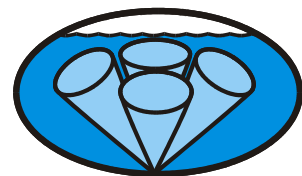


Long Ranger User's Guide



RD Instruments
Acoustic Doppler Solutions

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Long Ranger User's Guide

1 Introduction

Thank you for purchasing the RD Instruments (RDI) WorkHorse Long Ranger. This guide is designed to help first time Long Ranger users to set up, test, and deploy their ADCP.

This guide is designed for use *with* the Long Ranger Technical Manual. Where needed, there are references to detailed information and figures contained in the Long Ranger Technical Manual.



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

Long Ranger deployments are most often Self-Contained but can be Real-Time. Typically, deployments are considered to be Self-Contained when the ADCP is remotely deployed and powered using internal batteries. In this configuration, no external connections to the ADCP are made during the deployment. However, the ADCP can be connected to external power. This power can be provided either by an external battery case or from the shore. This type of deployment is still considered Self-Contained, but this guide may not consider all of the possibilities of this application.

Real-Time use refers to the fact you are viewing the data as the ADCP collects it via a personal computer. This data is also stored on the computer to allow for data playback and processing at a later time.



NOTE. When you receive your Long Ranger, look for a set up card that shows all of the pieces you should have in your box. If anything is missing or damaged, contact RDI immediately.

2 Long Ranger ADCP Applications

The Long Ranger ADCP is designed so that it can be used as a fully self-contained system. This means that it contains its own battery for power and internal recorder for the storage of all data that you have set it up to collect. Using the internal battery and recorder, the Long Ranger can be used for several-month autonomous current profile deployments from temporary or permanent mountings in the ocean, near-shore, harbors, and lakes.

WinSC is the software package for self-contained ADCP setup, data collection, and data review. For detailed information on how to use *WinSC*, see the [WinSC and PlanADCP User's Guide](#). *PlanADCP* (part of *WinSC*) lets you enter known or “best-guess” values for the various ADCP profiling parameters and shows predictions of expected results. For detailed information on how to use *PlanADCP*, see the [WinSC and PlanADCP User's Guide](#).

Table 1: Long Ranger Self-Contained Application Guide

Application	Blue Water	Costal and Continental Shelf
Autonomous deployment	Long Ranger using WinSC	Long Ranger using WinSC
	• Oceanography • Energy transport • Environmental monitoring • Engineering stress determination • Circulation/model studies • Boundary layer studies • Deep water oceanography	• Environmental monitoring • Costal engineering • Enabling safe movement • Measuring Power plant discharge • Protecting coastal land forms • Detecting sewer outfall • Monitoring sensitive environments • Planning new ports

The Long Ranger ADCP can also be used in real time applications that use “shore” power, take advantage of the internal battery power, or external battery power. Most often, Real-Time deployments have the Long Ranger ADCP connected to a computer so that data can be viewed as it is being collected, although data may also be recorded internally.

VmDas is the most often used software package for ADCP setup, real-time data collection, and data review. For detailed information on how to use *VmDas*, see the [VmDas User's Guide](#).

Table 2: Long Ranger Real-Time Application Guide

Application	Blue Water	Costal and Continental Shelf
Real-Time deployment	Long Ranger using VmDas • Current mapping • Oceanography • Boundary layer studies • Fisheries • Plankton biomass	Long Ranger using VmDas • Port and harbor monitoring • Water quality studies • Plume tracking • Environmental surveys • Planning new ports • Current mapping
Offshore oil and gas	Long Ranger using VmDas • Seismic prospecting • Exploration drilling • Field development • Production	



NOTE. The Long Ranger does not Bottom Track and is **not** intended for moving vessel applications.

3 Long Ranger Care

This section contains a list of items you should be aware of every time you handle, use, or deploy your Long Ranger. *Please refer to this list often.*

3.1 General Handling Guidelines

- Never set the transducer on a hard or rough surface. **The urethane faces may be damaged.**
- Always remove the retaining strap on the end-cap underwater-connect cable and dummy plug when disconnecting them. **Failure to do so will break the retainer strap.**
- Do not apply any upward force (i.e. pull the connector away from the end-cap) on the end-cap connector as the I/O cable is being disconnected. **Stressing the end-cap connector may cause the ADCP to flood.** Read the [Maintenance guide](#) for details on disconnecting the I/O cable.
- Do not expose the transducer faces to prolonged sunlight. **The urethane faces may develop cracks.** Cover the transducer faces on the Long Ranger if it will be exposed to sunlight.
- Do not expose the I/O connector to prolonged sunlight. **The plastic may become brittle.** Cover the connector on the Long Ranger if it will be exposed to sunlight.
- Do not store the ADCP in temperatures over 75 degrees C. **The urethane faces may be damaged.** Check the temperature indicator inside the shipping case. It changes color if the temperature limit is exceeded.
- Store batteries in a **cool dry location** (0 to 21 degrees C).
- Do not store batteries inside the ADCP for extended periods. **The batteries may leak.**
- Vent the system before opening by loosening the end-cap. **If the ADCP flooded with batteries installed, there may be gas inside the housing under pressure.**
- Do not scratch or damage the O-ring surfaces or grooves. **If scratches or damage exists, they may provide a leakage path and cause the ADCP to flood.** Do not risk a deployment with damaged O-ring surfaces.
- Do not lift or support a Long Ranger by the external I/O cable. **The connector or cable will break.**

3.2 Assembly Guidelines

- Read the [Maintenance guide](#) for details on Long Ranger re-assembly. Make sure the housing assembly O-rings stay in their groove when you re-assemble the Long Ranger. Tighten the hardware as specified. **Loose, missing, stripped hardware, or damaged O-rings can cause the Long Ranger transducer to flood.**
- Place a light amount of DC-111 lubricant on the end-cap connector pins (rubber portion only). **This will make it easier to connect or remove the I/O cable and dummy plug.**
- Do not connect or disconnect the I/O cable with power applied. An exception to this is the external battery case. 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. **The connector pins may become pitted and worn.**
- The Long Ranger I/O cable is *wet* mate-able, not *under water* mate-able.

3.3 Deployment Guidelines

- Align the compass whenever the battery pack or recorder module is replaced, or when any ferrous metals are relocated inside or around the Long Ranger housing. **Ferro-magnetic materials affect the compass.**
- The AC power adapter is not designed to withstand water. **Use caution when using on decks in wet conditions.**
- Avoid using ferro-magnetic materials in the mounting fixtures or near the Long Ranger. **Ferro-magnetic materials affect the compass.**

4 System Overview

The Long Ranger ADCP system consists of an ADCP, cables, battery pack, flash memory card, and software. Both battery capacity and memory can be increased with upgrades for longer deployments. The Long Ranger can also be used for direct-reading current profile operation. They only require the addition of a Windows® compatible computer to configure the ADCP and replay collected data.

4.1 Long Ranger ADCP Overview

The transducer assembly contains the transducer ceramics and electronics. The standard acoustic frequency is 75kHz. See the outline drawings in the [Long Ranger Installation Guide](#) for dimensions and weights.

I/O Cable Connector – Input/Output (I/O) cable connects the Long Ranger ADCP to the computer and external power supply.

Beam-3 Mark – The Beam-3 mark shows the location of Beam-3 (Forward).

Urethane Faces – The urethane faces covers the transducer ceramics. Never set the transducer on a hard surface. The urethane faces may be damaged.

Housing – The standard Long Ranger housing allows deployment depths to 1500 meters. The housing is available in 851.0mm (Self-Contained and optional External Battery Case) and 320.2mm (Direct Reading) lengths.

Thermistor – The Thermistor measures the water temperature.

Pressure Sensor – The pressure sensor (standard 200 Bar) measures water pressure (depth).

Transducer Head – The Long Ranger electronics and transducer ceramics are mounted to the transducer head. The numbers embossed on the edge of the transducer indicate the beam number. When assembling the unit, match the transducer beam number 3 with the Beam 3 mark on the end-cap.

End-Cap – The end-cap holds the I/O cable connector. When assembling the unit, match the Beam 3 mark on the end-cap with beam 3 number on the transducer.

Internal Battery Pack Modules – The internal battery pack modules (lower and upper modules) have 450 watt-hours (Wh) of usable energy at 0 C. When fresh, the voltage is +42 VDC. When depleted, the voltage drops to 30 VDC or less.

Flash Memory Card – Flash memory cards are available in 16, 20, 40, 85 and 220-MB cards. The standard configuration is one 40MB card.

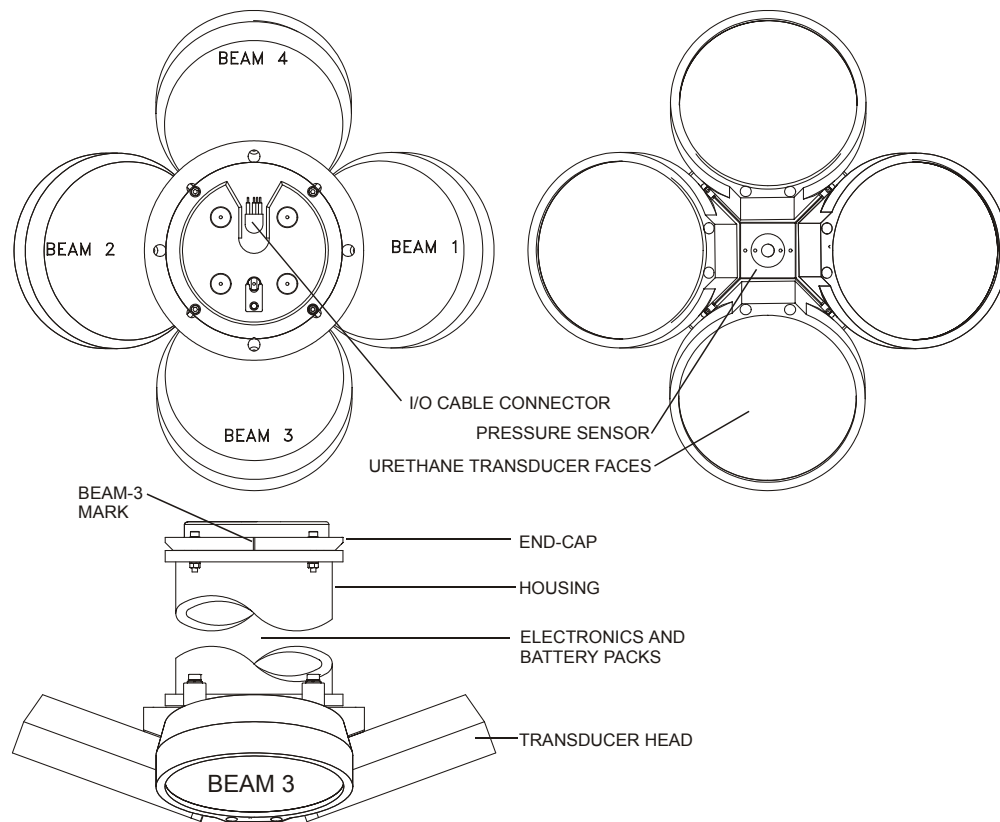


Figure 1. Long Ranger ADCP Overview

4.2 I/O Cable Overview

Always remove the retaining strap on the end-cap underwater-connect cable and dummy plug when disconnecting them. **Failure to do so will break the retainer strap.**

Do not apply any upward force (i.e. pull the connector away from the end-cap) on the end-cap connector as the I/O cable is being disconnected.

Stressing the end-cap connector may cause the ADCP to flood. Read the [Maintenance guide](#) for details on disconnecting the I/O cable.



Figure 2. Connecting and Disconnecting the I/O Cable

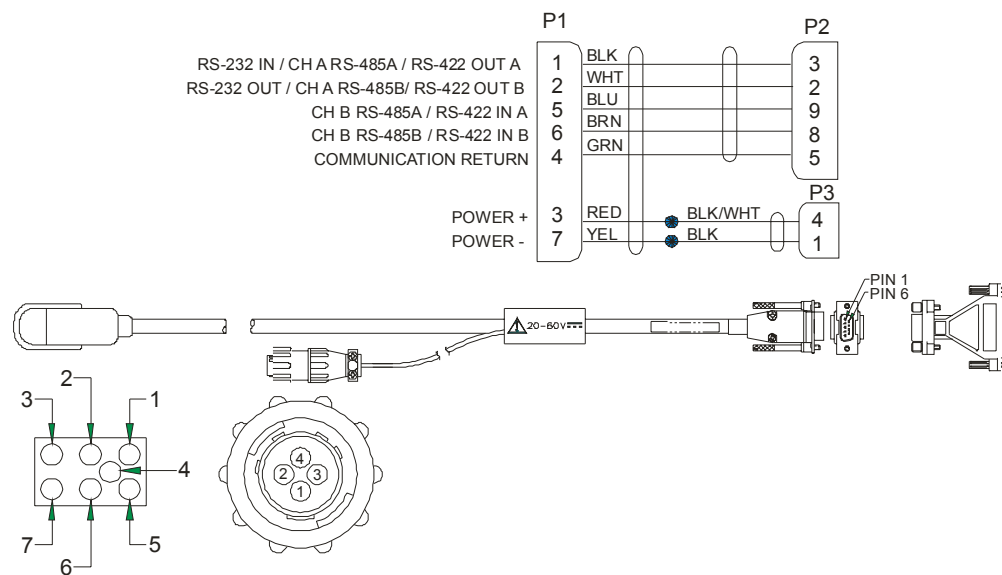


Figure 3. I/O Cable Overview

4.3 Battery Pack Overview

Long Ranger ADCPs require +20 to 50 VDC to operate. The standard AC adapter runs on any standard AC power and supplies +48 VDC to power the Long Ranger with or without the batteries installed.

If both the internal batteries and AC power adapter are connected, the Long Ranger will select the *highest* voltage source for use. The batteries (when fresh) supply +42 VDC and the AC power adapter output is +48 VDC. The Long Ranger will draw all power from the AC power adapter (the batteries will have no effect).

The Long Ranger holds two battery pack modules (upper and lower). Each battery module holds two battery cores. Battery cores should be replaced when the voltage falls below 30 VDC (measured across the battery power cable 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 case. The external battery case holds four batteries (2 battery modules), and can easily be replaced on-site. If placed a minimum of one meter away from the Long Ranger ADCP, no compass calibration will be required.

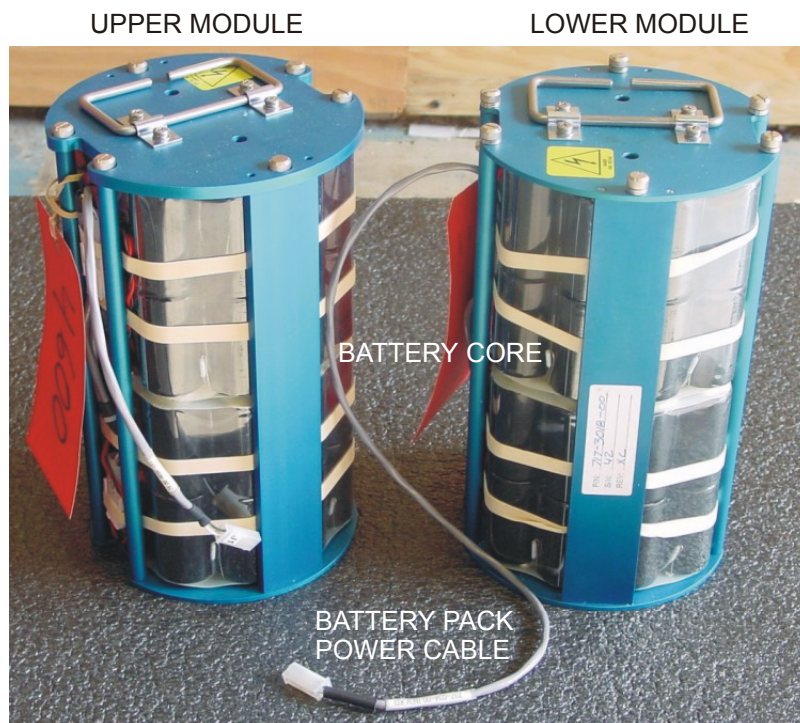


Figure 4. Battery Module Overview

4.4 Flash Memory Card Overview

Flash memory cards are available in 16, 20, 40, 85 and 220-MB cards. The internal recorder holds two cards for a maximum of 440 MB of recording space. 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](#)).



Figure 5. Memory Card Overview

4.5 Spare Parts

The following parts are included in the spare parts kit.

Table 3: Spare Parts

Description	Part number
O-ring, face	2-260
O-ring, bore	2-258
Anode, transducer	817-1086-00
Anode, end-cap	810-4006-00
Anode, housing	810-4005-00
Desiccant, sealed bag	DES3
Lubricant, silicone, 5.3 oz, Dow-Corning	DC-111
Fuse, 4.0 Amp, 250V fast-blow	GMA-4A
Spare close-up hardware	N/A

5 Long Ranger Setup

The Long Ranger may be configured in several ways using the optional upgrades.

- Self Contained (standard configuration)
- Direct Reading
- Direct Reading with External Battery Case

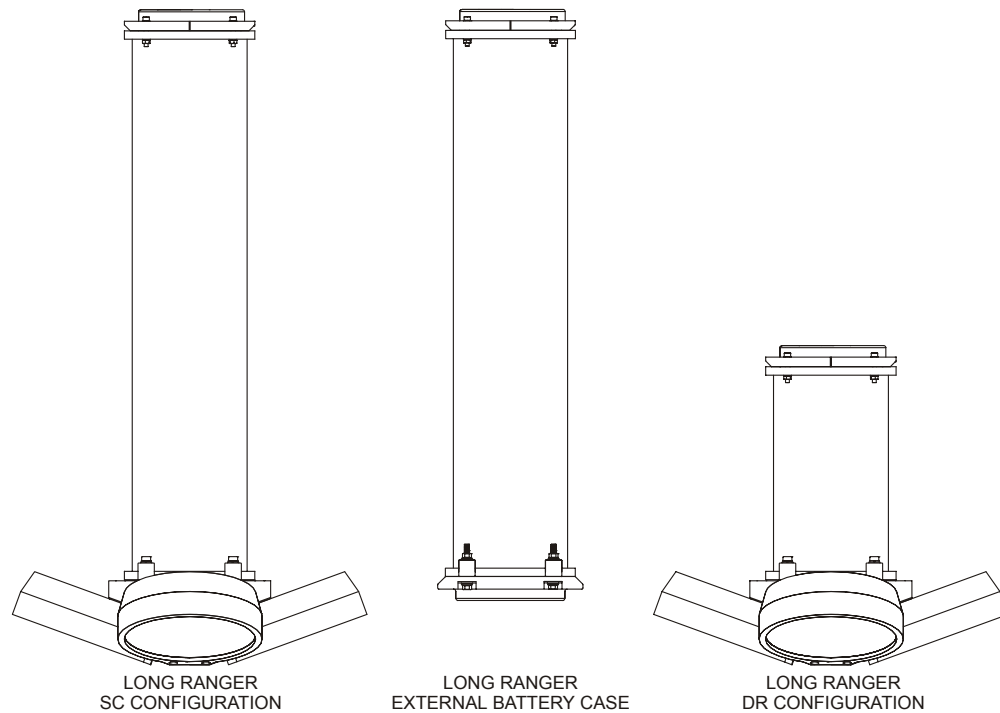


Figure 6. Size Comparison of Self-Contained and Direct-Reading

5.1 Self-Contained Setup

The standard self-contained configuration means that the Long Ranger ADCP uses internal batteries for power and internal recorder for the storage of all data that you have set it up to collect. Using the internal battery and recorder, the Long Ranger can be used for several-month autonomous current profile deployments from temporary or permanent mountings in the ocean, near-shore, harbors, and lakes.

Use [Figure 7](#) to connect the Long Ranger cables and AC power adapter to test the ADCP on your workbench.



NOTE. When you first receive your Long Ranger, the batteries are not installed. The internal batteries plug into a connector on the internal I/O cable. See the Maintenance Guide for battery installation instructions.

You will need a container of water large enough to submerge the Long Ranger's transducer head into during testing (four to five inches of water is sufficient). Testing the Long Ranger out of water may cause some tests to fail but causes no harm to the Long Ranger.

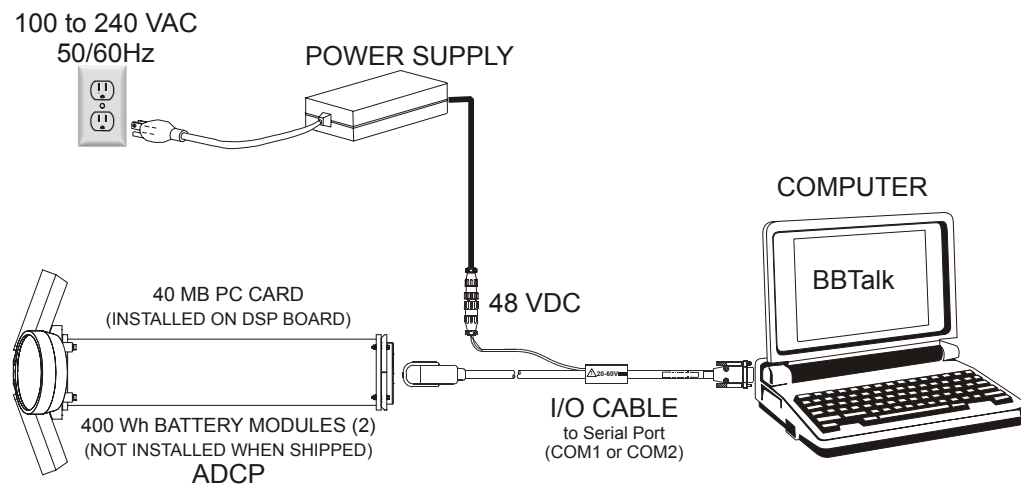


Figure 7. Long Ranger Self-Contained Connections

5.2 Direct-Reading

The Direct-Reading Long Ranger is used for real time data collection from a *stationary* platform (such as from an oil platform or from the bottom looking up and wired to shore).



NOTE. The Long Ranger does not Bottom Track and is **not** intended for moving vessel applications.

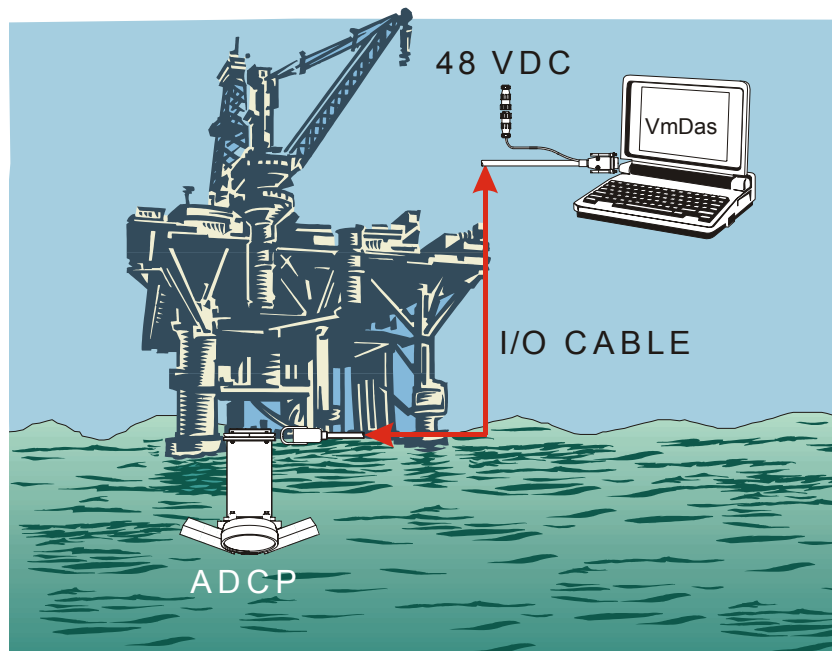


Figure 8. Direct-Reading Configuration

5.3 Direct-Reading with External Battery Case

The Direct-Reading Long Ranger with External Battery Case is designed to allow for mounting the transducer closer to the bottom or inside of a surface buoy with the batteries in a separate waterproof case. Using the external battery case and internal recorder, the Long Ranger can be used for several-month autonomous current profile deployments from temporary or permanent mountings in the ocean, near-shore, harbors, and lakes.

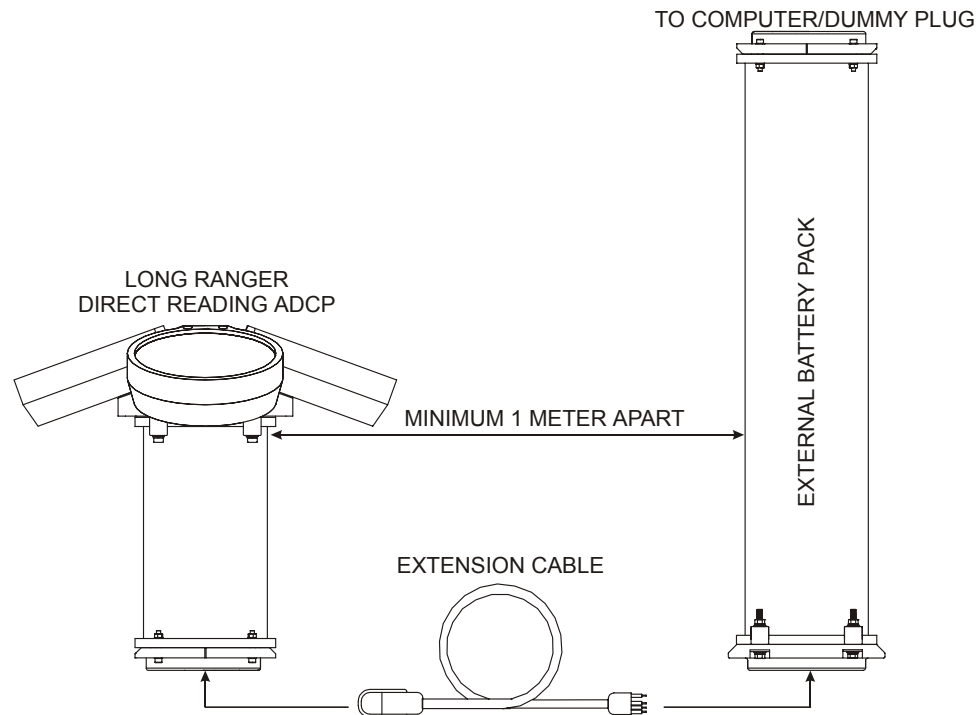


Figure 9. Direct-Reading with External Battery Case Configuration



NOTE. Adding the External Battery Case to a Self-Contained Long Ranger ADCP can increase the deployment length.

5.4 Serial Communication

The standard communications settings are RS-232, 9600-baud, no parity, 8 data bits and 1 stop bit. Self-contained applications receive no benefit from setting a faster baud rate.

You can set the Long Ranger for baud rates other than 9600 baud. If you make the new baud rates permanent, *WinSC* will search for the correct settings, (and will try COM2 but not COM3 or COM4). If you tell *WinSC* these settings, you will save the time required for searching. If you have

trouble connecting to the Long Ranger, use *WinSC's Auto Detect*, which searches for the Long Ranger's current serial port and baud rate.

RS422. The Long Ranger is normally set for RS232, but changing the switch setting on the high power I/O board will change it to RS422 (see the [Maintenance Guide](#) for board locations). Its settings are plainly marked on the access cutout. If the serial protocol is set for RS422 and your computer expects RS232, you will need an RS232-RS422 adapter between the Long Ranger cable and your computer. This user's guide assumes that you use RS232. There is no reason to use RS422 for Self-Contained operation.



NOTE. If you are using a high baud rate and/or a long I/O cable (greater than 50 meters) connected to a Direct Reading Long Ranger ADCP, RS-232 may not work. Switch to RS-422 and try to wake up the Long Ranger again.

5.5 What if the Long Ranger Does Not Respond

If your Long Ranger does not respond, check the serial port, cables, AC power, and battery connection. If necessary, refer to the [Troubleshooting Guide](#) in the Long Ranger technical manual.



NOTE. Long Rangers are shipped from the factory without the battery modules installed in the housing. Be sure to install the battery modules before deployment!

6 Software

RDI has utility programs to help you set up, use, test, and trouble-shoot your Long Ranger ADCP. Each program has a help file that you can print, or you can view help while running the program.

Table 4: Long Ranger Software

Program Name	Description
<i>BBTalk</i>	Windows ADCP communication program. Use this program to "talk" to the ADCP and to run test script files. <i>BBTalk</i> is included on the RDI Tools CD. For detailed information on how to use <i>BBTalk</i> , see the RDI Tools User's Guide .
<i>WinADCP</i>	Gives users a visual display of the entire set of data. You can zoom in on a portion of the data for closer analysis and you can export data to text or MatLab files. For detailed information on how to use <i>WinADCP</i> , see the WinADCP User's Guide .
Documentation CD	The Documentation CD has an Adobe Acrobat® (*.pdf) electronic version of the Long Ranger Technical Manual. Use the Documentation CD to search for information. For detailed information on how to use Adobe Acrobat® and the Documentation CD, see the Read This First Guide .



NOTE. See “[Long Ranger ADCP Applications](#),” [page 2](#) to see what software package to use for collecting data.

6.1 System Requirements

The Long Ranger software requires the following:

- Windows 95®, Windows 98®, Windows NT 4.0® with Service Pack 4 installed, Windows 2000®, or Windows XP®
- Pentium class PC 233 MHz (350 MHz or higher recommended)
- 32 megabytes of RAM (64 MB RAM recommended)
- 6 MB Free Disk Space (20 MB recommended)
- One Serial Port (two or more High Speed UART Serial Ports recommended)
- Minimum display resolution of 800 x 600, 256 color (1024 x 768 recommended)

6.2 Software Installation

To install the Long Ranger software, do the following.

- a. Insert the compact disc into your CD-ROM drive and then follow the browser instructions on your screen. If the browser does not appear, complete Steps “b” through “d.”
- b. Click the **Start** button, and then click **Run**.
- c. Type **<drive>:launch**. For example, if your CD-ROM drive is drive D, type **d:launch**.
- d. Follow the browser instructions on your screen

6.3 Long Ranger Software Philosophy

Self-contained data collection involves a series of independent steps. Using *WinSC*’s Deployment Wizard will ensure that the ADCP is setup correctly.

- Test your Long Ranger (*WinSC*)
- Plan your deployment (*PlanADCP* can be run separately or run inside *WinSC*)
- Transfer your “plan” into the Long Ranger and start data collection (*WinSC*)
- Transfer the data from the Long Ranger’s PC Card recorder to your computer (*WinSC*)

- Verify data integrity (*WinSC*)
- When you are satisfied that your recorded data is safely backed up, erase the Long Ranger PC Card recorder (*WinSC*)
- Display and process your data (*WinADCP* and *WinSC*)

The Long Ranger software is designed to allow you to set up your Long Ranger to get the best possible data without having to understand and use Long Ranger commands. *PlanADCP* creates command files. These files hold the commands that will be sent to the Long Ranger to start the deployment.

6.4 File Naming Conventions

The Long Ranger software gives you a complete record of information that might help you understand your data. To help you associate these files with your data, they use the same deployment name. Be careful not to lose these files!



NOTE. Choose and use Deployment Names carefully: they help you identify and organize all the data and log files associated with each deployment.

Raw Data files produced by *WinSC* have the following filename format:

*DeployName***000****.nnn**

Where:

<i>DeployName</i>	is a user-entered name for the deployment (up to 128 characters),
000	is the deployment number (changes with each stop/restart)
nnn	is the recorder card number, which is incremented when the recorder card is full (.000 = card one, .001 = card two)

The file extensions have the following meaning:

<i>DeployName</i> .WHP	WorkHorse command file created by <i>PlanADCP</i> .
<i>DeployName</i> .SCL	Deployment log file created by <i>WinSC</i> . This file contains all of the commands sent to the WorkHorse (from *.WHP) and the WorkHorse's system information before deployment.
<i>DeployName</i> .DPL	Binary deployment status file. This file keeps track of which steps were completed when using the deployment wizard.

7 Batteries and Power

All Long Ranger tests and operations work equally well using internal battery packs, external battery packs, or the AC power adapter.

7.1 AC Adapter

The AC Adapter runs on any standard AC power and supplies 48 VDC to run the Long Ranger when the batteries are not connected.

7.2 Alkaline Battery Pack Capacity

RDI specifies its battery packs to have 450 watt-hours (Wh) of usable energy at 0°C.



NOTE. Transmitted power increases or decreases depending on the input voltage. A fresh battery provides +42 VDC. Batteries spend most of their life at a nominal voltage of +33 VDC.

The transmitted power is decreased 1 DB if the input voltage drops from 42 VDC to 33 VDC. For a 75kHz Long Ranger ADCP, each DB will result in a decrease in range of one default depth cell.

Keep in mind the following:

- Standard Long Ranger battery packs hold 28 'D-cell' alkaline batteries with a voltage, when new, of approximately 42 VDC.
- When the capacity of a battery pack is 50% used, the voltage (measured across the battery connector under no-load conditions) falls to approximately 32-35 volts. However, keep in mind that this voltage is not an accurate predictor of remaining capacity.
- Batteries should be replaced when the voltage falls below 30 VDC (measured across the battery connector under no-load conditions).
- Battery packs differ from one to another.
- Store batteries in a cool dry location (0 to 21 degrees C).
- Do not store batteries inside the ADCP for extended periods. The batteries may leak.
- Use batteries within one year (shelf life).

7.3 External Battery Pack

The External Battery Pack holds two 450 Watt-hours (Wh) battery modules. To avoid affecting the compass, place the external battery case at least one meter away from the Long Ranger.

7.4 Bench-Top Battery Power Requirements

While the Long Ranger is awake and responding to commands, it consumes approximately 2.2 watts. A single internal battery pack supplies this power level for about five days. When the Long Ranger is asleep, it consumes less than one mw. A standard battery pack supplies sleep power for years. At every opportunity, the Long Ranger will “sleep” to conserve power while deployed.

7.5 Operation Modes

The Long Ranger has two modes of operation: *command mode*, and *ping mode* (also referred to as “Deployment Saver” Mode). Depending on what mode the ADCP is in; it will go either to sleep or to resume pinging.

In the Command Mode

Whenever you wake up your Long Ranger, power dissipation increases from less than one mw to around 2.2 w. If you leave the Long Ranger in command mode without sending a command for more than five minutes, the Long Ranger automatically goes to sleep. This protects you from inadvertently depleting batteries.

In the Ping Mode

After you send commands to the Long Ranger that tells it to start collecting data, the Long Ranger goes into deployment saver mode. If power is somehow removed and later restored, the Long Ranger simply picks up where it left off and continues to collect data using the same setup.

8 Testing Your Long Ranger

Use the following steps to test the ADCP.

- a. Connect and power up the ADCP as shown in [Figure 7, page 12](#).
- b. Start *WinSC* (for help on using *WinSC*, see the [WinSC User's Guide](#))
- c. At the **Welcome** screen, click **Test an ADCP**. Click **OK**. This will run the pre-deployment tests Deploy?, System?, TS?, PS0, PA, PC2, RS, and PC1. The results of the tests will be printed to the screen and saved to the log file (*.scl).

[Table 5, page 21](#) lists the tests *WinSC* runs, gives you guidelines for running the tests, and tells you what the results mean.

Table 5: Long Ranger ADCP Tests

Test	Guidelines	Results
Deploy?	This will show a list of the deployment commands and their current setting.	Verify the command settings.
System?	This will show a list of the system commands and their current setting.	Verify the command settings.
TS?	This will show the current setting of the real time clock.	Verify the clock setting.
PS0	Displays system parameters.	Verify the information is consistent with what you know about the setup of your system.
PA	Extensive pre-deployment test that tests the signal path and all major signal processing subsystems. This test may not pass unless the Long Ranger transducer face is immersed water.	All tests must pass.
PC2	Continuously updates sensor display. Rotate and tilt Long Ranger and watch the readings on the display change.	Satisfy yourself that the readings make sense.
RS	This will show the amount of used and free recorder space in megabytes.	Verify the recorder space is sufficient for the deployment.
PC1	Beam continuity test. Follow instructions to rub each beam in turn to generate a noise signal the Long Ranger uses to verify the transducer beam is connected and operational.	All beams must pass.

9 Internal Pressure Sensor

Use the AZ-command to zero out the pressure sensor at the deployment site.

- Connect and apply power to the system as described in [Figure 7, page 12](#).
- Start *BBTalk* and wakeup the ADCP (press the **END** key).
- On the **Transfer** menu, click **Command History**. In the **Enter a Command** box, enter **AZ** and click **OK**.
- Exit *BBTalk*.

9.1 Pressure Sensor Maintenance

In order to read the water pressure (depth), water must be able to flow through the anode and plastic disk over the pressure sensor. Antifoulant paint will block the sensor's port (a small hole that is drilled through the anode and plastic disk). You should tape off the hole in the anode during anti-fouling paint application.

During deployments, bio fouling may build up on the anode and plastic disk, and eventually clog the sensor port. If it is logistically possible to periodically inspect/clean the pressure sensor port hole, it is highly recommended. See the [Maintenance Guide](#) for instructions on how to clean the pressure sensor.

CAUTION.



The pressure sensor is filled with silicone oil. Never poke a needle or other object through the anode or plastic disk while either of them is 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 10. Pressure Sensor (With Anode)

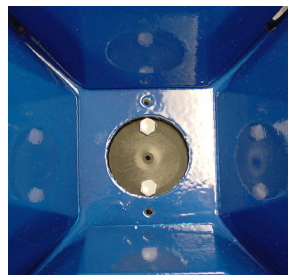


Figure 11. Pressure Sensor (Anode Removed)

10 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.

10.1 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.

- a. Position the shipping case on the floor as far away from metal objects as possible.
- b. Remove the vent on the side of the shipping case and use the hole to feed through the power and I/O cable.
- c. 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 13, page 26](#) through [Figure 16, page 28](#)).
- d. Connect the Long Ranger as shown in [“Long Ranger Setup,” page 11](#).
- e. 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.

10.2 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 24).

- Prepare the Long Ranger for calibration (see “[Preparing for Calibration](#),” page 22).
- 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**.

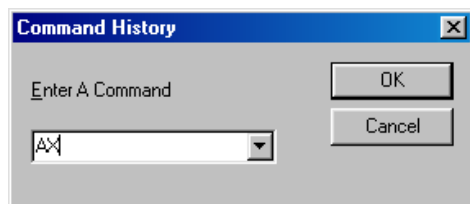


Figure 12. BBTalk Command History Box

- When prompted, rotate the shipping case with the Long Ranger inside slowly 360 degrees (approximately 5 degrees per second) (see [Figure 13, page 26](#)). *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).

10.3 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 14, page 27](#), through [Figure 16, page 28](#)). 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 13, page 26](#) and [Figure 14, page 27](#)).
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 13, page 26](#)).
- 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 13. Rotating the ADCP/Shipping Case During Compass Calibration



NOTE. Direct-Reading case shown.

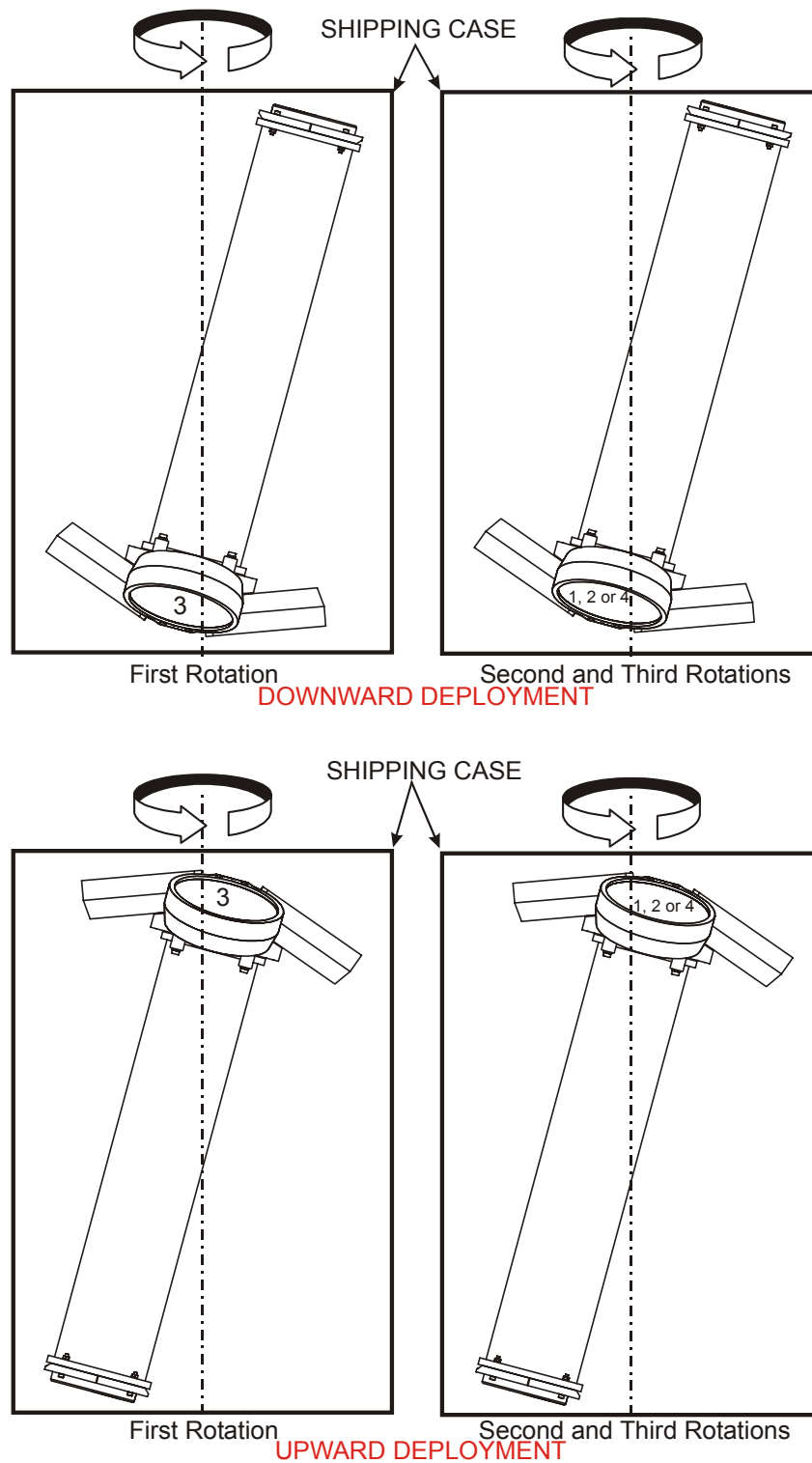


Figure 14. Compass Calibration



Figure 15. Self-Contained Long Ranger Tilted Position in Shipping Case

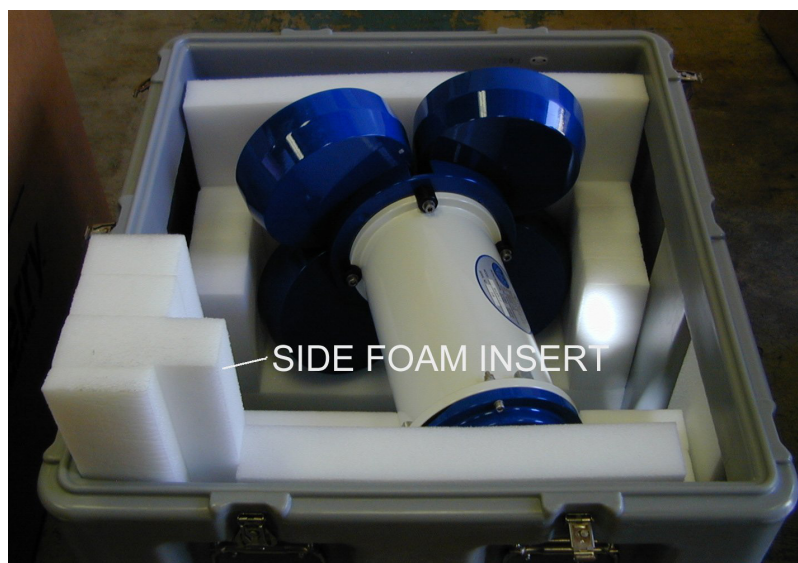


Figure 16. Direct-Reading Long Ranger Tilted Position in Shipping Case



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

11 Deployment Guide

Use the following steps and the Quick Reference card to setup the Long Ranger for a Self-Contained deployment.

11.1 Deployment Checklist

- ☐ Test the ADCP using *WinSC*
- ☐ Seal the ADCP for deployment
 - ☐ Install new o-rings; use silicone lubricant
 - ☐ Use fresh desiccant (2 bags) inside ADCP
 - ☐ Install and connect the battery
 - ☐ Check Recorder PC card is installed
- ☐ Visually inspect the ADCP
 - ☐ Check the transducer head condition
 - ☐ Check the zinc anode condition
 - ☐ Check the housing paint condition
 - ☐ All mounting hardware installed
 - ☐ Transducer faces clean and free from defects
- ☐ Verify the compass alignment using *WinSC*; if necessary, re-calibrate
- ☐ Check recorder status using *WinSC*
- ☐ Are biofouling precautions needed?
- ☐ Verify battery and recorder space requirements
- ☐ Zero pressure sensor at deployment site with AZ-command
- ☐ Check pressure sensor port hole is clear
- ☐ Install the dummy plug; use silicone lubricant

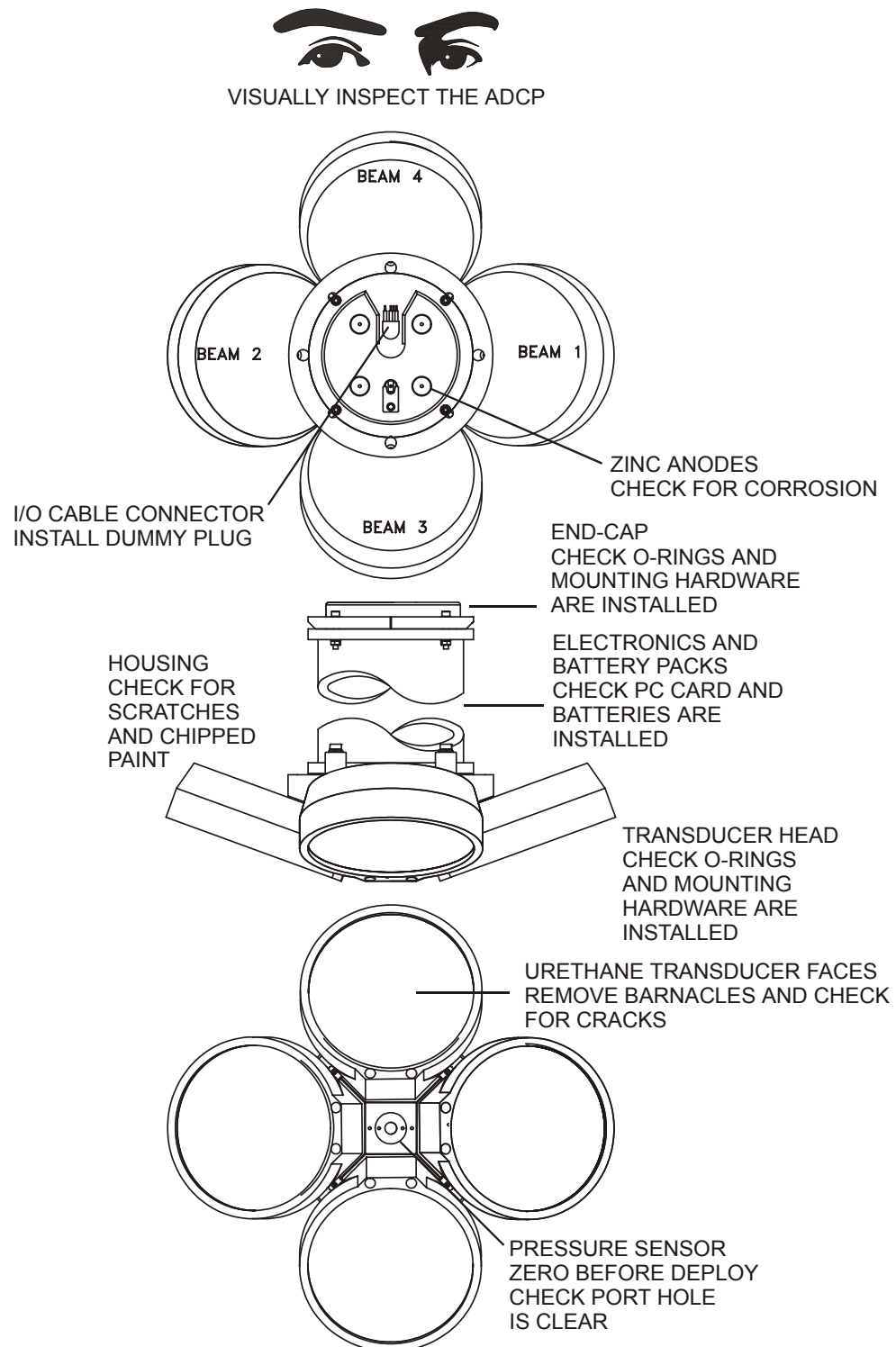


Figure 17. Visual Inspection before Deployment

11.2 Prepare the ADCP for Deployment

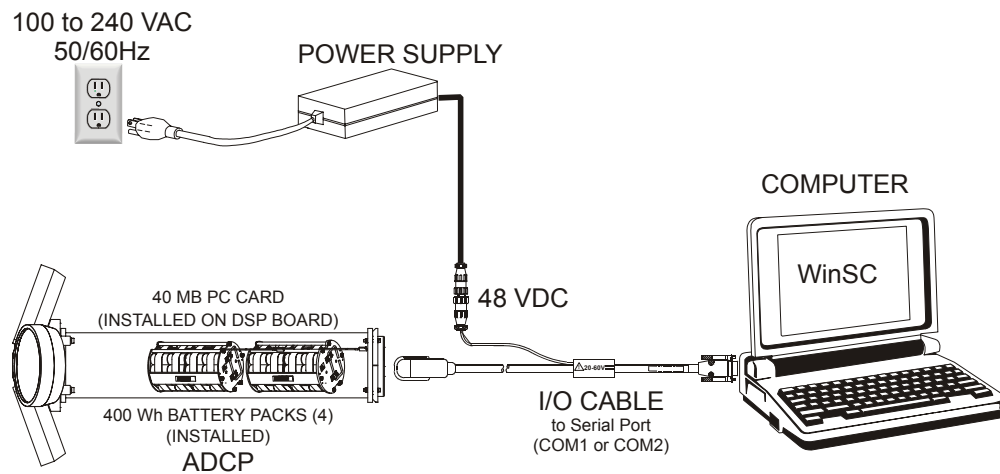


Figure 18. Prepare the ADCP

Things to remember while preparing the ADCP.

- Use the Deployment Checklist to verify that the ADCP is ready for the deployment.
- Test the ADCP using *WinSC*. Some tests will fail if the ADCP is not placed in water while the tests are being run.
- Use the AC power supply while testing the ADCP. Save the batteries for deployments.
- *Desiccant* lasts a year at specified Long Ranger deployment depths and temperatures. Remember that desiccant rapidly absorbs moisture from normal room air. Replace the desiccant whenever the Long Ranger housing or end-cap is removed.
- Verify the compass calibration.

11.3 Use the Deployment Wizard

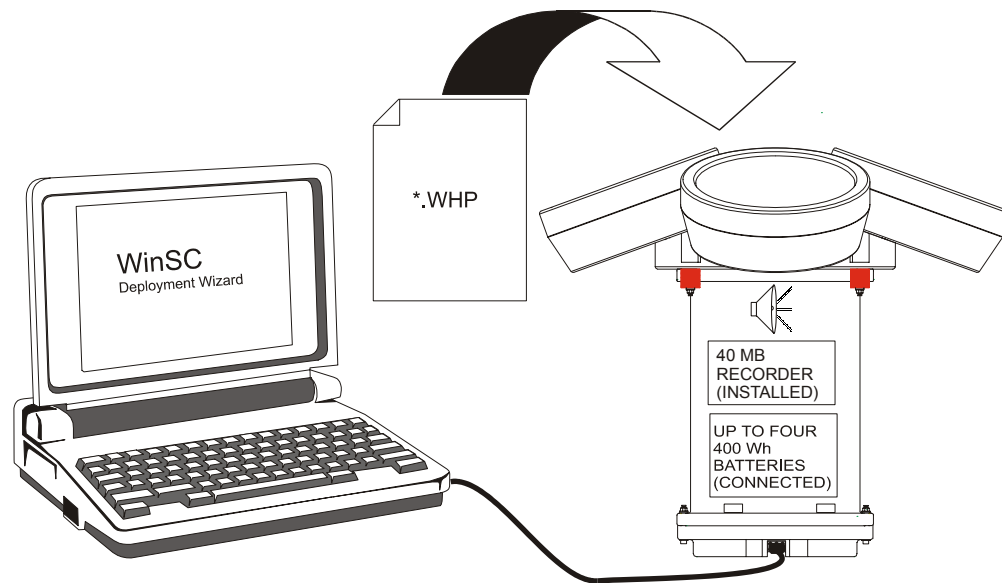


Figure 19. Using the Deployment Wizard

There are five steps the **Deployment Wizard** helps lead you through; Planning, Setting the ADCP's clock, Compass Verification, Pre-Deployment Tests, and sending/verifying the commands to the ADCP. RDI highly recommends using the wizard each time you deploy the ADCP. The deployment wizard will start whenever a new deployment file is created. To use the deployment wizard, do the following.

- a. Connect and power up the Long Ranger.
- b. Start *WinSC*.
- c. Start the Deployment Wizard by doing *one* of the following.
 - At the **Welcome** screen, click **Configure an ADCP for a New Deployment**. Click **OK**.
 - Click **File, New Deployment** (the deployment wizard will start automatically).
 - If you are working on an open deployment file (*.dpl), on the **Functions** menu, click **Deployment Wizard**.



NOTE. Choose and use Deployment Names carefully: they help you identify and organize all the data and log files associated with each deployment.

11.3.1 Plan the Deployment

The first step in the Deployment Wizard is planning. When you click **Next**, the program *PlanADCP* will start. For more information on *PlanADCP*, see the [WinSC User's Guide](#). If you want to skip this step, check the **Skip** box, or click **Next** to begin using *PlanADCP*.

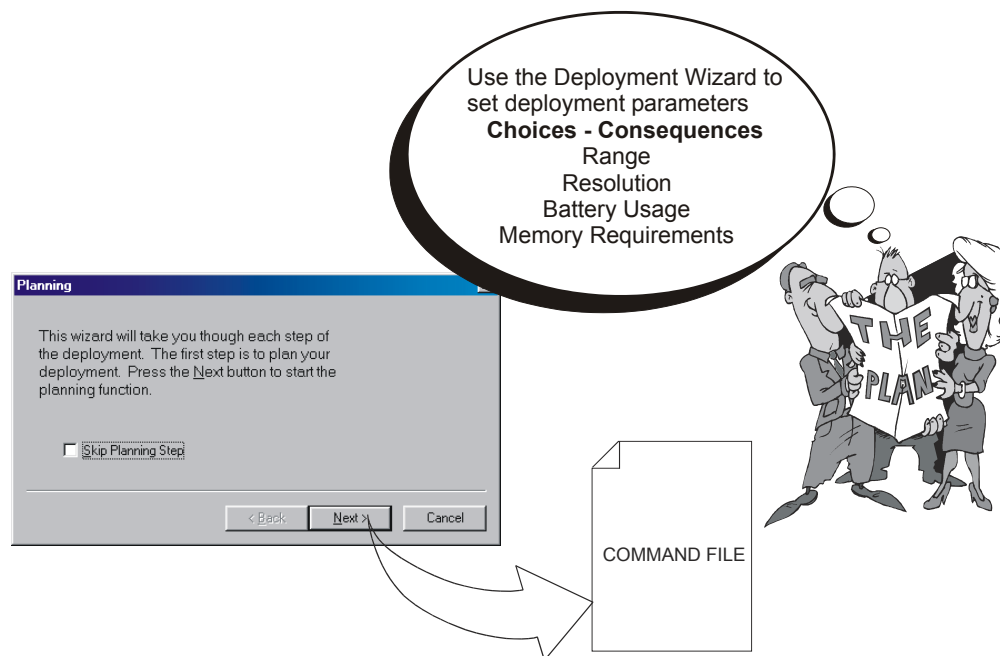


Figure 20. Plan the Deployment

Things to remember while using *PlanADCP*.

- *PlanADCP* can be run separately or within *WinSC*.
- *PlanADCP* allows you to make choices and see the consequences for the *entire* deployment. Once you decide on the optimum deployment setup, it creates a *Command File* with the commands you will later use to set up the Long Ranger for deployment.
- *PlanADCP* assumes that the Long Ranger is set to its factory defaults (it includes commands in the Command File that put the Long Ranger back to the factory defaults), and it adjusts only a subset of the available commands. Expert users may add other commands to the Command File.
- *Uniform sample times.* Start sample intervals on the minute by using a delayed start up. Instead of having your 10-minute sample intervals start at 15:36:47, delay startup a few minutes to have samples start at 15:40:00.

11.3.2 Set the ADCP's Clock

The second step in the Deployment Wizard will set the ADCP's clock to the computer's time and date using the TS-command. For more information on the TS-command, see the [Command and Output Data Format Guide](#). If you want to skip this step, check the **Skip** box or click **Next** to begin setting the clock.



NOTE. *Long Ranger time* is set from your computer's time. Be sure your computer is set to the time appropriate for your deployments before you use *WinSC* to start data collection.

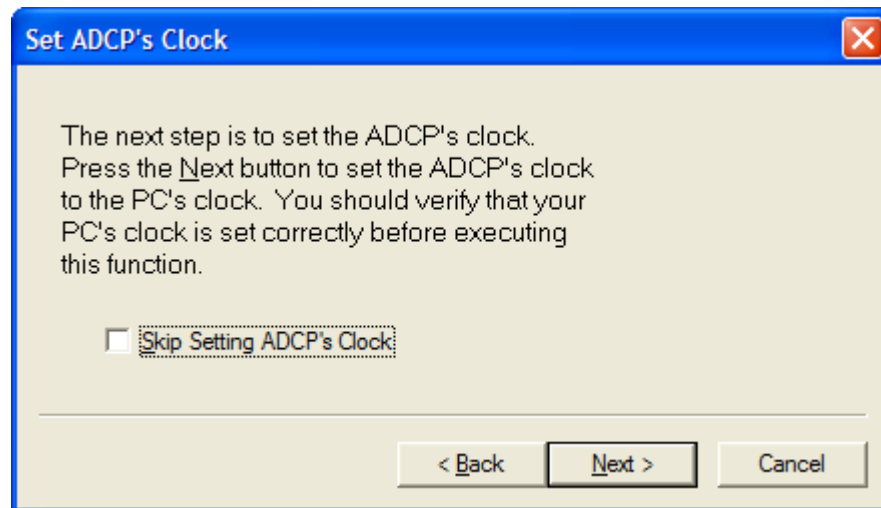


Figure 21. Deployment Wizard – Setting the Clock

11.3.3 Verify the Compass

The third step in the Deployment Wizard will verify the compass using the AX-command. For more information on the compass verification, see [“Compass Calibration Verification,” page 23](#). If you want to skip this step, check the **Skip** box or click **Next** to begin verifying the compass.

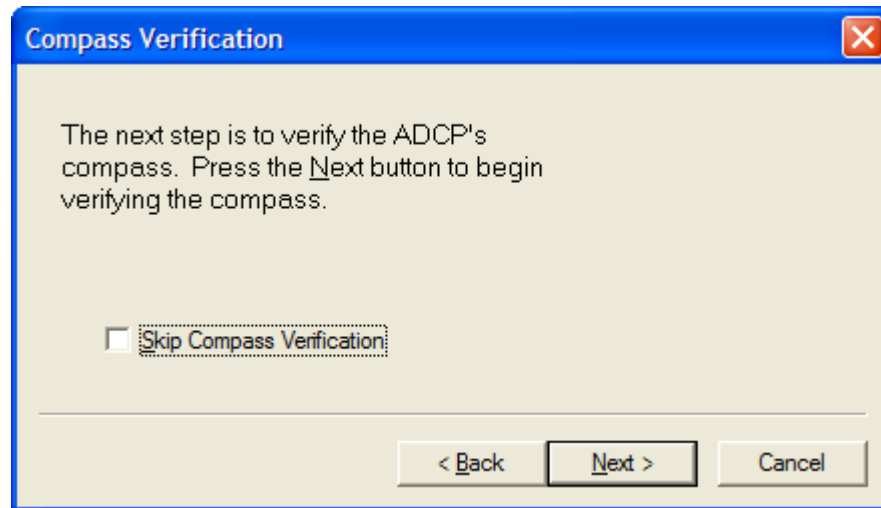


Figure 22. Deployment Wizard – Compass Verification

11.3.4 Run the Pre-Deployment Tests

The fourth step in the Deployment Wizard will run the pre-deployment tests Deploy?, System?, TS?, PS0, PA, PC2, RS, and PC1-commands. For more information on how to test your ADCP, see [“Testing Your Long Ranger,” page 20](#). If you want to skip this step, check the **Skip** box or click **Next** to begin the pre-deployment tests.

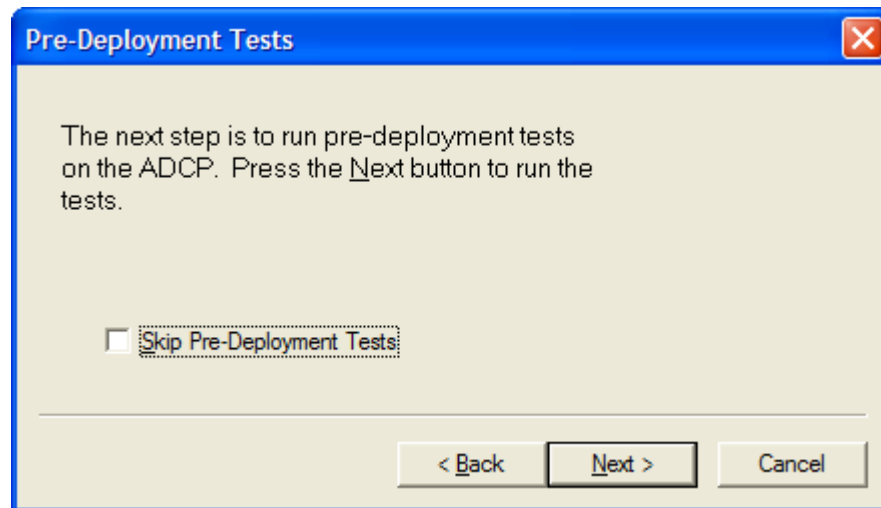


Figure 23. Deployment Wizard – Test the ADCP

11.3.5 Send the Commands

The fifth and final step in the Deployment Wizard will send the commands from the command file to the ADCP. Click **Next** to send the commands. When the commands have been sent to the ADCP, you should see a message “*You have successfully deployed the ADCP.*” Click **OK**.



NOTE. If you have created a new deployment file, you will be prompted to name the deployment. Choose and use Deployment Names carefully: they help you identify and organize all the data and log files associated with each deployment.

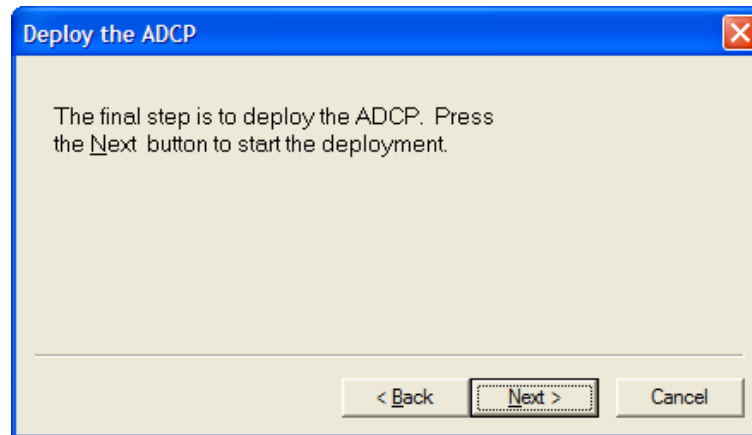


Figure 24. Deployment Wizard – Send the Commands

- The Long Ranger must be using battery power and be sealed, ready for deployment.
- *Ping beeps.* Whenever the Long Ranger pings, an internal beeper makes an audible beep. The beep consumes negligible energy and tells you the Long Ranger is pinging. If your command file has a Time of First Ping command, the ADCP will wait until that time to begin pinging, and therefore you will not hear it beep.
- View the deployment log file. This file shows all of the commands sent to the Long Ranger and the ADCP's response. If a command generates an error message, correct the problem and re-send the commands.



CAUTION

Do not send a break, any other command, or run any other programs once the commands have been sent to the ADCP or your commands will be over-written.

Disconnect the I/O cable before turning off power to the computer. Some computers may send a break signal out the serial ports when shutting down.

11.4 Deploy and Recover the ADCP

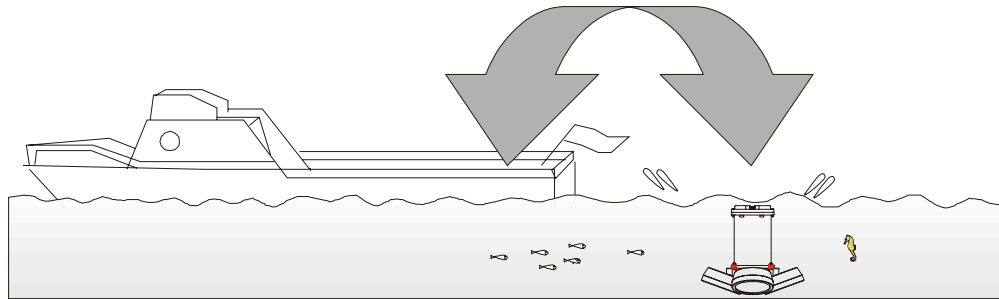


Figure 25. Deploy and Recover the ADCP

Things to remember while deploying the ADCP.

- Data files are *.SCL (deployment log file) and *000.000 (raw data). For example, if your deployment file is named *Test.dpl*, then the deployment log file will be *Test.scl* and the raw data file will be *Test000.000*.
- *Tilts*. The Long Ranger corrects data for tilts as large as 15°, but tilts reduce the effective range and increase the depth of surface contamination.
- *Anti-fouling paint*. You are free to use anti-fouling paint or other anti-fouling material over any surface of the Long Ranger. However, you should consider the following:
 1. Ensure that your coating can be used safely on plastic in general and polyurethane specifically.
 2. Apply it thinly and evenly to the transducer faces.
 3. Poorly applied coatings on the transducer could adversely affect instrument performance.
- *Magnetic material*. Keep the Long Ranger's compass away from magnetic material when you deploy the instrument. Check for magnetic fields by smoothly moving a compass around and near the Long Ranger and its mounting frame.

11.5 Recover the Data

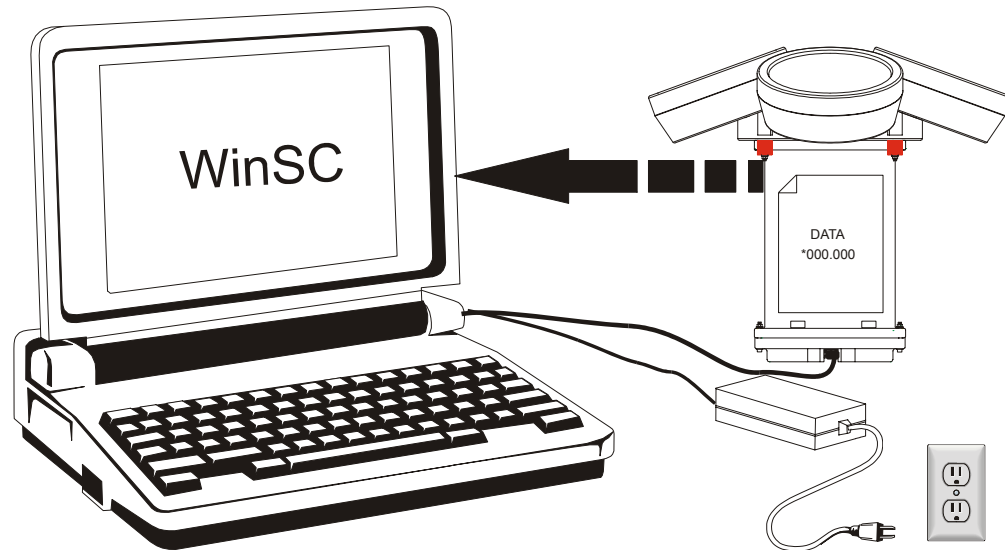


Figure 26. Recover the Data

Data are recorded internally on flash memory PC Cards that can be removed and plugged into many PC computers (especially laptops) and read the same as from any hard drive. If your computer is able to read the Long Ranger's flash card, recovering the data is as simple as copying from one disk to another.

However, be aware that because each computer uses different PC Card drivers, installing PC Card drivers on a laptop is not necessarily easy. If you cannot read the memory cards in your computer, use *WinSC* to read the data through the Long Ranger's serial port. RDI can supply or recommend laptops that can read our PC Card flash cards. Remove the flash cards by pushing a button on one side of the PC Card (see [Figure 5, page 10](#)). PC cards are installed with the label side toward the face of the transducer.

WinSC reads data files from the Long Ranger PC Card recorder via the serial port and saves the data to the computer's hard disk. It uses the Long Ranger's current Deployment Name to create a new directory for the data on the computer's hard drive. You can specify a different destination directory when you run *WinSC*. When *WinSC* is finished, you will find on your PC all the same files that are on your Long Ranger, and in the exact same format. *WinSC* transfers all data files even if you have recorded more than one deployment. *WinSC* transfers data using an error-correcting protocol (YMODEM), so you can be confident about the integrity of the data files.

11.6 Verify and View the Data

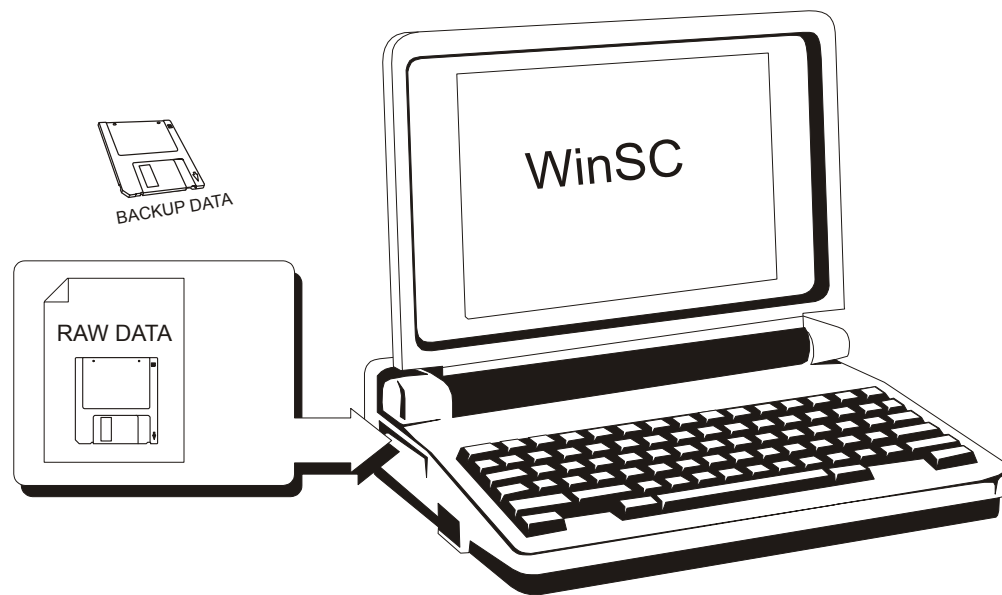


Figure 27. Verify and View the Data

WinSC rapidly scans each ensemble in your data files and checks them for integrity and quality. Its primary purpose is to ensure that you have properly transferred the data to your computer, but it also does some simple error and problem checking. Keep in mind that *WinSC* does not check every possible problem with your data.



NOTE. Check your data carefully and back it up before erasing the Long Ranger's data recorder.

WinADCP plays back data in a variety of formats (i.e. profiles, time series, and color contour plots). To view the data using *WinADCP*, open the raw data file.

To zoom in on the data, hold down the **Space Bar** and then click and hold the **Left mouse button** to create a “rubber band” selection box. When the mouse button is released, the selected portion of the Whole set is marked by a blinking box outline. The blinking box outlines a set of data called the Selected Set.



NOTE. The Whole Set or Sub Set form must be selected (the title bar color is highlighted) before the space bar is pressed.

11.7 Erase the Recorder

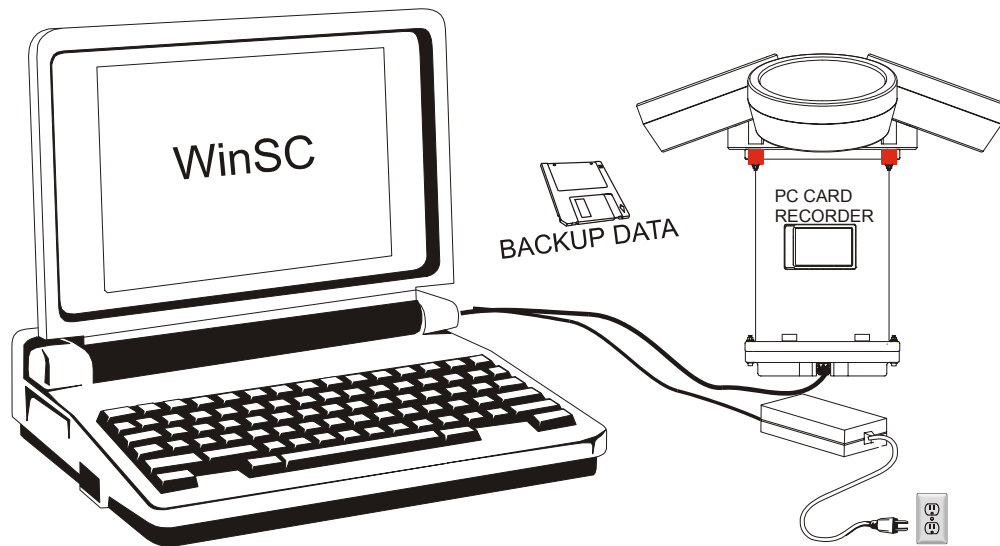


Figure 28. Erase the Recorder

WinSC can be used to erase the data recorder inside the Long Ranger. When instructed, *WinSC* erases all files in the recorder (be sure your data are safely backed up!). If you read the PC Card by putting it into your computer, you may delete the file(s) using the DOS delete command. Before you can delete the file, you must use the DOS attribute command to reset the read-only attribute.

12 Backing Up Data

Once you have recovered the data from your PC Card recorder, you should get in the habit of backing up all data files. Here are several examples of how to backup data.

- Remove the original PC Card containing data and store it in a safe place. Install another PC Card in its place.
- Backup your data to a CD-RW or other device.
- Download the data to another computer.

13 Reviewing the Data

13.1 'Where' was the Data?

The quickest way to find out the depth of each depth cell is to display your recorded data using *WinADCP*. The velocity display tells you the distance to the center of each cell. The computed distance assumes that the speed of sound is constant from the transducer to the depth cell. The actual distance is proportional to the average sound speed; if the average sound speed is 1% less than the sound speed at the transducer, the distance to the depth cell is 1% less than the displayed distance.

13.2 'When' was the Data?

The time recorded with each data record is the time of the beginning of the first ping of the ensemble. *PlanADCP* sets the ping interval so pings occur uniformly across the ensemble interval (as opposed to putting all the pings at the beginning of the interval). It leaves a few seconds at the end of each ensemble to allow time for data recording. Hence, the average time of the ensemble is midway between the recorded ensemble time and the time of the next ensemble.

13.3 'What' is the Data?

The Long Ranger records velocity data in units of mm/s. Calibration depends on how well the Long Ranger knew the speed of sound (which it computed based on its measured temperature and the salinity value it was given). A salinity error of 5 ppt introduces less than 0.5% velocity error.

14 A Few Principles of Operation

Consult RDI's Primer (ADCP Principles of Operation: a Practical Primer, Second Edition for BroadBand ADCPs) to learn more about Long Ranger principles of operation. The following are a few points from the Primer that may be worth knowing:

- Horizontal velocity measurement accuracy is unaffected by vertical stratification.
- Stratification has negligible affect on the ability of the Long Ranger to penetrate through the water; concentration of suspended particles is the main factor influencing profiling range.
- Long Ranger measurements are automatically corrected for tilts up to $\pm 20^\circ$. In addition to correcting for the beam pointing angles, the Long Ranger maps depth cells to other cells at the same depth.
- If you want to make measurements near the surface from a bottom-mounted Long Ranger, you should minimize the tilt.
- Depth cells are most sensitive to velocities at the center of the depth cell and less sensitive at the top and bottom. This sensitivity is reflected by what we call a 'triangular weighting function'. The details of this weighting function are rarely important for interpretation and use of your data.
- The actual maximum range can be different from the range predicted in *PlanADCP*. *PlanADCP* corrects for range variations caused by temperature and salinity, but it assumes typical scattering conditions. Weak backscatter can sometimes reduce range by a factor of two or more.
- In self-contained deployments, the maximum profiling range decreases with time as the battery voltage falls. This is because transmit power depends on battery voltage. Transmit power is optimized for about 32 volts. RDI's alkaline battery packs start at 42 VDC, but spend most of their useful lives within a few volts of 32 VDC.

15 Technical Support

If you have technical problems with your instrument, contact our field service group in any of the following ways:

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