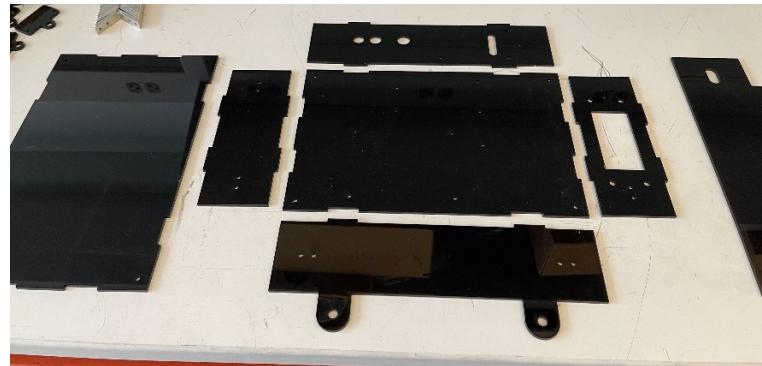


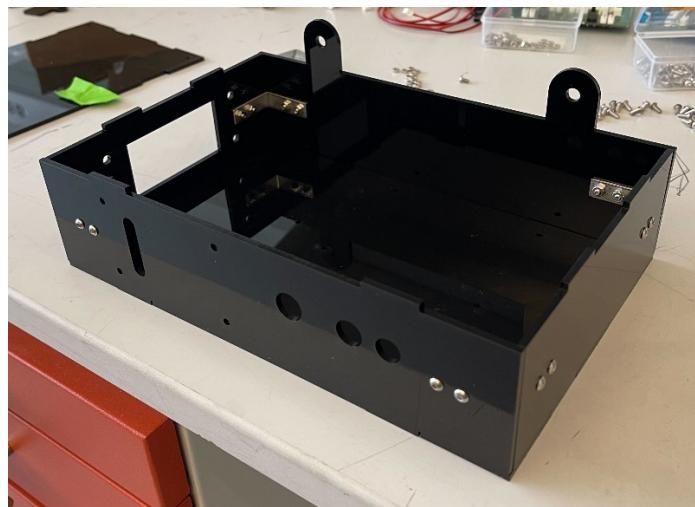
# Behavior Electronics Box Assembly Guide

1. Laser cut panels from acrylic sheets. See [Panels Illustrator File](#) for the illustrator file to use with the laser cutter.
  - a. Black Acrylic Sheet 1/8" (2)

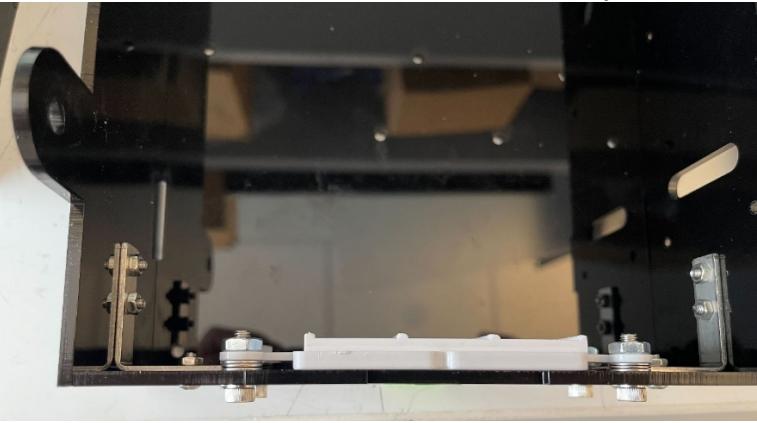
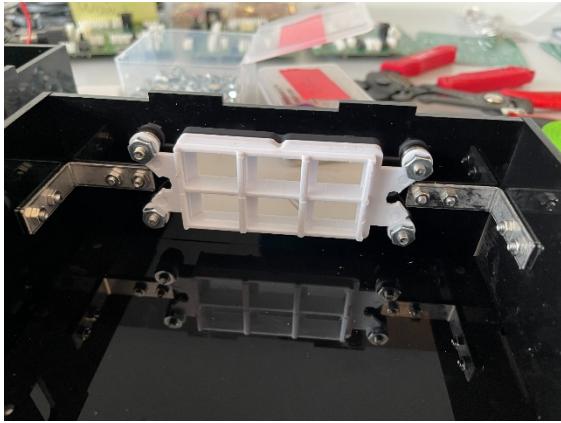


Note: the left panel will be the top and places at the end. The piece of the right will sit between the box and the aluminum breadboard.

2. Assemble panels into box (see pictures)
  - a. MakerBeam – 100315 brackets (4)
  - b. M3 x 0.5 mm x 8 mm screws (16)
  - c. M3 x 0.5 mm nuts (16)

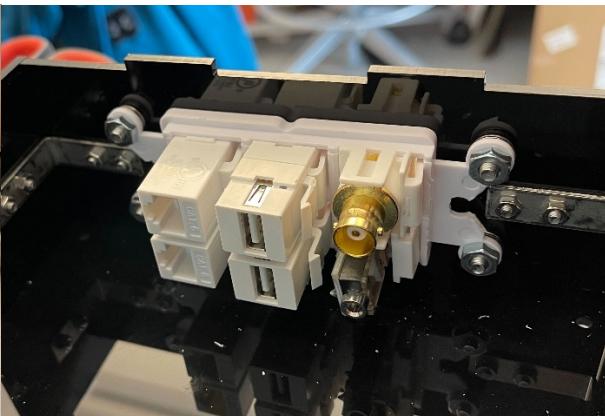


3. Attach faceplate
  - a. 8-32 x 1/2" screws (4)
  - b. 8-32 nuts (4)
  - c. Number 8 washer [0.172" diameter] (12)
  - d. RiteAV – 6 Port Insert [X000RGH3FX]



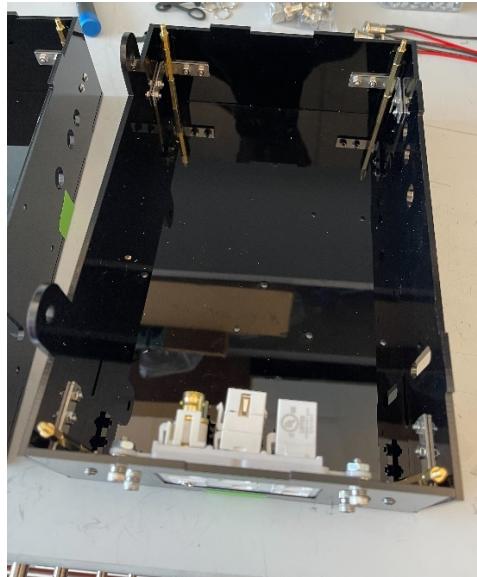
4. Attach Keystone Jacks to inside of Faceplate
  - a. Cat6 Keystone Jack (2)
  - b. USB A/B Female Keystone Jack (2)
  - c. BNC Keystone Jack (1)
  - d. Audio Keystone Jack (1)

5. Insert jacks into faceplate



Note: Green tape is to hold the bottom panel to the sides until the top has been screwed on

6. Screw in 4 outer standoffs. Each of these is made of two 25 mm and one 10 mm standoff
  - a. M3 x 0.5 mm, 25 mm standoff (8)
  - b. M3 x 0.5 mm, 10 mm standoff (4)



7. Screw In circuit board standoffs. Tall one is 25 mm and short one is 10 mm.

- a. M3 x 0.5 mm, 25 mm standoff (4)
- b. M3 x 0.5 mm, 10 mm standoff (5)



8. Make cables/components

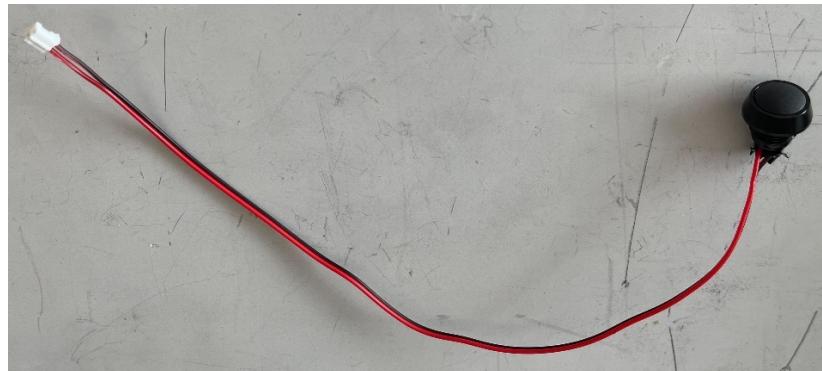
Note: when making JST connectors, make sure colors are consistent on both ends. Also remove

- a. 12 V power socket cable
  - i. You will need:
    1. Female power jack socket
    2. DC Power Male Plug
  - ii. Insert cable of power jack through the front faceplate of the box and then screw in the nut
  - iii. Solder power jack socket to DC power male plug, connecting red to red and black to black. Use heat-shrink tubing to cover connections.



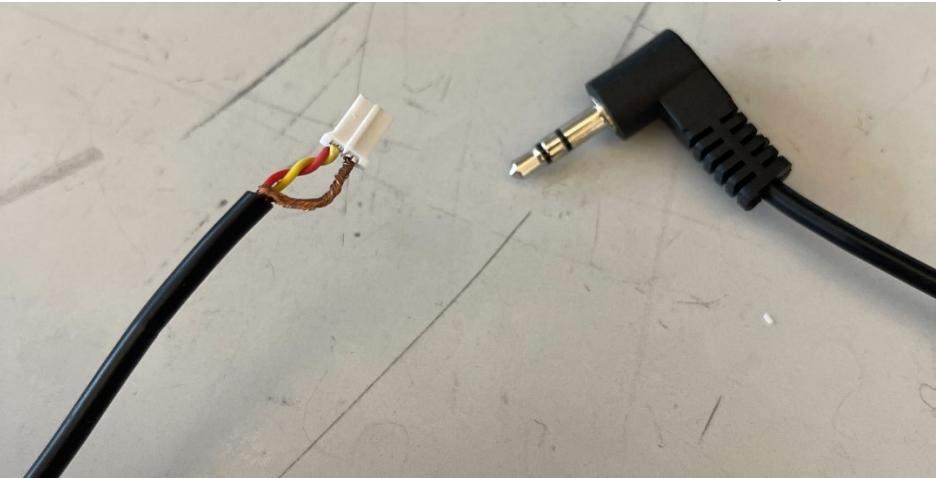
b. Push button cable

- i. You will need:
  1. Push button switch
  2. JST connector – 2 pin, 2mm
  3. Female Connector Crimp Header (2)
  4. 2 channel, 24 AWG wire (10 inches)
- ii. Crimp one end of wire to JST. Does not matter which color wire goes in which socket.
- iii. If not already soldered out-of-the-box, solder wire to the push button. Before soldering, take out small screws and wrap copper strand around sides, being sure nothing is shorted. Polarity of the wire again does not matter.
- iv. Reinsert screws
- v. Attach to side panel of box with nut.



c. Audio cable

- i. You will need:
  1. 3.5 mm male audio jack cable
  2. JST connector – 2 pin, 2 mm
  3. Female Connector Crimp Header (2)
- ii. Crimp 2-pin JST to audio cable. Twist the insulated strands together and insert them into the left socket like in the picture below.
- iii. Use heat-shrink tubing or electrical tape to cover the exposed wires.



d. BNC cable

i. You will need:

1. Female BNC cable
2. JST connector – 2 pin, 2 mm
3. Female Connector Crimp Header (2)

ii. Crimp 2-pin JST to BNC cable (the insulated strand should be on the right side like in the image below).

iii. Plug into pin 47 of behavior controller



e. Jumper cable

**Note:** you only need to make this if you would like the IP address of the behavior controller to be 192.168.1.121. If this is the first/only box to be hooked up to a BehaviorMate pc, you may skip this step.

i. You will need:

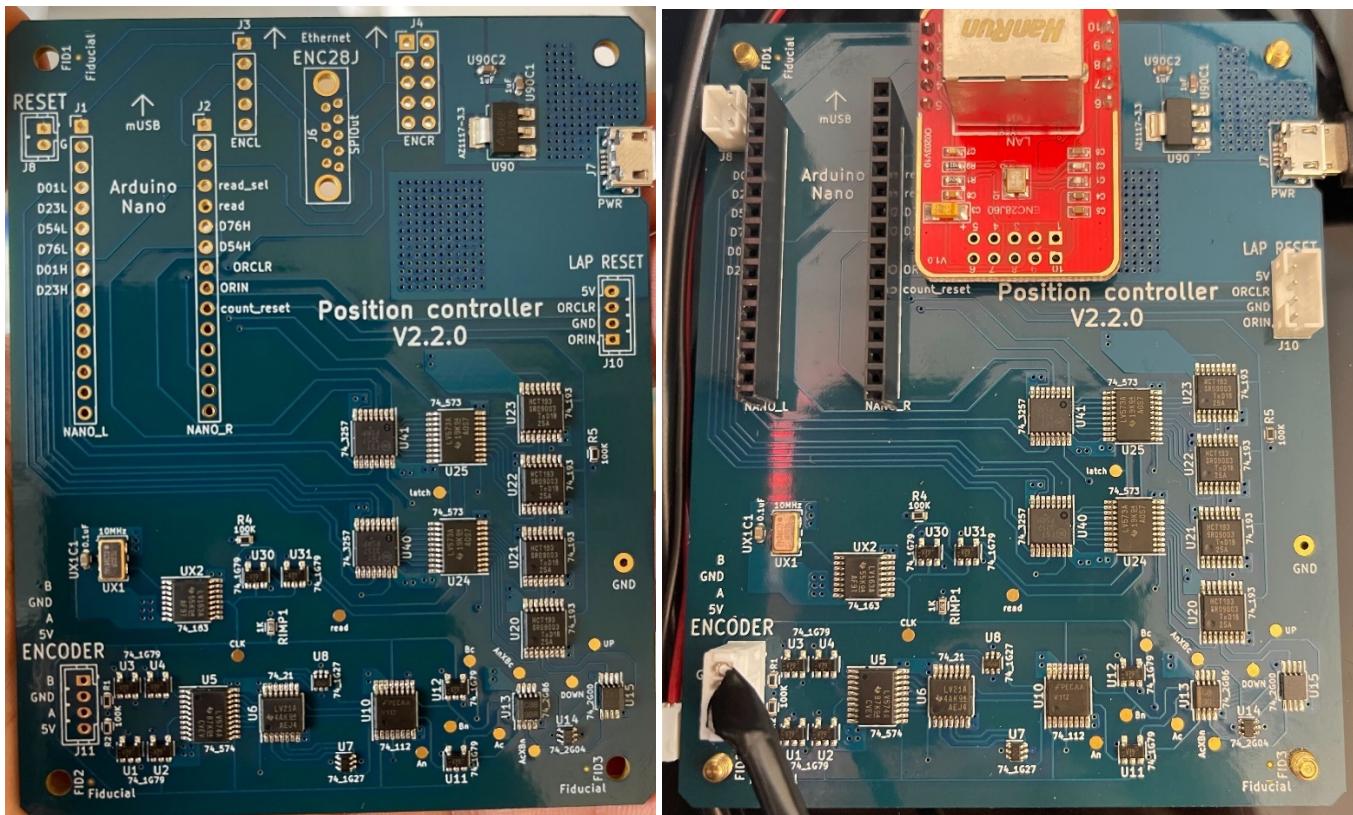
1. Single channel 24 AWG wire (1 inch)
2. JST connector – 2 pin, 2 mm
3. Female Connector Crimp Header (2)

ii. Crimp wire to each socket of a 2-pin JST connector.



### 9. Make position controller

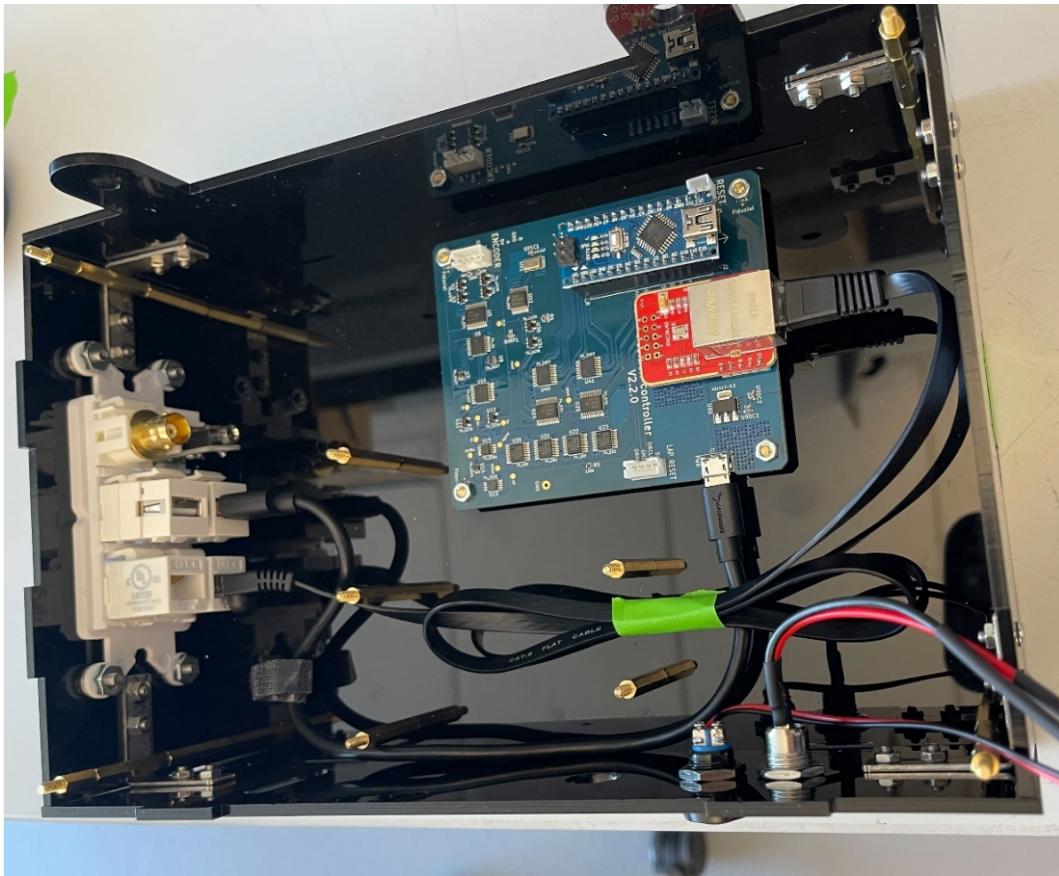
- a. You will need:
    - i. Position controller shield v2.2.0
    - ii. Arduino Nano
    - iii. Ethernet module
    - iv. JST Connector – 2 pin, 2mm
    - v. JST Connector – 4 pin, 2mm
    - vi. Female Connector Crimp Header (6)
    - vii. Male and Female header connectors
  - b. Solder two 15-pin sockets to the Arduino Nano through-holes
    - i. Tip: attach Arduino to sockets before soldering. Otherwise, sockets may be misaligned.
  - c. Solder ethernet module to J3 and left side of J4
  - d. Solder JST's to J8 and J10



#### 10. Add Position Controller to box

- a. You will need:

- i. Micro USB to USB-A cable (1)
- ii. Cat6 ethernet cable – 2 ft, flat wire (1)
- iii. M3 x 0.5 mm nut (4)



Note: picture above already has Arduino nano plugged in.

11. Load position controller program onto Arduino nano

- a. Clone the “arduino controller” repo ([https://gitlab.com/losoncylab/arduino\\_controller](https://gitlab.com/losoncylab/arduino_controller))
- b. Use the make command to build the .ino files
- c. Download and install the Arduino IDE (<https://www.arduino.cc/en/software>)
- d. In the Arduino IDE, open the “position\_controller\_v2” file in  
arduino\_controller/bin/position\_controller\_v2
- e. **Important:** by default the IP address of the position controller will be set to 192.168.1.102. If this will  
box will be the second one to be connected to a single BehaviorMate computer, you will need to change  
the IP address in Arduino code to 192.168.1.122 so BehaviorMate can communicate with both  
controllers without conflict.
- f. Plug in your nano to your PC with a Mini-B USB to USB-A cable
- g. Go to Tools > Board > Arduino AVR Boards and select Arduino Nano
- h. Go to Tools > Processor > and select either ATmega328P or ATmega328P (Old Bootloader). If your  
program fails to upload, try changing this option.
- i. Go to Tools > Port and select the port assigned to your nano. If you are unable to open the Serial  
Monitor (Tools > Serial Monitor), you have selected the wrong port. The port may change each time you  
plug in your nano so try different options if something seems wrong.
- j. Click the arrow in the top right of the IDE to upload the program to the nano.

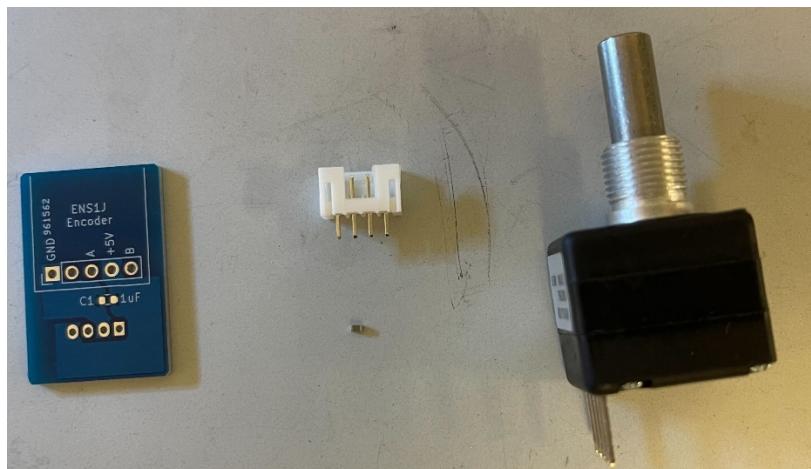
k. You should see an IP address in the serial monitor if everything went smoothly.

12. Insert nano into position controller female header sockets with USB port facing the side marked by “mUSB” on the position controller shield.

13. Make rotary encoder assembly

a. You will need:

- i. ENS1J adapter circuit v1.1.0 (1)
- ii. Rotary encoder (1)
- iii. 1 micro Farad 16V-rated capacitor (1)
- iv. 4 channel 24 AWG wire (1 two-foot strand)
- v. JST socket – 4 pin, 2 mm (1)
- vi. JST connector – 4 pin, 2 mm (2)

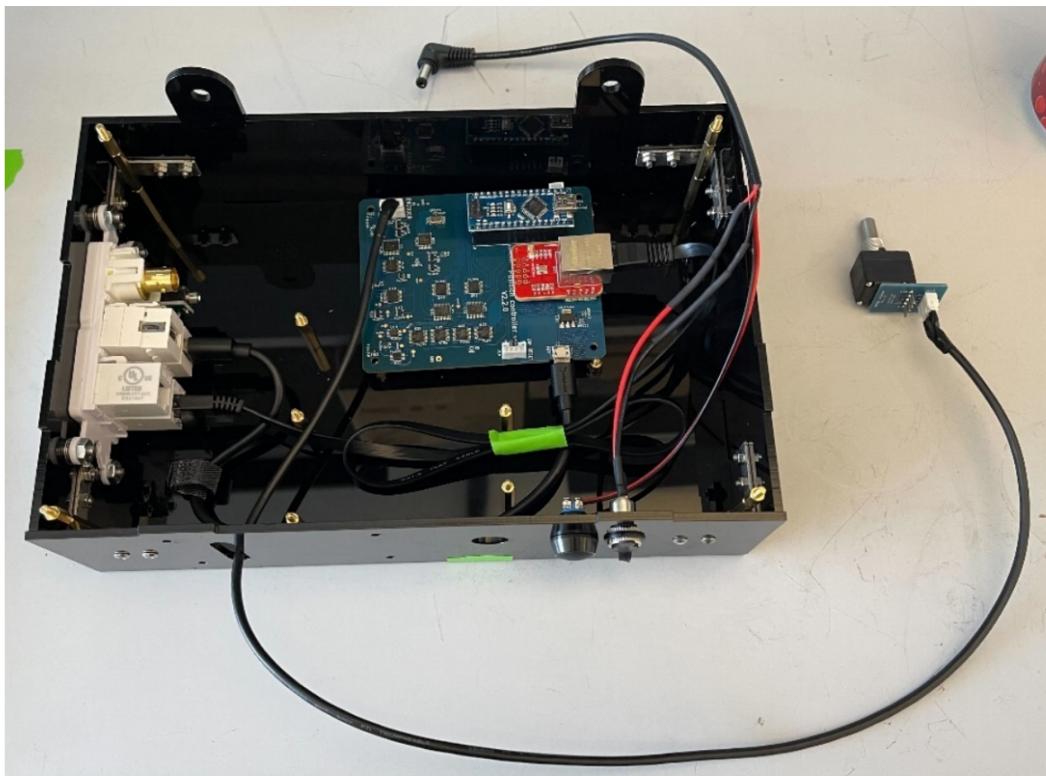


- b. Solder capacitor onto C1 of adapter circuit.
- c. Solder JST socket (see right photo below).
- d. Solder rotary encoder (see left photo below).



- e. Crimp 4-pin, 2 mm JST connectors on both sides of the two-foot strand of wire.

- f. Plug JST connector into ENCODER socket in position controller and JST socket on the rotary encoder assembly just made.



#### 14. Test position controller and rotary encoder

- a. Connect the box to your PC with an ethernet and USB-B in the jacks (white jacks on the front of the box) that your position controller is also connected to.
- b. Open BehaviorMate and turn the rotary encoder to make sure movement is being registered. You may need to hit the reset and zero position buttons to see movement.
- c. Don't install behavior controller until you know the position controller and rotary encoder are working since, the behavior controller will sit on top of the position controller.

#### 15. Make behavior controller

- a. You will need:
  - i. Behavior shield v1.0.7
  - ii. Behavior shield stencil
  - iii. Solder paste
  - iv. 4.7k resistors
  - v. 10k resistors
  - vi. 1 micro Farad, 35V capacitors
  - vii. JST connectors
  - viii. 12 DC Power adapter
  - ix. Ethernet module
  - x. Push Button Switch
  - xi. Odor control socket
  - xii. Voltage regulator
  - xiii. Micro USB connector

- xiv. HBridge chip
  - xv. Power barrel connector jack
  - xvi. Male headers
  - xvii. Female headers

b. Use stencil to apply solder paste for the back components. Check paste to make sure no components will be shorted. If only a few components have misapplied solder paste, remove paste with a q-tip soaked in ethanol, dry components with a dry q-tip, then manually solder by hand. No need to redo stencil for one or two components.

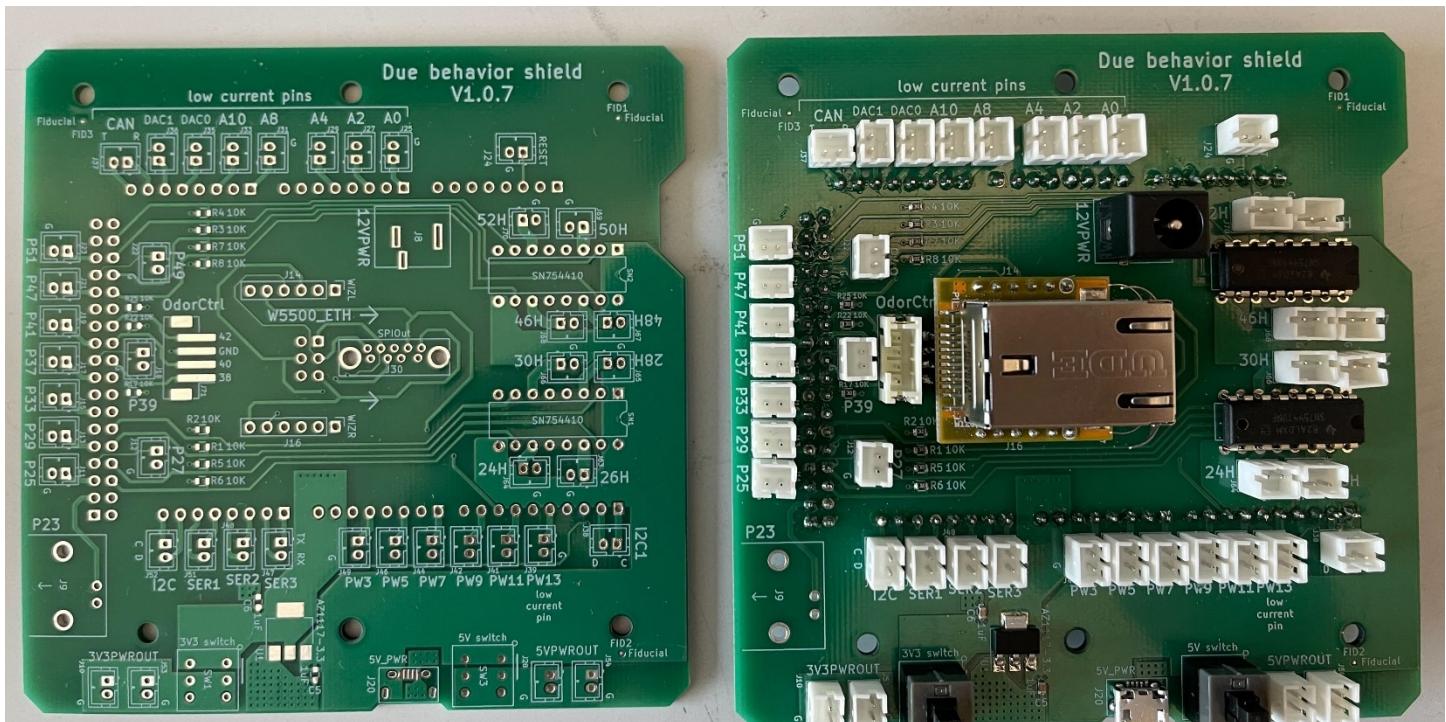
c. Place resistors and capacitors using microscope at soldering station. Give each component a gentle tap after placing so it sticks to board.

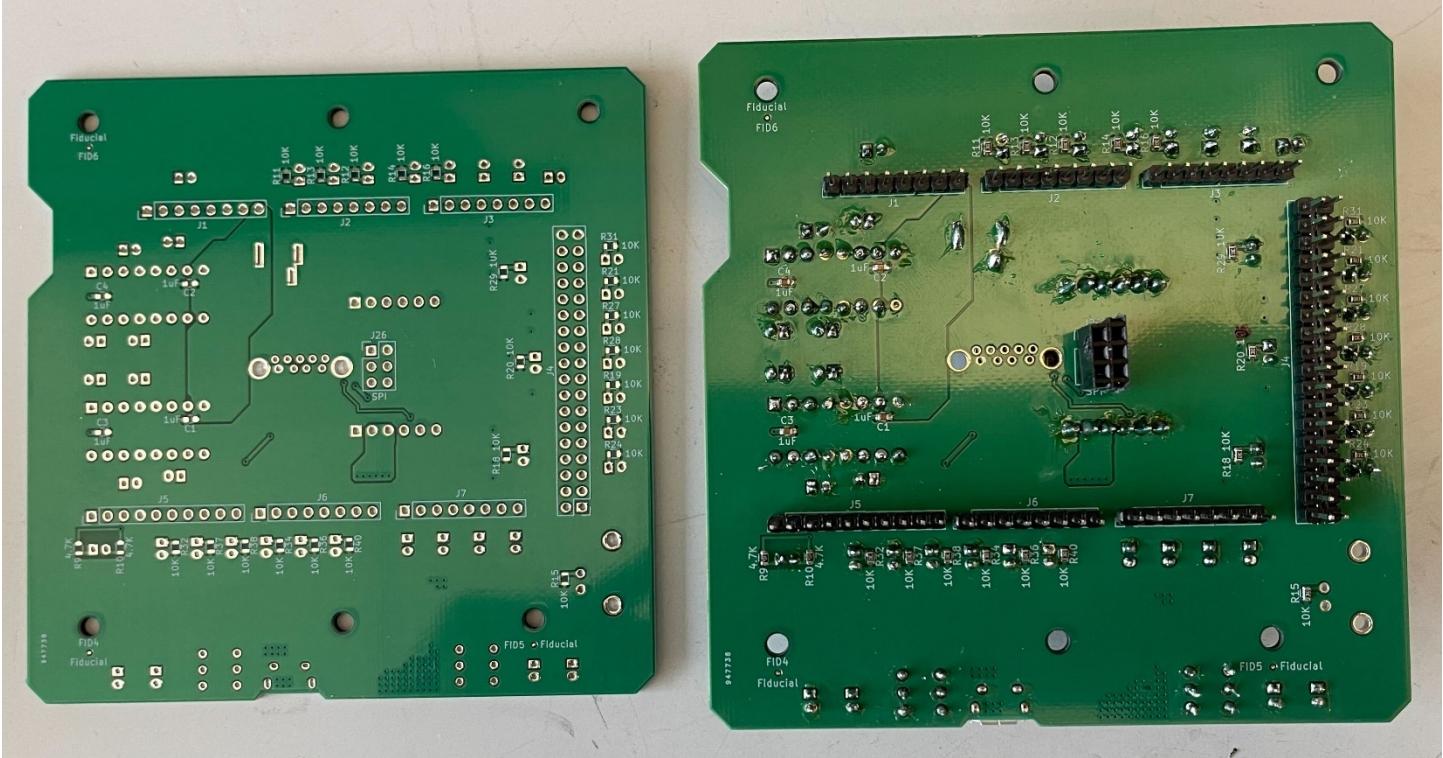
d. Bake in oven at peak temp 210 Celsius (should be cycle 2 but double check).

e. Use same stencil to apply solder paste for front components

f. Bake in oven at peak temp 160 Celsius (should be cycle 1).

i.

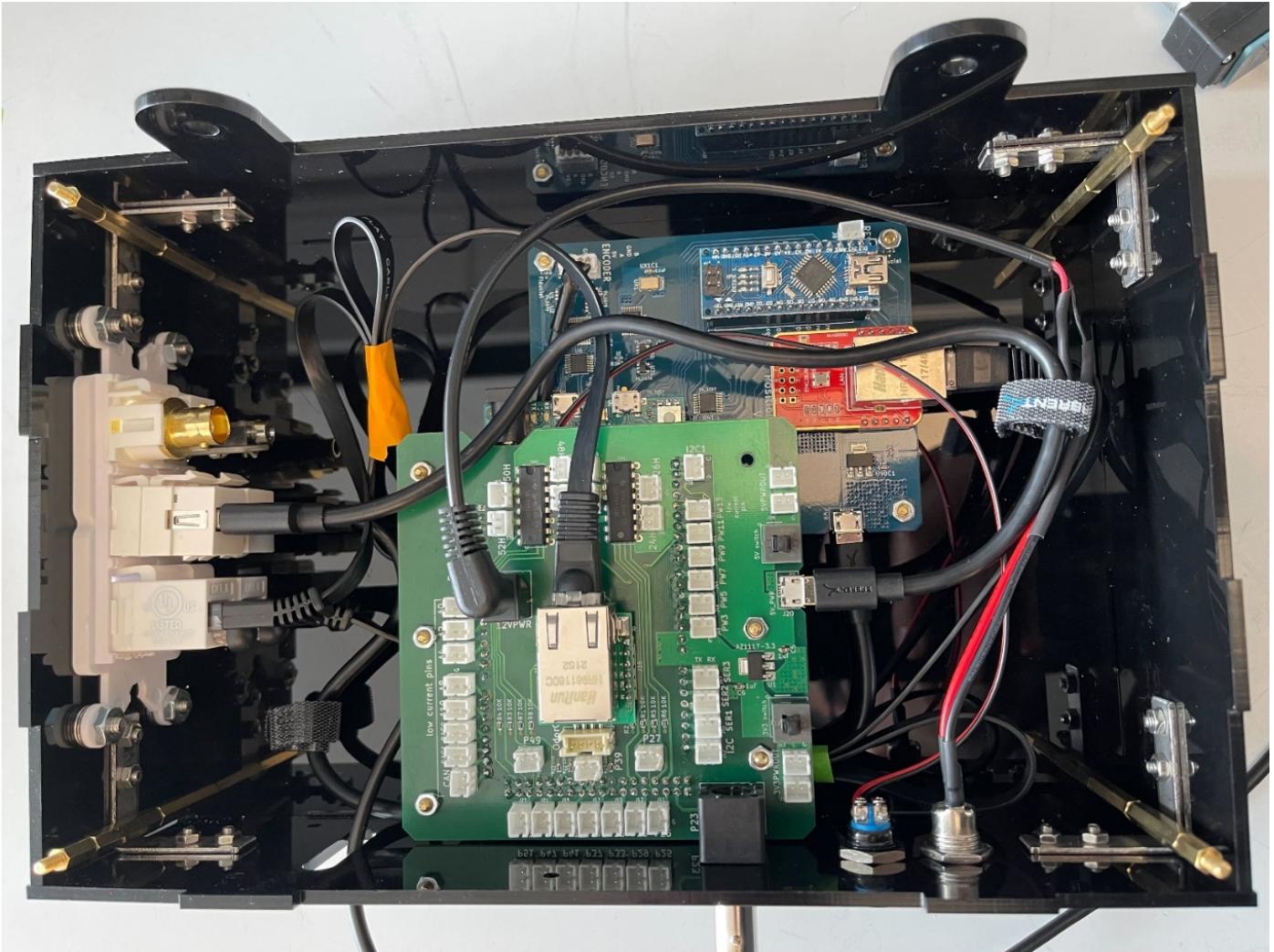




## 16. Load behavior controller program onto Arduino due

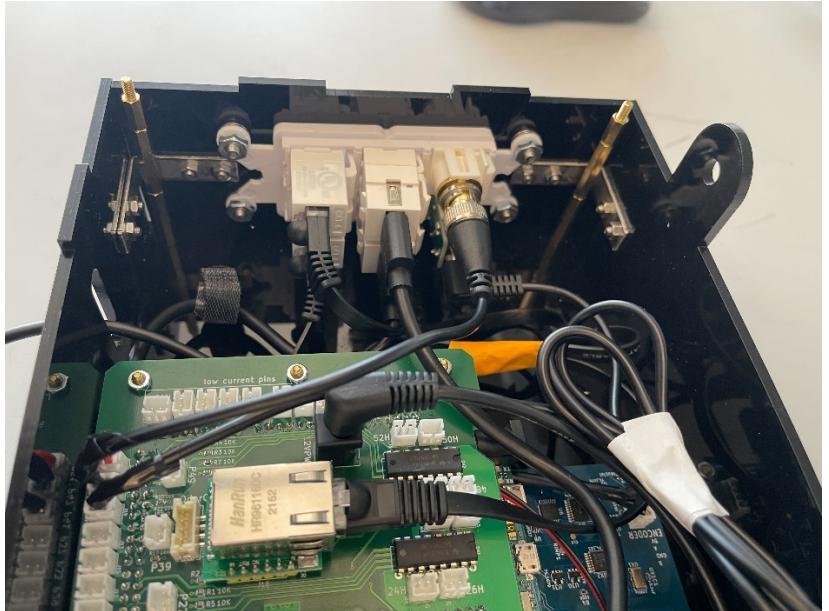
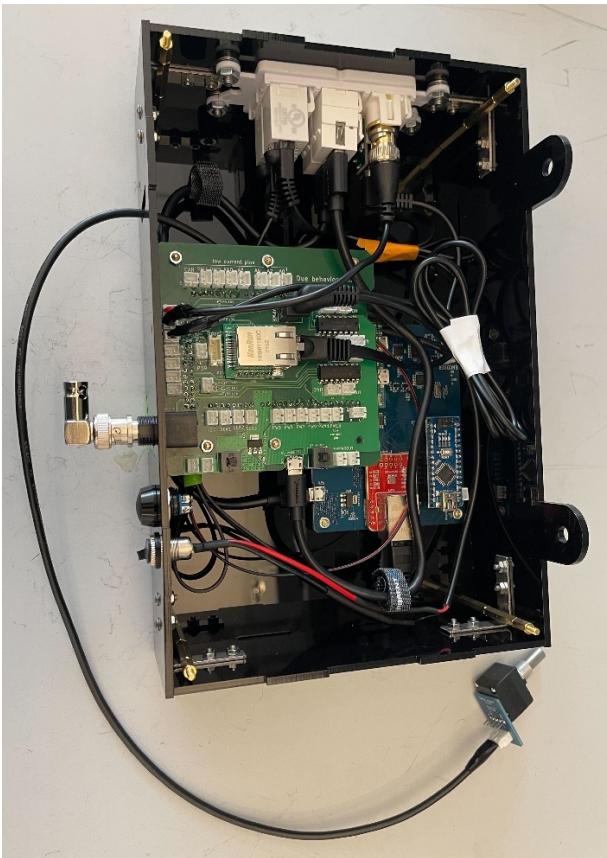
- In the Arduino IDE, open the “behavior\_controller” file in arduino\_controller/bin/behavior\_controller
- Plug in your due to your PC with a Micro USB to USB-A cable. Plug the micro-usb jack into the due port that is closer to the power barrel jack.
- Go to Tools > Board > Arduino ARM (32-bit) Boards > Arduino Due (Programming Port)
- Go to Tools > Port and select the port assigned to your due. If you are unable to open the Serial Monitor (Tools > Serial Monitor), you have selected the wrong port. The port may change each time you plug in your nano so try different options if something seems wrong.
- Click the arrow in the top right of the IDE to upload the program to the nano.
- You should see an IP address in the serial monitor if everything went smoothly.

17. Add behavior controller to box



18. Connect cables

- a. BNC cable should be connected to the BNC keystone and jack and the P47 JST socket on the behavior controller.
- b. The audio cable should be connected to the 3.5 mm audio keystone jack and the P41 JST socket on the behavior controller.
- c. Connect dc power jack made in step 8a. into 12VPWR on behavior controller
- d. Connector JST connector of push button cable to RESET socket on behavior controller
- e. Connector JST connector of audio cable to P41 socket on behavior controller
- f. The jumper, **if it needs to be added**, should go in the P51 JST socket on the behavior controller.
- g. Connect the ethernet module and micro-usb ports to the appropriate keystone jacks.

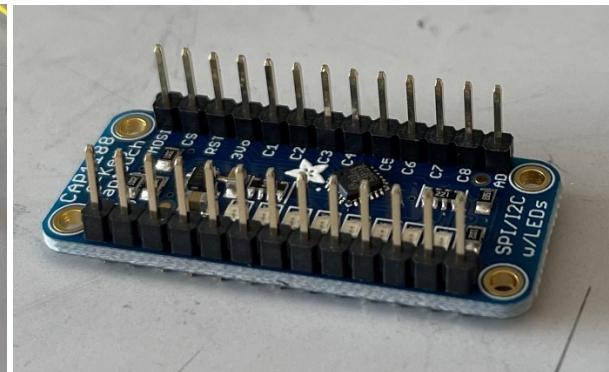
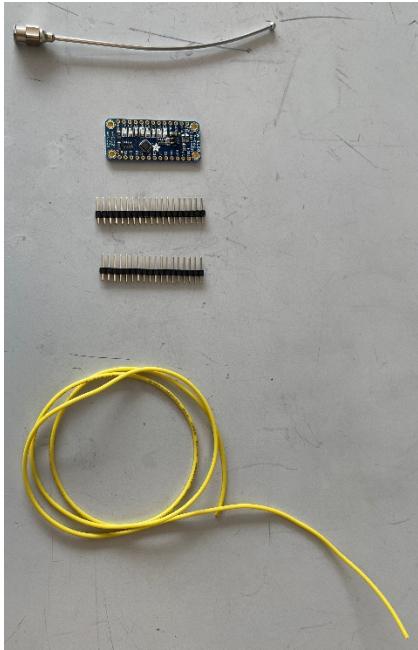


### 19. Make lickport assembly

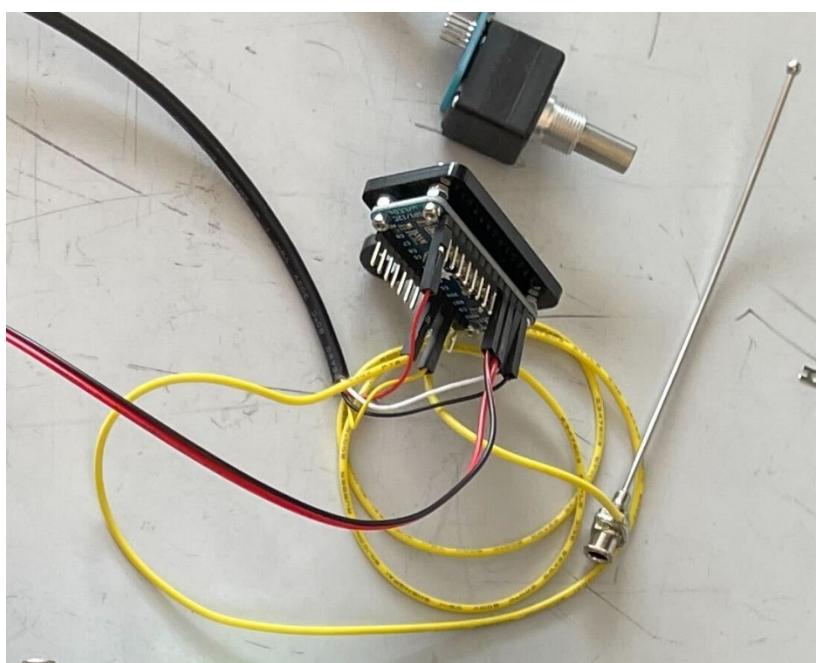
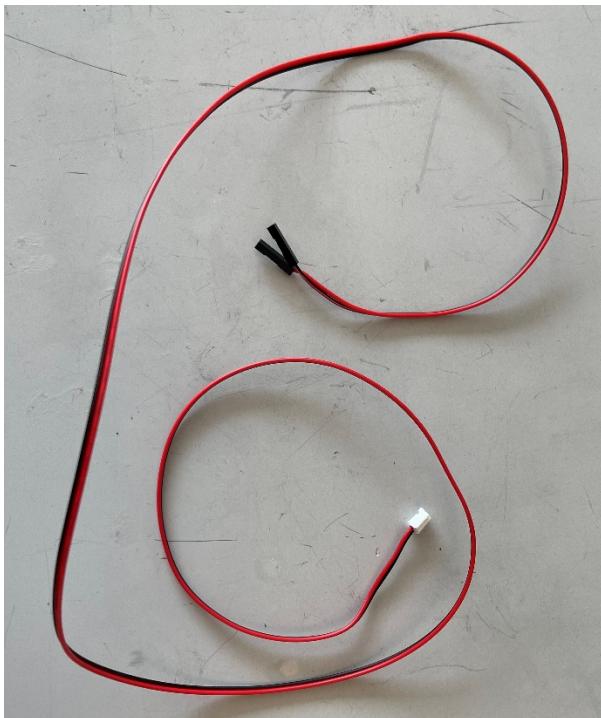
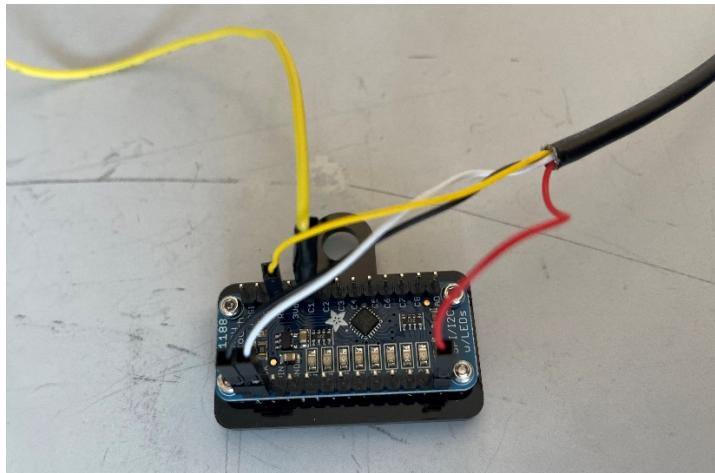
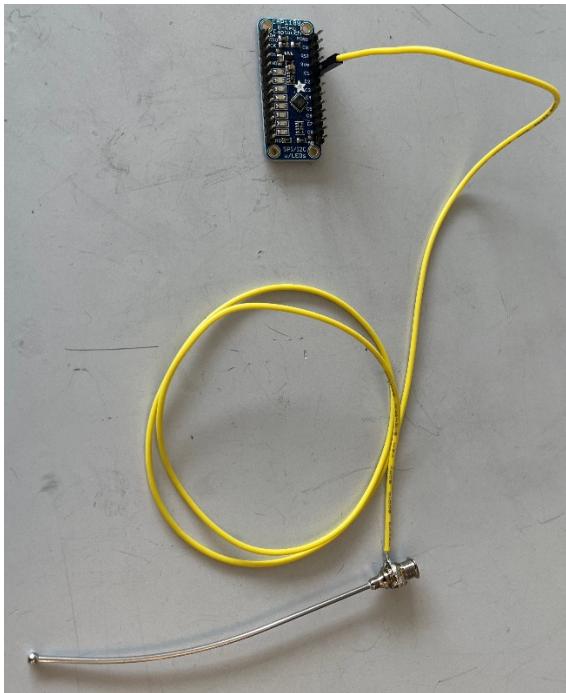
- a. You will need:
  - i. CAP1188 board
  - ii. Male headers
  - iii. 24 AWG single channel wire (2 feet)
  - iv. 24 AWG 4-channel wire (2 feet)
  - v. 22 AWG double channel, red/black wire (2 feet)
  - vi. Gavage needle (In this guide, the longer needle is used but the short one can also be used. The same instructions apply.)
  - vii. Dupont connector and appropriate crimp headers (7)
  - viii. JST connector – 2 pin, 2mm (5)
- b. Use Dremel, saw or other tool to create a canal in the gavage needle. Refer to the picture with the blue arrow below. This is where the 24 AWG wire will be soldered to the gavage needle.
- c. Remove about 2-3 inches of insulation from wire, wrap it around the canal, and use ample solder to fuse the wire to the gavage needle. Attach dupont connector to the other end of this wire and connect it to the C1 pin on the CAP board.
- d. On one end of the 22 AWG double channel wire, attach a 2 pin JST (make sure black goes to ground). On the other end, attach dupont connectors. Connect the JST side to J53 3V power connector on the behavior shield. For the dupont side, connect red to VIN and black to GND on the CAP board respectively.
- e. Remove about 2-3 inches of insulation of shielding from each end of the 4-channel wire. One side will only have JST connectors and the other side will only have dupont connectors. On the JST end, black and white will be connected to a 2-pin JST (with black going to ground), red will be connected to a 2-pin JST (red goes in non-ground, nothing in ground side), and yellow will be connected to a 2-pin JST (yellow goes in non-ground, nothing in ground side). On the dupont side, each wire goes to a single pin dupont connector.

Last Updated: 06/15/22

- f. Plug black/white cable JST into I2C of behavior shield. Plug black dupont into MISO on CAP board. Plug white dupont into SCK on CAP board.
- g. Plug red JST cable into PW3 of behavior shield. Plug red dupont into IRQ on CAP board.
- h. Plug yellow JST cable into PW5 of behavior shield. Plug yellow dupont into RST on CAP board.



Last Updated: 06/15/22



Last Updated: 06/15/22

