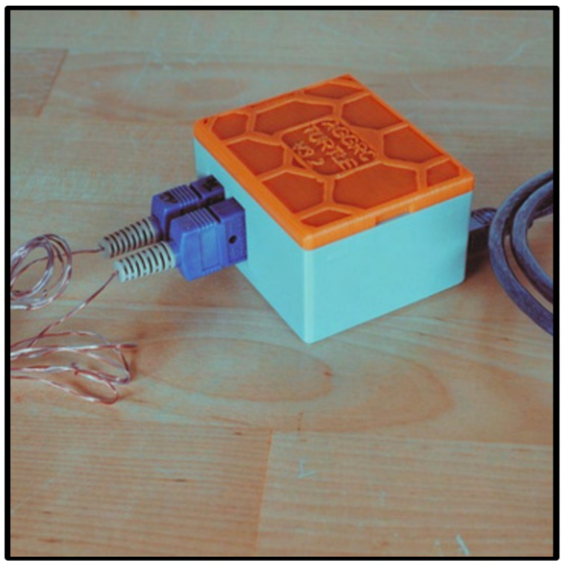
Aquatic Germplasm and Genetic Resources Center	**INSTITUTION** LSU AgCenter	**PROCEDURE ID:**
	MANUAL Open Hardware	**EFFECTIVE DATE:**
	SUBJECT TURTLE V3.6.3 User Manual	**REVISED/REVIEW:**

TURTLE V3.6.3 User Manual

AGGRC



Technical Support:

Cole Brumfield, (CBrumfield@agcenter.lsu.edu)

Please send us your comments and suggestions!

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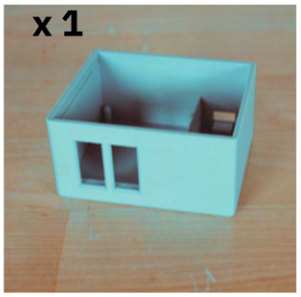
TURTLE Materials List

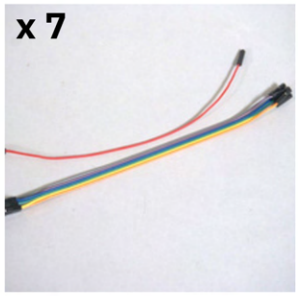


Case (Base)

***Required**

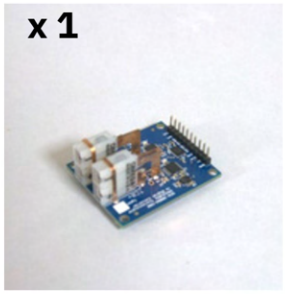
Case (Cover)

***Required**



Breadboard wires(female-female)

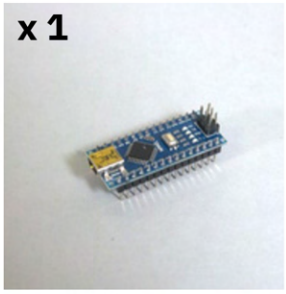
***Required**



2-Channel MAX31856 Breakout

***Required**

Link: https://www.playingwithfusion.com/productview.php?pdid=62&catid=1004



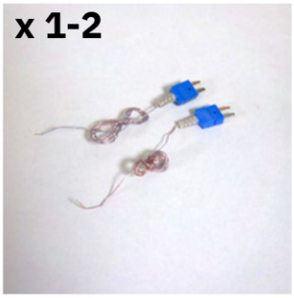
Arduino Nano (ATmega328P)

***Required**

Example: https://www.amazon.com/Arduino-A000005-ARDUINO-Nano/dp/B0097AU5OU?ref_=ast_sto_dp

USB-A to Mini USB Cable

***Required**



T Type thermocouple

***Required**

***3-D files can be found at:**
https://github.com/aggrc/TURTLE

AGGRC

***Note:** Color will vary for 3-D printed parts and breadboard wires

Downloading Files

Step 1: Download the Files

Navigate to the GitHub:
https://github.com/aggrc/TURTLE/releases/tag/V3.6.3

From there download:

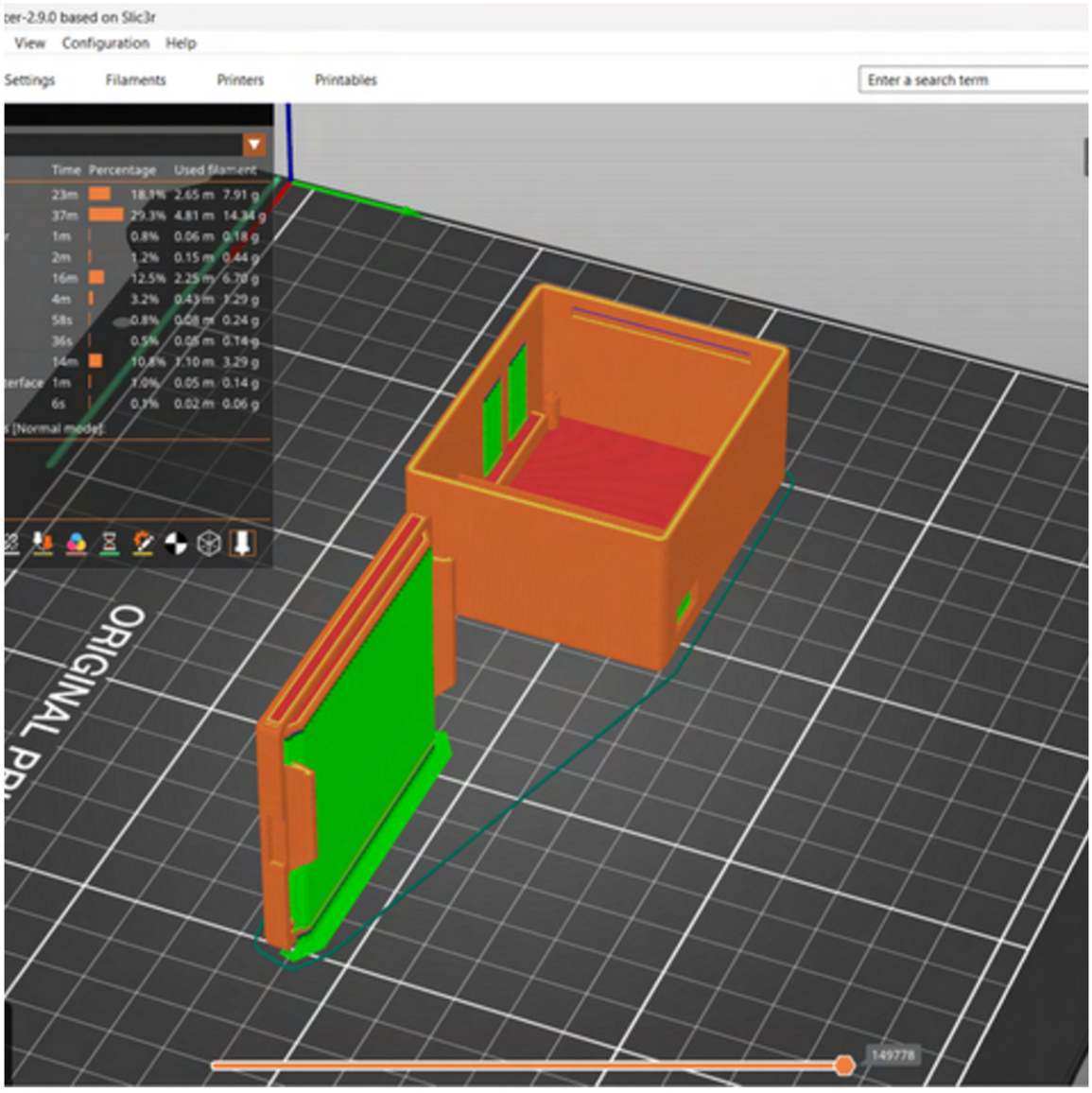
1. **TURTLE.App.Installer.exe**
2. **Source code (zip)**

Extract the downloaded folder named TURTLE-3.6.3

Step 2: Find stl files

Within the extracted folder navigate to the folder named **TURTLE_CaseV2.** This is where you can find the .stl files to print the TURTLE case.

Printing Orientation



It is recommend to print the case in this orientation. Supports are also necessary (in green)

Assembly

Step 1: Attach Wires between boards

Using breadboard wires make the following connections between the **Thermocouple Board(MAX31856)** and the **Arduino Nano**.

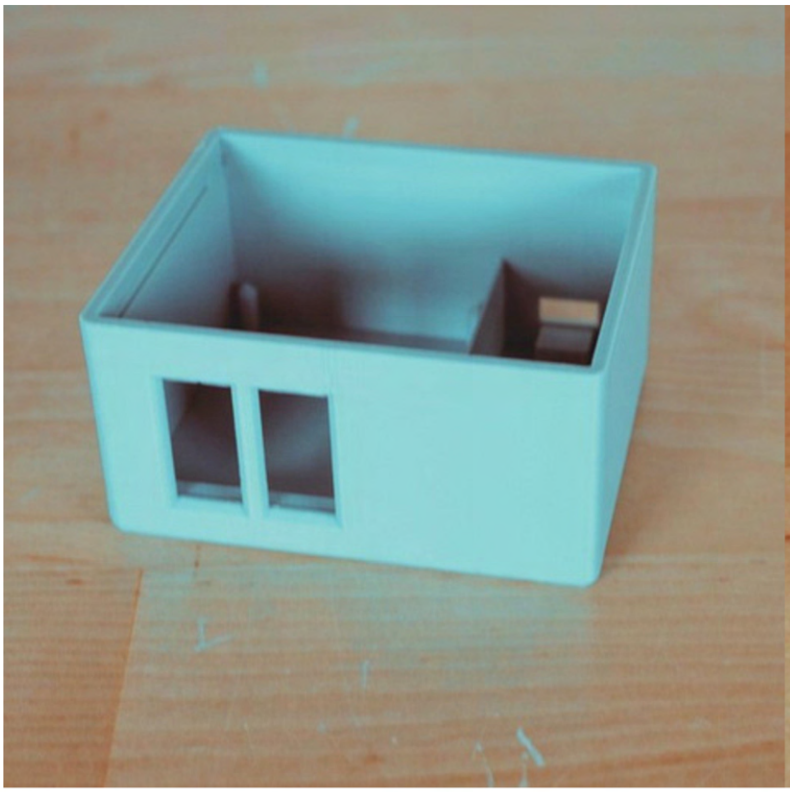
***Note:** Breadboard wire color may vary

Thermocouple Board	Breadboard Wire	Arduino Nano
GND		GND
V+		VIN
CS0		D9
SCK		D13
SDO		D12
SDI		D11
CS1		D10

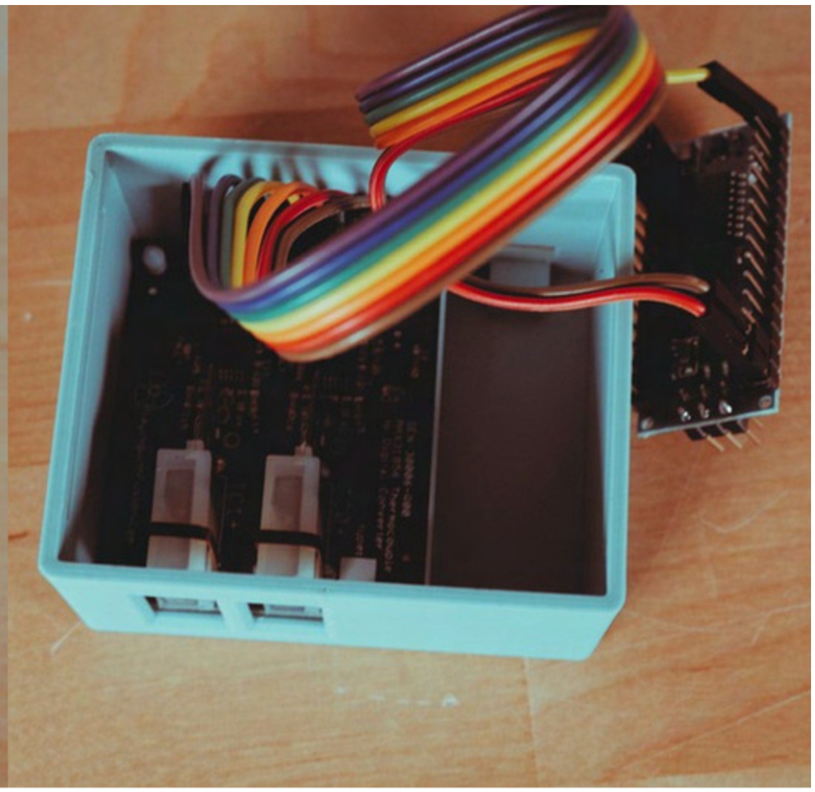
Assembly

Step 2: Orientate the MAX31856 inside of the case

Push the **MAX31856** board into the left side of the case.



Before

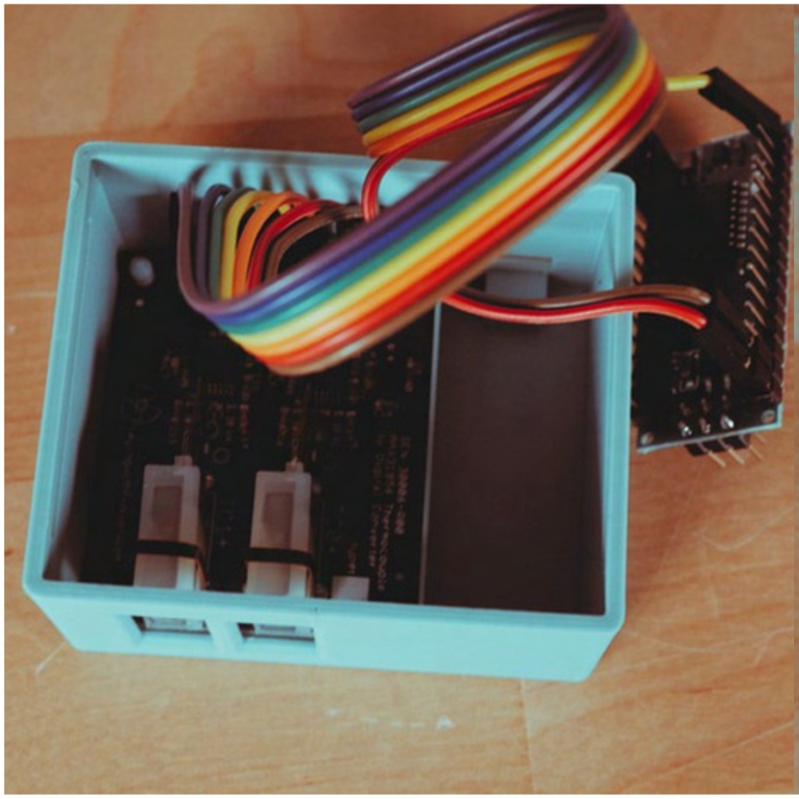


After

Assembly

Step 3: Orientate the Arduino Nano inside of the case

Push the **Arduino Nano** into the right side of the case. Make sure the Arduino Nano is pushed down enough so that the port can be accessed.



Before

After

Assembly

<u>Step 4</u>: Snap on cover

Snap the cover onto the case. It is easier to start with one side alligned.

Before

After

Uploading Arduino Code

Step 1: Download the Arduino IDE

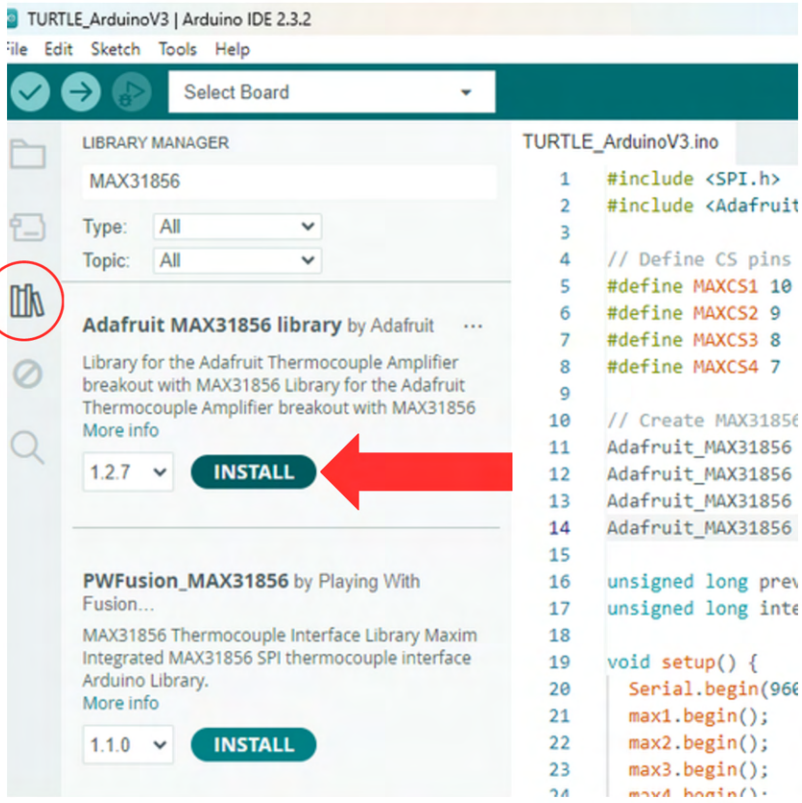
Download the Arduino IDE here: **https://www.arduino.cc/en/software**. Once downloaded, install the program.

Step 2: Open Arduino Code

Navigate to the folder you extracted earlier ("**TURTLE-3.6.3**"). From there open the file named "**TURTLE_ArduinoV3.ino**" using the Arduino IDE

Step 3: Install Libraries

Inside the Arduino IDE click on the icon (that looks like books) on the left. Type in the search bar "**MAX31856**". Click install or install all under the version titled "**Adafruit MAX31856 library**".

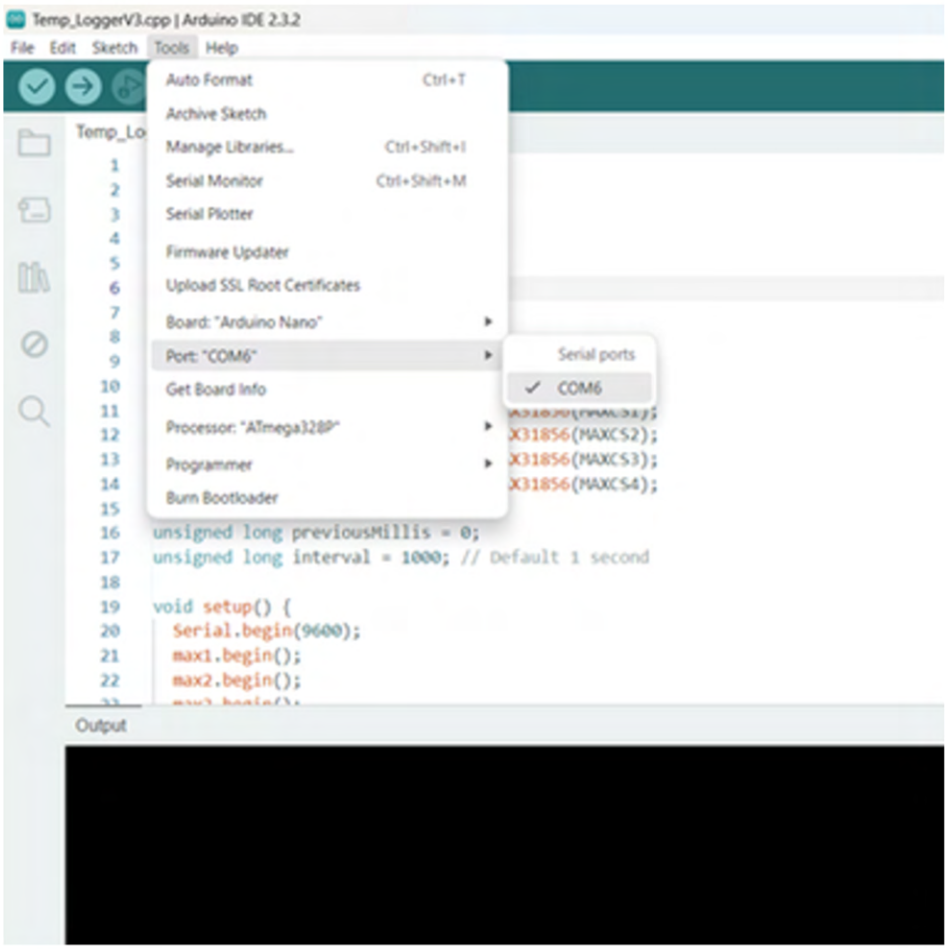


Uploading Arduino Code

Step 4: Selecting port

Plug in the TURTLE Device to your laptop/pc using the USB cable. Inside the Arduino IDE push the "**Tools**" drop down menu. Select "**Port**:". From there select the port assigned to your Arduino.

***Note:** Multiple ports may appear (from mice, keyboards, etc.). If you are having trouble finding the correct port continue to the next page.

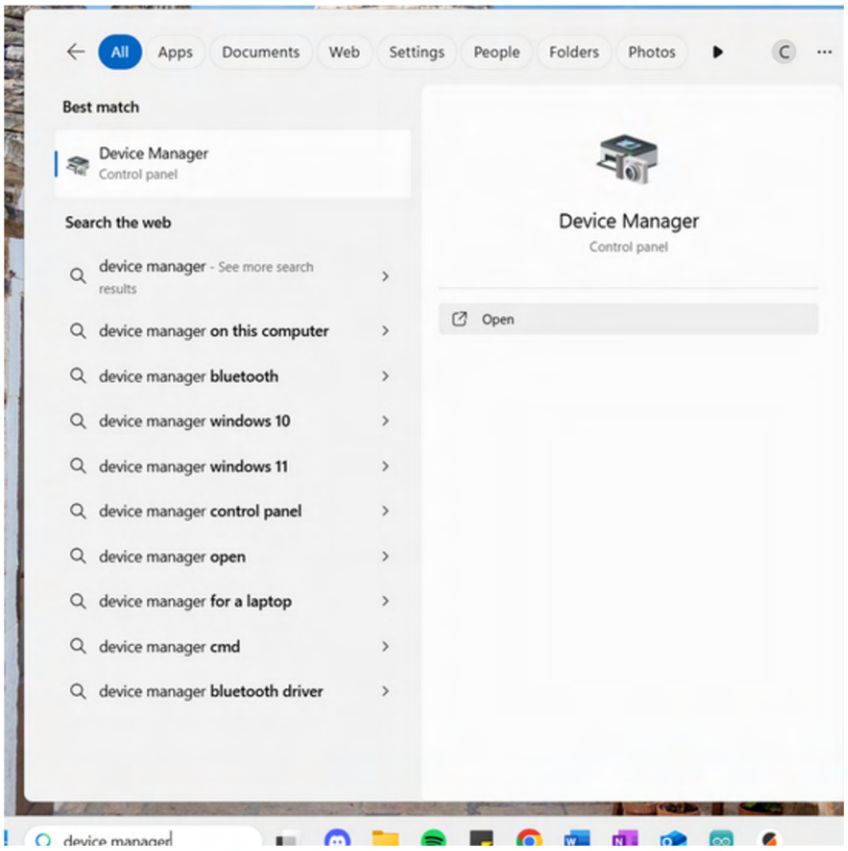


Uploading Arduino Code

*__Note:__ If you have already found the correct port you may continue to the page 13

Navigate to Device Manager

In the windows search bar enter device manager and open the program

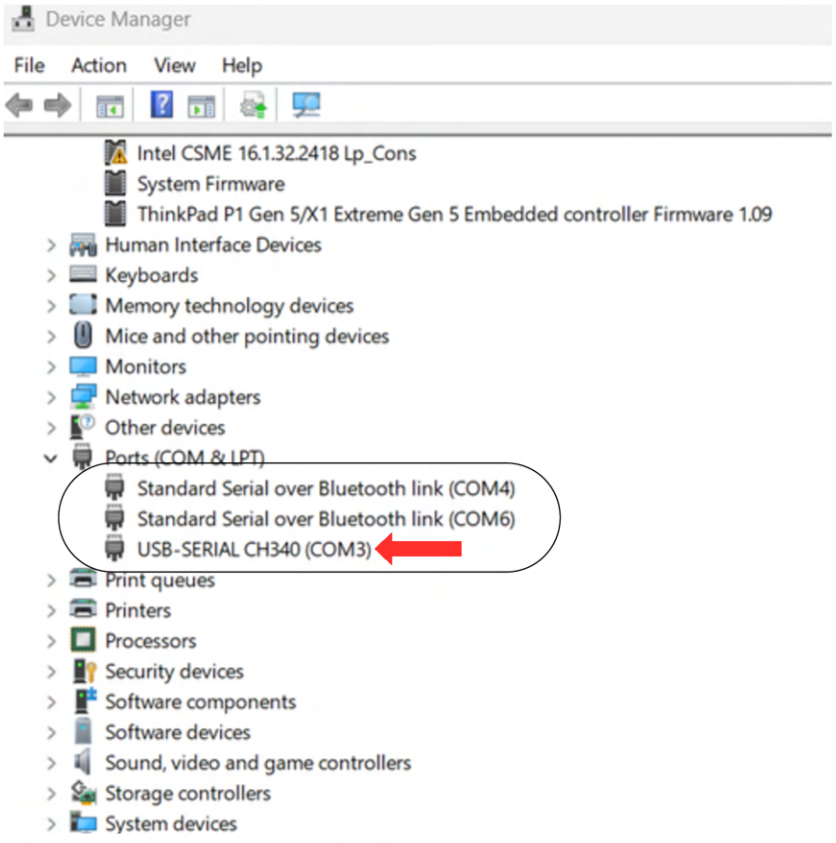


Uploading Arduino Code

*__Note:__ If you have already found the correct port you may continue to the page 13

Find the ports

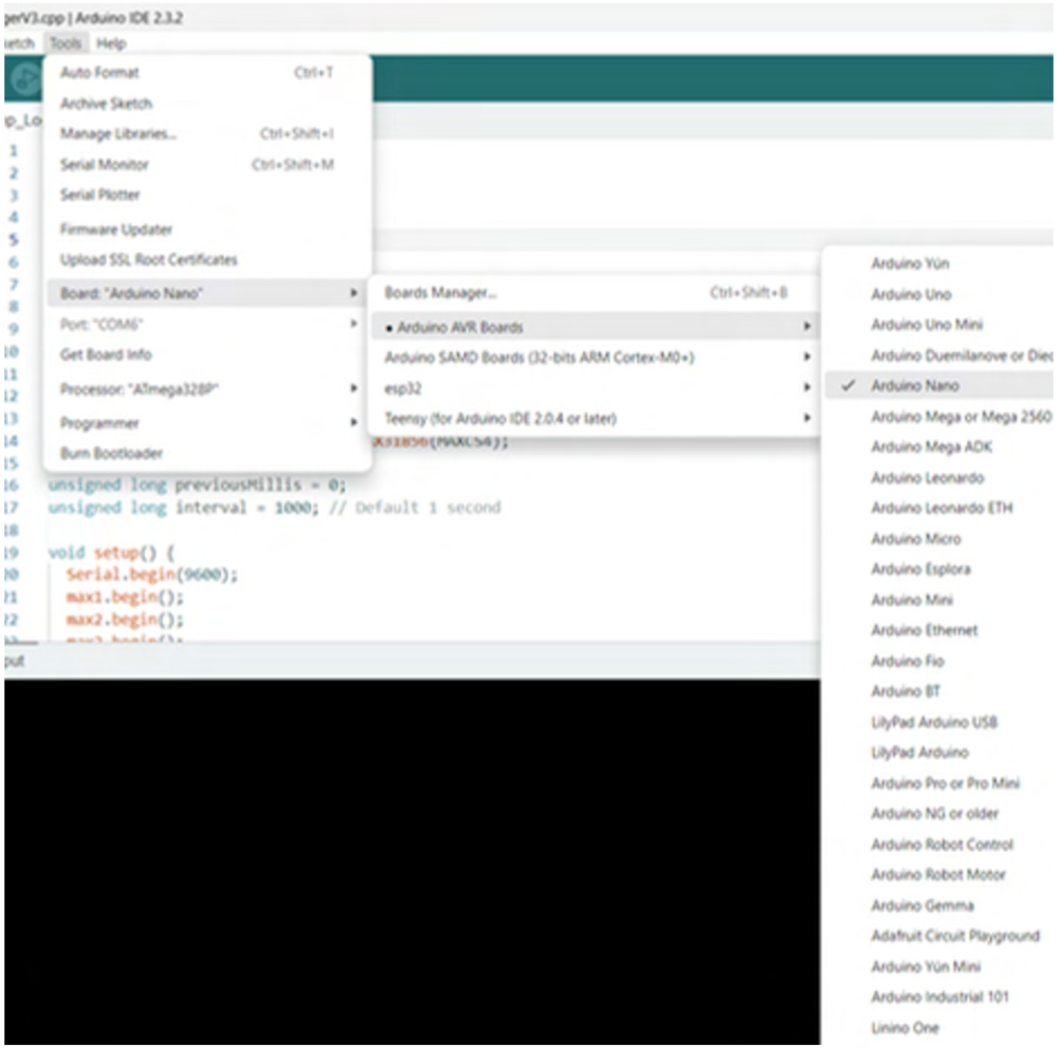
Scroll down in the device manager until you see ports. The port connected to the Arduino will say something like USB-SERIAL CH340 (COM#). Make sure to remember the COM# as this is the port you will use in the arduino IDE.



Uploading Arduino Code

Step 5: Selecting Board

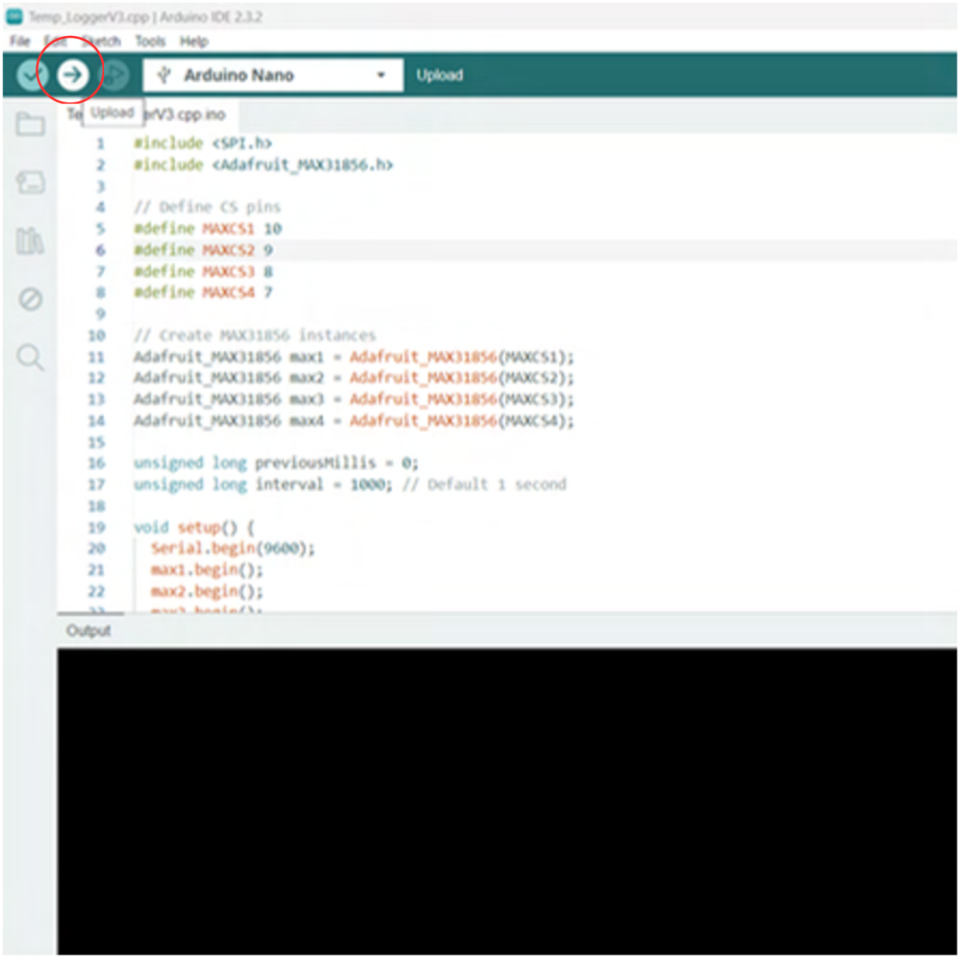
Push the “**Tools**” drop down menu. From the tools drop down navigate to “**Board**:” and then “**Arduino AVR Boards**” and select “**Arduino Nano**”



Uploading Arduino Code

Step 6: Uploading Code

Finally push the arrow button at the top left of the screen which will flash the code onto the Arduino.



TURTLE App Setup

Step 1: Download the Driver

Navigate to the folder extracted earlier (“TURTLE-3.6.3”).

Then extract the folder named Windows-CH340-Driver. Open that extracted folder, and inside you will find a file named SETUP. Double-click SETUP to install the driver, which allows your laptop or PC to connect to the TURTLE device.

Step 2: Download the App

Navigate to the file downloaded earlier: (“TURTLE.App.Installer.exe”).

Run **TURTLE.App.Installer.exe**. Make sure to check the “**create desktop shortcut**” check box. This will download the files needed for the app as well as a desktop shortcut on your device. Once complete you can delete the installer.

Regular Use

*__Note:__ The TURTLE must be connected to a laptop/pc at all times to function. The TURTLE has no on board memory or power yet.

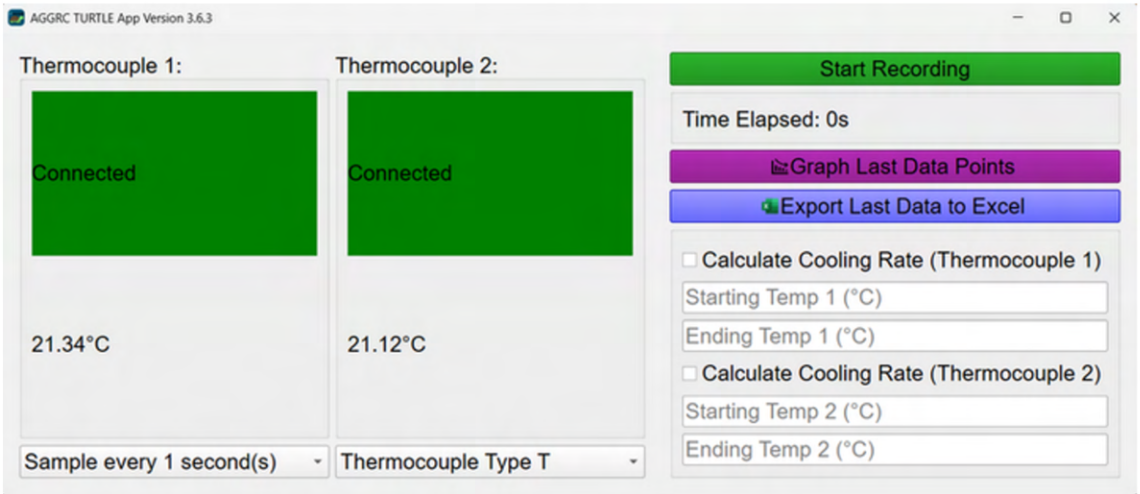
Regular Use:

To ensure the TURTLE operates smoothly, follow these steps in order when using the device:

1. Connect the thermocouple(s) to the TURTLE.
2. Connect the TURTLE to your laptop or PC using a mini-USB to USB cable.
3. Double-click the TURTLE application to launch it.

If the device and software are connected correctly, the program window will appear as shown below. All connected thermocouples will automatically begin displaying live temperature readings.

*__Note__: Data is not recorded until you click Start Recording.

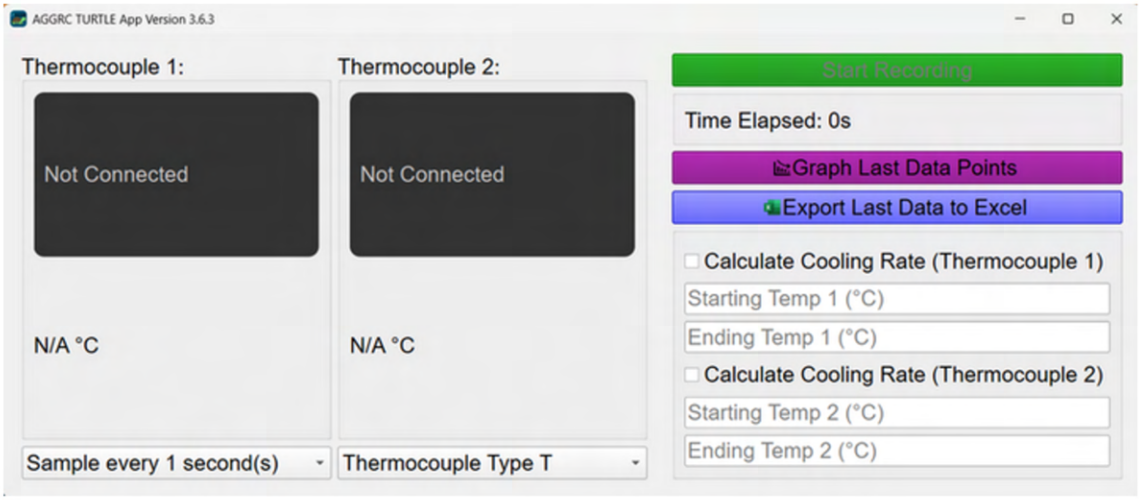


Regular Use Troubleshooting

Regular Use Troubleshooting:

If the program appears as shown below, even though the TURTLE and thermocouples are connected, try the following steps:

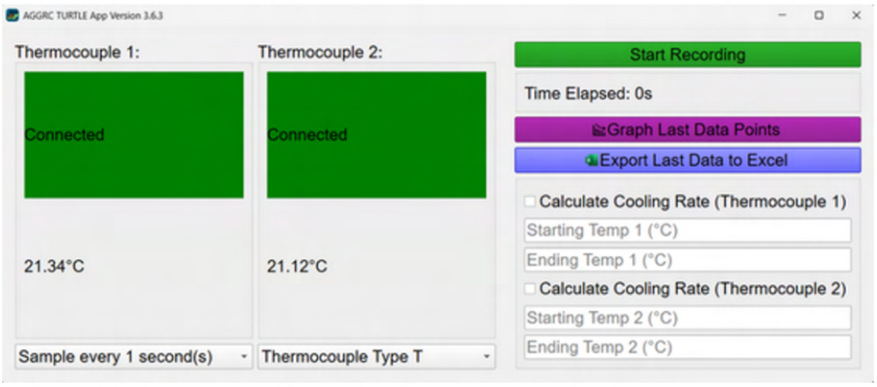
1. Unplug the TURTLE from your laptop/PC.
2. Disconnect the thermocouples.
3. Reconnect the thermocouples, ensuring they are fully inserted.
4. Plug the TURTLE back into your laptop/PC.
5. Restart the TURTLE application.



Starting & Ongoing Data Collection

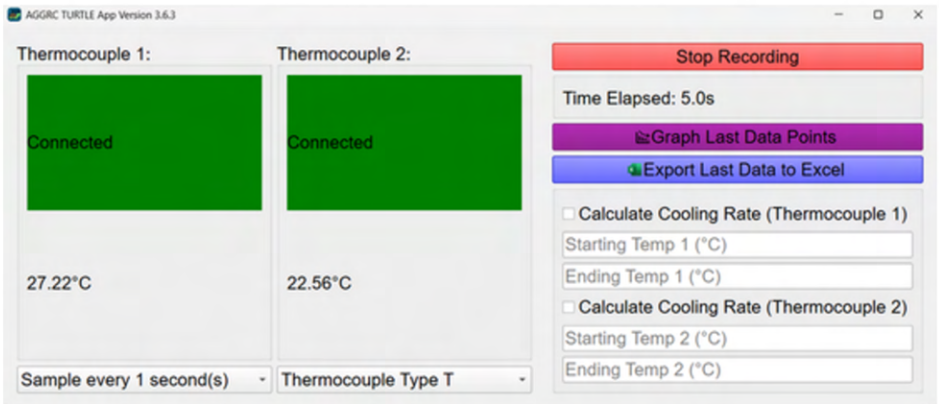
Starting Data Collection:

Before beginning an experiment, adjust the sampling rate and thermocouple type using the dropdown menus located beneath each thermocouple display. Once these settings are configured, you can begin saving temperature data by clicking the green **Start Recording** button in the top-right corner of the program window.



Ongoing Data Collection:

While data is being collected, the **Time Elapsed** counter will begin, showing the total duration of the recording. Although it is possible to change the sampling rate and thermocouple type during recording, this is not recommended, as it may cause inconsistencies in the saved data.



Ending Data Collection & Exporting Options

Ending Data Collection:

When you have completed an experiment, click the red Stop Recording button in the top-right corner. You can then export your data as either a picture graph or an Excel file.

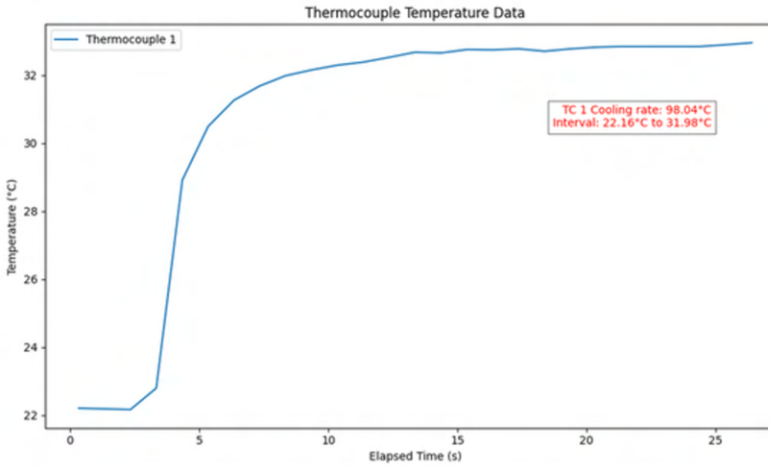
***Note:** If you press Start Recording again before exporting, your previous data will be overwritten and cannot be recovered.

Exporting Options:

Data can be exported either as an excel or picture graph. When saving as a graph push the **Graph Last Data Points** button and then push the save icon in the top left. When saving as an excel file push the **Export Last Data to Excel** button. Then choose where to save the file.

Calculating Cooling Rate:

The check box next to “Calculate Cooling Rate” must be checked in order for graphs and excel documents to display cooling rate. Use the start temp and ending temp entry boxes to enter the interval in question. The resulting cooling rate will be in C/min.



With “Calculate Cooling Rate” checked