EC Sensor Calibration

- Highly recommended to calibrate sensors individually (Repeat procedure for each sensor)

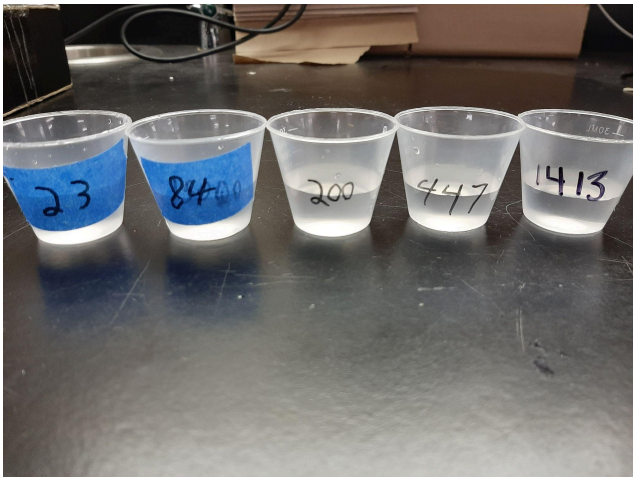
Materials

- Deionized (DI) water
- 23 uS/cm solution
- 84 uS/cm solution
- 200 uS/cm solution
- 447 uS/cm solution
- 1413 uS/cm solution
- Small cups
- Disposable Pipette
- Digital Thermometer
- EC sensor
- SmartRock boards
- Arduino IDE

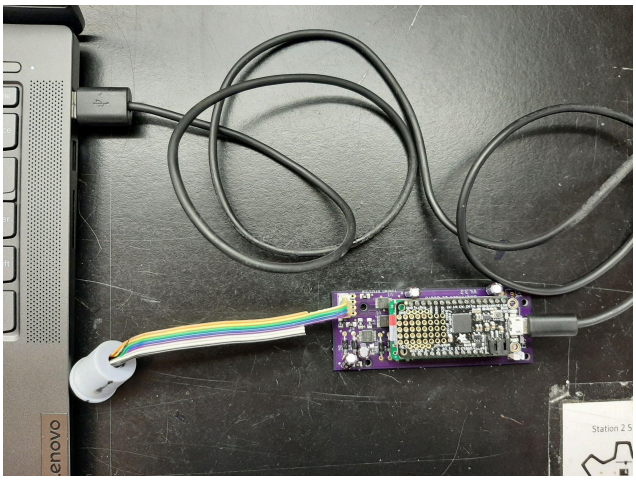
Procedure

Setup

1. Transfer the 5 solutions into 5 clean small cup



2. Rinse the inside of the EC sensor as well as the pipette and the digital thermometer with DI water and dry with a paper towel
3. Plug the EC sensor into the SmartRock board (JST connector), and your laptop/computer into the Feather board (USB to micro USB)
    a. You should see a red light flash every 4 seconds on the board



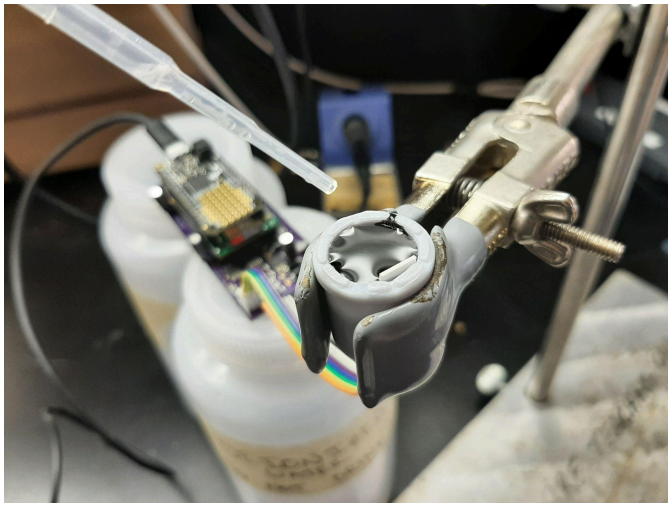
4. Place the EC sensor in a vice, or another stand, to hold the sensor upright and still
5. Setup the serial monitor for the Feather M0 in the Arduino IDE
    a. In the Arduino IDE go to File -> Preferences
    b. Paste this link in the box labeled “Additional Boards Manager URLs:” and click OK

i. https://adafruit.github.io/arduino-board-index/package_adafruit_index.json,https://github.com/OPEnSLab-OSU/Loom_Auxiliary/raw/master/package_loom_index.json

c. Next, go to Tools -> Board:"___" -> Boards Manager
d. Install "Arduino SAMD Boards" (version 1.6.11 or later), "Adafruit SAMD Boards", and "Loom SAMD Boards"
e. Close the boards manager and go to Tools -> Board"___" -> Adafruit Boards and select "Loomified Feather M0"
f. Setup is now complete, to see data from the sensor, go to Tools -> Serial Monitor, the sensor should output its signal to Analog1

Process

1. Insert the 23 uS/cm solution into the sensor using the disposable pipette (Fill to the top)



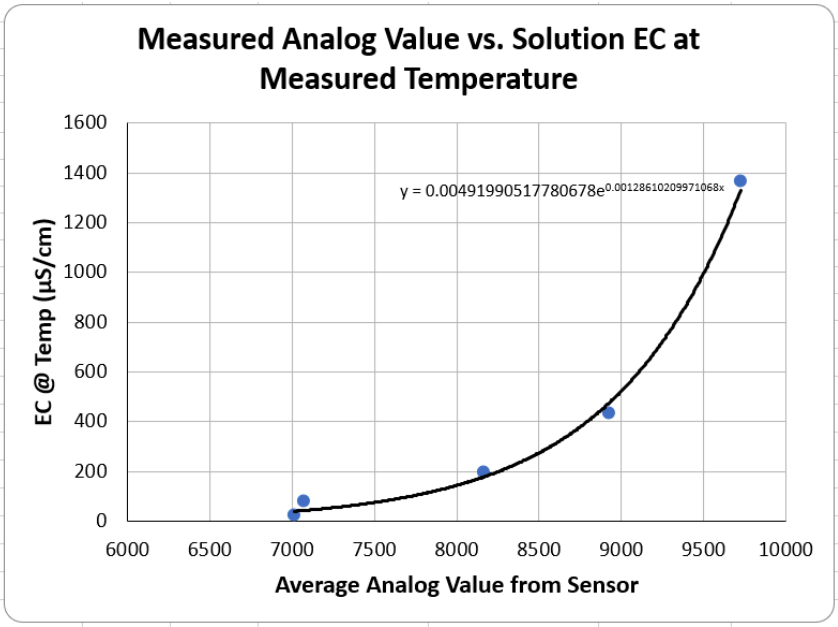
2. Insert the thermometer into the solution inside of the sensor and wait for the thermometer to read a constant value
3. Begin recording the temperature and Analog1 value on the serial monitor at constant intervals (try to get at least 10-20 data points for best accuracy)
4. Once data collection is complete, empty the water from the EC sensor and rinse the sensor, pipette, and thermometer with DI water.
5. Repeat steps 1-4 with each solution (not DI water)
6. Put data in excel for analysis

Data Analysis

1. Find linear relation between temperature and conductivity (need slope & intercept for each solution)
    a. Use Electrical Conductivity Temp Adjustment_2022-06-29 or find relation between temperature and conductivity online for each solution
2. Calculate the theoretical conductivity of the solution for each data point
    a. y=mx+b, where x is temperature, m is the slope for each solution, b is the intercept for each solution, and y is the theoretical conductivity at the actual temperature
3. Make a table of the average analog values, average temperatures, and average conductivity at the actual temperature for each solution

Solution value at 25°C (µS/cm)	Average Analog Value	Average Temperature	Average EC @ Temp (µS/cm)
23	7013	22.917	21.98
84	7071	23.121	81.01
200	8163	23.111	192.44
447	8926	22.974	430.35
1413	9725	23.177	1364.32

4. Plot a graph of the average analog values (x) vs the average conductivity at the actual temperature (y)
5. Add an exponential trendline and show the equation. This equation is your calibration curve to convert from sensor values to electrical conductivity



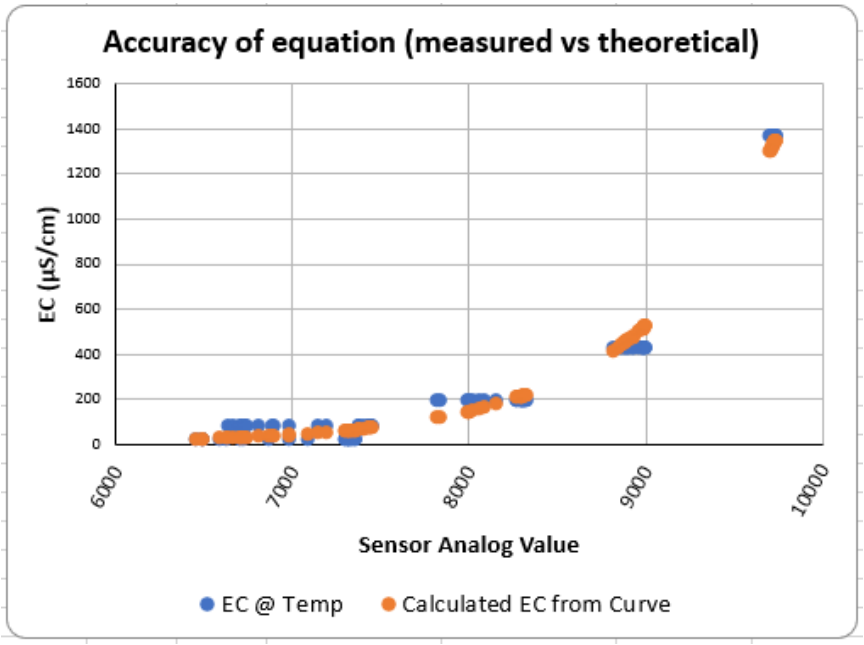
6. Copy the coefficients of the equation somewhere in the sheet to use for calculations
    a. Try to get as many decimal places as possible in the coefficients (at least 10) for maximum accuracy

Quick Accuracy Check

7. Check accuracy by calculating the EC for the average analog value for each solution and comparing it to the average conductivity at the actual temperature

Solution value at 25°C (µS/cm)	Average Analog Value	Average Temperature	Average EC @ Temp (µS/cm)	Calculated value (µS/cm)
23	7013	22.917	21.98	40.67
84	7071	23.121	81.01	43.82
200	8163	23.111	192.44	178.35
447	8926	22.974	430.35	476.09
1413	9725	23.177	1364.32	1329.50

8. To look for patterns or inconsistencies, calculate the EC for each data point and plot analog value (x) vs calculated EC value (y)



Extensive Accuracy Check

1. Insert various known solutions into sensor with the pipette
2. Confirm that the output value is within an acceptable range of the expected value (adjusted for temperature)
3. If not, recalibrate