

SeaTag-MOD™

Operator's Manual

Version 1.01



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1. Introduction

The SeaTag-MOD, a modular pop-up satellite archival tag (PSAT), takes an in depth observation to collect a variety of factors that define the behavior of marine wildlife. In communication with ARGOS satellite, SeaTag MOD reports data containing location, time, temperature, depth, and acceleration. The solar powered tag harvests energy from the sun and stores into a



super capacitor. When solar power is unavailable, there are battery options for the tag to retain energy. At the end of the period, the MOD releases from the observed animal by a microburst in the release section and floats to the surface. The MOD is reusable since the release section is a separate unit from the tag. With supporting software (SeaDock, SeaWatch, SeaTrack) the data can be retrieved, decoded, and ready to be analyzed.



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WC 133R-09-CN-0109

SeaTag MOD is one of the several tags that make up Desert Star System's line of animal tags and micro-observation stations developed for NOAA under the Small Business Innovative Research (SBIR) program. For more details on the SBIR program go to <http://desertstarsystems.businesscatalyst.com/sbirsttr.html>

2. Functions of the SeaTag-MOD

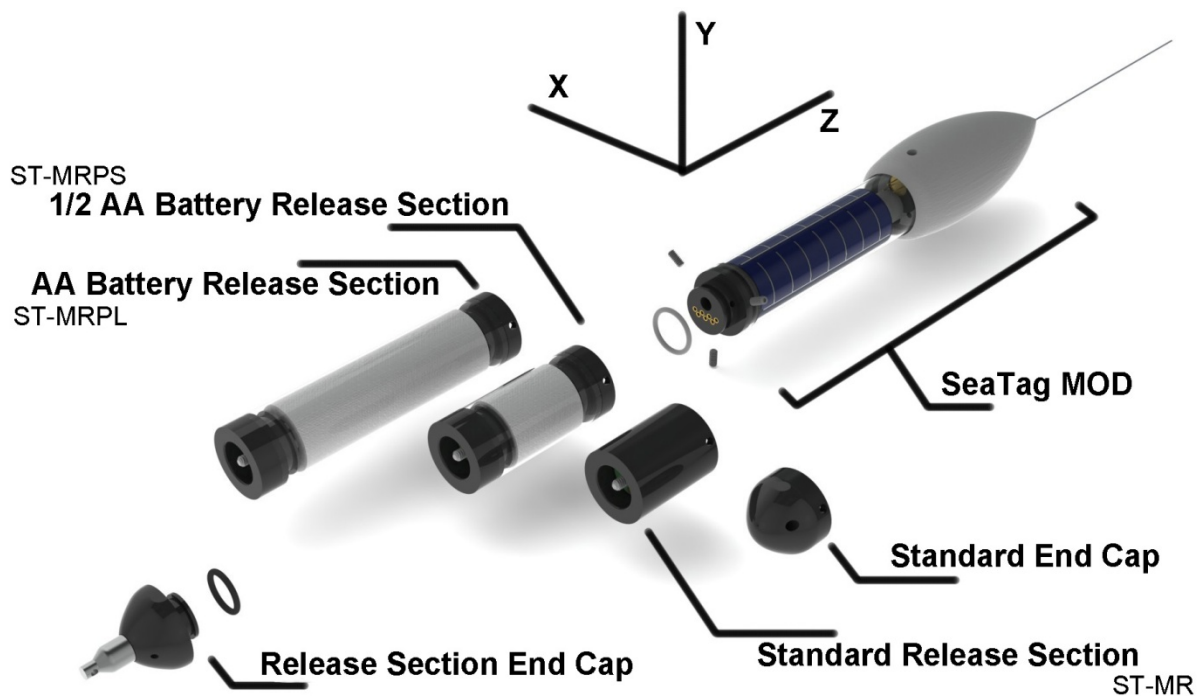


Figure 2.1 Technical Diagram of the MOD displaying XYZ axis, battery attachment options, and release sections.

Sensors

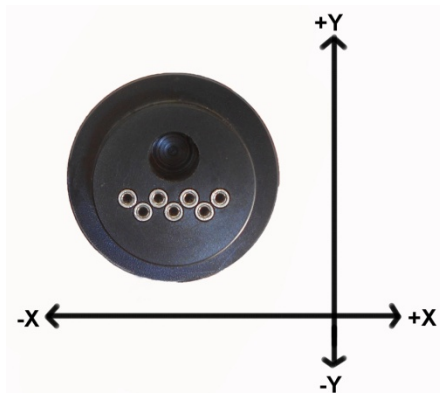
3 Axis Magnetometer: Measures the strength of Earth's magnetic field.

Solar Cell: Charges the tag's internal capacitor using sunlight.

Temperature Sensor: Measures the surrounding temperature.

Depth/Pressure Sensor: Measures depth.

3 Axis Accelerometer: Measures change in acceleration.



The image to the left shows the XY axis of the accelerometer in relation to the pins on the end cap.

Memory: Archived data is stored in a 2GB micro SD card.

Release Section: A plug in release section terminates the tag. The four options include a non-battery release section, two different battery release sections, and a non-release end cap.

Optional Battery Power

A battery release section is recommended if the tagged animal rarely occupies the “energy harvesting zone” or there is a chance of bio fouling that may occur. Having a battery section prevents inefficient performance such as data loss due to high sampling rate in lieu of available light. The battery is integrated with the release section located at the end cap of the tag. The available battery sizes are ½ AA and AA.

Energy Harvesting Zone

Through testing at several locations and different water types the general rule of thumb is that a tag can acquire enough power from the sun to recharge at twice the vertical visibility of the water. For example, if you can see 10 meters into the water column then the tag can acquire and store energy 20 meters below the surface.

For information on sensors go to *Technical Specifications*.

3. Getting Started with the SeaTag-MOD

For tags without internal batteries, place the tag in direct sunlight for at least 30 minutes to one hour (depending on available sunlight). Alternatively you can charge a tag by plugging it into the computer using the docking station (do not run software at this time). Charging times on computers vary, but 5-10 minutes is usually enough. A tag can also be charged indoors by using a high efficiency light bulb (recommend a *daylight* bulb); direct a fan onto the tag to avoid overheating.

You will need to charge the tag fully in order to wake it up from *Sleep Mode* before connecting it to the docking station software.

Set up docking station: plug USB cable into your PC, then plug the dock into the end of the MOD. Be very cautious that the pins are carefully aligned to the end of the MOD. Caution: Connecting a tag to a docking station without an o-ring installed does not take much force. If the tag has an o-ring installed we recommend pulling it off for any docking. The force from the opposing pressure may cause you to accidentally break pins on the tag which may result in the necessary replacement of both the tag and the docking station.

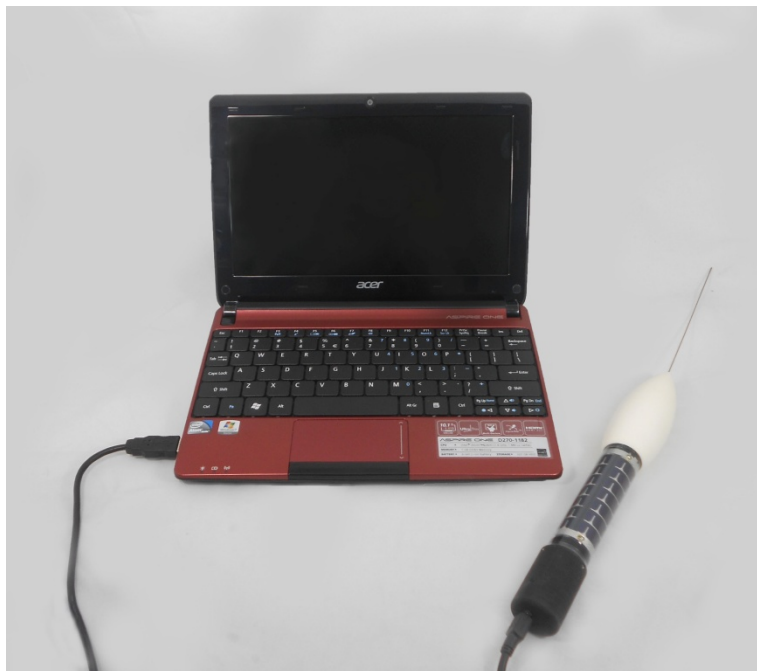


Figure 3.1 shows the set up between the MOD docking station and PC.

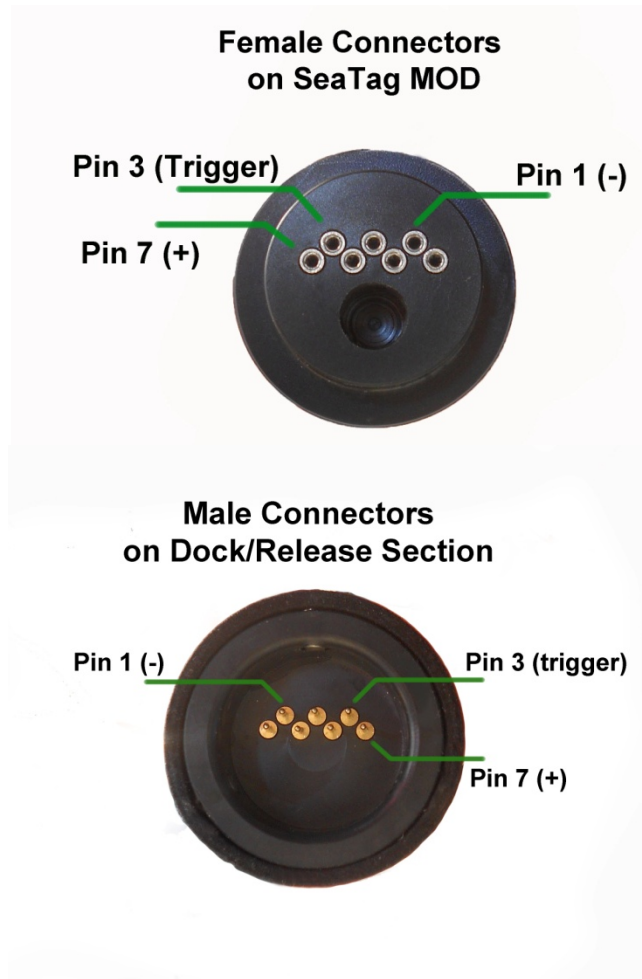


Figure 3.2 shows connector functions of the dock and the end cap of the MOD.

Installing Software: All of the SeaTag software is preprogrammed to the supplied laptop in the SeaTag Starter Kit. If you choose to use your personal computer please contact the Quality Control department for copies of the software (SeaDock, SeaWatch, and SeaTrack). Software is compatible with Windows XP, Windows Vista, Windows 7, and Windows 8.

Updating Software: For each program, check the title bar for the version number to distinguish whether the software is current. If in doubt, contact Desert Star for current the version number. **Note:** Version number is subject to change.

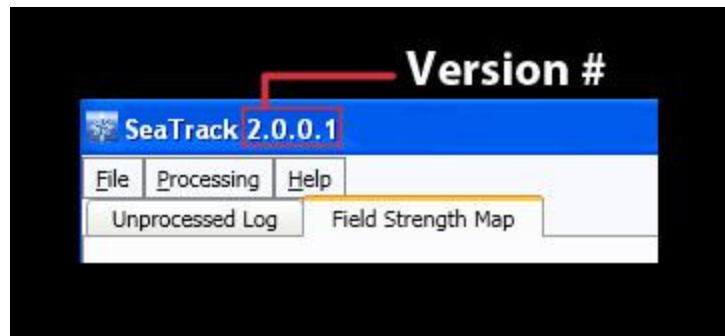


Figure 3.3 shows the location of the version number.

4. SeaDock: Connecting the SeaTag-MOD

SeaDock is designed to configure tags, retrieve archived data logs, and decode Argos logs. When using the menu bar, mouse over an option and a text window will then describe the function.

Note: Different configuration settings produce various data results. Also, configuration settings determine the rate of memory and energy usage. Improper settings rapidly drain the battery, which terminates the mission.

4.1 SeaDock: Start Tab

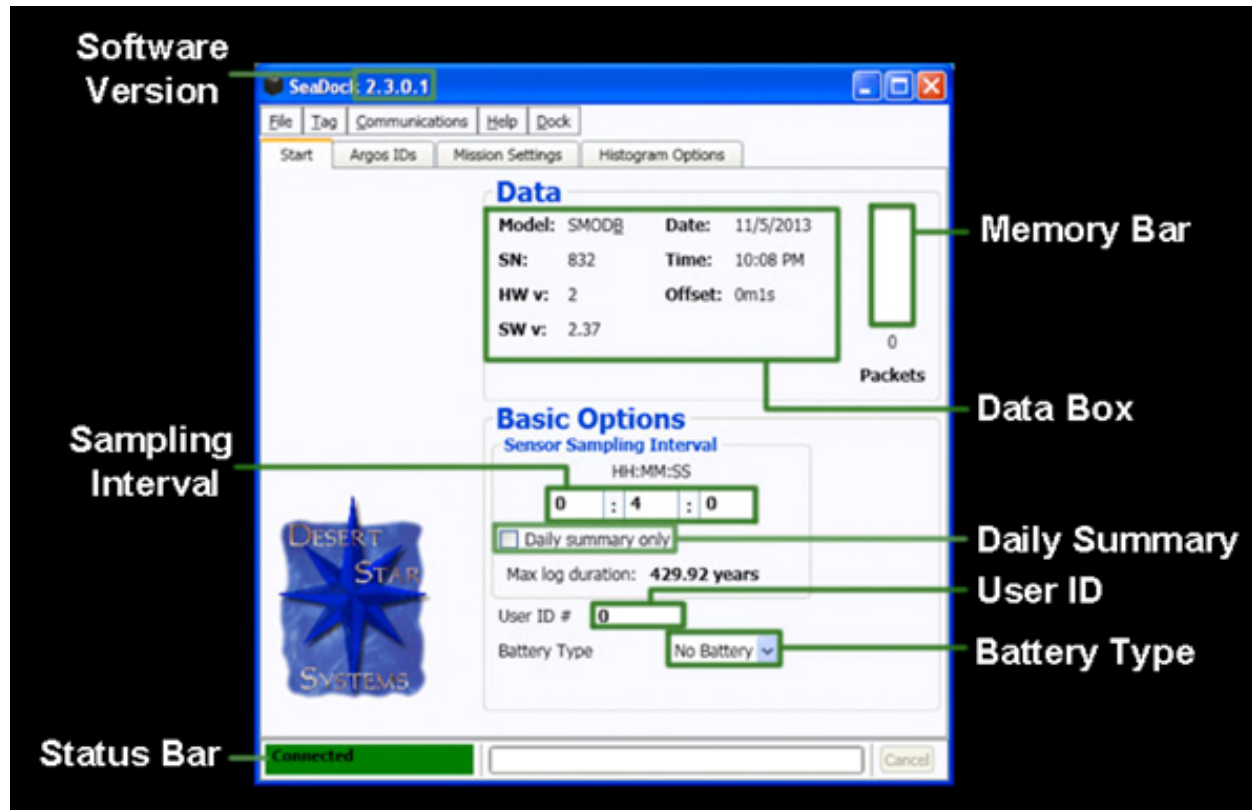


Figure 4.1 clarifies each area on the Start Tab.

Data Box: Displays the Model# and the Serial#. The SW v is the version # of the firmware. *Date* and *Time* is derived from the PC clock. An offset can occur through PC clock drift or PC synchronization error. Having a greater offset can affect the longitude estimation.

Note: An offset of 4 minutes can convert to a longitude error of 1 degree.

Memory Bar: This shows the current number of data packets stored into the tag's memory. Erasing the data packets before deployment is mandatory. To erase unwanted data packets in the memory bar click

Tag > Erase Logs

After the tag has been successfully erased click

Tag > Write Settings

User ID: Give the tag a distinctive ID# for record keeping. For example, ID#'s can be based on certain experiments or assigned to certain researchers.

Sensor Sampling Interval: Defines the rate at which the tag will acquire raw sensor data. The fastest sampling rate is once every 1.6 seconds (entered as 1 second). We strongly recommend reviewing our published application note on power requirements and data storage requirements prior to using a high rate of sensor sampling.

Daily Summary Only: This option is selected for daily averages of the sensors for that given day.

Battery Type: Select the appropriate battery type being used for that specific MOD.

Status Bar Modes:

Detecting(flashing)
 Reading(flashing)
 Connecting (flashing)
 Connected
 Disconnected
 Sleep Mode
 Updating Firmware(flashing)
 Connection Test

4.2 SeaDock: ARGOS ID Tab

Monitor each ID code in the Argos ID library. To add an ID code, enter the **Dec_ID** and **Hex_ID** received from ARGOS. IDs entered in the ARGOS ID library will be transferred to the ARGOS ID Code drop-down menu located in the *Mission Settings Tab*. The remaining columns will automatically fill in the data relating to the given IDs. The **notes** column is used for any distinct descriptions on an individual tag. The **Lock/Unlock Table** secures data entry to prevent input mistakes.

Dec_ID	Hex_ID	Tag_SN	Tag_VID	Start	End	TX_Days	Notes	Lock/Unlock Table
109739	508A4BE	96	0	8/27/2013	9/2/2013	362	None.	
109740	508A4C7	216	0	8/15/2013	9/2/2013	362	None.	
109741	508A4D4	177	0	1/1/1970	9/2/2013	360	None.	
109742	508A4E1	170	0	1/1/1970	8/28/2013	362	None.	
109743	508A4F2	76	0	1/1/1970	9/2/2013	362	None.	
109744	5155700	180	0	1/1/1970	9/2/2013	363	None.	
109745	5155713	210	0	1/1/1970	9/2/2013	363	None.	
109746	5155726	260	0	1/1/1970	9/3/2013	362	None.	
109747	5155735	143	0	8/15/2013	9/2/2013	363	None.	
109748	515574C	180	0	1/1/1970	8/28/2013	362	None.	
109749	515575F	493	0	7/24/2013	7/31/2013	365	None.	
109750	515576A	272	0	5/8/2012	7/8/2012	363	None.	
67609	63A4B98	0	0	1/1/0001	1/1/0001	0	None.	
67610	63A4BA0	0	0	1/1/0001	1/1/0001	0	None.	
67611	63A4BBE	0	0	1/1/0001	1/1/0001	0	None.	
67612	63A4BC7	0	0	1/1/0001	1/1/0001	0	None.	
67613	63A4BD4	0	0	1/1/0001	1/1/0001	0	None.	
67614	63A4BE1	0	0	1/1/0001	1/1/0001	0	None.	
67615	63A4BF2	239	0	7/13/2013	7/22/2013	363	None.	
67616	63CE300	209	0	1/1/1970	7/23/2013	363	None.	

Figure 4.2 outlines each column on the ARGOS ID tab.

4.3 SeaDock: Mission Settings Tab

Mission Type

There are three different mission modes:

- *Real-Time Tracking*
- *PSAT with RT Tracking*
- *Sleep Mode*

Each mode offers options that are specified for different mission types.

4.3.1 Real-Time Tracking- The tag is set to transmit only the most recent data. This mode is ideally used for researching animals that frequently reside at the surface (i.e. turtles and whales).

The screenshot shows the 'SeaDock 2.3.0.1' application window with the 'Mission Settings' tab selected. The window has a menu bar (File, Tag, Communications, Help, Dock) and a toolbar (Start, Argos IDs, Mission Settings, Histogram Options). The main content area is divided into several sections:

- Mission**
 - Mission Type**: Three radio buttons are present: 'Real-time Tracking' (selected), 'PSAT with RT tracking', and 'Sleep Mode'.
 - High-Res Acceleration**: Includes a checkbox for 'HRA Active', a 'Store HRA' checkbox, a numeric input for 'Measurements/point' (set to 1), a 'Measurement rate(sec)' (set to 10.00), and a 'Time interval per point' (set to 00:01).
 - ARGOS Transmission Load**: Shows 'Total packets/day' and 'Priority packets/day' both at 0.00. A 'Restore Default Settings' button is at the bottom.
- Data Transmission**
 - Argos ID Code**: A dropdown menu showing '50BA4BE'.
 - Packet Settings**
 - Transmitted Packet Selection**: A note states 'Only selected packets will be transmitted'. It includes a 'Priority Packets' section with checkboxes for 'Daily Summary', 'Depth Histogram', and 'G-Force Statistics', and an 'Other Packets' section with a checkbox for 'Sensor Packets'.
 - Real-time Transmissions**: Two radio buttons: 'Selected Packets' (selected) and 'ARGOS Position Only'.
 - Transmitter Settings**
 - Transmit Conditions**: Three checkboxes: 'Tag is vertical', 'Near-surface depth', and 'RF surface detection'.
 - Transmit Timing**: Three green buttons with values: '60' for 'Transmit Days', '45' for 'Transmit Rep. Period(sec)', and '300' for 'Transmit Current(mA)'.

At the bottom of the window, there is a status bar with a green 'Connected' indicator, a text input field, and a 'Cancel' button.

Figure 4.3.1 displays the Real-Time Tracking layout.

High Res Acceleration Column

HRA Active: When enabled this mode programs the MOD to record distinct changes in acceleration. This selection is for studying dynamic activity research.

Argos ID Code Column

Select the ARGOS ID for this specific tag. Be aware that each tag must have a unique ID. You enter the list of IDs on the Argos IDs tab, see previous section for details.

Transmitted Packet Selection

Daily Summary: This selection programs the MOD to transmit the data summary for that day along with an engineering packet every tenth transmission. This is commonly selected as it prioritizes these packets before raw sensor packets allowing you to receive the most important packets first.

Depth Histogram: This programs the MOD to transmit depth histograms. If you are not using depth histograms you do not need to select this box.

Sensor Packets: This programs the MOD to transmit raw sensor data based on the programmed sensor sampling rate (see Start tab). The tag will not begin transmitting raw sensor packets until it goes through its programmed priority loops.

Real Time Transmissions

Selected Packets: This programs the MOD to transmit the data chosen from the *Transmitted Packet Selection*, for use in real-time tracking.

ARGOS Position Only: This selection programs the tag to transmit the tag's ID and a magnetic field average. Also sends an engineering packet every tenth transmission.

Transmitter Settings

The purpose of these settings is to ensure the retrieval of data from the MOD by removing the possible factors that would hinder the MOD's signal.

Tag is Vertical: The tag must be oriented in a vertical position in order to transmit.

Near-Surface Depth: The tag must be near the surface in order to transmit.

RF Surface Detection: The tag detects whether it is underwater or at the surface using radio waves in order to proceed with the transmission. Commonly used on animals that surface occasionally and may support opportunistic transmissions. Otherwise, leave unselected to conserve power.

Transmit Timing

Transmit Days: Set the number of days the tag will transmit. The purpose of this setting is to ensure total data retrieval. We recommend setting the number of transmit days to coincide with your project and what the tag has recorded and expected to transmit.

Transmit Rep Period: The rate at which the tag transmits an Argos message. Most users, unless otherwise agreed upon by Argos, have a setting of 45 seconds.

Transmit Current: Sets the threshold of mA that is required to transmit data. This is more-or-less experimental; therefore, we recommend leaving it on the factory setting of 300mA.

4.3.2 PSAT with Real-Time Tracking- In this mode, the MOD collects data while transmitting a loop of all available data packets (data packets from the start date to the most recent packet collected). After releasing from the observed animal, the tag will cease to collect data and continue to transmit a loop of archived data.

The screenshot displays the SeaDock 2.3.0.1 software interface. The main window has a menu bar (File, Tag, Communications, Help, Dock) and a toolbar (Start, Argos IDs, Mission Settings, Histogram Options). The interface is divided into several panels:

- Mission:** Includes Mission Type (Real time Tracking, **PSAT with RT tracking**, Sleep Mode), Release Conditions (Mission End/Release Date, Crush Depth Exceeded, Constant Depth Release, CDR Days), High-Res Acceleration (HRA Active, Store HRA, Measurements/point, Measurement rate(sec), Time interval per point), and ARGOS Transmission Load (Total packets/day, Priority packets/day). A "Restore Default Settings" button is at the bottom.
- Start/End Dates (UTC):** Features a "Data Collection Start Date" calendar for November 2013 and a "Release Date" calendar for November 2013. Below the calendars are HH MM SS input fields.
- Data Transmission:** Includes Argos ID Code (50BA18E), Packet Settings (Transmitted Packet Selection: Priority Packets, Other Packets), Priority Transmission Timing (5, 3), Real-time Transmissions (Selected Packets, ARGOS Position Only), Transmitter Settings (Transmit Conditions: Tag is vertical, Near-surface depth, RF surface detection), and Transmit Timing (60, 45, 300).

The bottom status bar shows "CONNECTED" and a "Cancel" button.

Figure 4.3.2 displays the PSAT with RT Tracking layout.

Note: All options presented under *Real-time Tracking* have the same functions under *PSAT with RT Tracking*.

Release Conditions Tab

Constant Depth Release (CDR): The MOD is trigger to release if it had observed a constant depth for 'X' number of days. Such would be the case in the event of a mortality incident.

Start/End Dates (UTC) Tab

Mission Start Date: The tag begins to record data on the chosen date.

Mission End/Release: The tag will release from the animal on the chosen date. Caution: Make sure to select a date in the future or the tag will release as soon as it is connected to a release section.

HH:MM:SS- Enter the desired time of release (hours, minutes, seconds). The standard default is 12:00UTC.

Priority Transmission Timing Tab

At the end of the mission, the MOD will reach the surface transmit until the following requirements are met. This is to ensure full data retrieval.

Priority Transmit Loops: The number of times that a tag will transmit the Priority Packets which should be based on the number of packets that the tag collected and the interest in getting the "Priority Packets" before raw sensor data.

Priority Transmit Days: The number of days that a tag will transmit the Priority Packets.

The main caution point when setting up the *Priority Transmission Timing* is that you enter a minimum number of days and loops so that the tag has enough time to ensure that it has transmitted the most valuable information before transmitting all of the raw sensor data.

For information on Satellite Pass Predictions see <https://argos-system.clsamerica.com/cwi/Prediction.do>

4.3.3 Sleep Mode: This mode is for storing the MOD and ceases the transmission of the MOD. We recommend that you do not attach a release section during sleep mode to prevent any issues with the tags releasing during this time.

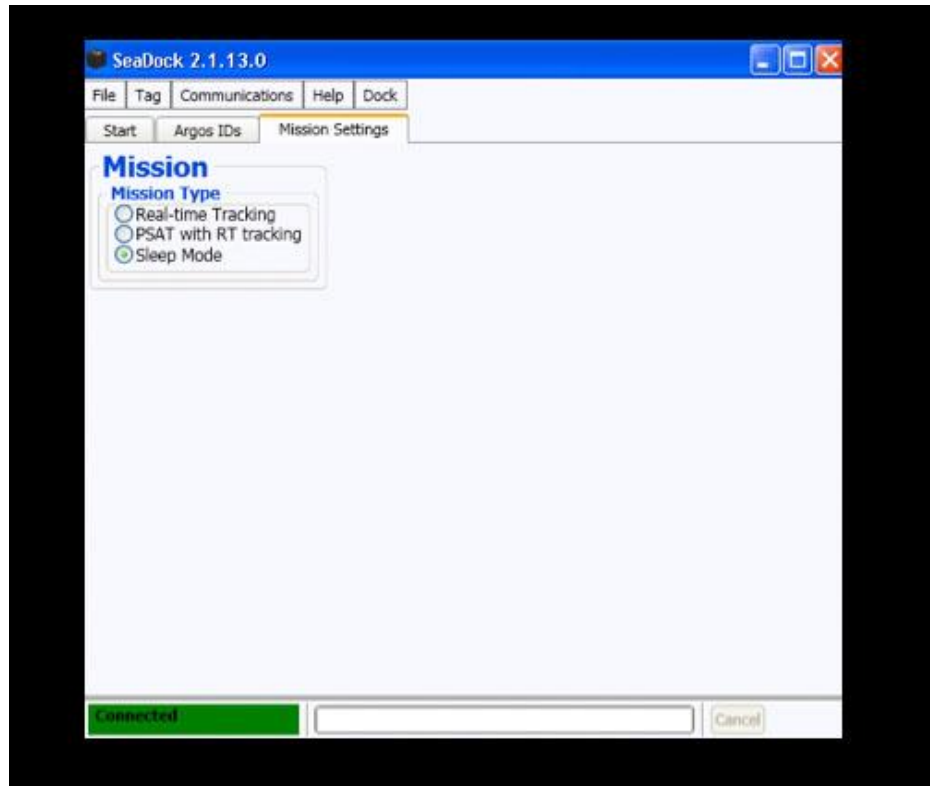


Figure 4.3.3 displays Sleep Mode layout.

4.4 Histogram Options Tab

Choose the settings for the depth histogram.

Select the time reference between *Local Time* (i.e. time referenced from the laptop used to configure the tag) or *UTC*.

Set the *Start Time* (associated with the time of day) and the *Duration* (how many hours).

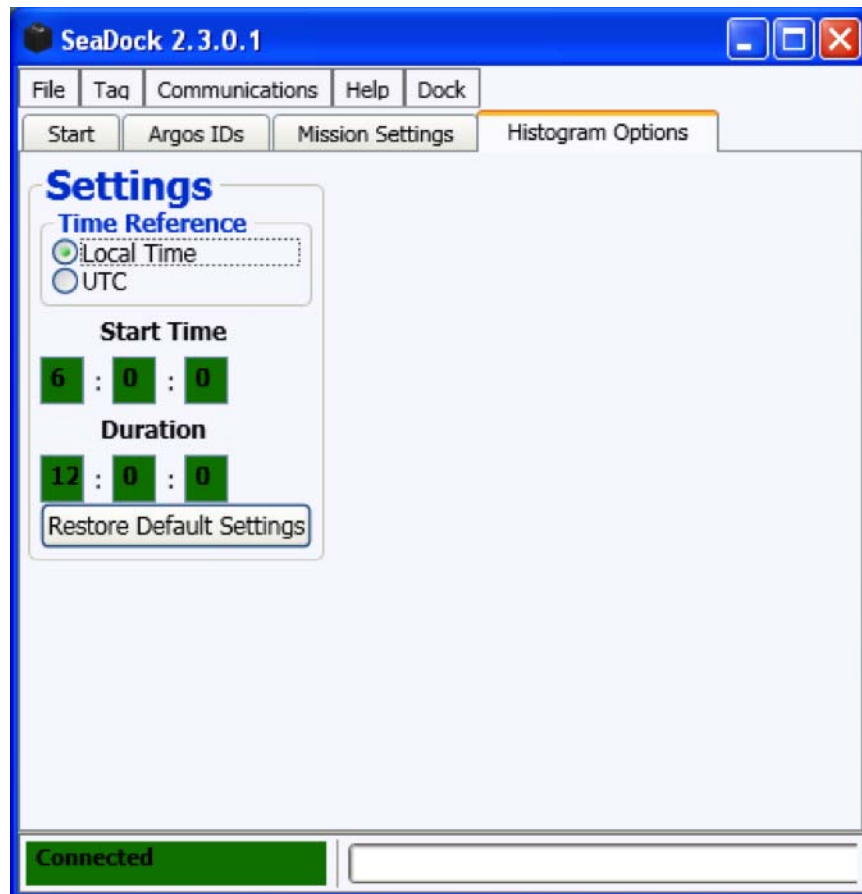


Figure 4.4 displays the Histogram Options tab.

4.5 Mini Mission

Before deploying the MOD, it is recommended to conduct a *Mini Mission*. The *Mini Mission* is a method where the operator can go through a practice run and evaluate the performance of the tag. Run the mission for at least 24 hours, though 3 days is recommended. Choose the available settings to configure the MOD. Place the MOD either in a blue or clear bucket filled with water. Be aware the testing area should be away from any objects that can affect the magnetometer (i.e. cars, cell phones, conductive metals).

Note: You should use the test release sections provided with your starter kit for the mini mission(s).



Figure 4.5 displays two tags in the process of a mini mission.

There are two types of missions:

- *Transmission Test*: This evaluates the Argos transmission of the tag and the data that is retrieved. This should be done just as a measure to ensure you entered the Argos IDs correctly.
- *Transmission and Release Test*: This evaluates the transmission of the tag and the data that is retrieved through Argos along with the witness of the release section performance. **Note**: Release Sections are not reusable.

Settings for *Transmission Test*:

- Set the desired start date.
- Set the end date one year ahead (prevents the MOD from triggering the release).
- Choose an ARGOS ID.
- In *Priority Packets* and *Other Packets*, select all data packets.
- In *Real Time Transmissions*, choose 'Selected Packets'.
- Leave all options in *Transmit Conditions* unselected.
- Go to **Tag > Write Settings**

Settings for *Transmission and Release Test*:

- Repeat all steps described in the previous test except to set end date on the last day of the mini mission, usually 3-5 days after Start Date, for the release section to trigger.

After the *Mini Mission*, examine the data packets to see that it correlates to the environment where the tags were tested. You can either download the logs directly from the tag or through the Argos website (or SeaWatch). For ease of data recovery we recommend to download the data from the tags directly.

4.6 Step-by-Step Configuration for Deployment

Ensure SeaDock is connected to the correct serial com port by going to:

Communications > Serial port > Com 'X'

Observe the status bar mode. It should show **Connected**

Once connected, check to see if the data box information is valid. Ideally, the memory bar should be empty in order to have the maximum amount of space for data storage.

Set *Sampling Rate Interval* or check the *Daily Summary* box.

Set *Mission Settings*. (Conduct *Mini Mission* prior to deployment).

Open raw communications window by going to:

Communications > Show raw communications

(For more information on raw communications see section below)

Click 'Sensor Test' to evaluate sensors.

Passing Sensor Test:

- VCAP: 2800-3600 mV
- VSOL: 3000-4000 mV
- TEMP: 19000-40000 mdeg C
- Magnetic Field: Each axis (x,y,z) should report a number other than zero

Double check over the settings, then go to:

Tag >Write Settings

4.7 Retrieving Data through SeaDock

To download logs go to:

Tag > Download Logs (all)

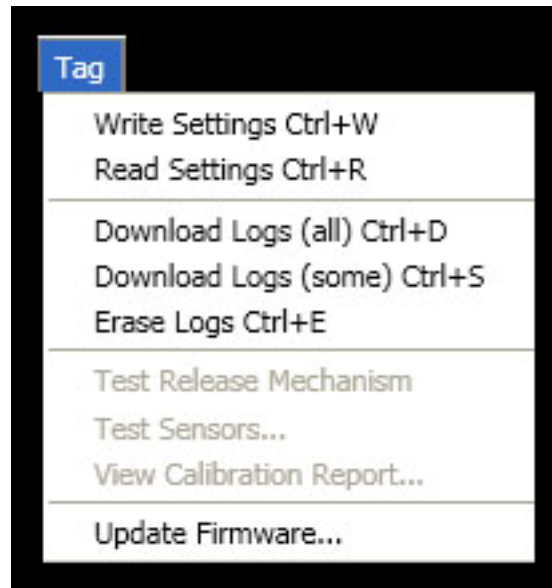


Figure 4.7.1 shows where Download Logs is located.

Once the download is successful, the files are located:

File > Open Tag Log Folder

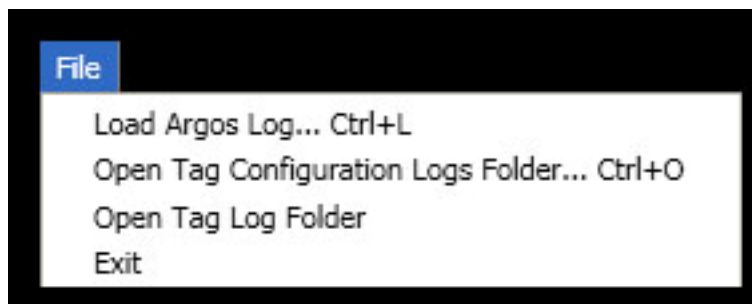


Figure 4.7.2 shows where Open Tag Log Folder is located.

To process raw ARGOS data using SeaDock, click:

File > Load Argos Log

5. Quickburst Release Kit

Watch the tutorial video <http://www.youtube.com/watch?v=Vo7aapiTI10>



Figure 5.1 shows the materials supplied in the release kit.

Materials

1. Silicon Grease
2. Battery Pack/Release Section
3. End Cap with O-ring
4. H-3 compound
5. Oxidizer
6. Measuring Spoon
7. Popsicle Stick
8. O-ring Remover
9. Allen Wrench & Screws
10. Silica Gel Pouch (to ensure freshness)

CAUTION: This release kit contains flammable substances once mixed. To avoid any hazards, prepare the compound in a non-flammable environment with the appropriate workspace and safety glasses.

Note: Be aware to keep total time of atmospheric exposure under one hour. If the substances absorb moisture, they can become ineffective and fail the release.

Step 1

Gently grind oxidizer bag using the Popsicle stick to break up compacted powder. Continue until oxidizer becomes fine-grained.

Step 2

Pour the full amount of oxidizer into the H-3 compound (container of charcoal). Close the lid and shake the container for 30 seconds to mix.

Step 3

Unscrew the nose cone from the tag. Take the measuring spoon and scoop one leveled spoonful of powder. Do not heap the scoop.

Step 4

Locate the circular ignition chip inside the burn chamber. Pour powder into the burn chamber. Distribute the powder evenly over the ignition chip by slightly tapping the MOD.

Step 5

Remove excess powder on the burn chamber (i.e. inner walls and the top lip of the cap). Inspect the nose cone and O-ring groove. Make sure that it is clean for a secure seal. Lube O-ring with a small amount of silicon grease (remember excessive grease can affect the seal). Snap O-ring on the groove of the nose cone.

Step 6

Screw nose cone on the MOD until flush.



Figure 5.2 dissects the end cap sections.

Step 7

Repeat **Step 5** when placing the o-ring at the end of the tag. Pair the release section with the tag by **carefully** aligning the pins.

Step 8

After connecting the tag and the release section, screw in the three set screws with an allen wrench. Make sure the screw holes are aligned to avoid stripping the threads.

Note: Once the substance is mixed you can no longer transport or ship the material legally without compliance with HAZMAT regulations. For information on legal transportation go to (<http://desertstarsystems.businesscatalyst.com/hazmat-regulations.html>).

6. SeaWatch

Outside of (<https://argos-system.clsamerica.com/cwi/Logon.do>) SeaWatch is the fundamental software for data recovery. The function of this software is to retrieve data from the ARGOS website by registering for data packets every hour (internet connection is required). Once the packets are received, SeaWatch then arranges the data to where the files are comprehensible for each tag. This program also removes duplicate data packets to avoid downloading repetitive data. SeaWatch is already programmed on the computer provided in the starter kit. If you want to install this software on additional computers please contact the Quality Control department.

SeaWatch can be located:

Start > All Programs > Desert Star Systems > SeaWatch

6.1 SeaWatch: Logging In

The username and password is the same the ARGOS login information.

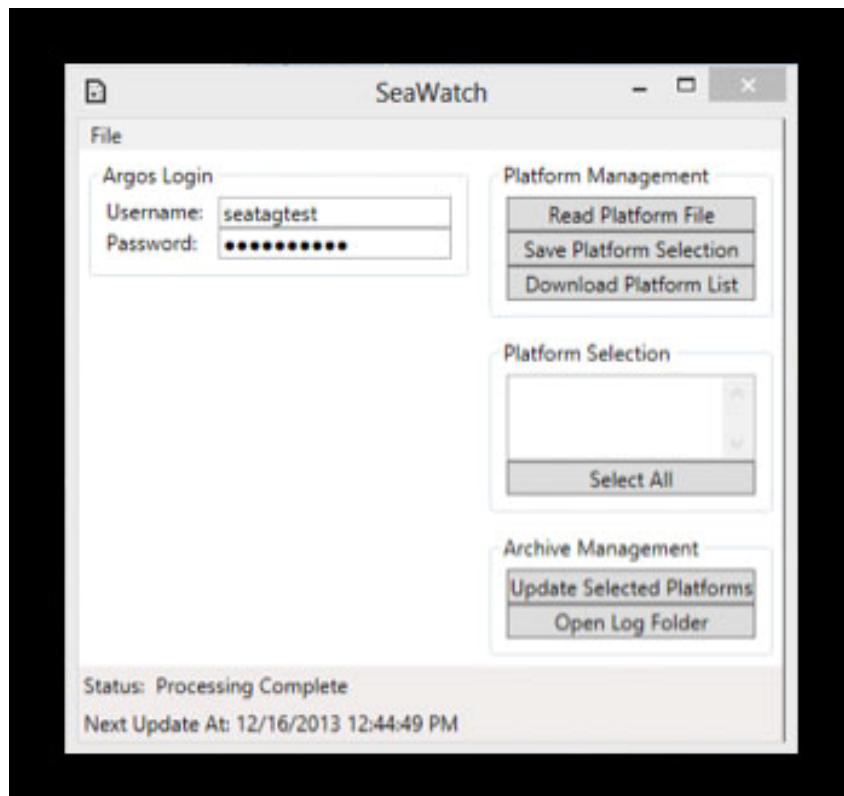


Figure 6.1 displays the SeaWatch Log-In window.

Be aware ARGOS can record random IDs from tags that were not deployed on that mission. Record familiar IDs used for that mission and ignore foreign IDs to prevent from misinterpreting data.



To verify when SeaWatch is active, there will be an “i” icon located on the bottom right of the computer screen.

6.2 SeaWatch: Accessing Data

Platform Management:

Read Platform File: Select this command to retrieve data files from the ARGOS account.

Save Platform Selection: This command saves the custom list containing specific tag IDs selected by the user.

Download Platform List: This command will initiate the automatic download from the ARGOS website, then process data packets.

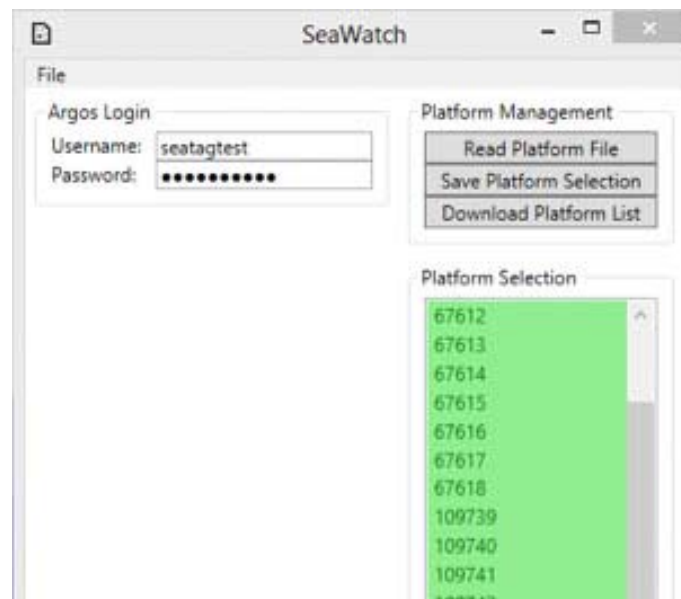


Figure 6.2 shows the Platform Selection Box populated with tag IDs.

Platform Selection Box:

Each tag ID is displayed in the box. Click to select or deselect a tag ID. The *Select All* option selects the entire list of tag IDs. Selected tag IDs are highlighted in green and unselected tag IDs are highlighted in red.

Archive Management:

Update Selected Platforms: Select this command to instantly receive data and bypass the hourly schedule of data retrieval.

Open Log Folder: Select this command to locate the data log folders.

Note: There are two types of data folders:

- *ARGOS Log Folder:* This folder contains position only data files providing longitude and latitude.
- *SeaTag Log Folder:* This folder contains processed data to where it is decipherable.

7. SeaTrack

Using SeaTrack, the collected positions (derived from the magnetic field intensity and noon time values) can be refined by setting data parameters and filter the outliers producing measurable data.

7.1 SeaTrack: How to Load a Log for Position Processing

Begin with the Unprocessed Log Tab and retrieve the log file by going to: **File > Open SeaTag Log**

Log files are located in:

- SeaWatch, click: **Open Log Folder**
- SeaDock, click: **File > Load Argos Log**

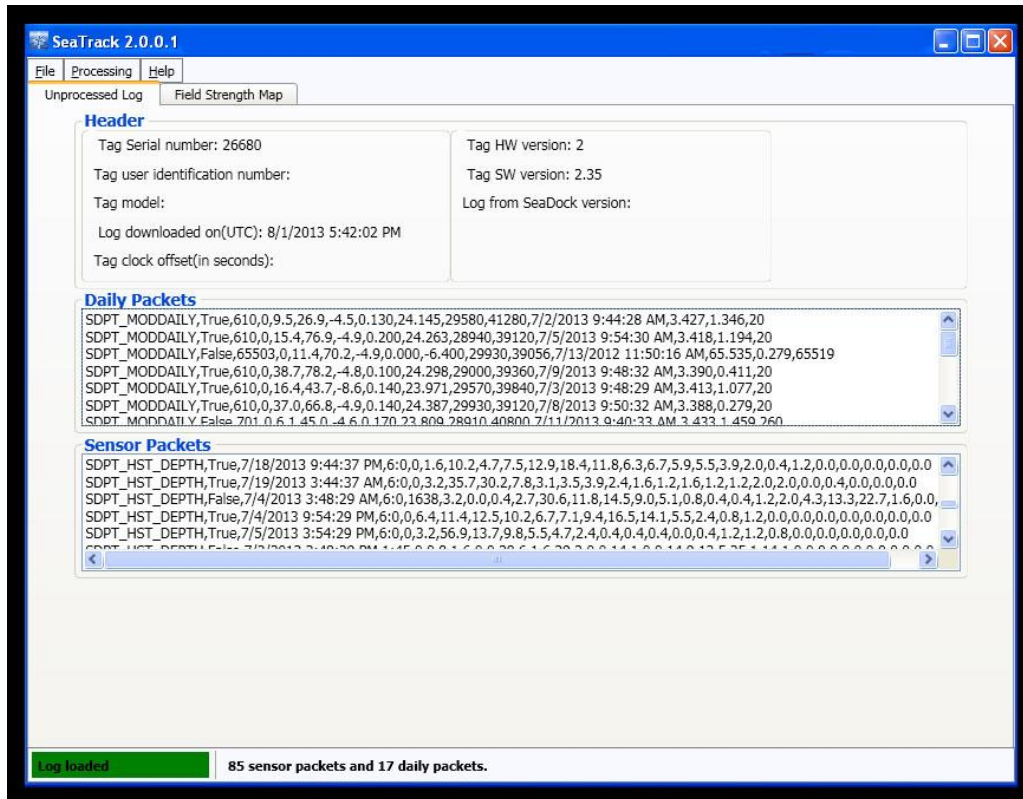


Figure 7.1 shows the Unprocessed Log tab populated with data.

The *Header Box* contains the identification of the tag, when the log was downloaded, clock offset, and the firmware version. Below the *Header Box*, the *Daily Packets* and *Sensor Packets* are displayed. **Note:** These data packets are not transmitted directly from ARGOS. They are recovered from SeaDock logs.

7.2 SeaTrack: How to Process a Log

Go to the Field Strength Map tab after the log files are loaded.

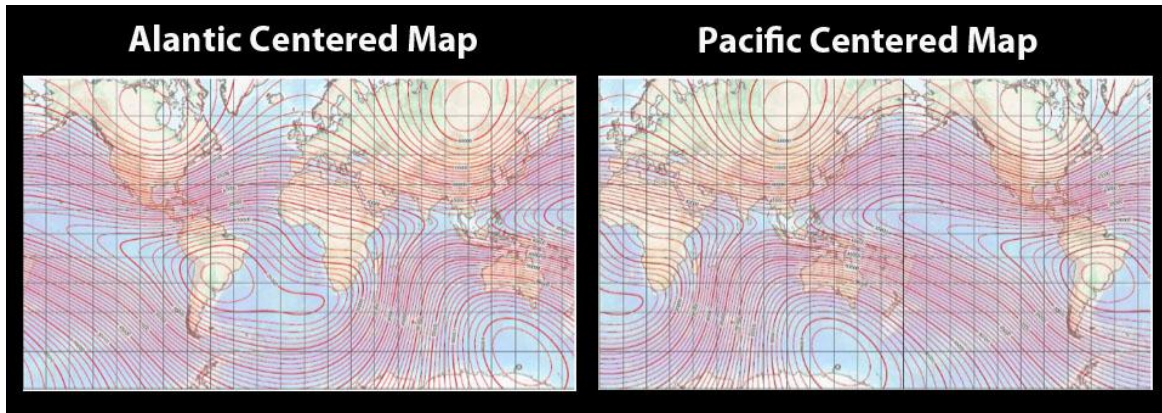


Figure 7.2.1 displays the option between Atlantic Centered Map or Pacific Centered Map.

Select *Atlantic centered* or *Pacific centered* map depending on tracking region.

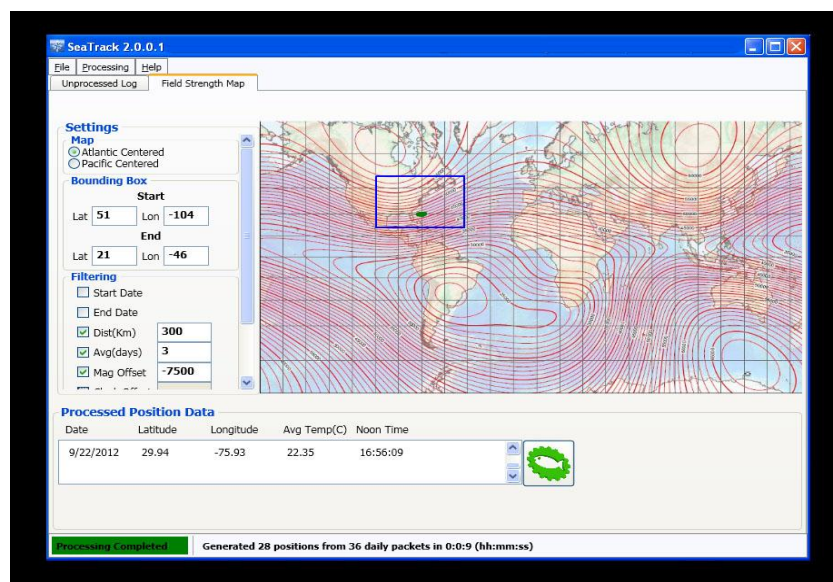


Figure 7.2.2 displays the bounding box on the Atlantic Centered Map in blue.

Bounding box: Set the box on the region of where the tracking took place.

To open box: Start from the upper left corner; left click and drag.

To close box: Single left click.

Another option is to manually enter the latitude and longitude coordinates of the bounding box.

Draw the entire bounding box to the entirety of the map if positions do not appear. Be aware that when the entire map is selected there will be two similar magnetic strength zones in the bounding box and can distort data by reflecting the plotted points. The reason is that there may be two magnetic file lines of the same value in the Southern and Northern hemisphere.

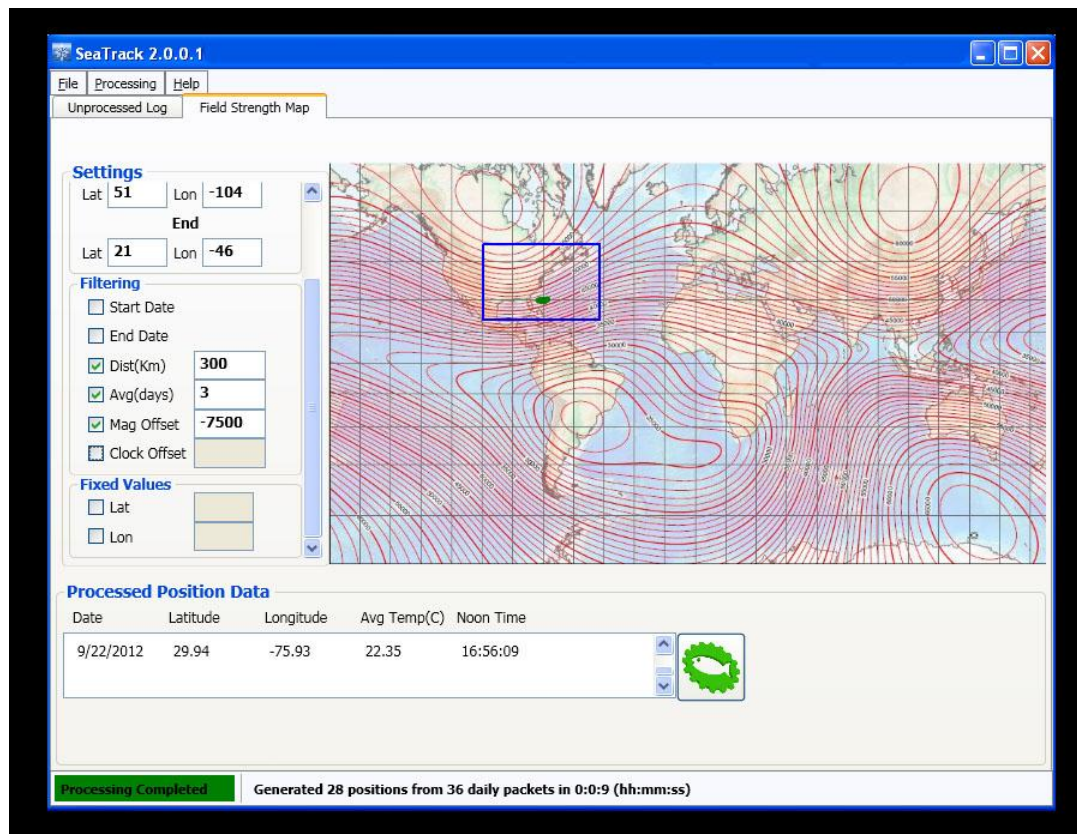


Figure 7.2.3 displays the filter settings located on the left side scroll menu.

Filtering Data: Set the parameters before plotting the data to remove any outliers and refine the position track.

Start Date: If selected, data will include the first reporting positions of the tag.

End Date: If selected, the endpoint is plotted where the tag was last on the animal, excluding data gathered from situations where the tag was floating on the surface or remained on a deceased animal.

Dist. (KM): Enter the limiting distance that the observed animal can travel in one day.

Avg. (days): To clearly visualize the animal's path enter the number of days to smooth the position track. Since the tag can have a possible error of 35 nautical miles, take the error and divide by the average distance of the animal's daily migration (35 nautical miles / distance of daily migration 35 nautical miles = # of days). It is recommended to apply different averages with low standard deviation and compare each map for narrowing a reasonable conclusion.

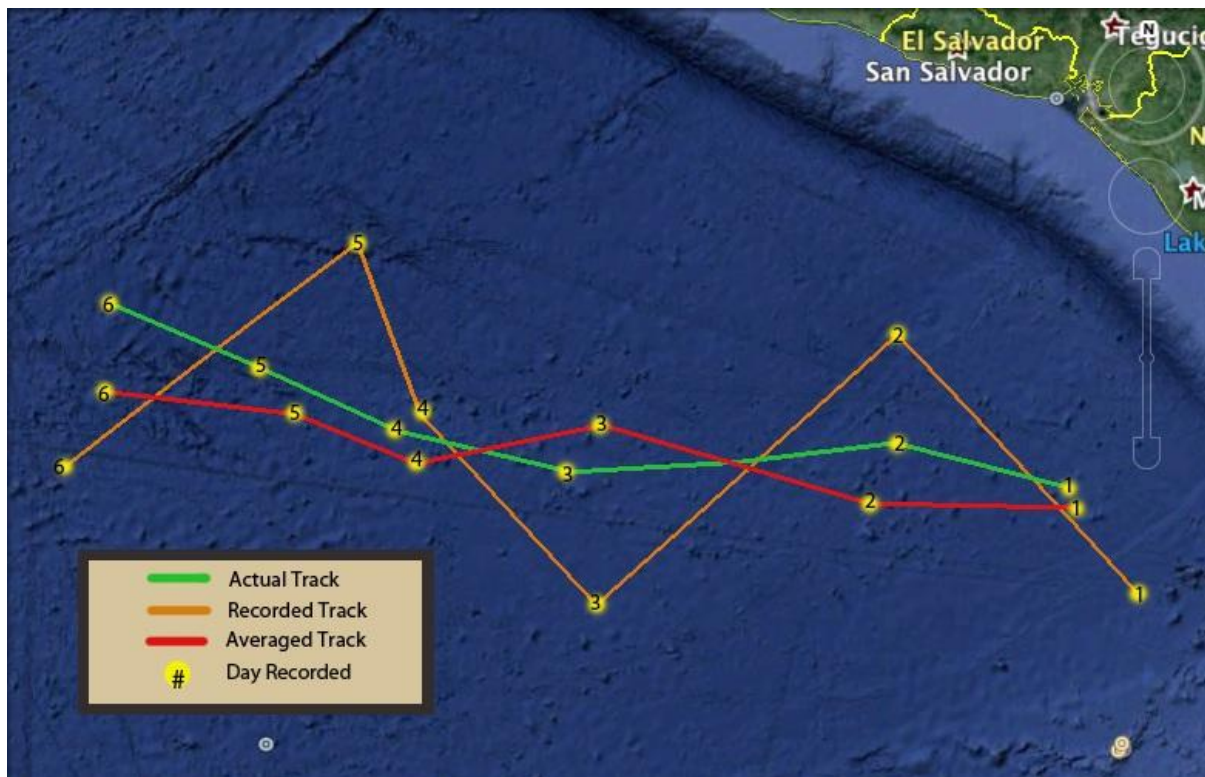


Figure 7.2.4 shows a map comparing simulated raw data from the tag to the processed data (after averaging) derives the new averaged track.

Mag Offset: Enter the magnetic offset to correct the reporting magnetic field. **Note:** The offset is added to the data. If the reported magnetic field is less than the actual magnetic field, enter a positive offset. If the reporting magnetic field is greater than the actual magnetic field, enter a negative offset.

Determining the offset: Observe the reported magnetic and latitude/longitude of where the tag was deployed. Using NOAA magnetic field calculator (<http://www.ngdc.noaa.gov/geomag-web#igrfwmm>), enter the known tagging latitude/longitude to get the actual magnetic field of that location. Subtract the tag's observed value from the predicted value to get the offset. To verify the offset, repeat the procedure using the location of where the tag was released. This offset should be similar to the value at the start of the track, defining a constant.

Clock Offset: Enter the clock offset. This is only necessary if the offset is 2 minutes or more. This offset can occur from PC synchronization error or the tag can experience a clock drift. To compute the offset compare the ARGOS time stamp to the tag's reported time located in the engineering packet. Enter a positive value for the offset if the reported tag time is earlier than the actual time. Enter a negative value for the offset if the reported tag time is later than the actual time.



Click the green fish (located near the bottom right of the window) to:

- Process data and compute positions.
- Abort data processing.

Exporting the position files

To export positions as a text file (.csv) go to: **File > Export > Processed**

Position Log

To export positions as a KML file go to: **File > Export > Google Earth Map**

It is recommended to save unprocessed data. Apply different filter settings. Save each variation and compare results for thorough conclusions.

8. Biofouling

During the tracking period, the MOD can be at risk of bio fouling. Various organisms (barnacles, mollusks, other bacteria) attached to the tag can greatly affect the performance. Consequently, bio fouling increases the drag, decreases the buoyancy, and limits the solar panel's intake of light. It is known that bio fouling occurs greater in tropical waters than in colder waters. To avoid bio fouling and maximize solar panel's performance, coat the MOD with *Propspeed* (a non-toxic, silicon based antifouling paint). **Note:** Do not use colored *Propspeed*. It can also limit the sunlight that can be absorbed by the solar cell.



Figure 8.1 (left) shows a Propspeed coated tag in action and (right) Propspeed antifoulant paint kit.

9. Test Tagging Attachments

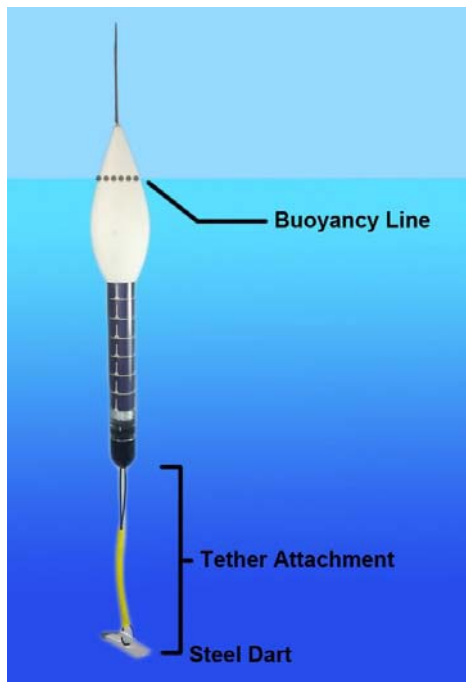


Figure 9.1 shows the buoyancy line of the MOD equipped with a tether attachment.

For the attachment method, the MOD was designed to sustain 5.3 grams in order to maintain its buoyancy. When using a different attachment, be sure to conduct a buoyancy test.

The antenna should be 7 inches out of the water, measuring from the water level on the float to the end of the antenna. If the tag cannot support the attachment, then it will sink as a result of shedding or send insufficient transmissions.

Desert Star Systems can provide an attachment created by Hallprint (additional costs apply). The attachment includes a swivel, dart head, and identification information printed on the tether.

10. Troubleshooting (Using SeaDock, Raw Comms window)

Try the following solutions, if any issues occur with the MOD.

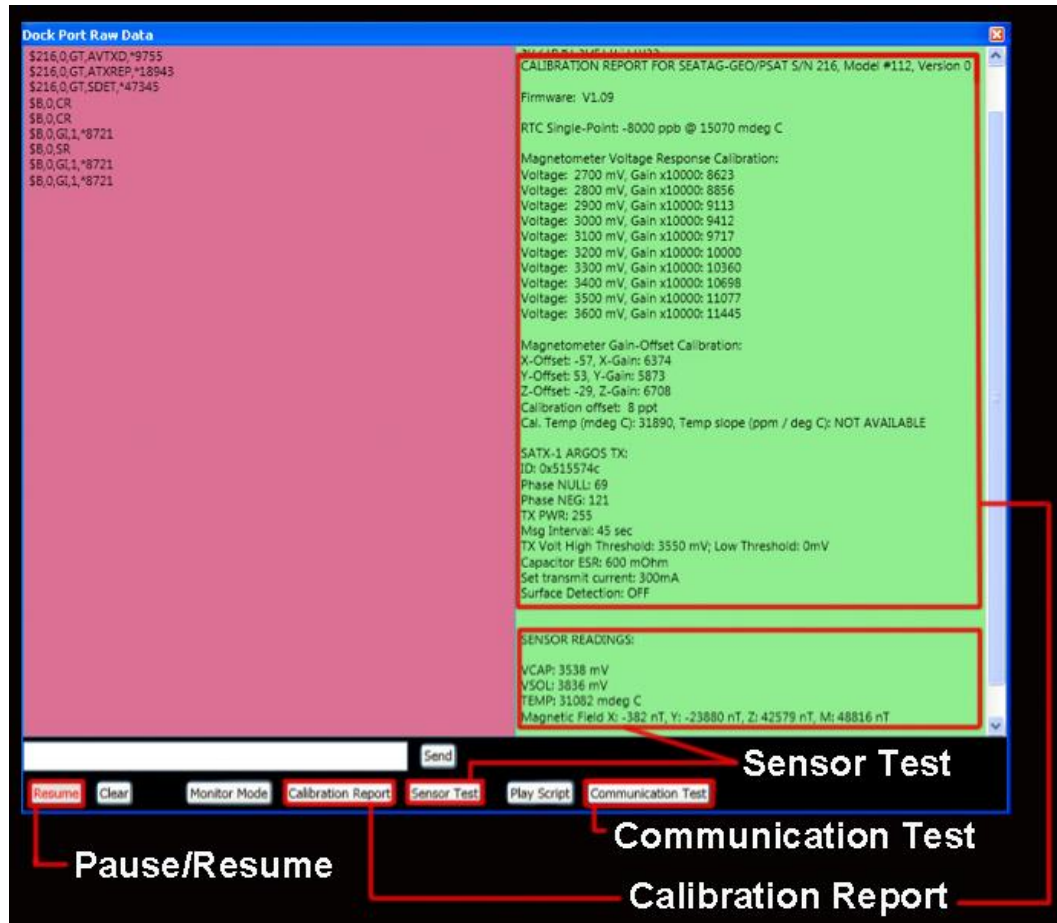


Figure 10.1 displays the raw communications window.

Click **Calibration Report** to verify the calibration. Click **Sensor Test** to evaluate the sensors. Click **Pause/Resume** to stop the data streaming in order to read the report.

Difficulties connecting the MOD- A fully charged MOD should connect to SeaDock within 5 minutes. If the tag does not connect, try the following procedures:

- Ensure that the tag is charged and awake from sleep mode.
- Confirm SeaDock is operating on the proper serial port.
- Disconnect the dock and shutdown SeaDock. Then, reconnect the dock and reopen SeaDock.
- Using a pair of tweezers, reset the tag by connecting one end to **Pin 1** and the other end to **Pin 7** (Refer to Figure 3.2 for pin diagram).

11. Desert Star Contacts

Customer Support & Quality Control

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Engineer & Advanced Technical Support

Marco Flagg

E-mail: engineering@desertstar.com

Skype: mflaggdss

12. SeaTag Extended Warranty

The tagging process contains certain risks such as the loss of a tag or failure to retrieve data. Environmental factors, mechanical issues, or user error configuration may potentially cause these risks. With this in mind, it is essential to have accessible support throughout the tagging process. Desert Star Systems offers a mission planning support service along with an enhanced warranty providing tag replacement. If interested in the additional warranty services please contact our Sales and Marketing department.

13. Additional Information

For more detailed information on the MOD go to:

- www.Desertstar.com
- Desert Star's Knowledge Base www.desertstar.com/FAQ
- Watch tutorial videos www.youtube.com/desertstarsystems
- Information on our Warranty Statement:
<http://desertstarsystems.businesscatalyst.com/resources/general/Warranty%20Statements.pdf>

14. Technical Specifications

Size & Weight:

	ST-MRP	ST-MRPS	St-MRPL
Length (exclude antenna):	157mm	187mm	232mm
Tube Diameter:	25mm	25mm	25mm
Float Max. Diameter:	39mm	39mm	39mm
Weight:	124.4g	139.1g	160.7g
Flotation in Saltwater:	19.3g (16% of weight)	19.7g (14% of weight)	20.2g (13% of weight)
Flotation in Freshwater:	16.2g (13% of weight)	16.2g (12% of weight)	16.2g (10% of weight)

Operating modes:

Real-Time Tracking: Live data of the latest daily summary is transmitted whenever the tag breaks the surface. Using this mode prevents the tag from releasing.

PSAT with RT Tracking: Live data of the latest daily summary is transmitted along with the data archive. The tag releases on the programmed end date.

Data transmitted:

- Archived or most recent daily summary packets.
- Engineering packets for diagnostics (every tenth transmission).
- Short (energy efficient) 'position only' packets available for real-time tracking.

ARGOS Transmissions:

Using solar energy, transmissions have reporting endurance generally for months to over a year (endurance can be limited by fouling and other environmental factors). We have had several tags transmit data for more than one year and a few limited to only several weeks.

Power Supply:

Stored solar power with optional battery sections (see ST-MRPS and ST-MRPL).

Sensors:

- Three-axis precision magnetometer, 15 nT resolution (approx. 0.03% of earth field)
- Solar power panel doubling as large-surface light sensor
- Temperature sensor, 0.002 deg C resolution
- Precision calibrated clock
- Three-axis accelerometer
- Pressure Sensor options
 - o (Standard) 2000m max depth, 0.15m resolution
 - o (Optional) 500m max depth, 0.04m resolution

Memory:

2GB Micro-SD card

(Optional) Higher capacity

Data Interface:

Through connector end-cap using supplied wired docking station (USB-TTL Serial).

Op. Temp. Range:

-20 deg C to +50 deg C (sensor accuracy may be reduced at temperature extremes).

Depth Rating:

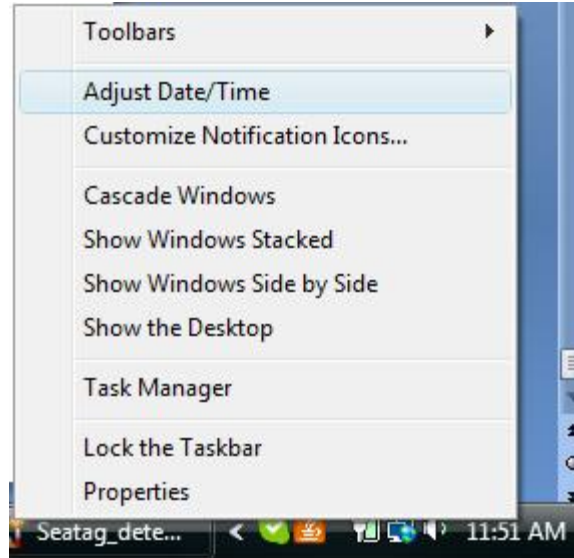
Design tested to 2000m (3000psi).

Important Notes:

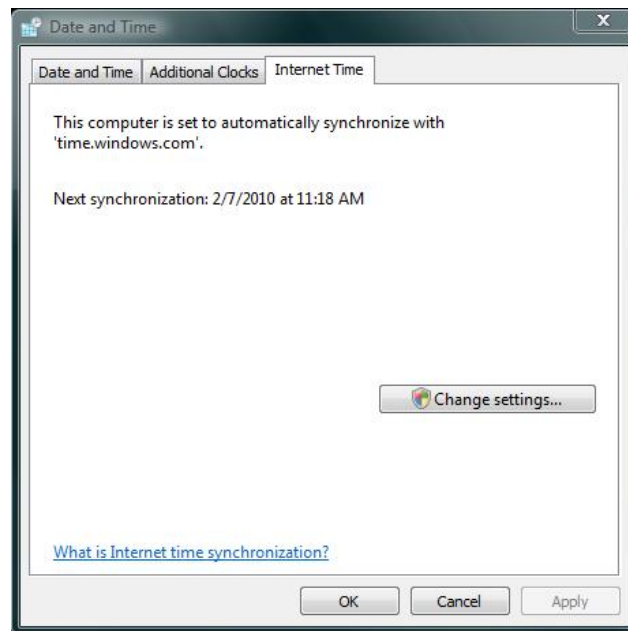
1. Technical specifications are subject to change without notice
2. Sizes and weights are approximate and may vary due to manufacturing tolerances or component changes
3. Absolute accuracy of sensors, power consumption and generation rates and the like are complex and in many cases dependent on operating conditions. Instead of guaranteeing any specific accuracy or results, we conduct lab and field measurements and publish the data as it is for your review.
4. The SeaTag section of our knowledge base at www.desertstar.com/FAQ contains various application notes and data sets providing field and lab performance measurements.
5. A 'Calibration Report' is stored on each tag and is available through the SeaDock software.
6. A 'Sensor Test' function in SeaDock allows for instantaneous testing of your tags sensor functionality.

Appendix A: Setting your computer to update its clock from the Internet

Setting your clock to update from the internet will insure its accuracy and increase the precision of your tags positioning. To make sure it's up to date and that this option is enabled do the following:

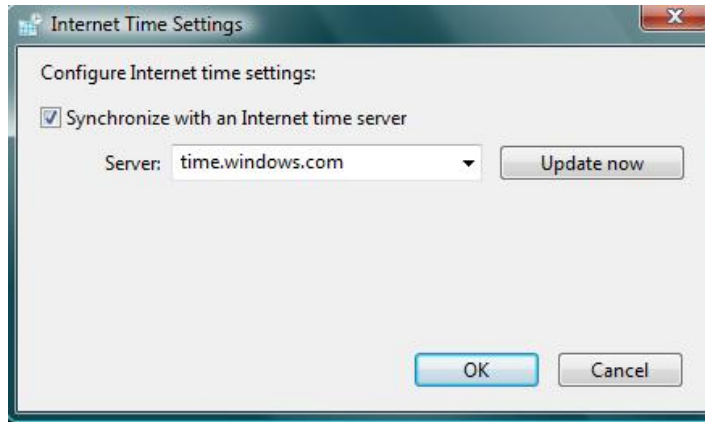


- **Step 1:** Right click on the clock at the bottom right hand corner of your screen and select “Adjust Date/Time”



- **Step 2:** Select the tab at the top that says “Internet Time” and click “Change settings...”

- **Step 3:** A window will pop up saying that windows needs your permission to perform this action. Click “Ok”.



- **Step 4:** The “Internet Time Settings” window will now appear. Make sure the box “Synchronize with an internet time server” is checked. Click “Update now” to update your clock using the time server that is listed.

That’s it. Your clock should be updated and set to auto-update with the internet time server.

Appendix B: Warranty Statement And Liability Disclaimer

Your SeaTag-MOD™ is a high quality product, which has been designed and manufactured in the United States of America. Like all Desert Star Systems products, it is backed up by a one year limited warranty. To make a warranty claim, call Desert Star Systems to obtain a return authorization number.

The precise legal wording of our warranty can be found on the following pages.

Desert Star Systems Terms of Sale

1. Desert Star System's general terms of sale are specified by the Uniform Commercial Code (UCC), supplemented by the following conditions and the warranty statements. Where Desert Star Systems terms of sale are in conflict with UCC, Desert Star Systems terms apply.
2. At times an advance payment either partially or in full is required for large orders. In these circumstances, no portion of this payment is refundable.
3. On orders with Net 30 terms, a return is acceptable for 30-days following delivery only if a shipped product is non-conforming within Desert Star Systems' specification. In addition a return must first be arranged with Desert Star

Systems. Payment constitutes acceptance of product and no return is available thereafter.

4. Desert Star Systems warranty applies (see below). A warranty claim requires that the product is returned to Desert Star Systems. Therefore, warranty is not available for devices deployed or lost at sea unless the device is recovered and returned to Desert Star Systems.
5. In order to support best success with our products, Desert Star Systems provides a number of resources, support and recommended techniques. We emphasize your use of these resources to optimize results with our products:
 - a. Desert Star Systems guarantees only minimal specifications, and instead relies on the publication of measured performance data in the knowledge base (<http://216.92.75.75/FAQ/>), application notes and other documents. Please evaluate this data to estimate suitability for your application. Please contact Desert Star Systems for any additional performance data.
 - b. Desert Star Systems provides on-site training and support. This is highly recommended to optimize the system performance and shorten the learning curve.
 - c. Please evaluate our products through a small initial purchase before following up with a large scale purchase. Please be aware that large scale orders in general require an advance payment in consideration of the discount, and that this advance payment is non-refundable. In addition, be aware of any lead time expectancies when placing a larger quantity order.
 - d. Operations should follow a ramp-up schedule of lab/pool testing, followed by testing in a controlled ocean environment (harbor testing), and then followed by the full deployment. The goal is to identify any problems or technology limitations at the earliest possible stage, when there is a maximum level of control and an ability to correct such problems.
6. Desert Star Systems return policy and warranty specifically excludes return or warranty claim on account of suitability for purpose. Suitability for purpose is out of Desert Star Systems' control. Please use a product evaluation based on the above recommended resources and techniques to establish suitability for purpose prior to any purchase.

Note: These terms along with any technical specifications, warranty implications, or pricing may change without notice at any time.

WARRANTY STATEMENT

Desert Star Systems ("Seller") warrants hardware products of its manufacture to be free from defects in design, workmanship and material under normal and proper use and service until the tag is deployed on the animal or up to one year following delivery to Buyer (whichever comes first). Seller agrees to repair or replace at the place of manufacture, without charge except shipping charges, all parts of said products which are returned, for Seller's inspection, to its factory within the warranty period, provided such inspection discloses that the defects are as above described and provided also that the equipment has not been altered or repaired other than with Seller's authorization and by its approved procedures, subjected to misuse, improper maintenance, negligence, or accident, damaged or had its serial number or any other part thereof altered, defaced or removed. Software is warranted to conform to Seller's Software Product Description applicable at the time of shipment to the Buyer. Seller's sole responsibility hereunder shall be to remedy any non-conformance of software to the Software Product Description during the one-year period following delivery. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY, PERFORMANCE OR FITNESS FOR PURPOSE.

LIABILITY DISCLAIMER

By purchasing or using any Desert Star Systems product, it is agreed and understood that in no event will Desert Star Systems or any of its representatives be held liable for any personal injuries or death or damages to property resulting from its operation, or for any other damages whether direct, indirect, or consequential even if Desert Star Systems has been advised of such actual or potential damages. Desert Star Systems science products are authorized for use only by properly trained scientists and technicians, and are NOT intended for general consumer use. The user must understand that the products are liable to sudden failure, including for example with SeaTag the premature firing of its energetic release mechanism. Marine activities are inherently dangerous. Proper safety procedures demand that the equipment user never rely solely on any single instrument, method or mechanism for his/her safety or the safety of property.

SeaTag Return & Refund Policy

1. SeaTag devices may be returned for replacement or refund only within a 30-day period following delivery, and **only** for non-conformance with Desert Star Systems specifications, as published for the product in the Operator's or Technical Reference manual. Products must be in factory new condition and without any alterations to qualify for refund or return and are at the discretion of the CEO of Desert Star Systems.
2. Returns for refund are subject to a 20% re-stocking fee.
3. Custom configured or designed versions of SeaTag are excluded from return or refund. These orders will be identified with appropriate language such as 'Customized Product – No Refund or Replacement Available'
4. Volume orders may require a partial up-front payment to qualify for the volume discount. Any such up-front payment will not be refunded in case of an order cancellation or product return.

NOTICE TO U.S. GOVERNMENT BUYERS

The equipment listed in this price schedule has been developed under phases 1 and 2 the Small Business Innovative Research (SBIR) program. Under DoD rules, the dual competition of the SBIR program satisfies the requirements of the Competition in Contracting Act (CICA). Thus, contracts for product delivery or follow-on research may be awarded on a sole-source basis, without the need for further competition. The contracting officer should establish, through consultation with the prospective COTR for the proposed contract as well as the COTR on the SBIR project whether the proposed follow-on R&D or production work meets the statutory criteria for 'SBIR Phase III'. For details please refer to www.pbcinc.com/sbir/phase3memo.htm.

Appendix C: Enhanced Warranty Option & Mission Planning Support Service

Tagging represents certain risks of tag or data loss that may be caused by a variety of environmental, system or mission specific factors. Tag or data loss can be hard to account for in the budgetary process, and is not covered by our standard warranty.

Further, while SeaTag-MOD with its advanced capabilities supports a wide range of new research objectives, tagging success also requires in-particular careful mission planning and ramp-up.

We are now offering a mission planning support service with an enhanced warranty that provides tag replacement even if the tag is not recovered. The service is charged on a per-tag basis, must be purchased with the tag, and is valid for one tag deployment for up to one year in duration.

What is Covered

1. Non-reporting: No ARGOS transmissions received from the tag after three month from programmed release date.
2. Impeded reporting: Less than 100 messages regardless of “checksum” received from the tag after a shedding event, or after constant depth release triggering event.
3. Premature mission abort: A mission abort due to a system failure, as indicated by the tags engineering report. Note that a “premature mission abort” does not include tag shedding.
4. Persistent archival data recording failure: This failure is also indicated by the engineering reports or a ‘no archival data available’ report. This does not cover write failures from which the tag subsequently recovers.
5. Sensor failure: Complete failure of a sensor (not degraded accuracy), as indicated by the tags engineering or data reports. Sensors include: light / solar, magnetometer, accelerometer, depth, and temperature.
6. Early battery depletion if it occurs at less than 50% of our predicted capacity.

What is Not Covered

1. Failure due to tag configuration not in compliance with your certified mission.
2. Mission abort due to crush depth exceeded or constant depth release trigger.
3. Sensor accuracy degradation.
4. Tag shedding.
5. Failure to comply with any of the requirements for an enhanced warranty claim.
6. Any change in this warranty that was not in effect at the time of this warranty purchase.
7. Any additional costs associated with the tag deployment.

What is Required for an Enhanced Warranty Claim

1. Purchase the enhanced warranty for each tag before the tag is deployed. The warranty is specific to a tag as defined by its serial number.
2. Submit a description of your mission or research plan to Desert Star Systems for certification. We will review and suggest changes if we spot risk factors. We reserve the right to not offer the warranty if we consider the risk as too high.
3. Configure your tags in SeaDock and send the configuration files of all tags to us prior to deployment. We will review and warn you of any mistakes. Re-submit configuration files after making any changes.
4. Once your tags are armed, run a one-day pre-tagging and ARGOS reporting test of each tag. Provide us with your ARGOS account log-in information for inspection. If the test was successful, we will give you a final go-ahead for tagging.
5. Deploy the tags.
6. Submit an image of each tagged animal to us for record keeping that the tag(s) were deployed or other proofs of tagging as authorized by Desert Star Systems.

If a failure of any of the items on the 'What is Covered' list occurs, provide documentation and Desert Star Systems will replace the failed tag free of charge (does not include shipping). You can reach us via email at CustomerSupport@desertstar.com.