

# Squarebot Upgrade (2.0 to 3.0) Conversion Instructions

**1** Collect and identify the parts from the list of materials below:

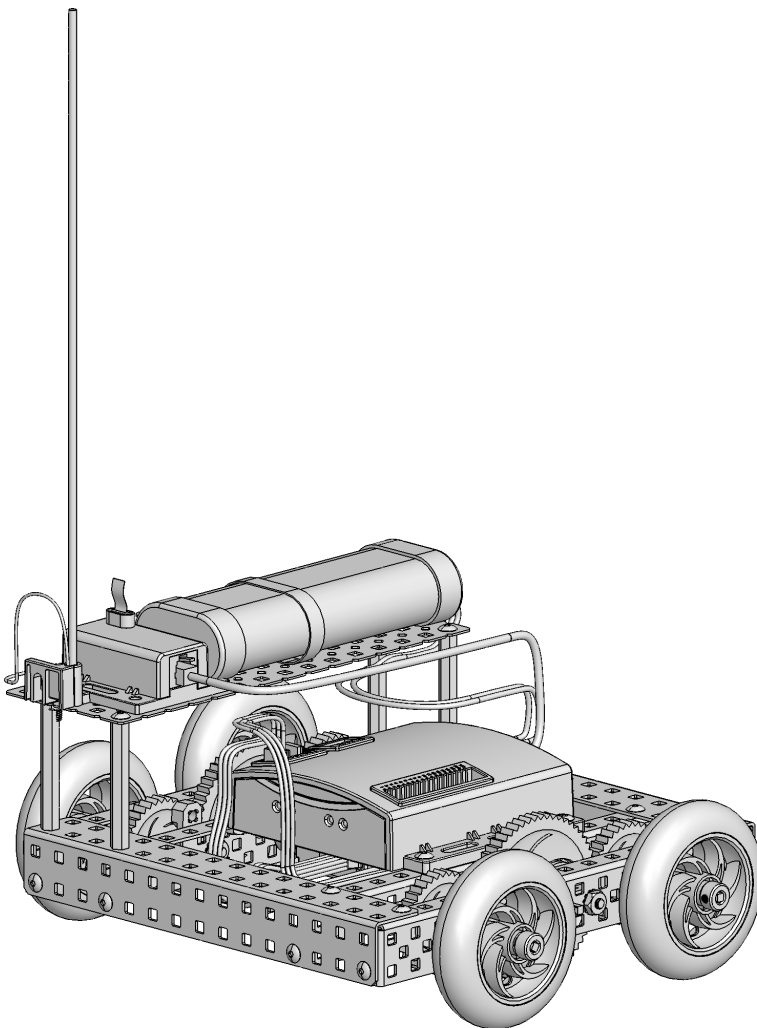
materials	qty
Squarebot 2.0	1
8-32 hex screw x 1/4"	16
8-32 hex screw x 1/2"	10
6-32 motor screw x 1/4"	1
keps nut (1/4")	26
square axle (12")	2
collar w/ threaded screw	3
plastic spacer .182"	5
plastic spacer .318"	1
*optical shaft encoder	2
limit switch	2
motor	1
washer, delrin	1
bearing block	2
long bar	4
lock plate	2
pivot	2
gusset	3
plate	1
wire tie	2
**hacksaw	1
**pliers	2
**metal file	1
**vice grip	1

\* Not included in standard kit: Optical Shaft Encoders (P/N 276-2156)  
Qty: 2 Sensors (1 pack)

\*\* Not included in standard kit

# Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

Squarebot 2.0 x 1



8-32 hex screw, 1/4" x 16



8-32 hex screw, 1/2" x 10



Can be substituted with 8-32 hex screws, 3/8"

6-32 hex screw, 1/4" x 1

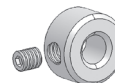


keys nut x 26

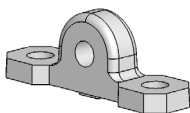


Can be substituted with lock nuts

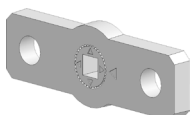
collar w/threaded screw x 3



bearing block x 2



lock plate x 2



plastic spacer .318" x 1

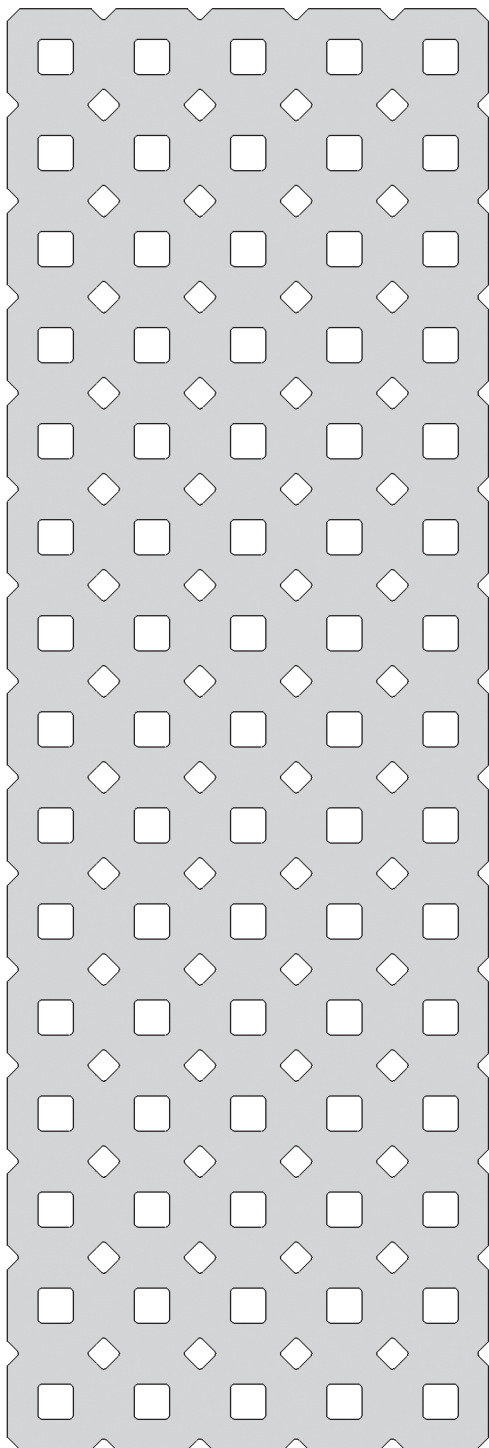


plastic spacer .182" x 5

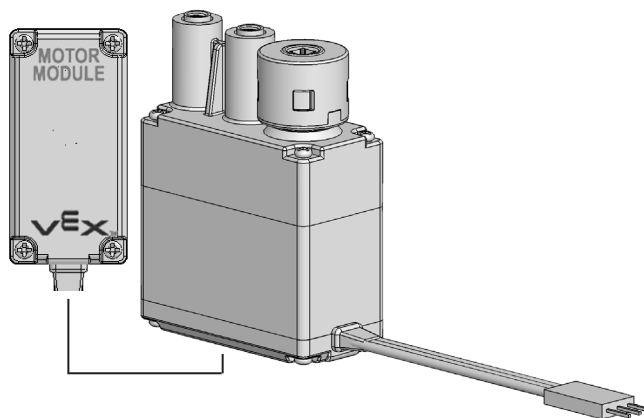


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

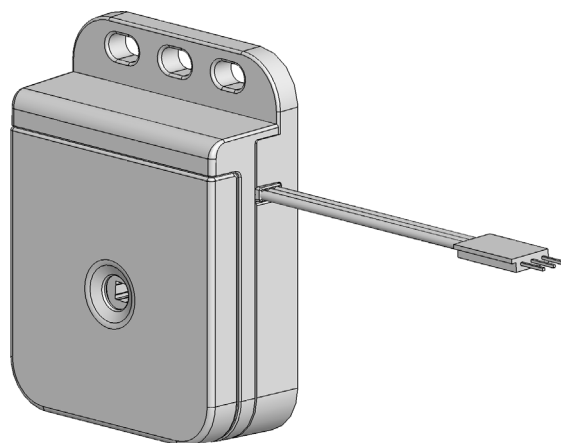
plate x 1



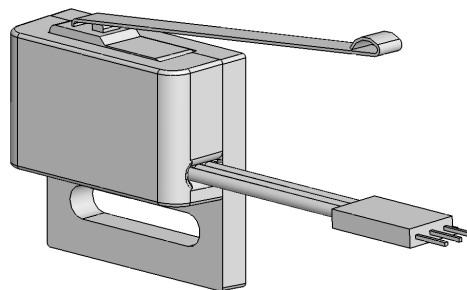
motor x 1



shaft encoder x 2

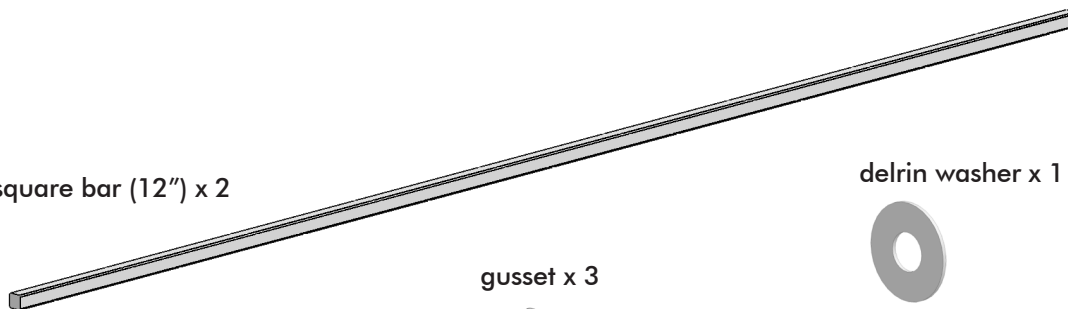


limit switch x 2



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

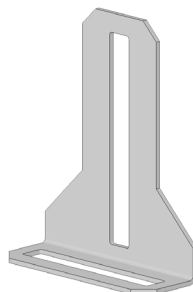
square bar (12") x 2



delrin washer x 1



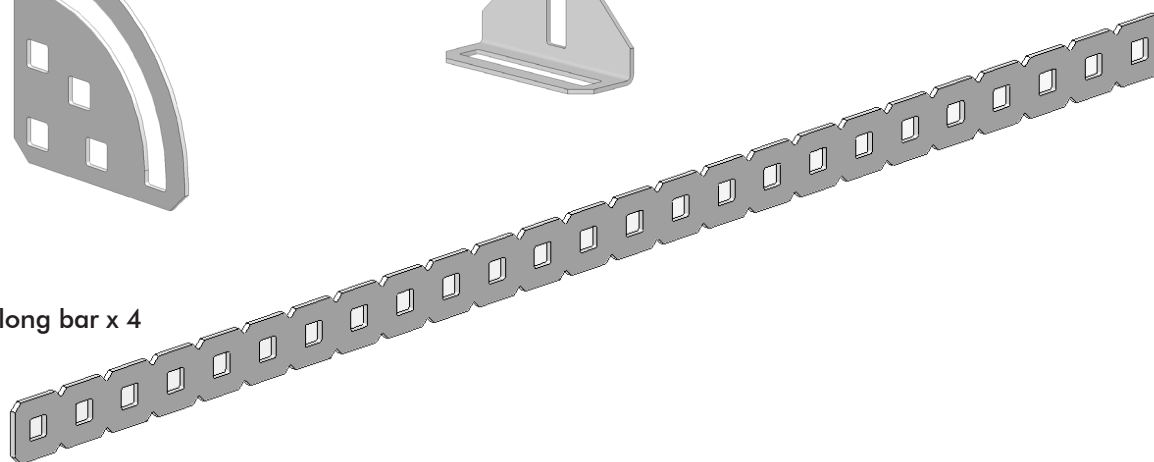
gusset x 3



pivot x 2



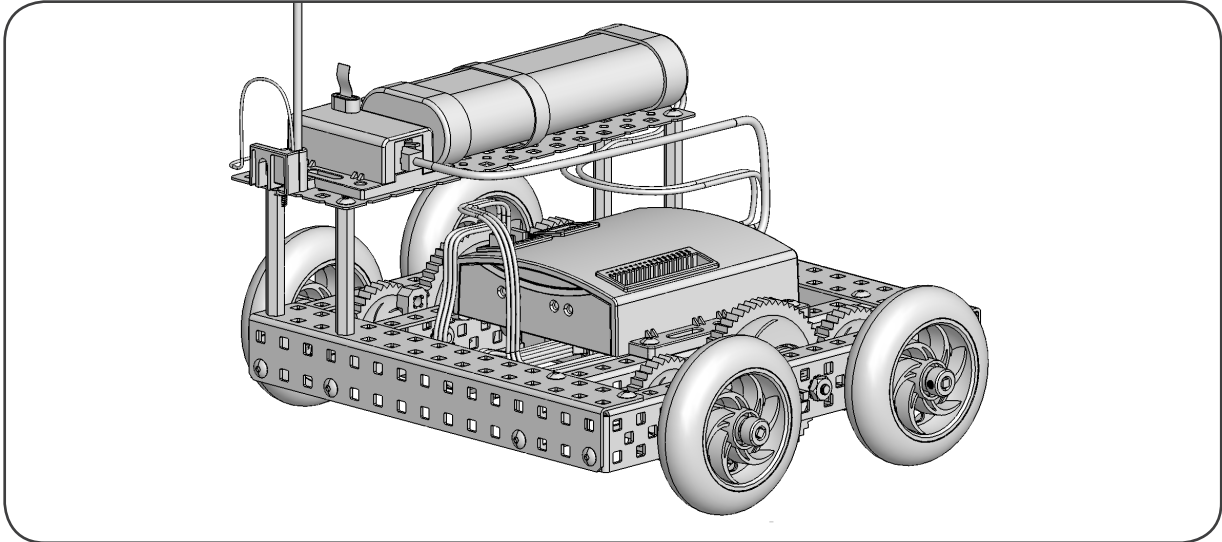
long bar x 4



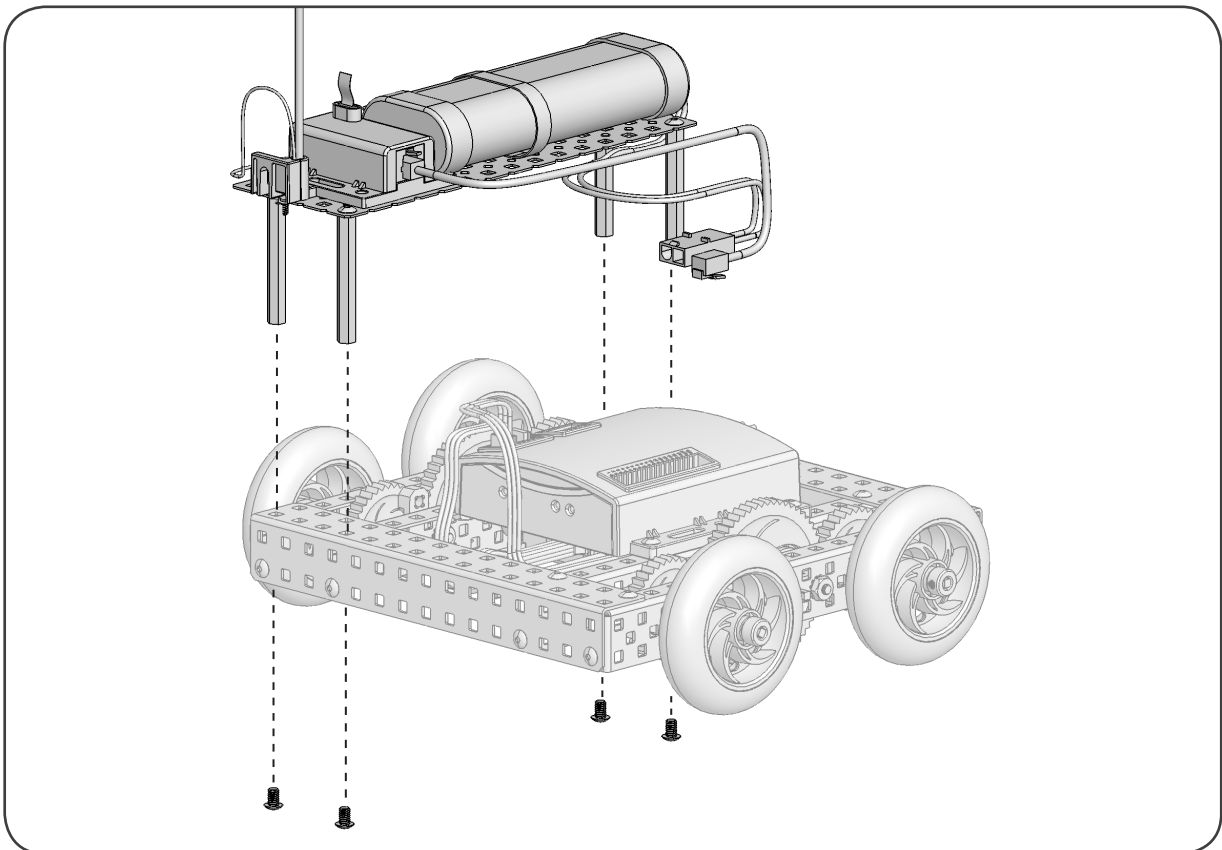
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 2 Disassembly of Squarebot 2.0

This set of instructions assumes that you are starting with a Squarebot 2.0.



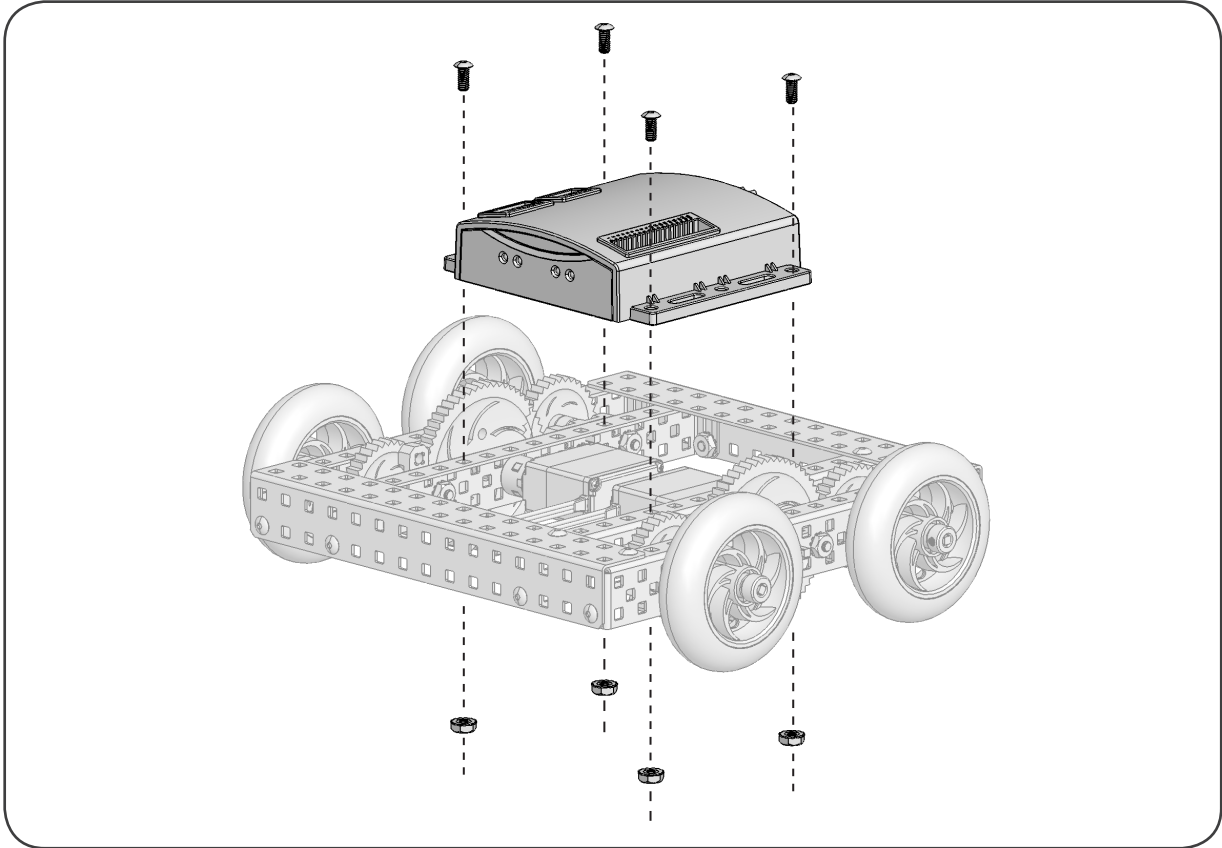
Remove the battery and receiver platform, and disassemble it. These parts are used to build new structures in following steps.



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 2 Disassembly of Squarebot 2.0 (cont.)

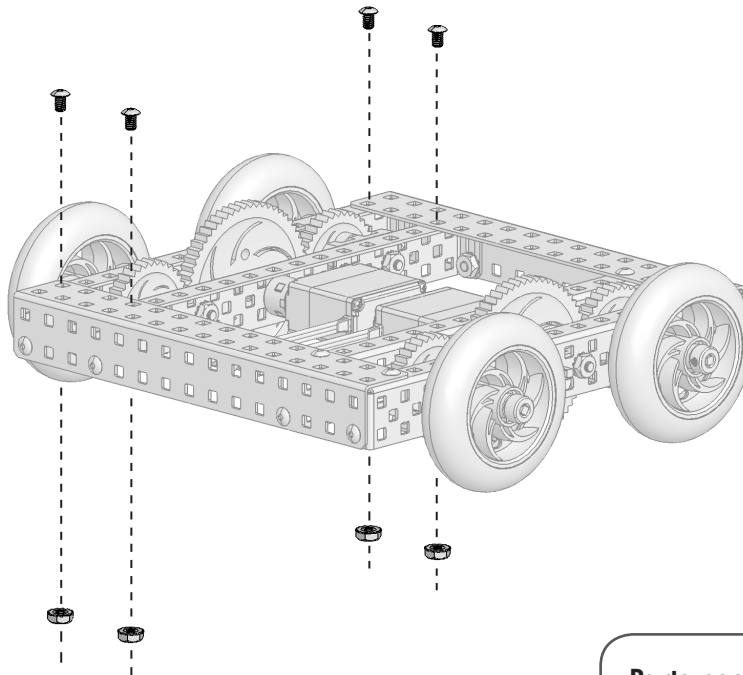
Remove the screws and detach the micro controller.



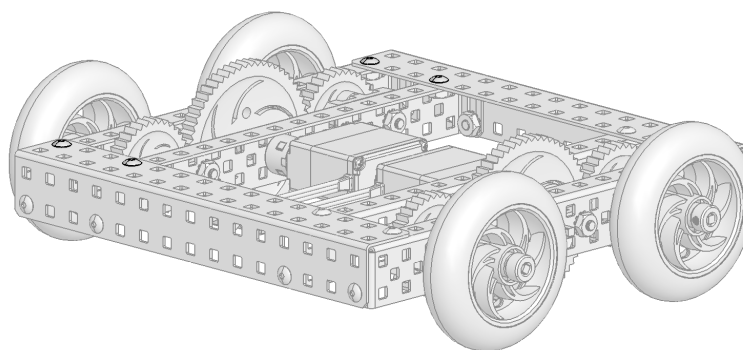
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 2 Disassembly of Squarebot 2.0 (cont.)

Add four 1/4" screws and four keps nuts to secure the front and rear bumpers to the right-side chassis rails.



Parts needed in this step:

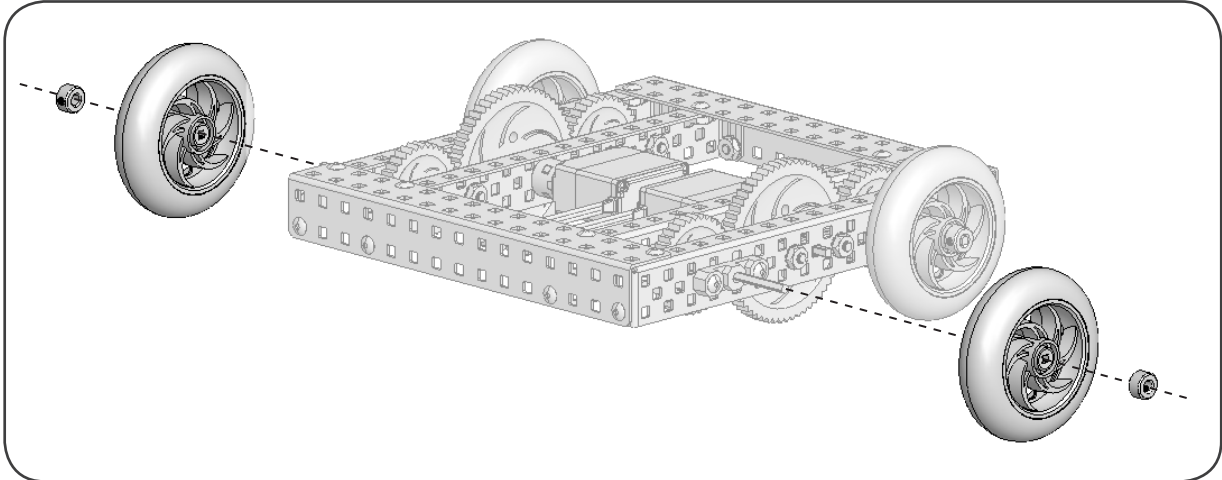


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 2 Disassembly of Squarebot 2.0 *(cont.)*

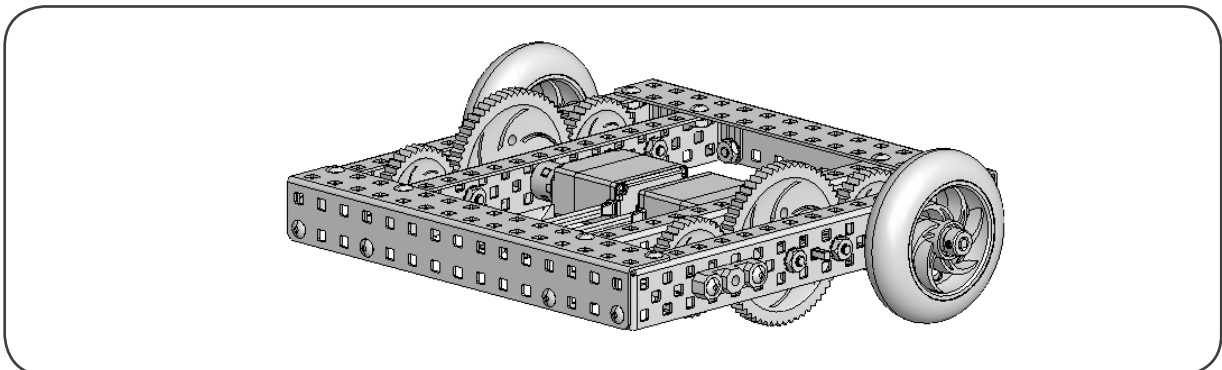
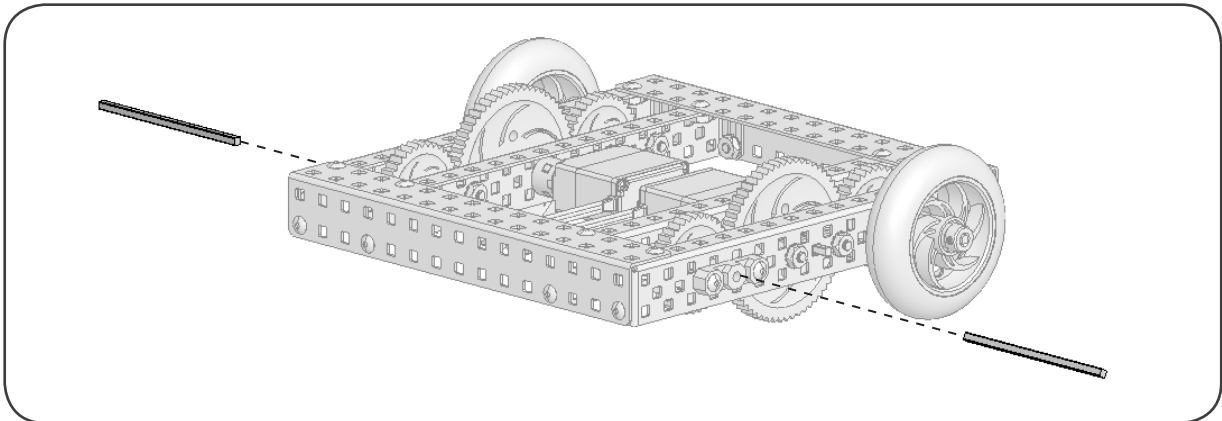
In order to connect the shaft encoders to the drive train, the 3" front square axles need to be replaced with 4.5" square axles.

Remove the front wheels and their collars.



Loosen the set screws on the inner collars (between the chassis rails and the gears), and remove the 3" square axles.

Note: This step also releases several gears and collars on the inner chassis. These will need to be replaced with the 4.5" square axles.





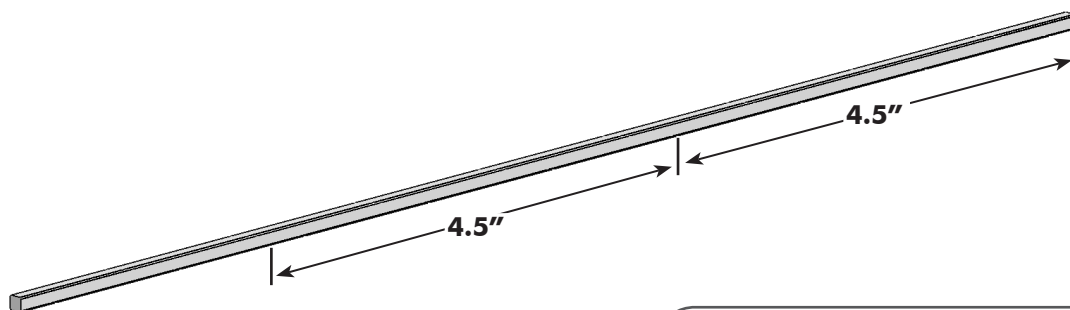
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 2 Disassembly of Squarebot 2.0 (cont.)

**CAUTION:**

This step involves cutting tools and permanent alterations to the materials in the VEX Starter Kit. Make sure you have permission before continuing. ALL APPLICABLE SAFETY PROCEDURES MUST BE OBSERVED WHILE PERFORMING THIS STEP.

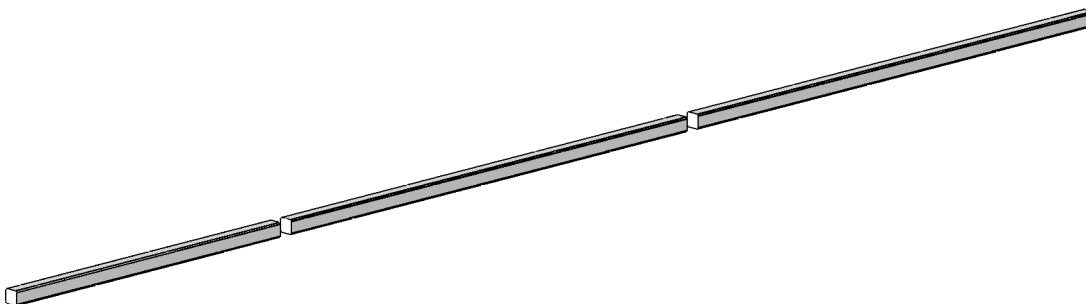
Since there are no 4.5" square axles in the starter kit, these must be cut from a 12" square axle. Using a ruler, measure out two 4.5" segments, marking them with a pencil.

**Parts needed in this step:**

12"  
x 1

Using a hacksaw or other appropriate tool, cut the 12" axle into the measured segments. File down all cut ends afterward to remove any sharp or rough edges.

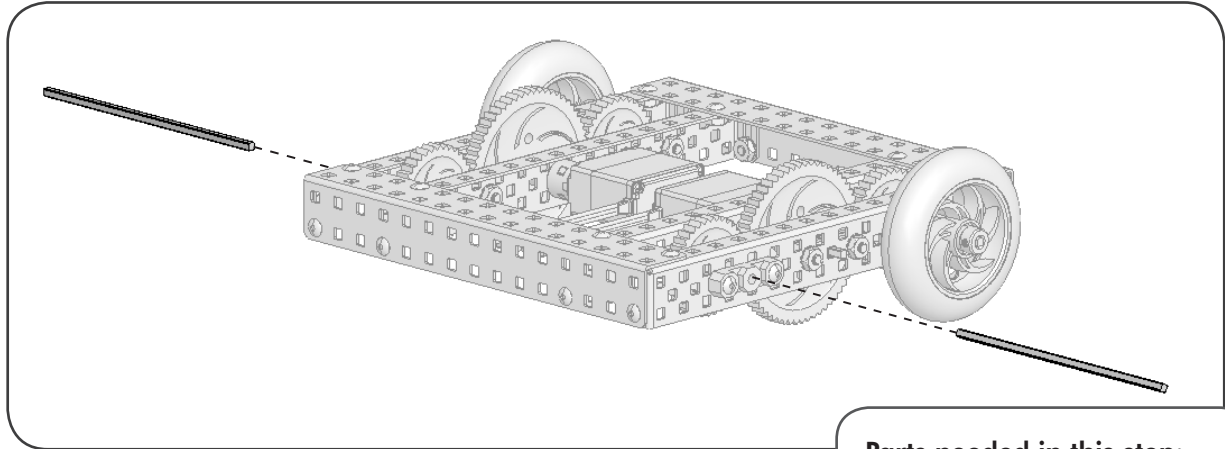
IF YOU ARE UNSURE ABOUT HOW TO USE THE TOOLS OR PERFORM THIS PROCEDURE SAFELY, DO NOT ATTEMPT THIS STEP ALONE. SEEK QUALIFIED ASSISTANCE BEFORE PROCEEDING.



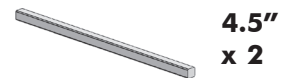
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 2 Disassembly of Squarebot 2.0 *(cont.)*

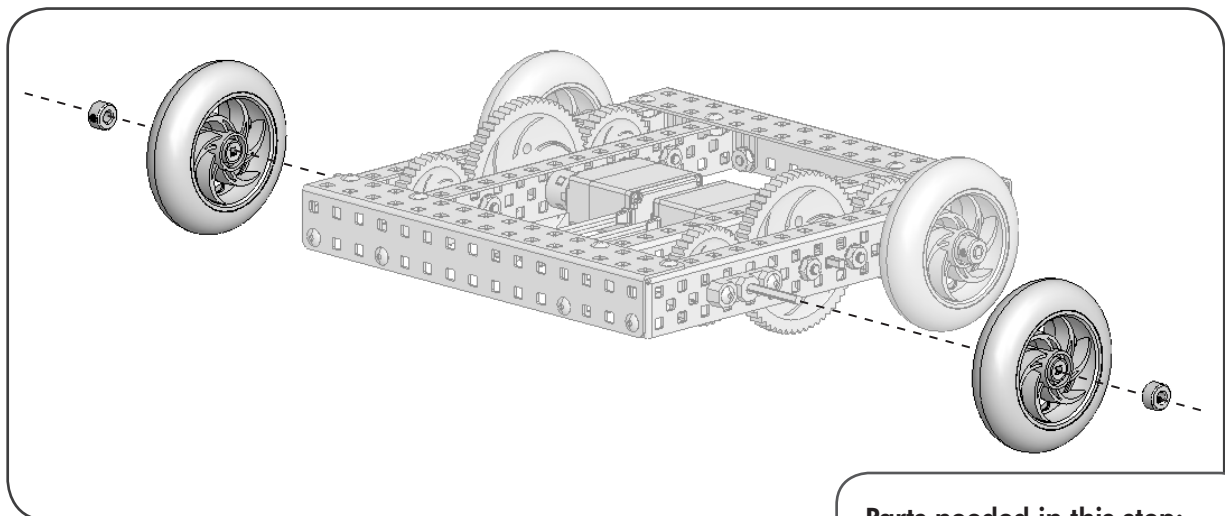
Replace the 3" square axles with 4.5" square axles, being careful to correctly realign the spacers, collars, and gears.



Parts needed in this step:



Reinstall the wheels and outermost collars.



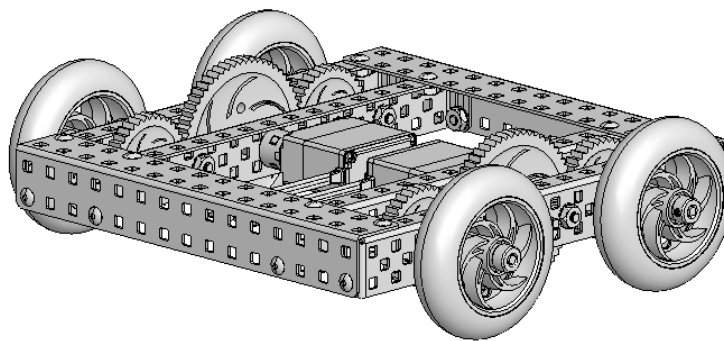
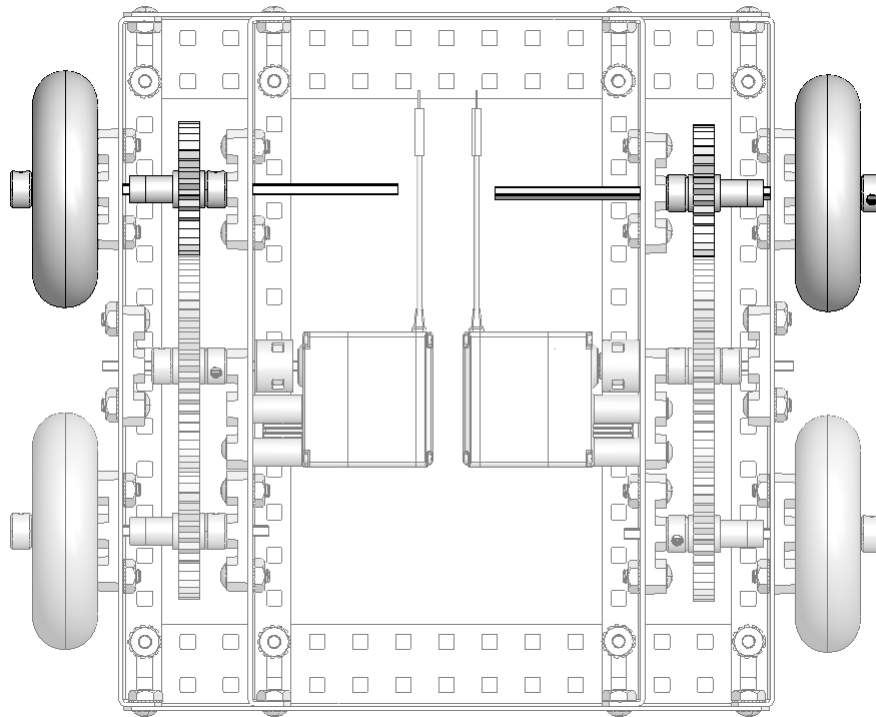
Parts needed in this step:



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 2 Disassembly of Squarebot 2.0 *(cont.)*

Before continuing on, verify that the drive train is still set up correctly after replacing the front square axles.

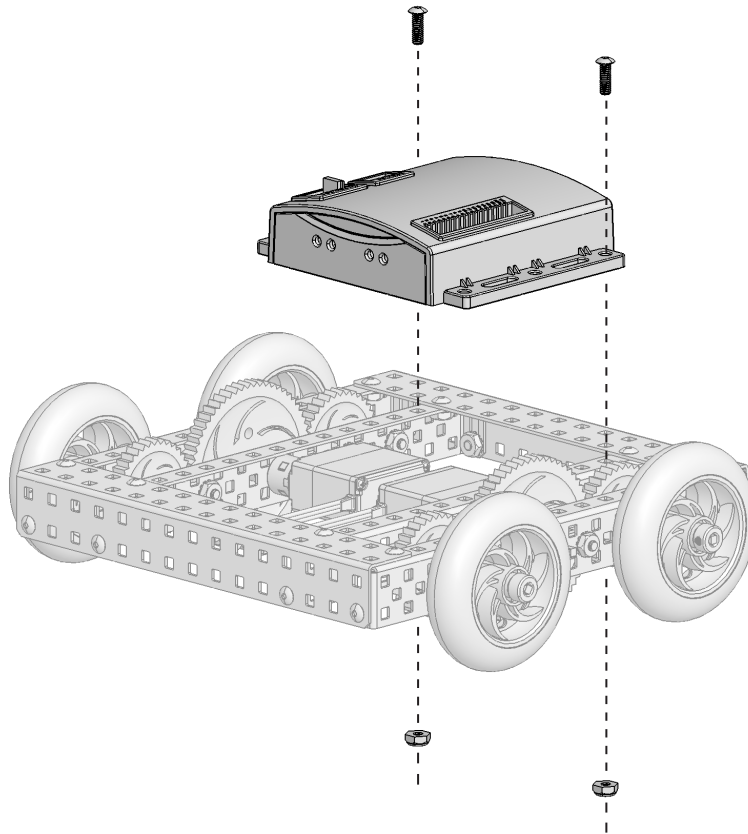


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

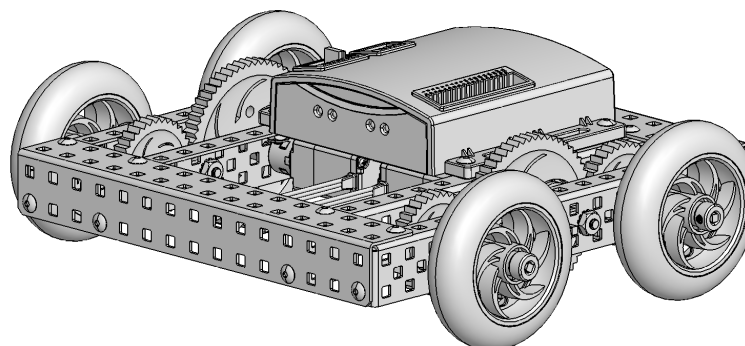
### 3 Micro controller installation

Install the micro controller so that the rear mounting holes are aligned with the rear-most exposed holes of the inner-chassis rails.

NOTE: The placement of the micro controller is purposely shifted backward to allow room for two shaft encoders.



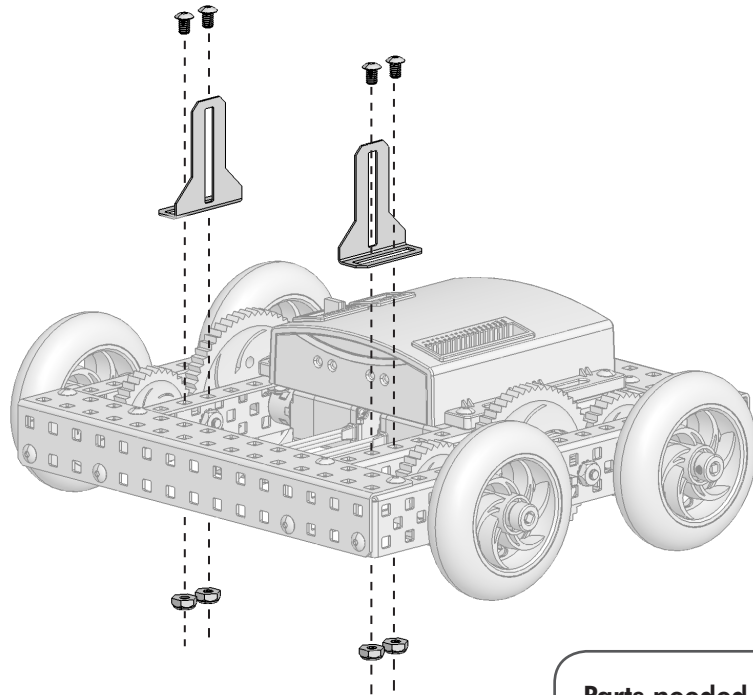
Parts needed in this step:



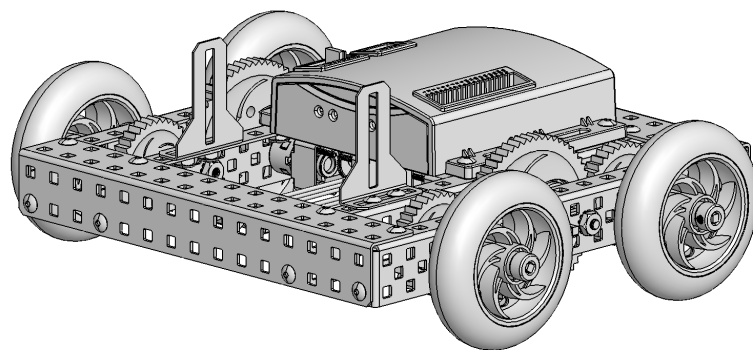
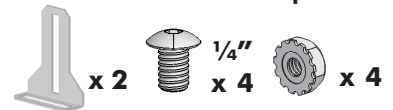
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 4 Encoder installation

Install two mounting gussets directly above the 4.5" square axles using two 1/4" screws and two keps nuts each.



Parts needed in this step:

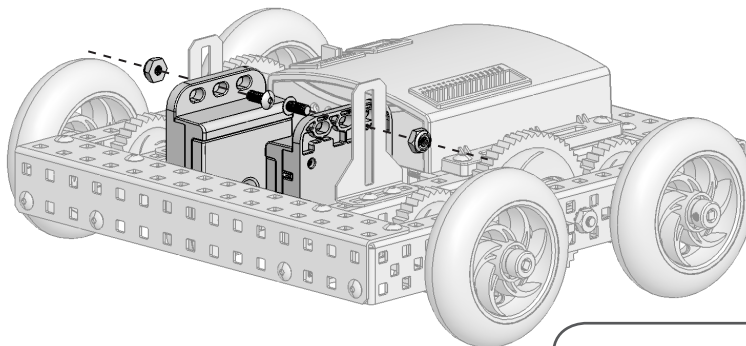


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

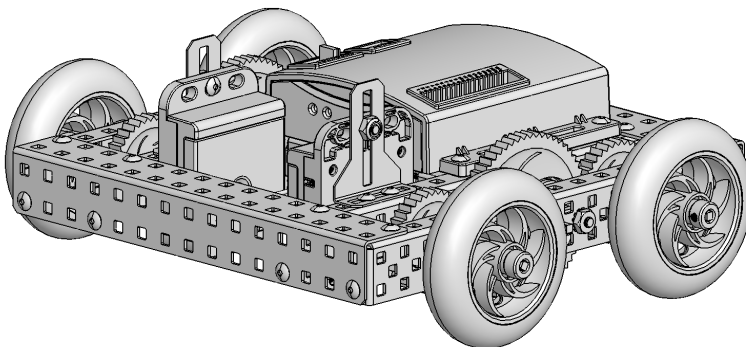
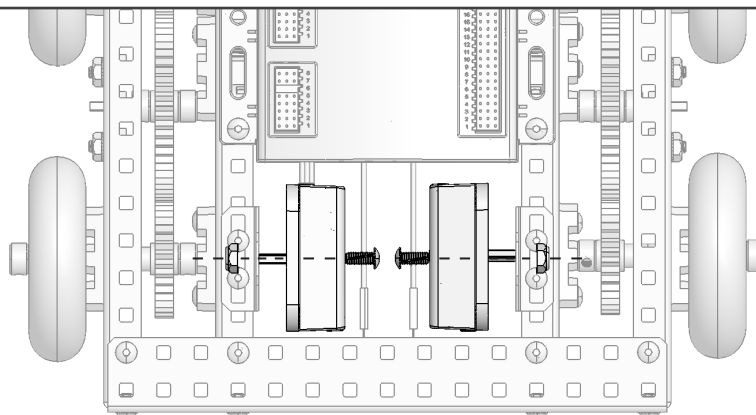
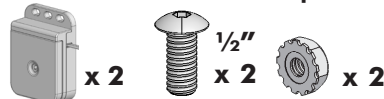
### 4 Encoder installation (cont.)

Install the encoders. Insert the 4.5" square axle through the hole in the center of the encoder body.

Once the encoders are aligned with the square axles, secure them to the mounting gussets.



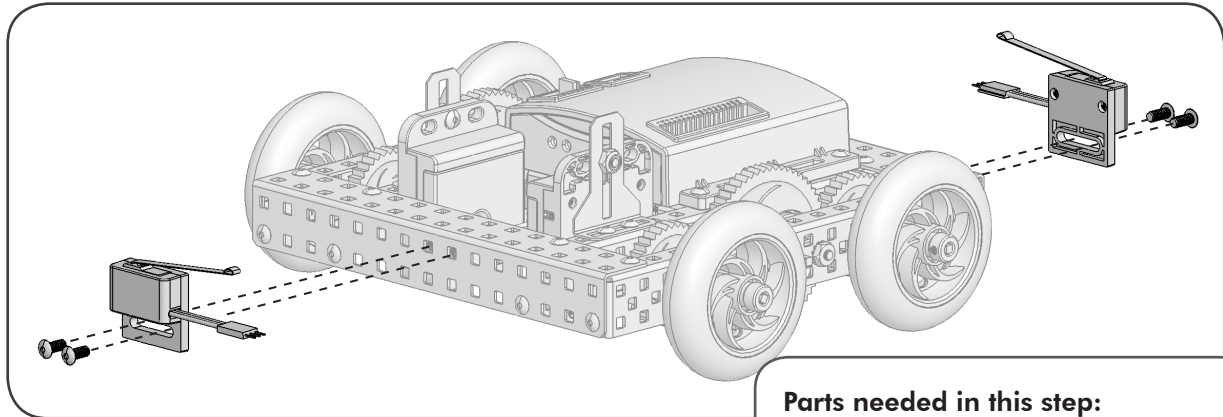
Parts needed in this step:



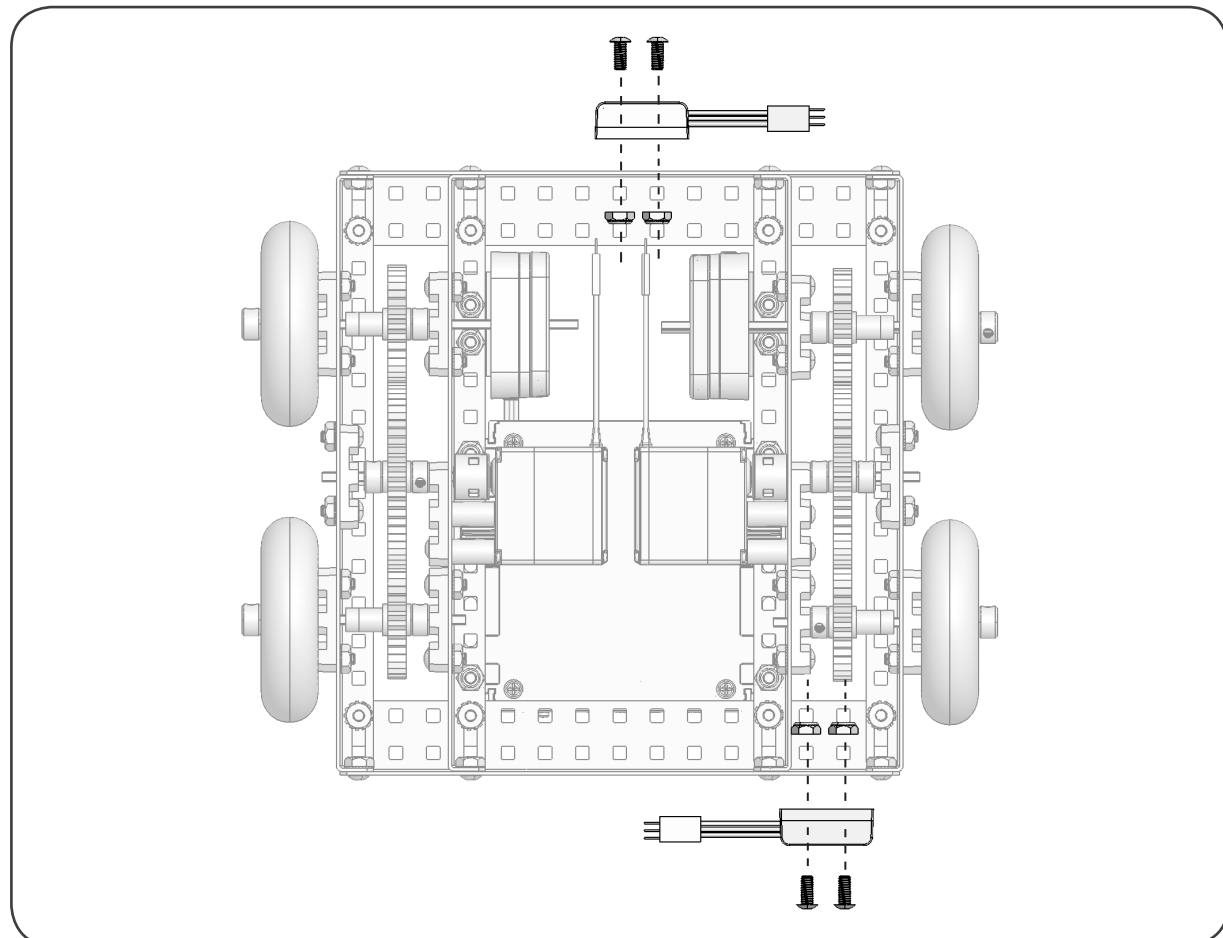
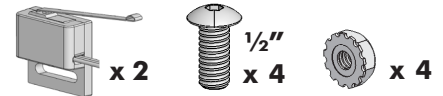
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 5 Limit switch installation

Install the front and rear limit switches. The front limit switch should be in the middle of the front bumper; the rear limit switch should be on the left side of the rear bumper (when seen from the rear).



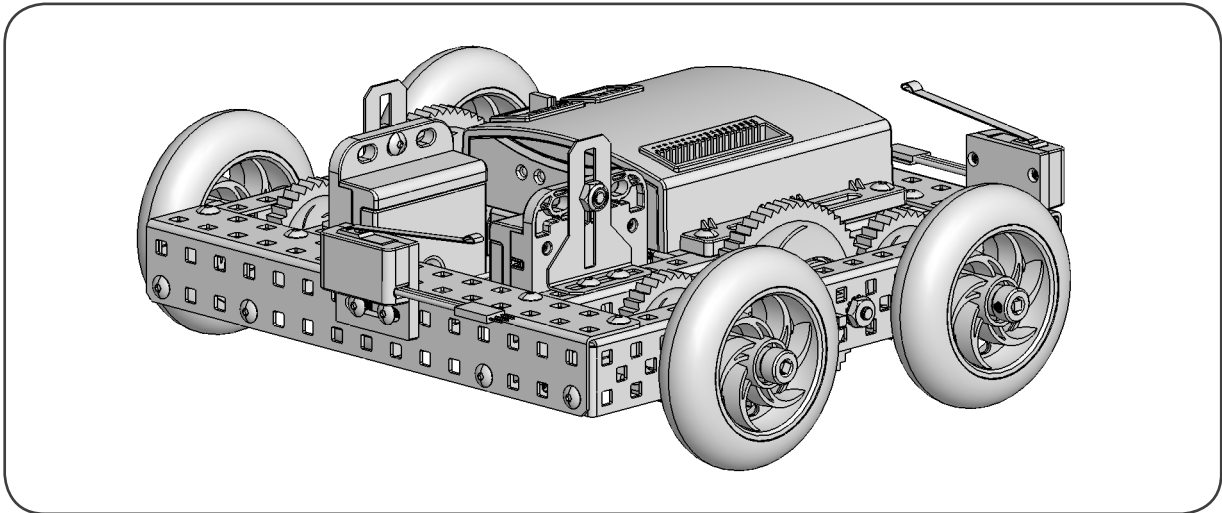
Parts needed in this step:



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 5 Limit switch installation (cont.)

Ensure that your assembly corresponds to this one before moving on.

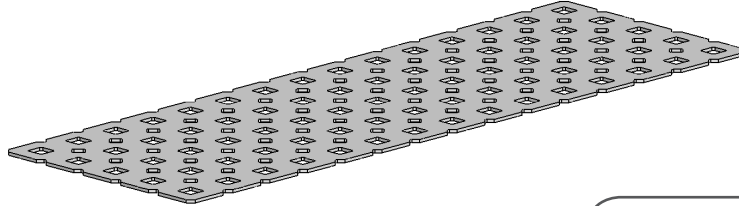




## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 6 Motor platform construction

Start with a large plate.

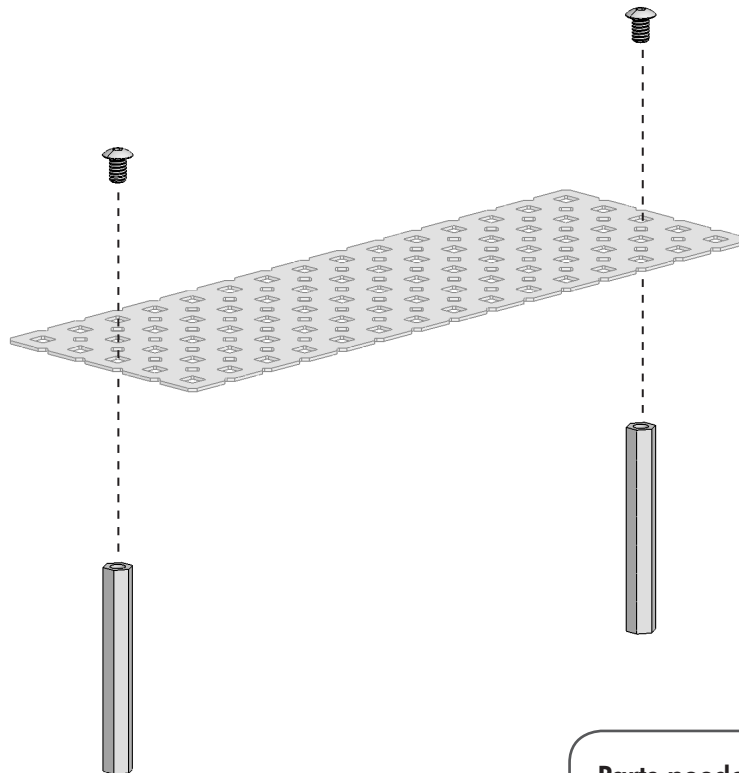


Parts needed in this step:

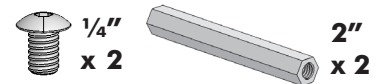


x 1

Attach two 2" standoffs to the large plate using two 1/4" screws.

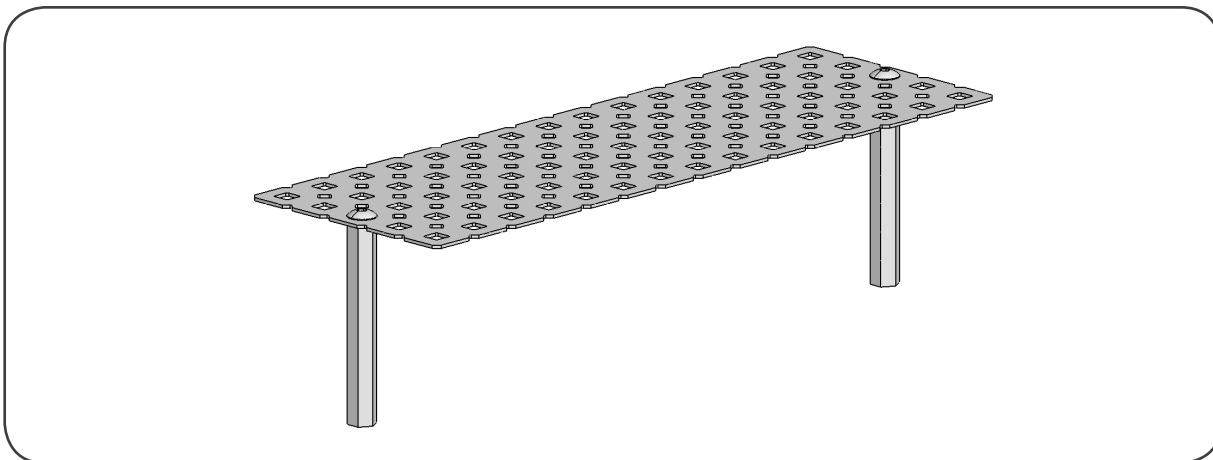


Parts needed in this step:



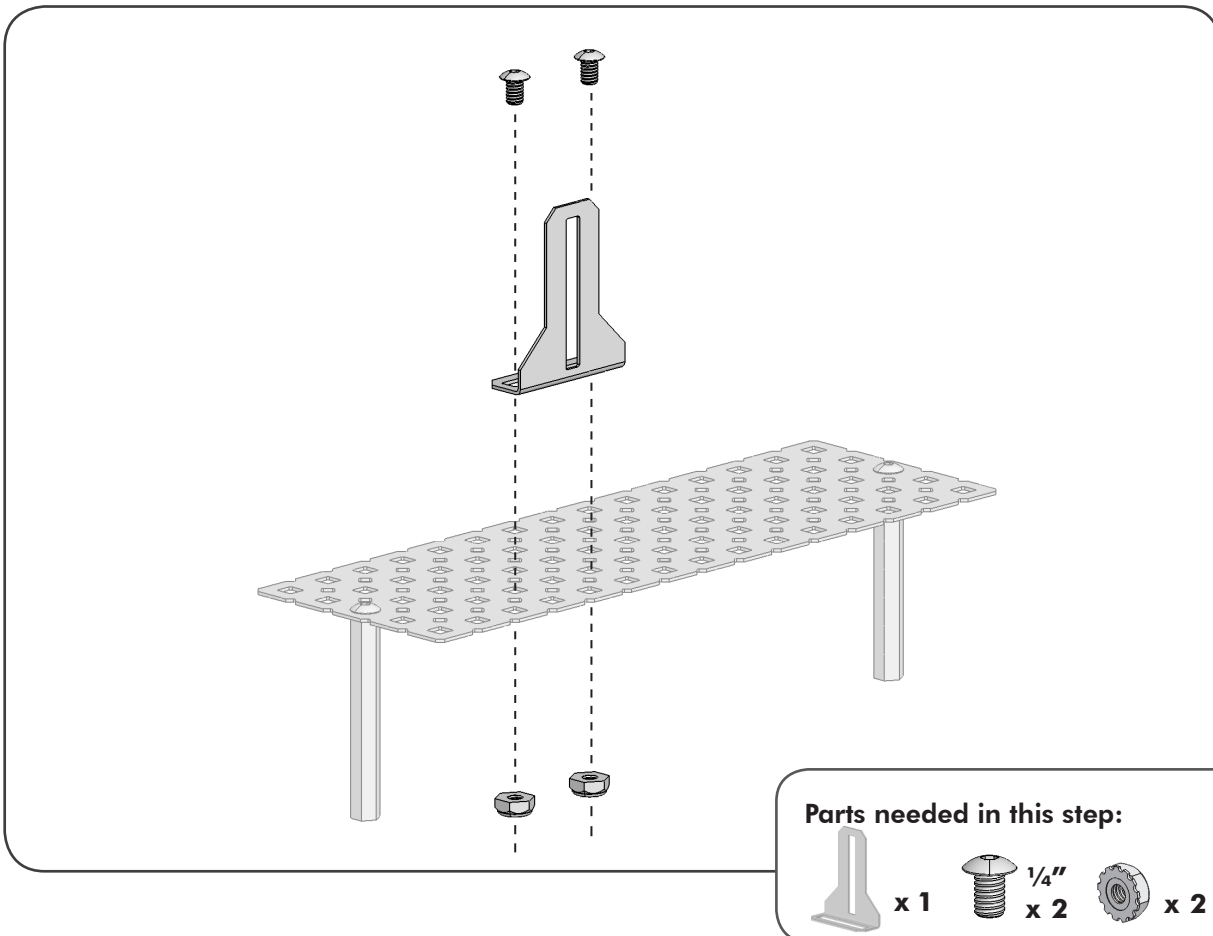
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 6 Motor platform construction (cont.)



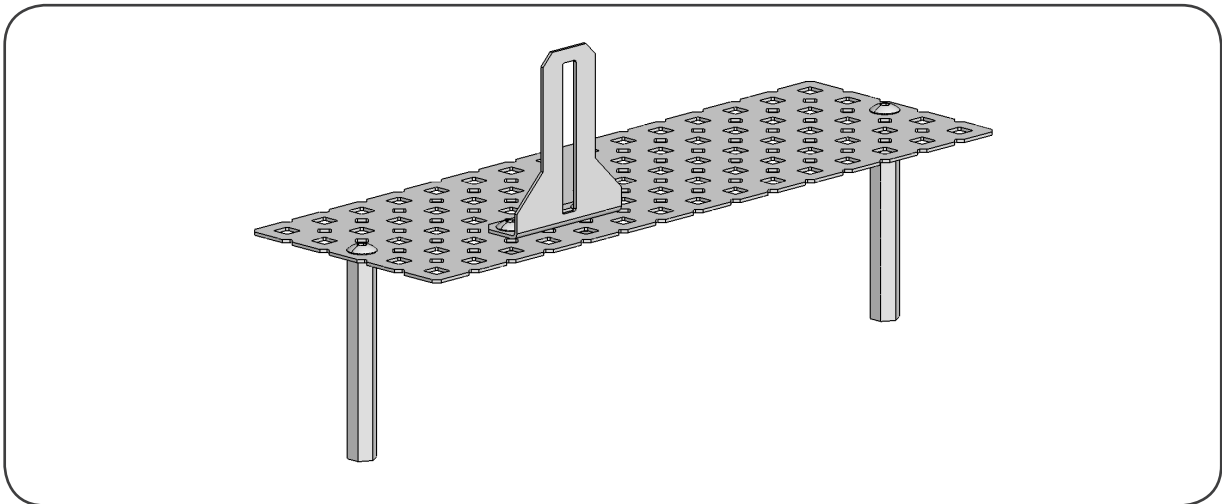
Secure a mounting gusset using two  $\frac{1}{4}$ " screws and two keps nuts.

NOTE: If you do NOT have the necessary gusset, see page 20 for an alternate solution using a wire tie.

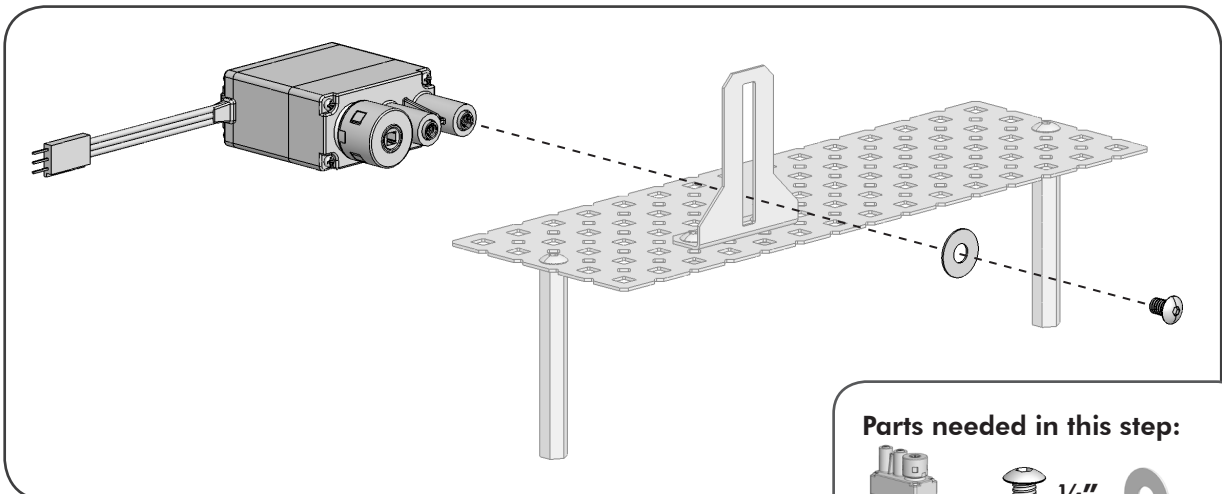


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

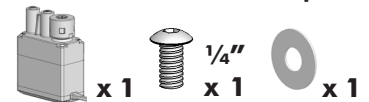
### 6 Motor platform construction (cont.)



Secure the motor to the gusset using a washer and one 1/4" motor screw.

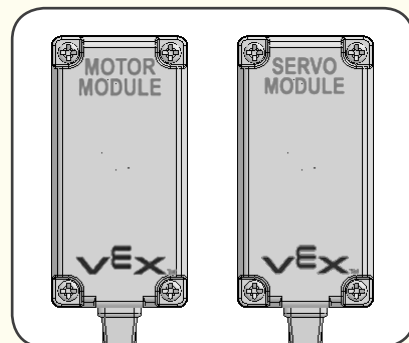


Parts needed in this step:



#### **NOTICE:**

Whether you are using a mounting gusset or the alternate wire tie method, ensure that you have attached a motor module, and not a servo module. A servo module rotates to a specific location between 0 and 180 degrees, but cannot perform full revolutions like a motor module.



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

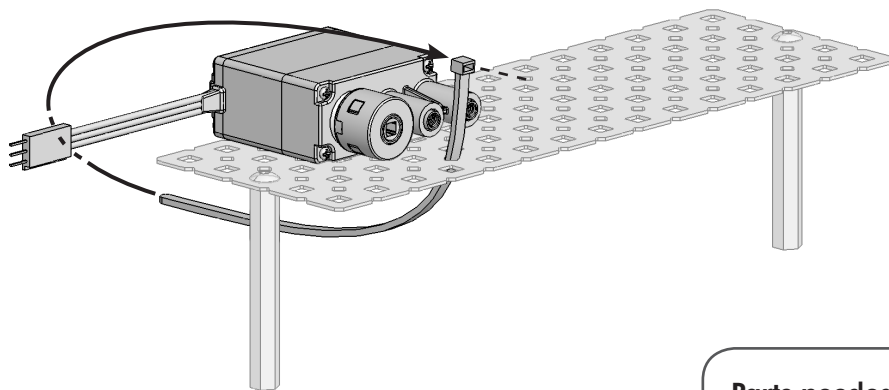
### 6 Motor platform construction (cont.)



#### **OPTIONAL:**

This set of steps is only required if you do NOT have the mounting gusset required in the previous step.

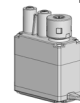
Secure a motor to the platform as shown, using a wire tie (or a series of wire ties, if one is too short).



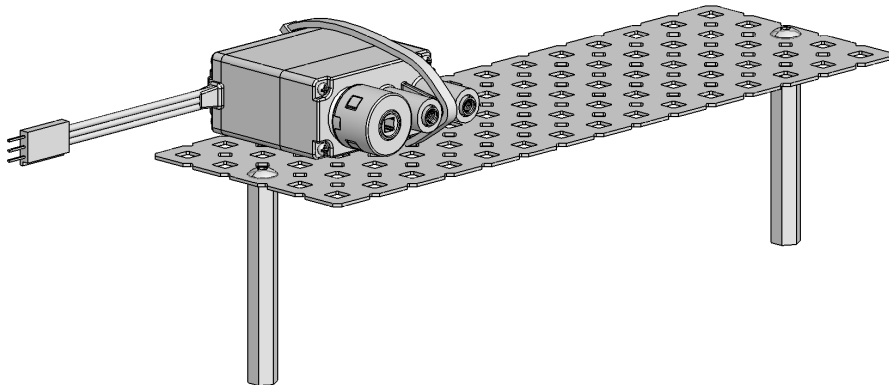
Parts needed in this step:



x 2

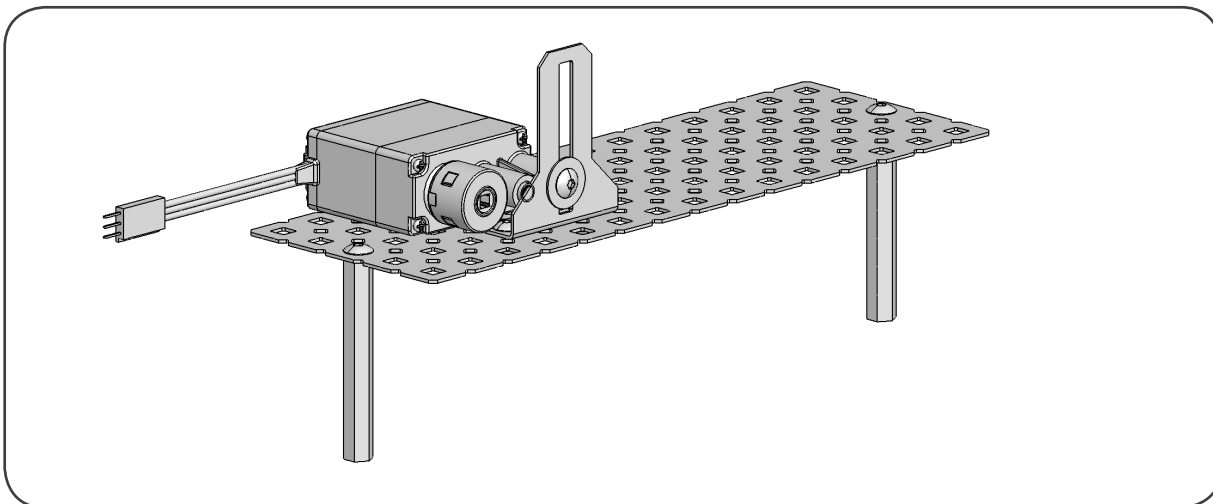


x 1

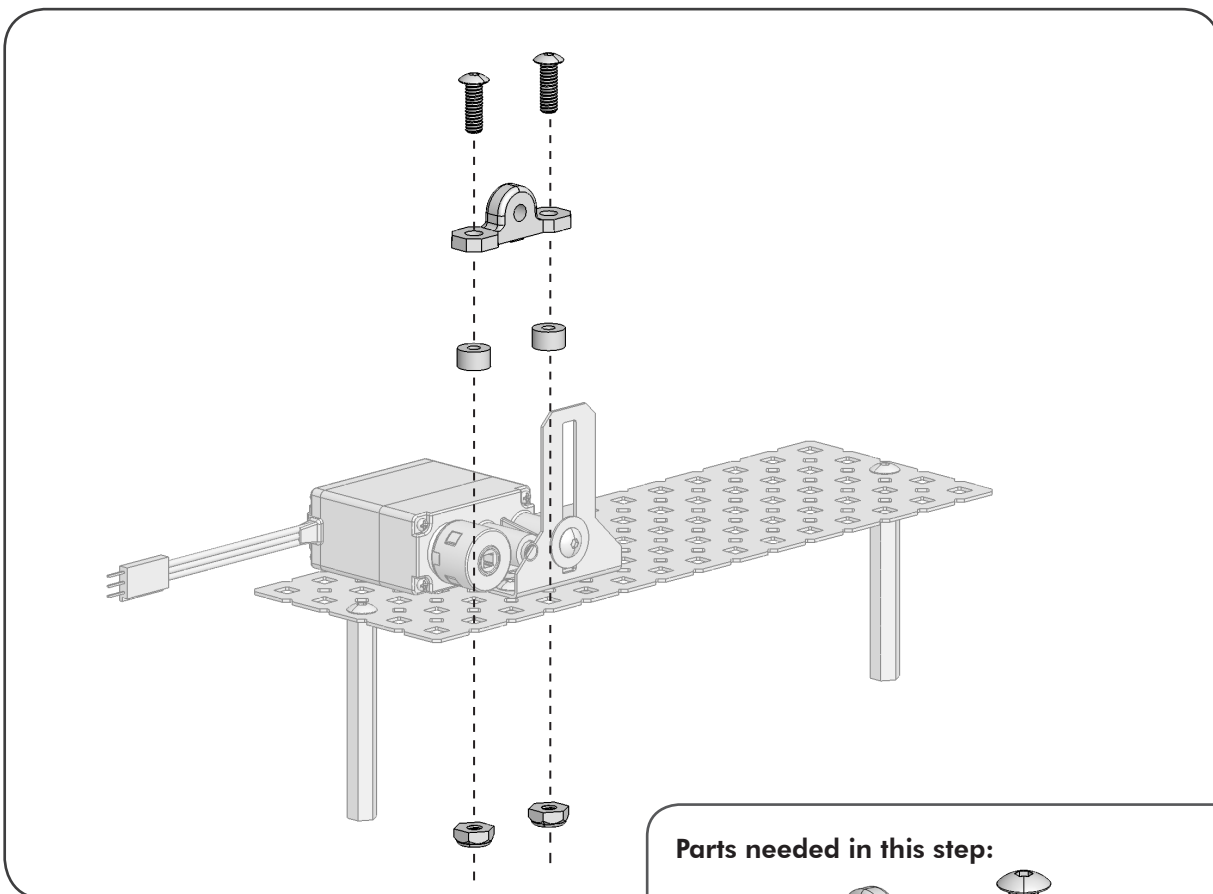


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

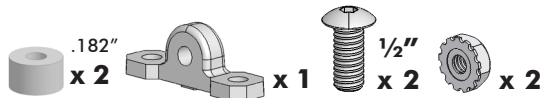
### 6 Motor platform construction (cont.)



Install a vertical bearing, raised up by spacers, so that the bearing hole and rotating shaft of the motor are aligned.

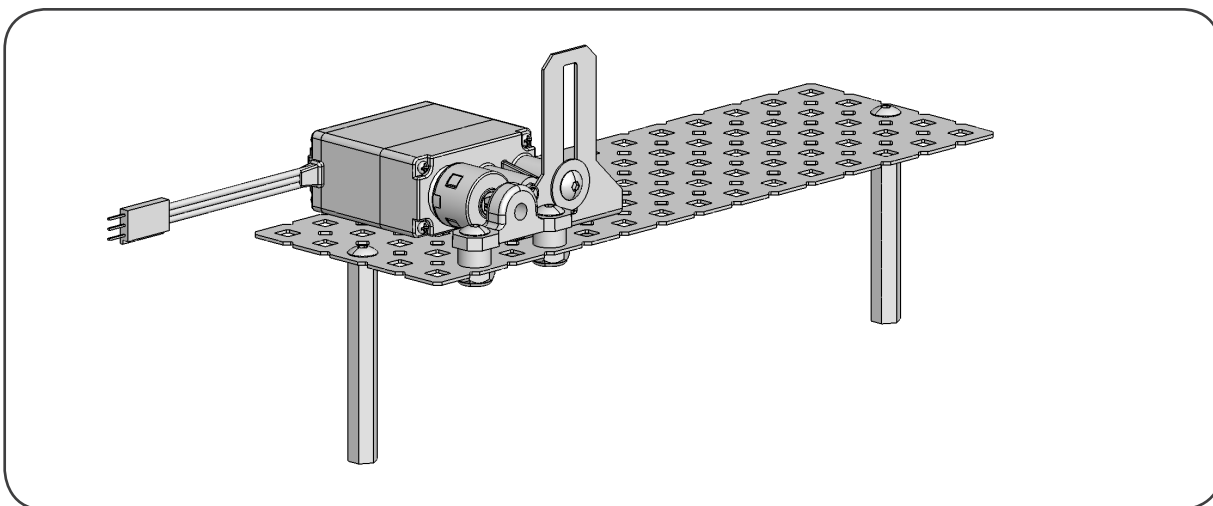


Parts needed in this step:

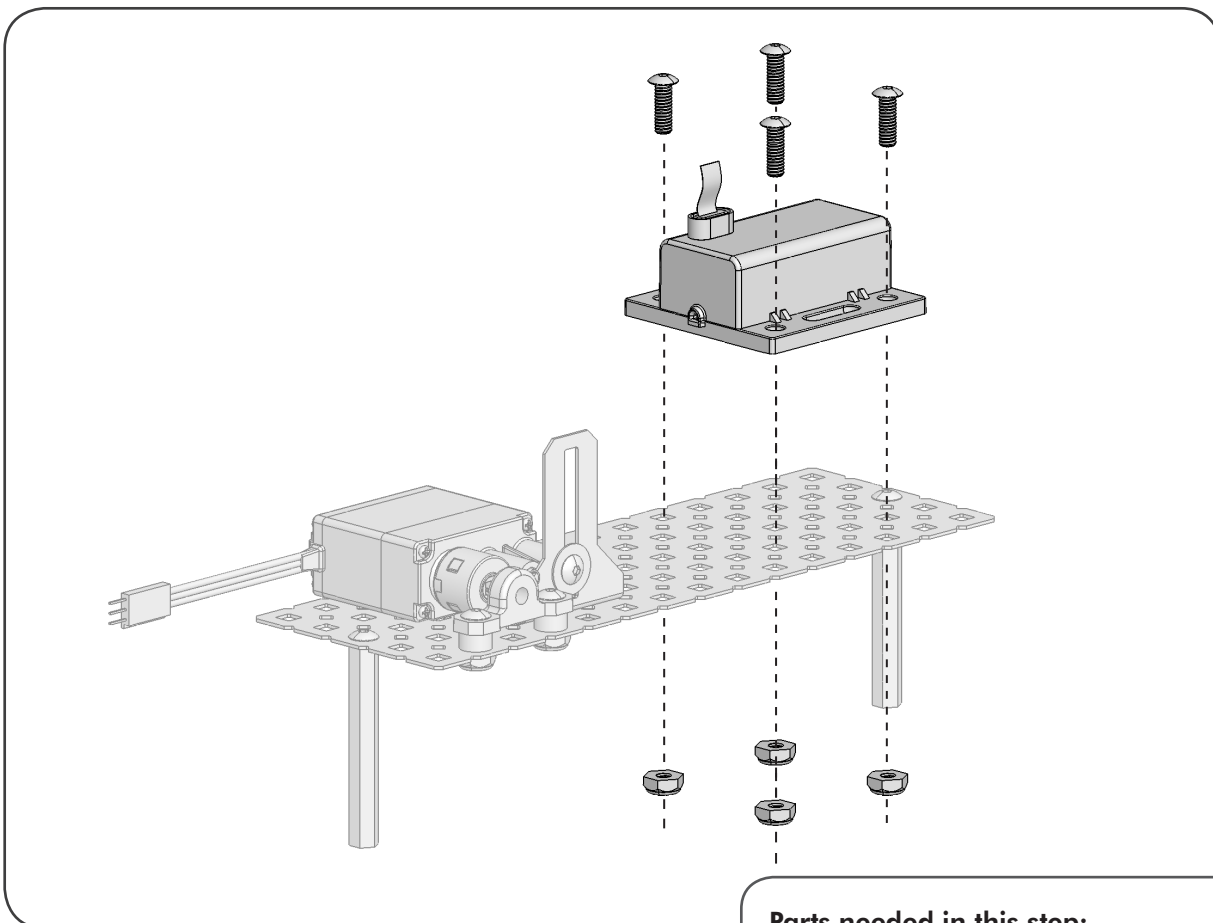


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 6 Motor platform construction (cont.)



Install the receiver.

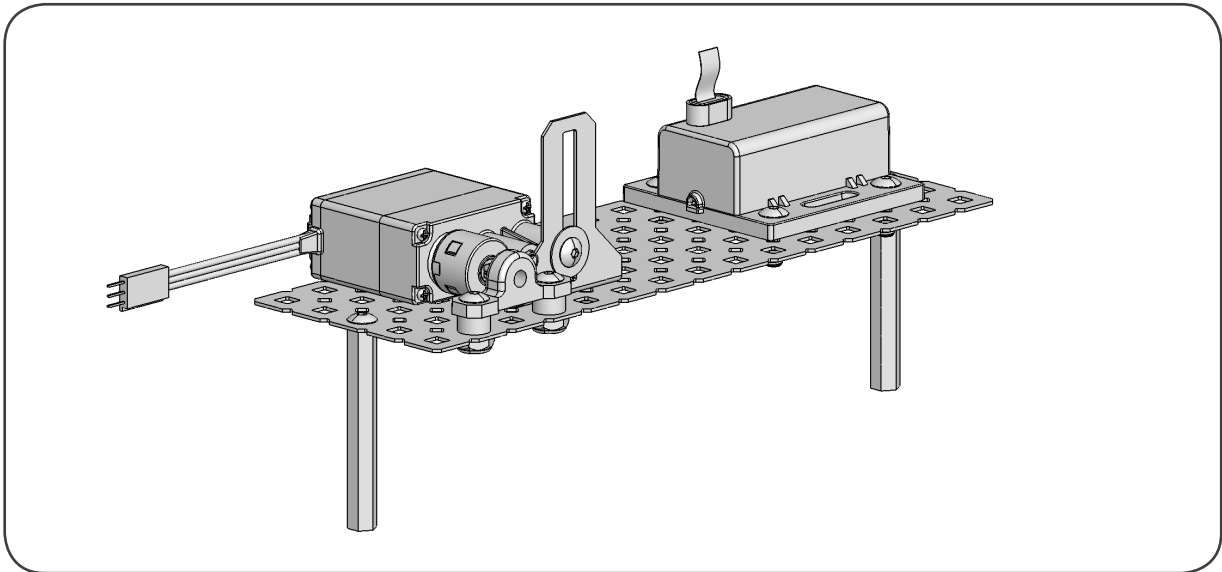


Parts needed in this step:

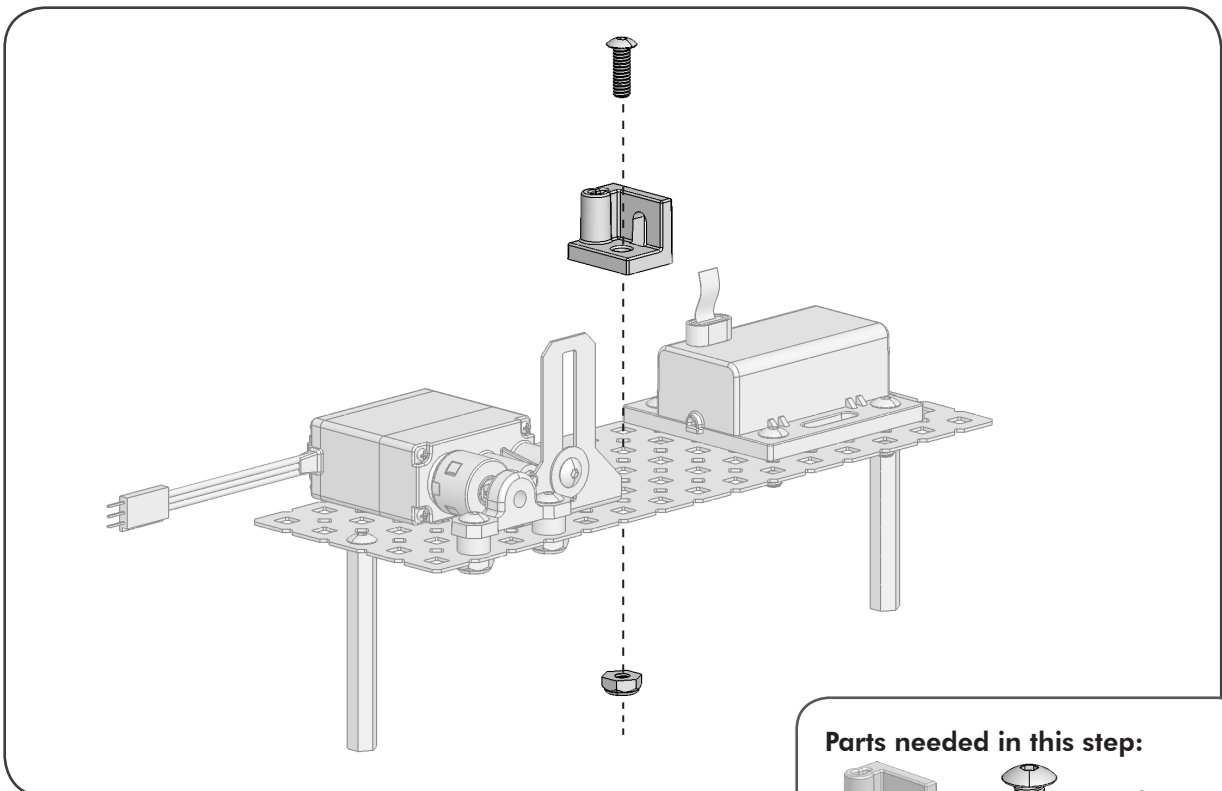


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

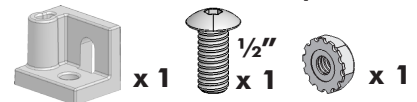
### 6 Motor platform construction *(cont.)*



Attach the antenna holder.

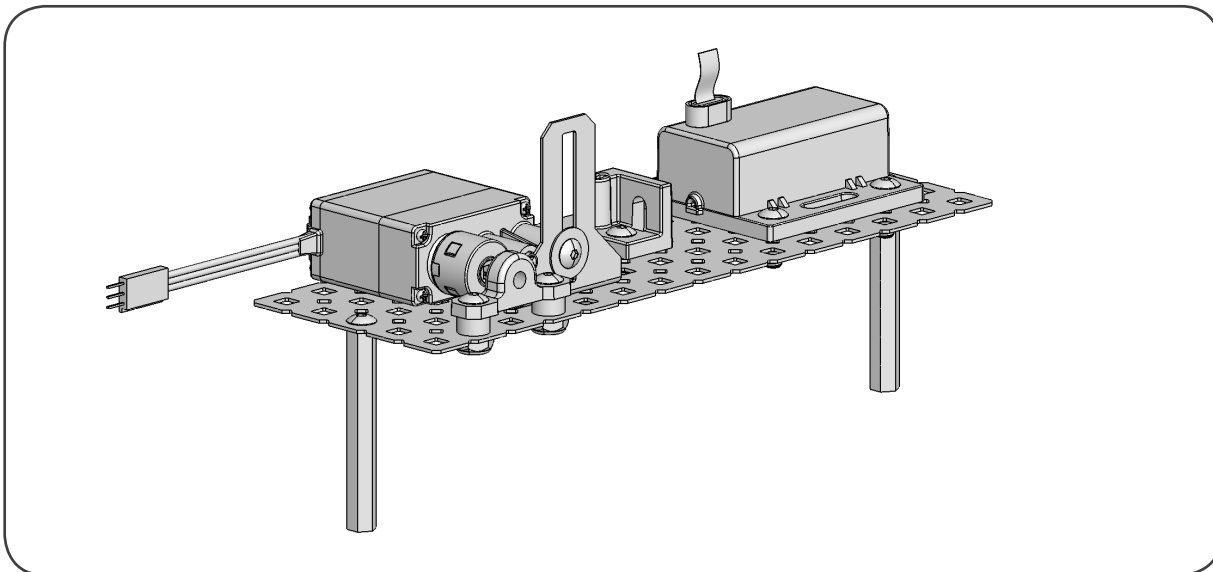


Parts needed in this step:

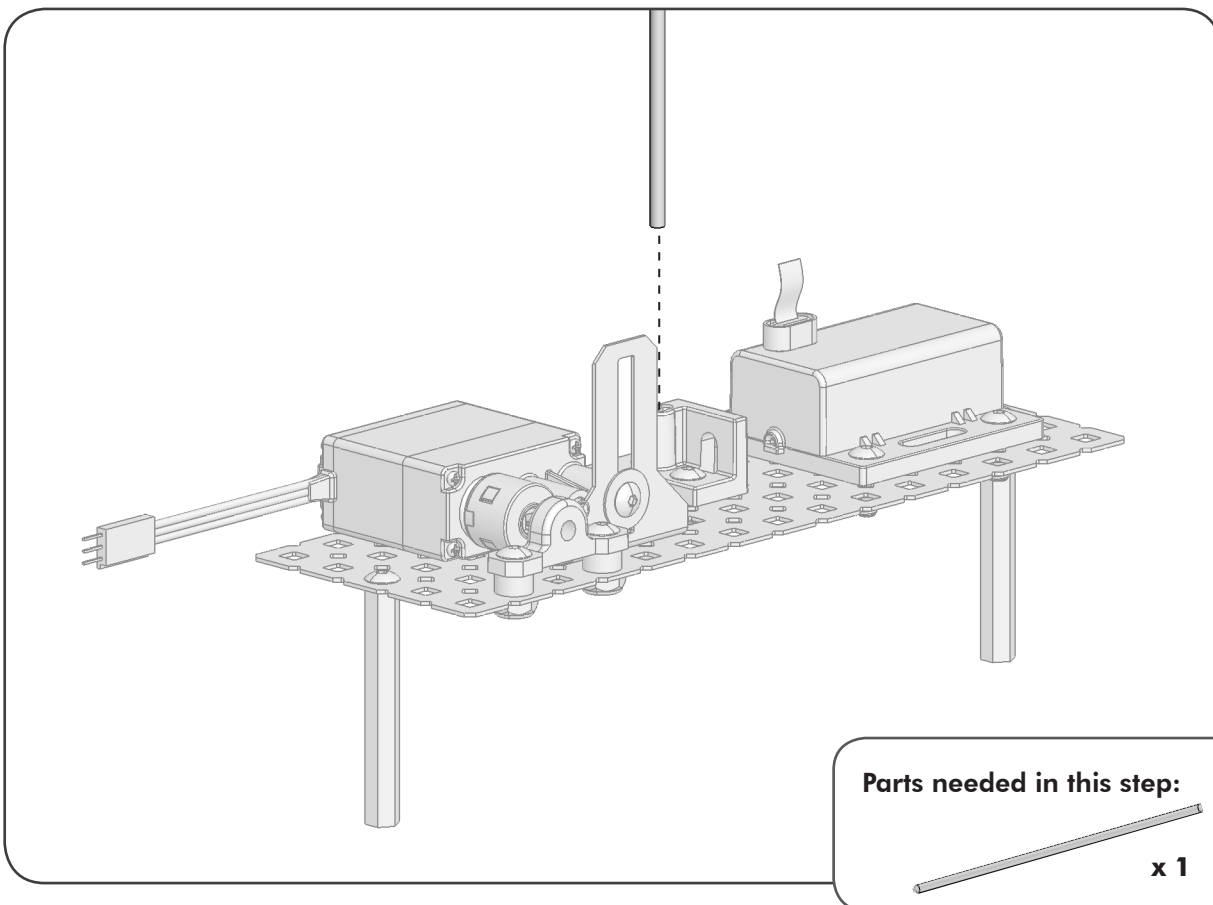


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 6 Motor platform construction *(cont.)*



Feed the antenna wire through the casing (not shown). Insert the casing into the antenna holder.



Parts needed in this step:

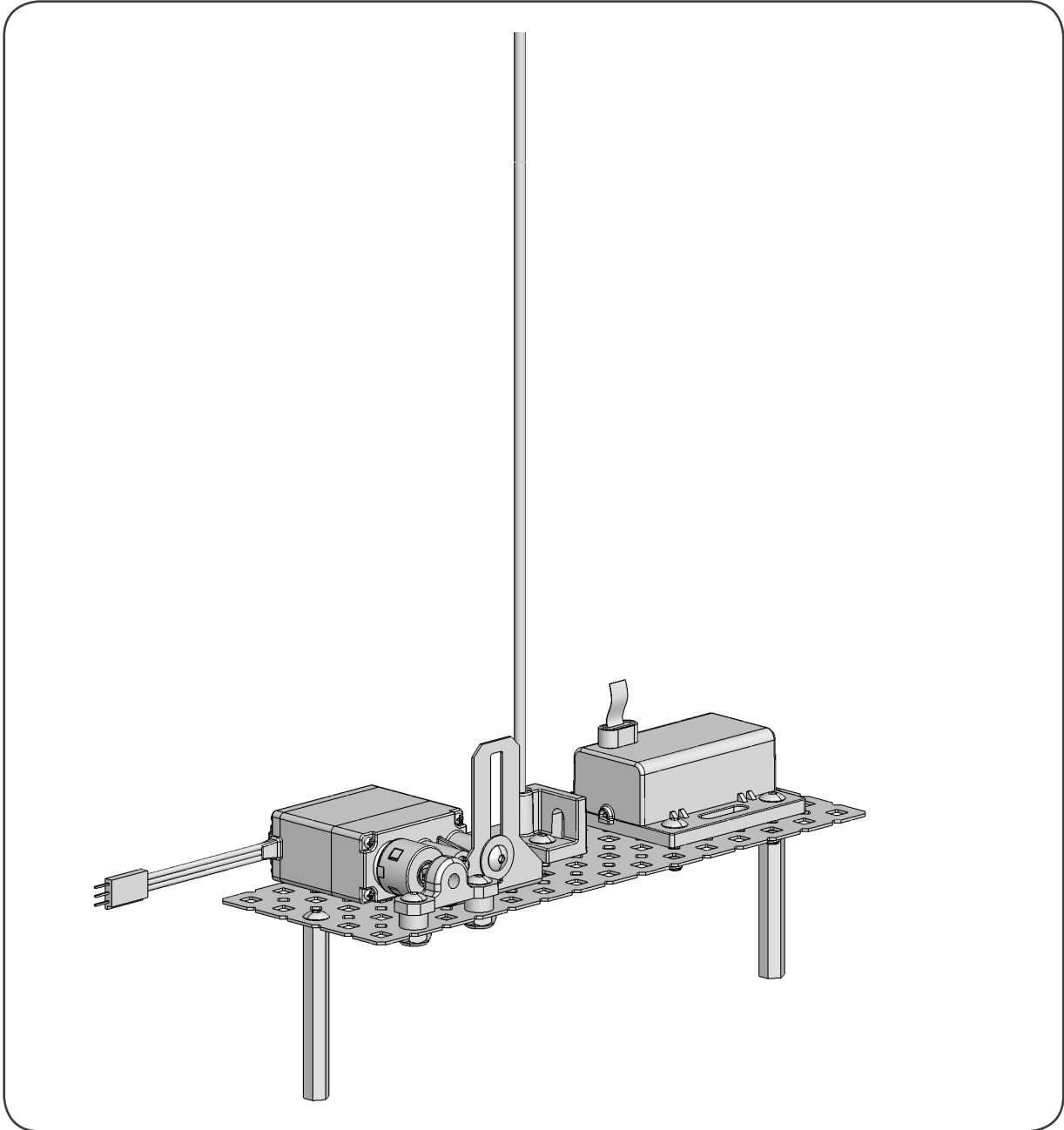
x 1



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 6 Motor platform construction (cont.)

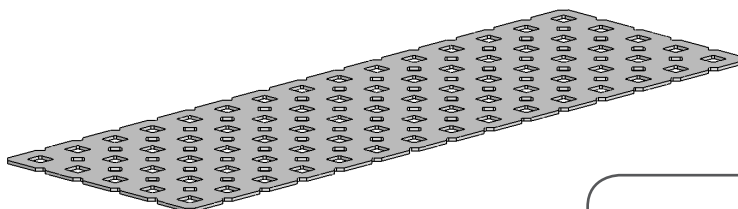
Your assembly should now look like this:



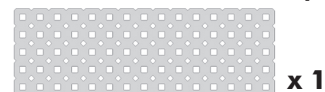
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 7 Battery platform construction

Start with a second large plate. The Squarebot 3.0 design uses another raised platform to hold the battery and stabilize the arm.

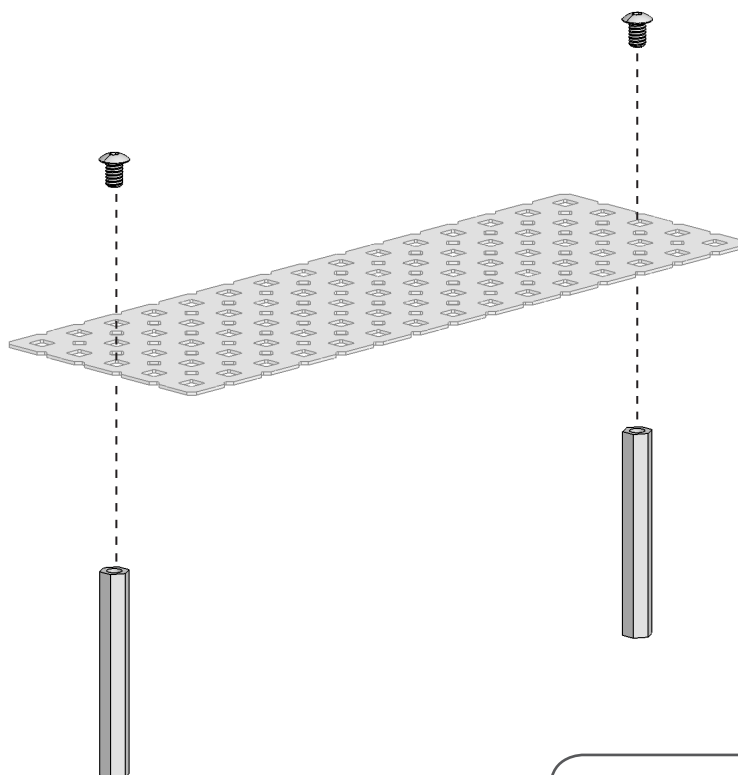


Parts needed in this step:



x 1

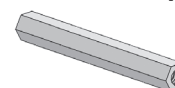
Attach two 2" standoffs to the large plate using two 1/4" screws.



Parts needed in this step:



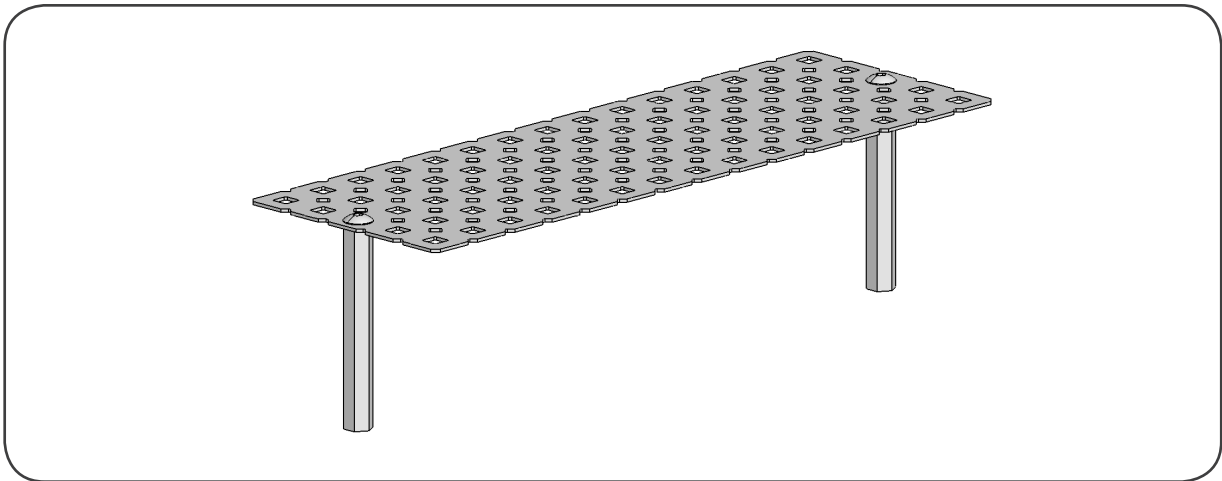
1/4"  
x 2



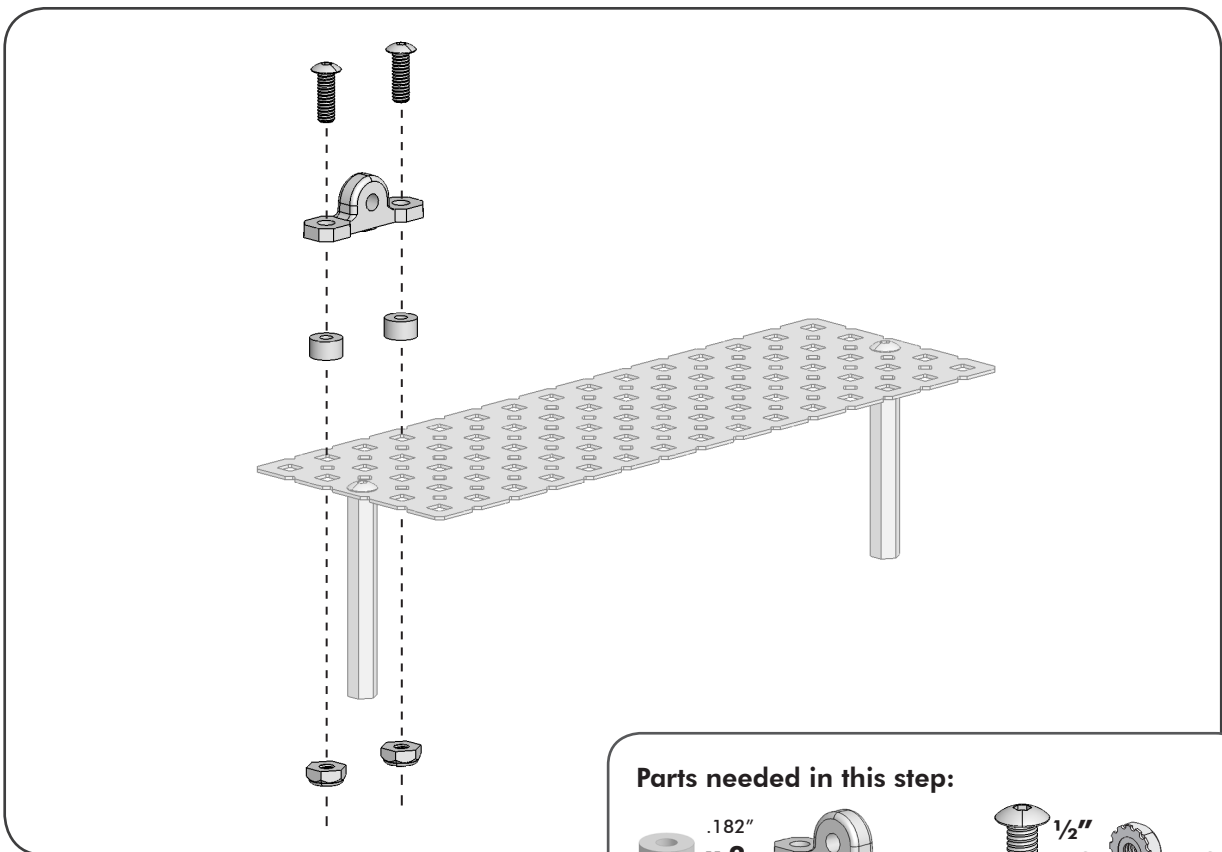
2"  
x 2

# Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*


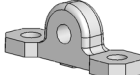


## 7 Battery platform construction (cont.)



Add a vertical bearing with spacers.

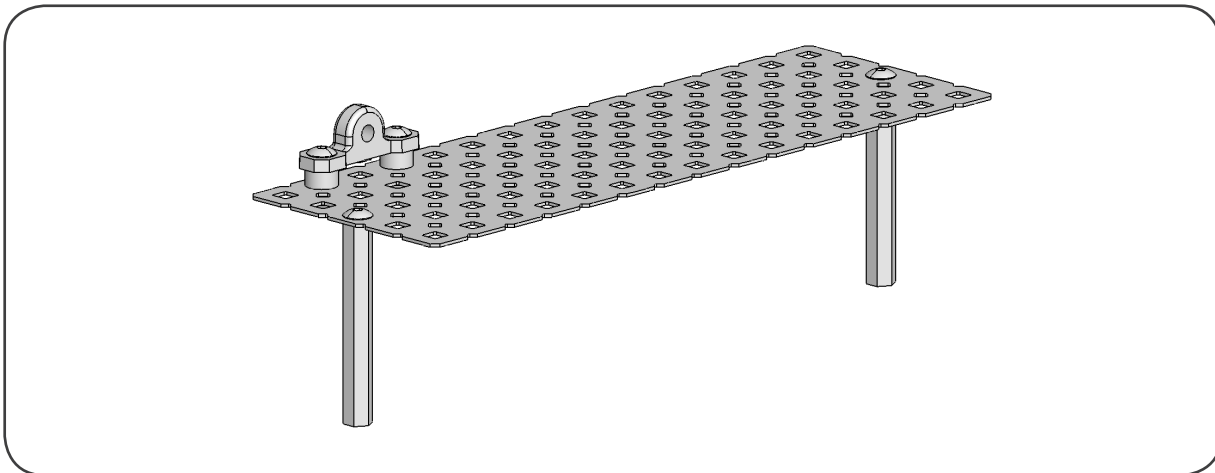


**Parts needed in this step:**

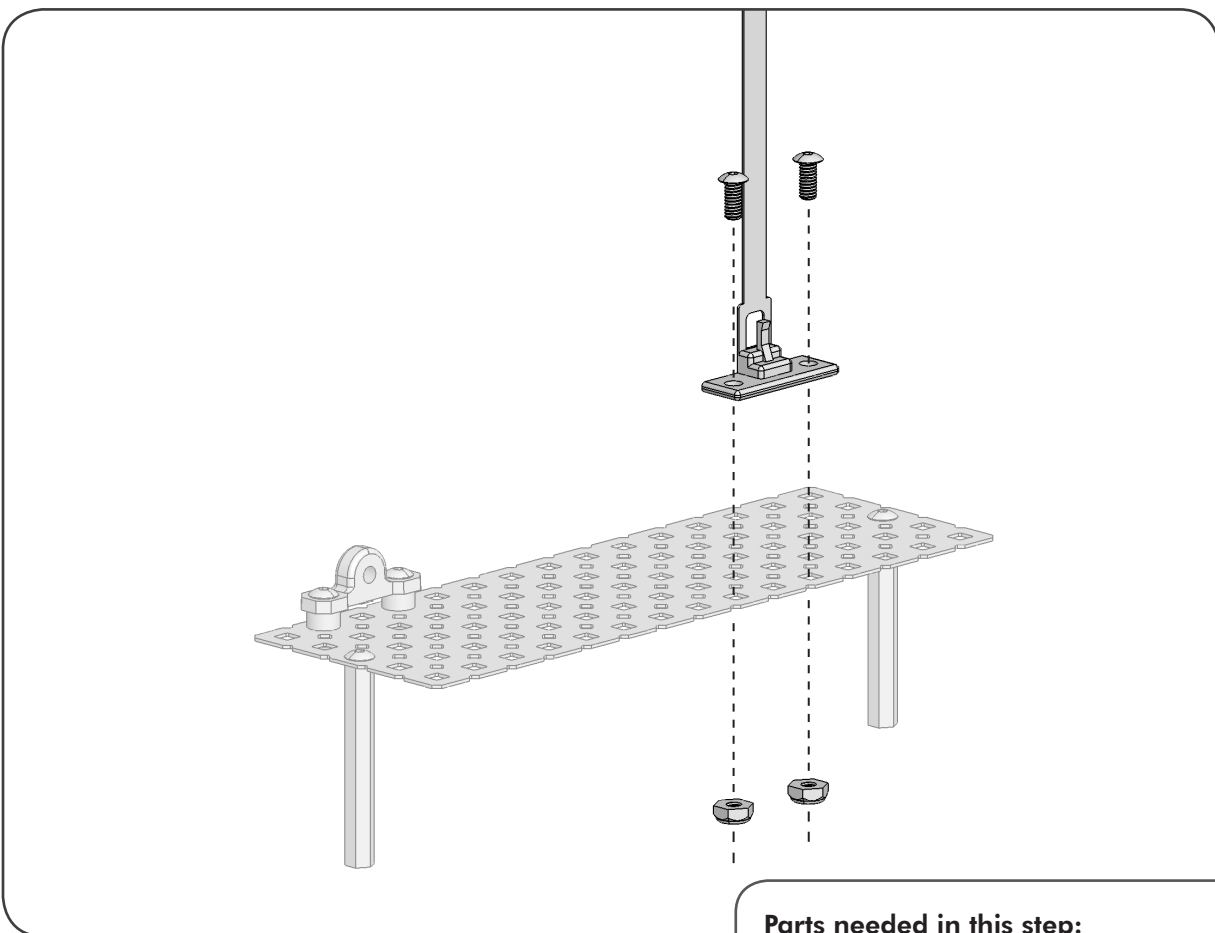
-   $.182''$   
**x 2**
-  **x 1**
-   $\frac{1}{2}''$   
**x 2**
-  **x 2**

# Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

## 7 Battery platform construction (cont.)



Attach the battery strap to the platform.



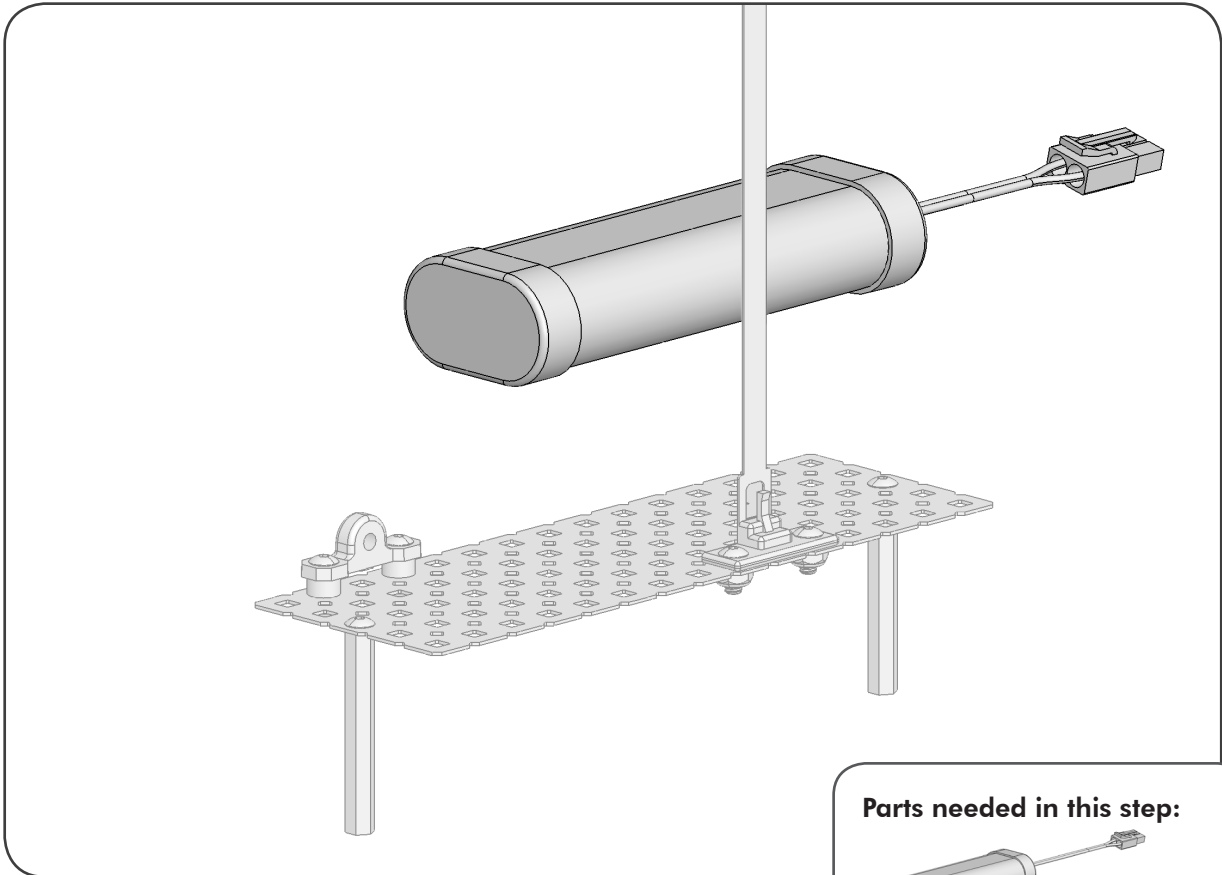
Parts needed in this step:



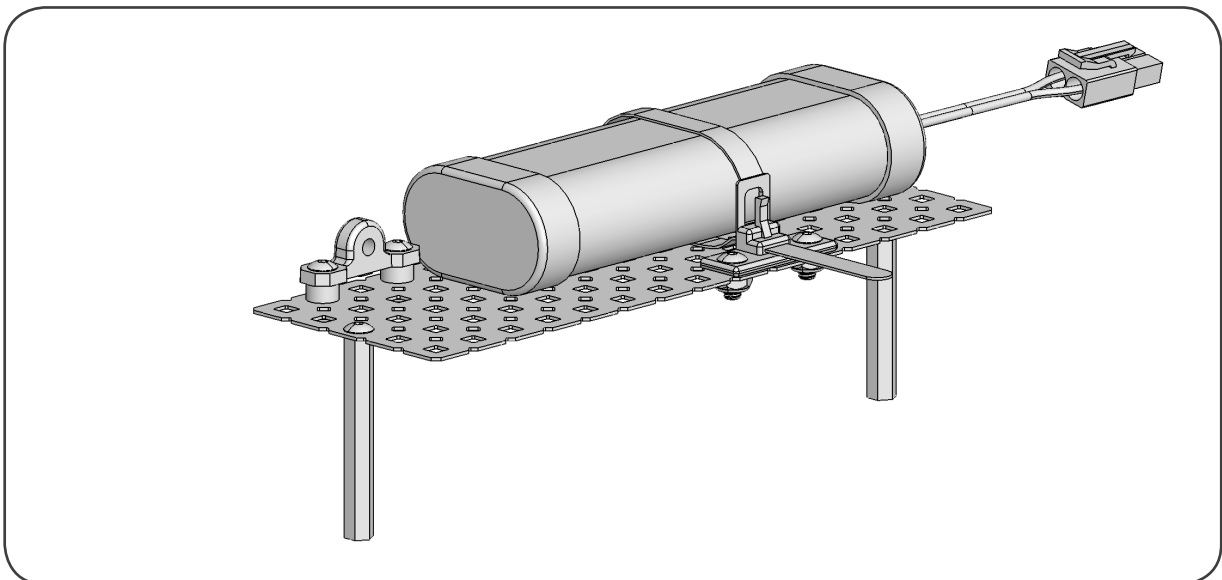
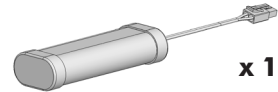
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 7 Battery platform construction (cont.)

Secure the battery in the battery strap.



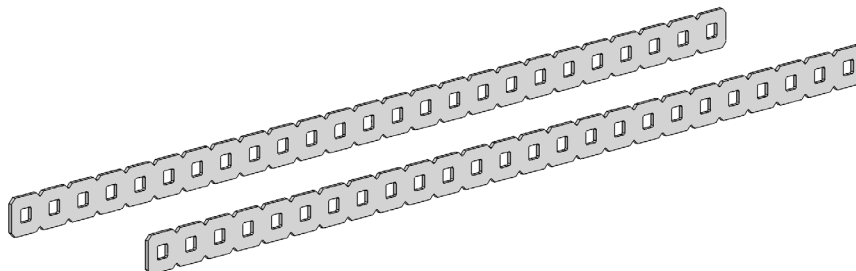
Parts needed in this step:



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 8 Arm construction

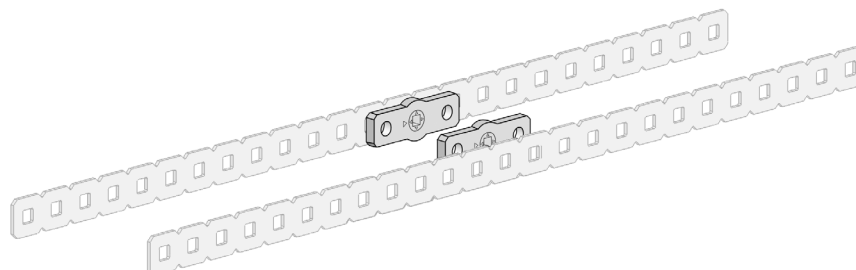
Start with two long bars.



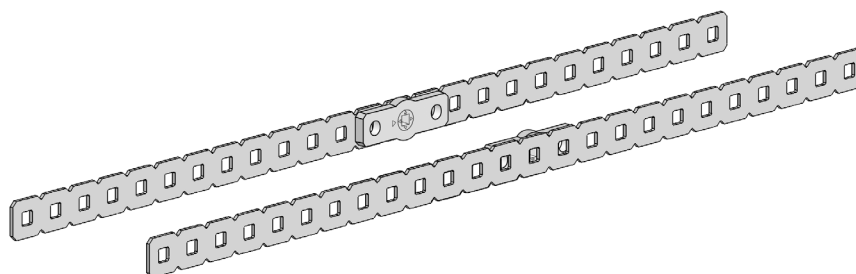
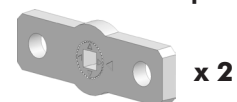
Parts needed in this step:



Add a lock plate to the inner face of each punched bar.



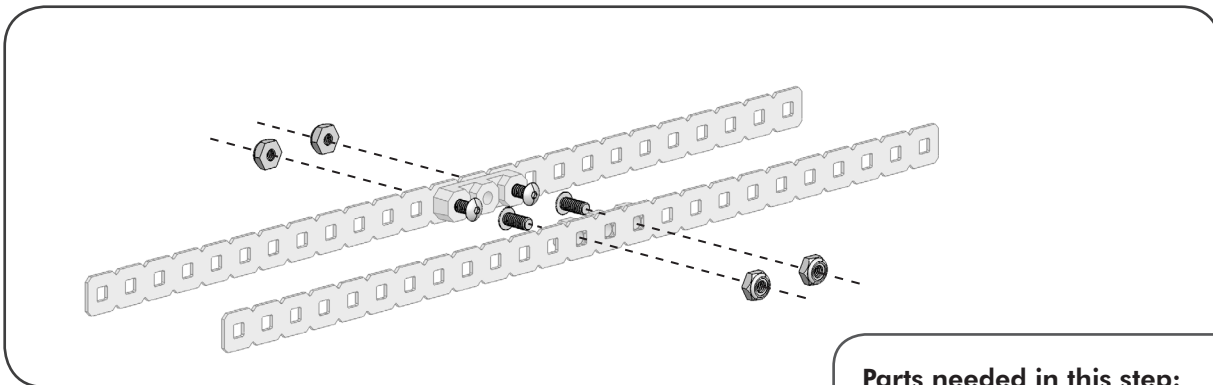
Parts needed in this step:



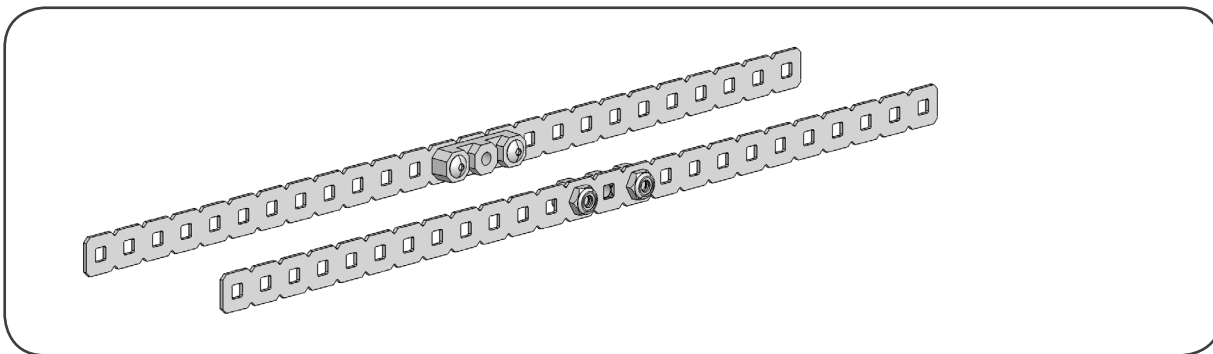
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 8 Arm construction (cont.)

Secure the lock plates to the long bars with two 1/2" screws and two keps nuts each.

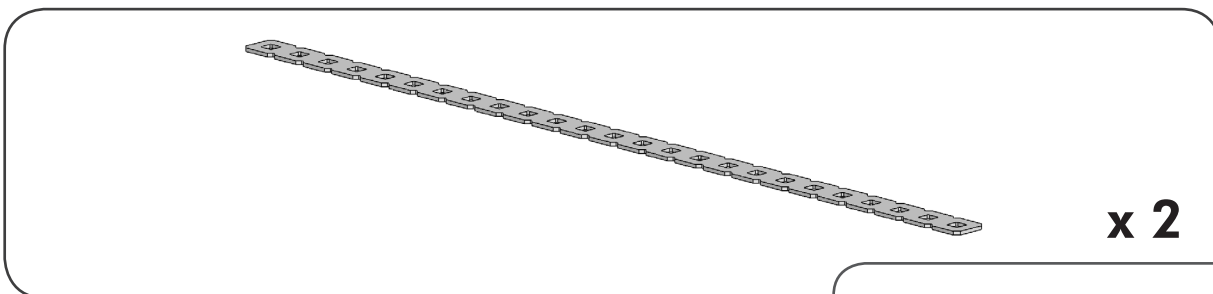


Parts needed in this step:



Retrieve two additional long bars.

NOTE: Though only one long bar is depicted in the next three steps, the required actions are to be performed on BOTH bars.



Parts needed in this step:

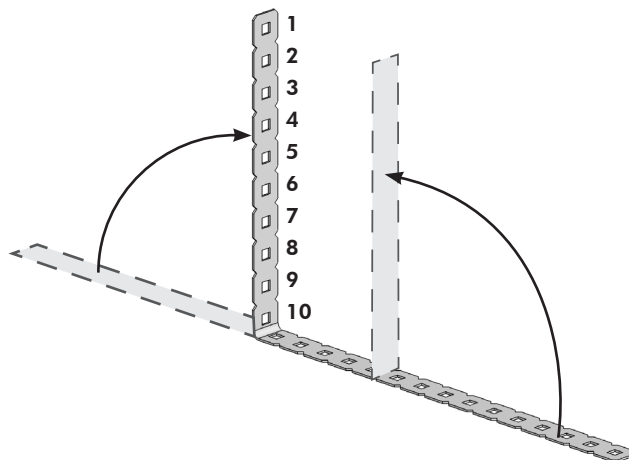


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

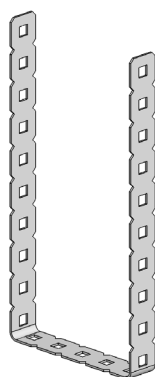
### 8 Motor platform construction

Counting 10 "squares" in from each end, bend the long bars at 90 degree angles, transforming them into U-shaped pieces.

NOTE: The recommended tools for completing this step are two sets of pliers, or one set of pliers and a vice grip.

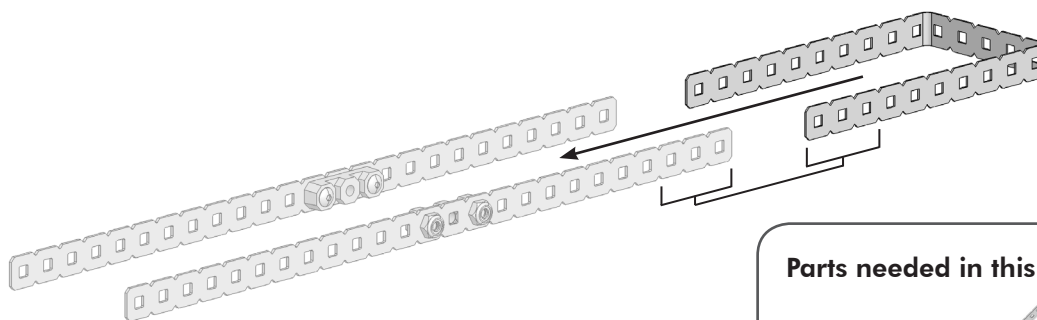


**x 2**



**x 2**

Place one U-shaped long bar so that it overlaps the unbent long bars by 3 "squares".



**Parts needed in this step:**

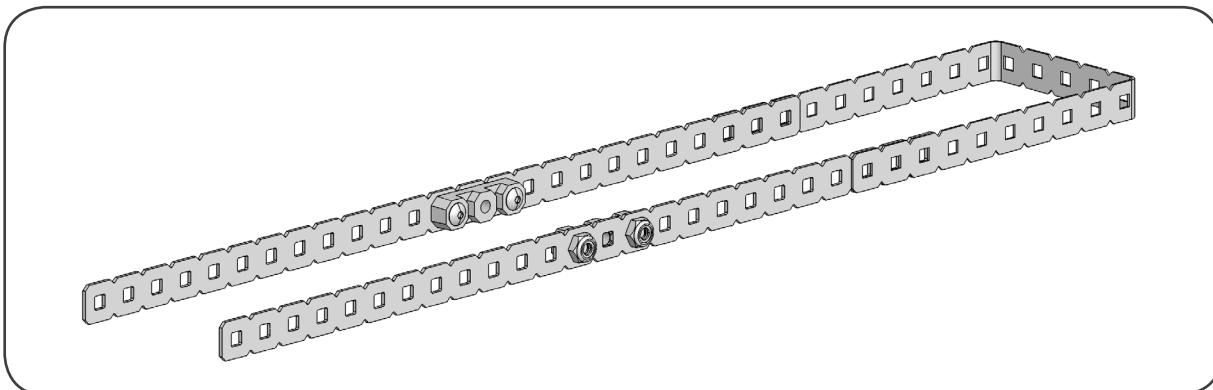


**x 1**

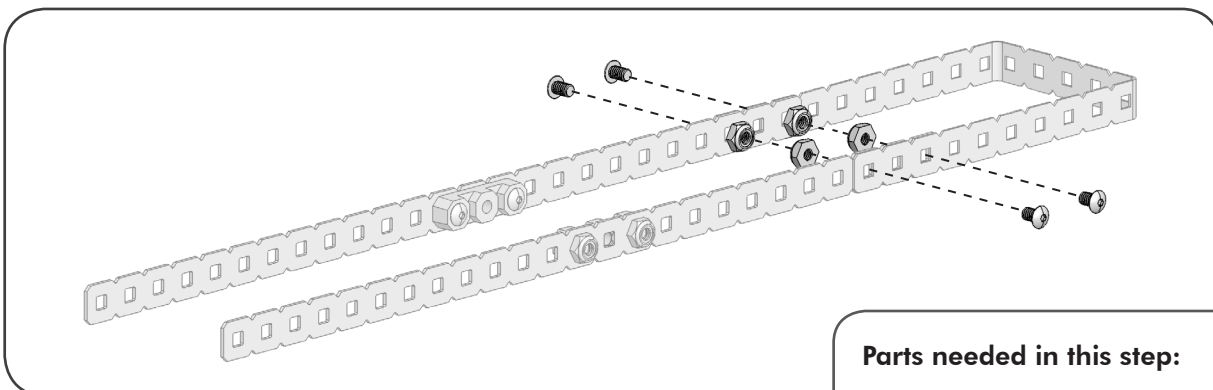


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

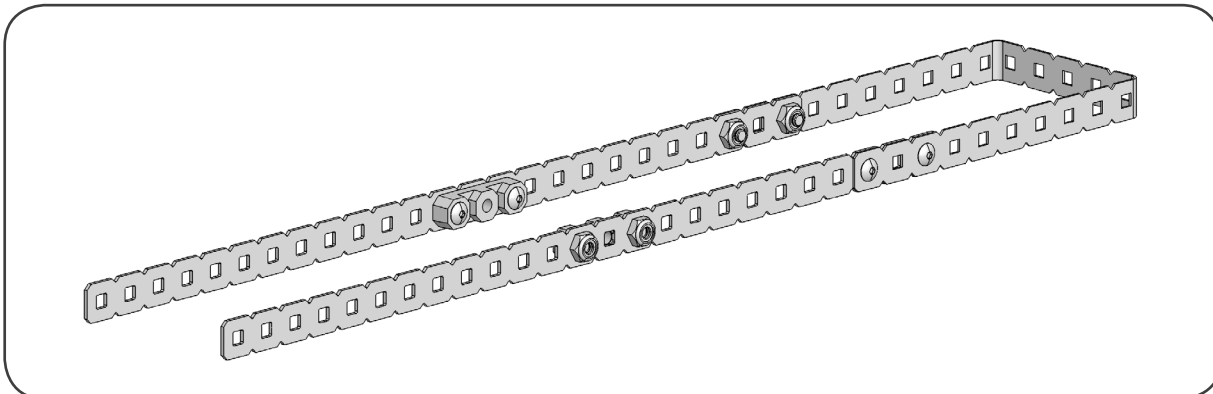
### 8 Arm construction (cont.)



Secure the U-shaped long bar.

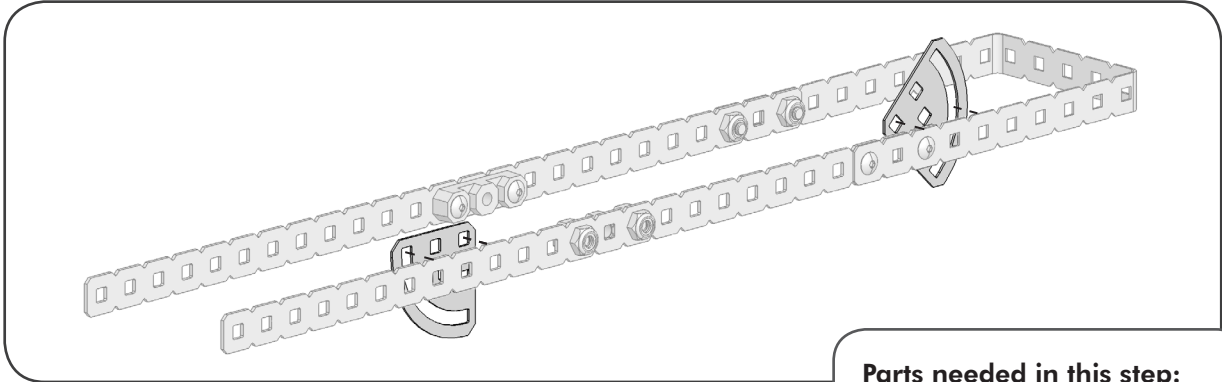


Parts needed in this step:

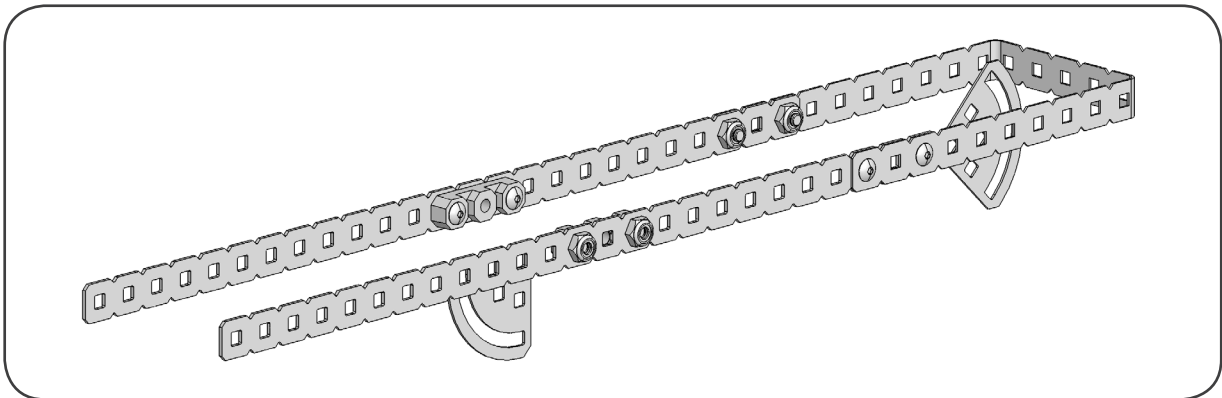


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

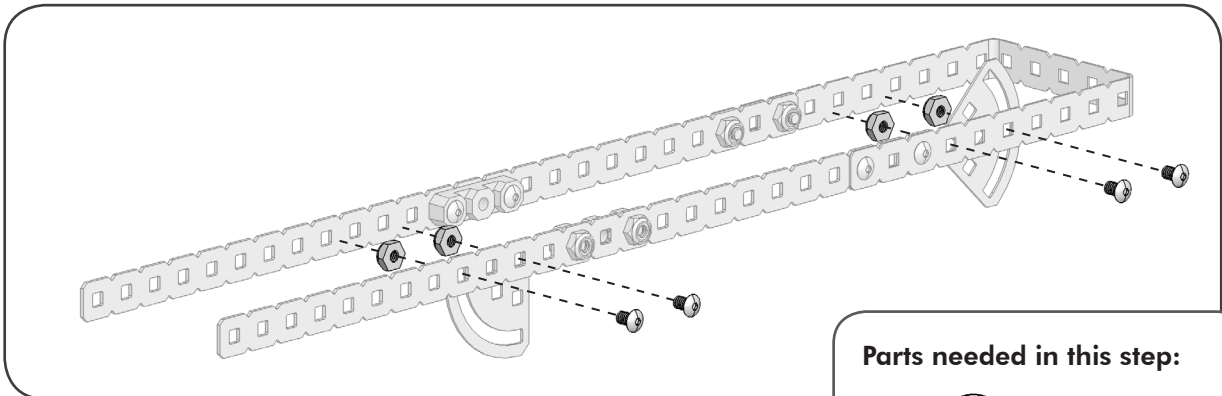
**8 Arm construction (cont.)**  
Add two pivots as shown.



Parts needed in this step:



Secure the pivots to the arm structure using two 1/4" screws and two keps nuts each.

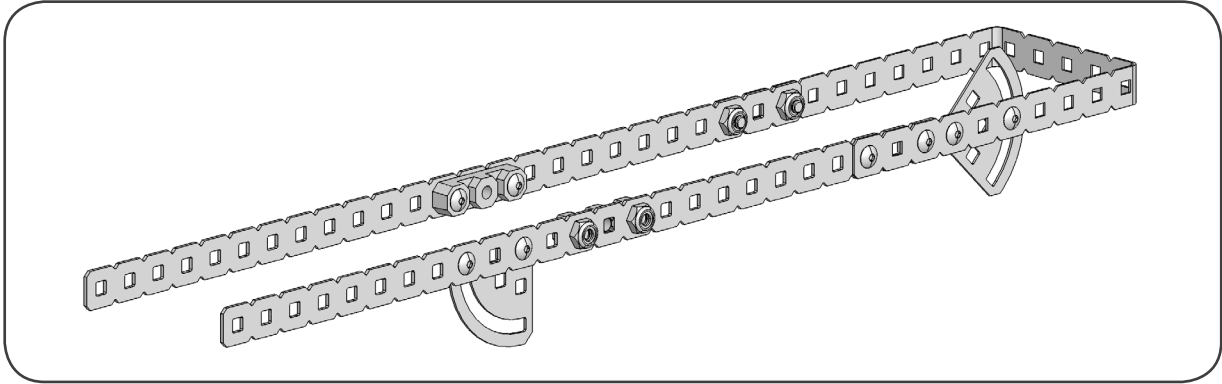


Parts needed in this step:

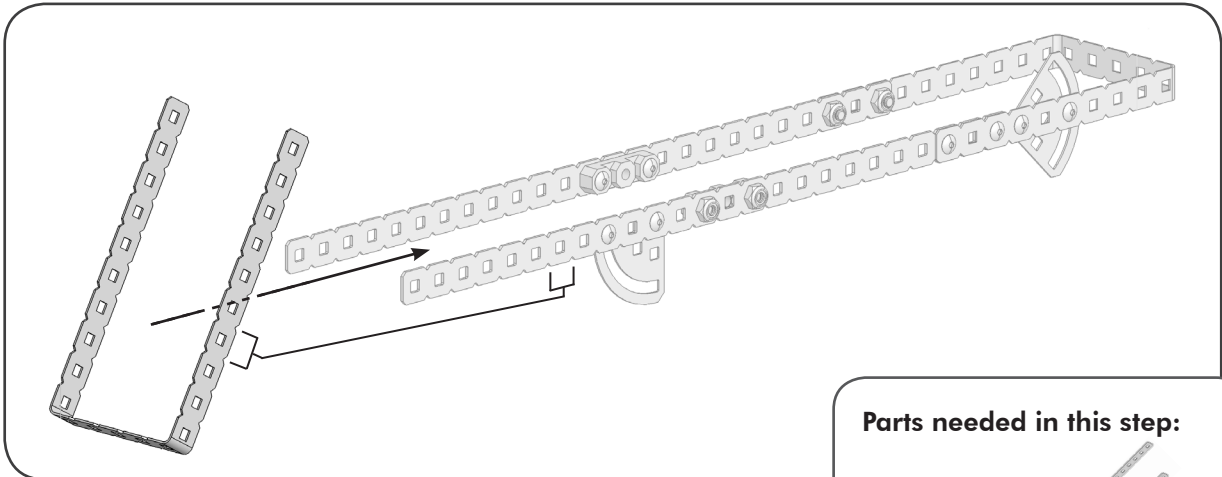


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

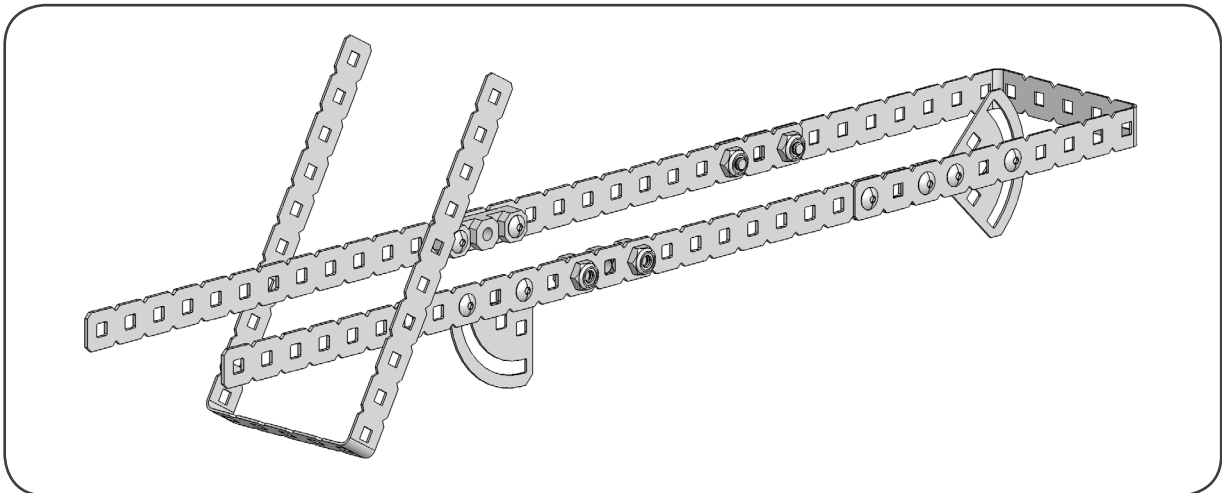
### 8 Arm construction (cont.)



Add the second U-bent long bar to the front of the arm.



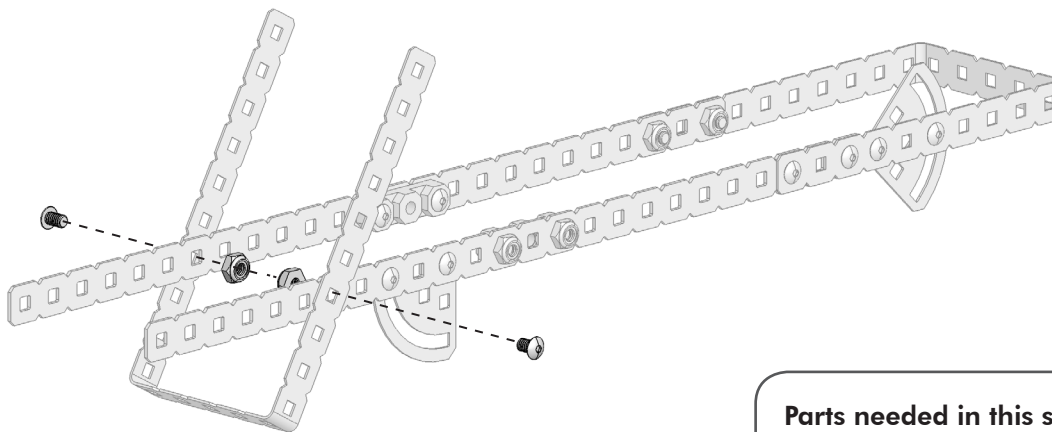
Parts needed in this step:



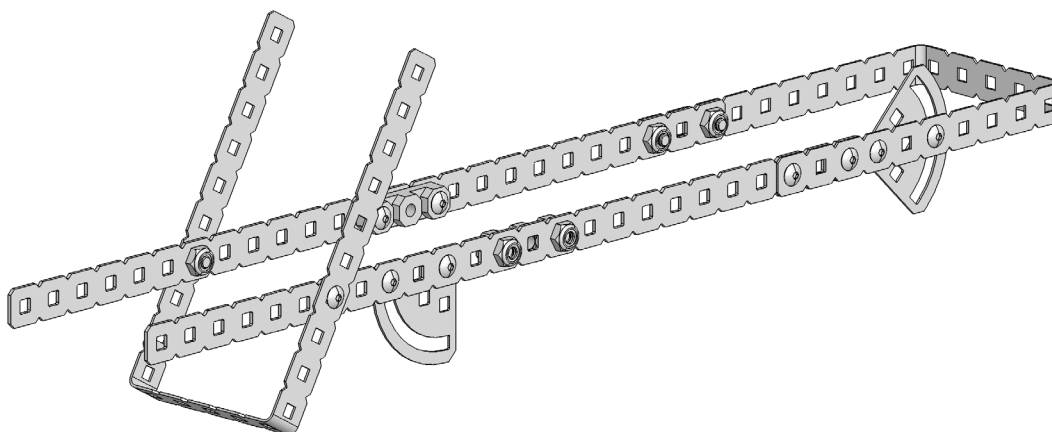
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 8 Arm construction (cont.)

Using the holes seven squares in from the ends of both the U-shaped long bar and the normal punched bars, connect them using two 1/4" screws and two keps nuts.



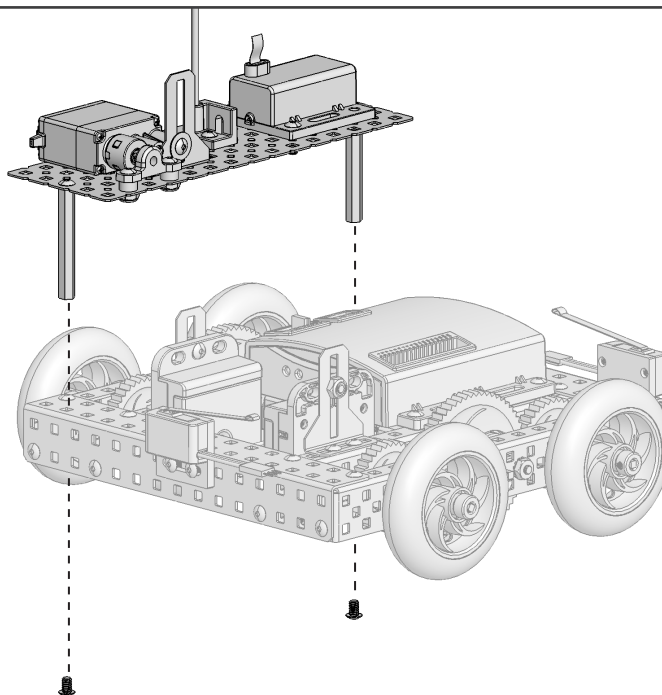
Parts needed in this step:



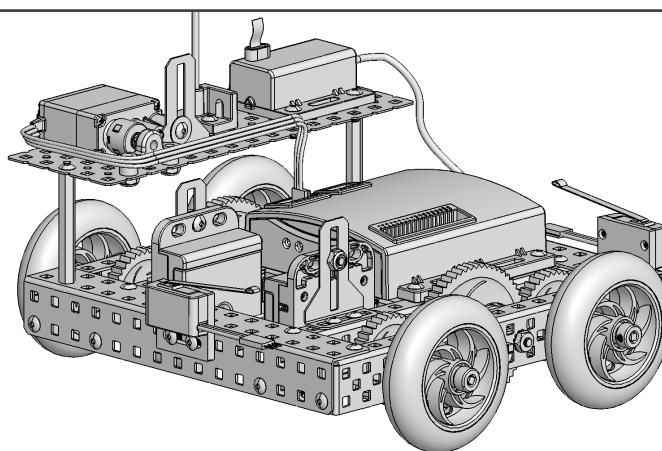
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 9 Structure Assembly

Attach the motor platform to the chassis using two 1/4" screws.



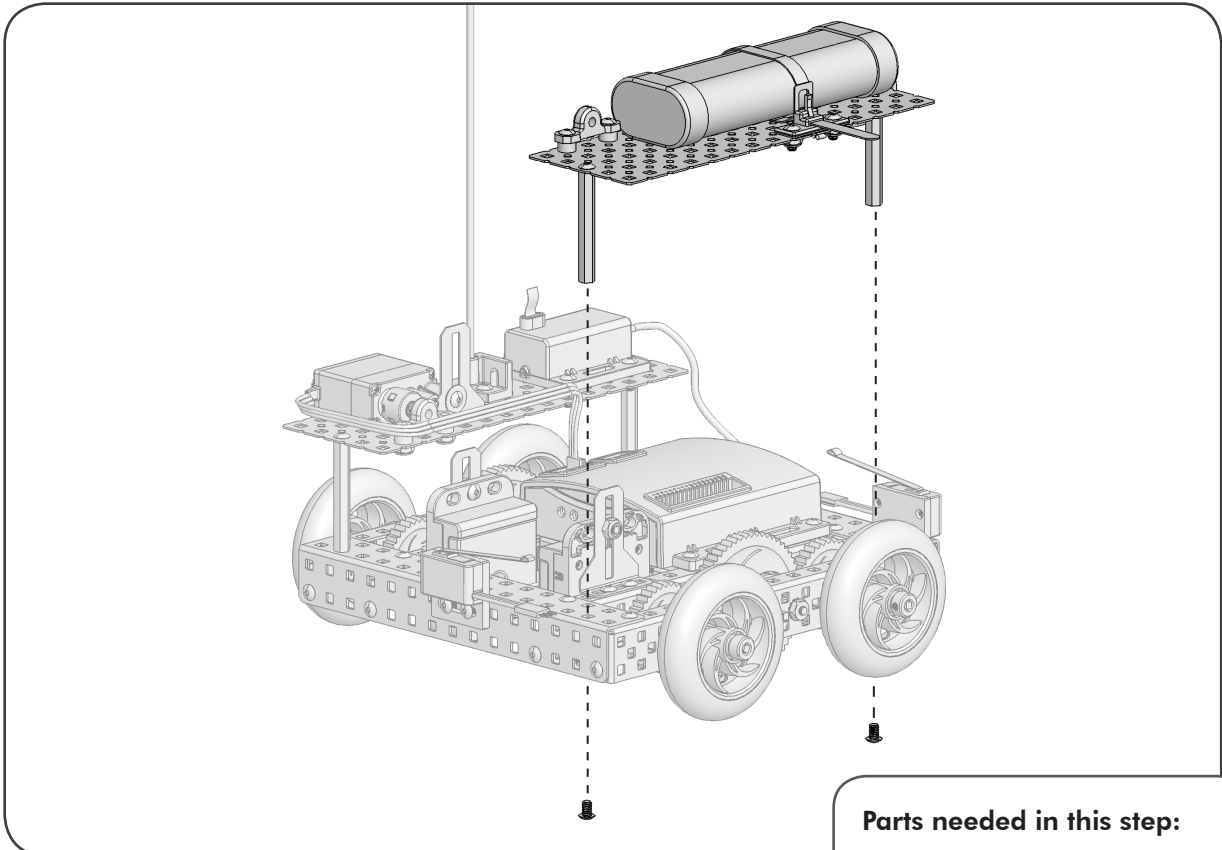
Parts needed in this step:



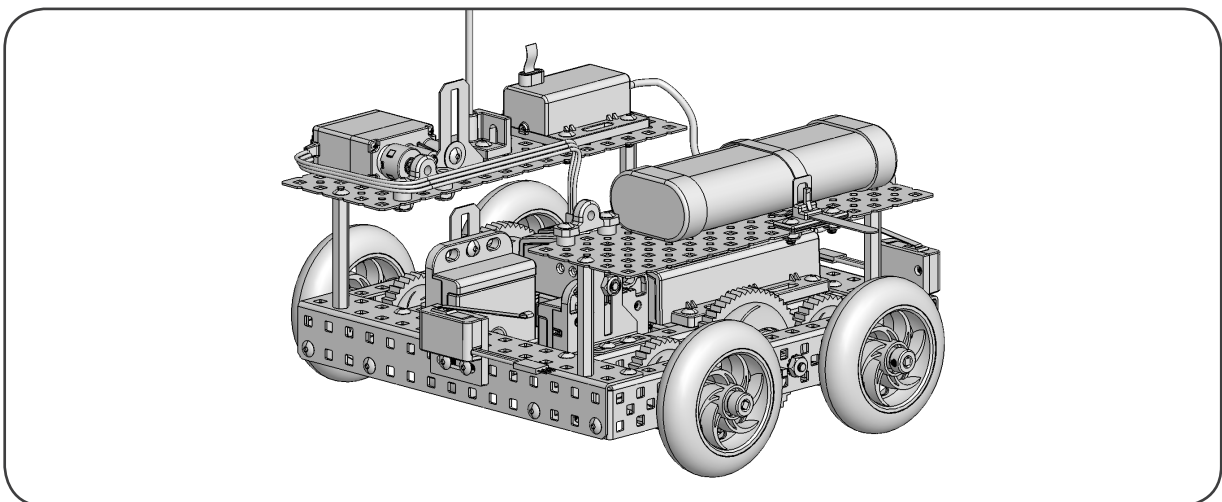
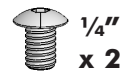
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 9 Structure Assembly *(cont.)*

Attach the battery platform to the chassis using two 1/4" screws.



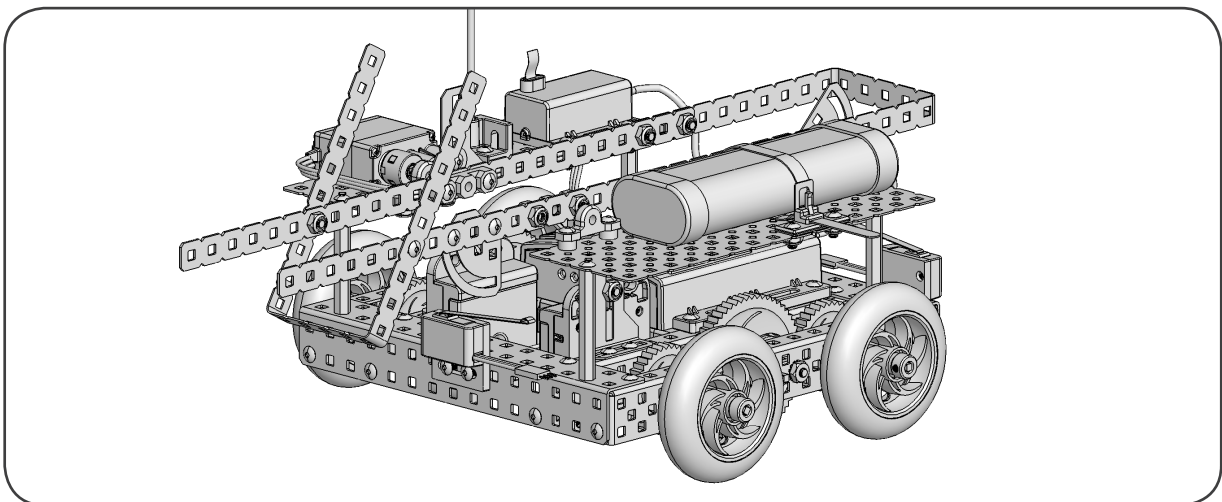
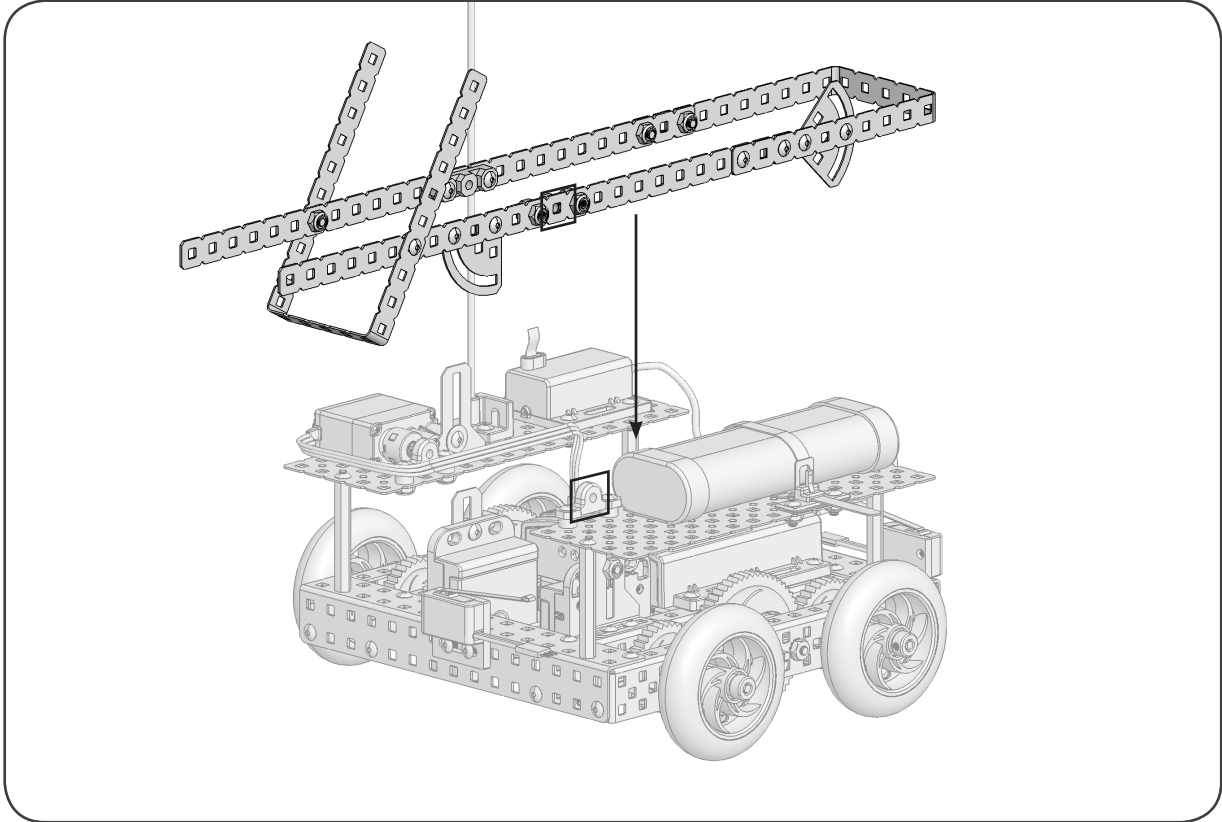
Parts needed in this step:



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 9 Structure Assembly *(cont.)*

Place the arm so that the open holes in the lock plates align with the holes in the bearing blocks.



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

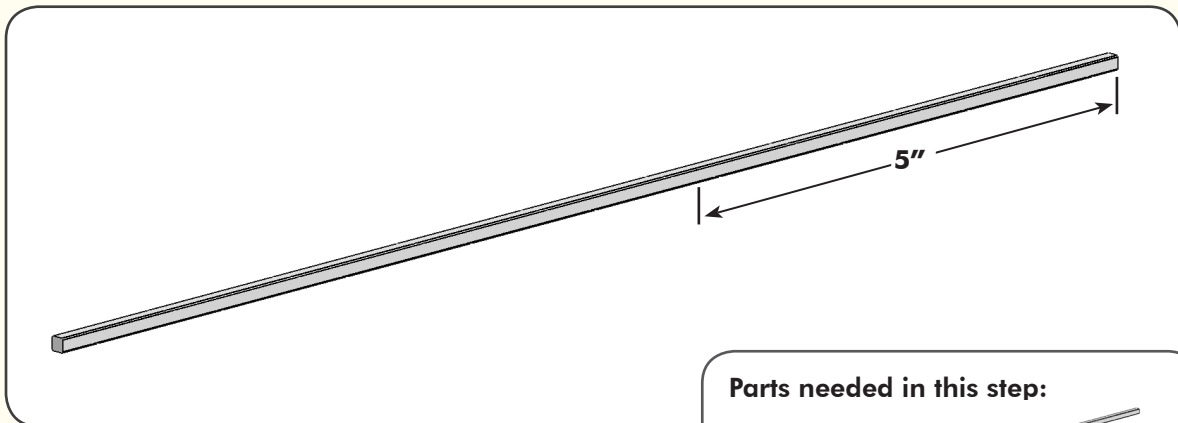
### 9 Structure Assembly (cont.)



#### **CAUTION:**

This step involves cutting tools and permanent alterations to the materials in the VEX Starter Kit. Make sure you have permission before continuing. **ALL APPLICABLE SAFETY PROCEDURES MUST BE OBSERVED WHILE PERFORMING THIS STEP.**

Since there are no 5" square axles in the starter kit, it must be cut from a 12" square axle. Using a ruler, measure out one 5" segment and mark it with a pencil.



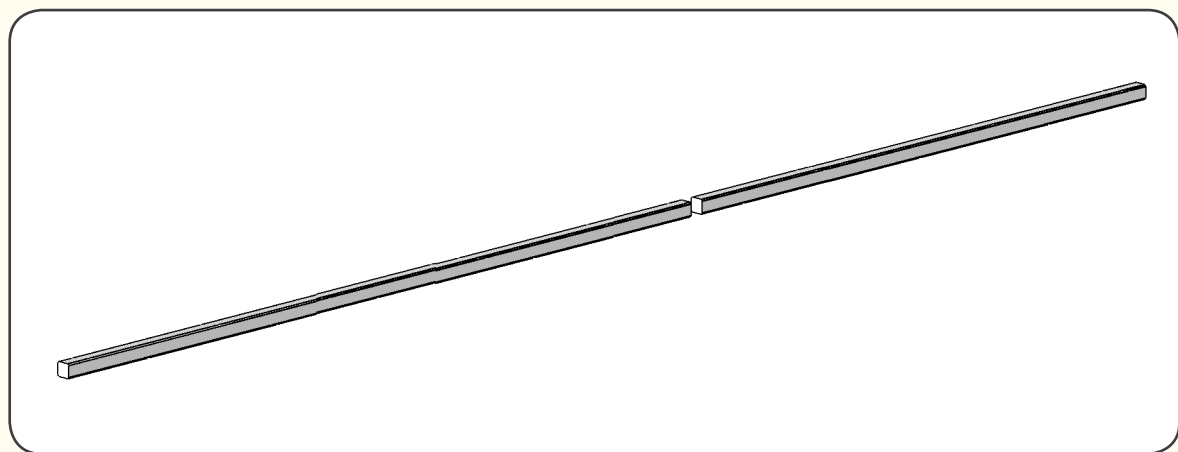
#### Parts needed in this step:



**12"  
x 1**

Using a hacksaw or other appropriate tool, cut the 12" axle into the measured segments. File down all cut ends afterward to remove any sharp or rough edges.

**IF YOU ARE UNSURE ABOUT HOW TO USE THE TOOLS OR PERFORM THIS PROCEDURE SAFELY, DO NOT ATTEMPT THIS STEP ALONE. SEEK QUALIFIED ASSISTANCE BEFORE PROCEEDING.**

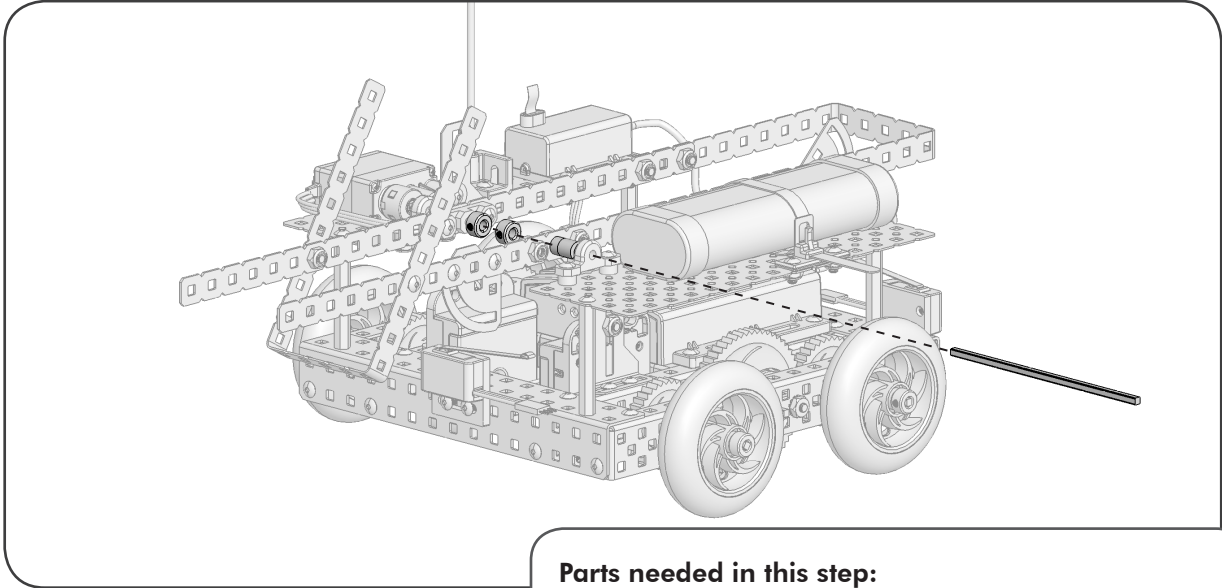




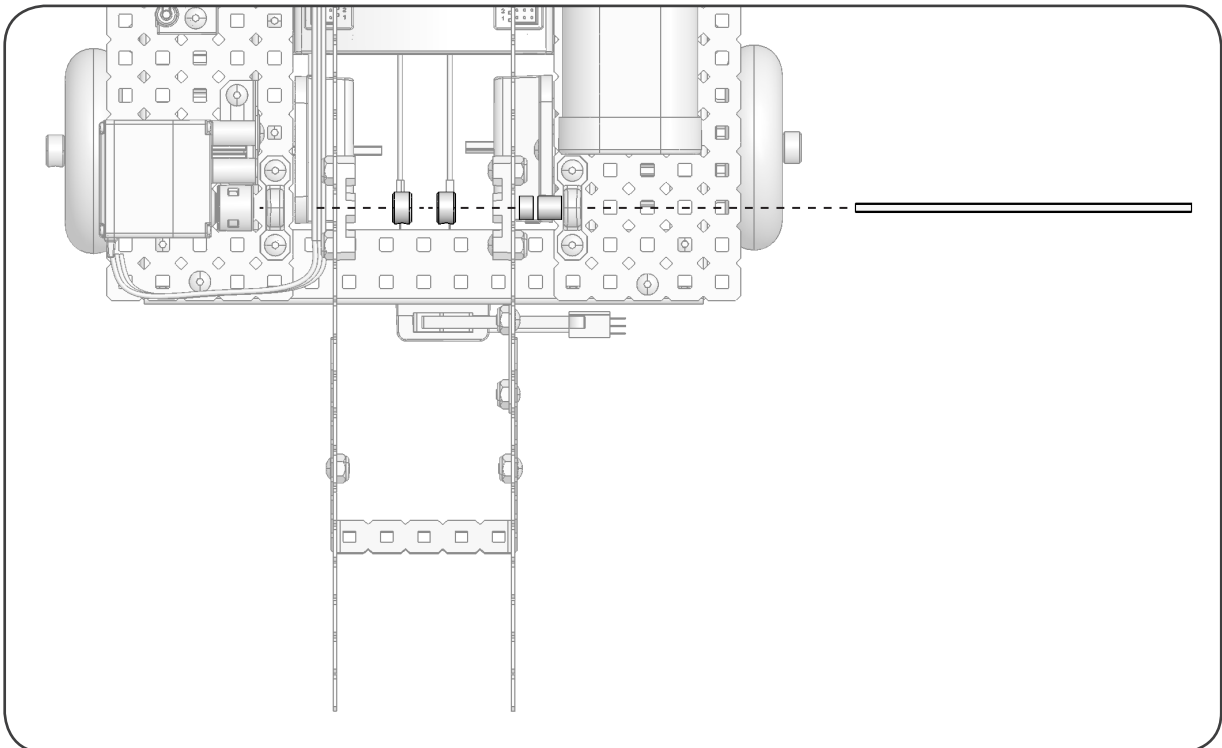
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 9 Structure Assembly *(cont.)*

Slide the 5" square bar through the center holes of the lock plates, bearing blocks, and motor, with a collar on the inner face of each lock plate. Also use one 0.318" and one 0.182" spacer between the bearing block on the battery platform and the arm.

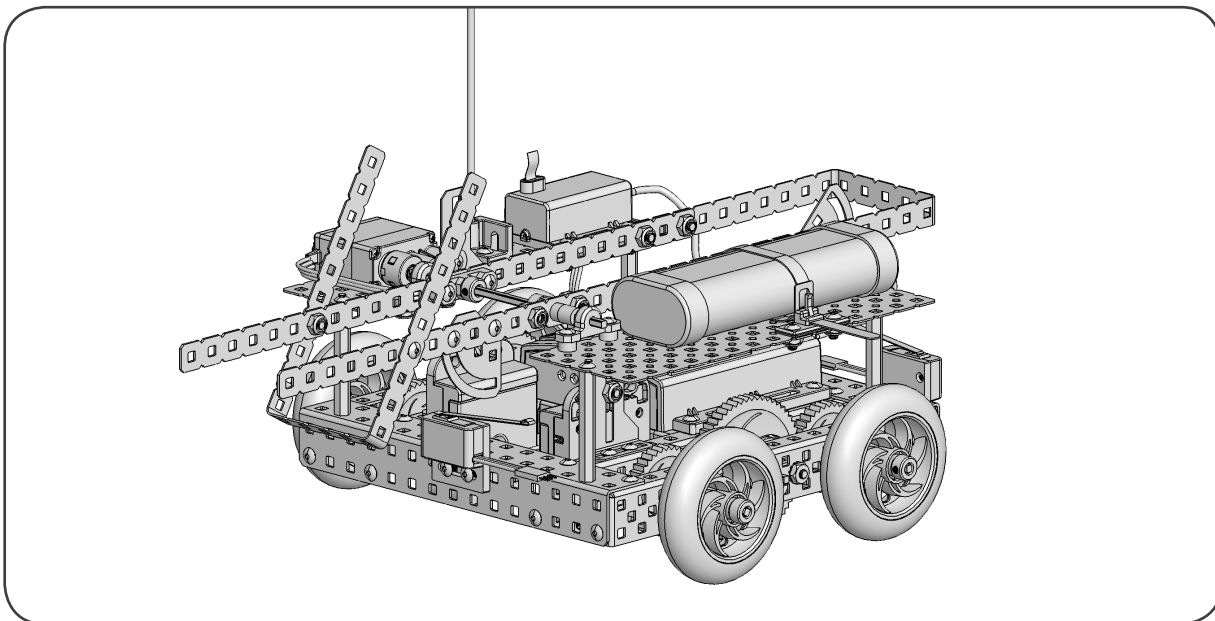


Parts needed in this step:

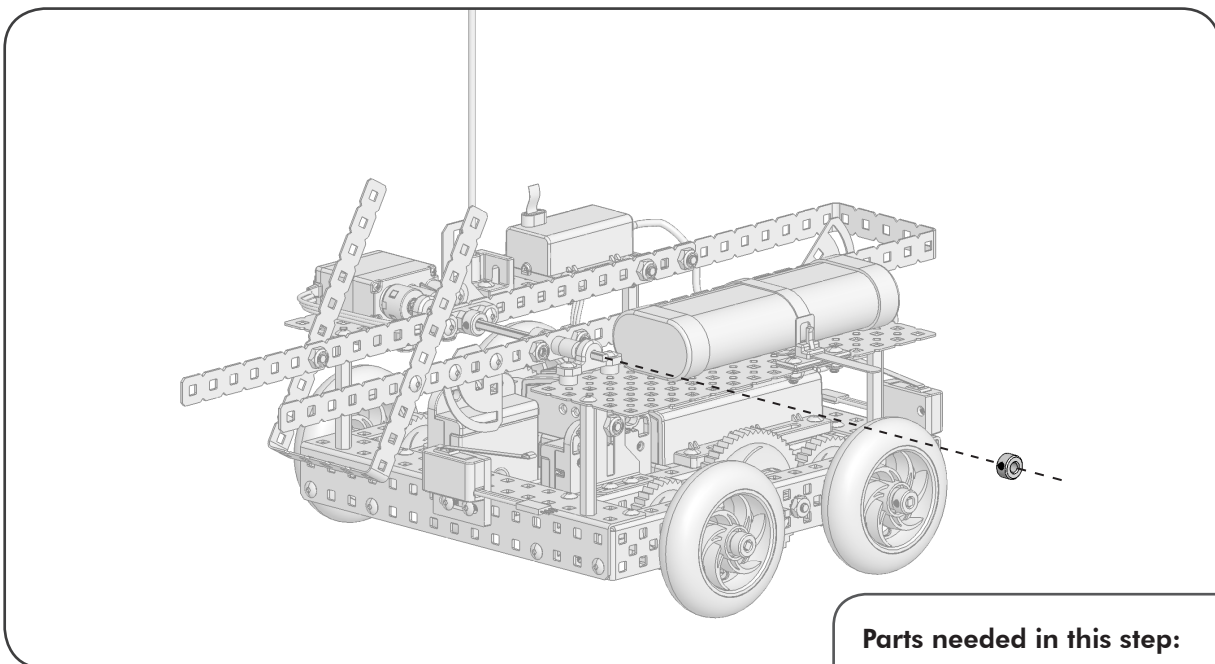


## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 9 Structure Assembly *(cont.)*



Add a collar to the end of the 5" square bar. Ensure that it and the other two collars along the bar have been tightened to keep the arm secure as it rotates.



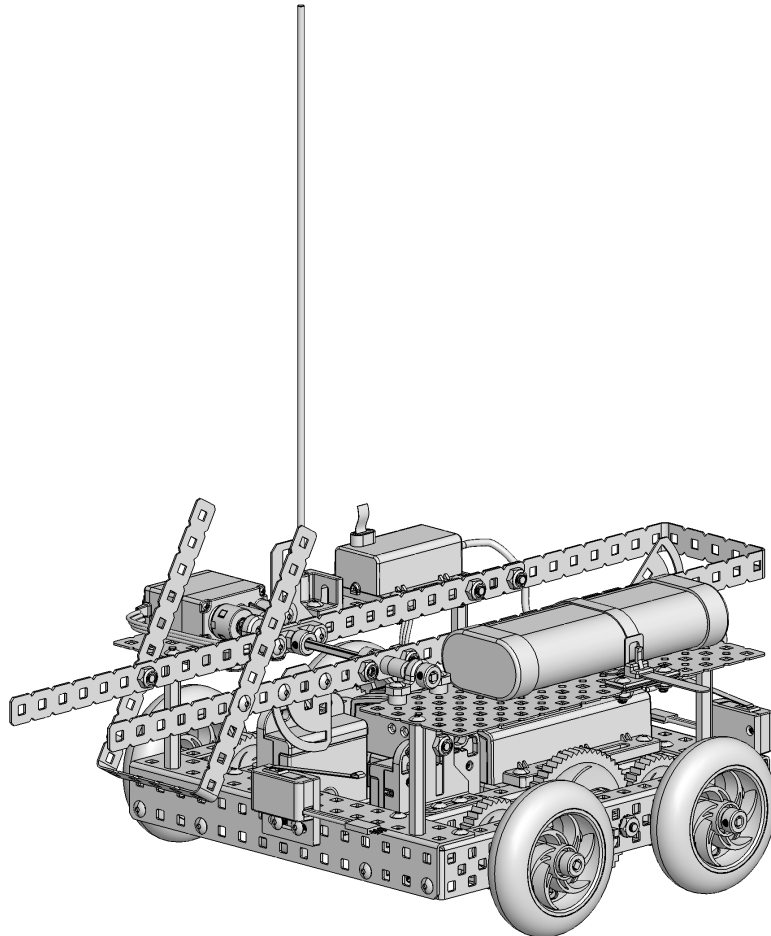
Parts needed in this step:



## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 9 Structure Assembly *(cont.)*

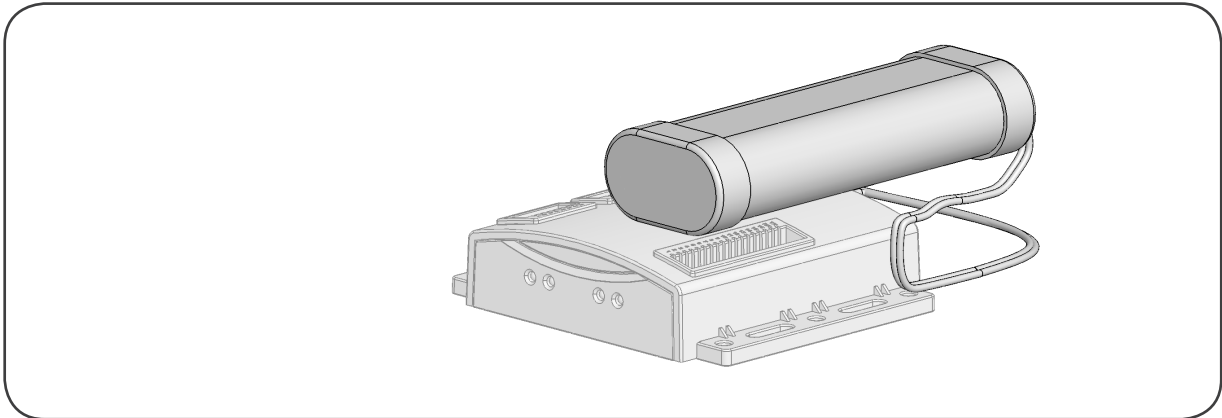
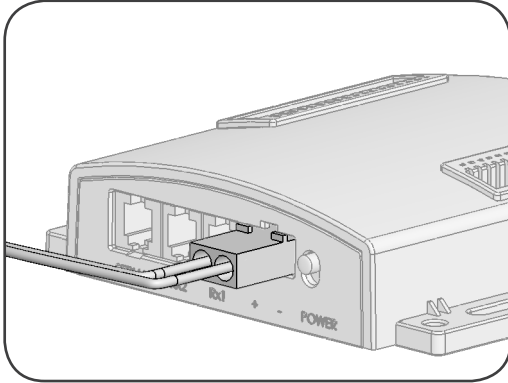
Ensure that your assembly corresponds to this one before moving on.



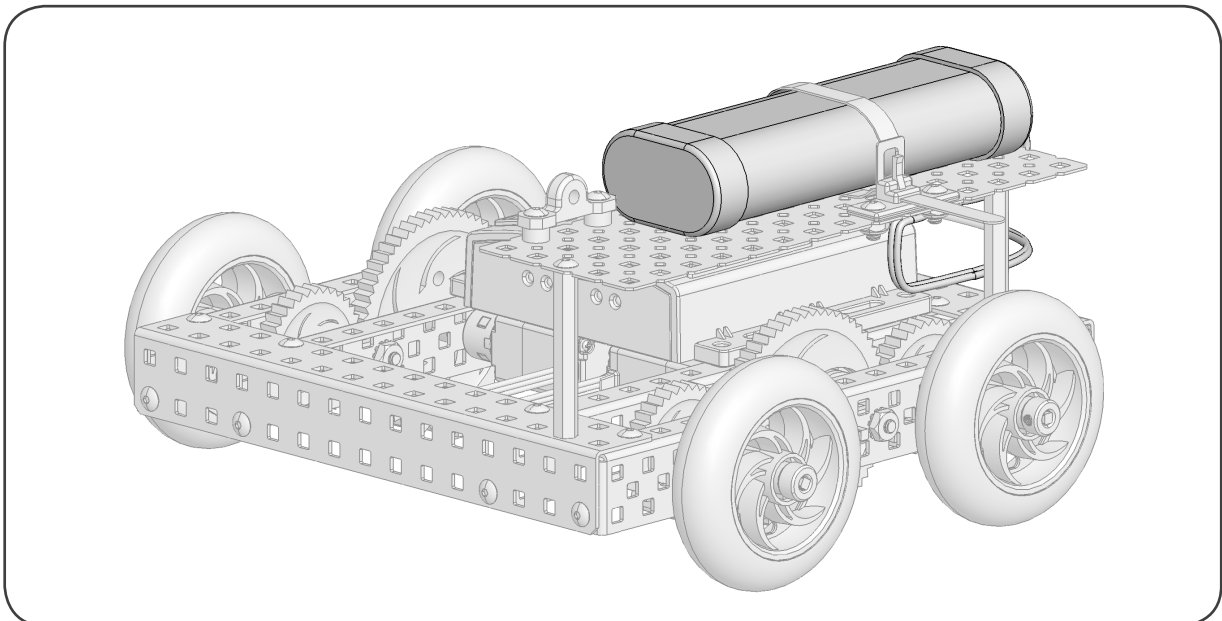
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 10 Wire Assembly *(cont.)*

Take the wire coming out of the battery and plug it into the matching white port on the back of the micro controller.



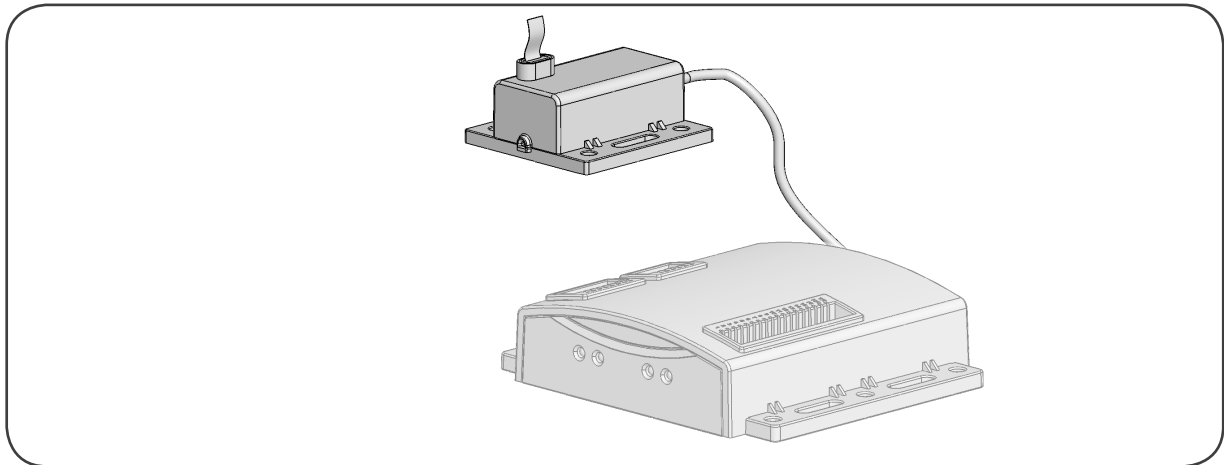
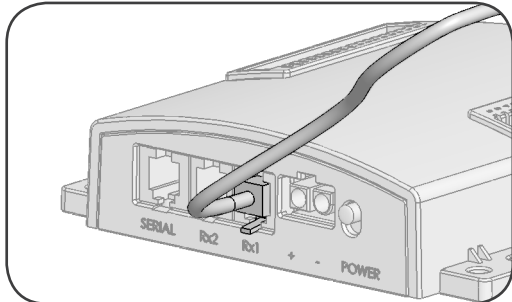
NOTE: Motor platform and arm not shown.



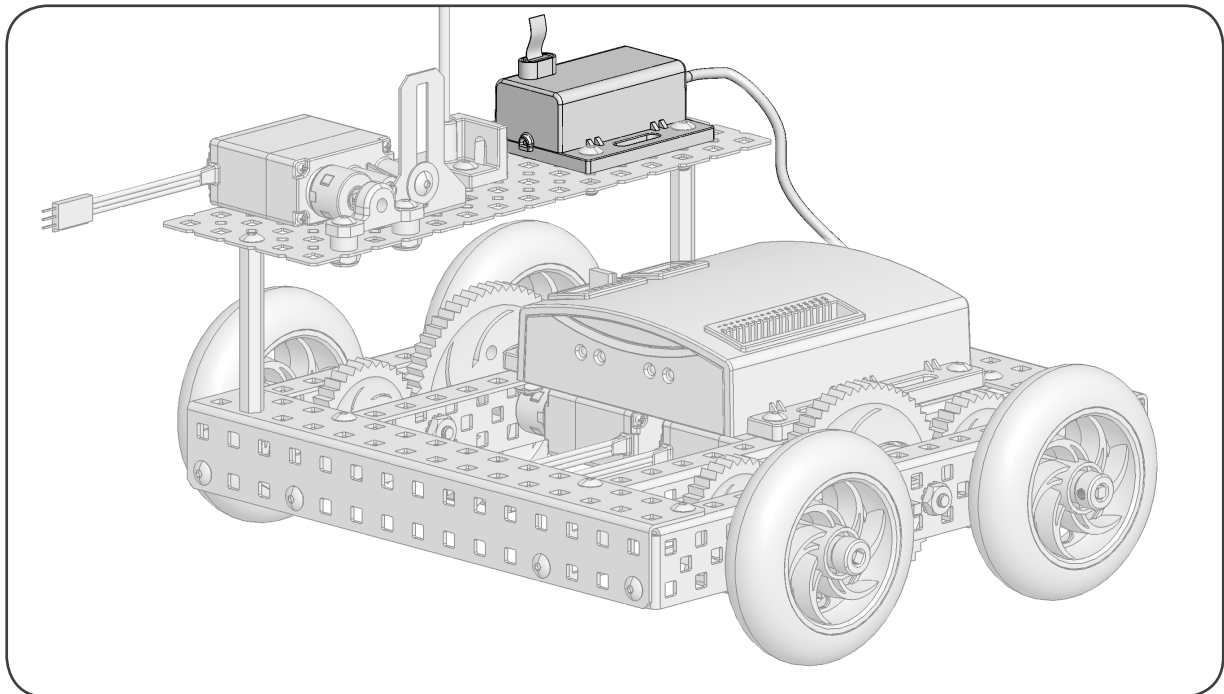
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 10 Wire Assembly *(cont.)*

Take the 9" RJ-10 wire (yellow phone cable) and plug one end into the yellow receiver module and the other end into the port marked "Rx1" on the back of the micro controller.



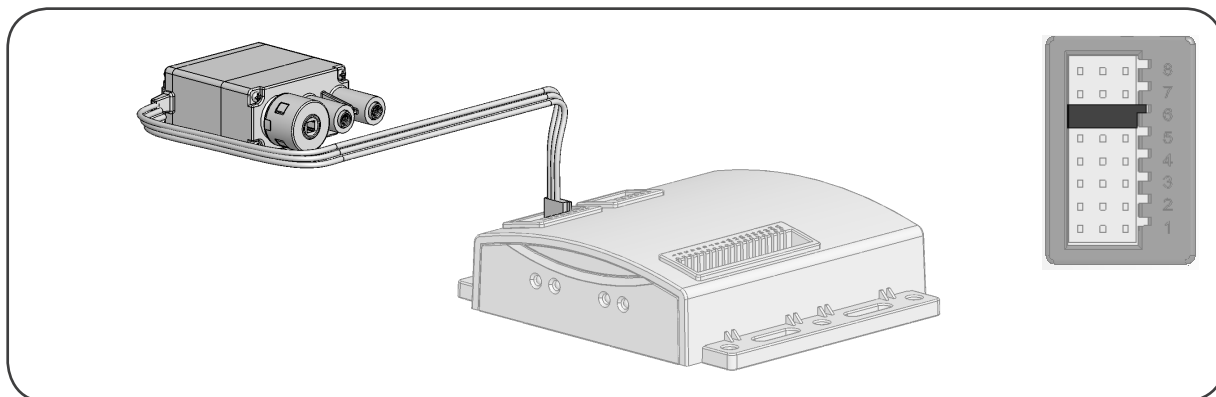
NOTE: Battery platform and arm not shown.



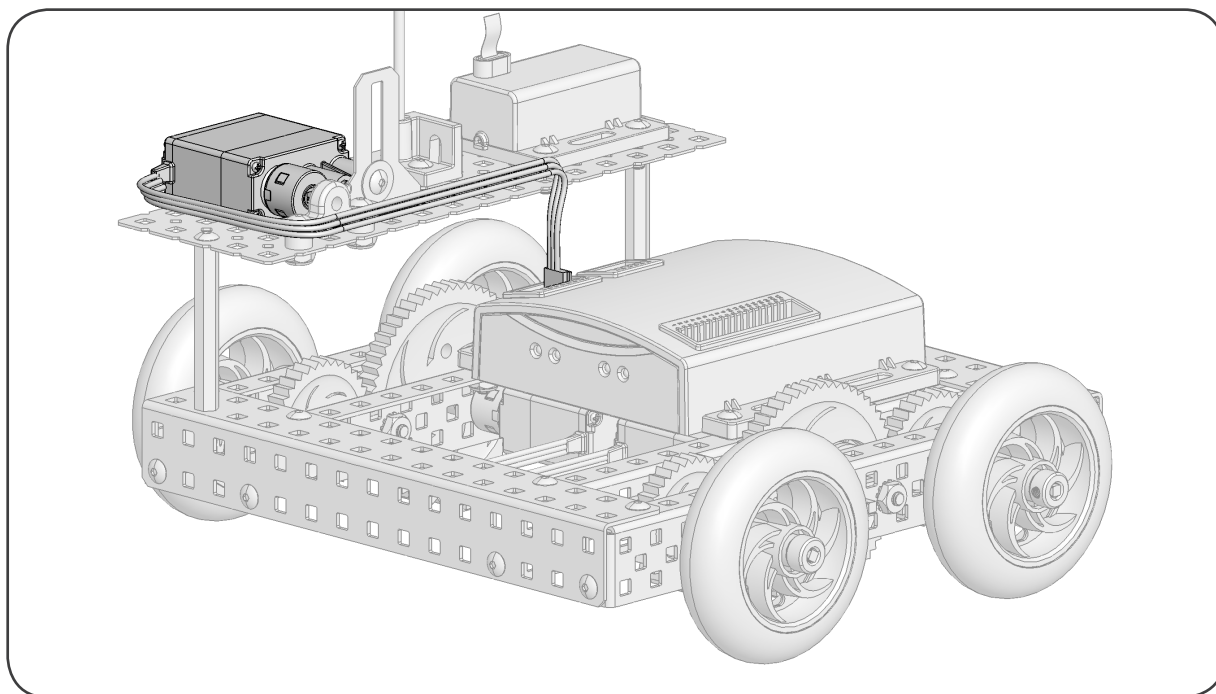
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 10 Wire Assembly (cont.)

Plug the arm motor wire into "MOTORS" port 6 on the micro controller.



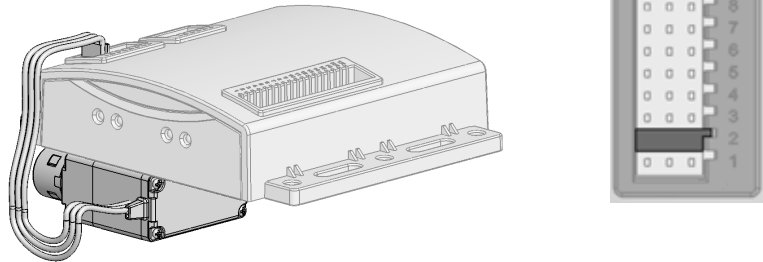
NOTE: Battery platform and arm not shown.



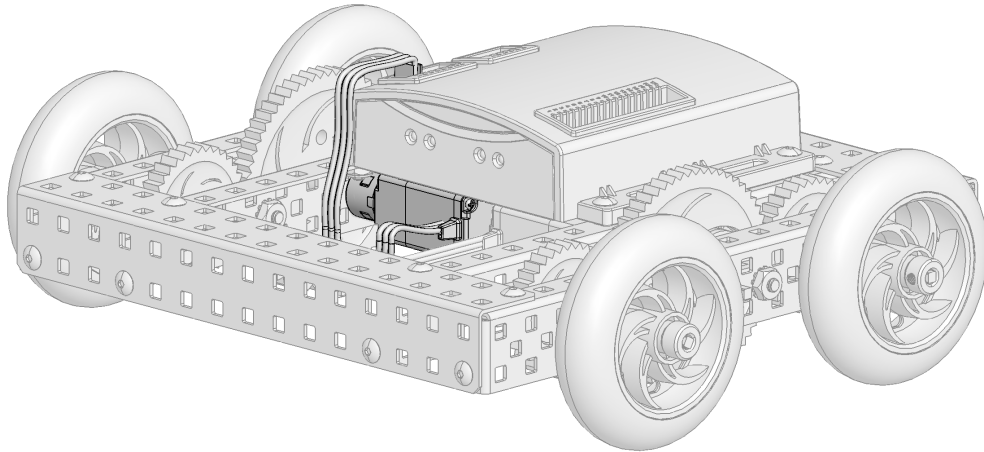
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 10 Wire Assembly *(cont.)*

Plug the wire coming from the right motor into "MOTORS" port 2. Right refers to the robot's right. The side of the micro controller with the LEDs is the front.



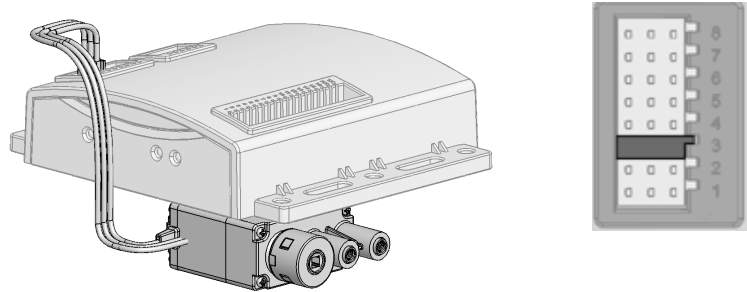
NOTE: Platforms and arm not shown.



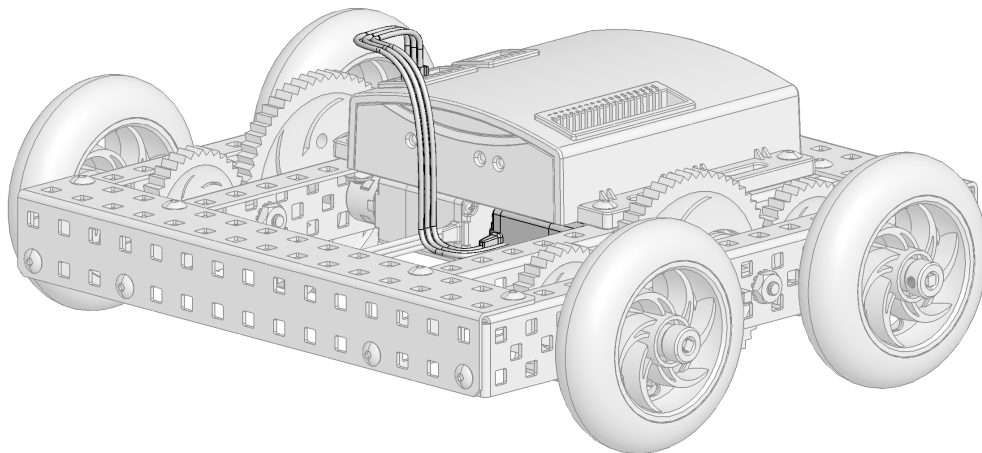
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 10 Wire Assembly *(cont.)*

Plug the wire that is attached to the left motor into "MOTORS" port 3 on the micro controller.



NOTE: Platforms and arm not shown.

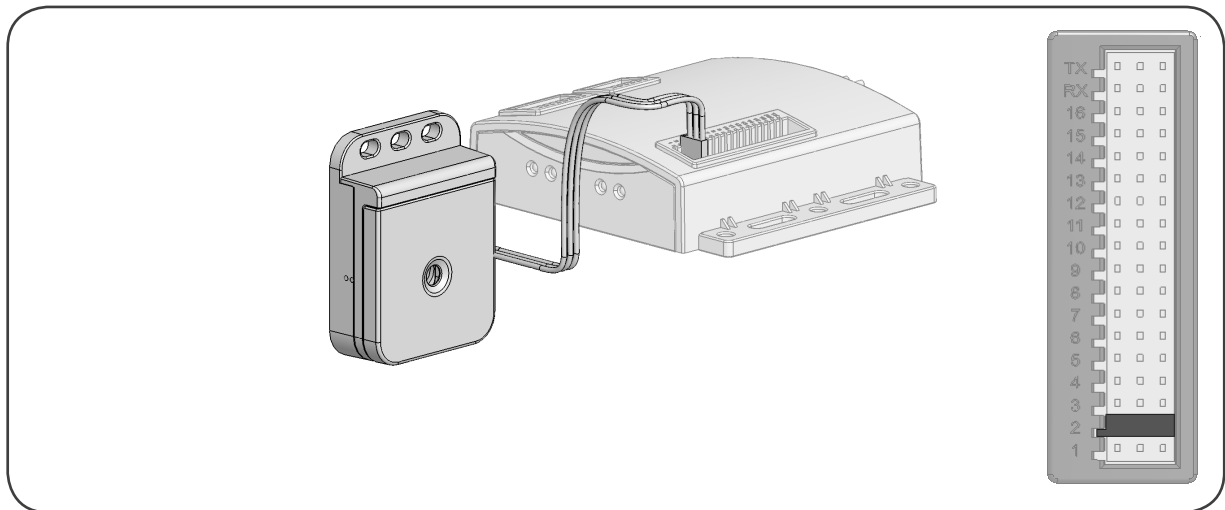




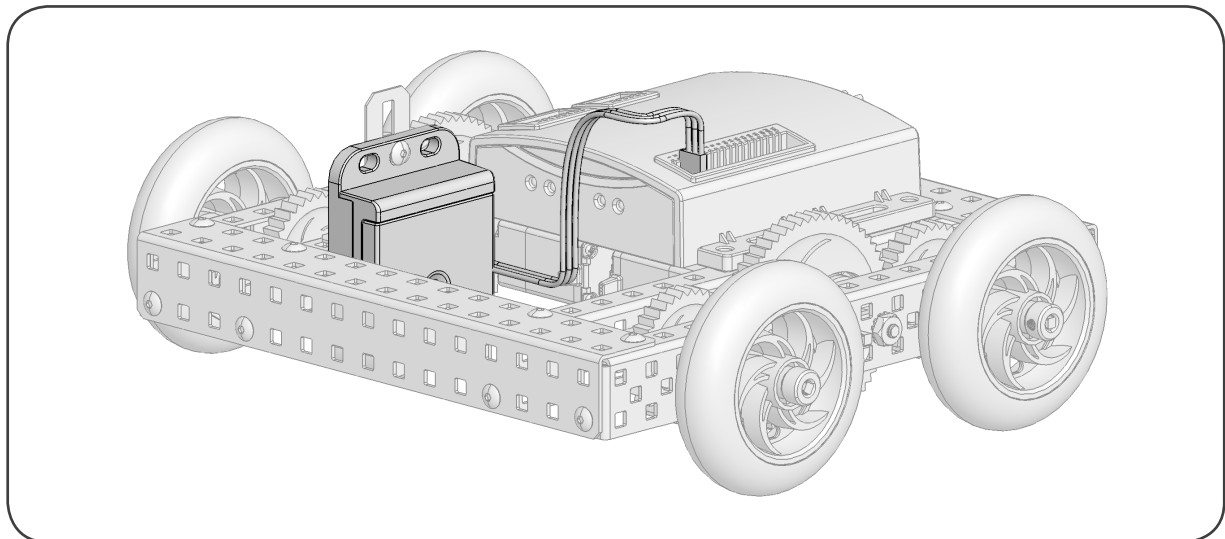
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 10 Wire Assembly (cont.)

Plug the right encoder wire into "ANALOG / DIGITAL" port 2 on the micro controller.



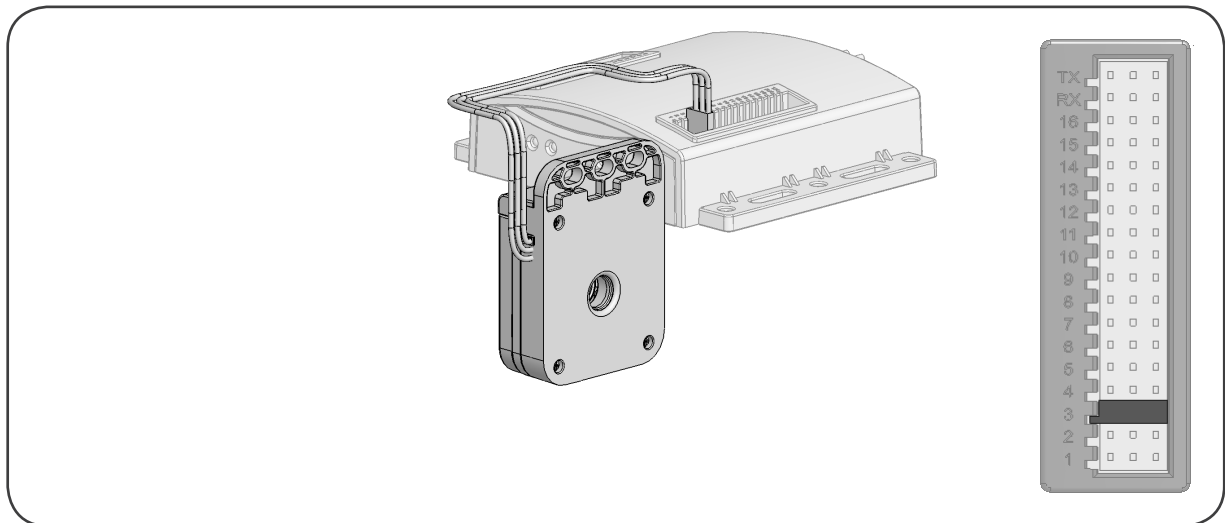
NOTE: Platforms and arm not shown.



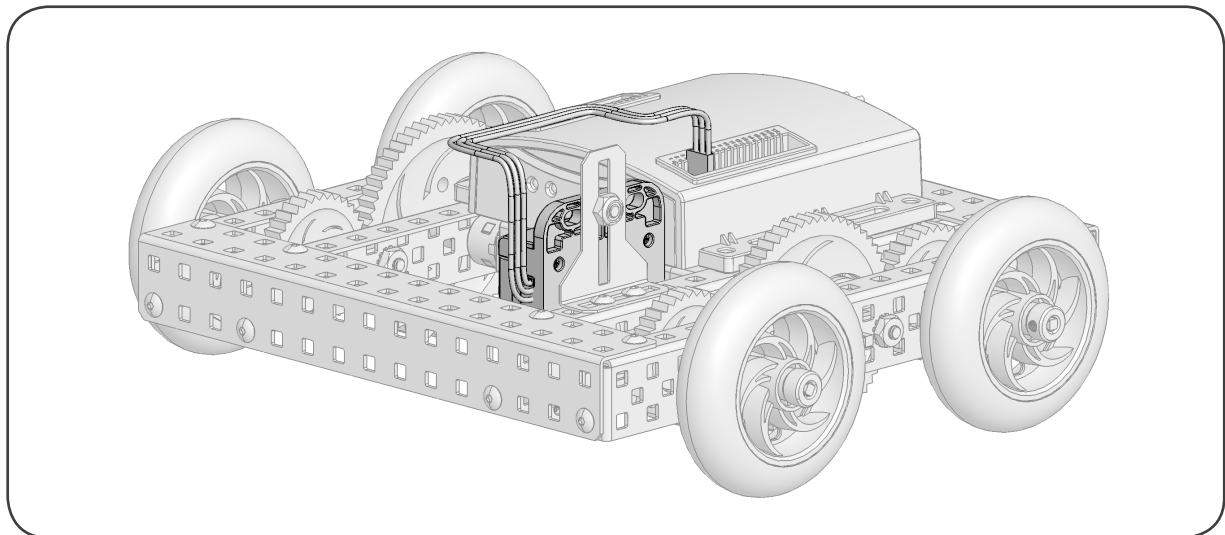
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 10 Wire Assembly *(cont.)*

Plug the left encoder wire into "ANALOG / DIGITAL" port 3 on the micro controller.



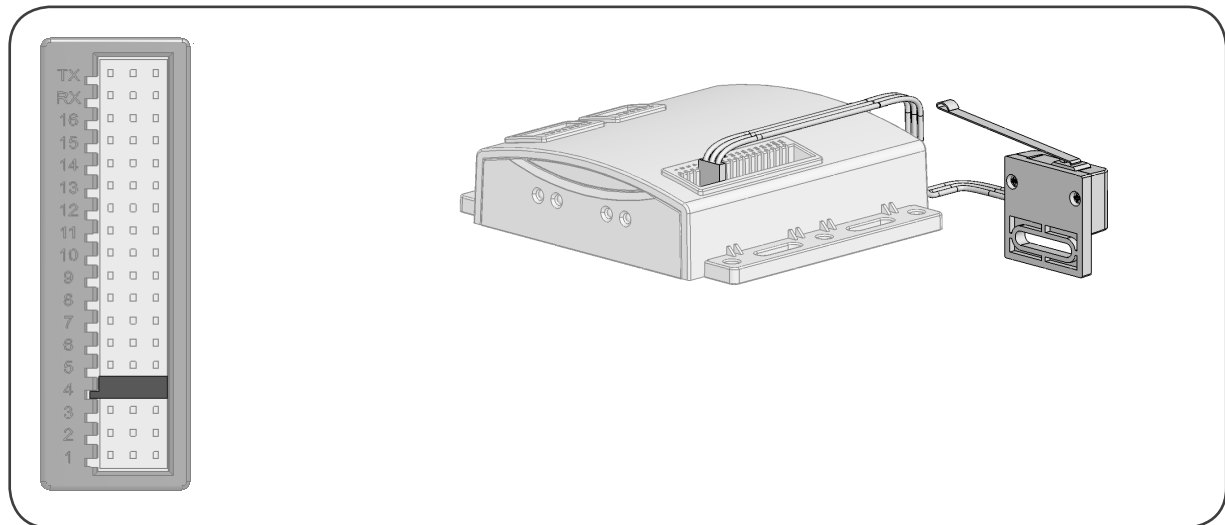
NOTE: Platforms and arm not shown.



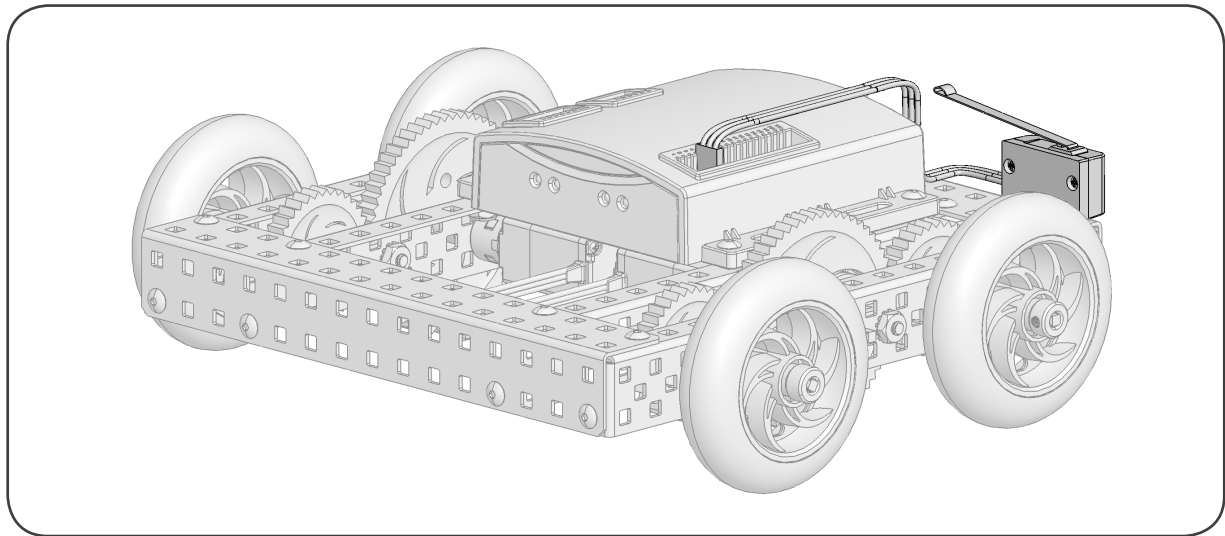
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 10 Wire Assembly (cont.)

Plug the rear limit switch wire into "ANALOG / DIGITAL" port 4 on the micro controller.



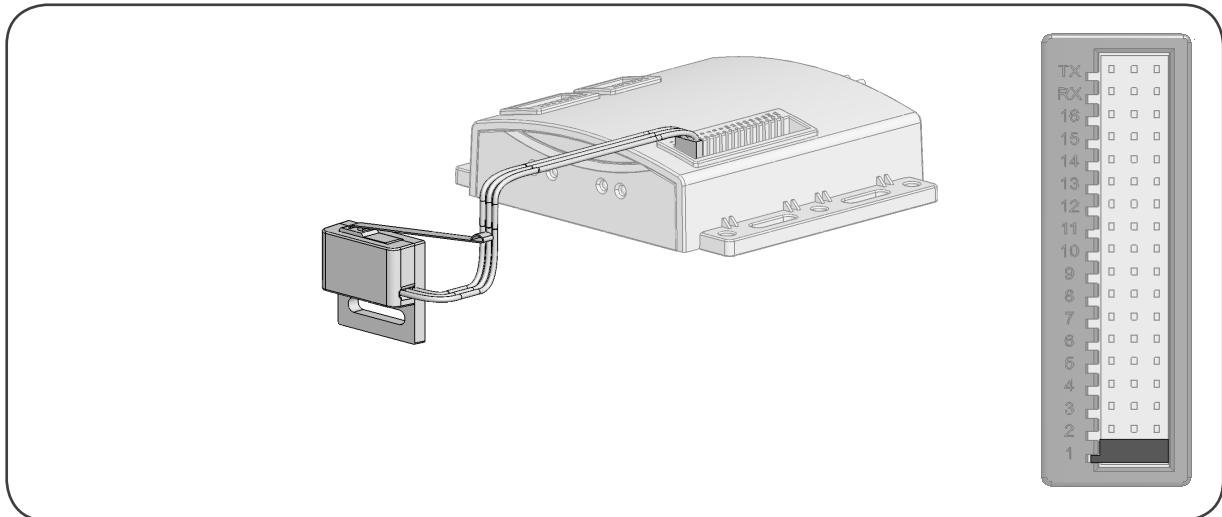
NOTE: Platforms and arm not shown.



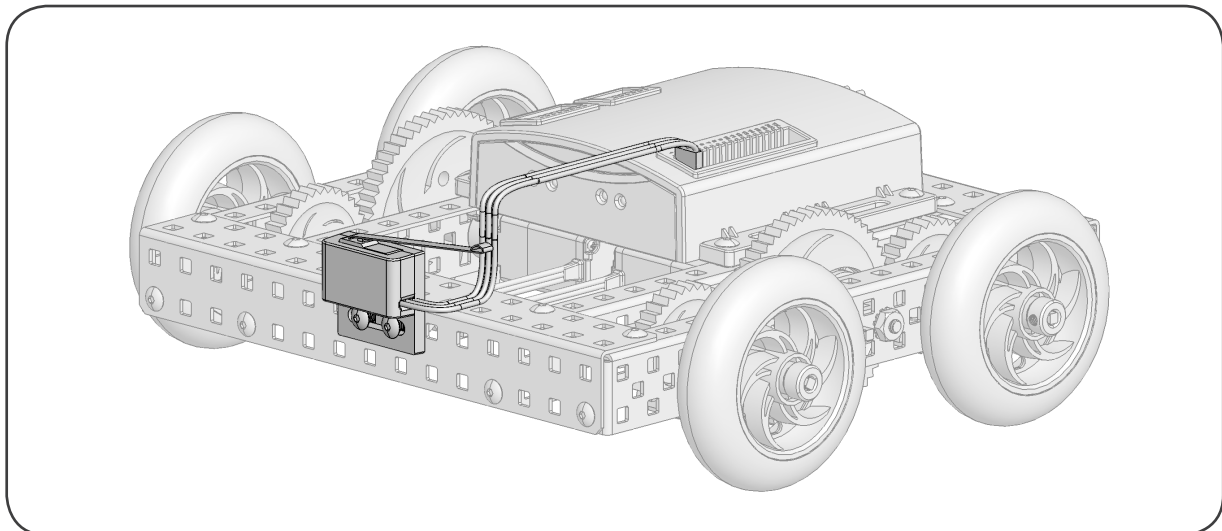
## Squarebot Upgrade (2.0 to 3.0) Conversion Instructions *(cont.)*

### 10 Wire Assembly (cont.)

Plug the front limit switch wire into "ANALOG / DIGITAL" port 1 on the micro controller.



NOTE: Platforms and arm not shown.



***Congratulations! Squarebot 3.0 is now complete!***