



# USER GUIDE

VERSION 1.0.1

APRIL 2019

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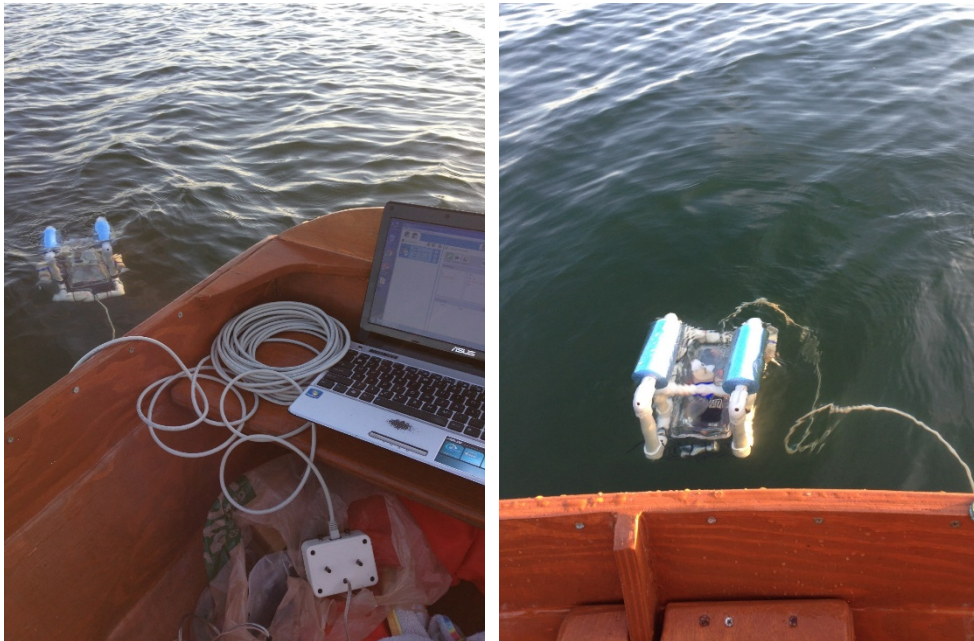
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## 1.0 Intro to SeaSense

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The SeaSense is a digital sensor platform designed for deployment in oceans, lakes, rivers, and other aquatic bodies of interest where scientific studies are typically performed by students, scientists, engineers, professors, and other science enthusiasts globally. The system features a data recording system for obtaining sensor data from its onboard turbidity, conductivity, pressure, temperature, and 9 degree of freedom inertial measurement unit.

The aim of this unique tool is to provide an easy to use and low-cost solution to various audiences globally whom otherwise would not have a direct hands-on opportunity to study and learn about aquatic environments due to limitations in high cost of equipment typically reserved for oceanographic institutions. In addition to serving as a tool for studying various environments, the onboard sensors are useful for enhancing navigation and studying performance of undersea robotic platforms such as the SeaPerch.



## 2.0 SeaSense Specifications

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Specifications for the SeaSense V1.1/V1.2 are listed below:

**RECOMMENDED OPERATING DEPTH:** 0 to 25 ft

### SENSOR SPECIFICATIONS:

- Conductivity (V1.1): 1000 to 15000  $\mu\text{S}/\text{cm}$
- Conductivity (V1.2): 10,000 to 100,000  $\mu\text{S}/\text{cm}$
- Temperature (Air/Water):  $-25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Pressure: 3PSI to 58 PSI absolute
- Turbidity: 0 to 3000 NTU
- Triaxial Accelerometer:  $\pm 4\text{g}$  range
- Triaxial Gyroscope: 2000  $^{\circ}/\text{s}$  range
- Magnetometer:
  - Magnetic field range typical  $\pm 1300\mu\text{T}$  (x-, y-axis)  $\pm 2500\mu\text{T}$  (z-axis)
  - Magnetic field resolution of  $\sim 0.3\mu\text{T}$

**RUN TIME:** Typically 16+ hours continuous run time after recharging AA batteries



### 3.0 Important Getting Started Considerations

Note this manual is for use with the SeaSense V1.1 and SeaSense V1.2 versions.

SeaSense V1.1 is suited for freshwater and is equipped with a K=1.0 conductivity sensor capable of measuring between 1000 to 15000  $\mu\text{S}/\text{cm}$ ,  $\pm 5\%$  F.S accuracy.

SeaSense V1.2 is suited for saltwater and is equipped with a K=10.0 conductivity sensor capable of measuring between 10,000 to 100,000  $\mu\text{S}/\text{cm}$ ,  $\pm 5\%$  F.S accuracy.

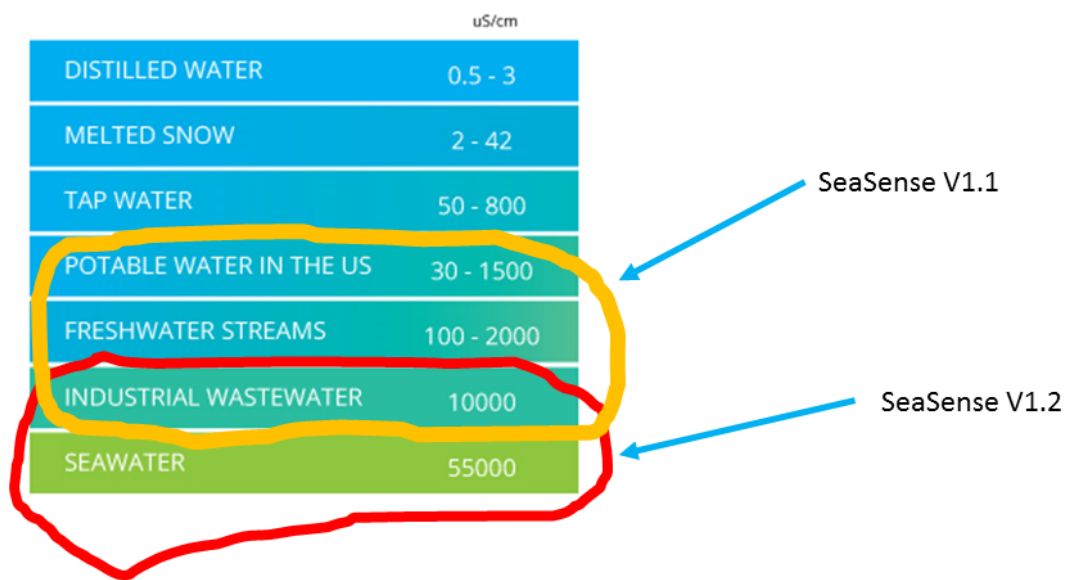


Figure 1 - SeaSense conductivity comparisons.

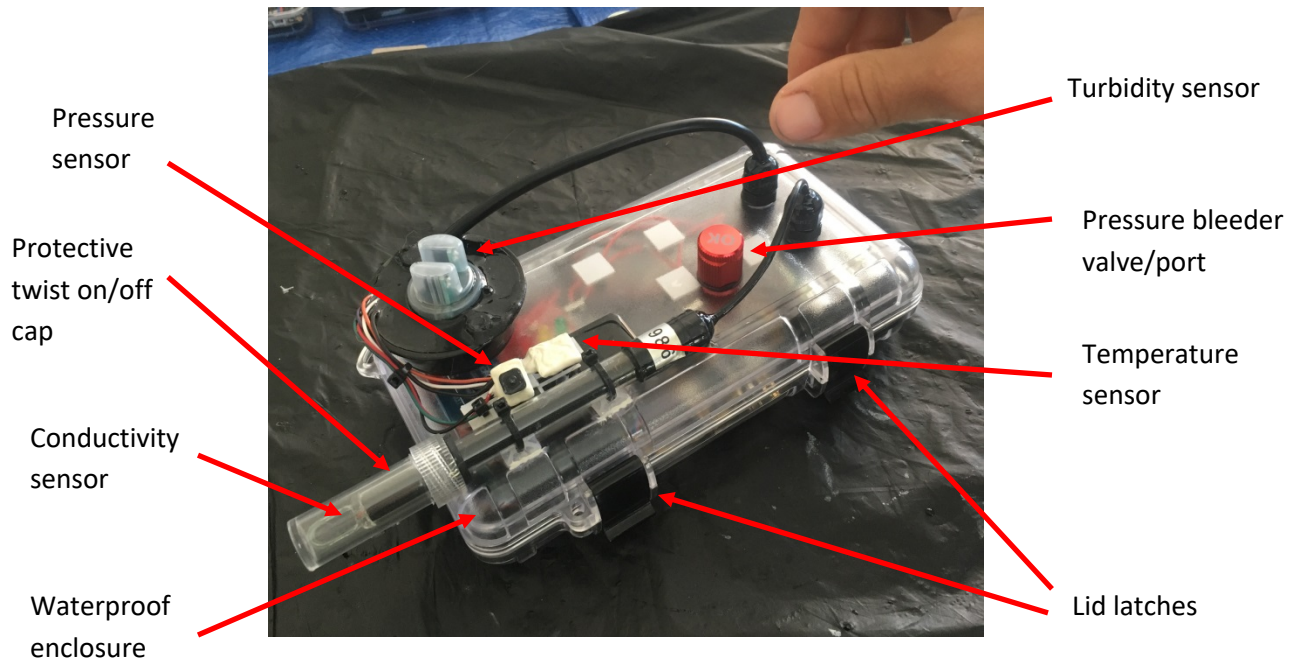


Figure 2 - SeaSense major unit components.

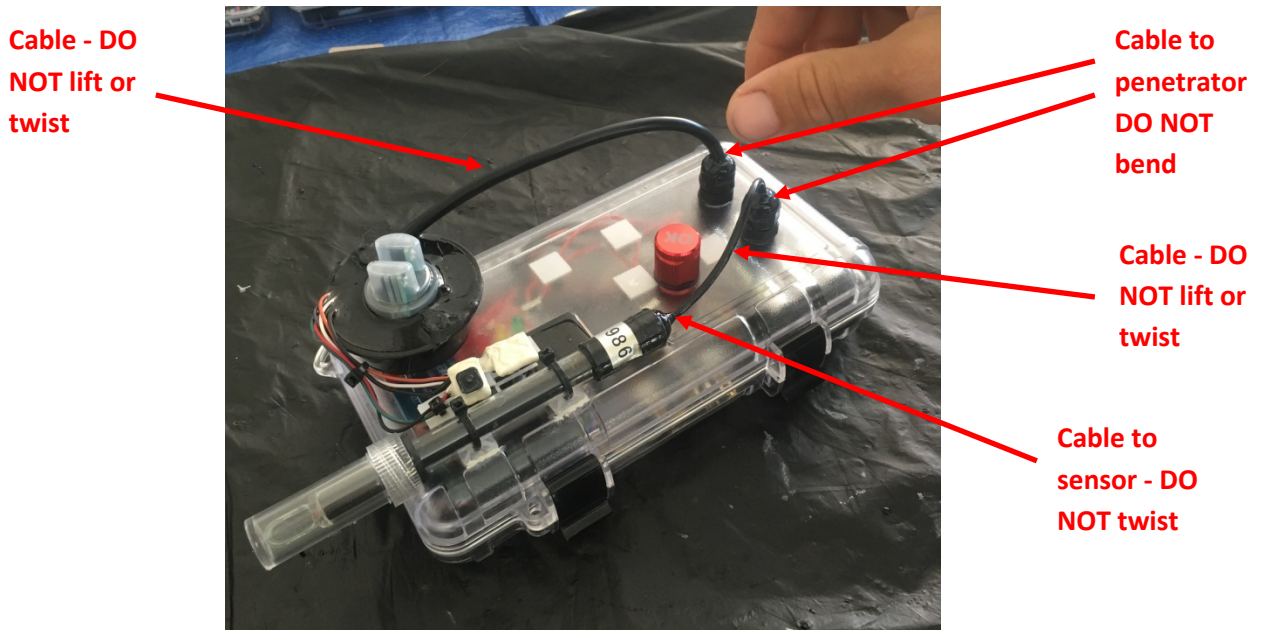
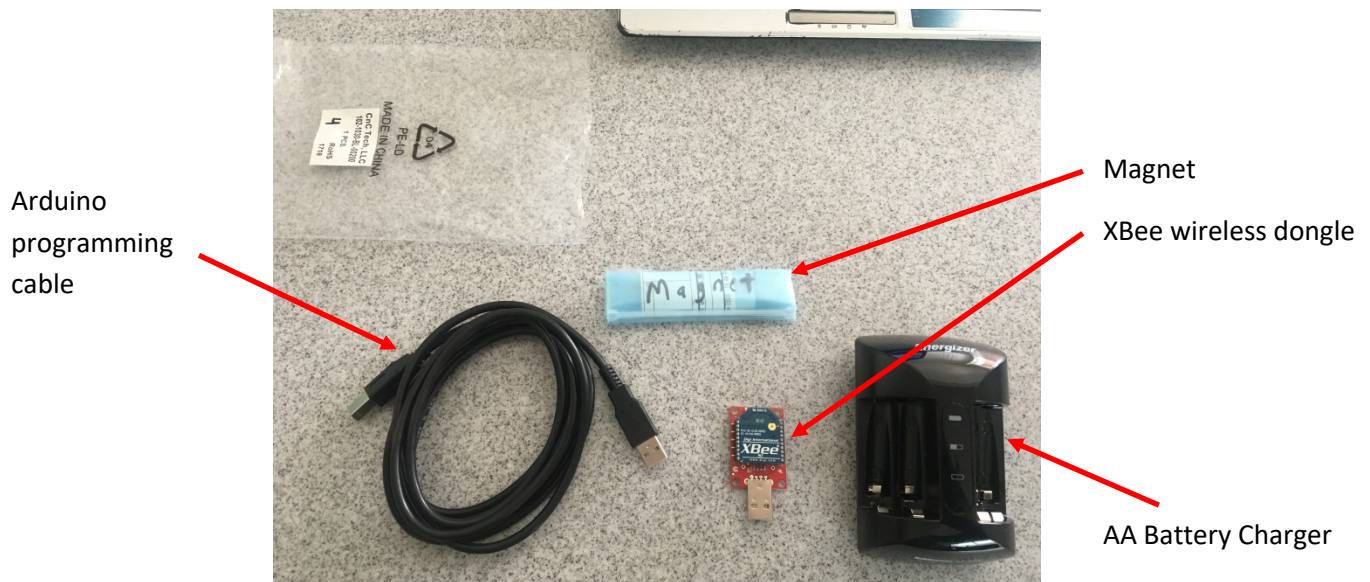


Figure 3 - SeaSense fragile areas for sealing.



**Figure 4** - SeaSense electronic accessory components.

Observe the major components and accessories shown in **Figures 2** and **4** and consider the following points:

- It is best to ship or store (long periods of time) the SeaSense with one AA battery removed. You can leave the other 5 in place. The SeaSense will ship with all AA batteries charged and one AA battery removed. You will need to re-install it before operating.
- Recommended operating depths for the SeaSense is 0 to 25 ft below the surface.
- **Make sure bleeder valve is fully tight** in clockwise direction before each deployment to ensure no leaks. Bleeder valve can be loosened in counter-clockwise direction to relieve pressure or vacuum so enclosure can be easily opened. See section 4 for details.
- **USE CAUTION** with cable penetrators, and cable running from penetrator to conductivity sensor and plastic cup containing wiring for Turbidity, pressure, temp sensors. Figure 3 shows fragile areas. Sealing compound applied to some cracks/crevices on these sensors/cabling and consistent bending or flexing may cause sealing to break free **especially on conductivity sensor**. **DO NOT grab/lift the SeaSense from these cables**.
- **Conductivity sensor is fragile**. Make sure it does not protrude past SeaPerch frame as it is fragile and can break if bumped into a hard surface.

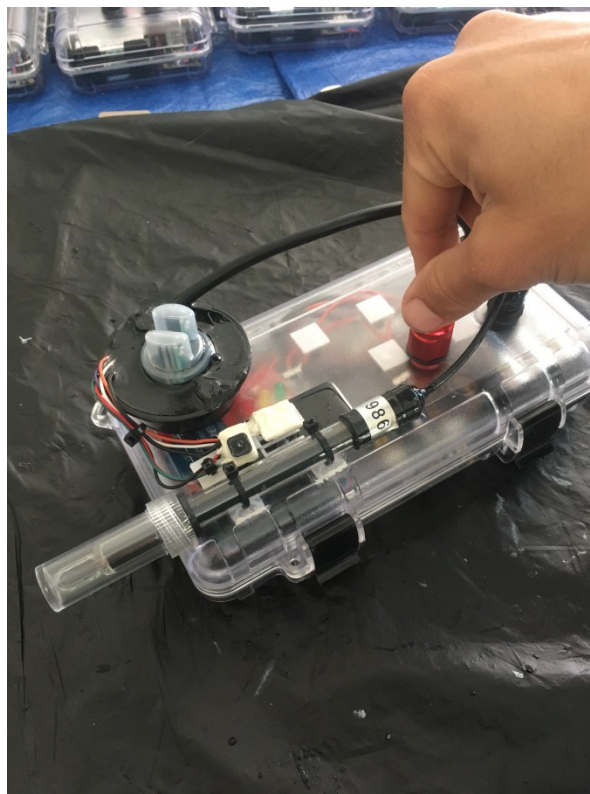
- Always rinse the hardware with faucet freshwater after use in any type of environment.
- Always rinse the tip of the conductivity sensor (remove plastic twist off cap) with distilled water. This is important for preserving the sensor electrodes.
- Leave magnet inside the provided plastic bag as it makes it easier to retrieve when it sticks to metal.
- Operate magnet carefully in a swipe fashion and never extremely close to the reed switch inside so as to not damage it (testing showed the ability to damage a reed switch if magnet is in direct contact with switch).
- Keep labeled bags with the corresponding SeaSense (a number will be visible at the bottom; this serves as a serial number). The XBee transmitter hardware/dongle is pre-configured to work with that particular SeaSense unit.
- SeaSense is positively buoyant by 1.7 lbs in freshwater and 1.75 lbs in seawater. You will need weights of about 1.7 lbs to deploy the SeaSense below the surface by itself or approximately 2.2 lbs to deploy with the SeaPerch. Hardware to provide ballasting weight is included in the kit.

## 4.0 Opening/Closing Enclosure & Seal Check

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This section gives instructions for opening and closing the SeaSense enclosure and verifying there are no leaks. **It is recommended to follow all the steps in this section every time the SeaSense enclosure lid is opened.** Also, the SeaSense enclosure lid will be difficult to open when there is an internal vacuum and the steps in this section will need to be followed.

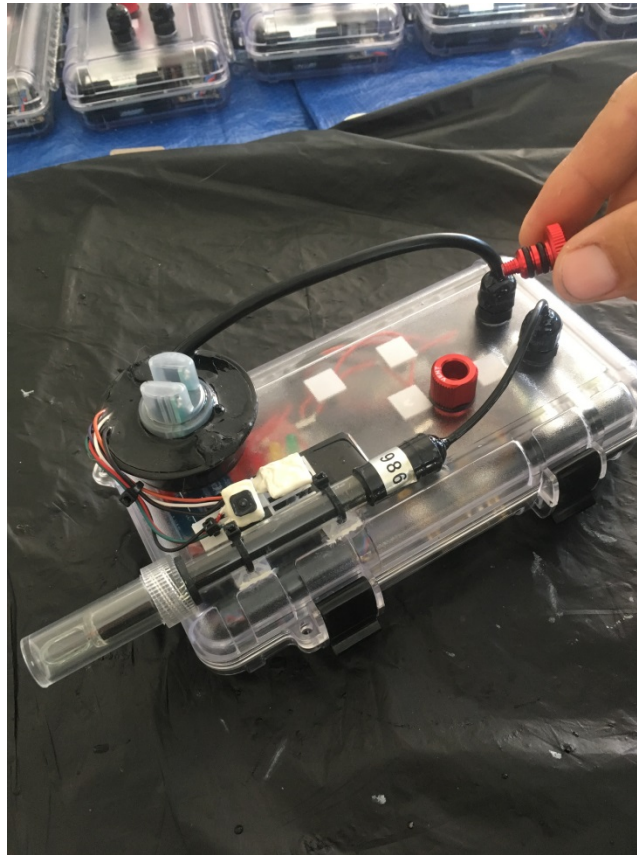
1. Loosen the bleeder valve with your fingers in the counter clockwise direction as shown in **Figure 5**.



**Figure 5** - Loosening of pressure bleeder valve.



2. Remove the valve by pulling up once fully loosened as shown in **Figure 6**.



**Figure 6** - Removal of pressure bleeder valve.

3. Open the SeaSense lid by gently pulling on the latches in an outward motion. Perform any work, data retrieval, or battery charging.
4. Ensure lid gasket and sealing surface is free of debris and close the lid and press on the latches in an inward direction.
5. Attach vacuum hand pump fitting into bleeder port as shown in **Figure 7** and pump by hand until the needle in the gauge shows a 6.5 psi vacuum.
6. Gently rest the vacuum pump on a flat surface and let sit for 10 minutes. Check the gauge reading after 10 minutes and it should read above 6 psi to be ready for operation. If vacuum is below 6 psi it is recommended to troubleshoot potential sealing issues and repeat steps 5 and 6.
6. See section 15 for suggestions on leak repair.



Figure 7 - Vacuum pump for seal check.

7. Equalize the pressure in the housing by pressing on the hand pump's equalizer as shown in Figure 8.



Press here to equalize

Figure 8 - Vacuum pump equalizer.

8. Remove vacuum pump fitting from bleeder port by pulling up on it.
9. Verify bleeder valve o-rings are free of debris otherwise clean carefully with lint-free cloth and water.
10. Install bleeder and tighten with fingers in clockwise direction until snug.

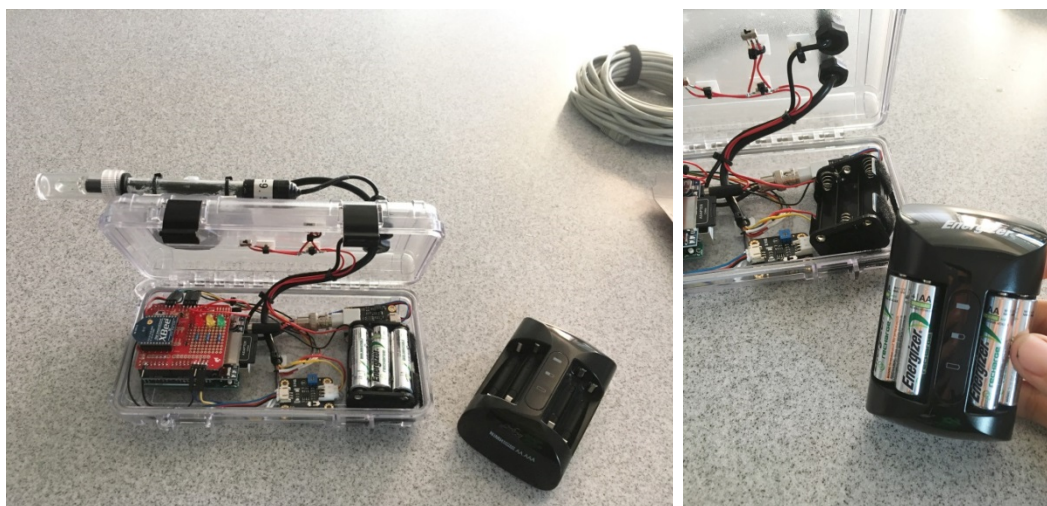


## 5.0 Charging SeaSense Batteries

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Charging the SeaSense AA rechargeable batteries is a straightforward process and is typically required once every few weeks with routine use or in the range of 16 hours with continuous use. **Batteries ship fully charged with the SeaSense.** To recharge batteries, follow the instructions below:

1. Locate the battery charger as shown in **Figure 9**.
2. Open the SeaSense waterproof enclosure and remove the AA batteries (total of 6) carefully from the battery holder without straining the red and black power wires.
3. Install batteries into charger, plug charger into a wall outlet and charge the first four and observe the status of the light as shown in **Figure 10**. When the light turns green remove the four batteries.
4. Charge the remaining two batteries with same approach as in step 3.
5. Reinstall all 6 AA batteries carefully with the correct orientation and position the battery holder so the Velcro keeps it secure.



**Figure 9** - SeaSense and battery charger.



**Figure 10** - Battery charge status (**red**=charging, **orange**=nearly done, **green**=finished).

## 6.0 Installing Arduino/XCTU Software & XBee Configuration

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Before proceeding to configure the XBee wireless hardware make sure to install both the Arduino Windows Software and the Digi XCTU software. Both of these can be downloaded online and instructions for installing this software are also available online.

The XBee hardware will typically ship already configured as a pair and the following steps are required only if you are having connection issues or if you mixed up a SeaSense and XBee dongle pair.

### Configuring XBee Hardware:

1. Install the XBee wireless dongle into your laptop as shown in **Figure 11**.
2. Power on the SeaSense using the provided magnet in a sideways swipe fashion (note the location to swipe through is shown in **Figure 12**). It may take a little trial and error and flipping magnet orientation and swipe direction to learn how to turn on/off the SeaSense.



**Figure 11** – XBee wireless dongle installed on laptop.

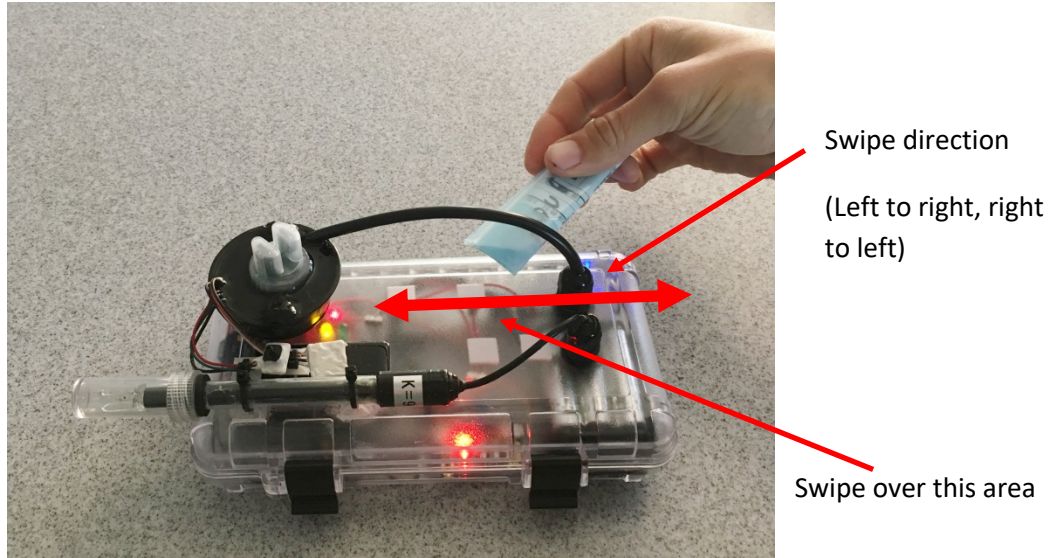


Figure 12 - Magnet swipe to turn on SeaSense.

- 3. Open the SeaSense waterproof enclosure (a reset button will be pressed in a later step).
- 4. On your laptop load XCTU.exe
- 5. Click on the add radio module as shown in **Figure 13**.

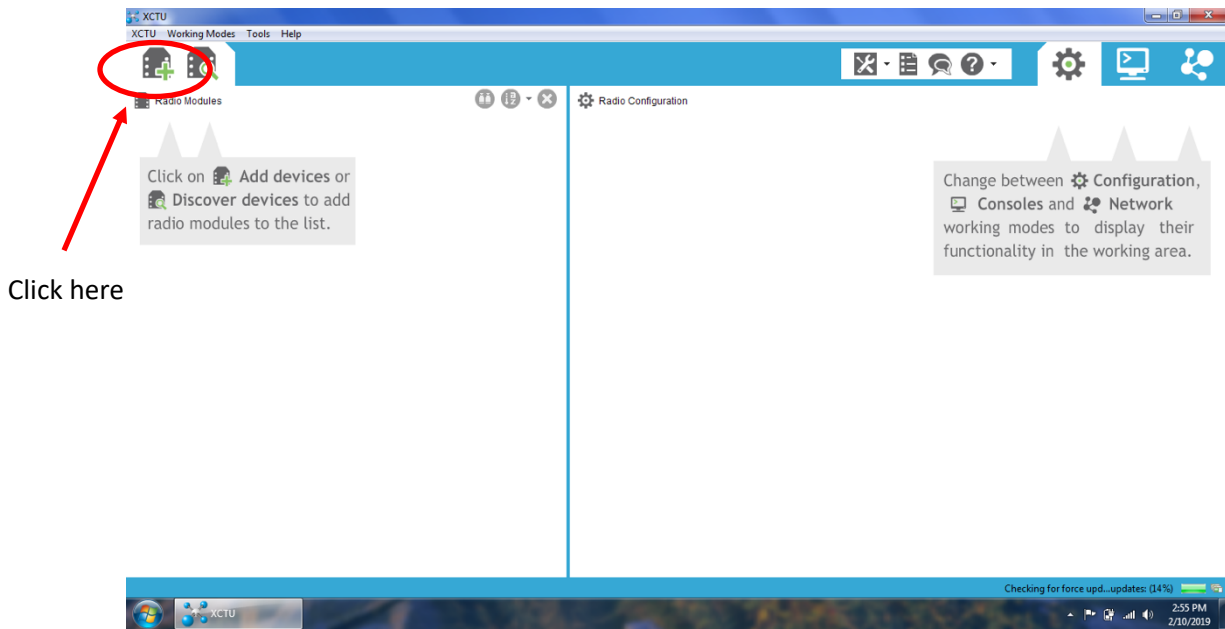
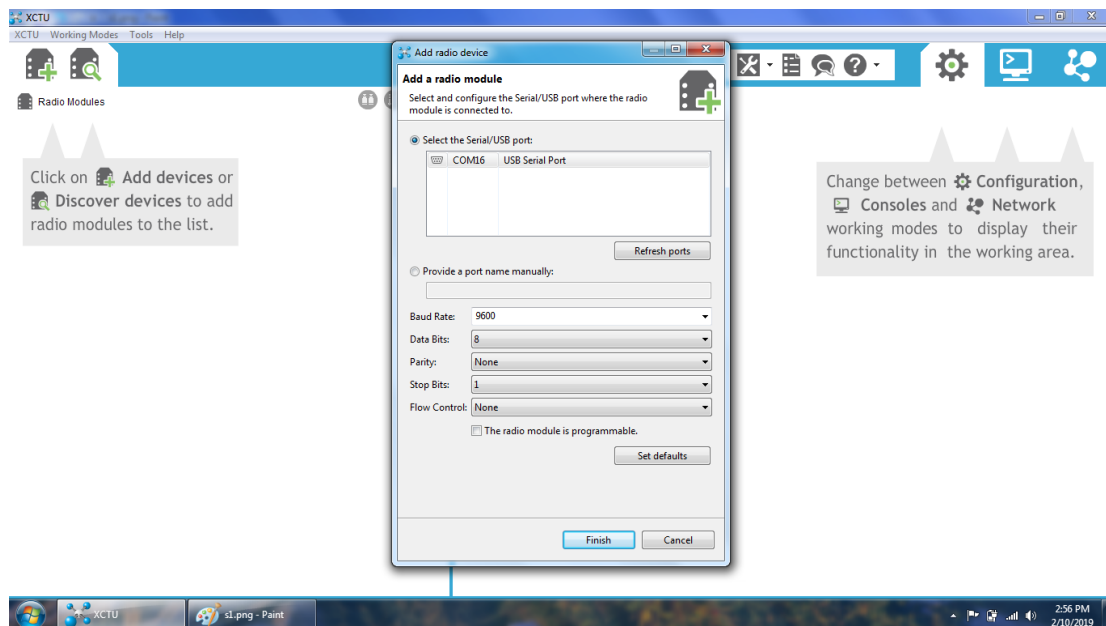


Figure 13 - XCTU software step 5.

6. A window will pop up with port settings (if this doesn't happen you may need to open Device Manager and perform troubleshooting procedures) as shown in **Figure 14**. Enter the following and then click on Finish:

- 9600 for Baud Rate
- 8 for Data bits
- None for parity
- Stop Bits 1
- Flow Control none.



**Figure 14** - XCTU software step 6.



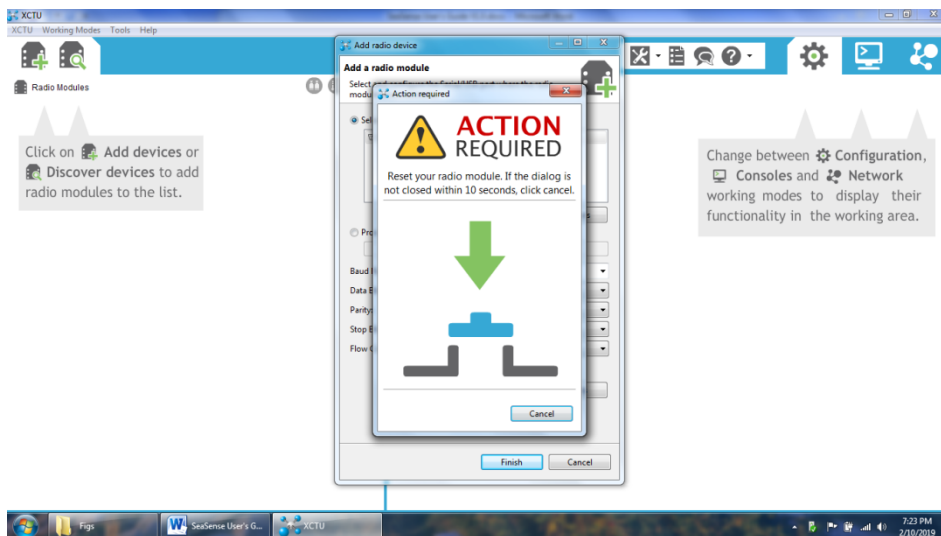


Figure 15 - XCTU software step 7.

7. A window will likely show up as shown in **Figure 15**. You may need to press the reset button on both the XBee USB dongle and the Arduino when this message pops up. You may also have to retry a couple of times (a retry window may pop up as well). **Figure 16** shows where the reset buttons are located.

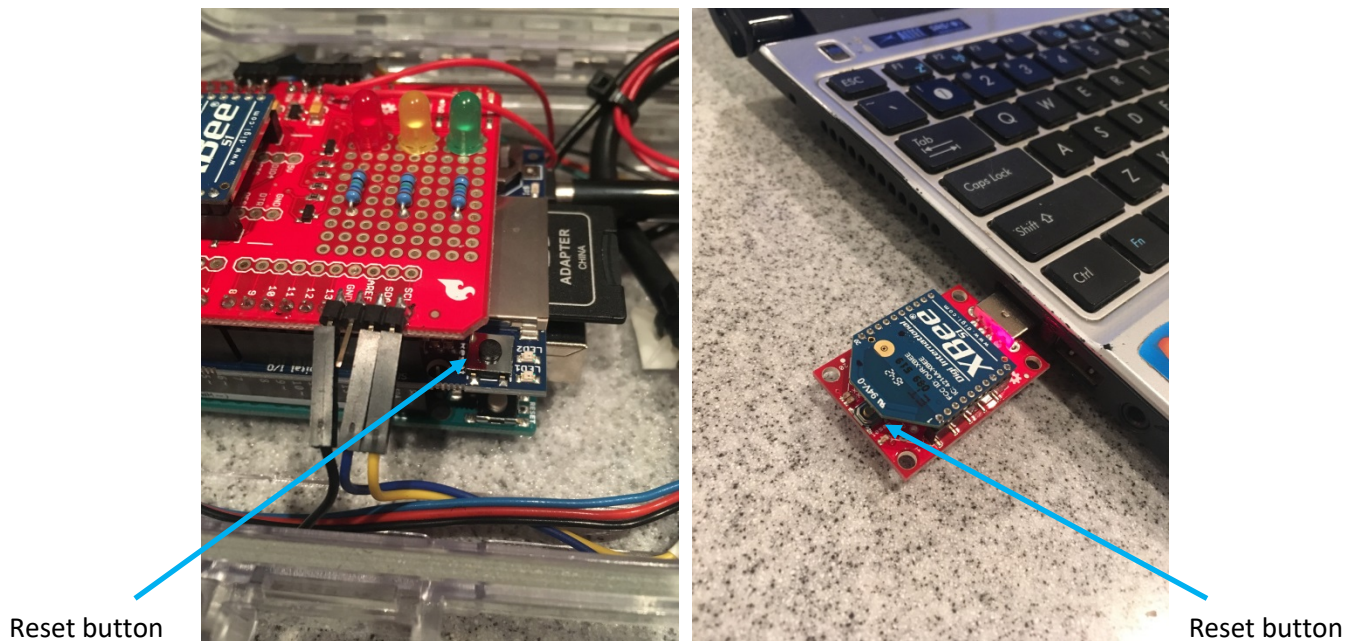
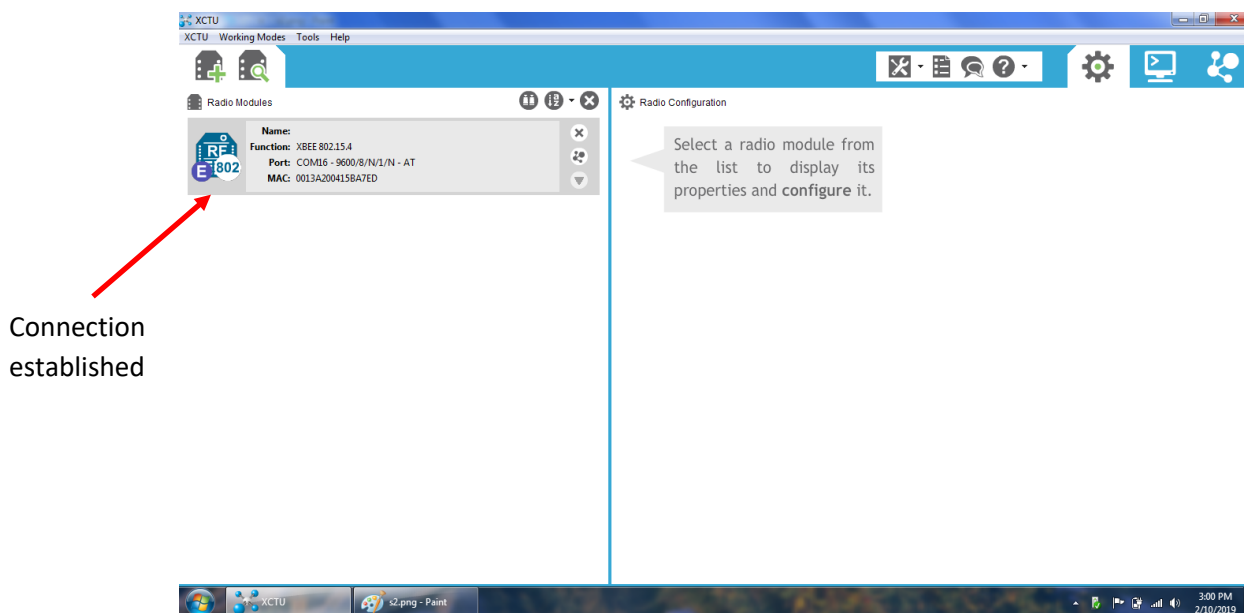


Figure 16 - Reset button locations.

8. Once the connection is established the window will automatically close and you will see the screen update as shown in **Figure 17**. You can now exit out of XCTU. You should not need to repeat these steps again unless there is a connection issue or the XBee dongle and SeaSense pair are mixed up.

9. Make sure no debris/particles are on sealing surfaces/gasket and close the SeaSense enclosure. It is recommended to follow instructions in section 4 prior to next deployment.



**Figure 17** - XCTU screen updated after connection established.

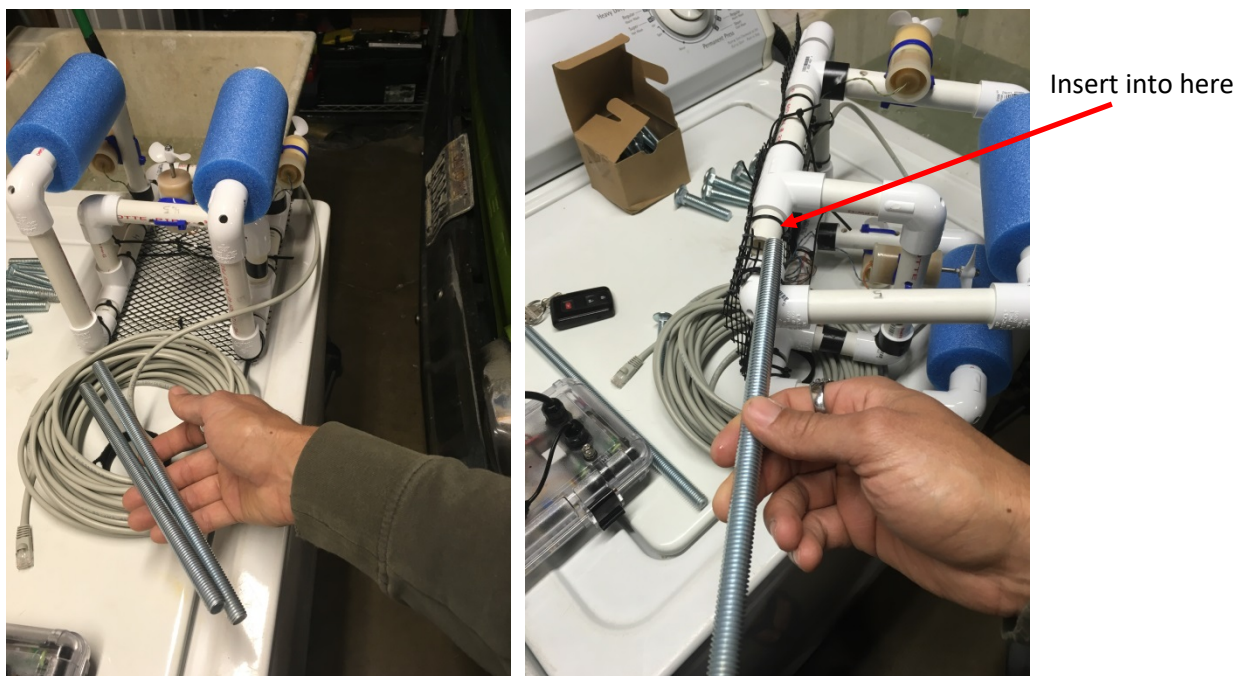
## 7.0 Installing SeaSense onto SeaPerch (optional)

This section outlines some suggestions for mounting the SeaSense onto a SeaPerch robot. The following are some key points to consider.

### BALLASTING:

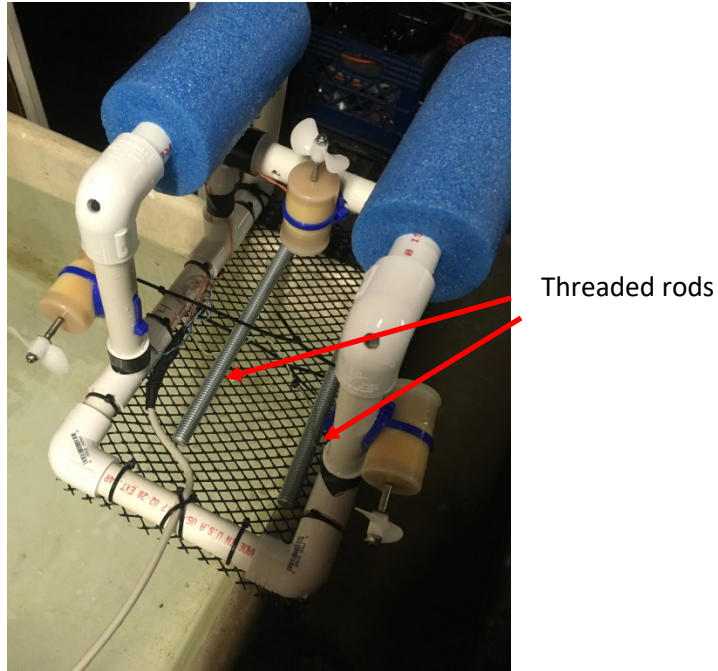
Threaded rods are provided in the kit as weights for ballasting the SeaPerch so it can stay slightly positive in buoyancy with the SeaSense installed. A total of four (4) are required.

- Disassemble the SeaPerch pontoon PVC pipe elbow at end and slide a 10" threaded rod into each side as shown in **Figure 18** then reinstall the pipe elbow.
- Two additional threaded rods need to go over the netting. The suggested placement is shown in **Figure 19**. Twist ties are ideal for securing them so you can fine tune and move backwards or forward to level the SeaPerch once the SeaSense is secured.



**Figure 18** - Threaded rods inserted into the SeaPerch pontoons.





**Figure 19** - Threaded rods over netting.

#### SEASENSE INSTALLATION:

- The SeaSense can be installed pointing backwards or forwards, the best orientation may take some experimentation, but it is better for the conductivity sensor not to protrude past SeaPerch frame because it is fragile and can break if it bumps into a hard surface.
- **Be careful** with the cables coming out of the SeaSense penetrators when sliding through (avoid hitting the center vertical SeaPerch thruster). It is ideal to not flex/move the cables coming out of the penetrators to preserve the sealing.
- **Figure 20** and **21** shows the SeaSense positioned in the SeaPerch with the conductivity sensor pointing to the rear. It is recommended to start with this configuration and place over the threaded rod.

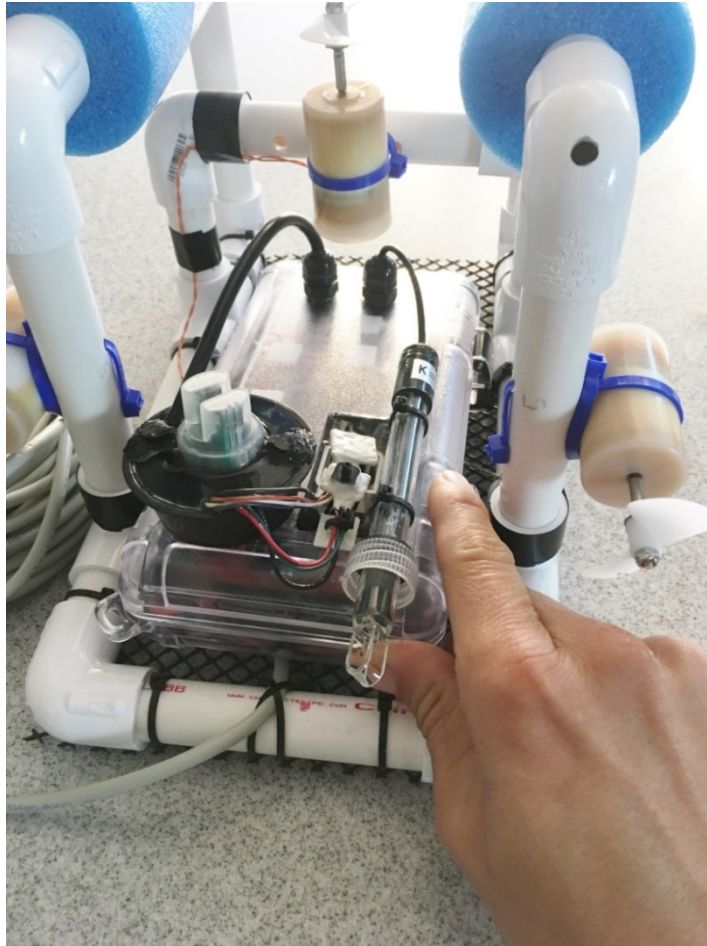


Figure 20 - SeaSense entry onto SeaPerch platform.

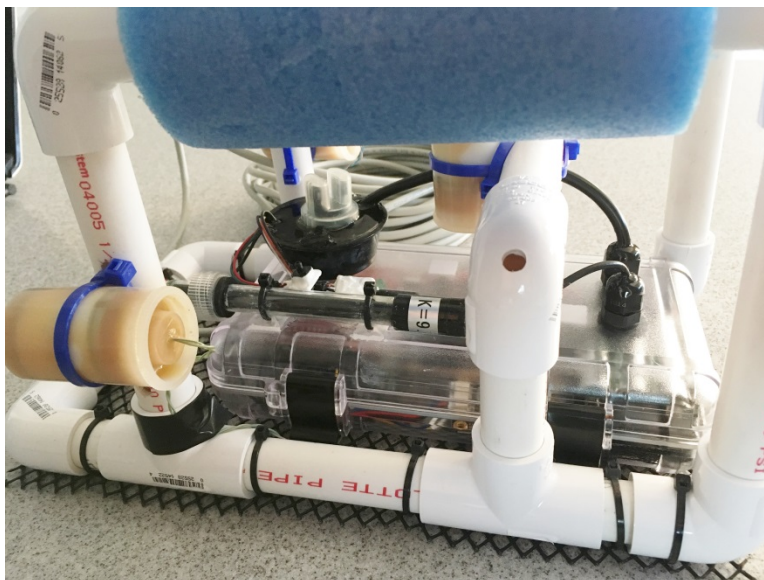


Figure 21 - Side view of SeaSense installed in SeaPerch.

- Twisty ties or cable ties are ideal for securing the SeaSense to the SeaPerch and are provided with the kit. The SeaSense has two locations for passing cable ties through as shown in **Figures 22** and **23**.
  - *Note: Twisty ties will be easier to install and remove especially for more frequent deployments and can be reused. Cable ties will be more durable but require tools and cannot be reused. You can choose between the two but twisty ties are an easier starting point for fine tuning placement.*
- Use three or four cable ties or a single twisty tie to make a big loop on the right side of the SeaSense as shown in **Figure 24**.



**Figure 22** - Photo showing left corner cable ties.

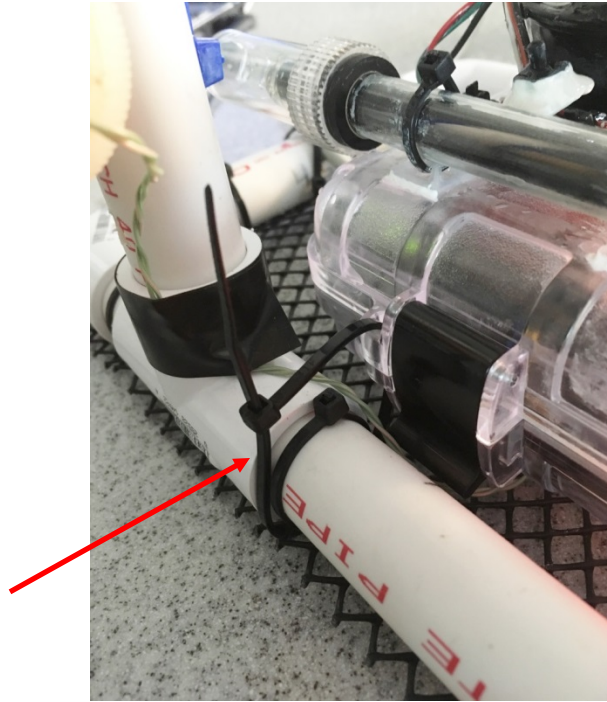


Figure 23 - Photo showing right corner cable ties.

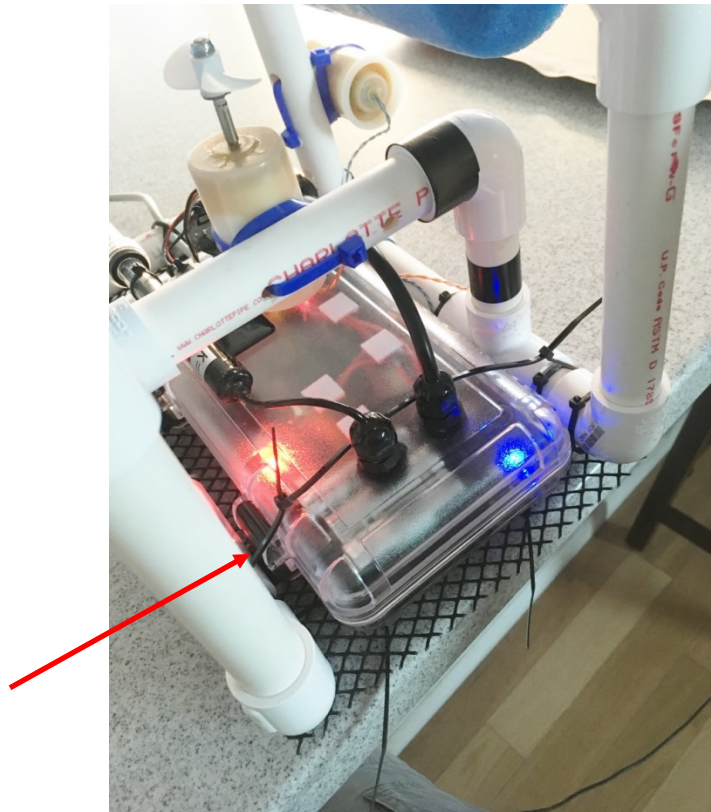


Figure 24 - Photo showing right side cable tie fastening.



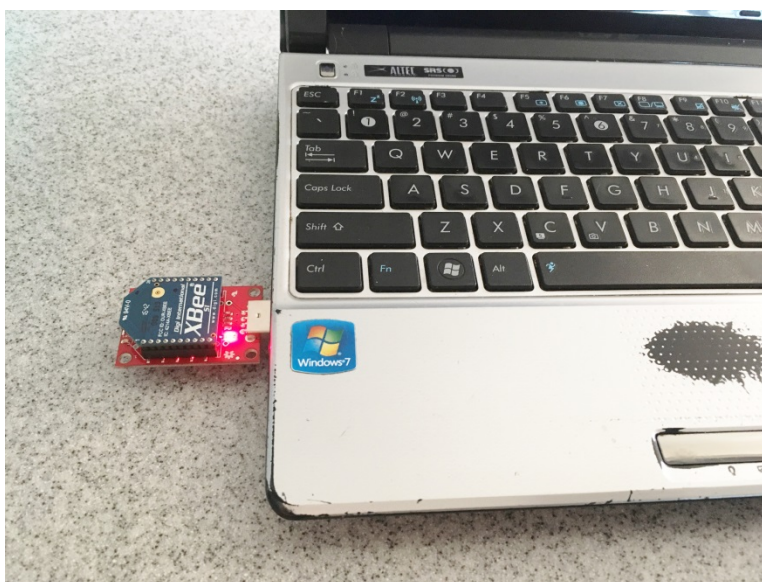
## 8.0 Setting up SeaSense for Deployment

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The following steps can be performed after the SeaSense is installed onto the SeaPerch or by itself if deploying the SeaSense standalone.

1. Plug in the XBee dongle into your laptop USB port as shown in **Figure 25**.
2. Point the SeaSense facing North (with conductivity sensor tip pointing north) or zero degrees using a handheld compass or a digital compass from a phone, etc. Utilize the enclosure or SeaPerch frame features to help you align to the compass. Next, power on the SeaSense using the provided magnet in a sideways swipe fashion (note the location to swipe through is shown in **Figure 26**). It may take a little trial and error and flipping magnet orientation and swipe direction to learn how to turn on/off the SeaSense.

**Note:** *SeaSense requires facing north when it is powered on for heading to be logged correctly. You can position it north and cycle power if you forgot.*



**Figure 25** - XBee dongle installed on laptop.

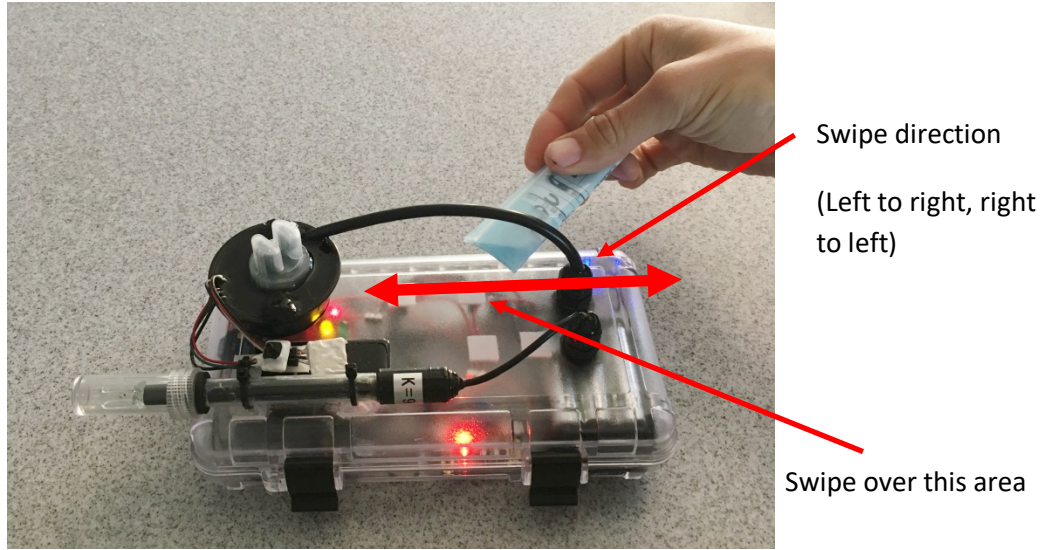


Figure 26 - XBee dongle installed on laptop.

3. Load the Arduino software and go to the Tools menu and make sure that the correct COM Port is selected in the Port submenu as shown in **Figure 27**. This COM port should be the one assigned to the XBee USB dongle. You can use Device Manager if additional information is needed.

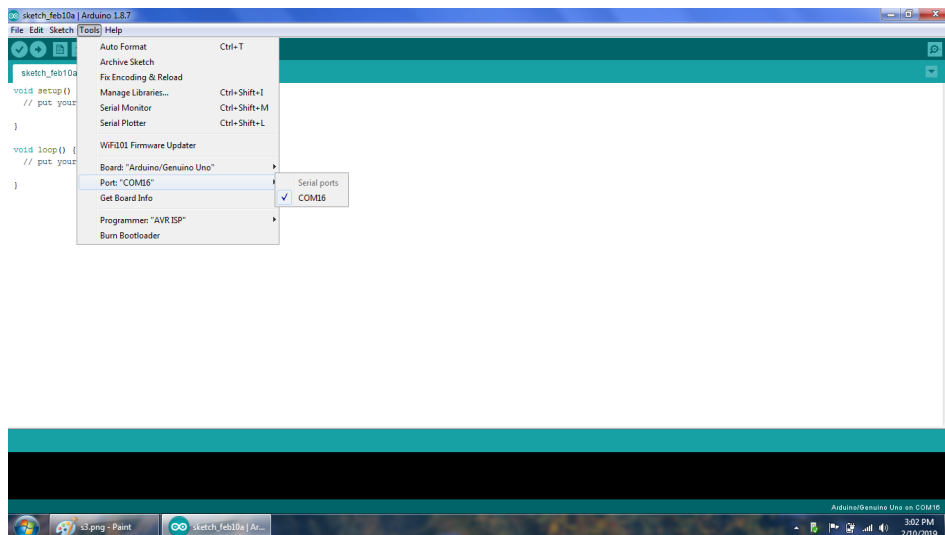
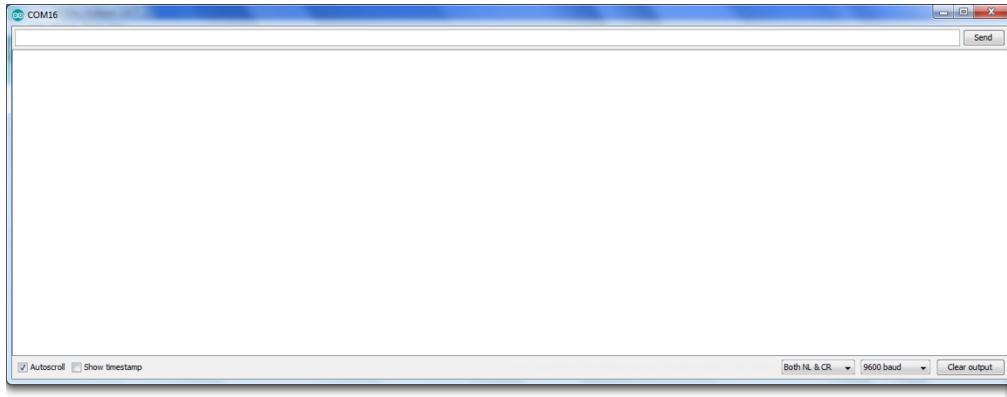


Figure 27 - Arduino software loaded.

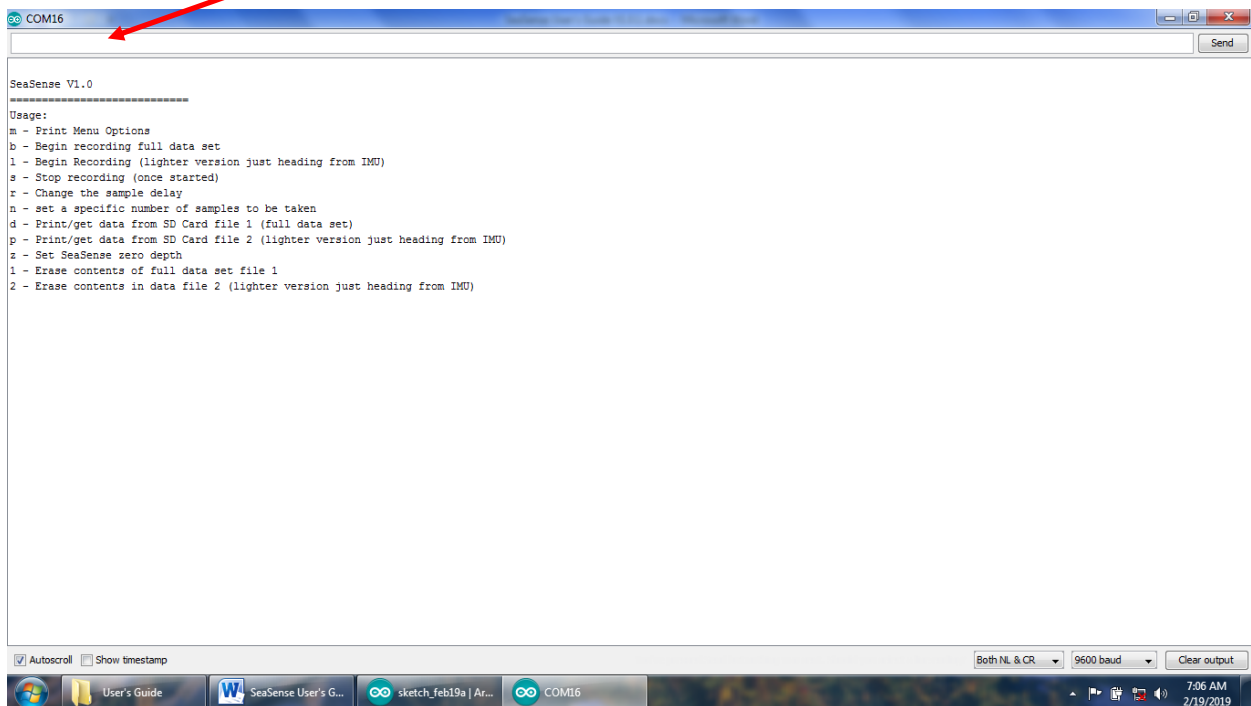
4. Go to Tools and click on Serial Monitor. A window should pop up as shown in **Figure 28**. You can change the settings on the lower part of the window. Make sure NL&CL is selected and the port is set to 9600 baud.



**Figure 28** - Serial Monitor loaded.

5. Click in region shown in **Figure 29** and type the letter *m* to print the SeaSense menu options.

Click in this region and type with keyboard for selecting menu options.



**Figure 29** - SeaSense Menu loaded.

6. A list of options will be displayed. Here is a brief description of each option:

- m – prints the SeaSense menu and is useful for redisplaying options at any point.
- b – begins recording data with all IMU information (gyroscopes, accelerometers, etc).
- l – begins recording data with just the heading from the IMU, and all other sensor data (turbidity, conductivity, temperature, pressure, etc). It is recommended to use option l for most missions.
- s – stops the recording process.
- r – change the sample delay as desired. Enter the number of milliseconds delay between each sample.
  - *Note: The current default setting of 33 milliseconds. Note even at 0 ms delay, the SeaSense has a sampling rate of approximately 4 samples per second.*
- n – record data for a specific number of samples. Set to zero (default) to log indefinitely.
- d – prints all data stored in the SD card (for the full data set file) This option is useful for downloading data from the menu and copying/pasting into Excel for analysis.
- p – prints all data stored in the SD card (for the light data set file). This option is useful for downloading data from the menu and copying/pasting into Excel for analysis.
- z – sets the zero depth. select this before placing the SeaSense in the water. Note default zero is reading when SeaSense is powered up.
- 1 – clears all data from the full data set file when using the b option.
- 2 – clears all data from the lighter version data set file when using the l option.

**NOTE:** You may want to clear all the data from the file before a mission depending on how you want to download the data. If using option 1 to download data, it might be a good idea to clear file contents (see section 12 for details).



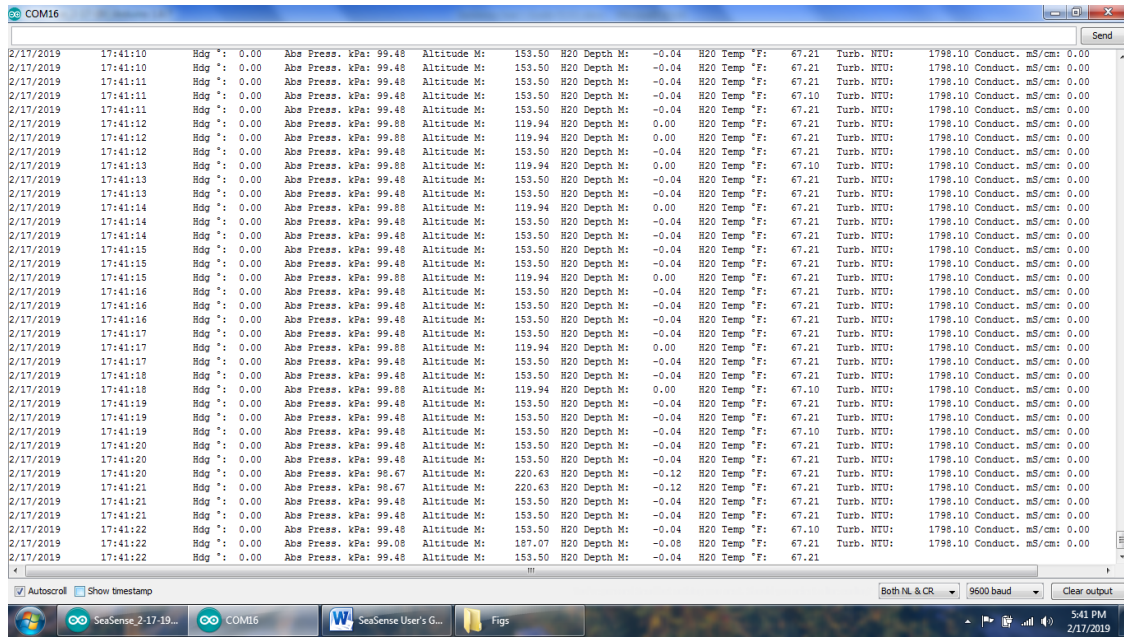
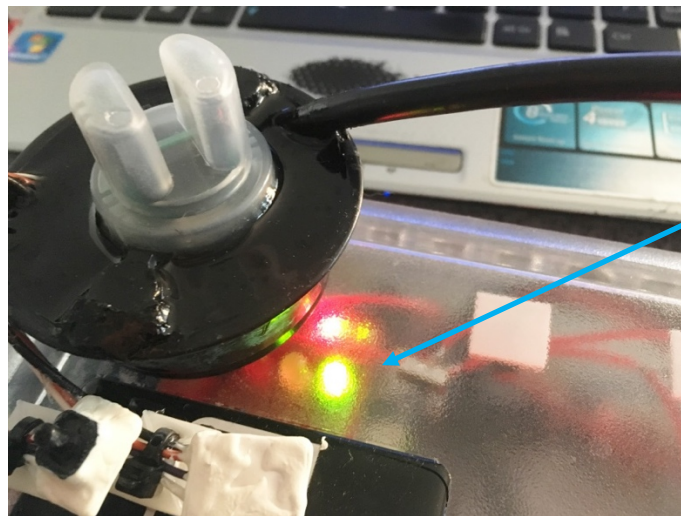


Figure 30 - SeaSense live data logging.

7. Select option I by typing I and pressing enter. You should see live data displayed and updated on the screen as shown in **Figure 30** while data is being recorded to the SD card.

- **NOTE:** The data display shows the date in Pacific time. Local time can be set manually following the steps in Section 14.

8. Notice the indicator light will turn from orange to green to indicate data logging is taking place as shown in **Figure 31**.

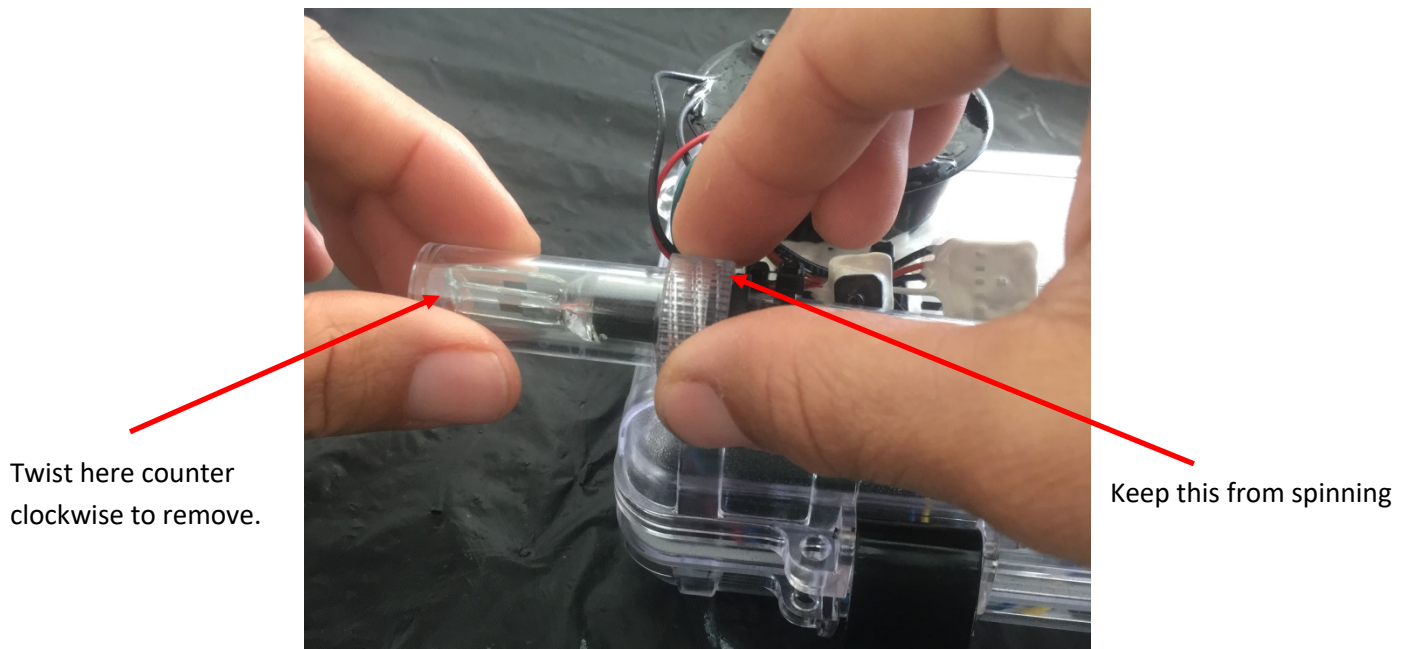


Green indicator light turns on.

Figure 31 - SeaSense data logging indicator turns green.

## 9.0 Deployment in water with SeaPerch (optional)

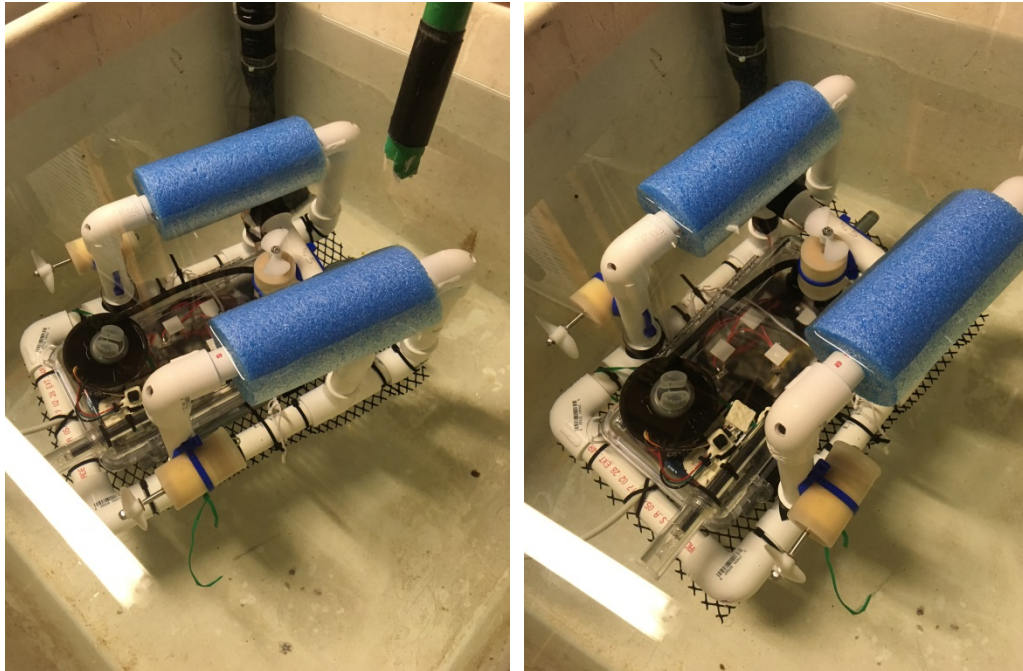
1. Gently remove the twist off protective cap from the conductivity sensor (counter-clockwise to twist off) and set aside for later use. It is recommended to twist off with one hand while gently holding the base with the other hand as shown in **Figure 32**. Note the image shows this before installed on the SeaPerch but you can also do this while the SeaSense is installed on the SeaPerch. This is crucial to prevent the conductivity sensor from spinning which will cause the sealing compound on the cabling to break on the other end.



**Figure 32** - Conductivity sensor protective cap removal.

2. Slide the threaded rods forward or backwards and in or out as necessary until the SeaPerch is trimmed evenly as shown in **Figure 33**. You may have better luck using twisty ties for securing everything since it will require some fine tuning and will be easier to reuse/reinstall.

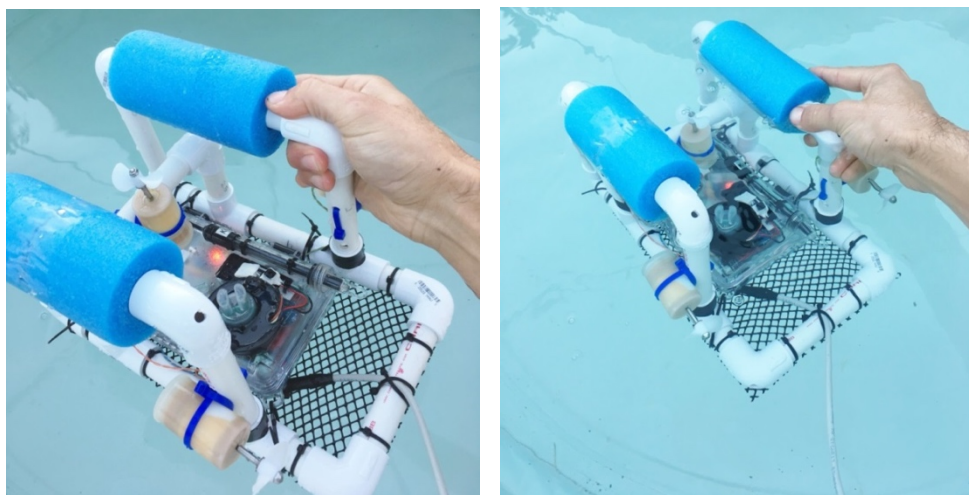
3. Make sure your laptop is connected to the SeaSense and a serial monitor window is already running. Select the z option from menu and place the SeaPerch/Sea Sense in water at desired zero depth. (Note you must first initiate the z option before placing the SeaSense in the water).



**Figure 33** - SeaPerch and SeaSense ballasted/trimmed after fine tuning thread rod placement.

4. Select the appropriate option to begin data logging and release the SeaPerch/SeaSense in the desired environment as shown in **Figure 34**. The following are additional suggestions:

- Make sure conductivity sensor does not protrude past SeaPerch frame so it does not hit a hard surface. **The conductivity sensor is fragile.**
- It is ideal to set up the data logging prior to placing the SeaSense in the water as the XBee transmission will likely have some issues through water.

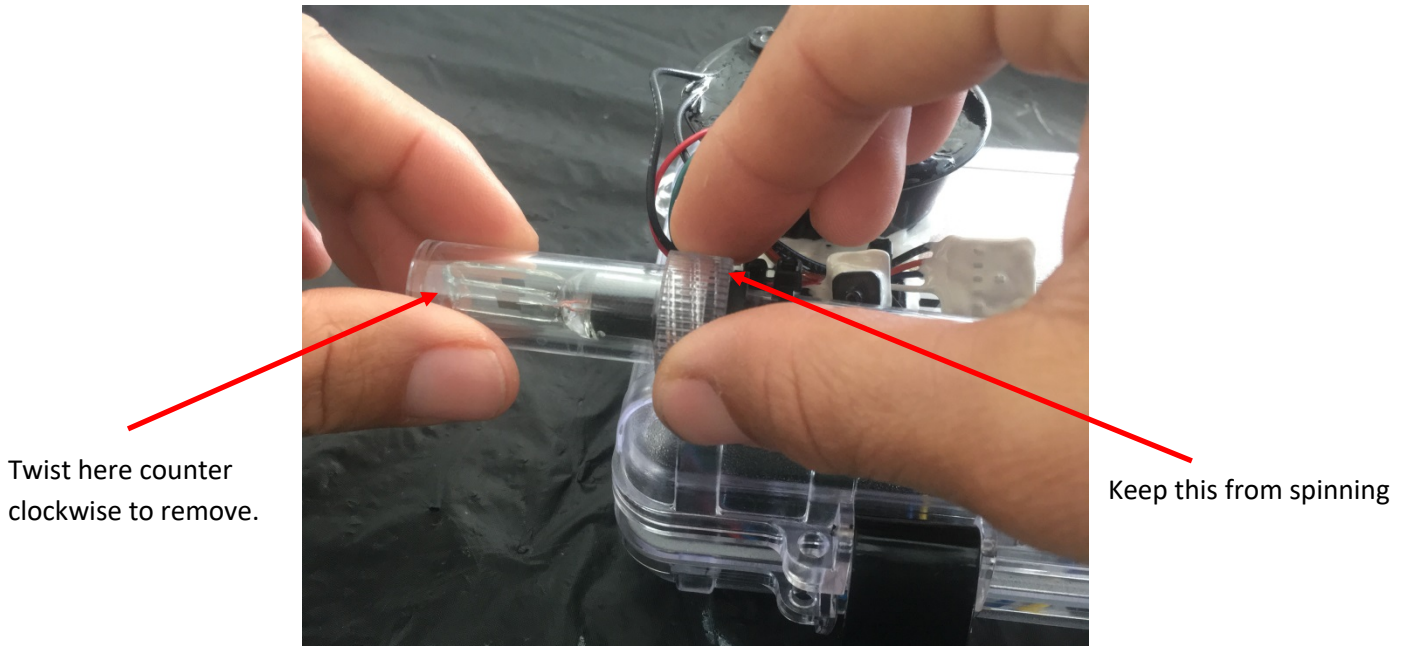


**Figure 34** - Photos showing SeaSense mounted to SeaPerch and deployed in pool.



## 10.0 Deployment in water (standalone)

1. Gently remove the twist off protective cap from the conductivity sensor (counter-clockwise to twist off) and set aside for later use. It is recommended to twist off with one hand while gently holding the base with the other hand as shown in **Figure 35**. This prevents the conductivity sensor from spinning which will cause the sealing compound on the cabling to break on the other end.



**Figure 35** - Conductivity sensor protective cap removal.

2. Weight will be required to submerge the SeaSense. Use three threaded rods and bundle them together so the threads are interlocked. Use cable ties to fasten and snug them together so they can't separate as shown in **Figure 36**.



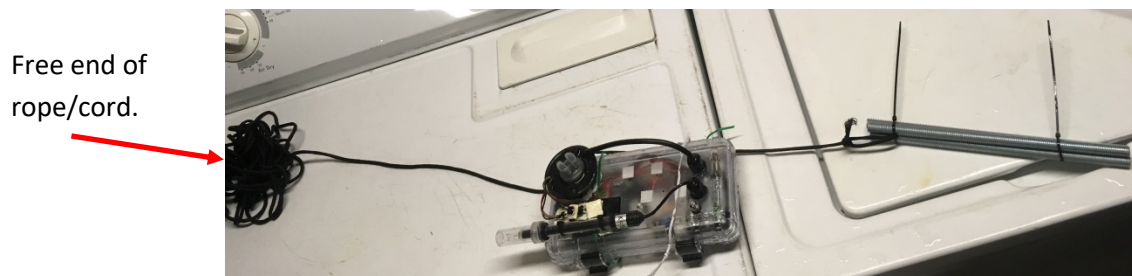
**Figure 36** - Threaded rod weights for submerging SeaSense.

3. Use the provided 27 ft of black 550 cord to tie a not over one of the cable ties. Make sure the cable tie is snug enough so the rope is secured to something that won't slip. Suggested knot type is a *bowline knot*.
4. Tie a knot to the SeaSense enclosure corner tab hole from the same cord inline about a foot or so above the weight as shown in **Figure 37**. Make sure it is secure.



**Figure 37** - In line knot tied on SeaSense.

3. Make sure your laptop is connected to the SeaSense and a serial monitor window is already running. Select the z option from menu and place the Sea Sense in water at desired zero depth. (Note you must first initiate the z option before placing the SeaSense in the water).
4. Select the appropriate option to begin data logging and release the SeaSense in the desired environment. Make sure to tie the free end of the rope to something secure so the SeaSense does not get lost. The free end is shown in Figure 38.



**Figure 38** - SeaSense ready for standalone deployment.

The following are additional suggestions:

- It is better to keep the SeaSense above the sea, ocean, or lake floor, rather than letting it rest on the bottom.
- Be careful the conductivity sensor does not hit hard objects like a pier piling, etc. **The conductivity sensor is fragile.**
- It is ideal to set up the data logging prior to placing the SeaSense in the water as the XBee transmission will likely have some issues through water.

## 11.0 Post Deployment Procedures

---

The following are suggestions for post deployment procedures:

1. Upon removing SeaPerch/SeaSense from its operational environment, rinse everything off thoroughly with fresh tap water as shown in **Figure 39**. Make sure to rinse the threaded rods including the ones inside the SeaPerch pontoons.



**Figure 39** - Rinsing of SeaSense in freshwater.

2. Rinse the conductivity sensor tip with distilled water after rinsing with tap water. This is recommended to prolong the life of the sensor.
3. Plug in the XBee dongle into your laptop and load the Arduino software and repeat instructions in Section 8 to get to the menu options. Type s and hit enter to stop the data logging (note you may have to do this a few times for it to stop). The status light should turn orange.
4. Power down the SeaSense using the magnet and a swipe motion.
5. After conductivity sensor tip is dry, reinstall the protective cap gently with clockwise twist motion. Be sure to keep the sensor from spinning using one hand to twist the cap off and the other to keep the sensor from rotating.

**NOTE:** You can turn off the SeaSense with the magnet before stopping the data logging if it's not feasible to do this at your test site. You can download data at a later time by following the instructions in Section 12.

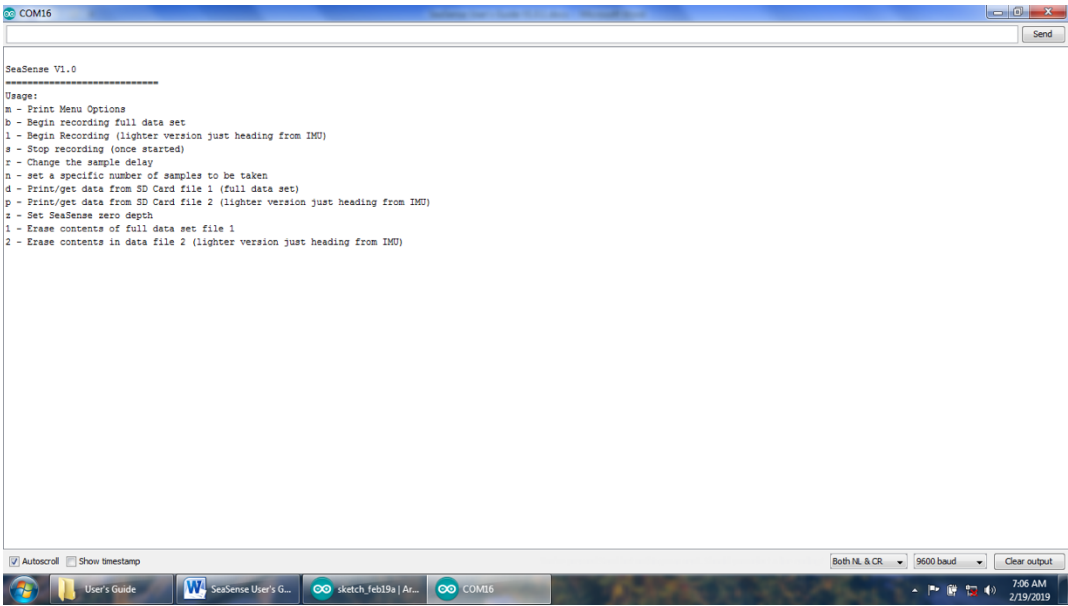
## 12.0 Downloading Data

This section outlines procedures for downloading data from SeaSense using two options:

- **Option 1** is much slower but eliminates the need to open the housing.
- **Option 2** is much faster but requires removing the SD Card.

### OPTION 1 (Utilizing the XBee dongle):

1. Plug the XBee dongle into your laptop.
2. Power on the SeaSense (see previous sections if you need a refresher on the instructions).
3. Load the Arduino software and make sure the correct port and port settings are selected under the Tools menu. See section 6 to refresh yourself on instructions if necessary.
4. Load the serial monitor under the Tools menu and make sure the correct settings are selected. See section 6 to refresh yourself on instructions if necessary.
5. If data is still logging (notice if indicator light is green or orange) type s and press enter (note - you may need to do this a few times to get it to stop).
6. Press m and hit enter for menu options and the menu should display as shown in **Figure 40**.



```
COM16
SeaSense V1.0
-----
Usage:
m - Print Menu Options
b - Begin recording full data set
l - Begin Recording (lighter version just heading from IMU)
s - Stop recording (once started)
r - Change the sample delay
n - set a specific number of samples to be taken
d - Print/get data from SD Card file 1 (full data set)
p - Print/get data from SD Card file 2 (lighter version just heading from IMU)
z - Set SeaSense zero depth
1 - Erase contents of full data set file 1
2 - Erase contents in data file 2 (lighter version just heading from IMU)
```

**Figure 40** - Menu options displayed after typing m and pressing enter.



7. Type p if you logged data using the l menu option, or type d if you logged data using the b menu option and press enter.
8. Data will be printed in the serial monitor as shown in **Figure 41**. Wait for all data to be printed (note this may take a very long time depending on how much data was logged).

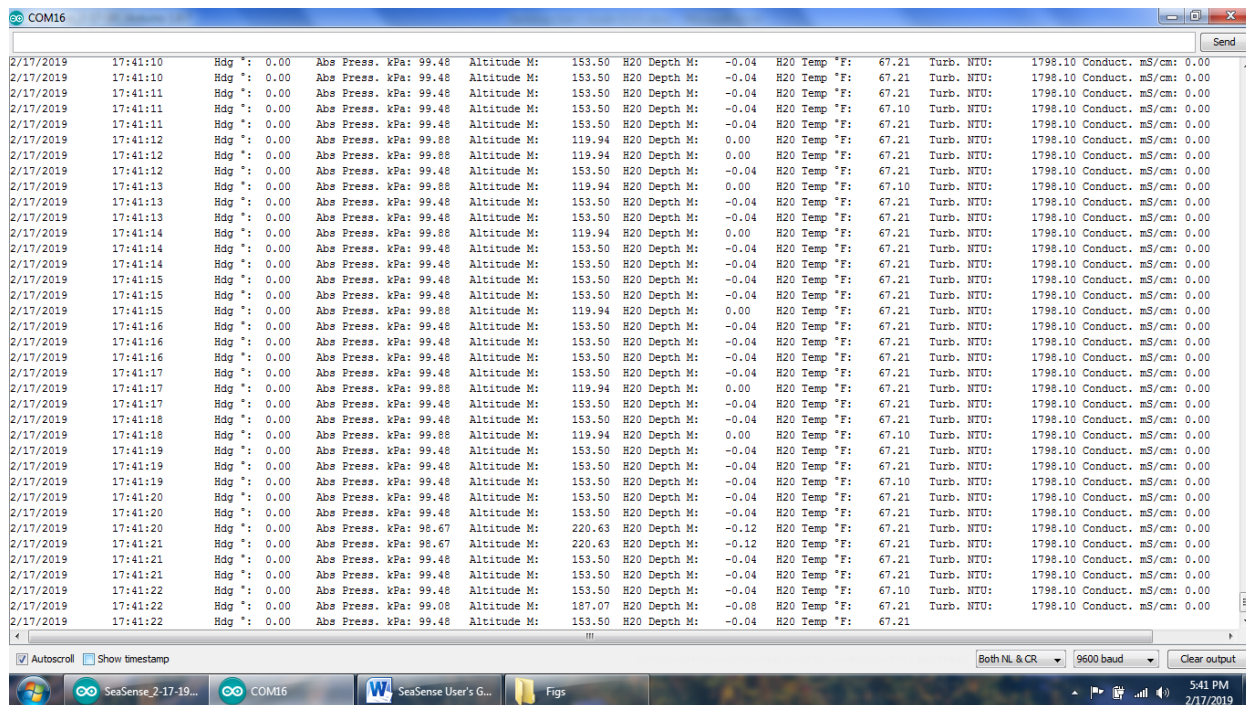
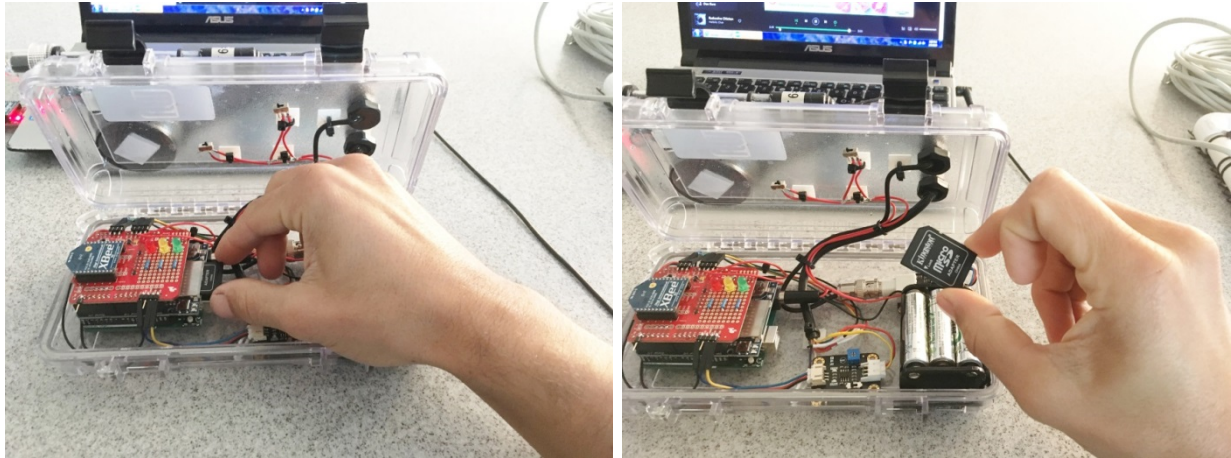


Figure 41 - Data being printed to the screen in serial monitor.

9. When printing of data to screen stops, load Excel or any other software of choice. Go back to the serial monitor screen and manually select all the data with the mouse and hit Control +C to copy. In Excel or other software of choice, use Control +V to paste the data.
10. Clear file contents using option 1 (for data logging using b option) or 2 (for data logging using l option) if desired.
11. Turn off SeaSense using the magnet and swiping motion.

**OPTION 2 (Removing the SD Card):**

1. Make sure the SeaSense unit is off.
2. Open the SeaSense enclosure and carefully remove the SD card as shown in **Figure 42**.



**Figure 42** - Removal of SD card from SeaSense.

3. Use an SD card reader on your laptop and navigate to the correct location in your file explorer (it should show up as a drive letter).
4. If using the l menu option for data logging, copy the file named *IMU\_Hdg.txt* to your local drive. If using the b menu option for data logging, copy the file named *IMU\_Data.txt* to your local drive.
5. If desired, delete the files from the drive in your windows explorer window by right clicking on the file and selecting delete. Note, this is optional.
6. Safely eject SD card using the eject icon in the windows task bar. This is good practice to prolong SD card life.
7. Remove SD card from laptop and carefully reinstall SD card into SeaSense.
8. Make sure no debris/particles are on sealing surfaces/gasket and close the SeaSense enclosure. It is recommended to check for leaks following instructions in section 4 before next deployment.
9. Load data contents from the data files you copied to your local drive using software such as Excel. The data files have a header to help you identify what the data fields contain.

## 13.0 Data Description and Fields List

---

When using the l menu option (*light version*) to log data the following is a description of data displayed to the Arduino serial monitor:

- Field 1: Date stored by the real-time clock.
- Field 2: Time stored by the real-time clock.
- Field 2: Hdg °: this is the heading of the SeaSense.
- Field 3: Abs Press. kpa: this is the absolute pressure in units of kilo Pascals.
- Field 4: Alt M: this is the altitude of the SeaSense in units of meters when it is in air.
- Field 5: H2O Depth M: this is the depth of the SeaSense underwater (not be sure to set the zero using the menu option or manually adjust the zero point in post-processing).
- Field 6: H2O Temp °F: this is the water temperature in degrees fahrenheit.
- Field 7: Turb. NTU: this is the measurement of turbidity in units of NTU.
- Field 8: Conduct. mS/cm: this is the measurement of conductivity in units of mS/cm.

Field list for data contained in *IMU\_HDG.TXT* log file or when using the p menu option:

- Field 1: Date
- Field 2: Absolute time
- Field 3: milliseconds count since SeaSense started current logging session
- Field 4: milliseconds count since SeaSense powered on.
- Field 5: Heading in degrees
- Field 6: Absolute pressure in kPa
- Field 7: Altitude in meters when in air
- Field 8: Water depth in meters
- Field 9: Water temperature in degrees F
- Field 10: Turbidity in NTU
- Field 11: Conductivity in mS/cm

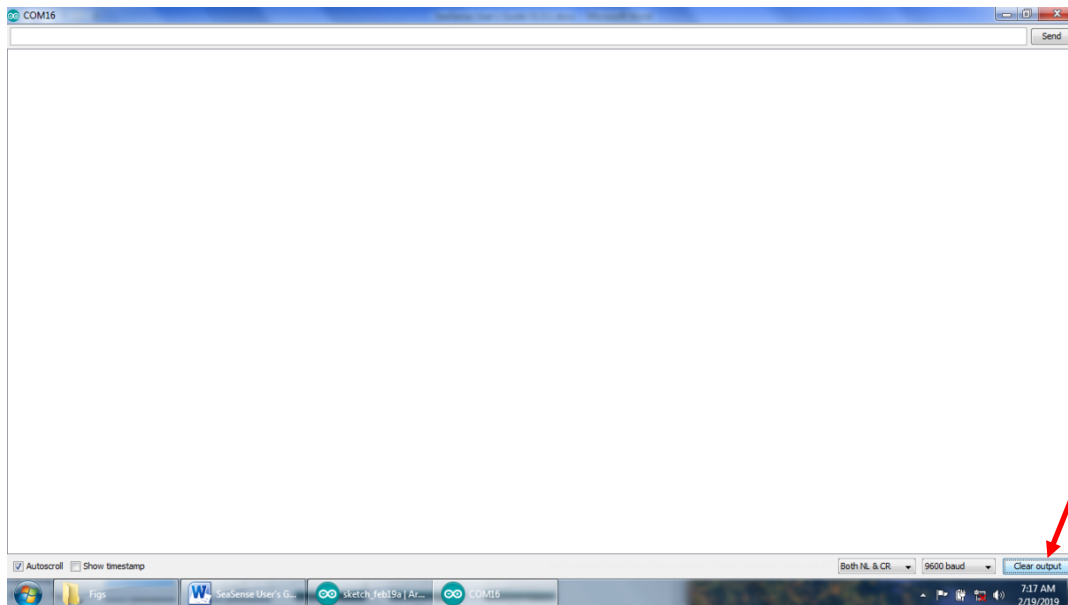
When using the b menu option (full data version) to log data the following is a description of data displayed to the Arduino serial monitor and in the log file *IMU\_DATA.TXT*:

- Field 1: Date
- Field 2: Absolute time
- Field 3: milliseconds count since SeaSense started current logging session
- Field 4: milliseconds count since SeaSense powered on.
- Field 5: Acceleration in X direction in  $m/s^2$ .
- Field 6: Acceleration in Y direction in  $m/s^2$ .
- Field 7: Acceleration in Z direction in  $m/s^2$ .
- Field 8: Magnetometer value in X direction in  $\mu T$ .
- Field 9: Magnetometer value in Y direction in  $\mu T$ .
- Field 10: Magnetometer value in Z direction in  $\mu T$ .
- Field 11: Gyroscope value in X direction in  $rad/s$ .
- Field 12: Gyroscope value in Y direction in  $rad/s$ .
- Field 13: Gyroscope value in Z direction in  $rad/s$ .
- Field 14: Euler value in X direction in degrees.
- Field 15: Euler value in Y direction in degrees.
- Field 16: Euler value in Z direction in degrees.
- Field 17: Linear acceleration in X direction in  $m/s^2$ .
- Field 18: Linear acceleration in Y direction in  $m/s^2$ .
- Field 19: Linear acceleration in Z direction in  $m/s^2$ .
- Field 20: Gravity in X direction in  $m/s^2$ .
- Field 21: Gravity in Y direction in  $m/s^2$ .
- Field 22: Gravity in Z direction in  $m/s^2$ .
- Field 6: Absolute pressure in kPa
- Field 7: Altitude in meters
- Field 8: Water depth in meters
- Field 9: Water temperature in degrees F
- Field 10: Turbidity in NTU
- Field 11: Conductivity in  $mS/cm$

## 14.0 Setting SeaSense Date & Time

The date and time are already preset when the SeaSense is shipped however it can be set manually at any point using the following procedures:

1. Power off the SeaSense (if it is currently on).
2. Make sure XBee dongle is plugged into laptop and Serial Monitor is open (see section 8 again for instructions as needed).
3. Click on the Clear Output button as shown in **Figure 43** if you were previously using the SeaSense and there is still text in the serial monitor screen.

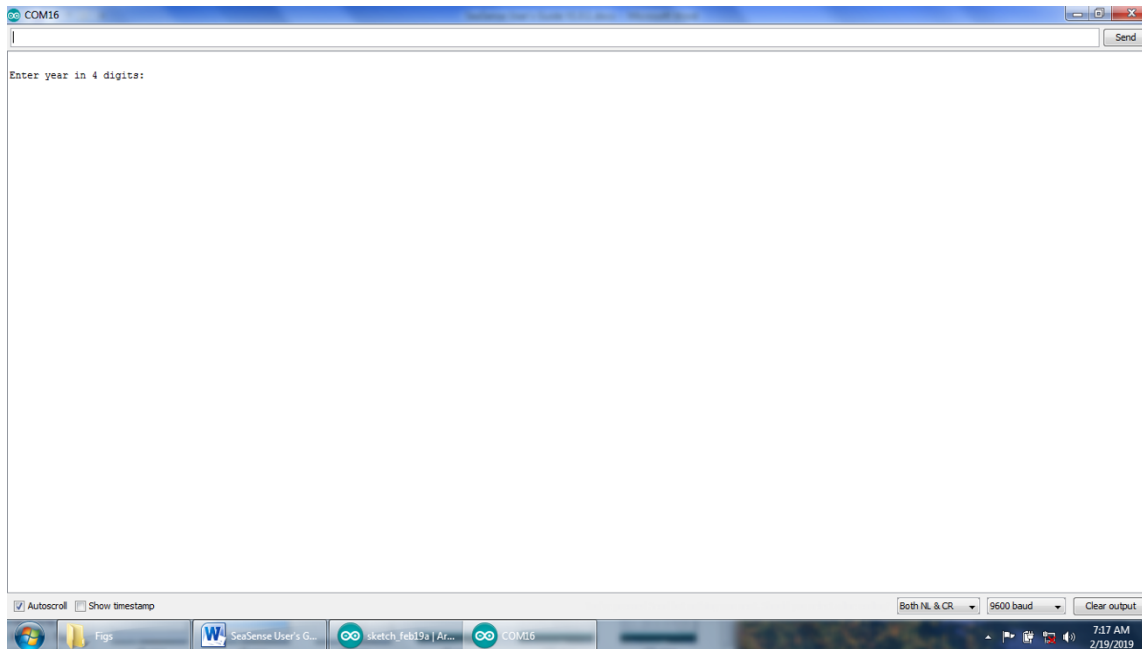


**Figure 43** - Blank serial monitor screen.

4. Power on the SeaSense and quickly navigate to the Serial Monitor and type the letter s and press enter. You need to do this after 1 second or so but before 4 seconds (*Note: you may need to type s and press enter a couple of times*)



5. Observe the message asking you to enter the year as shown in **Figure 44**. Enter this in 4 digits (ie. 2019) and press enter. Make sure to do this within 4 seconds or the read input will time out. (Note: if the menu shows up before prompting you to enter the year, repeat steps 1-4 again).



**Figure 44** - Set date and time process starting.

6. When prompted, enter the month in two digits and press enter (i.e for December enter 12). Do this within 4 seconds to avoid timeout.

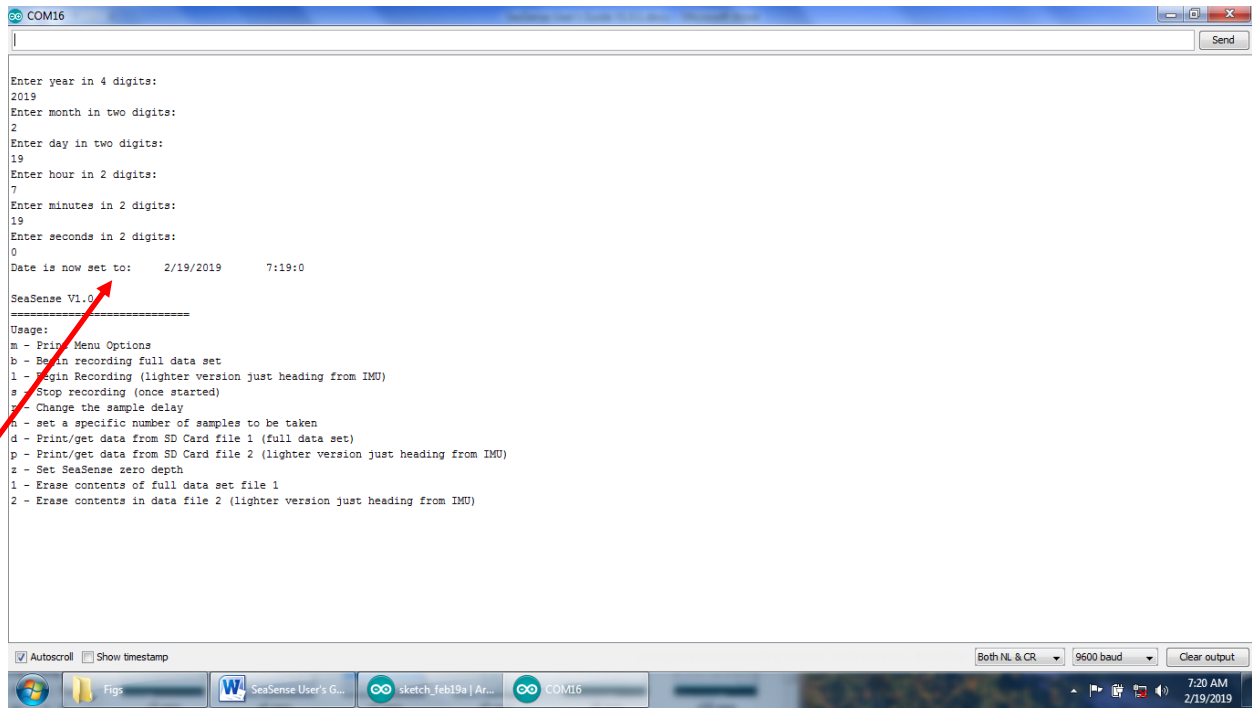
7. When prompted, enter the day in two digits and press enter. Do this within 4 seconds to avoid timeout.

8. When prompted, enter the hour in two digits and press enter. Do this within 4 seconds to avoid timeout.

9. When prompted, enter the minutes in two digits and press enter. Do this within 4 seconds to avoid timeout.

10. When prompted, enter the seconds in two digits and press enter. Do this within 4 seconds to avoid timeout. (Note: you may need to add a few seconds to the number you type or do this ahead of the clock you are synchronizing with by a few seconds because the set date/time function has a few seconds lag when it updates the SeaSense. You may want to repeat steps 1-10 a couple of times and learn a process that works for you if you need to get it exact).

11. If steps 1-10 are done correctly, the SeaSense will display the time you set followed by the menu options as shown in **Figure 45**.



**Figure 45** - Set date and time process updates SeaSense.

12. If the date and time were not set correctly, you can repeat steps 1-11 at any time.

13. You can power the SeaSense off or proceed to desired operation.

## 15.0 Leak Repairs

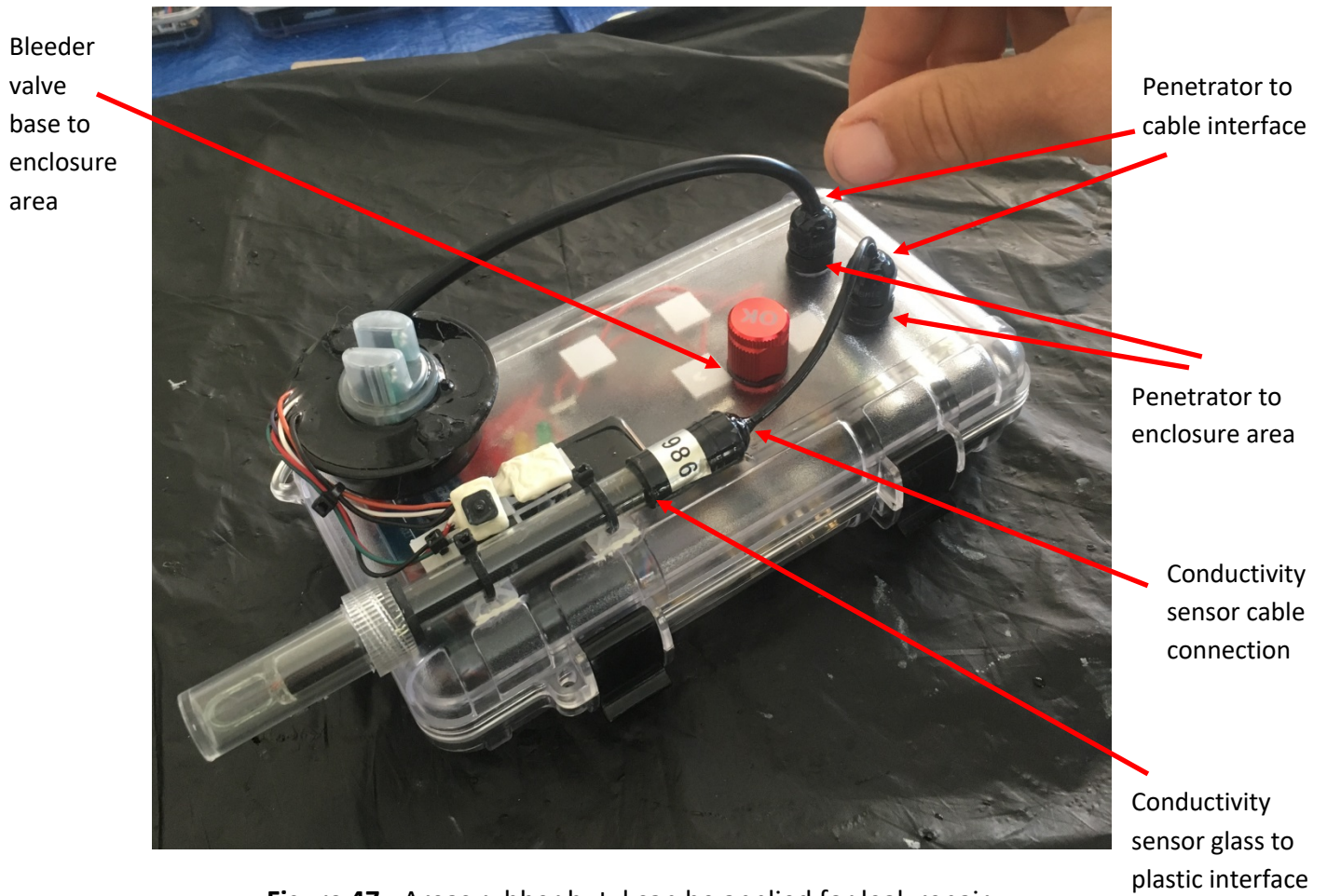
---

If a leak is detected, long-term repairs may be difficult to perform in the field. Inspect the gasket and sealing surface for any debris if there is a leak. If the lid gasket is fine, a suggested short-term repair is to use the provided black butyl rubber pieces provided in the kit for everything except the lid gasket. Do not apply butyl rubber to the gasket or gasket sealing surface. This repair is only for penetrators and cables.

Knead this into the suspected area as shown in **Figure 46** and make sure it is pressed firmly against the surfaces in contact. If you suspect a leak on at the penetrator or cable connector, it is best to apply all the way around the area. Repeat steps 5-10 in section 4 to check again for leaks. If a particular leak source is not evident, you can start with a penetrator and/or cable and continue until the leak is gone. Particular areas where rubber butyl can be applied are shown in Figure 47.



**Figure 46** - Temporary leak repair on SeaSense.



**Figure 47** - Areas rubber butyl can be applied for leak repair.

## 16.0 Upcoming User's Guide Features

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- Sensor re-calibration procedures.
- Troubleshooting procedures.
- Lid gasket repair

**For questions related to SeaSense**, please visit the SeaSense section of the RoboNation Community Forum at: <https://robonationforum.vbulletin.net/>.