

Delta Board Manufacturing

4-motor shield and 12-motor shield

Overview

- How to order the shields online with provided design files
- How to order parts from international suppliers (digikey and adafruit)
- Tools needed to complete manufacturing
- Getting Started guide
- Common debug steps

Parts

- Stacking headers:
<https://www.adafruit.com/product/2830>
- Female headers:
<https://www.adafruit.com/product/2886>
- Power jack:
<https://www.adafruit.com/product/373>
- Male headers:
<https://www.adafruit.com/product/392>
- ADC:
<https://www.adafruit.com/product/1083>
- Motor controller:
<https://www.adafruit.com/product/2927>
- Feather M0:
<https://www.adafruit.com/product/2772>

Parts

- 220 nF capacitors
- 12 V power supply
- USB cable (USB A to Micro-B)

Tools

Soldering iron

Power supply (12V)

Flux

Microusb cable

Tweezers

Third hand

PCBWay - Order Boards

1. Download zip files on Drive
 - a. Single Shield (4 motors) or
 - b. Triple Shield (12 motors)
2. Go to pcbway.com
3. Select PCB Instant Quote
 - a. Select Quick-Order PCB
 - b. Select gerber file
 - c. Upload zip file
 - i. One at a time, of the size you want.

The screenshot shows the PCBWay homepage with a navigation bar at the top. The main content area features a large banner for SMT orders and a step-by-step process for ordering. The 'PCB Instant Quote' section is highlighted with an orange box. Below it, the 'Quick-order PCB' button is also highlighted with an orange box.

The screenshot shows the 'PCB Specification Selection' page. It includes fields for board type, size, quantity, and layers. A 'Quick-order PCB' button is highlighted with an orange box. To the right, there's a promotional banner for PCB Assembly and Free Shipping.

The screenshot shows the 'PCB Specification Selection' page again, but with a larger focus on the 'Add Gerber File' button, which is highlighted with an orange box. Below it, there are options for board type and panel design.

Single Shield Order Example

It will detect the board size.

Match selections to options highlighted here except for Quantity.

Be sure to select how many boards you want. Keep in mind that shipping is the highest cost here...and always order extra boards in case you make soldering mistakes.

You can select calculate to see the price differences depending on quantity.

PCB Specification Selection [Return to Standard PCB](#) [Online Gerber Viewer](#)

PCB file (optional): [Project Outputs for Delta Single Shield.zip \(17 kb\)](#) 100% Success
Detected 2 layers board of 25.4 x 61mm(1.00 x 2.40 inches).
You have uploaded the file successfully and please check the parameters below. We'll continue to check all the individual layers to make sure that they're correct.

[Back to Upload File](#)

Board type: Single pieces Panel by Customer Panel by PCBWay

Different Design in Panel: 1 2 3 4 5 6 e.g.

* Size (single): 25.4 X 61 mm inch↔mm

* Quantity (single): 5 pcs

Layers: 1 Layer 2 Layers 4 Layers 6 Layers 8 Layers 10 Layers

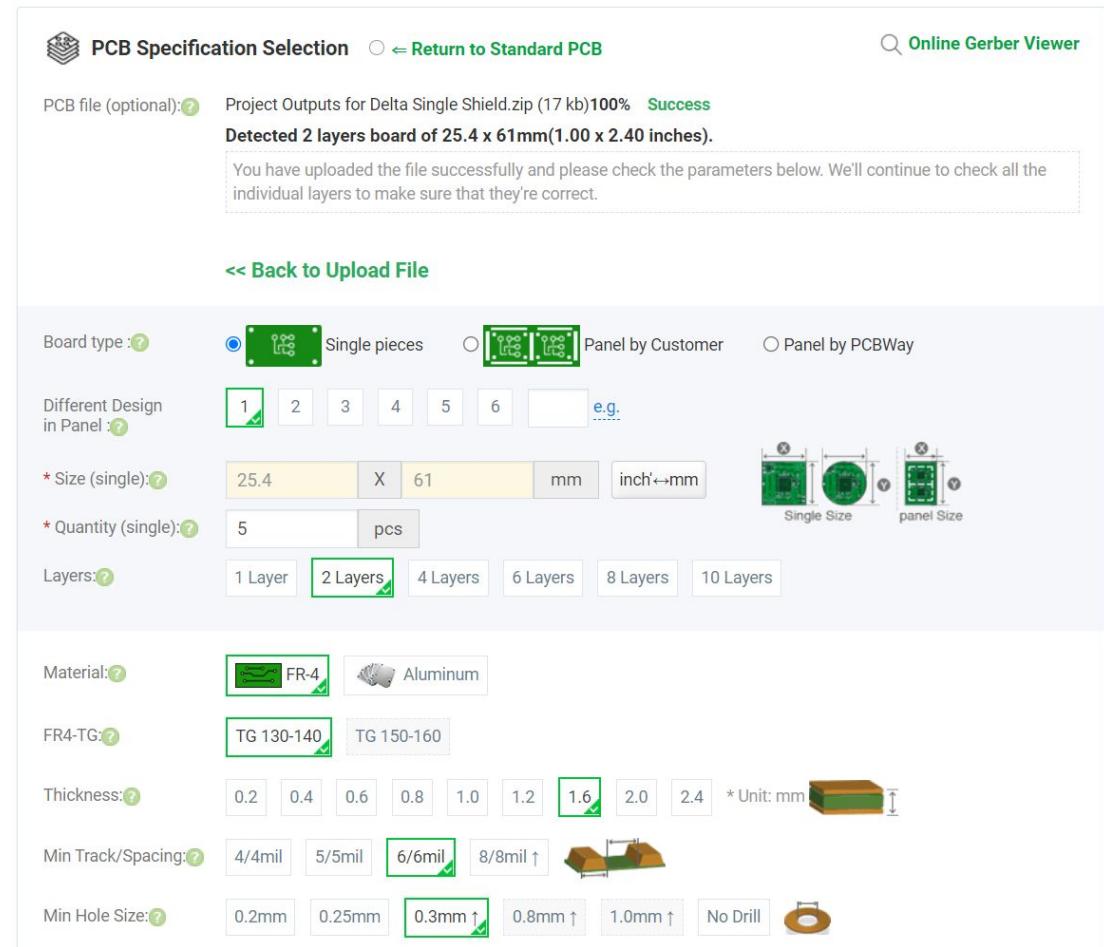
Material: FR-4 Aluminum

FR4-TG: TG 130-140 TG 150-160

Thickness: 0.2 0.4 0.6 0.8 1.0 1.2 1.6 2.0 2.4 * Unit: mm

Min Track/Spacing: 4/4mil 5/5mil 6/6mil 8/8mil ↑

Min Hole Size: 0.2mm 0.25mm 0.3mm ↑ 0.8mm ↑ 1.0mm ↑ No Drill



Single Shield Order Example

Match settings here.

Optional

- upgrade HASL with lead to Immersion gold (ENIG)
- select “not to add pcb product number” if you don’t want extra writing on the board. This does not affect functionality, just looks cleaner for 3\$ extra.

Min Hole Size: 0.2mm 0.25mm 0.3mm 0.8mm 1.0mm No Drill 

Solder Mask: Green Red Yellow Blue White Black
 Purple Matte black Matte green None

Silkscreen: White Black None

Edge connector: Yes No

Surface Finish: HASL with lead HASL lead free Immersion gold(ENIG) OSP None(Plain copper)

Via Process: Tenting vias Vias not covered
*For Gerber files, this choice is useless. It will be made according to files as default.

Finished Copper: Bare board(0 oz Cu) 1 oz Cu 2 oz Cu 3 oz Cu 

Extra pcb product number: Not to add extra pcb product number on board (extra+\$3)

Additional Options: Half-cut/Castellated Holes  UL Marking:  None

Other Special request: Fill in any PCB details to make it as clear as possible for us to understand your requirements.

Attention please! If you don't note not to add pcb order number on board, we will add it on board by default!

 SMD-Stencil Order together with PCB

 Assembly Service The above PCBs need assembly service

Single Shield Order Example

Price Examples

Pricing And Build Time		
PCB Price	Price Comparison Matrix	
Build Time	Qty	Total
<input checked="" type="radio"/> 24hours <small>?</small>	5	\$ 5.00
<input type="radio"/> Extra Urgent! <small>?</small>	5	\$ 92.02

⚠ Final price is subject to our review.

Shipping Cost: US \$19.33

UNITED STATES OF AMERICA ▾
DHL 2-4 business days, wt : 0.027 kg

CHN Time Zone(GMT+8): 2021/10/21 22:13:32

Payment before 2021/10/22 06:00 (GMT+8 Only PCB)

 Shipment Date 2021/10/23 AM	 Delivery Date 2021/10/26
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PCB Cost: ? US \$ 5.00
Shipping: US \$ 19.33
Total: **US \$ 24.33**

 **Save to Cart**

Pricing And Build Time		
PCB Price	Price Comparison Matrix	
Build Time	Qty	Total
<input checked="" type="radio"/> 24hours <small>?</small>	25	\$ 18.30
<input type="radio"/> Extra Urgent! <small>?</small>	25	\$ 100.48

⚠ Final price is subject to our review.

Shipping Cost: US \$19.33

UNITED STATES OF AMERICA ▾
DHL 2-4 business days, wt : 0.136 kg

CHN Time Zone(GMT+8): 2021/10/21 22:13:32

Payment before 2021/10/22 06:00 (GMT+8 Only PCB)

 Shipment Date 2021/10/23 AM	 Delivery Date 2021/10/26
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PCB Cost: ? US \$ 18.30
Shipping: US \$ 19.33
Total: **US \$ 37.63**

 **Save to Cart**

Pricing And Build Time		
PCB Price	Price Comparison Matrix	
Build Time	Qty	Total
<input checked="" type="radio"/> 24hours <small>?</small>	50	\$ 23.25
<input type="radio"/> Extra Urgent! <small>?</small>	50	\$ 105.23

⚠ Final price is subject to our review.

Shipping Cost: US \$19.33

UNITED STATES OF AMERICA ▾
DHL 2-4 business days, wt : 0.271 kg

CHN Time Zone(GMT+8): 2021/10/21 22:13:32

Payment before 2021/10/22 06:00 (GMT+8 Only PCB)

 Shipment Date 2021/10/23 AM	 Delivery Date 2021/10/26
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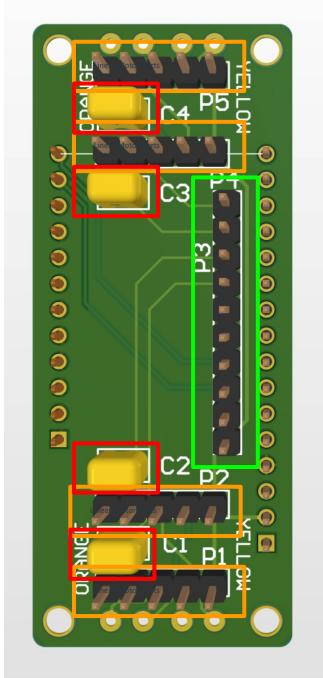
PCB Cost: ? US \$ 23.25
Shipping: US \$ 19.33
Total: **US \$ 42.58**

 **Save to Cart**

Top

Bottom

- Linear Motor Ports
- Decoupling Caps
- ADC Header
- Motor Controller Header

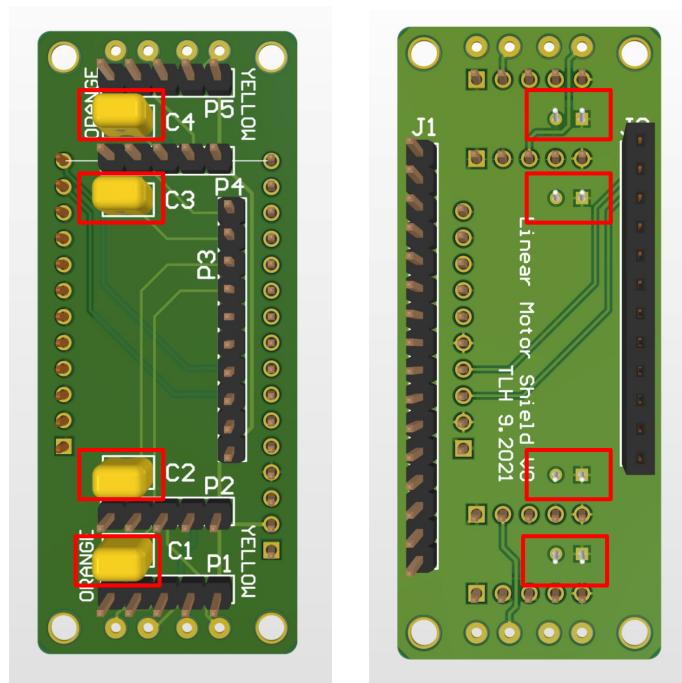


Note: These are
220nF in the design.
Can be in between
100-220 nF

Note: These should both
be male, will update
image

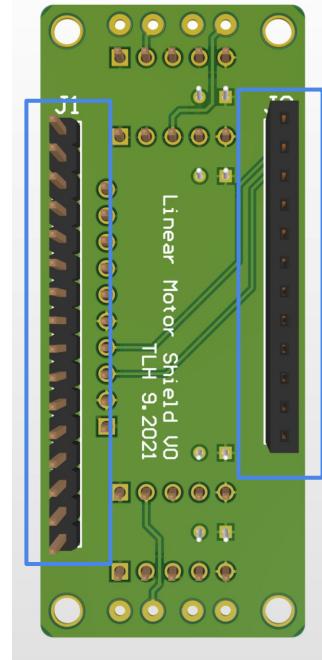
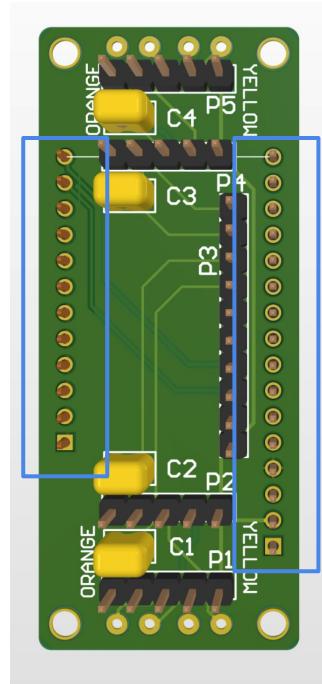
Soldering

1. Capacitors (insert from top, solder from bottom)
 - a. Single Shield: C1-C4
 - b. Triple Shield: C1-C12



Soldering

2. Male feather headers (insert from bottom, solder from top)
 - a. Single Shield: (1x) 12position (1x) 16position
 - b. Triple Shield: (3x) 12position (3x) 16position



Soldering

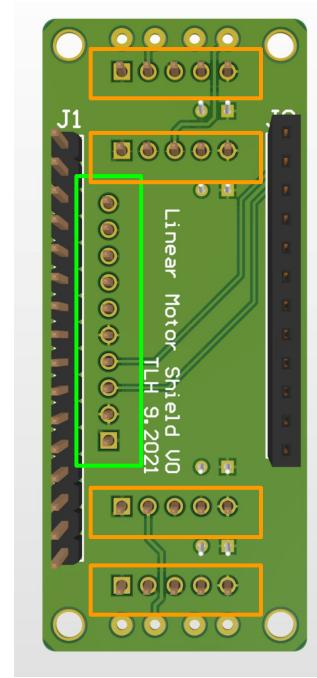
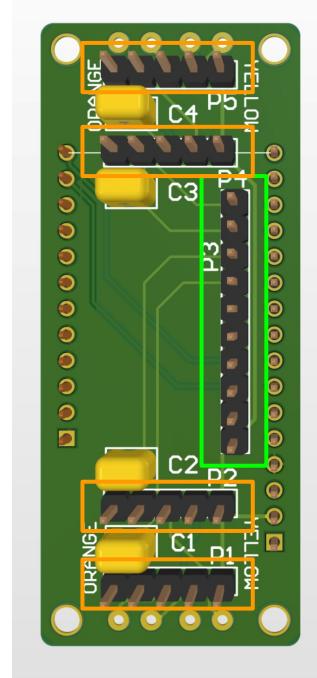
Motor Headers (insert from top, solder from bottom)

Linear Motor Ports

ADC Female Headers

ADC Header

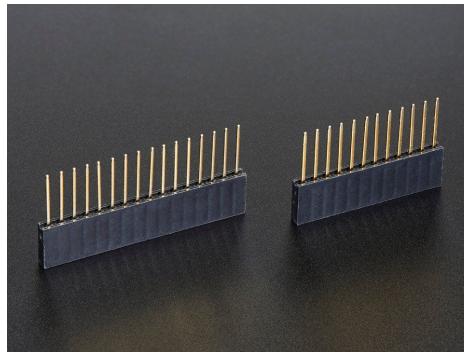
Shield is done! Moving onto commercial parts



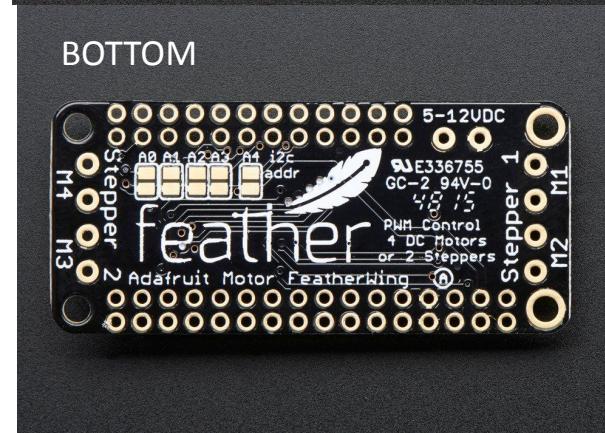
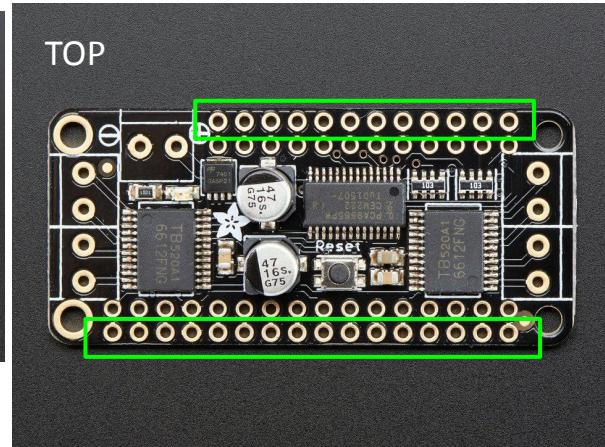
Soldering

Motor shield - stacking headers

- <https://www.adafruit.com/product/2830>
- Insert from the top of motor shield
- Solder from bottom of motor shield
- Use outer-most pins



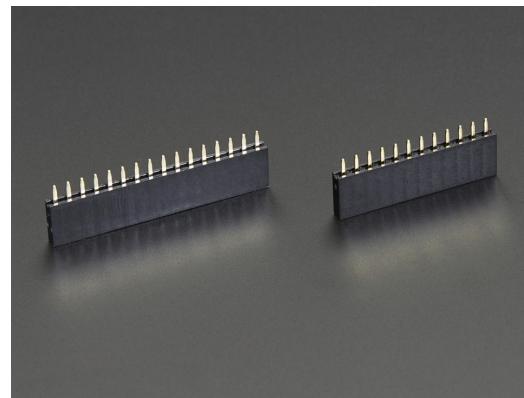
<https://www.adafruit.com/product/2927>



Soldering

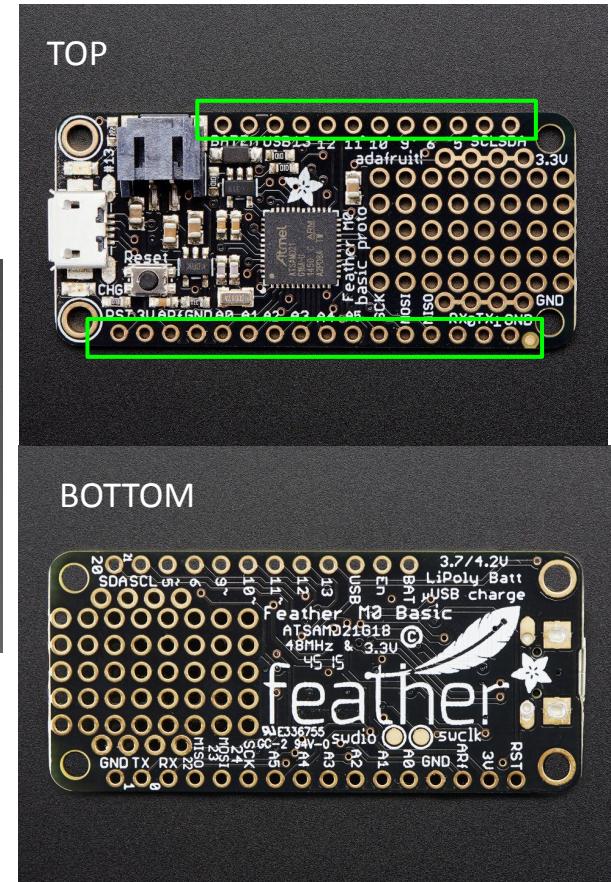
Feather M0 - female headers

- <https://www.adafruit.com/product/2886>
- Insert from top of feather M0
- Solder from Bottom of feather M0



<https://www.adafruit.com/product/2886>

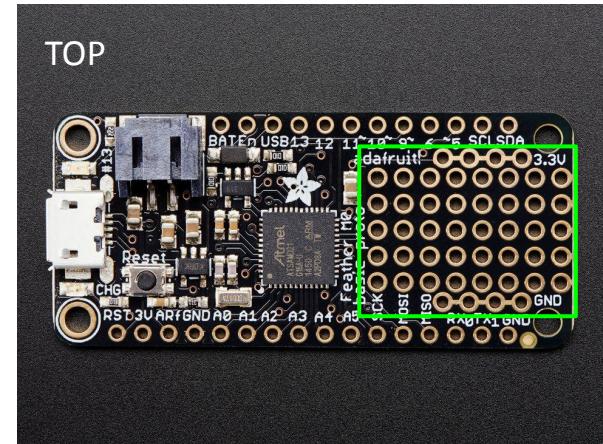
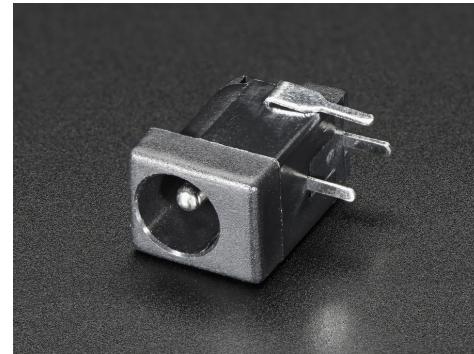
<https://www.adafruit.com/product/2772>



Soldering

Feather M0 - Power Jack

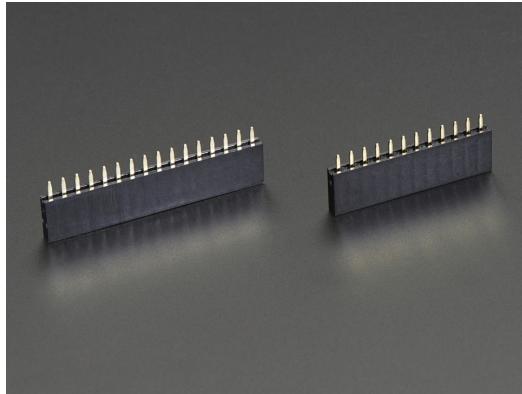
- <https://www.adafruit.com/product/373>
- Insert from top of feather M0
- Solder from Bottom of feather M0
- Solder all three pins down for stability
- Make barrel jack flush with the edge



Soldering

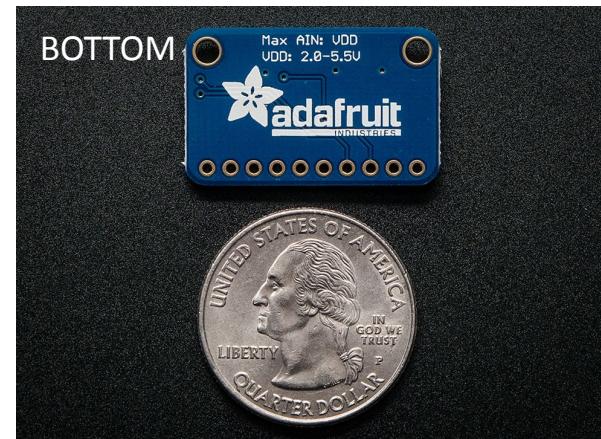
ADC - Female headers

- These will come with your boards
- 2.54mm pitch or 0.1" pitch (same)
- Cut to size (10 pins)
- DO NOT BUY SHORT ONES
- Insert from bottom of ADC
- Solder from top of ADC



<https://www.adafruit.com/product/2886>

<https://www.adafruit.com/product/1083>



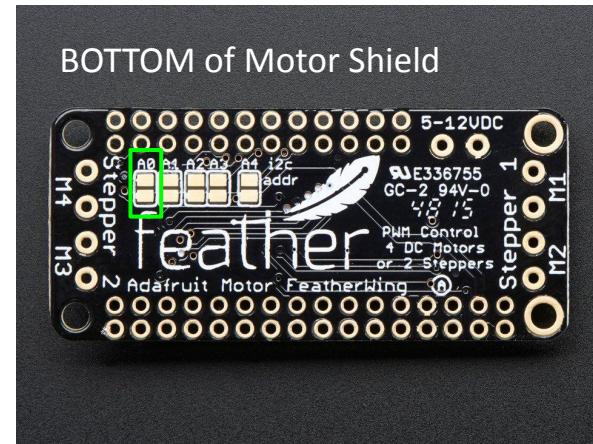
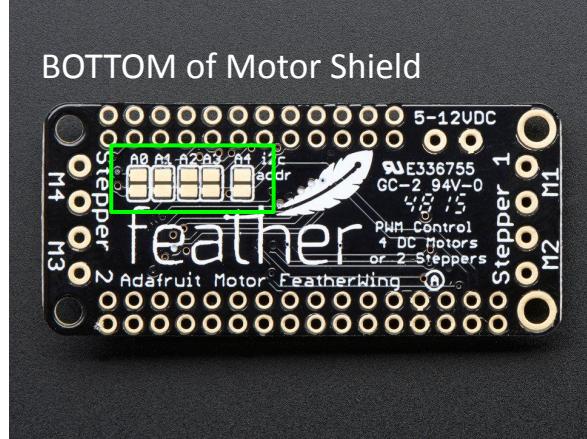
Address Selection Triple Shield Only

For Triple Shield, you will have three motor controllers.

For the first one, leave all address pins as-in (shown in picture)

For the second one, solder bridge across pins A0

For the third one, solder bridge across pins A1



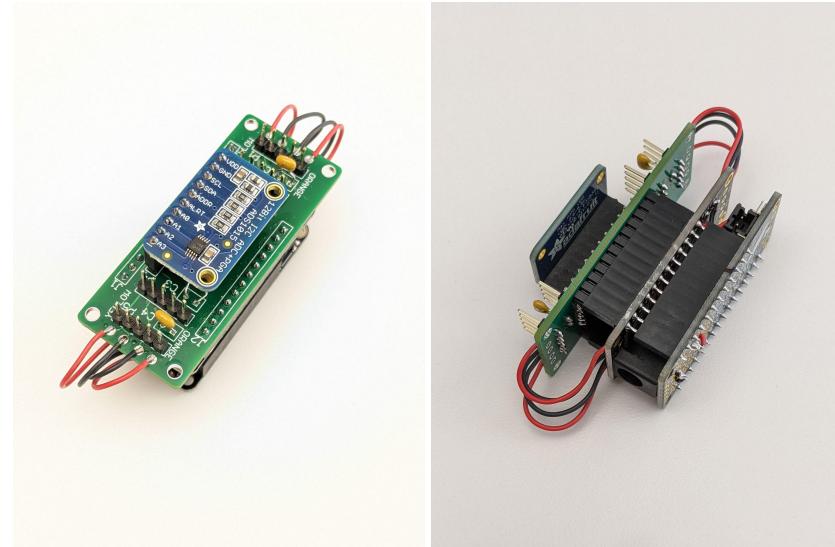
Almost done! Now we need to solder some final connections with wire.

1. Power Supply
2. Motor Connections

Prepare red and black wires

Wire strippers

Tweezers



Free Wire Soldering for Power Supply

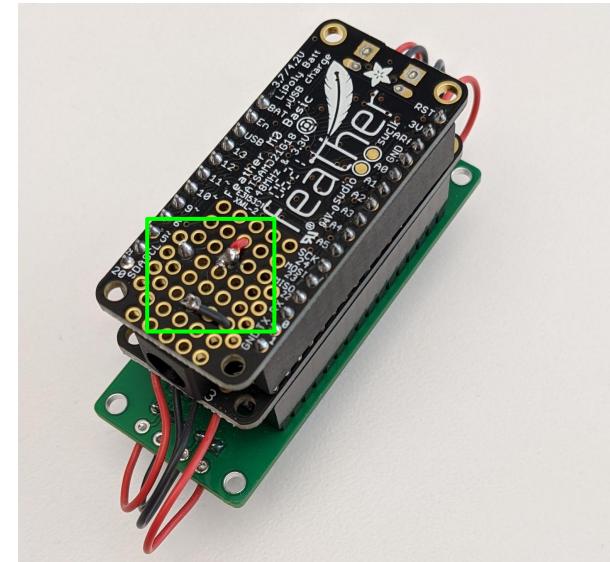
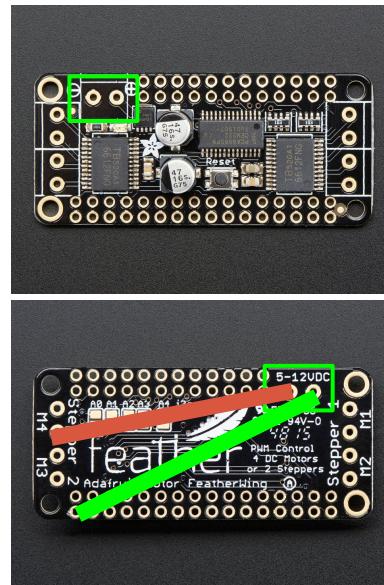
We need to connect the barrel jack on the Feather M0 to the 12V power supply on the center motor controller.

Solder a red wire to + side and black or green wire to the - side

Make the wires long enough to reach the barrel jack

Connect (+) red wire to the backmost pin on barrel jack. Connect (-) black wire to front most pin on barrel jack. Please look at reference photo carefully.

The single pin on the side of barrel jack does not need to be connected to any wire.

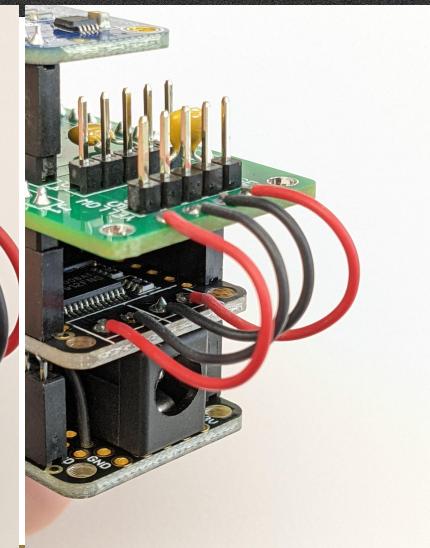
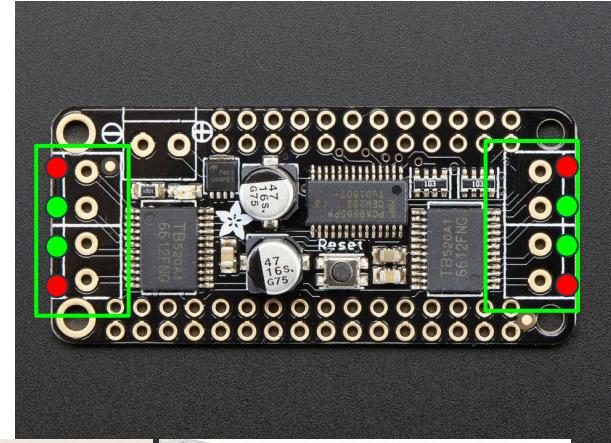


Free Wire Soldering for Motors

Starting with the motor controller, solder red wires on the outside and black wires of the inside

There should be 8 wires total sticking out from the motor controller now.

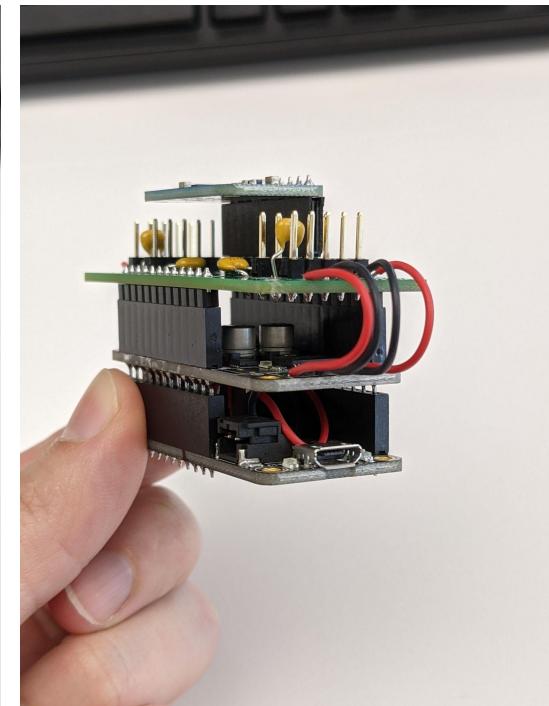
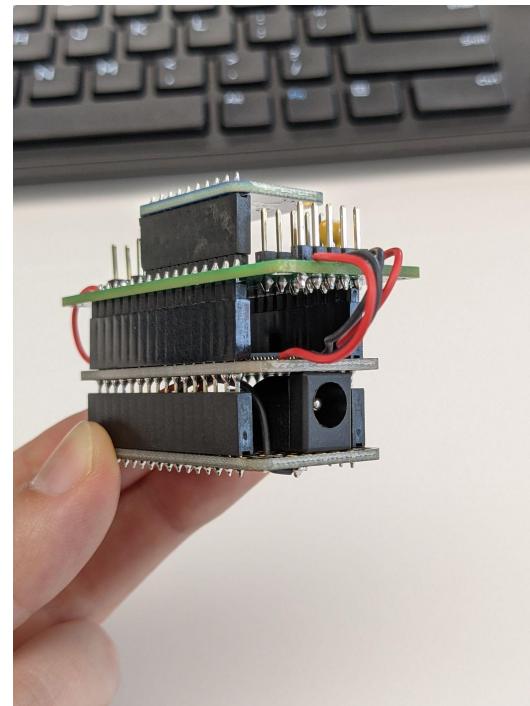
Place the green shield on top. Using tweezers, lift the wires and solder them to matching vias on top.



Stacking parts together

Stack everything together

ADC
Shield
Motor Controller
Feather M0



Testing

Test: Plug in 12V power supply

Expected response: Green Light for motor power supply

Test: Plug in microusb cable

Expected response: Orange light for uC power supply

If you do not get these LED lights do NOT proceed. You have a power problem.

Testing

I2C Scanner

- Motor Controller
 - 0x60, 0x61, 0x62
- ADC
 - 0x48, 0x49, 0x4A

Make sure all the parts you have plugged in show up on any i2c scanner

Final Integration

Move_finger.py

Test script from the github: https://github.com/iamlab-cmu/delta_array