

SPOT6

User Guide



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About this Guide

This guide describes the SPOT6 tag. Interacting with the tag, deploying the tag, and transmitted data products are explained.

Before you Begin

The list below shows what is required in order to configure and deploy a SPOT tag:

- A Windows computer with Tag Agent software and USB Blue driver installed
- A Wildlife Computers Portal account
- A USB Blue communications cable
- A magnet
- Argos account access

Visit wildlifecomputers.com to download the required Tag Agent software and setup a Portal account. At the end of this document there is a list of key concepts to reference. We recommend new users review this list.

Anatomy of a Tag

Wildlife Computers offers SPOT tags in many different shapes to suit specific applications. While the shapes may differ, all SPOT tags have several elements in common (Figure 1).

The communications port is where the USB Blue plugs into the tag. Prior to a deployment this port should be sealed with the plug provided by Wildlife Computers. Apply a small amount of silicone grease (supplied in shipment) to the port and press the plug into position. This prevents corrosion of the pins during the deployment; however, the plug is not required for the tag to function normally.

The wet/dry sensor is composed of several (2 or more) metal discs on the surface of the tag. None of the metal discs should be covered in any way as contact with sea water is essential for normal function of the tag. This includes anti-fouling substances and attachment adhesives (e.g. epoxy).

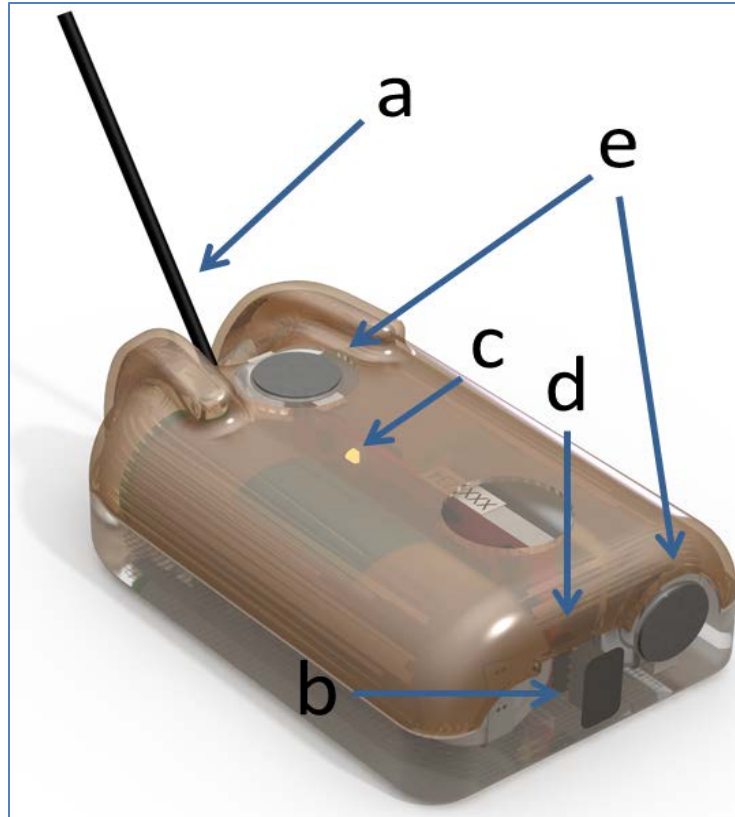


Figure 1 - A typical SPOT tag showing: (a) Argos antenna, (b) communications port with plug, (c) indicator light, (d) magnetic switch, (e) wet/dry sensors.

Note the magnetic switch is not visible on tag exterior. It is near the base of the communications port. Swiping the magnet across the communications port will activate the switch.

Interacting with a Tag

Tag Agent

Tag Agent software is used to change tag states and select tag settings. Tag Agent is also used to send configurations from the Tag Portal to the tag. Visit wildlifecomputers.com to download Tag Agent software and set up a Portal account.

To communicate with a tag, open Tag Agent Software. Use the USB Blue cable to plug the tag into your PC. Take care to ensure that the pins are aligned. Once plugged in, you may need to swipe a magnet near the tag communication port to establish connection. The Tag Agent home screen will appear with tag information on the left and sensor readings on the right (Figure 2).

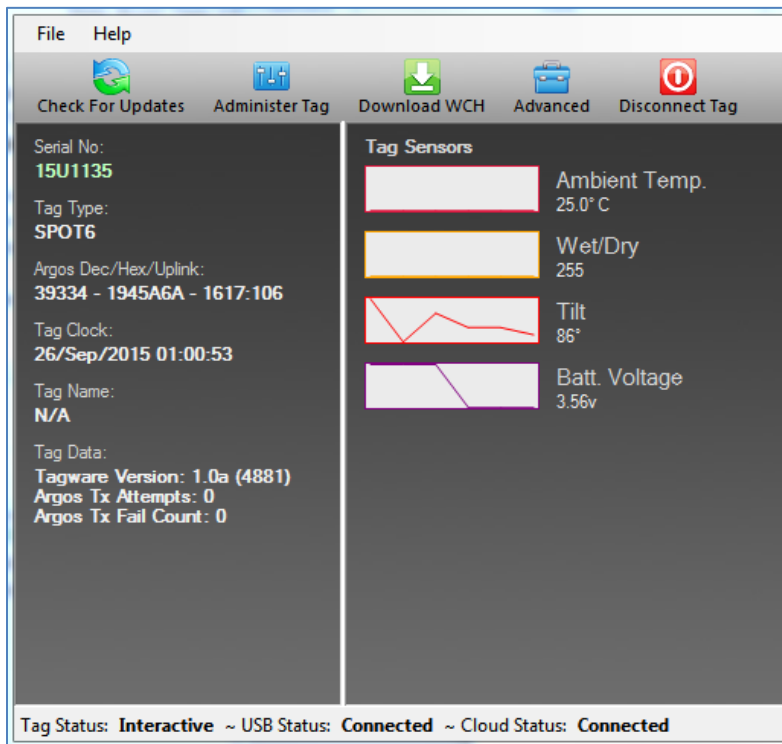


Figure 2 – Tag Agent home screen.

Stop, Auto Start, and Start

SPOT tags have 3 states: Stop, Auto Start, and Start (Figure 3). When in Start mode, a tag is running and will transmit to Argos. Auto Start allows the tag to Start by submersion in seawater or the swipe of a magnet, (for use in brackish or freshwater contact Wildlife Computers). In Stop, the tag will remain unresponsive unless connected to Tag Agent. Stop mode is used for storage of tags for periods longer than a month.

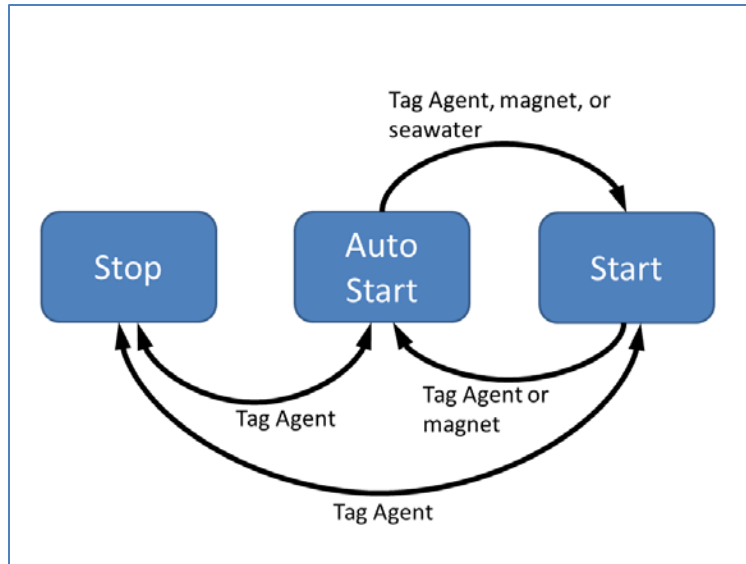


Figure 3 - Methods for changing a SPOT tag's state.

Changing Tag States

Within Tag Agent, the Disconnect Tag tab on the top right navigation bar can be used to put a tag in any state.

Once disconnected a magnet sequence can be used to change the state of the tag between Auto-Start and Start modes.

Passing a magnet near the communications port will cause the tag to blink the indicator light, revealing its current state.

- Two blinks and a pause repeated 3 times means the tag is in Auto Start.
- Ten rapid blinks indicate the tag is Started.
- No blinks indicate the tag is Stopped.

Passing a magnet near the communications port can also toggle the tag between Auto Start and Start. First, swipe the magnet and wait for the tag to indicate its current state. At the end of the blinking pattern, the indicator light will remain on for several seconds. If the magnet is swiped a second time during the extended light-on stretch, the state will toggle. The second swipe needs to happen in the window when the light is on (Figure 4).



Figure 4 - Magnet and indicator light sequence to switch from Auto Start to Start. After an initial swipe of a magnet near the communications port, the indicator light will show a double blink 3 times when in Auto Start. Then the indicator light will remain on for 2 seconds. Simultaneously swiping the magnet again with the light on will start the tag. The tag will blink 10 times rapidly and then remain lit for 2 seconds to show the tag has started.

Configuring Tag Settings

SPOT tag settings can be configured two ways, online using the Tag Portal or from within Tag Agent. The same setting selections are available from either programming avenue.

Tag Portal vs. Tag Agent

Tag Portal is used to configure tag settings online. Configuring can be done remotely, without connecting to your tag. This enables project coordinators to review and select settings for their associates and programming to be done while tags are in transit, before arrival. When logged into your Portal account a list of the tags which you have administer powers to can be viewed under the “My Tags” tab at the top of the screen. To select settings, click on the serial number of the tag you wish to configure or use the pencil icon (Figure 5).

Administrator(s)	Tag Type	Serial Number	PTT Id	Tagware Version	Name	
ashley@wctags.com, natalie.crandall7@gmail.com ✖	SPOT6	13U0080	40610	1.00a-3126	UT SPOT Flipper	
melinda0819@gmail.com, natalie.crandall7@gmail.com ✖, wctaggerpro@gmail.com	SPOT5	09S0587	91983	5.03d	Tester	
natalie.crandall7@gmail.com ✖	MiniPAT	11P0475	39332	2.4e		

Figure 5 – List of tags in Tag Portal. Selecting the serial number or the blue pencil icon will allow you to edit the settings for that specific tag.

When tags are in hand, Tag Agent software can be used to directly program settings. Programming with Tag Agent can be done on or offline. Note Tag Agent must be downloaded, opened, and credentials must be entered prior to using offline mode.

In Tag Agent, select the Administer Tag button in the upper menu to configure settings.



Figure 6 – Tag Agent menu bar. Select Administer Tag to edit tag settings.

A new window will open revealing 3 sections: Tag Information, Data Product Settings and Transmission Settings

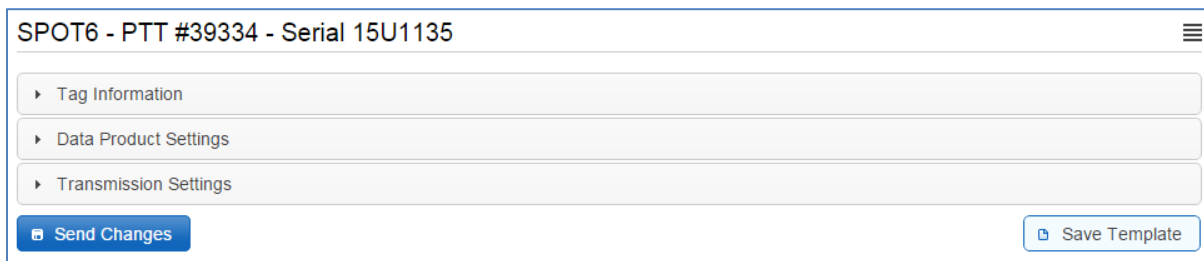


Figure 7 – Collapsed version of SPOT tag programming categories.

Tag Information

Tag Details & Argos Settings

Tag administrators (if applicable), tagware version and tag type are displayed on the Tag Details tab (Figure 8). The “Tag Name” field is an optional user-definable field which makes a tag or tags easy to find in the Tag Portal using the filter. The Argos Settings tab displays the PTT ID details.

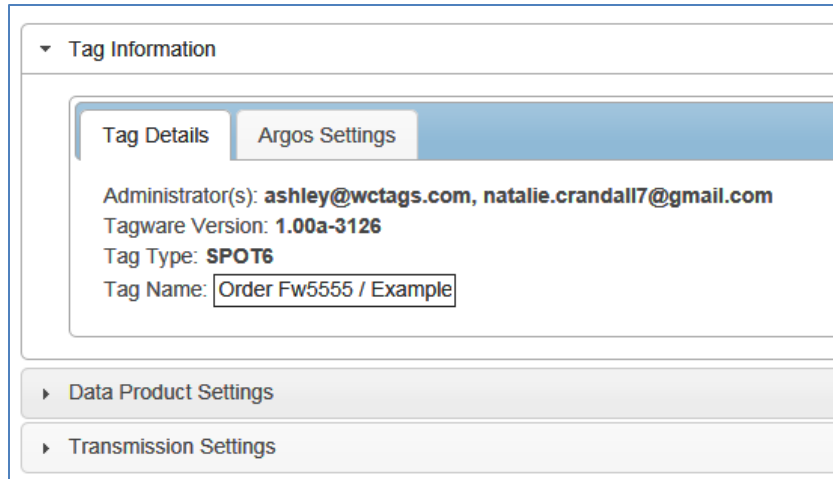


Figure 8 – Expanded view of Tag Details tab.

Data Product Settings

Data Products are the various types of data available from Wildlife Computer tags. In addition to providing locations, the SPOT tag can optionally transmit two types of data products. These are Time-at-Temperature histograms and Percent Dry Timelines. Enabling SPOT data products will generate larger messages which require more power to transmit. Note, the more data product messages that are created, the greater the impact on the battery life.

Summary Period Data

Time-at-Temperature Histograms (TAT)

This histogram reports the amount of time that the animal spent within each temperature bin. The amount of time is reported as a percentage of the histogram summary period.

Select the high temperature limit for each bin. Next choose the summary period. The summary period can range from 1 hour to 24 hours but the chosen period must divide the day evenly. The summary periods begin immediately after midnight UTC by default and run to the end of the UTC day. Selecting a 6 hour summary period will cause the tag to generate 4 histograms from 00:00hr to 06:00hr, 06:00hr to 12:00hr, 12:00hr to 18:00hr and 18:00hr to 24:00hr. This pattern will repeat on the next UTC day.

To measure behavior associated with local time, you can delay the start of each summary period by setting a summary period offset. Choosing an offset of 3 hours will shift the example summary periods as follows: 03:00hr to 09:00hr, 09:00hr to 15:00hr, 15:00hr to 21:00hr, 21:00hr to 03:00hr. Note that choosing a 1 hour summary period will cause 24 times more data to be generated than choosing a 24 hour summary period.

Be aware that the temperature sensor is buried in the tag and has a response time of approximately 30 minutes and will vary between tag shapes.

▼ Data Product Settings

Summary Period Data | Daily Data

Classic Histograms: Time-at-Temperature ⓘ ON

Temperature is sampled at a rate of (seconds): 3

Set the high temperature limit for each histogram bin. The tag can measure temperatures from -40°C to 60°C.

Bin #	1	2	3	4	5	6	7	8	9	10	11	12
High °C	3 °C	12 °C	16 °C	20 °C	25 °C	27 °C	30 °C	33 °C	35 °C	37 °C	40 °C	60.0 °C
Low °C	-40.0 °C	3.1 °C	12.1 °C	16.1 °C	20.1 °C	25.1 °C	27.1 °C	30.1 °C	33.1 °C	35.1 °C	37.1 °C	40.1 °C

Choose the histogram summary period (hours): 6 ▼

Choose the summary period start delay (hours): 3 ▼ UTC

Figure 9 – Example of Time-at-Temperature histogram with 6 hour summary periods and a 3 hour start delay.

Daily Data

Percent-Dry Timelines

This timeline reports the amount of time the tag was dry. The amount of time is reported as a percentage of each hour in the day. Choosing the Low-Resolution option will cause the tag report to the nearest 10%. The Low-Resolution timeline will also indicate when the tag was wet for the entire hour and when the tag was completely dry for the entire hour. The High-Resolution option will cause the tag to report to the nearest 1%.

► Tag Information

▼ Data Product Settings

Summary Period Data | Daily Data

The wet/dry sensor is sampled at a rate of (seconds): 3

Percent Dry Timelines ⓘ Off Low Resolution High Resolution

Figure 10 – Low resolution percent dry timeline enabled.

Transmission Settings

Data Uplinks

Argos uplinks serve two purposes: generation of locations and data transmission. The tag uses bursts of uplinks to generate locations. To generate an Argos location of known accuracy, 3 or more uplinks must be received by one satellite in a narrow window of time (<15 minutes). The location uplink schedule is user programmable and highly flexible. Hourly or daily transmission limits can be set. See further detail in the Transmission Modes section below.

The tag uses a separate schedule to transmit data messages. Data throughput is optimized by sending each data message multiple times (approximately 10) and separated in time (approximately 40 minutes). Data uplinks cannot be configured. They will occur independently of location uplinks and may be combined with a location uplink if they coincide.

Transmission Modes

At Sea Mode versus Hauled Out Mode

Transmission modes allow for independent schedules when the tag is in At Sea mode or Hauled Out mode. Using a seal as an example, locations during At Sea mode can be collected continuously at a high rate when the animal is very mobile. Then, when the tag enters Haul Out mode, just a few locations can be generated while the animal is on land and sedentary.

Transmission Patterns

Each mode has a schedule that can have one or more patterns. Additional patterns can be started on a calendar date or a fixed number of days after a deployment start. This allows the tag to modify its schedule to accommodate changing requirements during a deployment. For example, let's say that until June 10th At Sea locations are needed infrequently to monitor a long distance migration. After June 10th, when the breeding season begins, multiple locations per day are required to monitor fine scale movement. In this example, the initial pattern can be configured to generate locations every 7 days and from June 10th onwards, a second pattern is started to generate locations as often as possible (Figure 11)

Transmission Steps

A pattern is made up of sequential steps and a loop. The pattern will run to the last step, then revert to the step designated by the loop and repeat. This can be any step in the pattern. The loop allows steps in a schedule to be used only once or all the steps to be repeated (Figure 12).

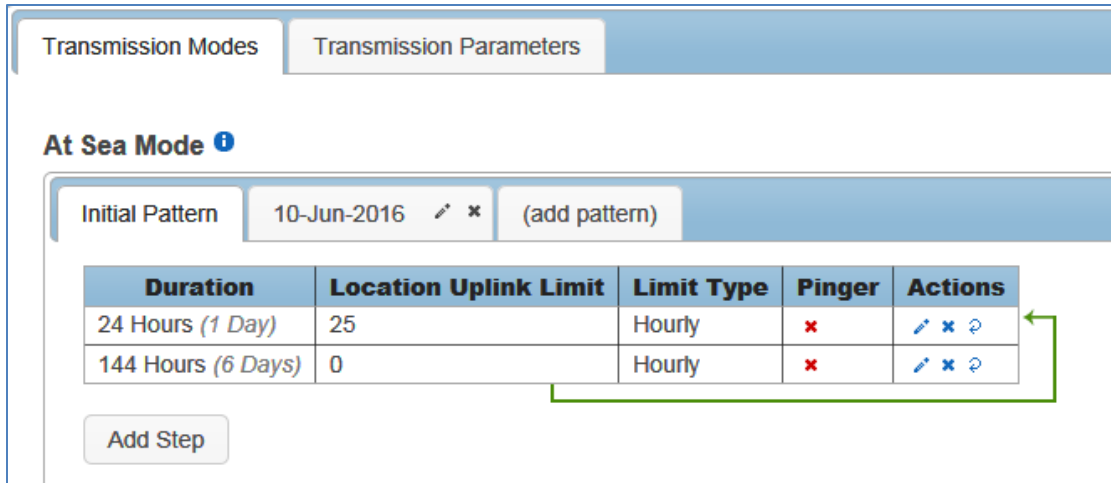


Figure 11 – Transmission schedule example with an initial pattern made up of 2 looping steps. Step one lasts for 1 day with a limit of 25 uplinks per hour. Step two lasts for 6 days with a limit of 0 uplinks per hour. On 10-June the next pattern is scheduled to begin.

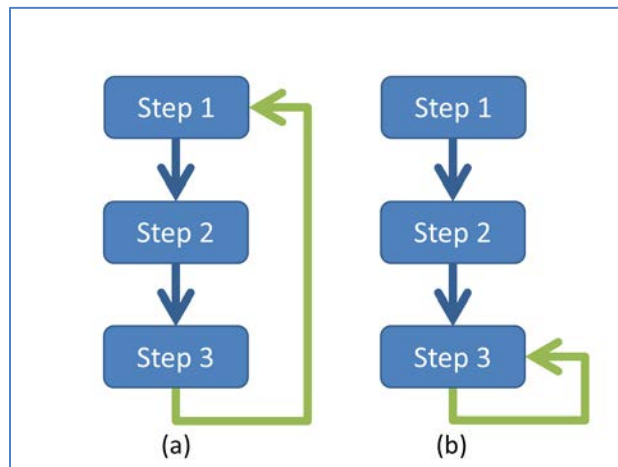


Figure 12- A pattern which repeats all steps (a), and a pattern which uses steps 1 and 2 once and then repeats the last step (b).

To configure pattern steps, select the pencil icon under the Actions column on the far right.

- 1) First select the duration of the step.
- 2) Next select the options for this step. You can opt to make the limit for the full duration of the step or hourly.
- 3) Finally, decide whether the pinger should be enabled during the step and whether you wish to Prevent Data Uplinks or Step Lock. Check the info button next to each option for an explanation.

The pinger is used for tag recovery. When enabled, the SPOT sends out low power “pings” every 2 seconds while at the surface. With an appropriate receiver and directional antenna the tag can be located.

Figure 13 – Example of a step lasting one day with an uplink limit of 25 attempts per hour and pinger enabled

If numerous steps have been set, the spiral arrow icon under the Actions column can be used to create loops.

Duration	Location Uplink Limit	Limit Type	Pinger	Actions
24 Hours (1 Day)	25	Hourly	✘	↻ ✎ ✖
144 Hours (6 Days)	0	Hourly	✘	↻ ✎ ✖

Figure 14 – 2 looping steps, created using the arrow icon.

Add additional patterns using the tabs above the scheduler.

Figure 15 – transmission schedule with 2 patterns.

Considerations for Setting Location Uplink Limits

Location uplinks for creating Argos locations can be limited in each step by the hour or over the entire step duration. The uplinks will occur as fast as possible each hour if hourly limits are chosen, or as fast as possible in each step if total step duration is chosen. For example, by choosing hourly limits for a step of 1 day, the tag will generate locations over the entire day. If limits are set for an entire step lasting 1 day, then locations will tend to occur in the first few hours of the day.

Only a fraction of location uplinks result in a location from the Argos system. Several uplinks must be received by a satellite in a single pass which lasts only 10-15 minutes. Furthermore, the tag does not know when an Argos satellite is overhead, and so must transmit many times to generate a location. When you set a location uplink limit, you are setting the maximum number of uplinks that happen as fast as possible in that time period. The realized uplinks are determined by the minimum time between uplinks (repetition rate), the surfacing behavior of the animal, and the uplink limit set in the step. The number of successful locations is determined by how those uplink attempts overlap with Argos satellite coverage.

In applications for animals that have limited surface time (e.g. cetaceans and sharks), animal behavior will most likely restrict uplinks. For animals with more surface time (e.g. pinnipeds), the tag uplink limit is more likely to be important.

For new SPOT6 users or novel applications, we strongly recommend contacting Wildlife Computers to discuss your application requirements and how to adjust your settings appropriately.

Transmission Parameters

Argos Uplink Mask

In a given location, the orbits of Argos satellites cause consistent gaps in satellite coverage. The Mask feature is used to save battery power by preventing the tag from attempting Argos uplinks during hours of poor satellite availability, regardless of the uplink schedule. All hours are UTC.

For example, we can see from the Argos Pass Prediction Software that in Hawaii the hour starting at 10:00UTC does not have any Argos satellite coverage and should be disabled (Figure 16).

Leave all hours enabled if you expect your tag to move more than 500 km.

Note: The pinger is not affected by the Argos Uplink Mask and will continue to transmit in any duty-cycle schedule where it is enabled.

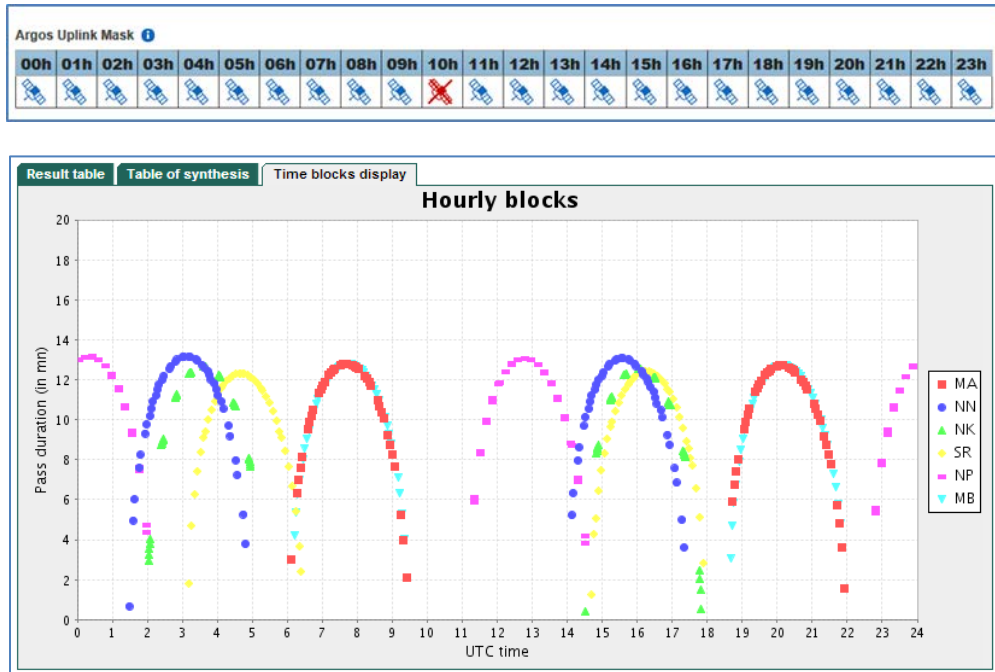


Figure 16 - Time Blocks display from Argos Satellite Pass Prediction for Honolulu, Hawaii, USA. Note the gap in satellite coverage in the 10:00 UTC hour.

Argos Pass Prediction Software is further explained in the Additional information section of this User Guide. If you expect your animal to move more than 500 km leave all hours enabled as satellite coverage will change drastically enough that masking hours isn't advised.

Argos Uplink Settings

The minimum uplink interval (or repetition rate) is set for At Sea mode and Hauled Out mode. Typical settings are 45 seconds and 90 seconds respectively.

Argos uplinks can be delayed by fractions of a second once the tag is ready to transmit and becomes dry. This is typically used for large cetaceans where the tag will start uplinks after 0.5 seconds of being dry to make sure the animal is well clear of the water and not likely to be splashed or re-submerged during an uplink.

To maximize the probability of receiving data messages, it is recommended that each unique message be sent 10 times. Changing the number of uplink attempts will greatly impact what data is received.

Loading Settings into a Tag

Once settings have been chosen use the blue Send Changes button (or Propose Changes if in Tag Portal) to load settings into tag. Tag Agent will confirm receipt of settings.

Creating Templates

Once tag settings have been configured a template can be saved. To save settings as a template, click the four horizontal lines in the shape of a square ≡ visible in the top right corner of the screen. You have the option of creating an online template or a local template file of the current settings selected. Local templates are used when no internet connection is available.

Viewing Configuration History

You can review a tag's configuration history using the arrow head icon on the left hand sidebar menu. Clicking the arrow head will expose the tag history and once viewed, clicking on the arrow head again will hide the History. Previous tag settings can be viewed by clicking on each date listed.

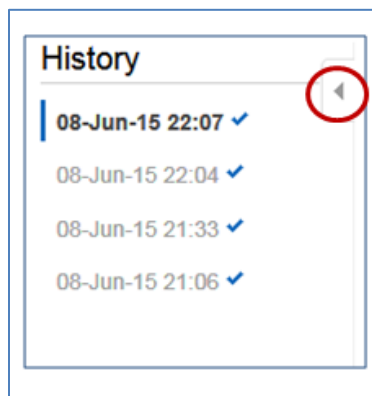


Figure 17 – A history of tag settings is exposed using the arrow icon.

Disconnect from SPOT

Use the Disconnect tab on the upper right of the Tag Agent home screen Menu to select the tag state before unplugging. If you are planning to deploy in the near future, select Auto Start mode. Tag will then auto deploy on saltwater submersion. Always disconnect the tag using the Disconnect button. Unplugging without setting the tag state could leave the tag in a mode that will rapidly deplete the battery.

Additional Information

Key Concepts

- Administrator – Someone who has the authority to publish tag settings.
- Argos ID – Uniquely identifies a transmitter for the Argos system. The ID consists of a decimal number and a hexadecimal (base 16) number.
- Argos location – A location generated by the Argos system from uplinks received during a satellite pass. Get more information about how the Argos system works here: <http://www.argos-system.org/web/en/391-faq-general-questions.php>
- Argos uplink – A radio transmission intended for the Argos satellite system.
- At Sea and Haul Out – Tag states controlled by wet/dry readings.
- Daily Data – Generated from sensors over a fixed 24-hour period.
- Data message – Created by the tag to transmit data through the Argos system. Each data message is transmitted as payload in an Argos uplink. In order to increase the likelihood of its reception by the Argos system, each message is sent a fixed number of times.
- Data Products – The various types of data available from Wildlife Computer tags.
- Deployment – The period when a tag is associated with an animal and actively collecting and sending telemetry data.
- Location uplink – A transmission intended to generate an Argos location. These uplinks can also carry a data message payload. Multiple uplinks are required to generate an Argos location.
- Pinger – A UHF radio tracking beacon.
- Start/Auto Start/Stop – Tag states. When Started, will generate locations and/or collect sensor data. Auto Start will allow the tag to Start using a magnet or when reading wet. Stop causes the tag to do nothing until reconnected to Tag Agent.
- Summary Period Data – Generated from sensors during a defined number of hours.
- Tag Agent Software – The program used to change tag states and select tag settings and connect a tag to the Wildlife Computers Tag Portal.
- Tagware – The software running on a tag.
- USB Blue – The Wildlife Computers communication cable required by Tag Agent.
- Tag Portal – The cloud-based service offered by Wildlife Computers for remote tag setup. A historic record of tag settings and templates is maintained within the Tag Portal.
- Wet and dry – The state of the tag as determined by the wet/dry sensor which measures conductivity

Argos Pass Prediction Software

CLS offers a satellite pass prediction program that helps forecast satellite coverage at a given location. To determine when satellites will be in view, log onto the CLS website www.argos-system.org and select

“DATA ACCESS.” Log in with your Argos Username and Password and then click on “Satellite pass prediction” in the left-hand column.

To run a simulation, select a pass prediction period or simply click “Simulation Duration” which defaults to a 24 hour run. Ensure all satellites are selected. Next click the Latitude and Longitude button and input your location coordinates. The location will display on the world map on the right hand side. Next complete the “Minimum Elevation Site” field. This is the horizon level. If tags are expected to have limited sky exposure (study site is in a fiord, etc.) the horizon level can be increased. The suggested default of 5 degrees is appropriate for open water deployments.

Once parameters have been configured, click “Simulate” below the world map.

Three output tabs will display at top left of the screen:

- Result Table - This is a detailed report of when passes will occur and the duration of each pass. The export icon in the top right hand corner can be used to export the data in .csv format. Note that the times shown are in UTC.
- Table of Synthesis - This table provides a quick view of the number of passes each satellite is making during the specified time frame. The cumulated time is useful for getting an idea of coverage for a specific satellite. Overlapping passes from multiple satellites are not considered, so this view over estimates overall satellite coverage.
- Time Blocks Display - The hourly blocks graph gives a visual of pass times. The graphic display makes it easy to see gaps when no satellites are overhead.

Priming Locations Prior to Deployment

Before deploying the SPOT, it is recommended to conduct a trial mission. Activating tags prior to deployment has several benefits. It provides exposure to the software and data, it allows you to evaluate the performance of the tag, and perhaps most importantly it enables Argos to secure a quality location at your field site prior to the animal being released. This is significant because the Kalman filtering algorithm uses not only measurements from the current satellite pass but also from prior satellite passes to calculate positions.

Run the trial mission for 4-6 hours, leaving the tag outside with a clear view of the sky. It can be beneficial to run a pass prediction via the Argos website to ensure multiple satellite passes are scheduled during the mission window.

So long as the primary purpose of the trial is to hit the Argos satellites and generate locations, the recommended settings are 1 step with a 300 uplink limit and no data products enabled. If data product testing is desired, ensure the summary periods fit within your 6 hour testing time frame.

When testing multiple tags it's important to space out the transmissions so they don't interfere with one another. This is most easily accomplished using the magnet technique. Alternatively, it can be accomplished by starting tags using Tag Agent, placing in a bucket of salt water and then pulling each tag out of the bucket 5 seconds apart.

After the trial, review your results in the Data Portal. Use Tag Agent to change the tag settings and switch the state to Auto Start or Stop.

Tag Storage and Battery Maintenance

Store tags in a cool environment (ideally around +5°C) to help minimize passivation and keep the batteries charged. When stored correctly, the amount of battery life lost per year is only 1-2%.

It is recommended to exercise the batteries every few months by sending a test transmission. This can be done in Tag Agent. Select "Advanced" and then "Send Test Transmission." The transmission voltage should read approximately 3.2v and the battery voltage displayed on the main sensor screen should be around 3.5v. If you receive a low voltage reading, it may be due to passivation forming during storage. Turn the tag on and leave it outside for several hours, then reconnect to Tag Agent and look at the transmission voltage.

Contacting Wildlife Computers

U.S. and International

Members of the Wildlife Computers technical sales and support team are located in Redmond, WA, USA, and Havelock North, New Zealand, allowing us to cover promptly a wide range of time zones.

Mailing and shipping

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For Asian Clients

While we welcome your direct correspondence, we recommend that you contact our colleague, Yong Huang, for assistance. Mr. Huang understands the special purchase processes for your countries, and will provide you with the best service for the best price. He also is fluent in Japanese, Chinese, and English.

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