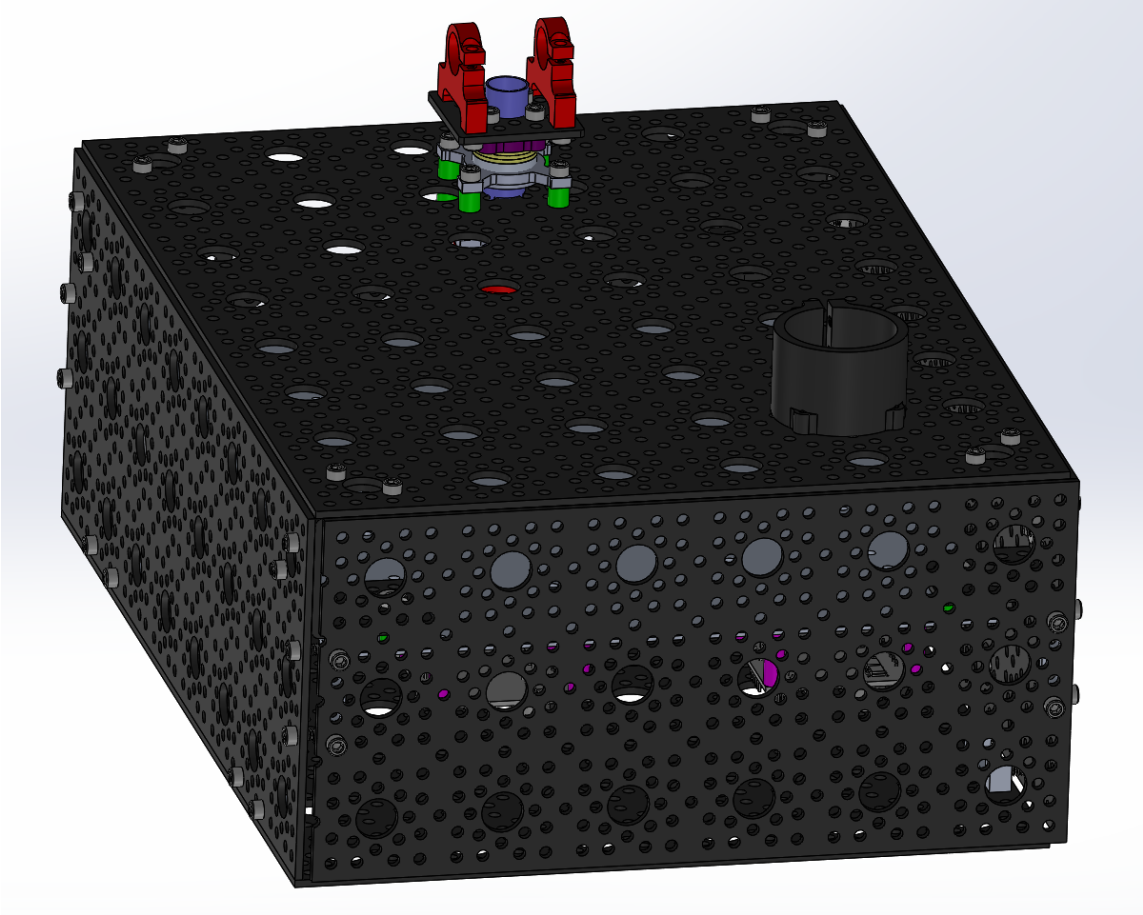

Open Source Rover: Body Assembly Instructions

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Contents

1 Machining/Fabrication

1.1 Cut the Front Aluminum Plate

For the large aluminum plates that make up the main body of our rover, we will need two 9x12 inch plates (top and bottom), two 12x4.5 inch plates (left and right sides), and one 9x4.5 inch plate (for the front; the back panel will be made of laser cut acrylic and described later). However, the aluminum plates on our parts list only come in the 9x12 inch and 4.5x12 inch sizes. We will therefore need to custom cut the front 9x4.5 inch panel. Cut one panel to the dimensions given in Figure 1.

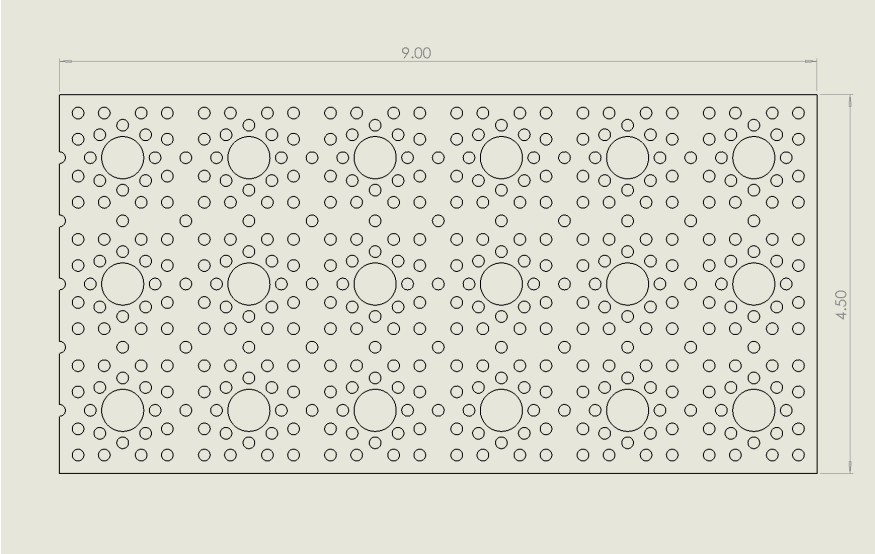


Figure 1: Cutting the front panel of the body

1.2 Laser Cut Parts

In order to put the electronics inside the robot body we need an electronics board. Additionally, the back panel of the rover requires a couple custom cutouts accessing components like our voltage monitor and the USB ports on the Raspberry Pi. One simple and inexpensive solution for these parts is to order pieces of laser cut acrylic. In the Body Assembly folder in the repository, there is a folder called Laser Cut Parts. That folder contains two .DXF files which are 2D path files for a laser cutter. If you have a laser cutter, you may cut these parts

yourselves. Also, there are many inexpensive laser cutting website services. An example of one of these sites is:

- https://www.sculpteo.com

To get the above parts from Sculpteo, go to Laser cutting and then upload these files (with mm selected as units). Hit Next. Make sure scale is set to 100%, change the material to Acrylic, have thickness to 1/8, and then select whatever color you wish.

1.3 9x12 Aluminum Plate Drilling

Next we need to drill a hole in one of the 9x12 Aluminum plates **S35** because we will need a hole of just over 0.5 in diameter for the differential pivot mount. There is already a small hole drilled in the location we want to use, but it needs to be widened substantially. Start with the drill # 23 and drill the hole shown by Figure 2. Repeat this with drill sizes stepping up until you get to a drill of 0.5 in. Take the 0.5 in hollow rod **S19** and make sure it spins freely in the hole you have created. If it does not, drill the hole slightly larger or sand/file the hole until the rod spins with no resistance.[1]

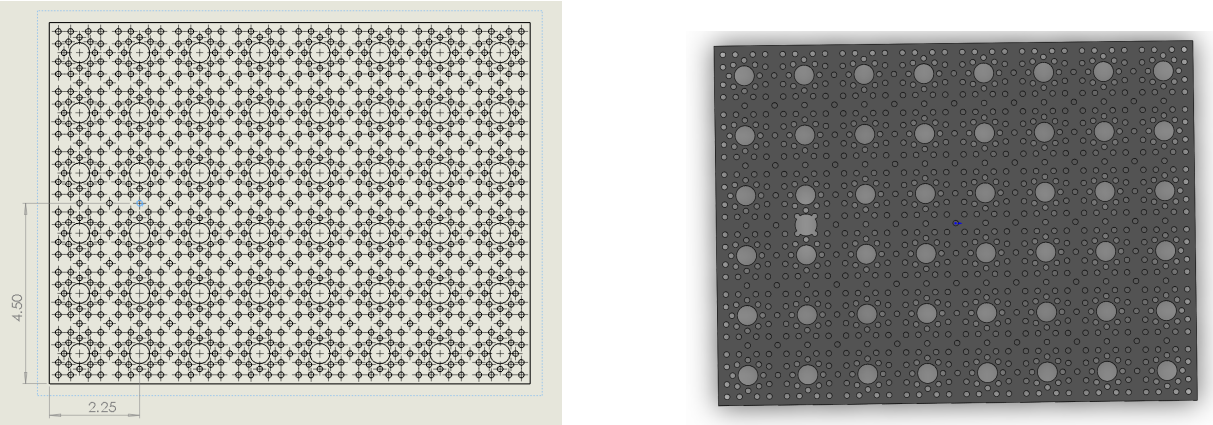


Figure 2: Drilling the Aluminum Plate

[1]The 0.5 in hollow rod must spin *freely* while mounted inside the bearing blocks (See step 2.2 Differential pivot for example). It may help to follow step 2.2 in this document to test if you have enough clearance.

2 Mechanical/Structural Assembly

2.1 Chassis

Table 1: Parts/Tools Necessary

Item	Ref	Qty	Image	Item	Ref	Qty	Image
1.5" Channel	S1	4		#6-32x3/8" Button Head Screw	B2	16	
4.5"x12" Aluminum Plate	S37	2		#6-32x1" Button Head Screw	B6	4	
1" PVC Clamp	S24	1		#6-32 Locking Hex Nut	B11	20	
9"x12" Aluminum Plate	S35A	1		Allen Key Set	D2		
#6-32x1/4" Button Head Screw	B1	4		5/16" Wrench	D1		

1. **Attach the channels to the Top panel:** Take the modified 9x12 Aluminum plate **S35A** and attach the four 1.5inch channel connectors **S1** using screws **B2** and hex nuts **B11** at each of the corners as shown in Figure 3. Make sure to use the inner circle for these screws and not the outer ones where there won't be enough clearance for the hex nut.

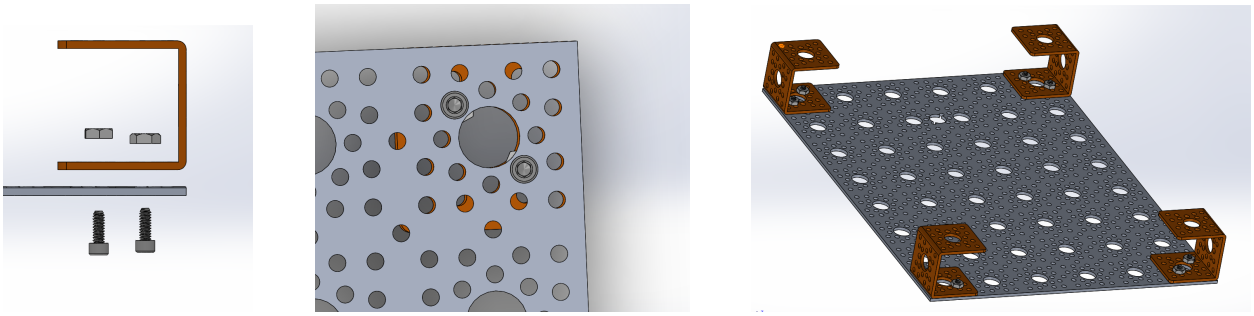


Figure 3: Attaching channels to aluminum plate

2. **Attach the side panels:** Attach the 4.5x12 plates **S37** to the channels using screws **B2** and hex nuts **B11**, again using the middle circle of holes for the screws and hex nuts.

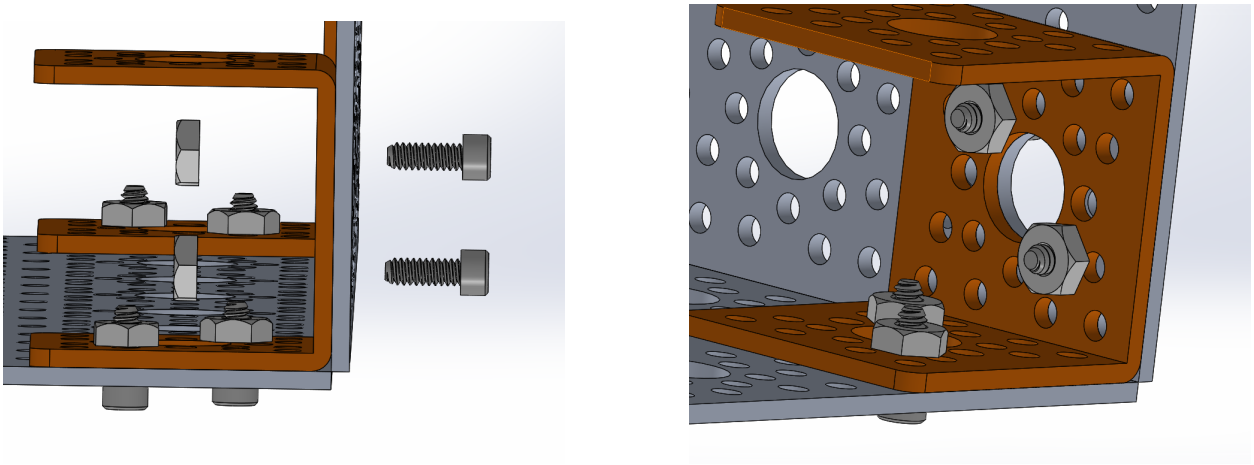


Figure 4: Attach the side panels

3. **Attach the PVC clamping hub:** Attach the 1-inch PVC bore clamping hub **S24** to the top plate of the body using screws **B1** wherever you would like your rover's "neck" to protrude from the body. We suggest using the location shown in Figure 5.

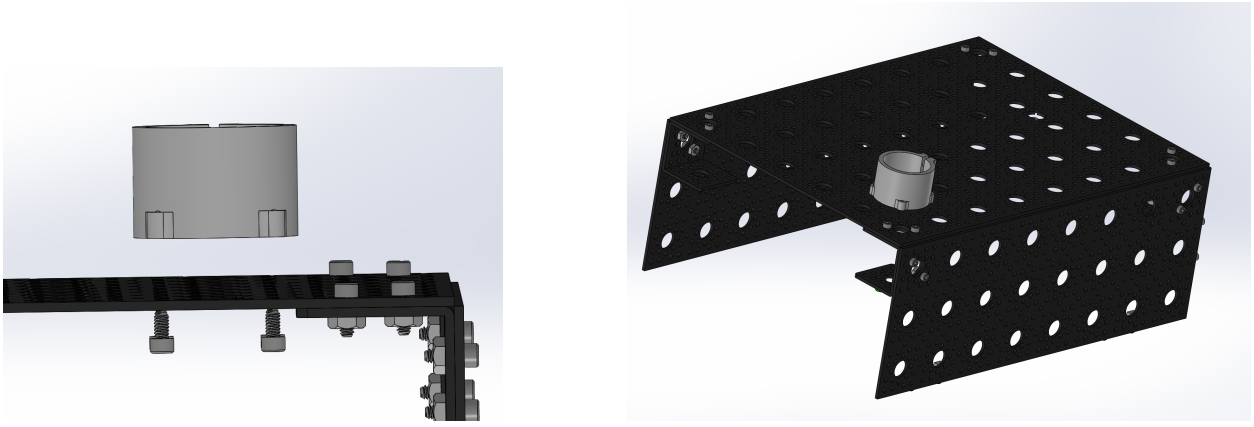


Figure 5: Attach the PVC clamp to top plate

2.2 Differential Pivot Block

The differential pivot is used to transfer weight off of the wheel that is currently climbing to the other front wheel, allowing the rover to climb more easily. Additionally, it serves as a

second contact point for the rover's body such that it does not rotate freely about the cross rod.

Table 2: Parts/Tools Necessary

Item	Ref	Qty	Image	Item	Ref	Qty	Image
Single Hole Pattern Bracket	S8	1		#6-32x1/4" Spacer	T1	8	
0.5" Pillow Bearing Block	S11	2		#6-32x1/4" Button Head Screw	B1	6	
0.5" Circular Clamping Hub	S13	1		#6-32x1" Button Head Screw	B6	4	
0.5"x2" Aluminum Rod	S19	1		0.5" Plastic Washer	W3	3	
0.5" Bottom Bore Clamp	S20	2		Allen Key Set	D2		
Collar Clamp	S22	1		5/16" Wrench	D1		

1. **Mount the pillow bearing blocks:** Using spacers **T1**, screws **B6**, and hex nut **B11**, mount the pillow blocks **S11** to the top of the body over the hole in the aluminum plate that you drilled earlier as shown in Figure 6.

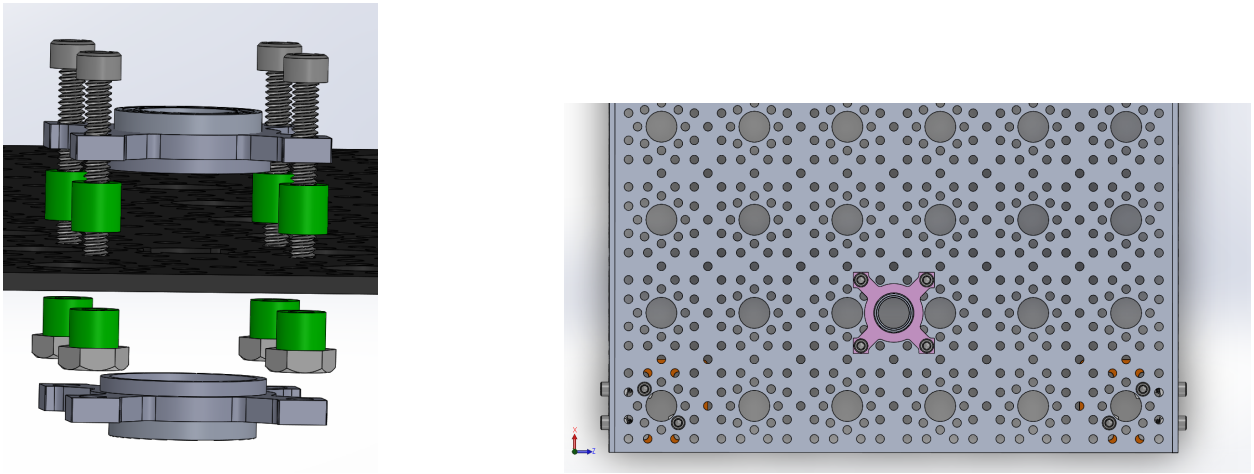
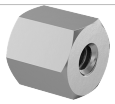
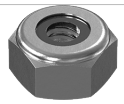
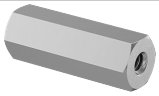
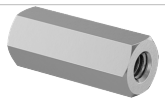


Figure 6: Mounting the pillow blocks

2.3 Electronics Board

Next up is preparing the electronics plate. This plate holds all the electrical components, including the Raspberry Pi, all 5 RoboClaw Motor controllers, and the voltage regulator.

Table 3: Parts/Tools Necessary

Item	Ref	Qty	Image	Item	Ref	Qty	Image
Raspberry Pi 3 Model B	E1	1		#6-32x1/2" Button Head Screw	B3	4	
RoboClaw Dual Motor Controller	E2	5		#4-40x1/4" Button Head Screw	B8	72	
5V Regulator	E4	1		M2.5x11mm Screw	B10	12	
#6x1/4" Spacer	T1	4		#2-56x3/16" Button Head Screw	B13	4	
#4-40x1/4" Threaded Standoff	T4	8		#6-32 Locking Nut	B11	4	
#4-40x1/2" Threaded Standoff	T5	12		#6-32 Washer	W1	12	
#4-40x3/4" Threaded Standoff	T6	8		Allen Key Set	D2		
M2.5x12mm Threaded Standoff	T7	4		5/16" Wrench	D1		
#2-56x3/8" Threaded Standoff	T8	2					

1. **Attaching the Standoffs** There are a few different standoffs here. By using different standoff heights,we gain access to the micro USB port on each of the individual RoboClaws. The Raspberry Pi also has its own metric standoffs. In Figure 7, the colors correspond to the following parts: Green:**T4**, Blue:**T5**, Pink:**T6**, Cyan:**T7**, Yellow:**T8**. Use the screw that corresponds to the spacer or standoff used.

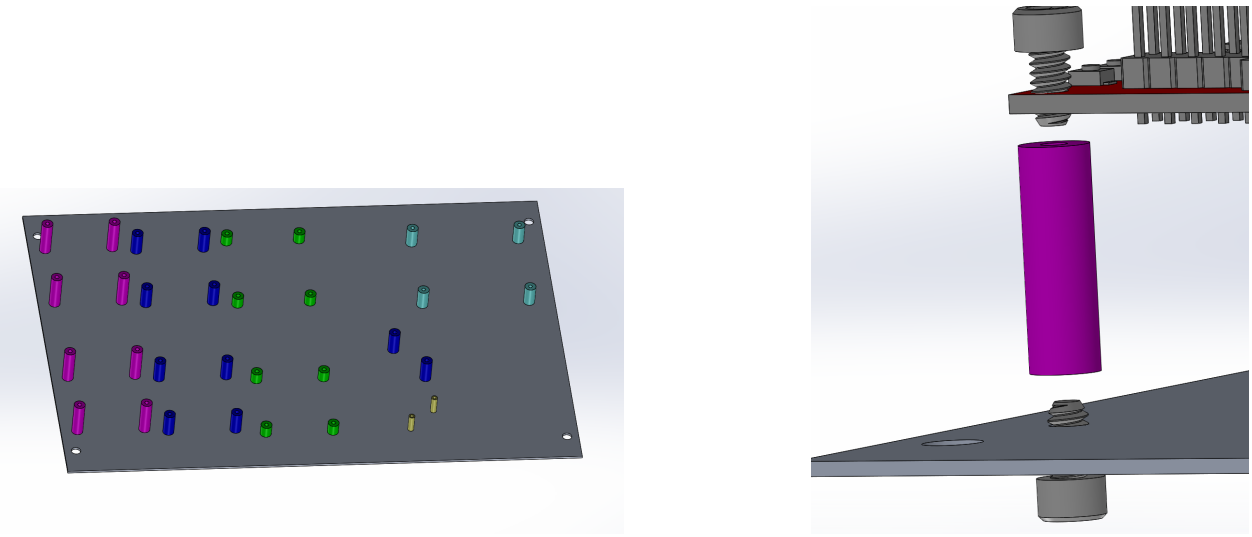


Figure 7: Electronics Board Step 1

2. **Mounting the Electronics:** Take the Raspberry Pi **E1**, RoboClaws **E2**, and voltage regulator **E4** and mount them in the locations shown in Figure 8, again using the screws **B8 and B10** corresponding with each standoff.

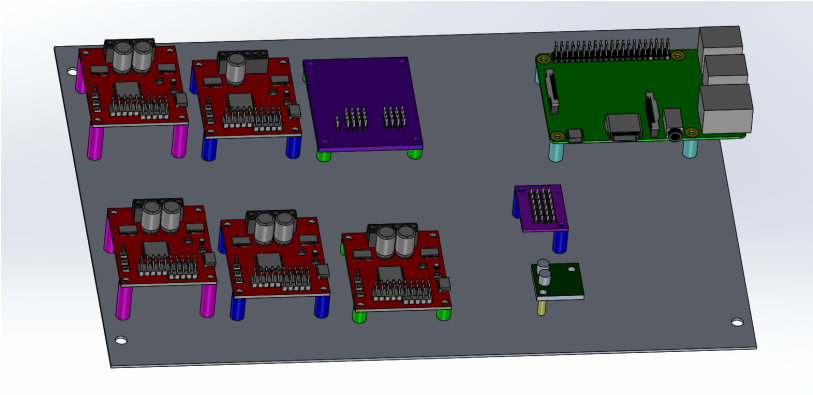


Figure 8: Electronics Board Step 2

3. **Mounting Electronics into Chassis:** Now that the electronics are on the plate, we can mount it into the chassis. Using screws **B3**, washers **W1** (3 washers per corner), and hex nuts **B11** attach the electronics board to the chassis at all four corners.[2]

[2]The washers give a small amount of extra space that is needed to fit the Voltage monitor in the system later.

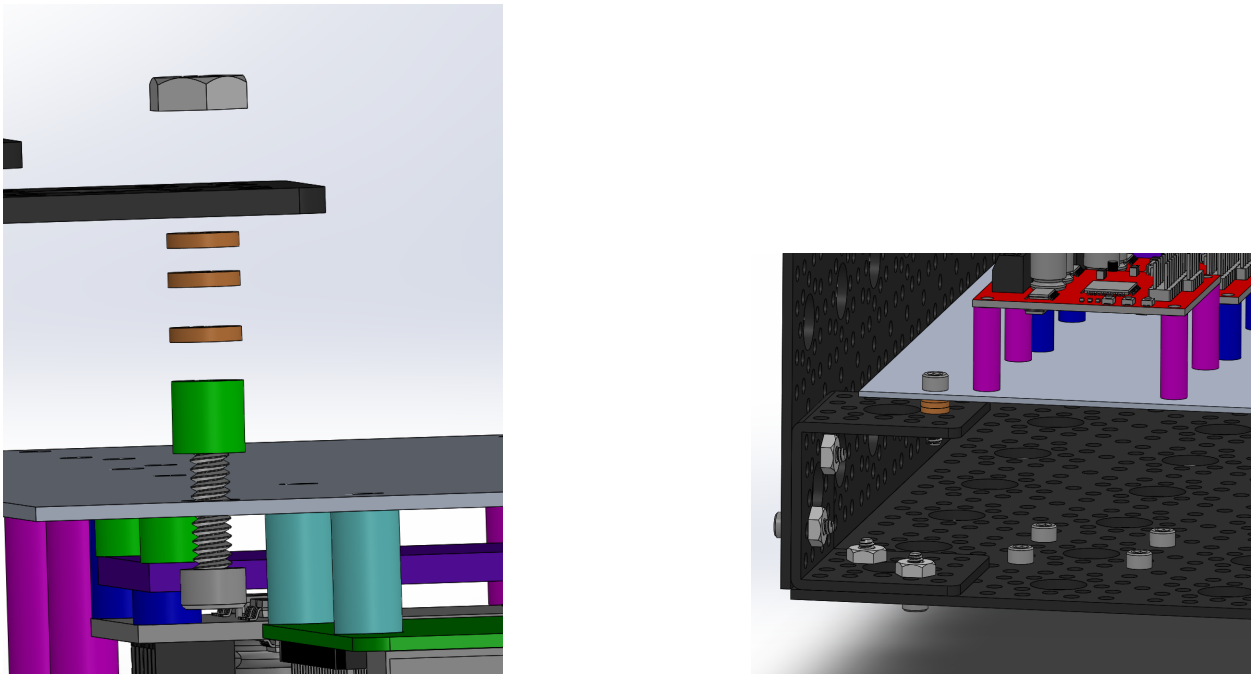


Figure 9: Electronics Board Step 3

Figure 10 shows how we mounted the volt meter as an example of how the pieces should fit together. If the volt meter does not fit in this gap, you can add additional washers from the previous step to space the electronics board farther from the top plate.

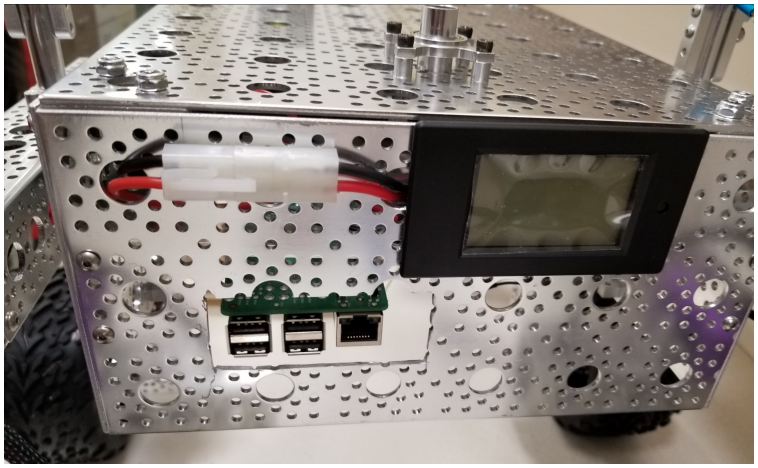
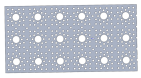
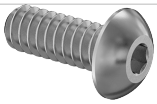
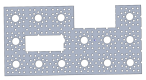


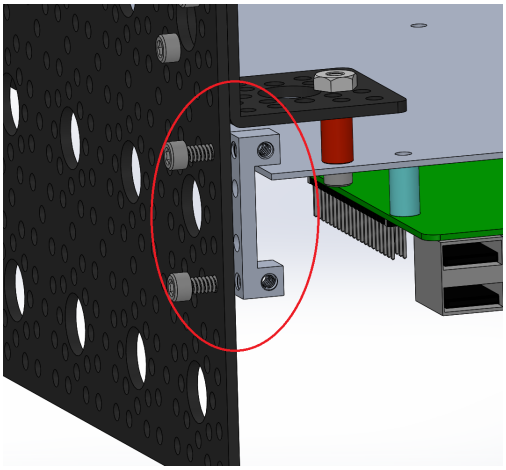
Figure 10: Volt meter and connectors mounted

2.4 Closing the Body

Table 4: Parts/Tools Necessary

Item	Ref	Qty	Image	Item	Ref	Qty	Image
Dual Side Mount A	S17	8		#6-32x1/4" Button Head Screw	B1	24	
4.5"x9" Aluminum Plate (modified)	S37A	1		#6-32x3/8" Button Head Screw	B2	8	
4.5"x9" Aluminum Plate (modified)	S37B	1		Allen Key Set	D2		
9"x12" Aluninum Plate	S35	1					

1. **Attach the Dual Side Mounts:** Mount Dual Side Mounts A **S17** using screws **B1** in the locations shown in Figure 11.



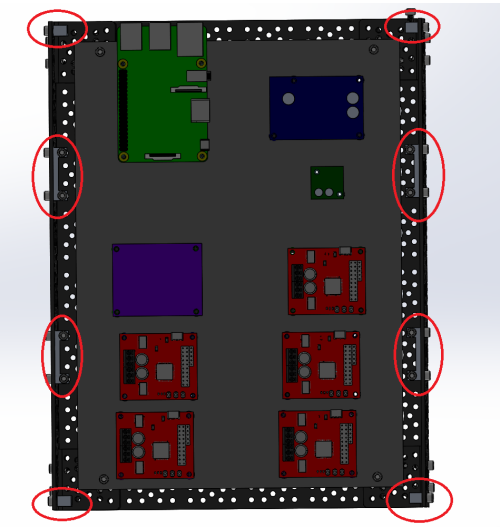


Figure 11: Dual Side Mount A locations

2. **Attach the front/back panel:** Attach the Acrylic back panel **S37B** to the "back" of the body using screws **B2** (the "back" of the rover will be the side with the Raspberry

Pi). The cutout should line up with the USB ports on the Pi. Repeat this with the aluminum plate for the front of the body with **S37A**.

Figure 12: Mounting the front/back panels

3. **Attach the bottom panel:** Attach the 9x12 Aluminum Plate **S35** to close the bottom of the body using screws **B1**.

   At this point the body should be complete with the differential pivot mount, electronics, and chassis and should look similar to Figure 13.

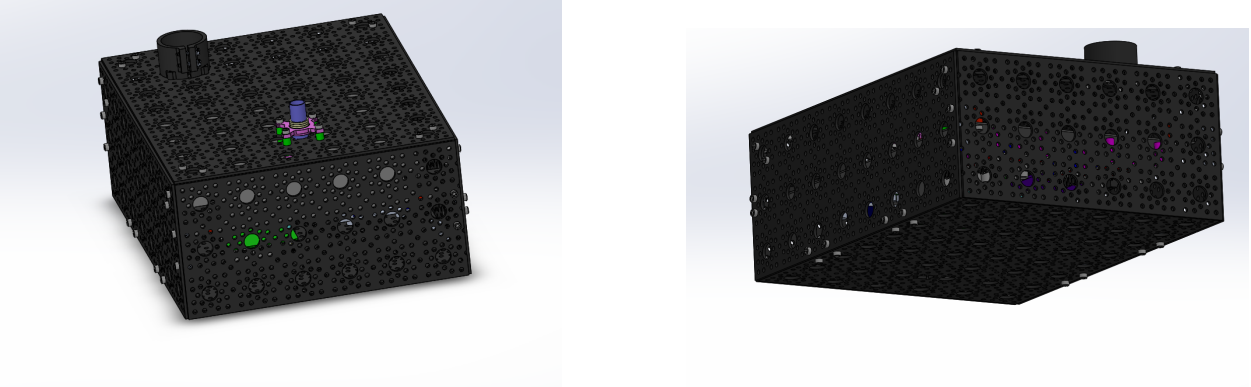


Figure 13: Finished Body Assembly