

Underwater Acoustic Release System

Acoustic Release Model AR-50-AA

(underwater release unit)

Acoustic Release Interrogator Model ARI-50

(topside command unit)

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OVERVIEW:

This underwater acoustic release system permits the underwater release of such items as an instrument package lifted by a float, a bungee that when released performs a desired action, etc. The acoustic release interrogator (ARI-50) sends a command to the underwater acoustic release (AR-50-AA). An additional feature includes a command to make the release unit become a very low power pinger to acknowledge operation or permit tracking (requires a special pinger tracking receiver and antenna not included with this system).

Each underwater release has a specific four digit unit identification number assigned to it by Sub Sea Sonics. To send an action command to the underwater release unit the following three steps are performed. First, the four digit identification number is selected using the interrogator keys while viewing it on an LCD display (two line by 16 character each line). Second, the specific action command is selected using the keys and LCD display. Third, both are transmitted to the underwater release unit.

The interrogator comes with a transducer on a cable that is placed in the water for use. The interrogator must be connected to a 12 VDC battery such as a gell cell or lead acid battery adequate to supply 5 amps during transmit.

DEPLOYMENT OF A RELEASE UNIT:

A. Installation of batteries inside a release unit:

1. **OPEN UNIT.** Remove the two ¼-20 button head screws from the end plug (Use caution; see SAFETY WARNINGS herein). To aid in the removal of the end plug use a tool such as a Phillips head screwdriver inserted into the non-threaded clear through hole in the external part of the end plug. Use this screwdriver as a handle to help work out the end plug. It helps to use your feet on this handle and gently twist and pull on the body of the release unit.
2. **CONNECT BATTERY PACK.** Check or connect a new a 13.5 volt battery pack such as the BAT-50-AA-L91. It must have the red wire connected to the units red wire (positive) and the black wire connected to units black wire (negative). These wires are soldered in attempt to avoid the possible failure from an intermittent connector. After soldering be sure to insulate using shrink tubing, tape or some reliable means.
3. **SLIP THE BATTERY PACK INTO PLACE.** Slip the battery pack into the housing keeping the red and black connecting wires dressed to the side while the battery pack is slipped into place. After the battery pack is in then coil and stuff the remaining slack wire in after the battery pack is fully in place. Use the foam rubber piece to further cushion the wires and battery pack.
4. **PREPARE THE END PLUG.** Prepare the end plug using O-rings that have been inspected for nicks and cuts and rot. O-rings are rubber and can rot with time and exposure and on occasion are bad when new. Slightly stretching them while inspecting them can reveal defects. The two O-rings used are #215 EPDM durometer 70. EPDM O-rings do not 'rot' like the more common Buna N O-rings can. Put silicon grease into the O-ring grooves and add some to the housing bore. Use a silicon grease that does not attack rubber such as Dow Corning #4 available at such places as McMaster-Carr. Install the O-rings and spread the silicon grease over them.
5. **REPLACE THE END PLUG.** Replace the end plug. Replace the ¼-20 x 5/8" button head screws being careful not to cross thread them. Do not over tighten them as the end plug and housing is a PVC plastic and does not have the strength of a metal.

B. Verify that the release unit is operating:

1. **ACTIVATE AND CHECK FOR GREEN LED FLASHING.** Connect a 270 ohm one watt resistor as a load across the water contacts (the link and the coil) to both turn the release unit on and provide a load for battery testing under load. (Alternatively a wet rag or higher resistance resistor could be used if testing under a load isn't deemed needed at this stage.) The LED will flash the unit identification code in binary (see elsewhere herein) for about 30 seconds and then go into listening mode. In listening mode it will flash the LED every 11

seconds +/- 30%. Verify this flash of about one per 10 seconds. (If a BTL-50-AA battery test load is available then it may be installed in place of the erosion link. It will both turn the unit on, provide the test load, and indicate when a release command has been received by turning on its red LED.)

2. **IN-AIR TEST.** Tests in-air can be performed on the release unit using the topside interrogator (ARI-50) with its transducer (TD-50) connected. Place the transducer within a few inches of the top center of the release unit for testing in air. Any of the commands can be checked.
3. **BATTERY TEST UNDER LOAD IN-AIR.** To check the battery voltage select the commanded action Brief Erosion (on for 10 seconds) or Release w/ Ping (on for 15 minutes). Use the BTL-50-AA (battery test load) or if not available connect a 270 ohm 1 watt resistor connected between the link and the "coil" contact. The red LED on the BTL-50-AA will indicate that release erosion would be occurring. A voltmeter can be used between the link (positive) and "coil" (negative) to check the release battery voltage under the 270 ohm load. On the BTL-50-AA the stainless steel wire protruding near the red LED is the positive contact. Connect the positive voltmeter lead here. The "coil" water contact is the negative contact. Connect the negative voltmeter lead there. Send the selected command. A new lithium cell battery pack (BAT-50-AA-L91) should measure > 13.4 volts. A lithium battery pack at the middle of its life nominally measures 13.0 volts. A near expired lithium pack nominally measures < 12.5 volts. A new pack should be good for 10 months including 35 releases with erosion link LK-40 (10 releases using LK-80). For critical releases suggest reducing these numbers to about one-half of the above (i.e. 35 -> 20 and 10 -> 6). [Note: Allowance here is made for the 0.1 volt drop which occurs across the internal switch inside the acoustic release AR-50-AA at 50 mA]. Each 5 minutes of a 270 ohm load will use up about 0.2% of the battery life while in release mode. To prevent this drain on the batteries and to save checkout time the unit can be taken out of release mode by removing the load and waiting for up to 60 seconds for the unit to check for continuity and if none shut itself off. After it is shut off any testing can be continued by again turning it on by reconnecting the test load, waiting about 20 seconds for the unit to stop flashing its unit identification code, and then sending the next test command.
4. **REMOVE TEST CONNECTIONS.** Remove the 270 ohm resistor or any other item (wet rag, BTL-50-AA, etc.) used to activate the unit. When submerged the salt water will turn on the unit by providing a conductive path between the link and 'coil' water contacts (just like the 270 ohm resistor did above). (Information note: A special internal circuit puts a tiny electric current through the link/coil water contacts once every 10 seconds to see if the unit is still in the water. This electric current is extremely small and will not cause noticeable erosion of the link. When a 'release' command has been received, this 'Am-I-in-the-water' test occurs every 60 seconds. This longer time is to prevent excessive interruption of the erosion process during a normal underwater release.) So during 'release' up to 60 seconds of wait with no connection are required to let the unit shut itself off.

C. Installing a new erosion release link:

1. **INSPECT THE POSITIVE CONTACT.** Remove the retainer cap and the expired erosion link. Inspect the positive contact on the top end of the release unit (near the ½ inch PVC threads). This contact is made from stainless steel and must be solid (not eaten away during a prior release due to the mistake of not having an O-ring in place protecting the link contact from the erosion process). Verify that it is solid by pressing on it with a screwdriver or knife or some other tool. (Stainless steel exposed to electrical erosion can turn into a honeycomb structure that looks solid at first glance but when stressed it collapses).
2. **INSTALL A NEW LINK WITH O-RING USING RETAINER CAP.** Obtain a new erosion release link (LK-40 or LK-80). Put it in place using the retainer cap and being certain that the O-ring is placed between the threaded contact end of the release and the spiral contact end of the link. Use a little silicon grease or silicon spray on the O-ring. The O-ring specifications are 11/16 OD, 7/16 ID O-ring #205 EPDM 70. It must be durometer 70. (The more common Buna N can be used but is subject to rot in air). Tighten the retainer cap only after being certain that the O-ring is in place. Failure to have the O-ring in place will not prevent the next release but will likely result in severe damage to the positive contact (the contact that the link makes contact to). Damage to this contact may make the AR-50-AA release unit worthless for future releases and may be irreparable. Tighten the retainer cap hand tight on the heavy side. As the retainer cap is tightened verify that the link becomes securely held in place (i.e. it must be secure to insure that the contact it makes is reliable)
3. **INSPECT LINK.** Verify the presence of each of the two exposed places at the base of the upside down 'U' shaped release loop. At these points the metal of the loop must be directly in contact with the salt water at the time of release. As an extra precaution verify that the two small metal erosion points are not covered with any hard to see coating. A small knife blade can be used to scrape a part of it to inspect it. Do not remove the erosion focusing paint. Verify that there will be no extra metal in contact with the link loop such as a metal hook for deployment. If extra metal were to make electrical contact with the erosion release link metal then it would become part of what would have to be eroded away. This would consume extra battery current, damage this metal, and if it is large enough may even prevent release.

D. Final deployment:

1. Note the release unit's four digit unit identification number needed for sending it commands.
2. Verify that an O-ring was put in place inside the link retainer cap and that the link is tightly held in place by the retainer cap.
3. Attach the release unit in the specific deployment configuration. Prevent any heavy sideways impact from hitting the top (erosion link) end as it is possible to

break this end off.

4. Verify that no metallic material is touching the link (e.g. a metal hook) as this could radically extend the erosion time and even prevent a release.
5. Verify that the pull on the link will be steady in one direction as continual bending of the link metal might eventually break it off.
6. Verify that the ships RADAR is off (not likely a problem, but a worthwhile precaution with high powered RADAR).
7. Verify that the green LED starts flashing when a conductive path is created between the link exposed stainless steel points and the 'coil' water contact. A wet rag, wet fingers touching each, a resistor, a shorting wire (but if used don't keep a wire on it during release), etc. can be used to initiate 20 seconds of the green LED flashing. (This both final checks unit operation and verifies that the link is in contact with the main electronics.)
8. If it is possible to see the green LED underwater it will flash about once every ten seconds indicating that it is working and listening for a command.
9. To prevent a premature release from a prior release command verify that it has been at least 15 minutes since the last release command was sent.

OPERATION OF THE INTERROGATOR:

Hookup of the acoustic release interrogator (topside command unit):

Supply 12 VDC from a gel cell battery or equivalent (needs 12 VDC at 5 amps for transmit, but only 10 mA when not transmitting). Connect the transducer to the interrogator and place the transducer in the ocean or very near the release unit if testing in air. If testing is done in air the transmitting transducer may have to be adjacent to the release unit body about six inches down from the link. If poor results are observed then try moving the transducer slightly. Maximum ranges of 3 inches to 3 feet in air are typical.

Operation of the interrogator (general concepts):

When first connected to a battery the LCD display on the unit displays a banner with company name, model name, model number, firmware version number, etc. To break out of this banner and get to the main menu hold the STOP key. The LCD now shows "MENU FOLLOWS: press N for next". From here the NEXT key can be pressed repeatedly to cycle through all of the activities that can be performed from this topside box. When advanced to one of interest press the ACCEPT key to accept it. Note that the second one down "Select Action...(unit action)" when selected with the ACCEPT key puts the unit into a sub menu. This sub menu is the only sub menu on the topside box. It is used to select the action desired by the underwater release. Once in this sub menu the NEXT key cycles through all possible actions (actions by the underwater release unit). See "ACTION = xxxxxx" headings on page 8.

Vocabulary: 'Box activity' generally refers to what the topside box is commanded to do (selected from the main menu). 'Action' generally refers to what the underwater release will be commanded to do (selected from the sub menu).

Interrogator box keys descriptions.

NEXT (N): Advances to next item on main menu or sub menu.

ACCEPT (A): Accepts the item currently displayed. If in the main menu it starts the box activity currently displayed. If in the "Select Action " sub menu it accepts the action for future transmission.

STOP (S): Stops the current box activity permitting changing to a new one. Has no effect on the underwater acoustic release.

RELEASE (R): Used only to verify that it is okay to proceed with transmitting the release command. It will not by itself cause the box to send a release command.

INCREASE (I) and DECREASE (D): Used for selecting the ID four digit number.

Operation of the interrogator (most common sequence):

After battery connection advance to the main menu by holding the STOP key. The

display will show "MENU FOLLOWS: press N for next".

1. Press the NEXT key once to get to the box activity "Select unit Id.. (release number)". Press ACCEPT to permit entering the unit ID. This four digit ID number identifies the unit which is to receive the command. Use the INCREASE and DECREASE keys to select the desired unit ID. Use the ACCEPT key to accept it as ready for transmission. The display flashes and then goes back to the top of the main menu, "MENU FOLLOWS: press N for next".
2. Press the NEXT key twice to get to the sub menu for entering the action to be sent to the underwater release unit. The LCD will show "Select Action...(unit action)". Press ACCEPT. The box has now entered a sub menu (the only sub menu in this interrogator box). By pressing the NEXT key repeatedly all of the actions that the underwater release can perform are displayed. As NEXT is repeatedly pressed the list loops back on itself. The only way to break out of the sub menu and get back to the main menu is to display one action and press ACCEPT. This accepts it as the action that will be sent to the underwater release unit when transmission (next step) is performed. As an example pick "Brief Erosion..." by pressing NEXT until "Brief Erosion...(10 sec erosion)" is displayed and then press ACCEPT. [BEWARE: This example, when transmitted in the next step, will cause the release unit (AR-50-AA) to apply the battery voltage to the release link (LK-xx) for 10 seconds. In this 10 seconds some of the link will erode away if unit is in salt water.]
3. Press the NEXT key three times to get to the box activity "Transmit once.... (send command)". When the ACCEPT key is pressed the box will transmit both the ID and the action selected above to the underwater release unit. During this transmission process the transducer must be connected and in water (unless testing in air). The single red LED on the topside box illuminates only during the actual acoustic transmissions. Transmission takes about 12 seconds.

Understanding the 'busy time' of the underwater release unit:

Whenever a command has been sent and received by a specific release unit this release unit is busy carrying out the command until the command is completed and it times out. During this busy time the release unit will not alter its action and will not be listening for another command. Sending another command will not confuse it; but, this too-soon command will be ignored. The busy times for each action are listed in the next paragraph and in a table below. Be particularly aware of the relatively long 15 minutes busy times for the two release commands. Trying to send another command to a unit that is busy could be confusing if one does not understand that the underwater release is not listening. If the unit is busy for 15 minutes performing a release then deployment in salt water before this 15 minutes is up will cause unwanted erosion of the release link. In other words, after testing in water or air with one of the release commands the unit is busy for the 15 minutes applying the release voltage to the link.

BESURE TO NOT DEPLOY IN SALT WATER UNTIL IT HAS BEEN GREATER THAN

15 MINUTES SINCE THE LAST RELEASE COMMAND WAS SENT. An alternative to waiting 15 minutes is to reset the unit by keeping the water switch contacts dry for 60 seconds or more.

Release unit time-out (busy) times:

Pinger Action = 60 sec (one ping per sec). Fast Ping Check = 10 sec. Brief Erosion = 10 sec. Release without ping = 15 min. Release with ping = 15 min.

Information about the other box activities:

The following box activities are selectable from the main menu and are generally not needed.

"Transmit Loop . . . automatic repeat": This transmits the command in the same way that "Transmit once" does except it continuously repeats the transmission of the ID and the action that the underwater release unit is to perform. If there were to be a problem getting the command through due to signal travel problems then this box activity could be used to save operator time. Use the STOP key to terminate this "Transmit Loop" box activity.

"SuppressionIs now ON" or "SuppressionIs now OFF": For all known applications leave it ON (the default). When ON the box precedes each timed pulse transmission with a 'suppression' transmission with energy in the lower inhibit channel frequency band. This prevents any acoustic signals that are weaker than the box transmitted signal from interfering with the box transmitted signal. In short it blocks out any man or animal interference as long as this interference is not as strong as the box 'suppression' signal.

"Directions . . . summary": This displays a brief directions-for-use summary.

An example of sending the command "Release with Ping":

Supply 12 VDC to the interrogator. Connect the transducer. Hold S for main menu. Press N once to get to Select Unit Id. Press A to be able to select the unit identification number desired. Use the I or D keys to set the unit Identification number. Once set use the A key to accept the one selected. The LCD display will flash the selected unit identification number and return to the main menu. Use the N key twice to advance to Select Action. Use the A key to accept the "select action" sub menu. Use the N key repeatedly to get to 'Release w/ Ping...unit busy 15min'. Use the A key to accept this action. Display will flash the action accepted and return to the main menu. Use the N key three times to advance to Transmit Once. Use the A key to accept and perform this activity. Since releasing is a non-reversible activity you will be asked to verify that you want to perform a release with the choice of S for stop or R for release. Press R. The unit will display TRANSMITTING..., etc. as the transmission of the 2.5 second steady synchronization/wake-up pulse followed by seven 20 ms precisely timed pulses occurs. The command will have been completed when the LCD displays END XMIT CYCLE.

All of the other command setups and transmissions are similar to this one.

A list of the 'actions' which can be sent to the underwater release unit follows:

These are accessed by the sub menu "Select Action" described above.

Action = Pinger (AR-50-AA):

Sending this action command causes the release unit to behave like a pinger for 60 seconds after which it times out. While acting as a pinger it emits one 20 ms ping once per second (1.00 sec +/- 2%). These pings can be picked up on a sensitive pinger receiver if the sea is relatively quiet. If a sensitive pinger receiver with tracking antenna is available the direction to the release unit can be obtained. Note that the AR-50-AA acoustic release units internal pinger only puts out about 10 mW of power. Accordingly, if there is too much ocean noise the pinging mode may not be able to be picked up. A pinger receiver is not supplied with the ARI-50 / AR-50-AA system. Vemco makes pinger receivers that have been used successfully to pickup the weak 10 mW signal from the AR-50-AA.

Release unit time-out times:

The following time-outs are used to free the release unit for another command. Pinger Action = 60 sec (one ping per sec). Fast Ping Check = 2 sec. Brief Erosion = 10 sec. Release with ping = 15 min. Release without ping = 15 min.

STORAGE:

1. Keep a new or used or dummy erosion link installed on each release unit when storing to protect the plastic threads and prevent accidental erosion of the positive contact (the one the link spiral contact touches).
2. If it is desired to prevent battery drain then keep the unit off by washing any salt or other conductive material off the area near the link and coil. Keep this area dry and free of any salt or contaminant that might conduct current.
3. Store out of direct sunlight.
4. Store such that the top (erosion link) end is protected from any heavy sideways impacts as it is possible to break this end off.

SAFETY WARNINGS:

1. Remove the battery access end plug with extreme caution in the event that the cavity leaked from underwater pressure or the batteries developed a gas and built up a pressure inside the cavity.

2. Do not touch the transducer while transmitting otherwise the sustained 2.5 second part of the transmission may overheat body tissues or cause other harm.

MISCELLANEOUS INFORMATION:

BUBBLES OFF OF THE "COIL" WATER CONTACT:

The stainless steel coil at the link end is the negative contact for the erosion process. During release erosion there will be bubbles coming off of it. A deposit can form on the 'coil' which can generally be left there but it is best to brush it off. It seems to rub or brush off easily when still wet from retrieval from the ocean.

EROSION TIME VS. WATER TEMPERATURE:

Lab tests indicate that the time to release increases 80% as the water temperature is lowered from 70 deg F (21 deg C) to 28 deg F (-2 deg C).

EROSION TIME VS. BATTERY VOLTAGE:

Lab tests indicate that the erosion time increases about 150% (2.5x) as the battery voltage decreases from 13.5 volts to 7 volts.

ACCIDENTAL LINK COATING INHIBITING EROSION:

Neither oil nor silicon spray applied as thick as possible right on the link erosion points inhibit erosion. Both seem to disappear even when very gently submerged into still water. However, if the contacts are covered with a thick covering of grease this will prevent erosion if the covering is 100%. Tests show that a 90% covering only doubles the erosion time. Accordingly, some accidentally deposited grease is very unlikely to cause a problem.

LINK CONTACT SMALL CAVITY LEAK:

Should the link cavity (where the O-ring resides) happen to leak this will not prevent a release. The majority of the electric current will still flow to the intended erosion points. However, should the cavity have leaked there might be erosion damage to the unit contact. It is a worth while precaution to inspect this contact by pressing on it with a screwdriver to verify it is solid (not damaged by crevice corrosion during a prior release).

VERY LOW RELEASE BATTERIES:

If the release unit battery voltage drops below 5.5 VDC due to unintended weak batteries, a special supervisory circuit resets the micro controller which shuts off any present activity (such as Release w/ Ping) and the unit returns to listen mode. This is a friendly failure as the unit will be immediately ready to try again. If this should happen wait for the batteries to recoup a bit and try again. If trying again is selected consider sending a less current using command such as the Brief Erosion command. If it is sent with Transmit Loop it will turn the erosion on for 10 seconds once every other

transmission cycle (about 10 seconds out of every 25 seconds) thereby reducing the average load on the batteries. But this is only a last resort and will not be necessary if adequate batteries are used.

THEORY OF OPERATION:

RELEASE RECEIVER:

The release unit receiver utilizes a low noise first stage followed by a high pass filter, more amplification followed by a phase locked loop detector.

RELEASE UNIT LISTENING MODE:

During normal deployment the release unit spends most of its time listening for an on-frequency signal. To keep the total battery current low (less than 200 micro amps) the receiver is turned on only once every 1.15 seconds (+/- 30%) to listen for a signal in the center frequency band (FM). This only takes 20 ms and if none is heard (usually the case) the receiver is shut off and the micro controller goes to sleep. This cycle keeps repeating until a signal in the center frequency band is detected and lasts longer than 8 ms. When this happens the receiver stays on and checks to see that the signal stays on longer than 80 % of the time for the next full second. It then checks for the signal absent for at least 300 ms. It then changes to pulse timing mode and times the six time periods formed by a total of seven 20 ms pulses. (A suppression frequency is transmitted before each pulse to suppress any on frequency interference such as echoes, biological interference, or man made signals. This combined with long times between pulses prevents interference from echoes.) Each of these 6 times is converted into an octal digit for a total of 18 bits. The first 12 bits contain the unit identification number. The next 3 bits tell the action requested. The last 3 bits are a parity check. As the times are received they are checked against the unit identification number for that unit. If any one of them is wrong the unit immediately goes back to listening mode where it will not respond to the additional 20 ms pulses left in the command being transmitted.

RELEASE UNIT RELEASE MODE:

When the release command is received, the micro controller switches on the release sub-circuit for the duration of the release mode time (e.g. 15 min). During this time the full battery voltage is applied to the 'link' (+) relative to the 'coil' (-) water contacts. The current flow is approximately 200 mA for a LK-40 link with its two 0.025 inch diameter by 0.1 inch long exposed points. A current limiting circuit limits the current to approximately 700 mA. A short across the 'link' to "coil" will not damage the release unit but will drain the batteries. If a heavy load or weak batteries cause the battery voltage to drop below 6 volts then a friendly reset of the micro controller would occur and a new command would have to be sent to restart the intended action.

NOTES REGARDING THE CHECKOUT OF AN AR-50-AA RELEASE UNIT:

Unit Identification Number: Each underwater release unit has a specific "unit identification number" or unit Id assigned to it. This number is between 0 and 4094 in decimal and is assigned by the factory. It is 12 bits in binary. In the unlikely event that this number is lost it can be read from a release unit by turning it on and observing the flashes on its outside LED. Single flashes indicate bit one and double flashes indicate bit 0. There is a spacing of about 1.2 second between each single or double flash. To observe this remove the unit from the water to turn it off. Wait for up to 13 sec for the unit to check to see if it is still in water and if not to shut itself off. (If unit was in the process of releasing then the wait for the out-of-water check requires up to 60 seconds). Next, with a helper at hand, make contact with a 100 ohm to 100,000 ohm resistor (or a wet rag) across the 'link' and 'coil' contacts until the unit starts flashing. Write down the flash counts (ex. 11 11 11 1 11 1 11 11 11 1 11 1) flashes = 000101000101 binary. Convert these to decimal (ex. 0325 decimal). This is the unit identification number which must be used with the topside command unit (acoustic release interrogator) to effect any of the actions that the release unit will

perform. This number can more easily be obtained by reading the number marked or tagged on the outside of the release unit if one is still there. Note that the unit Id goes with the electronics inside and cannot be changed. Unit Identification Numbers are assigned by Sub Sea Sonics. This permanent assignment eliminates the need for unit identification physical switches with their possibility of switch contact failure. It also keeps the assignment of numbers under the control of Sub Sea Sonics and reduces the chance of two users selecting the same unit identification in the same region of the ocean.

Listening Mode Of Release: When the release unit is turned on (submerged or a resistor or a wet rag or equivalent placed across the 'link' and 'coil') it first sends out its binary unit id by flashing the outside LED and then goes into its listening mode. In listening mode it wakes up from sleep every 1.15 second +/- 30% and checks for any signal on frequency FM (35714 Hz +/- 3%). If it does not hear one it goes back to sleep. This listening mode can be confirmed by observing the outside LED on release link end flash once for every ten wake ups which is once every 11.5 sec +/- 30%.

Actions By Release: When a command is sent by the Acoustic Release Interrogator, the release will flash the LED in response. First it will flash with very faint flashes every time a 3 bit symbol is received and confirmed correct for that specific release unit. There are 6 of these symbols. Next it will flash with normal brightness to indicate which command it received as per the following:

One flash every 1.00 sec (60 sec total) => Pinger Action (unit pings once per flash also).
20 very fast flashes (2 sec total) => Fast Pinger Check (unit pings once per flash also).
100 very fast flashes (10 sec total) => Brief Erosion Check (unit pings once per flash also).
No flashing occurs during Release w/o Ping (release without pinging). Release lasts 15 minutes.
One flash every 1.50 sec (for 15 minutes) => Release with Ping (unit pings once per flash also).

These actions can only be interrupted by turning the unit off. To turn the unit off it must be removed from water or the test resistor across the water contacts (link and coil) must be removed. This must be followed by waiting for the unit to check the these water contacts. This occurs every 11.5 sec +/- 30% for all but the 15 minute release which requires 60 seconds between am-I-in-the-water checks. [The reason for these long wait times till off is to reduce water contact erosion by stopping all current flow until specific check times. These check times last about 0.5 seconds.] Interrupting the commanded actions by shutting off the unit before the commanded action times out can save a lot of operator time in system checkout.

ACOUSTIC RELEASE SYSTEM SPECIFICATIONS:

AR-50-AA:

Acoustic release using fast electrolytic erosion of stainless steel for the release.

Multipath interference resistant by use of:

- Single frequency sent at any one time.
- Pulses spaced at least 1.0 seconds to permit echo die out before the next pulse.
- Suppression frequency spectrum transmitted to block echoes, noise, and interference.
- Long pulses used (20 ms or greater) for ample energy integration time.

Reception frequency bands:

Detection frequency set in phase locked loop 35714 Hz +/- 3%, FM.

Reception sensitivity: 1.5 micro volt rms with a 3000 ohm driving impedance for a logic level solid transition. (-27 dB relative to one micro bar.)

Reply frequency for very low power pings:

Single reply frequency 38462 Hz +/- 1%, FR.

Acoustic output: 10 milliwatt (151.5 dB relative to 1 micro Pascal at 1 meter).

Command reception: Seven pulses accurately time spaced preceded by a wake-up/synchronization 2.5 sec steady signal all on frequency FM and each pulse preceded by suppression frequency FS.

1,500 foot max. rated depth (2,000+ foot design)

80 lb. max. rated release load capability (80+ lb. design)

Main housing made from 1.25 inch nominal schedule 40 and schedule 80 PVC pipe (1.667 inch OD), an end cap, a coupling and a battery access solid PVC end plug using a double O-ring seal.

Total length 22 inches. Weight 2.5 pounds, approx. one pound in water.

Accepts link LK-40 (40 lb) or LK-80 (80 lb).

Powered by a single 13.5 VDC internal battery pack made from 9 lithium Energizer L91 size AA cells (BAT-50-AA-L91). As an alternate alkaline AA cells can be used but with significantly less performance (about one fourth the life and number of releases and

poor low temperature operation and shorter shelf life).

Battery current in listening mode is less than 200 micro amps.

Accepts BAT-50-AA-L91 battery pack and requires soldering two wires for replacement.

Unit is reverse battery protected.

Unit output is short circuit proof.

All unit external contacts are electrostatic discharge resistant and have passed a test during design checkout of 30 kV from a 25 pF capacitor..

ARI-50:

Acoustic release interrogator (for use with AR-50-AA).

Command transmission: Seven pulses accurately time spaced preceded by a wake-up/synchronization 2.5 sec steady signal all on frequency FM and each pulse preceded by suppression transmission on frequency FS.

Main frequency (FM): 35,714 Hz +/- 0.1% used for one 2.5 sec transmission followed by seven precisely timed 20 ms pulses used to convey the ID and action.

Suppress frequency spectrum (FS): 31,250 Hz +/- 0.1% 20 ms rapid pulse used to generate the suppress frequency spectrum.

Acoustic output: 10 watt (181.5 dB relative to 1 micro Pascal at 1 meter).

Power requirements: 12 volt 5 amp DC supply (user supplied gel cell or equivalent).

Interrogator typical operation steps:

Step 1: Unit identification number selected using Increase/Decrease keys.

Step 2: Action selected from sub menu using Next/Accept keys.

Step 3: Start transmission of command picked from main menu using Next/Accept keys.

TD-50:

Transducer for the ARI-50 interrogator. Made from a piezoelectric cylinder 1.0 inch OD by 0.5 inch high by 0.115 inch thick walls. Full electrostatic shield. Normally supplied on a 50 foot cable with a BNC connector. It can be modeled with a 4.7 nF capacitor and a 3000 ohm resistor in parallel. Its in circuit electrical 'Q' is about four making the tuning of the resonant transformer that drives it not critical.

BAT-50-AA-L91:

Battery pack for use with the AR-50-AA acoustic release. This battery pack is made by wiring nine Energizer L91 lithium AA size cells in series using welded contacts or a special factory verified soldering technique. Battery pack includes a spine, internal rubber spacers and shrink tubing to hold all the cells in place. Battery pack characteristics include 13.0 volts sustained under load, 3000 ma-hr, 15 year shelf life (90% of rated capacity, 21 deg C), excellent low temperature operation, high current handling capability, superior to alkaline in most every way. Meets transportation requirements of 49CFR 173.185 (b) and IATA special provisions A45. Red wire = positive, black wire = negative.

The battery pack can be tested before connection into the acoustic release by using a 270 ohm 1 watt temporary test load and measuring the voltage with an accurate voltmeter. A new battery pack should measure > 13.5 volts. A pack at mid life nominally measures 13.0 volts. Near expired pack nominally measures < 12.2 volts. This test does not absolutely guarantee that the battery pack is good but it is a worth while test that might catch a bad battery pack at this pre-installation stage.

For more information on these lithium batteries see <http://data.energizer.com> and type in L91 for product number.

BTL-50-AA:

Battery test load used for system checkout. This is installed in place of a release link. It has a black wire with 'coil' contact clip that must be connected to the 'coil' water contact. It both turns the AR-50-AA underwater acoustic release unit on, puts a 270 ohm battery test load on the unit, has a red LED that indicates release voltage present but doesn't turn on if the batteries are below 7 volts (very low batteries). Its brightness increases for batteries above 7 volts. It has an exposed stainless steel wire used for connecting to the positive lead of a voltmeter. The negative voltmeter lead goes to the 'coil' water contact. With this voltmeter connection the battery voltage under this load can be measured during system checkout in air.

LK-40:

Release link for AR-50-AA. One use only. Load rated at 40 lb on-axis load. Eroding strength members are two pieces of 0.025 inch diameter stainless steel alloy 308 wire configured as a loop. Erosion time 2 to 4 minutes at 1000 foot depth. This release link type will typically give 75 or more releases plus 10 months of operation using the BAT-50-AA-L91 lithium battery pack. Cut this in half for a large safety margin.

LK-80:

Release link for AR-50-AA. One use only. Load rated at 80 lb on-axis load. Eroding strength members are two pieces of 0.035 inch diameter stainless steel alloy 316L wire configured as a loop. Erosion time 4 to 8 minutes at 1000 foot depth. Uses about four times as much battery energy as the LK-40. This release link type will typically give 25 or more releases plus 10 months of operation using the BAT-50-AA-L91 lithium battery pack. Cut this in half for a large safety margin.