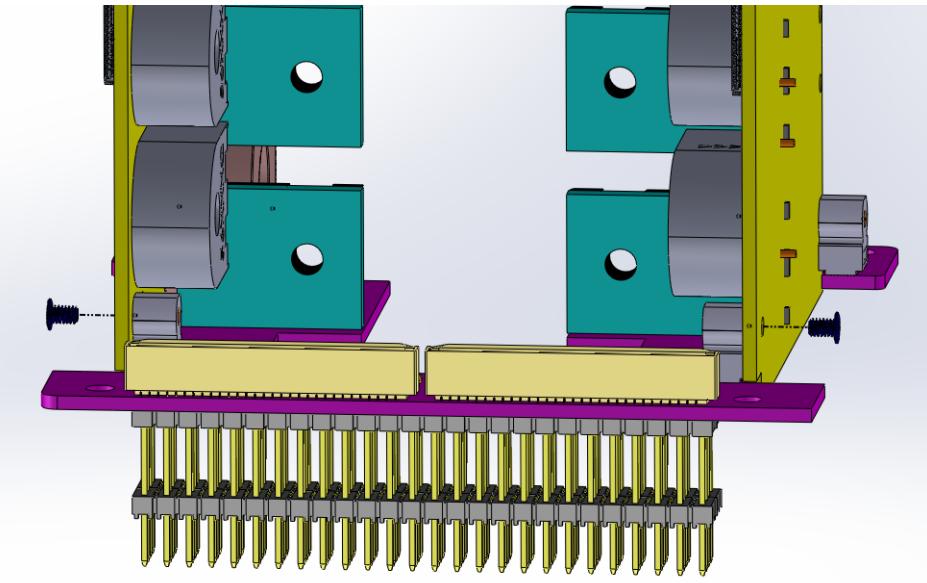


Figure 3: Use TWO M2 Board connection screws to connect the OUTER REAR of BPL and BPR to the Bottom Board's Right Angle Connectors.

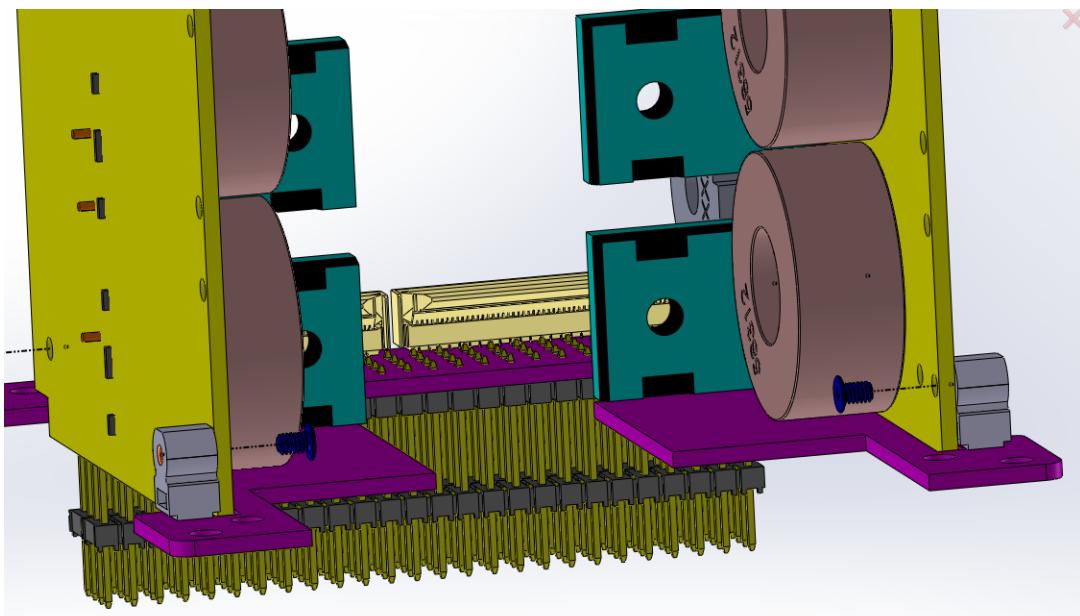


Figure 4: Use TWO M2 Board connection screws to connect the INNER FRONT of BPL and BPR to the Bottom Board's Right Angle Connectors.

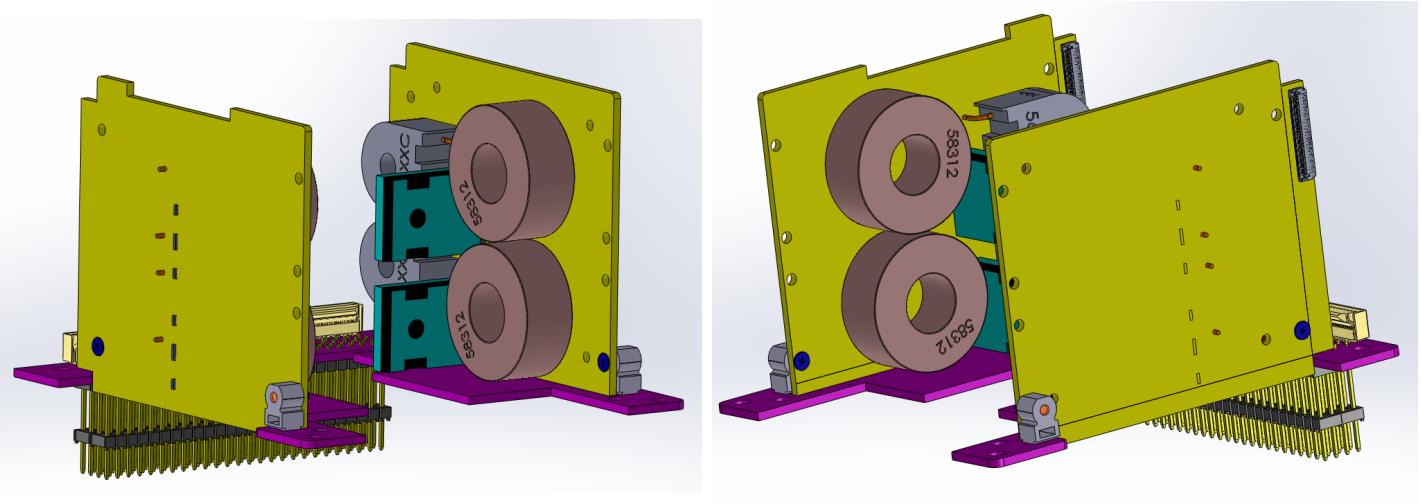


Figure 5: The Bottom Board, BPL and BPR should now look like this.

V Step Two: Connect Thrusters to B2

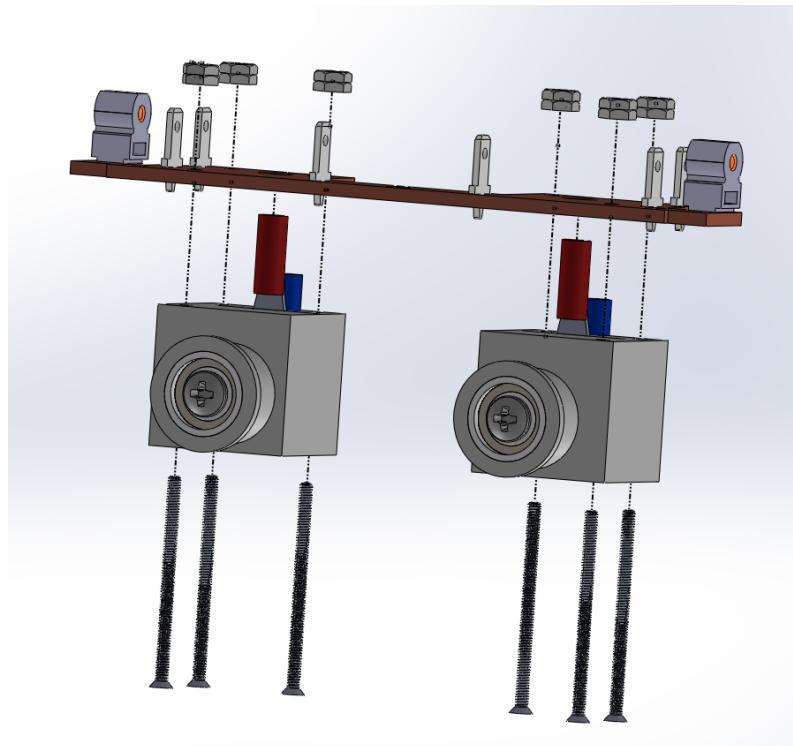


Figure 6: On B2, notice that the Right Angle Connectors and Wire Harnesses are facing UP. For EACH Thruster, use THREE 0-80 screws to go through the BOTTOM of the Thruster and into B2. Secure the 0-80 screws with TWO Thruster Fastener Hex Nuts per screw.

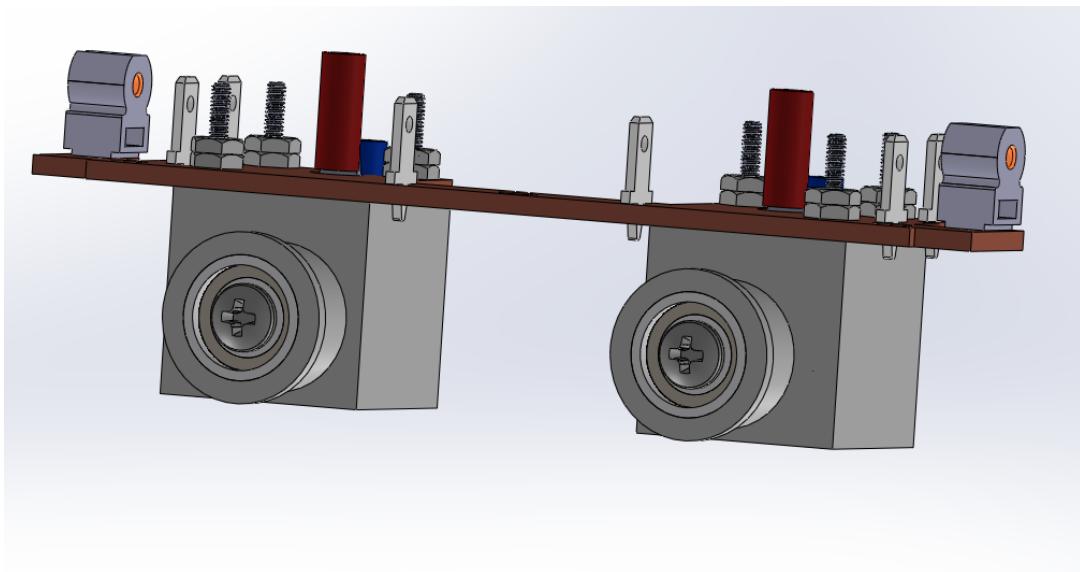


Figure 7: When connected, the Thrusters and B2 should look like this.

VI Step Three: Connect B2 to BPL and BPR

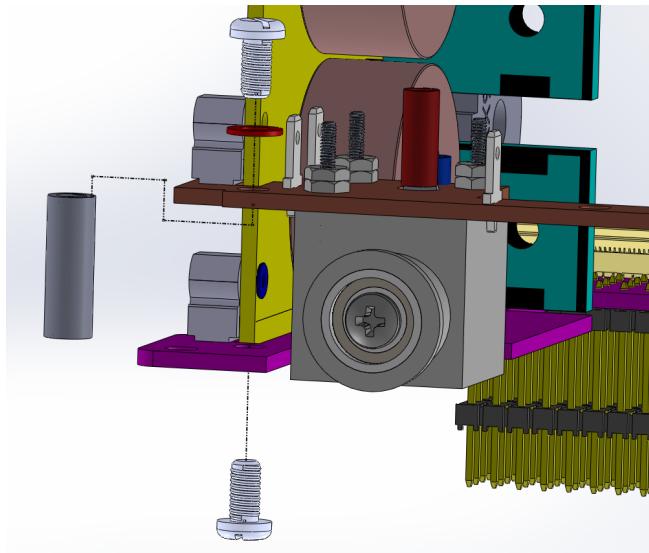


Figure 8: Position the Right Angle Connectors on B2 with their respective vertical holes on BPL and BPR. Starting from BPL, slide in a 14 mm Spacer between the Bottom Board and B2 between their respective horizontal holes. Tighten a M3 (FH) Spacer Screw into the bottom of the Spacer. Use a M3 Belleville Spring Lock Washer and a M3 (FH) Spacer Screw for the top connection into the Spacer.

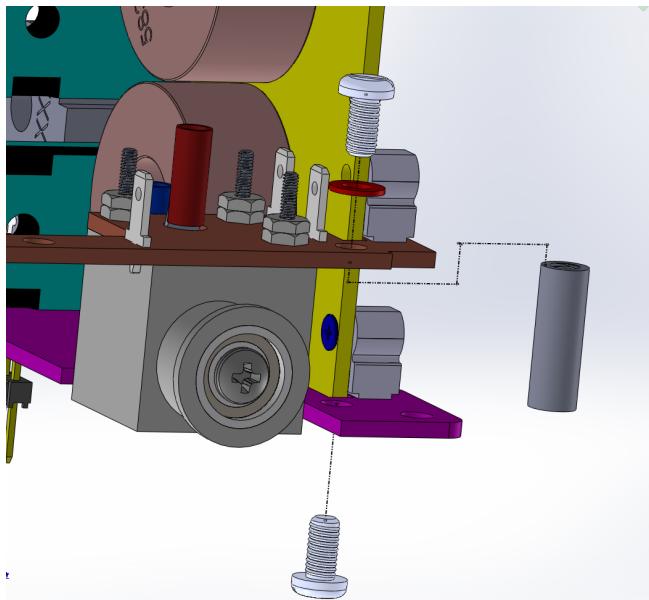


Figure 9: On BPR, slide in a 14 mm Spacer between the Bottom Board and B2 between their respective horizontal holes. Tighten a M3 (FH) Spacer Screw into the bottom of the Spacer. Use a M3 Belleville Spring Lock Washer and a M3 (FH) Spacer Screw for the top connection into the Spacer.

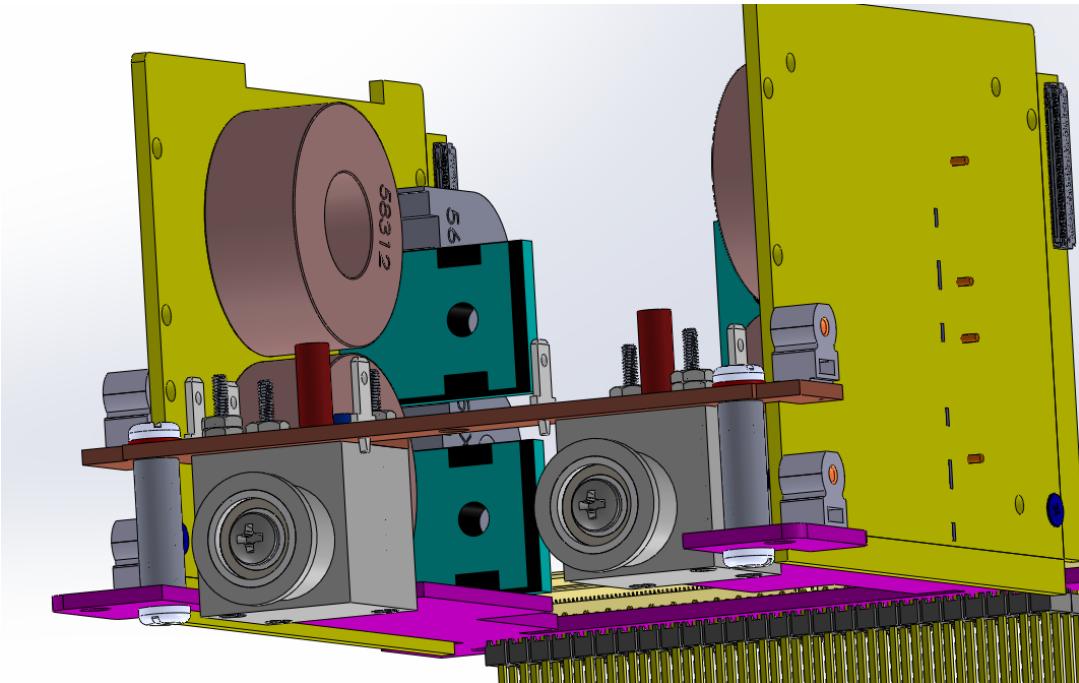


Figure 10: When connected, the Spacers, Belleville Spring Lock Washers, and M3 (FH) Spacer Screws should look like this.

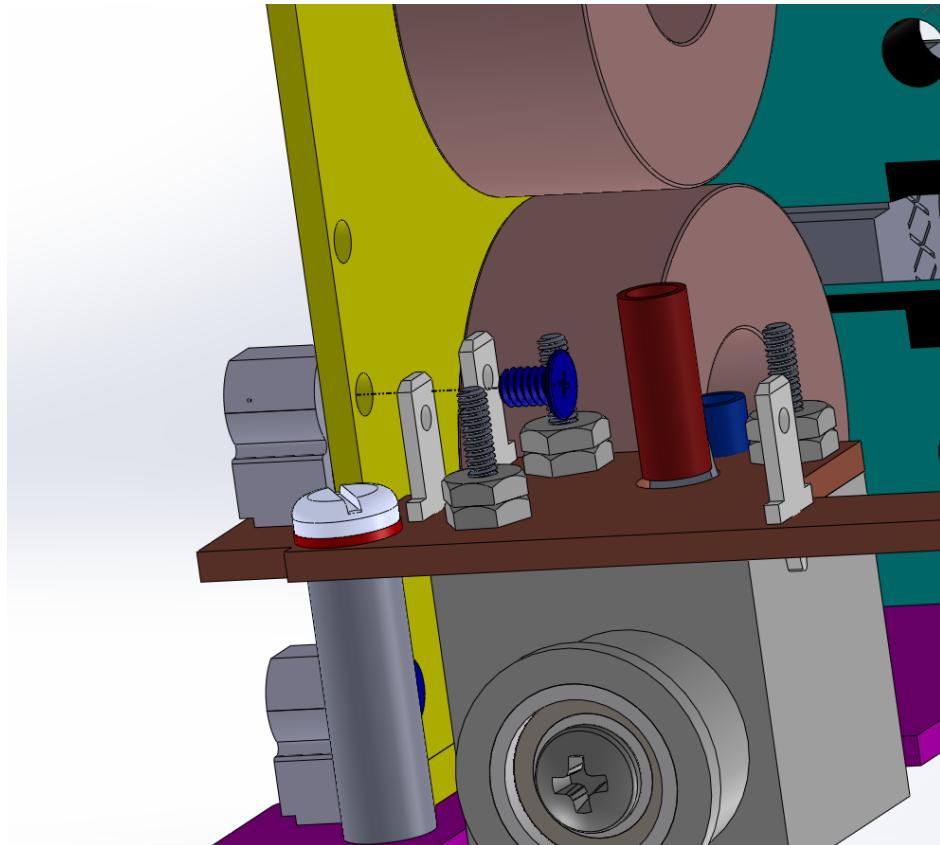


Figure 11: Use ONE M2 Board connection screw to connect the INNER FRONT of BPL to B2. To complete this step, you may need to bend the Wire Harness out of the way.

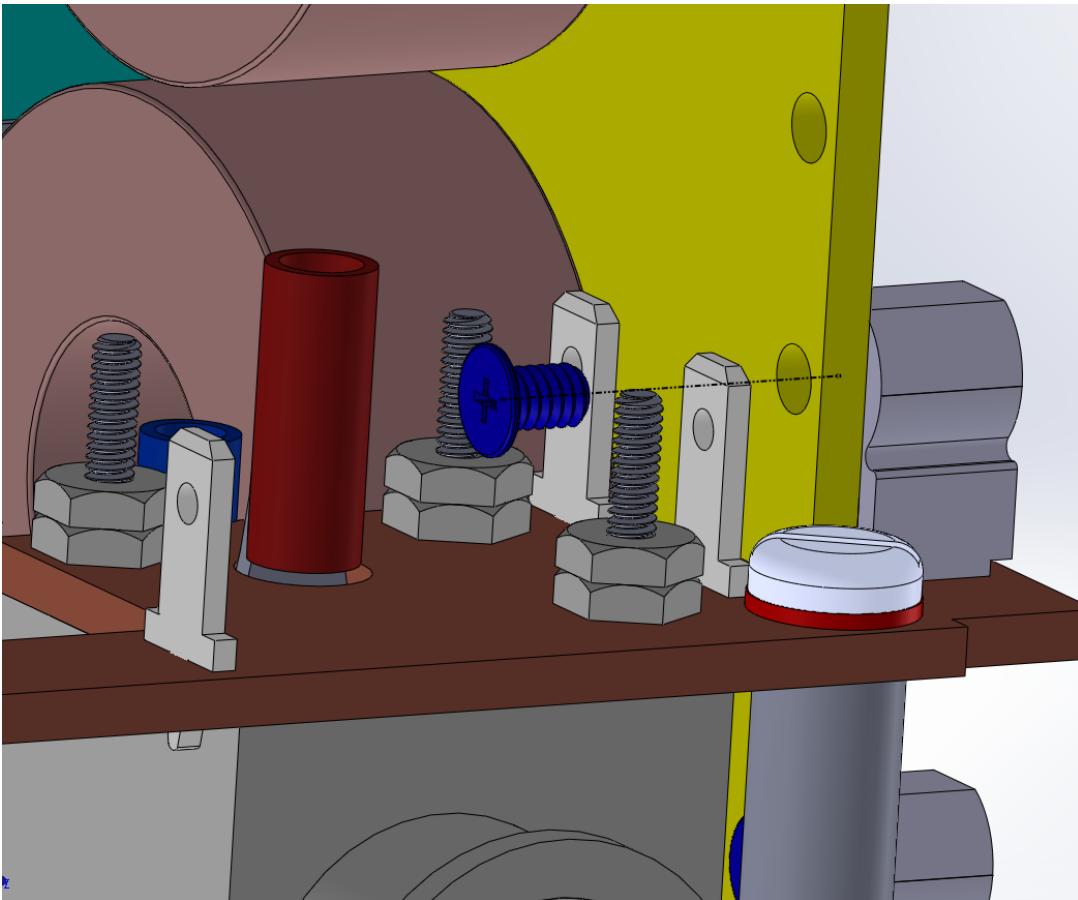


Figure 12: Use ONE M2 Board connection screw to connect the INNER FRONT of BPR to B2. To complete this step, you may need to bend the Wire Harness out of the way.

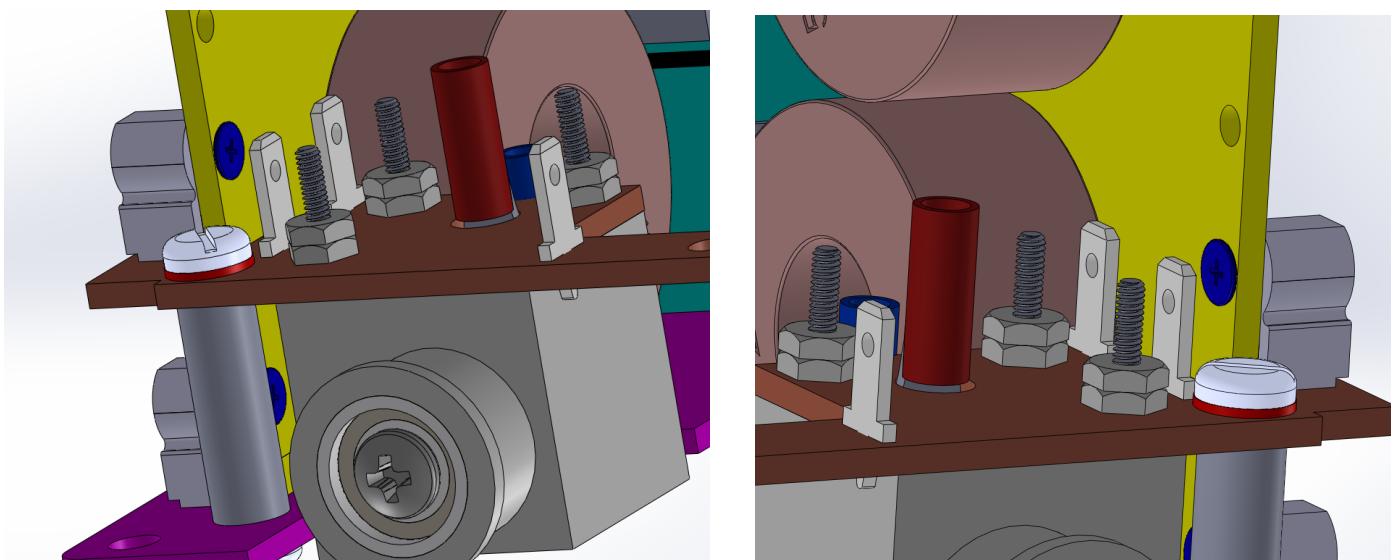


Figure 13: B2, BPL and BPR should now look like this.

VII Step Four: Solder the Thruster's Connections

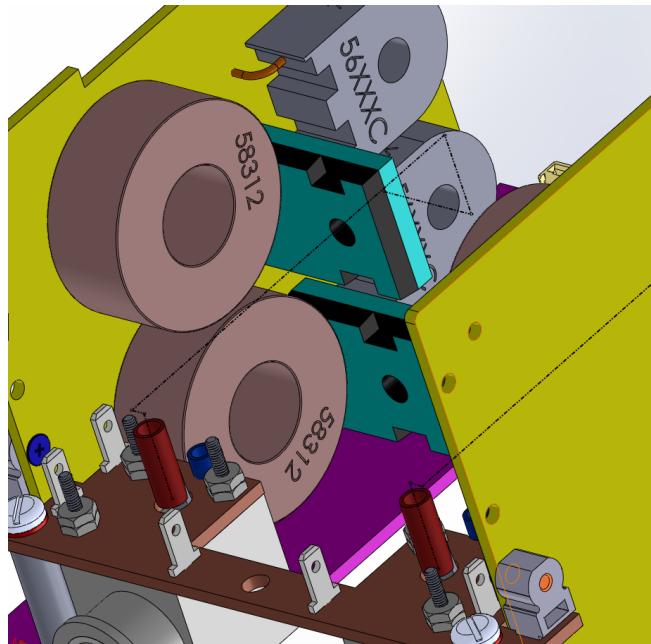


Figure 14: Solder and crimp a 16-22 AWG to Anode Ring Terminal (Red) on Thruster One. Run this wire to the back of BPL, through the BOTTOM Current Transformer and Solder to the terminal. Solder the Magnetic Coil and Cathode terminal to appropriate terminals (NOT SHOWN.)

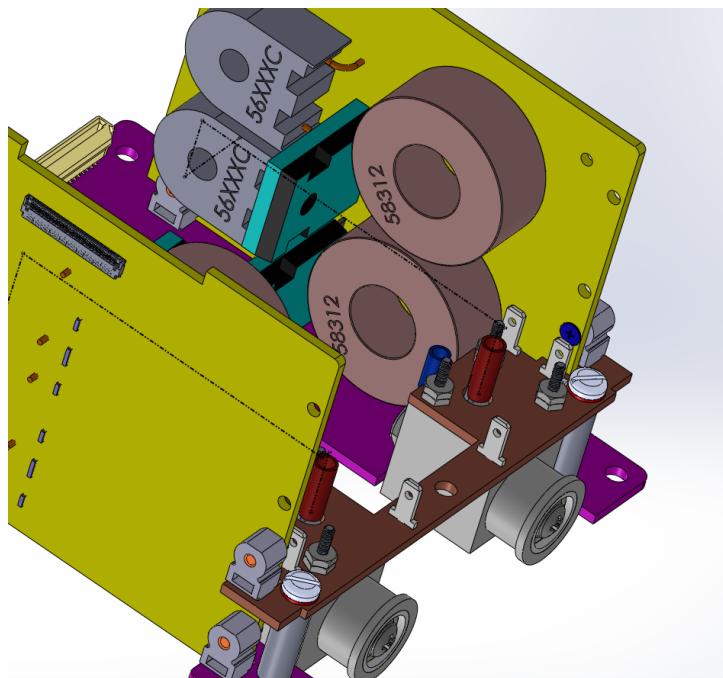


Figure 15: Solder and crimp a 16-22 AWG to Anode Ring Terminal (Red) on Thruster Two. Run this wire to the back of BPR, through the BOTTOM Current Transformer and Solder to the terminal. Solder the Magnetic Coil and Cathode terminal to appropriate terminals (NOT SHOWN.)

VIII Step Five: Connect the Top Board to BPL and BPR

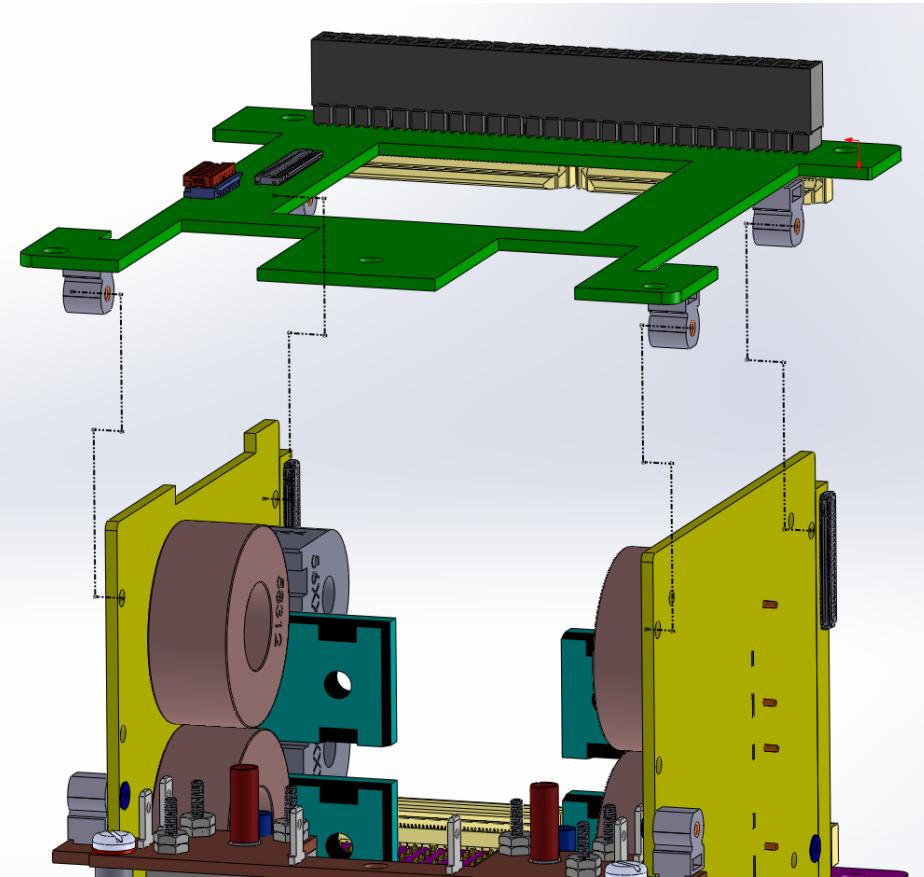


Figure 16: Line up the Right Angle Connectors on the Top Board with the holes shown on BPL and BPR.

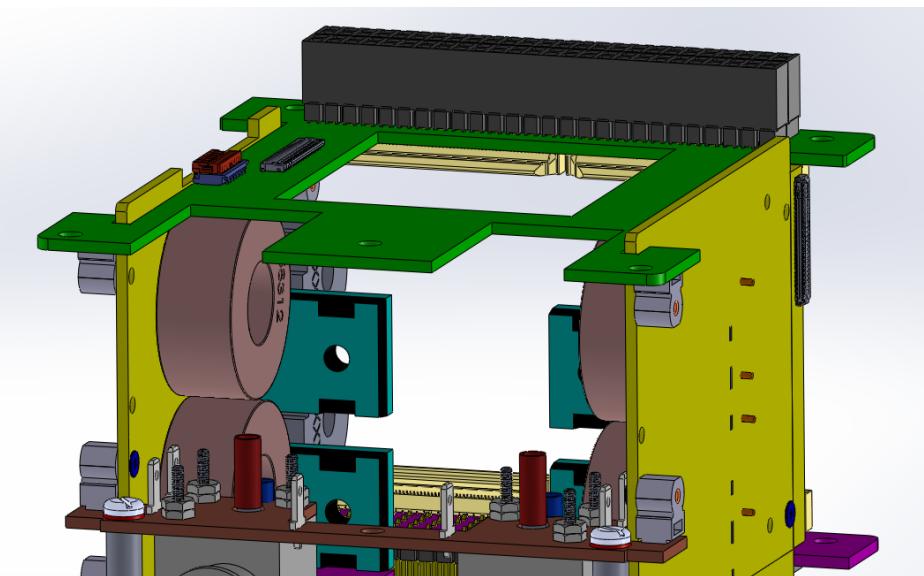


Figure 17: The Top Board, BPL and BPR should now look like this.

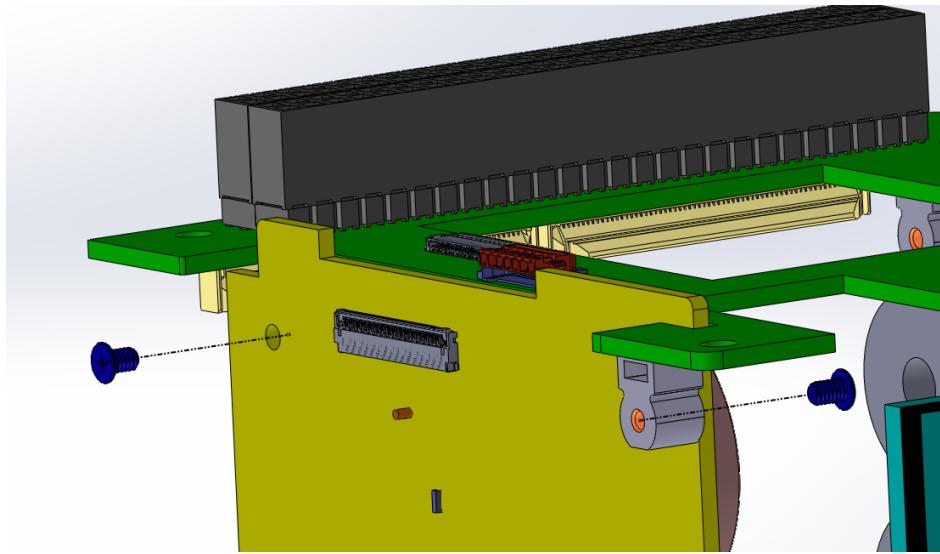


Figure 18: Use TWO M2 Board connection screws to connect the BPL to the Top Board's Right Angle Connectors.

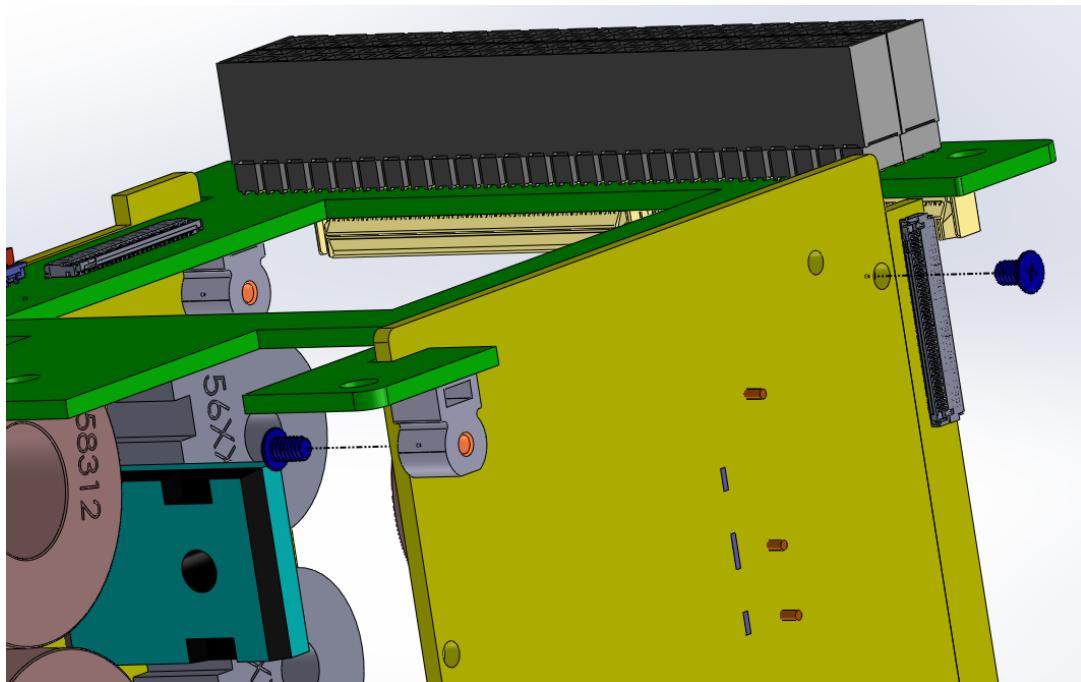


Figure 19: Use TWO M2 Board connection screws to connect the BPR to the Top Board's Right Angle Connectors.

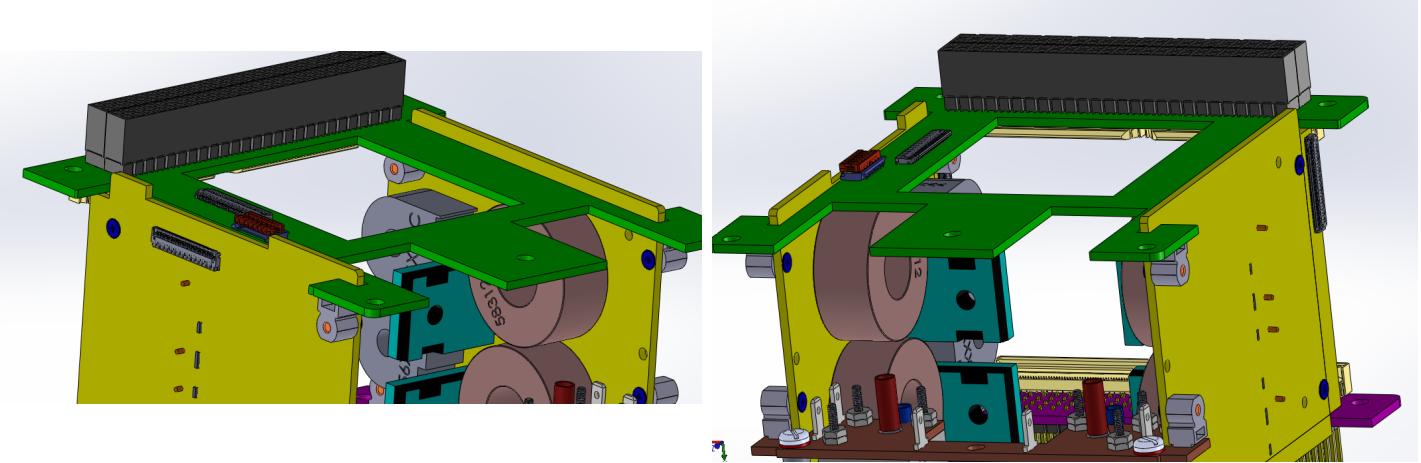


Figure 20: The Top Board, BPL and BPR should now look like this.

IX Step Six: Connect the Thrusters to T2

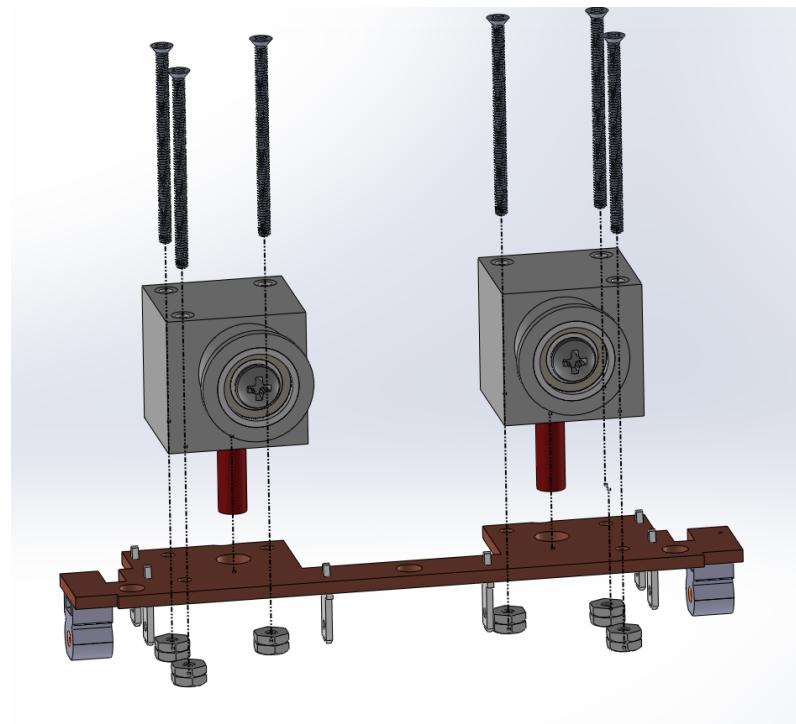


Figure 21: On T2, notice that the Right Angle Connectors and Wire Harnesses are facing DOWN. For EACH Thruster, use THREE 0-80 screws to go through the TOP of the Thruster and into T2. Secure the 0-80 screws with TWO Thruster Fastener Hex Nuts per screw.

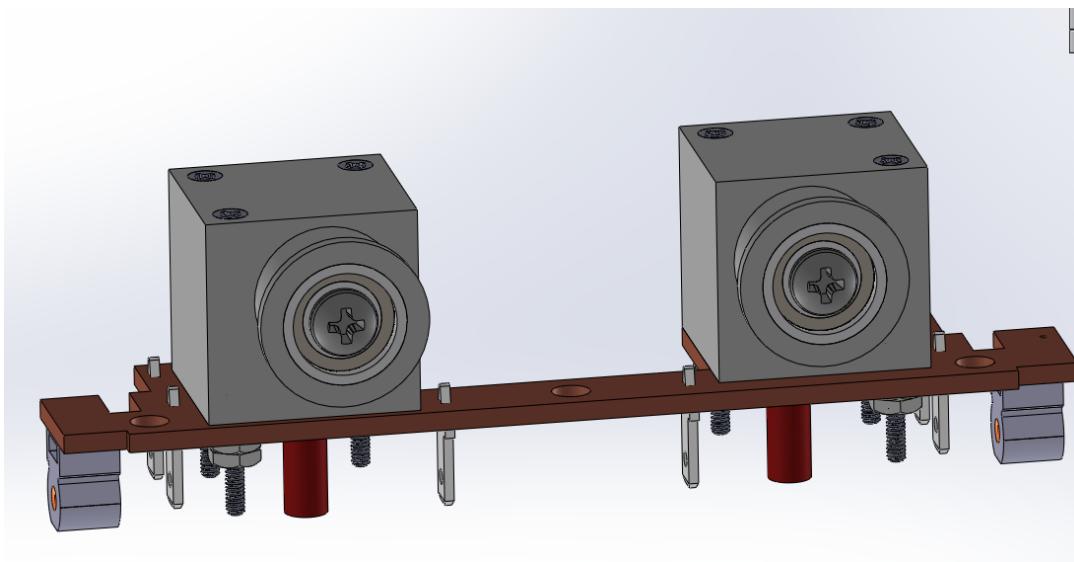


Figure 22: When connected, the Thrusters and T2 should look like this.

X Step Seven: Solder the Thruster's Connections

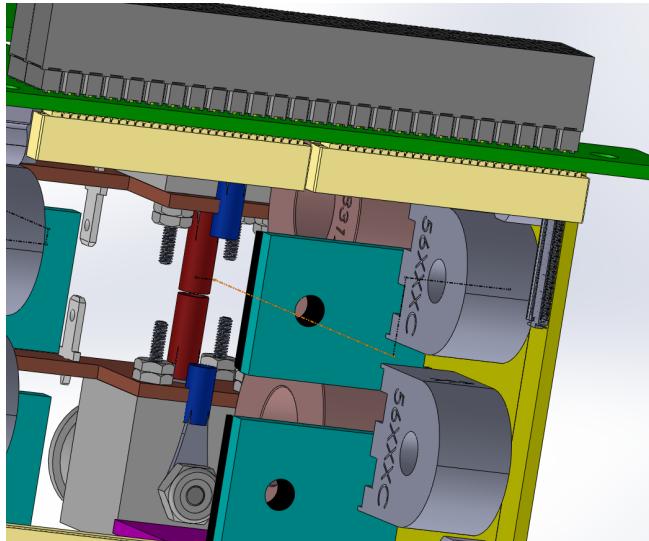


Figure 23: Solder and crimp a 16-22 AWG to Anode Ring Terminal (Red) on Thruster Two (Note that the position of the Thrusters are reversed on T2 compared to B2.) Run this wire to the back of BPL, through the TOP Current Transformer and Solder to the terminal. Solder the Magnetic Coil and Cathode terminal to appropriate terminals (NOT SHOWN.)

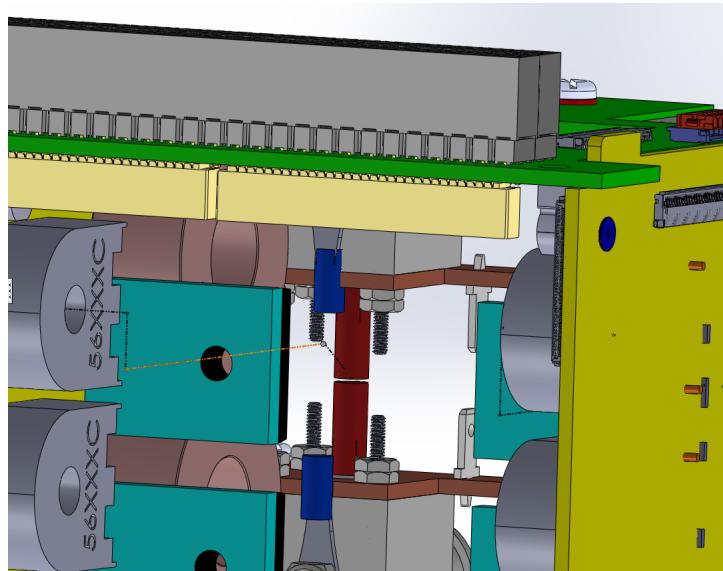


Figure 24: Solder and crimp a 16-22 AWG to Anode Ring Terminal (Red) on Thruster One. Run this wire to the back of BPR, through the TOP Current Transformer and Solder to the terminal. Solder the Magnetic Coil and Cathode terminal to appropriate terminals (NOT SHOWN.)

XI Step Eight: Connect T2 to BPL and BPR

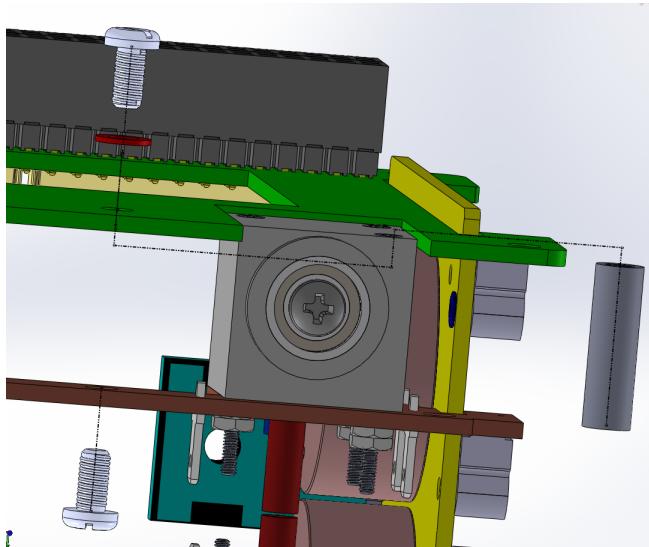


Figure 25: Position the Right Angle Connectors on T2 with their respective vertical holes on BPL and BPR. Slide in a 16 mm Spacer between the Top Board and T2 between their respective horizontal holes. Tighten a M3 (FH) Spacer Screw into the bottom of the Spacer. Use a M3 Belleville Spring Lock Washer and a M3 (FH) Spacer Screw for the top connection into the Spacer.

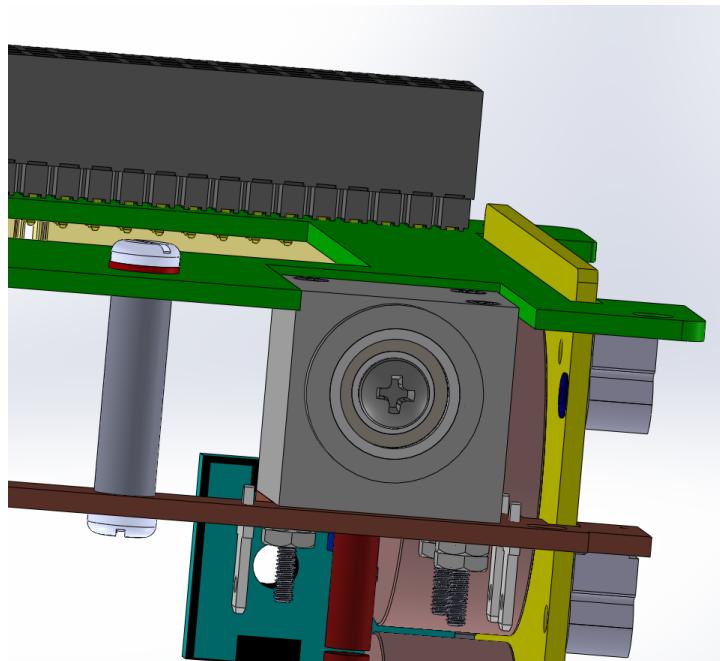


Figure 26: When connected, the Spacers, Belleville Spring Lock Washers, and M3 (FH) Spacer Screws should look like this.

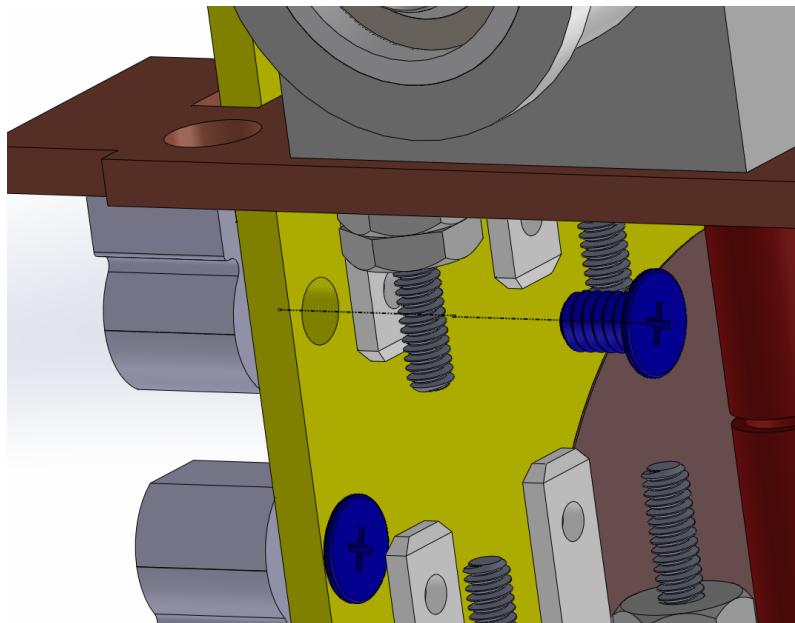


Figure 27: Use ONE M2 Board connection screw to connect the INNER FRONT of BPL to T2. To complete this step, you may need to bend the Wire Harness out of the way.

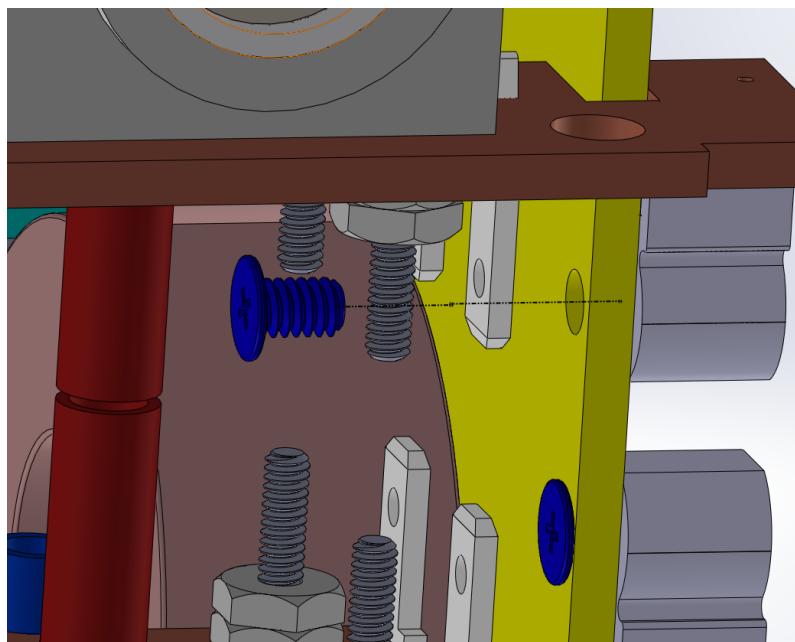


Figure 28: Use ONE M2 Board connection screw to connect the INNER FRONT of BPR to T2. To complete this step, you may need to bend the Wire Harness out of the way.

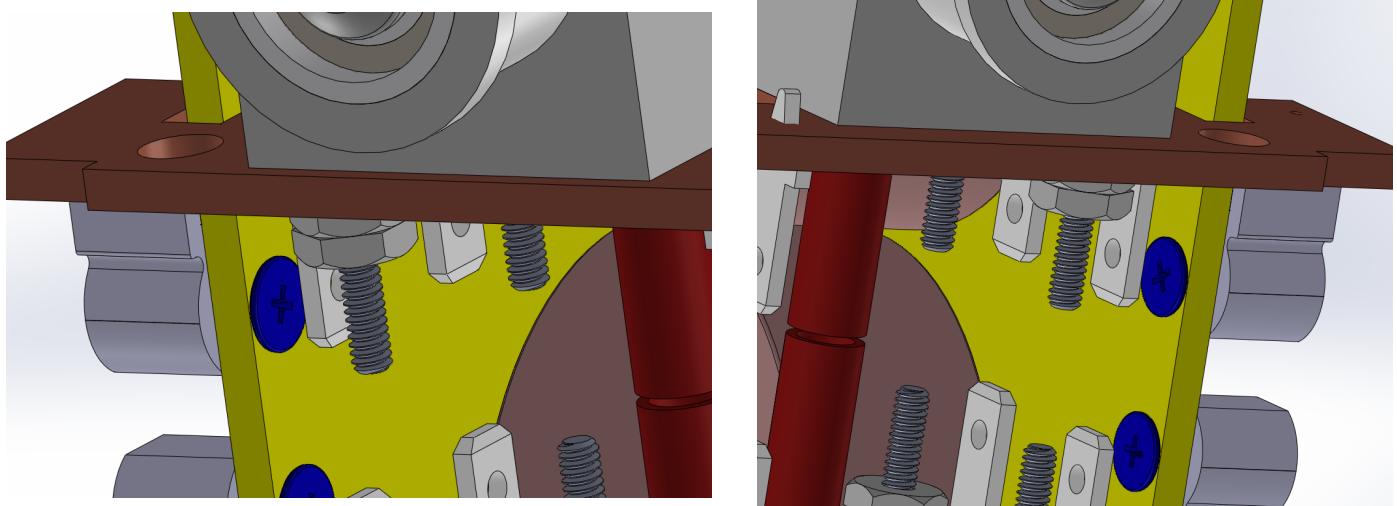
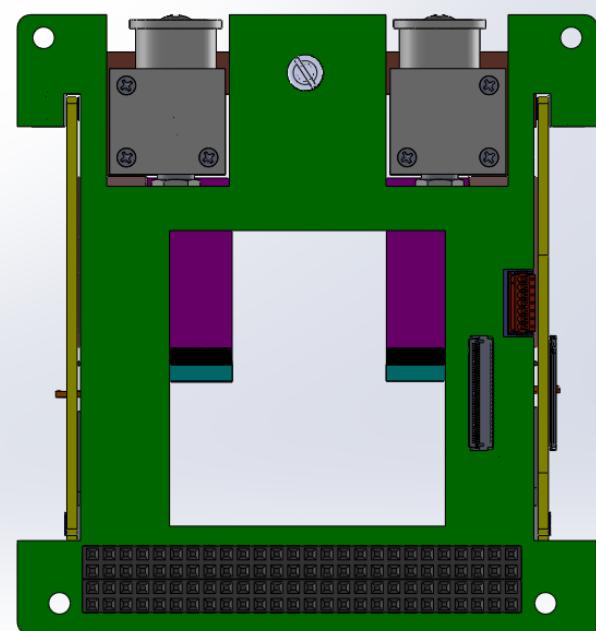
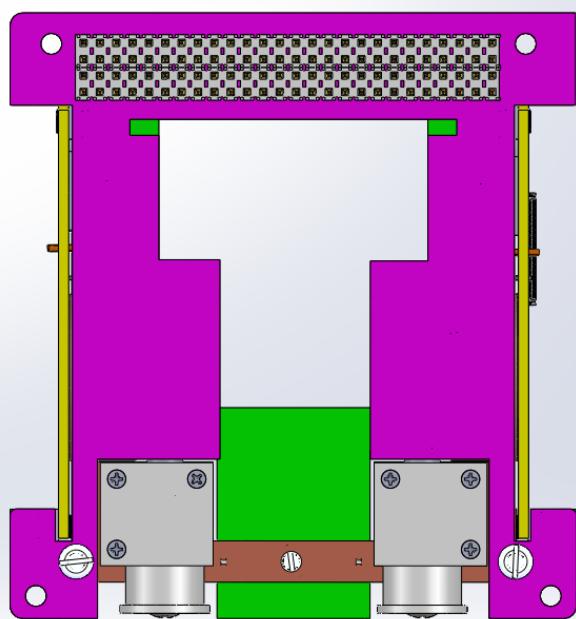


Figure 29: T2, BPL and BPR should now look like this.

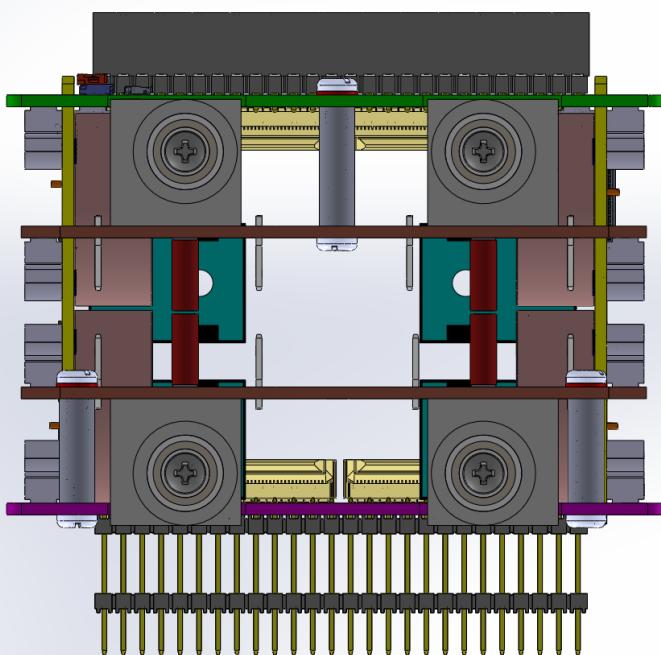
XII Final Appearance



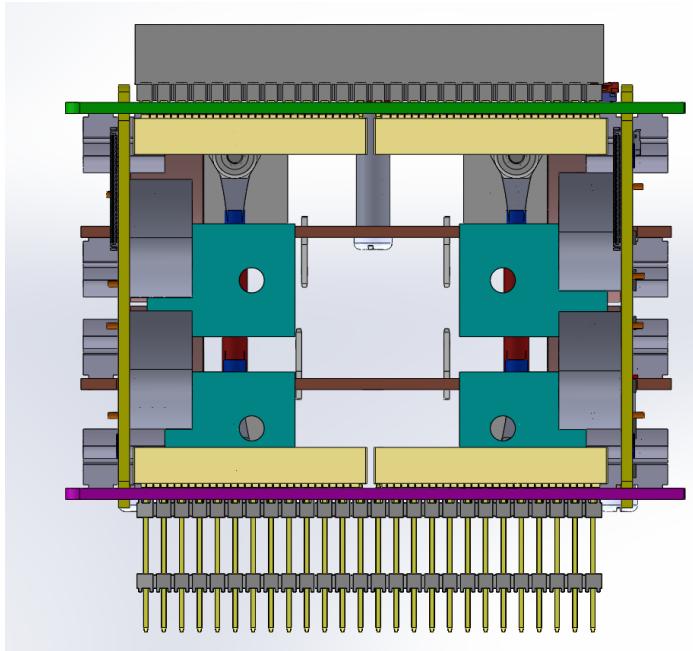
(a) Top View



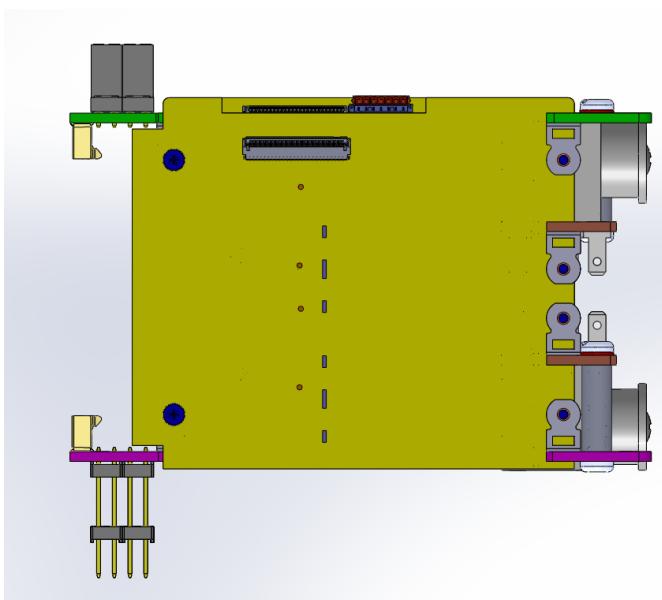
(b) Bottom View



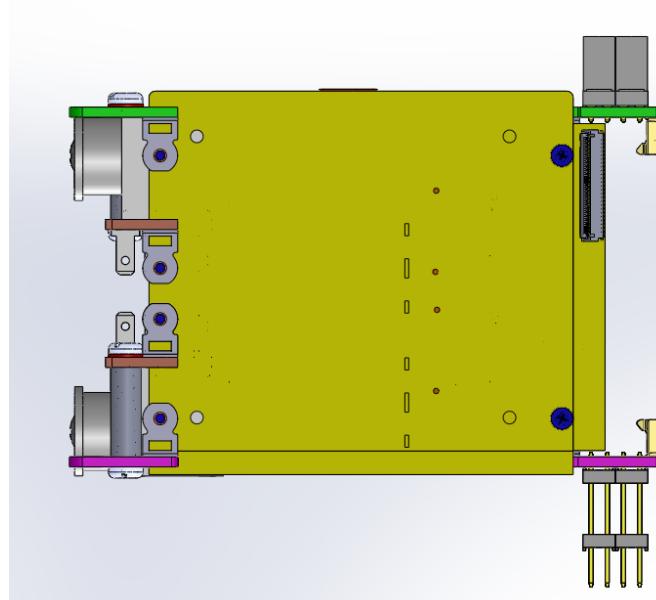
(a) Front View



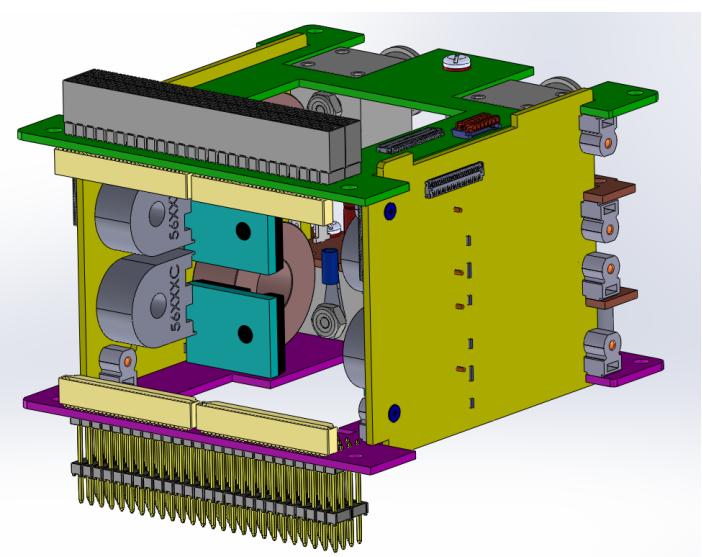
(b) Back View



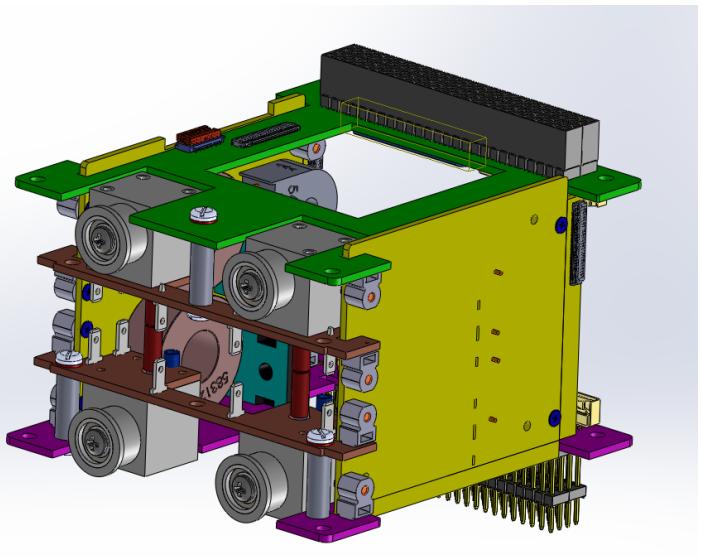
(a) BPL View



(b) BPR View



(a) Back Angled View



(b) Front Angled View

Part C

NASA GODDARD TESTING

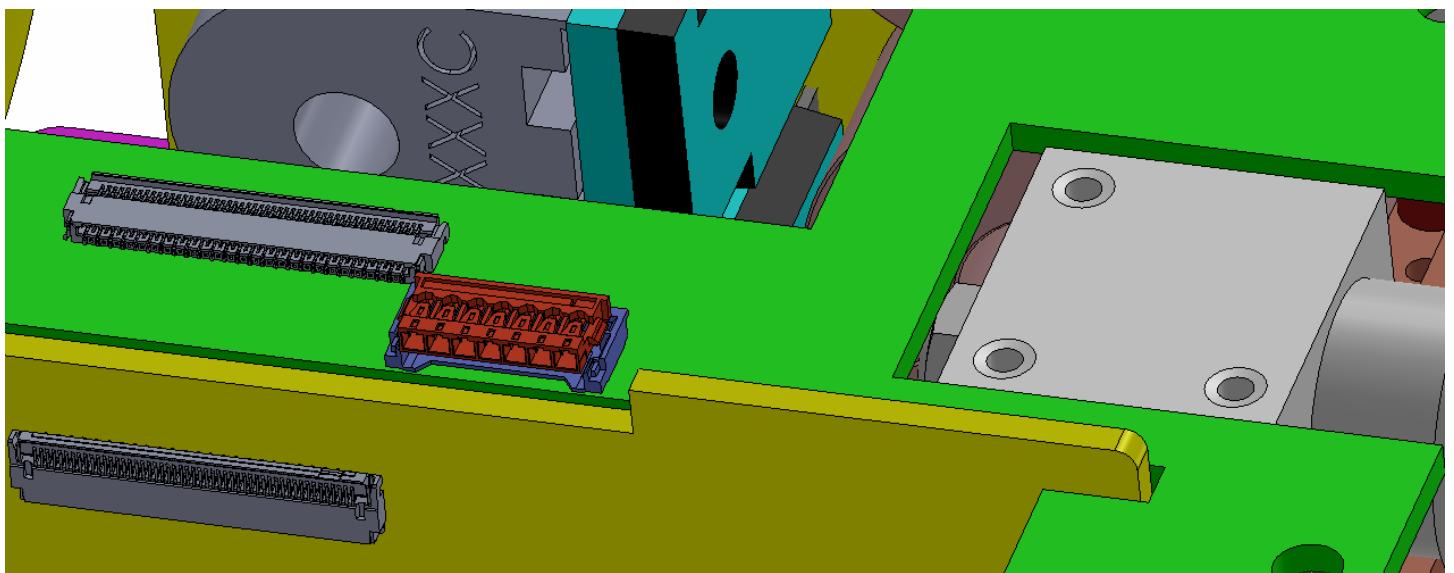


Figure 34: During testing, there is an additional cable which must be connected. A wire harness of 7 pins with 78172-0410 Crimp terminals must be inserted into the 78172 Pico EX mate Crimp housing, and the housing must be connected into the Top Board. This connection is for all ground testing at NASA Goddard's Facilities, as a CubeSat Bus is not present. This can also act as a backup in case I2C is not working properly with the system.

Part D

YONSEI INTEGRATION

XIII Yonsei Satellite

The μ CAT Sub-system will be shipped to Yonsei University as a whole tested system. The integration procedures written below are concepts based on the SolidWorks files that our team has received. The suggested integration is not an end all solution, and, if Yonsei University can find a better method, please do so at their convenience.

The fully assembled μ CAT Sub-system should be ready to integrate with Yonsei University's Satellite inner section, made up of three motors: Red, Blue and Green.

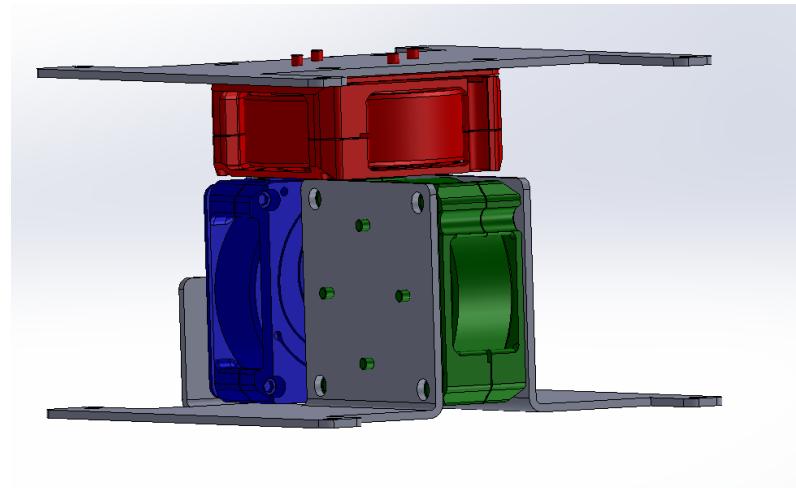
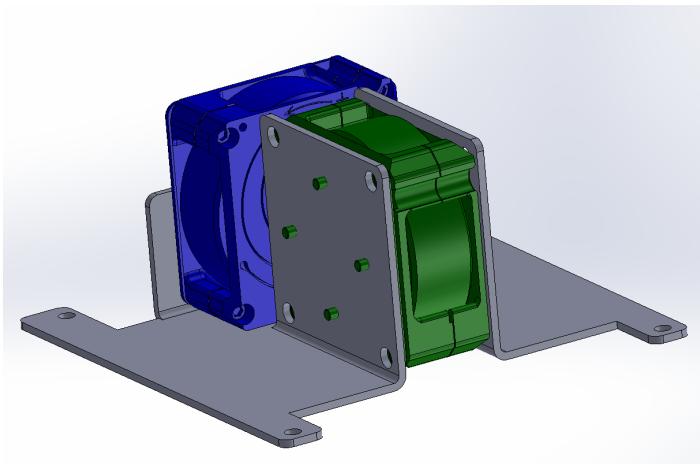
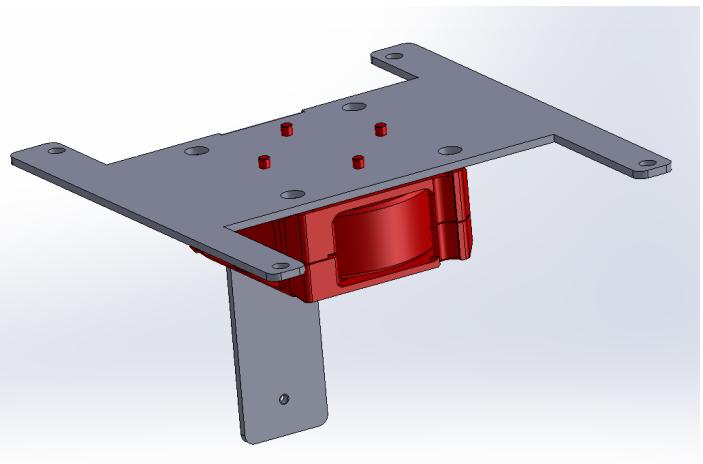


Figure 35: Yonsei University's Motors and.



(a) Bottom Motor Mount with Blue and Green Motors.



(b) Top Motor Mount with Red Motor.

XIV Bottom Wheel Mount

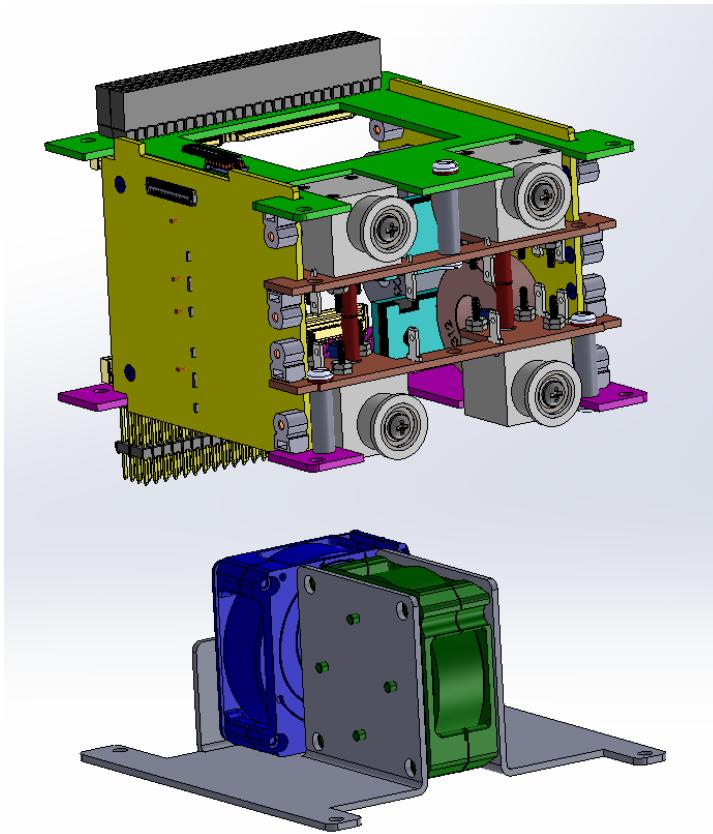


Figure 37: The μ CAT Sub-System should slide over the Bottom Motor Mount with Blue and Green Motors.

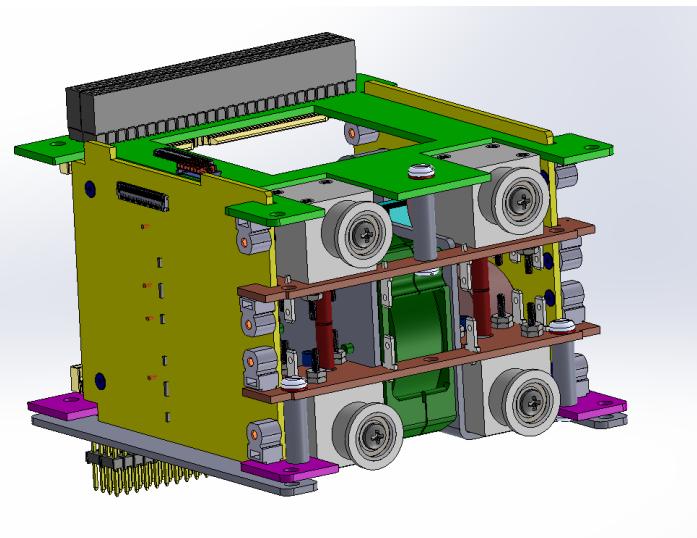


Figure 38: This is what the integrated system should now look like.

XV Top Wheel Mount

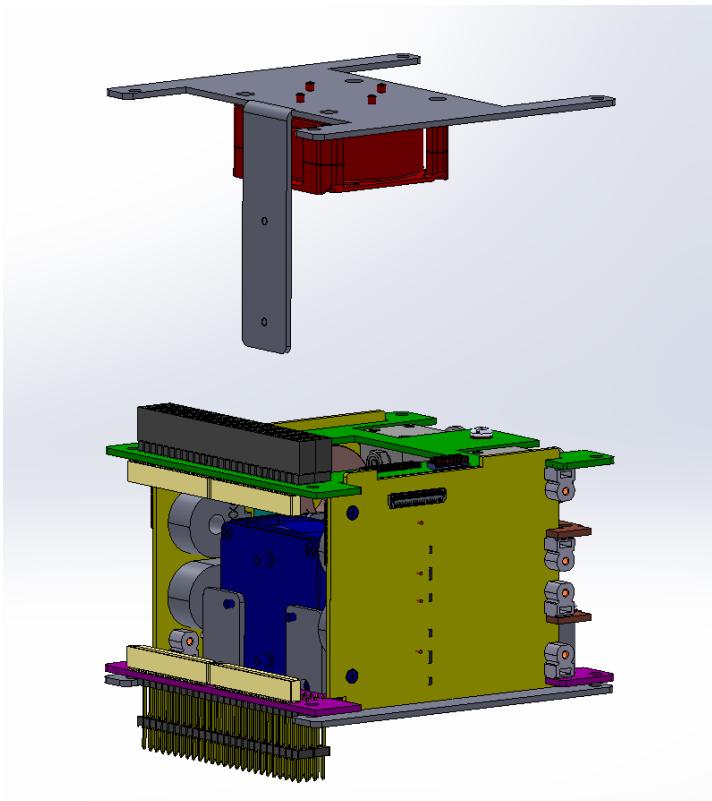


Figure 39: The Top Motor Mount and Red Motor should slide over the μ CAT Sub-system.

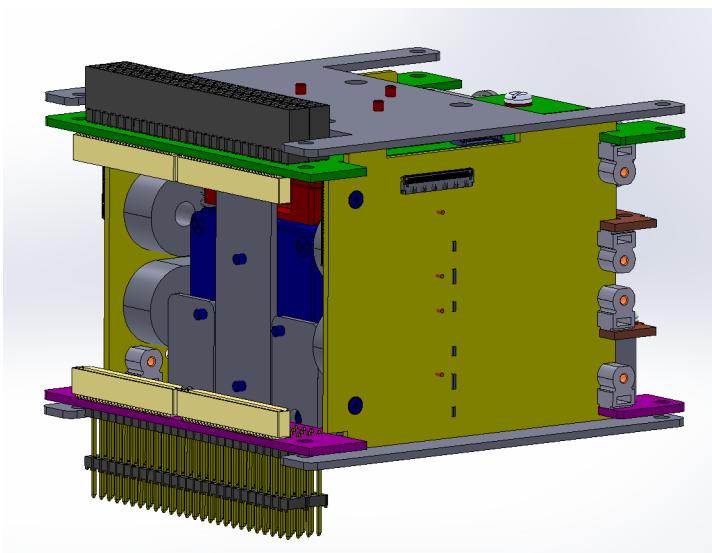


Figure 40: This is what the integrated system should now look like.

XVI Cord Connection

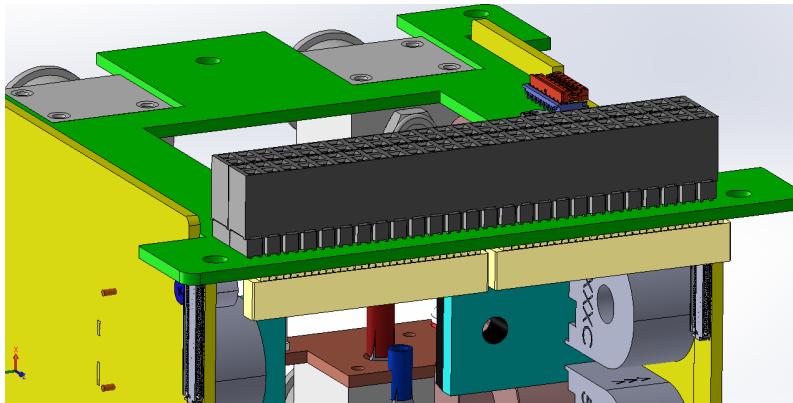


Figure 41: First, connect the TWO 60 pin Connectors from the Bottom Board to the Top Board. This must be placed in that order (Bottom Board to Top Board) as suggested from the manufacturers. Following that connection, a final wire connection using the 50 Pin Connector from BPL to BPR (NOT SHOWN) should be made.

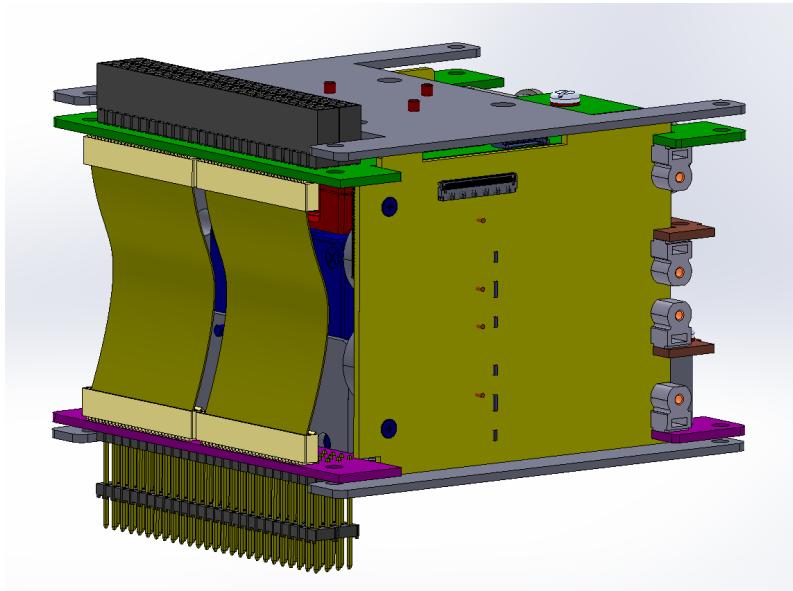


Figure 42: This is what the cable system should now look like.

XVII Conclusion

All of the required tools and pieces, as well as methods for building and integrating the μ CAT Sub-system with Yonsei University's satellite, with necessary figures, have been explained in this document. If the user has any questions or concern, please contact GWU MpNL.

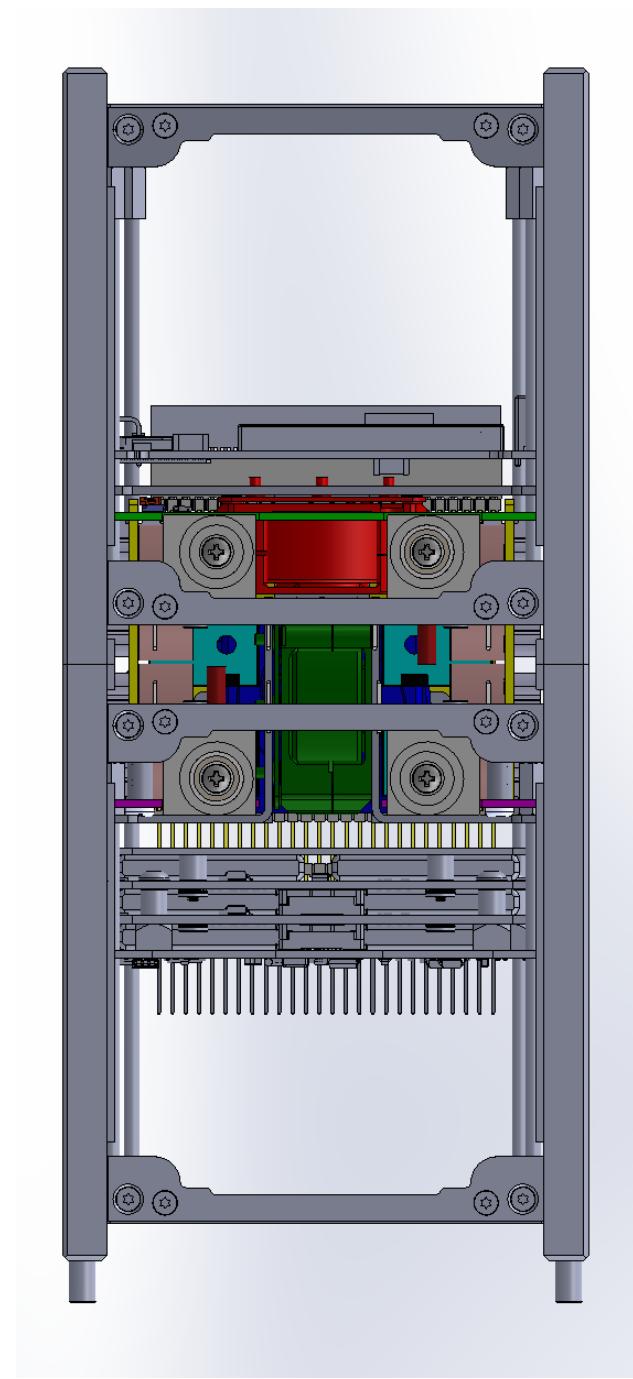


Figure 43: Full Integrated System.