Animatronic Cosplay Wings

Created by Ruiz Brothers

https://learn.adafruit.com/animatronic-cosplay-wings

Last updated on 2024-03-08 03:04:48 PM EST

Table of Contents

Overview 5

- Parts
- Hardware List

Circuit Diagram 10

- Adafruit Library for Fritzing
- Wired Connections

CircuitPython on Feather M4 Express 11

- Set up CircuitPython Quick Start!
- Further Information

Code 14

- Installing Project Code

3D Printing 16

- CAD Files
- Parts List
- Slice Settings
- Back Plate
- Servo Assembly
- Battery Holder Assembly
- PCB mount assembly

Servos Assembly 19

- Install Ball Bearing
- Install Servo Motor
- Secure Servo Motor
- Second Servo
- Servo Arm & Wing Holder
- Install Wing Holder Nuts
- Install Bearing Nut
- Secure Wing Holder
- Install Servo Horn
- Secure Servo Horn
- Assembled Servo Arms
- Servo Bearing Screw and Pin
- Install Bearing Pin
- Calibrate Servos
- Flag Markers
- Install Servo Arms
- Secure Bearing Pin & Screw
- Assembled Servo
- Second Servo
- Assembled and Calibrated

Wing Panels 30

- Wing Frames
- Attaching To the Backplate

Doubler Headers 37
• Headers for Doubler FeatherWing
• Installing Headers
• Install Doubler FeatherWing
• Secure PCB for Soldering
• Solder Headers
• Soldered Set of Headers
• Solder Second Set
• Dual Headers Soldered
Servo FeatherWing Headers 39
• Install Headers
• Soldering Headers
• Block Terminals & Headers
• Solder Terminal and Header
• Soldered ServoWing Headers
Feather Headers 41
• Headers for Feather
• Solder Headers
• Doubler FeatherWing
• Doubler FeatherWing Installed
Pot Switch Wiring 42
• Pot Switch Cables
• Solder Cables to Pot Switch
PowerBoost 1000C Wiring 43
• PowerBoost 1000C Resistor
• Install 10K Resistor
• Cables for PowerBoost 1000C
• Solder Cables to PowerBoost 1000C
• Wired PowerBoost 1000C
Doubler Wiring 46
• Connect PowerBoost to Doubler
• Wire PowerBoost 1000C to Doubler
• Connect PowerBoost to ServoWing
• Install Feathers to Doubler
• 3-pin JST cable
• Soldered 3-pin JST cable
• Connect Battery to PowerBoost for Testing
• Test Circuit
Battery Holder 51
• Hardware for Battery Holder
• Installing Hex Nuts
• Installed Hex Nuts
• Secure Battery Holder
• Installed Battery Holder
Back Plate Assembly 53
• Hardware for Servo Mounts
• Install Servo Mounts
• Secure Servo Mounts

- Secured Servo Mount
- Secured Servos
- Hardware for PCB Mount
- Secure PowerBoost to PCB Mount
- Hardware for PCB Mount
- Install PCB Mount to Back Plate
- Install PCB Standoffs
- Secured PCB Mount
- Reconnect Battery to PowerBoost
- Reconnect PowerBoost to Servo FeatherWing
- Install Doubler FeatherWing to PCB Mount
- Install Feather and Servo FeatherWing
- Connect Servos to Servo FeatherWing
- Install Battery to Back Plate
- Connect Potentiometer with Switch
- Final Build Circuit Test

Wear Them 63

Overview

This is not our first Cosplay Fairy Wings project, one of the first guides we published with Adafruit electronics is the Luna Fairy Wings (https://adafru.it/QER) (it's an awesome guide - please check it out for some inspiration!)

We want to properly credit some of the inspiration and tutorials we used in this project! The wing-construction technique is inspired by Fancy Fairy Wings (https://adafru.it/QES) and from the Fancy Fairy Wings & Things tutorial available at https://youtu.be/H4wJ42akriA (https://adafru.it/QAN)

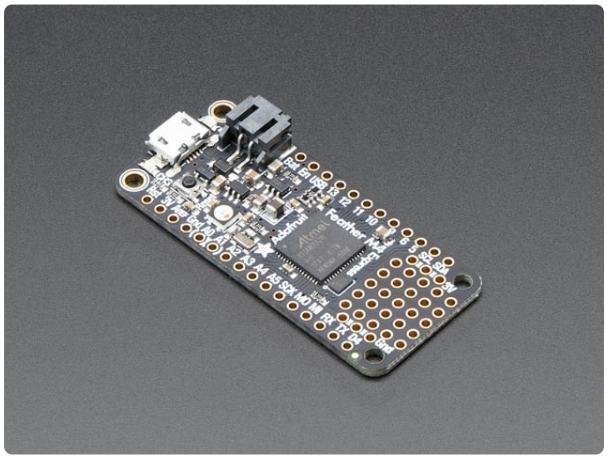
Take off and soar with these animatronic cosplay wings. The 3d printed back plate holds metal gear servos which are strong enough to support light to medium weight wings, and the lipoly battery will keep them flapping for hours.

You can attach store bought wings, or create your own unique fairy wings from cellophane and poster board or Bristol board. Make flapping dragon wings, or angel wings, or leathery bat wings if you like. The sky is the limit.

The wings are controlled by a potentiometer which gives you adjustable flapping speed and randomized flutters and pauses, so you can customize them to work exactly the way you want.

This is a moderately challenging build that requires some careful soldering and a lot of 3d printed parts, bits, and pieces. But when you're done, you'll have a flying machine you built yourself and can wear proudly.

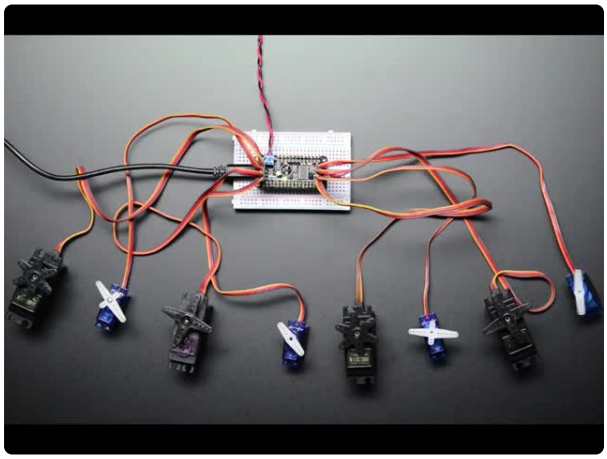
Parts



Adafruit Feather M4 Express - Featuring ATSAMD51

It's what you've been waiting for, the Feather M4 Express featuring ATSAMD51. This Feather is fast like a swift, smart like an owl, strong like a ox-bird (it's half ox,...

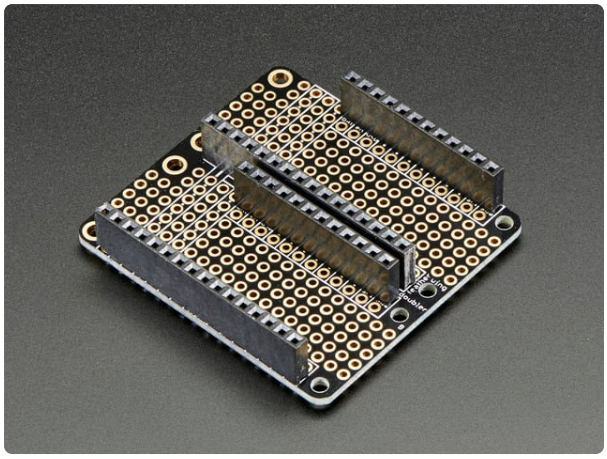
https://www.adafruit.com/product/3857



8-Channel PWM or Servo FeatherWing Add-on For All Feather Boards

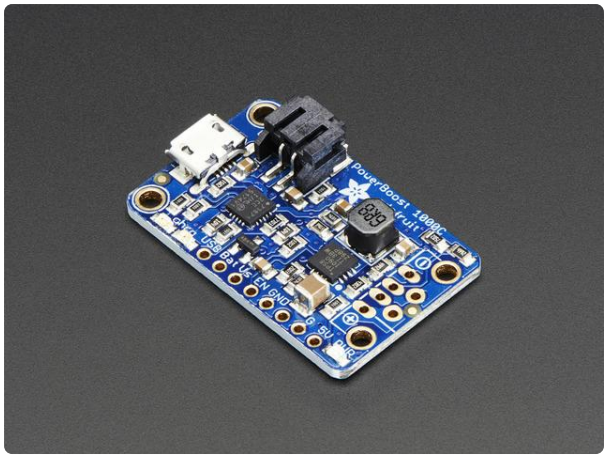
A Feather board without ambition is a Feather board without FeatherWings! This is the 8-Channel PWM or Servo FeatherWing, you can add 8 x 12-bit PWM outputs to...

https://www.adafruit.com/product/2928



FeatherWing Doubler - Prototyping Add-on For All Feather Boards

This is the FeatherWing Doubler - a prototyping add-on and more for all Feather boards. This is similar to our https://www.adafruit.com/product/2890



PowerBoost 1000 Charger - Rechargeable 5V Lipo USB Boost @ 1A

PowerBoost 1000C is the perfect power supply for your portable project! With a built-in load-sharing battery charger circuit, you'll be able to keep your power-hungry...
https://www.adafruit.com/product/2465

Micro Servo - High Powered, High Torque Metal Gear

Add even more power to your robot with this metal-geared servo. The tiny little servo can rotate approximately 180 degrees (~90 in each direction), and works just like the...
https://www.adafruit.com/product/2307

1 x 3.7v 2200mAh — https://www.adafruit.com/product/1781

Lithium Ion Cylindrical Battery

---

1 x Potentiometer with On/Off Switch — https://www.adafruit.com/product/3481

Panel Mount 10K Log Potentiometer w/ On-Off Switch - 10K Log w/ Switch

---

1 x 10K Resistor — https://www.adafruit.com/product/2784

Through-Hole Resistors - 10K ohm 5% 1/4W - Pack of 25

Female Headers
Short Headers Kit for Feather - 12-pin + 16-pin Female Headers

2 x Short Headers Kit for Feather - 12-pin + 16-pin Female Headers — https://www.adafruit.com/product/2940
Short Headers Kit for Feather - 12-pin + 16-pin Female Headers

---

1 x Ribbon Cable — https://www.adafruit.com/product/3890
Silicone Cover Stranded-Core Ribbon Cable - 10 Wire 1 Meter Long - 28AWG Black

---

1 x JST PH 2-Pin Cable - Female Connector 100mm — https://www.adafruit.com/product/261
JST PH 2-Pin Cable - Female Connector 100mm

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1 x JST PH 2-Pin Cable – Male Header 200mm — https://www.adafruit.com/product/3814
JST PH 2-Pin Cable – Male Header 200mm

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1 x JST PH 3-Pin Socket to Color Coded Cable - 200mm — https://www.adafruit.com/product/4046
JST PH 3-Pin Socket to Color Coded Cable - 200mm

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1 x STEMMA JST PH 3-Pin to Female Socket Cable - 200mm — https://www.adafruit.com/product/3894
STEMMA JST PH 3-Pin to Female Socket Cable - 200mm

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1 x Black Nylon Screw and Stand-off Set – M2.5 Thread — https://www.adafruit.com/product/3299
Black Nylon Screw and Stand-off Set – M2.5 Thread

---

1 x Radial Ball Bearing — https://www.adafruit.com/product/1178
608ZZ - Set of 4

---

1 x Stickvise PCB Vise — https://www.adafruit.com/product/3197
Stickvise PCB Vise

---

1 x Helping Third Hand Magnifier W/Magnifying Glass Tool - MZ101 — https://www.adafruit.com/product/291
Helping Third Hand Magnifier W/Magnifying Glass Tool - MZ101

Hardware List

This is a list of the screws, nuts and standoffs required for assembling this build.

Servo Mounts

- 2x 608ZZ radial ball bearing
- 4x M2.5 x 8mm screws
- 6x M3 lock nuts
- 4x M3 x 10mm screws
- 2x M3 x 15mm screws

Battery Holder

- 2x M3 x 8mm screws
- 2x M3 lock nuts

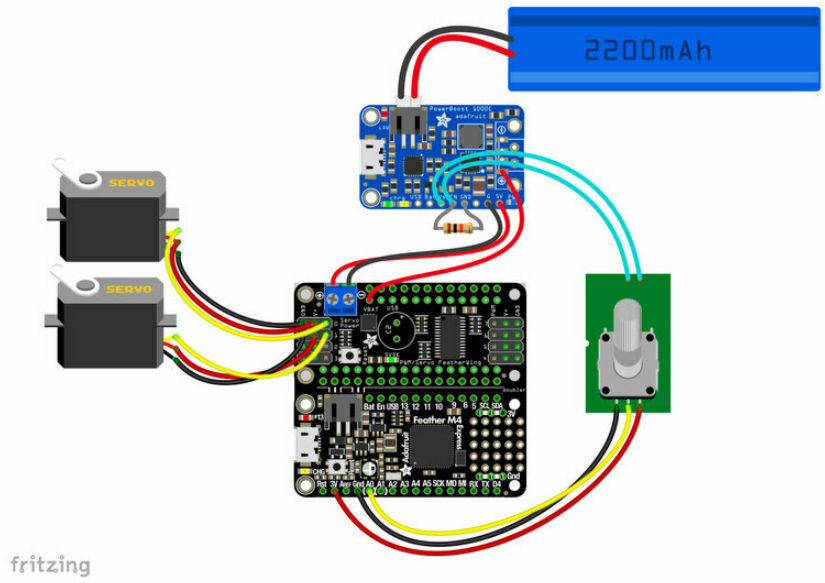
Back Plate

- 8x M2.5 x 6mm screws
- 8x M2.5 hex nuts
- 4x M2.5 x 8mm FF standoffs
- 4x M2.5 x 10mm screws
- 4x M2.5 hex nuts

Wing Holder

- 4x M3 lock nuts
- 4x M3 x 15mm screws

Circuit Diagram



The diagram below provides a visual reference for wiring of the components. This diagram was created using the software package Fritzing (https://adafru.it/oEP).

Adafruit Library for Fritzing

Use Adafruit's Fritzing parts library to create circuit diagrams for your projects. Download the library or just grab individual parts. Get the library and parts from GitHub - Adafruit Fritzing Parts (https://adafru.it/AYZ).

Wired Connections

PowerBoost 1000C to Servo FeatherWing

- 5V from PowerBoost to Voltage+ on Servo FeatherWing
- GND from PowerBoost to GND- on Servo FeatherWing

PowerBoost 1000C to FeatherWing Doubler

- 5V from PowerBoost 1000C to VBAT on Doubler FeatherWing

PowerBoost 1000C

- 10k Resistor on EN and GND
- 2200mAh battery to JST port on PowerBoost 1000C

Potentiometer with Switch to Doubler FeatherWing

- GND from potentiometer to GND on Doubler FeatherWing
- Signal from potentiometer to A0 on Doubler FeatherWing
- VCC from potentiometer to 3V on Doubler FeatherWing
- Switch to VS and EN on PowerBoost 1000C

Micro Servo to Servo FeatherWing

- Servo 1 to Channel 0 (GND, VCC, Signal) on Servo FeatherWing
- Servo 2 to Channel 1 (GND, VCC, Signal) on Servo FeatherWing

---

CircuitPython on Feather M4 Express

CircuitPython (https://adafru.it/tB7) is a derivative of MicroPython (https://adafru.it/BeZ) designed to simplify experimentation and education on low-cost microcontrollers. It makes it easier than ever to get prototyping by requiring no upfront desktop software downloads. Simply copy and edit files on the **CIRCUITPY** drive to iterate.

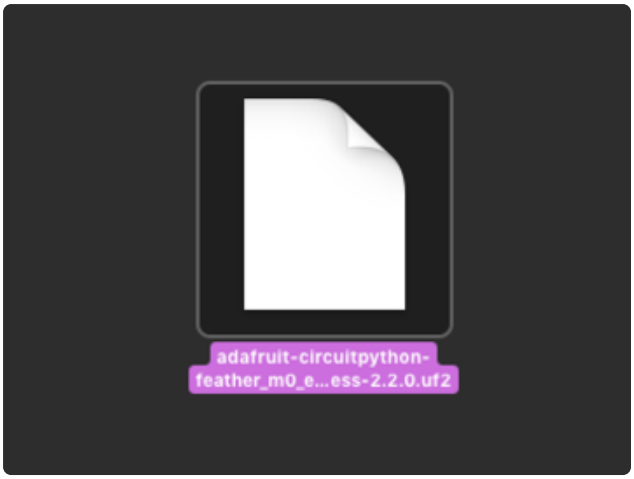
The following instructions will show you how to install CircuitPython. If you've already installed CircuitPython but are looking to update it or reinstall it, the same steps work for that as well!

Set up CircuitPython Quick Start!

Follow this quick step-by-step for super-fast Python power :)

Download the latest version of CircuitPython for this board via CircuitPython.org

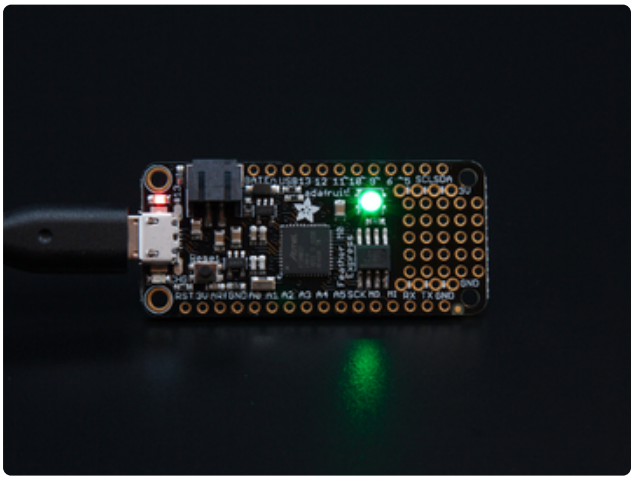
https://adafru.it/Emh



Click the link above and download the latest UF2 file.

Download and save it to your desktop (or wherever is handy).

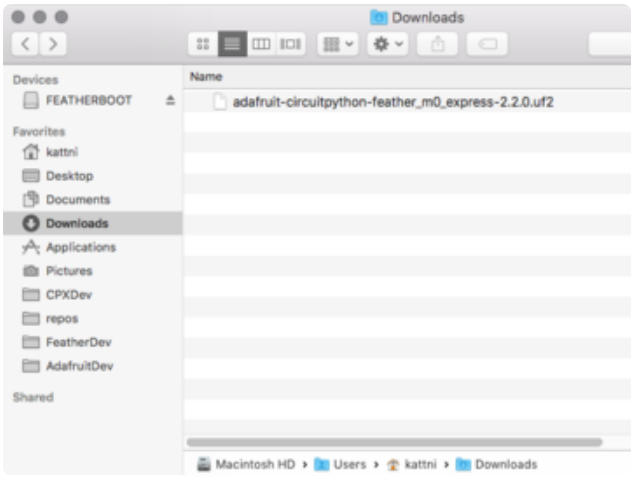
Plug your Feather M4 into your computer using a known-good USB cable.



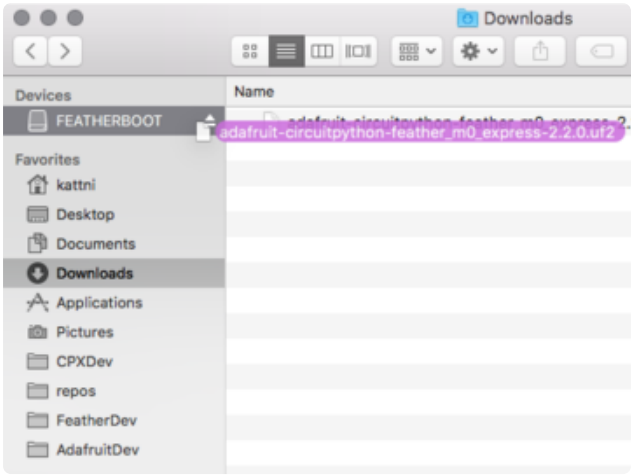
A lot of people end up using charge-only USB cables and it is very frustrating! So make sure you have a USB cable you know is good for data sync.

Double-click the **Reset** button next to the USB connector on your board, and you will see the NeoPixel RGB LED turn green. If it turns red, check the USB cable, try another USB port, etc. **Note:** The little red LED next to the USB connector will pulse red. That's ok!

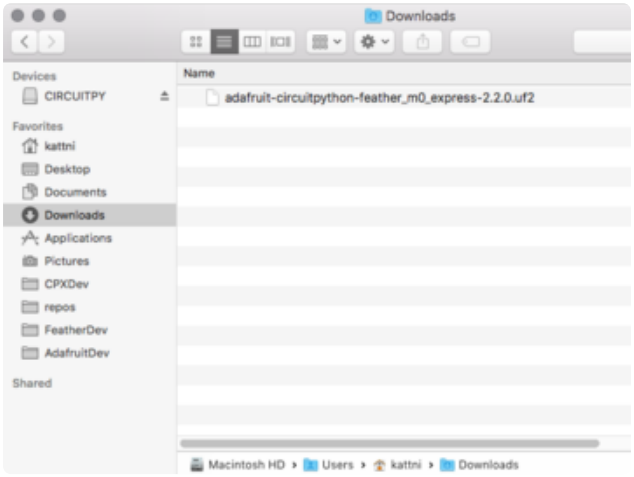
If double-clicking doesn't work the first time, try again. Sometimes it can take a few tries to get the rhythm right!



You will see a new disk drive appear called **FEATHERBOOT**.



Drag the **adafruit_circuitpython_etc.uf2** file to **FEATHERBOOT.**



The LED will flash. Then, the **FEATHERBOOT** drive will disappear and a new disk drive called **CIRCUITPY** will appear.

That's it, you're done! :)

Further Information

For more detailed info on installing CircuitPython, check out Installing CircuitPython (https://adafru.it/Amd).

Code

Take your Feather and plug it into your computer via a known good data + power USB cable. Have your Feather handy as you'll be performing most of the same steps for each. Your operating system will show a drive named **CIRCUITPY** when a board is plugged in. If you get a drive named **FEATHERBOOT** you'll likely need to install CircuitPython.

Installing Project Code

To use with CircuitPython, you need to first install a few libraries, into the lib folder on your **CIRCUITPY** drive. Then you need to update **code.py** with the example script.

Thankfully, we can do this in one go. In the example below, click the **Download Project Bundle** button below to download the necessary libraries and the **code.py** file in a zip file. Extract the contents of the zip file, open the directory **Fluttering_Fairy_Wings/** and then click on the directory that matches the version of CircuitPython you're using and copy the contents of that directory to your **CIRCUITPY** drive.

Your **CIRCUITPY** drive should now look similar to the following image:

```
# SPDX-FileCopyrightText: 2021 Erin St Blaine for Adafruit Industries
#
# SPDX-License-Identifier: MIT

"""
Fluttering Fairy Wings
Adafruit invests time and resources providing this open source code.
Please support Adafruit and open source hardware by purchasing
products from Adafruit!
Written by Erin St Blaine for Adafruit Industries
Copyright (c) 2020-2021 Adafruit Industries
Licensed under the MIT license.
All text above must be included in any redistribution.
"""
```

```
import time
import random
import board
from analogio import AnalogIn
from adafruit_servokit import ServoKit

analog_in = AnalogIn(board.A0)
kit = ServoKit(channels=8)

SERVO_MIN = 0
SERVO_MAX = 130
DELAY_MIN = 0.01  # In seconds, is the longest DELAY between servo moves
DELAY_MAX = 0.1   # In seconds, is the longest DELAY between servo moves

DELAY = DELAY_MAX

def set_delay():
    '''calibrate to potentiometer'''
    global DELAY # pylint: disable=global-statement
    DELAY = DELAY_MIN + DELAY_MAX * (65535 - analog_in.value) / 65535
    #print(DELAY\

while True:
    num_flaps = random.randint(1, 4)

    print("Flapping", num_flaps, "times")
    for flap in range(num_flaps):
        print("Open")
        set_delay()
        for angle in range(SERVO_MIN, SERVO_MAX, 2): # move 2 deg at a time
            kit.servo[0].angle = angle
            kit.servo[1].angle = SERVO_MAX-angle
            time.sleep(DELAY)
        print("Close")
        set_delay()
        for angle in range(SERVO_MIN, SERVO_MAX, 2): # move 2 deg at a time
            kit.servo[0].angle = SERVO_MAX-angle
            kit.servo[1].angle = angle
            time.sleep(DELAY*2)
    print("Waiting...")
    time.sleep(random.randint(2, 10))  # wait 2 to 10 seconds
```

Calibrating Your Wings

Servos and potentiometers have some variation between them. It's easy to adjust the code so the wings move only as far as you'd like them to move. For my wings, the optimum range was between 0-130 degrees.

If yours are not flapping far enough, or if they're hitting the end of your servo range, look for this line in the code:

```
SERVO_MIN = 0
SERVO_MAX = 130
```

Adjust the max and min values until your wings are in the range you want.

Potentiometers also have some variation. If your wings are moving too slowly at the "slow" end of your range, or too quickly at the "fast" end, you can set the max and min speeds in the code as well. Look for this line:

```
DELAY_MIN = 0.01  # In seconds, is the shortest DELAY between servo moves
DELAY_MAX = 0.1   # In seconds, is the longest DELAY between servo moves
```

Adjust the min and max delay until you're happy with your wing motion speed.

You can also adjust the number of flaps and the time between flaps.

```
num_flaps = random.randint(1, 4)
```

This line chooses a random interger between 1 and 4 and sets the wings to flap that many times. You can change the intergers to anything you'd like to make the wings flappier or stiller.

```
time.sleep(random.randint(2, 10))  # wait 2 to 10 seconds
```

The last line in the code chooses a random number of seconds to wait between flapping cycles. Change this to make the pauses shorter or longer.

3D Printing

CAD Files

STL files for 3D printing are oriented to print "as-is" on FDM style machines. Parts are designed to 3D print without any support material. Original design source may be downloaded using the links below.

Download CAD source files

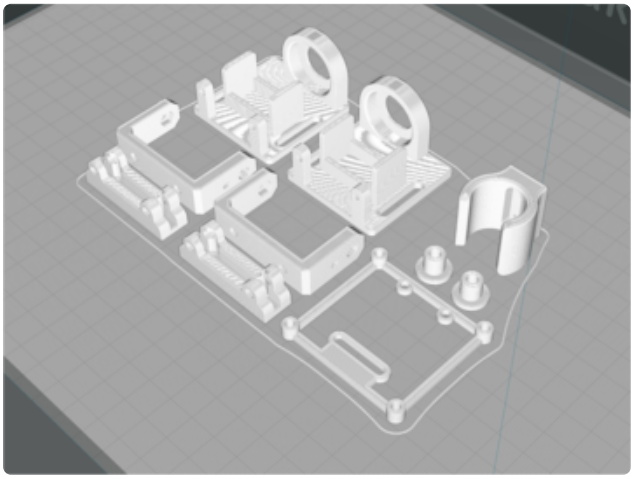
https://adafru.it/QEP

Download STL files

https://adafru.it/QEQ

Parts List

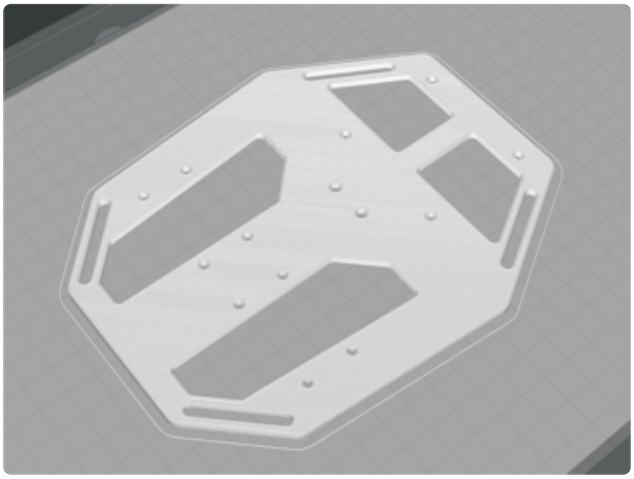
- servo-holder-a.stl
- servo-holder-b.stl
- servo-arm.stl
- servo-pin.stl
- wing-clip.stl
- back-plate.stl
- battery-clip.stl
- pcb-mount.stl



Slice Settings

The parts were sliced using CURA and FlashPrint using the slice settings below.

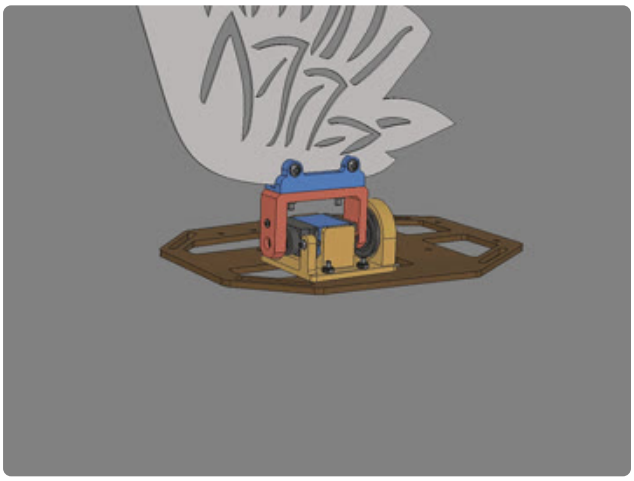
PLA filament 220c extruder
0.2 layer height
10% gyroid infill
60mm/s print speed
60c heated bed



Back Plate

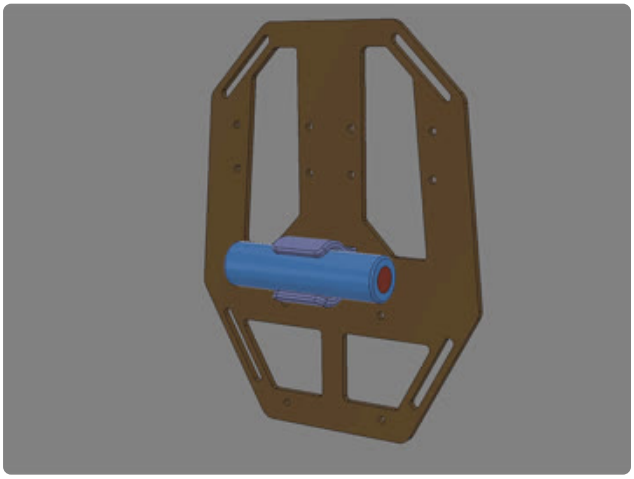
The back plate requires a minimum build volume.

Minimum Bed: 165mm x 135mm



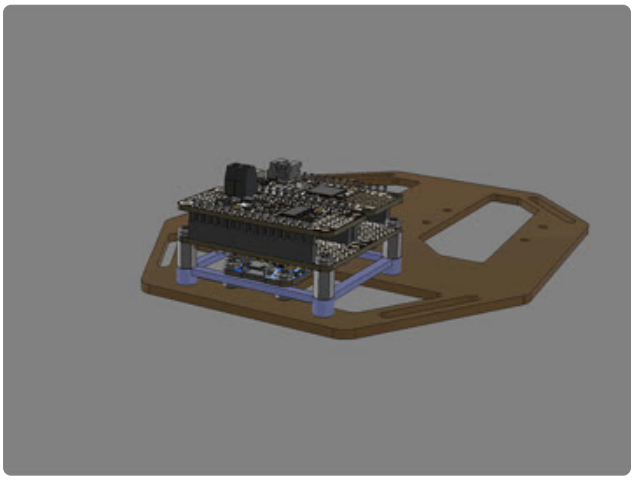
Servo Assembly

The servo mounts are secured to the back plate with screws and nuts. The micro servo is fitted into the servo mount and secured with screws. A ball bearing is fitted into the servo mount to counter weight the servo arm. The servo arm is secured to a servo horn and press fitted onto the shaft of the servo motor. The servo arm is secured to the bearing pin with a long screw. The wing holder is secured to the servo arm with screws and hex nuts. The wings are attached to the wing holder with screws and hex nuts.



Battery Holder Assembly

The battery holder is secured to the back plate with screws. Lock nuts are press fitted into the battery holder. The 2200mAh battery slides through the clip.



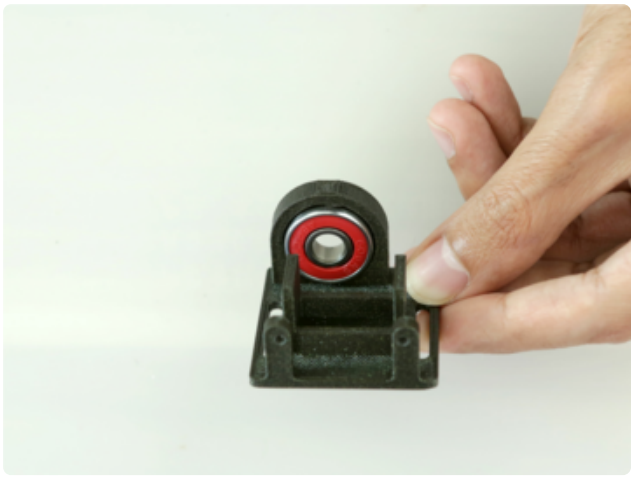
PCB mount assembly

The Feather M4 and Servo FeatherWing are fitted onto the Doubler FeatherWing. The PCB mount is secured to the back plate with screws and additional standoffs. The Doubler is secured to the standoffs on the PCB mount.

Servos Assembly

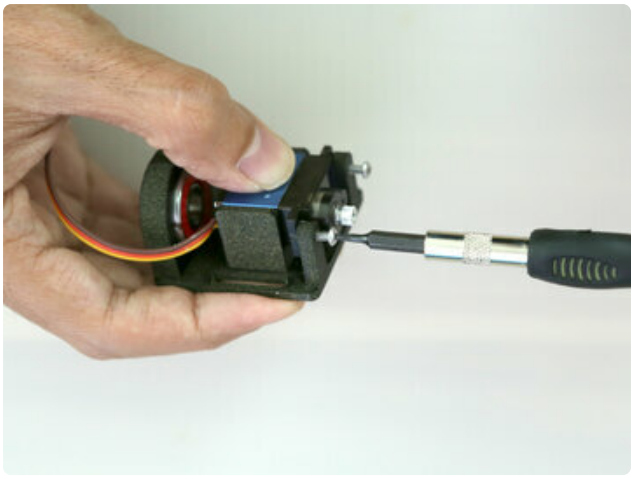
Install Ball Bearing

The 608ZZ ball bearing is press fitted into the circular cavity in the servo holder. It should have a snug fit.



Install Servo Motor

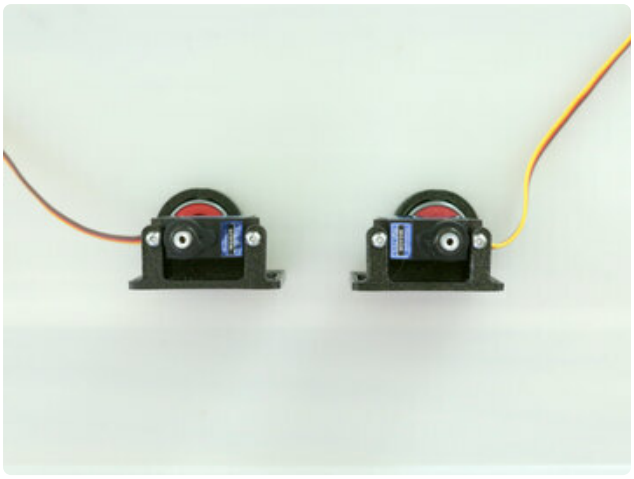
Place the servo motor into the holder with the shaft lined up with the bearing. Reference the photo for correct placement.



Secure Servo Motor

Install and secure screws to the servo holder while holding the motor in place.

2x M2.5 x 8mm



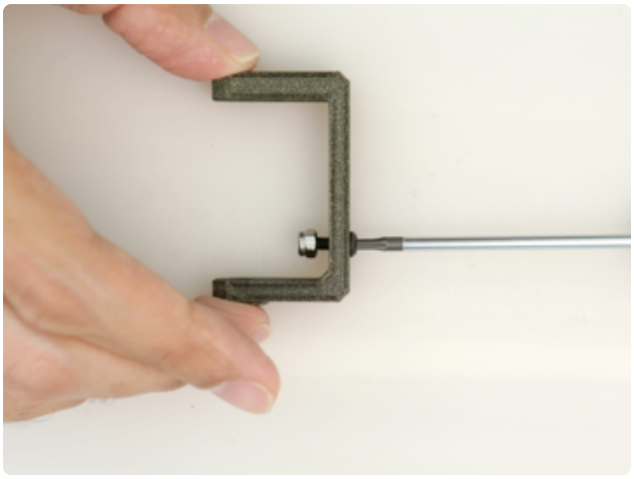
Second Servo

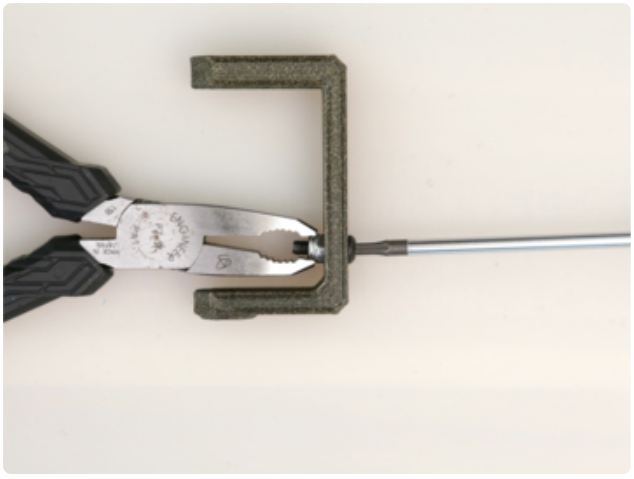
Repeat the servo holder assembly for the second servo motor. Note the servo motors are mirrored.

Servo Arm & Wing Holder

The wing holder is secured to the servo arm with two screws and nuts.

2x M3 x 10mm
2x M3 lock nuts





Install Wing Holder Nuts

Two lock nuts are force fitted into cavities on the servo arm.

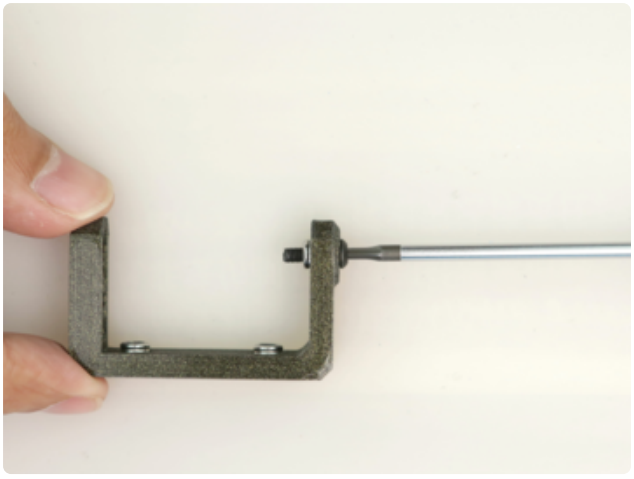
Insert a screw through one of the holes on the servo arm.

Use pliers to secure a lock nut onto the screw threads.

While gripping lock nut, fasten the screw to force the lock nut into the cavity.

Remove the screw by unfastening from the lock nut.

The lock nuts should remain installed inside the servo arm. Repeat this process for the second hole.



Install Bearing Nut

Use another screw to secure a third lock nut into the servo arm.

Using pliers, repeat the same process for installing the lock nut.

Remove the screw from the lock nut once it's installed.

Secure Wing Holder

The wing holder is now ready to review to the servo arm.

Place the wing holder over the servo arm.

Line up the mounting holes. Insert and fasten two screws into the lock nuts.

Repeat process for the second mounting hole.

Install Servo Horn

Get the servo horn and screw ready to install into the servo arm. The micro servo includes a few different horn and screws. Use the single armed horn and screw. Reference the photo for the correct servo horn.

Secure Servo Horn

Insert the servo horn into the cavity on the servo arm.

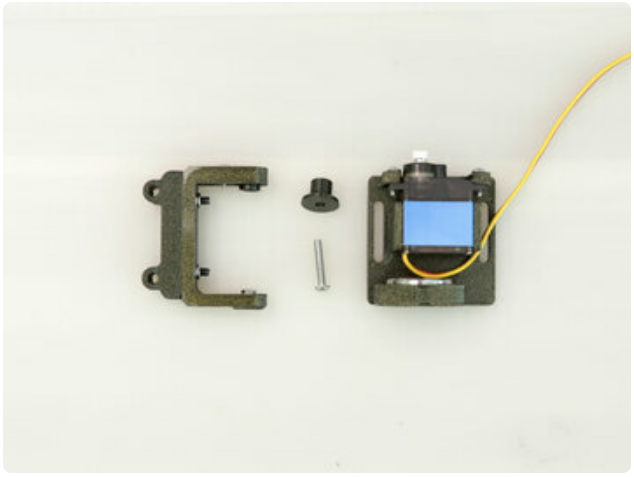
Press fit the servo horn into the servo arm.

While holding servo horn in place, insert and fasten screw.

Tightly fasten the screw to secure the servo horn to the servo arm.

Assembled Servo Arms

Repeat this process for the second servo arm. The two servo arms are identical.

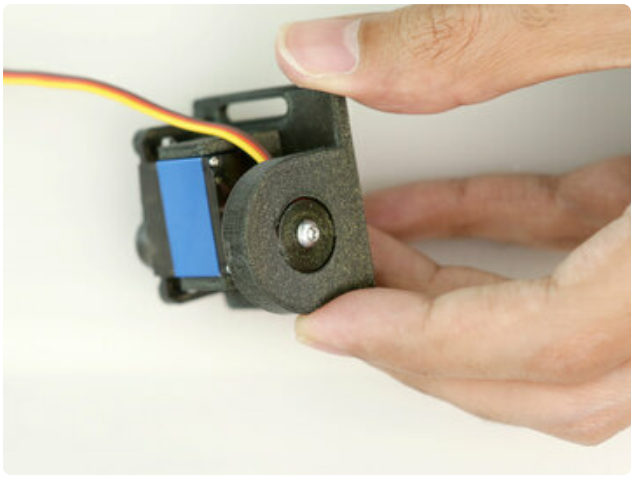


Servo Bearing Screw and Pin

The ball bearing requires a screw and pin.

Insert the screw into the pin. Reference the photo for correct placement.

M3 x 15mm



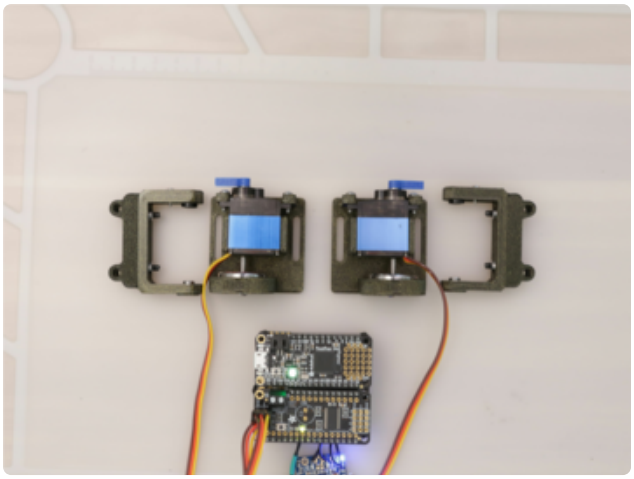
Install Bearing Pin

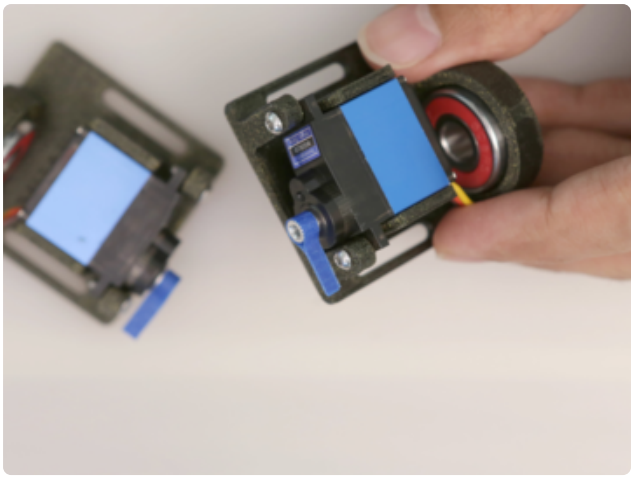
Insert the pin with the screw through the center of the ball bearing.

The pin has a loose fitting and will need to be held in place when securing it to the servo arm.

The pin is installed temporarily.

The servo must be calibrated before installing servo arm.





Calibrate Servos

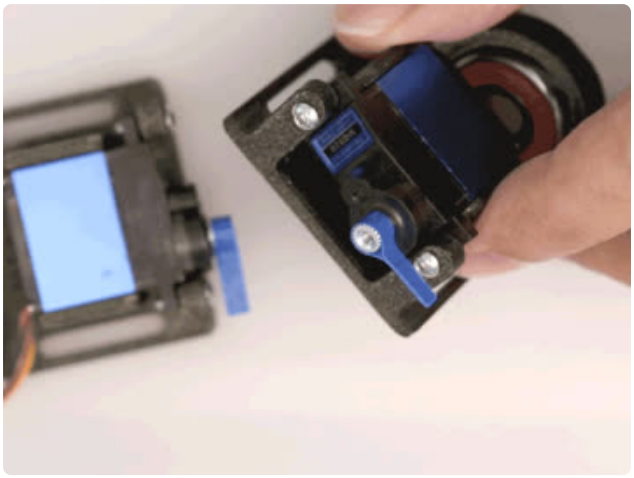
Before we can complete the assembly, the servos must be calibrated.

Connect the two servos to the Servo FeatherWing.

Turn on the PowerBoost 1000C. Code and libraries should be already installed and uploaded to Feather M4.

Observe the shaft and take note of the positions when it is rotating.

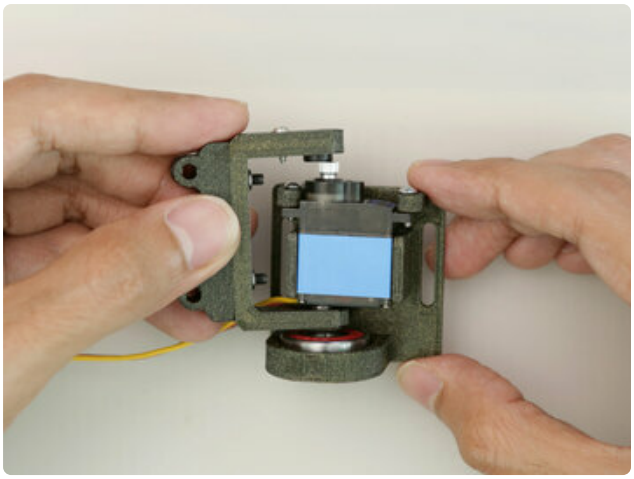
Use a piece of tag to create a flag. Wrap it around the shaft of the motor.

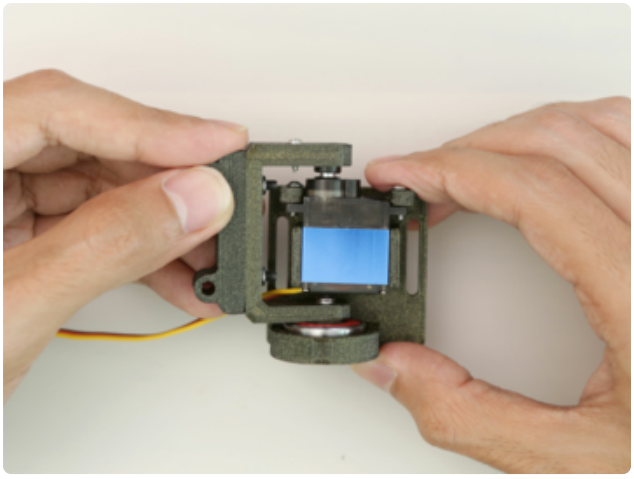


Flag Markers

A flag is a good way to indicate the position of the servo shaft. Use this to reference the best placement for the servo arms. A piece of tape serves well, wrapped on the shaft upon itself.

Turn off the circuit when the wings are paused and fully "opened".





Install Servo Arms

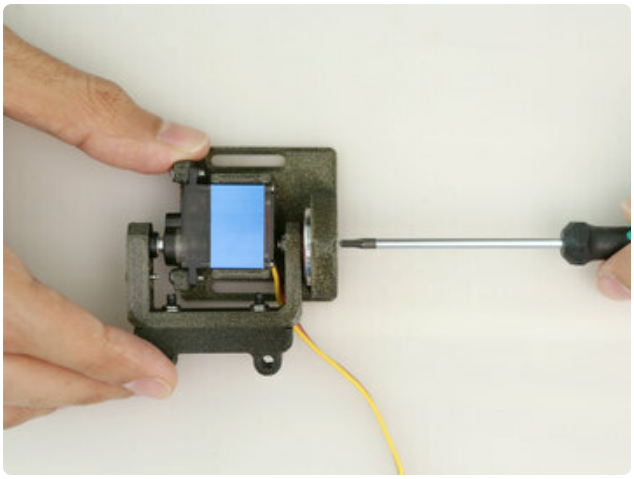
Remove the flags and begin to install the servo arms.

Remove the bearing pin and screw.

Carefully place the servo horn over the shaft of the servo.

Check the position of the servo matches the position of the flag.

Press the servo horn onto the shaft of the servo.



Secure Bearing Pin & Screw

Reinstall the bearing pin and screw.

Insert the screw into the lock nut that is press fitted into the servo arm.

Fasten and secure the screw to the servo arm.

Assembled Servo

The servo arm is ready for testing.

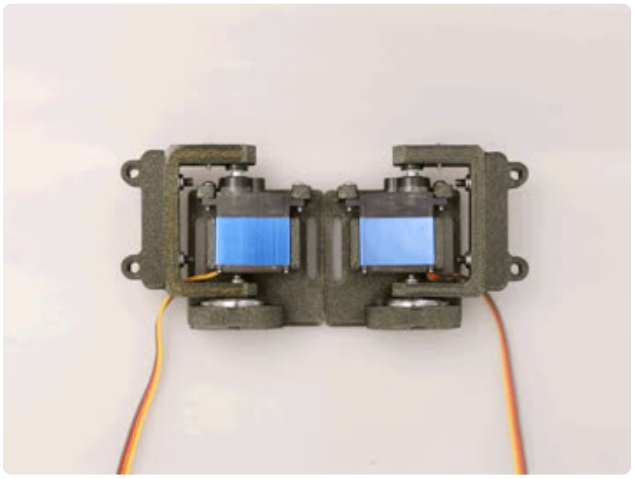
Be careful not to move the servo arm.

Forcefully moving the servo arm could strip the gears and damage the motor.

Second Servo

Repeat the assembly process for the second servo.

Adjust cables from the servos so they are not kinked when the servo arm is in motion.



Assembled and Calibrated

Time to test the two servos.

Connect the servos to the Servo FeatherWing.

Turn on PowerBoost 1000C. Code and libraries should be installed and uploaded.

Check the position of the servo arms are in the desired position.

Wing Panels

The easiest way to get your wings up and flying is to buy pre-made wings and attach them to your back plate. However, if you're looking for a handmade, unique custom set of wings, here is one way to build lightweight, translucent wings from cellophane and poster board.

We want to properly credit some of the inspiration and tutorials we used in this project! The wing-construction technique is inspired by Fancy Fairy Wings and from the Fancy Fairy Wings & Things tutorial available at https://youtu.be/H4wJ42akriA

You'll need:

- Poster board, chipboard or Bristol board for the wing frames
- 16g wire for support
- Colored or iridescent cellophane gift wrap (get this at the craft store)
- Therm-o-web iron-on vinyl (https://adafru.it/QAO)

- Jewels or findings for decoration
- Elastic straps or clear bra straps

Tools Needed

You can do this project largely by hand with a utility knife and an iron, and a lot of elbow grease. But having some good maker tools in your shop will make the job a lot easier and give you more accuracy with your cuts. Here's what I used:

- Cricut Maker Vinyl Cutter (https://adafru.it/QAP) with a 12"x24" strong grip cutting mat (https://adafru.it/QAQ)
- Laminating machine (you can find these for around $20 (https://adafru.it/QAR))
- A couple good pairs of pliers for wire manipulation
- Sewing needles and monofilament fishing line (https://adafru.it/QAS)
- Spray paint or holographic vinyl if you want colored wing frames

Wing Frames

My wings use three different variations of a frame design based on a cicada's wing. The largest wings (cicada_wings_1) are cut from chipboard. The thicker material along with the thicker frame design keeps these wings nice and rigid.

The smaller wings are cut from poster board. This lighter material combined with the more delicate wing veins in the design make these wings really flexible and bendy.

I've included a couple different designs in the .zip file below. All the files are ready to either print out and cut by hand, or to upload to your vinyl cutter software program.

Cicada_wing_files.zip

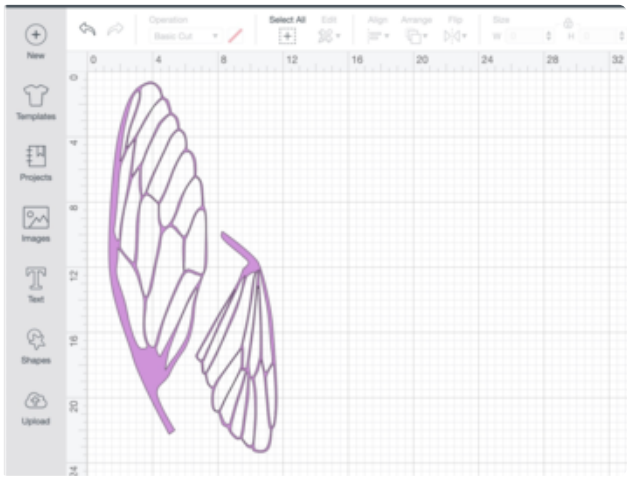
https://adafru.it/QAT

Cutting on a Cricut

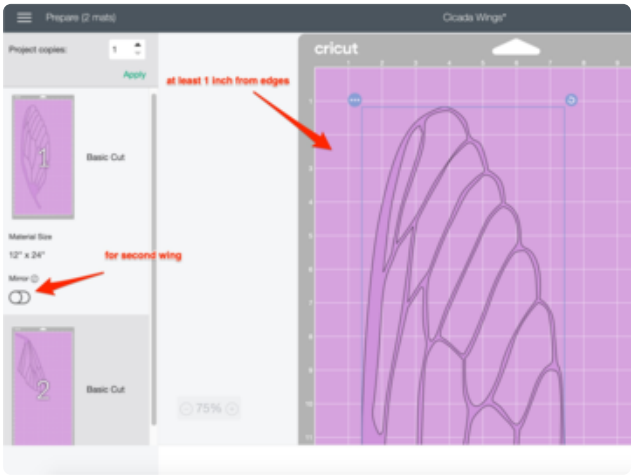
Open the Cricut Design Space app and choose "New Project". Click "Upload" and upload the wing design of your choice. Choose "Simple" on the next screen, then "Continue" on the next screen since there is no background to remove. On the third screen, select "Save as a Cut Image".

Import the uploaded images into your project. I like to make them a color other than black, so they are easier to see and work with. You'll need to resize them as well --

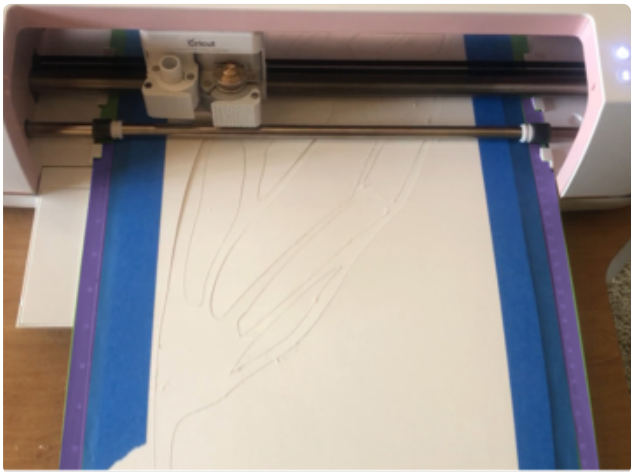
I've given you high resolution 300dpi images, since the Cricut software does a much better job with those, but that does mean you'll need to size each wing frame down.



Resize the wing files so they're at least an inch smaller than your maximum cutting area. On my 12x24 mat, my wings are no more than 11 inches wide and 23 inches tall.



Position the frames at least an inch from each edge. We're going to tape the poster board to the mat and we need to leave room for the tape.



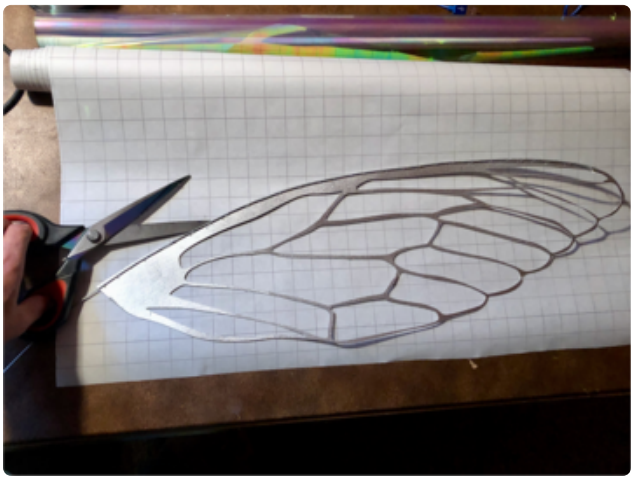
Tape your material to a strong grip cutting mat on all four sides. Press it down firmly so you get a really good grip. Using a clean strong grip mat is the best way to ensure success with your cut.

Another great tip: you can sharpen and clean your cutting blade by stabbing it into a rolled up ball of aluminum foil a bunch of times.

Now is the time to spray paint your wing frames in the color of your choice. My completed wings have large wings painted gold, medium wings painted silver, and small wings left white.

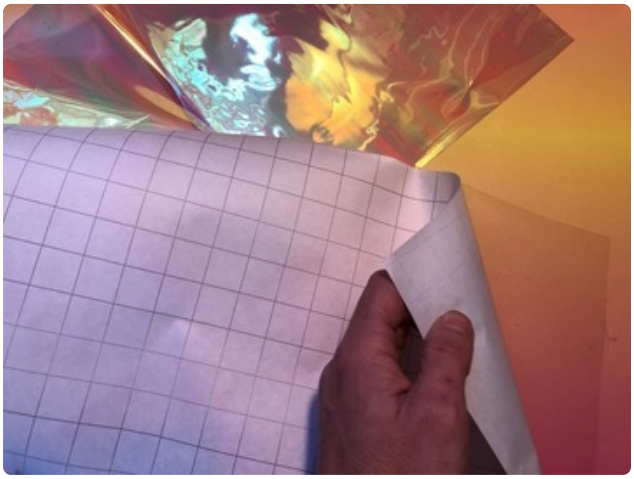
Wing Membranes

The wing membranes are made of cellophane gift wrap (from the craft store) bonded to Thermoweb heat bond vinyl. The Thermoweb is clear and gives a flexible strength, while the cellophane adds iridescence or color. Cellophane wrap comes in a lot of different colors, so you can go wild and make any color of wings you'd like.



Once your frames are dry, cut a piece of Thermoweb fusible vinyl a little larger than the wing frame. Be sure it extends past the frame on all sides.

Cut a piece of cellophane wrap about the same size. Don't worry about getting the size or shape exact yet; we'll trim it down later.



Peel the paper backing off the Thermoweb and lay it flat on the table with the sticky side up. Place the wing frame down on top of it, avoiding any wrinkles.

Place your cellophane wrap down on the table. Gently lower the wing and Thermoweb onto the cellophane layer so the sticky side connects with the cellophane. Again, try to avoid any wrinkles or bubbles. Take your time, and be sure it covers the whole frame and extends out past the edges on all sides.

The Thermoweb's strong bonding property is activated by heat. I experimented with different heat sources, and had success using an iron and also using a heat gun to gently heat the Thermoweb until it bonded to the cellophane and wing frame. However, I had the most success running the whole thing through a standard laminating machine on the 5 mil setting. The machine applied just the right amount of heat, evenly, while pressing and rolling out any wrinkles or bubbles that slipped in.

Tips for Success

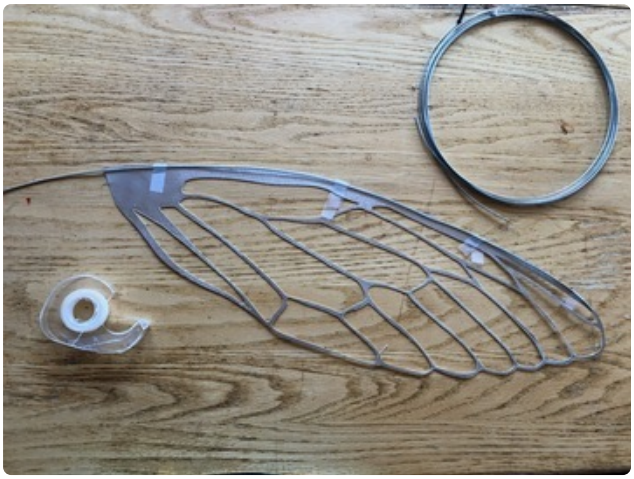
- Trim the cellophane and Thermoweb fairly close to the wing frames before laminating, or the machine might jam. It needs something stiff to grab on to.
- For a more weathered look, run the wings through the machine twice
- Remember you're making a left and a right wing. The wings will look slightly different from the front and back, so be sure to sandwich the wings in reverse order for the second side.

Once your Thermoweb and cellophane have bonded, trim the edges of the wing with a sharp knife or a heat tool. Leave about 1/8" of material around all the edges of your wing frames to keep it from separating.

Wire Supports

Adding a support wire along the top of the wing frame will stiffen the wings and make them posable. I used 16g steel wire from the hardware store.

Note: in the photos below, I'm attaching the wires before adding the membranes. However, in the process of building my final set of wings, I had a lot more success making the membranes first, then attaching the wires at the end. It was much harder to get the membranes smooth and perfect with the wire already attached.



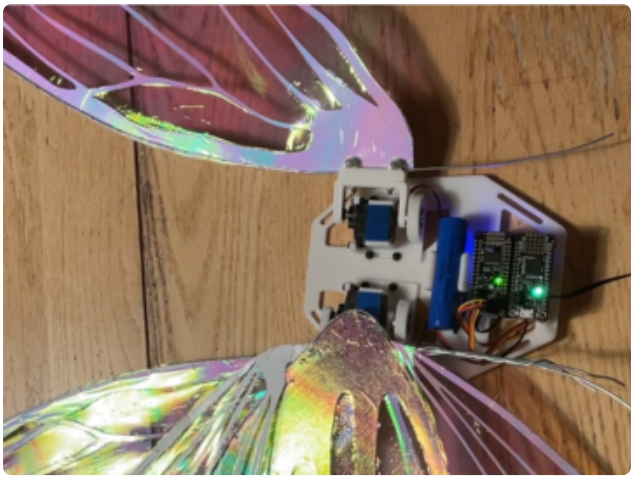
Bend the wire so that it fits neatly along the top of your wing frame. Use tape to hold it in place. Leave 6-8 extra inches of wire at the base where it will attach to the backplate.

Thread a needle with clear monofilament (fishing line). You can find this at an outdoor store, most hardware stores, and many craft stores.

Sew the wire along the edge of the wing frame. This wire will take a lot of abuse, so stitch it securely. I placed one stitch every 3/4" or so and knotted each stitch as I went.

Be sure to poke your needle through the poster board part of the frame and not through the membranes, which are delicate and will tear if you pierce them.

Attaching To the Backplate



Insert your front-most wing into the wing mount and mark where the screw holes go. Poke through the holes with something sharp and insert two M3 15mm screws, and tighten down with their corresponding nuts.

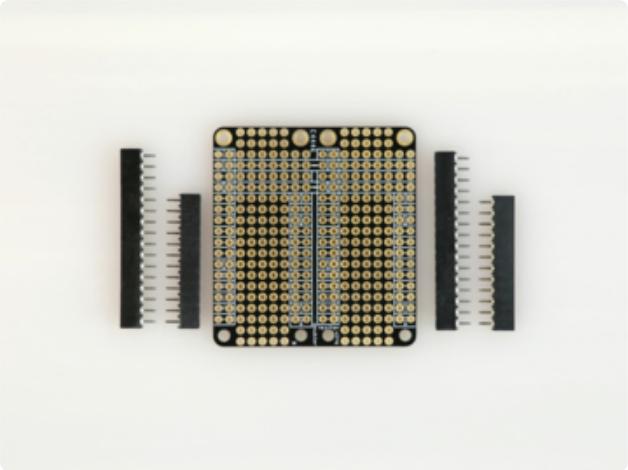
The wire along the top edge will fit right into the mount giving the wing stability.

Add any additional wing sections by sewing them with monofilament line to the mounted wing. Twist all the extending wires together to hold all the wing sections together as a unit. The wire will give strength and stability, and once you're sure everything is secure, you can bend the different wing sections out to varying degrees for a beautiful organic look.

Decorate your wings with lace, metal findings, jewels, glitter, or whatever makes your heart sing.

Sew elastic straps through the strap holes in the back mounting plate to fit your shoulders. You can use clear bra straps (available online or from the fabric store) if you want nearly invisible, adjustable straps for your wings.

Doubler Headers



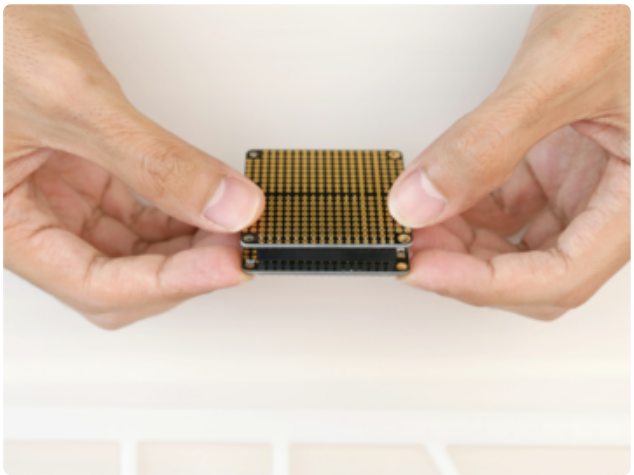
Headers for Doubler FeatherWing

Use 2x 12-pin and 16-pin short socket headers.

Installing Headers

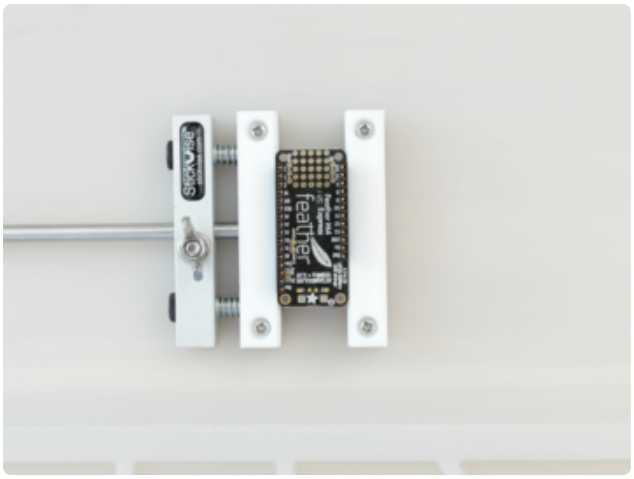
Use the headers on the Feather M4 to help install the socket headers to the Doubler FeatherWing.

Carefully fit the socket headers onto the male headers.



Install Doubler FeatherWing

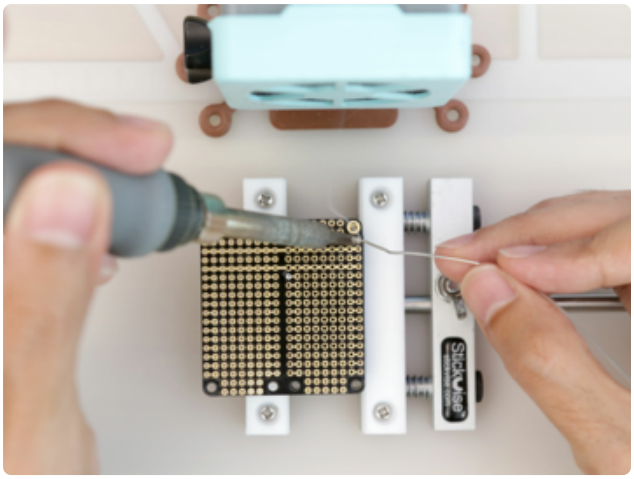
Place the Doubler FeatherWing over the pins of the socket headers. They should be fitted through the pins.



Secure PCB for Soldering

Use a PCB vise to secure the Feather with the socket headers installed.

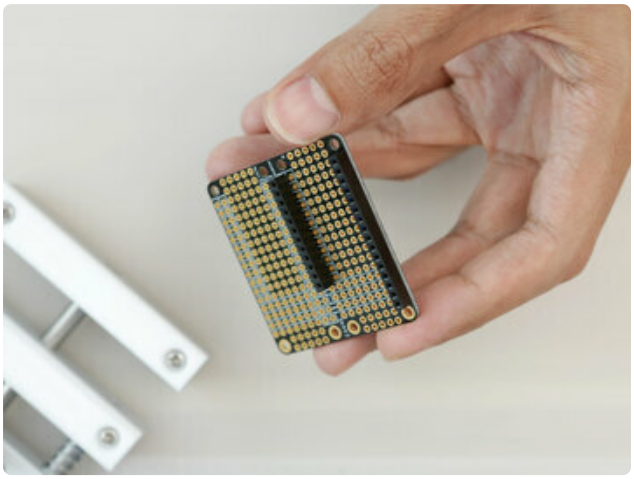
The Feather is secured face down with the pins from the socket headers facing up.



Solder Headers

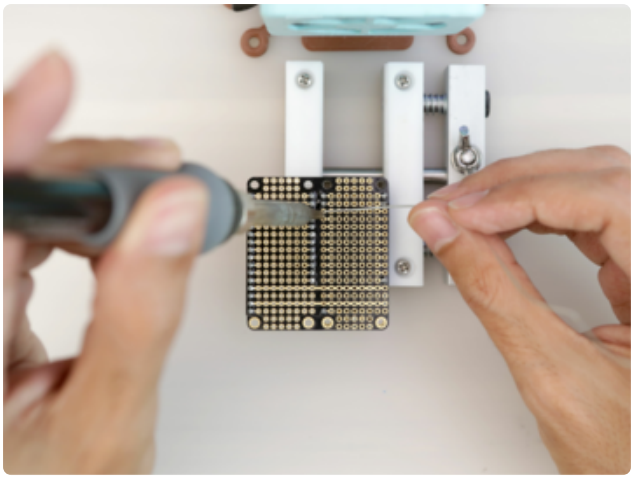
Place the Doubler FeatherWing over the two rows of pins. The silkscreen should be facing down.

Solder the 12-pin and 16-pin socket headers to the pins on the Doubler FeatherWing.



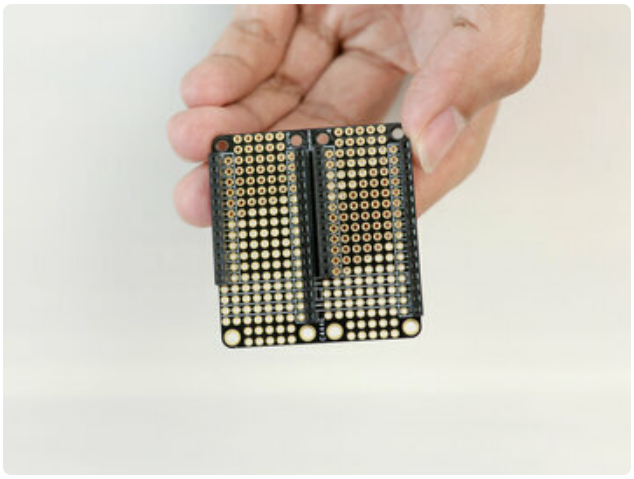
Soldered Set of Headers

Check the solder joints are solid and each of the pins has been fully soldered.



Solder Second Set

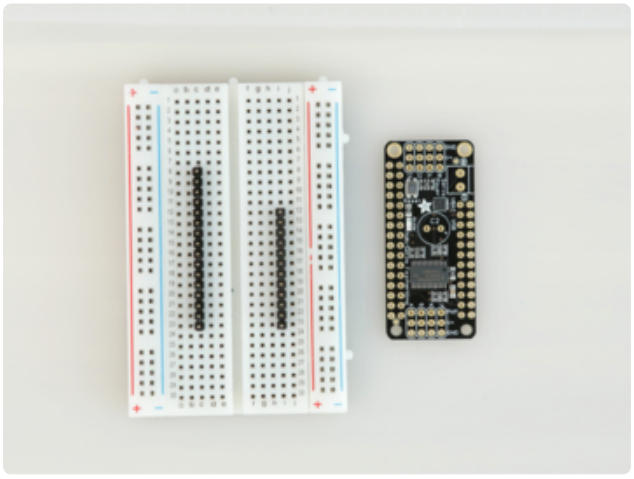
Repeat this process for the second set of 12-pin and 16-pin headers.



Dual Headers Soldered

Double check the the two sets of socket headers has been fully soldered.

Servo FeatherWing Headers



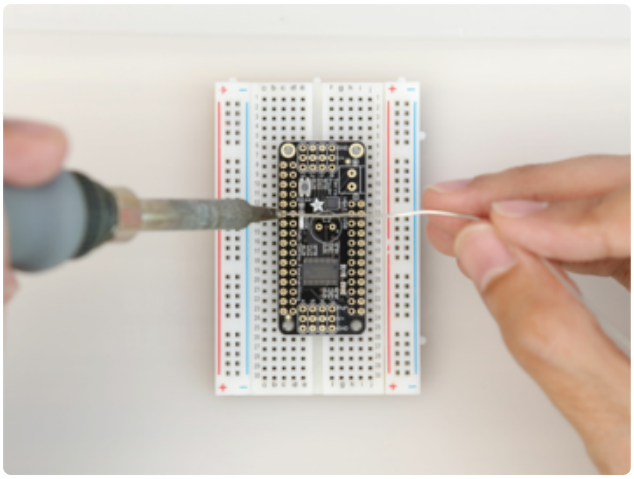
Install Headers

A set of 12-pin and 16-pin male header pins are soldered to the servo FeatherWing.

Use a breadboard to help install the headers.

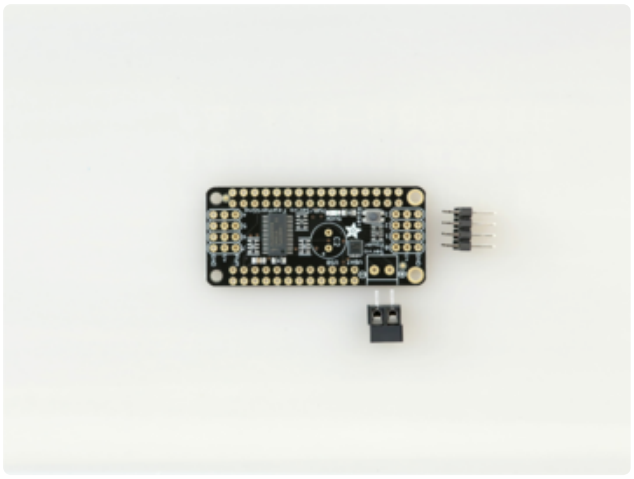
Place a 12-pin and 16-pin headers onto the breadboard.

Fit the servo FeatherWing over the twoheader pins.



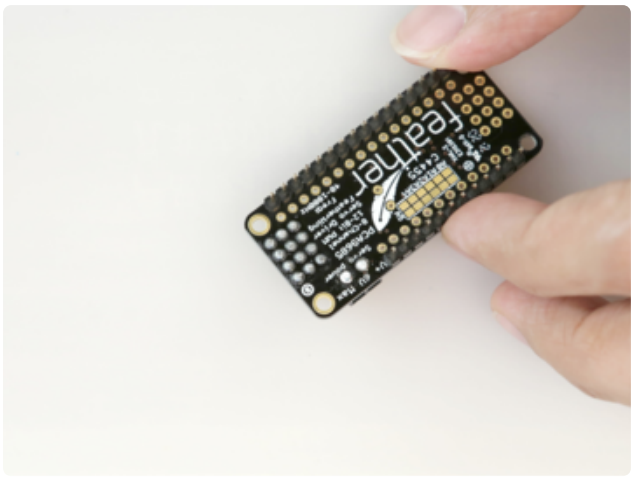
Soldering Headers

Solder all of the pins on the Servo FeatherWing.



Block Terminals & Headers

The screw-block terminal and 3x3 header pins that came with the Servo FeatherWing will need to be soldered.

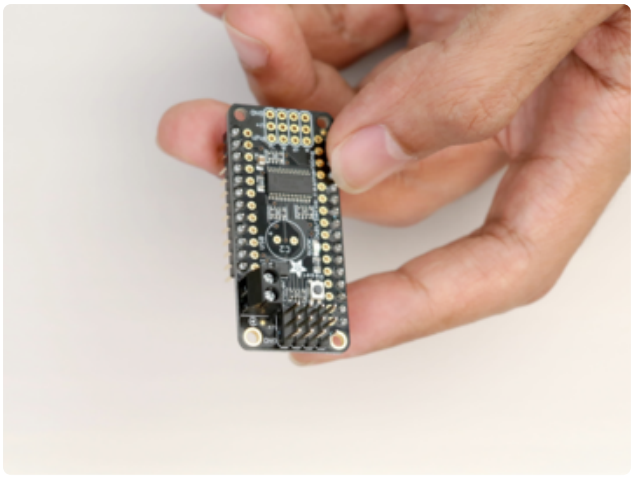


Solder Terminal and Header

Install the screw-block terminal and 3x4 headers to the Servo FeatherWing.

Use mounting tack to temporarily secure the screw-block terminal and headers to the Servo FeatherWing.

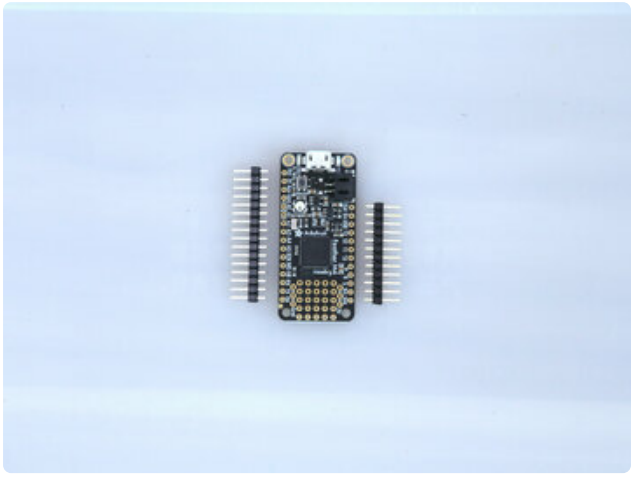
Solder all of the pins on the screw-block terminal and headers.



Soldered ServoWing Headers

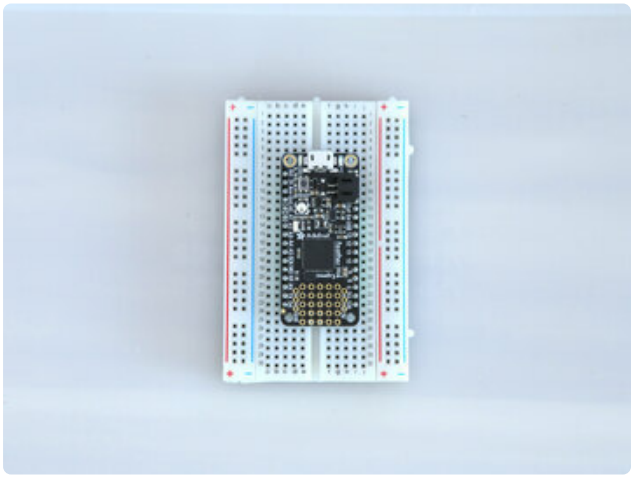
Double check the screw-block terminal and 3x3 headers have been fully soldered.

Feather Headers



Headers for Feather

Use a set of 12-pin and 16-pin male header pins on the Feather M4.



Solder Headers

Use a breadboard to help solder up the headers to the pins on the Feather M4.

Install the 12-pin and 16-pin headers onto the breadboard with proper spacing for the Feather M4.

Place the Feather M4 over the two headers.

Solder all of the pins on the Feather M4.

Doubler FeatherWing

The Feather M4 and Servo FeatherWing are press fitted onto the socket headers on the Doubler FeatherWing.

Doubler FeatherWing Installed

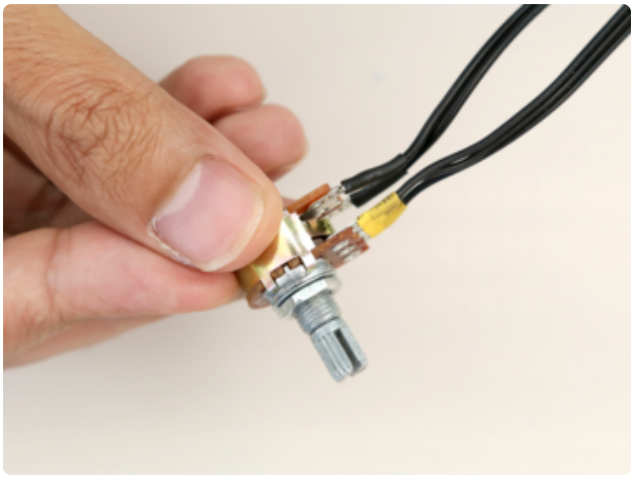
Install the Feather M4 and Servo FeatherWing onto the Doubler FeatherWing.

Pot Switch Wiring

Pot Switch Cables

The potentiometer with switch uses two long cables.

2-pin JST cable – 10cm long
3-pin JST cable – 10cm long



Solder Cables to Pot Switch

Solder the 2-pin JST cable to the two switch pins on the potentiometer.

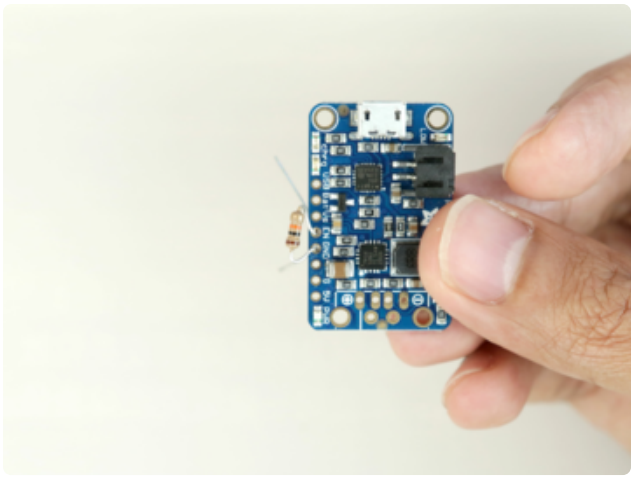
Solder the 3-pin JST cable to the voltage, ground and signal pins on the potentiometer.

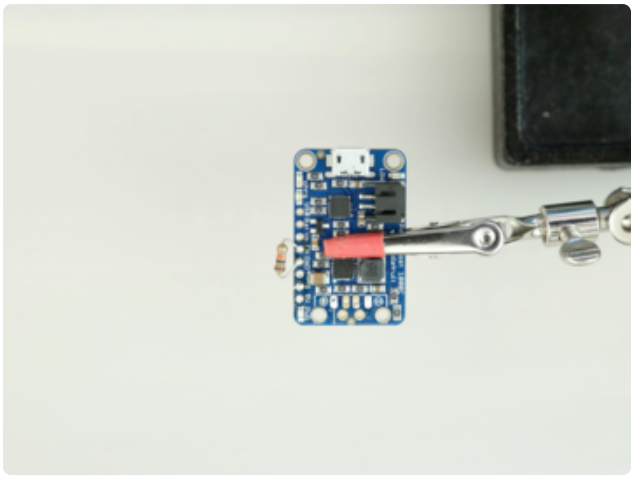
PowerBoost 1000C Wiring

PowerBoost 1000C Resistor

In order to make the potentiometer switch work with the PowerBoost, a 10k resistor is used.

Get the 10K resistor ready to install onto the PowerBoost 1000C.





Install 10K Resistor

Fit the legs of the resistor through the EN and GND pins on the PowerBoost 1000C.

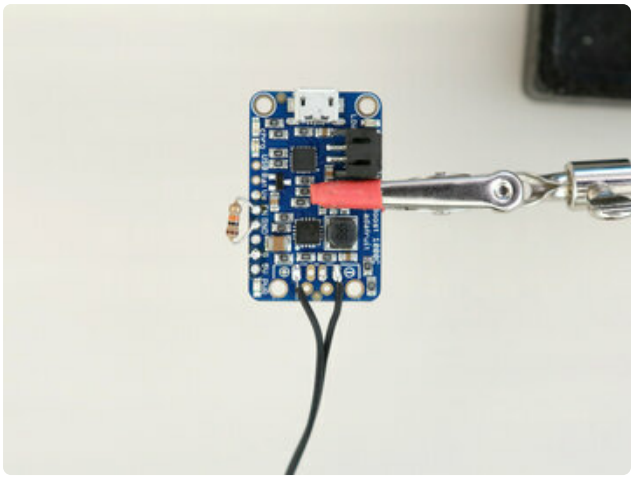
Secure the PowerBoost 100C to a PCB vise or set of third helping hands.

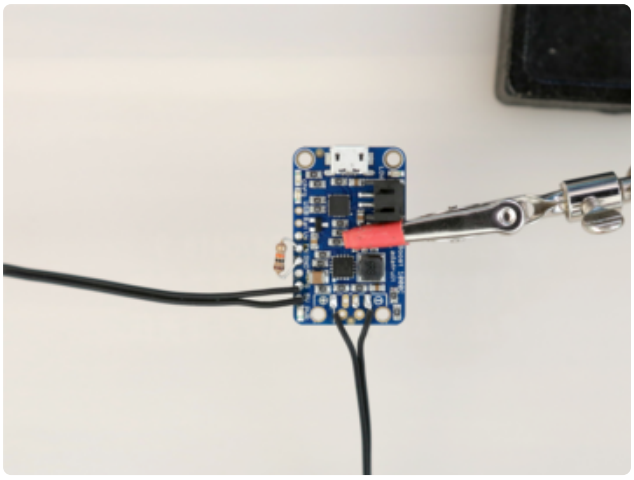
Solder the resistor to the EN and GND pins on the PowerBoost 1000C.

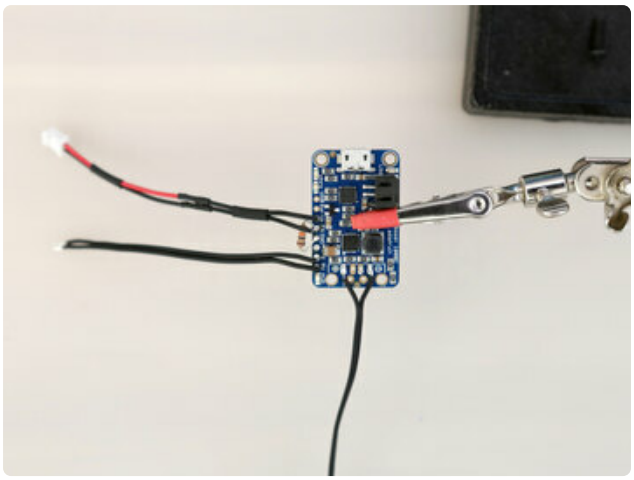
Cables for PowerBoost 1000C

Use the following cables for wiring up the PowerBoost 1000C.

1x 2-pin JST cable – 5cm long
2x 2-wire cable – 5cm long





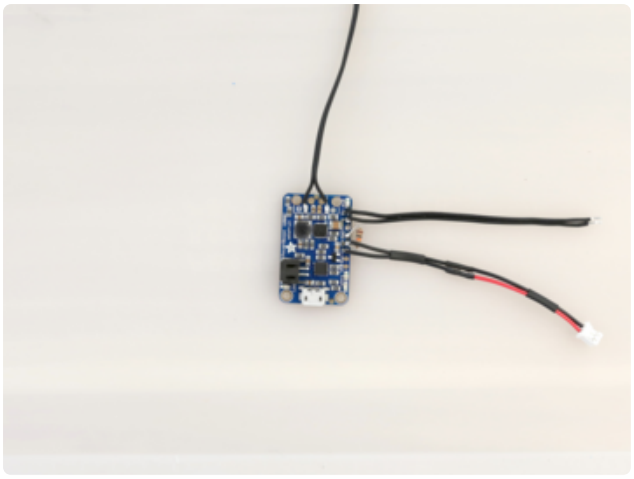


Solder Cables to PowerBoost 1000C

Solder one of the 2-wire cables to the 5V and GND pins on the PowerBoost 1000C.

Solder the second 2-wire cables to the voltage and ground pins on the PowerBoost 1000C.

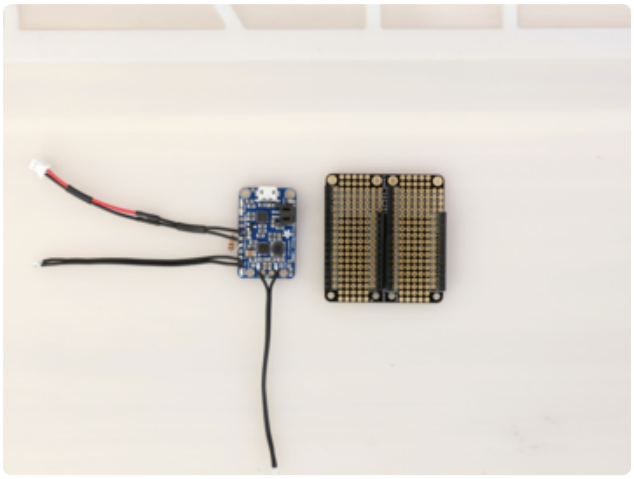
Solder the 2-pin JST cable to the EN and VS pins on the PowerBoost 1000C.



Wired PowerBoost 1000C

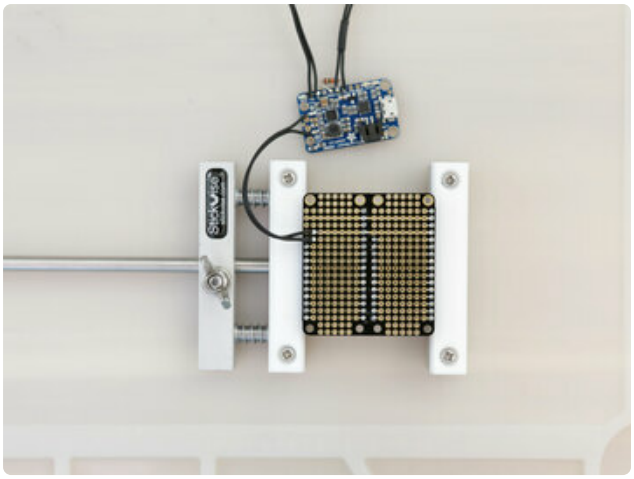
Double check all of the wires have been soldered to the PowerBoost 1000C.

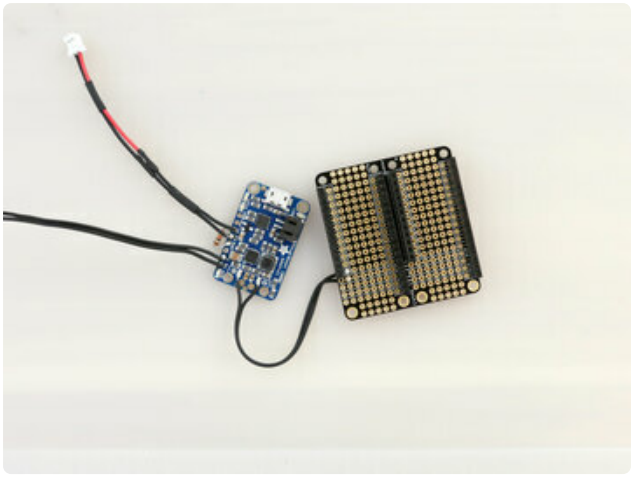
Doubler Wiring



Connect PowerBoost to Doubler

The power cable from the PowerBoost 1000C will need to be soldered to the Doubler FeatherWing.

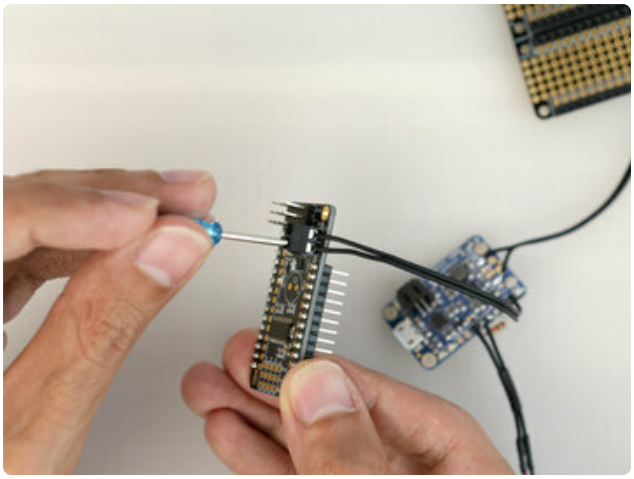


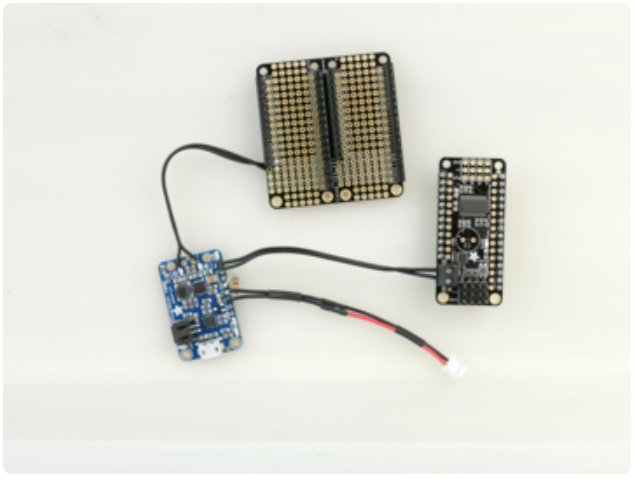


Wire PowerBoost 1000C to Doubler

Solder the 5V wire from the PowerBoost 1000C to the VBAT pin on the Doubler FeatherWing

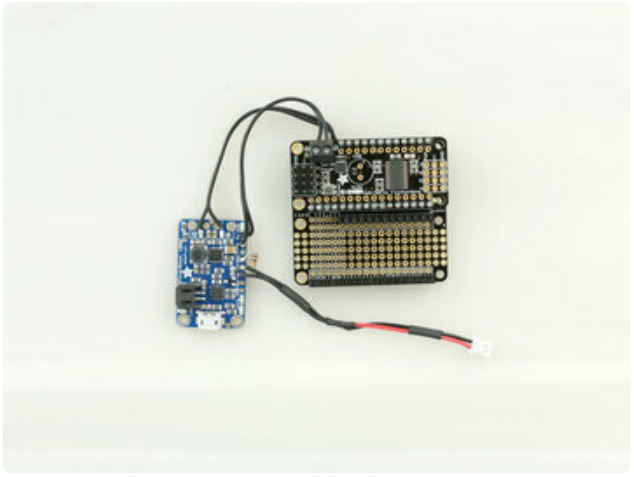
Solder the GND wire from the PowerBoost 1000C to the GND pin on the Doubler FeatherWing.





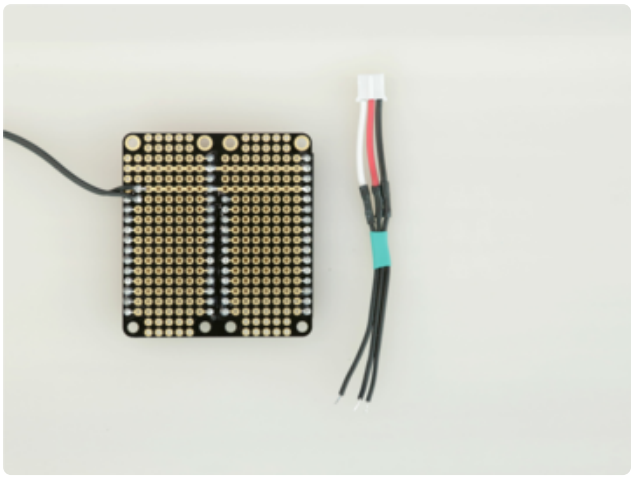
Connect PowerBoost to ServoWing

Hook up the remaining voltage and ground wires from the PowerBoost 1000C to the voltage and ground pins on the screw-block terminal on the ServoWing FeatherWing.



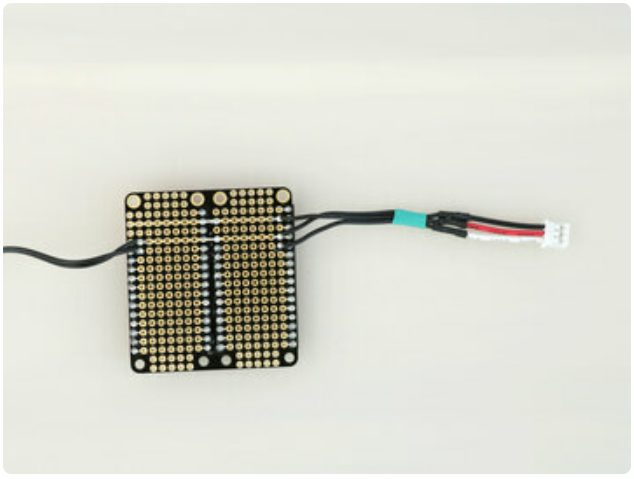
Install Feathers to Doubler

Fit the Feather M4 and Servo FeatherWing onto the Doubler FeatherWing.

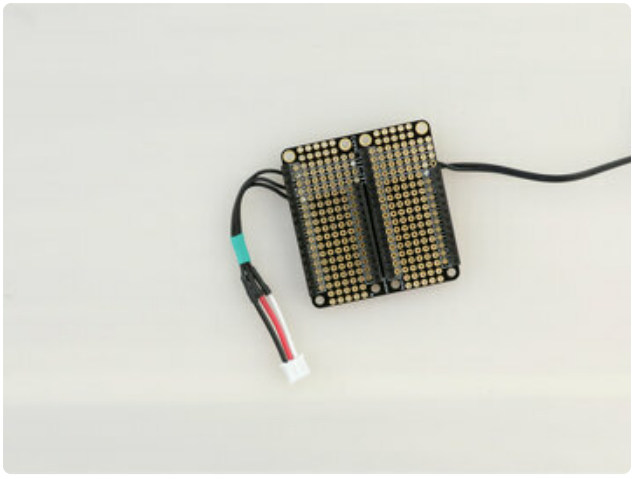


3-pin JST cable

A 3-pin JST cable is soldered to the Doubler FeatherWing for connecting the potentiometer to adjust the speed.

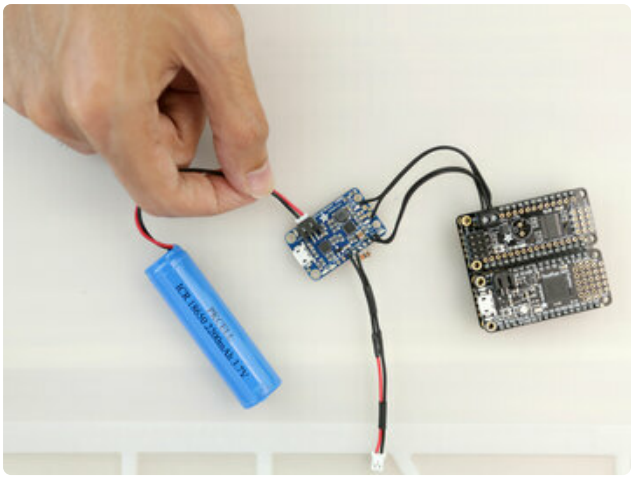


Solder the red wire to 3V pin, black wire to a ground pin and white wire to the A0 pin on the Doubler FeatherWing.



Soldered 3-pin JST cable

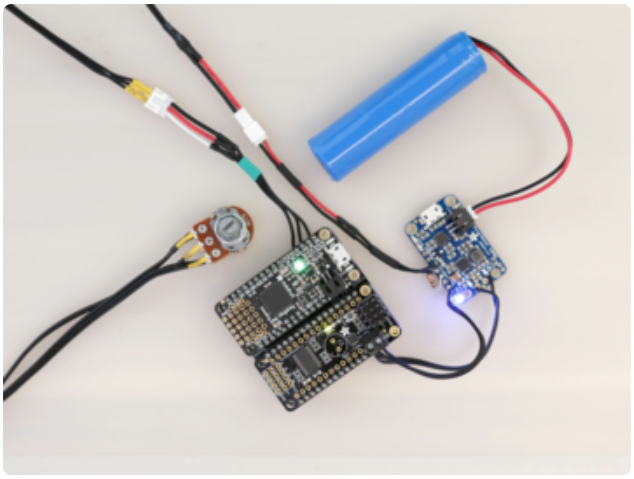
Double check the wires from the 3-pin JST cable has been fully soldered.



Connect Battery to PowerBoost for Testing

Plug in the cable from the battery to the JST port on the PowerBoost 1000C.

The PowerBoost 1000C shall remain off when the battery is connected.



Test Circuit

Connect the potentiometer switch to the PowerBoost 1000C.

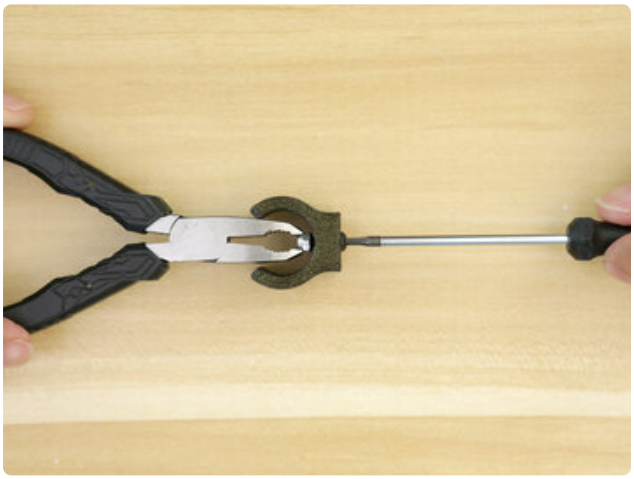
Use the switch on the potentiometer to turn on the PowerBoost 1000C.

Battery Holder

Hardware for Battery Holder

Use screws and lock nuts to secure the battery holder to the back plate.

M3 x 8mm screws
M3 lock nuts with nylon insert



Installing Hex Nuts

Insert an M3 x 8mm long screw through one of the holes on the battery holder.

Fasten an M3 lock nut onto the thread of the screws.

Use pliers to grip the lock nut while fastening the screw.

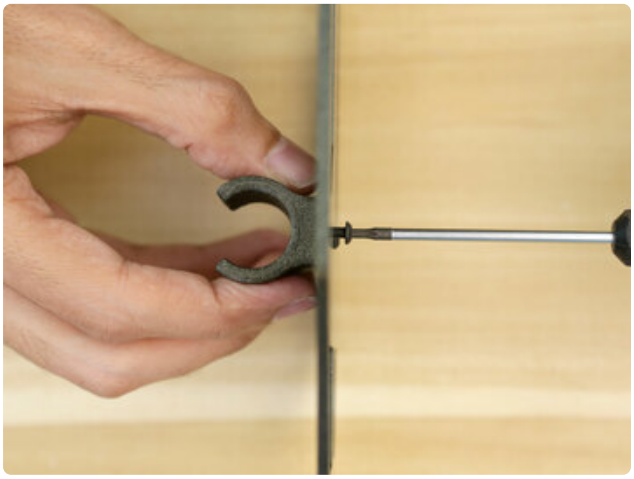
Fasten the M3 screw to force the M3 lock nut into the cavity.

Installed Hex Nuts

Repeat this process for the second lock nut.

The two nuts should be fully pressed into the cavities on the battery holder.

Remove the screws from the lock nuts to proceed.



Secure Battery Holder

Insert an M3 screw through the holes on the back plate. Reference the image below for the correct mounting holes.

Installed Battery Holder

Fasten the two M3 screws to secure the battery holder to the back plate.

Back Plate Assembly

Hardware for Servo Mounts

Use the following hardware to attach the servo mounts to the back plate.

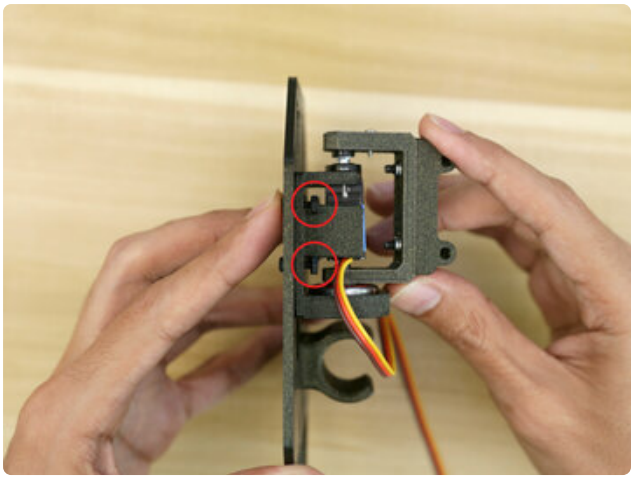
8x M2.5 x 10mm
8x M2.5 hex nuts

Install Servo Mounts

Insert one of the M2.5 x 10mm long screws through a mounting hole on the back plate.

Place the servo mount over the mounting hole and line it up with the slotted tabs.

Ensure the servo mount is in the correct orientation – Reference the image for best placement.

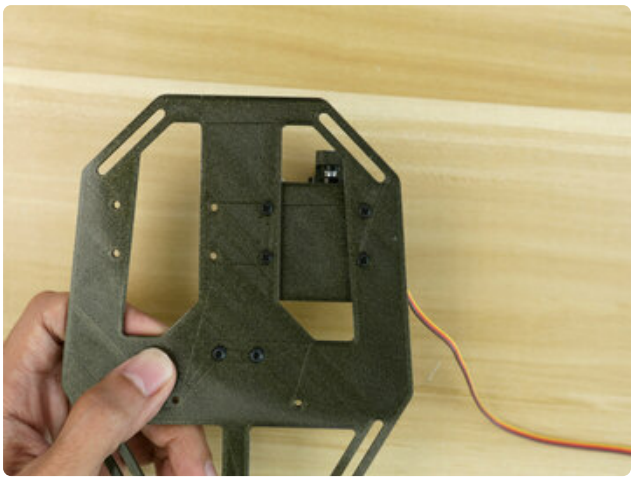


Secure Servo Mounts

While holding the servo mount in place, insert and fasten an M2.5 hex nuts onto the thread of the screw.

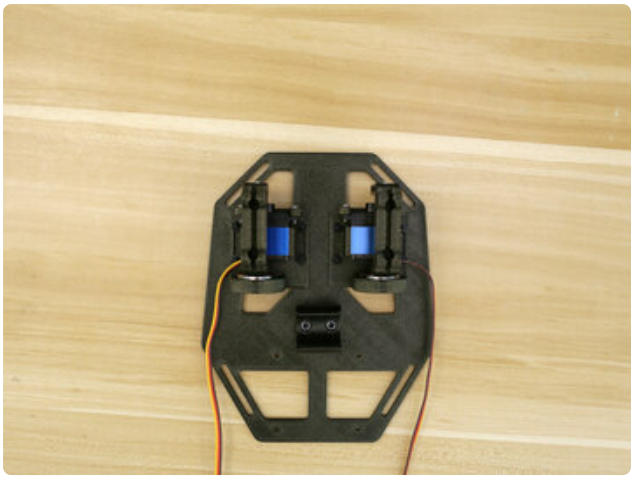
Finger tighten the hex nuts and proceed to install all four screws and nuts.

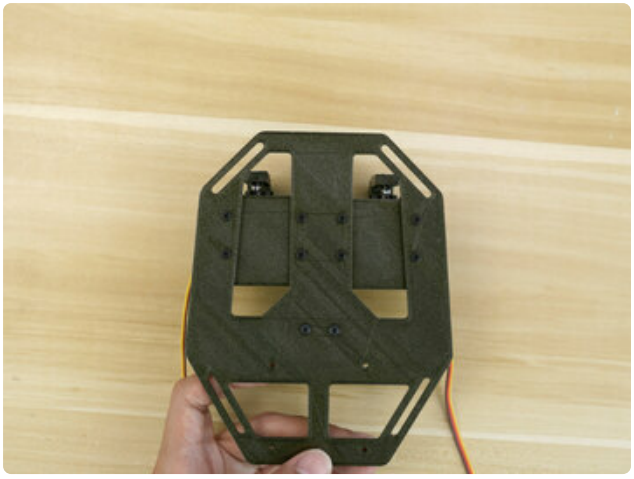
Use a screw driver to tighten fasten the hex nuts to the screws.



Secured Servo Mount

Ensure the heads of the screws are facing towards the wearers back. This minimizes discomfort on the wearer.



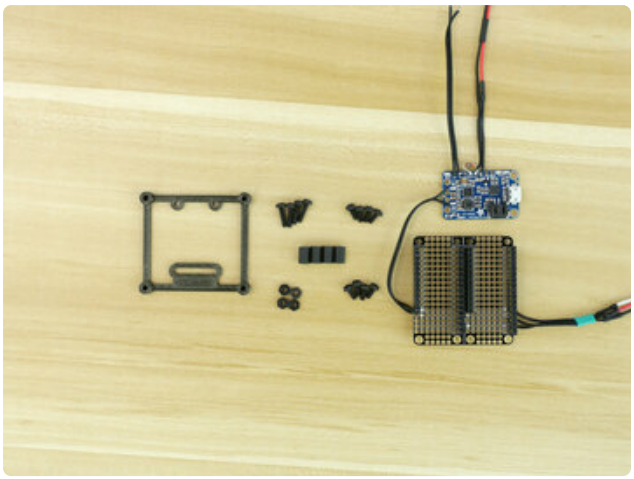


Secured Servos

Repeat the installation process for the second servo.

Double check the orientation of the two servos are correct and mirrored.

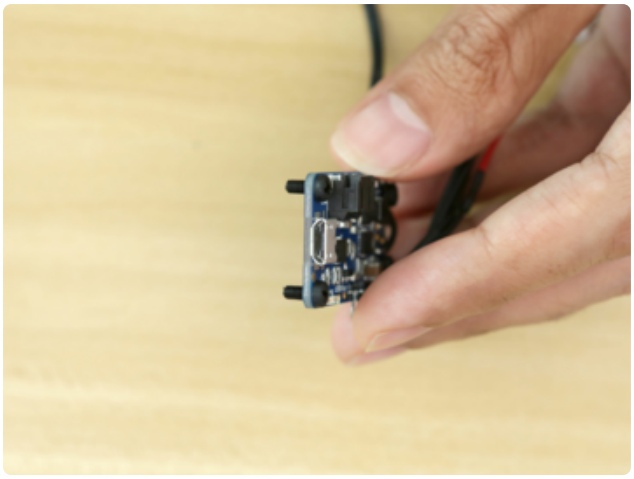
Ensure all of the hex nuts are tightly fastened to each of the screws.

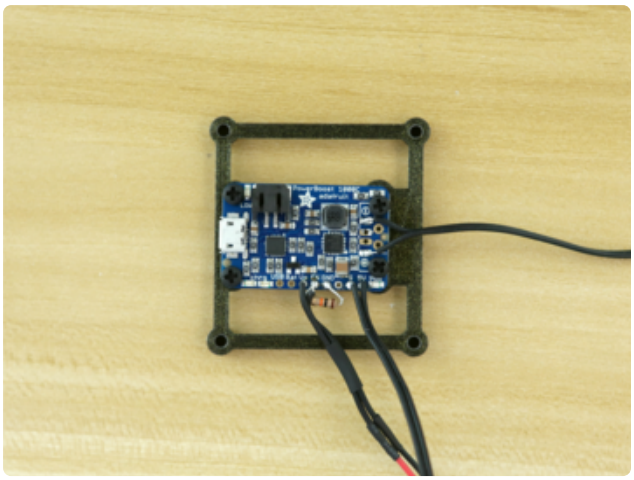


Hardware for PCB Mount

Use the following hardware for the PCB Mount.

4x M2.5 x 6mm FF standoffs
4x M2.5 x 12mm screws
8x M2.5 x 6mm screws
4x M2.5 hex nuts





Secure PowerBoost to PCB Mount

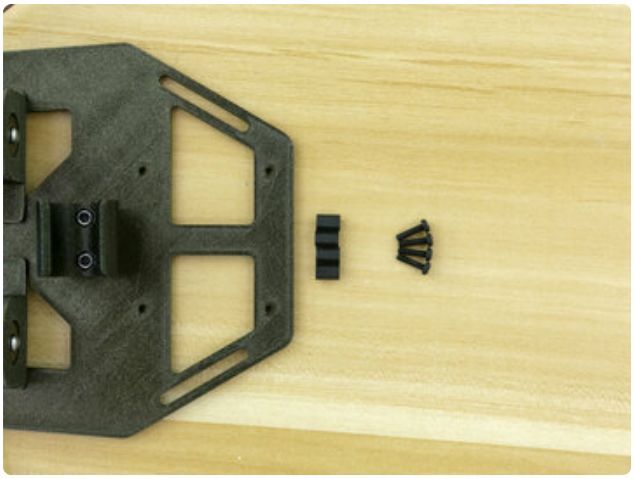
Insert 2x M2.5 x 6mm screws through the mounting holes on the PowerBoost 1000C.

Place the PowerBoost 100C over the center mounting holes on the PCB Mount.

Insert and fasten 2x M2.5 hex nuts onto the threads of the screws on the bottom of the PCB.

Optionally install an additional 2x M2.5 x 6mm screws to the mounting holes on the back end of the PowerBoost 100C.

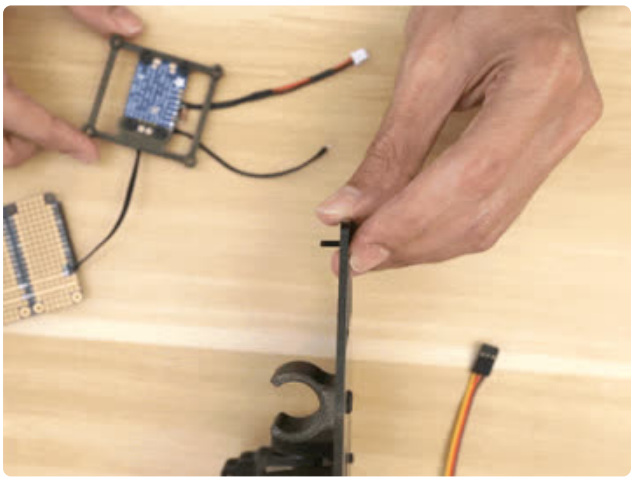
The mounting holes on the back end of the PowerBoost 1000C will need to be tapped in order to install M2.5 screws.



Hardware for PCB Mount

Use the following hardware to secure the PCB mount to the back plate.

4x M2.5 x 10mm screws
4x M2.5 x 6mm FF standoffs

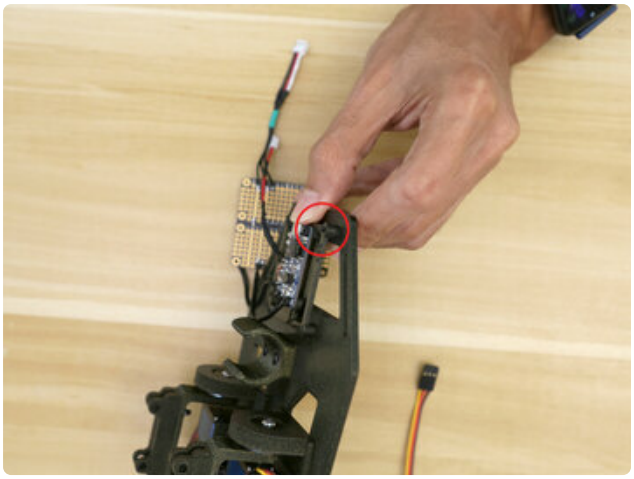


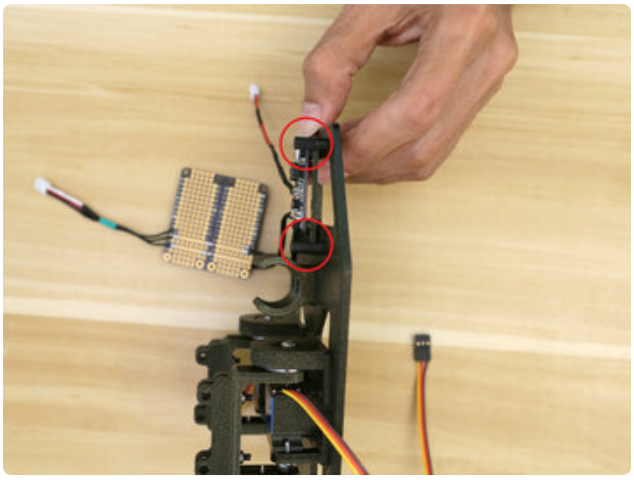
Install PCB Mount to Back Plate

Line up the mounting holes on the PCB mount with the mounting holes on the back plate.

Insert an M2.5 x 10mm long screws through one of the mounting holes on the back plate.

Place the PCB mount onto the thread of the screw.

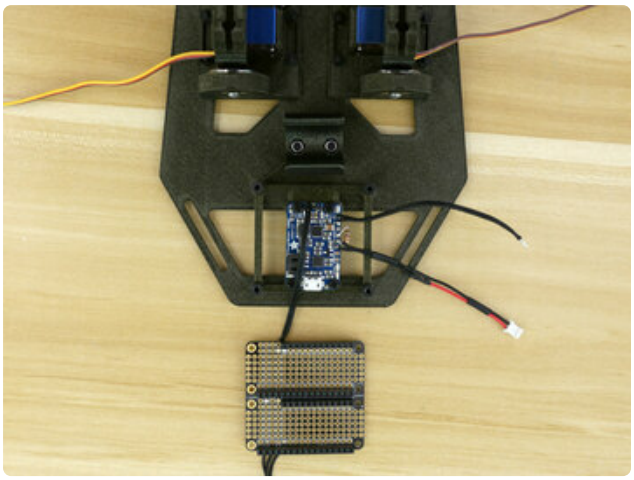




Install PCB Standoffs

While holding PCB mount in place install an M2.5 x 6mm FF standoff on to the thread of the screw.

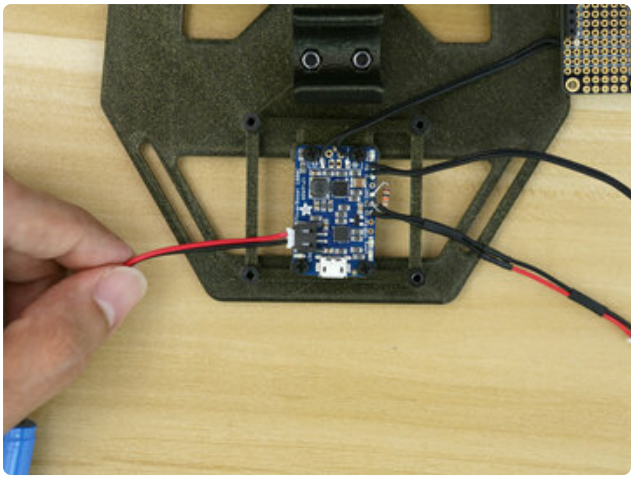
Repeat this process for the remaining standoffs and screws.



Secured PCB Mount

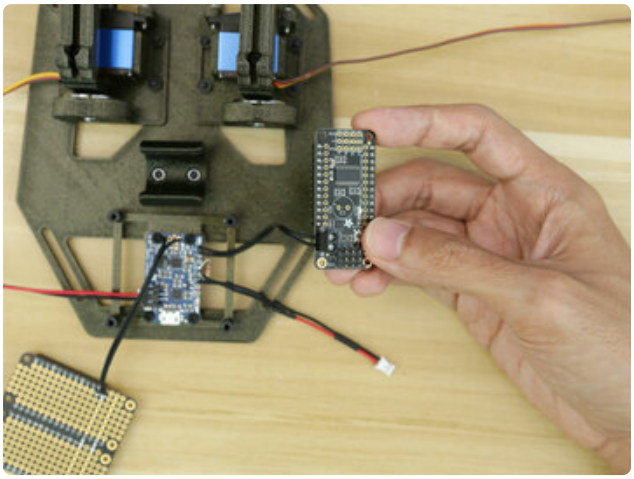
Check the standoffs on the PCB mount are tightly fastened and secured

The USB port from the PowerBoost 1000C should be pointing down to allow access for recharging the battery.



Reconnect Battery to PowerBoost

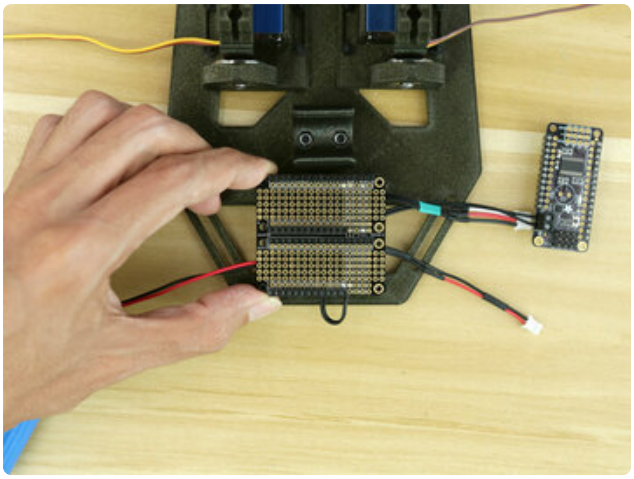
Plug in the battery to the JST port on the PowerBoost 1000C.

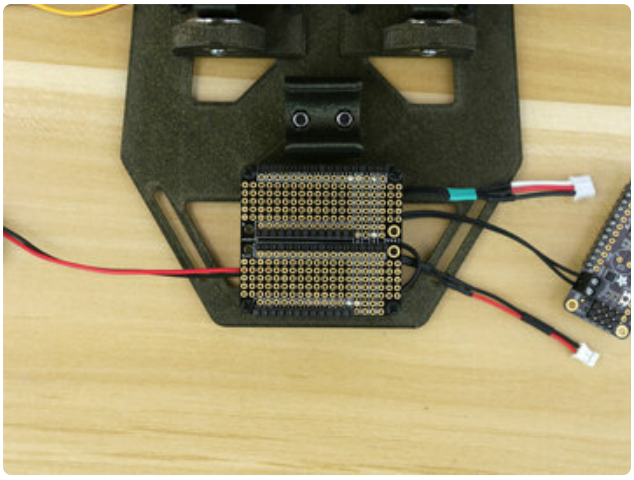


Reconnect PowerBoost to Servo FeatherWing

Insert the voltage and ground wires from the PowerBoost 1000C to the voltage and ground pins on the Servo FeatherWing screw block terminal.

Use screw driver to fasten and secure the wires to the screw block terminal.



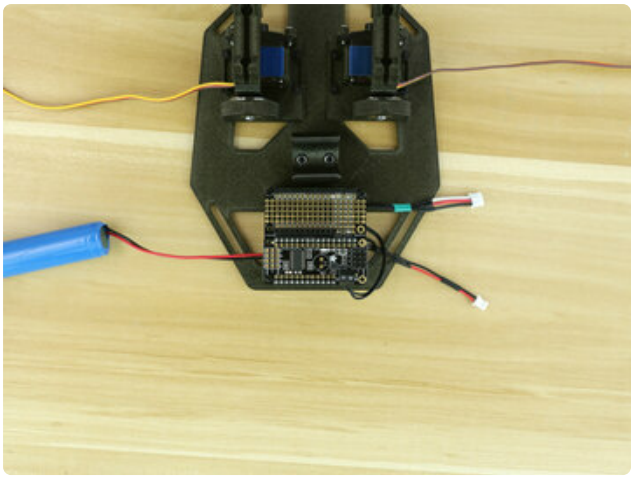


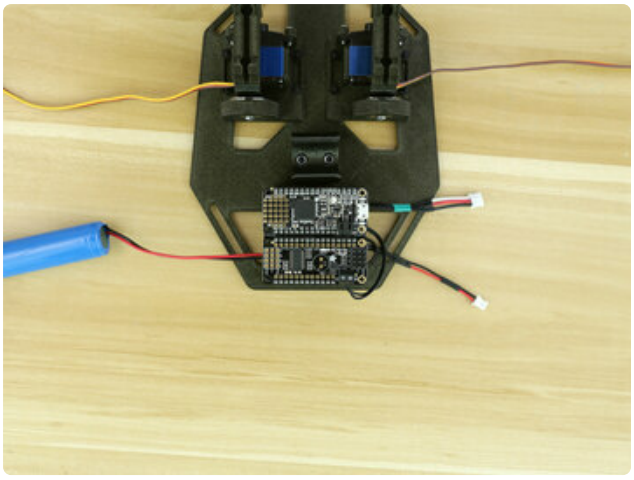
Install Doubler FeatherWing to PCB Mount

Place the Doubler FeatherWing onto the PCB Mount.

Line up the mounting holes on the Doubler FeatherWing with the standoffs on the PCB Mount.

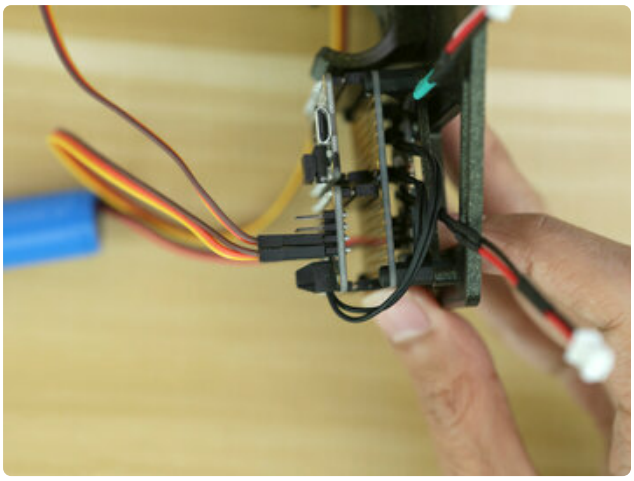
Insert and fasten M2.5 x 6mm screws to secure the Doubler FeatherWing to the PCB Mount.





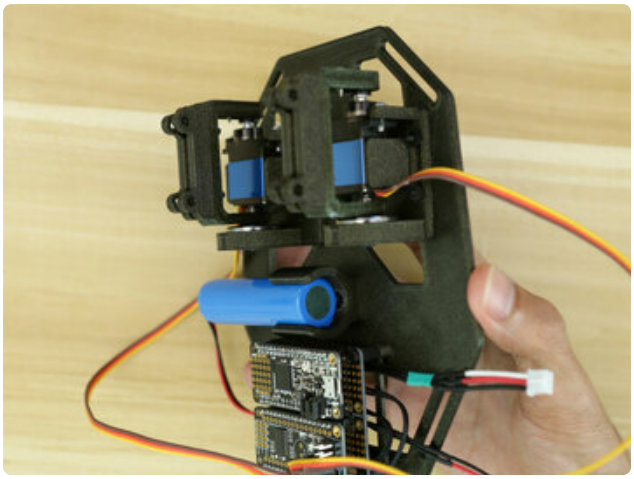
Install Feather and Servo FeatherWing

Install the Feather M4 and Servo FeatherWing to the Doubler FeatherWing.



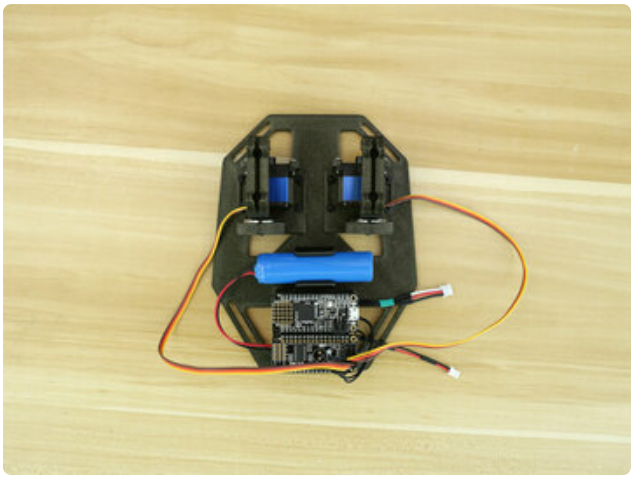
Connect Servos to Servo FeatherWing

Plug in the connectors from the servos to channel 0 and 1 on the Servo FeatherWing.

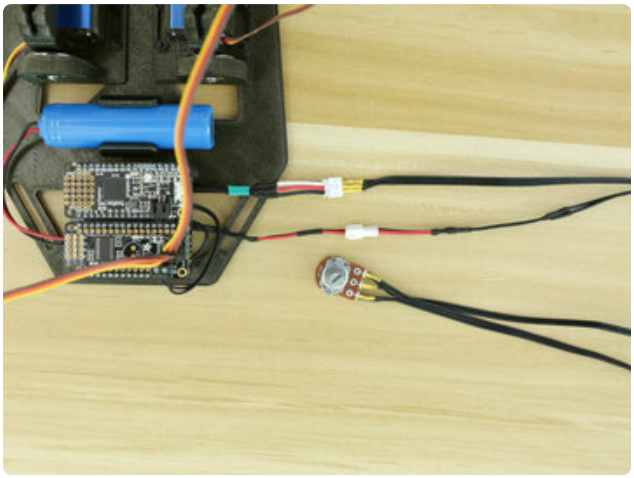


Install Battery to Back Plate

Slide the 2200mAh battery into the battery holder through the side of the clip.

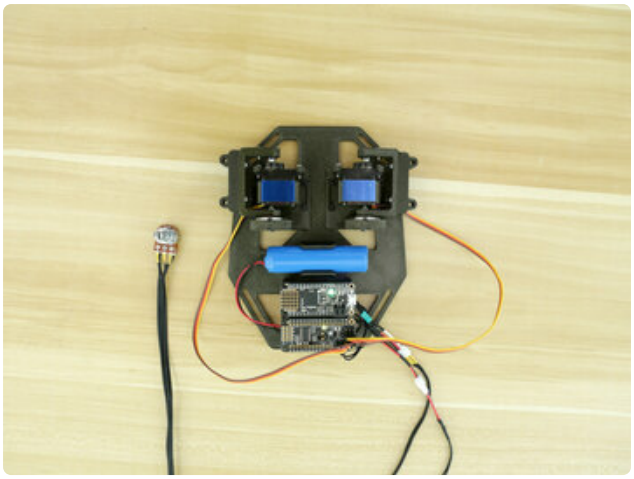


Adjust the battery so it's centered with the battery holder and back plate.



Connect Potentiometer with Switch

Plug in the 2-pin and 3-pin JST connectors from the potentiometer with switch to the JST connectors on the Doubler FeatherWing.



Final Build Circuit Test

Use the switch from the potentiometer to turn on and test the circuit.

Wear Them

We used stretchy elastic to make straps for my wings so they're easy to get on and off.

The servos will wear out and break if the wings get moved too much while they're powered off, so be careful with them when they're not in use. We find that storing them hung on the wall is a great way to display the artwork and keep them safe from getting crushed or moved too much.

If you've made big wings like these, you may find it's hard to get through doorways or maneuver in crowded environments when they're in the "open" position. You can use your potentiometer and switch to move them to the "closed" position and turn them off, and they'll stay in place there until you're ready to start flapping again.

We mounted my potentiometer in a wrist gauntlet so it's always within reach and won't get tangled up in my costume. With the wires threaded through the elastic strap, they stay tucked up against one's arm. Make sure to have several inches of ease in the wire, so you can't accidentally stretch your arm out and break a wire!