



# **ARC**

## ***Acoustic Release Control System***



## **Operator's Manual**

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## 1. Introduction

The ARC system is an acoustic release system for managing the deployment and retrieval of seafloor payloads. It consists of at least one ARC-1 release station (transponder/release unit), the surface station hardware, and the ARC surface station software. As the name “acoustic release” implies, the surface station communicates with the ARC-1 release stations using acoustic (sonar) signals.

This manual describes the system in detail, how to deploy and retrieve ARC-1 stations with their payloads, how to manage the record of the operation, and how to export the ARC position data for mapping in a GIS program (such as ARCVIEW). It also describes how to change ARC-1 batteries and reload a spent ARC-1 with a new release wire.

### The ARC-1 Station

The transponder is part of our modular acoustic systems so it can be controlled with either of our standard surface stations, the STM-1 or the the STM-10, and station firmware can be upgraded through download, to support new functions.

**The Release Device**

The ARC-1 release unit is based on an innovative design concept for the release device (patent pending). To release the payload from its anchor a corrosion-resistant connecting wire is melted with an electrical charge. Compared to traditional acoustic release units, which often use an electromagnetic release device (solenoid), this increases reliability and decreases cost.

**2. Operating the surface station**

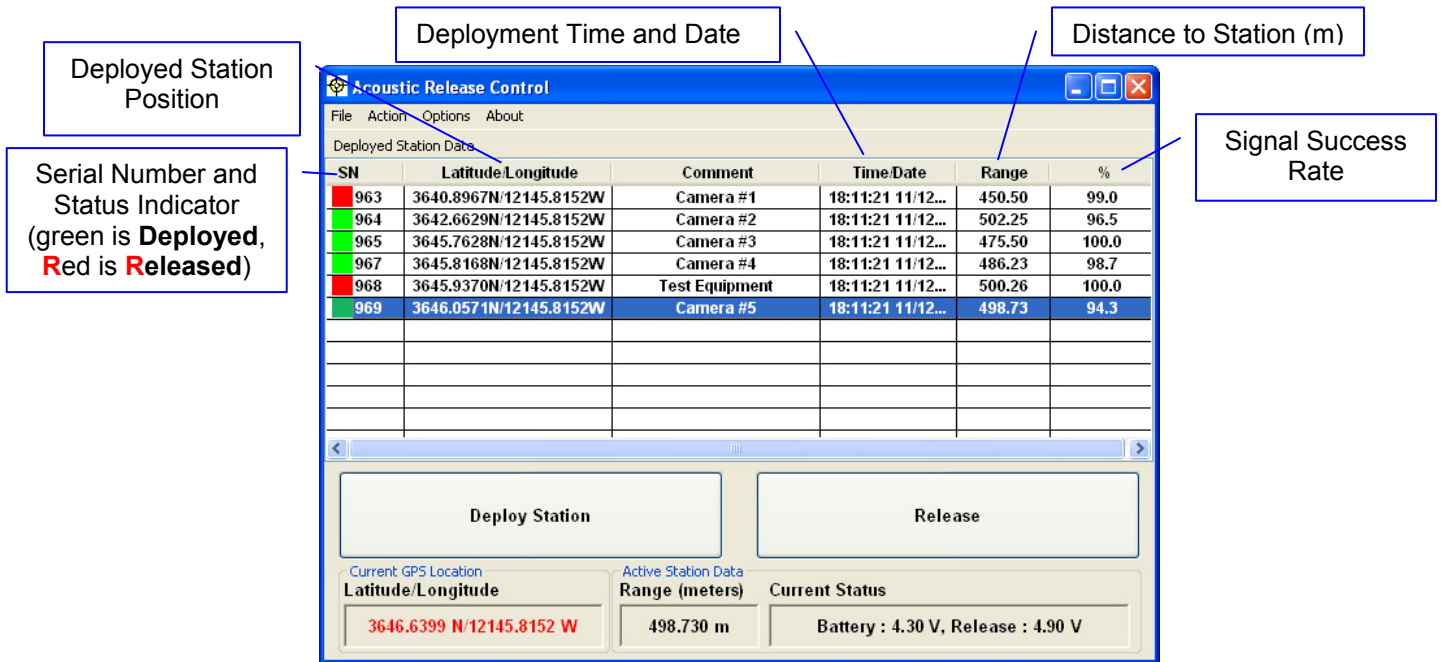
**The Control Display**

The Acoustic Release Control screen allows you to manage all deployment and release activities and provides a record of **Deployed** and **Released** stations. Figure 2.1 describes the data fields that have abbreviated names. The serial number of an ARC-1 station that has been deployed is listed with a green symbol next to it and one that has been released has a red symbol next to it.

**Adjusting column widths**

The column widths can be adjusted manually, by clicking and dragging the column-title dividers, or automatically by double-clicking the column-title dividers.

**Note: Do not use commas in the Comments column, they will be deleted by the software because commas are used to parse the data record.**



**Figure 2.1: The Acoustic Release Control Display**

**Managing the Mission Record**

During a mission there are actually four states that an ARC-1 station may be in: **Ready-to-deploy**, **Deployed**, **Released** (from the seafloor), and **Recovered**. As stated above, the ARC software tracks two of these, **Deployed** and **Released**. A **Released** station can be removed from the displayed list but it is recommended that they be left on the list (for the record) until after the mission is over and/or the mission information has been saved as a file separate from the default Deployment Log (which is over-written every time a change is made).

However, if an ARC-1 station is to be used again immediately it must be removed from the list before it can be deployed again. In this case, if you want to easily record the fact that it was released and re-deployed you can save a text record of the current Deployment Log by selecting **Save Deployment Log As** from the **File** menu. This will allow you to give the file a different name, such as the date/time or a series number.

### Working with release stations

**To add a station to the list:** With the ARC software running and the surface station transducer and release station transducer in a bucket of water together, click the **Deploy Station** button or select **Deploy Station** from the **Action** menu. Enter the appropriate information and click the OK button.

**To perform an action on a station:** Select the station from the list by clicking on it. This will "activate" the release station, i.e. the surface station will try to communicate with it.

If you have just selected a station and want to cancel the activation, select off the list (anywhere there is not a station listed) or you can right-mouse-click the currently activated station. This will stop communication attempts and deselect the station.

When activating a station the **Current Status** window will display the following messages:

1. "Activating : 1127... Sending ID Packet #1"
2. "Activating : 1127... Sending ID Packet #2"

**If a station falls asleep while still selected:** The station is asleep if the station is selected but no new data is being received (indicated in the Current Status area). The station will need to be reselected. To do this you can either select off of the station and then reselect the station to reactivate it or you can double-click the sleeping station.

### GPS Integration

Any GPS with a serial port connector can be used to provide automatic position data entry (the Garmin Etrex Summit has been used with good results). You will need a serial cable and possibly the instructions for changing output settings. You can select the com port for the GPS under **Options/GPS Com Port**. The ARC software will automatically recognize the GPS when it is plugged in. If it does not, restart the ARC software.

### Manual GPS position entry

If GPS integration is difficult or not available a GPS position can be manually entered into the comment column each time a station is deployed.

## 3. Equipment Preparation

Before any stations are deployed they must be prepared and the performance of the STM-1(or STM-10) surface station and the ARC-1 stations must be tested to ensure proper functioning.

1. Install batteries.
2. Check station LED light blink pattern (Table 3.1).

Blink Pattern	Station Status
One short blink per second	Working normally
Double-blink	It received an interrogate or reply
No blink	Station sleeping or battery dead

**Table 3.1: LED Blink Patterns**

3. Place a business card that identifies the owner and offers reward for return inside each station so that writing is visible through the clear housing. Use large letters because housing may be fouled.
4. Install release wire on all stations (see "ARC-1 Hardware" section).
5. **Critical Step:** Perform 50 lb load test. Scuba diving weights work well (Figure 3.1).
6. Paint mechanism with anti-fouling paint.
7. Put all stations in bait tank or bucket with enough water to cover the transducers. Link to each station acoustically to perform a Communication Test, checking battery, and checking capacitor voltage at the same time (see following subsection).



**Figure 3.1:**  
50 lb load test.

### Performing a Communication Test

1. Choose **Deploy Station** from the **Action** menu, enter the ARC-1 station serial number, and follow the instructions in the window that is displayed. Click OK to proceed to the Communication Connection Test Dialog window (Figure 3.1).
2. In the following window you will be instructed to place the station in the water for a System Communication Test. This can be a bucket of water if you are simply preparing prior to arrival at the drop-site.
3. When communication is established the software will display a GPS position and begin measuring the range to the station. This will add the station to the displayed list. Now it is ready to deploy. Unless you are directly on-target when you do this the GPS position that is automatically entered will be the wrong one. Disregard this until you are on-target, then you can use the **Mark GPS** command (or hot-key "M") to correct it (See next section for details).
4. The System Communication Test is complete when the Communication Connection Test Dialog window reports a successful communication link and the Continue button becomes activated.
5. **Critical Step:** Check the battery and capacitor operation by noting their levels in the **Connection Status** section of the System Communication Test window. The battery level should recover to 5 V or more after charging the capacitor and the capacitor should read 25 V or greater to ensure proper release functioning. **If they do not: DO NOT DEPLOY THE UNIT, its release function may be impaired.**



**Figure 3.2: System  
Communication Test**

## 4. Deploying an ARC-1 Station

1. **Critical Step:** Just prior to deploying a station, perform a second 50 lb load test (screw may have come loose due to vibration) then rig for deployment.
2. Use at least 10 lb flotation, but no more than 40 lb.
3. Before deploying the first station, and for selected stations thereafter, perform a **Noise Test** (see following subsection) to ensure that noise levels are not too high in the area of deployment.
4. When you are on-target, **select the station to be deployed** and hit the **Mark GPS** keystroke, "M", (or select **Mark GPS** from the **Action** menu) at the precise location of deployment.
5. After it has settled on the sea floor, monitor the range to the station for at least ten cycles. The software will record communication reliability as 'signal success rate' in the "%" column of the display.
6. The signal success rate should be monitored to check for poor sonar conditions in the area. If communication with the ARC-1 station is lost during descent, increase the surface station sensitivity (by adjusting the threshold slider down, in the Noise Test window).

7. If communication is not possible or is too unreliable (<50%), recover the station using standard recovery.
8. If standard recovery fails, try to recover using broadcast mode (Release All command).

**Warning: Broadcast Mode (Release All) is dangerous. Inadvertent use could cause unnoticed release and possible loss of release station and payload.**

## Performing a Noise Test

Common sources of noise include running engines and snapping shrimp (or other biological noise). A noise test will tell you if this background noise will interfere with system communication and also indicate if it may be high enough to keep the release station awake, thus draining its batteries prematurely. If the noise level is too high, look for sources of noise that can be turned off, such as engines. You can also reduce sensitivity by raising the signal **Threshold Level**, with the slider. However, this will reduce range. In these cases, baseline station distance may have to be reduced.

1. Place the release station's transducer in the water and select **Noise Test** from the **Action** menu.
2. Set the Threshold Level slider to 120 dB, see Figure 4.1, (the recommended noise limit) and press the Start Test button.
3. Test for 30 seconds to a minute. If the noise crosses the threshold every five seconds or more then you should adjust the threshold slider **upwards**. If there is very little noise you can move it downwards to increase the range of the system.



**Figure 4.1: The noise test display**

## Possible Deployment Problems

1. **Alkaline battery polarity:** Alkaline batteries can be installed backwards. If this happens the unit may not be able to charge the capacitor to 29V (it may remain in the 10V range). The unit should work fine once the problem is corrected.
2. **Boat Equipment Interference:**
  - Boat engine in idle may or may not be a problem.
  - Generators may cause high noise events every few seconds or so, but if it does not cause a system communication problem it can be left running during deployment.
  - During a previous mission a 50 kHz depth sounder generated about four strong (gain 1, 90 units) pulses per second at 44 kHz, and it was switched to 200 kHz during deployment. No noise was detected when operating at 200 kHz. In one test, sounder operations at 50 kHz still allowed ARC-1 to operate, but use of a 50 kHz sounder during ops should be avoided.
  - Scanning sonar can cause excessive noise and is not recommended during ARC-1 operations.
3. **Biological Noise:**

If biological noise is high the unit may not fall asleep after deployment, this would reduce the battery life and thus causing recovery failure. If there is high biological noise in the area put the release station in the water for 30 seconds without the boat engine or generator running. If it falls asleep (LED stops blinking) then the noise level is acceptable.

## 5. Releasing and Recovering an ARC-1 Station

1. Select the ARC-1 station you wish to retrieve from the available list and choose **Release Station** from the **Action** menu.
2. A dialog box will appear to double-check that this is the correct station you want to release from its anchor (Figure 4.1). Check that the ARC-1 station serial number is correct and select the **Yes** button.
3. The Current Status window displays the following.
  - 1) "Arming Station For Release... Please Wait".
  - 2) If arming fails it will show: "Arm Station Attempt # 1" (Count increases until successful)
  - 3) If successful: "Station Armed. Triggering Release"
  - 4) If triggering fails: "Trigger Station Attempt # 1" (Count increases until successful).
  - 5) "Station Release Command Acknowledged". This means the selected station has successfully received the release command and will now charge capacitors and burn the release wire (may take up to 30 seconds).
4. Watch for your payload to appear at the surface. You will be able to track its vertical progress using the range value for the released station.
5. Once the station is in-hand (Recovered) you should only remove it from the list of active stations if you are going to immediately deploy it again. Once a station is removed from the displayed station list there is no remaining record of it.
6. To remove released stations from the list select **Remove All Released Stations From List** from the **Action** menu.
7. At any time the status of a deployed station can be changed to "Released" and removed from the displayed list of stations (however, there are double-check dialog boxes to prevent mistakes). If a station is accidentally removed from the displayed list of stations before it is actually released from its anchor you can no longer release it individually. The only way to release it in that case is to use the **Release All Stations** command (on the **Release All Command** submenu on the **Action** menu). A confirmation window will appear during this operation also.

**Warning: Broadcast Mode (Release All) is dangerous. Inadvertent use could cause unnoticed release.**

### Releasing All Stations

This option is provided **for emergencies only**, it is not recommended except in unusual situations. If a payload and release have accidentally been dropped overboard without adding it to the list of deployed stations, (by entering the station serial number and performing a communications test) then the **Release All Stations** command will allow the station to be retrieved.

However, this command will also release any other Desert Star Systems ARC-1 transponders within range of the signal. If you execute this command the released ARC-1's must be recovered and their status on the list must each be manually changed to "Released". This is because when using this command the software has no way of knowing if a station was in range or not, unless you tell it. To change the status of a station on the list select the station and choose **Mark Selected Station Released** from the **Release All Command** submenu.

When the **Release All** command is given a dialog box will appear and count the number of attempted cycles of "release all" command and the Current Status display show the following:

1. "Sending Arm Command To Stations", then 10 seconds later:
2. "Sending Trigger Command To Stations"

This sequence repeats until you click the abort button on the dialog box.

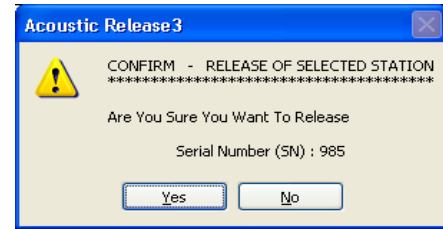


Figure 5.1: Release Confirmation

## 6. ARC-1 Mission-Life Test Procedure

This test is a recommendation only. It may have to be modified to suit your needs. It will decrease the probability of release station failures due to corrosion, battery drain (i.e. sleep-mode failure), or mechanical abrasion (wave or current action).

Ideally, one or several ARC-1 in a network should be periodically tested to obtain early warning of impending failure of the deployed array. The test station should be in a location where wave energy is highest (shallow water) and where acoustic noise may be strongest (reefs, shallow water). Test initially in short intervals, then in longer intervals. For example, after 1 week, after two weeks, after one month, after two months and then every three months. Follow this procedure:

1. Activate and range to deployed station. Make sure communication works fine and capacitor charges OK.
2. If possible, retrieve the station without triggering release using a diver or ROV, then proceed with step three. Otherwise, issue release command and proceed with step five.
3. Perform a 50 lb load test on the station.
4. Measure resistance across release wire. **It should not be more than 0.2 Ohms.** (Note: Scrape a small portion of retainer screws, then hold probes tightly on scraped shiny screw surface.)
5. Inspect the station, in particular the release arm. Make sure the arm is not fouled and can move freely.
6. Re-deploy the station.

## 7. Data Reporting and Exporting

### Printing the Deployment Log

Choose **Print Deployment Log** from the **File** menu to print the list of stations that are presently displayed. The printed list depicts a released station with an R before the serial number and a deployed station will have a D before the serial number.

### GIS Data Exporting

If you would like to export the data in the Deployment Log to a GIS program for mapping it is very likely you will have to convert it from a text format to a DBF format. The DBF file format can be used by most, if not all, GIS programs.

The Deployment Log is automatically saved as a comma delimited text file in the same folder as the ARC program. This can be opened in MicroSoft Excel, modified to suit the needs of your GIS program (i.e. lat/long terms in the correct format, etc...), and saved as a DBF file.

#### The text format stored on disk is as follows:

Serial Number, Comment Field, Time in seconds since UTC (since 1970), range in meters, success rate percent, Deployment Status, NMEA GPGLL without the \r\n

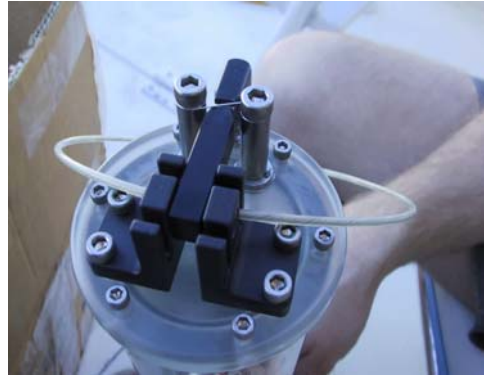
**Example:** 1105,Camera#1,1038265511,1.000000,51.612903,DEPLOYED,\$GPGLL,3713.3991,  
N,12145.8152,W,230942,V,S\*57

### Combining Cells in Excel

You may have to combine lat/long terms before your GIS program can use them. If you need to combine the terms in two columns (such as "3640.7642" and "N") you can find instructions for this in Excel's Help feature. The term to search for in Help is called "**concatenation**" (combining cells).

## 8. ARC-1 Hardware

The ARC-1 uses an innovative release device that consists of a replaceable wire connection (the release-wire) through which an electrical charge, from a capacitor, is shorted in order to melt it when the acoustic release signal is given. The release-wire connects two screw posts and holds a hinged lever in place. This hinged lever in turn prevents a thin wire loop (less than 100 mil thick) of anchor-wire from escaping until the release-wire is melted by an electrical charge.

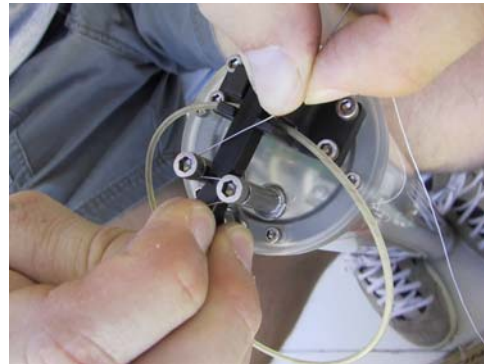


**Figure 8.1: The release device, with anchor wire loop and release wire.**

### Replacing the Release Wire

To replace a wire first loosen the screws holding the old wire pieces in place and then wrap new wire between the screws. When wrapping a new wire between the two screws it is important to remember two things:

1. **Do not wrap the wire a full turn on a screw post.** Wrapping more than about 270 degrees might cause the wire to overlap itself, thus putting all of the screw pressure on one point in the wire, deforming and weakening the wire at that point.
2. **It is important to keep the wire tight.** On each screw wrap the wire in the same direction that the screw turns, this will allow you to easily hold the wire tight when tightening the screws.
3. Tighten the screws until the wire is held firmly but not to the point where you judge it to deform the wire. **A 50 lb load test is critical at this point** (dive weights work well for a load test).



**Figure 8.2: Wrapping the release wire.**

### Changing Batteries

The acoustic transmitter module is powered by four AA size standard batteries and the receiver module is powered by a 3.6V D size lithium battery. The lithium battery connects to the receiver with a polarized 2 pin connector so it is not possible to connect it incorrectly. The battery area is accessible through the top cap of the transponder housing.

## 9. ARC-1 Technical Specifications

- 2.25" ( 5.7 cm) OD housing, approx. 27" (69 cm) long.
- Buoyancy: slightly positive.
- Capable of supporting a payload of 40 pounds (2X safety factor).
- Depth rating: 1000 feet (300 m).
- Powered by a set of 4 'AA' size alkaline cells and a 'D' size lithium cell.
- Battery life: 18 months (2X safety factor).
- Housed in serviceable polycarbonate plastic housing.
- Transponder functions support ranging to the units.
- No software configuration necessary.
- Station firmware can be upgraded through download, to support new functions.
- Standard Desert Star surface stations can be used as interrogators.