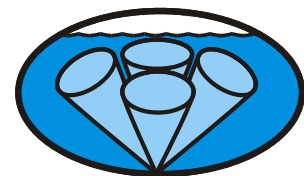


Long Ranger Maintenance Guide



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RD Instruments
Acoustic Doppler Solutions

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Long Ranger Maintenance Guide

1 Introduction

This guide explains how to prepare the Long Ranger for deployment, how to do certain maintenance procedures, and how to prepare the Long Ranger for storage or shipment.

Table 1, page 40 lists the items in the tools and spares parts kit. Use this kit when doing routine Long Ranger maintenance.



NOTE. When an addition or correction to the manual is needed, an Interim Change Notice will be posted to our web site on the Customer Service page (www.rdinstrument.com). Please check our web site often.

2 I/O Cable and Dummy Plug

The underwater connector (on the end-cap) and the I/O cable and dummy plug are molded wet-matable connectors. The end-cap connector is a factory-installed item. We do not recommend removing it for any routine maintenance.



NOTE. The dummy plug should be installed any time the I/O cable is removed. Use the dummy plug when the Long Ranger is in storage or is being handled.

2.1 Disconnecting the I/O Cable or Dummy Plug

The cable should be disconnected with a straight outward motion only. Use the following procedure to disconnect the cable.



CAUTION. When disconnecting the Long Ranger I/O cable, do not apply any upward force on the connector as it is being pulled off. Applying an upward angle as the cable is disconnected puts stress on the end-cap connector. This may cause several serious problems: a) The end-cap connector or connector pins can crack. b) The O-ring on the bottom of the end-cap connector can be damaged. c) The molded urethane on the end-cap connector may separate from the brass insert. **If the end-cap connector is damaged in any of these ways, your ADCP will flood.**

- a. Release the retaining strap by pulling it over the connector.
- b. Grasp the cable close to the end-cap (see [Figure 1](#)). Your thumb should rest against the edge of the end-cap.
- c. Pull the cable straight out away from the end-cap with a gentle side-to-side rocking motion. Do not apply any upward force on the connector as it is being disconnected.



Figure 1. Removing the I/O Cable

2.2 Connecting the I/O Cable or Dummy Plug

The cable should be connected with a straight inward motion only. Use the following procedure to connect the cable.



CAUTION. When connecting the WorkHorse I/O cable, do not apply any upward force on the connector as it is being pushed on. Applying an upward angle as the cable is connected puts stress on the end-cap connector. This may cause several serious problems: a) The end-cap connector or connector pins can crack. b) The O-ring on the bottom of the end-cap connector can be damaged. c) The molded urethane on the end-cap connector may separate from the brass insert. **If the end-cap connector is damaged in any of these ways, your ADCP will flood.**

- a. Apply a light coat of DC-111 lubricant to the rubber portion of the end-cap connector pins. This will help seat the connector.
- b. Gently push the cable straight in toward the end-cap connector. Do not apply any upward force on the connector as it is being connected.
- c. Roll the retaining strap over the connector.

3 Long Ranger Disassembly

This section explains how to remove and replace the end-cap and housing assembly to gain access to the ADCP's electronics, batteries, and internal recorder. Read all instructions and view the figures in the "[Parts Location Drawings](#)," [page 41](#) *before* doing the required actions.

3.1 End-Cap Removal Procedures

To remove the end-cap, do the following steps.

- a. Dry the outside of the Long Ranger.
- b. Stand the Long Ranger on its transducer faces on a soft pad.
- c. Disconnect the I/O cable and install the dummy plug (see "[I/O Cable and Dummy Plug](#)," [page 1](#)).



CAUTION. If the ADCP flooded with batteries installed, there may be gas under pressure inside the housing. As a precaution, loosen the four end-cap bolts (6-mm) to vent the system.

- d. Loosen (do not remove) the four end-cap bolts to vent the system.
- e. Once all four end-cap bolts (6-mm) have been loosened, remove the bolts from the end-cap.



NOTE. Make sure you save all hardware removed during this procedure for re-assembly.

- f. Carefully pull the end-cap away from the housing until you can gain access to the connector jack. Do not damage the mating surfaces.
- g. Squeeze the sides of the internal I/O cable connector to release it. Set the end-cap aside.



NOTE. A lanyard prevents the end-cap from being pulled too far away from the housing to prevent damage to the internal I/O cable. Once the internal I/O cable is disconnected, remove the screw holding the lanyard in place.

- h. When recovering the Long Ranger from a deployment, remove any water from the end-cap O-ring grooves. Clean the O-ring mating surfaces. Inspect the surfaces for damage. Even small scratches can cause leakage around the O-ring seal.

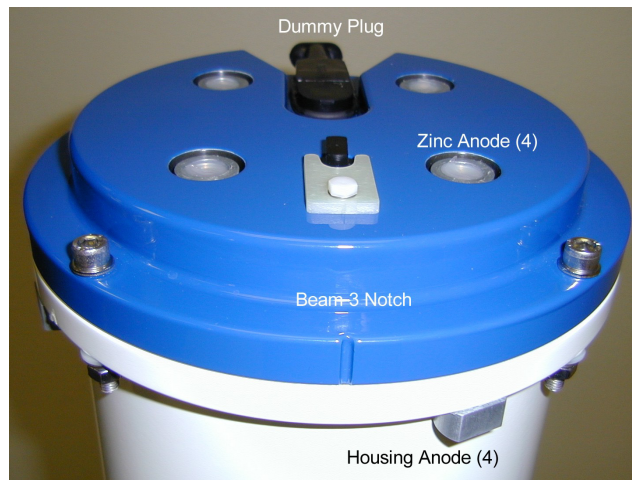


Figure 2. End-Cap Overview

3.2 Battery Pack Module Removal

- a. Remove all power to the Long Ranger.
- b. Remove the I/O cable and place the dummy plug on the I/O cable connector (see [“I/O Cable and Dummy Plug,”](#) page 1).
- c. Remove the end-cap (see [“End-Cap Removal Procedures,”](#) page 3).
- d. Disconnect the two battery power cables from the internal I/O cable (see [“Parts Location Drawings,”](#) page 41).
- e. Remove the wing nuts, lock washers, and washers holding the battery pack modules retaining plate onto the posts.
- f. Slide out the battery pack modules.

3.3 Housing Assembly Removal

- a. Remove all power to the Long Ranger.
- b. Remove the I/O cable and place the dummy plug on the I/O cable connector (see [“I/O Cable and Dummy Plug,”](#) page 1).
- c. Remove the end-cap (see [“End-Cap Removal Procedures,”](#) page 3) and battery modules (see [“Battery Pack Module Removal,”](#) page 4).
- d. Stand the Long Ranger on its transducer faces on a soft pad.
- e. Loosen and remove the four bolts (8-mm) that attach the housing flange to the transducer head assembly.
- f. Carefully lift the housing assembly straight up and away from the transducer until you can gain access to the connector jack on the electronic

chassis's high power I/O board (see [“Parts Location Drawings,”](#) page 41). Do not damage the mating surfaces of the housing or transducer.

- g. Squeeze the sides of the internal I/O cable connector to release it from the jack. Set the housing assembly aside.



NOTE. A lanyard prevents the housing from being pulled too far away from the transducer to prevent damage to the I/O cable. Once the I/O cable is disconnected, remove the screw holding the lanyard in place.

- h. Clean the O-ring mating surfaces with a soft, lint-free cloth. Inspect the surfaces for damage.
- i. When you are ready to re-assemble the Long Ranger, see [“Long Ranger Re-assembly,”](#) page 5.

4 Long Ranger Re-assembly

To replace the end-cap, battery modules, and housing, proceed as follows.

- a. If you are sealing the Long Ranger for a deployment, be sure you have done all appropriate maintenance items (see [“Sealing the Long Ranger for a Deployment,”](#) page 30).
- b. Make sure all printed circuit boards, spacers, cables, and screws have been installed.
- c. Install two fresh bags of desiccant just before closing the Long Ranger (see [“Desiccant Bags,”](#) page 26).

4.1 O-ring Inspection and Replacement

This section explains how to inspect/replace the Long Ranger O-rings. A successful deployment depends on the condition of two O-rings and their retaining grooves. Read all instructions *before* doing the required actions.

- Transducer assembly, face, 2-260 ([Table 1, page 40, item 3](#))
- Transducer assembly, bore, 2-258 ([Table 1, page 40, item 4](#))
- End-cap assembly, face, 2-260 ([Table 1, page 40, item 3](#))
- End-cap assembly, bore, 2-258 ([Table 1, page 40, item 4](#))

We strongly recommend replacing these O-rings whenever you disassemble the Long Ranger. Inspecting and replacing the O-rings should be the last maintenance task done before sealing the Long Ranger.



NOTE. We recommend you use new O-rings if you are preparing for a deployment.

- a. Inspect the O-rings. When viewed with an unaided eye, the O-rings must be free of cuts, indentations, abrasions, foreign material, and flow marks. The O-ring must be smooth and uniform in appearance. Defects must be less than 0.1 mm (0.004 in.).



CAUTION. If the O-ring appears compressed from prior use, replace it. **Weak or damaged O-rings will cause the ADCP to flood.**

- b. Clean and inspect the O-ring grooves. Be sure the grooves are free of foreign material, scratches, indentations, corrosion, and pitting. Run your fingernail across damaged areas. If you cannot feel the defect, the damage may be minor; otherwise, the damage may need repair.



CAUTION. Check the O-ring groove thoroughly. **Any foreign matter in the O-ring groove will cause the ADCP to flood.**

- c. Lubricate the O-ring with a thin coat of DC-111 lubricant ([Table 1, page 40, item 22](#)). Apply the lubricant using latex gloves. Do not let loose fibers or lint stick to the O-ring. Fibers can provide a leakage path.



NOTE. RDI uses Dow Corning's silicone lube model number 111 but any equivalent type of silicone O-ring lube can be used.



CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

4.2 Housing Assembly Replacement

- a. Stand the Long Ranger transducer assembly on a soft pad.
- b. Inspect, clean, and lubricate the O-rings on the housing (see [“O-ring Inspection and Replacement,” page 5](#)). Apply a very thin coat of silicone lube on the O-ring.



NOTE. We recommend you use new O-rings if you are preparing for a deployment.



NOTE. RDI uses Dow Corning's silicone lube model number 111 but any equivalent type of silicone O-ring lube can be used.



CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

- c. Connect the lanyard.

- d. Connect the internal I/O connector to the plug on the electronic chassis high power I/O board (see “Parts Location Drawings,” page 41).
- e. Gently lower the housing onto the transducer, aligning the mating holes. To avoid twisting the internal I/O cable, align the housing’s I/O cable access hole (see “Parts Location Drawings,” page 41) with the I/O cable connector on the electronic chassis. When mating the housing with the transducer head flange try to apply equal pressure to all parts of the O-ring. Make sure the face and bore O-rings remain in their retaining grooves.



CAUTION. Check that no wires or any other object is pinched between the housing and the transducer mounting plate. Use rubber bands to hold the wiring in place as necessary. **If the O-ring is not in the groove or if a wire or other object is pinched, the ADCP will flood.**

- f. Examine the housing assembly nuts, bolts, and washers (8 mm) for corrosion; replace if necessary. Figure 3, page 8 shows the assembly order of the transducer mounting hardware. *All* hardware items are needed to seal the Long Ranger properly.
- g. Install all four sets of hardware until “finger tight.”
- h. Tighten the bolts in small increments in a “cross” pattern until the split washer flattens out, and then tighten each bolt $\frac{1}{4}$ turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of 9.6 Newton-meters (85 pound-inches). Do not deform the plastic bushings.



CAUTION. Apply equal pressure to the O-rings as you tighten the bolts. If one bolt is tightened more than the others, the O-rings can become pinched or torn. **Damaged O-rings will cause the system to flood.**



CAUTION. Do not over tighten the bolts that hold the transducer, housing and end cap together. If you tighten too far, you can crack or break the plastic bushing. On the other hand, **leaving the bolts too loose can cause the system to flood.** Tighten the hardware to the recommended torque value.



NOTE. The recommended torque value for the transducer head 8mm bolts is 9.6 Newton-meters (85 pound-inches).

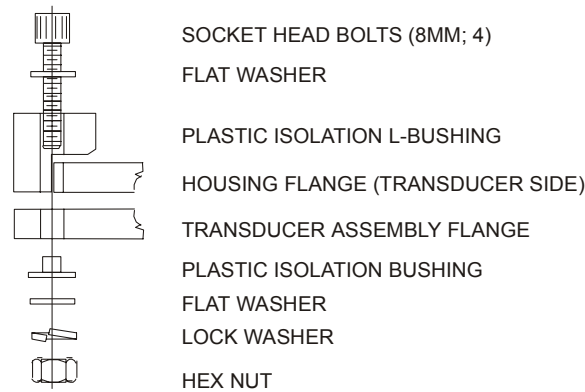


Figure 3. Housing Mounting Hardware

4.3 Battery Pack Module Replacement

- Slide the battery pack module assemblies onto the posts. Make sure the battery module does not pinch the battery pack power cable.



NOTE. When you first receive your Long Ranger, a shipping plate is installed to keep the rods in place. Remove and save this plate for future use.



NOTE. Use the clear plastic battery pack guide (it may have slid to the bottom of the rods) to hold the rods in position as you slide the bottom battery pack onto the posts.



NOTE. The top battery pack module has a thicker and larger diameter top plate as well as a shorter battery pack power cable. This module will not slide down as far into the housing as the bottom module.

- Place a flat washer, lock washer and wing nut on each of the posts. Tighten the nuts to hold the batteries in place.
- Connect the battery pack power cables to the internal I/O cable.
- Install the end-cap (see [“End-Cap Replacement,” page 9](#)).
- Align the compass (see [“Compass Calibration,” page 15](#)).



NOTE. If you are installing less than four battery cores, install both battery modules to maintain the proper spacing. Install the battery pack cores closest to the end-cap.

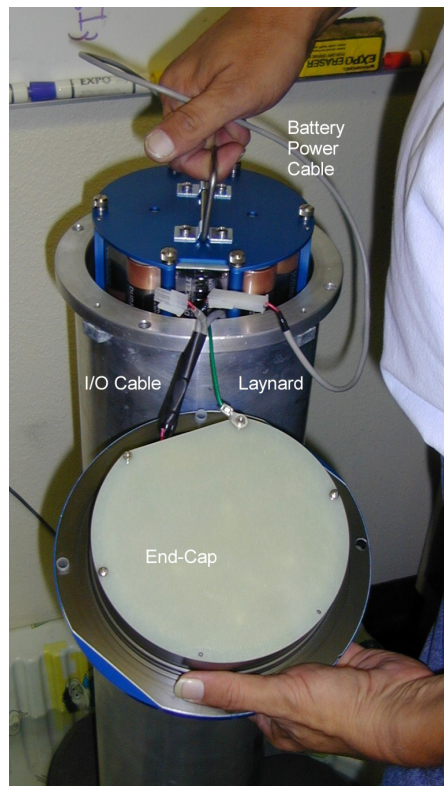


Figure 4. Installing the Battery Modules

4.4 End-Cap Replacement

- a. Stand the Long Ranger on its transducer face on a soft pad.
- b. Inspect, clean, and lubricate the O-ring on the housing (see [“O-ring Inspection and Replacement,”](#) page 5). Apply a very thin coat of silicone lube on the O-ring.



NOTE. We recommend you use new O-rings if you are preparing for a deployment.



NOTE. RDI uses Dow Corning's silicone lube model number 111 but any equivalent type of silicone O-ring lube can be used.



CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

- c. Connect the lanyard to the end-cap.
- d. Connect the internal I/O connector to the plug coming from the electronics chassis and batteries.

- e. Place the end-cap on the housing, aligning the mating holes and the beam 3 notch facing the beam 3 number embossed on the transducer head (see “Parts Location Drawings,” page 41). When mating the end-cap with the housing flange, try to apply equal pressure to all parts of the O-rings. Make sure the O-rings remain in their retaining grooves.



CAUTION. Check that no wires or any other object is pinched between the end-cap and the housing. Use rubber bands to hold the wiring in place as necessary. **If the O-ring is not in the groove or if a wire or other object is pinched, the ADCP will flood.**

- f. Examine the end-cap assembly nuts, bolts, and washers (6 mm) for corrosion; replace if necessary. Figure 5 shows the assembly order of the end-cap mounting hardware. *All* the hardware items are needed to seal the Long Ranger properly.
- g. Install all four sets of hardware until “finger-tight.”
- h. Tighten the bolts in small increments in a “cross” pattern until the split washer flattens out, and then tighten each bolt ¼ turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of 5.6 Newton-meters (50 pound-inches).



CAUTION. Apply equal pressure to the O-rings as you tighten the bolts. If one bolt is tightened more than the others, the O-rings can become pinched or torn. **Damaged O-rings will cause the system to flood.**



CAUTION. Do not over tighten the bolts that hold the transducer, housing and end cap together. If you tighten too far, you can crack or break the plastic bushing. On the other hand, **leaving the bolts too loose can cause the system to flood.** Tighten the hardware to the recommended torque value.



NOTE. The recommended torque value for the end-cap 6mm bolts is 5.6 Newton-meters (50 pound-inches).

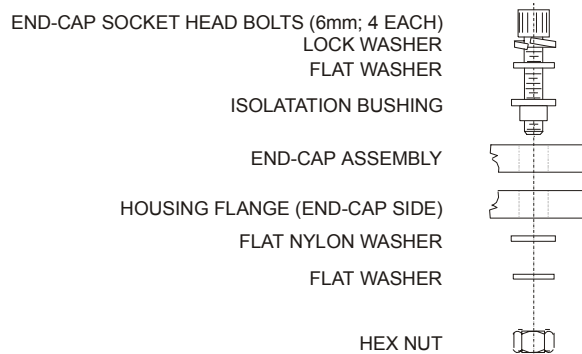


Figure 5. End-Cap Mounting Hardware

5 Direct Reading Conversion Kit

To convert the standard Self-Contained Long Ranger to the Direct-Reading configuration, do the following steps. See the “[Parts Location Drawings](#),” [page 41](#) for reference.

- a. Remove the end-cap from the Self-Contained housing (see “[End-Cap Removal Procedures](#),” [page 3](#)).
- b. Remove the battery modules (see “[Battery Pack Module Removal](#),” [page 4](#)).
- c. Remove the Self-Contained housing (see “[Housing Assembly Removal](#),” [page 4](#)). Do not remove the internal I/O cable from the housing (see next step).
- d. Connect the new short internal I/O cable to the High Power Amplifier assembly. Attach the lanyard to the assembly.
- e. Install the Direct-Reading housing (see “[Housing Assembly Replacement](#),” [page 6](#)).
- f. Attach the lanyard to the end-cap assembly. Install the end-cap (see “[End-Cap Replacement](#),” [page 9](#)).

External Battery Case. To convert the standard Self-Contained housing to an External Battery Case, do the following steps. See the “[Parts Location Drawings](#),” [page 41](#) for reference.

- a. Connect the internal I/O cable to the new transducer side end-cap and install the transducer side end-cap (see “[End-Cap Replacement](#),” [page 9](#)).



CAUTION. There is no lanyard connection on this end of the cable. Do not suspend the transducer side end-cap by the I/O cable.



NOTE. The transducer side end-cap uses the L-bushings to attach the end-cap to the housing. Once this end-cap is installed, there is no need to remove it. The batteries can not be accessed from this end of the housing.

- b. Insert the battery modules (see “[Battery Pack Module Replacement](#),” [page 8](#)).
- c. Attach the lanyard to the battery side end-cap assembly and install the end-cap (see “[End-Cap Replacement](#),” [page 9](#)).
- d. Place the dummy plug on the battery side end-cap.
- e. Connect the extension cable from the transducer side end-cap to the Direct-Reading Long Ranger.



NOTE. The external battery case connector is always “hot” when batteries are installed. When you connect the cable with power applied, you may see a small spark.



CAUTION. The external battery case should not be connected or disconnected underwater. The electrical output power will degrade the connector contacts and present a **potential electrical shock hazard to installation personnel** when the power connector is short-circuited in water. The external battery case output power cannot be enabled or disabled underwater.

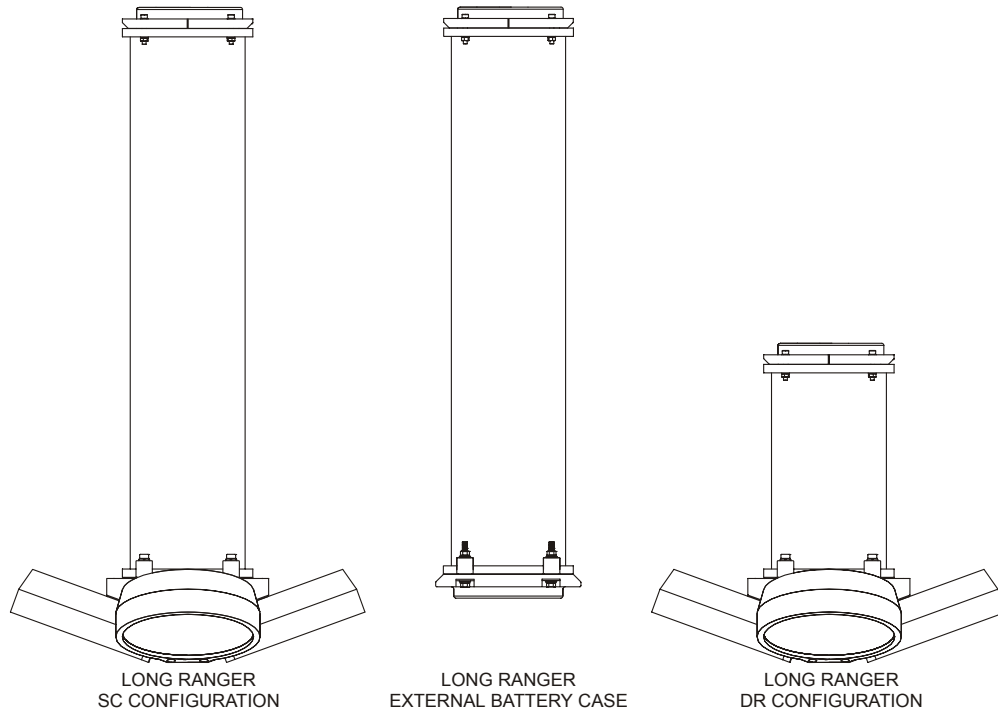


Figure 6. Self-Contained to Direct-Reading Conversion

6 Long Ranger Batteries

The Long Ranger system uses battery packs to provide power. Battery pack cores should be replaced when the voltage falls below 30 VDC (measured across the battery pack core connector under no-load conditions).



NOTE. Battery replacement induces both single and double cycle compass errors. The compass accuracy should be verified after replacing the battery pack. The compass does not have to be recalibrated if the compass verification passes specification.

These compass effects can be avoided by using an external battery pack. The external battery housing holds two battery modules (four battery cores), and can easily be replaced on-site. If the external battery case is placed a minimum of one meter away from the ADCP, no compass calibration will be required.

6.1 Battery Core Replacement

To replace the battery pack core, do the following steps. See the “[Parts Location Drawings](#),” [page 41](#) for reference.

- a. Remove the end-cap (see “[End-Cap Removal Procedures](#),” [page 3](#)).
- b. Remove the battery pack modules (see “[Battery Pack Module Removal](#),” [page 4](#)).
- c. Remove the battery pack module’s retaining plate by unscrewing the six thumbscrews.
- d. Disconnect each battery pack’s wiring harness.
- e. Slide out the used battery cores ([Figure 7](#), [page 14](#)).
- f. Test the new battery pack voltage by measuring across the battery connector under no-load conditions. The voltage should be +42 VDC for a new battery pack.
- f. Slide the new battery pack cores into the battery module. Make sure the battery power cable is not pinched by the battery pack. Use rubber bands to hold the wiring in place.
- g. Replace the battery pack module’s retaining plate. Use the pins to align the retaining plate.
- h. Install the battery module (see “[Battery Pack Module Replacement](#),” [page 8](#)).
- i. Install the end-cap (see “[End-Cap Replacement](#),” [page 9](#)).
- j. Align the compass (see “[Compass Calibration](#),” [page 15](#)).

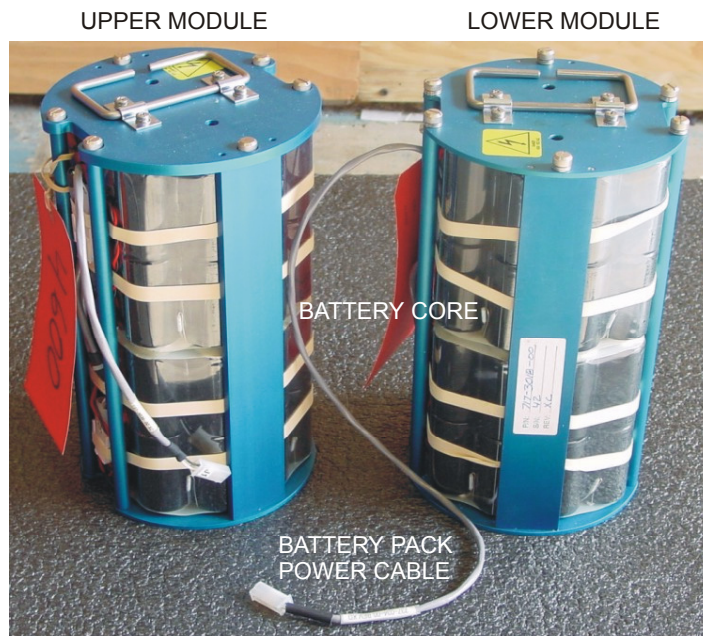


Figure 7. Battery Pack Modules

6.2 External Battery Case Battery Replacement

The optional external battery case holds two battery modules to provide power. Battery cores should be replaced when the voltage falls below +30 VDC (measured across the battery connector under no-load conditions). See the [“Parts Location Drawings,” page 41](#) for reference. To replace the battery cores, do the following steps.



CAUTION. The optional external battery case should not be connected or disconnected underwater. The electrical output power will degrade the connector contacts and present a **potential electrical shock hazard to installation personnel** when the power connector is short-circuited in water. The external battery case output power cannot be enabled or disabled underwater.

- a. Remove the battery side end-cap from the external battery case (see [“End-Cap Removal Procedures,” page 3](#)).
- b. Place the external battery case on its side and remove the retaining plate. Carefully pull out the battery pack module (see [“Battery Pack Module Removal,” page 4](#)).
- c. Replace the battery pack cores as needed (see [“Battery Core Replacement,” page 13](#)).
- d. Replace the desiccant bags inside the housing just before sealing the external battery case (see [“Desiccant Bags,” page 26](#)).
- e. Install the end-cap (see [“End-Cap Replacement,” page 9](#)).

7 Compass Calibration

The main reason for compass calibration is battery replacement. Each new battery carries a different magnetic signature. The compass calibration algorithm corrects for the distortions caused by the battery to give you an accurate measurement. You should be aware of the following items:

- We recommend against calibrating the Long Ranger while on a vessel. The ship's motion and magnetic fields from the hull and engine will likely prevent successful calibration.
- If you think your mounting fixture or frame has some magnetic field or magnetic permeability, calibrate the Long Ranger inside the fixture. Depending on the strength and complexity of the fixture's field, the calibration procedure may be able to correct it.



NOTE. If you will deploy your Long Ranger looking up, calibrate it looking up. If you will deploy it looking down, calibrate it looking down.



CAUTION. If you calibrate the compass in one direction (up or down) and deploy the ADCP in the opposite direction (i.e. calibrate it in a downward position and deploy it in an upward position) the compass calibration will be invalid. Compass errors in excess of 5 degrees may occur.



NOTE. If only the battery modules were removed and replaced back in the same orientation, the compass does not require calibration. If the battery cores were replaced, you **must** align the compass.

7.1 Preparing for Calibration



NOTE. Use the shipping case to rotate the Long Ranger during calibration—this way you will not scratch or drop the Long Ranger ADCP.

- Position the shipping case on the floor as far away from metal objects as possible.
- Remove the vent on the side of the shipping case and use the hole to feed through the power and I/O cable.
- Place the Long Ranger ADCP inside the shipping case. Place all the foam inserts around the ADCP to keep the instrument from shifting inside the case. If you are doing a compass *verification*, the Long Ranger can be straight or tilted inside the case. For the compass *calibration*, the Long Ranger must be tilted inside the case (see [Figure 9, page 19](#) through [Figure 12, page 21](#)).
- Connect the Long Ranger as shown in the Long Ranger User's Guide.
- Close and securely latch the shipping case cover.

- f. **Tip the shipping case on its end so that the Long Ranger ADCP is in the same orientation as it will be deployed.** The Long Ranger can rest on its end cap (deployed looking up), or it can rest on the transducer face (deployed looking down) inside the shipping case.



CAUTION. Do not tip the shipping case on its end without the cover in place and securely latched. The Long Ranger ADCP may fall out of the case causing damage to the instrument or personal injury.

7.2 Compass Calibration Verification

Compass calibration verification is an automated built-in test that measures how well the compass is calibrated. The procedure measures compass parameters at every 5° of rotation for a full 360° rotation. When it has collected data for all required directions, the Long Ranger computes and displays the results.



NOTE. Verify the compass if you have just replaced the memory module, or any ferrous metals is relocated inside or around the Long Ranger housing. Calibrate the compass if the batteries have been replaced (see “Compass Calibration Procedure,” page 17).

- Prepare the Long Ranger for calibration (see “[Preparing for Calibration](#),” page 15).
- Start *BBTalk*. See the [RDI Tools User’s Guide](#) for assistance on using *BBTalk*. Send a Break to wake up the Long Ranger.
- On the **Transfer** menu, click **Command History**. In the **Enter a Command** box, enter **AX** and click **OK**.

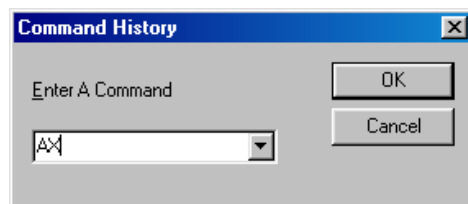


Figure 8. BBTalk Command History Box

- When prompted, rotate the shipping case with the Long Ranger inside slowly 360 degrees (approximately 5 degrees per second) (see [Figure 9, page 19](#)). *Using the shipping case to rotate the Long Ranger makes it easier to control the ADCP.* Rotate the Long Ranger smoothly and slowly. Pay particular attention to the Overall Error. For example;

```
HEADING ERROR ESTIMATE FOR THE CURRENT COMPASS CALIBRATION:
OVERALL ERROR:
  Peak Double + Single Cycle Error (should be < 5):    1.55
DETAILED ERROR SUMMARY:
  Single Cycle Error:                                   1.54
```

Double Cycle Error:	0.07
Largest Double plus Single Cycle Error:	1.61
RMS of 3rd Order and Higher + Random Error:	0.31

If the overall error is less than 2° , the compass does not require alignment. You can align the compass to reduce the overall error even more (if desired).

7.3 Compass Calibration Procedure

The built-in automated compass calibration procedure is similar to the alignment verification, but requires three rotations instead of one. The Long Ranger uses the first two rotations to compute a new calibration matrix and the third to verify the calibration. It will not accept the new matrix unless the calibration was carried out properly, and it asks you to verify that you want to use the new calibration if it is not as good as the previous calibration. While you are turning the Long Ranger for the two calibration rotations, the Long Ranger checks the quality of the previous calibration and displays the results. It compares these results with the results of the third calibration rotation.

There are two compass calibrations to choose from; one only corrects for hard iron while the other corrects for both hard and soft iron characteristics for materials rotating with the ADCP. Hard iron effects are related to residual magnetic fields and cause single cycle errors while soft iron effects are related to magnetic permeability that distorts the earth's magnetic field and causes double cycle errors. *In general, the hard iron calibration is recommended because the effect of hard iron dominates soft iron.* If a large double cycle error exists, then use the combined hard and soft iron calibration.

- a. Start *BBTalk*. Send a Break to wake up the Long Ranger.
- b. On the **Transfer** menu, click **Command History**. In the **Enter a Command** box, enter **AF** and click **OK**. When the calibration procedure starts, choose the calibration type.
- c. Use the followings steps to orientate the Long Ranger for the first rotation of the compass calibration.
 1. Place the Long Ranger inside the shipping case.
 2. Tilt the Long Ranger using the cutout in the foam inside the shipping case (see [Figure 10, page 20](#), through [Figure 12, page 21](#)). The Direct-Reading Long Ranger shipping case requires that the side foam insert be pulled out and placed on the other side of the case in order to tilt the ADCP.
 3. Place all the foam inserts around the Long Ranger to keep the instrument from shifting inside the shipping case.
 4. Close and securely latch the shipping case.

5. Tip the shipping case on its end keeping the same ADCP orientation as it will be deployed in (the Long Ranger can rest on its end cap (deployed looking up), or it can rest on the transducer face (deployed looking down) inside the shipping case (see [Figure 9, page 19](#) and [Figure 10, page 20](#)).
6. Check the on-screen instructions to see if the Long Ranger orientation is OK. Adjust as necessary.
- d. When prompted, rotate the Long Ranger slowly 360 degrees (approximately 5 degrees per second) using the shipping case to assist in rotating the ADCP (see [Figure 9, page 19](#)).
- e. The second rotation requires the Long Ranger to be tilted 15 degrees in another direction than from the first rotation.
 1. Place the shipping case on the floor.



CAUTION. Do not open the shipping case when the case is tipped on its end. The Long Ranger ADCP may fall out of the case causing damage to the instrument or personal injury.

2. Open the shipping case.
3. Rotate the Long Ranger so that another beam is in the center of the rotation.
4. Place all the foam inserts around the Long Ranger to keep the instrument from shifting inside the shipping case.
5. Close and securely latch the shipping case.
6. Tip the shipping case on its end keeping the same ADCP orientation as it was before (i.e. if the previous rotation had the ADCP on its end-cap, make sure the ADCP is still on its end-cap).
- f. When prompted, rotate the shipping case slowly 360 degrees (approximately 5 degrees per second).
- g. The third rotation requires the Long Ranger to be tilted 15 degrees in another direction than from the first and second rotations. Follow the steps as per the second rotation and the on-screen instructions to orient the Long Ranger correctly. When prompted, rotate the Long Ranger slowly 360 degrees (approximately 5 degrees per second).
- h. If the calibration procedure is successful, it records the new calibration matrix to nonvolatile memory. The Long Ranger will not change its matrix unless the calibration is properly carried out.
- i. If the calibration procedure is not successful, return your Long Ranger to the original factory calibration, by using the AR-command. Try using the AR-command if you have trouble calibrating your compass. In some

circumstances, a defective compass calibration matrix can prevent proper calibration.



Figure 9. Rotating the ADCP/Shipping Case During Compass Calibration



NOTE. Direct-Reading case shown.

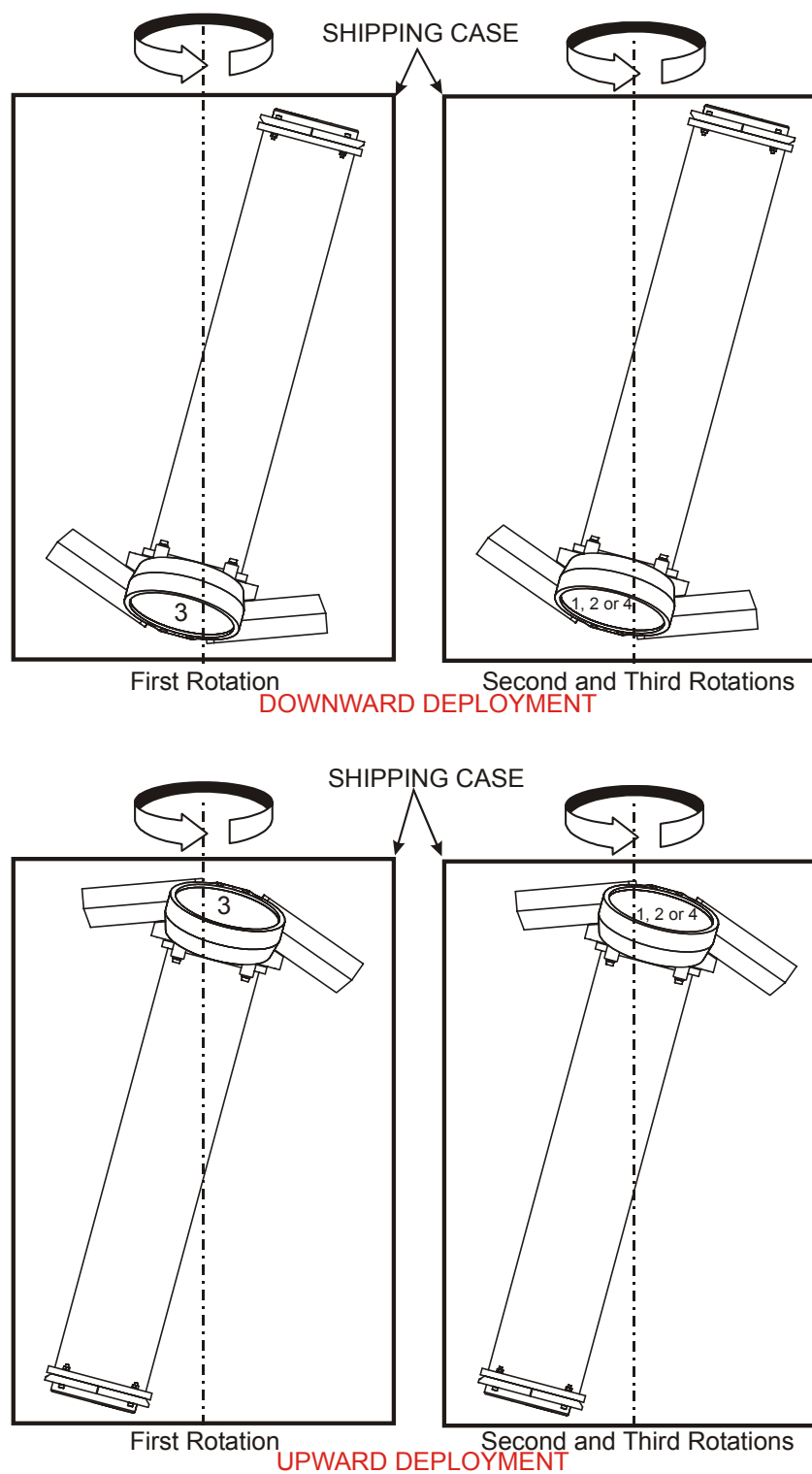


Figure 10. Compass Calibration



Figure 11. Self-Contained Long Ranger Tilted Position in Shipping Case

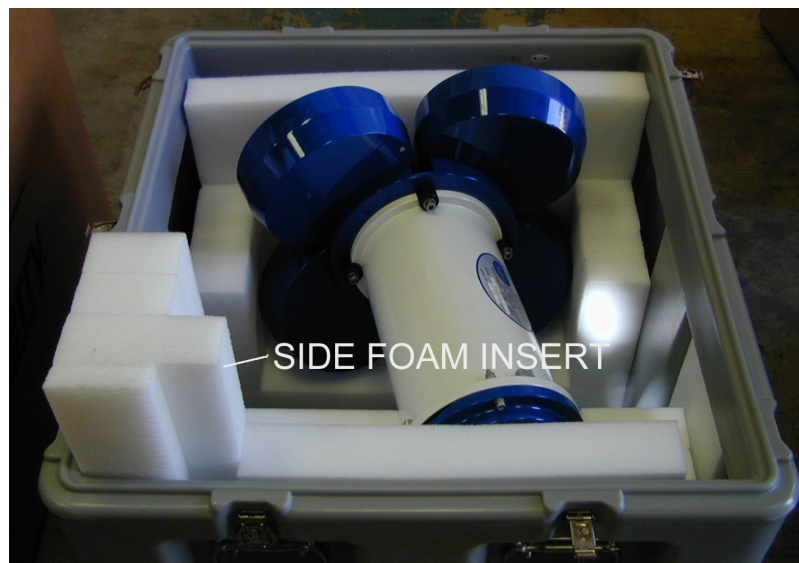


Figure 12. Direct-Reading Long Ranger Tilted Position in Shipping Case



NOTE. To tilt the Direct-Reading Long Ranger, move the side foam insert from the right side to the left.

8 Fuse Replacement

There is one fuse on the end-cap that protects the Long Ranger from excessive incoming power. If this fuse continues to blow, check your input power before applying power again.

- a. Turn off the power.
- b. Remove the end-cap (see [“End-Cap Removal Procedures,”](#) page 3).
- c. The fuse is located on the bottom of the end-cap ([Figure Figure 13](#)). Use a small flat-blade screwdriver to open the fuse housing. Turn the end 180° counter-clockwise to open the fuse housing.
- d. Gently pull the fuse housing out. Turn the housing to remove the fuse.
- e. Replace the fuse with the correct voltage and amperage fuse ([Table 1](#), [page 40 item 23](#)).
- f. Install the end-cap (see [“End-Cap Replacement,”](#) page 9).
- g. Test the system (see the [Test Guide](#)).

External Battery Pack Fuse. One fuse in the optional external battery pack protects the Long Ranger from excessive incoming power. If this fuse continues to blow, check your battery packs before connecting the external battery case again.

- a. Remove one end-cap from the external battery pack (see [“End-Cap Removal Procedures,”](#) page 3).
- b. Carefully lift out the battery pack (attached to the end-cap).
- c. Check the fuse using an ohmmeter. Replace the fuse if necessary with the correct voltage and amperage fuse ([Table 1](#), [page 40 item 23](#)).
- d. Install the end-cap (see [“End-Cap Replacement,”](#) page 9).

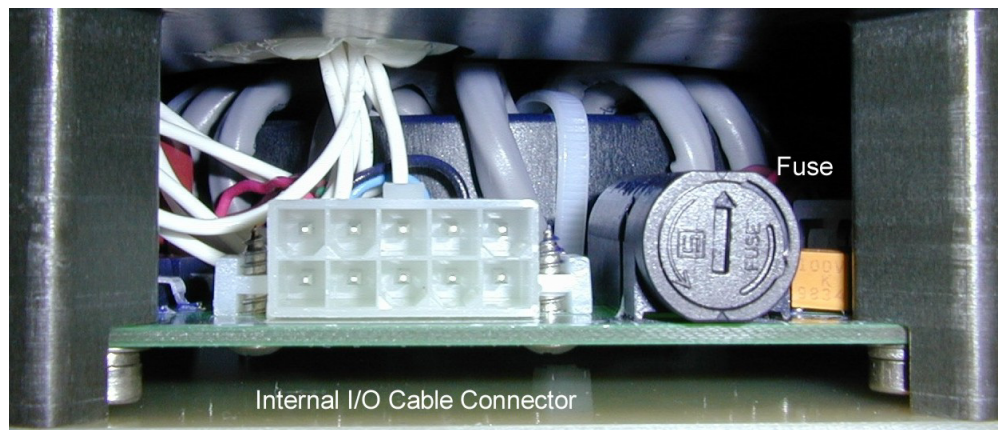


Figure 13. Fuse

9 Communications Setting

There is a switch on the high power I/O board (see [Figure 14](#)) that changes the communication settings between RS-232 and RS-422. Your computer and the Long Ranger must both be set to the same communication setting. Use a RS-232-to-RS-422 converter if the Long Ranger is using RS-422 communications and you computer only has an RS-232 COM port.



NOTE. The default setting is RS-232.



Figure 14. Communication Setting Switch

10 Firmware Upgrades

The firmware for Long Ranger ADCPs is located on flash RAM chips on the CPU board. Firmware must be downloaded. Use the following procedure to download firmware to the Long Ranger.

- a. Connect your Long Ranger to the computer as shown in the [User's Guide](#).
- b. Start the program *WHxxFW.exe* (where *xx* is the firmware number).
- c. Click **Setup**. Click the **View README.TXT** button to view the Readme.txt file for details on what is new in this version of the firmware.
- d. Click **Next** and follow the on-screen prompts.

- e. If you are not able to install the new firmware, contact Customer Service.
- f. After successfully upgrading the firmware, use *BBTalk* to test the ADCP (see the [Test Guide](#)).

11 Feature Upgrades

The feature upgrade installation program is used to install Bottom Tracking, Shallow Water Bottom Mode, Lowered ADCP (LADCP), Water Profiling (for Navigators), High-Resolution Water-Profiling mode, High Ping Rate, and Waves capabilities in a Workhorse ADCP.



NOTE. The upgrade disk is specific to the unit for which it was ordered. DO NOT attempt to install this feature for any other unit.



NOTE. Many feature upgrades require the latest firmware version to be installed in your ADCP. If you need to update the firmware, do this before installing the feature upgrade (see “Firmware Upgrades,” page 23).



NOTE. Bottom Track and the Shallow Water Bottom Mode are NOT available for Long Ranger ADCPs.

- a. Set up the Long Ranger as shown in the [User's Guide](#).
- b. Place the feature upgrade disk in the disk drive (usually the “A” drive).
- c. Click the Windows **Start** button, and then select **Run**.
- d. In the **Open** box, type A:\xxx.exe, where xxx is the ADCP’s CPU serial number. The installation program will start (see [Figure 15](#)). The program is encoded with the ADCP’s serial number and the requested feature upgrade.

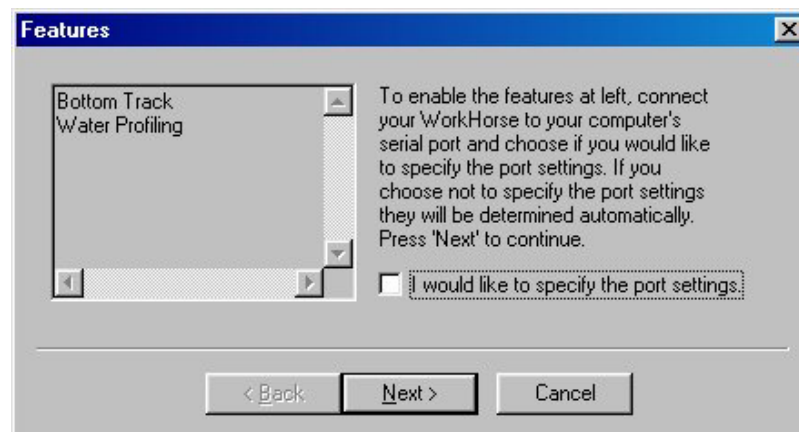


Figure 15. Installing Feature Upgrades

- e. To select the port settings, select the **I would like to specify the port setting** box and click **Next**.
- f. Select the **Serial Port** and **Baud Rate**.
- g. Click **Next** to install the feature upgrade. Click the **Finish** button to exit the program.

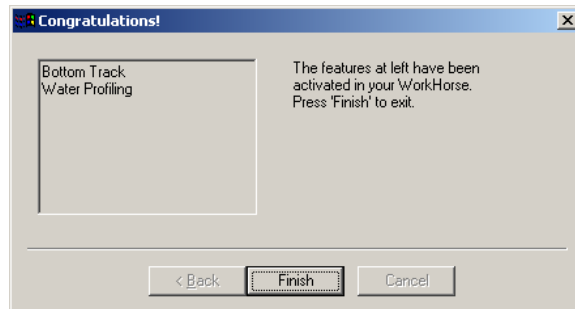


Figure 16. Feature Upgrade Completed

- h. Start *BBTalk* and use the OL command (see the [Workhorse Commands and Output Data Format guide](#)) to verify the feature upgrade has been installed.

12 PC Card Recorder

The PC Card recorder is located on the Digital Signal Processor (DSP) board inside the Long Ranger's electronics. To recover data, the card can be removed and used in a personal computer (PC), or left in the Long Ranger, and accessed by using *WinSC* (see the [WinSC User's Guide](#)). To remove or install a PC card, do the following.

- a. Turn off power to the Long Ranger.
- b. Remove the housing (see [“Housing Assembly Removal,” page 4](#)).
- c. Remove the PC cards by pushing the button on the side of the PCMCIA card slot (see [Figure 17, page 26](#)). The card should “pop” out of the connector. If you cannot reach the release button with your finger, use a plastic pen or non-conductive tool to depress the button. Do not try to force the card in or out of the connector. When PC cards are properly oriented, they slide easily in or out.
- d. When you are finished recovering the data, install the PC card back into the DSP board. PC cards install with the label side toward the face of the transducer.
- e. Install the housing (see [“Housing Assembly Replacement,” page 6](#)).



NOTE. RDI uses true 16-bit PCMCIA/ATA, 5-volt, type 2 memory cards made by SANDISK (old name was SUNDISK). These cards must be formatted before using in the Long Ranger. Other cards may work but we have not had any success. You can use 16 to 220MB cards (up to two cards).



Figure 17. PC Card Recorder Access Slot

13 Desiccant Bags

Desiccant bags are used to dehumidify the housing interior. The factory-supplied desiccant lasts a year at specified Long Ranger deployment depths and temperatures. Remember that desiccant rapidly absorbs moisture from normal room air.

The average dry weight of a new desiccant bag is 7.2 grams ($\pm 5\%$). The weight increases to 8.4 to 9 grams for a “used” desiccant bag. Used desiccant bags may be dried at 250° for 14 hours. As a minimum, replace the desiccant bags ([Table 1, page 40, item 21](#)) whenever you are preparing to deploy or store the Long Ranger for an extended time.



CAUTION. Do not open the desiccant bag. Contact with the silica gel can cause nose, throat, and skin irritation.



NOTE. Desiccant bags are shipped in an airtight aluminum bag to ensure maximum effectiveness. There is a moisture indicator inside the bag. If the moisture indicator is pink, do not use the desiccant bag until it has been dried. RDI recommends replacing the desiccant bag just before the deployment.

- a. Remove the end-cap (see [“End-Cap Removal Procedures,” page 3](#)).
- b. Remove the new desiccant bags from the airtight aluminum bag.
- c. Remove the old desiccant bags and install two new ones. Place the desiccant bags ([Table 1, page 40, item 21](#)) on top of the battery modules.
- d. Install the end-cap (see [“End-Cap Replacement,” page 9](#)).

14 Transducer Head Inspection

The urethane coating on the transducer faces is important to Long Ranger watertight integrity. Mishandling, chemicals, abrasive cleaners, and excessive depth pressures can damage the transducer ceramics or urethane coating. Inspect the transducer faces for dents, chipping, peeling, urethane shrinkage, hairline cracks, and damage that may affect watertight integrity or transducer operation. Repair of the transducer faces should only be done by RDI.



CAUTION. Never set the transducer on a rough surface; always use foam padding to protect the transducers.

15 Zinc Anode Inspection and Replacement

The Long Ranger has nine sacrificial zinc anodes; one on the transducer assembly, four on the end-cap assembly, and four on the housing flange. If the Long Ranger does not have exposed bare metal, properly installed anodes help protect the ADCP from corrosion while deployed. Read all instructions before doing the required actions.

15.1 Zinc Anode Inspection

The life of a zinc anode is not predictable. An anode may last as long as one year, but dynamic sea conditions may reduce its life. Use a six-month period as a guide. If the total deployment time for the anodes has been six months or more, replace the anodes. If you expect the next deployment to last six months or more, replace the anodes. Inspect the anodes as follows.

- a. Inspect the anodes on the transducer assembly, end-cap assembly, and housing flange for corrosion and pitting. If most of an anode still exists, you may not want to replace it.
- b. Inspect the RTV-covered screws that fasten each anode. If the RTV has decayed enough to let water enter between the screws and the anode, replace the RTV (see [“Zinc Anode Replacement,”](#) page 28).
- c. If you have doubts about the condition of the anodes, remove and replace the anode.

15.2 Zinc Anode Electrical Continuity Check

Check electrical continuity using a digital multimeter (DMM). All measurements must be less than five ohms. If not, reinstall the affected anode (see [“Zinc Anode Replacement,” page 28](#)).

Housing Anode. Measure the resistance between all four anodes. Scratch the surface of the anode with the DMM probe to make good contact if the anode is oxidized. The resistance should be less than five ohms.

End-Cap Anode. Remove the end-cap (see [“End-Cap Removal Procedures,” page 3](#)). Measure the resistance between the anode and the nut on the I/O cable connector on the inside of the end-cap. The resistance should be less than five ohms.

Transducer Anode. Remove the housing (see [“Housing Assembly Removal,” page 4](#)). Measure the resistance between the anode and any one of the screws holding the electronics to the transducer mounting plate. The resistance should be less than five ohms.

15.3 Zinc Anode Replacement

The following steps explain how to remove and replace the zinc anode/s.

- a. Remove the RTV from the anode screw heads. Remove the screws.
- b. The anode may stick to the ADCP because of the RTV used during assembly. To break this bond, first place a block of wood on the edge of the anode to protect the housing anodizing and paint. Carefully strike the block to loosen the anode.
- c. Clean the bonding area under the anode. Remove all foreign matter and corrosion. Apply a continuous 1-2 mm bead (0.04-0.08 in.) of RTV around each screw hole.
- d. Set a new anode in place and fasten with new screws. Use [Table 1, page 40, item #5](#) for the transducer, use [item #6](#) for the end-cap assembly anodes; and use [item #7](#) for the housing flange anodes.
- e. Fill the counter bore above each screw head with RTV. The RTV protects the screw heads from water and prevents breaking the electrical continuity between the anode, screw, and housing.
- f. Check the electrical continuity (see [“Zinc Anode Electrical Continuity Check,” page 28](#)). If any measurement is greater than one ohm, reinstall the affected anode.

CAUTION.

1. Do not use zinc anodes with an iron content of more than 0.0015%. The major factor controlling the electrical current output characteristics of zinc in seawater is the corrosion film that forms on the surface of the zinc. Corrosion product films containing iron have a high electrical resistance. As little as 0.002% iron in zinc anodes degrades the performance of the anode.
2. Do not use magnesium anodes. Magnesium rapidly corrodes the aluminum housing.
3. Do not connect other metal to the ADCP. Other metals may cause corrosion damage. Use isolating bushings when mounting the ADCP to a metal structure.

16 Protective Coating Inspection and Repair

RDI uses paint on the housing for identification and corrosion protection. For more protection, the case and the transducer assembly are first anodized. Do not damage the surface coatings when handling the ADCP. Inspect and repair the protective coating as follows. Read all instructions before doing the required actions.



NOTE. The procedures contained in this section apply to our standard aluminum systems. For systems made of other materials, contact RDI.

- a. Inspect the end-cap, housing, and transducer assemblies for corrosion, scratches, cracks, abrasions, paint blisters, exposed metal (silver-colored aluminum), exposed anodize (black or dark green), and exposed primer (yellow). Be critical in your judgment; the useful life of the Long Ranger depends on it.



CAUTION. The chemicals used in the following steps can be hazardous to your health. Read all material safety data sheets and manufacturer's instructions before handling these chemicals.

- b. If you are familiar with the repair of anodized coatings, proceed as follows; otherwise, send the Long Ranger to RDI for repair.
 1. Clean and prepare the damaged area using a fine-grade abrasive cloth or a fine-grade flexible Emory wheel. Remove all corrosion from the bare aluminum.
 2. Clean the area with trichlorethane or alcohol. Do not touch the area after cleaning.
 3. Anodize per MIL-A-8625, Type 3, Class 1.
 4. Seal with sodium dichromate only.
 5. Paint repaired area as described in step c below.

- c. Proceed as follows to repair or touch up the protective paint.
 1. Remove all loose paint without damaging the anodizing. Clean and prepare the damaged area using a fine-grade abrasive cloth. Feather the edges of the paint near the damaged area. Try to have a smooth transition between the paint and the damaged area. Do not sand the anodized area. If you damage the anodizing, see step b above for repair.
 2. Clean the area with trichlorethane or alcohol. Do not touch the area after cleaning.
 3. Paint with one coat of epoxy primer (manufacturer's part number 4500; see note below).
 4. Paint with one coat of orange or black paint (manufacturer's part number 4512-B (orange), 4511-B (black); see note below).



NOTE. RDI uses two-part epoxy type paint. This paint is manufactured by Pro-line Paint Manufacturing company, 2426 Main St., San Diego, CA, 92113, Telephone: (619) 231-2313; or 1168 Harbor, Long Beach, CA, 98813, Telephone: (213) 432-7961. Manufacturer's part numbers:
4500-A, Pro-thane Paint, Catalyst, Part A
4511-B, Pro-thane Paint, Black, Part B
4512-B, Pro-thane Paint, Orange, Part B

17 Sealing the Long Ranger for a Deployment

Use the following steps to seal the Long Ranger for a deployment.

- a. Check the Long Ranger electronics chassis; there should be no loose screws or missing hardware.
- b. Install the PC card(s) (see [“PC Card Recorder,” page 25](#)).
- c. Add two fresh desiccant bags inside the Long Ranger housing (see [“Desiccant Bags,” page 26](#)).
- d. Install the housing (see [“Housing Assembly Replacement,” page 6](#)).
- e. Replace/install the battery pack(s) (see [“Battery Pack Module Replacement,” page 8](#)).
- f. Install the end-cap (see [“End-Cap Replacement,” page 9](#)).
- g. Use the [Long Ranger User's Guide](#) to connect the Long Ranger system. Test the Long Ranger before the deployment (see the [Long Ranger Test Guide](#)).
- h. The Long Ranger is now ready for deployment unless you want to take steps to prevent biofouling (see [“Prevention of Biofouling,” page 31](#)).

18 Prevention of Biofouling

This section explains how to prevent the buildup of organic sea life (biofouling) on the transducer faces. Objects deployed within about 100 meters (≈ 328 feet) of the surface are subject to biofouling, especially in warm, shallow water.

Deep Water Deployments. Biofouling is not usually a problem in deep water (more than 100 meters). Soft-bodied organisms usually cause no problems. Do not apply antifouling grease if deploying the Long Ranger in deep water.

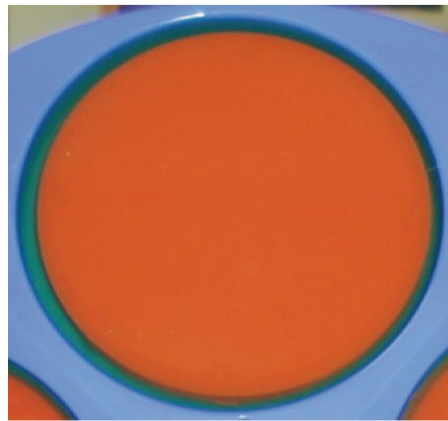
Shallow Water Deployments. Soft-bodied organisms usually cause no problems, but barnacles can cut through the urethane transducer face causing failure to the transducer and leakage into the Long Ranger.

In shallow-water applications, the use of antifouling grease may be appropriate if you cannot clean the transducer faces often (weekly), and if the antifouling grease meets all of your local safety and environmental laws (see the following cautions).

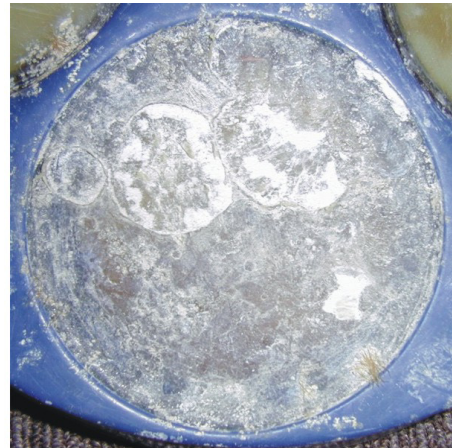
18.1 Controlling Biofouling

The best-known way to control biofouling is cleaning the Long Ranger transducer faces often. However, in many cases this is not possible. The following options can help reduce biofouling.

- Coat the entire Long Ranger with the recommended antifouling paint. Make sure that the paint is applied in an even coat over the transducer faces.
- Apply a thin coat (≈ 4 mm; ≈ 0.16 in.) of either a 50:50 mix of chili powder and petroleum jelly or chili powder and silicone grease to the transducer faces. The chili powder should be the hottest that can be found. Water flowing across the transducers will wash this mix away over time. The silicone mixture tends to last longer.



BEFORE



AFTER

Figure 18. Barnacle Damage



CAUTION. Barnacles can cut through the urethane transducer face causing failure to the transducer and leakage into the WorkHorse.

If using antifouling grease, remove the grease immediately after recovering the Long Ranger from its deployment. Remove the grease with soapy water. Be sure to wear protective gloves and a face shield.



CAUTION.

1. Do not arbitrarily use antifouling grease for deep-water applications. For shallow-water applications, barnacles are a threat to the transducer faces; using antifouling grease may be appropriate if you cannot clean the Long Ranger regularly (weekly). If using antifouling grease, remove it immediately after recovering the Long Ranger.
2. Antifouling grease is toxic. Read the product safety data sheet before using the grease. Wear gloves and a face shield when applying the grease. If the skin comes in contact with the grease, immediately wash the affected area with warm, soapy water.
3. All U.S. coastal states prohibit the use of tributyl-tins on boat hulls. The European Economic Commission has released a draft directive that would prohibit the use of many organo-tins after July 1989. We strongly recommend you obey your local laws.

18.2 Recommended Antifouling Paints

You can use almost any EPA approved anti-fouling paint on the housing or the urethane transducer faces. You do have to be extra careful with the urethane faces. We recommend the TRILUX II paint from Interlux.

Manufacturer	Contact
Courtalds Finishes	Telephone: 908-686-1300
Interlux brand paints	Web Page : www.interlux.com

18.3 Applying Antifouling Paints

Follow the urethane faces application instructions for TRILUX II. One thin coat can last for several months.



NOTE. If you have an optional pressure sensor, and you want pressure (depth) data, you cannot protect the pressure sensor from biofouling. The pressure sensor is located near the center of the transducer array, between the urethane-covered transducers. The sensor port is a small hole drilled through a copper screw (see [“Pressure Sensor Maintenance,” page 34](#)). You should tape off the screw during anti-fouling paint application.

This means that the sensor port is not fully protected from bio fouling. The sensor port is surrounded by the antifouling paint, but bio fouling may build up on the copper screw, and eventually clog the sensor port. However, most organisms do not seem to find the small amount of unpainted surface attractive. If it is logistically possible to periodically inspect/clean the pressure sensor screw, it is highly recommended. This tradeoff situation must be analyzed for individual deployments. Unfortunately, the location of the deployment site usually dictates action in this regard.

Metal Surfaces

a. Metal Surface Preparation

1. On bare aluminum metal, use 353/354 Vinylux solvent wash (thin with 355). Perform the Metal Surface Application (Step (b), below) between 1 and 24 hours.
2. On painted surfaces, use 120-grit sandpaper to remove gloss.

b. Metal Surface Application

1. Mask as necessary.
2. Apply one or two coats of Trilux-2 (active ingredient is copper thiocyanate) at 4 mil/coat. If applying a second coat, wait at least 12 hours to allow the first coat to dry. One coat lasts one season (3 to 4 months); two coats might last one year.



NOTE. Do NOT use cuprous oxide on or near aluminum systems.

Transducer Faces (urethane surfaces)

- a. Urethane Surface Preparation - Lightly sand by hand with 120-grit paper.
- b. Urethane Surface Application - Apply one or two coats of Trilux-2 at 4 mil/coat. If applying a second coat, wait at least 12 hours to allow the first coat to dry. One coat lasts one season (3-4 months); two coats might last one year.

19 Pressure Sensor Maintenance

In order to read the water pressure, water must be able to flow through the transducer anode and cover disk over the pressure sensor. The holes in the anode and cover disk may at times be blocked. Use the following procedure and [Figure 19, page 35](#) to clean the holes.

- a. Place the Long Ranger on its' side. Use a soft pad to protect the ADCP.
- b. Use a straight-slot screwdriver to remove the transducer anode (see [“Zinc Anode Replacement,” page 28](#)).
- c. Remove the two plastic screws holding the cover disk on.
- d. Gently clean out the hole in the anode and cover disk with a needle. If the hole becomes enlarged or the anode is corroded, replace the anode.
- e. Install the cover disk. Tighten the screws “finger tight” (2 in/lbs). Do not over tighten the screws or you may strip the threads on the plastic screws or cover disc.
- f. Install the transducer anode (see [“Zinc Anode Replacement,” page 28](#)).



CAUTION.

The pressure sensor is filled with silicone oil. Never poke a needle or other object through the anode or cover disk while the items are installed over the pressure sensor. You will perforate the sensor, causing it to fail.

Do not attempt to clean the surface of the pressure sensor. The diaphragm is very thin and easy to damage.

Do not remove the pressure sensor. It is not field replaceable.

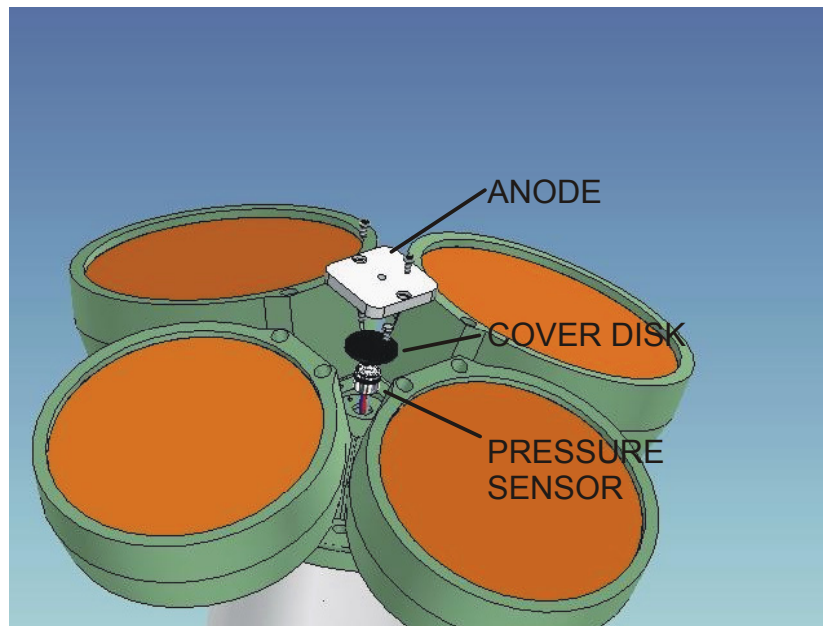


Figure 19. Long Ranger Pressure Sensor (Exploded View)

20 Storage and Shipping Maintenance

This section lists the maintenance items to do before storing the Long Ranger. These maintenance items include:

- Cleaning the Long Ranger with fresh, soapy water.
- Removing biofouling (see [“Removal of Biofouling,”](#) page 36).
- Inspecting the transducer head (see [“Transducer Head Inspection,”](#) page 27).
- Inspecting/replacing the O-rings (see [“O-ring Inspection and Replacement,”](#) page 5).
- Remove the battery pack modules (see [“Battery Pack Module Removal,”](#) page 4).
- Preparing the Long Ranger for final storage or shipping (see [“Final Storage or Shipping Preparation,”](#) page 36).

21 Removal of Biofouling

Before storing or shipping the Long Ranger, remove all foreign matter and biofouling. Remove soft-bodied marine growth or foreign matter with soapy water. Waterless hand cleaners remove most petroleum-based fouling. Rinse with fresh water to remove soap residue. Dry the transducer faces with low-pressure compressed air or soft lint-free towels.



CAUTION. The soft, thin urethane coating on the transducer faces is easily damaged. Do not use power scrubbers, abrasive cleansers, scouring pads, high-pressure marine cleaning systems, or brushes stiffer than hand cleaning brushes on the transducer faces.

If there is heavy fouling or marine growth, the transducer faces may need a thorough cleaning to restore acoustic performance. Barnacles do not usually affect Long Ranger operation. We do, however, recommend removal of the barnacles to prevent water leakage through the transducer face. Lime dissolving liquids such as Lime-Away™ break down the shell-like parts. Scrubbing with a medium stiffness brush usually removes the soft-bodied parts. Do NOT use a brush stiffer than a hand cleaning brush. Scrubbing, alternated with soaking in Lime-Away™, effectively removes large barnacles. After using Lime-Away™, rinse the Long Ranger with fresh water to remove all residues. If barnacles have entered more than 1.0-1.5 mm (0.04-0.06 in.) into the transducer face urethane, you should send the Long Ranger to us for repair. If you do not think you can remove barnacles without damaging the transducer faces, contact RDI.

22 Final Storage or Shipping Preparation

This section explains how to store or ship the Long Ranger. Clean and inspect the I/O connector for water or salt residue.



CAUTION. If you are shipping a Long Ranger to RDI for repair or upgrade, remove all customer-applied coatings or provide certification that the coating is nontoxic. This certification must include the name of a contact person who is knowledgeable about the coating, the name and manufacturer of the coating, and the appropriate telephone numbers. If you return the equipment without meeting these conditions, we have instructed our employees not to handle the equipment and to leave it in the original shipping container pending certification. If you cannot provide certification, we will return the equipment to you or to a customer-specified cleaning facility. All costs associated with customer-applied coatings will be at the customer's expense.

When shipping the Long Ranger through a Customs facility, be sure to place the unit/s so identifying labels are not covered and can be seen easily by the Customs Inspector. Failure to do so could delay transit time.



NOTE. RDI strongly recommends using the original shipping crate whenever transporting the Long Ranger.

If you need to ship or store the Long Ranger, use the original shipping crate whenever possible. If the original packaging material is unavailable or un-serviceable, additional material is available through RDI.

For repackaging with commercially available materials, use the following procedure:

- a. Use a strong shipping container made out of wood or plastic.
- b. Install a layer of shock-absorbing static-shielding material, 70-mm to 100-mm thick, around all sides of the instrument to firmly cushion and prevent movement inside the container.
- c. Seal the shipping container securely.
- d. Mark the container FRAGILE to ensure careful handling.
- e. In any correspondence, refer to the Long Ranger by model and serial number.

23 Returning Long Rangers to RDI for Service

When shipping the Long Ranger to RDI from either inside or outside the United States, the following instructions will help ensure the Long Ranger arrives with the minimum possible delay. Any deviation from these instructions increases the potential for delay.



NOTE. Do not ship the Long Ranger with the battery module cores installed.

23.1 Domestic Shipments

Step 1 - Get a Return Authorization

The best way to make sure RDI is aware of your intentions to ship equipment is to obtain a Return Authorization (RA) before sending the shipment. Return Authorizations are issued by Sales Administration or Customer Service and are used to notify us of your needs in advance of arrival so we can provide a faster turnaround. When requesting a Return Authorization, please give us the following information.

- What is being shipped (include the serial number)
- When you plan to send the shipment
- What problem(s) need correction
- When you need the instrument returned

When the Return Authorization is issued, we will tell you the RA number. Please include this number on all packages and correspondence.

Step 2 - Ship via air freight, prepaid



CAUTION. *Never ship the Long Ranger with lithium batteries inside.* Lithium batteries must be packaged and shipped according to the hazardous materials regulations of the International Air Traffic Association (IATA) via Air Cargo only.

Urgent Shipments should be shipped direct to RDI via any of several overnight or priority air services. Do not send urgent airfreight as part of a consolidated shipment. If you ship consolidated, you will save money, but may lose up to three days in transit time.

Non-urgent shipments may be shipped as part of a consolidated cargo shipment to save money. Also, some truck lines may offer equivalent delivery service at a lower cost, depending on the distance to San Diego.

Mark the Package(s)

To: RD Instruments, Inc. (RA Number)
9855 Businesspark Avenue
San Diego, CA 92131-1101

Step 3 - Urgent shipments

Send the following information by fax or telephone to RDI.

Attention: Sales Administration
Fax: (858) 695-1459
Phone: (858) 693-1178

- Detailed descriptions of what you are shipping (number of packages, sizes, weights, and contents).
- The name of the freight carrier
- Master Air bill number
- Carrier route and flight numbers for all flights the package will take

23.2 International Shipments

Step 1 - Get a Return Authorization

The best way to make sure RDI is aware of your intentions to ship equipment is to obtain a Return Authorization (RA) before sending the shipment. Return Authorizations are issued by Sales Administration or Customer Service and are used to notify us of your needs in advance of arrival so we can provide a faster turnaround. When requesting a Return Authorization, please give us the following information.

- What is being shipped (include the serial number)
- When you plan to send the shipment

- What problem(s) need correction
- When you need the instrument returned

When the Return Authorization is issued, we will tell you the RA number. Please include this number on all packages and correspondence.

Step 2 - Ship Via Air Freight, Prepaid



CAUTION. *Never ship the Long Ranger with lithium batteries inside.* Lithium batteries must be packaged and shipped according to the hazardous materials regulations of the International Air Traffic Association (IATA) via Air Cargo *only*.

Urgent Shipments should be shipped direct. Do not send urgent airfreight as part of a consolidated shipment. If you ship consolidated, you will save money, but may lose up to five days in transit time.

Non-urgent shipments may be shipped as part of a consolidated cargo shipment to save money.

Mark the package(s) as follows:

To: RD Instruments, Inc. (RA Number)
9855 Businesspark Avenue
San Diego, CA 92131-1101 USA
C/O: Paxton, Shreve & Hays
Lindbergh Field, San Diego Airport
2361 Airline Drive, #D
San Diego, CA 92101

Notify upon arrival
Phone: 858-692-3113
Fax: 858-692-0539

Step 3 - Include Proper Customs Documentation

The Customs statement should be completed very carefully. It should accurately and truthfully contain the following information.

- Contents of the shipment
- Value
- Purpose of shipment (example: "American made goods returned for repair")
- Any discrepancy or inaccuracy in the Customs statement could cause the shipment to be delayed in Customs.

Step 4 - Send the Following Information by Fax or Telephone to RDI**Attention:** Sales Administration**Fax:** (858) 695-1459**Phone:** (858) 693-1178

- Detailed descriptions of what you are shipping (number of packages, sizes, weights, and contents).
- The name of the freight carrier
- Master Air bill number
- Carrier route and flight numbers for all flights the package will take

24 Spare Parts

Table 1: Long Ranger Spare Parts

Item #	Qty	Part number	Description
1.	1	14800	Tool box, 14-1/2 H 7-1/2 H 5-1/2
2.	4	810-4004-00	Bushing, instrument housing
3.	2	2-260	O-ring, face
4.	2	2-258	O-ring, bore
5.	2	817-1086-00	Anode, transducer
6.	4	810-4006-00	Anode, end-cap
7.	4	810-4005-00	Anode, housing
8.	1	M13COMBINATION	Wrench, 13 mm combination
9.	1	M10COMBINATION	Wrench, 10 mm combination
10.	1	M5ALLENDRIVER	Ball type, metric
11.	1	M6ALLENDRIVER	Ball type, metric
12.	1	5503A39	Wrench, 3 mm, ball end, L
13.	4	M8X1.25X70SH	Screw, socket head, stainless steel 316
14.	4	M8WASHSPL	Washer, split lock, stainless steel 316
15.	8	M8WASHSTD	Washer, flat, M8, 17 mm OD, stainless steel 316
16.	4	M8X1.25NUT	Nut, hex, stainless steel 316
17.	4	M6X1.0X45SH	Screw, socket head, stainless steel 316
18.	8	M6WASHSTD	Washer, flat, 12.5 mm OD, stainless steel
19.	4	M6WASHSPL	Washer, split lock, stainless steel 316
20.	4	M6X1.0NUT	Nut, hex, stainless steel 316
21.	1	DES3	Desiccant, sealed bag
22.	1	DC-111	Lubricant, silicone, 5.3 oz, Dow-Corning
23.	2	GMA-3A	Fuse, 4.0 Amp, 250V, fast-blow

25 Parts Location Drawings

Use the following drawings to locate parts.

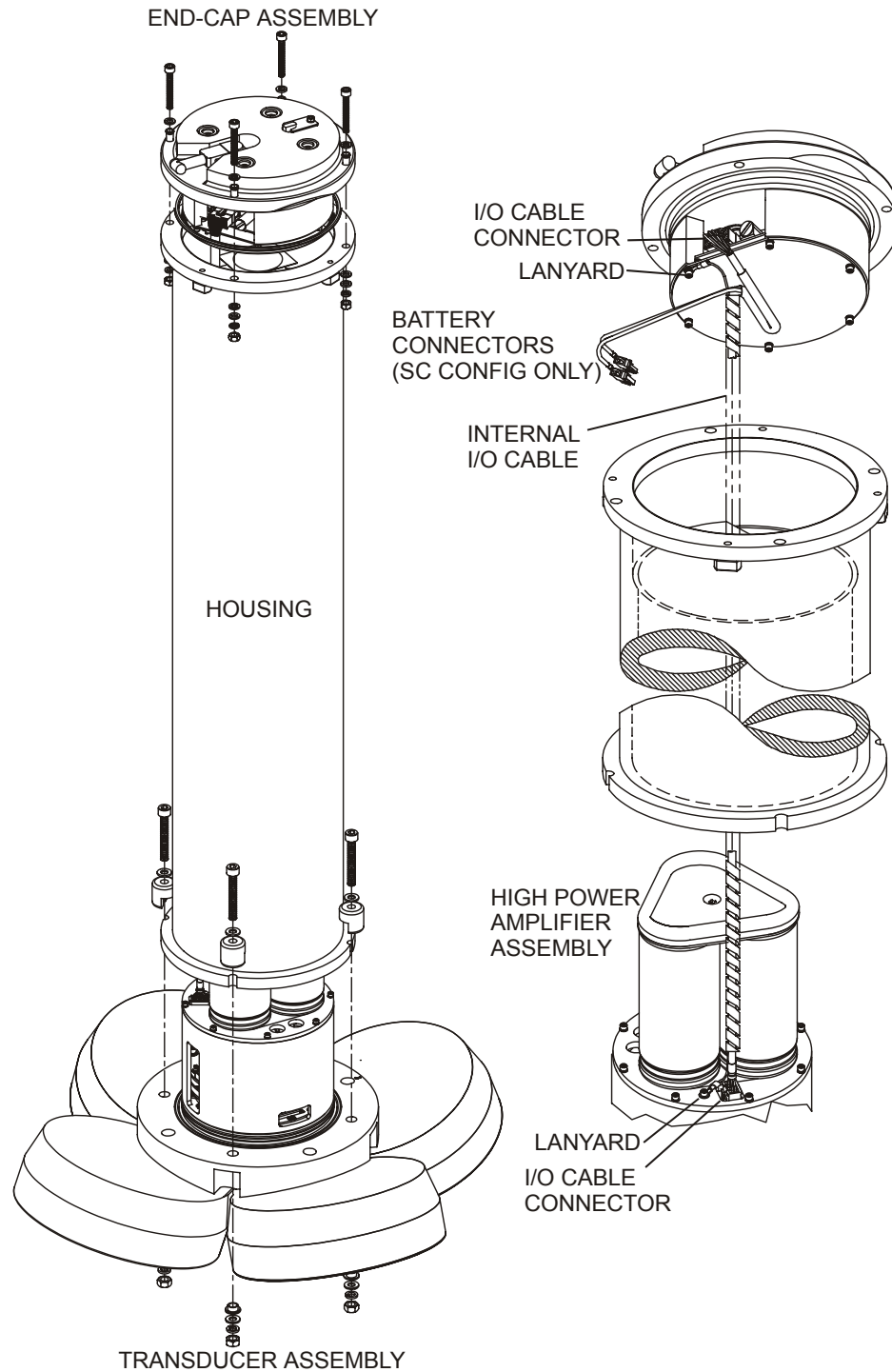


Figure 20. Long Ranger Housing Removal

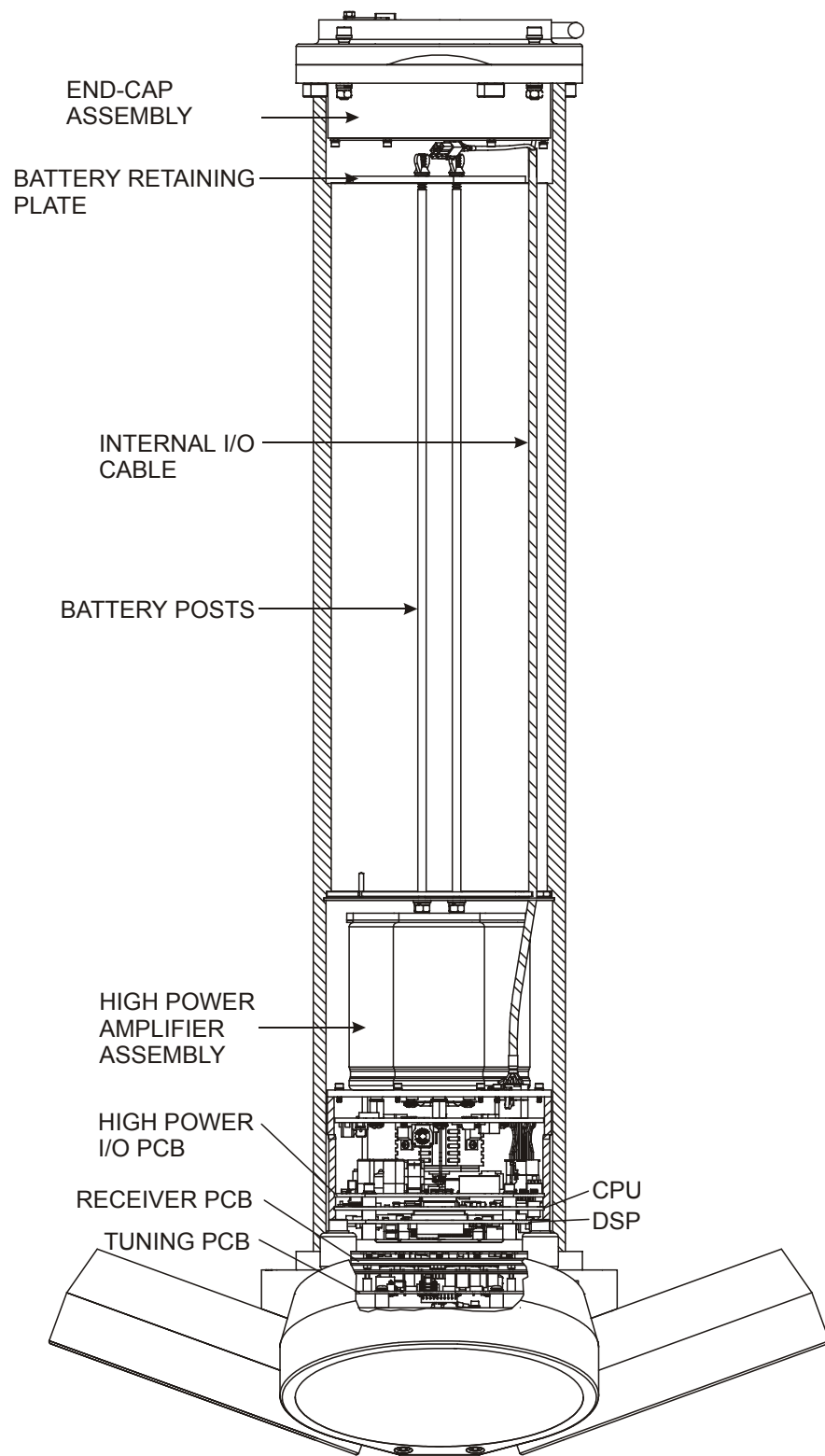


Figure 21. Long Ranger Part Locations

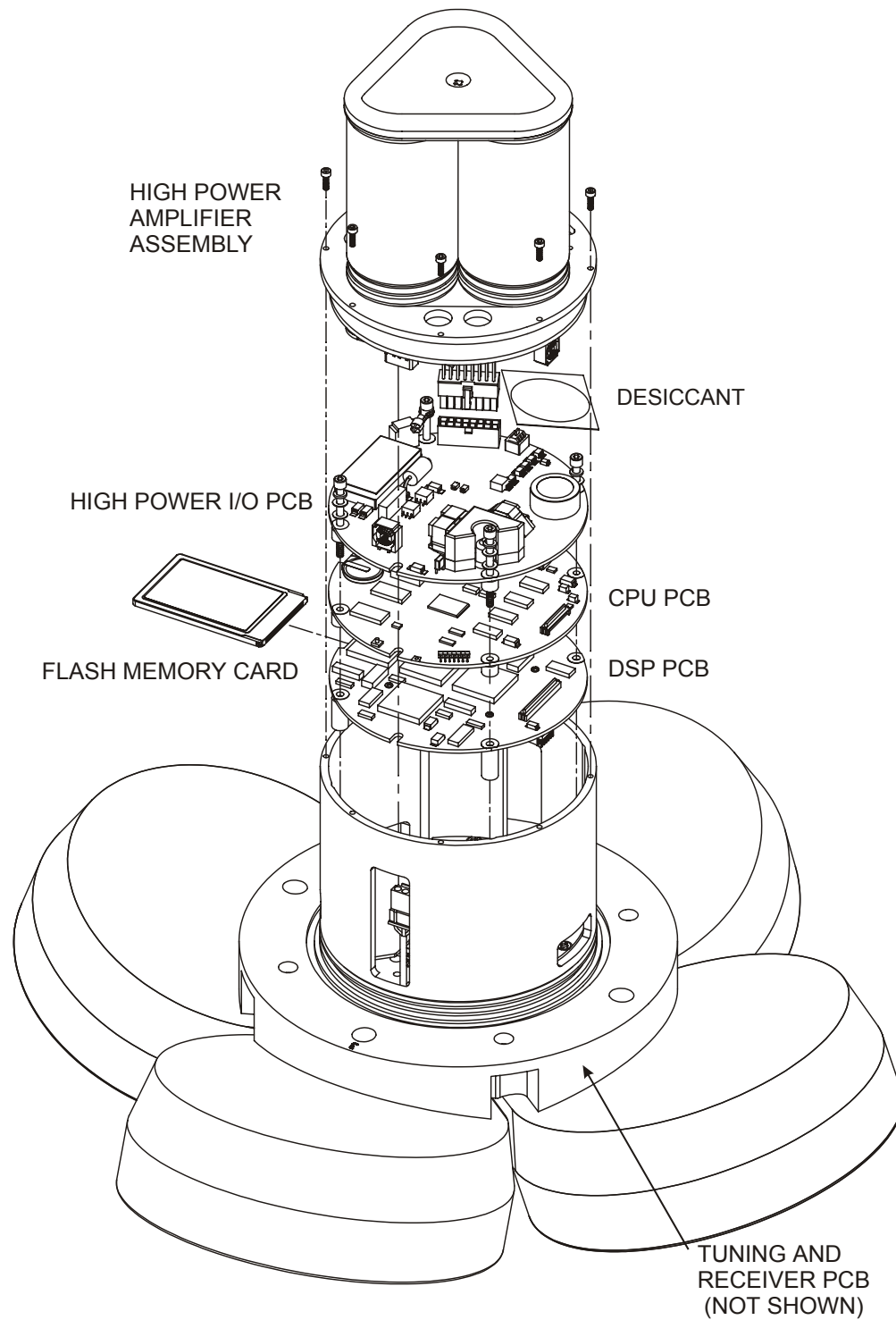


Figure 22. Long Ranger Transducer Electronics

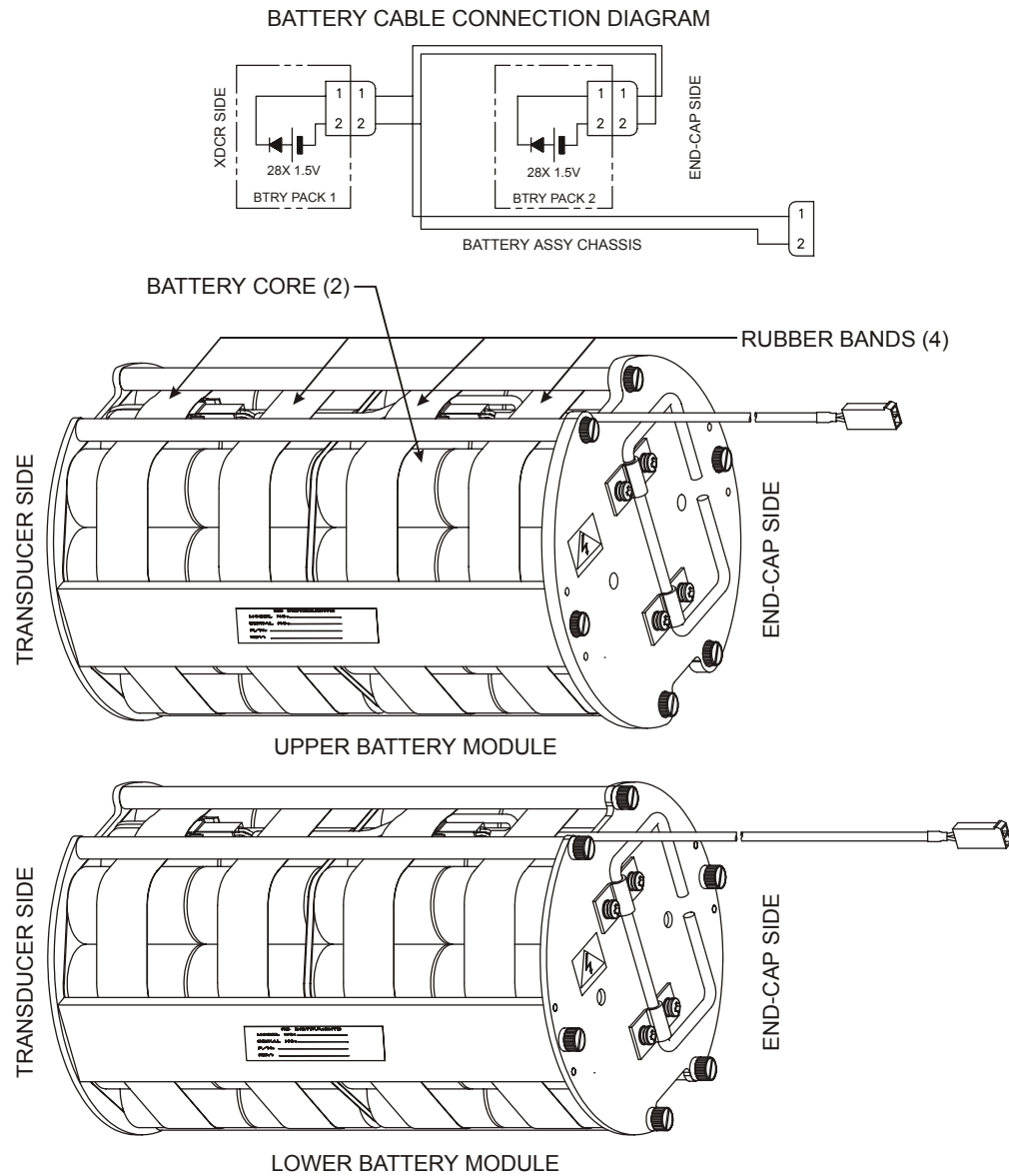


Figure 23. Long Ranger Battery Modules



NOTE. The top battery pack module has a thicker and larger diameter top plate as well as a shorter battery pack power cable. This module will not slide down as far into the housing as the bottom module.

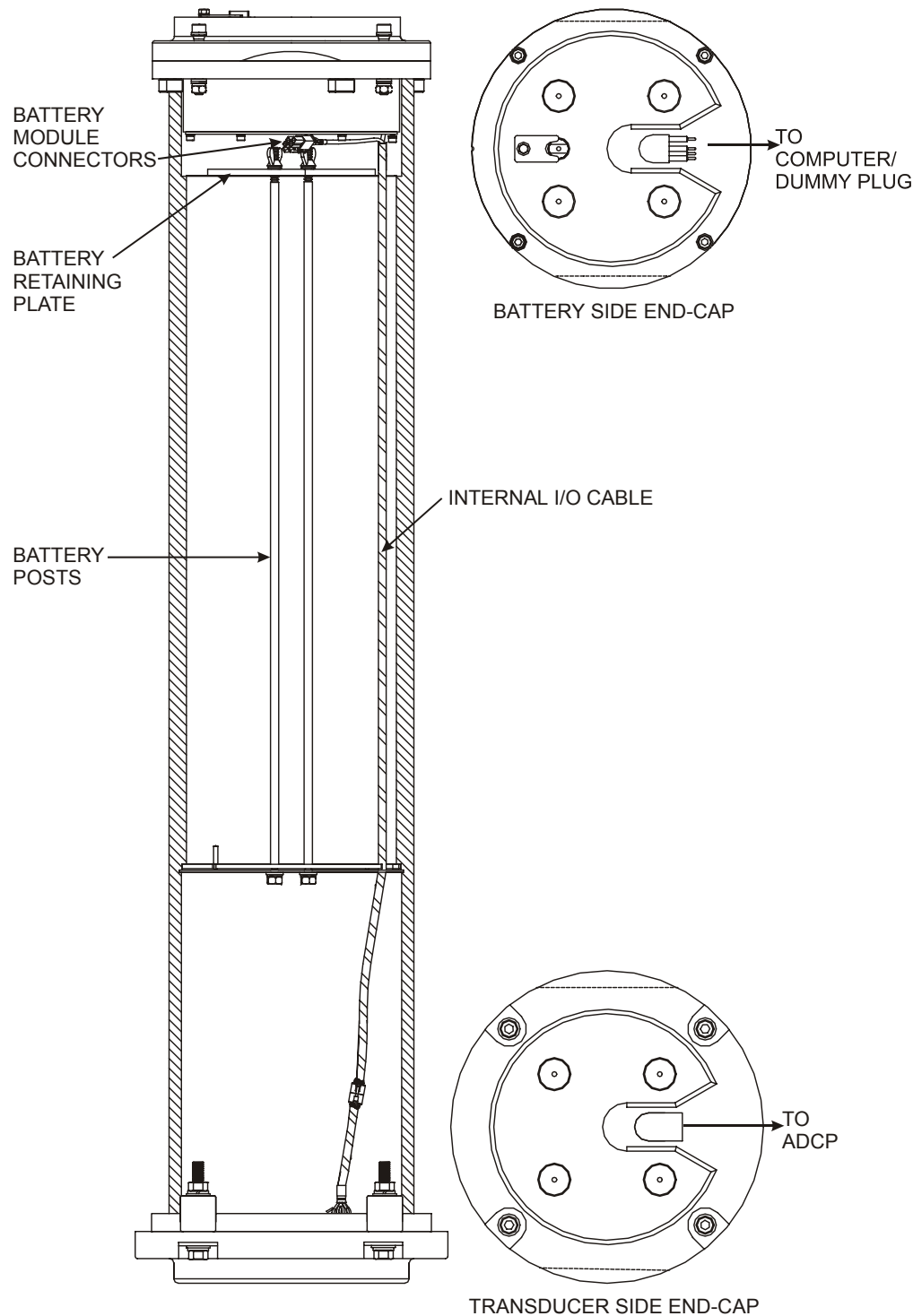


Figure 24. External Battery Case

NOTES