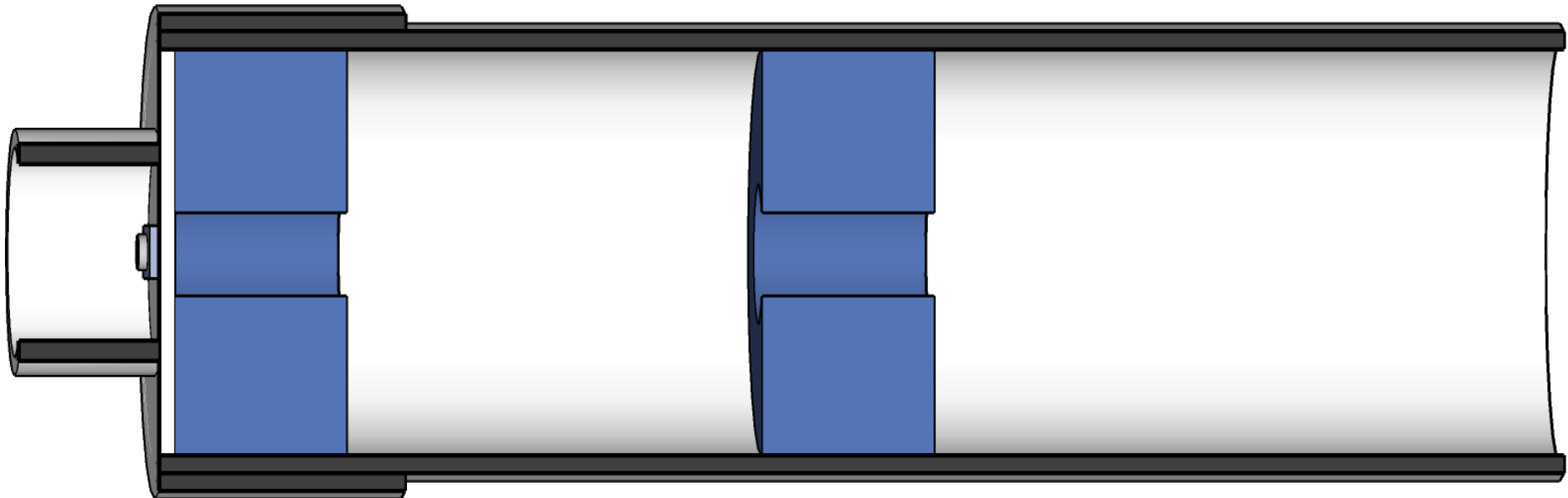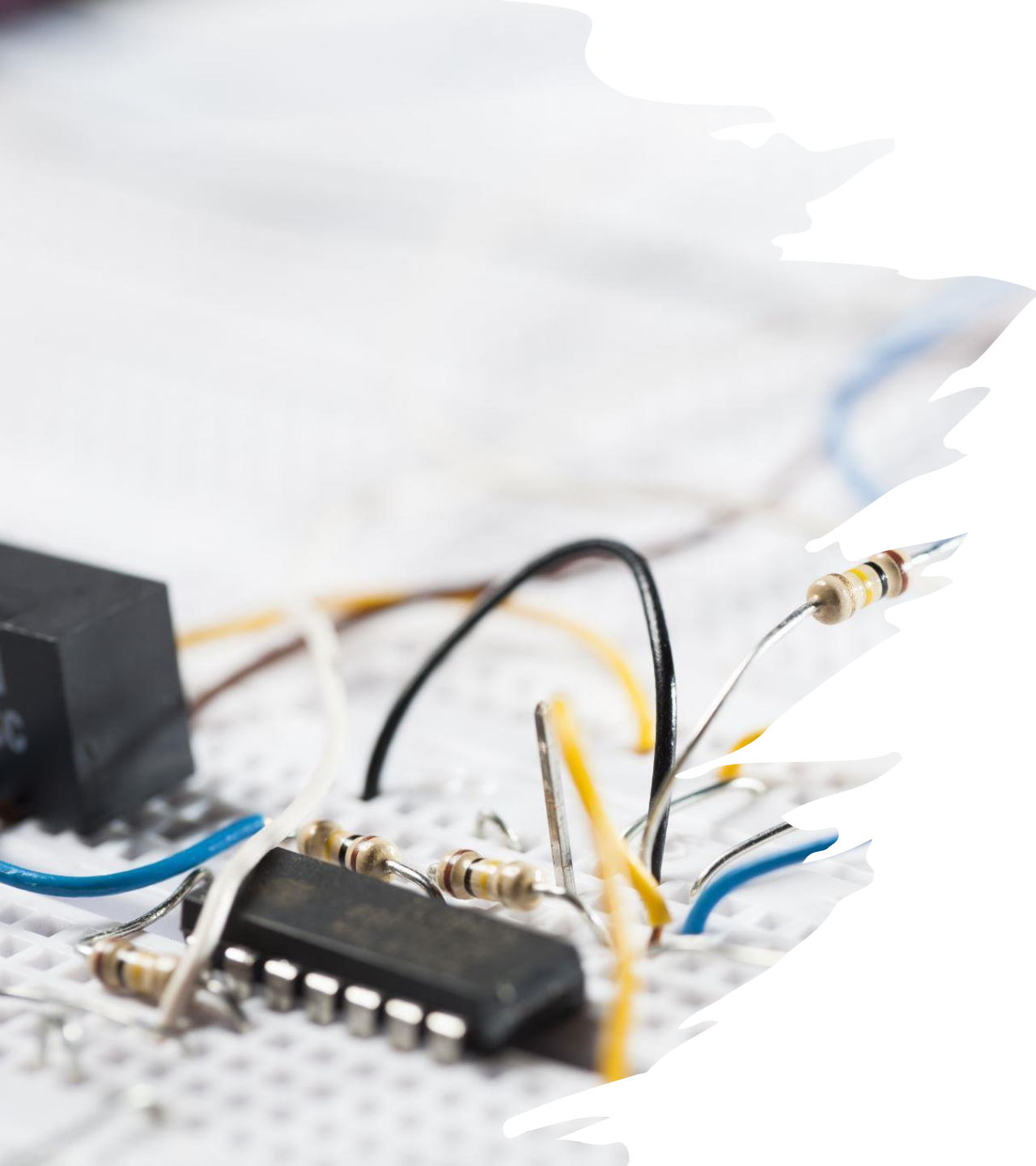# DIY Pressure Transducer (DIY4) Build Guide
(V1)

Overview

The construction of this DIY pressure transducer can be split into 2 parts:

1. Assembly and testing of electronics

2. Assembly of housing

The housing is easier to assemble. However, it requires some of the electronics in its construction, so we start with the assembly of electronics first.

Electronics Overview

There are 3 major elements of the electronics assembly

A.   Mainboard Assembly

B.   RTC Module Modifications
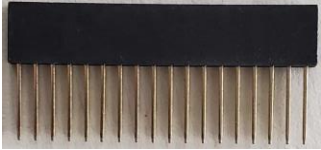
C.   Pressure Sensor Assembly

They can be done in any order, but I tried to arrange them here by soldering difficulty. So, Part A has the easiest soldering and Part C has the most difficult soldering.
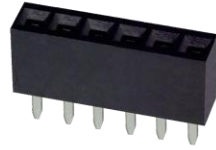
(A) Mainboard Assembly
Parts List (Not to scale)

1 x FireBeetle

1 x Shield PCB

1 x 18 pin female header

1 x 14 pin female header

1 x 18 pin male header

1 x 14 pin male header

2 x 6 pin female header

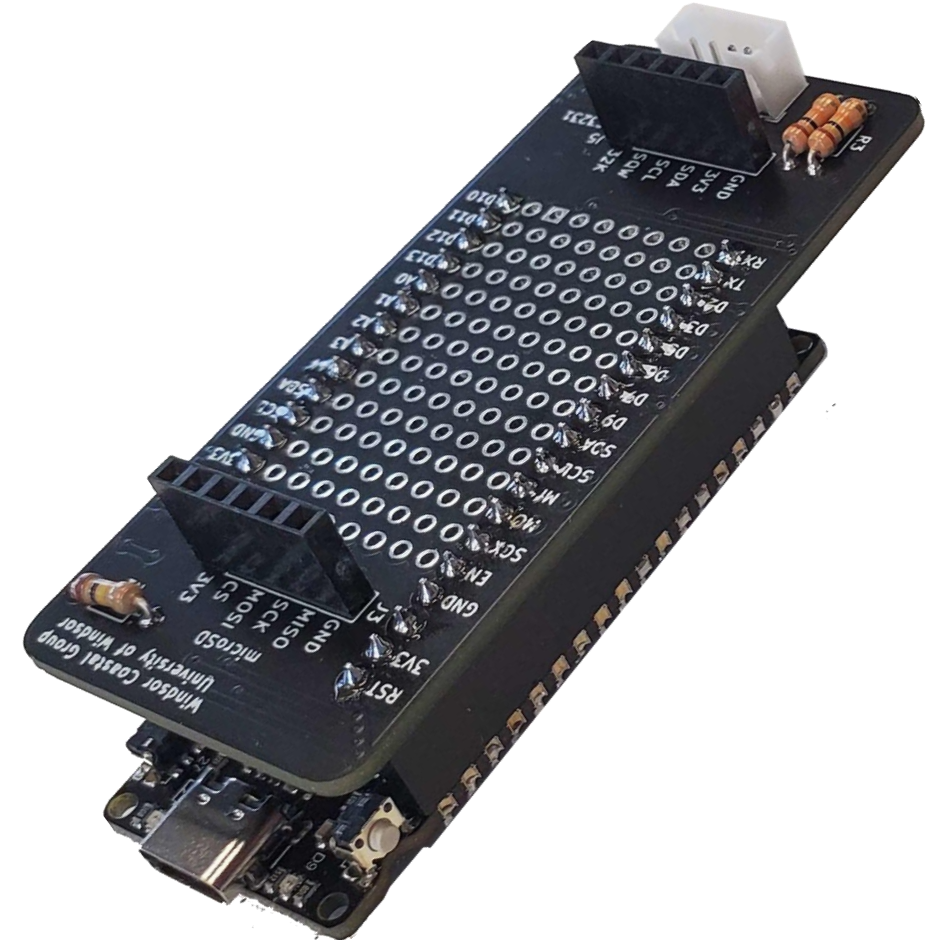1 x 4 pin male JST PH connector

2 x 10 KΩ resistor

1 x 100 KΩ resistor

1 x MOSFET

Assembled Mainboard

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(A) Mainboard Assembly Overview

The mainboard is the "brain" of the pressure transducer. It is made up of:
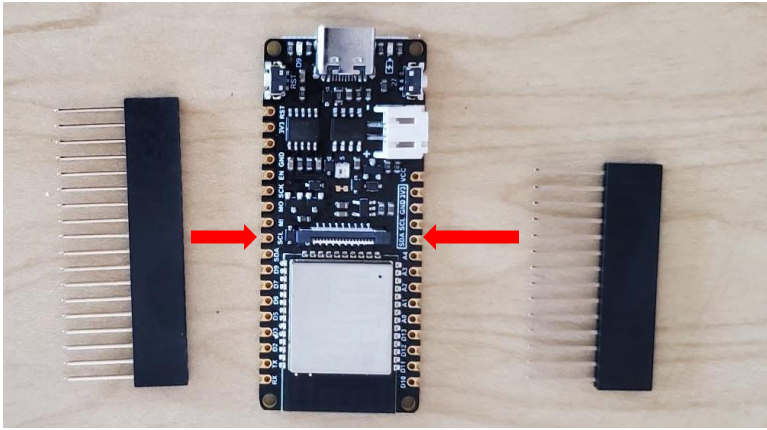- A microcontroller
- Plugs / connectors for the clock, microSD card module, and pressure sensor
- Several other components such as resistors.

The parts we will assemble here will allow all of the major components to be connected and communicate with each other.
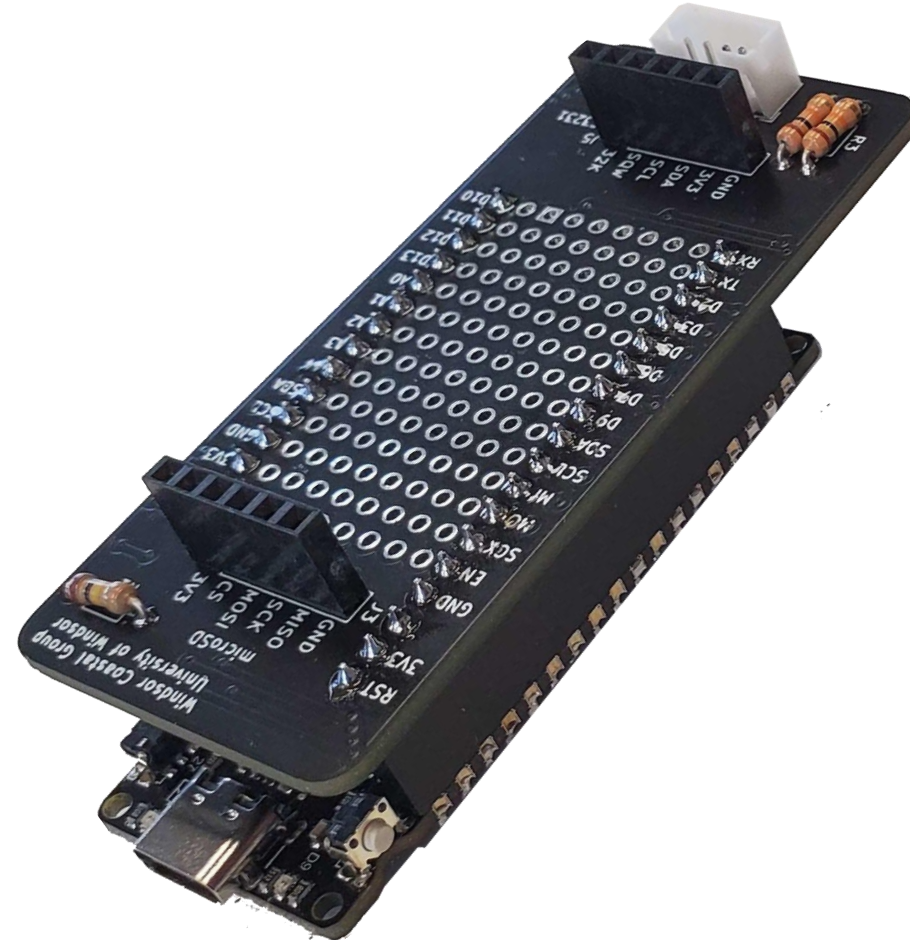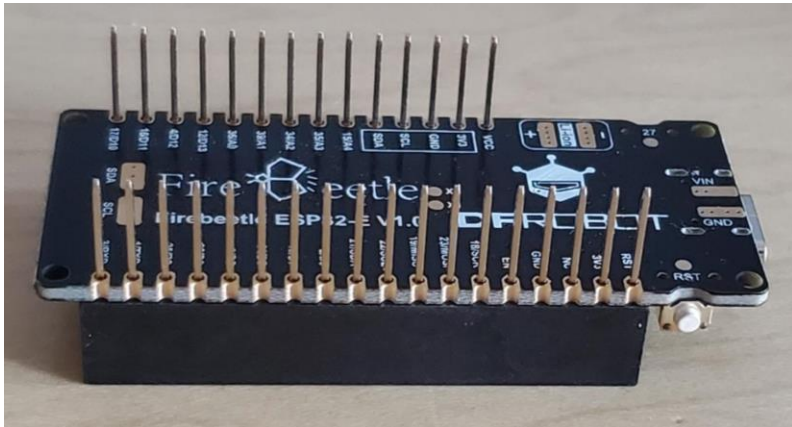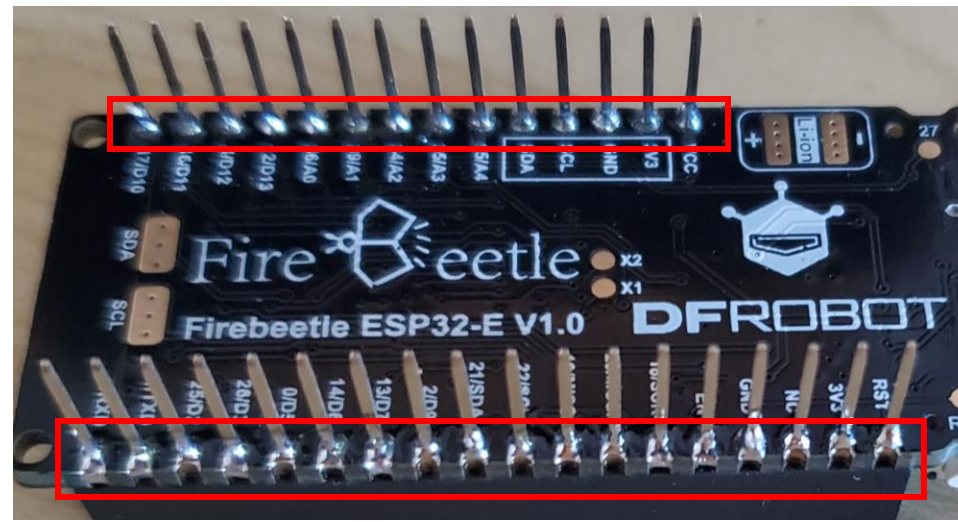
(A) Mainboard Assembly
Step 1: Solder FireBeetle header pins

Insert the header pins through the holes on each side of the FireBeetle.

Solder the pins to the board. Two important tips when soldering:

- Be sure to solder all of the pins. Soldering isn't just to hold things in place; it also creates electrical connections between the board and the pins.
- Avoid soldering pins together. No two pins should be connected by solder. If it happens, just remove the solder.

1 x FireBeetle

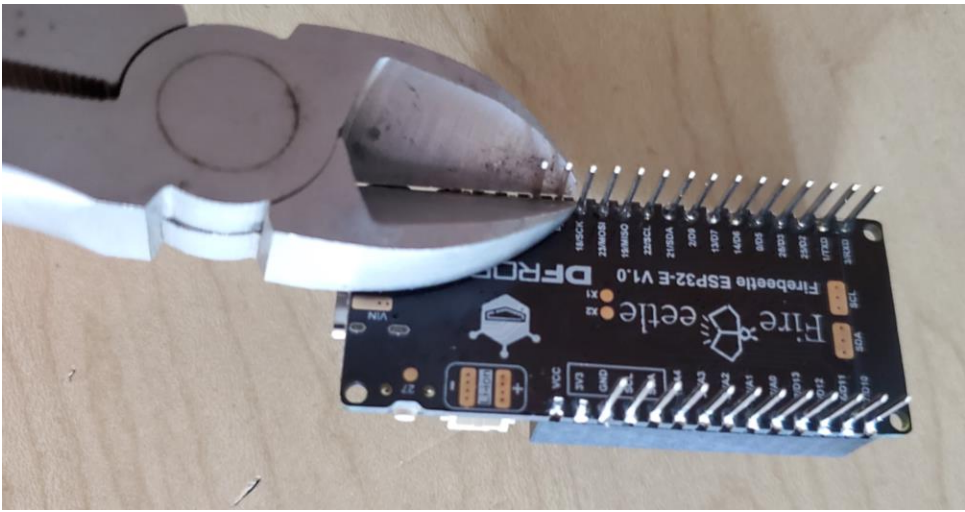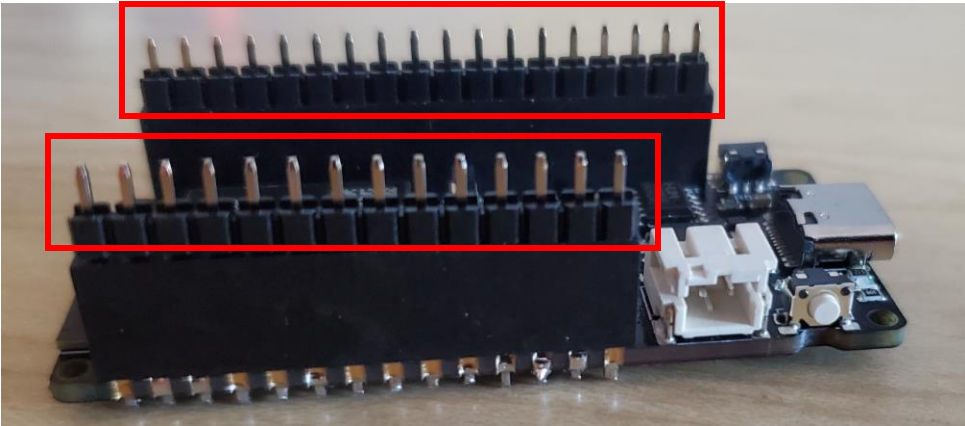1 x 18 pin female header

1 x 14 pin female header

Flip the FireBeetle upside down and rest it on the black part of the header pins. **Make sure the pins are aligned squarely with the board.**
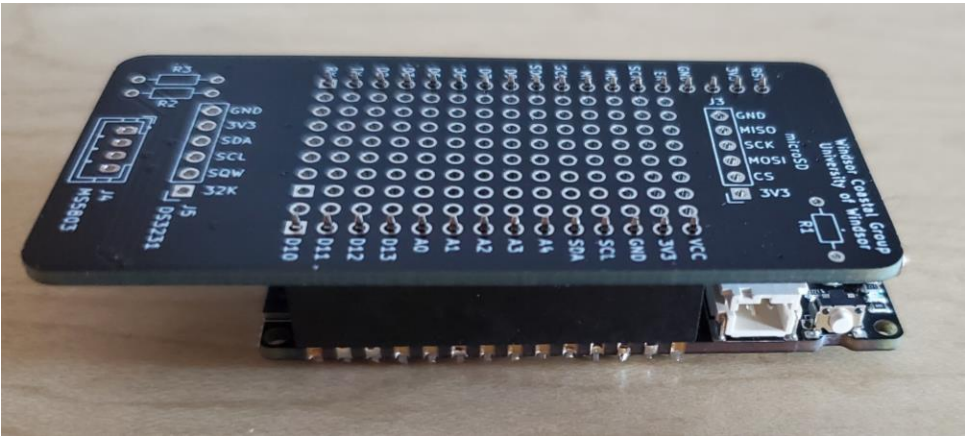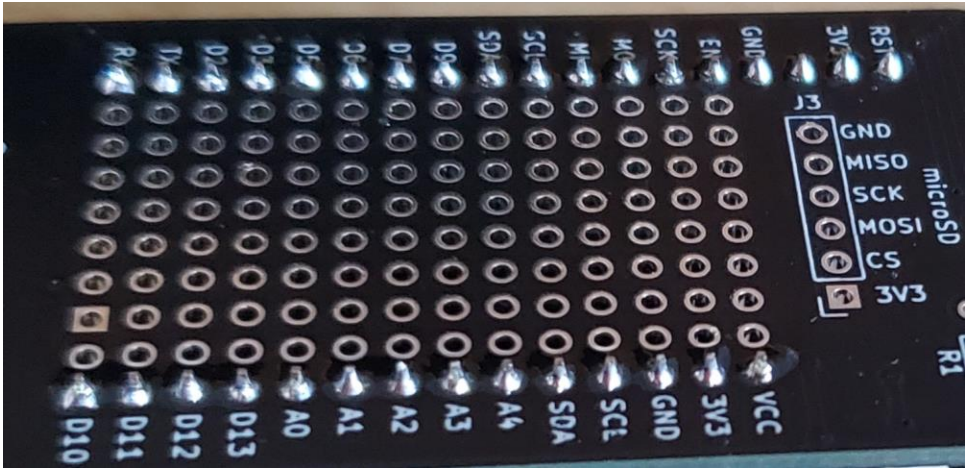
6

Cut the excess part of the pins

(A) Mainboard Assembly
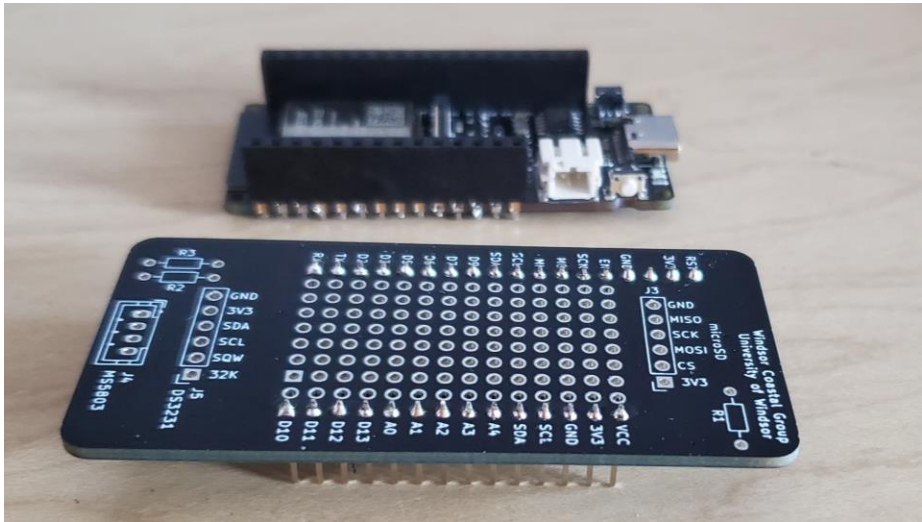## Step 2: Solder Shield header pins

Insert the long end of the male header pins into the female header you just soldered.

Fit the Shield onto the pins. Make sure the same side as shown in the image is facing up.
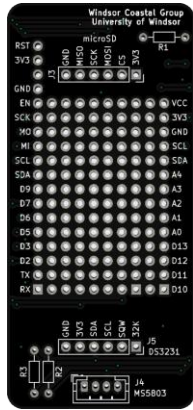

Solder the pins to the Shield. Again, be sure to solder every pin and avoid soldering pins together.

Separate the Shield from the FireBeetle. Pull evenly across the shield to avoid bending any pins, which are now attached to the Shield.
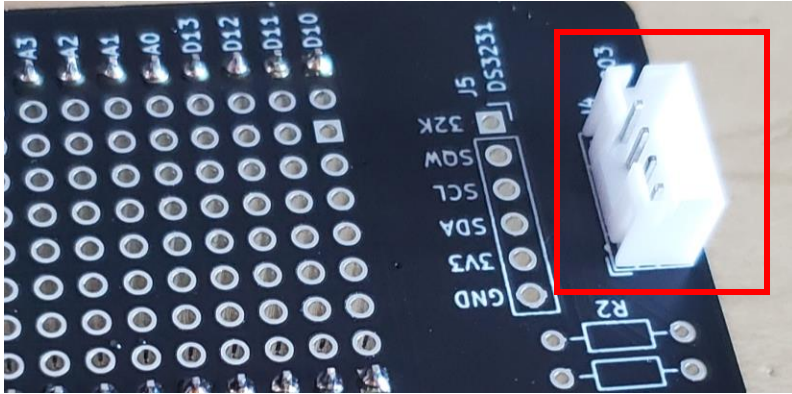
Parts

1 x Shield PCB

1 x 18 pin male header

1 x 14 pin male header

(A) Mainboard Assembly
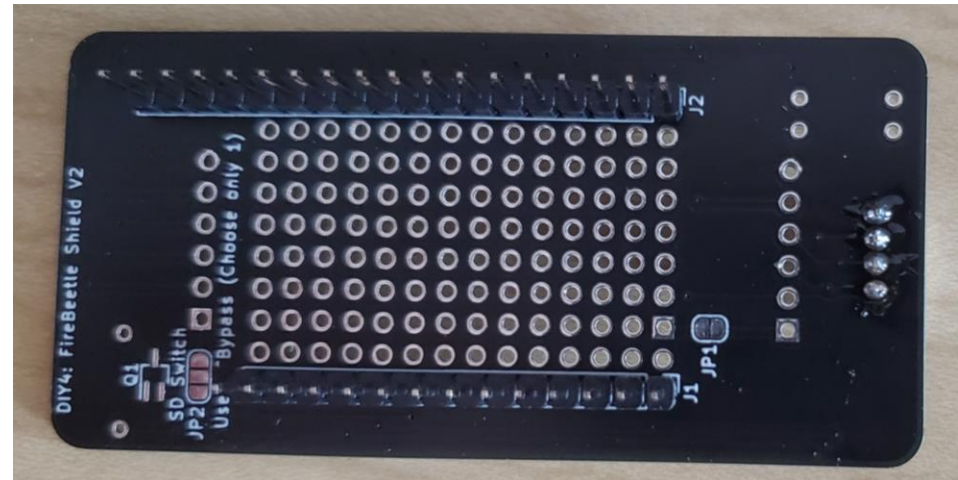## Step 3: Solder male JST PH connector

Place the male JST PH connector on the Shield at the row of pins labelled J4. **Be sure to orient the connector as shown in the image, with the gapped side facing into the board.**

Flip the Shield over so that it is resting on the JST PH connector. The pins should be visible as shown on the right side of the image.

1 x 4 pin male JST PH connector
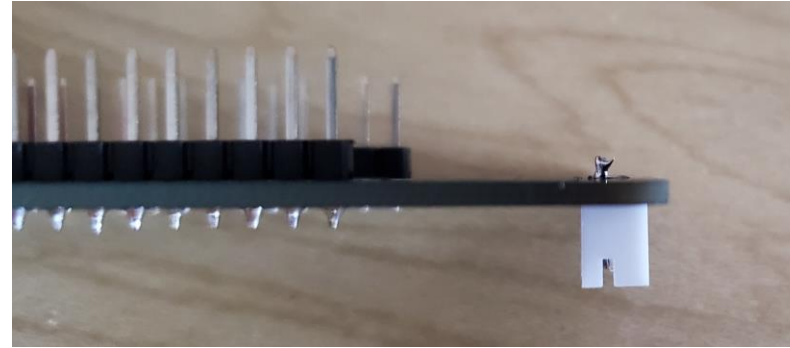
Solder the pins to the board. Start by soldering a single pin. Then, flip the shield over and ensure the JST PH connector is aligned squarely with the board. If not, use your soldering iron to heat the pin you just soldered and adjust the connector until it is square with the board.

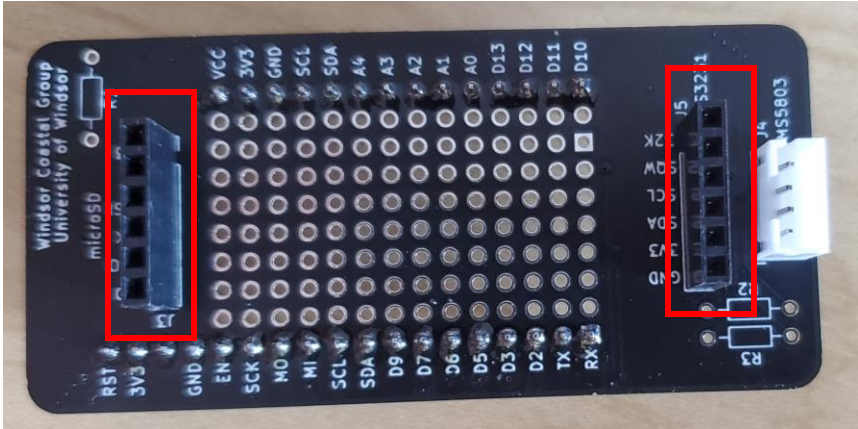Then solder the remaining pins.

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(A) Mainboard Assembly
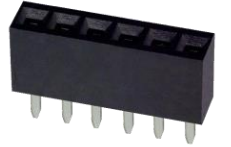## Step 4: Solder 2 x 6 pin female header

Insert a pin header through the row of holes labelled J3 and through the row of holes labelled J5. Ensure the headers are on the same side as the JST PH connector from the previous step.
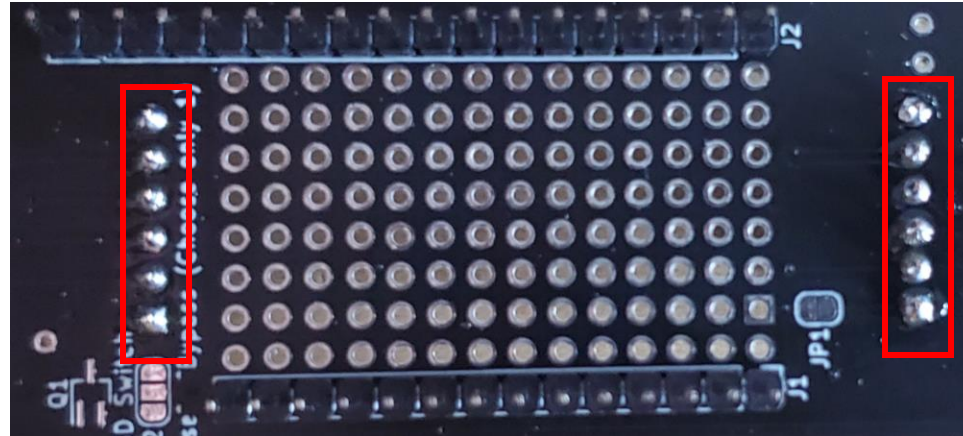

Flip the Shield over so that it is resting on the black part of the pin headers. Try to keep the pin headers aligned squarely with the board.
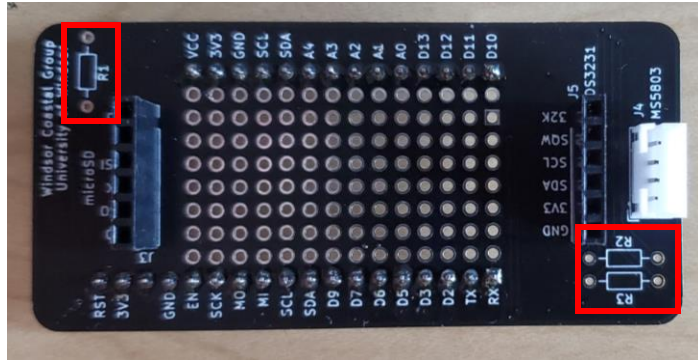

2 x 6 pin female header

Solder the pins to the board. Like in the previous step, start by soldering a single pin on each header. Then, flip the shield over and ensure the pin headers are still aligned squarely with the board. If not, apply heat to the pin(s) you soldered and adjust the header(s). Then solder the remaining pins.

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(A) Mainboard Assembly
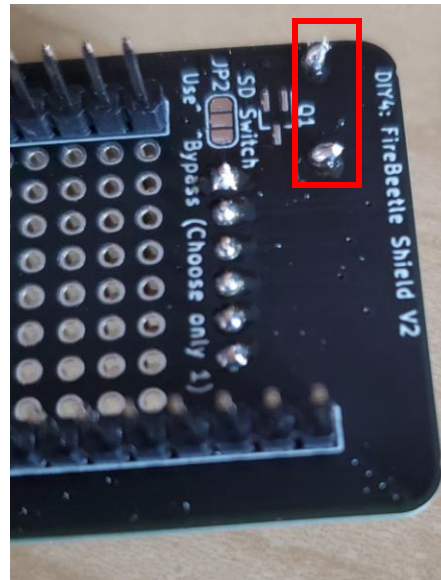## Step 5 : Solder resistors
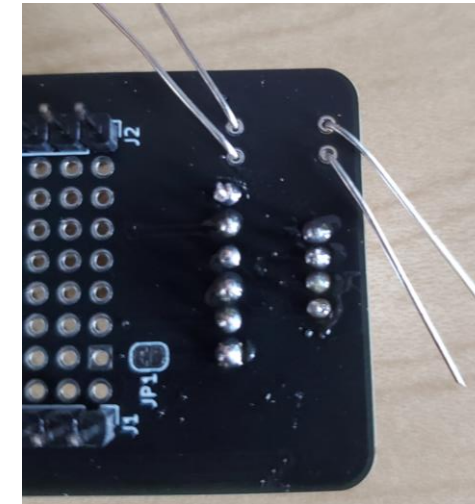

Locate labels R1, R2, and R3.

Insert a 100 KΩ resistor at R1.

Insert one 10 KΩ resistor at R2 and another at R3.

Flip the Shield over and solder the resistors into place, then cut the excess leads.

Parts

2 x 10 KΩ resistor

1 x 100 KΩ resistor

Note: The coloured bands on a resistor indicate its resistance value. If you accidentally mix up your resistors, you can use that to figure out which is which.
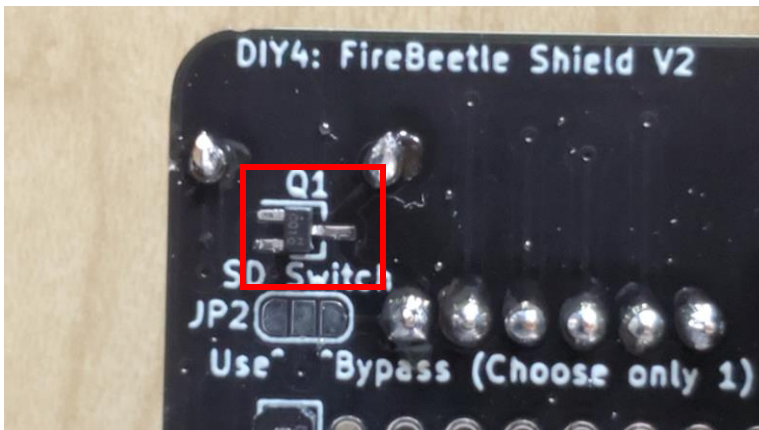
(A) Mainboard Assembly
Step 6: Solder MOSFET

Note: This step will be the trickiest so far because of how small the component is. You'll likely need a tool (e.g. tweezers) to hold the MOSFET in place while you solder.
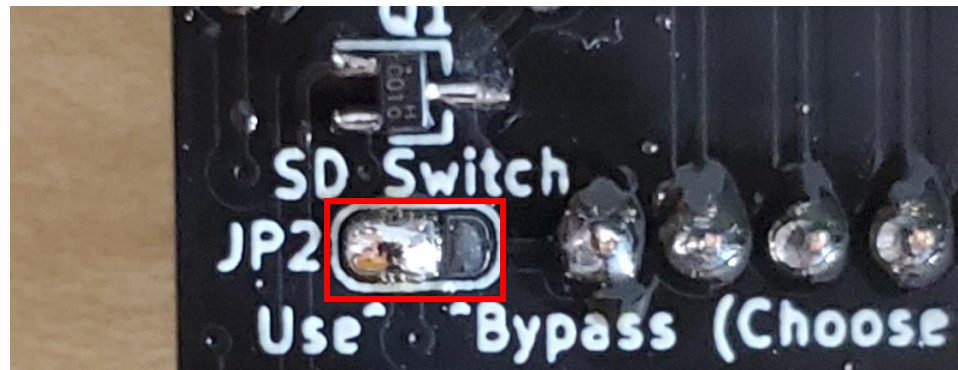
□ This is the MOSFET

Locate the label Q1 on the back of the Shield.

Line up the MOSFET on the 3 pads.

Solder the MOSFET into place. Start by soldering the single pad side to secure the component. When soldering the other two pads, be careful not to bridge the pads together.
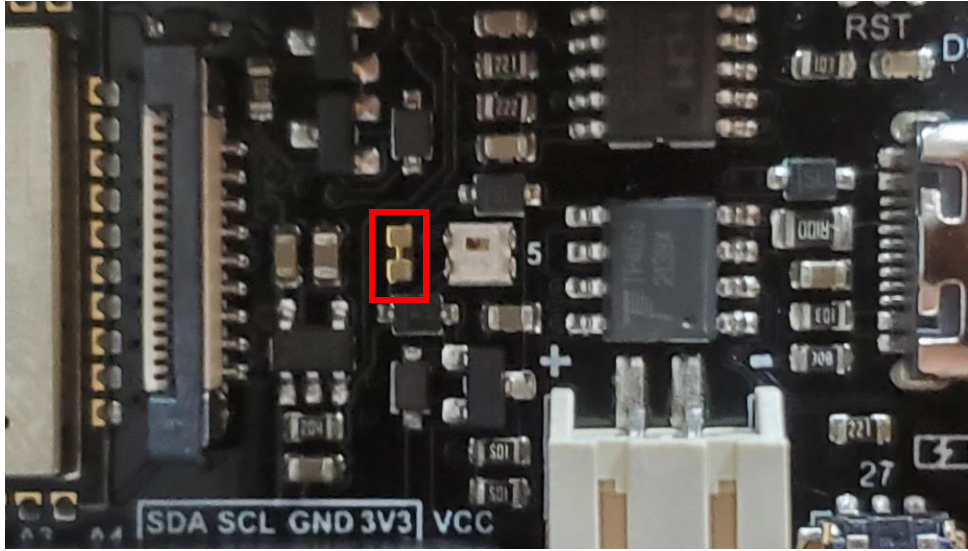
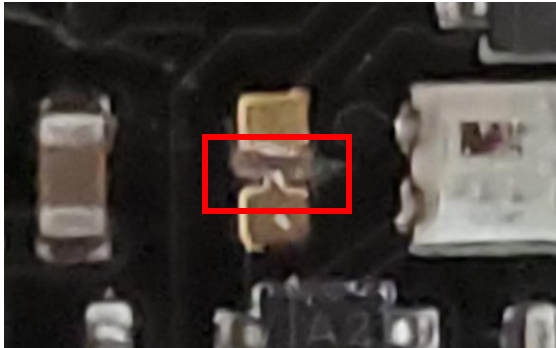Locate the 3 pads below the MOSFET. Solder a bridge between the **left two pads only**.

1 x MOSFET

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(A) Mainboard Assembly
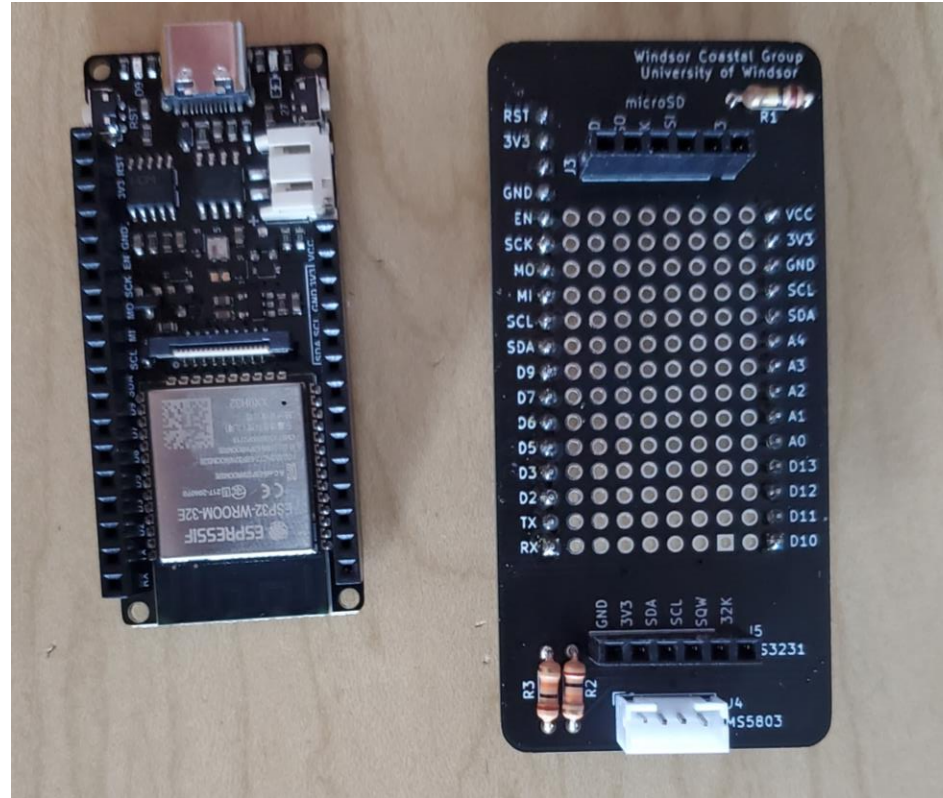## Step 7: Finishing steps

Retrieve the FireBeetle board from earlier. Locate the small gold-coloured pair of pads near the center of the board. Notice the thin line / trace connecting them.

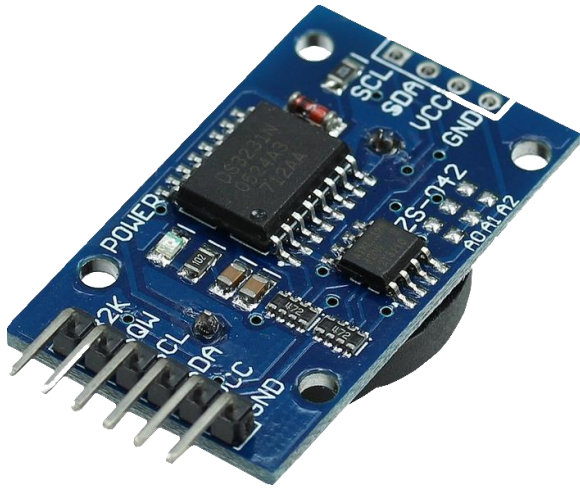Cut the thin line / trace between the two pads.

Mainboard assembly complete! You can now place the Shield back onto the FireBeetle, like in Step 2 (not shown in the image here).
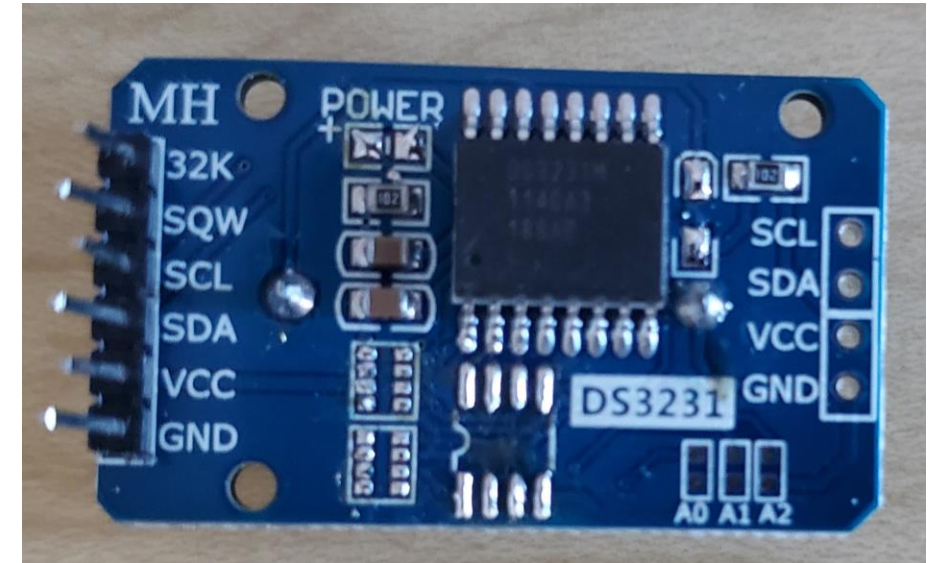
13

(B) RTC Module Modifications
Parts List

1 x DS3231 Real Time Clock (RTC) Module
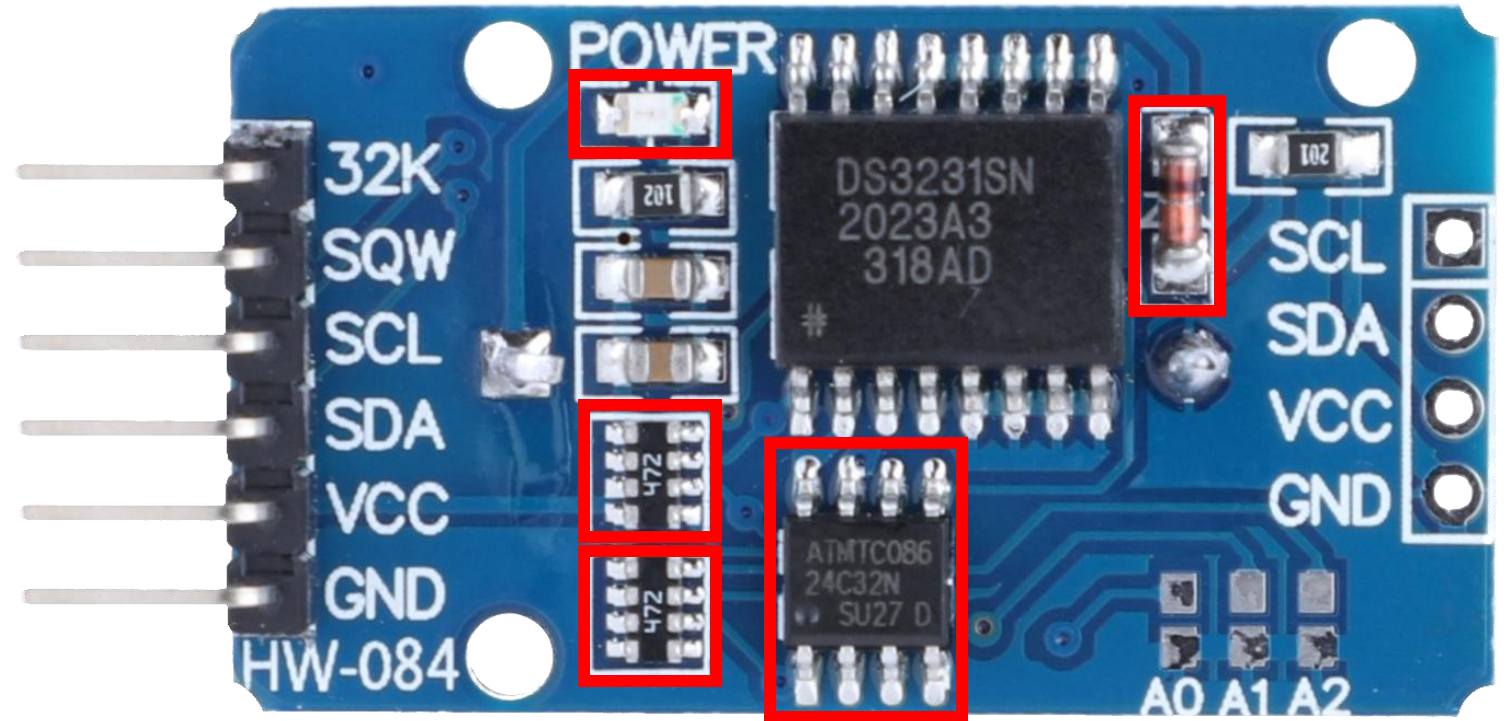
Modified RTC Module

(B) RTC Module Modifications Overview

Several components need to be removed from the RTC module before we can use it. They are highlighted in the red boxes in the image on the right.

We won't be using these components once they are removed, so don't worry about damaging them in the removal process. Do be careful not to damage other components on the board, however.

The components with more solder pads (e.g. the 3 components in the bottom left) can be frustrating to remove with just a soldering iron, but it can be done. Alternatively, if you have access to a hot air gun, it may be better suited for this process.
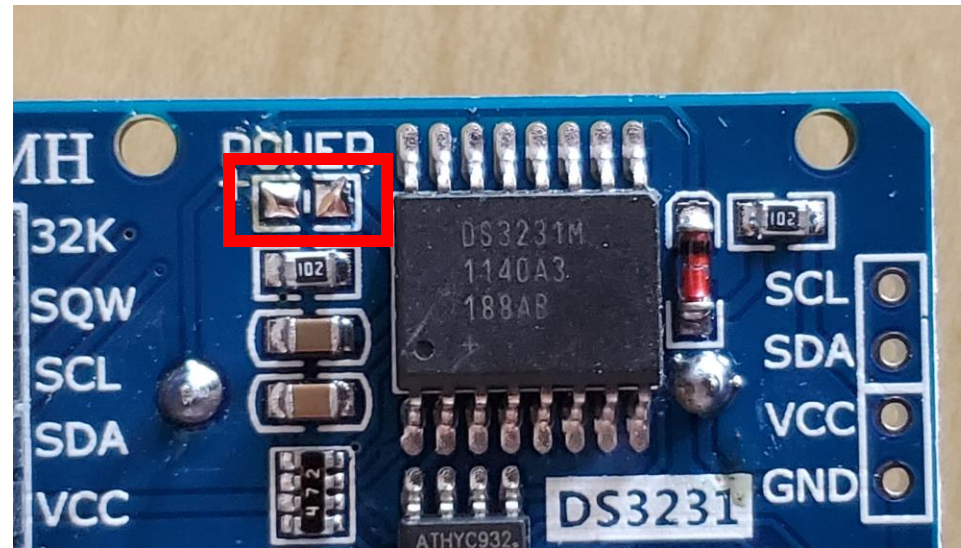
(B) RTC Module Modifications
Step 1: Remove power LED
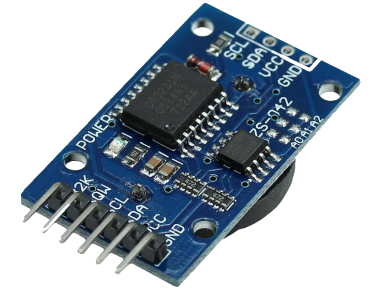
1 x DS3231 Real Time Clock (RTC) Module
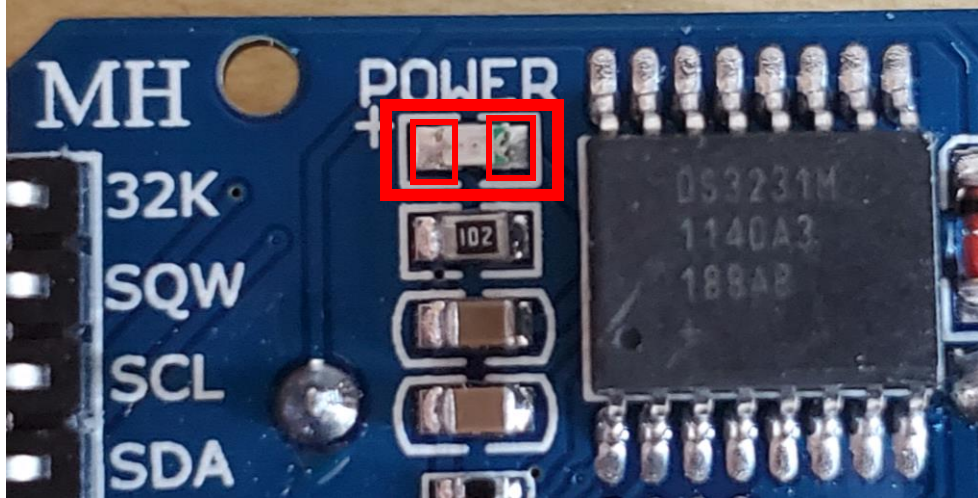
Locate the power LED on the RTC Module. Notice the small solder pad at each end of the LED.

Desolder the LED (remove it from the board). You'll need to apply heat to each pad using your soldering iron, alternating every few seconds, until the solder melts enough to move the component. Don't worry about damaging the LED, as it won't be needed for anything else.

Once the component is removed, make sure the pads are not connected (bridged) with solder. If this happens, you'll create a short circuit when the board is powered. Use your soldering iron (and solder wick if you have it) to fix this
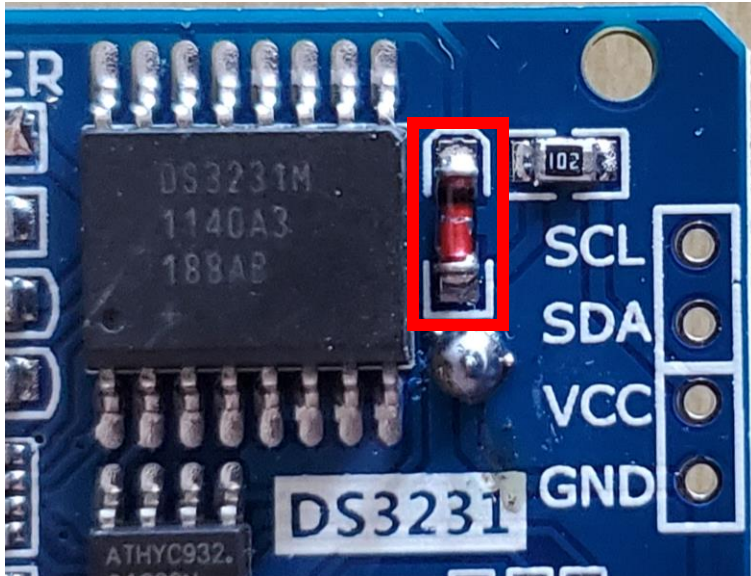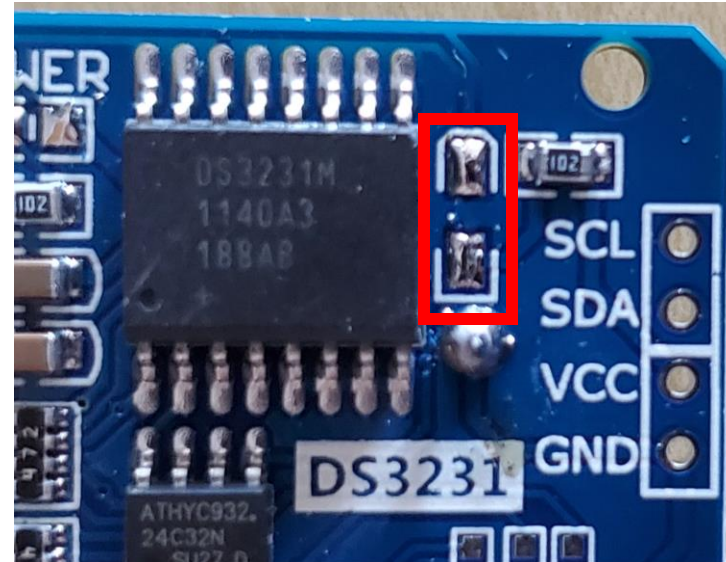
16

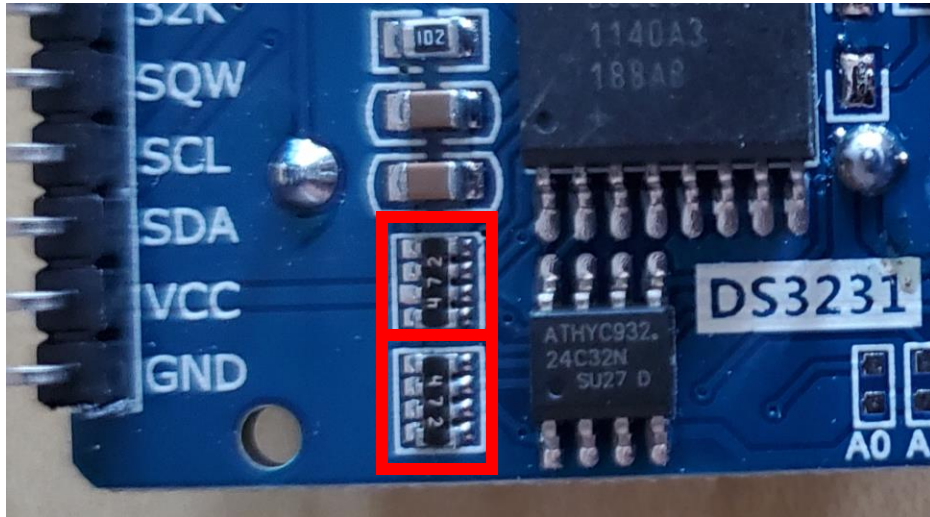# (B) RTC Module Modifications
Step 2 : Remove diode

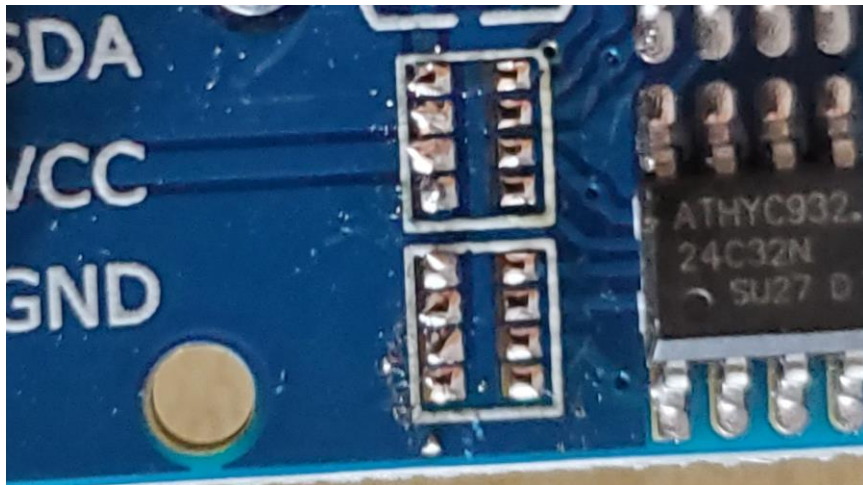Locate the red coloured diode on the RTC Module.

Desolder the diode. Use the same technique as the previous step.

(B) RTC Module Modifications
Step 3: Remove resistor arrays

Locate the two resistor arrays.

Desolder the arrays one at a time. This may take longer than the previous steps, as there are more pads that need to be heated.

I recommend applying a small amount of fresh solder on each side of pads which will help with heat transfer.
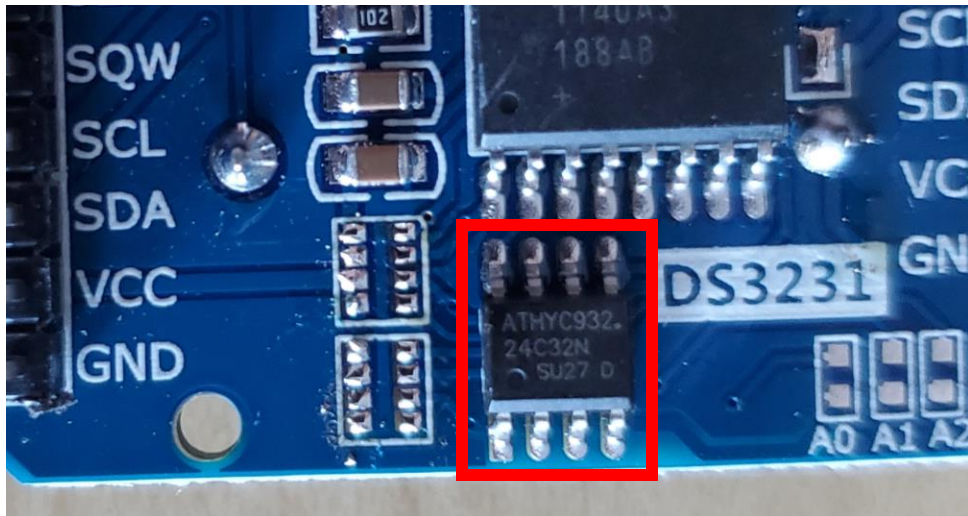

Again, ensure you don't leave pads bridged together accidentally (like in the image above), which could create a short circuit. If it happens, you can use your soldering iron to try and melt the solder and break the connection. You can also use solder wick if you have it.
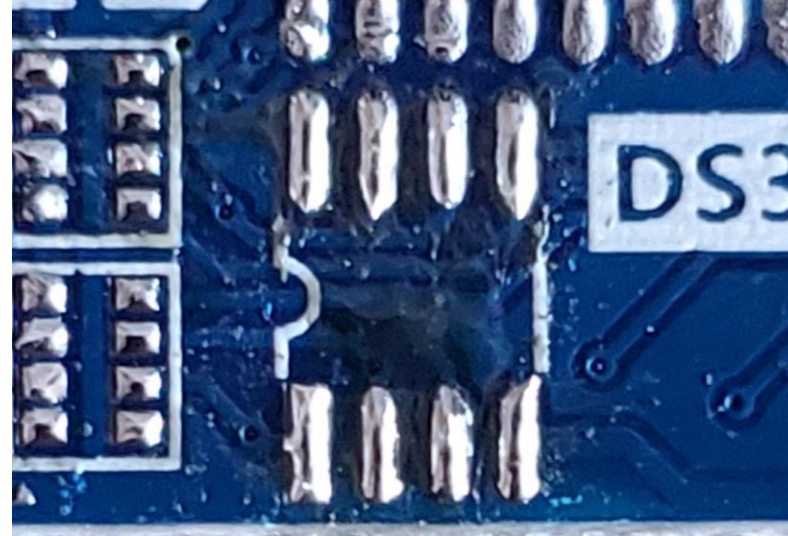
(B) RTC Module Modifications
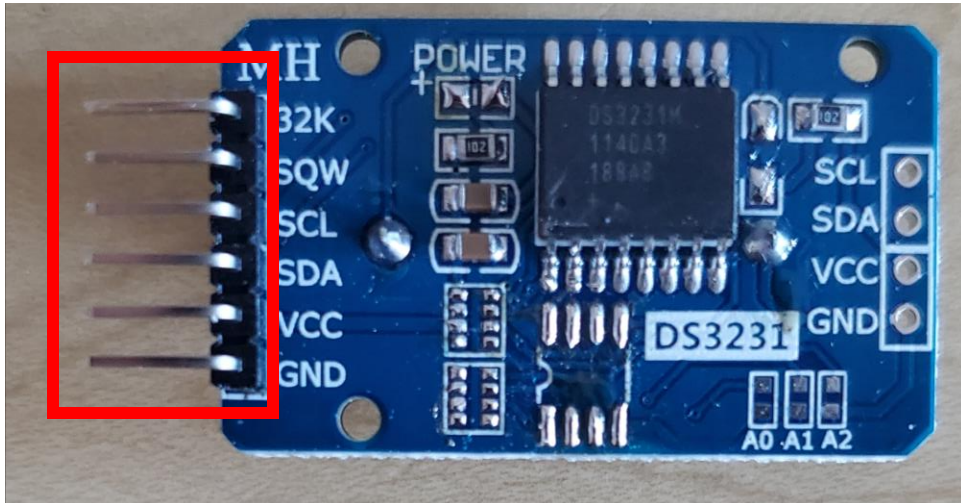## Step 4: Remove EEPROM chip
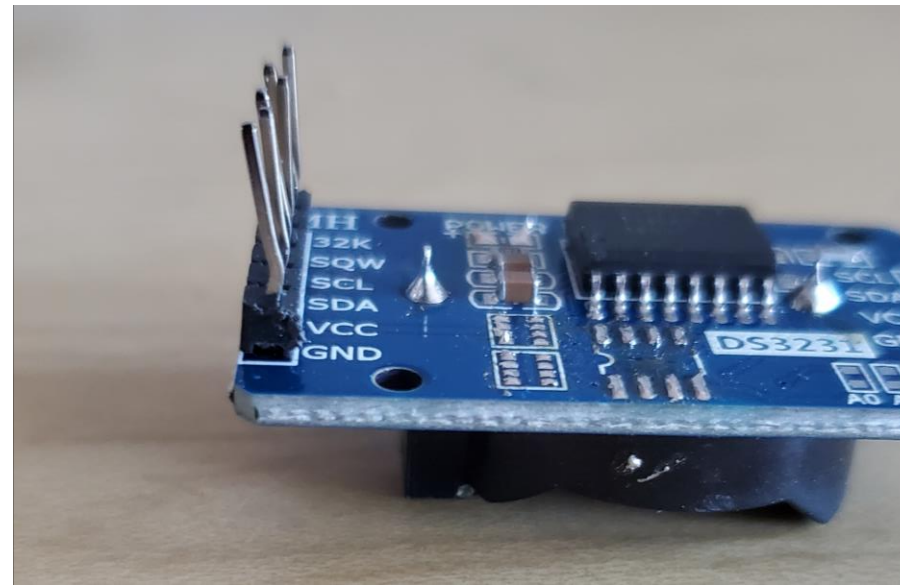
Locate the EEPROM chip.

Desolder the chip from the board. Because the pads are bigger and farther apart, I recommend desoldering one pad (or one side of pads) at a time and using a secondary tool to lift the metal legs of the chip as you desolder it.

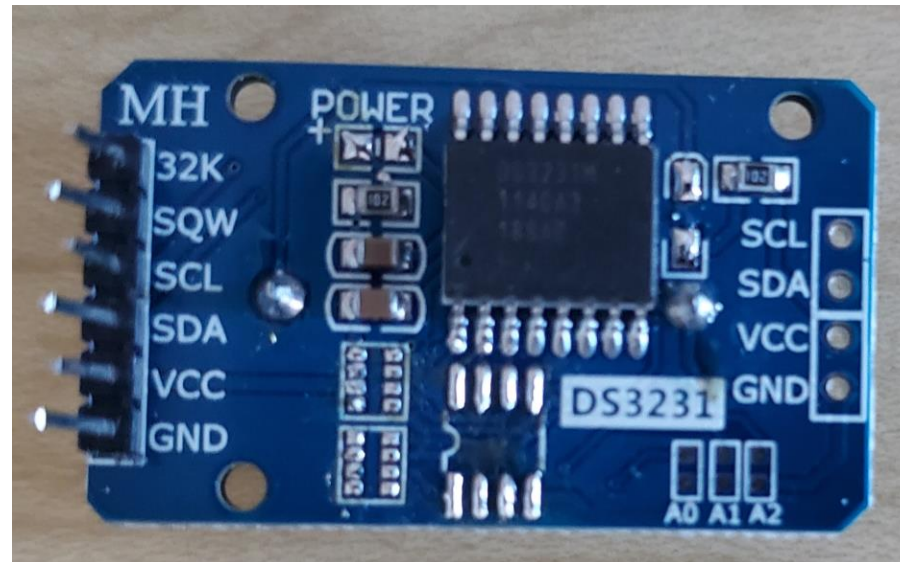## (B) RTC Module Modifications
Step 5: Bend the header pins

Locate the pins on the chip.

Use pliers to bend the pins so that they are perpendicular to the board.

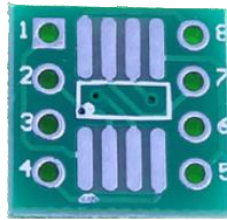

RTC module modifications complete!

(C) Pressure Sensor Assembly
Parts List

1 x MS5803-05BA
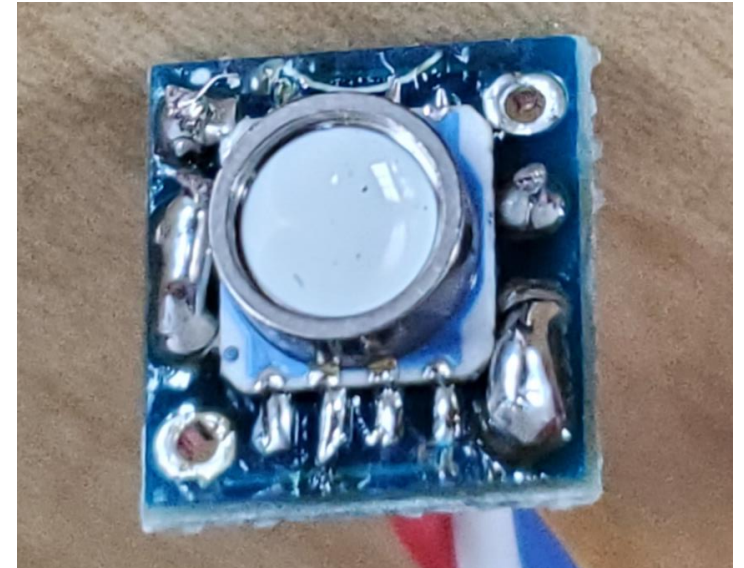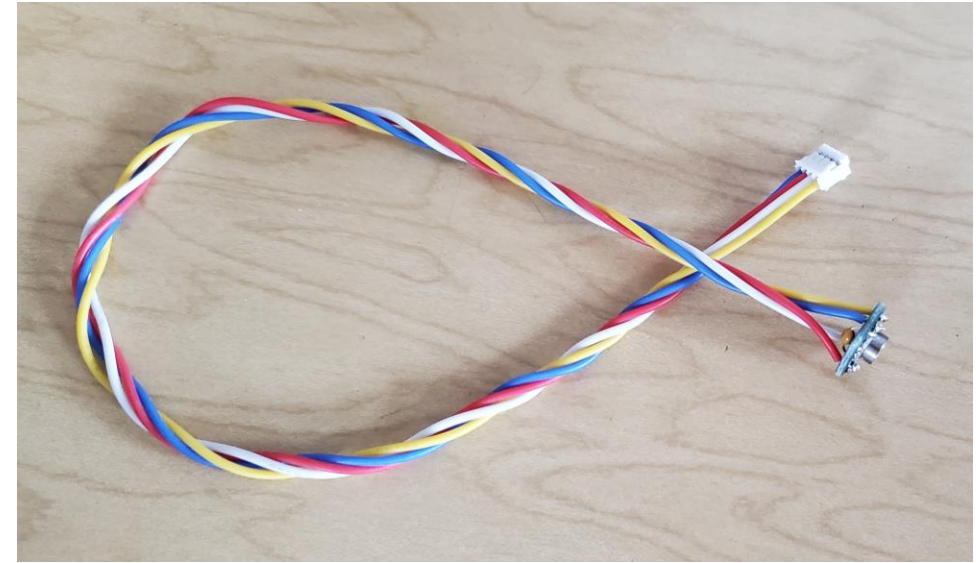Pressure Sensor
Module

1 x SOIC-8 Breakout
Board

1 x 0.1μF Capacitor

1 x 4 pin JST PH
female cable

Assembled Pressure Sensor

(C) Pressure Sensor Overview

The Pressure Sensor sits at the port of the Pressure Transducer Housing. In order for it to communicate with the electronics within the Housing, it must be wired up before we seal it in epoxy.
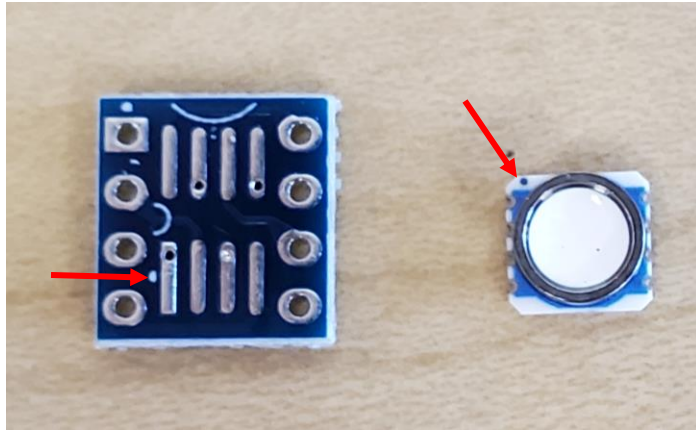
Unlike the other electronics, once the Housing is assembled in later steps, the Pressure Sensor will be inaccessible and therefore impossible to fix if a mistake is made.

So, take your time with these steps and be careful not to overheat the MS5803!
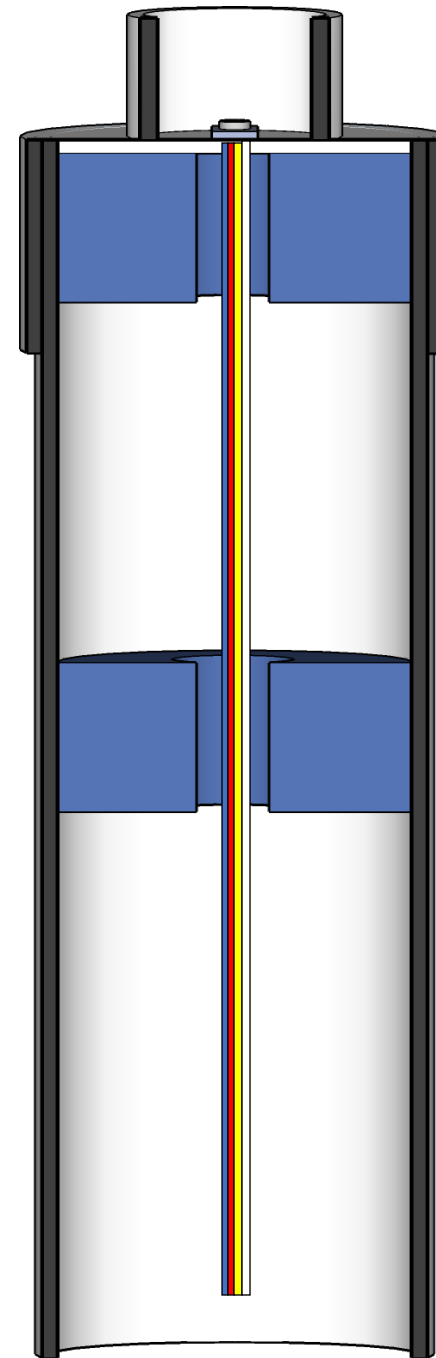
(C) Pressure Sensor Assembly
Step 1: Solder MS5803 to SOIC-8 Board

Start by familiarizing yourself with the orientation of the SOIC-8 Board (left) and MS5803 (right). The small dots (pointed to by arrows above) indicate the first pin position in each component.

Note: My SOIC-8 Board probably looks a little different from yours, however the pin layout should be the same, so the same steps will apply to both.
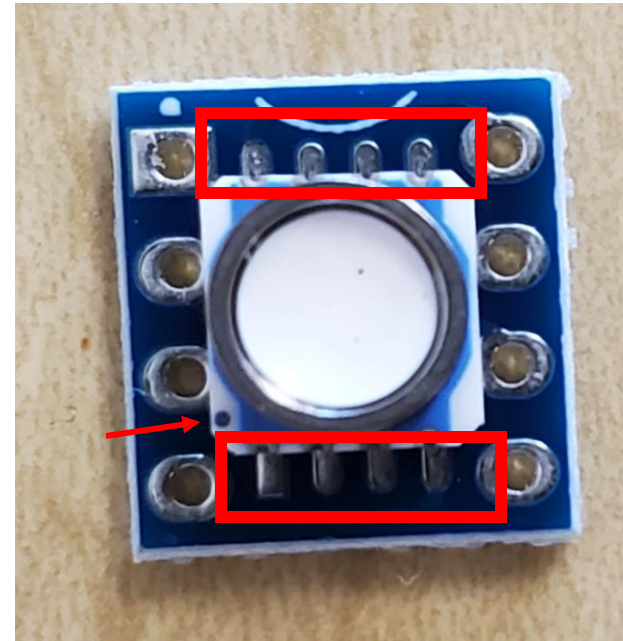

Align the MS5803 on the pads of the SOIC-8 Board. **Orientation matters here:** notice how the two dots indicated in the previous image line up (although one of them is covered in the image).

Also ensure that the pads of the MS5803 line up evenly on the SOIC-8 board. It's very easy to bump things around, so you may end up having to realign everything during the next steps.
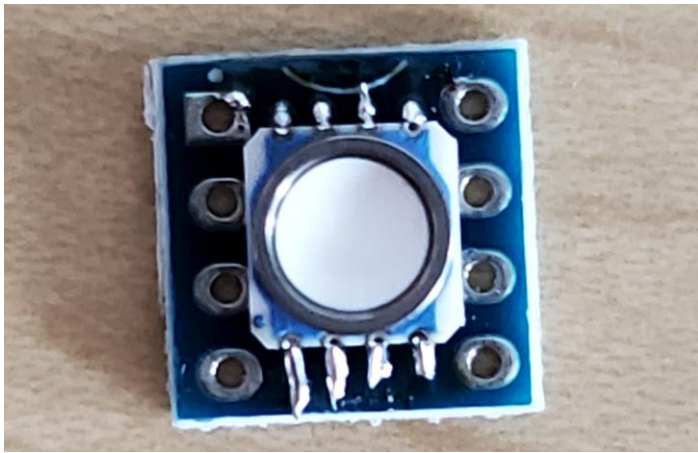
## Parts

1 x MS5803-05BA Pressure Sensor Module
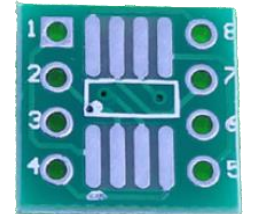
1 x SOIC-8 Breakout Board

Solder the MS5803 onto the SOIC-8 Board. Start by soldering one of the "corner" pads, since these are the easiest, before soldering the remaining pads. This is the trickiest step, because of how easy it is to bump the MS5803 out of place. Here are some tips:

- If you have small clips / clamps, you might be able to use them to hold the component in place.
- Rather than heating the pad and then applying solder, it may be easier to apply a small amount of solder to your soldering iron first. Then you can use this melted solder to make the connection, using your other hand to hold the components in place.
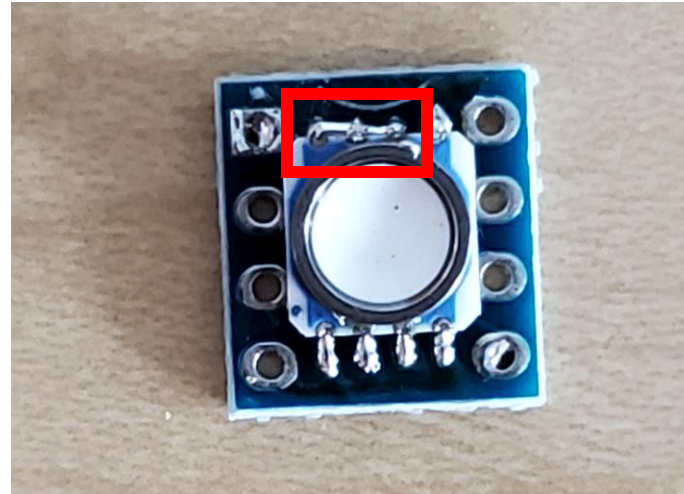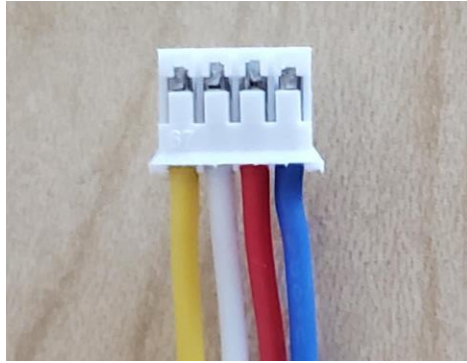

As usual, be careful to avoid bridging pads together.

This first step is probably the trickiest of the entire electronics assembly, simply because of how easy it is to bump the components out of place, and how small the soldering points are. It usually takes me quite a few tries just to get the first pad soldered!

(C) Pressure Sensor Assembly
## Step 2: Solder sensor cable

Identify which colour of your cable corresponds to each connection. Lay your cable **in the same orientation as shown in the image**. From left to right, the connection names will always be:
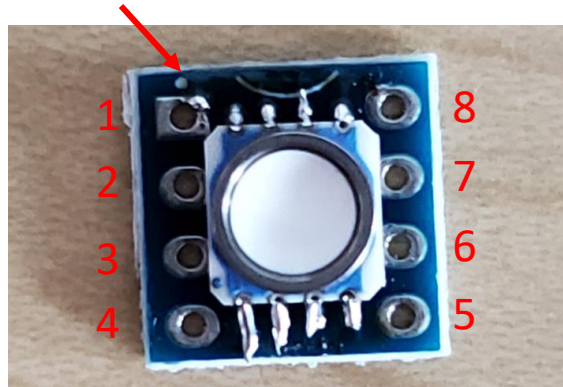SCL, SDA, VCC, GND

So, in this example:

SCL=Yellow
SDA=White

VCC=Red
GND=Blue

My cable probably uses different colours than yours, so be sure not to mix up the wire colours I use here with your own mapping.

1 x 4 pin JST PH female cable
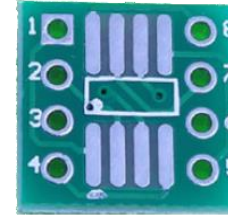
Notice the numbered holes on the SOIC-8 Board. If there are numbers on both sides, refer to the ones on the same side as the MS5803.
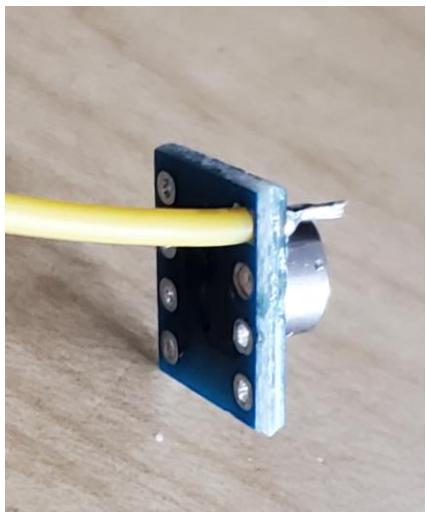

If the holes are unlabeled (like on my board) we can infer the numbers by looking for the dot (see the red arrow). This indicates the first pin, and the remaining pins are labelled as shown.
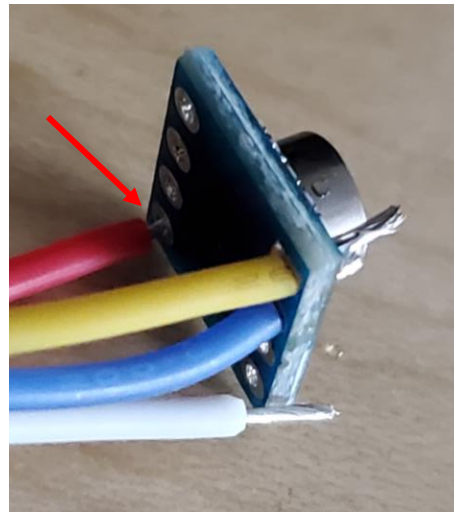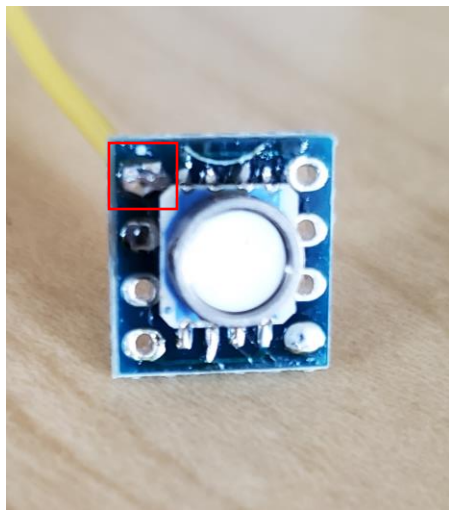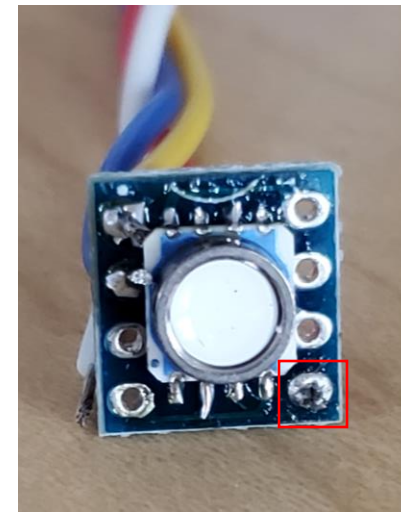
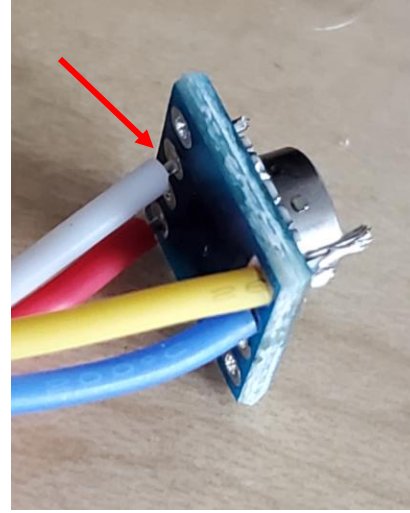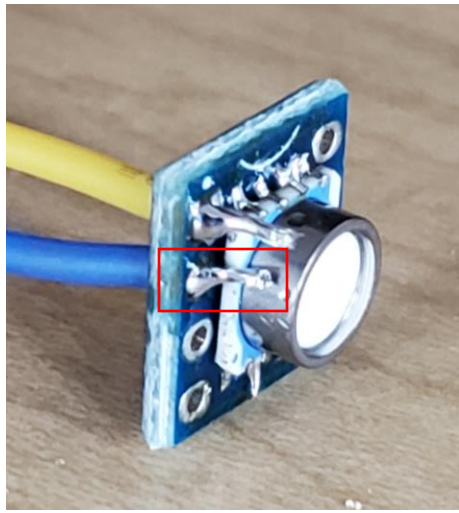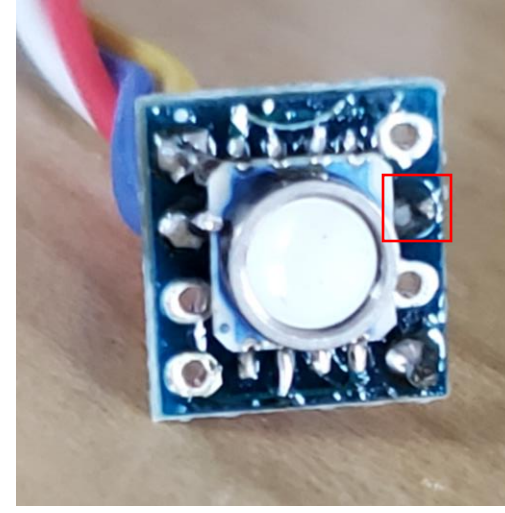Solder your SCL wire into Pin 1.

Solder your VCC wire into Pin 5.

Solder your GND wire into Pin 2.

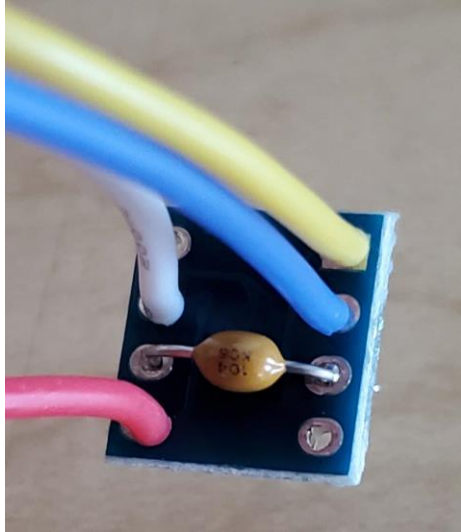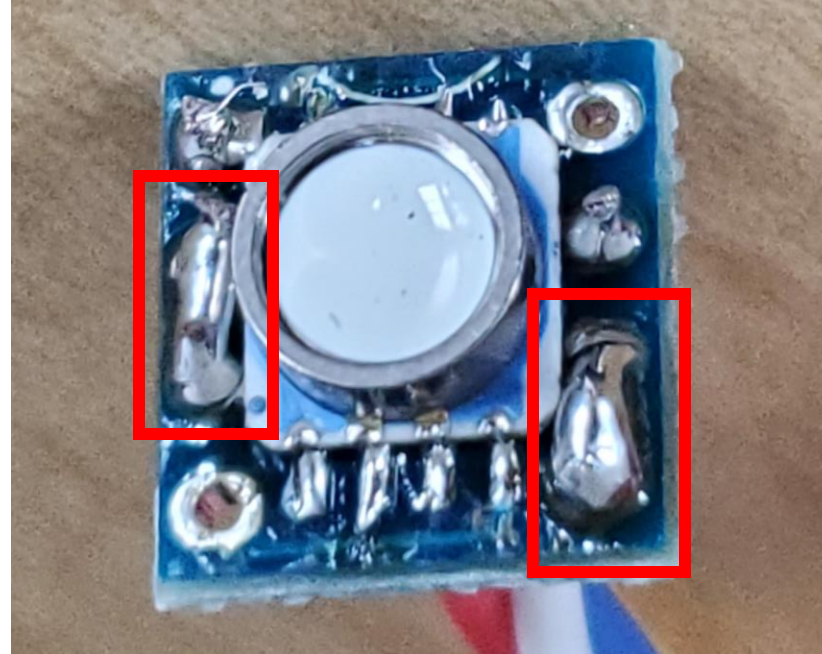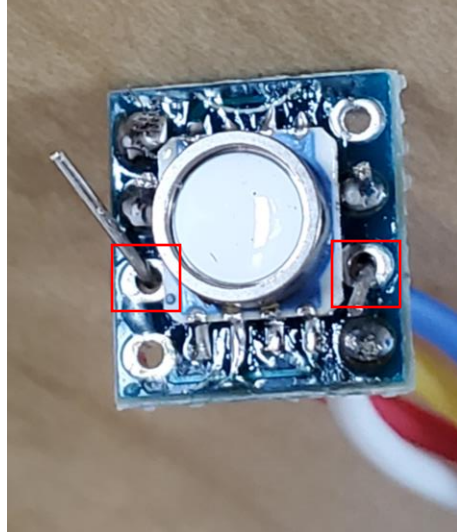Solder your SDA wire into Pin 7.

(C) Pressure Sensor Assembly
Step 3: Solder Capacitor

1 x 0.1µF Capacitor

Bend the leads of the Capacitor and fit it into Pin holes 3 and 6. Cut the excess of the leads of the Capacitor if necessary.

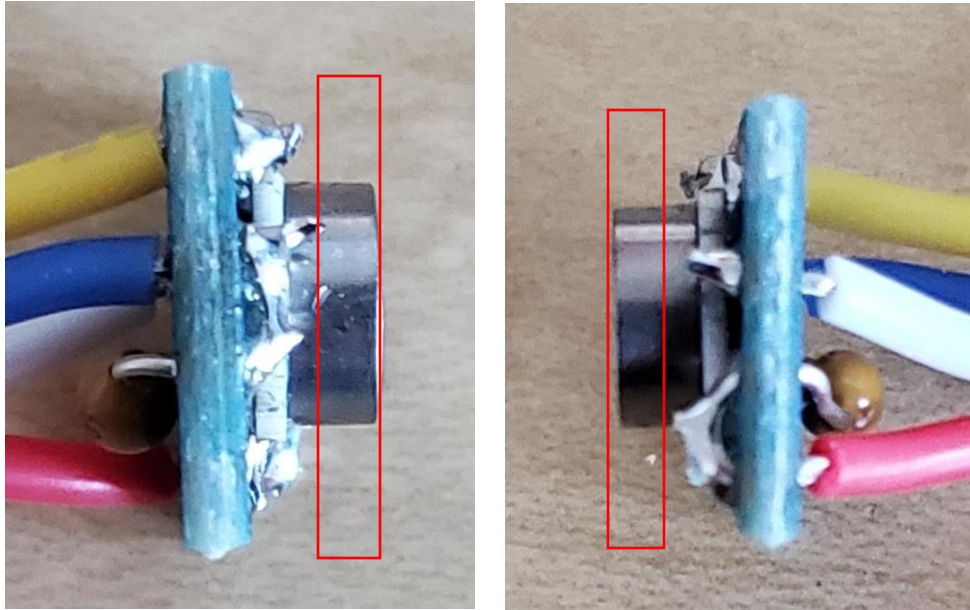Solder the capacitor into place **and bridge pin 2 to pin 3, and pin 5 to pin 6.**
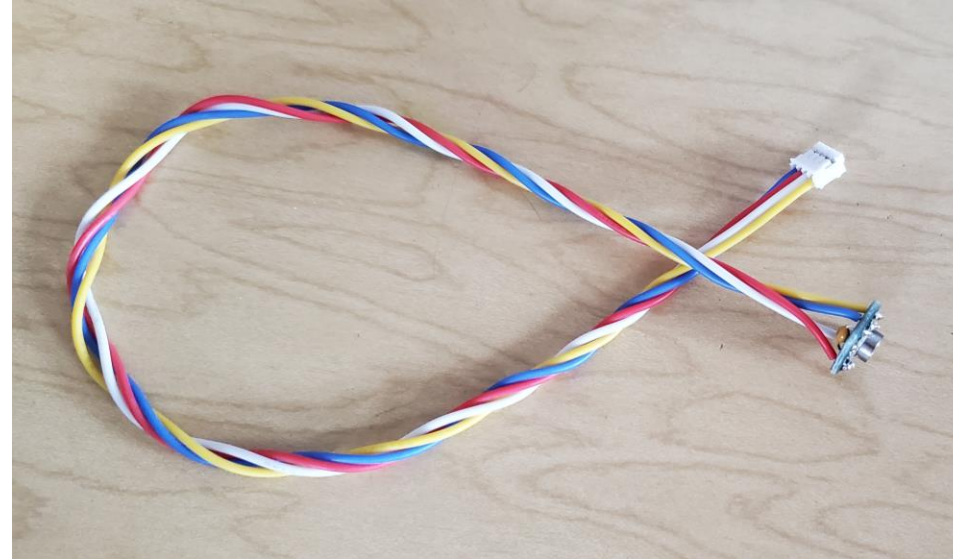
(C) Pressure Sensor Assembly
Step 4: Finishing touches

Use wire cutters and/or pliers to cut/bend any metal pieces that extend past the sensor port (the metal ring around the white sensor in the center).

The image shows a sensor with a good amount of room between the soldered metal and the top of the sensor port.

Pressure Sensor Assembly complete!