NORTH STAR Science and Technology

Customer Instructions/Notes for a Successful Deployment of North Star's PTTs

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General Instructions/Notes (All devices – solar & battery)

Magnet

- The purpose of the magnet is to control an internal switch in the electronics that controls whether the device is On/Off. When the magnet is firmly in place, the unit is Off. To activate the device (i.e., to turn it On), simply remove the magnet. The PTT will begin transmitting within a few seconds.
- Each time the magnet is removed, the PTT begins transmitting at the beginning of duty cycle season #1. In other words, applying and removing the magnet re-sets the PTT back to the beginning of duty cycle season #1 each time it is done.
- Placement of the magnet is specified by the affixed "Magnet" sticker (usually top/right side of device but differs slightly depending upon the model).
- NOTE: Sometimes the magnetic switch can "stick" in either position, in which case you should consult the troubleshooting section of this document (below).

Pre-deployment

- It is strongly recommended that devices be tested at some point prior to deployment. This is solely the User's responsibility! This will verify that nothing detrimental has happened during shipping and that the magnetic switch is working correctly, etc. A proper test would be to allow the unit to run for 1-2 On cycles and then check the Argos data for verification that all is well. The magnet should then be re-applied securely until deployment.
- All testing should occur in an open area, away from buildings, metal structures, etc. Place the PTT on something made of wood or plastic (or cardboard) up off the ground by at least 2-3 feet (the more the better). **Make sure there is NOTHING metal within 20 feet of the PTT that you are testing**.
- If the unit is a solar device, it should be placed outside so as to receive ample sunlight on the solar panels.
- Spacing/timing of activation of the devices is important to obtaining good testing data. If two or more devices transmit at close to or exactly the same time, they will compete with each other to be received and processed by the Argos satellites. Usually, the strongest signal will win and the weaker signal will not be heard. Thus, if you are testing more than one device, the magnets should be removed at intervals spaced out from each other as to allow all the devices to transmit with the maximum amount of time between them. This maximum can be calculated by dividing the repetition rate (seconds) by the number of devices being tested/deployed.

For example:

1. 6 Devices with a repetition rate of 60 seconds should be spaced 10 seconds apart.
2. 8 devices with a repetition rate of 60 seconds should be spaced approx. 7 seconds apart.
3. 8 devices with a repetition rate of 45 seconds should be spaced approx. 5 seconds apart.

- After testing is complete, solar devices should be placed in the sun for approx. 1 day with the unit turned Off (magnet attached but no tape covering the solar panels) to allow the battery(s)/capacitors to get a good charge before deployment. If the solar unit(s) sit for more than 2 weeks before deployment, place them in the sun for 1 more day prior to deployment, with the unit turned Off (magnet attached but no tape covering the solar panels). The rechargeable batteries in solar PTTs will self-discharge at a rate of about 1-2% per day when they are just sitting.
- If you have straight battery devices (no solar panels) and there will be a long period of time before they are deployed, it is a good idea to let the devices run for a few hours every 1-2 months to burn off the passivation layer that is typical in lithium batteries. Also, if the devices have been sitting for more than 2 months, they should be turned On and left On for at least 5 hours of transmission time immediately before deployment. [**NOTE:** Primary lithium batteries passivate. Essentially, a layer of material grows on the anode end of the battery when the battery is just sitting and not being used. This is a natural process, and in some ways it is a good thing because it helps to prevent self-discharge of the battery. The passivation layer grows very slowly in cold temperatures and much more quickly in hot temperatures. Running the PTT burns the passivation layer off of the battery and restores the proper voltage.]
- If you have solar devices and there will be a long time before deployment, please see the "Storage of PTTs" section below.
- For devices that have been equipped with VHF transmitters, be sure to remove the VHF magnet also, as the magnetic field from the VHF magnet could prevent the PTT from turning On. Also remove any tape, string, etc. from the enclosure and/or antennas that were used as precautions during shipping.
- All PTTs that we make output sensor data. The standard sensors are duty cycle season, battery voltage, activity, and temperature. In order to view the sensor data, you need to use our PTT Tracker program to process and parse the DS file. All of the sensor data is contained in the DS file that you get from Argos, and you must digest that file (in text format) through the PTT Tracker program in order to view the sensor data.

Deployment

- When it is time for deployment, and you are deploying multiple devices at the same time, simply remove the magnet(s) from the devices. Be sure to space them out following the testing instructions described above to alleviate competition for air time among them.**
- If not all devices are being deployed at the same time, but will within days of each other, it is still advisable to remove the magnets all together following the aforementioned spacing procedure. It is better to have units run for a short period

even though some are not being deployed for a few days. Otherwise, there is no guarantee you will not have multiple devices transmitting at the same time.**

- If you want to use the sensor data to infer a dead bird or a shed PTT, you cannot look at any 1 sensor for a definitive answer. Rather, you need to look at the totality of the data to make a decision about a possible dead bird or shed PTT. First, look at the location data. If the location data looks like a PTT may not be moving much, be suspicious. Then, look at the temperature data to see if the temperature is fluctuating with ambient temperatures. The temperature sensor is showing you temperature INSIDE the PTT, not outside the PTT. In a typical deployment on a living bird, the bird's body will tend to warm the PTT somewhat above ambient, colder temperatures. Generally speaking, a living bird will keep a PTT above about 10-15 C, even in very cold outside temperatures. In addition, you should look at the activity sensor. This is a simple switch inside the PTT, which opens and closes as the PTT moves around. Each time it opens and closes, it increments a counter. As long as the counter is continuing to increment over time, you can infer that the PTT is continuing to move. If, however, the counter ceases to increment, or slows down significantly, that could indicate a dead bird or a shed PTT. Sometimes a dead bird carcass will get scavenged, causing the counter to increment a little. All of these items (i.e., location data, temperature data, and activity data) will need to agree in order to infer a dead bird or a shed PTT. [NOTE: Solar PTTs almost never land upright so they will charge intermittently if they charge at all. If they are on their side, they will tend to develop a pattern of charging and transmitting, so look for it over days to weeks.]

**** Note: These spacing procedures are not as necessary if devices are being deployed in significantly different geographic locations, as the satellite transmission intercept times will be different.**

***** Note: You can purchase (for around $100-150 at any Radio Shack) a police scanner that you can tune to 401.664 MHz. This is the frequency that our Argos PTTs transmit, so if you have a scanner and you tune it to 401.664 MHz (you may need to go a few Hz up or down from this frequency to really lock it in), you can hear the bleeps when a PTT is transmitting. The bleeps will occur at whatever your repetition rate is (usually 60 seconds apart). This is just a nice way to verify that a PTT is – in fact – transmitting when you attach it to your target bird. Sometimes, very rarely, a magnetic switch can stick so that even though you have removed the magnet, the unit does not come On. See trouble-shooting below to learn how to unstick a magnetic switch.**

***** Note: North Star sells a directional Argos receiver ($1450 each, see attached fact sheet) that can be used not only to verify that a PTT is turned On, but also to find a PTT in the field. If a bird dies or sheds its PTT, or even if you just want to locate your target bird in the field, this receiver is essential. Recovering even 1 PTT with our Argos receiver will more than pay for itself.**

***** Note: North Star also sells a "Signal Finder" device for $65 (see attached fact sheet) that can also verify that a PTT has come On when you remove the magnet. The Signal Finder is a very simple device, but a useful one when turning a PTT On. Remember that the PTTs do not make any noises or blink any lights when they turn On, so it is always nice to verify when they do come On.**

Storage of PTTs

- For battery PTTs, if you are going to store any PTTs for any length of time (i.e., more than a few weeks), you should store them in a cool, dry place. A refrigerator is a perfect place because the cool temperatures will slow the growth of the passivation layer on the lithium batteries. Solar PTTs do not have the same lithium batteries, and thus they can be stored in any dry place.
- Make sure that all PTT magnets are securely in place and tight on the PTT. Sometimes, the tape holding the magnet down can get loose; and if it gets too loose, the magnet could come free of the PTT, and the unit could turn On. Rubber bands may be used to hold the magnet firmly in place.
- Also, if you are storing more than 1 PTT, try to be sure that they are not touching one another, as the magnets could cancel each other out if they are too close together.
- For solar PTTs, whether they be regular "Doppler" units or GPS PTTs, their batteries/capacitors require some (periodic) "exercise" in order to maintain their chemistry. **They should not be left in the sun with the magnets attached for long periods of time, as this will overcharge (and overheat) the batteries.** Rather, they should be charged in the sun for 1-2 days every 2-4 weeks, and turned On every once in a while (e.g. every month or so) to actually transmit for 5-8 hours at a time, the more the better. This process discharges the batteries/capacitors, which is essential to maintain the proper chemistry in the batteries/capacitors. We have learned through experience that if solar PTTs are left sitting for long periods of time, like six months or more, the batteries/capacitors can degenerate (due to lack of charging and discharging) enough to permanently FAIL. So be warned.

Special notes for GPS PTTs

- Solar powered GPS PTTs are designed to operate **outside**. If they are activated inside a building, the GPS receiver will not be able to acquire a GPS location, and the unit will waste a lot of battery power trying. So please, only turn On GPS PTTs outside, preferably in the sun.
- The GPS PTTs will need to be fully charged prior to deployment, so leave them outside in a sunny place for 1-2 sunny days prior to deployment.
- For testing a GPS PTT, turn it On **outside** and leave it **outside** in a sunny place, far away from any buildings or anything metal. Place it up off the ground about 2-3 feet or more on something plastic, wood, or cardboard so it is not sitting on the ground. Please be sure it is in a clear spot so that there are no trees or obstructions between the unit and the sky. Leave it outside running for long enough that it can go through 2 complete transmit cycles. For example, if you have programmed your GPS PTT to transmit 12 hours every 5-6 days, test it long enough (outside) to allow it to transmit through the first On period and then all the way through the next On period 5-6 days later. Then, if you are not deploying it right away, apply the magnet and (if possible) leave it in the sun for continued charging (making sure the solar panels are not covered). But don't leave it in the sun for extended periods of time, as this may overheat the battery/capacitors.
- Please do not turn a GPS PTT On and Off in rapid succession. If you are planning to test it, really test it by leaving it On for 2 full transmit cycles and leave it outside between them. The unit will be acquiring GPS locations between transmission periods, **so leave it outside** and running.

- The GPS PTTs are programmed to come On when the magnet is removed and to transmit for a few minutes before attempting the first GPS location. So leave them outside and be patient. When it is transmitting, the GPS PTT will transmit every 60 seconds, and **three out of every four messages** will include 2 stored GPS locations from the memory buffer (depending on programming). The unit will transmit one sensor message for every three GPS messages, 1 sensor message and then 3 GPS messages, and so on until the end of the transmit cycle. There are 24-30 GPS locations that are stored in the memory buffer (depending on programming), and each time a GPS message is sent the next 2 stored GPS locations are transmitted out. The unit works its way down the list and then starts over. So in practice, each stored GPS location is transmitted multiple times, so there will be duplicates in the data. Our PTT Tracker data processing program deletes the duplicate GPS locations so you do not have to. You must use our PTT Tracker program to decode and parse your data. The GPS data is contained in the DS file that you get from Argos, so the procedure to follow is to digest the DS file (as a text file) in the PTT Tracker program, and the output dbf file will contain the processed GPS data. The output dbf file can be opened in Excel.
- We offer 2 different types of GPS PTT firmware; one that outputs altitude data and one that does not. The PTT Tracker software will automatically determine what data your GPS PTT is outputting.

Trouble-Shooting

- If you have tested your PTT, and there is no Argos data or there is a problem with your Argos data (e.g., it does not look correct, it does not include any resolved locations, wrong format, anything), please contact North Star immediately. Contact Blake Henke, 410-961-6692, or blakehenke@msn.com. Most problems can be resolved quite easily, such as fixing the way Argos has formatted the data for a given PTT, but it is always better to get issues resolved BEFORE you deploy a PTT on a bird and let it go, because at that point you might not get the PTT back.
- By far the most likely problem that you might experience is a stuck magnetic switch. This is very rare, but occasionally it does happen that a magnetic switch does not open when the magnet is removed. Of course, you will not know this unless you have a police scanner present or Signal Finder and notice that there are no bleeps on the scanner/ Signal Finder after you have removed the magnet. [If you remove the magnet a day or 2 prior to deployment, you can always check the Argos data to be sure that your unit(s) are working properly.] If you think you have a stuck magnetic switch, you can try the following things, in order:
    1. Place the magnet on the side of the PTT, adjacent to where the "Magnet" sticker is located (but not on top of the "Magnet" sticker), hold it there for 20 seconds or more, and remove it quickly. This usually does the trick. But if not…
    2. Find a larger magnet and place it over the "Magnet" sticker on the PTT, leave it there for 20 seconds or more, and then remove it quickly. If this fails, try the same procedure again, but place the magnet to the side of the "Magnet" sticker, as explained above.
    3. Remove the magnet and smartly flick the PTT with your forefinger.
    4. Remove the magnet and drop the PTT from about 1-2 feet onto a hard surfaced table or something similar.
    5. Keep trying the above procedures till the PTTs activates.

6. If you cannot get it started after trying for a good while, we may need to have you send it back to us. But this is a last resort.

- Some regions of the world are very noisy at the Argos frequency. This means that there is a lot of background noise at 401.650 +/- MHz and around that frequency, and this makes it difficult for a low power transmission from a bird PTT to make it to the satellites and to be heard above the "noise." Regions that we know of that are noisy include Western Europe, especially Italy, Eastern Europe, especially Romania and that region, and Israel. See Appendix for more information.

Attachment (IMPORTANT NOTES FOR SOLAR PTT USERS)

- Many researchers use **Teflon ribbon** to attach their PTTs to their birds. This is a tried and true method, and it is still quite popular. If you need Teflon ribbon for your project, North Star stocks it in 0.44" width and 0.25" width. We can provide it for $8.50 per foot.
- A growing number of researchers are now using **neoprene straps** to affix their PTTs to their birds. The neoprene seems to hold up well over time, and it has the advantage of being able to stretch.
- **Solar units: It is extremely important with solar PTTs to do everything in your power to prevent feathers from covering up the solar panels, since feather cover could cause the unit to stop working for long periods of time. Clip all feathers above the PTT to prevent them from protruding over the solar panels, if possible. They will grow back, in time, but at least by clipping them you ensure many months of proper operation. [NOTE: Not all auxiliary marking permits allow for feather clipping, so follow your permit in all cases.] Also, it is a very wise idea to use a secondary neoprene pad under the PTT. We recommend using a thick neoprene pad, like an old mouse pad for a computer mouse, in addition to the thin neoprene pad that we supply with the PTT. We can supply the thicker neoprene at no cost, upon request. The use of 2 neoprene pads (or even one thicker one) will elevate the PTT up off the back of the bird and thereby raise it up and away from feather growth. You could also use a much larger neoprene pad (not so much thicker, but wider and longer) to help ensure that feathers do not grow over the top of the PTT. Once feathers grow over the PTT, or the bird preens the PTT under its back feathers, you may not hear from it again.**
- Affix the neoprene pad(s) to your PTTs using a glue that dries soft, like **contact cement**. Any soft glue will probably work. We do not recommend super glue, as it dries hard and brittle.

Helpful Hints

- **Police scanner:** You can purchase (for around $100-150 at any Radio Shack) a police scanner that you can tune to 401.650 +/- MHz (our PTTs typically output 401.664 MHz). This is the frequency that Argos PTTs transmit, so if you have a scanner and you tune it to 401.650 +/- MHz (you may need to go a few Hz up or down from this frequency to really lock it in), you can hear the bleeps when a PTT is transmitting. Most of our PTTs transmit 401.664 MHz The bleeps will occur at whatever your repetition rate is (usually 60 seconds apart). This is just a nice way to verify that a PTT is – in fact – transmitting when you attach it to your target bird.
- **Signal Finder:** This small device will also enable you to verify operation of a PTT (see attached fact sheet.)

Locating downed PTTs

- While it is certainly not easy to locate a downed PTT, it can be done with the right equipment and a lot of luck. In terms of equipment, you will need an Argos receiver with a directional, yagi antenna. Please ask us about these, as we do offer them for sale for $1450 each. In addition, it will be helpful to also have a police scanner tuned to 401.664 MHz. You will want to know when your PTT is scheduled to transmit next, and you should plan your field work around that time. You will need to be in the field, in the vicinity of the downed PTT, at the time it is transmitting, to be able to locate it.
- Once you are in the field, in the vicinity of the downed PTT (i.e., using the Argos data), and you think that the PTT should be transmitting, turn on your scanner and listen. If you are within 1-2 miles of the PTT, you should be able to hear the PTT bleeps on the police scanner. If you do, then you know you are in the right area. If so, turn Off the scanner and turn On the Argos receiver. Use the yagi antenna to determine the direction of the PTT from where you are, and move in that direction. In a slow, methodical manner, you should be able to move ever closer to the PTT, and eventually, to find it. But be patient, as these PTTs only transmit every 60 seconds.

Refurbishment and re-battery of recovered PTTs

- If you are able to recover a downed PTT, we may be able to refurbish it for you. We routinely re-battery and refurbish old PTTs (for a small fee) as a service to our clients. The fees that we charge for this service ($250-600 each) do not completely cover our expenses, so we offer the refurbishment service as a courtesy to our clients. Let us know if you have a PTT that could use a re-battery or refurbishment, and send it to us for evaluation.
- Clean the PTT first, and then send it to:

  Blake Henke
  North Star Science and Technology, LLC
  P.O. Box 438
  King George, VA 22485

  If you need a street address for FEDEX, use:

  Blake Henke
  North Star Science and Technology, LLC
  3325 Lenzi Lane
  King George, VA 22485
  (Check the box for “delivery without signature”)

APPENDIX

Argos Performance in Europe

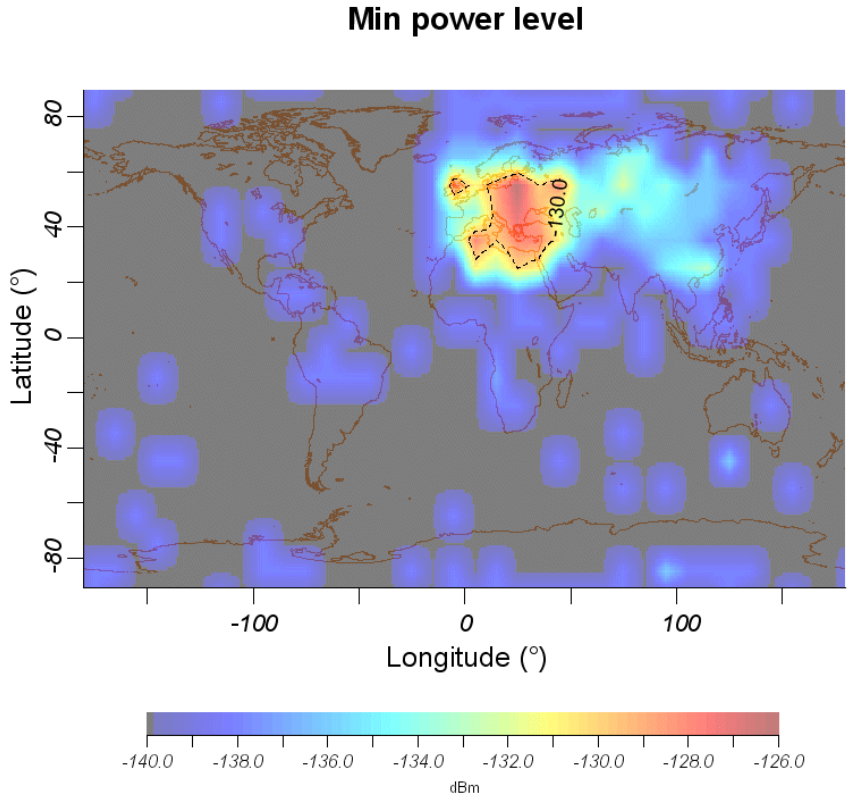
In "Tracker News" of winter 2005, Volume 6, Issue 2, an article spoke of the Argos performance in Europe. In the article below, the CLS group, operator of the Argos system, describes the status of investigations on this topic. Two main points are emphasized:

1) Estimating the mean level of noise in the European Region
2) Seeking discrete noise sources

1) Estimating the mean level of noise in Europe

This study takes advantage of the message dating and reception power level measurement (in dBm) capabilities of the Argos system. By combining this information with the precisely known satellite orbits, it is possible to link a date to a geographical position on the ground track for each Argos message received and produce a map (see figure below) of the minimum power levels received over the earth.

A specific set of measurements was made in late 2005. The results clearly show that, in the European region, the Argos instruments onboard the satellites are receiving a broadband noise with significant amplitude covering the total Argos frequency range. This noise makes it difficult to demodulate Argos messages that are reaching the satellite at a level of about -130 dBm or less. We are currently investigating the source of this noise.



Recall that the transmission power of your PTT is typically specified as the power at the amplifier output. Losses occurring in the link to and through the antenna will generally cause the actual radiated power to be less than the amplifier output. In general, Argos signals are received at the satellite at levels from -105 dBm (for high power PTTs) to -140 dBm (for very low power PTTs). The test results show that in the European Region, the lower power Argos signals are hidden by the noise.

The tests also indicated that some 0.5 watt PTTs are sometimes received by the satellite at -122 dBm, and sometimes at -130 dBm. Thus, the transmission conditions, including, for example, the quality of the antenna, position of the PTT on the Argos platform, etc. have a big effect on the signal level actually received at the satellite.

The test results suggest that currently, Argos transmissions in the European Region at 0.5 W or more will result in a higher probability of better reception by the satellite. It is still possible, nevertheless, that good results can still be obtained, under certain conditions, at 0.25 W assuming the antenna is well adapted and the PTT is situated in places offering good transmission conditions.

2) Seeking discrete noise sources

The Argos-2 instrument on the satellites can also detect discrete noise sources in the Argos frequency band and downlink the measured signals via a "pseudo-message" feature. Using this technique a discrete noise source has been located near an airport in Algeria (see picture below). An additional noise source has been located in Italy but the specific location is currently uncertain. The specific impact of these noise sources on Argos transmissions is also unknown. Consequently these measurements are still under way.

Summary

The CLS approach to addressing problems of potential "interference" in the European Region and elsewhere is both technical and administrative. On the technical side, in addition to the investigations described above, CLS has also developed some analytical tools that are now available to help Argos users optimize their PTT communications through careful selection of parameters such as transmission frequency, output power and, transmission protocol as a function of the deployment area. Since the performance of the Argos System depends on many parameters, it is recommended that you contact CLS to discuss your specific requirements and take advantage of the new tools to help define optimum transmission strategies.

Administratively, CLS has started actions via their parent organization, CNES, the French Space Agency, to resolve specific sources of interfering noise already identified and documented

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Jean-Pierre Malardé – CLS, Toulouse
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