



tinkertech

TinkerBot Instructions V1.0.2

Parts List



Acrylic Chassis



Battery Holder



Bumper Wires (x2)



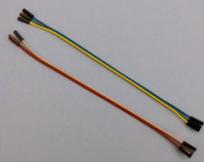
Ping-Pong Ball



Servo Motors + Accessories (x2)



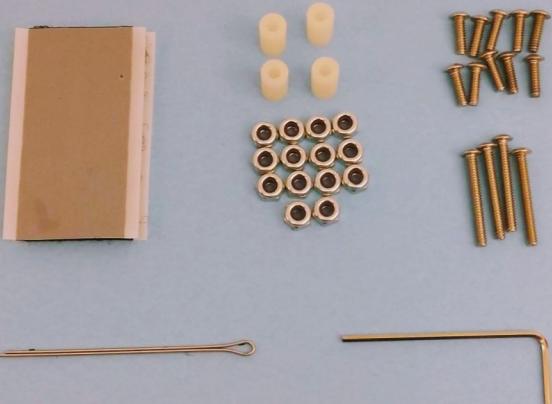
Line Tracker (x2)



3-Pin Female-Female Dupont Cable

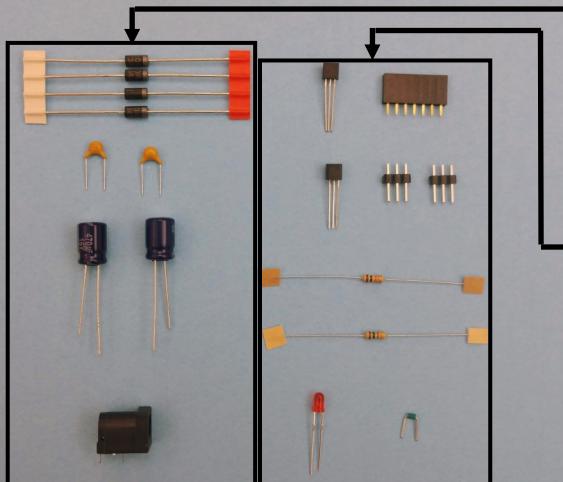


Printed Circuit Board



Hardware Bag

- Velcro
- Cotter Pin
- 1/2" Spacers (x4)
- 4-40 Lock Nuts (x14)
- 3/8" 4-40 Screws (x10)
- 7/8" 4-40 Screws (x4)
- 1/6" Hex Wrench



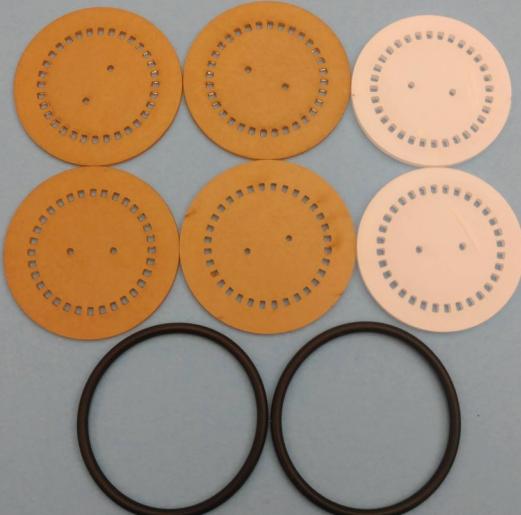
Electronics Bag

Column 1

- SR204 Schottky Diodes (4x)
- 1 μ F Ceramic Capacitor (2x)
- 470 μ F Electrolytic Capacitor (2x)
- Power Barrel Jack

Column 2

- 2N3906 Transistor (Green Dot)
- 7-Pin Female Header
- MCP1702 +5V Voltage Regulator
- 3-Pin Male Header (4x) (Only 2 shown here)
- 10k Ω Resistor (Brown-Black-Orange)
- 1.5k Ω Resistor (Brown-Green-Red)
- 3mm LED
- Jumper Wire



Wheel Bag

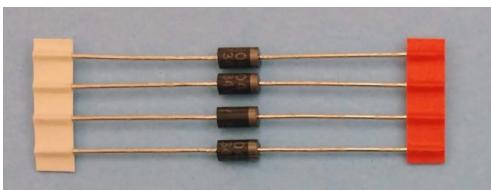
- 1/16" Thick Outer Wheels (Brown Backing) (x4)
- 1/8" Thick Inner Wheels (White Backing) (x2)
- O-Rings (x2)

Important Notes

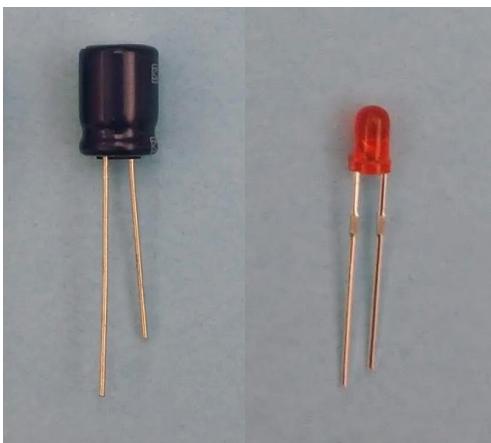


The $10\text{k}\Omega$ resistor is marked with the color code Brown-Black-Orange and the $1.5\text{k}\Omega$ resistor is marked with the color code Brown-Green-Red. The polarity of the resistors does not matter when inserting them.

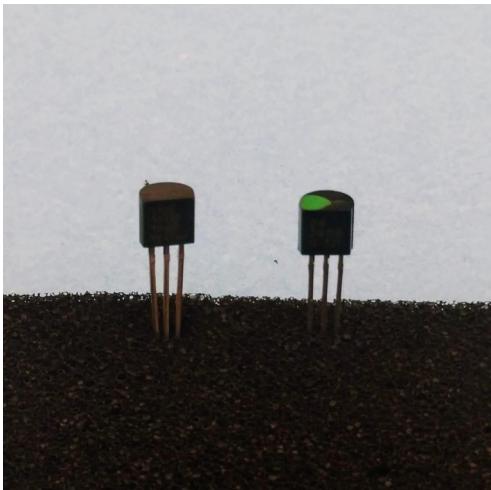
Polarity does matter for some of the other components.



The polarity of the diodes is indicated with a white stripe on the cathode (-) side of the components (on actual part, not on the paper holding them together).



For electrolytic capacitors (like the $470\mu\text{F}$ capacitors in this kit) and LEDs, the anode (+) side is indicated by a longer wire lead. The cathode (-) side is indicated by a white stripe on the side of the capacitor body and by a small flat on the side of the LED casing.



The transistor and voltage regulator in this kit are both in TO-92 packages. The orientation of the devices is indicated by a flat on the casing. To help you tell the difference, we've added a green dot to the transistor, while the voltage regulator will be plain.

Assemble The PCB

Resistors — R1, R2

Polarity of the resistors doesn't matter.

Make sure not to mix up the values, though. $R1 = 1.5k$, $R2 = 10k$.

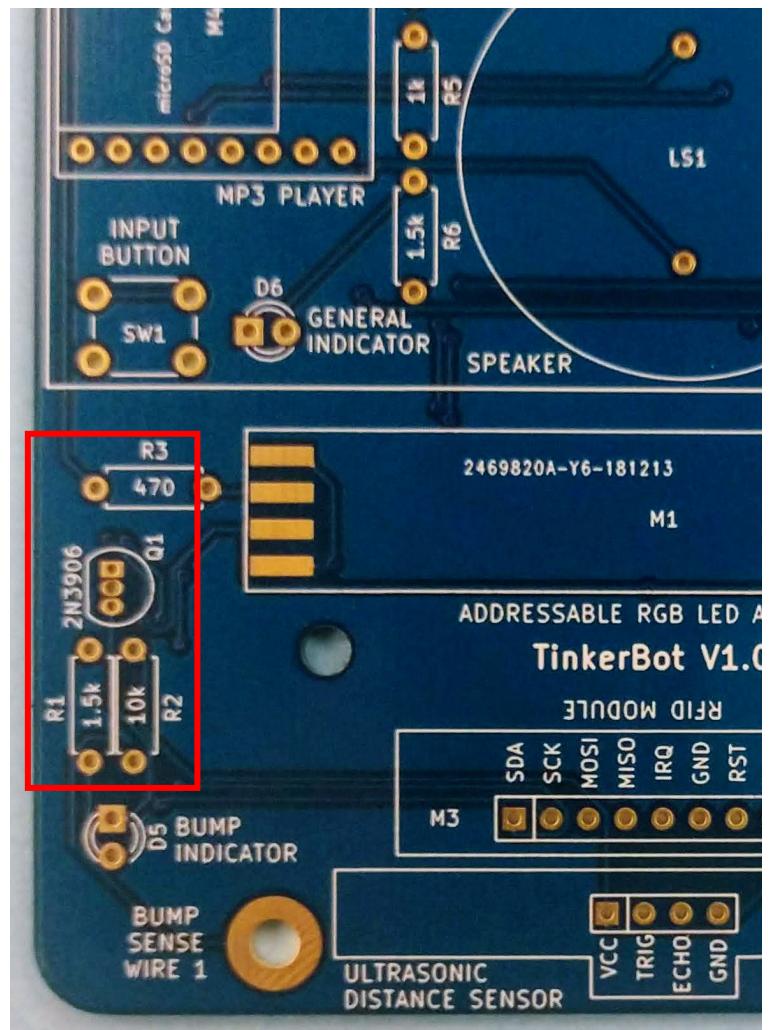
Be sure to bend the leads right at the body of the resistor, otherwise they may not fit.

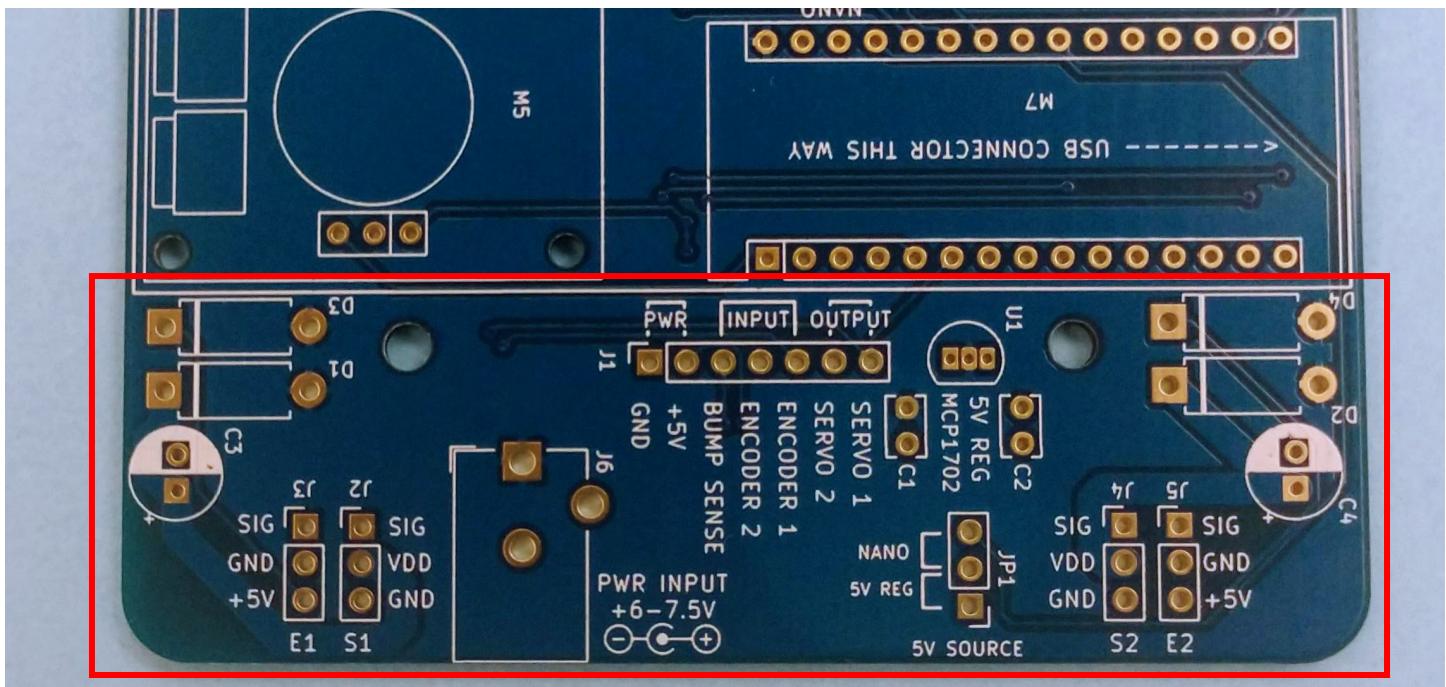
Transistor — Q1

Note the orientation of the flat. It can be very easy to create solder bridges between the leads of the TO-92 package, so try not to use too much solder. Remember the note from the previous page! The transistor has a green dot on it, so don't get it mixed up with the voltage regulator.

LED — D5

Pay attention to the polarity. The square pad on the PCB is the cathode (-) side, to put the short leg there..





Voltage Regulator — U1

Note the orientation of the flat. It can be very easy to create solder bridges between the leads of the TO-92 package, so try not to use too much solder.

1µF Capacitors — C1, C2

The polarity of ceramic capacitors does not matter, so these can be inserted in either direction.

Diodes — D1, D2, D3, D4

Note the white stripe on the PCB. The white stripe on the diodes should align with these. If you put the diodes in backwards, the servo motors will not work and you might even damage them when you apply voltage to the board.

470µF Capacitors — C3, C4

Pay attention to the polarity. The white area on the PCB corresponds with the white strip on the capacitor, indicating the cathode (-) side.

3-Pin Male Headers — J2, J3, J4, J5

Put the short side of the pins into the PCB.

7-Pin Female Header — J1

Self explanatory.

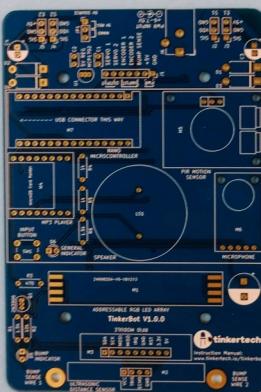
Power Barrel Jack — J6

Self explanatory.

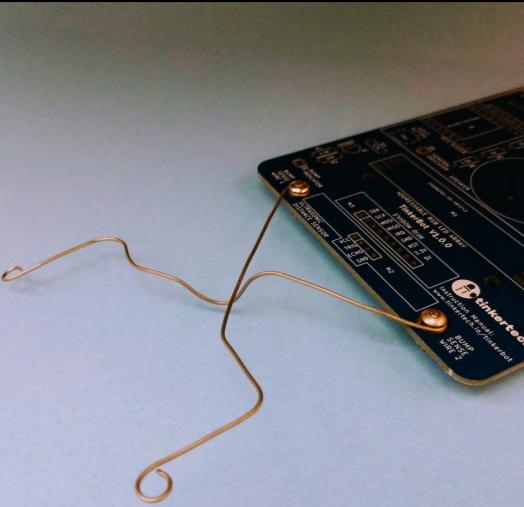
Jumper Wire — JP1

Insert the wire into the two holes indicated as "5V REG." You will not be using the other setting.

Attach the Bump Wires

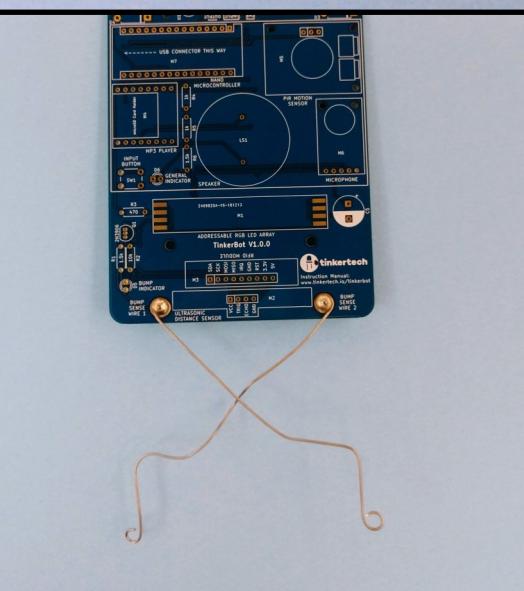


You'll need the two bump wires, two 3/8" 4-40 screws, and two 4-40 lock nuts, as well as your 1/16" hex wrench.



The orientation of the wires is important. The wire with a single bend should lay in the trough of the other wire when crossed over top as shown.

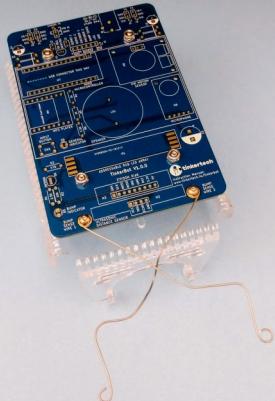
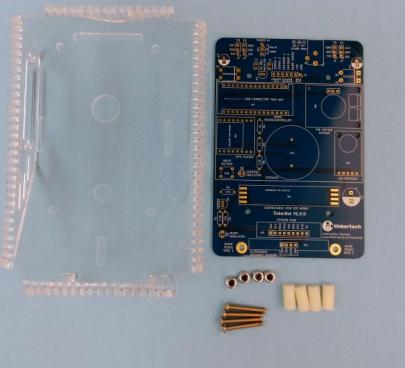
Don't worry about holding the bump wire in place the whole time you're tightening the lock nuts. Just get them mostly tightened, then position the antenna wire in the desired spot just before fully locking the nut in place.



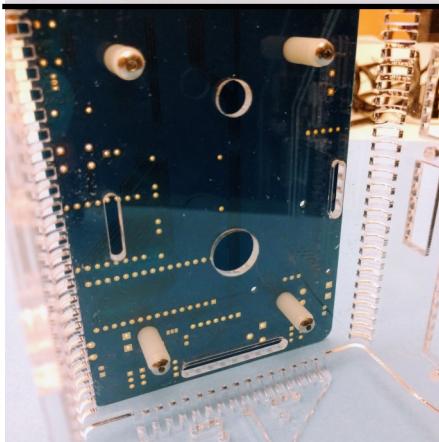
When both of the bump wires are attached, they should look like this from the top, with the ends parallel to each other and pointing forward.

Attach the PCB to the Chassis

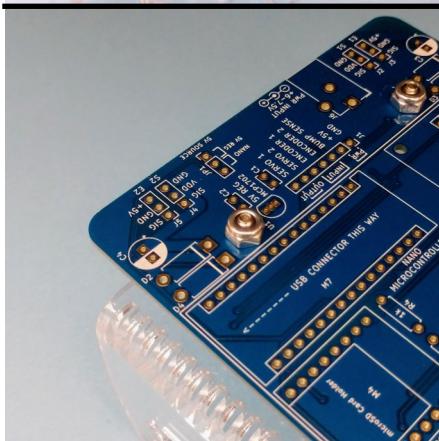
You'll need the PCB, four 7/8" 4-40 screws, four 4-40 lock nuts, and four 1/2" spacers.



Note the orientation of the PCB to the chassis. The bump wires should be in the same direction as the flap with the large curved opening.

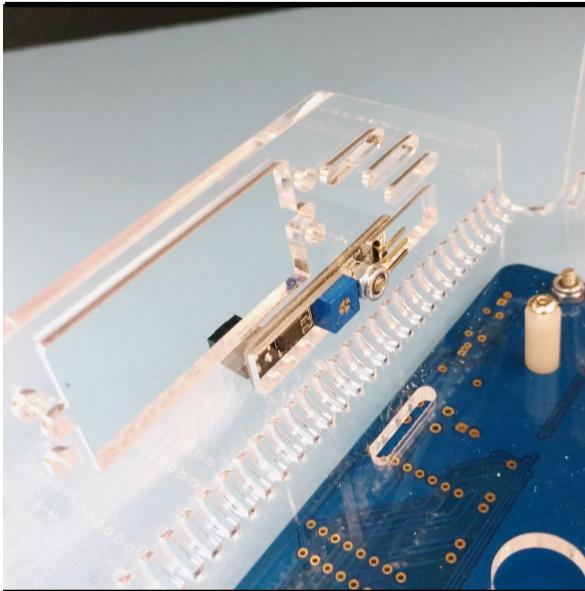


It's hard to tell in the photo because of the clear chassis, but the spacers are *between* the PCB and the chassis. Make sure to install the screws with the button head on the inside of the chassis...



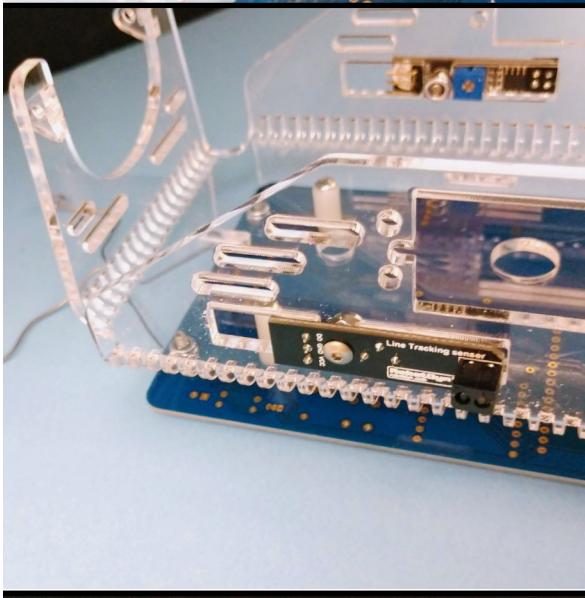
...and the nut on the top of the PCB. This is important because if the nuts are placed on the inside of the chassis, they will interfere later with placement of the battery holder.

Install the Encoders (Line Trackers)

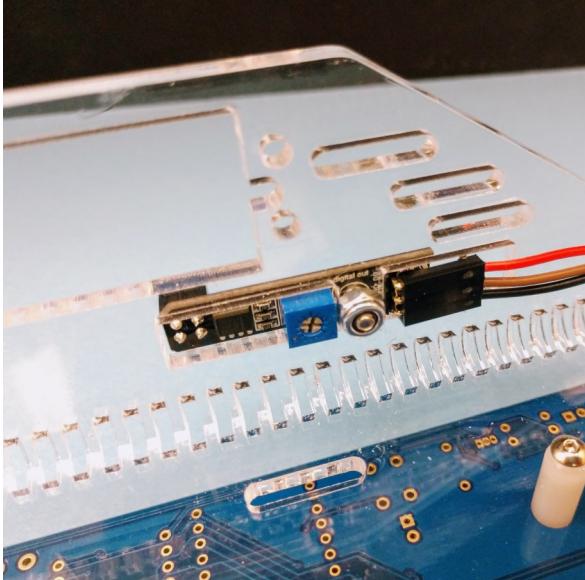


You'll need the two line tracker units, two 3-pin F-F Dupont cables, two 3/8" 4-40 screw and two 4-40 lock nuts.

Install the line tracker unit as shown in the photo. *It should be placed on the outside of the chassis*. The screw is inserted from the outside of the chassis and the nut from the inside. **Do not** overtighten the nut. Overtightening can damage the line tracker or the chassis, and prevent small adjustment movements of the line tracker that may be needed later. Tighten until just snug.

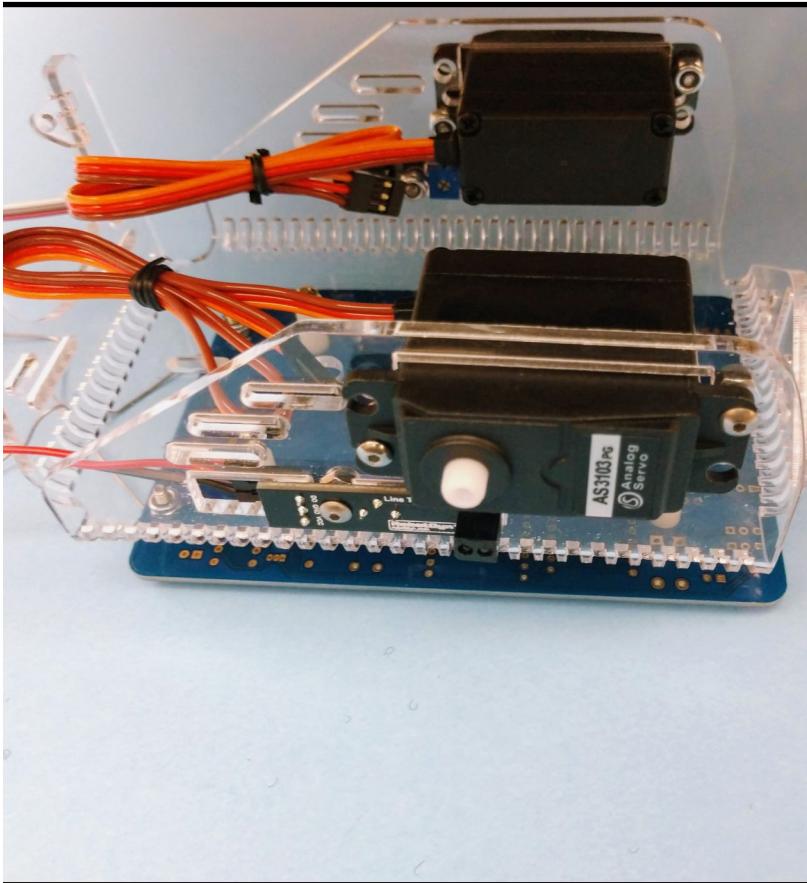


Install the line tracker unit on the opposite side.



Connect one of the 3-pin F-F Dupont cables to each of the line tracker units. The wire colors don't matter at this point.

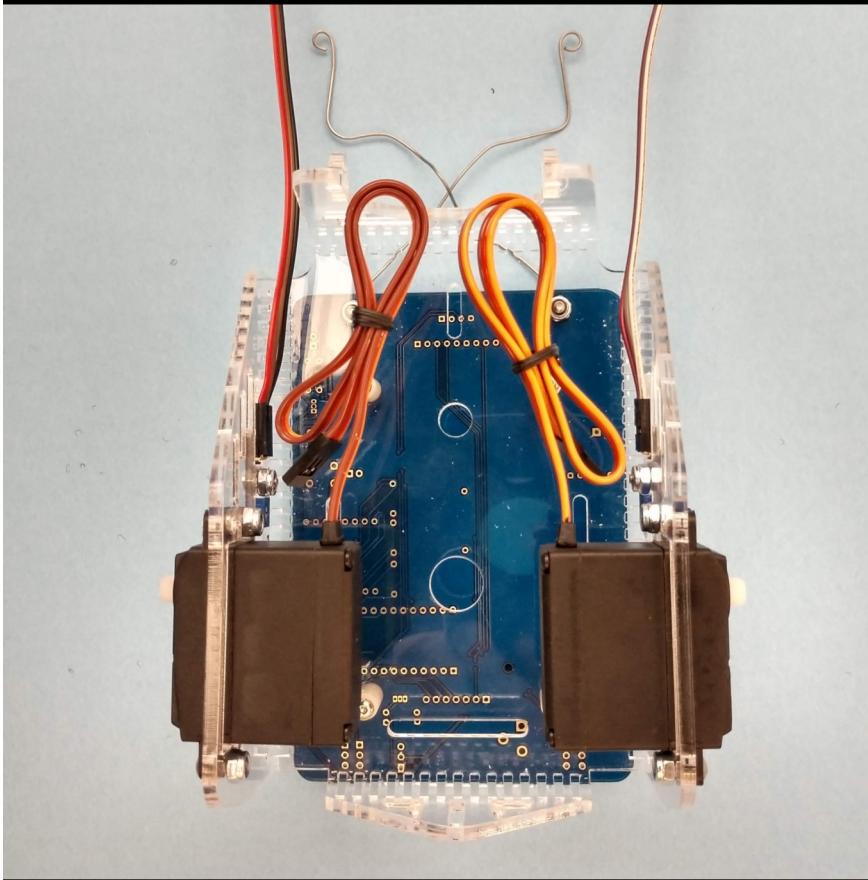
Install the Motors



You'll need the two servo motors, four 3/8" 4-40 screws, and four 4-40 lock nuts.

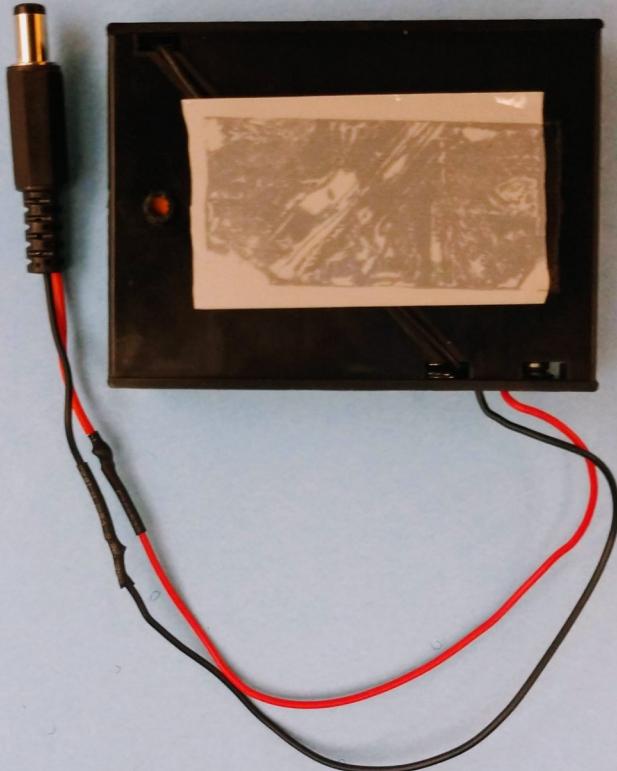
Install the motors as shown. Again, orientation matters, so note the direction of the cables and the output shaft. *The motors should be inserted from the outside of the chassis.* If the motor flanges are mounted on the inside of the chassis, the wheel will be too close to the encoder.

Fasten them in place with two screws and nuts placed in opposite corners of the motor.



When you're done with this step, the robot should look like this from the bottom.

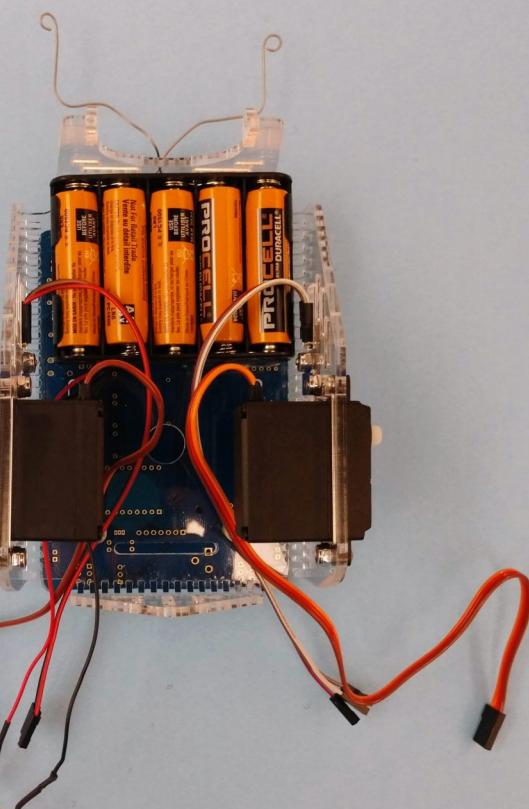
Install the Battery Holder



You'll need the Velcro pair, the battery holder, and five AA batteries.

Load the batteries into the battery holder. Wait for a couple of seconds and check to see if the batteries are getting warm. If they are, there is a short somewhere, so remove the batteries and demand a replacement.

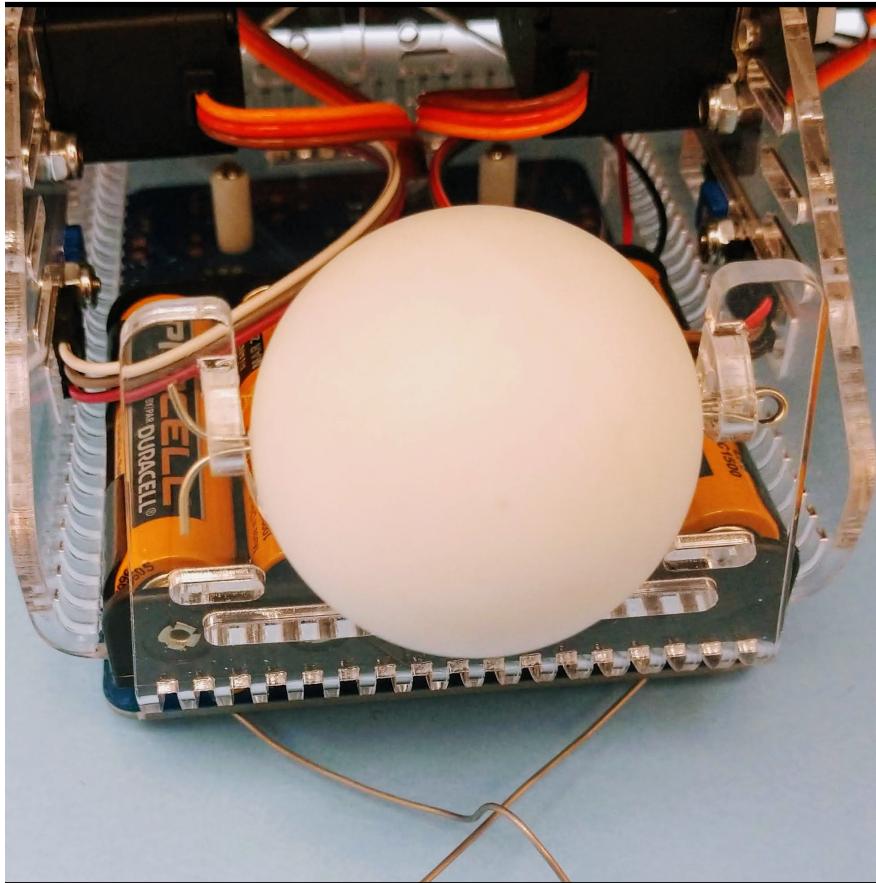
If the batteries do not get warm, then you're good to go. Peel off the backing from one side of your Velcro pair and attach it to the back of the battery holder.



Peel the backing off the other side of the Velcro and press the battery holder firmly against the inside of the chassis, with the cable pointing toward the rear.

Make sure the battery holder is as far forward as possible, otherwise your robot may tip up when changing from forward to reverse motion.

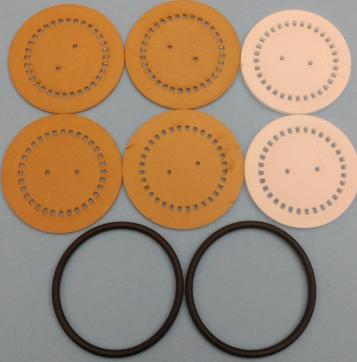
Install the Caster (Ping-Pong Ball)



You'll need the ping-pong ball and the cotter pin.

Install the ball as shown. Spread the at least one end of the cotter pin with fine tipped pliers. *Be careful* when doing this; accidentally applying too much force to the anchors can cause them to snap off the chassis.

Assemble the Wheels



Inside the wheel bag, there are parts for two wheels. Each wheel is comprised of a 1/8" thick inner wheel (white backer), two 1/16" thick outer wheels (brown backer), and one O-ring.

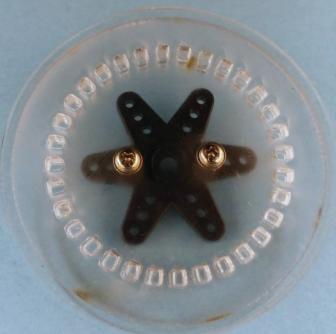


Remove the backing from the wheels. You'll find a utility or an X-Acto knife helpful here. If you don't remove the backing, the encoder may not function properly.

Find two screws and one of the mounting horns from the servo accessories bag. It doesn't matter which mounting horn you use.

Stack the parts in the following order:

- Mounting horn
- Outer wheel
- Inner wheel
- Outer wheel
- Screws

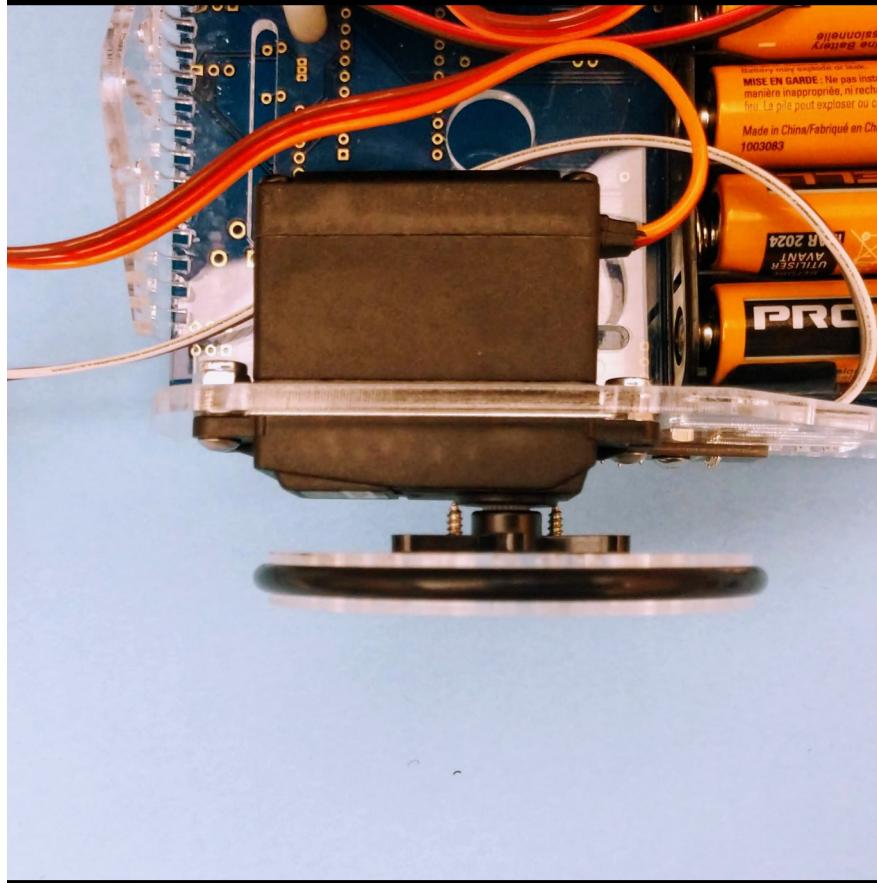


This will create a trough down the middle of the wheel. Insert the O-ring in the trough.

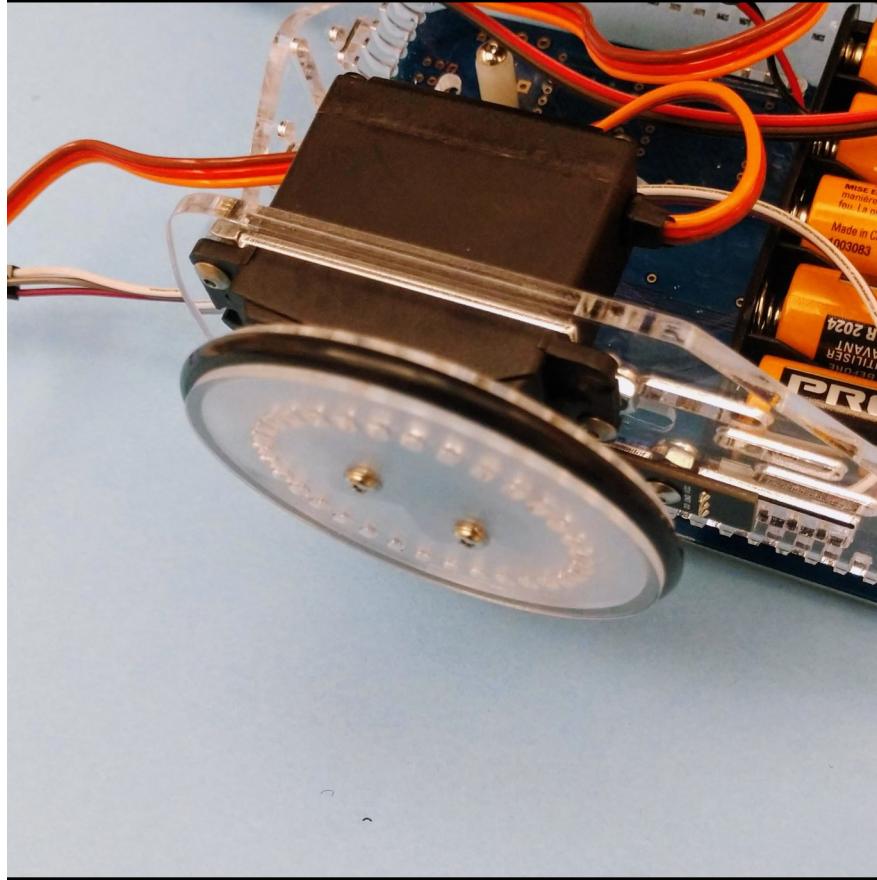
Repeat the process for the second wheel.



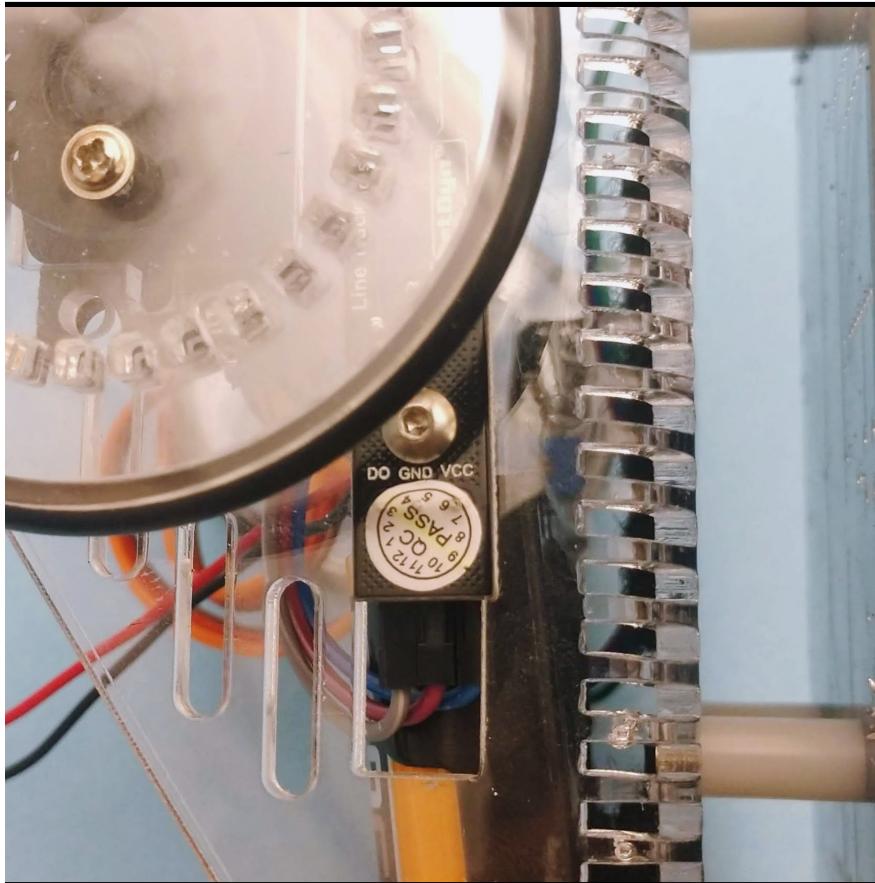
Mount the Wheels



Press the wheels onto the servos.



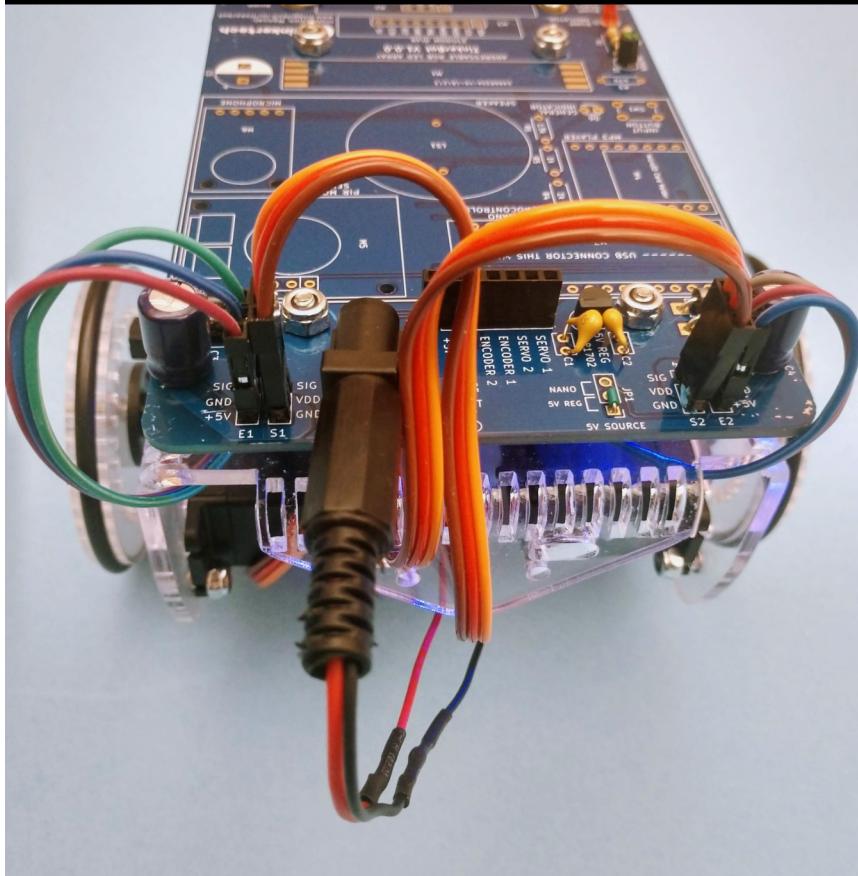
Connect the Cables



The servo cables have a standard color coding to them, as shown below.

The colors of the cables line trackers (encoders) cables, however, are arbitrary, so check them to determine which color goes to which pin.

Each side of the PCB has headers marked S1 and E1 or S2 and E2. These are for “servo” and “encoder.”



Connect the encoder cable to the “E” header on its side as follows:

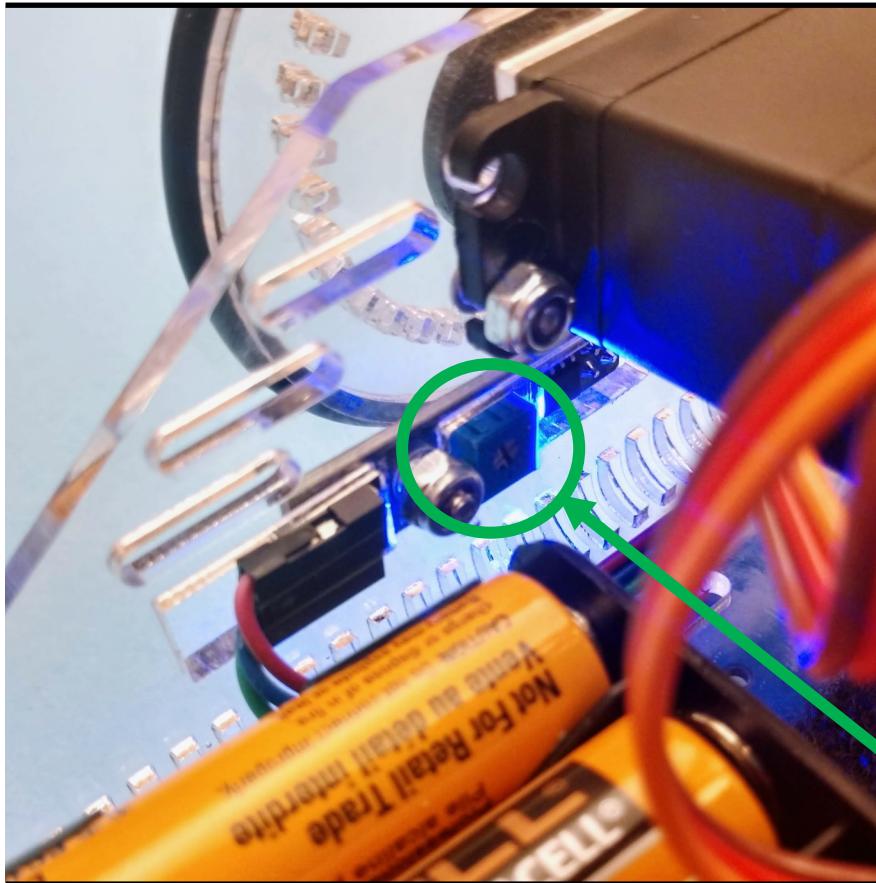
Line Tracker	PCB
DO	SIG
VCC	+5V
GND	GND

Connect each of the servo cables to the “S” header on its side as follows:

Servo	PCB
Orange	SIG
Red	VDD
Brown	GND

Plug in the power barrel jack.

Tune the Line Trackers (Encoders)



After plugging in the power cable, spin each of the wheels. A blue light near that wheel should blink on and off each time a hole in the wheel moves past the line tracker (encoder). just turns on.

If it does not, follow these troubleshooting steps in this order and re-check after each:

1. Verify that your cable wiring is correct
2. Check the alignment of the sensor head with the holes on the wheels
3. Turn the potentiometer on the line tracker counter-clockwise until the blue light turns off,

Version Change Log

V 1.0.0—Initial Release

V 1.0.1—Changed errant 440 μ F capacitor to 470 μ F. Changed errant 3/8" 4-40 screw count from 8 to 10. Added note on assembly page about transistor's green dot marking.

V 1.0.2—Clarified diode “white stripe” location. Clarified importance of motor mounting orientation. Emphasized line tracker mounting location on outside of chassis. Noted that cotter pin should be spread with pliers.