# Data Logger Build Documentation

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Required Parts: see MAG_PartsList_V3.xlsx (check for updates)

- Wire in multiple colors for ease of construction

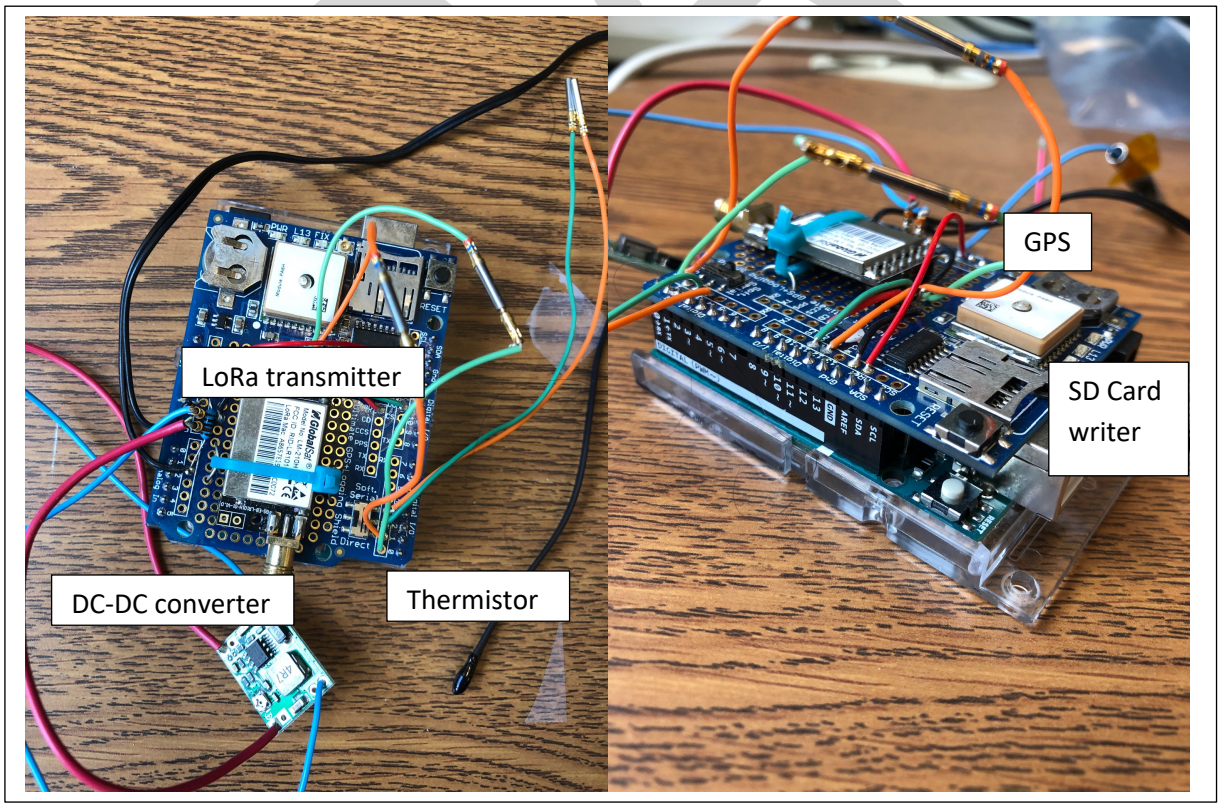
Tools:

- Wire stripper
- Soldering iron and solder
- Wire cutters

Be patience and do not rush! If you are stuck do not get frustrated -- ask for help.

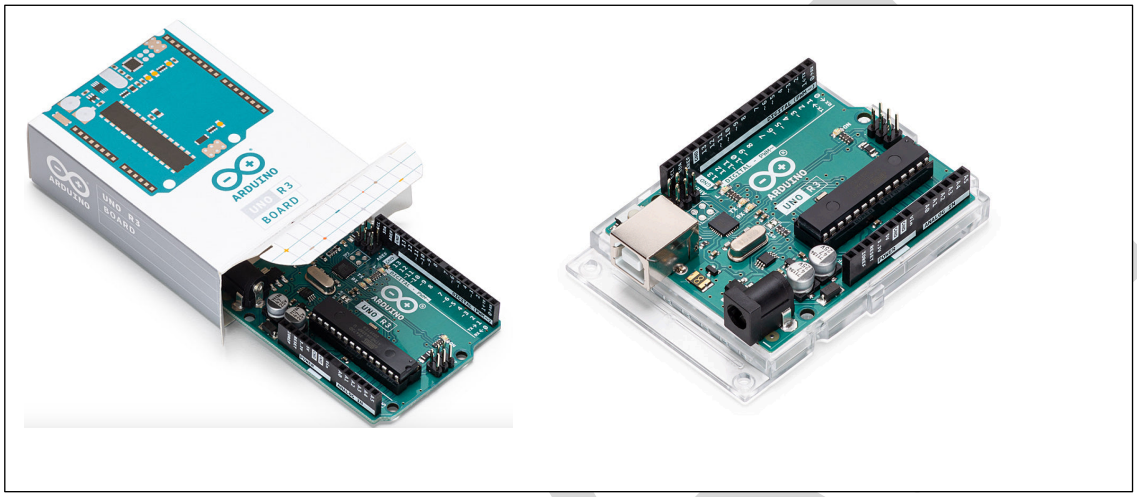
**Purpose of this document:**

The purpose of this document is to provide step-by-step instructions how to build the wireless data logger for a magnetometer unit. This data logger is equipped thermistor to measure the temperature, a DC-DC voltage regulator, a GPS module, a micro-SD card writer, and a LoRa transmitter. An assembled data logger unit is shown and described below in figure 1a and 1b.

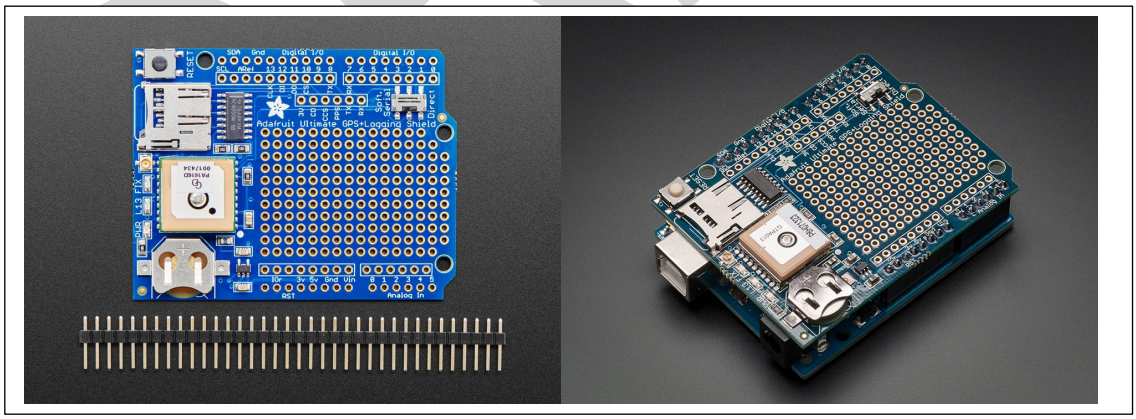


## Arduino Uno

is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. It builds the basis of the data logger (see below):



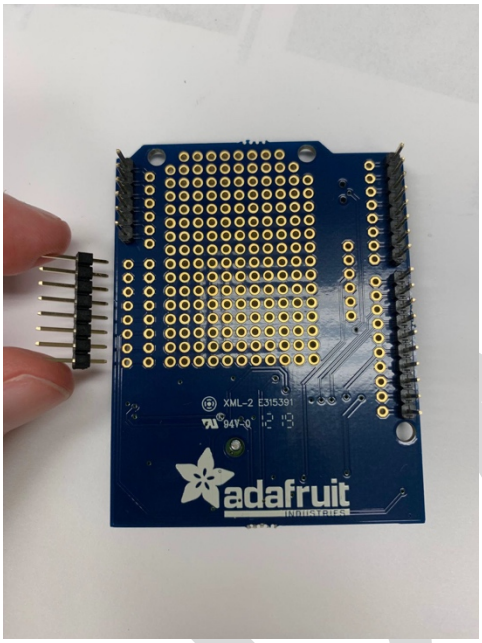
What needs to be built is the logger shield. We need the Adafruit Ultimate GPS Logger Shield - Includes GPS Module (shown in the lower left). Once assembled it will be mounted on top of the Arduino (see lower right).

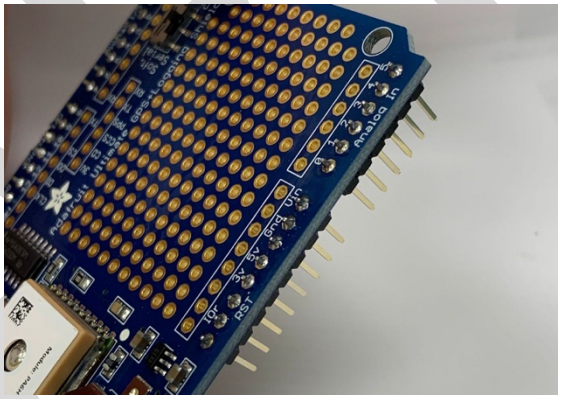


The Arduino is ready to use. There is no soldering required. All wiring and soldering is done at the Adafruit Ultimate GPS Logger Shield which is described below.

BY STEP INSTRUCTIONS

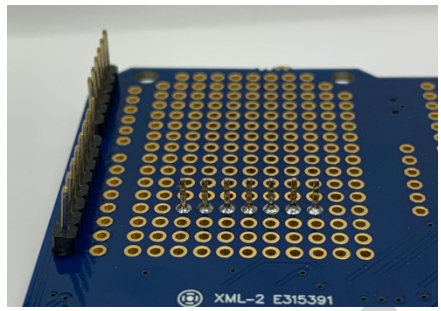
1.) Begin with Arduino UNO type board Adafruit Ultimate GPS logger shield, and pin headers. Cut the pin headers into 4 pieces - one with 6 pins, two 8 pins, and one 10 pins. With the board upside down as pictured, insert the short pin side into the board. Being careful not to melt the plastic, solder the pins into place from the other side of the board.



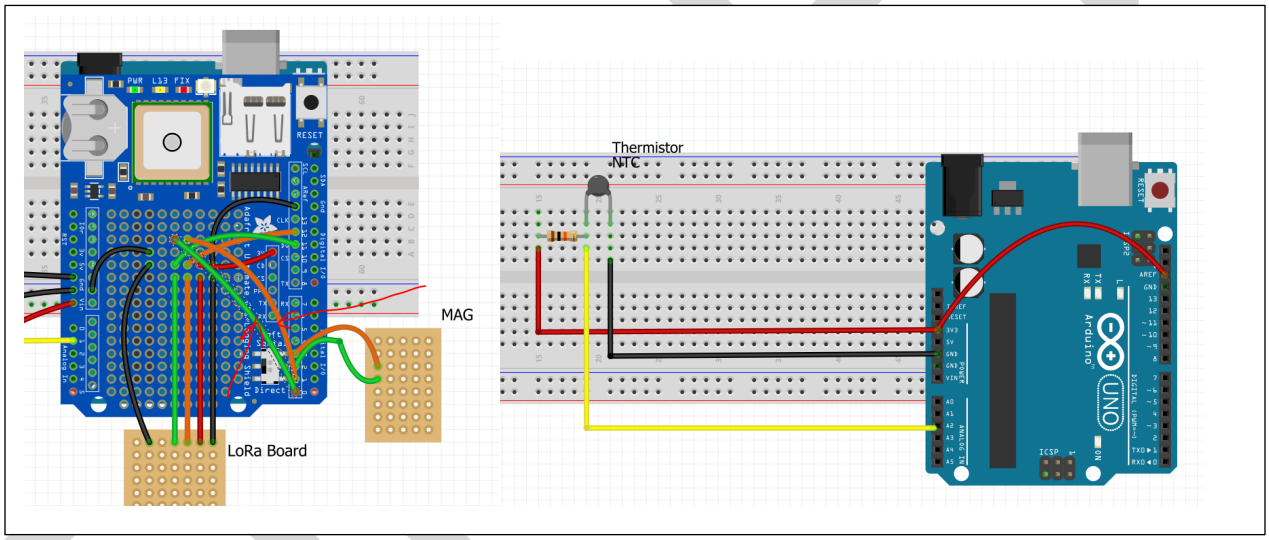



2.) Attach the LoRa board to the Adafruit board. Turn the board so the longer ends of the pin headers are facing the table, and oriented so the pre-attached components are at the bottom like in the image. Insert the LoRa pins in the center of the fourth row from the bottom - the end of the LoRa sticks out from the edge. They should be soldered from the other side.

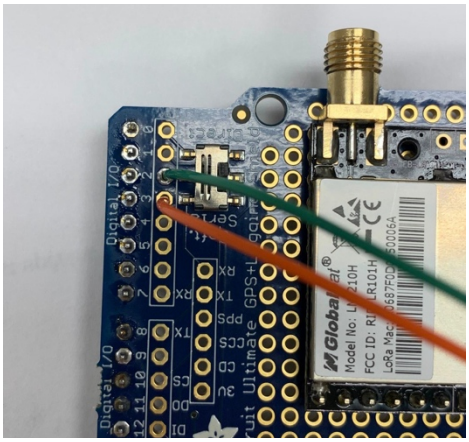
The LoRa won't be flat against the board - solder it so that the pins are straight. This will leave a small gap between the rest of the LoRa and the board.

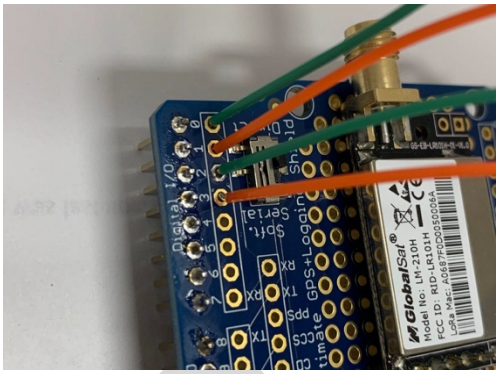



3.) Attach the LoRa board to the Adafruit board. Turn the board so the longer ends of the pin headers are facing the table, and oriented so the pre-attached components are at the bottom like in the image



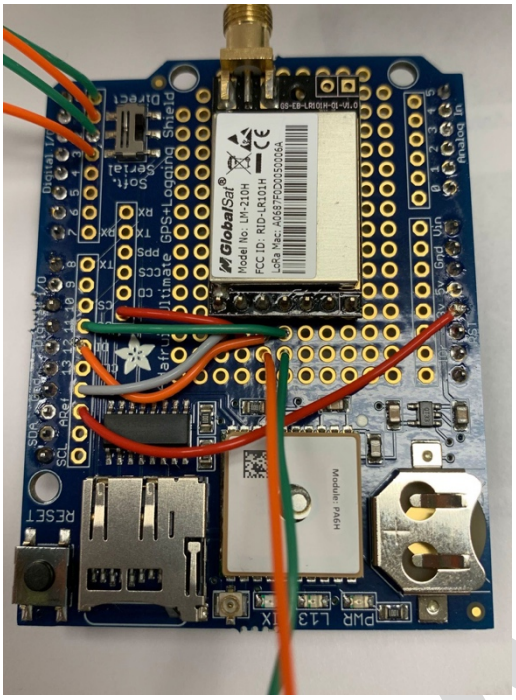

4.) Cut four pieces of wire - two of one color and two of another, around five inches long.





The wires will go into the 0, 1, 2, and 3 holes. Strip the ends of the wires. Insert the wires from the LoRa side of the board, and solder on the other side. Have 0 and 2 be one color, and 1 and 3 another color.

5.) This step is complicated at first but should be done in parts. This first image is what the board should look like after this entire step is completed.




a.) Begin by cutting a ~3 inch wire to use for the red wire in the image. Strip the ends of the wires and wrap one end around the pin labeled "3v" on the right and solder it in place. Insert the other end into the hole on the left labeled "Aref" and solder it from the other side of the board.

b.) For the next several cables, the cable management is easiest when the wires are as short as possible. Read this entire step, and then decide the easiest order to put them in. Instructions are given by the color they are in the example image.

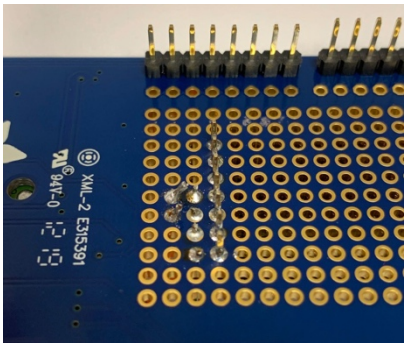
Gray wire: Left side inserts into hole on the left of the board between "ARef" and 13. Right side inserts into the first hole on the left, directly underneath the LoRa.

Red wire: Left side inserts into hole labeled "3V" on the left of the board. Right side inserts into the second hole from the left directly underneath the LoRa.

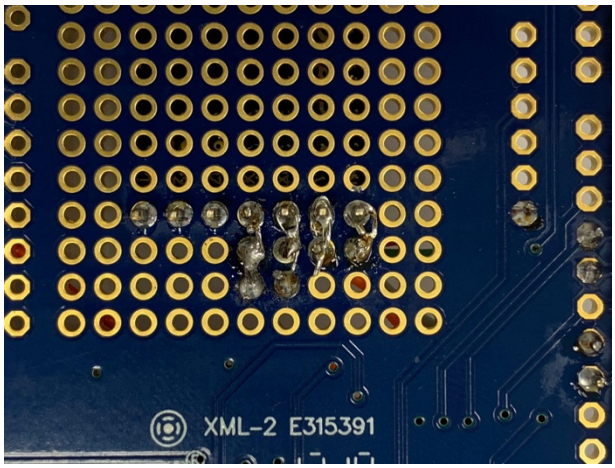
Orange wire: Left side inserts into hole labeled 12. Right side inserts into the third hole from the left directly underneath the LoRa.

Short green wire: Left side inserts into hole labeled 11. Right side inserts into the fourth hole from the left directly underneath the LoRa.

c.) Cut two longer wires of two different colors. As seen in the image, one wire should go fourth from the left underneath the LoRa, and one should go third from the right underneath the LoRa. The row in this step is the one directly below the one in step b. The image below shows what this looks like from the bottom.



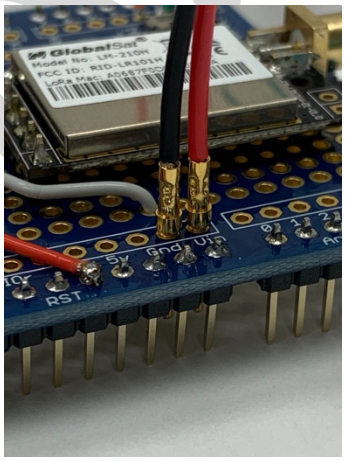
6.) Next, the connections on the back of the board need to be connected. With the board oriented to have the LoRa at the top, the wires on the back should be connected vertically.



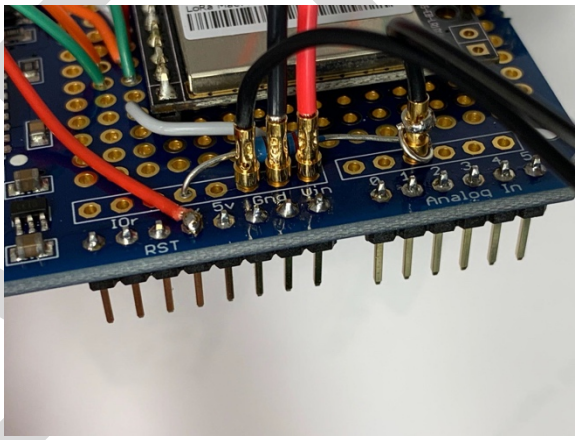

In the image, they are connected by wrapping a wire around it and soldering that into place. Be careful when soldering these together not to let the wires slip out as you heat the solder.

7.) Cut two longer lengths of wire at a thicker gauge - one black, and one red. These are for power. Crimp male connectors onto the ends after stripping them, that fit snugly into the holes on the boards. Insert them on the LoRa side of the board and solder underneath.

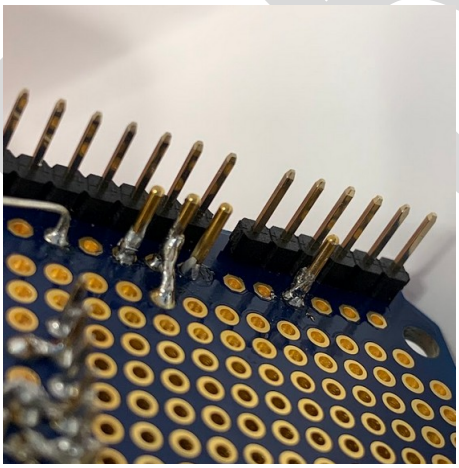

The black wire should go into “Gnd,” and the red one into “Vin,” on the right side of the board. Cut another short wire - this should insert on one side into the row directly underneath the LoRa, second from the right. The other end should insert into the hole to the left of where the Gnd wire is connected. These can be seen in the images.



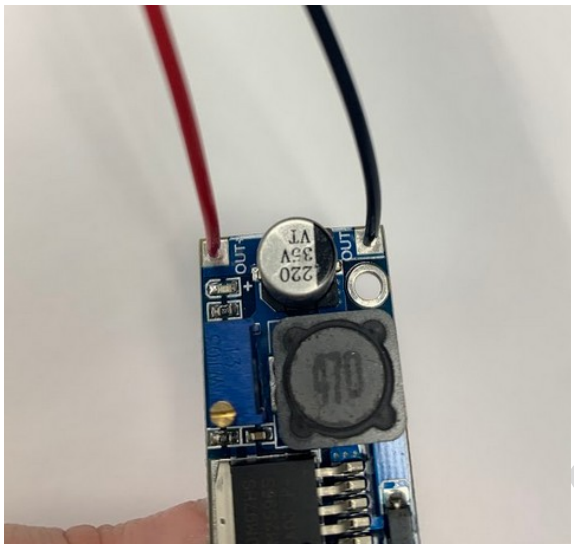

8.) Next, the temperature sensor and a resistor need to be connected. The two wires coming out of the temperature sensor both need to be stripped on the end and have male connectors crimped onto them. One end should be inserted into the hole directly below the Gnd hole (LoRa at the top of the board). The other should be inserted into the hole labeled 2, on the right of the board. A 120 ohm resistor should next be connected. One end should connect to the temperature sensor wire that is in hole 2. The other end should go through the hole to the left of the one marked 3v (that has a wire soldered onto it). See the image for resistor orientation.

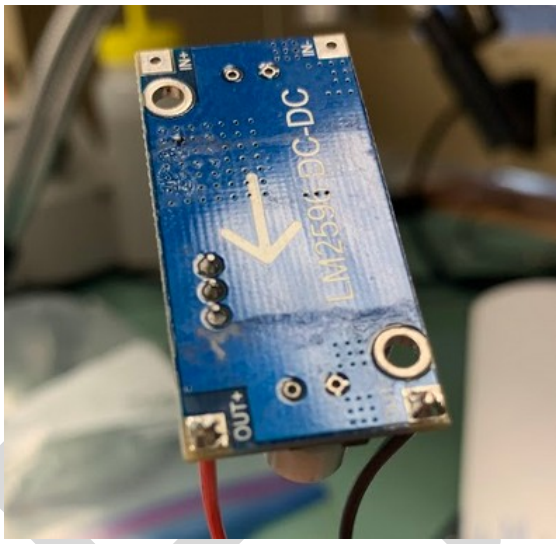



9.) The gray wire from step 6 should be soldered underneath the board to connect to the male connector in the Gnd hole. See image for example.

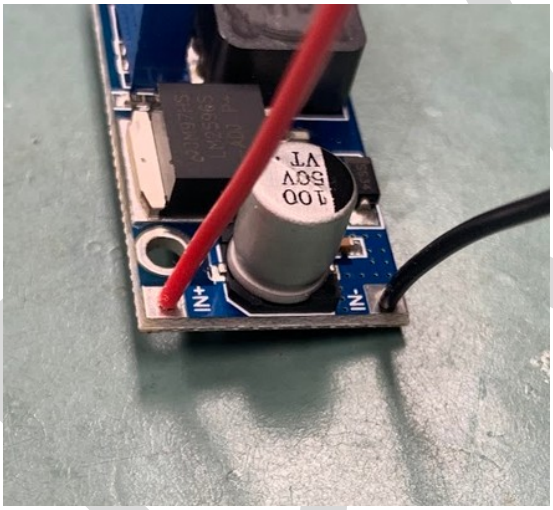


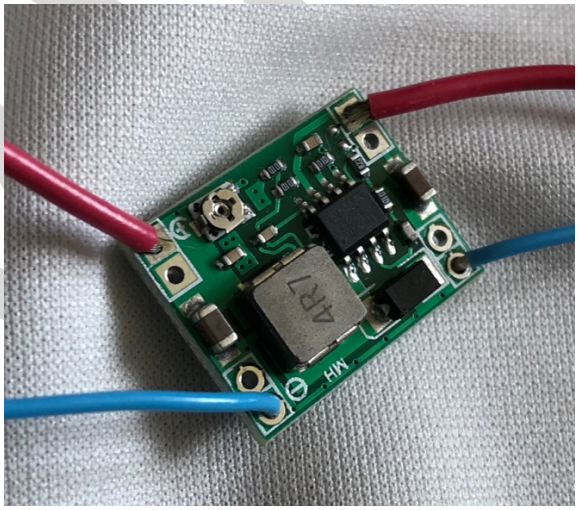
10.) Attach the longer red and black wires that are soldered into Vin and Gnd respectively onto the voltage regulator. Red into OUT + and black into OUT -.



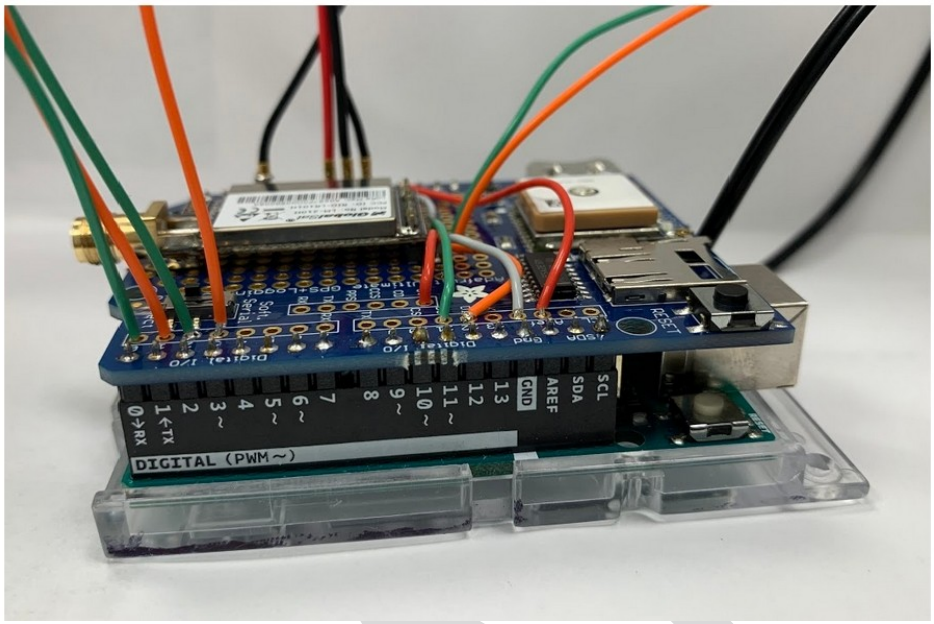

11.) Cut two more long lengths of red and black wire. On the other side of the voltage regulator, solder the red onto IN + and black onto IN -.



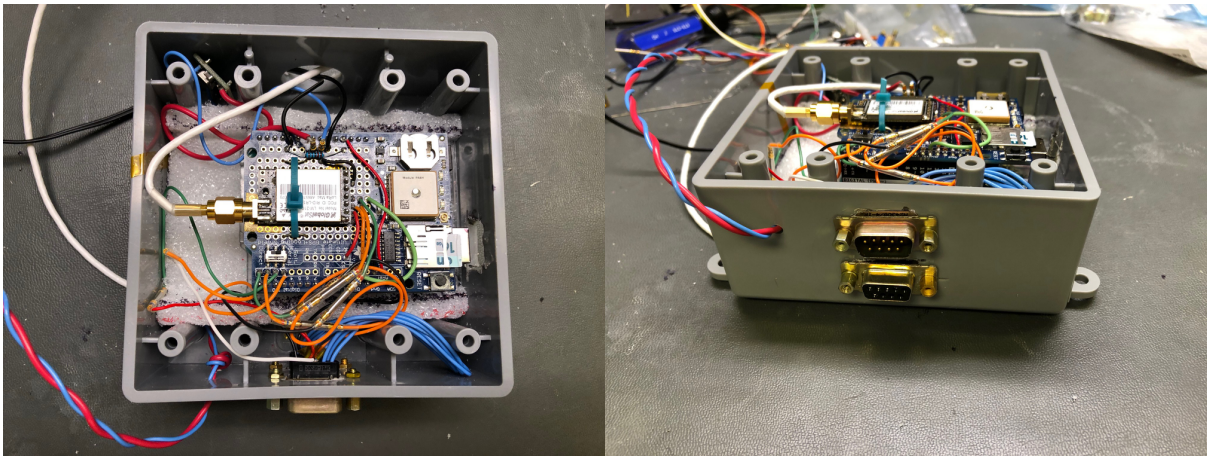

Note: There is a variety of these so-called Buck converters and almost all can be used but it is highly recommended to use those listed in the parts list.

12.) Attach the Adafruit board onto the Arduino using the pin headers. They should fit.




The data logger is now fully assembled and need to be placed in a protective housing. We used a plastic electrical junction box (2-Gang 32 cu. in. Type FSE Switch Box Gray) with a screw-on cover.

That box needs to be modified to fit into the electronics compartment and to accommodate the DB-9 connectors and the harness. We will provide this box and the connectors.



Congratulations! The data logger is now finished!

## Data logger software upload and configuration:

The Arduino Software (IDE) is an opensource software that makes easy to write a code and upload it to the board. However, it can become cumbersome for people who are not familiar with uploading software and code writing.

**We therefore ask you to return the assembled data logger to UNH. We will inspect it, upload the software, and make some functional tests.**

**We also offer to finish the data logger assembly if people cannot finish it.**

**PLEASE LET US KNOW**